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The following pages are the collation of the contents pages from each section and chapter of the TC30 Repair manual. Complete Repair part # 87361957

The sections used through out all New Holland product Repair manuals may not be used for each product. Each Repair manual will be made up of one or several books. Each book will be labeled as to which sections are in the overall Repair manual and which sections are in each book.

Sections 00, 10, 18, 21, 25, 27, 29, 31, 33, 35, 41, 44 and 90 are used with all tractors PIN #HK30001 and above.

Section 55 Electrical System – Chapters 1, 2, 3, and 4 are used with PIN #HK30001 to PIN #HK34732.
Section 55 Electrical System – Chapters 5, 6, 7 and 8 are used with PIN #HK34733 and above.

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Chapter 1 - General Information

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INTRODUCTION

This repair manual provides the technical information needed to properly service the New Holland TC30 tractor. Use this manual in conjunction with the operator's manual for complete operation, adjustment, and maintenance information.

On New Holland equipment, left and right are determined by standing behind the unit, looking in the direction of travel.

PRECAUTIONARY STATEMENTS

PERSONAL SAFETY

Throughout this manual and on machine decals, you will find precautionary statements ("**DANGER**", "**WARNING**", and "**CAUTION**") followed by specific instructions. These precautions are intended for the personal safety of you and those working with you. Please take the time to read them.

⚠ DANGER ⚠

This word "DANGER" indicates an immediate hazardous situation that, if not avoided, will result in death or serious injury. The color associated with Danger is RED.

⚠ WARNING ⚠

This word "WARNING" indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury. The color associated with Warning is ORANGE.

⚠ CAUTION ⚠

This word "CAUTION" indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. The color associated with Caution is YELLOW.

FAILURE TO FOLLOW THE "DANGER", "WARNING", AND "CAUTION" INSTRUCTIONS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH.

MACHINE SAFETY

The precautionary statement ("**IMPORTANT**") is followed by specific instructions. This statement is intended for machine safety.

IMPORTANT: *The word "IMPORTANT" is used to inform the reader of something he needs to know to prevent minor machine damage if a certain procedure is not followed.*

INFORMATION

NOTE: *Instructions used to identify and present supplementary information.*

SAFETY

PRECAUTIONARY STATEMENTS

A careful operator is the best operator. Most accidents can be avoided by observing certain precautions. To help prevent accidents, read and take the following precautions before operating this equipment. Equipment should be operated only by those who are responsible and instructed to do so.

Carefully review the procedures given in this manual with all operators. It is important that all operators be familiar with and Follow safety precautions.

THE TRACTOR

1. Read the Operator's Manual carefully before using the tractor. Lack of operating knowledge can lead to accidents.
2. Use an approved roll bar and seat belt for safe operation. Overturning a tractor without a roll bar can result in death or injury. If your tractor is not equipped with a roll bar and seat belt, see your New Holland Dealer.
3. Always use the seat belt. The only instance when the seat belt should not be used is if the roll bar has been removed from the tractor.
4. If a front end loader is to be installed, always use a FOPS (Falling Object Protective Structure) canopy to avoid injury from falling objects.
5. Use the handholds and step plates when getting on and off the tractor to prevent falls. Keep steps and platform cleared of mud and debris.
6. Do not permit anyone but the operator to ride on the tractor. There is no safe place for extra riders.
7. Keep all safety decals clean of dirt and grime, and replace all missing, illegible, or damaged safety decals. See the list of decals in the Decal section of this manual.

SERVICING THE TRACTOR

1. The cooling system operates under pressure which is controlled by the radiator cap. It is dangerous to remove the cap while the system is hot. Always turn the cap slowly to the first stop and allow pressure to escape before removing the cap entirely.
2. Keep any type of open flame away from the tractor and do not smoke while refueling. Wait for the engine to cool before refueling.
3. Keep the tractor and equipment, particularly brakes and steering, maintained in a reliable and satisfactory condition to ensure your safety and comply with legal requirements.
4. Keep open flame or cold weather starting aids away from the battery to prevent fires or explosions. Use jumper cables according to instructions to prevent sparks which could cause explosion.
5. Stop the engine before performing any service on the tractor.
6. Escaping hydraulic/diesel fluid under pressure can penetrate the skin causing serious injury. If fluid is injected into the skin, obtain medical attention immediately or gangrene may result.
   - DO NOT use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks.
   - Stop the engine and relieve pressure before connecting or disconnecting lines.
   - Tighten all connections before starting the engine or pressurizing lines.
7. Do not modify or permit anyone else to modify or alter this tractor or any of its components or functions without first consulting a New Holland Dealer.
8. The fuel oil in the injection system is under high pressure and can penetrate the skin. Unqualified persons should not remove or attempt to adjust a pump, injector, nozzle, or any other part of the fuel injection system. Failure to follow these instructions can result in serious injury.
9. Continuous long-term contact with used engine oil may cause skin cancer. Avoid prolonged contact with used engine oil. Wash skin promptly with soap and water.

10. Some components of your tractor, such as gaskets and friction surfaces (brake linings, clutch linings, etc.) may contain asbestos. Breathing asbestos dust is dangerous to your health. You are advised to have any maintenance or repair on such components carried out by an authorized New Holland Dealer. However, if service operations are to be undertaken on parts that contain asbestos, the essential precautions listed below must be observed:
    - Work out of doors or in a well ventilated area.
    - Dust found on the tractor or produced during work on the tractor should be removed by extraction, not by blowing.
    - Dust waste should be dampened, placed in a sealed container, and marked to ensure safe disposal.
    - If any cutting, drilling, etc. is attempted on materials containing asbestos, the item should be dampened and only hand tools or low speed power tools used.

OPERATING THE TRACTOR

1. Before starting the tractor, apply the parking brake, place the PTO lever in the "OFF" position, the lift control lever in the down position, the remote control valve levers in the neutral position, and the transmission in neutral.
2. Always sit in the tractor seat when starting the engine or operating controls. Do not start the engine or operate controls while standing beside the tractor.
3. Do not bypass the neutral start switches. Consult your New Holland Dealer if your neutral start controls malfunction. Use jumper cables only in the recommended manner. Improper use can result in tractor runaway.
4. Avoid accidental contact with the gear shift lever while the engine is running, as this can cause unexpected tractor movement.
5. Before getting off the tractor, disengage the PTO, turn the engine off, and apply the parking brake. Never get off the tractor while it is in motion.
6. Do not park the tractor on a steep incline.
7. Do not operate the tractor engine in an enclosed building without adequate ventilation. Exhaust fumes can cause death or illness.
8. If the power steering or engine ceases operating, stop the tractor immediately.
9. Pull only from the drawbar or the lower link drawbar in the down position. Use only a drawbar pin that locks in place. Pulling from the tractor rear axle or any point above the axle may cause the tractor to upset.
10. If the front end of the tractor tends to rise when heavy implements are attached to the three-point hitch, install front end or front wheel weights. Do not operate the tractor with a light front end.
11. Always set the hydraulic selector lever in position control when attaching or transporting equipment. Ensure hydraulic couplers are properly mounted and will disconnect safely in case of accidental detachment of implement.
12. Do not leave equipment in the raised position.
13. Use the flasher/turn signal lights and SMV signs when traveling on public roads both day and night (unless prohibited by law).
14. When operating at night, adjust lights to prevent blinding oncoming drivers.

DRIVING THE TRACTOR

1. Watch where you are going, especially at row ends, on roads, around trees and low hanging obstacles.
2. To avoid upsets, drive the tractor with care and at a safe speed. Use extra caution when operating over rough ground, when crossing ditches or slopes, and when turning corners.
3. To provide two-wheel braking, lock tractor brake pedals together when transporting on roads.
4. Do not coast or free wheel down hills. Use the same gear when going downhill as is used when going uphill.
5. Any towed vehicle with a total weight exceeding that of the towing tractor should be equipped with brakes for safe operation.
6. If the tractor becomes stuck or the tires become frozen to the ground, back up the tractor to prevent upset.
7. Always check overhead clearance, especially when transporting the tractor.
8. When operating at night, adjust lights to prevent blinding oncoming drivers.

OPERATING THE PTO

1. When operating PTO driven equipment, shut off the engine and wait until the PTO stops before getting off the tractor and disconnecting the equipment.
2. Do not wear loose clothing when operating the power take-off or when near rotating equipment.
3. When operating stationary PTO driven equipment, always place both gear shift levers in neutral, apply the tractor parking brake, and block the rear wheels front and back.
4. To avoid injury, do not clean, adjust, unclog, or service PTO driven equipment when the tractor engine is running.
5. Ensure the PTO master shield is installed at all times. Always replace the PTO shield cap when the PTO is not in use.

DIESEL FUEL

1. UNDER NO CIRCUMSTANCES should gasoline, alcohol, or blended fuels be added to diesel fuel. These combinations can create an increased fire or explosive hazard. Such blends are more explosive than pure gasoline in a closed container such as a fuel tank. DO NOT USE THESE BLENDS.
2. Never remove the fuel cap or refuel with the engine running or hot.
3. Do not smoke while refueling or when standing near fuel.
4. Maintain control of the fuel filler pipe nozzle when filling the tank.
5. Do not fill the fuel tank to capacity. Allow room for expansion.
6. Wipe up spilled fuel immediately.
7. Always tighten the fuel tank cap securely.
8. If the original fuel tank cap is lost, replace it with a New Holland approved cap. A non-approved, proprietary cap may not be safe.
9. Keep equipment clean and properly maintained.
10. Do not drive equipment near open fires.
11. Never use fuel for cleaning purposes.
12. Arrange fuel purchases so that winter grade fuels are not held over and used in the spring.

SAFETY FRAME (ROPS)

Your New Holland tractor is equipped with a safety frame. It must be maintained in a serviceable condition. Be careful when driving through doorways or working in confined spaces with low headroom.

UNDER NO CIRCUMSTANCES should you:

- modify, drill, or alter the safety frame in any way. Doing so may render you liable to legal prosecution.
- attempt to straighten or weld any part of the main frame or retaining brackets which have suffered damage. Doing so may weaken the structure and endanger your safety.
- secure any parts on the main frame or attach your safety frame with anything other than the special high tensile bolts and nuts specified.
- attach chains or ropes to the main frame for pulling purposes.
- take unnecessary risks even though your safety frame affords you the maximum protection possible.

WHEN YOU SEE THIS SYMBOL

IT MEANS:

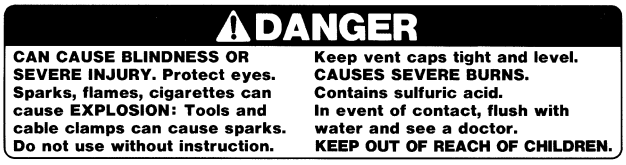
ATTENTION!

BECOME ALERT!

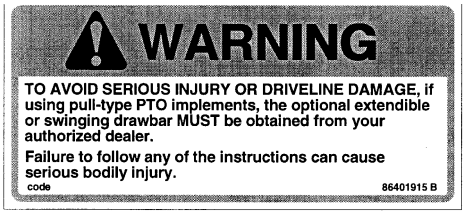
YOUR SAFETY IS INVOLVED!

SAFETY DECALS

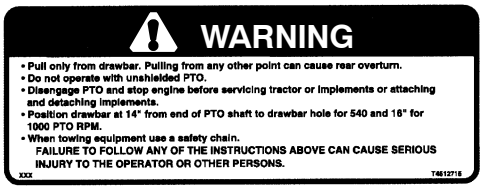
The following safety decals have been placed on your machine in the areas indicated. They are intended for your personal safety and for those working with you. Please take this manual and walk around your machine to note the content and location of these warning signs. Review these warning signs and the operating instructions detailed in this manual with your machine operators.



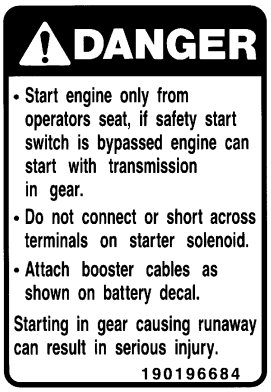
DANGER: Explosive/Acid - Poison
PART NO: SBA390197660
LOCATION: Top of Battery



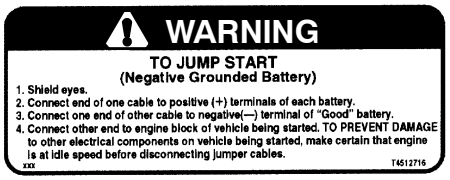
WARNING: Drawbar
PART NO: 86401915
LOCATION: Top PTO Shield



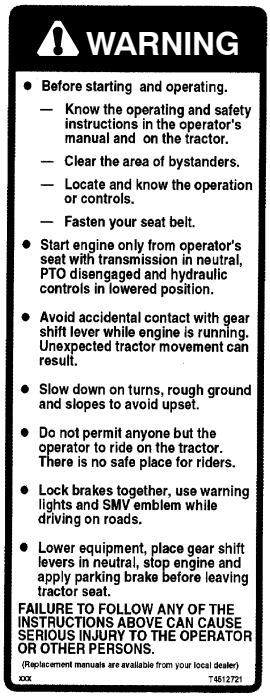
WARNING: Pull Only From Drawbar
PART NO: SBA390192292
LOCATION: Right Side of PTO Shield



DANGER: Start Engine Only From Operator's Seat
PART NO: SBA190196684
LOCATION: On Starter Motor

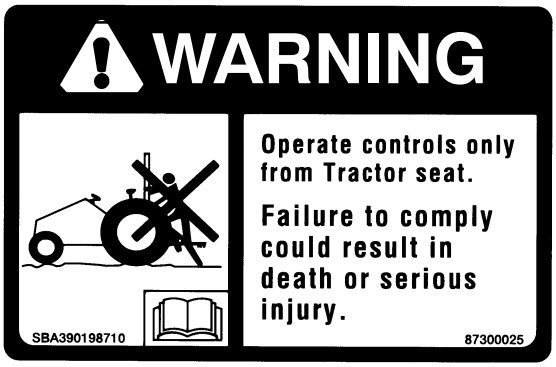


WARNING: To Jump Start
PART NO: SBA490990571
LOCATION: Left Side of Radiator Screen

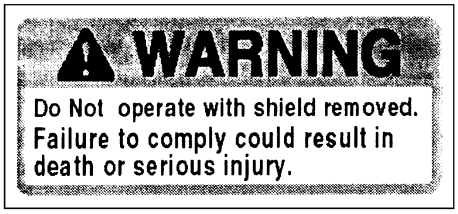


WARNING: Before Starting and Operating
PART NO: SBA390198380
LOCATION: Center of Right Fender

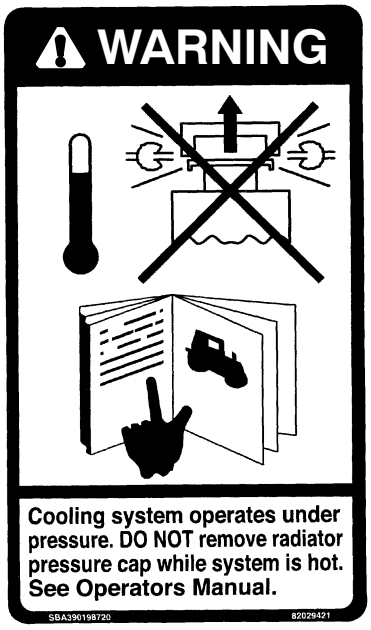
WARNING: Rotating Fan and Belts
PART NO: SBA390198470
LOCATION: Both Sides of Radiator



WARNING: Operate Controls Only From Tractor Seat
PART NO: SBA390198710
LOCATION: Inner RH & LH Fender Behind ROPS

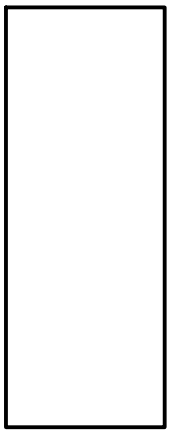


WARNING: Do Not Operate with Shield Removed
PART NO: SBA390198480
LOCATION: RH & LH Front of Dashboard and RH Engine Side Shield



WARNING: Cooling System Operates Under Pressure
PART NO: SBA39018720
LOCATION: Upper Rear of Radiator Screen

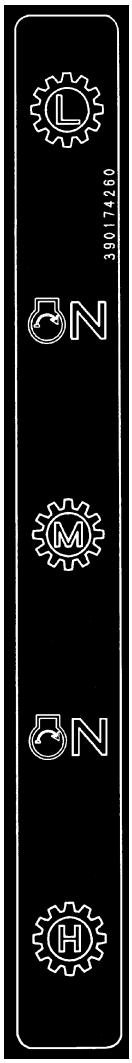
DANGER: Seatbelt/ROPS
PART NO: SBA390198930
LOCATION: Inner Surface of RH ROPS Upright

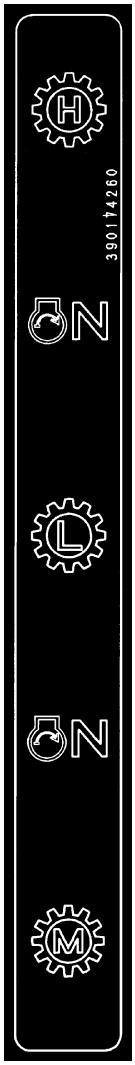


Red Reflective Tape
PART NO: SBA385150260
LOCATION: Rear Surface of RH & LH ROPS Uprights

INSTRUCTION DECALS

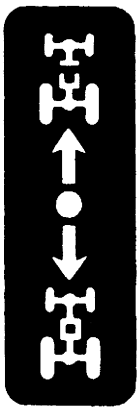
Range Selector Lever
(Manual)
PART NO:
SBA390174250
LOCATION:
Left Side Quadrant

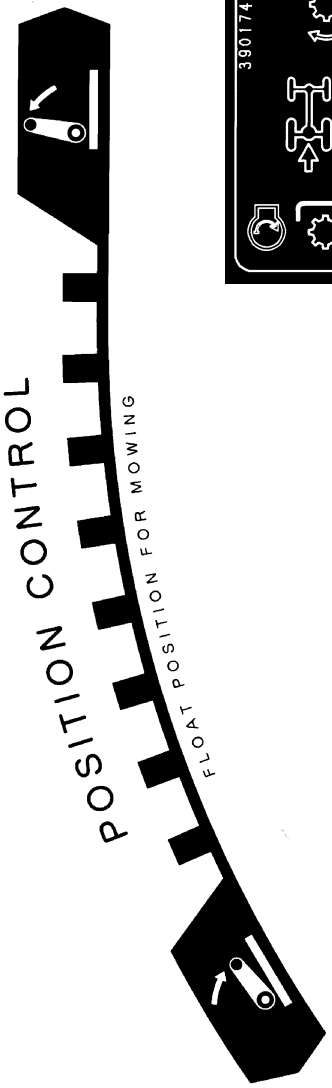




Range Selector Lever
– Hydrostatic
PART NO:
SBA390174260
LOCATION:
On the Lever Guide

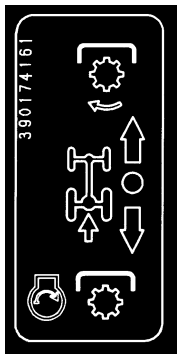
Front-Wheel Drive Control Lever
PART NO:
SBA390173870
LOCATION:
Below Seat Pan
Back of Lever



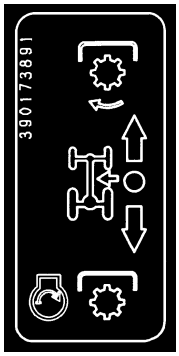


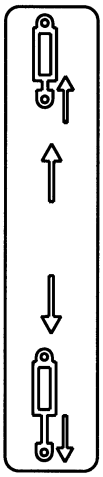
Position Control Lever
PART NO:
SBA390372490
LOCATION:
Right Side Fender

PTO Control Lever (Rear)
PART NO:
SBA390174161
LOCATION:
Inside of Left Fender

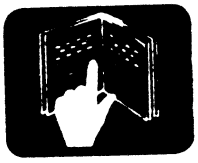


PTO Control Lever (Mid)
PART NO:
SBA390173891
LOCATION:
Inside of Left Fender

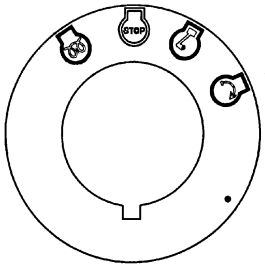




Operating Remote Control Valve-Single Spool (optional)
PART NO:
SBA390372560
LOCATION:
Right Side Quadrant

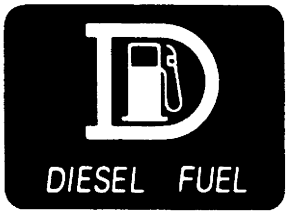


Hyd. Manifold Operation
(See Operator's Manual)
PART NO: SBA390198320
LOCATION:
Right-Hand Side of Hyd.
Manifold/Air Filter Cap



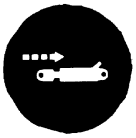
Starter Switch
PART NO: SBA390198900
LOCATION: Starter Switch, RH Side
of Instrument Panel

Engine Oil
PART NO: SBA390230220
LOCATION: Engine Oil
Filler Cap



Diesel Fuel
PART NO: SBA390198340
LOCATION: Under the Fuel Fill Lid

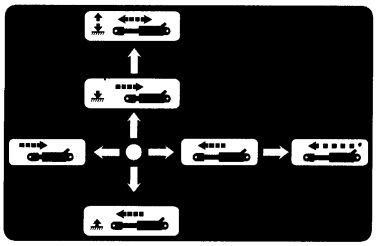
Coupler-Extending
(With double spool control valve)
PART NO: 86532920



Coupler-Retracting
(With double spool control valve)
PART NO: 86532919

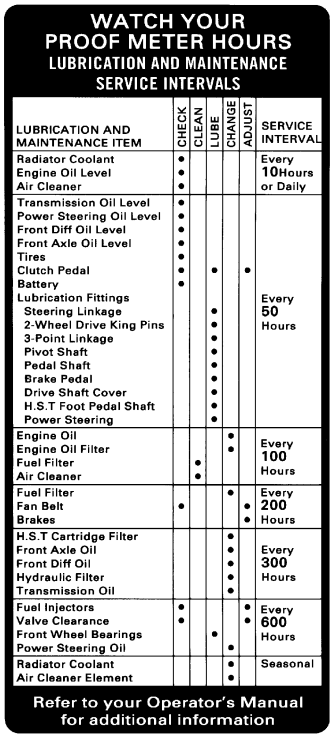
Coupler-Extending
(With double spool control valve)
PART NO: 86532921

Coupler-Retracting
(With double spool control valve)
PART NO: 86532922



Operating Remote
Control Valve-
Double Spool (optional)
PART NO:
86532911
LOCATION:
Cover of 2-Spool
Remote Valve

Power Steering Fluid
PART NO:
SBA390230230
LOCATION:
Top of P.S. Reservoir

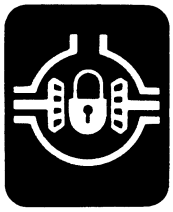


WATCH YOUR PROOF METER HOURS
LUBRICATION AND MAINTENANCE SERVICE INTERVALS

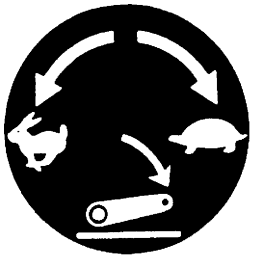
LUBRICATION AND MAINTENANCE ITEM	CHECK	CLEAN	LUBE	CHANGE	ADJUST	SERVICE INTERVAL
Radiator Coolant	•					Every 10 Hours or Daily
Engine Oil Level	•					
Air Cleaner	•					
Transmission Oil Level	•					
Power Steering Oil Level	•					
Front Diff Oil Level	•					
Front Axle Oil Level	•					
Tires	•					
Clutch Pedal	•		•		•	
Battery	•					
Lubrication Fittings						Every 50 Hours
Steering Linkage			•			
2-Wheel Drive King Pins			•			
3-Point Linkage			•			
Pivot Shaft			•			
Pedal Shaft			•			
Brake Pedal			•			
Drive Shaft Cover			•			
H.S.T Foot Pedal Shaft			•			
Power Steering			•			
Engine Oil				•		Every 100 Hours
Engine Oil Filter				•		
Fuel Filter		•				
Air Cleaner		•				
Fuel Filter				•		Every 200 Hours
Fan Belt	•				•	
Brakes					•	
H.S.T Cartridge Filter				•		Every 300 Hours
Front Axle Oil				•		
Front Diff Oil				•		
Hydraulic Filter				•		
Transmission Oil				•		
Fuel Injectors	•				•	Every 600 Hours
Valve Clearance	•				•	
Front Wheel Bearings			•			
Power Steering Oil				•		
Radiator Coolant				•		Seasonal
Air Cleaner Element				•		

Refer to your Operator's Manual for additional information

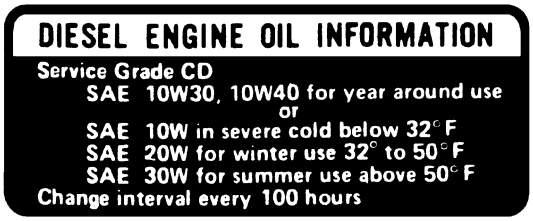
Lubrication and
Maintenance Intervals
PART NO:
SBA390198350
LOCATION:
Underside of Hood



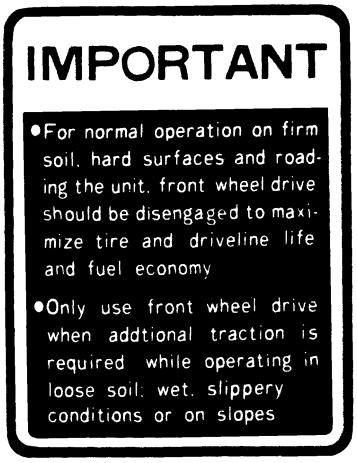
Differential Lock
PART NO: SBA390198300
LOCATION: Above Pedal



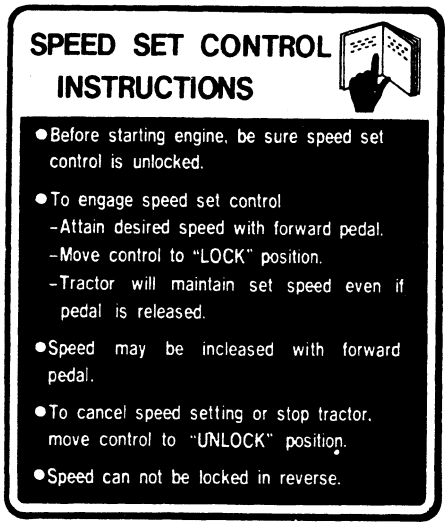
Flow Control Valve
PART NO: SBA390372470
LOCATION: Top of Flow Control Knob



Diesel Engine Oil Information
PART NO: SBA390198370
LOCATION: On Engine Filler Neck

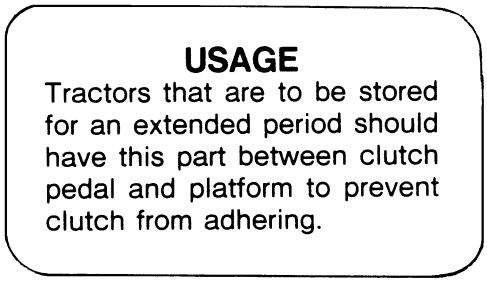


IMPORTANT - For Normal Operation
PART NO: SBA390198310
LOCATION: Center Panel of Steering Column Console



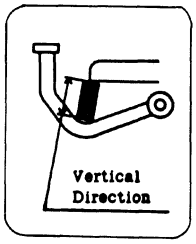
Speed Set Control Instructions (optional)
PART NO: SBA390198330
LOCATION: Top of L. H. Fender

Hand Throttle
PART NO: SBA390430290
LOCATION: Upper RH Dashboard



USAGE - Tractors That Are to Be Stored
PART NO: SBA390194690
LOCATION: On Clutch Pedal Spacer Block

Parking Brake
PART NO: SBA390198360
LOCATION: Below Seat Pan Inboard of Lever on RH Side



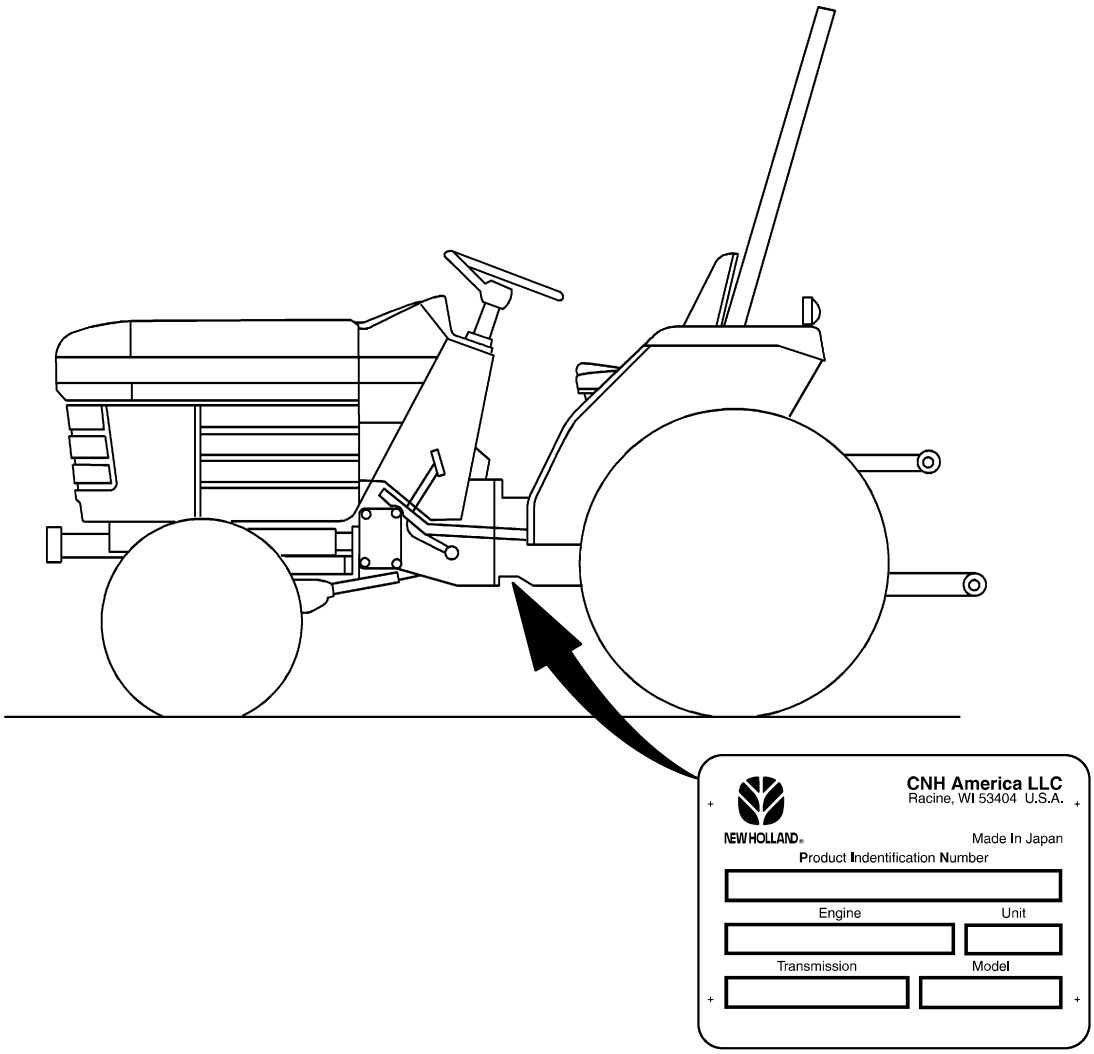
Installing Pedal Spacer
PART NO: SBA390194700
LOCATION: On Clutch Pedal Spacer Block

PLEASE READ CAREFULLY:

A PRODUCT IDENTIFICATION PLATE is located on the *left-hand side of the transmission housing*. The numbers on the plate are important in the event your tractor should require future service. For your convenience, have your dealer record these numbers in the appropriate spaces below.

New Holland North America, Inc. is continually striving to improve its products. We reserve the right to change prices, specification, or equipment at any time without notice.

All data given in this book is subject to production variations. Dimensions and weights are approximate only, and the illustrations do not necessarily depict tractors in standard condition. For exact information about any particular tractor, please consult your New Holland dealer.



50014013

INTERNATIONAL SYMBOLS

As a guide to the operation of your tractor, various universal symbols have been utilized on the instruments, controls, switches, and fuse box. The symbols are shown below with an indication of their meaning.

Thermostart starting aid

Alternator charge

Fuel level

Automatic Fuel shut-off

Engine speed (rev/min x 100)

Hours recorded

Engine oil pressure

Engine coolant temperature

Coolant level

Tractor lights

Headlamp main beam

Headlamp dipped beam

Work lamps

Stop lamps

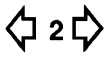
Horn

Radio

KAM
Keep alive memory

Turn signals

Turn signals -one trailer


Turn signals -two trailers

Front wind-screen wash/wipe

Rear wind-screen wash/wipe

Heater temp-erature control

Heater fan

Air conditioner

Air filter blocked

Parking brake

Brake fluid level

Trailer brake

Roof beacon

Warning! Corrosive substance

P.T.O.

N
Transmission in neutral

Creeper gears

Slow or low setting

Fast or high setting

Ground speed

Differential lock

Rear axle oil tem-perature

Transmission oil pressure

FWD engaged

FWD disengaged

Warning!

Hazard warning lights

Variable control

Pressurised! Open carefully

Position Control

Draft Control

Accessory socket

Implement socket

%age slip

Hitch raise (rear)

Hitch lower (rear)

Hitch height limit (rear)

Hitch height limit (front)

Hitch disabled

Hydraulic and transmission filters

Remote valve extend

Remote valve retract

Remote valve float

Malfunction! See Operator's Manual

Malfunction! (alternative symbol)

SPECIFICATIONS

	Model TC30
ENGINE	
Type	Diesel
Engine Gross Horsepower	22.4 kw (30.0)
Cylinders	3
Bore	84 mm (3.31″)
Stroke	90 mm (3.54″)
Displacement	1.496 L (91.3 cu. in.)
Compression Ratio	22.5:1
Firing Order	1-2-3
Low Idle Speed	950 – 1050 RPM
Maximum Speed:	
High Idle	2825 (2800 – 2850) RPM
Rated	2600 RPM
Valve Clearance (Cold):	
Intake	0.20 mm (0.008″)
Exhaust	0.20 mm (0.008″)
CAPACITIES	
Fuel Tank	27.0 liters/ 7.1 U.S. gals.
Cooling System	4.0 liters/ 4.2 U.S. qts.
Engine Crankcase:	
With Filter	4.0 liters/ 4.2 U.S. qts.
Rear Axle & Transmission (Includes Hydraulics)	
9x3 (Gear)	32.5 liters/ 8.6 gals.
HST	33.3 liters/ 8.8 gals.
Power Steering	1.6 liters/ 1.7 U.S. qts.
Front Axle Final Reduction	0.8 liters/ 0.85 U.S. qts.
Differential Gear Case	1.4 liters/ 1.5 U.S. qts.

	Model TC30
COOLING SYSTEM	
Type	Pressurized Liquid with Recirculating Bypass
Water Pump:	
Type	Centrifugal
Drive	V-Belt
Belt Deflection	5 mm – 10 mm (0.187 – 0.394″) when 5 kg (11 lbs.) thumb pressure is applied midway between belt pulleys
Fan Diameter	340 mm (13.4″)
Thermostat:	
Start to Open	82°C (180°F)
Fully Open	95°C (203°F)
Radiator Cap	0.9 bar (13 PSI)
ELECTRICAL SYSTEM	
Alternator	12-volt, Heavy Duty, 40 amps
Battery	12-volt, w/negative ground, 420 cca BCI Group 24
Starting Motor	Solenoid Pre-Engaged Reduction
FUEL SYSTEM	
Fuel Type	Diesel
Type of Fuel to Use if Above 40°F	No. 2-Diesel, Cetane Rating: Minimum 40
Type of Fuel to Use if Below 40°F	No. 1-Diesel, Cetane Rating: Minimum 40
Injection Pump:	
Type	In-Line
Timing	21° – 23° BTDC

	Model TC30
CLUTCH	
Type	225 mm (8.86″) – Transmission 9 x 3 & HST 215 mm (8.46″) – PTO (9 x 3) Transmission Dry Disc, Organic Face
Pedal Free-Travel	19 mm – 30 mm (3/4″ – 1-3/16″)
BRAKES	
Type	Wet Disc
Disc (2 per side)	155 mm x 123 mm Diameter (6.1″ x 4.84″)
STEERING	
Type	Power
Turns Lock-to-Lock:	
2WD	3.36/2.66
FWD	2.98/2.36
Front Wheel Toe-In	0 mm – 5 mm (0″ – 13/64″)
Turning Radius w/o Brakes:	
2WD	2641.6 mm (104″)
FWD	2946 mm (116″)
POWER TAKE-OFF	
Type	Transmission, single clutch – HST Live, dual clutch – 9 x 3
Shaft:	
Rear PTO	35 mm (1-3/8″)
Mid PTO	25.4 mm (1″)
Engine Speed for 540 RPM Rear PTO Operation	2420 RPM – 9 x 3 Transmission 2465 RPM – HST Transmission
Horsepower PTO Observed	19 kW (25.5 HP) – 9 x 3 Transmission 17.9 kW (24.0 HP) – HST Transmission
Engine Speed for 2000 RPM Optional Mid PTO Operation	2375 RPM – 9 x 3 Transmission 2420 RPM – HST Transmission
HYDRAULIC LIFT SYSTEM	
Type	Open Center
Pump Type	Gear
Pump Capacity	23.3 lpm (6.2 U.S. gpm)
System Relief Valve Setting	145 bar (2133 PSI)

Model TC30 – Gear

TRANSMISSION SPEEDS

Gear Position:	(2,600 RPM Engine Speed with 11.2 x 24 Rear Tires)
1st	1.21 KPH (0.75 MPH)
2nd	1.79 KPH (1.11 MPH)
3rd	2.57 KPH (1.60 MPH)
4th	3.83 KPH (2.38 MPH)
5th	5.65 KPH (3.51 MPH)
6th	8.11 KPH (5.04 MPH)
7th	9.80 KPH (6.09 MPH)
8th	14.47 KPH (8.99 MPH)
9th	20.76 KPH (12.90 MPH)
Reverse 1	1.79 KPH (1.11 MPH)
Reverse 2	5.65 KPH (3.51 MPH)
Reverse 3	14.47 KPH (8.99 MPH)

Model TC30 – Hydrostatic

TRANSMISSION SPEEDS

Gear Position:	(2,600 RPM Engine Speed with 11.2 x 24 Rear Tires)
Low	0-5.82 KPH (0 – 3.62 MPH)
Mid	0-12.09 KPH (0 – 7.52 MPH)
High	0-23.29 KPH (0 – 14.47 MPH)
Reverse Low	0-4.37 KPH (0 – 2.71 MPH)
Reverse Mid	0-9.07 KPH (0 – 5.64 MPH)
Reverse High	0-17.47 KPH (0 – 10.85 MPH)

	Model TC30
CAST IRON WEIGHTS	
Front End:	
R-4, Turf, & Ag. Tires—	
2WD & FWD	(3) weights @ 26 kg (57 lbs.) each
	Optional (2) weights @ 45 kg (100 lbs.) each
Rear Wheel:	
R-4 Tires	(4) weights @ 75 lbs. (34 kg) each (2) per wheel
Turf Tires	---
Ag. Tires	(4) weights (2) per wheel @ 48 kg (105 lbs.) each
DRAWBARS	
Fixed/Clevis	Standard
TIRES	
FRONT:	
Agricultural:	
2WD	5.50-16, 4PR, F2
FWD	7-14, 4PR, R1
Turf:	
2WD	23 x 8.50-14, 4PR, R3
FWD	25 x 8.50-14, 4PR, R3
Industrial:	
FWD	25 x 8.50-14, 6PR, R4
REAR:	
Agricultural	11.2-24, 4PR, R1
Turf	13.6-16, 4PR, R3
Industrial	15-19.50, 6PR, R4

	Model TC30
WHEEL BOLT TORQUES	
Front Wheel—	
Disc-to-Hub:	
2WD	122 N·m (90 ft. lbs.)
FWD	122 N·m (90 ft. lbs.)
Rear Wheel—	
Disc-to Rim & Disc-to Axle	169 N·m (125 ft. lbs.)
ROPS ATTACHING BOLT TORQUES	
ROPS to Rear Axle	75 N·m (55 ft. lbs.)
Seat Belt	47.4 N·m (35 ft. lbs.)

GENERAL DIMENSIONS

	Model TC30
(1)—LENGTH: (3 pt. Horizontal)	
2WD	
Turf Tires	2855 mm (112.4″)
Ag. Tires	2855 mm (112.4″)
4WD	
Turf Tires	2855 mm (112.4″)
Ag. Tires	2855 mm (112.4″)
R4	2855 mm (112.4″)
(2)—WHEEL BASE:	
2WD & FWD	1600 mm (63.0″)
HEIGHT:	
(3)—Top of Steering Wheel:	
Turf Tires	1356 mm (53.4″)
Ag. Tires	1379 mm (54.3″)
R4 Tires	1344 mm (52.9″)
(4)—Top of ROPS—Rigid:	
Turf Tires	2004 mm (82.9″)
Ag. Tires	2027 mm (83.8″)
R4 Tires	1991 mm (82.4″)

Model TC30

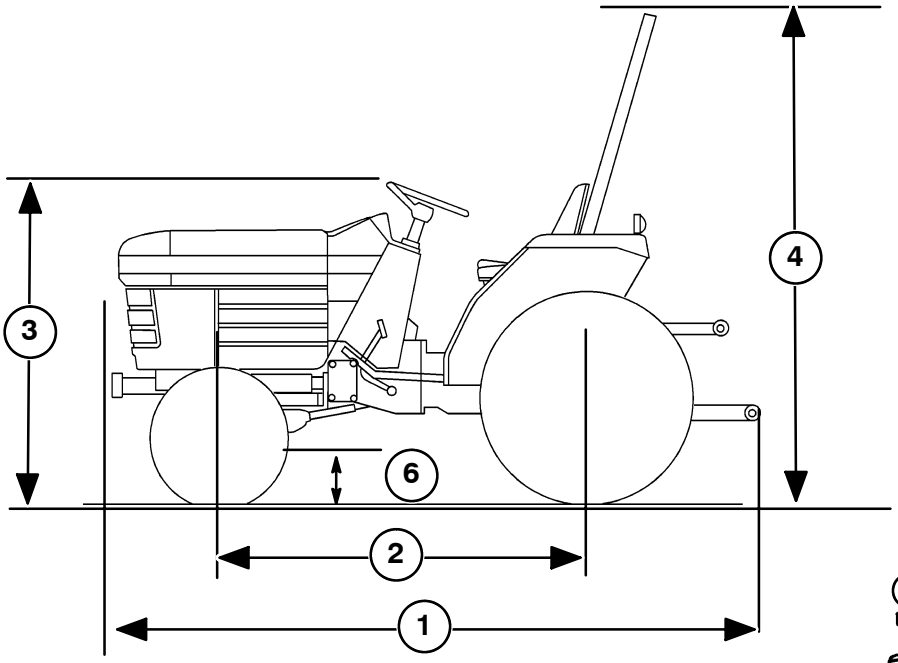
(5)—WIDTH:

Rear Axle—
Outside to Outside:

Turf Tires—	
Dished In	1463 mm (57.6″)
Dished Out	1487 mm (58.5″)
Ag. Tires—	
Dished In	1379 mm (54.3″)
Dished Out	1511 mm (59.5″)
R4 Tires—	
Dished Out (Only)	1575 mm (62.0″)

(6)—MINIMUM GROUND CLEARANCE:

Turf Tires	2960 mm (11.7″)
Ag. Tires	3040 mm (12.0″)
R4 Tires	2600 mm (10.2″)



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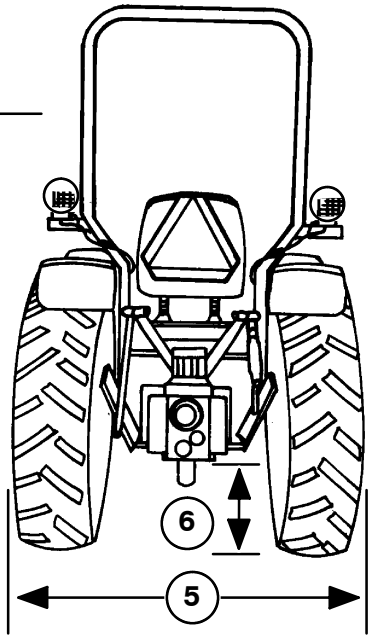

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Model TC30

WHEEL TREAD SETTINGS:

FRONT:

Agricultural:

2WD ..... 1016 mm – 1074 mm (40.0″ – 42.3″)

FWD ..... 1102 mm (43.4″)

Turf:

2WD ..... 1082 mm (42.6″)

FWD ..... 1151 mm (45.3″)

Industrial:

FWD ..... 1151 mm (45.3″)

REAR:

Agricultural ..... 1087 mm – 1217 mm (42.8″ – 47.9″)
(2WD & FWD)

Turf ..... 1120 mm – 1183 mm (44.1″ – 46.6″)
(2WD & FWD)

Industrial ..... 1183 mm (46.6″)
(2WD & FWD)

WEIGHT:

With ROPS & Ag Tires:

2WD	HST	9 x 3
	2199 kg 998 lbs.	2193 kg 995 lbs.
FWD	HST	9 x 3
Ag Tires	1042 kg 2298 lbs.	1039 kg 2291 lbs.
Turf	1016 kg 2240 lbs.	1013 kg 2233 lbs.
Industrial	1085 kg 2392 lbs.	1082 kg 2385 lbs.

MINIMUM HARDWARE TIGHTENING TORQUES

IN FOOT POUNDS (NEWTON-METERS) FOR NORMAL ASSEMBLY APPLICATIONS

INCH HARDWARE AND LOCKNUTS

NOMINAL SIZE	SAE GRADE 2		SAE GRADE 5		SAE GRADE 8		LOCKNUTS		NOMINAL SIZE
	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	GR.B w/GR5 BOLT	GR.C w/GR8 BOLT	
1/4	55* (6.2)	72* (8.1)	86* (9.7)	112* (13)	121* (14)	157* (18)	61* (6.9)	86* (9.8)	1/4
5/16	115* (13)	149* (17)	178* (20)	229* (26)	250* (28)	324* (37)	125* (14)	176* (20)	5/16
3/8	17 (23)	22 (30)	26 (35)	34 (46)	37 (50)	48 (65)	19 (26)	26 (35)	3/8
7/16	27 (37)	35 (47)	42 (57)	54 (73)	59 (80)	77 (104)	30 (41)	42 (57)	7/16
1/2	42 (57)	54 (73)	64 (87)	83 (113)	91 (123)	117 (159)	45 (61)	64 (88)	1/2
9/16	60 (81)	77 (104)	92 (125)	120 (163)	130 (176)	169 (229)	65 (88)	92 (125)	9/16
5/8	83 (112)	107 (145)	128 (174)	165 (224)	180 (244)	233 (316)	90 (122)	127 (172)	5/8
3/4	146 (198)	189 (256)	226 (306)	293 (397)	319 (432)	413 (560)	160 (217)	226 (306)	3/4
7/8	142 (193)	183 (248)	365 (495)	473 (641)	515 (698)	667 (904)	258 (350)	364 (494)	7/8
1	213 (289)	275 (373)	547 (742)	708 (960)	773 (1048)	1000 (1356)	386 (523)	545 (739)	1

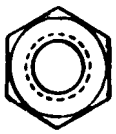
NOTE: Torque values shown with * are inch pounds.

IDENTIFICATION
CAP SCREWS AND CARRIAGE BOLTS

SAE GRADE 2

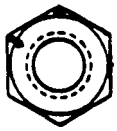
SAE GRADE 5

SAE GRADE 8



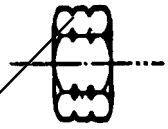
REGULAR NUTS

SAE GRADE 5 HEX NUTS



SAE GRADE 8 HEX NUTS

LOCKNUTS



GRADE IDENTIFICATION

GRADE A NO NOTCHES

GRADE B ONE CIRCUMFERENTIAL NOTCH

GRADE C TWO CIRCUMFERENTIAL NOTCHES

GRADE IDENTIFICATION

GRADE A NO MARKS

GRADE B THREE MARKS

GRADE C SIX MARKS

MARKS NEED NOT BE LOCATED AT CORNERS

GRADE A NO MARK
GRADE B LETTER B
GRADE C LETTER C

GRADE IDENTIFICATION

METRIC BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Foot-Pounds	Newton Meters	Pitch (mm)	Foot-Pounds	Newton-Meters
M6	4T, 4.8	1.0	3.6 – 5.1	4.9 – 6.9	------	------	------
	7T, 8T, 8.8		6.1 – 8.3	8.3 – 11.3			
	10T, 11T		8.6 – 11.6	11.7 – 15.7			
M8	4T, 4.8	1.25	9.4 – 12.3	12.7 – 16.7	1.0	11.2 – 14.9	15.2 – 20.2
	7T, 8T, 8.8		16.7 – 21.0	22.6 – 28.4		19.6 – 25.3	26.5 – 34.3
	10T, 11T		21.0 – 26.8	28.5 – 36.3		22.4 – 29.7	30.4 – 40.2
M10	4T, 4.8	1.5	18.8 – 24.6	25.5 – 33.3	1.25	21.0 – 26.8	28.5 – 36.3
	7T, 8T, 8.8		32.5 – 41.3	44.1 – 55.9		36.2 – 46.3	49.0 – 62.8
	10T, 11T		39.8 – 51.3	54.0 – 69.6		42.7 – 54.2	57.9 – 73.5
M12	4T, 4.8	1.75	27.5 – 34.8	37.3 – 47.1	1.25	31.8 – 40.5	43.1 – 54.9
	7T, 8T, 8.8		48.5 – 61.5	65.7 – 83.3		54.9 – 69.4	74.5 – 94.1
	10T, 11T		68 – 85.6	92 – 116		73.1 – 93.7	99 – 127
M14	4T, 4.8	2.0	46.3 – 59.3	62.8 – 80.4	1.5	51.4 – 64.4	69.7 – 87.3
	7T, 8T, 8.8		76.8 – 97.4	104 – 132		85.6 – 109	116 – 148
	10T, 11T		102.6 – 129	139 – 175		110 – 136	149 – 185
M16	4T, 4.8	2.0	63.5 – 81.2	86 – 110	1.5	67.2 – 84.9	91 – 115
	7T, 8T, 8.8		110 – 136.5	149 – 185		116 – 142	157 – 193
	10T, 11T		151.3 – 188	205 – 255		162 – 199	220 – 270
M18	4T, 4.8	2.0	83.4 – 104	113 – 141	1.5	96.7 – 120	131 – 163
	7T, 8T, 8.8		145 – 174	196 – 236		169 – 206	230 – 280
	10T, 11T		203 – 246	275 – 333		220 – 270	299 – 367
M20	4T, 4.8	2.5	106 – 133	144 – 180	1.5	126 – 155	171 – 211
	7T, 8T, 8.8		177 – 214	240 – 290		203 – 245	275 – 333
	10T, 11T		268 – 252	363 – 341		293 – 358	397 – 485

LUBRICANTS

RECOMMENDED LUBRICANTS AND COOLANTS

Lubricant	Type and Description	Part Number	Container Size
Engine Oil	AMBRA SUPER GOLD SSL ENGINE OIL SAE 10W-40	86994335	2.5G / 9.46L
	AMBRA SUPER GOLD HSP ENGINE OIL SAE 10W	86641050	5G / 18.93L
	AMBRA SUPER GOLD HSP ENGINE OIL SAE 10W-30	9613313	1QT / .946L
		86641052	1G / 3.785L
		9613314	2.5G / 9.46L
		9673508DS	5G / 18.93L
	AMBRA SUPER GOLD HSP ENGINE OIL SAE 30	9613286	1QT / .946L
		86641043	1G / 3.785L
		9613289	2.5G / 9.46L
		86641044	5G / 18.93L
	AMBRA SUPER GOLD HSP ENGINE OIL SAE 40	9624812DS	55G / 208.2L
	AMBRA SUPER GOLD HSP ENGINE OIL SAE 15W-40	86641081	1QT / .946L
		86641082	1G / 3.785L
		86641084	2.5G / 9.46L
		86641083	5G / 18.93L
	AMBRA SUPER GOLD HSP ENGINE OIL SAE 20W-50	86994337	5G / 18.93L
	AMBRA AUTO SUPREME SAE 5W-30	9673589DS	1QT / .946L
	AMBRA AUTO SUPREME SAE 10W-30	86641101	1QT / .946L
Transmission Oil	AMBRA MULTI TRAN	86639558	1G / 3.785L
		86639559	2.5G / 9.46L
		86639560	5G / 18.93L
	F200 Cold Weather Use	86523625DS	1G / 3.785L
		86523626DS	5G / 18.93L
	AMBRA MULTI TRAN SSL	86994339	2.5G / 9.46L
	AMBRA MULTI BIO S	86994341	2.5G / 9.46L
Hydraulic Oil	AMBRA MULTI G 134	9624655DS	1QT / .946L
		9624656DS	1G / 3.785L
		9624450	2.5G / 9.46L
		9624451	5G / 18.93L
	F200 Cold Weather Use	86523625DS	1G / 3.785L
		86523626DS	5G / 18.93L
	AMBRA HYDROSYSTEM 46 HYD FLUID	86109085	5G / 18.93L
	AMBRA HYDROSYSTEM 68 HYD FLUID	86994331	5G / 18.93L
	AMBRA HYDROSYSTEM 100 HYD FLUID	86994343	5G / 18.93L
ATF Oil	AMBRA HYDRODEX 3 ATF	9613304	1QT / .946L
		9613312	2.5G / 9.46L
Gear Oil	AMBRA HYPOIDE 90 GEAR LUBE	9613295	1QT / .946L
		9613294	2.5G / 9.46L
		86994348	16G / 60.6L
	AMBRA HYPOIDE 140 GEAR LUBE	87027134*	1QT / .946L
		87027135	2.5G / 9.46L
		86994351	16G / 60.6L
	AMBRA TRANSAXLE FLUID	86994352	5G / 18.93L
	AMBRA HYPOIDE SSL GEAR LUBE	86994354	1QT / .946L
Grease	AMBRA GR-9 MULTI-PURPOSE GREASE	9613310	TUBE - 14 OZ.
	AMBRA HI-TEMP GREASE	9861804DS	TUBE - 14 OZ.
	AMBRA CORN HEAD GREASE	94107DS	TUBE - 14 OZ.
	AMBRA GR 75 MD GREASE	87400001	TUBE - 14 OZ.
	AMBRA GR 1000 SYNTHETIC GREASE	86994355	TUBE - 14 OZ.
	LIMITED SLIP ADDITIVE	B96606	
Brake Fluid	BRAKE LHM FLUID (Mineral Based Oil)	86541699DS	1QT / .946L
Coolant	ESE-M97B18-D, Ethylene Glycol Coolant Concentrate	FGCC2701DS	1G / 3.785L
	Propylene Glycol Concentrate	FGCC2711DS	1G / 3.785L

ADJUSTMENTS

TIRE INFLATION PRESSURE

FRONT TIRE INFLATION PRESSURES		
Tire Type	**Tire Size**	**Inflation Pressure**
Agricultural: 2WD FWD	5.50-16, 4PR, F2 7-14, 4PR, R1	1.7 – 2.8 bar (24 – 40 PSI) 0.6 – 1.8 bar (8 – 26 PSI)
Turf: 2WD FWD	23 X 8.50-12, 4PR, R3 25 X 8.50-14, 4PR, R3	0.6 – 15 bar (8 – 22 PSI) 0.6 – 15 bar (8 – 22 PSI)
Industrial (R4)	25 X 8.50-14, 6PR, R4	0.6 – 2.2 bar (8 – 32 PSI)
REAR TIRE INFLATION PRESSURES		
Agricultural	11.2-24, 4PR, R1	0.8 – 1.2 bar (12 – 18 PSI)
Turf	13.6-16, 4PR, R3	0.8 – 1.0 bar (12 – 14 PSI)
Industrial (R4)	15-19.50, 6PR, R4	0.8 – 1.4 bar (12 – 20 PSI)

NOTE: *Do not underinflate or overinflate tires. Do not exceed maximum inflation pressure listed.*

SECTION 10 - ENGINE

Chapter 1 - Engine

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SPECIFICATIONS

GENERAL	TC30
Net Engine DIN in Kw(Hp)	24.0 (32.3)
Gross Engine in Kw(Hp)	24.6 (33.0)
PTO in Kw(Hp) w/9 x 3 w/HST	 21.7 (29.1) 20.1 (26.9)
Engine Model	N843
Number of Cylinders	3
Bore x Stroke in mm (in.)	84 x 90 (3.31 x 3.54)
Displacement in L(In^3)	1.50 (91.3)
Compression Ratio	22.5:1
Rated Speed in rpm	2600
Muffler Location	Under Hood
Firing Order	1-2-3
Low Idle Speed in rpm	1000 (950 – 1050)
High Idle Speed in rpm	2825 (2800 – 2850)
Cylinder Arrangement	In-line Vertical
Valve Arrangement	Overhead
CYLINDER BLOCK	**TC30**
Bore Standard in mm (in.)	84 - 84.019 (3.307 - 3.308)
Bore Maximum in mm (in.)	84.2 (3.315)
Head Surface Warp Standard in mm (in.)	0.05 (0.002)
Head Surface Warp Maximum in mm (in.)	0.12 (0.005)

CYLINDER HEAD	TC30
Head Warp in mm (in.)	
Standard	0.05 (0.002)
Maximum	0.12 (0.005)
Valve Seat Width in mm (in.)	
Standard	1.2 - 1.8 (0.047 - 0.071)
Maximum	2.5 (0.098)
PISTON	**TC30**
Valve Seat Sink in mm (in.)	
Standard	0.85 - 1.15 (0.0334 - 0.0453)
Maximum	1.8 (0.071)
Valve Angle	45°
Diameter in mm (in.)	
Standard	83.948 - 83.963 (3.3050 - 3.3056)
Minimum	83.7 (3.2953)
Bore Clearance in mm (in.)	
Standard	0.088 - 0.106 (0.0034 - 0.0041)
Maximum	0.3 (0.0118)
Piston Pin Bore in mm (in.)	
Standard	27.999 - 28.003 (1.10231 - 1.1025)
Maximum	28.02 (1.1031)
Piston Pin Clearances in mm (in.)	
Standard	−0.002 +0.008 (−0.00008 +0.0003)
Maximum	0.02 (0.0008)

PISTON PIN	TC30
Diameter in mm (in.)	
Standard	27.996 - 28.0 (1.1022 - 1.1024)
Maximum	27.97 (1.1012)
Pin-to-Bushing Clearance in mm (in.)	
Standard	0.01 - 0.25 (0.0004 - 0.001)
Maximum	0.08 (0.0031)
PISTON RING END GAP	**TC30**
1st Compression in mm (in.)	
Standard	0.2 - 0.35 (0.008 - 0.014)
Maximum	1.0 (0.03937)
2nd Compression in mm (in.)	
Standard	0.20 - 0.40 (0.008 - 0.016)
Maximum	1.0 (0.03937)
Oil Ring in mm (in.)	
Standard	0.20 - 0.40 (0.008 - 0.016)
Maximum	1.0 (0.03937)
PISTON RING COMPRESSION RING TO GROOVE SIDE CLEARANCE	**TC30**
1st Compression in mm (in.)	
Standard	0.07 - 0.11 (0.0027 - 0.0043)
Maximum	0.25 (0.010)
2nd Compression in mm (in.)	
Standard	0.04 - 0.08 (0.0015 - 0.0031)
Maximum	0.25 (0.010)
Oil Ring in mm (in.)	
Standard	0.02 - 0.06 (0.0008 - 0.0024)
Maximum	0.15 (0.006)

PISTON RING WIDTH	TC30
1st Compression in mm (in.)	1.97 - 1.99 (0.077 - 0.078)
2nd Compression in mm (in.)	1.47 - 1.49 (0.058 - 0.059)
Oil Ring in mm (in.)	2.97 – 2.99 (0.1169 – 0.1177)
CONNECTING ROD	**TC30**
Rod Twist in mm (in.)	
Standard	0.08 (0.003)
Maximum	0.2 (0.008)
Rod Bend in mm (in.)	
Standard	0.05 (0.002)
Maximum	0.15 (0.006)
Rod Side Play in mm (in.)	
Standard	0.1 - 0.3 (0.004 - 0.012)
Maximum	0.7 (0.028)
Crankshaft Bearing Clearance in mm (in.)	
Standard	0.035 - 0.085 (0.001 - 0.003)
Maximum	0.2 (0.008)
CRANKSHAFT	**TC30**
Journal Diameter in mm (in.)	
Standard	67.951 - 67.97 (2.675 - 2.6759)
Minimum	67.4 (2.654)
Crankpin Diameter in mm (in.)	
Standard	51.964 - 51.975 (2.0458 - 2.0460)
Minimum	51.4 (2.0236)
Runout in mm (in.)	
Standard	0.02 (0.0008)
Maximum	0.05 (0.002)

CAMSHAFT	TC30
Cam Height - Valve mm (in.)	
Standard	34.45 – 35.01 (1.356 – 1.378)
Minimum	34.0 (1.399)
Bend in mm (in.)	
Standard	0.03 (0.001)
Maximum	0.1 (0.004)
Cam Height - Fuel mm (in.)	
Standard	42.94 – 43.06 (1.691 – 1.695)
Minimum	42.81 (1.685)
VALVES	**TC30**
Stem Diameter - Intake in mm (in.)	
Standard	6.955 - 6.97 (0.2738 - 0.2744)
Minimum	6.89 (0.271)
Stem Diameter - Exhaust in mm (in.)	
Standard	6.94 - 6.95 (0.273 - 0.274)
Minimum	6.84 (0.269)
Guide Clearance- Intake in mm (in.)	
Standard	0.03 - 0.06 (0.001 - 0.002)
Maximum	0.2 (0.008)
Guide Clearance-Exhaust in mm (in.)	
Standard	0.04 - 0.065 (0.002 - 0.003)
Maximum	0.25 (0.010)
Valve Margin in mm (in.)	
Standard	0.925 - 1.075 (0.0364 - 0.0423)
Maximum	0.5 (0.0197)
Valve Lash in mm (in.)	0.2(0.008)
Valve Spring-Free Height in mm (in.)	
Standard	35 (1.378)
Minimum	33.5 (1.319)

VALVES	TC30
Valve Spring-Squareness in mm (in.)	
Standard	1.2 (0.047)
Maximum	2.0 (0.078)
Valve Spring-Compressed Height in mm (in.)	
Standard @ 8.1Kg (17.86Lb)	30.4(1.20)
Maximum @ 7Kg (15.43Lb)	30.4(1.20)
Valve Timing-Intake	
Open Before TDC	10°
Close After BDC	46°
Valve Timing-Exhaust	
Open Before TDC	46°
Close After BDC	16°
PUSH RODS	**TC30**
Length in mm (in.)	205.1 – 205.9 (8.075 – 8.106)
Diameter in mm (in.)	6.3 (0.248)
ROCKER ARM	**TC30**
Shaft Diameter in mm (in.)	
Standard	14.95 – 14.968 (0.5886 – 0.5893)
Minimum	14.87 (0.585)
Shaft to Rocker Clearance in mm (in.)	
Standard	0.032 - 0.068 (0.0013 - 0.0027)
Maximum	0.2 (0.008)
LUBRICATION SYSTEM	**TC30**
Relief Valve - Opening Pressure in Bar(Psi)	2.4 - 3.4 (35 - 50)
Rotor to Vane Clearance in mm (in.)	
Standard	0.1 - 0.15 (0.0004 - 0.006)
Maximum	0.25 (0.010)
Rotor to Cover Clearance in mm (in.)	
Standard	0.1 - 0.15 (0.0004 - 0.006)
Maximum	0.20 (0.008)
Rotor to Case Clearance in mm (in.)	
Standard	0.14 - 0.22 (0.006 - 0.009)
Maximum	0.30 (0.12)

COOLING SYSTEM

Type of System	Pressurized liquid w/recirculating by-pass
Water Pump:	
Type	Centrifugal
Drive	V-belt
Belt Deflection (tension)	5 to 10 mm (0.197 – 0.394 inch) when 5 kg (11 lbs.) is applied midway between pulleys
Fan Diameter	340 mm (13.4 in.)
Thermostat:	
Starts to Open	82°C (180°F)
Fully Open	95°C (203°F)
Radiator Cap Pressure	
Rating	0.9 bar (13 psi)
Coolant	Ethylene glycol and water in a 50/50 mixture
Capacity	4.0 Liters (4.2 Qts.)

METRIC BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Foot-Pounds	Newton Meters	Pitch (mm)	Foot-Pounds	Newton-Meters
M6	4T, 4.8	1.0	3.6 – 5.1	4.9 – 6.9	------	------	------
	7T, 8T, 8.8		6.1 – 8.3	8.3 – 11.3			
	10T, 11T		8.6 – 11.6	11.7 – 15.7			
M8	4T, 4.8	1.25	9.4 – 12.3	12.7 – 16.7	1.0	11.2 – 14.9	15.2 – 20.2
	7T, 8T, 8.8		16.7 – 21.0	22.6 – 28.4		19.6 – 25.3	26.5 – 34.3
	10T, 11T		21.0 – 26.8	28.5 – 36.3		22.4 – 29.7	30.4 – 40.2
M10	4T, 4.8	1.5	18.8 – 24.6	25.5 – 33.3	1.25	21.0 – 26.8	28.5 – 36.3
	7T, 8T, 8.8		32.5 – 41.3	44.1 – 55.9		36.2 – 46.3	49.0 – 62.8
	10T, 11T		39.8 – 51.3	54.0 – 69.6		42.7 – 54.2	57.9 – 73.5
M12	4T, 4.8	1.75	27.5 – 34.8	37.3 – 47.1	1.25	31.8 – 40.5	43.1 – 54.9
	7T, 8T, 8.8		48.5 – 61.5	65.7 – 83.3		54.9 – 69.4	74.5 – 94.1
	10T, 11T		68 – 85.6	92 – 116		73.1 – 93.7	99 – 127
M14	4T, 4.8	2.0	46.3 – 59.3	62.8 – 80.4	1.5	51.4 – 64.4	69.7 – 87.3
	7T, 8T, 8.8		76.8 – 97.4	104 – 132		85.6 – 109	116 – 148
	10T, 11T		102.6 – 129	139 – 175		110 – 136	149 – 185
M16	4T, 4.8	2.0	63.5 – 81.2	86 – 110	1.5	67.2 – 84.9	91 – 115
	7T, 8T, 8.8		110 – 136.5	149 – 185		116 – 142	157 – 193
	10T, 11T		151.3 – 188	205 – 255		162 – 199	220 – 270
M18	4T, 4.8	2.0	83.4 – 104	113 – 141	1.5	96.7 – 120	131 – 163
	7T, 8T, 8.8		145 – 174	196 – 236		169 – 206	230 – 280
	10T, 11T		203 – 246	275 – 333		220 – 270	299 – 367
M20	4T, 4.8	2.5	106 – 133	144 – 180	1.5	126 – 155	171 – 211
	7T, 8T, 8.8		177 – 214	240 – 290		203 – 245	275 – 333
	10T, 11T		268 – 252	363 – 341		293 – 358	397 – 485

ENGINE BOLT TORQUE SPECIFICATIONS

Tractor Model	TC30
Engine Model	J843/N843
Connecting Rod Cap Nuts	49 – 54 N·m (36 – 40 ft. lbs.)
Main Bearing Retaining Bolts	49 – 54 N·m (36 – 40 ft. lbs.)
Relief Valve Assembly	55 - 69 N·m (43 – 51 ft. lbs.)
Crankshaft Main Bearing Holder Bolts Rear Main (Socket Head Bolts) Center Main (Hex Head Bolts)	 25 – 29 N·m (18 – 22 ft. lbs.) 49 – 54 N·m (36 – 40 ft. lbs.)
Engine Rear Mounting Plate	12 – 17 N·m (9 – 12 ft. lbs.)
Flywheel Retaining Bolts	69 – 78 N·m (51 – 58 ft. lbs.)
Engine Front Plate	9 – 12 N·m (6 – 9 ft. lbs.)
Crankshaft Pulley Nut	274 – 333 N·m (202 – 246 ft. lbs.)
Cylinder head Bolt	98 – 103 N·m (72 – 76 ft. lbs.)
Rocker Arm Assembly	27 – 39 N·m (20 – 29 ft. lbs.)
Rocker Arm Locknut	12 – 16 N·m (9 – 12 ft. lbs.)
Oil Tube Banjo Bolt	10 – 13 N·m (7 – 9 ft. lbs.)
Oil Pressure Switch	14 – 20 N·m (11 – 14 ft. lbs.)
Rocker Cover Bolts	7 – 12 N·m (6 – 9 ft. lbs.)
Glow Plugs	15 – 20 N·m (11.1 – 15 ft. lbs.)
Cooling Fan Bolts	9 – 13 N·m (6.5 – 9.4 ft. lbs.)

ENGINE FUEL SYSTEM BOLT TORQUE SPECIFICATIONS

Tractor Model	TC30
Engine Models	J843/N843
Delivery Valve Holder	39 – 44 N·m (29 – 32.5 ft. lbs.)
Injector Assembly	59 – 69 N·m (43 – 51 ft. lbs.)

SPECIAL TOOLS

Tool No.	Description
FNH00120	Adapter - Compression Tester
OEM1074	Compression Test Gauge Assembly
FNH00117	Port Block Installer
FNH11097	Port Block Remover
FNH00011	Oil Pressure Test Fitting
Micrometer, Outside	0-1 inch
Micrometer, Outside	1-2 inch
Micrometer, Outside	2-3 inch
Micrometer, Inside	3/4-1 inch
Micrometer, Inside	2-3 inch
Micrometer, Inside	1-2 inch

COMPRESSION TEST AND TOOLS

Compression test is performed through the glow plug ports. The test adapter tool, 1, is equipped with quick coupler ends for easy installation of the hose and gauge.

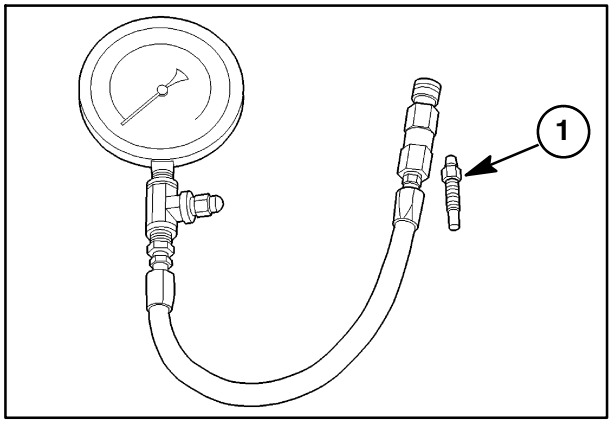
The procedures to perform a compression test are as follows:

1. Remove the wire lead from the fuel injection pump solenoid.
2. Remove the glow plug electrical wire and wire connector from top of the glow plugs.
3. Remove all of the glow plugs.

   IMPORTANT: *Be sure all the glow plugs are removed before starting the compression tests.*
4. Install the adapter Tool No. FNH 00120, hose and gauge assembly in each port and crank the engine until pressure stabilizes. The gauge should read 29.5 bar (427 psi) plus or minus 3.5 bar (50 psi).

   NOTE: *It may be necessary to remove some injector fuel lines to install the adapter tool.*

   NOTE: *There should not be more than 3.5 bar (50 psi) variation between the cylinders.*
5. When all three cylinders have been tested, reinstall the glow plugs and electrical connections.



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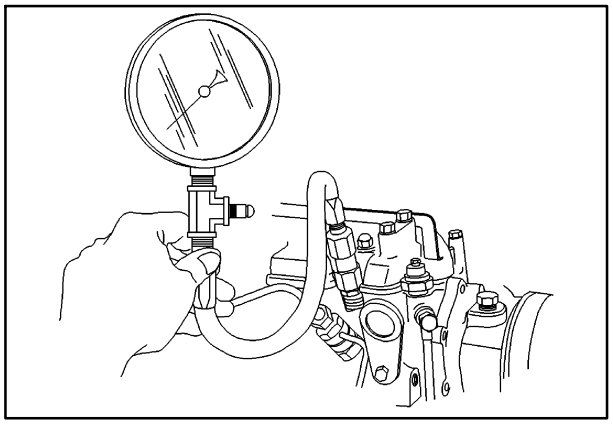


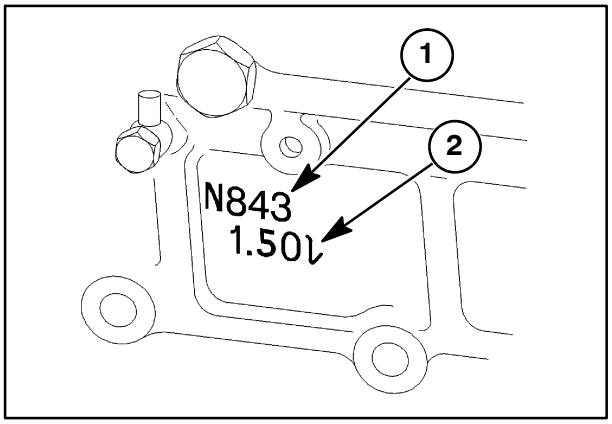
2

DESCRIPTION OF OPERATION – ENGINE

This chapter describes the engine overhaul and repair procedures of the TC30 Model.

NOTE: *Numeric value, 2, under the Engine Code, 1, indicates displacement of the engine in liters.*

Engine Identification	Tractor Model	Engine Power Hp (Kw)
N843	TC30	33 (24.6)



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CYLINDER HEAD AND VALVE TRAIN COMPONENTS

The cylinder head incorporates the valve assemblies, rocker arms, rocker shaft, push rods, and lifters. A swirl chamber located between the injector assembly and the main combustion chamber of the cylinders provides improved starting and greater fuel efficiency. Initial combustion starts in the precombustion chamber and as the expansion occurs a strong swirl pattern is created in the main combustion chamber for more complete combustion of the air-fuel mixture. The air intake manifold is built in the cast aluminum valve cover on all these engines.

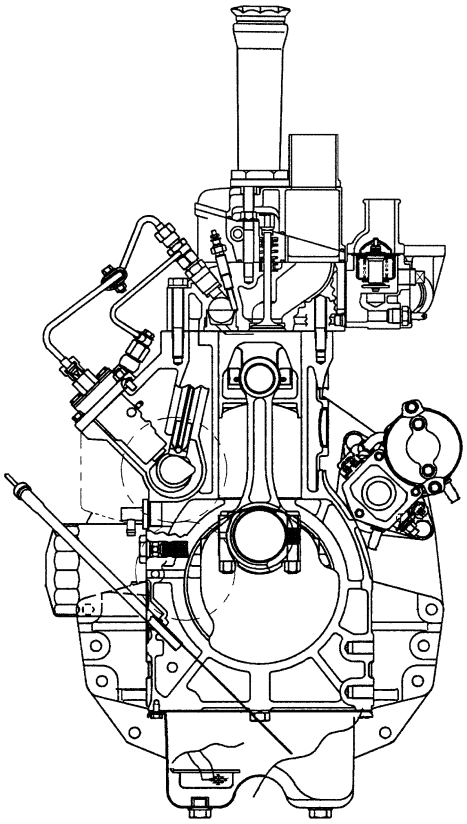
The breather valve is located on the valve cover. The valve opens when the crank housing pressure rises and the gas runs away to the intake manifold. The gas flows into the cylinder and is exhausted as exhaust fumes. The exhaust manifold is bolted on the left-hand side of the cylinder head on each of the models. Cylinder heads have integral valve guides. Standard size valves only are used. Figure 4 provides a cut-away front view of an engine.

CYLINDER BLOCK ASSEMBLY

The cylinder block assembly contains the pistons, connecting rods, crankshaft, timing gears, and engine oil pump. The crankshaft is supported on four main bearings. The front bearing is positioned in a bore in front of the block. The second, third, and fourth bearings are split liners located in holders bolted to the block. The camshaft is supported on two ball bearings located on each end of the block. Figure 5 provides a cutaway side view of the engine.

NOTE: *Due to Pollutant Regulations, some of parts relating to Engine exhaust (cylinder block, over size piston etc.) are not available for spares as an individual part.*

If necessary, replace with long block assembly.



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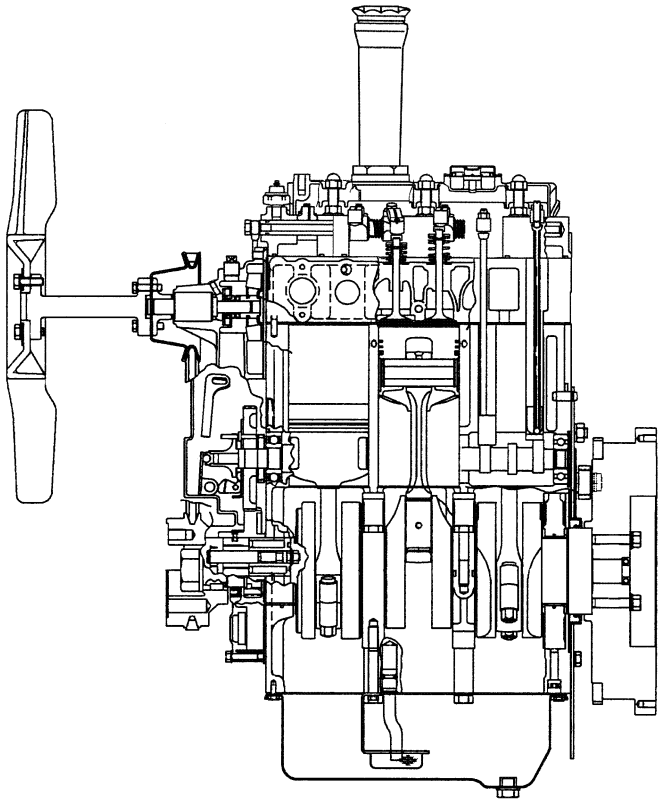

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5

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine does not develop full power	Clogged air cleaner	Inspect and replace air cleaner if necessary
	Fuel line obstructed	Check for crimped fuel line. Inspect fuel filter for cleanliness
	Improper injection timing	Repair/ replace components as required
	Improper nozzle injection pressure and angle	Check injection timing Inspect for proper injection pressure an angle
	Low cylinder compression	Check engine compression
	Insufficient fuel injection	Repair at authorized shop
	Improper valve lash adjustment	Adjust valves to correct tolerances
	Burned, worn or sticking valves	Inspect and replace as necessary
	Blown head gasket	Replace head gasket
	Worn or sticking piston rings	Overhaul as necessary
	Faulty engine stop solenoid	Replace stop solenoid
Low oil pressure	Engine oil level low	Fill to proper level
	Wrong grade of oil	Replace with correct grade oil
	Clogged oil pump filter	Change oil and filter
	Faulty oil pressure relief valve	Replace relief valve
	Worn oil pump drive shaft gears, or broken oil pipe	Inspect oil system and components. Replace defective components
	Excessive main or connecting rod bearing clearances	Replace bearings or shaft if necessary
	Oil pump axial clearance not properly set	Check pump clearance and shim as needed to proper tolerance
Engine will not stop	Faulty engine stop solenoid	Replace the stop solenoid
	Faulty starter switch	Replace starter switch

PROBLEM	POSSIBLE CAUSE	CORRECTION
Low cylinder compression	Burned, worn or sticking valves	Replace valves
	Bent valve stem	Replace valves
	Broken or weak valve spring	Replace valve spring
	Blown cylinder head gasket	Replace head gasket
	Worn or sticking piston rings	Replace piston rings
	Scored piston	Replace piston
Poor engine idling	Improper injection timing	Correct the injection timing
	Air in injection pump	Purge air from the system
	Improper governor adjustment	Adjust the governor
Oil pressure warning light fails to operate	Bulb burnt out	Replace the bulb
	Oil pressure sensor is faulty	Replace oil pressure sensor
	Warning light circuit faulty	Replace warning light circuit

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine knocks	Diluted or thin oil	Change engine oil and filter
	Insufficient oil supply	Check engine oil level
	Low oil pressure	Inspect lube system for restrictions
	Worn crankshaft thrust bearing	Replace relief valve
	Excessive flywheel runout	Replace thrust bearing
	Excessive connecting rod or main bearing clearance	Replace flywheel
		Replace bearings
	Seized bearing	Replace bearing and affected component if necessary
	Clogged oil passage	Clean out oil passages
	Bent or twisted connecting rod	Replace connecting rod
	Crankshaft journals out of round	Rework or replace crankshaft
	Excessive piston to cylinder bore clearance	Replace long block assembly
	Excessive piston ring side clearance	Replace piston rings
	Broken or damaged ring	Replace piston ring
	Excessive piston pin clearance	Replace piston pin or bushing
	Seized piston	Replace piston and, if necessary, engine block
	Piston pin retainer loose or missing	Replace retainer
	Improper valve lash adjustment	Adjust valve lash to specification
	Worn valve lifter	Replace valve lifter
	Excessive timing gear backlash	Replace all timing gears

PROBLEM	POSSIBLE CAUSE	CORRECTION
Excessive oil consumption	Engine oil level too high	Remove excess oil
	Leakage in cylinder head gasket	Replace head gasket
	Oil loss past the pistons and rings	Replace piston rings
	Worn, broken, or sticking piston rings	Replace piston rings
	Clogged return hole of oil ring	Unclog return oil hole and replace rings
	Worn valves, guides, or seals	Replace valves, guides, or seals
	Leakage past oil seals and gaskets	Replace leaking seals and gaskets
	External oil leaks from engine	Locate leaks and repair
Engine overheats	Insufficient amount of coolant in the radiator	Fill coolant to proper level
	Hose connection leaking or collapsed hose	Tighten hose connection or replace hose
	Radiator leakage	Locate leak and repair or replace radiator
	Loose, worn, or broken V-belt	Adjust V-belt tension or replace belt
	Radiator fins bent or clogged	Straighten out and clean fins
	Radiator cap not sealing	Replace radiator cap
	Thermostat operating improperly	Replace thermostat cap
	Insufficient amount of oil	Fill to proper level
	Water pump operating improperly	Replace water pump
	Improper valve clearance	adjust valve clearance to specification
	Restriction in exhaust system	Remove restriction
	Improperly installed cylinder head gasket	Reinstall head gasket in proper position
	Rust and/or scale clogged water ports	Backflush cooling system
	Extended engine idling	Shutdown engine during extended idling periods

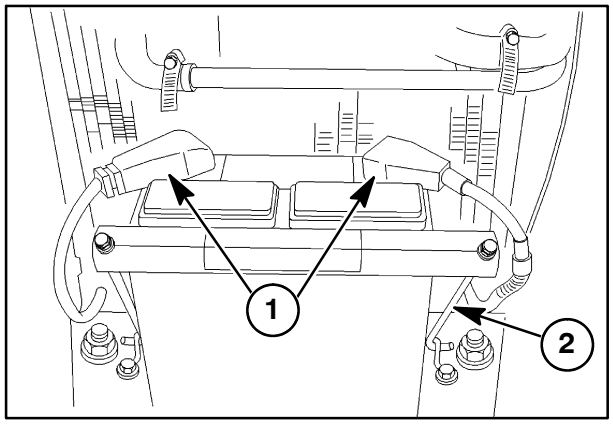
PROBLEM	POSSIBLE CAUSE	CORRECTION
Temperature gauge fails to reach normal operating temperature	Faulty temperature sender	Replace temperature switch
	Faulty thermostat	Replace thermostat
	Faulty temperature gauge	Replace temperature gauge
Engine does not start	Faulty starter switch	Replace switch
	Insufficient charging or complete discharge of battery	Check battery and charging system
	Lack of fuel	Fill fuel tank
	Air mixed in fuel system	Inspect fuel system for tightness
	Clogged fuel filter	Replace fuel filter
	Irregular or faulty fuel supply	Replace fuel supply
	Glow plug not heating	Replace glow plug
	Improper lubricating oil viscosity	Replace lube oil
	Clogged air cleaner	Replace air cleaner
	Faulty engine stop solenoid	Replace solenoid
	Burned out fuse (5 amp)	Replace fuse (5 amp)
Excessive exhaust smoke	Air cleaner dirty or restricted	Replace air cleaner
	Excessive fuel delivery	Adjust fuel delivery
Engine stops while operating	Lack of fuel in fuel tank	Fill fuel tank
	Clogged fuel filter	Replace filter
	Air mixed in fuel system	Inspect for air leaks
	Faulty engine stop solenoid	Replace solenoid
	Burned out fuse	Replace fuse
Undesirable exhaust color (black or light grey)	Unsuitable fuel	Replace fuel
	Excess injection	Adjust injection
	Faulty engine component	Replace as required
	Over loading	Decrease load
	Clogged air filter	Replace filter
Undesirable exhaust smoke (white or pale)	Excess engine oil	Drain oil to proper oil level
	Improper lubricating oil viscosity	Replace oil with specified viscosity
	Faulty injection timing	Adjust injection timing

OVERHAUL – ENGINE

ENGINE

Preparation

1. Disconnect the battery leads, 1, and battery hold down bracket, 2, to remove the battery.
2. Remove tractor hood and side panels.



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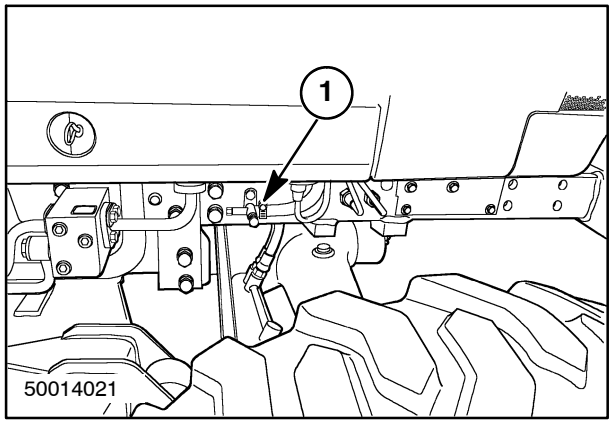
3. Turn coolant tap bolt, 1, counterclockwise to drain fluid. Remove the radiator assembly. See “Radiator Removal”, discussed later in this section.



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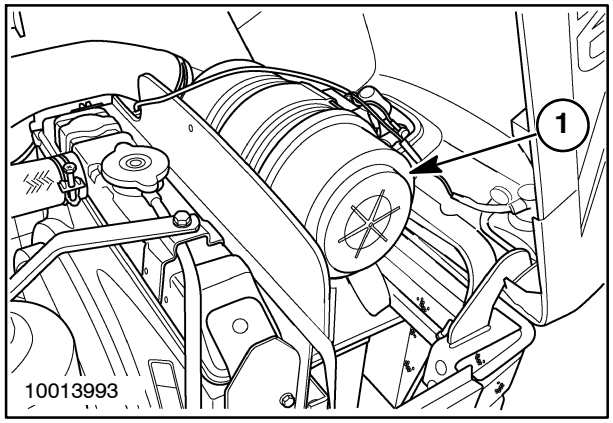
4. Remove the air cleaner assembly, 1, along with the air cleaner hoses.



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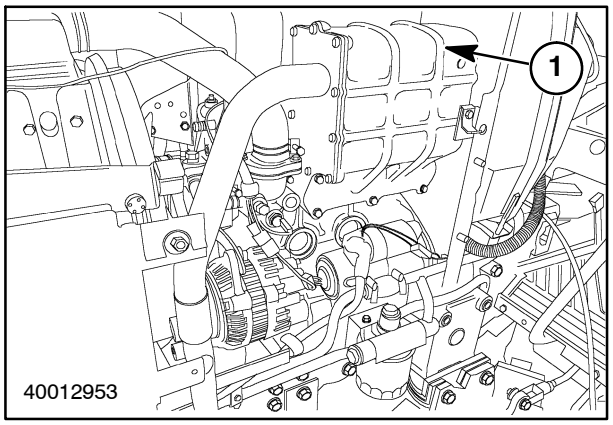
⚠ WARNING ⚠

Exhaust components may be extremely hot. Let components cool before removing.

5. Remove the exhaust muffler, 1, and tailpipe assembly.



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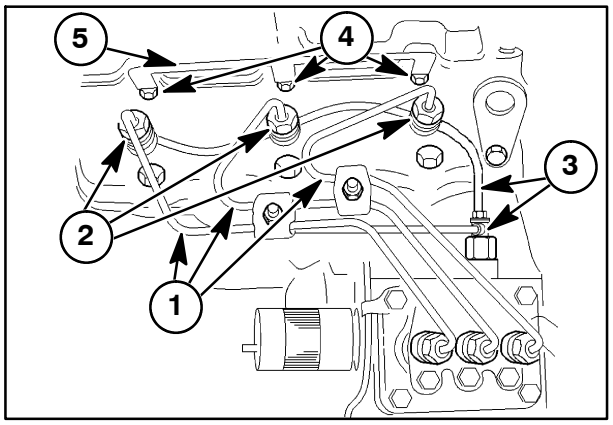
FUEL INJECTOR AND GLOW PLUG

Removal

1. Clean all dirt and oil from the injectors and surrounding areas.
2. Disconnect the fuel lines, 1, from the injectors and cap all openings.
3. Remove the injector fuel leak-off line, 3.
4. Remove the injector assemblies, 2.
5. Remove the glow plug bus connector, 5, and remove the glow plugs, 4.



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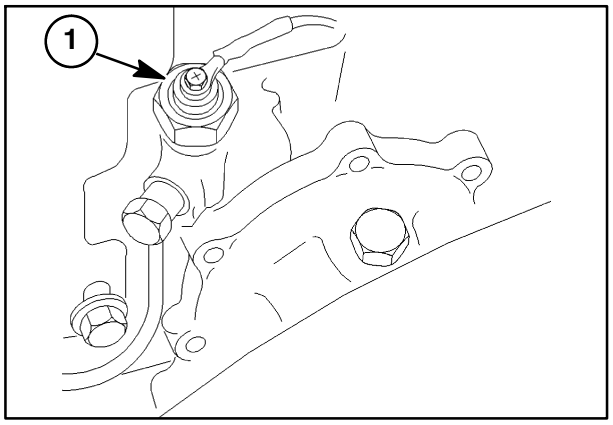
OIL PRESSURE SWITCH

Removal

Remove the oil pressure switch, 1.



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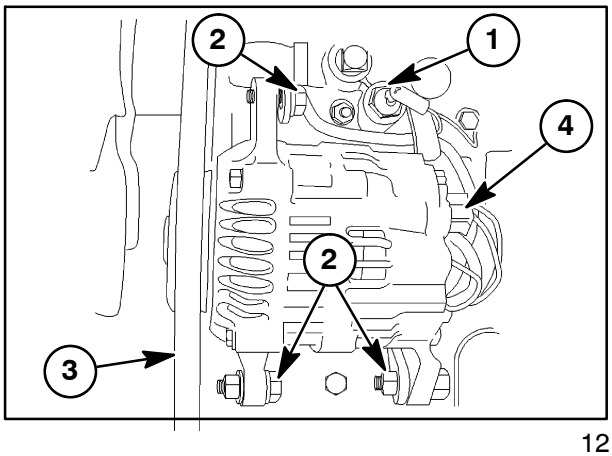
TEMPERATURE SENDING SWITCH AND ALTERNATOR

Removal

1. Remove the temperature sending switch, 1, from the front of the cylinder head.
2. Loosen the alternator mounting bolts, 2, and remove the V-belt, 3, from the drive pulley.
3. Disconnect the alternator wires from the back of alternator, 4.
4. Remove the alternator mounting bolts, 2, and remove the alternator.



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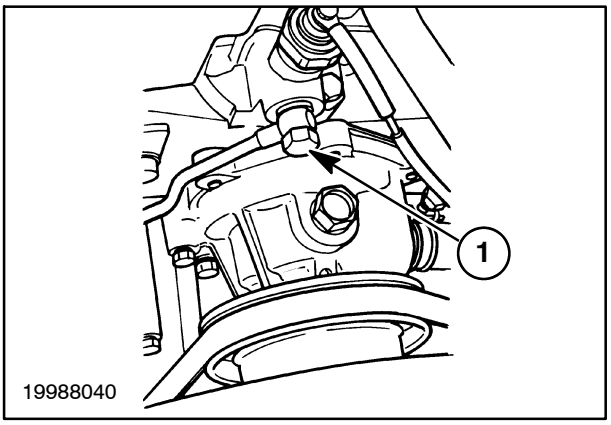
FAN, WATER PUMP, AND EXTERNAL OIL TUBE

Removal

1. Remove the fan and water pump assembly. See “Fan Removal” and “Water Pump Removal” discussed later in this section.
2. Remove the external oil transfer tube banjo bolt, 1, from the front of the cylinder head.



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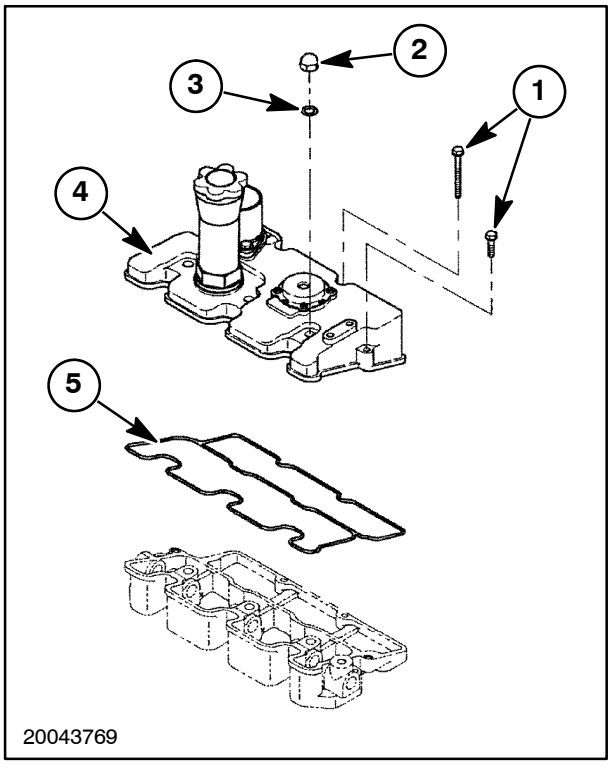
HEAD COVER

Removal

Remove the retaining bolts, 1, cap nuts, 2, and seal washers, 3, and remove the head cover, 4, with gasket, 5.



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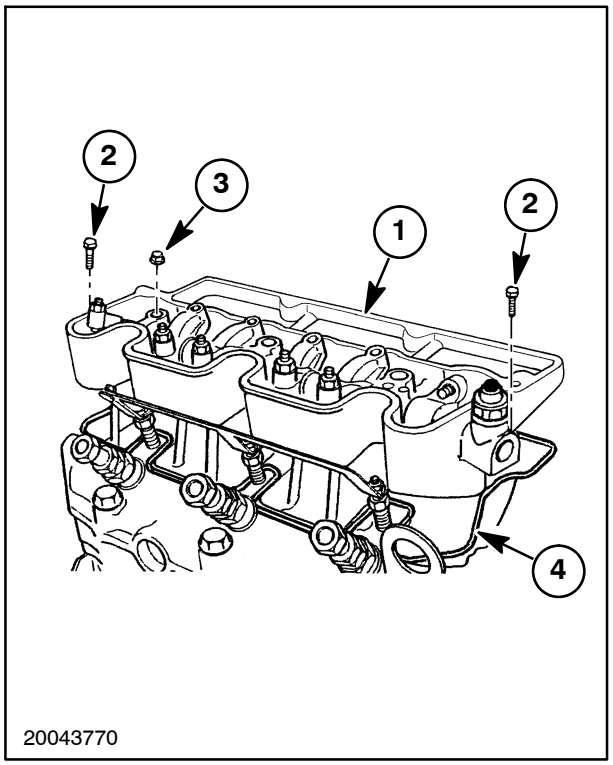
ROCKER ARM SHAFT AND SUPPORT BRACKET

Removal

Remove the bolts, 2, and nuts, 3. Remove the rocker arm shaft and support bracket as an assembly, 1, and gasket, 4.

NOTE: *Alternately loosen the rocker support bolts a turn at a time to prevent distorting the rocker shaft.*



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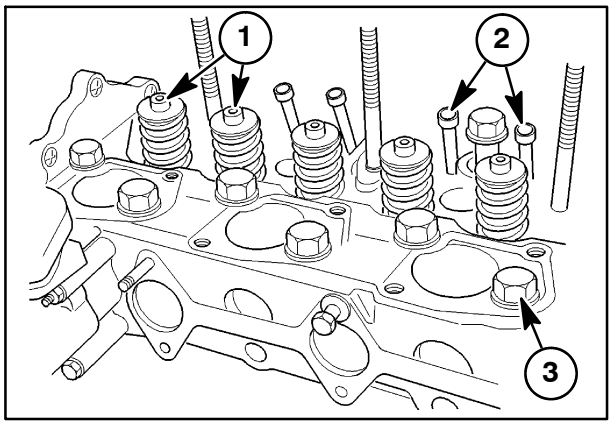
CYLINDER HEAD

Removal

NOTE: *Keep all valve components in separately marked containers for re-assembly in their original location.*

1. Remove the valve stem caps, 1, and push rods, 2.
2. To remove the cylinder head, remove the cylinder head bolts, 3, by alternately loosening a half turn at a time to prevent warping the head.

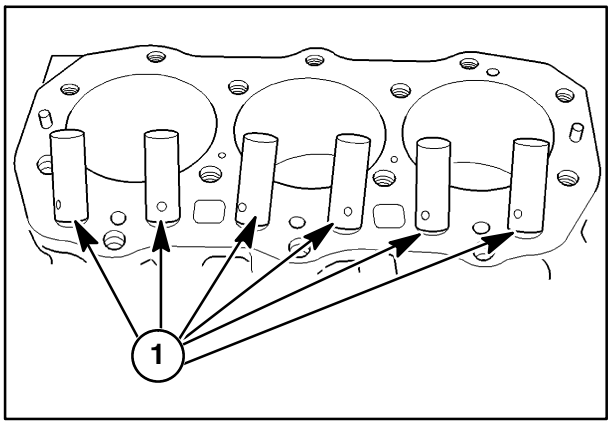


16

VALVE TAPPET

Removal

Remove the valve tappets, 1, from the machined bore in the cylinder block.

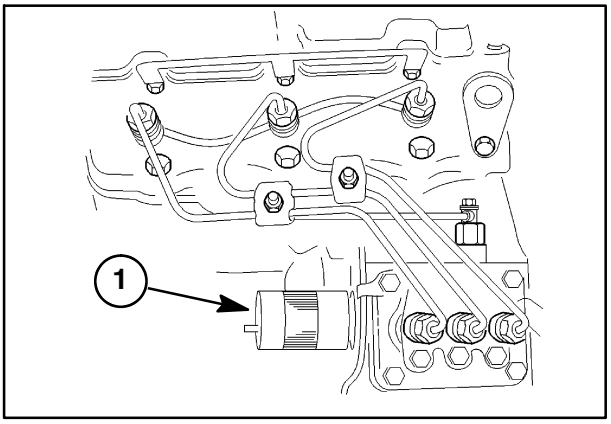


17

FUEL SHUTOFF SOLENOID

Removal

Remove the wire connector and unscrew the fuel shutoff solenoid, 1.

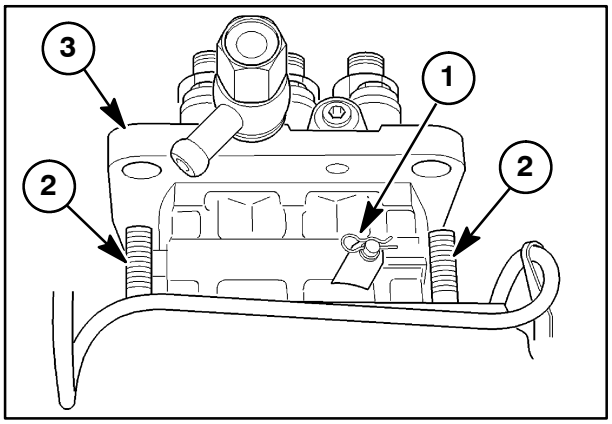


18

TIMING GEAR COVER

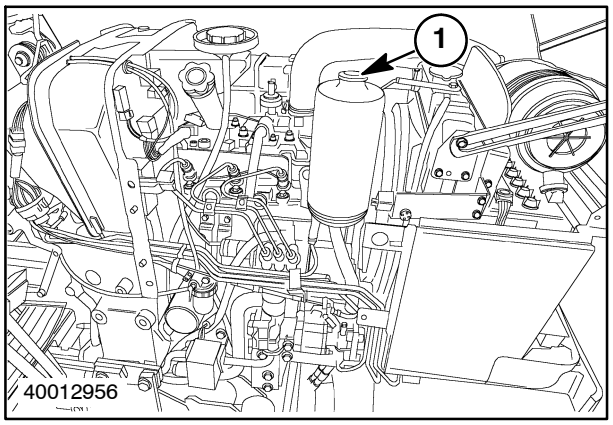
Removal

1. Drain the engine crankcase oil.
2. Remove the crankshaft pulley.
3. Disconnect the throttle control rod at the injection pump.
4. Loosen the four injection pump mounting bolts, 2, and raise the injection pump, 3, enough to remove the spring pin, 1, and separate the governor link from the control rack. Remove the injection pump.



19

5. Remove the power steering pump reservoir tank dipstick-filler cap, 1.



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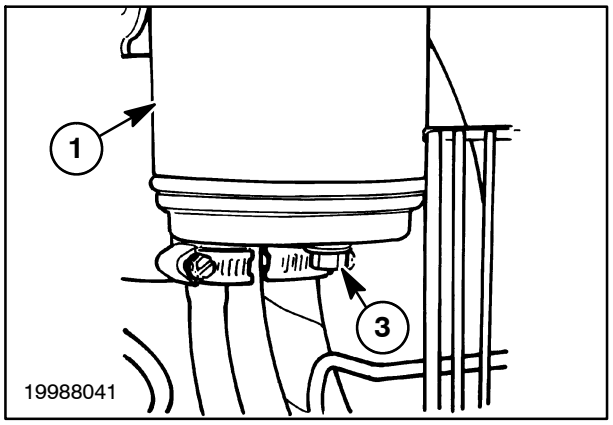
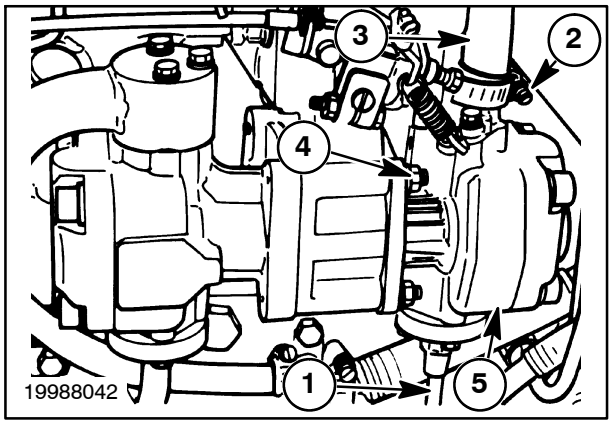
6. Remove the reservoir drain plug, 3, and drain the hydraulic fluid out of the reservoir tank, 1, into a suitable container.



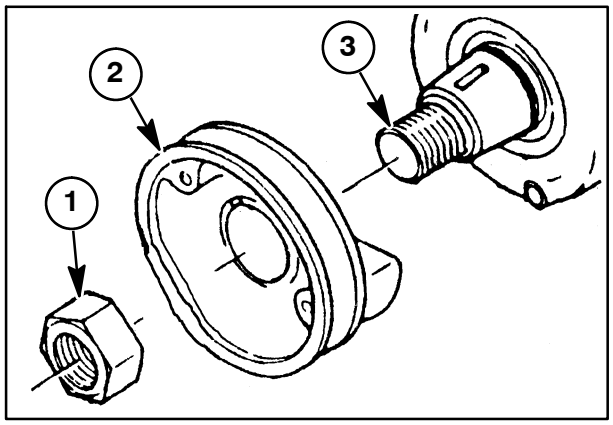
21

7. Loosen the hose clamp, 2, on the suction tube, 3, and remove the suction hose from the steering pump, 5.
8. Remove the pressure tube, 1, from the bottom of the steering pump.
9. Remove the through bolts, 4, and remove the steering pump from the front cover. Cap the lines and pump openings.



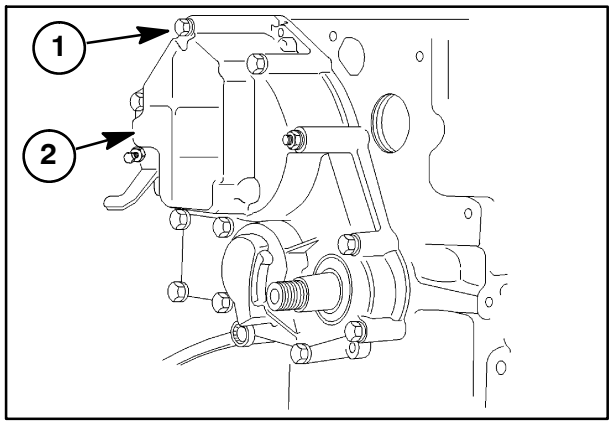
22

10. Remove retaining nut, 1. Pull crankshaft pulley, 2, off of crankshaft, 3.



23

11. Remove the retaining bolts, 1, and lift the cover, 2, off the locating dowels.



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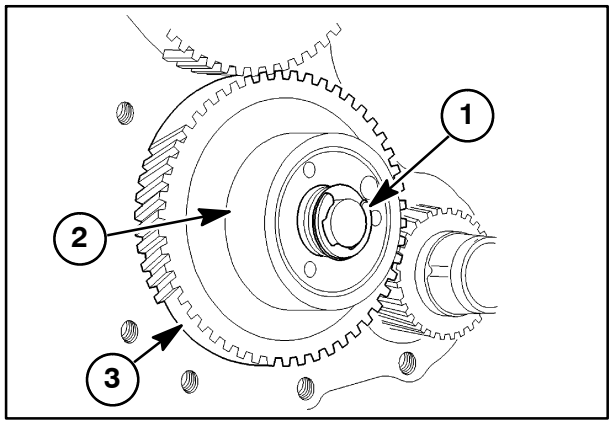
TIMING GEARS AND CAMSHAFT

Removal

1. Remove retaining ring, 1, and remove the idler gear, 3, and oil pump assembly, 2.



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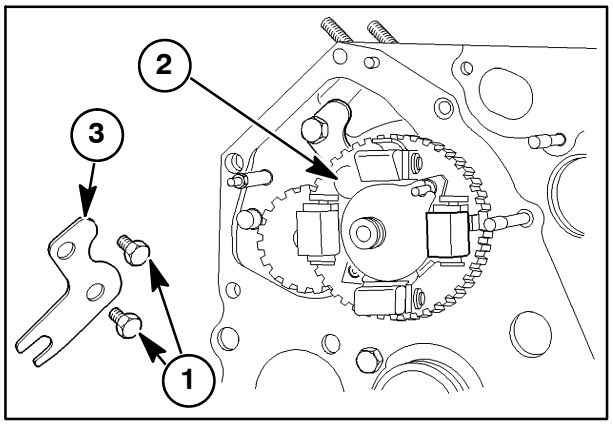
2. Remove the two bolts, 1, securing the keeper plate, 3. One must be accessed using the access hole, 2, in the cam gear.
3. Slide the camshaft and gear out of the camshaft bore.



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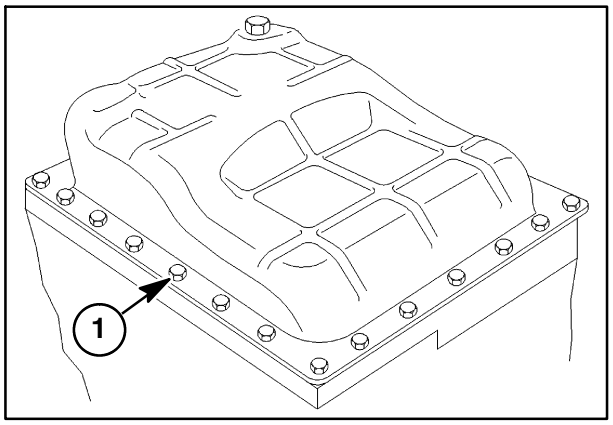
OIL SUMP

Removal

1. Remove the oil sump retainer bolts, 1.
2. Remove the oil sump and discard gasket.

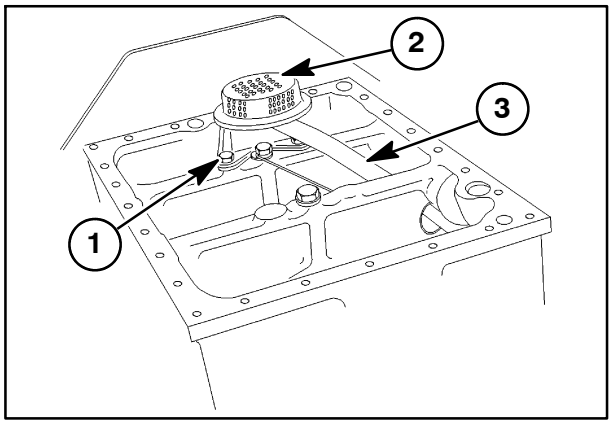


27

OIL SUCTION PIPE AND STRAINER

Removal

1. Remove the two retaining bolts, 1.
2. Remove the oil strainer, 2, and rotate the oil suction pipe, 3, out of its bore. Remove from the front side of the block.



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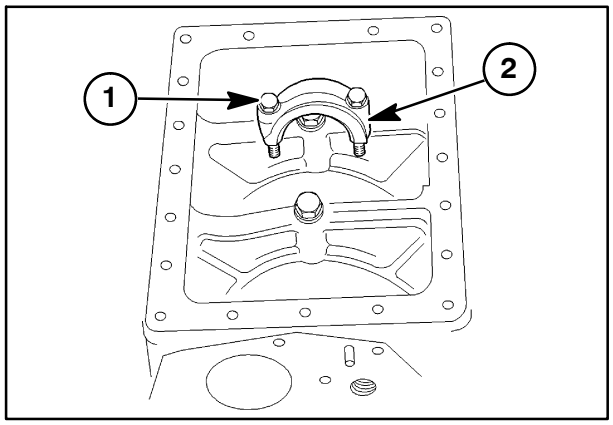
CONNECTING RODS, BEARINGS, PISTONS, AND RINGS

Removal

1. Remove the two bolts, 1, retaining the connecting rod caps, 2.
2. Remove the connecting rod caps and lower half of connecting rod bearing.
3. If necessary, remove any ridge from the top of the cylinder bores using a suitable ridge reamer.



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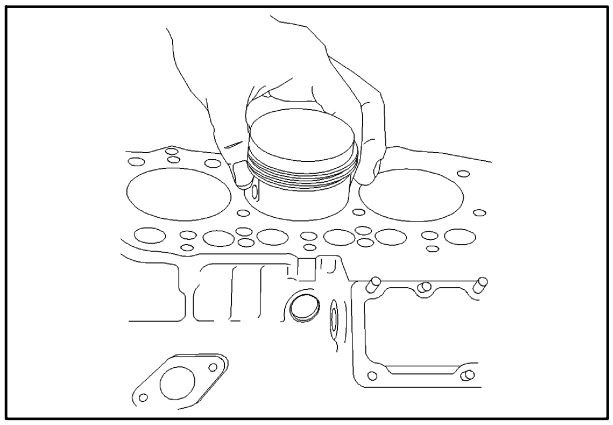
4. Push the piston and connecting rod out of the cylinder block.
5. Replace the connecting rod cap to the piston assembly it was removed from. Keep together in cylinder sequence.

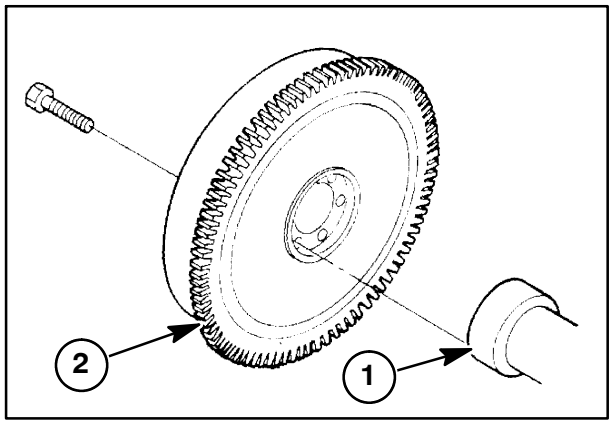


30

FLYWHEEL

Removal

1. Loosen the flywheel retaining bolts.
2. Using a brass drift and hammer, tap the end of the crankshaft, 1, to loosen the flywheel, 2, from the shaft.



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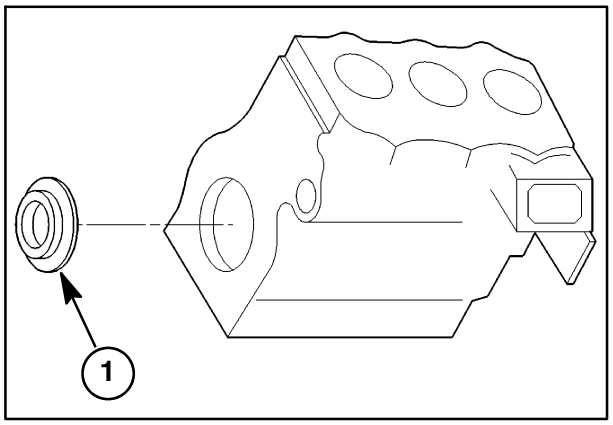
BACKPLATE AND OIL SEAL

Removal

1. Remove the backplate retaining bolts and remove the backplate.
2. Remove the rear oil seal, 1.



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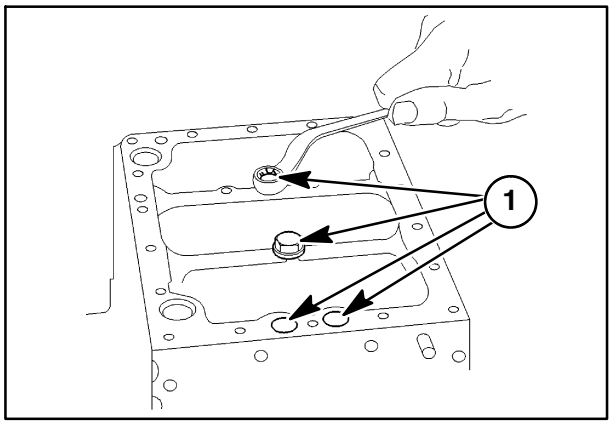
CRANKSHAFT AND MAIN BEARINGS

Removal

1. Remove the crankshaft bearing holder retaining bolts, 1.
2. Slide the crankshaft and main bearing assembly through the rear of the engine.



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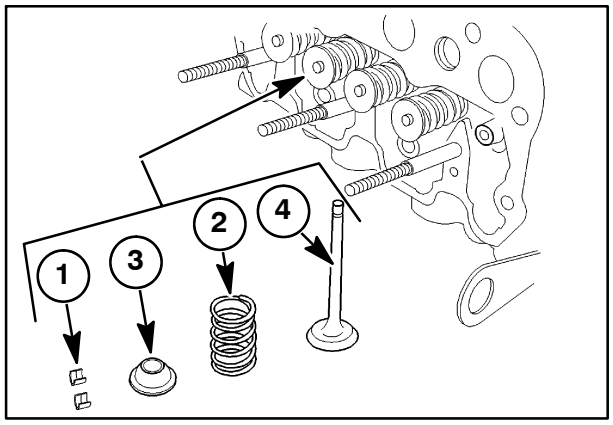
CYLINDER HEAD

Disassembly

1. Clean the cylinder head and remove any carbon deposits from around the valve heads.
2. Use a valve spring compressor and remove the valve spring retainer locks, 1, spring, 2, and spring retainer, 3, from each valve, 4.
3. Remove the valves and place the valve components together in separately marked containers for reassembly in their original position.



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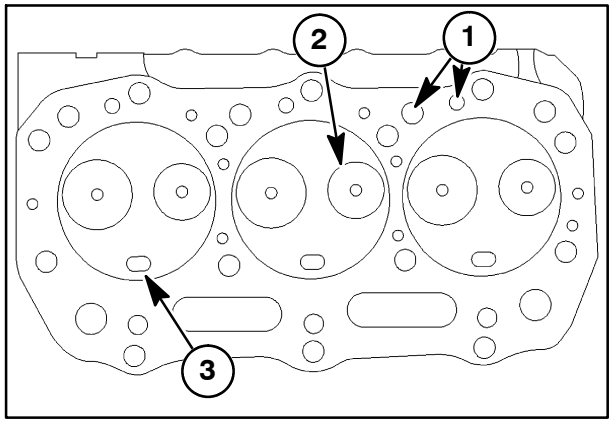
Inspection and Repair

1. Clean all carbon deposits from the combustion chamber and valve ports using a wire brush and scraper.
2. Clean all dirt and residue from the gasket surface using care not to scratch or nick the machined surface.
3. Clean the cylinder head in solvent and air dry.
4. Inspect the head for cracks or damage in the following areas:
   - Valve ports
   - Valve seats, 2
   - Prechamber, 3
   - External cracks in the water jackets, 1
5. Inspect the gasket surfaces for scratches or nicks, which could cause leakage.
6. Examine the core hole plugs for rust or signs of leakage. If a plug shows signs of damaging rust or leakage, replace all plugs in the head.
7. Inspect the prechamber for carbon deposits and looseness. Remove any carbon deposits found. If prechamber is found to be loose, cylinder head may be warped.



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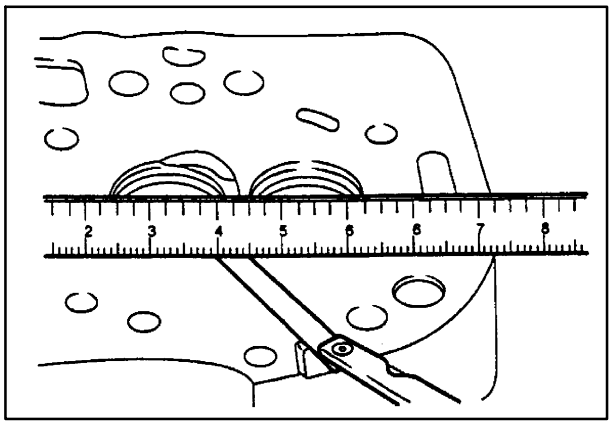
8. Use a straight edge and a feeler gauge and check the cylinder head for warp lengthwise, crosswise, and diagonally.



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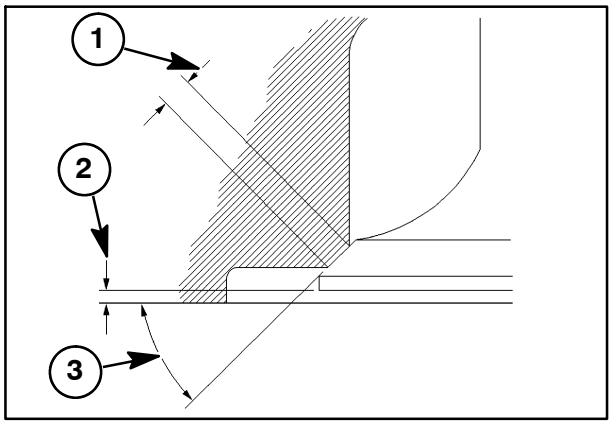
VALVE SEATS

Inspection and Repair

Examine the valve seats and surface the seat if damaged. Valve seat grinding requires that the seat be ground to the correct width and properly positioned. A valve that extends too deep into the combustion area will result in valve burning. If the valve is recessed too deep into the head it will cause a rapid build-up of carbon deposits.

1. Check the seat for surface defects. Use a 45° stone if necessary to reface. Grind away only enough material to provide a smooth even seat.



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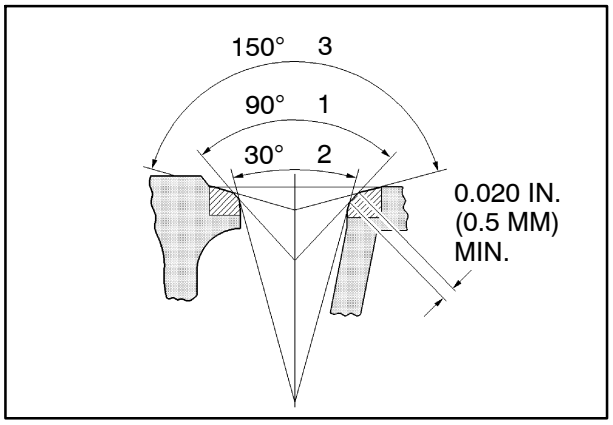
1. Correct Valve Seat Width and Location
2. Correct Valve Head Margin N843 0.7 - 1.0 mm (0.027 - 0.039″)
3. 45° Valve Seat Angle

2. Check the seat width. If necessary, use a 15° stone to lower the seat contact point and use a 75° stone to raise the seat contact point.

   NOTE: *Refacing the seat should always be coordinated with refacing of the valve to ensure a compression tight fit.*



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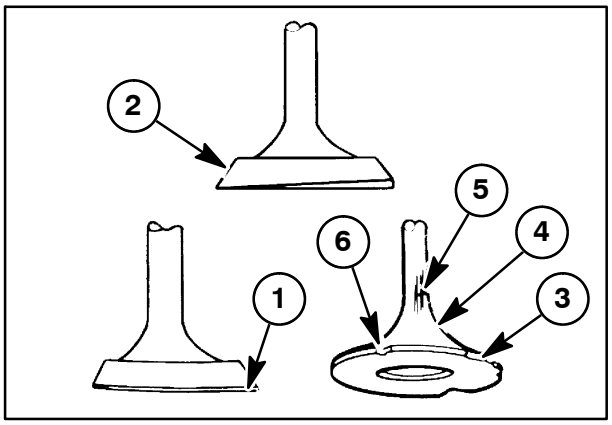
1. Seat angle - 45° Stone
2. Lower Seat Location - 15° Stone
3. Raise Seat Location - 75° Stone

VALVES

Inspection and Repair

1. Clean all deposits from the valves using a soft wire brush. Inspect the condition of the valves and discard any that are badly burned, cracked, or bent.



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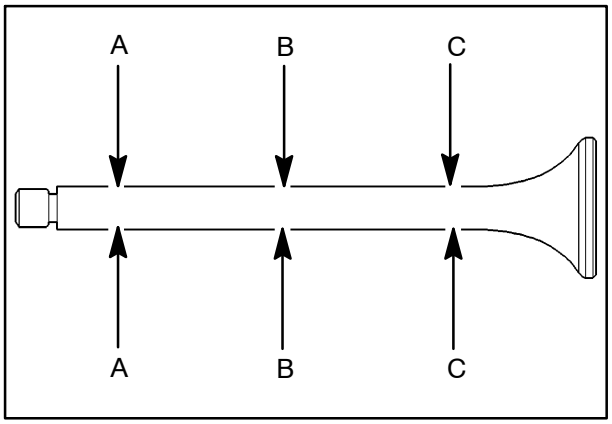
1. Margin Too Thin Min. 0.5 mm (0.02″)
2. Bent Valve
3. Pitting
4. Indented
5. Wear or Nicking
6. Burned

2. Using a micrometer, measure the valve stem at points “A,” “B,” and “C.”



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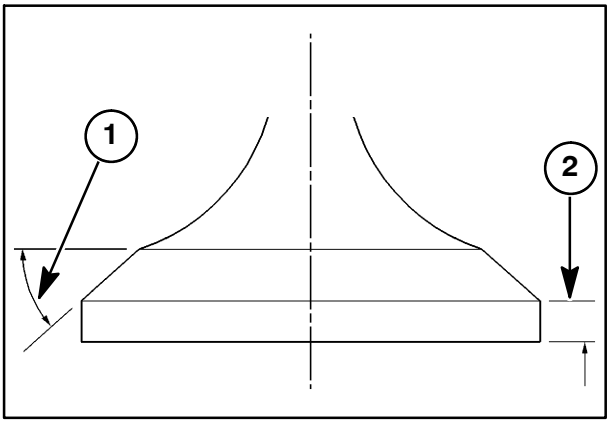
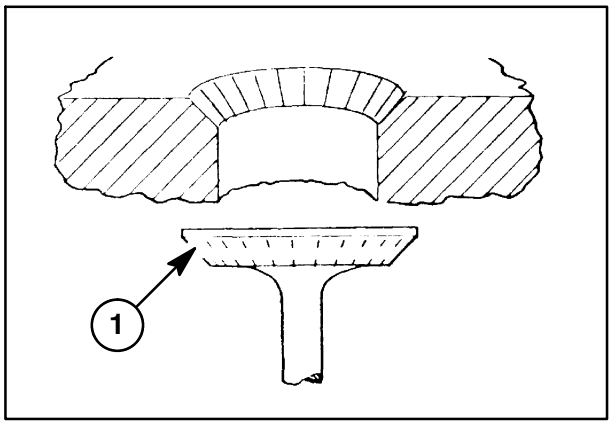
3. If inspection indicates that the valve may be reused, the valve should be ground.
4. After grinding the valve and seat, check to ensure the seat contacts the center of the valve face. Using Prussian Blue, lightly coat the valve seat, place the valve in position and rotate the valve slightly while holding a light pressure against the valve. If the blue is transferred to the center of the valve face, the contact is correct.



41

1. 45° Angle Seat
2. Minimum Valve Margin

5. If Prussian Blue is not available, mark the valve face or seat, 1, with a soft lead pencil. Rotate the valve slightly in the seat. The penciled lines will be broken at the seat contact area.



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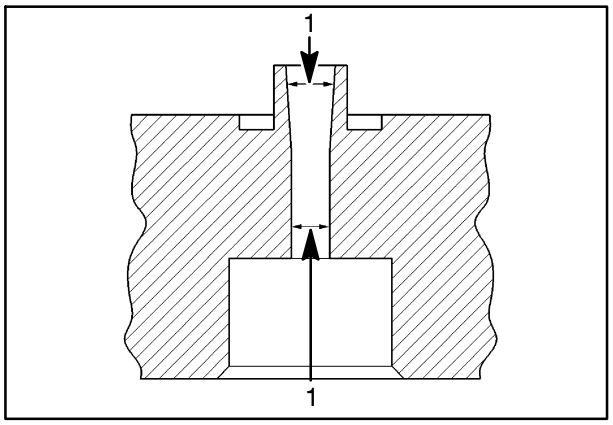
VALVE GUIDES

Inspection and Repair

Thoroughly clean the valve guides before attempting to check internal wear.

1. Using a telescoping gauge and micrometer, measure the valve guide bore at the top and bottom wear points, 1.



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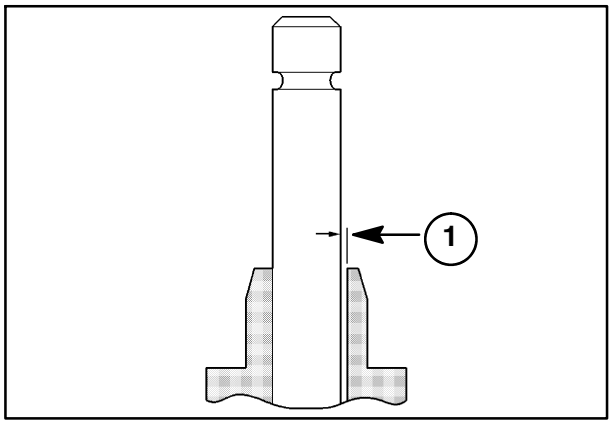
2. Determine the valve stem to valve guide clearance, 1, by subtracting the valve stem diameter from the valve guide diameter. Replace valves if the clearance, 1, is more than 0.2 mm (0.008″), intake valves, or 0.25 mm (0.010″), exhaust valves.
3. Replace the cylinder head if excessive clearance is determined and the valves have met all specified measurement requirements. See “Specifications”.



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VALVE SPRINGS

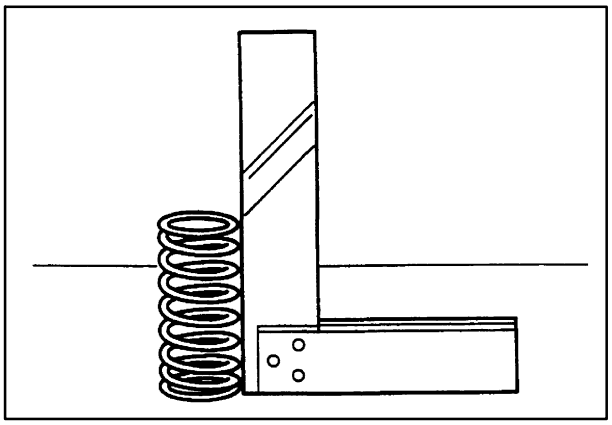
Inspection and Replacement

1. Place the valve springs on a flat surface. Measure the free length of the spring and squareness. Replace springs that do not meet the following specifications (all models):

Max. Out of Square	Min. Free-Length
2.0 mm (0.079″)	33.5 mm (1.319″)

2. Place the springs in a suitable spring load tester and measure the spring load rating. Replace springs that do not meet the following specifications (all models):

Standard	Maximum
8.1 kg (17.86 lbs.) at 30.4 mm (1.197″)	7 kg (15.43 lbs.) at 30.4 mm (1.197″)



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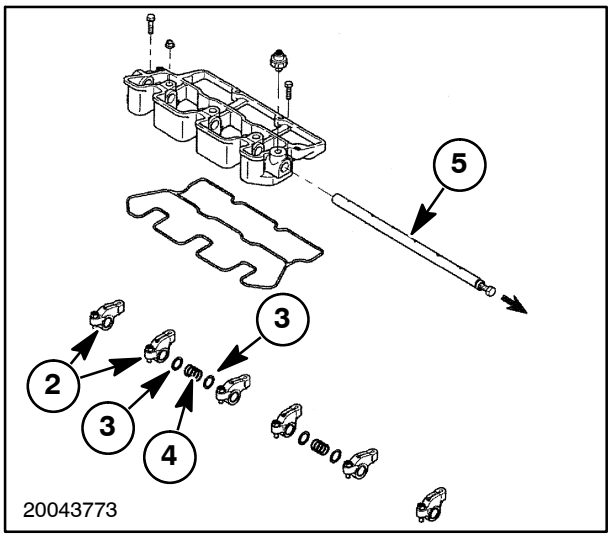
ROCKER ARMS

Inspection and Replacement

1. Thread an 8 mm bolt into the front end of the rocker shaft and slowly withdraw the rocker shaft while at the same time removing the rocker arms and springs.
2. Inspect the rocker arms and shaft for wear or damage. Check the adjusting screws for damaged threads or excessive wear.
3. Check the valve stem contact area for pitting or excessive wear. Slight wear patterns may be removed using a fine grit oil stone.



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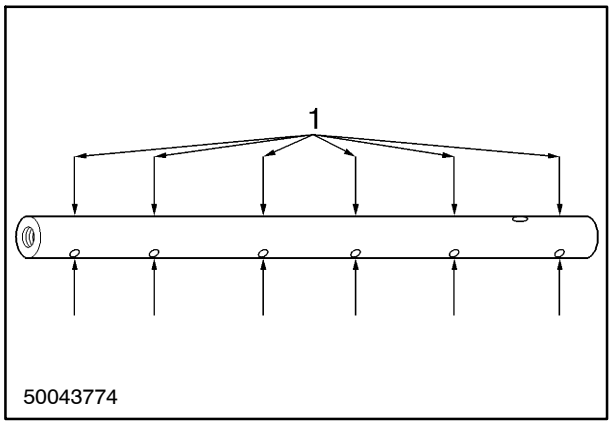
1. Rocker Arm
2. Shims
3. Spring
4. Rocker Arm Shaft

4. Using an outside micrometer, measure the wear points, 1, on the rocker shaft. Replace the rocker shaft if the wear at any point exceeds 0.2 mm (0.008″).

   NOTE: *The lube holes, one set on the bottom of the rocker shaft at 170° from the oil pressure check hole.*



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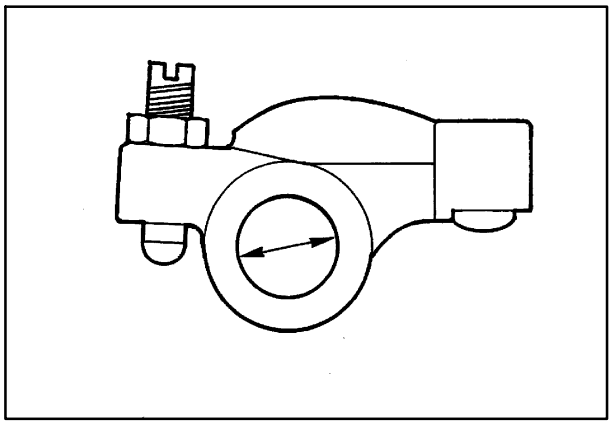
5. Using a telescoping gauge and micrometer, measure the inside of the rocker arm. Replace rocker arms having a bore diameter exceeding 11.57 mm (0.456″). Replace the rocker shaft and/or rocker arm if the rocker arm to shaft clearance exceeds 0.2 mm (0.008″).

   NOTE: *Rocker arms have no bushings and only one lube hole.*



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PUSH RODS

Inspection and Replacement

1. Check the push rods for straightness by rolling on a flat surface. Replace rods that are bent.
2. Inspect the ends of the push rods for excessive wear. If any push rod is worn, the corresponding lifter and rocker arm should also be inspected for excessive wear.

CYLINDER HEAD

Assembly

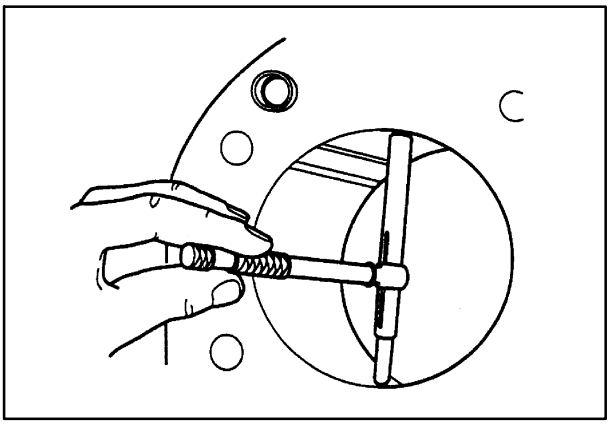
1. Insert each valve in the guide from which it was removed and lightly lap the valve to be sure of an even seat around the valve face. Remove the valve and remove all traces of lapping compound.
2. Install new intake valve seals on the valve guides using a suitable driver.
3. Using a spring compressor, assemble the valves, springs, retainers, and keepers.

CYLINDER BLOCK

Inspection

1. Inspect the cylinder block top face for cracks, damage, and warping in the same way as for the cylinder head. Replace the cylinder block if warp is greater than 0.12 mm (0.005″).
2. Visually inspect the cylinder bore. There should be no scoring, rust, or corrosion.
3. Using a telescoping gauge in line with the crankshaft, measure the inside diameter of the top of the bore (approximately 15 mm [0.6 in.] below the top of the engine block).
4. Repeat this measurement at right angles to the crankshaft at the same distance.
5. In line with the crankshaft at the bottom of the bore, measure (approximately 117 mm [4.60 in.] from the top of the cylinder).
6. Repeat this measurement at right angles to the crankshaft at the same distance.
7. If any of the measurements taken indicate worn or damaged cylinder bores, replace the long block assembly.

   NOTE: *If the cylinder bore measures 84.2 mm (3.315 ″) replace the block.*



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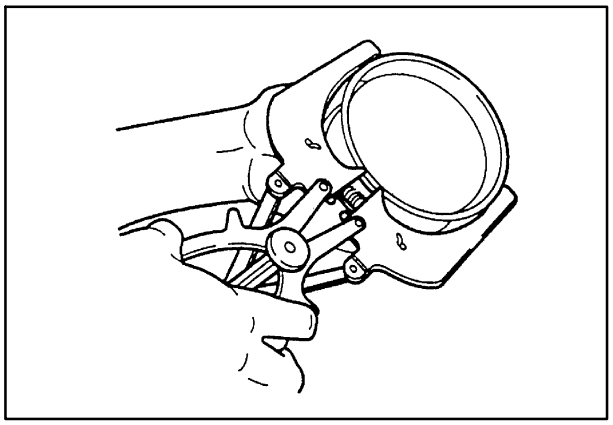
PISTONS

Disassembly and Inspection

1. Remove the piston rings using a piston ring tool.



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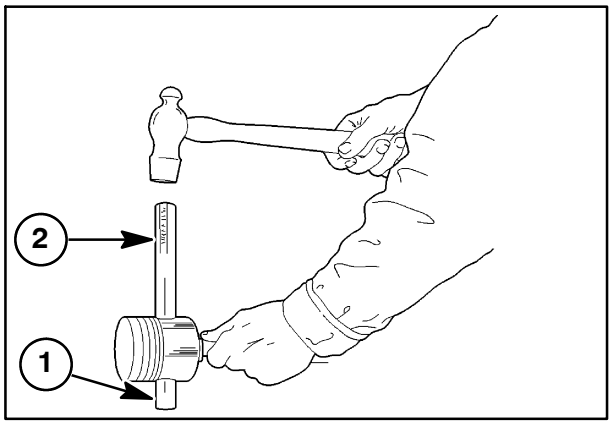
2. Remove the wrist pin, 1, retaining rings and drive the wrist pin out of the piston using pin remover Tool No. FNH 01585, 2.



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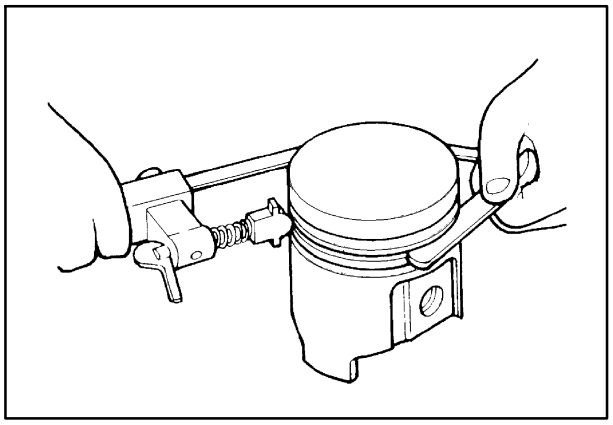
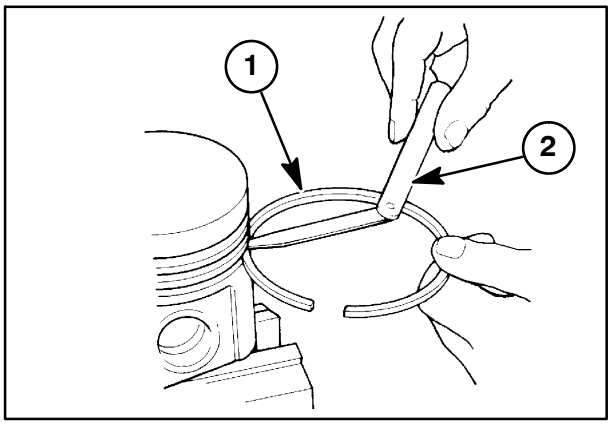
3. Wash the pistons and connecting rods in a suitable solvent and air dry.
4. Using a groove cleaner, remove the carbon deposits from the ring grooves. Be careful to avoid cutting any metal from either side or the bottom of the grooves.



52

5. Inspect the piston ring lands for excessive wear. Use a new ring, 1, and feeler gauge, 2, to check the ring side clearance. Replace pistons having a ring side clearance exceeding the following dimensions:

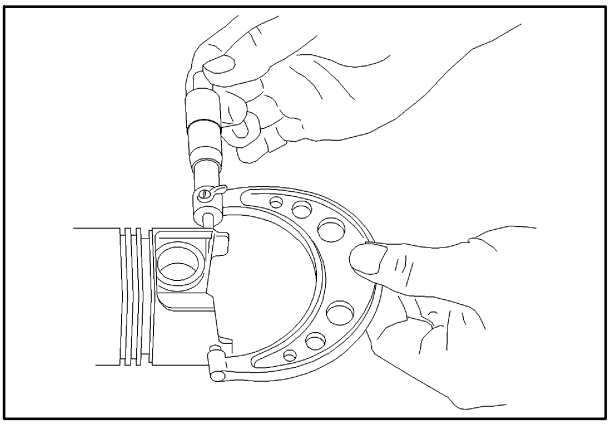
Compression Ring	Oil Control Ring
0.25 mm (0.010″)	0.15 mm (0.006″)



53

6. Using a micrometer, check the piston diameter at 90 degrees from the wrist pin bore. Replace pistons that are worn to less than the following dimensions:

Model	Wear Limit
TC30	83.7 mm (3.3″)



54

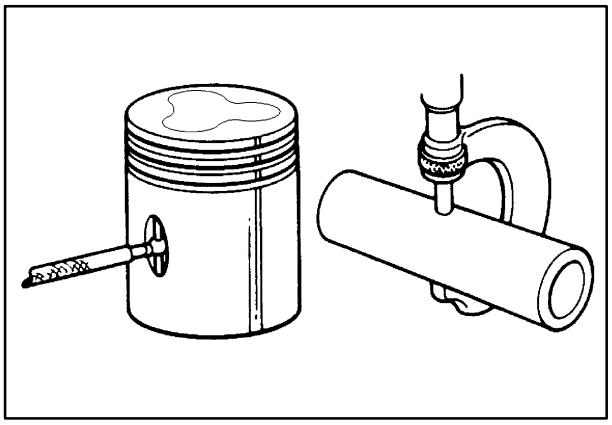
7. Using a telescoping gauge and a micrometer, measure the piston pin bore and the wrist pin diameter. Replace piston and/or wrist pins that exceed the following limits:

   Bore Diameter: 28.0 mm (1.102″)

   Pin Diameter: 27.98 mm (1.101″)

   Clearance: 0.02 mm (0.0008″)

   In some instances the wrist pin diameter may be equal to or slightly larger than the wrist pin bore. This interference fit is normal.



55

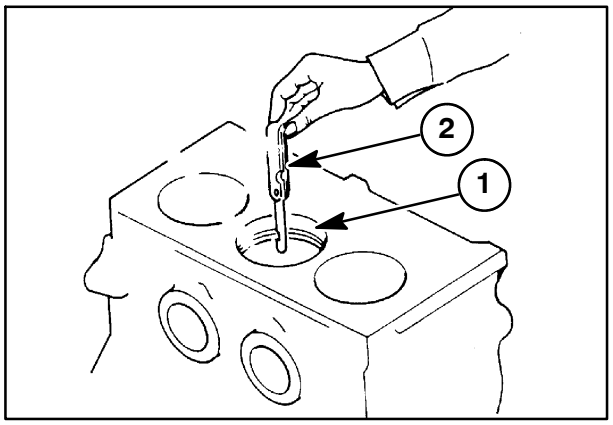
PISTON RINGS

Disassembly and Inspection

1. Position the piston rings, 1, one at a time, in the cylinder to the lowest point of travel. Use an inverted piston to square the ring in the bore.
2. With a feeler gauge, 2, measure the ring gap.

   The ring is shown at the top of its travel for clarity.

3. Replace worn rings with end gap clearance in excess of 1.0 mm (0.039″).



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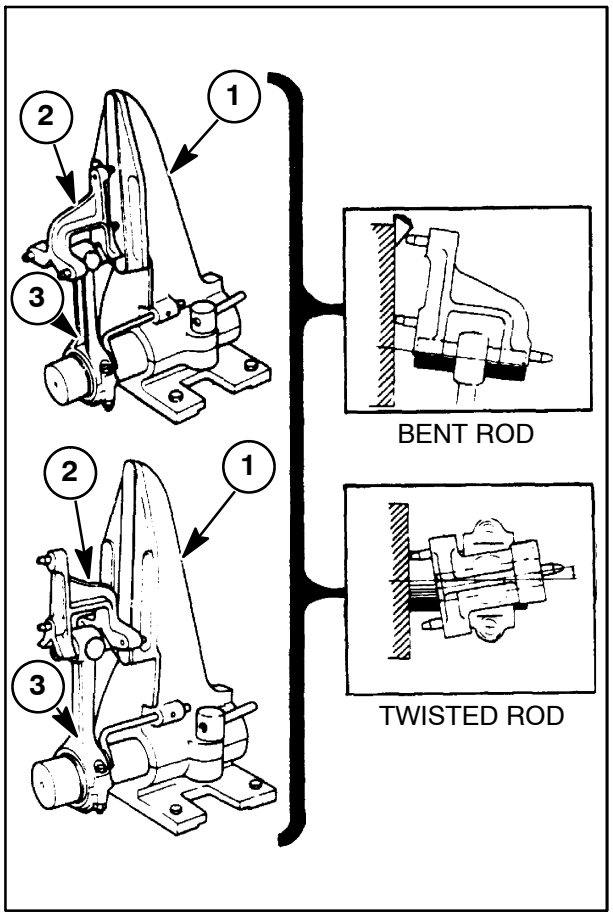
CONNECTING RODS

Disassembly and Inspection

1. Check the connecting rods for damage and alignment. Place each rod in an alignment fixture to check for bent or twisted condition.
2. Straighten or replace rods that are bent or twisted more than the following dimensions:

   Max. Bend: 0.15 mm (0.0059″) per 100 mm (3.94″)

   Twist: 0.2 mm (0.0078″) per 100 mm (3.94″)



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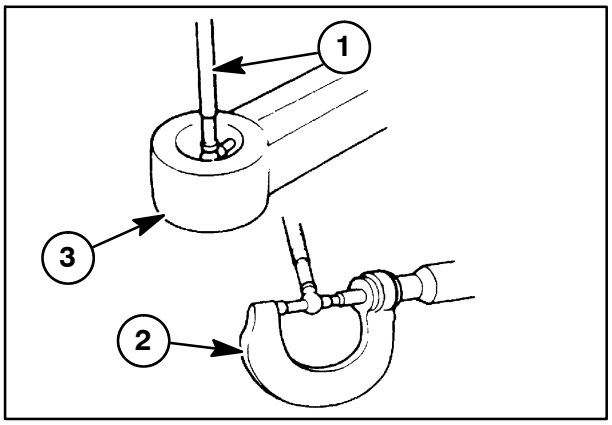
1. Alignment Fixture
2. Gauge
3. Connecting Rod

3. Using a telescoping gauge and a micrometer, measure the inside diameter of the connecting rod wrist pin bushing.
4. Replace bushings measuring more than the following:

Model	Max. Inside Diameter
TC30	28.0 mm (1.1024″)



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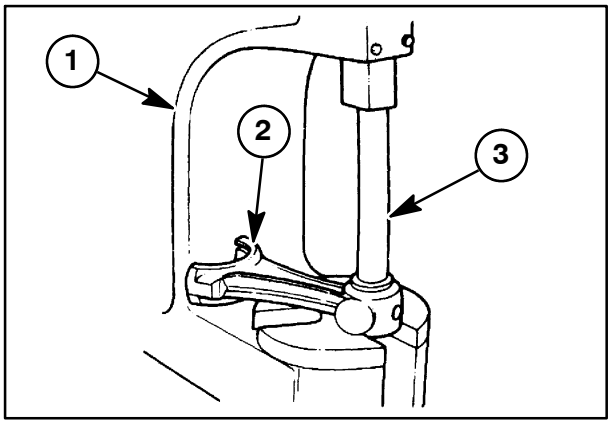
1. Hole Gauge
2. Micrometer
3. Connecting Rod

5. Remove and install the connecting rod wrist pin bushings using a suitable driver and press a new bushing into the rod bore.
6. Ream and hone the bushing to the following finish size.

Pin to Bushing Clearance

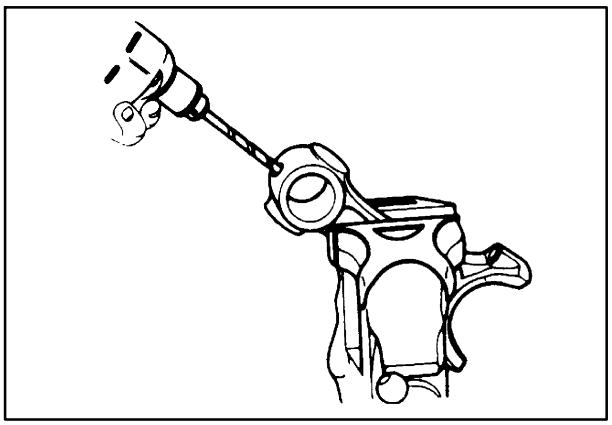
Std.	Max.
0.010 - 0.025 mm (0.00039 - 0.00098″)	0.08 mm (0.0031″)



59

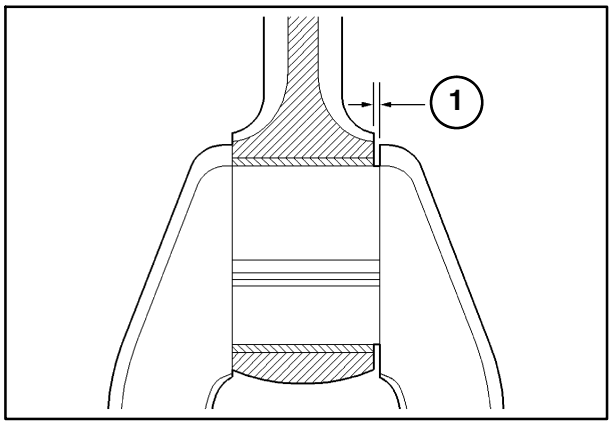
1. Press
2. Connecting Rod
3. Bushing Driver

7. When installing a new piston pin bushing, use the hole in the rod and drill a lube hole in the new bushing.



60

8. Install the connecting rod on the crankshaft and measure the play in shaft direction. If the play is more than 0.7 mm (0.028″) replace the connecting rod.

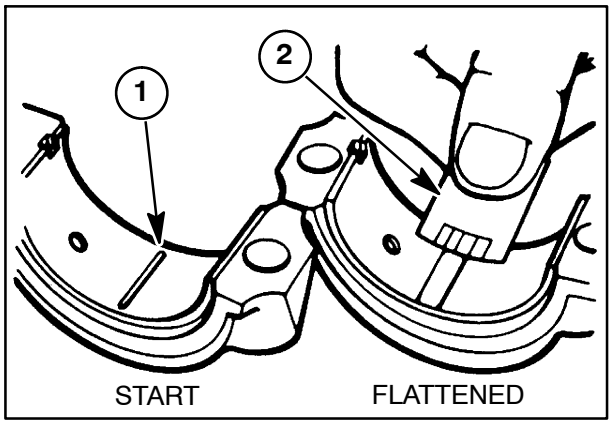


61

1. Side Clearance Check 0.7 mm (0.028″) Max.

CONNECTING ROD BEARING OIL CLEARANCE CHECK

1. Remove oil or foreign matter from the bearing and crankshaft.
2. Cut a piece of plastigauge, 1, to the same width as the bearing. Place it on the crankshaft. Avoid the oil hole.
3. Install the rod cap and torque to 49.0 - 53.9 N·m (36.2 - 39.8 ft. lbs.).
4. Remove the rod cap and measure the width of the flattened plastigauge using the plastigauge scale.
5. The width of the widest flattened plastigauge is the minimum clearance and the width of the narrowest plastigauge is the greatest clearance. Select the proper size bearing liners to obtain the correct clearance. See “Specifications”.



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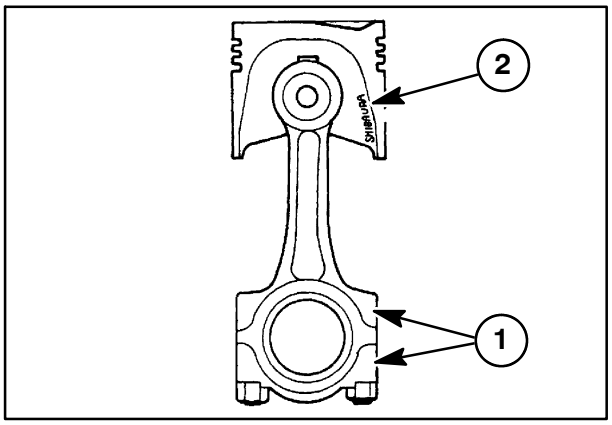
1. Plastigauge
2. Bearing Clearing Check

PISTONS, RINGS, AND CONNECTING ROD

Assembly

1. Assemble the pistons and connecting rods with the matching marks, 1, on the rods on the same side as the trade name “SHIBAURA,” 2, embossed on the inside of the piston skirt. Install the piston pin, and retaining rings.



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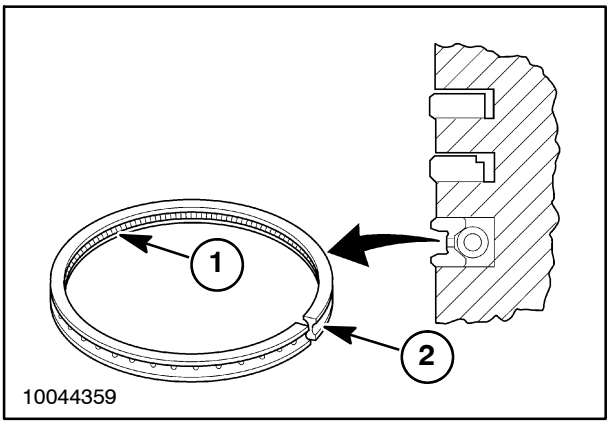
2. Using a suitable ring expander tool, install the piston rings positioning the ring gaps at approximately 120 degrees from each other. Install the third (oil ring) first as follows:

   Put the expander ring, 1, into position in its groove.

   Put the outer oil ring, 2, into position in its groove. Adjust the outer oil ring gap, so it is diametrically opposite to the joint of the expander ring.



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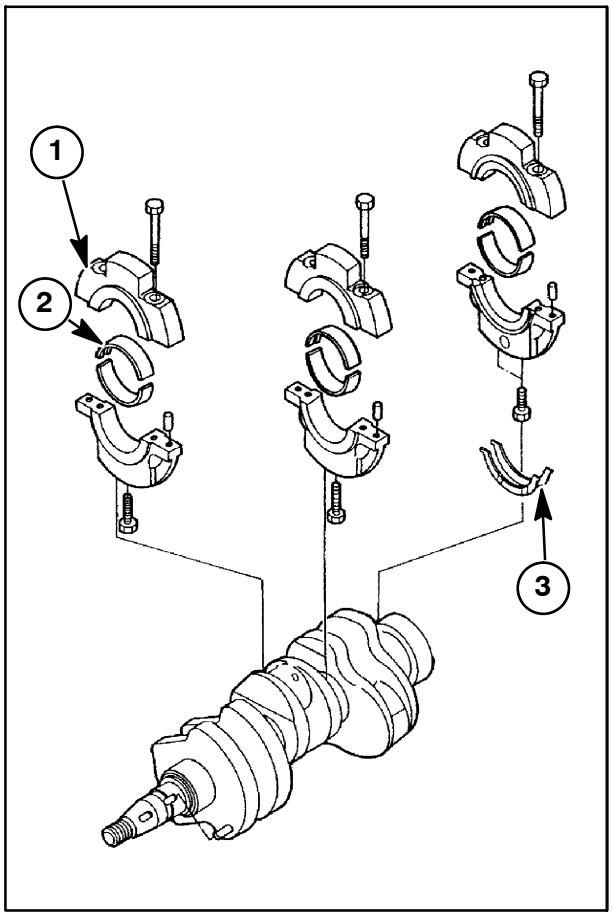
MAIN BEARING AND THRUST WASHER

Removal and Inspection

1. Remove the two retaining bolts from the bearing holders, 1.
2. Remove the bearing holders and bearing liners, 2.
3. Position a piece of plastigauge across the full width of the bearing liners.
4. Install the bearing holder and tighten the bolts to 49.0 - 53.9 N·m (36.2 - 39.8 ft. lbs.).

   NOTE: *Do not permit the bearing holder to rotate, even the slightest amount.*
5. Remove the bearing holders and measure the width of the flattened plastigauge using the gauge printed on the plastigauge package.
6. Replace components or grind the crankshaft to the next oversize bearing as required to obtain the correct clearance. See “Specifications” later in this section.
7. Check the thrust washer for wear, poor contact, burning, or other defects. Using a micrometer measure the washer thickness. If washer thickness is not within allowable limits or found to be defective, the washers must be replaced.

Standard Thickness:	2.95 - 3.0 mm (0.116 - 0.118″)
Allowable Limit:	2.8 mm (0.11″)



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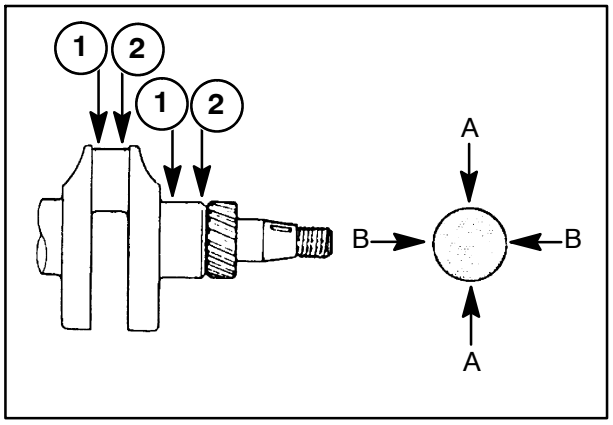
1. Holder
2. Main Liner
3. Thrust Bearing

CRANKSHAFT

Inspection

1. Inspect the crankshaft gear teeth for wear or damage and replace if necessary.



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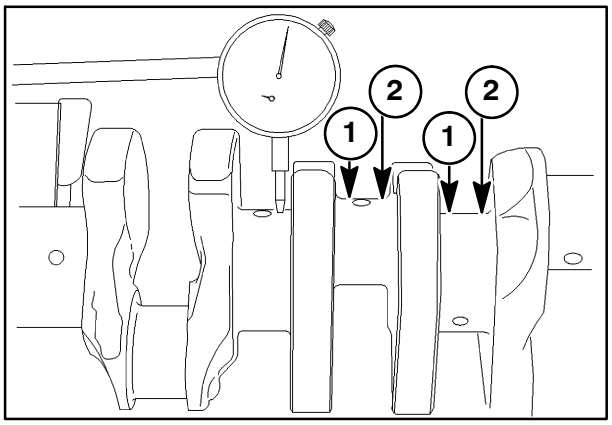
A. Taper Readings: 1 vs. 2
B. Out-of-Round Readings: A vs. B

2. Using a dial indicator, measure the crankshaft journals for size, runout, and tapper.
3. The amount of tapper in a journal is the difference in the measurements taken at points 1 and 2 on a journal.
4. The amount of out-of-round in a journal is the difference in the measurements taken at 90° points on the journal.

   NOTE: *The smallest reading taken at any one of the readings indicates the size of the journal. See "Specifications" for wear limits and repair recommendations.*

   NOTE: *Undersize bearings are available in 0.25 - 0.50 mm (0.010 - 0.020″) for both main and crankpin journals. See "Specifications" for wear limits and bearing usage.*
5. Mount the crankshaft in a set of V-blocks and measure the amount of runout using a dial indicator.
6. Straighten or replace crankshafts that exceed runout specifications. See "Specifications", discussed later in this Section.



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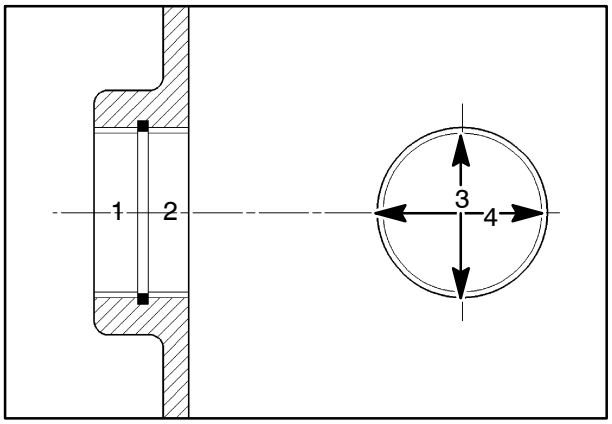
CRANKSHAFT BEARING (BUSHING)

Inspection

1. Check the bearing (bushing) for peeling, melting, seizure, or poor contact.
2. Using a telescoping gauge and micrometer, measure the oil clearance between the bearing (bushing) and the crankshaft journal.
3. Measure the inside diameters at positions 1 and 2. At each position, measure in both directions 3 and 4. The oil clearance can be obtained by subtracting this value from the maximum crankshaft journal diameter.
4. If the oil clearance exceeds 0.2 mm (0.0078″) replace the bearing (bushing) or grind the crankshaft journal. In this case, use an undersized bearing (bushing).



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Replacement

1. Remove the bearing from the front of the cylinder block housing using a bushing driving tool to prevent damage.
2. Inspect the bushing housing for marks, scratches, or damage.
3. The bushing should be smoothly pressed into the correct depth by using a bushing driving tool, aligning the oil hole, and direction of bushing.

   a. Press the bushing into the cylinder block from the engine front side.

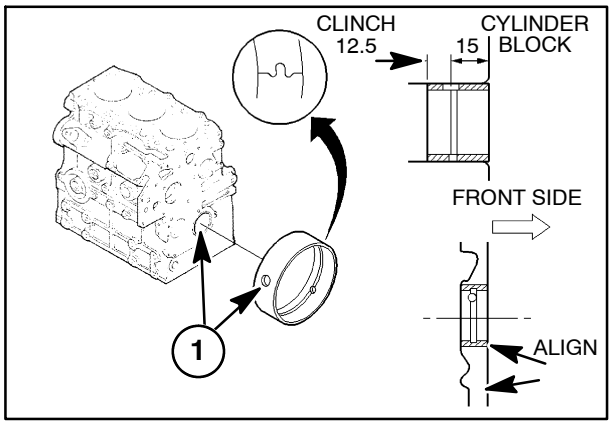
   NOTE: *Do not press the bushing into the cylinder block from the opposite side.*

   NOTE: *The correct pressing side is chamfered, etc., to allow smooth operation.*

   b. Lubricate the outer surface of the bushing.

   c. Align the oil hole, 1, of the housing and bushing.

   d. Press the bushing into the housing until the correct depth by using a bushing driving tool.
4. Confirm the housing and bushing oil holes are in alignment.



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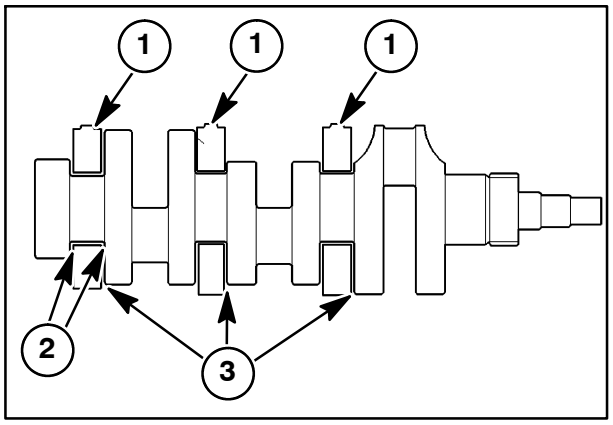
MAIN BEARING AND THRUST WASHER

Assembly

1. Install the bearing holders, 1, along with their liners. The rear bearing is also assembled along with the thrust bearing halves, one located on each side of the bearing. Be sure the bearing holders are correctly positioned on the shaft with the chamfered edge facing forward.
2. Torque the bearing holder retaining bolts to 49.0 - 53.9 N·m (36.2 - 39.8 ft. lbs.).



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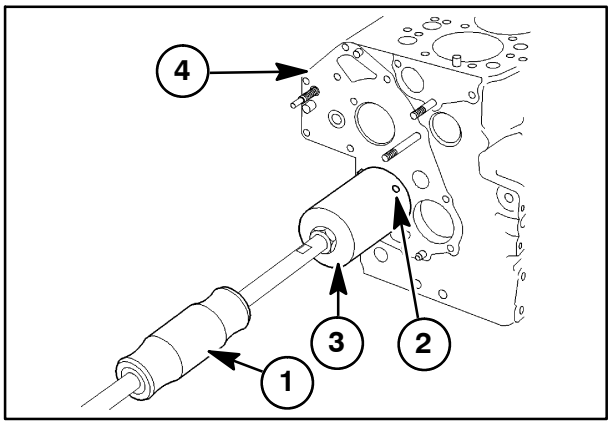
1. Bearing Holder
2. Thrust Bearing
3. Holder Chamfer

PORT BLOCK

Removal

NOTE: *The oil pump shaft and port block assembly is a press fit in the block.*

1. Using special Tool No. NH11097, 3, place the collars in the grooves of the port block assembly.
2. Align the set screws, 2, of the puller, 3, with the counterbores in the collars and tighten.
3. Using a sliding hammer, 1, remove the port block.
4. Remove plate, 4, from the block.



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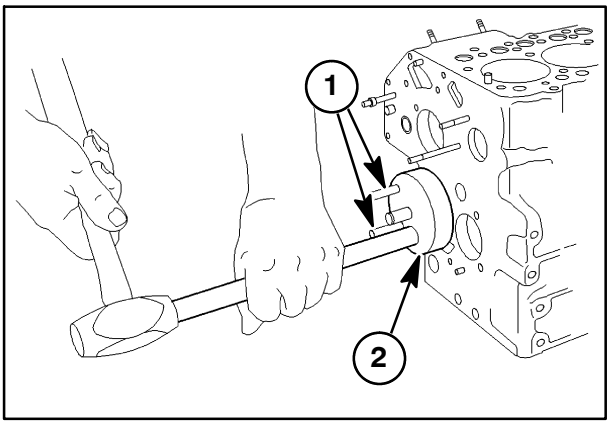
Installation

1. Using special Tool No. NH00117, 2, insert the threaded guide pins, 1, into the cylinder block.
2. Assemble the oil pump shaft to the port block using nut and washer.
3. Insert the port block assembly into the installer and place on the guide pins.
4. Using a suitable driver, install the port block assembly. The installer must bottom against the engine block when fully positioned.

   NOTE: *Plate, 4, Figure 71, must be removed from engine block for proper installation of the port block.*



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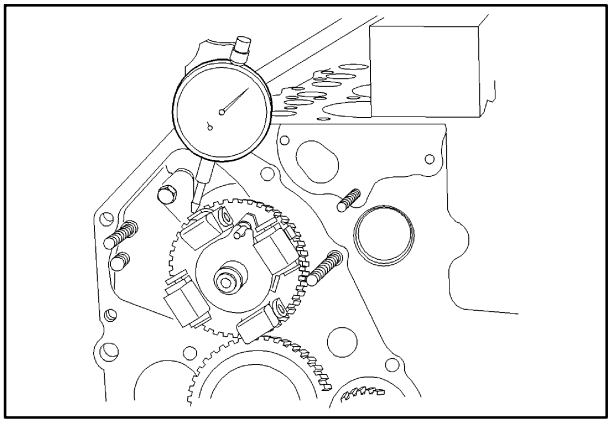
TIMING GEAR

Inspection

1. Check the timing gears for wear and damage on the contact area. Replace if any defect is found.
2. Measure the backlash of gears with a feeler gauge or dial indicator. If the allowable limit is exceeded, replace all timing gears.

Standard	Allowable Limit
0.08 mm (0.003″)	0.25 mm (0.010″)



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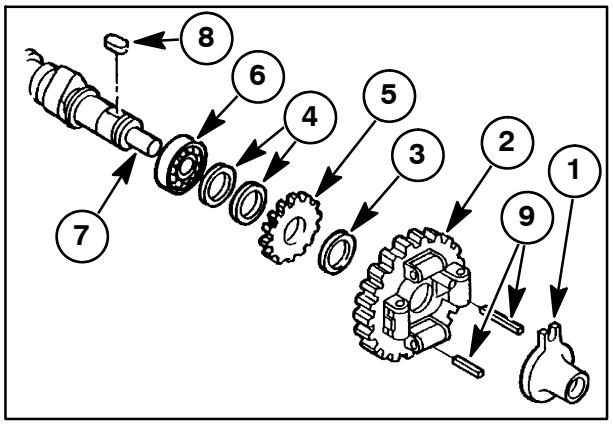
CAMSHAFT

Disassembly

1. Remove the slider, 1, from the camshaft gear.
2. Using a gear puller, remove the gear assembly, 2, spacer, 3, spacers, 4, spacer gear, 5, bearing, 6, and key, 8, from the camshaft, 7.



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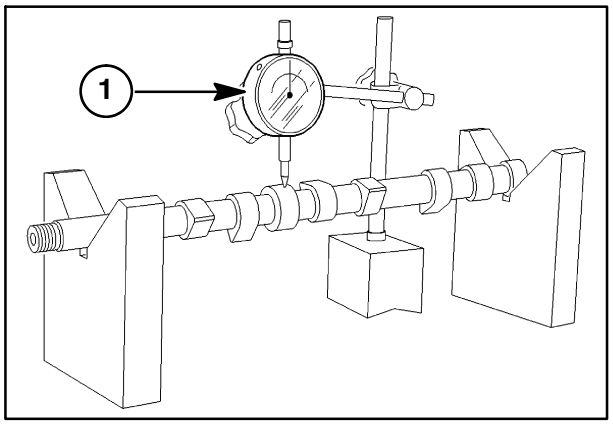
Inspection

1. Place the camshaft in a set of V-blocks and check the runout using a dial indicator, 1.
2. Replace or straighten the camshaft if the runout is greater than 0.1 mm (0.004″).
3. Using a micrometer, measure the height of the camshaft lobes.
4. Replace the camshaft if any of the cam lobes are worn to less than the following dimensions:

   Valve Lobe: 33.7 mm (1.326″)

   Injection Pump Lobe: 41. mm(1.646″)



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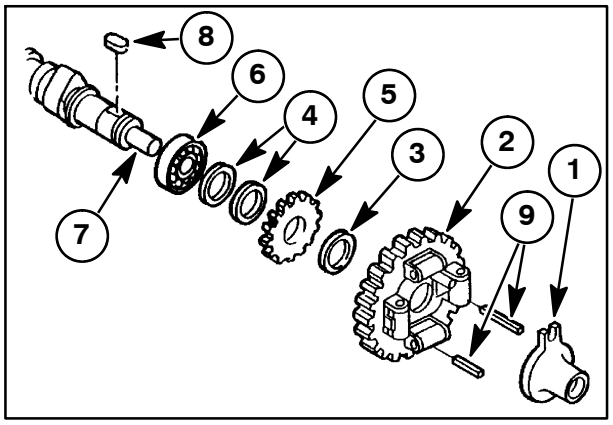
Assembly

1. Install bearing, 6, two spacers, 4, spacer gear, 5, and spacer, 3.

   NOTE: *The spacer gear, 5, serves as a spacer only. There is no other purpose for this gear.*
2. Insert key, 8, into key slot on shaft and press the gear assembly over the shaft onto the key.



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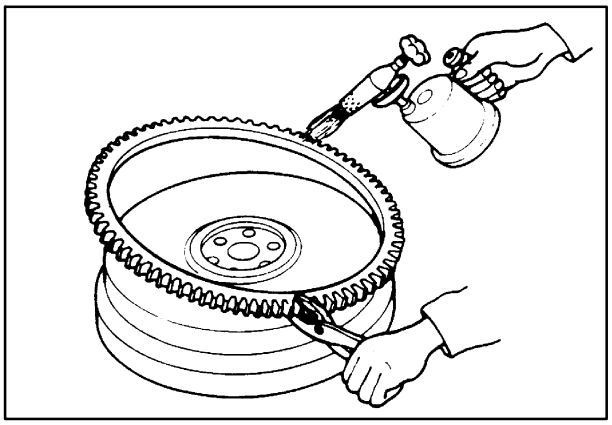
FLYWHEEL

Inspection and Repair

1. Inspect the ring gear for cracked, broken, chipped, or worn gear teeth. If found damaged, replace the ring gear.
2. If necessary, remove the starter ring gear using a hammer and chisel to crack the ring gear.
3. To reinstall a new ring gear, heat the new ring gear to 120 - 150°C (245 - 300°F) from the inside only. Be careful not to overheat the ring gear teeth. Use a temperature sensitive crayon to mark the inside of the ring gear. Quench the ring gear quickly to obtain a good shrink fit onto the flywheel.



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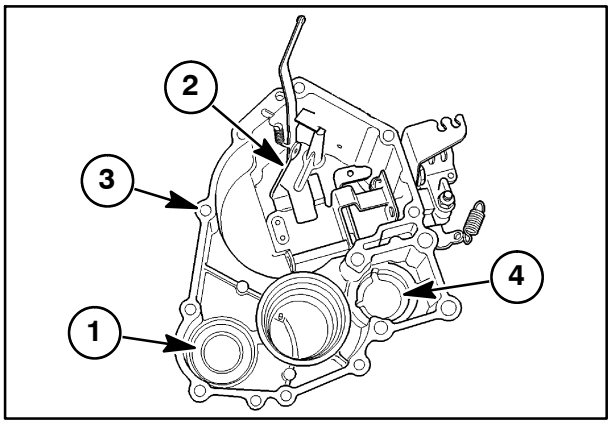
TIMING GEAR HOUSING

The timing gear housing, 3, contains the front oil seal, 1, power steering seal, 4, and the governor linkage assembly, 2. See “Governor Assembly” for governor linkage repair and replacement procedures.



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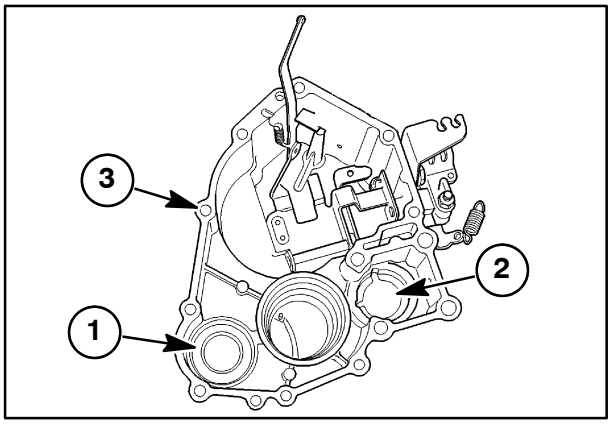
FRONT OIL SEAL AND STEERING PUMP SEAL

Replacement

1. Remove the front oil seal, 1, from the timing gear cover, 3, and insert a new oil seal in its place.
2. Remove the steering pump seal, 4, located on the front of the timing gear cover, and replace with a new seal.



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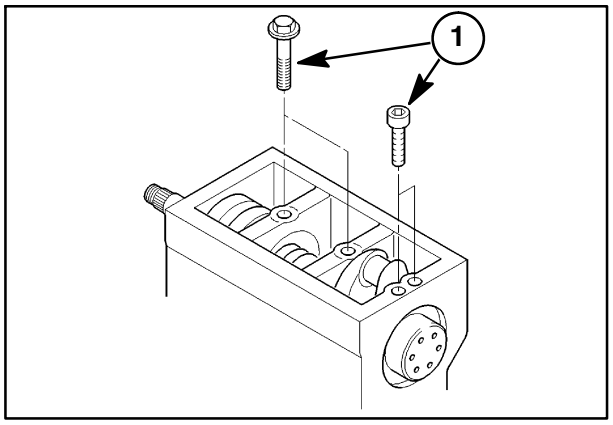
CRANKSHAFT AND BEARING HOLDER

Installation

1. Install the crankshaft with bearing holder through the rear of the cylinder block.
2. Align the threaded holes on the bearing holders with the bolt holes in the cylinder block.
3. At the flywheel end install the two socket head hex bolts, at each center bearing install the hex head bolt. Torque the socket head bolts to 24 - 31 N·m (18 - 22 ft. lbs.). Torque the hex head bolts to 49 - 54 N·m (36 - 40 ft. lbs.).
4. Using a dial indicator, measure the crankshaft end float (thrust). If the thrust is not within the allowable limit, remove the crankshaft and check the thrust washers.

Standard Thrust	Allowable Limit
0.1 - 0.4 mm (0.004 - 0.016″)	0.5 mm (0.020″)



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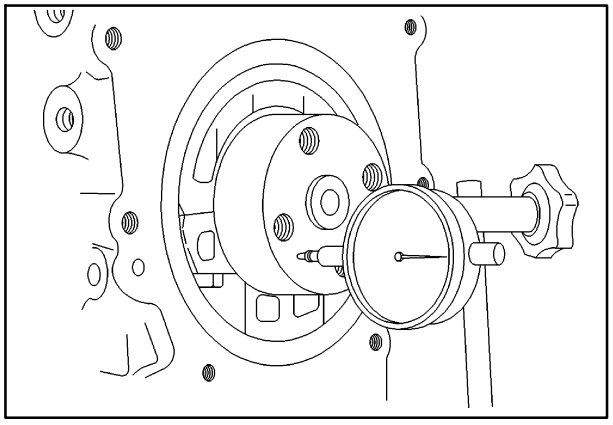
1. Bearing Holder Bolts



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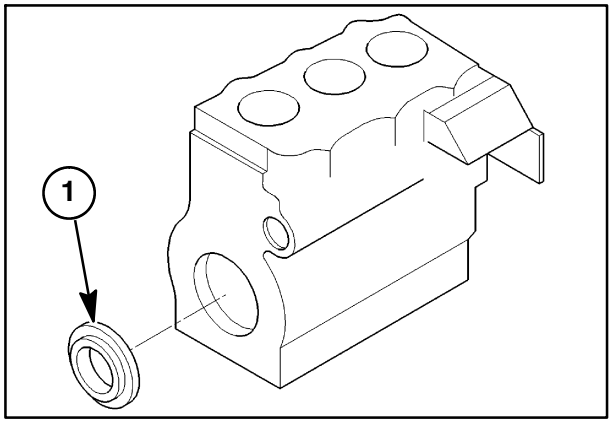
REAR OIL SEAL AND BACKPLATE

Installation

1. Install the rear oil seal, 1, over the rear of the crankshaft.

   NOTE: *The rear oil seal is a press fit retained by the backplate.*
2. Apply liquid gasket sealer to the backplate attaching bolts,install the back and tighten the back plate bolts to 14 - 18 N·m (10 - 13 ft. lbs.).



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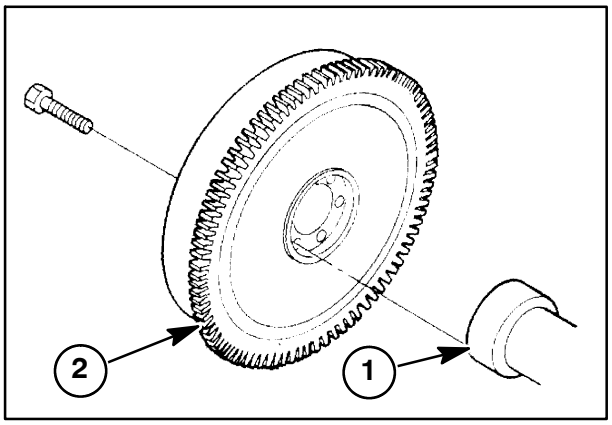
FLYWHEEL

Installation

1. Fit the flywheel, 2, to the crankshaft, 1, and align the bolt holes.
2. Install the flywheel retaining bolts and tighten to 58 - 68 N·m (43 - 50 ft. lbs.).



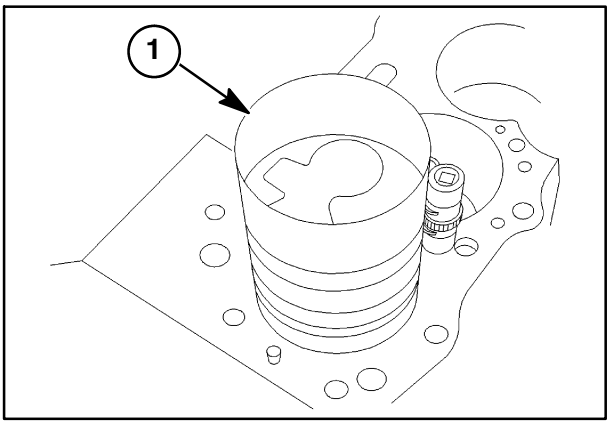
83

PISTONS AND CONNECTING RODS

Installation

1. Coat the bearing faces, pistons, and piston rings with clean engine oil. Slide the piston rings to permit a sufficient amount of oil to be applied in the grooves.
2. Set the piston ring gaps 90 degrees apart from each other. Do not position these gaps toward the piston pin or the right angle of the pin.
3. Using a piston ring compressor, 1, insert the pistons in the cylinders with the prechamber side of the piston facing the injection pump side. The connecting rod marks should also face the injection pump side.

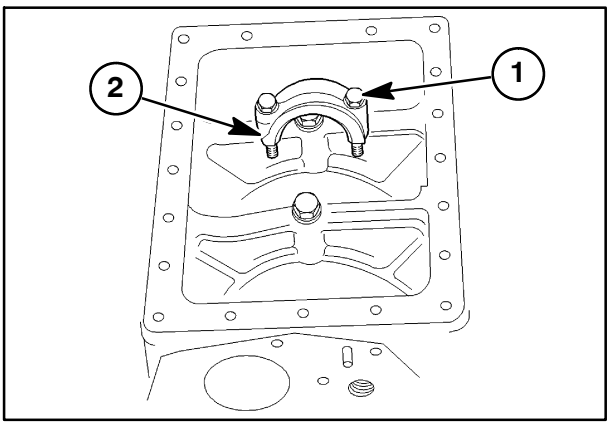
   NOTE: *Install the pistons from the front to the rear in order.*



84

4. Install the connecting rod caps, 2, making sure the rod and cap matching marks align. Tighten the connecting rod cap screws, 1, to 49 - 54 N·m (36 - 40 ft. lbs.).

   NOTE: *After installation, ensure the crankshaft moves freely. Ensure the axial play of 0.1 - 0.3 mm (0.004 - 0.012 ″) is provided.*



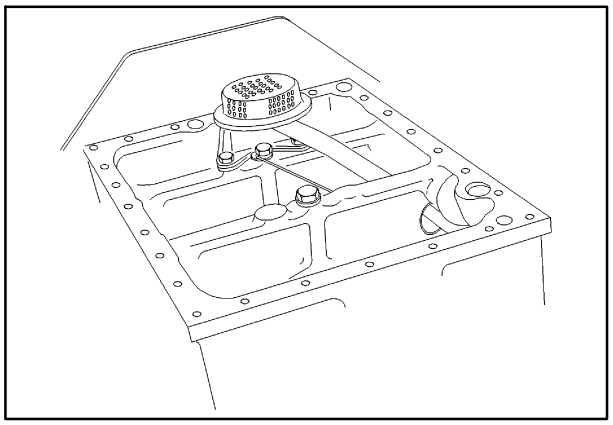
85

OIL SUCTION PIPE AND SUCTION STRAINER

Installation

1. Install a new O ring on the suction pipe and rotate the suction pipe into its bore.
2. Install the suction strainer over the suction pipe and align the bolt holes.

   NOTE: *If suction strainer bolt holes do not align, the suction pipe is either too far into its bore or not in far enough. Adjust as needed.*
3. Install the strainer retaining bolts and tighten to 8.8 - 12.9 N·m (6.5 - 9.5 ft. lbs.).

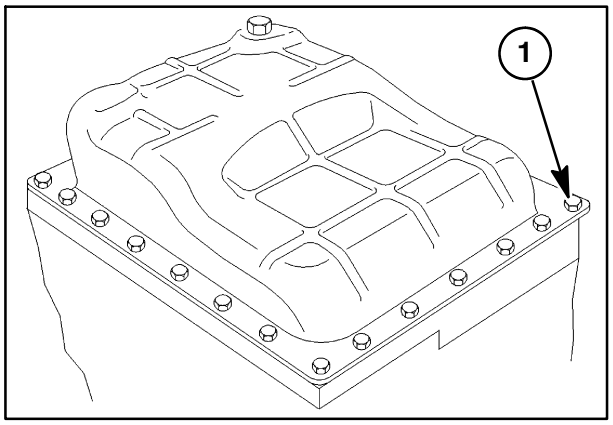


86

OIL SUMP

Installation

1. Apply a thin coat of gasket sealer to the oil sump sealing area.
2. Install a new gasket, the oil sump and the retaining bolts. Tighten the retaining bolts, 1, diagonally and evenly.

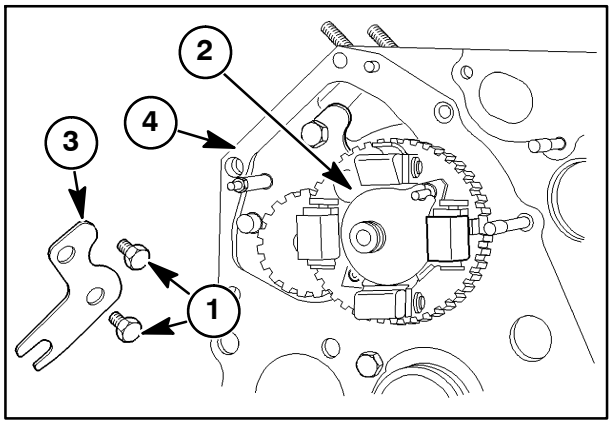


87

CAMSHAFT AND CAMSHAFT GEAR

Installation

1. Install the front plate, 4, and gasket on the mounting dowels and tighten the retaining bolts.
2. Carefully insert the camshaft into its bore so as not to damage the bearings or bearing surfaces.
3. Align the retaining plate, 3, to the block bolt holes, 2, and install the retaining bolts, 1. Tighten the bolts to 8.8 - 12.9 N·m (6.5 - 9.5 ft. lbs.).



88

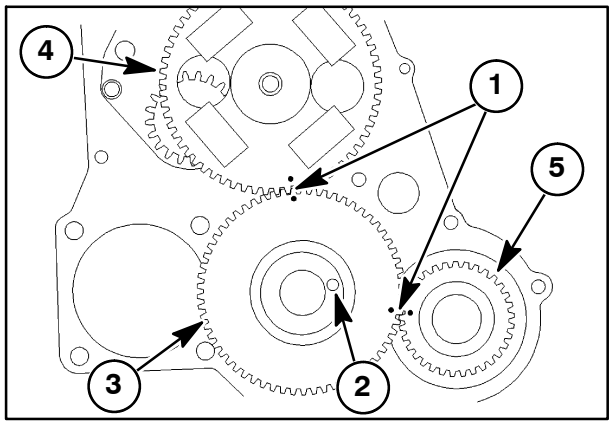
IDLER GEAR, OIL PUMP, AND INJECTION TIMING

Installation

1. Install the thrust washer, on the idler gear shaft.
2. Align the timing marks, 1, on the idler gear, 3, crankshaft gear, 5, and the camshaft gear, 4.
3. Complete the installation of the oil pump and adjust axial clearance. See "Oil Pump Installation and Adjustment" discussed later in this section.

   NOTE: *Do not turn the crankshaft until the timing gear cover is installed.*

   NOTE: *Number 3 piston (cylinder next to the flywheel) will be at top dead center when timing marks align.*

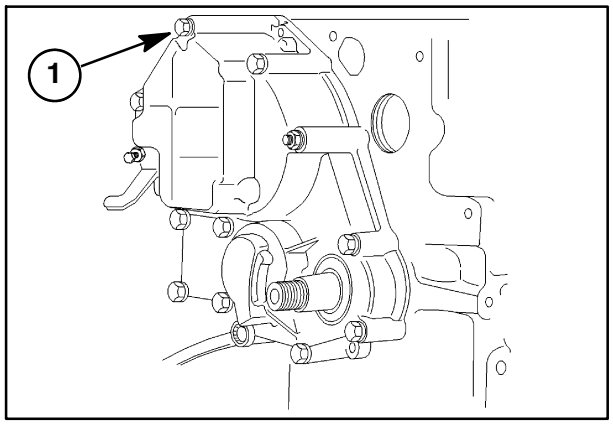


89

TIMING GEAR COVER

Installation

1. Install new cover gasket.
2. Insert the governor linkage through the block.
3. Rotate the oil pump cover to position the spring pin hole, 2, Figure 89, to align with spring pin in timing cover.
4. Install cover locating pin in the oil pump cover plate.
5. Install the cover retaining bolts, 1.

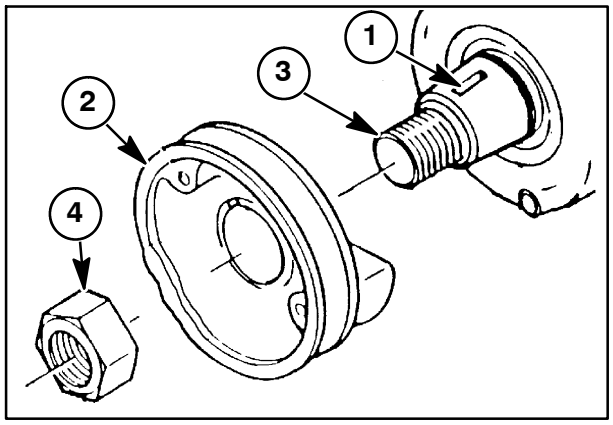


90

CRANKSHAFT PULLEY

Installation

1. Align the keyway, 1, on the crankshaft pulley, 2, and the crankshaft, 3. Push the pulley onto the shaft.
2. Install the retaining washer and nut, 4, and torque to 274.4 - 333.2 N·m (202.5 - 245.9 ft. lbs.).

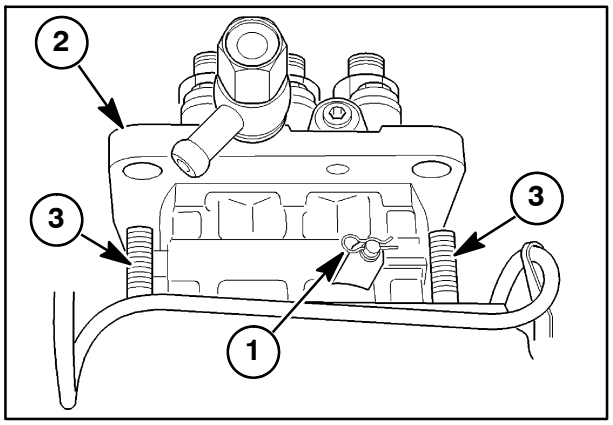


91

FUEL INJECTION PUMP

Installation

1. Insert the injection pump, 2, and shim in position in the block. Connect the injection pump control rack and governor link with the snap pin, 1.
2. Push the injection pump, 2, onto its mounting studs, 3, and install the retaining nuts and bolts.



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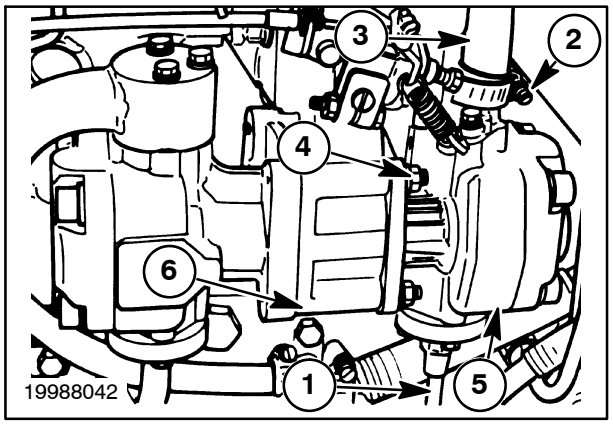
POWER STEERING PUMP

Installation

1. Mount the power steering pump, 5, in position on the timing gear cover, 6, with its four retaining bolts, 4.
2. Attach the pressure tube, 1, to the bottom of the steering pump, 5.
3. Install the suction line, 3, on the suction tube and tighten the hose clamp, 2.



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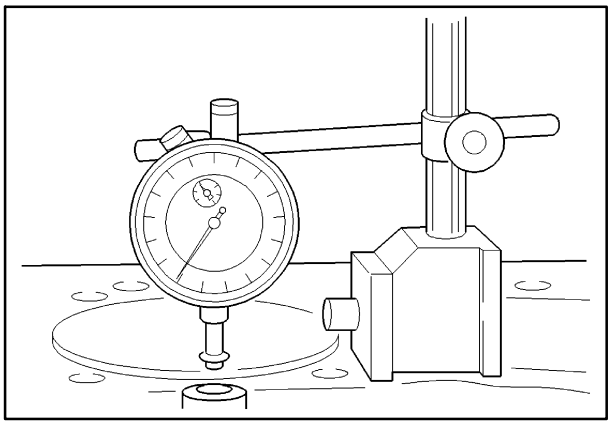
HEAD GASKET SELECTION

During assembly, the ultimate engine compression ratio is established by the thickness of the head gasket used. For service replacement, head gaskets of different thickness are available. The correct head gasket must be selected based upon the amount the piston protrudes above the face of the block when at top dead center. The correct head gasket usage is determined as follows:



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1. Position each of the pistons at top dead center and, using a dial indicator, determine the distance each piston projects above the face of the block.

   NOTE: *Measure each of the pistons while holding a slight down pressure on the piston. Use the dimension taken from the cylinder which has the greatest projection and select a head gasket as indicated in the following chart.*

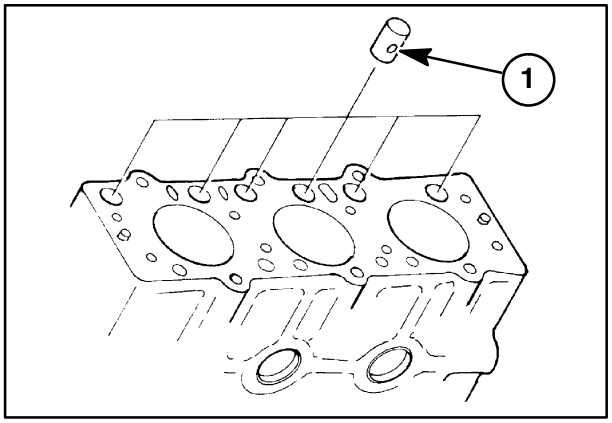
   NOTE: *The variation in the amount of protrusion among all pistons must be within 0.1 mm (0.004 in.).*

Model	Measurement Value	Head Gasket Part No.	Installed Thickness
TC30	0.5 - 0.7 mm (0.019 - 0.027″)	111147491	t = 1.3 mm (0.51″)
TC30	0.7 - 0.8 mm (0.027 - 0.031″)	111147501	t = 1.4 mm (0.55″)

CYLINDER HEAD

Assembly

1. Install the valve tappets, 1.



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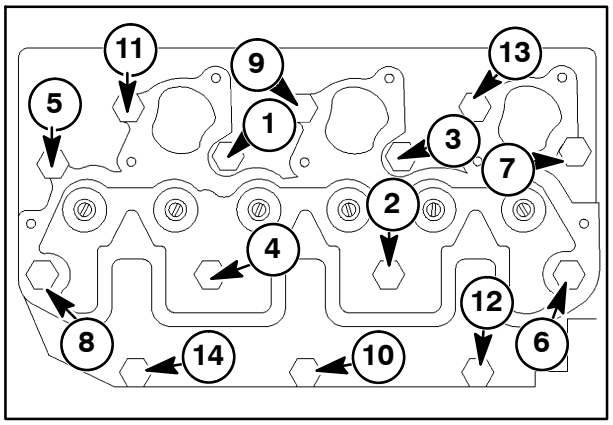
2. Select the proper head gasket and place it on the block with the side marked with the last four digits of the part code no. up.
3. Tighten the head bolts in the sequence as shown. Tighten first to half torque value, then to the final torque specification of 88 - 94 N·m (65 - 69 ft. lbs.).
4. Install the push rods and valve stem caps in their original location.
5. Install the rocker shaft support assembly onto the head and tighten the bolts to 20 - 25 N·m (14.5 - 18 ft. lbs.).



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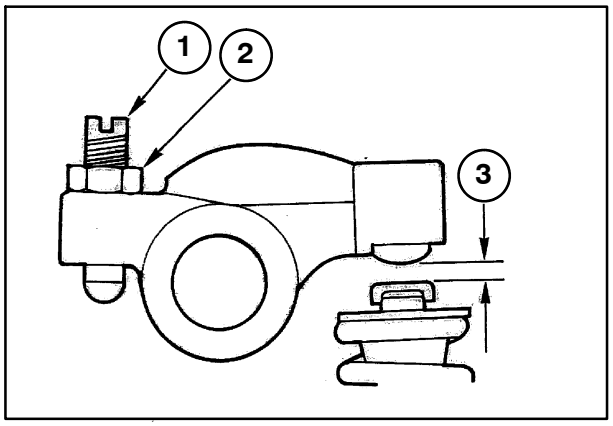
VALVE CLEARANCE ADJUSTMENT

1. Adjust the rocker arm to valve clearance. Be sure the tappet is in its lowest position before making the adjustment. To be sure the tappet is in its lowest position, bring the piston to top dead center on the compression stroke (both valves closed).
2. Loosen the nut and adjust the clearance of both the intake and exhaust valves to 0.2 mm (0.008″) with the adjusting screw.



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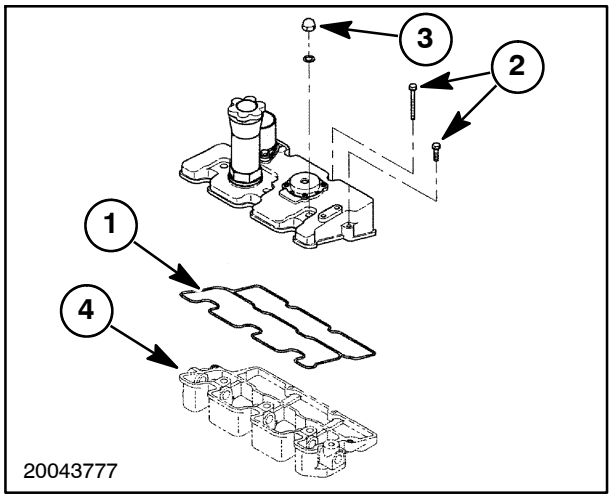
1. Adjusting Screw
2. Locknut
3. Valve Clearance 0.2 mm (0.008″)

HEAD COVER

Installation

1. Install a new gasket, 4, and position the head cover, 1, over the rocker arms.
2. Install the head cover retaining bolts, 2, cap nuts, 3, and tighten to 12 - 16 N·m (9 - 19 ft. lbs.).



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WATER PUMP AND COOLING FAN

Installation

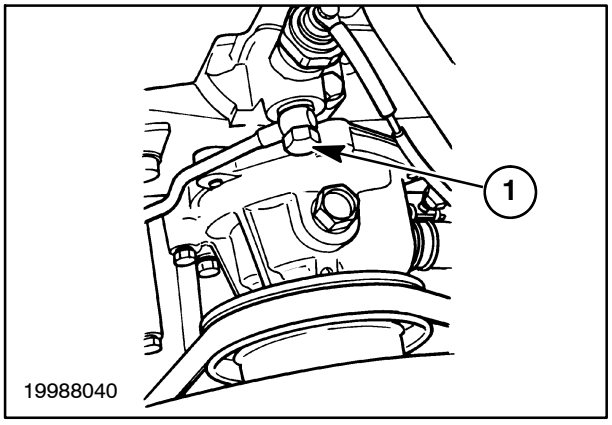
Install the water pump and fan assembly. See “Water Pump Installation” and “Cooling Fan Assembly Installation” discussed later in this section.

EXTERNAL OIL TUBE

Installation

Connect the external oil tube to the cylinder head and on side of engine block. Tighten the banjo bolt, 1, to 9 - 12 N·m (7 - 9 ft. lbs.).

NOTE: *The banjo bolt has oil port holes drilled in it. Do not use a standard bolt in its place.*



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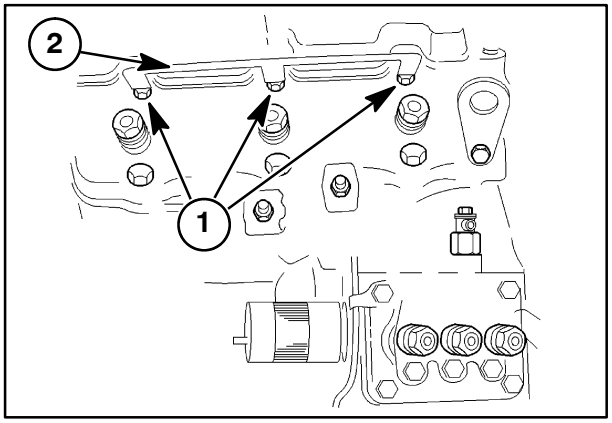
GLOW PLUG AND CONNECTOR

Installation

1. Install the glow plugs, 1, and torque to 15 - 20 N·m (11 - 14.5 ft. lbs.).
2. Install the glow plug connector, 2.

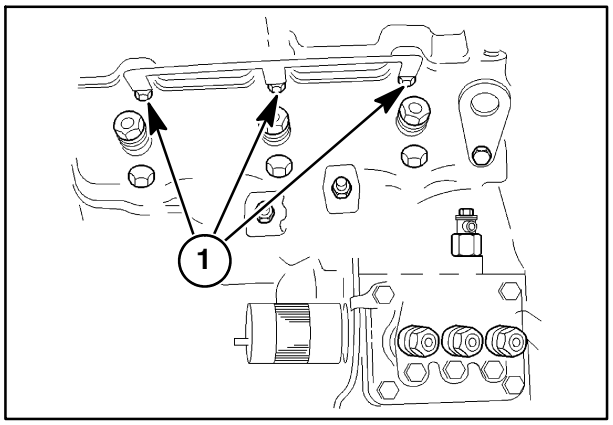


100

FUEL INJECTOR

Installation

Install the fuel injectors, 1, and torque to 60 - 69 N·m (55 - 51 ft. lbs.).

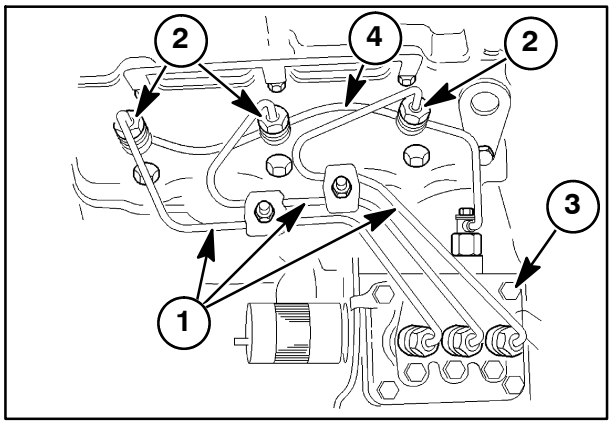


101

FUEL PIPING

Installation

1. Install the fuel return line, 4, on the ejectors, 2, and injector pump, 3.
2. Install the injection piping, 1, and torque to 15 - 24 N·m (11 - 18 ft. lbs.).

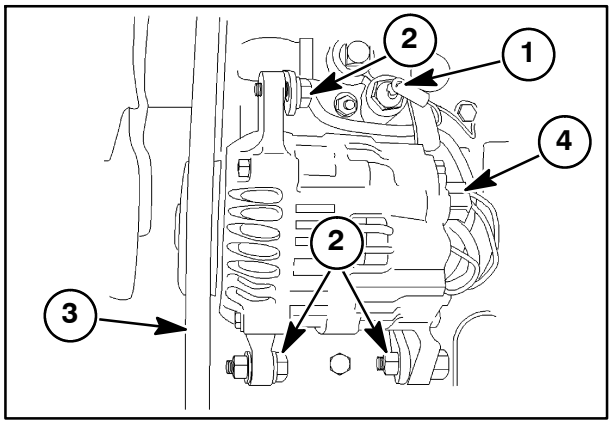


102

ALTERNATOR AND TEMPERATURE SENDER SWITCH

Installation

1. Install the temperature sender switch, 1, and torque to 15 - 20 N·m (11 - 14.5 ft. lbs.).
2. Install the alternator with its mounting bolts, 2, snug.
3. Install the V-belt, 3, adjust to 10 - 15 mm (7/16 - 9/16″) deflection tension, and tighten the alternator bolts.
4. Connect the wiring to the back of the alternator at location 4.



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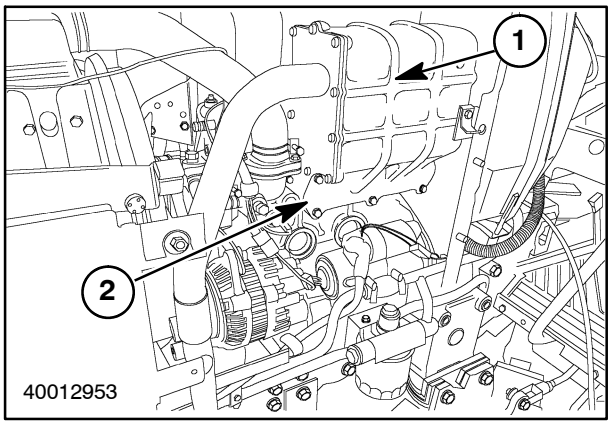
EXHAUST MANIFOLD

Installation

Install the exhaust manifold, 2, gasket and muffler, 1.



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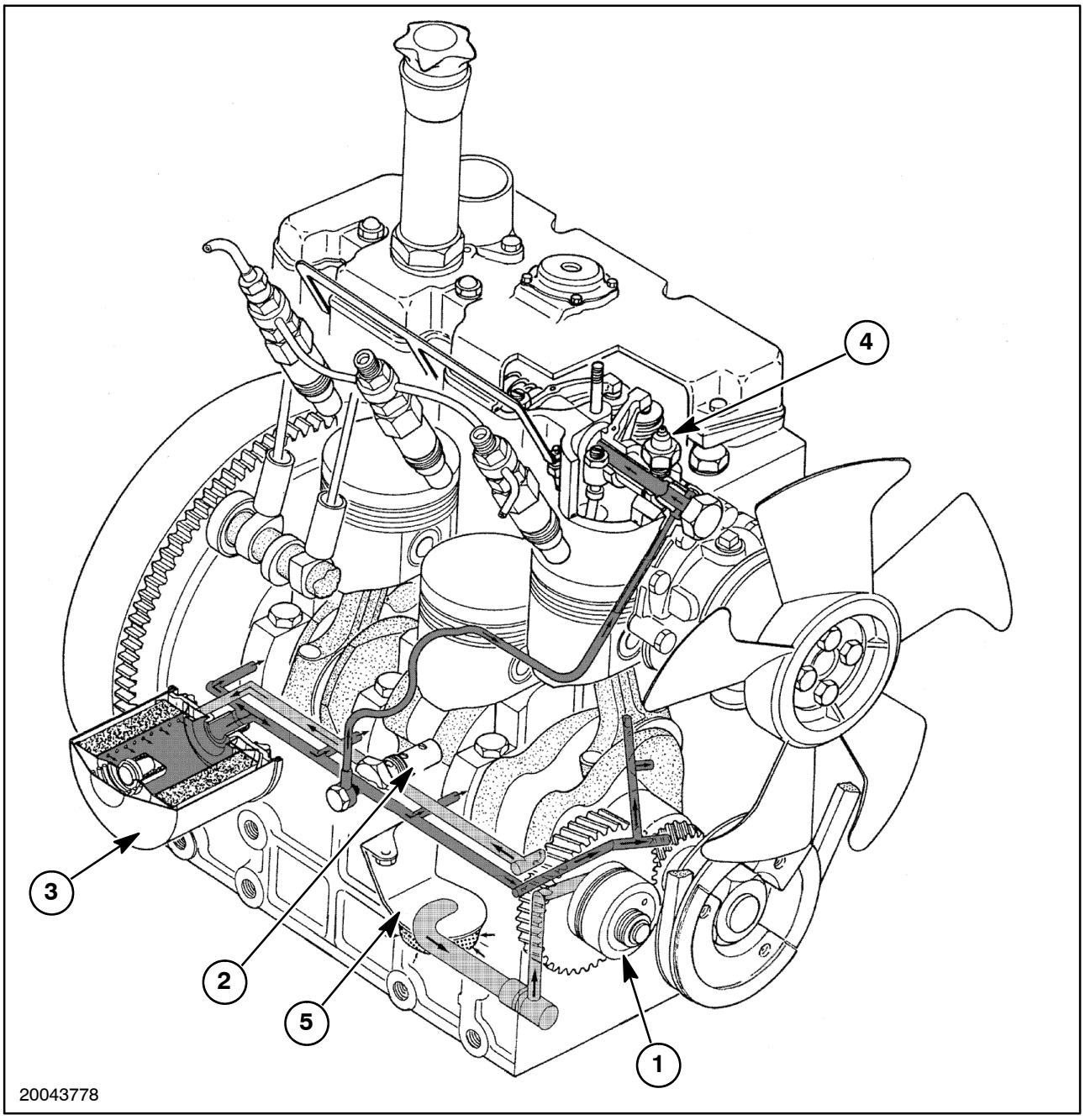
DESCRIPTION OF OPERATION - ENGINE LUBRICATION SYSTEM

Op. 10 304

The oil pump assembly is located within the idler gear at the front of the block, below and to the left of the crankshaft as viewed from the front of the engine. The oil pump is driven by the crankshaft gear.

Oil is picked up from the sump through the suction strainer and intake tube and drawn into the lower side drilling in the block to the oil pump. Oil from the pump flows through passages in the block, past the relief valve, through the oil filter and returns to the main oil gallery in the area of the drilled bolt located on the side of the block. Oil flow in the main oil gallery extends to the four main bearings. Oil flow to the main bearings passes through drilled passages in the crankshaft to the three connecting rod bearings. The remaining portion of the oil flow is directed through the external tube to the rocker arm assembly. Oil flows from the external tube into a passage in the rocker arm bracket to the rocker arm shaft. Oil leakage from clearance between the rocker arms and the shaft overflows in the valve cover and lubricates the valve stems, push rods, and tappets. The relief valve is mounted on the side of the engine block and intersects the main oil passage. When the oil pressure exceeds the rated pressure, oil is bypassed through the relief valve directly to the sump. The cylinder walls, pistons, and piston pins are splash lubricated by the crankshaft.



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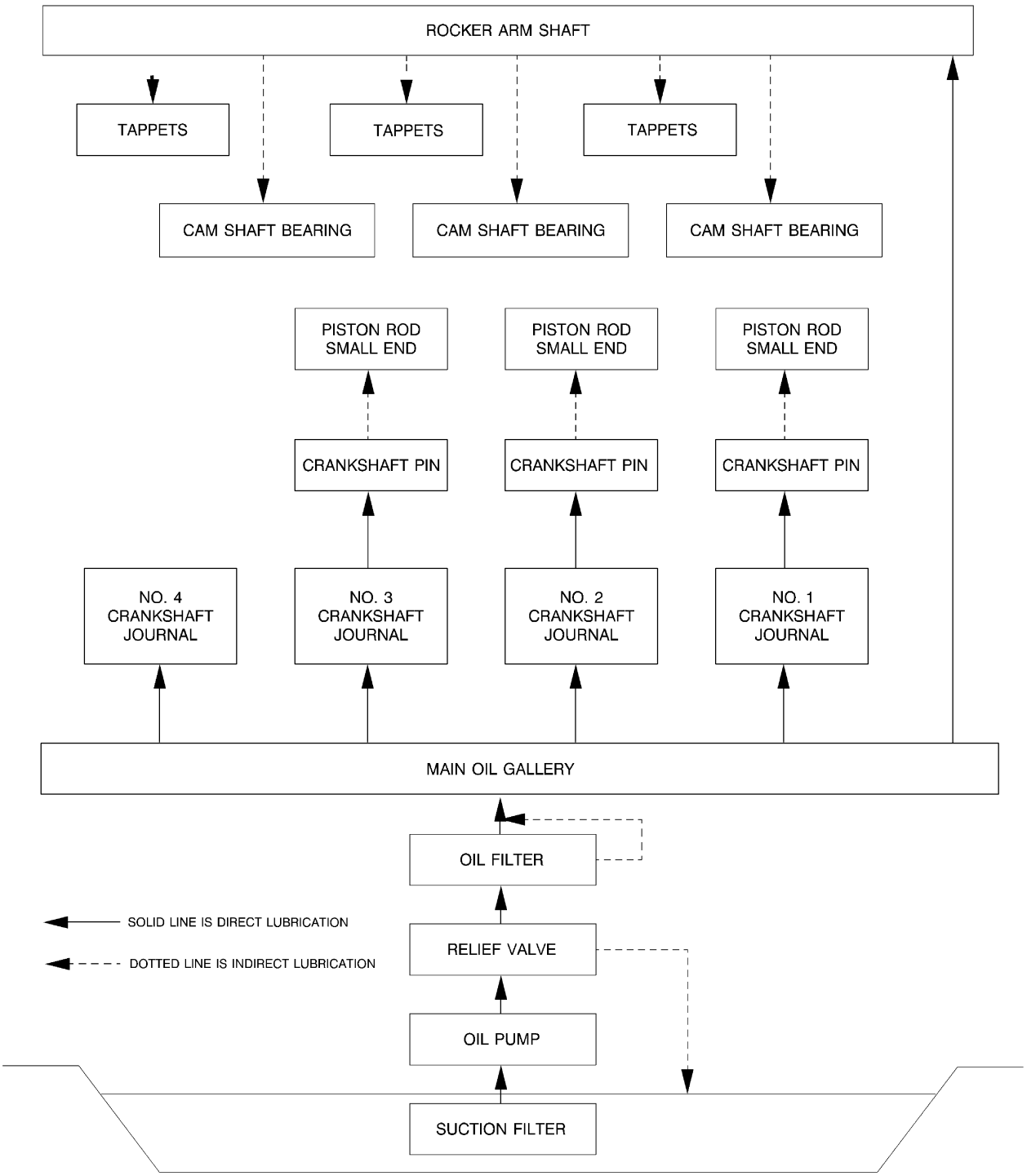
1. Oil Pump
2. Relief Valve
3. Oil Filter
4. Oil Pressure Switch
5. Suction Strainer

MODEL TC30 OIL FLOW CHART



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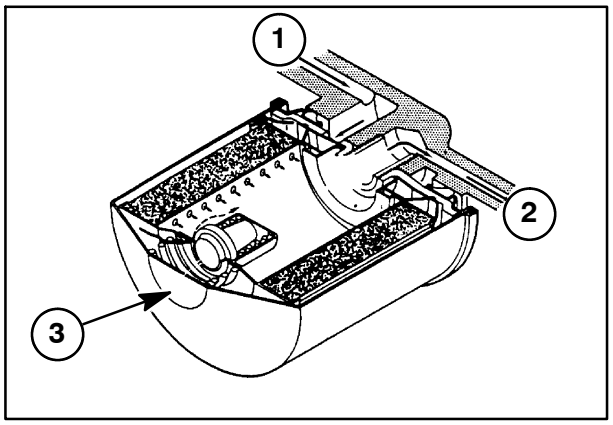
OIL FILTER

Op. 10 206

Construction and Function

These engines utilize a cartridge type filter. Pressurized oil flow from the pump enters from 1, and is filtered by a full flow filter before discharge through 2. When the full flow filter is clogged, the safety valve, 3, opens to bypass the oil.



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Maintenance

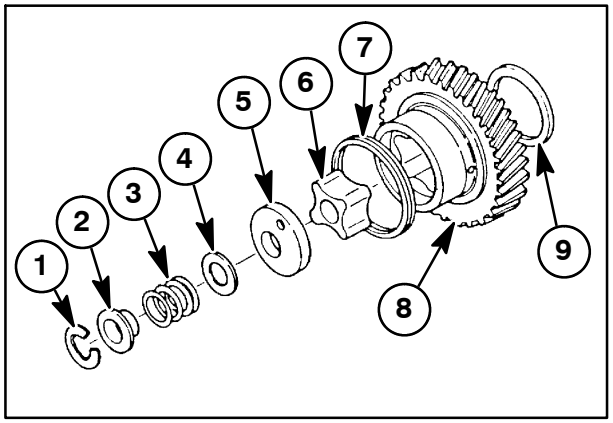
The oil filter must be replaced every 100 hours of operation. When installing a new filter, coat its face with clean oil. Hand tighten only.

OIL PUMP

Op. 10 304

Removal

1. Drain the engine oil and remove the spin-on type oil filter.
2. Drain the radiator and remove the cooling fan and water pump assemblies. See “Cooling Fan Removal” and “Water Pump Removal”.
3. Remove the timing gear cover. See “Timing Gear Cover Removal”.
4. Remove the retaining ring, 1. Remove the idler gear, 8, and oil pump assembly, 1 through 9.



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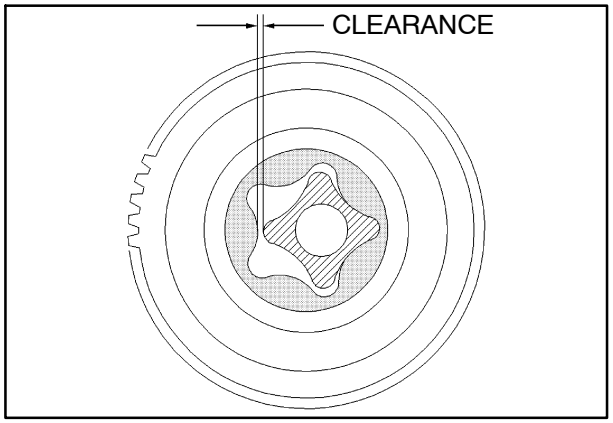
Inspection

1. Check for excessive wear on the pump cover, 5, and the port block. If port block requires replacement, see “Port Block Removal”.
2. Inspect the pump shaft and rotor, 6, for excessive wear or scratches.
3. Measure the rotor to vane clearance. Replace the components as required, if clearance is not within specified tolerances.

Std.	Max.
0.01 - 0.15 mm (0.0004 - 0.006″)	0.25 mm (0.010″)



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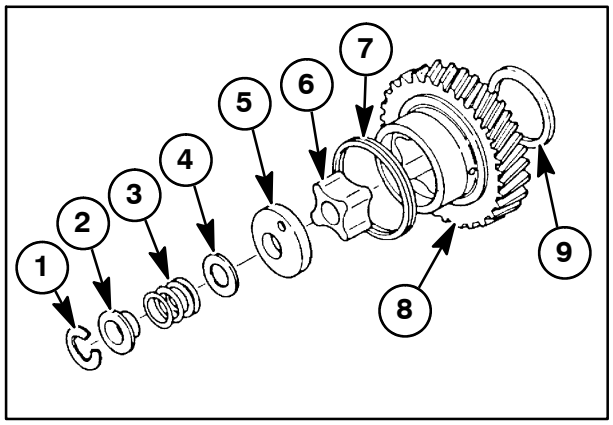
Installation and Adjustment

1. If the port block assembly was removed, install a new port block assembly. “See Port Block Assembly Installation”.
2. Install the thrust washer, 9, and align the set marks on the idler gear, 8, crankshaft gear, and camshaft gear, and install the idler gear on the port shaft.
3. Install the rotor, 6, and spring, 7.
4. Install the oil pump cover, 5, shim, 4, spring, 3, and collar, 2. Secure the assembly to the shaft with the retaining ring, 1.



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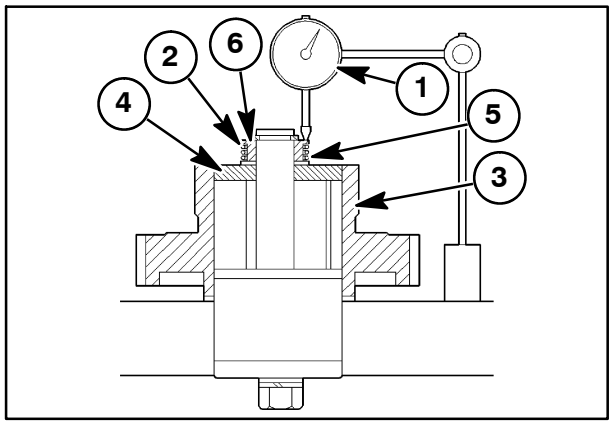
5. Using a dial indicator, 1, measure the axial movement of the collar, 6. The standard clearance is 0.15 - 0.22 mm (0.006 - 0.009″) and the maximum allowable is 0.30 mm (0.012″). Install or remove shims, 5, (PN SBA-199286340) as needed to obtain the standard clearance value.
6. Install the water pump and cooling fan assembly. See “Water Pump Installation” and “Cooling Fan Installation”.
7. Install the timing gear cover. See “Timing Gear Cover Installation”.
8. Refill the radiator to its proper coolant level.
9. Replace the engine oil filter and fill the sump with oil.



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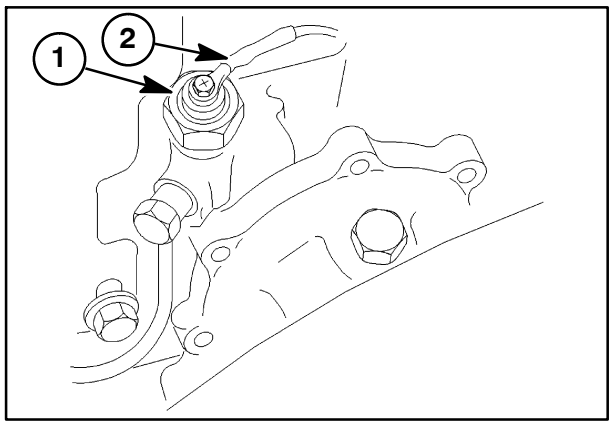
1. Dial Indicator
2. Spring
3. Idler Gear
4. Oil Pump Cover
5. Shim
6. Collar

ENGINE OIL PRESSURE CHECK

1. Disconnect the sending lead, 2, and remove the oil pressure sending unit, 1.



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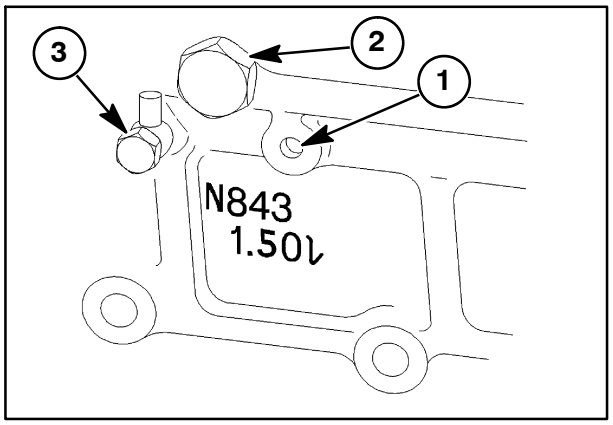
NOTE: *Main gallery access port, 1, located next to the relief valve, 2, and external oil tube, 3.*



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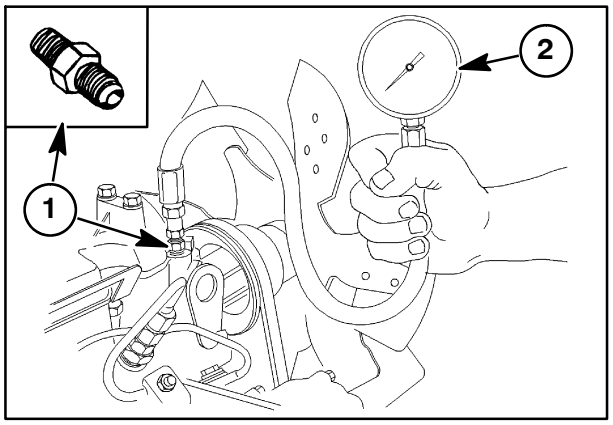
2. Install the oil pressure test fitting No. FNH00011, 1, and test gauge, 2. Start the engine and observe gauge indicator. Gauge should indicate between 0.98 - 1.47 bar (14.22 - 21.33 psi) at low idle and 2.45 - 2.94 bar (35.5 - 42.6 psi) at high idle.

   NOTE: *Pressure test should be with engine at normal operating temperature.*

3. If the gauge did not indicate the oil pressure within specified tolerances at low and high idle, troubleshoot the lube oil system. See “Trouble-shooting”.



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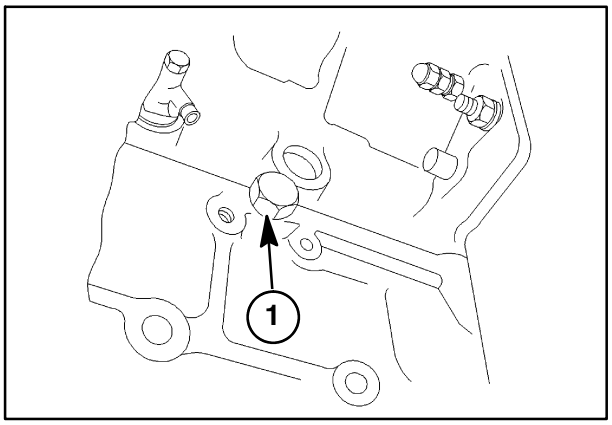
OIL PRESSURE RELIEF VALVE



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Removal

Unscrew the oil pressure relief valve, 1, and remove from the block.

NOTE: *Pressure test should be with engine at normal operating temperature.*

Installation

Install a new O ring seal over the relief valve and screw the valve into the block. Tighten to 58.8 - 68.6 N·m (43.4 - 50.6 ft. lbs.).

OIL CONSUMPTION

Log oil consumption as follows:

1. Change the engine oil and filter. Use the oil specified in the loader operator's manual.
2. Run the engine for 2 minutes.
3. Check the dipstick and add oil, if required, so the level is at the full mark.
4. Fill the fuel tank with fuel.
5. Record fuel consumption in liters (gallons), oil added in liters (gallons), and hour reading. Record fuel and oil use for 100 hours of operation, which is the recommended oil change interval. Check the dipstick before running the engine each day.

The maximum allowable oil consumption is 0.8%. The following table gives examples:

Fuel Consumption, Liters (Gallons)	Oil Consumption, Liters (Quarts)	Percentage
189.27 L (50 gal.)	1.5 L (1.6 qts.)	0.79%
378.54 L (100 gal.)	3.03 L (3.2 qts.)	0.80%
757.08 L (200 gal.)	6.06 L (6.4 qts.)	0.80%

If the oil consumption is greater than 0.8% of the fuel consumption, oil usage is excessive. A sample calculation for oil consumption follows:

$$\% \text{ consumption} = \frac{\text{Quantity of Oil in Liters (gallons)}}{\text{Quantity of Fuel in Liters (gallons)}} \times 100$$

Assume 0.25 Liters (0.07 gallons) oil is added for 50 Liters (13.2 gallons) fuel.

$$\% \text{ consumption} = \frac{0.25 \text{ L}}{50 \text{ L}} \times 100 \quad \text{or} \quad \frac{0.07 \text{ gallons}}{13.2 \text{ gallons}} \times 100$$

% consumption =0.5%

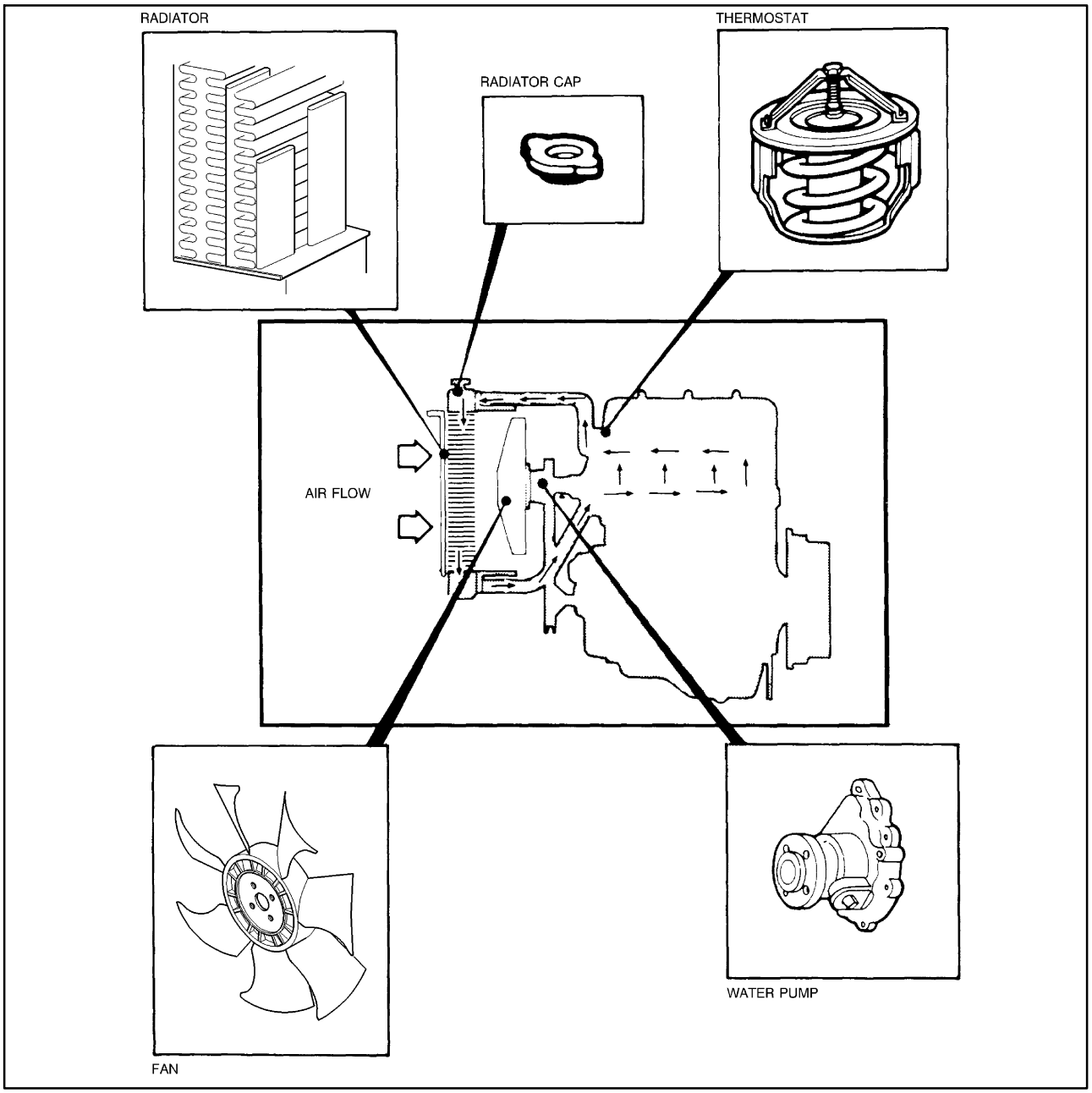
DESCRIPTION OF OPERATION - COOLING SYSTEM

Op. 10 400

The cooling system is the recirculating bypass type with a full length water jacket for each cylinder cast into the block. The coolant is drawn from the bottom of the radiator by the water pump and passes around the cylinders and into the cylinder head.

The thermostat is located in the front of the cylinder head and thermostatically controls the flow of coolant from the engine to the radiator. When the thermostat is closed only a small amount of coolant is permitted to flow through the thermostat bypass to the radiator to effect a faster warm-up. When the thermostat is open, the coolant flows from the water outlet connection to the top tank of the radiator for maximum cooling.

Cooling occurs as the coolant passes down through the radiator cores which are exposed to the air flow created by the fan as air is drawn through the radiator.



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MAINTENANCE

⚠ WARNING ⚠

The cooling system operates under pressure which is controlled by the radiator cap. It is dangerous to remove the cap from a hot engine or while the engine is running. Always shut the engine off and allow it to cool before removing the radiator cap. When removing the cap, use a thick cloth to cover the cap and slowly turn the cap to the first stop to allow pressure to escape before removing the cap completely.

Clean the cooling system to remove rust, sludge, and other foreign material by using a coolant system cleaning solvent. In severe cases, pressure flushing may be required. A pulsating or reverse flow flushing will more effectively loosen and remove foreign material than a steady flushing in normal direction of coolant flow. If pressure flushing is to be used, always remove the thermostat and make sure the head bolts are tightened properly.

COOLANT

The coolant is a permanent type ethylene-glycol base antifreeze and should be used all year.

Drain and flush the cooling system every twelve months and replace the coolant with fresh antifreeze and pure water.

After the coolant has been drained from the radiator and block, flush the system by placing a water hose in the radiator filler neck. With the drain open and the system full of water, start the engine and run it until the water flowing from the drain is clear. Stop the engine and allow the system to drain, then replace the coolant with new 50/50 mixture antifreeze and pure water.

RADIATOR CAP

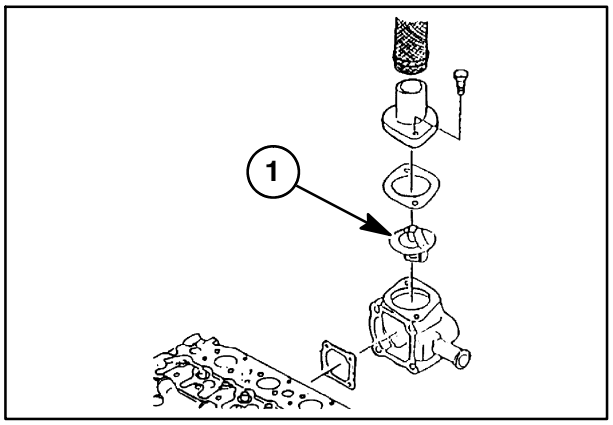
The radiator cap acts to pressurize the cooling system, as a pressure relief valve and also acts as a vent valve. The pressure valve permits a limited pressure buildup in the cooling system as the coolant heats up. This increased pressure increases the boiling point of the coolant. If excess pressure builds up in the system, the pressure relief valve will open until the pressure returns to the proper level, 0.9 bar (13 psi).

When the engine is shut off and the coolant cools, a vacuum condition is created in the system. A vent valve in the radiator cap opens to permit outside air pressure to enter the system when this condition exists.

Op. 10 402

THERMOSTAT

The thermostat, 1, is located between the coolant outlet on the engine and the radiator. In this position the thermostat is able to sense the coolant temperature in the engine and regulate the flow of coolant to the radiator. When the engine is cold, only a small amount of coolant flows to the radiator through the thermostat bypass. As the engine warms up, the thermostat opens to allow sufficient coolant flow to the radiator to maintain a constant engine temperature.



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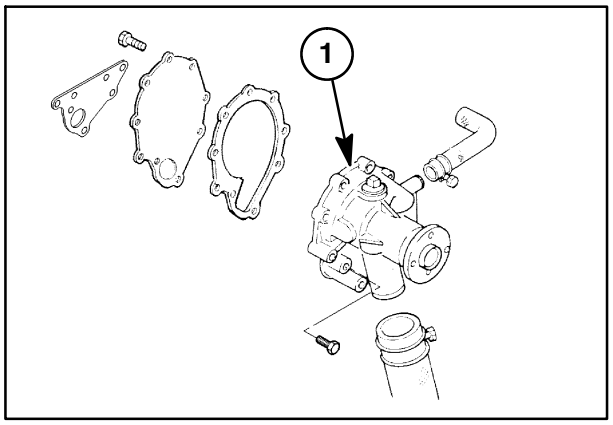
Op. 10 402

WATER PUMP

The water pump, 1, is an impeller attached to a shaft which is belt driven by the engine crankshaft. The impeller circulates water by centrifugal force. Coolant entering the pump housing from the radiator through the lower hose is thrown outward against the housing with sufficient force to cause a circulating action.



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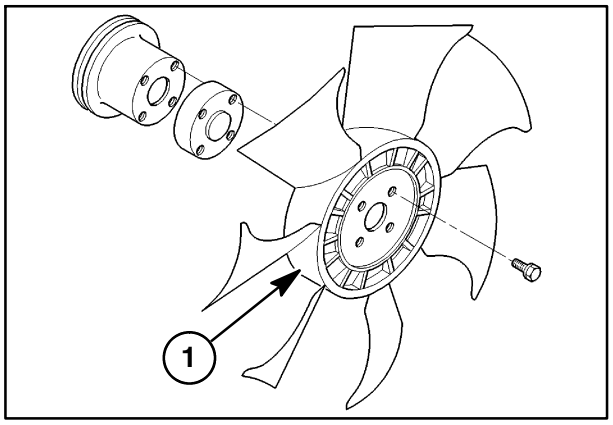
Op. 10 414

COOLING FAN

A seven-blade cooling fan, 1, is belt driven by the engine crankshaft and is mounted on the water pump shaft. The cooling fan is positioned behind the radiator to draw air over the radiator cooling fins. To increase and concentrate the volume of air flowing through the radiator, a shroud is positioned around the fan.



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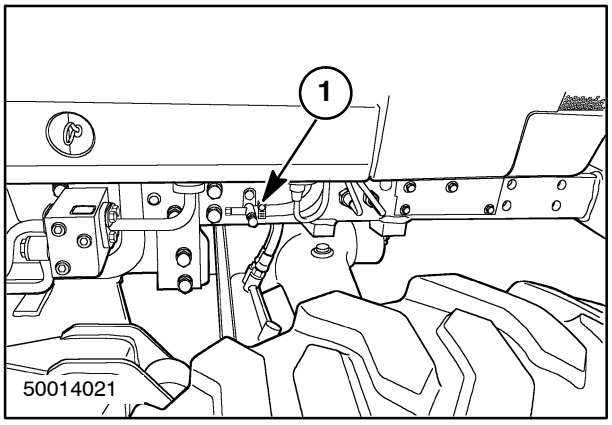
OVERHAUL - COOLING SYSTEM

Op. 10 406

RADIATOR

Removal

1. With the hood open, remove the tractor side panels.
2. Drain the radiator and engine coolant at tap, 1, into a clean container. Remove the radiator cap to assist draining.



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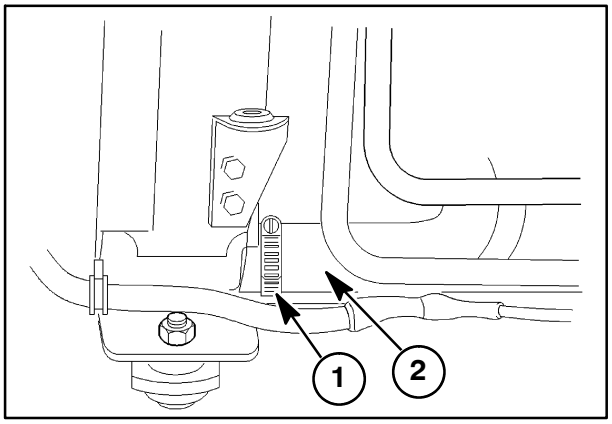
3. Loosen the lower radiator hose clamp, 1, and remove the hose, 2, from the radiator.



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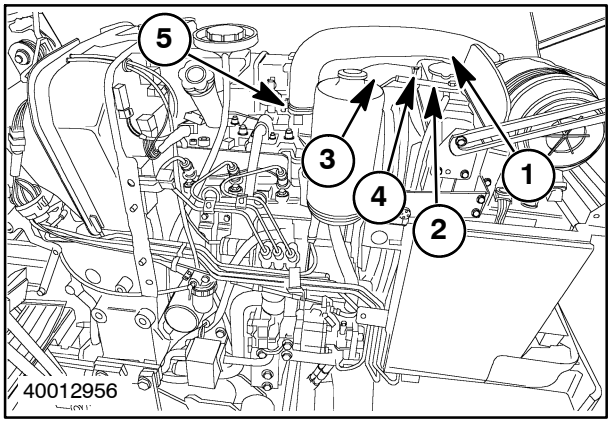
4. Remove the air cleaner inlet tube, 1, by loosening clamp, 5.
5. Loosen the upper radiator hose clamp, 4, and remove the upper hose, 3.
6. Remove the radiator top brace, 2.



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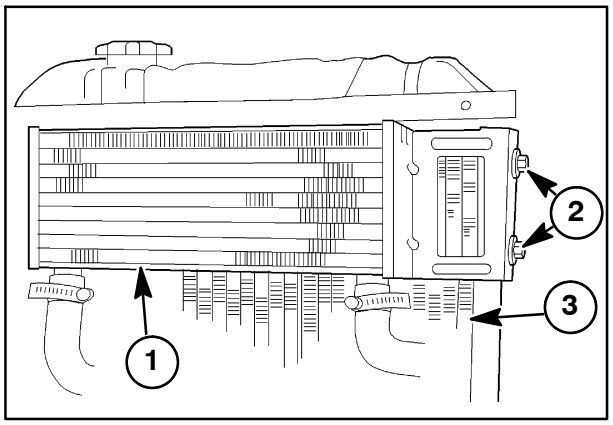
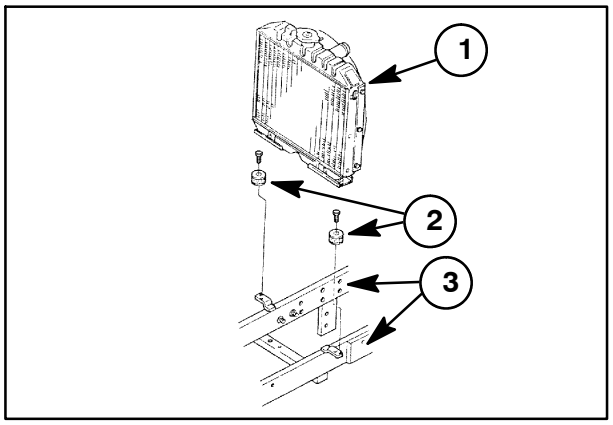
7. If equipped with HST cooler, 1, remove the cooler mounting bolts, 2, from the sides of the radiator, 3, and slide the cooler forward, away from the radiator.



123

8. Remove the bottom support bolts and insulators, 2, from the frame, 3, and remove the radiator and shroud assembly, 1.



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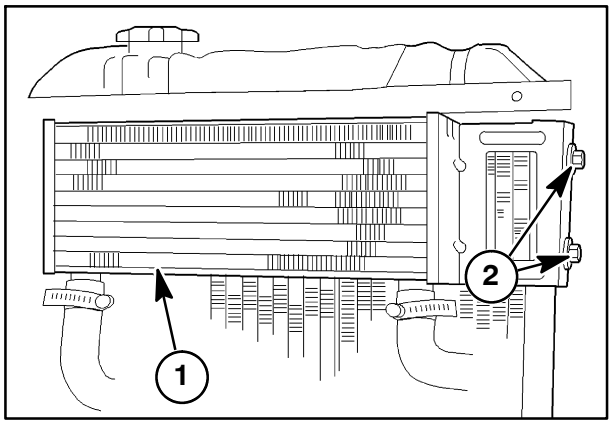
Inspection and Repair

1. Inspect the radiator fins and be sure they are free from obstruction.
2. Check the radiator for signs of coolant leakage and repair as required.

Installation

1. Place the radiator assembly in position on the engine frame and tighten the mounting bolts.
2. If equipped with HST cooler, 1, place the cooler in position on the radiator and tighten the mounting bolts, 2.



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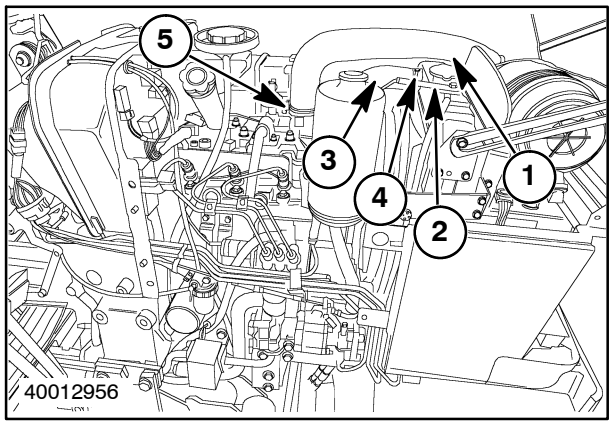
3. Install the radiator top brace, 2.
4. Install the air cleaner inlet tube, 1, with clamp, 5.
5. Install the upper radiator hose, 3, and tighten the hose clamp, 4.



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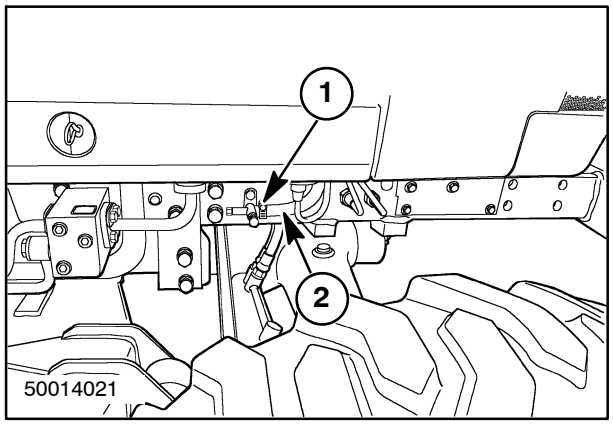
6. Install the radiator drain hose, 2, and tighten the tap, 1.



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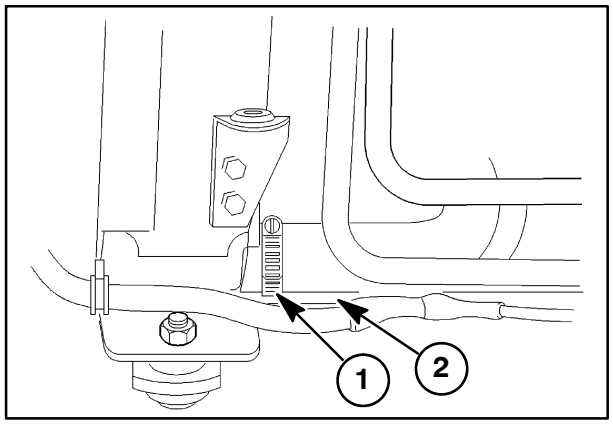
7. Install the lower radiator hose, 2, and tighten the hose clamp, 1.



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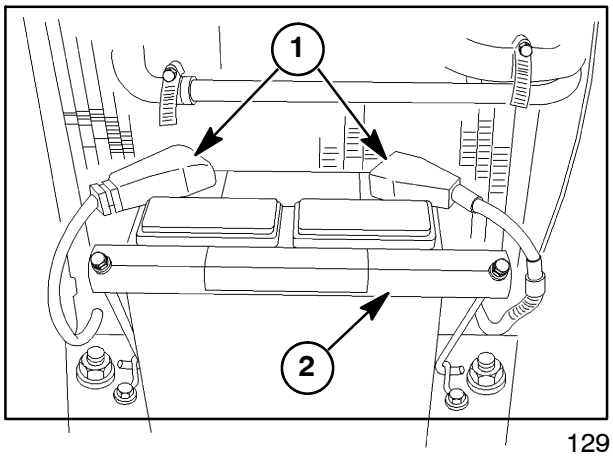
8. Install the battery and hold down bracket, 2, then connect cables, 1.
9. Replace the coolant with 50/50 mixture anti-freeze and pure water.
10. Install the radiator cap. Start the engine and run for several minutes and check the hose connections for any leakage.



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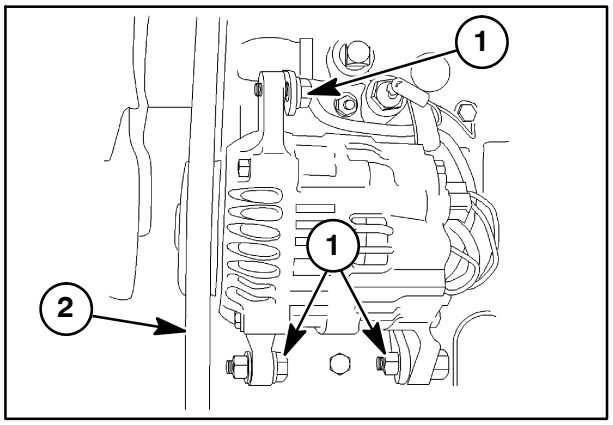
Op. 10 402

WATER PUMP

Removal

1. Remove the radiator assembly. See “Radiator Removal”.
2. Loosen the alternator mounting bolts, 1, and adjusting bracket and remove the drive belt, 2.



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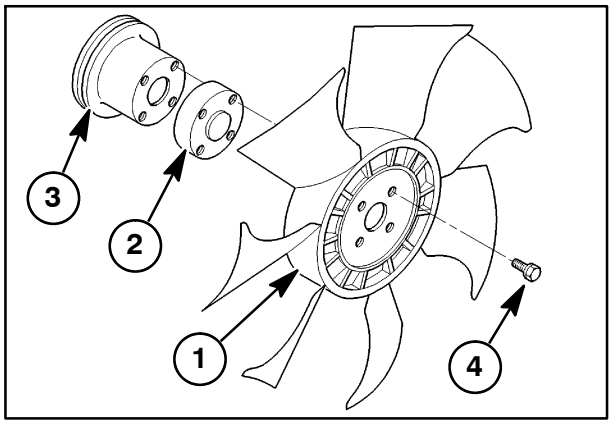
3. Remove the attaching bolts, 4, cooling fan, 1, fan holder, 2, and pulley, 3.



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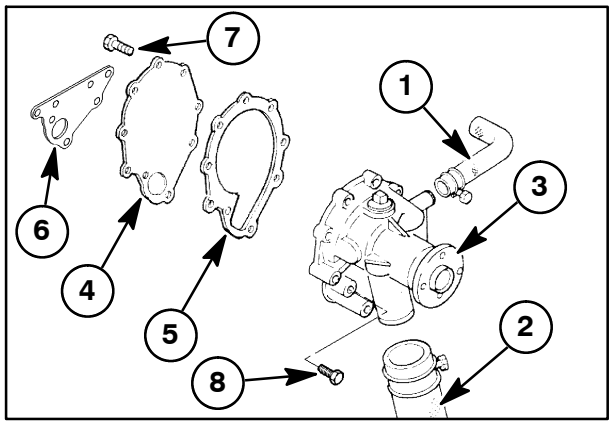
4. Remove the bypass hose, 1, and lower radiator hose, 2, from the water pump, 3.
5. Remove the water pump retaining bolts, 8, and remove the water pump, 3, and gasket, 5, from engine.
6. Remove the water pump mounting plate, 4, and gasket, 6.



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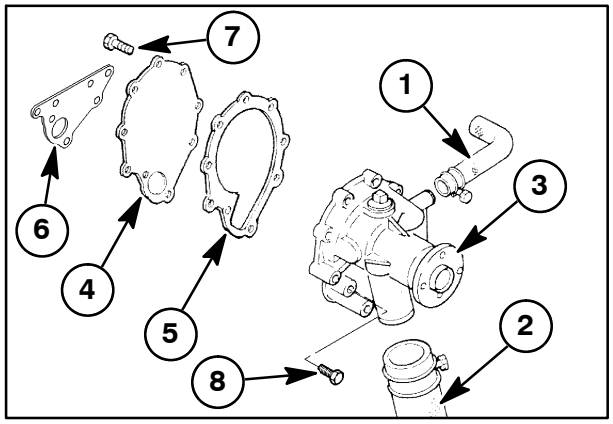
1. Bypass Hose
2. Lower Radiator Hose
3. Water Pump
4. Mounting Plate
5. Gasket
6. Gasket, Mounting Plate
7. Retaining Bolt, (Mounting Plate)
8. Water Pump Retaining Bolt

Inspection and Repair

Inspect the water pump for indications of coolant leakage from around the pump shaft. If coolant leakage is evident, or if the water pump is noisy when running, replace the water pump.



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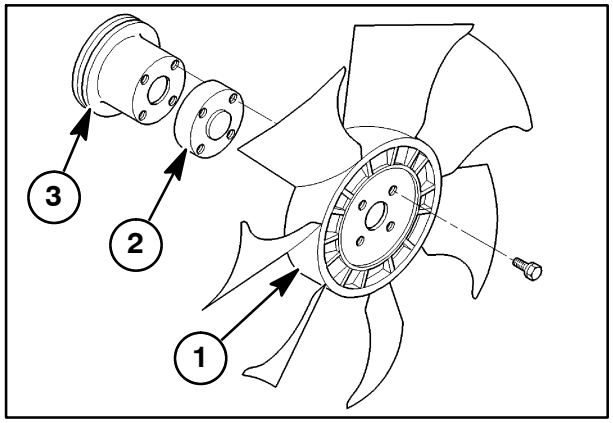
Installation

1. Install the water pump mounting plate, 4, and new gasket, 5.
2. Install the water pump, 3, and new gasket, 6, and tighten the retaining bolts, 7 and 8.
3. Install the bypass hose, 1, and lower radiator hose, 2, on the water pump and tighten the hose clamps.
4. Install the pulley, 3, fan holder, 2, and cooling fan, 1, and tighten the attaching bolts.



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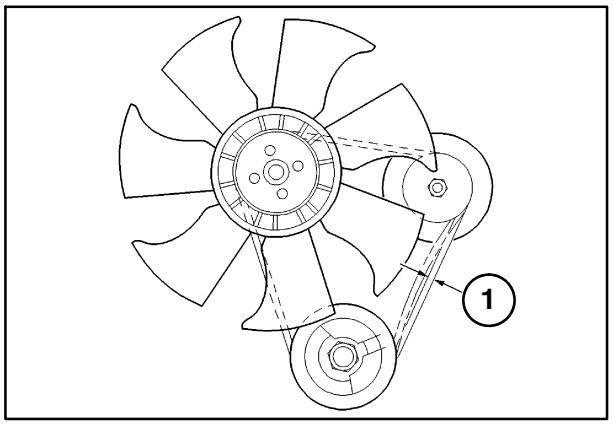
5. Install the drive pulley and adjust the alternator drive belt tension to obtain a deflection, 1, of 5 – 10 mm (0.197 - 0.394″) when 5 kg (11 lbs.) is applied between the pulleys and tighten the alternator mounting bolts.
6. Install the radiator assembly. See “Radiator Installation”.



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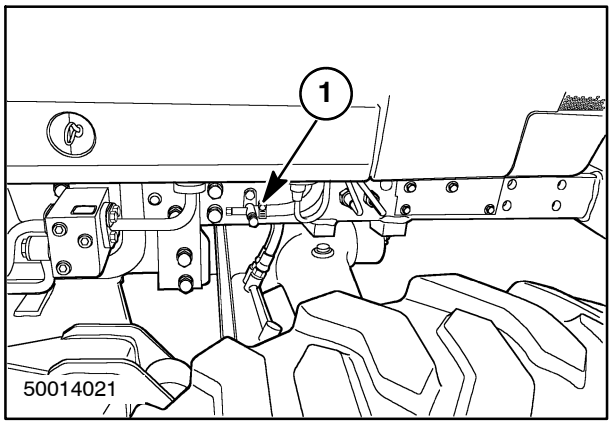
Op. 10 402

THERMOSTAT

Removal

1. Remove the radiator cap.
2. Open the radiator drain tap, 1, and collect the coolant in a clean container.



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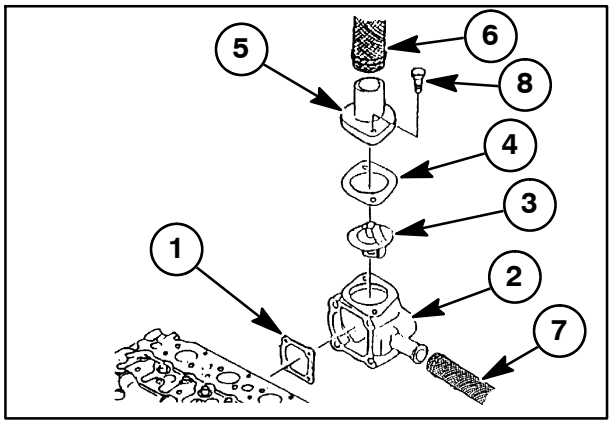
3. Remove the radiator hose, 6, and bypass hose, 7, from the thermostat housing, 2.
4. Remove the retaining bolts, 8, and remove the thermostat cover, 5, gasket, 4, thermostat, 3, and gasket, 1.



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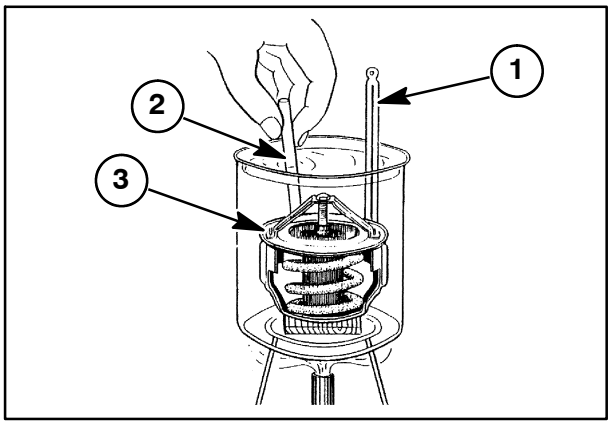
Inspection and Repair

1. Place the thermostat, 3, in a container filled with a 50/50 mixture of antifreeze and water. Insulate the thermostat from the bottom of the container.
2. Place a high temperature thermometer, 1, in the coolant mixture and heat the container.
3. Use a 0.08 mm (0.003″) feeler gauge, 2, to determine when the thermostat begins to open.
4. Note the coolant temperature at which the thermostat starts to open and when it is fully opened.
5. Replace the thermostat if it fails to open at the specified temperature.

