MC22, MX28, MC35
REPAIR MANUAL
COMPLETE CONTENTS

The following pages are the collation of the contents pages from each section and chapter of the MC22, MC28, and MC35 Repair manual. Complete Repair part # 87557971.

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.

The sections listed above are the sections utilized for the MC22, MC28, and MC35 Tractors.

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SECTION 10 – ENGINE AND FUEL SYSTEMS

BOOK 1 - 87557972

Chapter 2 – Fuel Systems (Continued)

CONTENTS

SECTION 41 - STEERING

BOOK 3 - 87557974

Chapter 1 - Steering (Continued)

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SECTION 55 - ELECTRICAL

BOOK 4 - 87557975

Chapter 4 - Charging and Starting Systems (Continued)

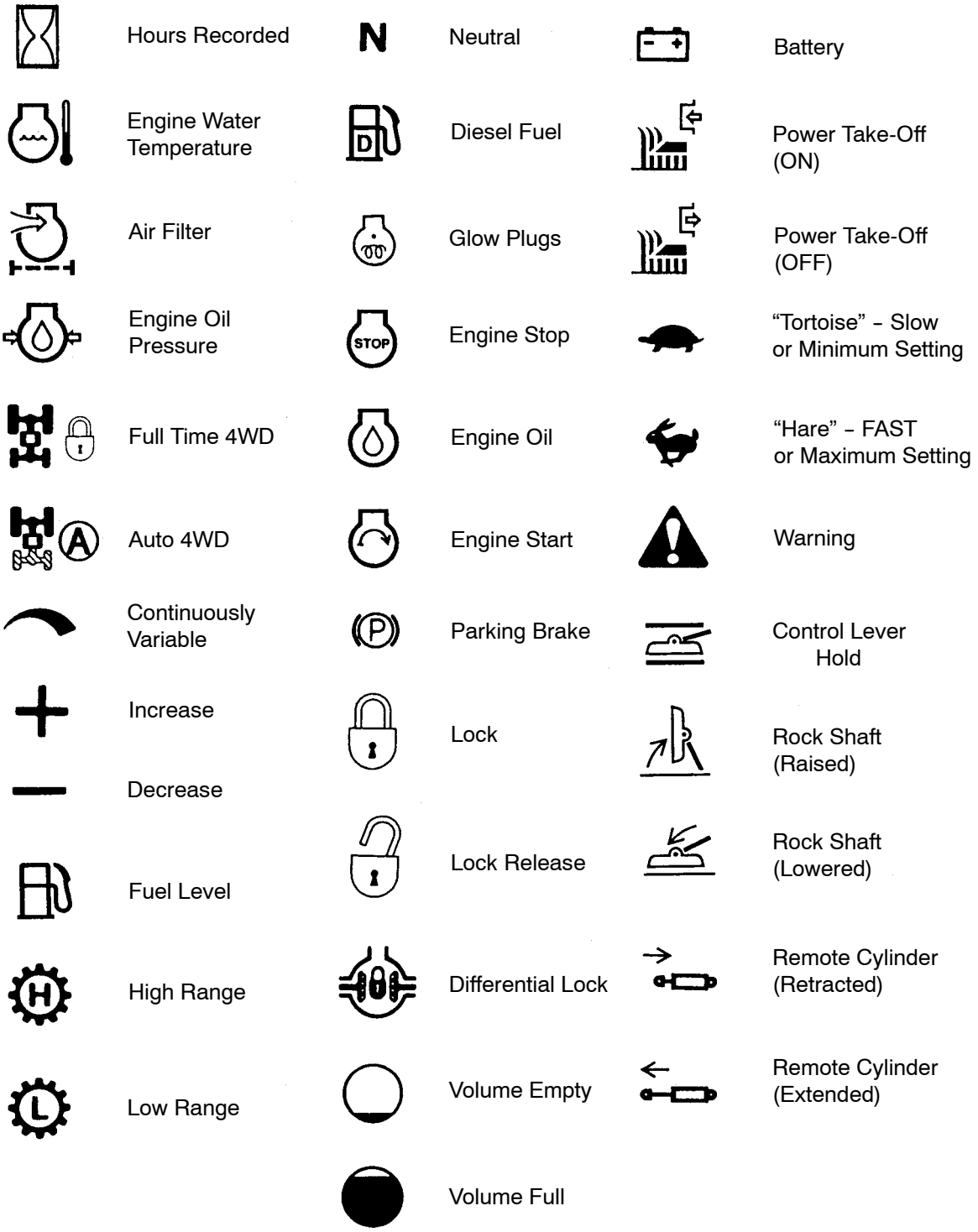
CONTENTS

OPERATING THE MOWER DECK

1. Release the Commercial Mower HST foot pedal, apply the parking brake, place PTO lever in the "OFF" position, the lift control lever in neutral position and the transmission in neutral before starting the engine.
2. Do not start the engine or operate controls while standing beside the unit. Always sit in the seat when starting the engine or operating controls.
3. Do not bypass the neutral safety start switch. Consult your New Holland Dealer if your neutral safety start controls malfunction.
4. Use jumper cables only in the recommended manner. Improper use can result in the unit running away.
5. Avoid accidental contact with the gear shift lever while the engine is running.
6. Do not get off the Commercial Mower while it is in motion.
7. Disengage the PTO, shut off the engine and apply the parking brake before getting off the unit.
8. Do not park the Commercial Mower on a steep incline.
9. Do not operate the engine in an enclosed building without adequate ventilation. Exhaust fumes can cause death.
10. If the engine operates erratically, stop the engine immediately.
11. Do not leave equipment in the raised position.
12. Do not operate the Commercial Mower or any attachments while under the influence of alcohol, medication, controlled substances or when tired.
13. Do not operate near ditches, holes, embankments or any other terrain which may collapse under machine weight. The risk of machine tip-over increases when the ground is loose or wet.
14. When working in cooperation with other operators, always let others know what you are doing ahead of time.
15. Never try to mount or dismount from a moving unit.
16. Do not operate the Commercial Mower with bare feet. Keep hands, feet and clothing away from power-driven parts.
17. Do not drive the machine on streets or highways. Watch for traffic when you cross roads or operate near roads.
18. Look to the rear before and when backing. You must disengage blades before shifting into reverse. Make sure that the area immediately behind you is clear of obstructions or holes and small children. Use extra caution when the machine is equipped with a grass catcher.
19. Do not cross gravel roads with the PTO engaged.
20. Do not operate the mower deck without locking the hood and seat.
21. Disengage power to the mower deck when transporting or when not in use.
22. Disengage power to the mower deck before backing up. Do not mow in reverse unless absolutely necessary and then only after careful observation of the entire area behind the mower deck.
23. When mowing proceed as follows:
    a. Mow only in daylight or in good artificial light.
    b. Never make a cutting height adjustment while the engine is running if the operator must dismount to do so.
    c. Check the blade mounting bolts for proper tightness at frequent intervals.
    d. Shut off the engine when removing the grass catcher or clearing the chute.
24. Watch for holes in the terrain and other hidden hazards.
25. Do not stop or start suddenly when going uphill or downhill. Mow up and down the face of steep slopes, never cross the face.
26. Disengage power to attachment(s) and stop the engine before leaving the operators position.
27. Never leave equipment in the raised position.
28. Always keep the discharge side of the cutter directed away from people and objects which could be struck by debris thrown from the cutter.
29. Install Commercial Mower weights to increase stability when operating on slopes.

INTERNATIONAL SYMBOLS

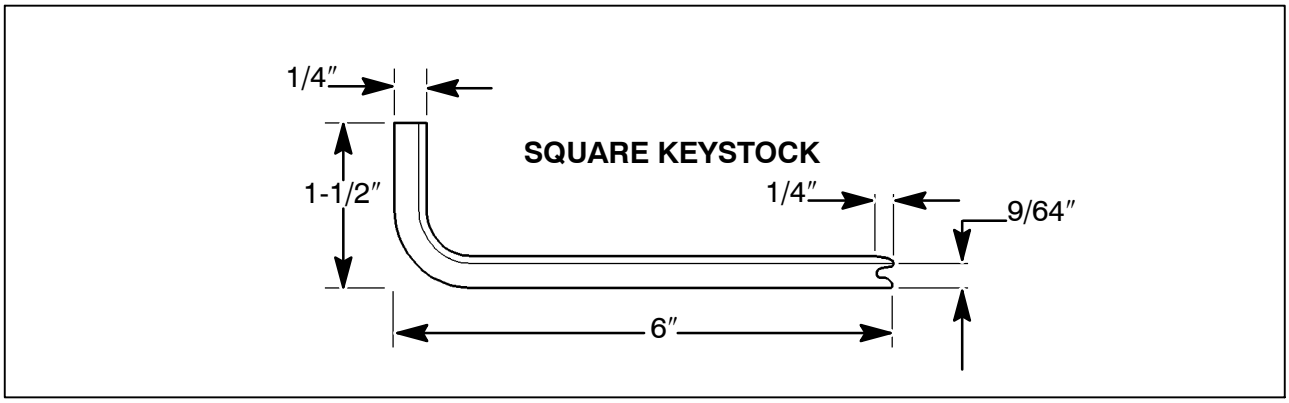
As a guide to the operation of your Commercial Mower, various universal symbols have been utilized on the instruments and controls. The symbols are depicted and described below.



SPECIAL TOOLS

Bore Gauge	19-25 mm (0.75 – 1.0 in.)
Compression Test Adapter	FNH00120
Cylinder Bore Gauge	25-51 mm (1-2 in.)
Cylinder Bore Gauge	51-76 mm (2-3 in.)
Dial Indicator (Magnetic Base)	FNH01345
Gauge, 0-138 bar (0-2000 psi)	FNH02504
HST High Pressure Relief Valve Test Fitting	NH01410
HST Charge Pressure Relief Valve Test Fitting	NH01411
Injector Adapter Set	FNH01728
Injector Nozzle Tester	FNH01721
Micrometer	0-25 mm (0-1 in.)
Micrometer	25-51 mm (1-2 in.)
Micrometer	51-76 mm (2-3 in.)
Oil Pressure Test Fitting	FNH00011
Oil Pump Port Block Installer Tool (MC22)	FNH11063A
Oil Pump Port Block Installer Tool (MC28 & MC35)	FNH00117
Oil Pump Port Block Removal Tool	FNH11097
Power-steering test fitting	NH01412
PTO Clutch Spring Compressor	NH01413
*Steering Motor Return Spring Installation Tool	Manufacture
Transaxle Alignment Rods	NH01414
Transaxle range fork Detent Ball Installation Tool	FNH01580

*Refer to figure below for tool manufacturing instructions.



CYLINDER HEAD SPECIFICATIONS

Tractor Model	MC22	MC28	MC35
Engine Model	S773	J843	N843L
Head Warp Standard Maximum	 0.05 mm (0.002 in.) 0.12 mm (0.005 in.)	 0.05 mm (0.002 in.) 0.12 mm (0.005 in.)	 0.05 mm (0.002 in.) 0.12 mm (0.005 in.)
Valve Seat Width Standard Maximum	 1.7 – 2.1 mm (0.067 – 0.082 in.) 2.5 mm (0.098 in.)	 1.7 – 2.1 mm (0.067 – 0.082 in.) 2.5 mm (0.098 in.)	 1.7 – 2.1 mm (0.067 – 0.082 in.) 2.5 mm (0.098 in.)
Valve Seat Sink (Recess) Standard Maximum	 0.85 – 1.15 mm (0.0334 – 0.0453 in.) 1.8 mm (0.0708 in.)	 0.85 – 1.15 mm (0.0334 – 0.0453 in.) 1.8 mm (0.0708 in.)	 0.85 – 1.15 mm (0.0334 – 0.0453 in.) 1.8 mm (0.0708 in.)
Valve Angle	45°	45°	45°

PISTON SPECIFICATIONS

Tractor Model	MC22	MC28	MC35
Engine Model	S773	J843	N843L
Piston Diameter Standard Minimum	 76.933 – 76.948 mm (3.02889 – 3.02942 in.) 76.700 mm (3.0197 in.)	 83.948 – 83.963 mm (3.30503 – 3.30562 in.) 83.7 mm (3.2953 in.)	 83.948 – 83.963 mm (3.30503 – 3.30562 in.) 83.7 mm (3.2953 in.)
Bore Clearance Standard Maximum	 0.0525 – 0.0815 mm (0.0021 – 0.0032 in.) 0.25 mm (0.010in.)	 0.088 – 0.106 mm (0.0034 – 0.0041 in.) 0.30 mm (0.0118in.)	 0.088 – 0.106 mm (0.0034 – 0.0041 in.)0.30 mm (0.0118in.)
Piston Wrist Pin Bore Standard Maximum	 20.988 – 21.002 mm (0.8267 – 0.8268 in.) 21.016 mm (0.827 in.)	 24.999 – 25.003 mm (0.984 – 0.9843 in.) 25.014 mm (0.984 in.)	 27.996 – 28.000 mm (1.102 – 1.1023 in.) 27.98 mm (1.102 in.)
Piston Pin Clearance Standard Maximum	±0.004 mm (0.00015 in.) 0.02 mm (0.0008 in.)	–0.001 – +0.007 mm (–0.000393 – + 0.0002 in.) 0.02 mm (0.0008 in.)	–0.001 – +0.007 mm (–0.000393 – + 0.0002 in.) 0.02 mm (0.0008 in.)
Available Oversizes (Non-emissionized)	0.5 mm (0.02 in.)	0.5 mm and 1.0 mm (0.020 and 0.040 in.)	0.5 mm and 1.0 mm (0.020 and 0.040 in.)

METRIC BOLT TORQUE SPECIFICATIONS - ALL MODELS

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	3.6-4.3	4.9-6.9	------	------	------
	7T, 8T, 8.8		6.1-8.3	8.3-11.3			
	10T, 11T		8.7-11.5	11.7-15.7			
M8	4T, 4.8	1.25	9.4-12.3	12.7-16.7	1.0	11.2-14.8	15.2-20.1
	7T, 8T, 8.8		16.6-21	22.6-28.4		26.8-25.3	26.5-34.3
	10T, 11T		21-26.7	28.5-36.3		22.4-29.6	30.4-40.2
M10	4T, 4.8	1.5	18.8-24.6	25.5-33.3	1.25	21-26.7	28.4-36.2
	7T, 8T, 8.8		32.5-41.2	44.1-55.9		36.2-46.3	49-62.7
	10T, 11T		39.8-51.3	54-69.6		42.7-54.2	57.8-73.5
M12	4T, 4.8	1.75	27.4-34.7	37.3-47	1.25	31.8-40.5	43.1-54.9
	7T, 8T, 8.8		48.5-61.5	65.7-83.3		55-69.4	74.5-94.1
	10T, 11T		68-85.3	92-116		73-93.3	99-126
M14	4T, 4.8	2.0	46.3-59.3	62.8-80.4	1.5	51.4-64.3	69.6-87.2
	7T, 8T, 8.8		76.7-96.9	104-132		86.1-109	117-148
	10T, 11T		103-128	139-175		110-136	149-184
M16	4T, 4.8	2.0	64-81	86.1-110	1.5	67.3-84.6	91.1-114
	7T, 8T, 8.8		110-136	149-185		116-142	157-192
	10T, 11T		152-188	205-255		163-190	221-269
M18	4T, 4.8	2.0	84-104	113-141	1.5	97-120	132-162
	7T, 8T, 8.8		145-173	196-236		170-206	231-279
	10T, 11T		203-246	275-333		221-271	298-367
M20	4T, 4.8	2.5	107-132	144-180	1.5	127-155	172-210
	7T, 8T, 8.8		178-213	240-290		203-246	275-333
	10T, 11T		268-325	363-441		293-358	397-485

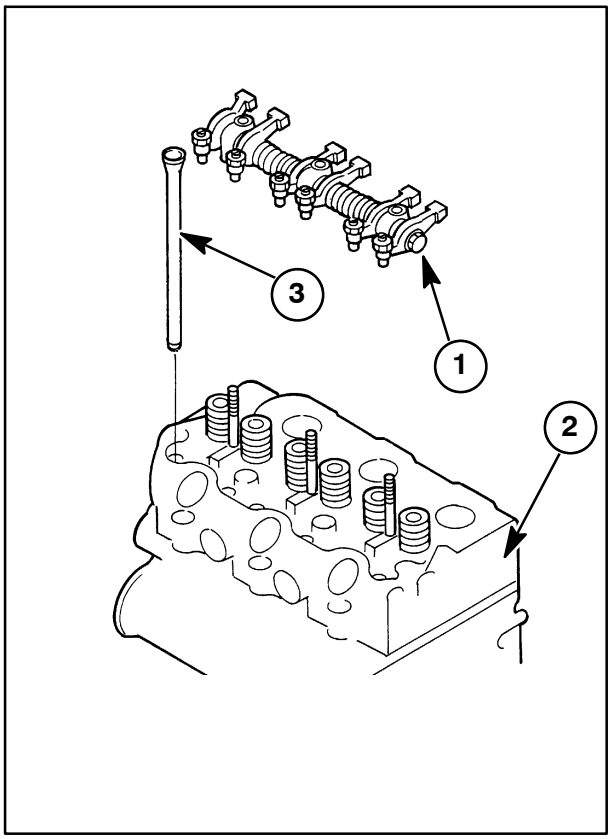
PROBLEM	POSSIBLE CAUSE	CORRECTION
Oil pressure warning light fails to operate	Bulb burnt out	Replace the bulb
	Oil pressure sensor is faulty	Replace oil pressure sensor
	Warning light circuit faulty	Replace warning light circuit
Engine knocks	Diluted or thin oil	Change engine oil and filter
	Insufficient 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 piston with correct oversized piston
	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
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

ROCKER ARM AND PUSHROD – MC22

Removal

IMPORTANT: If valve train components will be reused, label each component for location in the cylinder head/engine block. This is so the components can be returned to their removal location upon assembly of the engine.

1. Remove the three nuts retaining the rocker arm assembly, 1, to the cylinder head, 2. The rocker arms and rocker arm shaft can then be removed as an assembly.
2. Remove the pushrods, 3, from the cylinder head.



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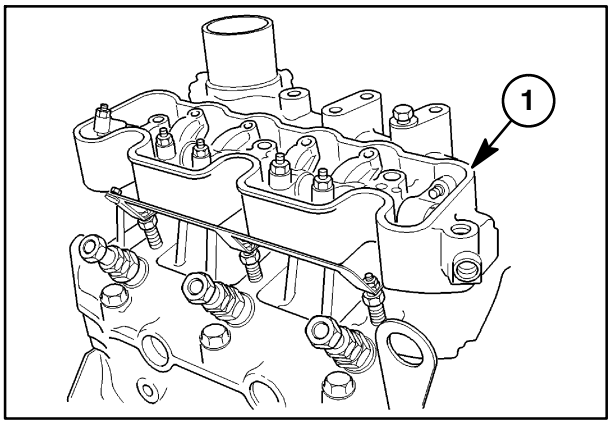
ROCKER ARM, SUPPORT BRACKET, AND PUSHROD – MC28 AND MC35

Removal

IMPORTANT: *When removing the rocker arm assembly and support bracket, loosen each bolt one-half turn in a crossing pattern until all of the head bolts can be finger-turned or the bolts no longer secure the assembly to the cylinder head.*

IMPORTANT: *If valve train components will be reused, label each component for location in the cylinder head/engine block. This is so the components can be returned to their removal location upon assembly of the engine.*

1. Remove the bolts which retain the rocker arm shaft and support bracket to the cylinder head and remove from the cylinder head as an assembly, 1.



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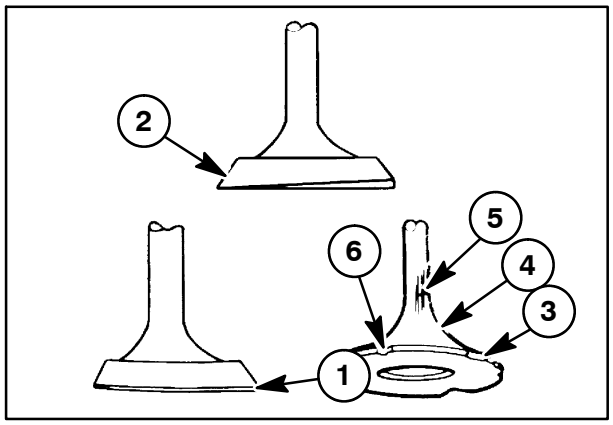
VALVES

Inspection and Repair

1. Clean all deposits and inspect each valve for the following defects and damage:
   - Margin too thin, 1
   - Bent valve, 2
   - Pitting, 3
   - Indented, 4
   - Wear or nicks, 5
   - Burning, 6

   Replace any valves that show signs of damage or wear.



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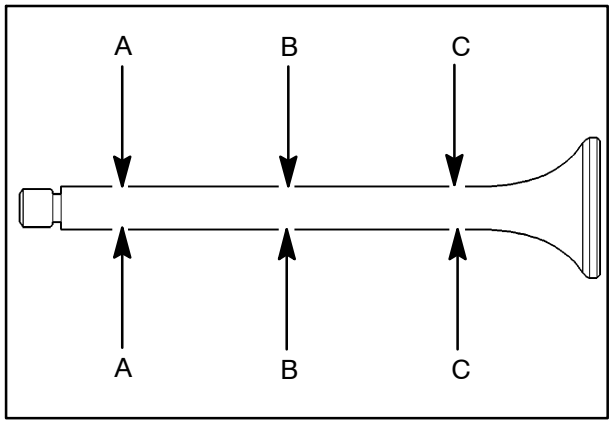
2. Using a suitable micrometer, measure the valve stems at point “A”, “B”, and “C”. Compare measurements with the chart below.

Intake Valve Stem Diameter	
Standard	6.95 – 6.97 mm (0.2738 – 0.2744 in.)
Minimum	6.89 mm (0.271 in.)
Exhaust Valve Stem Diameter	
Standard	6.94 – 6.95 mm (0.273 – 0.274 in.)
Minimum	6.84 mm (0.269 in.)



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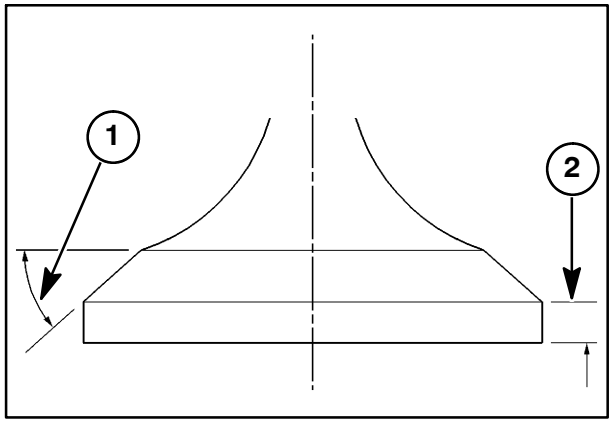
   If the diameter of a valve stem is found to be not uniform or within specifications, replace the valve.

3. Inspect the valve seat angle, 1. The angle should be 45°.
4. Inspect the valve margin, 2. The standard thickness is 0.775 – 1.075 mm (0.0305 – 0.0423 in.). The minimum thickness is 0.5 mm (0.0197 in.). If the thickness is below minimum specifications, replace the valve.
5. If inspection determines that the valve may be re-used, the valve should be ground to match the valve seat.
6. After grinding the valve and valve seat, coat the valve seat, 2, with Prussian blue and place the corresponding valve in the cylinder head. Rotate the valve while putting light pressure against the valve. If the blue is transferred from the valve seat to the center of the valve face, contact is correct and the valve and seat were properly ground.



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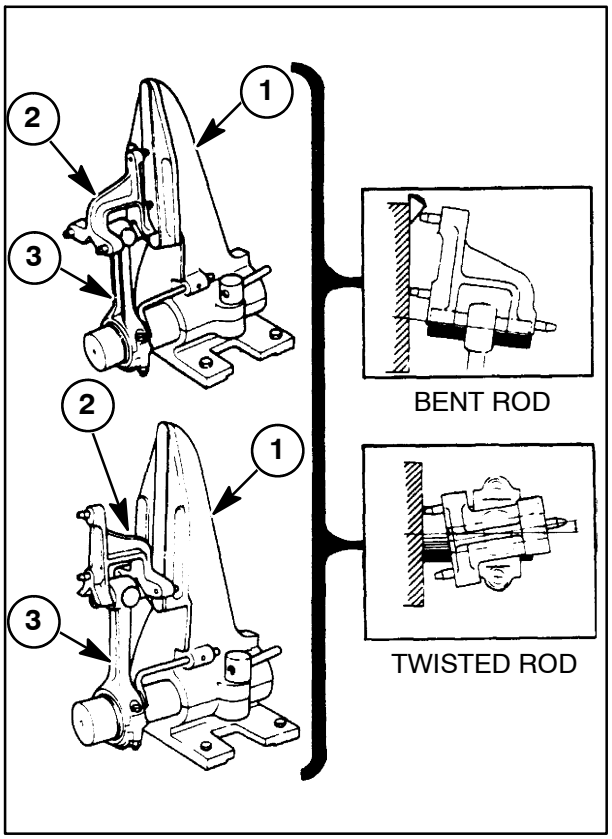
CONNECTING RODS

Inspection

1. Use a connecting rod alignment fixture to check each connecting rod for damage such as warping, bends, or twisting.
2. Straighten or replace rods which are bent or twisted to more than the following specifications:

Connecting Rod Twist	
Standard	0.08 mm (0.003 in.)
Maximum	0.20 mm (0.008 in.)
Connecting Rod Bend	
Standard	0.05 mm (0.002 in.)
Maximum	0.15 mm (0.059 in.)



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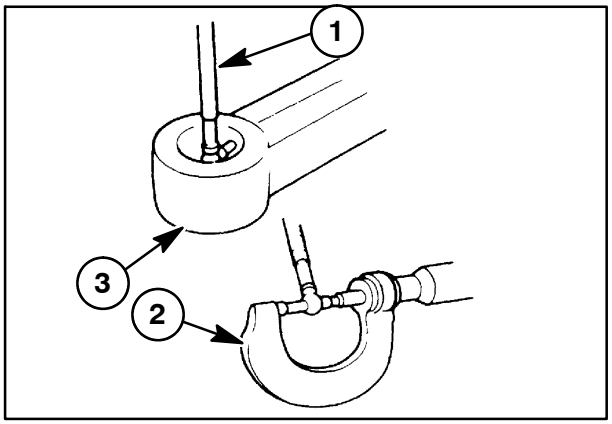
1. Alignment fixture
2. Gauge
3. Connecting rod

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



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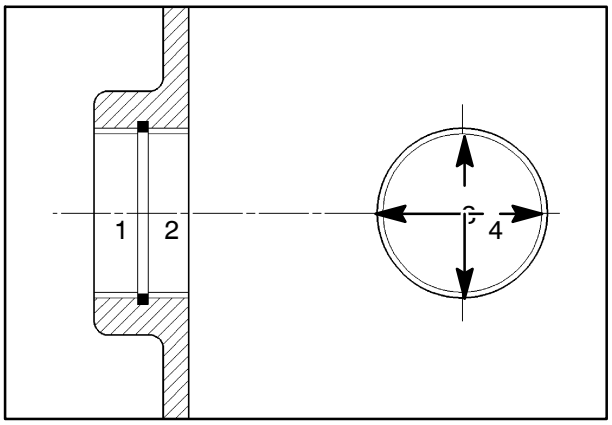
1. Hole gauge
2. Micrometer
3. Connecting rod

Tractor Model	**MC22**	**MC28**	**MC35**
Engine Model	S773	J843	N843L
Maximum Bushing Inside Diameter	20 mm (0.787)	25 mm (0.984 in.)	28 mm (1.102 in.)

MAIN JOURNAL NUMBER ONE BEARING (BUSHING)

Inspection

1. Journal #1 main bearing is located in the front of the engine block. This bearing may also be considered a bushing. Inspect the bearing for signs of improper contact, melting, seizure, or any other damage. Replace the bearing if signs of damage or excess wear are present.
2. Use a telescoping gauge to measure the inside diameter of the bearing at points 1 and 2. Take two readings, 90° from each other at points 3 and 4 for each diameter measurement.
3. Find the bearing oil clearance by calculating the difference in the diameter of main journal number 1 on the crankshaft from the diameter measurements taken for the main bearing.
4. Replace the bearing if clearance exceeds 0.2 mm (0.079 in.). In this case, an undersize bearing will need to be used and the crankshaft will need to be machined.
5. To replace the bearing, use a suitable driver to push the bearing out of the front of the engine block.
6. Inspect bearing housing in the engine block for damage such as scratches, marks or any wear. Repair or replace the engine block if damaged.
7. The new bearing will need to be pressed into the front of the engine block using a suitable driver. When installing the new bearing, use the following guidelines:
   - Lubricate the bearing when installing into the engine block.
   - Align the oil holes, 1, in the bearing with the oil holes in the block when installing.
   - Install the bearing through the front of the block with the thick portion of the bearing facing front, away from the block.
   - Proper depth of the bearing is obtained when the bearing is face is aligned with the front of the block.
8. Once the bearing is installed, confirm that the bearing oil holes are in proper alignment with the oil holes in the engine block.



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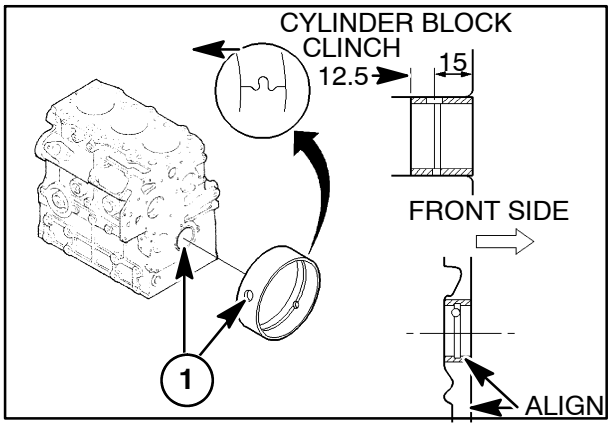

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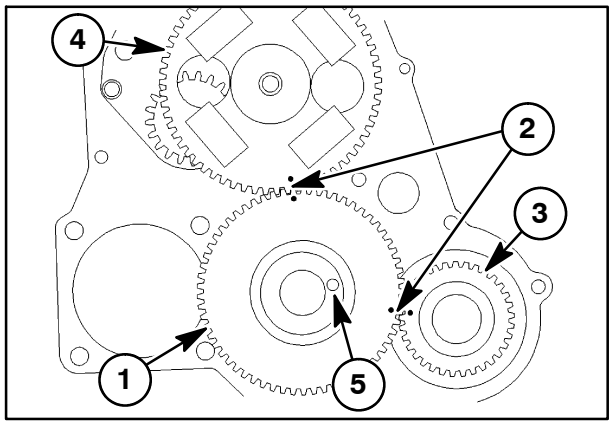
OIL PUMP, IDLER GEAR, AND INJECTION TIMING

Installation

1. Install the thrust washer onto the idler gear shaft.
2. Install the idler gear, 1, onto the idler gear shaft.
3. Align the timing marks, 2, on the idler gear, 1, the crankshaft gear, 3, and the camshaft gear, 4.
4. Install the oil pump, 5, onto the idler gear shaft and complete installation of the oil pump by adjusting axial clearance. Refer to the "Oil Pump Installation and Adjustment" described later in this section.

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

NOTE: *When the timing marks are aligned, cylinder #3 will be at top dead center.*



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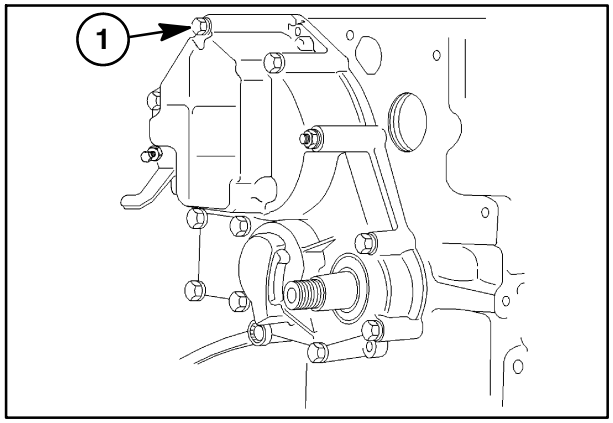
TIMING GEAR COVER

Installation

NOTE: *Before installing the timing gear cover over the timing gears, be sure that the slider is installed onto the camshaft gear.*

1. Install a new gasket for the timing gear cover.
2. Insert the fuel governor linkage through the engine block.
3. Rotate the oil pump so the spring pin hole, 2, in the previous figure is aligned with the spring pin in the timing gear cover.
4. Install the cover onto the engine block and secure the cover to the engine block using the retaining bolts, 1.



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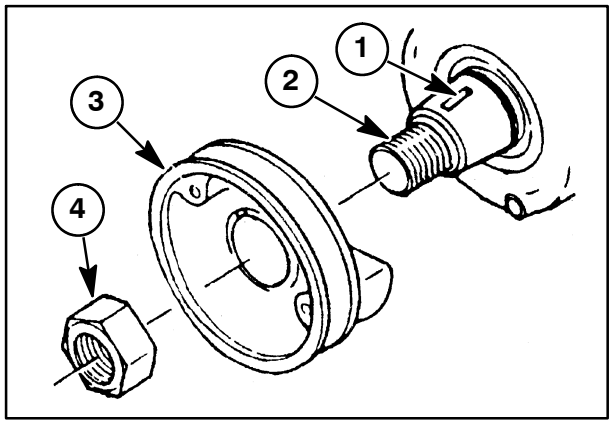
CRANKSHAFT PULLEY

Installation

1. Install the crankshaft key into the keyway, 1, of the crankshaft, 2. Align the key with recess in the crankshaft pulley, 3, and install the pulley onto the crankshaft.
2. Install the retaining nut, 4, onto the crankshaft. Torque the retaining nut to 118 – 127 N·m (87 – 94 ft.-lbs.) for MC22 models and 274 – 333 N·m (203 – 246 ft.-lbs.) for MC28 and MC35 models.



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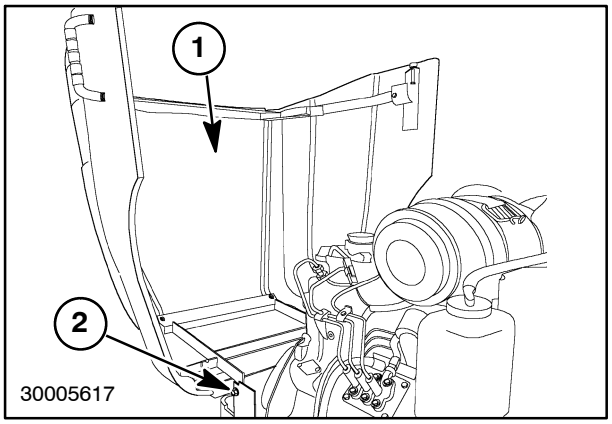
16. Add engine oil to the engine. Use the chart below to determine how much oil to add.

Tractor Model	MC22	MC28	MC35
Engine Oil Capacity, With Filter	2.5 liters (2.6 quarts)	4.6 liters (4.9 quarts)	4.8 liters (5.0 quarts)

17. Install the engine cover, 1, to the tractor and secure using the two bolts, 2.
18. Connect the negative (-) battery cable to the battery.