   Thermostat opening temperature:
   Start to open: 82°C (180°F)
   Fully open: 95°C (203°F)
6. Thoroughly clean the gasket mating surfaces before installing thermostat.



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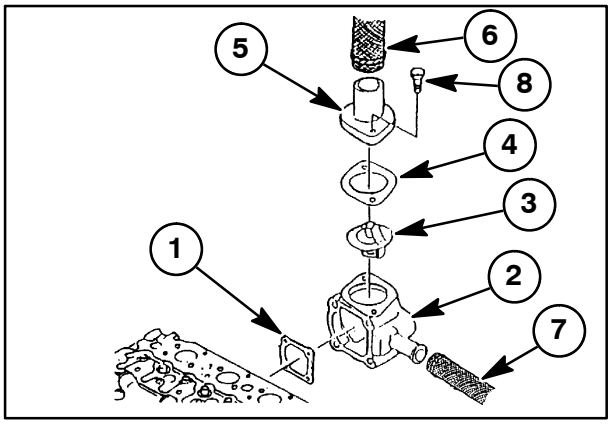
Installation

1. Attach gasket, 1, and thermostat housing, 2, to the engine block.
2. Place the thermostat, 3, in position in the thermostat housing, 2.
3. Install the gasket, 4, and thermostat cover, 5, and tighten the retaining bolts, 8.
4. Install the radiator hose, 6, and bypass hose, 7, on the thermostat housing, 2, and tighten the hose clamps.
5. Close the radiator drain and refill the radiator with 50/50 mixture of antifreeze and pure water.
6. Install the radiator cap and start the engine and run for a few minutes to check for any leakage.



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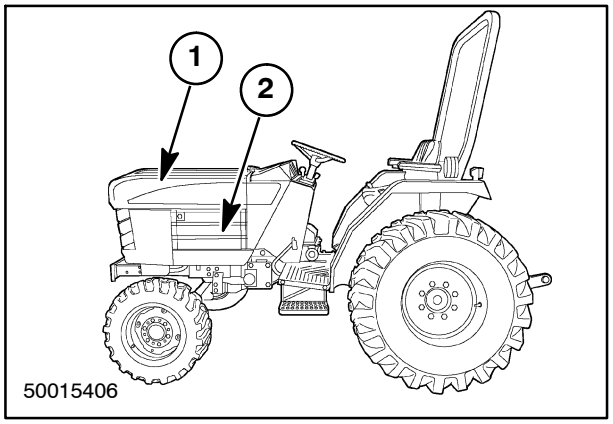
SEPARATING THE TRACTOR

ENGINE/CLUTCH HOUSING

Removal

1. Place jack stands under the clutch housing for support.
2. Open the hood, 1, and remove the screens, 2.



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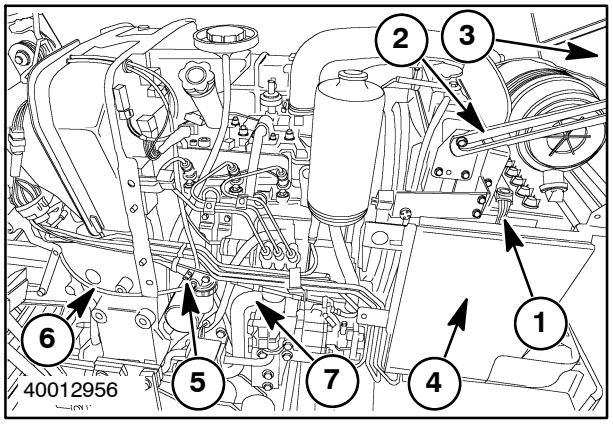
3. Disconnect the negative (–) battery cable, 1, from the negative (–) battery terminal.
4. If equipped, remove the loader control valve mounts and valve. Cap and plug all openings.
5. Disconnect the headlight wire harness.
6. Remove the hood support, 2.
7. Remove the hood pivot pin cotter pins and remove the hood, 3, from the tractor.
8. Remove the side cover, 4, from each side of the tractor.



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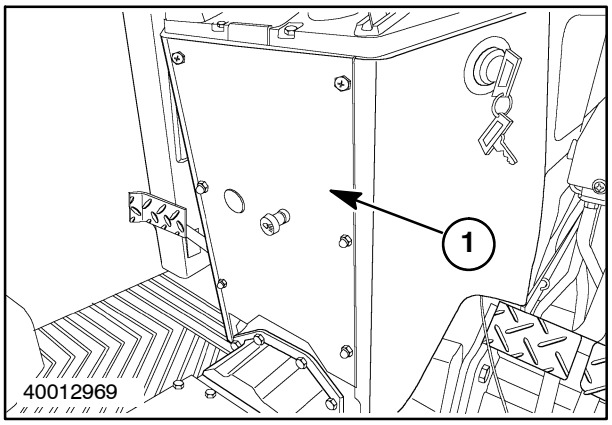
⚠ WARNING ⚠

Allow the engine to cool before draining fuel. Do not expose diesel fuel to open flame. Do not smoke while near diesel fuel. Injury or death may result. Clean up fuel spills immediately.

NOTE: *The fuel tank can store up to 7.1 gallons (27 liters) of fuel.*

9. Remove the fuel hose, 5, from the fuel shutoff valve and drain the fuel into a clean container.
10. Remove the throttle control cable, 6, from the injection pump lever.
11. Remove the hydraulic suction tube, 7, from the tractor. Cap and plug all openings. On HST models the charge pump supply must be removed from the right side of the clutch housing.

12. Loosen the steering column shroud center panel, 1, to gain access to the light switch wire harness. Disconnect the light switch from the tractor wire harness. Remove the steering shroud center panel, 1, from the tractor.
13. Disconnect the wire harness connectors from the instrument panel, the key switch, and the rear harness assembly.



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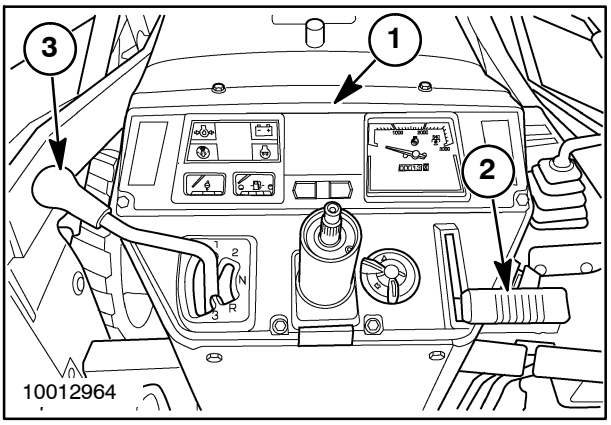
14. Remove the instrument panel, 1, from the instrument panel shroud assembly.
15. Remove the throttle control lever handle, 2.
16. Remove the gear shift lever handle, 3.
17. Remove the instrument panel shroud as an assembly.



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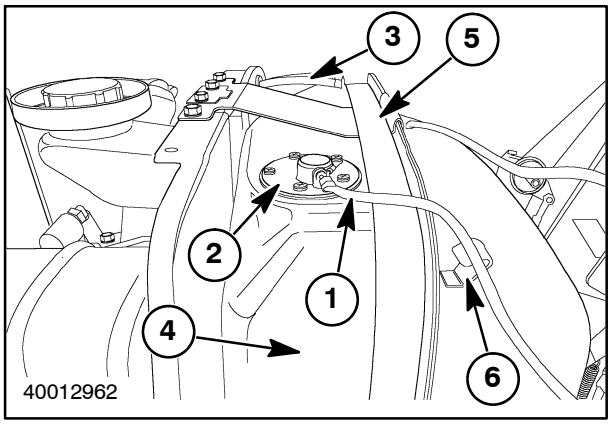
18. Disconnect the wire leads, 1, from the fuel level sending unit, 2.
19. Disconnect the fuel return lines, 3, from the top of the fuel tank, 4.
20. Remove the fuel tank retaining band, 5.
21. Release any wire harness straps, 6, and remove the fuel tank, 4, from the tractor.



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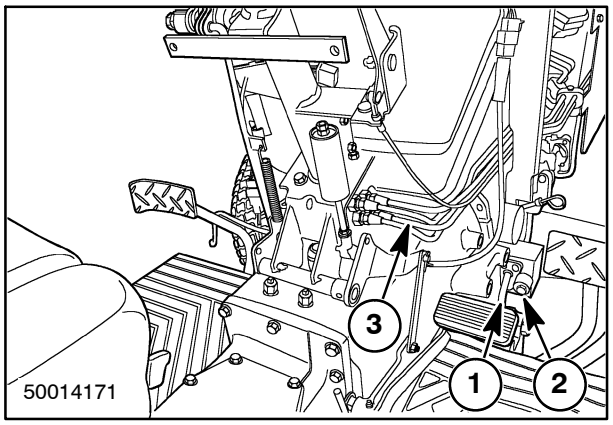
22. Remove the hydraulic system pressure tube, 1, from the tractor. Cap and plug all openings.
23. Remove the oil return line, 2, from the tractor. Cap and plug all openings.
24. Disconnect the four power steering oil tubes, 3, from the steering motor. Cap and plug all openings.



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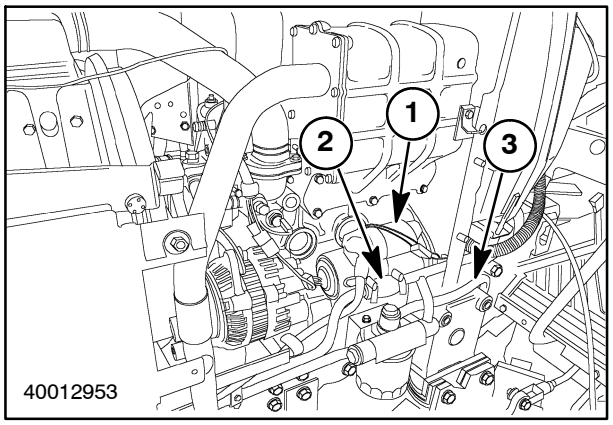
25. Disconnect the starter motor wiring from the starter and remove the starter, 1, from the engine.
26. If equipped with a hydrostatic transmission, disconnect the transmission to cooler tube, 2, at the hose connector.
27. Remove the cooler return tube, 3.
28. Remove the engine to transmission buckle-up bolts and carefully separate the engine from the transmission.



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Installation
Installation generally follows the removal procedure in reverse order.

NOTE: *Tighten all hardware to the specified torque.*

During installation, clean the engine and clutch housing mating surfaces and coat with liquid sealer. Use caution to prevent excess sealer from entering the inside of the housing and contaminating the hydraulic fluid supply.

SECTION 10 - ENGINE

Chapter 2 - Fuel System

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SPECIFICATIONS

INJECTION PUMP	
Pump Manufacturer Assembly Number TC30	ZEXEL 104135-3050
Type	In-Line
Timing (Before TDC) TC30	 21° - 23°
Timing (Piston Height at Injection: Start BTDC) TC30	 3.895 - 4.655 mm (0.1533 - 0.1833″)
Injection Nozzle Nozzle Type Needle Valve Diameter (All Models) Pintle Diameter (All Models)	 Throttle 0.4 mm (0.0157″) 1.0 mm (0.039″)
Injection Pressure TC30	 148 bar (2150 psi)
Spray Angle	4°
Service Adjustments Idle Speed Max. No-Load Speed TC30	 950 1050 rpm 2800 – 2850 rpm
TORQUE SPECIFICATIONS	
Delivery Valve Holder	39.2 - 44.1 N·m (28.9 - 32.5 ft. lbs.)
Injector Assemble	59 - 69 N·m (43 - 51 ft. lbs.)

Use the following standards when checking/adjusting the fuel injection pump.

Standards for Injection Pump Adjustment

Model of Engine:

N843 TC30

Pump Assembly

TC30 ..... No. 104135-3050
SHIBAURA Code No. 131017700

Standards for Adjusting the Injection Pump:

Rotating direction ..... Clockwise when observed from the front

Nozzle NP-DN4PDN117

Nozzle holder
TC30 105148-1210

Nozzle valve opening pressure
TC30 ..... 148 bar (2150 ± 71 psi)

Injection pipe
TC30 ..... 1.6 mm (0.063″) x 6 mm (0.235″) O.D. x 370 mm (14.5″) length

Fuel oil flow pressure ..... 0.193 bar (2.8 psi)

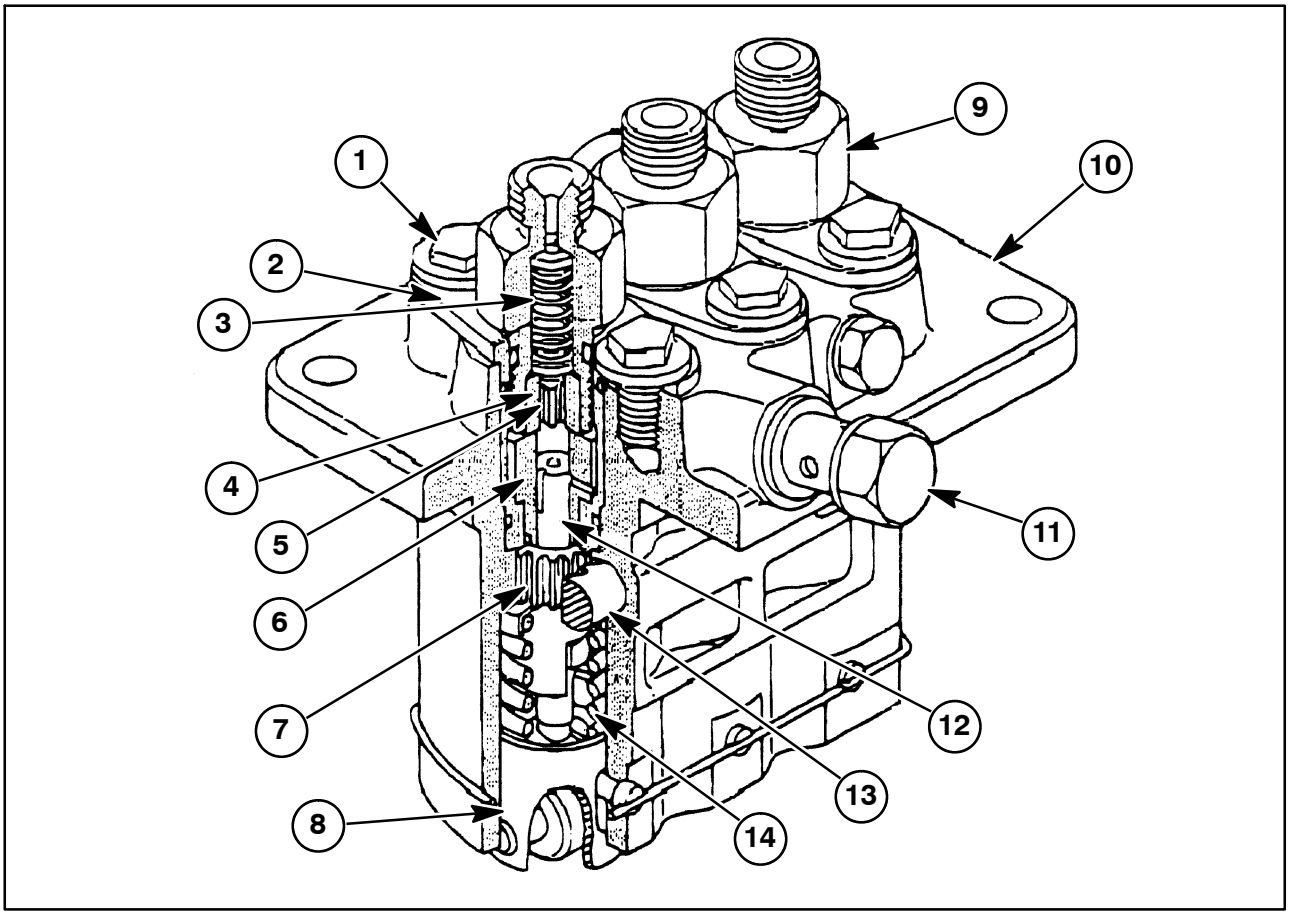
Test oil ..... Light oil

SPECIAL TOOLS

Injector Nozzle Tester FNH01721

Injector Adapter Set FNH01728

DESCRIPTION OF OPERATION - INJECTION PUMP



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1. Five-Sided Bolt
2. Sleeve Flange
3. Delivery Valve Spring
4. Delivery Valve Seat
5. Delivery Valve
6. Plunger Barrel
7. Control Sleeve
8. Tappet
9. Delivery Valve Holder
10. Pump Housing
11. Eye Bolt
12. Plunger
13. Control Rack
14. Plunger Spring

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The PFR injection pump is mounted in the engine's cylinder block. It differs from the E type injection pump in that it does not have a camshaft, but is driven by the engine's camshaft. Plunger, 12, movement is constant, being raised by the tappet, 8, and returned by the plunger spring, 14, as the engine rotates. The plunger barrel's, 6, suction and discharge port opens onto the pump housing's fuel oil chamber, which is always filled with fuel oil.

When the plunger descends, fuel oil is sucked into the plunger barrel, and when the plunger reaches its lowest point, the suction of fuel oil stops.

The plunger then ascends, and when the plunger barrel's suction and discharge port is closed by the plunger, the fuel oil pressure increases. The fuel oil then raises the delivery valve, 5, and is delivered through the injection pipe to the nozzle holder. When the fuel oil pressure exceeds the force of the nozzle spring's set force, fuel oil is injected into the engine's combustion chamber in the form of a fine spray.

The plunger further ascends, and when the plunger helix meets the plunger barrel's suction and discharge port, fuel delivery ends (at the same time injection from the nozzle also ends). the delivery valve is then closed by the set force of the delivery valve spring so that fuel oil is no longer delivered, even though the plunger continues to ascend.

TROUBLESHOOTING

GENERAL

PROBLEM	POSSIBLE CAUSE	CORRECTION
Fuel not reaching injection point	1. Fuel shutoff valve closed	1. Open the fuel shut-off valve
	2. Restricted fuel filter	2. Check and flush the fuel filter clean
	3. Faulty fuel stop solenoid	3. Check fuel stop solenoid. See “Fuel Stop Solenoid”
	4. Air in fuel system	4. Check for air leaks on suction side of system. Bleed the fuel system
	5. Fuel leakage	5. Check all the fuel lines and connections for tightness or possible damage
Fuel reaching nozzles but engine will not start	1. Low cranking speed	1. Check cranking
	2. Incorrect throttle adjustment	2. Check throttle control rod travel
	3. Incorrect pump	3. Check pump timing
	4. Fuel leakage	4. Check all fuel lines for leakage or possible damage
	5. Faulty injectors	5. See “Injector Troubleshooting”
	6. Low compression	6. Check engine compression. See “Engine Compression Test”
Engine hard to start	1. Low cranking speed	1. Check cranking speed
	2. Incorrect pump timing	2. Check pump timing
	3. Restricted fuel filter	3. Check and flush fuel filter clean
	4. Contaminated fuel	4. Check fuel for water in the fuel
	5. Low compression	5. Check engine compression. See “Engine Compression Test”
	6. Air in fuel system	6. Check for air leaks on suction side of system. Bleed the fuel system
Engine starts and stops	1. Fuel restriction	1. Check and flush restricted fuel lines or fuel filter
	2. Contaminated fuel	2. Check for water in the fuel
	3. Restricted air intake	3. Check for restrictions in the air intake
	4. Engine overheating	4. Check cooling system
	5. Air in system	5. Check for air leaks on suction side of system. Bleed fuel system

PROBLEM	POSSIBLE CAUSE	CORRECTION
Erratic engine operation (surge, misfiring, poor governor regulation)	1. Fuel leakage	1. Check the injector lines and connectors for leakage
	2. Fuel starvation	2. Check and flush clean restricted fuel lines or filter
	3. Incorrect pump timing	3. Check the pump timing
	4. Air in system	4. Check for air leaks on suction side of system. Bleed system
	5. Contaminated fuel	5. Check for water in the fuel
	6. Faulty or sticking injector nozzles	6. See “Fuel Injector Troubleshooting”
	7. Incorrect engine timing	7. Check for faulty engine valves
Engine does not develop full power or speed	1. Incorrect throttle adjustment	1. Check for insufficient throttle movement
	2. Incorrect maximum no-load speed	2. Check maximum no-load speed adjustment
	3. Fuel starvation	3. Check and flush clean restricted fuel lines and filter
	4. Air in system	4. Check for air leaks in suction side of the system. Bleed system
	5. Incorrect timing	5. Check pump timing
	6. Low compression	6. Check engine compression. See “Engine Compression Test”
	7. Incorrect engine timing	7. Check for improper valve adjustment or faulty valves
Engine emits black smoke	1. Restricted air intake	1. Check for a restricted air intake
	2. Engine overheating	2. Check cooling system
	3. Incorrect timing	3. Check pump timing
	4. Faulty injectors	4. See “Injector Troubleshooting”
	5. Low compression	5. Check engine compression. See “Engine Compression Test”
	6. Incorrect engine timing	6. Check engine timing
Pump fails to deliver fuel to all injectors	1. Blocked fuel lines to pump	1. Remove fuel lines and flush or replace
	2. Air in system	2. Bleed system
	3. Control rod seized in “OFF” position	3. Repair or replace control cable

PROBLEM	POSSIBLE CAUSE	CORRECTION
Pump fails to deliver fuel to one injector	1. Air in fuel line to injector	1. Bleed fuel line
	2. Plunger spring broken	2. Replace spring
	3. Plunger seized	3. Repair or replace barrel and plunger
	4. Delivery valve seized	4. Repair or replace delivery valve
Governor fails to maintain maximum or minimum no-load fuel delivery	1. Control spring broken	1. Replace control spring
	2. Governor weights seized	2. Repair or replace weight assembly and/or camshaft
	3. Governor weight carrier broken	3. Replace weight assembly
	4. Slider seized	4. Replace slider and/or camshaft
	5. Pump link spring broken	5. Replace spring

GOVERNOR SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Sluggish governor response	Slider cone binding on camshaft	Replace slider cone
	Fuel rack binding in injection pump	Lubricate rack. Repair or replace injection pump
	Governor weights binding on pivot pins	Repair governor assembly
	Linkage arm between governor linkage and injection pump rubbing on cylinder block	Straighten or replace linkage arm assembly
	Binding of throttle arm on pivot shaft	Lubricate or replace throttle arm or shaft
Engine runs away (Excessive Speed)	Slider cone stuck at “in” position	Replace slider cone or check camshaft for binding
	Linkage arm between governor linkage and injection pump stuck	Repair or replace linkage arm assembly
	Fuel rack stuck in full fuel position	Lubricate or repair injection pump
Engine will not develop rated speed	Smoke screw adjusted too far into engine block	Contact nearest New Holland CBU service office
	Fuel rack stuck in low fuel position	Lubricate or repair injection pump
Engine speed surging	Broken dampner spring on linkage arm	Replace dampner spring
	Damaged governor spring	Replace governor spring
	Worn linkage	Inspect and repair linkage as needed

INJECTORS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Nozzle does not "buzz" while injecting	1. Needle valve stuck	1. Check needle valve for carbon build-up and binding
	2. Excessive fuel leakage	2. Check valve and valve seat for scores or other indications of leakage
	3. Nozzle damage	3. Examine the nozzle retaining nut for damage
Nozzle leak-back	1. Needle valve worn	1. Replace nozzle assembly
	2. Blocked nozzle assembly	2. Check for carbon or foreign matter on faces of nozzle and nozzle holder. Flush clean or replace
	3. Loose nozzle retaining nut	3. Inspect faces and tighten nozzle retaining nut
Nozzle opening pressure incorrect	1. Incorrectly adjusted nozzle retaining nut	1. Check retaining nut for looseness
	2. Damaged nozzle or seized needle valve	2. Replace nozzle assembly
	3. Block nozzle orifice	3. Check nozzle orifice for carbon or foreign matter. Flush clean or replace
Nozzle seat leakage	1. Nozzle incorrectly seated	1. Check for carbon or foreign matter on faces of nozzle or nozzle holder
	2. Sticking or binding needle valve	2. Repair or replace nozzle assembly

BREATHER VALVE

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine emitting a bluish smoke	Excessive blow by gases of engine. Possible worn piston rings or scored cylinder walls.	Replace piston rings, hone cylinder walls to seat new rings.
	Engine breather valve is stuck in "OPEN" position. Valve diaphragm is damaged allowing valve not to close.	Replace engine breather valve diaphragm.
	Oil mist separator mesh screens allowing oil to enter intake manifold damaged or missing separator mesh screens.	Replace oil mist separator mesh screens.
Engine seals leaking oil	Excessive crankcase pressure. High pressure caused by breather valve not opening.	Inspect diaphragm for damage or contamination. Replace diaphragm if necessary.
	Vent hole in valve body plugged.	Remove valve body from engine and clean vent hole.

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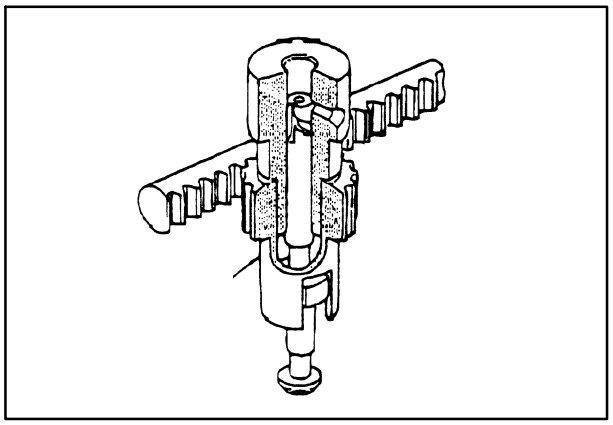
FUEL VARIATION MECHANISM

As well as pressurizing the fuel oil, the injection pump also functions to vary the fuel injection quantity.

A control sleeve is installed around the plunger barrel, and a flange on the bottom of the plunger is inserted into a groove in the control sleeve. Teeth on the control sleeve are engaged with teeth on the control rack so that movement of the control rack results in rotation of the plunger and, consequently, variation of the fuel injection quantity.



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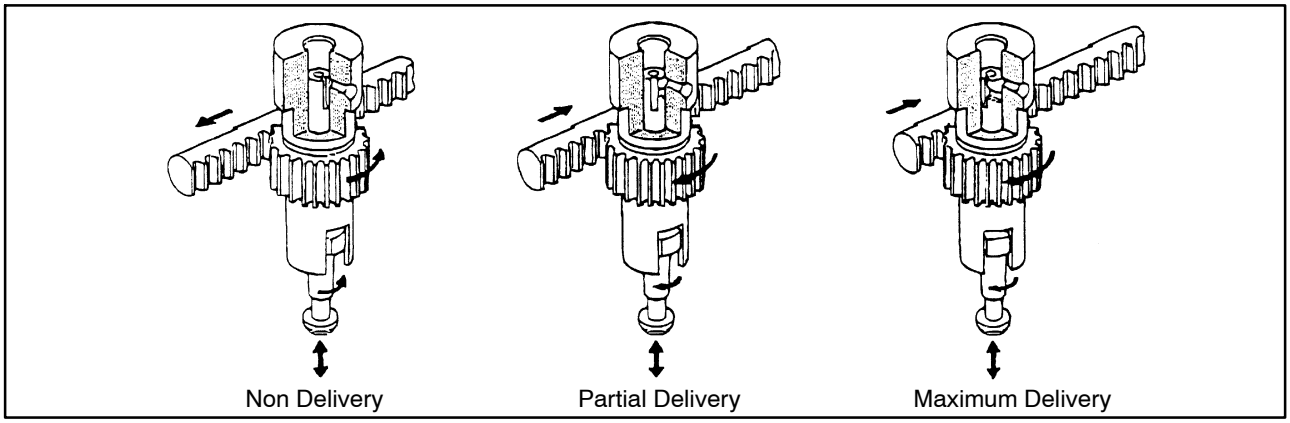

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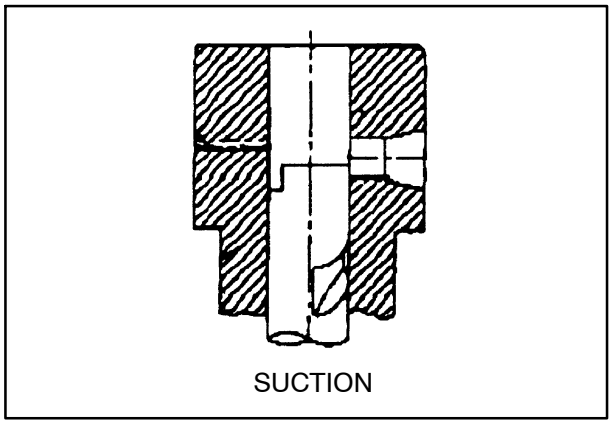
CTD (Compact Timing Device) MECHANISM

When the plunger descends, fuel oil is sucked into the barrel, and when the plunger reaches its lowest point, the suction is finished.



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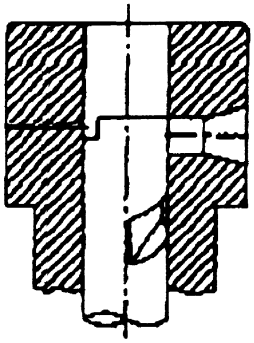
In case of the standard plunger, the plunger then ascends, and when the barrel's main port is closed by the plunger, the fuel oil pressure increases, and the fuel delivery starts.

CTD type plunger (the barrel has sub port), whether the fuel delivery starts or not is owing to the engine's rev speed. Namely, when the engine's rev speed is low. the delivery does not start. Because sub port is still opened, and fuel oil pressure does not increase. But, when the engine's rev speed is high, sub port's diameter is so small that it can be considered as being closed. For this reason, the fuel oil pressure increases and the delivery starts.



DELIVERY START (HIGH SPEED)

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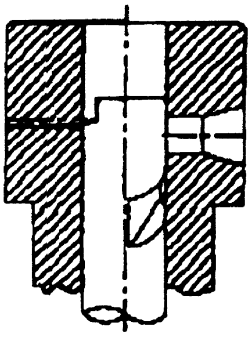
The plunger further ascends, and when the barrel's sub port is closed by the plunger, the fuel oil pressure increases and the delivery starts, regardless of the engine's rev speed.



DELIVERY START (LOW SPEED)

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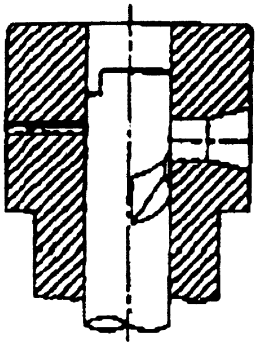
The plunger further more ascends, and when the plunger main lead meets the barrel's main port, the fuel oil pressure decreases, and the fuel delivery ends.



DELIVERY END

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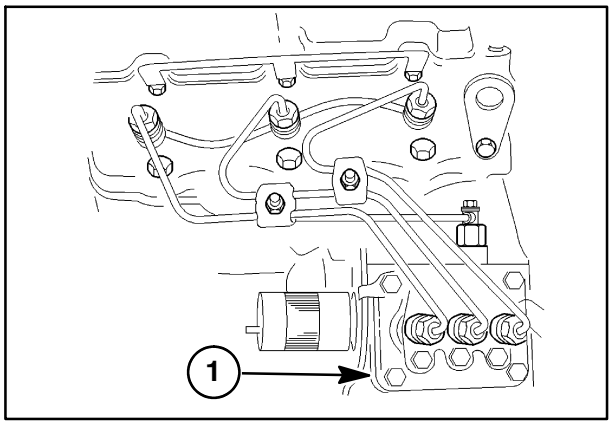
The fuel injection pump, 1, is a constant stroke type pump and has one pumping element for each cylinder. The injection pump operates at one-half engine speed.



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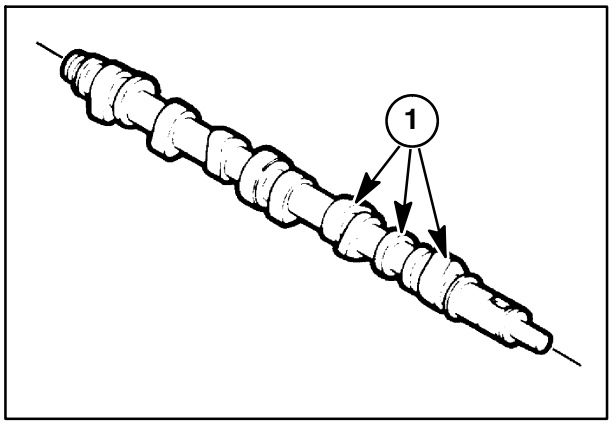
The pumping elements are operated by cam lobes, 1, that are incorporated on the engine valve train camshaft, which is driven by the engine oil pump gear.



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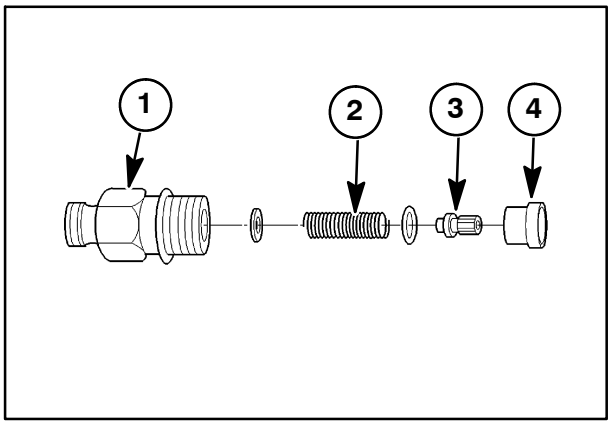
DELIVERY VALVES

Located above each pumping element is a delivery valve assembly which consists of a delivery valve holder, 1, spring, 2, piston and stem assembly, 3, operating within a cylindrical guide, 4, which terminates in a conical seat. The lower part of the stem has four vertical flutes which accurately locate within the guide while permitting fuel to pass. Above the flutes is a piston which is a lapped fit in the bore of the valve guide.



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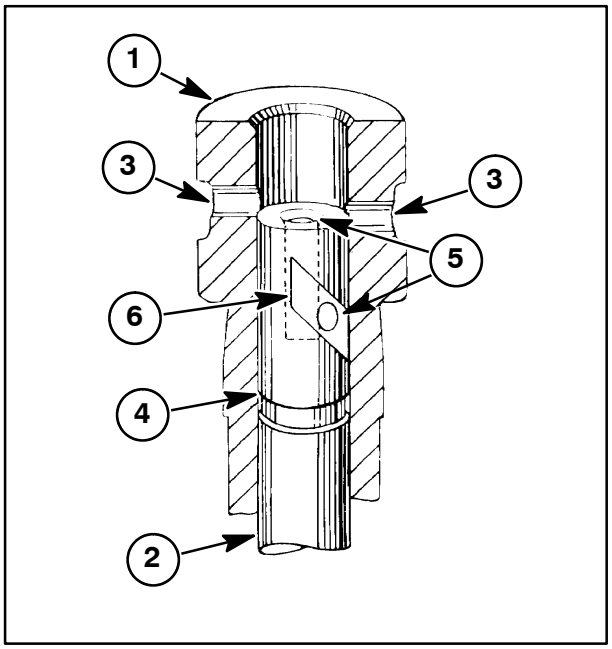
The delivery valve serves as a non-return valve and also as a means of rapidly reducing the fuel pressure in the injector line when injection ceases. Rapid pressure reduction is required to be sure injector needle valve “snaps” shut to prevent fuel “dribble,” a condition which can cause carbon formation on the injector tip.

Fuel Delivery

The pumping elements accurately meter and deliver the fuel to the injectors. Each of the pumping elements consists of a barrel, 1, and plunger, 2, lapped together to give an accurate fit. Two diametrically opposed drillings in the barrel form fuel inlets, 3, and the barrel is splined, with a master spline, for correct location within the pump body.

An annular groove, 4, is machined around the plunger into which fuel leaking between the barrel and plunger may accumulate. This leakage provides lubrication of the barrel and plunger surfaces. The plunger has a fuel port, 5, which terminates in a helical groove, 6, machined in the periphery of the plunger. The purpose of the groove is to control the effective pumping stroke of the plunger.



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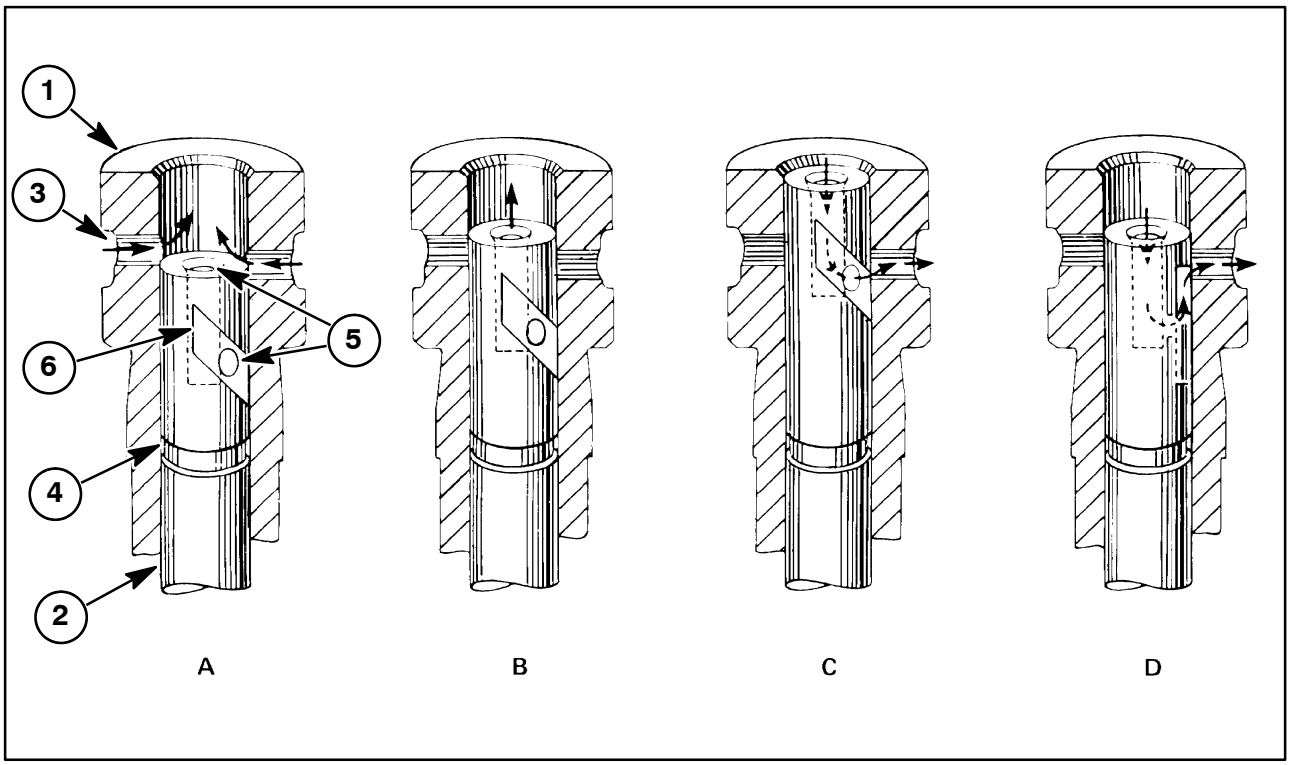

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1. Barrel
2. Plunger
3. Fuel Inlet
4. Angular Groove
5. Fuel Port – Center Drilling
6. Helical Groove

The element operates as follows:

Position A: With the plunger at the bottom of the stroke, fuel flows into the barrel through the two inlet ports to fill the space above the plunger, the center drilling, and the helical groove.

Position B: As the plunger rises, the two inlet ports in the barrel are cut off by the plunger and the fuel is trapped. This point is called “spill cut-off” or “point of injection”. Further upward movement of the plunger tends to compress the trapped fuel until the delivery valve, which acts as a non-return and unload valve, is lifted from the seat and allows the fuel to pass through the injector line to the injector. The pressure developed lifts the injector needle valve off the seat and injection takes place.

Position C: Injection ceases when the upper edge of the helical groove uncovers the lower edge of the inlet port. The pressurized fuel is allowed to escape back through the drilling to the low pressure area of the inlet port.

This pressure drop causes the injector needle valve to close and injection to cease. The plunger continues to the top of the stroke and is returned by a spring for the next cycle.

The effective pumping stroke is the distance between the top of the plunger and the point on the helical groove which uncovers the inlet port.

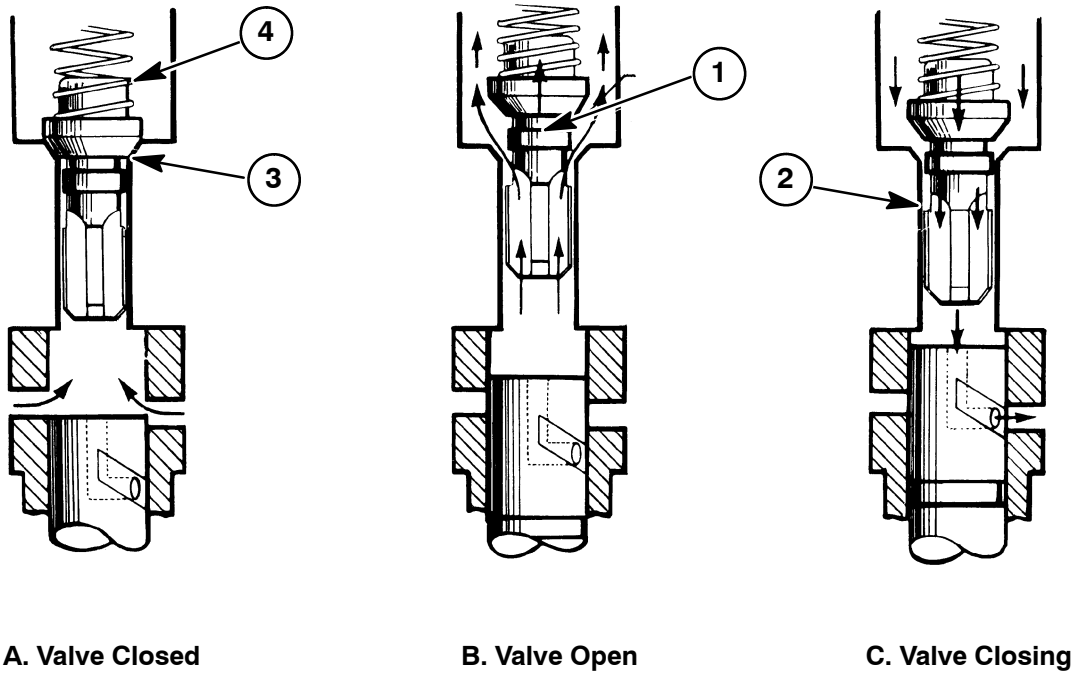
If the plunger is rotated clockwise so the helical groove uncovers the inlet port at a lower point on the plunger, the pumping stroke and the amount of fuel injected will be increased. Conversely, if the plunger is rotated counterclockwise, the effective pumping stroke and amount of fuel injected will be reduced.

Position D: At this stage, the plunger has rotated to a position where the helical groove has reached the bottom of the inlet port before the plunger has risen sufficiently to close both inlet ports.

During the remainder of the stroke, the helical groove remains in contact with the inlet ports, so no pressure is produced and no injection can take place.

This is the “no delivery” or “stop” position, which occurs when the stop lever moves the control rod to the fully forward position.

NOTE: *The plungers have a slot machined across the crown. When the access fuel device is operated and the control rod is in the maximum fuel position, the slots align with the inlet ports of the barrel to retard inlet port closure and assist easy starting.*



A. Valve Closed **B. Valve Open** **C. Valve Closing**

13

1. Piston
2. Valve Guide
3. Conical Seat
4. Spring

The delivery valve operates as follows:

Position A: The pump plunger is at the bottom of the stroke and the inlet ports are uncovered so the barrel and delivery valve guide are filled with fuel. At this position the fuel is at low pressure, thus allowing the spring pressure to retain the valve on its seat.

Position B: The plunger has risen and closed both inlet ports. Injection has now commenced. The fuel is now under pressure and overcomes the spring tension, lifting the delivery valve off its seat until the piston is clear of the guide permitting fuel to pass through to the injector.

Position C: The helical groove has uncovered the inlet port and released the fuel pressure. The delivery valve spring, assisted by the high pressure still existing in the injector line, forces the delivery valve to close rapidly.

During closing, the piston portion of valve returning into the guide increases the volume of the injector line by the volume of this part of the valve.

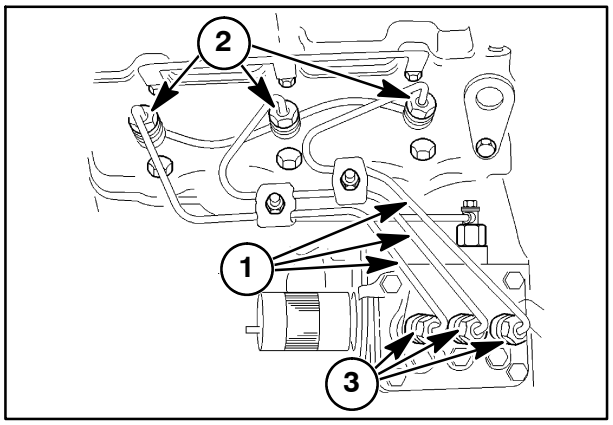
This sudden increase in the volume of the injector line causes a rapid collapse of pressure and allows the injector needle valve to “snap” shut.

Op. 10 214

INJECTION PUMP

Removal

1. Remove the fuel injection lines, 1, by loosening nuts, 2, on the injectors and nuts, 3, on the injector pumps. Cap all openings to prevent contamination.



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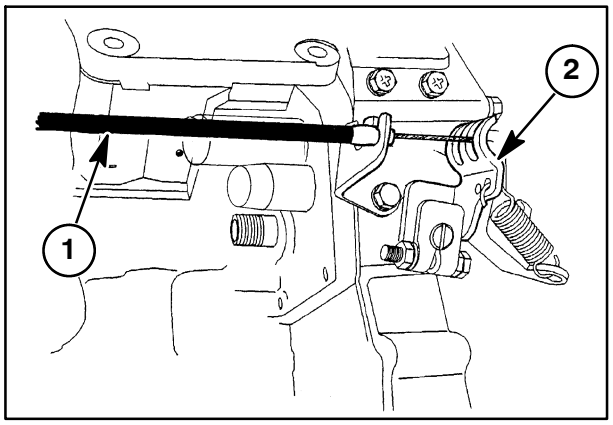
2. Disconnect the throttle control cable, 1, from the timing gear cover lever, 2.



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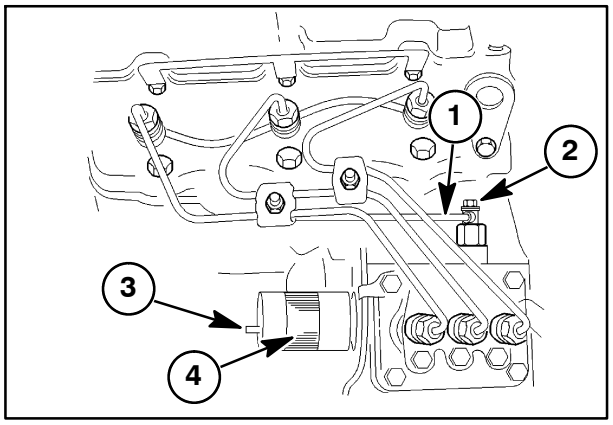
3. Disconnect the fuel inlet line, 1, on the injection pump by loosening bolt, 2. Disconnect the engine fuel stop solenoid lead, 3, then unscrew the solenoid, 4, from the fuel injection pump housing.



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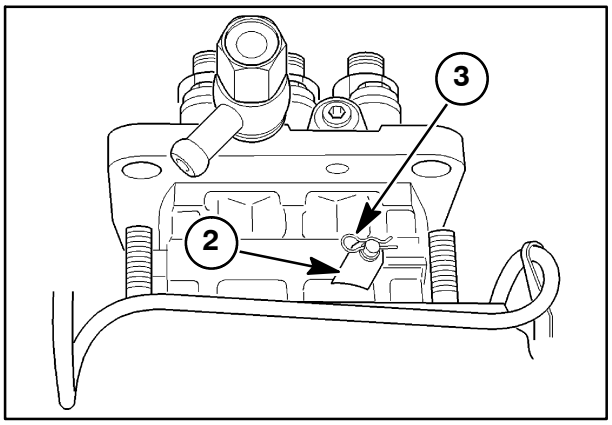
4. Remove the injection pump mounting nuts and bolts. Raise the pump and remove the spring pin, 3, and separate the governor link, 2, from the pump control rack, 1, Figure 19.
5. Remove the injection pump.

   NOTE: *If there are shims between the pump mounting flange and the engine block, carefully remove the shims and retain for installation.*



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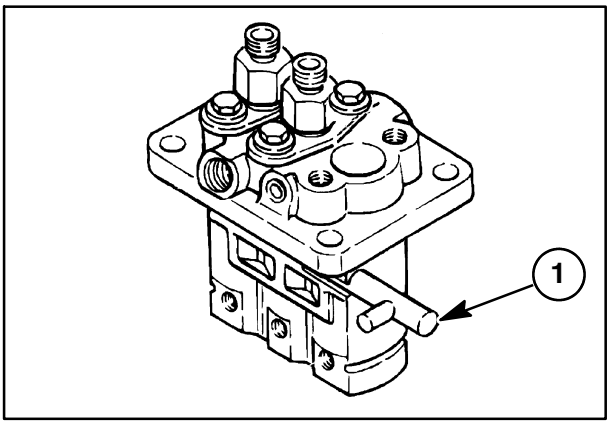
Repair

If an injection pump is suspected of being faulty, it should be tested and repaired by an authorized Diesel Service Station only.



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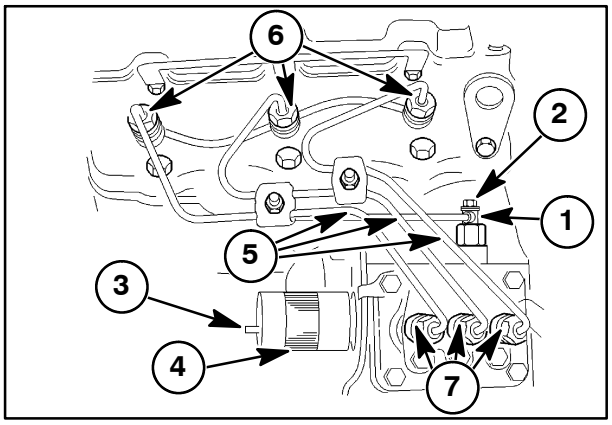
Installation

Installation generally follows removal procedures in reverse.

1. Attach pump rack to governor linkage.
2. Install injection pump assembly into engine housing.
3. Install fuel solenoid, 4, into rear of injector housing and connect lead, 3.
4. Connect fuel inlet line, 1, by tightening bolt, 2.
5. Install injector lines, 5, by tightening nuts, 6, at the injectors and nuts, 7, at the pump.

If the pump is being replaced or if the timing is unknown, proceed to “Timing and Governor Adjustment”.

After installation bleed air from the fuel system. See “Bleeding the Fuel System”.



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TIMING AND GOVERNOR ADJUSTMENT

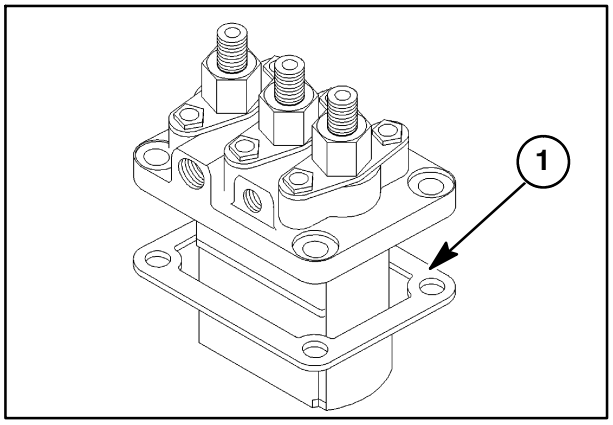
Op. 10 230

ORIGINAL PUMP AND DRIVE COMPONENTS

Installation

NOTE: *The engine stop solenoid must be removed before installing the pump.*

1. Position the injection pump in the block using the original shim gasket, 1, or a new one of the same thickness.



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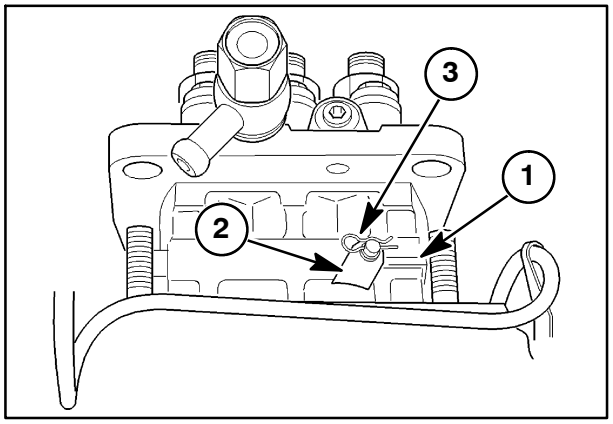
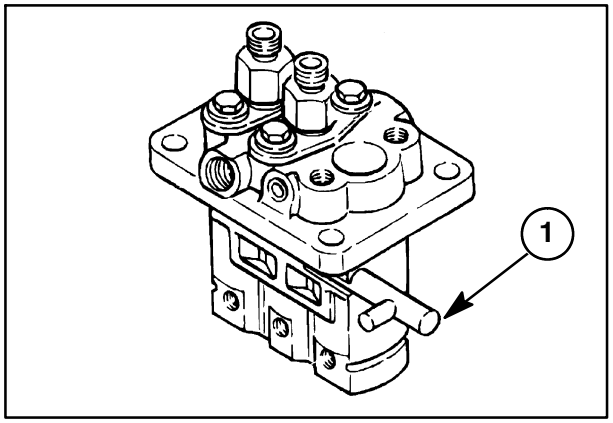
2. Connect the governor link, 2, to the pump control rack, 1, and secure with spring pin, 3.



21

NOTE: *Check the control rack, 1, for any binding conditions by moving the pump control lever back and forth.*

3. Install the pump mounting nuts and bolts and tighten to 39 - 44 N·m (29 - 33 ft lbs).
4. If necessary to verify pump timing, spill-time the pump as outlined in “Spill-Timing Procedure”.



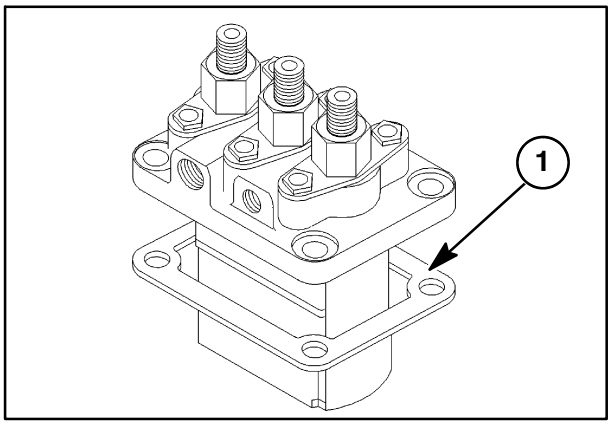
22

NEW PUMP OR DRIVE COMPONENT

Installation

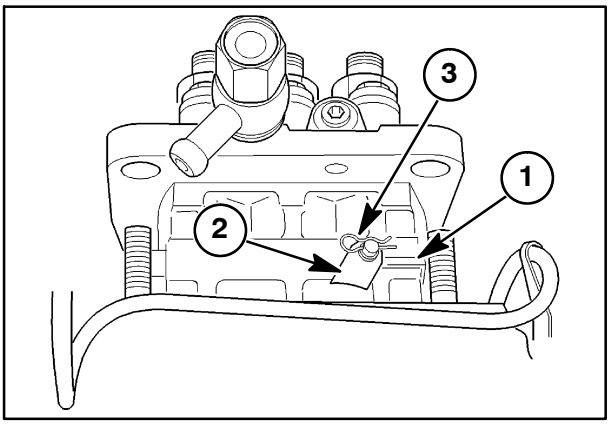
NOTE: *The engine stop solenoid must be removed before installing the pump.*

1. Position the pump in the block using a new shim gasket, 1, of 0.5 mm (0.020″) thickness.



23

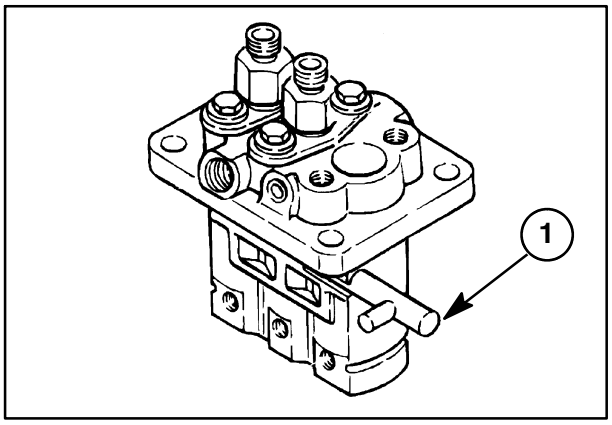
2. Connect the governor link, 2, to the pump control rack, 1, and secure with the spring pin, 3.



24

NOTE: *Check the control rack, 1, for any binding conditions by moving the pump control lever back and forth.*

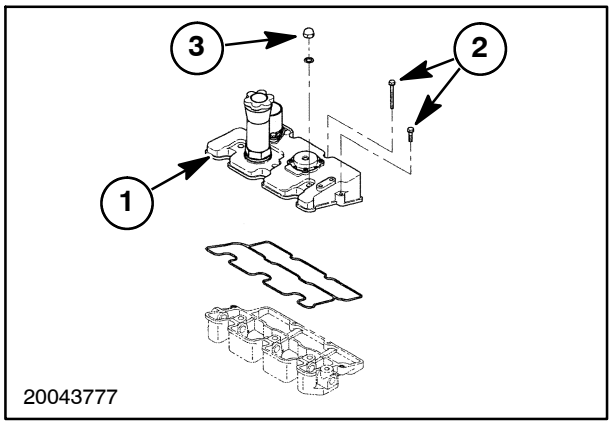
3. Install the pump mounting bolts and tighten to 39 - 44 N·m (29 - 33 ft lbs).
4. Spill-time the pump. See “Spill-Timing Procedure”.



25

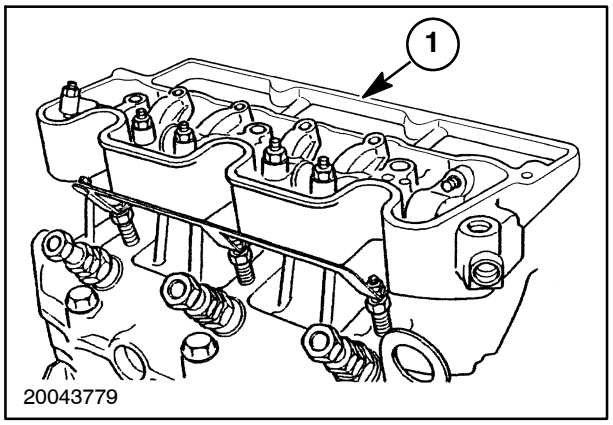
SPILL-TIMING PROCEDURE

1. Remove the head cover, 1, from the top of the engine, by loosening bolts, 2, and cap nuts, 3.
2. Find top dead center of the No. 1 cylinder (No. 1 cylinder is the closest to the engine fan). No. 1 cylinder must be on the compression stroke. (Intake and exhaust rocker arms will be loose.)



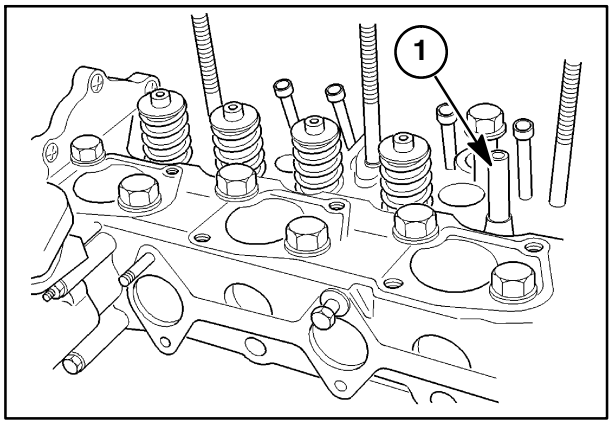
26

3. Remove the rocker arm housing and rocker arm assembly, 1, from the engine.



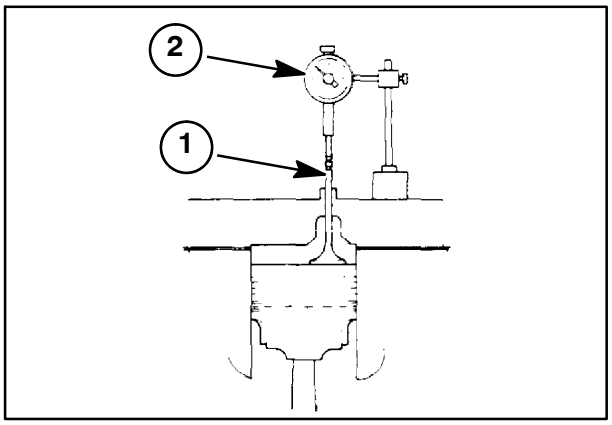
27

4. Remove the keepers and spring from No. 1 cylinder intake valve, 1.



28

5. To verify true top dead center of piston travel, install a dial indicator, 2, on the valve stem (No. 1 cyl.), 1. Be sure the valve stem is sitting on top of the piston. Rotate the crankshaft until the indicator needle reverses direction. The point the needle reverses direction is true top dead center.

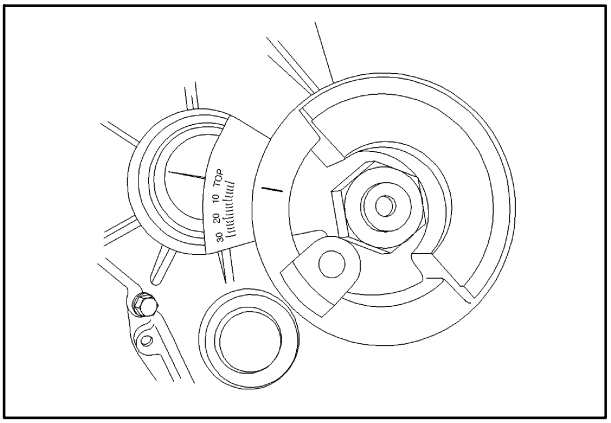


29

6. Verify that the timing mark on the crankshaft pulley is in line with the "TOP" mark on the timing scale. If the mark on the crankshaft pulley is not in line with the "TOP" mark, verify piston top dead center by repeating step 5. If the pulley mark is slightly off, remark the pulley and proceed.

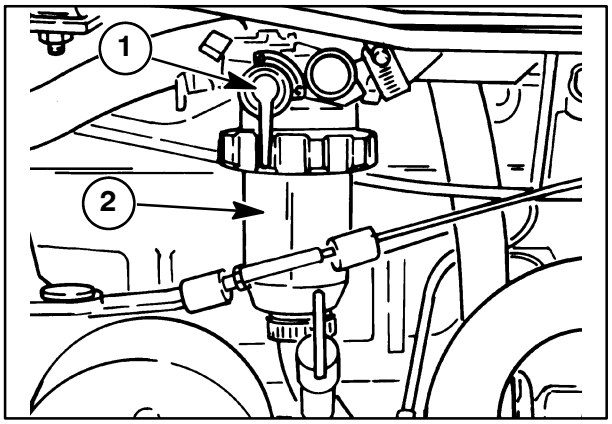
   NOTE: *Color the timing mark on the crankshaft pulley and appropriate marks on the timing scale to increase visibility.*

7. Reinstall the valve spring, keepers, rocker arm assembly, housing and valve cover.



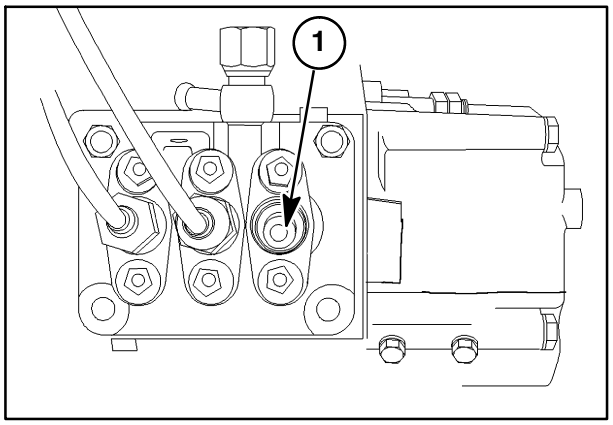
30

8. Shut off the fuel supply at shutoff valve, 1, to the injection pump at the fuel filter, 2.



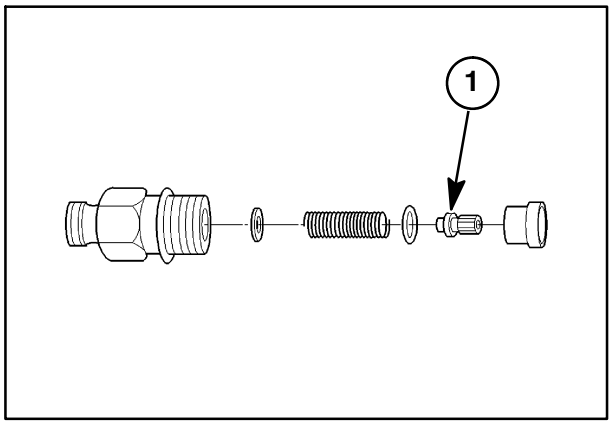
31

9. Remove the No. 1 injection line, 1.



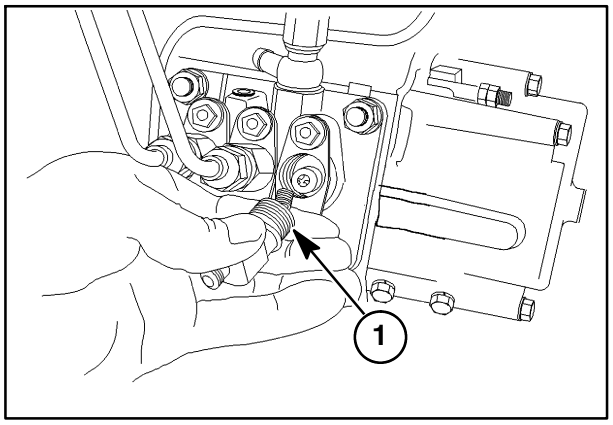
32

10. Remove the delivery valve piston, 1, from the No. 1 delivery valve.



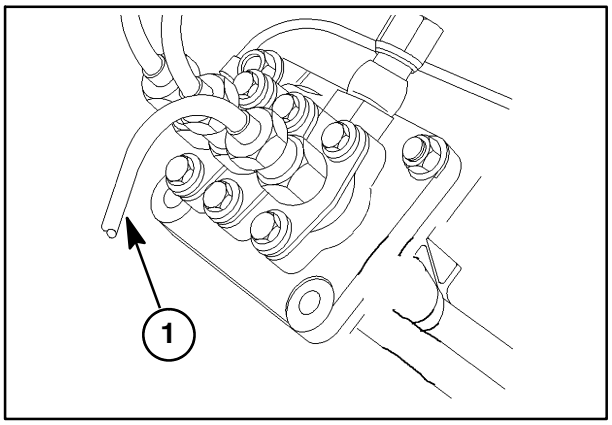
33

11. Reinstall the spring and holder, 1, into the injection pump and tighten securely. Insert a small diameter wire down through the holder, 1, and bend a hook on the end of the wire to hold the spring, washer, and the valve in the holder, while re-installing in the injection pump. Remove the wire just prior to the holder being seated in the pump.



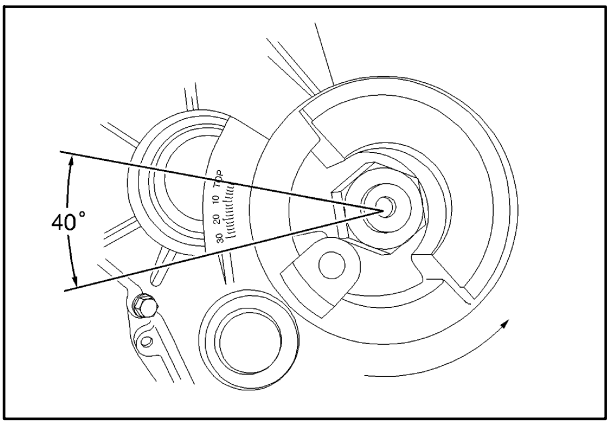
34

12. Fabricate a spill tube, 1, from a discarded injection line and install the tube on the No. 1 port on the injection pump.
13. Remove the fuel shutoff solenoid from the injection pump.



35

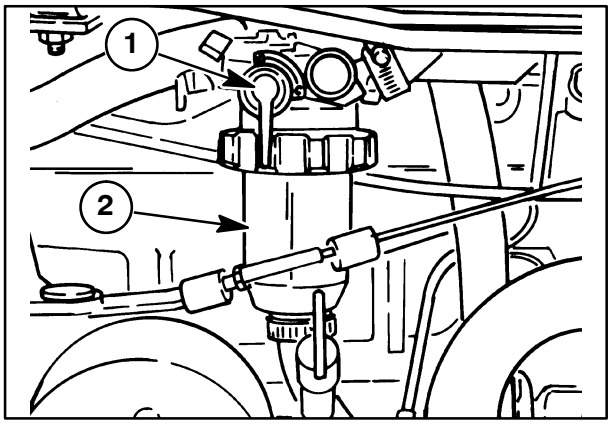
14. Rotate the crankshaft counterclockwise (viewed from the front of the engine) approximately 40°.



36

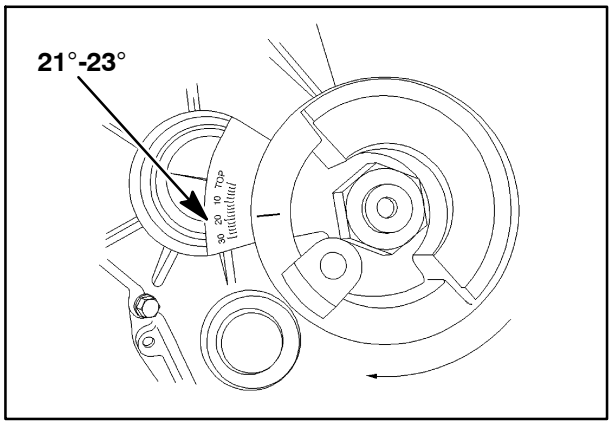
15. Turn on the fuel supply at shutoff valve, 1, to the injection pump at the filter, 2. Fuel should flow out of the spill tube on the No. 1 cylinder port.
16. If installed, remove the engine stop solenoid.
17. Place governor lever, to full throttle position.

NOTE: *The rack must be completely open and accurately match timing, for CTD pump.*



37

18. Rotate the crankshaft clockwise. When the timing mark on the crankshaft pulley is in line with the 21° - 23° marks on the scale, fuel should stop flowing from the spill tube.



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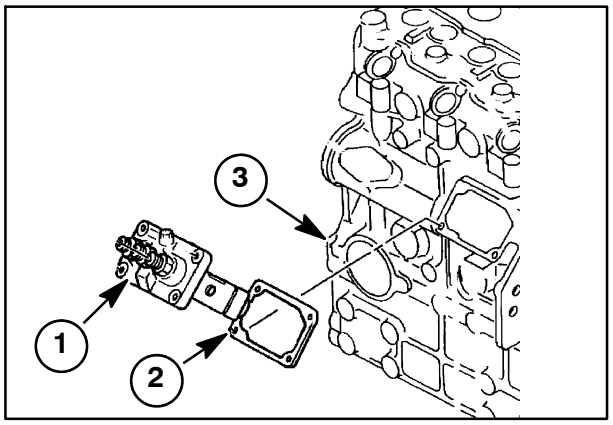
19. If fuel does not stop flowing at the appropriate timing mark, the injection pump timing must be adjusted by adding or removing shims, 2, located between the injection pump, 1, and the engine block, 3.
20. Adding shims will retard the pump timing and removing shims will advance the pump timing.

    NOTE: *A shim thickness of 0.1 mm (0.03937˝) will change the pump timing by 0.96 degree.*
21. Assemble all components that were removed from the engine and fuel system.



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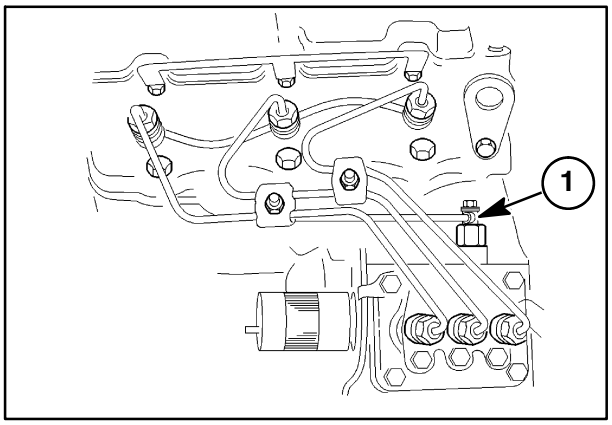
BLEEDING THE FUEL SYSTEM

Bleed the fuel system after any of the following conditions:

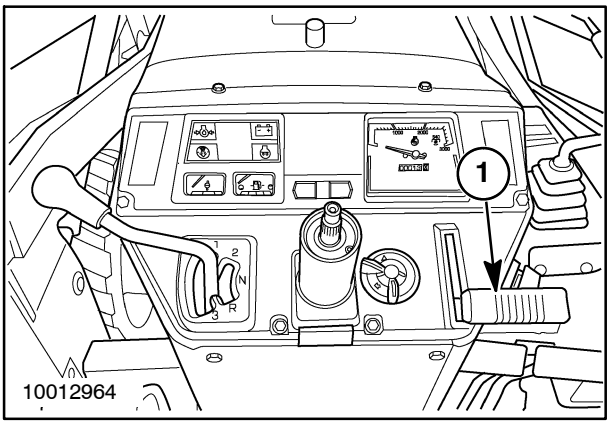
1. When a new filter is installed.
2. After the tractor has run out of fuel.
3. When any of the fuel lines have been disconnected.
4. When the injection pump has been removed.

5. Ensure adequate fuel is in the fuel tank and the fuel shutoff valve is open.
6. Open the bleed screw, 1, on the injection pump.



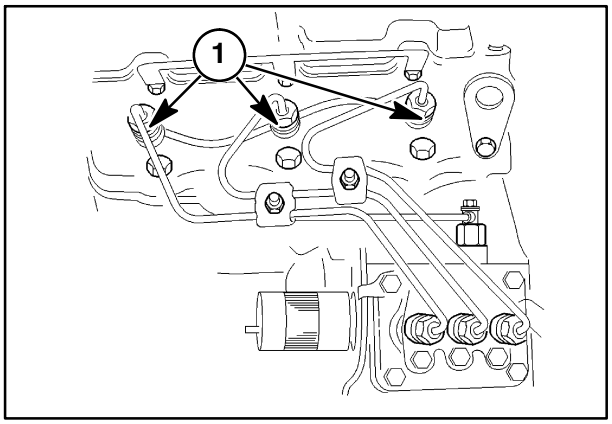
40

7. Set the throttle, 1, in the full open position and crank the engine for a few seconds to allow the air to be expelled from the injector lines.



41

8. If the engine does not start, loosen the injector lines at the injectors, 1, one at a time while cranking the engine.
9. Be sure all lines are properly torqued when completed.



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FUEL SETTINGS ADJUSTMENTS

FUEL SCREW/HIGH IDLE

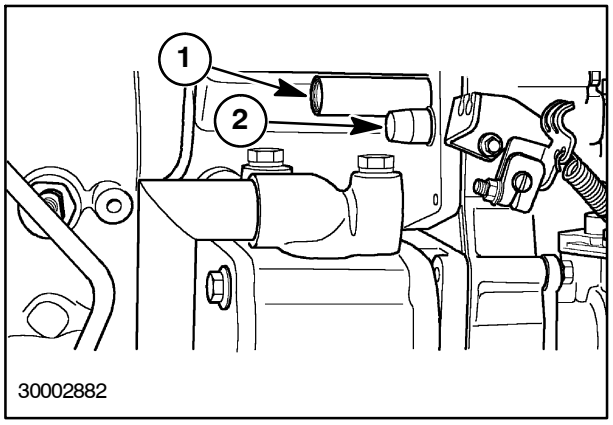
The correct adjustment is required to reset to the original production setting to ensure the engine will be within the certified emission limits.

NOTE: *EPA engine is certified to EPA emission legislation.*

No one is permitted to adjust the fuel flow rate more than the max figure of submitting for power setting.

Adjustment only made by New Holland Area Service Managers, due to EPA emission regulations.

Contact New Holland representative for adjustment of fuel setting, 1, on high speed idle, 2.



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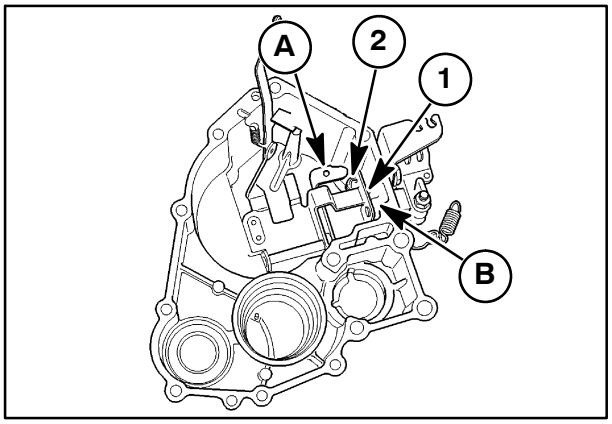
DESCRIPTION OF OPERATION – GOVERNOR

Op. 10 230

The governor assembly is mounted on the forward end of the camshaft. To disassemble and assemble the governor assembly, see “Governor Case Disassembly” and “Governor Assembly Case”.

As the engine speed increases the throttle arm, 1, contacts the fuel screw adjuster at contact point A, and the high-speed idle stop screw at B. During the engine speed increase tension is placed on the governor spring, 2.



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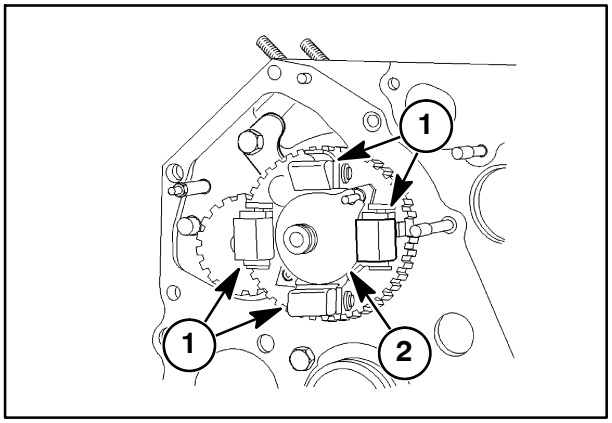
As engine speed increases the four governor weights, 1, pivot outward and push on the slider cone, 2. The weights and slider cone are located on the end of the camshaft.



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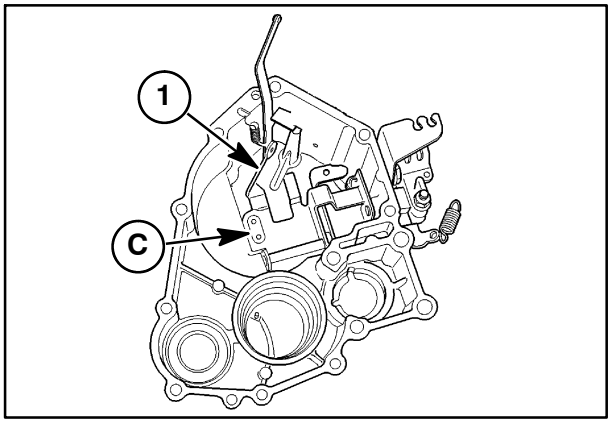
The slider cone, 2, contacts the governor linkage arm, 1, at contact pad, C. As the cone moves forward it pushes the linkage arm, 1, forward, which is connected to the injection pump rack assembly. When the injection pump rack moves forward the fuel delivery is decreased and the engine speed decreases.



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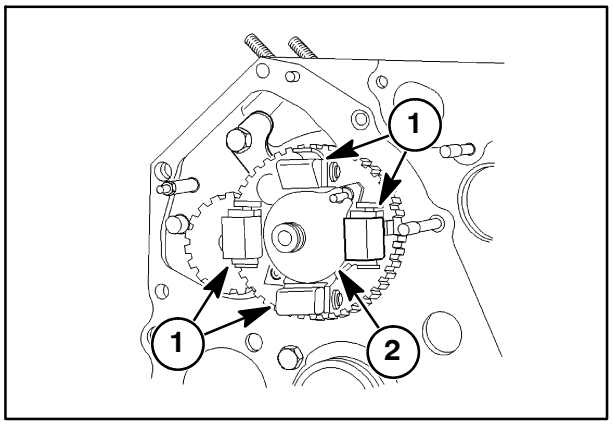
As the engine speed decreases the governor weights, 1, pivot inward allowing the slider cone, 2, to move rearward.

As the slider cone, 2, moves rearward, the governor linkage arm, 1, allows the fuel injection pump rack to move rearward to the full fuel position and the engine speed increases.



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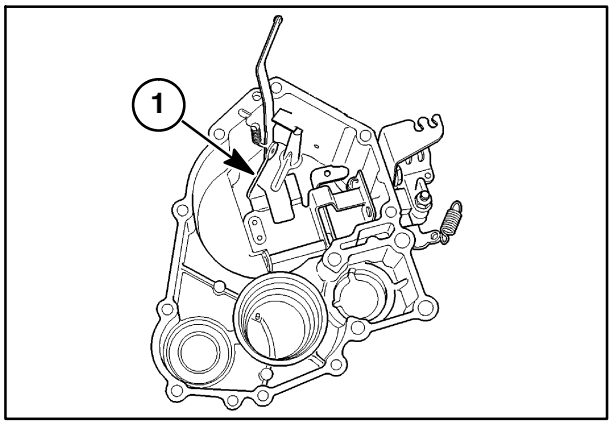
Engine speed depends upon several factors. The throttle setting determined by governor spring tension. The pressure exerted by the slider cone on the governor linkage, and positioning of the injection pump rack.

All the governor linkage parts are located inside the engine timing gear cover, 1. To inspect or replace any of the governor linkage parts, the timing gear case and injection pump must be removed from the engine.



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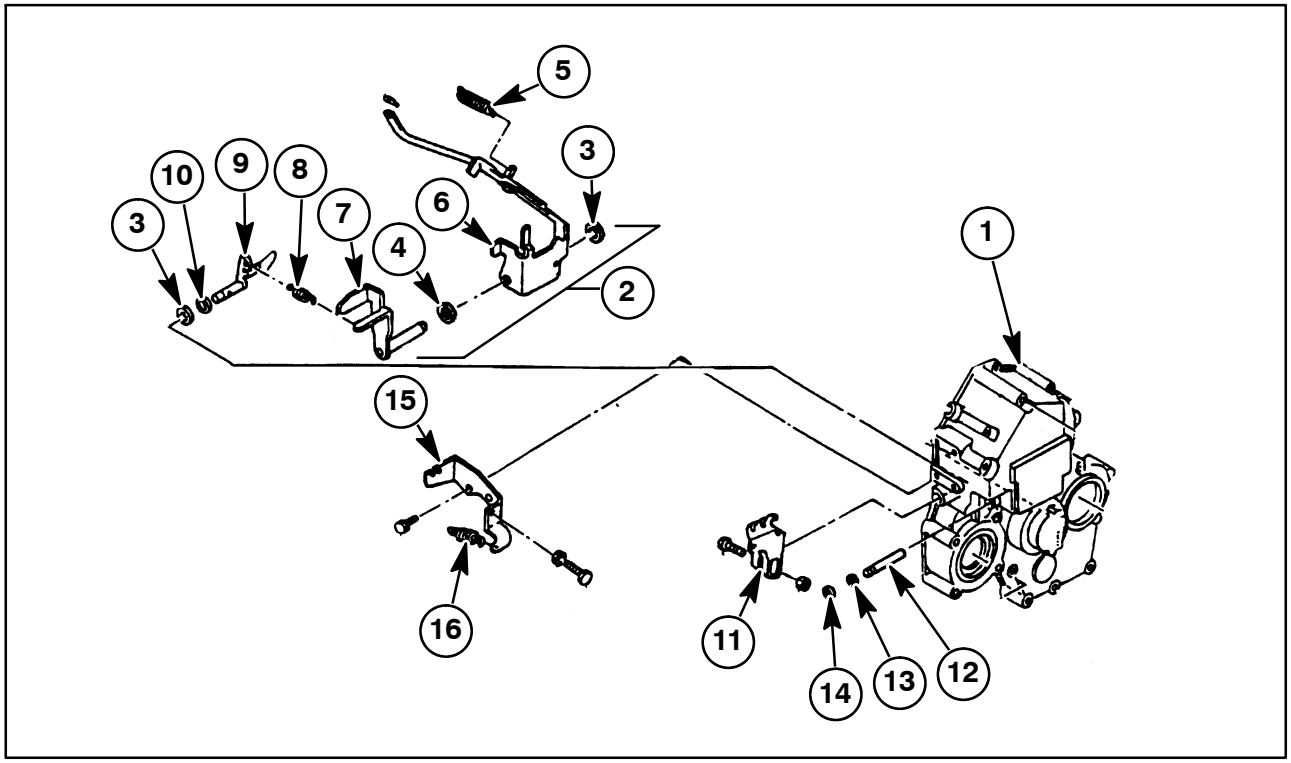

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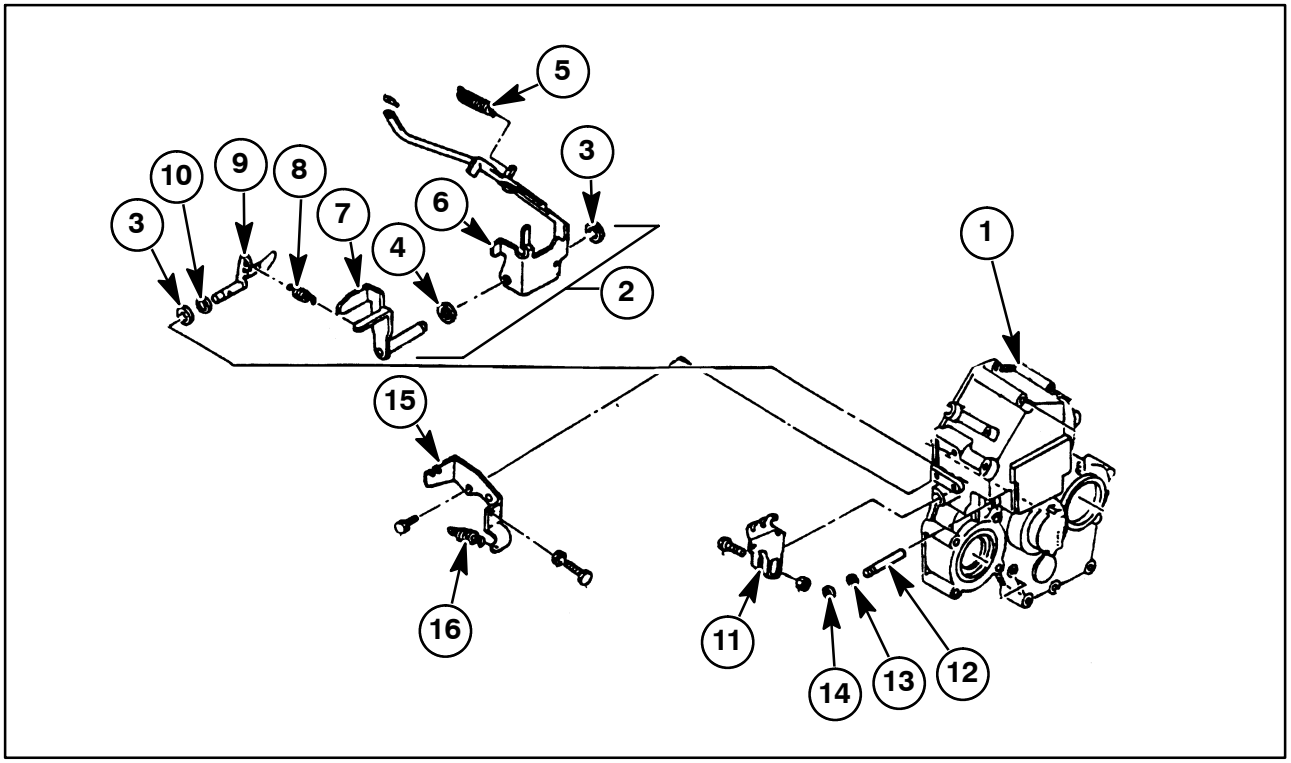
1. Timing Gear Cover (Case Assembly)
2. Linkage/Spring Lever Assembly
3. E-Snap Ring
4. Spacer Washer
5. Dampener Spring
6. Linkage Arm
7. Spring Holder Stay
8. Governor Spring
9. Throttle Arm
10. O Ring
11. Throttle Lever
12. Linkage Pivot Shaft
13. O Ring
14. E-Snap Ring
15. Throttle Cable Stay
16. Throttle Cable Stay Spring

GOVERNOR

Disassembly

1. Remove injection pump and timing gear cover from the engine as discussed in the Engine section.
2. Remove the timing gear cover, 1, from the front of the engine. Remove throttle lever, 11, from the outside end of throttle arm, 9.
3. Remove E-ring, 3, from throttle arm, 9. Push arm into timing cover until. There is enough space to remove governor spring, 8. Remove governor spring, from throttle arm, 9. Now, remove throttle arm from timing cover. Inspect O ring, 10, that is on the arm. Replace the O ring if it is damaged. Remove throttle cable stay, 15, from timing gear cover, 1.
4. Remove E-ring, 14, from the outside end of linkage pivot shaft, 12. Pull pivot shaft, 12, out of the timing case. Inspect O ring, 13, on shaft. Replace if damaged.
5. Remove linkage arm assembly, 6, from the timing cover, 1. Remove governor spring, 8, and dampner spring, 5, from the linkage. Check spring holder arm, 7, making sure it pivots freely. Confirm that spacer washer, 4, is installed between arm and arm base. Also make sure the E-ring, 3, is installed in the groove of spring holder arm. Check all pivot points, slot and pin locations for any signs of wear. Replace the linkage/spring lever assembly, 2, if wear is present.



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1. Timing Gear Cover (Case Assembly)
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9. Throttle Arm
10. O Ring
11. Throttle Lever
12. Linkage Pivot Shaft
13. O Ring
14. E-Snap Ring
15. Throttle Cable Stay
16. Throttle Cable Stay Spring

Assembly

1. Install governor spring, 8, onto throttle arm, 9.

   NOTE: *Spring is installed onto front spring holder arm with spring inserted from the inside of the arm.*

2. Place linkage arm assembly, 6, into case.

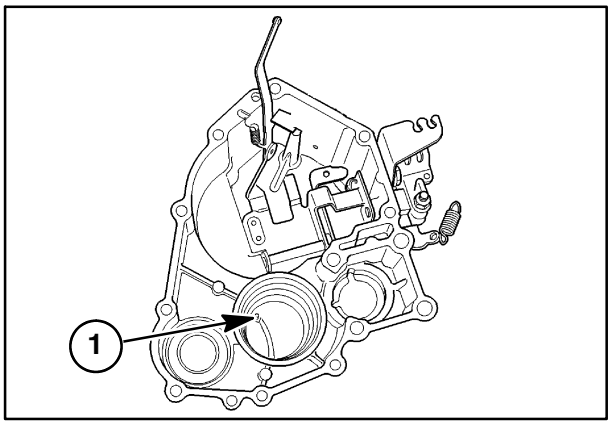
   NOTE: *Check that spacer washer, 4, is installed between spring holder arm and base. Confirm E-ring, 3, is installed into groove of spring holder arm, 7.*

   The shaft is orientated with tapered end towards outside of case. With O ring, 13, installed and the shaft lubricated, insert pivot shaft, 12, into case. Install shaft through linkage arm, 6, until O ring is in the cover, 1. Install E-ring, 14, onto shaft, then push shaft into case until E-ring touches case.

3. Install throttle arm, 9, with O ring, 10, from the inside of the case, until the O ring engages into the case. Install other end of governor spring, 8, into the slotted hole of the throttle arm. This end of the spring is installed from the outside of the arm. Once the spring is installed, push the rest of throttle arm into the case. Insert E-ring, 3, into the groove of the throttle arm.

4. Install throttle cable stay, 15, onto timing gear cover, 1. Install throttle lever, 11, onto the throttle arm, 9. Align the slot, A, in the throttle lever, with the groove, B of the throttle arm, Figure 54. Retain lever to arm by tightening clamp bolt and nut. After the clamp bolt is tightened, pivot throttle lever back and forth to check if all the linkage pivots freely. Install throttle cable stay spring, 16, onto the throttle lever, 11, and throttle cable stay, 15.

NOTE: *Make sure dowel, 1, aligns with guide hole, 2, on the oil pump cover.*



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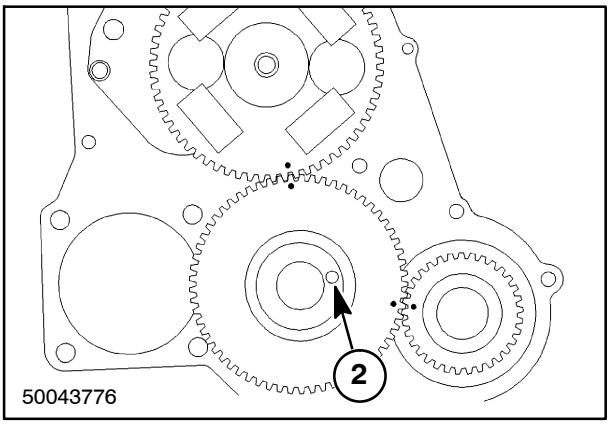

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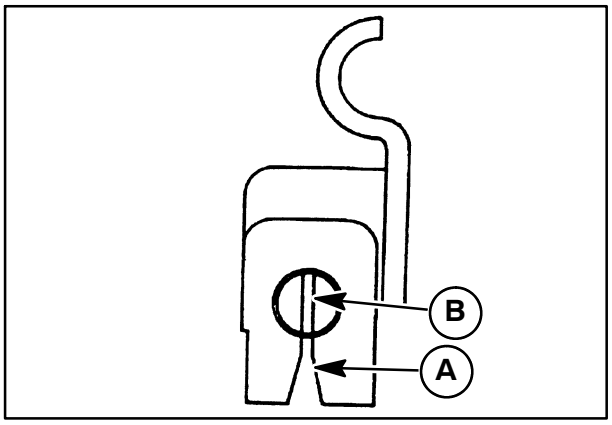
NOTE: *The aligning of the slot, A, in the lever with the groove, B, in the arm properly indexes the lever and attaching cables to the internal linkage.*



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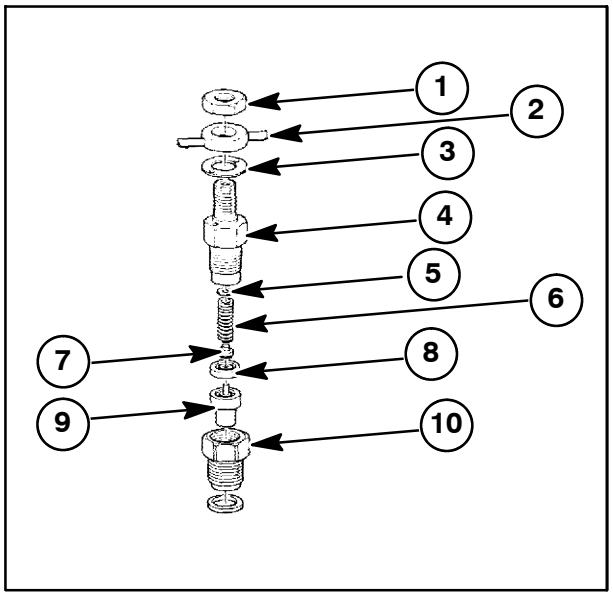
DESCRIPTION OF OPERATION - INJECTORS

Op. 10 218

Pintle type injectors are used in all TC30 tractors. The injectors have a 1.0 mm (0.039″) single orifice and are set at 118 bar (1706 psi). The pressure adjustment is made by adding or deleting shims, 5, from the top of the injector pressure adjusting spring. The pintle type injectors have an injection angle of 4°. The injector pipes are of the same length for each cylinder to help keep the injection intervals in time.

Each injector consists of a nozzle assembly, 9, a nozzle holder/ nut, 10, and injector needle valve regulating spring, 6, spacer, 8, push rod, 7, injector body, 4, leak off-line, 2, washer, 3, and nut, 1.

The engine injection function is to inject fuel into a pressurized cylinder in a fully atomized condition which provides efficient combustion with minimum amount of smoke.



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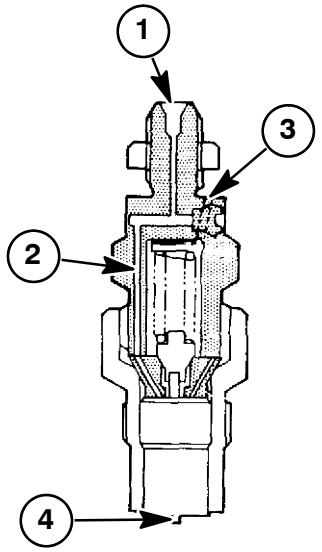
1. Nut
2. Leak-Off Line
3. Washer
4. Injector Body
5. Shims
6. Spring
7. Push Rod
8. Spacer
9. Nozzle Assembly
10. Nozzle Nut

Fuel from the injection pump enters the injector fuel inlet, 1, and passes down through a drilling in the nozzle holder and body, 2, to the needle valve seat, 4.

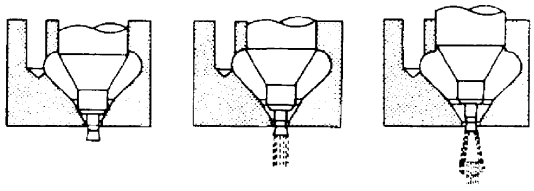
To provide lubrication of the injector, a small amount of fuel is permitted to leak up between the needle valve and the nozzle body. The excess fuel rises to the top of the injector and returns to the fuel tank through the injection return line, 3.



Injector Assembly

55

The fuel, pressurized by the injection pump, lifts the needle valve off the seat against the action of the spring pressure, B. The fuel is then forced, in the atomizing state, through the 1 mm (0.039″) orifice in the nozzle tip, C. When pressure from the injection pump drops, the needle valve snaps back onto its seat under pressure from the spring, A.



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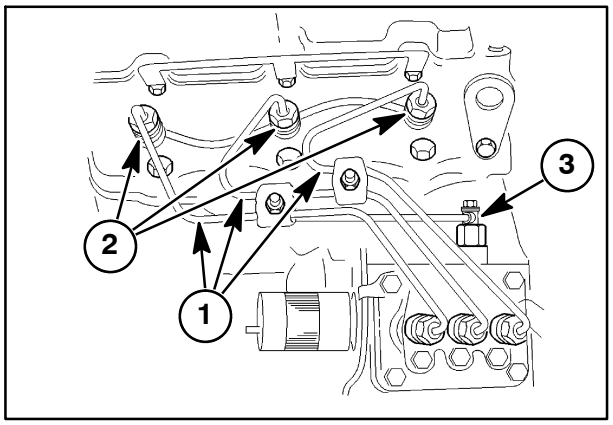
A. Nozzle Closed
B. Nozzle Initial Opening
C. Nozzle Fully Opened

INJECTORS

Removal

1. Clean all dirt, oil, and grease from the injectors, 2, and surrounding areas.
2. Disconnect the fuel lines, 1, from the injectors, 2, and cap all openings.
3. Remove the fuel leak-off line, 3.



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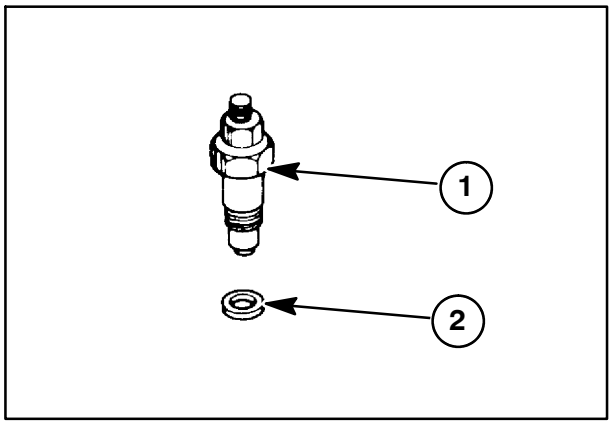
4. Remove the injectors, 1, and sealing washers, 2.



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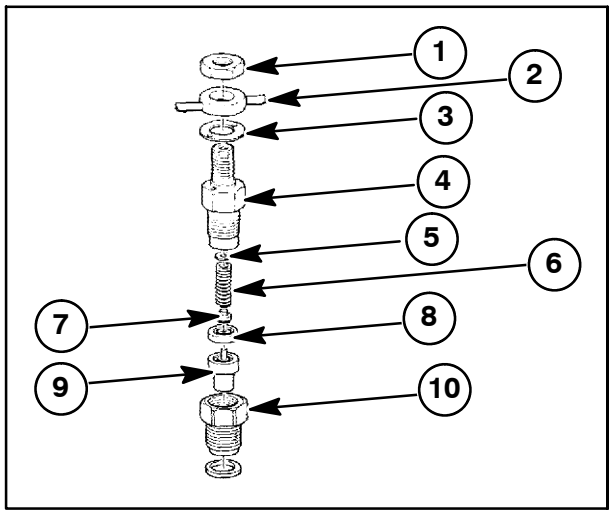
Disassembly

1. Loosen and remove the nozzle nut, 10, from the nozzle body, 9, being careful not to drop or damage the nozzle.
2. Remove the nozzle assembly, 9, spacer, 8, spring, 6, and shim(s), 5.
3. Clean the nozzle body and needle and check the nozzle for any burn or score marks. Check the needle seat for evidence of fuel leakage or carbon deposits.
4. Correct fuel leakage at the seat using a polishing stick and polish the seat area.
5. Inspect the upper and lower contact surfaces of the nozzle holder and spacer to assure a clean contact surface area.
6. Clean the nozzle spray orifice hole using a 1.0 mm (0.040″) wire in a pin vice.



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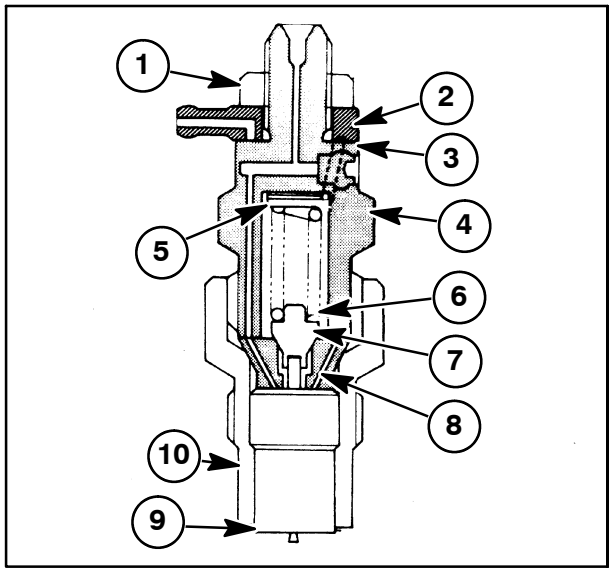
1. Nut
2. Leak-Off Line
3. Washer
4. Injector Body
5. Shims
6. Spring
7. Push Rod
8. Spacer
9. Nozzle Assembly
10. Nozzle Nut

Assembly and Adjustment

Clean all parts in clean fuel oil and assemble while still wet.

1. Install shim(s), 5, spring, 6, spacer, 8, and nozzle assembly, 9, in the injector body, 4.
2. Install the nozzle nut, 10, and tighten to 29 - 33 ft. lbs.
3. Check and adjust the injector pressure setting using injector nozzle tester No. FNH01721 and adapter fitting No. 23622. Adjust the pressure setting to 118 bar (1706 psi) when adding or removing shims, 5.



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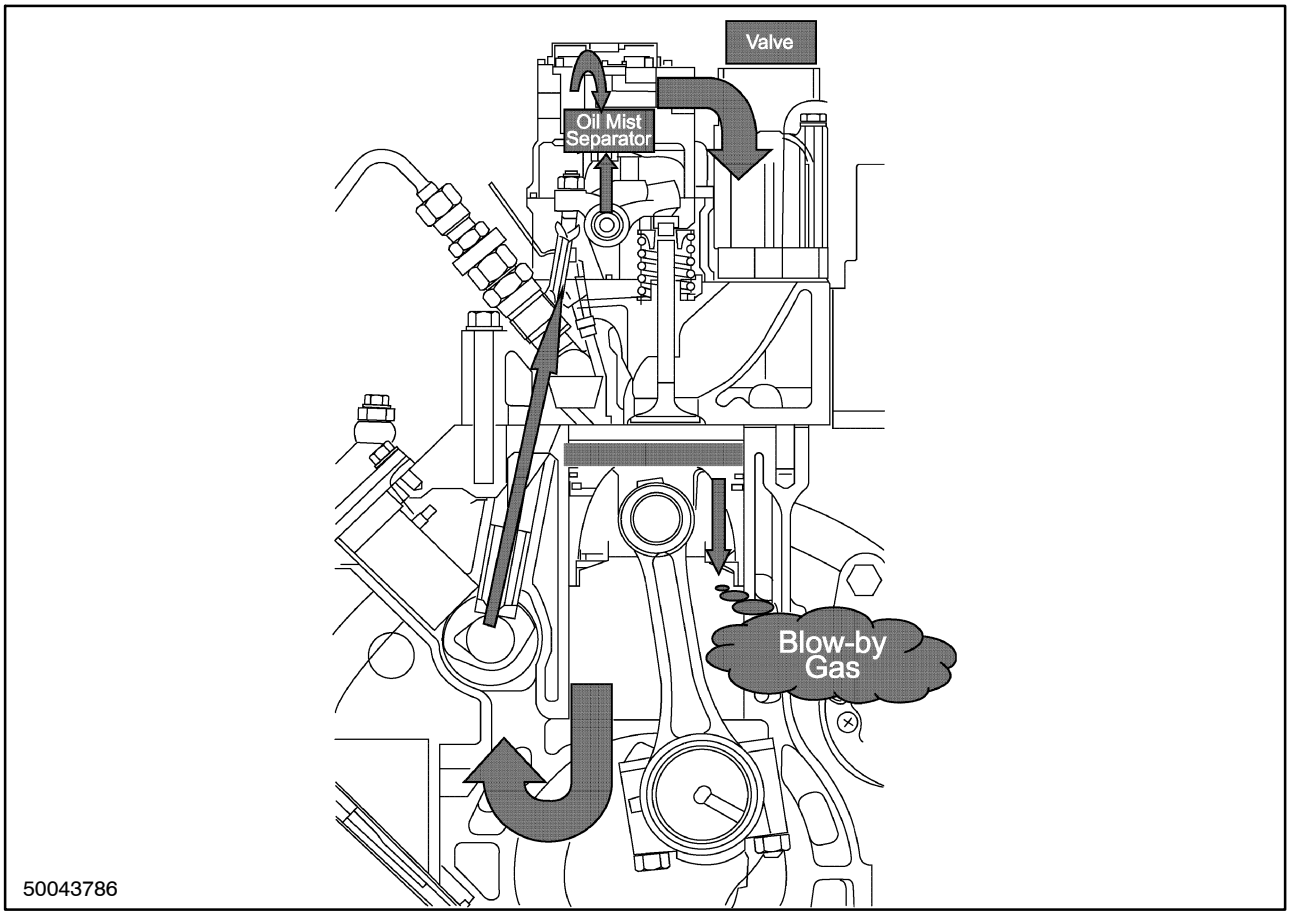
1. Nut
2. Leak-Off Line
3. Washer
4. Injector Body
5. Shims
6. Spring
7. Push Rod
8. Spacer
9. Nozzle Assembly
10. Nozzle Nut

DESCRIPTION OF OPERATION – ENGINE BREATHER VALVE



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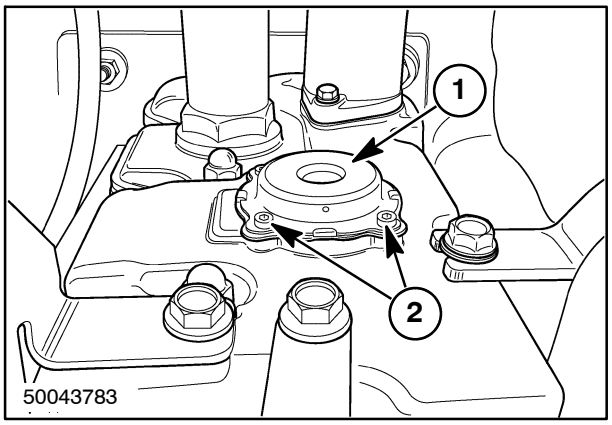
1. When the gas (created by combustion) passes through the piston ring, the gas is called “blow-by-gas”.
2. When the crankcase pressure is less than 25 mm/H_2O, the valve closes and the blow-by-gas is trapped in the crankcase.
3. The blow-by-gas flows into the oil mist separator and when crankcase pressure increases to approximately 25 mm/H_2O the valve opens. The valve opening allows blow-by-gas to pass into the intake manifold and be burned with the aspirated air.
4. Therefore, the pressure inside of the crankcase must be maintained from 25 to 100 mm/H_2O so that the blow-by-gas can not be discharged into the air.
5. EPA Tier 2 requires the internal breather systems for all naturally aspirated engines except the turbocharged engines.

The breather valve, 1, is located atop the head cover. Under the breather valve housing, is a diaphragm, that allows the engine to recirculate combustion gases, when the crankcase pressure builds.

BREATHER VALVE

Removal

1. Remove the four screws, 2, and pull breather valve, 1, from head cover.



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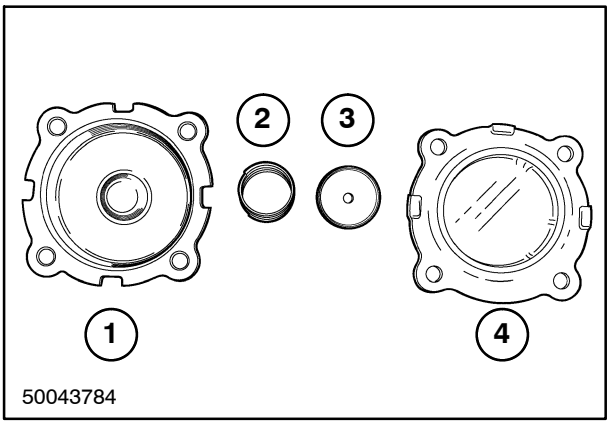
The breather valve consists of the following: Cover, 1, Spring, 2, Spring Retainer, 3, Diaphragm, 4.

NOTE: *The breather valve must be replaced as an assembly, not by individual pieces.*

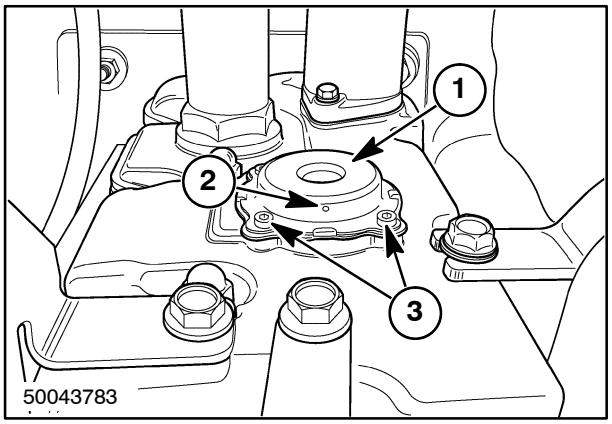


63

Installation

1. Place breather valve, 1, onto head cover. Make sure vent hole, 2, is toward the front of the tractor, for easy access and fasten with four bolts, 3.

IMPORTANT: *Always keep small vent hole, 2, free of oil and other debris, as to allow the crankcase, to vent properly.*



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SECTION 18 - CLUTCH

Chapter 1 - Clutch

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DESCRIPTION OF OPERATION - SINGLE CLUTCH

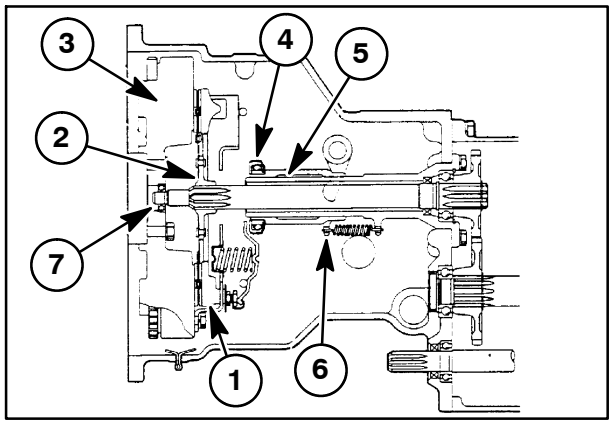
2WD 9 x 3 AND HST MODELS

9 x 3 Gear Transmission (2WD)

A single clutch is standard equipment on the model TC30 2WD tractors equipped with the 9 × 3 gear transmission.

NOTE: *Pilot bearing, 7, in flywheel used with 9 x 3 transmission.*

1. Clutch Pressure Plate
2. Clutch Disc
3. Flywheel
4. Clutch Release Bearing
5. Hub
6. Return Spring
7. Pilot Bearing

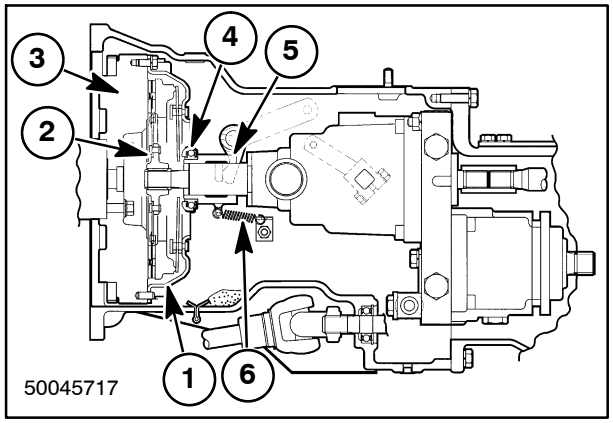


1

HST Drive Transmission

A single disc clutch is standard equipment on the Model TC30 tractors equipped with the HST transmission.

1. Clutch Pressure Plate
2. Clutch Disc
3. Flywheel
4. Clutch Release Bearing
5. Hub
6. Return Spring

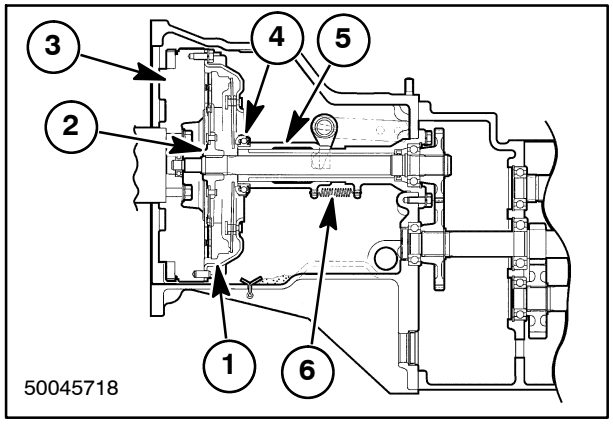


2

The clutch assembly consists of the clutch pressure plate, 1, clutch disc, 2, flywheel, 3, clutch release bearing, 4, hub assembly, 5, and return spring, 6.

The clutch disc is a dry organic type assembly, which is mechanically operated. The clutch disc is installed between the flywheel and the pressure plate assembly. The clutch pressure plate is attached to the flywheel with six bolts.

In the engaged position, the spring-loaded pressure plate presses the clutch disc into contact with the engine flywheel. The power flow from the engine is transmitted by the friction between the clutch disc linings and the surface of the flywheel and the clutch pressure plate.



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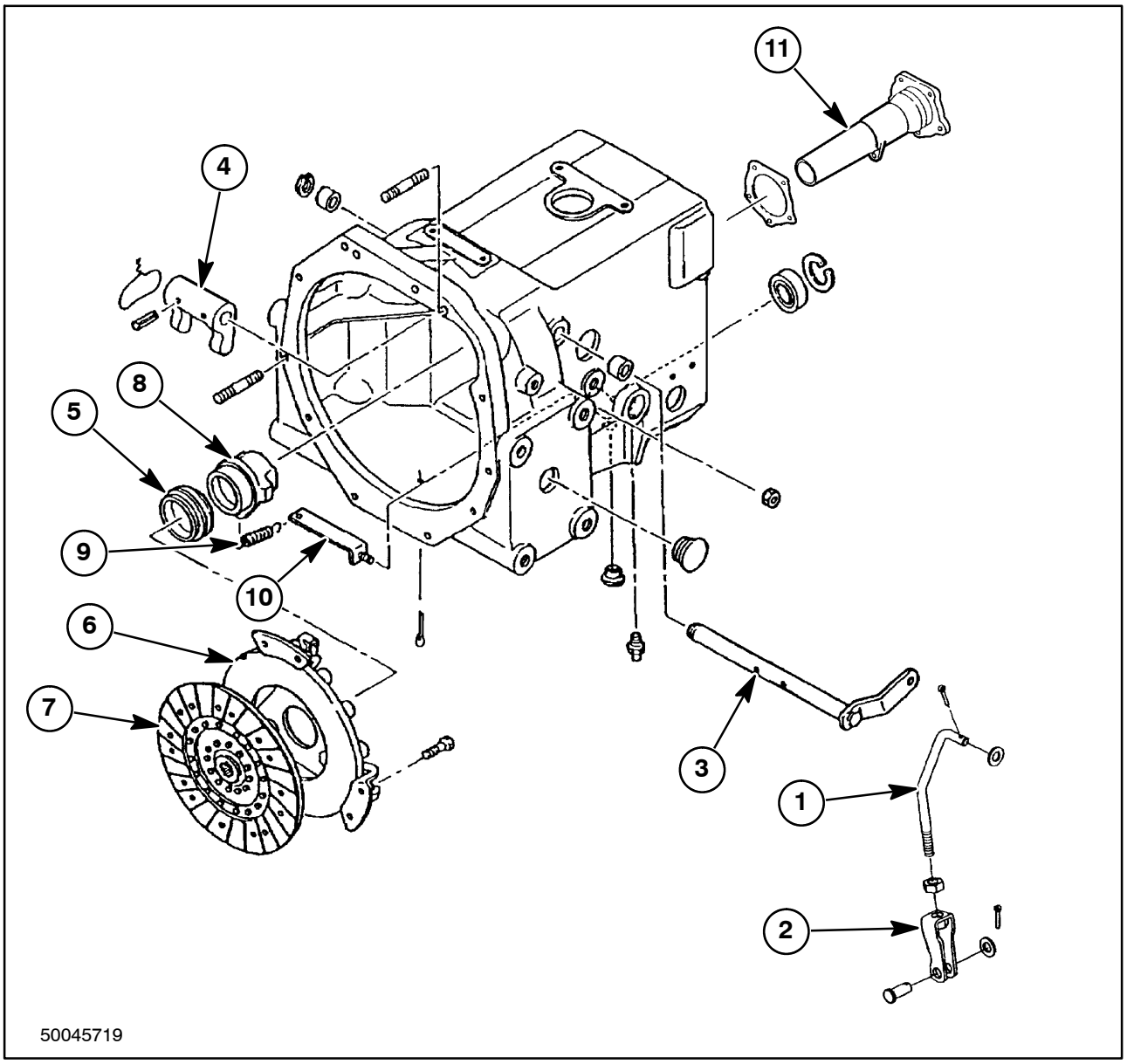


4

CLUTCH PEDAL ASSEMBLY

The clutch pedal assembly is connected by an adjustable rod, 1, to a clevis, 2, and cross shaft assembly, 3, on which a fork, 4, is mounted.

Depressing the clutch pedal causes the cross shaft, 3, and fork, 4, to move the release bearing, 5, forward and depress the pressure plate release levers. This action draws the pressure plate, 6, away from the clutch disc, 7, releasing the disc from contact with the flywheel.

The friction drive from the engine is then disconnected to enable gear changes to take place.

After a gear change is made and the clutch pedal is released, the release bearing and hub are returned to the free position by a spring, 9, attached to a hanger, 10, on HST models or retainer, 11, on 9 x 3 models.

The main springs of the pressure plate assembly, 6, then reassert pressure on the plate moving it forward to press the clutch disc, 7, into contact with the flywheel and establish the drive to the transmission.

The release bearing, 5, is pre-lubricated and never requires lubrication. The pressure plate assembly, 6, is not repairable and must be replaced as a complete assembly if service is required.

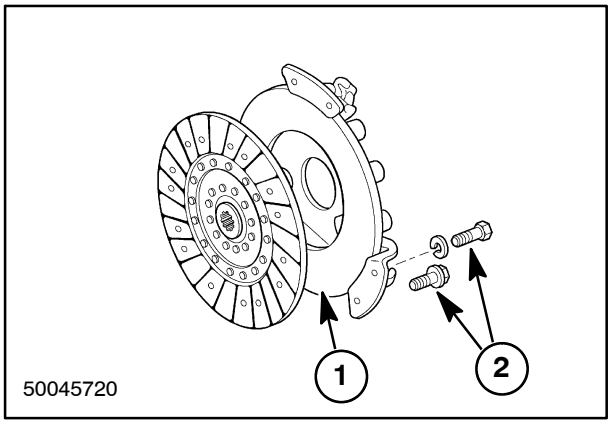
OVERHAUL - SINGLE CLUTCH

Removal

The single clutch is serviced as a complete assembly only. Overhaul of the single clutch is limited to removing the clutch and inspection and adjustment of the release lever height.

1. Separate the tractor between the engine and clutch housing. See “Separating the Tractor,” in section 10.
2. Remove the six pressure plate retaining bolts, 2, and remove the clutch assembly, 1, from the flywheel.

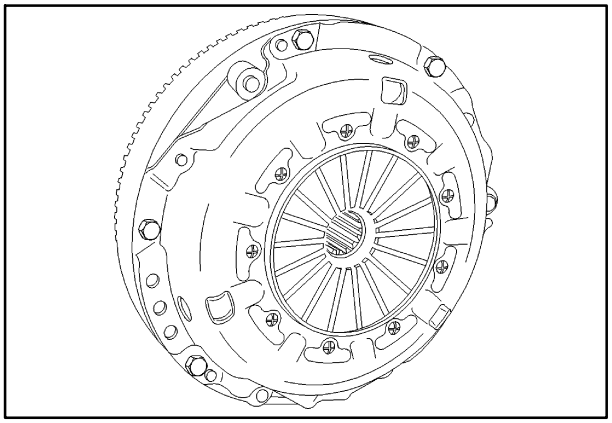
   NOTE: *Remove the attaching bolts gradually and evenly to prevent distorting the pressure plate assembly.*



5

Inspection

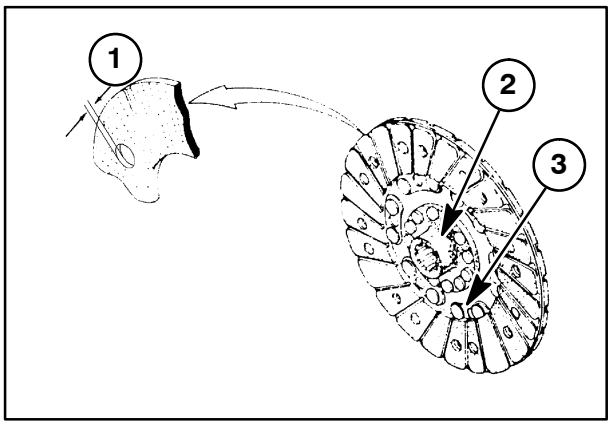
1. Inspect the pressure plate for scoring, cracks, or overheating. Minor imperfections may be removed by resurfacing the pressure plate face.
2. Inspect the release lever for wear or damage.
3. Inspect the release lever pivot pins and springs for excessive wear or damage.



6

4. Inspect the clutch disc lining for excessive wear. Replace the clutch disc lining if the lining is worn to less than 0.3 mm (0.012″), 1, from the top of the rivet head.
5. Inspect the clutch lining for indications of overheating, scoring, or oil impregnation in the lining.
6. Inspect the clutch hub spline, 2, for excessive wear.
7. Inspect the six cushioning springs, 3, for signs of wear or damage.
8. If any damage to the disc is apparent, replace the clutch disc assembly.

   NOTE: *Flywheel surface may be machined down a maximum of 1.27 mm (0.050″).*

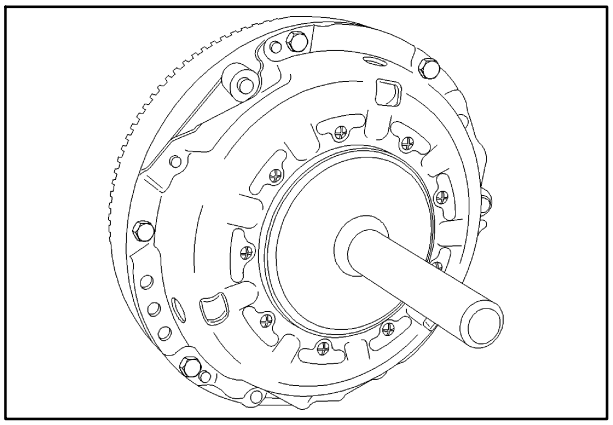


7

Installation

IMPORTANT: *When installing a new pressure plate assembly, the pressure plate friction surface must be wiped clean with a suitable solvent to remove the protective film.*

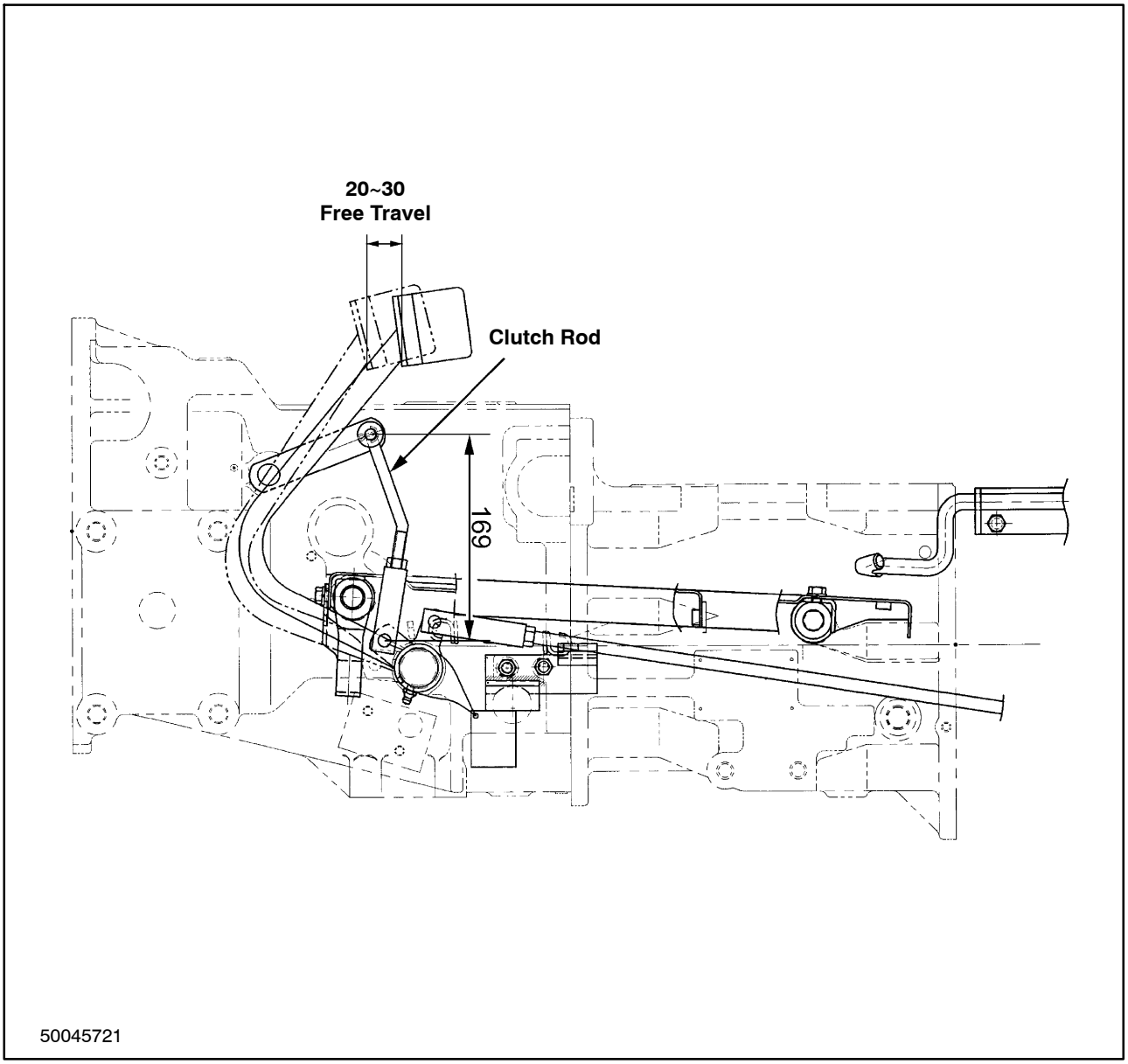
1. Lightly lubricate the hub splines of the transmission input shaft using a high temperature lubricant.
2. Using the clutch alignment arbor, FNH01260, position the clutch disc and pressure plate on the flywheel.
3. Position the clutch pressure plate on the flywheel and install the six attaching bolts. Tighten the attaching bolts evenly and torque to 22.6 - 28.4 N·m (16.6 - 21 ft. lbs.).



8

ADJUSTMENTS - SINGLE CLUTCH

FREE-PLAY ADJUSTMENT - HST MODELS ONLY



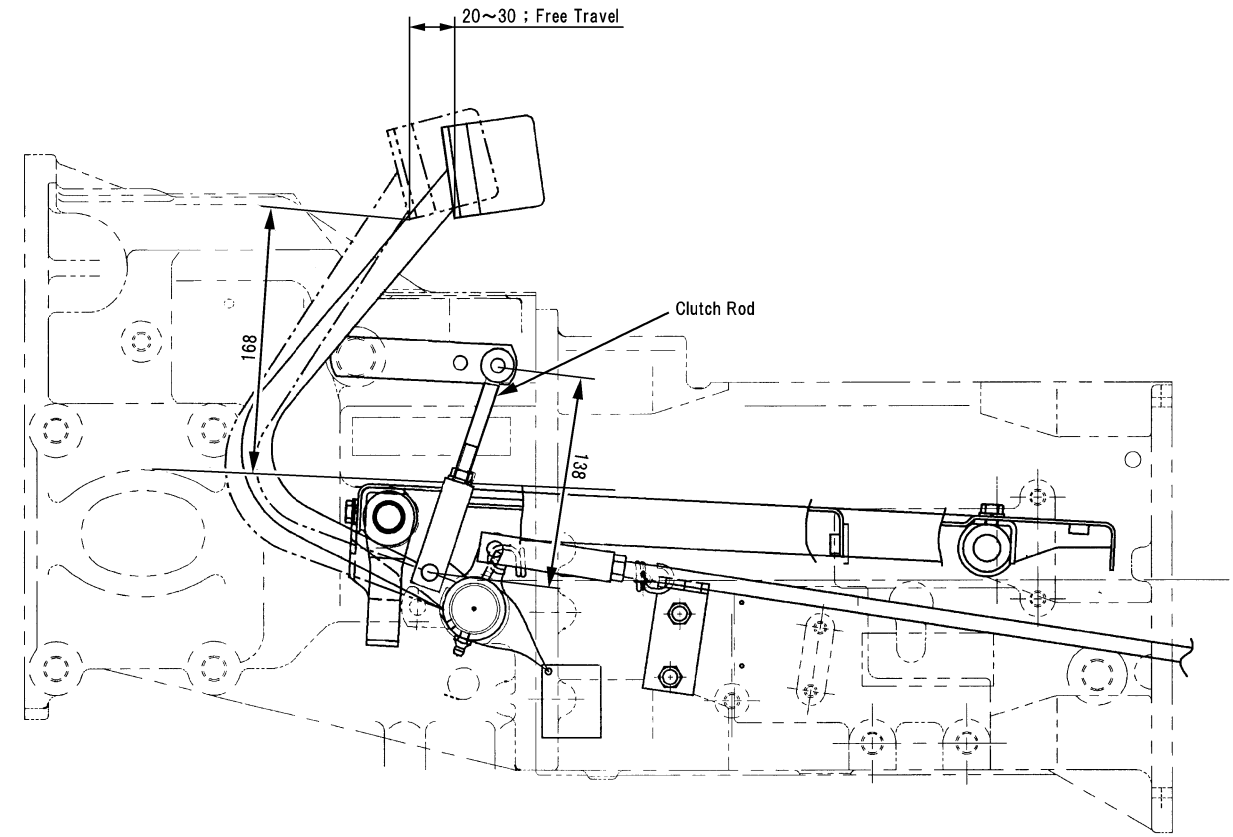
9

The clutch free-play is the amount of distance the clutch pedal moves from the fully released position to the point where resistance is first experienced.

Adjusting the clutch rod changes the amount clutch pedal free-play.

1. Remove the cotter pin securing the clutch rod to the cross shaft bell crank (upper connection).
2. The initial length of the clutch rod should be approximately 169 mm (6-1/4″).
3. Lengthen or shorten the clutch rod to obtain between 20 - 30 mm (3/4 - 1-3/16″) of free-play travel. Lengthening the clutch rod translates into increased clutch free-play travel. Shortening the clutch rod translates into decreased free-play travel.
4. Connect the clutch rod to the cross shaft bellcrank by using a new cotter pin.

FREE-PLAY ADJUSTMENT - 2WD 9 x 3 GEAR TRANSMISSION MODELS ONLY



10

The clutch free-play is the amount of distance the clutch pedal moves from the fully released position to the point where resistance is first experienced.

Adjusting the clutch rod changes the amount clutch pedal free-play.

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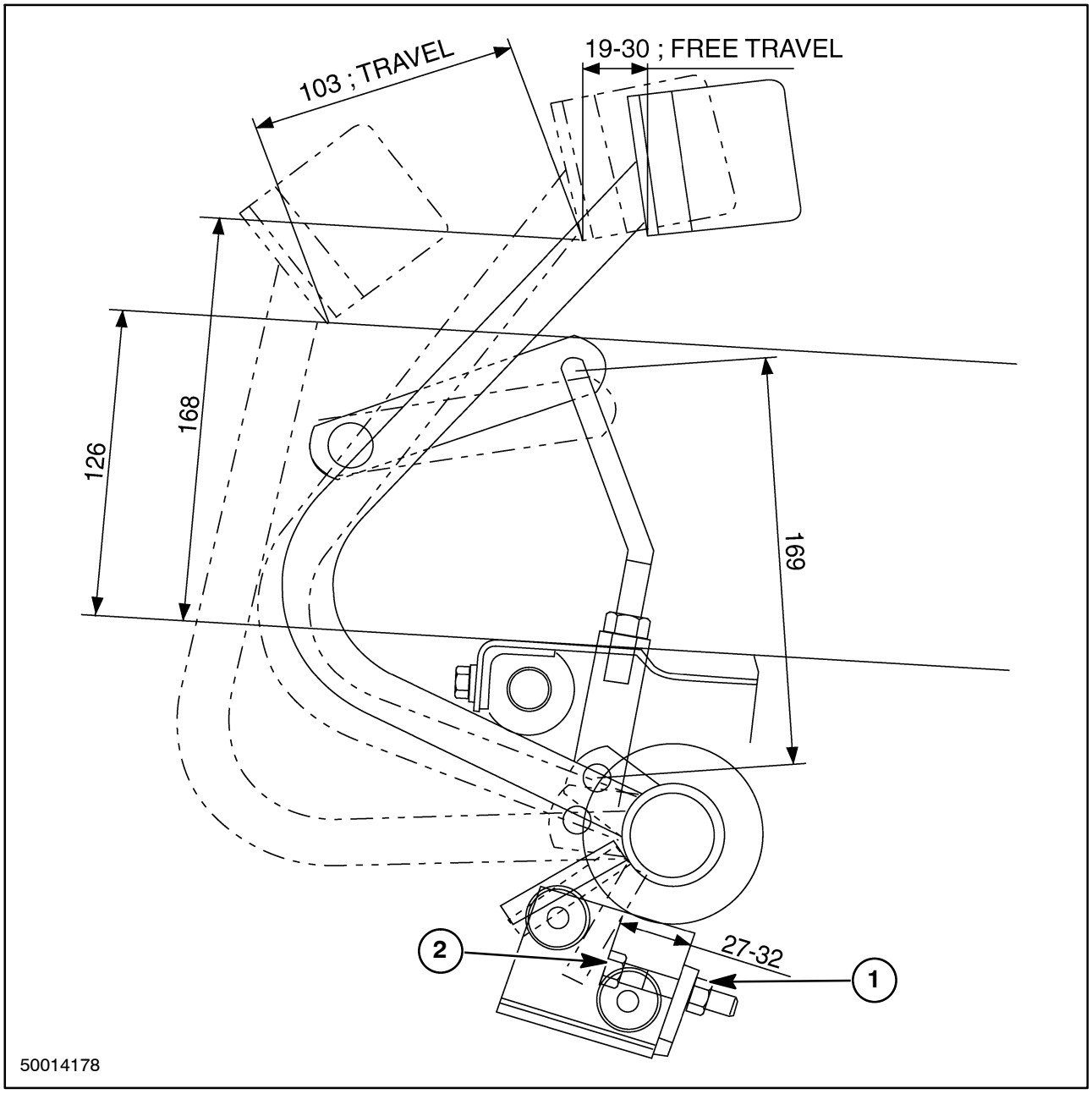
4. Connect the clutch rod to the cross shaft bellcrank by using a new cotter pin.

STOP ADJUSTMENT - HST and 2WD 9 x 3 TRANSMISSIONS MODELS

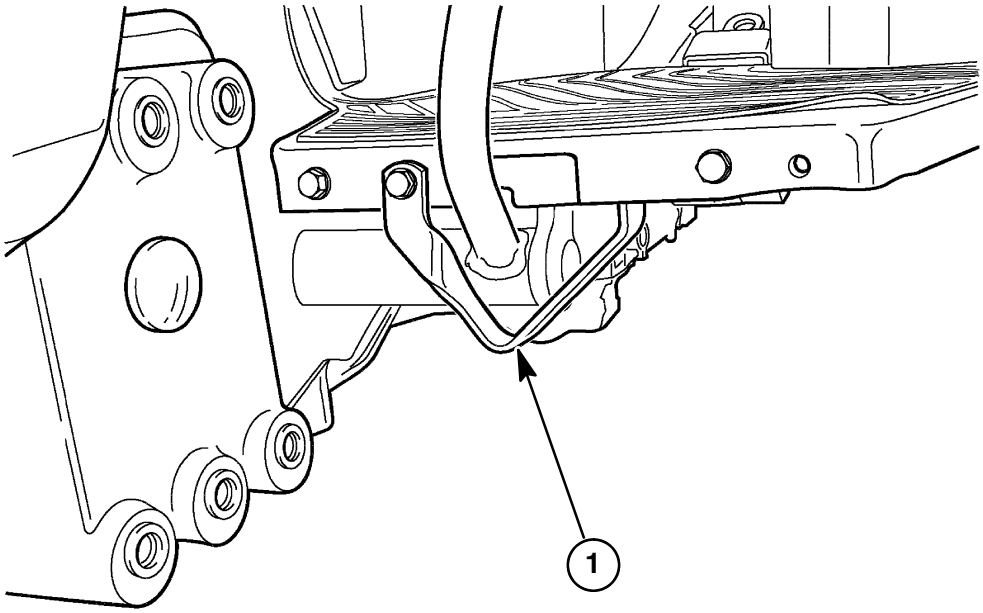


11

The clutch stop adjustment prevents the clutch mechanism from rotating too far. Follow the clutch free-play adjustment procedure before adjusting the clutch engagement travel.

1. Perform clutch free-play adjustment procedure described earlier in this manual.
2. Loosen the jam nut, 1, and adjust the stop bolt, 2, to an initial length of 27 - 32 mm (1-1/16 - 1-1/4″).
3. Adjust the stop bolt to obtain 103 mm (4-3/64″) of total allowable travel from the point of clutch engagement (end of free travel) to the stop bolt.
4. Tighten the jam nut, 1, to keep the stop bolt in position.

CLUTCH STOP - HST and 2WD 9 x 3 TRANSMISSION MODELS ON OR ABOVE SERIAL NUMBER HK14260



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12

The (nonadjustable) clutch stop, 1, prevents the clutch mechanism from rotating too far when the clutch pedal is depressed.

This style clutch stop can be installed on earlier production TC30 tractors, if there is an interference with a mid mount mower and earlier style clutch stop bracket.

DESCRIPTION OF OPERATION - DOUBLE CLUTCH

9 x 3 GEAR TRANSMISSION (4WD) MODELS

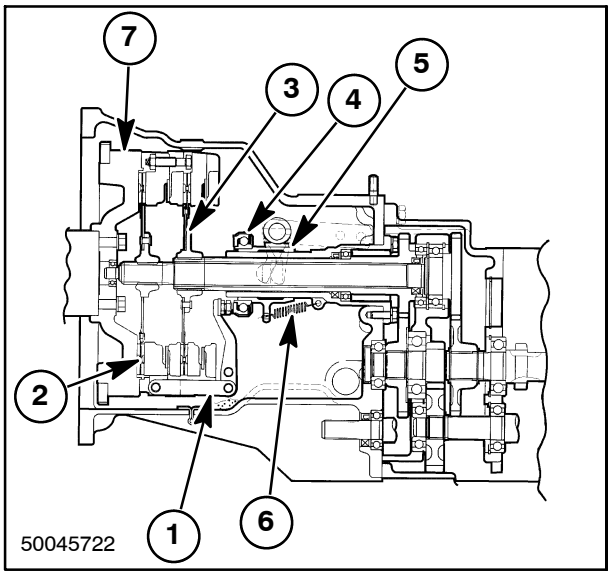
The double clutch is standard equipment on the Model TC30 tractors equipped with 4WD and the 9 x 3 gear transmission.

The double clutch permits the drive to the transmission to be disconnected from the main transmission to facilitate gear changes without stopping the drive to the PTO.

The double clutch utilizes two 215 mm (8.45″) diameter discs. A transmission clutch disc transmits power from the engine to the main transmission input shaft and a second clutch disc transmits power from the engine to the PTO input shaft.

The double clutch is mounted to a recessed flywheel with six bolts.

The double clutch pressure plate release lever height is adjustable and should be checked and adjusted, if required, whenever the clutch is serviced or a new clutch is installed.



13

1. Pressure Plate Assembly
2. Transmission Clutch Disc
3. PTO Clutch Disc
4. Clutch Release Bearing
5. Hub
6. Return Spring
7. Flywheel

OVERHAUL - DOUBLE CLUTCH

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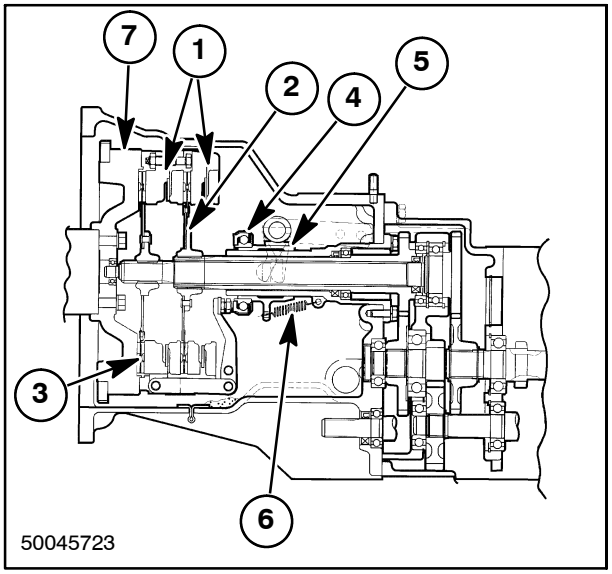
Disassembly

1. Separate the tractor between the engine and the clutch housing. See “Separating the Tractor,” in Section 10.
2. Remove the six bolts retaining the pressure plate to the flywheel and remove the pressure plates, 1, and discs, 2 and 3 assembly.

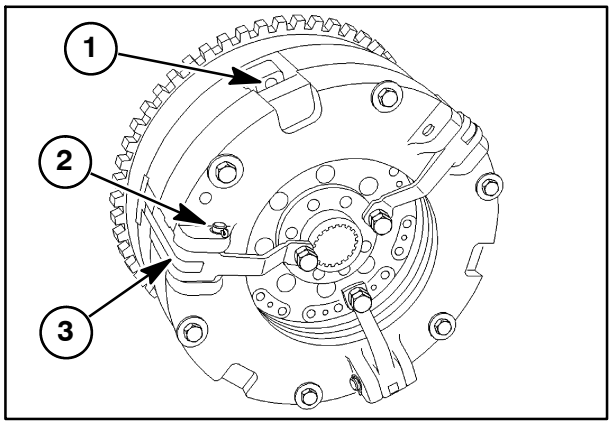
   NOTE: *Remove the attaching bolts gradually and evenly to prevent distorting the pressure plate assembly.*



14

1. Pressure Plate Assembly
2. PTO Clutch Disc
3. Transmission Clutch Disc
4. Clutch Release Bearing
5. Hub
6. Return Spring
7. Flywheel

3. Loosen the three PTO clutch release adjusting bolts, 1, gradually and evenly until the bolts are disengaged from the bottom pressure plate.
4. Remove the three release lever pins, 2, from the cover and swing the release levers and links, 3, out of the way.
5. Separate the remaining components of the assembly.

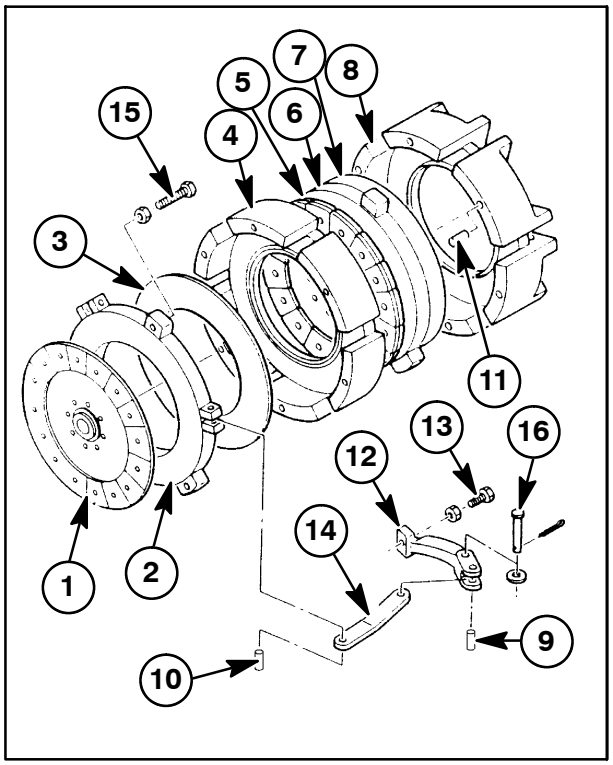


15

Inspection

1. Inspect the pressure plates for scoring, cracks, or signs of overheating. Minor imperfections may be removed by resurfacing the pressure plate surface.
2. Inspect the release levers, 12, for excess wear or damage.
3. Inspect the release lever and link pivot pins for excess wear or damage.
4. Inspect the clutch disc lining for excess wear. Replace the clutch disc if the lining is worn to less than 0.3 mm (0.012″) from the top of the rivet heads.
5. Inspect the clutch linings for signs of overheating, scoring, or oil impregnation in the lining.
6. Inspect the hub spline for excess wear.
7. Inspect the cushioning springs for signs of wear or damage.

NOTE: *Flywheel surface may be machined down a maximum of 1.27 mm (0.050″).*



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1. Clutch Disc Assembly (Transmission)
2. Pressure Plate
3. Diaphragm Spring
4. Clutch Cover - Inner
5. Clutch Disc Assembly (PTO)
6. Pressure Plate
7. Diaphragm Spring
8. Clutch Cover - Outer
9. Dowel Pin
10. Dowel Pin
11. Pin
12. Release Lever
13. Adjusting Bolt
14. Link
15. Adjusting Bolt
16. Pin

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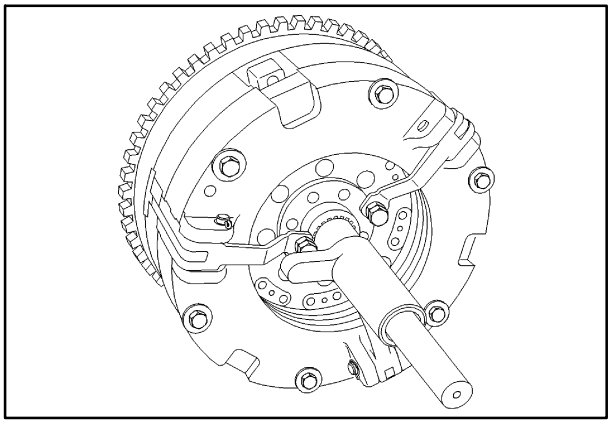
Assembly

1. Install one diaphragm spring, 7, (dome side away from flywheel) in the clutch outer cover, 8.
2. Install the PTO pressure plate, 6, in the clutch outer cover.
3. Install the PTO clutch disc, 5, with long side of hub away from flywheel.
4. Install the clutch inner cover, 4.
5. Install one diaphragm spring, 3, (dome side away from flywheel) in the clutch cover.
6. Install the transmission pressure plate, 2, in the clutch cover.
7. Install release lever link, and pin assemblies, 11, 12, 13, and 14.
8. Install the three PTO clutch release bolts, 15, into the transmission pressure plate (finger tight only).
9. Install the transmission clutch disc, 1, between the flywheel and the pressure plate with long side of hub away from flywheel.
10. Position the clutch pressure plate assembly on the flywheel and install the six mounting bolts.
11. Use alignment arbor, Tool No. FNH00077, align the clutch disc with the flywheel.
12. Tighten the six mounting bolts evenly to 34 N·m (25 ft. lbs.).



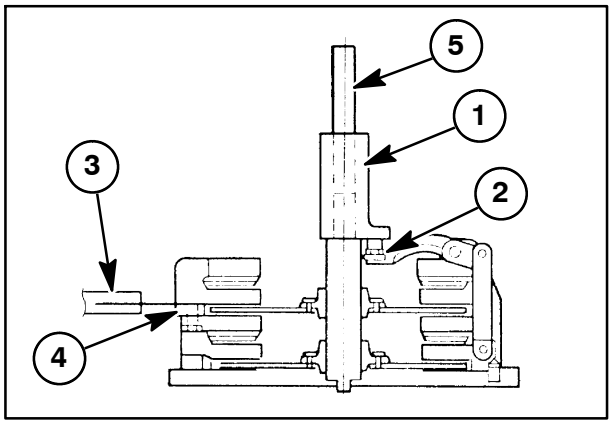
17

ADJUSTMENTS - DOUBLE CLUTCH

NOTE: *The following adjustments are made with the clutch assembly installed on the flywheel.*

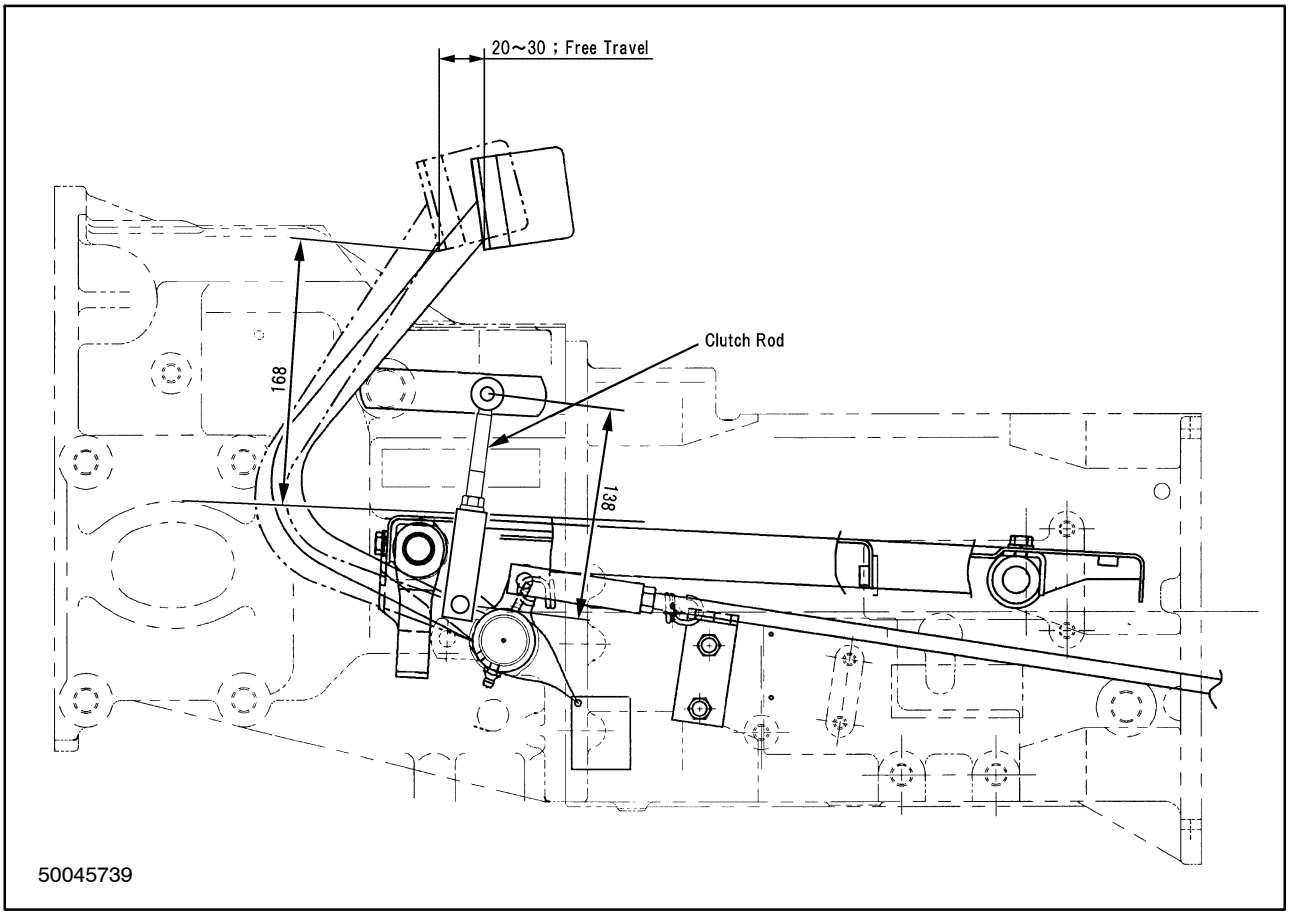
1. Install alignment arbor, Tool No. FNH00077, 5, in the clutch assembly until the arbor bottoms out in the pilot bearing.
2. Using a feeler gauge, 3, check the PTO clutch release adjusting bolt, 4, to pressure plate gap. The gap should be between 0.9 - 1.0 mm (0.0354 - 0.0394″). Readjust the bolt so the gap is within this dimension.
3. Tighten the adjusting bolt locknuts and recheck the gap.
4. Slide swing lever gauge over end of arbor until gauge Tool No. FNH01267, 1, contacts shoulder on arbor. Swing gauge over each of the height adjusting bolts, 2. Adjust each bolt, until the bolt head just touches the swing gauge.
5. Tighten the adjusting bolt locknuts and recheck the settings.

   NOTE: *When installing a new pressure plate assembly, the pressure plate friction surface must be wiped clean using a suitable solvent to remove the protective film.*



18

FREE-PLAY ADJUSTMENT - 9 x 3 GEAR TRANSMISSION MODELS WITH DOUBLE CLUTCH



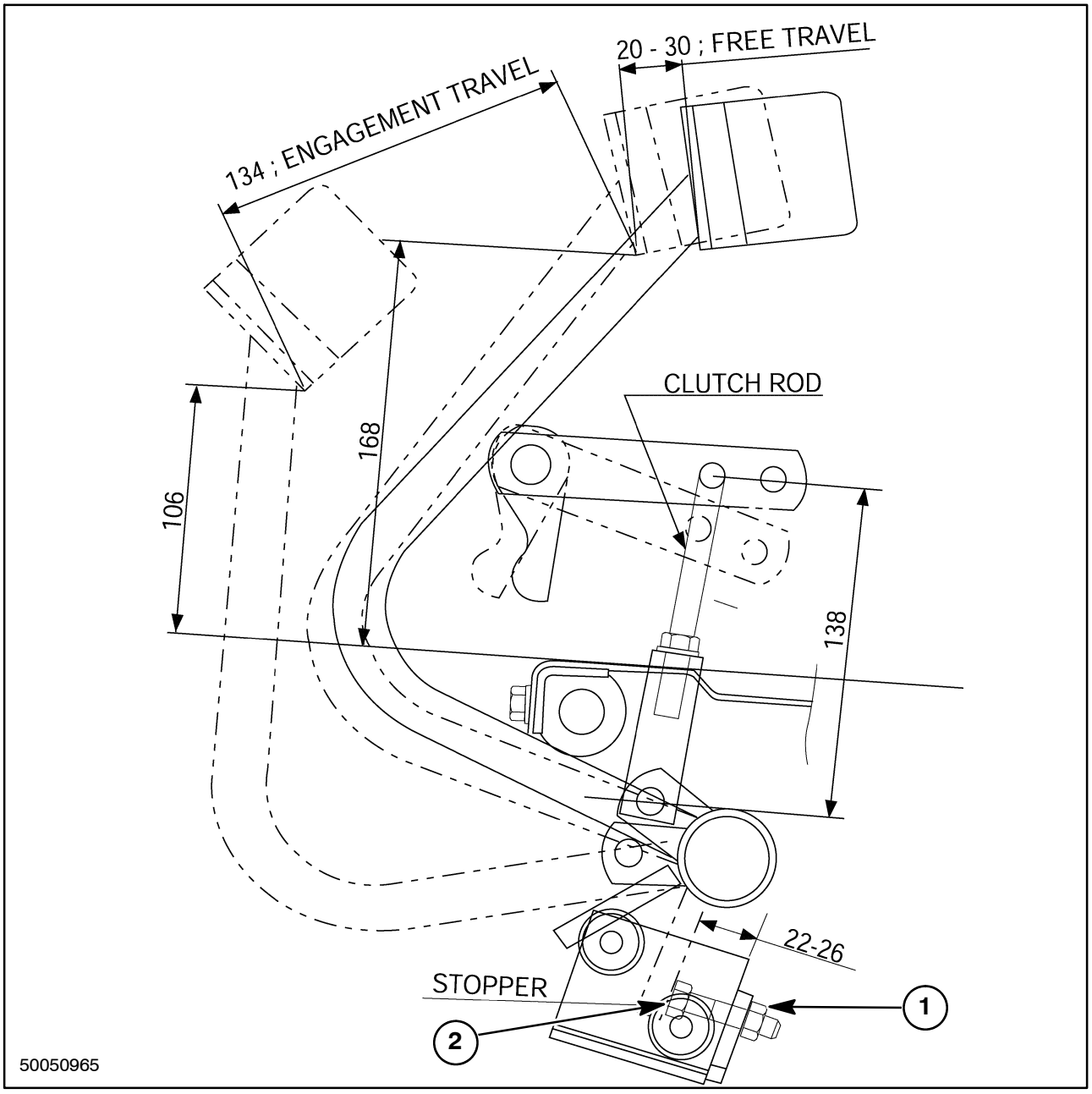
19

The clutch free-play is the amount of distance the clutch pedal moves from the fully released position to the point where resistance is first experienced.

Adjusting the clutch rod changes the amount clutch pedal free-play.

1. Remove the cotter pin securing the clutch rod to the cross shaft bell crank (upper connection).
2. The initial length of the clutch rod should be approximately 138 mm (5-7/16″).
3. Lengthen or shorten the clutch rod to obtain between 19 - 30 mm (3/4 - 1-3/16″) of free-play travel. Lengthening the clutch rod translates into increased clutch free-play travel. Shortening the clutch rod translates into decreased free-play travel.
4. Connect the clutch rod to the cross shaft bellcrank by using a new cotter pin.

STOP ADJUSTMENT – FWD and 9 x 3 GEAR TRANSMISSION MODELS WITH DOUBLE CLUTCH

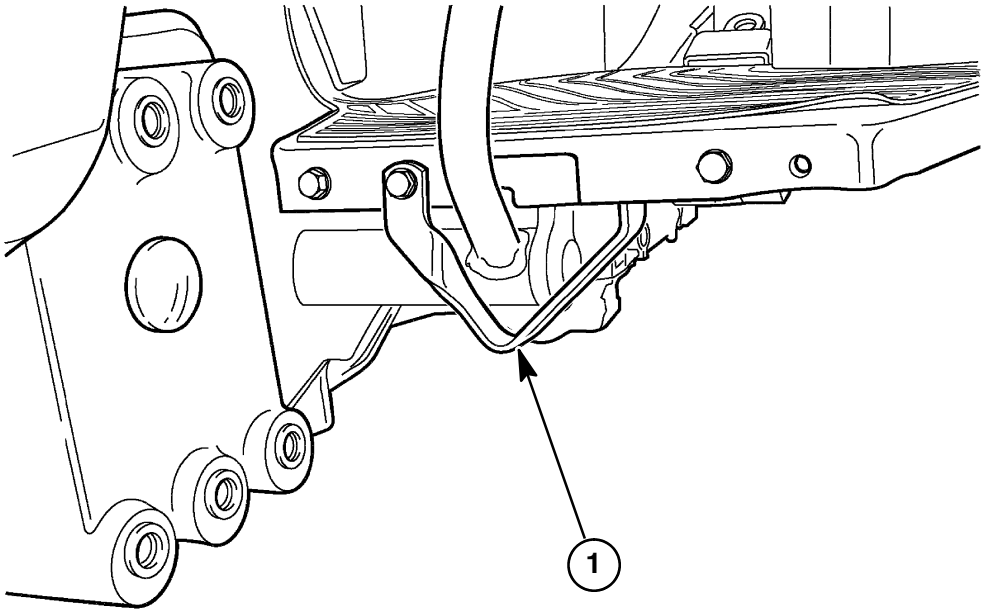


20

The clutch stop adjustment prevents the clutch mechanism from rotating too far. Follow the clutch free-play adjustment procedure before adjusting the clutch engagement travel.

1. Perform clutch free-play adjustment procedure described earlier in this manual.
2. Loosen the jam nut, 1, and adjust the stop bolt, 2, to an initial length of 22 - 26 mm (7/8 - 1-1/32″).
3. Adjust the stop bolt to obtain 134 mm (5-9/32″) of total allowable travel from the point of clutch engagement (end of free travel) to the stop bolt.
4. Tighten the jam nut to keep the stop bolt in position.

CLUTCH STOP - FWD 9 x 3 TRANSMISSION MODELS ON OR ABOVE SERIAL NUMBER HK14260



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21

The (nonadjustable) clutch stop, 1, prevents the clutch mechanism from rotating to far when the clutch pedal is depressed.

This style clutch stop can be installed on earlier production TC30 tractors, if there is an interference with a mid mount mower and earlier style clutch stop bracket.

SERVICING CLUTCH-RELATED COMPONENTS

Op. 18 110

CLUTCH PILOT BEARING

A pre-lubricated ball bearing, 2, is installed at the rear of the engine to support the front end of the transmission input shaft. The pilot bearing is located in the flywheel, 1.

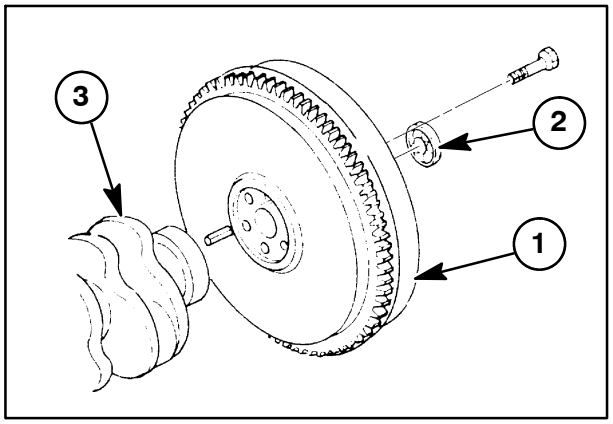
Whenever the clutch has been removed, inspect the pilot bearing by turning the inner race by hand and observe for abnormal noise, uneven rotation, or excessive free play.

Removal

If any of the above conditions are noted, remove the pilot bearing using a suitable puller.

Installation

Apply a few drops of sealer to the outer race and install the bearing using a suitable driver. Be sure the driver contacts only the outer race so as not to damage the bearing during installation.



22

1. Flywheel
2. Pilot Bearing
3. Crankshaft

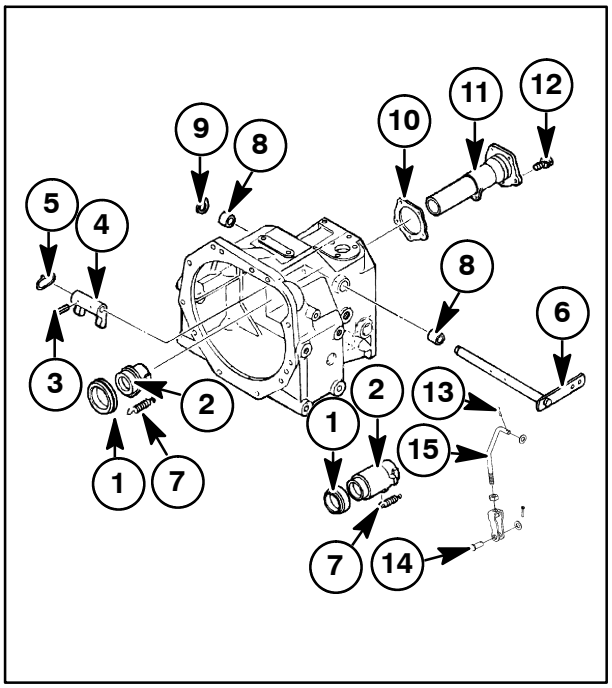
CLUTCH RELEASE BEARING

The clutch release bearing, 1, is a pre-lubricated ball bearing and is mounted on the sliding hub, 2, which is supported on the front input shaft retainer, 11.

A fork, 4, mounted on the cross shaft, 6, is engaged with the bearing, 1, and hub assembly, 2.

On tractors equipped with single clutch, initial movement of the clutch pedal causes the release bearing to come in contact with the release levers. Further movement of the clutch pedal disengages the clutch and drive to the transmission input shaft and stops the transmission and PTO drive.

On tractors equipped with the double clutch, depressing the clutch pedal approximately half-way disengages the transmission drive, but allows the drive to continue to the PTO. Further movement of the clutch pedal causes the clutch to disengage the drive to the PTO.



23

1. Bearing
2. Hub (short - HST)
3. Pin
4. Fork
5. Safety Wire
6. Cross Shaft
7. Return Spring
8. Bushing
9. Snap Ring
10. Gasket
11. Retainer
12. Bolt
13. Cotter Pin
14. Clevis Pin
15. Adjustment Rod

Removal

1. Separate the tractor between the engine and the clutch housing. See “Separating the Tractor,” in Section 10.
2. Remove the cotter pin, 13, and clevis pin, 14, and remove the adjustment rod, 15, from the clutch release cross shaft, 6.
3. Remove the release bearing, 1, and hub return spring, 7, and slide the bearing and hub, 2, off the support, 11.
4. Using a suitable puller and step plate, remove the bearing, 1, from the hub, 2.

Inspection

Rotate the bearing by hand and observe the following conditions:

1. Abnormal noise.
2. Uneven rotation when turned slowly by hand.
3. Excessive free play.
4. Scoring on the inner surface.
5. Indications of lubricant leakage at the oil seal.

Installation

1. Install the bearing, 1, onto the hub, 2.
2. Install the bearing, 1, and hub, 2, onto the support, 11, and install the return spring, 7.
3. Install the adjustment rod, 15, on the clutch release cross shaft, 6, and attach with the cotter pin, 13, and clevis pin, 14.

CLUTCH LINKAGE COMPONENTS

Op. 18 100

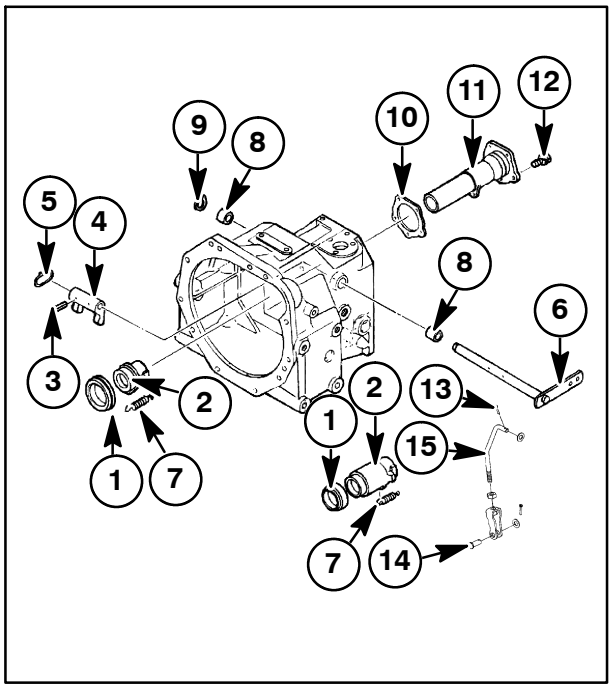
CLUTCH CROSS SHAFT BUSHINGS

Removal

1. Separate the tractor between the engine and the clutch housing. See “Separating the Tractor,” in section 10.
2. Remove the cotter pin, 13, and clevis pin, 14, and remove the adjustment rod, 15, from the clutch cross shaft, 6.
3. Remove the snap ring, 9, from the right hand end of the cross shaft, 6.
4. Remove the safety wire, 5, and roll pin, 3, from the fork, 4, and cross shaft, 6. Withdraw the cross shaft from the clutch housing.
5. Use a suitable driver, remove the bushings, 8, from the clutch housing.

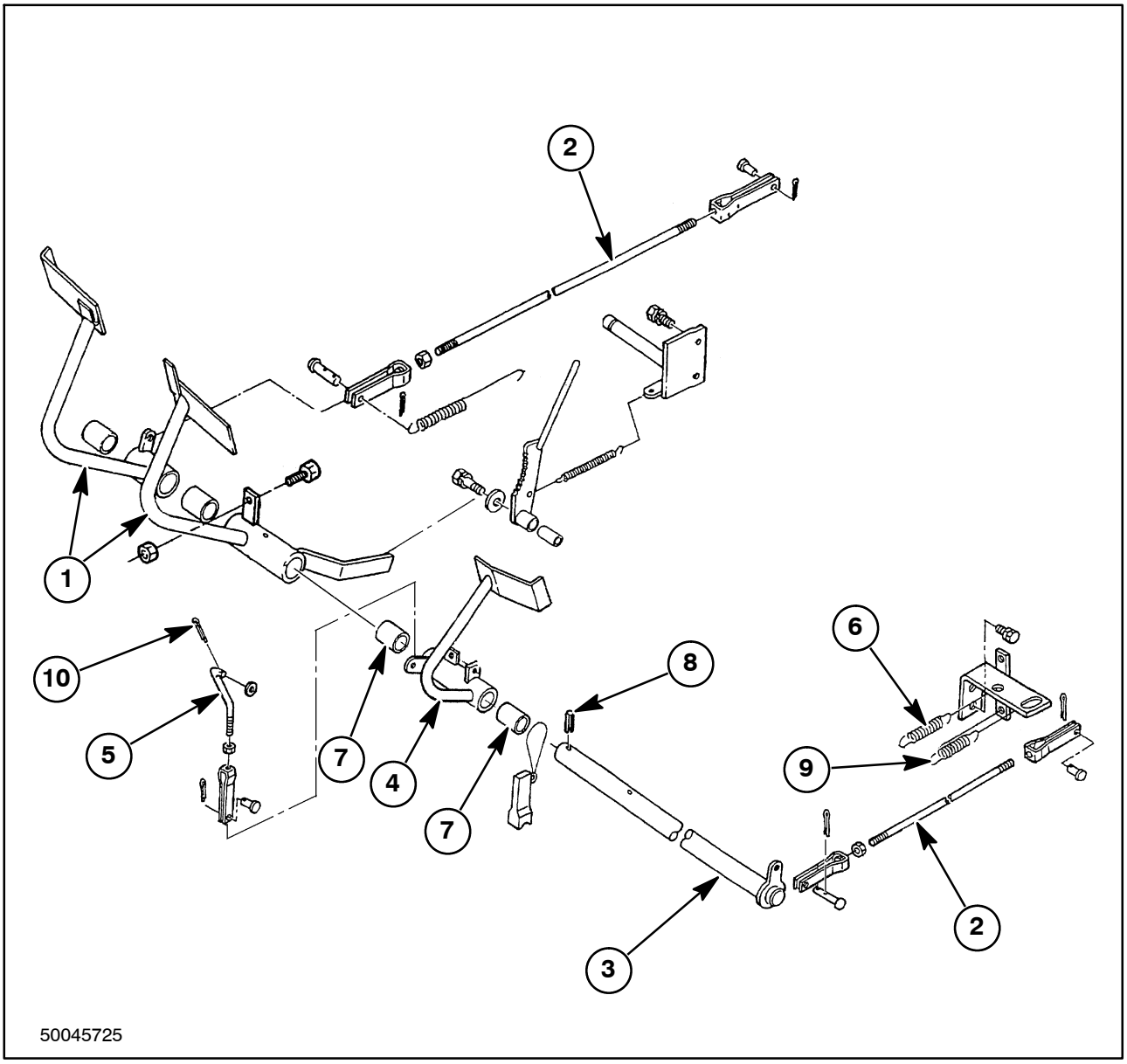
Installation

Installation of the cross shaft generally follows the removal procedures in reverse.



24

1. Bearing
2. Hub
3. Pin
4. Fork
5. Safety Wire
6. Cross Shaft
7. Return Spring
8. Bushing
9. Snap Ring
10. Gasket
11. Retainer
12. Bolt
13. Cotter Pin
14. Clevis Pin
15. Adjustment Rod



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CLUTCH PEDAL BUSHINGS

Removal

1. Disconnect the brake actuating rods, 2, and brake return springs, 9, from the cross shaft, 3, on both sides of the tractor.
2. Remove the two roll pins, 8, from the brake cross shaft and brake pedal assembly, 1.
3. Remove the clutch pedal return spring, 6.
4. Remove the cotter pin, 10, and clutch adjustment rod, 5, from the clutch pedal, 4.
5. Withdraw the brake cross shaft from the support and remove the pedal from the shaft.
6. Using a suitable driver, remove the bushings, 7, from the clutch pedal assembly.
7. Reinstall new bushings using a suitable bushing driver.

Installation

Installation of the clutch pedal bushings generally follows the removal procedure in reverse.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Excessive clutch pedal free-play or loss of adjustment reserve.	1. Worn clutch disc. 2. Clutch linkage out of adjustment.	1. Replace disc. 2. Adjust linkage.
1. Clutch noisy when free.	1. Defective release bearing. 2. Defective clutch pilot bearing.	1. Replace bearing. 2. Replace bearing.
1. Clutch slipping.	1. Incorrect pedal free-play. 2. Worn disc facings. 3. Clutch pressure springs weak from overheating.	1. Adjust free travel. 2. Replace disc. 3. Overhaul or install new clutch assembly.
1. Clutch fails to engage smoothly.	1. Defective clutch. 2. Defective pressure plate assembly. 3. Worn clutch pilot bearing. 4. Defective flywheel.	1. Replace disc. 2. Replace pressure plate assembly. 3. Replace bearing. 4. Replace flywheel.
1. Difficulty in engaging gears.	1. Pedal free travel out of adjustment. 2. Damaged or out of adjustment release levers.	1. Adjust pedal free travel. 2. Repair, replace, or adjust release levers.
1. Pedal will not return completely to release position.	1. Broken clutch pedal return spring.	1. Replace spring.

SPECIFICATIONS

	MODEL - HST 9 × 3 (2WD)	MODEL - 9 × 3 (4WD)
ITEM	**SINGLE CLUTCH**	**DOUBLE CLUTCH**
No. of Clutch Plates	**1 (2 Facings)**	**2 (4 Facings)**
Facing: Outside Diameter	225 mm (8.86″)	215 mm (8.46″) PTO 225 mm (8.86″) Transmission
Inside Diameter	150 mm (5.90″)	150 mm (5.90″)
Thickness	3.2 mm (0.1259″)	3.2 mm (0.1259″)
Height of Release Lever	35.5 +/– 1.0 mm (1.40″ +/– 0.04″)	96.5 +/– 0.7 mm (3.80″ +/– 0.276″)
Clearance Between Driveshaft and Clutch Disc	0.50 - 1.00 mm (0.0078 - 0.0137″)	0.050 - 0.1 mm (0.0028 - 0.11″)
Allowable Clearance Limit	0.6 mm (0.0236″)	0.25 mm (0.0098″)
Clearance Between Driveshaft and Clutch Disc in the Rotational Direction	0.2 - 0.35 mm (0.0019 - 0.0039″)	0.050-0.1 mm (0.0019 - 0.0039″)
Allowable Clearance Limit	0.8 mm (0.0098″)	0.25 mm (0.0098″)
Clearance Between Retainer and Hub	0.025 - 0.1 mm (0.009 - 0.0039″)	0.025 - 0.1 mm (0.009 - 0.0039″)
Allowable Clearance Limit	0.8 mm (0.0314″)	0.8 mm (0.0314″)
Length of Release Hub Return Spring	1.28″ (32.5 mm)	1.28″ (32.5 mm)
Thickness of Clutch Disc (AT free)	8.65 ± 0.4 mm (0.34 ± 0.016″)	8.3 ± 0.3 mm (0.327 ± 0.012″)
Allowable Limit	7.2 mm (0.28″)	7.2 mm (0.28″)
Depth of Clutch Rivets	1.2 mm (0.0472″)	1.2 mm (0.0472″)
Allowable Limits	0.3 mm (0.012″)	0.3 mm (0.012″)
Height of Release Lever from Flywheel Surface	35.5 mm (1.40″)	96.5 mm (3.80″*)
Allowable Limit	34.5 - 36.5 mm (1.36 - 1.44″)	35.8 - 37.2 mm (3.77 - 3.83″)
Deflection of Clutch Disc	Max. 1.0 mm (0.039″)	Max. 1.0 mm (0.039″)
Standard Clutch Pedal Free-Play	20 - 30 mm (0.79 - 1.18″)	20 - 30 mm (0.79 - 1.18″)
Flywheel Surfacing Maximum Limit	1.27 mm (0.050″)	1.27 mm (0.050″)

BOLT TORQUES

Flywheel Mounting Bolts . . . . . 69 - 78 N·m (51 - 57.7 ft. lbs.)

Clutch Mounting Bolts . . . . . 22.6 - 28.4 N·m (16.6 - 21 ft. lbs.)

SPECIAL TOOLS

Gauge - Lever height adjustment double clutch FNH01267

Alignment arbor - Single clutch FNH01260

Alignment arbor - Double clutch FNH00077

SECTION 21 - GEAR TRANSMISSION

Chapter 1 - Gear Transmission 9 x 3

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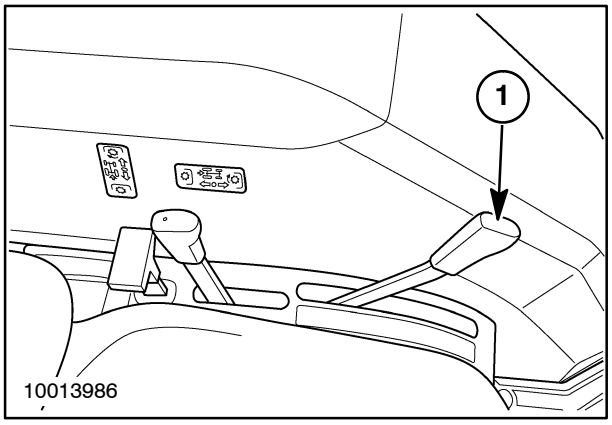
DESCRIPTION OF OPERATION

9 x 3 GEAR TRANSMISSION

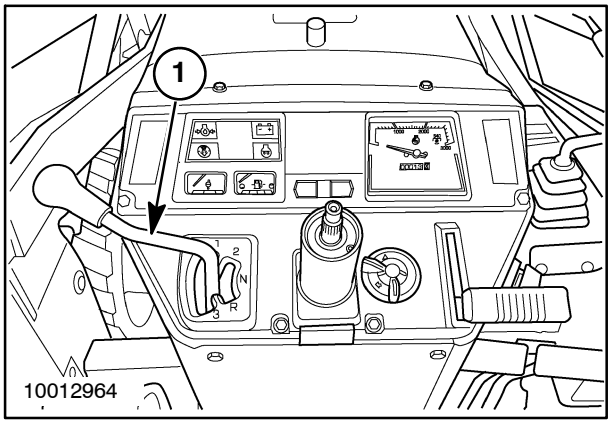
The standard 9 × 3 gear transmission is a three speed main gearbox with each range having three forward and one reverse speed, for a total of nine forward and three reverse speeds.

The range selector shift lever, 1, controls operation of the range transmission.



1

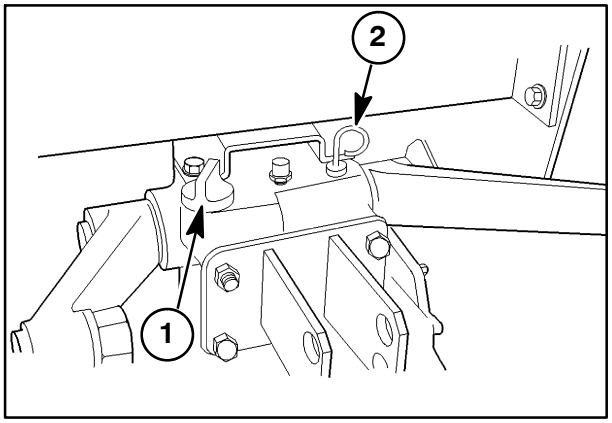
The main shift lever, 1, controls the three forward and one reverse speeds of the main transmission.



2

The transmission housing is a part of a common fluid reservoir which provides gear lubricant for the differential transmission and hydraulic system. The fluid used is NH134 or equivalent.

The fluid fill plug, 1, and the fluid level check dipstick, 2, are located on the rear of the hydraulic lift cover.



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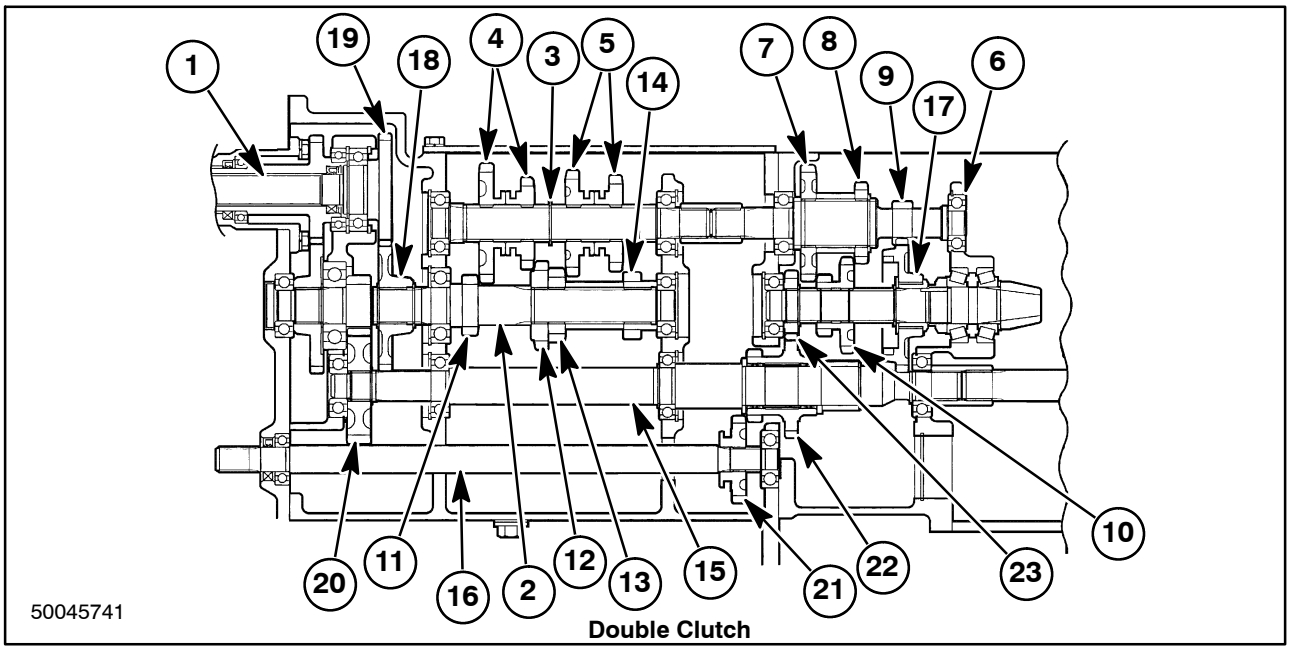
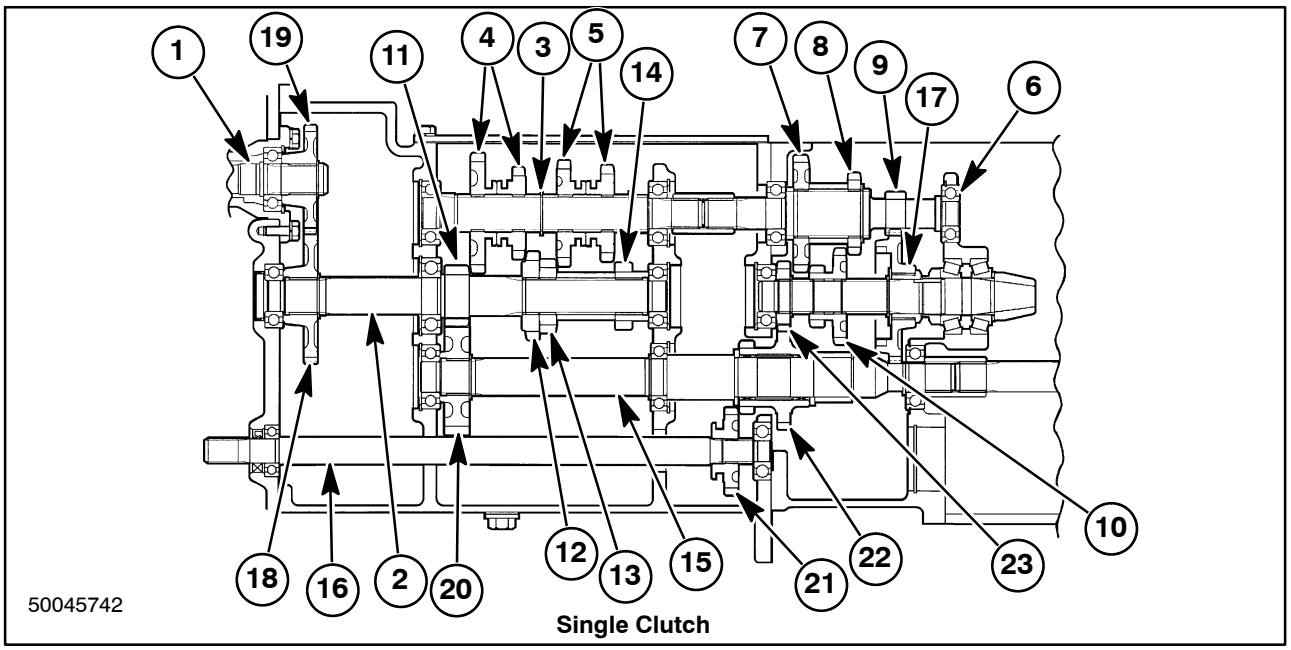


Double Clutch

4



Single Clutch

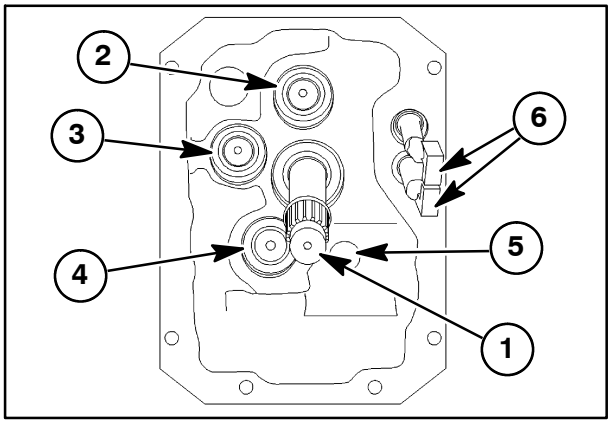
5

1. Input Shaft
2. Countershaft
3. Front Main Shaft
4. Sliding Gear (1-3) (31T - 23T)
5. Sliding Gear (2-R) (27T-24T)
6. Rear Main Shaft
7. High Range Gear (36T) - Fixed
8. Mid-Range Gear (24T) - Fixed
9. Low Range Gear (11T) - Fixed
10. Sliding Gear (High, Middle, Low) (17T-29T)
11. 1st Gear (14T) - Fixed
12. 3rd Gear (22T) - Fixed
13. 2nd Gear (18T) - Fixed
14. Reverse Gear (16T) - Fixed
15. PTO Countershaft
16. 4WD Drive Shaft
17. Low Range Gear (42T) - Fixed
18. Counter Gear (42T): Single Clutch Model; 41T: Double Clutch Model
19. Fixed Gear (33T): Single Clutch Model; 34T: Double Clutch Model
20. PTO Fixed Gear (30T)
21. FWD Sliding Gear (26T)
22. FWD Counter Gear (21T - 32T)
23. FWD Fixed Gear (20T)

Figure 4 and 5 provides a cross-sectional view of a transmission with gear identification.

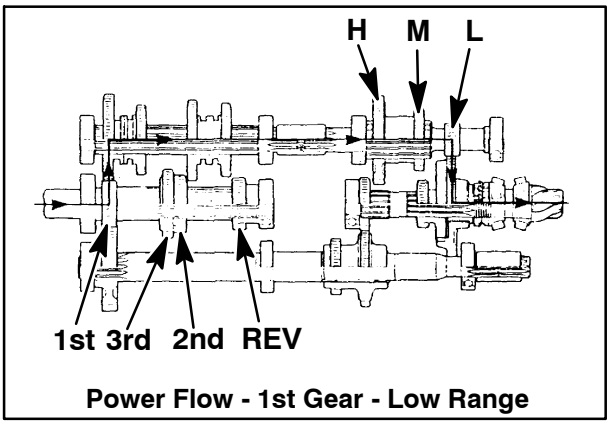
Figure 6, shows location of the transmission shafts when tractor is split at the clutch and transmission housing.

1. Countershaft
2. Main Shaft
3. Reverse Idler Shaft
4. PTO Countershaft
5. FWD Shaft
6. Main Gear Shift Rod



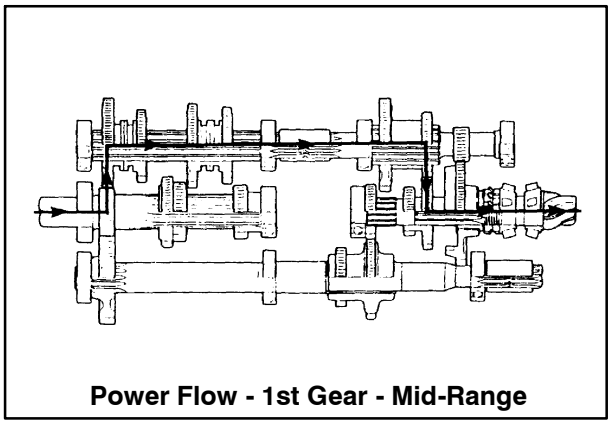
6

Figure 7 through 18 show the nine forward and three reverse power flows through the transmission.



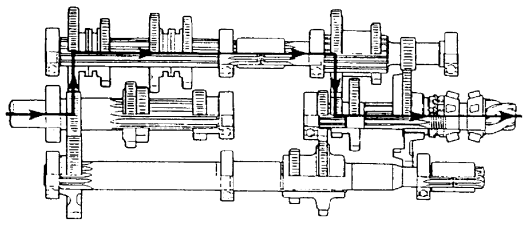
Power Flow - 1st Gear - Low Range

7



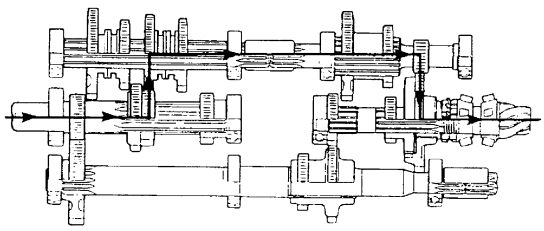
Power Flow - 1st Gear - Mid-Range

8



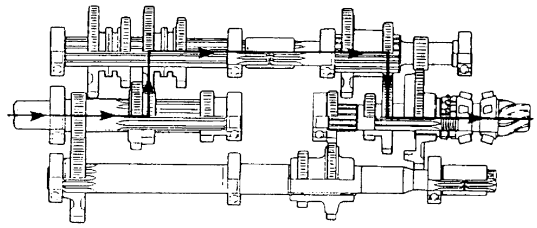
Power Flow - 1st Gear - High Range

9



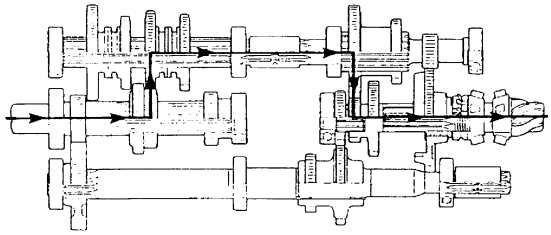
Power Flow - 2nd Gear - Low Range

10



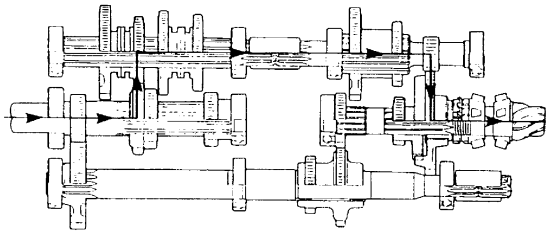
Power Flow - 2nd Gear - Mid-Range

11



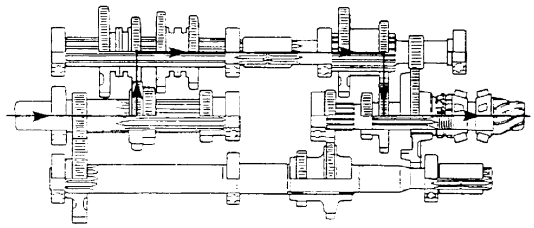
Power Flow - 2nd Gear - High Range

12



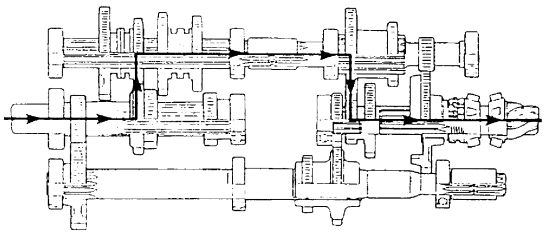
Power Flow - 3rd Gear - Low Range

13



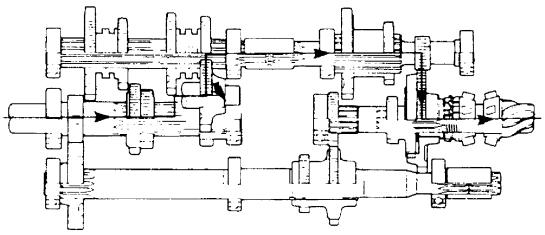
Power Flow - 3rd Gear - Mid-Range

14



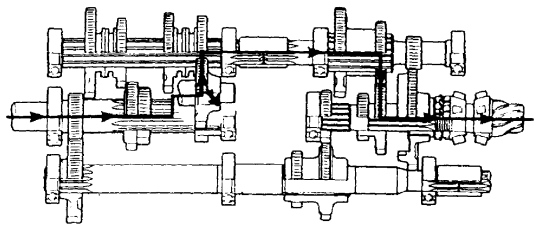
Power Flow - 3rd Gear - High Range

15



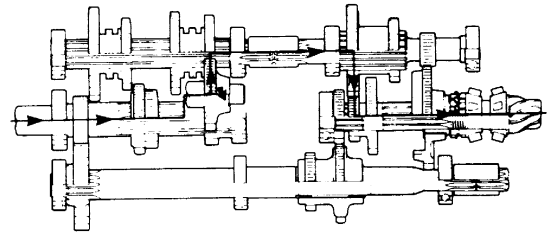
Power Flow - Reverse Gear - Low Range

16



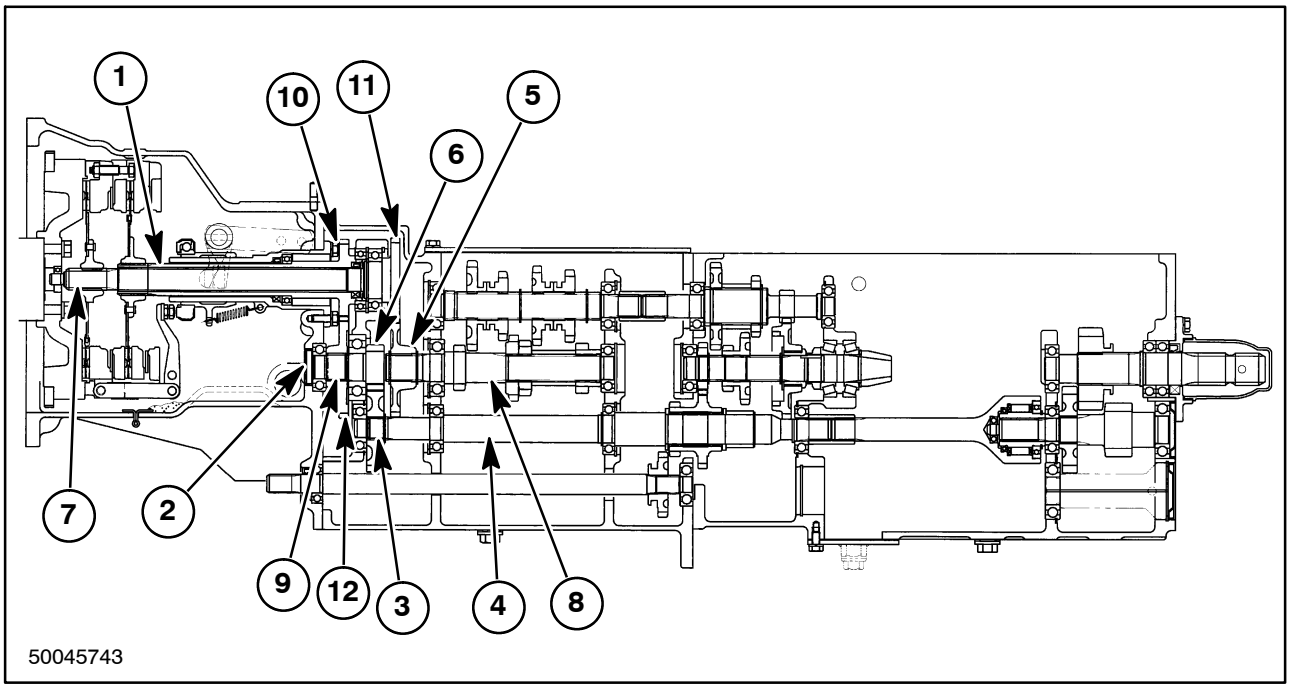
Power Flow - Reverse Gear - Mid-Range

17



Power Flow - Reverse Gear - High Range

18



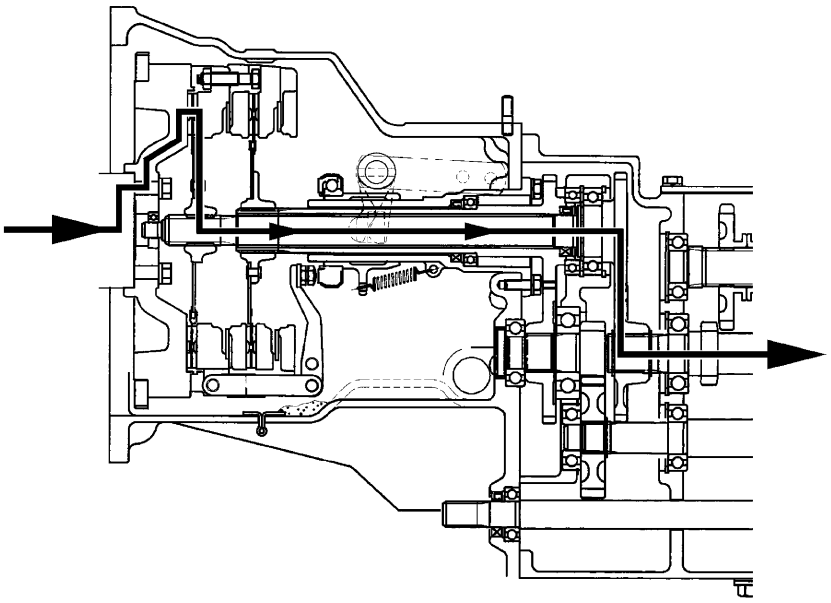
19

9 x 3 Gear Transmission with a Double Clutch

1. PTO - Input Shaft
2. Cover Seal (PTO)
3. Front PTO Countershaft Gear - 30T
4. Front PTO Countershaft
5. Counter Gear (Transmission)
6. PTO Countershaft Fixed Gear
7. Transmission - Input Shaft
8. Transmission Countershaft
9. PTO Upper Countershaft
10. PTO Input Shaft Fixed Gear
11. Transmission Input Shaft Fixed Gear
12. PTO Upper Countershaft Gear

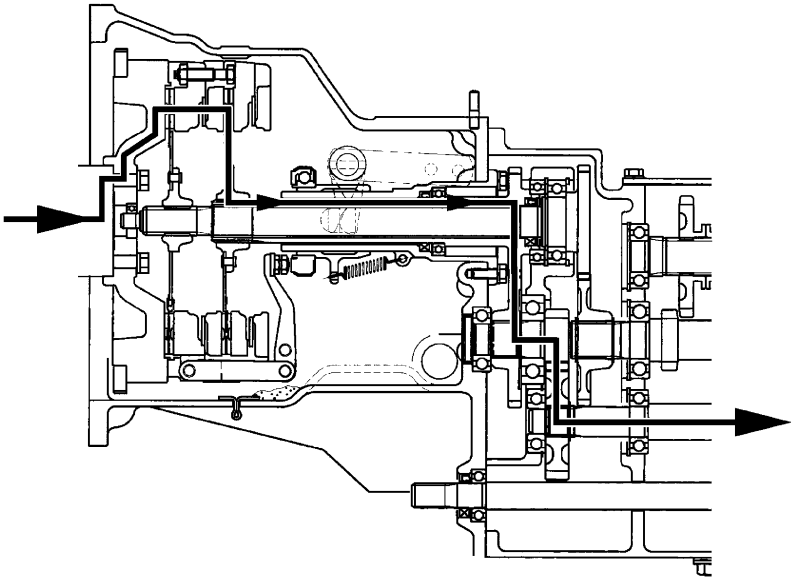
Figure 19 provides a cross-sectional view of a 9 x 3 transmission with a double-clutch.

Figures 20 and 21 show initial power flow to the rear PTO and main transmission shaft. Power flow from the main shaft is identical to the single clutch 9 x 3.



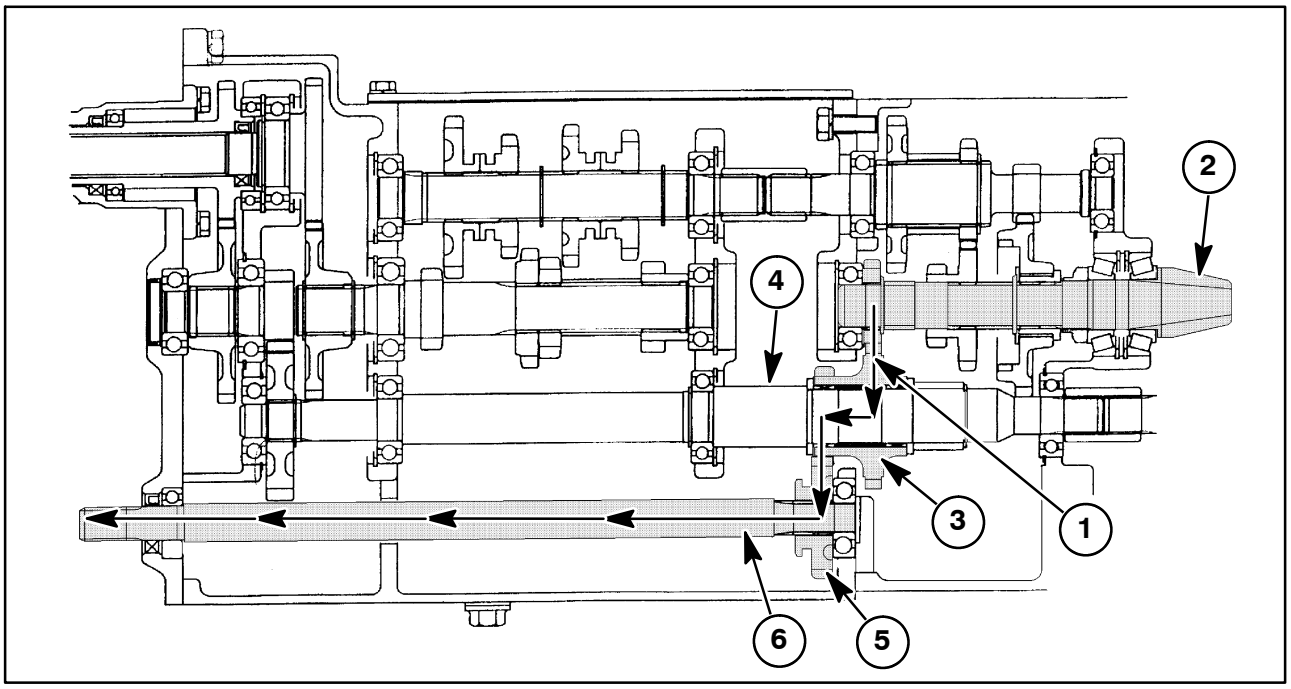
50045744 **Double Clutch Power Flow - Transmission Input**

20



50045745 **Double Clutch Power Flow - PTO Input**

21

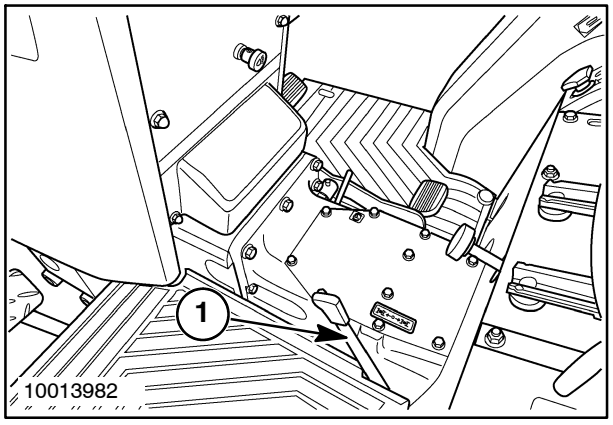


22

FWD Power Flow

If equipped with front wheel drive, the drive pinion shaft, 2, contains FWD gear, 1. The front PTO countershaft, 4, contains fixed gear, 3. The front wheel drive shaft, 6, and sliding gear, 5, are also provided.

The front-wheel drive control lever, 1, is located on the left-hand side of the transmission. To engage front-wheel drive, depress the clutch pedal fully and move the lever completely rearward. To disengage front-wheel drive, depress the clutch pedal and move the lever fully forward.



23

TRANSMISSION ASSEMBLY

Removal

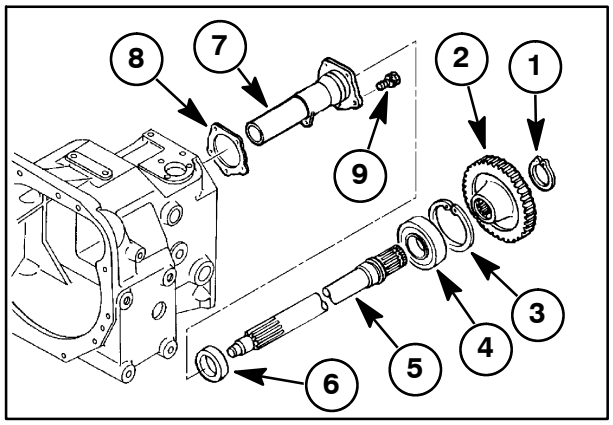
1. Drain the transmission and differential fluid into a suitable clean container.
2. Remove the transmission assembly from the tractor. See “Separating the Tractor,” later in this section.

Op. 21 148 63

SINGLE CLUTCH INPUT SHAFT

Removal

1. Remove the snap ring, 1, and gear (31T), 2, from the input shaft, 5.
2. Remove bearing retaining snap ring, 3, and withdraw the shaft, 5, bearing, 4, and seal, 6, from the clutch housing.
3. Remove retaining bolts, 9.
4. Remove the throw-out bearing hub return spring from the retainer and remove the retainer, 7, and gasket, 8, from the clutch housing.

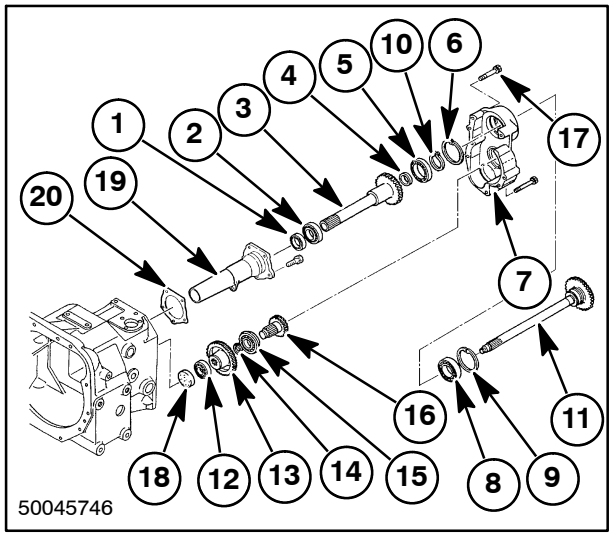


24

DOUBLE CLUTCH INPUT SHAFT

Removal

1. Remove the case bolts, 17, and remove the case, 7, input shaft, 11, and gears as an assembly from the clutch housing.
2. Remove snap ring, 10, and remove the input shaft, 11, from the case.
3. Withdraw the PTO input shaft, 3, from the clutch housing.
4. Remove seal, 18, bearing, 12, and gear, 13.
5. Remove snap ring, 14, and remove bearing, 15, and the shaft and gear assembly, 16.



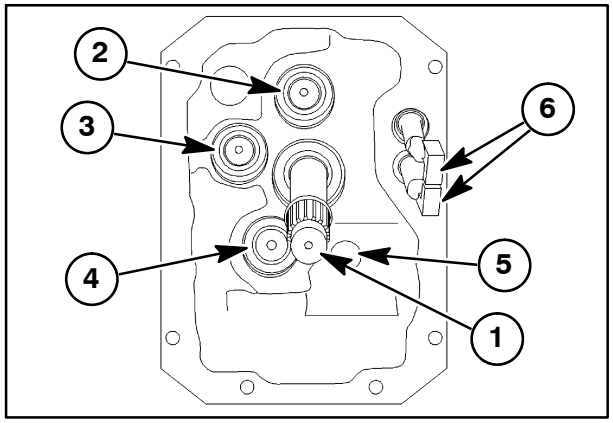
25

SINGLE AND DOUBLE CLUTCH MAIN GEAR SHIFTER ROD

Removal

NOTE: *Refer to figure for location of the main gear shift rod, 6.*

1. Countershaft
2. Main Shaft
3. Reverse Idler Shaft
4. PTO Countershaft
5. FWD Shaft
6. Main Gear Shift Rod

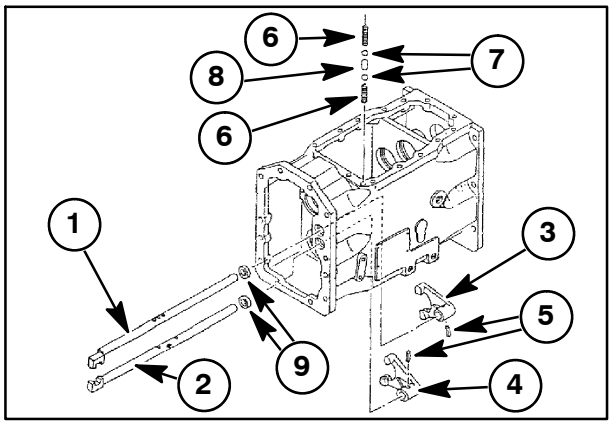


26

1. Remove the upper detent spring, 6. Using a small pencil type magnet, remove the detent ball, 7.
2. Drive roll pin, 5, out of the shift fork, 3.
3. Remove the top shift rod, 1, sliding it forward out of the housing. Remove the fork, 3, and interlock (balk) pin, 8.

   NOTE: *The lower shift rod must be in neutral position before the upper shift rod can be removed.*
4. Drive the roll pin, 5, out of the bottom shift fork, 4, and slide the bottom shift rod, 2, forward out of the housing.

   NOTE: *Use care not to lose the detent spring and ball as they will be expelled with considerable force when released by the shift rod.*
5. Remove the lower detent ball, 7, and spring, 6.



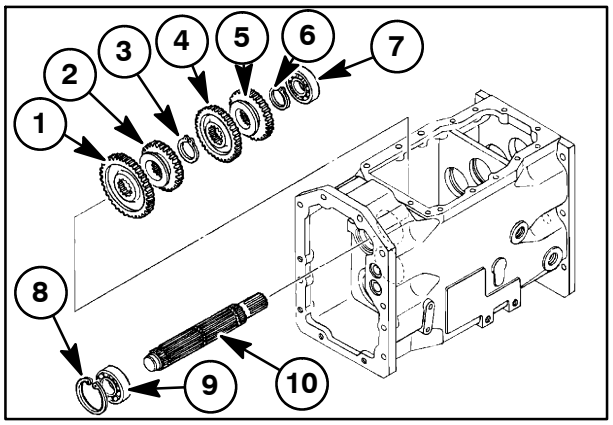
27

MAIN SHAFT

Removal

NOTE: *Refer to Figure 4 for double clutch and Figure 5 for single clutch, for countershaft, 6, location (page 21-4).*

1. Remove snap ring, 8.
2. Remove snap rings, 3 and 6, from the shaft grooves and place them toward the rear of the shaft.
3. Gently drive the main shaft forward while supporting the gears and snap rings and remove from the case.
4. Remove the 1st gear 33T, 1, 3rd gear (23T), 2, (2nd) gear (27T), 4, and Reverse gear (24T), 5.



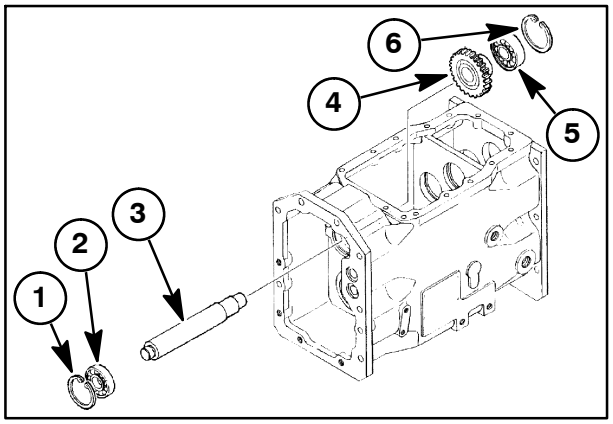
28

REVERSE IDLER SHAFT

Removal

NOTE: *Refer to Figure 4 for double clutch and Figure 5 for single clutch, for reverse idler shaft, 3, (page 21-4).*

1. Remove snap ring, 1.
2. Gently drive the idler shaft, 3, forward while supporting the counter gear, 4, and bearings, 2 and 5, and remove from the case.
3. Remove snap ring, 6, bearing, 5, counter gear (23T), 4, and bearing, 2.



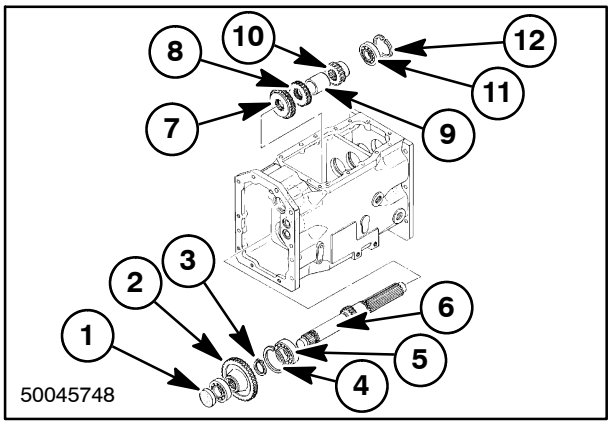
29

SINGLE CLUTCH COUNTERSHAFT

Removal

NOTE: *Refer to Figure 5 for countershaft, 6, location (pages 21-4 and 21-5).*

1. Remove bearing, 1, and gear 42T, 2.
2. Remove snap ring, 3, bearing retainer snap ring, 4, and gently drive the countershaft forward to provide enough room for removal of fixed gears, 7, 8, and 10.
3. Remove snap ring, 12, rear bearing, 11, 3rd gear (22T), 7, 2nd gear (18T), 8, spacer, 9, and reverse gear (16T), 10, from the housing.
4. Remove the countershaft, 6, and front bearing, 5, as an assembly from the case.



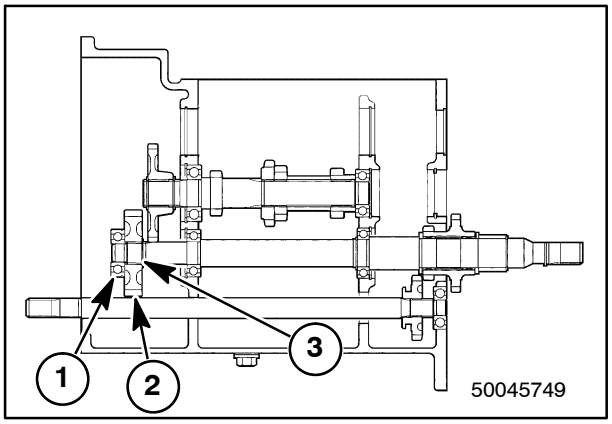
30

DOUBLE CLUTCH COUNTERSHAFT

Removal

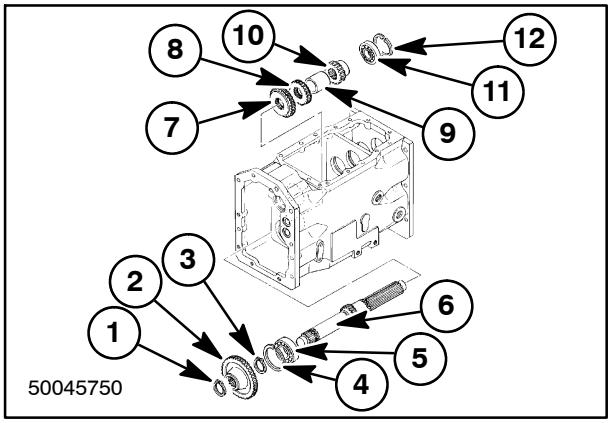
NOTE: *Refer to Figure 4 for countershaft, 6, location (page 21-4).*

1. Remove the front bearing, 1, fixed gear (30T), 2, and snap ring, 3, from the PTO countershaft, 16.



31

2. Remove snap ring, 1, and gear (41T), 2.
3. Remove snap ring, 3, bearing retainer snap ring, 4, and gently drive the countershaft forward to provide enough room for removal of fixed gears, 7, 8, and 10.
4. Remove snap ring, 12, ring bearing, 11, 3rd gear (22T), 7, 2nd gear (18T), 8, spacer, 9, and reverse gear (16T), 10, from the housing.
5. Remove the countershaft, 6, and front bearing, 5, as an assembly from the case.



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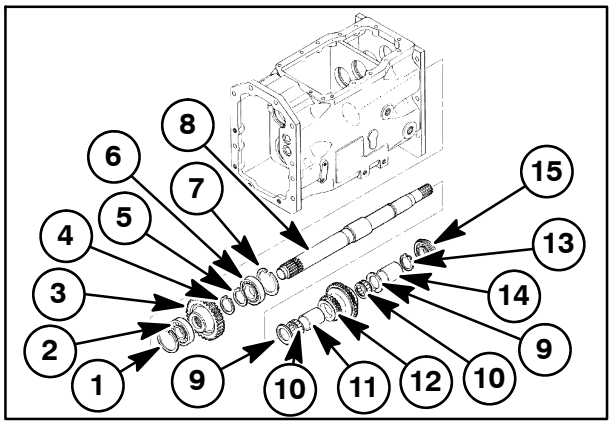
SINGLE CLUTCH PTO COUNTERSHAFT

Removal

NOTE: *Refer to Figure 5 for PTO countershaft, 8, location (page 21-4).*

1. If equipped with FWD, remove snap ring, 13, and remove the thrust washers, 9, gear set (21T-32T), 12, needle bearings, 10, and spacers, 11 and 14, from the shaft, 8.
2. Remove snap ring, 7, from the rear side of the center bearing bore.
3. Gently drive the PTO countershaft, 8, out through the rear of the case.
4. Remove snap rings, 4 and 5, bearing, 6, and snap ring, 7, from the PTO countershaft.



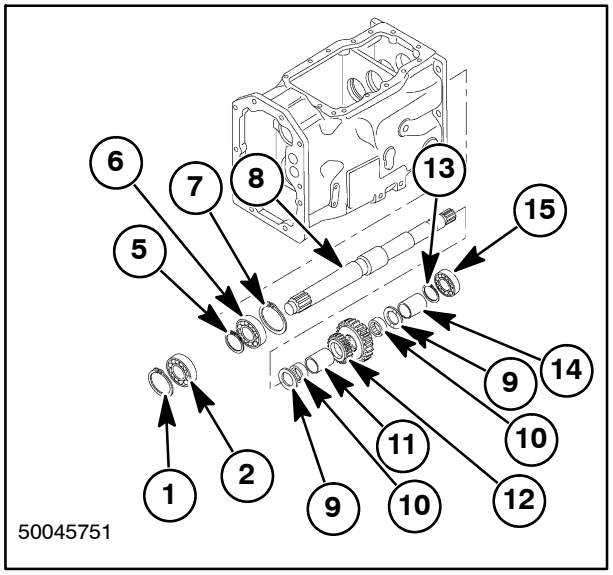
33

DOUBLE CLUTCH PTO COUNTERSHAFT

Removal

NOTE: *Refer to Figure 4 for PTO countershaft, 8, location (page 21-4).*

1. If equipped with FWD, remove snap ring, 13, and remove the thrust washers, 9, gear set (21T-32T), 12, needle bearings, 10, and spacers, 11 and 14, from the shaft, 8.
2. Remove snap ring, 7, from the rear side of the center bearing bore.
3. Gently drive the PTO countershaft, 8, out through the rear of the case.
4. Remove snap ring, 1, and bearing, 2, from the housing.
5. Remove snap ring, 5, and bearing, 6, from the PTO countershaft.



34

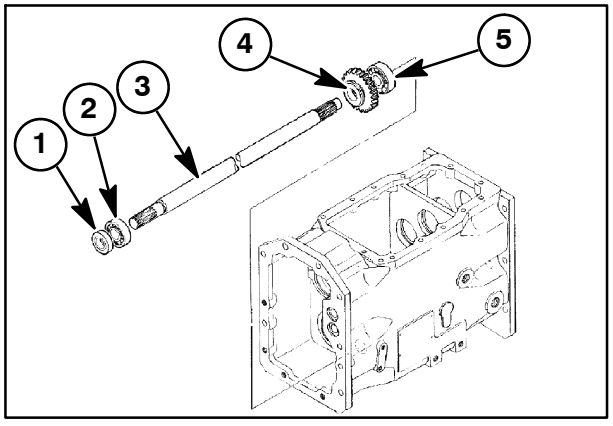
FWD DRIVE SHAFT

SINGLE AND DOUBLE CLUTCH

Removal

NOTE: *Refer to Figure 22 for FWD drive shaft, 3, location (page 21-10).*

1. Gently drive the shaft, 3, toward the front of the case while supporting the sliding gear (26T), 4, and remove from the case.
2. Remove the seal, 1, and bearings, 2, from the clutch housing.
3. Remove the bearing, 5, from the housing



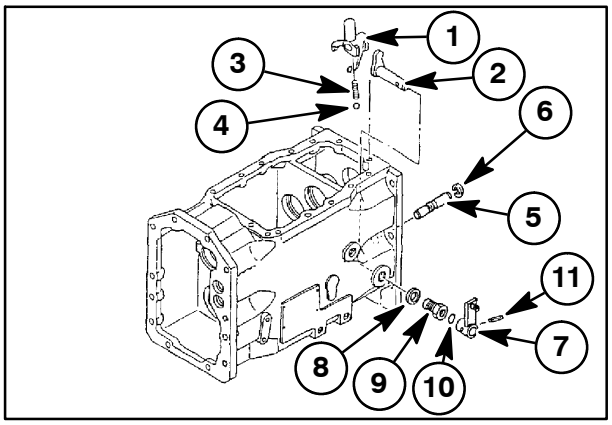
35

FWD SHIFT ROD

Removal

1. Drive the roll pin, 11, out of the change lever, 7, and remove the change lever.
2. Remove the snap ring, 6, and shift rod, 5, from the rear of the case.

   NOTE: *Use care not to lose the detent ball and spring when separating the rod from the fork.*
3. Remove the shifter fork, 1, shifter arm, 2, detent spring, 3, and detent ball, 4, from the case.
4. Remove shift guide, 9, with O ring, 10, and seal washer, 8.



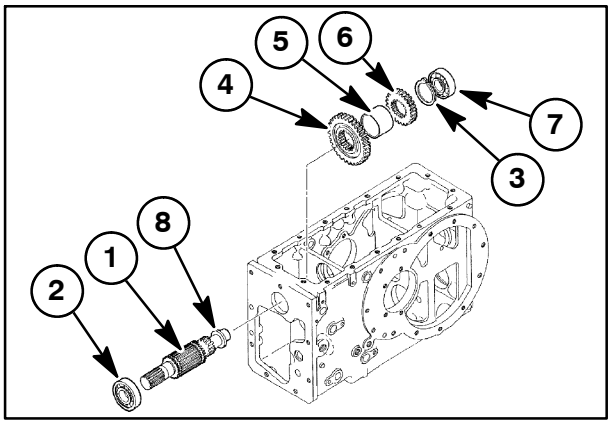
36

REAR MAIN SHAFT

Removal

1. Remove the snap ring, 3, from its shaft groove and slide it to the rear of the shaft, 1.
2. While sliding the gears, 4 and 6, rearward on the shaft, gently drive the shaft forward removing it from the case.
3. Remove bearings, 2 and 7, from the shaft.
4. Remove snap ring, 3, gears, high gear (36T), 4, mid-range gear (24T), 6, and collar, 5, from the shaft.

   NOTE: *The low range gear (11T), 8, is part of rear main shaft, 1.*



37

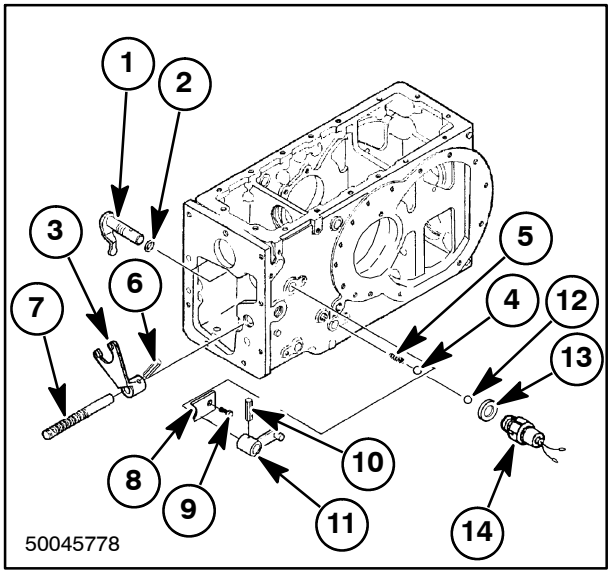
RANGE GEAR SHIFTER ROD

Removal

NOTE: *To remove shifter arm, 1, the drive pinion must be removed first.*

1. Drive out the roll pin, 6, from the shifter fork, 3.
2. Drive the roll pin, 10, out of the change lever, 11, and remove the change lever.
3. Remove the range gear safety switch, 14, seal washer, 13, and detent ball, 12, from the housing.
4. Remove the shifter rod, 7, forward and remove it from the front of the case.

   NOTE: *Use care not to lose the detent ball and spring when the rod is separated from the fork.*
5. Remove the shifter fork, 3, detent spring, 5, and detent ball, 4.
6. Remove bolt, 9, retaining plate, 8, and remove the shifter arm, 1, and O ring, 2.



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DRIVE PINION

Removal

For removal, disassembly, and inspection of the drive pinion shaft assembly, see “Differential, Rear Axle and Brakes”.

Inspection

1. Wash all components using a suitable cleaning solvent and dry air.
2. Inspect all bearings for excess wear, score marks, discoloration from overheating, or other damage. Rotate the bearings by hand and check for roughness while slowly rotating the inner and outer races.
3. Lubricate all bearings with a clean lubricant, Ambra Multi G 134 or equivalent, before installation.
4. Inspect the transmission case for pitting, cracks, worn bearing bores, or other damage.
5. Check the detent springs for wear, chipped or weak spring tension.
6. Inspect the detent balls for pitting, excess wear, or other damage.
7. Inspect the shift rail detent grooves for excess wear.
8. Inspect the clearance between the shifter rod and its housing bearing. Clearance should be 0.03 - 0.1 mm (0.001 - 0.004″). The maximum wear limit is 0.3 mm (0.012″).
9. Inspect all gears for excess wear, chipped teeth, or other damage. Check the gear backlash by inserting the mating assemblies into the casing and using a feeler gauge. Gear backlash should be between 0.4 - 0.16 mm (0.016 - 0.006″), with a maximum wear limit of 0.6 mm (0.024″).
10. Inspect the shift forks for excess wear, bending, or other damage. Check the clearance between the shifter fork and slide gear. The clearance should be between 0.2 - 0.4 mm (0.008 - 0.016″), and the maximum wear limit of 1.0 mm (0.040″).

Pre-installation Instructions

1. Lubricate all parts thoroughly with clean transmission fluid, Ambra Multi G 134 or equivalent, prior to assembly.
2. Install new gaskets and seals during assembly.

DRIVE PINION

Installation

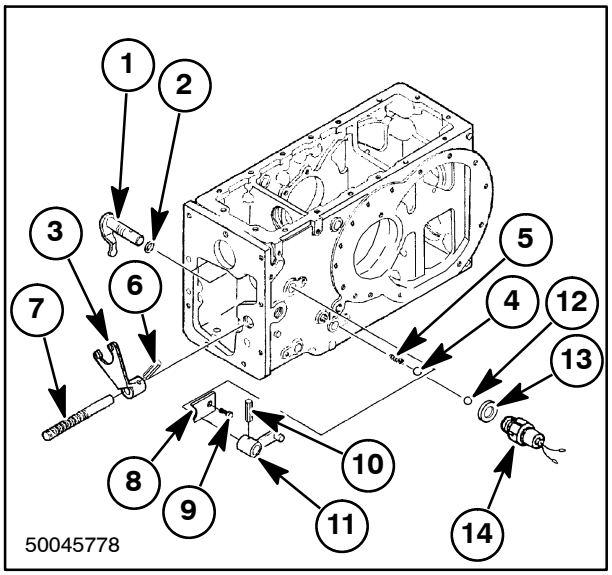
NOTE: *Install the shift arm into the housing before installing the drive pinion.*

See "Differential, Rear Axle and Brakes" for assembly and adjustments of the drive and pinion shaft assemblies.

RANGE GEAR SHIFTER ROD

Installation

1. Install the shift arm, 1, into the housing and a new O-ring, 2, onto the shift arm shaft.
2. Install the detent spring, 5, detent ball, 4, into the housing.



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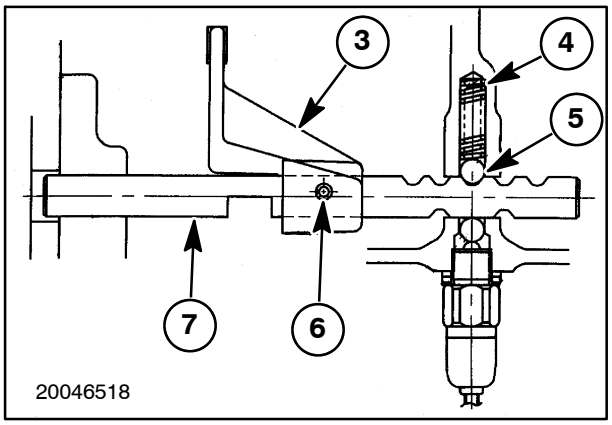
NOTE: *To aid in the installation of the shift rail, use a small piece of round stock, or a socket that is the same diameter as the outside diameter of the shift rail to preload the detent ball and spring. Use detent ball tool FNH00081, to install round stock.*

3. Position the shifter fork, 3, into the housing, and install the shift rail, 7, through the fork, 3, and drive in the roll pin, 6, into the fork, 3.
4. Install the retaining plate, 8, and retaining bolt, 9, out of the housing.
5. Position the change lever, 11, on the shift lever and install the roll pin, 10.
6. Install the detent ball, 12, seal washer, 13, and range gear safety switch.

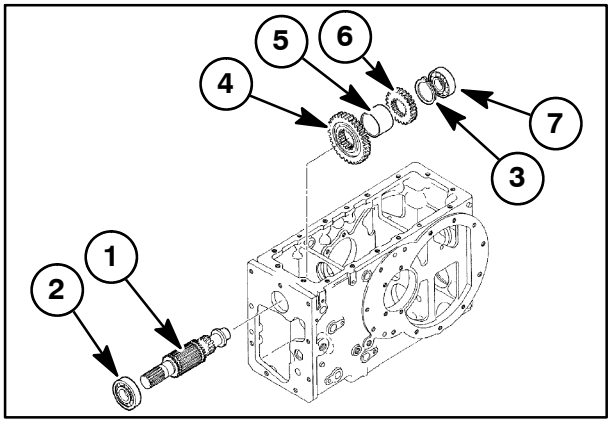


40

REAR MAIN SHAFT

Installation

1. Install bearing, 2, on the rear main shaft, 1.
2. Insert the shaft into its bore in the case.
3. Install high gear (36T), 4, collar, 5, mid-range gear (24T), 6, snap ring, 3, and bearing, 7, on the shaft.



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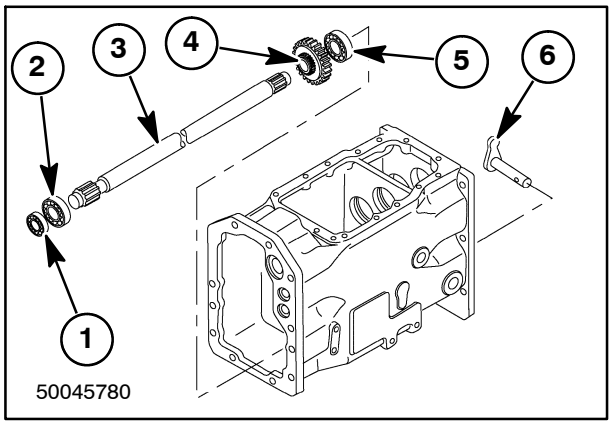
FWD DRIVE SHAFT

Installation

NOTE: *If the FWD shift arm, 6, was removed, install it first.*

1. Install the shaft, 3, from the front end with the sliding gear (26T), 4, and bearing, 5.
2. Using a suitable driver, install the oil seal, 1, and bearing, 2, into the clutch housing.



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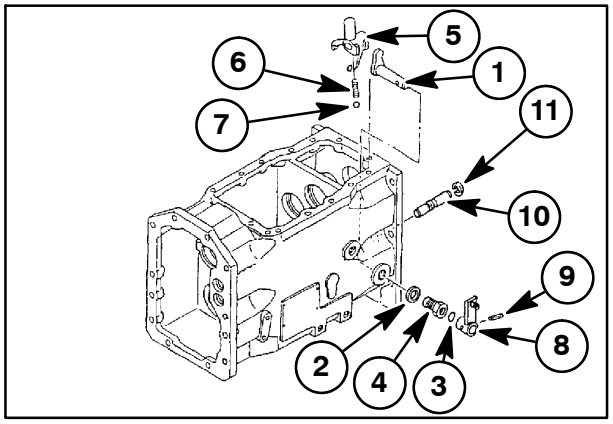
FWD SHIFT ROD

Installation

1. Install the shifter arm, 1, in the transmission.
2. Using new sealing washer, 2, and O ring, 3, install the shift arm guide, 4.
3. Install spring, 6, and detent ball, 7, into shift fork, 5.

NOTE: *To aid in the installation of the shift rail, use a small piece of round stock, or a socket that is the same diameter as the outside diameter of the shift rail, to preload the detent ball and spring inside the shift fork.*

4. Install the shifter fork, 5, with detent spring, 7, and detent ball, 6, preassembled, into the transmission case.
5. Position the change lever, 8, over the shifter arm, 1, and install roll pin, 9.
6. Install shift rod, 10, and snap ring, 11.



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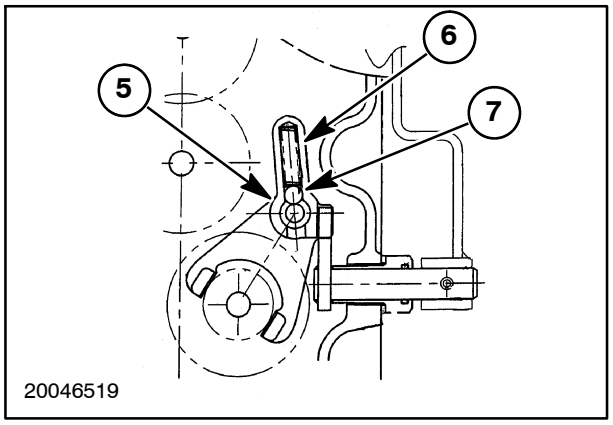

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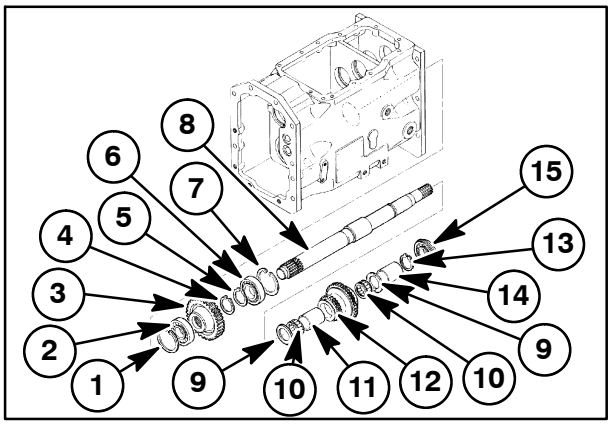
SINGLE CLUTCH PTO COUNTERSHAFT

Installation

1. Install the snap ring, 1, and bearing, 2, into the housing.
2. Install the bearing, 6, and secure with snap ring, 5, onto the shaft, 8.
3. Install the snap ring, 4, onto the shaft, 8.
4. Position the fixed gear (30T), 3, into the housing and insert the shaft, 8, from the rear and secure with snap ring, 7, into the housing.
5. If equipped with FWD install spacers, 11, and 14, needle bearings, 10, gear (21T - 31T), 12, thrust washers, 9, and snap ring, 13, onto the shaft, 8.
6. Install bearing, 15, into the rear transmission housing.



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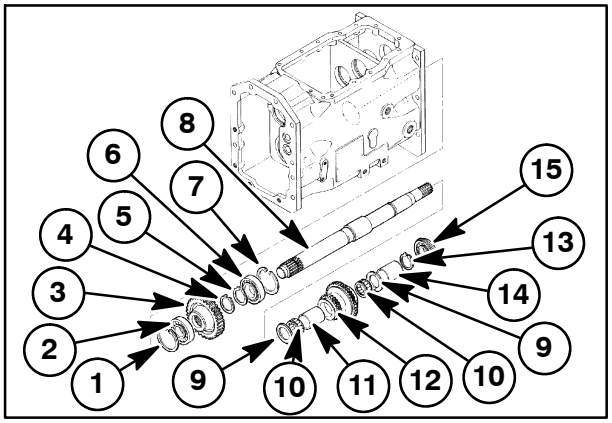
DOUBLE CLUTCH PTO COUNTERSHAFT

Installation

1. Install the snap ring, 1, and bearing, 2, into the housing.
2. Install the bearing, 6, and secure with snap ring, 5, onto the shaft, 8.
3. Install the snap ring, 4, onto the shaft, 8.
4. Insert the shaft, 8, from the rear and secure with snap ring, 7, into the housing.
5. If equipped with FWD install spacers, 11, and 14, needle bearings, 10, gear (21T - 31T), 12, thrust washers, 9, and snap ring, 13, onto the shaft, 8.
6. Install bearing, 15, into the rear transmission housing.



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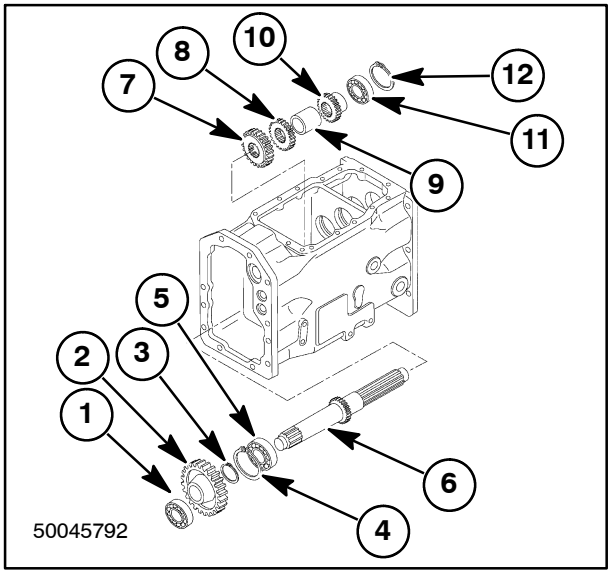
SINGLE CLUTCH COUNTERSHAFT

Installation

1. Install the snap ring, 12, and bearing, 11, into the housing.
2. Position the countershaft, 6, and bearing, 5, in the case from the front end.
3. Install the 3rd gear (22T), 7, 2nd gear (18T), 8, collar, 9, reverse gear (16T), 10.
4. Push the shaft and bearing assembly into place.
5. Install the snap ring, 4, snap ring, 3, gear (42T), 2, and bearing, 1.

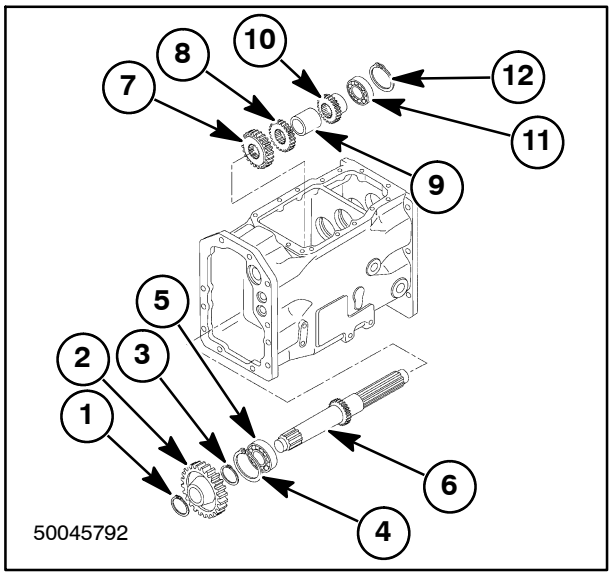


47

DOUBLE CLUTCH COUNTERSHAFT

Installation

1. Install the snap ring, 12, and bearing, 11, into the housing.
2. Position the countershaft, 6, and bearing, 5, in the case from the front end.
3. Install the 3rd gear (22T), 7, 2nd gear (18T), 8, collar, 9, reverse gear (16T), 10.
4. Push the shaft and bearing assembly into place.
5. Install the snap ring, 4, snap ring, 3, gear (41T), 2, and snap ring, 1, on the shaft.



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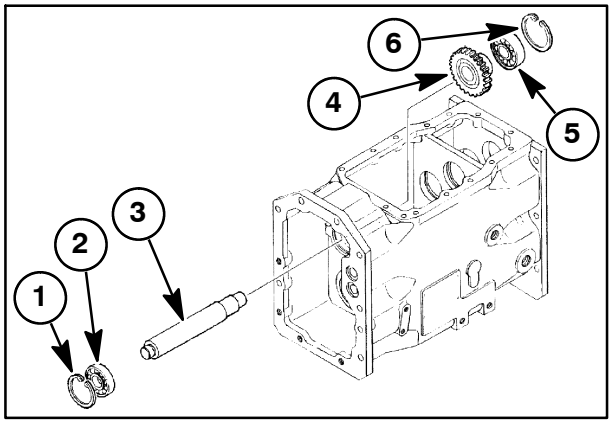
REVERSE IDLER

Installation

1. Install the snap ring, 6, and bearing, 5, into the housing.
2. Position the counter gear (23T), 4, and bearing, 5, into the housing.
3. Insert the reverse idler shaft through the counter gear into the position in the case.
4. Install bearing, 2, and snap ring, 1.



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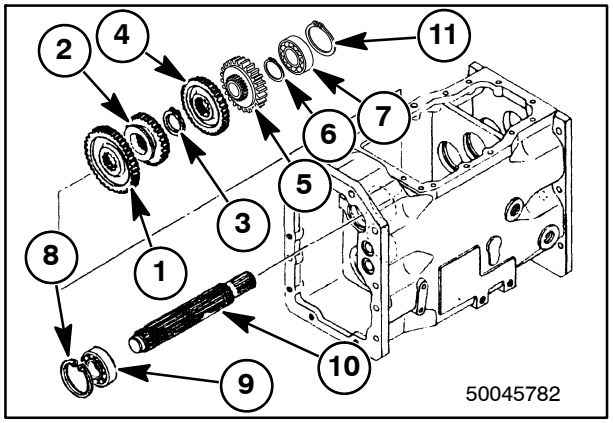
MAIN SHAFT

Installation

1. Install the snap ring, 11, and bearing, 7, into the housing.
2. Position the main shaft, 10, and bearing, 9, in the case from the front end.
3. Install 1st gear 33T, 1, 3rd gear (23T), 2, snap ring, 3, 2nd gear (27T), 4, and reverse gear (24T), 5, and snap ring, 6, on the shaft.
4. Push the shaft assembly into place and install snap ring, 8.



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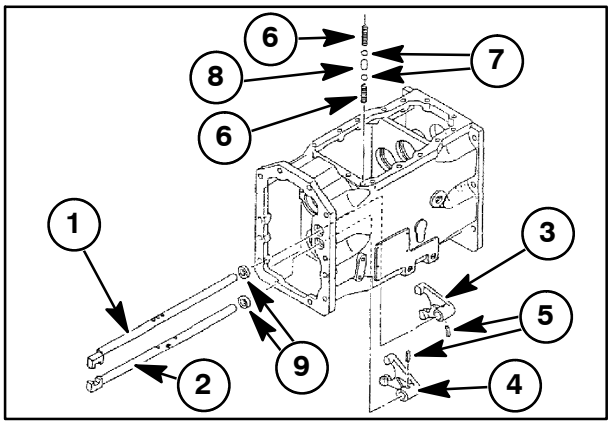
MAIN GEAR SHIFTER ROD

Installation

1. Install the lower detent ball, 7, and spring, 6. Use detent ball holder tool FNH00081 to compress ball and spring, when installing shift rail.
2. Slide the bottom shift rail, 2, into the housing and install the shift fork, 4, and roll pin, 5.
3. Install (balk) pin, 8, into housing and into detent groove in lower rail. Then slide upper shift rail, 1, into the housing and install fork, 3, and roll pin, 5.
4. Install the upper detent ball, 7, and spring, 6.

   NOTE: *Upper shift rail, 1, operates the 2nd and reverse gears. Lower shift rail, 2, operates the 1st and 3rd gears.*



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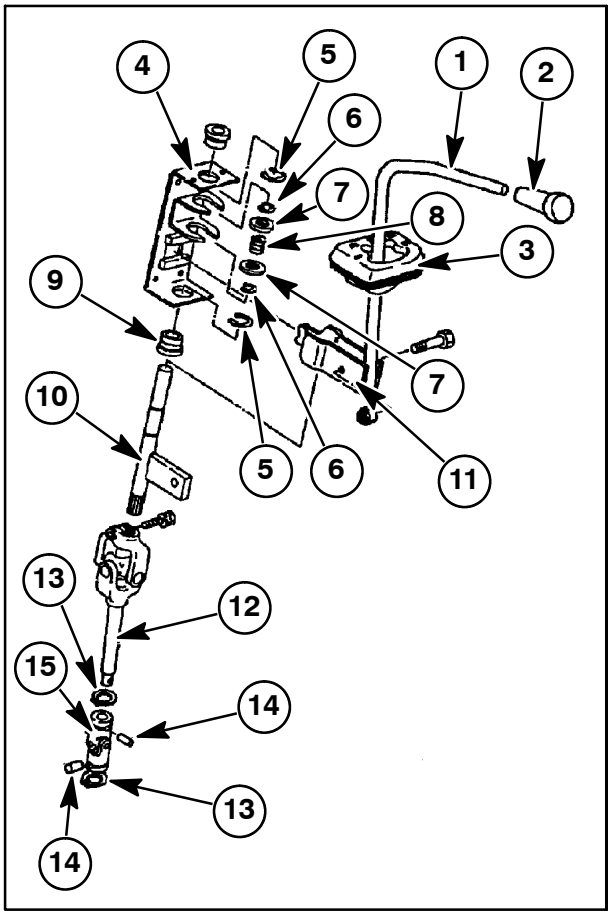
MAIN TRANSMISSION SHIFT LEVER

Op. 21 130

Removal and Overhaul

1. Remove the center steering shroud and the left side panel.
2. Remove the lower snap ring, 13, drive the pin, 14, out of the universal joint, 15, and shaft, 12.
3. Remove the lever bracket, 4, from the steering column. Raise the linkage assembly and disconnect the universal joint, 15, from the lower shaft, 12.
4. Using conventional repair procedures; overhaul the linkage assembly as required.

1. Lever
2. Grip
3. Rubber
4. Bracket
5. Snap Ring
6. Snap Ring
7. Washer
8. Spring
9. Bushing
10. Shaft
11. Link Assembly
12. Universal and Shaft Assembly
13. Snap Ring (2)
14. Pin (2)
15. Universal Joint



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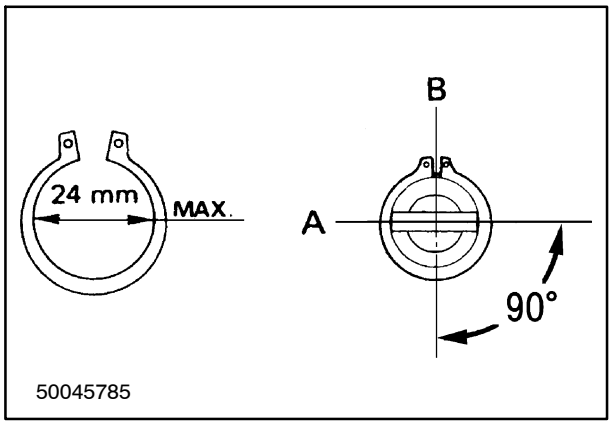
Installation

1. Connect the universal joint, 15, into the lower shaft, 12. Install the lever bracket, 4, into the steering column.
2. Drive the pin, 14, into the universal joint, 15, and shaft, 12, and install the lower snap ring.

IMPORTANT: *To retain the pin, 14, in the shaft, 12, rotate the snap ring 90° from the snap ring end gap.*

3. Install the center steering shroud and the left side panel.



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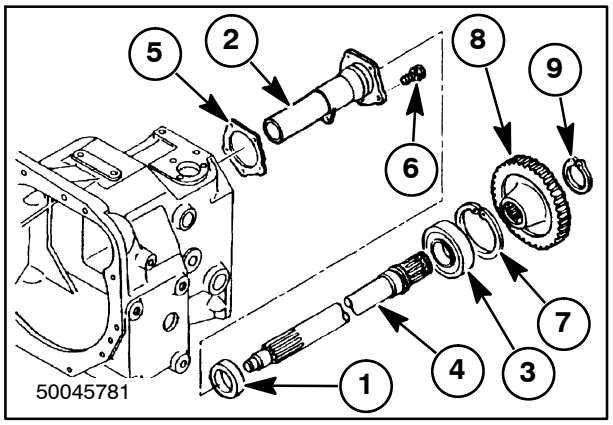
SINGLE CLUTCH INPUT SHAFT

Installation

1. Install a new oil seal, 1, into the retainer hub, 2.
2. Install the bearing, 3, onto the input shaft, 4.
3. Install a new gasket, 5, and retainer hub, 2, with M8x20 retainer bolts, 6.
4. Install the input shaft, 4, into the retainer hub, 2, and secure with snap ring, 7.
5. Install the fixed gear, 8, and secure with snap ring, 9.



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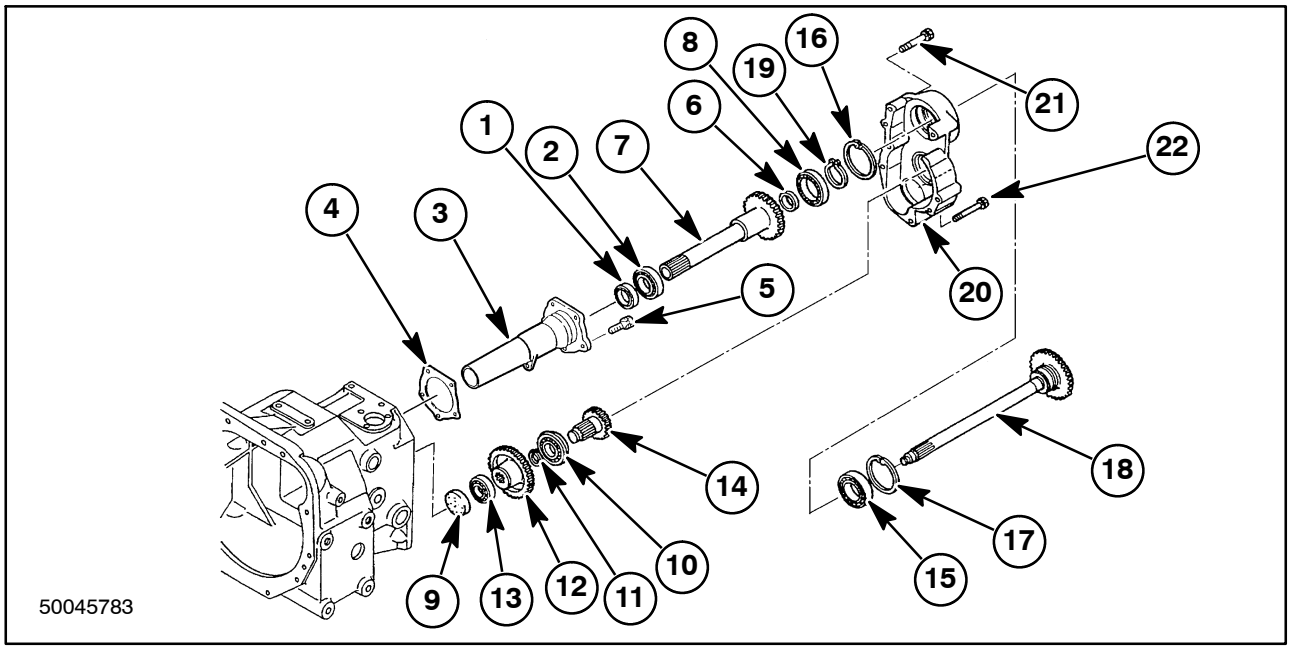
DOUBLE CLUTCH INPUT SHAFT

Installation

1. Install a new oil seal, 1, and bearing, 2, into the retainer hub, 3.
2. Install a new gasket, 4, and retainer hub, 3, with retainer bolts, 5.
3. Install a new oil seal, 6, into the PTO drive shaft, 7.
4. Install the bearing, 8, onto the PTO drive shaft, 7.
5. Install a new seal cover, 9, into the clutch housing.
6. Install the PTO drive shaft, 7, into the retainer hub.
7. Install the bearing, 10, snap ring, 11, fixed gear, 12, and bearing, 13, onto the PTO drive shaft, 14.
8. Install the PTO countershaft into the clutch housing.
9. Install the bearing, 15, secure with snap rings, 16 and 17, into the double clutch input shaft case.
10. Install the drive shaft, 18, into the double clutch input shaft case, and secure with snap ring, 19.
11. Install the double input shaft case, 20, to the rear of the clutch housing.
12. Install five M8 x 60 bolts, 21, and one M8 x 50 bolt, 22, to secure input shaft case. Torque bolts to 27 N·m (20 ft.-lbs.).