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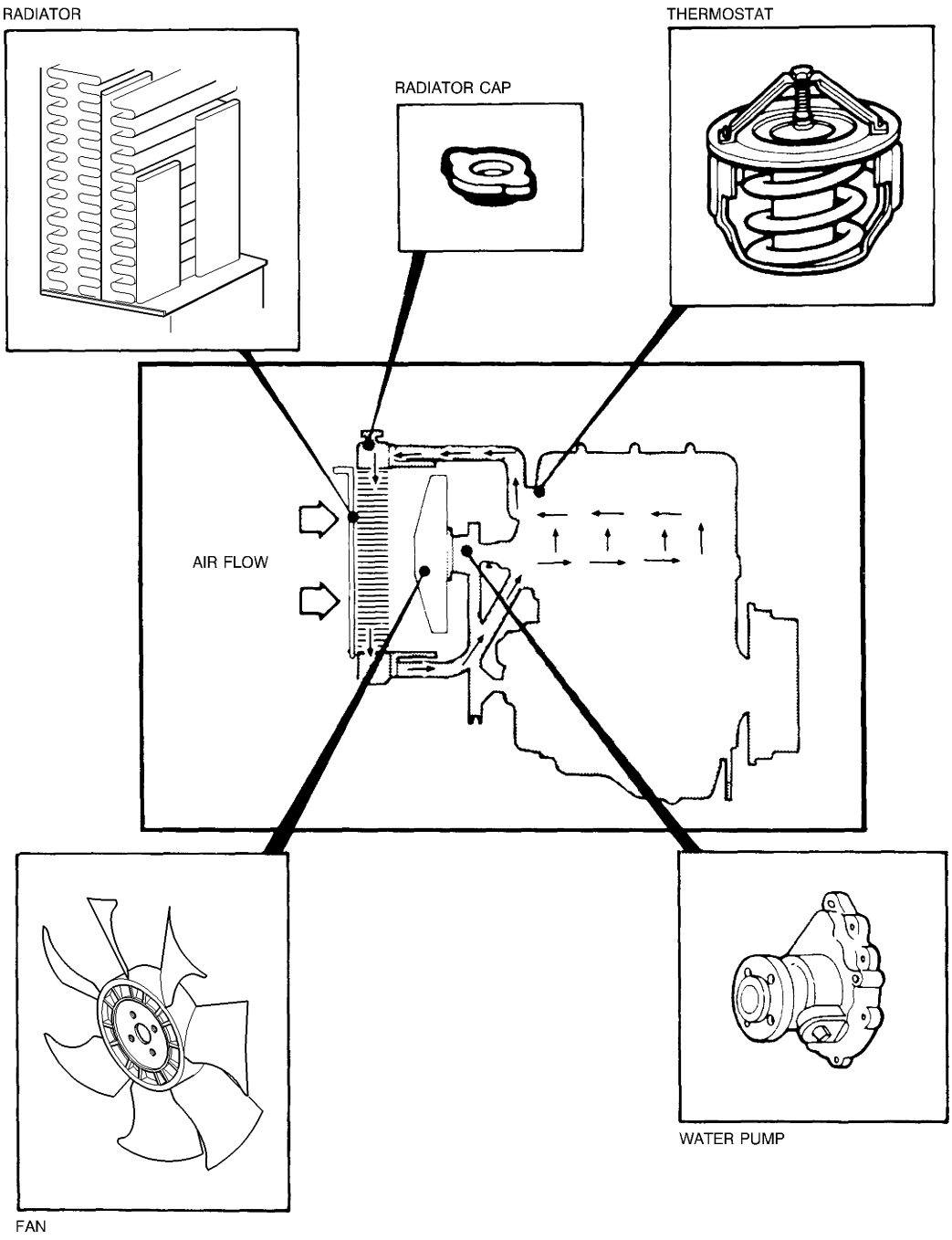

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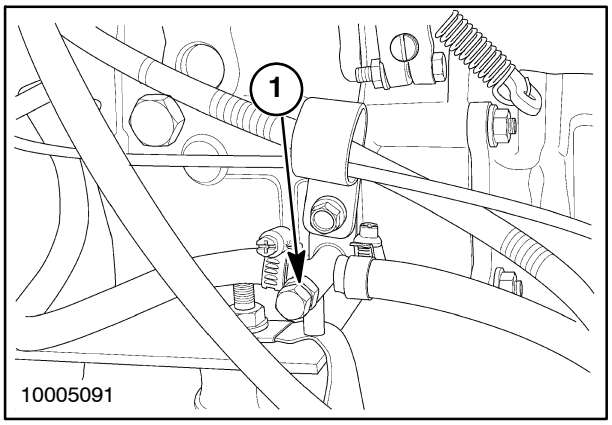
11. Be sure the radiator petcock, 1, is closed and fill the radiator with a 50/50 mixture coolant and water. Use the chart below for cooling system capacity.



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Tractor Model	MC22	MC28	MC35
Cooling System Capacity	4.2 L (4.4 qt)	5.1 L (5.3 qt)	5.3 L (5.6 qt)

12. Connect the negative (–) battery cable from the battery.

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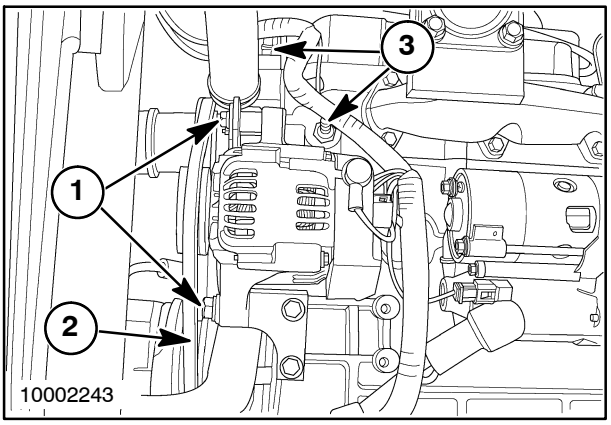
WATER PUMP – MC22

Removal

1. Remove the radiator as described previously in this section.
2. Loosen the alternator mounting bolts, 1, and remove the fan belt, 2, from the tractor.
3. Disconnect the wiring harness leads, 3, from the coolant temperature switch and the coolant temperature sensor.



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SECTION 10 – ENGINE AND FUEL SYSTEMS

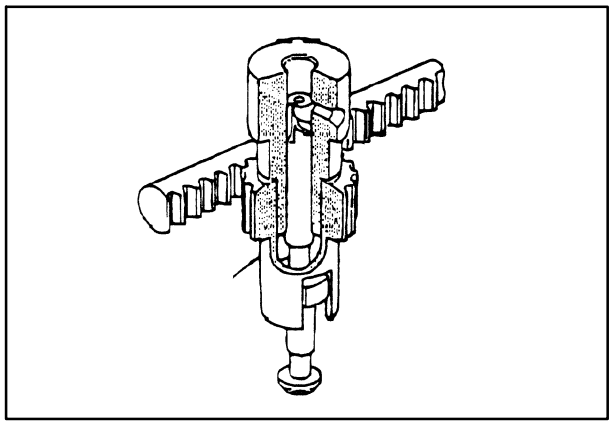
Chapter 2 – Fuel Systems

CONTENTS

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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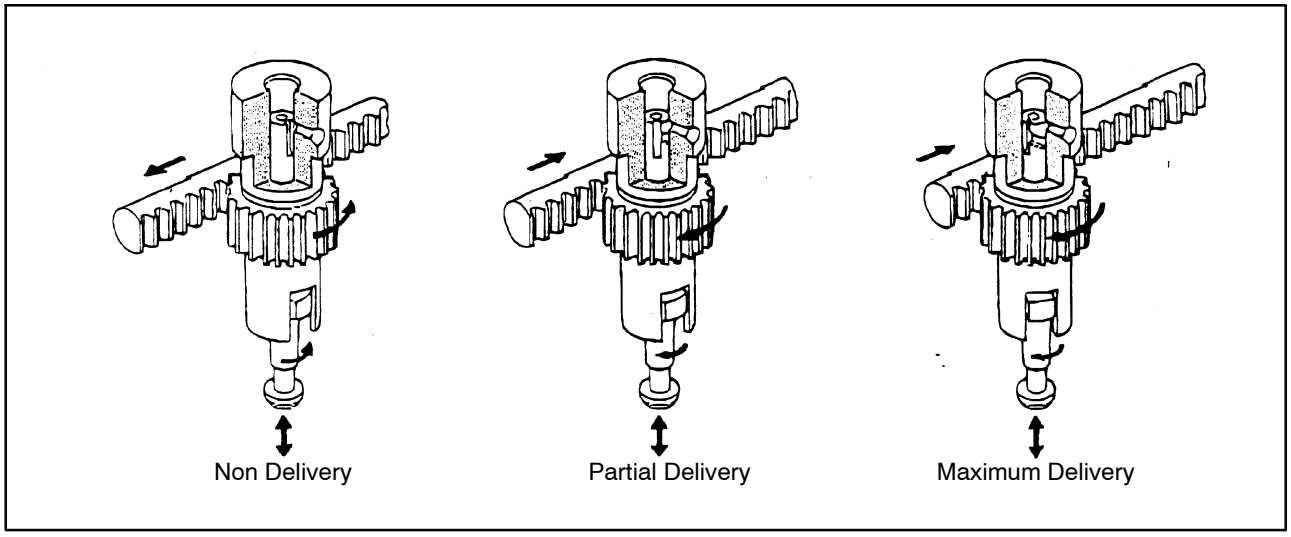

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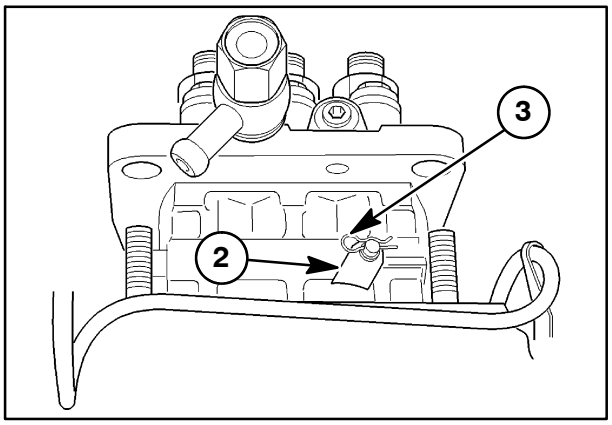
4. Remove the injection pump mounting nuts and bolts. Raise the pump and remove the spring pin, 3, and separate the governor link, 2, from the pump control rack, 1, Figure 25.
5. Remove the injection pump.

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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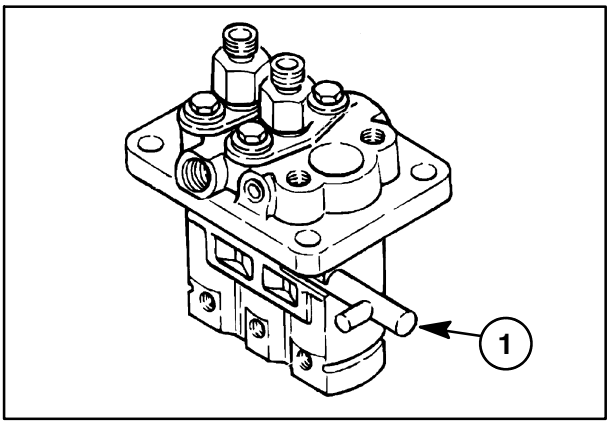
Repair

If the tractor is still within the New Holland warranty period, the pump should be replaced with a new assembly from New Holland Service Parts.

If the tractor is outside the warranty period, the pump should be repaired by an authorized Zexel diesel fuel injection repair center.



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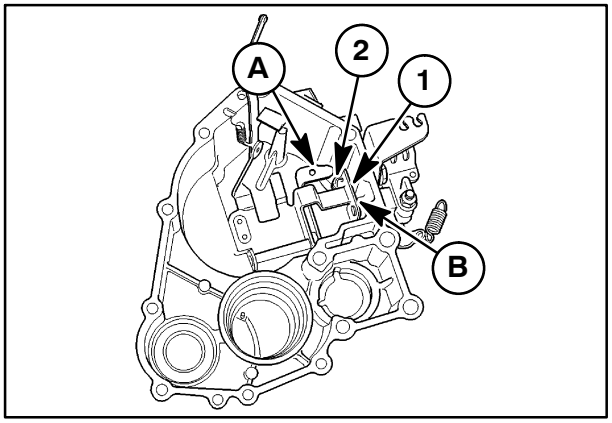
DESCRIPTION AND OPERATION – GOVERNOR

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,” discussed later in this section.

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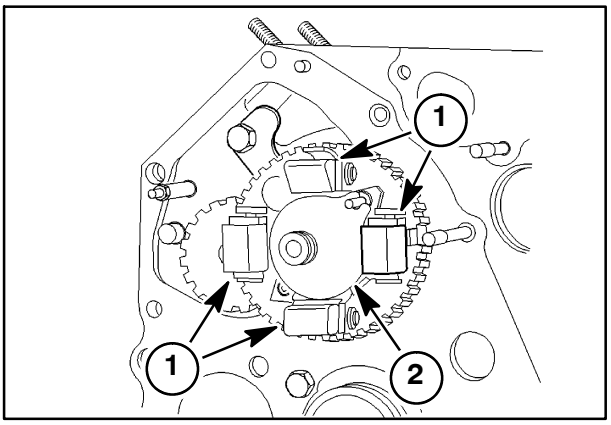
As engine speed increases the four governor weights, 1, pivot outward and push on the slider cone, 2. The weights and slider cone are located on the end of the camshaft.



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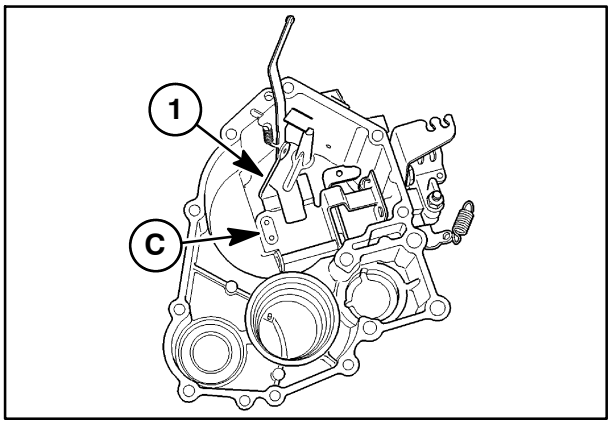
The slider cone, 2, (Figure 47) contacts the governor linkage arm, 1, at contact pad, C. As the cone moves forward it pushes the linkage arm, 1, forward, which is connected to the injection pump rack assembly. When the injection pump rack moves forward the fuel delivery is decreased and the engine speed decreases.



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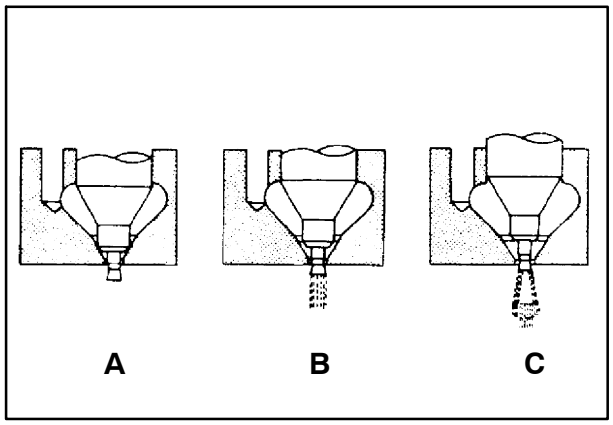
The fuel, pressurized by the injection pump, lifts the needle valve off the seat against the action of the spring pressure, B. The fuel is then forced, in the atomizing state, through the 1 mm (0.039″) orifice in the nozzle tip, C. When pressure from the injection pump drops, the needle valve snaps back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



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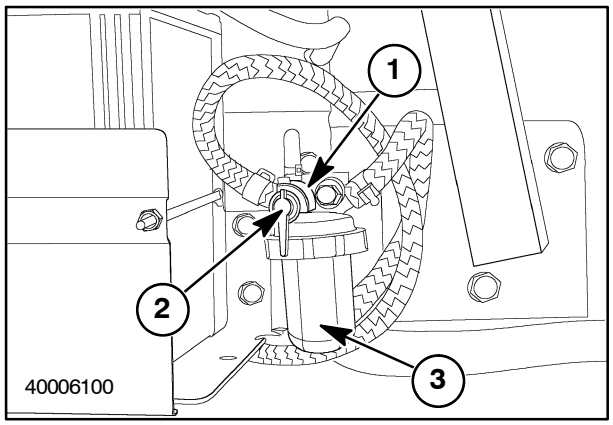
A. Nozzle closed
B. Nozzle initial opening
C. Nozzle fully opened

FUEL FILTER AND SHUTOFF VALVE

All MC model tractors are equipped with an inline fuel filter, 1, to remove foreign particles from the fuel. This prevents clogging and smooth operation of the tractor fuel system and engine. The body of the fuel filter housing is equipped with a shutoff valve, 2, which prevents flow of fuel to the engine when in the “OFF” position. The fuel filter bowl, 3, should be emptied after every 100 hours of use and the fuel filter should be changed after the first 50 hours of use and every 200 hours thereafter.



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REAR TO FRONT AXLE RATIO

IMPORTANT: *On tractors equipped with FWD (Front Wheel Drive) the front to rear axle ratio (1.18 to 1, with and acceptable range of 1.15 – 1.21), is critical and must be maintained for safe and efficient use of the tractor. This ratio applies to all available tire options. Following is a list of problems that may occur if the front to rear axle ratio is not maintained:*

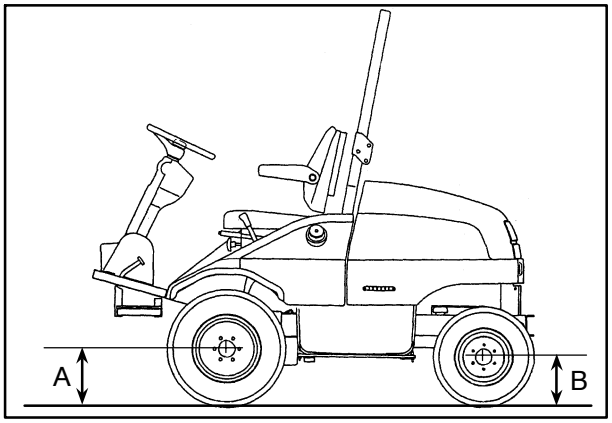
- Engine will lug down or stall when operating on hard surfaces.
- The front wheel drive lever will not remain in the engaged position, or is difficult to disengage.
- Failure of the driveline gears.
- Failure of the front axle, ring and pinion gears.
- Premature tire wear.

To calculate the front to rear axle ratio, use method 1 or method 2.

Method 1:

1. Obtain a measurement from the center of the front axle to the ground (Distance A), and center of the rear axle to the ground (Distance B).
2. Divide Distance A by Distance B to calculate the front to rear axle ratio. (“A” ÷ “B” = Front to rear ratio).
3. To change the front to rear ratio, increase or decrease the tire inflation pressure.