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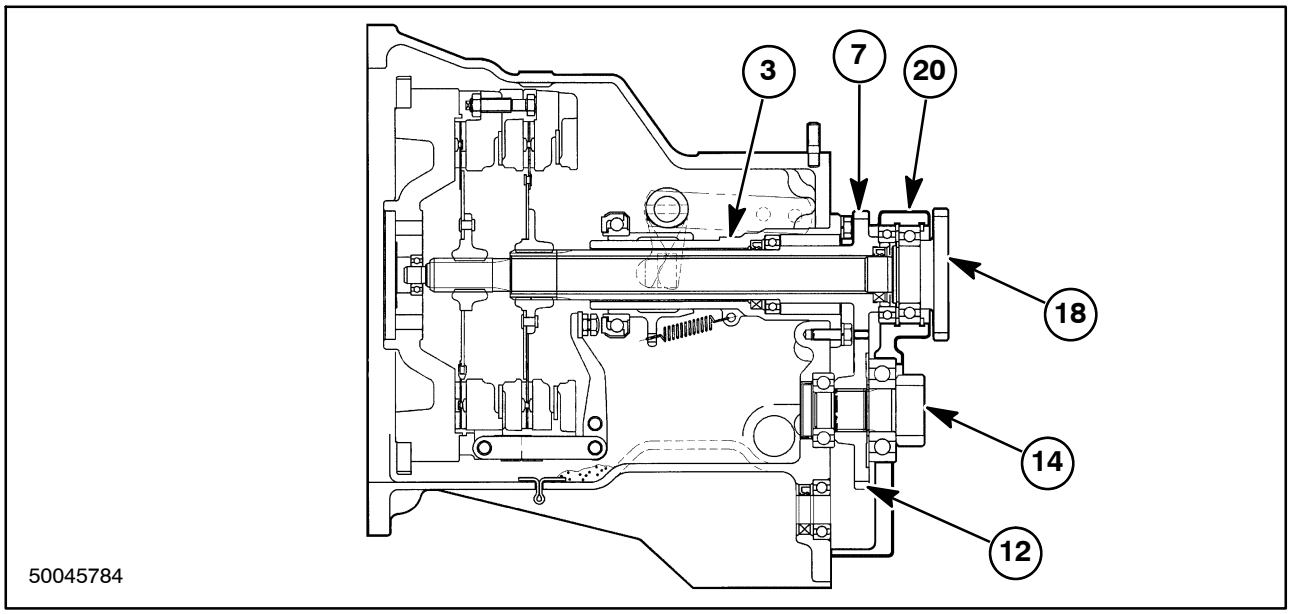

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SEPARATING THE TRACTOR

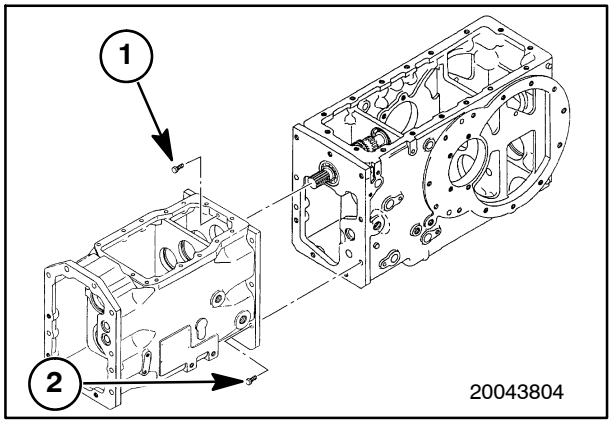
9 x 3 GEAR TRANSMISSION

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Separate the engine from the clutch housing as described earlier in this section.
3. Remove the brake and clutch pedal return spring.
4. Disconnect the foot throttle linkage from the pedal.
5. Disconnect the rear wire harness from the transmission case.
6. Disconnect and remove the brake pedal control rods from each side.
7. Remove the clutch housing to transmission buckle-up bolts.
8. Using a heavy rubber mallet, loosen the clutch housing mating joint. While rotating the shift lever, slide the clutch housing forward separating the shift lever ball end from the shift rail notches.

   NOTE: *The steering column and shift linkage do not need to be removed for this operation.*

9. Remove the transmission cover.
10. Remove the hydraulic lift cover.
11. Remove the internal buckle-up bolt, 1.
12. Attach an overhead hoist to the transmission case.
13. Remove the external buckle-up bolts, 2.



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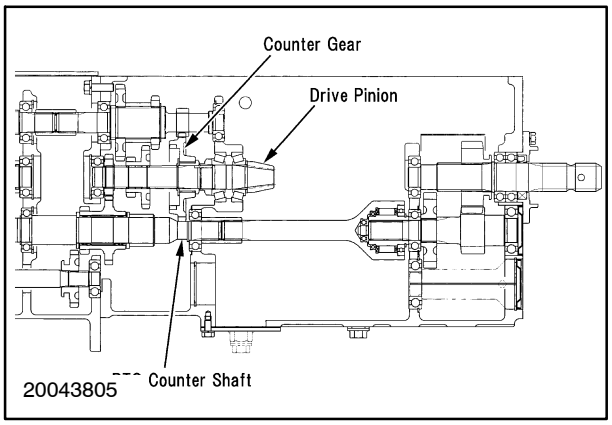
NOTE: *On models with a 9x3 transmission, the PTO counter shaft must be turned before separation. The flat face of the PTO counter shaft, must face the counter gear avoiding any interference.*

14. Using a heavy rubber mallet, loosen the transmission case mating joint and slide the transmission forward off the dowel pins.



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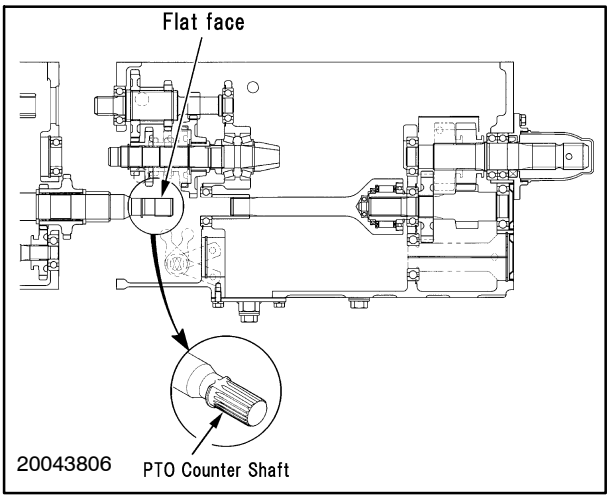
Installation

Installation generally follows the removal procedures in reverse order.

NOTE: *On models with a 9x3 transmission, the flat face of the PTO counter shaft must be turned towards the counter gear to avoid any interference, prior to installation.*

During installation, clean the transmission, clutch housing, and rear axle center housing mating surfaces and coat with liquid sealer. Use caution to prevent excess sealer from entering the inside of the housing and contaminating the hydraulic fluid supply.



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SPECIFICATIONS

9× 3 GEAR TRANSMISSION

Gear Backlash	0.04 - 0.16 mm (0.002- 0.006″)
Wear Limit	0.6 mm (0.024″)
Clearance Between Slide Gear and Shifter Fork	0.2 - 0.4 mm (0.008- 0.016″)
Wear Limit	1.0 mm (0.040″)
Clearance Between Shifter Rod and Housing Bearing	0.03 - 0.1 mm (0.0012- 0.004″)
Wear Limit	0.3 mm (0.012″)

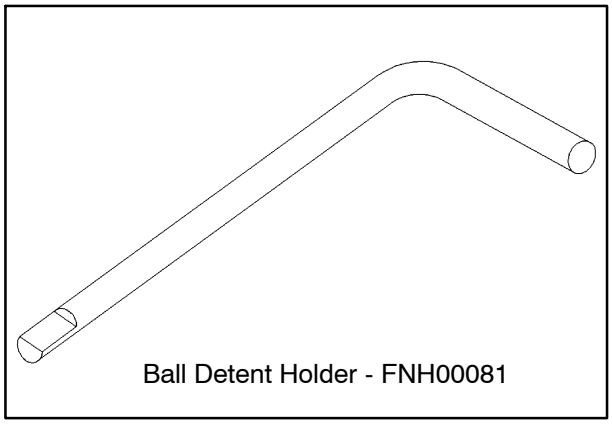
GENERAL BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch	Pounds-Feet	Newton Meters	Pitch	Pounds-Feet	Newton Meters
M6	4T	1.0	3.6.5.1	4.9.6.9	—	—	—
	7T		6.1.8.3	8.3.11.3			
	10T		8.7.11.6	11.8.15.7			
M8	4T	1.25	9.4.12.3	12.7.16.7	1.0	11.2.14.8	15.2.20.1
	7T		16.6.21.0	22.6.28.4		19.5.25.3	26.5.34.3
	10T		21.0.26.8	28.4.36.3		22.4.29.7	30.4.40.2
M10	4T	1.5	18.8.24.6	25.5.33.3	1.25	21.0.26.8	28.4.36.3
	7T		32.5.41.2	44.1.55.9		36.2.46.3	49.0.62.8
	10T		39.8.51.4	53.9.69.9		42.7.54.2	57.9.73.5
M12	4T	1.75	27.5.34.7	37.3.47.1	1.25	31.8.40.5	43.1.54.9
	7T		48.5.61.5	65.7.83.4		55.0.69.4	74.5.94.1
	10T		68.0.85.4	92.9.116		73.1.93.3	99.0.127
M14	4T	2.0	46.3.59.3	62.8.80.4	1.5	51.4.64.4	69.6.87.3
	7T		76.7.96.9	104.131		86.1.1.09	117.148
	11T		102.129	139.175		108.137	147.186
M16	4T	2.0	63.6.81.0	86.3.110	1.5	67.3.84.6	91.3.115
	7T		110.136	149.184		116.142	157.192
	11T		152.188	206.255		163.199	221.270
M18	4T	2.0	83.9.104	114.141	1.5	95.9.120	313.163
	7T		145.174	196.235		170.206	131.279
	11T		203.246	275.333		221.271	299.368
M20	4T	2.5	106.132	144.179	1.5	127.156	172.211
	7T		177.213	240.289		203.246	275.333
	11T		268.325	363.441		293.358	397.485

SPECIAL TOOLS

0-5000 psi gauge - OEM 1463

0-300 psi gauge - OEM 1455



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SECTION 25 - FWD FRONT AXLE

Chapter 1 - FWD Front Axle

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SPECIFICATIONS

FOUR WHEEL DRIVE

Differential Pinion Gear to Pinion Shaft Clearance	0.1 mm (0.004 in.)
Differential Pinion Bear Thrust Washer Thickness	1.2 mm (0.047 in.)
Differential side Gear To Pinion Gear Backlash	0.2 - 0.3 mm (0.078 - 0.012 in.)
Drive Pinion Bearing Pre-Load	13 - 17 kg (28.7 - 37.4 lbs.) pull
Differential Housing Pivot Trunnion to Bushing Clearance -	
Front	0.02 - 0.15 mm (0.0008 - 0.006 in.)
Maximum	0.35 mm (0.014 in.)
Rear	0.02 - 0.15 mm (0.0008 - 0.006 in.)
Maximum	0.35 mm (0.014 in.)
King Pin Inclination (fixed)	10°
Chamber (fixed)	2°
Final Pinion Gear-To-Bevel Gear Backlash	0.2 - 0.4 mm (0.008 - 0.016 in.)
Front Axle Pivot End Play	0.3 mm (0.012 in.)
Maximum	0.8 mm (0.15 in.)
Front Wheel Toe-In	0 - 5 mm (0 - 3/16 in.)
Ball Joint Nut Torque	43.1 - 54.9 N·m (31.8 - 40.5 ft. lbs.)

BOLT TORQUE SPECIFICATIONS

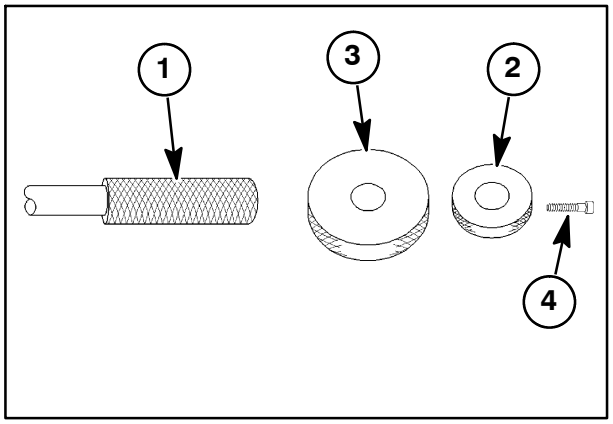
		Coarse Thread			Fine Thread		
Bolt Size	**Grade No.**	**Pitch (mm)**	**Foot· Pounds**	**Newton· Meters**	**Pitch (mm)**	**Foot· Pounds**	**Newton· Meters**
M6	4T	1.0	3.6·5.1	4.9·6.9	—	—	—
	7T		6.1·8.3	8.3·11.3			
	10T		8.7·11.6	11.8·15.7			
M8	4T	1.25	9.4·12.3	12.7·16.7		11.2·14.8	15.2·20.1
	7T		16.6·21.0	22.6·28.4		19.5·25.3	26.5·34.3
	10T		21.0·26.8	28.4·26.3		22.4·29.7	30.4·40.2
M10	4T	1.5	18.8·24.6	25.5·33.3		21.0·26.8	28.4·36.3
	7T		32.5·41.2	44.1·55.9		36.2·46.3	49.0·62.8
	10T		39.8·51.4	53.9·69.9		42.7·54.2	57.9·73.5
M12	4T	1.75	27.5·34.7	37.3·47.1		31.8·40.5	43.1·54.9
	7T		48.5·61.5	65.7·83.4		55.0·69.4	74.5·94.1
	10T		68.0·85.4	92.9·11.6		73.1·93.3	99.0·127
M14	4T	2.0	46.3·59.3	62.8·80.4		51.4·64.4	69.6·87.3
	7T		76.7·96.9	104·131		86.1· 109	117·148
	10T		102·129	139·175		108·137	147·186
M16	4T	2.0	63.6·81.0	86.3·110		67.3·84.6	91.3·115
	7T		110·136	149·184		116·142	157·192
	10T		152·188	206·255		163·199	221·270
M18	4T	2.0	83.9·104	114·141		95.9·120	313·163
	7T		145·174	196·235		170·206	131·379
	10T		203·246	275·333		221·271	299·368
M20	4T	2.5	106·132	144·179		127·156	172·211
	7T		177·213	240·289		203·246	275·333
	10T		268·325	363·441		293·358	397·485

SPECIAL TOOLS

Seal Driver Set FNH00293

Includes:

1. 27488 Handle
2. 27515 Drive Plate
3. 27536 Drive Plate
4. 10020 Socket Head Cap Screw
5. FNH00294 Wear Ring Installer



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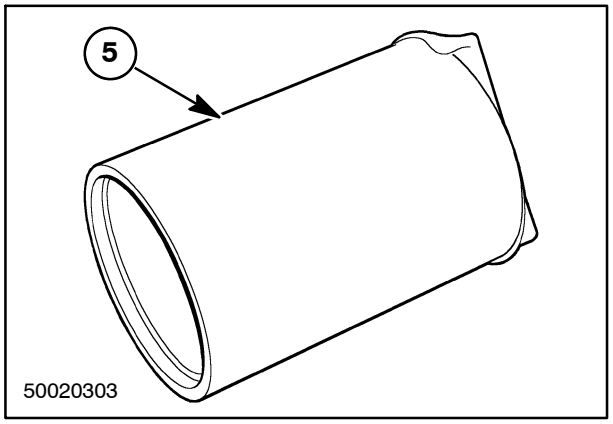


2

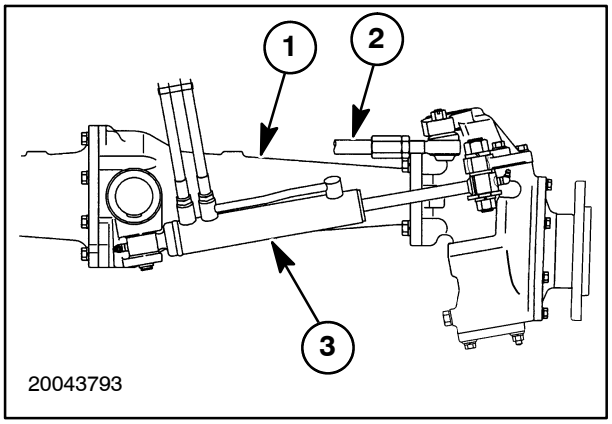
DESCRIPTION OF OPERATION – FRONT-WHEEL DRIVE FRONT AXLE

Op. 25 100
The front-wheel drive is optional equipment and is available on all models. The front-wheel drive system uses the same supporting system as the two-wheel drive models.

IMPORTANT: *The front-wheel drive front axle, 1, is not adjustable and the front wheels are not to be reverse.*

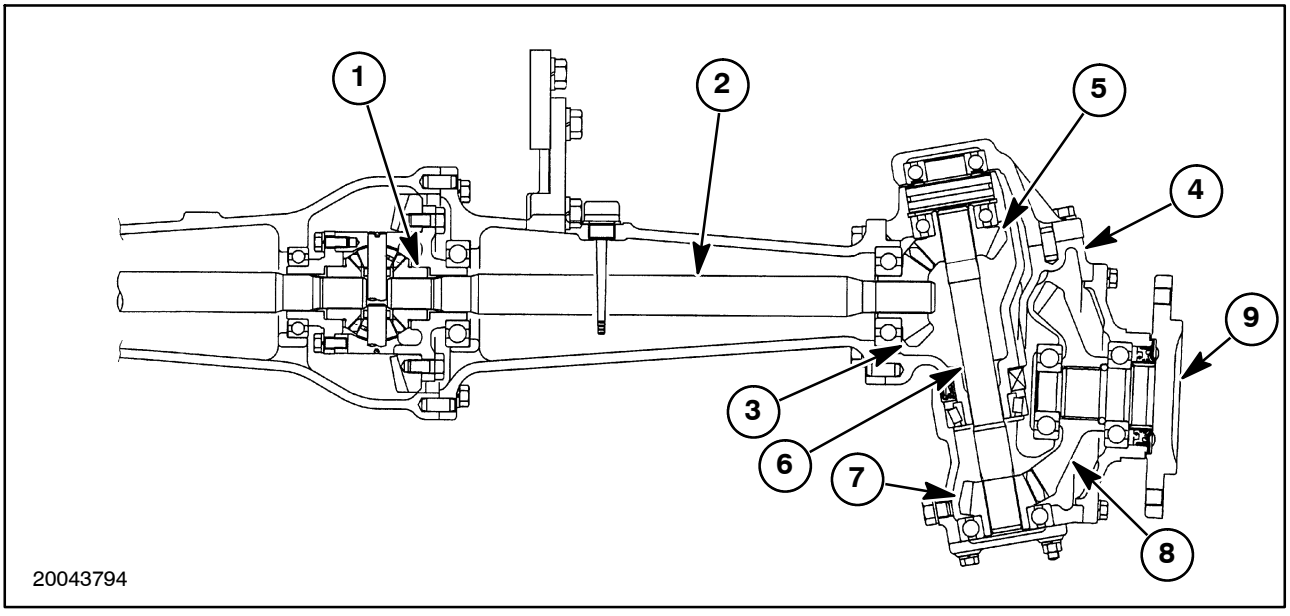
The front-wheel drive tread setting for agricultural tires is 1102.4 mm (43.4″).

The front-wheel tie rod assembly, 2, is adjustable for toe-in adjustments. The power steering cylinder, 3, is located between the front axle and the steering arm.



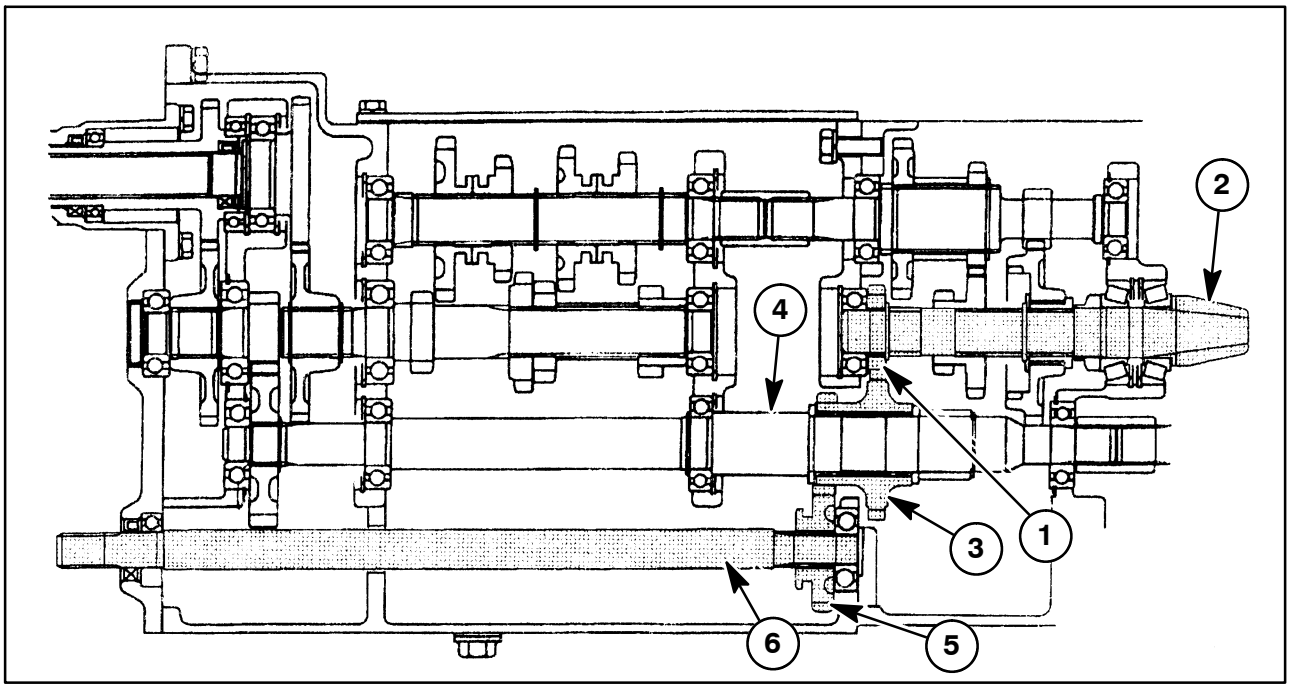
3

Power to the front wheels flows from the front axle differential side gear, 1, and axle shaft, 2, to the reduction gear box assembly, 4. A pinion gear, 3, on the axle shaft drives an idler pinion, 5, and idler shaft, 6, in the drop box. A final drive pinion, 7, on the idler shaft drives the bevel gear, 8, which is splined to the wheel hub and shaft assembly, 9.



4

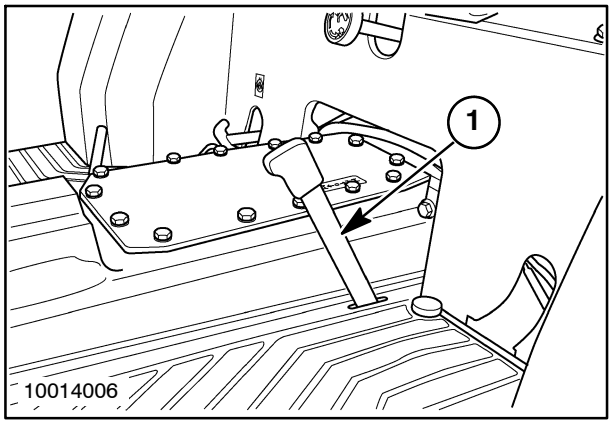
1. Differential Side Gear
2. Axle Shaft
3. Pinion Gear
4. Reduction Drop Box
5. Idler Pinion Gear
6. Idler Pinion Shaft
7. Final Pinion Gear
8. Final Bevel Gear
9. Wheel Hub and Axle



5

If equipped with front wheel drive, the pinion shaft, 2, contains FWD gear, 1. The front PTO countershaft, 4, contains counter gear, 3. The front wheel drive shaft, 6, and sliding gear, 5, are also provided.

The front-wheel drive control lever, 1, is located along the left-hand side of the transmission. To engage front-wheel drive, depress the clutch pedal fully and move the lever completely rearward. To disengage front-wheel drive, depress the clutch pedal and move the lever fully forward.



6

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
Front Wheel Shimmy	1. Worn pivot shaft and/or bushings 2. Loose tie-rod 3. Loose spindle arm 4. Worn king pin and/or bearing	1. Replace pivot shaft and/or bushings 2. Tighten tie-rod 3. Tighten spindle arm 4. Replace king pin and/or bearing
Hard Steering	1. Faulty power steering system	1. Inspect and repair power steering system
Loose Spindle	1. Worn bushing 2. Worn spindle shaft 3. Worn or damaged thrust bearing	1. Replace bushing 2. Replace spindle shaft 3. Replace thrust bearing

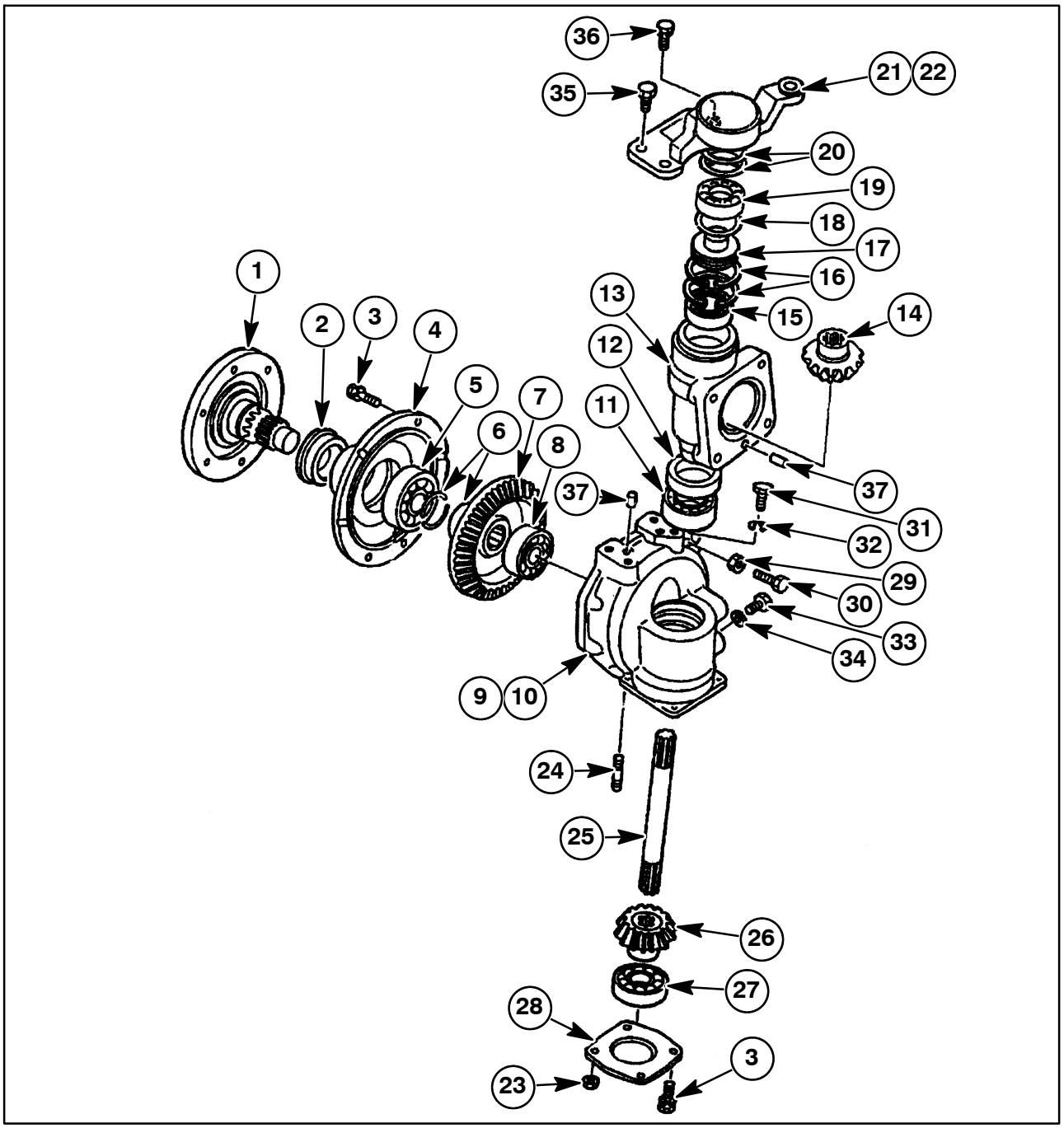
OVERHAUL

FRONT-WHEEL DRIVE FRONT AXLE

Removal

Remove the axle as an assembly from the tractor. See “Separating the Tractor,” later in this section.

NOTE: *Prior to removal of the axle from the support, check the axle pivot end play. See “Inspection,” discussed later in this section.*



7

1. Wheel Shaft
2. Oil Seal
3. Bolt, M8 x 25
4. Cover
5. Ball Bearing
6. Clip
7. Final Gear
8. Ball Bearing
9. Drop Box Casing Assembly, LH (includes items 37 and 24)
10. Drop Box Casing Assembly, RH (includes items 37 and 24)
11. Tapered Roller Bearing
12. Oil Seal
13. Idler Casing Assembly (includes item 37)
14. Final Pinion Gear
15. Ball Bearing
16. Snap Ring
17. King Pin
18. O ring
19. Ball Bearing
20. Shims, 0.2, 0.5
21. Steering Arm LH
22. Steering Arm RH
23. Nut
24. Bolt
25. Driveshaft
26. Gear
27. Ball Bearing
28. Cover
29. Nut
30. Bolt, M10 x 25
31. Plug
32. Seal Washer
33. Drain Plug
34. Seal Washer
35. Bolt
36. Bolt
37. Dowel Pin

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REDUCTION GEAR - DROP BOX

Disassembly (Figure 7)

1. Remove the front wheel hub bolts and remove the front wheels.
2. Remove the tie rod from the steering arm, 21 or 22. Tap the steering arm to loosen the ball joint pin if necessary.
3. Remove drain plug, 33, and drain the oil from the drop box case, 9 or 10, in a clean container.
4. Remove the power steering cylinder from the steering arm and front axle. See “Steering,” Section 41.
5. Remove the case cover bolts, 3, and remove the wheel hub, 1, cover, 4, and final bevel gear, 7, as an assembly.

⚠ WARNING ⚠

The drop box, 9 or 10, are free to disengage and fall away from the idler gear case, 13, when the steering arm, 21 or 22, bolts, 35 and 36, are removed. Use care to avoid accidental disengagement of the components. Uncontrolled dropping of the components may cause personal injury.

6. Remove the four retaining bolts, 35 and 36 from the steering arms, 21 or 22.
7. Remove the drop box case, 9 or 10; the final drive pinion, 26; and the final drive shaft, 25; as an assembly from the idler case, 13.
8. Remove the final pinion, 26, bearing, 27, cover, 28, and shaft, 25, as an assembly from the drop box, 9 or 10.
9. Remove the idler case, 13, from the front axle.
10. Remove the oil seal, 12, and taperer roller bearing, 11, from the drop box case, 9 or 10.
11. Remove the wheel hub shaft inner bearing, 8, from the shaft and remove the final drive bevel gear, 7.
12. Remove split clip, 6, and gently drive the hub and shaft assembly, 1, out of the cover, 4.
13. Remove the bearing, 5, and oil seal, 2, from the cover, 4.
14. Remove the final pinion gear, 14, and bearing, 15, from inside of the idler case, 13.
15. Remove the axle drive pinion gear and O ring seal from the front axle housing.
16. Remove the bearing, 19, king-pin, 17, O ring, 18, and snap ring, 16, from the case, 13.

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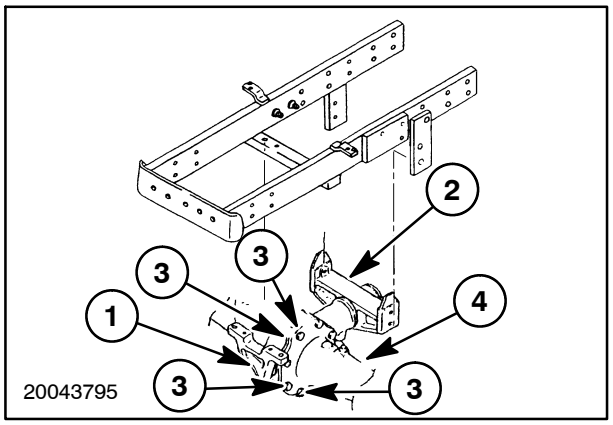
FRONT AXLE AND DIFFERENTIAL

Disassembly

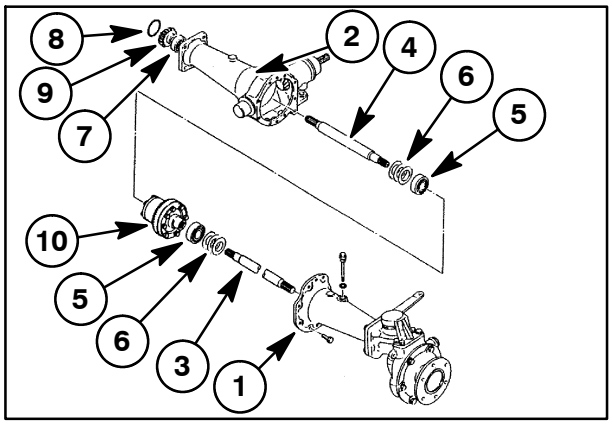
NOTE: *Follow process in "Separating the Tractor," later in this section, for removal of front axle from the tractor frame.*

1. Remove the axle pivot front and rear bearing holders, 1 and 2, from the axle.
2. Remove the left axle housing retaining bolts, 3, and remove the axle housing and shaft as an assembly, 4.
3. Remove the differential assembly, 10, and differential carrier bearings, 5, from the axle housing, 2.
4. Remove the axle outer pinion gear, 9, from and gently drive the axle shaft, 3 or 4, inward to remove from the housing, 1 or 2.

   NOTE: *Observe the quantity and size shims, 6, between the axle shaft inner bearing and the axle housing. Shim sizes are: 0.1 mm (0.004″), 0.2 mm (0.008″), and 0.5 mm (0.020″).*
5. Check the differential side gear to pinion backlash. Replace the gears if backlash exceeds 0.3 mm (0.012″).



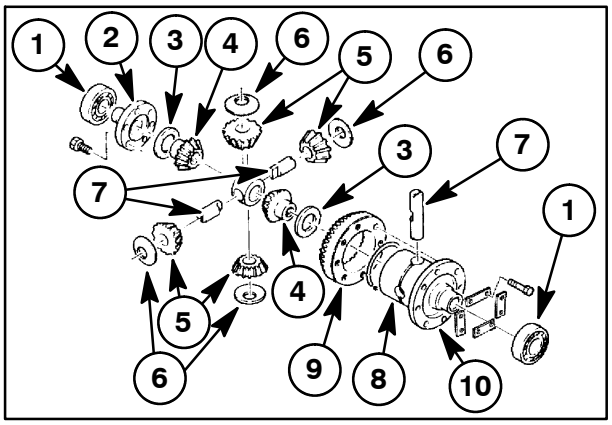
8



9

1. Axle Housing - Left
2. Axle Housing - Right
3. Axle Shaft - Left
4. Axle Shaft - Right
5. Differential Carrier Bearing
6. Shims
7. Outer Bearing
8. O ring
9. Pinion Drive Gear
10. FWD Differential Assembly

6. Remove the bolts from the differential case cover, 2.
7. Remove the differential side gear, 4, and thrust washer, 3.
8. Remove the pinion gear shaft retaining ring, 8, and slide the pinion shaft, 7, out of the case.
9. Remove the four pinion gears, 5, and thrust washers, 6.
10. Remove the differential side gear, 4, and thrust washer, 3.



10

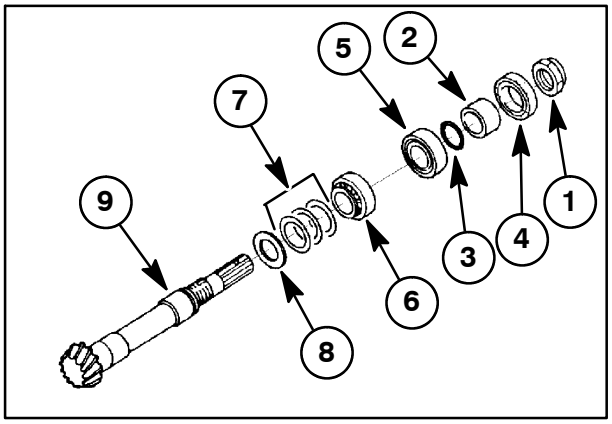
1. Differential Carrier Bearing
2. Differential Case Cover
3. Thrust Washer
4. Differential Side Gear (2)
5. Pinion Gear (4)
6. Pinion Thrust Washer (4)
7. Pinion Shafts (3)
8. Pinion Shaft Retaining Ring
9. Ring Gear
10. FWD Differential Case

DRIVE PINION

Disassembly

1. Remove the drive pinion locknut, 1.
2. Remove the oil seal, 4, collar, 2, and O ring, 3.
3. Gently drive the pinion shaft inward and remove the pinion assembly, 9, with tapered roller bearing, 6, thrust washer, 8, and shims, 7, from the axle housing as an assembly.

   NOTE: *Observe the quantity and size shims used on the pinion shaft. Shim sizes are: 0.1 mm (0.004 ″), 0.2 mm (0.008 ″), and 0.5 mm (0.020 ″).*
4. Remove the bearing, 6, shims, 7, and thrust washer, 8, from the pinion shaft.
5. Remove the tapered roller bearing, 5, from the case.



11

1. Locknut
2. collar
3. O Ring
4. Oil Seal
5. Tapered Roller Bearing
6. Tapered Roller Bearing
7. Shims
8. Thrust Washer
9. FWD Pinion Shaft

FRONT AXLE

Inspection and Repair

1. Wash all parts in a suitable solvent and air dry.
2. Check the clearance between the axle pivot bushings and differential case trunnions. Replace the bushing in the bearing holders if clearance is excessive:

Bearing Clearance

Front and Rear	0.02 mm (0.0008″)
Wear LImit	0.35 mm (0.014″)

NOTE: *When bushings are replaced, install new bushings using a suitable driver and recess the bushings to allow for the O rings and the seals.*

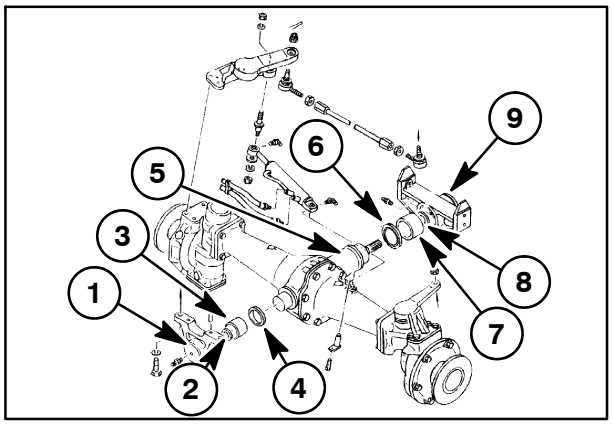
3. Using a suitable driver, install new oil seals being sure to install with the seal lips facing toward the differential assembly.
4. If not checked previously, assemble the differential housing to support, and check the axle pivot end play. Use a dial indicator to measure the end play clearance. If the end play is greater than 0.8 mm (0.0315″), loosen the mounting bolts and slide rear bearing holder forward to obtain the proper clearance. Tighten the retaining bolts and repeat the check until end play is within limits.
5. Install the tie rod ends onto the steering arms and torque the retaining castle nuts to 199 - 235 N·m (142 - 172 ft. lbs.).

DIFFERENTIAL

Inspection and Repair

1. Wash all parts in a suitable solvent and air dry.
2. Using a telescoping gauge and micrometer, measure the pinion gear bore and the pinion shaft diameter and determine the gear to shaft clearance. Replace the gear and/or shaft if the clearance exceeds 0.5 mm (0.02″).
3. Measure the differential to side gear thrust washer thickness. Replace the thrust washers if the thickness is less than 0.7 mm (0.0276″). Measure the pinion gear thrust washer thickness. Replace the thrust washers, if the thickness is less than 0.9 mm (0.0354″).

   NOTE: *If the thrust washers are replaced, recheck the side gear to pinion gear backlash during assembly. Refer to backlash check made during disassembly.*
4. Inspect all gear teeth for excess wear or damage. Replace gears if teeth wear is excessive.



12

1. Front Bearing Holder
2. Thrust Washer
3. Bushing (Front)
4. Oil Seal (Front)
5. Pivot Trunnion
6. Oil Seal (Rear)
7. Bushing (Rear)
8. Thrust Washer
9. Rear Bearing Holder

GEAR REDUCTION - DROP BOX

Inspection and Repair

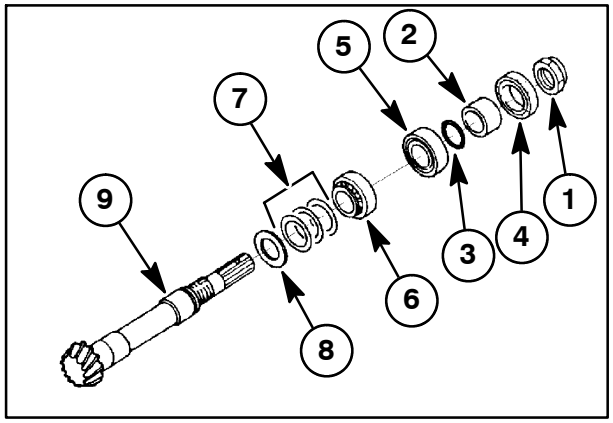
1. Wash all parts in a suitable solvent and air dry.
2. Inspect the gears for excessive wear or damage. Replace gears that show excessive wear. See " Assembly," for gear backlash checks.
3. Inspect the splines on the pinion gears, idler shaft, and axle shaft for excess wear or damage.
4. Check the bearings for wear or roughness. Rotate the bearings by hand and replace bearing as required.
5. On assembly, check the bevel gear and pinion backlash. See "Gear Reduction - Drop Box Assembly," discussed later in this section.

FRONT AXLE AND DIFFERENTIAL

Assembly

1. Install the thrust washer, 8, shims, 7, and front pinion bearing, 6, on the drive pinion, 9.

   NOTE: *Shim sizes are: 0.1 mm (0.004 ″), 0.2 mm (0.008 ″), and 0.5 mm (0.020 ″).*
2. Insert the pinion in place in the differential housing.
3. Install the outer bearing, 5, on the pinion shaft in the differential housing.
4. Using a suitable driver, install the oil seal, 4, O ring, 3, and collar, 2, on the shaft.



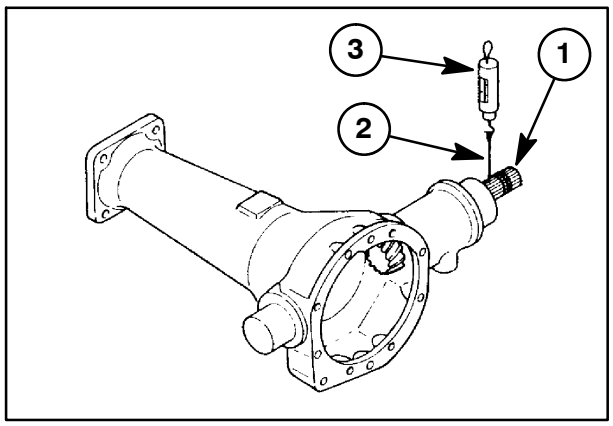
13

1. Nut
2. Collar
3. O ring
4. Oil Seal
5. Tapered Roller Bearing
6. Tapered Roller Bearing
7. Shims
8. Thrust Washer
9. Pinion Assembly

5. Install the pinion locknut, and tighten to obtain the correct bearing pre-load as follows:

   Wrap a strong cord, 2, around the pinion shaft, 1. Using a pull scale, 3, measure the pounds pull to rotate the pinion shaft.

   Tighten or loosen the locknut as necessary to obtain a pre-load 13 - 17 kg (28.7 - 37.4 lbs.) of pull.

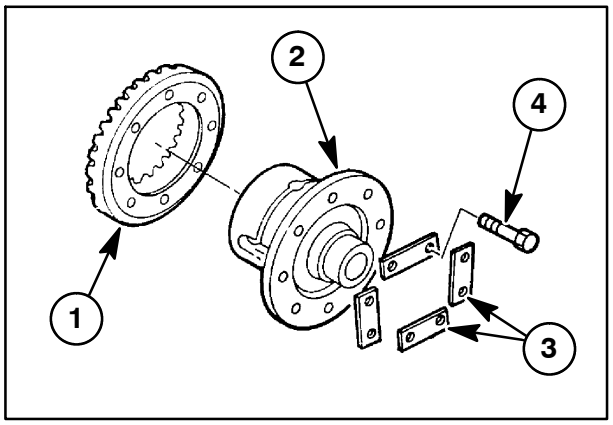


14

DIFFERENTIAL GEAR

Assembly

1. Install the differential ring gear, 1, to the case, 2, and align the mounting bolt holes.
2. Install new locking plates, 3, and attaching bolts, 4, and torque to 44 - 56 N·m (32 - 41 ft. lbs.).



15

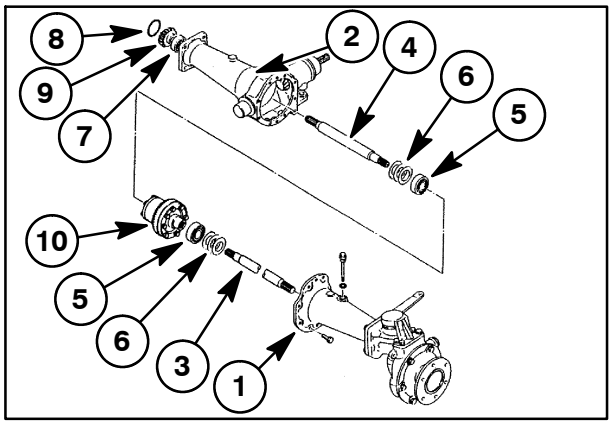
AXLE AND DIFFERENTIAL

Assembly

1. Install the shim pack, 6, and carrier bearing, 5, in the differential axle housing, 2.

   NOTE: *Shim sizes are: 0.1 mm (0.004 ″), 0.2 mm (0.008 ″), and 0.5 mm (0.020 ″).*
2. Install the axle shaft, 4, in the housing from the outer end through the shim pack.
3. Install the axle shaft outer bearing, 7.
4. Position the differential assembly, 10, in the housing inserting the differential outer cover end inside the bearing, 5, previously positioned in the axle housing, 2.
5. Assemble the left axle shaft and housing in the same manner described in steps 1 through 4.
6. Apply liquid gasket to the left axle housing mating surface and align the right and left axle housings together.
7. Install the axle retaining bolts and tighten to the specified torque. See “Bolt Torque Specifications,” discussed later in this Section.

   NOTE: *The differential carrier bearing pre-load and ring gear backlash must be checked and adjusted if differential case bearings, axle shaft inner bearings, or axle shaft have been replaced.*



16

1. Axle Housing - Left
2. Axle Housing - Right
3. Axle Shaft - Left
4. Axle Shaft - Right
5. Differential Carrier Bearing
6. Shims
7. Outer Bearing
8. O ring
9. Pinion Drive Gear
10. FWD Differential Assembly

DIFFERENTIAL CASE BEARING PRE-LOAD CHECK AND ADJUSTMENT

1. Position the differential carrier bearing, 7, and shim pack, 2, in place in the right differential axle housing, 6.
2. Place the differential assembly, 5, in the housing being sure the differential case is fully seated inside the bearing, 7.
3. Position the left differential case bearing, 8, on the differential case, being sure it is fully seated.
4. Measure the distances “A” and “B”. Add or subtract shims from the shim pack so that the measurements “A” - “B” = 0.15 mm (0.006″).

RING GEAR-TO-PINION BACKLASH CHECK AND ADJUSTMENT

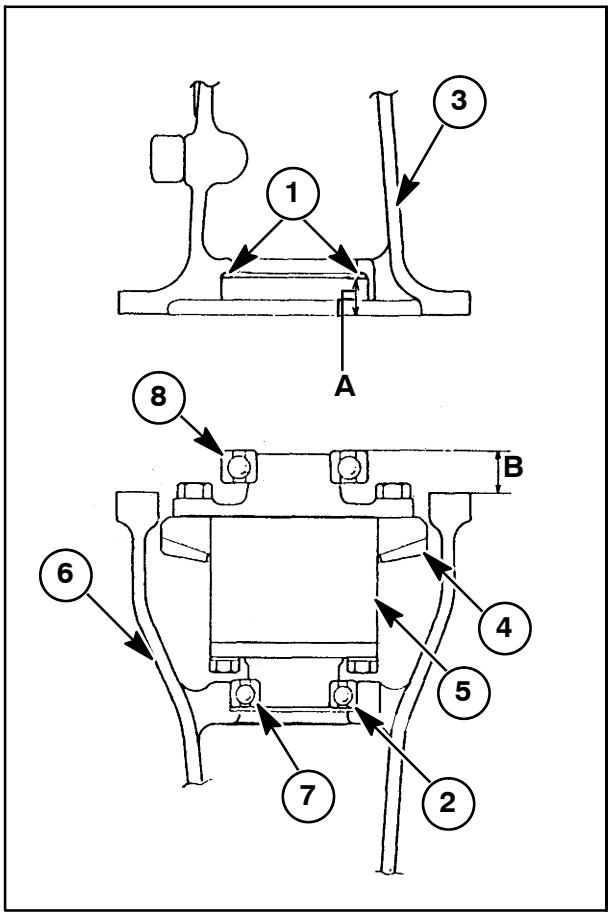
Ring gear-to-pinion backlash must be checked and adjusted whenever new components are used or if the shim requirements are unknown.

NOTE: *This is a continuation of the carrier bearing pre-load adjustment.*

1. Assemble the differential axle housing complete with axle shaft, bearing, and drive pinion following the disassembly procedure in reverse.
2. Position the assembled axle housing assembly in a vertical position, supported by the housing and not the shaft.

   NOTE: *For personal safety, be sure the assembly is properly supported to prevent falling.*
3. Position the differential assembly in the housing being sure the differential case is fully seated in the bearing and axle housing counterbore.

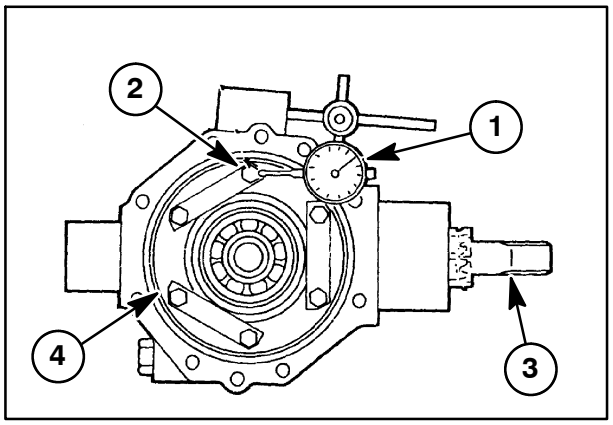
   NOTE: *Be sure there is clearance between the ring gear and the pinion gear. There must not be any interference.*



17

1. Shims, 0.1 mm (0.004″), 0.2 mm (0.008″) and 0.5 mm (0.020″)
2. Shims, 0.1 mm (0.004″), 0.2 mm1 (0.008″) and 0.5 mm (0.020″)
3. Axle Housing - Left
4. Ring Gear
5. Differential Case
6. Axle Housing - Right
7. Bearing - Right
8. Bearing - Left

4. Place a dial indicator, 1, on the axle housing. Rock the ring gear back and forth to obtain the ring gear free-play clearance reading on the dial indicator.



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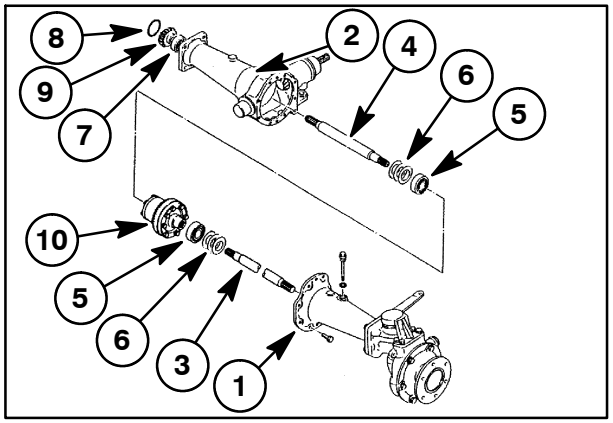
1. Dial Indicator
2. Ring Gear Bolt Head
3. Pinion Shaft
4. Ring Gear

5. If the reading is not within the range of 0.10 - 0.15 mm (0.004 - 0.006″), adjust the shims, 6, between the left and right axles to obtain the correct free-play clearance.
6. Apply Prussian blue to the pinion shaft gear teeth.
7. Rotate the pinion until the ring gear has rotated one complete revolution.
8. Inspect the gear tooth marking. If the markings are incorrect adjust the pinion gear assembly as required to obtain the correct pattern as shown in Figure 20.



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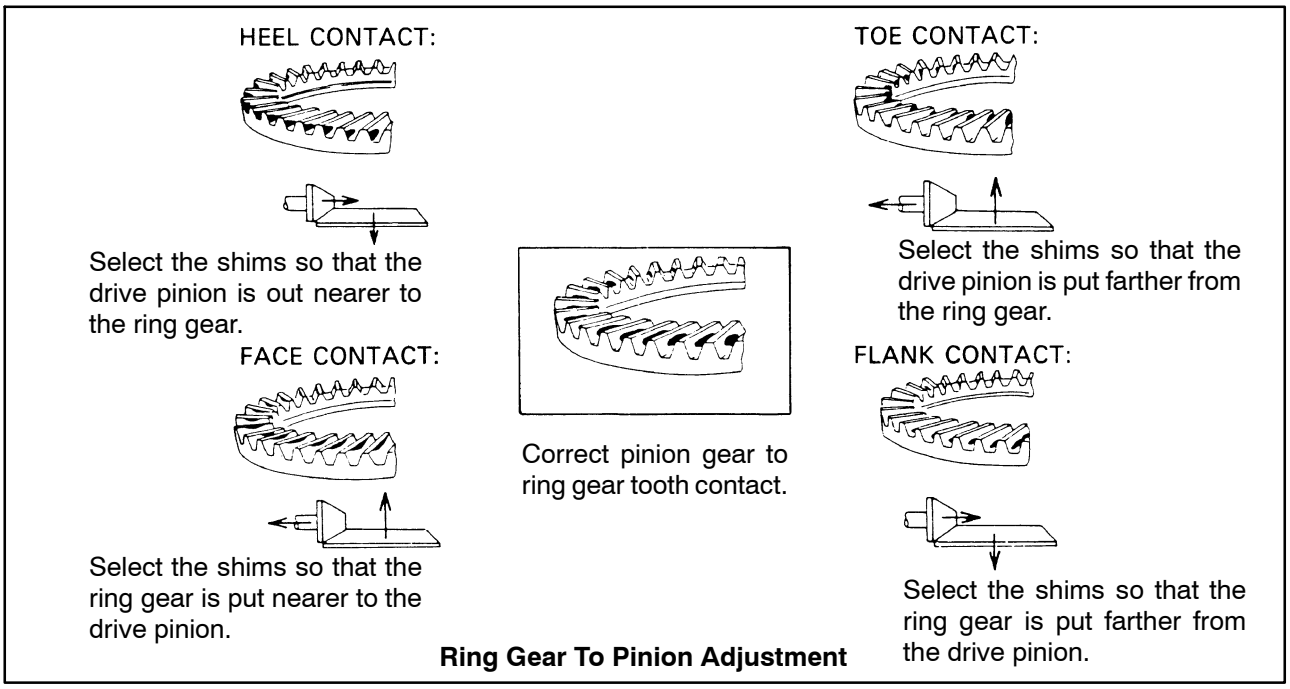
1. Axle Housing - Left
2. Axle Housing - Right
3. Axle Shaft - Left
4. Axle Shaft - Right
5. Differential Carrier Bearing
6. Shims
7. Outer Bearing
8. O ring
9. Pinion Drive Gear
10. FWD Differential Assembly



Ring Gear To Pinion Adjustment

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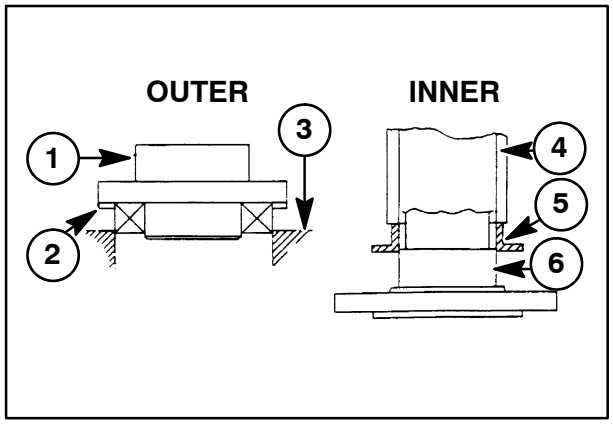
REDUCTION GEAR BOX

Assembly

1. Installation of the oil seal assembly, 2 and 5, is a two step process. Use tool No. FNH00294 to install the inner seal wear ring on the axle shaft. Use tool No. 27536, 27515, drive plates, with tool No. 27488, handle to install the outer part of the seal in the axle cover.

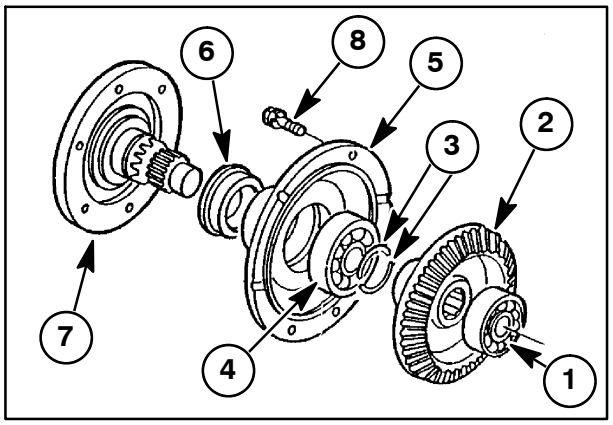
   NOTE: *Seal installation tools 27488, 27515, 27536, and 00294 are included in the Seal Driver Set FNH00293.*



21

1. Seal Installer
2. Seal Outer Half
3. Axle Cover
4. Wear Ring Installer Tool
5. Seal Inner Wear Ring
6. Axle Shaft

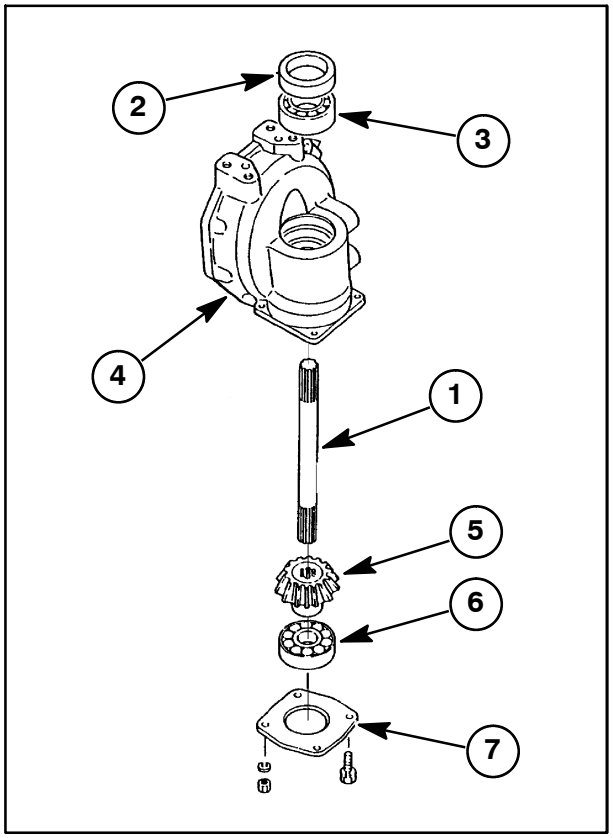
2. Position the wheel shaft outer bearing, 4, and oil seal, 6, in the cover, 5.
3. Install the hub and shaft assembly, 7, in the cover.
4. Position the two piece locking ring, 3, in the shaft groove.
5. Install the bevel gear, 2, on the shaft, 7. Be sure the bevel gear counterbore hub fits down fully over the locking ring.
6. Install the inner bearing, 1, on the shaft.



22

1. Inner Bearing
2. Final Bevel Gear
3. Split Ring
4. Outer Bearing
5. Drop Box Cover
6. Oil Seal
7. Hub and Shaft Assembly
8. Bolt

7. Install the idler gear bearing, 3, and seal, 2, in the drop box case, 4.
8. Install the final drive pinion gear, 5, bearing, 6, and cover, 7, in the bottom of the drop box case.
9. Install the final pinion shaft, 1, from the top.



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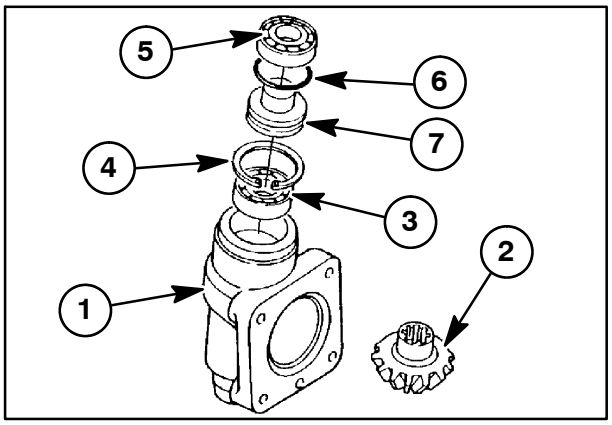
1. Final Pinion Shaft
2. Oil Seal
3. Bearing
4. Drop Box Case
5. Final Pinion Gear
6. Bearing
7. Cover

10. Install the idler bearing, 3, snap ring, 4, king pin, 7, O ring, 6, and bearing, 5, into the idler case, 1.
11. Position the idler gear, 2, inside the idler case, into the bearing, 3.

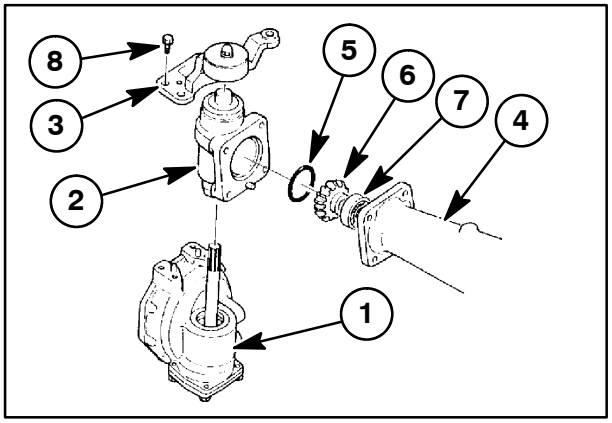


24

1. Idler Case
2. Idler Pinion Gear
3. Bearing
4. Snap Ring
5. Bearing
6. O ring
7. King Pin

12. Position the idler case, 2, onto the drop box case, 1.
13. Install the steering arm assembly, 3, and shims onto the idler gear case.

    NOTE: *Install shims, 0.2 mm (0.008″), and 0.5 mm (0.020″), as required.*
14. Install the retaining bolts, 8, and tighten to the specified torque. See “Bolt Torque Specifications,” discussed later in this Section.
15. Install the pinion gear, 6, and bearing, 7, on the axle shaft. Apply liquid gasket to the mating surface of the axle housing, 4, and idler gear case, 2.
16. Position the O ring, 5, in place on the axle housing and install the drop box assembly, 1, 2, and 3, to the axle housing, 4.
17. Install the retaining bolts and tighten to the specified torque. See “Bolt Torque Specifications,” discussed later in this section.
18. Apply liquid gasket to the drop box cover mating surface and install the cover and hub assembly to the drop box case, 1.
19. Install the retaining bolts and tighten to the specified torque. See “Bolt Torque Specifications”.



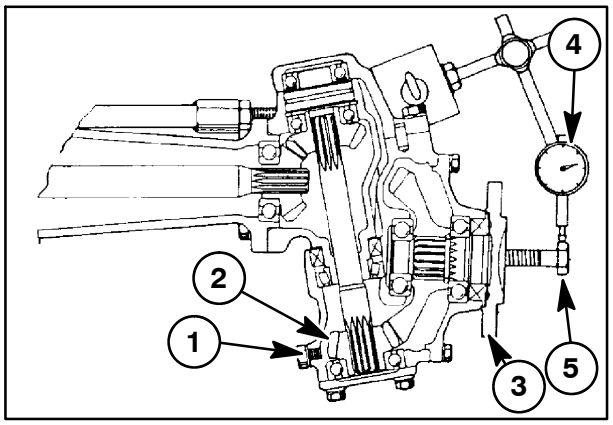
25

1. Drop Box Case
2. Idler Gear Case
3. Steering Arm Assembly
4. Axle Housing
5. O ring
6. Pinion Drive Gear
7. Outer Bearing
8. Bolt

BEVEL GEAR-TO-PINION BACKLASH CHECK

With the front wheels removed and the front end of the tractor supported, check the bevel gear-to-pinion gear backlash.

1. Remove the oil plug, 1, from the drop box case and drain the oil in a suitable container.
2. Install a long bolt in the drain plug hole, 1, so that it contacts the pinion gear, 2, and keeps it from rotating.
3. Install a bolt, 5, in the wheel hub flange, 3, and attach a dial indicator, 4.
4. Rotate the hub back, 3, and forth and observe the dial indicator, 4, reading. Replace the bearings and/or gears if the backlash exceeds 0.5 mm (0.020″).



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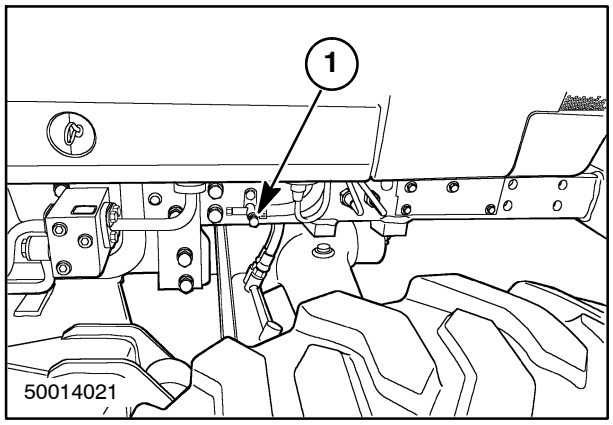
1. Drain Plug
2. Final Pinion Gear
3. Wheel Hub
4. Dial Indicator
5. Hub Bolt

SEPARATING THE TRACTOR

FRONT AXLE - 4WD

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Open the radiator drain valve, 1, and drain the engine coolant into a clean container.



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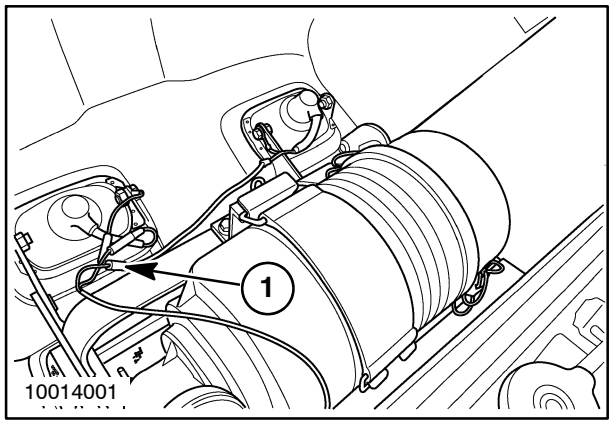
3. Disconnect the headlight wiring harness, 1.



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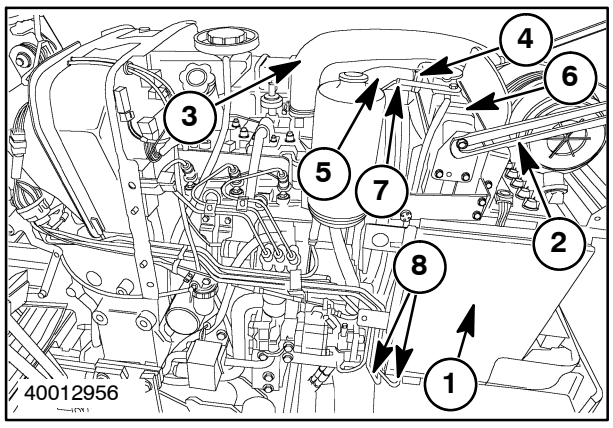
4. Open the hood and remove the two side screens and panels, 1.
5. Remove the hood support, 2, and the two hinge pins to remove the hood from the tractor.
6. Remove the air cleaner assembly, 3, from the tractor engine.
7. Loosen the upper and lower radiator hose clamps, 4, to remove the hoses, 5, from the radiator, 6.
8. Remove the radiator upper support brace, 7, located on top of the radiator.
9. Disconnect the power steering tubes, 8, from the radiator and cap all openings.



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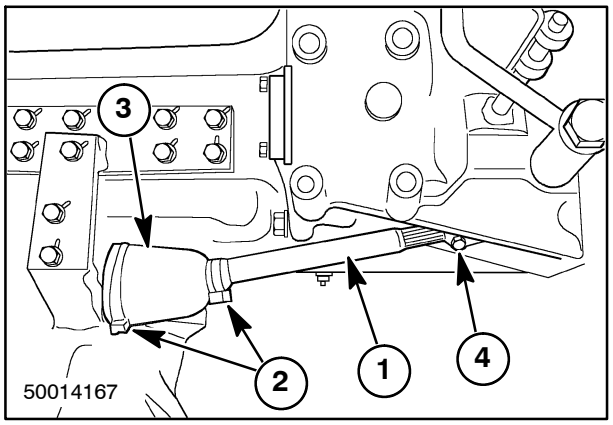
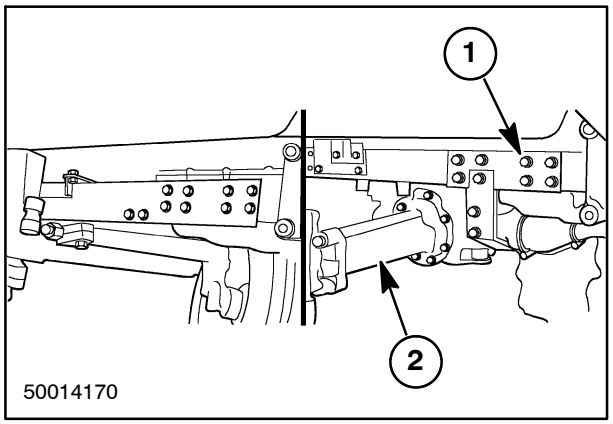
10. Locate the FWD drive shaft, 1, and remove the two boot clamps, 2. Slide the rubber boot, 3, rearward to gain access to the front universal joint.
11. Remove the universal joint retaining bolt, 4, from each end of the drive shaft. Disconnect the transmission end of the drive shaft.
12. Remove the drive shaft front universal from the axle drive pinion shaft.



30

13. Using a floor jack and safety stands under the clutch housing, raise the tractor to support the weight of the front end.
14. Remove the retaining bolts, 1, from each side of the support rails.
15. Carefully roll the front axle assembly, 2, away from the tractor.



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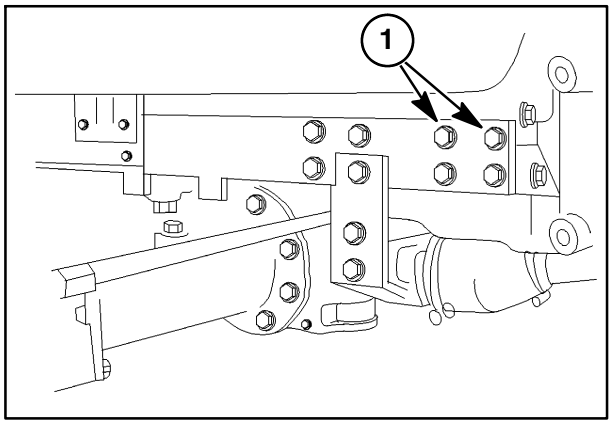
FRONT AXLE (2WD - 4WD)

Installation

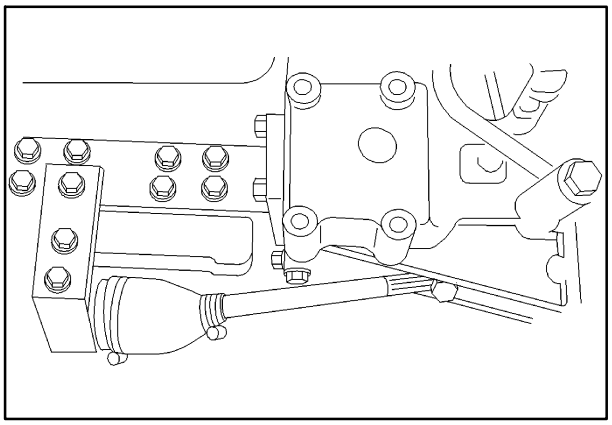
NOTE: *Tighten all hardware to specified torque. See Specifications.*

1. Raise the tractor to provide enough clearance to roll the front axle assembly into position.
2. Install the bolts, 1, on each side of the support rail. Torque the bolts to 204 N·m (150 ft. lbs.).



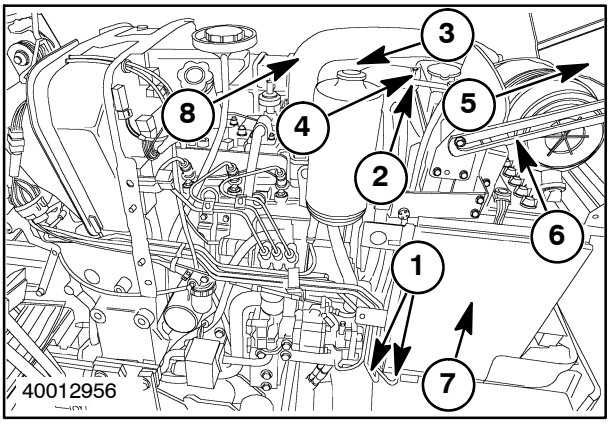
32

3. On FWD models, install each end of the driveshaft by using a universal joint retaining bolt.
4. Slide the rubber boot into position and tighten the clamps.



33

5. Connect the power steering tubes, 1, to the front axle support.
6. Install the radiator upper support brace, 2,
7. Connect the upper and lower radiator hoses, 3, and tighten the hose clamps, 4.
8. Install air cleaner assembly, 8, onto the tractor
9. Connect the negative (–) battery cable to the negative (–) battery terminal.
10. Install the hood, 5, with the attaching hardware.
11. Install the hood support, 6.
12. Connect the headlight wire harness.
13. Install the side panels, 7, and screens (not shown).
14. Fill the coolant system with the proper coolant mixture. See the “Engine” Section.



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SECTION 27 - DIFFERENTIAL, REAR AXLE

Chapter 1 - Differential, Rear Axle

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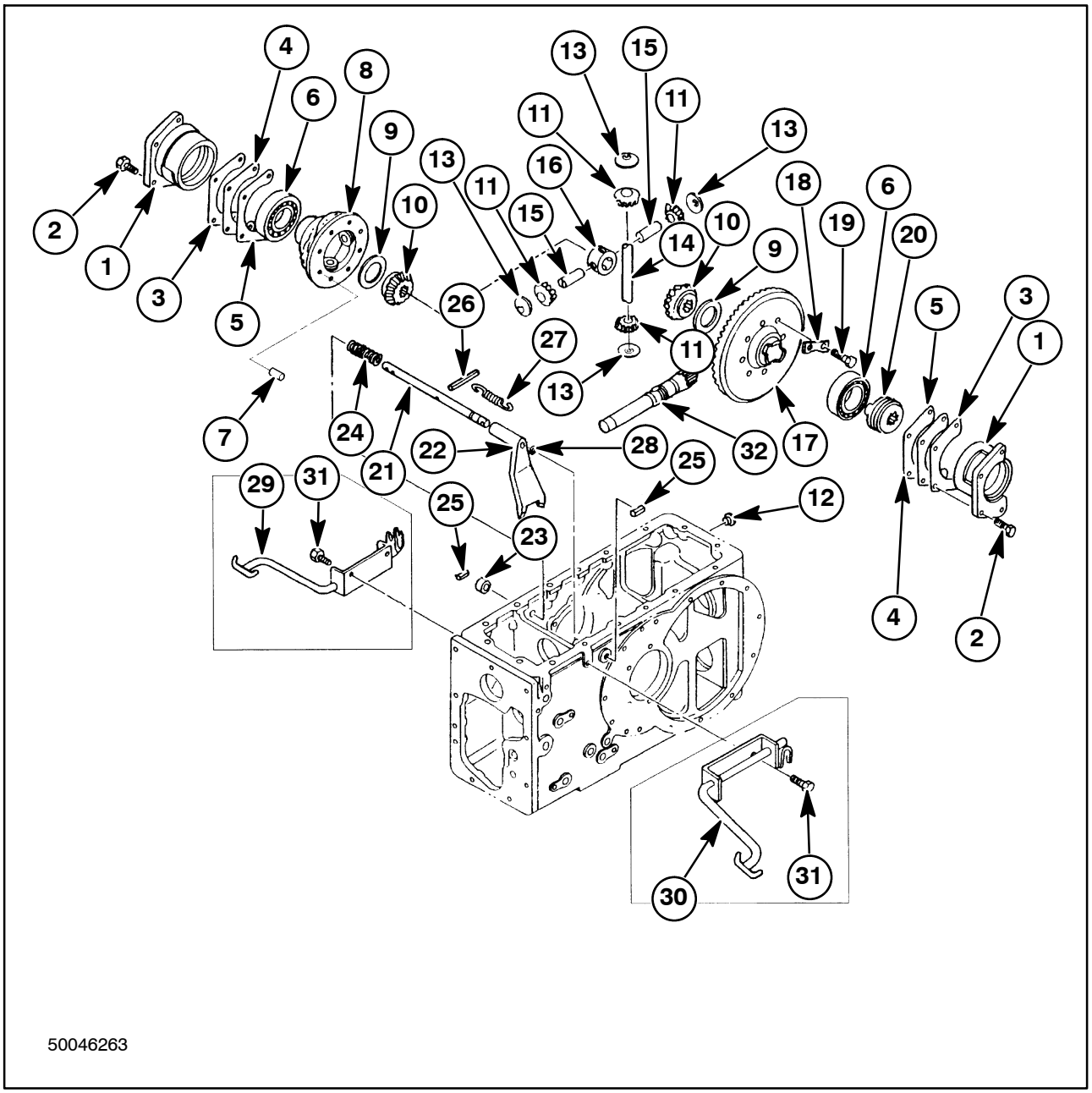
DESCRIPTION OF OPERATION



1

Differential Assembly

1. Bearing Carrier
2. Bolt M10 x 25
3. Shim 0.5 mm (0.020″)
4. Shim 0.3 mm (0.012″)
5. Shim 0.1 mm (0.004″)
6. Ball Bearing
7. Dowel Pin
8. Differential Housing
9. Thrust Washer
10. Differential Gear Side - 16T
11. Differential Pinion Gear - 10T
12. Blank Plug
13. Thrust Washer
14. Pinion Shaft
15. Pinion Shaft
16. Joint
17. Ring Gear Assembly - 47T
18. Lock Plate
19. Bolt M10 x 1.5 x 30
20. Differential Lock Clutch
21. Differential Lock Shaft
22. Differential Lock Fork
23. Oil Seal
24. Spring
25. Roll Pin
26. Roll Pin
27. Spring
28. O ring
29. Differential Lock Pedal 9 × 3
30. Differential Lock Pedal (HST)
31. Bolt M8 x 16
32. Drive Pinion - 7T

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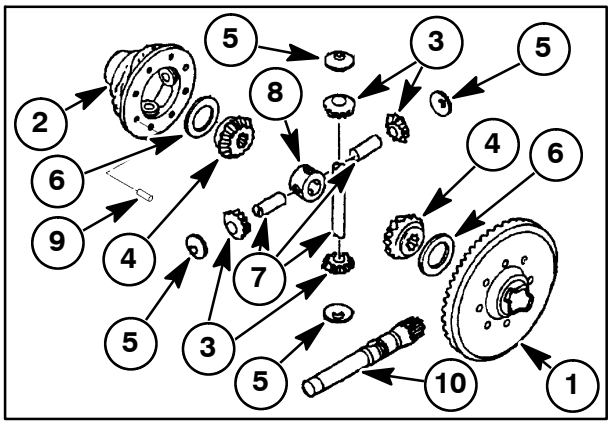
DIFFERENTIAL ASSEMBLY

The differential assembly (refer to Figure 1) consists of the drive pinion, 32, ring gear, 17, differential case, 8, differential pinion gears, 11, and differential lock, 20 - 22. The differential lock is available on all TC30 tractors.

Power is transmitted by the transmission to the differential drive pinion, 10, and ring gear, 1,. The ring gear is bolted to the differential case, 2, which contains the differential pinion gears, 3, and axle side gears, 4, Figure 2.

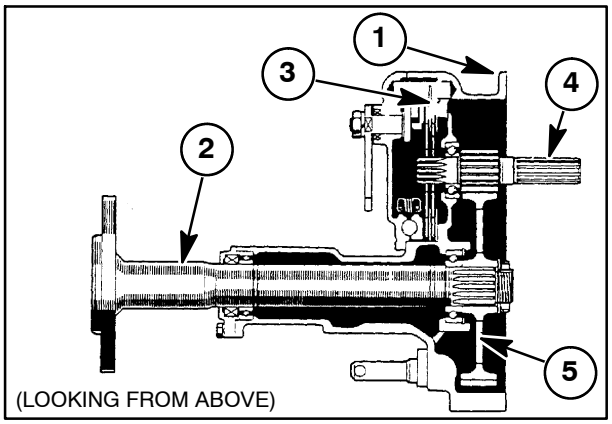
As the differential case rotates, the four differential pinion gears rotate and drive the two axle side gears.



2

1. Ring Gear - 47T
2. Differential Housing
3. Pinion Gear - 10T
4. Differential Side Gear - 16T
5. Thrust Washer (4)
6. Thrust Washer (2)
7. Pinion Shaft
8. Joint
9. Dowel Pin
10. Drive Pinion - 7T

The final drive pinions, 4, are splined to the side gears and mesh with the final drive gear, 5. As the final drive pinions rotate with the differential assembly, power is transmitted to the final drive gears and rear axles, 2.



3

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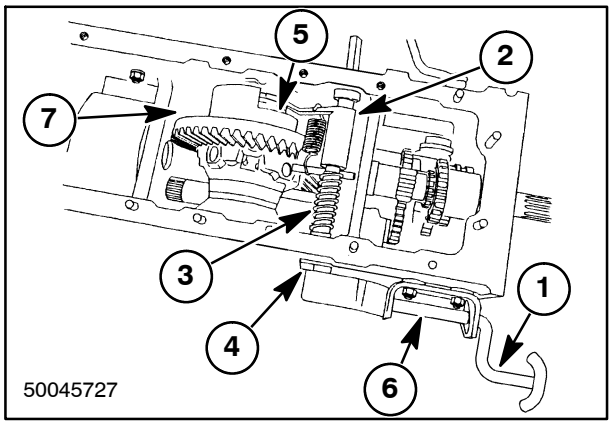
DIFFERENTIAL LOCK

A differential lock is provided to lock the differential system so that both rear wheels rotate when power is provided by the transmission even though one wheel may lose traction.

The differential lock control lever, 1, is foot operated. The pedal lever is located on the right side of the differential housing on gear transmission, and on the left side on HST transmission.

Depressing the differential lock pedal, 1, rotates the shaft, 6, moving the differential lock shaft, 4, causing the fork, 2, to move toward the differential assembly, 7, and at the same time compressing the return spring, 3. This action causes the clutch, 5, to move toward the differential, 7.

When the pedal is released, the return spring moves the fork outward to disengage the clutch.



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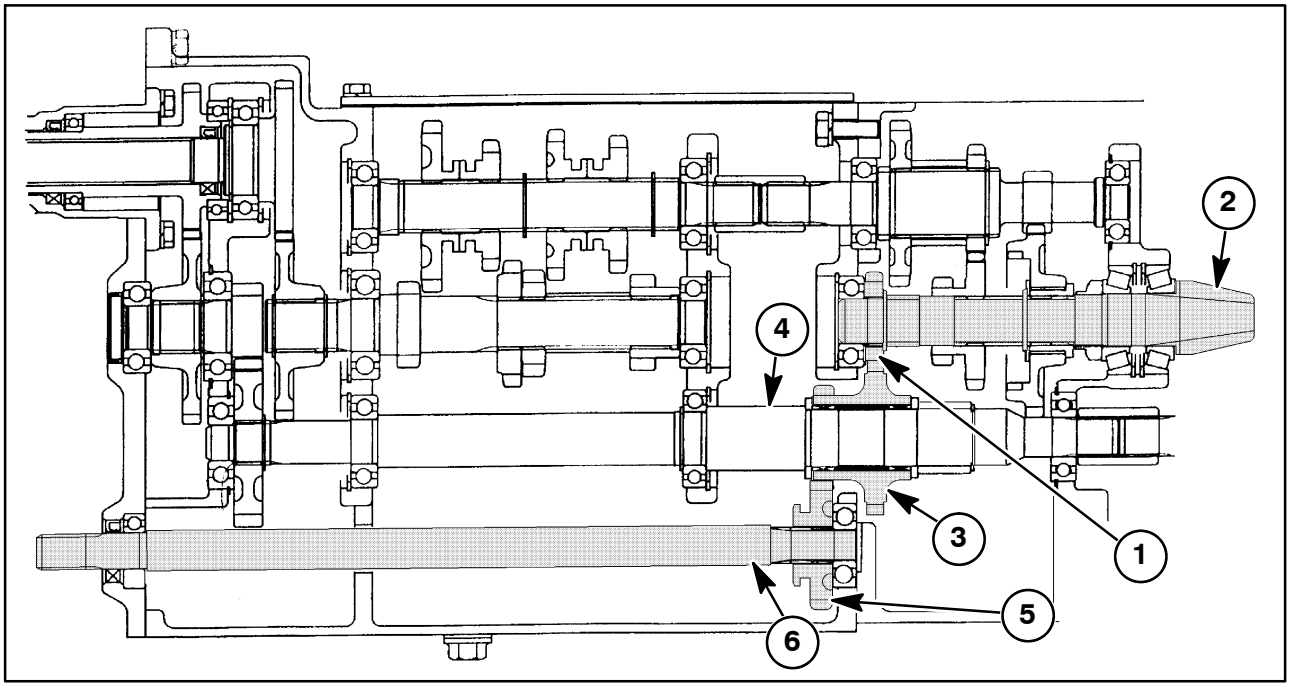

5

If equipped with front wheel drive, the drive pinion shaft, 2, contains FWD gear, 1. The front PTO countershaft, 4, contains counter gear, 3. The front wheel drive shaft, 6, and sliding gear, 5, are also provided.

OVERHAUL

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DIFFERENTIAL

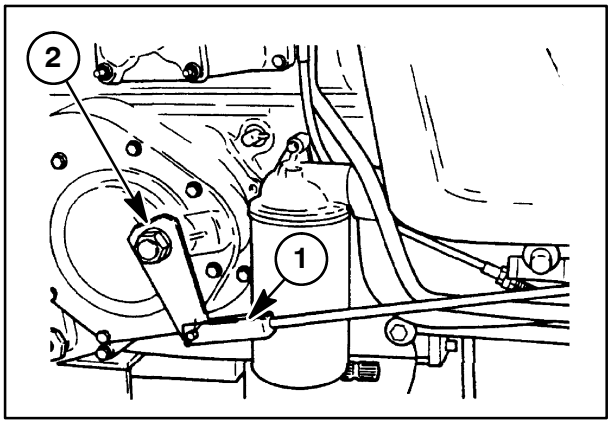
Removal

The differential assembly may be removed without removing the center housing from the tractor. To do so, remove both of the rear axle housings and the hydraulic lift cover and related components, see "Hydraulic System, Lift Cylinder Removal." If the center housing needs to be removed, see "Separating, Rear Axle and Center Housing Removal," discussed later in this chapter.

1. Remove the rear wheels and fenders from the tractor.
2. Drain the fluid from the combined transmission, rear axle, and hydraulic reservoir system.
3. Remove the lower lift links and stabilizers.
4. Disconnect the brake control rod, 1, from the brake cover lever, 2.
5. Attach a suitable overhead lifting device, 1, to the rear axle assembly, 2, and remove the axle housing retaining bolts.
6. Carefully move the axle assembly out and away from the tractor. The final gear and final differential pinion remain with the axle assembly.

⚠ WARNING ⚠

The axle housing is difficult to balance. Exercise care during removal to avoid personal injury.



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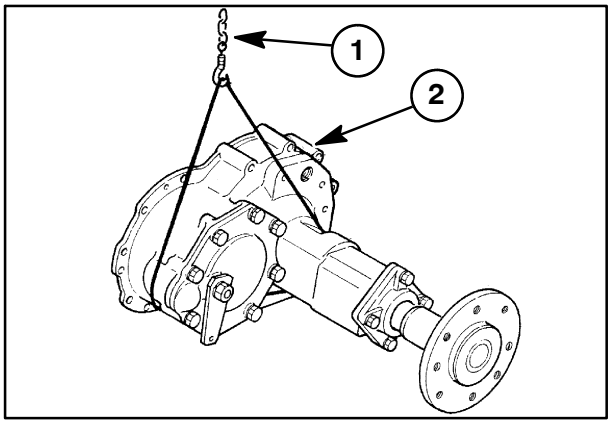

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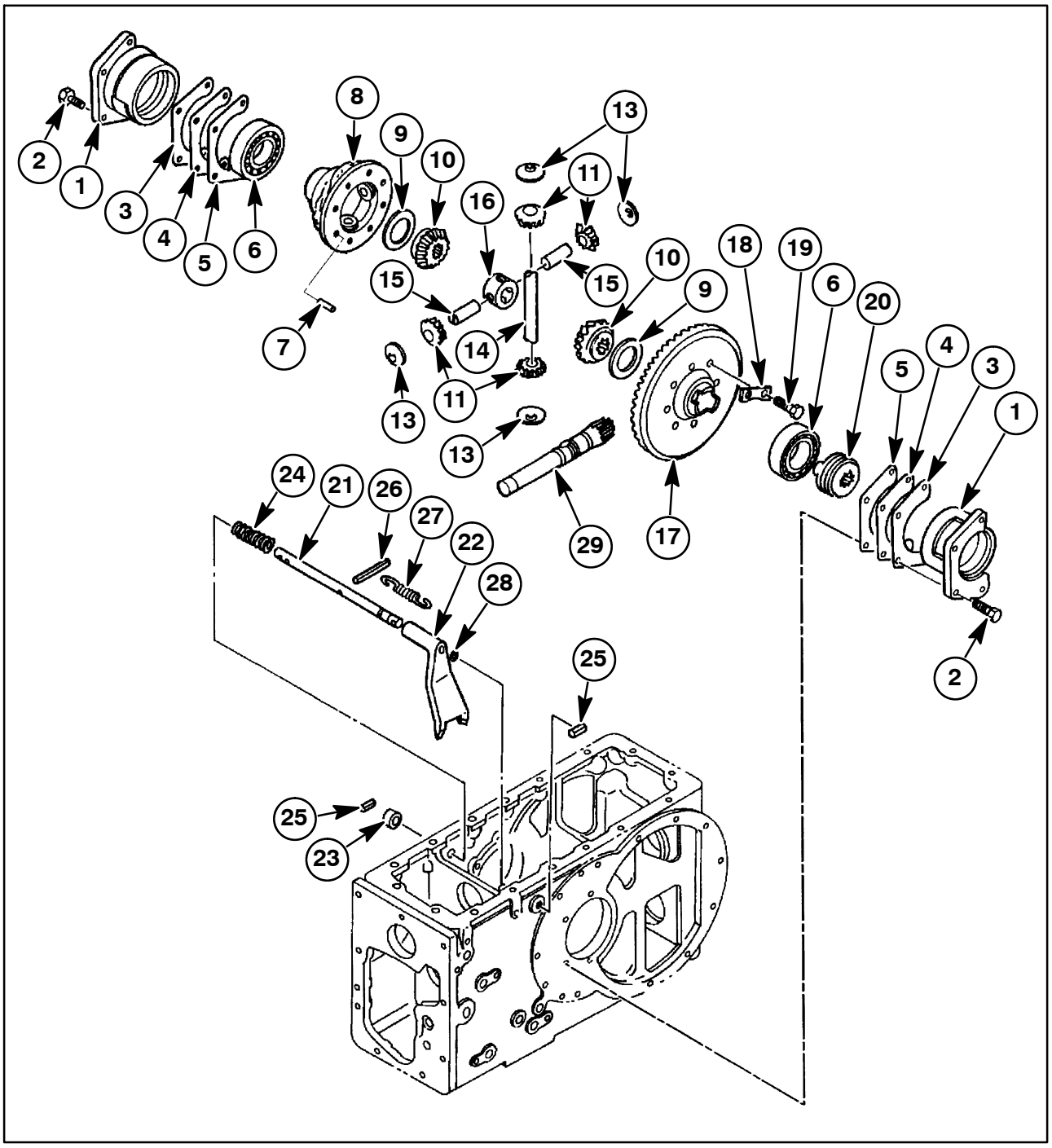


8

1. Bearing Carrier Housing
2. Bolt M10 x 25
3. Shim 0.5 mm (0.020″)
4. Shim 0.3 mm (0.012″)
5. Shim 0.1 mm (0.004″)
6. Ball Bearing
7. Dowel Pin
8. Differential Housing
9. Thrust Washer
10. Differential Gear
11. Gear
12. Blank Plug
13. Thrust Washer
14. Pinion Shaft
15. Pinion Shaft
16. Joint
17. Ring Gear Assembly - 47T
18. Locking Plate
19. Cap Screw M10 x 1.5 x 30
20. Differential Lock Clutch
21. Differential Lock Shaft
22. Differential Lock Fork
23. Oil Seal
24. Spring
25. Spring Pin
26. Spring Pin
27. Spring
28. O ring
29. Drive Pinion - 7T

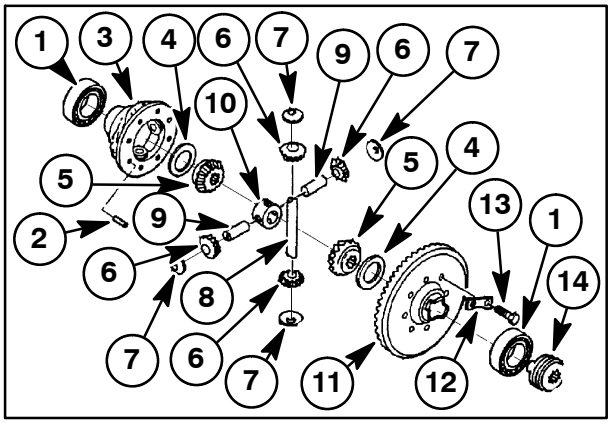
7. Remove the opposite axle assembly in the same manner.
8. Remove the right- and left- hand differential bearing carrier, 1. Note the number and thickness of the shims, 3, 4, and 5, located between the bearing carrier and housing on each side for ease of assembly.
9. Remove the differential lock mechanism, 21 - 28, and pedal. Remove spring pins, 25, from the differential lock shaft, 21, on both sides of the housing. Unhook spring, 27, from spring pin, 26, and differential lock fork, 22. Now remove shaft, 21, pin, 26, fork, 22, and return spring, 24, from the housing.
10. Remove the differential assembly, 6 - 20, from the top of the rear axle housing.

Disassembly

1. Remove the bolts, 13, from the differential case, 3, and ring gear, 11, and separate the ring gear from the differential housing.
2. Remove the axle side gear, 5, and thrust washer, 4.
3. Remove the differential pinion shafts, 8 and 9, thrust washers, 7, and pinion gears, 6.
4. Remove the remaining axle side gears and thrust washers.

Inspection

1. Inspect the gear teeth for excessive wear or damage.
2. Measure the thickness of the differential gear thrust washers, 7. Replace washers that exceed the allowable limit of 0.9 mm (0.035″). Original thickness is 1.2 mm (0.047″).
3. Inspect the drive pinion shaft and ring gear for excessive wear. Normal pinion shaft to ring gear, 11, backlash is 0.1 - 0.3 mm (0.004 - 0.012″). Replace if the clearance exceeds 0.5 mm (0.02″). See “Ring Gear and Pinion Gear Pattern and Specification Adjustment,” discussed later in this section.
4. Inspect the bearings for excessive wear or binding when rotated by hand.



9

1. Ball Bearing
2. Dowel Pin
3. Differential Housing
4. Thrust Washer
5. Differential Side Gears (2) - 16T
6. Pinion Gears (4) - 10
7. Thrust Washer
8. Pinion Shaft
9. Pinion Shaft
10. Joint
11. Ring Gear - 47T
12. Locking Tab
13. Bolt
14. Differential Lock Clutch

DRIVE PINION

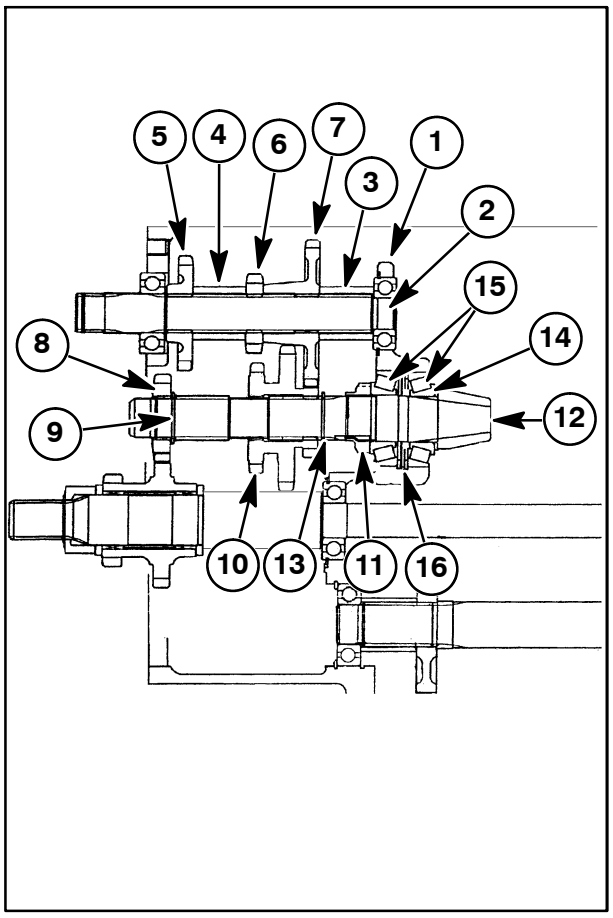
Removal

When the drive pinion is to be removed, the rear axle center housing must be separated from the transmission to permit the pinion bearing preload adjustment on the assembly. See “Separating the Tractor,” later in this chapter.

If not previously removed, remove the cover from the top of the rear axle center housing.

Disassembly (with HST Transmission)

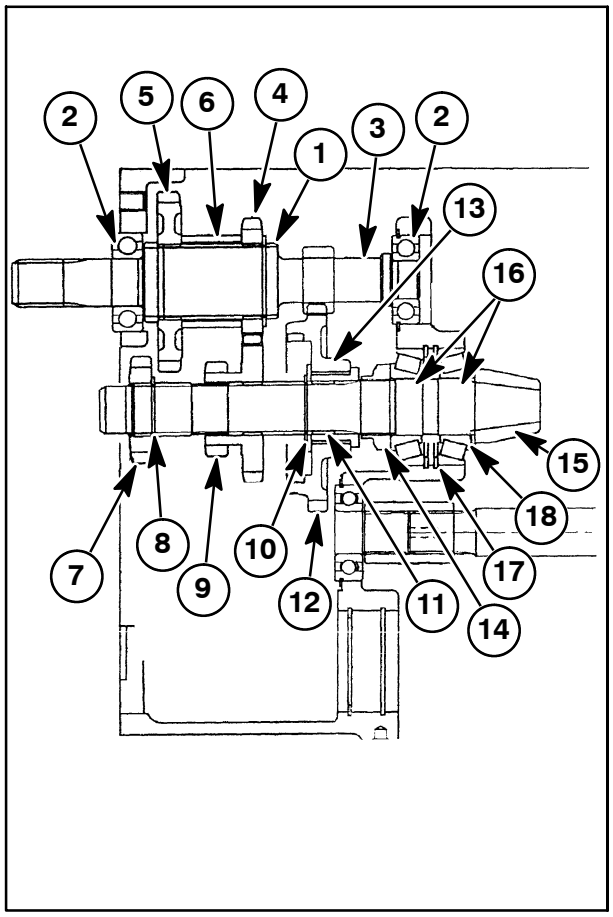
1. Remove the ball bearing, 1, from the rear main drive shaft, 2, by gently tapping the drive shaft forward, out the front of the rear axle housing.
2. Slide the drive shaft forward and remove collar, 3, and fixed gear (high range) - 36T, 7, fixed gear (low range) - 18T, 6, collar, 4, and fixed gear (mid-range) - 27T, 5, from housing.
3. Remove the fixed gear (FWD)-20T, 8, snap ring, 9. Move slide gear 26T - 36T - 18T, 10, forward to remove snap ring, 13.
4. Loosen locknut, 11, and slide the drive pinion, 12, out through the rear of the case, while removing slide gear, 10, and locknut, 11, out the top of the housing. Remove bearings, 15, and snap rings, 16, from the housing. Note the number and thickness of shims, 14.



10

Disassembly (with 9 × 3 Transmission)

1. Remove snap ring,1.
2. Remove the bearing, 2, from the rear main drive shaft, 3.
3. Slide the drive shaft, 3, forward and remove fixed gear; (mid)-24T, 4, collar, 6, and fixed gear (high)-36T, 5, off the rear of the drive shaft, out the top of the housing.
4. Remove the fixed gear (FWD)-20T, 7, snap ring, 8, move sliding (High - Mid) gear-17T-29T, 9, towards the front.
5. Remove snap ring, 10, move (Low) counter gear-42T, 12, off coupling, 13, and move spacer, 11, away from locknut, 14.
6. Loosen locknut, 14, and slide the drive pinion, 15, out through the rear of the case, to remove sliding gear, 9, counter gear, 12, coupling, 13, spacer, 11, and locknut, 14, out of the top of the housing.
7. Remove bearings, 16, and snap rings, 17, from the housing. Note the number and thickness of shims, 18.



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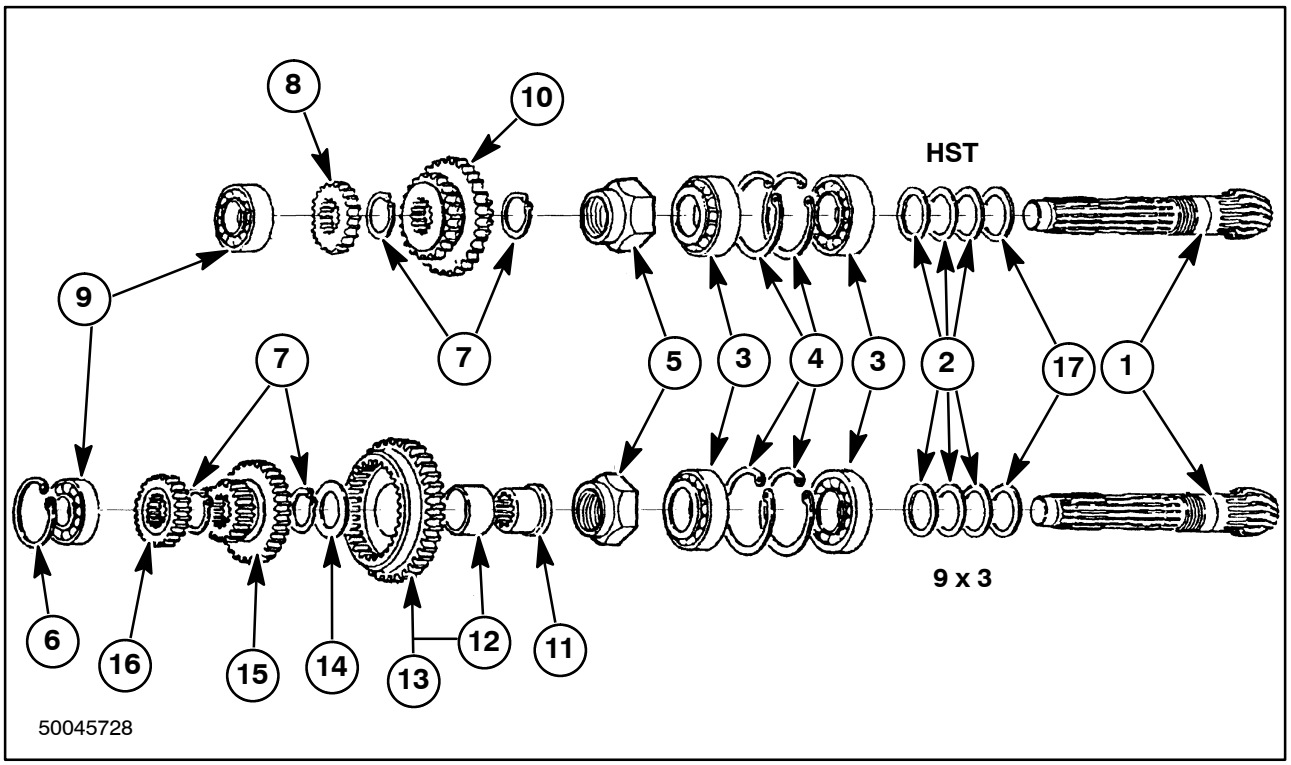


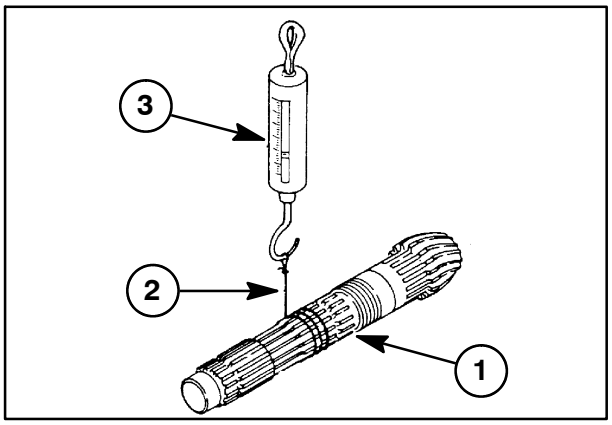
12

1. Drive Pinion Shaft - 7T
2. Shims
3. Ball Bearing
4. Snap Ring
5. Locknut
6. Snap Ring
7. Snap Ring
8. FWD Fixed Gear - 20T
9. Ball Bearing
10. HST Range Sliding Gear - 26T (Mid) - 36T (Low) - 18T (High)
11. Coupling
12. Bushing
13. 9 x 3 Low Range Counter Gear - 42T
14. Thrust Washer
15. 9 x 3 Range Sliding Gear - 17T (High) - 29T (Mid)
16. 4WD Gear - 20T (9 x 3)
17. Thrust Washer

Assembly and Installation

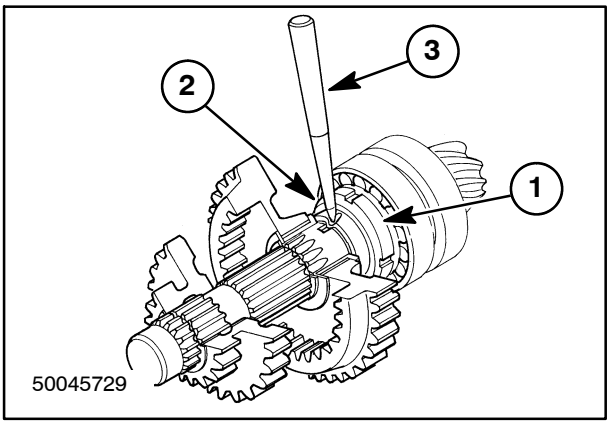
1. If removed, install the two drive pinion bearing snap rings, 4, and bearings, 3, into the housing wall.
2. Place the thrust washer, 17, and shims, 2, onto the drive pinion shaft, 1. Insert the drive pinion shaft into the housing from the rear of the case.
3. While installing the drive pinion, for a HST transmission, tighten the lock nut, 5. Install snap rings, 7, sliding gear, 10, fixed gear, 8, and finally bearing, 9.
4. While installing the drive pinion for a 9 x 3 transmission, tighten the lock nut, 5. Install coupling, 11, bushing, 12, gear, 13, thrust washer, 14, secured with snap rings, 7. Install sliding gear, 15, FWD gear, 16, bearing, 9, and snap ring, 6.
5. If removed, install the snap ring, 6, and bearing, 9, into the transmission housing.

6. Adjust the pinion bearing preload using a strong cord wrapped around the pinion shaft, 1, and pull scale, 3. Tighten the pinion locknut to obtain the specified pounds of constant pull to rotate the pinion assembly. Preload for bearings at a constant load should be 23.6 – 30.2 kg (52 – 66.5 lbs.).



13

7. Bend the collar of the locknut, 1, at the drive pinion shaft groove, 2, with a punch, 3.

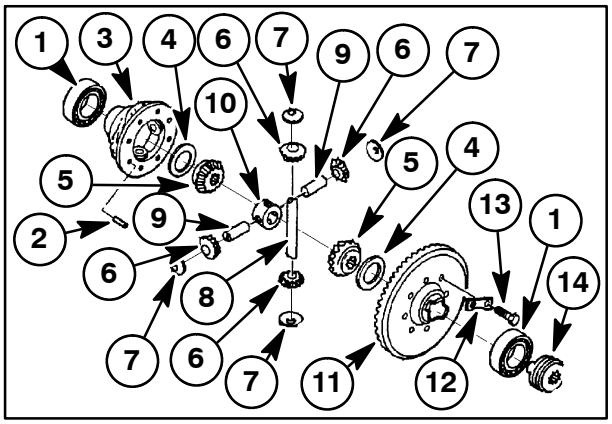


14

DIFFERENTIAL

Assembly and Installation

1. Assemble the differential pinion shafts, 8 and 9, pinion gears, 6, thrust washers, 7, and side gears, 5, with thrust washers, 4, into the differential housing, 3.
2. Install the ring gear, 11. Using new bolts, 13, tighten the ring gear to 44.1 - 55.9 N·m (32.6 - 41.3 ft. lbs.) with locking tab, 12.

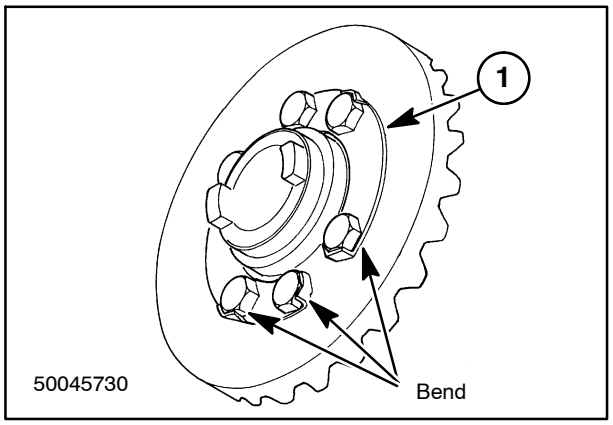


15

1. Ball Bearing
2. Dowel Pin
3. Differential Housing
4. Thrust Washer
5. Differential Side Gears (2) - 16T
6. Pinion Gears (4) - 10
7. Thrust Washer
8. Pinion Shaft
9. Pinion Shaft
10. Joint
11. Ring Gear - 47T
12. Locking Tab*
13. Bolt
14. Differential Lock Clutch

3. Bend the locking tab, 1, with a chisel.

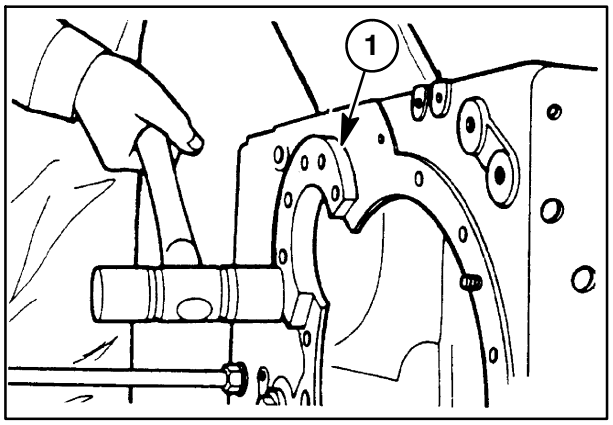
   NOTE: *Use a new locking tab when reassembling differential.**



16

4. Position the differential assembly in the housing and install the right and left bearing carriers, 1.

   NOTE: *When installing the original components, use the same quantity and thickness shims on each side as removed during disassembly.*



17

NOTE: *When the drive pinion, ring gear, bearing or other components are reused, reassemble using the same shims. When the drive pinion and ring gear are replaced, adjust the shims as described below. The ring gear and pinion are serviced as a set and must be replaced together.*

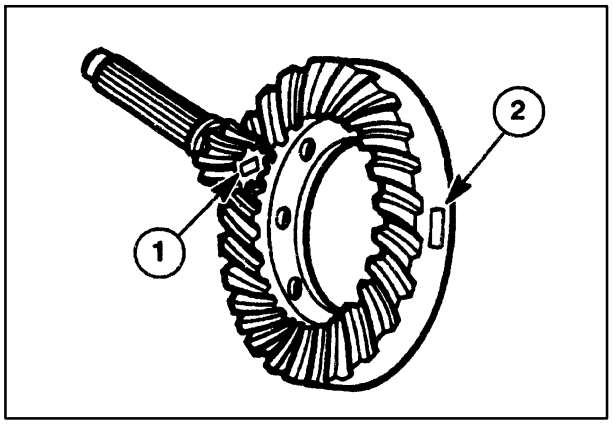
Increase or decrease the number of shims at the back of the drive pinion to cover the difference between the allowances of old pinion and that of new pinion which are marked on the drive pinion ends (allowances of old pinion minus that of new pinion).

NOTE: *When the value of allowance is zero, the value is not stamped on the drive pinion end.*

For example:

Allowances of replaced pinion drive:	–0.2
Allowances of new drive pinion:	+0
In this case (–0.2) – (+0) =	–0.2

Decrease the shims by 0.2 mm



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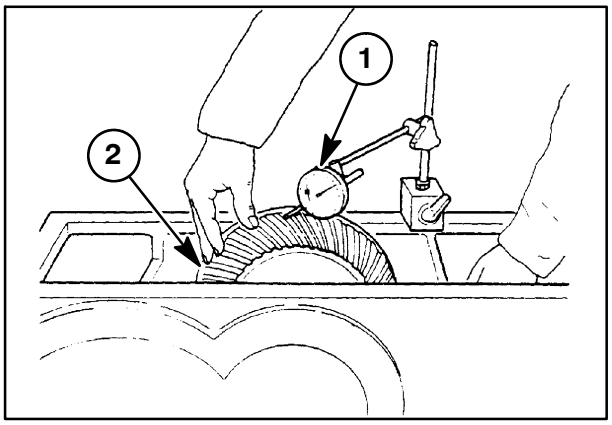
Ring Gear and Pinion - Tolerance Stamping

1. Tolerance Stamp and Assembly Number - Pinion
2. Assembly Number

5. If new differential components are used, adjust the backlash and ring gear contact patterns as follows:
   - Place a dial indicator, 1, at a right angle to the top of a ring gear tooth.
   - Rock the ring gear, 2, back and forth and observe the dial indicator reading.
   - Adjust the shims to obtain the correct backlash. See “Specifications,” discussed later in this section.
   - Using Prussian Blue on the pinion gear teeth, rotate the pinion gear and check the gear tooth pattern. Adjust the differential and pinion shims to obtain the correct tooth pattern. See “Specifications,” discussed later in this section.



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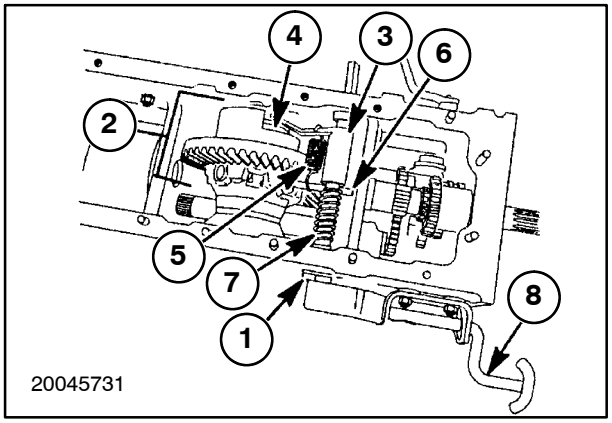
6. Slide differential lock shaft, 1, into differential assembly, 2, while installing fork, 3, into clutch, 4, spring, 5, spring pin, 6, and return spring, 7. Install oil seal and O ring into housing then secure shaft with spring pins on outside of housing to differential lock pedal, 8.

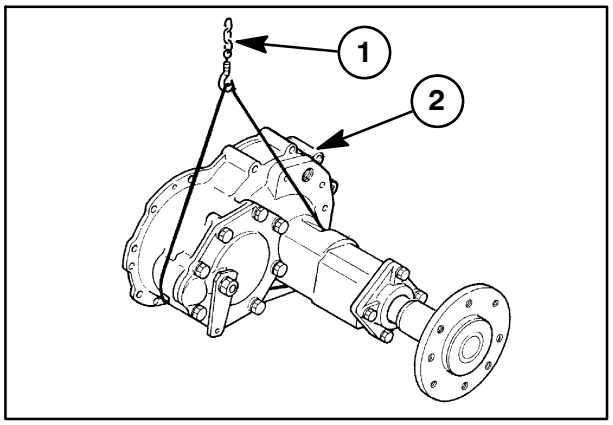


20

7. Attach a suitable overhead lifting device, 1, to the rear axle, 2.
8. Carefully align the axle in place with its mounting holes on the case and secure with the mounting bolts. Be sure to align the final gear and final pinion with the housing.

⚠ WARNING ⚠

The axle housing is difficult to balance. Exercise care during removal to avoid personal injury.



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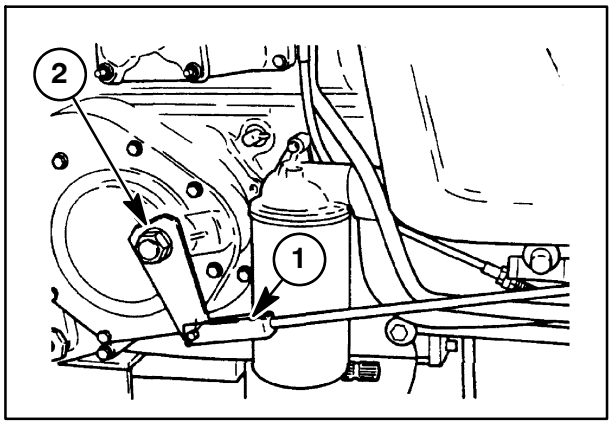
9. Install the opposite axle assembly in the same manner.
10. Reconnect the brake control rod, 1, to the brake cover lever, 2.
11. Install the lower links and stabilizers.
12. Fill the transmission, rear axle, and hydraulic system to its proper fluid level.
13. Install the rear wheels and fenders.

NOTE: *See "Separating, Rear Axle and Center Housing Installation," discussed later in this chapter..*



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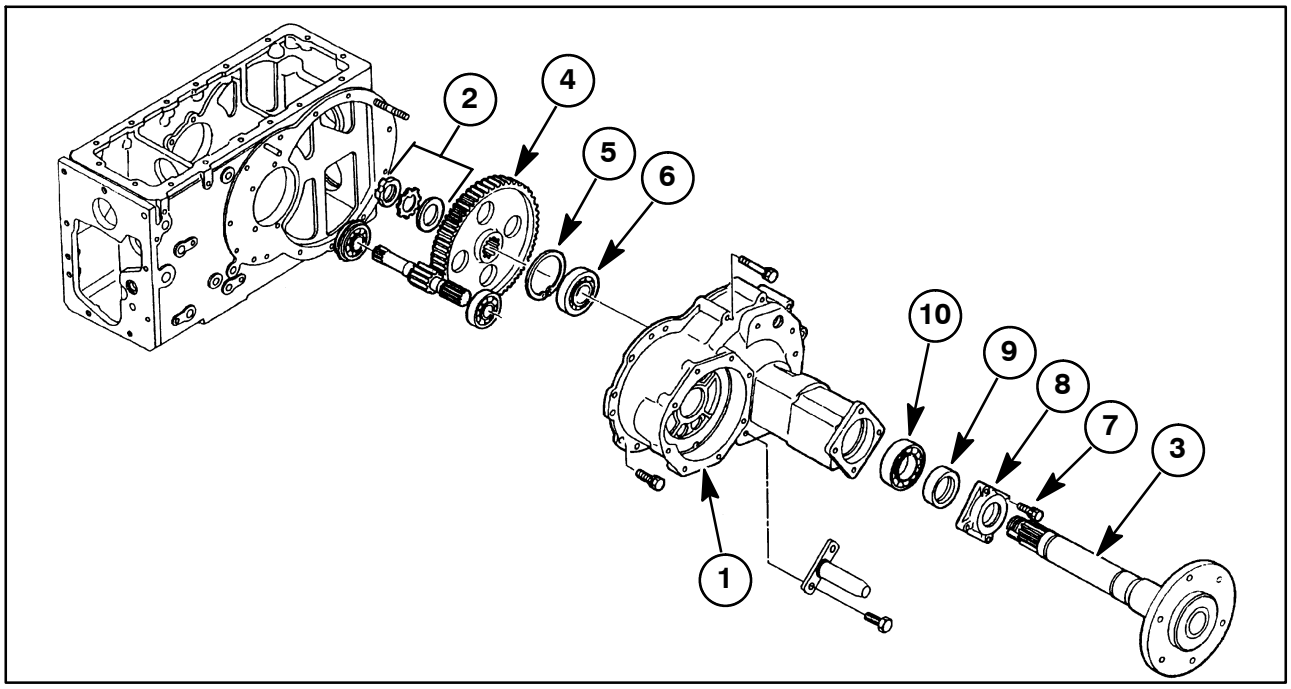

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REAR AXLE

Removal

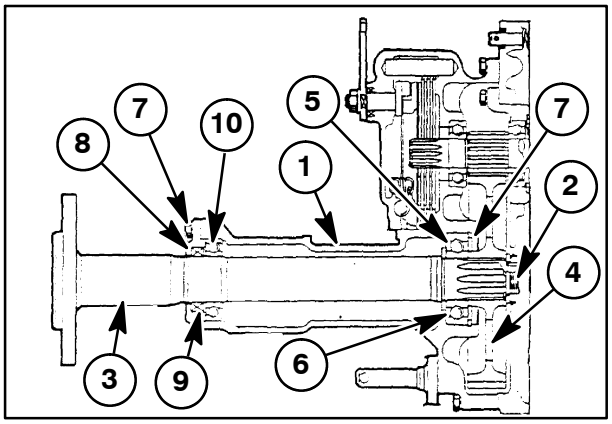
1. Remove the rear axle assembly, 1, as described under “Differential - Removal,” discussed earlier in this section.

Disassembly

1. Remove the locknut, washer, and spacer, 2, from the axle shaft, 3.
2. Remove the final reduction gear-65T, 4.
3. Remove the seal retainer bolts, 7, retainer, 8, and seal, 9, from the axle housing.
4. Drive the axle shaft, 3, outward and remove from the axle housing, 1, remove bearing, 10, snap ring and bearing, 6.

Inspection

1. Clean the axle components in a suitable solvent and air dry.
2. Inspect the bearings for excess wear or damage.
3. Inspect the final reduction gear teeth for excess wear or damage.



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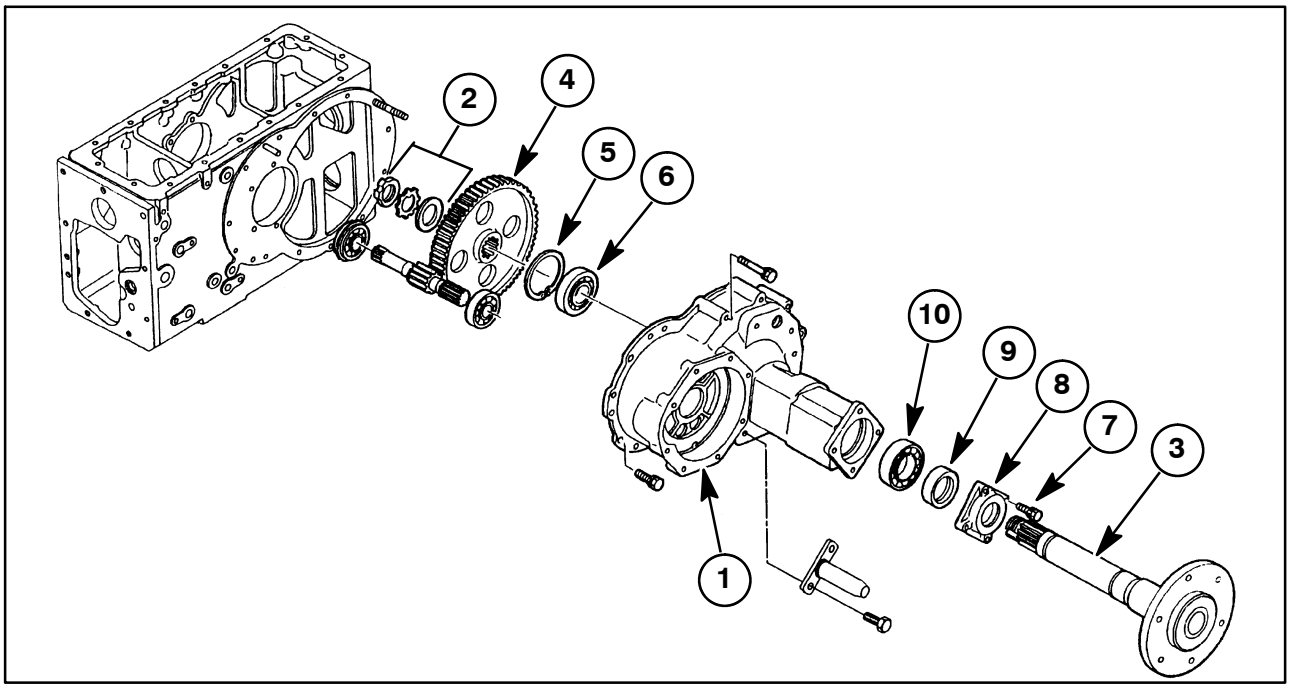

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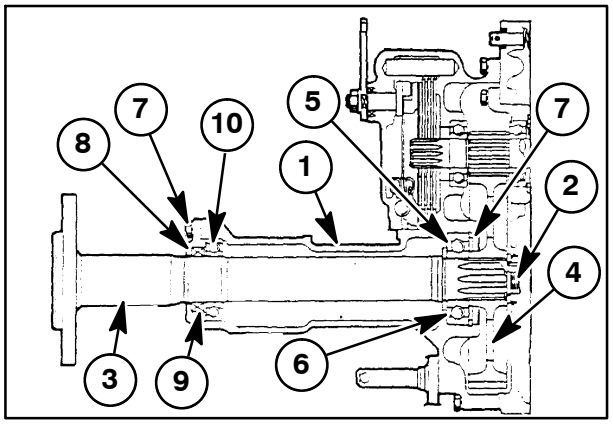
Assembly

1. If removed, install the two axle support bearings, 6 and 10. Reinstall the inner bearing snap ring, 5.
2. Install a new oil seal, 9, in the retainer housing.
3. Position the seal retainer, 8, and seal, 9, on the axle shaft, 3, and gently drive the axle into the housing, using care not to damage the seal.
4. Position the seal retainer, 8, on the housing and install the retaining bolts, 7.
5. Install the final reduction gear, 4, onto the axle and secure with spacer, washer, and locknut, 2.



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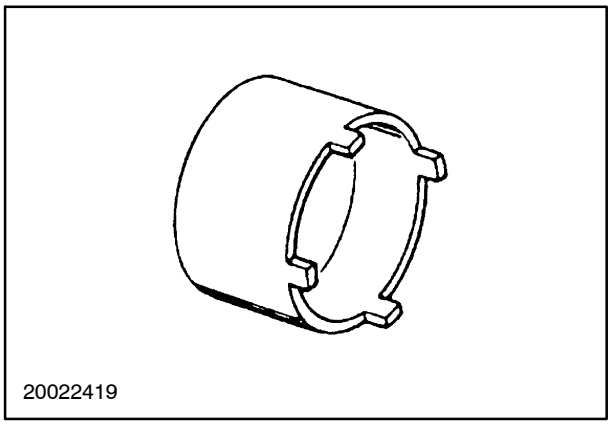
6. Torque spanner nut to 88 - 101 N·m (65 - 75 ft. lbs.) using locknut header socket #FNH00088.
7. Install the rear axle as described earlier in this section.



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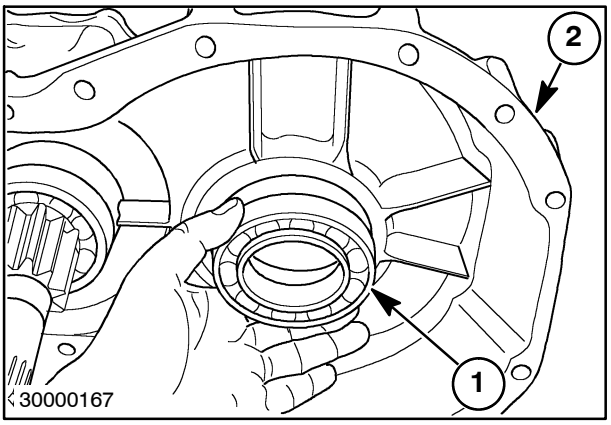
8. Install the inner axle shaft bearing, 1, into the axle case, 2.



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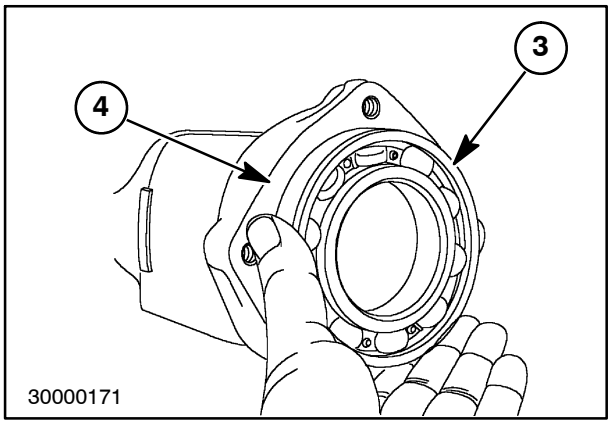
9. Install the outer axle shaft bearing, 3, into the axle case, 4.



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AXLE SEAL

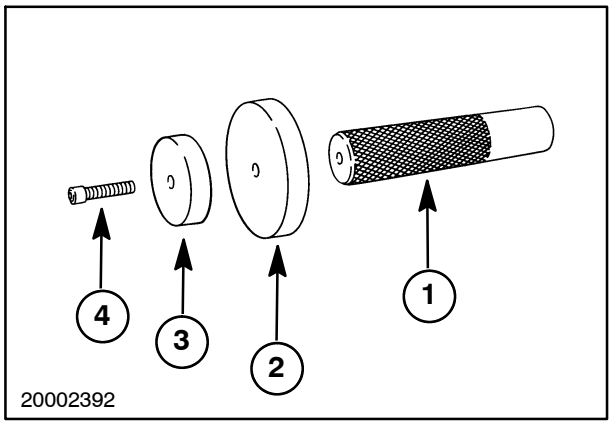
Installation

1. Assemble the special installation tool, from the seal installer kit #NH00293. Use handle, 1, drive plate, 2, drive plate, 3, and secure with the supplied retaining screw, 4.

TOOL CHART

Model	Tool No.	Size
TC30	1. Handle 27488	
	2. Plate	2-13/16″
	3. Plate	1-15/16″
	4. Screw	

NOTE: *The orientation of the axle seal, 1, in the axle shaft retainer, 2, is such that the rubber side of the seal faces inward and the metal side of the seal faces outer side of the axle shaft retainer.*



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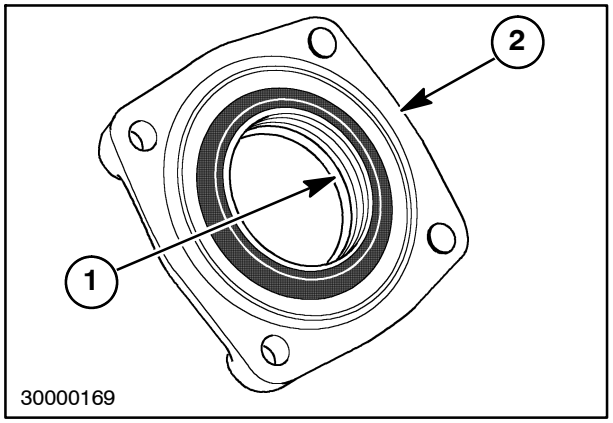

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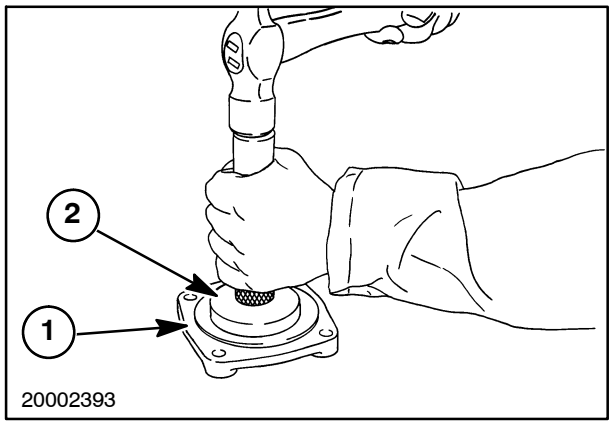
2. Install a new axle seal into the axle shaft retainer, 1, using the special seal driver tool, 2.



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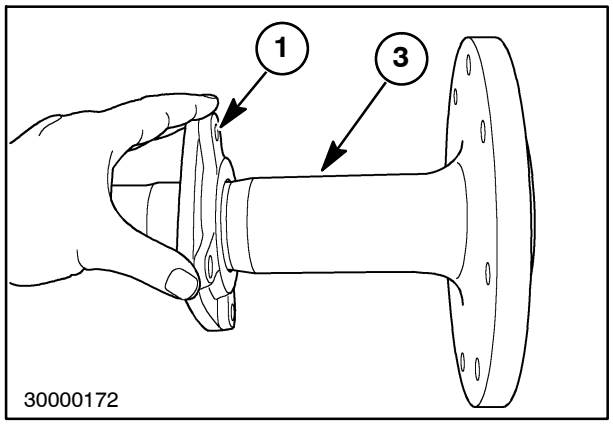
3. Lubricate the new seal with petroleum jelly and slide the axle shaft retainer, 1, onto the axle, 3.



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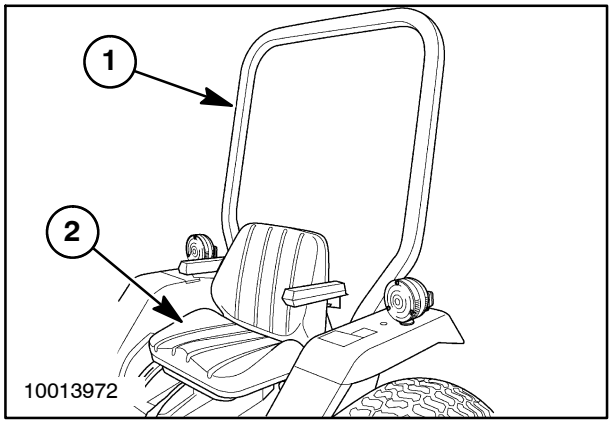
REAR AXLE/CENTER HOUSING

Removal

1. Drain the fluid from the transmission, rear axle, and hydraulic system and collect into a clean container.
2. Remove the ROPS assembly, 1.
3. Remove the seat assembly, 2.
4. Place a wedge between the engine side rails and the front axle to prevent the engine from tipping.
5. Place blocking beneath the front and rear wheels.
6. Place safety jack stands under the transmission.
7. Remove the rear wheels.
8. Remove the lower links.
9. Remove the brake and clutch pedal springs from the step plates.
10. Disconnect the linkage rods from the actuator arms.
11. Disconnect the foot throttle pedal linkage from the pedal (9 x 3).
12. Remove the step plates.
13. Disconnect the wiring from the taillight fixtures.
14. Remove the range transmission control, 1, rear and mid PTO (if equipped), 2, and 4WD grips.



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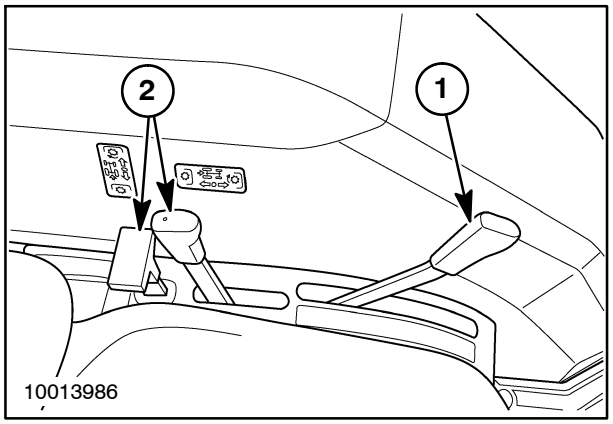

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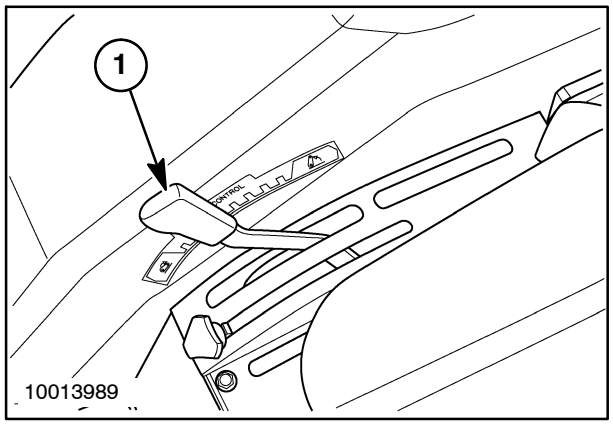
15. Remove the HPL and rear remote lever (if equipped) grips, 1.
16. Remove the fenders and platform assembly from the tractor.



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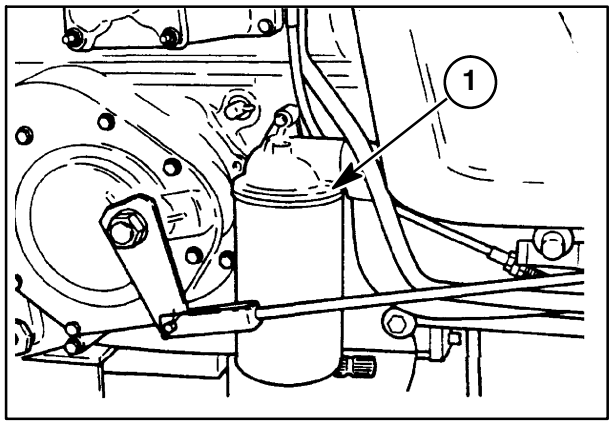
17. Remove the hydraulic filter and mounting flange, 1, as an assembly.



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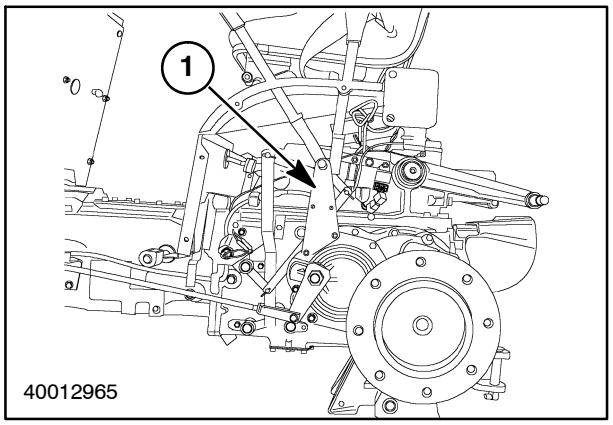
18. Remove the transmission range gear and PTO shift linkage support bracket, 1, from the brake housing.
19. Remove the hydraulic system suction tube, pressure tube, and fluid return tube from the lift cover.
20. If equipped with hydrostatic transmission, remove the transmission fluid return tube.
21. Remove the hydraulic lift cover.
22. Remove the transmission cover.
23. Remove the internal buckle-up bolt.



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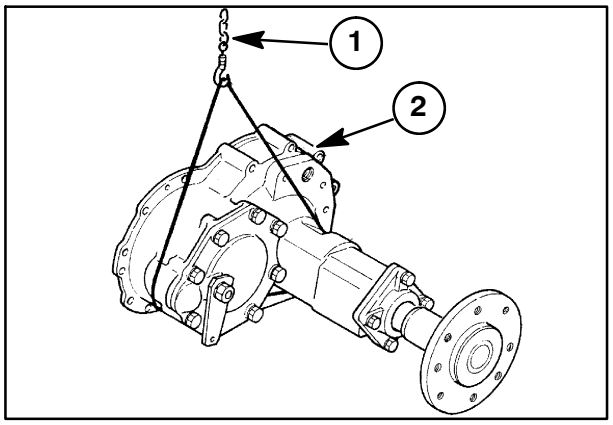
24. Attach an overhead hoist, 1, to the rear axle assembly, 2, from the center housing.
25. Remove the external buckle-up bolts and gently remove the rear axle assembly from the transmission.

⚠ WARNING ⚠

The rear axle assembly is difficult to balance. Exercise care during removal to avoid personal injury.



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Installation

Installation generally follows the removal procedure in reverse order.

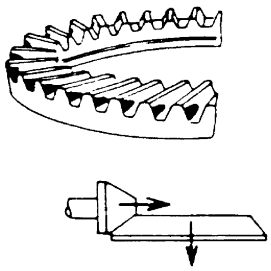
During installation, coat the transmission and center housing mating surfaces with liquid sealer. Use caution to prevent excess sealer from entering the inside of the housing and contaminating the hydraulic fluid supply.

SPECIFICATIONS

DIFFERENTIAL	
Differential Gear Thrust Washer	
Thickness	1.2 mm (0.047 in.)
Allowable Limit	0.9 mm (0.035 in.)
Differential Drive Pinion to Ring Gear Backlash	
Normal	0.1 - 0.3 mm (0.004 - 0.012 in.)
Allowable Limit	0.5 mm (0.020 in.)

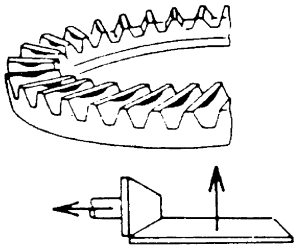
RING GEAR AND PINION GEAR PATTERN SPECIFICATION AND ADJUSTMENT

HEEL CONTACT:

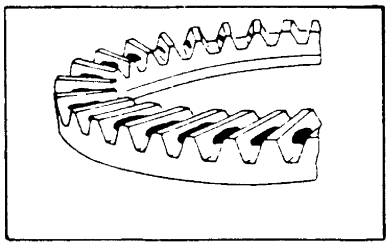


Select the shims so that the drive pinion is out nearer to the ring gear.

FACE CONTACT:

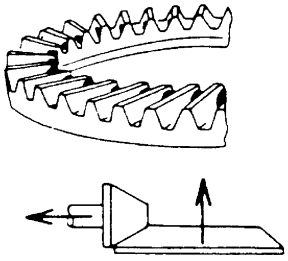


Select the shims so that the ring gear is put nearer to the drive pinion.



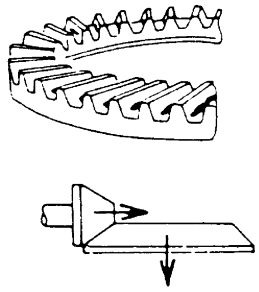
Correct pinion gear to ring gear tooth contact.

TOE CONTACT:



Select the shims so that the drive pinion is put farther from the ring gear.

FLANK CONTACT:



Select the shims so that the ring gear is put farther from the drive pinion.

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BOLT TORQUE SPECIFICATIONS

Ring gear and differential cage housing bolts . . . . . 49.0 - 63.7 N·m (36.2 - 47.0 ft. lbs.)

		Coarse Thread			Fine Thread		
Bolt Size	**Grade No.**	**Pitch (mm)**	**Foot· Pounds**	**Newton· Meters**	**Pitch (mm)**	**Foot· Pounds**	**Newton· Meters**
M8	4T	1.25	9.4·12.3	12.7·16.7		11.2·14.8	15.2·20.1
	7T		16.6·21.0	22.6·28.4		19.5·25.3	26.5·34.3
	10T		21.0·26.8	28.4·26.3		22.4·29.7	30.4·40.2
M10	4T	1.5	18.8·24.6	25.5·33.3		21.0·26.8	28.4·36.3
	7T		32.5·41.2	44.1·55.9		36.2·46.3	49.0·62.8
	10T		39.8·51.4	53.9·69.9		42.7·54.2	57.9·73.5
M12	4T	1.75	27.5·34.7	37.3·47.1		31.8·40.5	43.1·54.9
	7T		48.5·61.5	65.7·83.4		55.0·69.4	74.5·94.1
	10T		68.0·85.4	92.9·11.6		73.1·93.3	99.0·127

SECTION 29 - HYDROSTATIC TRANSMISSION

Chapter 1 - Hydrostatic Transmission

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DESCRIPTION OF OPERATION – HYDROSTATIC TRANSMISSION

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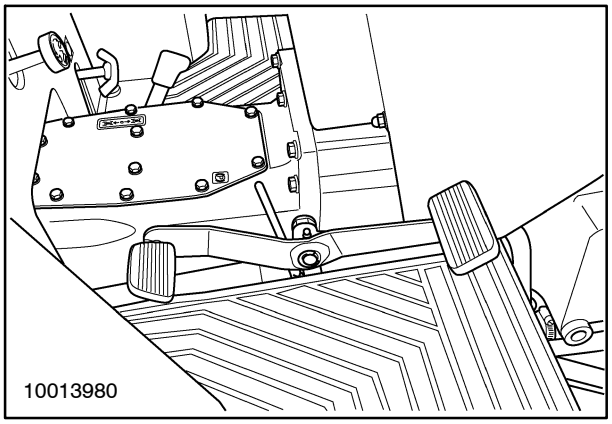
The hydrostatic transmission consists of a variable displacement piston type hydraulic pump and a fixed displacement piston type motor assembly located in the engine clutch housing. The variable displacement pump is driven by the input shaft connected to the engine flywheel clutch. The pump supplies hydraulic power to the fixed displacement motor, which drives the three range transmission gearbox.

The hydrostatic unit, operated by a foot control pedal, can be advanced in forward, stopped, or reverse. The foot pedal automatically returns to neutral (stopped) position when it is released. The speed is controlled by varying the amount of movement of the pedal from the neutral position. A cruise control system is available as a dealer installed accessory. When a constant forward speed is desired on level terrain, setting the speed control (cruise) switch to the “SET” position will hold the foot pedal in the fixed position and permit the operator to remove his foot from the pedal. When the speed control (cruise) switch is “RELEASED” the foot pedal automatically returns to neutral and the tractor stops.



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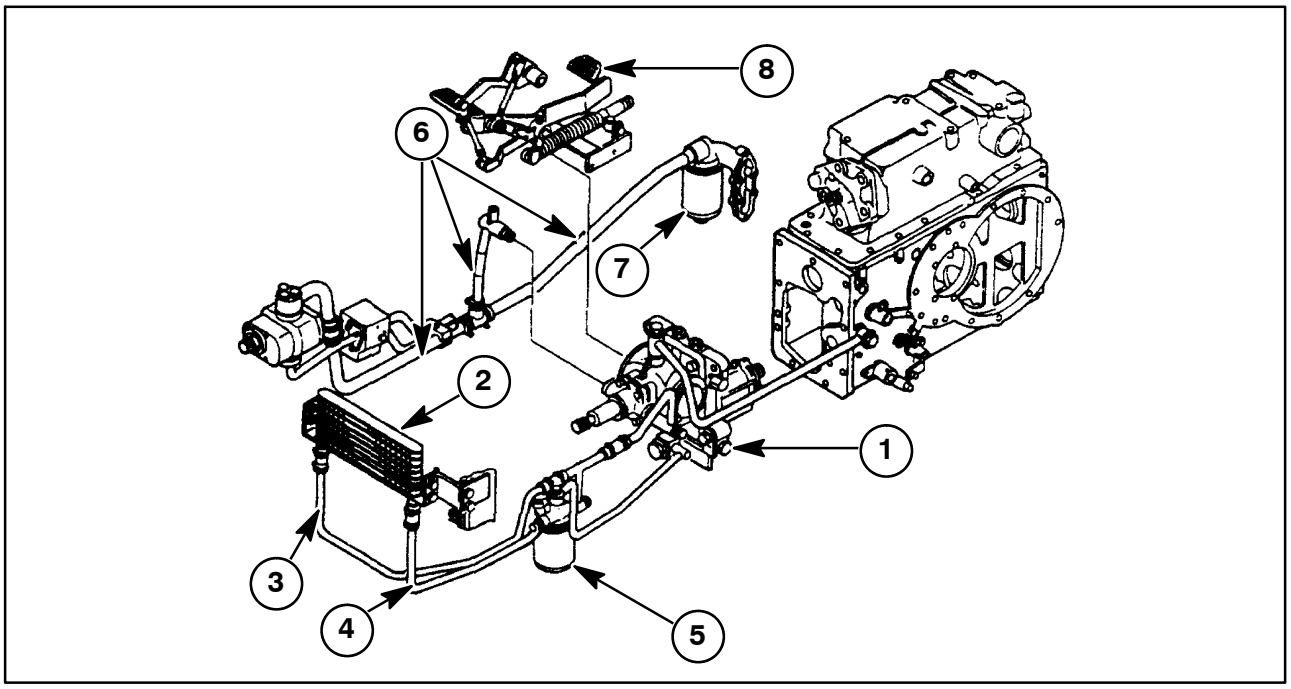
NOTE: *The operator can depress the pedal further from the set position to travel at a faster speed momentarily. The pedal will return to the set position (and speed) when released. The pedal (cruise) control can be set in reverse.*

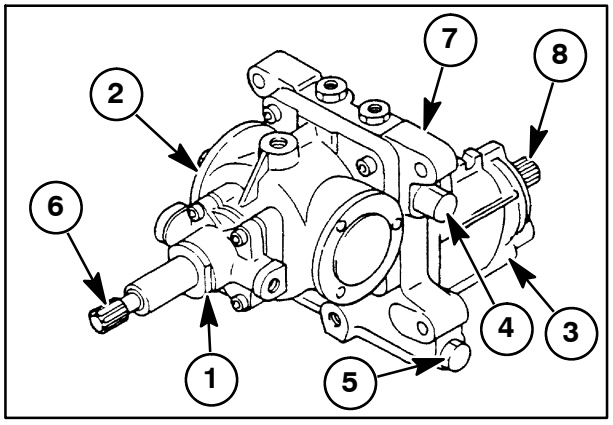


2

1. Hydrostatic Unit
2. Oil Cooler
3. Oil Line to Cooler
4. Oil Line from Cooler
5. Filter (HST)
6. Suction Tube
7. Suction Filter (Hydraulic)
8. Foot Pedal Control

The hydrostatic unit uses fluid contained in the rear axle and transmission gearbox reservoir compartment. The hydrostatic system consists of an inlet (suction) filter, 7, hydrostatic transmission unit, 1, transmission fluid cooler, 2, final filter, 5, and connecting tubing, 3, 4, and 6.

The hydrostatic unit consists of a charge pump, 1, variable displacement piston type pump, 2, fixed displacement piston type motor, 3, high pressure relief valve, 4, two feed (check) valves and neutral valve assemblies, 5, and an internal charge pump relief valve. The input shaft, 6, driven by the engine clutch, is splined to the variable displacement piston pump and extends out the port block, 7, to drive the PTO shaft. The charge pump, 1, driven by the input shaft, 6, draws fluid from the transmission sump and charges the hydraulic system with fluid under pressure at all times. High pressure fluid supplied by the piston pump, 2, drives the motor, 3, and powers the transmission assembly, through drive shaft, 8.



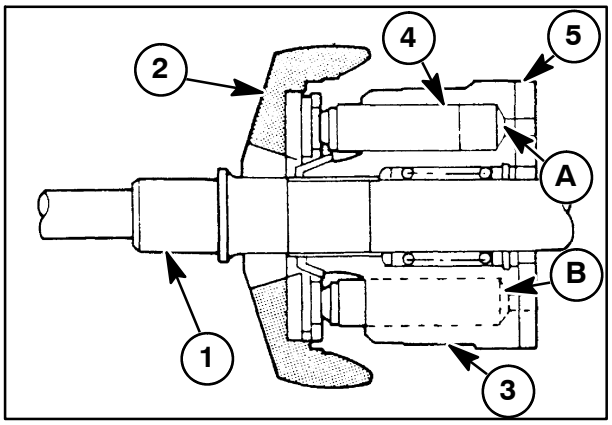
3

Op. 29 212

VARIABLE DISPLACEMENT PUMP

Operation

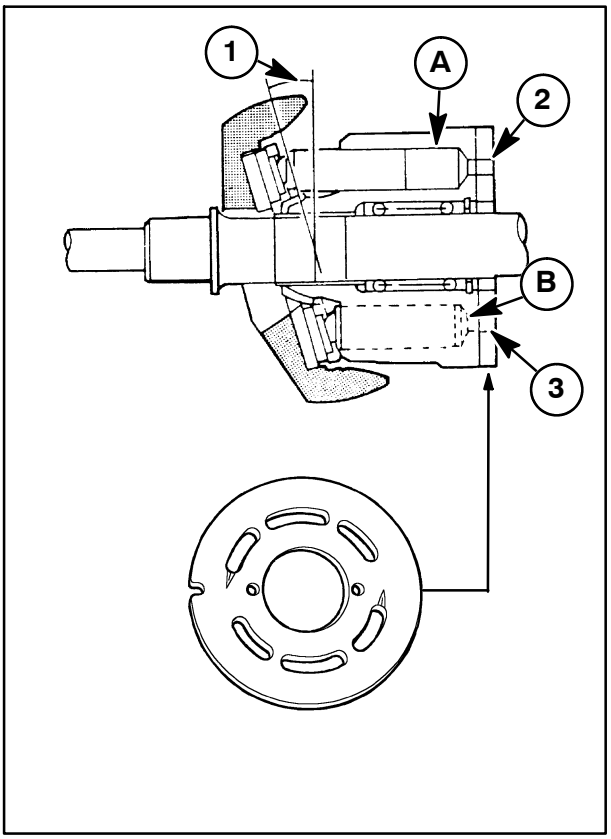
The pump cylinder block, 3, and pistons, 4, are splined to the input shaft, 1. In neutral position, the swash plate, 2, is in the vertical position and is at a right angle to the pistons and the pistons do not stroke. When in the neutral position, the displacement in the cylinders “A” and “B” are equal and no fluid flows through the pump valve port plate, 5.



4

When the swash plate is tilted at an angle, 1, fluid in the cylinder in position “A” is discharged out through the port, 3, in the valve plate, 2, as the cylinder is rotated to position “B”. Maximum fluid flow is obtained when the swash plate is at maximum tilt angle.

NOTE: *The pump always rotates in one direction. Two notches on the valve plate, 2, limit rotation in one direction.*



5

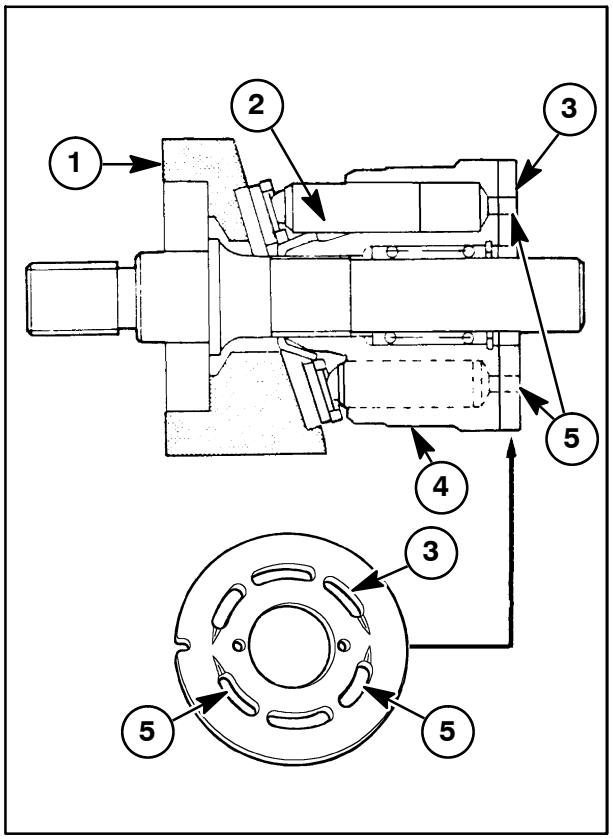
Op. 29 212

FIXED DISPLACEMENT MOTOR

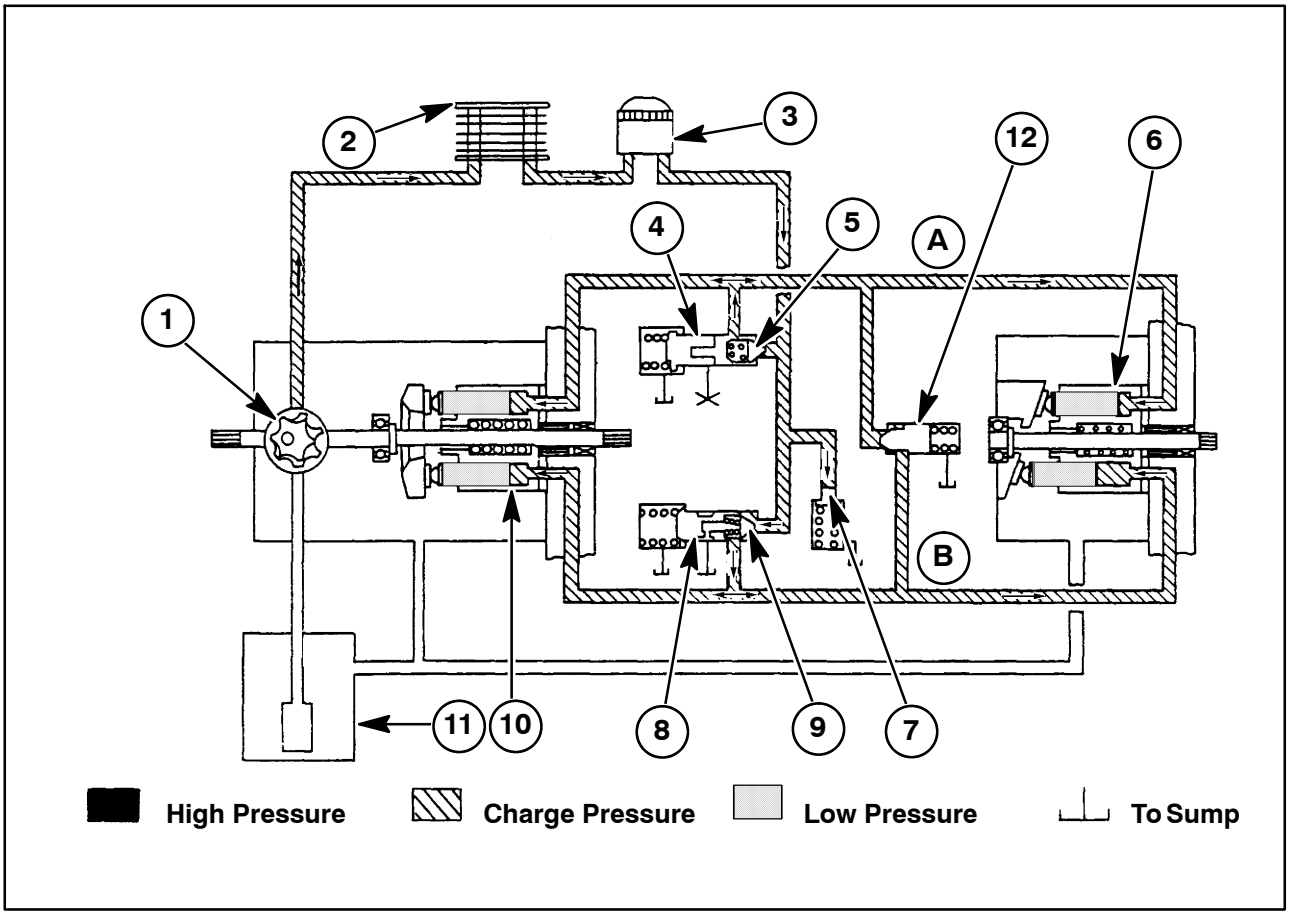
Operation

Fluid flow from the piston pump enters one of the set of ports, 5, in the valve port plate, 3, of the motor and exerts a pressure against the end of the pistons, 2, in line with the port. Fluid pressure on the pistons causes the cylinder block, 4, and pistons, 2, to rotate. A drive shaft splined to the motor cylinder block then drives the transmission gearbox.

NOTE: *The motor rotates in both directions to provide either forward or reverse movement. Four notches in the valve plate, 3, allow both directional rotations.*



6



7

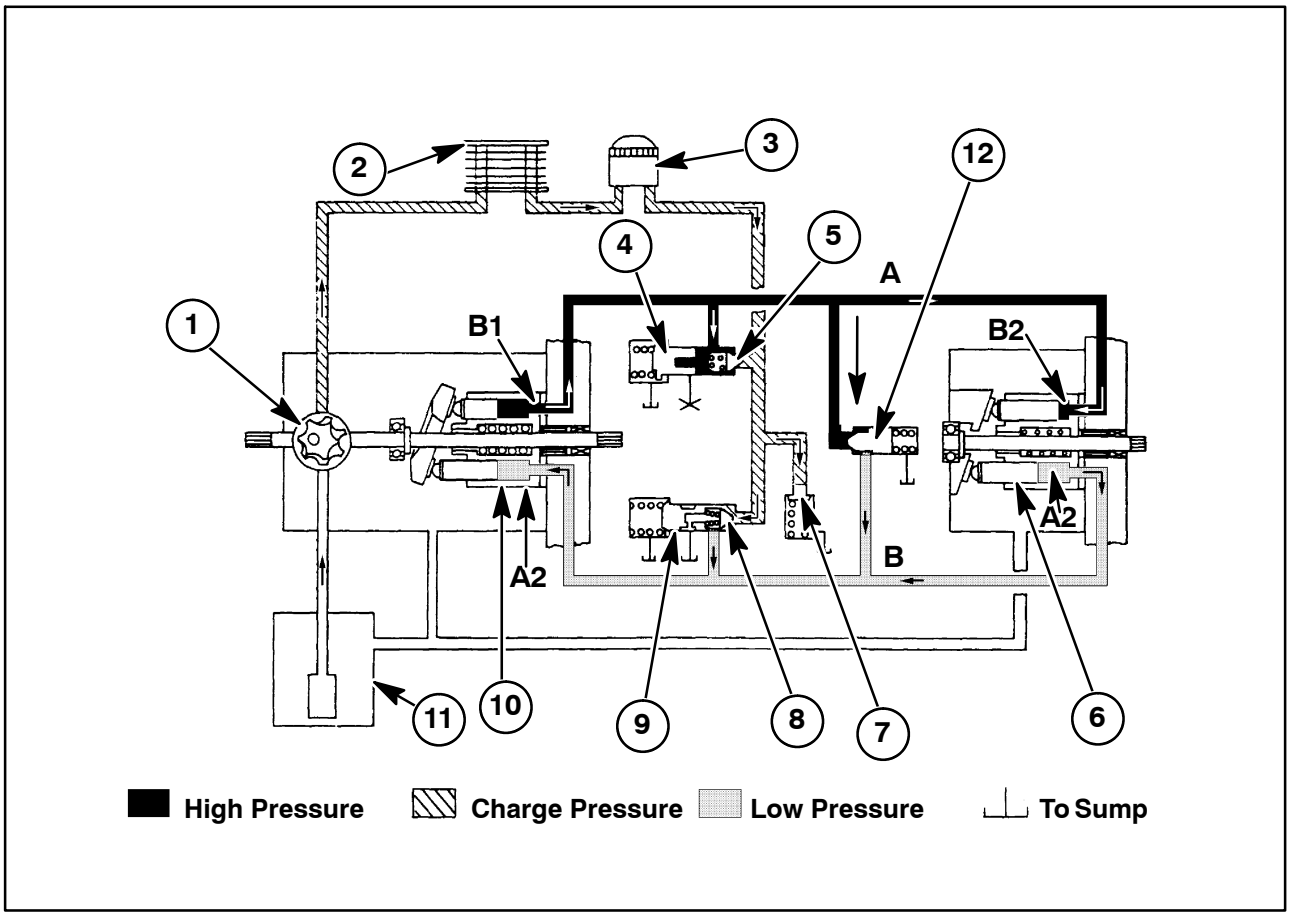
FLUID FLOW NEUTRAL POSITION

1. Charge Pump
2. Cooler
3. Filter (HST)
4. Neutral Valve
5. Feed (Check) Valve “A”
6. Hydrostatic Motor
7. Charge Pump Relief Valve
8. Neutral Valve
9. Feed (Check) Valve “B”
10. Hydrostatic Pump
11. Reservoir
12. High Pressure Relief

FLUID FLOW

Neutral Position

Fluid drawn from the transmission reservoir, 11, is pressurized by the rotor type charge pump, 1. The fluid flows from the charge pump to the cooler, 2, and filter, 3, through feed (check) valves, 5 and 9, and neutral valves, 4 and 8, assemblies and returns to the sump via the charge pump relief valve, 7. The charge pump relief valve maintains 5.2 - 6.6 bar (75.4 - 95.7 psi) pressure to the feed (check) valves, 5 and 9, at all times. Fluid flow past the feed (check) valves pressurizes the passages “A” and “B” and the pump and motor cylinder blocks. Because of equal pressures in passages “A” and “B” the motor does not rotate. The neutral valves, 4 and 8, are in a normally open position allowing fluid flow past the feed (check) valves, 5 and 9, to return to the sump. The neutral valves are set at 34.3 - 37.2 bar (498 - 540 psi) and remain open until this pressure is exceeded.



8

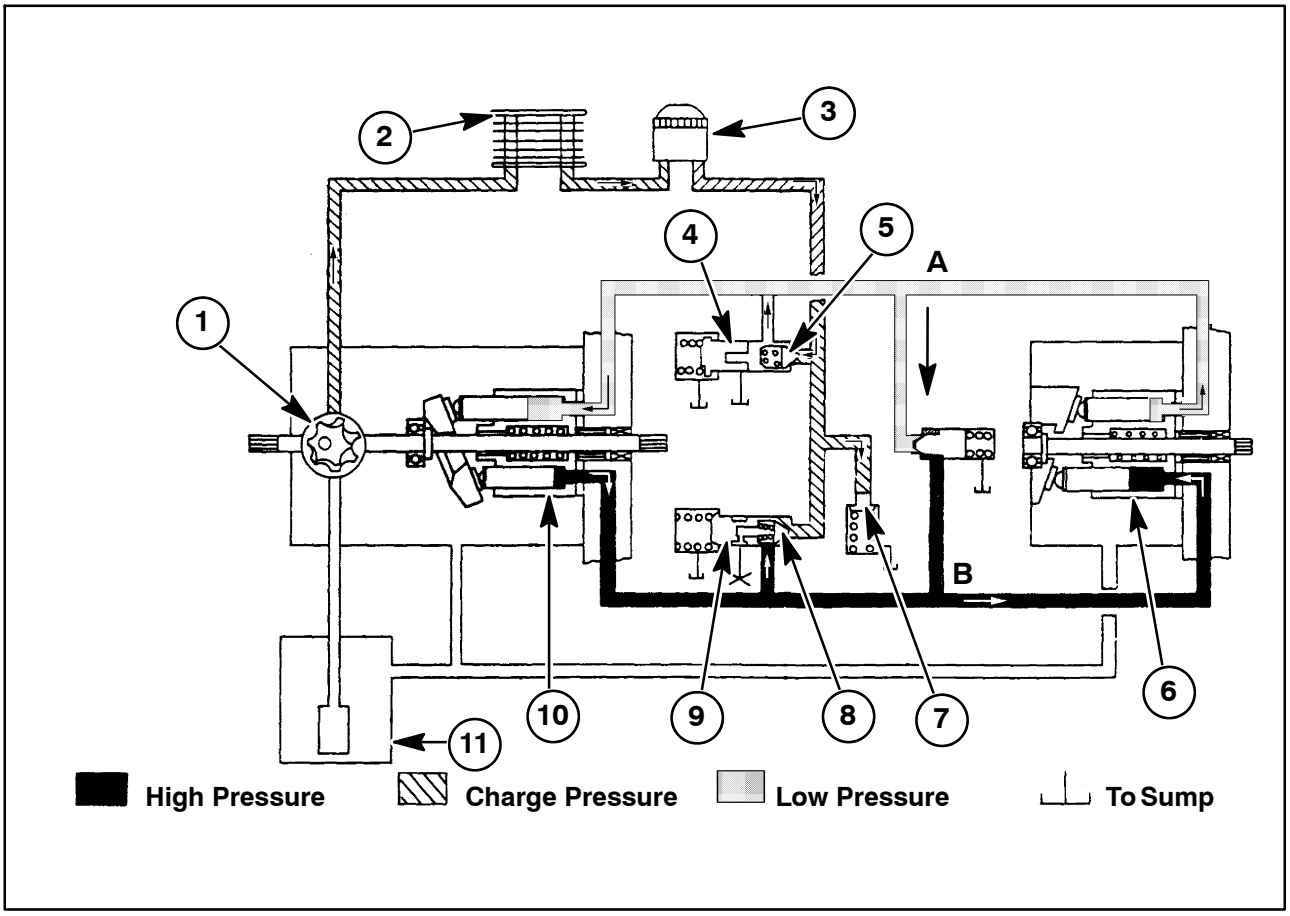
FLUID FLOW FORWARD POSITION

1. Charge Pump
2. Cooler
3. Filter (HST)
4. Neutral Valve
5. Feed (Check) Valve “A”
6. Hydrostatic Motor
7. Charge Pump Relief Valve
8. Neutral Valve
9. Feed (Check) Valve “B”
10. Hydrostatic Pump
11. Reservoir
12. High Pressure Relief

Forward Position

When the foot pedal is shifted slightly forward, the pump swash plate is tilted at a slight angle and a small quantity of fluid is discharged from the piston pump into passage “A”. This small quantity of fluid passes through the neutral valve, 4, and returns to the sump while causing a slight pressure increase in passage “A”. When the foot pedal is depressed further forward, increased fluid flows from the piston pump, through passage “A”. Pump pressure on the back of feed (check) valve, 5, closes the feed valve and pressure increases on the neutral valve, 4. At a pressure above 34.3 - 37.2 bar (498 - 540 psi), the neutral valve, 4, closes the return to sump and all fluid flow from pump passage “A” flows to the hydrostatic motor, 6, causing the motor to rotate. Fluid discharged from the hydrostatic motor, 6, at A2 into passage “B” flows back to the hydrostatic pump, 10, to complete the cycle. When fluid leakage in the system causes a drop in pressure on the suction passage “B” below 5.2 - 6.6 bar (75.4 - 95.7 psi) pressure setting, feed (check) valve, 8, opens and provides make-up fluid from the charge pump. Excess fluid from the charge pump is returned to the sump via the charge pump relief valve, 7.

The high pressure relief valve, 12, protects the motor, 6, opening when pressure is above 274 bar (3981 psi).



9

FLUID FLOW REVERSE POSITION

1. Charge Pump
2. Cooler
3. Filter
4. Neutral Valve
5. Feed (Check) Valve “A”
6. Hydrostatic Motor
7. Charge Pump Relief Valve
8. Neutral Valve
9. Feed (Check) Valve “B”
10. Hydrostatic Pump
11. Reservoir
12. High Pressure Relief

Reverse Position

When the foot pedal is depressed in the reverse position, fluid flows from the hydrostatic pump, 10, into passage “B.” Pump pressure on the back of feed (check) valve, 8, causes it to close and increase pressure on the neutral valve, 9. At a pressure above 34.3 - 37.2 bar (498 - 540 psi) the neutral valve, 9, closes the return to sump and all fluid flow from passage “B” flows to the hydrostatic motor, 6.

Fluid pressure acting on the motor pistons causes the motor to rotate in the reverse direction. Fluid discharged from the motor, 6, flows back through passage “A” to the hydrostatic pump, 10, to complete the cycle. When fluid leakage in the system causes a drop in pressure on the suction passage “A” below 5.2 - 6.6 bar (75.4 - 95.7 psi) pressure setting, feed (check) valve, 5, opens and provides make-up fluid from the charge pump. Excess fluid from the charge pump is returned to the pump via the charge pump relief valve, 7.

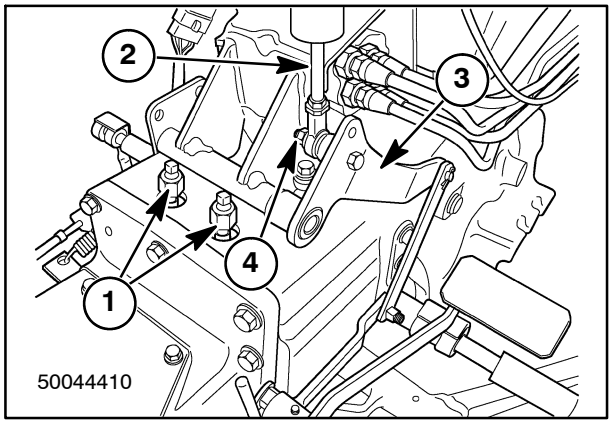
The high pressure relief valve, 12, protects the motor, 6, opening when pressure is above 274 bar (3981 psi).

OVERHAUL – HYDROSTATIC UNIT

Op. 29 202

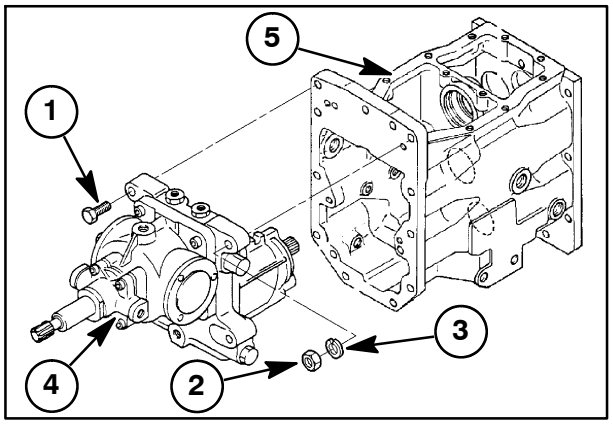
Removal

1. Drain the transmission fluid into a suitable clean container.
2. Separate the tractor between the clutch and front transmission housing. See “Separating the Tractor,” later in this section.
3. Remove the two test port adapters, 1.
4. Disconnect the HST control rod, 2, from the HST pedal link assembly, 3, by removing the nut, 4.



10

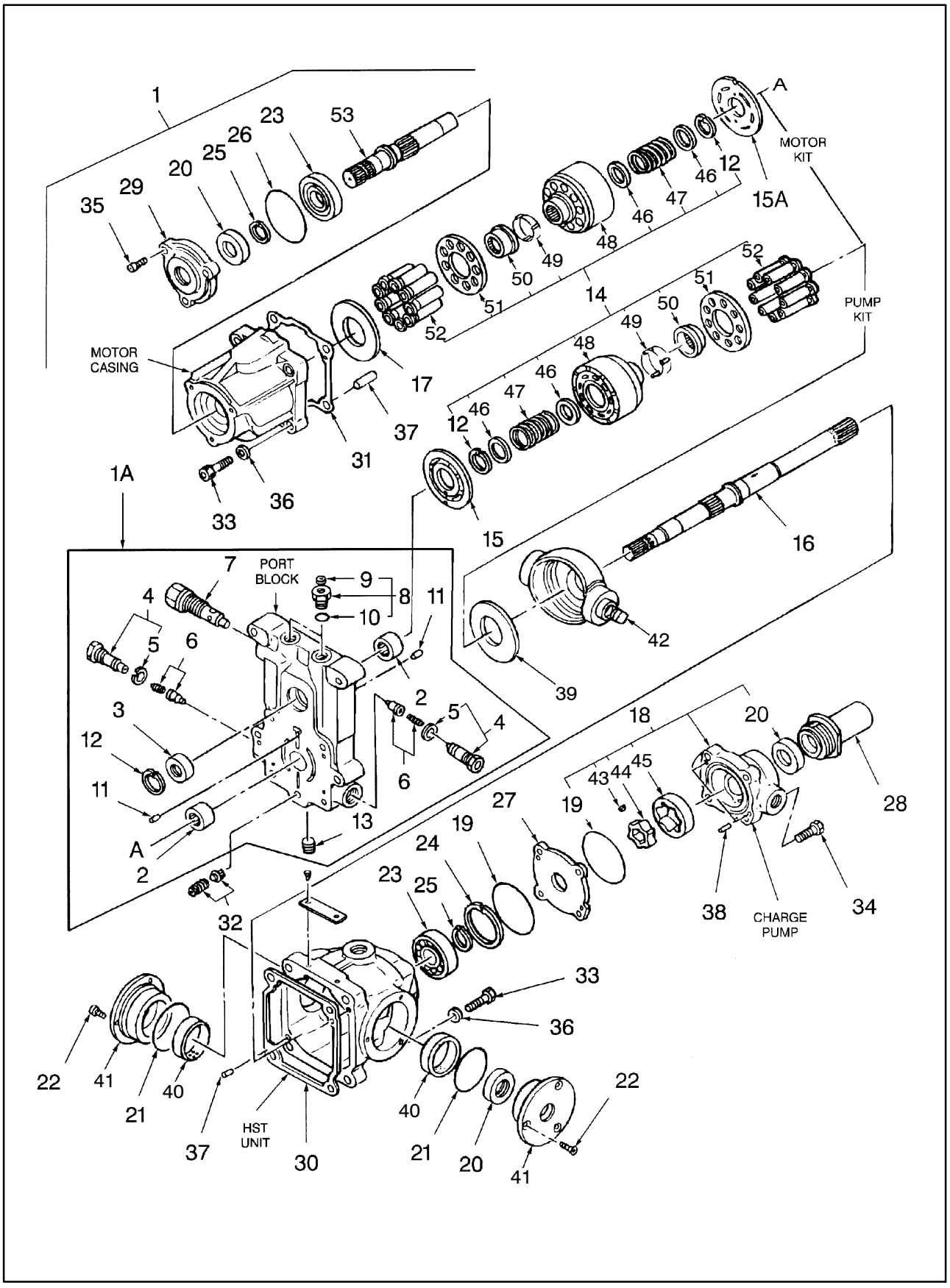
5. Remove the clutch housing attaching bolts and remove the clutch housing.
6. Remove the hydrostatic unit retaining bolts, 1, nuts, 2, and washers, 3, and remove the hydrostatic unit, 4, from the front transmission case, 5.



11

Precautions Before Disassembly

1. Be sure to thoroughly clean the tractor to remove all dirt and foreign particles from the unit.
2. Plug or cap all hydraulic lines and openings to prevent foreign particles from entering the system.
3. Drain the fluid from the HST unit.
4. Maintain a clean work area so as to not contaminate or damage any of the precision surfaces of the HST components.
5. Handle the HST components with care so as to not scratch or otherwise cause damage to the parts.


MOTOR KIT
PUMP KIT
MOTOR CASING
PORT BLOCK
HST UNIT
CHARGE PUMP

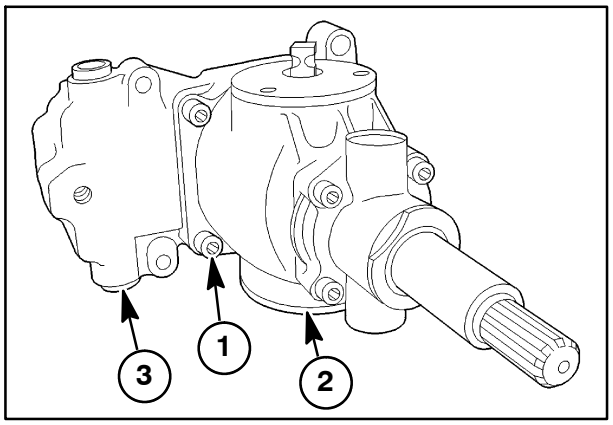
12

1. HST Assembly
1A. Block Kit
2. Needle Bearing
3. Oil Seal
4. Neutral Valve Assembly
5. Seal
6. Feed (Check) Valve Kit
7. Relief Valve Assembly
8. Plug Assembly
9. Gasket
10. O ring
11. Pin
12. Snap Ring
13. 1/8 Pipe Thread Plug
14. Rotating Pump/Motor Group
15. Valve Plate (Pump)
15A. Valve Plate (Motor)
16. Input Shaft (PTO)
17. Thrust Plate (Motor)
18. Charge Pump Kit
19. O ring
20. Oil Seal
21. O ring
22. Screw
23. Ball Bearing
24. Snap Ring
25. Snap Ring
26. O ring
27. Plate
28. Holder
29. Cover (Motor)
30. Gasket (Pump)
31. Gasket (Motor)
32. Charge Relief Valve
33. Bolt
34. Bolt
35. M6 x 20 Bolt
36. Washer
37. Dowel Pin
38. Dowel Pin
39. Thrust Plate (Pump)
40. Bushing
41. Swash Plate Cover
42. Swash Plate
43. Key
44. Inner Rotor
45. Outer Rotor
46. Washer
47. Spring
48. Cylinder Block
49. Pins
50. Retainer Holder
51. Piston Retainer
52. Pistons
53. Output Shaft (Transmission)

HYDROSTATIC PUMP

Disassembly

1. Remove the four hexagon socket bolts, 1, retaining the HST pump, 2, to the port block, 3. Tap the port block with a soft hammer to loosen the pump assembly.

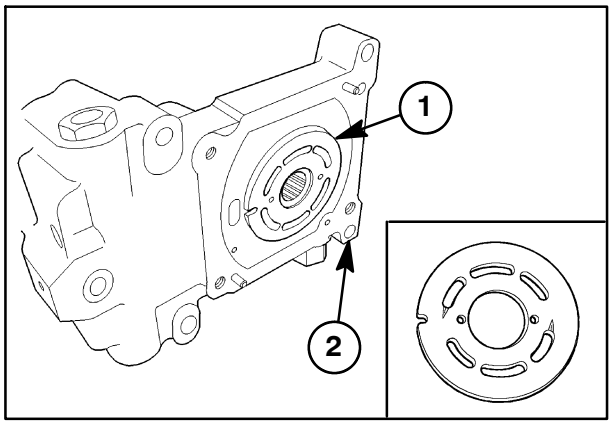


13

2. Remove the pump sufficiently enough to confirm the position of the valve port plate, 1.

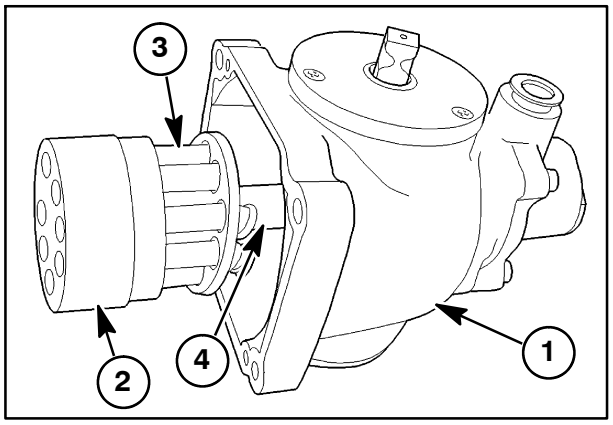
   NOTE: *The valve plate, 1, will adhere to either the pump cylinder block or to the port block, 2, surface. Exercise care in removing the pump to prevent the valve plate from inadvertently being dropped during disassembly.*

3. Remove the pump assembly and valve plate, 1. The valve plate will have two feathering notches.



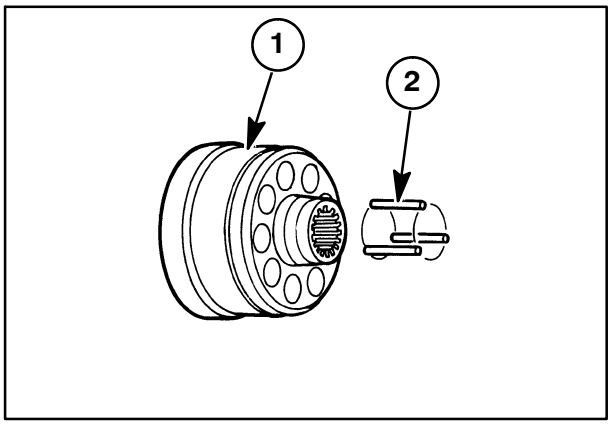
14

4. Slide the pump cylinder block, 2, and piston assembly, 3, off the input shaft, 4, to remove from pump housing, 1. Pistons may adhere to thrust plate and pull out of the pump cylinder block.



15

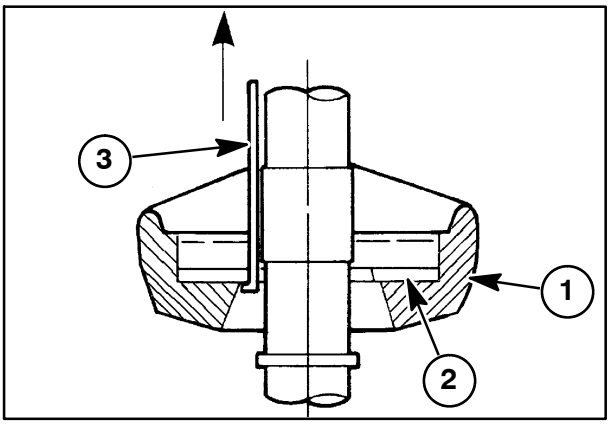
NOTE: *Be careful not to lose the three pins, 2, from the pump cylinder block, 1.*



16

5. Remove the thrust plate, 2, from the swash plate, 1. If it is hard to remove, use a hook type tool, 3, to remove the plate.

   NOTE: *Tapered edge of thrust plate faces towards the swash plate.*



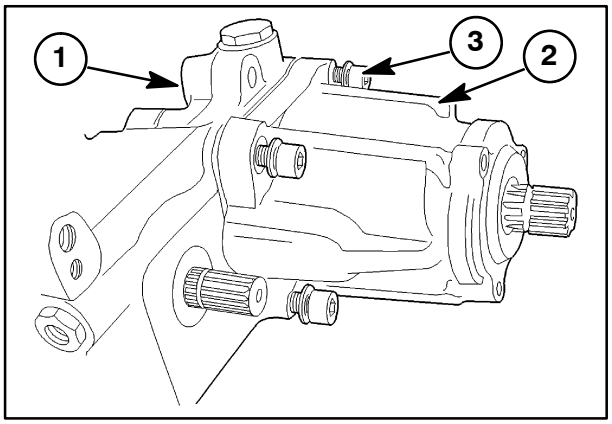
17

HYDROSTATIC MOTOR

Disassembly

1. Remove the four hexagon head sockets bolts, 3, securing the motor housing, 2, to the port block, 1. Tap the port block with a soft hammer to loosen the motor assembly.

   NOTE: *Once the motor assembly is separated from the port block the charge pump relief valve tappet and spring may fall out.*

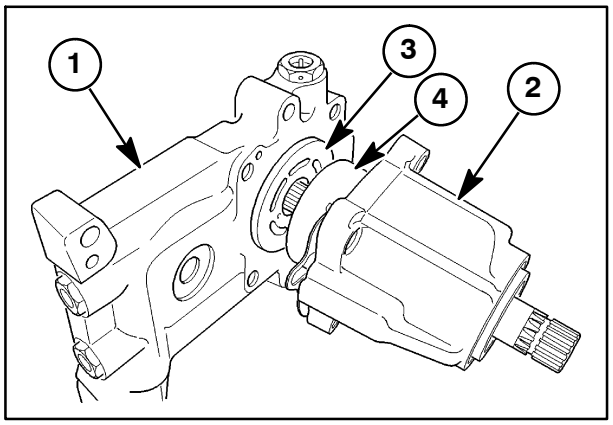


18

2. Remove the motor housing, 2, sufficiently enough to confirm the location of the valve port plate, 3.

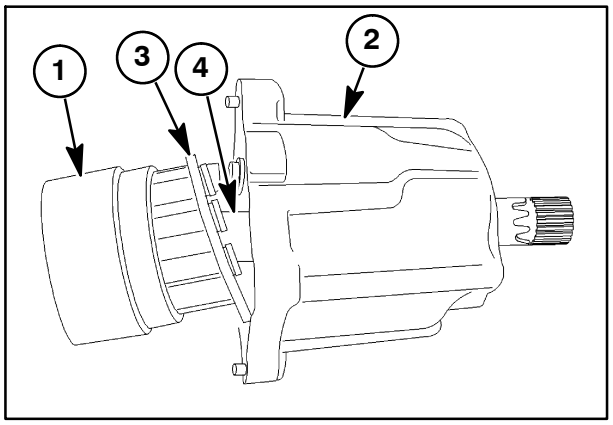
   NOTE: *The valve plate, 3, will adhere to either the motor cylinder block, 4, surface or the port block, 1, surface. Exercise care in removing the motor to prevent the valve plate to inadvertently being dropped during disassembly.*

3. Remove the motor assembly, 2, and valve plate, 3. The valve plate will have four feathering notches.



19

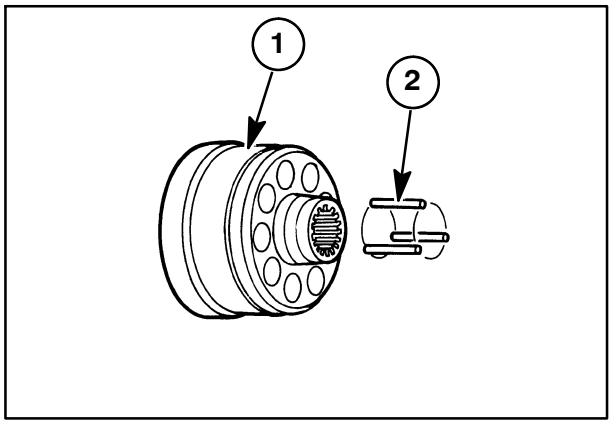
4. Slide the motor cylinder block, 1, and piston assembly, 3, off the motor output shaft, 4, to remove from motor housing, 2.



20

5. Remove the thrust plate from the motor housing. If it is hard to remove, use a hook type tool to remove the plate.

   NOTE: *Be careful not to lose the three pins, 2, from the pump cylinder block, 1.*

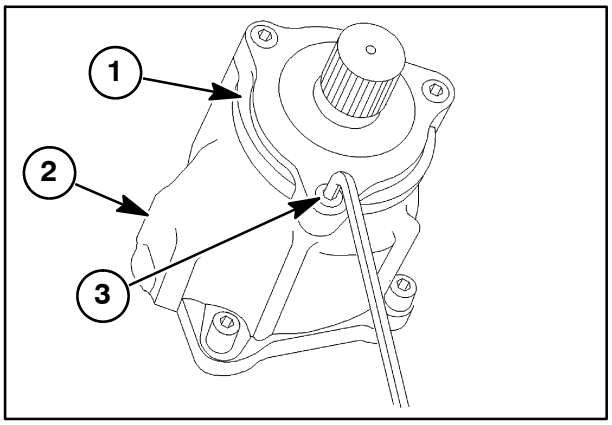


21

HYDROSTATIC MOTOR SHAFT

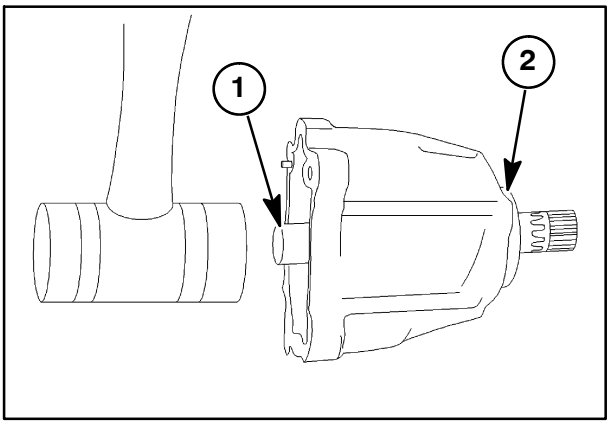
Removal

1. Remove the three hexagon socket bolts, 3, retaining the cover, 1, to the motor housing, 2, and remove the cover.



22

2. Using a soft hammer gently drive the shaft, 1, and bearing, 2, as an assembly out of the housing.



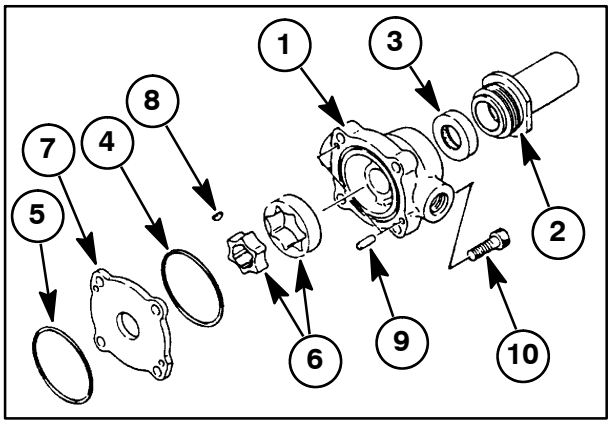
23

CHARGE PUMP

Removal

1. Remove the throw-out bearing hub, 2, and seal, 3.
2. Remove the four bolts, 10, retaining the charge pump to the housing and remove O ring, 5, wear plate, 7, O ring, 4, rotors, 6, key, 8, and pin, 9, from the housing, 1, and shaft.

   NOTE: *Identify the position of the inner and outer rotor so as to assemble in their original position. Rotate shaft until the key, 8, is on the top of the shaft. The large notch on the inside rotor will help reference the position of the rotors on the shaft.*
3. Remove the snap ring from the inner case, drive out the shaft and bearing as an assembly from the front of the case.

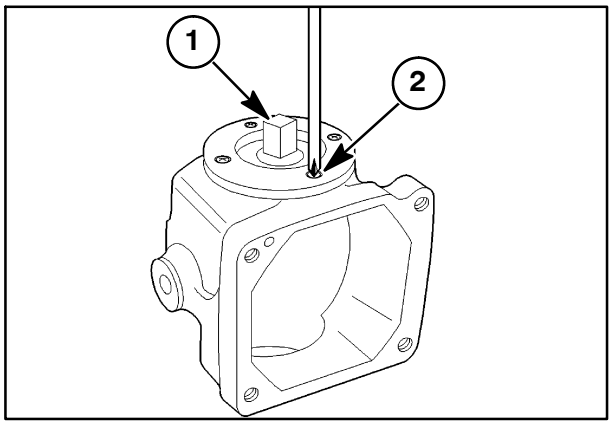


24

SWASH PLATE

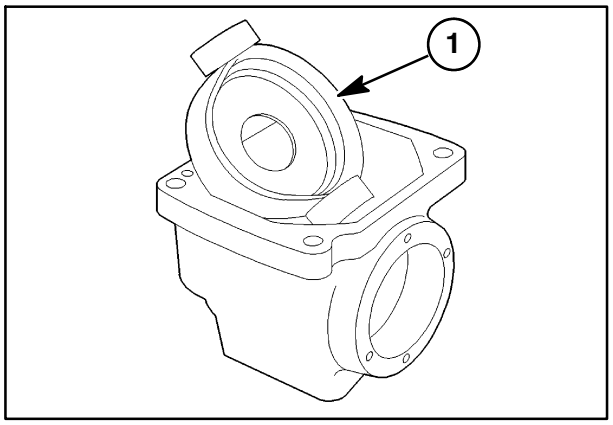
Removal

1. Scribe alignment marks on the swash plate covers. Remove the cover screws, 2, from each side.
2. Gently tap the axial end of the swash plate with a soft hammer and remove the opposite side cover.
3. Gently tap on the exposed trunnion end, 1, with a soft hammer and remove the remaining cover.



25

4. Remove the variable swash plate, 1.



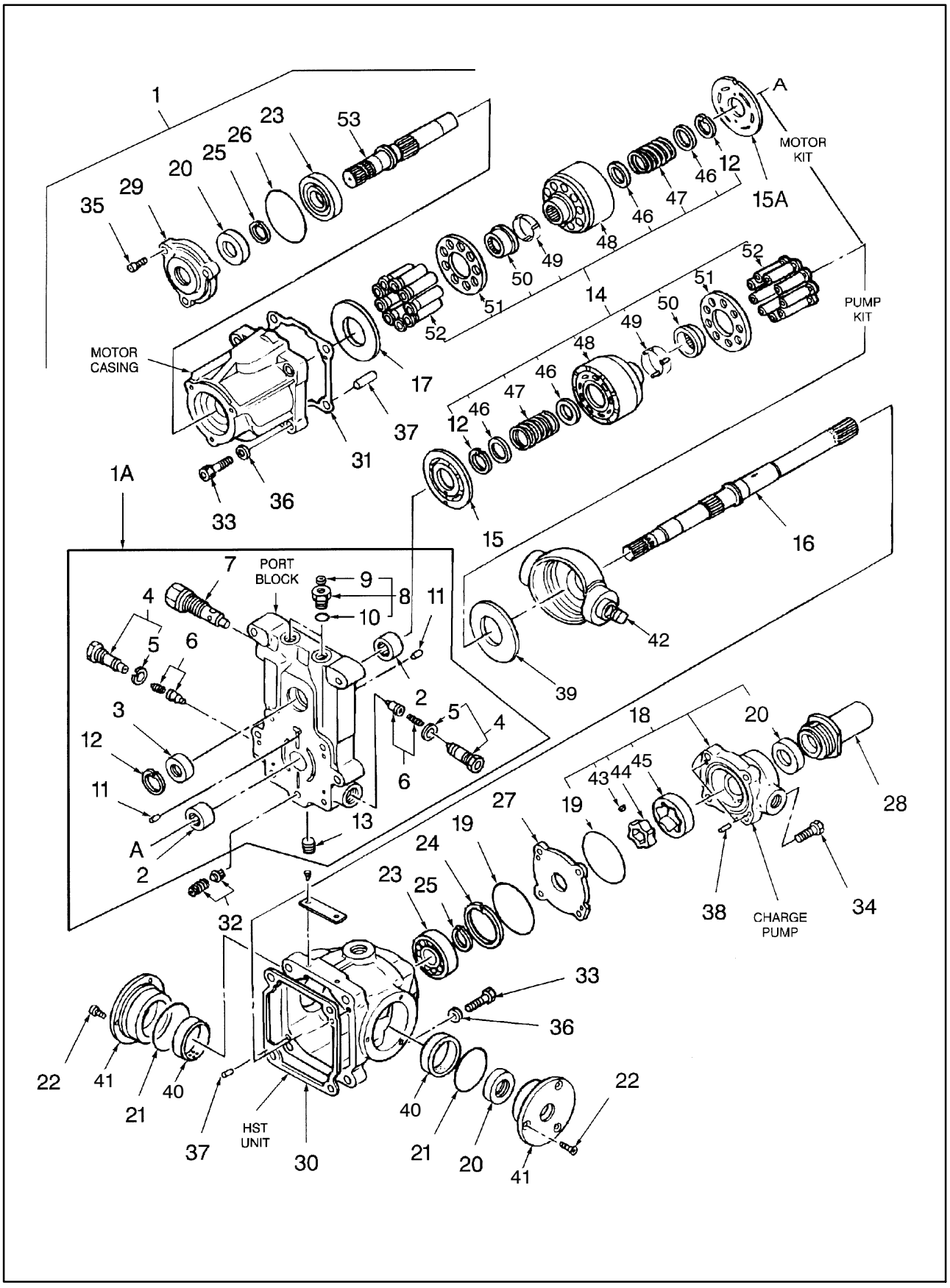
26

HYDROSTATIC TRANSMISSION

Inspection

Inspect the hydrostatic components for the following conditions:

1. Excessive wear or scored pistons and cylinder bores in the pump and motor block assemblies.
2. Excessive wear or scored cylinder block and valve port plate mating surfaces.
3. Excessive wear or scored charge pump rotor faces and lobes.
4. Excessive wear or scored charge pump body and wear plate surfaces.
5. Check the ball bearings for excessive wear and looseness or uneven rotation when rotated by hand.
6. Inspect the variable swash plate bushings for excessive wear or scoring. Replace the cover and bushings as an assembly if required.
7. Inspect the valve plates for wear, scratches, and grooves. Replace the valve plates if required.


MOTOR KIT
PUMP KIT
MOTOR CASING
PORT BLOCK
HST UNIT
CHARGE PUMP

27

1. HST Assembly
1A. Block Kit
2. Needle Bearing
3. Oil Seal
4. Neutral Valve Assembly
5. Seal
6. Feed (Check) Valve Kit
7. Relief Valve Assembly
8. Plug Assembly
9. Gasket
10. O ring
11. Pin
12. Snap Ring
13. 1/8 Pipe Thread Plug
14. Rotating Pump/Motor Group
15. Valve Plate (Pump)
15A. Valve Plate (Motor)
16. Input Shaft (PTO)
17. Thrust Plate (Motor)
18. Charge Pump Kit
19. O ring
20. Oil Seal
21. O ring
22. Screw
23. Ball Bearing
24. Snap Ring
25. Snap Ring
26. O ring
27. Plate
28. Holder
29. Cover (Motor)
30. Gasket (Pump)
31. Gasket (Motor)
32. Charge Relief Valve
33. Bolt
34. Bolt
35. M6 x 20 Bolt
36. Washer
37. Dowel Pin
38. Dowel Pin
39. Thrust Plate (Pump)
40. Bushing
41. Swash Plate Cover
42. Swash Plate
43. Key
44. Inner Rotor
45. Outer Rotor
46. Washer
47. Spring
48. Cylinder Block
49. Pins
50. Retainer Holder
51. Piston Retainer
52. Pistons
53. Output Shaft (Transmission)

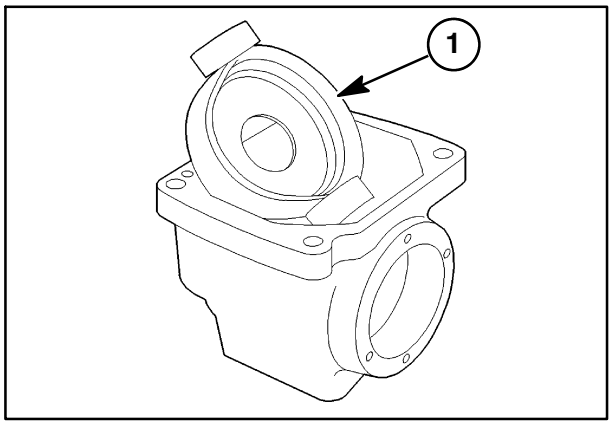
HYDROSTATIC PUMP

Assembly

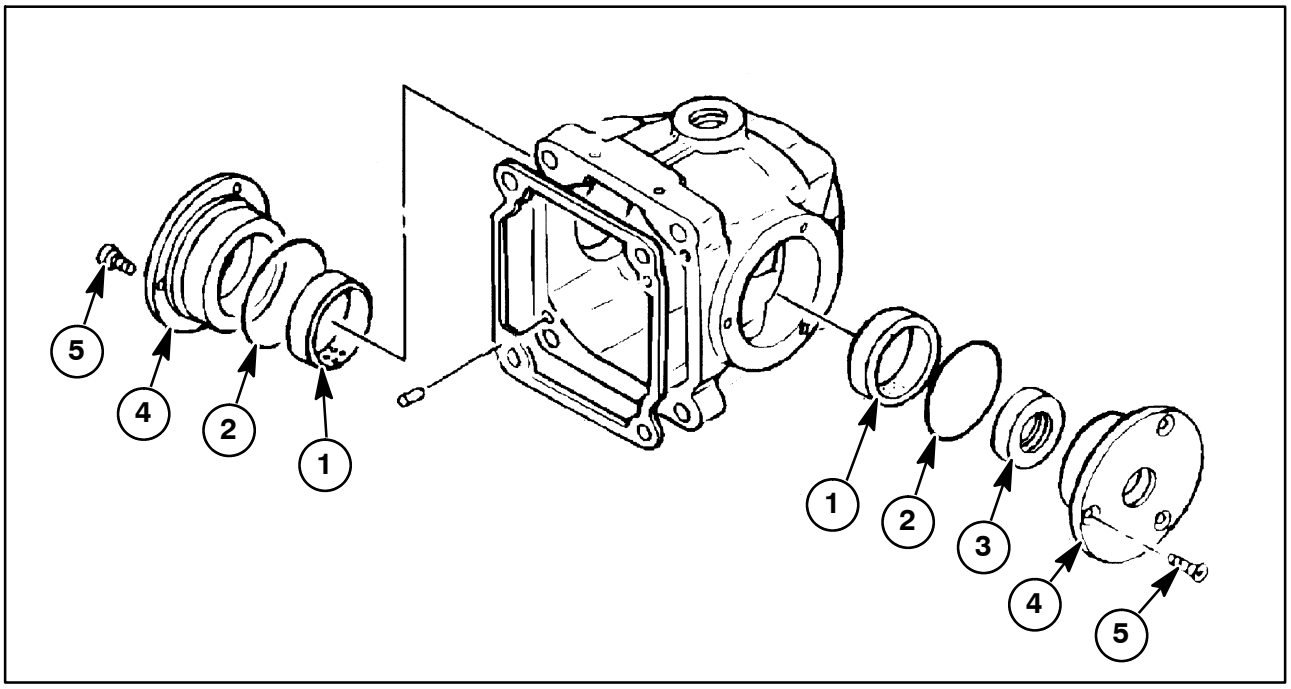
NOTE: *Replace all seals upon reassembly of the HST unit.*

Before assembly be sure all components are thoroughly coated with transmission fluid, Ambra Multi G 134 or equivalent.

1. Position the variable swash plate, 1, into the case in the same orientation as removed.



28



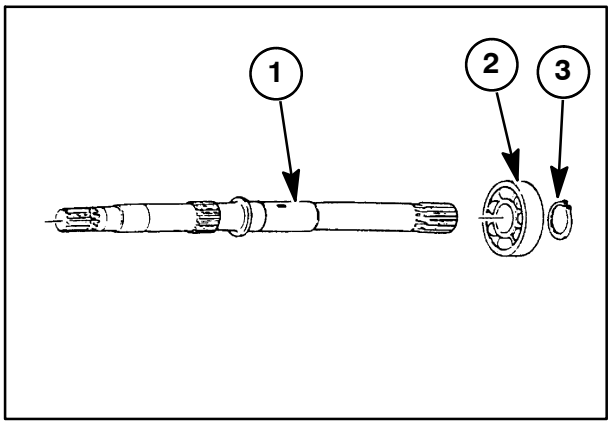
29

1. Bushing
2. O ring
3. Oil Seal
4. Cover
5. Retaining Screw

2. Align the swash plate covers and install the bushings, 1, O rings, 2, oil seal, 3, and covers, 4, into the case. Tighten the retaining screws, 5, to 3.92 ± 0.39 N·m (2.89 ± 0.29 ft lbs).

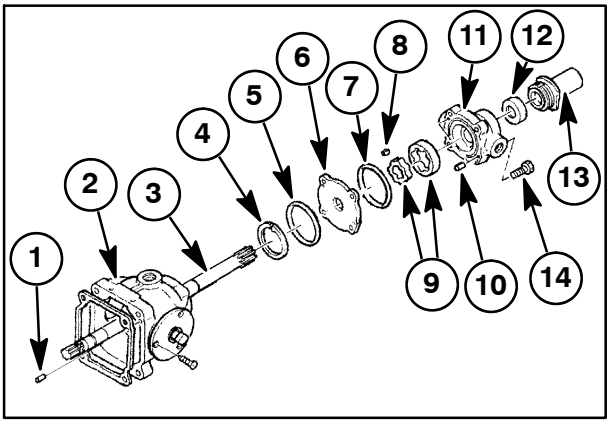
   NOTE: *Be sure to align the cover scribe marks, and install the covers in their original position.*

3. Press bearing, 2, in place on the input shaft, 1, and secure with snap ring, 3.



30

4. Install the input shaft and bearing assembly, 3, into the housing, 2. Secure in place with snap ring, 4.
5. Install dowel pin, 10, and O ring, 5, in the hydrostatic pump housing, 2.
6. Install wear plate, 6, in place on the pump housing, 2.
7. Install key, 8, and pump rotor assembly, 9, on the pump shaft, 3.
8. Press the seal, 12, in place in the charge pump housing, 11, and install the throw-out bearing hub, 13, to the case. Tighten the hub to 58.80 ± 5.9 N·m (43.39 ± 4.39 ft. lbs.).
9. Install O ring, 7, to the charge pump housing.
10. Install the charge pump subassembly to the case and tighten the retaining bolts, 14, to 17.7 ± 1.7 N·m (13.0 ± 1.3 ft. lbs.).

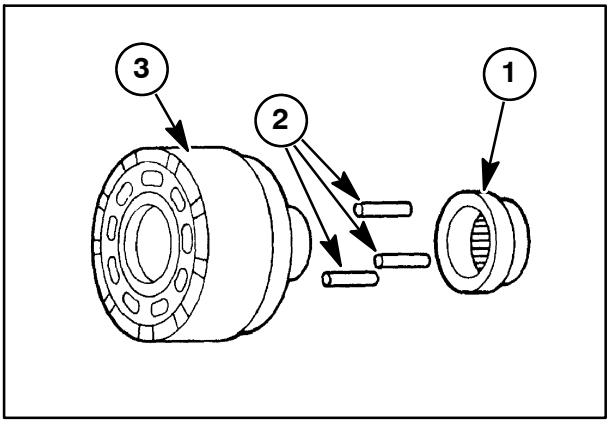


31

HST PISTON PUMP CYLINDER BLOCK

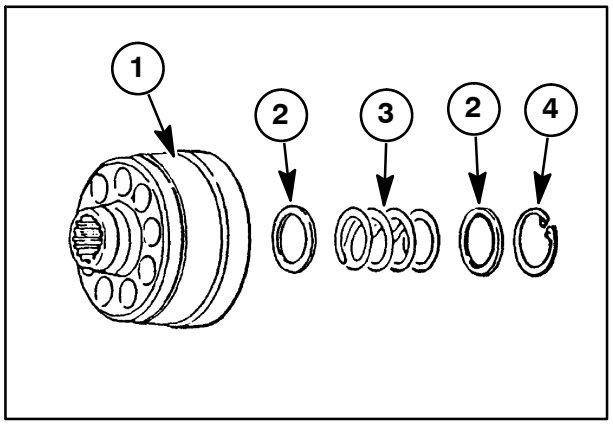
Assembly

1. Assemble the pins, 2, and retainer holder, 1, to the cylinder block, 3.



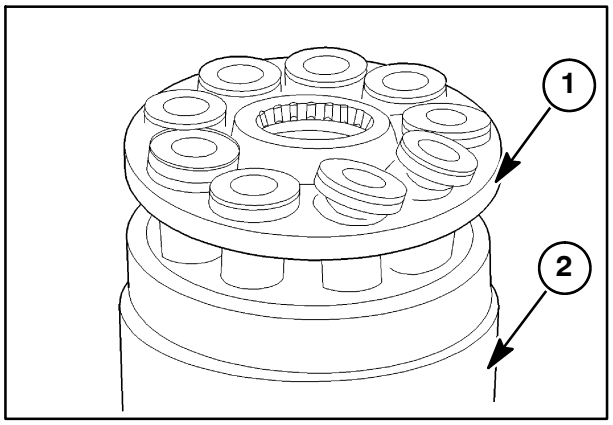
32

2. If removed, assemble the washers, 2, spring, 3, and snap ring, 4, in the cylinder block, 1.



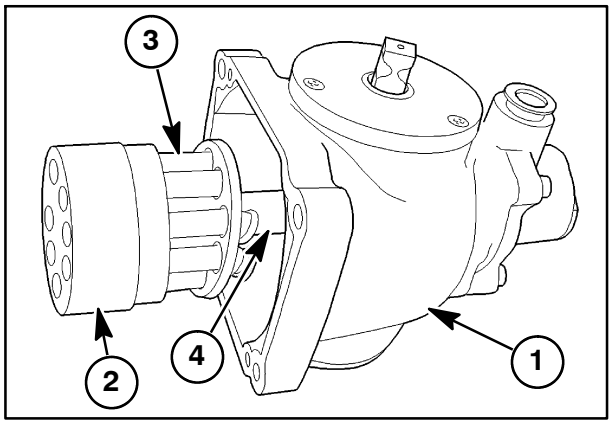
33

3. Assemble the piston and retainer assembly, 1, into the cylinder block, 2.



34

4. Install the thrust plate in position in the bottom of the housing in the variable swash plate. Place tapered end facing the swash plate.
5. Install the assembled cylinder block, 2, and piston, 3, onto the input shaft, 4, into the pump housing, 1. Be careful to keep all pistons in their proper cylinder block locations.

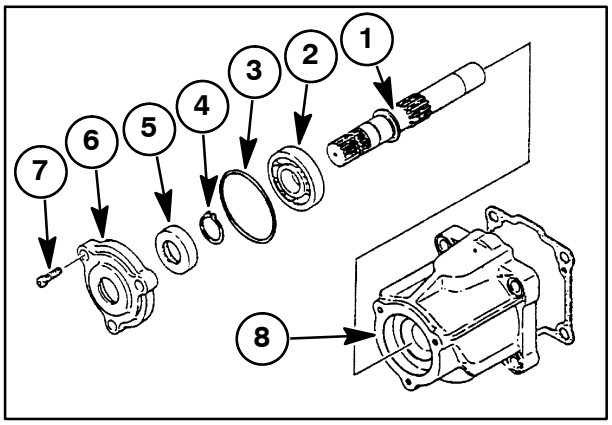


35

HST MOTOR CYLINDER BLOCK

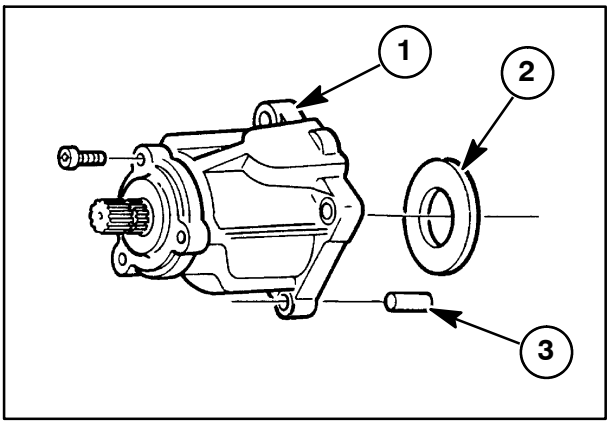
Assembly

1. If removed, press bearing, 2, onto drive shaft, 1, and secure with snap ring, 4.
2. Install the oil seal, 5, and O ring, 3, into the case cover, 6.
3. Install the drive shaft, 1, into the motor housing, 8.
4. Install the cover, 6, and tighten the retaining bolts, 7, to 4.9 ± 0.49 N·m (3.61 ± 0.36 ft. lbs.).



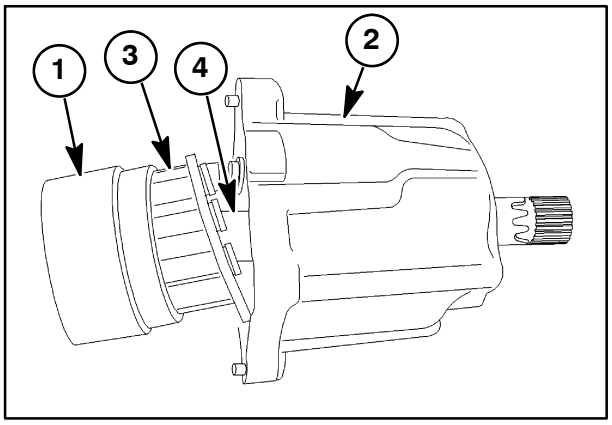
36

5. Position the thrust plate, 2, in the bottom of the motor housing, 1, against the fixed swash plate. If removed, install dowel pin, 3.



37

6. Position the motor cylinder block, 1, and pistons, 3, onto the output shaft, 4, into the pump housing, 2. Be careful to keep the pistons in the cylinder block holes.



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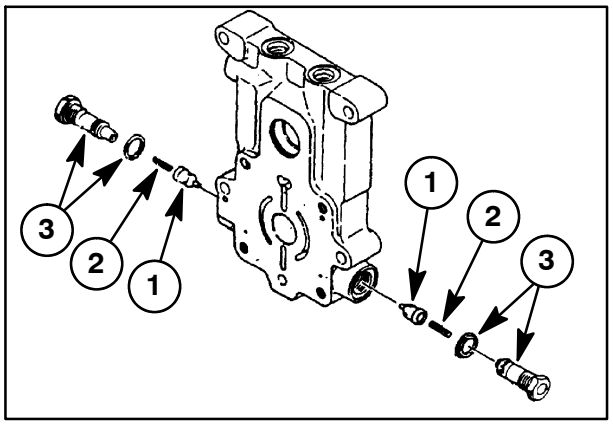
Op. 29 130

PORT BLOCK NEUTRAL AND FEED VALVES

Two sets of neutral, 3, and feed (check) valves, 1, are utilized in the hydrostatic transmission unit. One set functions for forward travel and the other for reverse travel. The neutral valves operate (close off flow) at 34.4 - 37.2 bar (498 - 540 psi).



39

Disassembly

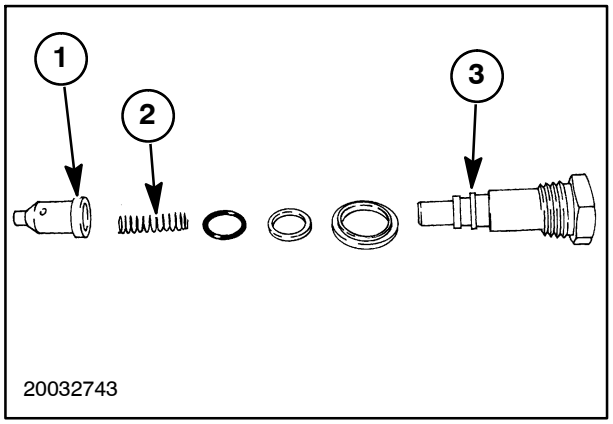
1. Remove the neutral valve assembly, 3, from the housing.
2. Remove the feed (check) valve spring, 2, and poppet, 1.

Inspection

1. Inspect the feed (check) valve poppet, 1, for excess wear or scoring. Check the poppet in the bore for a sticking or binding condition.
2. Inspect feed valve springs, 2, for wear, distortion, or other damage.

NOTE: *If the feed valve poppet or spring indicates signs of damage, replace the neutral valve as an assembly.*

3. If hydraulic tests indicate faulty neutral valve, 3, operation, replace the neutral valve as an assembly.



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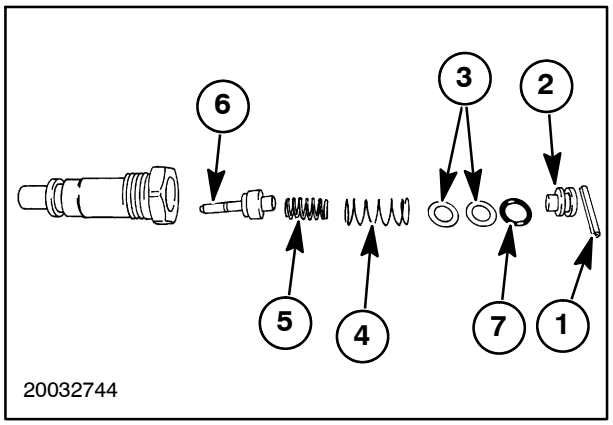
NEUTRAL VALVE SERVICING

Disassembly

The neutral valves can be disassembled if needed. Drive roll pin, 1, from valve body, remove end cap, 2, shims, 3, outer spring, 4, inner spring, 5, and valve poppet, 6. O ring, 7, can be replaced on end cap if needed.



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Inspection

Check valve body for damage to the poppet seat or for contamination. Insert poppet into valve body and check for binding during poppet travel in valve bore.

Assembly

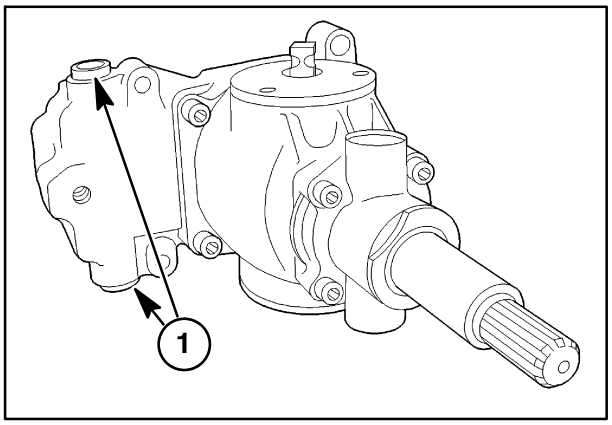
To reassemble, insert poppet, 6, inner spring, 5, outer spring, 4, shims, 3, end cap with O ring, 2. While pushing end cap into valve body drive roll pin, 1, into valve body.

FEED VALVES SERVICING

Inspection

1. Inspect the feed (check) valve poppet for excess wear or scoring. Check the poppet in the bore for a sticking or binding condition.
2. Inspect feed valve springs for wear, distortion, or other damage.

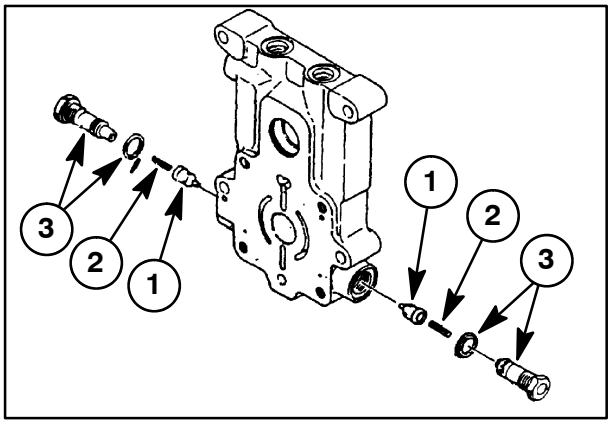
   NOTE: *If the feed valve poppet or spring indicates signs of damage, replace the neutral valve as an assembly.*
3. If hydraulic tests indicate faulty neutral valve operation, replace the neutral valve, 1, as an assembly.



42

Assembly

1. Install the feed valve spring, 2, and poppet, 1, onto the end of the neutral valve, 3 and install the assembly in the port block.
2. Tighten the neutral valve to 36.75 ± 2.45 N·m (27.12 ± 1.80 ft. lbs.).



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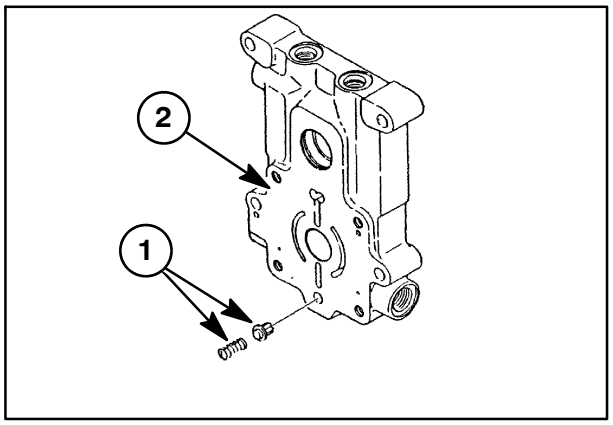
CHARGE PUMP RELIEF VALVE

The charge pump relief valve, 1, functions to maintain approximately 5.2 - 6.6 bar (75.4 - 95.7 psi) of pressure in the oil supply system to the piston pump at all times. Excess oil not required by the piston pump is returned to the sump via the charge pump relief valve.



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Disassembly

Remove the spring and valve, 1, from the hydrostatic motor side of the port block, 2.

Inspection

1. Inspect the valve seat for excess wear or scoring. Check the valve in the bore for a sticking or binding condition.
2. Inspect the valve spring for wear or damage.

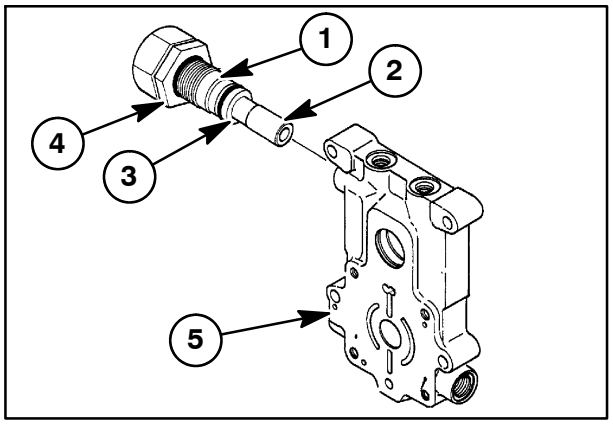
   NOTE: *If damage is observed, replace the valve and spring as a kit assembly.*

Assembly

Install the valve and spring, 1, in the motor side of the port block, 2.

HIGH PRESSURE RELIEF VALVE

A single high pressure relief valve assembly, 1, is located in the piston pump to motor passages of the port block, 5, and protects the drive motor from overloads in both forward and reverse directions. In the forward direction, high pressure fluid acts upon the end of the relief valve plunger, 2, and in the reverse direction, high pressure fluid acts upon the shoulder of the relief valve plunger, 3. High pressure fluid passes through the suction side passage at pressure above 274 bar (3981 psi) to the return passage relieving the pump from overloads.



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Removal

Unscrew the relief valve at nut area, 4, and remove from the port block, 5.

Installation

Install the relief valve in the port block and torque to 83.7 ± 4.9 N·m (40.0 ± 3.6 ft. lbs.).

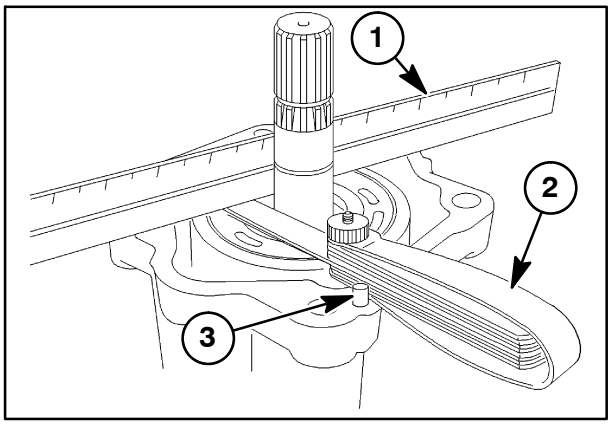
HYDROSTATIC PUMP AND PORT BLOCK

Assembly

1. Using a straight edge, 1, and feeler gauge, 2, measure the depth of the cylinder block surface below the housing end. The clearance should be approximately 2.0 mm (0.078″).

   NOTE: *If insufficient clearance is found, disassemble the pump assembly and recheck the thrust plate position and assembly procedure.*

   NOTE: *Port block valve plate is not installed on the cylinder block.*



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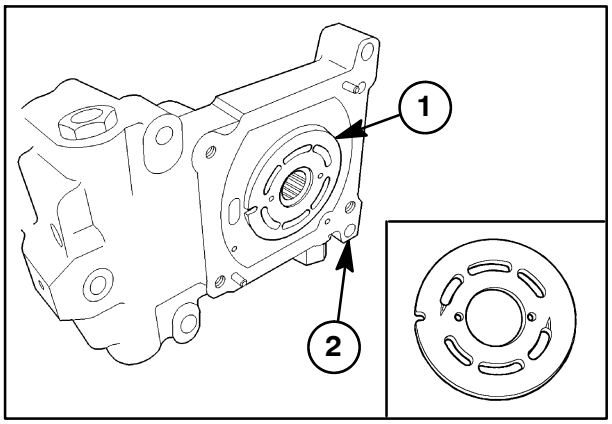
2. If removed, install the two dowel pins, 3, in the pump housing.
3. Coat the gasket surface with petroleum jelly and position the gasket on the pump housing.
4. Install the port valve plate, 1, with tapered opening onto the port block, 2.

   NOTE: *The pump side valve plate has two feathering notches.*



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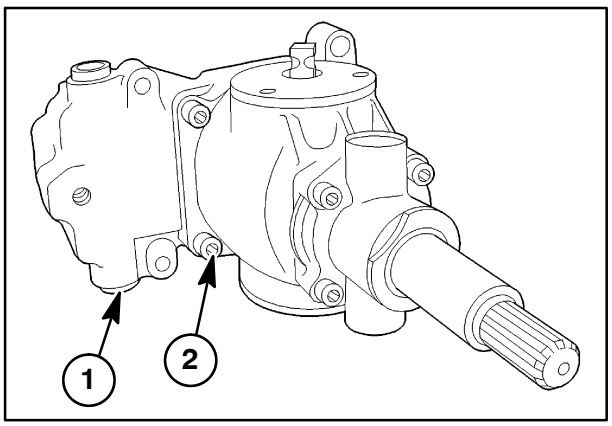
5. Install the pump housing assembly to the port block, 1.
6. Tighten the four socket head bolts, 2. Be sure that the input shaft rotates freely and then torque the bolts to 34.3 ± 3.4 N·m (25.3 ± 2.5 ft. lbs.).



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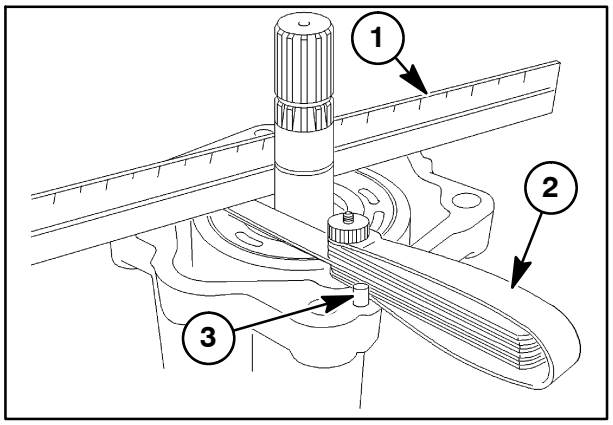
HYDROSTATIC MOTOR AND PORT BLOCK

Assembly

1. Using a straight edge, 1, and feeler gauge, 2, measure the depth of the cylinder block surface below the housing end. Clearance should be approximately 2.0 mm (0.078″).

   NOTE: *If insufficient clearance is found, disassemble the motor assembly and recheck the position of the thrust plate and assembly procedures.*

   NOTE: *Port block valve plate is not installed on the cylinder block.*



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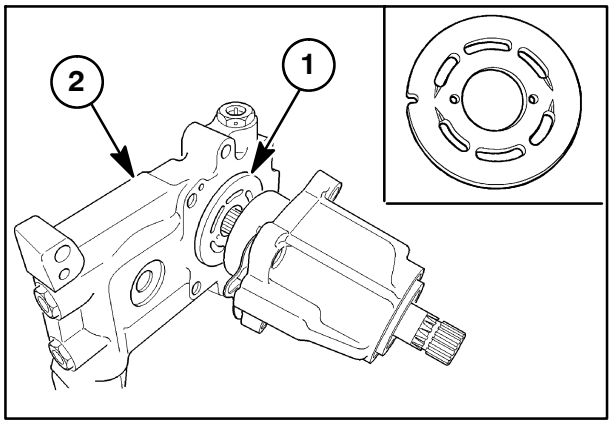
2. If removed, install the two dowel pins, 3, in the motor housing.
3. Coat the gasket surface with petroleum jelly and position the gasket on the motor housing.
4. Install the port valve plate, 1, onto the port block, 2.

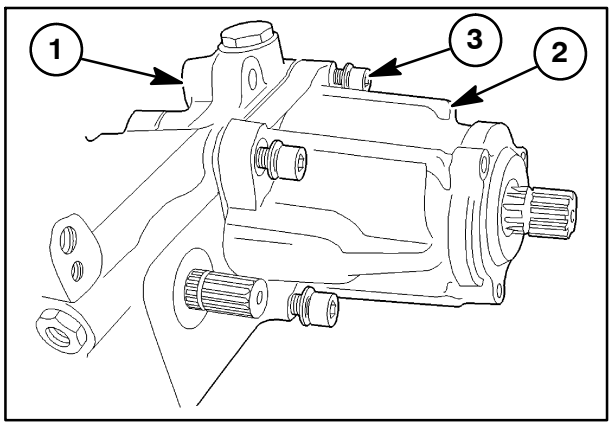
   NOTE: *The motor side valve plate has four feathering notches.*

5. Apply petroleum jelly to the charge pump relief valve and spring. Install the spring in the pump housing bore and the poppet in the port block.



50

6. Install the assembled motor housing, 2, to the port block, 1, be sure to align the relief valve spring and poppet.
7. Tighten the four socket head bolts, 3. Be sure the input and output shafts rotate freely and then tighten the bolts to 34.3 ± 3.4 Nm (25.3 ± 2.5 ft. lbs.).



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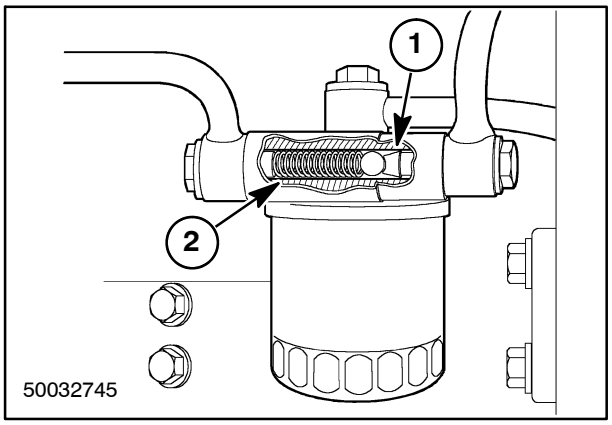
HST COOLER CHECK VALVE

1. A check valve, 1, is located in the HST filter manifold, 2. This check valve protects the cooler from excess pressure due to high fluid viscosity or a restriction in the cooler circuit.

NOTE: *The check valve ONLY protects the HST cooler from excessive pressures. The check valve does not protect the HST filter from excessive pressures due to high oil viscosity or filter restrictions.*



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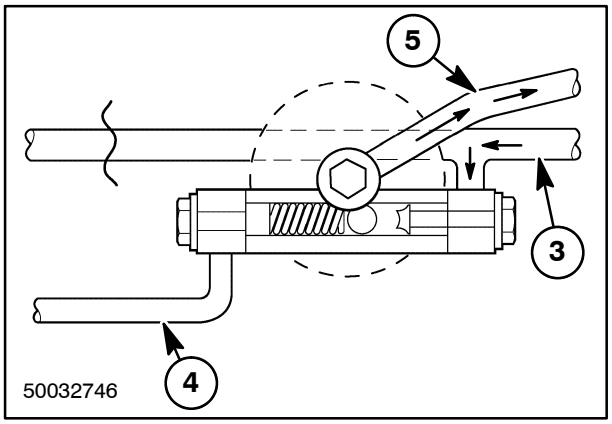
2. If the restriction becomes large enough, a pressure differential will be created across the HST filter. When the pressure differential between inlet cooler line, 3, and outlet cooler line, 4, becomes greater than 9.9 bar (142 psi), the check valve will open. When the check valve opens, the HST cooler is bypassed and oil flow is routed through the HST filter and is transferred by line, 5, to the HST port block.



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Disassembly

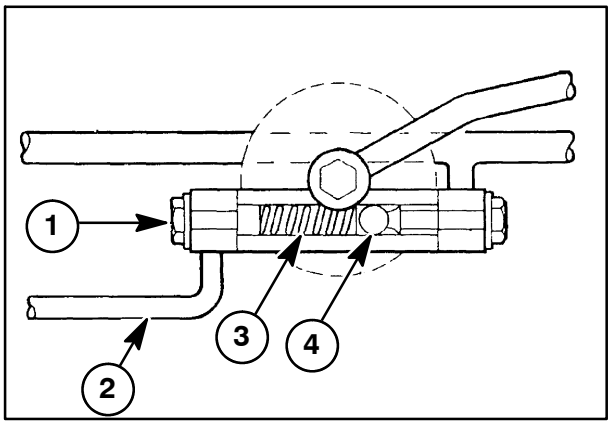
1. Remove the banjo bolt, 1, from the cooler return line, 2, and remove spring, 3, and ball, 4.
2. Remove the banjo bolt, 5, from inlet tube, 6.

Inspection

1. Inspect the spring and ball for wear or damage. Replace faulty components if required.
2. Inspect the ball seat in the filter manifold body for damage or contamination.
3. If seat is damaged, replace filter manifold.

Assembly

1. Install the ball, 4, and spring, 3, into the filter manifold and tighten banjo bolt, 1, onto the return line, 2.



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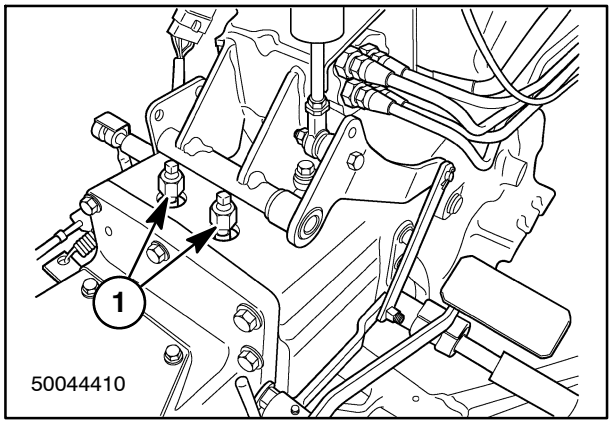
PRESSURE TESTS

HIGH PRESSURE RELIEF VALVE

Test

1. Remove the shroud center panel to gain access to the test port tubes, 1.
2. Operate the tractor to warm the fluid to 25° - 50°C (80° - 120°F) before performing this hydraulic test.
3. The test ports, 1, access the HST unit through holes in top of the clutch housing.



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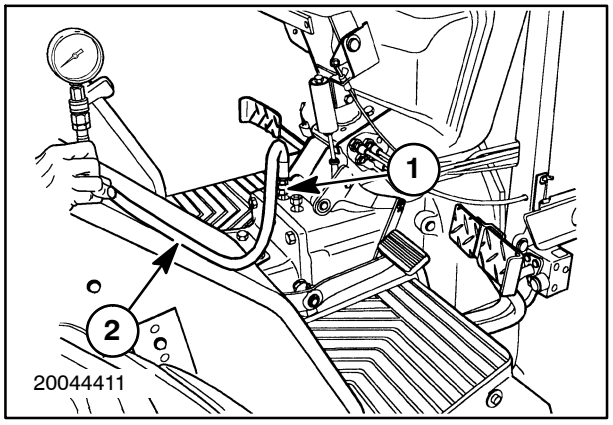
4. Install test fitting Tool No. NH01378, 1, in the test port.
5. Install a 0 - 5000 psi gauge No. OEM 1463, 2, to the test fitting.
6. Securely lock the parking brake.
7. Place the range lever in high range.
8. Disengage the clutch and start the engine. Set throttle speed to 2500 rpm.
9. Be sure the transmission foot pedal is in neutral position and then release the clutch.
10. Slowly move the foot pedal in the forward position to obtain a reading on the pressure gauge. Read the maximum pressure on the gauge. Pressure reading should be 265 - 284 bar (3839 - 4124 psi) at 16 Lpm (4.2 gpm).

    IMPORTANT: *Read pressure in minimum time to prevent overheating and possible damage to the transmission.*



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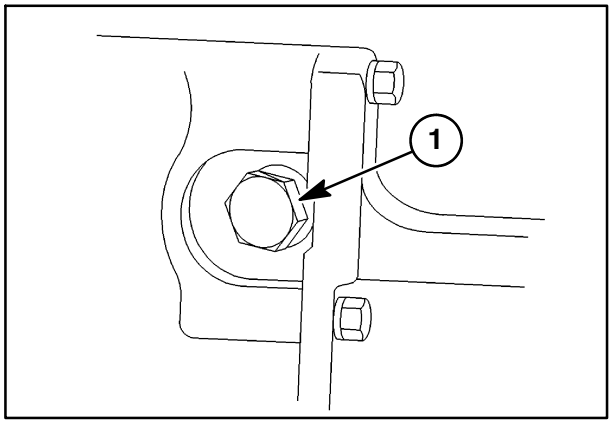
11. If necessary to replace the relief valve, 1, remove the tractor seat and left side fender and replace the relief valve. Retest the new relief valve for correct pressure setting.

    The relief valve is adjustable by shimming between the spring and valve cap. Add shims to increase pressure or remove shims to decrease. The following shim thicknesses will change pressure readings.

Shim Thickness	Pressure Change
0.076 mm (0.003″)	4.8 bar (70 psi)
0.5 mm (0.020″)	27.6 bar (400 psi)



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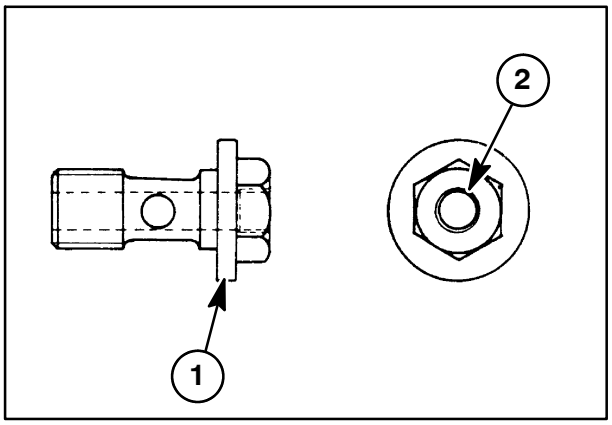
NOTE: *If the relief valve is faulty, replace as an assembly.*

CHARGE PUMP RELIEF VALVE

Test

1. Operate the tractor to warm the fluid to 25° - 50°C (80° - 120°F) before performing this hydraulic test.
2. Remove the banjo bolt, from the cooler tube to the filter inlet side.
3. Drill and tap a banjo bolt (Part No. SBA398480240) for pressure testing as shown, with the center hole drilled all the way through the bolt. Attach proper fittings to the bolt head and pressure gauge.



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1. Banjo Bolt (for Pressure Test)
2. Drill and Tap - 1/8 in NPT

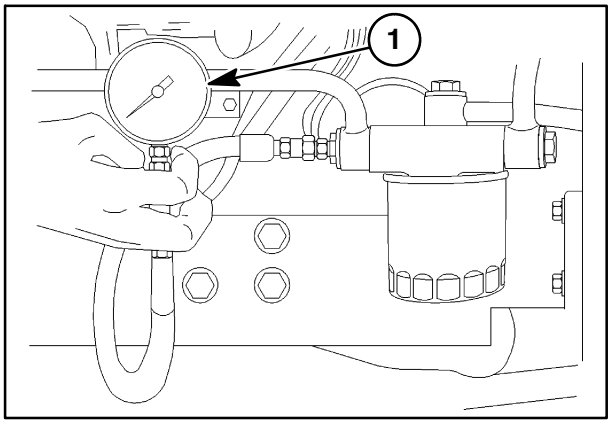
IMPORTANT: *Prior to testing HST charge pressure, install a new HST filter and have oil operating temperature to approximately 32 °C and (90 °F).*

4. Install a OEM 1455 0 - 21 bar (0 - 300 psi) pressure gauge, 1, to the special banjo bolt.
5. Set the range selector in neutral.
6. Set the engine throttle at 2500 rpm and read the pressure gauge. The pressure reading should be 5.2 - 6.6 bar (75.4 - 95.7 psi).
7. If the charge pressure reading is low, check the following:

- Restricted suction filter
- Check or replace the charge pump relief valve
- Check and repair the charge pump

8. If charge pressure reading is high, check the following:

- Restriction in HST filter
- Restriction in cooler circuit.
- Stuck or restricted charge pump relief valve.



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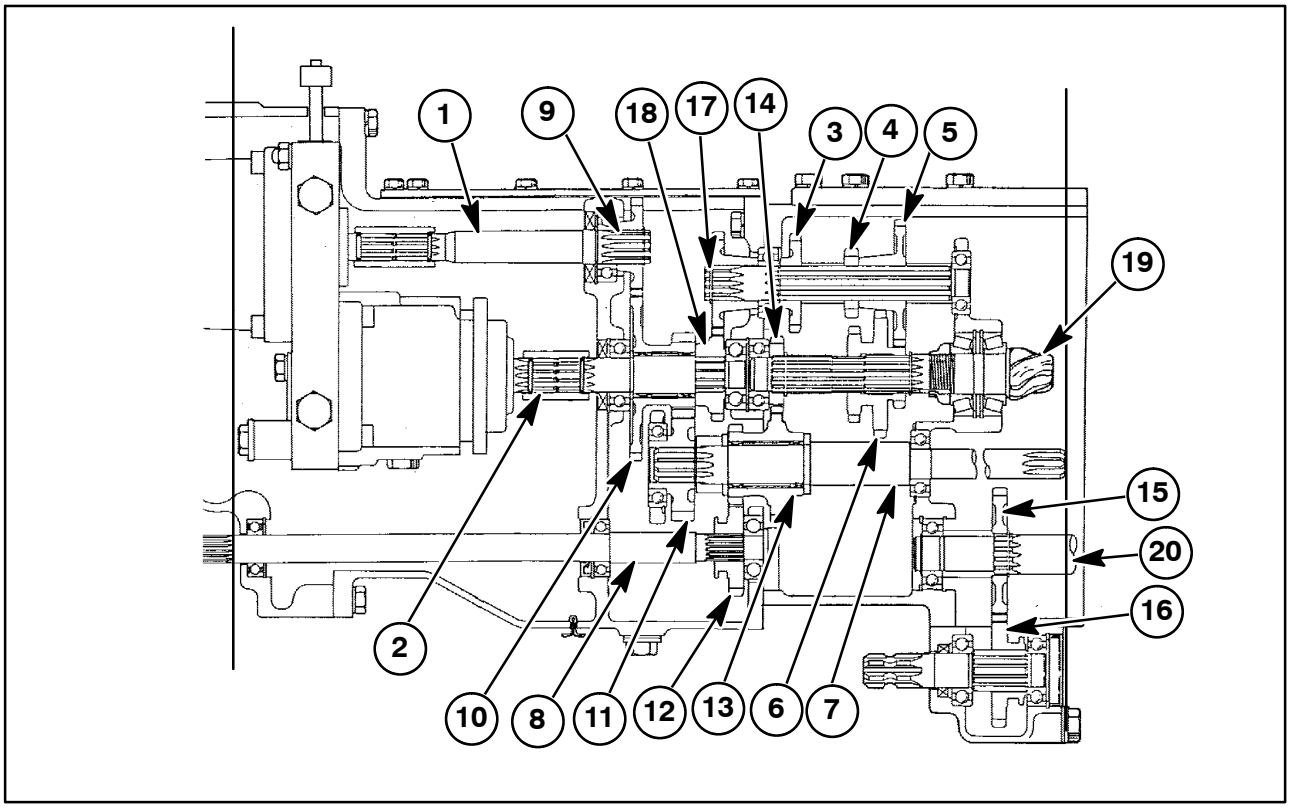
DESCRIPTION OF OPERATION - HYDROSTATIC TRANSMISSION GEARBOX



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1. Input Shaft (PTO)
2. Input Shaft (Transmission)
3. Middle Range Gear 27T
4. Low Range Gear 18T
5. High Range Gear 36T
6. High (18T), Middle (26T), Low (36T) Sliding Gear
7. PTO Countershaft
8. Front Wheel Drive Shaft
9. Fixed Gear 26T (PTO)
10. Counter Gear 50 x 18T (Transmission)
11. Fixed Gear, (PTO)
12. Sliding Gear, (4WD)
13. Counter Gear, (4WD)
14. Fixed Gear, (4WD)
15. Counter Gear (Mid-PTO)
16. Sliding Gear (Mid-PTO)
17. Fixed Gear, (Main Shaft)
18. Fixed Gear, (Pinion Shaft)
19. Drive Pinion
20. Countershaft (Mid-PTO)

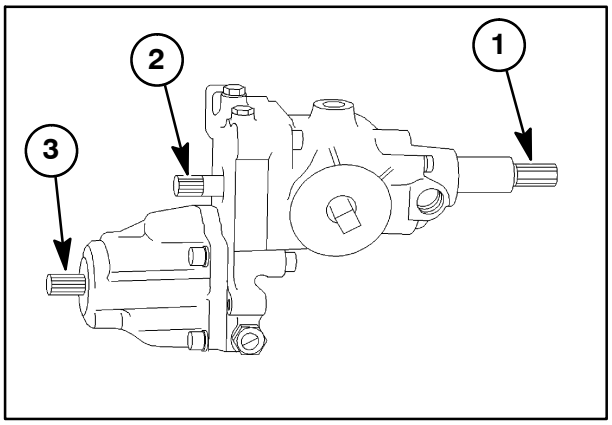
Op. 29 300

The hydrostatic transmission gearbox provides the power flow from the hydrostatic unit for the following functions:

1. Three-speed gear ratio to the rear axle drive pinion.
2. Power take-off drive through a gear reduction to the rear PTO and mid-power take-off output shafts.
3. Front wheel drive when equipped.

HST UNIT

1. The upper PTO drive shaft, 2, is also the input shaft, 1, and provides a direct drive from the engine to the PTO front countershaft.
2. The lower input shaft, 3, provides hydrostatic motor power to drive the rear axle assembly.



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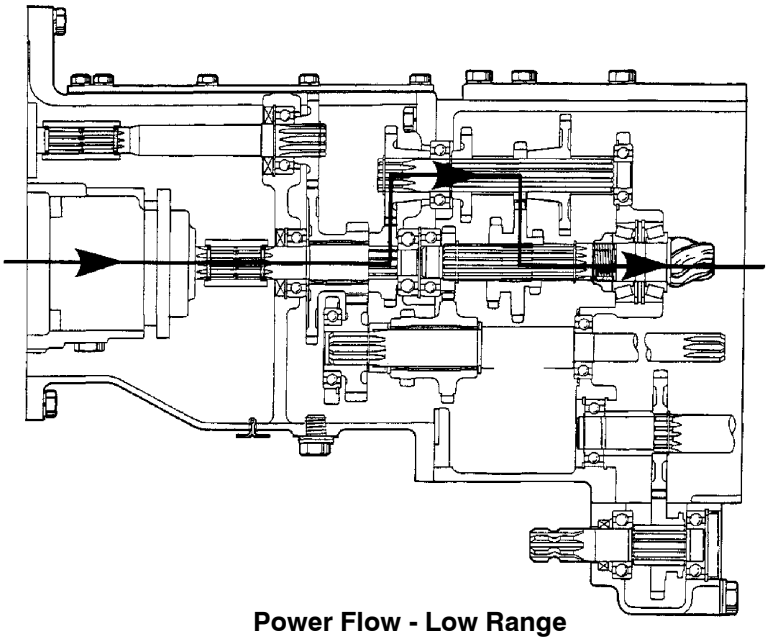
POWER FLOW

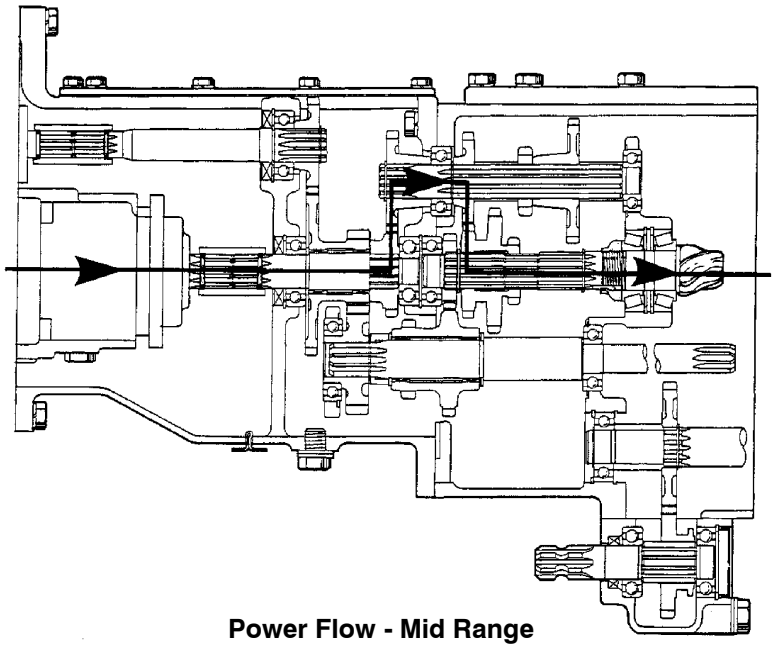
Gearbox

Power flows through the gearbox for high, low, and mid-range gear speed is shown in the following illustrations. Power flow to the rear power take-off output shaft is shown in the following illustrations. Power flow for front wheel drive is shown in the following illustrations.



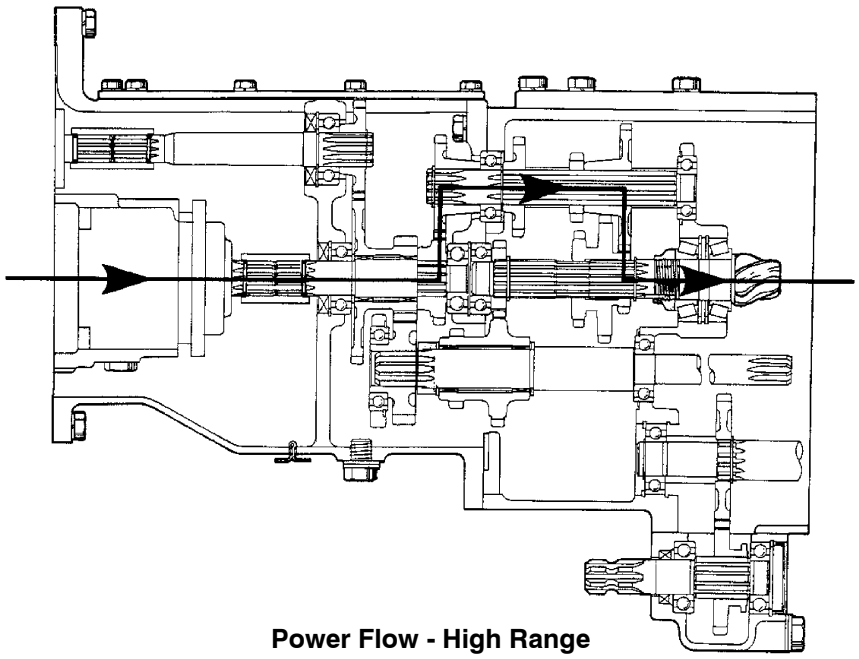
Power Flow - Low Range

62



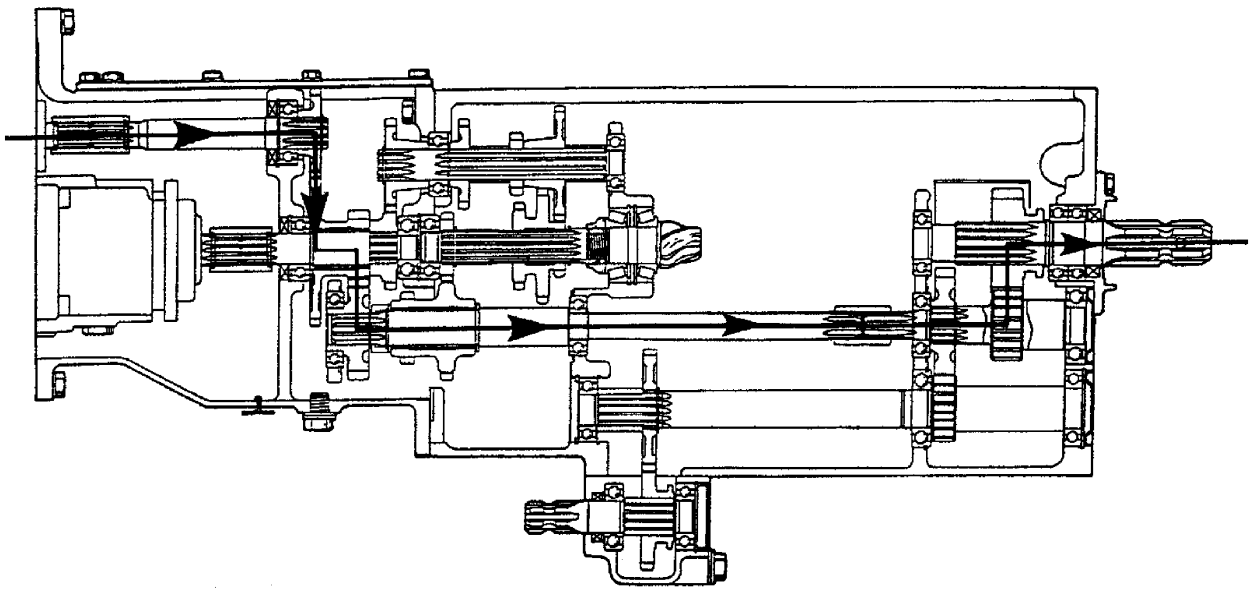
Power Flow - Mid Range

63



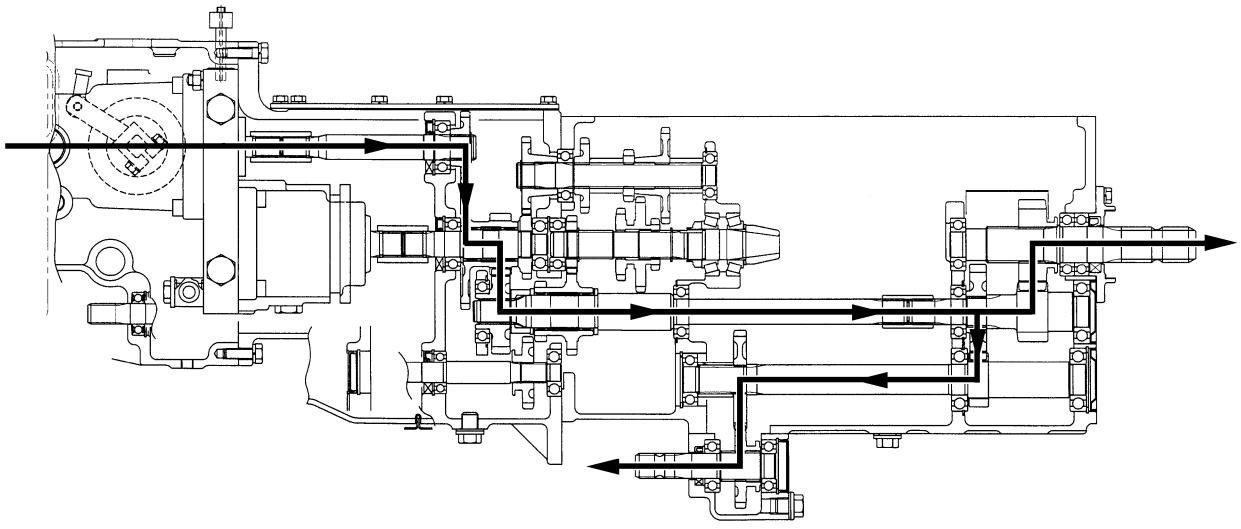
Power Flow - High Range

64



Power Flow - Rear-PTO

65



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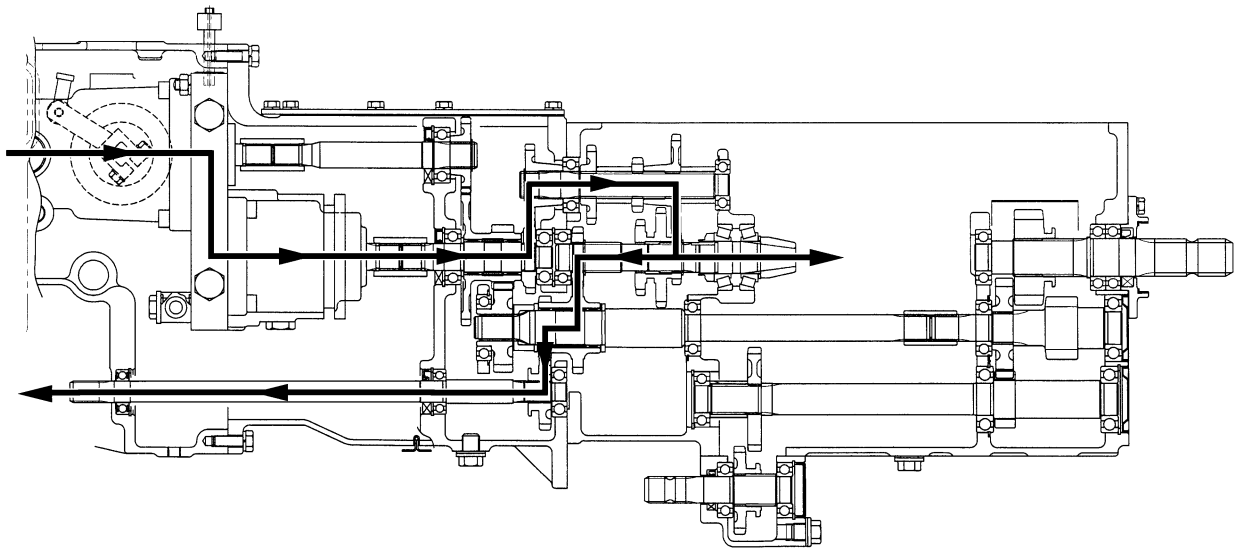
Power Flow - Mid-PTO

66



20044413

Power Flow - Front Wheel Drive

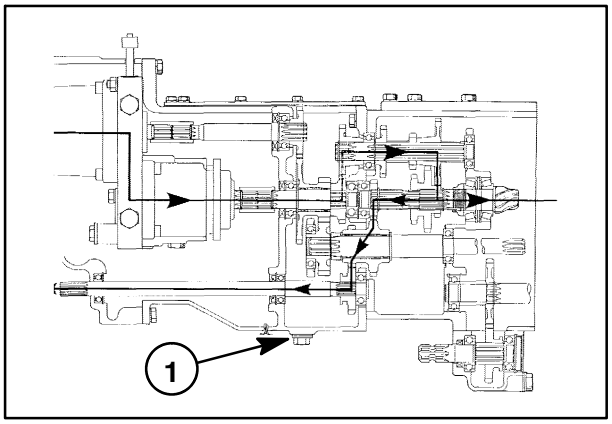
67

OVERHAUL – TRANSMISSION GEARBOX

HST TRANSMISSION

Removal

1. Drain the transmission case fluid into a suitable container from drain plug, 1.
2. Separate the transmission case from the engine and rear transmission. See “Separating the Tractor, later in this section”.



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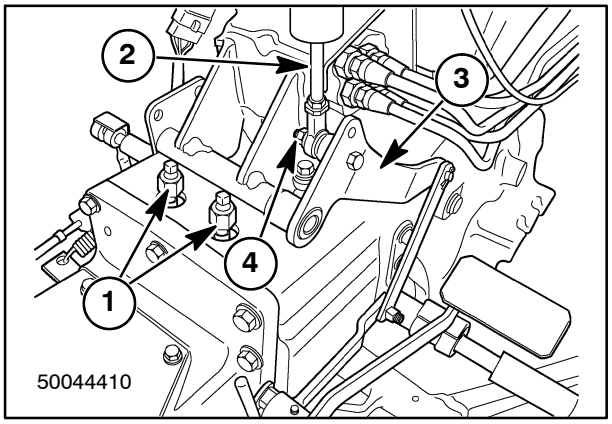
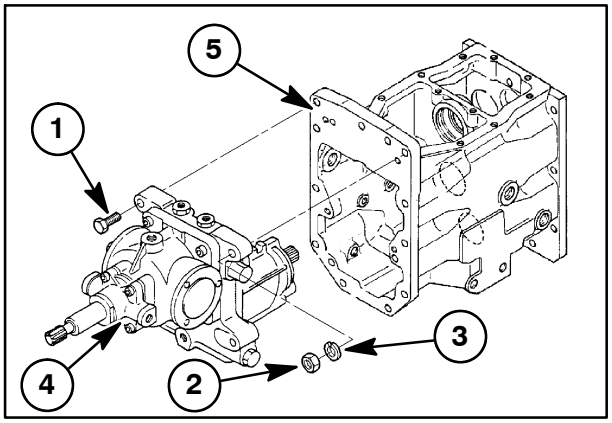
Disassembly

1. Remove the two test port adapters, 1.
2. Disconnect the HST control rod, 2, from the HST pedal link assembly, 3, by removing the nut, 4.
3. Drain the transmission fluid into a suitable clean container.
4. Separate the tractor between the clutch and front transmission housing. See “Separating the Tractor, later in this section”.



69

5. Remove the clutch housing attaching bolts and remove the clutch housing.
6. Remove the hydrostatic unit retaining bolts, 1, nuts, 2, and washers, 3. Remove the PTO input shaft and transmission input shaft from their couplers. Remove the hydrostatic unit, 4, from the case, 5.



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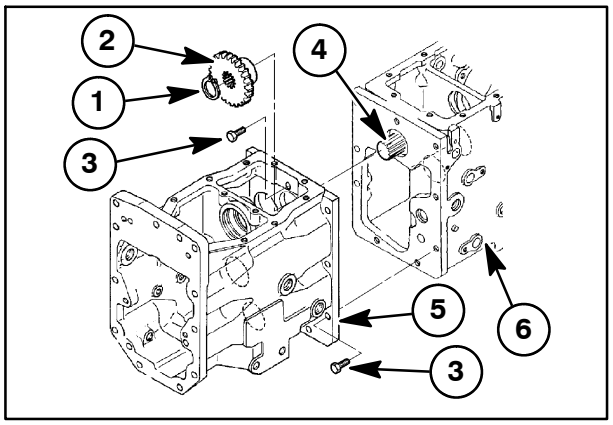
TRANSMISSION CASE

Removal

1. Remove snap ring, 1, and fixed gear (28T), 2, from the rear main shaft, 4.
2. Remove the transmission to rear axle buckle-up bolts, 3. Note that one of the buckle-up bolts is located inside the case. Remove the transmission case, 5, from the rear axle center housing, 6.



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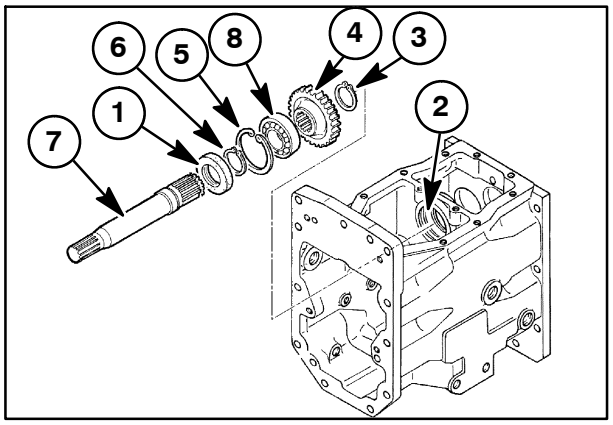
PTO INPUT SHAFT

Removal

1. Remove the oil seal, 1, from the front of the bearing wall, 2.
2. Remove snap ring, 3, and gear (26T), 4, from the rear of the bearing wall, 2.
3. Remove snap rings, 5 and 6, from the front of the bearing wall.
4. Gently drive the PTO input shaft, 7, and bearing, 8, from the bearing wall, and remove from the case.



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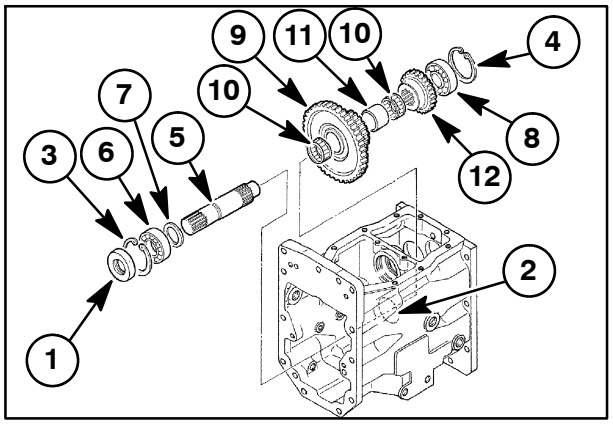
TRANSMISSION INPUT SHAFT

Removal

1. Remove the input shaft oil seal, 1, from the front of the bearing wall, 2.
2. Remove the bearing retaining snap ring, 3, also from the front and snap ring, 4, from the rear.
3. While supporting the gears, slide the input shaft, 5, front bearing, 6, and thrust washer, 7, out the front of the bearing wall, 2, and remove from case.
4. Remove bearing, 8, counter gear (50T - 18T), 9, needle bearings, 10, spacer, 11, and fixed gear (25T), 12, out through the top of the case.
5. If necessary, use a suitable gear puller to remove the bearing, 8, from the transmission input shaft, 5.



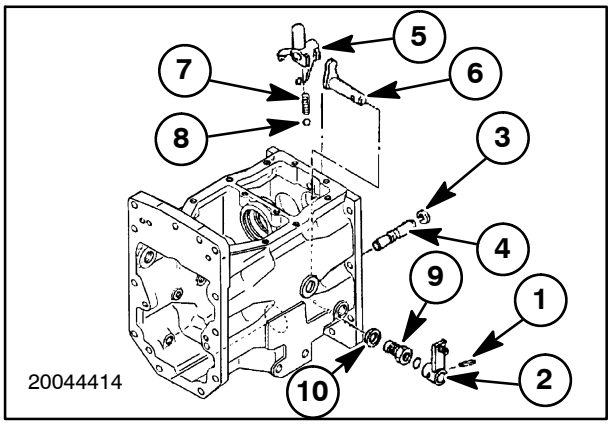
73

FWD SHIFT ROD

Removal

1. Slide the roll pin, 1, out of the change lever, 2, and remove the change lever.
2. Remove snap ring, 3, and shift rod, 4, from the rear of the transmission case.

   NOTE: *Use care not to lose the detent ball and spring when separating the rod from the fork.*
3. Remove the shifter fork, 5, shifter arm, 6, detent spring, 7, and detent ball, 8, from inside the case.
4. Remove shift guide, 9, and seal washer, 10.



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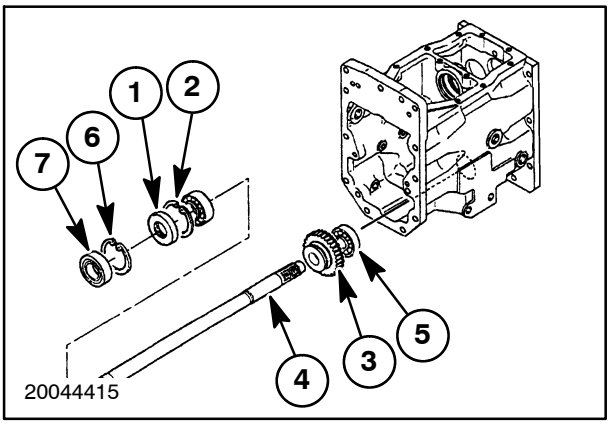
FWD DRIVE SHAFT

Removal

1. Remove and discard the seal, 1, from housing wall.
2. Remove the bearing snap ring, 2, from shaft at housing wall.
3. While supporting the sliding gear (26T), 3, pull the FWD shaft, 4, with bearing, 6, out the front of the case.
4. Remove the sliding gear (26T), 3, and rear bearing, 5, from transmission case.
5. Remove snap ring, 6, and remove front bearing, 7, from the clutch housing.



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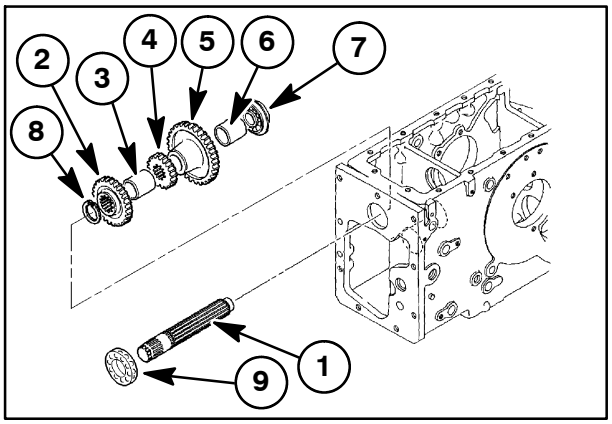
REAR MAIN SHAFT

Removal

1. Gently drive the rear main shaft, 1, forward while removing the rear main bearing, 7, from the rear axle housing.
2. While supporting the gears, 2, 4, and 5, and spacers, 3 and 6, remove the shaft, 1, from the front of the rear axle case.
3. Remove bearing, 9, snap ring, 8, mid-range gear (27T), 2, spacer, 3, low range gear (18T), 4, high range gear (36T), 5, and spacer, 6, from the rear axle housing.



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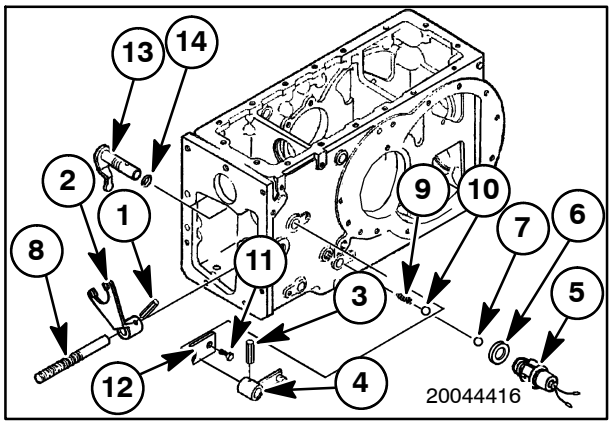
RANGE GEAR SHIFTER ROD

Removal

1. Drive out the roll pin, 1, from the shift fork, 2.
2. Drive the roll pin, 3, out of the change lever, 4, and remove the change lever.
3. Remove the range gear safety switch, 5, seal washer, 6, and detent ball, 7, from the housing.
4. Remove the shifter rod, 8, forward and remove it from the front of the rear axle housing.

   NOTE: *Use care not to lose the detent ball and spring when the rod is separated from the fork.*
5. Remove the shifter fork, 2, detent spring, 9, and detent ball, 10, from inside the case.
6. Remove bolt, 11, retaining plate, 12, from outside the case, and remove the shifter arm, 13, and O ring, 14, from inside the rear axle housing.



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DRIVE PINION SHAFT

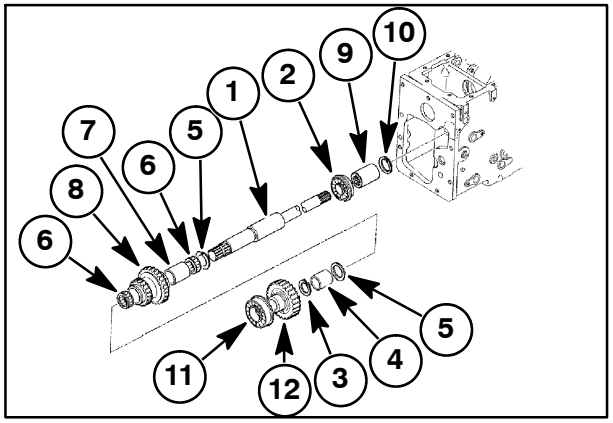
Removal

For removal, disassembly, and inspection of the drive pinion shaft assembly see “Differential, Rear Axle,” discussed in Section 27.

PTO COUNTERSHAFT REMOVAL

Removal

1. Remove the PTO countershaft, 1, and bearing, 2, from the center housing.
2. Remove the snap ring, 3, and bearing, 2, from the PTO countershaft, 1.
3. With FWD, remove the snap ring, 3, collar, 4, thrust washers, 5, needle bearings, 6, collar, 7, and counter gear (32T – 21T), 8, from the PTO countershaft, 1.
4. If necessary, remove the coupling, 9, with snap ring, 10, from the front of the rear PTO countershaft.
5. Remove the bearing, 11, and fixed gear (26T), 12, from the HST transmission housing.



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Inspection

1. Wash all components using a suitable cleaning solvent and air dry.
2. Inspect all bearings for excess wear, score marks, discoloration from overheating, or other damage. Rotate the bearings by hand and check for roughness while slowly rotating the inner and outer races.
3. Lubricate all bearings with a clean lubricant, Ambra Multi G 134 or equivalent, before installation.
4. Inspect the transmission case for pitting, cracks, worn bearing bores, or other damage.
5. Check the detent springs for wear, chipped or weak spring tension.
6. Inspect the detent balls for pitting, excess wear, or other damage.
7. Inspect the shift rail detent grooves for excess wear.
8. Inspect all gears for excess wear, chipped teeth, or other damage. Check the gear backlash by inserting the mating assemblies into the casing and using a feeler gauge. Gear backlash should be between 0.05 - 0.16 mm (0.002 - 0.006″), with a maximum wear limit of 0.6 mm (0.0236″).
9. Inspect the clearance between the shifter rod and its housing bearing. Clearance should be 0.03 - 0.1 mm (0.001 - 0.004″). The maximum wear limit is 0.3 mm (0.0118″).

DRIVE PINION

Assembly

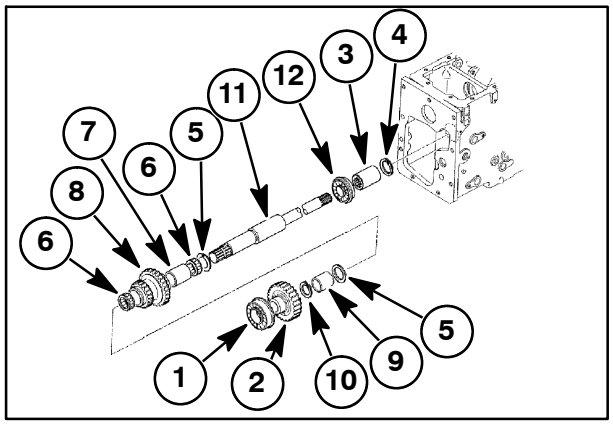
See “Differential, Rear Axle,” discussed in Section 27, for assembly and adjustments of the drive pinion assembly.

PTO COUNTERSHAFT

Assembly

1. Install the bearing, 1, and fixed gear (26T), 2, into the HST transmission housing.
2. If removed, install the coupling, 3, with snap ring, 4, on the rear PTO countershaft.
3. With FWD, install thrust washer, 5, needle bearing, 6, collar, 7, needle bearing, 6, counter gear (32T – 21T), 8, thrust washer, 5, collar, 9, and snap ring, 10, on the PTO countershaft, 11.

   NOTE: *Grooves in thrust washers, 5, face toward needle bearing.*
4. Install the snap ring, 10, and bearing, 12, on the PTO countershaft, 11.
5. Install the PTO countershaft, 11, in the center housing.



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RANGE GEAR SHIFTER ROD

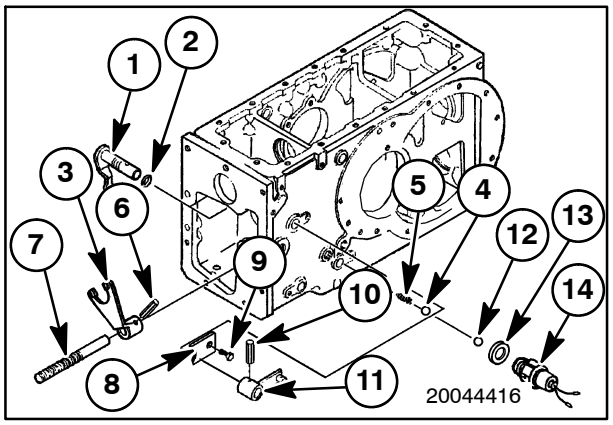
Assembly

NOTE: *Install the shift arm, 1, in the housing before installing the drive pinion.*

1. Lubricate a new O ring, 2, with petroleum jelly and install on the shift arm, 1.
2. Install the shift arm, 1, in the housing.
3. Install the detent ball, 4, and detent spring, 5, in the housing.

NOTE: *To aid in the installation of the shift rail into the shift fork, use a small piece of round stock or a socket of the same diameter as the shift rail, to insert into the shift fork to preload the detent spring and ball.*

4. Position the shifter fork, 3, in the housing and install the shift rail, 7, through the fork, 3. Remove the socket or round stock used to preload the detent spring and ball.
5. Drive a new roll pin, 6, into the fork, 3, and rail, 7.
6. Install the retaining plate, 8, and bolt, 9, to secure the shift arm.
7. Position the change lever, 11, on the shift arm, 1, and install a new roll pin, 10.
8. Install the detent ball, 12, seal washer, 13, and range gear safety switch, 14.



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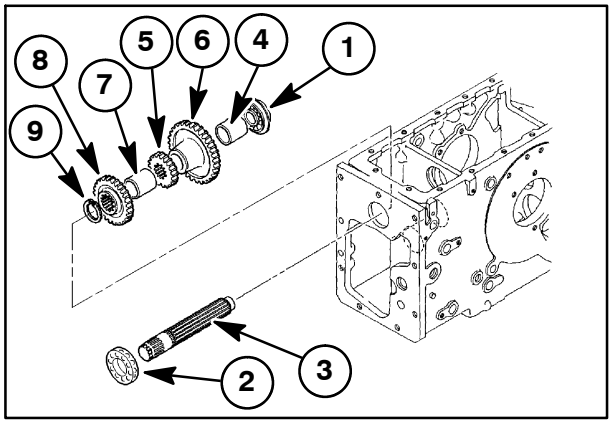
REAR MAIN SHAFT

Assembly

1. Install the bearing, 1, into the center of the housing.
2. Install bearing, 2, on the shaft, 3.
3. Position the spacer, 4, low range gear (18T), 5, high range gear (36T), 6, spacer, 7, mid-range gear (27T), 8, and snap ring, 9, in the center housing.
4. Install the shaft, 3, through the front of the housing while supporting the gears, 8, 5, and 6, and spacers, 7 and 4. Push the shaft assembly into place.



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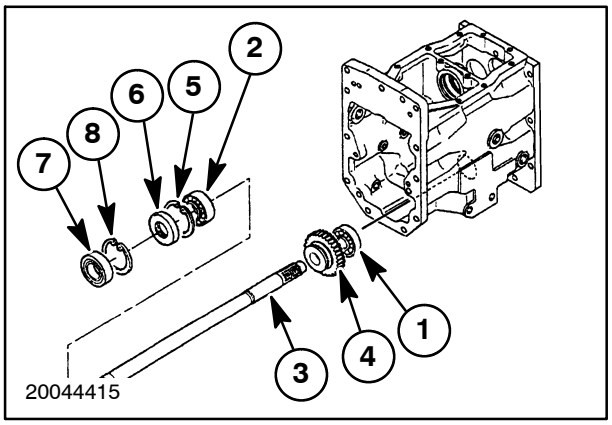
FWD MAIN SHAFT

Assembly

1. Install the rear main bearing, 1, into the transmission case wall.
2. Install the bearing, 2, onto the front end of the shaft, 3, until fully seated.
3. Insert the shaft, 3, with bearing, 2, into the case, through the sliding gear (22T), 4, and into bearing, 1, until fully seated.
4. Install snap ring, 5, into case wall to secure shaft and bearing assembly.
5. Lubricate the ID of a new seal, 6, with petroleum jelly and install seal over the shaft, into the case wall until seated.
6. Install bearing, 7, and snap ring, 8, into the clutch housing.



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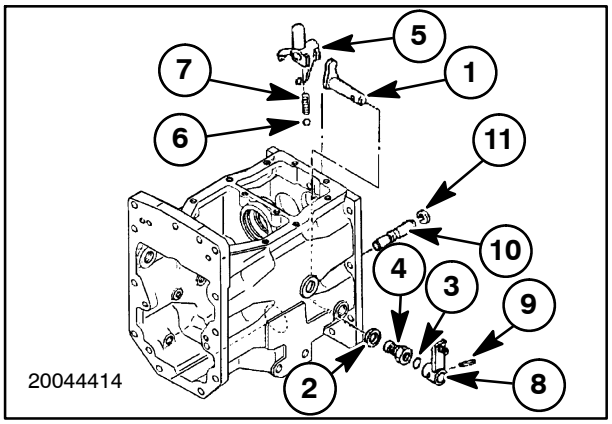
FWD SHIFT ROD

Assembly

1. Install the shifter arm, 1, in the inside of the transmission.
2. Using new sealing washer, 2, and O ring, 3, install the shift arm guide, 4, from the outside.
3. Install the shifter fork, 5, detent ball, 6, and detent spring, 7, on the inside of housing.
4. Position the change lever, 8, over the shifter arm, 1, and install roll pin, 9.
5. Install the shift rod, 10, and snap ring, 11, from the rear of the transmission case.



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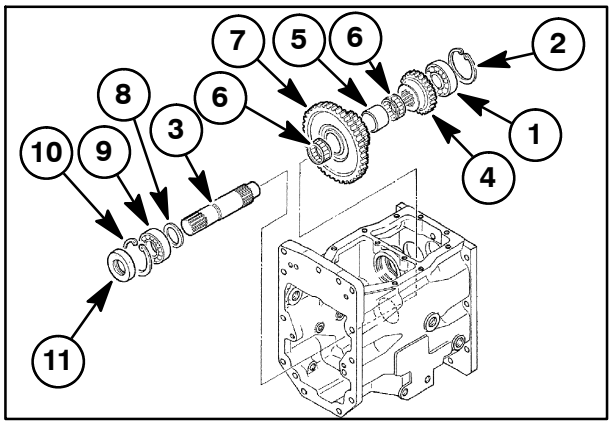
TRANSMISSION INPUT SHAFT

Assembly

1. If removed, install bearing, 1, and snap ring, 2, on the shaft, 3.
2. Slide the input shaft into the middle of the case and install fixed gear (25T), 4, spacer, 5, needle bearings, 6, and counter gear (50T - 18T), 7, onto the shaft as it slides into place.
3. Push the shaft into place and install the thrust washer, 8, front bearing, 9, and snap ring, 10, into the middle wall of the case.
4. Using a suitable driver, install a new seal, 11, onto the shaft into the middle wall of rear transmission case.



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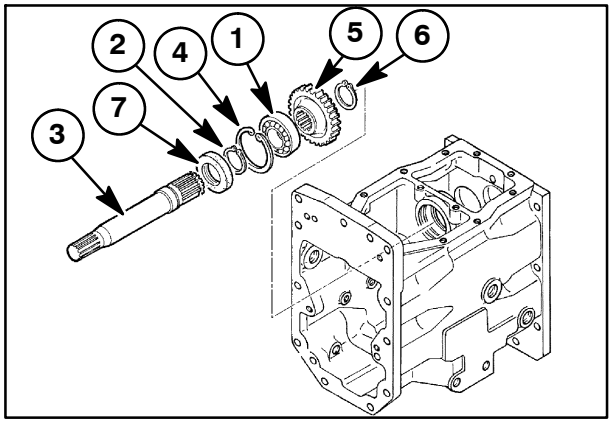
PTO INPUT SHAFT

Assembly

1. Install bearing, 1, and snap ring, 2, on the shaft, 3.
2. Insert the shaft into the case and install snap ring, 4, gear (26T), 5, and snap ring, 6, onto the rear end of shaft.
3. Using a suitable driver, install a new seal, 7, onto shaft, 3, and into the middle wall of the transmission case.



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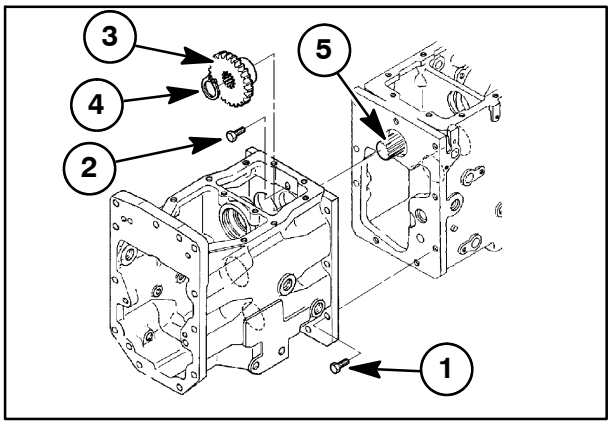
TRANSMISSION CASE

Assembly

1. Align the transmission case to the with the rear axle center housing and install buckle-up bolts, 1. One bolt on the inside of the transmission case, 2.
2. Install fixed gear (28T), 3, and snap ring, 4, onto the rear main shaft, 5.



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MID-PTO LINK

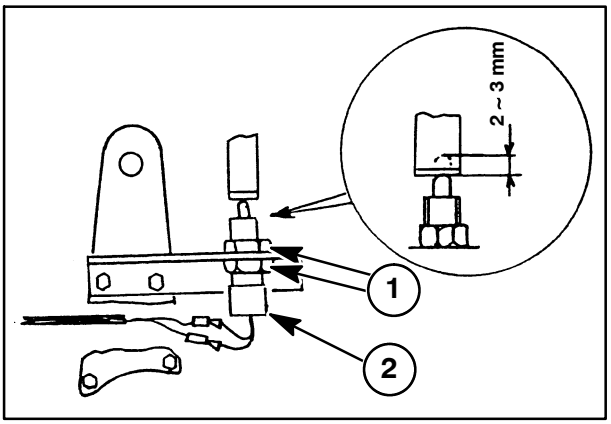
Adjustment

The Mid PTO engages when the control lever is lifted upward. When the control lever is pushed down (Mid PTO OFF), the leg on the bottom of the control lever should depress the switch plunger. When the switch plunger is depressed, the switch contacts close and allow the tractor to start.

1. Shift the Mid PTO to the disengagement position (Pushed Down).
2. Use the adjusting nuts, 1, on the switch assembly, 2, to raise the switch so that the plunger is depressed between 2 - 3 mm (0.080 - 0.120″). Tighten the adjusting nuts to lock the switch into position.
3. Confirm proper switch adjustment using the chart below

Mid PTO Engaged (Lever Pulled Up)	Tractor Will Not Start
Mid PTO Disengaged (Lever Pushed Down)	Tractor Will Start

4. Install the L.H. fender assembly and rear wheel onto the tractor. Torque wheel retaining bolts to 169 N·m (125 ft. lbs.).



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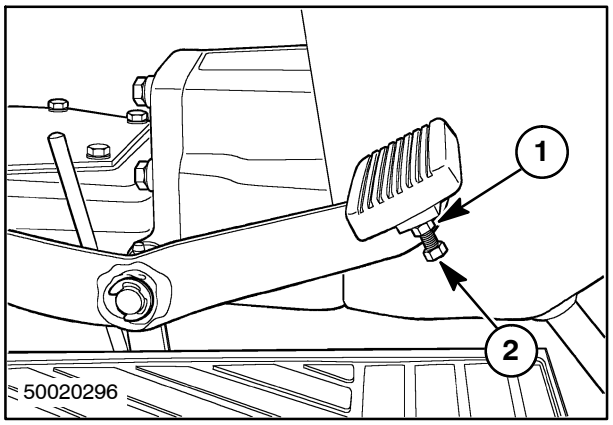
PEDAL FORWARD STOP

Adjustment

1. Loosen jam nut, 1, and turn stop bolt, 2, into pedal to increase distance between floor board and stop bolt.
2. Stroke pedal to full forward position, until internal transmission stop is hit.
3. Turn stop bolt, 2, outwards, until bolt head contacts floor board and then lengthen bolt by two full turns.
4. Tighten jam nut, 1, on stop bolt, 2.



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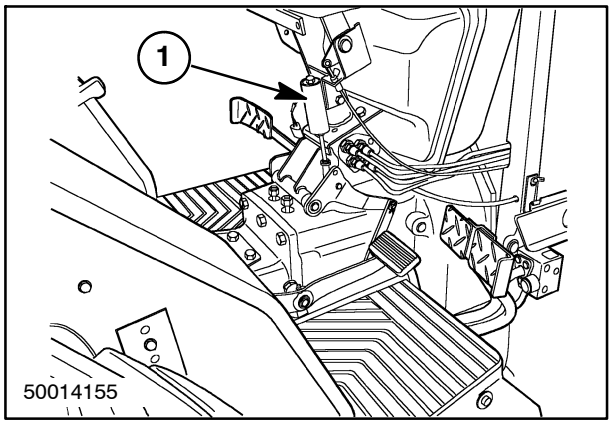
Op. 29 200

HST CONTROL LINKAGE

HST Neutralizer (Spring Holder)

The HST neutralizer, 1, is used to return the HST pump swash plate back to the neutral (vertical) position when the HST pedals are released. The spring-loaded neutralizer is attached to the steering column and a linkage that is connected to the HST pump and the HST control pedals. As the operator releases the HST pedal, the neutralizer mechanically pushes the HST pedal and the pump swash plate back into the neutral position. If not functioning properly, clean, inspect, repair, and adjust the neutralizer accordingly.



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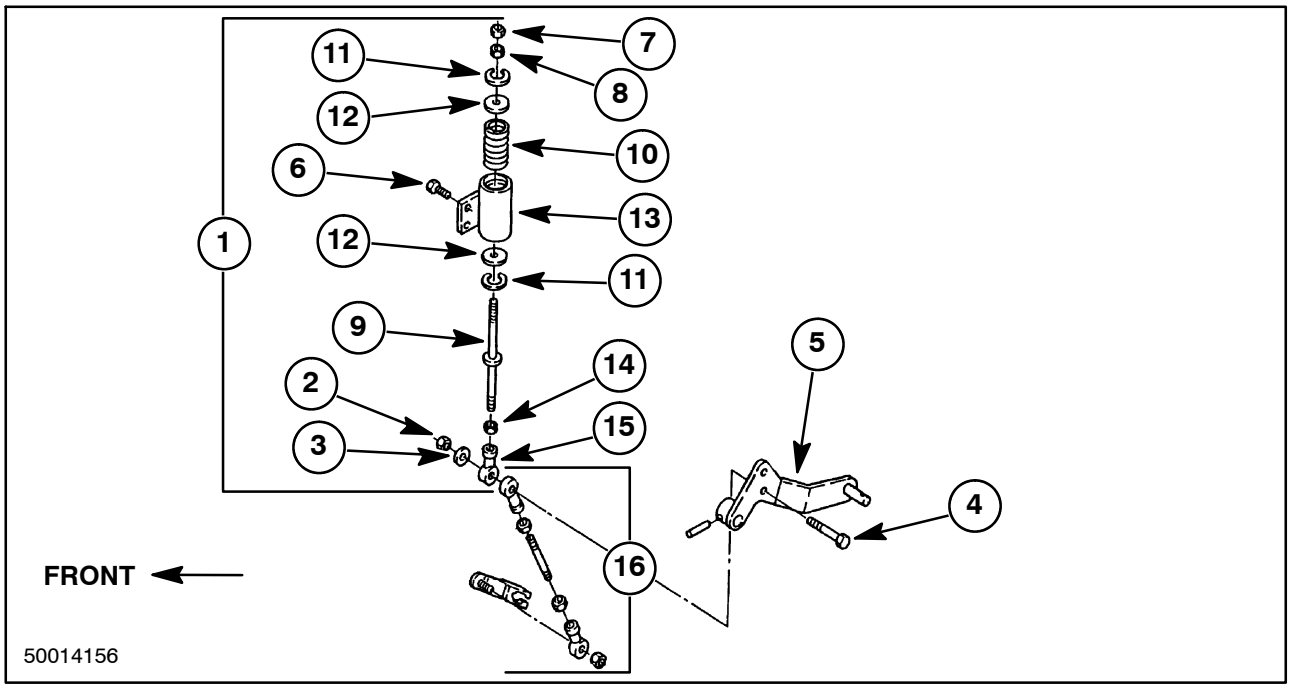

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Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the covers from the steering column to gain access to the HST neutralizer, 1.
3. Disconnect the lower connection of the HST neutralizer, 1, by removing the nut, 2, flat washer, 3, and retaining bolt, 4, that fastens the HST neutralizer, 1, to the HST pedal linkage, 5.
4. Remove the upper connection of the HST neutralizer, 1, by removing the two retaining bolts, 6, that fasten the HST neutralizer, 1, to the steering column.

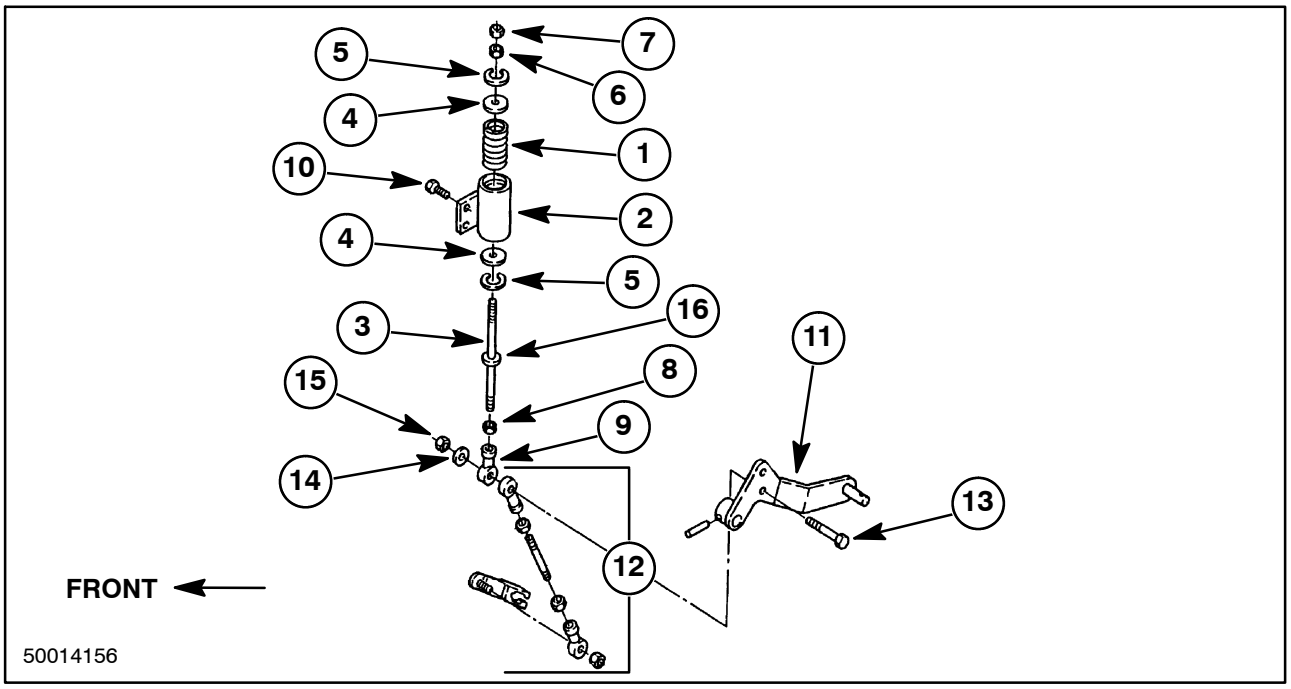
Disassembly

1. Remove the HST neutralizer from the tractor.

   NOTE: *While removing the rod, 9, note the orientation for future installation.*
2. Loosen and remove the jam nut, 7, and hex nut, 8, from the rod, 9, to relieve the tension from the spring, 10, within the HST neutralizer.
3. Remove the snap rings, 11, and flat washers, 12, to remove the rod, 9, and the spring, 10, from the spring holder, 13.
4. Loosen the locking nut, 14, and remove the rod end, 15, from the rod, 9.

Inspection

1. Inspect the spring holder, 13, for scratches and uneven wear. Make sure the spring holder is clean and lubricated with an anti-seize compound.
2. Inspect the rod, 9. Make sure the rod is not bent or damaged. Make sure the rod end, 15, is not stripped or cracked.
3. Inspect the washers, 12, for wear or damage. Damaged washers may cause the neutralizer to function poorly.
4. Check for any play in the HST control linkage. Tighten or replace loose components as necessary.
5. Check the primary link assembly, 16, for loose or damaged components.



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Assembly

1. Make sure the neutralizer components are clean and properly lubricated.
2. Insert the spring, 1, into the spring holder, 2.
3. Insert the rod, 3, through the spring, 1, and place a flat washer, 4, on both sides of the spring, 1.
4. Secure the flat washers, 4, by installing a snap ring, 5, into each end of the spring holder, 2.
5. Thread a hex nut, 6, onto top end of the rod, 3. Tighten the hex nut enough to eliminate the play in the HST neutralizer. Do not overtighten the hex nuts or the HST neutralizer will not function properly.
6. Use the jam nut, 7, to lock the hex nut, 6, into position.
7. Install the hex nut, 8, followed by the rod end, 9, onto the rod, 3.

Installation

1. Install the upper portion of the HST neutralizer onto the steering column by using the two retaining bolts, 10.
2. Connect the rod end, 9, to the HST pedal linkage, 11, and the primary link, 12, by using the retaining bolt, 13, with the flat washer, 14, and the hex nut, 15.

HST NEUTRAL

Adjustment

1. Raise the tractor rear and front axles so the rear and front wheels are off the ground and place safety stands under the axles.

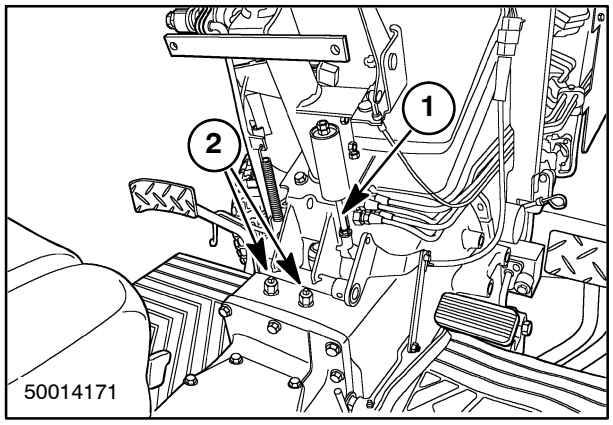
   NOTE: *Disengage front wheel drive. (FWD) Place the throttle at high idle position. Place HST transmission range in High position.*
2. Start and place the HST pedal in the **NEUTRAL** position. The rear wheels should not rotate in either direction. If the wheels are rotating proceed to the next step.
3. Adjust **Neutral** by loosening jam nut, 8, and turn the adjustment weld-nut, 16, a 1/4 turn at a time, clockwise for reverse wheel rotation or counter-clockwise for forward rotation, until the rear wheels do not rotate in either direction. Be sure to check neutral adjustment at high idle engine speed.
4. Once neutral is found, tighten jam nut, 8, and cycle HST pedal several times in both forward and reverse directions and check if linkage neutralizes. If wheels creep, repeat adjustment procedure. Also check for any binding of linkage and loose or worn parts.

SEPARATING THE TRACTOR

HYDROSTATIC UNIT

Removal

1. Separate the engine from the clutch housing, discussed earlier in this section.
2. Drain the transmission rear axle and hydraulic system and collect the oil in a clean container.
3. Remove the right and left step plates.
4. If equipped with a remote control valve, disconnect the control valve hydraulic lines and control linkage. Cap and plug all openings.
5. Disconnect and remove the brake control rods from each side.
6. Loosen the hose clamp and remove the tube from the hydrostatic unit.
7. Disconnect the hydrostatic control rod from the hydrostatic unit.
8. Disconnect the HST neutralizer control rod, 1, from the linkage lever.
9. Remove the eye bolts and remove the HST fluid return tube.
10. Remove the two HST test port pipes, 2.
11. If not previously removed, remove the cooler return tube and clamp.
12. Remove the clutch housing buckle-up bolts.
13. Using a heavy rubber mallet, loosen the clutch housing and slide it forward off the dowel pins.



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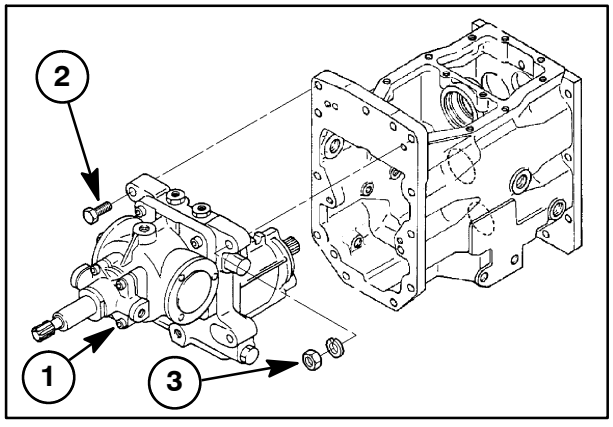
14. Remove the four HST mounting bolts, 2, nut and washer, 3, and remove the HST unit, 1, from the gearbox.



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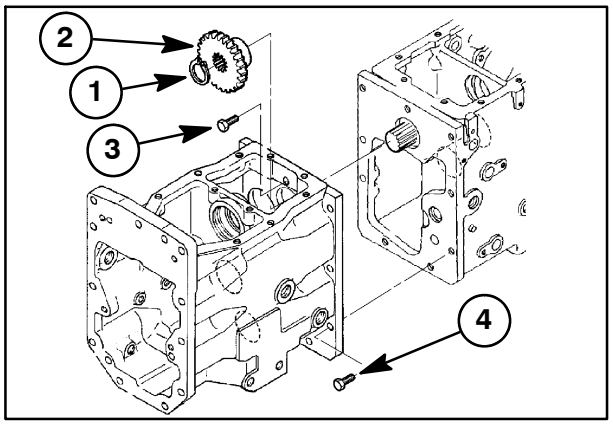
HYDROSTATIC GEARBOX

Removal

1. Separate the engine from the clutch housing, described earlier in this section.
2. Remove the hydrostatic transmission as described earlier in this section.
3. Remove the transmission cover and the hydraulic lift cover.
4. Remove the snap ring, 1, and drive gear, 2.
5. Remove the internal buckle-up bolt, 3.
6. Attach an overhead hoist to the gearbox case.
7. Remove the external buckle-up bolts, 4.
8. Using a heavy rubber mallet, loosen the gear case and slide the gear case forward off the dowel pins.

NOTE: *The transmission range gears are located in the rear axle center housing.*



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HYDROSTATIC UNIT AND GEARBOX

Installation

Installation generally follows the removal procedure in reverse order.

During installation, coat the transmission, clutch housing, and rear axle center housing mating surfaces with liquid sealer. Use caution to prevent excess sealer from entering the inside of the housing and contaminating the hydraulic fluid supply.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
HST Transmission fails to operate	Clutch or input shaft failure	Repair or replace as required
HST Erratic operation	Low fluid pressure	Fill to proper level
HST Abnormal noise	Low charge pressure	Check charge relief valve
	Clogged suction strainer	Clean strainer
	Fluid viscosity high	Replace fluid
	Charge pump defective	Replace pump kit
	Defective charge pump relief valve	Replace relief valve
	Defective cylinder block	Replace cylinder block
HST Tractor fails to stop at neutral	Linkage out of adjustment	Adjust neutral position
	Neutral cannot be adjusted	Replace trunnion shaft joint
	Defective neutral valve	Replace neutral valve
HST Fluid leakage	Charge pressure too high (above 9.8 bar (142 psi)	Check charge pressure, repair as needed
	Stuck charge pump relief valve in the HST	Check charge pump relief valve
	Return oil line restricted	Repair as required
HST Low power	Low fluid pressure	Replace high pressure relief valve
	Internal fluid leakage	Remove assembly
		Overhaul HST

SPECIFICATIONS

HYDROSTATIC TRANSMISSION

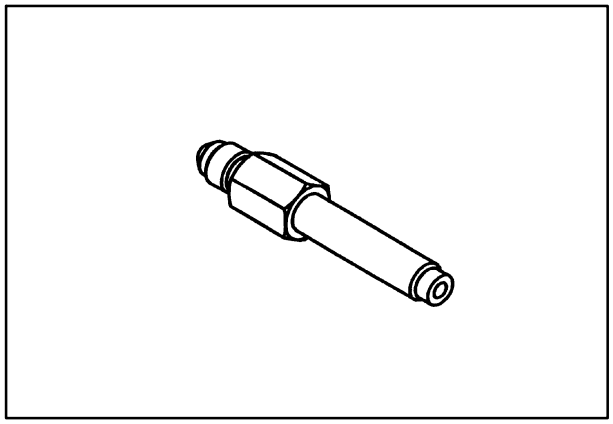
Type	HVFD-23C23M
Theoretical Displacement of Pump	0 - 0.023 L/rev. (0 - 1.41 cu. in./rev.)
Theoretical Displacement of Motor	0.023 L/rev. (1.41 cu. in./rev.)
Theoretical Displacement of Charge Pump	0.005 L/rev. (0.30 cu. in./rev.)
Maximum Input Speed	2900 rpm
High Pressure Relief Valve	274 bar (3981 psi)
Output Speed	2510 rpm @ 147 bar (2133 psi)
Output Torque	79 N·m (59 ft. lbs.) @ 274 bar (3981 psi)
Charge Pump Relief Valve	5.2 - 6.6 bars (75.4 - 95.7 psi) @ 2500 rpm
Swash Plate Tilt Angle (Pump)	0 - 18˚
Swash Plate Tilt Angle (Motor)	0 - 18˚
Operating Moment	Max. 17.6 N·m (13 ft. lbs.) N = 1000 260 rpm hp = 50 200 kg/cm^2

BOLT TORQUES

Hydrostatic Transmission Cover Screws	2 - 2.5 N·m (1.4 - 9 ft. lbs.)
Charge Pump Housing Bolts	16 - 19 N·m (12 - 14 ft. lbs.)
Hydrostatic Transmission Port Block Retaining Bolts	31 - 38 N·m (23 - 28 ft. lbs.)

SPECIAL TOOLS

High Pressure Test Fitting - FNH10615 or NH01378



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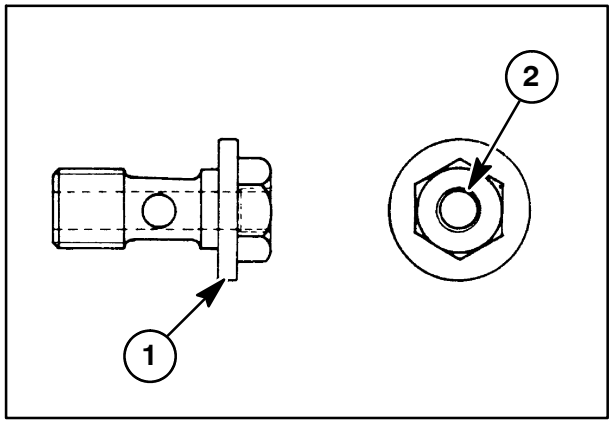
Banjo Bolt Test Fitting - SBA398480240



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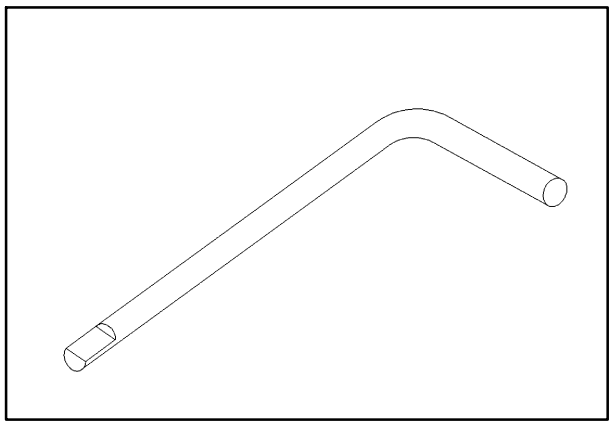
1. Banjo Bolt (for Pressure Test)
2. Drill and Tap - 1/8 in NPT

Detent Ball Holder - FNH00081



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SECTION 31 - POWER TAKE-OFF SYSTEMS

Chapter 1 - Power Take-off Systems

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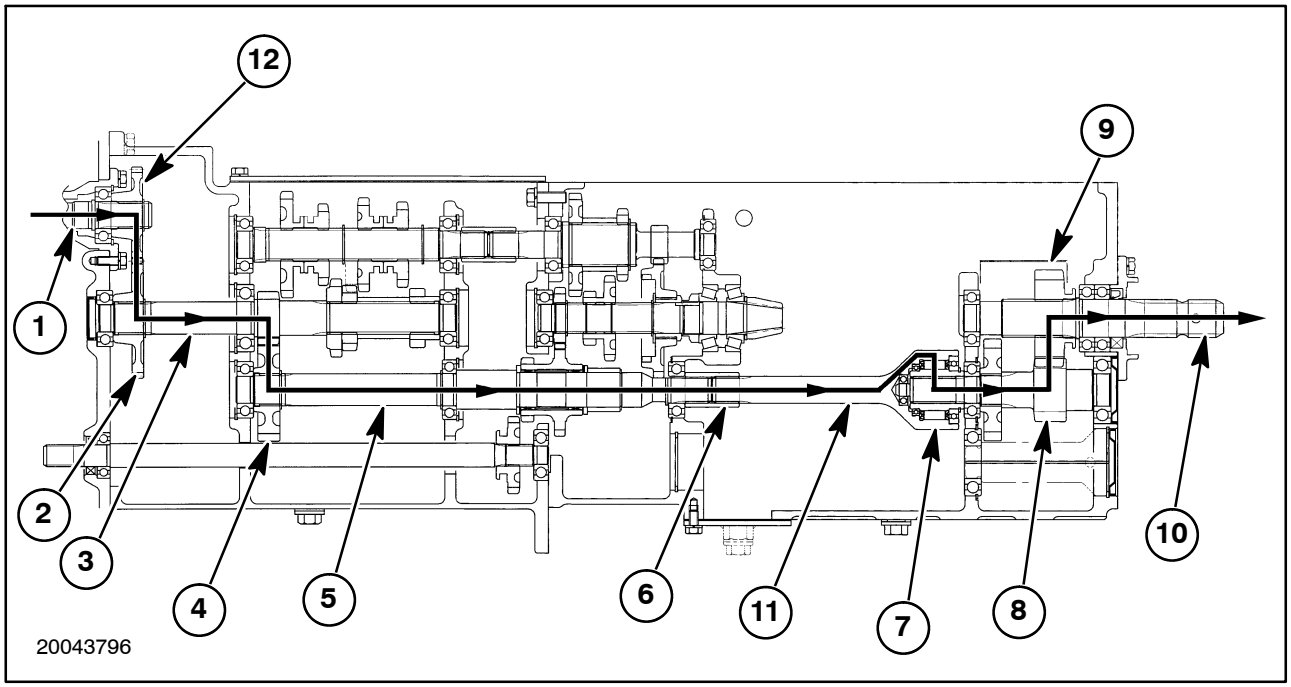
SPECIFICATIONS

Models	Type	Output Shaft Size in mm (in.)		Engine Speed at 540 rpm in rpm	PTO Shaft End-Play in mm (in.)	Observed PTO Rating in kW/ (hp)
		Rear	Mid			
TC30 2WD 9 x 3 (Gear)	Transmission	35 (1.38)	25.4 (1)	2420	0.05 - 0.18 (0.002 - 0.007)	19.0 (25.5)
TC30 HST	Live	35 (1.38)	25.4 (1)	2465	0.05 - 0.18 (0.002 - 0.007)	16.2 (21.7)

BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Foot-Pounds	Newton Meters	Pitch (mm)	Foot-Pounds	Newton-Meters
M6	4T, 4.8	1.0	3.6 – 5.1	4.9 – 6.9	------	------	------
	7T, 8T, 8.8		6.1 – 8.3	8.3 – 11.3			
	10T, 11T		8.6 – 11.6	11.7 – 15.7			
M8	4T, 4.8	1.25	9.4 – 12.3	12.7 – 16.7	1.0	11.2 – 14.9	15.2 – 20.2
	7T, 8T, 8.8		16.7 – 21.0	22.6 – 28.4		19.6 – 25.3	26.5 – 34.3
	10T, 11T		21.0 – 26.8	28.5 – 36.3		22.4 – 29.7	30.4 – 40.2
M10	4T, 4.8	1.5	18.8 – 24.6	25.5 – 33.3	1.25	21.0 – 26.8	28.5 – 36.3
	7T, 8T, 8.8		32.5 – 41.3	44.1 – 55.9		36.2 – 46.3	49.0 – 62.8
	10T, 11T		39.8 – 51.3	54.0 – 69.6		42.7 – 54.2	57.9 – 73.5
M12	4T, 4.8	1.75	27.5 – 34.8	37.3 – 47.1	1.25	31.8 – 40.5	43.1 – 54.9
	7T, 8T, 8.8		48.5 – 61.5	65.7 – 83.3		54.9 – 69.4	74.5 – 94.1
	10T, 11T		68 – 85.6	92 – 116		73.1 – 93.7	99 – 127
M14	4T, 4.8	2.0	46.3 – 59.3	62.8 – 80.4	1.5	51.4 – 64.4	69.7 – 87.3
	7T, 8T, 8.8		76.8 – 97.4	104 – 132		85.6 – 109	116 – 148
	10T, 11T		102.6 – 129	139 – 175		110 – 136	149 – 185
M16	4T, 4.8	2.0	63.5 – 81.2	86 – 110	1.5	67.2 – 84.9	91 – 115
	7T, 8T, 8.8		110 – 136.5	149 – 185		116 – 142	157 – 193
	10T, 11T		151.3 – 188	205 – 255		162 – 199	220 – 270
M18	4T, 4.8	2.0	83.4 – 104	113 – 141	1.5	96.7 – 120	131 – 163
	7T, 8T, 8.8		145 – 174	196 – 236		169 – 206	230 – 280
	10T, 11T		203 – 246	275 – 333		220 – 270	299 – 367
M20	4T, 4.8	2.5	106 – 133	144 – 180	1.5	126 – 155	171 – 211
	7T, 8T, 8.8		177 – 214	240 – 290		203 – 245	275 – 333
	10T, 11T		268 – 252	363 – 341		293 – 358	397 – 485

DESCRIPTION OF OPERATION – TRANSMISSION DRIVE POWER TAKE-OFF



1

1. Input Shaft
2. Transmission Countershaft Gear - 42T
3. Transmission Countershaft
4. PTO Countershaft Gear - 30T
5. Front PTO Countershaft
6. Coupling
7. One-Way Clutch
8. PTO Rear Countershaft - 12T
9. PTO Sliding Gear - 20T
10. PTO Output Shaft
11. Center PTO Countershaft
12. PTO Input Gear - 33T

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9 x 3 GEAR TRANSMISSION - SINGLE CLUTCH

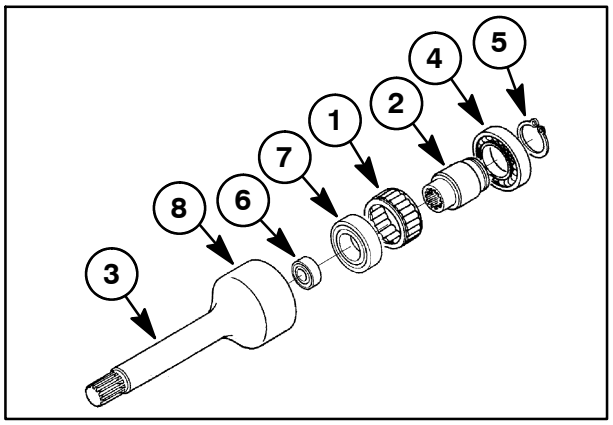
The tractors are equipped with the 9 × 3 gear transmission with a single clutch 540 rpm transmission drive power take-off system. The PTO is driven from the flywheel clutch and transmission input shaft. A gear, 12, on the input shaft, 1, is in constant mesh with the splined gear, 2, on the transmission countershaft, 3.

The transmission countershaft, 3, is in constant mesh with the PTO countershaft gear, 4, on the front PTO countershaft, 5, and drives the front, center, and rear countershafts, 5, 11, and 8. A sliding gear, 9, on the PTO output shaft, 10, engages and disengages the rear PTO countershaft, 8. A one-way clutch, 7, is utilized on the 9 × 3 gear transmission. The one-way clutch assembly provides a positive drive in one direction only and free wheels in the opposite direction. Viewed from the rear of the tractor, when the PTO shaft is rotated clockwise the shaft will free wheel; when turned in the counter- clockwise direction the shaft will lock-up. The one-way clutch prevents the power take-off equipment from transmitting power back into the PTO driveline with possible damage to the tractor.

NOTE: *Tractors equipped with the double clutch (live PTO) and hydrostatic transmissions do not have a one-way clutch in the drive line.*

The one-way clutch consists of an inner and outer race, 2 and 8, and a one-way bearing, 1. The inner race is splined to the rear PTO countershaft and the outer race is an integral part of the center PTO countershaft, 3.

In operation, when the transmission clutch is being disengaged, the momentum of the PTO equipment will cause the output to continue to rotate and will cause the one-way clutch inner race to rotate faster than the center PTO countershaft and the one-way bearing will free wheel. The transmission drive power take-off can be operated only while the transmission clutch and PTO selector lever are in the engaged position. To engage the PTO, fully depress the clutch pedal and then engage the PTO, by pushing the selector lever forward (down). Release the clutch pedal and the PTO shaft will start to rotate. To disengage the PTO, fully depress the clutch pedal and push the PTO selector lever rearward (up).



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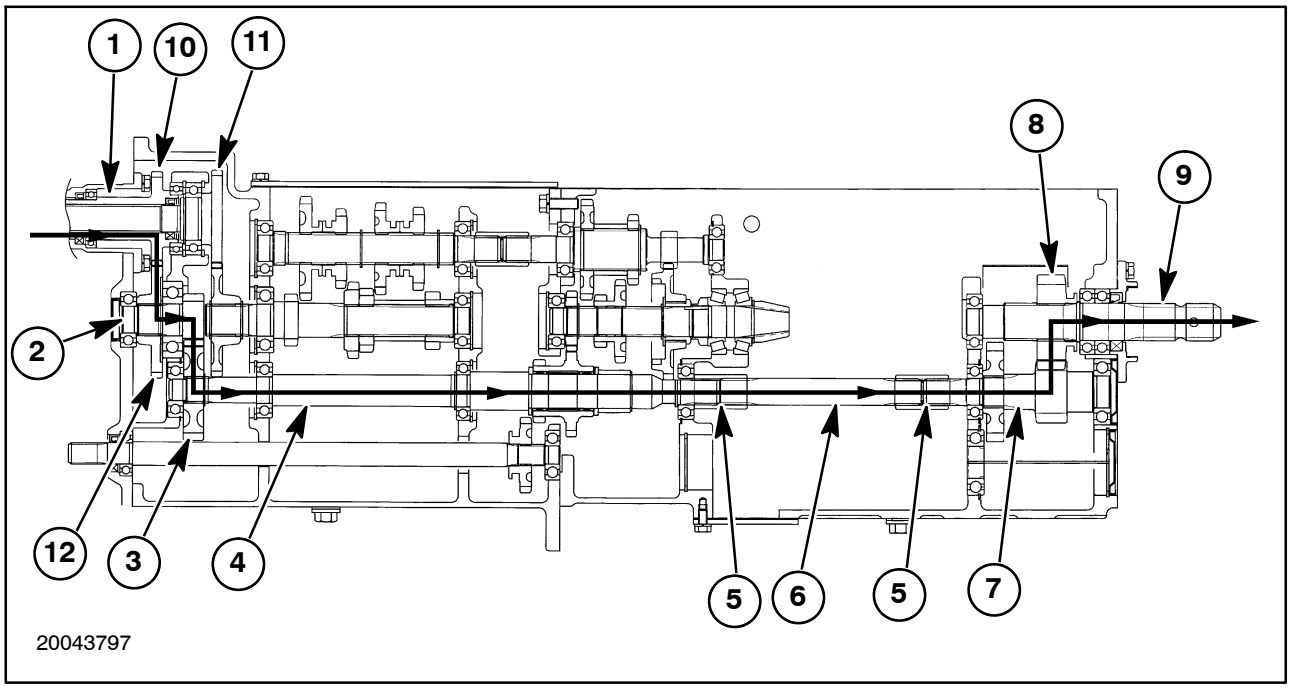


3

9x3 Gear Transmission Double Clutch

1. PTO - Input Shaft
2. PTO Upper Countershaft
3. Front PTO Countershaft Gear - 30T
4. Front PTO Countershaft
5. Coupling
6. Middle PTO Countershaft
7. Rear PTO Countershaft - 12T
8. Sliding Gear - 20T
9. Output Shaft
10. PTO Input Shaft Fixed Gear
11. Transmission Input Shaft Fixed Gear
12. PTO Upper Countershaft Gear

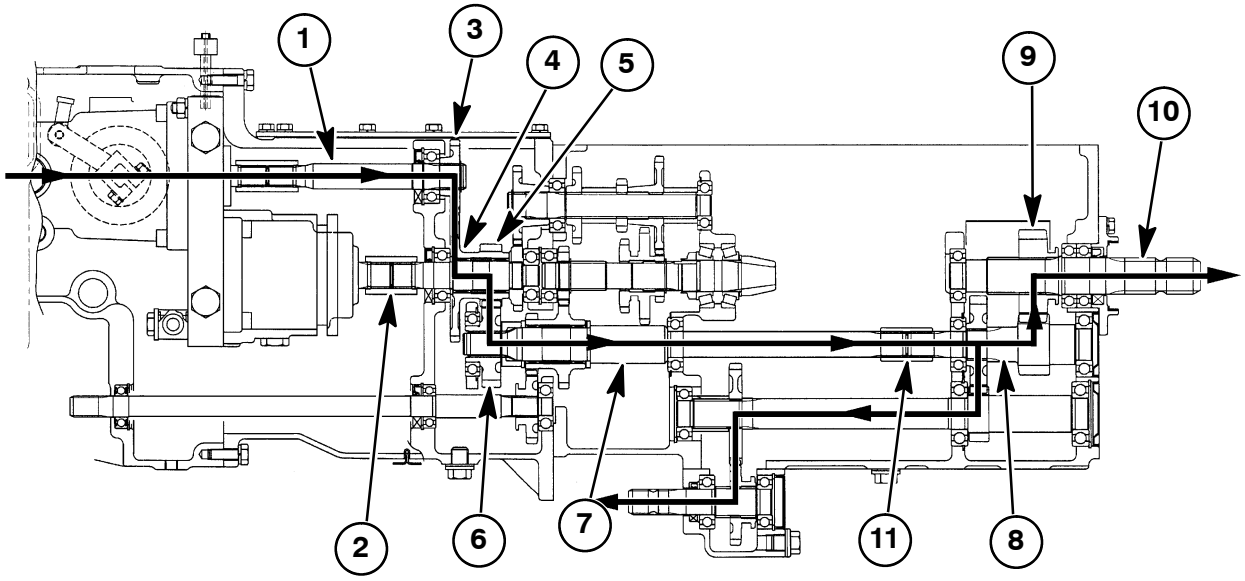
LIVE POWER TAKE-OFF

The live power take-off is standard on the 9 x 3 (4WD) and HST Models tractors.

The power take-off drive is taken from a second clutch disc on the flywheel clutch through a separate power take-off input shaft, 1. The power take-off input shaft incorporates a gear, 10, which is in constant mesh with the PTO upper countershaft gear, 12. The PTO upper countershaft, 2, is in constant mesh with the front PTO countershaft gear, 3.

The front PTO countershaft, 4, extends out the rear of the transmission assembly and is splined by a coupling, 5, to the center PTO countershaft, 6. The center PTO countershaft is splined by a coupling, 5, to the PTO rear countershaft, 7. A slide gear, 8, on the PTO output shaft, 9, engages and disengages the rear PTO countershaft.

NOTE: *When the clutch pedal is depressed halfway to facilitate gear changes, the PTO drive is maintained without interruption. Depressing the clutch pedal fully will stop the power take-off. To disengage the PTO, the clutch pedal must be fully depressed and the selector lever moved fully rearward (up).*



4

1. PTO - Input Shaft (PTO)
2. Input Shaft (Trans.)
3. PTO Input Gear - 26T
4. Reduction Gear - 50T
5. Reduction Gear - 18T
6. Countershaft Gear 26T
7. PTO Countershaft
8. Rear PTO Countershaft - 12T
9. Sliding Gear - 20T
10. Output Shaft
11. Coupling

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POWER TAKE-OFF DRIVE - HYDROSTATIC TRANSMISSION

On the hydrostatic transmission, the power is taken from the flywheel clutch and is transmitted by a direct shaft through the hydrostatic unit to the transmission gearbox. A gear, 3, on the PTO input shaft, 1, is in constant mesh with the 50-tooth reduction gear, 4, on the transmission input shaft, 2. The 18-tooth reduction gear, 5, is in constant mesh with the countershaft gear, 6, on the front PTO countershaft, 7. Countershaft gear, 6, drives shafts, 7 and 8. The front PTO countershaft is splined by a coupler, 11, to the rear PTO countershaft, 8, which meshes with sliding gear, 9, on the PTO output shaft, 10.

The power take-off can be operated only while the transmission clutch and PTO selector levers are in the engaged position. To engage the PTO, fully depress the clutch pedal and push the PTO selector lever forward (down). Release the clutch pedal and the PTO shaft will start to rotate. To disengage the PTO, fully depress the clutch pedal and push the PTO selector lever rearward (up).

OVERHAUL - POWER TAKE-OFF

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POWER TAKE-OFF

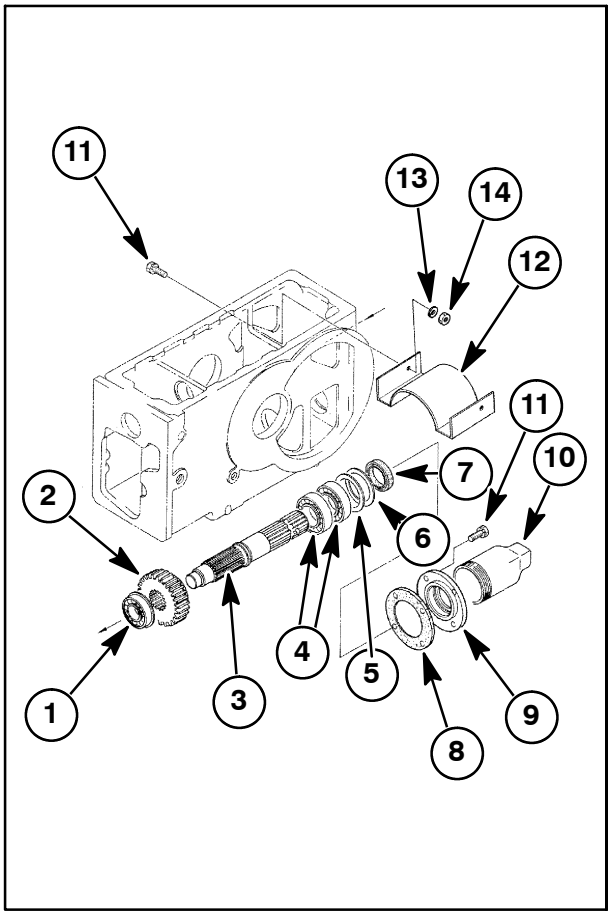
Removal

Separate the tractor between the transmission and the rear axle housing. See “Separating the Tractor,” in Section 27.

OUTPUT SHAFT

Removal

1. Remove the attaching hardware, 11, 13, and 14, and remove the bracket, 12.
2. Remove the four rear cover retaining bolts, 11, and remove the rear cover, 9, cap, 10, gasket, 8, and oil seal, 7.
3. Drive the PTO output shaft, 3, out the rear while supporting the sliding gear, 2, and bearing, 1.
4. Remove the sliding gear, 2, and bearing, 1, through the top of the case.
5. Remove the shims, 5 and 6, and bearings, 4, from the shaft.



5

1. Ball Bearing
2. Sliding Gear - 20T
3. PTO Output Shaft
4. Ball Bearing
5. Shim - 0.2 mm (0.008″) As Required
6. Shim - 0.5 mm (0.020″) As Required
7. Oil Seal
8. Gasket
9. Rear Cover
10. Cap
11. Bolt
12. Bracket
13. Washer
14. Nut

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CENTER COUNTERSHAFT

Removal

Slide the center countershaft, 1, 4, or 11, depending on the transmission type, forward and remove it from the top of the case.

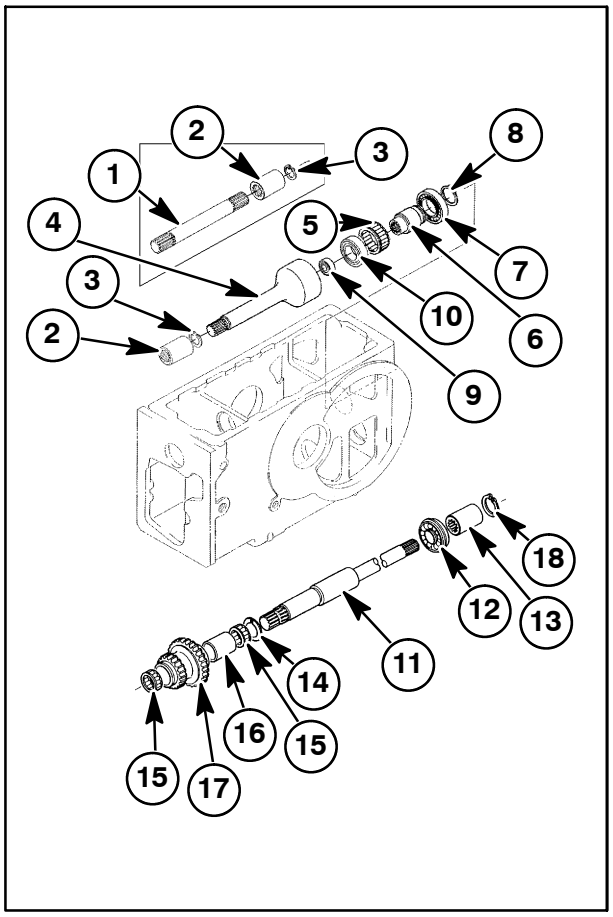
NOTE: *Center countershaft, 1, will be found in tractors with a double clutch. Center countershaft, 4, belongs to tractors with 9 x 3 single clutch transmissions. Center countershaft, 11, is found in tractors with the HST transmission.*

NOTE: *If equipped with the one-way clutch, the PTO center countershaft consists of the one-way bearing, 5, outer race, 4, and inner race, 6.*

ONE-WAY CLUTCH

Disassembly

1. Remove the snap ring, 8.
2. Pull the ball bearing, 7, and inner race, 6, out.
3. Remove the one-way bearing, 5.
4. Remove ball bearings, 9 and 10.



6

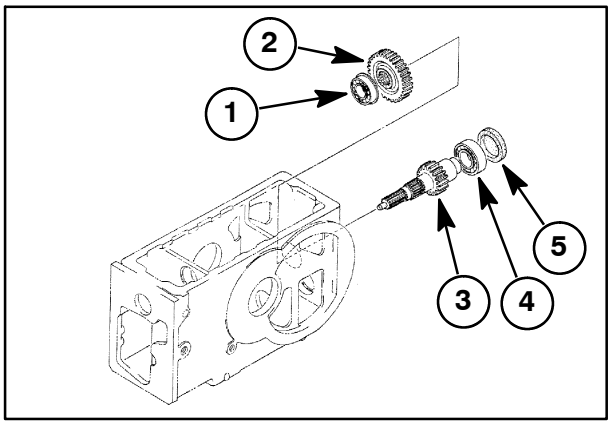
1. PTO Center Countershaft*
2. Coupling
3. Snap Ring
4. PTO Center Countershaft (Outer Race)
5. One-Way Bearing
6. Coupling (Inner Race)
7. Ball Bearing
8. Snap Ring
9. Ball Bearing
10. Ball Bearing
11. HST Countershaft
12. Bearing
13. Coupling
14. Thrust Washer
15. Needle Bearing
16. Collar
17. 4WD Counter Gear
18. Snap Ring

REAR COUNTERSHAFT

Removal

1. Remove the rear countershaft seal cover, 5.
2. Drive the rear countershaft, 3, rearward and remove the fixed gear, 2, and bearing, 1.
3. Remove the countershaft, 3, and bearing, 4, out the rear of the case.

   NOTE: *Fixed gear, 2, is present with HST tractors. The countershaft, 3, is the same for gear and HST tractors.*



7

1. Ball Bearing
2. Fixed Gear - 25T
3. PTO Rear Countershaft - 12T
4. Ball Bearing
5. Seal Cover

FRONT COUNTERSHAFT

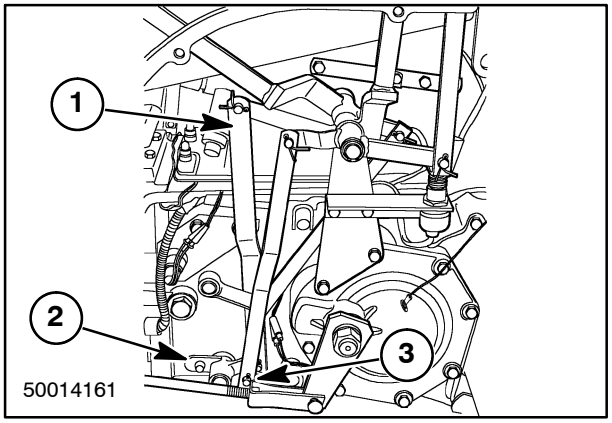
Removal

See “Transmission Systems,” discussed in Sections 21 and 29.

SHIFTER

Removal

1. Remove left side rear tire.
2. Disconnect and remove the link, 1, from the rear change lever, 2, by removing cotter pin, 3.



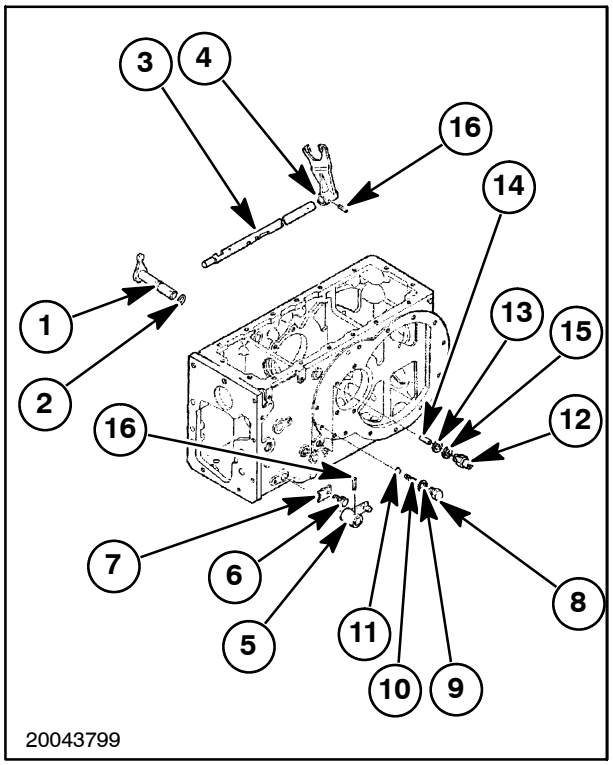
8

1. Rear PTO Link
2. Rear Change Lever
3. Cotter Pin

3. Drive the roll pin, 16, out of the change lever, 5, and remove the lever.
4. Remove retaining plate, 7, and remove the shift arm, 1.

   NOTE: *Remove the mid-PTO countershaft before removing the PTO shift arm, 1.*
5. Remove rear PTO safety switch, 12, washer, 13, pin, 14, and shims, 15.

   NOTE: *Use care to not lose the detent spring as it will be expelled with considerable force when the bolt is removed.*
6. Remove the bolt, 8, and remove the detent spring, 10, detent ball, 11, and seal washer, 9.
7. Drive the roll pin, 16, out of the shifter fork, 4, and remove the shifter fork.
8. Slide the shift rail, 3, out from the front of the case.



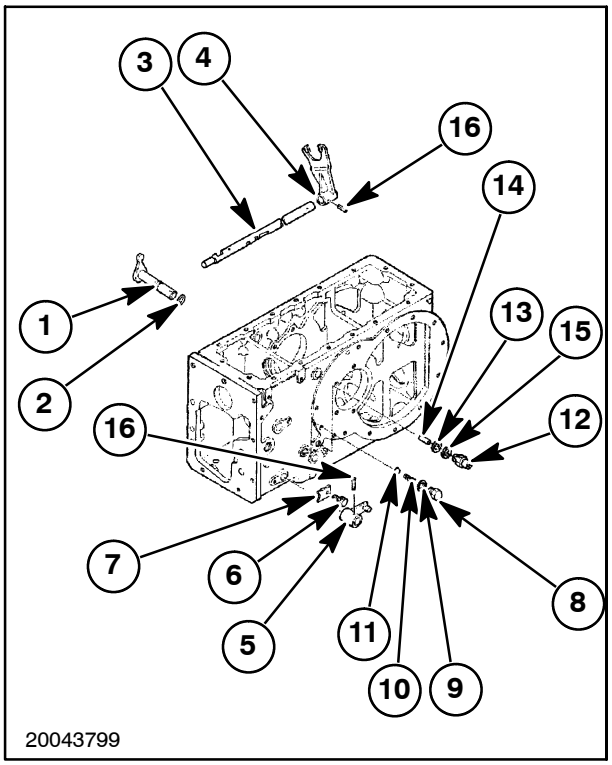
9

1. Shift Arm
2. O ring
3. Shifter Rail
4. Shifter Fork
5. Change Lever
6. Bolt
7. Plate
8. Bolt
9. Seal Washer
10. Detent Spring
11. Detent Ball
12. PTO Safety Switch
13. Seal Washer
14. Pin
15. Shim - 0.008″
0 .020″
16. Roll Pin

SHIFTER

Assembly

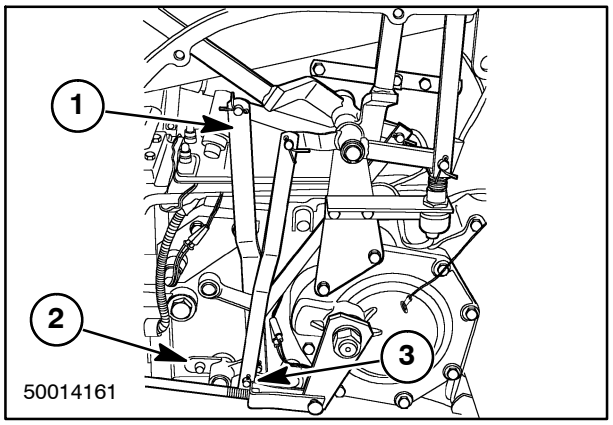
1. Slide the shifter rail, 3, in place through the front of the case.
2. Install the shifter fork, 4, in place on the shift rail and install roll pin, 16.
3. Install the detent ball, 11, and detent spring, 10, and secure in place with bolt, 8, and new seal washer, 9.
4. Install pin, 14, seal washer, 13, shims, 15, and rear PTO safety switch, 12.
5. Install shift arm, 1, and secure in place with retaining plate, 7, and bolt, 6.
6. Install change lever, 5, and roll pin, 16.



10

1. Shift Arm
2. O ring
3. Shifter Rail
4. Shifter Fork
5. Change Lever
6. Bolt
7. Plate
8. Bolt
9. Seal Washer
10. Detent Spring
11. Detent Ball
12. PTO Safety Switch
13. Seal Washer
14. Pin
15. Shim - 0.008″
0.020″
16. Roll Pin

7. Reconnect the rear PTO shift link, 1, to the rear change lever, 2, with cotter pin, 3.



11

1. Rear PTO Link
2. Rear Change Lever
3. Cotter Pin

FRONT COUNTERSHAFT

Assembly

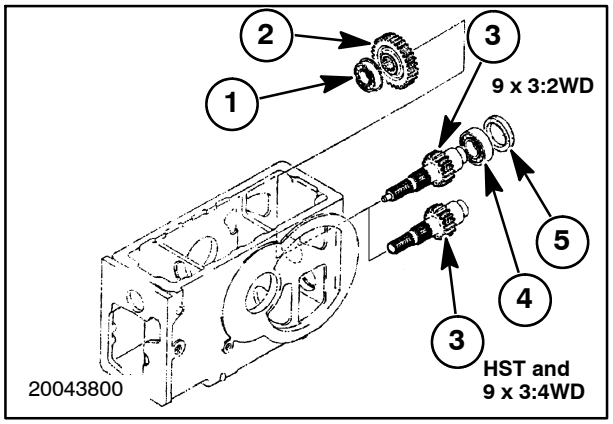
See “Transmission Systems,” discussed in Sections 21 and 29.

REAR COUNTERSHAFT

Assembly

1. Install the PTO rear countershaft-12T, 3, and ball bearing, 4, in place through the rear of the case.
2. Install the fixed gear-25T, 2, and ball bearing, 1, onto the countershaft.
3. Slide the assembly into place and install the seal cover, 5, using a suitable driver.

   NOTE: *Fixed gear, 2, is present with all TC30 tractors. The countershaft, 3, is the same for gear (double clutch only) and HST tractors.*



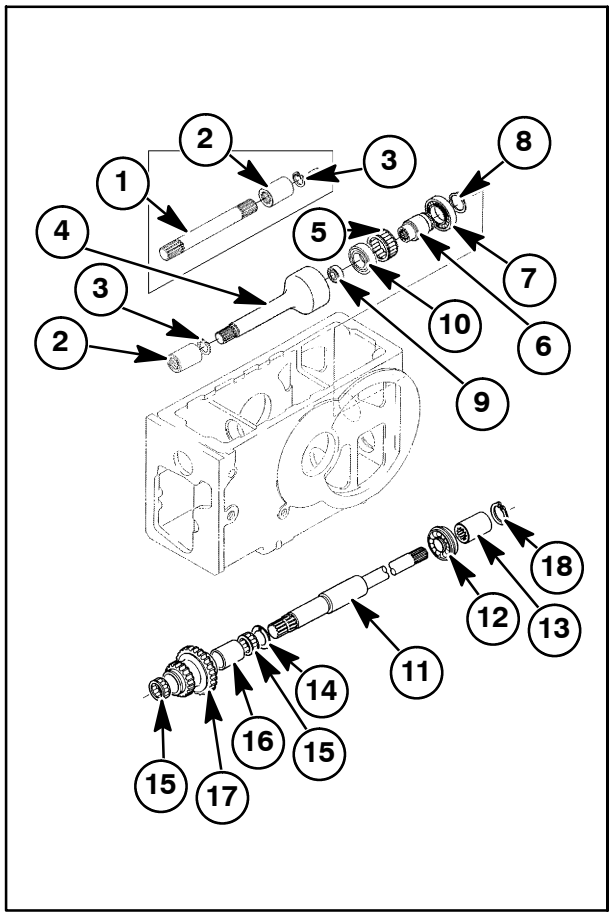
12

CENTER COUNTERSHAFT

NOTE: *If equipped with the one-way clutch, the PTO center countershaft consists of the one-way bearing, outer race, and inner race.*

Assembly

1. Install ball bearings, 9 and 10, on the center shaft.
2. Install one-way bearing, 5.
3. Install inner race, 6, and ball bearing, 7.
4. Install snap ring, 8.

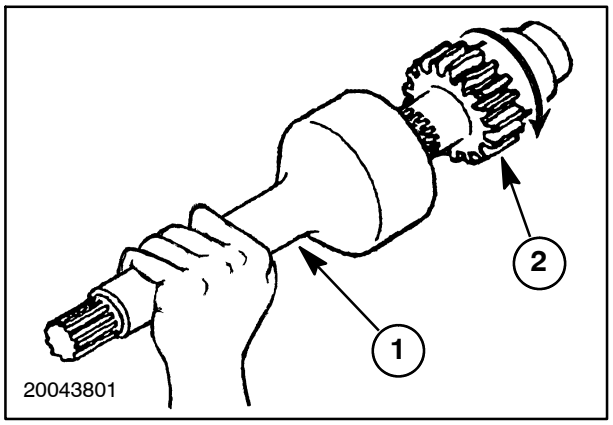


13

1. PTO Center Countershaft*
2. Coupling
3. Snap Ring
4. PTO Center Countershaft (Outer Race)
5. One-Way Bearing
6. Coupling (Inner Race)
7. Ball Bearing
8. Snap Ring
9. Ball Bearing
10. Ball Bearing
11. HST Countershaft
12. Bearing
13. Coupling
14. Thrust Washer
15. Needle Bearing
16. Collar
17. 4WD Counter Gear
18. Snap Ring

5. Install the rear countershaft, 1, to the rear of the one way clutch coupling, 2.
6. Rotate the rear PTO countershaft, 1, while holding the one way clutch outer race, 2 (fig.15).

IMPORTANT: *If the rear PTO countershaft, 1, rotates counterclockwise, as viewed from the rear, the assembly is correct. If the rear PTO countershaft, 1, is unable to rotate counterclockwise, as viewed from the rear, the assembly is incorrect. The one way bearing needs to be reversed.*

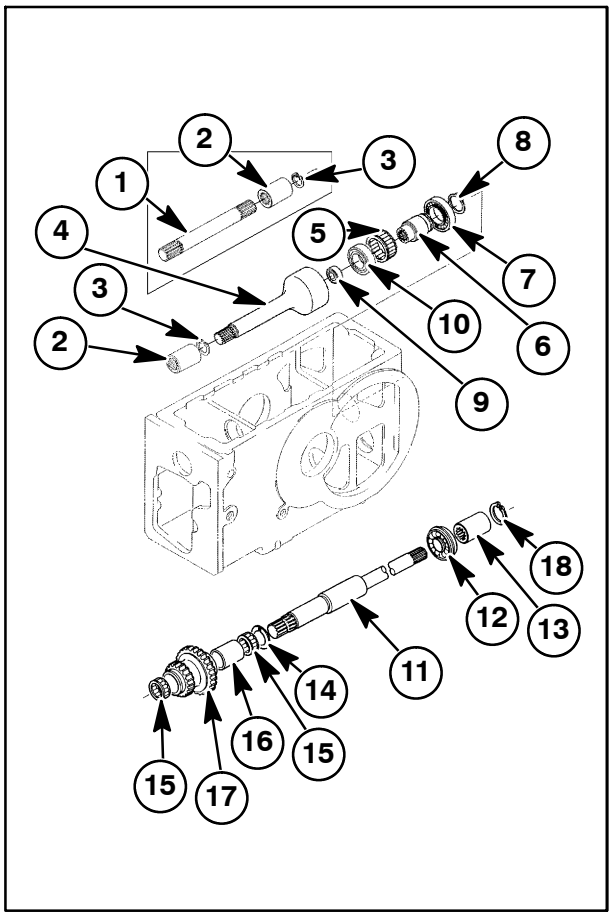


14

Installation

Install the power take-off center shaft, 1, 4, or 11, depending on transmission type, from the top of the case and slide into position. Using coupler, 2, connect the power take off center shaft with front PTO countershaft.

NOTE: *Center countershaft, 1, will be found in tractors with a double clutch. Center countershaft, 4, belongs to tractors with 9 x 3 single clutch transmissions. Center countershaft, 11, is found in tractors with the HST transmission.*

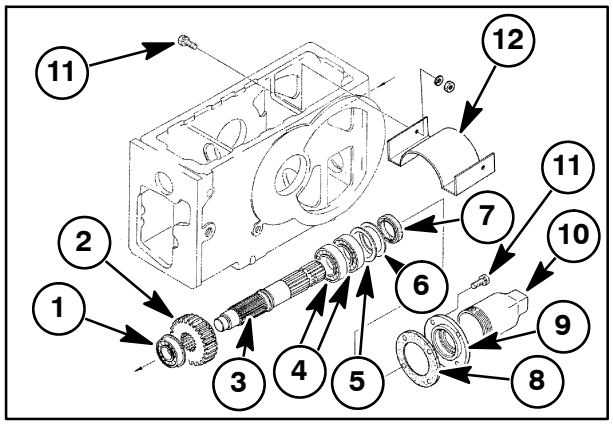


15

OUTPUT SHAFT

Assembly

1. Install bearings, 4, on the output shaft, 3.
2. Insert the output shaft through the rear of the case and install the sliding gear, 2, and bearing, 1, onto the shaft.
3. Push the assembly into place and install shims, 5 and 6, oil seal, 7, gasket, 8, and rear cover, 9, with bolts, 11.
4. Check the shaft end play using a dial indicator. Adjust as necessary to obtain an end play of 0.05 - 0.18 mm (0.002 - 0.007″) by removing or adding shims, 5 or 6.
5. After shaft end play is corrected, install bracket, 12, and cap, 10.



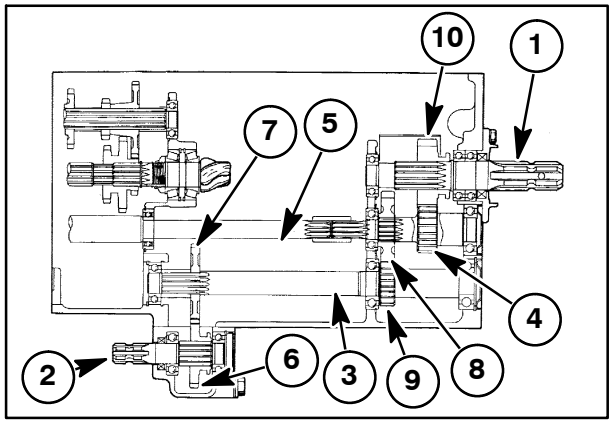
16

1. Ball Bearing
2. Sliding Gear - 20T
3. PTO Output Shaft
4. Ball Bearing
5. Shim - 0.2 mm (0.008″) As Required
6. Shim - 0.5 mm (0.020″) As Required
7. Oil Seal
8. Gasket
9. Rear Cover
10. Cap
11. Bolt
12. Bracket

DESCRIPTION OF OPERATION – MID-MOUNT POWER TAKE-OFF

The mid-mount power take-off is standard equipment on all model tractors equipped with the hydrostatic transmission and is available as a dealer-installed option on the 9 × 3 gear transmission.

The mid-mount PTO countershaft, 3, incorporates a gear, 9, that is in constant mesh with the PTO countershaft gear, 8. A sliding gear, 6, on the mid-mount PTO output shaft, 2, engages and disengages the mid-mount PTO countershaft gear, 7.



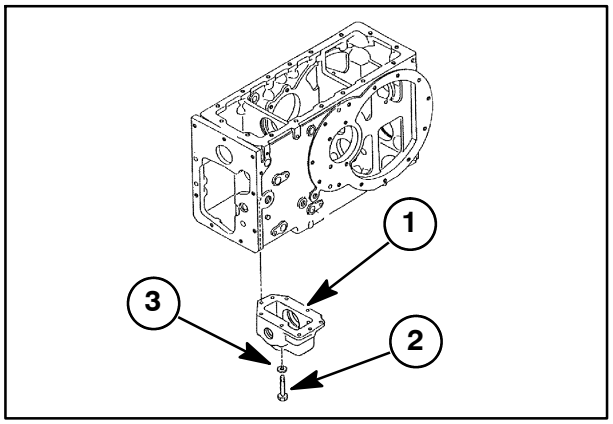
17

1. Rear PTO Output Shaft
2. Mid-Mount PTO Output Shaft
3. Mid-Mount PTO Countershaft
4. PTO Rear Countershaft - 12T
5. PTO Middle Countershaft
6. Mid-Mount PTO Sliding Gear - 31T
7. Fixing Gear - Mid-PTO - 37T
8. Fixed Gear - 25T
9. Mid PTO Countershaft Gear - 13T
10. PTO Sliding Gear - 20T

OVERHAUL - MID-MOUNT PTO

MID-MOUNT PTO

1. Remove the PTO output shaft. See “PTO Output Shaft Removal,” discussed earlier in this section.
2. Remove the PTO center countershaft. See “PTO Center Countershaft Removal,” discussed earlier in this section.
3. Remove the rear countershaft. See “Rear Countershaft Removal,” discussed earlier in this section.
4. Remove the mid-mount PTO gearbox, 1, as an assembly.



18

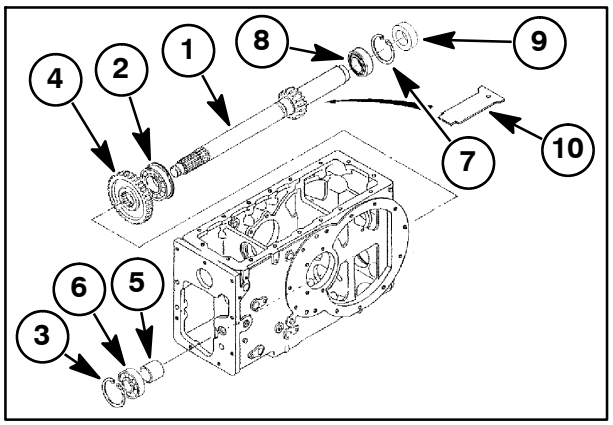
1. Mid-Mount PTO Gear Case
2. Bolt
3. Spring Washer

COUNTERSHAFT

Removal

1. Remove the sealing cover, 9, and snap ring, 7, from the rear of the case.
2. Gently drive the countershaft, 1, rearward and remove the shaft and rear bearing, 8, as an assembly.
3. Remove fixed gear, 4, and spacer, 5, from the bottom of the case.
4. Remove snap ring, 3, and bearing, 6.

   NOTE: *Bearing, 2, remains in the rear axle housing. Spacer plate, 10, retains bearing, 2, in place if a mid-PTO is not installed.*



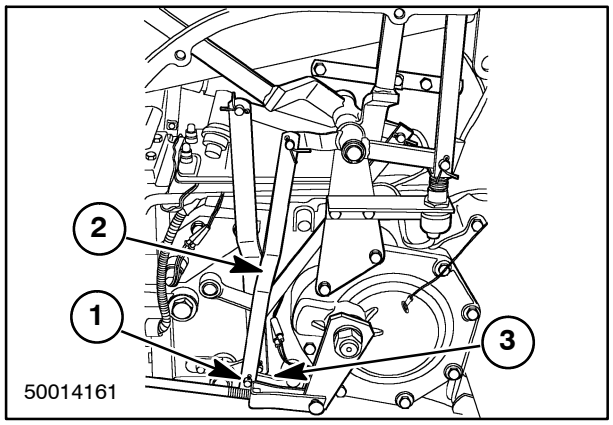
19

1. Countershaft - 13T
2. Bearing
3. Snap Ring
4. Fixed Gear - 37T
5. Spacer
6. Bearing
7. Snap Ring
8. Bearing
9. Sealing Cover
10. Plate Spacer Plate
(removed when mid-PTO is installed.)

SHIFTER ARM

Removal

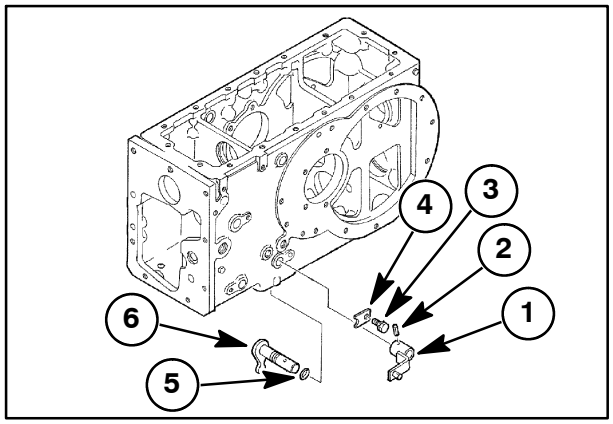
1. Remove the link, 2, from the change lever, 3, by removing cotter pin, 1.



20

1. Cotter Pin
2. Mid-PTO Link
3. Mid-PTO Change Lever

2. Drive roll pin, 2, out of the change lever, 1, and remove the lever.
3. Remove bolt, 3, and plate, 4, and remove the shift arm, 6, and O ring, 5, from the case.



21

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GEARBOX

Disassembly

Mid-Mount PTO Gear Shifter Removal

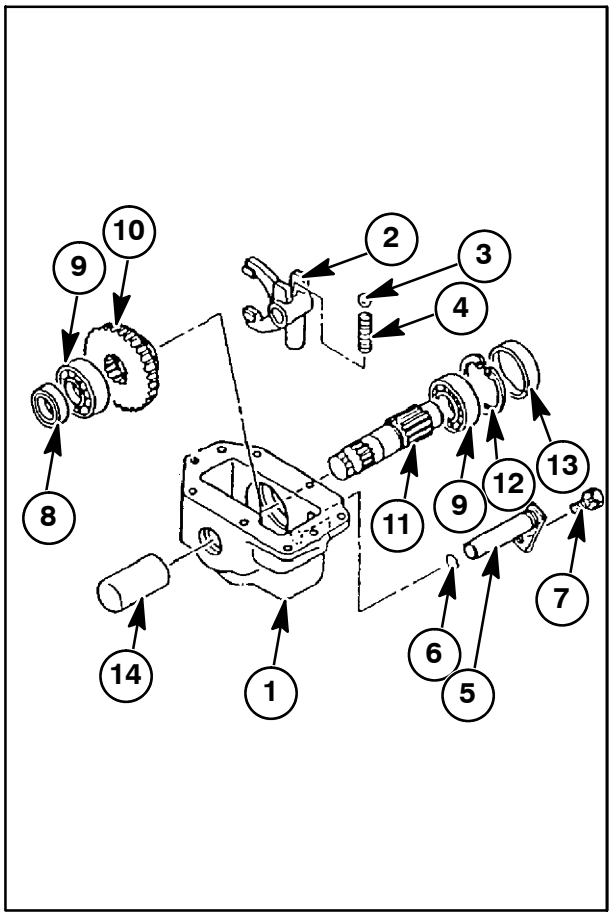
1. Remove the shift rail retaining bolt, 7.
2. Pull the shift rail, 5, out the rear of the case.

   NOTE: *Use care not to lose the detent spring and ball as they will be expelled with considerable force when released by the shift rail.*
3. Remove the shift fork, 2, detent spring, 4, and detent ball, 3.

Mid-Mount PTO Output Shaft Removal

1. Pry out sealing plug, 13, and cup, 14.
2. Remove snap ring, 12.
3. Drive the PTO output shaft, 11, out through rear of gearbox.
4. Remove the sliding gear, 10, from the case.
5. Remove bearing, 9, from the case.

   NOTE: *Seal, 8, may remain in gearbox housing.*



22

1. Mid-Mount PTO Gearbox
2. Shifter Fork
3. Detent Ball
4. Detent Spring
5. Shift Rail
6. O ring
7. Bolt
8. Oil Seal
9. Ball Bearing
10. Sliding Gear - 31T
11. Mid-Mount PTO Output Shaft
12. Snap Ring
13. Sealing Plug
14. Protective Sleeve

Inspection

1. Clean all parts in a suitable solvent and air dry.
2. Inspect all parts for excessive wear or damage.
3. Check the bearings for uneven rotation when turned by hand.
4. Inspect the shift rail grooves for excessive wear.
5. Inspect the detent spring and ball for wear damage.

Assembly

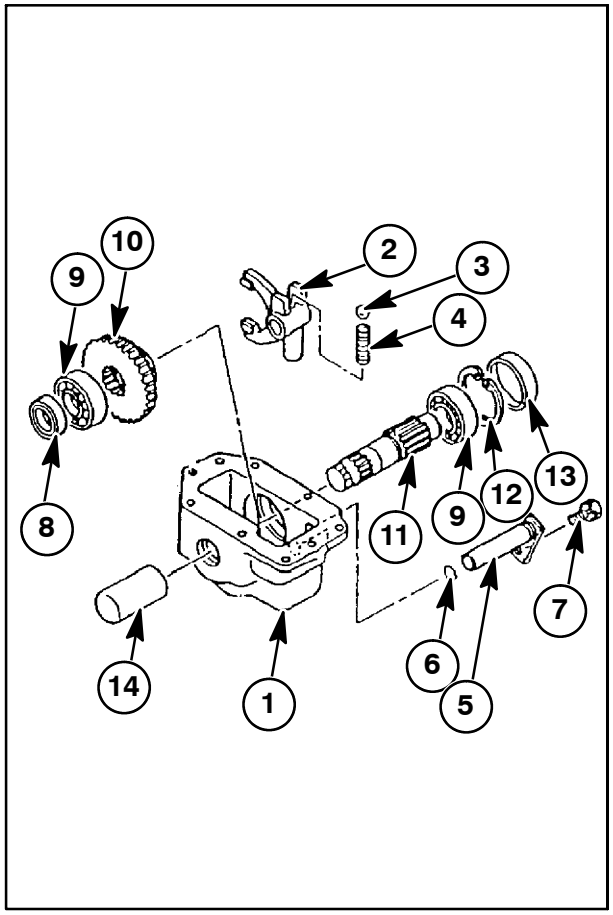
NOTE: *Install a new seal, 8, if removed. Also, install shifter arm assembly before mid-PTO case is attached to rear axle housing.*

Output Shaft Installation

1. Install bearing, 9, in the case.
2. Install sliding gear, 10, onto output shaft, 11, as it is installed.
3. Install the PTO output shaft through the rear of the case.
4. Install snap ring, 12.
5. Install sealing plug, 13, and cup, 14.

Gear Shifter Installation

1. Install the detent ball, 3, detent spring, 4, and shift fork, 2, onto output shaft, 11.
2. Install the shift rail, 5, through the rear of the case.
3. Install the shift rail retaining bolt, 7.
4. Install mid-mount PTO gearbox to bottom of transmission case. Seal with liquid gasket.



23

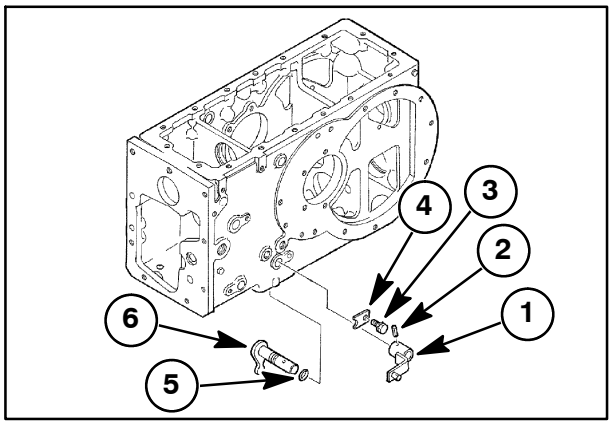
1. Mid-Mount PTO Gearbox
2. Shifter Fork
3. Detent Ball
4. Detent Spring
5. Shift Rail
6. O ring
7. Bolt
8. Oil Seal
9. Ball Bearing
10. Sliding Gear - 31T
11. Mid-Mount PTO Output Shaft
12. Snap Ring
13. Sealing Plug
14. Protective Sleeve

SHIFTER ARM

Assembly

NOTE: *Install shifter arm assembly before mid-PTO case is attached to rear axle housing.*

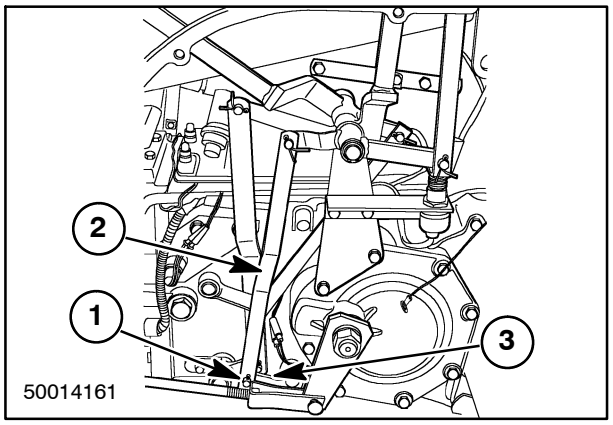
1. Using new O ring, 5, install the shift arm, 6, and secure with plate, 4, and bolt, 3.
2. Install the change lever, 1, and roll pin, 2.



24

3. Connect the link, 2, to the change lever, 3, by installing cotter pin, 1.

   NOTE: *Make sure mid-PTO safety switch operates correctly when linkage is installed.*



25

1. Cotter Pin
2. Mid-PTO Link
3. Mid-PTO Change Lever

COUNTERSHAFT

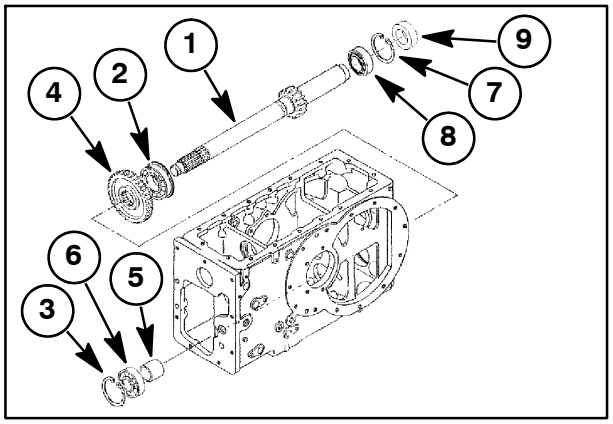
Assembly

1. Install bearing, 6, and snap ring, 3, into housing.
2. Install the countershaft, 1, and bearing, 8, in the case.
3. Install spacer, 5, and fixed gear, 4, on the countershaft, as it is placed into the case.
4. Install snap ring, 7, then sealing cover, 9.

REAR PTO COMPONENTS

Assembly

1. Install the PTO rear countershaft. See “Rear PTO Countershaft Assembly,” discussed earlier in this section.
2. Install the PTO center countershaft. See “PTO Center Countershaft Assembly,” discussed earlier in this section.
3. Install the PTO output shaft. See “PTO Output Shaft Installation,” discussed earlier in this section.



26

1. Countershaft - 13T
2. Bearing
3. Snap Ring
4. Fixed Gear - 37T
5. Spacer
6. Bearing
7. Snap Ring
8. earing
9. Sealing Cover

SECTION 33 - BRAKES

Chapter 1 - Brakes

CONTENTS

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	Brake Linkage Adjustment	6

SPECIFICATIONS

BRAKES	
Number of Discs: Outside Diameter Inner Diameter	4 155 mm (6.1 in.) 123 mm (4.84 in.)
Brake Discs: Lining Groove Depth Allowable Limit	 0.1 mm (0.004 in.) 0.0 mm (0.0 in.)
Stators Level Difference Allowable Limit	 0.1 mm (0.004 in.)
Clearance of Pedal Shaft and Bushing Allowable Limit	0.05 - 0.35 mm (0.002 - 0.014 in.) 1.0 mm (0.039 in.)
Brake Pedal Free Play	35 - 45 mm (1.38 - 1.77 in.)

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REAR AXLE AND BRAKES

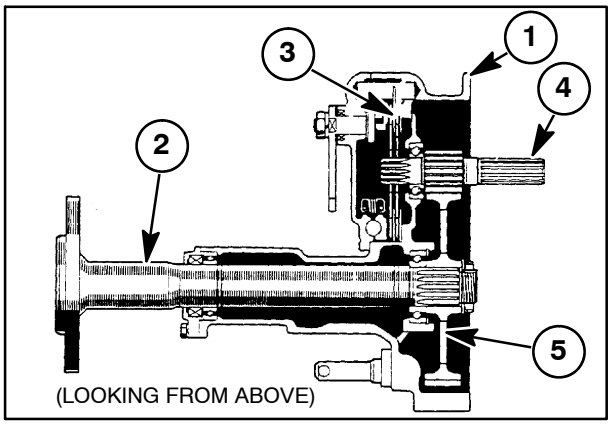
The rear axle is a double reduction type, using the conventional ring gear and pinion for primary reduction and a final drive pinion, 4, and gear, 5, for secondary reduction.

The axle housing, 1, encloses the brake discs and stators, 3. The rear axle, 2, and differential components are lubricated by the common reservoir.

The axles must be pressed out of the housings to service the bearings and oil seals.

The brakes are wet disc type and are mechanically actuated. The brakes are located in the outside of the differential housing and are enclosed in the front portion of the axle housing. The brakes are sealed against dust and moisture entry by the cover.

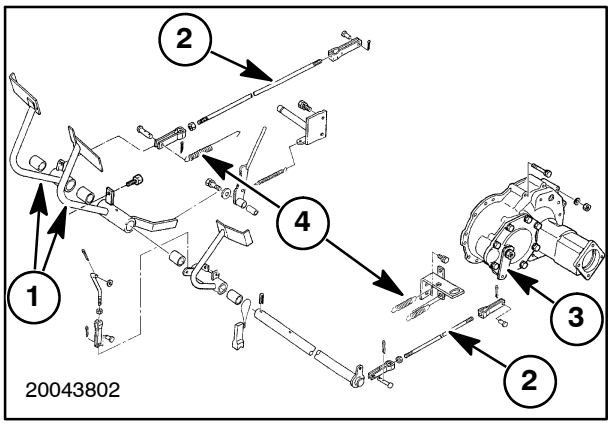
The brake discs are splined to the final drive pinion and turn at the same speed as the differential assembly.



1

Brake Operation

Depressing a brake pedal, 1, operates the actuator lever, 3, through the movement of the brake rod, 2, and spring, 4.

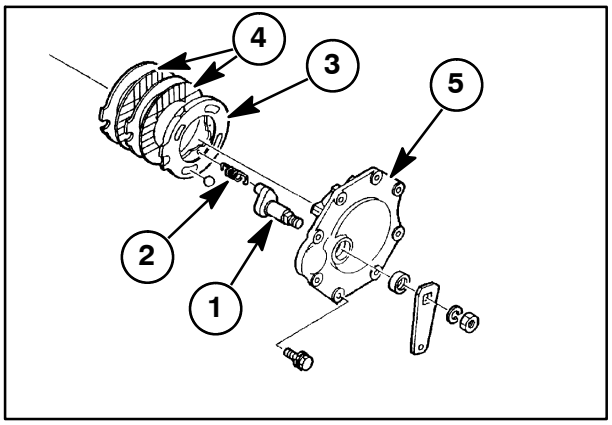


2

This causes the cam, 1, to overcome the actuator return spring, 2, and force the actuator plate, 3, against the rotating brake discs, 4, to perform the braking action.

When the brakes, 1, are released, the pedal return spring, 4, pulls the actuator lever, 3, back to its original position (Figure 2).

The actuator return spring, 2, pulls the actuator plate, 3, away from the brake discs, 4, towards the outer brake cover, 5 (this Figure).



3

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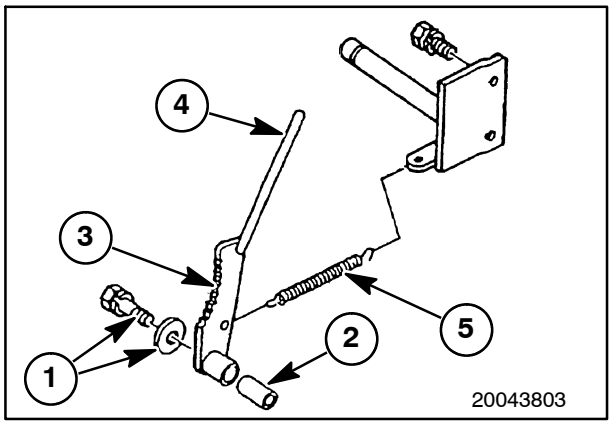
PARKING BRAKE

A parking brake is provided to hold the brakes in a locked position. The control holds the pawl in a locked position on the inside brake pedal only.



4

1. Bolt and Washer
2. Spacer
3. Parking Brake Pawl
4. Parking Brake Control Handle
5. Extension Spring

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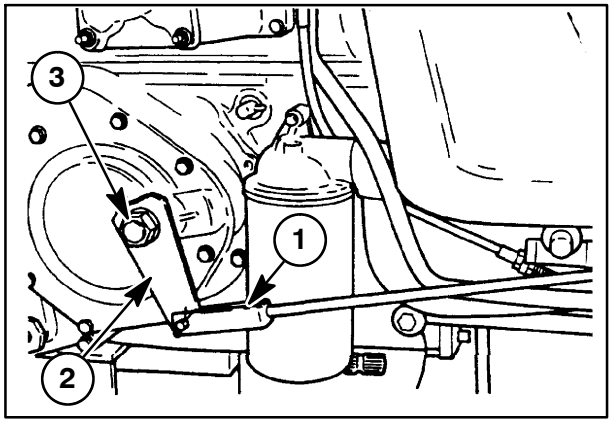
BRAKES AND FINAL PINION OVERHAUL

Removal

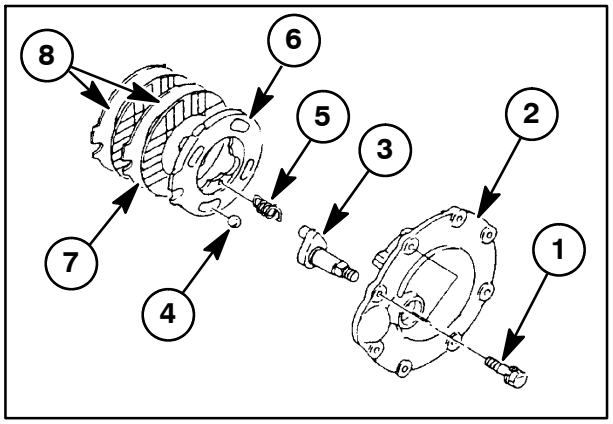
The brakes may be serviced without removing the rear axle housing from the differential center housing assembly. The rear axle housing must be removed to service the final pinion.

1. Disconnect the brake rod clevis, 1, at the brake cover lever, 2. Remove the lever, 2, from the cam shaft, 3.



5

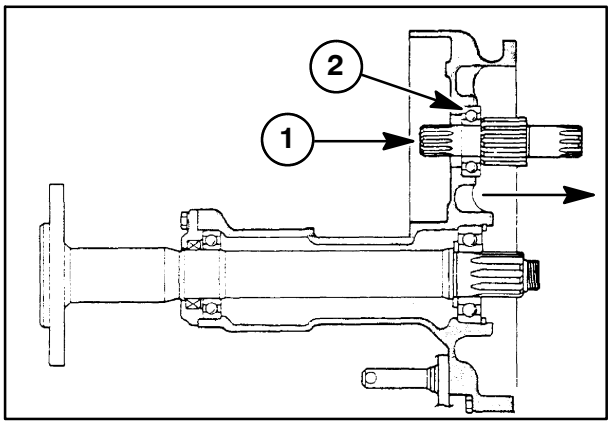
2. Remove the cover bolts, 1, and remove the cover, 2.
3. Remove the cam, 3, three springs, 5, four balls, 4, and actuator plate, 6.
4. Remove the brake disc, 7, and stators, 8, from the final pinion shaft.



6

5. If the final pinion is to be removed, gently drive the final drive pinion-11T, 1, and bearing, 2, out of the housing.

   NOTE: *The axle housing must be removed from the tractor prior to pinion shaft removal. See "Differential - Removal," discussed in section 27.*



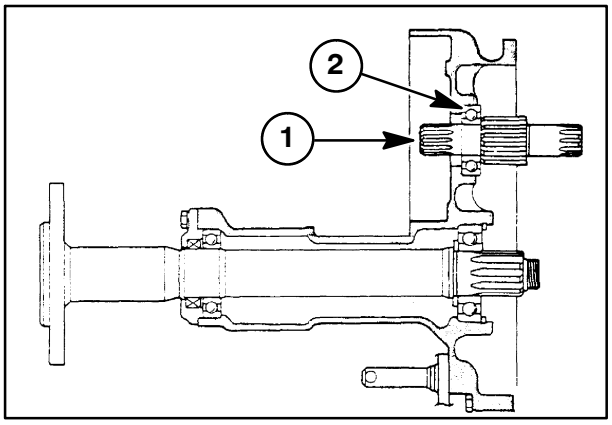
7

Inspection

1. Inspect the brake discs for excess wear or damage. Replace the discs if the lining groove depth is not within the allowable limit, 0.0 mm (0.0″) allowable, 0.1 mm (0.004″) normal.
2. Inspect the stators for excess wear or damage. Replace the stators if not within the allowable level difference of 0.1 mm (0.004″).
3. Inspect the brake cover, steel balls, actuating cam, and springs for wear. Replace worn or damaged parts.

Assembly and Installation

1. If removed, install the final pinion support bearing, 2, and final drive pinion-11T shaft, 1.



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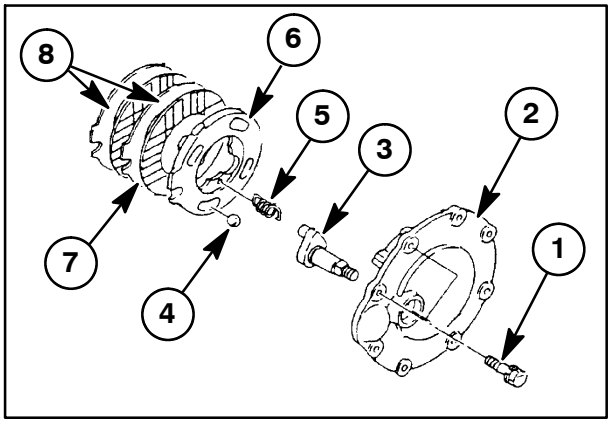
2. Install the brake discs, 7, stators, 8, onto the final pinion.
3. Install the oil seal and actuating cam, 3, in the cover, 2.
4. Install steel balls, 4, and springs, 5, between the actuator plate, 6, and cover, 2.



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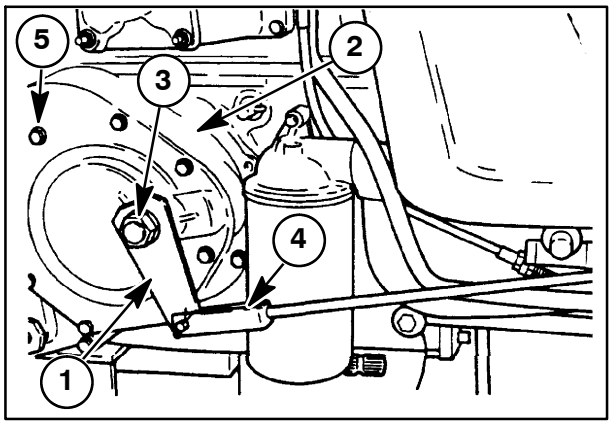
5. Attach the brake cover lever, 1, to cam, 3. Connect the brake rod clevis, 4. Tighten cover, 2, on with bolts, 5.



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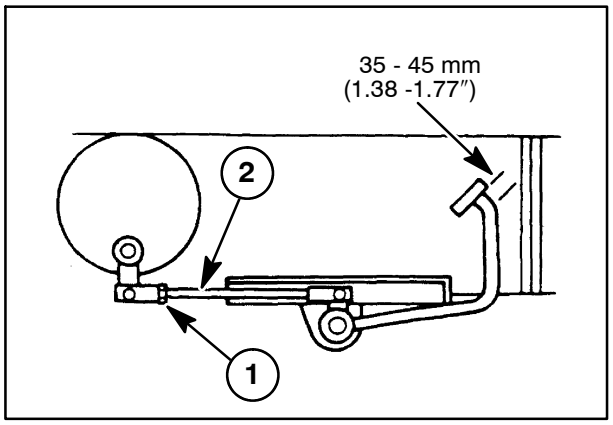
Brake Linkage Adjustment

1. Check the brake pedal free travel and, if necessary, adjust the brake rod, 2, by loosening locknut, 1, to obtain 35 - 45 mm (1.38 - 1.77″) free travel at the pedal.

   NOTE: *Be sure to test drive the tractor to make sure the braking action on both wheels is equal. If necessary, adjust the outer brake rod to equalize the free-play travel*

2. Tighten the clevis locknuts securely.



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SECTION 35 - HYDRAULIC SYSTEM

Chapter 1 - Hydraulic System

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SPECIFICATIONS

Hydraulic Pump

Type . . . . . Gear

Pump Capacity
. . . . . 23.3 L/min (6.2 GPM)

Pump Speed (rpm)
. . . . . 2200 rpm

Engine Speed (rpm)
. . . . . 2600 rpm

System Relief Valve Setting . . . . . 145 ± 5 bar (2133 ± 70 psi)

Lift Cylinder Diameter . . . . . 2.76″ (70 mm)

Maximum Lift Capacity . . . . . 1290 kg (2865 lbs.)

Safety Valve Setting . . . . . 250 ± 20 bar (3625 ± 290 psi)

Double-Spool
Remote Control Relief Valve Setting . . . . . 121 bar (1750 psi)

Reservoir Capacity
9 x 3 . . . . . 32.5 L (8.6 gal.)
HST . . . . . 33.3 L (8.8 gal.)

Recommended Hydraulic Oil . . . . . Ambra Multi G 134
Cold Weather Option F200

BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Foot-Pounds	Newton Meters	Pitch (mm)	Foot-Pounds	Newton-Meters
M6	4T, 4.8	1.0	3.6 - 5.1	4.9 - 6.9	------	------	------
	7T, 8T, 8.8		6.1 - 8.3	8.3 - 11.3			
	10T, 11T		8.6 - 11.6	11.7 - 15.7			
M8	4T, 4.8	1.25	9.4 - 12.3	12.7 - 16.7	1.0	11.2 - 14.9	15.2 - 20.2
	7T, 8T, 8.8		16.7 - 21.0	22.6 - 28.4		19.6 - 25.3	26.5 - 34.3
	10T, 11T		21.0 - 26.8	28.5 - 36.3		22.4 - 29.7	30.4 - 40.2
M10	4T, 4.8	1.5	18.8 - 24.6	25.5 - 33.3	1.25	21.0 - 26.8	28.5 - 36.3
	7T, 8T, 8.8		32.5 - 41.3	44.1 - 55.9		36.2 - 46.3	49.0 - 62.8
	10T, 11T		39.8 - 51.3	54.0 - 69.6		42.7 - 54.2	57.9 - 73.5
M12	4T, 4.8	1.75	27.5 - 34.8	37.3 - 47.1	1.25	31.8 - 40.5	43.1 - 54.9
	7T, 8T, 8.8		48.5 - 61.5	65.7 - 83.3		54.9 - 69.4	74.5 - 94.1
	10T, 11T		68 - 85.6	92 - 116		73.1 - 93.7	99 - 127
M14	4T, 4.8	2.0	46.3 - 59.3	62.8 - 80.4	1.5	51.4 - 64.4	69.7 - 87.3
	7T, 8T, 8.8		76.8 - 97.4	104 - 132		85.6 - 109	116 - 148
	10T, 11T		102.6 - 129	139 - 175		110 - 136	149 - 185
M16	4T, 4.8	2.0	63.5 - 81.2	86 - 110	1.5	67.2 - 84.9	91 - 115
	7T, 8T, 8.8		110 - 136.5	149 - 185		116 - 142	157 - 193
	10T, 11T		151.3 - 188	205 - 255		162 - 199	220 - 270
M18	4T, 4.8	2.0	83.4 - 104	113 - 141	1.5	96.7 - 120	131 - 163
	7T, 8T, 8.8		145 - 174	196 - 236		169 - 206	230 - 280
	10T, 11T		203 - 246	275 - 333		220 - 270	299 - 367
M20	4T, 4.8	2.5	106 - 133	144 - 180	1.5	126 - 155	171 - 211
	7T, 8T, 8.8		177 - 214	240 - 290		203 - 245	275 - 333
	10T, 11T		268 - 252	363 - 341		293 - 358	397 - 485

Flow Control - Cylinder Head Retainers . . . . . 65.7 - 83.4 N·m (48.5 - 61.5 ft. lbs.)

Hydraulic Pump Retainers . . . . . 22 - 28 N·m (16 - 20 ft. lbs.)

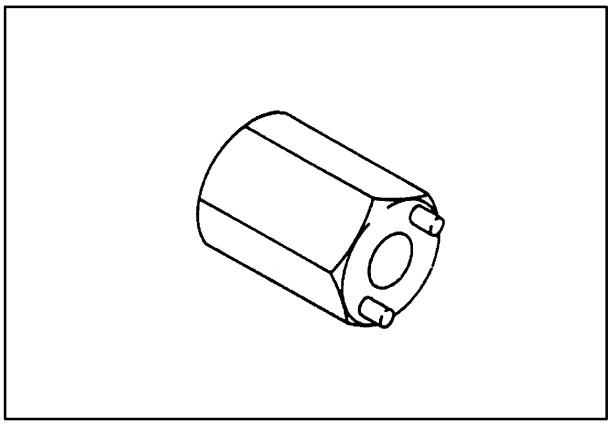
SPECIAL TOOLS

Description ..... Tool No.

Hose
7/16″ - 20 FJIC SE x Quick Connect Fitting x 16.25″ length FNH02106

Gauge 0 - 3000 PSI OEM1462

Lowering Valve Seat Removal Tool FNH00357



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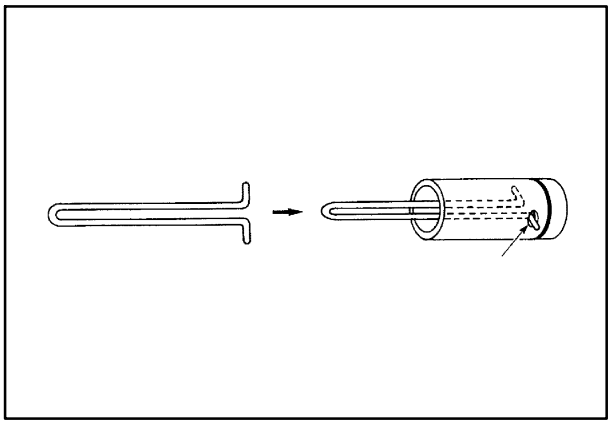
Check Valve Seat

Removal Tool - Fabricate Using 2 - 3 mm Dia. (0.080 - 0.120″) Wire



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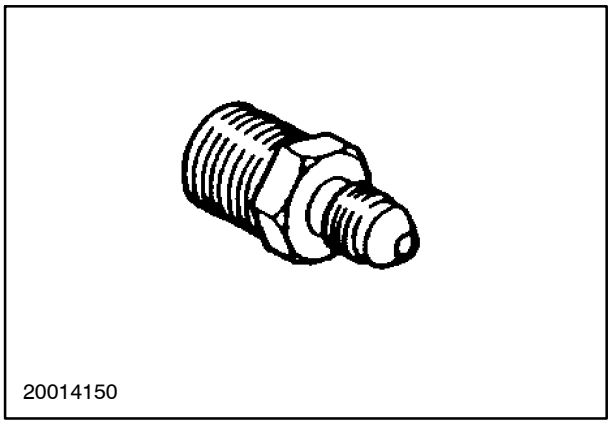
Pressure Test Fitting, Hydraulic

Tool #FNH07560



3

TROUBLESHOOTING

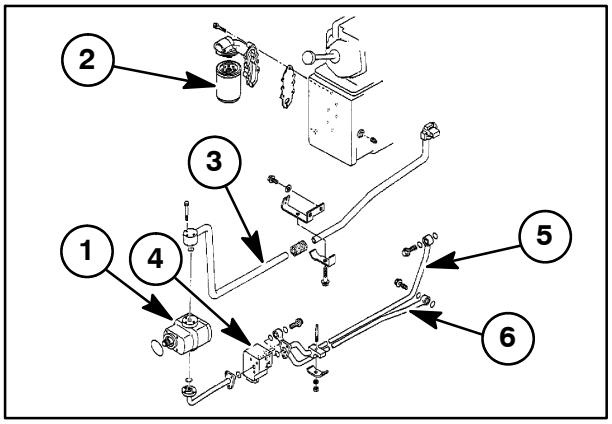
PROBLEM	POSSIBLE CAUSE	CORRECTION
Implement fails to lift when lever is in raised position	1. Linkage out of adjustment	1. Adjust external and internal linkage
	2. Relief valve setting too low	2. Perform system relief valve pressure test
	3. Faulty safety valve	3. Repair or replace safety valve
	4. O ring failure on control valve body to cover	4. Repair as required
	5. Excessive fluid leakage past lift cylinder piston seal	5. Replace seal, piston, or cylinder as required
	6. Restricted suction filter	6. Clean or replace as required
	7. Unload valve does not close	7. Check unload valve operation
	8. Poppet valve remains open	8. Check poppet valve adjustment and operation
Lift arms cycle up and down when lever is in neutral position	1. Faulty poppet valve and seat	1. Repair or replace as required
	2. Faulty check valve and seat	2. Replace
	3. Leaking O rings (poppet valve and seat, valve cover, unload valve plug)	3. Inspect and repair as required
	4. Poppet valve out of adjustment	4. Adjust to proper clearance
Implement settles too fast when engine is stopped	1. Faulty check valve and seat	1. Replace
Implement rises too slowly	1. Suction filter restricted	1. Clean or replace as required
	2. Pump capacity too low	2. Perform flow test and replace pump as required
	3. Excessive leakage past piston seal	3. Inspect cylinder and piston, repair as needed
	4. Faulty relief valve	4. Repair or replace
	5. Faulty safety valve	5. Repair or replace
Implement will not lower	1. Flow control valve in closed position	1. Open valve
	2. Poppet valve out of adjustment	2. Adjust poppet valve clearance
Implement does not raise to full height	1. Position control rod out of adjustment	1. Adjust position control rod
Relief valve operates when implement is in full raise position	1. Position control rod out of adjustment	1. Adjust position control rod
Hydraulic fluid overheats	1. Faulty pump	1. Replace pump
	2. Restricted filter	2. Clean or replace

DESCRIPTION OF OPERATION - HYDRAULIC SYSTEM

Op. 35 000

The hydraulic position control is standard equipment on all model tractors. The open center hydraulic system consists essentially of a fluid reservoir, hydraulic pump, lift cylinder and piston, control valve, and lift links.

The rear axle and transmission housing serve as a common hydraulic fluid reservoir and supply fluid to the hydraulic pump, 1, through the filter, 2, and suction tube, 3. The hydraulic pump supplies fluid to the system control valve through the combination relief-diverter valve manifold, 4, and the high-pressure line, 5. The control valve, when operated, affects raise, neutral, or lowering action of the lift arms. Hydraulic fluid is returned through line, 6.



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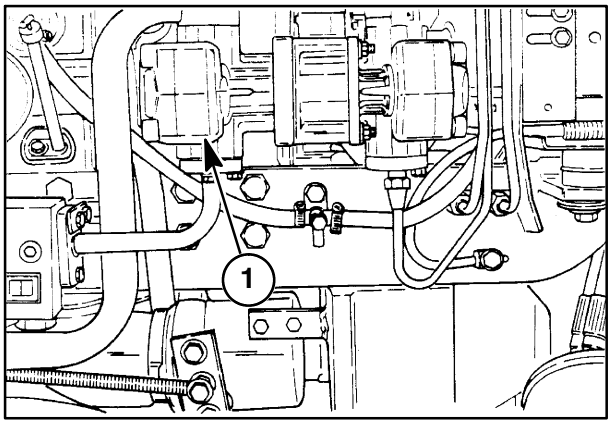
The hydraulic pump, 1, is mounted on the right side of the engine and is driven by the engine oil pump gear located on the front of the engine block.



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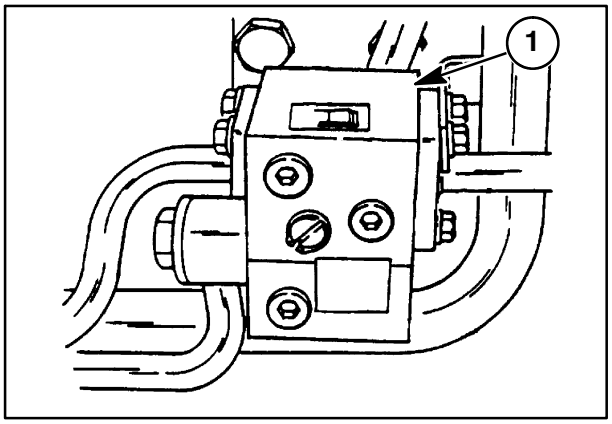
The hydraulic fluid is pressurized by the hydraulic pump and flows through the combination system relief-diverter manifold, 1, mounted on the right-hand side of the tractor, to the control valve, which is located inside the hydraulic lift cover assembly.



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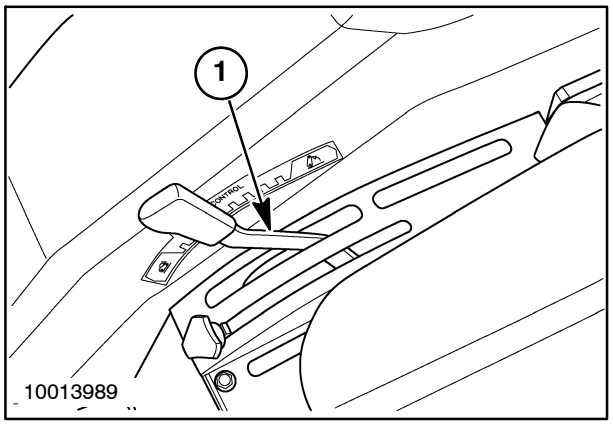
The hydraulic system is controlled by a single lever, 1. An adjustable stop, 2, on the quadrant provides a reference for returning the control lever to a preset position.



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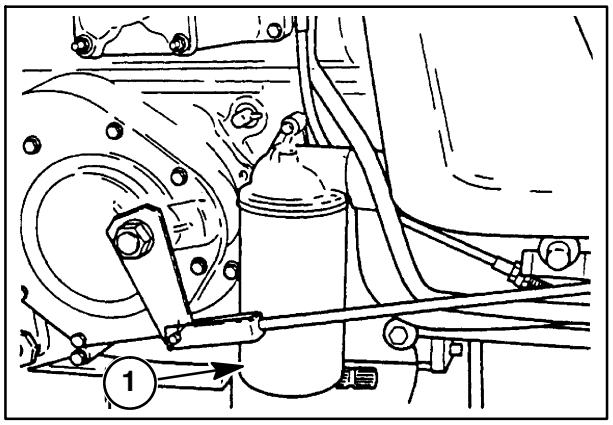
HYDRAULIC FLUID FILTER

The suction filter, 1, is a canister-type filter. The filter should be replaced after 300 hours of use.



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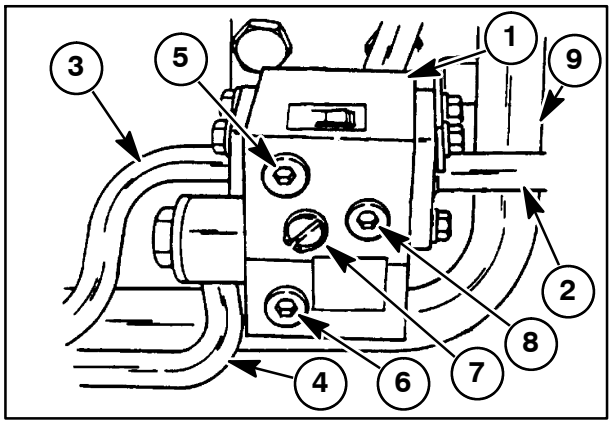
Op. 35 080

COMBINATION SYSTEM RELIEF - DIVERTER VALVE MANIFOLD ASSEMBLY

The combination system relief-diverter valve manifold, 1, is located in the high-pressure line on the right side of the tractor. Line, 9, supplies the pump from the reservoir. Line, 2, brings fluid from the pump to the manifold. Line, 3, supplies the hydraulic powered lift valve (control valve). Line, 4, provides a return path back to reservoir. The diverter spool, 7, normally provides flow directly to the HPL when the slot is in the 2 o'clock position.

The diverter spool, 7, when rotated to the 10 o'clock position supplies the auxiliary hydraulics. The plugs, 5, 6, and 8, are removed to connect the auxiliary pumping. Port, 5, (PB for power beyond) bring flow pressure back from the front remote. This flow now supplies the HPL valve or rear remote. Port, 6, (T for tank) connects the front remote with a path to the reservoir. Port, 8, (P for pressure) provides pressure out of the manifold to the front remote valve.



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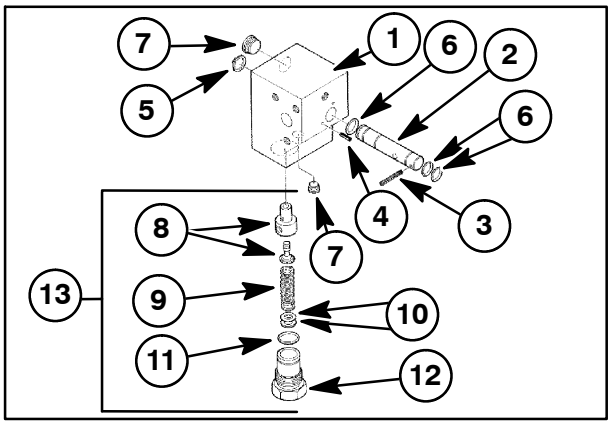
The valve assembly contains the system relief valve,13, which protects the hydraulic pump from overload conditions. The valve body, 1, also serves as a manifold, containing hose connection ports for use with auxiliary hydraulic equipment, such as loaders. The diverter valve spool, 2, permits the operator to select operation of either the auxiliary hydraulic lift system circuits or the hydraulic lift system by rotating the diverter valve spool to the desired position.



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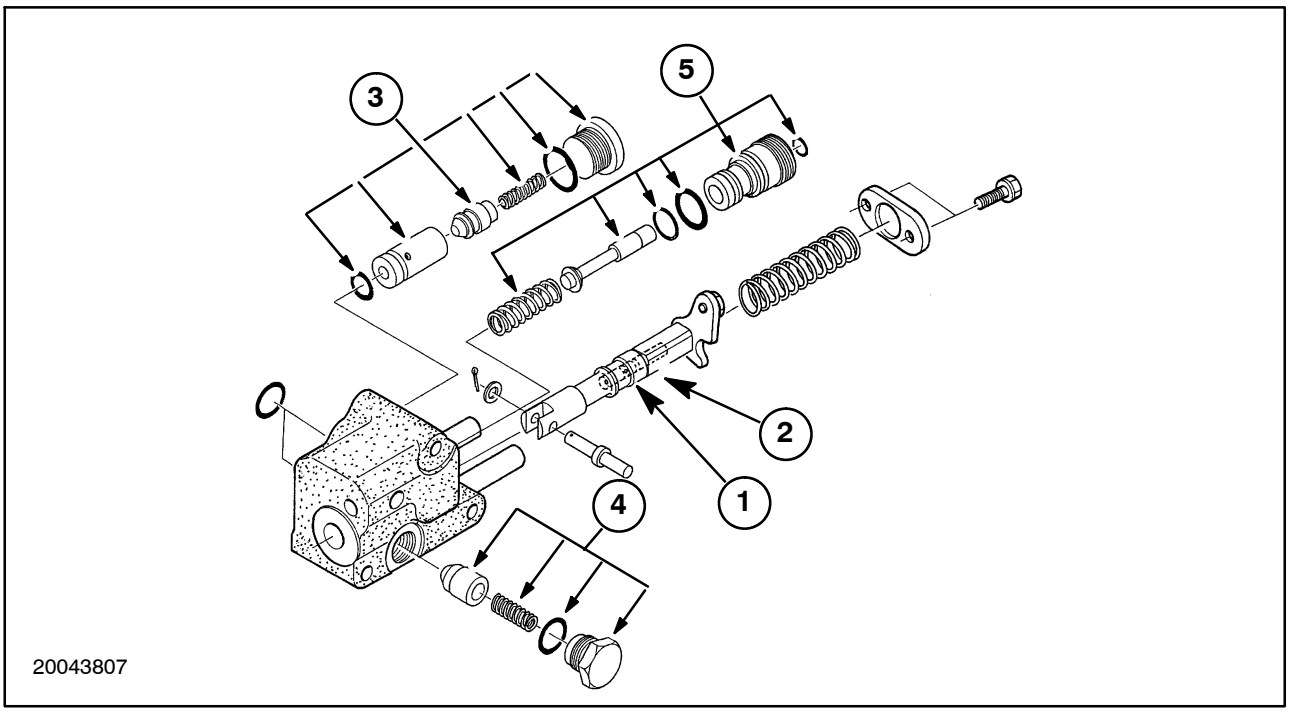
1. Valve Body
2. Diverter Valve Spool
3. Roll PIn
4. Roll Pin
5. Snap Ring
6. O rings
7. Plug
8. Housing and Poppet
9. Spring
10. Shim
11. O ring
12. Cap Plug
13. System Relief Valve Assembly

Op. 35 200

CONTROL VALVE ASSEMBLY (HPL)

The control valve assembly is located inside the hydraulic lift cover and contains the control valve spool, 1, bypass spool, 2, check valve, 3, unload valve, 4, and lowering valve, 5.



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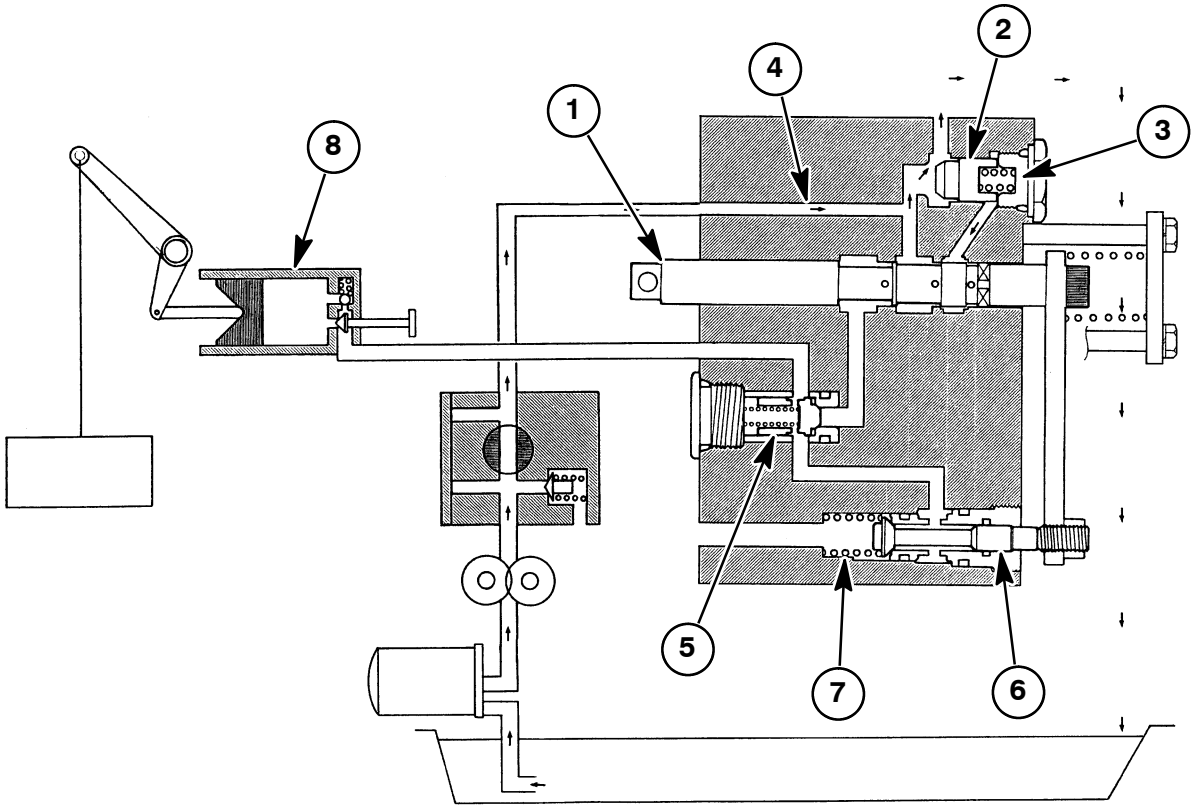

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Neutral Position - Fluid Flow

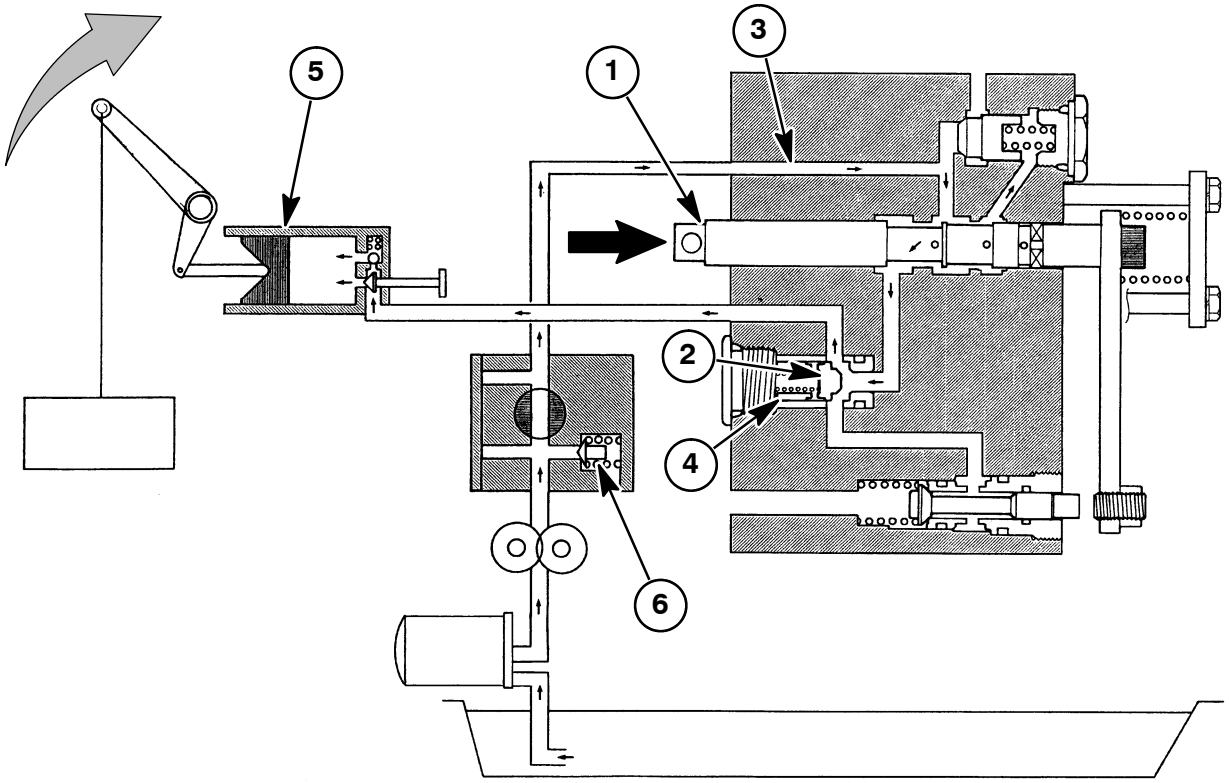
12

Op. 35 210

NEUTRAL POSITION - FLUID FLOW

In the neutral position, the control valve spool, 1, is centered in the valve body. As fluid from the hydraulic pump is directed to the valve body, the fluid pressure moves the unload valve, 2, and compresses the spring, 3. This opens the passages, 4, to the sump. Fluid then flows from the pump to these passages and returns to the sump.

Fluid trapped in the lift cylinder, 8, under weight caused by the implement on the lift arms, exerts pressure on the cylinder side of the check valve, 5. This holds it in a closed position. The lowering valve spool, 6, positioned by the spring, 7, retains the fluid in the lift cylinder and maintains the implement in a fixed position.



20043810

Raising Position - Fluid Flow

13

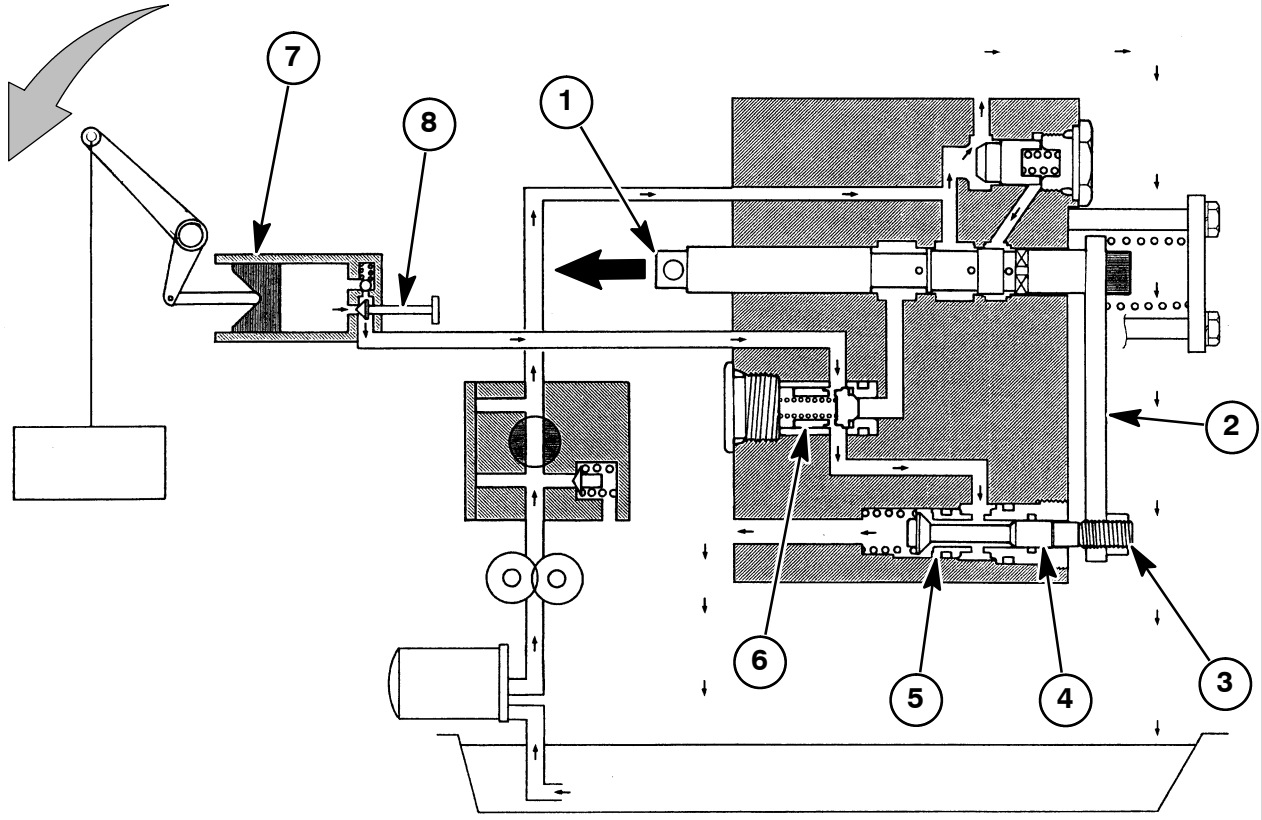
Op. 35 210

RAISING POSITION - FLUID FLOW

When the position control lever is moved to the raise position, the control valve spool, 1, is moved inward (rearward). The fluid passages in the control valve are opened, and fluid flows to the check valve, 2, through the check valve fluid passage, 3.

Fluid pressure against the check valve overcomes the check valve spring, 4, and the lift cylinder fluid static pressure on the check valve. This raises the check valve off its seat, allowing fluid to flow to the lift cylinder, 5, to raise the implement. When the fluid pressure exceeds 2135 psi (150 bar), the relief valve, 6, opens and fluid is returned to the sump.

A high pressure safety valve in the lift cylinder head protects against shock loads by opening at pressures exceeding 250 ± 20 bars (3625 ± 290 psi), returning fluid to sump.



20043811 **Lowering Position - Fluid Flow**

14

Op. 35 210

LOWERING POSITION - FLUID FLOW

When the position control lever is moved to the lowering position, the control valve spool, 1, is moved forward (outward). The plate, 2, and adjusting bolt, 3, attached to the control valve spool, also move forward, making contact with the lowering valve spool, 4, and pushing it off its seat, 5.

Fluid from the sump flows through the passages in the control valve spool and plunger and returns to the sump in the same manner as in the neutral position.

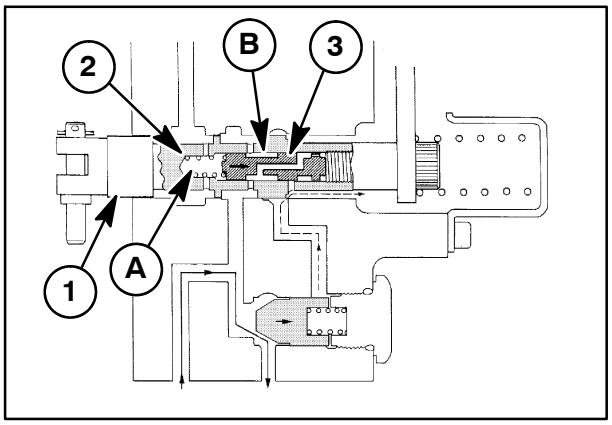
Fluid in the lift cylinder, 7, flows through the passage past the check valve, 6, to the lowering valve spool and seat and returns to the sump, permitting the implement to lower.

The HPL drop rate control valve, 8, can be adjusted to limit flow returning from lift cylinder to HPL valve.

Op. 35 200

BYPASS SPOOL - FLUID FLOW - CLOSED POSITION

The bypass spool and spring are located in the control valve spool, 1. The purpose of the bypass spool is to protect the hydraulic system from excessive pressure. The bypass spool, 3, is held in position (to the right-hand side of the control valve spool) by a spring, 2, and the cylinder passage pressure (A), which is normally higher than the oil pump passage pressure (B).



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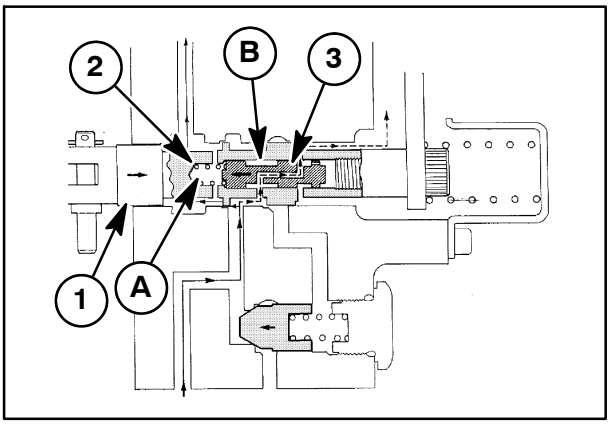
Op. 35 200

BYPASS SPOOL - FLUID FLOW - OPEN POSITION

When the control lever is moved to the raise position, fluid flows from the pump and the cylinder passage (A) fluid pressure becomes lower than the fluid pressure at passage (B). The bypass spool operates (moves to the left-hand side of the control valve spool) and the bypass circuit is opened, allowing the remaining fluid to flow to the sump via the bypass spool, 3.

When the cylinder passage pressure (A) and the fluid pump passage pressure (B) become equal, the bypass spool returns to its normal position, and the bypass passage is closed.



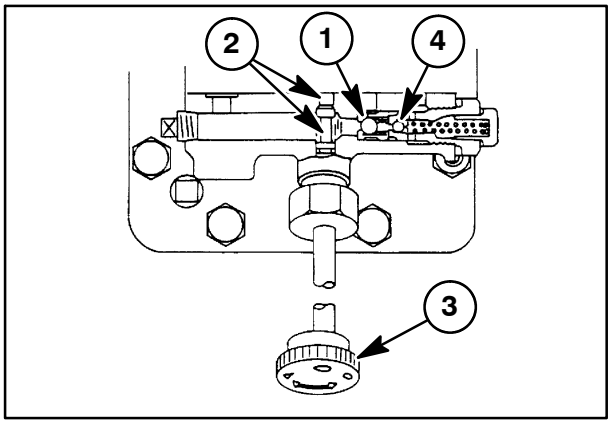
16

FLOW CONTROL VALVE

Fluid flow from the pump enters the lift cylinder through the check ball, 1, and the flow control valve needle and seat, 2. When the needle valve is closed or severely restricted, fluid pressure opens the check valve and flows to the lift cylinder during the raising cycle. The one-way check valve prevents fluid from returning to the lift cylinder, and the lift arms remain at their set height.

During the lowering cycle, the fluid being exhausted from the lift cylinder must return to the reservoir via the needle valve and seat, 2. The needle valve control knob, 3, must be adjusted to obtain the desired rate of drop.

The high-pressure safety valve, 4, located in the flow control valve body, protects the lift cylinder against shock loads. When cylinder pressure exceeds 250 +/– 20 bars (3625 +/– 290 psi), the safety valve opens and allows the cylinder fluid to escape to the sump.

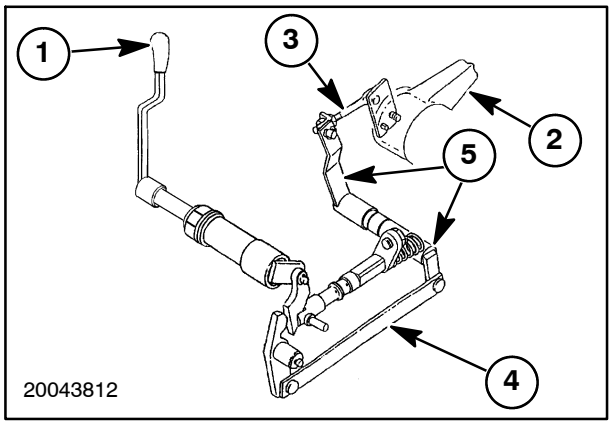


17

LINKAGE OPERATION - SINGLE LEVER - POSITION CONTROL

The single-lever hydraulic system uses a single-quadrant control lever, 1, which is connected to the control valve spool by internal linkage, to maintain mounted implements at a constant height relative to the tractor.

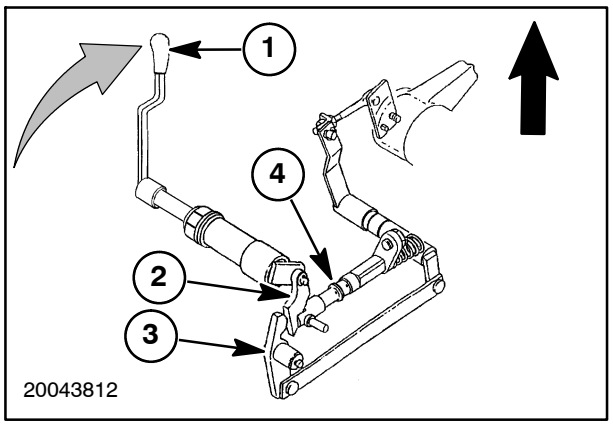
When the control lever is moved, the internal linkage and control valve spool activate the hydraulic system, and the lift arms, 2, respond to the movement of the control lever, 1, by either raising, lowering, or remaining in neutral condition. The rod, 3, which is connected to the lift arm, actuates the feedback links, 4 and 5, to move the control valve spool to the neutral position when the desired height is reached.



18

POSITION CONTROL OPERATION - NEUTRAL POSITION TO RAISE

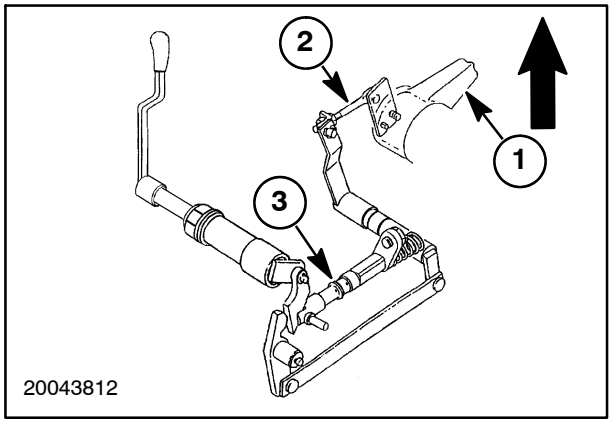
When the position control lever, 1, is moved to the raise position, the cam, 2, is rotated between the cam, 3, and the control valve spool, 4, forcing the control valve inward into a raise position. Pump fluid then flows to the lift cylinder, and the lift arms raise.



19

RAISE POSITION TO NEUTRAL POSITION

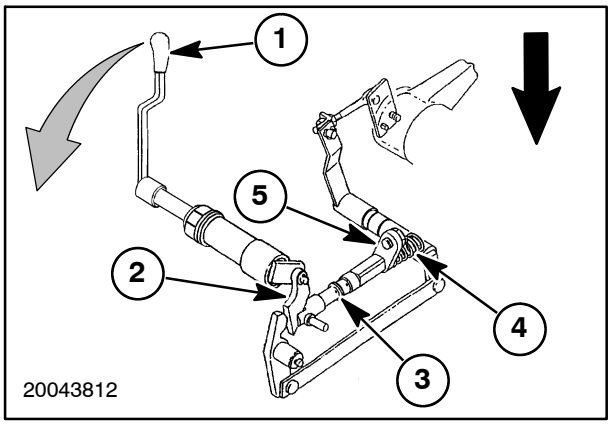
When the lift arms, 1, raise, the feedback link, 2, moves rearward allowing the spring-loaded control valve spool, 3, to move forward (outward) to the neutral position. Pump fluid flow is redirected to the sump, and the lift arms stop raising.



20

NEUTRAL POSITION TO LOWERING POSITION

When the control lever, 1, is moved to the lowering position, the cam, 2, is moved upward, reducing the pressure on the control valve spool, 3. The spring, 4, then moves the control valve spool forward (outward) and pump fluid flow is directed to the sump. The lowering arm and screw, 5, moves toward the valve spool (not shown) pushing it off its seat. This allows the cylinder fluid to exhaust to the sump via the flow control valve and lowers the lift arms.



21

OVERHAUL - LIFT CYLINDER

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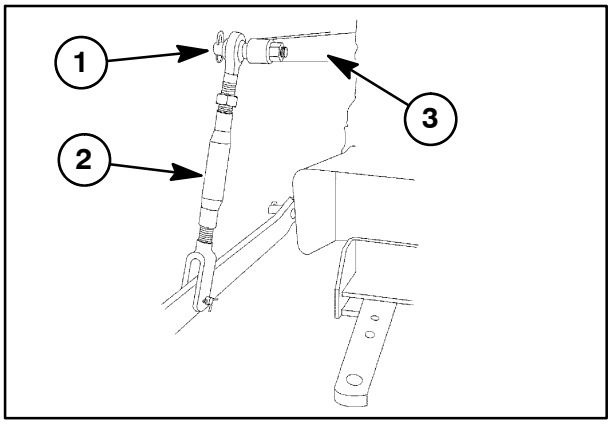
LIFT CYLINDER

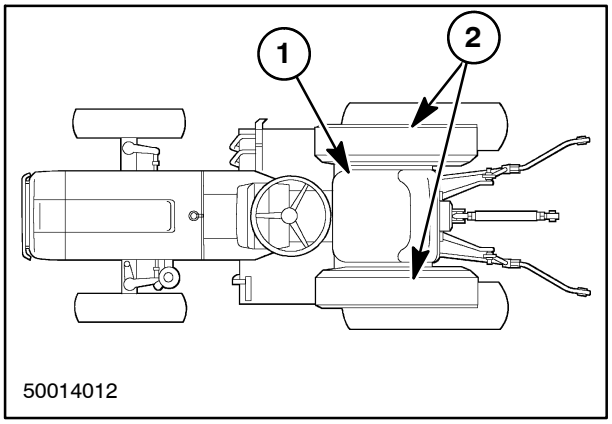
Removal

1. Before removing the lift cover assembly, discharge the fluid from the lift cylinder by lowering the lift links to their lowest position.
2. Disconnect the wiring harness at the fenders.
3. Remove the clevis pins, 1, and disconnect the position control rods, 2, from the lift arms, 3, on both sides.



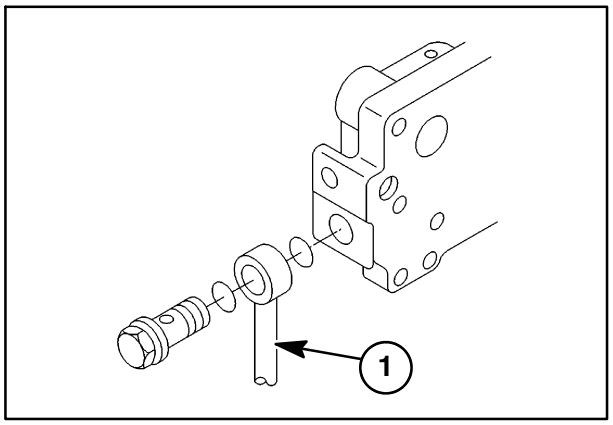
22

4. Remove the seat, 1, and seat suspension.
5. Remove the left and right fender assemblies, 2, from the tractor.



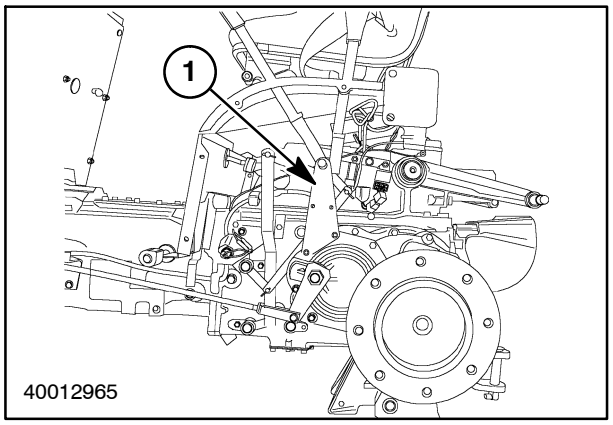
23

6. Disconnect the high-pressure line, 1, from the lift cover.



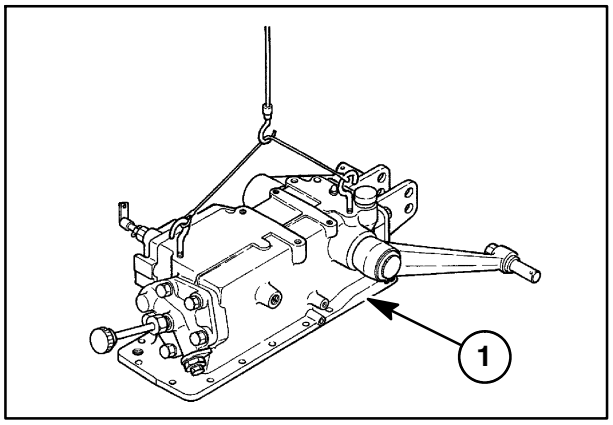
24

7. Disconnect the shifter linkage, 1.
8. Remove the shifter levers and support bracket as an assembly.



25

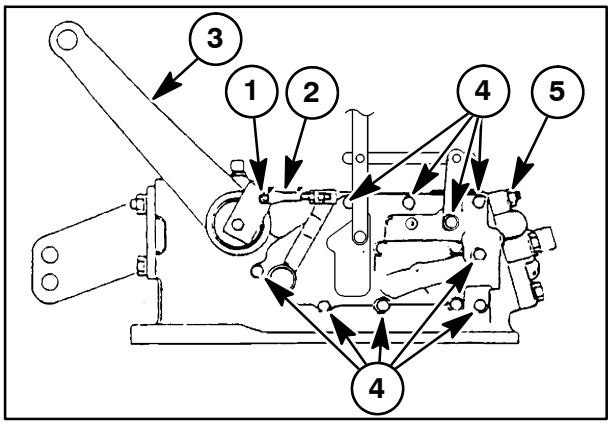
9. Using a suitable overhead hoist, remove the lift cover, 1, from the tractor.



26

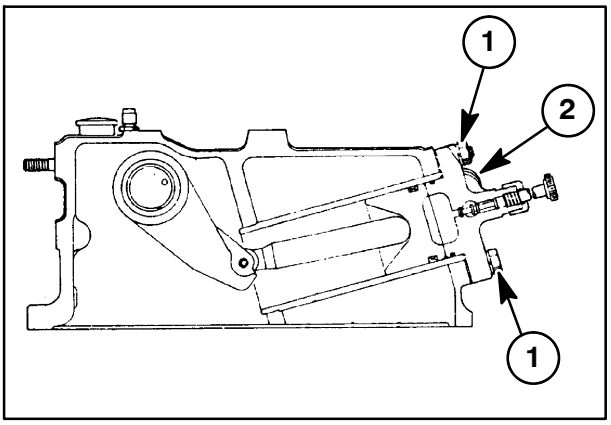
Disassembly

1. Remove the pin, 1, and remove the position control rod, 2, from the lift arm, 3.
2. Remove the lever grip.
3. Remove the cover bolts, 4, and remove the cover and valve as an assembly.



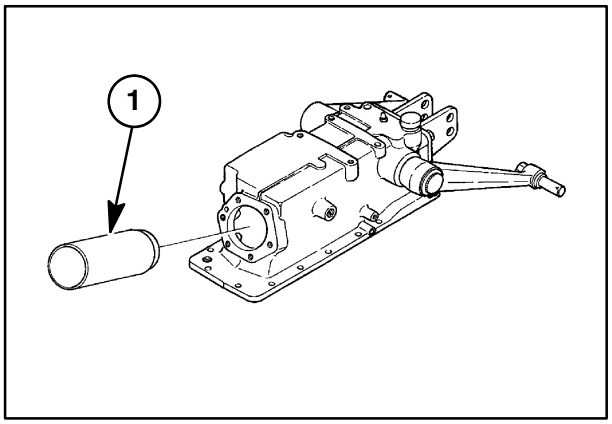
27

4. Remove the flow control valve-attaching bolts and nuts, 1, and remove the cover, 2, and valve as an assembly.



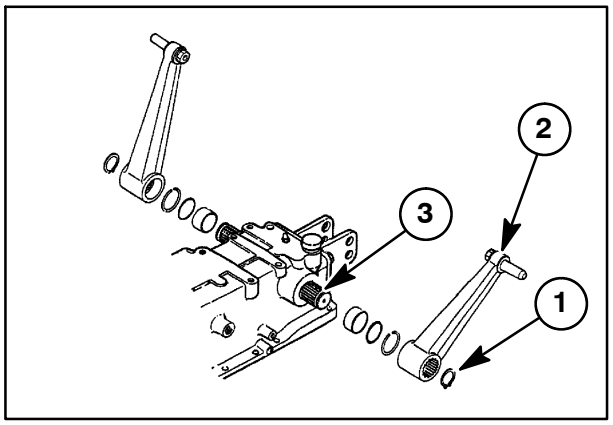
28

5. Remove the cylinder liner, 1, through the front of the cover assembly.
6. Using a wood dowel, push the piston out of the liner through the head end.



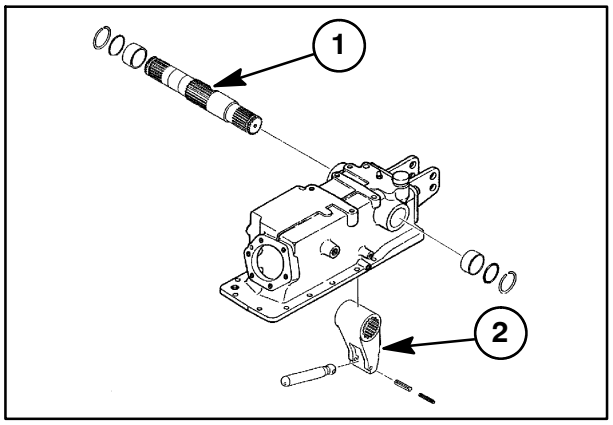
29

7. Remove the feedback link, from the cross shaft.
8. Remove the snap rings, 1, holding the lift arms, 2, on the cross shaft, 3, from each side.
9. Scribe a mark on the cross shaft, 3, and lift arm, 2, for assembly purposes, and remove the lift arms using a suitable puller.



30

10. Scribe a mark on the ram arm, 2, and cross shaft, 1, for assembly purposes.
11. Slide the ram arm back on the shaft, 1, while pulling the cross shaft out the left side of the housing.



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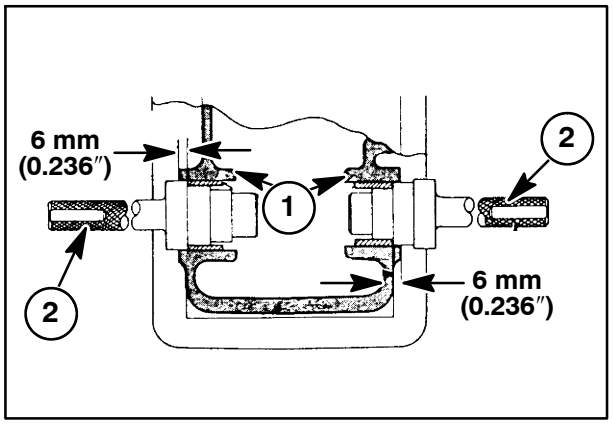
Inspection and Repair

1. Check the piston and cylinder for excessive wear or damage. Replace if necessary.
2. Check the cross shaft bushings, 1, for excessive wear or damage. Replace the bushings if necessary using a suitable driver, 2.

   NOTE: *Be sure to install the bushings to the correct depth as shown.*



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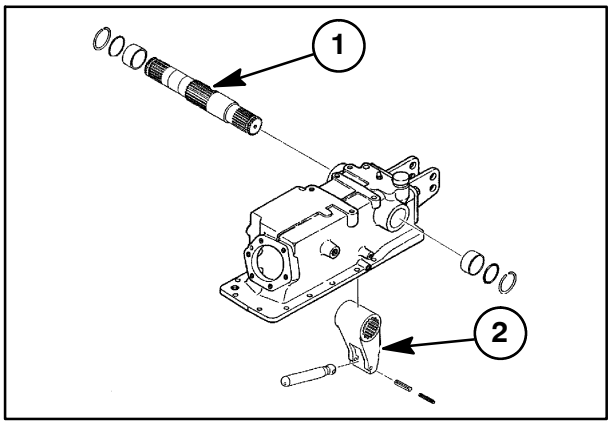
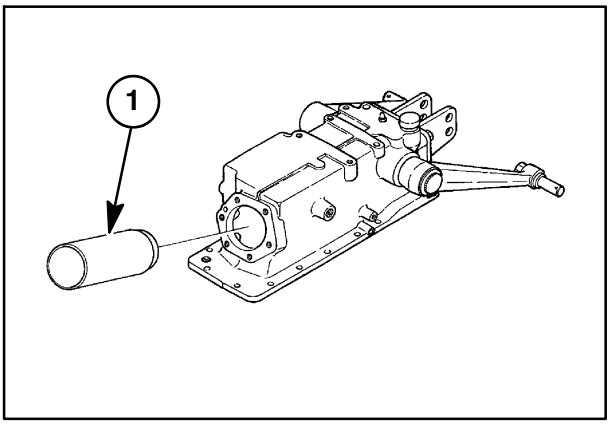
Assembly

1. Clean all parts in a suitable solvent and air dry.
2. Apply clean hydraulic fluid to all parts, including O rings and seals, during assembly.
3. Install the cross shaft, 1, in the cover while aligning the ram arm, 2, to the scribe marks made during disassembly.



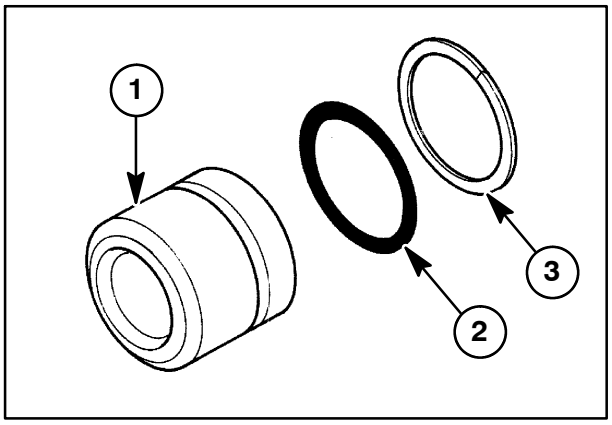
33

4. Install the cylinder liner, 1, in the lift cover housing. Be sure to position the piston rod inside the liner during installation.



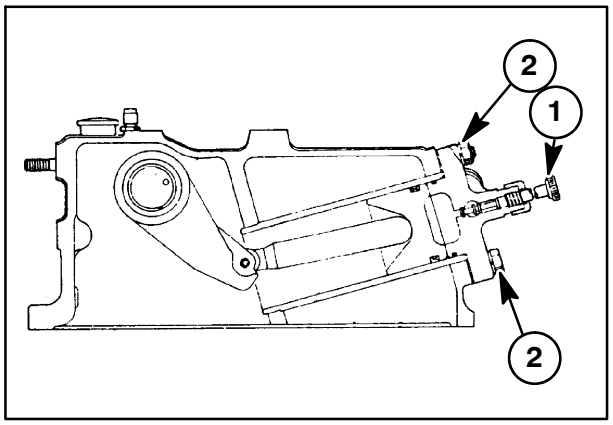
34

5. Install the O ring, 2, and backup ring, 3, on the piston, 1, and carefully install the piston in the cylinder.



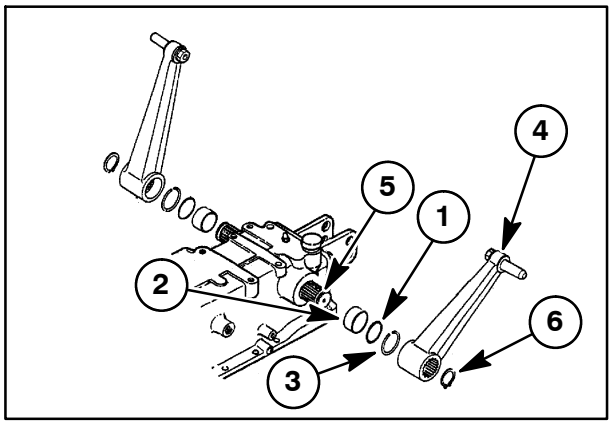
35

6. Using a new O ring and gasket, install the flow control valve assembly, 1, and tighten the nuts and bolts, 2, to 65.7 - 83.4 N·m (48.5 - 61.5 ft. lbs.).



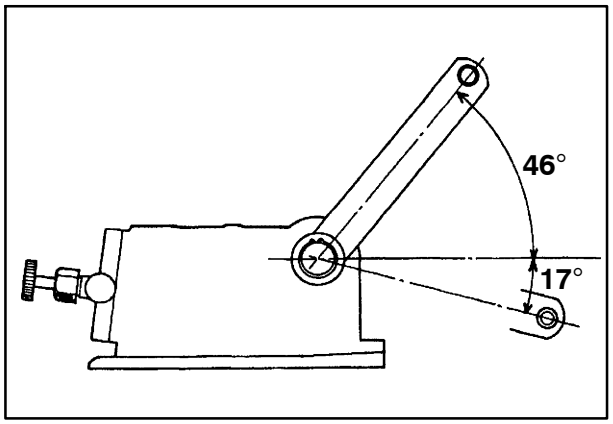
36

7. Using a new O ring, 1, install the bushings, 2, spring washers, 3, and lift arms, 4, on each side of the cross shaft, 5. Secure in place with snap rings, 6.



37

NOTE: *Be sure to align the reference marks scribed at time of disassembly. If no scribe marks are present, install the lift arms positioned as shown.*



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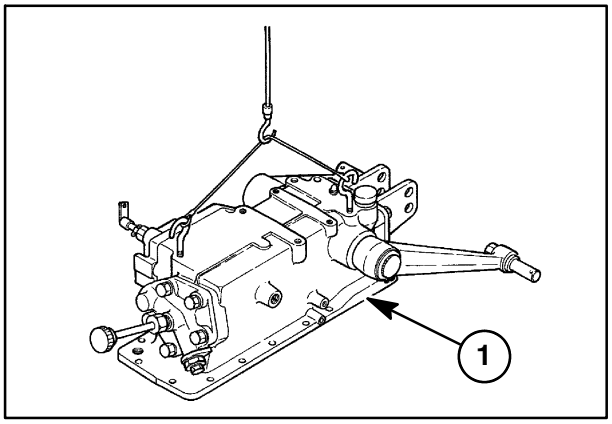
8. Install the lift cover assembly, 1, on the tractor and tighten the bolts to the specified torque. See "Torque Specifications," discussed later in this section.
9. Install the top link bracket assembly, control linkage and hydraulic line following the removal procedures.

   NOTE: *Observe and follow the linkage and main spring adjustment procedures described later in this section.*
10. Install the fenders, seat, seat belt, and floor mat.



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FLOW CONTROL VALVE

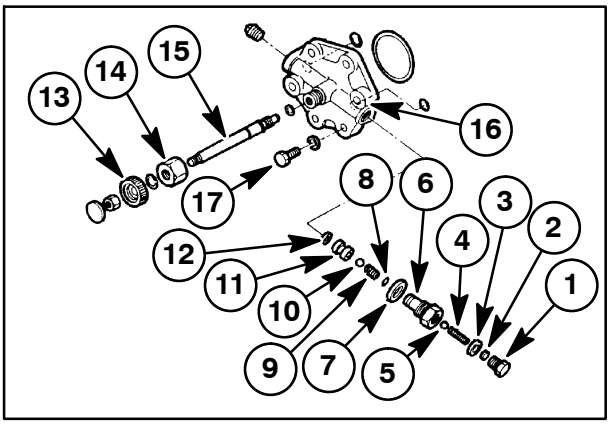
Removal

1. Remove the cylinder head-retaining bolts, and nut, 17.
2. Carefully remove the cylinder head assembly.

Disassembly

1. Remove the safety valve guide bolt, 1, and the shims, 3, sealing washer, 2, spring, 4, and ball, 5.

   NOTE: *Observe the quantity of shims, 2, used between the spring and guide bolt.*
2. Remove the check valve body, 6, seal, 7, O ring, 8, spring, 9, ball, 10, guide, 11, and gasket, 12.
3. Remove the flow control valve knob, 13, and nut, 14, and then screw the valve stem, 15, out of the body, 16.



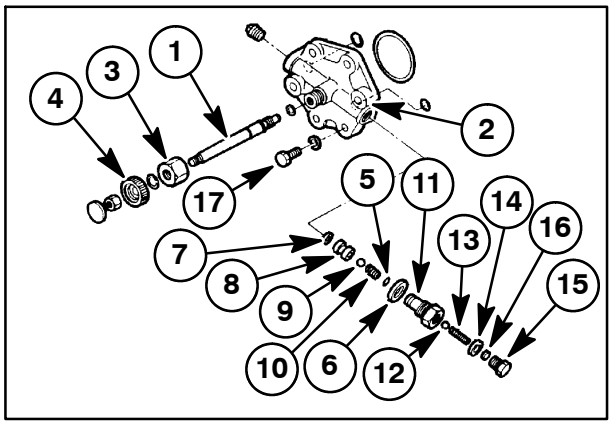
40

Inspection

1. Wash the components in a suitable solution and air dry.
2. Inspect the valve seat for excess wear or damage.
3. Inspect the flow control valve stem (seat) and the two balls for excess wear or damage.
4. Inspect the springs for excess wear or chipping.

Assembly

1. During assembly, apply clean hydraulic fluid to all components.
2. Screw the valve stem, 1, into the body, 2.
3. Install the nut, 3, and valve knob, 4, on the guide.
4. Using new O ring, 5, seal, 6, and gasket, 7, install the guide, 8, ball, 9, spring, 10, and check valve body, 11.
5. Install the ball, 12, spring, 13, sealing washer, 14, and valve guide bolt, 15, using the same amount of shims, 16, removed during disassembly.



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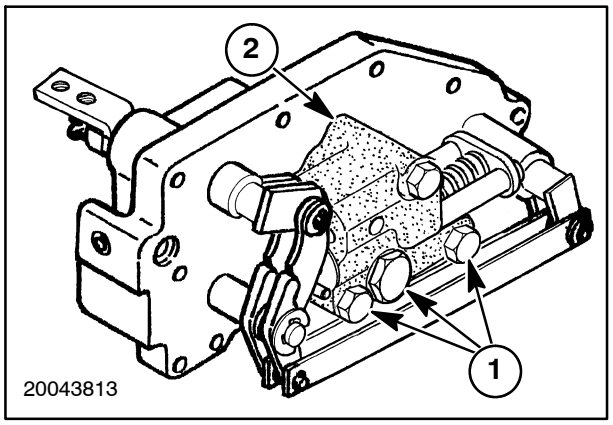
HYDRAULIC CONTROL VALVE

Removal

See “Lift Cover Assembly”, discussed earlier in this section.

Disassembly

1. Remove the valve to cover retaining bolts, 1, and remove the valve, 2, from the cover.



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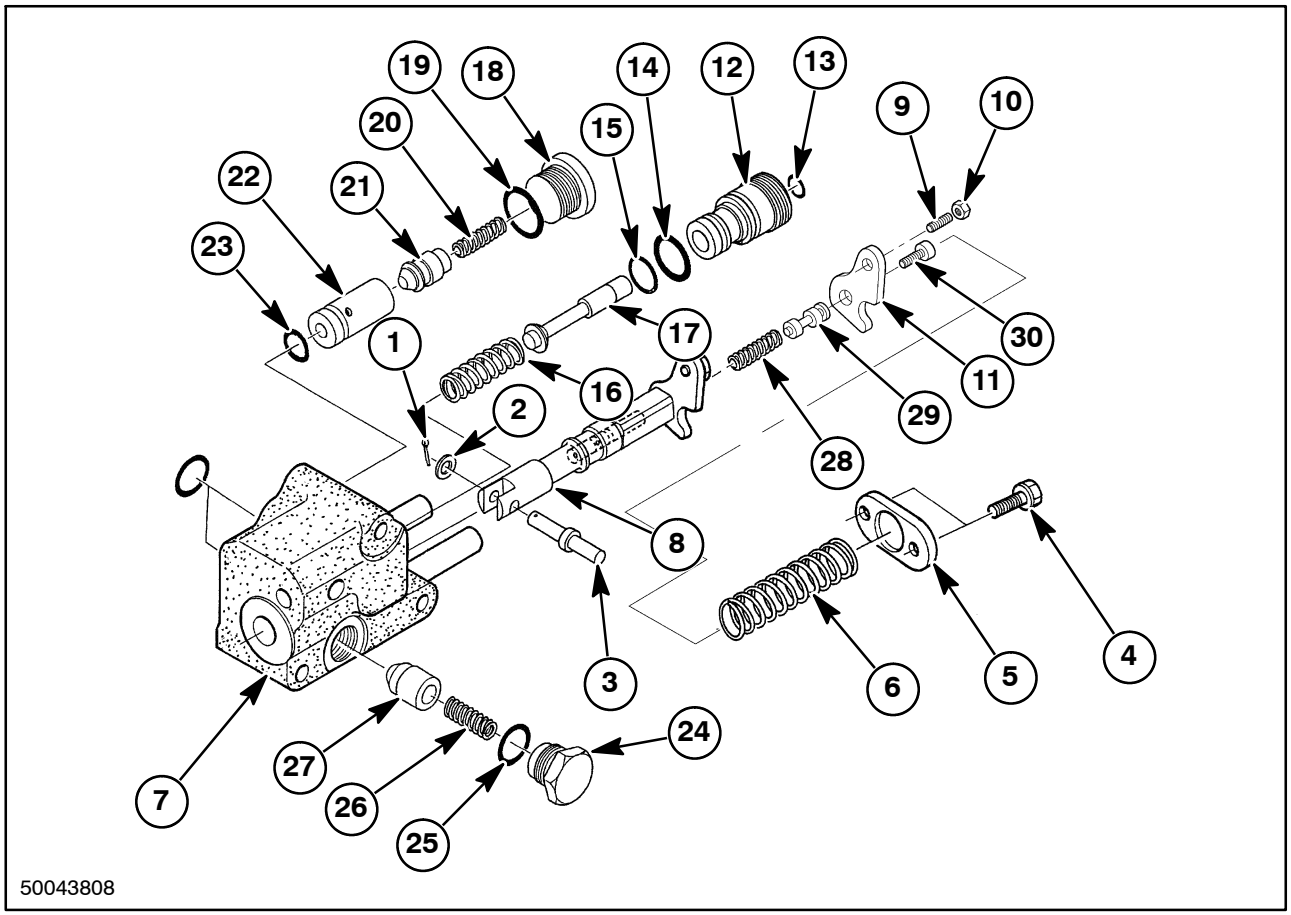
2. Remove the cotter pin, 1, washer, 2, and pin, 3, from the control valve spool.
3. Loosen the bolt, 4, and remove plate, 5, and spring, 6, from the control valve body, 7.
4. Remove the control valve spool, 8, from the valve body, 7.

NOTE: *Do not remove the adjusting screw, 9, nut, 10, or plate, 11, from the control valve spool, 8, unless required, as this will affect the valve adjustment settings.*

5. Using special tool # NH00357, remove the lowering valve seat, 12, O rings, 13, spring, 16, and lowering valve spool, 17, from the valve body.
6. Remove the check valve plug, 18, O ring, 19, spring, 20, check valve, 21, valve seat, 22, O ring, 23, from the valve body.
7. Remove the plug, 24, O ring, 25, spring, 26, and unload valve, 27, from the valve body.
8. If necessary, loosen bolt, 30, and remove plate, 11, bypass spool, 29, and spring, 28.

NOTE: *Bypass spool, 29, should slide freely inside spool, 8.*



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Inspection

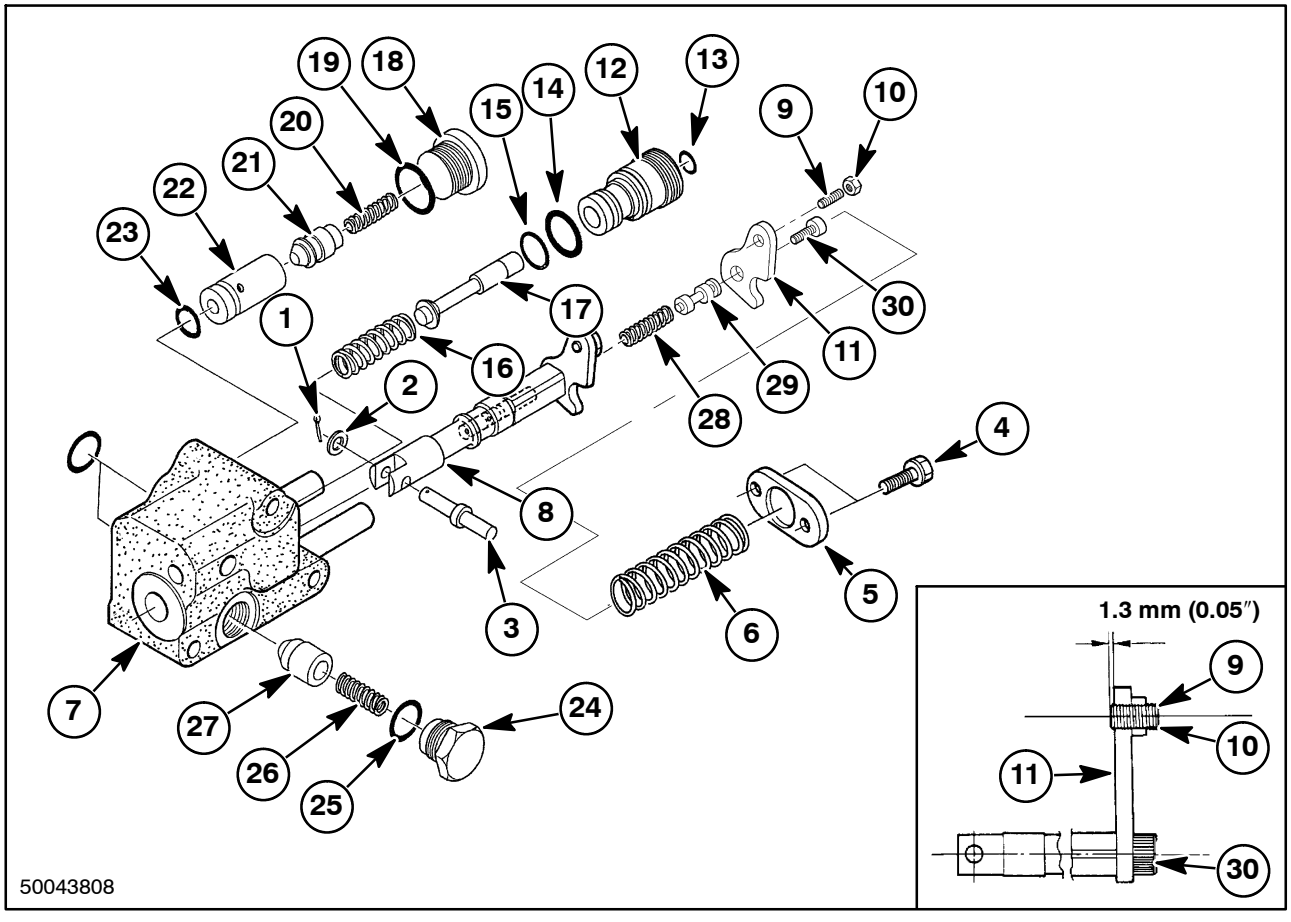
1. Clean all components in a suitable solvent and air dry.
2. Inspect the valve spool and bore for excessive wear, scratches, or other damage.

NOTE: *The control valve assembly and body must be replaced as a matched set.*

3. Inspect the check valve seat and bushing seat area for uneven wear or other damage. Replace the valve and bushing as a set, if required.
4. Inspect the unload valve and valve seat area for uneven wear or damage. Replace the valve and valve seat as a set, if required.
5. Inspect the shutoff valve and valve seat area for uneven wear or other damage. Replace the valve and valve seat as a set, if required.
6. Inspect all O-ring grooves for nicks or burrs.

Assembly

1. Apply clean hydraulic fluid to all components, including O rings and seals, during assembly.
2. Replace all O rings, gaskets, and seals using new parts.
3. Install the unload valve, 27, spring, 26, and plug, 24, with O ring, 25, in the valve body. Torque the plug to 98 - 117.6 N·m (72.88 - 86.8 ft. lbs.).
4. Install seat, 22, with O ring, 23, check valve, 21, spring, 20, and plug, 18, with O ring, 19, in the valve body. Torque the plug to 58 - 58.8 N·m (43.4 - 50 ft. lbs.).
5. Install the spring, 16, lowering valve spool, 17, lowering valve seat, 12, with O ring, 13, in the valve body. Torque the lower ring valve seat to 79 N·m (21.7 ft. lbs.).
6. If removed, assemble the bolt, 30, plate, 11, bypass spool, 29, spring, 28, nut, 10, and screw, 9, as follows.
   - Remove the oil from the threads of the bolt, 30, and valve spool, 8, and apply thread sealant to them.
   - Insert the spring, 28, and bypass spool, 29, into the valve spool, 8.
   - Install the plate, 11, in position with center pin, torque bolt, 30, to 10 - 15 N·m (7.4 - 11 ft. lbs.).
   - Install bolt, 9, until it projects 1.3 mm (0.05") from the plate. Install nut, 10, onto bolt, 9, tighten and torque to 18 - 22 N·m (13-16 ft. lbs.).
7. Install the control valve spool, 8, into the valve body, 7.
8. Install the spring, 6, plate, 5, and secure with bolts, 4. Torque bolts to 7-10 N·m (5-7.3 ft. lbs.).
9. Install the pin, 3, through the control valve spool, 8, secure with cotter pin, 1, and washer, 2.



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Installation

1. Using new O rings, install the control valve to the cover.
2. Install the handles to the cover.
3. Position the control valve and cover assembly with a new gasket on the lift cover assembly and install the attaching bolts. Tighten the attaching bolts to the specified torque. See “Specifications,” discussed later in this section.
4. Install the guides and handle grips.
5. Install the position control link and adjust as described later in this section.

COMBINATION SYSTEM RELIEF VALVE AND DIVERTER VALVE ASSEMBLY

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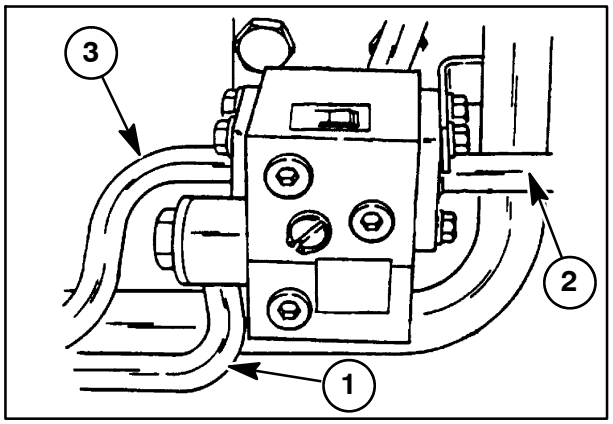
Removal

1. Disconnect the relief valve to sump return line, 1, at the valve body fitting.
2. Remove the pump pressure line, 2, and the pressure line to the control valve, 3, at the valve body fitting.
3. Remove the valve retaining bolt and remove the valve assembly. Cap and plug all openings.



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Disassembly

1. Remove the relief valve plug, 12, with O ring, 11.

   NOTE: *Make a note of the quantity of shims, 10, used between the spring, 9, and plug, 12. Retain the shims for use during assembly.*

   NOTE: *One shim, 0.2 mm (0.0008″) thickness will change the pressure setting approximately 7.0 bar (100 psi).*

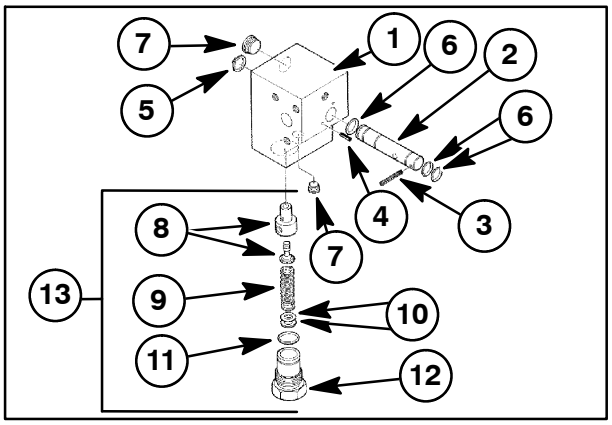
2. Remove the spring, 9, and relief valve and seat assembly, 8.
3. Remove the roll pin, 3, from the diverter valve spool, 2, and withdraw the spool from the manifold body.

Inspection

1. Inspect the relief valve seat and guide for excess wear or score marks.
2. Inspect the spring for wear or damage.
3. Inspect the diverter valve spool and valve body for excess wear or score marks.
4. Replace the manifold as an assembly if found to be damaged.

Assembly

1. Using new O rings, 6, install the diverter valve spool, 2, in the manifold body and install roll pin, 3.
2. Install the relief valve and seat assembly, 8, and spring, 9, in the valve body.
3. Install the shims, 10, removed during disassembly and install the plug, 12, with O ring, 11, in the valve body.



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1. Valve Body
2. Diverter Valve Spool
3. Roll Pin
4. Roll Pin
5. Snap Ring
6. O rings
7. Plug
8. Housing and Poppet
9. Spring
10. Shim
11. O ring
12. Cap Plug
13. System Relief Valve Assembly

ADJUSTMENTS

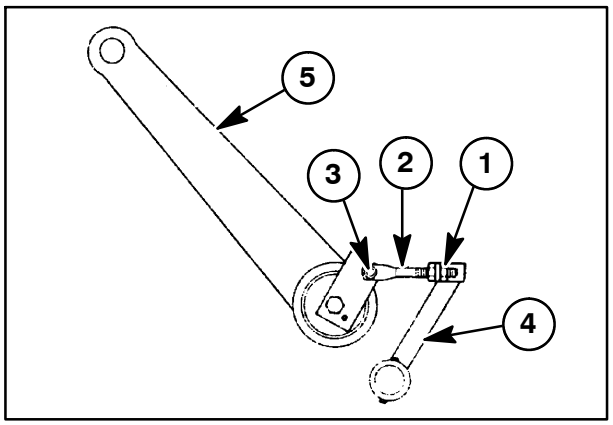
Op. 35 124

HPL LINKAGE ADJUSTMENTS

The length of the position control rod is critical and careful adjustment must be observed for proper operation. If the control rod is adjusted too short, the control valve spool will remain in the raised position when the lift arms have reached their maximum height and the system relief valve will blow. If the control rod is too long, the control valve spool will return to neutral before the lift arms reach their full height. The position control rod should be adjusted any time the link is disconnected for service to the hydraulic system, or any time the relief valve operation is noticed while the lift arms are at the full raise position.

ADJUSTMENT PROCEDURE

1. Loosen the locknut, 1, on the position control rod, 2, and remove the pin, 3, from the link.
2. Set the control lever, 4, to the highest position, but not in the notch of the upper stop.
3. Start the engine. The lift arms, 5, should raise and the relief valve should operate.
4. Move the control lever down until the relief valve ceases operation.
5. Adjust the length of the position control rod and clevis to align the pin holes. Then lengthen the rod one additional turn and install the pin. Tighten the locknut.
6. Check the operation. The relief valve should not operate when the lift arms are in the fully raised position.



47

CONTROL LEVER

Adjustment

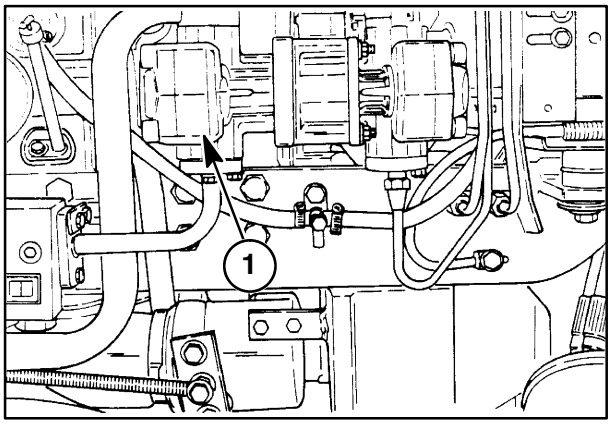
The control lever, 1, should not move from vibration. If adjustment is required, remove the cotter pin, 2, and adjust the nut, 3, to obtain 2.5 - 3.5 kg (5.5 - 7.7 lbs) of pull at the lever knob.

DESCRIPTION OF OPERATION - HYDRAULIC PUMP AND FILTER

Op. 35 304

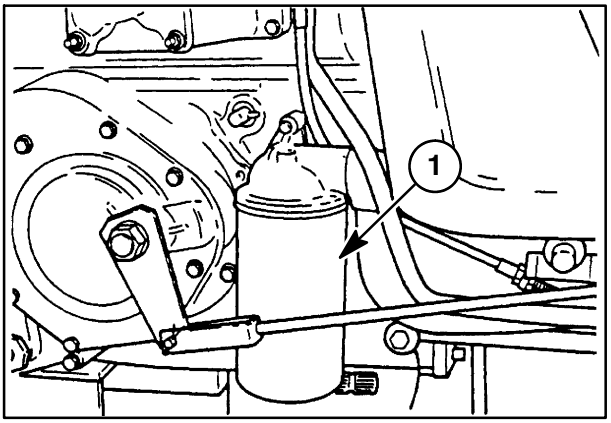
The hydraulic pump, 1, is mounted on the right side of the engine and is driven by the engine oil pump gear mounted on the front of the engine block.

The hydraulic pump is a gear-type pump and, with the exception of replacing the seals, is not serviceable.



48

A suction-type filter, 1, is located in the inlet line on the right-hand side of the rear axle center housing. The filter is serviced by replacing the complete canister assembly. The filter should be replaced after 300 hours of use.

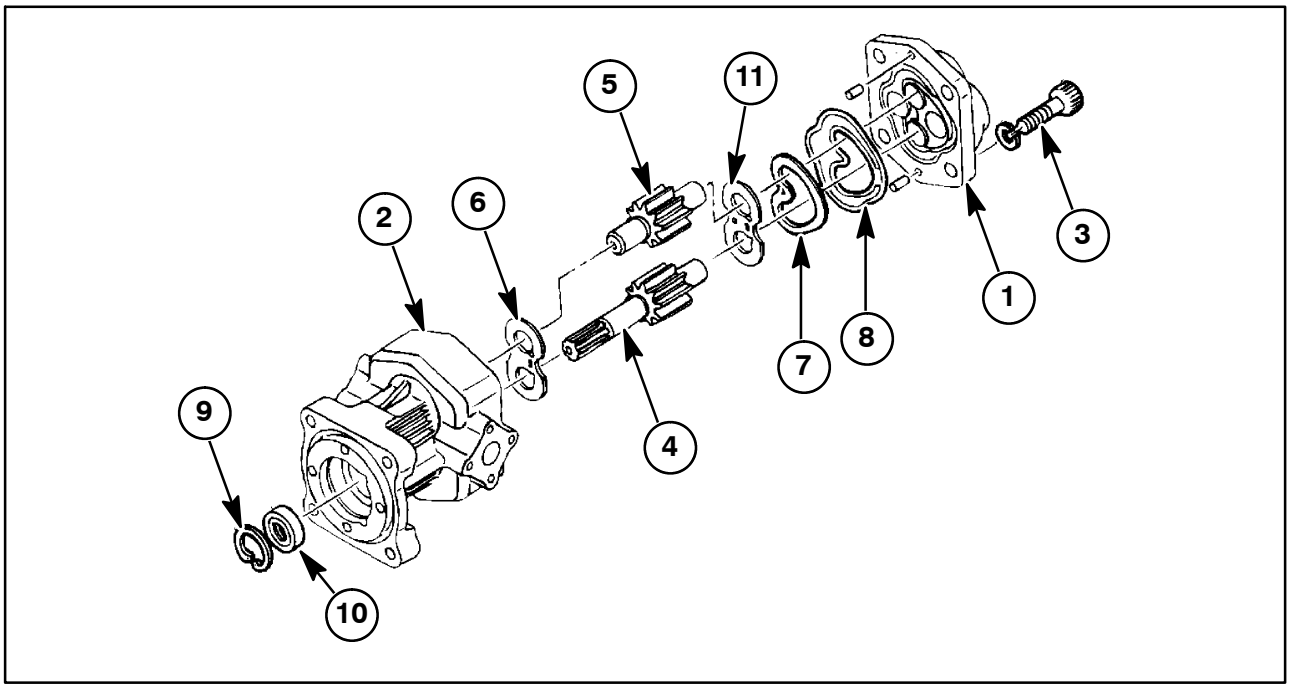


49

HYDRAULIC PUMP

The only parts serviced on the hydraulic pump are the shaft seal and internal O rings. If troubleshooting indicates a faulty pump, replace the pump with a new assembly.

Pump Flow	LPM (GPM)
TC30	23.3 (6.2)



50

Disassembly

1. Place the pump in a soft-jawed vise with the drive shaft, 4, facing downward.
2. Scribe a line on the pump cover, 1, and pump body, 2, for ease in assembly.
3. Remove the four bolts, 3, securing the cover and remove the cover.
4. Push outward on the drive shaft, 4, and remove the outer wear plate, 11.
5. Remove the drive shaft, 4, and driven gear, 5, from the housing.
6. Using a brass hook, or dental pick, remove the inner wear plate, 6, backup ring, 7, and seal ring, 8.

   NOTE: *The inner, 6, and outer, 11, wear plates are not the same. Be sure during assembly that the wear plates are assembled correctly.*
7. Remove the pump body from the vise. Remove the snap ring, 9, and shaft seal, 10, from the pump body.

Inspection and repair

1. Wash all parts in clean solvent and air dry.
2. Discard all O rings and seals.
3. Inspect the parts for wear or damage, and if necessary, replace the pump.

Assembly

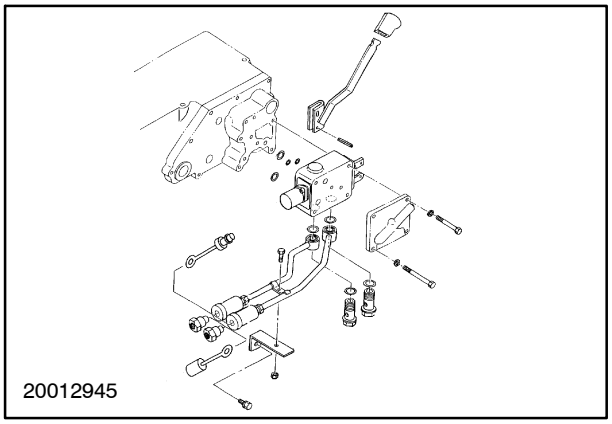
1. Lubricate all parts during assembly with clean hydraulic fluid.
2. Place the pump body in a soft-jawed vise.
3. Install the inner wear plate, 6.

   NOTE: *The inner, 6, and outer, 11, wear plates are not the same. The rectangular slots in the wear plates should be installed to the pump pressure side, and the wear plate with two openings is installed on the cover side of the gears.*
4. Install the drive shaft, 4, and driven gear, 5, in the housing.
5. Install the outer wear plate, 11.
6. Install seal, 8, and backup ring, 7, in the groove in the pump cover, 1.
7. Install the pump cover, 1, to the body, 2. Align the scribe line made during disassembly, and secure with the four retaining bolts, 3. Torque the bolts to 22 - 28 N·m (16 - 20 ft. lbs.).
8. Remove the pump from the vise. Install the shaft seal, 10, and snap ring, 9.

DESCRIPTION OF OPERATION - REMOTE VALVES

Op. 35 204
Single-spool (rear) and double-spool (front) remote control valves are available as dealer accessories.

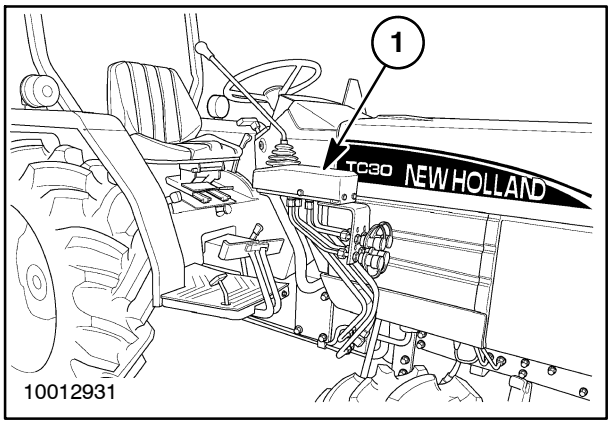
The single-spool remote control valve is mounted on the outside of the main control valve cover plate on the right-hand side of the hydraulic lift cover. This option is available.



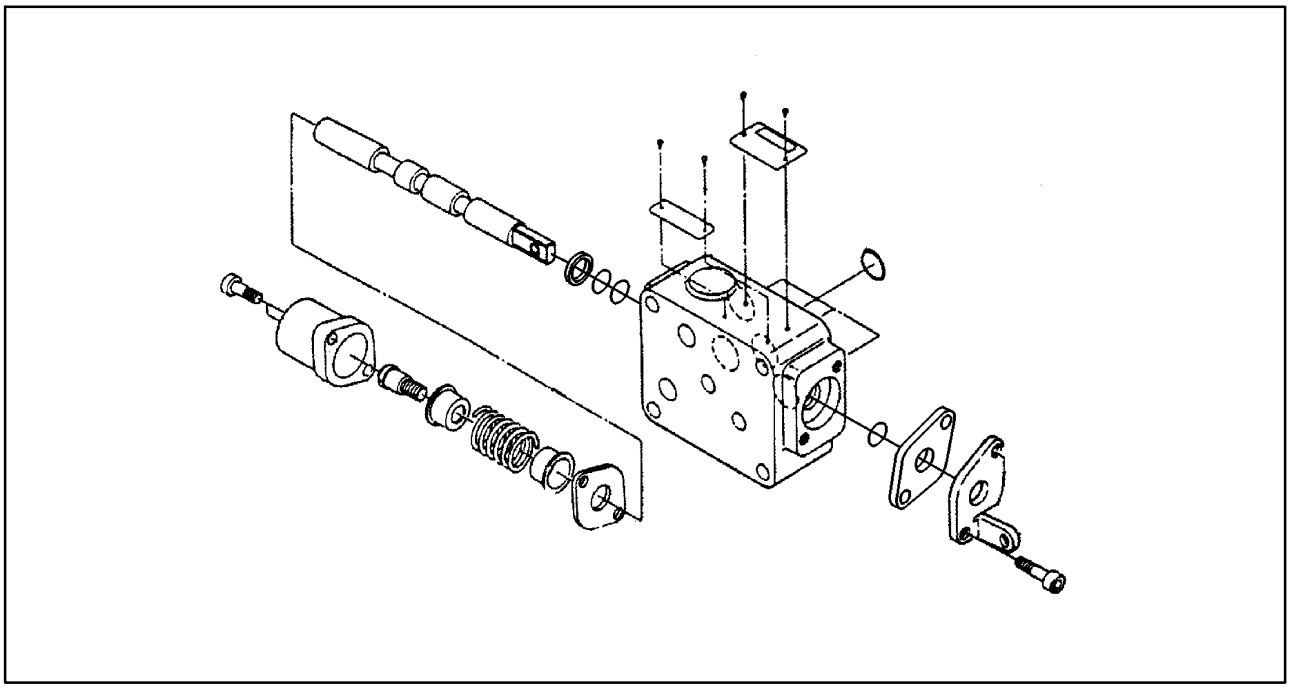
51

The double-spool remote control valve, 1, is mounted on the right fender.

Both the single- (rear) and double- (front) spool remote control valves utilize the double-acting control spool as shown in Figures 53 and 54.



52



53

REAR (SINGLE-SPOOL) REMOTE VALVE

The rear remote valves are equipped with self-centering springs so that the spools automatically return to neutral when the control handle is released following a raise or lowering operation.

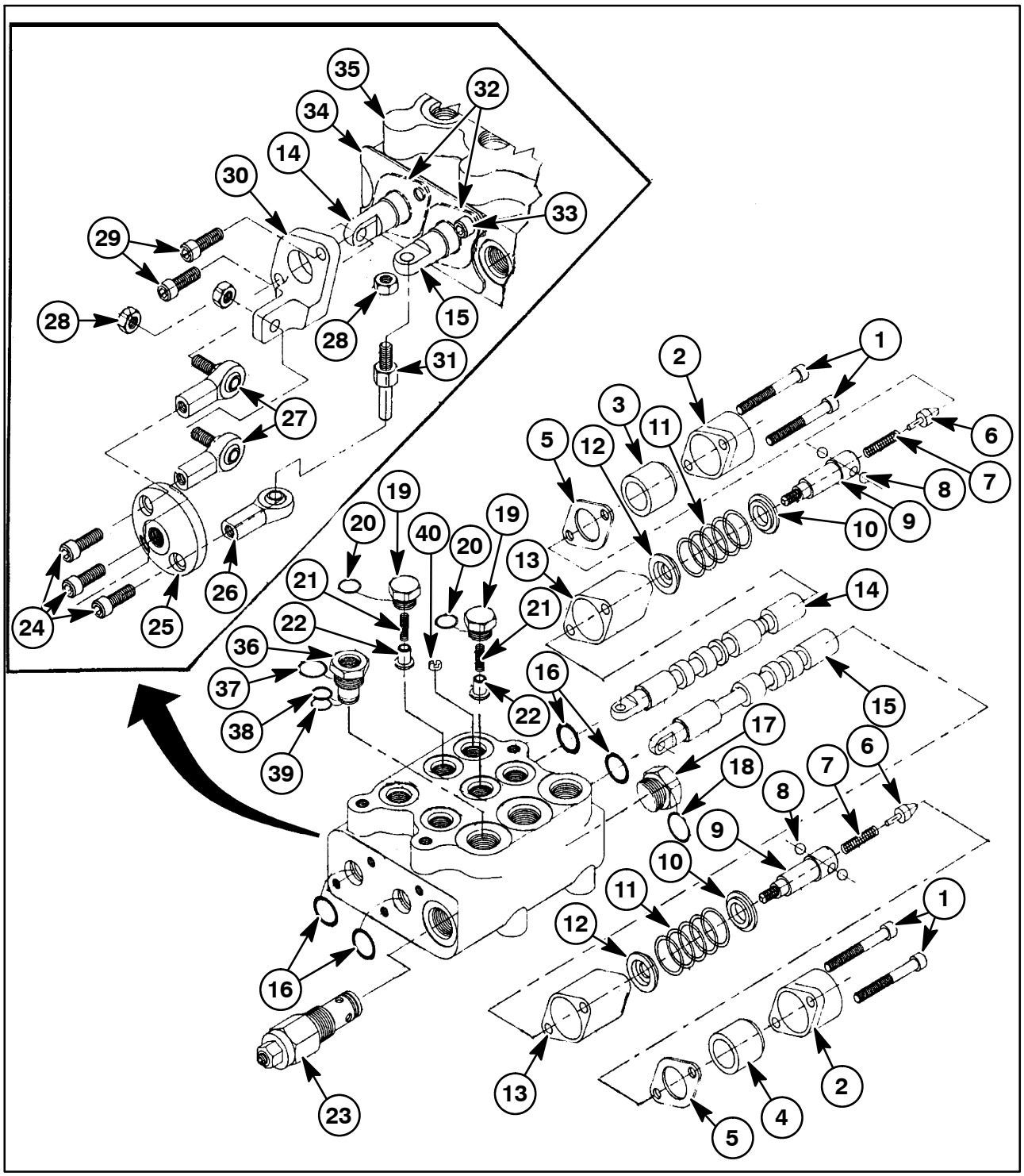
Op. 35 184

FRONT (DOUBLE-SPOOL) REMOTE VALVE (Figure 54)

The double-spool remote valve also contains a spring-loaded detent mechanism to provide a float position for loader operation. In float position, fluid is free to flow between piston and rod sides of the loader lift cylinder allowing the lift arms to float over uneven terrain.

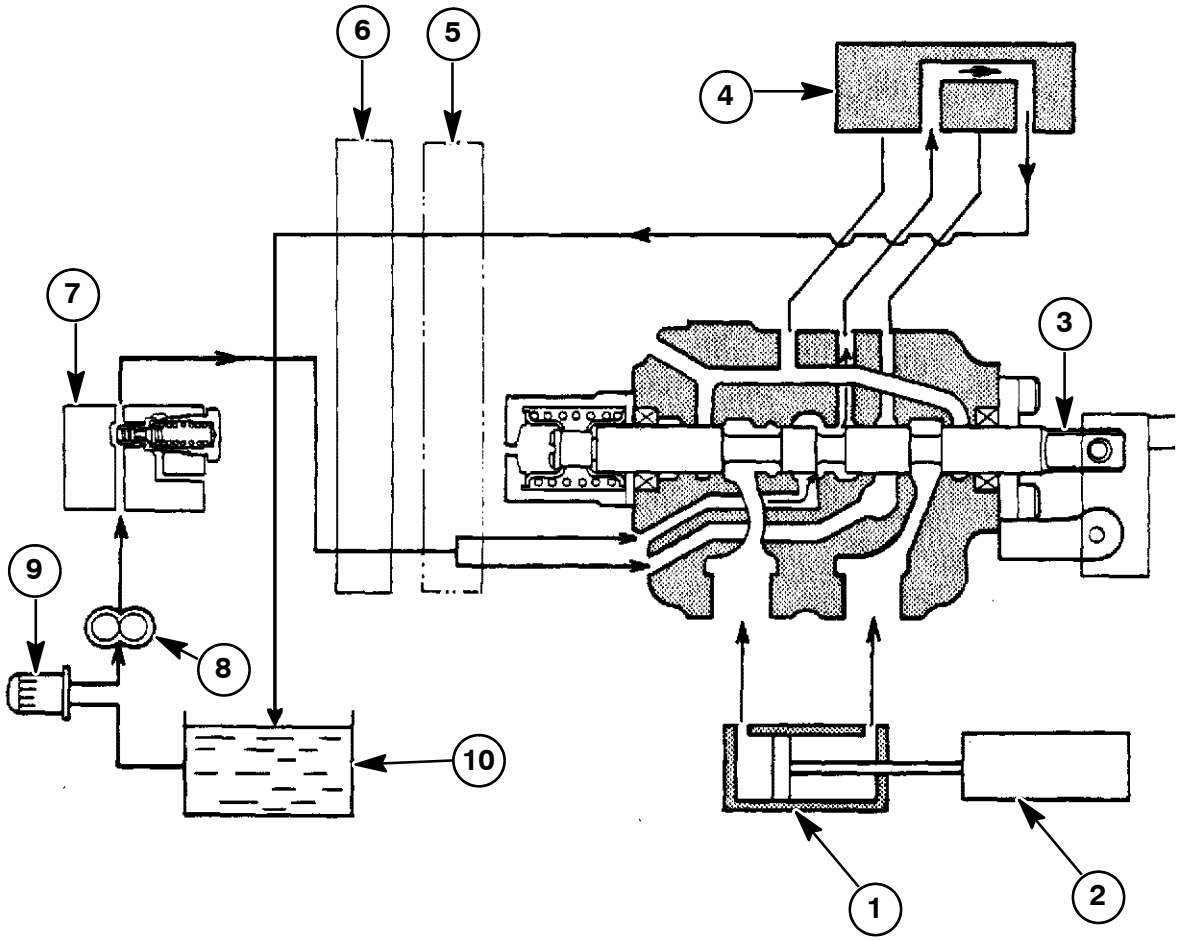
The double-spool remote control valve contains check valves located in the valve spool passages. The check valves function to hold the loader lift and bucket cylinders in a fixed position while the valve is being initially operated to prevent dropping the load. In operation, the check valve is retained on its seat by spring force plus the back side pressure of fluid contained in the loader cylinder. During initial spool movement, pump-pressurized fluid fills the passage to the check valve, and the remaining pump fluid flows to the sump through the open center passage. With continued spool movement, the open center passage closes. Pump pressure increases on the force of the check valve, overcoming the backside pressure, and causes the check valve to open. Pump fluid flow then flows to the cylinder. This action prevents any backflow out of the cylinder and provides a smooth-lifting action of the loader.

NOTE: *Separate installation instructions are provided for the different remote valve kits.*



54

1. Cap Screws
2. End Cap
3. Float Detent Sleeve
4. Float Detent Sleeve
5. Retainer
6. Poppet
7. Detent Spring
8. Detent Balls
9. Detent Retainer
10. Washer
11. Spring
12. Stop Cup
13. Spacer
14. Float Spool
15. REGEN Spool
16. O ring
17. Plug
18. O ring
19. Check Plug
20. O ring
21. Spring
22. Load Check Poppet
23. Relief Valve Assembly
24. Cap Screw
25. Flange
26. Rod End
27. Rod End Assemblies
28. Nuts
29. Cap Screw
30. Clevis
31. Spool Stud
32. Retaining Plate
33. Cap Screws
34. Mounting Plate
35. Valve Body
36. Power Beyond Outlet Connector
37. O ring
38. Backup Washer
39. O ring
40. Orifice - 2.75 mm (0.108″) hole



FLUID FLOW NEUTRAL POSITION

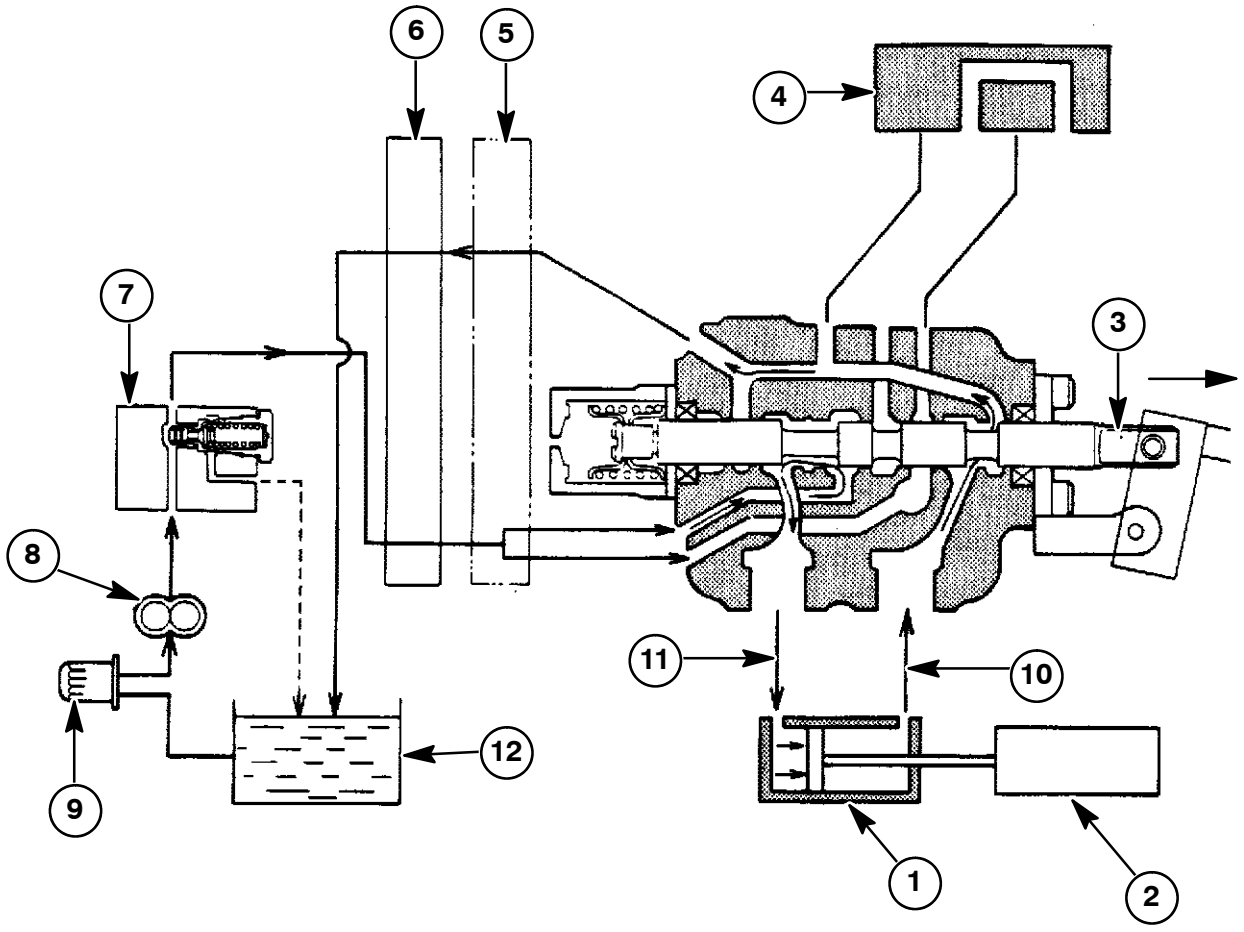
55

1. Remote Cylinder
2. Implement Load
3. Remote Valve Spool
4. Lift Cover End Cap
5. Lift Cover Assembly
6. HPL Control Valve
7. Relief/Diverter Block Manifold
8. Pump
9. Filter
10. Reservoir

FLUID FLOW - NEUTRAL POSITION - REAR (SINGLE-SPOOL) REMOTE SYSTEM

With the control valve in the neutral position, fluid flows from the pump, 8, past the system relief valve, 7, through the main control valve, 6, and lift valve cover, 5, and into the remote control valve. In the neutral position, the remote valve spool, 3, directs the pump fluid flow back through the three-point hydraulic system to the sump.

Fluid contained in the remote cylinder, 1, is blocked by the control valve spool, 3, and the implement, 2, is held in a fixed position.



FLUID FLOW - REMOTE CYLINDER EXTENDING

56

1. Remote Cylinder
2. Implement Load
3. Remote Valve Spool
4. Lift Cover End Cap
5. Lift Cover Assembly
6. HPL Control Valve
7. Relief/Diverter Block Manifold
8. Pump
9. Filter
10. Return Passage
11. Supply Passage
12. Reservoir

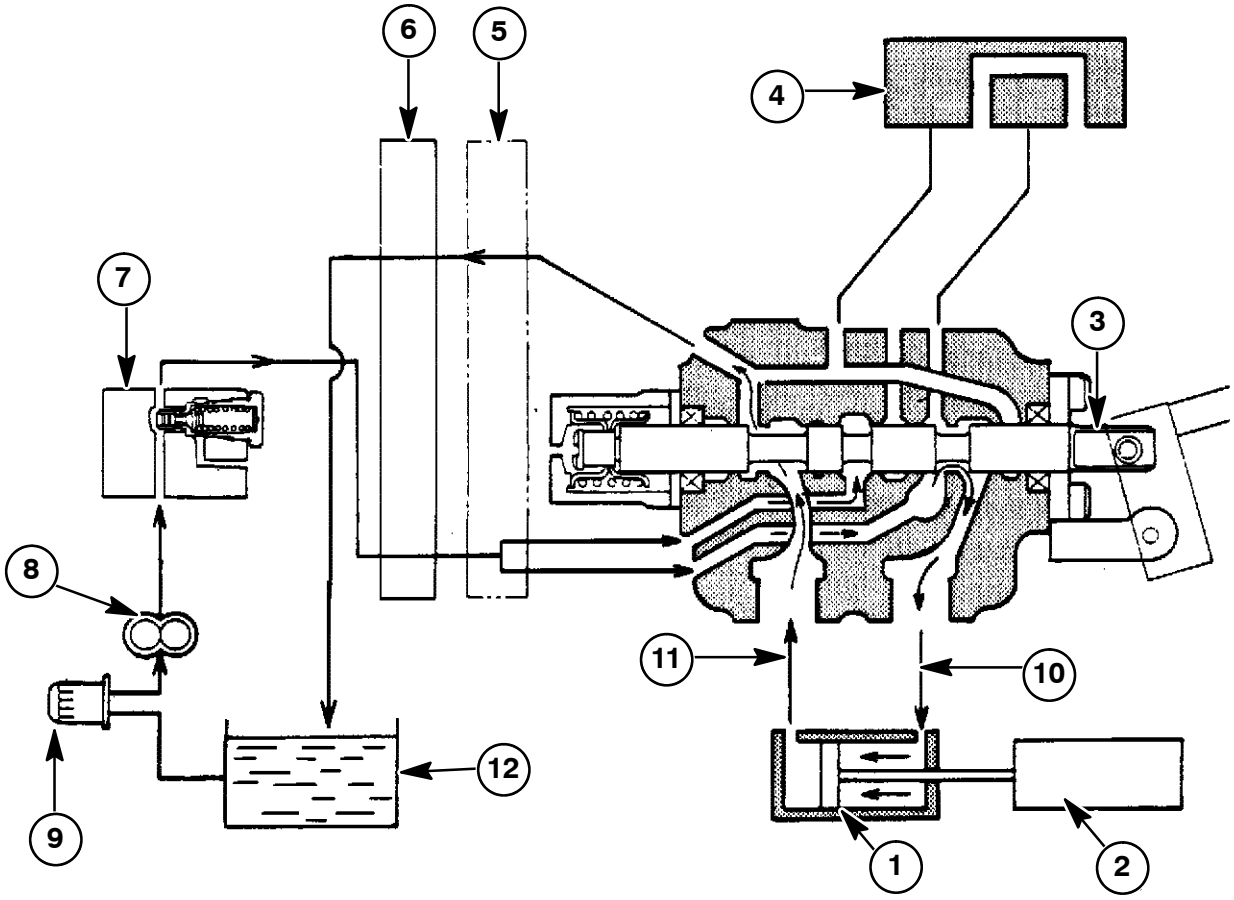
FLUID FLOW - REMOTE CYLINDER EXTENDING - REAR (SINGLE-SPOOL) REMOTE SYSTEM

When the remote control valve lever is pushed forward, the valve spool is moved outward to extend the cylinder.

Fluid flows from the pump, 8, past the system relief valve, 7, through the main control valve, 6, and lift valve cover, 5, to the remote control valve. The control valve spool, 3, now directs the fluid flow through passage, 11, to the piston side of the remote cylinder, 1, and extends the cylinder. Fluid in the rod side of the cylinder returns to the sump through the return passage, 10.

Fluid flow to the three-point hydraulic system is blocked by the spool during this operation.

If the fluid pressure exceeds 147 ± 5 bar (2130 ± 70 psi), the main relief valve, 7, opens, and the fluid returns to the sump.



FLUID FLOW - REMOTE CYLINDER RETRACTING

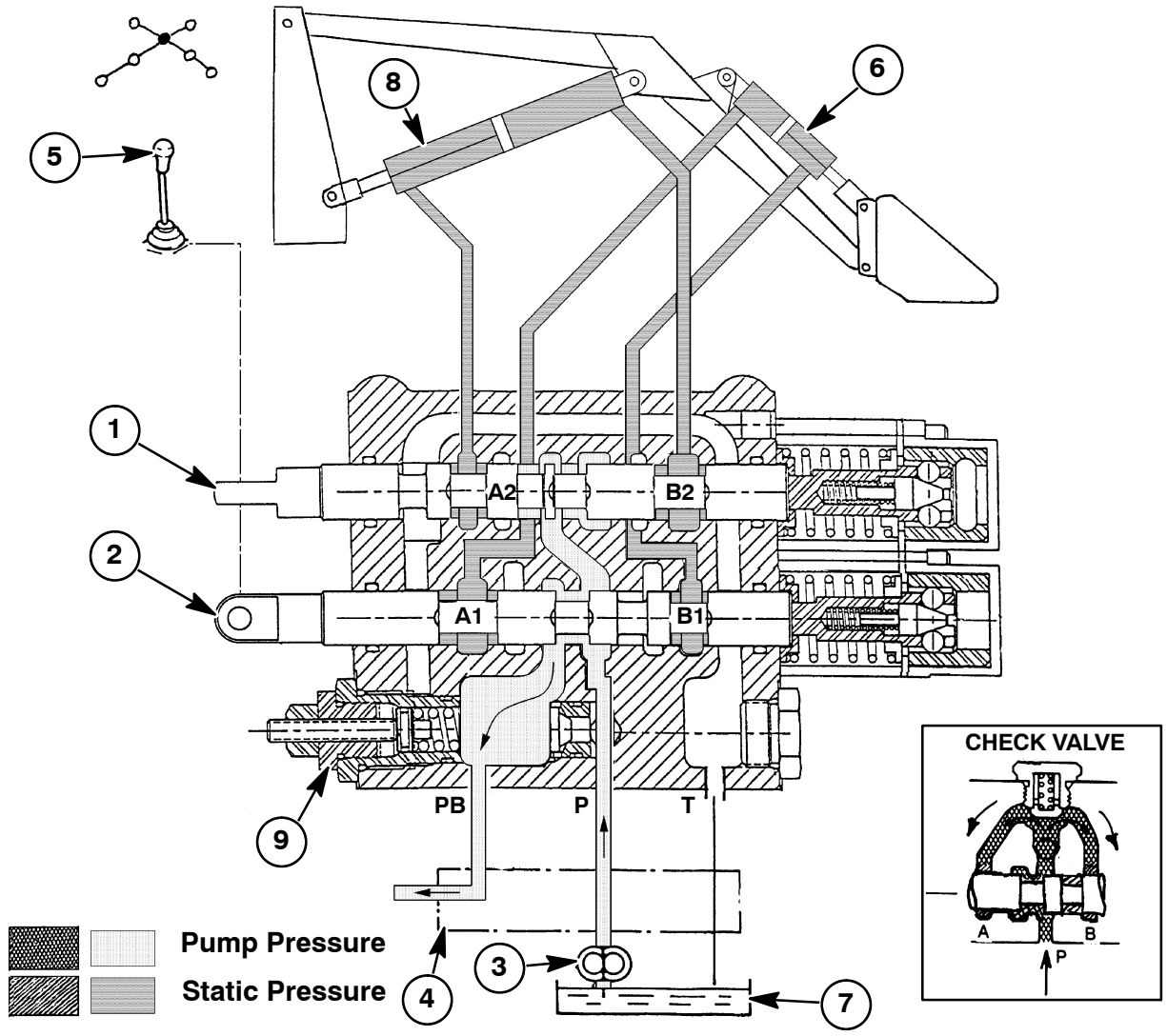
57

1. Remote Cylinder
2. Implement Load
3. Remote Valve Spool
4. Lift Cover End Cap
5. Lift Cover Assembly
6. HPL Control Valve
7. Relief/Diverter Block Manifold
8. Pump
9. Filter
10. Return Passage
11. Supply Passage
12. Reservoir

FLUID FLOW - REMOTE CYLINDER RETRACTING - REAR (SINGLE-SPOOL) REMOTE SYSTEM

When the remote control valve lever is pulled rearward, the control valve spool, 3, is moved inward to retract the remote cylinder, 1. Fluid then flows from the pump, 8, past the system relief valve, 7, through the main control valve, 6, and lift valve cover, 5, to the remote control valve. The control valve spool, 3, now directs the fluid flow through passage, 10, to the rod side of the remote cylinder, 1, and retracts the cylinder. Fluid in the piston side of the cylinder returns to the sump through passage, 11, and internal passages in the remote and main control valve and permits the cylinder to retract.

Whenever the remote cylinder pressure exceeds 147 ± 5 bar (2130 ± 70 psi), the main relief valve opens, and the fluid returns to the sump.



FLUID FLOW - BUCKET CONTROL - NEUTRAL AND LIFT CONTROL - NEUTRAL

58

FRONT (DOUBLE-SPOOL) REMOTE CONTROL SYSTEM

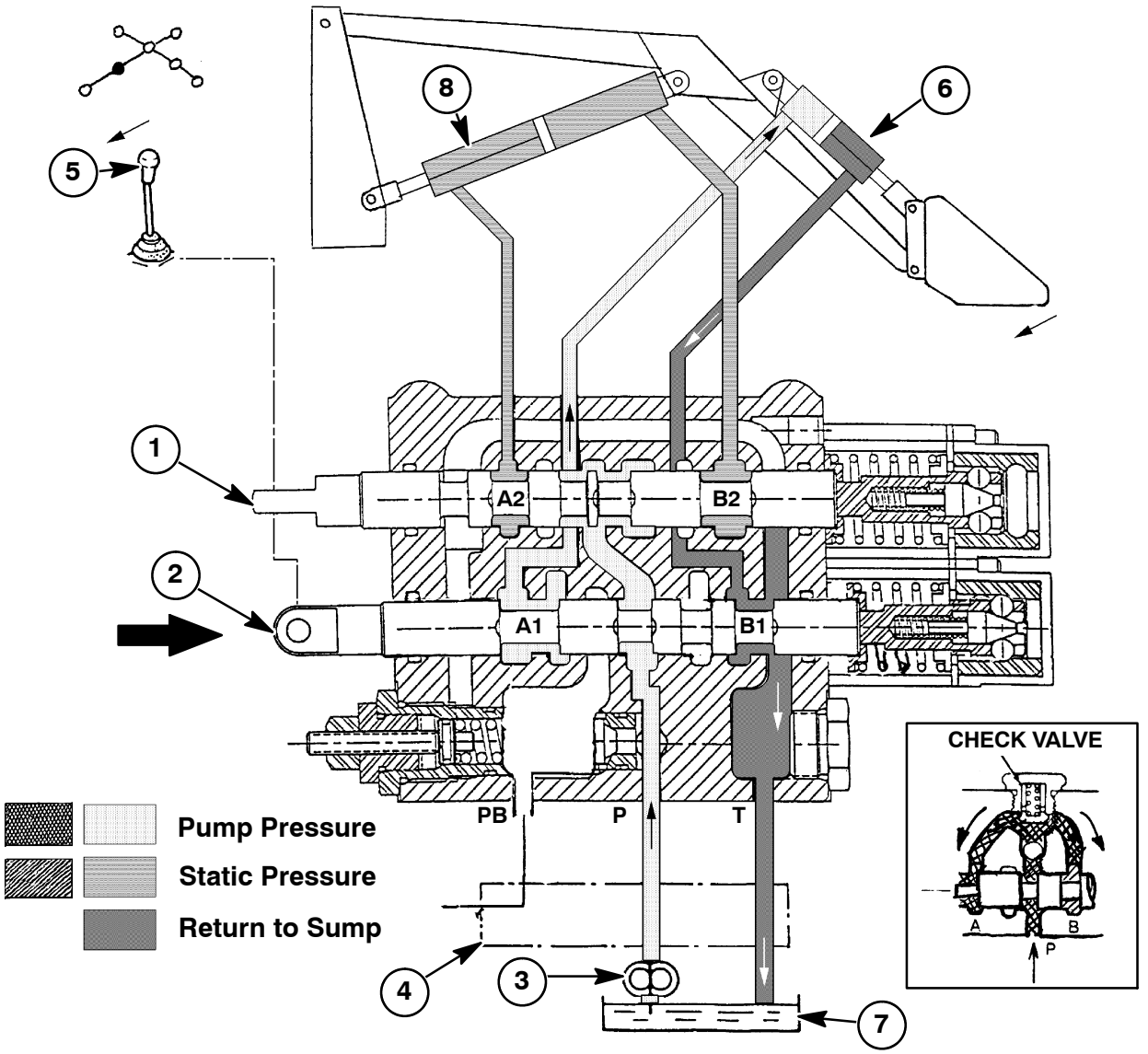
Fluid Flow - Bucket Control - Neutral and Lift Control - Neutral

In the neutral position, both spools, 1 and 2, are centered in the valve body. Fluid from the hydraulic pump, 3, is directed to the center of the two control valve spools. In this position, the spool lands block the passage to the loader cylinders. Fluid contained in the loader bucket, 6, and lift cylinders, 8, is trapped by the spool, and the cylinder remains in a fixed position.

Pump fluid pressure flows through the diverter valve manifold, 4, and enters the valve body at passage "P" to the open center passage of both spools.

Because all cylinder passages are blocked, the fluid flows out the power beyond "PB" port and through the main hydraulic system control valve. If the fluid is not used by the three-point hydraulic system, it is redirected back to the hydraulic system.

Remote relief valve, 9, opens when pressure exceeds 121 bar (1750 psi).

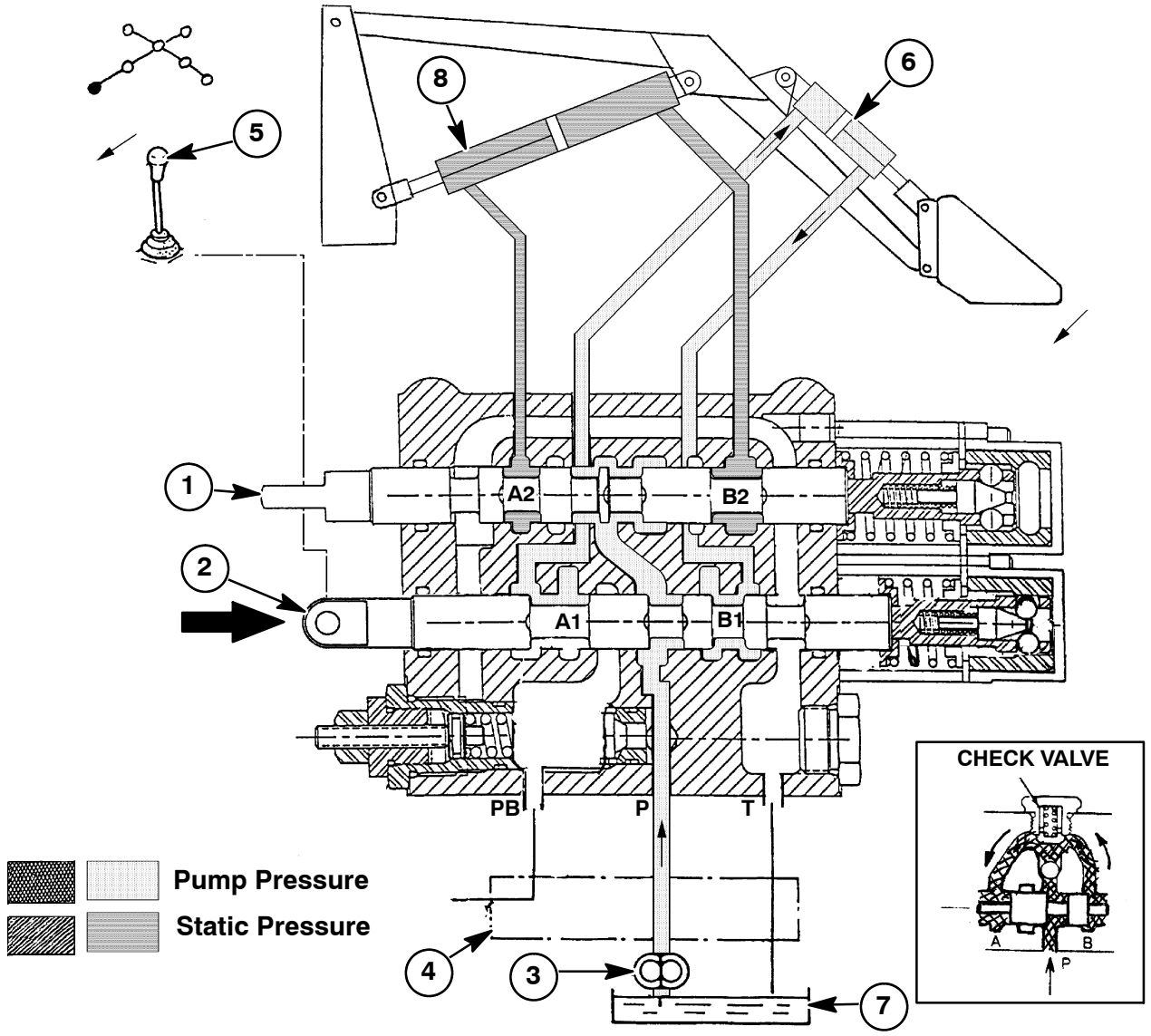


FLUID FLOW - BUCKET CONTROL - DUMPING AND LIFT CONTROL - NEUTRAL

59

FLUID FLOW - BUCKET CONTROL - DUMPING AND LIFT CONTROL - NEUTRAL

When the control lever, 5, is moved to the dumping position, the bucket control valve spool, 2, is moved inward. Fluid flow from the hydraulic pump, 3, is directed to the piston side of the bucket cylinder, 6. The fluid contained in the rod side of the bucket cylinder flows out of the cylinder through passage “B1” exiting the valve at port “T” and flows to the reservoir, 7.