NOTE: *Do not exceed the tire inflation pressures recommended in the Operator’s Manual. Consult the Operator’s Manual for the available tire sizes for a specific tractor.*

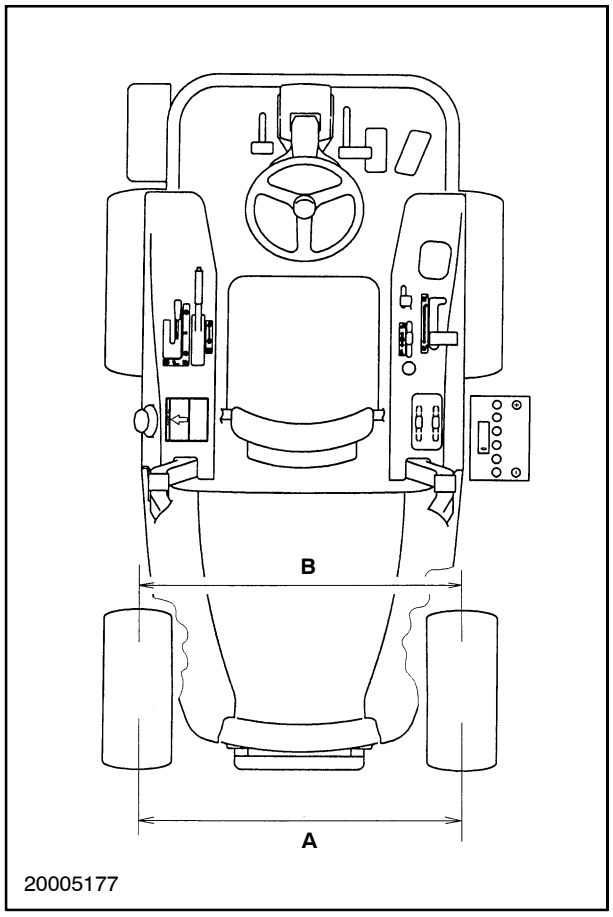


1

ADJUSTMENT

REAR WHEEL TOE-IN

It is possible to adjust the toe-in of the rear wheels by adjusting the length of the tie rod. This is to ensure the proper operation of the rear axle and the tractor tracks and steers properly. The toe on the MC is factory set to 5 mm (0.200 in.) of toe-in and should not need adjusted unless the tie rod is disassembled. Toe is figured by finding the distance, “A”, and subtracting the distance, “B”, from distance “A”.



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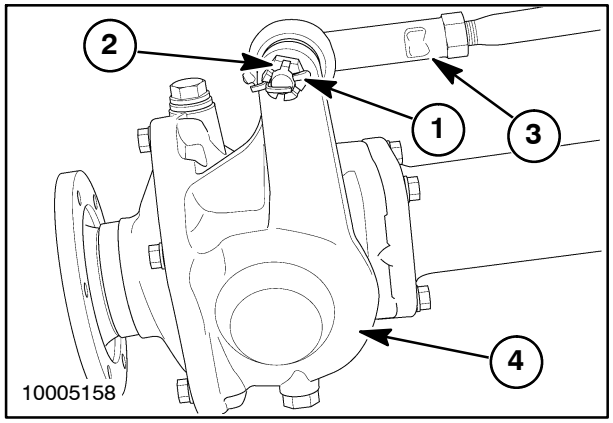
To adjust the length of the tie rod, proceed as follows:

8. Measure the amount of toe on the rear axle before adjustment. Compare the measurement with the factory preset 5 mm (0.200 in.) of toe-in. The difference of the actual toe and factory preset toe will be the amount of adjustment required.
9. Remove the cotter pin, 1, and retaining nut, 2, from one end of the tie rod. Disconnect the tie rod from the rear axle.
10. Loosen the nut, 3, locking the tie rod end, 4, into place.
11. Move the tie rod end the amount figured from step one.
12. Tighten the nut, 3, that locks the tie rod end, 4, into place.
13. Install the tie rod back onto the rear axle and secure the tie rod with the retaining nut, 2. Torque the nut to 74 - 94 N·m (55 - 69 ft. lbs.). Install the cotter pin, 1, onto the tie rod end.
14. Check the toe to ensure proper adjustment.



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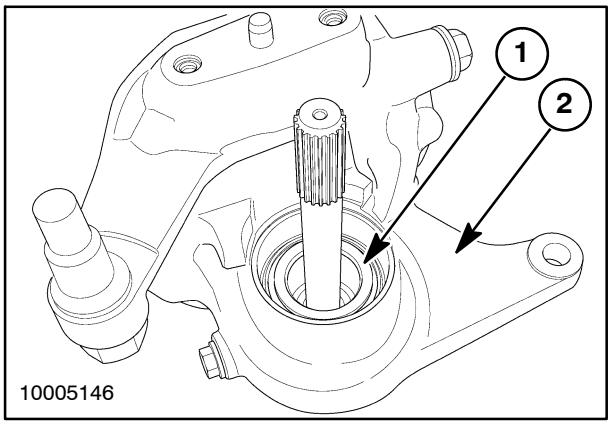
4. Install the bearing, 1, into the drop box housing, 2.



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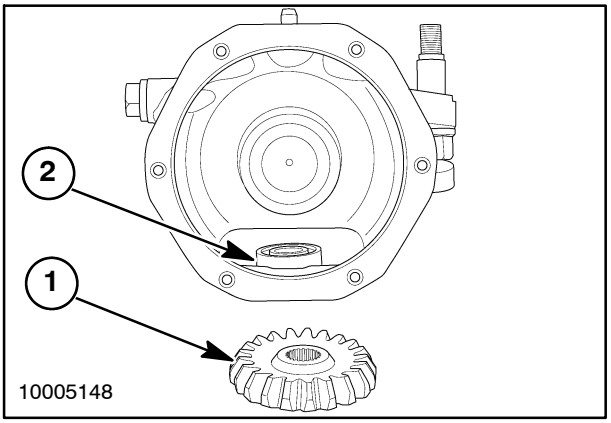
5. Place the bearing, 2, and final pinion gear, 1, into the drop box housing.



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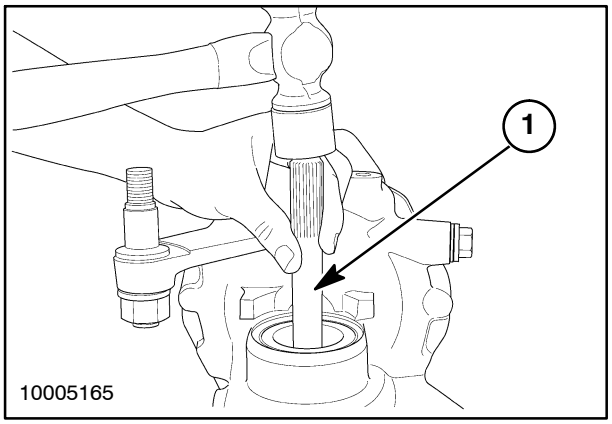
NOTE: *Install the end of the pinion driveshaft with shorter splines into the drop box.*

6. Use a suitable hammer to install the pinion driveshaft, 1, into the final pinion gear and bearing. Be sure that the drive shaft is properly seated in the final pinion gear and bearing.



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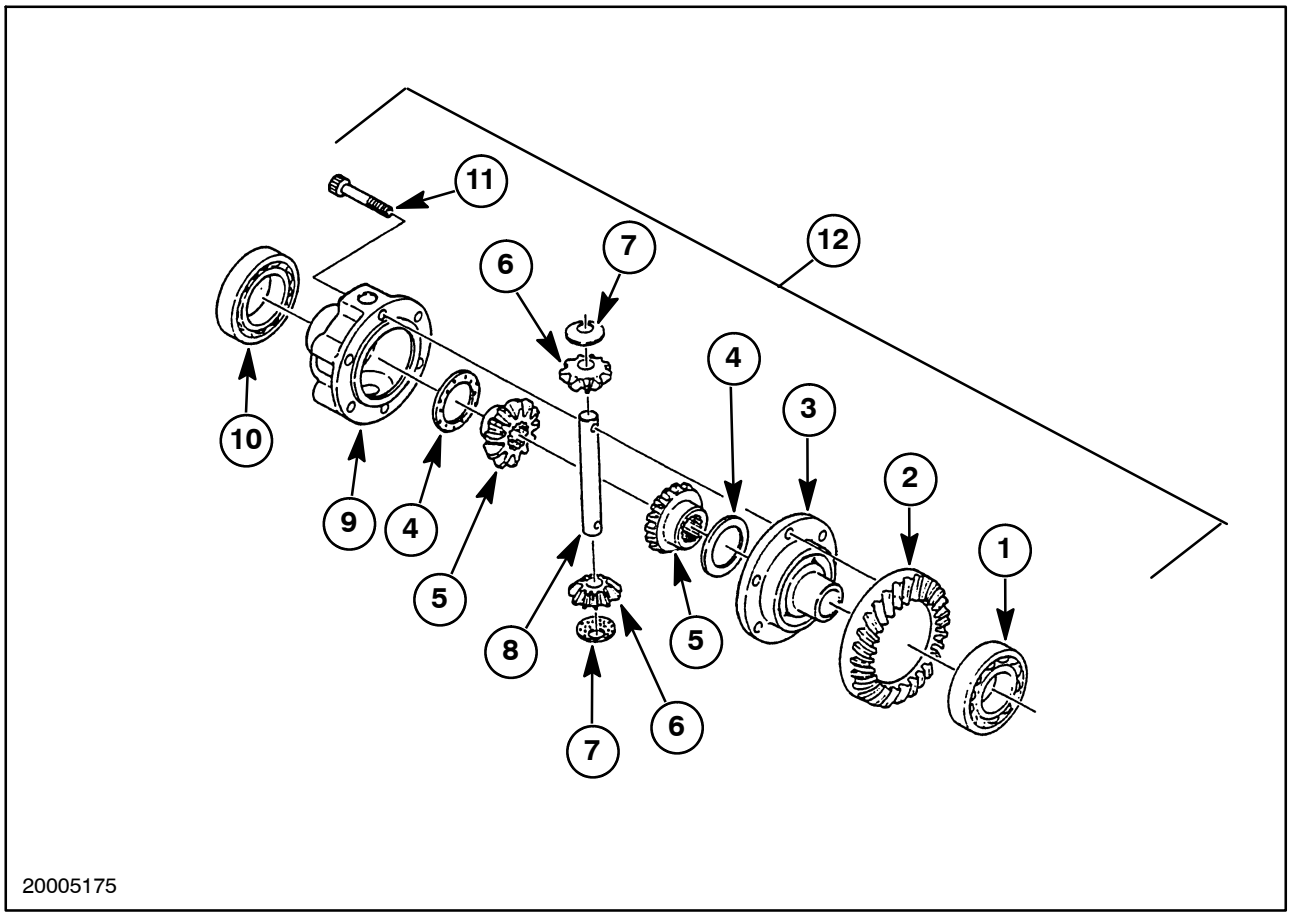

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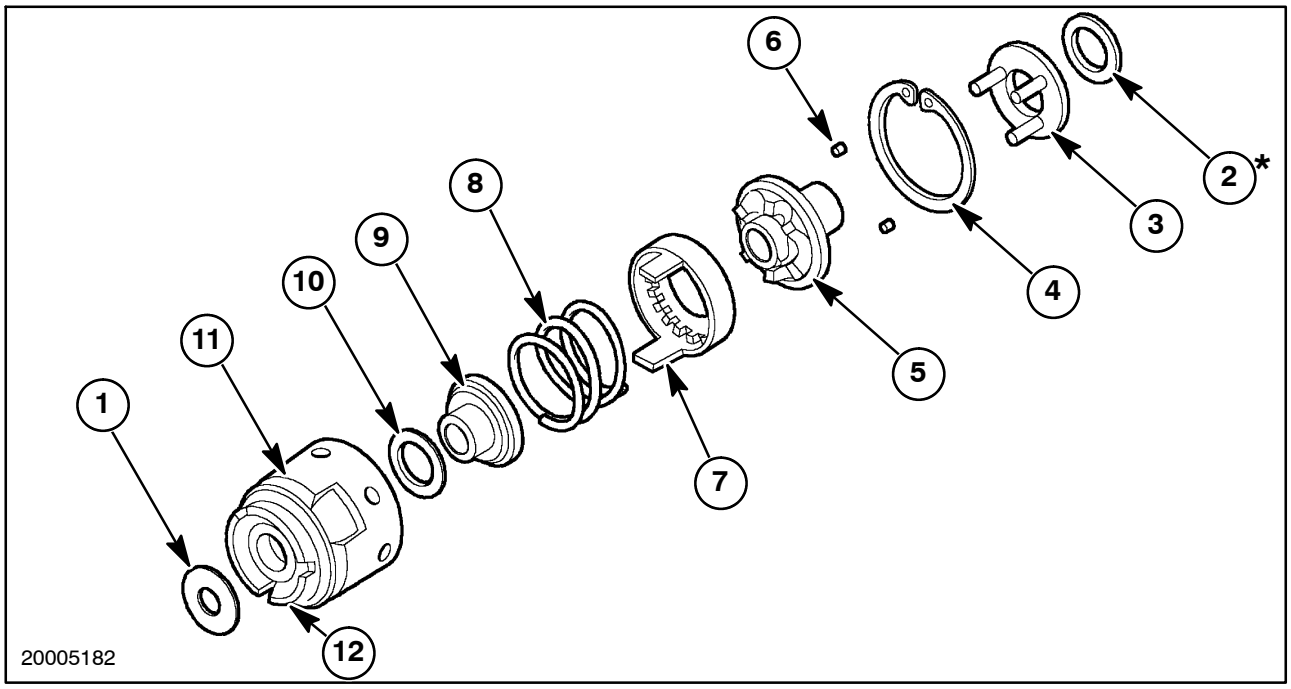
1. Bearing
2. Ring Gear
3. Side Cover
4. Thrust Washer
5. Side Pinion Gear
6. Spider Gear
7. Thrust Washer
8. Pinion Shaft
9. Carrier
10. Bearing
11. Bolt
12. Differential Assembly

NOTE: *Be sure not to lose any parts of the rear differential when removing the six bolts from the differential.*

9. Remove the six bolts, 11, which hold the rear differential assembly, 12, together. Heat may need to be applied to the bolts in order to remove them from the differential assembly.
10. Remove the ring gear, 2, from the side cover, 3.
11. Remove the shaft, 8, from the carrier, 9.
12. Separate the side cover, 3, from the carrier, 9.
13. The thrust washers, 4, 7, spider gears, 6, and the side pinion gears, 5, will be free to remove from the carrier, 9.



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1. Thrust Washer (Thin) 2.46 mm (0.097″)
2. Thrust Washer* (Thick) 4.40 mm (0.174″)
3. Locking Sheave
4. Snap Ring
5. Drive Cam
6. Keeper Pins
7. Center Cam
8. Compression Spring
9. Driven Cam
10. Thrust Washer
11. Clutch Housing
12. Friction Brake

**Removed on later production or replacement clutch assembly.*

NOTE: *If two way (Sensitrack ™) clutch was replaced previously thrust washer, 2, will not be present. Locking sheave, 3, has been changed combining the two pieces into one.*

Disassembly

1. Remove the locking sheave, 3, from the drive cam, 5.
2. Remove the snap ring, 4, that retains the drive cam, 5, in the clutch housing, 11.
3. Remove the two (2) keeper pins, 6, from the clutch housing, 11.
4. Remove the drive cam, 5, from the clutch housing.
5. Remove the center cam, 7, compression spring, 8, and the driven cam, 9, and the thrust washer, 10, from the clutch housing.

NOTE: *The clutch housing has four plastic cams that are held on by a spring and is used as a clutch friction brake, 12. The clutch brake is not serviceable and should not be removed.*

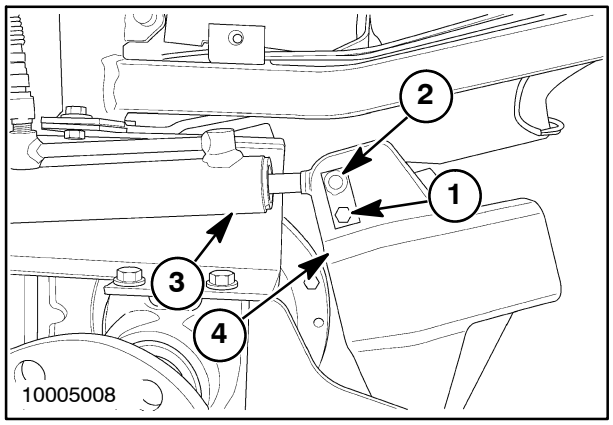
Inspection

1. Clean all parts in a suitable solvent and allow to air dry. Apply a thin coat of Permatex Gasket Eliminator 518 to the mating surfaces of the front and rear transmission. Thoroughly removing old sealant.
2. Inspect the drive cam, driven cam, and center cam mating areas for damage or excessive wear. Replace parts found to have damage or excessive wear.
3. Inspect the compression spring for distortion. Replace as necessary.
4. Inspect the thrust washers for damage or excessive wear. Replace the thrust washers as necessary.
5. Inspect the clutch housing for damage or excessive wear. Replace the clutch as necessary.
6. Inspect the locking sheave and the engagement fork blocks for pitting or nicks. Replace the components if flaws cannot be removed with fine emery cloth.

SPECIFICATIONS

Clearance Between Differential Pinion Gears and Shaft	0.1 mm (.004 in.) Std.
	0.5 mm (.020 in.) Max.
Differential Pinion Gear Thrust Washer Thickness	1.2 mm (.047 in.)
	0.9 mm (.035 in.)
Differential Gear Thrust Washer Thickness (Side Gears)	2.0 mm (.079 in.) Std.
	1.7 mm (.067 in.) Min.
Drive Pinion Preload	196 N [20 Kg] (44 lbs.)
Drive Pinion and Ring Gear Backlash	0.1 – 0.2 mm (0.0039 – 0.0079 in.)
	0.4 mm (0.0157 in.) Max.
Differential Side Gear to Pinion Gear Backlash	0.1 – 0.15 mm (0.004-0.006 in.)
	0.3 mm (0.012 in.) Max.
Clearance Between Range Sliding Gear and Shifter Fork	0.2-0.4 mm (0.008 – 0.016 in.)
	1.0 mm (0.0394 in.) Max.

9. Loosen and remove the retaining bolt, 1, and remove the retainer pin, 2, from the rod end of the lift cylinder, 3. Disconnect the lift cylinder, 3, from the lift bracket, 4. Repeat for the opposite side.