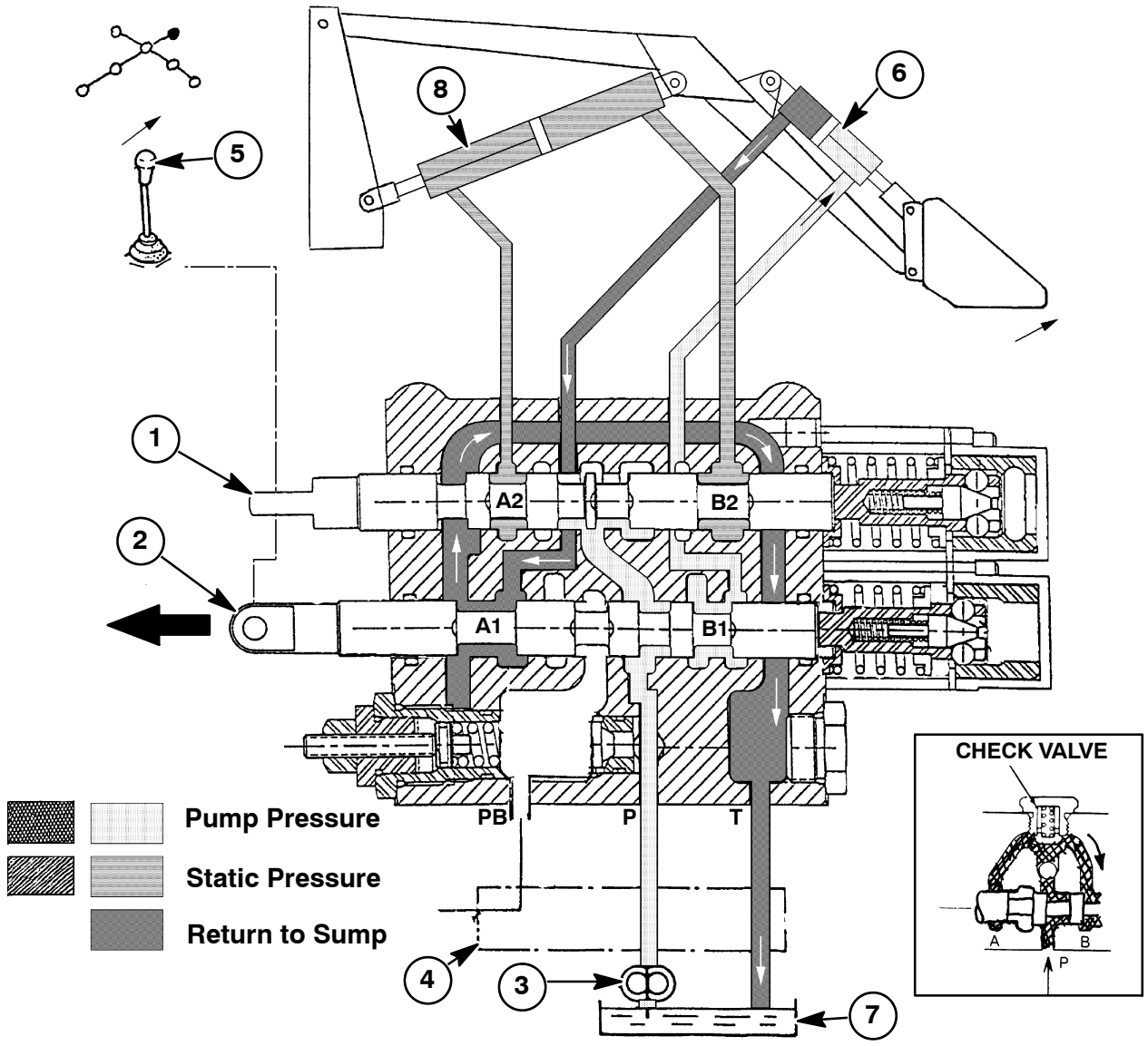


FLUID FLOW - BUCKET CONTROL - DUMPING REGEN AND LIFT CONTROL - NEUTRAL

60

FLUID FLOW - BUCKET CONTROL - DUMPING REGEN AND LIFT CONTROL - NEUTRAL

When the control lever, 5, is moved to the REGEN position, the bucket control valve spool, 2, is moved completely inward. Fluid flow from the hydraulic pump, 3, is directed to the piston side of the cylinder, 6. Fluid on the rod side flows out of the through passage “B1,” overcomes the check valve spring force, and flows to passage “A1” where it is combined with the pump fluid and is directed to the piston side of the cylinder, allowing faster bucket-tipping action without cavitation.

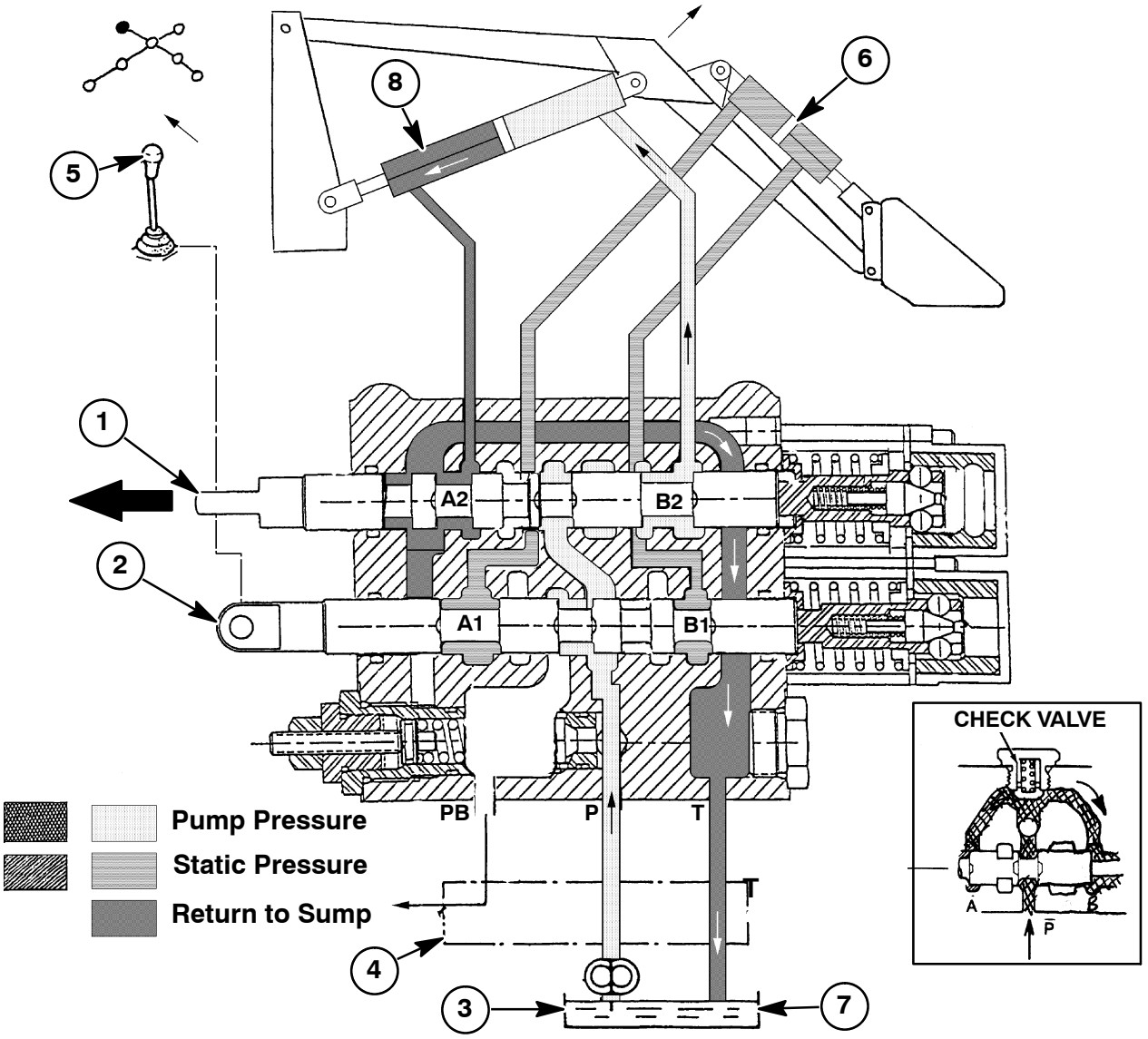


FLUID FLOW - BUCKET CONTROL - ROLL BACK AND LIFT CONTROL - NEUTRAL

61

FLUID FLOW - BUCKET CONTROL - ROLL BACK AND LIFT CONTROL - NEUTRAL

When the control lever, 5, is moved to the roll back position, the bucket control valve spool, 2, is moved outward. Fluid flow from the hydraulic pump, 3, is directed to the rod side of the cylinder, 6. Fluid flow from the piston side of the cylinder flows through passage “A1” exiting the valve at port “T” and flows to the reservoir, 7.

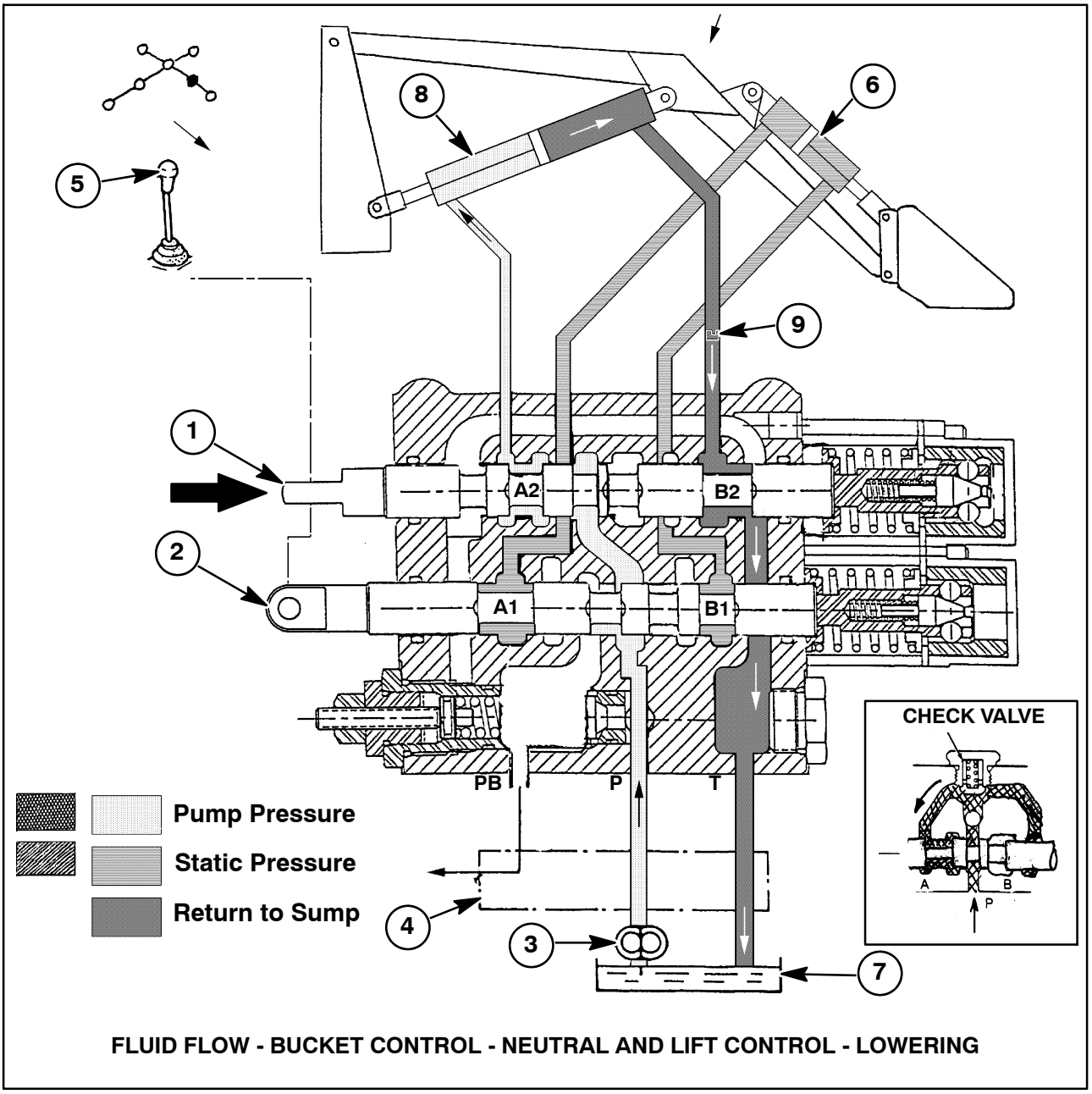


FLUID FLOW - BUCKET CONTROL - NEUTRAL AND LIFT CONTROL - RAISE BOOM

62

FLUID FLOW - BUCKET CONTROL - NEUTRAL AND LIFT CONTROL - RAISING

When the control lever, 5, is moved to the raising position the lift control valve spool, 1, is moved outward. Fluid flow from the hydraulic pump, 3, is directed to the piston side of the lift cylinder, 8. The fluid contained in the rod side of the lift cylinder flows out of the cylinder past port “T” to the reservoir, 7, allowing the implement to raise. Because the bucket control valve spool, 2, is in the neutral position, the fluid trapped in the bucket cylinder, 6, is blocked by the spool, and the bucket cylinder is held in a fixed position.



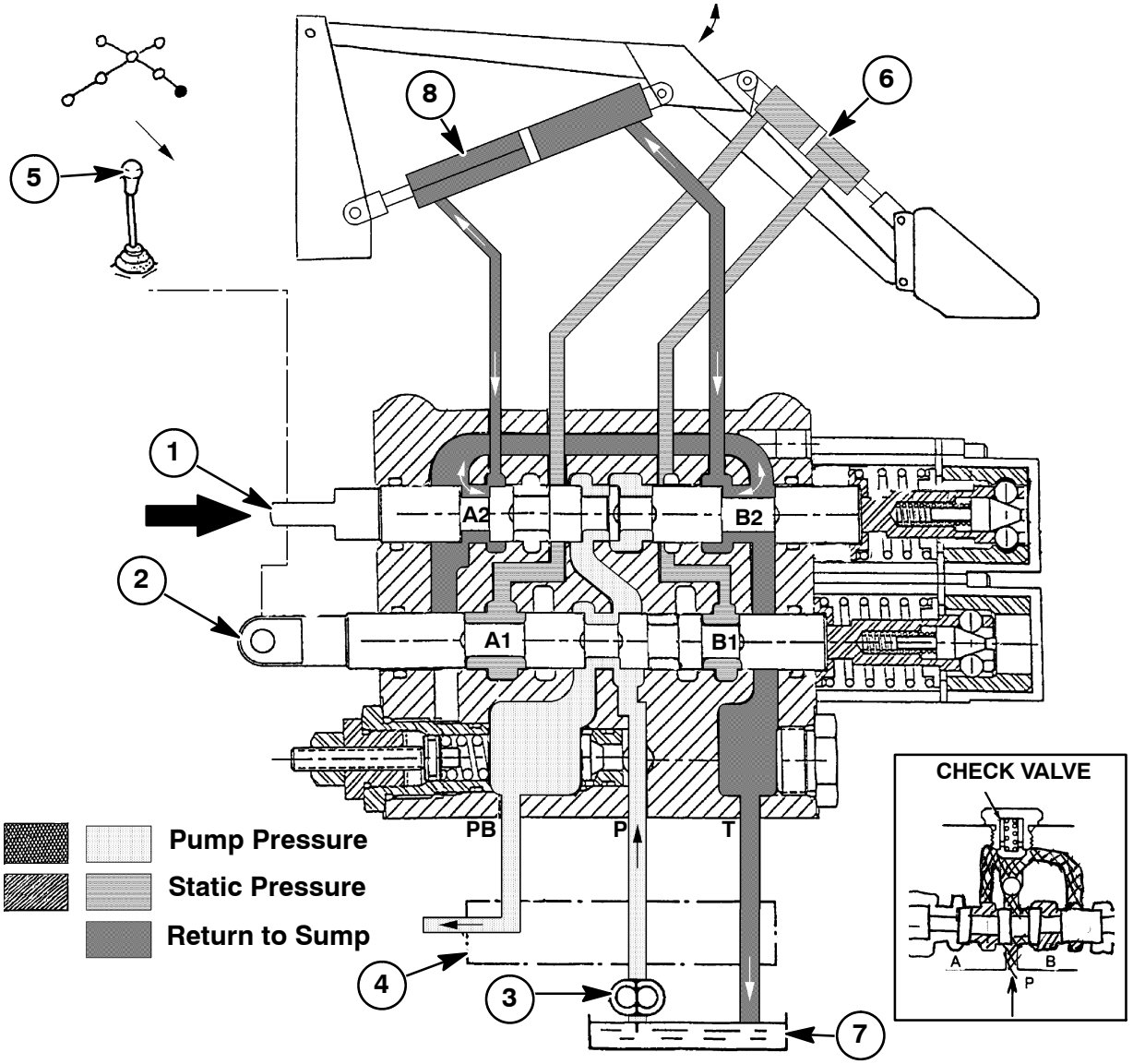
FLUID FLOW - BUCKET CONTROL - NEUTRAL AND LIFT CONTROL - LOWERING

63

FLUID FLOW - BUCKET CONTROL - NEUTRAL AND LIFT CONTROL - LOWERING

When the control lever, 5, is moved to the lowering position, the lift control valve spool, 1, is moved inward. Fluid flow from the hydraulic pump, 3, is directed to the rod side of the cylinder, 8. The fluid contained in the piston side of the cylinder flows out of the cylinder past port “T” to the reservoir, 7, allowing the implement to lower.

NOTE: *A controlled lowering cycle is achieved because of the reduced flow through the orifice, 9.*



FLUID FLOW - BUCKET CONTROL - NEUTRAL AND LIFT CONTROL - FLOAT

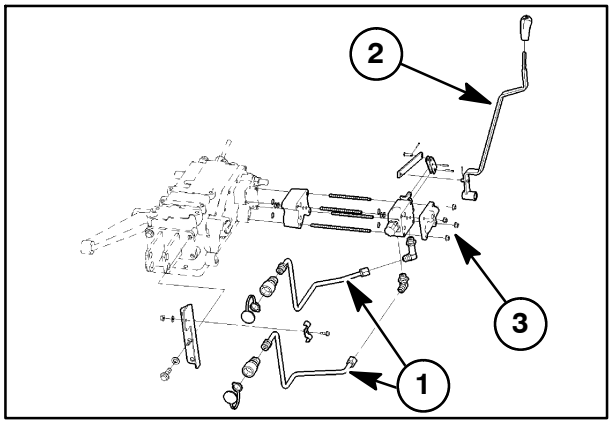
64

FLUID FLOW - BUCKET CONTROL - NEUTRAL AND LIFT CONTROL - FLOAT

When the lift control lever, 5, is moved to the detent position (float), the control valve spool is moved inward beyond the normal lowering position. In this position, passages “A2” and “B2” are connected, and fluid is free to move between the lift cylinder rod and piston ends. The loader lift arms then move up and down as the loader passes over uneven terrain. Pump fluid pressure is directed out through the “PB” port to the hydraulic system through the diverter valve manifold, 4.

OVERHAUL - REAR (SINGLE-SPOOL) REMOTE VALVE

REAR (SINGLE-SPOOL) REMOTE VALVE



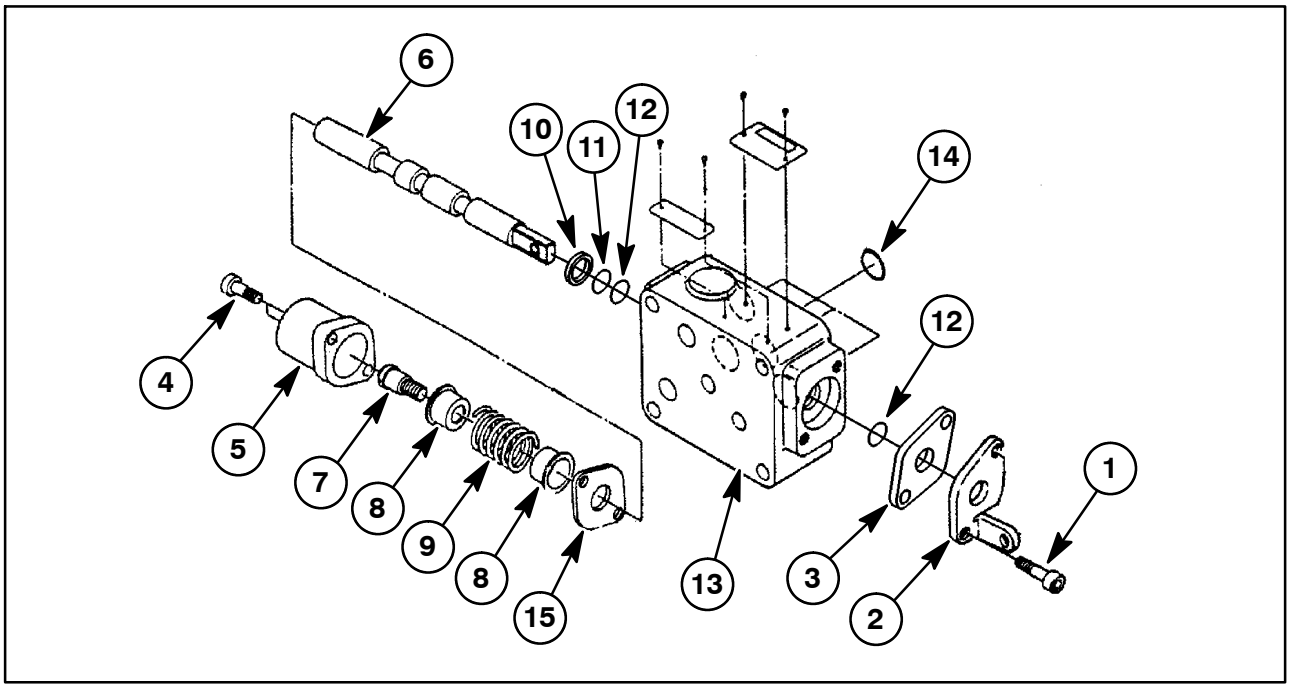
65

Removal

1. Thoroughly clean the area around the remote control valve and disconnect the remote tubes, 1, from the valve.
2. Disconnect the lever, 2, from the valve spool and body.
3. Remove the mounting nuts, 3, and remove the valve from the lift cover.

Disassembly

1. Remove bolts, 1, and remove the bracket, 2, and plate, 3.
2. Remove bolts, 4, end cap, 5, and withdraw the spool, 6, with bolt, 7, spring seats, 8, spring, 9, plate, 15, washer, 10, seal washer, 11, and O ring, 12, from the body, 13.
3. Remove O ring, 12, from the spool bore on the opposite end of the valve body.
4. Remove the O rings, 14.
5. Remove bolt, 7, and separate the spring, 9, and spring seats, 8, if necessary.



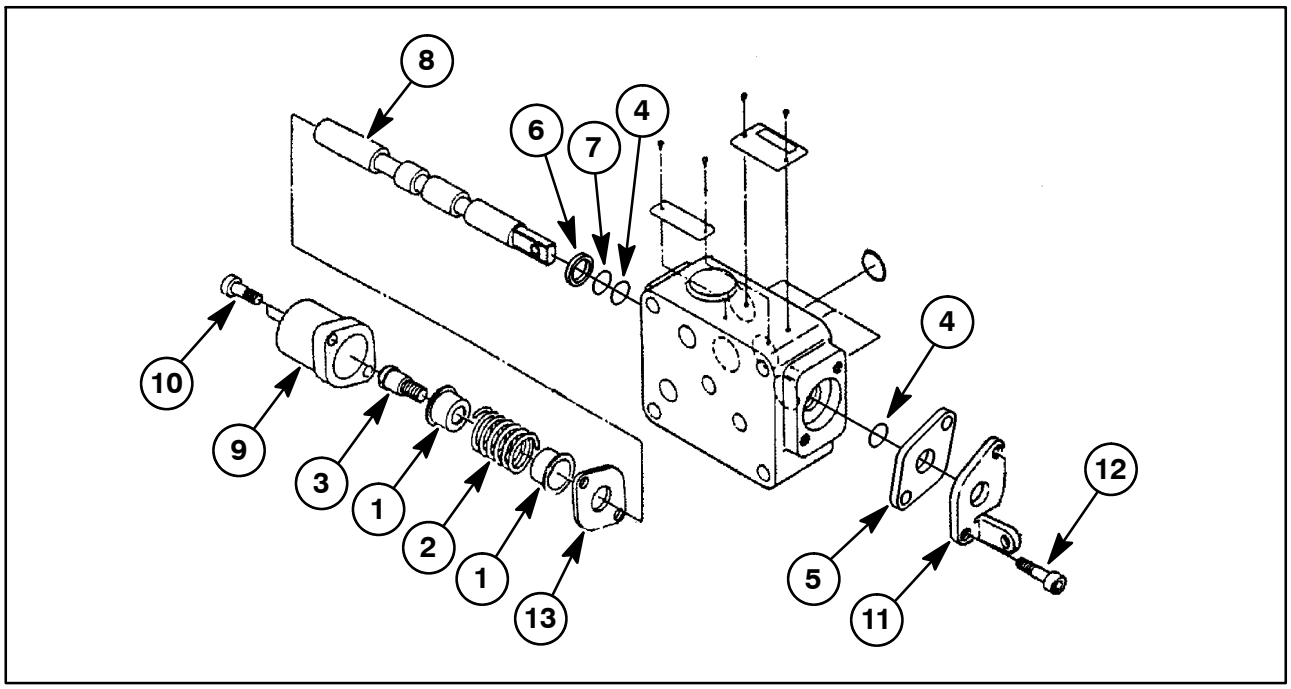
66

Inspection

1. Inspect the spool and spool bore for pitting, scratches, or excess wear. If inspection reveals defects, replace the control valve assembly.
2. Check that the spool moves freely in the spool bore. If defective, replace the control valve assembly.

Assembly

1. Assemble the spring seats, 1, and spring, 2, with bolt, 3.
2. Install new O ring, 4, in the spool bore of the valve body.
3. Install plate, 13, washer, 6, seal washer, 7, and O ring, 4, over the spool, 8, and insert the assembly into the bore in the valve housing.
4. Install the end cap, 9, and secure with bolts, 10.
5. Install plate, 5, bracket, 11, and secure with bolts, 12.

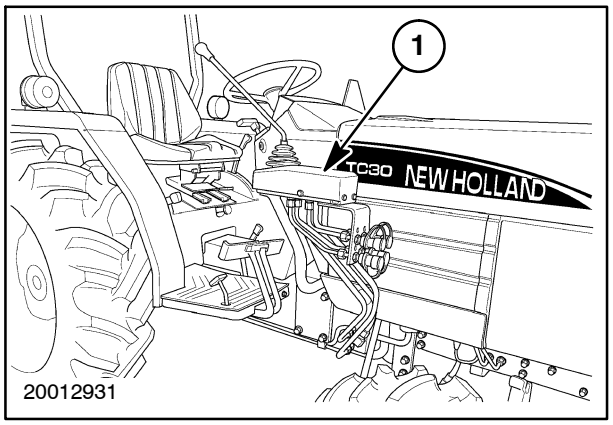


67

FRONT (DOUBLE-SPOOL) REMOTE CONTROL VALVE

Removal

1. Remove the control valve cover-retaining bolts and remove the control valve cover, 1.
2. Disconnect the piping from the control valve. Plug and cap all openings.
3. Remove the control valve-retaining bolts and remove the control valve.



68

Disassembly

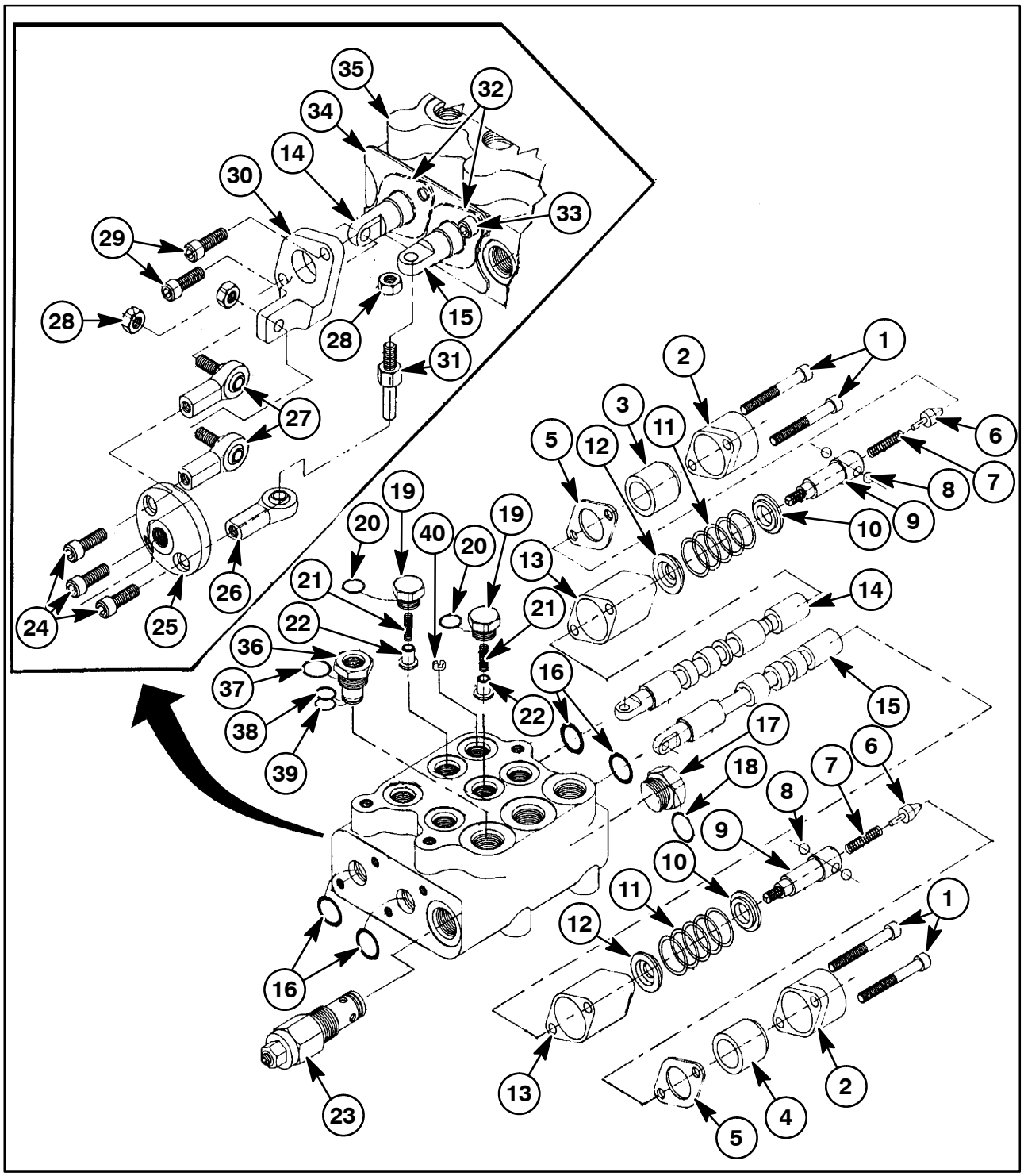
1. Loosen the joystick locknut and remove the joystick.
2. Remove the nuts, 28, and remove the handle kit (refer to Figure 68).
3. Remove cap screws, 29, and remove the clevis, 30.
4. Remove cap screws, 33, and remove the mounting plate, 34, and retainer plates, 32.

IMPORTANT: *The detent balls are under pressure and can fly out when the detent sleeve is removed. use care not to lose the detent balls during removal.*

5. Remove cap screws, 1, from the float spool, 14. Wrap a rag around the end cap, 2, and slowly pull outward until detent balls, 8, snap out.
6. Remove the end cap, 2, float detent sleeve, 3, poppet, 6, detent spring, 7, detent balls, 8, retainer, 5, and spacer, 13.
7. Gently slide the float spool, 14, with stop cup, 12, spring, 11, washer, 10, and detent retainer, 9, out of the valve body.

IMPORTANT: *The float spool, 14, and REGEN spool, 15, are not interchangeable and will only work in their respective bores. Ensure that the spools are inserted into the proper bores during reassembly.*

8. Remove the O rings, 16, from the grooves in the valve body.
9. Disassemble the REGEN spool, 15, in the same manner as the float spool using steps 5 through 8.
10. Remove the plug, 17, and O ring, 18.
11. Remove the load check plugs, 19, O rings, 20, springs, 21, and load check poppets, 22, from the check valve ports.
12. Remove the power beyond outlet connector, 36, with O ring, 37, backup washer, 38, and O ring, 39.
13. Remove the relief valve assembly, 23, and repair as described later in this section.



69

1. Cap Screws
2. End Cap
3. Float Detent Sleeve
4. Float Detent Sleeve
5. Retainer
6. Poppet
7. Detent Spring
8. Detent Balls
9. Detent Retainer
10. Washer
11. Spring
12. Stop Cup
13. Spacer
14. Float Spool
15. REGEN Spool
16. O ring
17. Plug
18. O ring
19. Check Plug
20. O ring
21. Spring
22. Load Check Poppet
23. Relief Valve Assembly
24. Cap Screw
25. Flange
26. Rod End
27. Rod End Assemblies
28. Nuts
29. Cap Screw
30. Clevis
31. Spool Stud
32. Retaining Plate
33. Cap Screws
34. Mounting Plate
35. Valve Body
36. Power Beyond Outlet Connector
37. O ring
38. Backup Washer
39. O ring
40. Orifice - 2.75 mm (0.108″) hole

Inspection

1. Inspect the spools and the spool bores for pitting, scratches, or excess wear. If found defective, replace the remote control valve assembly.
2. Check that the spool moves freely in the spool bore. If defective, replace the remote control valve assembly.
3. Inspect the load check valve poppets for pitting or scratches.
4. Inspect all springs for distortion. Replace if found to be defective.
5. Replace all O rings and seals during reassembly and lightly lubricate with petroleum jelly.

Assembly

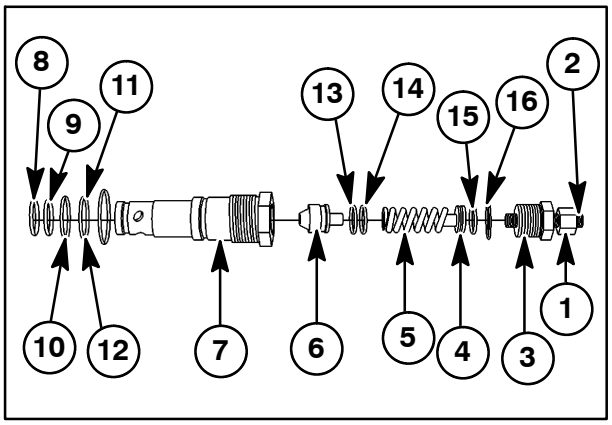
1. Install the relief valve assembly, 23. Torque the assembly to 27 - 34 N·m (20 - 25 ft. lbs.).
2. Using new O ring, 37, backup washer, 38, and O ring, 39, install the power beyond outlet connector, 36, and torque to 27 - 34 N·m (20 - 25 ft. lbs.).
3. Install the load check poppets, 22, springs, 21, O rings, 20, and check plugs, 19, and torque to 27 - 34 N·m (20 - 25 ft. lbs.).
4. Install O ring, 18, and plug, 17, and torque to 27 - 34 N·m (20 - 25 ft. lbs.).
5. If the detent retainer, 9, washer, 10, spring, 11, and stop cup, 12, were removed from either spool, reassemble to the spool and torque to 7 - 10 N·m (5 - 7 ft. lbs.).
6. Install O rings, 16, in their grooves in the valve body and carefully slide the REGEN spool, 15, into its bore.
7. Install spacer, 13, and retainer, 5, over the spool.
8. Compress the spring, 7, using poppet, 6, into the detent retainer, 9, and install the detent balls, 8. Then install the REGEN detent sleeve, 4, over the assembly.

   NOTE: *The float detent sleeve, 3, has a groove on the inside. The REGEN detent sleeve, 4, does not.*
9. Install the end cap, 2, and secure the assembly with cap screws, 1. Tighten the cap screws to 11 - 15 N·m (9 - 11 ft. lbs.).
10. Assemble the float spool in the same manner using steps 5 through 9.
11. Install the retainer plates, 32, and mounting plate, 34, and install cap screws, 33, on the REGEN side. Torque the cap screws to 11 - 15 N·m (9 - 11 ft. lbs.).
12. Install the clevis, 30, over the float spool, 14, and tighten the retaining bolts, 29, to 11 - 15 N·m (9 - 11 ft. lbs.).
13. Install the spool stud, 31, on the REGEN spool end, 15, and the rod end assemblies, 27, on the clevis, 30, and the float spool end, 14. Apply Loctite #680 to the threads and tighten the nuts, 28, to 10 N·m (85 in. lbs.).
14. Screw the joy stick into the assembly and tighten its locknut.

RELIEF VALVE

Disassembly

1. Loosen the adjusting screw locknut, 1, and back off the adjusting screw, 2.
2. Remove the relief valve bonnet, 3, adjusting screw, 2, and locknut, 1.
3. Remove the spring seat, 4, spring, 5, and valve poppet, 6, from the body, 7.
4. Remove O rings and backup rings, 8, through 16.



70

Inspection

Inspect the valve seat and disc for scratches, nicks, or other damage. If any damage is found to any part of the valve, replace the complete assembly.

Assembly

1. Install new O rings and backup rings, 8 through 16.
2. Install the valve poppet, 6, spring, 5, and spring seat, 4, in the valve body, 7.
3. Install the relief valve bonnet, 3, with locknut, 1, and adjusting screw, 2.
4. Install the relief valve in the double-spool valve body and adjust the valve as described later in this section.

Adjustment

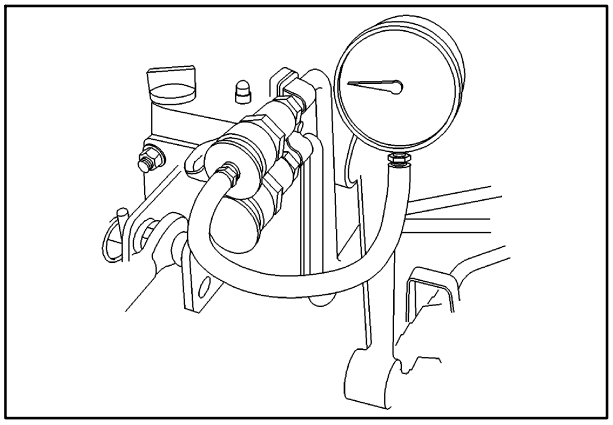
Loosen locknut, 1, and turn screw, 2, clockwise to increase pressure. Turn the screw counterclockwise to decrease pressure.

PRESSURE TESTING

MAIN SYSTEM RELIEF VALVE

NOTE: *If equipped with the rear (single-spool) valve kit, perform this procedure with gauge connected to the remote piping, this Figure. Otherwise, connect the gauge to the diverter valve manifold, Figure 72.*

1. If equipped with the rear (single-spool) kit, connect a 0 - 207 bar (0 - 3000 psi) pressure gauge #OEM1462 and hose 7/16″ – 20 PJIC x female quick connect x 16.25″ in length as shown, and proceed to step 3.



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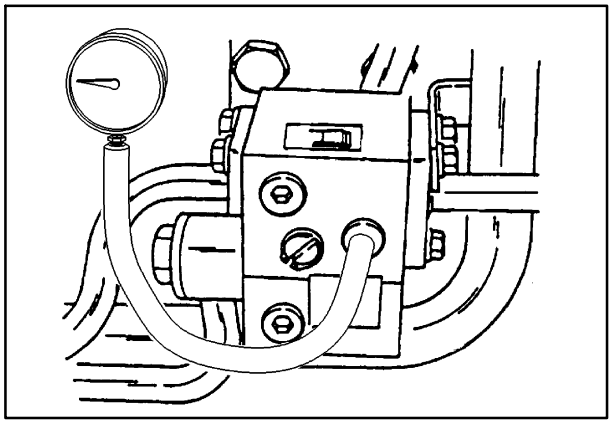
2. Remove the manifold plug from the diverter valve and install fitting #FNH07560 into the (power out, P) port. Connect a 0 - 207 bar (0 - 3000 psi) pressure gauge #OEM1462 and hose 7/16″ – 20 PJIC x female quick connect x 16.25″ in length to the fitting.
3. Start the engine and operate the hydraulic system to warm the hydraulic fluid to normal operating temperature.
4. Set the throttle rpm at full throttle.
5. Move the diverter valve to the 10 o'clock position and observe pressure indication on the pressure gauge. Pressure should be 147 ± 5 bar (2130 ± 70 psi).
6. If required, adjust the pressure setting by adding or removing shims from the relief valve. One shim, 0.2 mm (0.008″) thickness, will change the pressure setting approximately 7.0 bar (100 psi).

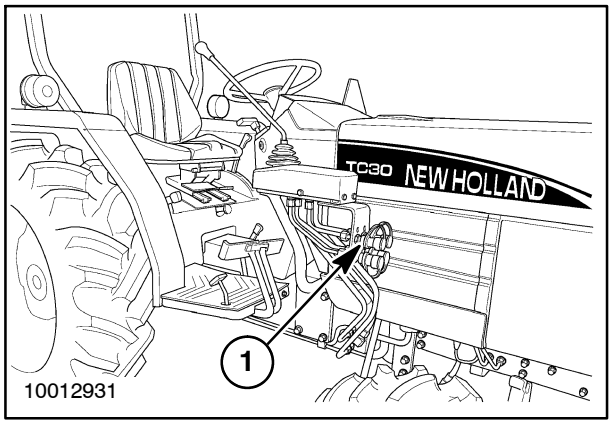
   NOTE: *Shim kit SBA340293230 contains three 0.2 mm (0.008″) and three 0.4 mm (0.015″) shims.*



72

FRONT (DOUBLE-SPOOL) REMOTE CONTROL VALVE

1. Install a 0 - 207 bar (0 - 3000 psi) pressure gauge #OEM1462 to the high-pressure tube, 1.
2. Start the engine and operate the hydraulic system to warm the hydraulic fluid to normal operating temperature.
3. Set the throttle rpm at full throttle.
4. Move the control lever to lift control-raising position and observe pressure indication on the gauge. Pressure should be 121 bar (1750 psi).
5. If required, adjust the relief valve pressure setting by loosening the locknut and turning the adjusting screw, refer to items 1 and 2, Figure 70.



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INLET RESTRICTION TEST

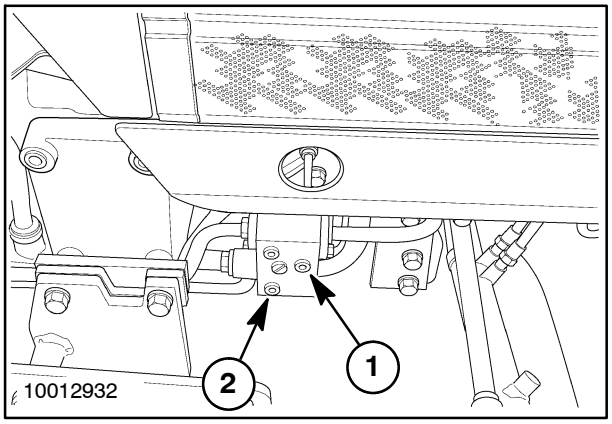
Perform the inlet restriction test to check for the hydraulic lines and filter for damage, obstructions, or air leaks. A hydraulic flow meter is required to perform the inlet restriction test.

⚠ WARNING ⚠

Leaks of pressurized hydraulic fluid can penetrate the skin and cause severe injuries. Tighten all of the connectors before starting the engine. If hydraulic fluid has penetrated the skin, seek medical assistance immediately.

NOTE: *If equipped with a rear (single-spool) kit, connect the flow meter to the female quick couplers in the same manner as described below.*

1. Make sure the diverter valve adjuster screw is in the 10 o'clock position.
2. Remove the manifold plug, 1, from the diverter valve.
3. Connect a hydraulic line from the "Power Out" ('P') port of the diverter valve to the "Inlet" port of the flow meter.
4. Remove the manifold plug, 2, from the diverter valve.
5. Connect a hydraulic line from the "Tank" port ('T') to the "Return" port of the flow meter.



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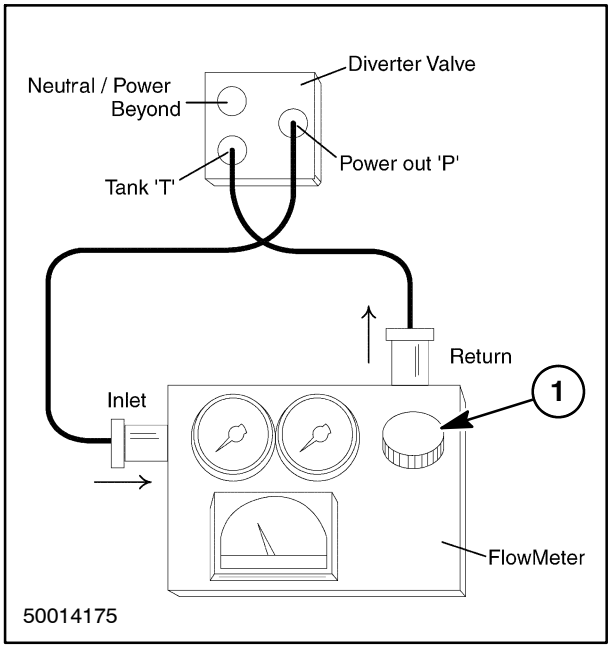
6. Start the engine and operate the hydraulic system to warm the hydraulic fluid to normal operating temperature.
7. Open the restrictor valve, 1, to allow full flow through the flow meter.
8. Run the engine at 1200 RPM and record the flow meter reading.
9. Run the engine at 2400 RPM and read the flow meter. The reading should indicate that the flow has doubled. If the meter reading is low, check the hydraulic lines, and filter for damage, clogs, or air leaks. If there are no problems with the hydraulic lines or the hydraulic filter, the hydraulic pump may require replacement. Use the Pump Efficiency Test described below to further inspect the hydraulic pump.



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PUMP EFFICIENCY TEST

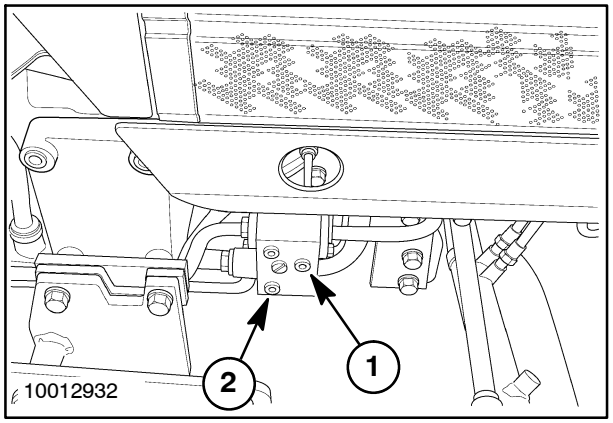
The pump efficiency test measures the hydraulic pump output to determine if the pump is excessively worn or damaged. Perform the pump efficiency test only after the inlet restriction test has been completed. A hydraulic flow meter is required to perform the pump efficiency test.

⚠ WARNING ⚠

Leaks of pressurized hydraulic fluid can penetrate the skin and cause severe injuries. Tighten all of the connectors before starting the engine. If hydraulic fluid has penetrated the skin, seek medical assistance immediately.

NOTE: *If equipped with a rear (single-spool) kit, connect the flow meter to the female quick couplers in the same manner as described below.*

1. Make sure the diverter valve adjuster screw is in the 10 o'clock position.
2. Remove the manifold plug, 1, from the diverter valve.
3. Connect a hydraulic line from the "Power Out" ('P') port of the diverter valve to the "Inlet" port of the flow meter.
4. Remove the manifold plug, 2, from the diverter valve.
5. Connect a hydraulic line from the "Tank" port ('T') to the "Return" port of the flow meter.



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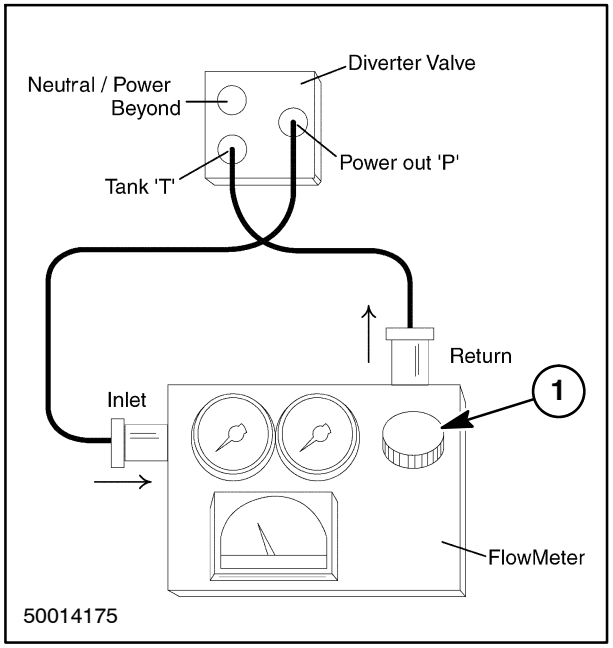
6. Start the engine and operate the hydraulic system to warm the hydraulic fluid to normal operating temperature.
7. Operate the tractor engine at full RPM. Observe the flow meter reading. The no load reading should be approximately 6.2 (GPM) / 23.3 (LPM).
8. Tighten the flow restrictor valve, 1, on the flow meter until the system pressure is 1900 - 2000 (psi) / 150 (kg/cm^2).
9. Observe the flow meter reading, the results should be approximately 80% of the no-load flow rating [4.96 (GPM) / 18.64 (LPM)]. If testing shows the hydraulic pump output is low, the pump requires replacement.



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SECTION 41 - STEERING

Chapter 1 - Steering

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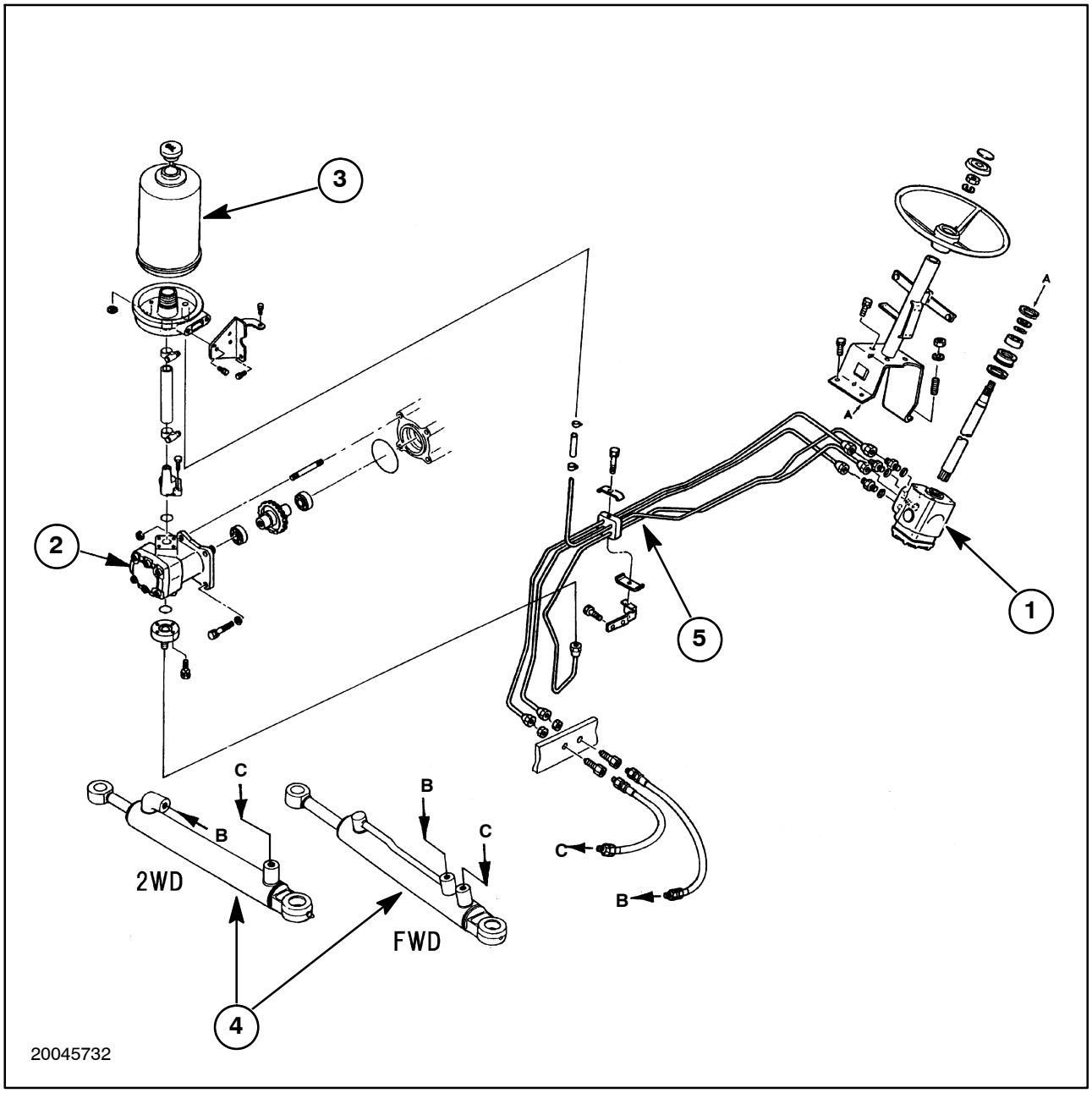
DESCRIPTION OF OPERATION

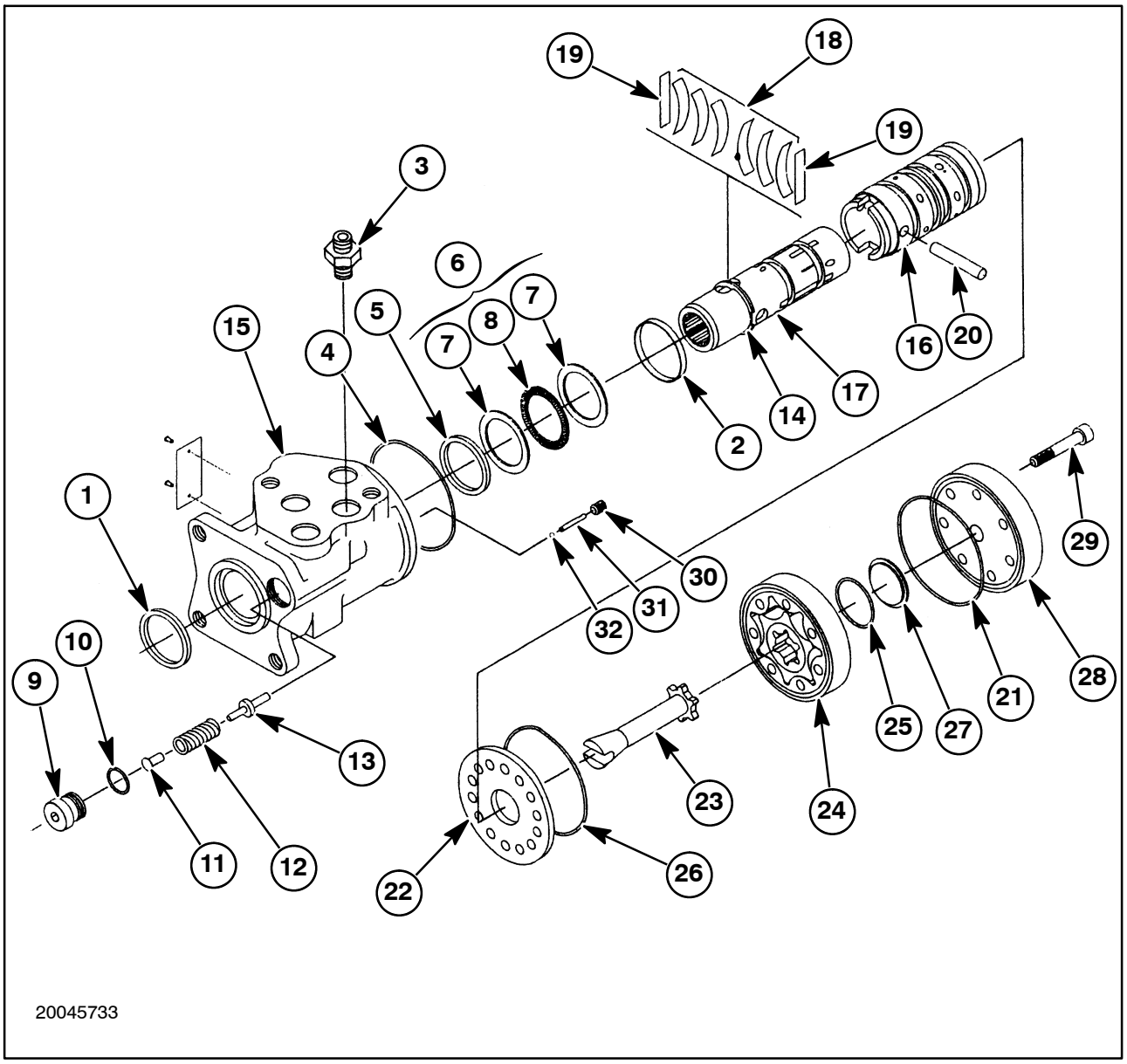


1

POWER STEERING SYSTEM

The power steering system described in this section is standard equipment for all model tractors. The power steering is a fully hydraulic system.

The power steering system consists of a power steering control motor, 1, pump, 2, reservoir, 3, cylinder assembly, 4, and tubing, 5.



2

Power Steering Control Motor

1. Dust Seal
2. Spring Retaining Ring
3. "P" Port Check Connector
4. O Ring
5. Oil Seal
6. Needle Bearing Kit
7. Lace Bearing
8. Thrust Needle
9. Relief Plug
10. O Ring
11. Damper Collar
12. Spring
13. Poppet
14. Retaining Ring
15. Housing
16. Sleeve
17. Spool
18. Centering Spring
19. Flat Spring
20. Pin
21. O Ring
22. Spacer Plate
23. Drive Shaft
24. Gerotor Pump
25. O Ring
26. O Ring
27. Plate
28. End Cap
29. Screw
30. Check Valve Retainer Screw
31. Check Valve Retainer Pin
32. Check Valve Ball

Op. 41 204

POWER STEERING CONTROL MOTOR

Spool and Sleeve

1. The spool, 17, and sleeve, 16, constitute a rotary valve for selectively changing the fluid passage as well as direction of the pressurized fluid flow. There are three forms of fluid passage. The first is for the neutral state, the second is for right turning, and the third is for left turning.
2. The spool is fitted to be rotatable within the sleeve, which is similarly fitted into the bore of the valve body. The spool and sleeve are mechanically interconnected.
3. Leaf springs, 18 and 19, extend through the spool and sleeve, and urge the spool to take the indicated position relative to the sleeve. This position corresponds to the neutral state, and persists as long as the steering handwheel is at its center position, for straight ahead driving.
4. A diametrically extended pin, 20, is loosely fitted to the drive shaft at the center and to the sleeve, there being some clearance between the pin and the radial holes in the spool. When the drive shaft, spool, and sleeve are in the indicated positions, the sleeve and shaft are capable of as much as 10° in either direction (CW or CCW) relative to the spool. By this angular displacement, the fluid passage for right turning or left turning is introduced.

Drive Shaft

1. The pump drive shaft, 23, is slightly tilted off the spool axis, and is splined into the pump gear of the gerotor pump assembly by its bottom end. As mentioned earlier, this shaft is connected to the pin, 20, by its top end.
2. In the event of loss of fluid pressure, turning the steering wheel turns this shaft, due to the spool and pin connection, to rotate the pump gear, so that the gerotor can operate as a manually driven pump to produce hydraulic fluid pressure.

Gerotor Pump

The gerotor pump, 24, provides the steering system with a back-up device for steering, and operates as previously described.

Check Valve

The check valve, 30, 31, and 32, normally remains closed, which prevents the pressurized fluid from flowing from its “IN” side to its “OUT” side. If fluid pressure is not available, the check valve unseats permitting fluid to be drawn from the reservoir to the “IN” side.

Relief Valve

The relief valve, 9, 10, 11, 12, and 13, prevents excess fluid pressure build-up within the steering pump and circuit. This excess pressure may be caused by the steering wheel being turned to its full travel and against its stops or by preventing the front wheels from turning.

NOTE: *Relief valve is adjustable. Turning clockwise increases pressure, counterclockwise decreases pressure.*

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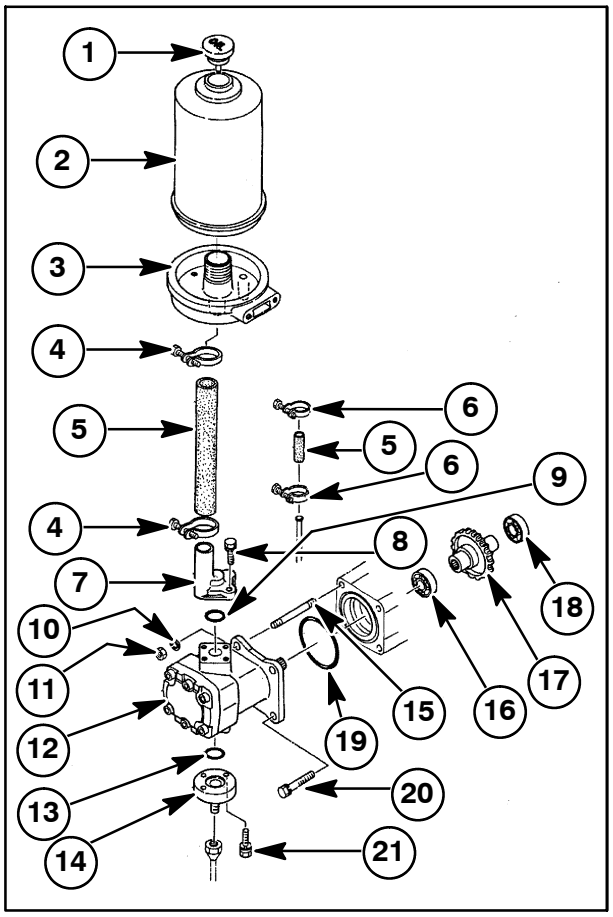
POWER STEERING PUMP

The power steering pump, 12, is mounted on the front right side of the engine and is driven by the engine oil pump gear. Other than replacing the pump seals, there is no maintenance for the pump. Should any of the pump components fail, the entire pump is to be replaced with a new assembly.



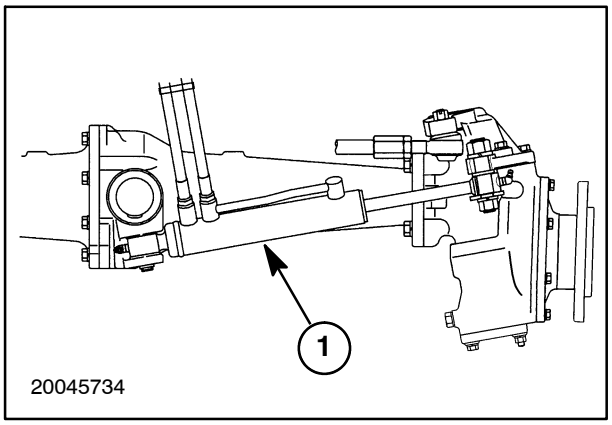
3

1. Cap/Dipstick
2. Reservoir/Filter
3. Base
4. Clamp
5. Hose
6. Clamp
7. Pump Inlet Adapter
8. Bolt
9. O Ring
10. Lock Washer
11. Nut
12. Pump Assembly
13. O Ring
14. Pump Outlet Adapter
15. Stud
16. Bearing
17. Pump Drive Gear
18. Bearing
19. O Ring
20. Bolt
21. Bolt

Op. 41 216

POWER STEERING CYLINDER

The power steering cylinder, 1, is mounted transversely under the tractor with the cylinder end pinned to a fixed member and the rod end attached to either the tie rod or to the spindle arm.



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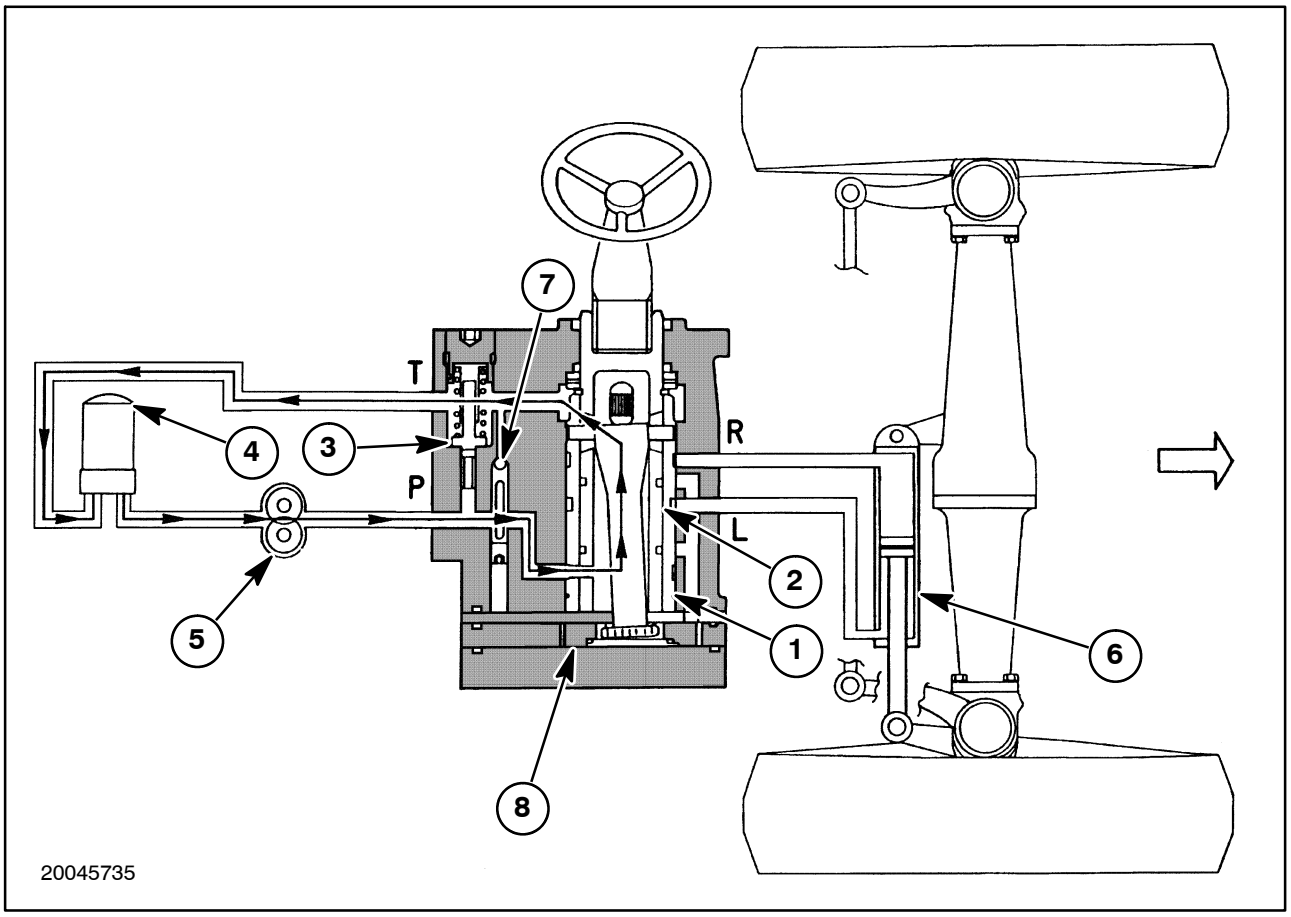


5

1. Sleeve
2. Spool
3. Relief Valve Assembly
4. Reservoir
5. Power Steering Pump
6. Cylinder
7. Check Valve Assembly
8. Gerotor Gear Pump

Op. 41 200

POWER STEERING OPERATION

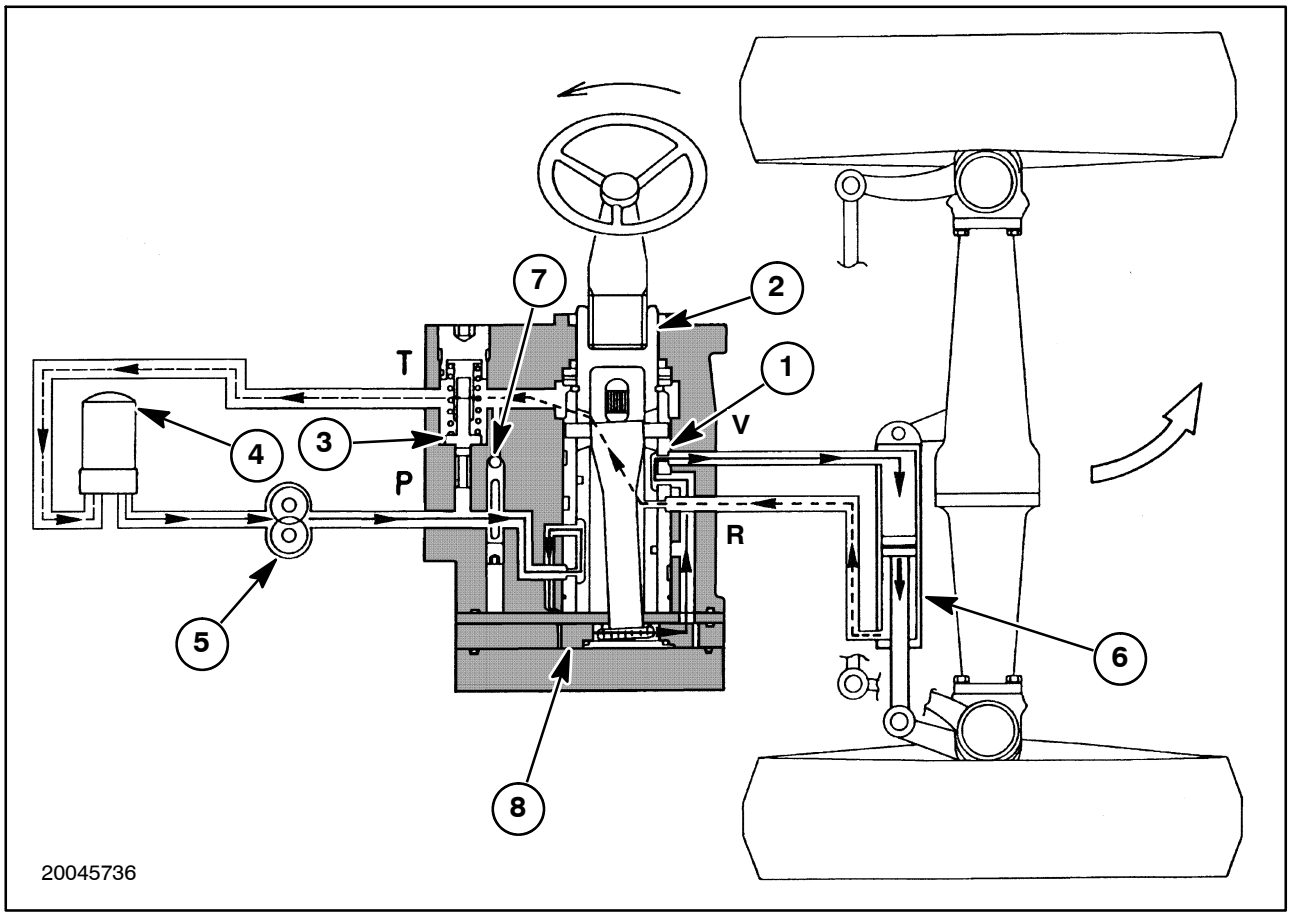
Fluid Flow - Neutral Position

Pressurized fluid from the power steering pump enters the valve body at port “P”. The fluid flows through the check valve, 7, past the relief valve, 3, and through radial holes in the sleeve, 1, to the center of the valve spool, 2.

NOTE: *There are 24 radial holes in the sleeve, 1, that index with 12 grooves provided in the spool.*

In the neutral position the fluid flows through the hollow spool and returns to the reservoir via port “T”.

Passage to ports “L” and “R,” leading to the cylinder, 6, are blocked by the second spool and sleeve. Fluid contained in the tubes and cylinder is trapped and the cylinder remains in a fixed position. In this position the front wheels hold at a straight ahead position. Because the system is fully hydraulic, there is no road feel or front wheel reaction transmitted to the steering wheel.



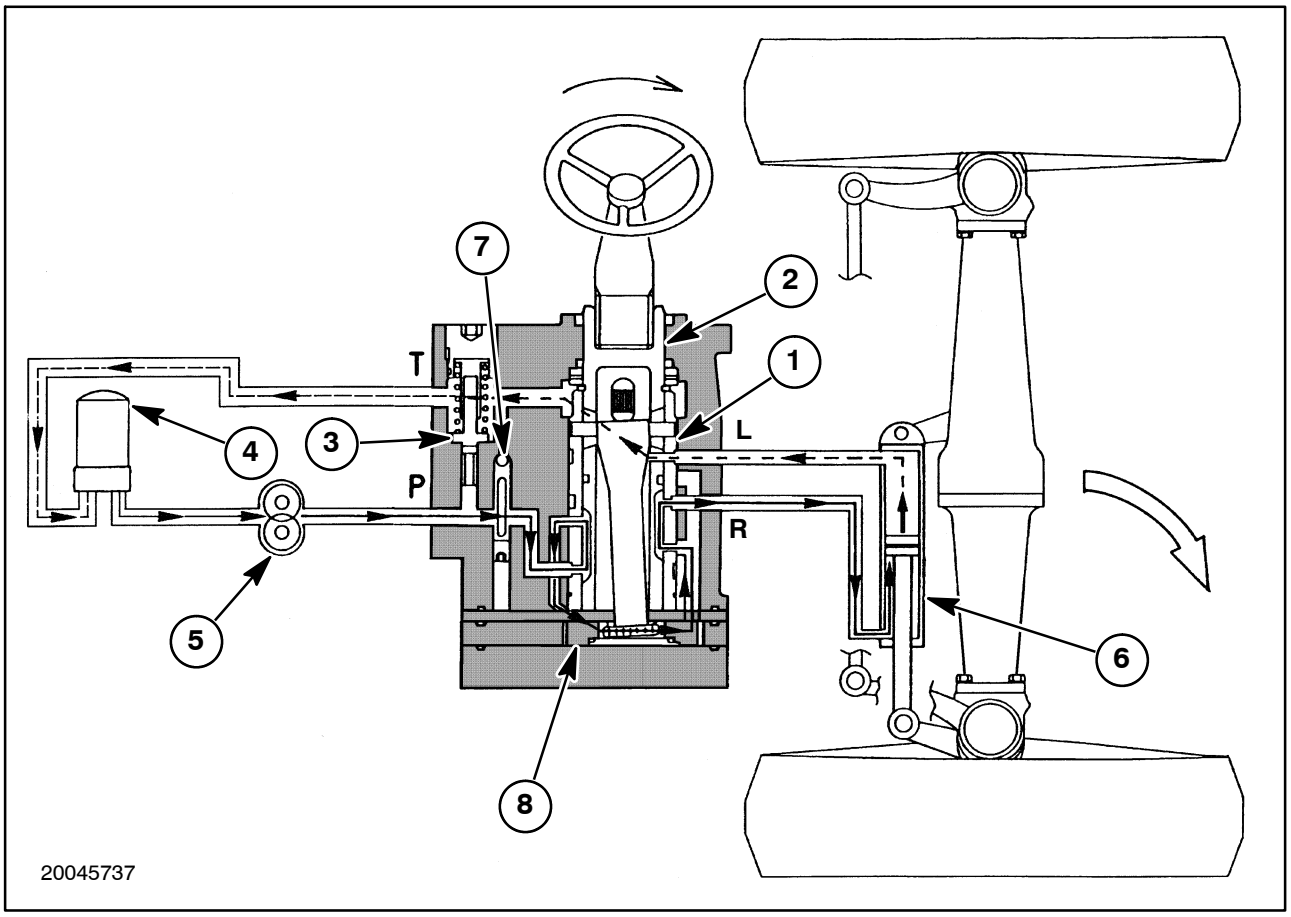
6

1. Sleeve
2. Spool
3. Relief Valve Assembly
4. Reservoir
5. Power Steering Pump
6. Cylinder
7. Check Valve Assembly
8. Gerotor Gear Pump

Fluid Flow - Left Turn

Turning the steering wheel to the left rotates the valve spool and indexes grooves in the spool with holes in the sleeve allowing fluid flow to enter passages “F,” “E,” and “D” in the control valve gear pump. Because the gear pump is turning counterclockwise, the fluid flows through passages “C,” “B,” and “A,” to port “L” and to the power steering cylinder.

Fluid enters the cylinder barrel end of the cylinder and causes the front wheels to turn left. Fluid contained in the cylinder rod side returns to the control valve through port “R” and is directed back to the reservoir through port “T”.



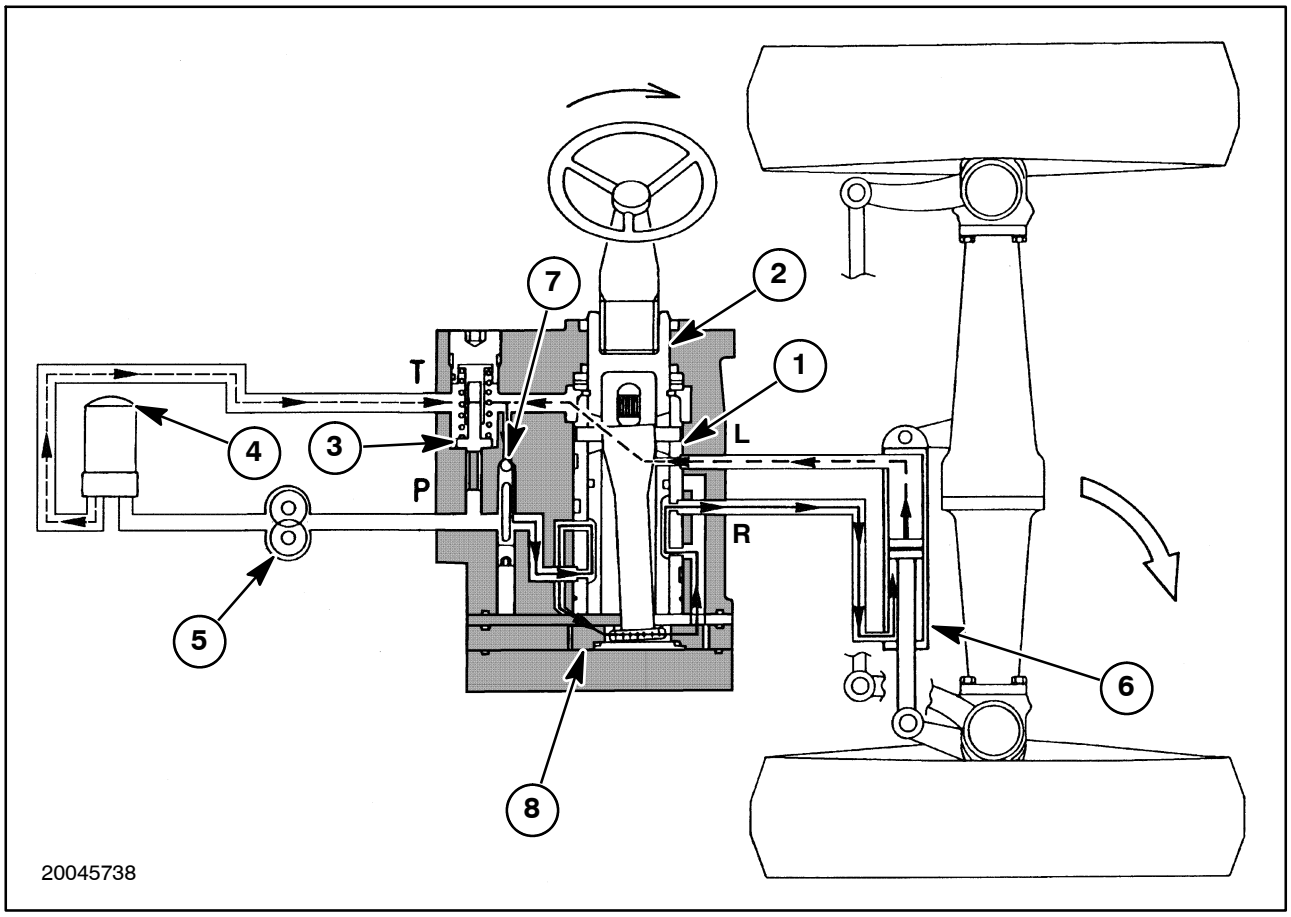
7

1. Sleeve
2. Spool
3. Relief Valve Assembly
4. Reservoir
5. Power Steering Pump
6. Cylinder
7. Check Valve Assembly
8. Gerotor Gear Pump

Fluid Flow - Right Turn

Turning the steering wheel to the right (clockwise) rotates the spool clockwise and indexes the grooves in the spool with holes in the sleeve for right turn.

Fluid flow from the pump enters the gear pump passages “A,” “B,” and “C” and flows out passages “D,” “E,” and “F” to the valve port “R” to the cylinder. Fluid in the piston side of the cylinder returns to the control valve through port “L” and is directed back to the reservoir through port “T”.



8

1. Sleeve
2. Spool
3. Relief Valve Assembly
4. Reservoir
5. Power Steering Pump
6. Cylinder
7. Check Valve Assembly
8. Gerotor Gear Pump

POWER STEERING MANUAL OPERATION

In the event of a power steering pump failure or engine shut-down, the steering system can be operated manually.

Turning the steering wheel drives the gerotor pump in the control valve assembly to force fluid to the power steering cylinder according to the direction that the steering wheel is being turned. Fluid from the opposite side of the cylinder returns to the control valve. A check valve, 7, located in the connecting passage between the “T” and “P” passages, unseats and allows the fluid and any reservoir fluid that may be required to flow through the check valve and connecting passage to the “P” port passage, supplying the fluid required for the pressure side of the system.

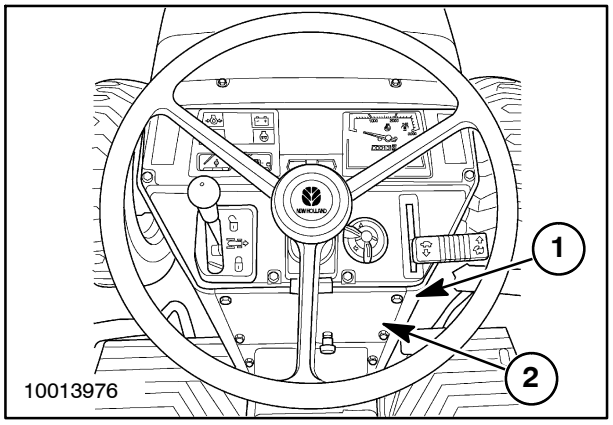
OVERHAUL

Op. 41 204

STEERING CONTROL MOTOR

Removal

IMPORTANT: *Cleanliness is extremely important when repairing hydraulic steering control motors. Work in a clean area. Before disconnecting the hydraulic lines, clean the port area of the control motor. Before disassembly, drain the oil from the control motor, plug or cap the ports and thoroughly clean the exterior of the control motor. During disassembly, cleaning, repair and assembly use caution to protect machined surfaces.*



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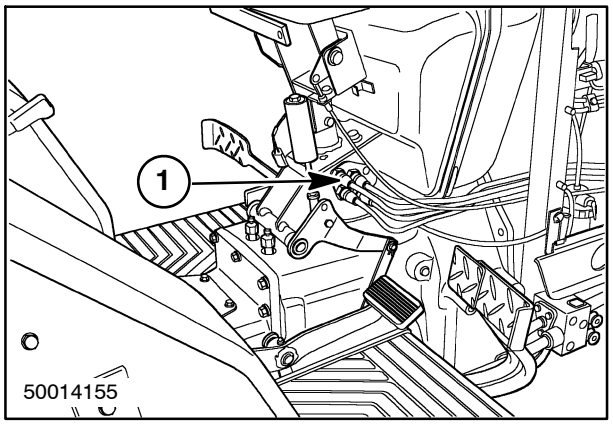
1. Remove the right, 1, rear hood and rear panel from the tractor.
2. Disconnect the power steering tubing, 1, from the steering motor. Cap and plug all openings.



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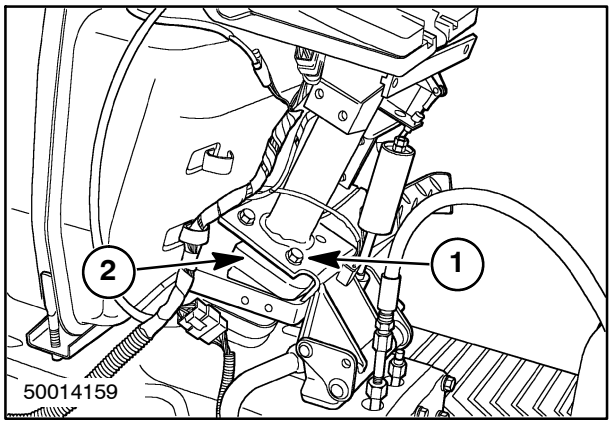
3. Remove the three motor mounting bolts, 1.
4. Lower the control motor, 2, and remove from the right side of the tractor.

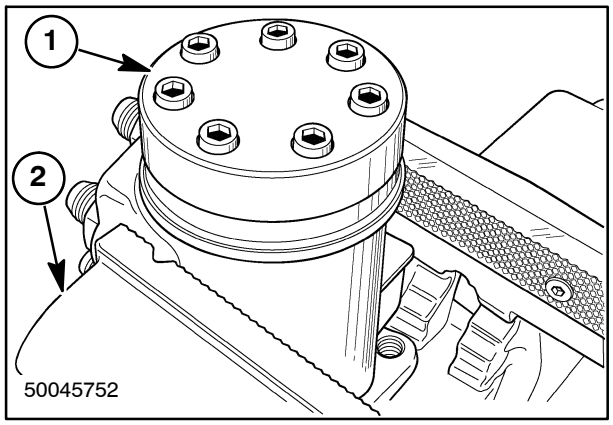


11

Disassembly

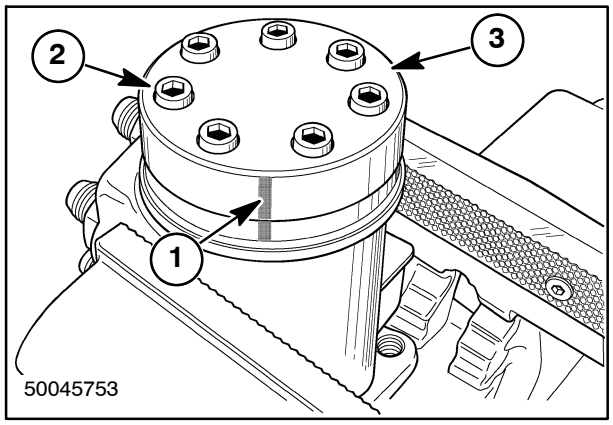
IMPORTANT: *Do not over tighten the motor in the vise. Housing damage may result.*

1. Clamp the steering control motor, 1, in a vise, 2. Use just enough clamping force to hold the housing securely.



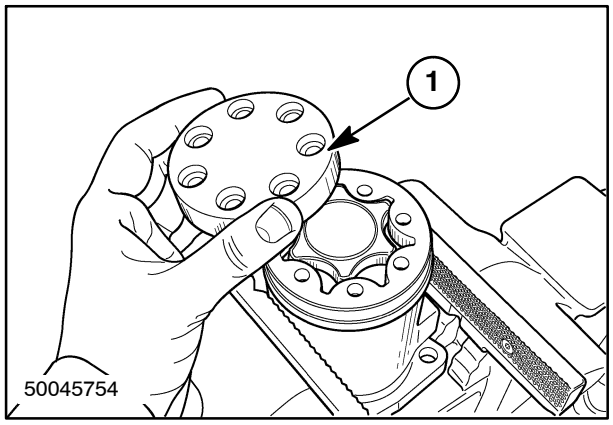
12

2. Use a paint pen to mark a line, 1, on the outside of the housing parts, for proper assembly at a later time.
3. Loosen and remove the seven socket head cap screws, 2, from the end cap, 3.



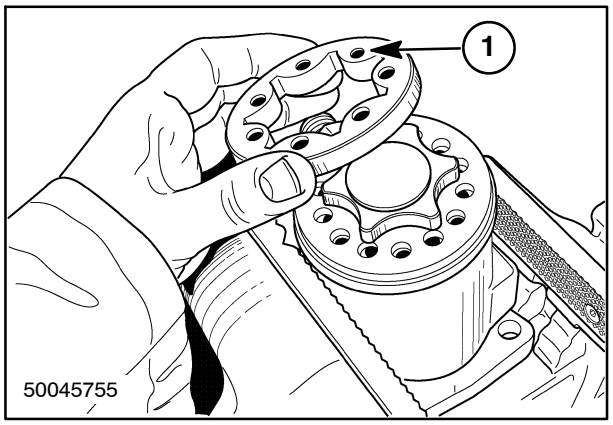
13

4. Remove the end cap, 1.
5. Remove and discard the O Ring in the end cap.



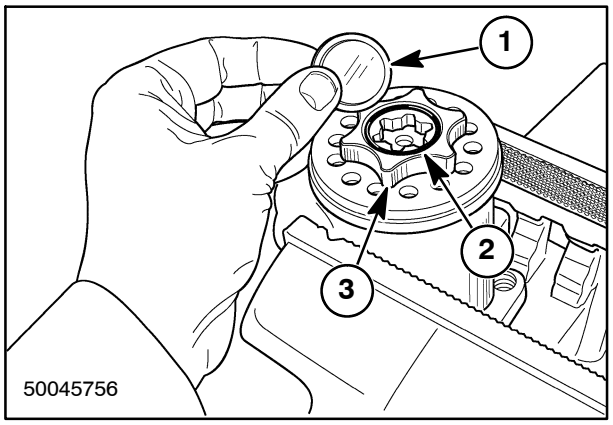
14

6. Remove the gerotor ring, 1.
7. Remove and discard the O Ring in the gerotor ring.



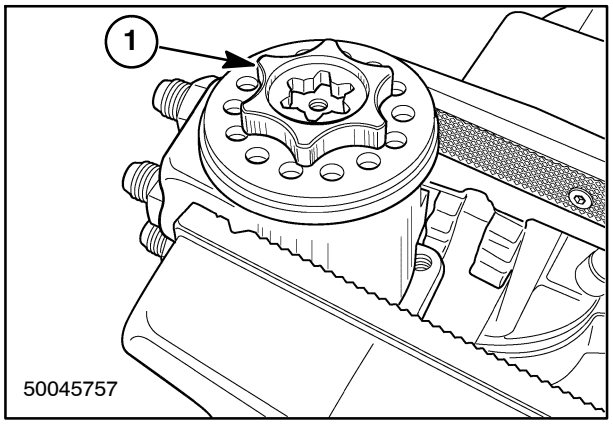
15

8. Remove the spacer plate, 1, and O Ring, 2 from top of rotor, 3.



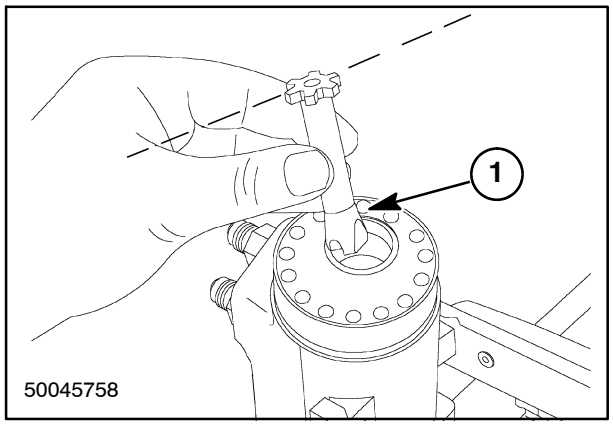
16

9. Remove the rotor, 1.



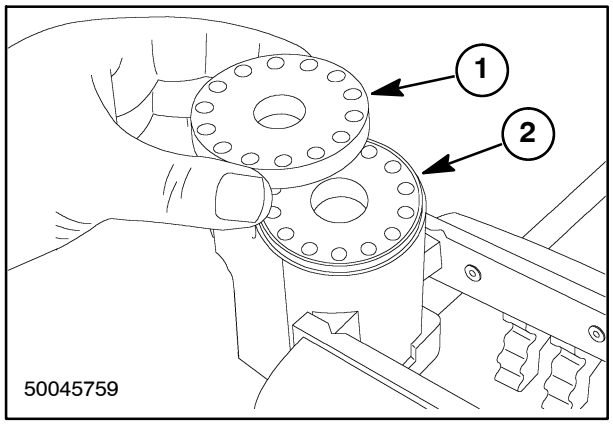
17

10. Mark a line on the top of the drive shaft, parallel to the port face of the housing for proper re-assembly timing.
11. Remove the drive shaft, 1, from the housing.



18

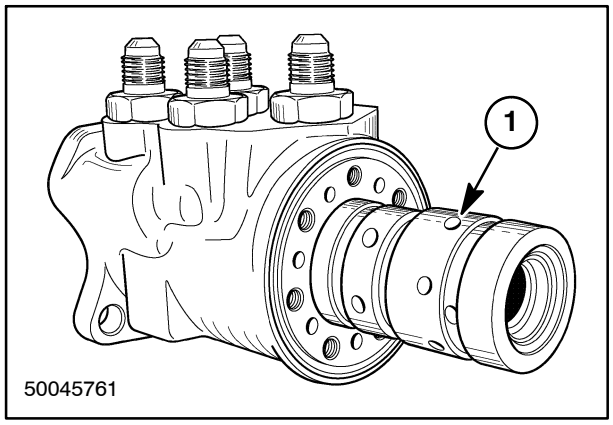
12. Remove the wear plate, 1, and O Ring, 2.
13. Remove the steering control motor from the vise.



19

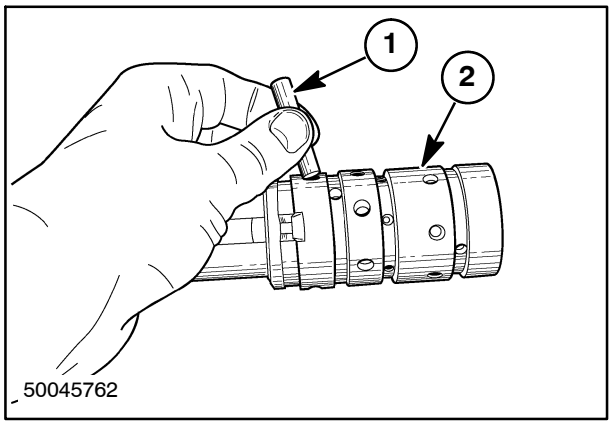
IMPORTANT: *The spool and sleeve assembly is a very close fit in the housing. The pin must be kept in a horizontal orientation during spool and sleeve removal, to avoid damage to the surface of the housing bore.*

14. Position the control motor housing so that the spool and sleeve pin is in a horizontal position.
15. Carefully remove the spool and sleeve assembly, 1. Slight rotation of the spool and sleeve is necessary during removal due to close, fit tolerances.



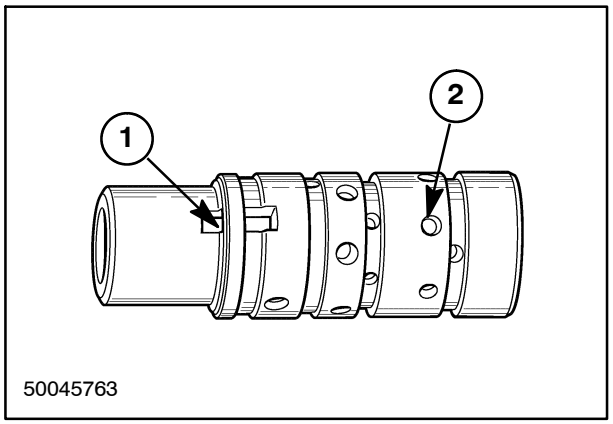
20

16. Remove the pin, 1, from the spool and sleeve assembly, 2.



21

17. Remove the centering spring retaining ring, 1, from the sleeve, 2.

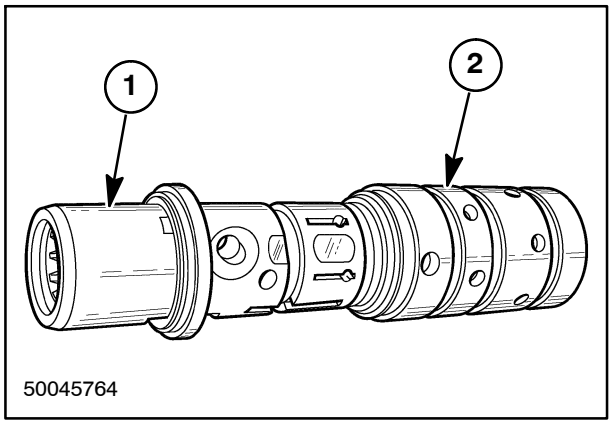


22

⚠ CAUTION ⚠

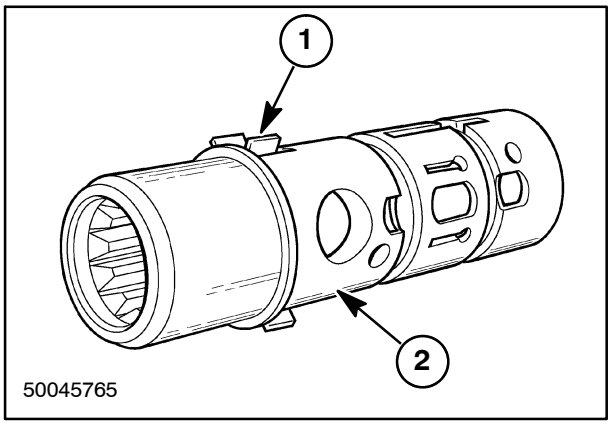
Centering springs are under tension. Use care when separating spool and sleeve. Springs may exit the spool with considerable force. Wear eye protection during removal of centering springs and separation of spool and sleeve.

18. Remove the spool, 1, from the sleeve, 2.



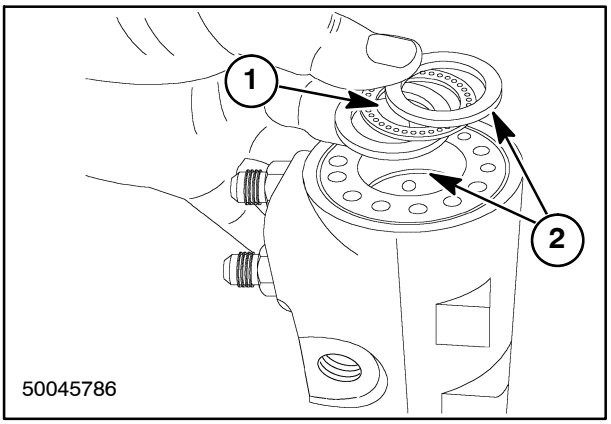
23

19. Use pliers to carefully remove centering springs, 1, from spool, 2.



24

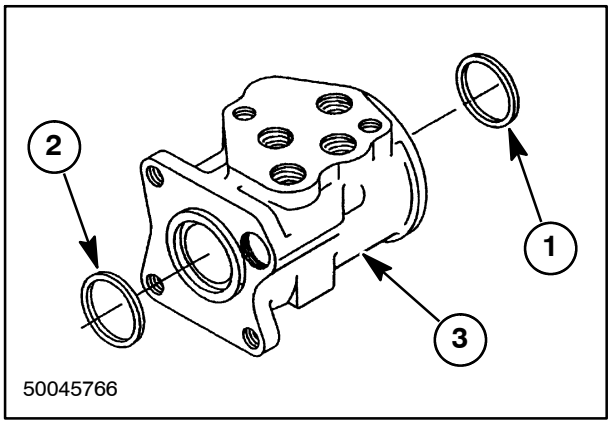
20. Remove the bearing, 1, and both bearing races, 2, from the housing.



25

IMPORTANT: *Be careful not to damage the dust seal seat during seal removal.*

21. Remove the O Ring seal, 1, and dust seal, 2, from the control motor housing, 3.



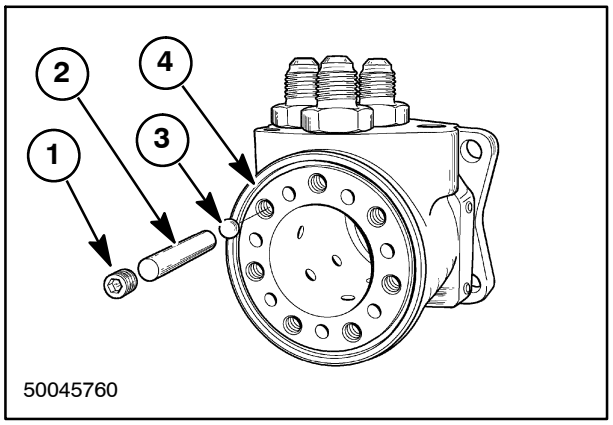
26

22. Remove the retainer screw, 1, retainer pin, 2 and check ball, 3 from the housing, 4.

⚠ WARNING ⚠

Failure to follow the relief valve removal instructions will result in equipment failure.

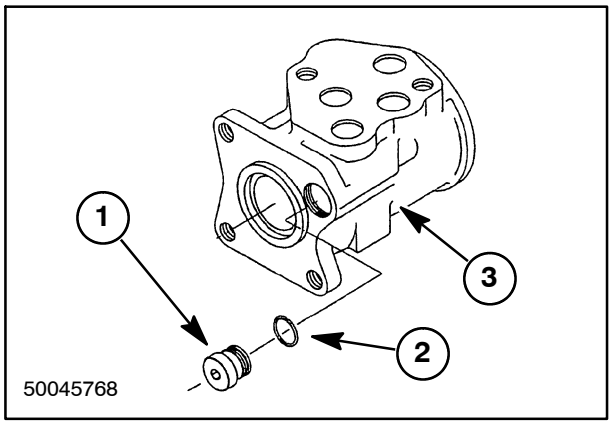
IMPORTANT: *It is critical to count the turns required to remove the relief plug.*



27

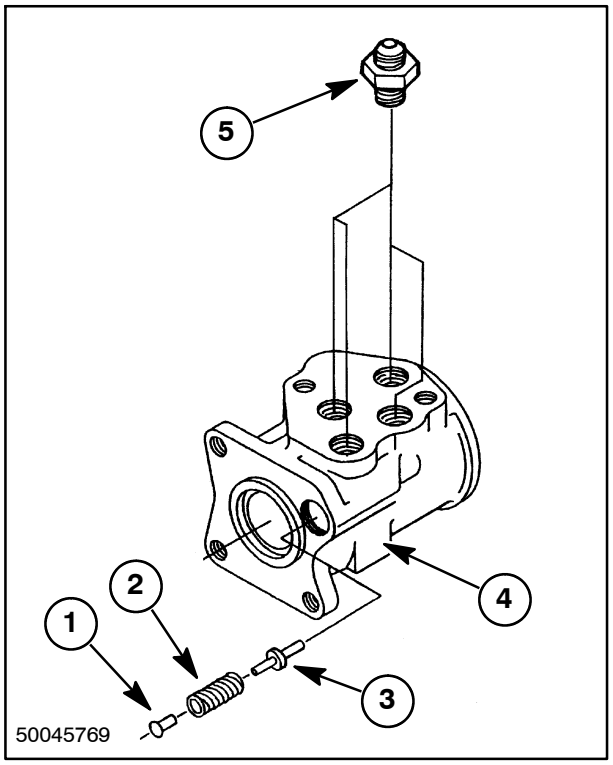
23. Remove the relief plug, 1, O Ring, 2, from the side of the control motor housing, 3.

IMPORTANT: *If not necessary, do not remove relief valve from the control motor housing.*



28

24. If necessary, remove the relief valve (damper collar, 1, spring, 2, and poppet, 3) from the control motor housing, 4.
25. If necessary, remove the four adapters, 5.



29

Inspection

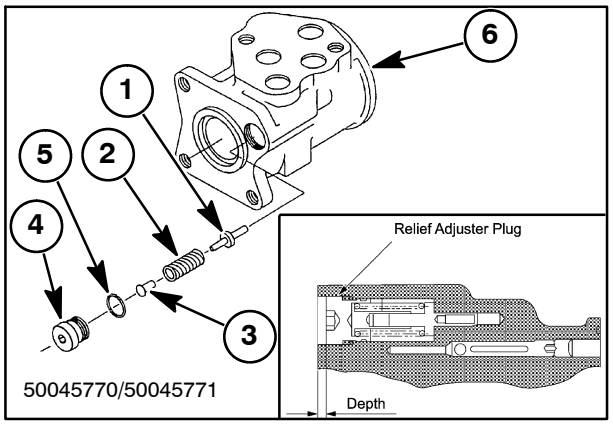
1. Thoroughly clean all parts in a suitable solution and allow to air dry. Use compressed air to dry parts. NEVER wipe parts dry with paper towels or cloth as lint in a hydraulic system will cause damage.
2. Discard all old seals and O Rings. Always use new seals and O Rings when reassembling steering control motors.
3. Lubricate all new seals and O Rings with petroleum jelly prior to installation.
4. Lubricate all machined surfaces and bearings with clean hydraulic oil prior to assembly.
5. Inspect the spool and sleeve for evidence of sticking, scuff marks and any other damage. Replace as required.
6. Inspect the spool and retainer pins to make sure they are not bent or cracked.
7. Inspect the internal splines on the spool for wear or damage.
8. Inspect the inside machined surfaces of the housing for wear or damage.
9. Inspect the gerotor parts for wear or damage.
10. Inspect the drive shaft for wear or damage.
11. Inspect the thrust bearing and bearing races for wear or damage.
12. Inspect the centering springs for distortion. Centering springs that are distorted or have lost tension should be replaced.
13. Inspect check ball, damper collar, poppet and spring for wear or damage.

Assembly

1. If it was removed, install the relief valve (poppet, 1, spring, 2, damper collar, 3), relief adjuster plug, 4, and a new O Ring, 5, into the housing, 6.

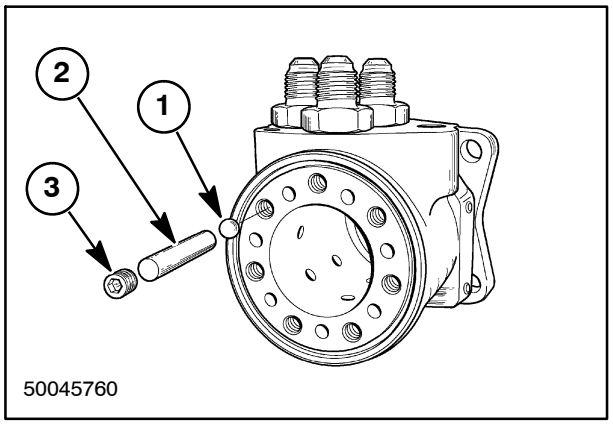
IMPORTANT: *It is critical to use the same number of turns when installing the relief plug. One turn of the relief plug is 14.7 bar (213.3 psi).*

IMPORTANT: *When installing the poppet, make sure the bleed hole is at the bottom of the relief valve cavity.*



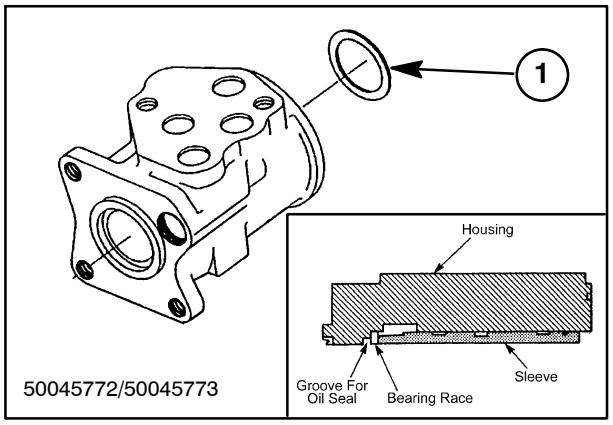
30

2. Install the check ball, 1, retainer pin, 2 and retainer screw, 3. Tighten the screw to 12.8 N·m (9.4 ft.-lbs.).



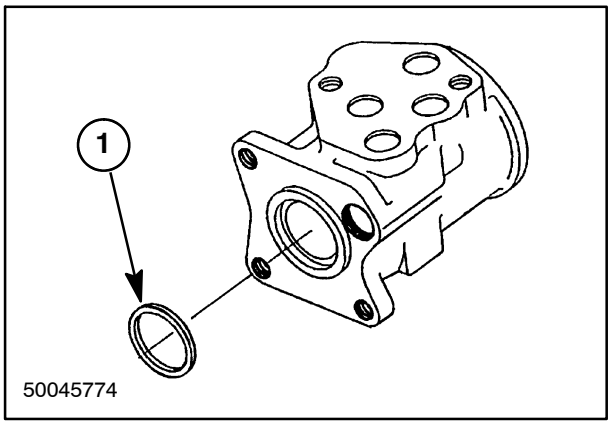
31

3. Lubricate and install a new O Ring seal, 1, into the control motor housing.



32

4. Lubricate and install a new dust seal, 1, in the input end of the housing.

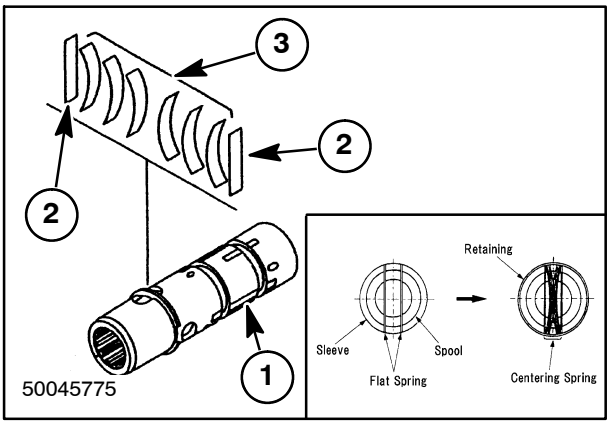


33

⚠ WARNING ⚠

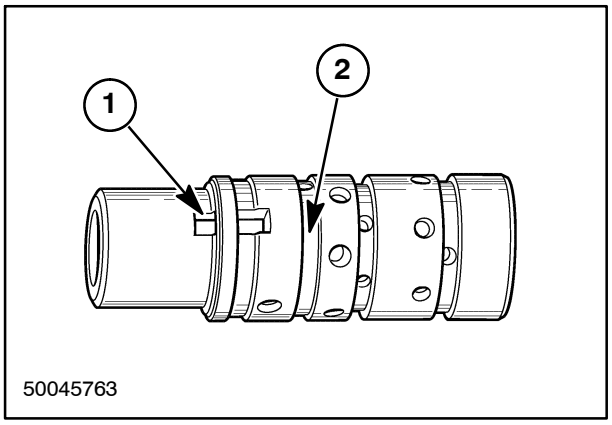
Wear eye protection and use caution when installing centering springs. Springs are under tension and could exit the spool with great force.

5. Install the centering springs into the spool, 1. It is best to install the two flat pieces, 2, first and then install the curved springs, 3, three at a time.



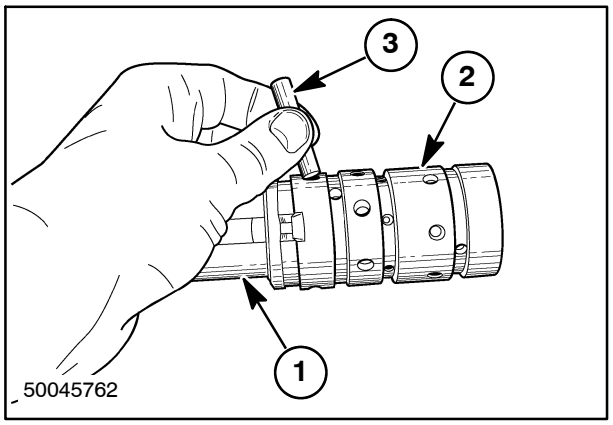
34

6. Center the springs, 1, in the spool and fit the retaining ring, 2, over the centering springs.



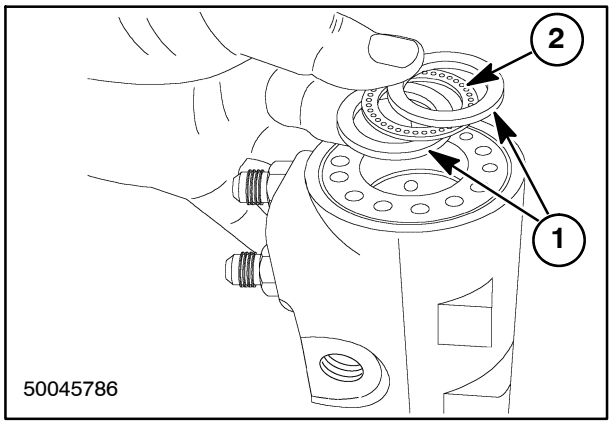
35

7. Apply a light coating of clean hydraulic fluid to the spool, 1, and slide it into the sleeve, 2. Be sure the centering springs fit into the notches in the sleeve.
8. Install the pin, 3.



36

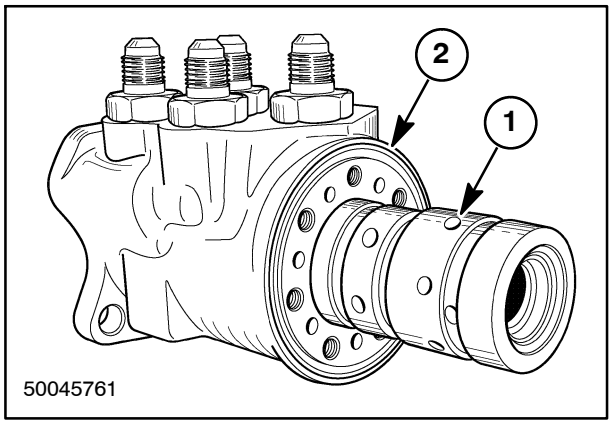
9. Apply a light coating of petroleum jelly to the inner edge of the dust seal and O Ring seal.
10. Install the bearing races, 1, and thrust bearing, 2, into the housing bore. The thrust bearing is placed between the races.



37

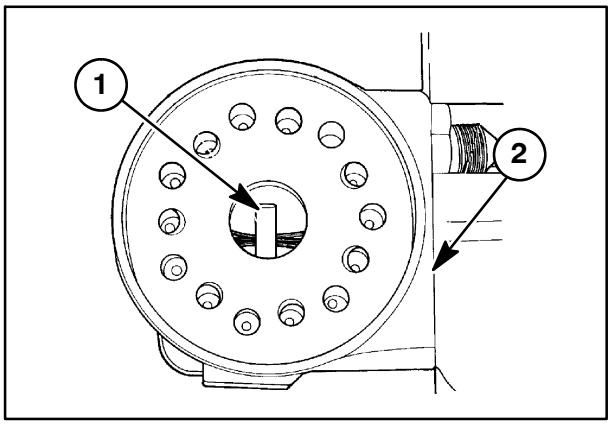
IMPORTANT: *Use care not to damage the quad seal and dust seal during installation of spool and sleeve assembly.*

11. Apply a light coating of clean hydraulic fluid to the spool and sleeve assembly, 1, and slide it carefully into the housing bore, 2.



38

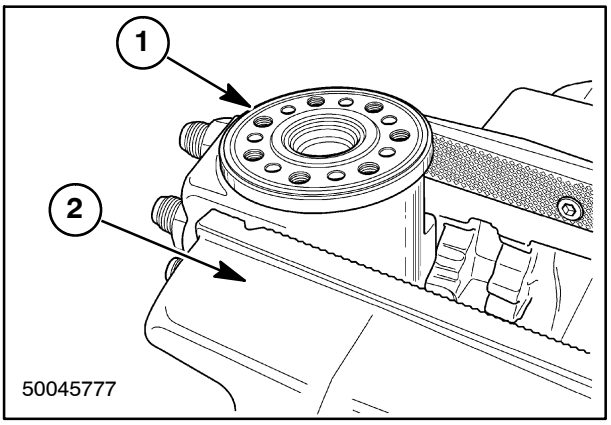
12. Position the spool and sleeve assembly so that the pin, 1, is parallel with the port face of the housing, 2.



39

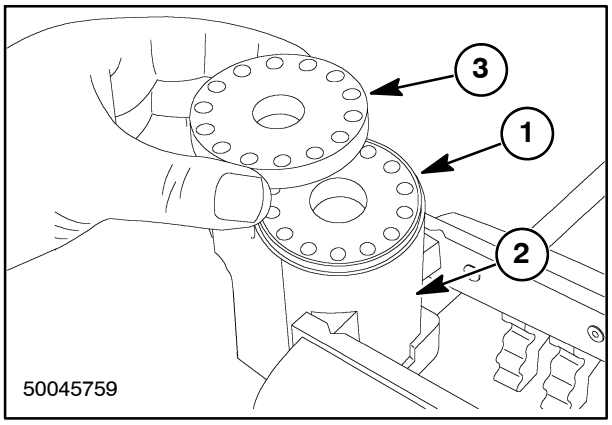
IMPORTANT: *Do not overtighten the housing in the vise. Housing damage may result.*

13. Clamp the housing, 1 in a vise, 2. Use just enough clamping force to hold the housing securely.



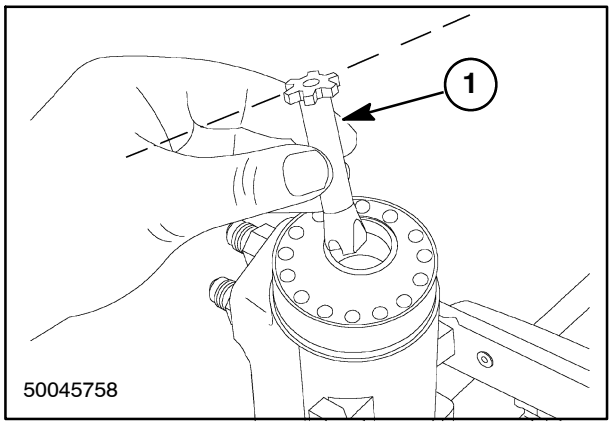
40

14. Lubricate a new O Ring, 1, with petroleum jelly and install in the groove of the housing, 2.
15. Install the wear plate, 3, onto the housing. Be sure to align the holes as well as the paint marks made during disassembly.



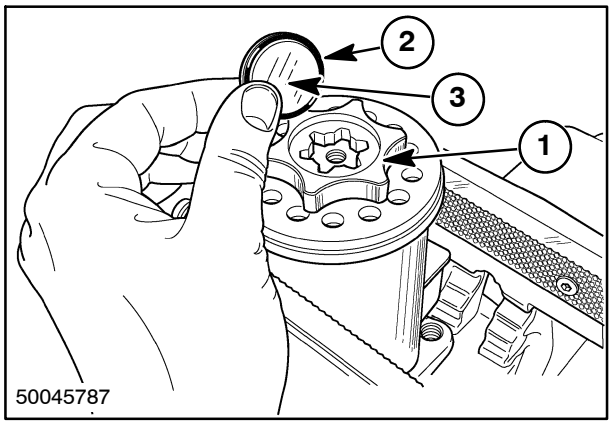
41

16. Install the drive shaft, 1. Be sure to engage the slot in the drive shaft with the pin.



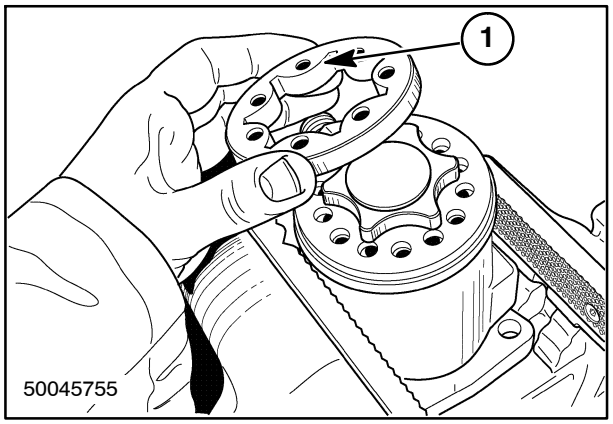
42

17. Install the rotor, 1, onto the drive shaft.
18. Lubricate a new O Ring, 2, with petroleum jelly and install into the groove on the spacer plate, 3.
19. Install the spacer plate, 3.



43

20. Lubricate a new O Ring, with petroleum jelly and install into the groove on the gerotor ring, 1.
21. Install the gerotor ring, aligning the paint marks made during disassembly.



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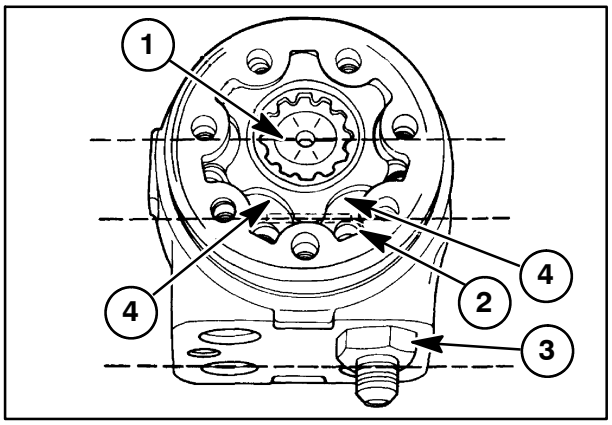
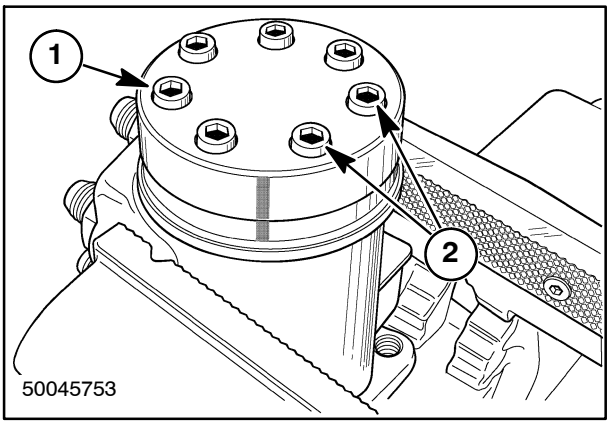
22. When the steering control motor is assembled properly, the components are in the correct timing position to allow the motor to function properly. The following areas should be aligned:
    - The port face, 3, of the housing
    - The pin, 2, through the spool and sleeve
    - The line, 1, drawn on the drive shaft
    - The middle of the two valleys, 4, in the rotor
23. If any of these areas are not aligned, the steering control motor will not operate properly.



45

24. Place the end cap, 1, on the housing. Make sure to align the paint marks.
25. Install the seven socket head cap screws, 2, and hand tighten.



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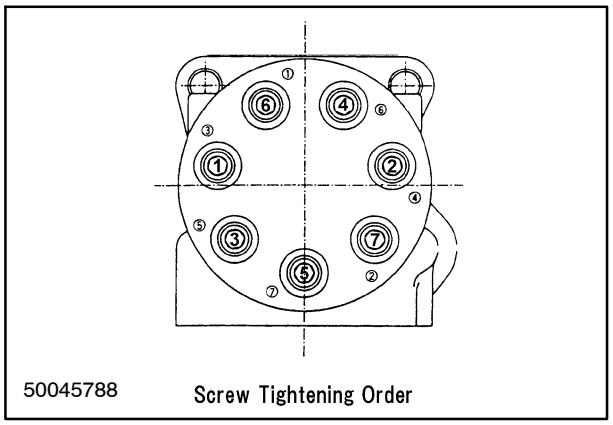
26. Snug the screws in a crisscross pattern evenly.
27. With the seven screws snugged evenly, use a torque wrench to tighten the screws in the same crisscross pattern to 9.8 N·m (86.7 in. lbs.).



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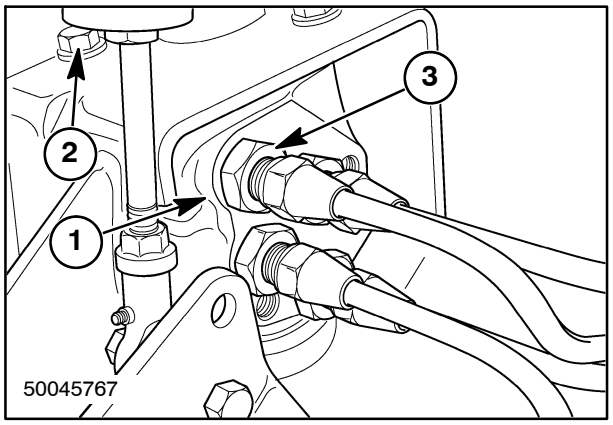
Installation

1. Install the steering control motor, 1, onto the steering column. Be sure to align the splines on the control motor input shaft, with the splines on the end of the steering column shaft.
2. Install and tighten the three mounting bolts, 2.
3. Turn the steering wheel left and right to check for freedom of movement. The spool should turn freely in the steering control motor.
4. Remove any caps and plugs on lines and ports.
5. Connect the power steering tubes, 3, to the steering control motor, 1.
6. Start the engine and turn the steering wheel from stop to stop until the relief valve begins to operate. This will purge any trapped air from the system.



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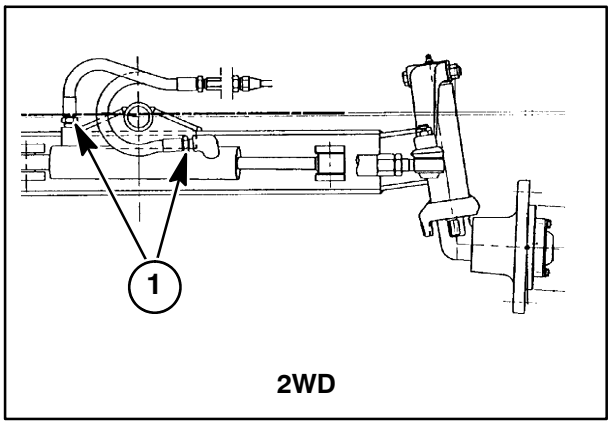
Op. 41 216

STEERING CYLINDER

Removal

1. Disconnect the steering hoses, 1, to the power steering cylinder and cap all openings.
2. Remove the cylinder from the tractor.



2WD

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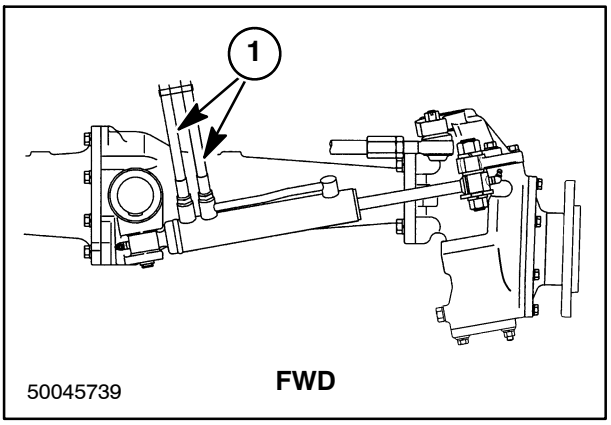
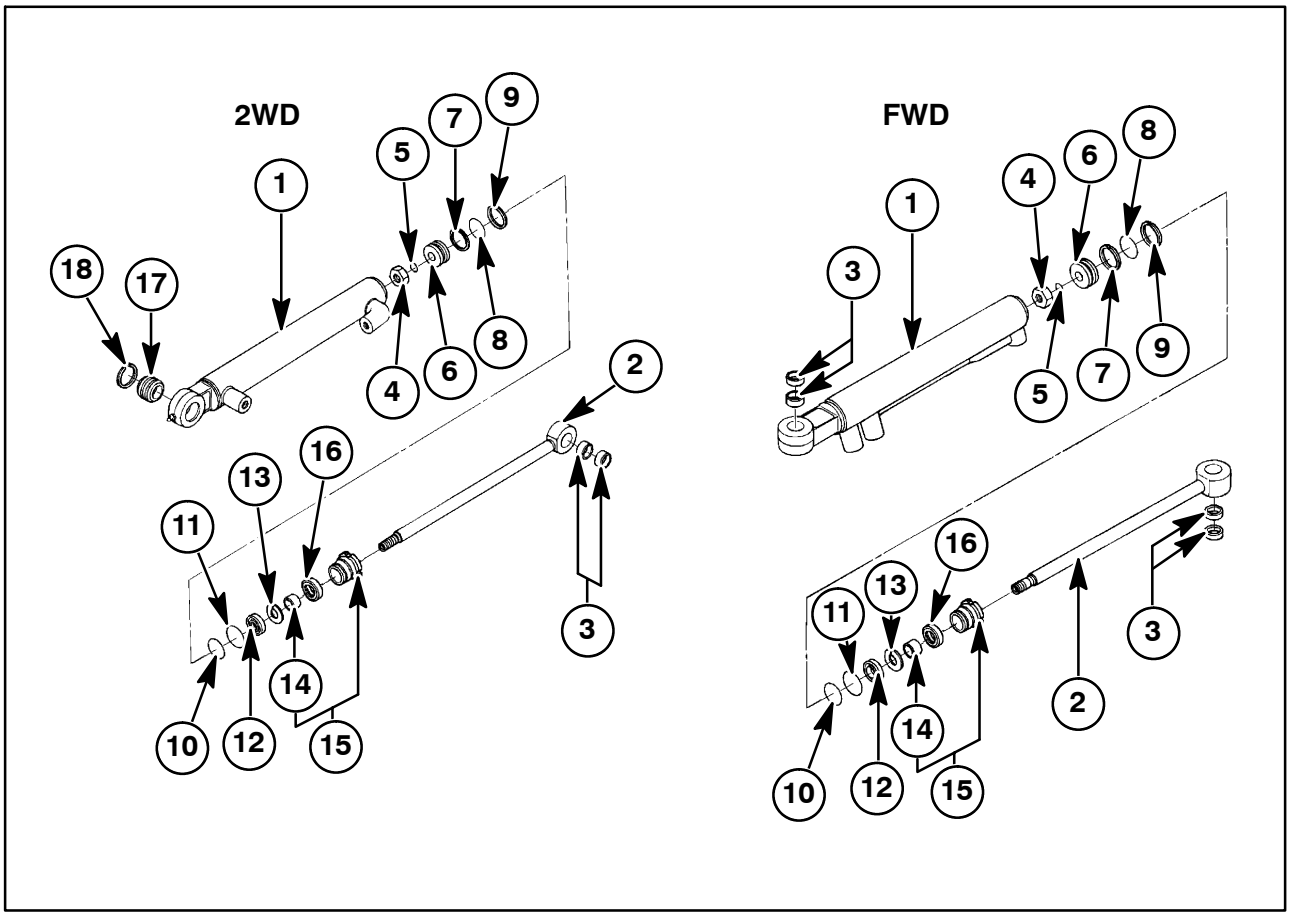


FWD

50



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1. Cylinder Tube
2. Piston Rod
3. Bushing
4. Nut
5. O Ring - Rod
6. Piston
7. Back-up Ring
8. O Ring - Piston
9. Back-up ring
10. O Ring - Cylinder Head
11. O Ring
12. U-Ring Seal
13. Back-up Ring
14. Bushing
15. Cylinder Gland Head Assembly
16. Wiper-Ring
17. Spherical Bearing
18. Snap Ring

Disassembly

1. Using a suitable chisel, straighten the cylinder tube crimping, 1, from the cylinder gland head, 15.
2. Using a spanner wrench, unscrew the cylinder gland head, 15, out of the cylinder tube. Pull the piston rod, 2, cylinder gland head, and piston assemblies, 6, out of the tube.
3. Remove the piston nut, 4, and O Ring, 5, from the rod, 2, and remove the piston assembly, 6 - 9.

Inspection

1. Inspect the inside of the tube for any scuffing or scarring, or unusual wear.
2. Inspect the piston for scuffing, score marks, or other damage.
3. Using micrometers, measure the inside diameter of the cylinder tube and the outside diameter of the piston to determine the working clearance. Replace if the clearance is in excess of 0.7 mm (0.028″).
4. Inspect the cylinder rod for excess wear, straightness, and scoring. Replace if damaged.
5. Inspect the anchor pins and bearings for excess wear and excessive clearance. Replace the anchor pins or bearings if the clearance in greater than 0.5 mm (0.019″).
6. Check the rod to cylinder gland head clearance. Replace the bushing if the clearance is in excess of 0.3 mm (0.012″).
7. On assembly replace all O Rings and seals with new ones.

Assembly

1. Install new bushings and O Rings, 10 - 16, on the cylinder gland head, 15, and insert the assembly over the piston rod.
2. Assemble the back-up rings and O Ring, 5 - 9, on the piston, 6, and install on the piston rod, 2. Tighten the piston nut to 35 N·m (26 ft. lbs.).
3. Insert the assembly into the cylinder tube, 1, and tighten the cylinder gland head, 15, to 127 N·m (94 ft. lbs.).
4. Crimp the end of the cylinder tube at the cylinder gland head to prevent the cylinder gland head from loosening.

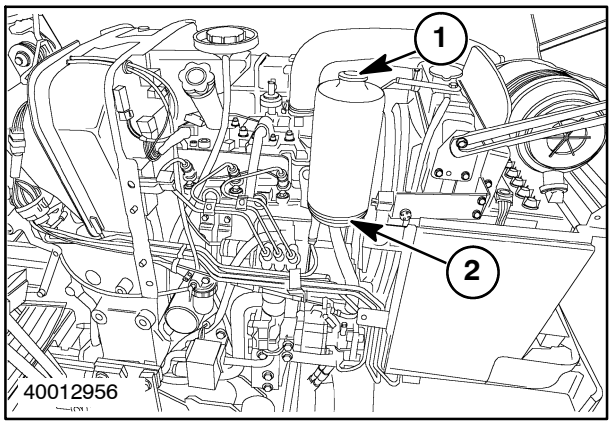
Installation

1. Install the cylinder on the tractor.
2. Using sealing tape connect the power steering hoses to the cylinder.
3. Start the tractor, operate the steering system, and check for any leaks.

POWER STEERING PUMP AND RESERVOIR TANK

Removal

1. Remove the reservoir tank dipstick-filler cap, 1.
2. Remove the drain plug, 2, and drain the fluid into a suitable container.



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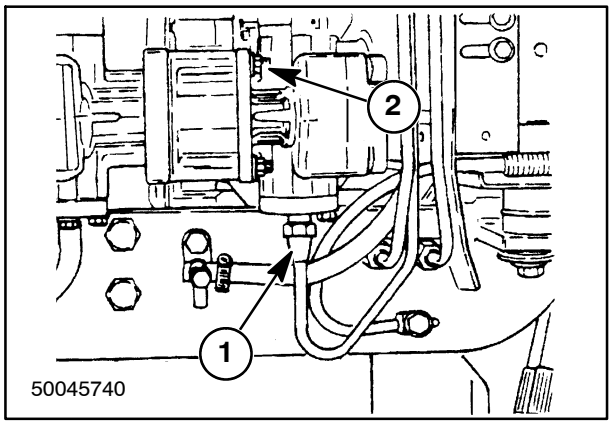
3. Loosen the hose clamp on the power steering pump suction tube and remove the suction hose.
4. Remove the pressure tube, 1, from the bottom of the steering pump.
5. Remove the through bolts, 2, and remove the steering pump from the timing gear cover.

   NOTE: *The only service that can be done to the power steering pump is to replace the seals and rings. If any other part of the pump is damaged the entire unit must be replaced.*



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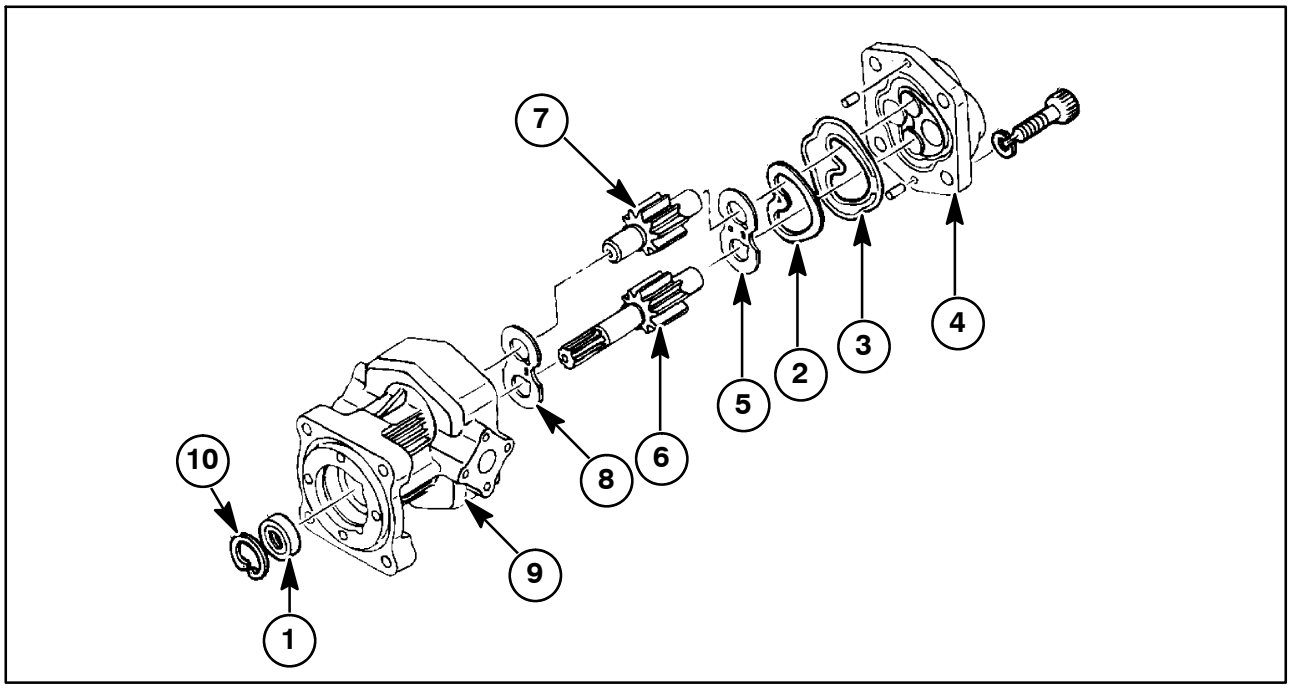

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Disassembly

1. Place the pump in a soft jawed vice with the drive shaft facing downward.
2. Scribe a line on the pump body for ease in assembly.
3. Remove the six bolts securing the cover to the pump and remove the cover, 4.
4. Remove the seal ring, 3, back-up ring, 2, and outer wear plate, 5.
5. Remove the drive, 6, and driven gears, 7, from the housing, 9.
6. Using a brass hook, or dental pick, remove the inner wear plate, 8, from the pump housing.
7. Remove the snap ring, 10 and shaft seal, 1, from the pump housing, 9.

Inspection and Repair

1. Wash all parts in a clean solvent and air dry.
2. Discard all used rings and seals and replace with new.
3. Inspect all parts for damage or wear. If any part of the pump is found defective, replace the entire assembly.

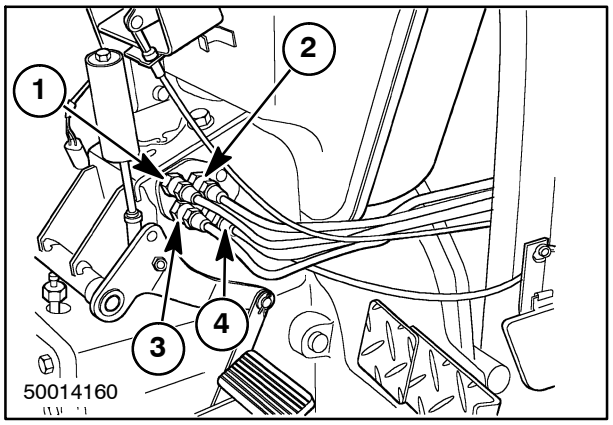
Assembly

NOTE: *Use the scribe marks made during disassembly to assemble the pump in its original orientation.*

1. Install a new shaft seal, 1, in the pump housing, 9.
2. Install inner wear plate, 8.
3. Install the drive, 6, and driven, 7, gears in the housing, 9.
4. Install new back-up ring, 2, seal ring, 3, and outer wear plate, 5.
5. Install the pump cover, 4, and secure with the six retaining bolts. Torque the bolts to 21 - 27 N·m (16 - 20 ft. lbs.).

POWER STEERING LINES

The power steering lines should not be switched with any other tractor. All mounting clamps should be correctly installed and properly secured to prevent loosening.



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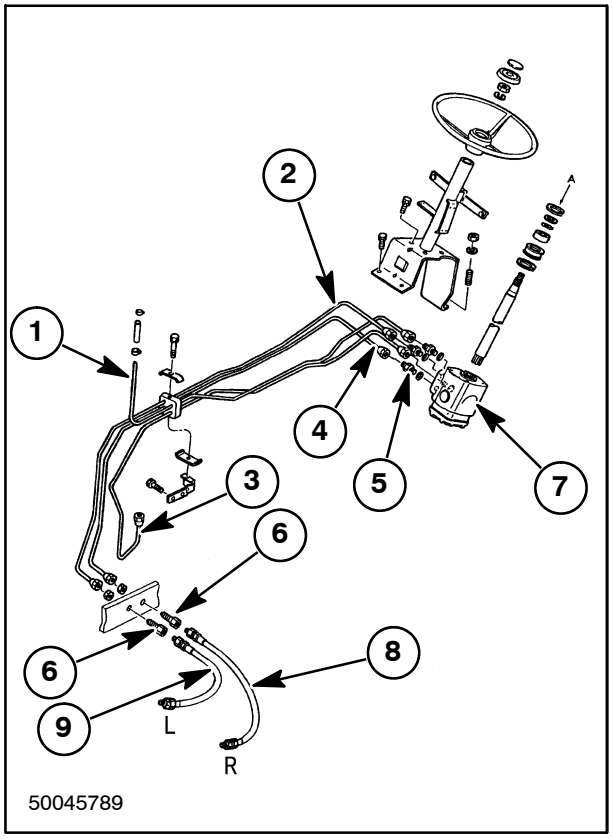
1. Return Line to Tank
2. Left Turn Line
3. Pressure Line
4. Right Turn Line

Inspection

1. Inspect the oil hoses, 8 and 9, for cracks, leaks, or other damage.
2. If hoses need to be replaced, wind new hose with thread sealant and tighten.



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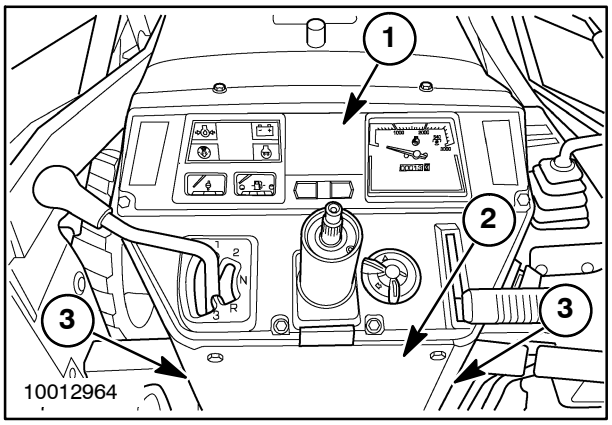
1. Oil piping: T
2. Oil piping: L
3. Oil piping: P
4. Oil piping: R
5. Adapter (4)
6. Adapter (2)
7. Steering case
8. Oil hose: R
9. Oil hose: L

STEERING COLUMN

Removal and Disassembly

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Loosen the instrument panel, 1, from the console.
3. Disconnect the tachometer cable and wire harnesses to remove the instrument panel, 1, from the operator console.
4. Remove the rear cover, 2, from the operator console.
5. Remove the left and right side covers, 3, from the operator console to gain access to the steering linkage.
6. Disconnect the throttle linkage, 1, from the steering column assembly, 2.
7. Remove the HST neutralizer assembly, 3, and if so equipped, the HST speed lock (cruise control) assembly, 4, from the steering column assembly, 2.



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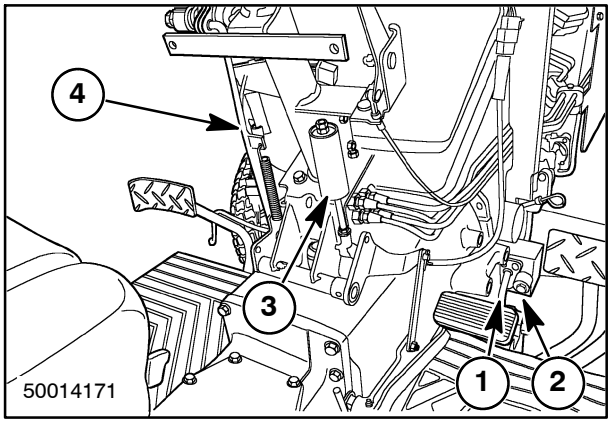

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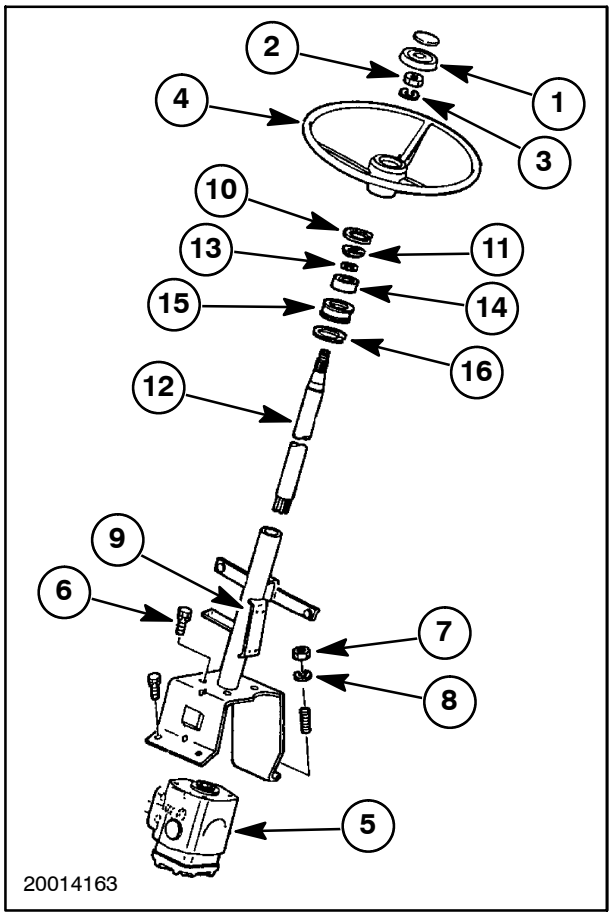
8. Remove the steering wheel center cap, 1, to gain access to the retaining nut, 2.
9. Remove the retaining nut, 2, with lock washer, 3, and use a puller to remove the steering wheel, 4, from the steering column.
10. Place a block of wood under the steering motor, 5, for support.
11. Remove the retaining bolts, 6, the hex nuts, 7, and lock washers, 8, to remove the steering column assembly, 9, from the tractor.
12. Remove the snap ring, 10, to remove the spacer, 11, and the steering shaft, 12, from the steering column assembly, 9.
13. Remove the snap ring, 13, the bearing, 14, the rubber isolator, 15, and the snap ring, 16, from the steering shaft, 12.
14. Inspect all steering components for wear or damage and replace as necessary.



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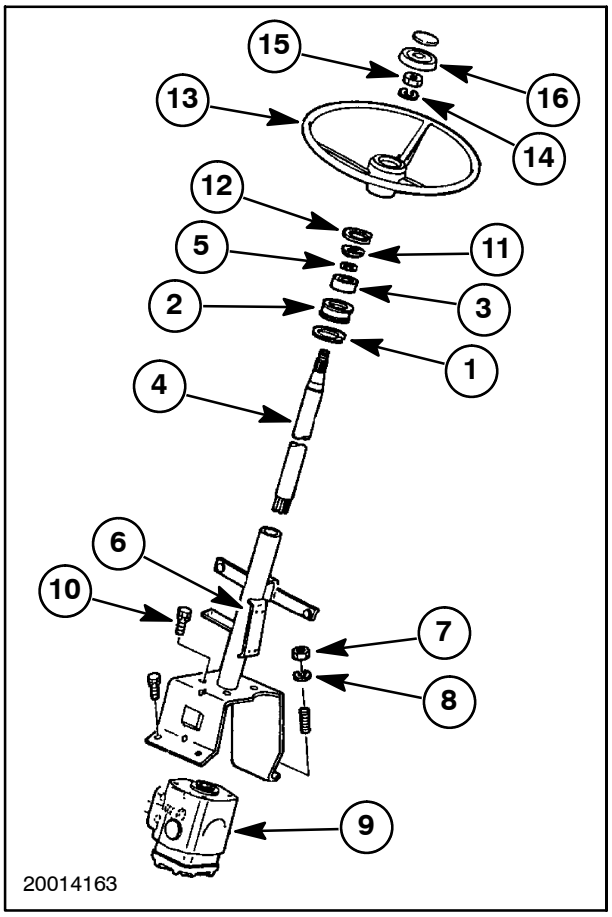
Assembly and Installation

1. Slide the snap ring, 1, the rubber isolator, 2, and the bearing, 3, onto the steering shaft, 4, and secure by using the snap ring, 5.
2. Install the steering column assembly, 6, by using the hex nuts, 7, with lock washers, 8.

   NOTE: *Make sure the steering shaft teeth align with the steering motor teeth before installing.*
3. Apply anti-seize compound to the end of the steering shaft. Carefully insert the steering shaft, 4, through the steering column assembly, 6 and into the steering motor, 9. Thread the retaining bolts, 10, into the motor. Do not tighten at this point.
4. Slide the spacer, 11, onto the end of the steering shaft, 4, and secure by using the snap ring, 12.
5. Rotate the steering shaft to ensure proper alignment with the steering motor. Tighten the retaining bolts, 10.
6. Apply anti-seize compound to the threads on the steering shaft, 4.
7. Install the steering wheel, 13, by using the lock washer, 14, and hex nut, 15. Torque retaining nut to 29.8 N·m (22 ft. lbs.).
8. Install the steering wheel center cap, 16.
9. Install the Rear, Left, and Right, operator console covers onto the tractor.
10. Connect the tachometer and instrument panel wire harness to the instrument panel.
11. Install the instrument panel.
12. Connect the negative (-) battery cable to the negative (-) battery terminal.



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TROUBLESHOOTING

Most malfunctions in the steering system can usually be traced to dirt or foreign matter in the system. Dirt can cause such things as stickiness, erratic operation, or hard steering.

Before considering the procedures below, follow these suggested steps:

1. Check the pump for proper relief valve action. See “Pressure Testing,” discussed later in this section.
2. Jack the front end of the tractor off the ground and cycle the steering from stop to stop to check for front axle binding.
3. Be sure the hydraulic hoses from the pump-to-motor and from the motor-to-cylinder are hooked up correctly.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Steering	1. ORBITROL (control valve unit)	
	(1) ORBITROL not aligned to steering column.	Reposition ORBITROL. (If loosening its mounting bolts lightens the handwheel, it means that ORBITROL was in misalignment.)
	(2) Spool-and-sleeve combination is seized because of foreign matter.	Replace.
	(3) Overtightening of the end cap bolts.	Re-tighten to the specified torque limit.
	2. Oil pump	
	(1) The pump is stuck and will not work.	Replace oil pump.
	(2) The pump is worn down.	Replace oil pump.
	(3) Pumping performance inadequate.	Test pump performance and, if necessary, remove the pump. Disassemble the pump and inspect the internal seals. Refer to the pump seal kit repair section.
	3. Relief valve	
	(1) The valve is damaged because of internal deterioration.	Replace control valve assembly.
	(2) Pressure setting is too low.	Replace control valve assembly.
Steering Wheel Will Not Return To Neutral Or Will Turn By Itself	1. ORBITROL	
	(1) Spool-and-sleeve combination is stuck and will not rotate.	Replace control valve assembly.
	(2) ORBITROL not aligned to steering column.	Re-align.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Cylinder Will Not Follow Steering Wheel Rotation Or Will Respond Sluggishly.	1. ORBITROL	
	(1) ORBITROL has been improperly rebuilt, resulting in valve mistiming.	Repair.
	2. Steering cylinder	
	(1) Air is trapped in the cylinder.	Bleed air out.
	(2) Internal oil leakage because of damaged piston seal.	Replace the seal.
Steering Wheel Will “Kick Back.”	1. ORBITROL	
	(1) ORBITROL has been improperly rebuilt, resulting in valve mistiming.	Repair.
	2. Piping	
	(1) Pipes are improperly connected to the four ports of ORBITROL.	Correct the pipe connections.
Oil Leakage	1. Leaky oil seal	Replace oil seal.
1. From the splined connection of column to spool.	(1) Dirty hydraulic oil.	Change the oil.
2. From mated face joints (valve body, spacer plate, ORBITROL, end cap.)	2. Damaged O Ring	Replace.
	(1) A pinched or damaged O Ring in a mated face joint can be the cause, which resulted from lack of attention in reassembling the ORBITROL.	

PRESSURE TESTING

PUMP, STEERING MOTOR, AND RELIEF VALVE

Test

1. With the tractor engine stopped, disconnect one of the hydraulic lines that run to the steering cylinder.
2. Connect a tee fitting, 3, and a 0 - 3000 psi pressure gauge, 4, to the end of the line from the steering motor, 1, and cap the line leading to the steering cylinder, 2.

   NOTE: *Figure 55 identifies the power steering lines.*
3. Install a male end cap, 2, into the open end of the tee.
4. Start the tractor engine, and allow it to high idle. Observe the pressure gauge, it should indicate 0 psi.
5. Turn the steering wheel so that the line which the gauge is connected to receives steering pump fluid pressure intended for the steering cylinder. For example, if the gauge is connected to the left side of the cylinder, as viewed from the operator's seat, turn the wheel to the left. Observe the gauge and the following:

Test Results

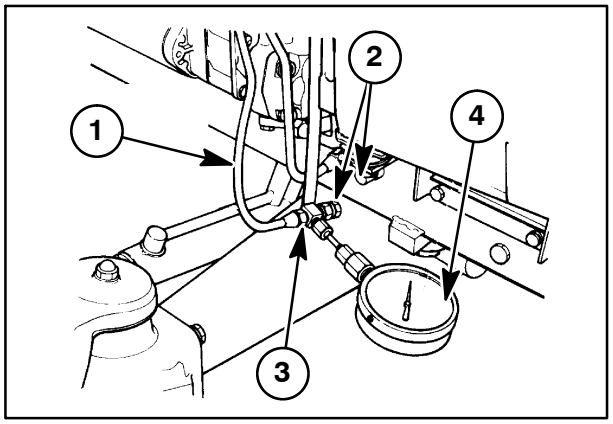
If the pressure gauge reading rises before the steering wheel is turned, it indicates that the steering motor will have to be disassembled and inspected.

If the pressure gauge reading to the relief valve setting of 97.9 - 103.5 bar (1420 - 1500 psi), when the steering wheel is turned, the steering pump relief valve is working properly.

If the pressure gauge reading is below the relief valve setting, it may indicate that the relief valve is not working properly, or the pump parts are worn.

6. Stop the tractor engine.

   NOTE: *The steering system relief valve is located on the top side of the steering motor. Rotate the relief valve cap clockwise to increase the pressure and counterclockwise to decrease the pressure, Figure 29.*



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1. Steering Motor to Steering Cylinder Line
2. Caps Male Plug FNH00009
   Female Cap FNH00010
3. "Tee" Fitting (FNH11451)
4. 0 - 3000 psi Pressure Gauge OEM1462

STEERING CYLINDER

Test

After testing the steering motor relief valve, set up the system as follows to test the steering cylinder:

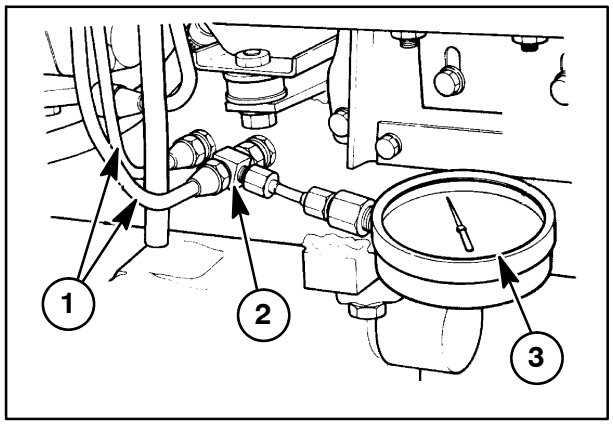
1. Remove the caps from the tee fitting and steering cylinder connections.
2. Attach the tee fitting to the steering cylinder connection.
3. Start the tractor engine and turn the steering wheel so that the line which the gauge is connected to will receive the fluid pressure from the pump. Observe the gauge when the steering linkage reaches the limit of its travel.

   NOTE: *Figure 55 identifies the power steering lines.*
4. Repeat the procedure for the other side of the cylinder. Observe the following:

Test Results

If the pressure rises to the relief valve setting of 97.9 - 103.5 bar (1420 - 1500 psi) at both stops, it indicates that the system is operating properly.

Repeat the procedure for the other side of the cylinder.



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1. Steering Motor to Steering Cylinder Lines
2. “Tee” Fitting (FNH11451)
3. 0 - 3000 Psi Gauge OEM1462

SPECIFICATIONS

OIL PUMP CAPACITY . . . . . 26 lpm (6.8 gpm) @ 2800 Engine rpm

POWER STEERING TYPE . . . . . Full Hydraulic

STEERING CYLINDER

- Stroke - 2WD . . . . . 187 ± 1.25 m (7.36 ± 1/16 in.)
- Stroke - FWD . . . . . 185 ± 1.25 mm (7.28 ± 1/16 in.)
- Inside Diameter . . . . . 35 mm (1.38 in.)

RELIEF VALVE PRESSURE

- All Models . . . . . 97.9 - 103.5 bar (1420 -1500 psi)

OIL SPECIFICATIONS . . . . . Ambra Multi G 134

STEERING CYLINDER

- Piston-to-Tube Clearance . . . . . 0.7 mm (0.027 in.) max.
- Anchor Pin-to-Bushing Clearance
  - Piston Rod Eye . . . . . 0.5 mm (0.020 in.) max.
  - Tube Eye . . . . . 0.5 mm (0.020 in.) max.
- Cylinder Rod-to-Gland
  - Bushing Clearance . . . . . 0.3 mm (0.012 in.) max.

TORQUE SPECIFICATIONS

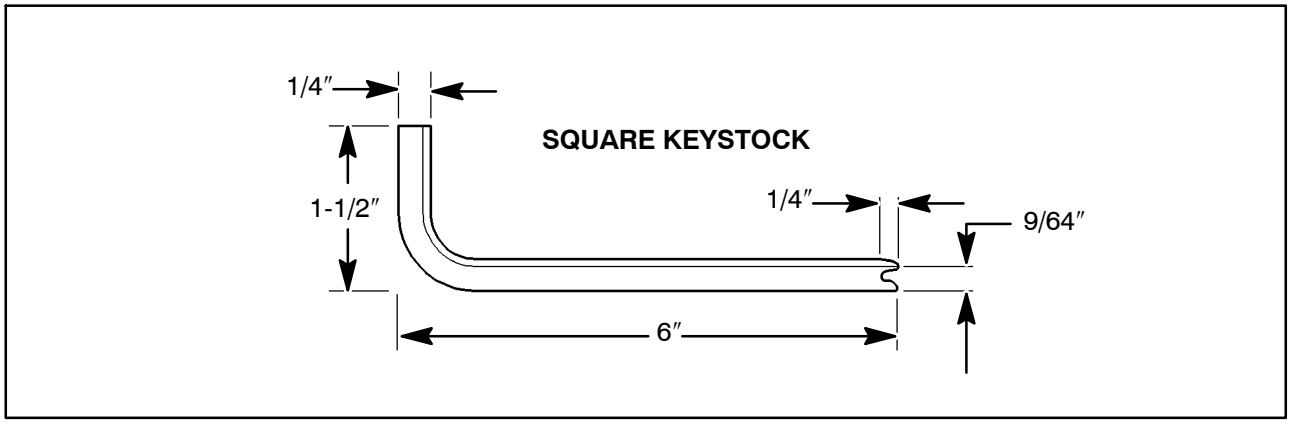
- Power Steering Cylinder Gland Head . . . . . 127 N·m (94 ft. lbs.)
- Power Steering Cylinder Piston Nut . . . . . 35 N·m (26 ft. lbs.)

ANCHOR PIN RETAINING BOLT . . . . . 12 - 16 N·m (9 - 12 ft. lbs.)

POWER STEERING PUMP BOLTS . . . . . 21 - 27 N·m (16 - 20 ft. lbs.)

SPECIAL TOOLS

	Tool No.
Gauge 0 - 3000 psi	OEM 1462
Hose	Procure Locally
Tee Fitting	FNH11451
Male Plug	FNH00009
Female Cap	FNH00010



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NOTE: *Manufacture tool according to dimensions above.*

BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Foot· Pounds	Newton-Meter	Pitch (mm)	Foot· Pounds	Newton-Meter
M6	4T	1.0	3.6–5.1	4.9–6.9	---	---	---
	7T		6.1–8.3	8.3–11.3			
	10T		8.7–11.6	11.8–15.7			
M8	4T	1.25	9.4–12.3	12.7–16.7	1.0	11.2–14.8	15.2–20.1
	7T		16.6–21.0	22.6–28.4		19.5–25.3	26.5–34.3
	10T		21.0–26.8	28.4–36.3		22.4–29.7	30.4–40.2
M10	4T	1.5	18.8–24.6	25.5–33.3	1.25	21.0–26.8	28.4–36.3
	7T		32.5–41.2	44.1–55.9		36.2–46.3	49.0–62.8
	10T		39.8–51.4	53.9–69.6		42.7–54.2	57.9–73.5
M12	4T	1.75	27.5–34.7	37.3–47.1	1.25	31.8–40.5	43.1–54.9
	7T		48.5–61.5	65.7–83.4		55.0–69.4	74.5–94.1
	10T		68.0–85.4	92.2–116		73.1–93.3	99.0–127
M14	4T	2.0	46.3–59.3	62.8–80.4	1.5	51.4–64.4	69.6–87.3
	7T		76.7–96.9	104–131		86.1–109	117–148
	11T		102–129	139–175		108–137	147–186
M16	4T	2.0	63.6–81.0	86.3–110	1.5	67.3–84.6	91.2–115
	7T		110–136	140–184		116–142	157–192
	11T		152–188	206–255		163–199	221–270
M18	4T	2.0	83.9–104	114–141	1.5	96.9–120	131–163
	7T		145–174	196–235		170–206	230–279
	11T		203–246	275–333		221–271	299–368
M20	4T	2.5	106–132	144–141	1.5	127–156	172–211
	7T		177–213	240–289		203–246	275–333
	11T		268–325	363–441		293–358	397–485

SECTION 44 - WHEELS, TIRES AND 2WD AXLE

Chapter 1 - 2WD Front Axle and Related Parts

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	Removal and Disassembly	4
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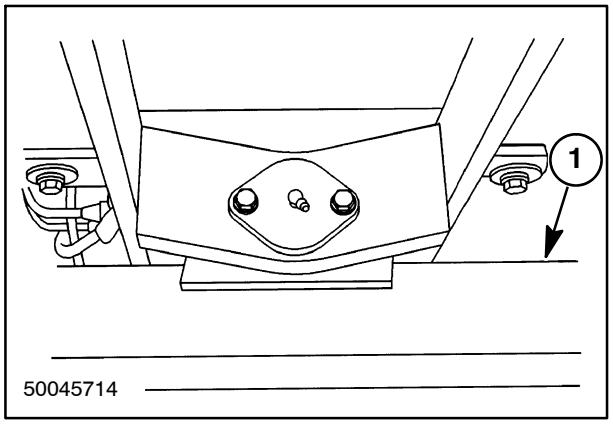
DESCRIPTION OF OPERATION

Op. 44 101

TWO-WHEEL DRIVE

A fixed, non-adjustable 2WD front axle, 1, is standard equipment on the Model TC30 tractors.

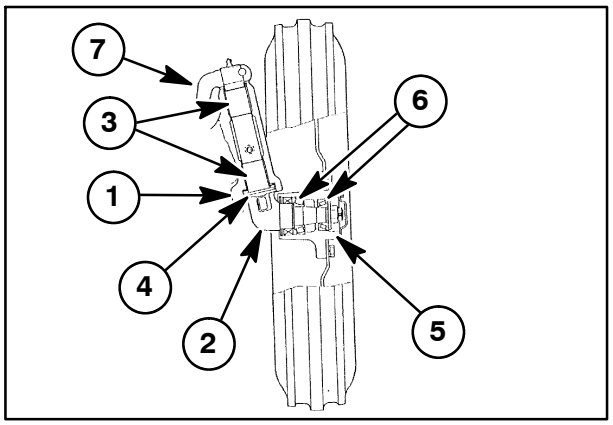
The center section is mounted centrally to the engine support by a pivot shaft. The axle rotates on the pivot shaft, thereby maintaining the tractor chassis in a level position and ensuring stable operation even on irregular ground.



1

The outer ends of the front axle accept the front wheel spindles, 2. The spindles are located by bushings, 3, in the outer axle sections, 1, and a thrust bearing, 4, at the lower end of the axle section supports the vertical load. The spindle acts as the king pin and keeps a constant inclination to the axle.

The top of the wheel spindles are splined to accept the spindle arms, 7, which are securely clamped. The spindle arms provide the means for interaction with the power steering system control linkage. The front wheel hub, 5, is supported on the wheel spindle by two opposing tapper roller bearings, 6.



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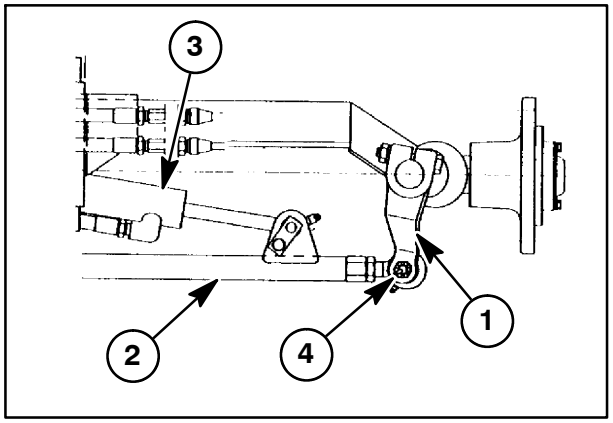
1. Outer Axle Assembly
2. Spindle (King Pin)
3. Spindle Bushings (2)
4. Thrust Bearing
5. Hub
6. Taper Bearings
7. Spindle Arm

A castle nut, 4, on the spindle is used to retain the outer cone and roller bearing assembly and provide a means of adjustment for the bearing pre-load.

The right and left spindle arms, 1, are connected together with an adjustable tie rod, 2. The tie rod adjustment is also utilized for making toe-in adjustments. The power steering cylinder, 3, is located between the front axle and the tie rod.



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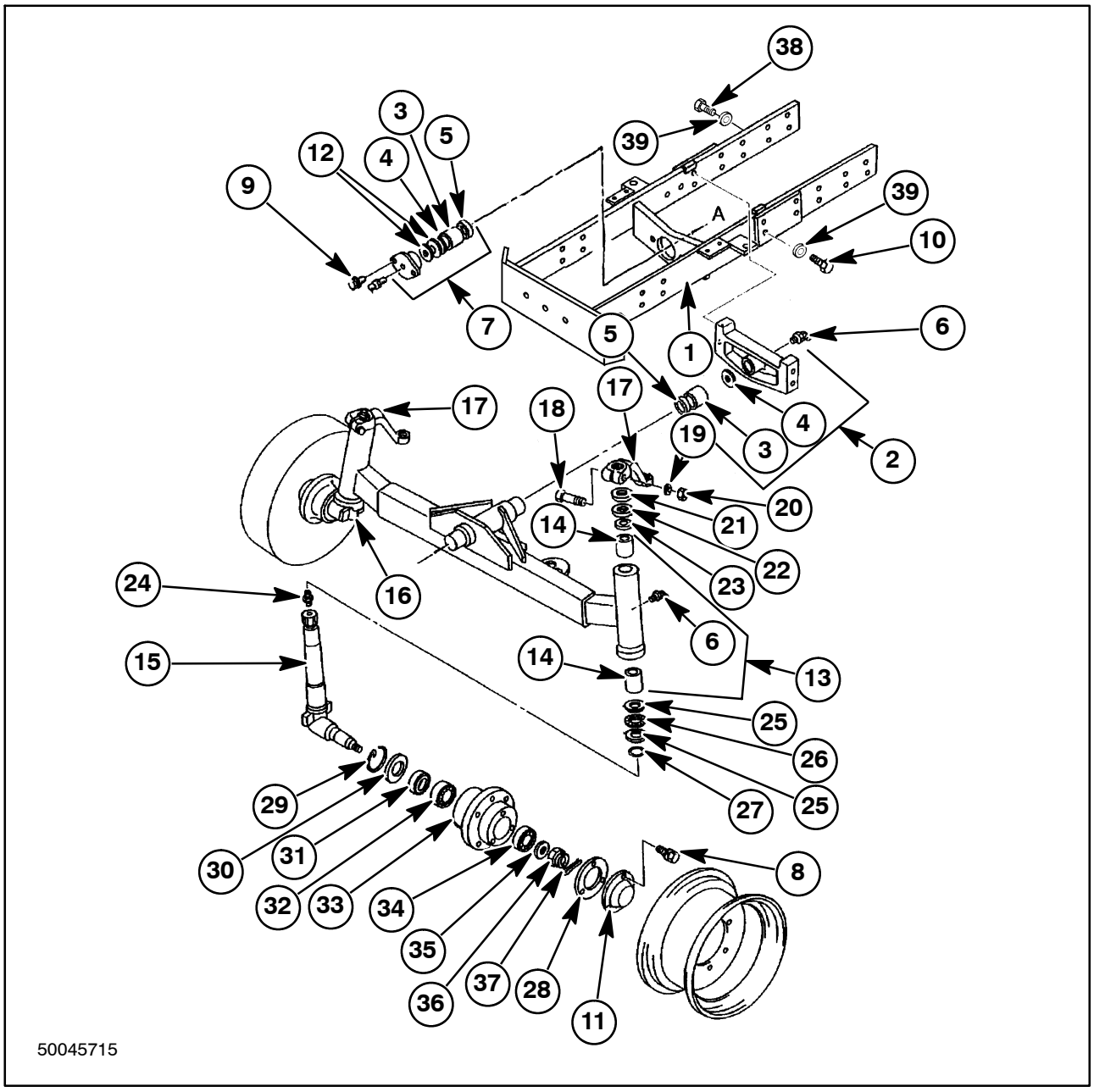
TWO-WHEEL DRIVE COMPONENTS



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1. Front Axle Support
2. Casing Assembly (Rear)
3. Bushing
4. Thrust Washer
5. Oil Seal
6. Grease Nipple
7. Casing Assembly (Front)
8. Bolt, M6 x 12
9. Bolt, M10 x 25
10. Bolt, M14 x 1.5 x 45
11. Wheel Cap
12. Shims, 0.2T, 0.5T
13. Shaft Assembly
14. Bushing
15. Kingpin, LH
16. Kingpin, RH
17. Spindle Arm
18. Bolt
19. Spring Washer
20. Nut
21. Spacer
22. Shim, 0.5T
23. Oil Seal
24. Grease Nipple
25. Thrust Washer
26. Needle Thrust Bearing
27. O ring
28. Gasket
29. Clip
30. Spacer
31. Oil Seal
32. Tapered Roller Bearing
33. Front Wheel Hub
34. Tapered Roller Bearing
35. Spacer
36. Castle Nut
37. Split Pin
38. Bolt, M14 x 1.5 x 40

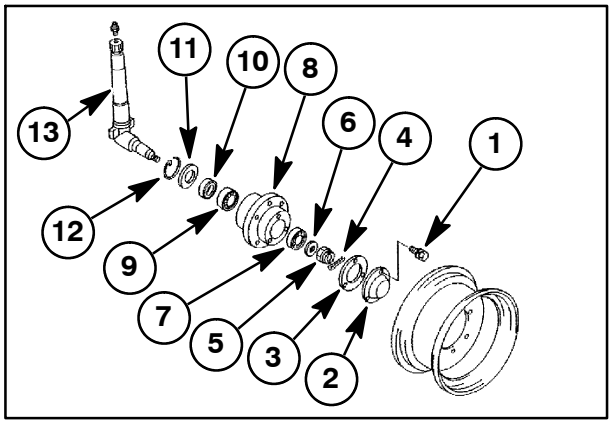
OVERHAUL

FRONT WHEEL HUB

Removal and Disassembly

1. Remove the power steering cylinder from the front axle tie rod. See “Steering,” Section 41.
2. Remove the front axle from the tractor. See “Separating the Tractor,” later in this chapter.

   NOTE: *Check the axle end play prior to removal from the support. See “Inspection,” later in this section.*
3. Remove the front wheels from the axle hub, 8.
4. Remove bolts, 1, wheel cap, 2, and gasket, 3.
5. Remove cotter pin, 4, and remove the castle nut, 5, and spacer, 6.
6. Withdraw the hub, 8, and bearing assembly from the king pin, 13.
7. Remove the outer bearing, 7, from the hub.
8. Remove the clip, 12, and remove spacer, 11, oil seal, 10, and tapered bearing, 9.



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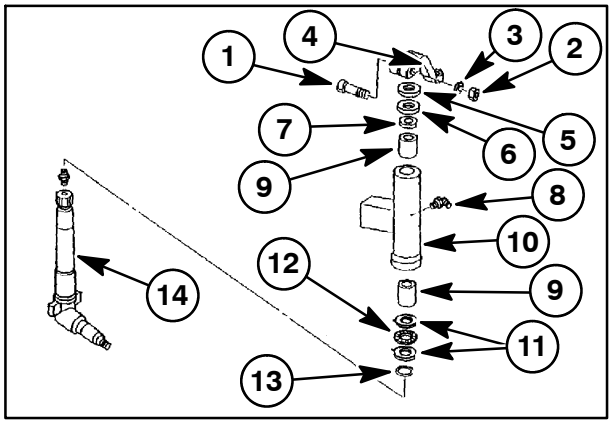
SPINDLE

Removal and Disassembly

1. Loosen and remove the nut, 2, washer, 3, and bolt, 1, from the spindle arm, 4.
2. Remove the upper spacer, 5, shim, 6, oil seal, 7, and bushing, 9, from the spindle (kingpin), 14.
3. Remove the spindle, 14, from the axle shaft assembly, 10.
4. Remove the bushing, 9, thrust washers, 11, thrust bearing, 12, and O ring, 13, from the spindle.



6

1. Bolt
2. Nut
3. Washer
4. Spindle Arm
5. Spacer
6. Shim 0.5T
7. Oil Seal
8. Grease Fitting
9. Bushing
10. Axle Shaft Assembly
11. Thrust Washer
12. Thrust Bearing
13. O ring
14. Kingpin

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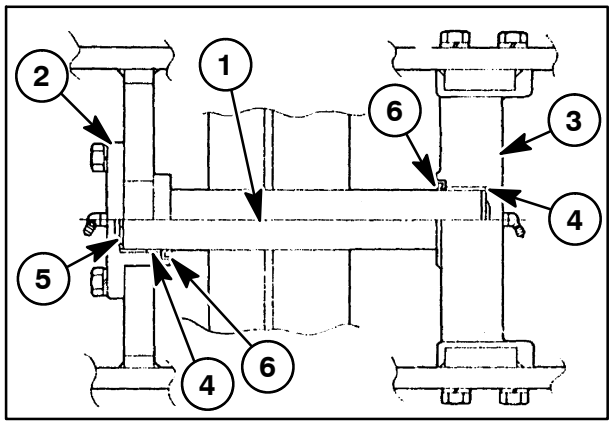
FRONT WHEEL HUB AND SPINDLE

Inspection and Repair

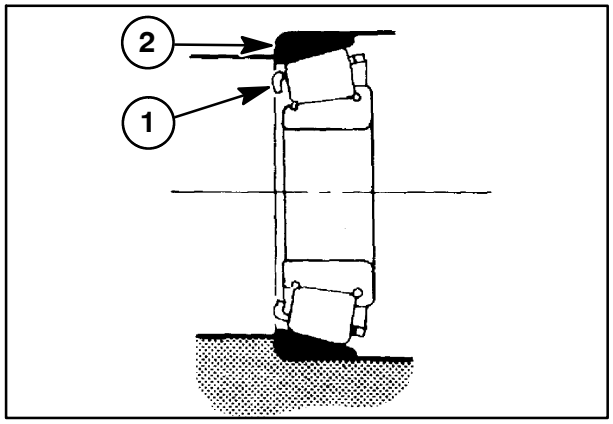
1. Clean all parts in a suitable solvent and air dry.
2. Check the end play of the front axle pivot shaft. Use a dial indicator to measure the end play clearance. If end play is greater than 0.5 mm (0.020″) add shims to front of pivot shaft.
3. Measure the pivot bearing journal diameter and the bushing inside diameter and determine the working clearance. Replace the bushings if the clearance exceeds 0.3 mm (0.012″).



7

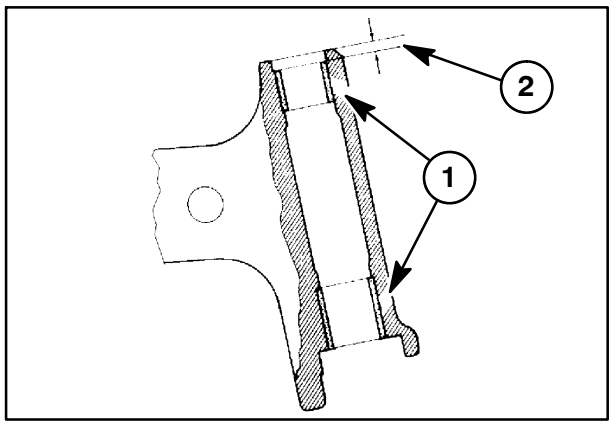
1. Pivot Pin
2. Casing - Front
3. Casing - Rear
4. Bushing
5. Shims
6. Oil Seal

4. Inspect the front wheel hub bearings for wear or damage. Replace bearings exhibiting uneven rotation when rotated by hand. Replace both the bearing race, 2, and bearing, 1, if either are found defective.



8

5. Inspect spindle bushing for excess wear or damage. Replace bushings not meeting the requirements shown in this Figure, or that are found to be damaged.
6. Inspect the spindle shaft and axle bearing journals for excess wear or damage. Replace if required.
7. Replace all oil seals and O rings during assembly.



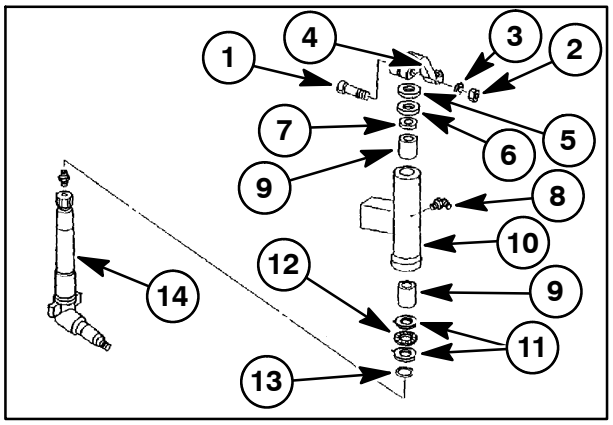
9

1. Bushings
2. Recess Depth - 5 - 7 mm (0.197 - 0.276″)

SPINDLE

Assembly and Installation

1. Thoroughly lubricate all components during assembly.
2. Install a new O ring, 13, thrust washer, 11, thrust bearing, 12, thrust washer, 11, and bushing, 9, on the spindle shaft (kingpin), 14.
3. Insert the spindle into the axle assembly and install bushing, 9.
4. Using a suitable installer tool, install the oil seal, 7, being sure to position the seal with the lips facing up.
5. Install shim, 6, spacer, 5, and spindle arm, 4, on the spindle shaft (kingpin), 14.
6. Install bolt, 1, washer, 3, and nut, 2. Tighten to specified torque. See “Bolt Torque Specifications,” discussed later in this section.



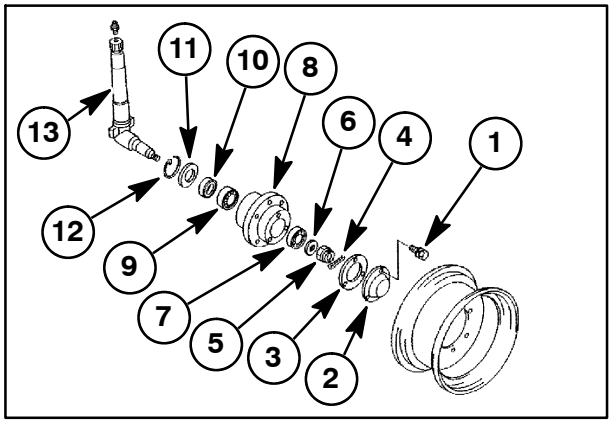
10

1. Bolt M12 x 70
2. Nut
3. Washer
4. Spindle Arm
5. Spacer
6. Shim 0.5T
7. Oil Seal
8. Grease Fitting
9. Bushing
10. Axle Shaft Assembly
11. Thrust Washer
12. Thrust Bearing
13. O ring
14. Kingpin

FRONT WHEEL HUB

Assembly and Installation

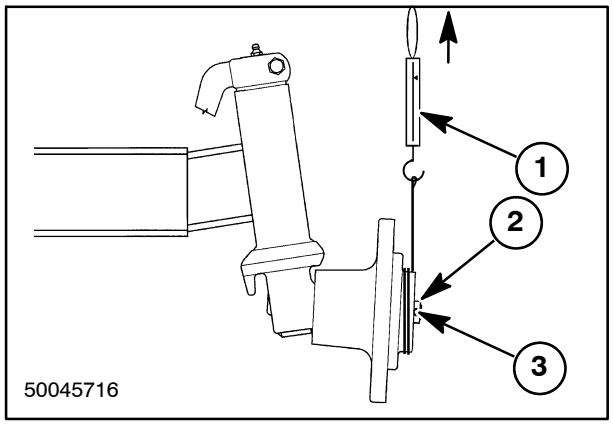
1. Pack the wheel hub bearings, 7 and 9, with grease.
2. Install bearing, 9, oil seal, 10, spacer, 11, and clip, 12, into the hub, 8.
3. Place the hub on the spindle and install taper bearing, 7, spacer, 6, and castle nut, 5, over the protruding spindle shaft into the hub.



11

1. Bolt M6 x 12
2. Wheel Cap
3. Gasket
4. Cotter Pin
5. Castle Nut
6. Spacer
7. Taper Bearing
8. Hub
9. Taper Bearing
10. Oil Seal
11. Spacer
12. Clip
13. King Pin

4. Tighten the castle nut, 2, while pulling slowly on the pull scale, 1, until a constant pull of 58.8 – 86.2 N (13.2 – 19.4 lbs.) is obtained while rotating the front wheel hub. Install a new cotter pin, 3.



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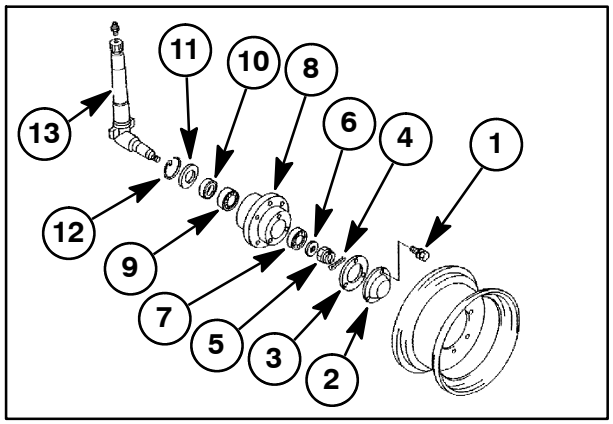
5. Using a new gasket, 3, install wheel cap, 2, and secure with bolts, 1.
6. Install the axle to the tractor. See “Separating the Tractor,” later in this chapter.
7. Position the tie rod ends to the spindle arms and secure with castle nut and cotter pin. Torque the castle nut to 199 - 235 N·m (146 - 173 ft. lbs.).

   NOTE: *Use care in installing the power steering cylinder and hoses. Be sure hoses do not touch or rub against frame parts during operation.*
8. Connect the power steering cylinder to the front axle tie rod. See “Steering,” Section 41.



13

1. Bolt M6 x 12
2. Wheel Cap
3. Gasket
4. Cotter Pin
5. Castle Nut
6. Spacer
7. Taper Bearing
8. Hub
9. Taper Bearing
10. Oil Seal
11. Spacer
12. Clip
13. King Pin

SEPARATING THE TRACTOR

FRONT AXLE – 2WD

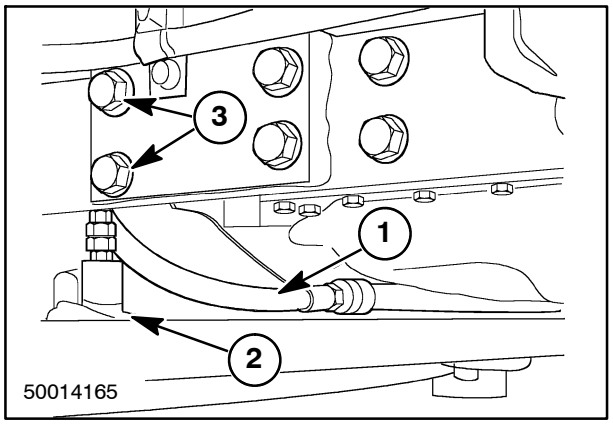
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two hoses, 1, from the power steering cylinder, 2, and cap all openings.
3. Position a floor jack under the transmission, to support the front end of the tractor.

⚠ CAUTION ⚠

Use safety jack stands to support the tractor. Otherwise, serious injury could result.

4. Disconnect the headlight wiring harness, 1.



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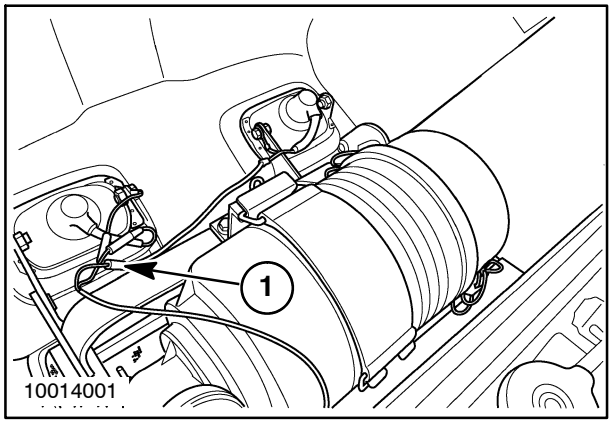

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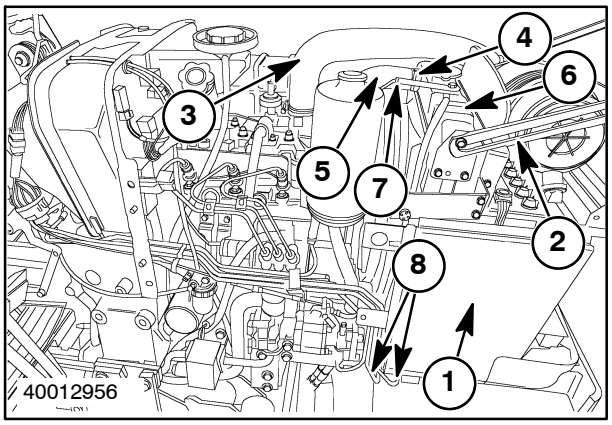
5. Open the hood and remove the two side screens and panels, 1.
6. Remove the hood support, 2, and the two hinge pins, to remove the hood from tractor.
7. Remove the air cleaner assembly, 3, from tractor.
8. Loosen the upper and lower radiator hose clamps, 4, remove the hoses, 5, from the radiator, 6.
9. Remove the radiator upper support brace, 7, located on the top of the radiator.



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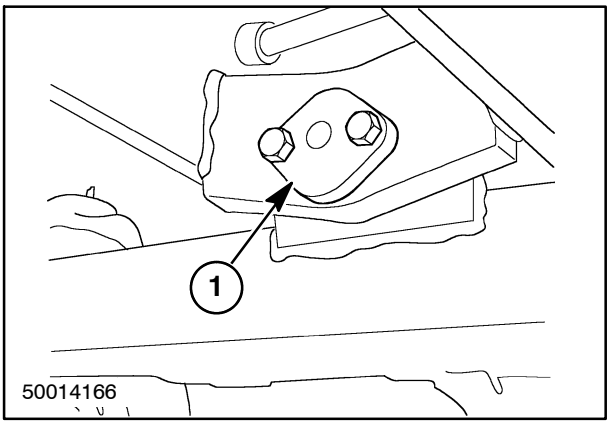
10. Remove the axle pivot front bearing casing, 1, from the tractor frame.
11. Remove the axle pivot rear support retaining bolts, 3, (refer to fig. 1).
12. Gently raise the front end of the tractor while separating the axle pivot from the front support.
13. Gently roll the front axle assembly forward until clear from the tractor.



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TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
Front Wheel Shimmy	1. Worn spindle shaft and/or bushings	1. Replace spindle shaft and/or bushings
	2. Worn pivot shaft and/or bushings	2. Replace pivot shaft and/or bushings
	3. Loose wheel hub nut	3. Tighten wheel hub nut
	4. Loose tie-rod	4. Tighten tie-rod
	5. Loose or damaged thrust bearing	5. Tighten or replace thrust bearing
	6. Loose spindle arm	6. Tighten spindle arm
Hard Steering	1. Spindle bushings lack lubrication	1. Apply lubrication to spindle bushings
	2. Damaged spindle shaft and/or bushings	2. Replace spindle shaft and/or bushings
	3. Worn or damaged thrust bearing	3. Replace thrust bearing
	4. Faulty power steering system	4. Inspect and repair power steering system
Loose Spindle	1. Worn bushing	1. Replace bushing
	2. Worn spindle shaft	2. Replace spindle shaft
	3. Worn or damaged thrust bearing	3. Replace thrust bearing

SPECIFICATIONS

TWO WHEEL DRIVE

King Pin Inclination (fixed)	0.08°
Toe-In	0 - 5 mm (0 - 3/16 in.)
Caster (fixed)	0°
Camber (fixed)	3°
Pivot Shaft to Bushing Clearance	0.02 - 0.15 mm (0.0008 - 0.006 in.)
Wear Limit	0.3 mm (0.012 in.)
Front Axle End Play - Maximum	0.2 mm (0.008 in.)
Shims Available	0.2 mm (0.008 in.) 0.5 mm (0.020 in.)
Ball Joint Torque	199 - 235 N·m (146 - 173 ft. lbs.)

BOLT TORQUE SPECIFICATIONS

		Coarse Thread			Fine Thread		
Bolt Size	**Grade No.**	**Pitch (mm)**	**Foot· Pounds**	**Newton· Meters**	**Pitch (mm)**	**Foot· Pounds**	**Newton· Meters**
M6	4T	1.0	3.6·5.1	4.9·6.9	—	—	—
	7T		6.1·8.3	8.3·11.3			
	10T		8.7·11.6	11.8·15.7			
M8	4T	1.25	9.4·12.3	12.7·16.7		11.2·14.8	15.2·20.1
	7T		16.6·21.0	22.6·28.4		19.5·25.3	26.5·34.3
	10T		21.0·26.8	28.4·26.3		22.4·29.7	30.4·40.2
M10	4T	1.5	18.8·24.6	25.5·33.3		21.0·26.8	28.4·36.3
	7T		32.5·41.2	44.1·55.9		36.2·46.3	49.0·62.8
	10T		39.8·51.4	53.9·69.9		42.7·54.2	57.9·73.5
M12	4T	1.75	27.5·34.7	37.3·47.1		31.8·40.5	43.1·54.9
	7T		48.5·61.5	65.7·83.4		55.0·69.4	74.5·94.1
	10T		68.0·85.4	92.9·11.6		73.1·93.3	99.0·127
M14	4T	2.0	46.3·59.3	62.8·80.4		51.4·64.4	69.6·87.3
	7T		76.7·96.9	104·131		86.1· 109	117·148
	10T		102·129	139·175		108·137	147·186
M16	4T	2.0	63.6·81.0	86.3·110		67.3·84.6	91.3·115
	7T		110·136	149·184		116·142	157·192
	10T		152·188	206·255		163·199	221·270
M18	4T	2.0	83.9·104	114·141		95.9·120	313·163
	7T		145·174	196·235		170·206	131·379
	10T		203·246	275·333		221·271	299·368
M20	4T	2.5	106·132	144·179		127·156	172·211
	7T		177·213	240·289		203·246	275·333
	10T		268·325	363·441		293·358	397·485

SECTION 44 - WHEELS, TIRES AND 2WD AXLE

Chapter 2 - Tread Settings and Ballasting

CONTENTS

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	Wheels and Tires – Tread Settings and Ballasting	2
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	FWD Tread Setting	2
	Rear Axle Tread Setting	3
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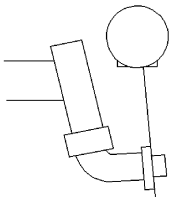
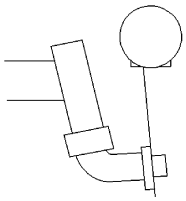
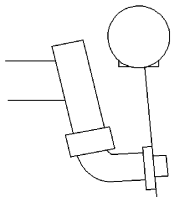
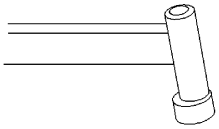
	Rear Wheel Weight Installation	5
	Ag. Tire	5
	R4 Tire (Weight Installed with Flat Side Facing Outward)	5
	Liquid Ballast	6
	Tire Pressure	6
	Wheel Nut Torque Specifications	6

WHEELS AND TIRES – TREAD SETTINGS AND BALLASTING

WHEEL POSITION / AXLE POSITION			
	AG TIRE 5.50-16		TURF TIRE 23 × 8.50-12
FIXED 	1016 mm (40″)	1074 mm (42.3″)	1082 mm (42.6″)

2WD

1

2WD TREAD SETTING

The front wheel tread setting on the Model TC30 2WD tractors, equipped with a fixed axle, is adjustable by reversing the front wheels only. Figure 1 provides the tread width setting for these models.

FWD TREAD SETTING

The front-wheel drive is available on all models. The front-wheel drive axle is non-adjustable and the front wheels must not be reversed. The FWD front wheel tread width is as follows:

FWD

Tire	Type	Tread Width
AGRI	7 - 14	1102 mm (43.4″)
TURF	25 x 8.5 - 14	1151 mm (45.3″)
TURF	24 x 8.5 - 14	1151 mm (45.3″)
R4	25 x 8.5 - 14	1151 mm (45.3″)

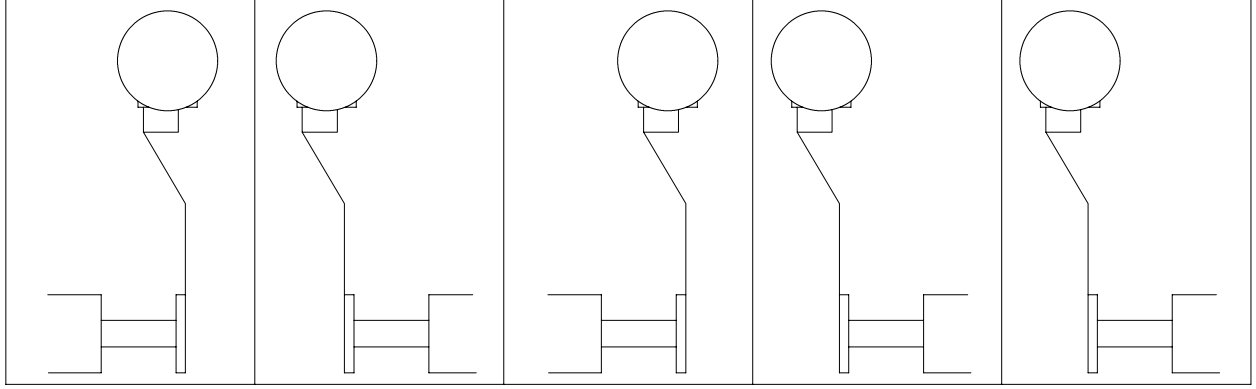
NOTE: *Turf tire 24 x 8.5 - 14 replaces turf tire 25 x 8.5 - 14.*

NOTE: *Tread settings are measured from center of tire to opposite center of tire.*

IMPORTANT: *Never attempt to widen the tread setting of FWD axle by reversing front wheels, because axle failure will occur.*

NOTE: *Torque front wheel bolts to 122 N·m (90 ft. lbs.). Torque tie rod adjusting nut to 42 - 56 N·m (31 - 41 ft. lbs.).*

REAR WHEEL TREAD WIDTH SETTING (ALL MODELS) - cm (Inch)				
AG. TIRE		TURF TIRE		R4 TIRE
11.2-24		13.6-16		15-19.5
1087 mm (42.8″)	1217 mm (47.9″)	1120 mm (44.1″)	1184 mm (46.6″)	1184 mm (46.6″)



2

REAR AXLE TREAD SETTING

The rear axle tread setting for all models is shown in Figure 2. The rear wheel tread width is adjusted by a combination of repositioning the rear wheel rims and discs and by switching the wheels from side to side.

NOTE: *Torque rear wheel bolts to 169 N·m (125 ft. lbs.).*

TRACTOR WEIGHTING

For sufficient traction and maximum performance in heavy draft operations, and to counterbalance rear-mounted equipment, weight should be added to the tractor in the form of liquid ballast, cast iron weights, or a combination of both. Only enough weight should be added to provide good traction and stability. Adding more weight than is needed results in unnecessary soil compaction, increased rolling resistance, and higher fuel consumption.

NOTE: *When adding weight to the tractor, tire pressures may need to be increased. Refer to the Tire Inflation Pressure chart found in this manual.*

WEIGHTING FOR STABILITY

Front end ballast may be required for stability and steering control when weight is transferred from the front wheels to the rear wheels as an implement is raised by the tractor three-point hitch.

As a general guide:

Ballast the tractor (less implement) so that approximately one-third of the tractor weight is on the front wheels. For optimum traction, tractors equipped with front-wheel drive should be ballasted so that 40 - 45% of machine weight is on the front wheels.

When a mounted implement is raised to the transport position, the front wheel reaction should be at least 20% of tractor weight.

Add additional front end ballast as required for stability during operation and transport. Tractor front end ballast may not always maintain satisfactory stability if the tractor is operated at high speed on rough terrain. Reduce tractor speed and exercise caution under these conditions.

When using front-mounted equipment, add weight to the rear axle to maintain good traction and stability. Front-mounted equipment varies in weight. Refer to equipment manual for ballasting.

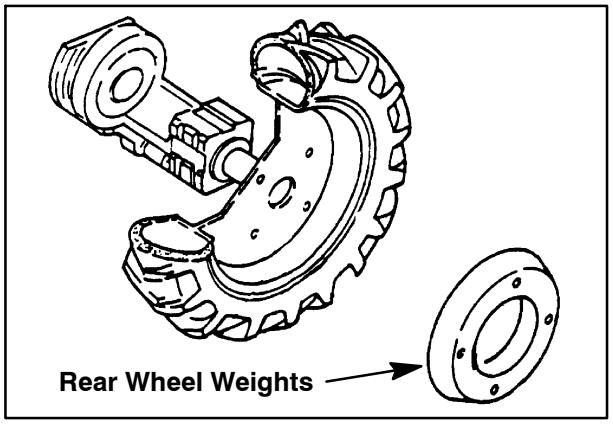
WEIGHTING LIMITATIONS

The weighting limitations that follow are limitations only. They do not imply that the tractor should be weighted to attain the weights given. Use only enough weight to obtain good performance.

Maximum Front End Weight R4 & TURF, 2WD/4WD	52 kg (114 lbs.)
Maximum Front End Weight AG Tires - Super Steer Only	26 kg (57 lbs.)
Rear Wheel Weights - AG Tires Only	
Number Segments Per Wheel @ 48 kg (105 lbs.)	2
Maximum Allowable Weight	95.5 kg (210 lbs.)
Rear Wheel Weights - R4 Tires Only	
Number Segments Per Wheel @ 34 kg (75 lbs.)	2
Maximum Allowable Weight	68 kg (150 lbs.)

***NOTE:** Rear wheel weights not available for turf tires.*

***NOTE:** Obtain wheel weight attaching hardware locally.*



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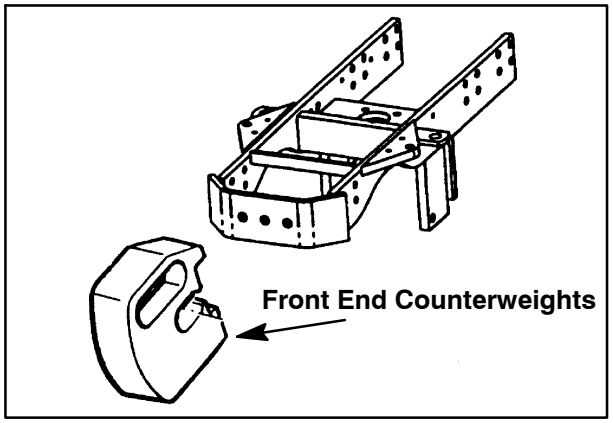

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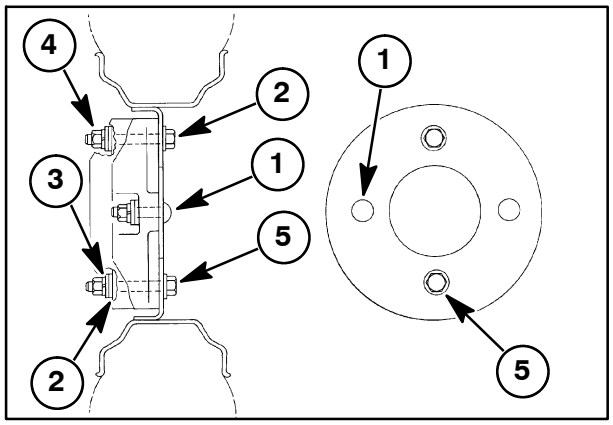
REAR WHEEL WEIGHT INSTALLATION



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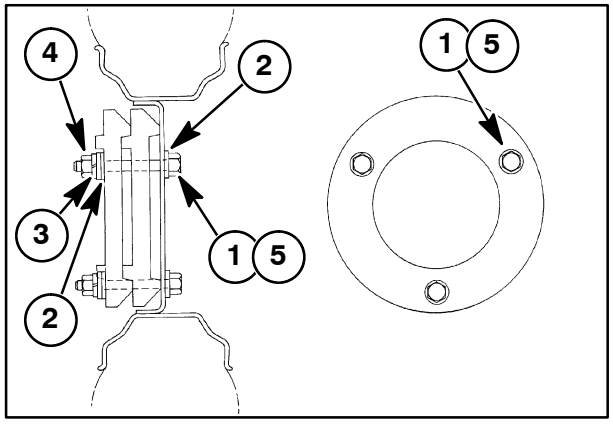
(Ag. Tire)
Hardware needed one weight installed per wheel:

Item	Description	Qty
1	5/8″ x 3-1/2″ carriage bolt	4
2	5/8″ flat washer	8
3	5/8″ lock washer	4
4	5/8″ nut	4

Hardware needed two weights installed per wheel:

Item	Description	Qty
1	5/8″ x 3-1/2″ carriage bolt	2
2	5/8″ flat washer	10
3	5/8″ lock washer	4
4	5/8″ nut	4
5	5/8″ x 7″ cap screw	2



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(R4 Tire) (Weight installed with flat side facing outward)
Hardware needed one weight installed per wheel:

Item	Description	Qty
1	1/2″ x 4″ cap screw	3
2	1/2″ flat washer	9
3	1/2″ lock washer	3
4	1/2″ nut	3

Hardware needed two weights installed per wheel:

Item	Description	Qty
2	1/2″ flat washer	9
3	1/2″ lock washer	3
4	1/2″ nut	3
5	1/2″ x 6-1/2″ cap screw	3

LIQUID BALLAST

When adding weight by filling the tires with liquid ballast, a calcium chloride solution is recommended because of its low freezing point and greater weight per gallon to fill the tires. See your New Holland dealer.

Tires should never be filled beyond 75% capacity. Fill the tires to the valve stem with the valve stem positioned at the top of the wheel.

TIRE PRESSURE

Tire pressure must be considered when adding weights, implements, or attachments to the tractor or damage to the tractor may occur.

The chart below outlines tire inflation pressures.

FRONT TIRE INFLATION PRESSURES		
Tire Type	**Tire Size**	**Inflation Pressure**
Agricultural:		
2WD	5.50-16, 4PR, F2	1.7 - 2.8 bar (24 - 40 psi)
FWD	7-14, 4PR, R1	0.6 - 1.8 bar (8 - 26 psi)
Turf:		
2WD	23 × 8.50-12, 4PR, R3	0.6 - 15 bar (8 - 22 psi)
FWD	25 × 8.50-14, 4PR, R3	0.6 - 15 bar (8 - 22 psi)
Industrial (R4)	25 × 8.50-14, 6PR, R4	0.6 - 2.2 bar (8 - 32 psi)
REAR TIRE INFLATION PRESSURES		
Agricultural	11.2-24, 4PR, R1	0.8 - 1.2 bar (12 - 18 psi)
Turf	13.6-16, 4PR, R3	0.8 - 1.0 bar (12 - 14 psi)
Industrial (R4)	15-19.50, 4PR, R4	0.8 - 1.4 bar (12 - 20 psi)

NOTE: *Do not under inflate or over inflate tires. Do not exceed maximum inflation pressure listed.*

WHEEL NUT TORQUE SPECIFICATIONS

Front Wheel Bolts . . . . . 122 N·m (90 ft. lbs.)

Rear Wheel Bolts . . . . . 169 N·m (125 ft. lbs.)

SECTION 55 - ELECTRICAL SYSTEM

Chapter 1 - Electrical Components

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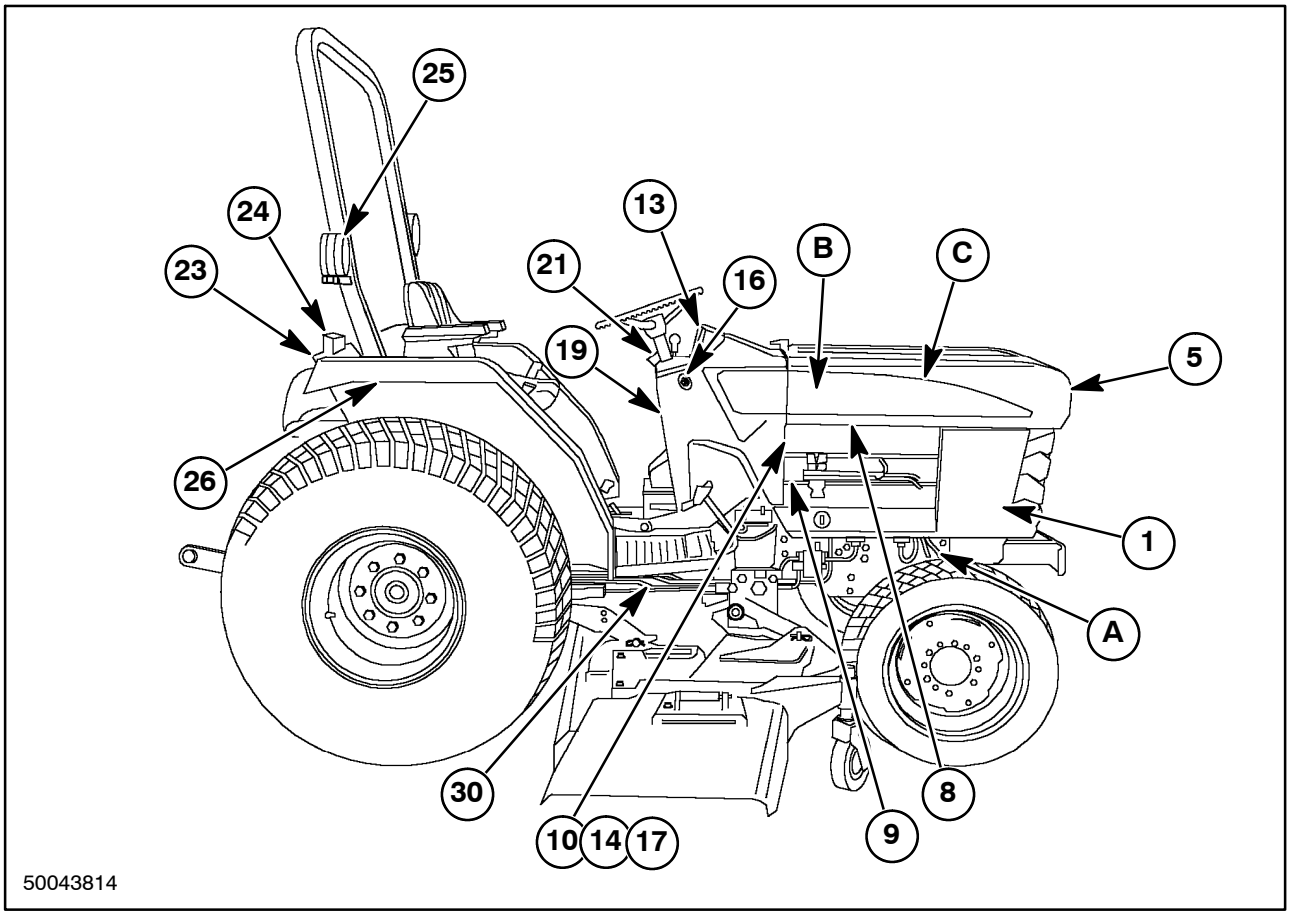
INTRODUCTION



1

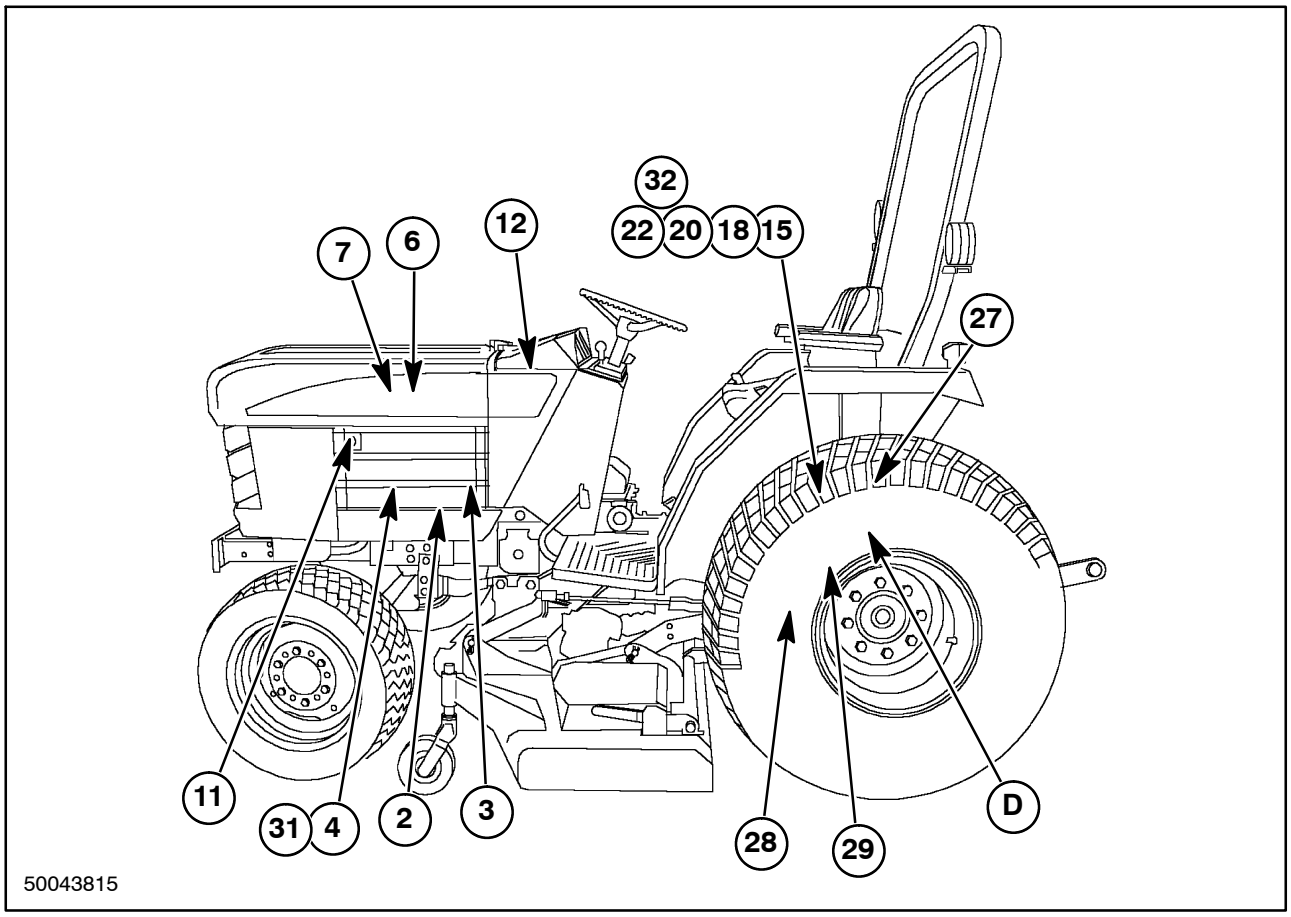
The TC30 Series electrical system is a 12-volt negative (–) ground system consisting of three main wiring harnesses (hood, front main, and rear chassis).

NOTE: *References to the directions left, right, front, and rear, are made while sitting in the operator seat.*

Op. 55 100

COMPONENT LOCATION AND FUNCTION

1. **Battery -** Located under the hood, in front of the radiator; electrical power source.
2. **Fusible Link -** Located on the left side of the engine directly above the starter; protects the entire electrical system from damage due to excessive current.
3. **Starter -** Located on the left side of the engine; rotates the engine for starting.
4. **Alternator -** Located on the left side of the engine; generates power to charge the battery.
5. **Headlights -** Located on the front of the tractor; illuminates the area in front of the tractor.
6. **Air Filter Restriction Switch -** Located on top of the engine, the air filter restriction switch illuminates an indicator light on the instrument panel, warning the operator when the air filter element becomes restricted.
7. **Oil Pressure Switch -** Located in front of the cylinder head; provides warning of low engine oil pressure.
8. **Glow Plugs -** Located on the right side of the cylinder head; aid in engine startup by warming the air in the combustion chamber.
9. **Fuel Shutoff Solenoid -** Located on the right of the engine, on the fuel injection pump, the fuel shutoff solenoid shuts off fuel flow to the injection pump to stop the engine.



2

10. **Fuse Block -** Located in the engine compartment, on the right side of the firewall; stores the fuses that protect individual circuits from damage due to excessive current.

11. **Coolant Temperature Sensor -** Located in the thermostat housing on the left side of the engine; warns the operator of high engine temperatures.

12. **Fuel Level Sender -** Located within the fuel tank; sends a signal indicating fuel level to the fuel gauge on the left side of the instrument panel.

13. **Instrument Panel -** Located on the dash panel, the instrument panel houses gauges and indicator lights that monitor tractor functions and warn the operator of potential problems.

14. **Glow Plug Indicator Light Timer -** Located in the engine compartment, on the right side of the firewall; controls current flow to the glow plug indicator light within the instrument panel. When the key switch is turned to the "HEAT" position, the glow plug timer sends current to the glow plug indicator light for approximately four to five seconds. The glow plug timer does not control current flow to the engine glow plugs. The timer turns the indicator light off by opening the circuit to the light on the instrument panel.

15. **Safety Start Relay -** Located in the engine compartment, on the right side of the firewall; controls current flowing to the starter.

16. **Key Switch -** Located on the right side of the operator's console; the four-position key switch connects current flowing from the battery to the engine glow plug circuit, the starting circuit or the safe operation circuit.

17. **Hazard Flasher/Turn Signal Control Module -** Located in the engine compartment, on the right side of the firewall; controls current flowing to the hazard flasher/turn signal lights on the rear fenders.

18. **Seat Safety Switch Timer -** Located on the lift cover behind the left fender; when the tractor is running, the seat timer creates a one-second delay before shutting off the tractor engine, should the operator get off of the seat. The seat safety switch shuts the tractor engine off by cutting the ground to the control circuit in the kill relay, which in turn stops current flow to the fuel shutoff solenoid. The fuel shutoff solenoid then extends to stop fuel flowing through the fuel injectors.

19. **Light Switch -** Located on the rear console cover; controls current flow to the headlights and taillights.

20. **Diode -** Located on the lift cover behind the left fender; the diode directs current within a circuit to allow the use of one wire within multiple circuits to control a relay.

21. **Hazard/Turn Signal Switch -** Located on the right side of the dash panel; controls current flowing to the hazard flasher/turn signal control module.

22. **Fuel Shutoff Relay -** Located on the lift cover behind the left fender; controls current flowing to the fuel shutoff solenoid. When current is interrupted and no longer provided to the kill relay, the relay becomes de-energized and no longer provides current to the fuel shutoff solenoid, stopping the tractor.

23. **Rear Worklight (optional) -** Located on the right rear fender of the tractor; illuminates the area behind the tractor to make traveling in reverse and connecting implements easier during low light conditions.

24. **Taillights -** Located on the rear fenders of the tractor; provides warning to rearward motorists during transport.

25. **Hazard Lights -** Located on the rear fenders of the tractor; provide warning during transportation and emergency.

26. **Seat Safety Switch -** Located beneath the operator seat; controls the ground path for the control circuit of the seat safety switch timer. When the operator leaves the seat, the seat safety switch timer deactivates after a two second delay, the kill relay then stops the engine. The tractor will continue to run with the seat unoccupied as long as the parking brake is applied, the Mid PTO (optional) is disengaged, and the transmission range is in neutral.

27. **Mid PTO Safety Switch (optional) -** Located on the Mid PTO linkage found behind the left rear fender; the Mid PTO safety switch is part of the START and SAFE OPERATION circuits. The tractor will not start unless the Mid PTO switch is closed (mid PTO in the "Off" position). The tractor will continue to run with the operator out of the seat, providing the parking brake is applied, the transmission is in a neutral position, and the Mid PTO is in the "Off" position (control lever pushed down).

28. **Transmission Range Safety Switch -** Located on the transmission range linkage behind the left rear fender; the Transmission Range Safety Switch is part of the START and Safe Operation circuits. The tractor will not start unless the Transmission Range Safety Switch is closed (range shifted into a NEUTRAL position). The tractor will continue to run with the operator out of the seat, providing the parking brake is applied, the transmission is in a neutral position, and the Mid PTO (Optional) is in the "Off" position (control lever pushed down).

29. **Rear PTO Safety Switch -** Located on the left side of the transmission housing behind the left rear fender; the rear PTO switch is part of the START circuit. The tractor will not start if the rear PTO switch is open (rear PTO engaged). Unless the transmission is in neutral and the parking brake is applied.

30. **Parking Brake Safety Switch -** Located on the parking brake linkage found under the right-side floor panel; the Parking Brake Safety Switch is part of the START and Safe Operation circuits. The tractor will start with the operator out of the operator seat, providing the parking brake is applied, the transmission is in a neutral position and the Mid PTO (Optional) is in the "Off" position (control lever pushed down). The tractor will continue to run with the operator out of the seat, providing the parking brake is applied, the transmission is in a neutral position, and the Mid PTO (Optional) is in the "Off" position (control lever pushed down).

31. **Charging System Diode -** Located on the left side of the engine near the alternator. The charging system diode is used to prevent current from flowing into the low charge indicator light within the instrument panel.

32. **Tail Light Relays -** Located on the lift cover behind the left fender; controls current flowing to the tail light.

Ground Locations

A. Right Side Frame Rail

B. Top of Engine

C. Tractor Hood

D. Rear Chassis (Directly above left rear axle housing)

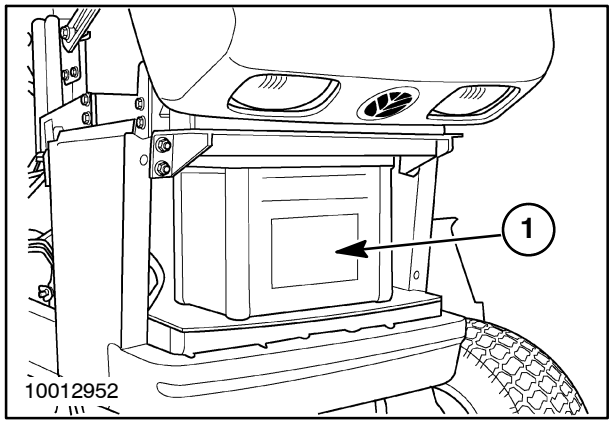
⚠ WARNING ⚠

Before working on any component of the electrical system, the negative (–) battery cable should be disconnected from the battery, as electrical shock or damage to system components may occur. Some testing requires 12-volt power; care should be taken in cases where power is needed.

DESCRIPTION AND TESTING - ELECTRICAL SYSTEM COMPONENTS

BATTERY

The TC30 tractors are equipped with a BCI group 24, 12-volt, 56 Ah, battery, 1, with a minimum cold cranking ability of 420 amps at 0° F (-18°C). The battery is located underneath the hood in front of the radiator.



3

The battery connections must be tight and free of corrosion. If necessary, wash the battery terminals with a solution of baking soda and water, making sure the solution does not get inside the battery. After cleaning, wash the battery with clean water, then apply a small amount of petroleum jelly to the terminals to prevent corrosion.

A good battery charge must be maintained in freezing temperatures. If the battery is allowed to become discharged or run down, the electrolyte level will become weak and possibly freeze. This can result in damage to the battery case. If water must be added, use distilled water. Add the water just before using the tractor. This ensures that the water will mix with the electrolyte during the charging process, preventing the water from freezing.

Check the specific gravity of the electrolyte to determine battery charge.

Electrolyte Level

NOTE: *Check the battery electrolyte level after every 50 hours of operation.*

⚠ WARNING ⚠

Always check the electrolyte level with the tractor engine off, as an explosive gas is produced inside the battery when the alternator is charging. Do not use an exposed flame and do not smoke when checking the battery electrolyte level.

To check the battery electrolyte level:

1. Clean the top of the battery, then remove the vent plugs.
2. If the electrolyte level is low, add distilled water. The correct level is when the liquid is between the upper and lower line.

NOTE: *Keep distilled water in a nonmetallic container that is clean and well covered.*

3. Install the vent plugs after making sure the vent holes are not blocked. After adding water at below freezing temperatures, run the engine for a period of time. This allows the battery to charge, preventing the water from freezing.

Removal

1. Raise the tractor hood to its fully raised position.
2. Disconnect the negative (-) and positive (+) battery cables from the battery.
3. Remove the grille from the front of the tractor.
4. Remove the battery hold-down hardware and carefully remove the battery from the tractor.

Installation

1. Orient the battery so that the posts are toward the rear of the tractor. Install the battery and the battery hold-down hardware.

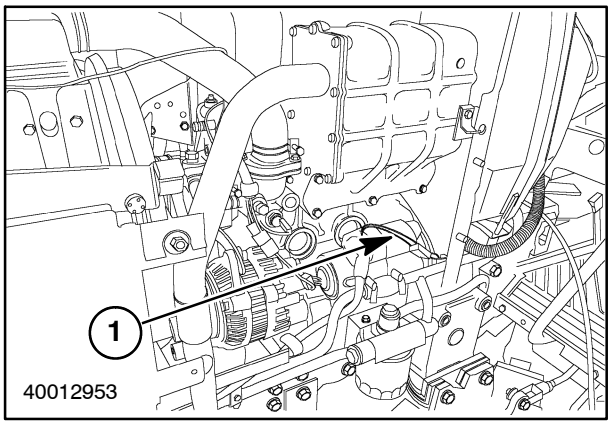
IMPORTANT: *Crossing of battery terminals may cause damage to the electrical system.*

2. Connect the positive (+) battery cable to the positive (+) battery terminal and the negative (-) battery cable to the negative (-) battery terminal.
3. Install the grille onto the front of the tractor.

FUSIBLE LINK

A fusible link wire, 1, is used to protect the tractor's electrical system. If too much amperage passes through this wire, it will melt down so that it will not allow current to pass (similar to the way a fuse works). The fusible link wire, 1, is a red wire that goes from the starter terminal to a connector that links into the main wiring harness.

FUSIBLE LINK RATING	
68°F (20°C)	20 Amps
158°F (69°C)	15 Amps



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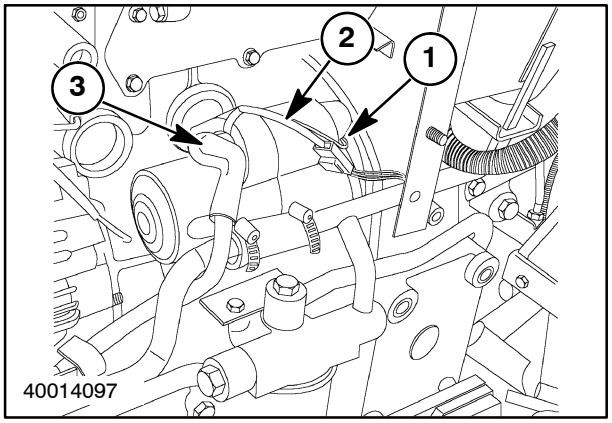
Replacement

1. Disconnect the negative (–) and positive (+) battery cables from the battery.
2. Unplug the connector, 1, linking the wire to the main wiring harness.
3. Remove the old fusible link wire, 2, from the starter terminal, 3.
4. Replace the old fusible link wire with a new one - first attaching the starter terminal and then connecting it to the main wire harness.

IMPORTANT: *Always replace the fusible link wire with the appropriate fusible link wire for this tractor (part #SBA385603370).*



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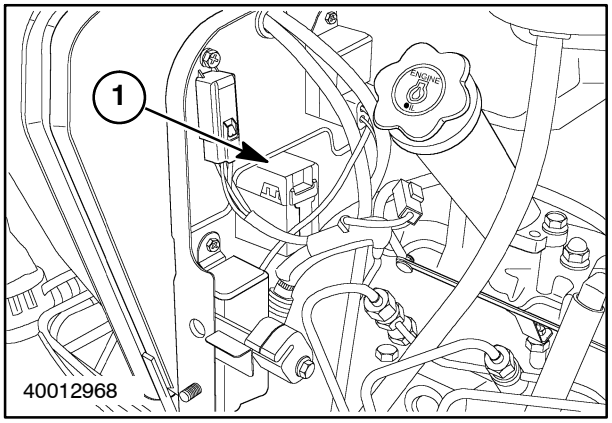
FUSE BLOCK

The fuse box, 1, is located in the engine compartment on the side of the tractor firewall. The fuse box houses three fuses which protect the individual circuits of the tractor. Access the fuses by removing the plastic cover from the fuse box.

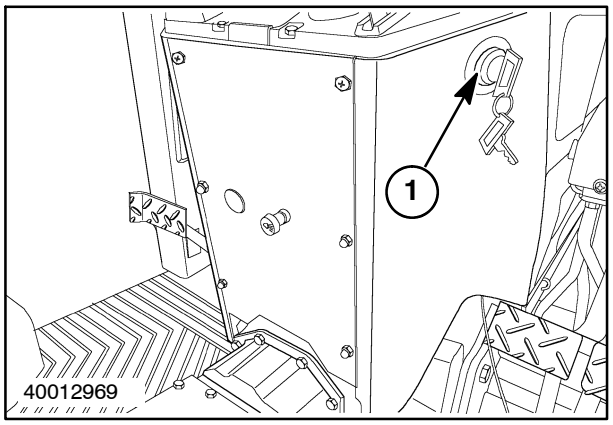
Fuse Size	Description
5 Amp	Alternator, Instrument Panel, Kill Relay, Seat Safety Switch Timer
15 Amp	Head Lights, Hazard Lights, Tail Light
10 Amp	Hazard Flasher/Turn Signal Control Module



6

KEY SWITCH

The key start switch, 1, is located on the right side panel. The key switch has four key-operated positions; HEAT, STOP, AC/RUN, and START. Turning the key from the STOP position will align the electrical contacts within the key switch. With the contacts aligned, the circuit is closed and battery current will flow through the circuit.

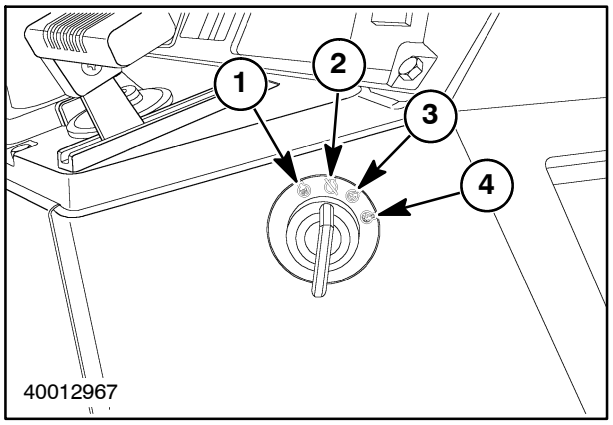


7

1. HEAT POSITION

NOTE: *The key switch is spring-loaded to return to the STOP position, 2, when released from the HEAT position, 1.*

When the key is rotated counterclockwise to the “Heat” position, 1, current is allowed to flow from the battery to the engine glow plugs. The glow plugs aid in starting the engine in cold climates.



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2. STOP POSITION

In the STOP position, 2, there is no battery power supplied to electrical circuits and the key may be removed from the key switch to prevent unauthorized use of the tractor. The STOP position also stops the tractor engine, when running.

3. AC/RUN POSITION

When the key switch is rotated clockwise to the AC/RUN position, 3, battery power is supplied to operate the electrical accessories without the engine running. The switch will also be in this position while the tractor is running.

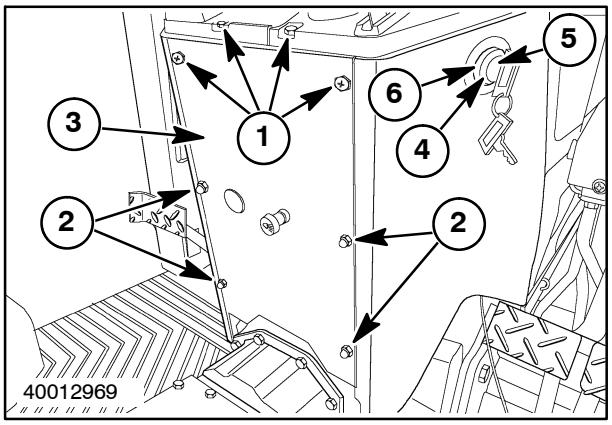
4. START POSITION

NOTE: *The key switch is spring-loaded to return to the AC/RUN position, 3, when released from the START position, 4.*

When the key switch is turned clockwise to the START position, 4, power is supplied to the starter motor to crank and start the engine. This position also provides current to the engine glow plugs to aid in starting the tractor engine.

Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the four screws, 1, and the four nuts, 2, to remove the center access panel, 3, from the operator console.
3. Remove the nut, 4, from the key switch, 5.
4. Carefully remove the sealing washer, 6, from the key switch, 5, and push the switch through the console toward the center access panel opening.
5. Disconnect the key switch, 5, from the tractor wire harness to remove the switch from the tractor.



9

Testing

NOTE: *The key switch is not serviceable and must be replaced if testing determines the switch is defective.*

Use an ohmmeter to test the key switch for electrical continuity in each of the four positions.

	19	30	17	50	AC
HEAT	•	•			•
OFF					
AC/RUN		•			•
START		•	•	•	•

• = Indicates that continuity exists.

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the switch from the tractor. Disconnect all wires from the key switch.

Installation

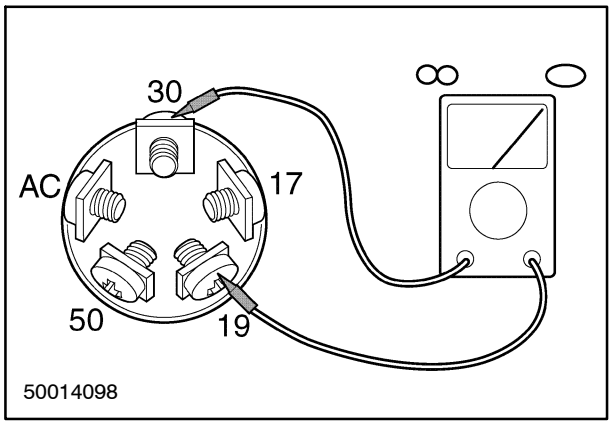
1. Connect the key switch wire harness to the key switch by using the chart below.

Key Switch Terminal	Wire Color
Terminal 30	RED
Terminal 17	BLACK/WHITE
Terminal 19	BLACK/WHITE
Terminal 50	YELLOW/BLACK
Terminal AC	WHITE/RED

2. Connect the key switch wire harness to the tractor wire harness.
3. From inside the operator console, insert the key switch through the key switch hole, slide the sealing washer, and thread the nut onto the key switch. Tighten the nut.
4. Install the center access panel by using the two bolts and four nuts, with washers.
5. Connect the negative (–) battery cable to the negative (–) battery terminal.

HEAT POSITION

1. Turn the key switch to the HEAT position and hold. Touch an ohmmeter test probe to the terminal marked 30.
2. Touch the other ohmmeter test probe to the terminal marked 19. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal 19. If continuity does not exist between terminals 30 and 19 when the key switch is in the HEAT position, the switch is defective and requires replacement.



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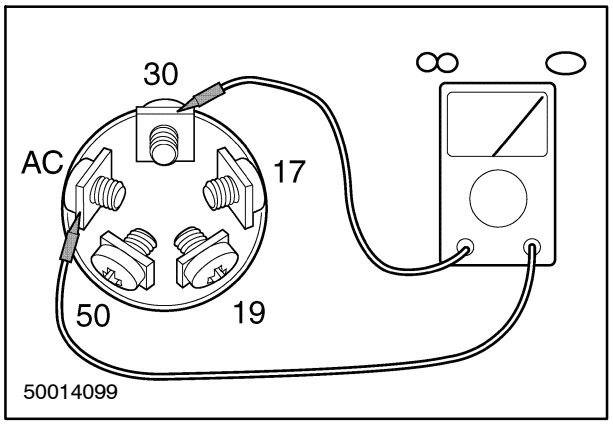
3. With the key switch still in the HEAT position, touch an ohmmeter test probe to the terminal marked 30.
4. Touch the other ohmmeter test probe to the terminal marked AC. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal AC. If continuity does not exist between terminals 30 and AC when the key switch is in the HEAT position, the switch is defective and requires replacement.

If continuity exists in a way that is not described in this testing procedure (while the key switch is in the HEAT position), the switch is defective and requires replacement.



11

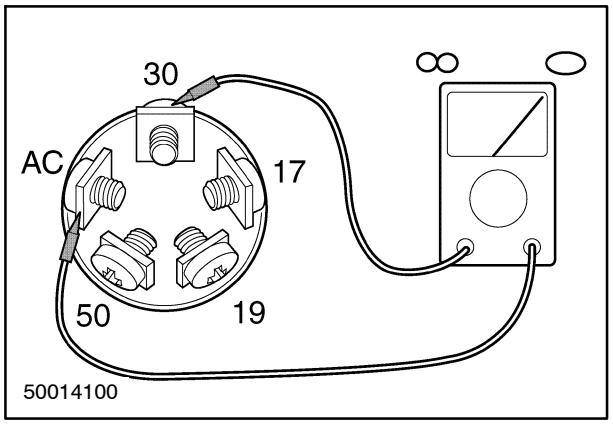
STOP POSITION

Continuity should not exist between any of the switch terminals when the key switch is in the STOP position. If continuity exists between any of the switch terminals when the key switch is in the STOP position, the switch is defective and requires replacement.

AC/RUN POSITION

1. Turn the key switch to the AC/RUN position. Touch an ohmmeter test probe to the terminal marked 30.
2. Touch the other ohmmeter test probe to the terminal marked AC. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal AC. If continuity does not exist between terminals 30 and AC when the key switch is in the AC/RUN position, the switch is defective and requires replacement.

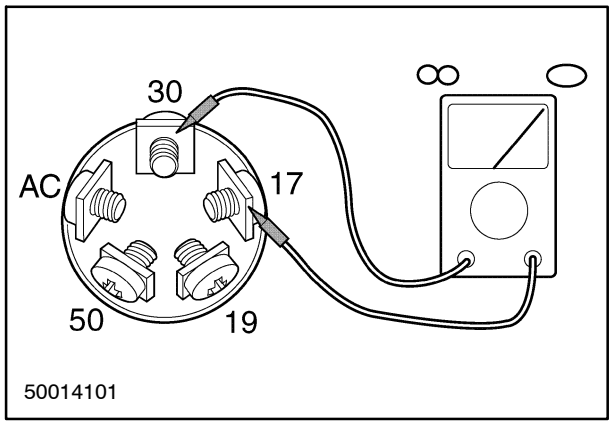
If continuity exists in a way that is not described in this testing procedure (while the key switch is in the AC/RUN position), the switch is defective and requires replacement.



12

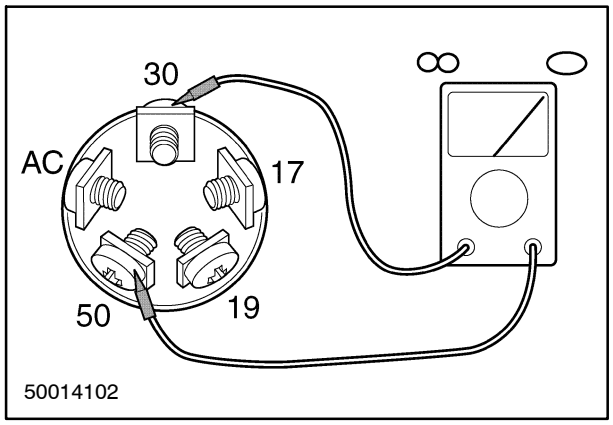
START POSITION

1. Turn the key switch to the START position and hold. Touch an ohmmeter test probe to the terminal marked 30.
2. Touch the other ohmmeter test probe to the terminal marked 17. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal 17. If continuity does not exist between terminals 30 and 17 when the key switch is in the START position, the switch is defective and requires replacement.



13

3. With the key switch still in the START position, touch an ohmmeter test probe to the terminal marked 30.
4. Connect the other ohmmeter test probe to the terminal marked 50. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal 50. If continuity does not exist between terminals 30 and 50 when the key switch is in the START position, the switch is defective and requires replacement.



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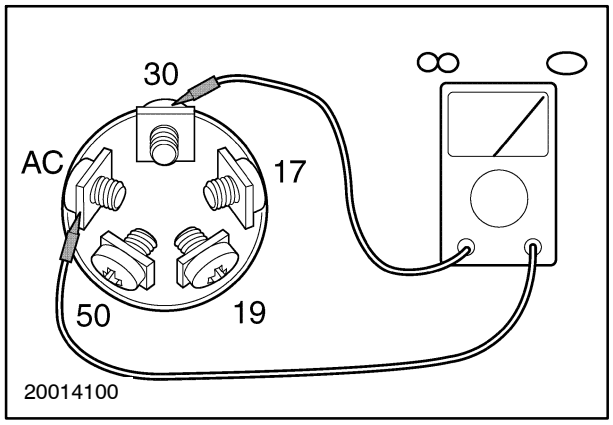
5. With the key switch still in the START position, touch an ohmmeter test probe to the terminal marked 30.
6. Connect the other ohmmeter test probe to the terminal marked AC. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal AC. If continuity does not exist between terminals 30 and AC when the key switch is in the START position, the switch is defective and requires replacement.

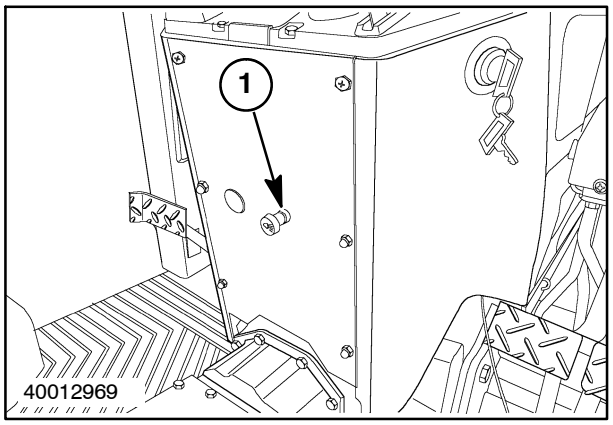
If continuity exists in a way that is not described in this testing procedure (while the key switch is in the START position), the switch is defective and requires replacement.



15

LIGHT SWITCH

The light switch, 1, is a push-pull type switch located on the center access panel of the operator console. The light switch controls current flowing to the headlights and taillights. The key switch must be in either the HEAT, START, or AC/RUN, position for current to flow to the light switch. When the light switch is pulled to the “On” position, the tractor headlights and taillights illuminate.



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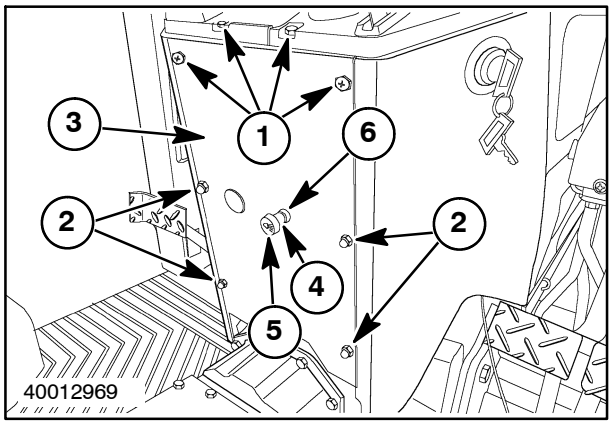
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the four screws, 1, and the four nuts, 2, to remove the center access panel, 3, from the operator console.
3. Remove the screw, 4, and the knob, 5, to remove the nut, 6, from the light switch.
4. Disconnect the light switch from the tractor wire harness and remove from the center access panel.



17

Testing

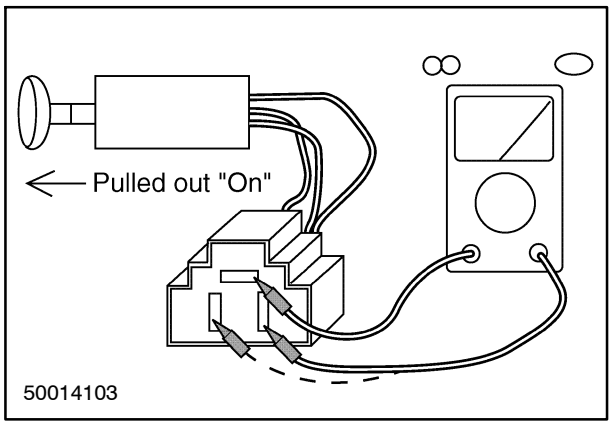
Use an Ohmmeter to test the light switch for electrical continuity.

ON POSITION

1. Pull the light switch outward to the “On” position.
2. Continuity should exist between the three switch terminals. If continuity does not exists between the three switch terminals, the switch is defective and requires replacement.

OFF POSITION (Not Shown)

1. Push the light switch inward to the “Off” position.
2. There should be no continuity between any of the switch terminals when the light switch is in the “Off” position. If continuity exists between the switch terminals when the light switch is in the “Off” position, the switch is defective and requires replacement.



18

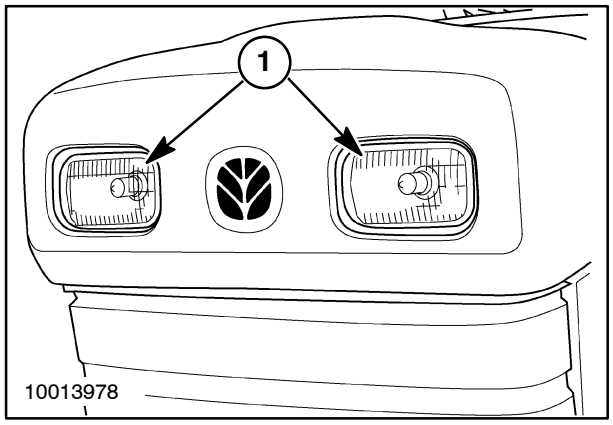
Installation

1. Connect the light switch to the tractor wire harness.
2. Insert the light switch into the back of the center access panel, slide the sealing washer onto the light switch. Thread the nut onto the light switch and tighten. Install the handle onto the switch by using the screw.
3. Install the center access panel by using the four screws and four nuts, with washers.

Op. 55 404

HEADLIGHTS

The headlights, 1, are located on the front of the tractor. The two headlights illuminate the area in front of the tractor for increased visibility in low light conditions. The headlight assemblies contain a bulb that may be replaced if the bulb burns out.

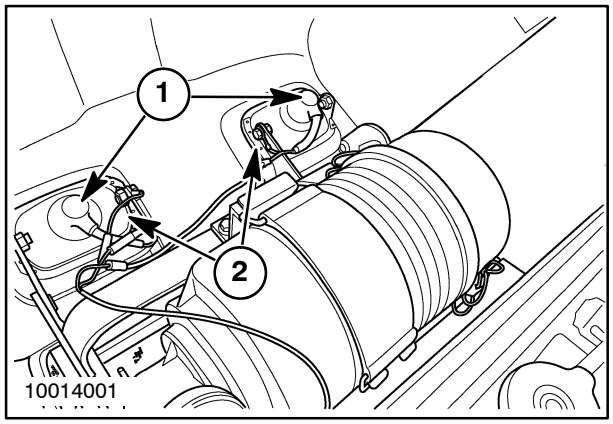


19

Removal

NOTE: *The same procedure is used for both sides.*

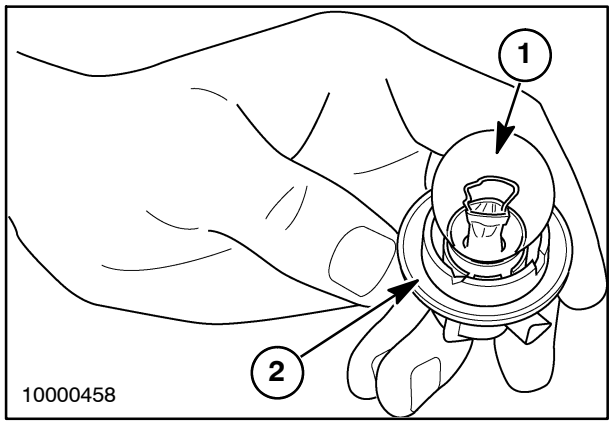
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. To remove the headlight bulb, rotate the bulb socket, 1, counterclockwise and remove the bulb and socket from the headlight assembly, 2.



20

Inspection

1. Remove the bulb, 1, from the socket, 2. Inspect the bulb and filament for damage or corrosion. Replace as necessary.
2. If the bulb is OK, check the bulb socket for corrosion. Clean or replace as necessary.



21

Installation

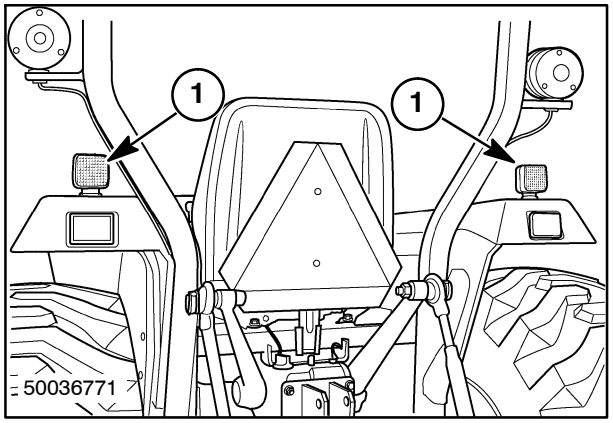
1. Insert the headlight bulb into the headlight socket and rotate clockwise so that the bulb locks into the socket.
2. Place the headlight bulb and socket into the headlight assembly. Rotate the socket clockwise so that the socket locks into the headlight assembly.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

NOTE: *Replace with a size 12-volt 35 watt bulb.*

Op. 55 404

TAILLIGHTS

The taillights, 1, are located on the left and right rear fenders. The two taillights illuminate the rear of the tractor to provide warning to approaching vehicles.

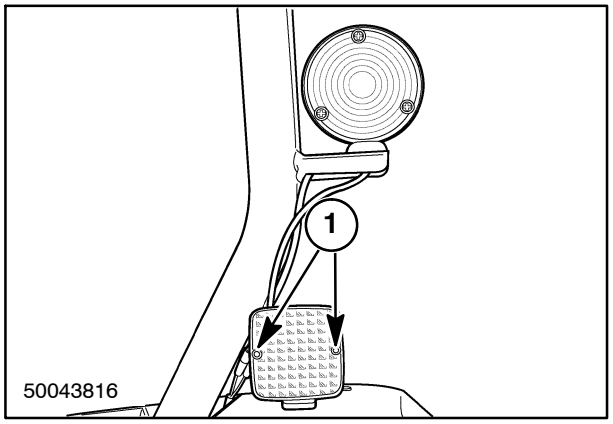


22

Removal

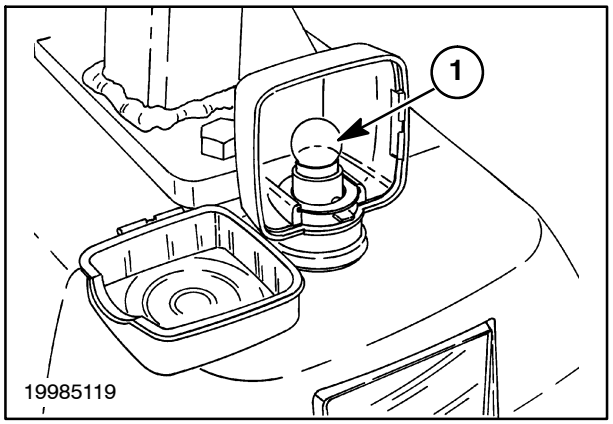
NOTE: *The same procedure is used for both sides.*

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the two screws, 1, securing the lens and pull the lens away from the body.



23

3. Push down on the bulb, 1, and rotate counterclockwise to remove the bulb from the taillight assembly.



24

Inspection

1. Remove the bulb from the socket. Inspect the bulb and filament for damage or corrosion. Replace as necessary.
2. If the bulb is OK, check the bulb socket for corrosion. Clean or replace as necessary.

Installation

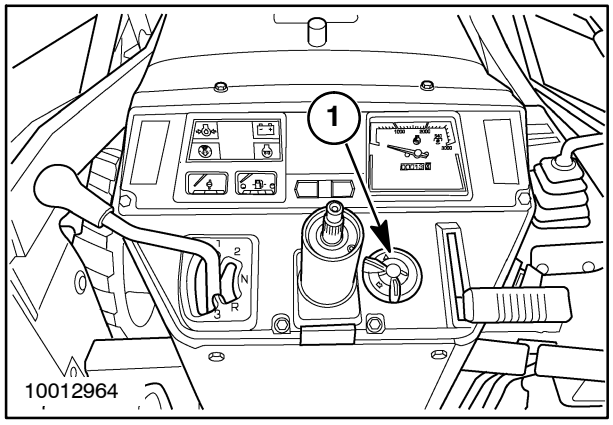
1. Place the taillight bulb and socket into the taillight assembly. Rotate the socket clockwise so that the socket locks into the taillight assembly.
2. Press the lens onto the light body until it snaps into place.
3. Connect the negative (–) battery cable to the negative (–) battery terminal.

NOTE: *Replace with an 18W-12-volt bulb.*

HAZARD/TURN SIGNAL COMBINATION SWITCH

NOTE: *The steering wheel was removed to better show the dash panel components.*

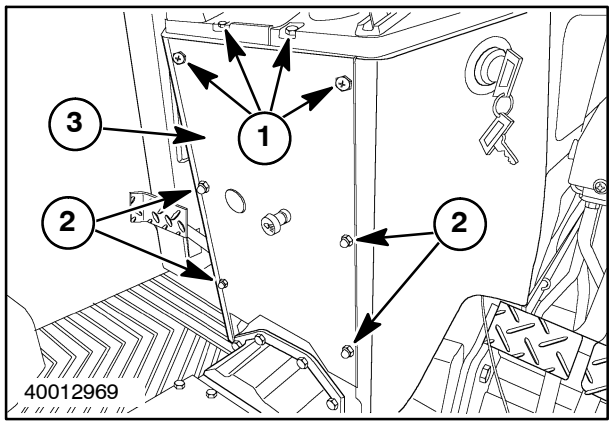
The hazard/turn signal combination switch, 1, is located on the right side of the steering column on the dash panel. The combination switch contains two separate switches. The upper switch controls the hazard flashers while the lower switch controls the turn signals. When the hazard switch is activated, both lights flash on and off simultaneously unless a turn signal is activated. When a turn signal is activated, the corresponding flasher will flash on and off while the opposite flasher remains on (solid). The hazard/turn signal combination switch also controls the flasher indicator lights within the instrument panel. The flasher indicator lights illuminate to show the operator that the flashers are activated. See INSTRUMENT PANEL for more information on the flasher indicator lights.



25

Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the four screws, 1, and the four nuts, 2, to remove the center access panel, 3, from the operator console.
3. Disconnect the tractor wire harness from the hazard/ turn signal combination switch.



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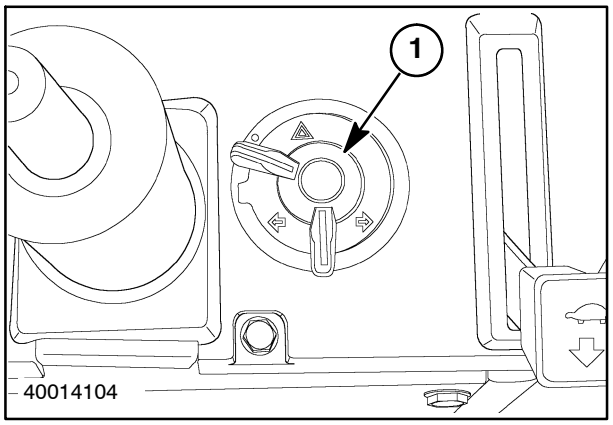
4. Reach underneath the dash panel to release the locking tabs on the hazard/turn signal combination switch, 1, and push the switch from the dash panel.



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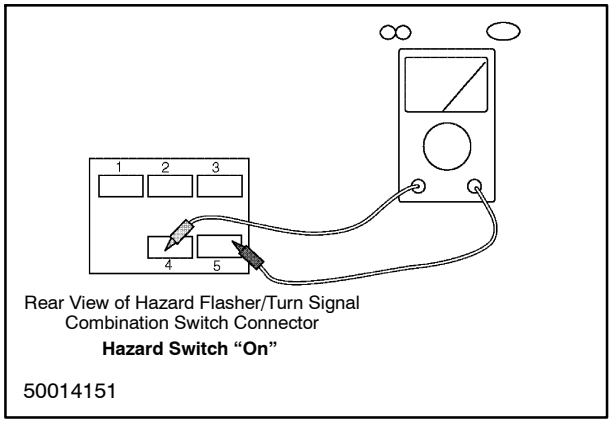
Testing
Use an ohmmeter to perform the three tests on the hazard / turn signal combination switch.

Test 1
Test 1 is used to determine if the combination switch is functioning properly when in the “Hazard On” position.

NOTE: *Disregard any terminal markings on the switch connector. Refer to the terminal markings in the illustration for the testing.*

1. Switch the hazard switch to the “On” position.
2. Touch an ohmmeter test probe to terminal 4 of the switch connector.
3. Touch the other ohmmeter test probe to terminal 5. The ohmmeter should show little or no resistance indicating that continuity exists between terminals 4 and 5. If continuity does not exist between terminals 4 and 5 when the hazard switch is in the “On” position, the switch is defective and requires replacement.



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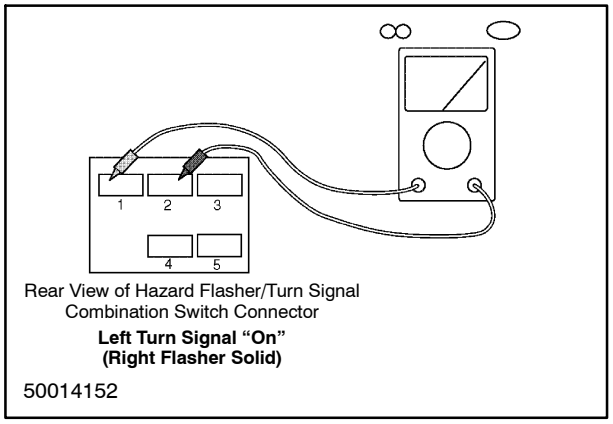
Test 2
Test 2 is used to determine if the combination switch is functioning properly while in the “Left Turn Signal” position.

NOTE: *Disregard any terminal markings on the switch connector. Refer to the terminal markings in the illustration for the testing.*

1. Switch the turn signal switch to the “Left” position.
2. Touch an ohmmeter test probe to terminal 1 of the switch connector.
3. Touch the other ohmmeter test probe to terminal 2. The ohmmeter should show little or no resistance indicating that continuity exists between terminals 1 and 2. If continuity does not exist between terminals 1 and 2 when the turn signal switch is in the “Left” position, the switch is defective and requires replacement.



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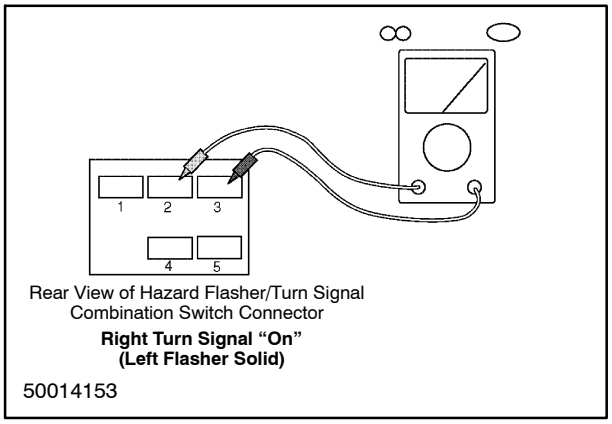
Test 3

Test 3 is used to determine if the combination switch is functioning properly while in the “Right Turn Signal” position.

NOTE: *Disregard any terminal markings on the switch connector. Refer to the terminal markings in the illustration for the testing.*

1. Switch the turn signal switch to the “Right” position.
2. Touch an ohmmeter test probe to terminal 2 of the switch connector.
3. Touch the other ohmmeter test probe to terminal 3. The ohmmeter should show little or no resistance indicating that continuity exists between terminals 2 and 3. If continuity does not exist between terminals 2 and 3 when the turn signal switch is in the “Right” position, the switch is defective and requires replacement.



Rear View of Hazard Flasher/Turn Signal Combination Switch Connector

Right Turn Signal “On”
(Left Flasher Solid)

50014153

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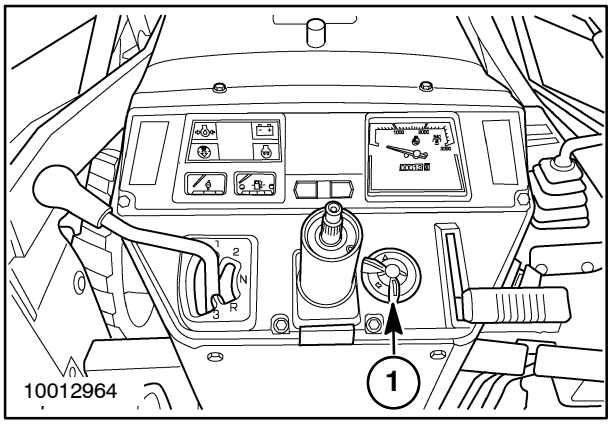
Installation

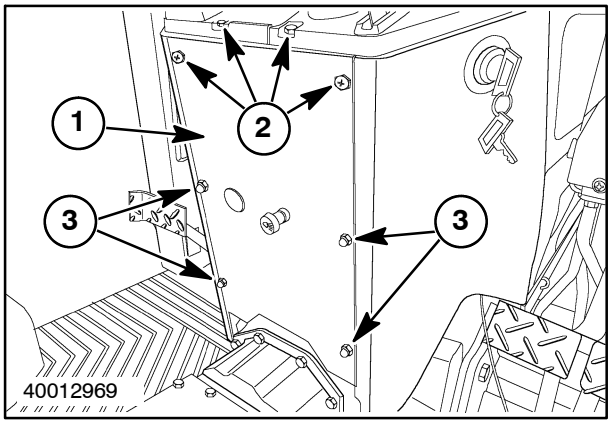
NOTE: *The steering wheel was removed to better show the dash panel components.*

1. Insert the hazard/turn signal switch, 1, into the dash panel so that the switch locks into place.
2. Connect the hazard/turn signal switch wire harness to the tractor wire harness.



31

3. Install the center access cover, 1, by using the four screws, 2, and the four nuts, 3, with washers.
4. Connect the negative (–) battery cable to the negative (–) battery terminal.



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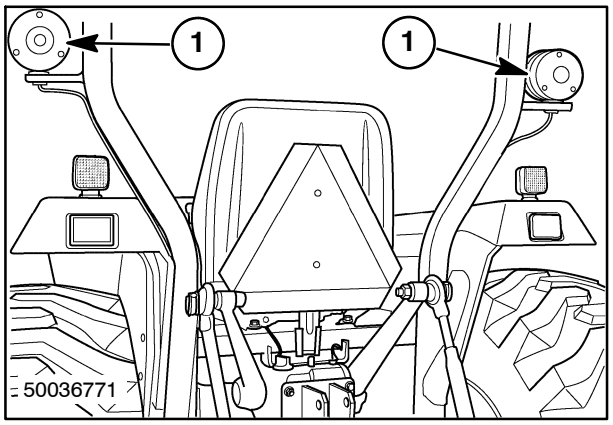
HAZARD/TURN SIGNAL LIGHTS

The hazard/ turn signal lights, 1, are located on the left and right rear fenders. The two hazard/ turn signal lights provide warning to approaching vehicles of a slow moving or turning vehicle. The hazard/ turn signal lights should be used in low visibility situations or at slow speeds on public roads.

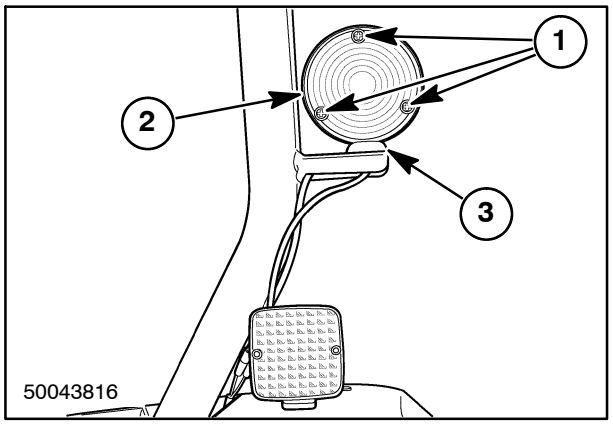


33

Removal

NOTE: *The same procedure is used for both sides.*

1. Remove the three screws, 1, to remove the lens, 2, from the light body, 3.
2. Push down on the bulb and rotate counterclockwise to remove the bulb from the light assembly.



34

Inspection

1. Remove the bulb from the socket. Inspect the bulb and filament for damage or corrosion. Replace as necessary.
2. If the bulb is OK, check the bulb socket for corrosion. Clean or replace as necessary.

Installation

1. Install the flasher bulb into the socket of the light assembly.
2. Install the lens onto the light body by using the three screws.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

NOTE: *Replace with a 1076 bulb.*

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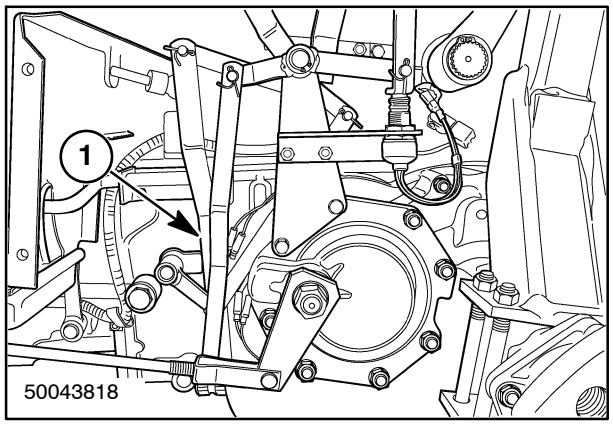
TRANSMISSION RANGE SAFETY SWITCH

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the transmission range safety switch.*

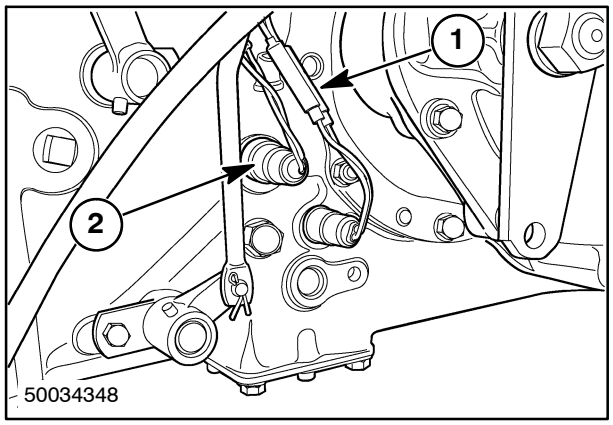
The transmission range safety switch, 1, is a single-pole, push-button type switch located on the range shifting linkage along the left side of the transmission housing. When the transmission is switched into the high, medium, or low, ranges, the switch contacts are open, not allowing the tractor to start. When the transmission is in one of the neutral range positions, the switch plunger extends to close the contacts, completing the circuit and allowing the tractor to start.



35

Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Disconnect the two switch wire leads, 1, from the tractor wire harness.
3. Unthread the transmission range safety switch, 2, from the range shifter linkage to remove the switch from the tractor.



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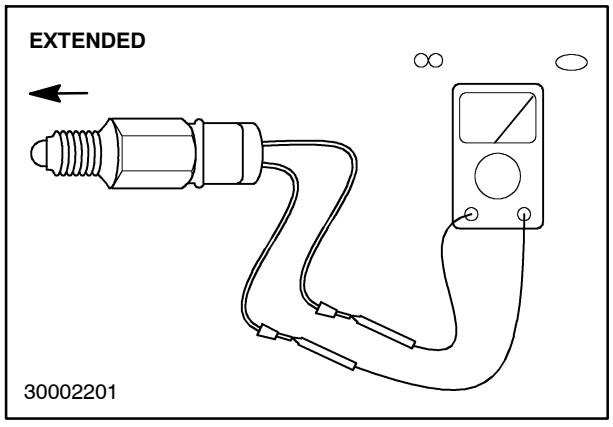
Testing

Use an ohmmeter to test both positions of the transmission range safety switch for electrical continuity.

EXTENDED POSITION

1. With the switch plunger in the “extended” position, touch one of the test probes to the one switch lead. Touch the other test probe to the other switch lead.
2. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If continuity does not exist between the two switch terminals when the switch is in the “extended” position, the switch is defective and requires replacement.



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RETRACTED POSITION (Not Shown)

1. With the switch plunger pushed in to the “retracted” position, there should be no continuity between the two switch terminals. If continuity exists between the two switch terminals when the switch plunger is in the retracted position, the switch is defective and requires replacement.

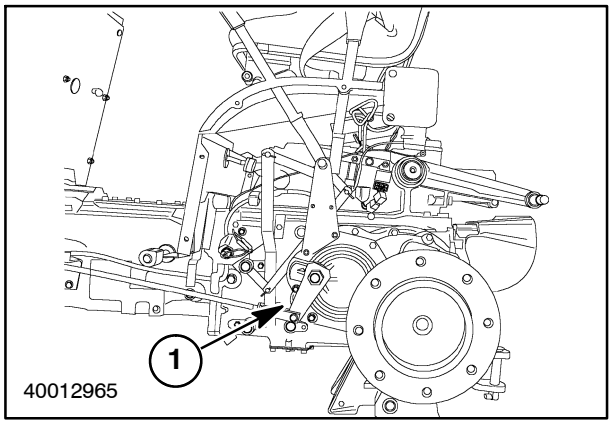
Installation

1. Thread the switch into the transmission range shifting linkage and connect the switch wires to the tractor wire harness.
2. Connect the negative (-) battery cable to the negative (-) battery terminal.

REAR PTO SAFETY SWITCH

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the rear PTO safety switch.*

The rear PTO safety switch, 1, is a single-pole, push-button type switch located on the left side of the gearbox housing. When the rear PTO is in the "On" position (lever pushed forward), the switch contacts are open. The tractor will not start with the Rear PTO engaged unless the parking brake is applied. When the rear PTO is in the "Off" position, the switch plunger retracts to close the contacts, completing the circuit and allowing the tractor to start.



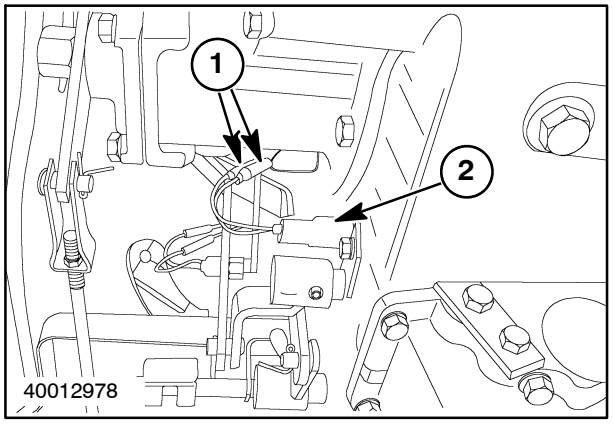
38

Removal

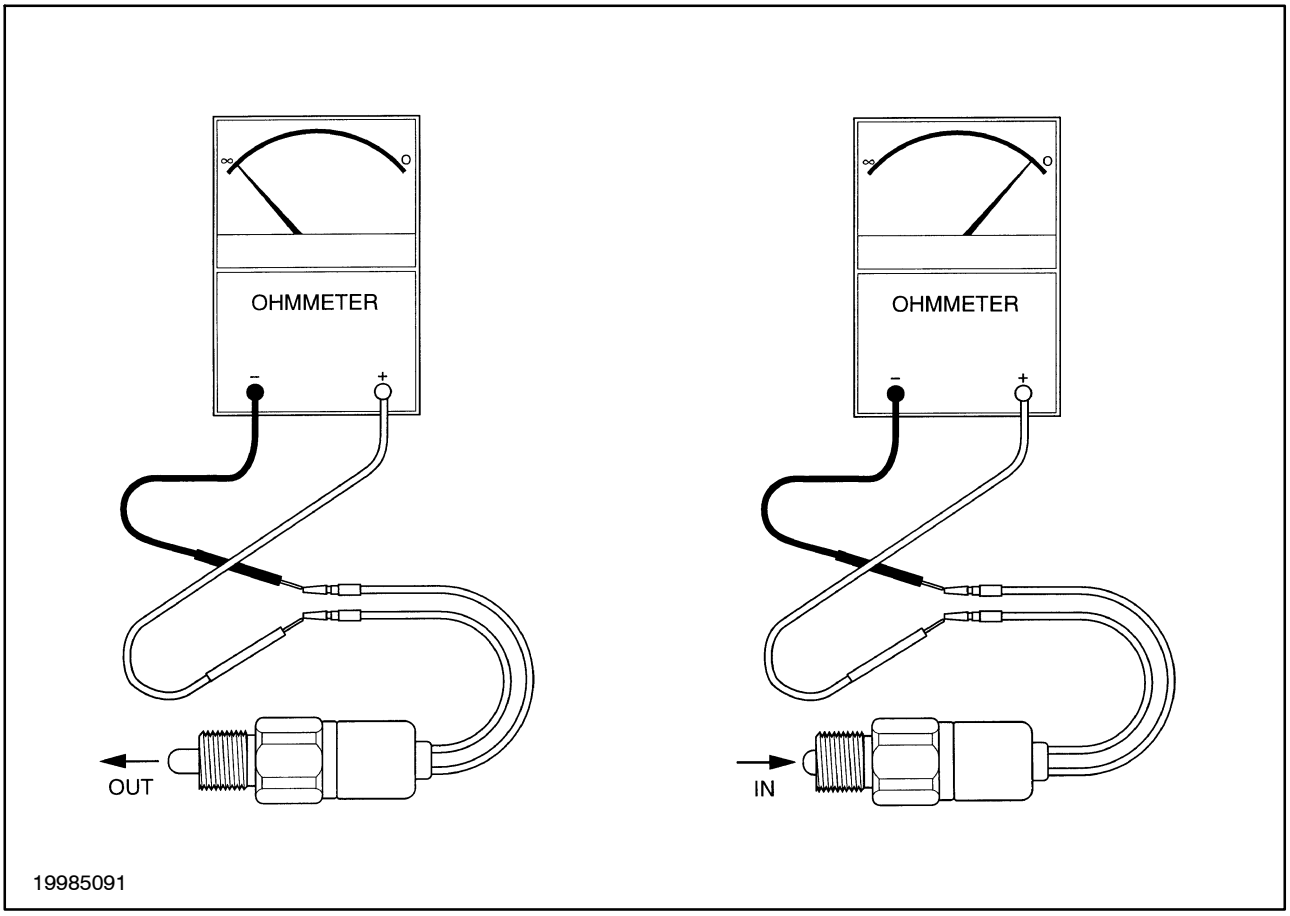
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two switch wire leads, 1, from the tractor wire harness.
3. Unthread the switch, 2, from the left side of the gearbox housing.

Testing

Use an ohmmeter to test both positions of the rear PTO safety switch for electrical continuity.



39



40

EXTENDED POSITION

1. With the switch plunger pushed in to the "extended" position (OUT), there should be no continuity between the two switch terminals. If continuity exists between the two switch terminals when the switch plunger is in the "extended" position, the switch is defective and requires replacement.

RETRACTED POSITION

1. With the switch plunger in the "retracted" position (IN), touch one of the test probes to the one switch lead. Touch the other test probe to the other switch lead.
2. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If continuity does not exist between the two switch terminals when the switch is in the "retracted" position, the switch is defective and requires replacement.

Installation

1. Thread rear PTO switch into the gearbox housing and tighten.
2. Connect the switch wire leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

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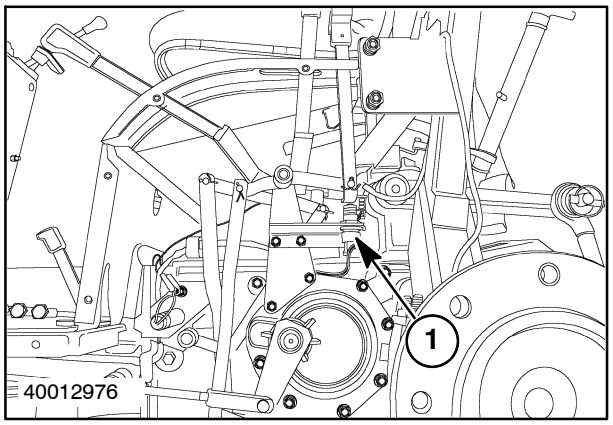
MID PTO SAFETY SWITCH (STANDARD ON HST MODELS/OPTIONAL FOR 9 X 3 MODELS)

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the Mid PTO safety switch.*

The mid PTO safety switch, 1, is a single-pole, push-button type switch located on the left side of the gearbox housing. When the mid PTO is in the "On" position (lever pulled upward), the switch contacts are open, not allowing the tractor to start. When the mid PTO is in the "Off" position (lever pushed down), the switch plunger retracts to close the contacts, completing the circuit and allowing the tractor to start.



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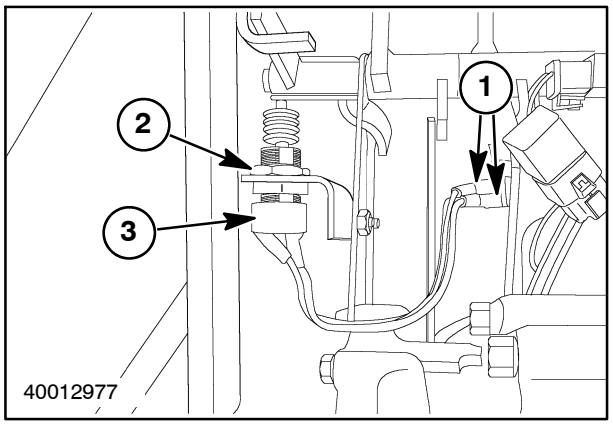
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two switch wire leads, 1, from the tractor wire harness.
3. Remove the nut, 2, to remove the mid PTO switch, 3, from the tractor.



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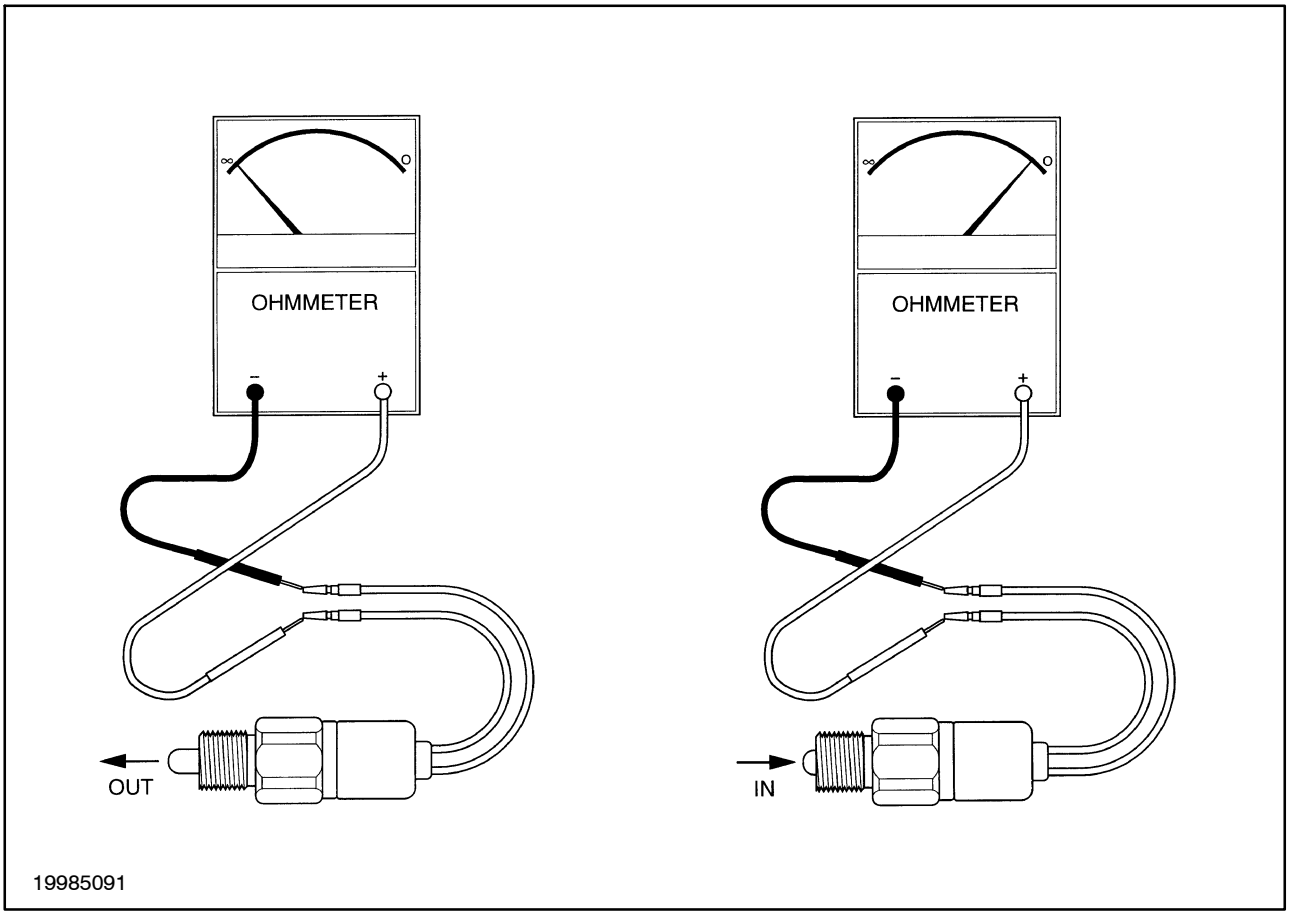
Testing

Use an ohmmeter to test both positions of the mid PTO safety switch for electrical continuity.



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EXTENDED POSITION

4. With the switch plunger pushed in to the "extended" position (OUT), there should be no continuity between the two switch terminals. If continuity exists between the two switch terminals when the switch plunger is in the "extended" position, the switch is defective and requires replacement.

RETRACTED POSITION

1. With the switch plunger in the "retracted" position (IN), touch one of the test probes to the one switch lead. Touch the other test probe to the other switch lead.
2. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If continuity does not exist between the two switch terminals when the switch is in the "retracted" position, the switch is defective and requires replacement.

Installation

1. Install the mid PTO switch onto the tractor by using the adjusting nut.
2. Connect the switch wire leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.
4. Use the two adjusting nuts on the switch assembly to raise the switch so that the plunger is depressed between 2 - 3 mm when the lever is in the control lowered position. Tighten the adjusting nuts to lock the switch into position.
5. Confirm proper switch adjustment using the chart below.

Mid PTO Engaged (Lever Pulled Up)	Tractor Will Not Start
Mid PTO Disengaged (Lever Pushed Down)	Tractor Will Start

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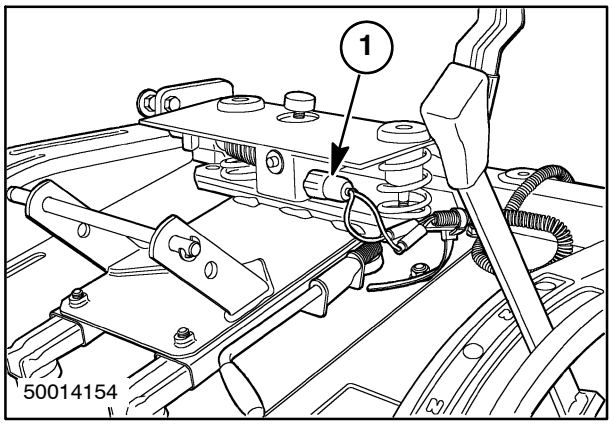
SEAT SAFETY SWITCH

The seat safety start switch, 1, is a single pole, push-button type switch located underneath the operator seat. When the operator is not present, the switch contacts are open and will not allow the tractor to start. When the operator is present, the switch contacts are closed, allowing the tractor to start.

NOTE: *The operator seat was removed to better show the seat safety switch location. Removal of the seat is not necessary.*



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Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Tilt the operator seat forward to gain access to the seat safety switch.
3. Disconnect the two seat safety switch wire leads from the tractor wiring harness.
4. Unthread the retaining nut to remove the seat safety switch, 1, from the mounting bracket.

Testing

Use an ohmmeter to test the seat safety switch for electrical continuity.

Switch Plunger Extended (Out)

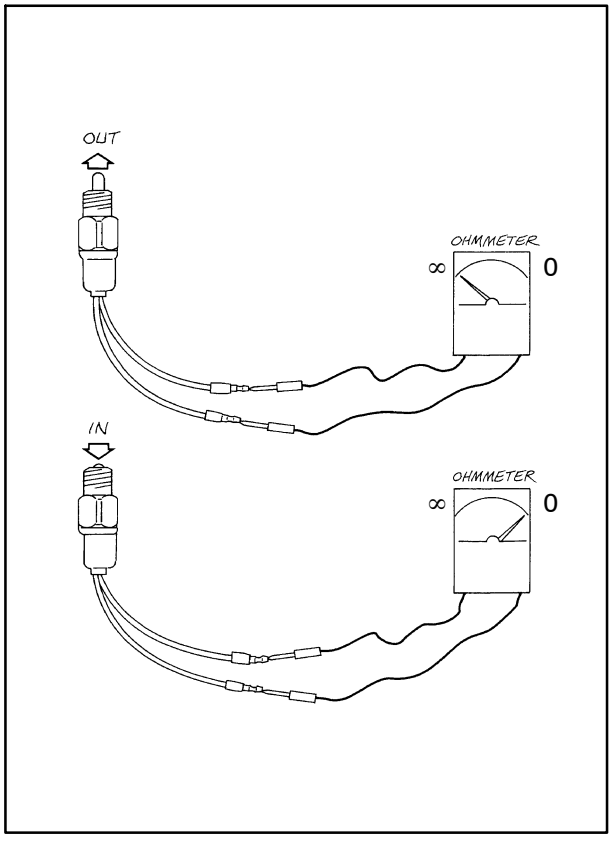
1. Remove the seat safety switch.
2. When the switch is in the raised (operator not seated) position, the switch contacts should be open and there should be high resistance, indicating no continuity. If continuity exists when the switch is in extended position, the seat switch is defective and requires replacement.

Switch Plunger Retracted (In)

1. Press the switch down (operator seated) and observe the reading on the ohmmeter. There should be little or no resistance, indicating that continuity exists between the two switch terminals. If the resistance is high, there is no continuity, the switch is defective and requires replacement.

Installation

1. Insert the seat safety switch into the mounting bracket and secure by threading the nut onto the switch.
2. Connect the two wire leads of the seat safety switch to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



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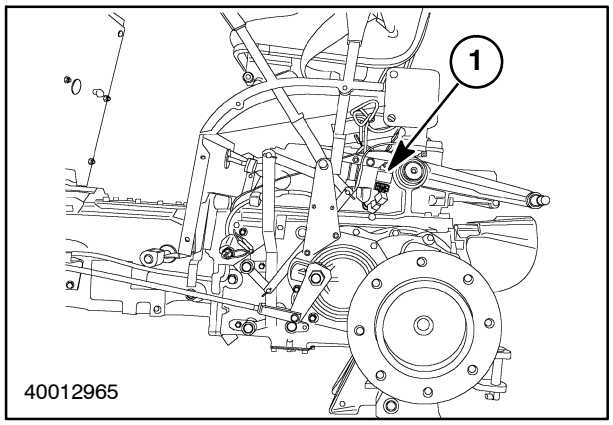
SEAT SAFETY SWITCH TIMER

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the seat safety switch timer.*

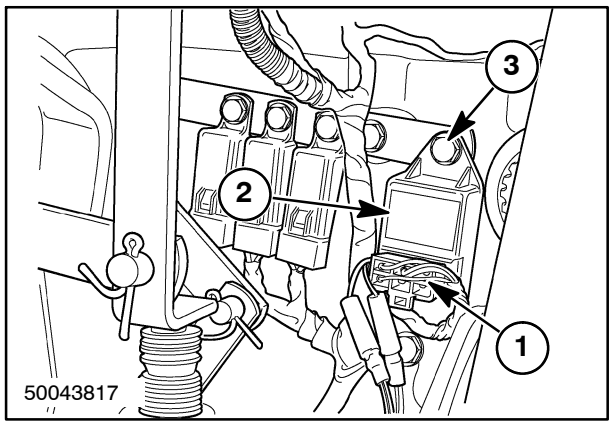
1. The seat safety switch timer, 1, is located on the left side of the lift cover behind the left rear fender. When the tractor is running, the seat timer creates a one-second delay before shutting off the tractor engine, should the operator get off the seat. The seat safety switch shuts the tractor engine off by cutting the ground to the control circuit in the kill relay, which in turn stops current flow to the fuel shutoff solenoid.
2. If the tractor transmission range is in the neutral position and the parking brake is applied, the tractor will continue to run while unoccupied.



46

Removal

3. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
4. Remove the plug, 1, from the seat safety switch timer, 2.
5. Remove the retaining bolt, 3, to remove the seat safety switch timer, 2, from the tractor.



47

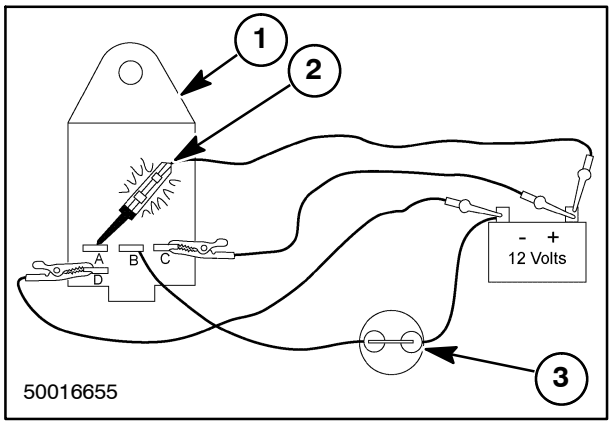
Testing

Use a 12-volt power source, a suitable test light, and a suitable switch to determine if the seat safety switch timer is functioning properly.

ON POSITION

NOTE: *The terminals are not letter or number-coded on the seat safety switch timer.*

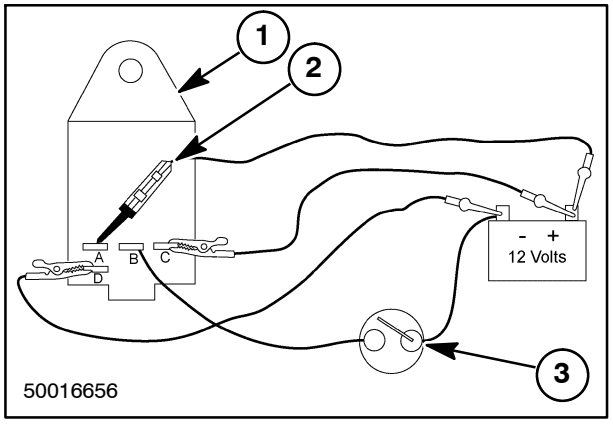
1. Connect a jumper wire to the from the positive (+) terminal of a 12-volt power supply to terminal “C” on the seat timer, 1.
2. Connect a test light, 2, from the positive (+) terminal of a 12-volt power supply to terminal “A” on the seat timer, 1.
3. Connect a jumper wire equipped with a suitable toggle switch, 3, from the negative (-) terminal of a 12-volt power supply to terminal “B” on the seat timer, 1.
4. Connect a jumper wire from the negative (-) terminal of a 12-volt power supply to terminal “D” on the seat timer, 1.
5. Switch the toggle switch to the “On” position and observe the test light, 2. The test light should illuminate.



48

OFF POSITION

1. Switch the toggle switch to the “Off” position and observe the test light. The test light should illuminate for approximately 2 seconds and then turn off. If the test light fails to illuminate or does not turn off after approximately 2 seconds, the seat timer is defective and requires replacement.



49

Installation

2. Install the seat safety switch timer by using the retaining bolt.
3. Connect the connector to the seat safety switch timer.
4. Connect the negative (-) battery cable to the negative (-) battery terminal.

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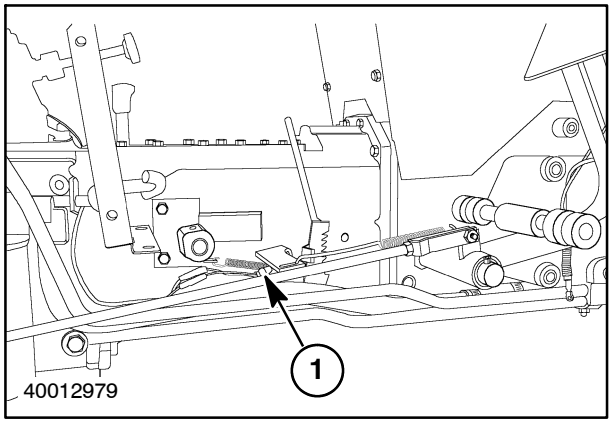
PARKING BRAKE SAFETY SWITCH

NOTE: *The right-side operator platform was removed to better show the position of the brake switch.*

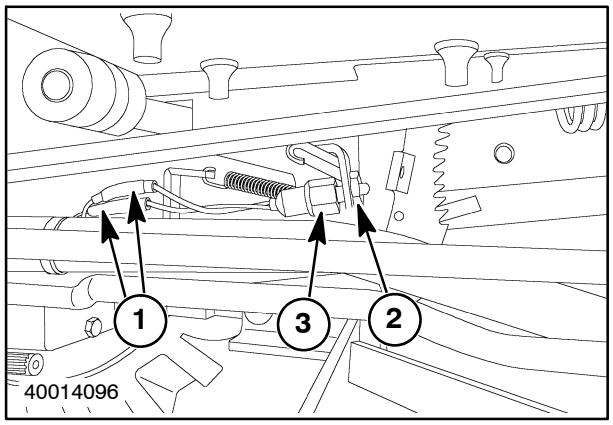
The parking brake safety switch, 1, is a single-pole, push-button type switch located directly behind the parking brake lever. When the parking brake is engaged, the switch contacts are closed, allowing the tractor to start or run with the operator out of the operator seat, providing the Mid PTO is NOT engaged and the range is in neutral.



50

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two switch leads, 1, from the tractor wire harness.
3. Remove the adjusting nut, 2, to remove the parking brake switch, 3, from the tractor.



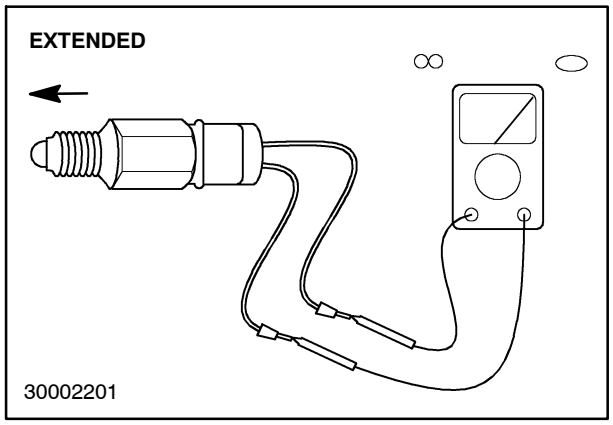
51

Testing

Use an ohmmeter to test both positions of the parking brake safety switch for electrical continuity.

EXTENDED POSITION

1. With the switch plunger in the "extended" position, touch one of the test probes to the one switch lead. Touch the other test probe to the other switch lead.
2. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If continuity does not exist between the two switch terminals when the switch is in the "extended" position, the switch is defective and requires replacement.



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RETRACTED POSITION (Not Shown)

1. With the switch plunger pushed in to the "retracted" position, there should be no continuity between the two switch terminals. If continuity exists between the two switch terminals when the switch plunger is in the retracted position, the switch is defective and requires replacement.

Installation

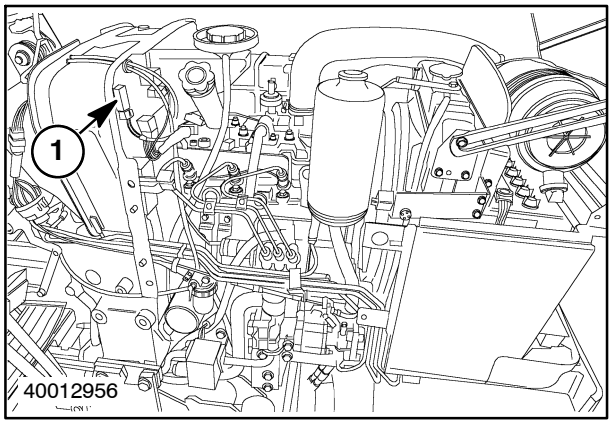
1. Install the parking brake safety switch by using the adjusting nut.
2. Connect the two switch leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.
4. Make sure the switch is adjusted so that the switch plunger is depressed 2 - 3 mm when the parking brake is NOT engaged.

RELAYS

Relays are used on the TC30 tractor to automatically complete (close) a circuit. There are four relays used on the TC30 tractor. Both relays use the same part number and are interchangeable. A relay contains two parts of a circuit. One part, the control circuit, uses current to energize a coil. The other part, the function circuit, is a switch. When energized, the coil of the relay becomes an electromagnet opening or closing the function circuit.

SAFETY START RELAY

The safety start relay, 1, is located in the engine compartment on the right side of the tractor firewall. The start relay controls current flowing to the fuel shutoff solenoid. When the key switch is turned to the START position, current flows to the control circuit of the safety start relay. The safety switches (Rear PTO, Mid PTO, Transmission Range Switch, and the Seat Safety Switch) control the ground path to the start relay. If the ground path to the start relay is interrupted by one of the safety switches, the relay will not energize. When the ground circuit to the start relay is complete, the start relay energizes and powers the starter motor.



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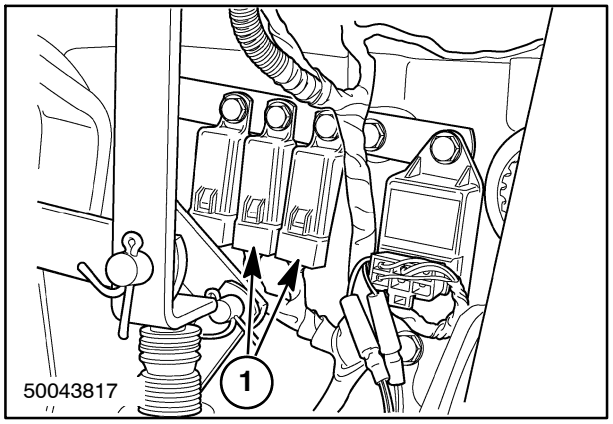
TAIL LIGHT RELAYS

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the relays.*

The relays, 1, are located on the lift cover behind the left rear fender; controls current flow to the tail lights. When current is interrupted and no longer provided to the relay, the relay becomes de-energized and no longer provides current to the tail lights.



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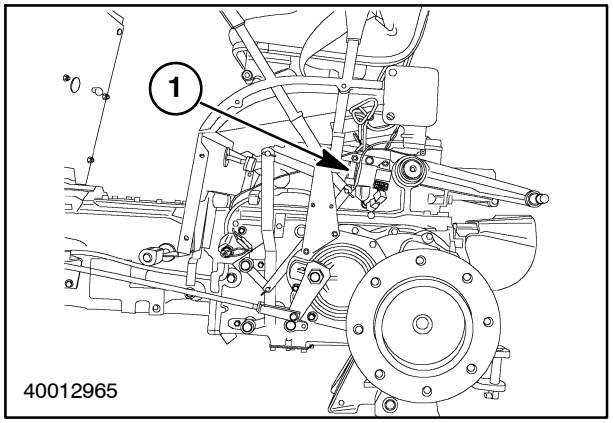
FUEL SHUTOFF RELAY

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the fuel shutoff relay.*

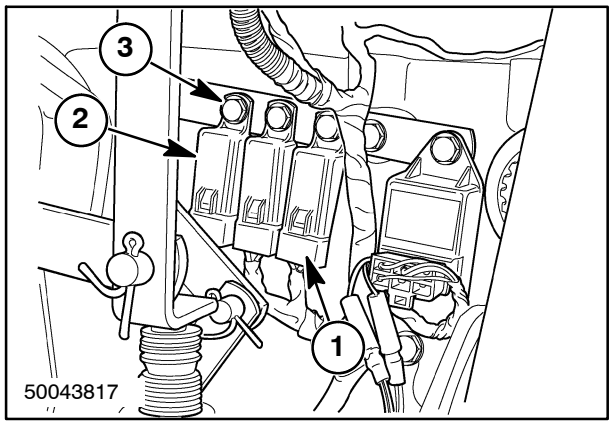
The fuel shutoff relay, 1, is located on the left side of the lift cover behind the left rear fender. The fuel shutoff relay controls current flowing to the fuel shutoff solenoid. If the ground circuit to the fuel shutoff relay is interrupted by one of the safety switches, the fuel shutoff relay becomes de-energized and no longer delivers current to the fuel shutoff solenoid. This causes the fuel shutoff solenoid to extend, stopping fuel from flowing into the engine.



55

Removal (All Relays)

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Unplug the connector, 1, from the fuel shutoff relay, 2.
3. Remove the retaining bolt, 3, to remove the relay, 2, from the tractor.



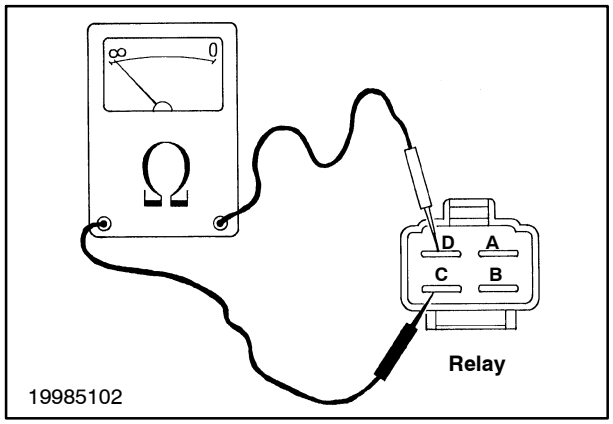
56

Testing (All Relays)

Use a 12-volt power source and an ohmmeter to verify that the relay is functioning properly.

NON-ENERGIZED

1. Connect the ohmmeter test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading.
2. There should be no continuity between the terminals "C" and "D" when the relay is not energized. If continuity exists between terminals "C" and "D" when the relay is not energized, the relay is defective and requires replacement.



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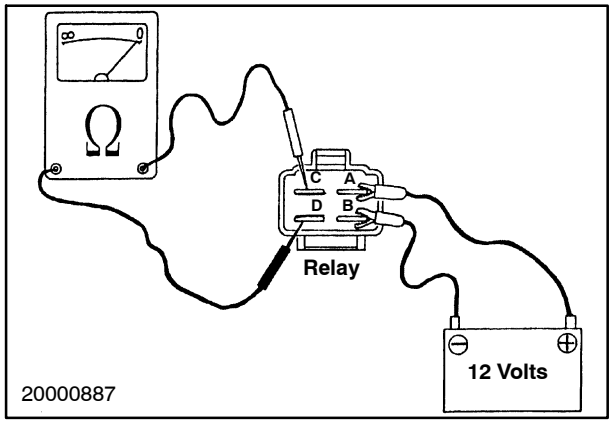
ENERGIZED

1. Connect a jumper wire from the positive (+) terminal of the 12-volt power source to the "A" terminal of the relay.
2. Connect the negative (-) terminal of the 12-volt power source to the "B" terminal of the relay.
3. Connect the ohmmeter test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading.
4. There should be little or no resistance between the "C" and "D" terminals of the relay when energized, indicating that continuity exists between terminals "C" and "D". If continuity does not exist between terminal "C" and "D" when the relay is energized, the relay is defective an requires replacement.



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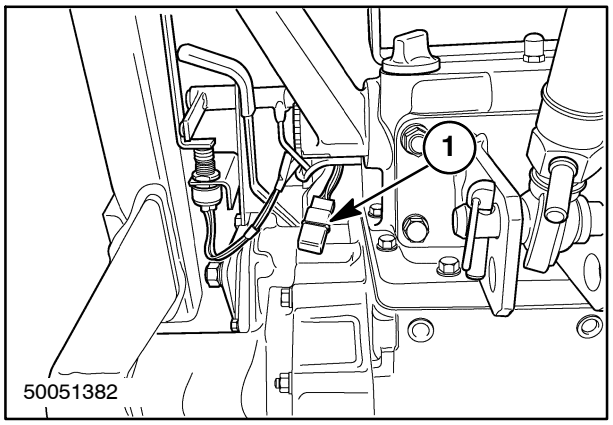
Installation (All Relays)

1. Plug the relay into the connector on the tractor wire harness.
2. Install the relay onto the tractor by using the retaining bolt.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

DIODES

Safety Start/Safe Operation Diode Pack

The Safety Start/Safe Operation diode pack, 1, is located behind the left fender on the left side of the lift cover. The diode pack contains two individual diodes that force current to flow in one direction. Diodes allow the use of one wire within multiple circuits to control current flow to electrical components such as relays.



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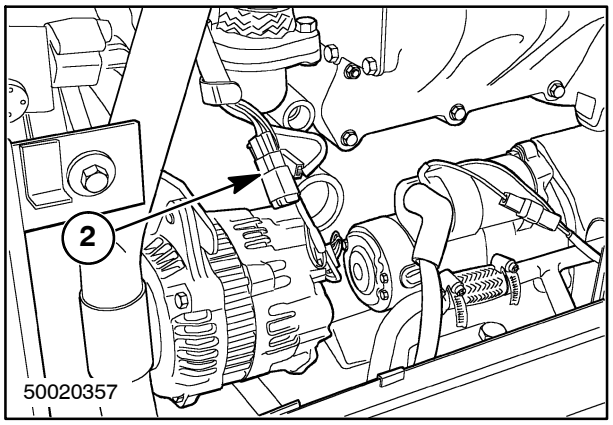
Charging System Diode

The charging system diode, 2, is located along the left side of the engine near the alternator. The charging system diode is used to prevent current from back feeding into the low charge indicator light within the instrument panel.



60

Removal (All Diodes)

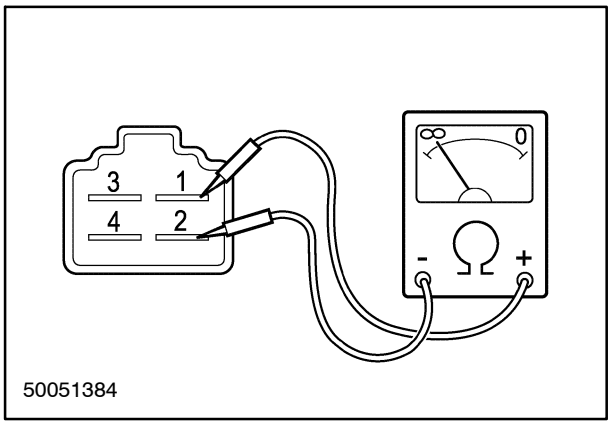
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Unplug the connector from the diode.
3. Remove the diode from the tractor.

Testing Safe Start/Safe Operation Diode Pack

1. Remove the diode module suspected of being faulty from the tractor.

NOTE: *For this test, an electrical multimeter with diode test capabilities may be used in place of an ohmmeter. If a multimeter with diode testing capabilities is unavailable, use an ohmmeter to test as described below.*

2. Using an ohmmeter, touch the red, positive (+), test probe to diode terminal “1”. Touch the black, negative (–), ohmmeter test probe to diode terminal “2”. Observe the ohmmeter.
3. The ohmmeter should show high resistance, indicating no continuity and that current is not flowing through the diode in that direction. If there is continuity. Check to see that the test probes are on the correct terminals, and if they are, the diode module is defective and needs replaced.



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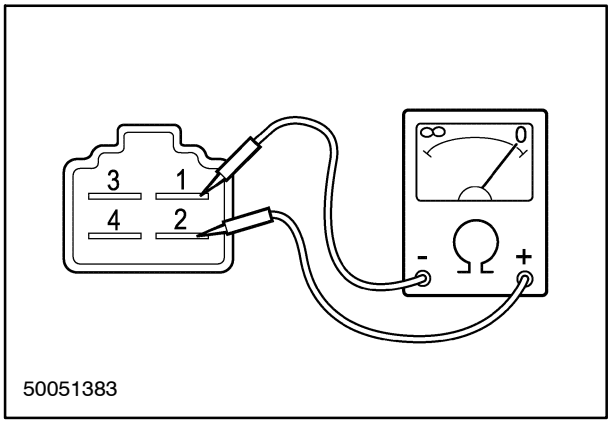
4. If the previous test indicated the diode was functioning properly, touch the red, positive (+), ohmmeter test probe to terminal “2” of the diode and the black, negative (–), test probe to terminal “1” of the diode.
5. Observe the ohmmeter. The ohmmeter should show little or no resistance, indicating continuity in that direction. If the ohmmeter does not show continuity, the diode module is defective and needs replaced.
6. Repeat test on terminals “3” and “4”.



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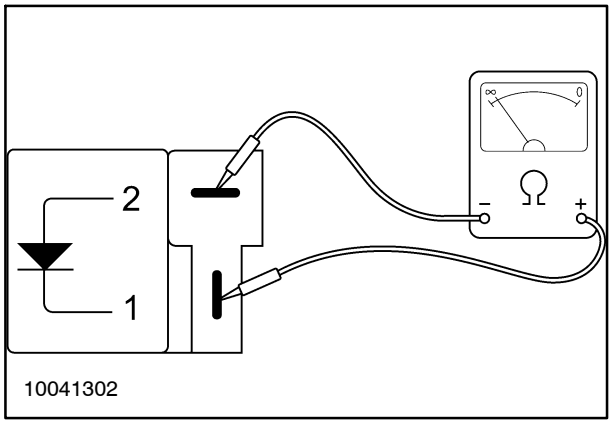
Testing Charging System Diode

1. Remove the diode module suspected of being faulty from the tractor.

NOTE: *For this test, an electrical multimeter with diode test capabilities may be used in place of an ohmmeter. If a multimeter with diode testing capabilities is unavailable, use an ohmmeter to test as described below. A diode will only allow current flow in one direction.*

2. Using an ohmmeter, touch the red, positive (+), test probe to diode terminal "1". Touch the black, negative (-), ohmmeter test probe to diode terminal "2". Observe the ohmmeter.
3. The ohmmeter should show high resistance, indicating no continuity and that current is not flowing through the diode in that direction. If there is continuity. Check to see that the test probes are on the correct terminals, and if they are, the diode module is defective and needs replaced.



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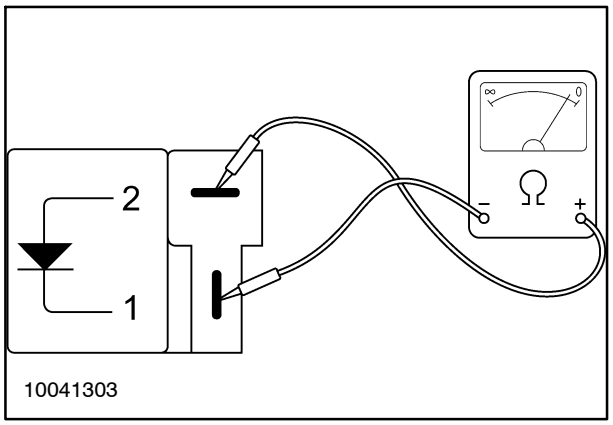
4. If the previous test indicated the diode was functioning properly, touch the red, positive (+), ohmmeter test probe to terminal "2" of the diode and the black, negative (-), test probe to terminal "1" of the diode.
5. Observe the ohmmeter. The ohmmeter should show little or no resistance, indicating continuity in that direction. If the ohmmeter does not show continuity, the diode module is defective and needs replaced.



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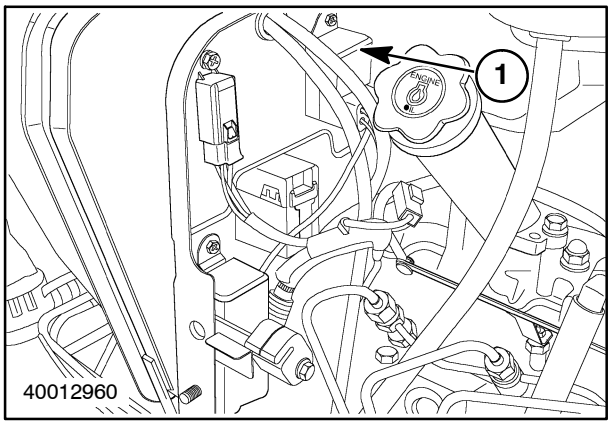
Installation (All Diodes)

1. Plug the diode into the connector on the tractor wire harness.
2. Connect the negative (-) battery cable to the negative (-) battery terminal.

ENGINE GLOW PLUG INDICATOR LIGHT TIMER

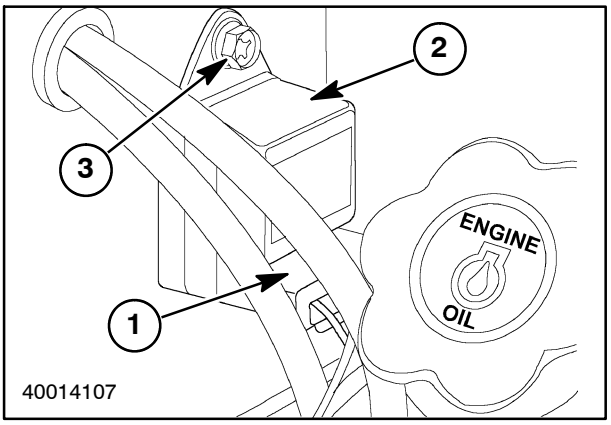
The engine glow plug indicator light timer, 1, is located in the engine compartment, on the right side of the firewall. The glow plug timer controls the ground path to the glow plug indicator light within the instrument panel. When the key switch is turned to the “HEAT” position, the glow plug timer completes the ground path to the glow plug indicator light for approximately four to five seconds. The glow plug timer does not control current flow to the engine glow plugs. After approximately four seconds, the timer opens the ground circuit to turn the indicator light off.



65

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the plug, 1, from the glow plug timer, 2.
3. Remove the retaining bolt, 3, to remove the glow plug timer, 2, from the tractor.



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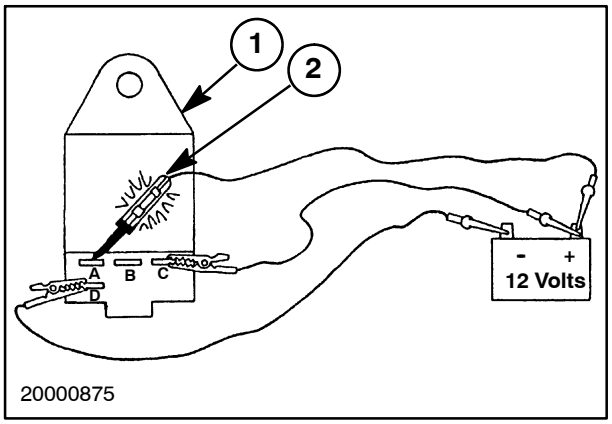
Testing

Use a 12-volt power source, a suitable test light, and jumper wires to determine if the glow plug indicator light timer is functioning properly.

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the glow plug indicator light timer from the tractor.
3. Connect a jumper wire from the positive (+) terminal of the 12-volt power source to the “C” terminal of the glow plug indicator light timer, 1.
4. Connect a test light, 2, from the positive (+) terminal of the 12-volt power source to the “A” terminal of the glow plug indicator light timer, 1.
5. Connect a jumper wire from the negative (-) terminal of the 12-volt power source to the “D” terminal of the glow plug indicator light timer, 1. Observe the test light, 2.
6. The test light should illuminate for approximately 4 - 5 seconds and then turn off. If the test light fails to illuminate or does not turn off after 4 - 5 seconds, the timer is defective and requires replacement.



67

Installation

1. Install the engine glow plug indicator light timer by using the retaining bolt.
2. Connect the two switch leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

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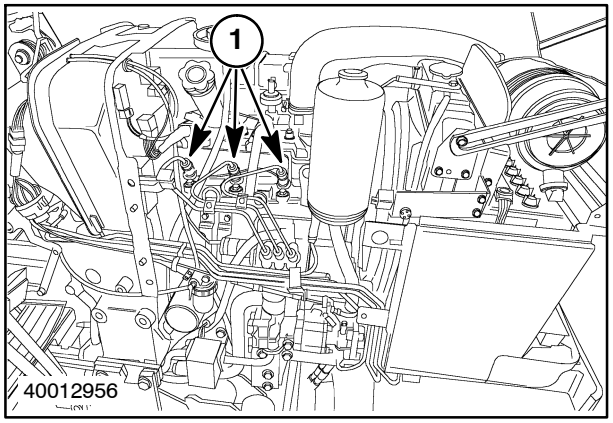
ENGINE GLOW PLUGS

The engine glow plugs, 1, are located on the right side of the cylinder head, below the fuel injectors. The glow plugs are used to preheat the air in the pre-combustion chamber. This aids in the starting of the engine when cold.



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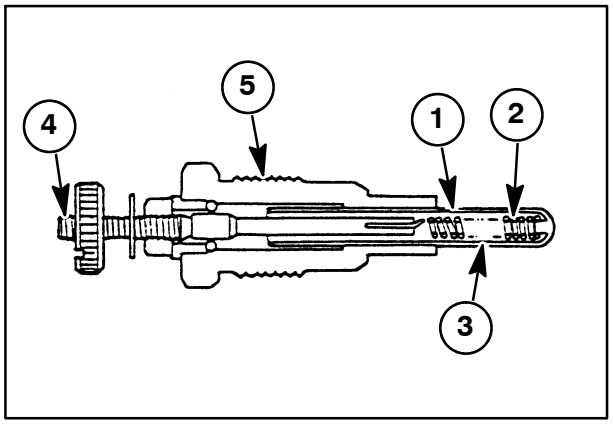
The glow plugs use a heating element that is contained in a stainless steel sheath, 1. The coiled heating wire, 2 is sintered into magnesium oxide powder, 3. The magnesium oxide powder is used to evenly transfer heat to the stainless steel sheath, which heats the air in the combustion chamber. The magnesium oxide powder is also used to insulate the heating wire from the outer sheath and glow plug body.

The glow plug heats when electrical current is passed from the glow plug electrode, 4, to one end of the heating wire, 2. Electrical resistance warms the heating wire when electrical current is flowing through the wire. The opposite end of the wire is connected to the sheath. The sheath and the glow plug body, 5, are grounded by the engine block.



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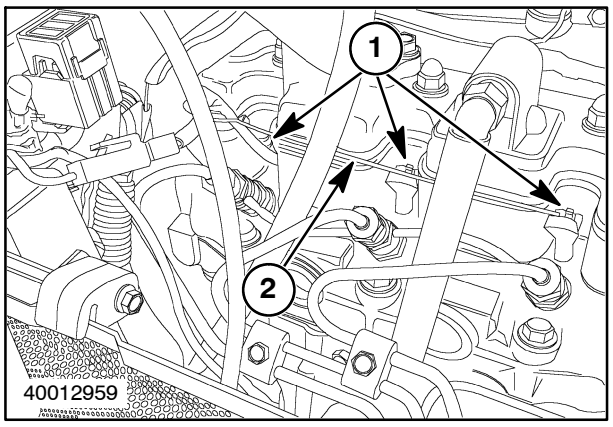
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the three nuts, 1, and the washers securing the electrode bar, 2, to the glow plugs.
3. Remove the glow plugs from the cylinder engine head.



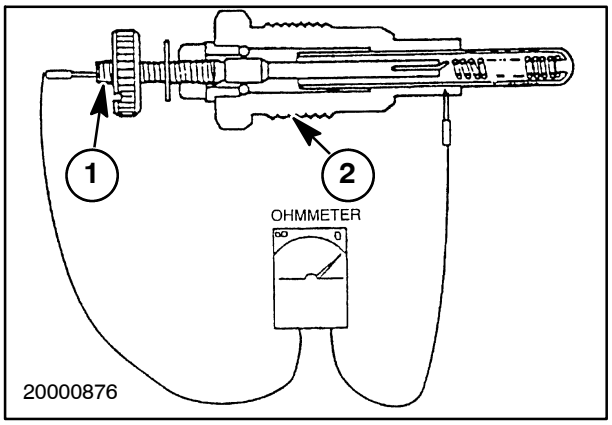
70

Testing

1. Clean the carbon from the glow plug sheath.

NOTE: *Do not test resistance using the glow plug sheath.*

2. Using an ohmmeter, touch one of the test probes to the glow plug electrode, 1. Touch the other test probe to the glow plug body, 2.
3. Observe the ohmmeter. A resistance reading of 1.6 ohms maximum is normal for the engine glow plugs. If the resistance reading is too high, the glow plug is defective and requires replacement.



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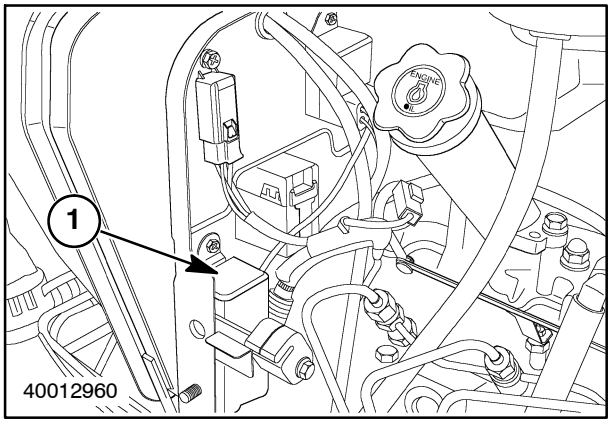
Installation

1. Thread the glow plugs into the engine cylinder head. Torque each glow plug to 10 - 15 N·m (11.0 - 14.5 ft. lbs.).
2. Install the electrode bar and the washers onto the glow plugs. Secure by using the three nuts.
3. Connect the negative (–) battery cable to the negative (–) battery terminal.

HAZARD FLASHER/TURN SIGNAL CONTROL MODULE

The hazard flasher/turn signal control module, 1, is located in the engine compartment, on the right side of the firewall. The control module controls current flowing to the hazard flasher/turn signal lights on the rear fenders. Refer to the chart below for the functions of the control module.

HAZARD/TURN SIGNAL SWITCH POSITION	RESULT
Hazard switch “On”	Both flashers blink in unison
Left turn signal “On”	Left flasher blinks and right flasher remains solid.
Right turn signal “On”	Right flasher blinks and left flasher remains solid



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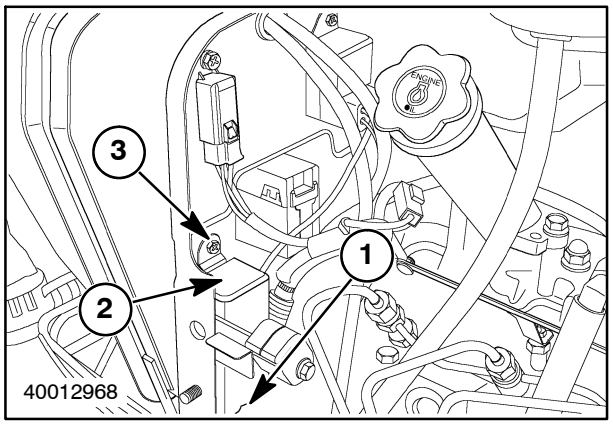
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Unplug the connector, 1, from the control module, 2.
3. Remove the retaining bolt, 3, to remove the relay, 2, from the tractor.



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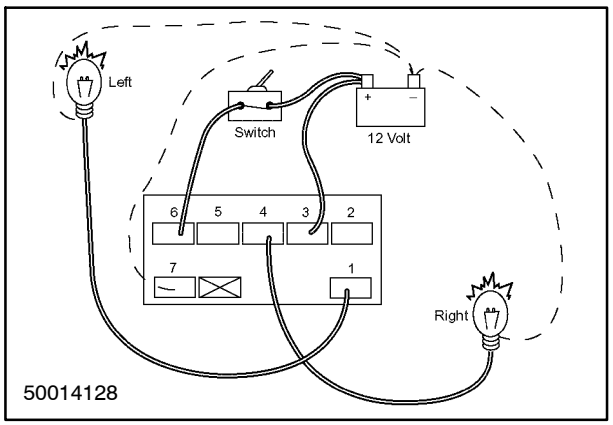
Testing

Use a 12-volt power source, a suitable switch, jumper wires and two test lights to perform the 3 tests on the hazard flasher /turn signal control module.

NOTE: *Disregard terminal markings on the module. Refer to terminal markings in the illustration.*

Test 1 - Test 1 is used to verify that the control module is supplying power to both of the hazard lights. This test simulates the hazard switch being turned to the "On" position.

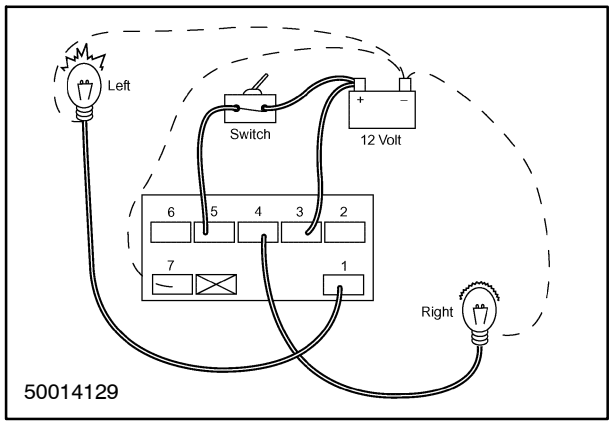
1. Connect a test light to terminal 1 of the control module. This test light will simulate the left flasher.
2. Connect a test light to terminal 4 of the control module. This test light will simulate the right flasher.
3. Connect a jumper wire to the positive (+) terminal of the power source and the switch. Connect a jumper wire to the switch and terminal 6 on the control module.
4. Connect a jumper wire to the positive (+) terminal of the power source and terminal 3 of the control module.
5. Connect a jumper wire to the negative (-) terminal of the power source and terminal 7 of the control module.
6. Switch the switch to the "On" position, observe the two test lights. Both should flash on and off simultaneously.



74

Test 2 - Test 2 is used to verify that the control module is functioning properly when the left turn signal is activated. This test simulates the turn signal switch being turned to the “Left” position.

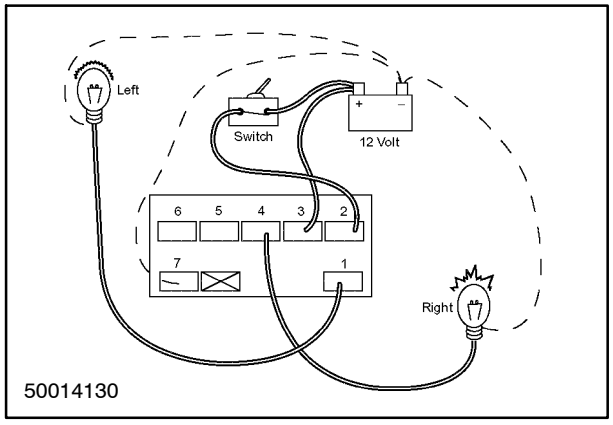
1. Connect a test light to terminal 1 of the control module. This test light will simulate the left flasher.
2. Connect a jumper wire to the positive (+) terminal of the power source and the switch. Connect a jumper wire to the switch and terminal 5 on the control module.
3. Connect a jumper wire to the positive (+) terminal of the power source and terminal 3 of the control module.
4. Connect a jumper wire to the negative (-) terminal of the power source and terminal 7 of the control module.
5. Turn the switch to the “On” position and observe the two test lights. The left light should flash while the right light remains illuminated (solid).



75

Test 3 - Test 3 is used to verify that the control module is functioning properly when the right turn signal is activated. This test simulates the turn signal switch being turned to the “Right” position.

1. Connect a test light to terminal 1 of the control module. This test light will simulate the left flasher.
2. Connect a jumper wire to the positive (+) terminal of the power source and the switch. Connect a jumper wire to the switch and terminal 2 on the control module.
3. Connect a jumper wire to the positive (+) terminal of the power source and terminal 3 of the control module.
4. Connect a jumper wire to the negative (-) terminal of the power source and terminal 7 of the control module.
5. Turn the switch to the “On” position and observe the two test lights. The right light should flash while the left light remains illuminated (solid).



76

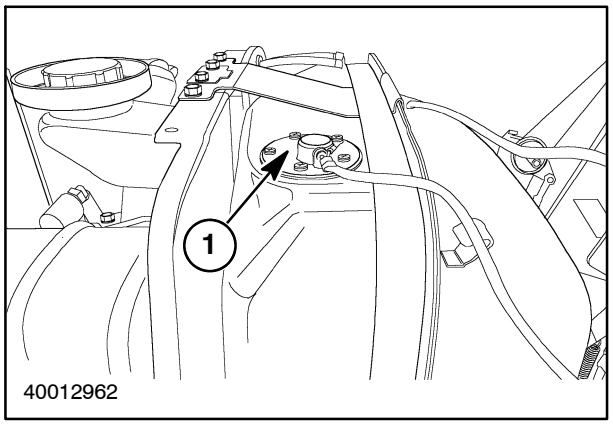
Installation

1. Install the control module onto the tractor firewall by using the retaining bolt.
2. Plug the tractor wire harness connector into the control module.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

Op. 55 410

FUEL LEVEL SENDER

The fuel level sending unit, 1, is mounted on top of the inside of the fuel tank. The sender float moves up and down with the fuel level in the tank, while changing the resistance to the ground circuit of the fuel gauge.



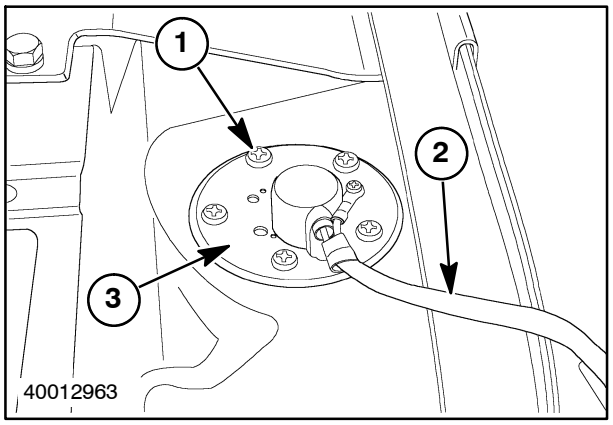
77

Removal

⚠ WARNING ⚠

Do not expose diesel fuel to open flame or spark. Clean up spills immediately. Do not smoke while near diesel fuel. Serious injury could result.

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the panels from the center console of the tractor to gain access to the fuel tank.
3. Remove the five screws, 1, and disconnect the wire harness, 2, to remove from the fuel level sending unit, 3, from the fuel tank.



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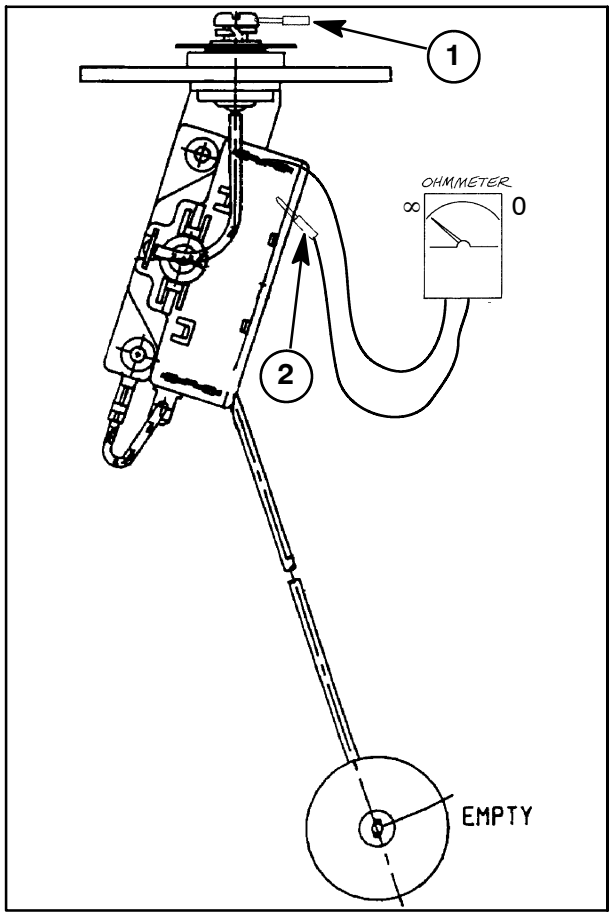
Testing
Use an ohmmeter to test the fuel level sender.

1. Remove the sender from the fuel tank.
2. Attach one of the meter leads to the center post, 1, of the sender. Attach the other meter lead to the ground spade terminal, 2, of the sender body.
   - With the sender in the EMPTY (DOWN) position, the meter reading will be 103 - 117 ohms.
   - With the sender in the FULL (UP) position, the meter reading will be 1 - 5 ohms.

If test results do not match the above, replace the fuel level sender.



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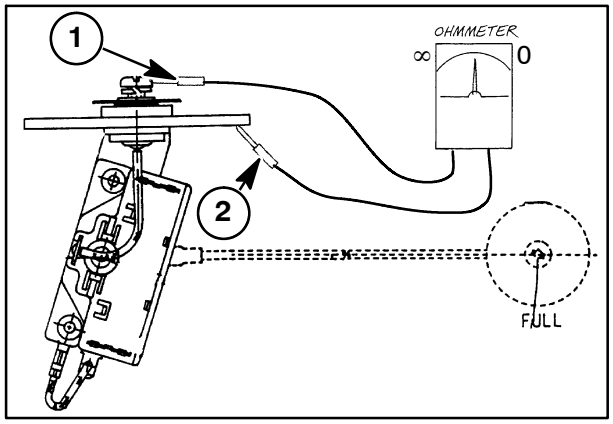

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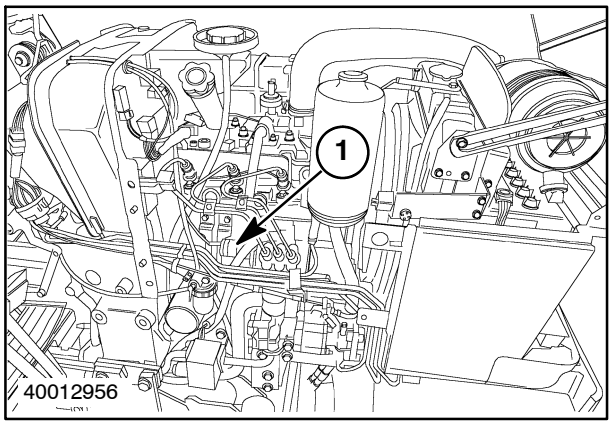
Installation

1. Install the fuel level sending unit by using the five screws.
2. Connect the tractor wire harness to the fuel level sending unit.
3. Install the panels onto the center console of the tractor.
4. Connect the negative (–) battery cable to the negative (–) battery terminal.

FUEL SHUTOFF SOLENOID

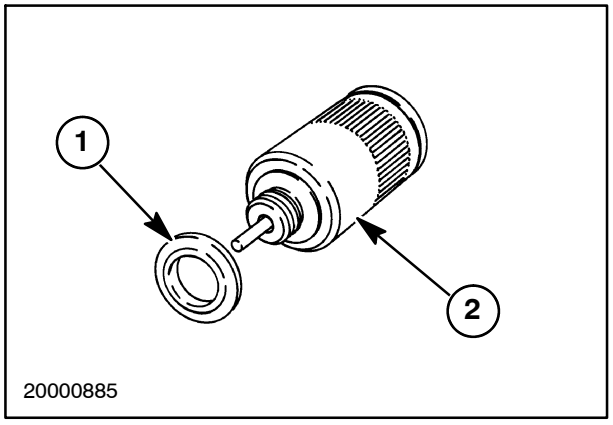
The injection pump is equipped with a fuel shutoff solenoid, 1, threaded into the rear of the injection pump casting. The solenoid plunger is spring-loaded; when the solenoid is not energized the plunger pushes the injection pump control rack forward into the closed (shut-off) position. When the solenoid is energized, as when the key switch is turned to the “On” and “Start” Positions, the solenoid plunger is retracted and the governor linkage moves the pump control rack rearward into operating position.



81

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the fuel shutoff wire from the fuel shutoff solenoid.
3. Using pliers, remove the solenoid from the rear of the injection pump casting.
4. Remove the sealing washer, 1, from the fuel shutoff solenoid, 2.



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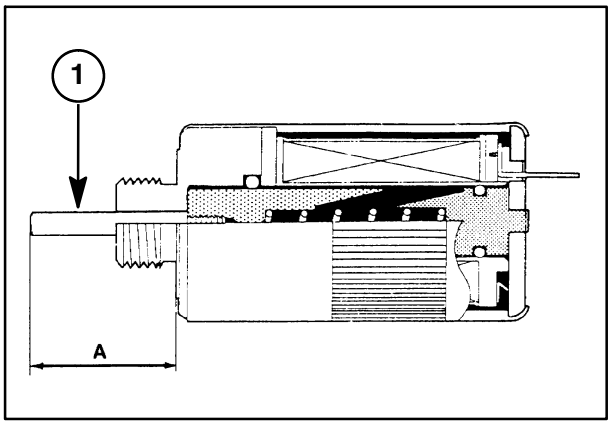
Testing

1. With the solenoid de-energized, measure the protrusion distance “A” of the plunger, 1, as shown at right.
   - In the shut-off position, the plunger protrusion distance, A, should measure 25.5 - 26.4 mm (1.004 - 1.04″).



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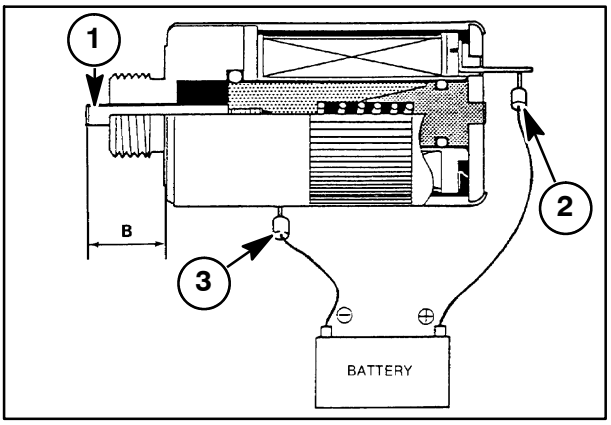
2. Connect a jumper wire from the solenoid terminal, 2, to the battery positive (+) terminal. Connect a second jumper from the battery negative (–) terminal to the solenoid body, 3. The solenoid plunger will retract. Measure the protrusion distance “B” of the plunger, 1, as shown at right.
   - In the retracted position, the plunger protrusion distance, B, should measure 11.5 - 14.5 mm (0.453 - 0.571″).

If the measurements are not within the limits specified above, replace the solenoid.



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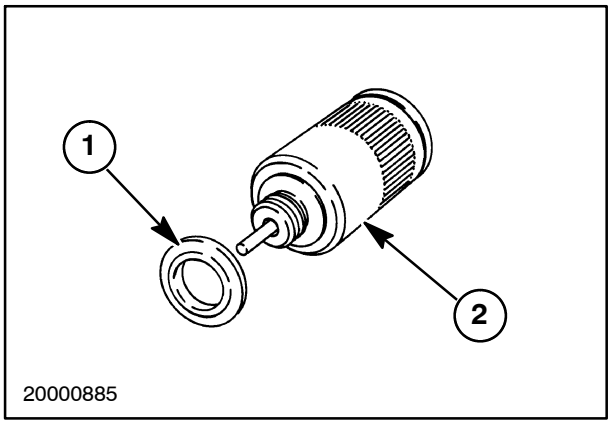
Installation

1. Install a new sealing washer, 1, onto the fuel shutoff solenoid, 2.
2. Thread the fuel shutoff solenoid, 2, into the back of the injection pump casting and tighten.
3. Connect the fuel shutoff solenoid wire to the fuel shutoff solenoid.
4. Connect the negative (–) battery cable to the negative (–) battery terminal.



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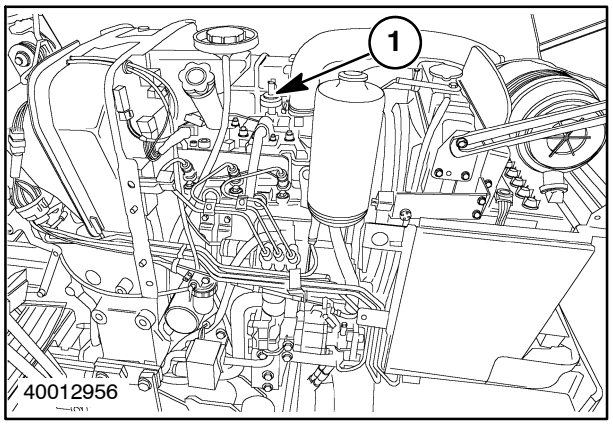
Op. 55 414

AIR FILTER RESTRICTION SWITCH

The air filter restriction switch, 1, is located on the engine valve cover/intake manifold. The air filter restriction switch is a vacuum operated switch, which detects when the air filter becomes clogged or restricted. The contacts within the switch are normally open. When the air filter becomes clogged or restricted, the vacuum created closes the contacts within the switch, completing the ground circuit that illuminates an indicator light within the instrument panel warning the operator of the air restriction. The switch is preset to close at 20 in. H_2O ± 2 in. H_2O of vacuum.



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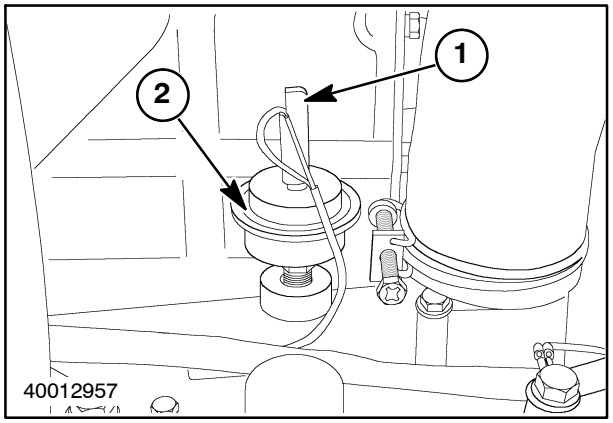
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two wire harness leads, 1, from the air filter restriction switch, 2. Note where each lead is connected for ease of installation.
3. Unthread the air filter restriction switch, 2, from the engine valve cover/intake manifold.



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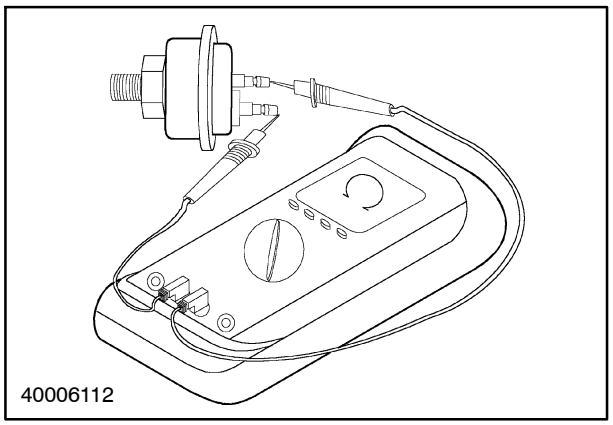
Testing

Use an ohmmeter to test if the air filter restriction switch is functioning properly.

1. Touch an ohmmeter test probe to each terminal on the switch. Observe the ohmmeter. The ohmmeter should indicate that no continuity exists between the two terminals. If continuity exists, the switch is defective and requires replacement.
2. Apply a vacuum of approximately 20 in. H_2O ± 2 in. H_2O to the switch. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If there is no continuity between the two switch terminals, the switch is defective and requires replacement.



88

Installation

1. Apply LocTite 567 thread sealant to the switch threads and install the switch into the engine valve cover/intake manifold.

NOTE: *When installing the two wire harness leads onto the air restriction switch, be sure the orange wire is connected to the insulated terminal on the switch.*

2. Connect the two wire harness leads to the air filter restriction switch.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

Op. 55 414

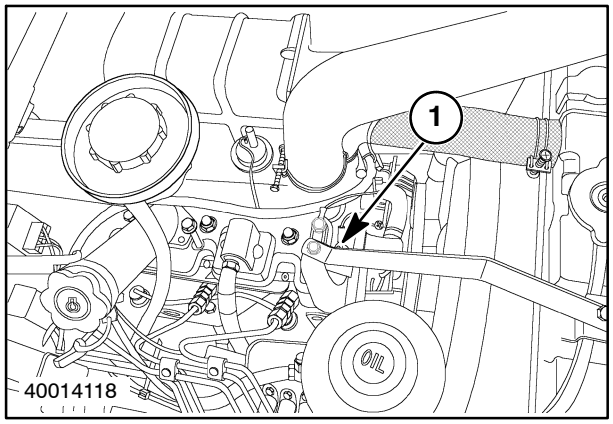
OIL PRESSURE SWITCH

The oil pressure switch, 1, is located underneath the radiator support bracket on the front of the engine cylinder head. The switch opens under normal oil pressure (above 6 PSI) and closes when the oil pressure is low (below 6 PSI) to complete the ground circuit of the oil pressure warning light.

When the ground circuit is completed, the oil pressure warning light within the instrument panel illuminates. The engine oil pressure switch is closed before the tractor engine is started, and is opened after the engine is started. If the warning light fails to stop illuminating after the engine is started, the oil level inside the engine may be low or there may be a problem with the tractor engine.

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the retaining screw, 1, that secures the electrical ring terminal to the oil pressure switch, 2.
3. Unthread the oil pressure switch, 2, from the engine cylinder head.



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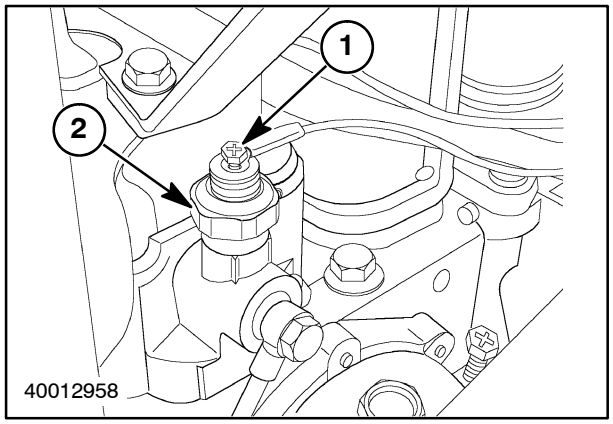

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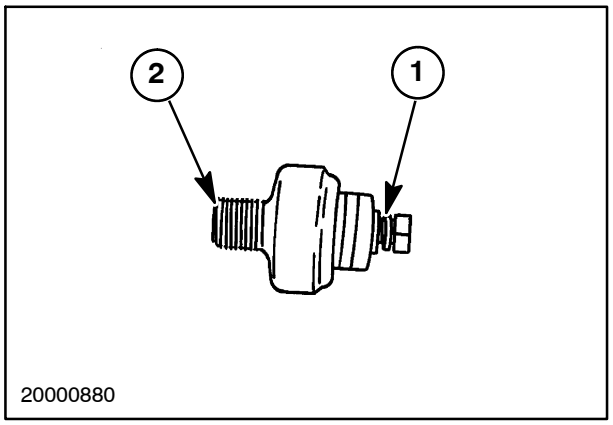
Testing

1. Using an ohmmeter, touch one test lead to the pressure switch terminal, 1, and the other test lead to the threads of the switch body, 2.
2. Observe the ohmmeter. There should be little or no resistance, indicating continuity in the switch. If there is no continuity, the switch is defective and needs replaced.

⚠ CAUTION ⚠

Do not use high pressure compressed air for the following test, otherwise damage may occur to the oil pressure switch.



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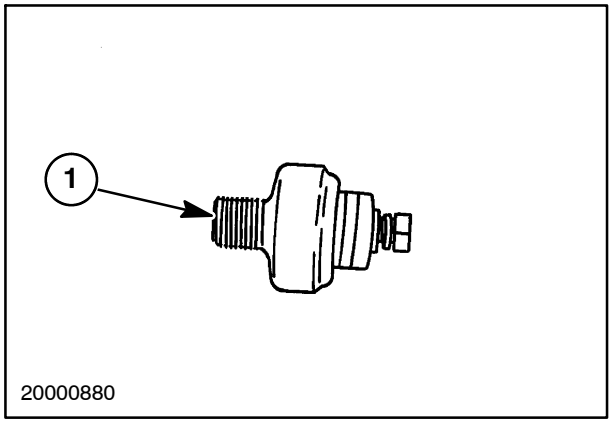
NOTE: *The following test is not a calibrated test. The purpose of the test is to see if the switch contacts open at pressure.*

3. While the test leads are connected to the switch, pressurize the switch oil pressure port, 1, with low pressure (10 - 20 psi) compressed air.
4. Observe the ohmmeter. While air pressure is being supplied to the oil pressure port, the ohmmeter should indicate high resistance, or no continuity. If there is continuity, the switch is defective and needs replaced.



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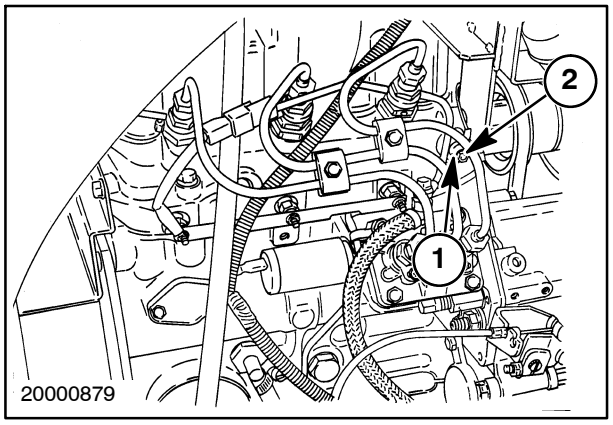
Installation

1. Apply LocTite® - 567 thread sealant onto the switch threads and install the oil pressure switch, 1, into the engine cylinder head.
2. Install the ring terminal onto the oil pressure switch by using the retaining screw, 2.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



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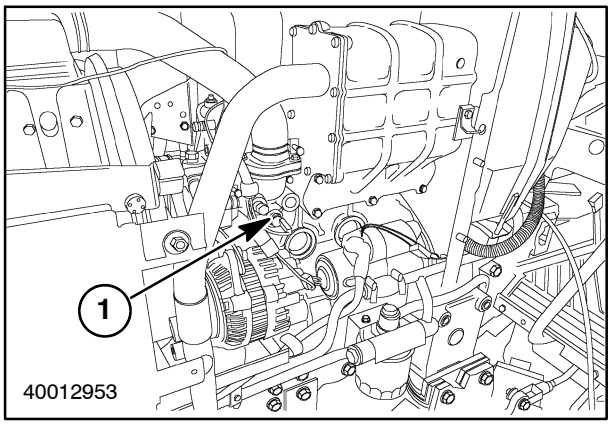
Op. 55 414

COOLANT TEMPERATURE SENDING UNIT

The engine coolant temperature sending unit, 1, is located on the left side of the thermostat housing on the model TC30 tractors. The sending unit regulates a variable resistance to ground, which translates to movement of the engine temperature gauge within the instrument panel. The sending unit decreases ground resistance as the coolant temperature rises, causing the temperature gauge to rise.



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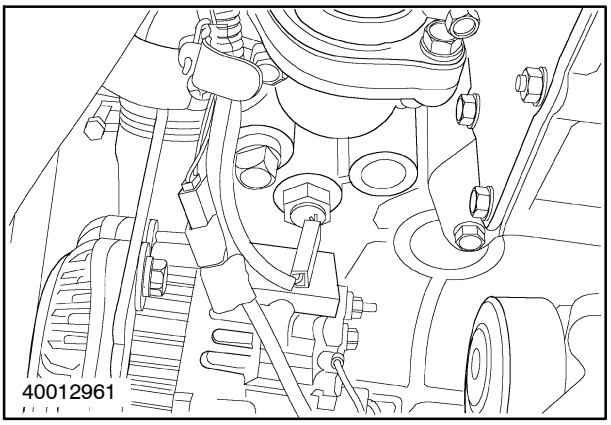
Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Drain the engine coolant from the radiator into a clean pan.
3. Disconnect the wire lead from the sending unit.
4. Unthread the engine coolant-sending unit from the thermostat housing for removal.



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Installation

1. Apply Loctite - 567 to the threaded portion of the engine coolant temperature sending unit.
2. Install the engine coolant temperature sending unit into the thermostat housing.
3. Connect the wire lead to the engine coolant temperature sending unit.
4. Fill the radiator with the recommended coolant mixture.
5. Connect the negative (–) battery cable to the negative (–) battery terminal.

SECTION 55 - ELECTRICAL SYSTEM

Chapter 2 - Electrical Circuits

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	Fuel Level Circuit	44
	Low Oil Pressure Circuit	48
	Air Restriction Circuit	52
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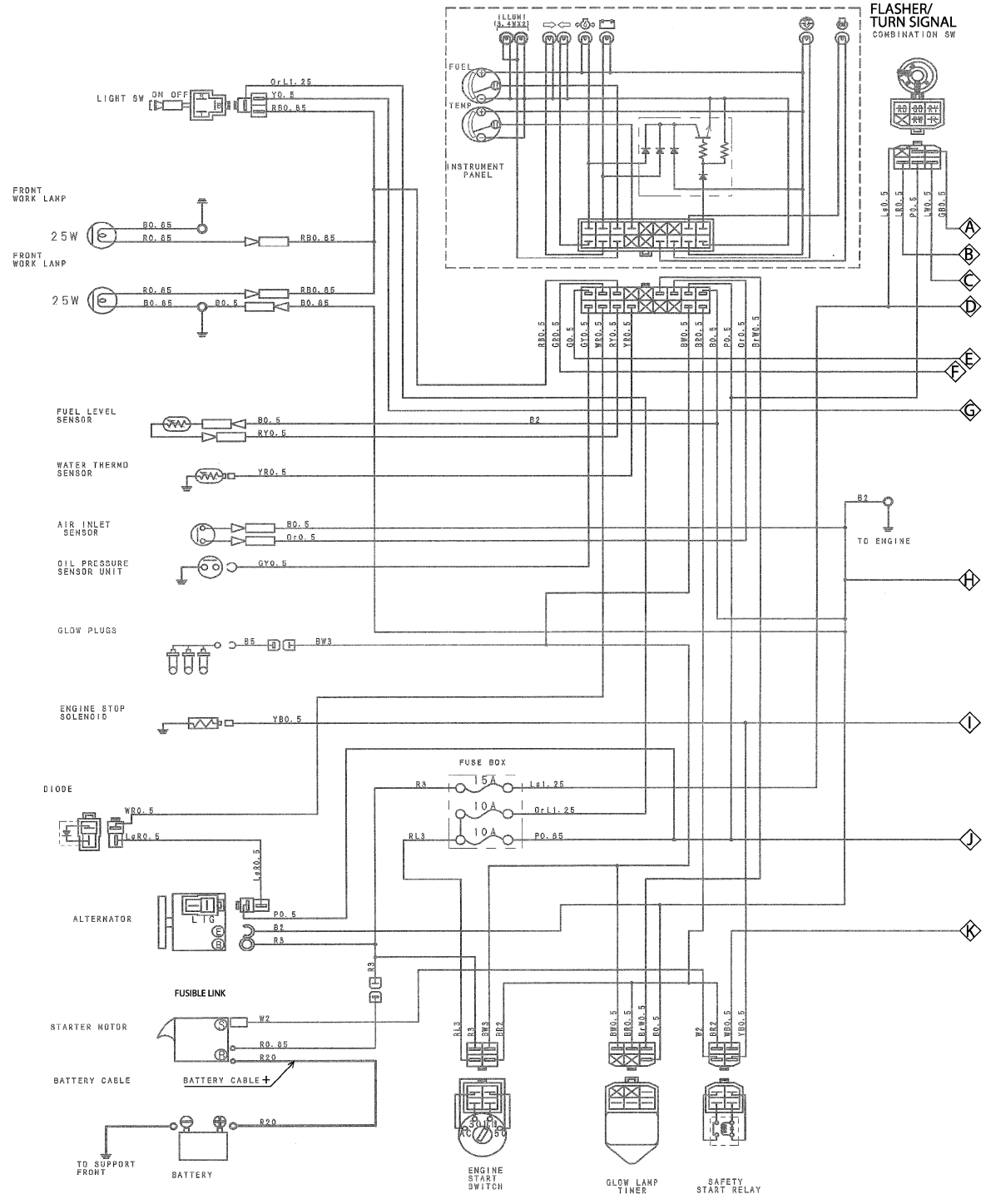
COMPLETE ELECTRICAL WIRING DIAGRAM



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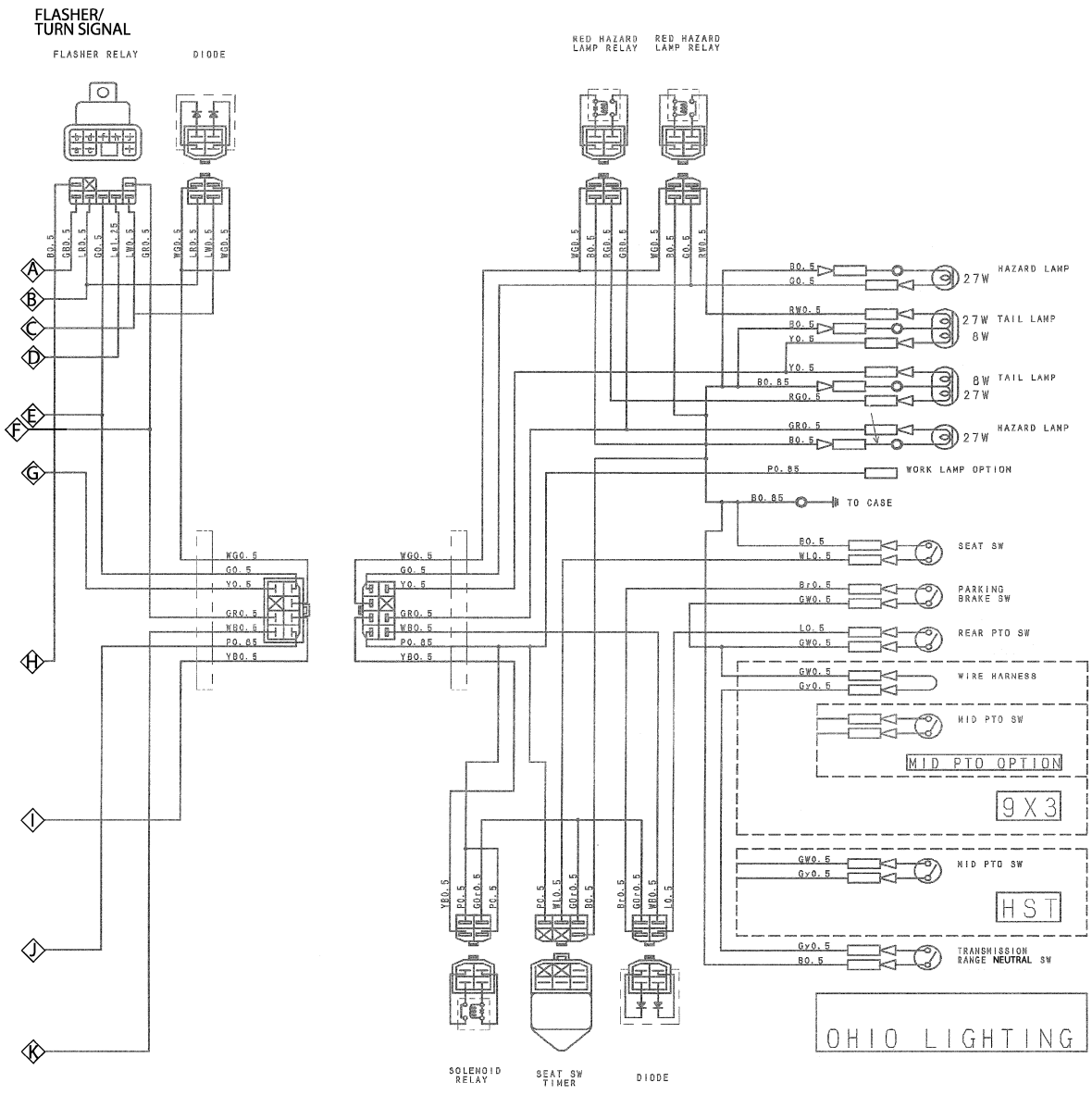


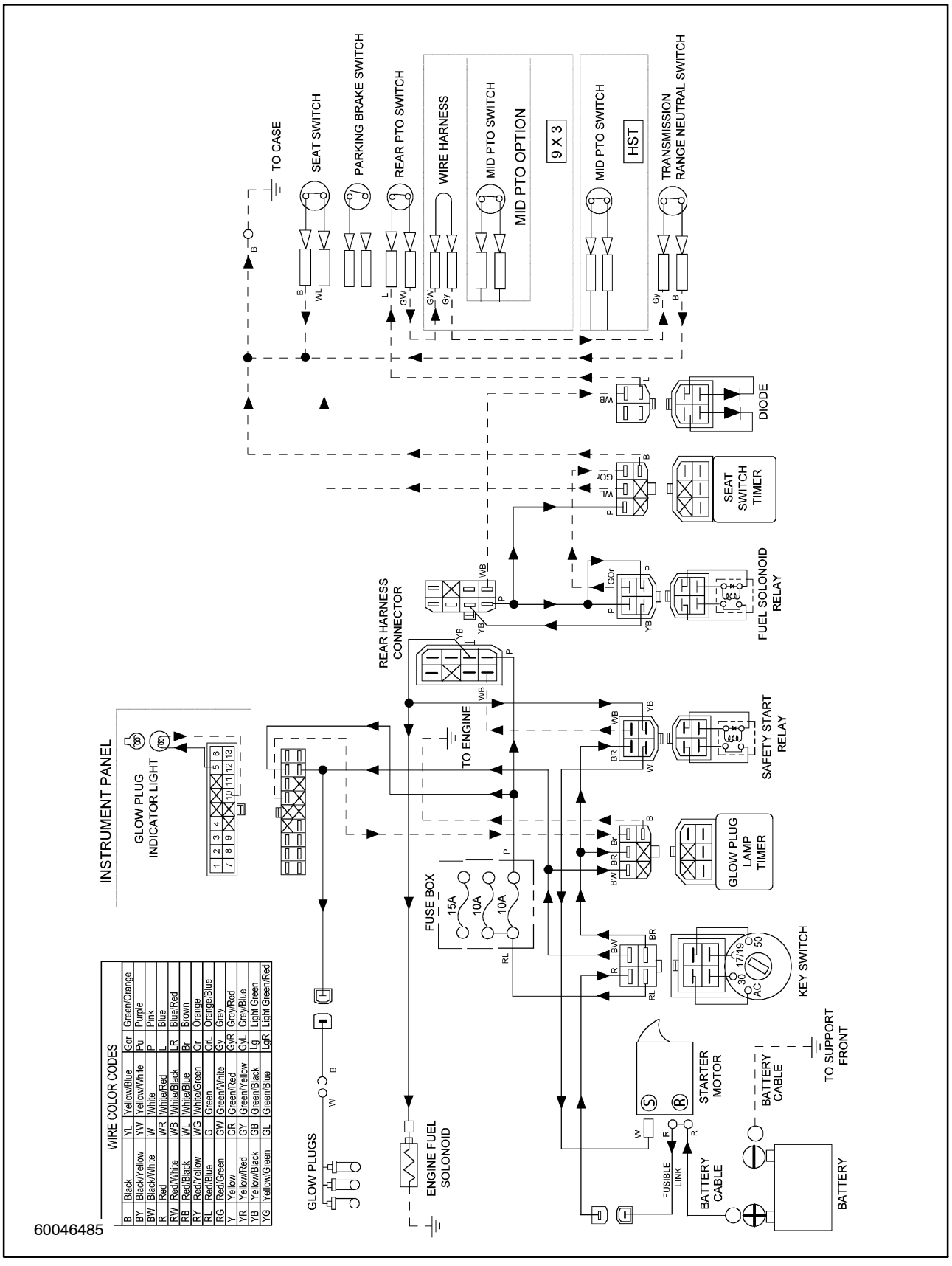
TC30
COMPLETE SCHEMATIC

PIN # HK30001 to HK34732

WIRE COLOR CODES					
B	Black	YR	Yellow/Red	GY	Green/Yellow
BW	Black/White	YW	Yellow/White	P	Pink
BY	Black/Yellow	W	White	Pu	Purple
R	Red	WB	White/Black	L	Blue
RB	Red/Black	WG	White/Green	LR	Blue/Red
RG	Red/Green	WL	White/Blue	Br	Brown
RL	Red/Blue	WR	White/Red	Or	Orange
RW	Red/White	G	Green	OrL	Orange/Blue
RY	Red/Yellow	GB	Green/Black	Gy	Grey
Y	Yellow	GL	Green/Blue	GyL	Grey/Blue
YB	Yellow/Black	GOR	Green/Orange	GyR	Grey/Red
YG	Yellow/Green	GR	Green/Red	Lg	Light Green
YL	Yellow/Blue	GW	Green/White	LgR	Light Green/Red

50036224

STARTING CIRCUIT (OPERATOR PRESENT)



60046485

STARTING CIRCUIT (OPERATOR PRESENT)

NOTE: *The starting circuit is shown with:*

- **Operator Present**
- **Parking Brake "Off"**
- **Rear PTO "Off"**
- **Transmission Range in Neutral Position**
- **Mid PTO "Off" (Optional)**

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.
3. When the key switch is in the "Start" position, current crosses from terminal 30 to the "AC", "50", and "17,19" terminals.

Terminal "AC"

1. Current flows from the "AC" terminal of the key switch and reaches the fuse panel.
2. Current passes through the 10-amp fuse within the fuse panel to reach terminal 12 of the instrument panel and a the wire splice.

Terminal 12 of the Instrument Panel

- Current enters terminal 12 and provides power to the charge, low oil pressure, and air restriction warning lights. The warning lights illuminate for a short time during engine startup.
- The wire splice sends current to the seat safety switch timer and the fuel solenoid relay.

Seat Safety Switch Timer

- Current enters the seat safety switch timer. The seat safety switch controls the ground path for the seat safety switch timer. With the operator seated, the seat safety switch closes to complete the ground path to the seat safety switch timer. This activates the seat safety switch timer completing the ground path to the fuel solenoid relay. The fuel solenoid relay energizes and latches.

Fuel Solenoid Relay

- Current enters the coil within the fuel solenoid relay. The ground path to the fuel solenoid relay is controlled by the seat safety switch timer. When the seat safety switch timer is activated, the fuel solenoid relay energizes and latches.
- When the fuel solenoid relay latches, current flows to a the wire splice. The wire splice splits the current into two different paths.
- The one path leads to the coil within the safety start relay. The ground path to the safety start relay is controlled by the diode, the rear PTO, the transmission range, and the mid PTO (optional) safety switches. Providing the safety switches are in the "Off" or "Neutral" positions, the safety start relay energizes. When energized, the safety start relay latches and sends current to the switching terminal of the starter. The starter cranks the engine for starting.
- The other path leads to the fuel shutoff solenoid. The fuel shutoff solenoid is grounded directly to the engine, allowing it to become energized. When the fuel shutoff solenoid is energized, the needle within the fuel shutoff solenoid retracts to permit fuel flow.

Terminal 50
Current flows from the terminal 50 of the key switch and reaches the safety start relay and the glow plug lamp timer.

Safety Start Relay

- Current enters the functioning circuit of the safety start relay. When the safety start relay is energized, the relay latches. Current then flows to the starter. The starter cranks the engine for starting.

Glow Plug Lamp Timer

- Current enters the glow plug lamp timer. The ground path to the glow plug lamp timer is completed through the wire harness to the right side of the engine, allowing the glow plug lamp timer to function. When the glow plug lamp timer is activated, the timer latches for approximately four seconds. This completes the ground circuit for the glow plug indicator light within the instrument panel (terminal 10). The light illuminates.

Terminal 17, 19
Current flows from terminal 17,19 of the key switch and reaches the instrument panel (terminal 5), the glow plug lamp timer, and the engine glow plugs.

Instrument Panel

- Current enters Terminal 5 of the instrument panel and reaches the glow plug indicator light. The ground path (Terminal 10) to the glow plug indicator light travels to the glow plug lamp timer. When the glow plug lamp timer is activated, the ground path to the glow plug indicator light is completed, allowing the glow plug indicator light to illuminate for approximately four seconds.

Glow Plug Lamp Timer

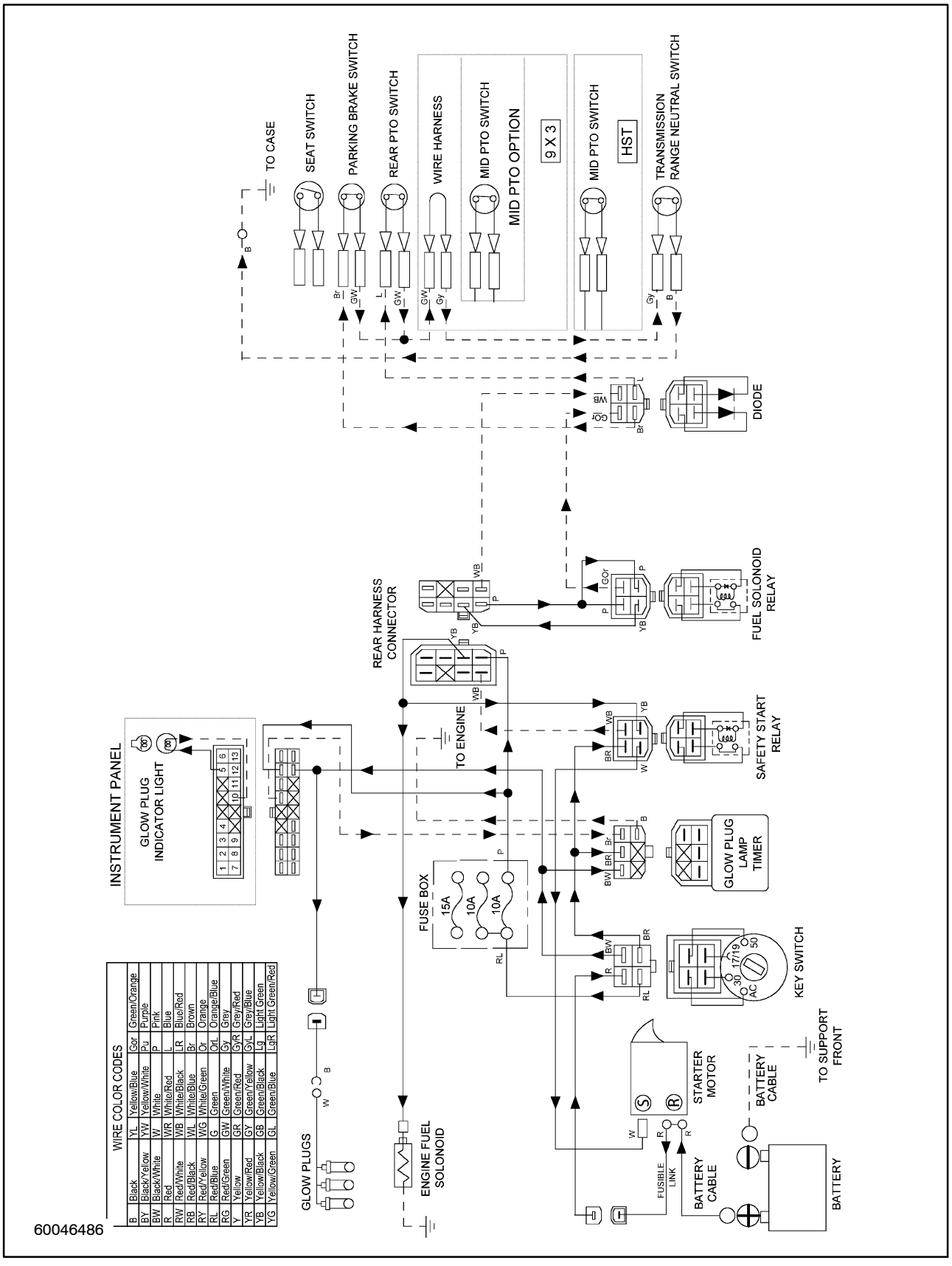
- Current reaches the glow plug lamp timer. The glow plug lamp timer becomes energized and latches to complete the ground path to the glow plug indicator light within the instrument panel. The glow plug indicator light illuminates.

Engine Glow Plugs

- Current reaches the engine glow plugs. The glow plugs are grounded directly to the engine block. Current enters the engine glow plugs and causes them to warm the pre-combustion chamber. The engine glow plugs assist tractor starting in cold climates.

TROUBLESHOOTING – STARTING CIRCUIT (OPERATOR PRESENT)		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Starter motor will not energize	Insufficient battery charge	Test battery. Charge, add water, or replace as necessary
	Blown 10-amp fuse	Inspect and replace 10-amp fuse as necessary
	Blown fusible link	Inspect and replace fusible link as necessary
	Defective key switch	Test key switch and replace as necessary
	Defective PTO, seat, and transmission range safety switches	Test switches and replace as necessary
	Malfunctioning safety start relay, or seat switch timer	Inspect and replace as necessary
	Defective start circuit diode	Test diode and replace as necessary
	Malfunctioning starter motor	Test starter motor and repair or replace as necessary
Starter motor energizes, but fails to start engine (lacks exhaust smoke)	Defective fuel shutoff relay	Test fuel solenoid relay and replace as necessary
	Malfunctioning seat safety switch or seat safety switch timer	Test the components and replace as necessary

STARTING CIRCUIT (NO OPERATOR PRESENT)



4

STARTING CIRCUIT (NO OPERATOR PRESENT)

NOTE: *The starting circuit is shown with:*

- **No Operator Present**
- **Parking Brake "On"**
- **Rear PTO "OFF"**
- **Transmission Range in Neutral Position**
- **Mid PTO (Optional) in the "Off" Position**

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.
3. When the key switch is in the "Start" position, current crosses from terminal 30 to the "AC", "50" and "17,19", terminals. Current flow from each of these terminals is described individually below.

Terminal "AC"

1. Current flows from the "AC" terminal of the key switch and reaches the fuse panel.
2. Current passes through the 10-amp fuse within the fuse panel to reach a the wire splice. The wire splice splits current into two different paths. The one path sends current to terminal 12 of the instrument panel and the other path sends current through the rear harness connector to a the wire splice.

Terminal 12 of the Instrument Panel

- Current enters terminal 12 and provides power to the charge, low oil pressure, and air restriction warning lights. The warning lights illuminate for a short time during engine startup.

Wire Splice

- The wire splice sends current to the seat safety switch timer and the fuel solenoid relay.

Seat Safety Switch Timer

- When the operator is not present, the ground path to the seat safety switch timer is not complete. When the ground path is not complete, the seat safety switch timer is not activated.

Fuel Solenoid Relay

The fuel solenoid relay splits the current into two different paths:

- The one path sends current to the coil within the fuel solenoid relay. The ground path to the coil within the fuel solenoid relay travels through the diode to reach the parking brake switch. When the parking brake is applied, the parking brake switch closes and allows the ground path to continue to the mid PTO safety switch. When the mid PTO is in the "Off" position, the switch closes and allows the ground path to continue to the transmission range safety switch. When the range switch is in the neutral position, the fuel solenoid relay ground path is completed. When the ground path to the fuel solenoid relay is complete, the relay energizes and latches.
- The other path sends current to the functioning circuit of the fuel solenoid relay. When the relay is energized and latches, current crosses and flows through the rear harness connector to reach a the wire splice.

Wire Splice

The wire splice splits current into two different paths.

- The one path sends current to the coil within the safety start relay. The ground path to the coil within the safety start relay travels through the diode to the rear PTO safety switch. When the rear PTO is in the "OFF" position, the switch closes and allows the ground path to travel to the Mid PTO safety switch (If equipped). When the Mid PTO is in the "OFF" position, the switch closes and allows the ground path to continue to the transmission range safety switch. When the transmission is in a Neutral position, the switch closes and the ground path travels to the HPL housing. The ground path is completed, allowing the safety start relay to energize and latch.
- The other path sends current to the fuel shutoff solenoid. The fuel shutoff solenoid is grounded directly to the engine block, allowing the solenoid to function. When energized, the needle within the fuel shutoff solenoid retracts to allow fuel flow into the tractor engine.

Terminal "50"

1. Current flows from the "50" terminal of the key switch to reach a the wire splice. The wire splice splits current into two different paths:
   - The one path sends current to the functioning circuit of the safety start relay. The fuel solenoid relay controls current flow to the coil within the safety start relay. When energized, the safety start relay latches to allow current to flow to the engine starter. The starter cranks the engine for starting.
   - The other path sends current to the glow plug lamp timer.

NOTE: *The glow plug lamp timer controls the ground path to the glow plug indicator light within the instrument panel. The glow plug lamp timer does not control current flowing to the engine glow plugs.*

- Current flows from terminal "50" of the key switch and reaches the glow plug lamp timer. The timer energizes. When energized, the timer completes the ground path to the glow plug indicator light within the instrument panel. The glow plug indicator light illuminates. The glow plug lamp timer opens the ground path after approximately four seconds, causing the light to go off.

Terminal "17, 19"

Current flows from terminal 17, 19 of the key switch and reaches terminal 5 of the instrument panel, the glow plug lamp timer, and the engine glow plugs.

Instrument Panel

- Current enters terminal 5 of the instrument panel and reaches the glow plug indicator light. The ground path (terminal 10) to the glow plug indicator light travels to the glow plug lamp timer. When the glow plug lamp timer is activated, the ground path to the glow plug indicator light is completed for approximately four seconds. This allows the glow plug indicator light to illuminate until the timer opens the ground path.

Glow Plug Lamp Timer

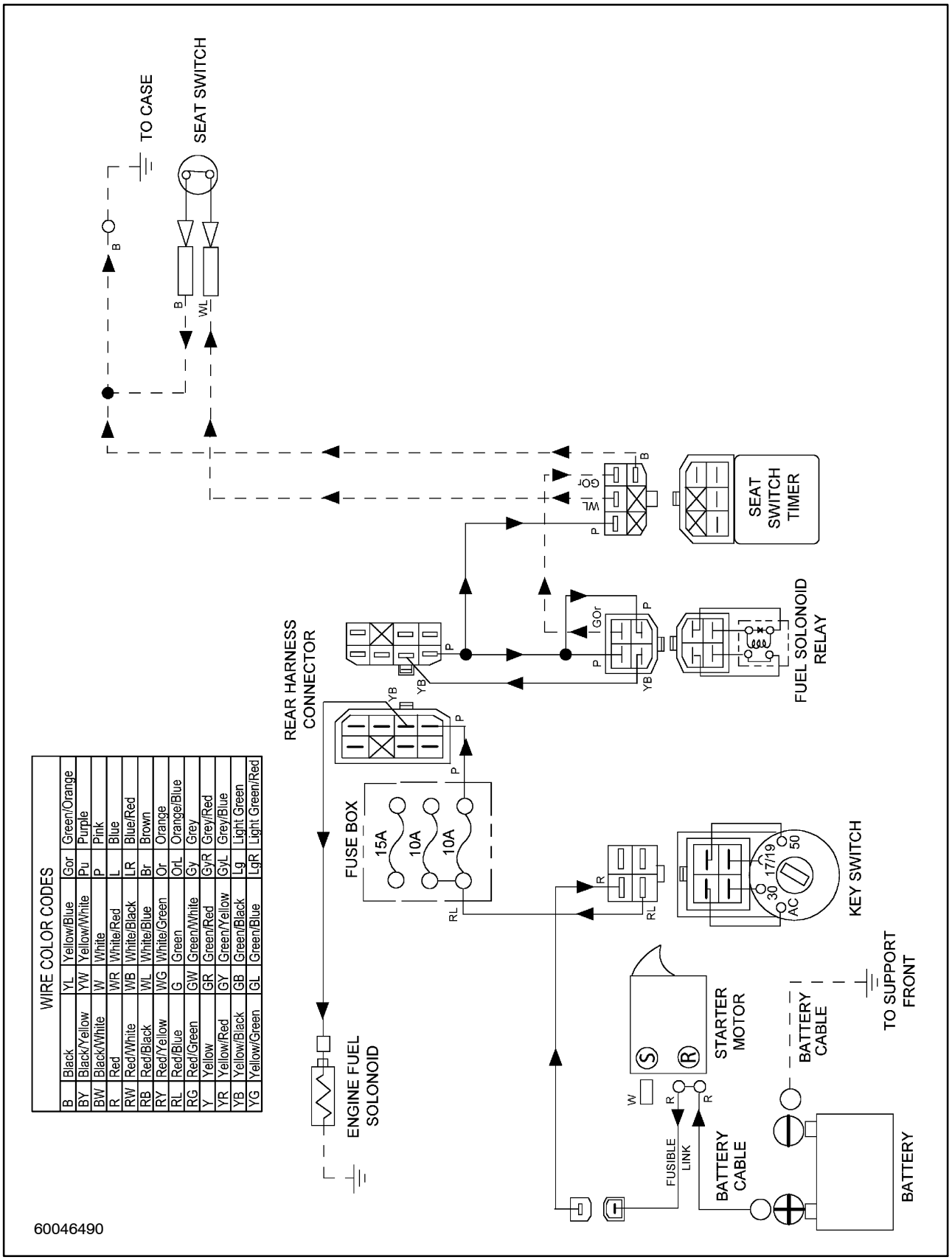
- Current reaches the glow plug lamp timer. The glow plug lamp timer becomes energized and latches to complete the ground path to the glow plug indicator light within the instrument panel. The glow plug indicator light illuminates.

Engine Glow Plugs

- Current reaches the engine glow plugs. The glow plugs are grounded directly to the engine block. Current enters the glow plugs and causes them to warm the pre-combustion chamber. The engine glow plugs assist the tractor starting in cold conditions.

TROUBLESHOOTING – STARTING CIRCUIT (NO OPERATOR PRESENT)		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Starter motor will not energize	Insufficient battery charge	Test battery. Charge, add water, or replace as necessary
	Blown 10-amp fuse	Inspect and replace 10-amp fuse as necessary
	Blown fusible link	Inspect and replace fusible link as necessary
	Defective key switch	Test key switch and replace as necessary
	Defective PTO and transmission range safety switches	Test switches and replace as necessary
	Malfunctioning safety start relay	Inspect and relay as necessary
	Defective start circuit diode	Test diode and replace as necessary
	Malfunctioning starter motor	Test starter motor and repair or replace as necessary
Starter motor energizes, but fails to start engine (lacks exhaust smoke)	Defective fuel solenoid relay	Test relay and replace as necessary
	Malfunctioning fuel shutoff solenoid	Test fuel shutoff solenoid and replace as necessary

SAFE OPERATION CIRCUIT (OPERATOR PRESENT)



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SAFE OPERATION CIRCUIT (OPERATOR PRESENT)

Run Circuit

NOTE: *The Safe Operation circuit is shown with:*

- **Operator Present**

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.
3. When the key switch is in the “Run” position, current crosses from terminal 30 to the “AC”, terminal.
4. Current flows from the “AC” terminal of the key switch and reaches the fuse panel.
5. Current passes through the 10-amp fuse within the fuse panel to reach a the wire splice. The wire splice splits the current into two paths.
   - The one path sends the current to the seat switch timer.
   - The other path travels to a the fuel solenoid relay that sends the current to the control and functioning circuits of the fuel solenoid relay.

Control Circuit of the Fuel Solenoid Relay

6. Current enters the coil within the fuel solenoid relay. The ground path to the fuel solenoid relay is controlled by the seat safety switch timer. When the operator is present, the seat safety switch closes to complete the ground path to the seat safety switch timer.
7. When the ground path to the seat safety switch timer is complete, the seat safety switch timer activates and latches.
8. When the seat safety switch timer latches, the ground path to the fuel solenoid relay is complete. The fuel solenoid relay energizes and latches.

Functioning Circuit of the Fuel Solenoid Relay

The other path sends current to the functioning circuit of the fuel solenoid relay. When the fuel solenoid relay latches, current flows through the functioning circuit of the fuel solenoid relay to the fuel shutoff solenoid. The fuel shutoff solenoid is grounded directly to the engine, allowing it to become energized. When the fuel shutoff solenoid energizes, the needle within the fuel shutoff solenoid retracts to permit fuel flow.

TROUBLESHOOTING – SAFE OPERATION CIRCUIT (OPERATOR PRESENT)		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Engine does not continue to run while operator is not seated	Defective key switch	Test key switch and replace as necessary
	Defective seat switch	Test seat switch and replace as necessary
	Defective seat switch timer	Test timer and replace as necessary
	Malfunctioning fuel shutoff solenoid	Test fuel shutoff solenoid and replace as necessary
	Blown 10-amp fuse	Inspect 10-amp fuse and replace as necessary
	Defective fuel solenoid relay	Test relay and replace as necessary
	Open wiring in safe operation circuit	Check for loose connectors, grounds, and wiring damage

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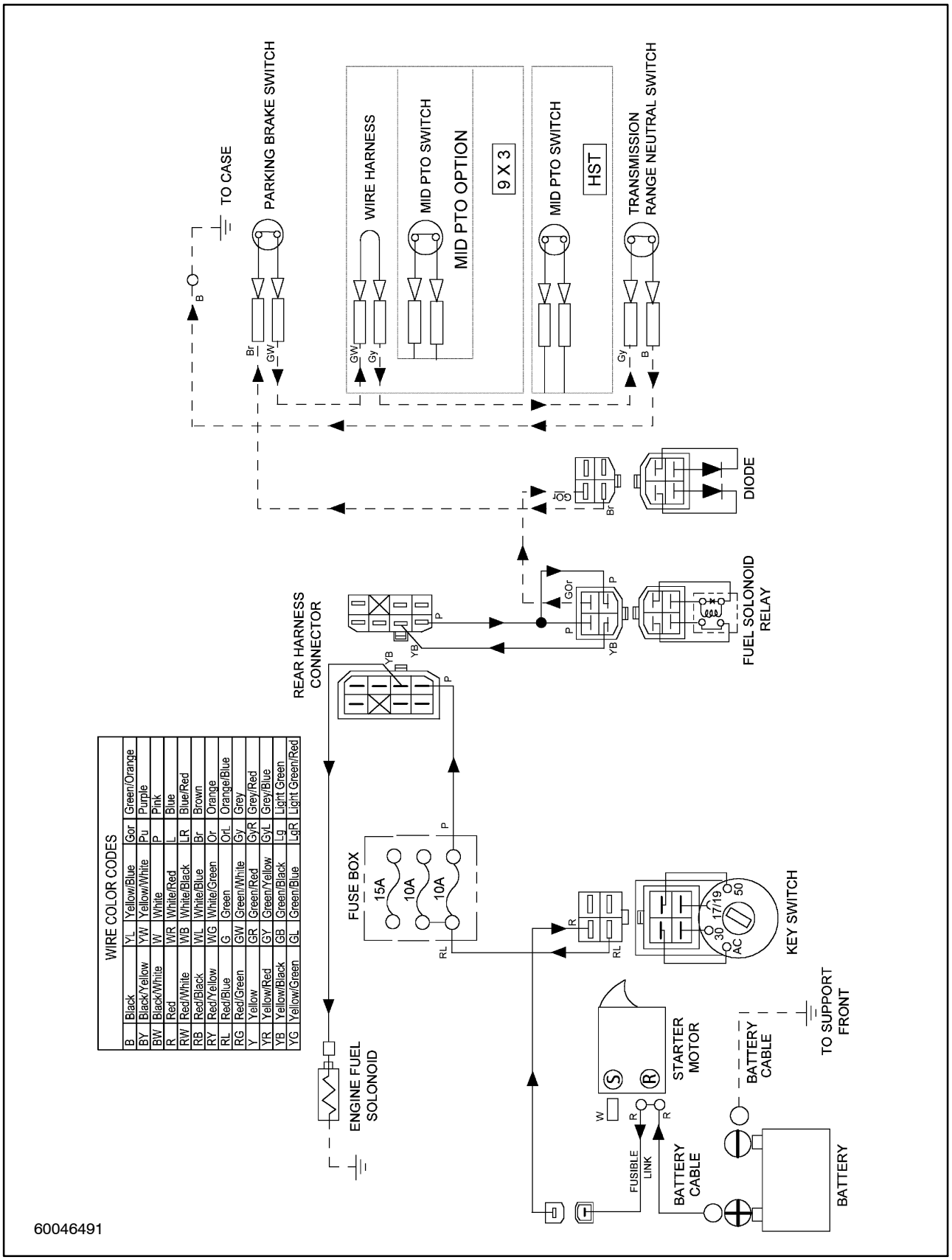
SAFE OPERATION CIRCUIT (NO OPERATOR PRESENT)



SAFE OPERATION CIRCUIT (NO OPERATOR PRESENT)

NOTE: *The Safe Operation circuit is shown with:*

- **No Operator Present**
- **Parking Brake "On"**
- **Transmission Range in Neutral Position**
- **Mid PTO "Off" (Optional)**

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.
3. When the key switch is in the "Run" position, current crosses from terminal 30 to the "AC", terminal.
4. Current flows from the "AC" terminal of the key switch and reaches the fuse panel.
5. Current passes through the 10-amp fuse within the fuse panel to reach a the wire splice. The wire splice splits the current into two paths.
    - The wire splice sends current to the control circuit and the functioning circuit of the fuel solenoid relay.

Control Circuit of the Fuel Solenoid Relay

6. Current enters the coil within the fuel solenoid relay. The ground path to the fuel solenoid relay travels through the diode to the parking brake switch. When the parking brake is applied, the switch closes to allow the ground path to reach the Mid PTO safety switch.
7. The mid PTO safety switch closes when the mid PTO is in the "OFF" position, allowing the ground path to reach the transmission range safety switch.
8. The transmission range safety switch closes when the range selector lever is placed in the neutral position, completing the ground path. This allows the fuel solenoid relay to energize and latch.

Functioning Circuit of the Fuel Solenoid Relay

The other path sends current to the functioning circuit of the fuel solenoid relay. When the fuel solenoid relay latches, current flows to the fuel shutoff solenoid. The fuel shutoff solenoid is grounded directly to the engine, allowing it to become energized. When the fuel shutoff solenoid is energized, the needle within the fuel shutoff solenoid retracts to permit fuel flow.

TROUBLESHOOTING - SAFE OPERATION CIRCUIT (NO OPERATOR PRESENT)		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Engine does not continue to run while operator is not seated with the parking brake applied, range in neutral and mid PTO is "OFF"	Defective parking brake switch	Test parking brake safety switch and replace as necessary
	Defective key switch	Test key switch and replace as necessary
	Defective range neutral or mid PTO safety switches	Test switches and replace as necessary
	Defective fuel solenoid relay	Test relay and replace as necessary
	Defective diode	Test diode and replace as necessary
	Malfunctioning fuel shutoff solenoid	Test fuel shutoff solenoid and replace as necessary
	Blown 10-amp fuse	Inspect 10-amp fuse and replace as necessary
	Open wiring in safe operation circuit	Check for loose connectors, grounds, and wiring damage

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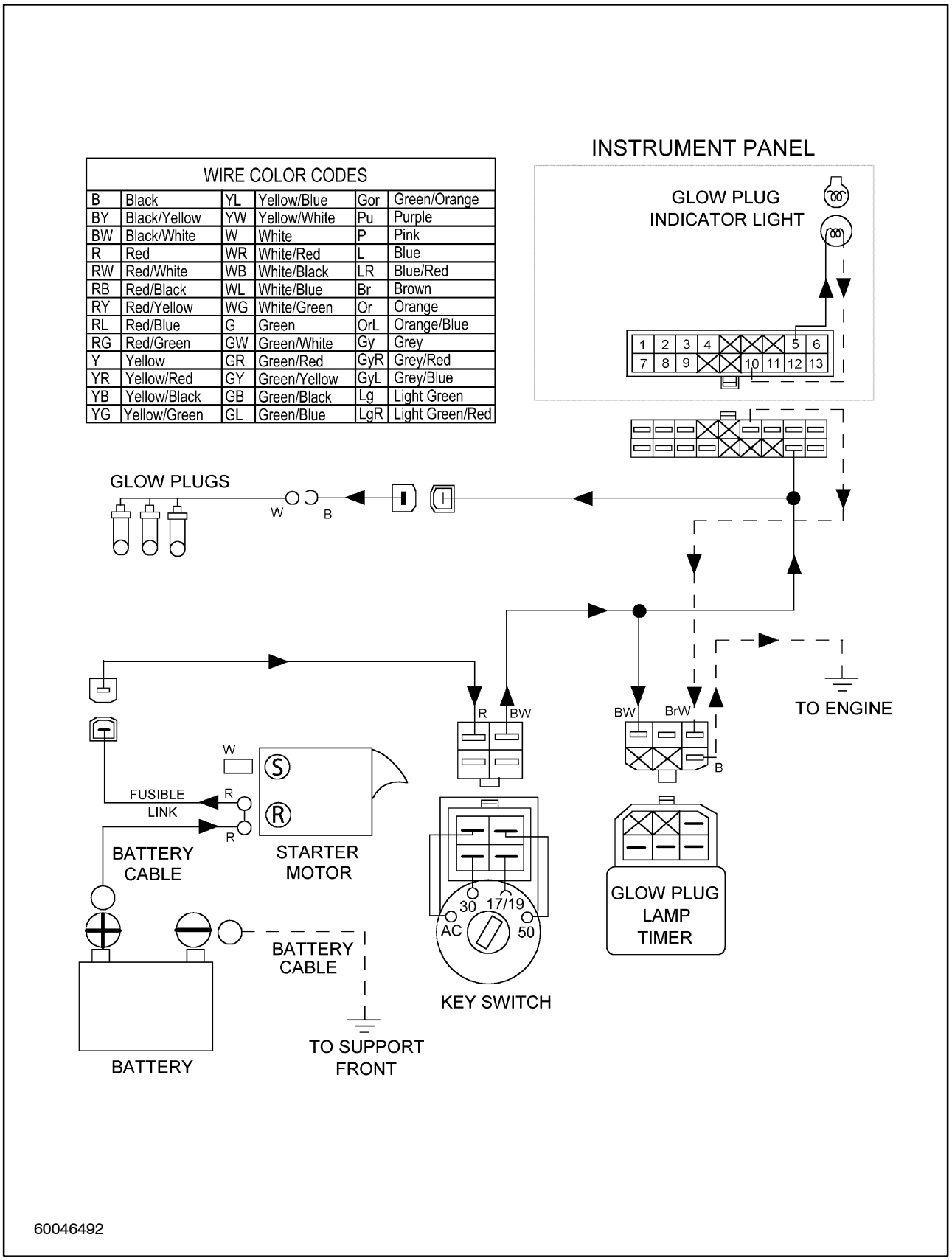
ENGINE GLOW PLUG CIRCUIT



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ENGINE GLOW PLUG CIRCUIT

The engine glow plug circuit includes all the circuits and the components that heat the engine glow plugs and illuminate the glow plug indicator light when the key switch is turned to the “HEAT” or “START” position.

NOTE: *When the key switch is in the “HEAT” position, electrical current is being supplied from terminal 30 to terminal 17/19 and the terminal “AC” of the key switch. When the key switch is in the “START” position, electrical current is being supplied from terminal 30 to terminal 50, terminal 17/19, and terminal “AC” of the key switch.*

NOTE: *When the key switch is in the “HEAT” or “START” position, power is constantly being supplied to the engine glow plugs. The glow plug indicator light timer does not control current flow to the engine glow plugs, only current to the glow plug indicator light within the instrument panel.*

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to a connector. Current passes through the connector to terminal 30 of the key switch.
3. When the key switch is in the “HEAT” position, current crosses from terminal 30 to terminal 17/19 of the key switch.
4. Current flows from terminal 17/19 to a the wire splice. The wire splice splits the current into two paths:
    - One path sends current to the engine glow plug lamp timer. The ground path to the glow plug lamp timer is completed through the wire harness to the left side of the engine, allowing the glow plug to become activated. When activated, the timer latches, completing the circuit from terminal 10 of the instrument panel to ground. This causes the glow plug indicator light to illuminate. The timer opens the circuit after approximately 4 seconds, causing the light to stop illuminating.
    - The other path sends current to a the wire splice. The wire splice splits current into two paths.
    - The one path sends the current to the engine glow plugs. The engine glow plugs are grounded directly to the engine block, allowing each of the glow plugs to function. When powered, the engine glow plugs warm the pre-combustion chamber to ease starting the tractor engine in cold climates.
    - The other path sends current to terminal 5 of the instrument panel. Current enters terminal 5 of the instrument panel and reaches the engine glow plug indicator light. The glow plug lamp timer controls the ground path to the indicator light. When current energizes the glow plug lamp timer, the ground path to the indicator light closes, allowing the light to illuminate. The timer opens approximately four seconds after being activated, causing the light to stop illuminating.

TROUBLESHOOTING – ENGINE GLOW PLUG CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Glow Plugs	Blown Fusible Link Wire	Check fusible Link Wire and replace as necessary
	Malfunctioning Key Switch	Check Switch and Replace as Necessary
	Poor Circuit Connections	Check Switch connections and circuit and repair as necessary
	Malfunctioning Glow Plugs	Test Glow Plugs and replace as necessary

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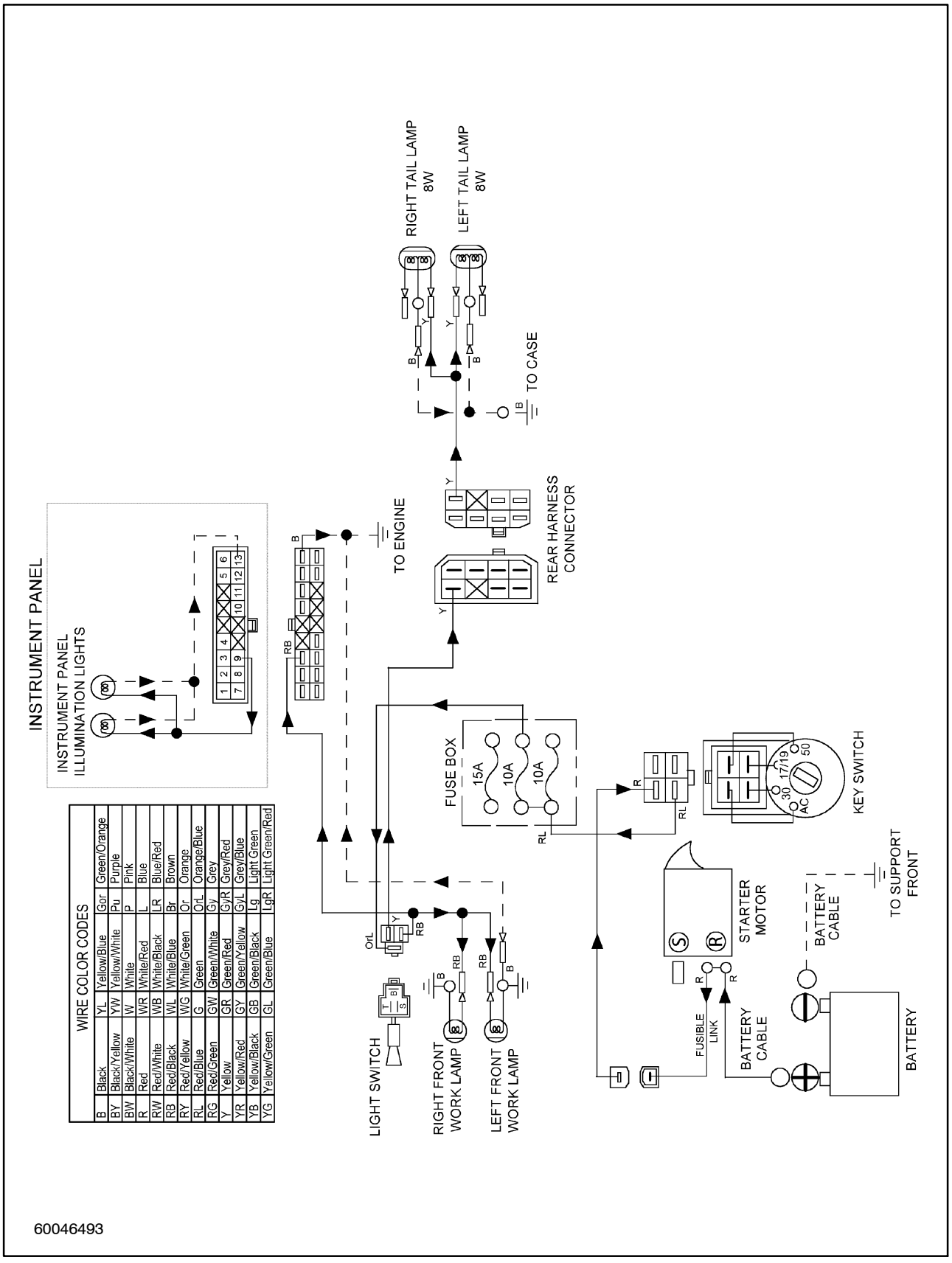
LIGHTING CIRCUIT



LIGHTING CIRCUIT

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.
3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10 amp fuse within the fuse block, to reach the “B” terminal of the light switch.
4. When the light switch is in the “On” position (Pulled out), current crosses from the “B” terminal to the “S” and “T” terminals of the light switch.
5. Current exits the “S” terminal of the light switch and reaches a the wire splice. The wire splice splits the current into two different paths:
   - The one path leads current to terminal 9 of the instrument panel. Current enters terminal 9 and reaches the instrument panel lights (back-lighting). The ground path for the instrument panel lights travels from terminal 13 of the instrument panel to reach the left side of the engine block, allowing the bulbs to illuminate the instrument panel.
   - The other path leads current to a the wire splice that directs the current to the left and right work lights. The ground sources for both of the work lights are located at the tractor hood, which is connected to the wire harness that travels to the left side of the engine block. This completes the circuit, allowing the work lights to illuminate.
6. Current exits the “T” terminal of the light switch and travels through a connector to a the wire splice. The wire splice sends the current to the left and right taillights. The ground source for the left and right taillights is located at the left and right taillight-mounting brackets, allowing the left and right taillights to illuminate.

TROUBLESHOOTING – LIGHTING CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Headlights, Taillights, or Rear Work Light (Optional)	Blown 10-amp fuse	Check fuse and replace as necessary
	Malfunctioning Light Switch	Replace Switch as necessary
	Blown Bulbs	Replace bulbs as necessary
	Improper ground circuit	Check lighting connections and circuit grounds and repair as necessary

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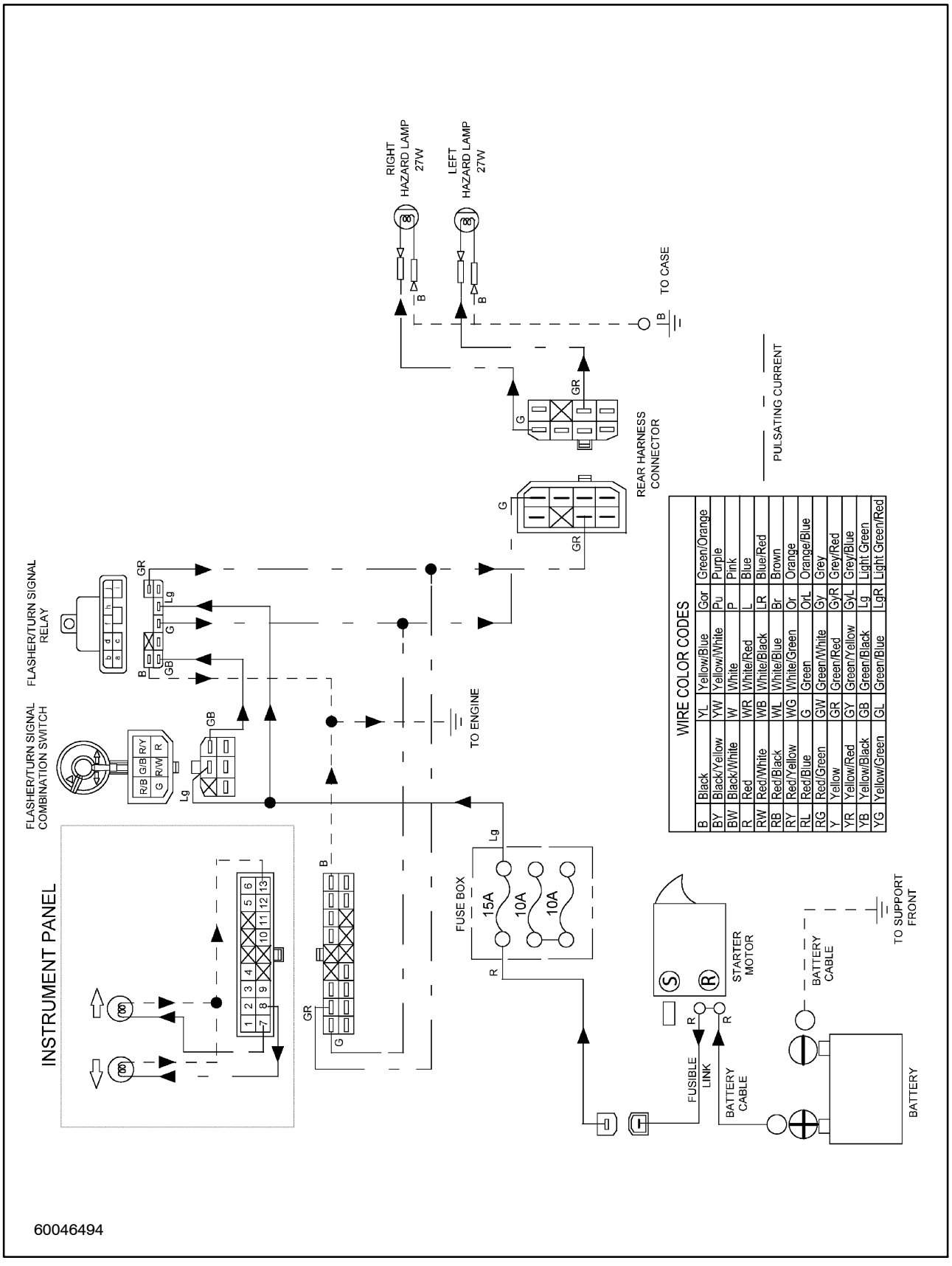
HAZARD FLASHER CIRCUIT



HAZARD FLASHER CIRCUIT

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.
2. From the starter, current flows through the fusible link to the fuse panel.
3. Current passes through the 15-amp fuse within the fuse panel to reach a the wire splice.
4. The wire splice directs the current to terminal “H” of the flasher relay and to the “R/W” terminal of the hazard/turn signal switch.
5. When the hazard portion of the switch is moved to the “On” position, current crosses from the “R/W” terminal to the “R” terminal.
6. Current flows from the “R” terminal of the switch to terminal “B” of the flasher turn signal relay.
7. The control module is grounded through terminal “A”, allowing the flasher to function.
8. When the control module is activated, pulsing current flows from terminal “F” and terminal “J”.

Terminal 4

- Current flows from terminal “F” of the control module and reaches a the wire splice. The wire splice splits the current into two different paths.

1. Current flows from the wire splice to terminal 7 of the instrument panel. Current enters terminal 7 and reaches the right flasher indicator light. The ground path for the indicator light travels from terminal 13 of the instrument panel to the left side of the engine block, allowing the light to illuminate. The right flasher indicator light flashes on and off.
2. Current flows from the wire splice to the right hazard light. The right hazard light is grounded at the hazard light mounting bolt, allowing the light to illuminate. The right hazard light flashes on and off.

Terminal “j”

- Current flows from terminal “j” of the flasher control module and reaches a the wire splice. The wire splice splits current into two different paths.

1. Current flows from the wire splice to terminal 8 of the instrument panel. Current enters terminal 8 and reaches the left flasher indicator light. The ground path for the indicator light travels from terminal 13 of the instrument panel to the left side of the engine block, allowing the light to illuminate. The left indicator light flashes on and off.
2. Current flows from the wire splice to the left hazard light. The left hazard light is grounded at the hazard light mounting bolt, allowing the light to illuminate. The left hazard light flashes on and off.

TROUBLESHOOTING - HAZARD FLASHER CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Hazard Lights	Blown 15-amp fuse	Check fuse and replace as necessary
	Malfunctioning Hazard Flasher/ Turn Signal Switch	Test switch and replace as necessary
	Blown Bulbs	Check for any blown bulbs and replace as necessary
	Improper Ground Circuit	Check hazard light circuit connections and circuit grounds and repair as necessary
	Malfunctioning Hazard Flasher/ Turn Signal Relay	Check relay and replace as necessary

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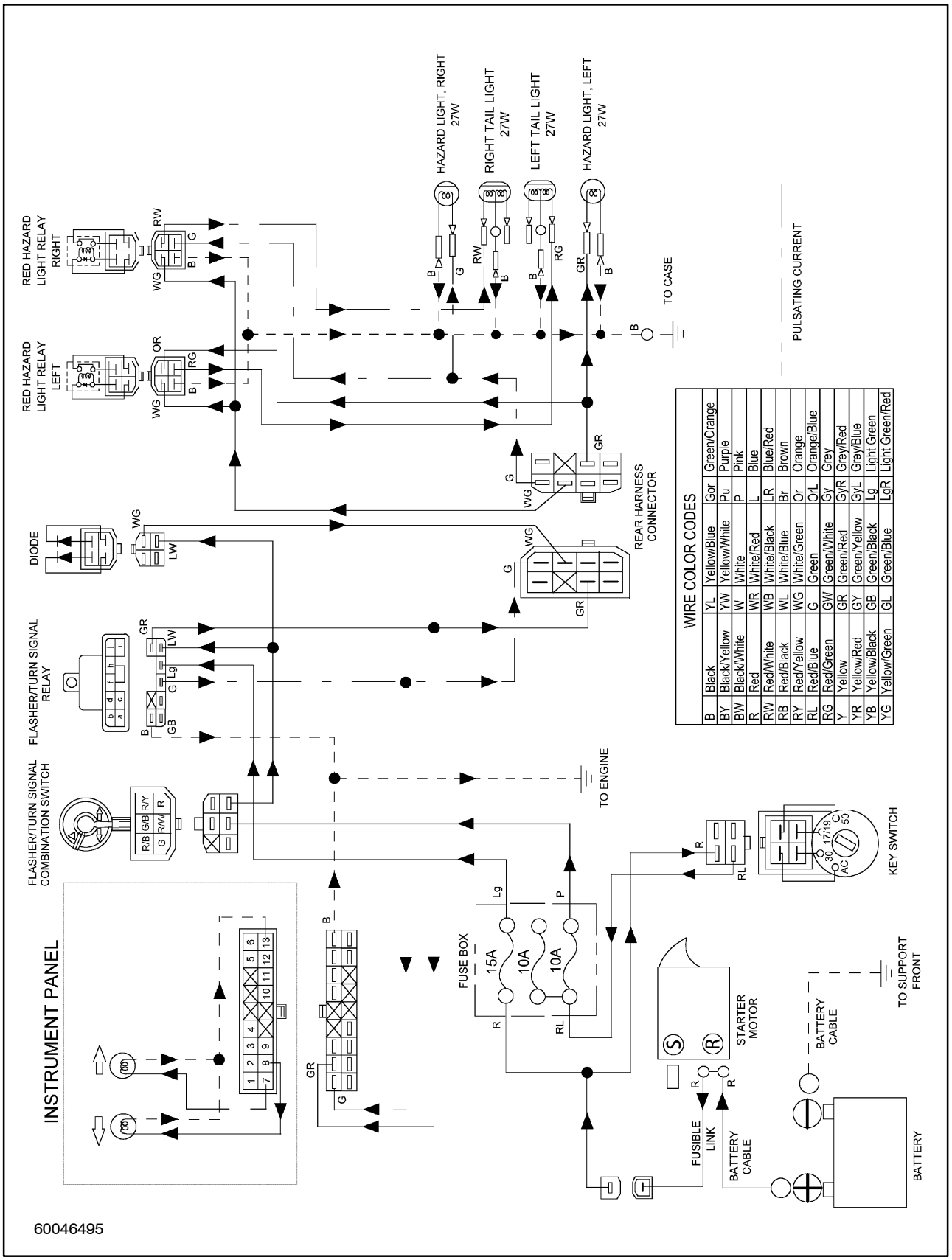
RIGHT TURN SIGNAL CIRCUIT



RIGHT TURN SIGNAL CIRCUIT

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.
2. From the starter, current flows through the fusible link to a the wire splice. The wire splice directs the current into two paths:

The one path sends current to the fuse panel.

1. Current reaches the fuse panel and passes through 15-amp fuse.
2. From the 15-amp fuse, current flows to terminal “h” of the hazard flasher/turn signal relay. This terminal provides power to the relay. The ground path to the relay travels from terminal “a” to reach the right side frame rail near the battery.

The other path directs current to terminal 30 of the key switch.

1. When the key switch is turned to the AC/RUN position, current crosses from terminal 30 to terminal AC.
2. Current flows from the key switch to reach the 10-amp fuse within the fuse panel.
3. Current passes through the 10-amp fuse to reach the “G/B” terminal of the hazard/turn signal switch.
4. When the turn signal portion of the switch is moved to the “Right” turn signal position, current crosses from the “G/B” terminal to the “R/Y” terminal.
5. Current flows from the “R/Y” terminal to reach terminal “j” of the hazard flasher/turn signal relay and a diode.
6. The diode supplies current to the coil side of the left and right red hazard light relays.
7. The relay activates and sends pulsing current from terminal “f” to a the wire splice.
8. The wire splice splits the pulsing current into two paths.

The one path sends the pulsing current to terminal 7 of the instrument panel.

- Pulsing current enters terminal 7 of the instrument panel and reaches the right turn signal indicator bulb. The ground path to the right turn signal indicator bulb travels from terminal 13 of the instrument panel to reach the right side frame rail near the battery. This causes the right turn indicator bulb within the instrument panel to flash.

The other path sends current to the rear harness connector.

- Pulsating current passes through the connector to reach a wire splice, from the splice current travels two paths.

  One path sends pulsating current to the right turn signal/hazard flasher. When flasher is provide with a ground circuit the flasher will pulsate on and off.

  The other path sends pulsating current to the control side of the right red hazard light relay. When the relay coil side is provide with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the control side of the relay latches sending pulsating current to the right side taillight. When the taillight is provide with a ground source, the taillight will pulsate on and off.

9. The flasher/turn signal relay sends current out of terminal “i” of the relay to a wire splice, that splits into two paths.

The one path sends current to terminal 8 of the instrument panel.

- Current enters terminal 8 of the instrument panel and reaches the left turn signal indicator bulb. The ground path to the indicator bulb travels from terminal 13 of the instrument panel to the right side of the frame rail near the battery. This causes the left indicator bulb to illuminate constant.

The other path sends current to the rear harness connector.

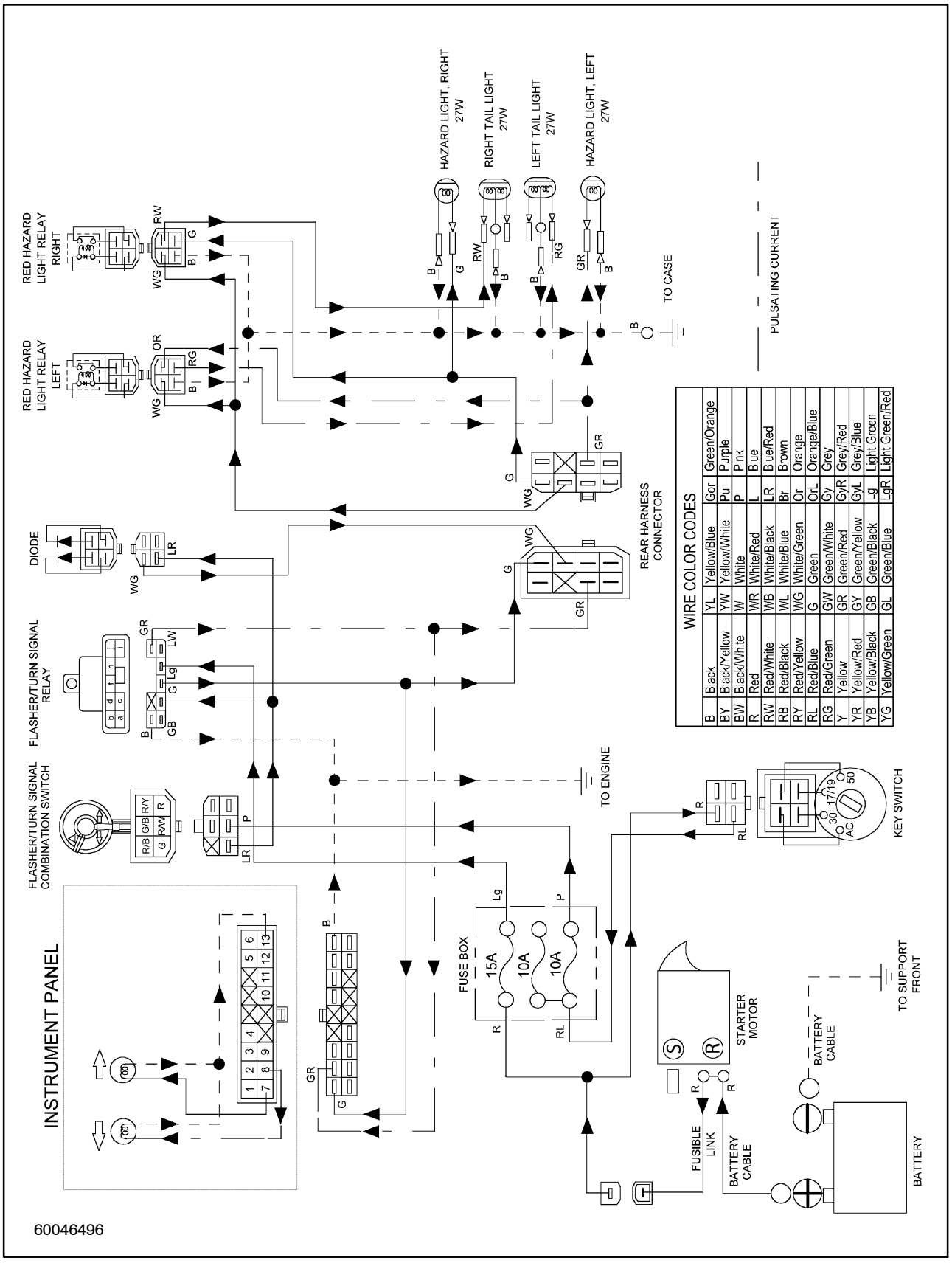
- Current passes through the connector to reach a wire splice, from the splice current travels two paths.

  One path sends current to the left turn signal/hazard flasher. When flasher is provided with a ground circuit the flasher will illuminate constant.

  The other path sends current to the control side of the right red hazard light relay. When the relay coil side is provided with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the control side of the relay latches sending current to the left side taillight. When the taillight is provided with a ground source, the left taillight will illuminate constant.

TROUBLESHOOTING – RIGHT TURN SIGNAL CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative right turn signal flasher light	Blown 10-amp fuse	Check fuse and replace as necessary
	Blown 15-amp fuse	Check fuse and replace as necessary
	Malfunctioning Hazard Flasher/ Turn Signal Switch	Test switch and replace as necessary
	Blown bulb	Check for any blown bulbs and replace as necessary
	Improper Ground Circuit	Check Right turn signal circuit connections and circuit grounds and repair as necessary
	Malfunctioning Hazard Flasher/ Turn Signal Relay	Check relay and replace as necessary
Inoperative right taillight	Defective right red hazard relay	Check relay and replace as necessary
	Improper ground circuit	Check circuit grounds and replace as necessary

LEFT TURN SIGNAL CIRCUIT



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LEFT TURN SIGNAL CIRCUIT

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.
2. From the starter, current flows through the fusible link to a the wire splice. The wire splice directs the current into two paths:

The one path sends current to the fuse panel.

1. Current reaches the fuse panel and passes through the 15-amp fuse.
2. From the 15-amp fuse, current flows to terminal “h” of the hazard flasher/turn signal relay. This terminal provides power to the relay. The ground path to the relay travels from terminal “a” to reach the right side frame rail near the battery.

The other path directs current to terminal 30 of the key switch.

1. When the key switch is turned to the “AC/RUN” position, current crosses from terminal 30 to terminal AC.
2. Current flows from the key switch to reach the 10-amp fuse within the fuse panel.
3. Current passes through the 10-amp fuse to reach the “G/B” terminal of the hazard/turn signal switch.
4. When the turn signal portion of the switch is moved to the “Left” turn signal position, current crosses from the “G/B” terminal to the “R/B” terminal.
5. Current flows from the “R/B” terminal to reach terminal “d” of the hazard flasher/turn signal relay and a diode.
6. The diode supplies current to the coil side of the left and right red hazard light relays.
7. The relay activates and sends pulsing current from terminal “i” to a the wire splice.
8. The wire splice splits the pulsing current into two paths.

The one path sends the pulsing current to terminal 8 of the instrument panel.

- Pulsing current enters terminal 8 of the instrument panel and reaches the left turn signal indicator bulb. The ground path to the left turn signal indicator bulb travels from terminal 13 of the instrument panel to reach the right side frame rail near the battery. This causes the left turn indicator bulb within the instrument panel to flash.

The other path sends current to the rear harness connector.

- Pulsating current passes through the connector to reach a wire splice, from the splice current travels two paths.

  One path sends pulsating current to the left turn signal/hazard flasher. When flasher is provide with a ground circuit the flasher will pulsate on and off.

  The other path sends pulsating current to the control side of the left red hazard light relay. When the relay coil side is provide with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the control side of the relay latches sending pulsating current to the left side taillight. When the taillight is provide with a ground source, the taillight will pulsate on and off.

9. The flasher/turn signal relay sends current out of terminal “f” of the relay to a wire splice, that splits into two paths.

The one path sends current to terminal 7 of the instrument panel.

- Current enters terminal 7 of the instrument panel and reaches the left turn signal indicator bulb. The ground path to the indicator bulb travels from terminal 13 of the instrument panel to the left side of the frame rail near the battery. This causes the left indicator bulb to illuminate constant.

The other path sends current to the rear harness connector.

- Current passes through the connector to reach a wire splice, from the splice current travels two paths.

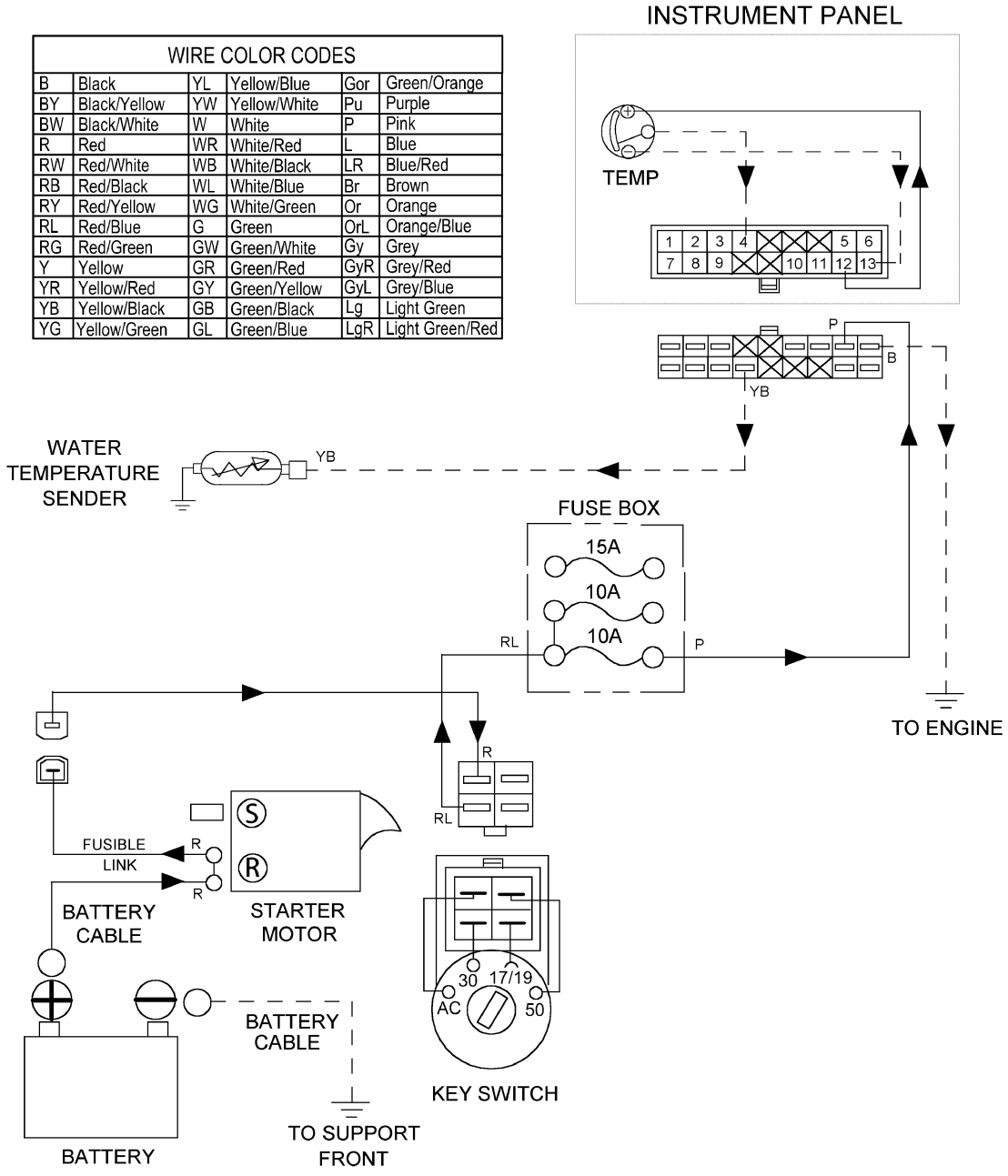
  One path sends current to the right turn signal/hazard flasher. When flasher is provided with a ground circuit the flasher will illuminate constant.

  The other path sends current to the control side of the right red hazard light relay. When the relay coil side is provide with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the control side of the relay latches sending current to the right side taillight. When the taillight is provided with a ground source, the right taillight will illuminate constant.

TROUBLESHOOTING – LEFT TURN SIGNAL CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative left turn signal flasher light	Blown 10-amp fuse	Check fuse and replace as necessary
	Blown 15-amp fuse	Check fuse and replace as necessary
	Malfunctioning Hazard Flasher/ Turn Signal Switch	Test switch and replace as necessary
	Blown bulb	Check for any blown bulbs and replace as necessary
	Improper ground circuit	Check left turn signal circuit connections and circuit grounds and repair as necessary
	Malfunctioning Hazard Flasher/ Turn Signal Relay	Check relay and replace as necessary
Inoperative left taillight	Defective left red hazard relay	Check relay and replace as necessary
	Improper ground circuit	Check circuit grounds and replace as necessary

ENGINE COOLANT TEMPERATURE CIRCUIT

WIRE COLOR CODES					
B	Black	YL	Yellow/Blue	Gor	Green/Orange
BY	Black/Yellow	YW	Yellow/White	Pu	Purple
BW	Black/White	W	White	P	Pink
R	Red	WR	White/Red	L	Blue
RW	Red/White	WB	White/Black	LR	Blue/Red
RB	Red/Black	WL	White/Blue	Br	Brown
RY	Red/Yellow	WG	White/Green	Or	Orange
RL	Red/Blue	G	Green	OrL	Orange/Blue
RG	Red/Green	GW	Green/White	Gy	Grey
Y	Yellow	GR	Green/Red	GyR	Grey/Red
YR	Yellow/Red	GY	Green/Yellow	GyL	Grey/Blue
YB	Yellow/Black	GB	Green/Black	Lg	Light Green
YG	Yellow/Green	GL	Green/Blue	LgR	Light Green/Red



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ENGINE COOLANT TEMPERATURE CIRCUIT

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire and through a connector to terminal 30 of the key switch.
3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10-amp fuse within the fuse block, to reach the terminal 12 of the instrument panel.
4. Current flows from terminal 12 of the instrument panel and reaches the engine temperature gauge. The ground path for the temperature gauge travels from terminal 13 of the instrument panel to the engine temperature sending unit.
5. The ground path for the temperature gauge exits the instrument panel at terminal 13 and is then directed to the ground terminal at the steering column.
6. The needle within the temperature gauge is controlled by variable resistance to ground. The ground path exits the temperature gauge and terminal 4 of the instrument panel to travel to the engine temperature sending unit. At the sending unit, the resistance to ground changes as the engine temperature changes. The temperature gauge translates this resistance into movement of the gauge needle.
7. A constant ground to temperature gauge is provided by terminal 13 of the instrument panel.

TROUBLESHOOTING - ENGINE COOLANT TEMPERATURE CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Engine Temperature Gauge	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning engine coolant gauge within the instrument panel	Replace Gauge as Necessary
	Improper ground circuit	Check connections and circuit grounds and repair as necessary
	Malfunctioning Engine Temperature Sender	Test Engine Temperature Sender and replace as necessary

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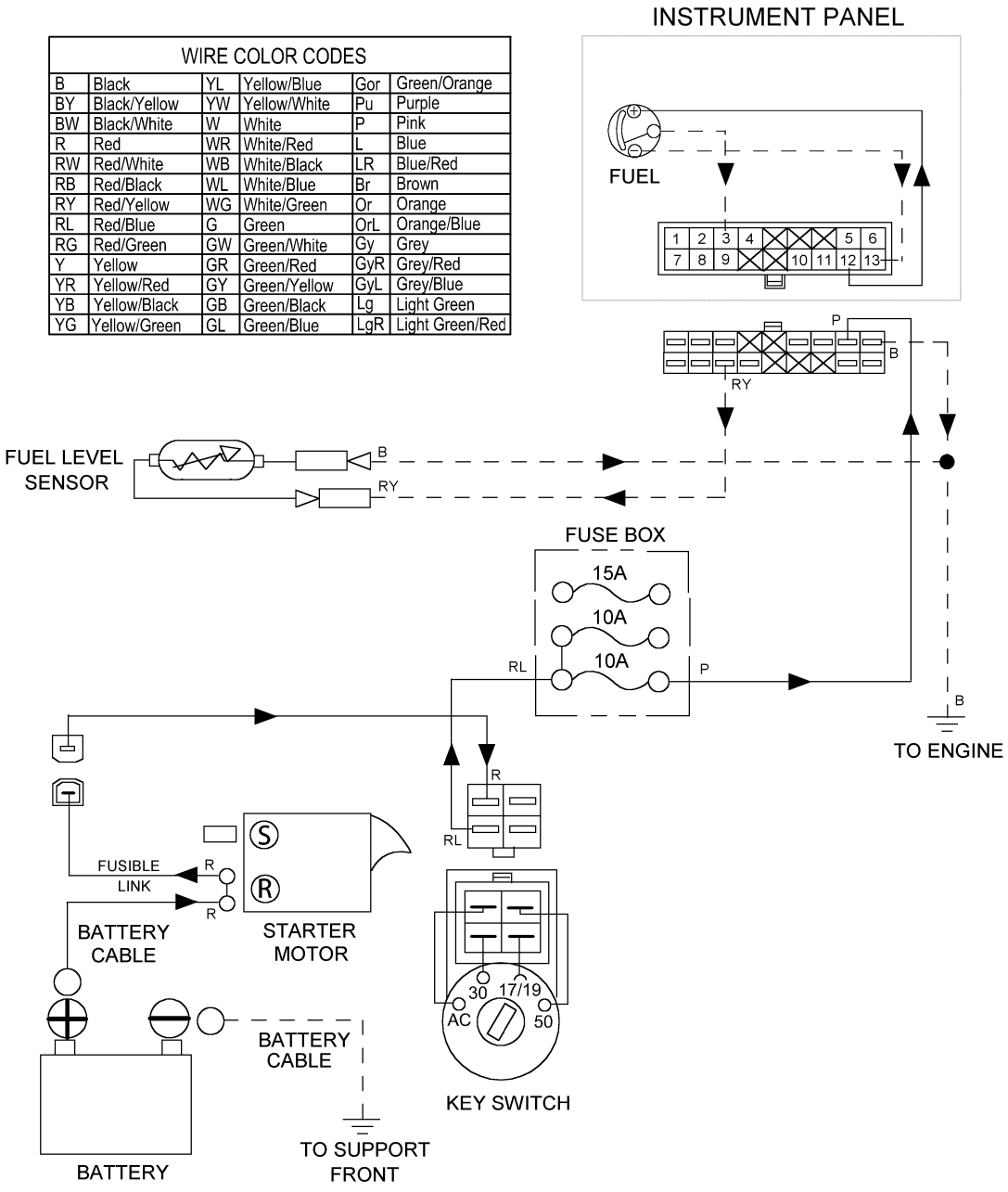
FUEL LEVEL CIRCUIT

WIRE COLOR CODES					
B	Black	YL	Yellow/Blue	Gor	Green/Orange
BY	Black/Yellow	YW	Yellow/White	Pu	Purple
BW	Black/White	W	White	P	Pink
R	Red	WR	White/Red	L	Blue
RW	Red/White	WB	White/Black	LR	Blue/Red
RB	Red/Black	WL	White/Blue	Br	Brown
RY	Red/Yellow	WG	White/Green	Or	Orange
RL	Red/Blue	G	Green	OrL	Orange/Blue
RG	Red/Green	GW	Green/White	Gy	Grey
Y	Yellow	GR	Green/Red	GyR	Grey/Red
YR	Yellow/Red	GY	Green/Yellow	GyL	Grey/Blue
YB	Yellow/Black	GB	Green/Black	Lg	Light Green
YG	Yellow/Green	GL	Green/Blue	LgR	Light Green/Red



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13

FUEL LEVEL CIRCUIT

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire and through a connector to terminal 30 of the key switch.
3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10-amp fuse within the fuse block, to reach terminal 12 of the instrument panel.
4. Current flows from terminal 12 of the instrument panel and reaches the fuel gauge. The ground path for the fuel gauge travels from terminal 3 of the instrument panel to the fuel level sending unit.
5. The ground path to the fuel level sending unit travels to the left side of the engine block. The fuel level sending unit controls a variable resistance to ground. As the fuel level within the fuel tank falls, the resistance to ground changes, translating into movement of the needle within the fuel gauge.
6. A constant ground to temperature gauge is provided by terminal 13 of the instrument panel.

TROUBLESHOOTING – FUEL LEVEL CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative fuel level gauge	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning fuel level sending unit	Test fuel level sending unit and replace as necessary
	Improper ground circuit	Check fuel level sending unit connections and circuit grounds and repair as necessary
	Malfunctioning fuel gauge	Test fuel gauge and replace fuel gauge as necessary

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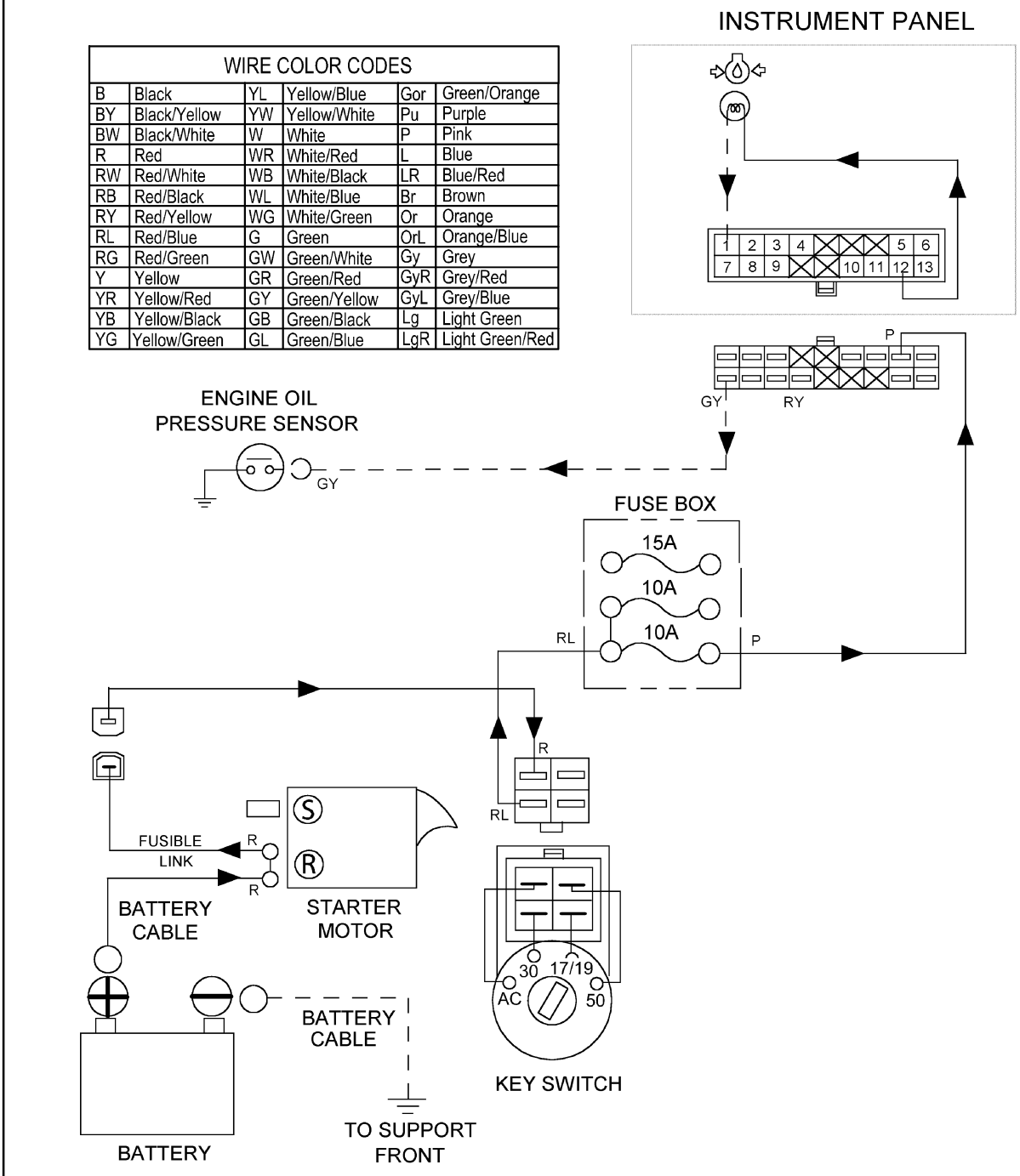
LOW OIL PRESSURE CIRCUIT

WIRE COLOR CODES					
B	Black	YL	Yellow/Blue	Gor	Green/Orange
BY	Black/Yellow	YW	Yellow/White	Pu	Purple
BW	Black/White	W	White	P	Pink
R	Red	WR	White/Red	L	Blue
RW	Red/White	WB	White/Black	LR	Blue/Red
RB	Red/Black	WL	White/Blue	Br	Brown
RY	Red/Yellow	WG	White/Green	Or	Orange
RL	Red/Blue	G	Green	OrL	Orange/Blue
RG	Red/Green	GW	Green/White	Gy	Grey
Y	Yellow	GR	Green/Red	GyR	Grey/Red
YR	Yellow/Red	GY	Green/Yellow	GyL	Grey/Blue
YB	Yellow/Black	GB	Green/Black	Lg	Light Green
YG	Yellow/Green	GL	Green/Blue	LgR	Light Green/Red



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14

LOW OIL PRESSURE CIRCUIT

NOTE: *The low oil pressure should illuminate during engine startup. The light should go off soon after the engine is started. If the light fails to go off after the engine is started, stop the engine and correct the problem.*

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire and through a connector to terminal 30 of the key switch.
3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10-amp fuse within the fuse block, to reach terminal 12 of the instrument panel.
4. Current flows from terminal 12 of the instrument panel and reaches the low oil pressure warning light. The ground path for the low oil pressure warning light travels from terminal 1 of the instrument panel to the oil pressure switch.
5. When the oil pressure falls below .41 bar (6 PSI), the oil pressure switch closes to provide the low oil pressure warning light with ground. This causes the light to illuminate, warning the operator of engine problems. Do not run the engine when the low oil pressure warning light is on as serious damage to the engine could occur.

TROUBLESHOOTING - LOW OIL PRESSURE CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Low Oil Pressure Warning Light	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning Low Oil Pressure Warning Light within the Instrument Panel	Replace Low Oil Pressure Warning Light Bulb as Necessary
	Improper ground circuit	Check Low Oil Pressure Switch connections and circuit grounds and repair as necessary
	Malfunctioning Low Oil Pressure Switch	Test Low Oil Pressure Switch and replace as necessary

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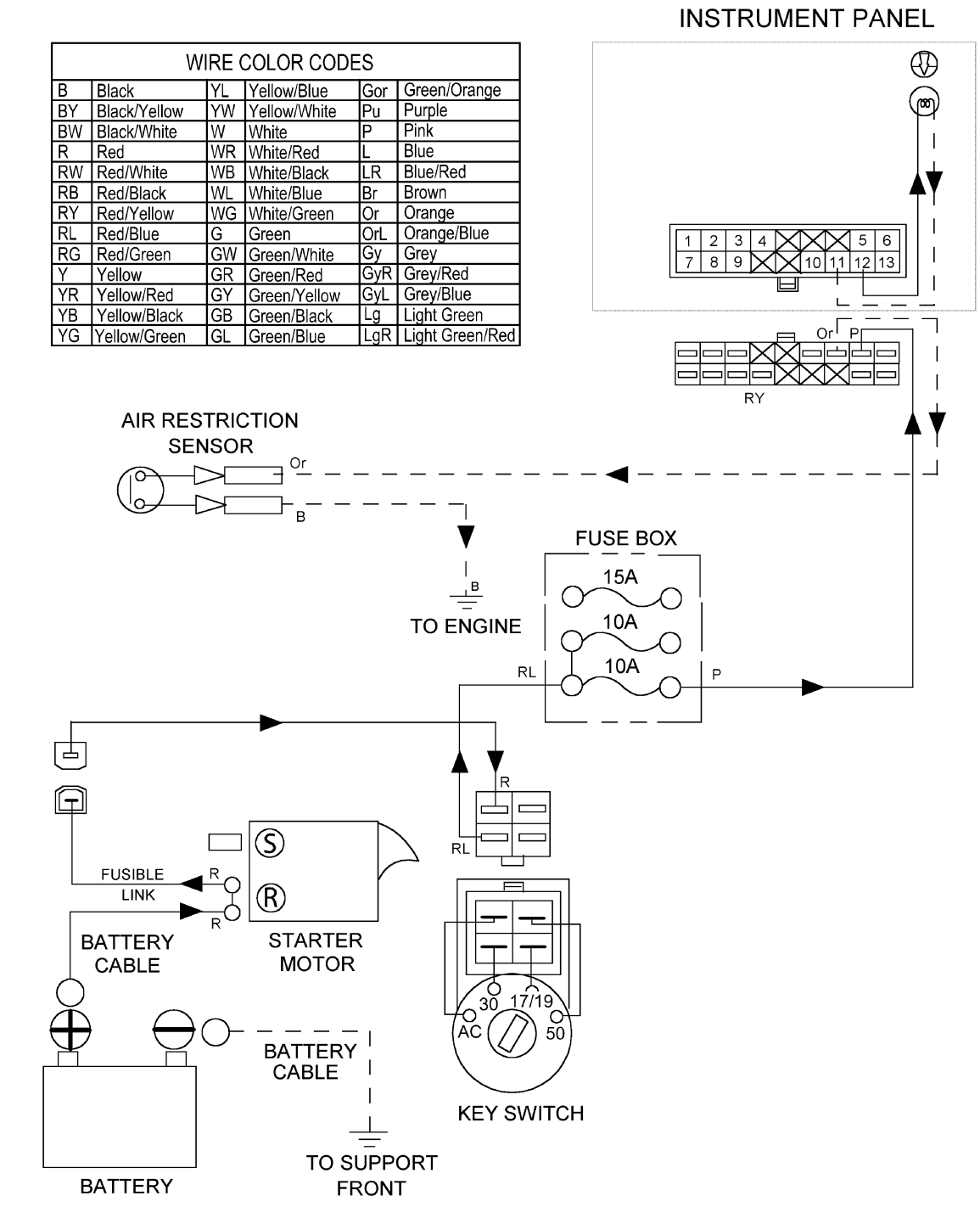
AIR RESTRICTION CIRCUIT

WIRE COLOR CODES					
B	Black	YL	Yellow/Blue	Gor	Green/Orange
BY	Black/Yellow	YW	Yellow/White	Pu	Purple
BW	Black/White	W	White	P	Pink
R	Red	WR	White/Red	L	Blue
RW	Red/White	WB	White/Black	LR	Blue/Red
RB	Red/Black	WL	White/Blue	Br	Brown
RY	Red/Yellow	WG	White/Green	Or	Orange
RL	Red/Blue	G	Green	OrL	Orange/Blue
RG	Red/Green	GW	Green/White	Gy	Grey
Y	Yellow	GR	Green/Red	GyR	Grey/Red
YR	Yellow/Red	GY	Green/Yellow	GyL	Grey/Blue
YB	Yellow/Black	GB	Green/Black	Lg	Light Green
YG	Yellow/Green	GL	Green/Blue	LgR	Light Green/Red



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AIR RESTRICTION CIRCUIT

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.
3. When the key switch is in the “AC/Run” position, current crosses from terminal 30 to the “AC” terminal.
4. Current travels from the “AC” terminal of the key switch to the fuse panel.
5. Current passes through the 10-amp fuse within the fuse panel and reaches terminal 12 of the instrument panel.
6. Current enters terminal 12 and reaches the air restriction warning light within the instrument panel.
7. The air restriction switch controls the ground path to the warning light. When the air flow through the intake manifold drops below safe levels, the switch closes to complete the ground path, to terminal 11, causing the air restriction warning light to illuminate. This warns the operator that the air system is restricted and must be cleared to avoid engine damage.

TROUBLESHOOTING - AIR RESTRICTION CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Air Restriction Warning Light	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning Air Restriction Light within the Instrument Panel	Replace Air Restriction Bulb as Necessary
	Improper ground circuit	Check Air Restriction Switch connections and circuit grounds and repair as necessary
	Malfunctioning Air Restriction Switch	Test Air Restriction Switch and replace as necessary
Air Restriction Warning Light Stays Illuminated	Malfunctioning Air Restriction Switch	Test Air Restriction Switch and replace as necessary
	Air Inlet Restriction	Check Air Filter and Air Intake Hose
	Short circuit in ground circuit	Check Wire Harness for damaged ground wire

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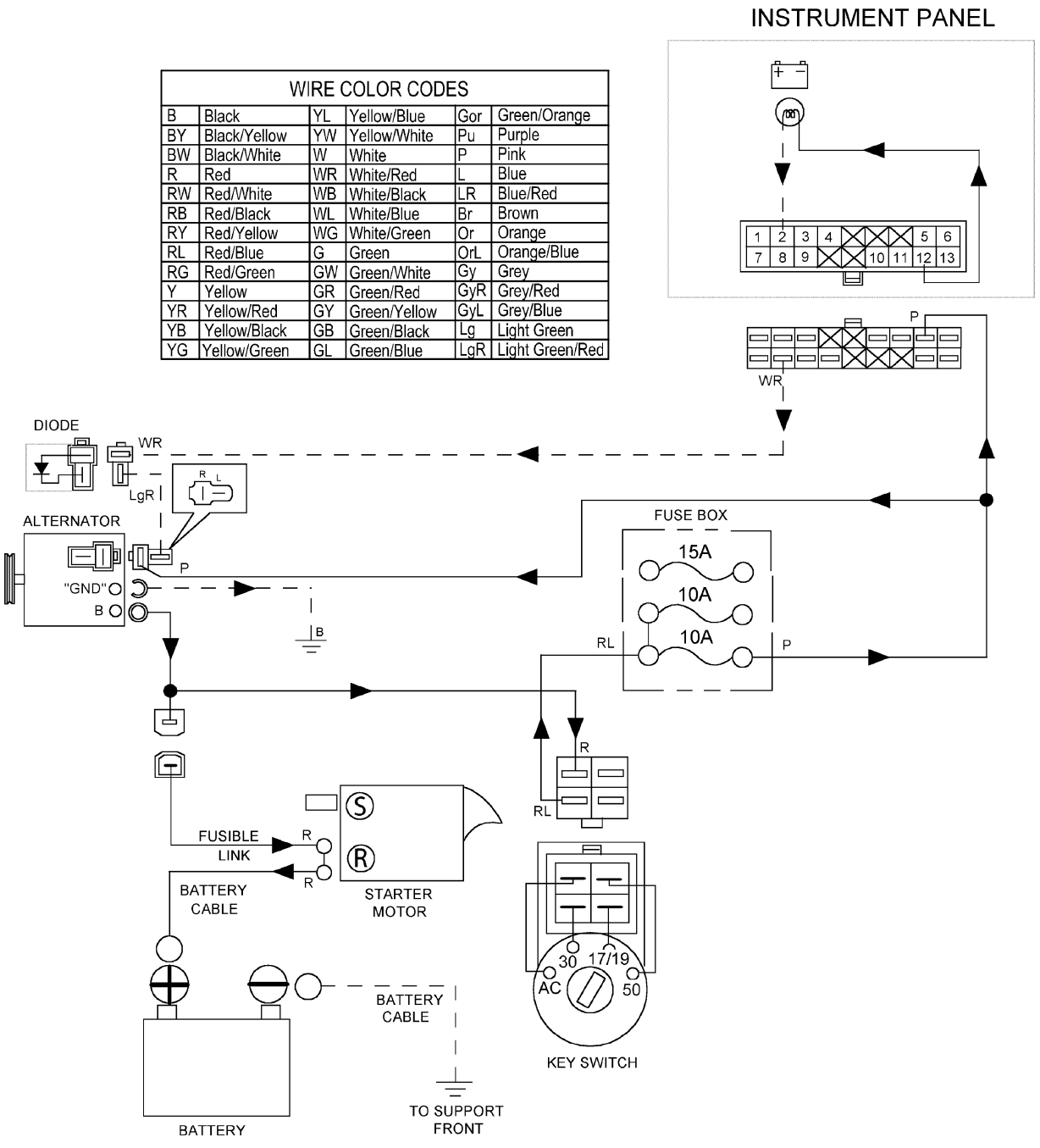
CHARGE CIRCUIT



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16

CHARGE CIRCUIT

1. Current starts at the battery and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to a the wire splice. The wire splice splits current into two different paths.
   - One path goes to the “B” terminal of the alternator.
   - The other path travels to terminal “30” of the key switch.
3. When the key switch is in the “ACC/RUN” position, current flows from the “ACC” terminal to the 10-amp fuse within the fuse panel. Current passes through the fuse to a the wire splice. The wire splice splits the current into two different paths.
   - One path sends current to terminal “12” of the instrument panel connector. Terminal “12” provides current to the charge indicator light.
   - The other path sends current to the “R” (Regulator) terminal of the alternator.
4. The alternator is grounded by the “GND” terminal on the alternator through the wiring harness to the engine block.
5. If the tractor engine is not running or the alternator is not producing a sufficient amount of charge, (with the key switch in the “ACC/RUN” position). The charge indicator light will illuminate.
   - The current for the indicator light is provided by terminal “12” of instrument panel connector.
   - The ground circuit for the indicator light is provided by terminal “2” of instrument panel connector. From terminal “2” the ground path passes through a diode that is located at alternator R/L connector, then to the “L” terminal of alternator. The ground source for the “L” terminal is provided by the field coil.
   - When the ground circuit is complete to terminal “2” and current is provided to terminal “12” by the key switch, the charge indicator light will illuminate.
6. When the tractor is running with the alternator rotating and key switch in “ACC/RUN” position, the alternator produces an increased regulated voltage to the battery.
   - When the alternator is producing current, the ground circuit, through the “L” terminal, for the charge indicator light is disrupted causing the indicator light to not illuminate.
   - The “R” regulator terminal controls the voltage output from the alternator. If current is not present at the “R” terminal the alternator will not produce current.
   - The “B” terminal of the alternator is the output connection between the alternator and the battery.

TROUBLESHOOTING – CHARGING CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Charge light remains illuminated	Faulty alternator component	Test alternator and repair a necessary
	Short circuit to ground between alternator and warning lamp	Check wiring and repair as necessary
Charge light does not illuminate	Blown 10-amp fuse	Inspect 10-amp fuse and replace as necessary
	Faulty charge indicator bulb	Inspect indicator bulb and replace as necessary
	Open charge light circuit	Inspect connections, grounds, and wiring for charge circuit and repair as necessary
	Alternator diode open	Check diode for proper continuity
Insufficient or no battery charge, hard starting, or dim indicator light	Battery charge less than 75%	Test battery. Charge, add water, or replace as necessary
	Fan belt slipping	Check fan belt tension, adjust as necessary
	Loose wiring connections	Check wiring connections for charge circuit, repair as necessary
	Continuity fault in external wiring	Check wiring harness and repair as necessary
	Open alternator excitation circuit to terminal “R” of alternator	Inspect the white/blue wire from 10-amp fuse to “R” terminal of alternator
Battery failure, frequent burnout of lamps and fuses	Overcharge condition	Check alternator voltage output and repair as necessary
	Ground circuit for alternator short-circuited	Check alternator wiring and connections and repair as necessary

SECTION 55 - ELECTRICAL SYSTEM

Chapter 3 - Instrument Panel

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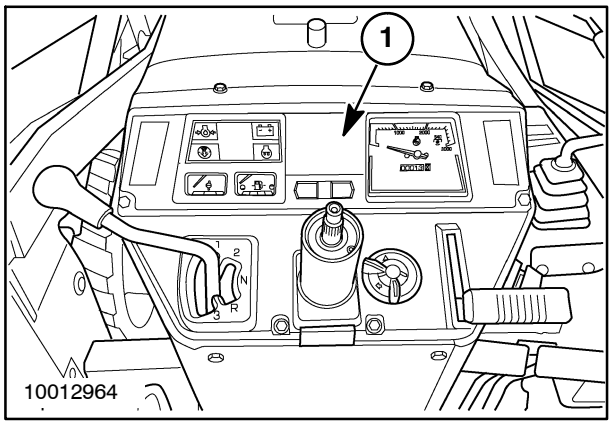
INSTRUMENT PANEL

NOTE: *The steering wheel was removed to better illustrate the instrument panel. Removal of the steering wheel is not necessary for servicing the instrument panel.*

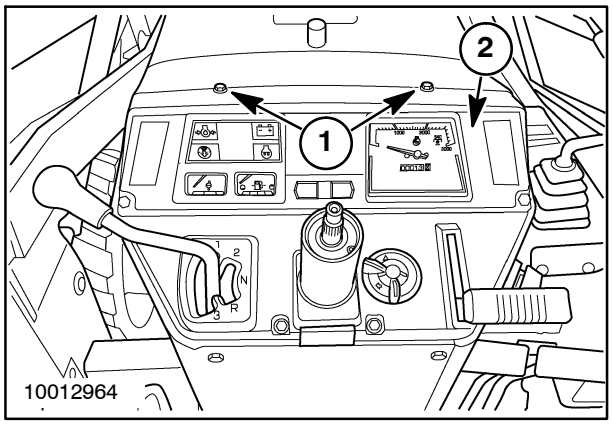
The instrument panel, 1, is located at the top of the dash panel. The instrument panel houses gauges and lights that monitor tractor functions.



1

Removal

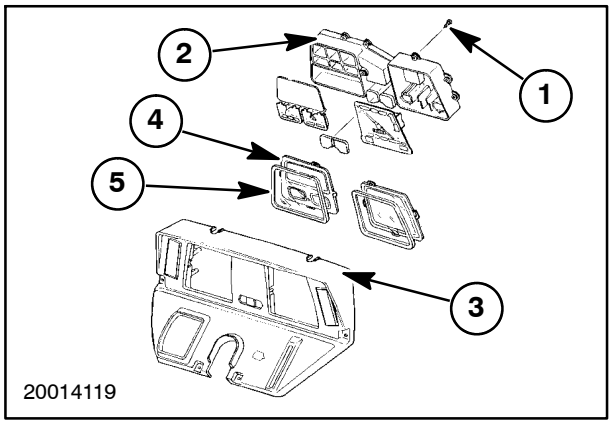
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the six screws, 1, to loosen the instrument panel, 2, from the dash panel.
3. Disconnect the tachometer cable and the wire harness to remove the instrument panel from the tractor.



2

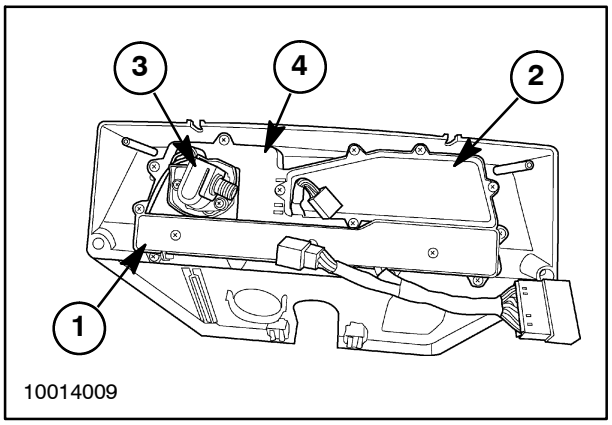
Disassembly

1. Remove the thirteen screws, 1, from the rear of the instrument panel to remove the instrument panel component housing, 2, from the instrument panel cover, 3.
2. Remove the retainer/gaskets, 4, and lenses, 5, from the instrument panel cover.



3

3. Remove the metal access plate, 1, and the plastic access plate, 2, and the tachometer drive, 3, from the back of the instrument panel component housing, 4.



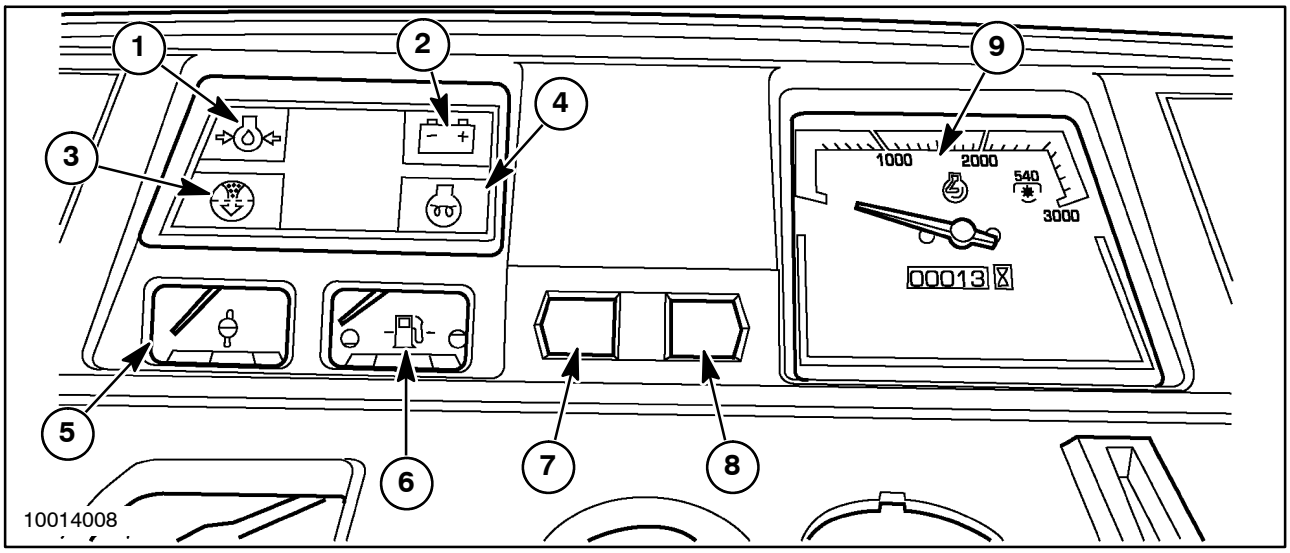
4

Assembly

1. Place the retainer/gaskets and lenses into the instrument panel cover.
2. Install the metal access plate and/or the plastic access plate onto the back of the instrument panel component housing.
3. Install the instrument panel component housing into the instrument panel cover by using the thirteen screws.

Installation

1. Connect the wire harness and the tachometer cable to the instrument panel.
2. Install the instrument panel into the tractor dash panel by using the six screws.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



5

INSTRUMENT PANEL COMPONENTS

Component Identification & Description

1. **Oil Pressure Warning Light** - Illuminates when the key switch is in the “On” or “Heat” positions and remains lit for a short period of time after the engine is started. The oil pressure warning light illuminates when the engine oil pressure falls below 6 PSI. If this occurs, stop the tractor engine immediately to investigate and correct the cause.
2. **Battery Charge Warning Light** - Illuminates when the key switch is in the “AC/Run” or “Heat” positions and remains lit for a short period of time after the engine is started. If this bulb becomes lit during operation, it indicates that the charging system is not operating normally. As the battery can become fully discharged under these conditions, the problem should be investigated as soon as possible.
3. **Air Filter Restriction Warning Light** - The air filter restriction warning light illuminates when the air intake system becomes clogged with foreign matter, such as dirt. When the air filter restriction light illuminates service the intake system as soon as possible. Tractor performance will suffer when the air intake system is restricted.
4. **Glow Plug Indicator Light** - The glow plug indicator light illuminates when the key switch is turned to the “Heat” and “Start” positions, indicating that the glow plugs are energized and heating the tractor engine combustion chambers. The indicator light will stay illuminated for four seconds when the key switch is turned to the “Heat” position and remains illuminated when the key switch is turned to the “Start” position.
5. **Coolant Temperature Gauge** - The temperature gauge indicates engine coolant temperature. The temperature gauge is activated when the key switch is turned to the “AC/Run” position, as battery current is being supplied to the gauge. The red portion of the temperature gauge indicates an engine overheating condition. When the temperature needle enters the red portion of the gauge, the operator should turn off the tractor engine and investigate a possible engine malfunction.
6. **Fuel Gauge** - The fuel gauge indicates the amount of fuel within the fuel tank. The fuel gauge is activated when the key switch is in the “AC/Run” position, as battery current is being supplied to the gauge. The right side of the gauge indicates an empty fuel tank. The fuel gauge needle will move from right to left as the tractor engine consumes fuel.
7. **Left Flasher Indicator** - The left flasher indicator illuminates when the left flasher is turned on.
8. **Right Flasher Indicator** - The right flasher indicator illuminates when the right flasher is turned on.
9. **Tachometer/Hourmeter:**

   Tachometer - Registers engine RPM. The gauge is marked in increments of 100 and returns to zero when the engine is not running. A cable mechanically controls the tachometer on the TC30 tractor. The tachometer is not serviceable and requires replacement if not functioning properly.

   Hourmeter - Records the hours and portions of hours the tractor engine has operated. A cable mechanically controls the hourmeter on the TC30 tractor. Use the hourmeter as a guide to determine hourly service and maintenance intervals. The hourmeter is not serviceable. The hourmeter requires replacement if not functioning properly.

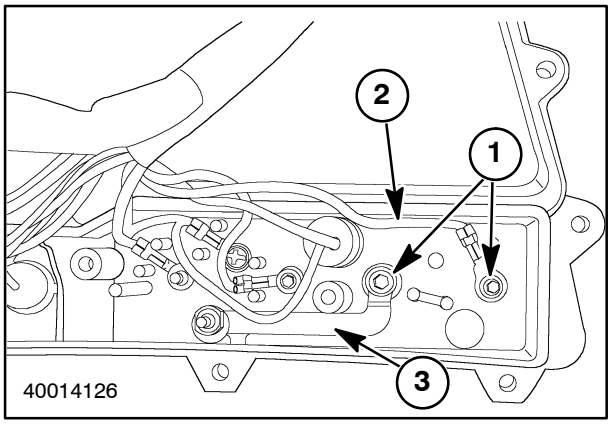
   NOTE: *Registration of hours and portions of hours your tractor has operated, will be based on an average engine speed of 1867 RPM. Engine speeds below 1867 RPM, accumulate hours at a slower rate than clock hours. Engine speeds above 1867 RPM, accumulate hours at a faster rate than clock hours.*

Removal, Testing & Installation
This section describes the removal, testing, and installation of the components within the instrument panel.

COOLANT TEMPERATURE GAUGE

Removal

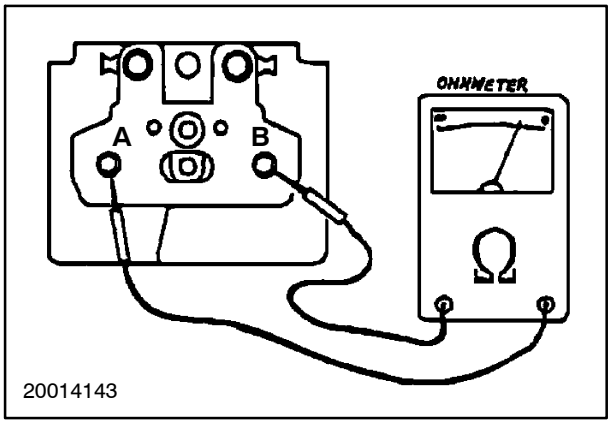
1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the instrument panel SEE INSTRUMENT PANEL REMOVAL.
3. Remove the instrument panel component housing from the instrument panel cover. SEE INSTRUMENT PANEL DISASSEMBLY.
4. Remove the metal access plate from the back of the instrument panel component housing. SEE INSTRUMENT PANEL DISASSEMBLY.
5. Remove the two nuts, 1, to disconnect the wire lead, 2, and the ground buss bar, 3, from the terminals on the coolant temperature gauge.
6. Remove the coolant temperature gauge from the instrument panel component housing.



6

Testing
Use an ohmmeter to check the coolant temperature gauge for electrical continuity.

1. Touch an ohmmeter lead to terminal A on the back of the temperature gauge.
2. Touch the other ohmmeter test lead to terminal B on the back of the coolant temperature gauge.
3. Observe the ohmmeter. The ohmmeter should show a resistance reading of 55 ± 3 ohms. If the ohmmeter reading is not between 52 and 58 ohms, the temperature gauge is faulty and requires replacement.



7

Installation

1. Slide the temperature gauge into the instrument panel component housing and use the two nuts to attach the wire lead and the ground buss bar onto the two temperature gauge terminals.
2. Install the metal access plate into the instrument panel component housing.
3. Install the instrument component housing into the instrument panel cover.
4. Connect the wire harness and the tachometer cable to the instrument panel.
5. Install the instrument panel into the tractor by using the six screws.
6. Connect the negative (-) battery cable to the negative (-) battery terminal.

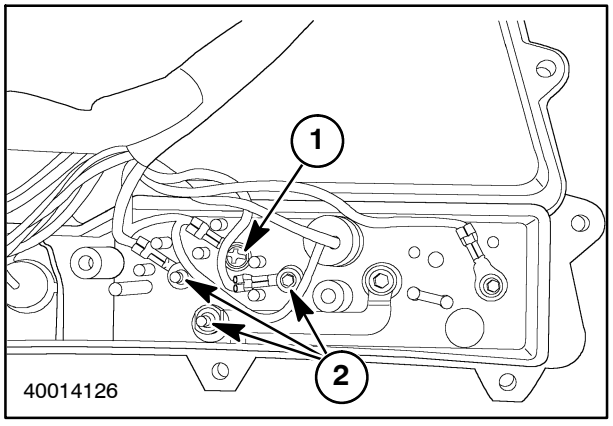
FUEL GAUGE

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the instrument panel SEE INSTRUMENT PANEL REMOVAL.
3. Remove the instrument panel component housing from the instrument panel cover. SEE INSTRUMENT PANEL DISASSEMBLY.
4. Remove the metal access plate from the back of the instrument panel component housing. SEE INSTRUMENT PANEL DISASSEMBLY.

NOTE: *To ensure proper installation, label each of the wire leads for proper orientation before disconnecting.*

5. Remove the screw, 1, and the three nuts, 2, to disconnect the wire leads from the fuel gauge terminals.
6. Remove the fuel gauge from the instrument panel component housing.



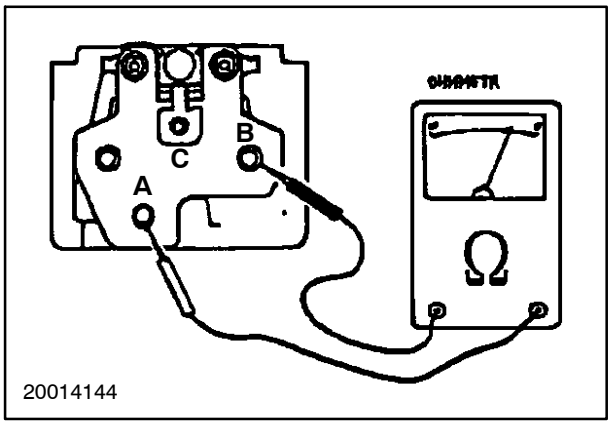
8

Testing

Use an ohmmeter to check the fuel gauge for electrical continuity.

Test 1

1. Touch an ohmmeter lead to terminal A on the back of the fuel gauge.
2. Touch the other ohmmeter test lead to terminal B on the back of the fuel gauge.
3. Observe the ohmmeter. The ohmmeter should show a resistance reading of 55 ± 3 ohms. If the ohmmeter reading is not between 52 and 58 ohms, the fuel gauge is faulty and requires replacement.



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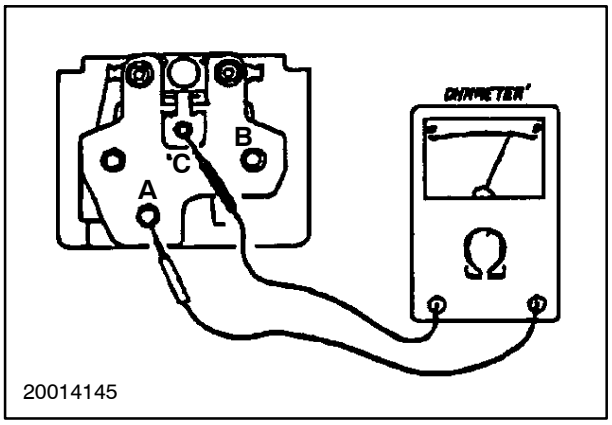
Test 2

1. Touch an ohmmeter lead to terminal A on the back of the fuel gauge.
2. Touch the other ohmmeter test lead to terminal C on the back of the fuel gauge.
3. Observe the ohmmeter. The ohmmeter should show a resistance reading of about 70 ohms. If the ohmmeter reading is not approximately 70 ohms, the fuel gauge is faulty and requires replacement.



10

Installation

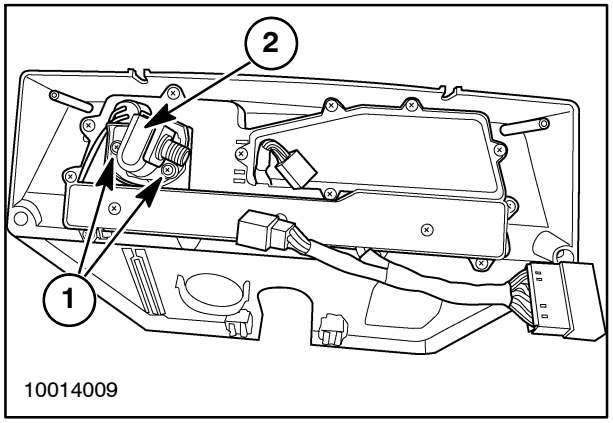
1. Slide the fuel gauge into the instrument panel component housing and use the three nuts and the one screw to attach the wire leads and the ground buss bar onto the four fuel gauge terminals.
2. Install the metal access plate into the instrument panel component housing.
3. Install the instrument component housing into the instrument panel cover.
4. Connect the wire harness and the tachometer cable to the instrument panel.
5. Install the instrument panel into the tractor by using the six screws.
6. Connect the negative (–) battery cable to the negative (–) battery terminal.

TACHOMETER/HOURMETER

Removal

NOTE: *Check the tachometer cable for damage before removing the tachometer from the instrument panel.*

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the instrument panel SEE INSTRUMENT PANEL REMOVAL.
3. Remove the instrument panel component housing from the instrument panel cover. SEE INSTRUMENT PANEL DISASSEMBLY.
4. Remove the two screws, 1, to remove the tachometer drive, 2, from the instrument panel component housing.



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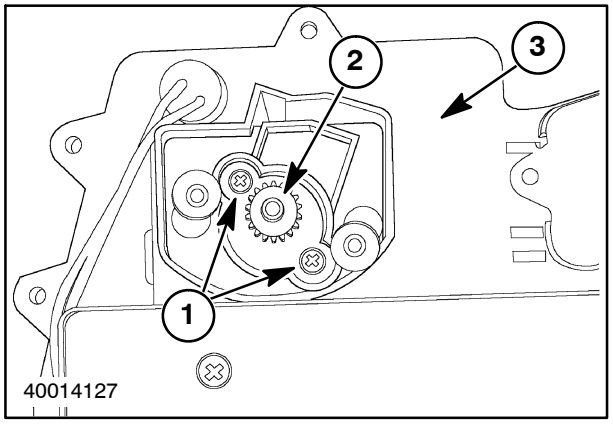
5. Remove the two screws, 1, to remove the tachometer, 2, from the instrument panel component housing, 3.



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Inspection

1. Inspect the tachometer cable for excessive wear or damage.
2. Inspect all gears in the tachometer drive and the tachometer gauge for excessive wear or damage. Replace the tachometer drive or the tachometer as necessary.

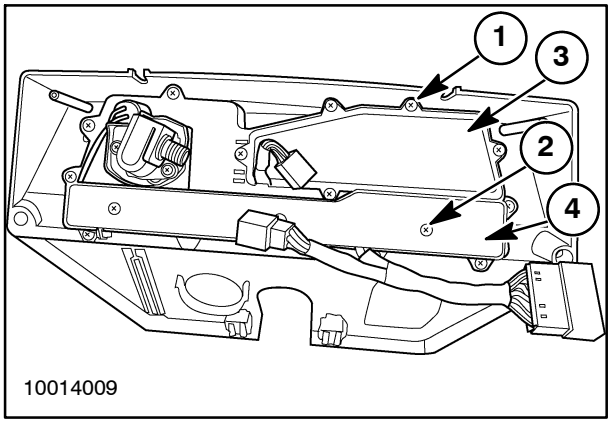
Installation

1. Install the tachometer by using the two screws.
2. Install the tachometer drive by using the two screws.
3. Install the instrument component housing into the instrument panel cover.
4. Connect the wire harness and the tachometer cable to the instrument panel.
5. Install the instrument panel into the tractor by using the six screws.
6. Connect the negative (-) battery cable to the negative (-) battery terminal.

Instrument Panel Bulb List

#	Function	Quantity	Bulb Size
1	Tachometer Back Light	1	158 HD
2	Indicator Lights	4	D9 158 54
3	Right/Left Directional Arrows, Fuel/Temperature Gauges Back Light	3	12V - 3W

Remove mounting screws, 1 or 2, and back panels, 3 or 4, to gain access to indicator light bulbs, or gauge back lights and flasher arrow bulbs.



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SECTION 55 - ELECTRICAL SYSTEM

Chapter 4 - Alternator and Starter

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SPECIFICATIONS – ALTERNATOR

Manufacturer	Mitsubishi
Model	A007T03877
Polarity	Negative Ground
Rotational Direction (viewed from pulley)	Clockwise
Drive Belt Tension	10 - 15 mm (0.39 - 0.59 in.) deflection @ 9 - 11 kg (20 - 25 lb.) of force
Adjusting Voltage	14.5 - 15.0 volts
Load Characteristics	
Terminal voltage	13.5 volts
Current	30 amp minimum
Rpm	2500
Brush Length	
Wear Limit (min. length)	5 mm (0.20 in.)
Original	18.5 mm (0.728 in.)
Brush Contact Rings	
Wear Limit (min. diameter)	22.1 mm (0.871 in.)
Original Diameter	22.7 mm (0.894 in.)
Bearing	
Front	ECSC8
Rear	6303DDG
Stator Coil Resistance	less than 1.0 ohm
Rotor Coil Resistance	2.8 ohms

DESCRIPTION OF OPERATION – CHARGING SYSTEM

Op. 55 301

The TC30 model tractors are equipped with a 40-amp output alternator. The alternator is equipped with an integrated circuit (IC) regulator, meaning voltage is regulated internally and electronically within the alternator.

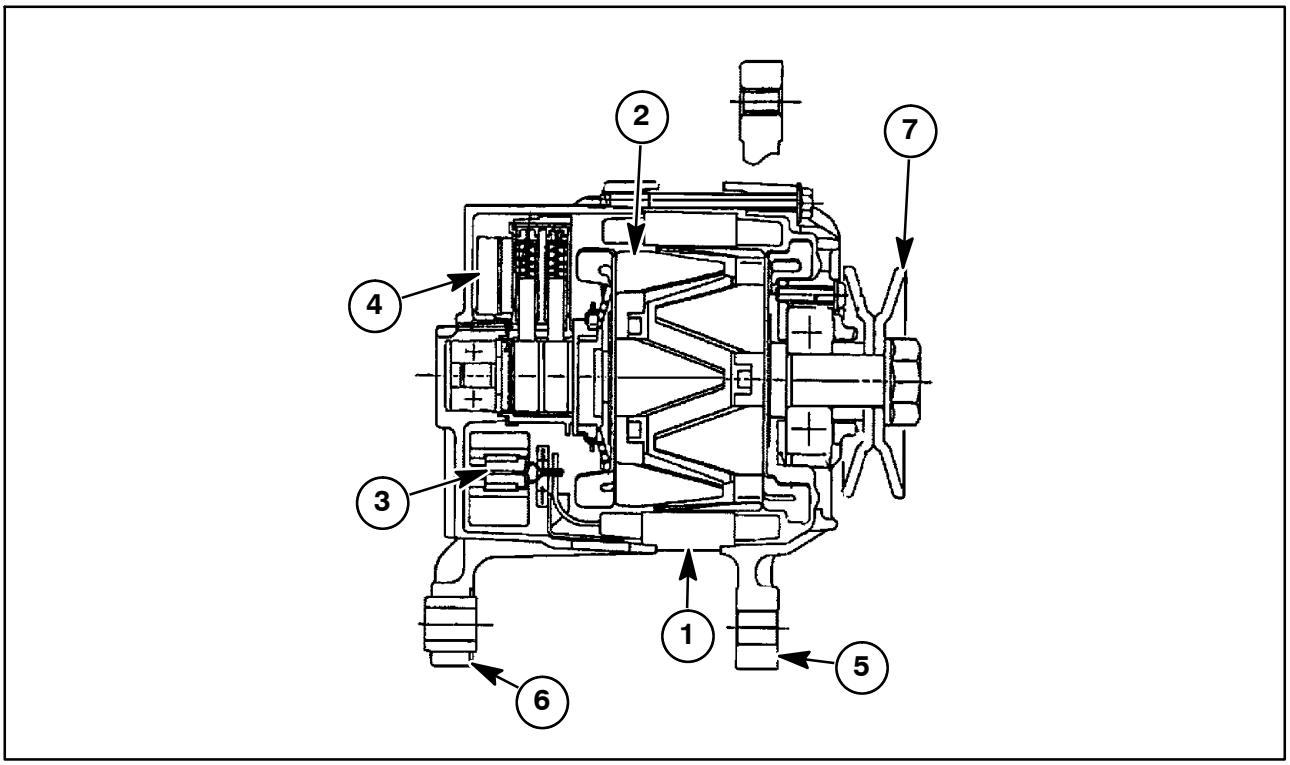
The principle components of the alternator are the stator, 1, the rotor, 2, and the rectifier assembly, 3, and the IC regulator, 4.

The rectifier assembly, 3, consists of two heat sinks, one positive (+) and one negative (–), and a diode trio. The diode trio is used as a field supply diode and is connected to terminal “L” on the alternator.

The IC regulator, 4, is a solid state unit and can only be serviced as an assembly.

The internal components of the alternator are housed in a two piece frame, which is divide into a drive end (front) frame, 5, and a rear frame, 6. The frame contains open slots to allow for cooling of the alternator.

The alternator rotor is rotated in the frame by using a belt driven pulley, 7, which is powered off of the engine crankshaft pulley by a belt.



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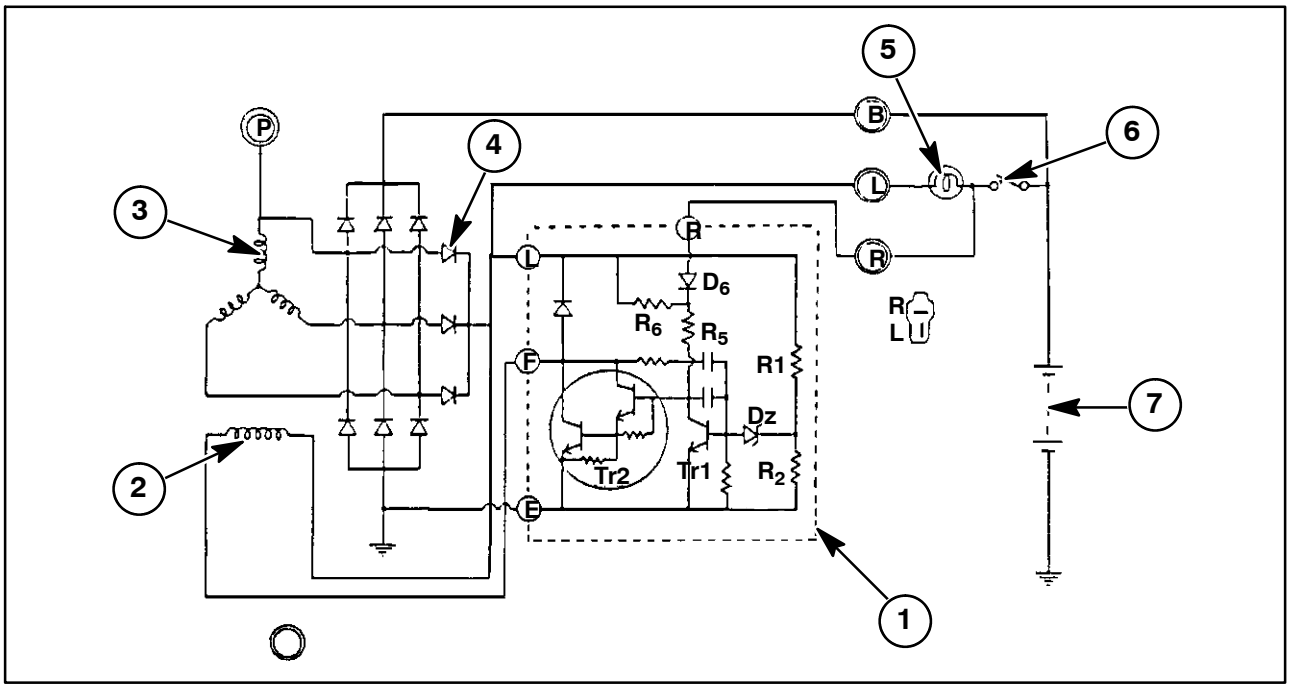

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CHARGING CIRCUIT

The charging circuit and internal connections are shown. The charging system consists of an IC voltage regulator, 1, (enclosed with dotted lines), a battery, 7, and connecting wires. Because of the use of IC, the voltage regulator is very compact and is built into the alternator.

The IC voltage regulator, 1, permits the field current to flow directly from the diode trio, 4, to the field coil, 2, without passing through the external circuit. Consequently, there are no voltage drops caused by the key switch or the external wiring as with conventional vibrating-contact regulators mounted separately from the alternator. To aid in initial voltage buildup when the engine is started, the field current is supplied through the indicator lamp, 5, from the battery, 7.

Since the frequency pulse output of 1/10 the alternator speed develops on the “P” terminal, this terminal is used for speed detection.

PRINCIPLE OF IC REGULATOR

The basic function of the IC voltage regulator is to make the terminal voltage constant by detecting the generated voltage and increasing/decreasing the field current.

As indicated, the regulator consists of two basic sections: a voltage control device and an output device to handle the field current. The voltage control device includes the voltage divider network, R1 and R2, a zener diode, DZ, for voltage reference, and a single amplifying transistor, Tr1. The output device is a darlington-type amplifier which is called power transistor, Tr2. The power transistor, Tr2, is placed in series with the alternator field coil and ground.

The signal amplifying transistor, Tr1, senses the generated voltage and turns the power transistor, Tr2, on and off many times per second most of the time the engine is in operation.

The basic operating principles are explained as follows, see Figure 3:

1. When the key switch, 6, is closed, current from the battery, 7, flows through the indicator lamp, 5, and resistor R6, which are in parallel to the field coil, 2. From here it continues to flow on through the field coil, 2, to the ground, completing the circuit back to the battery, 7.
2. When the alternator begins to rotate, AC voltages are generated by the stator coil, 3. The diodes in the rectifier assembly change the stator AC voltages to DC voltage which appears between ground and the “B” terminal.

   The stator also supplies DC field current through the diode trio, 4, the field coil, 2, the power transistor, Tr2, and then through the diodes in the rectifier assembly back to the stator.
3. When the generated voltage is low, no current flows in the zener diode, DZ, since the voltage at point “A” is lower than the zener voltage.
4. As the speed and voltage increase, the voltage at point “A” also increases until it reaches the limiting value set at the factory. As the zener diode, DZ, breaks down, current flows through R1, DZ, and the base-emitter circuit of Tr1 to ground. This renders Tr1 conductive, so that much of the current flows through the collector-emitter circuit of Tr1. This reduces the base current of Tr2 thereby reducing the field current. This means that Tr1 turns on and Tr2 turns off.
5. When the generated voltage decreases, the zener diode, DZ, again turns off and Tr1 also turns off. This cycle repeats many times per second, and the alternator output voltage is, therefore, regulated within a narrow limit.

   In other words, the action is similar to the conventional vibrating-contact regulator, in that current to the field coil, 2, is varied to limit the output voltage, but in place of the voltage coil and spring system, there is a voltage divider network, R1 and R2, and a zener diode, DZ.

TROUBLESHOOTING - ALTERNATOR

NO CHARGING

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Loose connection, short circuit	Repair
Alternator	Loose connection, no ground, short circuit	Repair or replace
	Defective rectifier	Replace
	Loose connection on RF resistor	Replace
Regulator	Defective regulator	Replace
	Loose connection of alternator or regulator	Repair or replace

INSUFFICIENT CHARGING

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Loose connection or short circuit	Repair
Alternator	Loose drive belt	Repair
	Short in rotor coil	Replace
	Short in stator coil	Replace
	Defective rectifier	Replace
	Insufficient brush contact	Repair or replace
Regulator	Defective regulator	Replace
	Loose connection of alternator and regulator	Repair
Battery	Defective battery	Replace

OVERCHARGE

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Battery	Internal short	Replace
Regulator	Defective regulator	Replace

UNSTABLE CHARGING CIRCUIT

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Loose connection or open wire	Repair or replace
Alternator	Loose drive belt	Repair
	Short in rotor coil	Replace
	Short in stator coil	Replace
	Broken brush or spring	Replace
	Loose connection	Repair
Regulator	Defective regulator	Replace
	Loose connection at alternator and regulator	Repair or replace

ABNORMAL NOISE OF ALTERNATOR

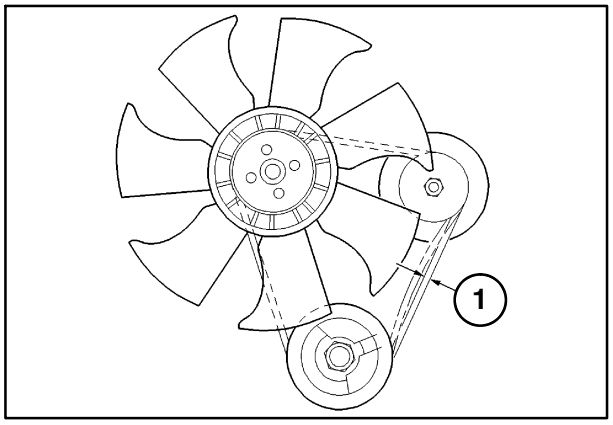
FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Alternator	Loose mounting hardware	Repair
	Defective bearings	Repair or replace
	Rotor core and stator in contact	Replace
	Defective diode	Replace
	Short in stator coil	Replace

TESTING AND OVERHAUL – ALTERNATOR

PRELIMINARY ALTERNATOR TESTS

Alternator Drive Belt

1. Check the alternator drive belt deflection by applying 9 - 11 kg (20 - 25 lb.) of force between the crank pulley and the alternator pulley, 1. Belt deflection should be 10 - 15 mm (0.39 - 0.59 in.).



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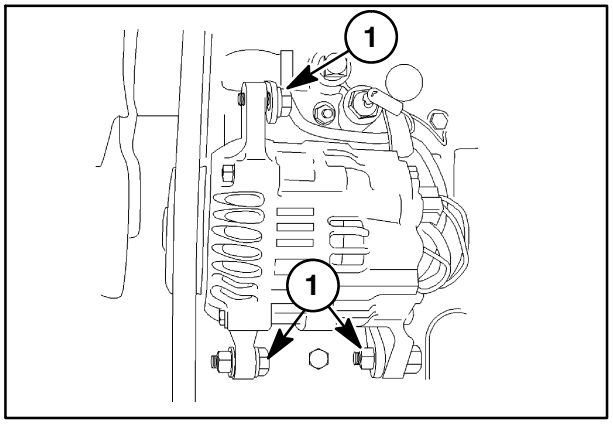
2. If the drive belt deflection needs adjusted, loosen the alternator adjusting/mounting bolts, 1, and adjust the alternator as needed to obtain proper belt deflection.



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Alternator Output

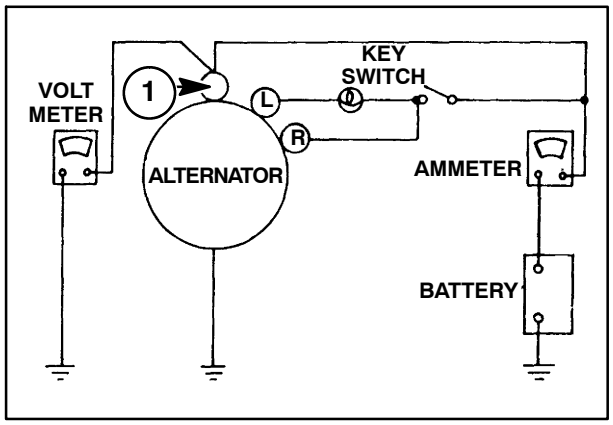
NOTE: *Use the following methods if an alternator/ charging system analyzer is unavailable.*

1. Connect a 50-amp capacity test ammeter between the positive battery cable and the key switch.
2. Connect a voltmeter to the battery terminal, 1, of the alternator and to a ground source.
3. Observe the voltmeter. The meter should indicate battery voltage. If the voltmeter does not read battery voltage, the wiring between the alternator and the battery may be faulty and should be repaired or replaced. If the battery voltage reading is correct, proceed to the next step.

⚠ WARNING ⚠

Do not attempt to start the engine without first shorting the wires between the ammeter leads. Otherwise, injury or damage to charging and testing components may occur.

4. Use a jumper wire to short the test ammeter leads and start the tractor engine.
5. After the tractor engine is started, remove the jumper wire between the test leads of the ammeter.
6. Increase the engine speed to approximately 2000 RPMs and observe the ammeter reading.
7. If the ammeter indicates 5 amps or less, observe the voltmeter reading. The voltmeter is indicating adjusting voltage, which is the amount of increased voltage the alternator supplies to the battery. The reading should indicate a higher voltage than what is indicated when voltage is taken at the battery. If the reading is not higher, the alternator is not generating enough voltage and a component may be malfunctioning.
8. If the ammeter indicates more than 5 amps, continue to charge the battery until the ammeter reading falls below 5 amps. If the reading does not fall below 5 amps, test the battery or replace the battery with one that is fully charged.



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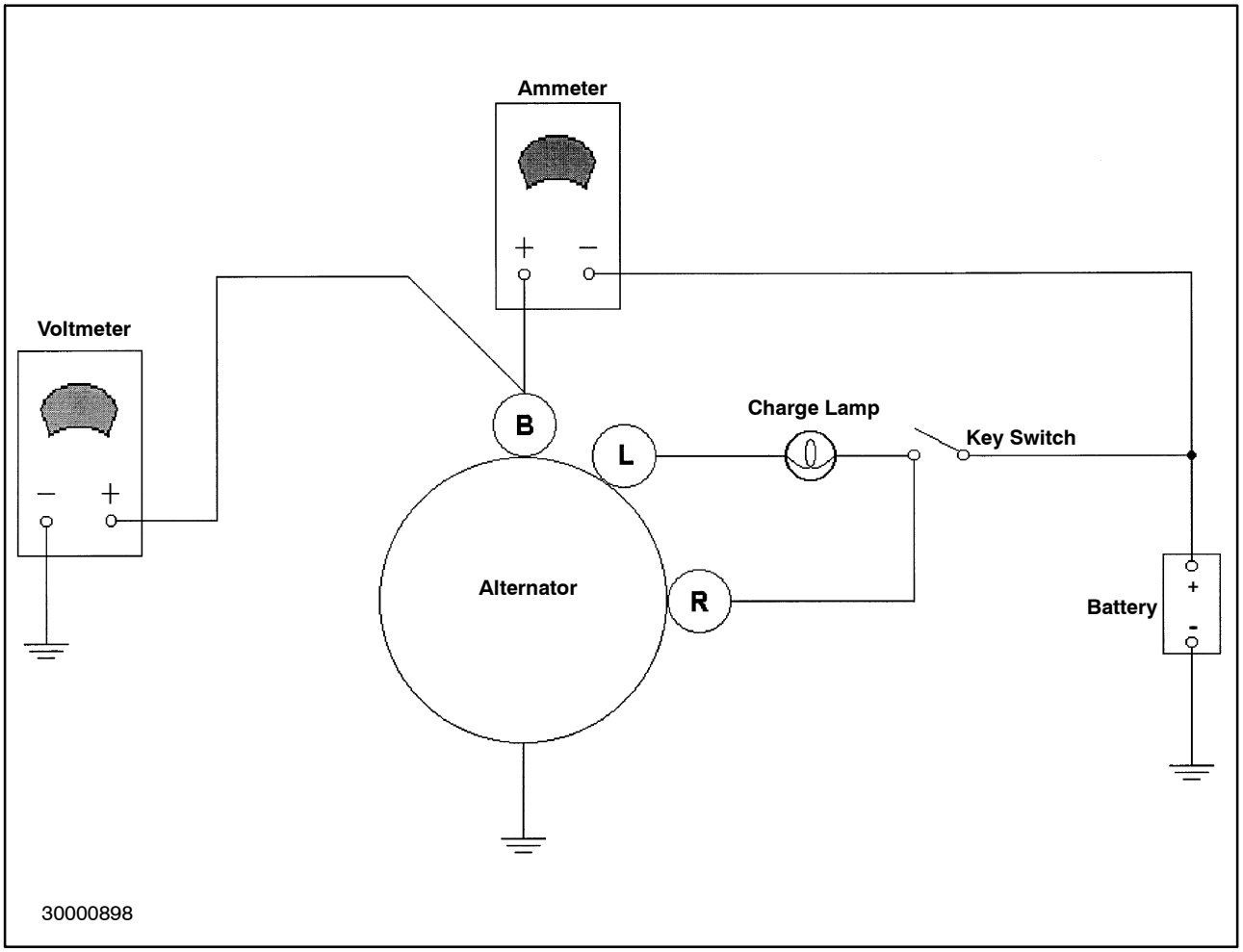
NOTE: *bench testing the alternator will achieve the best results for the following test. (See alternator bench testing).*

9. If the previous test was satisfactory, open the key switch (OFF) and connect an ammeter between the battery terminal, "B", of the alternator and the battery wire, as shown.
10. Connect the positive (+) lead of a voltmeter to the "B" terminal on the alternator. Connect the negative (-) lead to a suitable ground. Confirm that the voltmeter indicates battery voltage.
11. Apply the parking brake and start the tractor engine. Turn on all 12-volt powered accessories such as the headlight and indicator lights. Immediately raise engine RPMs to 2000 or more and record the maximum value indicated on the ammeter.
12. If the amperage value is more than 70% of the nominal alternator output as described in alternator specifications, the alternator is considered to be working satisfactorily.

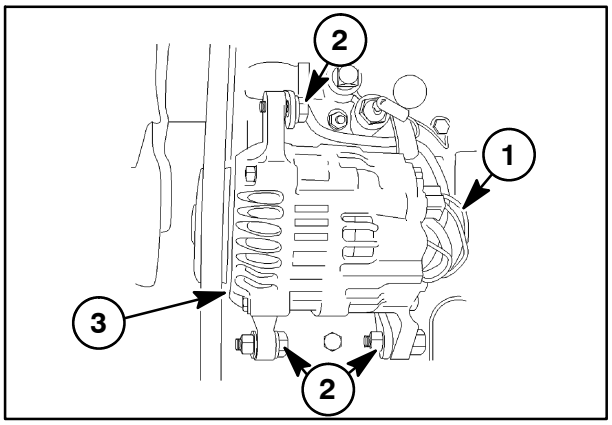


6

ALTERNATOR

Removal

1. Disconnect the negative (-) battery cable from the battery.
2. Disconnect all wiring, 1, from the rear of the alternator.
3. Loosen the alternator mounting bolts, 2, and remove the V-belt, 3, from the alternator drive pulley.
4. Remove the alternator mounting bolts, 2, and remove the alternator from the tractor engine.



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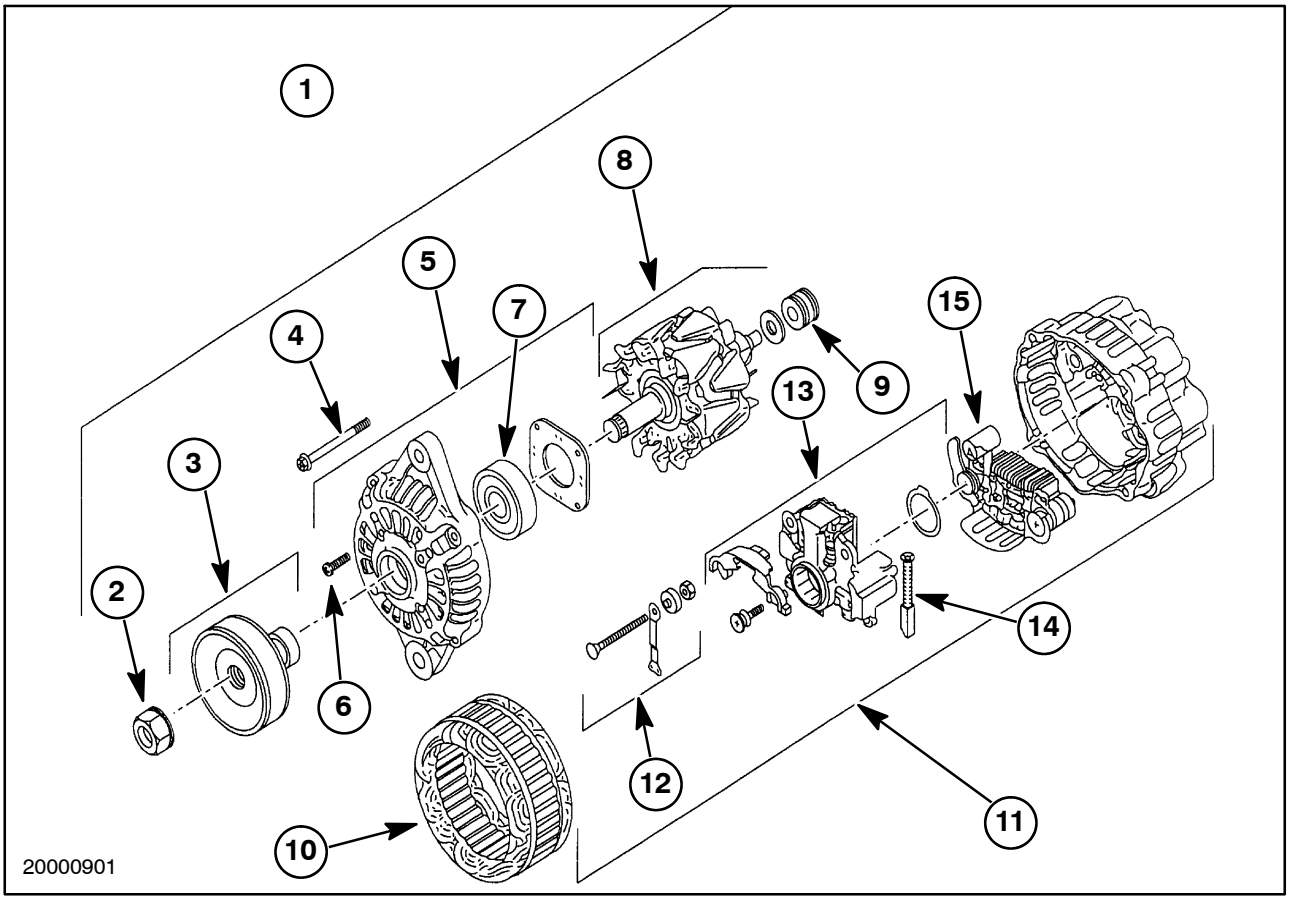
Disassembly

1. Mark the front alternator frame, 5, the rear alternator frame, 11, and the stator, 10, with scribe marks to insure that the alternator is assembled as taken apart.



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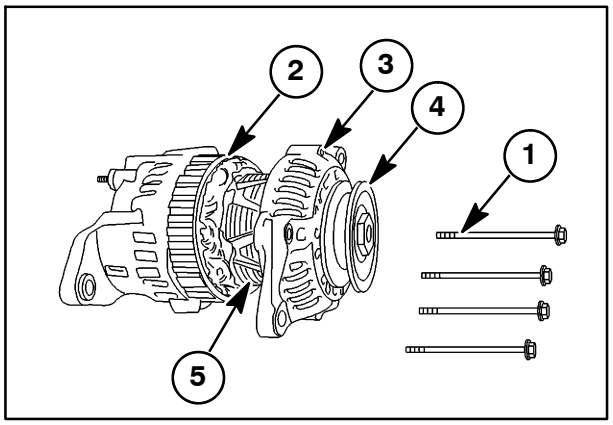
1. Alternator Assembly
2. Nut
3. Pulley Assembly
4. Set Screw
5. Cover Assembly
6. Set Screw
7. Ball Bearing
8. Rotor Assembly
9. Ball Bearing
10. Stator
11. Cover Assembly
12. Terminal Set
13. Regulator
14. Brush Spring
15. Rectifier Assembly

2. Remove the four (4) alternator frame retaining bolts, 1.
3. Carefully separate the front frame, 3, and the rear frame and stator, 2. The rotor assembly, 5, and pulley, 4, will be removed with the front frame, 3.



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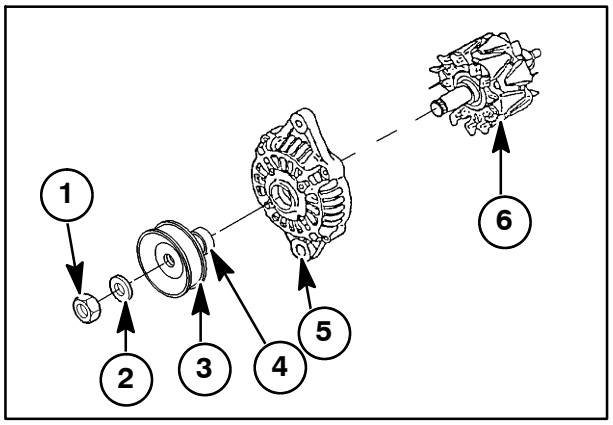
4. To remove the pulley nut, 1, use an impact wrench or place the rotor, 6, into a soft jaw vice and use a wrench. Remove the washer, 2, pulley, 3, spacer, 4, and front frame, 5, from the rotor, 6.



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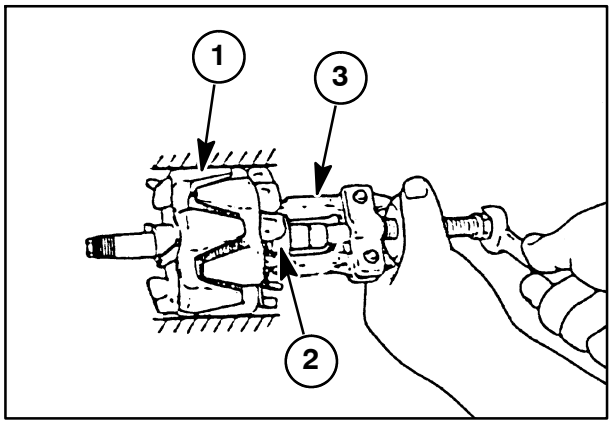
NOTE: *When removing the rear rotor bearing from the rotor, be sure to apply even pressure to the rotor assembly.*

5. The rear rotor bearing, 2, may be removed from the rotor, 1, by using a bearing puller, 3.



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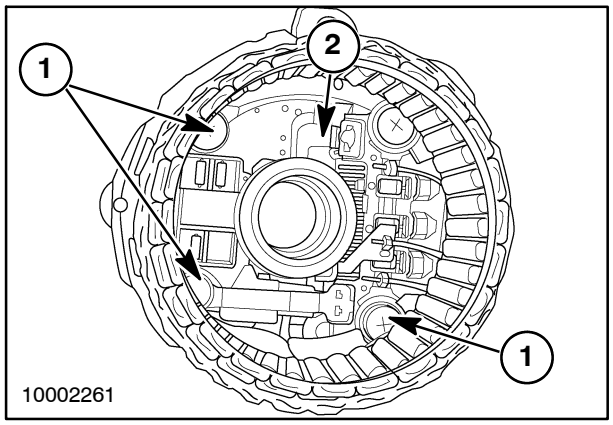
6. Remove the three (3) screws, 1, which secure the regulator/rectifier assembly, 2, to the rear alternator frame.



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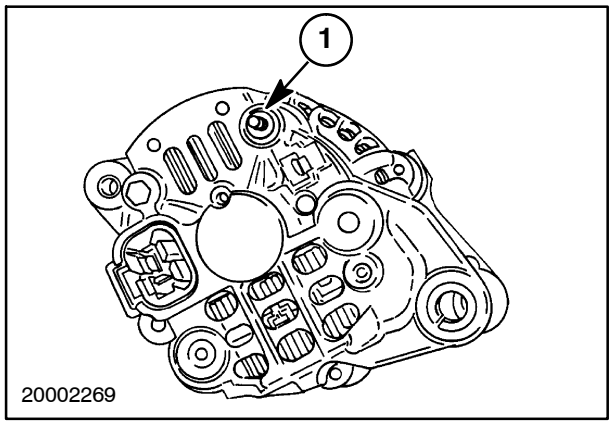
7. Remove the battery terminal nut, 1, from the rear of the alternator frame.
8. Carefully remove the stator and the regulator/rectifier assembly from the rear alternator frame.



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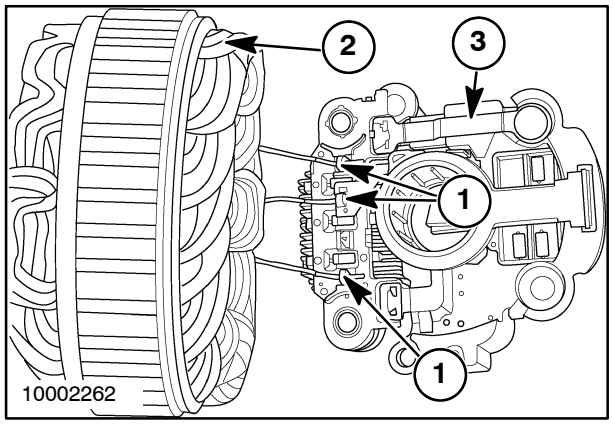
⚠ CAUTION ⚠

Preheat the soldering iron before attempting to unsolder the stator leads or the regulator/rectifier assembly. To avoid damage to the rectifier diodes, use a pair of needle nose pliers to remove excess heat from the area being soldered. Hold the pliers just below the solder joint on the rectifier to remove excess heat. Use a damp cloth to cool the components once they have been separated.

9. Unsolder the three stator leads, 1, and remove the stator, 2, from the rectifier/regulator assembly, 3.



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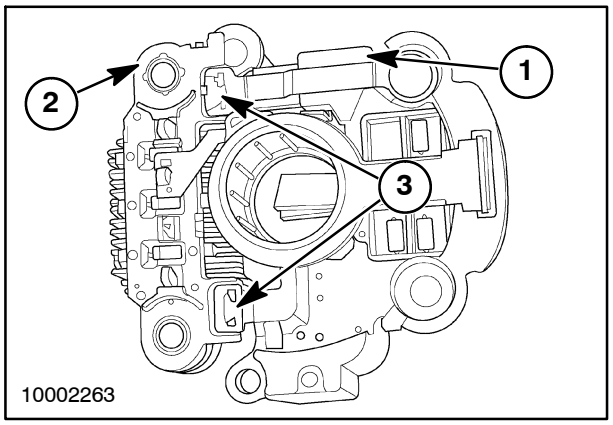
10. Unsolder the IC regulator assembly, 1, from the rectifier assembly, 2, at the solder joints, 3.



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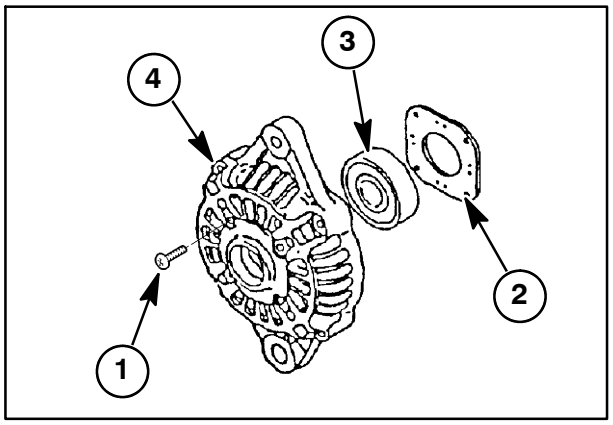
11. Remove the four (4) screws, 1, from the front alternator frame, 4. Remove the retaining plate, 2, and the front rotor bearing, 3.



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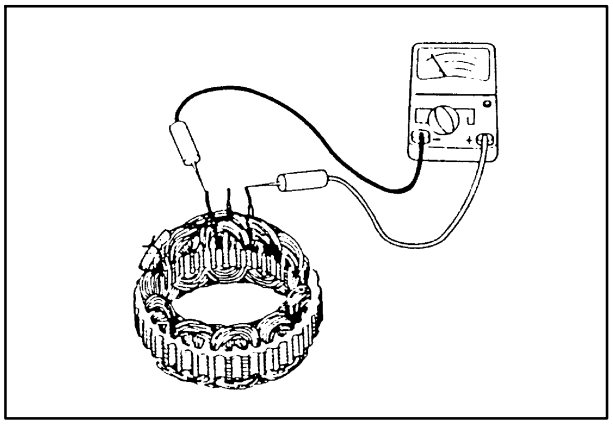
Testing and Inspection

Stator

1. Using an ohmmeter, touch the ohmmeter test probes to different leads of the stator coil.
2. Observe the ohmmeter. The ohmmeter should read a resistance of less than 1 ohm, for each of the phase wires, indicating continuity.
3. If there is no continuity, inspect the lead wire connection for breaks. The lead wire may be repaired with solder if damage is not excessive. If the lead wire is good, the stator coil is faulty and the stator needs replaced.



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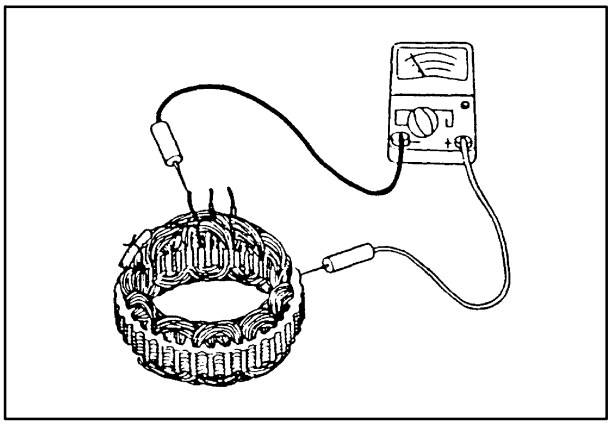
4. Using an ohmmeter, touch one ohmmeter test probe to the stator coil and the other test probe to the stator core.
5. Observe the ohmmeter. Resistance should be high, indicating no continuity between the coil and core. If there is continuity, the stator is defective and needs replaced.



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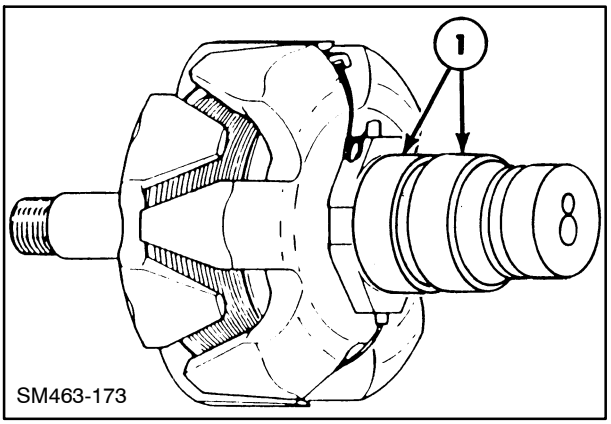
Rotor

1. Inspect the rotor brush contacts, 1, for pitting, roughness, and dirt. If necessary, use # 600 grit fine sandpaper to clean dirt off of the contacts. If the contacts are pitted or damaged excessively, replace the rotor.



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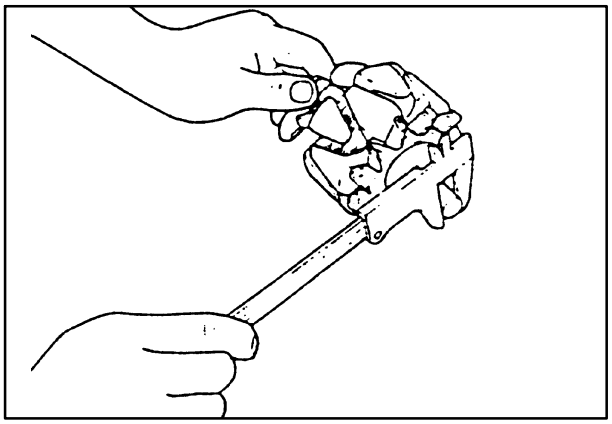
2. Use a suitable measuring device to determine the outer diameter of each brush contact. The minimum outer diameter of the brush contacts is 22.1 mm (0.871 in.).



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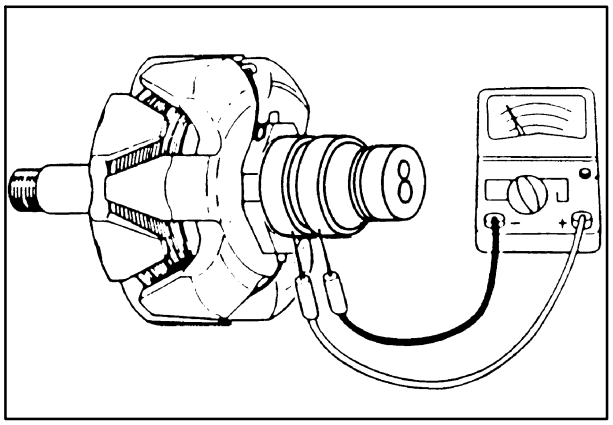
3. Using an ohmmeter, touch one ohmmeter test probe to a brush contact. Touch the other test probe to the remaining brush contact.
4. Observe the ohmmeter. The ohmmeter resistance reading should be approximately 3 ohms. If the reading is not as specified, the rotor is defective and needs replaced.