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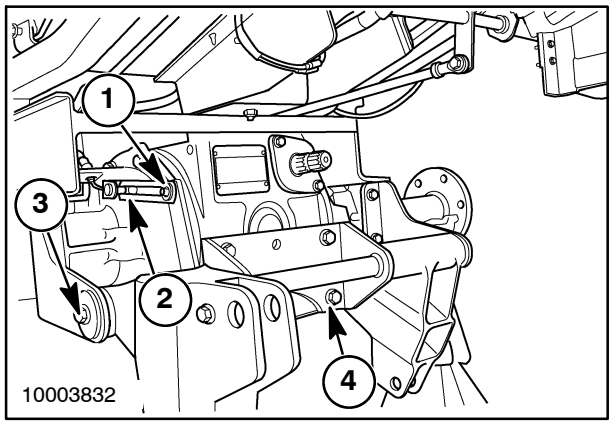
10. Remove the cotter pin and washer from the retaining pin, 1, for the PTO safety lockout bracket, 2.
11. Loosen, but do not remove, the bolts, 3, which secure the left and right lift arms to the lift arm assembly, 4.



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RANGE GEAR AND COUNTERSHAFT

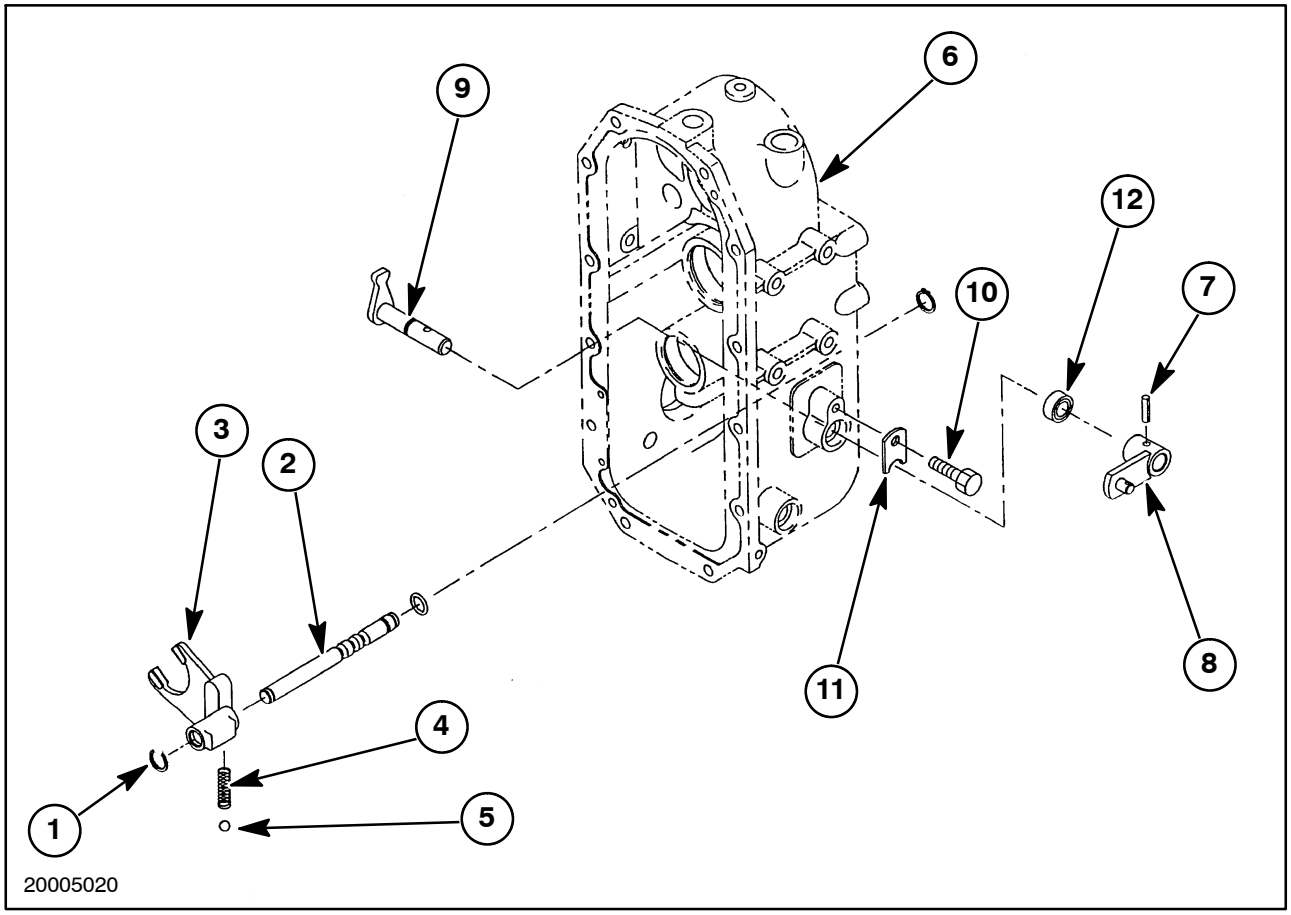
Removal

1. Remove the e-ring, 1, from the range shift rail, 2.

⚠ WARNING ⚠

Place a shop towel under the detent hole in the range shift fork, 3, to restrain the detent spring, 4, and ball, 5, from being expelled with considerable force, when the range shift rail, 2, is removed from the shift fork, 3, and the rear transmission housing.

2. Gently tap the range shift rail, 2, from the rear transmission housing, 6, and out of the range shift fork, 3.
3. Drive the roll pin, 7,out of the change lever, 8, and out of the change shaft, 9. Remove the change lever, 8.
4. Loosen and remove the retaining bolt, 10, and the lockdown plate, 11.
5. Remove the change shaft, 9, from the rear transmission housing, 6.
6. Remove and discard the change shaft seal, 12, from the rear transmission housing, 6.



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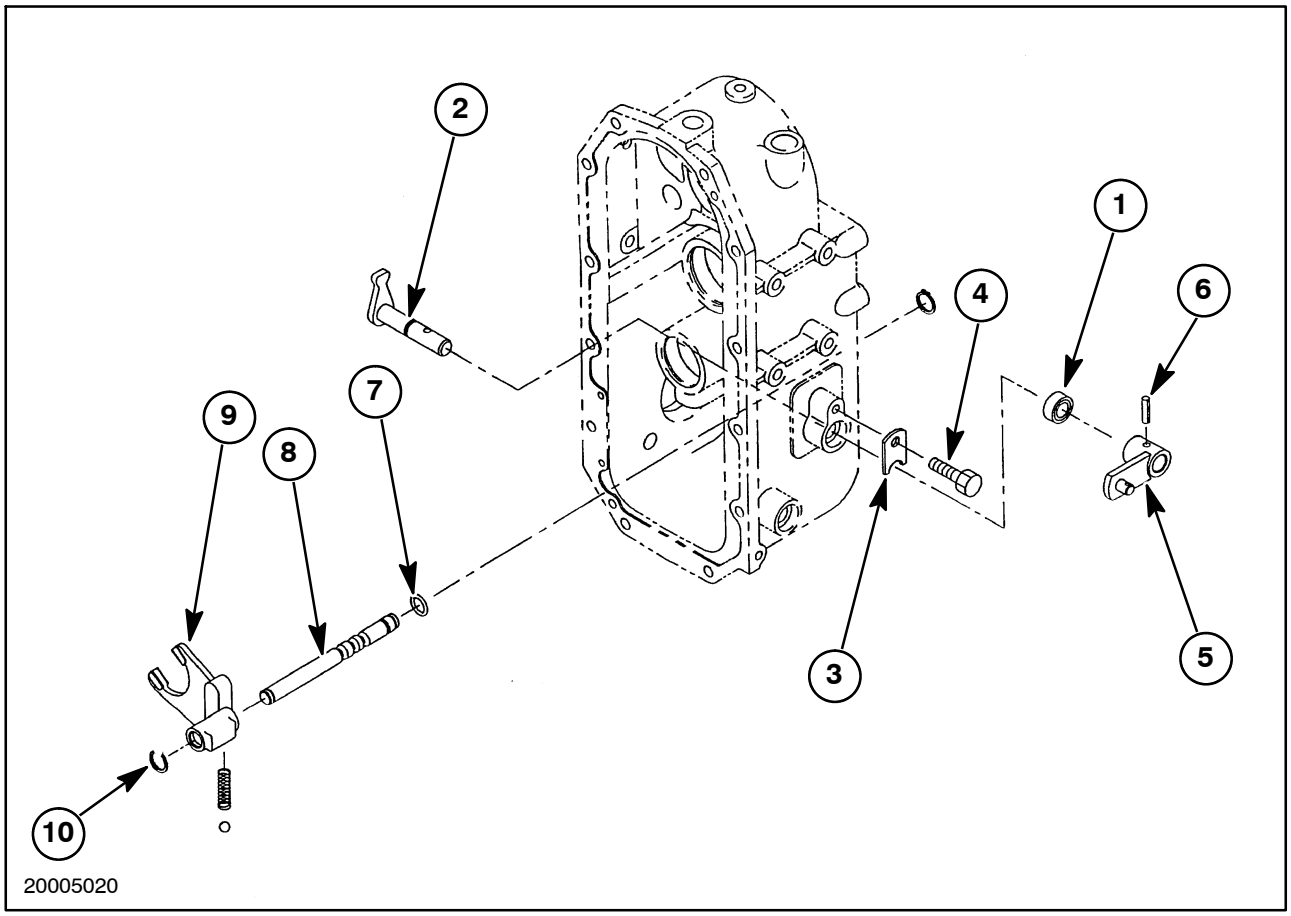
12. Install the shift fork, 9, into the rear transmission cover, aligning the shift arm, 2, with the slots on the shift fork, 9.
13. Install the shift rail, 8, through the rear transmission cover, and secure with a new e-ring, 10.

NOTE: *Recover special tool #FNH01580 from inside rear transmission cover.*



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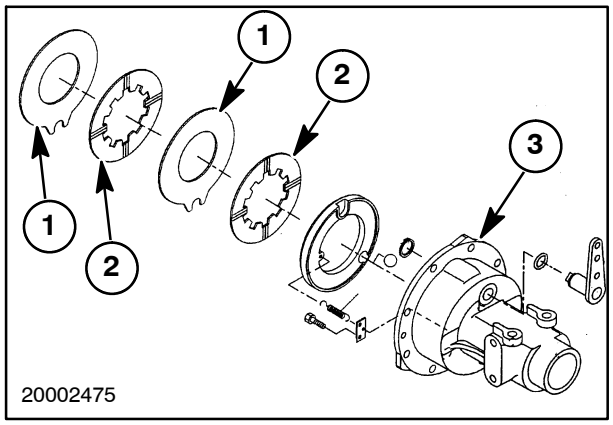
Disassembly

1. Remove the stators, 1, and the fiber brake discs, 2, from the axle housing, 3.



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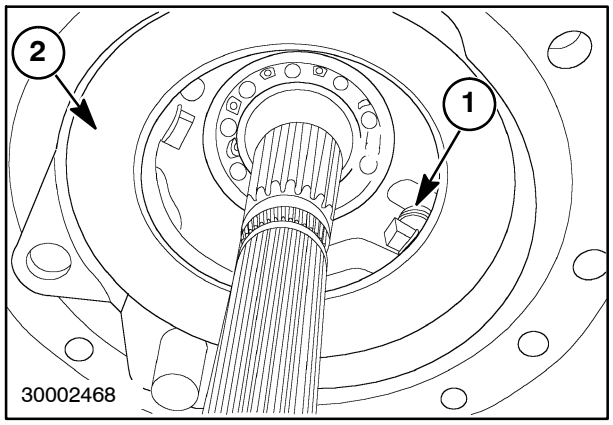
2. Disconnect the brake springs, 1, from the brake actuator plate, 2.



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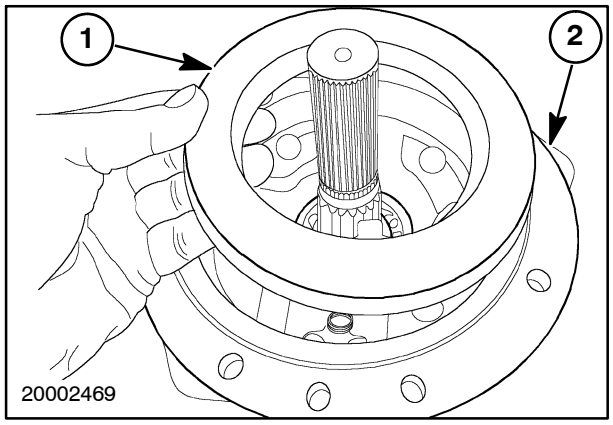
3. Remove the brake actuator plate, 1, from the axle housing, 2.



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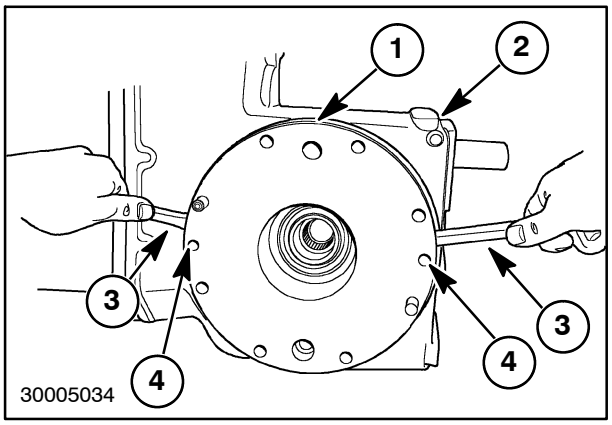
NOTE: *Support the differential and ring gear assembly when removing the right side bearing carrier.*

6. Remove the right differential bearing carrier, 1, from the differential housing, 2, using two pry bars, 3, placed at the locating pins, 4. Pry carefully to avoid damaging the mating surfaces of the bearing carrier, 1, and the differential housing, 2.



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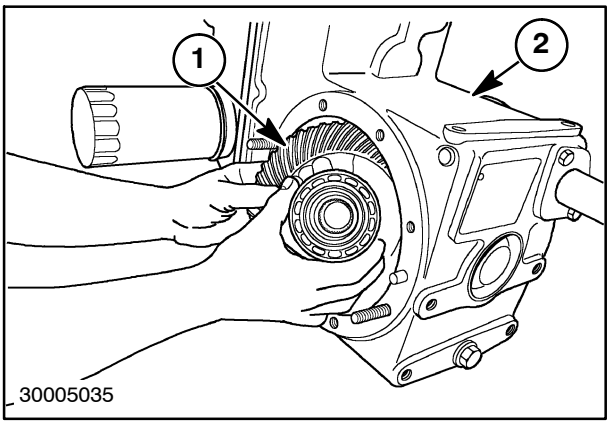
7. Remove the differential and ring gear assembly, 1, from the differential housing, 2.



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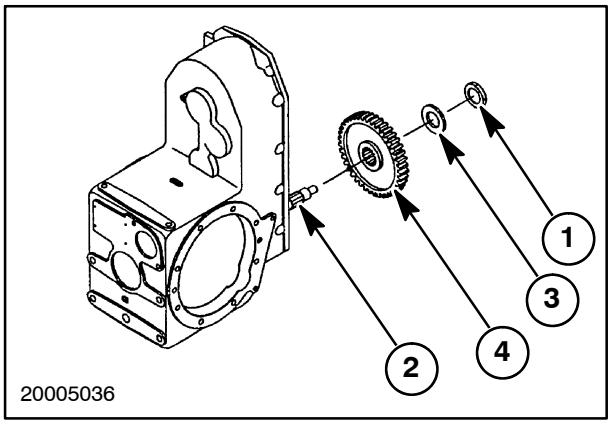
8. Remove the pinion shaft retaining nut, 1, from the pinion shaft, 2.
9. Remove the washer, 3, and the fixed gear, 4, from the pinion shaft, 2.



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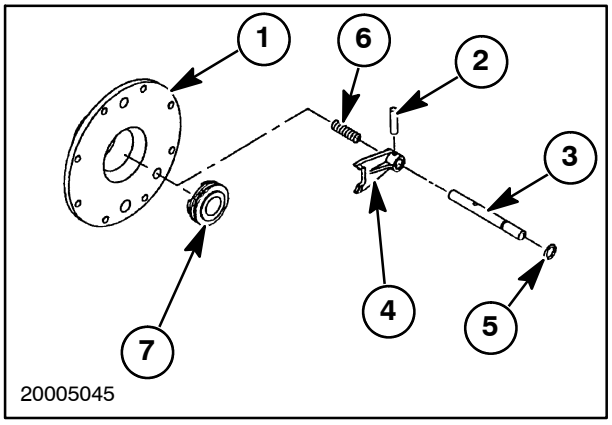
DIFFERENTIAL LOCK

Removal/Disassembly

1. Remove the left side axle housing from the differential housing.
2. Remove the differential bearing carrier, 1, from the differential housing.
3. Drive the roll pin, 2, from the differential lock shaft, 3.
4. Pull the differential lock shaft, 3, from the shift fork, 4, and the bearing carrier, 1.
5. Remove and discard the O ring, 5, from the differential lock shaft, 3.
6. Remove the spring, 6, from the bearing carrier, 1.
7. Remove the shift fork, 4, from the bearing carrier, 1.
8. Remove the differential lock clutch, 7, from the bearing carrier, 1.



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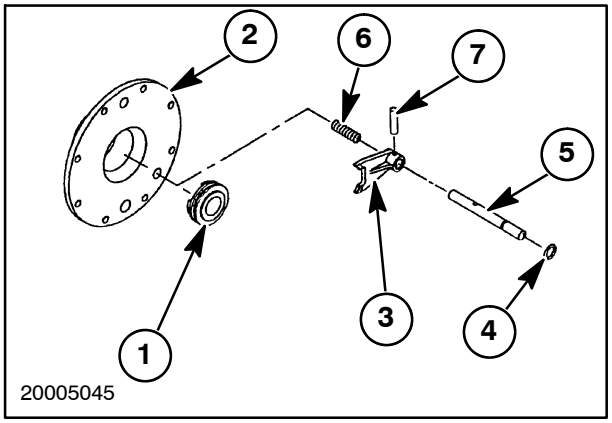
Inspection

1. Wash all parts in a suitable solvent and allow to air dry.
2. Inspect the parts for excessive wear or damage. Repair or replace as necessary.

Assembly/Installation

1. Position the differential lock clutch, 1, in the bearing carrier, 2.
2. Install the shift fork, 3, onto the differential lock clutch, 1.
3. Lubricate a new O ring, 4, and install on the differential lock shaft, 5.
4. Install the differential lock shaft, 5, through the bearing carrier, 2, the shift fork, 3, and the spring, 6.
5. Place the assembly in a vise or a press, and compress the differential lock shaft, 5, to align the roll pin holes in the lock shaft and the shift fork, 3.
6. Install a new roll pin, 7, and remove the assembly from the press or the vise.
7. Install the assembled bearing carrier onto the differential housing.
8. Install the axle assembly onto the differential housing.



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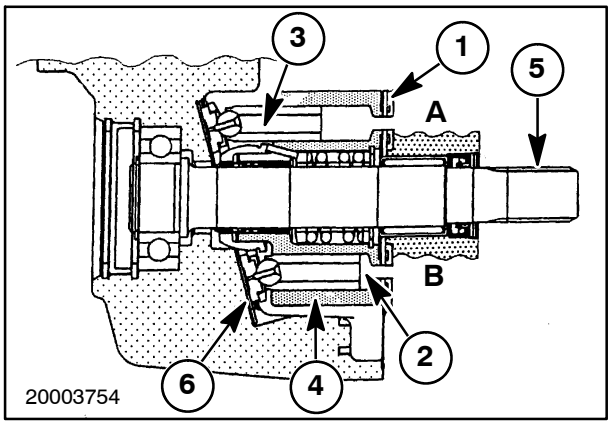
FIXED DISPLACEMENT MOTOR OPERATION

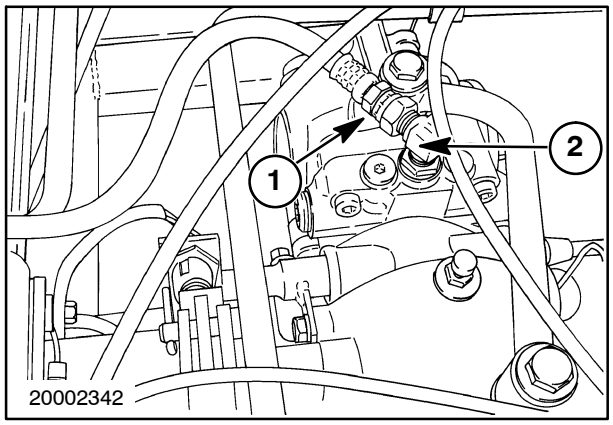
Hydraulic fluid flow from the piston pump is forced into the cylinders in position “A” through the valve plate, 1, and the inlet/outlet ports, 2. The pressure exerted by the hydraulic fluid on the ends of the pistons, 3, causes the cylinder block, 4, and pistons to rotate. The cylinder block is splined to the hydraulic pump output shaft, 5, which drives the transmission gearbox. Hydraulic fluid exits the cylinder block through the inlet/outlet ports at position “B”. Since the angle that the piston rotates on is not able to change, the displacement of the pump does not change. The motor does not have a swash plate and rides on a thrust washer, 6, which rests on the inside of the hydrostatic unit housing.



8

CHARGE PRESSURE RELIEF

1. Disconnect the hydrostatic transmission (HST) supply hose, 1, and 90° fitting, 2, from the top of the transmission.



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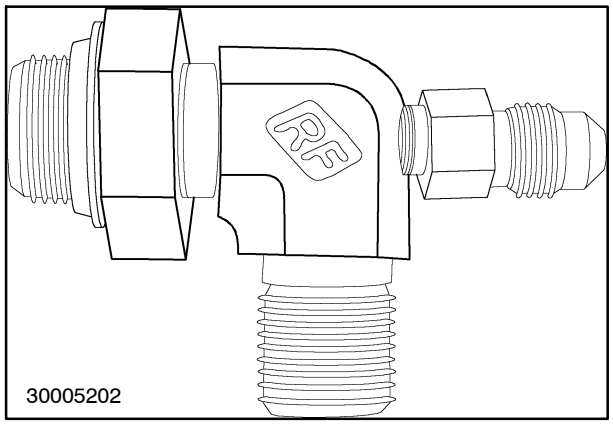
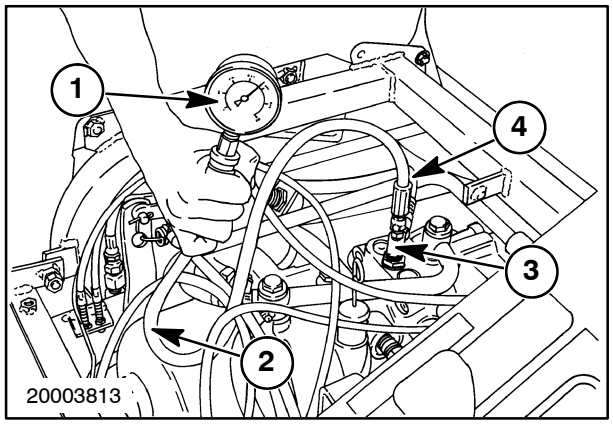
2. Install a “tee” fitting #NH01411 onto the HST supply fitting.



23

3. Connect a 0 – 25 bar (0 – 400 PSI) pressure gauge, 1, and hose, 2, to the “tee” fitting, 3.
4. Connect the hydraulic fluid supply hose, 4, to the “tee” fitting.
5. With the range shift lever in neutral, start the tractor engine
6. Increase the tractor engine speed to full throttle.
7. Observe the pressure gauge. The pressure reading should be approximately 4.9 bar (71.1 PSI). If the charge pressure relief is not as specified, check the Troubleshooting section for possible cause.



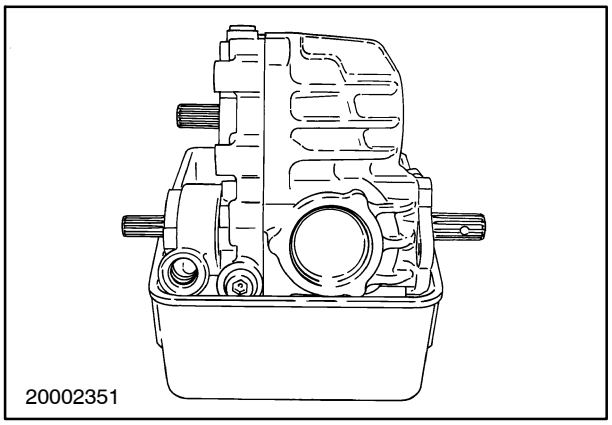
24

Op. 29 218

Disassembly

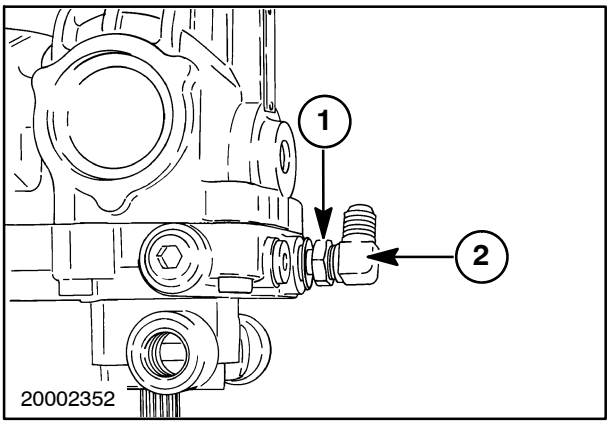
NOTE: *Before disassembling the HST unit, be sure that the work area is clean and free from foreign materials, as contamination will reduce the working life of the HST unit. When handling HST unit components use care not to cause damage to parts and components of the HST unit.*

1. Drain any remaining hydraulic fluid from the HST unit by turning the unit upside down and letting the fluid drain from the return to sump outlet into a suitable container.



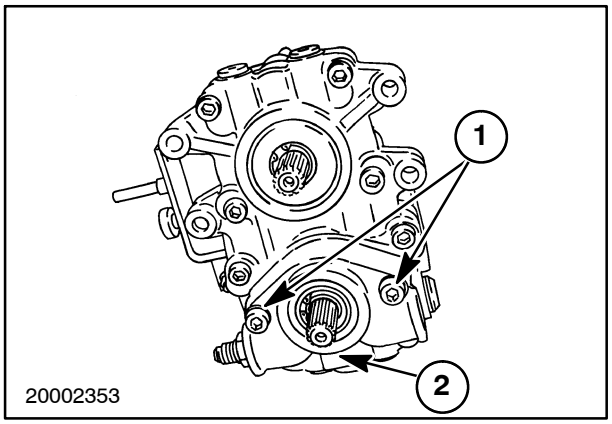
46

2. Loosen the jam nut, 1, from the 90° hose fitting, 2, and remove the fitting from the HST unit.



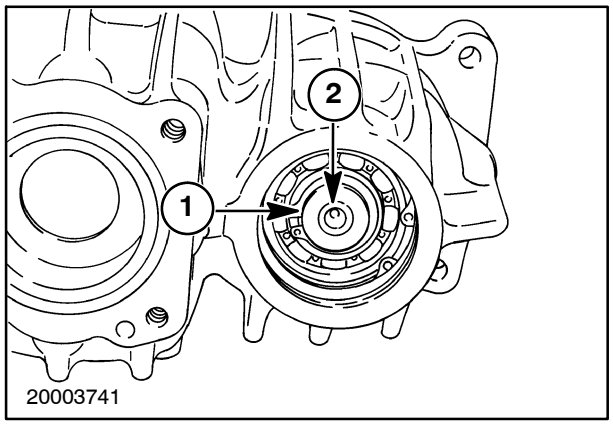
47

3. Remove the two (2) socket cap bolts, 1, that secure the charge pump, 2, to the HST unit. The charge pump can then be removed from the HST.



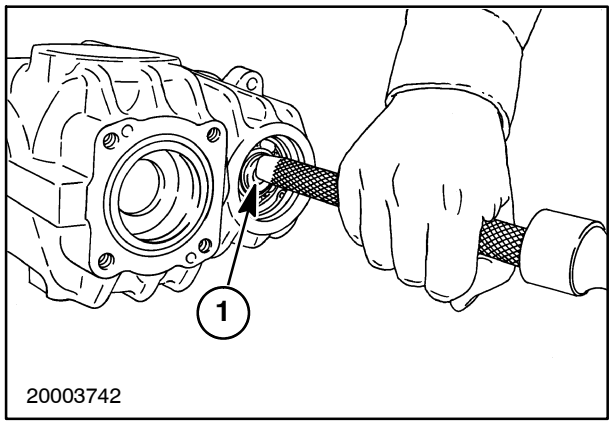
48

38. Use snap ring pliers to remove the small snap ring, 1, from the hydraulic motor output shaft, 2.



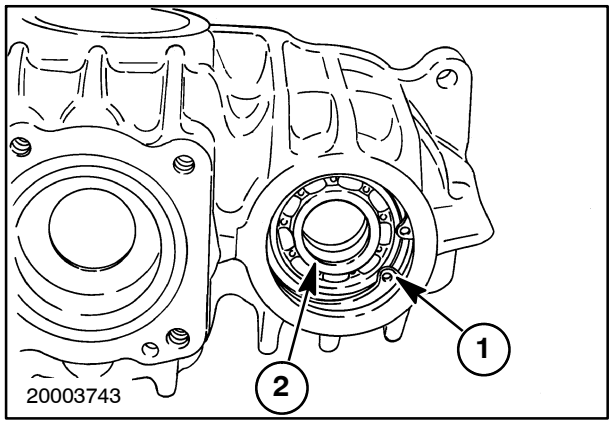
76

39. Use a hammer and suitable drift to tap the output shaft, 1, from the HST housing.



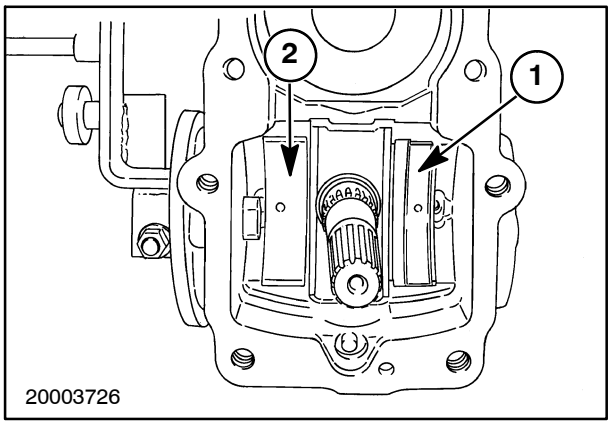
77

40. Use snap ring pliers to remove the snap ring, 1, which retains the output shaft bearing, 2, in the HST housing.



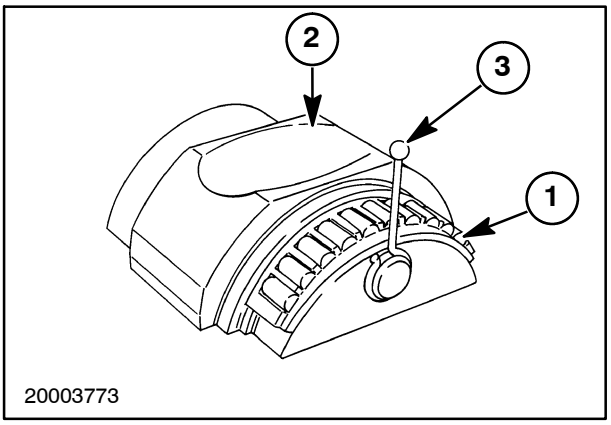
78

18. Install the two (2) swash plate bushings, 1, and, 2, in the HST housing.



103

19. To facilitate assembly, lubricate the swash plate roller bearing, 1, with petroleum jelly, and place the bearing on the swash plate, 2, with the swash bearing locating rod, 3, in the notch of the roller bearing.

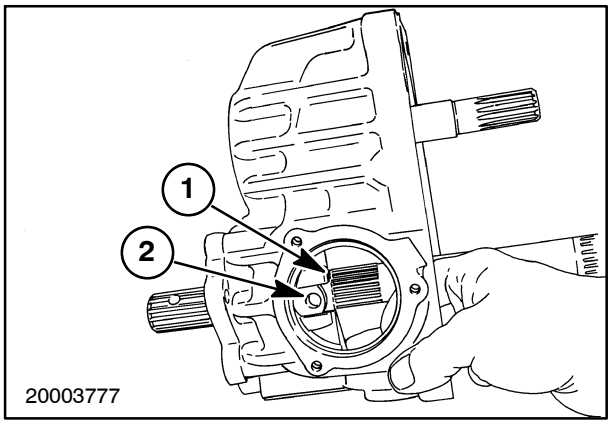


104

20. Carefully place the swash plate assembly, 1, in the HST housing, making sure that the bearing locating rod is in the proper recess of the HST housing.

IMPORTANT: *When installing the swash plate key, be sure that the hole offset is facing to right side of the case.*

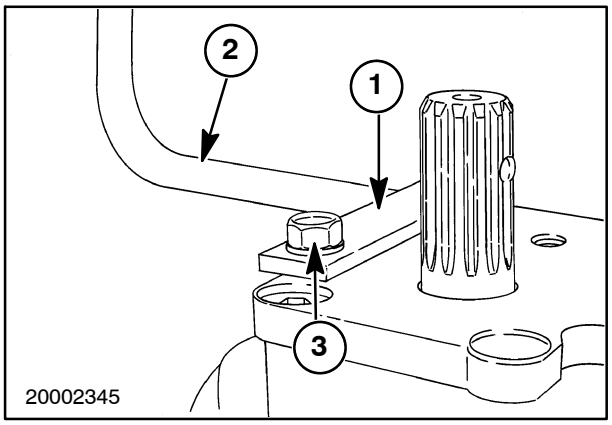
21. While holding the swash plate, install the swash plate key, 2, into the recess of the swash plate, 1.



105

NOTE: *Illustration shows clamp from underneath tractor.*

8. Install the clamp, 1, that holds the hydraulic fluid cooler return line, 2, using the M10x16 retaining bolt, 3.



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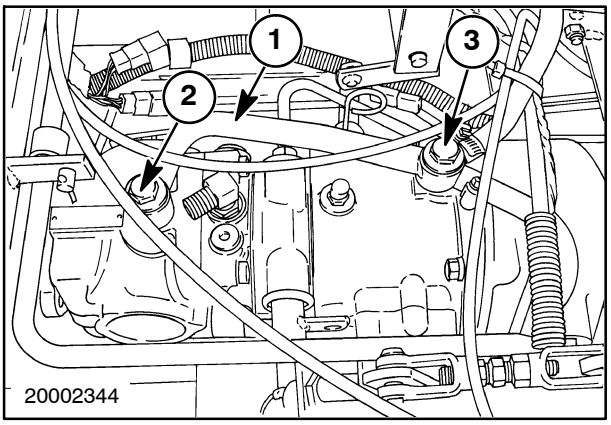
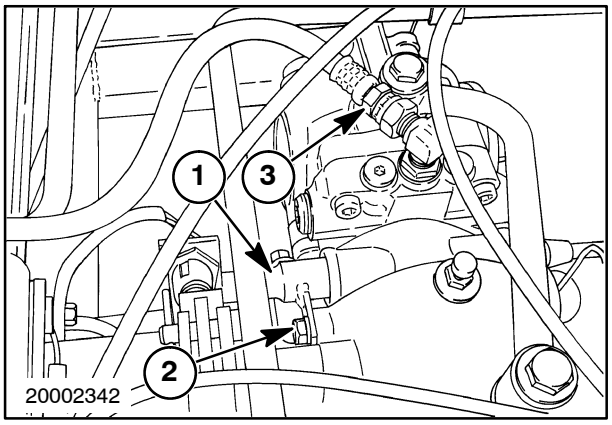
9. Install the HST return to sump line, 1, and secure the line using the banjo bolt, 2. Be sure to use new O rings on the banjo bolt. Tighten the return to sump line banjo bolt, 3, on the gearbox.



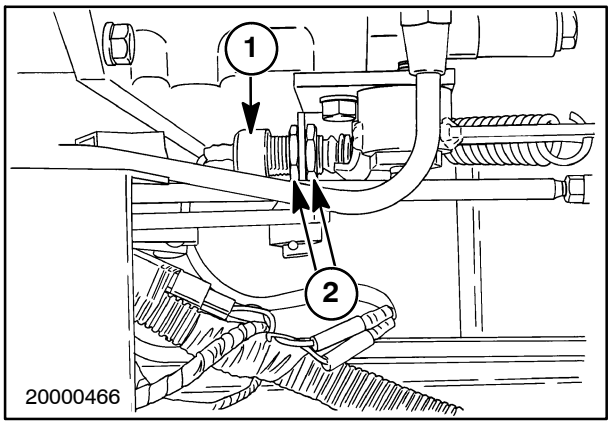
134

10. Replace the O ring on the HST charge pump suction line, 1, and push the line into the HST unit. Secure the line to the HST using the bolt, 2.
11. Connect the HST supply hose, 3, to the top of the transmission.