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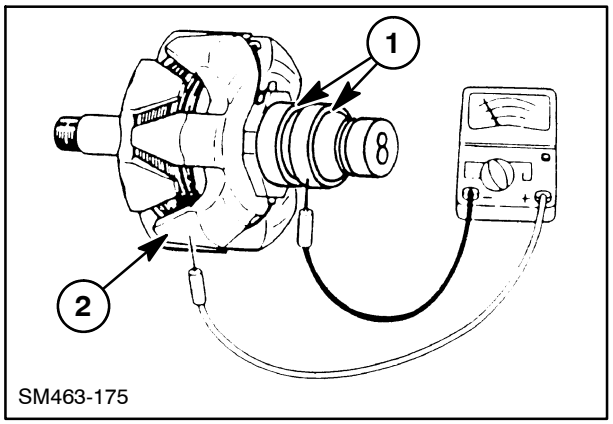
NOTE: *When testing the resistance between the brush contacts and rotor poles, be sure that the ohmmeter test probe touching the rotor pole is not insulated by paint.*

5. Using an ohmmeter, touch one ohmmeter test probe to one of the rotor brush contacts, 1, and the other test probe to one of the rotor poles, 2.
6. Observe the ohmmeter. Resistance should be high, indicating no continuity between the rotor poles and brush contacts. If there is continuity, the rotor is defective and needs replaced.



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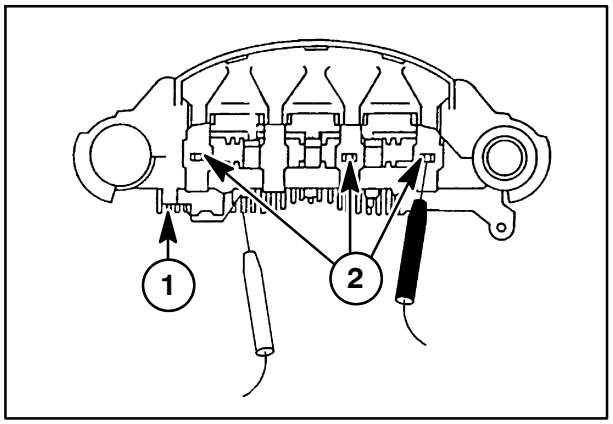
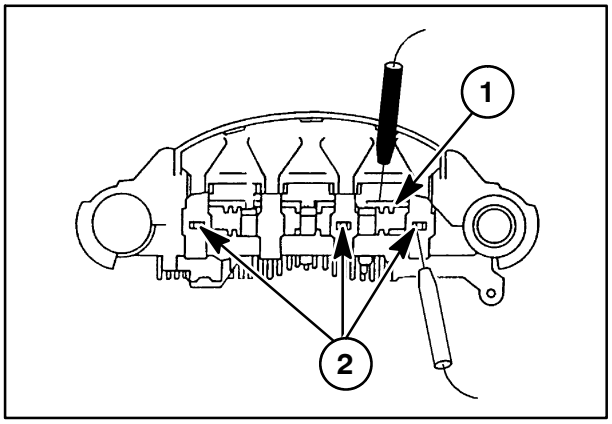
Rectifier Assembly

1. Using an ohmmeter, touch the positive (+) test probe to the positive (+) portion of the diode plate, 1, and the negative (–) test probe to the other test probe to a stator coil lead connection terminals, 2.
2. Observe the ohmmeter for continuity.
3. Now switch the positions of the test probes and observe the ohmmeter for continuity. The ohmmeter should indicate continuity in one direction only. If there is continuity in both directions or no continuity at all, the rectifier assembly is defective and needs replaced.



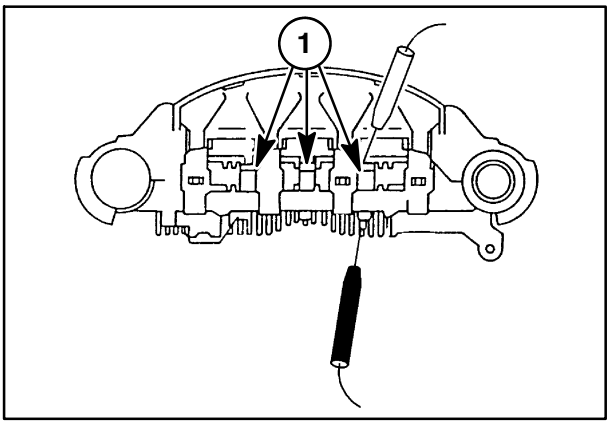
23

4. Using the same procedure described in the three previous steps, test the diodes between the negative (–) portion of the diode plate, 1, and the stator lead connections, 2. Again, replace the rectifier assembly if the diodes test defective.



24

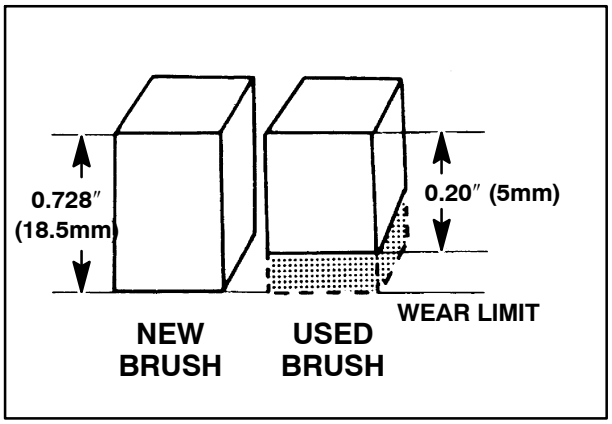
5. Test each of the three small diodes, 1, by touching the positive (+) ohmmeter test probe to one end of a diode and the negative (–) test probe to the opposite end of the diode.
6. Observe the ohmmeter for continuity.
7. Now switch the positions of the test probes and observe the ohmmeter for continuity. The ohmmeter should indicate continuity in one direction only. If there is continuity in both directions or no continuity at all, the rectifier assembly is defective and needs replaced.



25

Alternator Brushes

1. Carefully clean the alternator brushes with a soft, dry cloth and electrical component cleaner, if available.
2. Inspect the brushes and brush springs for corrosion, damage, stretched springs, or a damaged brush holder. If damaged, replace the brush assembly.
3. Use a suitable measuring device to measure brush wear. The minimum brush length is 5 mm (.020 in.). If either brush is worn beyond specifications, replace the brush assemblies.



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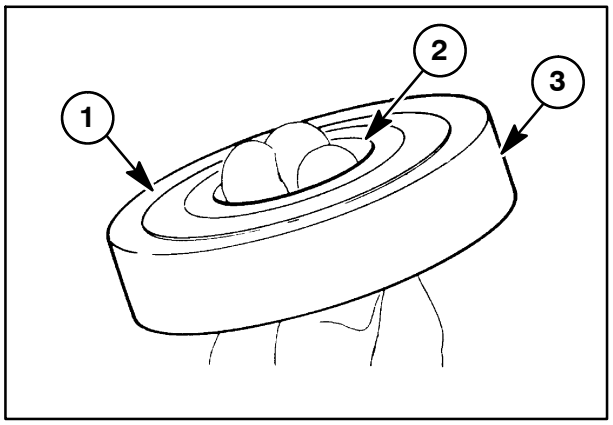
Alternator Bearings

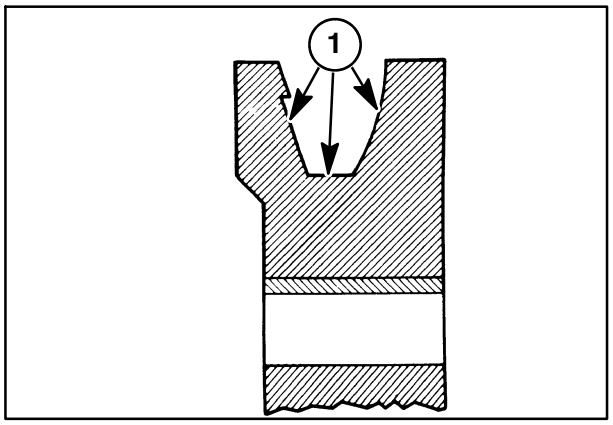
1. Inspect the alternator bearings for smooth operation by spinning the bearing. Replace bearings that are rough and do not rotate smoothly.
2. Inspect the bearings for grease leakage between the bearing seal, 3, and races, 1, 2.
3. Inspect the inner race, 1, and the outer race, 2, for signs of spinning in the alternator frame or on the rotor shaft.
4. Replace bearings that are damaged in any way.



27

Drive Pulley

1. Inspect the drive pulley for a worn, bent, cracked, or otherwise damaged belt groove, 1.
2. A polished surface in the bottom of the belt groove indicates a worn pulley.



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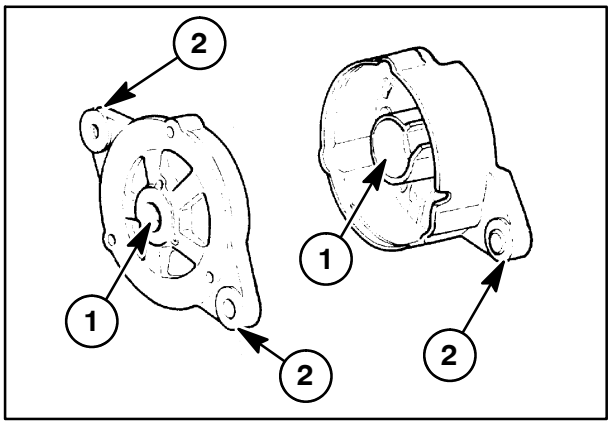
Alternator Frames

1. Inspect the bearing housing bores, 1, for scoring, cracks or evidence that the bearing was spinning inside the bore.
2. Inspect the frames for cracked or broken mounting bosses, 2, or any other distortion or damage.

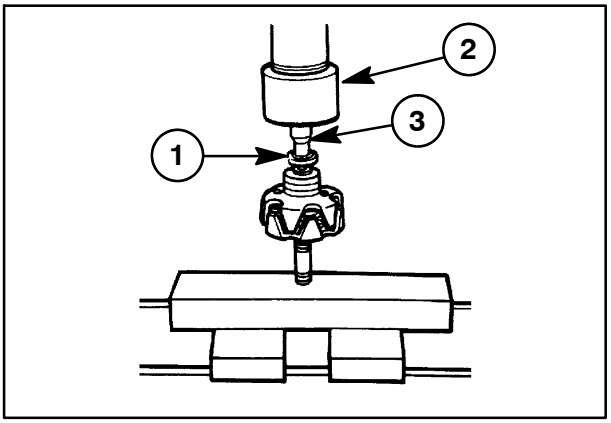


29

Assembly

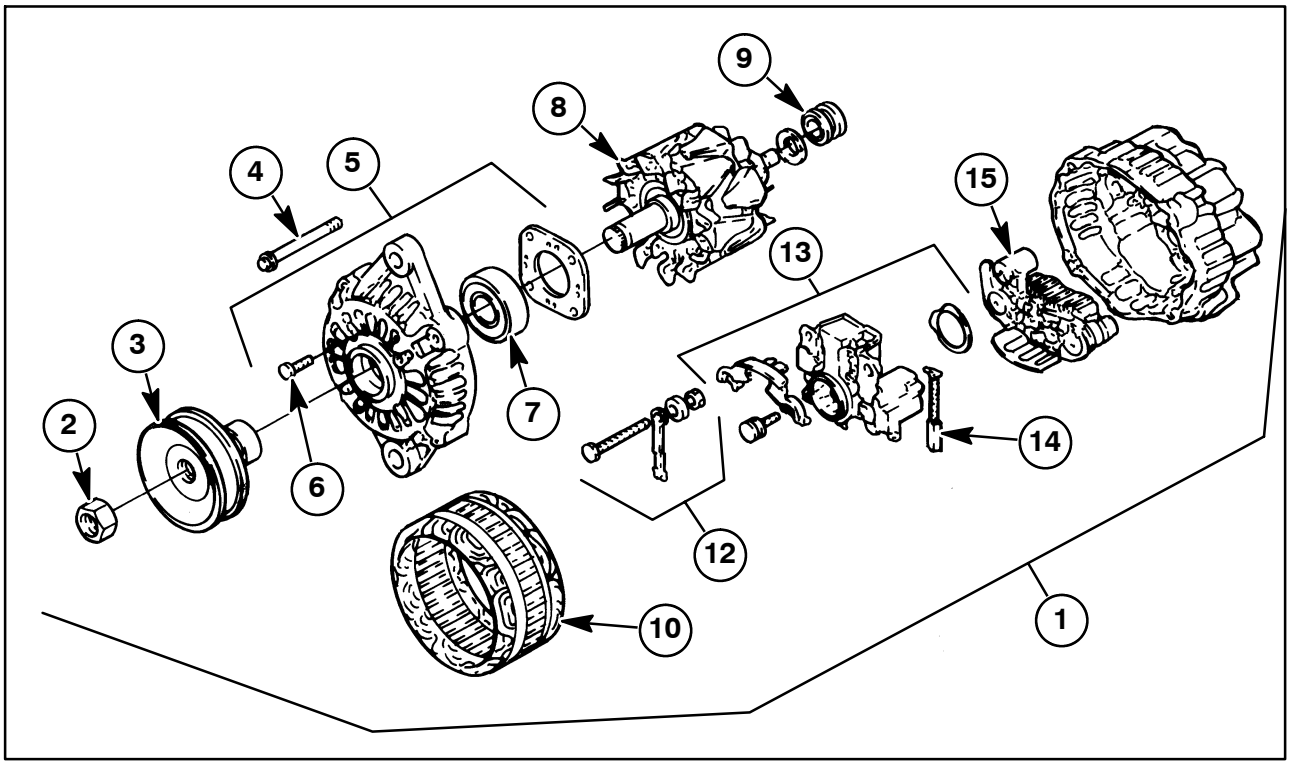
NOTE: *When installing the rear rotor bearing, be sure that top sleeve used to press the bearing onto the rotor contacts the inner race of the bearing only.*

1. Install the rear rotor bearing, 1, and spacer onto the rotor by using a press, 2, and two sleeves, such as tubing or 15 mm deep sockets, 3. The bottom sleeve will support the rotor as the top sleeve presses the rear bearing spacer onto the rotor.



30

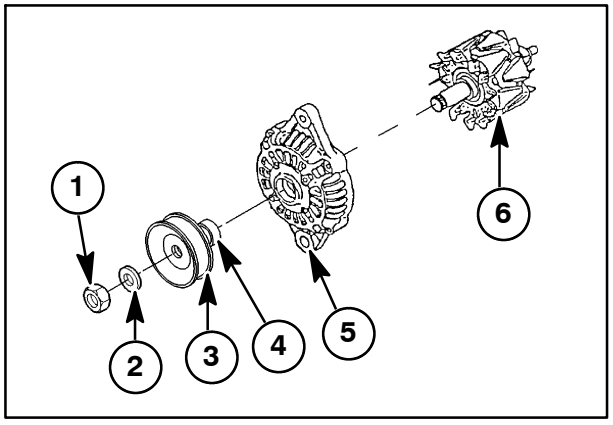
2. Install the front rotor bearing, 3, and front bearing retaining plate, 1, into the front alternator frame, 4, and secure using the four (4) retaining screws, 2.



31

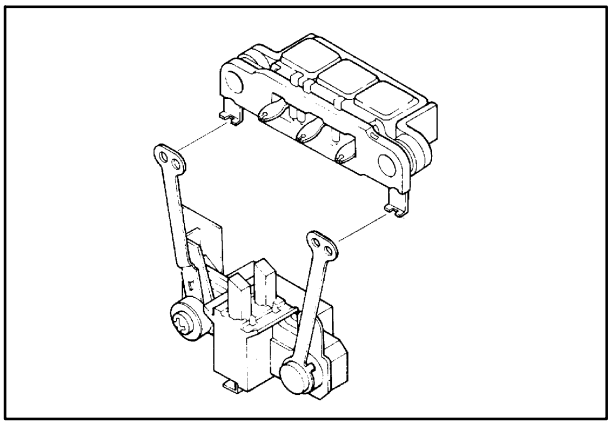
1. Alternator Assembly
2. Nut
3. Pulley Assembly
4. Set Screw
5. Cover Assembly
6. Set Screw
7. Ball Bearing
8. Rotor Assembly
9. Ball Bearing
10. Stator
11. Cover Assembly
12. Terminal Set
13. Regulator
14. Brush Spring
15. Rectifier Assembly

3. Install the washer, 2, pulley, 3, spacer, 4, and front frame, 5, onto the rotor, 6.
4. To install the pulley nut, 1, use an impact wrench or place the rotor, 6, into a soft jaw vice and use a wrench to tighten the pulley assembly to the rotor.



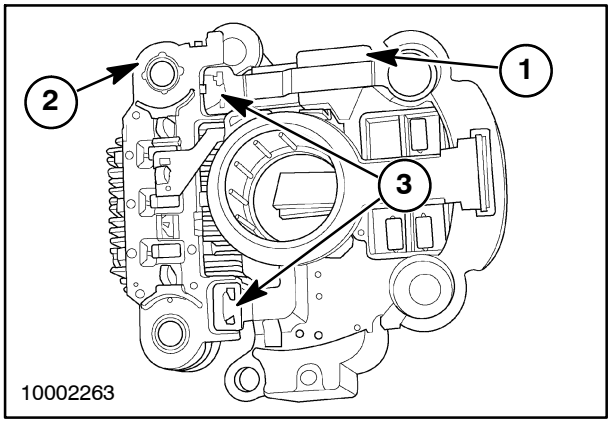
32

5. Use the following guidelines when soldering alternator components.
   - Clean all terminals to be soldered and remove excess solder.
   - Preheat the soldering iron and use rosin-core solder to solder terminals and/or wires. To avoid damage to the rectifier diodes, use a pair of needle nose pliers to remove excess heat from the area being soldered. Hold the pliers just below the solder joint on the rectifier to remove excess heat.
   - Make good, solid, solder joints for best alternator performance.
   - After soldering, quickly cool the solder joint with a damp cloth.



33

6. Solder the IC regulator, 1, and rectifier, 2, together at the solder joints, 3



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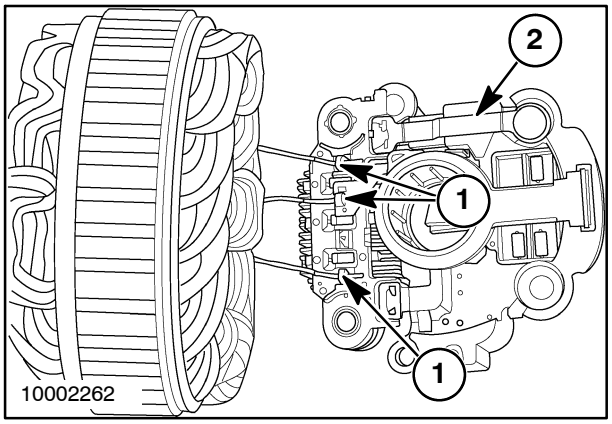
7. Solder the stator leads, 1, to the terminals on the rectifier/regulator assembly, 2.



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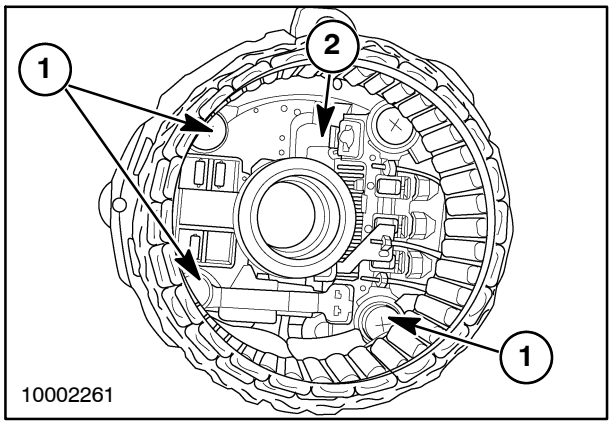
NOTE: *Secure the regulator/rectifier assembly to the rear alternator frame before pressing the stator into the rear frame.*

8. Secure the regulator/rectifier assembly, 2, to the rear alternator frame using the three (3) retaining screws, 1. Manually press the stator assembly into the rear alternator frame.



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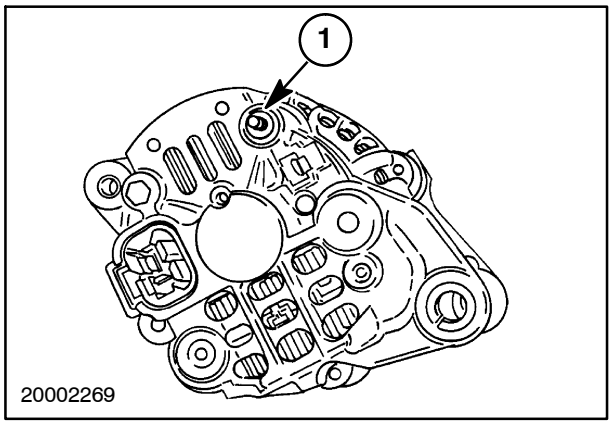
9. Install the battery terminal nut, 1, to the rear of the alternator frame.



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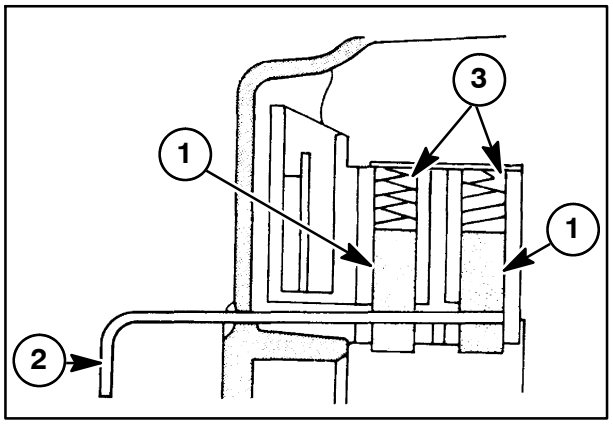
10. Push the brushes, 1, and springs, 3, into the brush holder and insert a piece of wire, 2, through the rear of the alternator frame and into the brush holder to hold the brushes out of the way while the alternator halves are being assembled.



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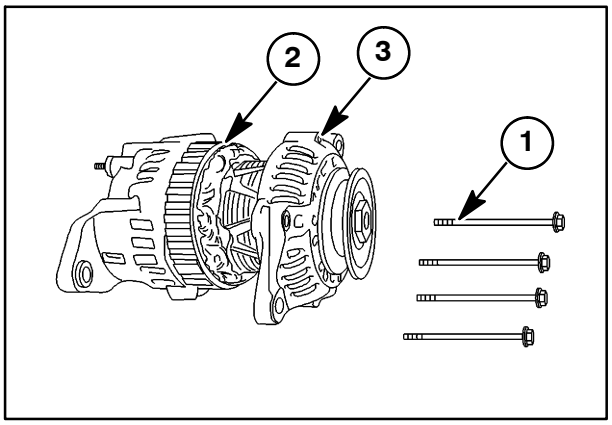
11. Assemble the front alternator frame, 3, and rear alternator frame, 2, together. Be sure to align the scribe marks made when the alternator was disassembled to insure proper reassembly. Use the four (4) bolts, 1, to secure the front and rear frames together.



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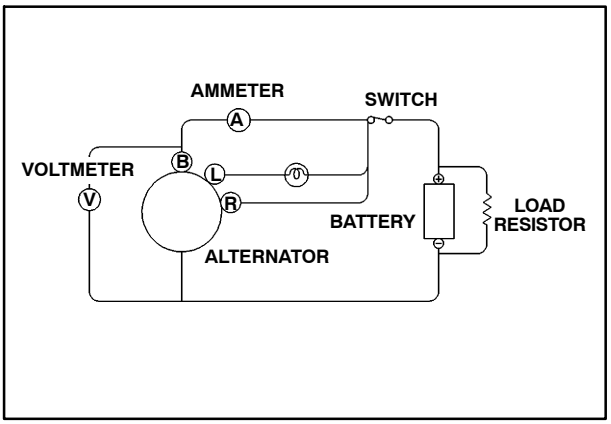
ALTERNATOR BENCH CHECK

1. Connect the alternator to a testing circuit, as shown. Set the load resistance to zero (0).

NOTE: *Alternator rotation direction is clockwise, as viewed looking at the pulley.*

2. Slowly increase the alternator rotational speed and observe the voltage reading indicated on the voltmeter.
3. If the voltage is uncontrolled when increasing alternator speed and increases above 15.5 volts, disassemble and check the alternator for malfunctioning components.
4. If the voltage reading is below 15.5 volts, set alternator's rotational speed to 2500 RPM and set the load resistance to achieve maximum output from the alternator.
5. If the amperage value is more than 70% of the nominal alternator output as described in alternator specifications, the alternator is considered to be working satisfactorily.



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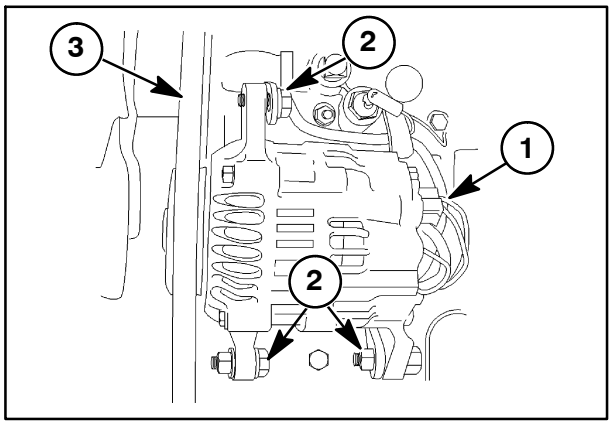
Installation

1. Align the alternator with the alternator mounting holes located on the engine block and brackets. Use the adjusting/mounting bolts, 2, to secure the alternator to the mounting brackets. Be sure to install the V-belt, 3, into the drive pulley.
2. Connect all wire terminals, 1, to rear of the alternator.



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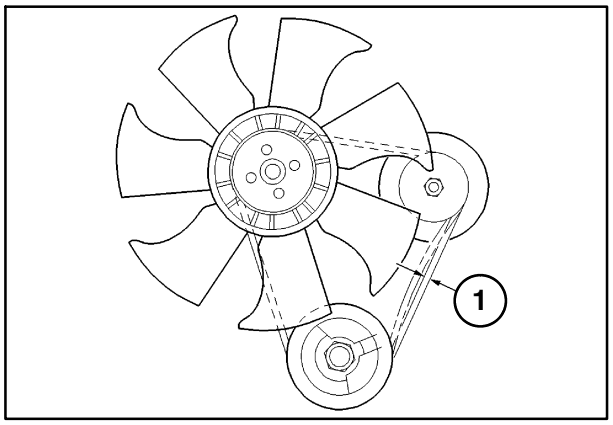
3. Adjust the alternator drive belt deflection by loosening the mounting bolts and moving the alternator into or away from the engine block. Belt deflection should be 10 - 15 mm (0.39 - 0.59 in.) when applying 9 - 11 kg (20 - 25 lb.) of force between the crank pulley and the alternator pulley, 1.



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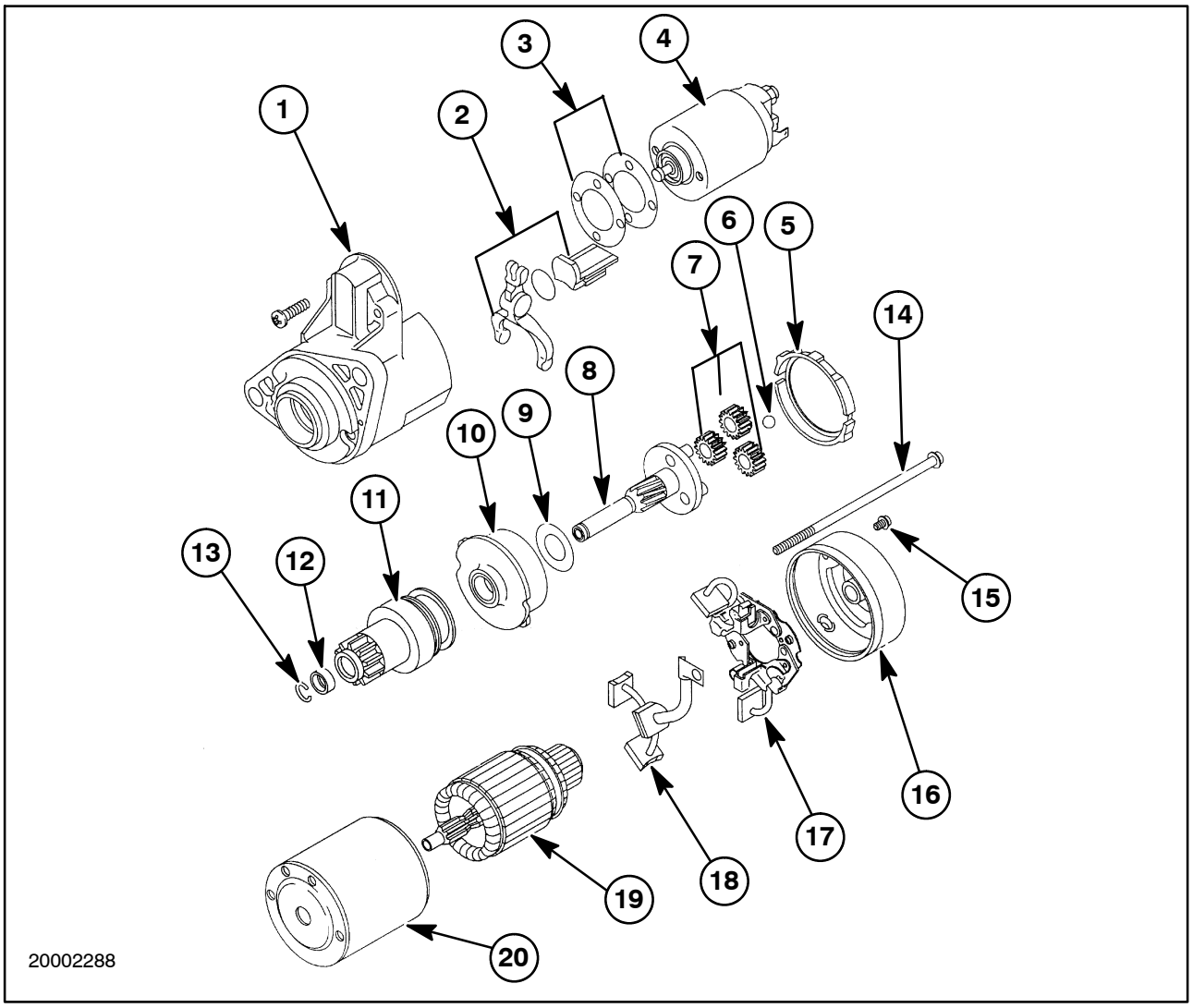
SPECIFICATIONS – STARTER MOTOR

Manufacturer	Mitsubishi
Model	M001T66081
Current Draw	
Under Load	300 amps
No Load	110 amps
No Load RPM	2400 RPM min.
No Load Voltage	11 volts
Clutch System	Overrunning Pinion Clutch
Brush Length	
New	17.5 mm (0.689 in.)
Wear Limit	10 mm (0.394 in.)
Brush Spring Tension	1.4 - 2.6 kg (3.1 - 5.7 lb.)
Commutator Diameter	
New	29.4 mm (1.157 in.)
Wear Limit	28.8 mm (1.134 in.)
Commutator Insulation Depth	0.4 - 0.6 mm (0.016 - 0.024 in.)
Armature Runout	
Commutator	0.2 mm (0.008 in.) max.
Armature Shaft	0.05 mm (0.002 in.) max.
Pinion Shaft Movement Limit	0.5 - 2.0 mm (0.020 - 0.080 in.)

DESCRIPTION OF OPERATION - STARTING SYSTEM

Op. 55 201

The TC30 starting system consists of a starter motor equipped with an electromagnetic starter solenoid, a key switch, a start relay, several safety switches, and heavy-duty wiring.



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1. Front starter housing
2. Lever assembly
3. Shims
4. Solenoid
5. Retaining ring
6. Steel ball
7. Planetary gears
8. Pinion shaft
9. Washer
10. Orbital gear
11. Pinion clutch
12. Stop ring
13. Snap ring
14. Through bolt
15. Bolt
16. Brush cover
17. Brush holder
18. Brush set
19. Armature
20. Permanent magnet housing

STARTER MOTOR ASSEMBLY

The starter motor features a reduction mechanism that utilizes a planetary gearing system to achieve torque required to crank the tractor engine. The reduction system is compromised of an orbital gear, three planetary gears, a gear shaft with an overrunning clutch, and an armature gear.

The starter uses permanent magnets for magnetic field induction. The magnetic field is produced from six magnets that are mounted in the yoke. The magnets are positioned according to polarity.

The magnets are not removable from the yoke.

STARTER SOLENOID

The starter solenoid is mounted on top of the starter motor assembly. The solenoid incorporates two coils, a pull-in coil and a hold-in coil. When the key switch is turned to the “START” position and the safety start relay is closed (safety switches closed), current from the battery will energize the solenoid’s two coils. With the coils energized, the solenoid attracts the plunger, which is attached to a fork. The fork pushes the pinion gear out to engage the flywheel. At the same time, a set of contacts on the solenoid become closed, allowing current to flow to the starter motor. Closing the contacts also supplies current to both ends of the solenoid pull-in coil, which makes the coil become inoperative. The hold-in coil continues to engage the pinion gear with the flywheel.

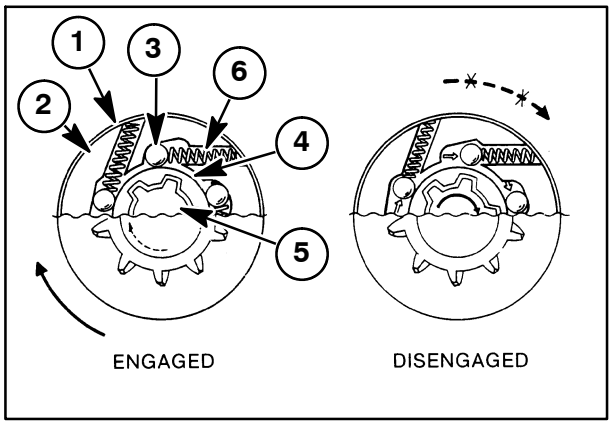
PINION CLUTCH

To prevent the engine from driving the starter motor once the engine is running, the pinion is equipped with an overrunning clutch. The clutch will disengage the pinion gear from the rest of the starter components once the engine has been started and the key switch is in the “START “ position.

The clutch consists of an outer shell, 1, a cam with tapered notches, 2, rollers, 3, roller springs, 6, a splined pinion collar/tube that acts as a clutch hub, 4, and the pinion shaft, 5. As the starter motor engages and rotates, the rollers are locked against the pinion collar with the tension provided by the roller springs. While the rollers are locked, the clutch assembly is locked, allowing the pinion gear to rotate the flywheel. When the engine starts, the flywheel moves faster than the starter motor and this causes the rollers to become unlocked. With the rollers unlocked, the clutch assembly is unlocked, allowing the pinion gear and shaft to turn independently of the starter motor.

The clutch is not serviceable and is replaced as a complete assembly.

Once the engine is started and the key switch is released from the “START” position, the solenoid’s pull in coil becomes energized, pulling the solenoid plunger in, which disengages the pinion from the flywheel.



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1. Clutch Gear - Outer Shell
2. Cam
3. Roller
4. Spline Tube - Inner (Pinion Collar)
5. Pinion Shaft
6. Roller Spring

TROUBLESHOOTING – STARTER MOTOR

PINION SHAFT FAILS TO ADVANCE

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Open circuit, battery, and switch terminal connections	Repair or replace
	Open circuit, fuse	Replace fuse
Key switch	No contact	Repair or replace
Starter motor	Sleeve bearing burnt out	Repair or replace
	Lever broken	Replace
Solenoid	Plunger movement defective or coil open or shorted	Repair or replace

PINION MOTOR ROTATES BUT NO ROTATION TRANSMITTED TO ENGINE

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Starting motor	Clutch defective	Replace
	Orbital gear or planetary gears damaged	Replace

MOTOR ROTATES BEFORE PINION MESHES WITH RING GEAR

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Starter motor	Shift lever damaged	Replace
	Slip ring defective	Replace
	Pinion teeth worn	Replace
	Pinion push out position defective	Adjust
Engine	Ring gear worn	Replace
Solenoid	Solenoid defective	Replace

PINION MESHES WITH RING GEAR BUT STARTING MOTOR FAILS TO TURN

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Line connecting solenoid to battery broken or defective ground	Repair or replace
	Lead wire connecting solenoid to motor tightened improperly	Repair or replace
Starting motor	Ball bearing locked	Replace
	Brush worn	Replace
	Improper installation	Reinstall
	Brush spring defective	Replace
	Commutator dirty	Clean
	Armature of field coil defective	Repair or replace
	Field coil-to-brush connection defective	Replace
Solenoid	Contact not touching properly	Replace
	Contact contacting surface roughened	Replace
Battery	In discharge state	Recharge or replace

MOTOR FAILS TO STOP AFTER ENGINE STARTS AND KEY SWITCH IS TURNED OFF

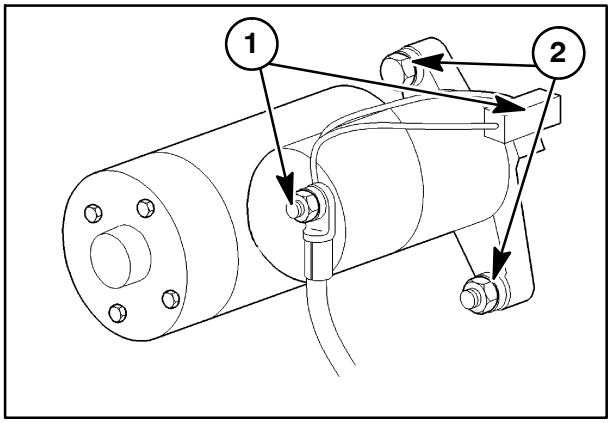
FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Key switch	Switch defective	Replace
Solenoid	Solenoid defective	Replace

TESTING AND OVERHAUL - STARTER MOTOR

STARTER MOTOR

Removal

1. Remove the wiring harness connections, 1, from the starter motor.
2. Remove the two (2) bolts, 2, which secure the starter motor to the tractor engine.



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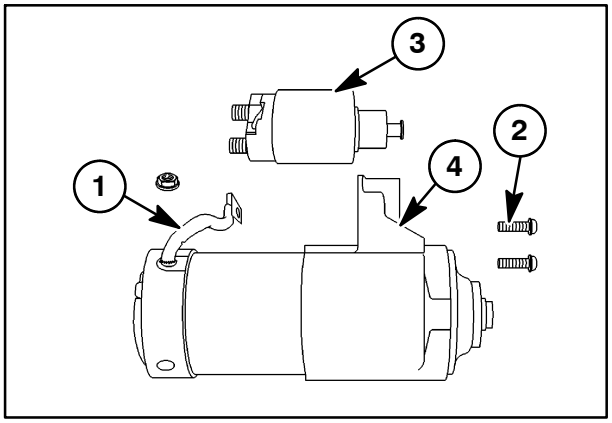
Disassembly

⚠ CAUTION ⚠

When disassembling the starter motor, do not clamp the starter in a vice or strike with a hammer, as the starter may be damaged beyond repair.

NOTE: *before removing the field coil strap, make note of the solenoid terminal the strap is connected to.*



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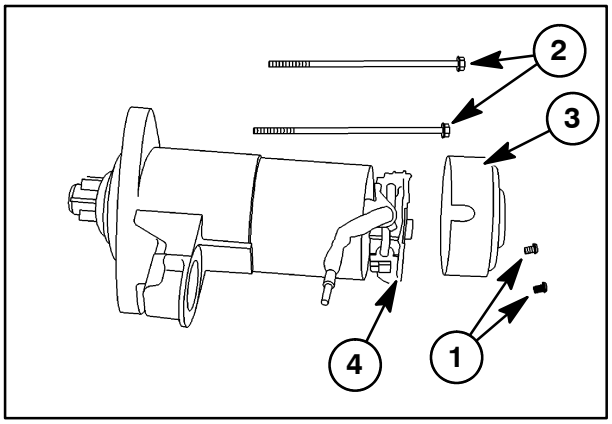
1. Disconnect the field coil strap, 1, from the solenoid, 3.

NOTE: *Before removing the starter solenoid and plunger assembly, 3, scribe aligning marks on the solenoid housing and the starter housing, 4.*

2. Remove the two (2) screws, 2, that secure the solenoid and plunger assembly, 3, to the starter housing, 4.
3. Remove the retaining bolts, 1, holding the brush cover, 3, to the starter assembly.
4. Remove the two (2) long through bolts, 2, from the starter assembly.
5. After the brush cover, 3, is removed from the starter assembly, slide the brush holder, 4, off of the armature commutator.



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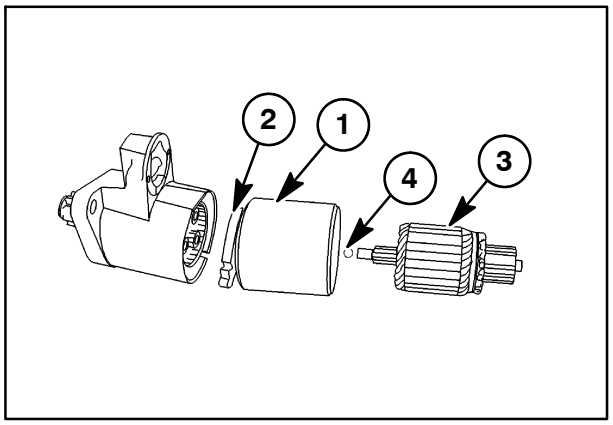
6. Remove the magnet housing, 1, rubber cover, 2, armature, 3, and steel armature ball, 4, from the starter assembly. Be sure not to lose the armature ball.

NOTE: *If removing the bearing from the armature, place the bearing puller on the inner race of the bearing only.*

7. If necessary, the armature bearing may be removed from the armature using a bearing puller.



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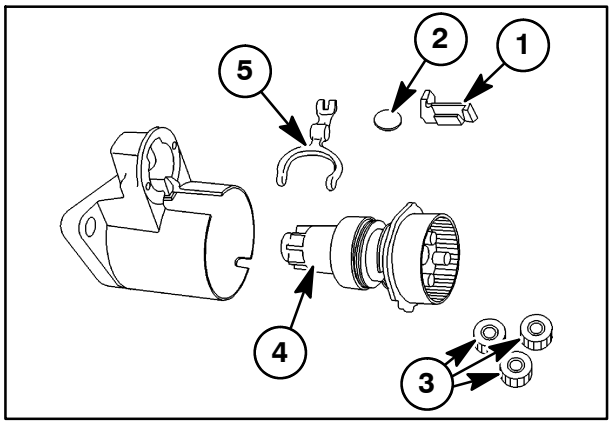
8. Remove the lever packing, 1, and plate, 2, from the starter housing.
9. Remove the planetary, gears, 3, pinion shaft/ clutch assembly, 4, and lever, 5, as a complete assembly from the starter housing.



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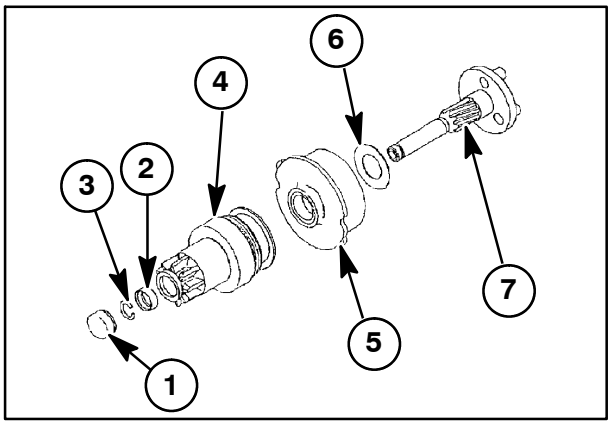
10. To remove the overrunning clutch, 4, from the pinion shaft assembly, 5, 6, 7, remove the plastic cap, 1, from the end of the pinion gear.
11. Slide a piece of appropriately sized metal tubing over the pinion shaft, against the stop ring, 2. Tap the pipe with a hammer to remove the stop ring and expose the snap ring, 3.
12. Remove the tubing and then use snap ring pliers to remove the snap ring, 3.
13. Separate the overrunning clutch from the pinion shaft assembly.



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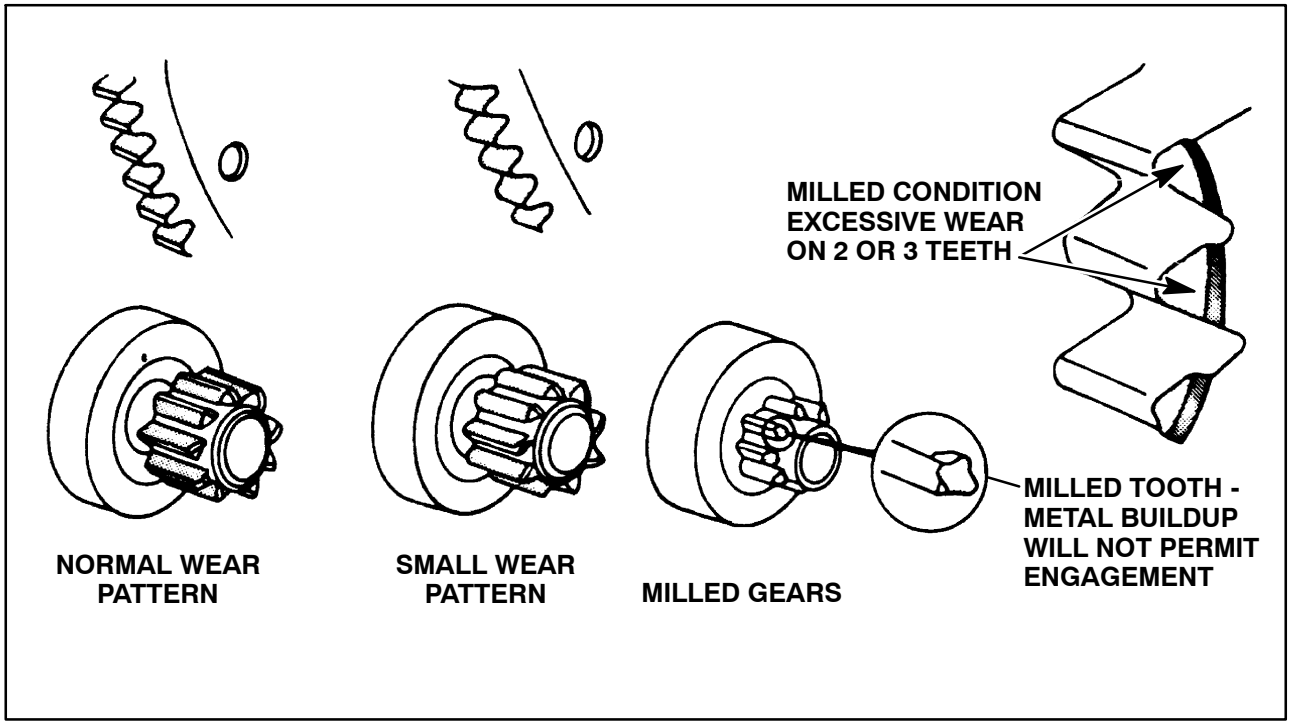
1. Plastic cap
2. Stop ring
3. Snap ring
4. Overunning clutch
5. Internal gear assembly
6. Washer
7. Gear shaft

Inspection

1. Inspect the gear splines on the pinion clutch, the pinion, the armature, the orbital gear, and the planetary gears for damaged or missing splines. Replace any damaged parts.
2. Hold the pinion clutch housing and rotate the pinion. The pinion should rotate smoothly, although not necessarily easily, in one direction only. If the pinion can spin in both directions, the clutch is defective and needs replaced.



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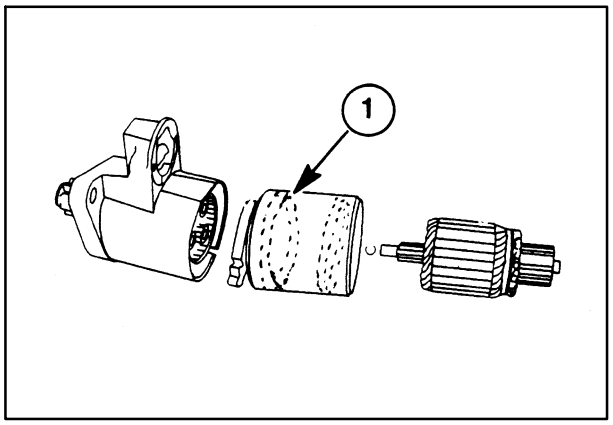
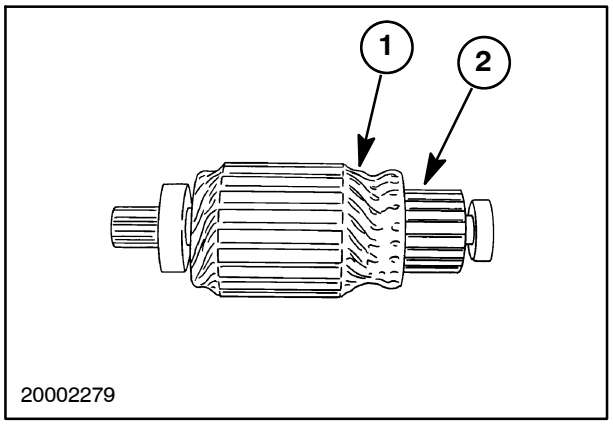
3. Inspect the permanent magnets, 1, for cracks, looseness, or any other damage. Replace the assembly if found to be damaged in any way.
4. Inspect the motor housing, brush cover, and starter housing for damage such as cracks, fatigue, wear, etc. Replace any damaged parts.
5. Inspect the brush terminals, battery terminals, and motor terminals for corrosion, loose connections or damage. Repair or replace any damaged parts.



52

6. Inspect the armature windings, 1, for burnt, broken, or loose connections.
7. Clean and inspect the solenoid plunger contact ring and solenoid contacts. Dirty contacts or pitting may be cleaned with fine grit sandpaper or a fine abrasive pad.
8. Inspect that all bearings rotate freely when rotated manually by hand and are not damaged or have excessive play. Replace any damaged bearings.
9. Inspect the commutator contacts, 2, for burnt segments, indicating an open winding.



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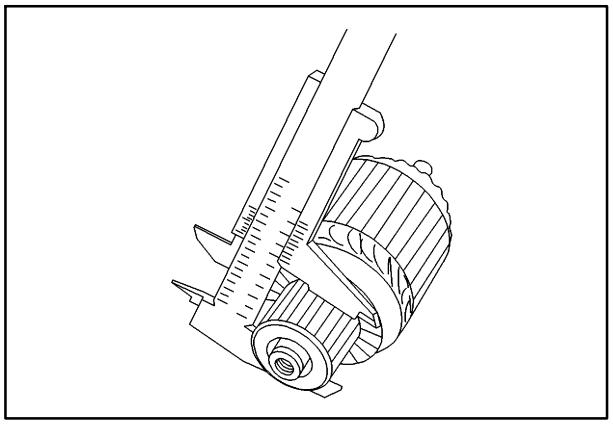
10. Use a suitable measuring device to measure the commutator diameter. The minimum commutator diameter is 28.8 mm (1.134 in.). If the commutator is worn beyond these specifications, replace the armature.



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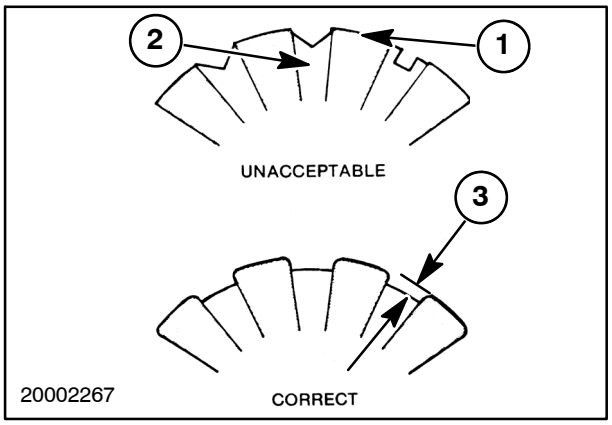
11. Inspect the mica insulating valleys, 2, between the commutator contacts, 1, for uneven wear. Use a suitable measuring device to check the distance, 3, between the top of the contact to the bottom of the insulating valley. The distance should be 0.4 - 0.6 mm (0.016 - 0.024 in.). If the distance is not within these specifications or there is uneven wear, the insulating valleys may be undercut with a suitable file.



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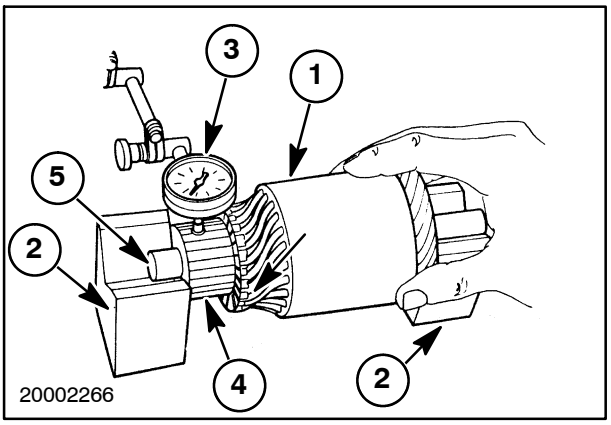
NOTE: *If not previously removed, the armature bearings will need to be removed for this test.*

12. Place the armature, 1, in a set of precision V-blocks, 2, and use a dial indicator, 3, to measure commutator, 4, runout and shaft, 5, runout. Commutator runout should not be more than 0.2 mm (0.008 in.). Shaft runout should not be more than 0.05 mm (0.002 in.).



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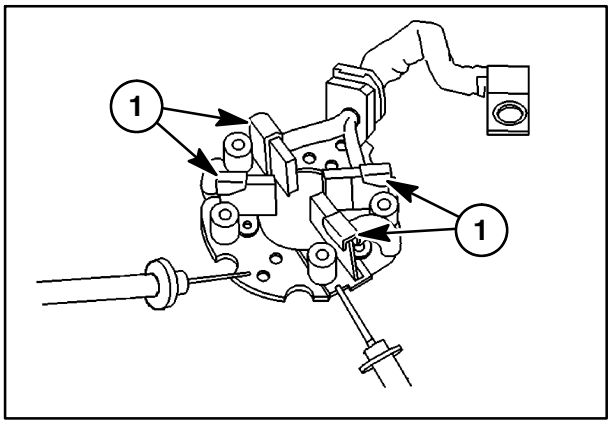
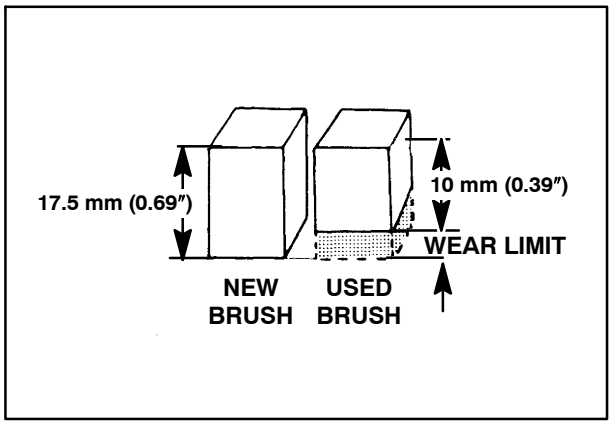
13. Check each of the four brushes, 1, for wear or damage.



57

NOTE: *When measuring the brush length, remove the brush from the brush support and measure the middle portion of the brush.*

14. Use a suitable measuring device to measure the length of the armature brushes. Compare the measurement of each brush with brush length specifications. If the brush is not within specifications or is damaged in any way, replace the brushes.



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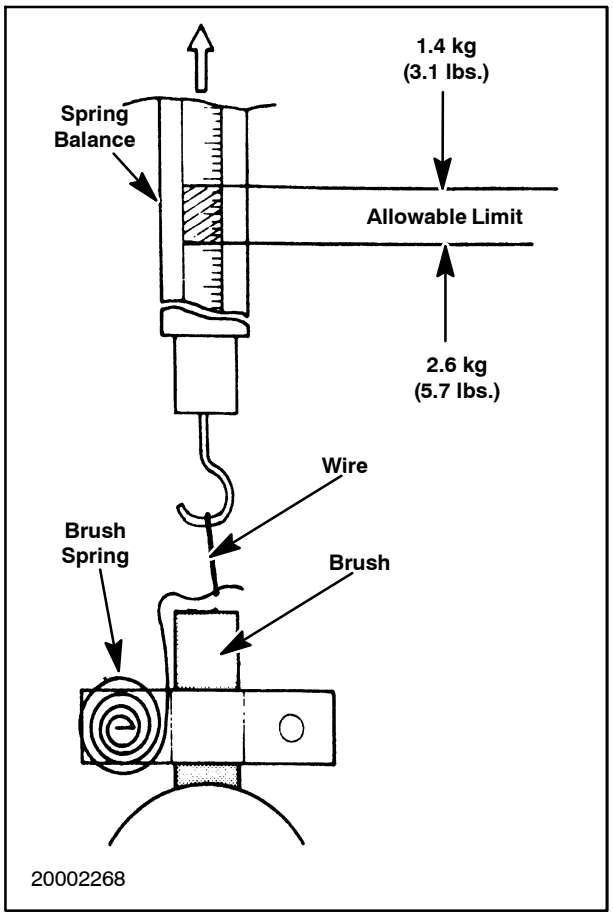
15. Test the brush spring tension by connecting a spring balance to the brush spring and pulling until the spring moves. Observe the reading indicated on the spring balance. If the reading is between 1.4 - 2.6 kg (3.1 - 5.7 lb.), the spring tension is within specifications. Otherwise, replace the brush springs.



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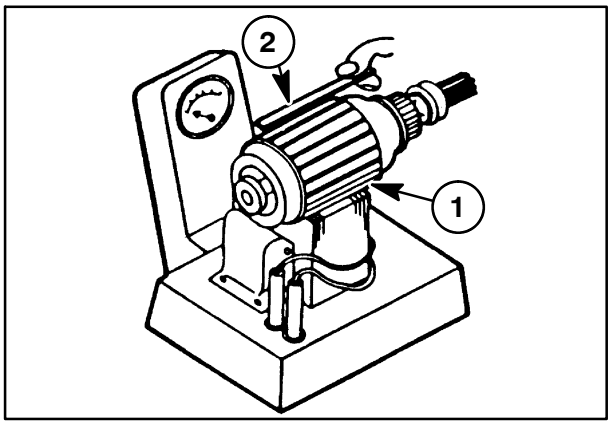
Testing

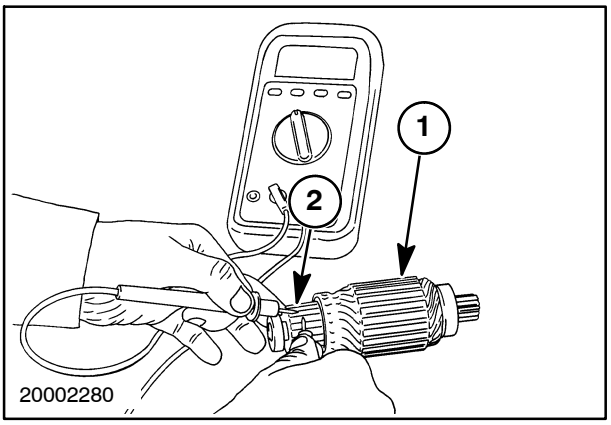
Armature

1. Use a growler, 2, to inspect the armature coil, 1, for short circuits. Replace if the armature is shorted.



60

2. Use an ohmmeter to test for continuity in the armature coil, 1.
3. Touch one ohmmeter test probe to a commutator contact, 2. Touch the ohmmeter test probe to an adjacent commutator contact.
4. Observe the ohmmeter. Repeat the test on each adjacent commutator contact. Little or no resistance indicates that there is continuity and the armature coil is good. High resistance indicates that the armature is defective and needs replaced.



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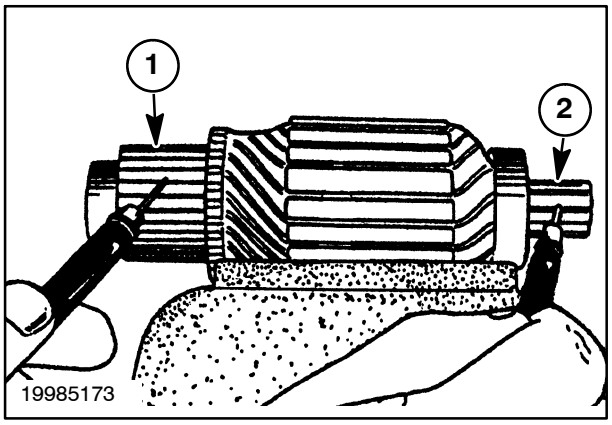
5. If the armature is tested OK, touch one ohmmeter test probe to a commutator contact, 1. Touch the other test probe to the armature shaft, 2.
6. Observe the ohmmeter. A high resistance reading indicates the armature is good. Little or no resistance indicates that the armature is defective and needs replaced.



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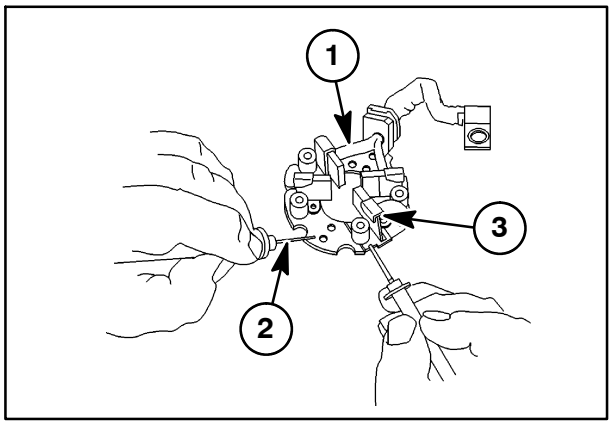
Brush Holder

1. Use an ohmmeter to test the brush holder assembly, 1.
2. Touch one test probe to the insulated brush holder, 3, and the other test probe to the brush holder plate, 2.
3. Observe the ohmmeter. Repeat the test for the opposite insulated brush holder.
4. A reading of high resistance indicates no continuity and the brush holder is good. Little or no resistance indicates that there is continuity and the brush holder is defective and needs replaced.



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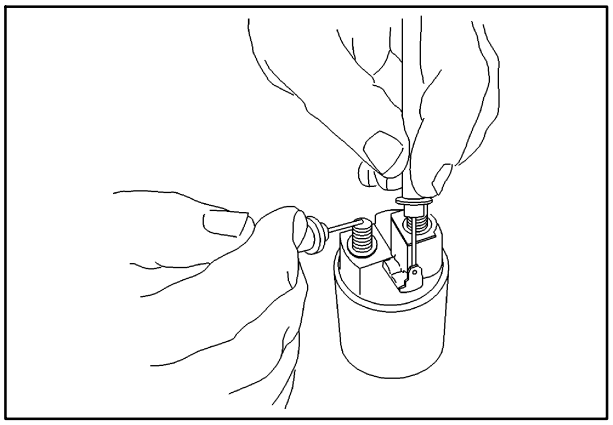
Starter Solenoid

1. Use an ohmmeter to check the starter solenoid for proper operation and continuity.
2. Touch one ohmmeter test probe to terminal “M” of the starter solenoid.
3. Touch the other ohmmeter test probe to the body (ground) of the solenoid.
4. Observe the ohmmeter. There should be little or no resistance, indicating continuity. If there is no continuity, the starter solenoid is defective and needs replaced.



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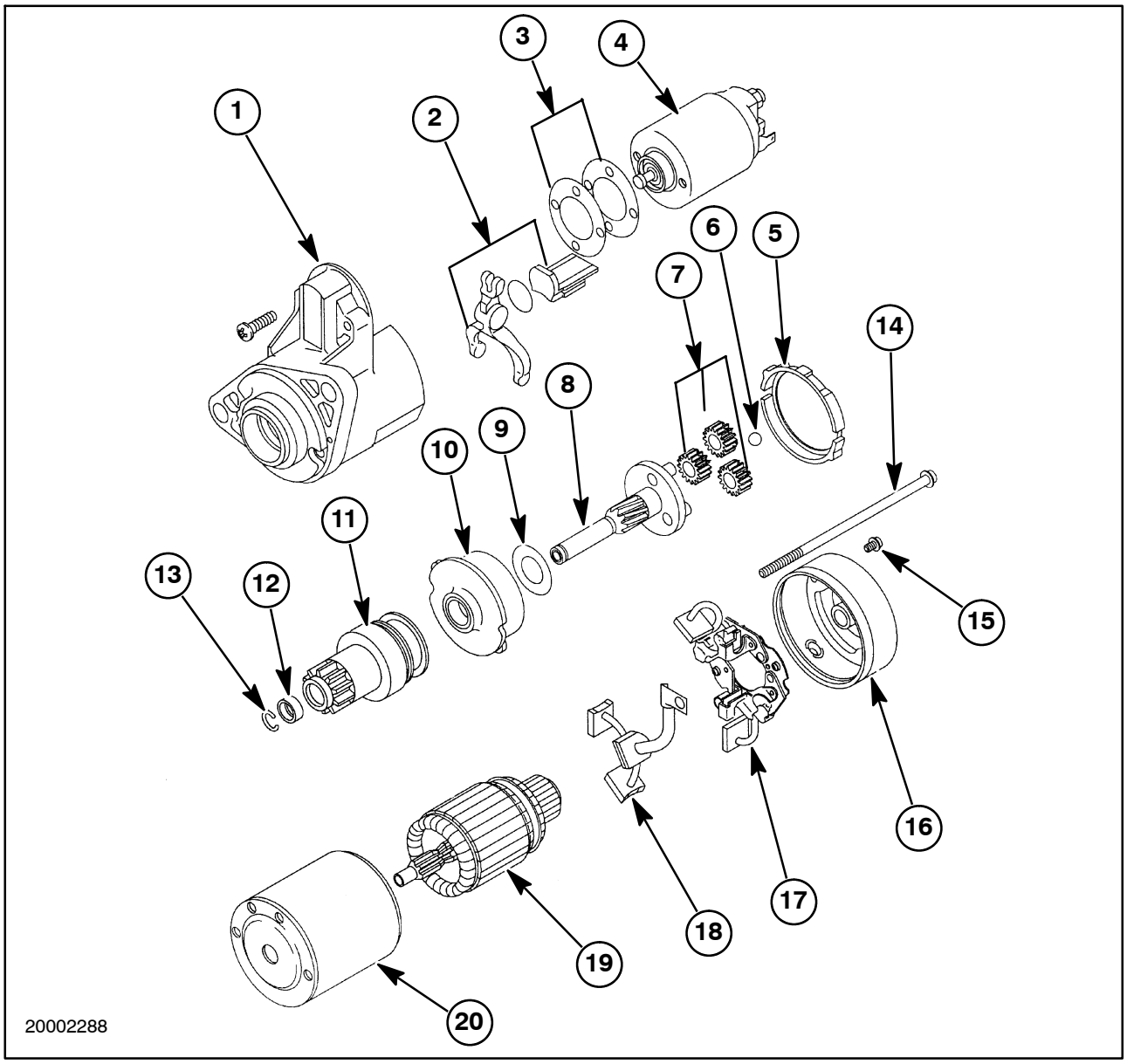

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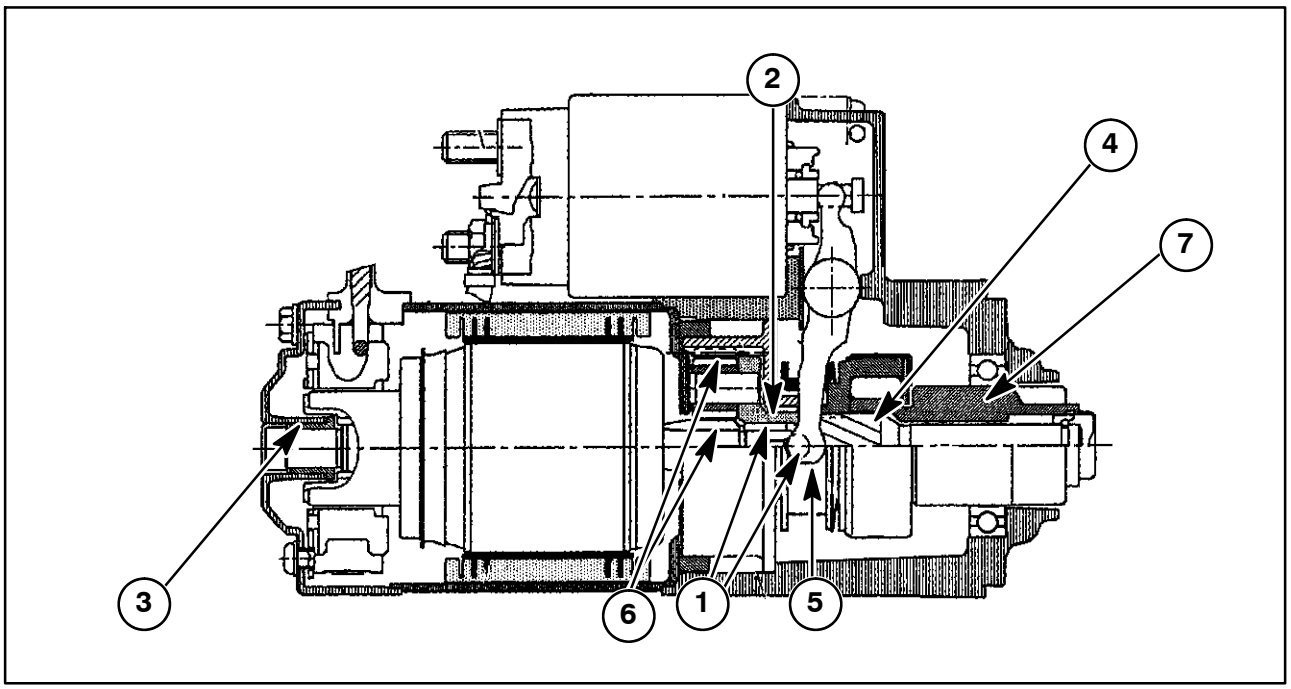
1. Front starter housing
2. Lever assembly
3. Shims
4. Solenoid
5. Retaining ring
6. Steel ball
7. Planetary gears
8. Pinion shaft
9. Washer
10. Orbital gear
11. Pinion clutch
12. Stop ring
13. Snap ring
14. Through bolt
15. Bolt
16. Brush cover
17. Brush holder
18. Brush set
19. Armature
20. Permanent magnet housing

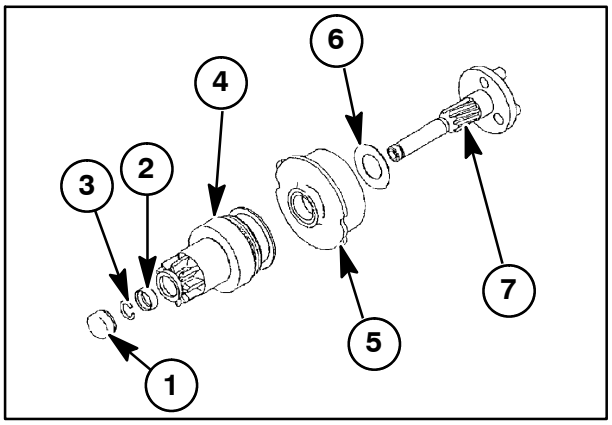
Assembly

1. Apply grease to the following areas as the starter is being assembled:
   - Sleeve and ball, 1.
   - Sleeve bearing in the orbital gear, 2.
   - Sleeve bearing in the rear brush cover, 3.
   - Pinion shaft assembly splines, 4.
   - Sliding surfaces of the lever and pinion clutch, 5.
   - Armature shaft gear, orbital gear, and planetary gears, 6.
   - Sliding surfaces of the pinion and front bearing, 7.



66

2. Assemble the pinion shaft, 7, washer, 6, orbital gear, 5, and clutch, 4, together.
3. Use snap ring pliers to install the snap ring, 3, onto the pinion shaft assembly.
4. Install the stop ring, 2, onto the pinion shaft assembly.
5. Push the plastic cap, 1, into the end of the pinion.



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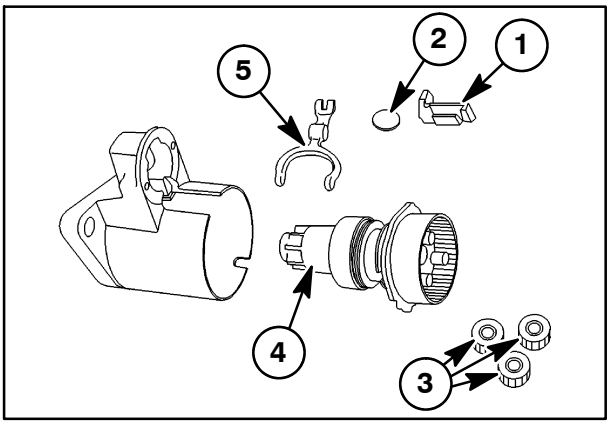
6. Install the lever, 5, the lever packing, 1, and plate, 2, into the starter housing.
7. Install the pinion shaft assembly, 4, into the starter housing
8. Install the planetary gears, 3, into the orbital gear of the pinion shaft assembly.



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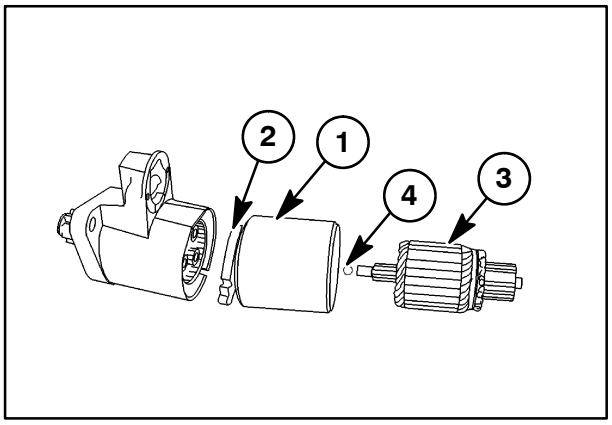
9. Install the ball, 4, rubber cover, 2, field coil assembly, 1, and the armature, 3, into the starter motor housing.



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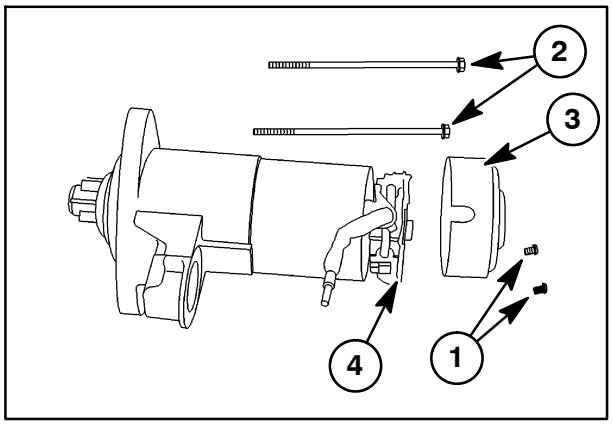
NOTE: *when installing the brush holder, be sure the solenoid wire will be properly aligned for connection to the starter solenoid.*

10. Install the brush holder, 4, with the brushes, onto the armature shaft.
11. Install the brush cover, 3 over the brush holder and secure with the two (2) small screws, 1.
12. Install the two (2) long bolts, 2, into the starter housing.

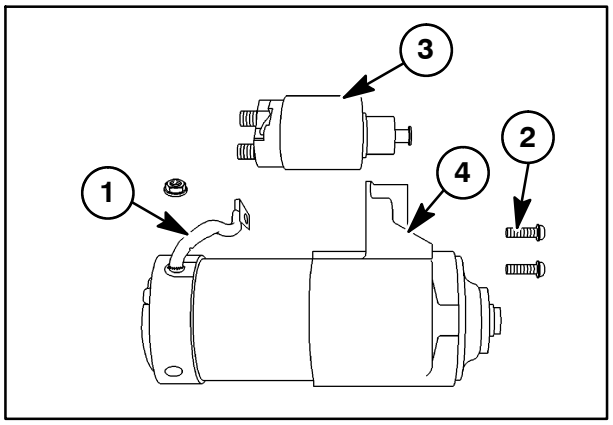


70

13. Align the aligning marks scribed into the solenoid, 3, and starter motor housing, 4, and install the solenoid/plunger assembly into the starter motor housing, 4. Secure the solenoid using the two (2) retaining screws, 2.

NOTE: *When installing the field coil strap to the solenoid, be sure to bolt the strap to the correct solenoid terminal.*

14. Bolt the field coil strap, 1, to the “M” terminal of the solenoid, 3.



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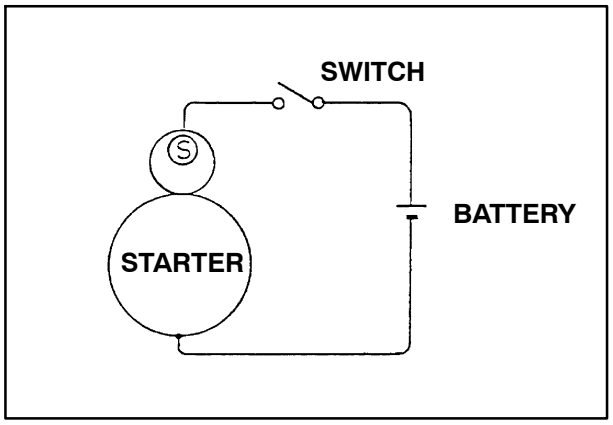
Pinion Position Adjustment

After completing the starter assembly, the position of the pinion should be checked to be sure the pinion gear will engage the flywheel properly. After the pinion shaft has been pushed out, there should be between 0.5 and 2.0 mm (0.020 - 0.080 in.) of play when the end of the pinion gear is pushed in towards the starter. To check the pinion position, proceed as follows:

1. Connect a battery and switch to the battery terminal of the starter and the “S” terminal of the solenoid.
2. Close the switch. This will shift the pinion gear into cranking position.



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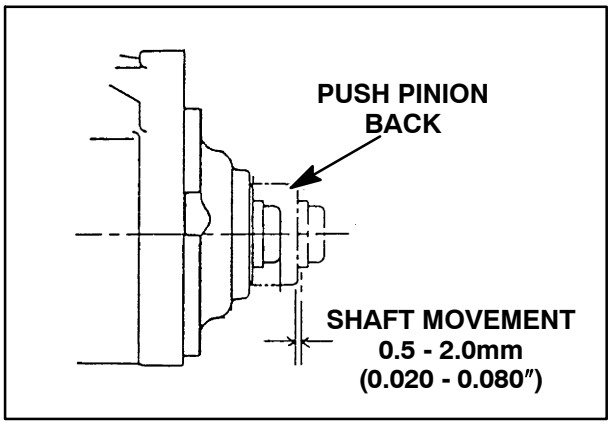
3. Push the pinion shaft back into the starter housing by hand and measure the amount of pinion shaft movement (play).
4. If the amount of movement does not fall within the specified limit, adjust the movement by adding or removing shims that are located between the solenoid and starter motor housing. Adding shims will decrease the amount of play in the pinion shaft.



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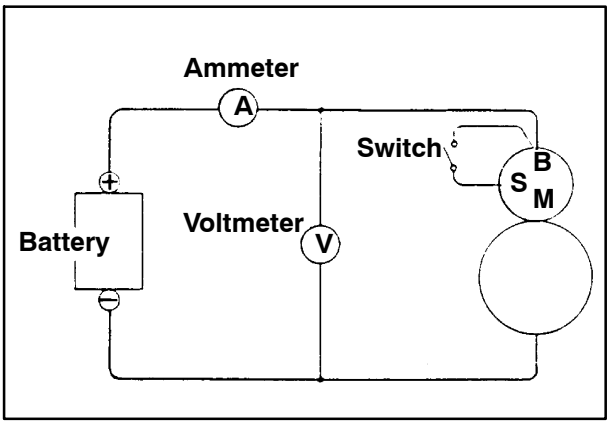
No Load Test

⚠ CAUTION ⚠

Do not operate the starter for more than 30 seconds at a time.

1. Connect an ammeter and voltmeter to the circuit described for pinion adjustment.
2. Close the switch and record the readings indicated on the ammeter and voltmeter.
3. Service limits are 11 volts, 110 amps maximum at 2400 RPM.



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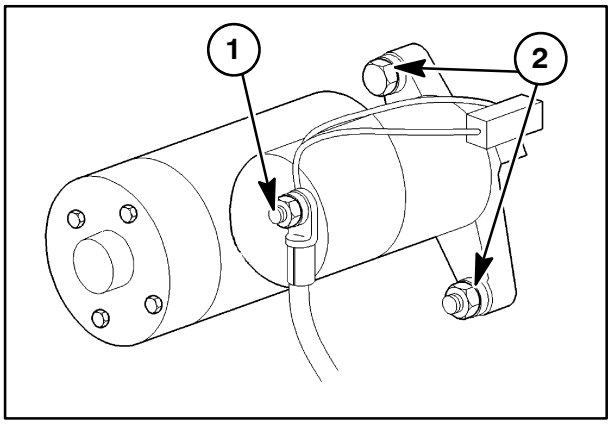
Installation

1. Install the two (2) bolts, 2, which secure the starter motor to the tractor engine.
2. Install the wiring harness connections, 1, to the starter motor.



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SECTION 55 - ELECTRICAL SYSTEM

Chapter 5 - Electrical Components
PIN Number HK34733 and Above

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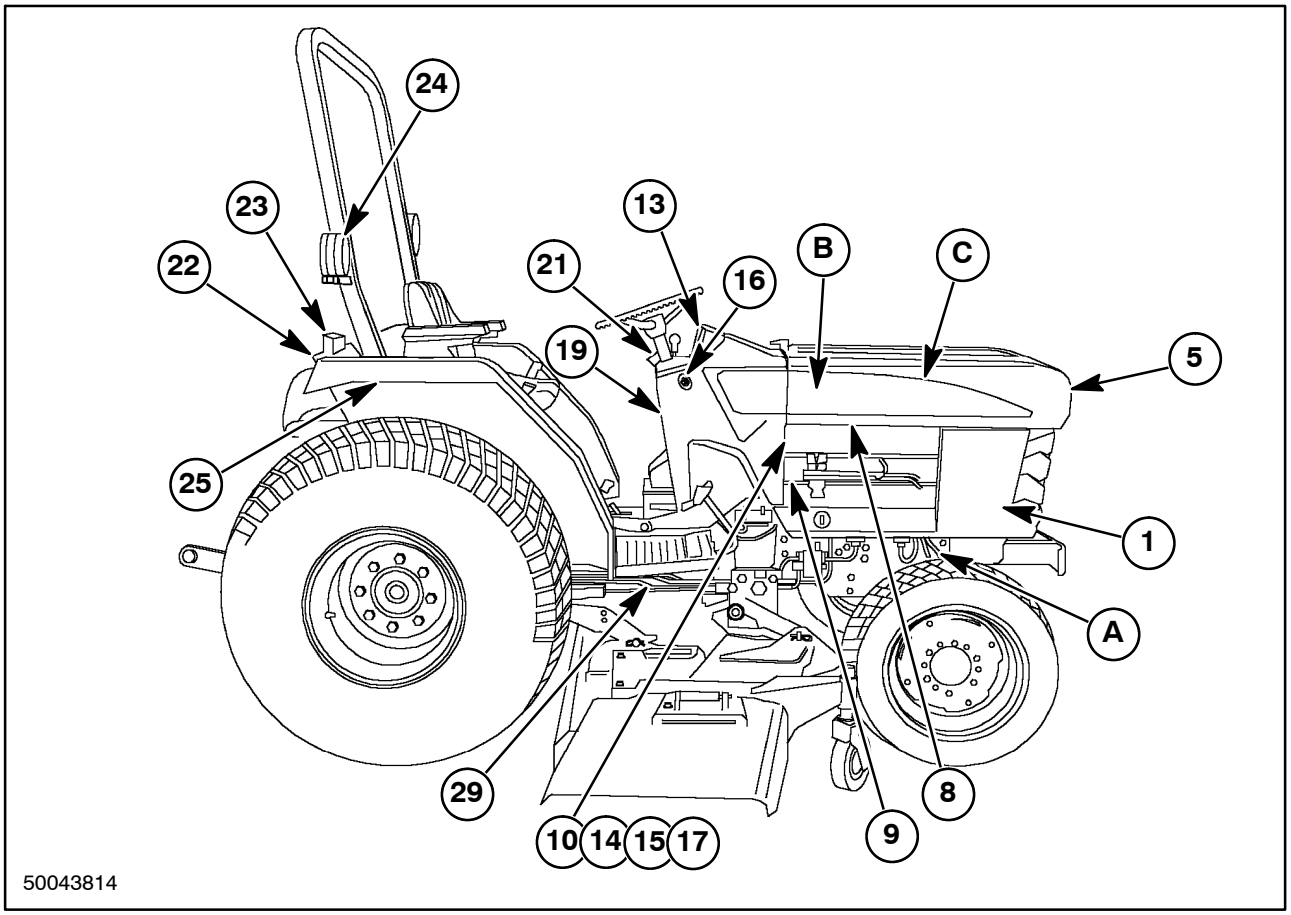
INTRODUCTION



1

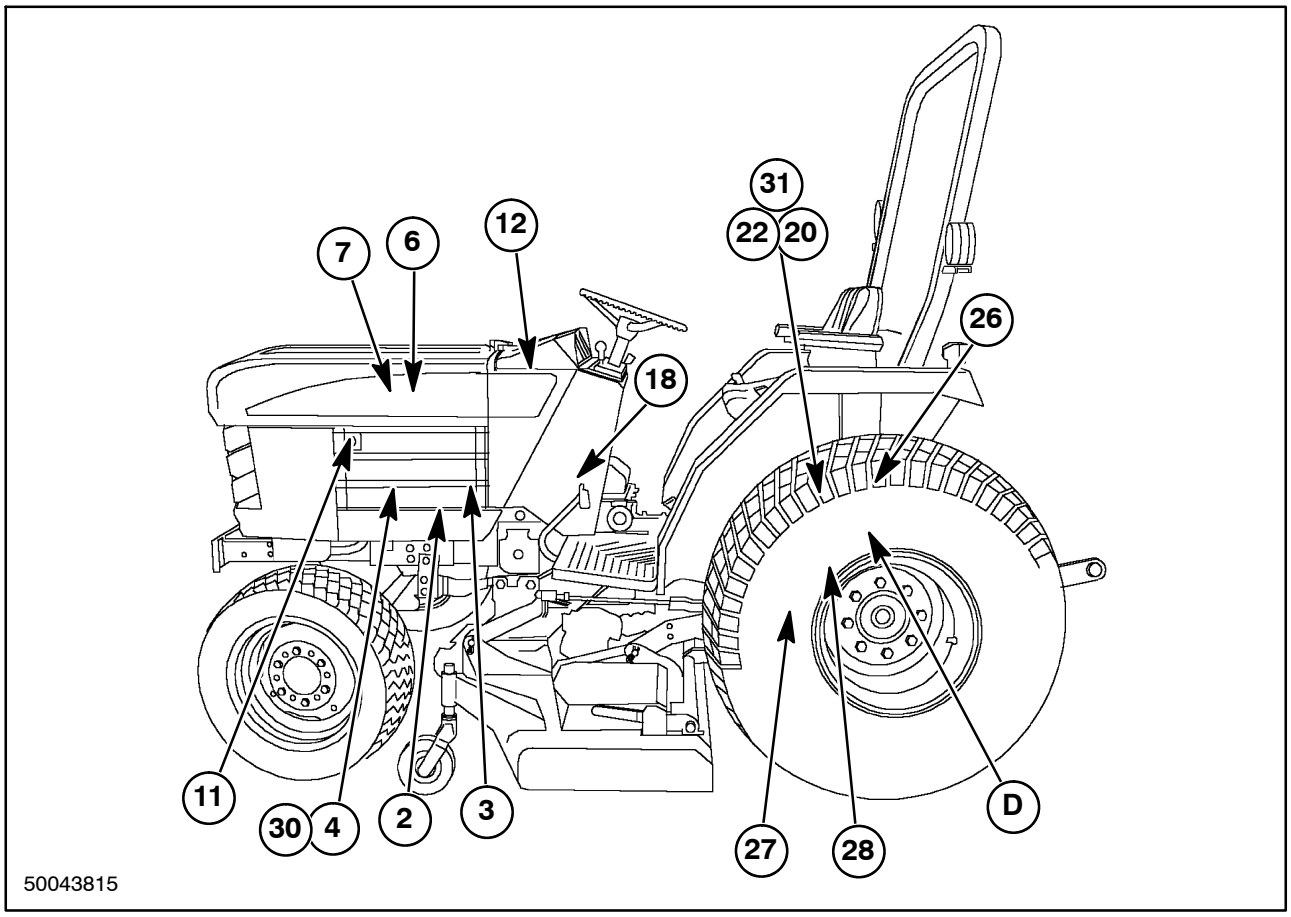
The TC30 Series electrical system is a 12-volt negative (–) ground system consisting of three main wiring harnesses (hood, front main, and rear chassis).

NOTE: *References to the directions left, right, front, and rear, are made while sitting in the operator seat.*

Op. 55 100

COMPONENT LOCATION AND FUNCTION

1. **Battery –** Located under the hood, in front of the radiator; electrical power source.
2. **Fusible Link –** Located on the left side of the engine directly above the starter; protects the entire electrical system from damage due to excessive current.
3. **Starter –** Located on the left side of the engine; rotates the engine for starting.
4. **Alternator –** Located on the left side of the engine; generates power to charge the battery.
5. **Headlights –** Located on the front of the tractor; illuminates the area in front of the tractor.
6. **Air Filter Restriction Switch –** Located on top of the engine, the air filter restriction switch illuminates an indicator light on the instrument panel, warning the operator when the air filter element becomes restricted.
7. **Oil Pressure Switch –** Located in front of the cylinder head; provides warning of low engine oil pressure.
8. **Glow Plugs –** Located on the right side of the cylinder head; aid in engine startup by warming the air in the combustion chamber.
9. **Fuel Shutoff Solenoid –** Located on the right of the engine, on the fuel injection pump, the fuel shutoff solenoid shuts off fuel flow to the injection pump to stop the engine.



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10. **Fuse Block –** Located in the engine compartment, on the right side of the firewall; stores the fuses that protect individual circuits from damage due to excessive current.

11. **Coolant Temperature Sensor –** Located in the thermostat housing on the left side of the engine; warns the operator of high engine temperatures.

12. **Fuel Level Sender –** Located within the fuel tank; sends a signal indicating fuel level to the fuel gauge on the left side of the instrument panel.

13. **Instrument Panel –** Located on the dash panel, the instrument panel houses gauges and indicator lights that monitor tractor functions and warn the operator of potential problems.

14. **Safety Controller –** Located in the engine compartment, on the right side of the firewall. The controller provides current during the start and run safety circuits, coordinates operator's presence in seat with, PTO and transmission range functions. Controller also is involved with PTO and glow plug indicator lights, fuel shutoff solenoid and alarm buzzer.

15. **Safety Start Relay –** Located in the engine compartment, on the right side of the firewall; controls current flowing to the starter.

16. **Key Switch –** Located on the right side of the operator's console; the four-position key switch connects current flowing from the battery to the engine glow plug circuit, the starting circuit or the safe operation circuit.

17. **Hazard Flasher/Turn Signal Control Module –** Located in the engine compartment, on the right side of the firewall; controls current flowing to the hazard flasher/turn signal lights on the rear fenders.

18. **Alarm Buzzer –** Located under the instrument panel cowling, mounted to the right side of the steering column. Buzzer will alarm when one of the following safety switches:

    - Park brake
    - Seat
    - Rear PTO
    - Mid PTO
    - Range Gear

    and safety controller detect an unsafe operation.

19. **Light Switch –** Located on the rear console cover; controls current flow to the headlights and taillights.

20. **Diode –** Located on the lift cover behind the left fender; the diode directs current within a circuit to allow the use of one wire within multiple circuits to control a relay.

21. **Hazard/Turn Signal Switch –** Located on the right side of the dash panel; controls current flowing to the hazard flasher/turn signal control module.

22. **Rear Worklight (optional) –** Located on the right rear fender of the tractor; illuminates the area behind the tractor to make traveling in reverse and connecting implements easier during low light conditions.

23. **Taillights –** Located on the rear fenders of the tractor; provides warning to rearward motorists during transport.

24. **Hazard Lights –** Located on the rear fenders of the tractor; provide warning during transportation and emergency.

25. **Seat Safety Switch –** Located beneath the operator seat; controls the ground path for the control circuit of the seat safety switch timer. When the operator leaves the seat, the seat safety switch timer deactivates after a two second delay, the kill relay then stops the engine. The tractor will continue to run with the seat unoccupied as long as the Mid PTO (optional) is disengaged, and the transmission range is in neutral.

26. **Mid PTO Safety Switch (optional) –** Located on the Mid PTO linkage found behind the left rear fender; the Mid PTO safety switch is part of the START and SAFE OPERATION circuits. The tractor will not start unless the Mid PTO switch is closed (mid PTO in the "Off" position). The tractor will continue to run with the operator out of the seat, the transmission is in a neutral position, and the Mid PTO is in the "Off" position.

27. **Transmission Range Safety Switch –** Located on the transmission housing behind the left rear fender; the Transmission Range Safety Switch is part of the START and Safe Operation circuits. The tractor will not start unless the Transmission Range Safety Switch is closed (range shifted into a NEUTRAL position). The tractor will continue to run with the operator out of the seat, the transmission is in a neutral position, and the Mid PTO (Optional) is in the "Off" position.

28. **Rear PTO Safety Switch –** Located on the left side of the transmission housing behind the left rear fender; the rear PTO switch is part of the START circuit. The tractor will not start if the rear PTO switch is open (rear PTO engaged). Unless the transmission is in neutral and the park brake is applied.

29. **Park Brake Safety Switch –** Located on the park brake linkage found under the right-side floor panel; the Park Brake Safety Switch is part of the START and Safe Operation circuits. The tractor will start with the operator out of the operator seat, providing the transmission is in a neutral position and the Mid PTO (Optional) is in the "Off" position. The tractor will continue to run with the operator out of the seat, providing the transmission is in a neutral position, and the Mid PTO (Optional) is in the "Off" position.

30. **Charging System Diode –** Located on the left side of the engine near the alternator. The charging system diode is used to prevent current from flowing into the low charge indicator light within the instrument panel.

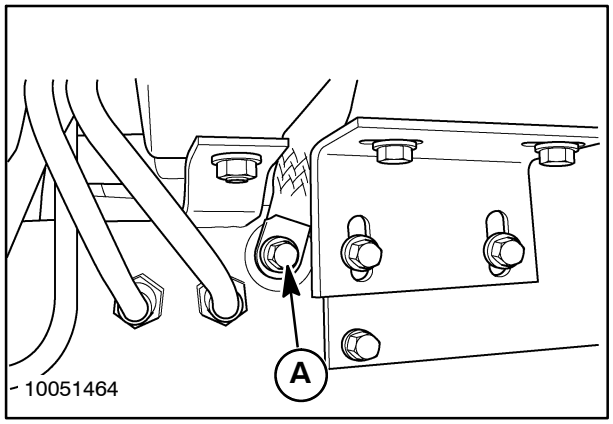
31. **Tail Light Relays –** Located on the lift cover behind the left fender; controls current flowing to the tail light.

⚠ WARNING ⚠

Before working on any component of the electrical system, the negative (–) battery cable should be disconnected from the battery, as electrical shock or damage to system components may occur. Some testing requires 12-volt power; care should be taken in cases where power is needed.

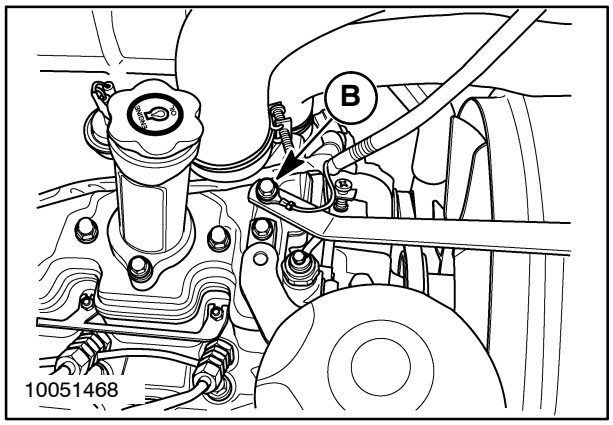
Ground Locations

A. Right Side Frame Rail



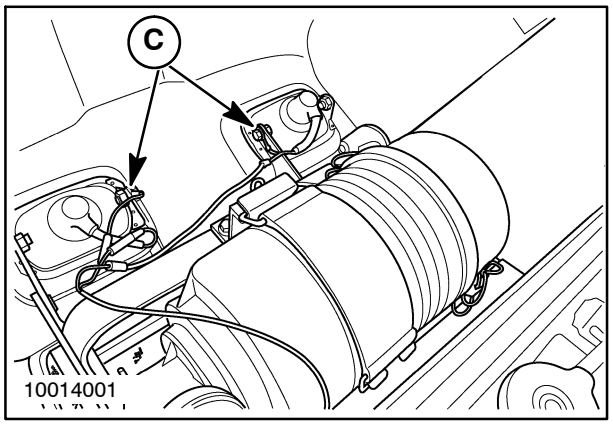
3

B. Top of Engine



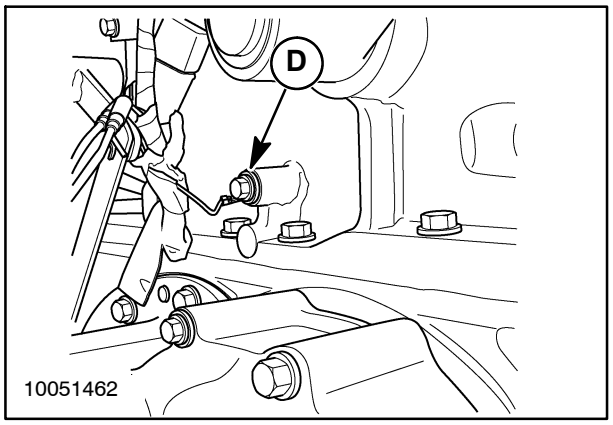
4

C. Tractor Hood



5

D. Rear Chassis (directly above left rear axle housing)

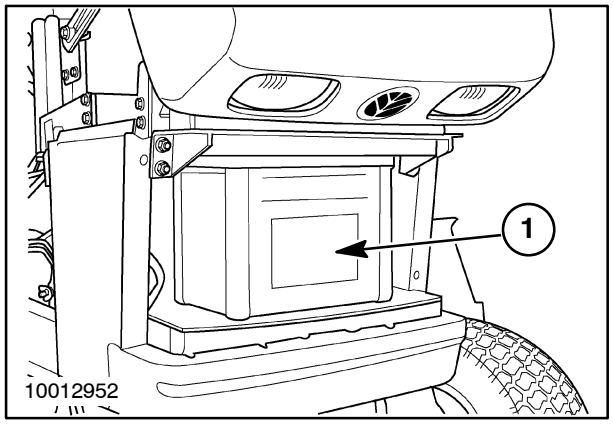


6

DESCRIPTION AND TESTING – ELECTRICAL SYSTEM COMPONENTS

BATTERY

The TC30 tractors are equipped with a BCI group 24, 12-volt, 56 Ah, battery, 1, with a minimum cold cranking ability of 420 amps at 0° F (–18°C). The battery is located underneath the hood in front of the radiator.



7

The battery connections must be tight and free of corrosion. If necessary, wash the battery terminals with a solution of baking soda and water, making sure the solution does not get inside the battery. After cleaning, wash the battery with clean water, then apply a small amount of petroleum jelly to the terminals to prevent corrosion.

A good battery charge must be maintained in freezing temperatures. If the battery is allowed to become discharged or run down, the electrolyte level will become weak and possibly freeze. This can result in damage to the battery case. If water must be added, use distilled water. Add the water just before using the tractor. This ensures that the water will mix with the electrolyte during the charging process, preventing the water from freezing.

Check the specific gravity of the electrolyte to determine battery charge.

Electrolyte Level

NOTE: *Check the battery electrolyte level after every 50 hours of operation.*

⚠ WARNING ⚠

Always check the electrolyte level with the tractor engine off, as an explosive gas is produced inside the battery when the alternator is charging. Do not use an exposed flame and do not smoke when checking the battery electrolyte level.

To check the battery electrolyte level:

1. Clean the top of the battery, then remove the vent plugs.
2. If the electrolyte level is low, add distilled water. The correct level is when the liquid is between the upper and lower line.

NOTE: *Keep distilled water in a nonmetallic container that is clean and well covered.*

3. Install the vent plugs after making sure the vent holes are not blocked. After adding water at below freezing temperatures, run the engine for a period of time. This allows the battery to charge, preventing the water from freezing.

Removal

1. Raise the tractor hood to its fully raised position.
2. Disconnect the negative (-) and positive (+) battery cables from the battery.
3. Remove the grille from the front of the tractor.
4. Remove the battery hold-down hardware and carefully remove the battery from the tractor.

Installation

1. Orient the battery so that the posts are toward the rear of the tractor. Install the battery and the battery hold-down hardware.

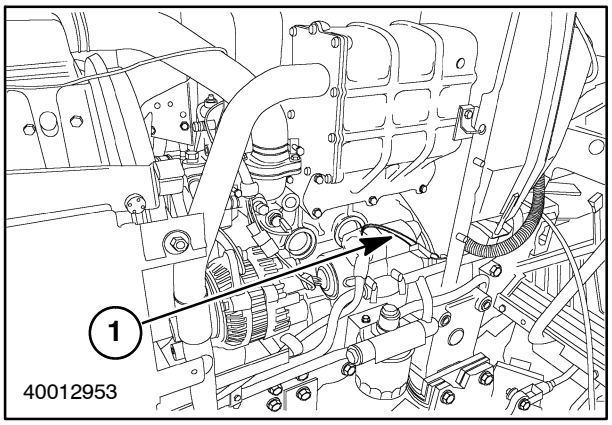
IMPORTANT: *Crossing of battery terminals may cause damage to the electrical system.*

2. Connect the positive (+) battery cable to the positive (+) battery terminal and the negative (-) battery cable to the negative (-) battery terminal.
3. Install the grille onto the front of the tractor.

FUSIBLE LINK

A fusible link wire, 1, is used to protect the tractor's electrical system. If too much amperage passes through this wire, it will melt down so that it will not allow current to pass (similar to the way a fuse works). The fusible link wire, 1, is a red wire that goes from the starter terminal to a connector that links into the main wiring harness.

FUSIBLE LINK RATING	
68°F (20°C)	20 Amps
158°F (69°C)	15 Amps

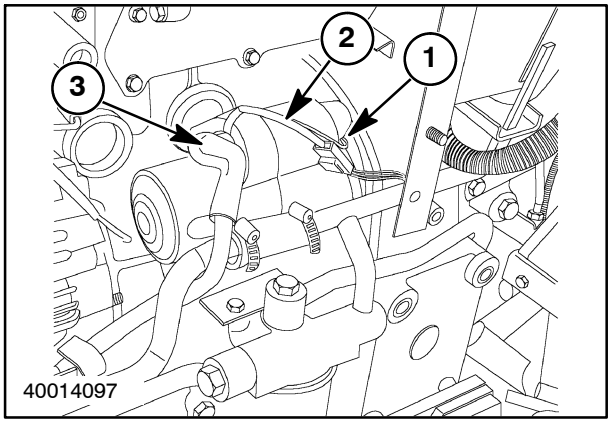


8

Replacement

1. Disconnect the negative (–) and positive (+) battery cables from the battery.
2. Unplug the connector, 1, linking the wire to the main wiring harness.
3. Remove the old fusible link wire, 2, from the starter terminal, 3.
4. Replace the old fusible link wire with a new one - first attaching the starter terminal and then connecting it to the main wire harness.

IMPORTANT: *Always replace the fusible link wire with the appropriate fusible link wire for this tractor (part #SBA385603370).*



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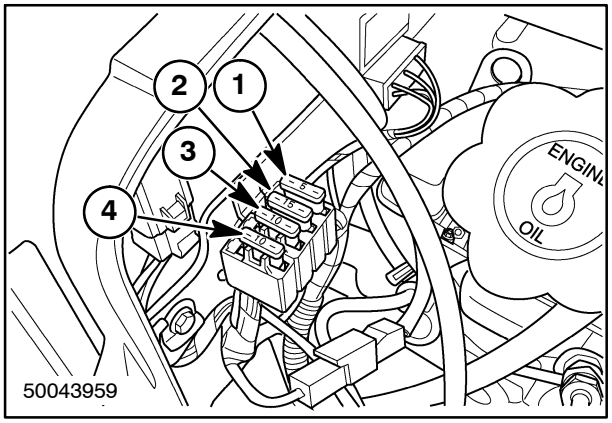
FUSE BLOCK

The fuse box is located in the engine compartment on the right side of the tractor firewall. The fuse box houses four fuses which protect the individual circuits of the tractor. Access the fuses by removing the plastic cover from the fuse box.

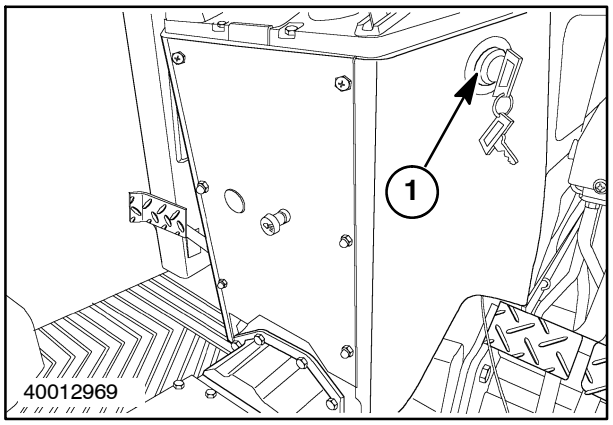
Fuse #	Fuse Size	Description
1	5 Amp	Safety controller, park brake switch
2	15 Amp	Hazard lights
3	10 Amp	Headlights, tail lights, instrument panel lights
4	10 Amp	Fuel solenoid, alternator, instrument panel gauges and indicator lights, turn signal, safety controller, PTO indicator light, seat, rear PTO, mid PTO and transmission range neutral safety switches, optional rear work light.



10

KEY SWITCH

The key start switch, 1, is located on the right side panel. The key switch has four key-operated positions; HEAT, STOP, AC/RUN, and START. Turning the key from the STOP position will align the electrical contacts within the key switch. With the contacts aligned, the circuit is closed and battery current will flow through the circuit.

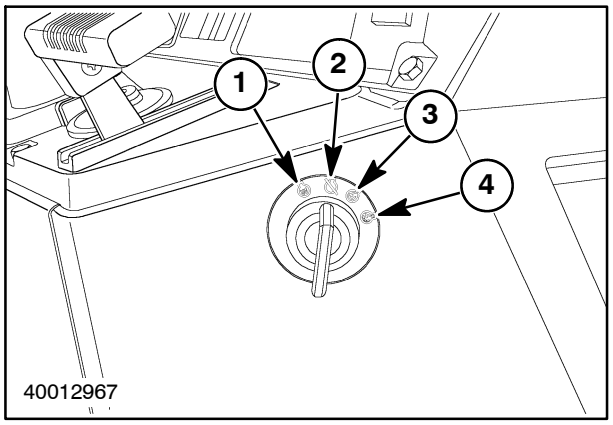


11

1. HEAT POSITION

NOTE: *The key switch is spring-loaded to return to the STOP position, 2, when released from the HEAT position, 1.*

When the key is rotated counterclockwise to the “Heat” position, 1, current is allowed to flow from the battery to the engine glow plugs. The glow plugs aid in starting the engine in cold climates.



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2. STOP POSITION

In the STOP position, 2, there is no battery power supplied to electrical circuits and the key may be removed from the key switch to prevent unauthorized use of the tractor. The STOP position also stops the tractor engine, when running.

3. AC/RUN POSITION

When the key switch is rotated clockwise to the AC/RUN position, 3, battery power is supplied to operate the electrical accessories without the engine running. The switch will also be in this position while the tractor is running.

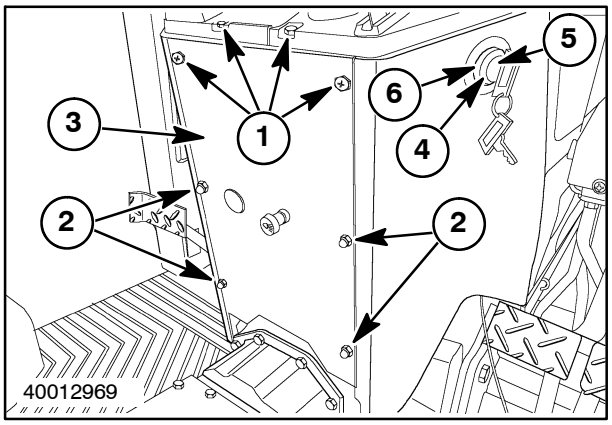
4. START POSITION

NOTE: *The key switch is spring-loaded to return to the AC/RUN position, 3, when released from the START position, 4.*

When the key switch is turned clockwise to the START position, 4, power is supplied to the starter motor to crank and start the engine. This position also provides current to the engine glow plugs to aid in starting the tractor engine.

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the four screws, 1, and the four nuts, 2, to remove the center access panel, 3, from the operator console.
3. Remove the nut, 4, from the key switch, 5.
4. Carefully remove the sealing washer, 6, from the key switch, 5, and push the switch through the console toward the center access panel opening.
5. Disconnect the key switch, 5, from the tractor wire harness to remove the switch from the tractor.



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Testing

NOTE: *The key switch is not serviceable and must be replaced if testing determines the switch is defective.*

Use an ohmmeter to test the key switch for electrical continuity in each of the four positions.

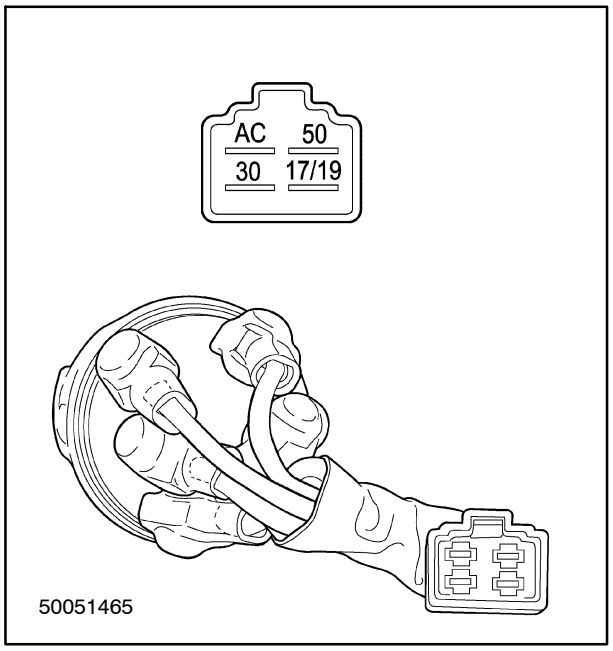
	19	30	17	50	AC
HEAT	•	•			•
OFF					
AC/RUN		•			•
START		•	•	•	•

• = Indicates that continuity exists.

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the switch from the tractor. Disconnect all wires from the key switch.

Key Switch Terminal Identification

Key Switch Terminal	Wire Color
Terminal 30	RED
Terminal 17	BLACK/WHITE
Terminal 19	BLACK/WHITE
Terminal 50	BLACK
Terminal AC	RED/WHITE



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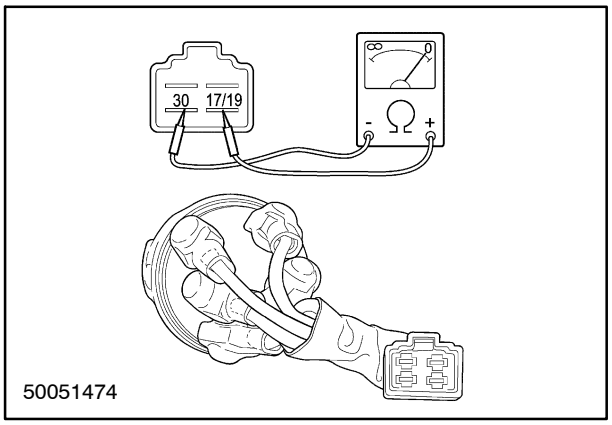
Installation

1. Connect the key switch wire harness to the tractor wire harness.
2. From inside the operator console, insert the key switch through the key switch hole, slide the sealing washer, and thread the nut onto the key switch. Tighten the nut.
3. Install the center access panel by using the two bolts and four nuts, with washers.
4. Connect the negative (–) battery cable to the negative (–) battery terminal.

HEAT POSITION

1. Turn the key switch to the HEAT position and hold. Touch an ohmmeter test probe to the terminal marked 30.
2. Touch the other ohmmeter test probe to the terminal marked 19. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal 19. If continuity does not exist between terminals 30 and 19 when the key switch is in the HEAT position, the switch is defective and requires replacement.



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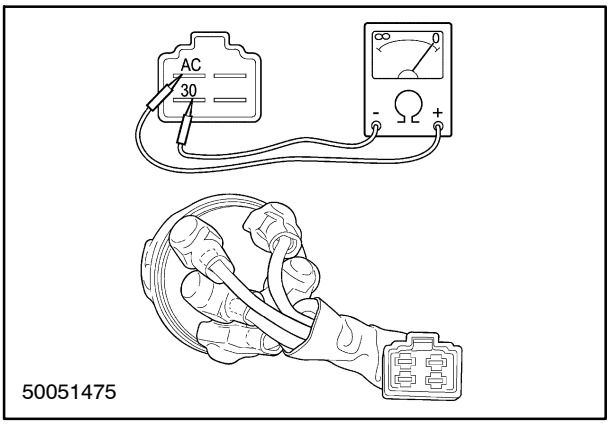
3. With the key switch still in the HEAT position, touch an ohmmeter test probe to the terminal marked 30.
4. Touch the other ohmmeter test probe to the terminal marked AC. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal AC. If continuity does not exist between terminals 30 and AC when the key switch is in the HEAT position, the switch is defective and requires replacement.

If continuity exists in a way that is not described in this testing procedure (while the key switch is in the HEAT position), the switch is defective and requires replacement.



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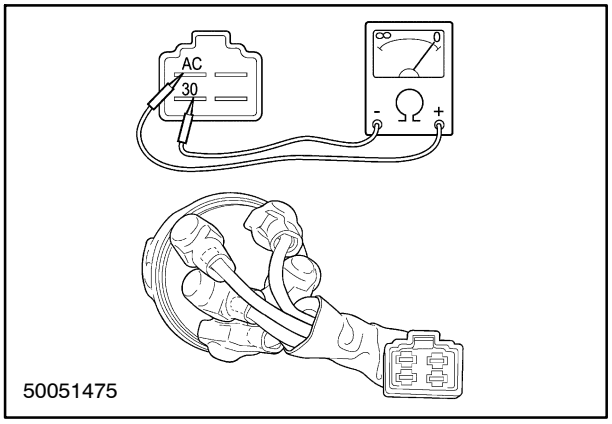
STOP POSITION

Continuity should not exist between any of the switch terminals when the key switch is in the STOP position. If continuity exists between any of the switch terminals when the key switch is in the STOP position, the switch is defective and requires replacement.

AC/RUN POSITION

1. Turn the key switch to the AC/RUN position. Touch an ohmmeter test probe to the terminal marked 30.
2. Touch the other ohmmeter test probe to the terminal marked AC. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal AC. If continuity does not exist between terminals 30 and AC when the key switch is in the AC/RUN position, the switch is defective and requires replacement.

If continuity exists in a way that is not described in this testing procedure (while the key switch is in the AC/RUN position), the switch is defective and requires replacement.



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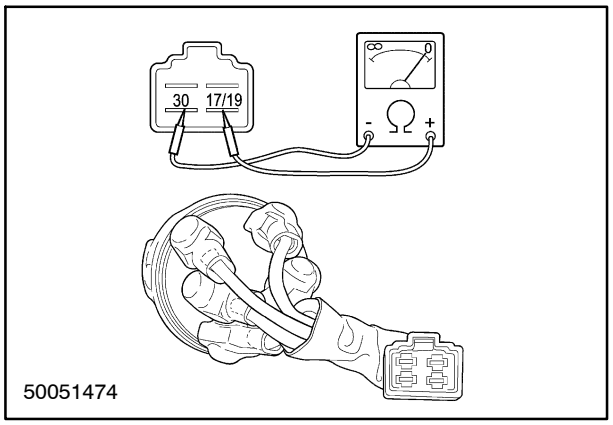
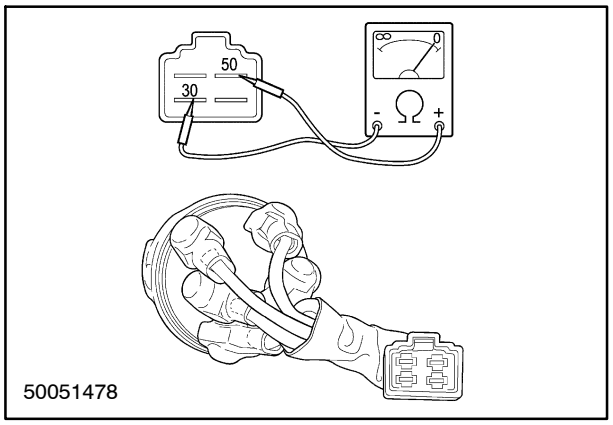
START POSITION

1. Turn the key switch to the START position and hold. Touch an ohmmeter test probe to the terminal marked 30.
2. Touch the other ohmmeter test probe to the terminal marked 17. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal 17. If continuity does not exist between terminals 30 and 17 when the key switch is in the START position, the switch is defective and requires replacement.



18

3. With the key switch still in the START position, touch an ohmmeter test probe to the terminal marked 30.
4. Connect the other ohmmeter test probe to the terminal marked 50. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal 50. If continuity does not exist between terminals 30 and 50 when the key switch is in the START position, the switch is defective and requires replacement.



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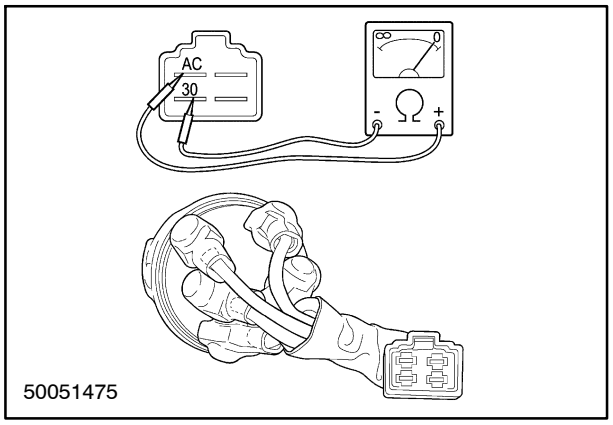
5. With the key switch still in the START position, touch an ohmmeter test probe to the terminal marked 30.
6. Connect the other ohmmeter test probe to the terminal marked AC. The ohmmeter should show little or no resistance indicating that continuity exists between terminal 30 and terminal AC. If continuity does not exist between terminals 30 and AC when the key switch is in the START position, the switch is defective and requires replacement.

If continuity exists in a way that is not described in this testing procedure (while the key switch is in the START position), the switch is defective and requires replacement.



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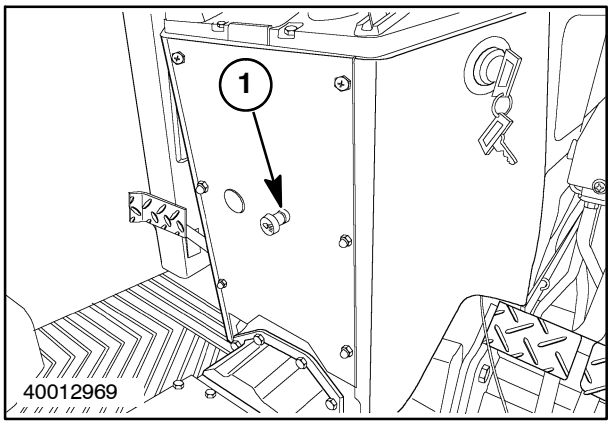
LIGHT SWITCH

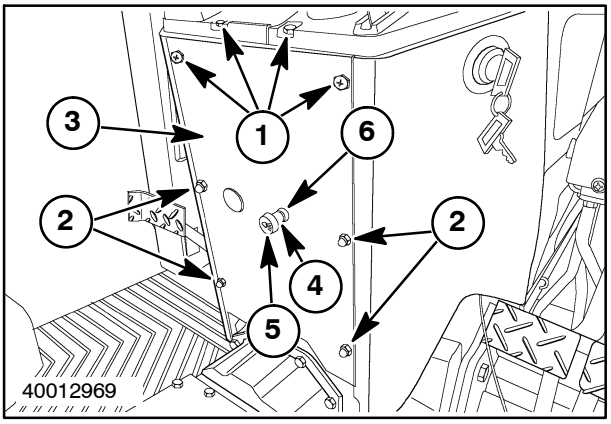
The light switch, 1, is a push-pull type switch located on the center access panel of the operator console. The light switch controls current flowing to the headlights and taillights. The key switch must be in either the HEAT, START, or AC/RUN, position for current to flow to the light switch. When the light switch is pulled to the “On” position, the tractor headlights and taillights illuminate.



21

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the four screws, 1, and the four nuts, 2, to remove the center access panel, 3, from the operator console.
3. Remove the screw, 4, and the knob, 5, to remove the nut, 6, from the light switch.
4. Disconnect the light switch from the tractor wire harness and remove from the center access panel.



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Testing

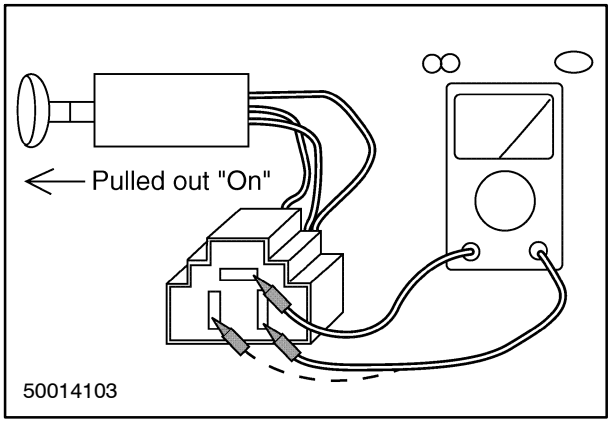
Use an Ohmmeter to test the light switch for electrical continuity.

ON POSITION

1. Pull the light switch outward to the “On” position.
2. Continuity should exist between the three switch terminals. If continuity does not exists between the three switch terminals, the switch is defective and requires replacement.

OFF POSITION (Not Shown)

1. Push the light switch inward to the “Off” position.
2. There should be no continuity between any of the switch terminals when the light switch is in the “Off” position. If continuity exists between the switch terminals when the light switch is in the “Off” position, the switch is defective and requires replacement.



23

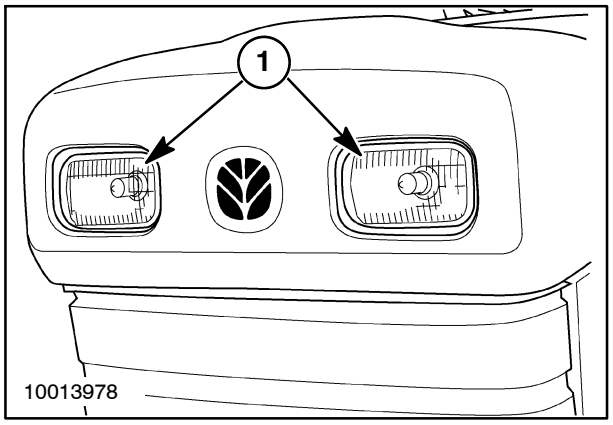
Installation

1. Connect the light switch to the tractor wire harness.
2. Insert the light switch into the back of the center access panel, slide the sealing washer onto the light switch. Thread the nut onto the light switch and tighten. Install the handle onto the switch by using the screw.
3. Install the center access panel by using the four screws and four nuts, with washers.

Op. 55 404

HEADLIGHTS

The headlights, 1, are located on the front of the tractor. The two headlights illuminate the area in front of the tractor for increased visibility in low light conditions. The headlight assemblies contain a 25 watt bulb that may be replaced if the bulb burns out.



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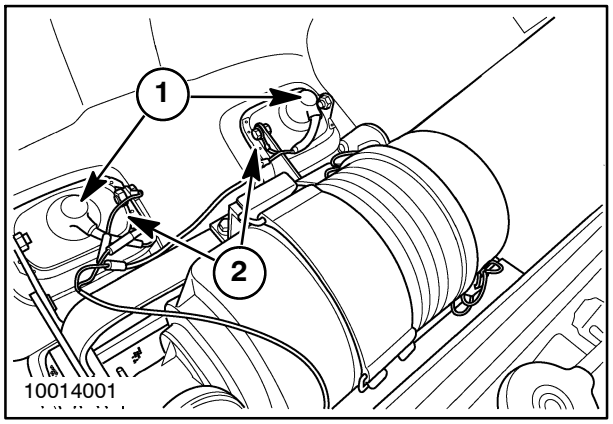
Removal

NOTE: *The same procedure is used for both sides.*

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. To remove the headlight bulb, rotate the bulb socket, 1, counterclockwise and remove the bulb and socket from the headlight assembly, 2.



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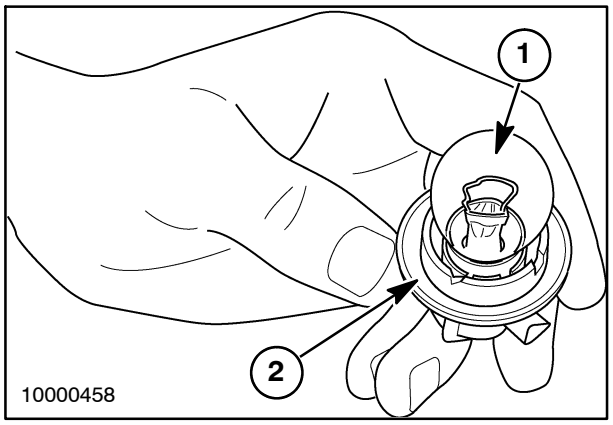
Inspection

1. Remove the bulb, 1, from the socket, 2. Inspect the bulb and filament for damage or corrosion. Replace as necessary.
2. If the bulb is OK, check the bulb socket for corrosion. Clean or replace as necessary.



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Installation

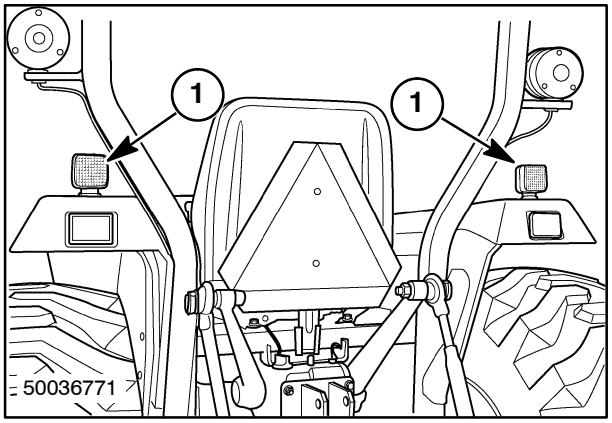
1. Insert the headlight bulb into the headlight socket and rotate clockwise so that the bulb locks into the socket.
2. Place the headlight bulb and socket into the headlight assembly. Rotate the socket clockwise so that the socket locks into the headlight assembly.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

NOTE: *Replace with a size 12-volt 25 watt bulb.*

Op. 55 404

TAILLIGHTS

The taillights, 1, are located on the left and right rear fenders. The two taillights illuminate the rear of the tractor to provide warning to approaching vehicles.

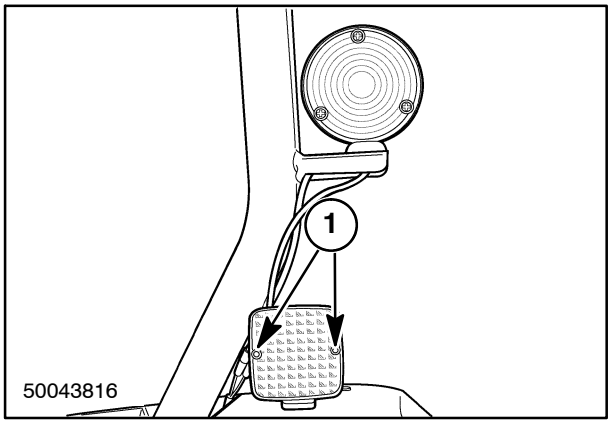


27

Removal

NOTE: *The same procedure is used for both sides.*

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the two screws, 1, securing the lens and pull the lens away from the body.



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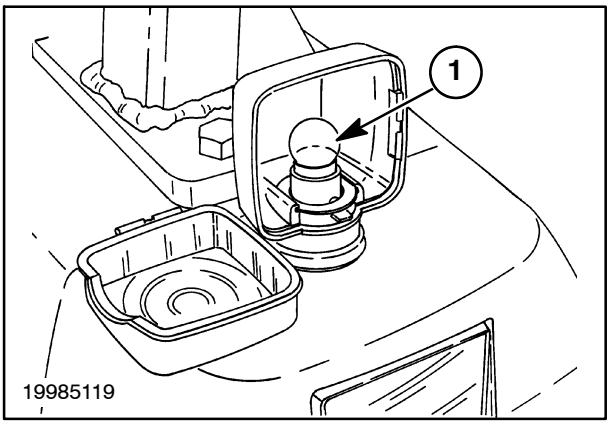
3. Push down on the bulb, 1, and rotate counterclockwise to remove the bulb from the taillight assembly.



29

Inspection

1. Remove the bulb from the socket. Inspect the bulb and filament for damage or corrosion. Replace as necessary.
2. If the bulb is OK, check the bulb socket for corrosion. Clean or replace as necessary.

Installation

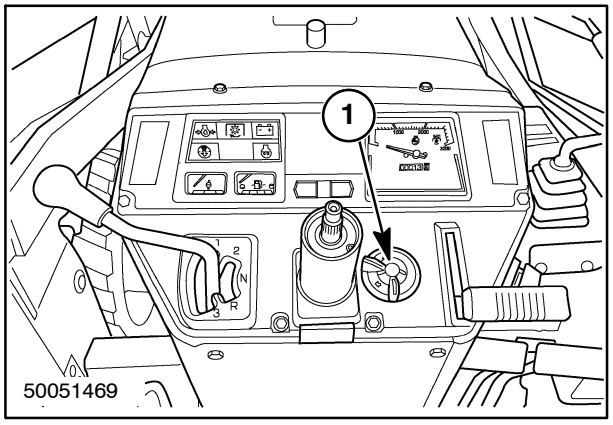
1. Place the taillight bulb and socket into the taillight assembly. Rotate the socket clockwise so that the socket locks into the taillight assembly.
2. Press the lens onto the light body until it snaps into place.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

NOTE: *Replace with an 18W-12-volt bulb.*

HAZARD/TURN SIGNAL COMBINATION SWITCH

NOTE: *The steering wheel was removed to better show the dash panel components.*

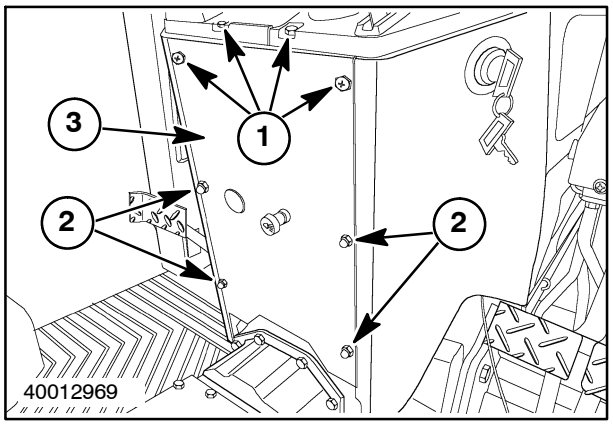
The hazard/turn signal combination switch, 1, is located on the right side of the steering column on the dash panel. The combination switch contains two separate switches. The upper switch controls the hazard flashers while the lower switch controls the turn signals. When the hazard switch is activated, both lights flash on and off simultaneously unless a turn signal is activated. When a turn signal is activated, the corresponding flasher will flash on and off while the opposite flasher remains on (solid). The hazard/turn signal combination switch also controls the flasher indicator lights within the instrument panel. The flasher indicator lights illuminate to show the operator that the flashers are activated. See INSTRUMENT PANEL for more information on the flasher indicator lights.



30

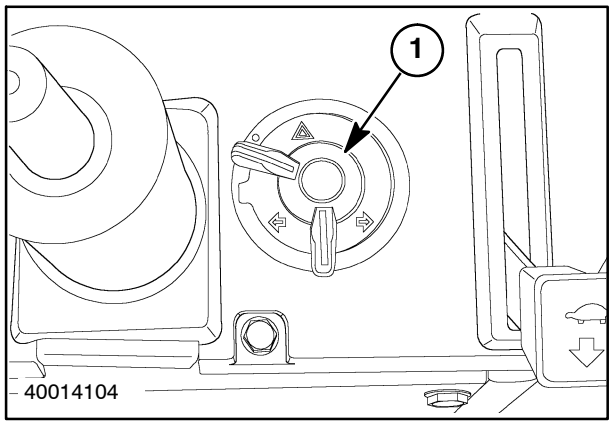
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the four screws, 1, and the four nuts, 2, to remove the center access panel, 3, from the operator console.
3. Disconnect the tractor wire harness from the hazard/ turn signal combination switch.



31

4. Reach underneath the dash panel to release the locking tabs on the hazard/turn signal combination switch, 1, and push the switch from the dash panel.



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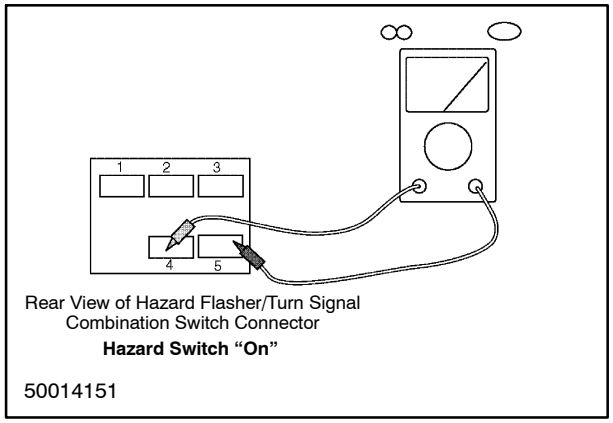
Testing
Use an ohmmeter to perform the three tests on the hazard / turn signal combination switch.

Test 1
Test 1 is used to determine if the combination switch is functioning properly when in the “Hazard On” position.

NOTE: *Disregard any terminal markings on the switch connector. Refer to the terminal markings in the illustration for the testing.*

1. Switch the hazard switch to the “On” position.
2. Touch an ohmmeter test probe to terminal 4 of the switch connector.
3. Touch the other ohmmeter test probe to terminal 5. The ohmmeter should show little or no resistance indicating that continuity exists between terminals 4 and 5. If continuity does not exist between terminals 4 and 5 when the hazard switch is in the “On” position, the switch is defective and requires replacement.

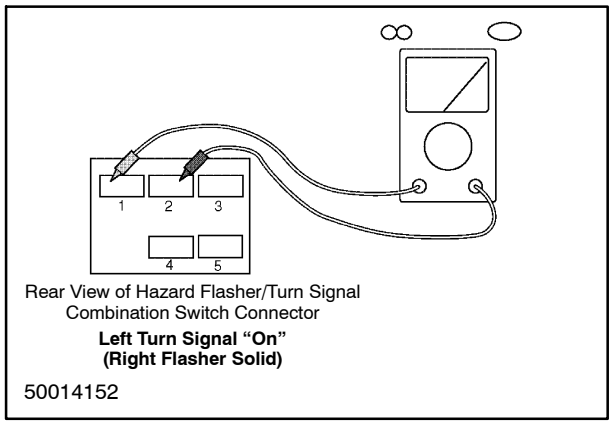


33

Test 2
Test 2 is used to determine if the combination switch is functioning properly while in the “Left Turn Signal” position.

NOTE: *Disregard any terminal markings on the switch connector. Refer to the terminal markings in the illustration for the testing.*

1. Switch the turn signal switch to the “Left” position.
2. Touch an ohmmeter test probe to terminal 1 of the switch connector.
3. Touch the other ohmmeter test probe to terminal 2. The ohmmeter should show little or no resistance indicating that continuity exists between terminals 1 and 2. If continuity does not exist between terminals 1 and 2 when the turn signal switch is in the “Left” position, the switch is defective and requires replacement.



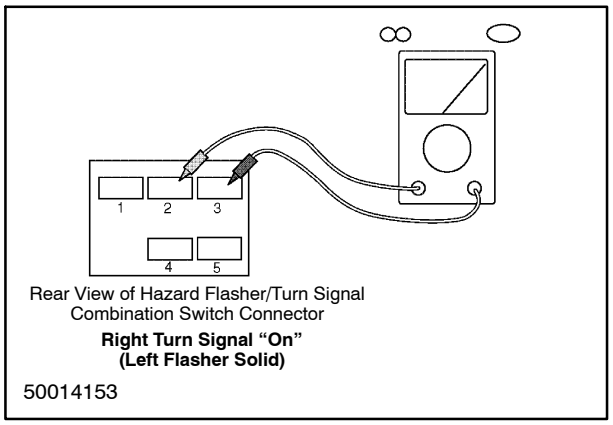
34

Test 3

Test 3 is used to determine if the combination switch is functioning properly while in the “Right Turn Signal” position.

NOTE: *Disregard any terminal markings on the switch connector. Refer to the terminal markings in the illustration for the testing.*

1. Switch the turn signal switch to the “Right” position.
2. Touch an ohmmeter test probe to terminal 2 of the switch connector.
3. Touch the other ohmmeter test probe to terminal 3. The ohmmeter should show little or no resistance indicating that continuity exists between terminals 2 and 3. If continuity does not exist between terminals 2 and 3 when the turn signal switch is in the “Right” position, the switch is defective and requires replacement.



Rear View of Hazard Flasher/Turn Signal Combination Switch Connector

Right Turn Signal “On” (Left Flasher Solid)

50014153

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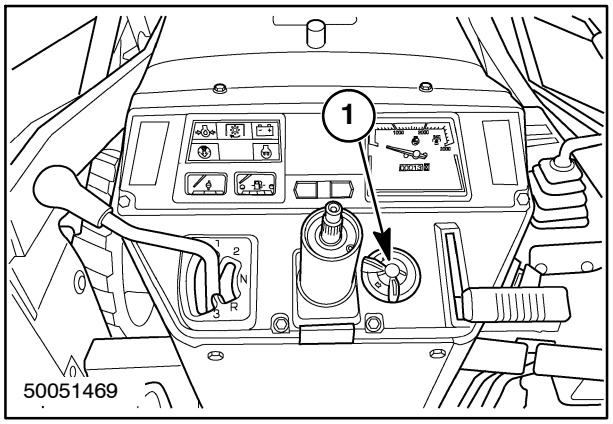
Installation

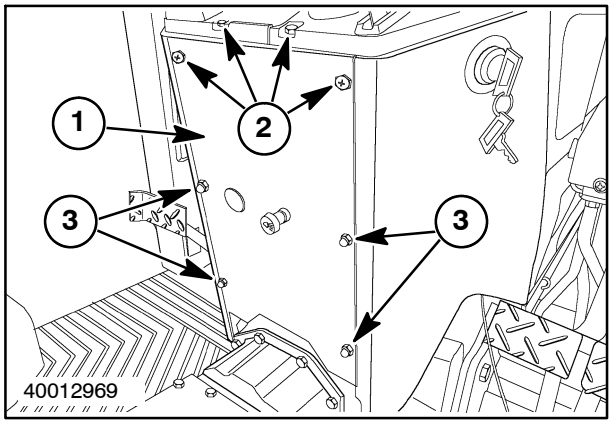
NOTE: *The steering wheel was removed to better show the dash panel components.*

1. Insert the hazard/turn signal switch, 1, into the dash panel so that the switch locks into place.
2. Connect the hazard/turn signal switch wire harness to the tractor wire harness.



36

3. Install the center access cover, 1, by using the four screws, 2, and the four nuts, 3, with washers.
4. Connect the negative (–) battery cable to the negative (–) battery terminal.



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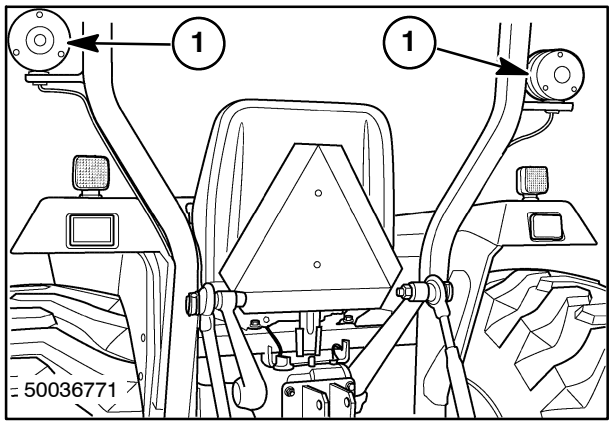
HAZARD/TURN SIGNAL LIGHTS

The hazard/ turn signal lights, 1, are located on the left and right rear fenders. The two hazard/ turn signal lights provide warning to approaching vehicles of a slow moving or turning vehicle. The hazard/ turn signal lights should be used in low visibility situations or at slow speeds on public roads.



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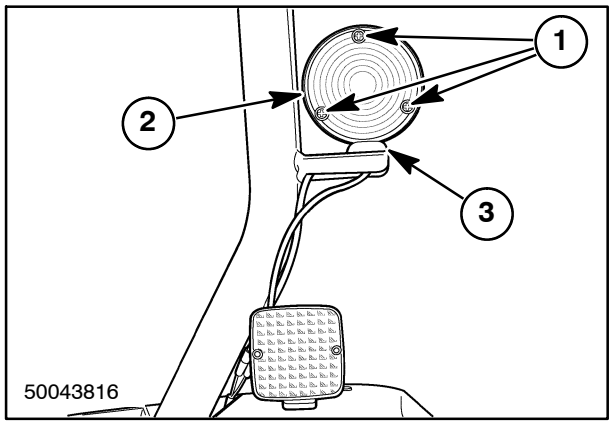
Removal

NOTE: *The same procedure is used for both sides.*

1. Remove the three screws, 1, to remove the lens, 2, from the light body, 3.
2. Push down on the bulb and rotate counterclockwise to remove the bulb from the light assembly.



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Inspection

1. Remove the bulb from the socket. Inspect the bulb and filament for damage or corrosion. Replace as necessary.
2. If the bulb is OK, check the bulb socket for corrosion. Clean or replace as necessary.

Installation

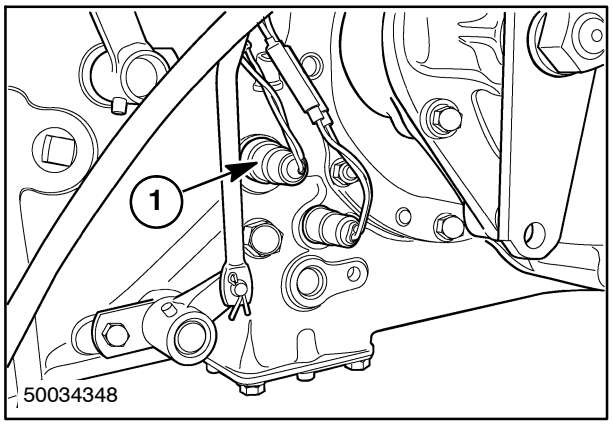
1. Install the flasher bulb into the socket of the light assembly.
2. Install the lens onto the light body by using the three screws.
3. Connect the negative (–) battery cable to the negative (–) battery terminal.

NOTE: *Replace with a 1076 bulb.*

TRANSMISSION RANGE SAFETY SWITCH

Description

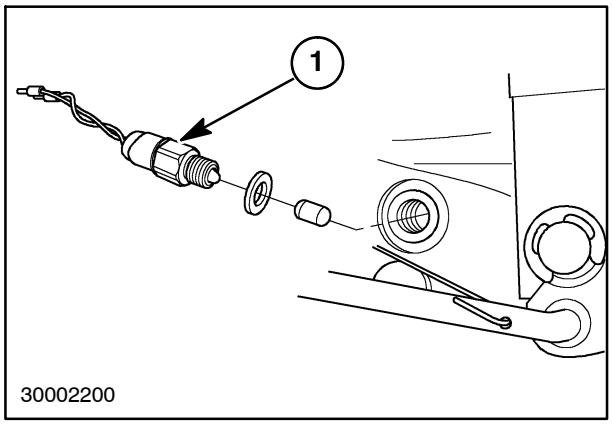
The transmission range safety switch, 1, is a single-pole, single-throw, switch located along the left side of the transmission. The switch is activated by the range shift lever. When the range is in neutral, the switch is closed to allow current to flow to the neutral start relay.



40

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the transmission range safety switch, 1, from the tractor wire harness.
3. Unthread the switch, 1, from the transmission housing.



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Testing

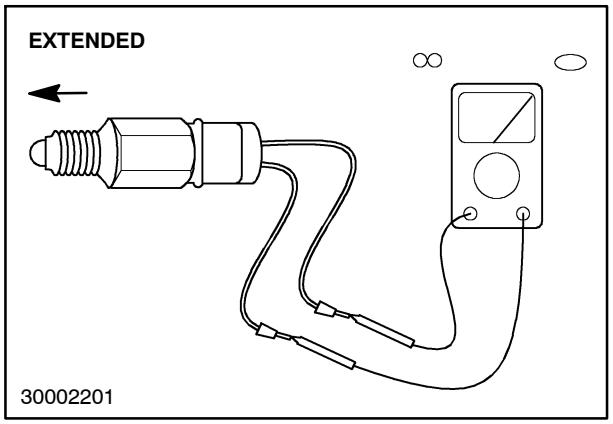
Use an ohmmeter to test the transmission range safety switch for electrical continuity.

Extended Position

1. With the transmission range safety switch plunger in the extended position, there will be electrical continuity across the terminal leads.

Retracted Position (Not Shown)

1. With the switch plunger in retracted position, continuity will not exist between the terminal leads.



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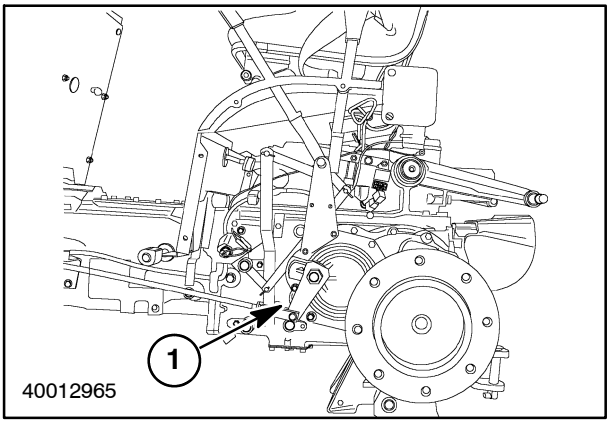
Installation

1. Thread the transmission range safety switch, 1, into the left side of the transmission.
2. Connect the safety switch leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

REAR PTO SAFETY SWITCH

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the rear PTO safety switch.*

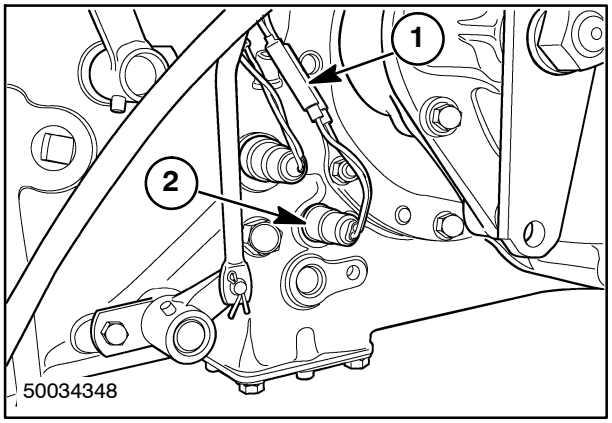
The rear PTO safety switch, 1, is a single-pole, push-button type switch located on the left side of the gearbox housing. When the rear PTO is in the "On" position (lever pushed forward), the switch contacts are open. The tractor will not start with the Rear PTO engaged. When the rear PTO is in the "Off" position, the switch plunger retracts to close the contacts, completing the circuit and allowing the tractor to start.



43

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two switch wire leads, 1, from the tractor wire harness.
3. Unthread the switch, 2, from the left side of the gearbox housing.



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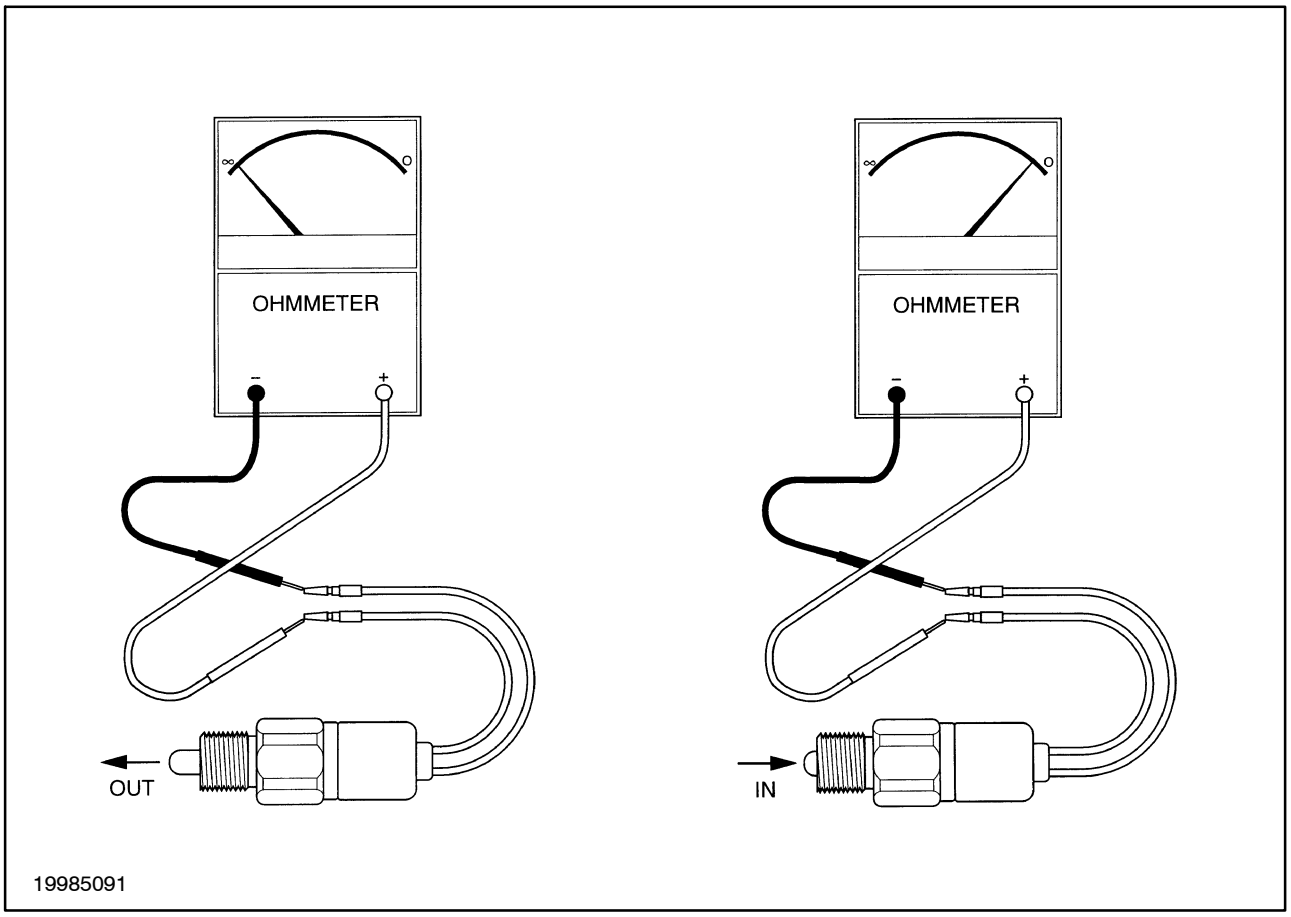
Testing

Use an ohmmeter to test both positions of the rear PTO safety switch for electrical continuity.



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EXTENDED POSITION

1. With the switch plunger in the “extended” position (OUT), there should be no continuity between the two switch terminals. If continuity exists between the two switch terminals when the switch plunger is in the “extended” position, the switch is defective and requires replacement.

RETRACTED POSITION

1. With the switch plunger pushed into the “retracted” position (IN), touch one of the test probes to the one switch lead. Touch the other test probe to the other switch lead.
2. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If continuity does not exist between the two switch terminals when the switch is in the “retracted” position, the switch is defective and requires replacement.

Installation

1. Thread rear PTO switch into the gearbox housing and tighten.
2. Connect the switch wire leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

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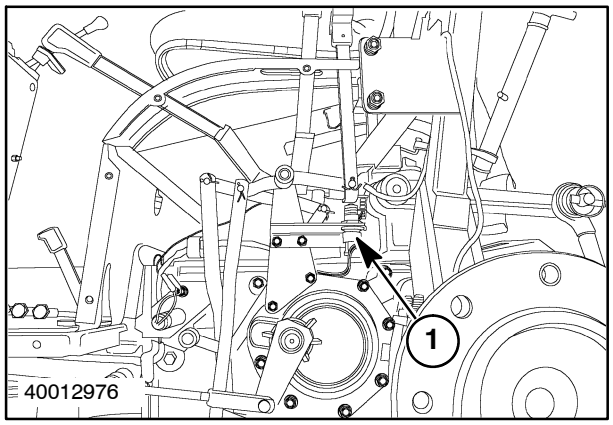
MID PTO SAFETY SWITCH (STANDARD ON HST MODELS/OPTIONAL FOR 9 X 3 MODELS)

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the Mid PTO safety switch.*

The mid PTO safety switch, 1, is a single-pole, push-button type switch located on the left side of the gearbox housing. When the mid PTO is in the "On" position (lever pulled upward), the switch contacts are open, not allowing the tractor to start. When the mid PTO is in the "Off" position (lever pushed down), the switch plunger retracts to close the contacts, completing the circuit and allowing the tractor to start.



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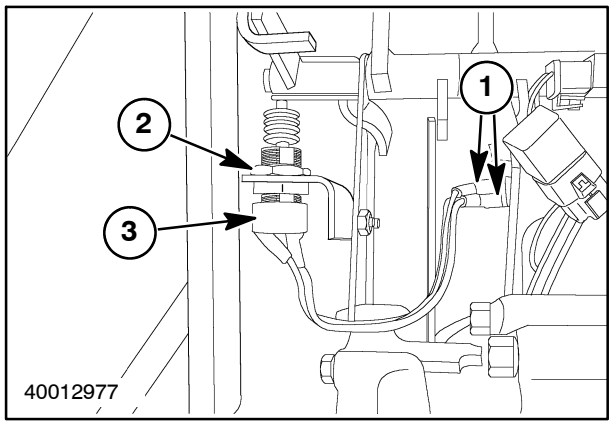
Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Disconnect the two switch wire leads, 1, from the tractor wire harness.
3. Remove the nut, 2, to remove the mid PTO switch, 3, from the tractor.



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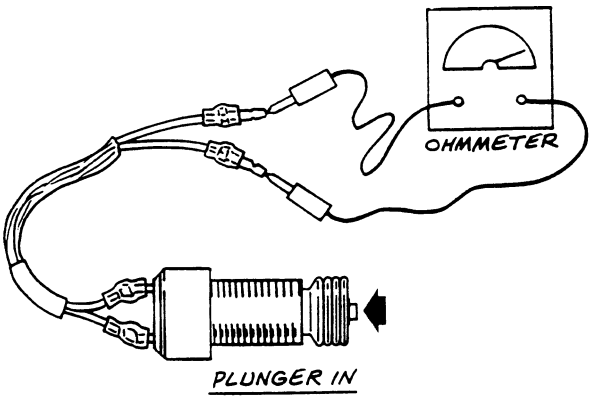
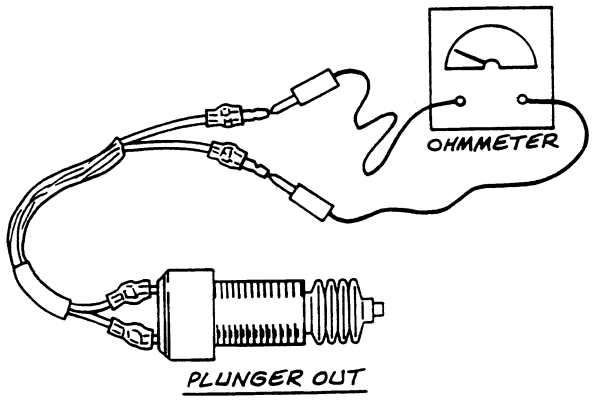
Testing

Use an ohmmeter to test both positions of the mid PTO safety switch for electrical continuity.





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EXTENDED POSITION

4. With the switch plunger in the "extended" position (OUT), there should be no continuity between the two switch terminals. If continuity exists between the two switch terminals when the switch plunger is in the "extended" position, the switch is defective and requires replacement.

RETRACTED POSITION

1. With the switch plunger is pushed into the "retracted" position (IN), touch one of the test probes to the one switch lead. Touch the other test probe to the other switch lead.
2. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If continuity does not exist between the two switch terminals when the switch is in the "retracted" position, the switch is defective and requires replacement.

Installation

1. Install the mid PTO switch onto the tractor by using the adjusting nut.
2. Connect the switch wire leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.
4. Use the two adjusting nuts on the switch assembly to raise the switch so that the plunger is depressed between 2 - 3 mm when the lever is in the control lowered position. Tighten the adjusting nuts to lock the switch into position.
5. Confirm proper switch adjustment using the chart below.

Mid PTO Engaged (Lever Pulled Up)	Tractor Will Not Start
Mid PTO Disengaged (Lever Pushed Down)	Tractor Will Start

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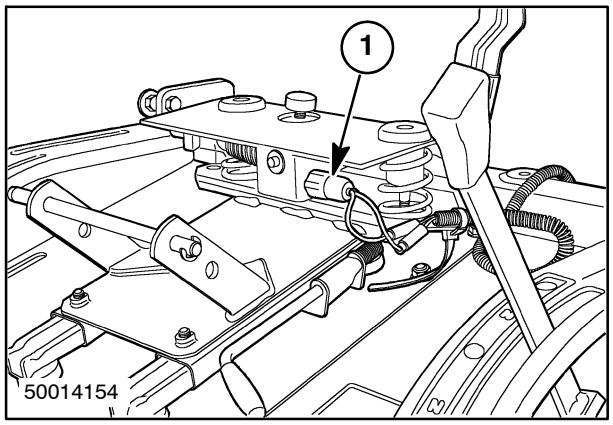
SEAT SAFETY SWITCH

The seat safety start switch, 1, is a single pole, push-button type switch located underneath the operator seat. When the operator is not present, the switch contacts are open and will not allow the tractor to start. When the operator is present, the switch contacts are closed, allowing the tractor to start.

NOTE: *The operator seat was removed to better show the seat safety switch location. Removal of the seat is not necessary.*



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Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Tilt the operator seat forward to gain access to the seat safety switch.
3. Disconnect the two seat safety switch wire leads from the tractor wiring harness.
4. Unthread the retaining nut to remove the seat safety switch, 1, from the mounting bracket.

Testing

Use an ohmmeter to test the seat safety switch for electrical continuity.

Switch Plunger Extended (Out)

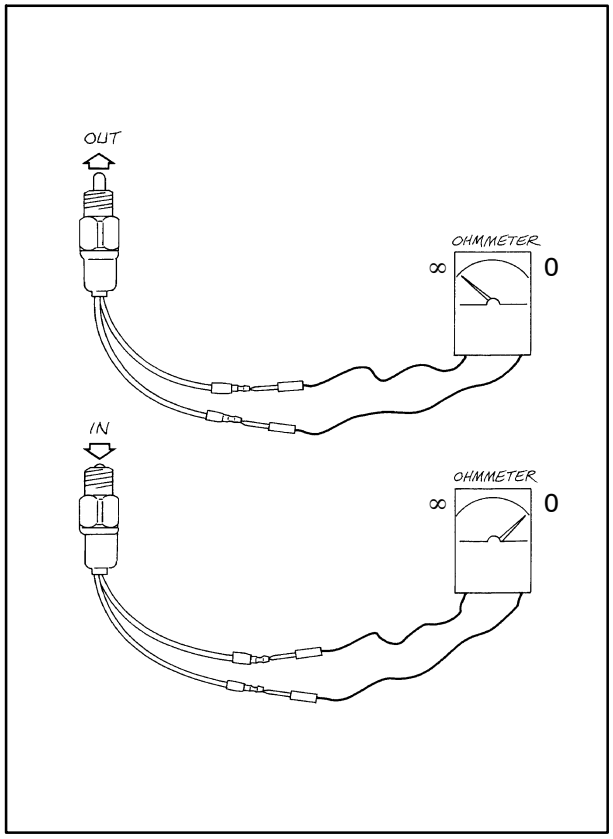
1. Remove the seat safety switch.
2. When the switch is in the raised (operator not seated) position, the switch contacts should be open and there should be high resistance, indicating no continuity. If continuity exists when the switch is in extended position, the seat switch is defective and requires replacement.

Switch Plunger Retracted (In)

1. Press the switch down (operator seated) and observe the reading on the ohmmeter. There should be little or no resistance, indicating that continuity exists between the two switch terminals. If the resistance is high, there is no continuity, the switch is defective and requires replacement.

Installation

1. Insert the seat safety switch into the mounting bracket and secure by threading the nut onto the switch.
2. Connect the two wire leads of the seat safety switch to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



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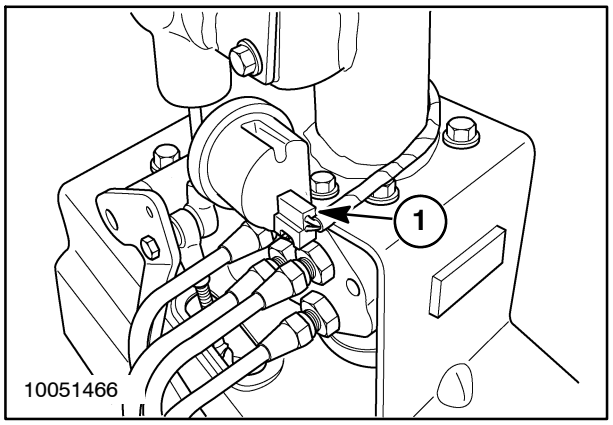
SAFETY ALARM (BUZZER)

The safety alarm buzzer, 1, is located under the dashboard cowling, on the right side of the steering column. The buzzer will alarm for approximately for eight seconds, when an unsafe condition occurs, warning the operator.

For Example:

- The buzzer will alarm, with the key in the "OFF" position and the park brake disengaged.
- The buzzer will alarm, during starting, with the range gear not in neutral. (tractor will not start)



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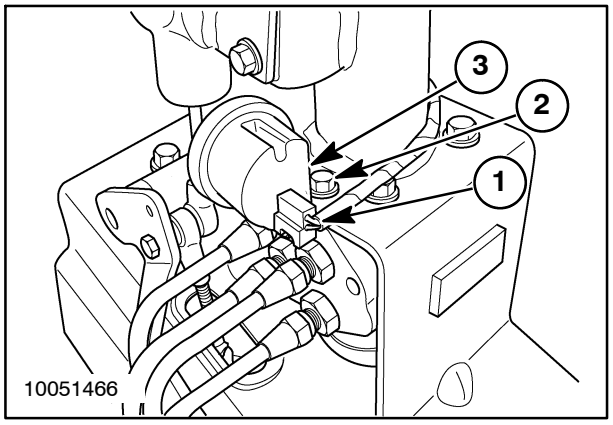
Removal

1. Disconnect the negative (-) battery cable from the battery negative (-) terminal.
2. Remove steering wheel and steering wheel cowling to gain access to alarm buzzer.
3. Disconnect the buzzer connector, 1, from the tractor wire harness
4. Remove mounting bolt, 2, and buzzer, 3, from the tractor mainframe.



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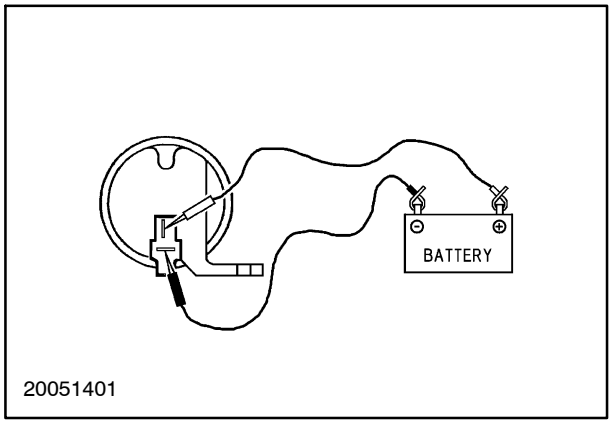
Inspection

NOTE: *The buzzer cannot be inspected with an ohmmeter.*

1. Connect terminal "A" to the positive (+) post of the battery.
2. Connect the terminal "B" to the negative (-) post of the battery.
3. The buzzer should alarm while connected to the battery.
4. If the buzzer does NOT alarm while connected to battery, replace the buzzer.



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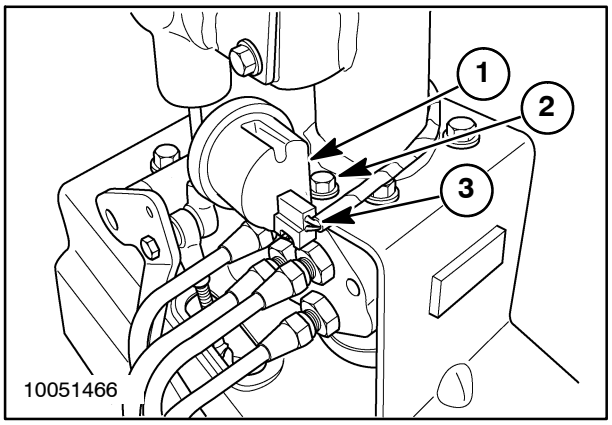
Installation

1. Install the buzzer, 1, on the main frame using mounting bolt, 2.
2. Connect the buzzer connector, 3, to the tractor wire harness.
3. Install steering wheel cowling and steering wheel.
4. Connect the negative (–) battery cable from the battery negative (–) terminal.



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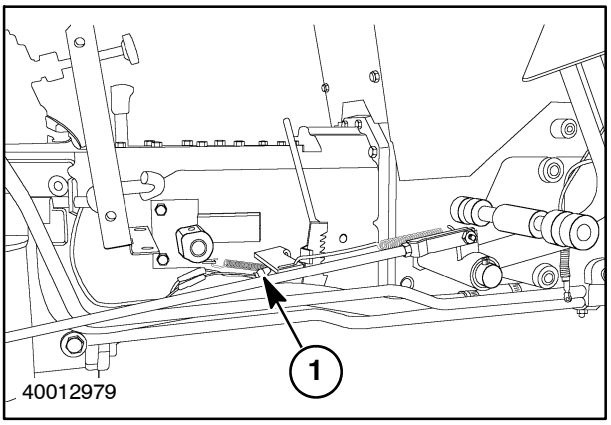
PARK BRAKE SAFETY SWITCH

NOTE: *The right-side operator platform was removed to better show the position of the brake switch.*

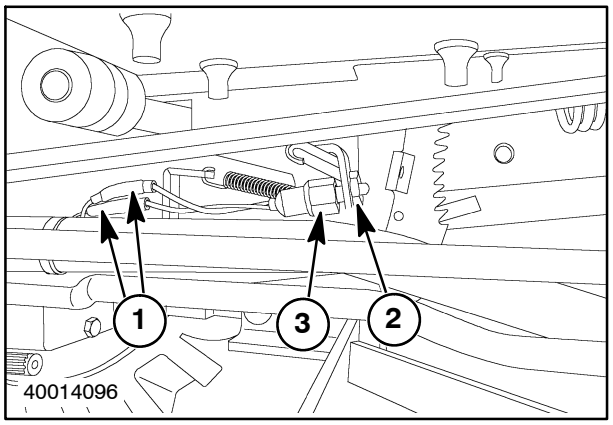
The park brake safety switch, 1, is a single-pole, push-button type switch located directly behind the park brake lever. When the park brake is engaged, the switch contacts are closed.



55

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two switch leads, 1, from the tractor wire harness.
3. Remove the adjusting nut, 2, to remove the park brake switch, 3, from the tractor.



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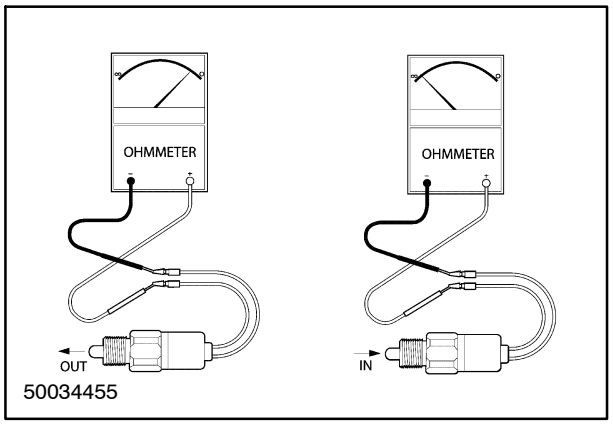
Testing

Use an ohmmeter to test both positions of the park brake safety switch for electrical continuity.

EXTENDED POSITION

1. With the switch plunger in the "extended" position, touch one of the test probes to the one switch lead. Touch the other test probe to the other switch lead.
2. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If continuity does not exist between the two switch terminals when the switch is in the "extended" position, the switch is defective and requires replacement.



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RETRACTED POSITION

1. With the switch plunger pushed in to the "retracted" position, there should be no continuity between the two switch terminals. If continuity exists between the two switch terminals when the switch plunger is in the retracted position, the switch is defective and requires replacement.

Installation

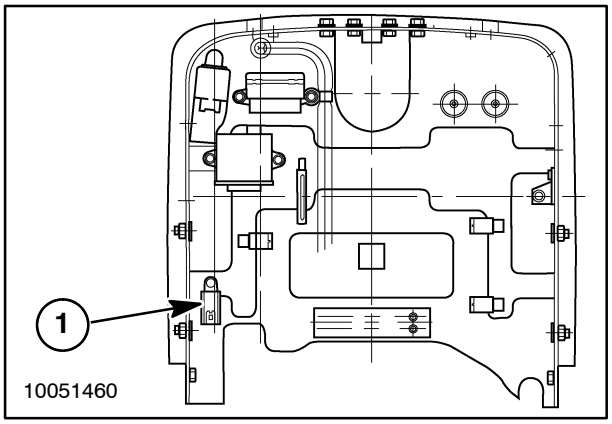
1. Install the park brake safety switch by using the adjusting nut.
2. Connect the two switch leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.
4. Make sure the switch is adjusted so that the switch plunger is depressed 2 - 3 mm when the park brake is NOT engaged.

RELAYS

Relays are used on the TC30 tractor to automatically complete (close) a circuit. There are three relays used on the TC30 tractor. All relays use the same part number and are interchangeable. A relay contains two parts of a circuit. One part, the control circuit, uses current to energize a coil. The other part, the function circuit, is a switch. When energized, the coil of the relay becomes an electromagnet opening or closing the function circuit.

SAFETY START RELAY

The safety start relay, 1, is located in the engine compartment on the lower right side of the tractor firewall. The start relay controls current flowing to the starter solenoid. When the key switch is turned to the "START" position, current flows to the switch side of the relay. The safety controller provides current to the coil side of the relay when the transmission range, rear PTO, mid PTO safety switches are closed, allowing the controller to activate the start relay. The ground source to the relay is provided by the ground terminal located at the engine cylinder head. When current and ground are provided to the coil side of the relay, the relay energizes allowing the relay contacts to close, which allows current to be sent to the engine starter solenoid.



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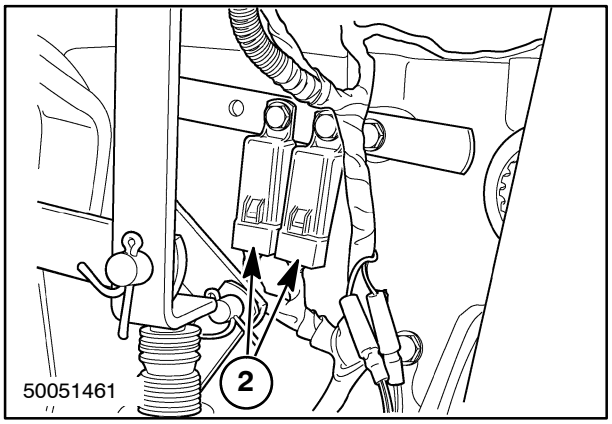
TAIL LIGHT RELAYS

NOTE: *The left rear wheel and the left rear fender were removed to better show the location of the relays.*

The relays, 2, are located on the lift cover behind the left rear fender; controls current flow to the tail lights. When current is interrupted and no longer provided to the relay, the relay becomes de-energized and no longer provides current to the tail lights.



59

Removal (All Relays)

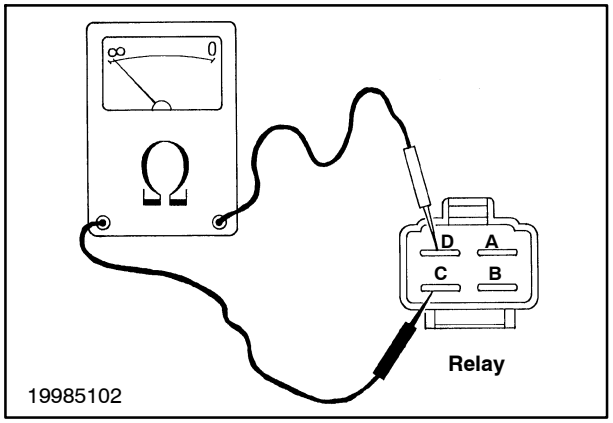
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Unplug the connector from the relay.
3. Remove the retaining bolt to remove the relay from the tractor.

Testing (All Relays)

Use a 12-volt power source and an ohmmeter to verify that the relay is functioning properly.

NON-ENERGIZED

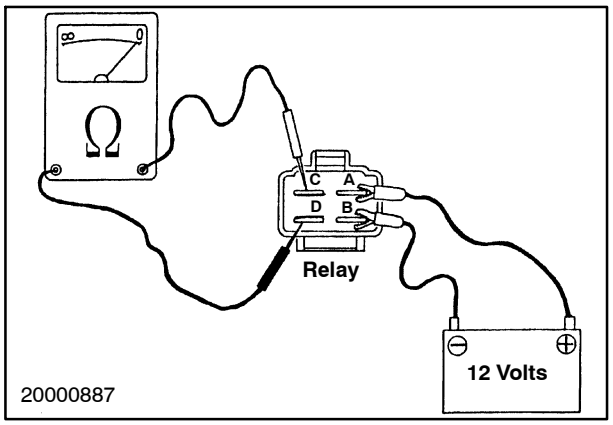
1. Connect the ohmmeter test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading.
2. There should be no continuity between the terminals "C" and "D" when the relay is not energized. If continuity exists between terminals "C" and "D" when the relay is not energized, the relay is defective and requires replacement.



60

ENERGIZED

1. Connect a jumper wire from the positive (+) terminal of the 12-volt power source to the "A" terminal of the relay.
2. Connect the negative (-) terminal of the 12-volt power source to the "B" terminal of the relay.
3. Connect the ohmmeter test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading.
4. There should be little or no resistance between the "C" and "D" terminals of the relay when energized, indicating that continuity exists between terminals "C" and "D". If continuity does not exist between terminal "C" and "D" when the relay is energized, the relay is defective an requires replacement.



61

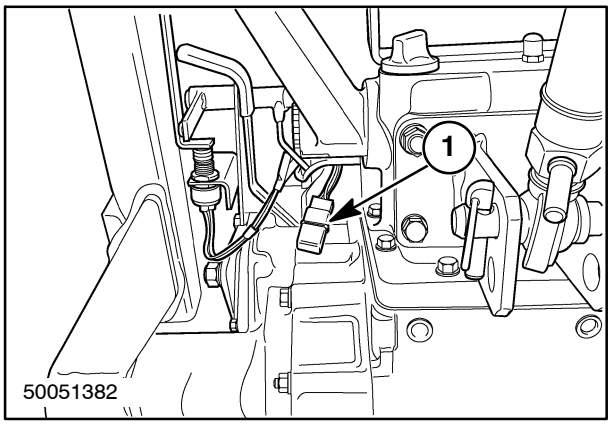
Installation (All Relays)

1. Plug the relay into the connector on the tractor wire harness.
2. Install the relay onto the tractor by using the retaining bolt.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

DIODES

Ohio Lighting Diode Pack (Optional)

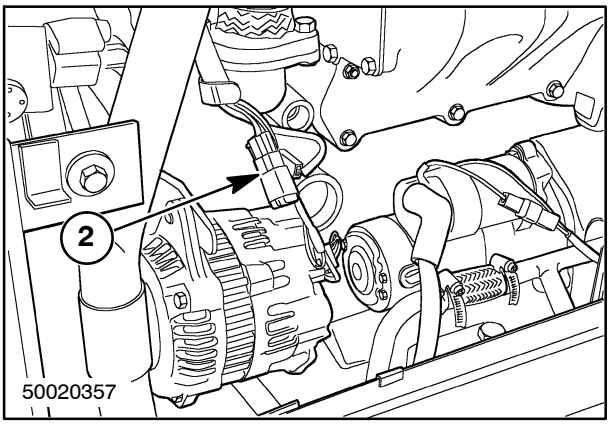
The diode pack, 1, is located behind the left fender on the left side of the lift cover. The diode pack contains two individual diodes that force current to flow in one direction. Diodes allow the use of one wire within multiple circuits to control current flow to electrical components such as relays.



62

Charging System Diode

The charging system diode, 2, is located along the left side of the engine near the alternator. The charging system diode is used to prevent current from back feeding into the low charge indicator light within the instrument panel.



63

Removal (All Diodes)

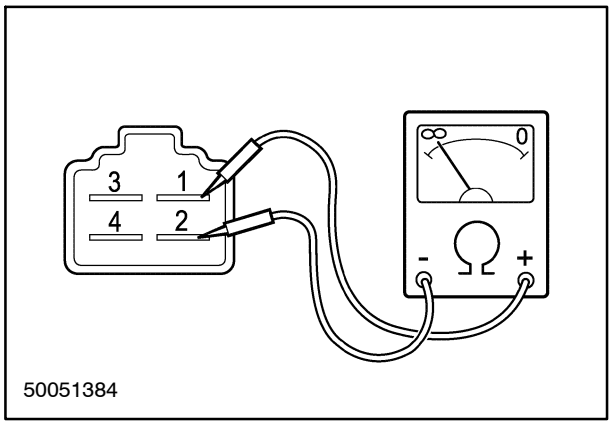
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Unplug the connector from the diode.
3. Remove the diode from the tractor.

Testing Ohio Lighting Diode Pack

1. Remove the diode module suspected of being faulty from the tractor.

NOTE: *For this test, an electrical multimeter with diode test capabilities may be used in place of an ohmmeter. If a multimeter with diode testing capabilities is unavailable, use an ohmmeter to test as described below.*

2. Using an ohmmeter, touch the red, positive (+), test probe to diode terminal "1". Touch the black, negative (-), ohmmeter test probe to diode terminal "2". Observe the ohmmeter.
3. The ohmmeter should show high resistance, indicating no continuity and that current is not flowing through the diode in that direction. If there is continuity. Check to see that the test probes are on the correct terminals, and if they are, the diode module is defective and needs replaced.



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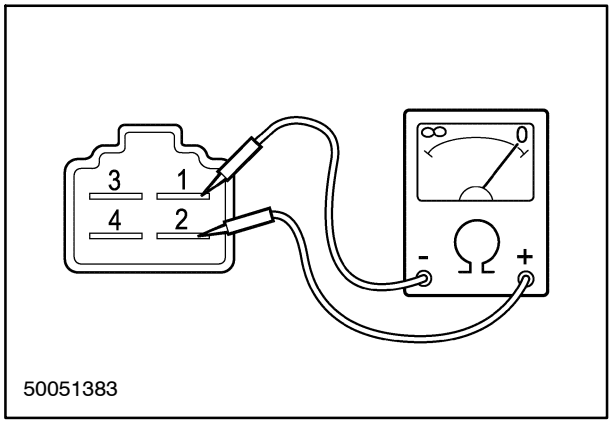
4. If the previous test indicated the diode was functioning properly, touch the red, positive (+), ohmmeter test probe to terminal "2" of the diode and the black, negative (-), test probe to terminal "1" of the diode.
5. Observe the ohmmeter. The ohmmeter should show little or no resistance, indicating continuity in that direction. If the ohmmeter does not show continuity, the diode module is defective and needs replaced.
6. Repeat test on terminals "3" and "4".



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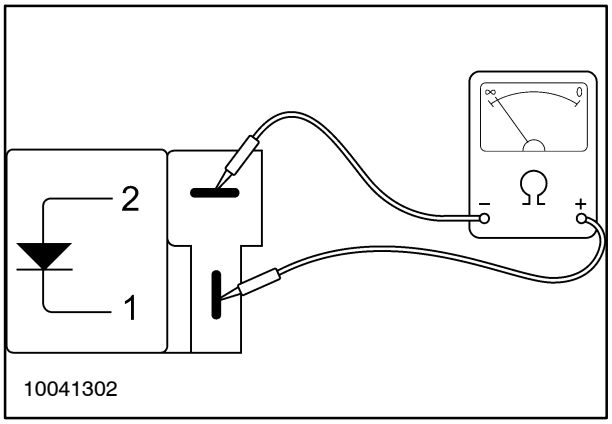
Testing Charging System Diode

1. Remove the diode module suspected of being faulty from the tractor.

NOTE: *For this test, an electrical multimeter with diode test capabilities may be used in place of an ohmmeter. If a multimeter with diode testing capabilities is unavailable, use an ohmmeter to test as described below. A diode will only allow current flow in one direction.*

2. Using an ohmmeter, touch the red, positive (+), test probe to diode terminal “1”. Touch the black, negative (–), ohmmeter test probe to diode terminal “2”. Observe the ohmmeter.
3. The ohmmeter should show high resistance, indicating no continuity and that current is not flowing through the diode in that direction. If there is continuity. Check to see that the test probes are on the correct terminals, and if they are, the diode module is defective and needs replaced.



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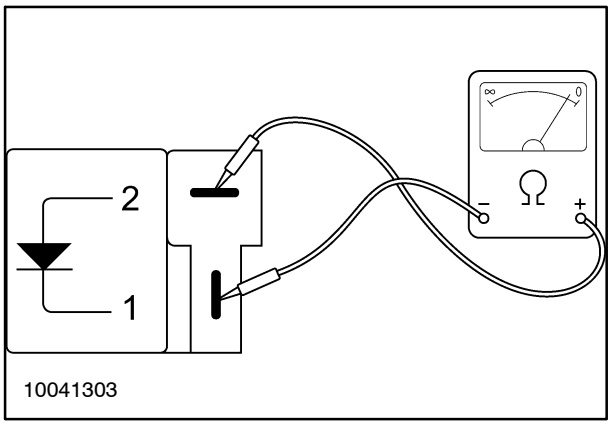
4. If the previous test indicated the diode was functioning properly, touch the red, positive (+), ohmmeter test probe to terminal “2” of the diode and the black, negative (–), test probe to terminal “1” of the diode.
5. Observe the ohmmeter. The ohmmeter should show little or no resistance, indicating continuity in that direction. If the ohmmeter does not show continuity, the diode module is defective and needs replaced.



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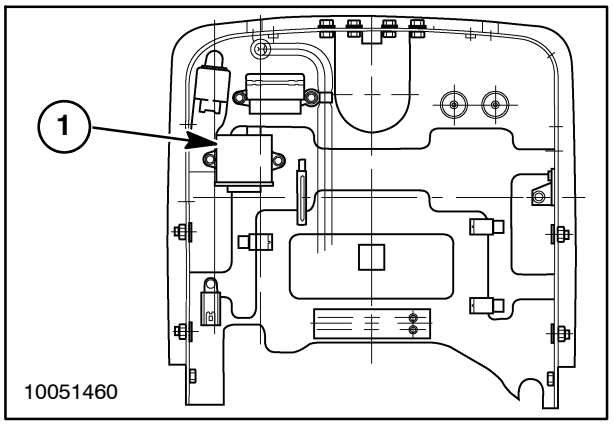
Installation (All Diodes)

1. Plug the diode into the connector on the tractor wire harness.
2. Connect the negative (–) battery cable to the negative (–) battery terminal.

SAFETY CONTROLLER

The safety controller, 1, is located in the engine compartment on the right side of the tractor firewall. The controller coordinates the safety start, safe operation and shutdown functions of the tractor electrical system.



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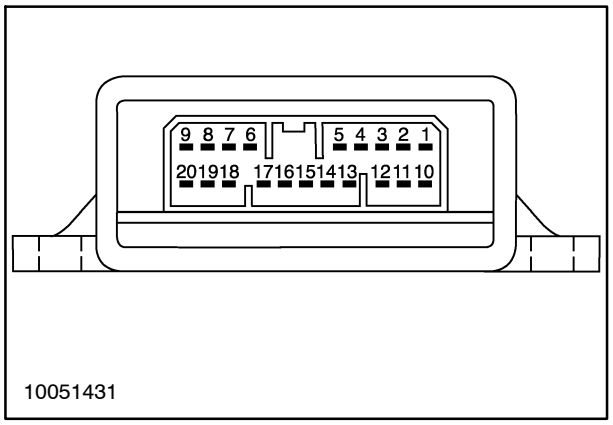
Removal

1. Open tractor hood.
2. Disconnect the negative (-) battery cable from the (-) battery terminal.
3. Disconnect the safety controller from the tractor wire harness.
4. Remove the two mounting screws and the controller from the tractor.



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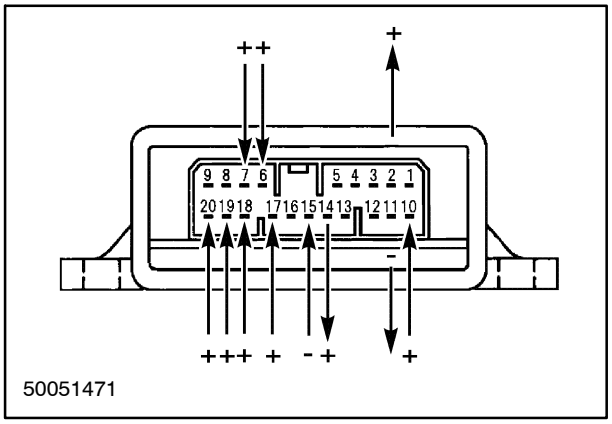
Terminal Identification

(As viewed from the bottom of the controller)

Terminal #	Function	Terminal #	Function
1	NA	11	Ground (-)
2	To start relay	12	NA
3	NA	13	NA
4	To Alarm	14	NA
5	To fuel shutoff solenoid	15	From glow plug indicator light
6	From terminals “17&18” of key switch	16	From PTO indicator light
7	From mid PTO switch	17	From terminal “50” of key switch
8	From seat switch	18	From “AC” terminal of key switch
9	From park brake switch	19	From range gear switch
10	From 5-amp fuse	20	From rear PTO switch

Testing Safety Start Circuit
Using a 12 volt supply and an ohm meter test current at indicated terminals.

Input (+)	Terminals #s 6,7,10,17,18,19,20
Ground (-)	Terminal #s 11
Input (-)	Terminal #s 15
Output (+)	Terminals #s 2,14



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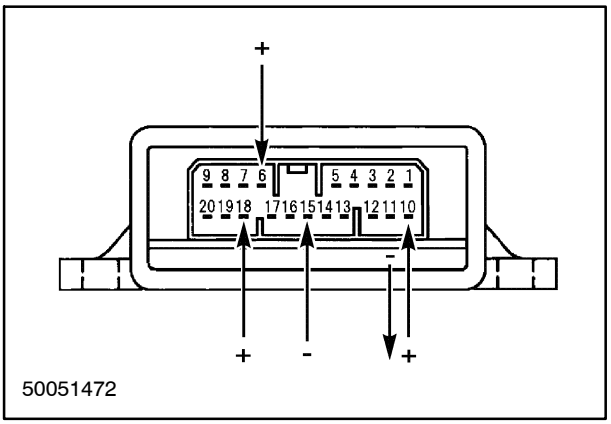
Testing Glow Plug Circuit
Using a 12 volt supply and an ohm meter test current at indicted terminals.

Input (+)	Terminals #s 6,10,18,
Ground (-)	Terminal #s 11
Input (-)	Terminals #s 15



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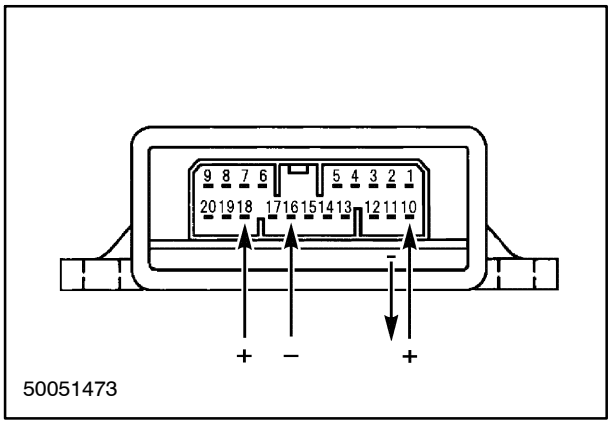
Testing PTO Indicator Light Circuit
Using a 12 volt supply and an ohm meter test current at indicted terminals.

Input (+)	Terminals #s10,18,
Ground (-)	Terminal #s 11
Input (-)	Terminals #s 16



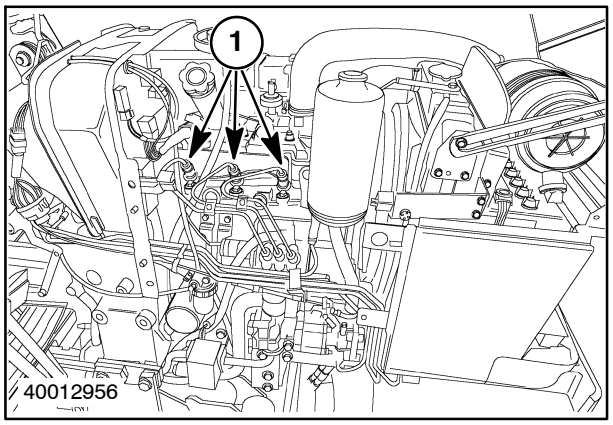
72

Installation
1. Install the controller to the tractor using the two mounting screws.
2. Connect the safety controller to the tractor wire harness.
3. Reconnect the negative (-) battery cable to the (-) battery terminal.
4. Close the tractor hood.

Op. 55 201

ENGINE GLOW PLUGS

The engine glow plugs, 1, are located on the right side of the cylinder head, below the fuel injectors. The glow plugs are used to preheat the air in the pre-combustion chamber. This aids in the starting of the engine when cold.



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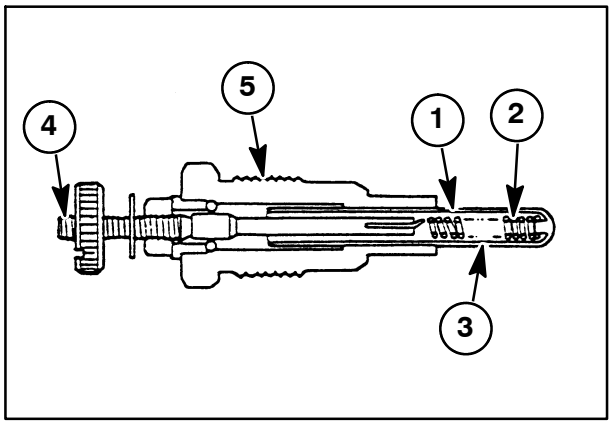
The glow plugs use a heating element that is contained in a stainless steel sheath, 1. The coiled heating wire, 2 is sintered into magnesium oxide powder, 3. The magnesium oxide powder is used to evenly transfer heat to the stainless steel sheath, which heats the air in the combustion chamber. The magnesium oxide powder is also used to insulate the heating wire from the outer sheath and glow plug body.

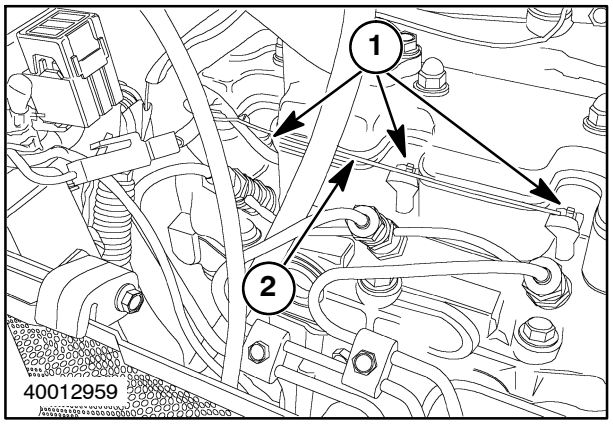
The glow plug heats when electrical current is passed from the glow plug electrode, 4, to one end of the heating wire, 2. Electrical resistance warms the heating wire when electrical current is flowing through the wire. The opposite end of the wire is connected to the sheath. The sheath and the glow plug body, 5, are grounded by the engine block.



74

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the three nuts, 1, and the washers securing the electrode bar, 2, to the glow plugs.
3. Remove the glow plugs from the cylinder engine head.



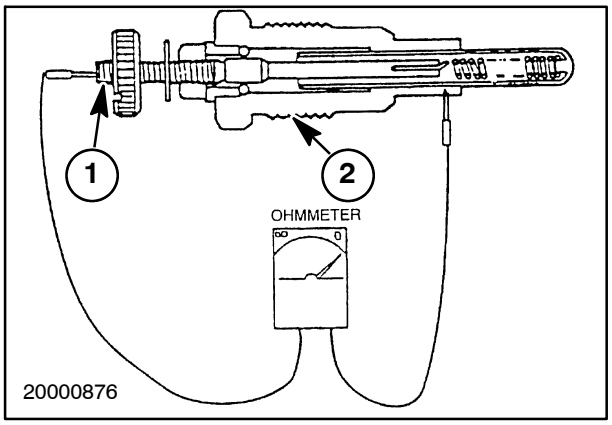
75

Testing

1. Clean the carbon from the glow plug sheath.

NOTE: *Do not test resistance using the glow plug sheath.*

2. Using an ohmmeter, touch one of the test probes to the glow plug electrode, 1. Touch the other test probe to the glow plug body, 2.
3. Observe the ohmmeter. A resistance reading of 1.6 ohms maximum is normal for the engine glow plugs. If the resistance reading is too high, the glow plug is defective and requires replacement.



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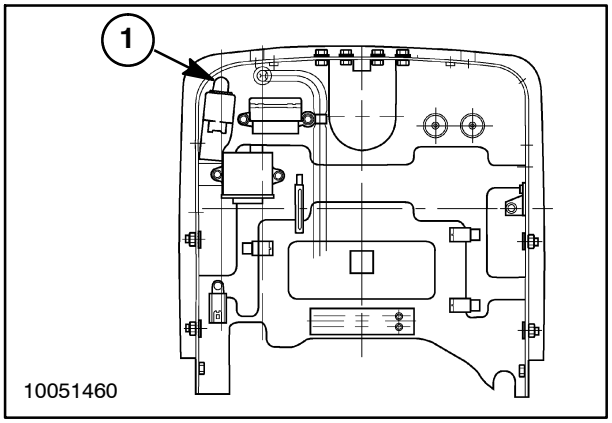
Installation

1. Thread the glow plugs into the engine cylinder head. Torque each glow plug to 10 - 15 N·m (11.0 - 14.5 ft. lbs.).
2. Install the electrode bar and the washers onto the glow plugs. Secure by using the three nuts.
3. Connect the negative (–) battery cable to the negative (–) battery terminal.

HAZARD FLASHER/TURN SIGNAL CONTROL MODULE

The hazard flasher/turn signal control module, 1, is located in the engine compartment, on the right side of the firewall. The control module controls current flowing to the hazard flasher/turn signal lights on the rear fenders. Refer to the chart below for the functions of the control module.

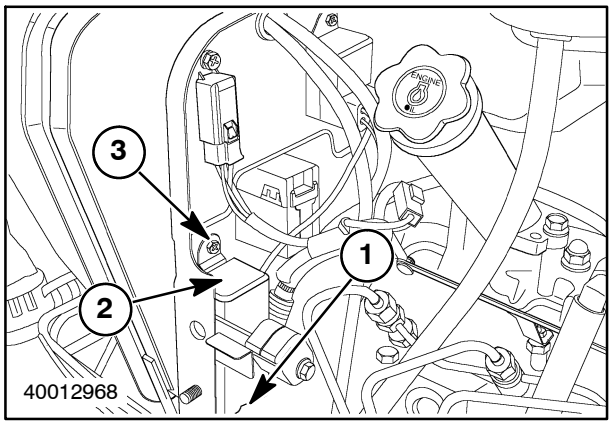
HAZARD/TURN SIGNAL SWITCH POSITION	RESULT
Hazard switch “On”	Both flashers blink in unison
Left turn signal “On”	Left flasher blinks and right flasher remains solid.
Right turn signal “On”	Right flasher blinks and left flasher remains solid



77

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Unplug the connector, 1, from the control module, 2.
3. Remove the retaining bolt, 3, to remove the relay, 2, from the tractor.



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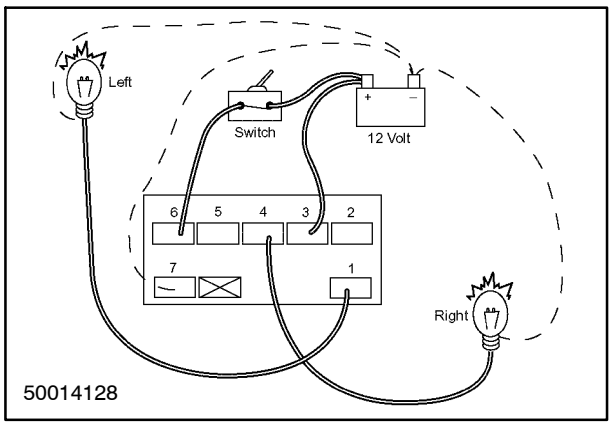
Testing

Use a 12-volt power source, a suitable switch, jumper wires and two test lights to perform the 3 tests on the hazard flasher /turn signal control module.

NOTE: *Disregard terminal markings on the module. Refer to terminal markings in the illustration.*

Test 1 - Test 1 is used to verify that the control module is supplying power to both of the hazard lights. This test simulates the hazard switch being turned to the "On" position.

1. Connect a test light to terminal 1 of the control module. This test light will simulate the left flasher.
2. Connect a test light to terminal 4 of the control module. This test light will simulate the right flasher.
3. Connect a jumper wire to the positive (+) terminal of the power source and the switch. Connect a jumper wire to the switch and terminal 6 on the control module.
4. Connect a jumper wire to the positive (+) terminal of the power source and terminal 3 of the control module.
5. Connect a jumper wire to the negative (-) terminal of the power source and terminal 7 of the control module.
6. Switch the switch to the "On" position, observe the two test lights. Both should flash on and off simultaneously.



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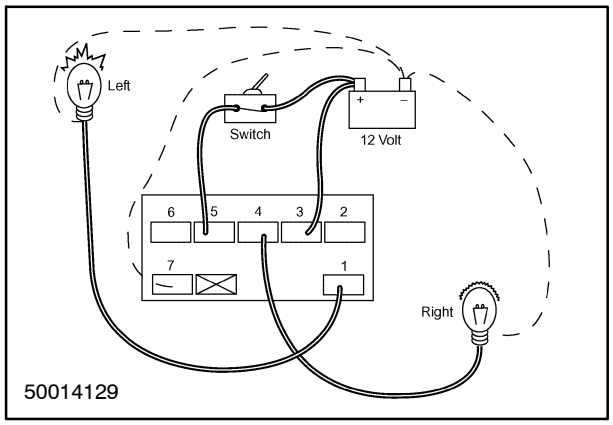
Test 2 - Test 2 is used to verify that the control module is functioning properly when the left turn signal is activated. This test simulates the turn signal switch being turned to the “Left” position.

1. Connect a test light to terminal 1 of the control module. This test light will simulate the left flasher.
2. Connect a jumper wire to the positive (+) terminal of the power source and the switch. Connect a jumper wire to the switch and terminal 5 on the control module.
3. Connect a jumper wire to the positive (+) terminal of the power source and terminal 3 of the control module.
4. Connect a jumper wire to the negative (-) terminal of the power source and terminal 7 of the control module.
5. Turn the switch to the “On” position and observe the two test lights. The left light should flash while the right light remains illuminated (solid).



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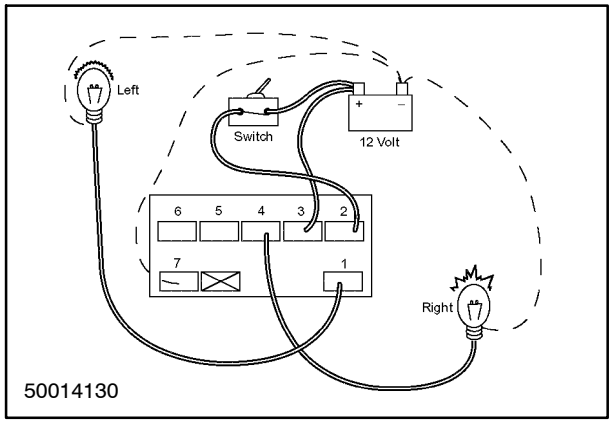
Test 3 - Test 3 is used to verify that the control module is functioning properly when the right turn signal is activated. This test simulates the turn signal switch being turned to the “Right” position.

1. Connect a test light to terminal 1 of the control module. This test light will simulate the left flasher.
2. Connect a jumper wire to the positive (+) terminal of the power source and the switch. Connect a jumper wire to the switch and terminal 2 on the control module.
3. Connect a jumper wire to the positive (+) terminal of the power source and terminal 3 of the control module.
4. Connect a jumper wire to the negative (-) terminal of the power source and terminal 7 of the control module.
5. Turn the switch to the “On” position and observe the two test lights. The right light should flash while the left light remains illuminated (solid).



81

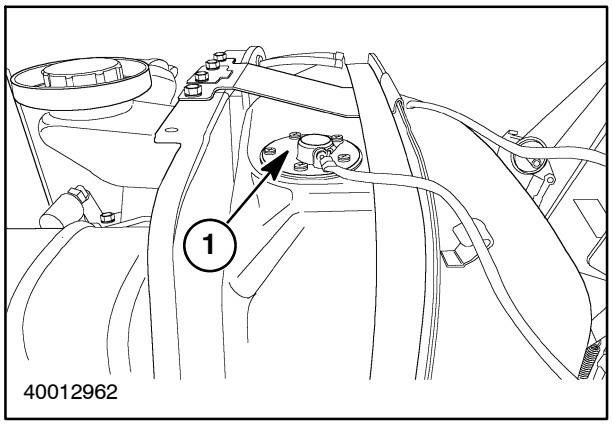
Installation

1. Install the control module onto the tractor firewall by using the retaining bolt.
2. Plug the tractor wire harness connector into the control module.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

Op. 55 410

FUEL LEVEL SENDER

The fuel level sending unit, 1, is mounted on top of the inside of the fuel tank. The sender float moves up and down with the fuel level in the tank, while changing the resistance to the ground circuit of the fuel gauge.



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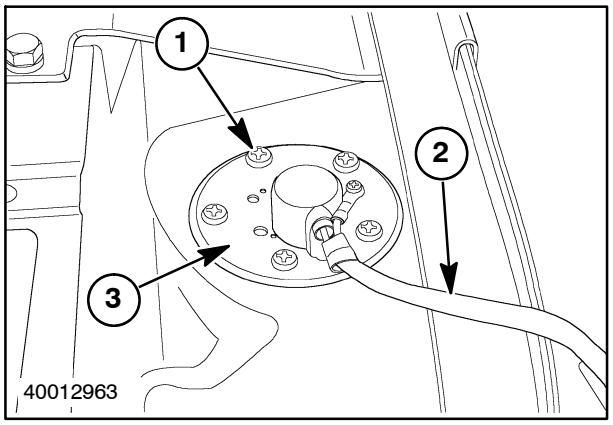
Removal

⚠ WARNING ⚠

Do not expose diesel fuel to open flame or spark. Clean up spills immediately. Do not smoke while near diesel fuel. Serious injury could result.

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the panels from the center console of the tractor to gain access to the fuel tank.
3. Remove the five screws, 1, and disconnect the wire harness, 2, to remove from the fuel level sending unit, 3, from the fuel tank.



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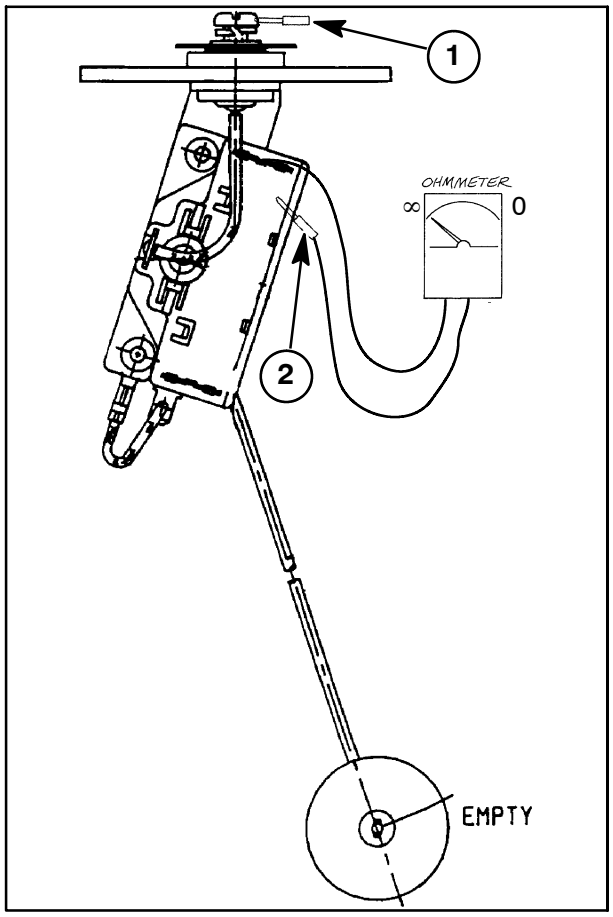
Testing
Use an ohmmeter to test the fuel level sender.

1. Remove the sender from the fuel tank.
2. Attach one of the meter leads to the center post, 1, of the sender. Attach the other meter lead to the ground spade terminal, 2, of the sender body.
   - With the sender in the EMPTY (DOWN) position, the meter reading will be 103 - 117 ohms.
   - With the sender in the FULL (UP) position, the meter reading will be 1 - 5 ohms.

If test results do not match the above, replace the fuel level sender.



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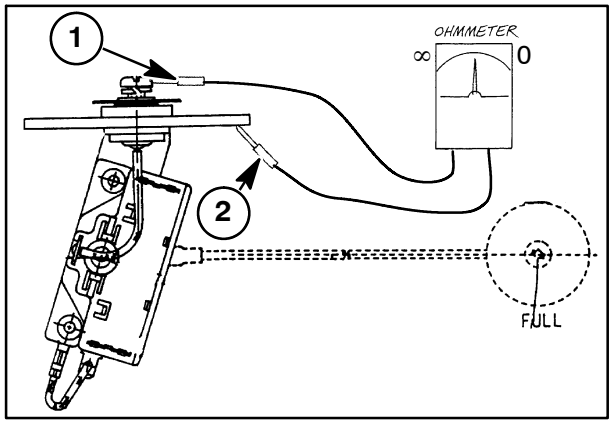

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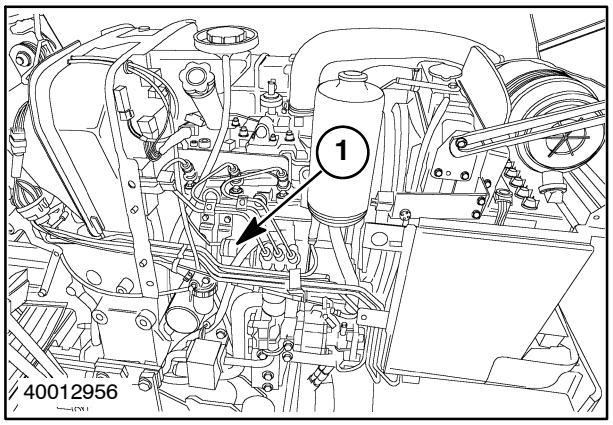
Installation

1. Install the fuel level sending unit by using the five screws.
2. Connect the tractor wire harness to the fuel level sending unit.
3. Install the panels onto the center console of the tractor.
4. Connect the negative (–) battery cable to the negative (–) battery terminal.

FUEL SHUTOFF SOLENOID

The injection pump is equipped with a fuel shutoff solenoid, 1, threaded into the rear of the injection pump casting. The solenoid plunger is spring-loaded; when the solenoid is not energized the plunger pushes the injection pump control rack forward into the closed (shut-off) position. When the solenoid is energized, as when the key switch is turned to the “On” and “Start” Positions, the solenoid plunger is retracted and the governor linkage moves the pump control rack rearward into operating position.



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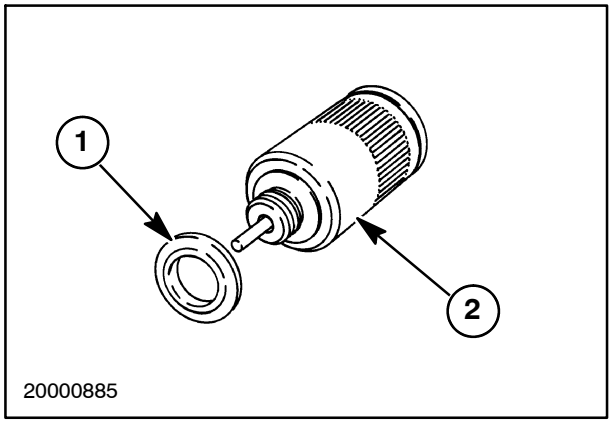
Removal

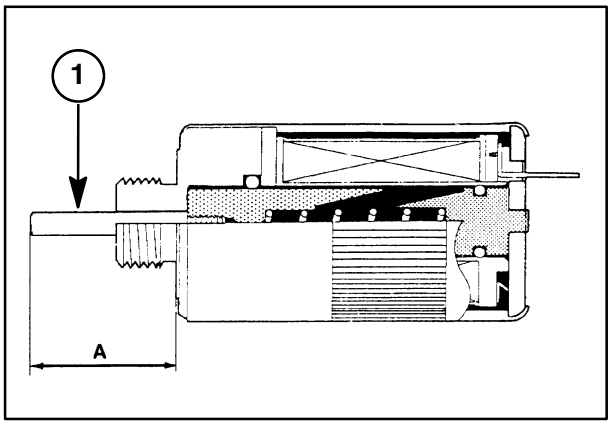
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the fuel shutoff wire from the fuel shutoff solenoid.
3. Using pliers, remove the solenoid from the rear of the injection pump casting.
4. Remove the sealing washer, 1, from the fuel shutoff solenoid, 2.



87

Testing

1. With the solenoid de-energized, measure the protrusion distance “A” of the plunger, 1, as shown at right.
   - In the shut-off position, the plunger protrusion distance, A, should measure 25.5 - 26.4 mm (1.004 - 1.04″).



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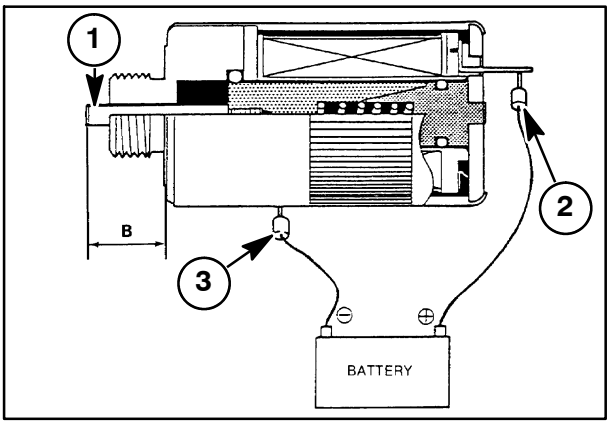
2. Connect a jumper wire from the solenoid terminal, 2, to the battery positive (+) terminal. Connect a second jumper from the battery negative (–) terminal to the solenoid body, 3. The solenoid plunger will retract. Measure the protrusion distance “B” of the plunger, 1, as shown at right.
   - In the retracted position, the plunger protrusion distance, B, should measure 11.5 - 14.5 mm (0.453 - 0.571″).

If the measurements are not within the limits specified above, replace the solenoid.



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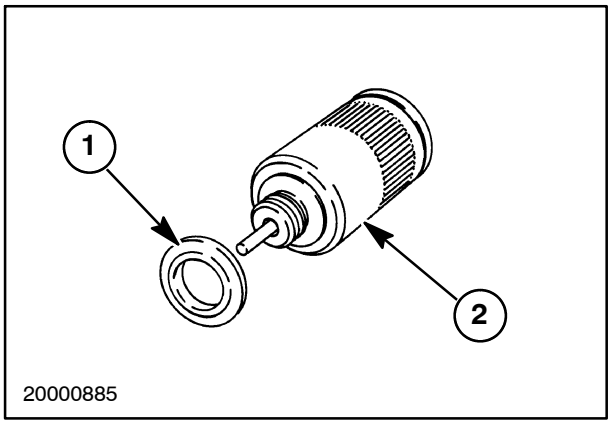
Installation

1. Install a new sealing washer, 1, onto the fuel shutoff solenoid, 2.
2. Thread the fuel shutoff solenoid, 2, into the back of the injection pump casting and tighten.
3. Connect the fuel shutoff solenoid wire to the fuel shutoff solenoid.
4. Connect the negative (–) battery cable to the negative (–) battery terminal.



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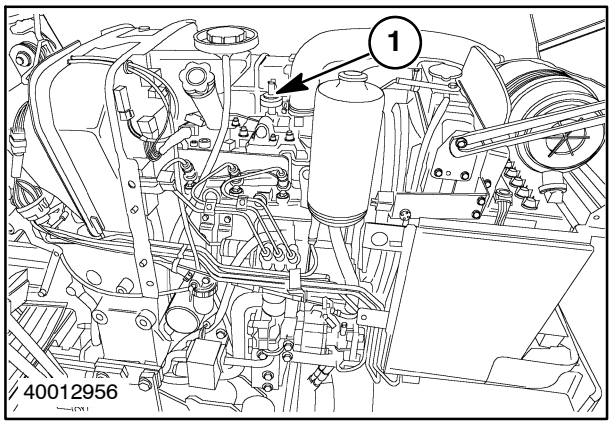
Op. 55 414

AIR FILTER RESTRICTION SWITCH

The air filter restriction switch, 1, is located on the engine valve cover/intake manifold. The air filter restriction switch is a vacuum operated switch, which detects when the air filter becomes clogged or restricted. The contacts within the switch are normally open. When the air filter becomes clogged or restricted, the vacuum created closes the contacts within the switch, completing the ground circuit that illuminates an indicator light within the instrument panel warning the operator of the air restriction. The switch is preset to close at 20 in. H_2O ± 2 in. H_2O of vacuum.



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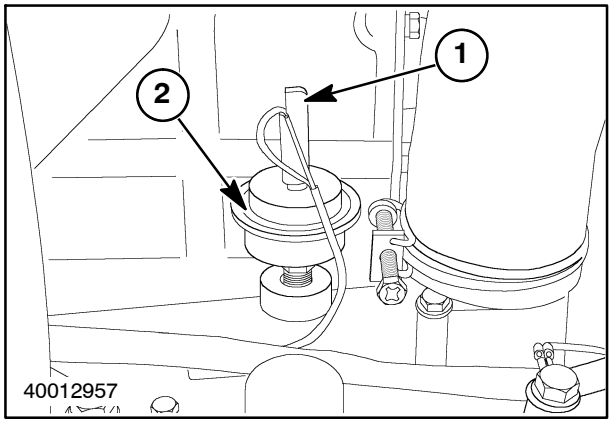
Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Disconnect the two wire harness leads, 1, from the air filter restriction switch, 2. Note where each lead is connected for ease of installation.
3. Unthread the air filter restriction switch, 2, from the engine valve cover/intake manifold.

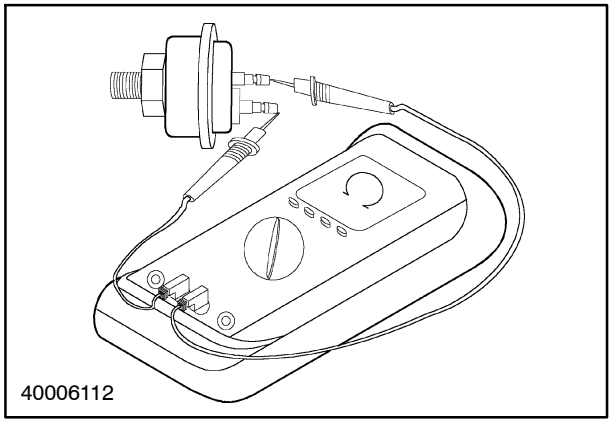


92

Testing

Use an ohmmeter to test if the air filter restriction switch is functioning properly.

1. Touch an ohmmeter test probe to each terminal on the switch. Observe the ohmmeter. The ohmmeter should indicate that no continuity exists between the two terminals. If continuity exists, the switch is defective and requires replacement.
2. Apply a vacuum of approximately 20 in. H_2O ± 2 in. H_2O to the switch. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating that continuity exists between the two switch terminals. If there is no continuity between the two switch terminals, the switch is defective and requires replacement.



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Installation

1. Apply LocTite 567 thread sealant to the switch threads and install the switch into the engine valve cover/intake manifold.

NOTE: *When installing the two wire harness leads onto the air restriction switch, be sure the orange wire is connected to the insulated terminal on the switch.*

2. Connect the two wire harness leads to the air filter restriction switch.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.

Op. 55 414

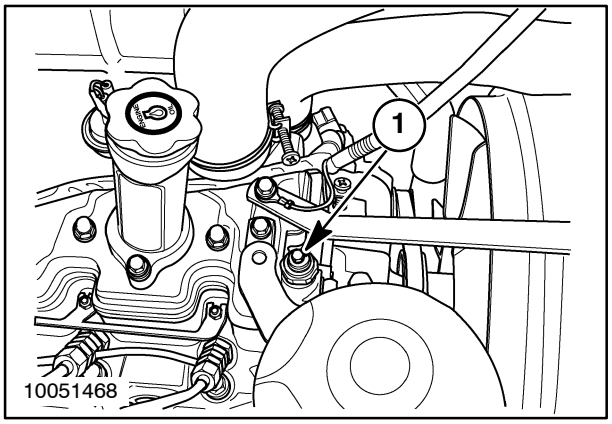
OIL PRESSURE SWITCH

The oil pressure switch, 1, is located underneath the radiator support bracket on the front of the engine cylinder head. The switch opens under normal oil pressure (above 6 PSI) and closes when the oil pressure is low (below 6 PSI) to complete the ground circuit of the oil pressure warning light.

When the ground circuit is completed, the oil pressure warning light within the instrument panel illuminates. The engine oil pressure switch is closed before the tractor engine is started, and is opened after the engine is started. If the warning light fails to stop illuminating after the engine is started, the oil level inside the engine may be low or there may be a problem with the tractor engine.

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the retaining screw, 1, that secures the electrical ring terminal to the oil pressure switch, 2.
3. Unthread the oil pressure switch, 2, from the engine cylinder head.



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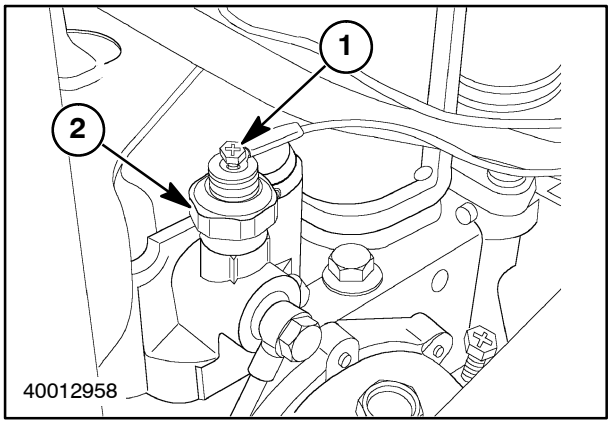

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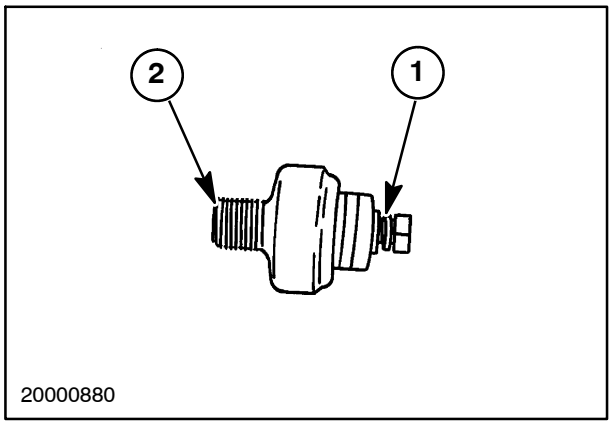
Testing

1. Using an ohmmeter, touch one test lead to the pressure switch terminal, 1, and the other test lead to the threads of the switch body, 2.
2. Observe the ohmmeter. There should be little or no resistance, indicating continuity in the switch. If there is no continuity, the switch is defective and needs replaced.

⚠ CAUTION ⚠

Do not use high pressure compressed air for the following test, otherwise damage may occur to the oil pressure switch.



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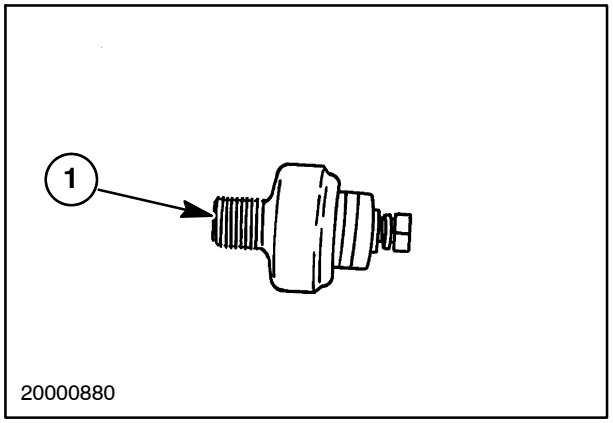
NOTE: *The following test is not a calibrated test. The purpose of the test is to see if the switch contacts open at pressure.*

3. While the test leads are connected to the switch, pressurize the switch oil pressure port, 1, with low pressure (10 - 20 psi) compressed air.
4. Observe the ohmmeter. While air pressure is being supplied to the oil pressure port, the ohmmeter should indicate high resistance, or no continuity. If there is continuity, the switch is defective and needs replaced.



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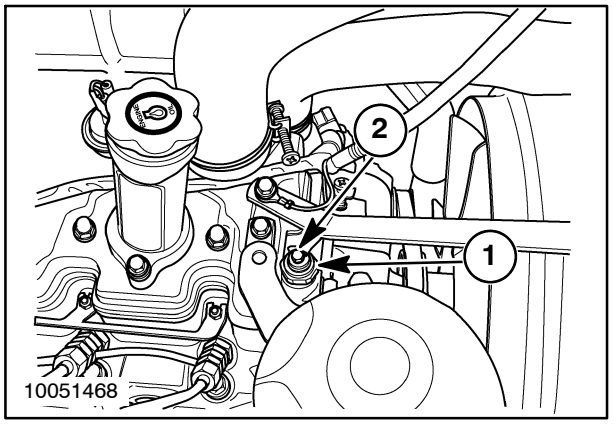
Installation

1. Apply LocTite® - 567 thread sealant onto the switch threads and install the oil pressure switch, 1, into the engine cylinder head.
2. Install the ring terminal onto the oil pressure switch by using the retaining screw, 2.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



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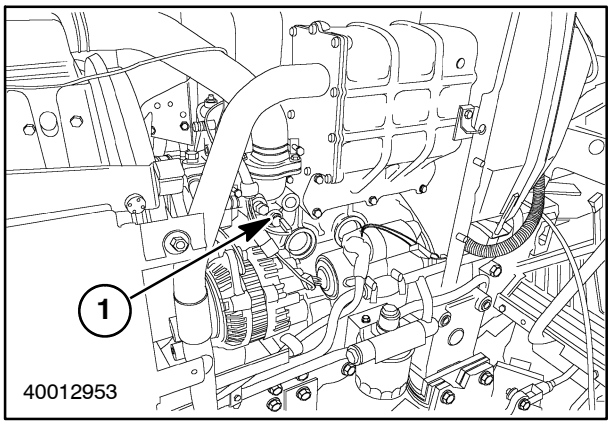
Op. 55 414

COOLANT TEMPERATURE SENDING UNIT

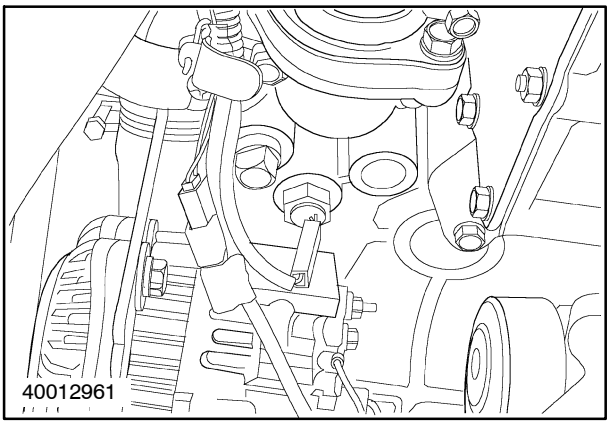
The engine coolant temperature sending unit, 1, is located on the left side of the thermostat housing on the model TC30 tractors. The sending unit regulates a variable resistance to ground, which translates to movement of the engine temperature gauge within the instrument panel. The sending unit decreases ground resistance as the coolant temperature rises, causing the temperature gauge to rise.



99

Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Drain the engine coolant from the radiator into a clean pan.
3. Disconnect the wire lead from the sending unit.
4. Unthread the engine coolant-sending unit from the thermostat housing for removal.



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Installation

1. Apply Loctite - 567 to the threaded portion of the engine coolant temperature sending unit.
2. Install the engine coolant temperature sending unit into the thermostat housing.
3. Connect the wire lead to the engine coolant temperature sending unit.
4. Fill the radiator with the recommended coolant mixture.
5. Connect the negative (–) battery cable to the negative (–) battery terminal.

SECTION 55 - ELECTRICAL SYSTEM

Chapter 6 - Electrical Circuits
PIN Number HK34733 and Above

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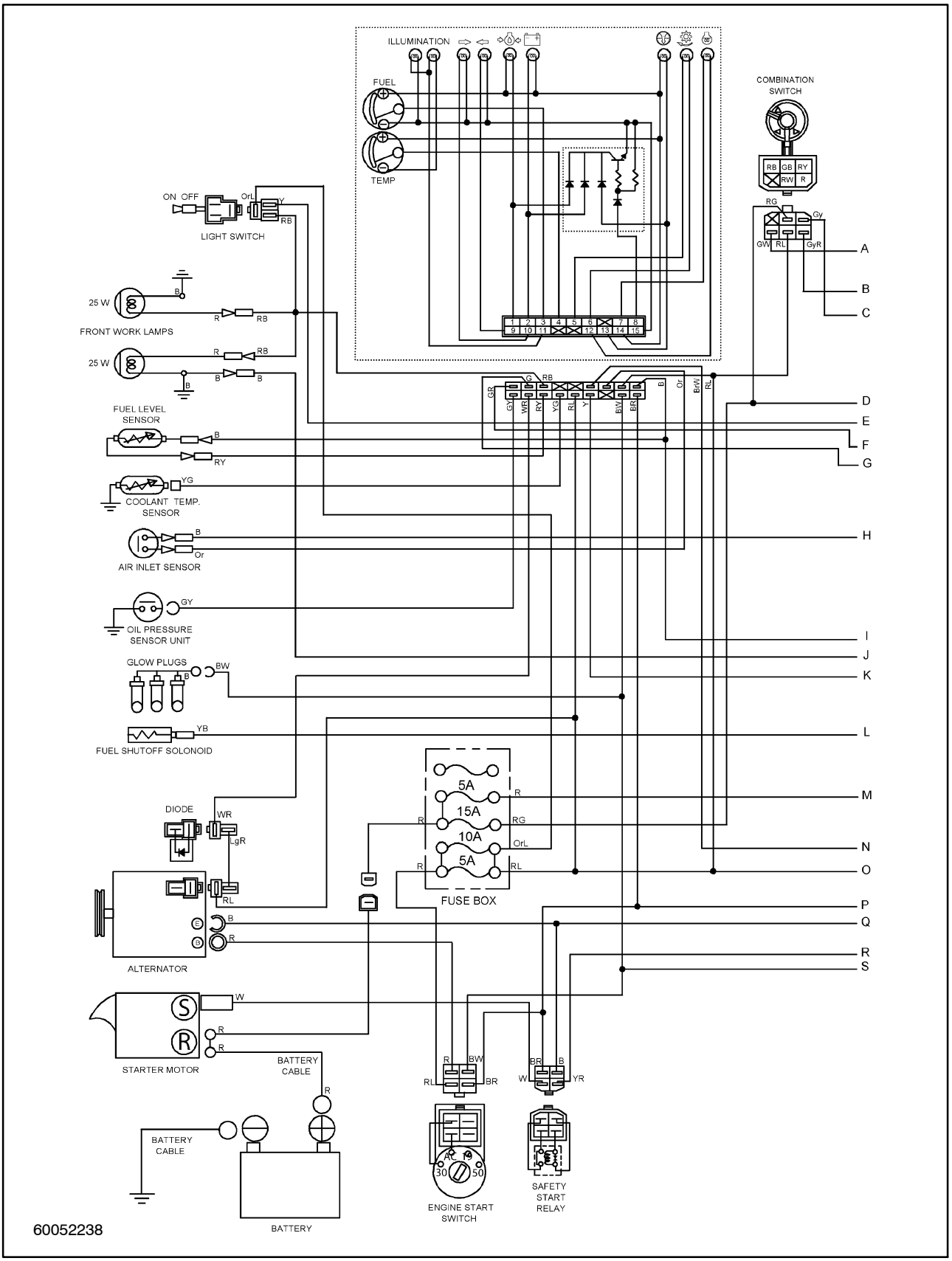
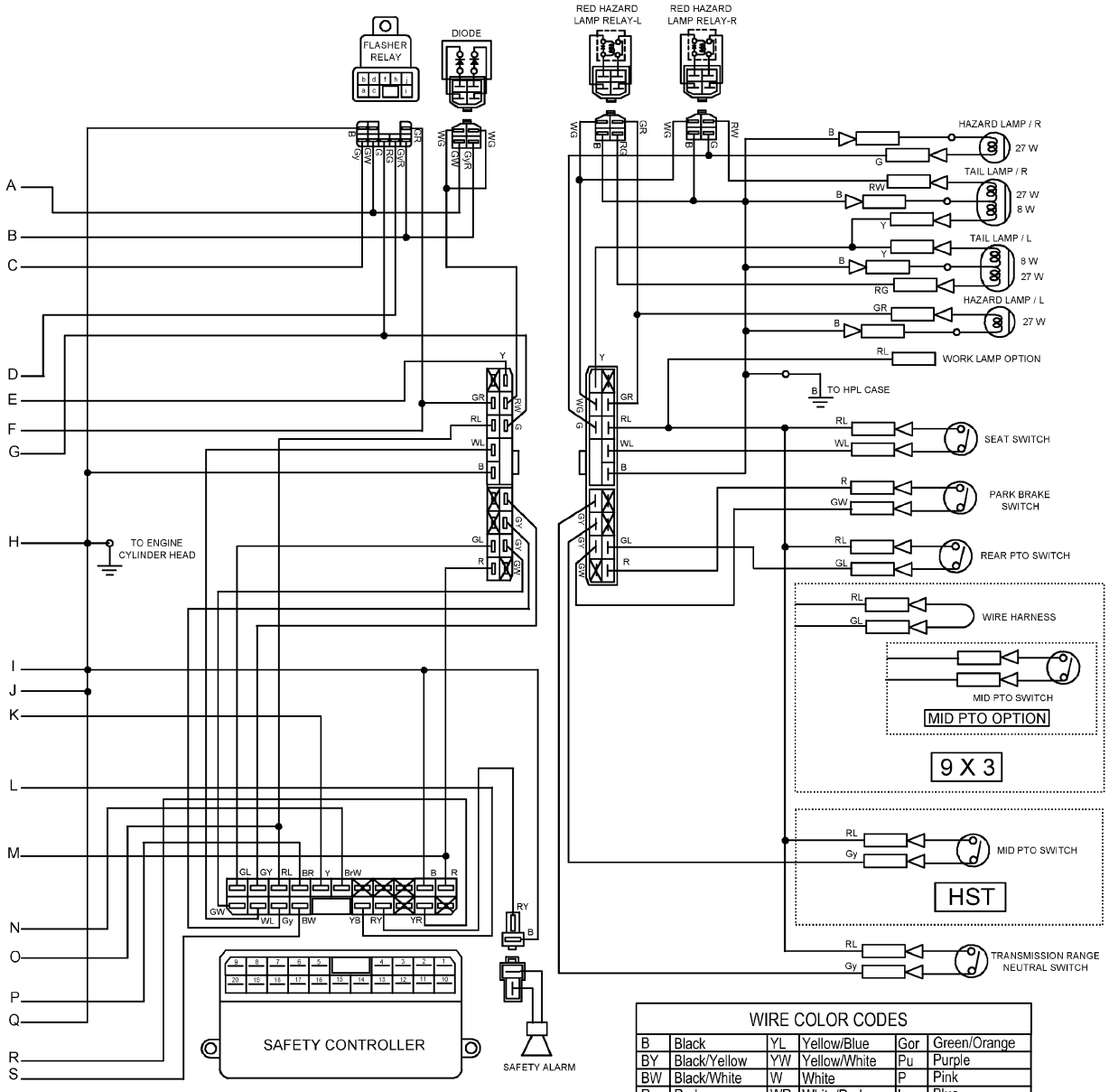
COMPLETE ELECTRICAL WIRING DIAGRAM – PIN # HK34733 AND ABOVE



1



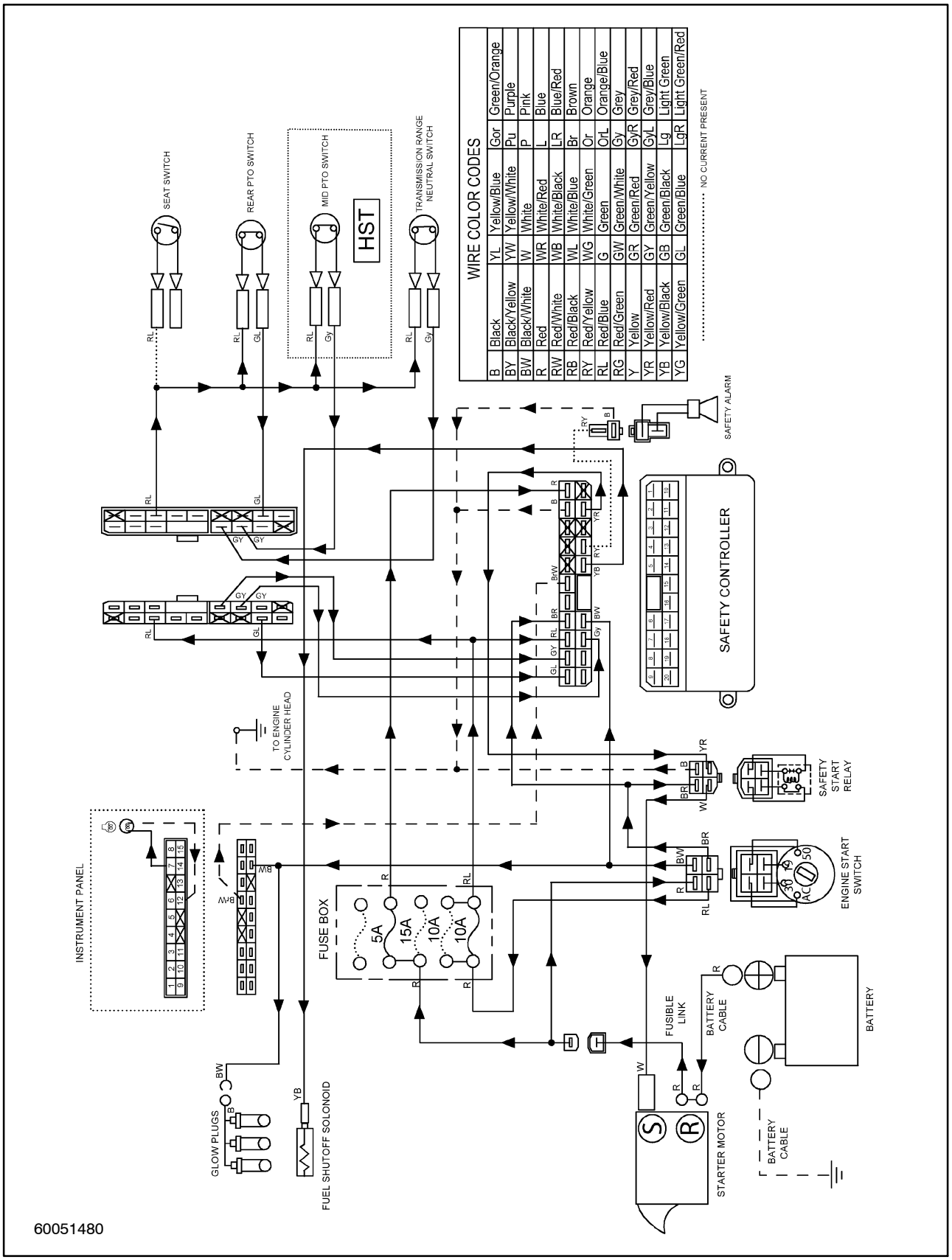
WIRE COLOR CODES					
B	Black	YL	Yellow/Blue	Gor	Green/Orange
BY	Black/Yellow	YW	Yellow/White	Pu	Purple
BW	Black/White	W	White	P	Pink
R	Red	WR	White/Red	L	Blue
RW	Red/White	WB	White/Black	LR	Blue/Red
RB	Red/Black	WL	White/Blue	Br	Brown
RY	Red/Yellow	WG	White/Green	Or	Orange
RL	Red/Blue	G	Green	OrL	Orange/Blue
RG	Red/Green	GW	Green/White	Gy	Grey
Y	Yellow	GR	Green/Red	GyR	Grey/Red
YR	Yellow/Red	GY	Green/Yellow	GyL	Grey/Blue
YB	Yellow/Black	GB	Green/Black	Lg	Light Green
YG	Yellow/Green	GL	Green/Blue	LgR	Light Green/Red

TC30

PIN # HK34733 and Above

60052239

STARTING CIRCUIT (OPERATOR PRESENT OR NOT PRESENT) - PIN # HK34733 AND ABOVE



3

STARTING CIRCUIT (OPERATOR PRESENT OR NOT PRESENT) – PIN # HK34733 AND ABOVE

NOTE: *The starting circuit is shown with:*

- Operator present or not present
- Transmission range in “NEUTRAL” position
- Rear PTO and mid PTO in “OFF” position

NOTE: *The seat switch and the park brake switch are unrelated to the safety start system of the tractor. If the park brake is not applied, the safety alarm will sound for approximately eight seconds but the tractor will still be able to start.*

1. Current starts at the battery and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire. From the fusible link, the current spits into two different directions due to a wire connector.

   First path – sends current to:
   - 5-amp fuse

   Second path – sends current to:
   - Terminal “30” of the key switch
3. The 5-amp fuse supplies current to terminal 10 of the safety controller.
4. When the key switch is in the “START” position current crosses from terminal “30” to the “AC”, “50” and “19” terminals.

Terminal “AC” of key switch

1. Current flows from the “AC” terminal of the key switch to the # 1 fuse (10 amp) of the fuse panel.
2. #1 fuse (10 amp) supplies current to:
   - Terminals #18 of the safety controller
   - Seat, rear PTO, mid PTO and range gear safety switches

Terminal “50” of key switch

Current flows from the “50” terminal of the key switch to the switch side of the starter relay and terminal #17 of the safety controller.

Terminal “19” of key switch

Current flows from the “19” terminal of the key switch to the engine glow plugs, terminal #7 of the instrument panel and terminal #6 of the safety controller.

Rear PTO safety switch function

When the rear PTO is in the “OFF” position the PTO safety switch closes, sending current to terminal #20 of the safety controller.

Mid PTO safety switch function

When the mid PTO is in the “OFF” position the PTO safety switch closes, sending current to terminal #7 of the safety controller.

Range Gear safety switch function

When the range gear selector is in the “Neutral” position the safety switch closes, sending current to terminal #19 of the safety controller.

Ground Circuits

Ground source for the starting circuit is located on the front of the engine cylinder head. Ground circuit is provided to the following components:

- Starter relay (coil side)
- Terminal #11 of the safety controller

Safety Controller Functions

When the proper current inputs and ground path circuits are provided the following safety controller output currents and ground paths occur:

Controller Inputs:

- Terminal #6, from key switch terminal “19”
- Terminal #7, from mid PTO switch
- Terminal #10, from 5-amp fuse
- Terminal #17, from key switch terminal “50”
- Terminal #18, from 10-amp fuse
- Terminal #19, from range gear safety switch
- Terminal #20, from rear PTO safety switch

Controller Outputs:

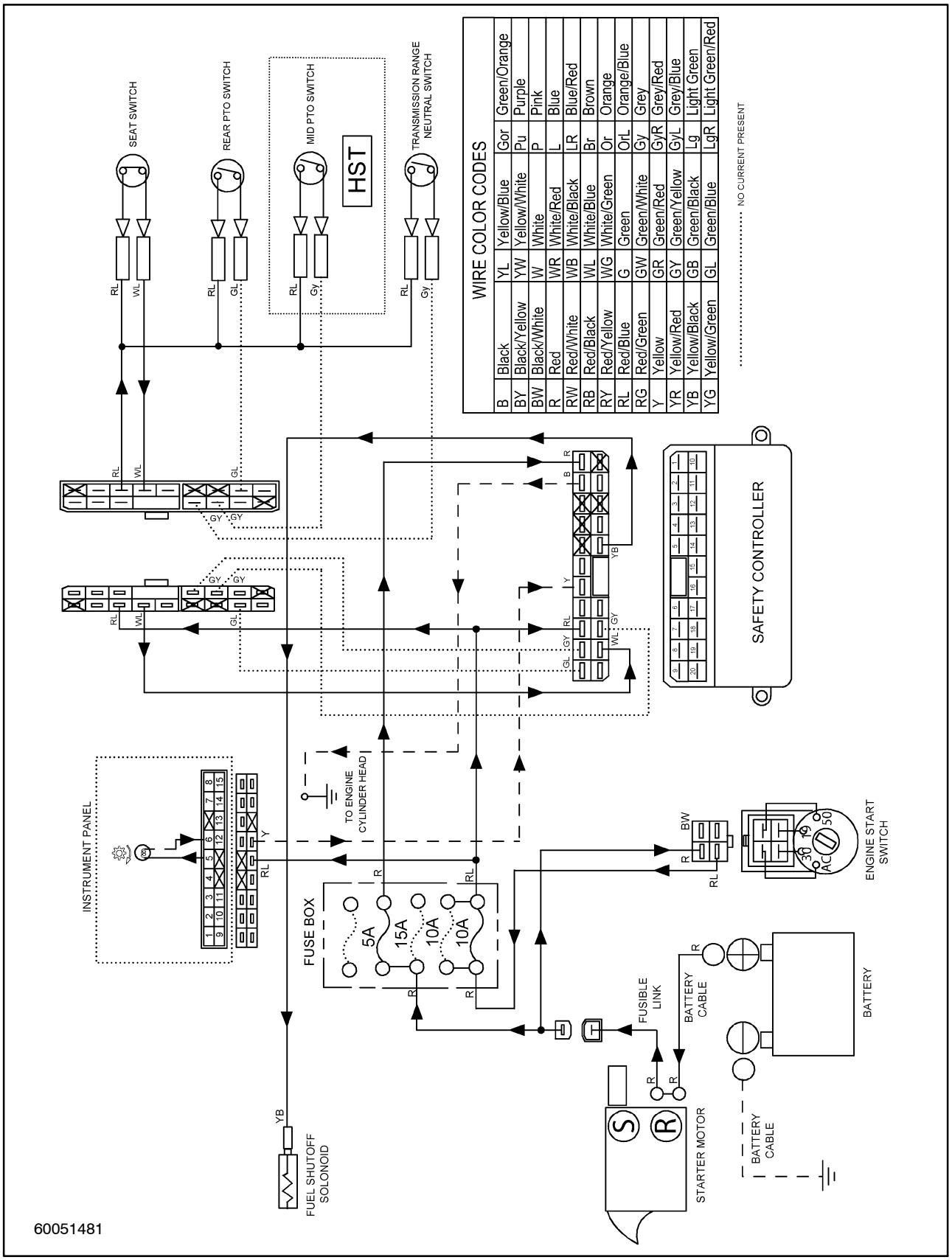
- Terminal #2, provides current to the starter relay (coil side).
  This current energizes and latches the starter relay, allowing current to be sent to the starter motor to rotate the engine.
- Terminal #4, provides current to the safety alarm.
  This current allows the alarm to sound, to warn operator of unsafe operating condition.
- Terminal #5, provides current to fuel shutoff solenoid.
  This current energizes the fuel shutoff solenoid, allowing fuel to be delivered from the injection pump.

Glow Plug Indicator Light

When current is provided to the glow plug indicator light, terminal #7 of the instrument panel from terminal “19” of the key switch and a ground source provided to terminal #12 from terminal #15 of the safety controller, the glow plug indicator light will illuminate during the starting cycle.

TROUBLESHOOTING – STARTING CIRCUIT OPERATOR PRESENT or NOT PRESENT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Starter motor will not energize.	Insufficient battery charge	Test battery. Charge, add water, or replace as necessary
	Blown fusible link	Inspect and replace fusible link as necessary
	Blown 10-amp fuse	Inspect and replace fuse as necessary
	Blown 5-amp fuse	Inspect and replace fuse as necessary
	Defective rear PTO, mid PTO, or transmission range safety switch.	Test switches and replace as necessary
	Defective safety controller	Test safety controller and replace as necessary
	Malfunctioning starter motor	Test starter motor and repair or replace as necessary.
Starter mot energizes, but fails to start engine (lacks exhaust smoke)	Defective safety controller	Test safety controller and replace as necessary
	Solenoid wire connector is disconnected or corroded.	Check solenoid connector for proper connection
	Defective fuel shutoff solenoid	Test solenoid and replace if necessary

SAFE OPERATION CIRCUIT (OPERATOR PRESENT) - PIN # HK34733 AND ABOVE



4

SAFE OPERATION CIRCUIT (OPERATOR PRESENT) – PIN # HK34733 AND ABOVE

The following explains the safety switch and safety controller functions for current flow When the operator is seated on the tractor and the key switch is placed in the “AC/RUN” position.

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.
2. From the starter, current flows through the fusible link to reach terminal “30” of the key switch.
3. Current is supplied to the 5-amp fuse of the fuse block, the 5-amp fuse supplies current to terminal # 10 of the safety controller.
4. When the key switch is in the “AC/RUN” position, current crosses from terminal “30” to the “AC terminal.

Key Switch Terminal “AC”

1. Current travels from the “AC” terminal of the key switch to reach the 10-amp fuse, within the fuse block.
2. The 10-amp fuse supplies current to:
    - Instrument panel, terminal #5 for PTO indicator light
    - Seat, rear PTO, mid PTO, transmission range safety switches
    - Terminal #18 of Safety Controller

Safety Switches Functions

1. When the operator is on the seat, the safety switch close, sending current to terminal #8 of the safety controller.

Ground Circuits

1. Ground source is provided by the steering column ground terminal to:
    - Terminal #11 of the safety controller

Safety Controller Functions

Controller Inputs:

- Terminal #8, from the seat safety switch
- Terminal #10, from the 5-amp fuse
- Terminal #18, from the 10-amp fuse

Ground Source:

- Terminal #11

Controller Outputs:

- Terminal 5, to fuel shutoff solenoid

1. Terminal #5 sends current to the fuel shutoff solenoid, this allows the solenoid to remain energized, with the solenoid energized, the solenoid plunger retracts to permit the fuel injection pump to deliver fuel to the injectors allowing the engine to remain operating.

NOTE: *There is a one second delay system built into the safety controller. The engine will continue to run if the operator is out of the seat for one second or less. If the operator is out of the seat for more than one second, the safety controller will cut off the current to the fuel shutoff solenoid and the engine will stop.*

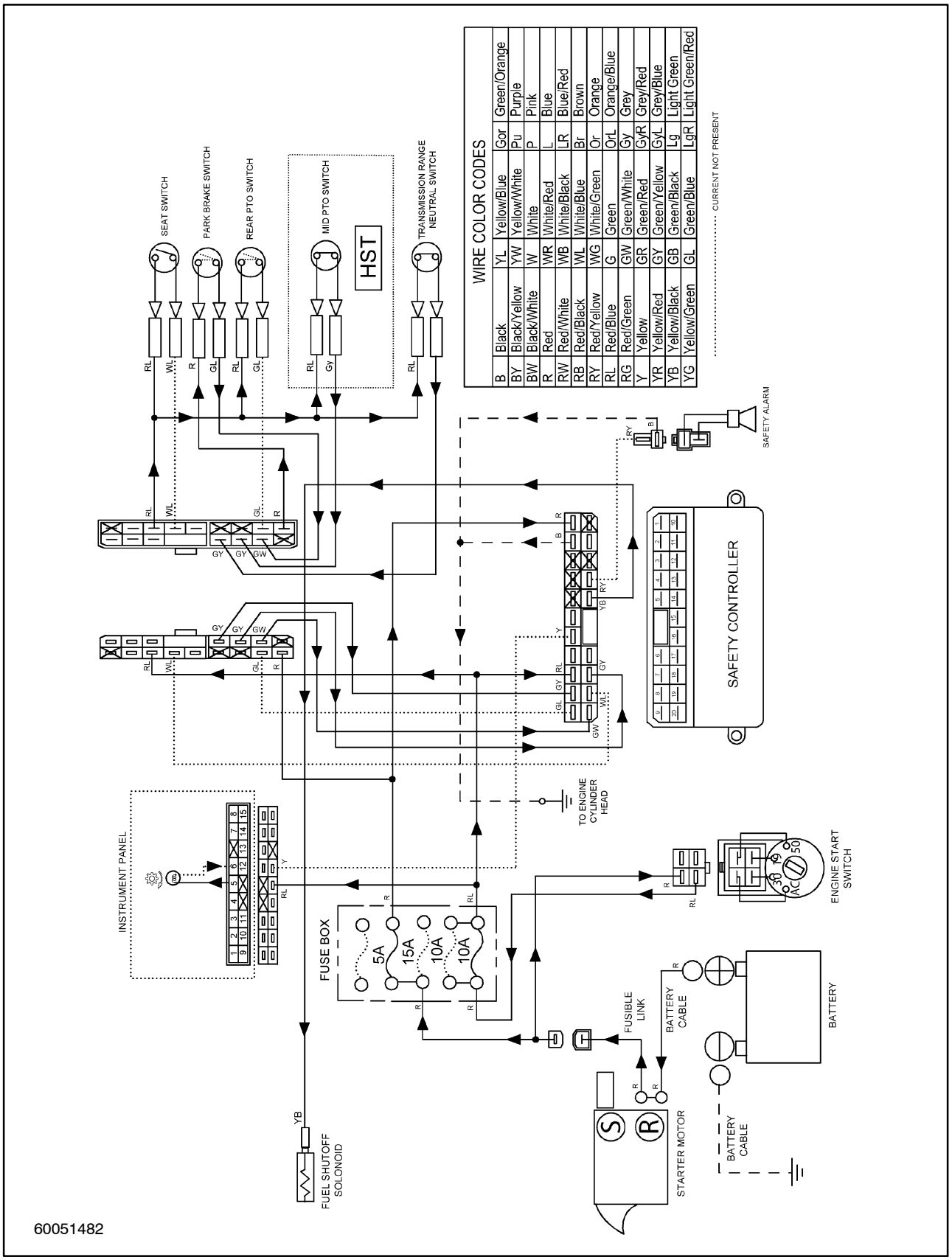
Instrument Panel Indicator Lights

If either the rear or mid PTO is engaged the PTO indicator light will illuminate.

1. Current is supplied to instrument panel terminal #5 by the 10-amp fuse.
2. The ground source is supplied to instrument panel terminal #6 by terminal #16 of the safety controller.

TROUBLESHOOTING – SAFE OPERATION CIRCUIT OPERATOR PRESENT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Engine does NOT continue to run while operator is seated.	Blown 10-amp fuse	Inspect and replace fuse as necessary
	Blown 5-amp fuse	Inspect and replace fuse as necessary
	Defective safety controller	Test safety controller and replace as necessary
	Defective seat safety switch	Test switch, replace if necessary
	Defective key switch	Test switch, replace if necessary
	Malfunctioning fuel shutoff solenoid	Test solenoid and replace if necessary

SAFE OPERATION CIRCUIT (OPERATOR NOT PRESENT) - PIN # HK34733 AND ABOVE



5

SAFE OPERATION (OPERATOR NOT PRESENT) – PIN # HK34733 AND ABOVE

NOTE: *The safe operation circuit is shown with:*

- Operator not present
- Transmission range switch in neutral position
- Rear PTO “engaged or not engaged”
- Mid PTO “not engaged”

The following explains the safety switch and safety controller functions for current flow When the operator is NOT seated on the tractor and the key switch is placed in the “AC/RUN” position.

NOTE: *The park brake switch is unrelated to the safe operation system of the tractor. If the park brake is not applied, the safety alarm will sound for approximately eight seconds but the tractor will still continue to run.*

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.
2. From the starter, current flows through the fusible link to reach terminal “30” of the key switch.
3. Current is supplied to the 5-amp fuse of the fuse block, the 5-amp fuse supplies current to terminal # 10 of the safety controller.
4. When the key switch is in the “AC/RUN” position, current crosses from terminal “30” to the “AC terminal.

Key Switch Terminal “AC”

1. Current travels from the “AC” terminal of the key switch to reach the 10-amp fuse, within the fuse block
2. The 10-amp fuse supplies current to:
   - Instrument panel terminal # 5 for PTO indicator light
   - Seat safety switch
   - Terminal #18 of Safety Controller

Safety Switches Functions

1. When the operator is not on the seat, the safety switch opens, terminating the current flow.
2. The transmission range switch is closed when in the “NEUTRAL” position
3. The park brake may be applied or not applied. If the park brake is not applied the safety alarm will sound for approximately eight seconds.

Ground Circuits

1. Ground source is provided by the steering column ground terminal to:
   - Terminal #11 of the safety controller

Safety Controller Functions

Controller Inputs:

- Terminal #7, from the mid PTO safety switch
- Terminal #9, from park brake safety switch
  (If park brake is applied)
- Terminal #10, from the 5-amp fuse
- Terminal #18, from the 10-amp fuse
- Terminal #19, from the transmission range safety switch

Ground Source:

- Terminal #11

Controller Outputs:

- Terminal 5, to fuel shutoff solenoid

1. Terminal #5 sends current to the fuel shutoff solenoid, this allows the solenoid to remain energized, with the solenoid energized, the solenoid plunger retracts to permit the fuel injection pump to deliver fuel to the injectors allowing the engine to remain operating.