135

3. To adjust the switch, 1, to the forward or rearward, loosen the switch retaining/adjusting nuts, 2, and move the switch to the desired position.
4. If the switch plunger is not fully released to the "OUT" position (will not start) when the directional pedals are depressed, the switch needs adjusted towards the front of the tractor until the switch plunger is fully released when the directional pedal is depressed.
5. If the switch plunger is not fully depressed to the "IN" position (will start) when the tractor pedals are released (neutral), the switch needs adjusted towards the rear of the tractor until the switch plunger is fully depressed when the tractor pedals are released (neutral).
6. Tighten the retaining/adjusting nuts, 2, when the switch, 1, is moved to the proper position.



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OVERHAUL

Op. 31 220

PTO

NOTE: *The PTO is not serviceable in the tractor. The PTO is located in the front transaxle housing. The transaxle must be removed from the tractor and disassembled to gain access to the PTO for service.*

Removal

Remove hydrostatic transmission. See Section 29 – Hydrostatic Transmission, Removal, for removal procedure

NOTE: *The rear axle must be removed on models equipped with 4WD, remove the driveshaft prior to removal of transaxle.*

Remove rear axle and driveshaft (4WD only). See Section 25 – Rear Axle, Removal, for removal procedure.

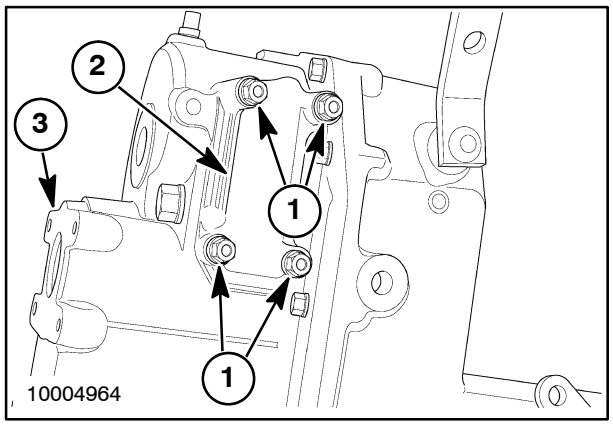
NOTE: *When placing unit on jackstands, be sure to allow enough space under the machine to lower and remove the transaxle.*

Remove the front axle assembly, hydraulic lift arms, control linkage for PTO, range selector, and 4WD from the tractor. See Section 27-Differential, Front Axle for the removal procedure.

REAR TRANSMISSION

Disassembly

1. Loosen and remove the nuts, 1, that secure the side PTO cover, 2, to the rear transmission housing, 3. Remove the cover.

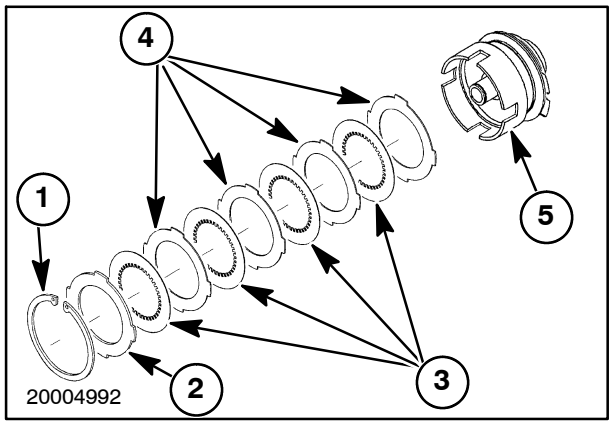


5

PTO CLUTCH

Disassembly

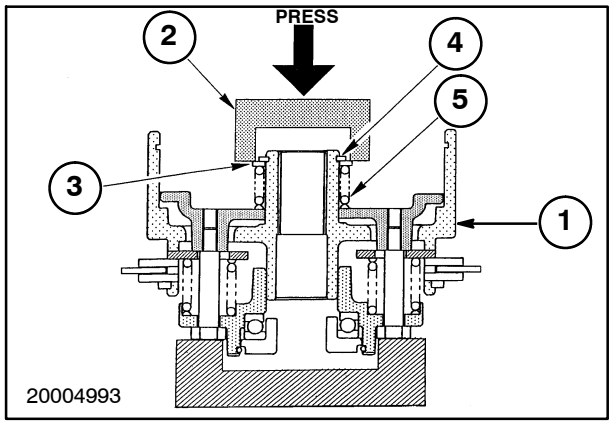
1. Remove the PTO clutch assembly from the PTO input shaft and front transmission case.
2. Remove the retaining ring, 1, the backing ring, 2, the fiber clutch discs, 3, and separator plates, 4, from the clutch housing, 5.



31

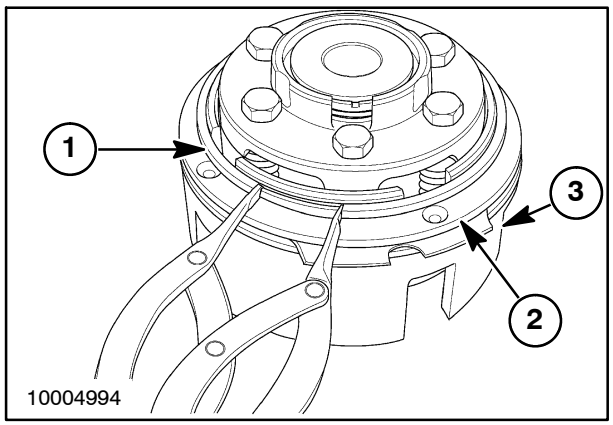
3. Place the clutch housing, 1, in a suitable press.
4. Use the special clutch jig, 2, (Special Tool # NH01413) to press on the washer, 3.
5. With pressure on the washer, 3, remove and discard the retaining ring, 4.
6. Release the pressure on the washer slowly, and remove the washer, 3, and spring, 5.
7. Remove the clutch housing from the press.

NOTE: *Pay attention to the orientation of the brake disc retaining ring for reassembly purposes.*



32

8. Remove the retaining ring, 1, that secures the brake disc assembly, 2, to the clutch housing, 3.



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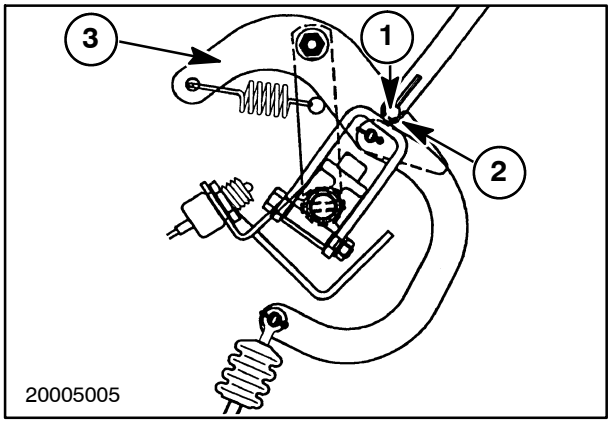
Op. 31 101

AUTOMATIC PTO DISENGAGEMENT SYSTEM

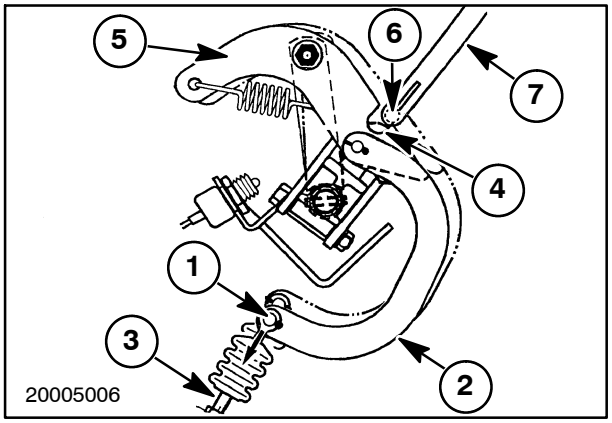
The MC 22, 28, and 35 commercial mower is equipped with an automatic PTO disengagement system, to automatically stop any PTO driven implement when the lift arms are raised higher than the preset height. This section discusses the operation, removal, disassembly, assembly, installation and proper adjustment of the disengagement system.

With the lift arms in the lowered position and the PTO control lever in the “ON” position, the pin, 1, on the control lever engages the slot, 2, on the shift cam, 3. In this position, the PTO is engaged and operating.



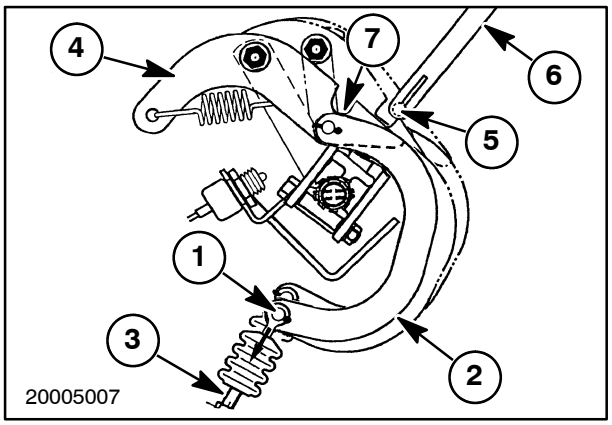
57

With the lift arms raised to just less than the highest position, the pin, 1, on the bell crank, 2, is pulled downward by the disengagement cable, 3, allowing the slot, 4, in the shift cam, 5, to be engaged with the pin, 6, on the control lever, 7. At this point the pin, 6, is still resting on the edge of the slot, 4, in the shift cam, 5, allowing the PTO to be engaged and operating.



58

When the lift arms are raised to the highest position, the pin, 1, on the bell crank, 2, is pulled further downward by the disengagement cable, 3. The shift cam, 4, is pulled down allowing the pin, 5, on the control lever, 6, to exit the slot, 7, in the shift cam, 4, automatically disengaging the PTO and stopping the attached implement.



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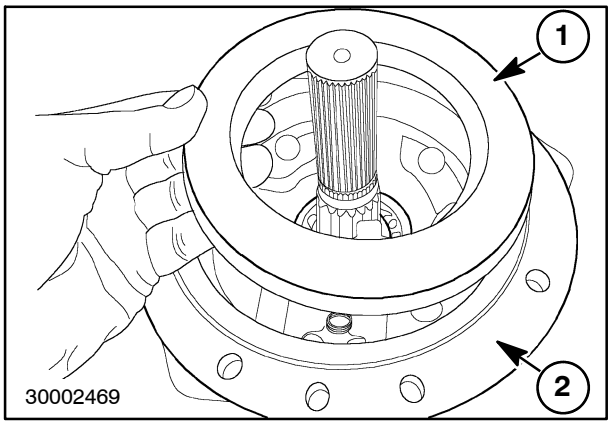
METRIC BOLT TORQUE SPECIFICATIONS

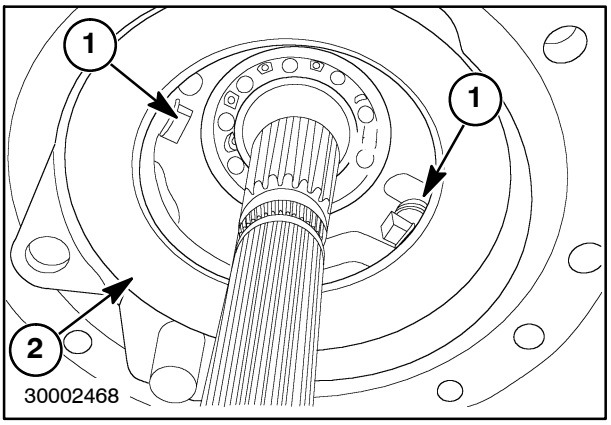
Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Foot-Pounds	Newton Meters	Pitch (mm)	Foot-Pounds	Newton-Meters
M6	4T, 4.8	1.0	3.6-4.3	4.9-6.9	------	------	------
	7T, 8T, 8.8		6.1-8.3	8.3-11.3			
	10T, 11T		8.7-11.5	11.7-15.7			
M8	4T, 4.8	1.25	9.4-12.3	12.7-16.7	1.0	11.2-14.8	15.2-20.1
	7T, 8T, 8.8		16.6-21	22.6-28.4		26.8-25.3	26.5-34.3
	10T, 11T		21-26.7	28.5-36.3		22.4-29.6	30.4-40.2
M10	4T, 4.8	1.5	18.8-24.6	25.5-33.3	1.25	21-26.7	28.4-36.2
	7T, 8T, 8.8		32.5-41.2	44.1-55.9		36.2-46.3	49-62.7
	10T, 11T		39.8-51.3	54-69.6		42.7-54.2	57.8-73.5
M12	4T, 4.8	1.75	27.4-34.7	37.3-47	1.25	31.8-40.5	43.1-54.9
	7T, 8T, 8.8		48.5-61.5	65.7-83.3		55-69.4	74.5-94.1
	10T, 11T		68-85.3	92-116		73-93.3	99-126
M14	4T, 4.8	2.0	46.3-59.3	62.8-80.4	1.5	51.4-64.3	69.6-87.2
	7T, 8T, 8.8		76.7-96.9	104-132		86.1-109	117-148
	10T, 11T		103-128	139-175		110-136	149-184
M16	4T, 4.8	2.0	64-81	86.1-110	1.5	67.3-84.6	91.1-114
	7T, 8T, 8.8		110-136	149-185		116-142	157-192
	10T, 11T		152-188	205-255		163-190	221-269
M18	4T, 4.8	2.0	84-104	113-141	1.5	97-120	132-162
	7T, 8T, 8.8		145-173	196-236		170-206	231-279
	10T, 11T		203-246	275-333		221-271	298-367
M20	4T, 4.8	2.5	107-132	144-180	1.5	127-155	172-210
	7T, 8T, 8.8		178-213	240-290		203-246	275-333
	10T, 11T		268-325	363-441		293-358	397-485

4. Install the brake actuator plate, 1, into the axle housing, 2.



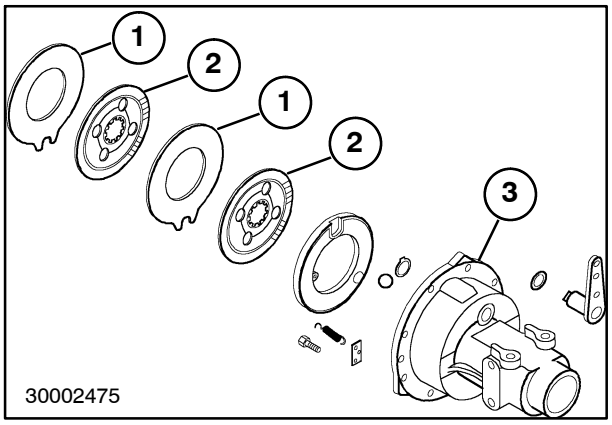
23

5. Connect the brake springs, 1, to the brake actuator plate, 2.



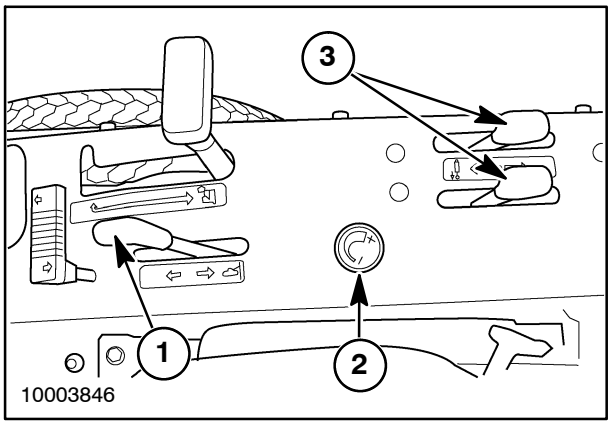
24

6. Install the stators, 1, and the fiber brake discs, 2, into the axle housing, 3.



25

The hydraulic system is controlled by a lever, 1, and knob, 2, located on the top of the right tractor fender. The lever is attached to the lift control valve and controls the raising or lowering of the tractor implement. The knob, 2, is attached to the weight transfer valve and opens or closes the valve when rotated counterclockwise or clockwise. Two remote valves, available as dealer installed accessories, may be added to the tractor and are controlled by the two rear levers, 3.

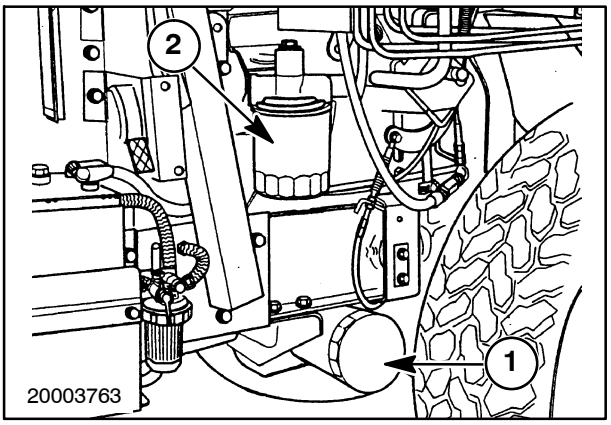


2

Op. 35 300

HYDRAULIC FLUID FILTER

The MC models tractors are equipped with a canister-type suction filter, 1, which is located on the right side of the tractor gearbox. The suction filter removes foreign particles and contaminants from the hydraulic fluid that may damage components of the hydraulic system. The tractor is also equipped with another, secondary, canister-type filter, 2. This filter protects the tractor's hydrostatic transmission (HST) and removes foreign particles and contaminants from the hydraulic fluid. The filters should be replaced after the first 50 hours of use and every 300 hours thereafter.