Instrument Panel Indicator Lights

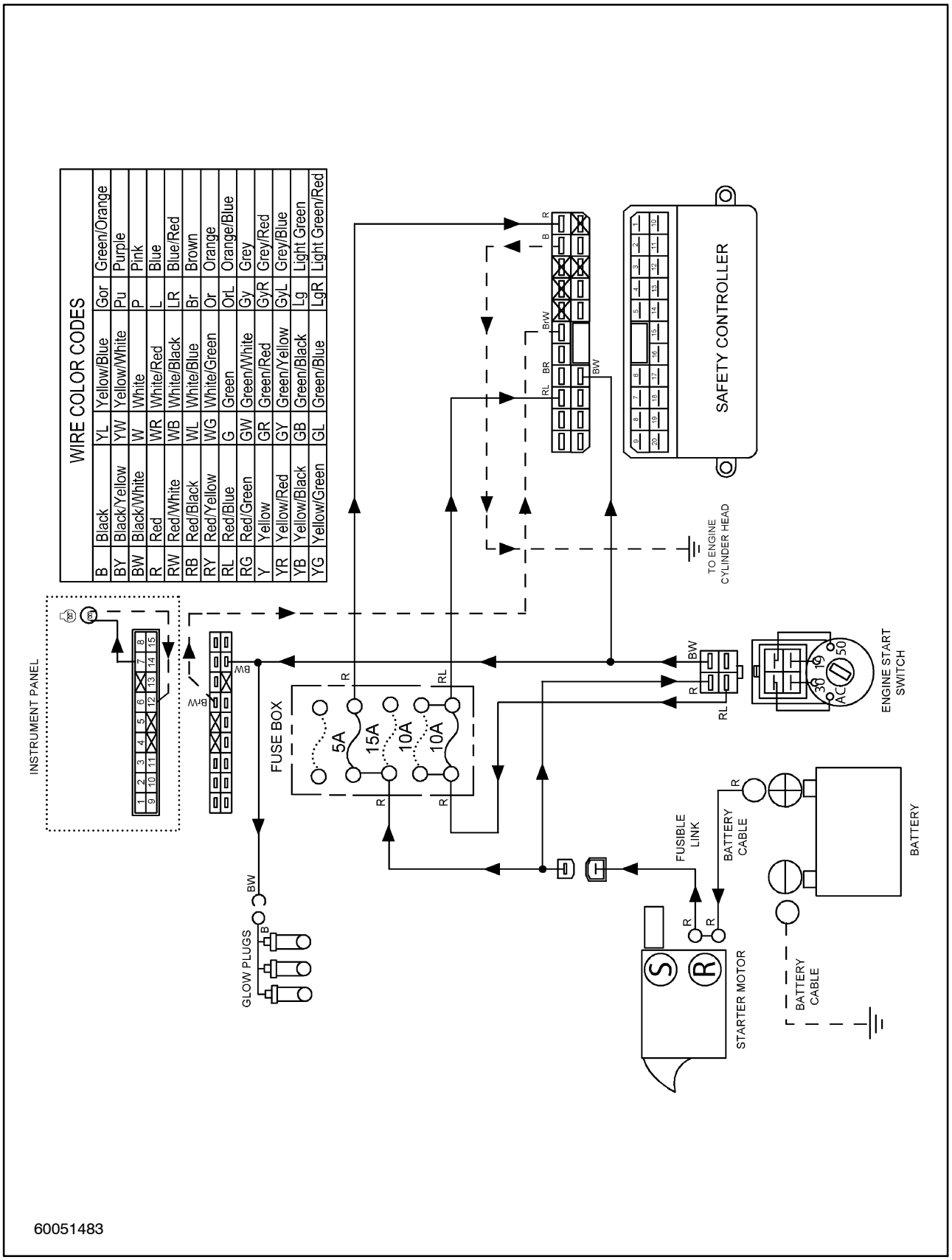
If the rear PTO is engaged the PTO indicator light will illuminate.

1. Current is supplied to instrument panel terminal #5 by the 10-amp fuse.
2. The ground source is supplied to instrument panel terminal #6 by terminal #16 of the safety controller.

NOTE: *The tractor will not remain running, if the mid PTO is engaged and the operator is not in the seat.*

TROUBLESHOOTING – SAFE OPERATION CIRCUIT OPERATOR NOT PRESENT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Engine does NOT continue to run while operator is NOT seated.	Blown 10-amp fuse	Inspect and replace fuse as necessary
	Blown 5-amp fuse	Inspect and replace fuse as necessary
	Defective safety controller	Test safety controller and replace as necessary
	Defective transmission range safety switch	Test switch, replace if necessary
	Defective key switch	Test switch, replace if necessary
	Malfunctioning fuel shutoff solenoid	Test solenoid and replace if necessary

ENGINE GLOW PLUG CIRCUIT - PIN # HK34733 AND ABOVE



6

ENGINE GLOW PLUG CIRCUIT – PIN # HK34733 AND ABOVE

The following explains the glow plugs heat and indicator light circuits, when the key switch is placed in the "HEAT" position.

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.
2. From the starter, current flows through the fusible link to reach terminal "30" of the key switch and the 5 –amp fuse.
3. Current is supplied to the 5-amp fuse of the fuse block, the 5-amp fuse supplies current to terminal # 10 of the safety controller.
4. When the key switch is in the "HEAT" position, current crosses from terminal "30" to the "AC" and "19 terminals.

Key Switch Terminal "AC"

1. Current travels from the "AC" terminal of the key switch to reach the 10-amp fuse, within the fuse block
2. The 10-amp fuse supplies current to:
    - Terminal #18 of the Safety Controller

Key Switch Terminal "19"

1. Terminal "19" of the key switch provides current to:
    - Engine Glow Plugs
    - Terminal #6 of the Safety Controller
    - Terminal #7 of the Instrument Panel

Ground Circuits

1. Ground source is provided by the steering column ground terminal to:
    - Terminal #11 of the safety controller

Safety Controller Functions

Controller Inputs (+):

- Terminal #6 , from terminal "19" of the key switch
- Terminal #10, from the 5-amp fuse
- Terminal #18, from the 10-amp fuse

Ground Source:

- Terminal #11

Controller Inputs (-):

- Terminal #15

1. The safety controller supplies a ground source with terminal #15 to terminal #12 of the instrument panel for the glow plug indicator light. The glow plug indicator light will illuminate for approximately four seconds.

NOTE: *The glow plugs will continue to heat as long as the key switch is in the "HEAT" or "START" positions. The safety controller only regulates the glow plug indicator light of the instrument panel.*

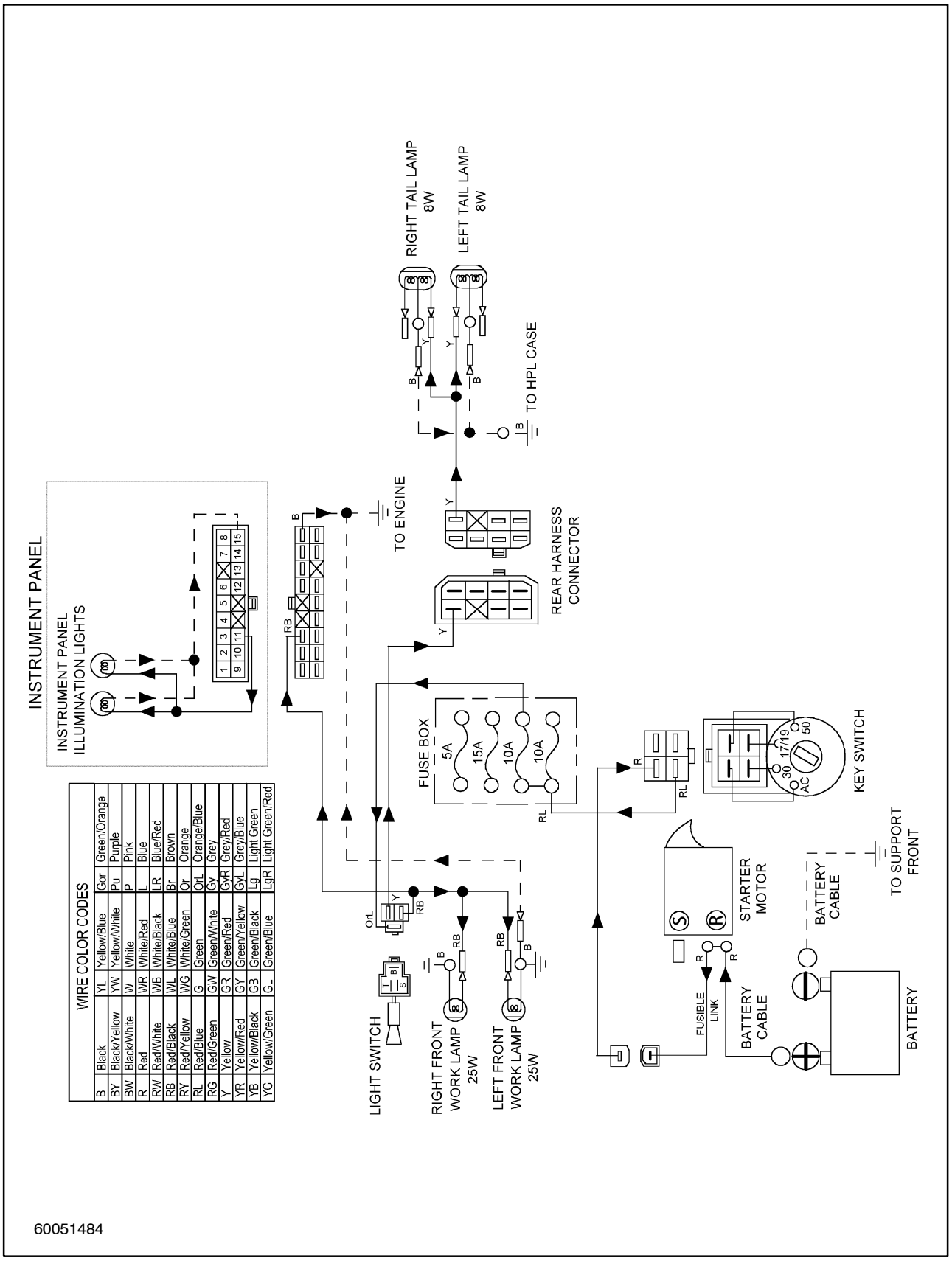
Instrument Panel Glow Plug Indicator Light

During the glow plug heat cycle the indicator light will illuminate for approximately four seconds.

1. Current is supplied to instrument panel terminal #7 by terminal #19 of the key switch
2. The ground source is supplied to instrument panel terminal #12 by terminal #15 of the safety controller.

TROUBLESHOOTING – ENGINE GLOW PLUG CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative glow plugs	Failed fusible link	Check fusible link and replace as necessary
	Malfunctioning key switch	Test key switch, replace if necessary.
	Glow plug connector not connected or corroded.	Check connection, repair as necessary.
	Defective glow plug	Test glow plugs, replace as necessary.
Inoperative glow plug indicator light	Blown 5-amp fuse.	Test fuse, replace as necessary.
	Blown 10-amp fuse.	Test fuse, replace as necessary.
	Defective safety controller	Test controller, replace as necessary.
	Open wiring in glow plug indicator light circuit	Check for loose or broken wires and connectors.
	Improper ground circuit	Check ground terminal at engine cylinder head for corrosion.

LIGHTING CIRCUIT – PIN # HK34733 AND ABOVE



LIGHTING CIRCUIT - PIN # HK34733 AND ABOVE

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.

2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.

3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10 amp fuse within the fuse block, to reach the “B” terminal of the light switch.

4. When the light switch is in the “On” position (Pulled out), current crosses from the “B” terminal to the “S” and “T” terminals of the light switch.

5. Current exits the “S” terminal of the light switch and reaches a the wire splice. The wire splice splits the current into two different paths:

   - The one path leads current to terminal 11 of the instrument panel. Current enters terminal 11 and reaches the instrument panel lights (back-lighting). The ground path for the instrument panel lights travels from terminal 15 of the instrument panel to reach the left side of the engine block, allowing the bulbs to illuminate the instrument panel.

   - The other path leads current to a the wire splice that directs the current to the left and right work lights. The ground sources for both of the work lights are located at the tractor hood, which is connected to the wire harness that travels to the left side of the engine block. This completes the circuit, allowing the work lights to illuminate.

6. Current exits the “T” terminal of the light switch and travels through a connector to a the wire splice. The wire splice sends the current to the left and right taillights. The ground source for the left and right taillights is located at the left and right taillight-mounting brackets, allowing the left and right taillights to illuminate.

TROUBLESHOOTING - LIGHTING CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Headlights, Taillights, or Rear Work Light (Optional)	Blown 10-amp fuse	Check fuse and replace as necessary
	Malfunctioning Light Switch	Replace Switch as necessary
	Blown Bulbs	Replace bulbs as necessary
	Improper ground circuit	Check lighting connections and circuit grounds and repair as necessary

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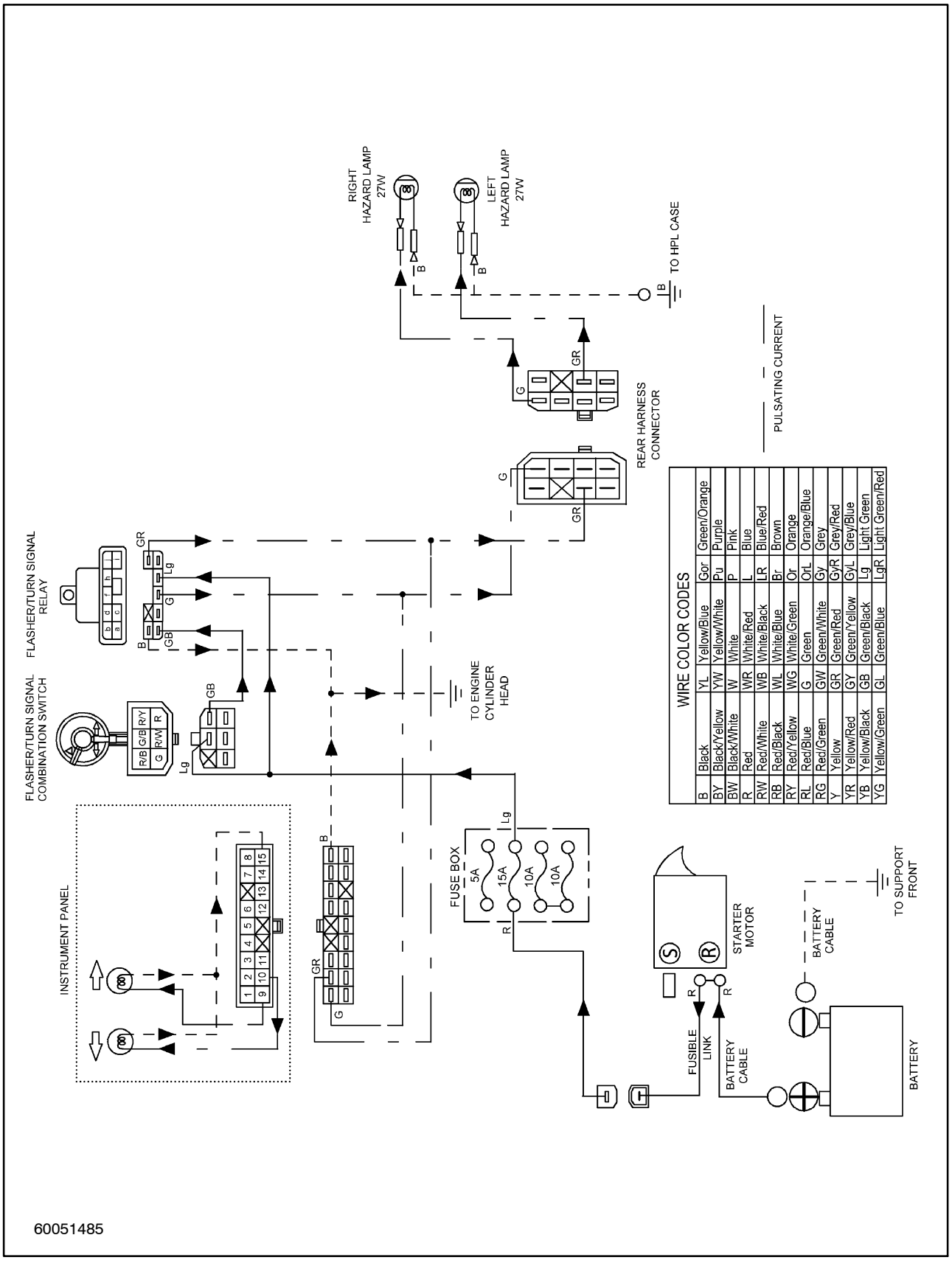
HAZARD FLASHER CIRCUIT - PIN # HK34733 AND ABOVE



HAZARD FLASHER CIRCUIT – PIN # HK34733 AND ABOVE

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.

2. From the starter, current flows through the fusible link to the fuse panel.

3. Current passes through the 15-amp fuse within the fuse panel to reach a the wire splice.

4. The wire splice directs the current to terminal “H” of the flasher relay and to the “R/W” terminal of the hazard/turn signal switch.

5. When the hazard portion of the switch is moved to the “On” position, current crosses from the “R/W” terminal to the “R” terminal.

6. Current flows from the “R” terminal of the switch to terminal “B” of the flasher turn signal relay.

7. The flasher relay is grounded through terminal “A”, allowing the flasher to function.

8. When the relay is activated, pulsing current flows from terminal “F” and terminal “i”.

Terminal 4

- Current flows from terminal “F” of the control module and reaches a the wire splice. The wire splice splits the current into two different paths.

1. Current flows from the wire splice to terminal 9 of the instrument panel. Current enters terminal 9 and reaches the right flasher indicator light. The ground path for the indicator light travels from terminal 15 of the instrument panel to the left side of the engine block, allowing the light to illuminate. The right flasher indicator light flashes on and off.

2. Current flows from the wire splice to the right hazard light. The right hazard light is grounded at the hazard light mounting bolt, allowing the light to illuminate. The right hazard light flashes on and off.

Terminal “i”

- Current flows from terminal “i” of the flasher control module and reaches a the wire splice. The wire splice splits current into two different paths.

1. Current flows from the wire splice to terminal 10 of the instrument panel. Current enters terminal 10 and reaches the left flasher indicator light. The ground path for the indicator light travels from terminal 15 of the instrument panel to the left side of the engine block, allowing the light to illuminate. The left indicator light flashes on and off.

2. Current flows from the wire splice to the left hazard light. The left hazard light is grounded at the hazard light mounting bolt, allowing the light to illuminate. The left hazard light flashes on and off.

TROUBLESHOOTING – HAZARD FLASHER CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Hazard Lights	Blown 15-amp fuse	Check fuse and replace as necessary
	Malfunctioning Hazard Flasher/Turn Signal Switch	Test switch and replace as necessary
	Blown Bulbs	Check for any blown bulbs and replace as necessary
	Improper Ground Circuit	Check hazard light circuit connections and circuit grounds and repair as necessary
	Malfunctioning Hazard Flasher/Turn Signal Relay	Check relay and replace as necessary

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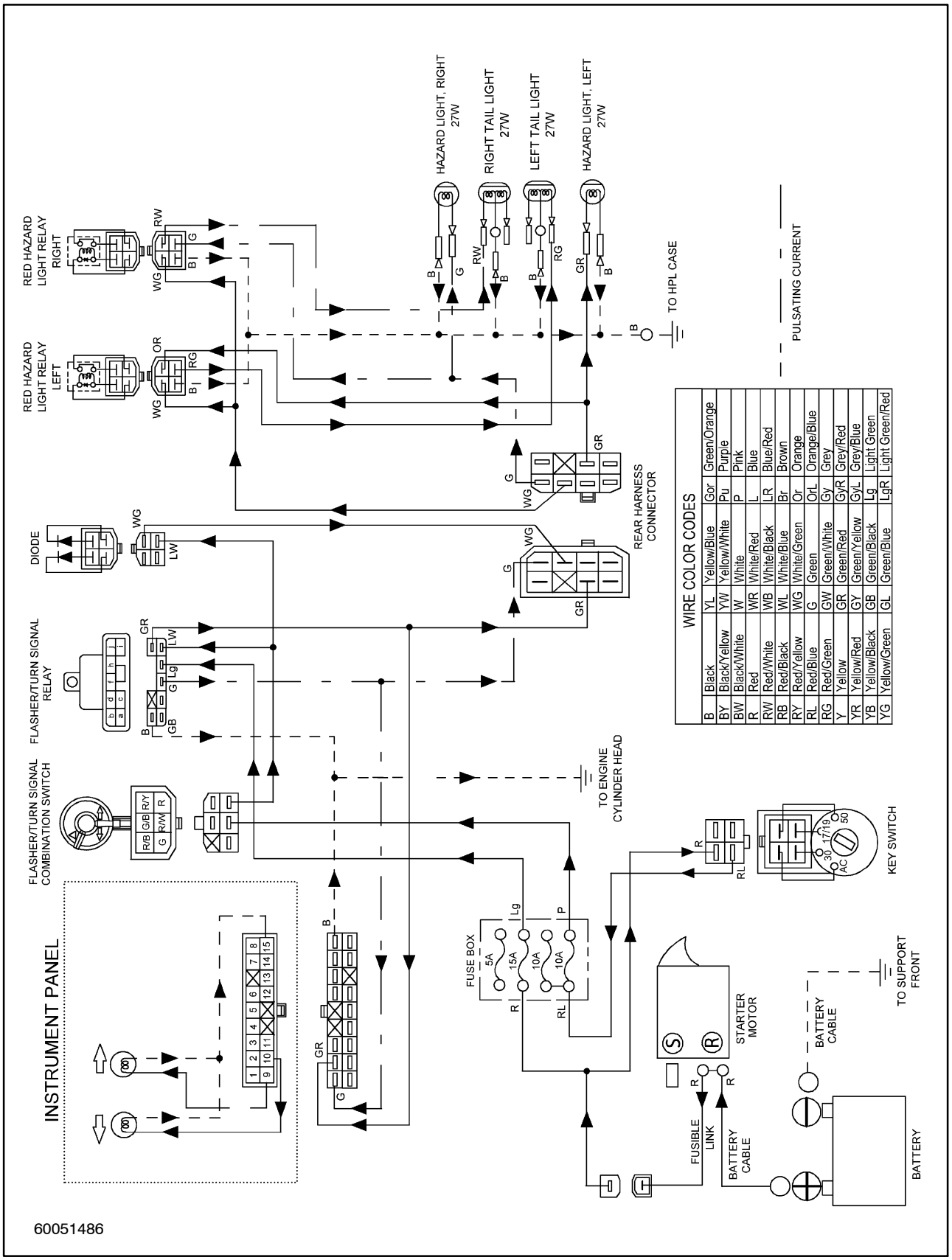
RIGHT TURN SIGNAL CIRCUIT - PIN # HK34733 AND ABOVE



RIGHT TURN SIGNAL CIRCUIT - PIN # HK34733 AND ABOVE

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.

2. From the starter, current flows through the fusible link to a the wire splice. The wire splice directs the current into two paths:

The one path sends current to the fuse panel.

1. Current reaches the fuse panel and passes through 15-amp fuse.

2. From the 15-amp fuse, current flows to terminal “h” of the hazard flasher/turn signal relay. This terminal provides power to the relay. The ground path to the relay travels from terminal “a” to reach the right side frame rail near the battery.

The other path directs current to terminal 30 of the key switch.

1. When the key switch is turned to the AC/RUN position, current crosses from terminal 30 to terminal AC.

2. Current flows from the key switch to reach the 10-amp fuse within the fuse panel.

3. Current passes through the 10-amp fuse to reach the “G/B” terminal of the hazard/turn signal switch.

4. When the turn signal portion of the switch is moved to the “Right” turn signal position, current crosses from the “G/B” terminal to the “R/Y” terminal.

5. Current flows from the “R/Y” terminal to reach terminal “j” of the hazard flasher/turn signal relay and a diode.

6. The diode supplies current to the coil side of the left and right red hazard light relays.

7. Terminal “f” of the flasher relay sends current to a wire splice.

8. The wire splice splits the pulsing current into two paths.

The one path sends the pulsing current to terminal 9 of the instrument panel.

- Pulsing current enters terminal 9 of the instrument panel and reaches the right turn signal indicator bulb. The ground path to the right turn signal indicator bulb travels from terminal 15 of the instrument panel to reach the right side frame rail near the battery. This causes the right turn indicator bulb within the instrument panel to flash.

The other path sends current to the rear harness connector.

- Pulsating current passes through the connector to reach a wire splice, from the splice current travels two paths.

  One path sends pulsating current to the right turn signal/hazard light. When light is provide with a ground circuit the light will pulsate on and off.

  The other path sends pulsating current to the control side of the right red hazard light relay. When the relay coil side is provide with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the relay energizes and the control side of the relay latches sending pulsating current to the right side taillight. When the taillight is provide with a ground source, the taillight will pulsate on and off.

9. The flasher/turn signal relay sends current out of terminal “i” of the relay to a wire splice, that splits into two paths.

The one path sends current to terminal 10 of the instrument panel.

- Current enters terminal 10 of the instrument panel and reaches the left turn signal indicator bulb. The ground path to the indicator bulb travels from terminal 15 of the instrument panel to the engine cylinder head. This causes the left indicator bulb to illuminate constant.

The other path sends current to the rear harness connector.

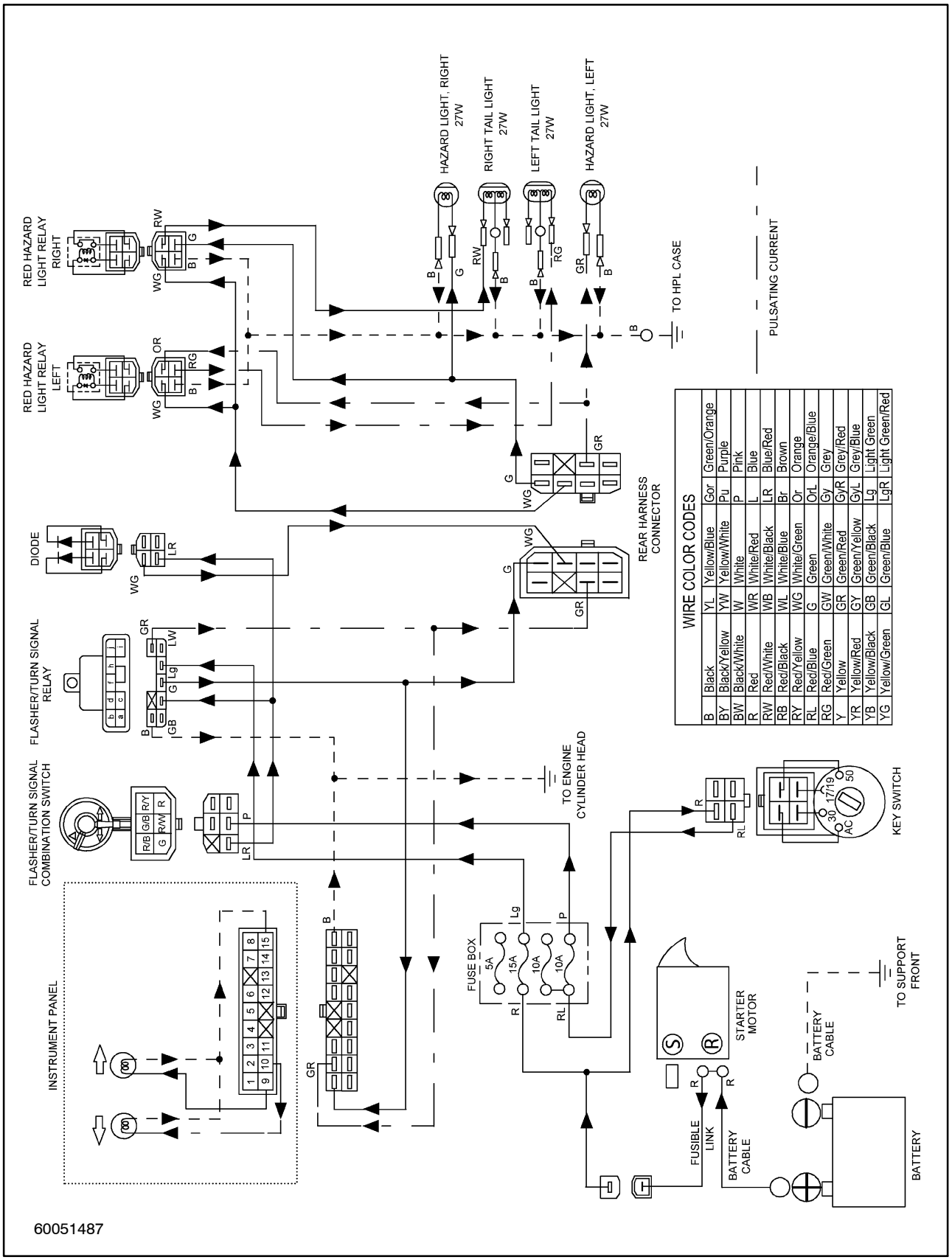
- Current passes through the connector to reach a wire splice, from the splice current travels two paths.

  One path sends current to the left turn signal/hazard flasher. When flasher is provided with a ground circuit the flasher will illuminate constant.

  The other path sends current to the control side of the left red hazard light relay. When the relay coil side is provided with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the relay energizes and the control side of the relay latches sending current to the left side taillight. When the taillight is provided with a ground source, the left taillight will illuminate constant.

TROUBLESHOOTING – RIGHT TURN SIGNAL CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative right turn signal flasher light	Blown 10-amp fuse	Check fuse and replace as necessary
	Blown 15-amp fuse	Check fuse and replace as necessary
	Malfunctioning Hazard Flasher/Turn Signal Switch	Test switch and replace as necessary
	Blown bulb	Check for any blown bulbs and replace as necessary
	Improper Ground Circuit	Check Right turn signal circuit connections and circuit grounds and repair as necessary
	Malfunctioning Hazard Flasher/Turn Signal Relay	Check relay and replace as necessary
Inoperative right taillight	Defective right red hazard relay	Check relay and replace as necessary
	Improper ground circuit	Check circuit grounds and replace as necessary

LEFT TURN SIGNAL CIRCUIT - PIN # HK34733 AND ABOVE



LEFT TURN SIGNAL CIRCUIT - PIN # HK34733 AND ABOVE

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.

2. From the starter, current flows through the fusible link to a the wire splice. The wire splice directs the current into two paths:

The one path sends current to the fuse panel.

1. Current reaches the fuse panel and passes through the 15-amp fuse.

2. From the 15-amp fuse, current flows to terminal “h” of the hazard flasher/turn signal relay. This terminal provides power to the relay. The ground path to the relay travels from terminal “a” to reach the right side frame rail near the battery.

The other path directs current to terminal 30 of the key switch.

1. When the key switch is turned to the “AC/RUN” position, current crosses from terminal 30 to terminal AC.

2. Current flows from the key switch to reach the 10-amp fuse within the fuse panel.

3. Current passes through the 10-amp fuse to reach the “G/B” terminal of the hazard/turn signal switch.

4. When the turn signal portion of the switch is moved to the “Left” turn signal position, current crosses from the “G/B” terminal to the “R/B” terminal.

5. Current flows from the “R/B” terminal to reach terminal “d” of the hazard flasher/turn signal relay and a diode.

6. The diode supplies current to the coil side of the left and right red hazard light relays.

7. Terminal “i” of the flasher relay sends current to a wire splice.

8. The wire splice splits the pulsing current into two paths.

The one path sends the pulsing current to terminal 10 of the instrument panel.

- Pulsing current enters terminal 10 of the instrument panel and reaches the left turn signal indicator bulb. The ground path to the left turn signal indicator bulb travels from terminal 15 of the instrument panel to reach the right side frame rail near the battery. This causes the left turn indicator bulb within the instrument panel to flash.

The other path sends current to the rear harness connector.

- Pulsating current passes through the connector to reach a wire splice, from the splice current travels two paths.

  One path sends pulsating current to the left turn signal/hazard light. When the light is provide with a ground circuit the light will pulsate on and off.

  The other path sends pulsating current to the control side of the left red hazard light relay. When the relay coil side is provide with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the relay energizes and the control side of the relay latches sending pulsating current to the left side taillight. When the taillight is provide with a ground source, the taillight will pulsate on and off.

9. The flasher/turn signal relay sends current out of terminal “f” of the relay to a wire splice, that splits into two paths.

The one path sends current to terminal 9 of the instrument panel.

- Current enters terminal 9 of the instrument panel and reaches the right turn signal indicator bulb. The ground path to the indicator bulb travels from terminal 15 of the instrument panel to the engine cylinder head. This causes the left indicator bulb to illuminate constant.

The other path sends current to the rear harness connector.

- Current passes through the connector to reach a wire splice, from the splice current travels two paths.

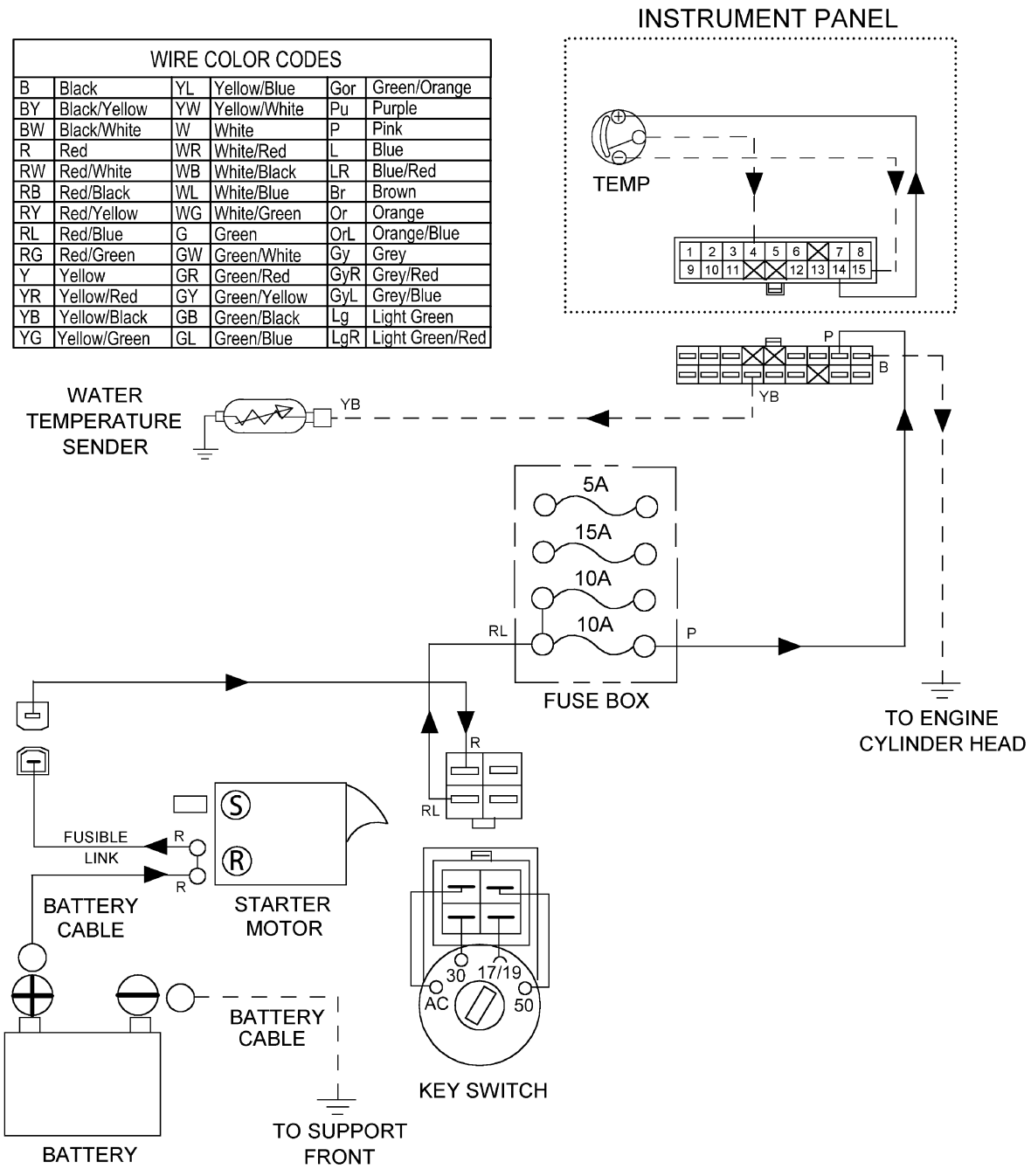
  One path sends current to the right turn signal/hazard flasher. When flasher is provided with a ground circuit the flasher will illuminate constant.

  The other path sends current to the control side of the right red hazard light relay. When the relay coil side is provide with current from terminal R/Y of the turn signal switch and a ground circuit from the transmission case, the relay energizes and the control side of the relay latches sending current to the right side taillight. When the taillight is provided with a ground source, the right taillight will illuminate constant.

TROUBLESHOOTING – LEFT TURN SIGNAL CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative left turn signal flasher light	Blown 10-amp fuse	Check fuse and replace as necessary
	Blown 15-amp fuse	Check fuse and replace as necessary
	Malfunctioning Hazard Flasher/Turn Signal Switch	Test switch and replace as necessary
	Blown bulb	Check for any blown bulbs and replace as necessary
	Improper ground circuit	Check left turn signal circuit connections and circuit grounds and repair as necessary
	Malfunctioning Hazard Flasher/Turn Signal Relay	Check relay and replace as necessary
Inoperative left taillight	Defective left red hazard relay	Check relay and replace as necessary
	Improper ground circuit	Check circuit grounds and replace as necessary

ENGINE COOLANT TEMPERATURE CIRCUIT - PIN # HK34733 AND ABOVE

WIRE COLOR CODES					
B	Black	YL	Yellow/Blue	Gor	Green/Orange
BY	Black/Yellow	YW	Yellow/White	Pu	Purple
BW	Black/White	W	White	P	Pink
R	Red	WR	White/Red	L	Blue
RW	Red/White	WB	White/Black	LR	Blue/Red
RB	Red/Black	WL	White/Blue	Br	Brown
RY	Red/Yellow	WG	White/Green	Or	Orange
RL	Red/Blue	G	Green	OrL	Orange/Blue
RG	Red/Green	GW	Green/White	Gy	Grey
Y	Yellow	GR	Green/Red	GyR	Grey/Red
YR	Yellow/Red	GY	Green/Yellow	GyL	Grey/Blue
YB	Yellow/Black	GB	Green/Black	Lg	Light Green
YG	Yellow/Green	GL	Green/Blue	LgR	Light Green/Red



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ENGINE COOLANT TEMPERATURE CIRCUIT – PIN # HK34733 AND ABOVE

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.

2. From the starter motor, current flows through the fusible link wire and through a connector to terminal 30 of the key switch.

3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10-amp fuse within the fuse block, to reach the terminal 14 of the instrument panel.

4. Current flows from terminal 14 of the instrument panel and reaches the engine temperature gauge. The ground path for the temperature gauge travels from terminal 4 of the instrument panel to the engine temperature sending unit.

5. The ground path for the temperature gauge exits the instrument panel at terminal 15 and is then directed to the ground terminal at the engine cylinder head.

6. The needle within the temperature gauge is controlled by variable resistance to ground. The ground path exits the temperature gauge and terminal 4 of the instrument panel to travel to the engine temperature sender. At the sender, the resistance to ground changes as the engine temperature changes. The temperature gauge translates this resistance into movement of the gauge needle.

7. A constant ground to temperature gauge is provided by terminal 15 of the instrument panel.

TROUBLESHOOTING - ENGINE COOLANT TEMPERATURE CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Engine Temperature Gauge	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning engine coolant gauge within the instrument panel	Replace Gauge as Necessary
	Improper ground circuit	Check connections and circuit grounds and repair as necessary
	Malfunctioning Engine Temperature Sender	Test Engine Temperature Sender and replace as necessary

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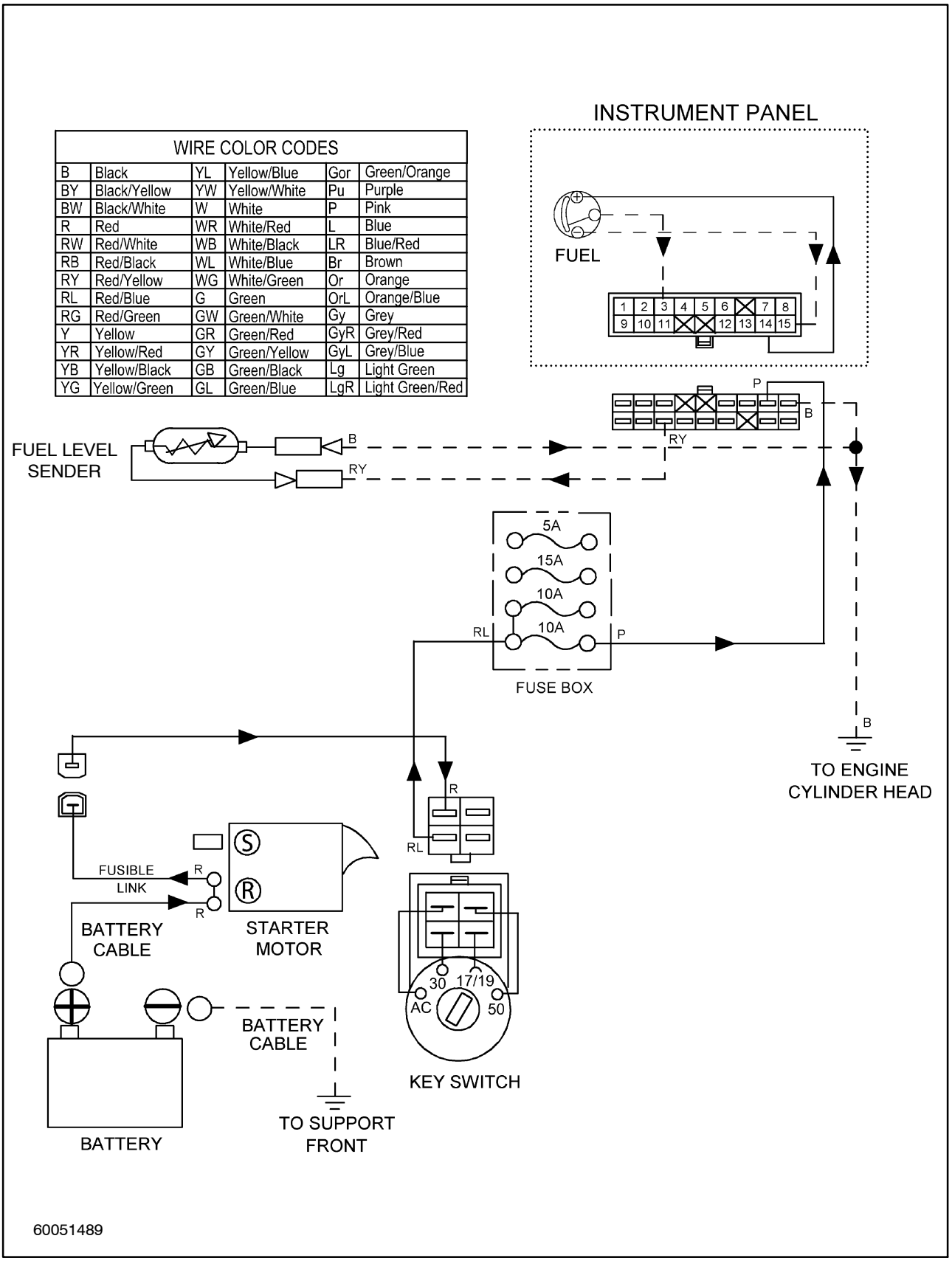
FUEL LEVEL CIRCUIT - PIN # HK34733 AND ABOVE



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FUEL LEVEL CIRCUIT – PIN # HK34733 AND ABOVE

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.

2. From the starter motor, current flows through the fusible link wire and through a connector to terminal 30 of the key switch.

3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10-amp fuse within the fuse block, to reach terminal 14 of the instrument panel.

4. Current flows from terminal 14 of the instrument panel and reaches the fuel gauge. The ground path for the fuel gauge travels from terminal 3 of the instrument panel to the fuel level sender.

5. The ground path for the fuel level gauge exists the instrument panel at terminal 15 and is then directed to the ground terminal at the engine cylinder head.

6. The needle within the fuel level gauge is controlled by variable resistance to ground. The ground path exists the fuel level gauge and terminal 3 of the instrument panel to travel to the fuel level sender. At the sender, the resistance to ground changes as the fuel level in the tank rises or lowers, translating into movement of the gauge needle.

7. A constant ground to temperature gauge is provided by terminal 15 of the instrument panel.

TROUBLESHOOTING - FUEL LEVEL CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative fuel level gauge	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning fuel level sender	Test fuel level sender and replace as necessary
	Improper ground circuit	Check fuel level sender connections and circuit grounds and repair as necessary
	Malfunctioning fuel gauge	Test fuel gauge and replace fuel gauge as necessary

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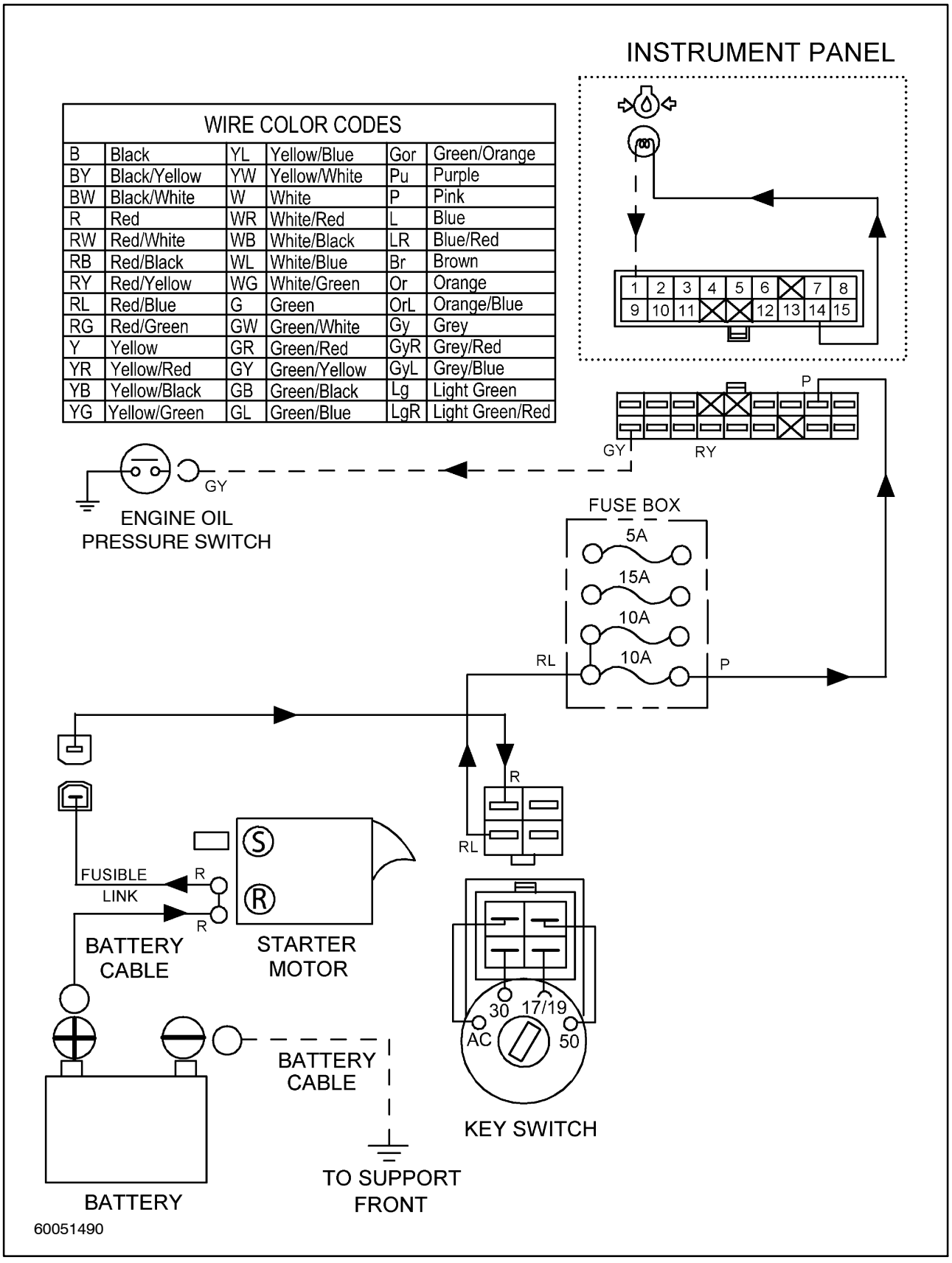
LOW OIL PRESSURE CIRCUIT - PIN # HK34733 AND ABOVE



WIRE COLOR CODES					
B	Black	YL	Yellow/Blue	Gor	Green/Orange
BY	Black/Yellow	YW	Yellow/White	Pu	Purple
BW	Black/White	W	White	P	Pink
R	Red	WR	White/Red	L	Blue
RW	Red/White	WB	White/Black	LR	Blue/Red
RB	Red/Black	WL	White/Blue	Br	Brown
RY	Red/Yellow	WG	White/Green	Or	Orange
RL	Red/Blue	G	Green	OrL	Orange/Blue
RG	Red/Green	GW	Green/White	Gy	Grey
Y	Yellow	GR	Green/Red	GyR	Grey/Red
YR	Yellow/Red	GY	Green/Yellow	GyL	Grey/Blue
YB	Yellow/Black	GB	Green/Black	Lg	Light Green
YG	Yellow/Green	GL	Green/Blue	LgR	Light Green/Red

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LOW OIL PRESSURE CIRCUIT – PIN # HK34733 AND ABOVE

NOTE: *The low oil pressure should illuminate during engine startup. The light should go off soon after the engine is started. If the light fails to go off after the engine is started, stop the engine and correct the problem.*

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable, to the engine starter motor.

2. From the starter motor, current flows through the fusible link wire and through a connector to terminal 30 of the key switch.

3. When the key switch is in the “AC/RUN” position, current crosses from terminal 30 to the “AC” terminal of the key switch. From the “AC” terminal of the key switch, current passes through the 10-amp fuse within the fuse block, to reach terminal 14 of the instrument panel.

4. Current flows from terminal 14 of the instrument panel and reaches the low oil pressure warning light. The ground path for the low oil pressure warning light travels from terminal 1 of the instrument panel to the oil pressure switch.

5. When the oil pressure falls below .41 bar (6 PSI), the oil pressure switch closes to provide the low oil pressure warning light with ground. This causes the light to illuminate, warning the operator of engine problems. Do not run the engine when the low oil pressure warning light is on as serious damage to the engine could occur.

TROUBLESHOOTING – LOW OIL PRESSURE CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Low Oil Pressure Warning Light	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning Low Oil Pressure Warning Light within the Instrument Panel	Replace Low Oil Pressure Warning Light Bulb as Necessary
	Improper ground circuit	Check Low Oil Pressure Switch connections and circuit grounds and repair as necessary
Low Oil Pressure Warning Light Remains Illuminated	Malfunctioning Low Oil Pressure Switch	Test Low Oil Pressure Switch and replace as necessary
	Low Engine Oil Pressure	Test Engine Oil Pressure. Repair as necessary.

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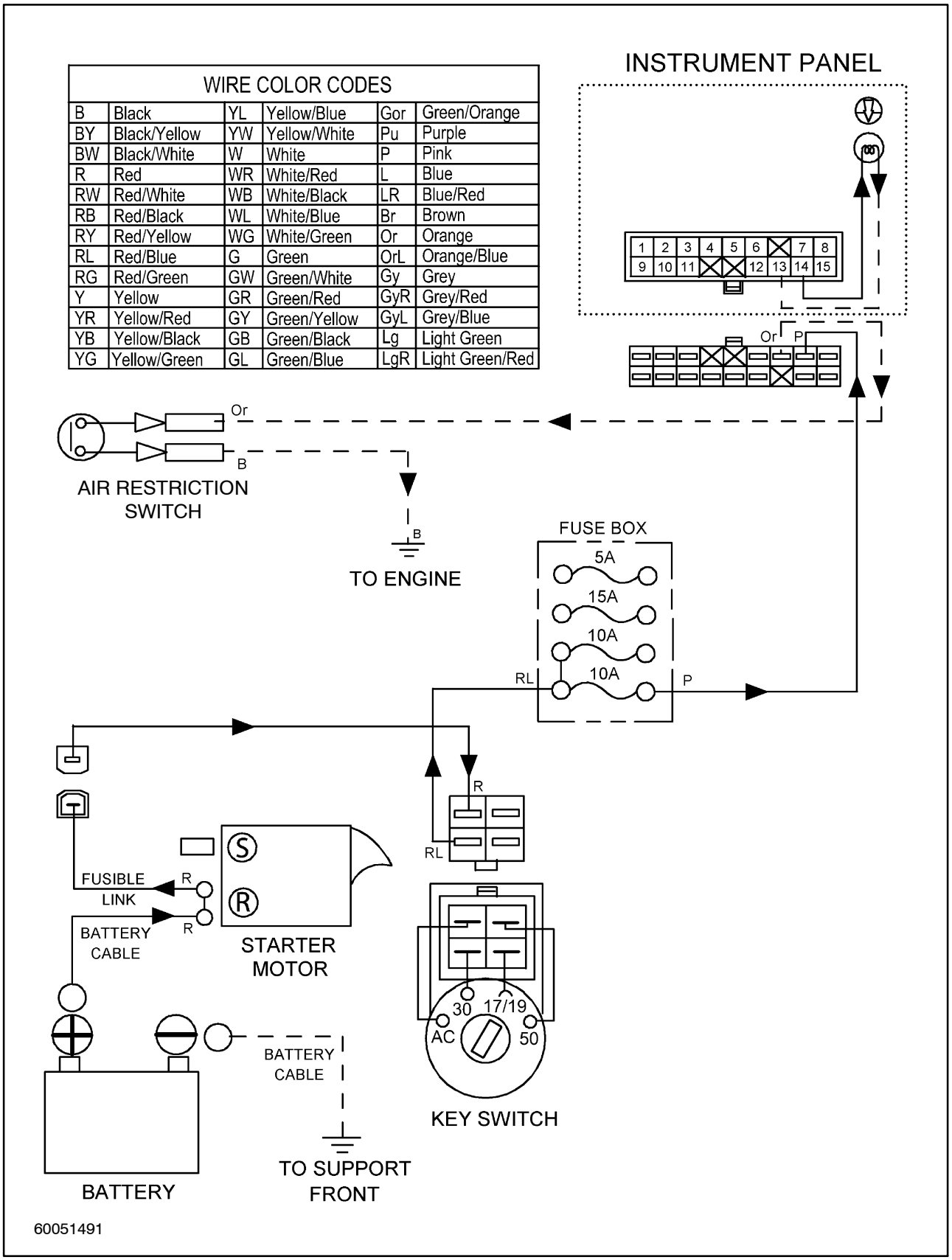
AIR RESTRICTION CIRCUIT - PIN # HK34733 AND ABOVE



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AIR RESTRICTION CIRCUIT – PIN # HK34733 AND ABOVE

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link wire to terminal 30 of the key switch.
3. When the key switch is in the “AC/Run” position, current crosses from terminal 30 to the “AC” terminal.
4. Current travels from the “AC” terminal of the key switch to the fuse panel.
5. Current passes through the 10-amp fuse within the fuse panel and reaches terminal 14 of the instrument panel.
6. Current enters terminal 14 and reaches the air restriction warning light within the instrument panel.
7. The air restriction switch controls the ground path to the warning light. When the air flow through the intake manifold drops below safe levels, the switch closes to complete the ground path, to terminal 13, causing the air restriction warning light to illuminate. This warns the operator that the air system is restricted and must be cleared to avoid engine damage.

TROUBLESHOOTING - AIR RESTRICTION CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Inoperative Air Restriction Warning Light	Blown 10-amp instrument panel fuse	Check fuse and replace as necessary
	Malfunctioning Air Restriction Light within the Instrument Panel	Replace Air Restriction Bulb as Necessary
	Improper ground circuit	Check Air Restriction Switch connections and circuit grounds and repair as necessary
	Malfunctioning Air Restriction Switch	Test Air Restriction Switch and replace as necessary
Air Restriction Warning Light Stays Illuminated	Malfunctioning Air Restriction Switch	Test Air Restriction Switch and replace as necessary
	Air Inlet Restriction	Check Air Filter and Air Intake Hose for Restrictions
	Short circuit in ground circuit	Check Wire Harness for damaged ground wire

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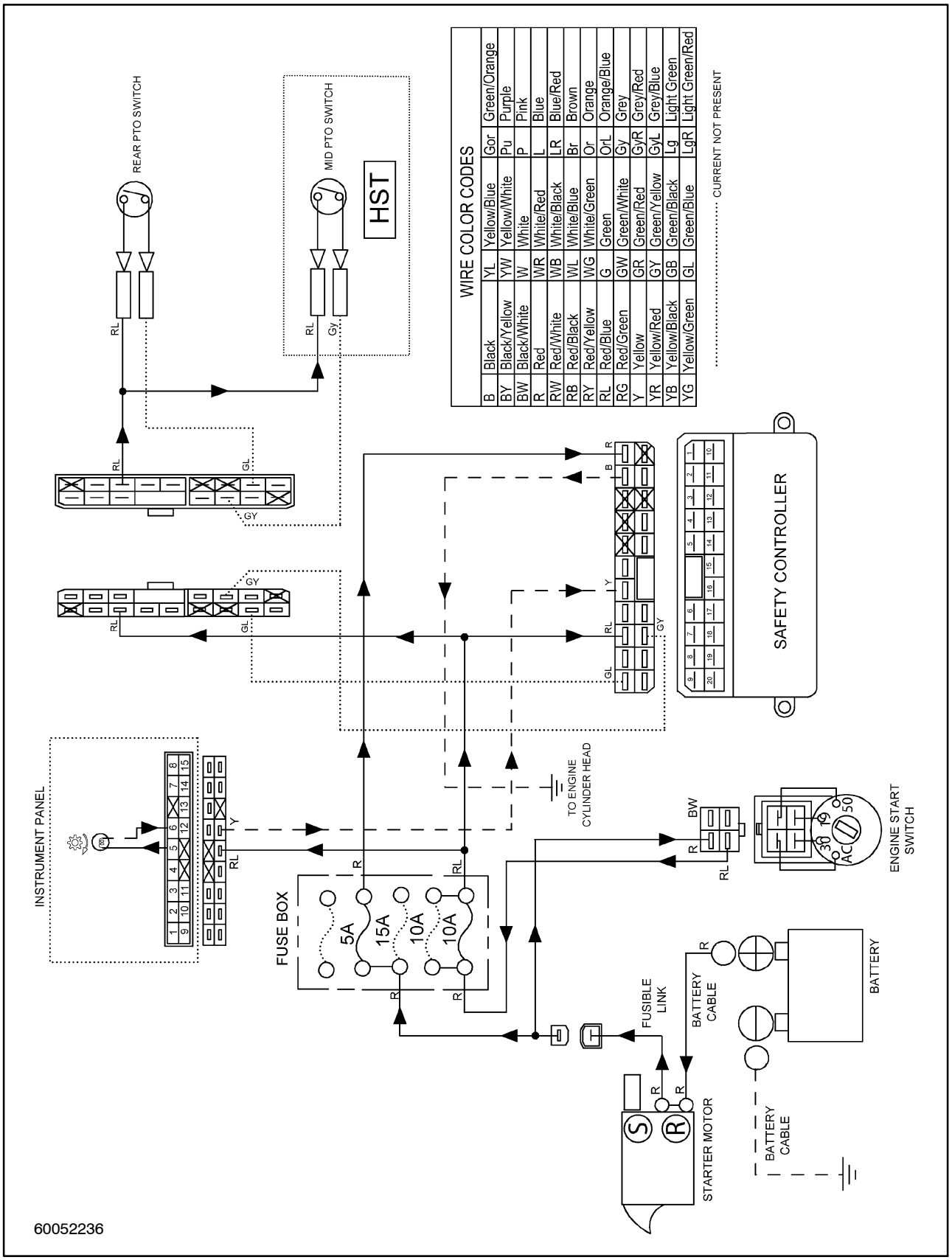
PTO INDICATOR LIGHT CIRCUIT – PIN # HK34733 AND ABOVE



PTO INDICATOR LIGHT CIRCUIT – PIN # HK34733 AND ABOVE

The following explains the rear and mid PTO safety switch and safety controller functions, that control the current and ground circuits to the PTO indicator light located in the instrument panel.

1. Current flows from the positive (+) battery terminal, through the positive (+) battery cable to the starter.
2. From the starter, current flows through the fusible link to reach terminal “30” of the key switch and the 5-amp fuse.
3. Current is supplied to the 5-amp fuse of the fuse block, the 5-amp fuse supplies current to terminal # 10 of the safety controller.
4. When the key switch is in the “AC/RUN” position, current crosses from terminal “30” to the “AC”.

Key Switch Terminal “AC”

1. Current travels from the “AC” terminal of the key switch to reach the 10-amp fuse, within the fuse block
2. The 10-amp fuse supplies current to:
   - Terminal #18 of the Safety Controller
   - Terminal # 5 of the Instrument Panel
   - Rear and Mid PTO Safety Switches

Rear PTO Safety Switch

When the rear PTO is in the engaged position, the safety switch opens terminating current to terminal #20 of the safety controller.

Mid PTO Safety Switch

When the mid PTO is in the engaged position, the safety switch opens terminating current to terminal #7 of the safety controller.

Safety Controller Functions

Controller Inputs (+):

- Terminal #10, from the 5-amp fuse
- Terminal #18, from the 10-amp fuse

Ground Source:

- Terminal #11

Controller Inputs (-):

- Terminal #16

1. When current and ground source is supplied the safety controller is activated, the safety controller supplies a ground source for the PTO indicator light with terminal #16 of the safety controller.

Instrument Panel PTO Indicator Light

When either the rear or mid PTO(s) are engaged, the current is removed from the safety controller and allows the PTO indicator light to have a source to ground which allows the PTO indicator light to illuminate.

1. Current is supplied to instrument panel terminal #5 by the 10-amp fuse.
2. The ground source is supplied to instrument panel terminal #6 by terminal #16 of the safety controller.

TROUBLESHOOTING - PTO INDICATOR LIGHT CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
PTO indicator light will not illuminate, with either the rear or mid PTO(s) are engaged.	Defective indictor light bulb.	Check bulb, replace as necessary
	Blown 10-amp fuse	Inspect and replace fuse as necessary
	Blown 5-amp fuse	Inspect and replace fuse as necessary
	Defective safety controller	Test safety controller and replace as necessary
	Defective rear PTO safety switch	Test switch, replace if necessary
	Defective mid PTO safety switch	Test switch, replace if necessary
	Improper ground circuit	Check engine cylinder head ground terminal for proper connection or corrosion.
PTO indicator light constantly illuminates, when either the rear or mid PTO(s) are not engaged.	Malfunctioning rear or mid PTO safety switch .	Test switch, replace if necessary
	Instrument panel terminal #6 shorted to ground.	Check wire harness for damage, repair as necessary.
	Defective safety controller.	Test safety controller and replace as necessary.

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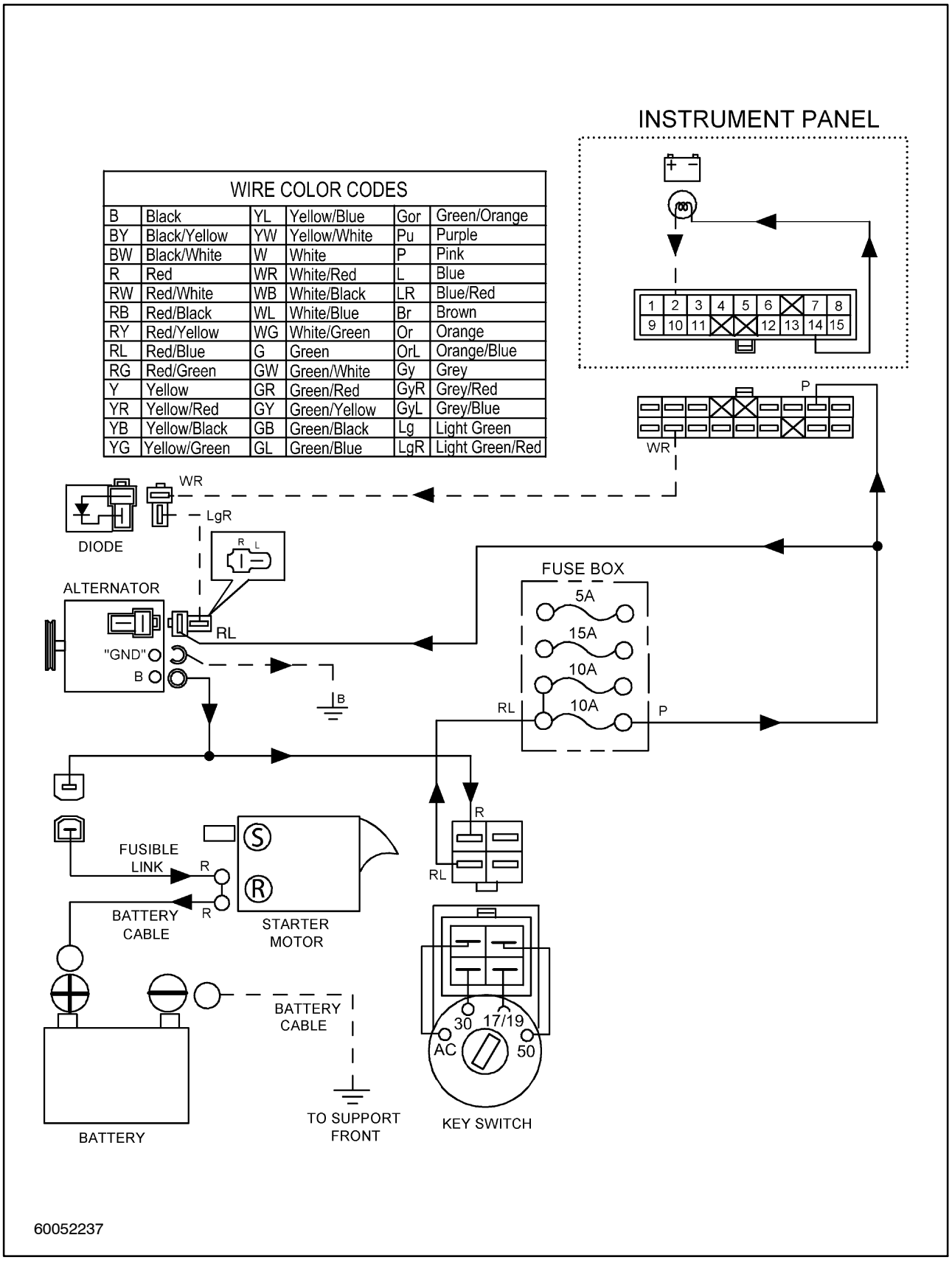
CHARGE CIRCUIT - PIN # HK34733 AND ABOVE



CHARGE CIRCUIT - PIN # HK34733 AND ABOVE

1. Current starts at the battery and flows through the positive (+) battery cable to the engine starter motor.

2. From the starter motor, current flows through the fusible link wire to a the wire splice. The wire splice splits current into two different paths.
   - One path goes to the “B” terminal of the alternator.
   - The other path travels to terminal “30” of the key switch.

3. When the key switch is in the “ACC/RUN” position, current flows from the “ACC” terminal to the 10-amp fuse within the fuse panel. Current passes through the fuse to a the wire splice. The wire splice splits the current into two different paths.
   - One path sends current to terminal “14” of the instrument panel connector. Terminal “14” provides current to the charge indicator light.
   - The other path sends current to the “R” (Regulator) terminal of the alternator.

4. The alternator is grounded by the “GND” terminal on the alternator through the wiring harness to the engine block.

5. If the tractor engine is not running or the alternator is not producing a sufficient amount of charge, (with the key switch in the “ACC/RUN” position). The charge indicator light will illuminate.
   - The current for the indicator light is provided by terminal “14” of instrument panel connector.
   - The ground circuit for the indicator light is provided by terminal “2” of instrument panel connector. From terminal “2” the ground path passes through a diode that is located at alternator R/L connector, then to the “L” terminal of alternator. The ground source for the “L” terminal is provided by the field coil.
   - When the ground circuit is complete to terminal “2” and current is provided to terminal “14” by the key switch, the charge indicator light will illuminate.

6. When the tractor is running with the alternator rotating and key switch in “ACC/RUN” position, the alternator produces an increased regulated voltage to the battery.
   - When the alternator is producing current, the ground circuit, through the “L” terminal, for the charge indicator light is disrupted causing the indicator light to not illuminate.
   - The “R” regulator terminal controls the voltage output from the alternator. If current is not present at the “R” terminal the alternator will not produce current.
   - The “B” terminal of the alternator is the output connection between the alternator and the battery.

TROUBLESHOOTING – CHARGE CIRCUIT		
PROBLEM	**POSSIBLE CAUSE**	**CORRECTION**
Charge light remains illuminated	Faulty alternator component	Test alternator and repair a necessary
	Short circuit to ground between alternator and warning lamp	Check wiring and repair as necessary
Charge light does not illuminate	Blown 10-amp fuse	Inspect 10-amp fuse and replace as necessary
	Faulty charge indicator bulb	Inspect indicator bulb and replace as necessary
	Open charge light circuit	Inspect connections, grounds, and wiring for charge circuit and repair as necessary
	Alternator diode open	Check diode for proper continuity
Insufficient or no battery charge, hard starting, or dim indicator light	Battery charge less than 75%	Test battery. Charge, add water, or replace as necessary
	Fan belt slipping	Check fan belt tension, adjust as necessary
	Loose wiring connections	Check wiring connections for charge circuit, repair as necessary
	Continuity fault in external wiring	Check wiring harness and repair as necessary
	Open alternator excitation circuit to terminal “R” of alternator	Inspect the red/blue wire from 10-amp fuse to “R” terminal of alternator
Battery failure, frequent burnout of lamps and fuses	Overcharge condition	Check alternator voltage output and repair as necessary
	Ground circuit for alternator short-circuited	Check alternator wiring and connections and repair as necessary

SECTION 55 - ELECTRICAL SYSTEM

Chapter 7 - Instrument Panel
PIN Number HK34733 and Above

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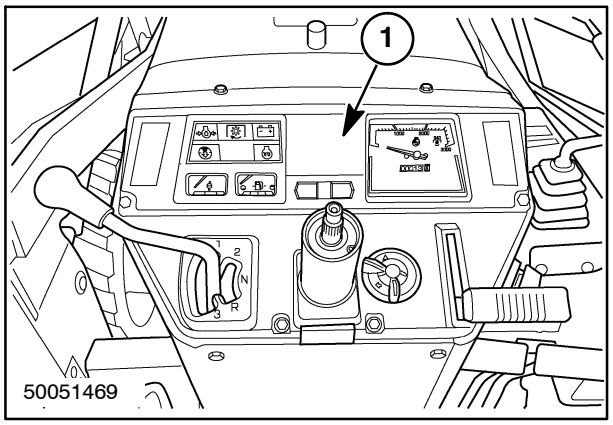
INSTRUMENT PANEL

NOTE: *The steering wheel was removed to better illustrate the instrument panel. Removal of the steering wheel is not necessary for servicing the instrument panel.*

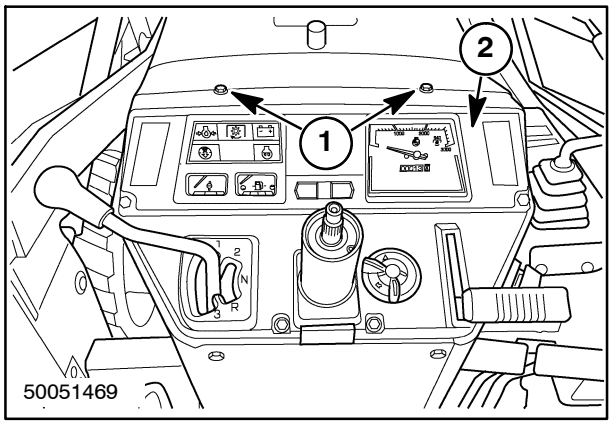
The instrument panel, 1, is located at the top of the dash panel. The instrument panel houses gauges and lights that monitor tractor functions.



1

Removal

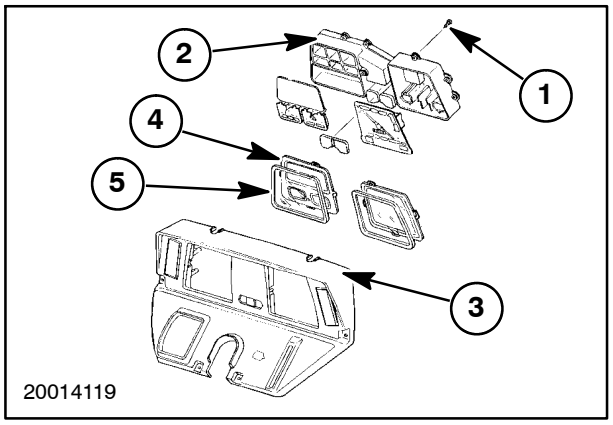
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the six screws, 1, to loosen the instrument panel, 2, from the dash panel.
3. Disconnect the tachometer cable and the wire harness to remove the instrument panel from the tractor.



2

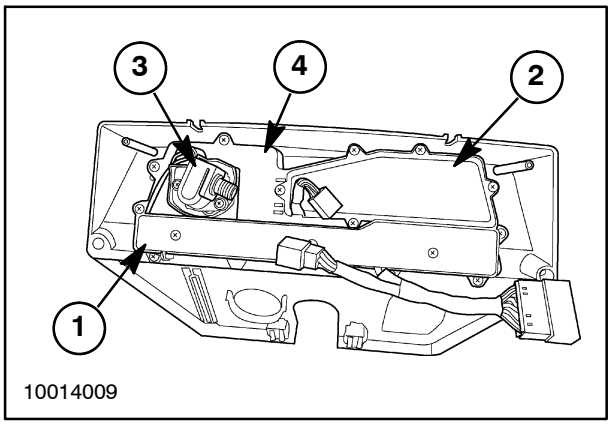
Disassembly

1. Remove the thirteen screws, 1, from the rear of the instrument panel to remove the instrument panel component housing, 2, from the instrument panel cover, 3.
2. Remove the retainer/gaskets, 4, and lenses, 5, from the instrument panel cover.



3

3. Remove the metal access plate, 1, and the plastic access plate, 2, and the tachometer drive, 3, from the back of the instrument panel component housing, 4.



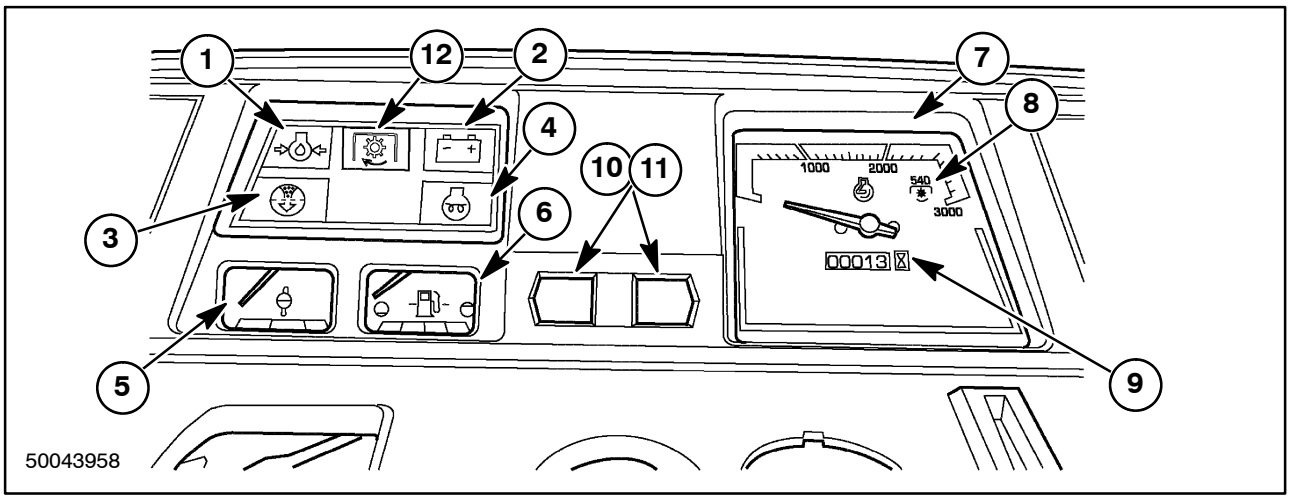
4

Assembly

1. Place the retainer/gaskets and lenses into the instrument panel cover.
2. Install the metal access plate and/or the plastic access plate onto the back of the instrument panel component housing.
3. Install the instrument panel component housing into the instrument panel cover by using the thirteen screws.

Installation

1. Connect the wire harness and the tachometer cable to the instrument panel.
2. Install the instrument panel into the tractor dash panel by using the six screws.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



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INSTRUMENT PANEL

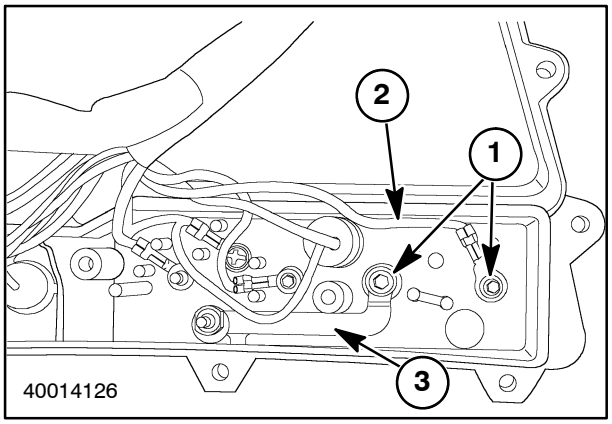
1. **Engine Oil Pressure Warning Light** – Illuminates with the key switch in the "ON or "HEAT" positions and remains lit for a short period of time after the engine is started. The light indicates oil pressure only and goes out when sufficient oil pressure is present at the oil sender. If the bulb illuminates during operation of tractor, stop the tractor engine immediately and investigate the cause.
2. **Battery Charge Warning Light** - Illuminates when the key switch is in the "ON" or "HEAT" positions and goes out when the engine is started. If this bulb becomes illuminated during tractor operation, it indicates that the charging system is not working properly. As the battery can become fully discharged under these conditions, the problem should be investigated immediately.
3. **Air Cleaner Restriction Warning Light** – Illuminates when the engine air filter needs to be cleaned or replaced. The engine has to be running and the key switch is in the "ON" position for the light to illuminate. The warning light monitors the engine intake air flow and when approximately 20 inches of vacuum is obtained, the indicator light will illuminate.
4. **Cold Starting Indicator Light** – Illuminates when the key switch is turned to the "HEAT" position. It remains lit for approximately six seconds, when the key is held in the "HEAT" position , during which time the glow plugs are heating the precombustion chambers of the engine cylinder head.
5. **Temperature Gauge** – Indicates engine coolant temperature. It is activated when the key switch to the "ON" or "HEAT" positions. The gauge will register cold with the key switch in the "OFF" position. If the need registers in the white range of the gauge, this indicates a normal operating temperature. If the needle moves to the red portion of the gauge, this indicates an overheated condition. Stop the tractor engine immediately and investigate the cause.
6. **Fuel Gauge** - Indicates the amount of diesel fuel remaining in the tractor fuel tank. The gauge is activated when the key switch is in the "ON" or "HEAT" positions. It will register empty with the key switch in the "OFF" position.
7. **Tachometer** – Registers engine RPM (Revolutions Per Minute). The gauge is marked in increments of 100 and will return to zero when the engine is not running
8. **PTO Speed Indicator** – Determined by the position of the needle on the tachometer. The tachometer is marked to indicate 540 PTO RPM. If the needle registers above the 540 RPM mark, this indicates a dangerous over speed condition, and the engine RPM should be reduced immediately.
9. **Proof Meter** – Records the hours and portions of hours that your tractor has been operated. Use the proof meter as a guide to determine hourly service and maintenance intervals. NOTE: Registration of hours and portions of hours your tractor has operated, will be based on an average engine speed of 1867 RPM. Engine speeds below 1867 RPM, accumulate hours at a slower rate than clock hours. Engine speeds above 1867 RPM, accumulate hours at a faster rate than clock hours.
10. **Hazard Flasher Warning Lights** – Operate when the flasher switch is turned on, regardless of the key switch position. Use the flasher warning lights and the SMV emblem when traveling on public roads, day or night.
11. **Flasher Turn Lights** – Operate when the turn signal switch is activated. Rotate the switch counterclockwise for right turns, the right arrow will flash. Rotate the switch clockwise for left turns, the left arrow will flash. The key switch has to be in the "RUN" position.
12. **PTO "ON" Indicator Light** - The PTO indicator light will illuminate amber when either the rear or mid PTO is engaged and the key switch is in the "ACC/RUN" position.

Removal, Testing & Installation
This section describes the removal, testing, and installation of the components within the instrument panel.

COOLANT TEMPERATURE GAUGE

Removal

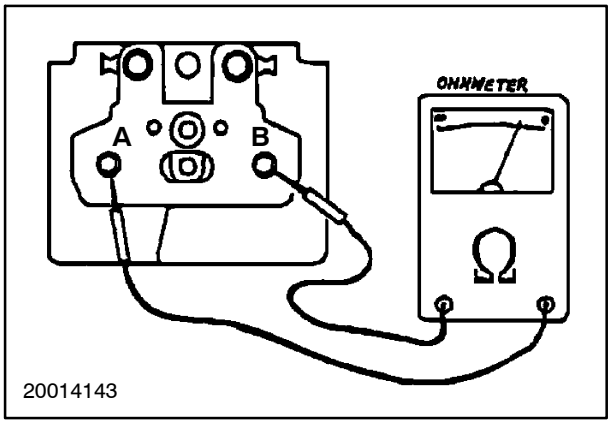
1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the instrument panel SEE INSTRUMENT PANEL REMOVAL.
3. Remove the instrument panel component housing from the instrument panel cover. SEE INSTRUMENT PANEL DISASSEMBLY.
4. Remove the metal access plate from the back of the instrument panel component housing. SEE INSTRUMENT PANEL DISASSEMBLY.
5. Remove the two nuts, 1, to disconnect the wire lead, 2, and the ground buss bar, 3, from the terminals on the coolant temperature gauge.
6. Remove the coolant temperature gauge from the instrument panel component housing.



6

Testing
Use an ohmmeter to check the coolant temperature gauge for electrical continuity.

1. Touch an ohmmeter lead to terminal A on the back of the temperature gauge.
2. Touch the other ohmmeter test lead to terminal B on the back of the coolant temperature gauge.
3. Observe the ohmmeter. The ohmmeter should show a resistance reading of 55 ± 3 ohms. If the ohmmeter reading is not between 52 and 58 ohms, the temperature gauge is faulty and requires replacement.



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Installation

1. Slide the temperature gauge into the instrument panel component housing and use the two nuts to attach the wire lead and the ground buss bar onto the two temperature gauge terminals.
2. Install the metal access plate into the instrument panel component housing.
3. Install the instrument component housing into the instrument panel cover.
4. Connect the wire harness and the tachometer cable to the instrument panel.
5. Install the instrument panel into the tractor by using the six screws.
6. Connect the negative (-) battery cable to the negative (-) battery terminal.

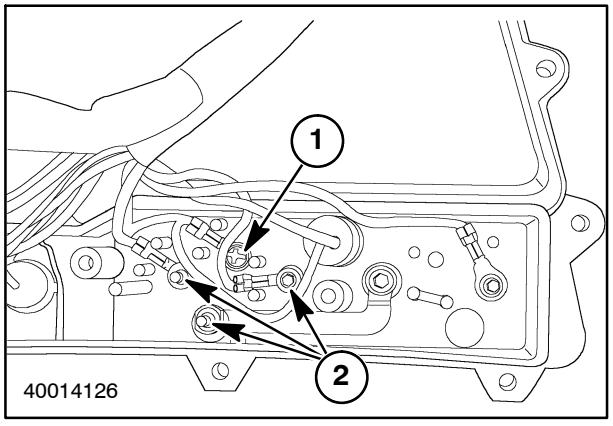
FUEL GAUGE

Removal

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the instrument panel SEE INSTRUMENT PANEL REMOVAL.
3. Remove the instrument panel component housing from the instrument panel cover. SEE INSTRUMENT PANEL DISASSEMBLY.
4. Remove the metal access plate from the back of the instrument panel component housing. SEE INSTRUMENT PANEL DISASSEMBLY.

NOTE: *To ensure proper installation, label each of the wire leads for proper orientation before disconnecting.*

5. Remove the screw, 1, and the three nuts, 2, to disconnect the wire leads from the fuel gauge terminals.
6. Remove the fuel gauge from the instrument panel component housing.



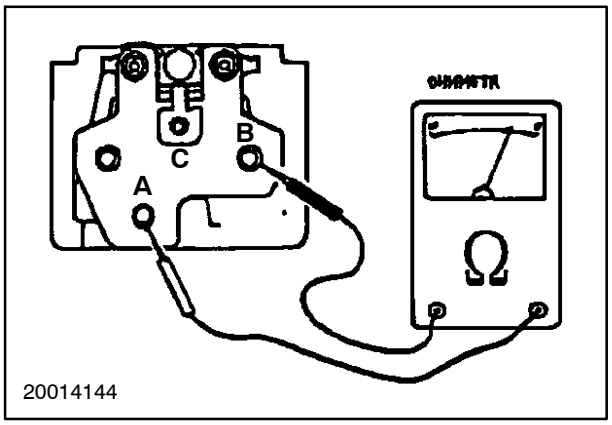
8

Testing

Use an ohmmeter to check the fuel gauge for electrical continuity.

Test 1

1. Touch an ohmmeter lead to terminal A on the back of the fuel gauge.
2. Touch the other ohmmeter test lead to terminal B on the back of the fuel gauge.
3. Observe the ohmmeter. The ohmmeter should show a resistance reading of 55 ± 3 ohms. If the ohmmeter reading is not between 52 and 58 ohms, the fuel gauge is faulty and requires replacement.



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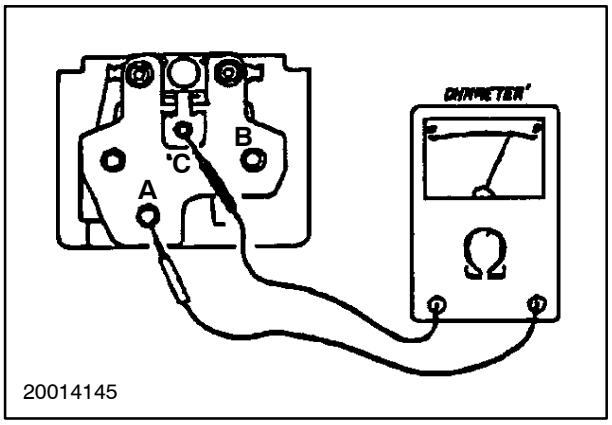
Test 2

1. Touch an ohmmeter lead to terminal A on the back of the fuel gauge.
2. Touch the other ohmmeter test lead to terminal C on the back of the fuel gauge.
3. Observe the ohmmeter. The ohmmeter should show a resistance reading of about 70 ohms. If the ohmmeter reading is not approximately 70 ohms, the fuel gauge is faulty and requires replacement.



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Installation

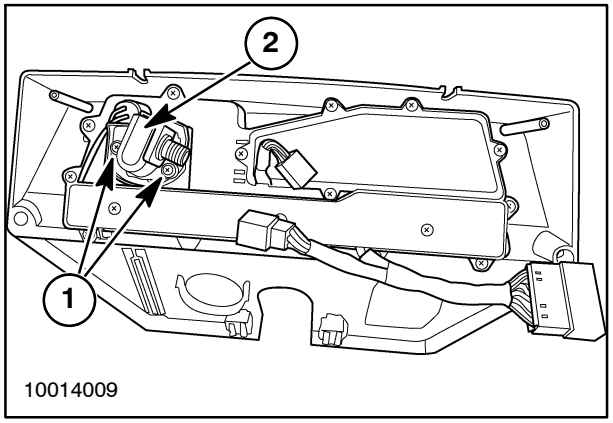
1. Slide the fuel gauge into the instrument panel component housing and use the three nuts and the one screw to attach the wire leads and the ground buss bar onto the four fuel gauge terminals.
2. Install the metal access plate into the instrument panel component housing.
3. Install the instrument component housing into the instrument panel cover.
4. Connect the wire harness and the tachometer cable to the instrument panel.
5. Install the instrument panel into the tractor by using the six screws.
6. Connect the negative (–) battery cable to the negative (–) battery terminal.

TACHOMETER/HOURMETER

Removal

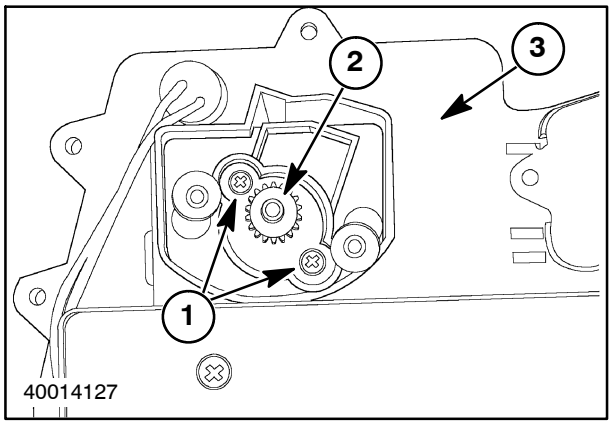
NOTE: *Check the tachometer cable for damage before removing the tachometer from the instrument panel.*

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the instrument panel SEE INSTRUMENT PANEL REMOVAL.
3. Remove the instrument panel component housing from the instrument panel cover. SEE INSTRUMENT PANEL DISASSEMBLY.
4. Remove the two screws, 1, to remove the tachometer drive, 2, from the instrument panel component housing.



11

5. Remove the two screws, 1, to remove the tachometer, 2, from the instrument panel component housing, 3.



12

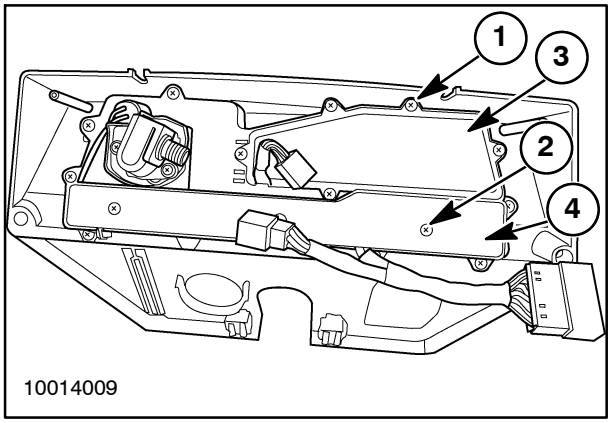
Inspection

1. Inspect the tachometer cable for excessive wear or damage.
2. Inspect all gears in the tachometer drive and the tachometer gauge for excessive wear or damage. Replace the tachometer drive or the tachometer as necessary.

Installation

1. Install the tachometer by using the two screws.
2. Install the tachometer drive by using the two screws.
3. Install the instrument component housing into the instrument panel cover.
4. Connect the wire harness and the tachometer cable to the instrument panel.
5. Install the instrument panel into the tractor by using the six screws.
6. Connect the negative (-) battery cable to the negative (-) battery terminal.

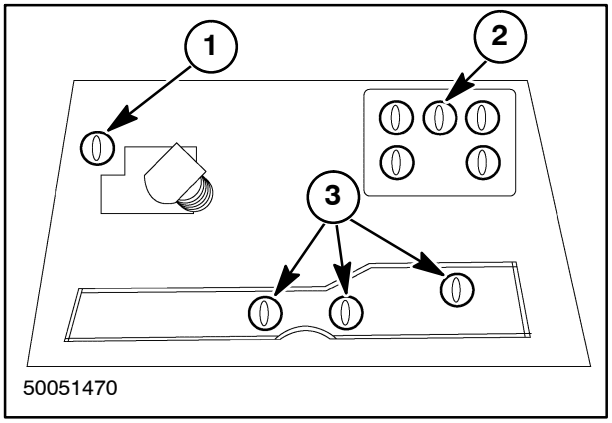
Remove mounting screws, 1 or 2, and back panels, 3 or 4, to gain access to indicator light bulbs, or gauge back lights and flasher arrow bulbs.



13

Instrument Panel Bulb List

#	Function	Quantity	Bulb Size
1	Tachometer Back Light	1	158 HD
2	Indicator Lights	5	D9 158 54
3	Right/Left Directional Arrows, Fuel/Temperature Gauges Back Light	3	12V - 3W



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SECTION 55 - ELECTRICAL SYSTEM

Chapter 8 - Alternator and Starter
PIN Number HK34733 and Above

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SPECIFICATIONS – ALTERNATOR

Manufacturer	Mitsubishi
Model	A007T03877
Polarity	Negative Ground
Rotational Direction (viewed from pulley)	Clockwise
Drive Belt Tension	5 - 10 mm (0.197 - 0.394 in.) deflection @ 5 kg (11 lb.) of force
Adjusting Voltage	14.5 - 15.0 volts
Load Characteristics	
Terminal voltage	13.5 volts
Current	30 amp minimum
Rpm	2500
Brush Length	
Wear Limit (min. length)	5 mm (0.20 in.)
Original	18.5 mm (0.728 in.)
Brush Contact Rings	
Wear Limit (min. diameter)	22.1 mm (0.871 in.)
Original Diameter	22.7 mm (0.894 in.)
Bearing	
Front	ECSC8
Rear	6303DDG
Stator Coil Resistance	less than 1.0 ohm
Rotor Coil Resistance	2.8 ohms

DESCRIPTION OF OPERATION – CHARGING SYSTEM

Op. 55 301

The TC30 model tractors are equipped with a 40-amp output alternator. The alternator is equipped with an integrated circuit (IC) regulator, meaning voltage is regulated internally and electronically within the alternator.

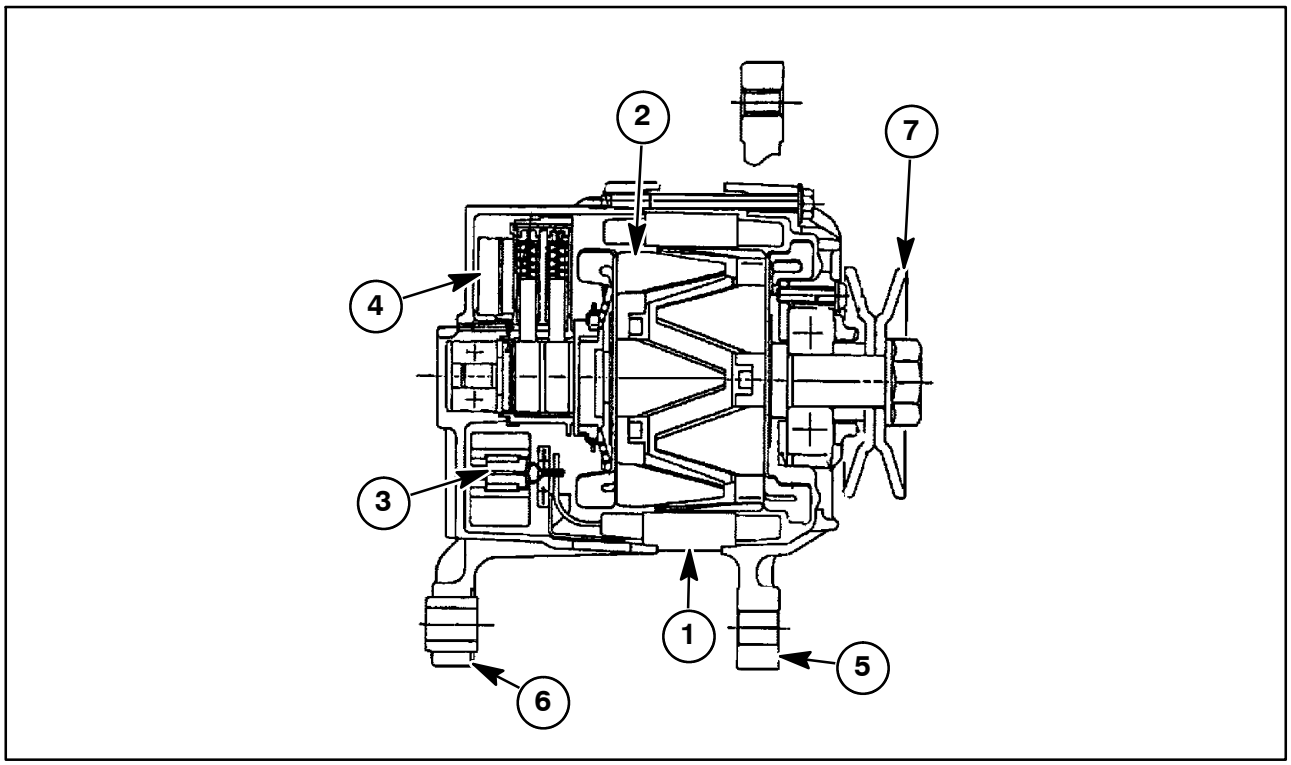
The principle components of the alternator are the stator, 1, the rotor, 2, and the rectifier assembly, 3, and the IC regulator, 4.

The rectifier assembly, 3, consists of two heat sinks, one positive (+) and one negative (–), and a diode trio. The diode trio is used as a field supply diode and is connected to terminal “L” on the alternator.

The IC regulator, 4, is a solid state unit and can only be serviced as an assembly.

The internal components of the alternator are housed in a two piece frame, which is divide into a drive end (front) frame, 5, and a rear frame, 6. The frame contains open slots to allow for cooling of the alternator.

The alternator rotor is rotated in the frame by using a belt driven pulley, 7, which is powered off of the engine crankshaft pulley by a belt.



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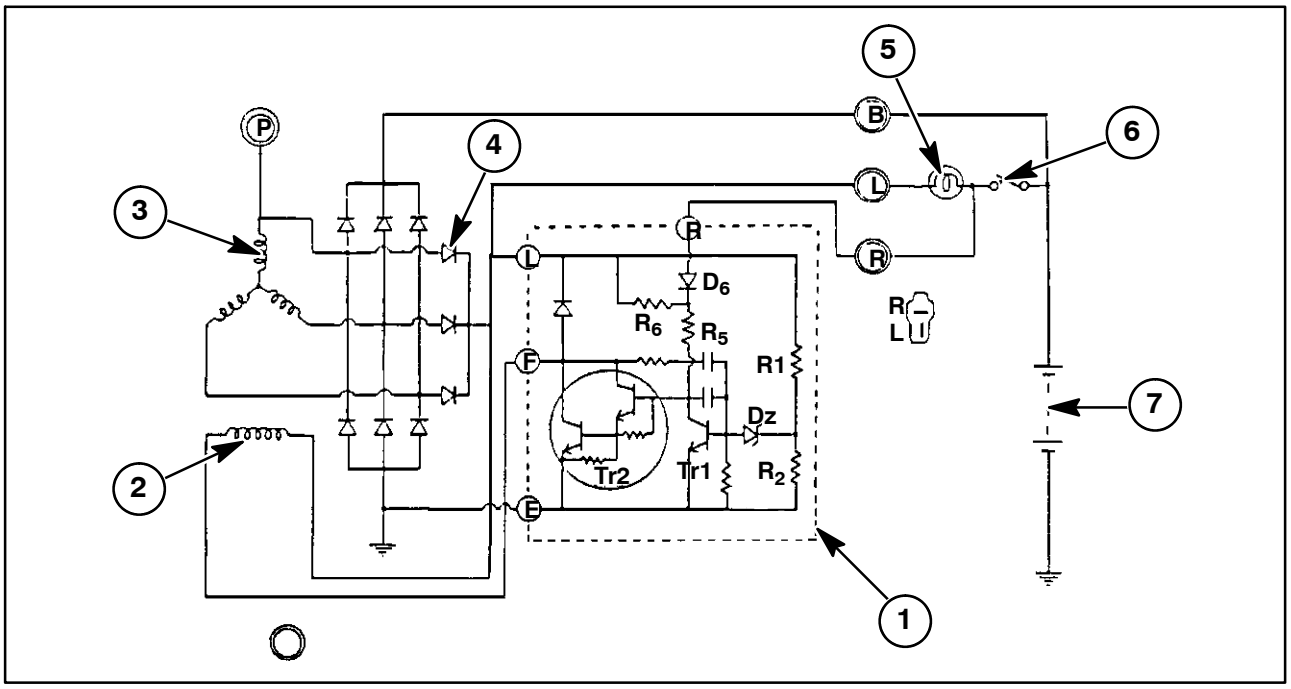


2

CHARGING CIRCUIT

The charging circuit and internal connections are shown. The charging system consists of an IC voltage regulator, 1, (enclosed with dotted lines), a battery, 7, and connecting wires. Because of the use of IC, the voltage regulator is very compact and is built into the alternator.

The IC voltage regulator, 1, permits the field current to flow directly from the diode trio, 4, to the field coil, 2, without passing through the external circuit. Consequently, there are no voltage drops caused by the key switch or the external wiring as with conventional vibrating-contact regulators mounted separately from the alternator. To aid in initial voltage buildup when the engine is started, the field current is supplied through the indicator lamp, 5, from the battery, 7.

Since the frequency pulse output of 1/10 the alternator speed develops on the “P” terminal, this terminal is used for speed detection.

PRINCIPLE OF IC REGULATOR

The basic function of the IC voltage regulator is to make the terminal voltage constant by detecting the generated voltage and increasing/decreasing the field current.

As indicated, the regulator consists of two basic sections: a voltage control device and an output device to handle the field current. The voltage control device includes the voltage divider network, R1 and R2, a zener diode, DZ, for voltage reference, and a single amplifying transistor, Tr1. The output device is a darlington-type amplifier which is called power transistor, Tr2. The power transistor, Tr2, is placed in series with the alternator field coil and ground.

The signal amplifying transistor, Tr1, senses the generated voltage and turns the power transistor, Tr2, on and off many times per second most of the time the engine is in operation.

The basic operating principles are explained as follows, see Figure 3:

1. When the key switch, 6, is closed, current from the battery, 7, flows through the indicator lamp, 5, and resistor R6, which are in parallel to the field coil, 2. From here it continues to flow on through the field coil, 2, to the ground, completing the circuit back to the battery, 7.
2. When the alternator begins to rotate, AC voltages are generated by the stator coil, 3. The diodes in the rectifier assembly change the stator AC voltages to DC voltage which appears between ground and the “B” terminal.

   The stator also supplies DC field current through the diode trio, 4, the field coil, 2, the power transistor, Tr2, and then through the diodes in the rectifier assembly back to the stator.
3. When the generated voltage is low, no current flows in the zener diode, DZ, since the voltage at point “A” is lower than the zener voltage.
4. As the speed and voltage increase, the voltage at point “A” also increases until it reaches the limiting value set at the factory. As the zener diode, DZ, breaks down, current flows through R1, DZ, and the base-emitter circuit of Tr1 to ground. This renders Tr1 conductive, so that much of the current flows through the collector-emitter circuit of Tr1. This reduces the base current of Tr2 thereby reducing the field current. This means that Tr1 turns on and Tr2 turns off.
5. When the generated voltage decreases, the zener diode, DZ, again turns off and Tr1 also turns off. This cycle repeats many times per second, and the alternator output voltage is, therefore, regulated within a narrow limit.

   In other words, the action is similar to the conventional vibrating-contact regulator, in that current to the field coil, 2, is varied to limit the output voltage, but in place of the voltage coil and spring system, there is a voltage divider network, R1 and R2, and a zener diode, DZ.

TROUBLESHOOTING - ALTERNATOR

NO CHARGING

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Loose connection, short circuit	Repair
Alternator	Loose connection, no ground, short circuit	Repair or replace
	Defective rectifier	Replace
	Loose connection on RF resistor	Replace
Regulator	Defective regulator	Replace
	Loose connection of alternator or regulator	Repair or replace

INSUFFICIENT CHARGING

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Loose connection or short circuit	Repair
Alternator	Loose drive belt	Repair
	Short in rotor coil	Replace
	Short in stator coil	Replace
	Defective rectifier	Replace
	Insufficient brush contact	Repair or replace
Regulator	Defective regulator	Replace
	Loose connection of alternator and regulator	Repair
Battery	Defective battery	Replace

OVERCHARGE

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Battery	Internal short	Replace
Regulator	Defective regulator	Replace

UNSTABLE CHARGING CIRCUIT

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Loose connection or open wire	Repair or replace
Alternator	Loose drive belt	Repair
	Short in rotor coil	Replace
	Short in stator coil	Replace
	Broken brush or spring	Replace
	Loose connection	Repair
Regulator	Defective regulator	Replace
	Loose connection at alternator and regulator	Repair or replace

ABNORMAL NOISE OF ALTERNATOR

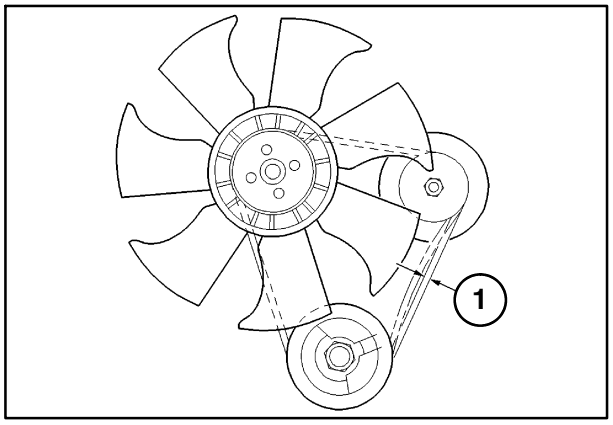
FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Alternator	Loose mounting hardware	Repair
	Defective bearings	Repair or replace
	Rotor core and stator in contact	Replace
	Defective diode	Replace
	Short in stator coil	Replace

TESTING AND OVERHAUL – ALTERNATOR

PRELIMINARY ALTERNATOR TESTS

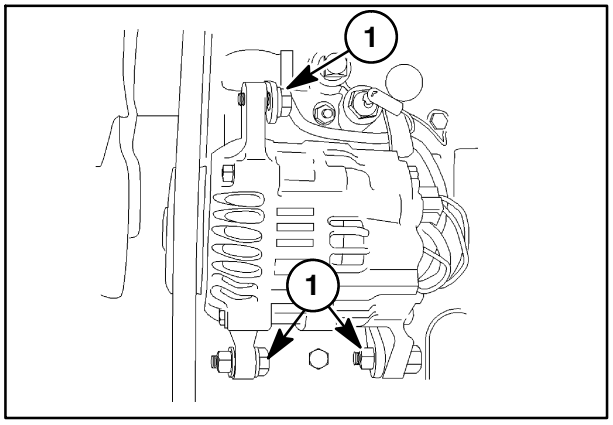
Alternator Drive Belt

1. Check the alternator drive belt deflection by applying 5 kg (11 lb.) of force between the crank pulley and the alternator pulley, 1. Belt deflection should be 5 - 10 mm (0.197 - 0.394 in.).



3

2. If the drive belt deflection needs adjusted, loosen the alternator adjusting/mounting bolts, 1, and adjust the alternator as needed to obtain proper belt deflection.



4

Alternator Output

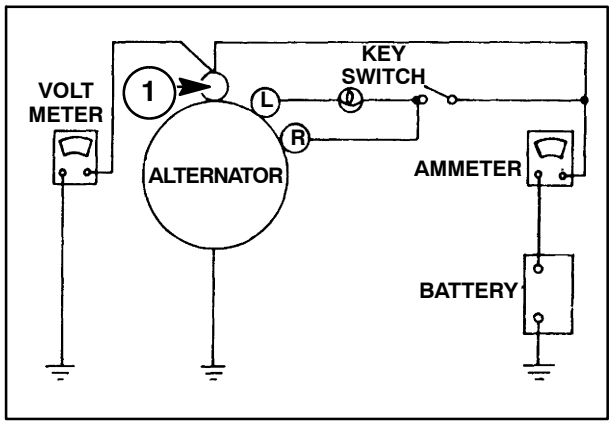
NOTE: *Use the following methods if an alternator/ charging system analyzer is unavailable.*

1. Connect a 50-amp capacity test ammeter between the positive battery cable and the key switch.
2. Connect a voltmeter to the battery terminal, 1, of the alternator and to a ground source.
3. Observe the voltmeter. The meter should indicate battery voltage. If the voltmeter does not read battery voltage, the wiring between the alternator and the battery may be faulty and should be repaired or replaced. If the battery voltage reading is correct, proceed to the next step.

⚠ WARNING ⚠

Do not attempt to start the engine without first shorting the wires between the ammeter leads. Otherwise, injury or damage to charging and testing components may occur.

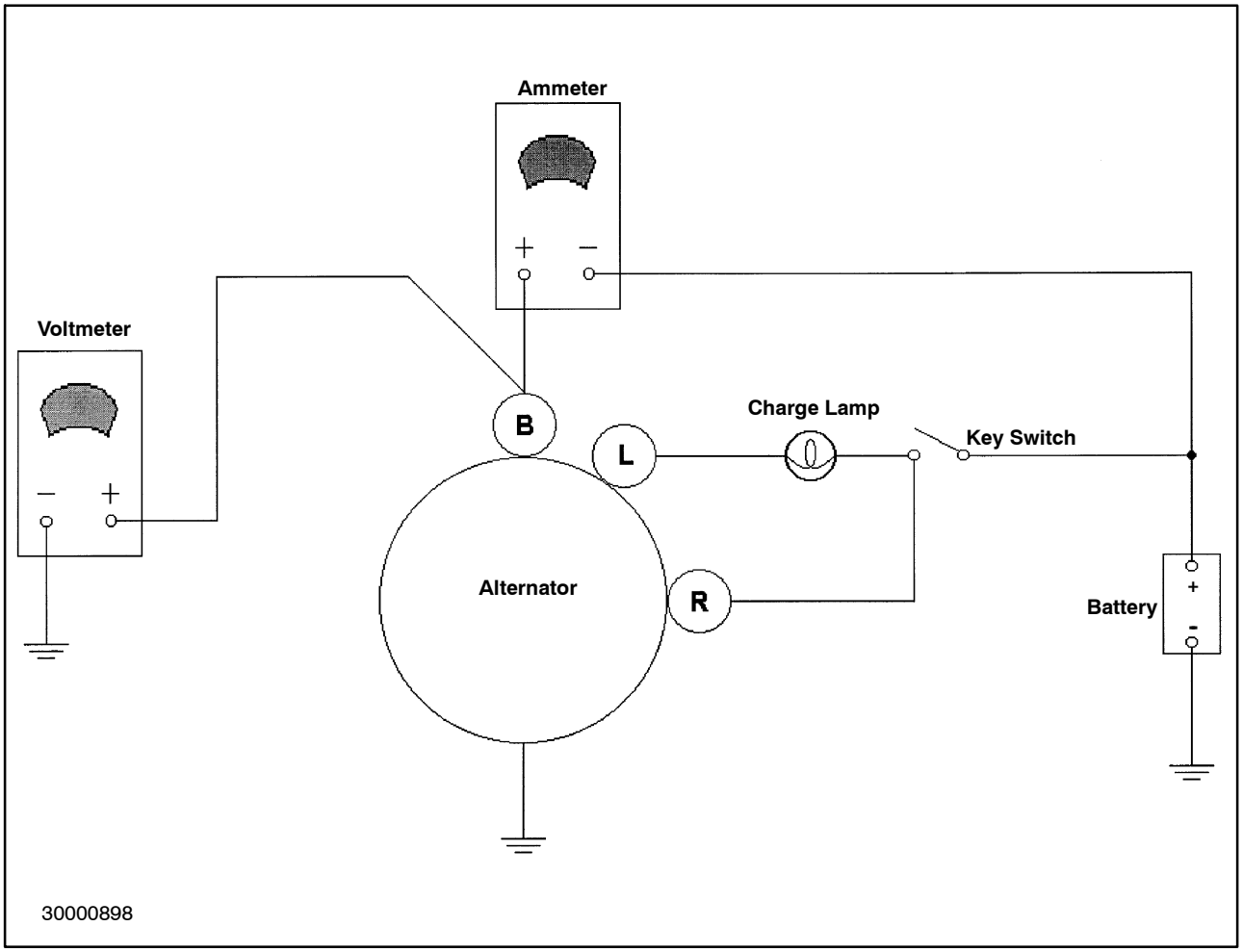
4. Use a jumper wire to short the test ammeter leads and start the tractor engine.
5. After the tractor engine is started, remove the jumper wire between the test leads of the ammeter.
6. Increase the engine speed to approximately 2000 RPMs and observe the ammeter reading.
7. If the ammeter indicates 5 amps or less, observe the voltmeter reading. The voltmeter is indicating adjusting voltage, which is the amount of increased voltage the alternator supplies to the battery. The reading should indicate a higher voltage than what is indicated when voltage is taken at the battery. If the reading is not higher, the alternator is not generating enough voltage and a component may be malfunctioning.
8. If the ammeter indicates more than 5 amps, continue to charge the battery until the ammeter reading falls below 5 amps. If the reading does not fall below 5 amps, test the battery or replace the battery with one that is fully charged.



5

NOTE: *bench testing the alternator will achieve the best results for the following test. (See alternator bench testing).*

9. If the previous test was satisfactory, open the key switch (OFF) and connect an ammeter between the battery terminal, "B", of the alternator and the battery wire, as shown.
10. Connect the positive (+) lead of a voltmeter to the "B" terminal on the alternator. Connect the negative (-) lead to a suitable ground. Confirm that the voltmeter indicates battery voltage.
11. Apply the parking brake and start the tractor engine. Turn on all 12-volt powered accessories such as the headlight and indicator lights. Immediately raise engine RPMs to 2000 or more and record the maximum value indicated on the ammeter.
12. If the amperage value is more than 70% of the nominal alternator output as described in alternator specifications, the alternator is considered to be working satisfactorily.

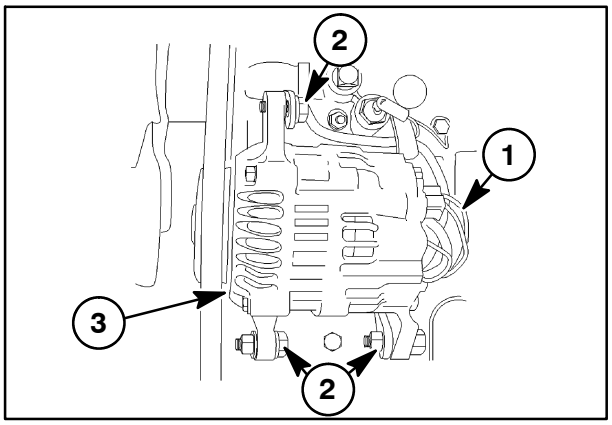


6

ALTERNATOR

Removal

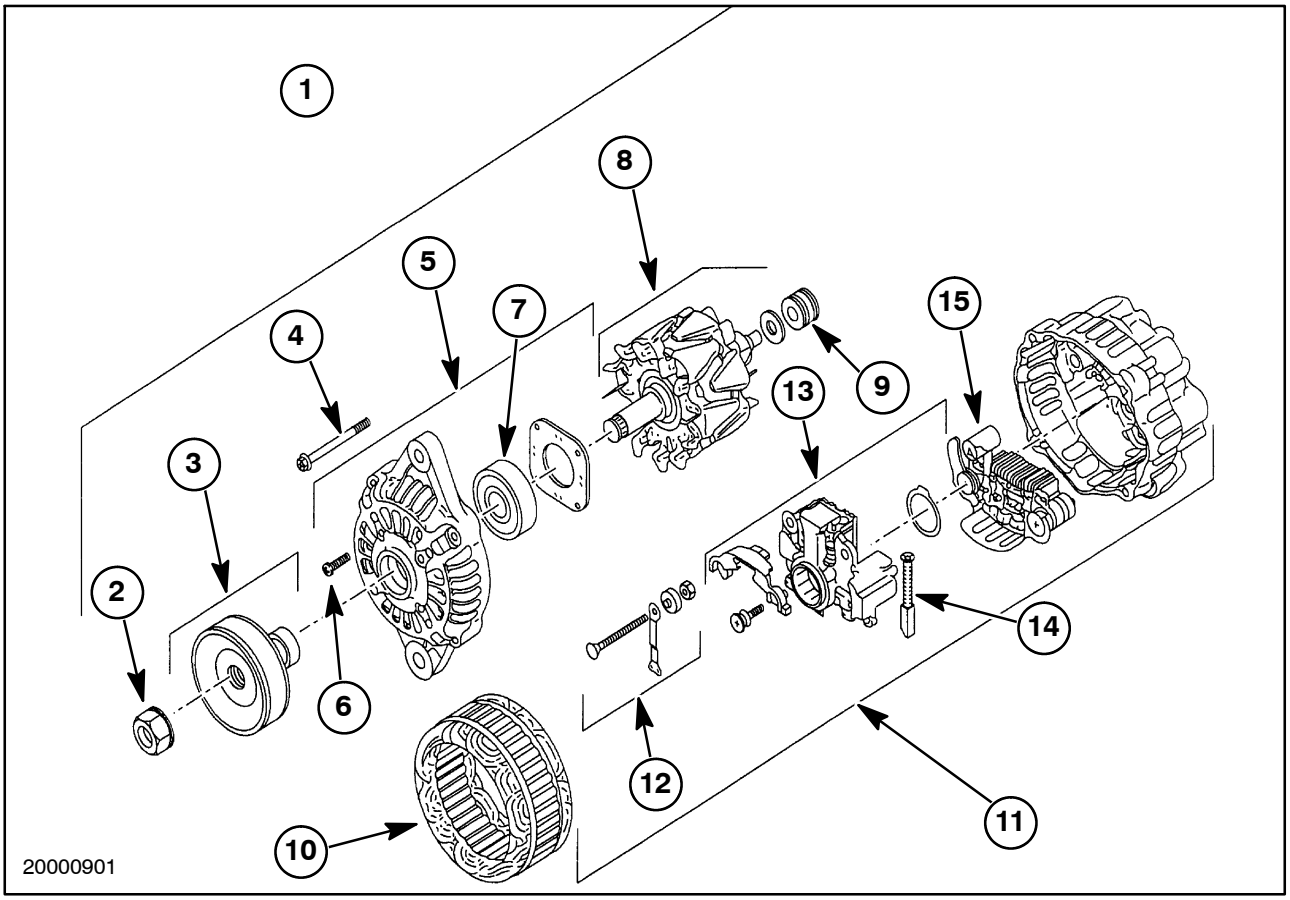
1. Disconnect the negative (-) battery cable from the battery.
2. Disconnect all wiring, 1, from the rear of the alternator.
3. Loosen the alternator mounting bolts, 2, and remove the V-belt, 3, from the alternator drive pulley.
4. Remove the alternator mounting bolts, 2, and remove the alternator from the tractor engine.



7

Disassembly

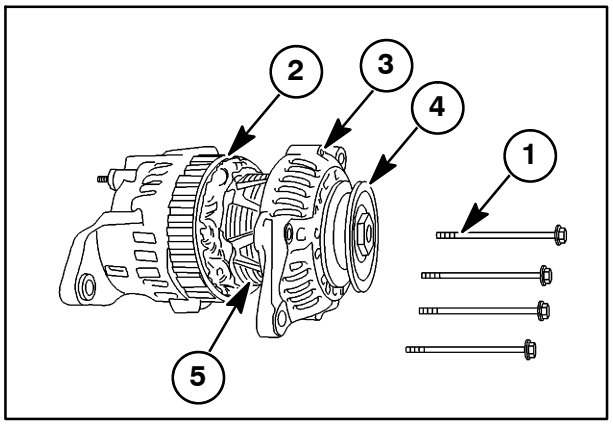
1. Mark the front alternator frame, 5, the rear alternator frame, 11, and the stator, 10, with scribe marks to insure that the alternator is assembled as taken apart.



8

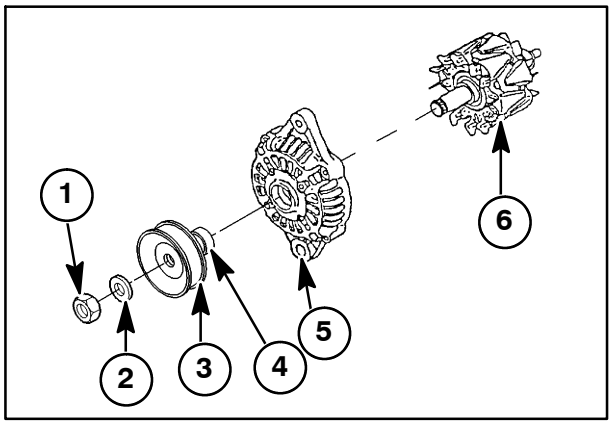
1. Alternator Assembly
2. Nut
3. Pulley Assembly
4. Set Screw
5. Cover Assembly
6. Set Screw
7. Ball Bearing
8. Rotor Assembly
9. Ball Bearing
10. Stator
11. Cover Assembly
12. Terminal Set
13. Regulator
14. Brush Spring
15. Rectifier Assembly

2. Remove the four (4) alternator frame retaining bolts, 1.
3. Carefully separate the front frame, 3, and the rear frame and stator, 2. The rotor assembly, 5, and pulley, 4, will be removed with the front frame, 3.



9

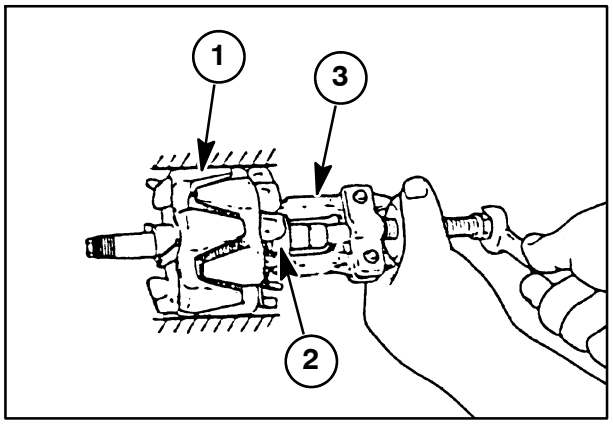
4. To remove the pulley nut, 1, use an impact wrench or place the rotor, 6, into a soft jaw vice and use a wrench. Remove the washer, 2, pulley, 3, spacer, 4, and front frame, 5, from the rotor, 6.



10

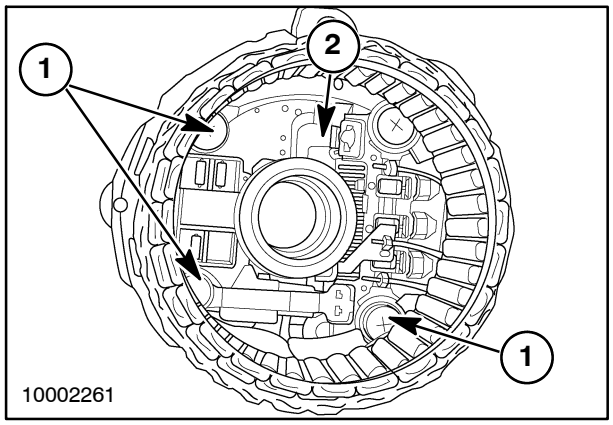
NOTE: *When removing the rear rotor bearing from the rotor, be sure to apply even pressure to the rotor assembly.*

5. The rear rotor bearing, 2, may be removed from the rotor, 1, by using a bearing puller, 3.



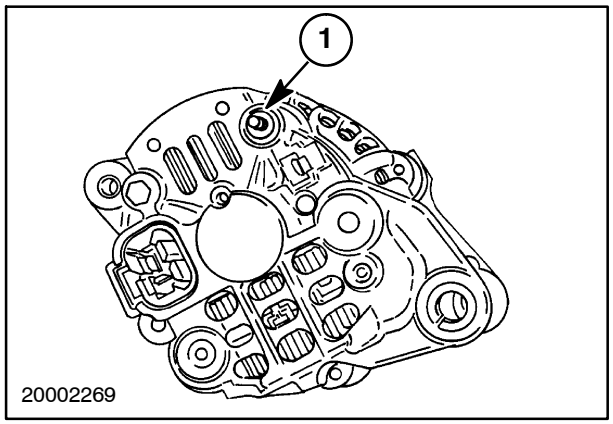
11

6. Remove the three (3) screws, 1, which secure the regulator/rectifier assembly, 2, to the rear alternator frame.



12

7. Remove the battery terminal nut, 1, from the rear of the alternator frame.
8. Carefully remove the stator and the regulator/rectifier assembly from the rear alternator frame.

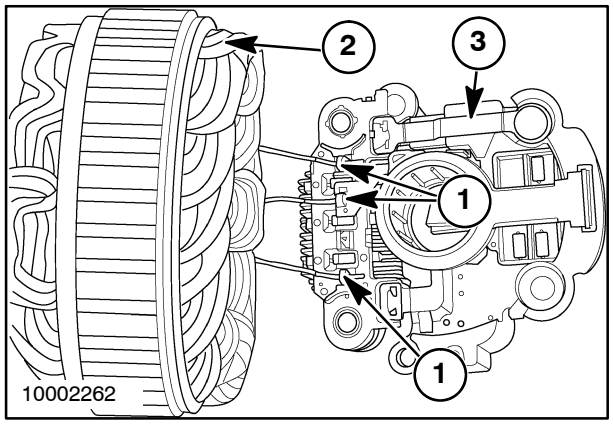


13

⚠ CAUTION ⚠

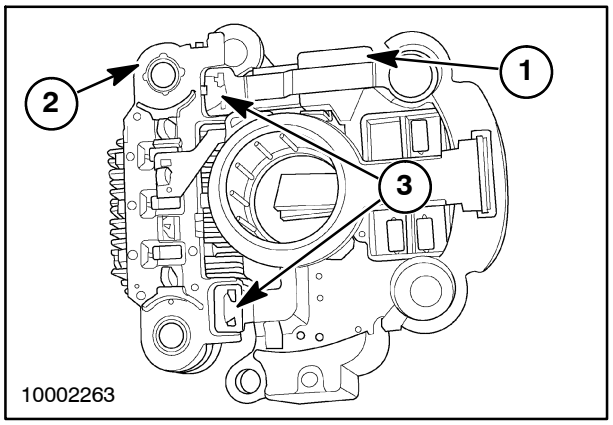
Preheat the soldering iron before attempting to unsolder the stator leads or the regulator/rectifier assembly. To avoid damage to the rectifier diodes, use a pair of needle nose pliers to remove excess heat from the area being soldered. Hold the pliers just below the solder joint on the rectifier to remove excess heat. Use a damp cloth to cool the components once they have been separated.

9. Unsolder the three stator leads, 1, and remove the stator, 2, from the rectifier/regulator assembly, 3.



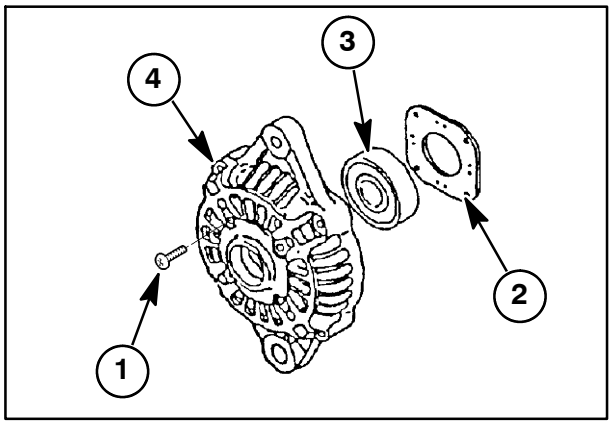
14

10. Unsolder the IC regulator assembly, 1, from the rectifier assembly, 2, at the solder joints, 3.



15

11. Remove the four (4) screws, 1, from the front alternator frame, 4. Remove the retaining plate, 2, and the front rotor bearing, 3.



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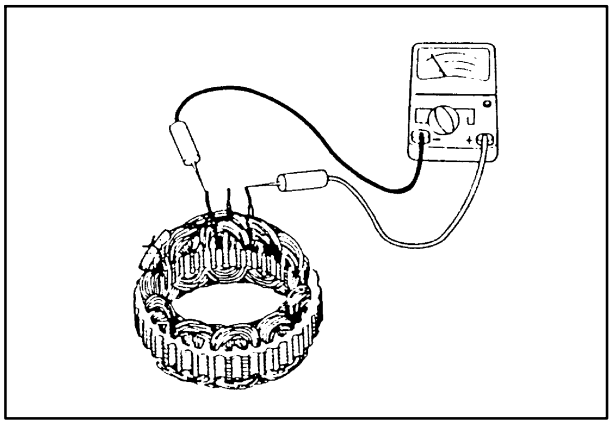
Testing and Inspection

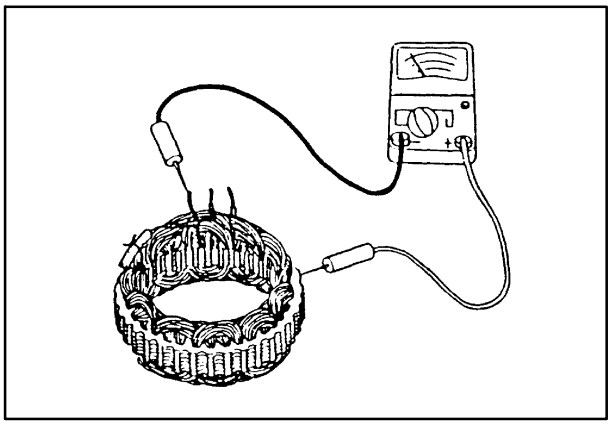
Stator

1. Using an ohmmeter, touch the ohmmeter test probes to different leads of the stator coil.
2. Observe the ohmmeter. The ohmmeter should read a resistance of less than 1 ohm, for each of the phase wires, indicating continuity.
3. If there is no continuity, inspect the lead wire connection for breaks. The lead wire may be repaired with solder if damage is not excessive. If the lead wire is good, the stator coil is faulty and the stator needs replaced.



17

4. Using an ohmmeter, touch one ohmmeter test probe to the stator coil and the other test probe to the stator core.
5. Observe the ohmmeter. Resistance should be high, indicating no continuity between the coil and core. If there is continuity, the stator is defective and needs replaced.



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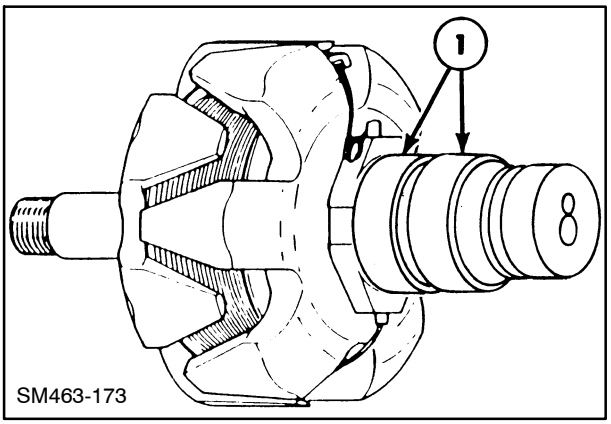
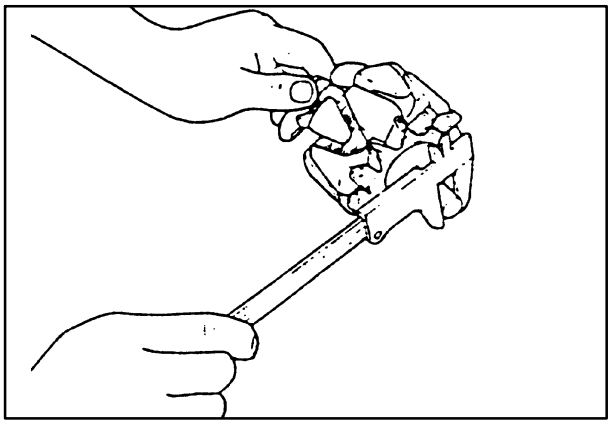
Rotor

1. Inspect the rotor brush contacts, 1, for pitting, roughness, and dirt. If necessary, use # 600 grit fine sandpaper to clean dirt off of the contacts. If the contacts are pitted or damaged excessively, replace the rotor.



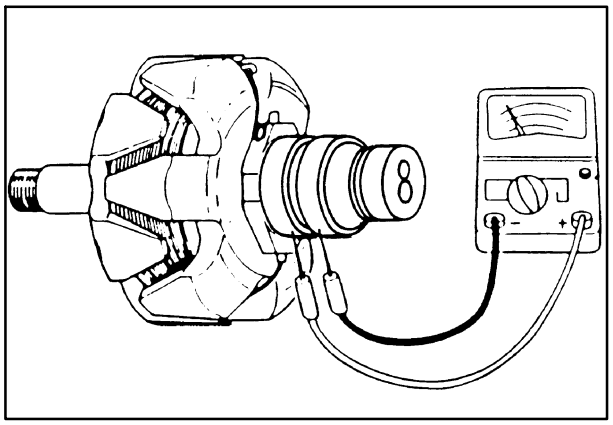
19

2. Use a suitable measuring device to determine the outer diameter of each brush contact. The minimum outer diameter of the brush contacts is 22.1 mm (0.871 in.).



20

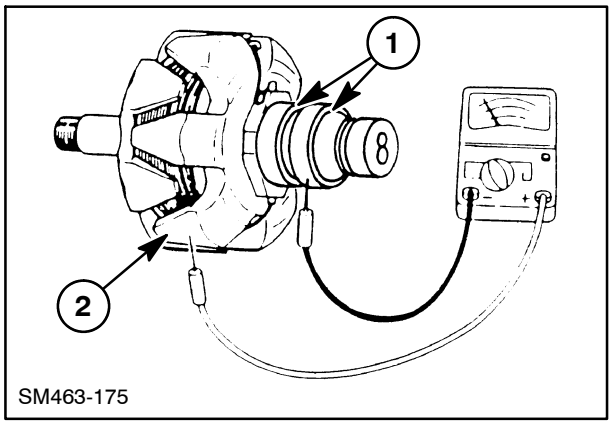
3. Using an ohmmeter, touch one ohmmeter test probe to a brush contact. Touch the other test probe to the remaining brush contact.
4. Observe the ohmmeter. The ohmmeter resistance reading should be approximately 3 ohms. If the reading is not as specified, the rotor is defective and needs replaced.



21

NOTE: *When testing the resistance between the brush contacts and rotor poles, be sure that the ohmmeter test probe touching the rotor pole is not insulated by paint.*

5. Using an ohmmeter, touch one ohmmeter test probe to one of the rotor brush contacts, 1, and the other test probe to one of the rotor poles, 2.
6. Observe the ohmmeter. Resistance should be high, indicating no continuity between the rotor poles and brush contacts. If there is continuity, the rotor is defective and needs replaced.



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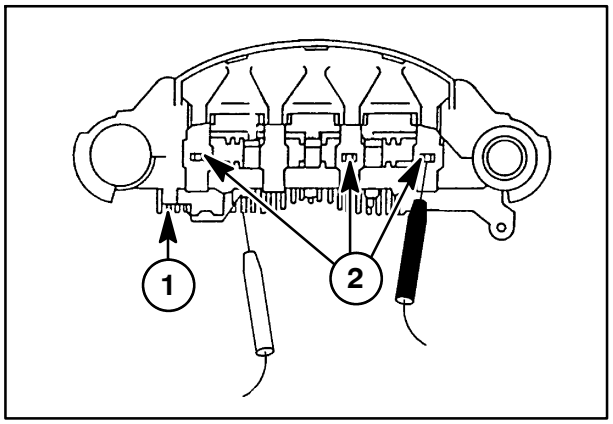
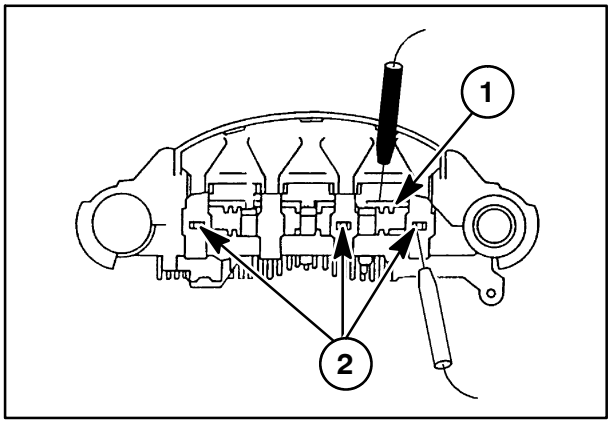
Rectifier Assembly

1. Using an ohmmeter, touch the positive (+) test probe to the positive (+) portion of the diode plate, 1, and the negative (–) test probe to the other test probe to a stator coil lead connection terminals, 2.
2. Observe the ohmmeter for continuity.
3. Now switch the positions of the test probes and observe the ohmmeter for continuity. The ohmmeter should indicate continuity in one direction only. If there is continuity in both directions or no continuity at all, the rectifier assembly is defective and needs replaced.



23

4. Using the same procedure described in the three previous steps, test the diodes between the negative (–) portion of the diode plate, 1, and the stator lead connections, 2. Again, replace the rectifier assembly if the diodes test defective.



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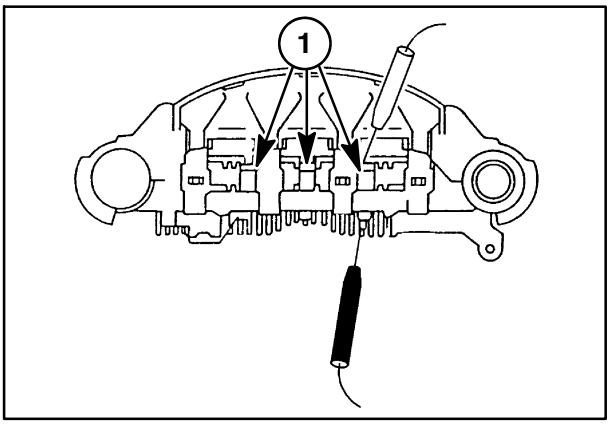
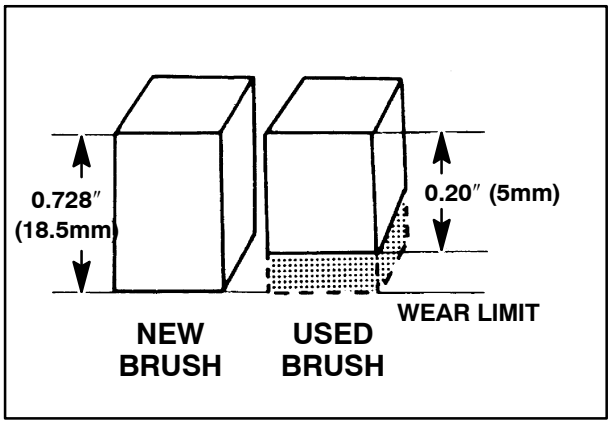
5. Test each of the three small diodes, 1, by touching the positive (+) ohmmeter test probe to one end of a diode and the negative (–) test probe to the opposite end of the diode.
6. Observe the ohmmeter for continuity.
7. Now switch the positions of the test probes and observe the ohmmeter for continuity. The ohmmeter should indicate continuity in one direction only. If there is continuity in both directions or no continuity at all, the rectifier assembly is defective and needs replaced.



25

Alternator Brushes

1. Carefully clean the alternator brushes with a soft, dry cloth and electrical component cleaner, if available.
2. Inspect the brushes and brush springs for corrosion, damage, stretched springs, or a damaged brush holder. If damaged, replace the brush assembly.
3. Use a suitable measuring device to measure brush wear. The minimum brush length is 5 mm (.020 in.). If either brush is worn beyond specifications, replace the brush assemblies.



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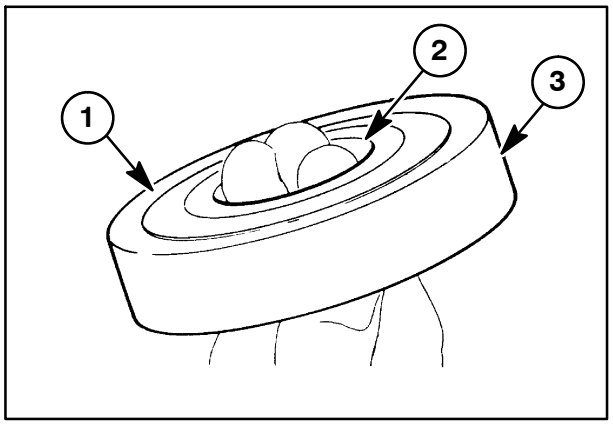
Alternator Bearings

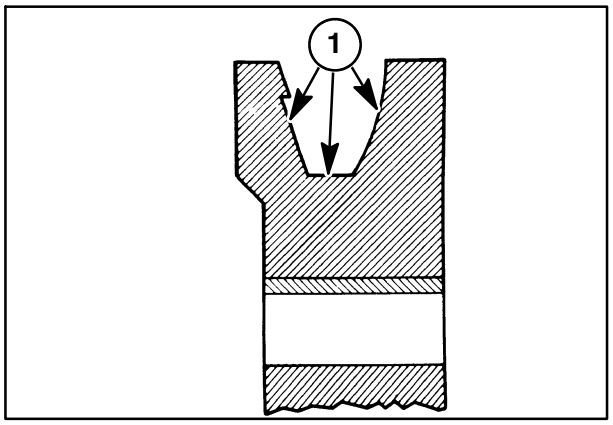
1. Inspect the alternator bearings for smooth operation by spinning the bearing. Replace bearings that are rough and do not rotate smoothly.
2. Inspect the bearings for grease leakage between the bearing seal, 3, and races, 1, 2.
3. Inspect the inner race, 1, and the outer race, 2, for signs of spinning in the alternator frame or on the rotor shaft.
4. Replace bearings that are damaged in any way.



27

Drive Pulley

1. Inspect the drive pulley for a worn, bent, cracked, or otherwise damaged belt groove, 1.
2. A polished surface in the bottom of the belt groove indicates a worn pulley.



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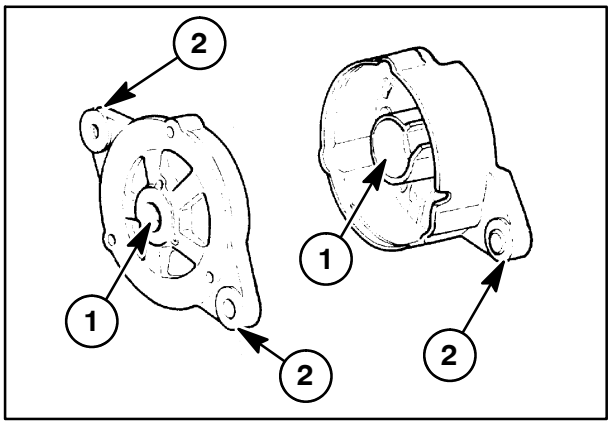
Alternator Frames

1. Inspect the bearing housing bores, 1, for scoring, cracks or evidence that the bearing was spinning inside the bore.
2. Inspect the frames for cracked or broken mounting bosses, 2, or any other distortion or damage.

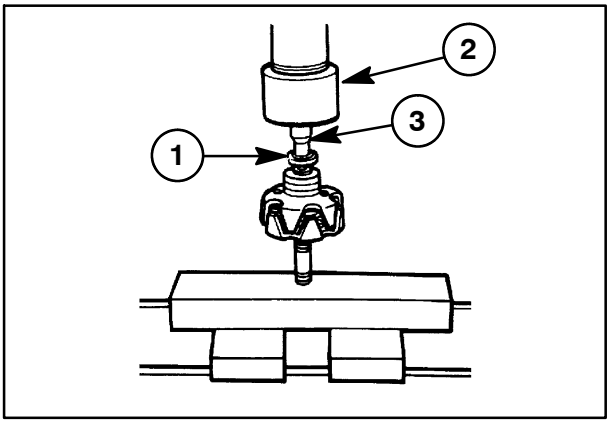


29

Assembly

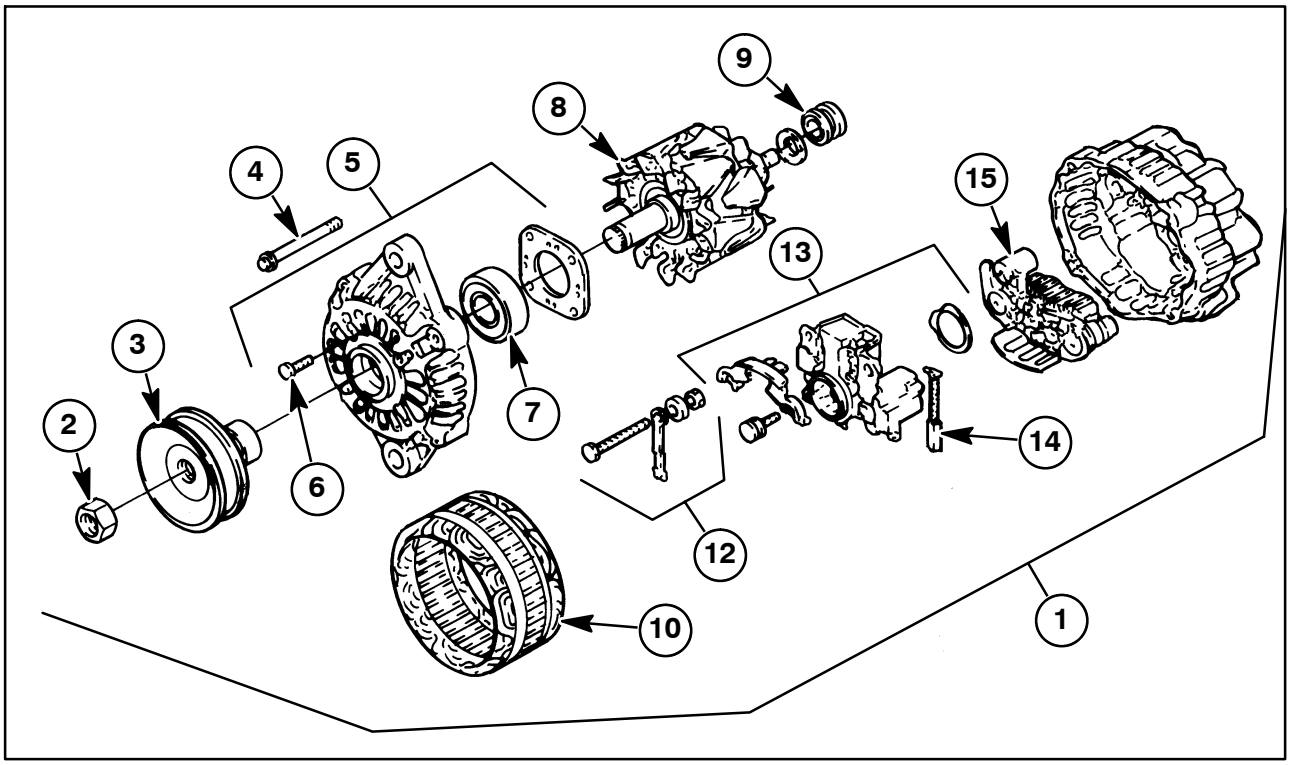
NOTE: *When installing the rear rotor bearing, be sure that top sleeve used to press the bearing onto the rotor contacts the inner race of the bearing only.*

1. Install the rear rotor bearing, 1, and spacer onto the rotor by using a press, 2, and two sleeves, such as tubing or 15 mm deep sockets, 3. The bottom sleeve will support the rotor as the top sleeve presses the rear bearing spacer onto the rotor.



30

2. Install the front rotor bearing, 3, and front bearing retaining plate, 1, into the front alternator frame, 4, and secure using the four (4) retaining screws, 2.



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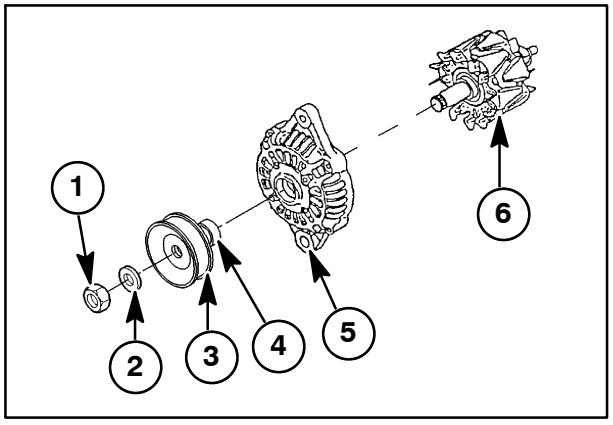
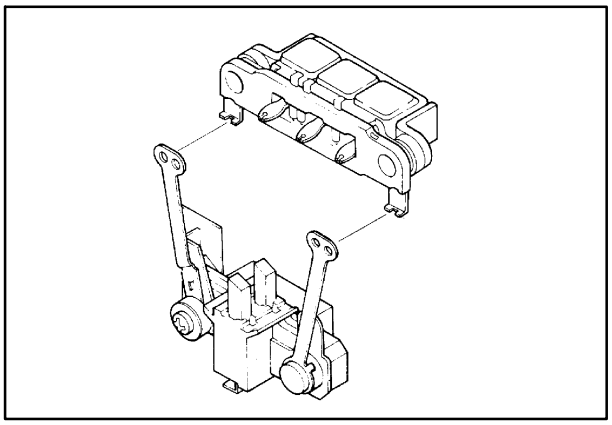
1. Alternator Assembly
2. Nut
3. Pulley Assembly
4. Set Screw
5. Cover Assembly
6. Set Screw
7. Ball Bearing
8. Rotor Assembly
9. Ball Bearing
10. Stator
11. Cover Assembly
12. Terminal Set
13. Regulator
14. Brush Spring
15. Rectifier Assembly

3. Install the washer, 2, pulley, 3, spacer, 4, and front frame, 5, onto the rotor, 6.
4. To install the pulley nut, 1, use an impact wrench or place the rotor, 6, into a soft jaw vice and use a wrench to tighten the pulley assembly to the rotor.



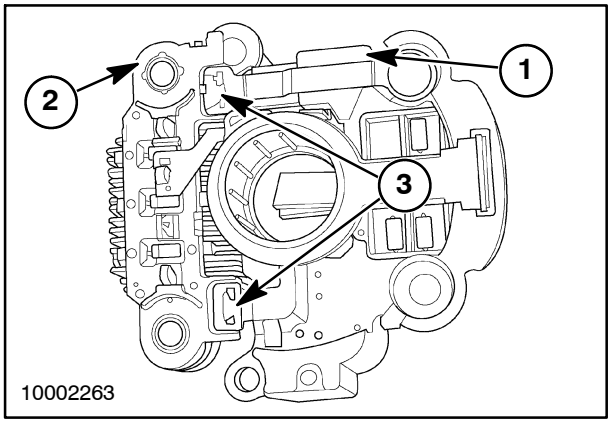
32

5. Use the following guidelines when soldering alternator components.
   - Clean all terminals to be soldered and remove excess solder.
   - Preheat the soldering iron and use rosin-core solder to solder terminals and/or wires. To avoid damage to the rectifier diodes, use a pair of needle nose pliers to remove excess heat from the area being soldered. Hold the pliers just below the solder joint on the rectifier to remove excess heat.
   - Make good, solid, solder joints for best alternator performance.
   - After soldering, quickly cool the solder joint with a damp cloth.



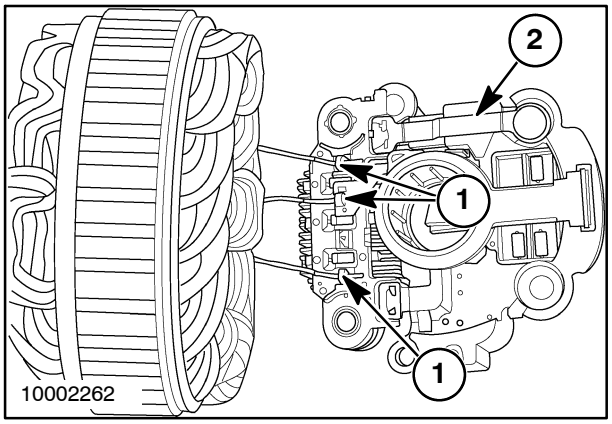
33

6. Solder the IC regulator, 1, and rectifier, 2, together at the solder joints, 3



34

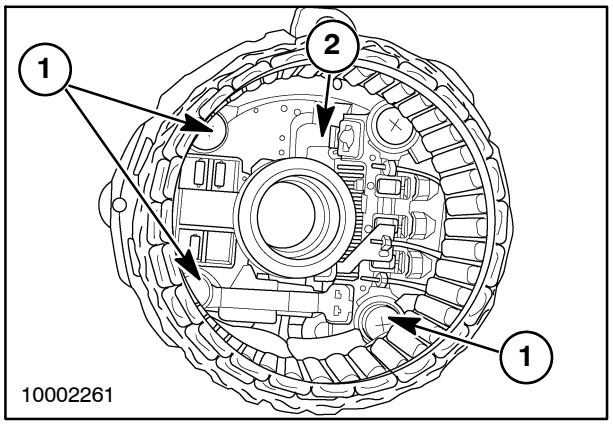
7. Solder the stator leads, 1, to the terminals on the rectifier/regulator assembly, 2.



35

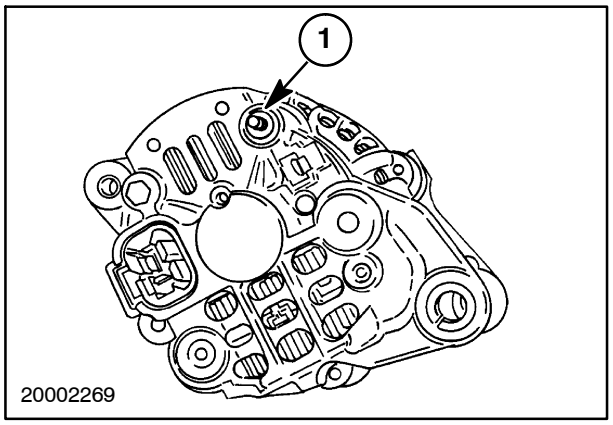
NOTE: *Secure the regulator/rectifier assembly to the rear alternator frame before pressing the stator into the rear frame.*

8. Secure the regulator/rectifier assembly, 2, to the rear alternator frame using the three (3) retaining screws, 1. Manually press the stator assembly into the rear alternator frame.



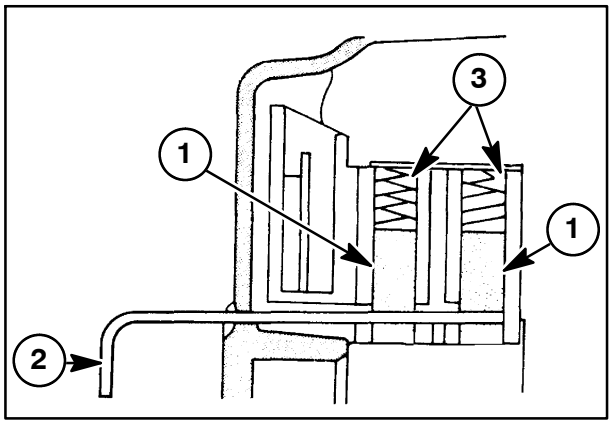
36

9. Install the battery terminal nut, 1, to the rear of the alternator frame.



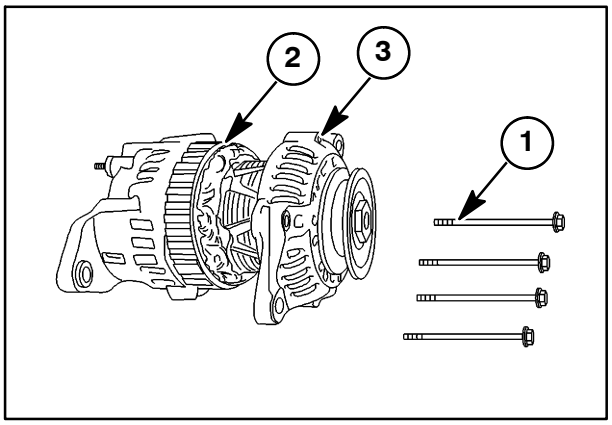
37

10. Push the brushes, 1, and springs, 3, into the brush holder and insert a piece of wire, 2, through the rear of the alternator frame and into the brush holder to hold the brushes out of the way while the alternator halves are being assembled.



38

11. Assemble the front alternator frame, 3, and rear alternator frame, 2, together. Be sure to align the scribe marks made when the alternator was disassembled to insure proper reassembly. Use the four (4) bolts, 1, to secure the front and rear frames together.



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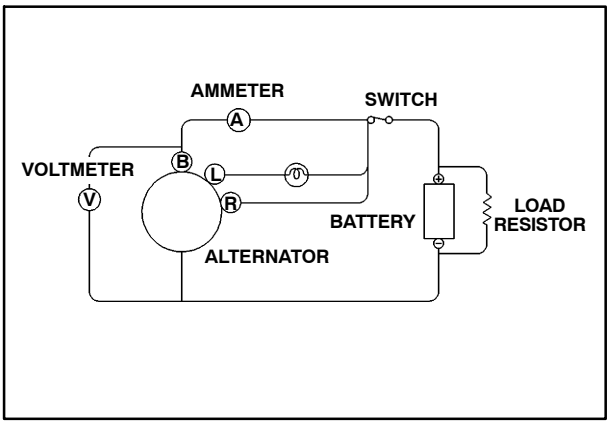
ALTERNATOR BENCH CHECK

1. Connect the alternator to a testing circuit, as shown. Set the load resistance to zero (0).

NOTE: *Alternator rotation direction is clockwise, as viewed looking at the pulley.*

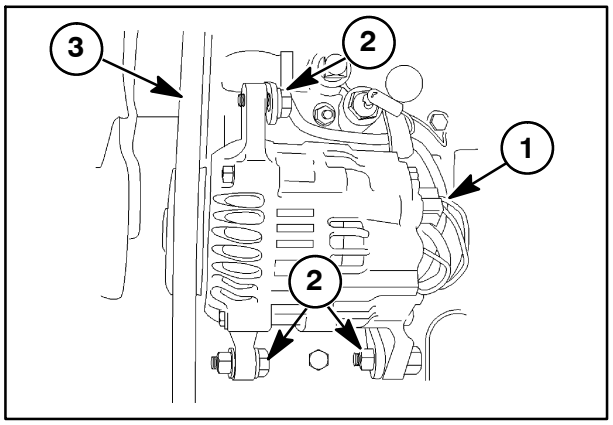
2. Slowly increase the alternator rotational speed and observe the voltage reading indicated on the voltmeter.
3. If the voltage is uncontrolled when increasing alternator speed and increases above 15.5 volts, disassemble and check the alternator for malfunctioning components.
4. If the voltage reading is below 15.5 volts, set alternator's rotational speed to 2500 RPM and set the load resistance to achieve maximum output from the alternator.
5. If the amperage value is more than 70% of the nominal alternator output as described in alternator specifications, the alternator is considered to be working satisfactorily.



40

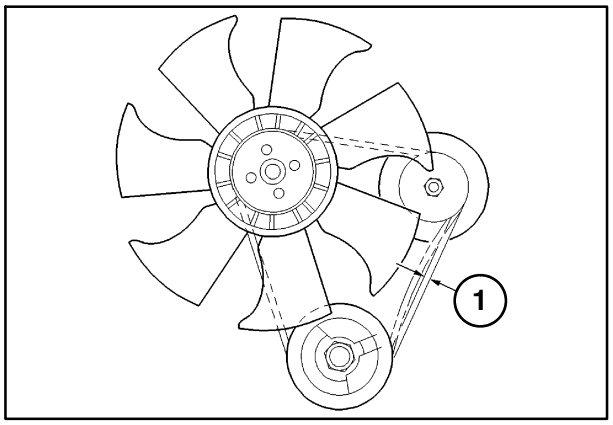
Installation

1. Align the alternator with the alternator mounting holes located on the engine block and brackets. Use the adjusting/mounting bolts, 2, to secure the alternator to the mounting brackets. Be sure to install the V-belt, 3, into the drive pulley.
2. Connect all wire terminals, 1, to rear of the alternator.



41

3. Adjust the alternator drive belt deflection by loosening the mounting bolts and moving the alternator into or away from the engine block. Belt deflection should be 5 - 10 mm (0.197 - 0.394 in.) when applying 5 kg (11 lb.) of force between the crank pulley and the alternator pulley, 1.



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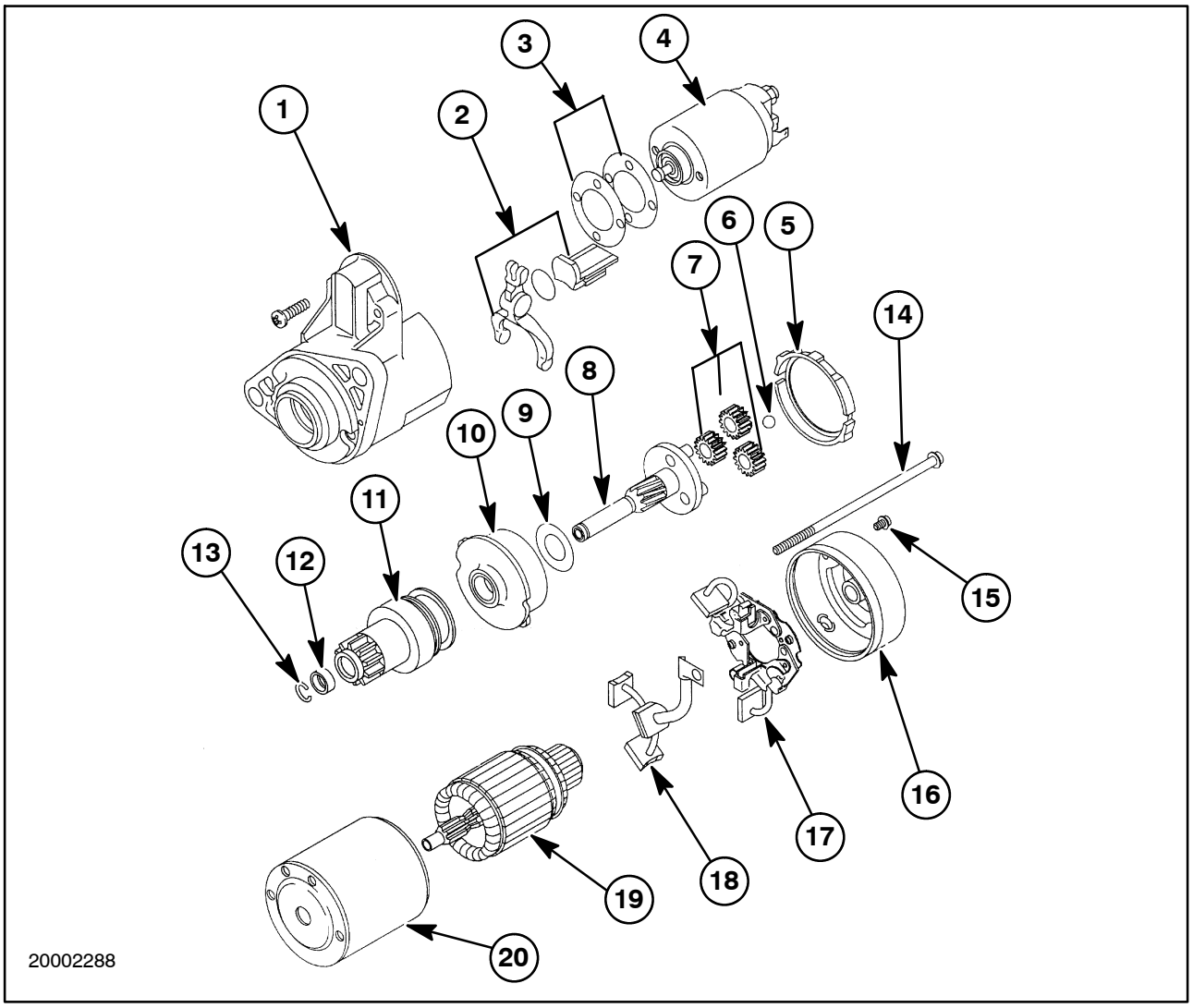
SPECIFICATIONS – STARTER MOTOR

Manufacturer	Mitsubishi
Model	M001T66081
Current Draw	
Under Load	300 amps
No Load	110 amps
No Load RPM	2400 RPM min.
No Load Voltage	11 volts
Clutch System	Overrunning Pinion Clutch
Brush Length	
New	17.5 mm (0.689 in.)
Wear Limit	10 mm (0.394 in.)
Brush Spring Tension	1.4 - 2.6 kg (3.1 - 5.7 lb.)
Commutator Diameter	
New	29.4 mm (1.157 in.)
Wear Limit	28.8 mm (1.134 in.)
Commutator Insulation Depth	0.4 - 0.6 mm (0.016 - 0.024 in.)
Armature Runout	
Commutator	0.2 mm (0.008 in.) max.
Armature Shaft	0.05 mm (0.002 in.) max.
Pinion Shaft Movement Limit	0.5 - 2.0 mm (0.020 - 0.080 in.)

DESCRIPTION OF OPERATION - STARTING SYSTEM

Op. 55 201

The TC30 starting system consists of a starter motor equipped with an electromagnetic starter solenoid, a key switch, a start relay, several safety switches, and heavy-duty wiring.



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1. Front starter housing
2. Lever assembly
3. Shims
4. Solenoid
5. Retaining ring
6. Steel ball
7. Planetary gears
8. Pinion shaft
9. Washer
10. Orbital gear
11. Pinion clutch
12. Stop ring
13. Snap ring
14. Through bolt
15. Bolt
16. Brush cover
17. Brush holder
18. Brush set
19. Armature
20. Permanent magnet housing

STARTER MOTOR ASSEMBLY

The starter motor features a reduction mechanism that utilizes a planetary gearing system to achieve torque required to crank the tractor engine. The reduction system is compromised of an orbital gear, three planetary gears, a gear shaft with an overrunning clutch, and an armature gear.

The starter uses permanent magnets for magnetic field induction. The magnetic field is produced from six magnets that are mounted in the yoke. The magnets are positioned according to polarity.

The magnets are not removable from the yoke.

STARTER SOLENOID

The starter solenoid is mounted on top of the starter motor assembly. The solenoid incorporates two coils, a pull-in coil and a hold-in coil. When the key switch is turned to the “START” position and the safety start relay is closed (safety switches closed), current from the battery will energize the solenoid’s two coils. With the coils energized, the solenoid attracts the plunger, which is attached to a fork. The fork pushes the pinion gear out to engage the flywheel. At the same time, a set of contacts on the solenoid become closed, allowing current to flow to the starter motor. Closing the contacts also supplies current to both ends of the solenoid pull-in coil, which makes the coil become inoperative. The hold-in coil continues to engage the pinion gear with the flywheel.

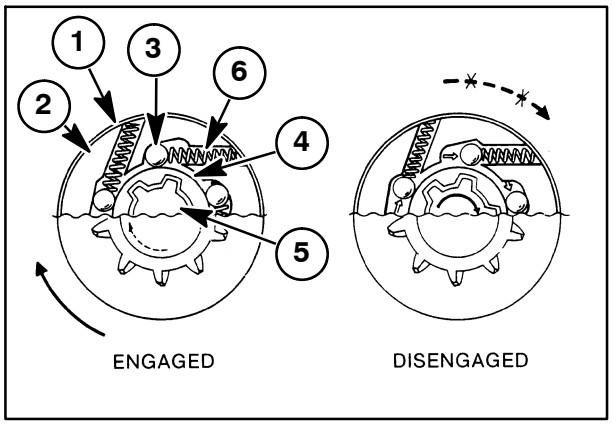
PINION CLUTCH

To prevent the engine from driving the starter motor once the engine is running, the pinion is equipped with an overrunning clutch. The clutch will disengage the pinion gear from the rest of the starter components once the engine has been started and the key switch is in the “START “ position.

The clutch consists of an outer shell, 1, a cam with tapered notches, 2, rollers, 3, roller springs, 6, a splined pinion collar/tube that acts as a clutch hub, 4, and the pinion shaft, 5. As the starter motor engages and rotates, the rollers are locked against the pinion collar with the tension provided by the roller springs. While the rollers are locked, the clutch assembly is locked, allowing the pinion gear to rotate the flywheel. When the engine starts, the flywheel moves faster than the starter motor and this causes the rollers to become unlocked. With the rollers unlocked, the clutch assembly is unlocked, allowing the pinion gear and shaft to turn independently of the starter motor.

The clutch is not serviceable and is replaced as a complete assembly.

Once the engine is started and the key switch is released from the “START” position, the solenoid’s pull in coil becomes energized, pulling the solenoid plunger in, which disengages the pinion from the flywheel.



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1. Clutch Gear - Outer Shell
2. Cam
3. Roller
4. Spline Tube - Inner (Pinion Collar)
5. Pinion Shaft
6. Roller Spring

TROUBLESHOOTING – STARTER MOTOR

PINION SHAFT FAILS TO ADVANCE

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Open circuit, battery, and switch terminal connections	Repair or replace
	Open circuit, fuse	Replace fuse
Key switch	No contact	Repair or replace
Starter motor	Sleeve bearing burnt out	Repair or replace
	Lever broken	Replace
Solenoid	Plunger movement defective or coil open or shorted	Repair or replace

PINION MOTOR ROTATES BUT NO ROTATION TRANSMITTED TO ENGINE

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Starting motor	Clutch defective	Replace
	Orbital gear or planetary gears damaged	Replace

MOTOR ROTATES BEFORE PINION MESHES WITH RING GEAR

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Starter motor	Shift lever damaged	Replace
	Slip ring defective	Replace
	Pinion teeth worn	Replace
	Pinion push out position defective	Adjust
Engine	Ring gear worn	Replace
Solenoid	Solenoid defective	Replace

PINION MESHES WITH RING GEAR BUT STARTING MOTOR FAILS TO TURN

FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Wiring	Line connecting solenoid to battery broken or defective ground	Repair or replace
	Lead wire connecting solenoid to motor tightened improperly	Repair or replace
Starting motor	Ball bearing locked	Replace
	Brush worn	Replace
	Improper installation	Reinstall
	Brush spring defective	Replace
	Commutator dirty	Clean
	Armature of field coil defective	Repair or replace
	Field coil-to-brush connection defective	Replace
Solenoid	Contact not touching properly	Replace
	Contact contacting surface roughened	Replace
Battery	In discharge state	Recharge or replace

MOTOR FAILS TO STOP AFTER ENGINE STARTS AND KEY SWITCH IS TURNED OFF

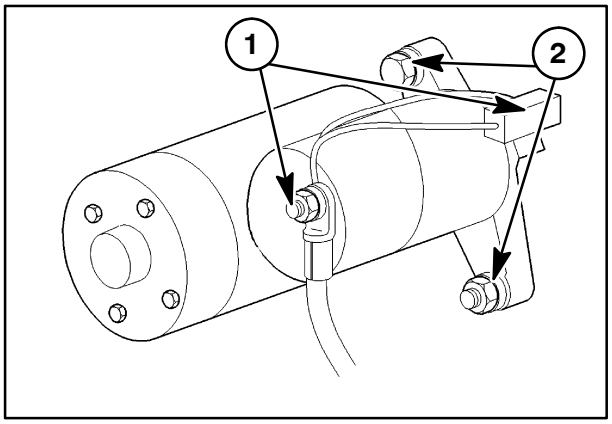
FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Key switch	Switch defective	Replace
Solenoid	Solenoid defective	Replace

TESTING AND OVERHAUL - STARTER MOTOR

STARTER MOTOR

Removal

1. Remove the wiring harness connections, 1, from the starter motor.
2. Remove the two (2) bolts, 2, which secure the starter motor to the tractor engine.



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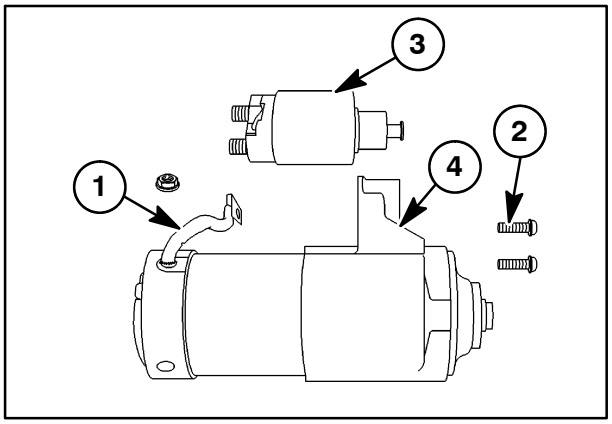
Disassembly

⚠ CAUTION ⚠

When disassembling the starter motor, do not clamp the starter in a vice or strike with a hammer, as the starter may be damaged beyond repair.

NOTE: *before removing the field coil strap, make note of the solenoid terminal the strap is connected to.*



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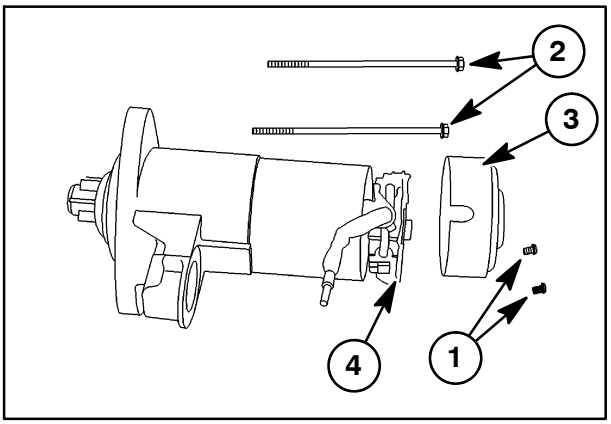
1. Disconnect the field coil strap, 1, from the solenoid, 3.

NOTE: *Before removing the starter solenoid and plunger assembly, 3, scribe aligning marks on the solenoid housing and the starter housing, 4.*

2. Remove the two (2) screws, 2, that secure the solenoid and plunger assembly, 3, to the starter housing, 4.
3. Remove the retaining bolts, 1, holding the brush cover, 3, to the starter assembly.
4. Remove the two (2) long through bolts, 2, from the starter assembly.
5. After the brush cover, 3, is removed from the starter assembly, slide the brush holder, 4, off of the armature commutator.

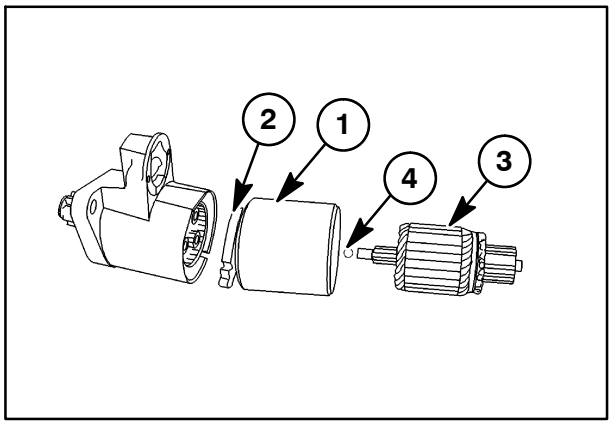


47

6. Remove the magnet housing, 1, rubber cover, 2, armature, 3, and steel armature ball, 4, from the starter assembly. Be sure not to lose the armature ball.

NOTE: *If removing the bearing from the armature, place the bearing puller on the inner race of the bearing only.*

7. If necessary, the armature bearing may be removed from the armature using a bearing puller.



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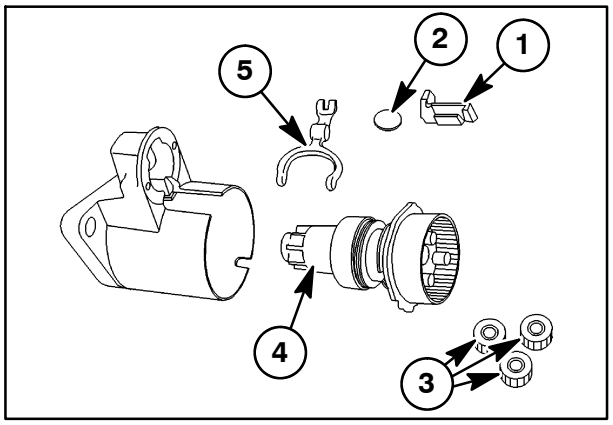
8. Remove the lever packing, 1, and plate, 2, from the starter housing.
9. Remove the planetary, gears, 3, pinion shaft/ clutch assembly, 4, and lever, 5, as a complete assembly from the starter housing.



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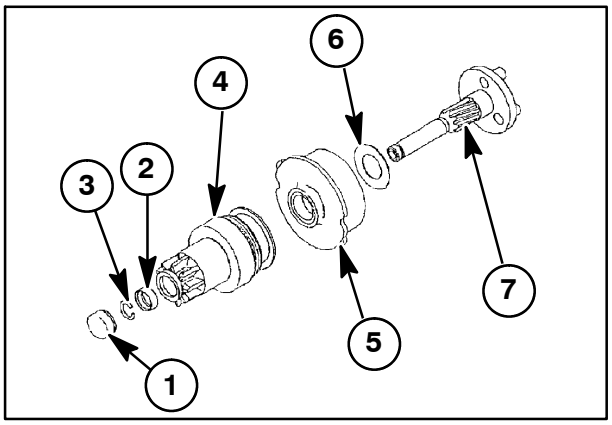
10. To remove the overrunning clutch, 4, from the pinion shaft assembly, 5, 6, 7, remove the plastic cap, 1, from the end of the pinion gear.
11. Slide a piece of appropriately sized metal tubing over the pinion shaft, against the stop ring, 2. Tap the pipe with a hammer to remove the stop ring and expose the snap ring, 3.
12. Remove the tubing and then use snap ring pliers to remove the snap ring, 3.
13. Separate the overrunning clutch from the pinion shaft assembly.

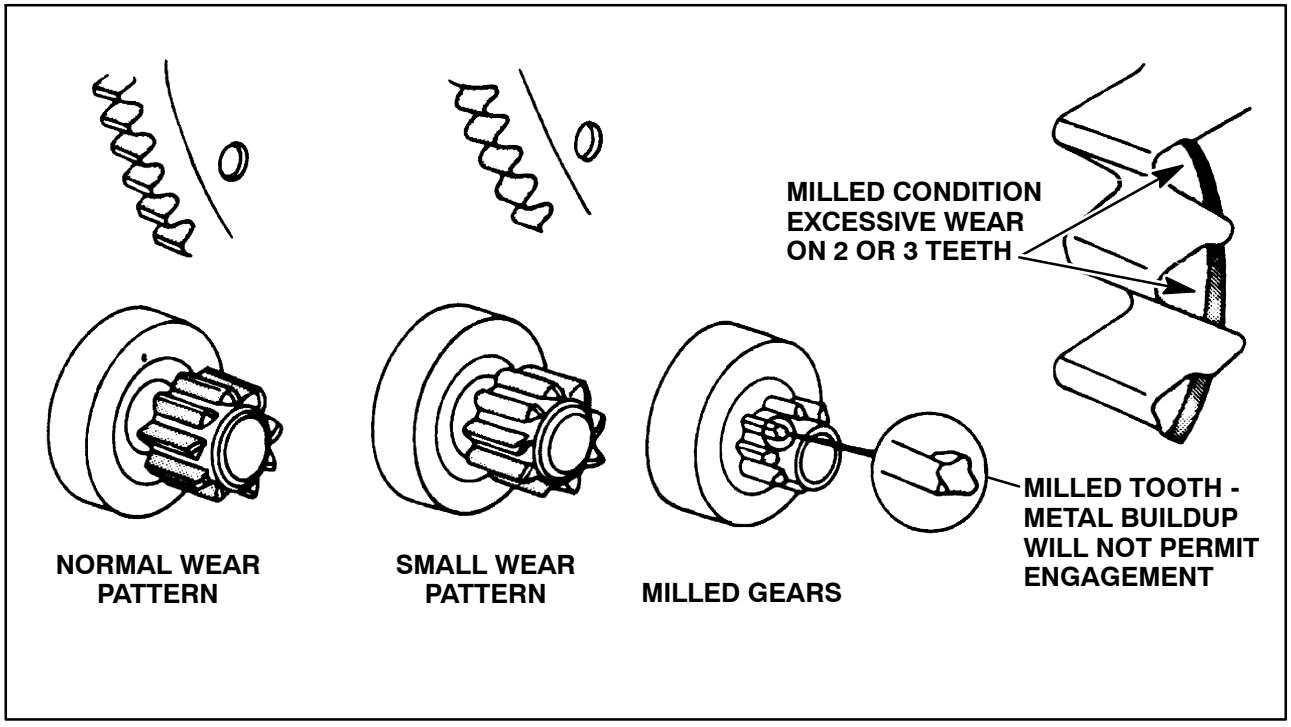


50

1. Plastic cap
2. Stop ring
3. Snap ring
4. Overunning clutch
5. Internal gear assembly
6. Washer
7. Gear shaft

Inspection

1. Inspect the gear splines on the pinion clutch, the pinion, the armature, the orbital gear, and the planetary gears for damaged or missing splines. Replace any damaged parts.
2. Hold the pinion clutch housing and rotate the pinion. The pinion should rotate smoothly, although not necessarily easily, in one direction only. If the pinion can spin in both directions, the clutch is defective and needs replaced.



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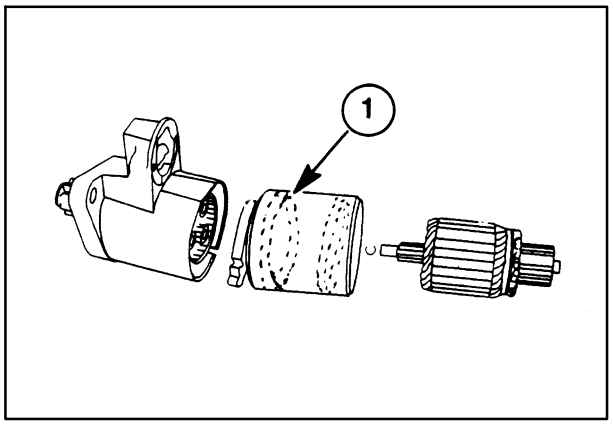
3. Inspect the permanent magnets, 1, for cracks, looseness, or any other damage. Replace the assembly if found to be damaged in any way.
4. Inspect the motor housing, brush cover, and starter housing for damage such as cracks, fatigue, wear, etc. Replace any damaged parts.
5. Inspect the brush terminals, battery terminals, and motor terminals for corrosion, loose connections or damage. Repair or replace any damaged parts.



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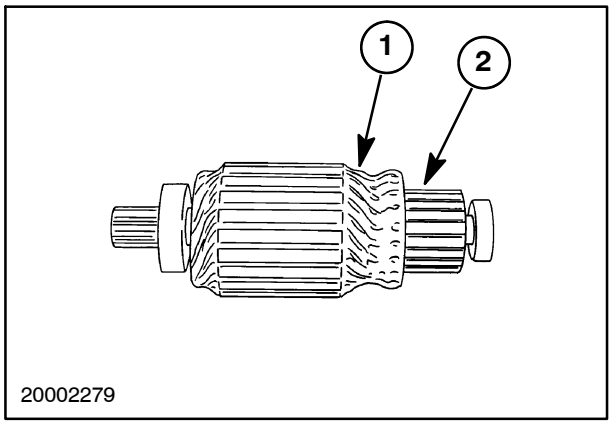
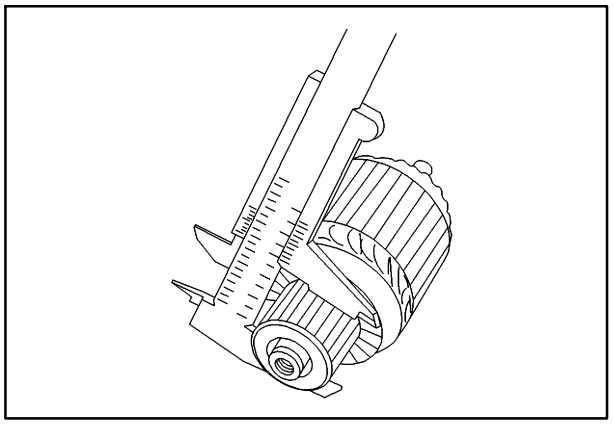
6. Inspect the armature windings, 1, for burnt, broken, or loose connections.
7. Clean and inspect the solenoid plunger contact ring and solenoid contacts. Dirty contacts or pitting may be cleaned with fine grit sandpaper or a fine abrasive pad.
8. Inspect that all bearings rotate freely when rotated manually by hand and are not damaged or have excessive play. Replace any damaged bearings.
9. Inspect the commutator contacts, 2, for burnt segments, indicating an open winding.



53

10. Use a suitable measuring device to measure the commutator diameter. The minimum commutator diameter is 28.8 mm (1.134 in.). If the commutator is worn beyond these specifications, replace the armature.



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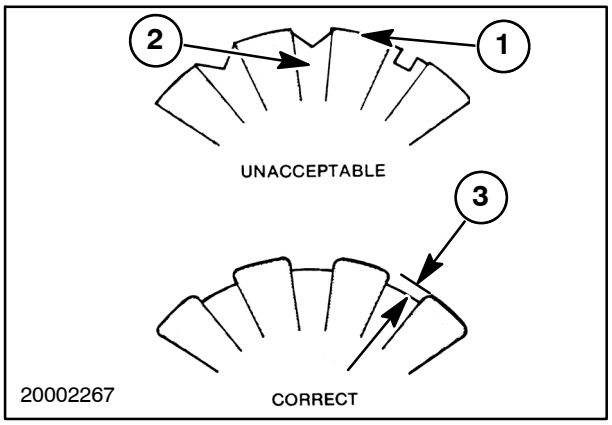
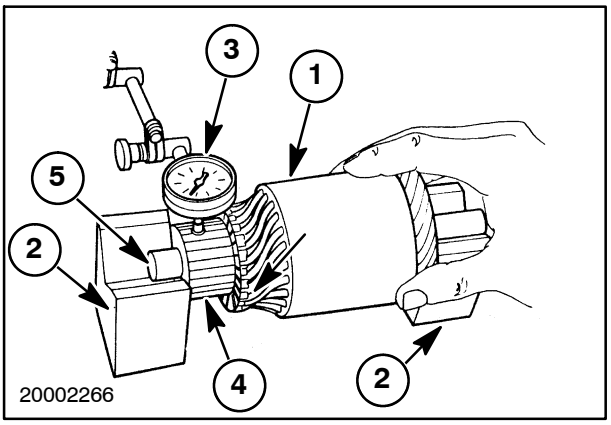
11. Inspect the mica insulating valleys, 2, between the commutator contacts, 1, for uneven wear. Use a suitable measuring device to check the distance, 3, between the top of the contact to the bottom of the insulating valley. The distance should be 0.4 - 0.6 mm (0.016 - 0.024 in.). If the distance is not within these specifications or there is uneven wear, the insulating valleys may be undercut with a suitable file.



55

NOTE: *If not previously removed, the armature bearings will need to be removed for this test.*

12. Place the armature, 1, in a set of precision V-blocks, 2, and use a dial indicator, 3, to measure commutator, 4, runout and shaft, 5, runout. Commutator runout should not be more than 0.2 mm (0.008 in.). Shaft runout should not be more than 0.05 mm (0.002 in.).



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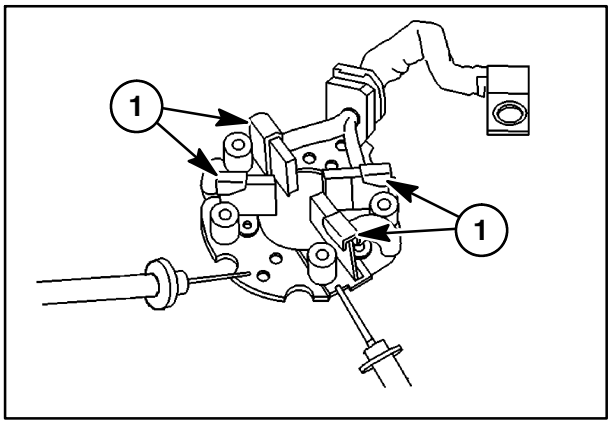
13. Check each of the four brushes, 1, for wear or damage.



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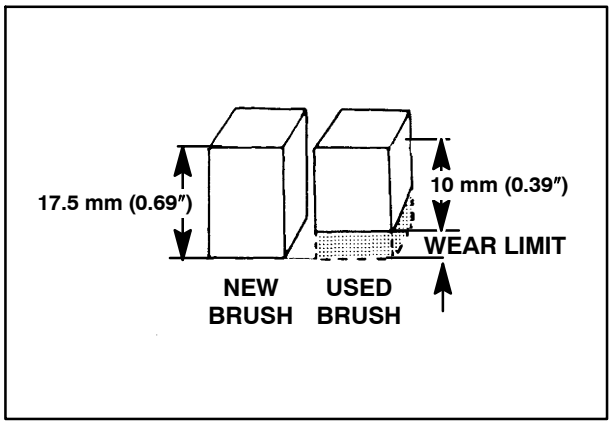
NOTE: *When measuring the brush length, remove the brush from the brush support and measure the middle portion of the brush.*

14. Use a suitable measuring device to measure the length of the armature brushes. Compare the measurement of each brush with brush length specifications. If the brush is not within specifications or is damaged in any way, replace the brushes.



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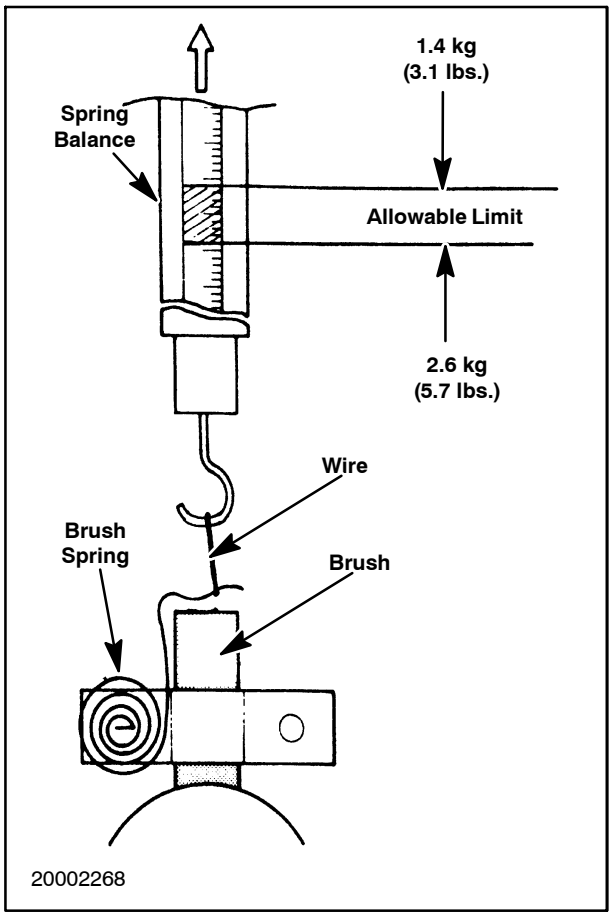
15. Test the brush spring tension by connecting a spring balance to the brush spring and pulling until the spring moves. Observe the reading indicated on the spring balance. If the reading is between 1.4 - 2.6 kg (3.1 - 5.7 lb.), the spring tension is within specifications. Otherwise, replace the brush springs.



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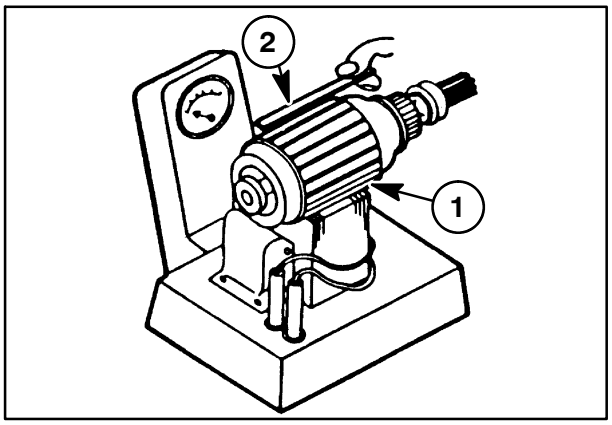
Testing

Armature

1. Use a growler, 2, to inspect the armature coil, 1, for short circuits. Replace if the armature is shorted.



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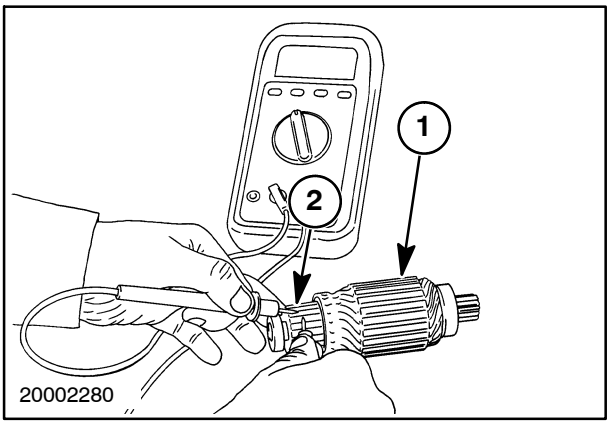
2. Use an ohmmeter to test for continuity in the armature coil, 1.
3. Touch one ohmmeter test probe to a commutator contact, 2. Touch the ohmmeter test probe to an adjacent commutator contact.
4. Observe the ohmmeter. Repeat the test on each adjacent commutator contact. Little or no resistance indicates that there is continuity and the armature coil is good. High resistance indicates that the armature is defective and needs replaced.



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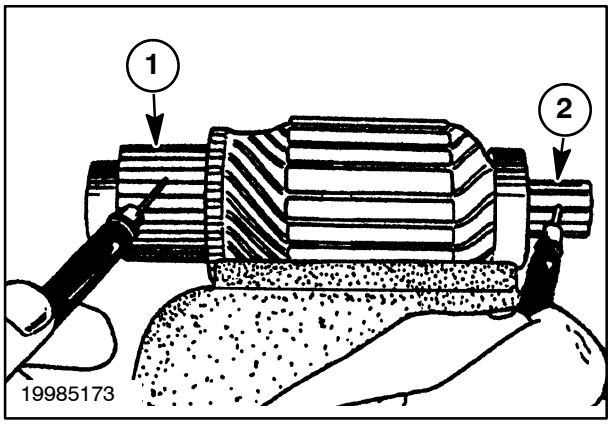
5. If the armature is tested OK, touch one ohmmeter test probe to a commutator contact, 1. Touch the other test probe to the armature shaft, 2.
6. Observe the ohmmeter. A high resistance reading indicates the armature is good. Little or no resistance indicates that the armature is defective and needs replaced.



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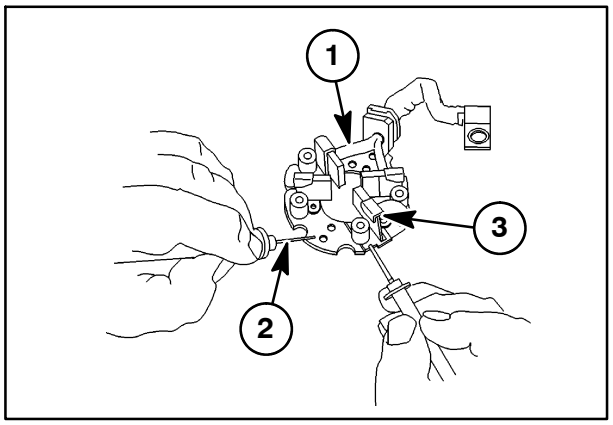
Brush Holder

1. Use an ohmmeter to test the brush holder assembly, 1.
2. Touch one test probe to the insulated brush holder, 3, and the other test probe to the brush holder plate, 2.
3. Observe the ohmmeter. Repeat the test for the opposite insulated brush holder.
4. A reading of high resistance indicates no continuity and the brush holder is good. Little or no resistance indicates that there is continuity and the brush holder is defective and needs replaced.



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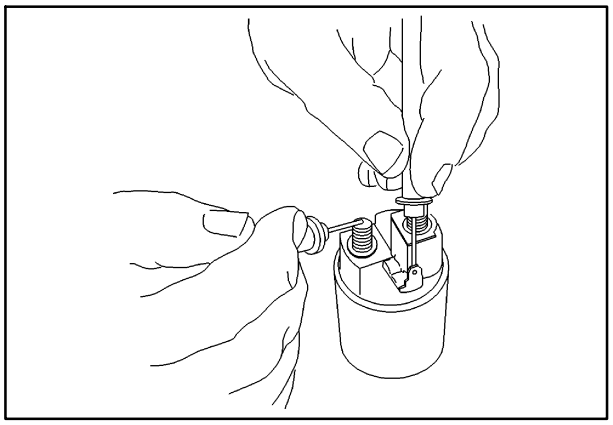
Starter Solenoid

1. Use an ohmmeter to check the starter solenoid for proper operation and continuity.
2. Touch one ohmmeter test probe to terminal “M” of the starter solenoid.
3. Touch the other ohmmeter test probe to the body (ground) of the solenoid.
4. Observe the ohmmeter. There should be little or no resistance, indicating continuity. If there is no continuity, the starter solenoid is defective and needs replaced.



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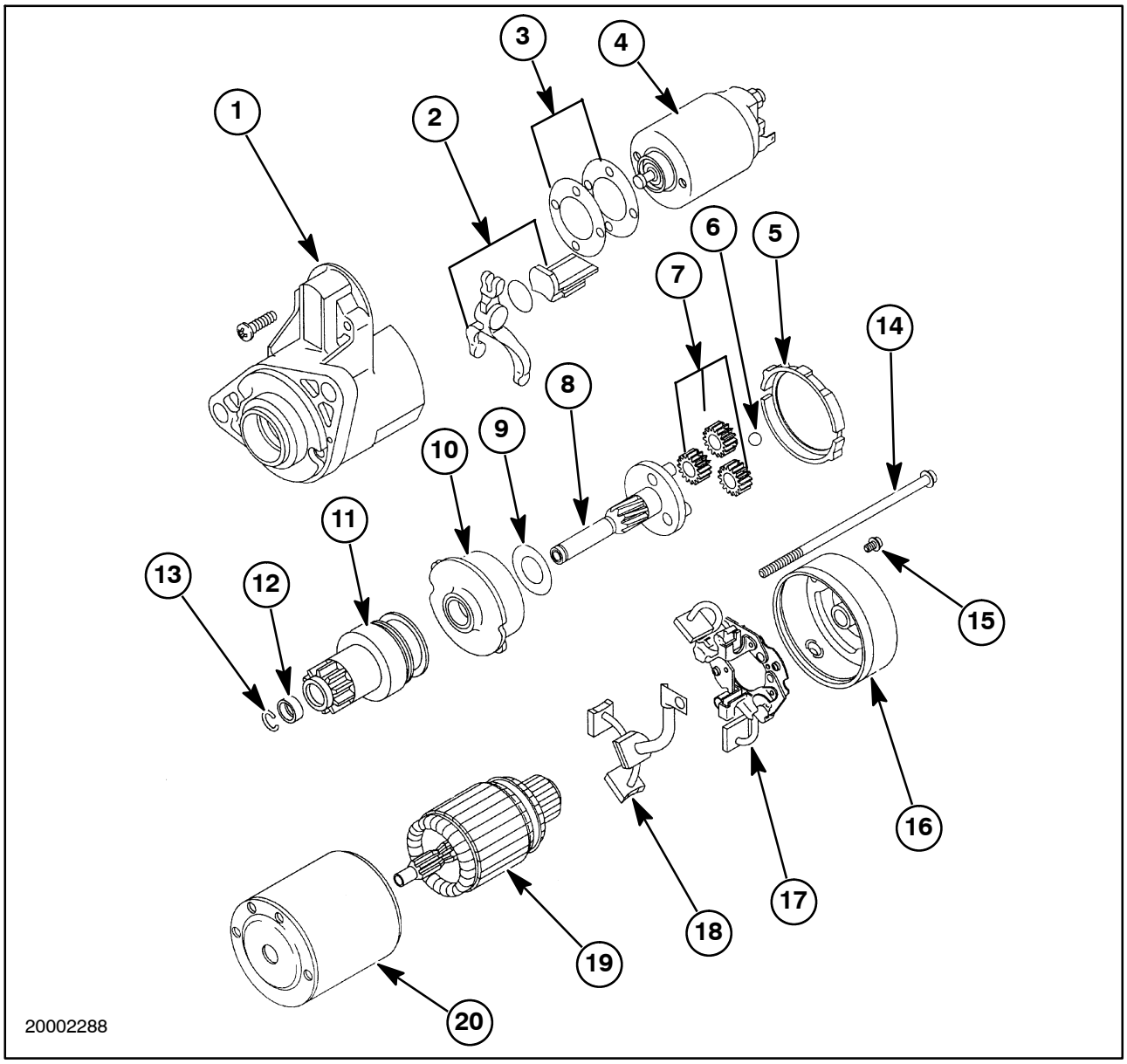
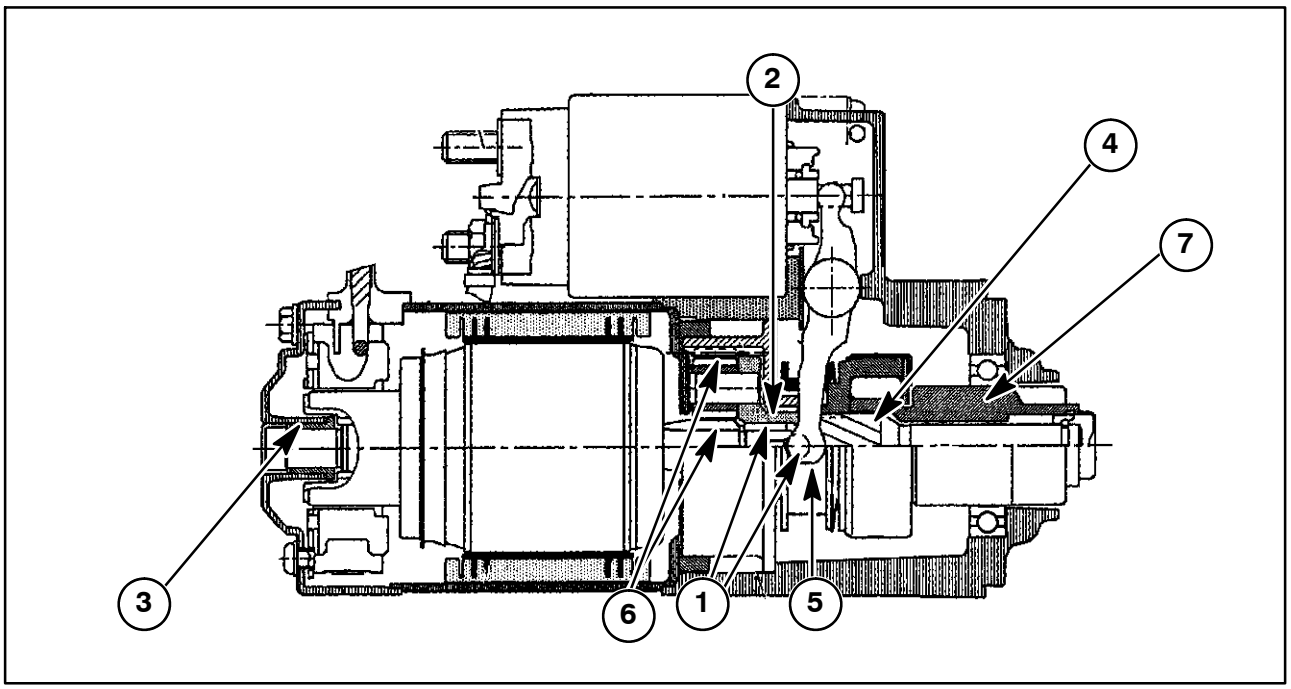


65

1. Front starter housing
2. Lever assembly
3. Shims
4. Solenoid
5. Retaining ring
6. Steel ball
7. Planetary gears
8. Pinion shaft
9. Washer
10. Orbital gear
11. Pinion clutch
12. Stop ring
13. Snap ring
14. Through bolt
15. Bolt
16. Brush cover
17. Brush holder
18. Brush set
19. Armature
20. Permanent magnet housing

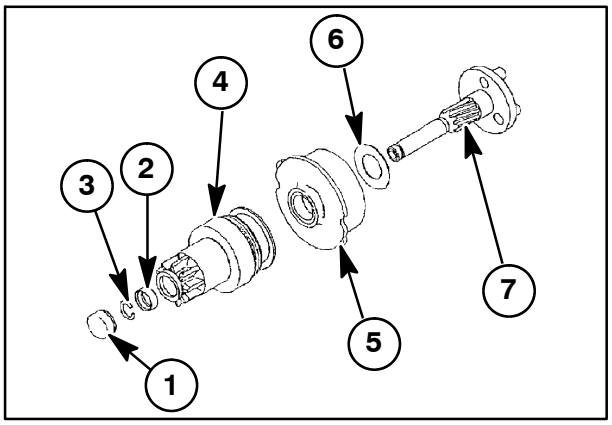
Assembly

1. Apply grease to the following areas as the starter is being assembled:
   - Sleeve and ball, 1.
   - Sleeve bearing in the orbital gear, 2.
   - Sleeve bearing in the rear brush cover, 3.
   - Pinion shaft assembly splines, 4.
   - Sliding surfaces of the lever and pinion clutch, 5.
   - Armature shaft gear, orbital gear, and planetary gears, 6.
   - Sliding surfaces of the pinion and front bearing, 7.



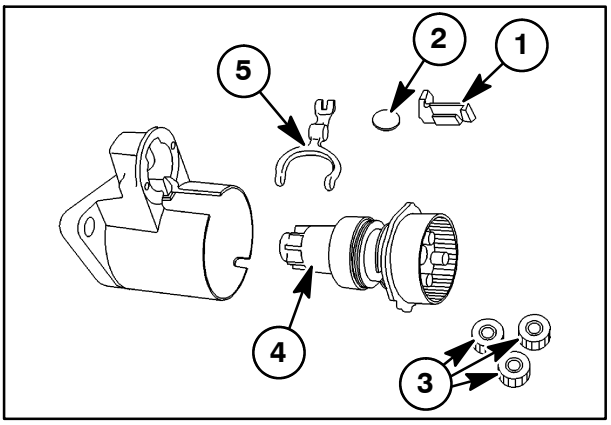
66

2. Assemble the pinion shaft, 7, washer, 6, orbital gear, 5, and clutch, 4, together.
3. Use snap ring pliers to install the snap ring, 3, onto the pinion shaft assembly.
4. Install the stop ring, 2, onto the pinion shaft assembly.
5. Push the plastic cap, 1, into the end of the pinion.



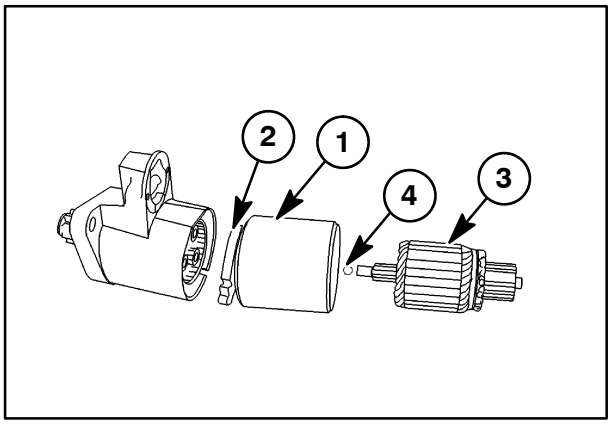
67

6. Install the lever, 5, the lever packing, 1, and plate, 2, into the starter housing.
7. Install the pinion shaft assembly, 4, into the starter housing
8. Install the planetary gears, 3, into the orbital gear of the pinion shaft assembly.



68

9. Install the ball, 4, rubber cover, 2, field coil assembly, 1, and the armature, 3, into the starter motor housing.



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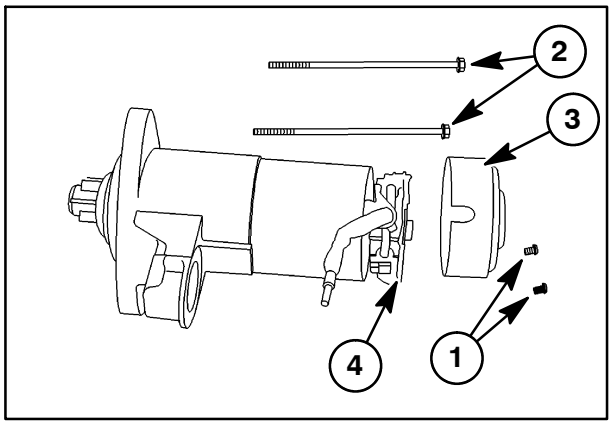
NOTE: *when installing the brush holder, be sure the solenoid wire will be properly aligned for connection to the starter solenoid.*

10. Install the brush holder, 4, with the brushes, onto the armature shaft.
11. Install the brush cover, 3 over the brush holder and secure with the two (2) small screws, 1.
12. Install the two (2) long bolts, 2, into the starter housing.

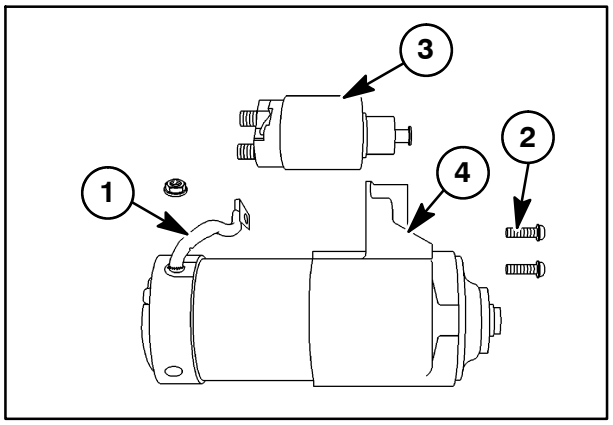


70

13. Align the aligning marks scribed into the solenoid, 3, and starter motor housing, 4, and install the solenoid/plunger assembly into the starter motor housing, 4. Secure the solenoid using the two (2) retaining screws, 2.

NOTE: *When installing the field coil strap to the solenoid, be sure to bolt the strap to the correct solenoid terminal.*

14. Bolt the field coil strap, 1, to the “M” terminal of the solenoid, 3.



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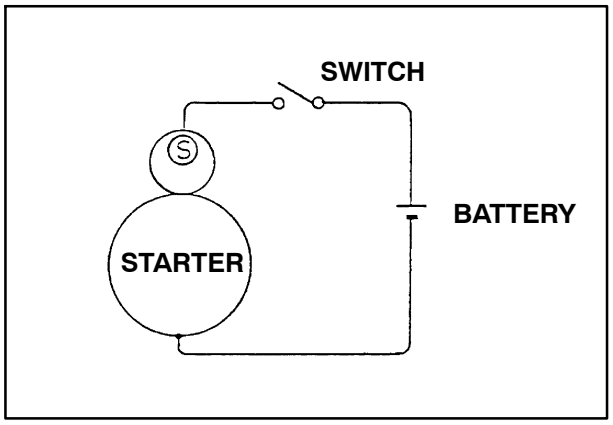
Pinion Position Adjustment

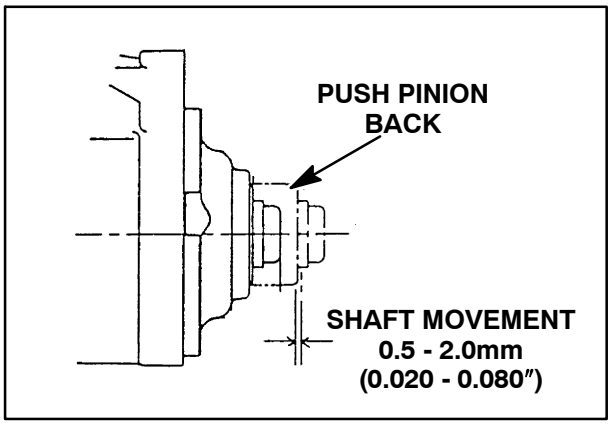
After completing the starter assembly, the position of the pinion should be checked to be sure the pinion gear will engage the flywheel properly. After the pinion shaft has been pushed out, there should be between 0.5 and 2.0 mm (0.020 - 0.080 in.) of play when the end of the pinion gear is pushed in towards the starter. To check the pinion position, proceed as follows:

1. Connect a battery and switch to the battery terminal of the starter and the “S” terminal of the solenoid.
2. Close the switch. This will shift the pinion gear into cranking position.



72

3. Push the pinion shaft back into the starter housing by hand and measure the amount of pinion shaft movement (play).
4. If the amount of movement does not fall within the specified limit, adjust the movement by adding or removing shims that are located between the solenoid and starter motor housing. Adding shims will decrease the amount of play in the pinion shaft.



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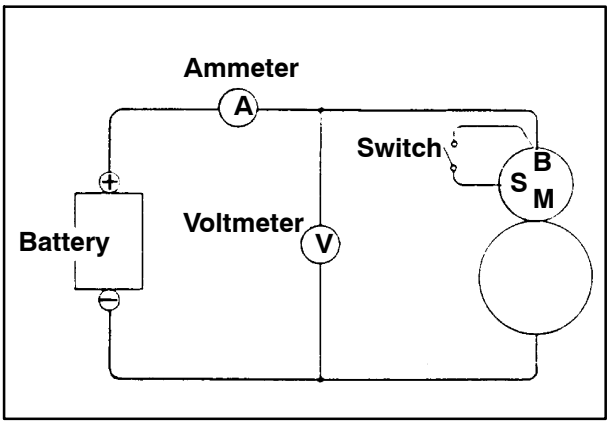
No Load Test

⚠ CAUTION ⚠

Do not operate the starter for more than 30 seconds at a time.

1. Connect an ammeter and voltmeter to the circuit described for pinion adjustment.
2. Close the switch and record the readings indicated on the ammeter and voltmeter.
3. Service limits are 11 volts, 110 amps maximum at 2400 RPM.



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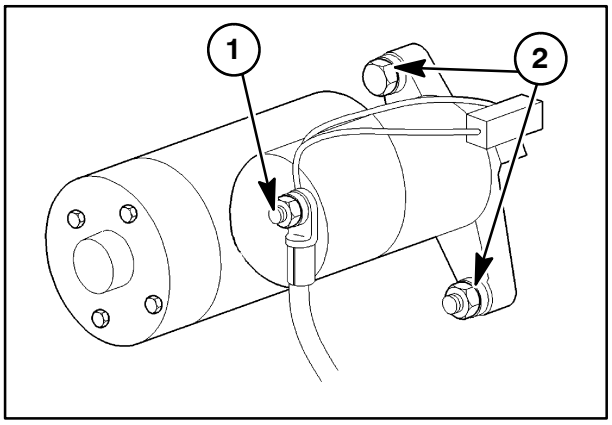
Installation

1. Install the two (2) bolts, 2, which secure the starter motor to the tractor engine.
2. Install the wiring harness connections, 1, to the starter motor.



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SECTION 90 - PLATFORM

Chapter 1 - Platform

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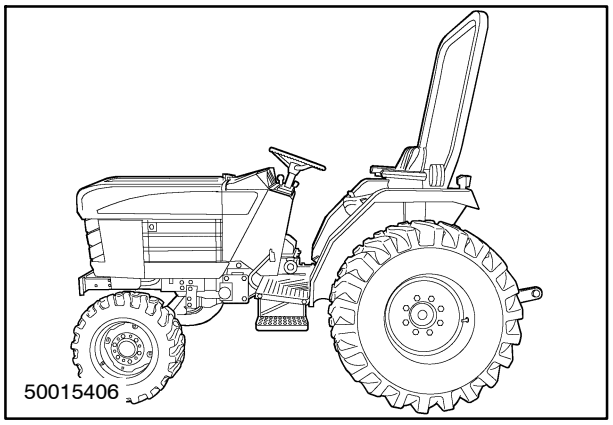
DESCRIPTION OF OPERATION

This section describes the removal and installation of components such as, dash panels, fenders, and the side steps.

⚠ DANGER ⚠

Lift and handle all heavy parts using suitable lifting equipment. Support parts or an assembly by means of suitable slings, hooks, or jack stands. Make sure that no person is near a raised load.

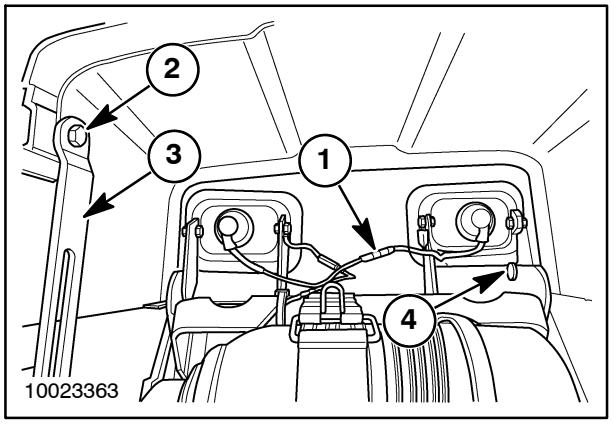


1

HOOD

Removal

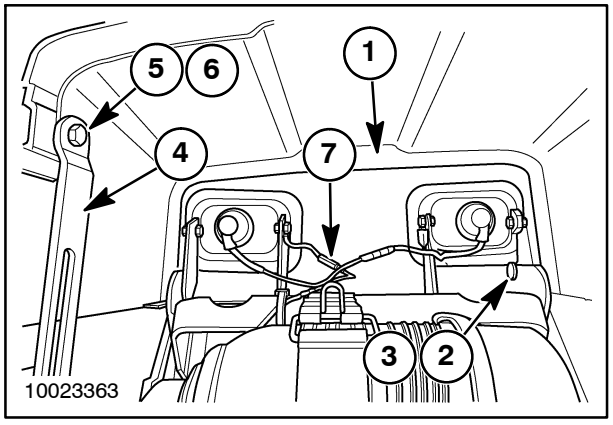
1. Release the hood latch to raise and latch the hood in the upward position.
2. Disconnect the headlight wiring, 1, from the main wire harness.
3. Remove the hinge pin, 2, to disconnect the hood support bracket, 3, from the hood.
4. Use a lift to support the tractor hood.
5. Remove the hinge pin, 4, to disconnect the hood from the tractor.
6. Slide the hood to the right to remove the hood from the tractor.



2

Installation

1. Use a lift to raise the hood, 1, into position over the tractor.
2. Slide the hood onto the hood hinges and secure to the tractor by using the hinge pin, 2, with flat washer, 3.
3. Install the hood support bracket, 4, by using the hinge pin, 5, with flat washer, 6.
4. Connect the headlight wiring, 7, to the main wire harness.



3

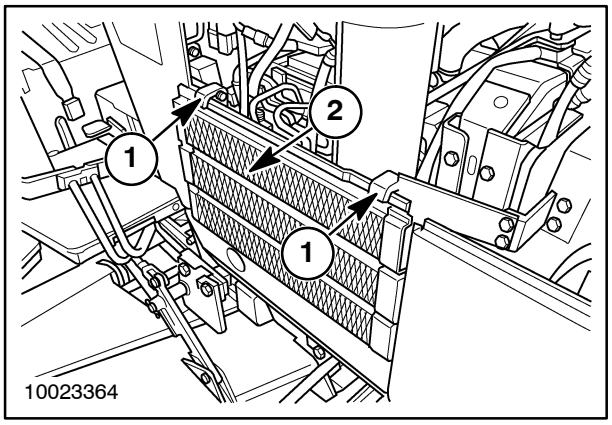
SIDE COVERS

Removal

1. Raise the tractor hood until secure.
2. Lift the rubber latches, 1, to release the side cover, 2, from the tractor.

Installation

1. Position the lower portion of the side cover and lock the top in place by using the rubber latches.



4

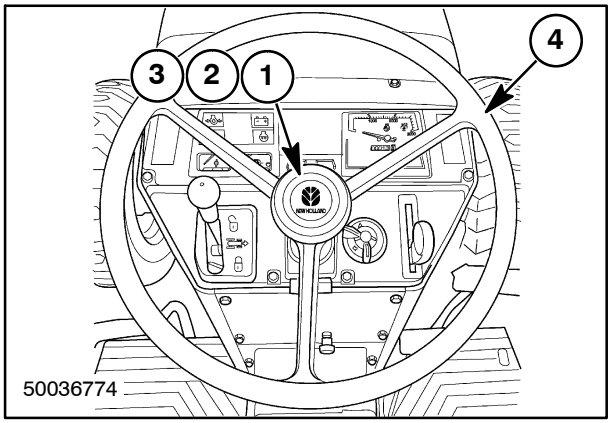
STEERING WHEEL

Removal

1. Carefully pry the plastic cap, 1, from the center of the steering wheel to gain access to the steering wheel mounting nut.
2. Unthread the nut, 2, with washer, 3, and use a puller to remove the steering wheel, 4, from the steering column.

Installation

1. Apply anti-seize compound onto the steering column spline.
2. Install the steering wheel onto the steering column by using the nut with the washer. Apply standard torque to the mounting hardware.
3. Press the plastic cap into the center of the steering wheel.



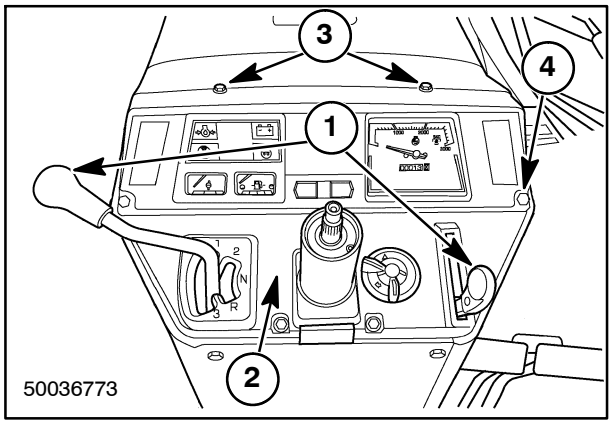
5

DASH PANEL

Removal

NOTE: *The steering wheel was removed to better illustrate the instrument panel. Removal of the steering wheel is not necessary to remove the instrument panel from the tractor.*

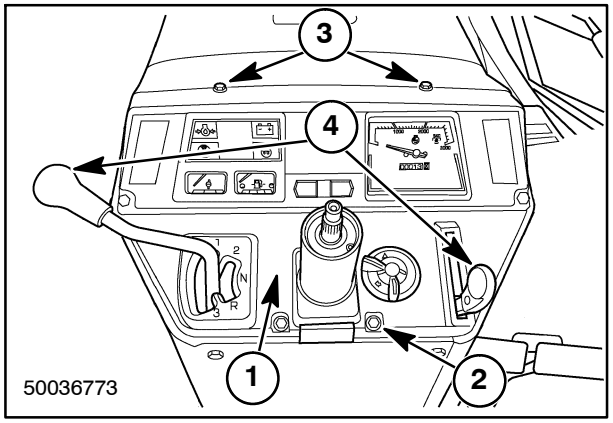
1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the two grips, 1, to allow removal of the dash panel, 2.
3. Remove the two machine screws, 3, from the dash panel, 2.
4. Remove the four retaining bolts, 4, to raise the dash panel, 2, from the operator console.
5. Disconnect the tachometer cable and wiring harness to remove the dash panel from the operator console.



6

Installation

1. Connect the wire harness and tachometer cable to the instrument panel.
2. Place the dash panel, 1, on the operator console.
3. Secure the dash panel, 1, by using the four retaining bolts, 2, and two screws, 3.
4. Install the grips, 4, onto the appropriate levers.
5. Connect the negative (–) battery cable to the negative (–) battery terminal.



7

SEAT

Removal and Disassembly

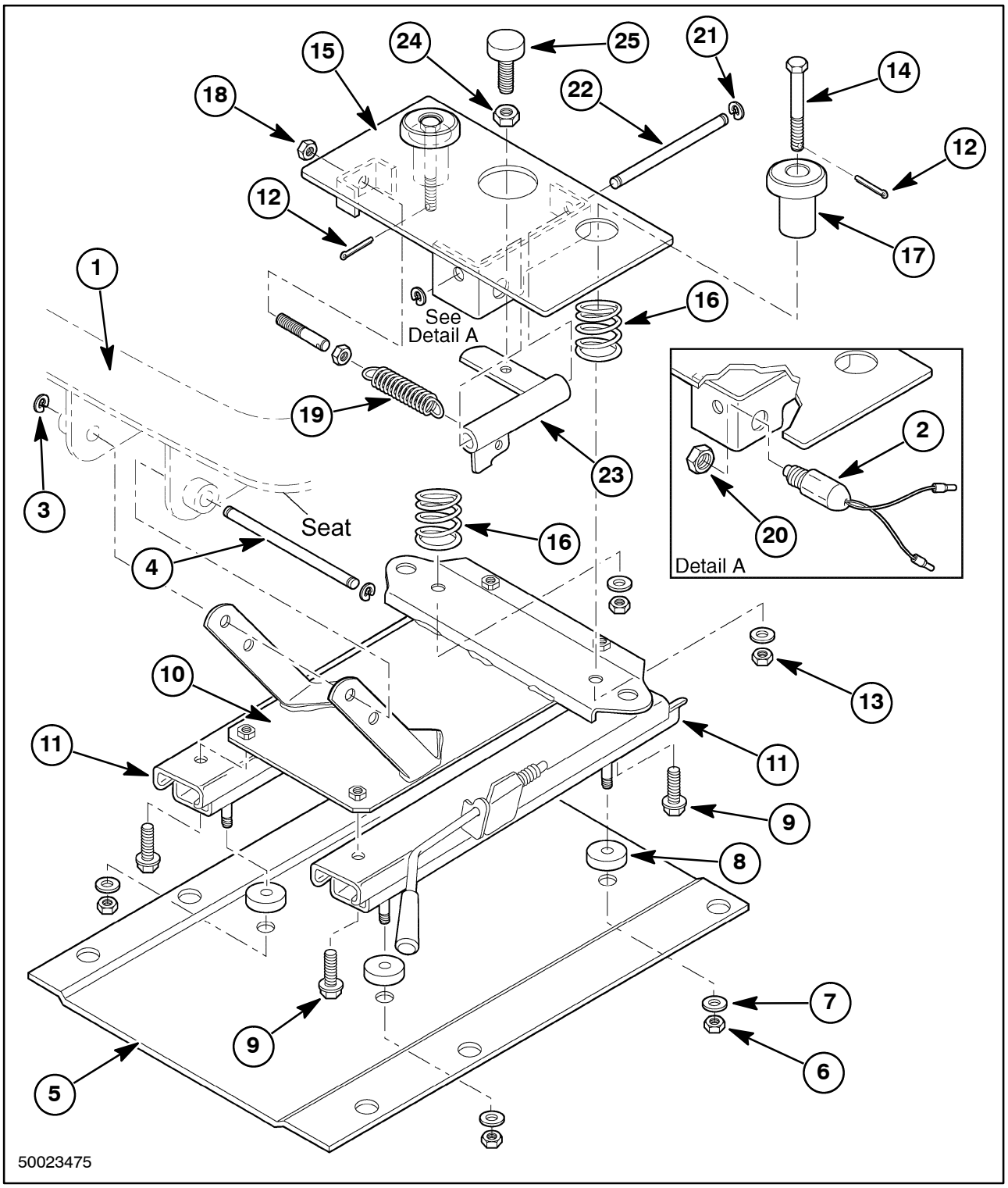
1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Tilt seat, 1, forward.
3. Disconnect the seat safety switch, 2, from the tractor wire harness.
4. Remove the e-clip, 3, and rod, 4, from the seat and seat support bracket.
5. Lift the seat from the tractor.
6. Remove the six M8 hex nuts to remove the seat base, 5, and seat assembly from the tractor.
7. Unthread the four M10 nuts, 6, and lock washers, 7, from the seat assembly and remove the seat base from the seat assembly.
8. Remove the four spacers, 8, from the seat assembly.

NOTE: *Slide the slide rails forward and rearward to gain access to the slide rail mounting hardware.*

9. Remove the four M8 x 16 retaining bolts, 9, with lock washers from the seat support bracket, 10, to remove slide rails, 11.

NOTE: *The slide rail components are not serviced separately. If the slide rail does not function properly, replace the slide rail as an assembly.*

10. Remove the two cotter pins, 12, and unthread the M8 hex nuts, 13, from the M8 retaining bolts, 14.
11. Remove the spring bracket, 15, from the seat support bracket, 10.
12. Remove the coil springs, 16, rubber spacers, 17, and M8 retaining bolts, 14, from the spring bracket.
13. Loosen the M8 adjusting nut, 18, to relieve tension on the seat switch spring, 19.
14. Remove the seat switch spring, 19, from the spring bracket, 15.
15. Unthread the seat safety switch, 2, from the M14 hex nut, 20, to remove the seat safety switch from the spring bracket.
16. Remove the e-clip, 21, to remove the rod, 22, and seat switch control lever, 23, from the seat spring bracket, 15.
17. Loosen the jam nut, 24, to remove the seat plunger, 25, from the control lever, 23.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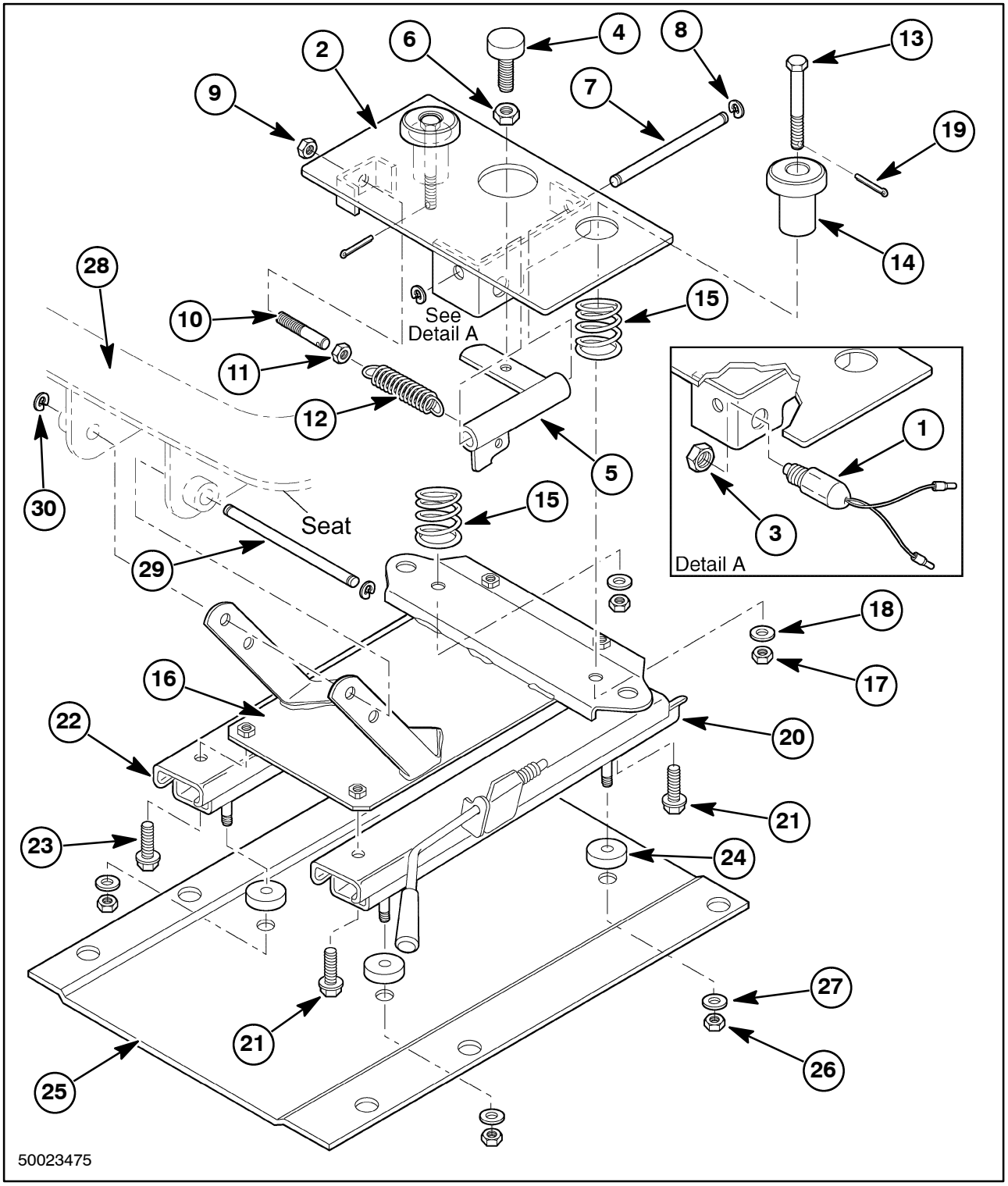
8

Assembly and Installation

1. Install the seat safety switch, 1, into the spring bracket, 2, by using the M14 hex nut, 3.
2. Thread the seat plunger, 4, into the control lever, 5, until approximately three threads are visible on the other side of the control lever. Tighten the locking nut, 6, to secure the seat plunger.
3. Install the control lever onto the spring bracket by using the rod, 7. Secure the rod by using the two e-clips, 8.
4. Thread one M8 hex nut, 9, onto the adjusting rod, 10 and insert the adjusting rod into the spring bracket.
5. Thread the other M8 hex nut, 11, onto the adjusting rod, 10.
6. Fasten the spring, 12, to the control lever and the adjusting rod. Tighten the adjusting rod until the spring is 3-1/8″ from the center of each of the hooks found at each end of the spring.
7. Insert the M8 retaining bolts, 13, with rubber spacers, 14, into the spring bracket.
8. Slide a coil spring, 15, over both of the rubber spacers.
9. Install the spring bracket, 2, onto the seat support bracket, 16, by using the M8 hex nuts, 17, with flat washers, 18.
10. Tighten the two M8 hex nuts, 17, enough to insert a cotter pin, 19, through both of the M8 retaining bolts, 13.
11. Install the left slide rail w/locking lever, 20, onto the seat support bracket, 16, by using the two M8x16 retaining bolts with washers, 21.
12. Install the right slide rail, 22, onto the seat support bracket by using the two M8 retaining bolts with washers, 23.
13. Slide a spacer, 24, onto each of the four threaded studs on the slide rails.
14. Install the seat base, 25, onto the slide rails by using the four M10 hex nuts, 26, with lock washers, 27.
15. Install the seat assembly with seat base onto the tractor by using the six M8 hex nuts.
16. Connect the seat safety switch wire leads to the tractor wire harness.
17. Install the seat, 28, onto the seat support bracket, 16, by using the rod, 29, with the two e-clips, 30.
18. Connect the negative (-) battery cable to the negative (-) battery terminal.



9

ROLL OVER PROTECTION SYSTEM (ROPS)

Removal

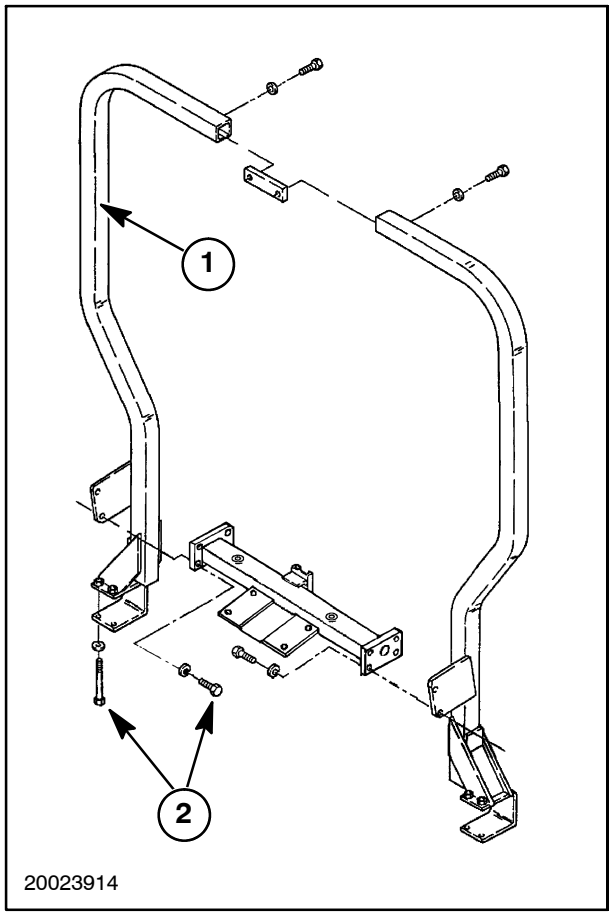
DANGER

Lift and handle all heavy parts using suitable lifting equipment. Support parts or an assembly by means of suitable slings, hooks, or jack stands. Make sure that no person is near a raised load.

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.

IMPORTANT: *Make sure no wires are fastened to the ROPS before removal.*

2. Support the ROPS assembly, 1, before removing the retaining bolts, 2.
3. Unthread the eight retaining bolts, 2, from the tractor frame.
4. Use a suitable lifting device to lower the ROPS assembly, 1, from the tractor.



10

Installation

DANGER

Lift and handle all heavy parts using suitable lifting equipment. Support parts or an assembly by means of suitable slings, hooks, or jack stands. Make sure that no person is near a raised load.

1. Install the ROPS, 1, by using the eight retaining bolts, 2. Torque the hardware to 75 N·m (55 ft.-lbs.).
2. Connect the negative (-) battery cable to the negative (-) battery terminal.

FUEL TANK

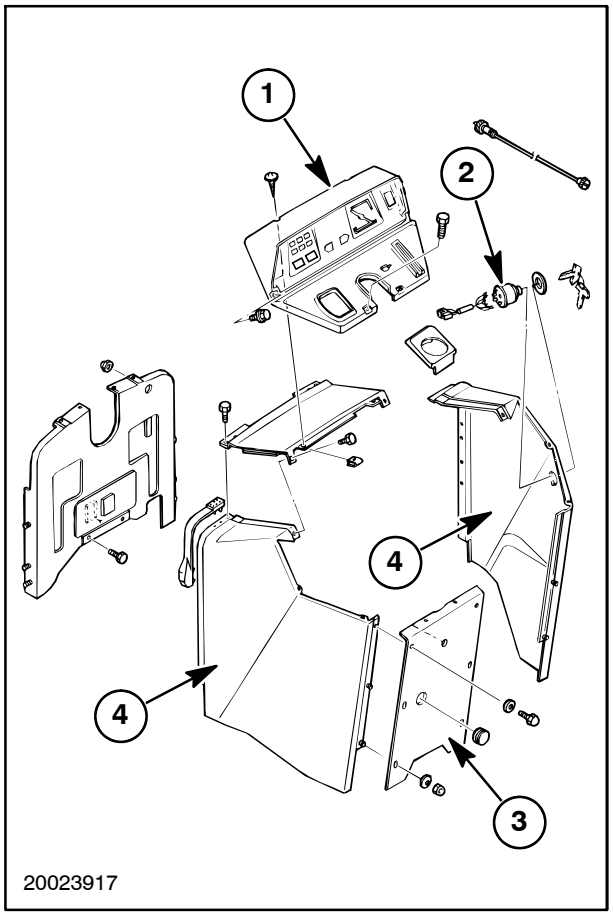
Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the dash panel, 1. See “Dash Panel Removal”.
3. Disconnect the key switch, 2, from the tractor wire harness.
4. Remove the center cover, 3, from the side covers, 4.
5. Remove the side covers, 4, from the tractor.

⚠ WARNING ⚠

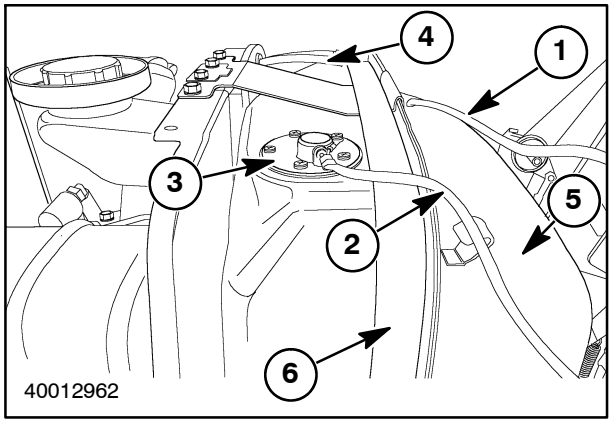
Allow the engine to cool before draining fuel. Do not expose diesel fuel to open flame. Do not smoke while near diesel fuel. Injury or death may result. Clean up fuel spills immediately.

NOTE: *The fuel tank can store up to 27 liters (7.1 gallons) of fuel.*



11

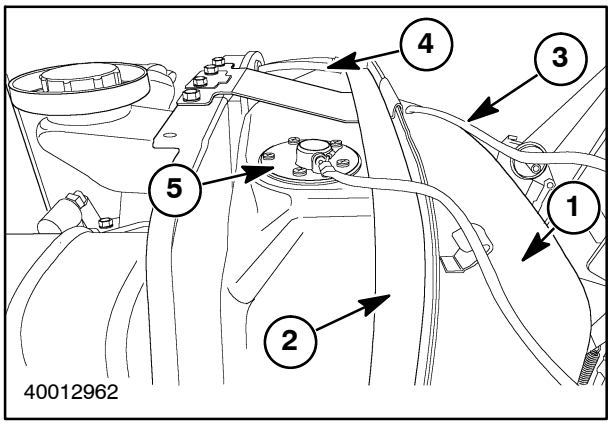
6. Remove the fuel hose, 1, from the fuel shutoff valve and drain the fuel into a clean container.
7. Disconnect the wire leads, 2, from the fuel level sending unit, 3.
8. Disconnect the fuel return lines, 4, from the top of the fuel tank, 5.
9. Remove the fuel tank retaining band, 6.
10. Remove the fuel tank, 5, from the tractor.



12

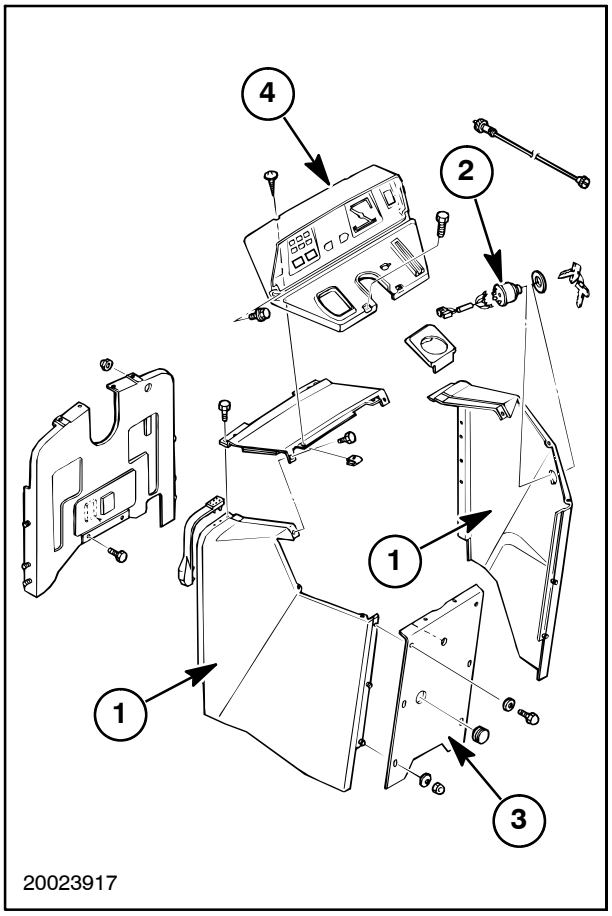
Installation

1. Install the fuel tank, 1, by using the tank retaining band, 2.
2. Connect the fuel hose, 3, and return lines, 4.
3. Install the fuel level sending unit, 5.
4. Connect the fuel level sending unit to the tractor wire harness.



13

5. Install the side covers, 1, onto the tractor.
6. Connect the key switch, 2, to the tractor wire harness.
7. Install the center cover, 3, onto the side covers.
8. Install the dash panel, 4, onto the operator console. See “Dash Panel Installation”.
9. Connect the negative (–) battery cable to the negative (–) battery terminal.

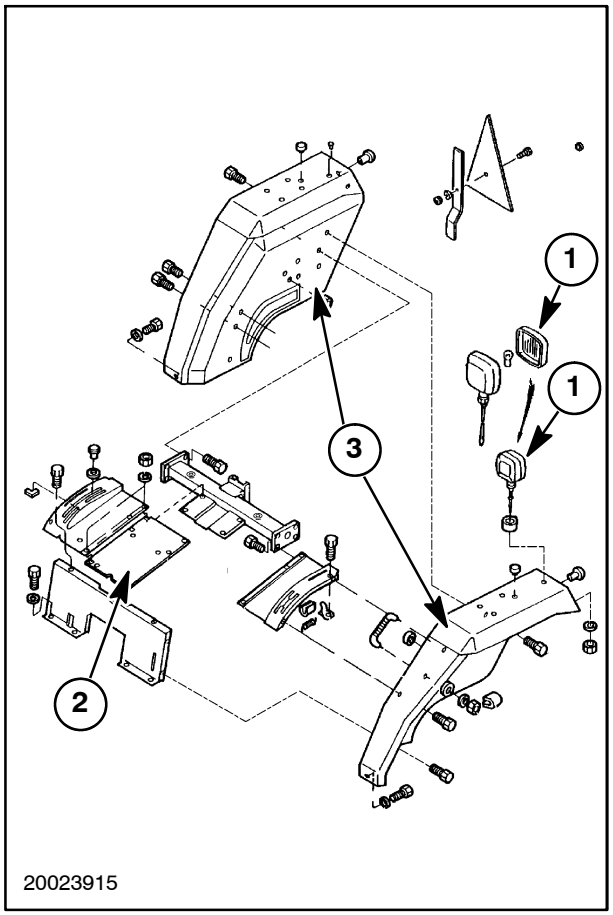


14

REAR FENDERS

Removal

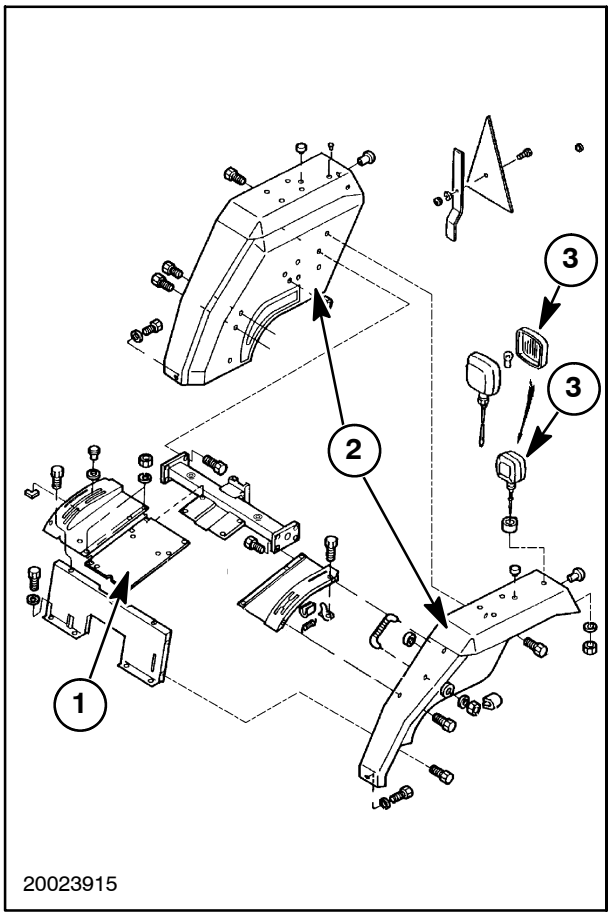
1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Remove the ROPS. See “ROPS removal”.
3. Remove the seat assembly. See “Seat Removal”.
4. Remove the grips from any control levers that pass through the inner fenders.
5. Remove the left and right taillights and flasher warning lights, 1.
6. Remove the seat deck, 2, from the tractor frame.
7. Support the rear axles and remove the rear wheels.
8. Remove the left and right fenders, 3.



15

Installation

9. Install the ROPS. See “ROPS Installation”.
10. Install the seat deck, 1, onto the tractor frame.
11. Install the seat assembly. See “Seat Installation”.
12. Install the left and right fenders, 2, onto the tractor.
13. Install the light assemblies, 3, onto the rear fenders.
14. Apply standard torque to all hardware.
15. Install the rear wheels. Torque the wheel mounting bolts to169 N·m (125 ft.-lbs.).
16. Connect the negative (–) battery cable to the negative (–) battery terminal.



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OPERATOR PLATFORM

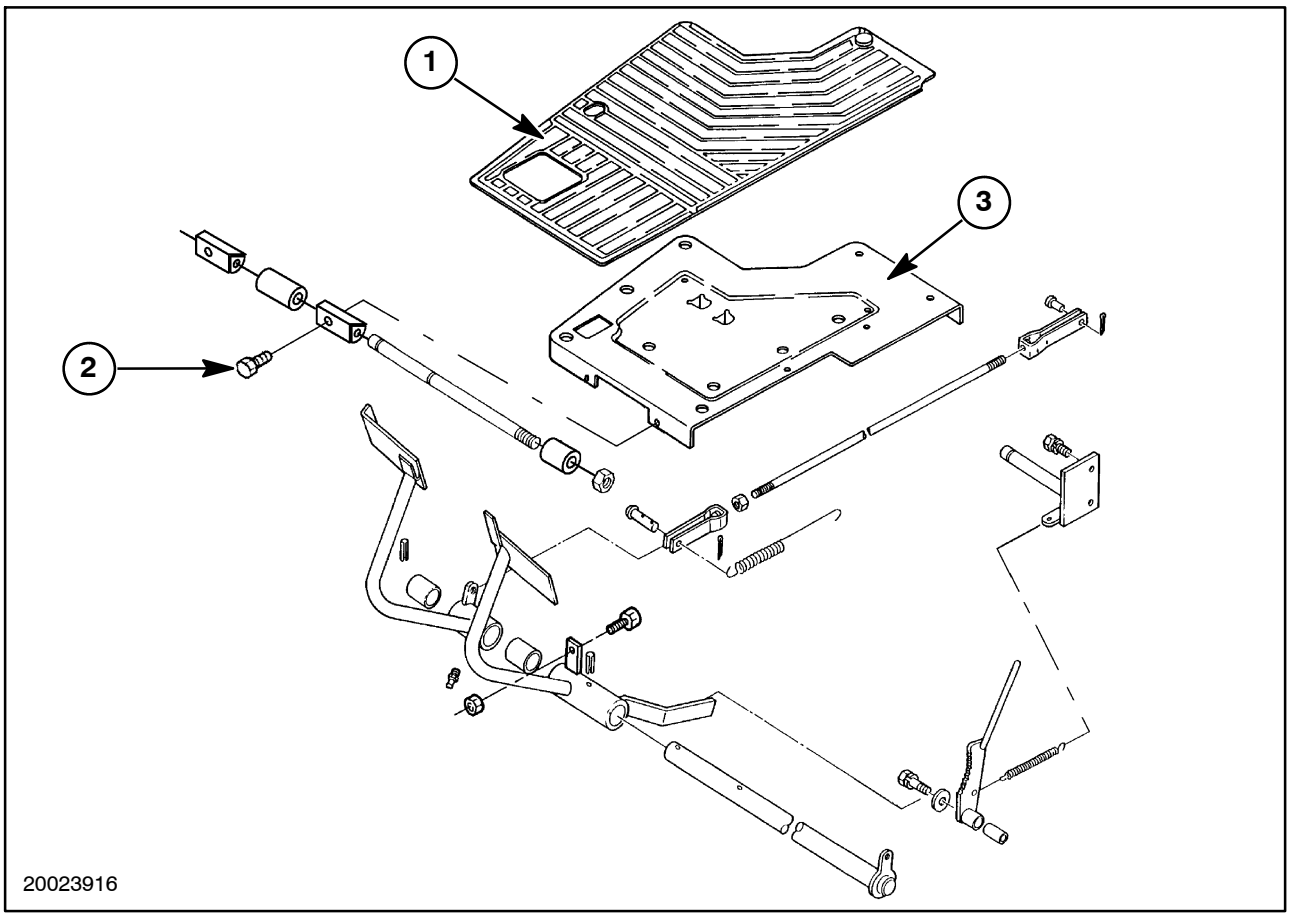
Removal

1. Disconnect the negative (–) battery cable from the negative (–) battery terminal.
2. Lift the rubber traction mats, 1, from the operator platform.

NOTE: *Make sure that no wire harnesses are attached to the operator platforms before removing from the tractor.*

NOTE: *The left side operator panel may be equipped with a clutch stop bracket. Removal of the clutch stop bracket is necessary for operator platform removal.*

3. If equipped, remove the clutch stop bracket from the left side operator platform.
4. Remove the mounting bolts, 2, to remove the operator platform, 3, from the tractor.



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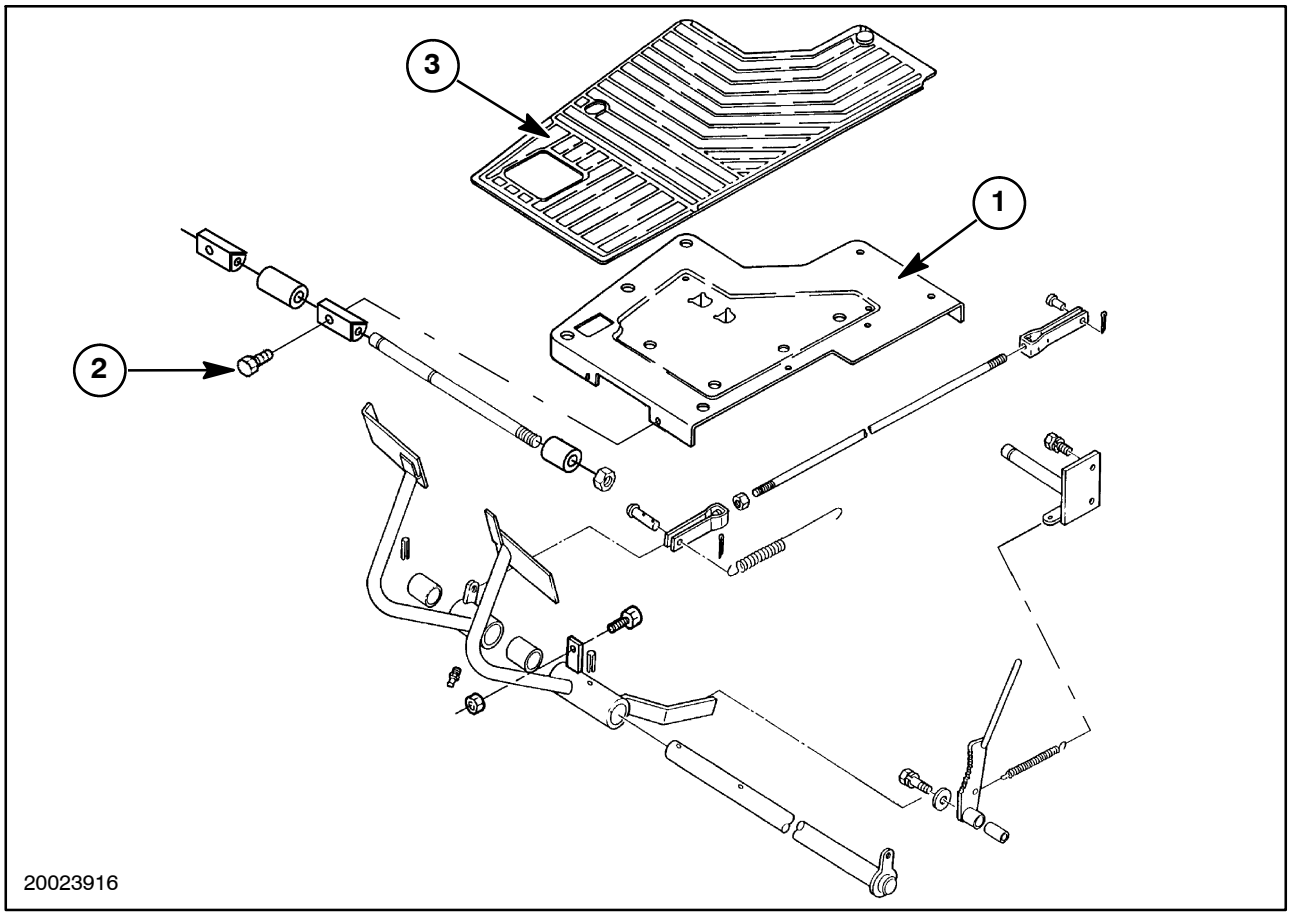
Installation

1. Install the operator panel, 1, by using the retaining bolts, 2.
2. Fasten the rubber traction mats, 3, to the operator platform, 1.
3. If removed, install the clutch stop bracket.
4. Connect the negative (-) battery cable to the negative (-) battery terminal.



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