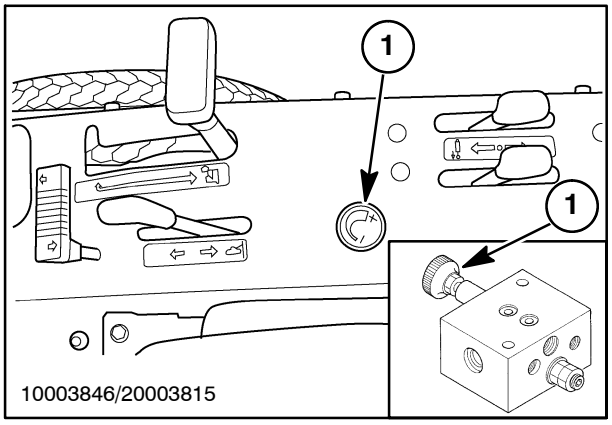


3

WEIGHT TRANSFER VALVE

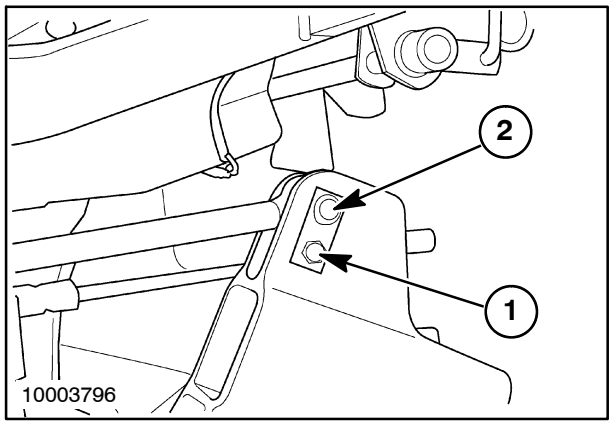
The weight transfer valve, 1, is incorporated into the control valve body. This valve is used to transfer weight from an attached implement to the front tractor wheels or from the front tractor wheels to the implement attached to the tractor. This is accomplished by controlling the flow of hydraulic fluid that is being directed from the hydraulic lift cylinders and lift control valve back to the hydraulic fluid reservoir.

Hydraulic fluid flows through the weight transfer valve when the control valve is in the "lower" or "float" position.



4

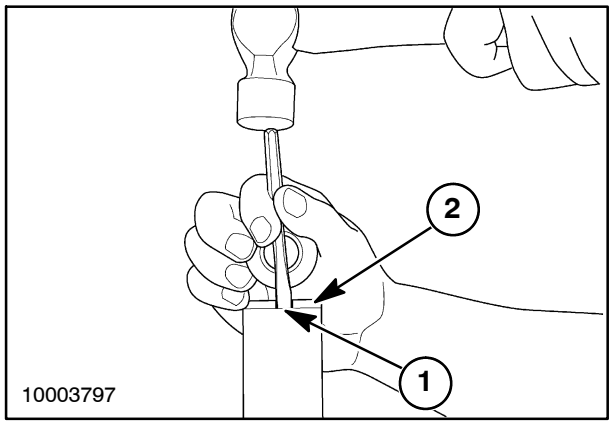
9. Remove the bolt, 1, from the front lift cylinder retaining pin, 2. Remove the pin from the lift arms and cylinder.
10. Remove the lift cylinder from the tractor.



21

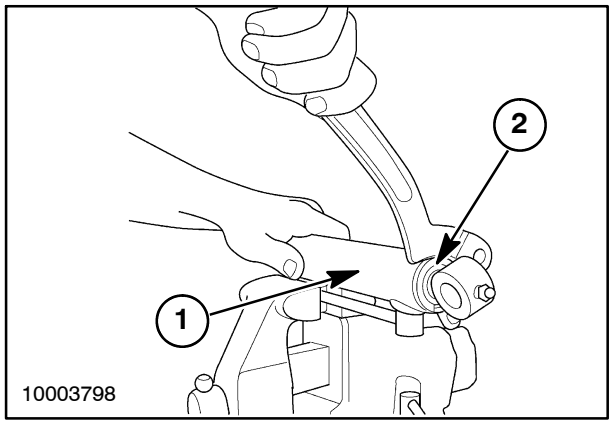
Disassembly

1. Use a hammer and suitable punch or chisel to push the tab, 1, on the lift cylinder out so that the cylinder head, 2, may be removed.



22

2. Place the cylinder, 1, in a soft jaw vice and use a spanner wrench to remove the cylinder head, 2, from the cylinder. Slide the piston and rod assembly from the cylinder.



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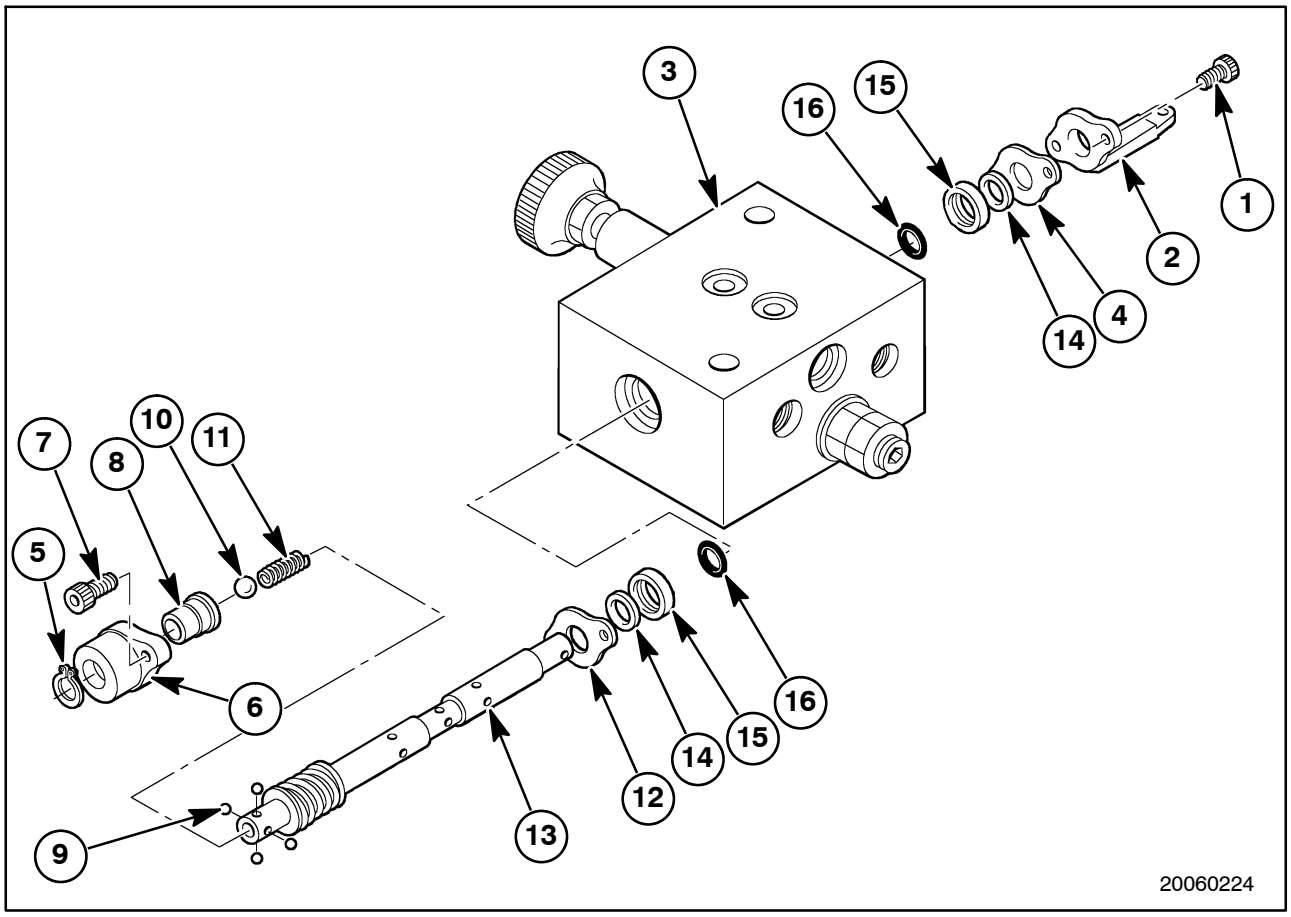

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1. Socket Head Screws
2. Control Lever Linkage
3. Valve Body
4. Spool Retainer
5. Snap Ring
6. Valve Spool End Cap
7. Socket Head Screw
8. End Cap Sleeve
9. Detent Balls (4)
10. Detent Locking Balls
11. Detent Spring
12. Spool Retainer
13. Valve Spool
14. Plastic Sealing Washer
15. Bronze Retaining Ring
16. O ring

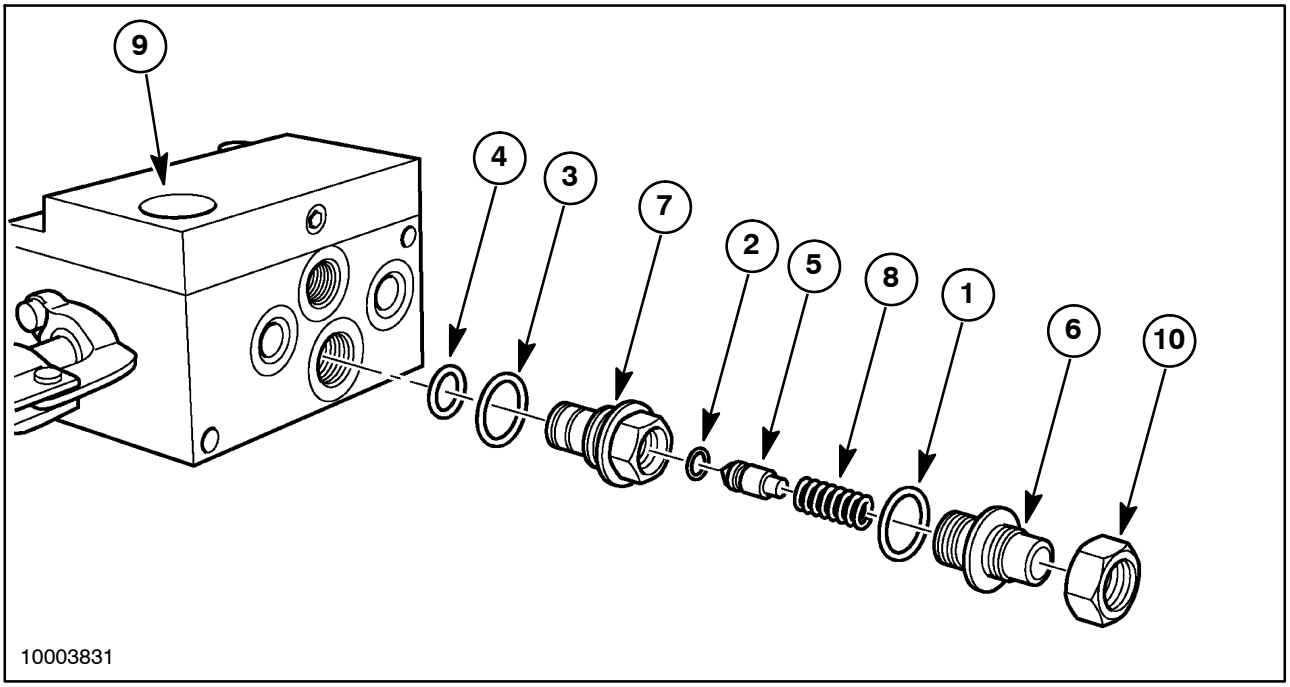
4. Remove the two socket head bolts, 1, which retain the control lever linkage, 2, to the valve body, 3. Remove the linkage from the valve.
5. Remove the spool retainer, 4, from the valve body.
6. Remove the snap ring, 5, from the spool end cap, 6.

NOTE: *When removing the end cap sleeve, and spool end cap from the valve body, be sure not lose any of the detent balls or the spring that is underneath the end cap, as these components are loose.*

7. Remove the two socket head bolts, 7, which retain the end cap sleeve, 8, and spool end cap, 6, to the valve body, 3.
8. Carefully remove the spool end cap, 6, and sleeve, 8, from the valve body. The four (4) detent balls, 9, detent locking ball, 10, and spring, 11, can then be removed. From the valve.
9. Remove the spool retainer, 12, from the valve body.
10. Carefully remove the valve spool, 13, from the valve body, 3.
11. The plastic sealing washers, 14, the bronze retaining rings, 15, and the O rings, 16, can then be removed from both ends of the valve body, 3. Use care not to damage the bronze retaining rings.

Inspection

1. Inspect the relief valve poppet for scoring, pitting, excessive wear or any other damage. Replace parts as necessary.
2. Inspect the relief valve spring for damage or weakness. Replace the spring as necessary.
3. Inspect the relief valve bore inside the lift control valve body for scoring, pitting, excessive wear or any other damage. Replace the valve as necessary.



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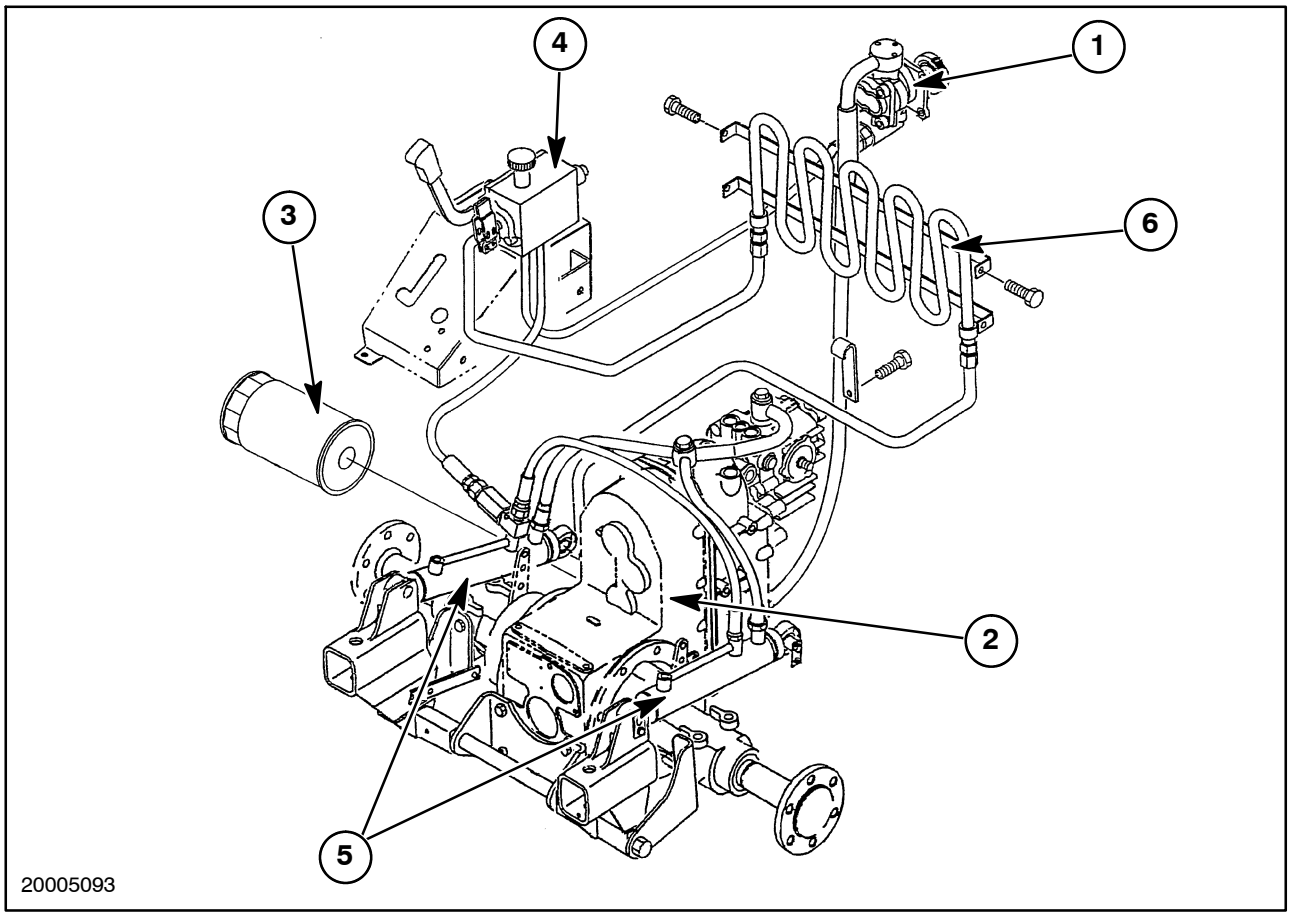
1. O ring
2. O ring
3. O ring
4. O ring
5. Poppet
6. Adjusting Screw
7. Poppet Seat
8. Spring
9. Lift Control Valve
10. Locknut

Assembly

1. Lubricate and install new O rings, 1, 2, 3, 4, on the relief valve poppet, 5, the relief valve adjusting screw, 6, and the poppet seat, 7.
2. Install the poppet seat, 7, the relief valve poppet, 5, and the relief valve spring, 8, into the relief valve bore of the lift control valve, 9.

NOTE: *When installing the lift valve adjusting screw, do not leave the screw threaded all the way into relief valve, otherwise an over pressure condition may occur in the hydraulic system.*

3. Thread the relief valve adjusting screw all the way into the bore of the lift control valve until snug. Then back the adjusting screw out two and one-half turns (2.5) turns.
4. Install the locking nut, 10, onto the relief valve adjusting screw, 6.



87

The hydraulic pump, 1, suctions hydraulic fluid from the hydraulic fluid reservoir, 2, through a canister-type filter, 3. The hydraulic pump then pressurizes hydraulic fluid and directs the fluid to the lift control valve, 4. Fluid is then used by the lift cylinders, 5, to operate an attachment or is directed through the hydraulic fluid cooler, 6, and back to the hydraulic fluid reservoir.

Pump Flow	lpm (gpm)
MC22	7.2 (1.90)
MC 28, MC 35	9.1 (2.40)

OVERHAUL

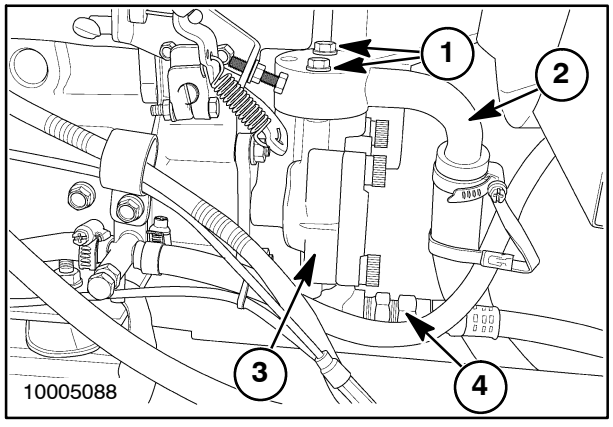
HYDRAULIC PUMP

Removal

1. Disconnect the negative (-) battery cable from the battery.

NOTE: *The MC 22 mower uses two bolts to secure the hydraulic fluid suction line to the hydraulic pump and the MC 28 and MC 35 uses three bolts.*

2. Remove the bolts, 1, that secure the hydraulic fluid suction line, 2, to the hydraulic pump, 3.
3. Disconnect the high pressure hydraulic fluid supply line, 4, from the hydraulic fluid pump, 3.



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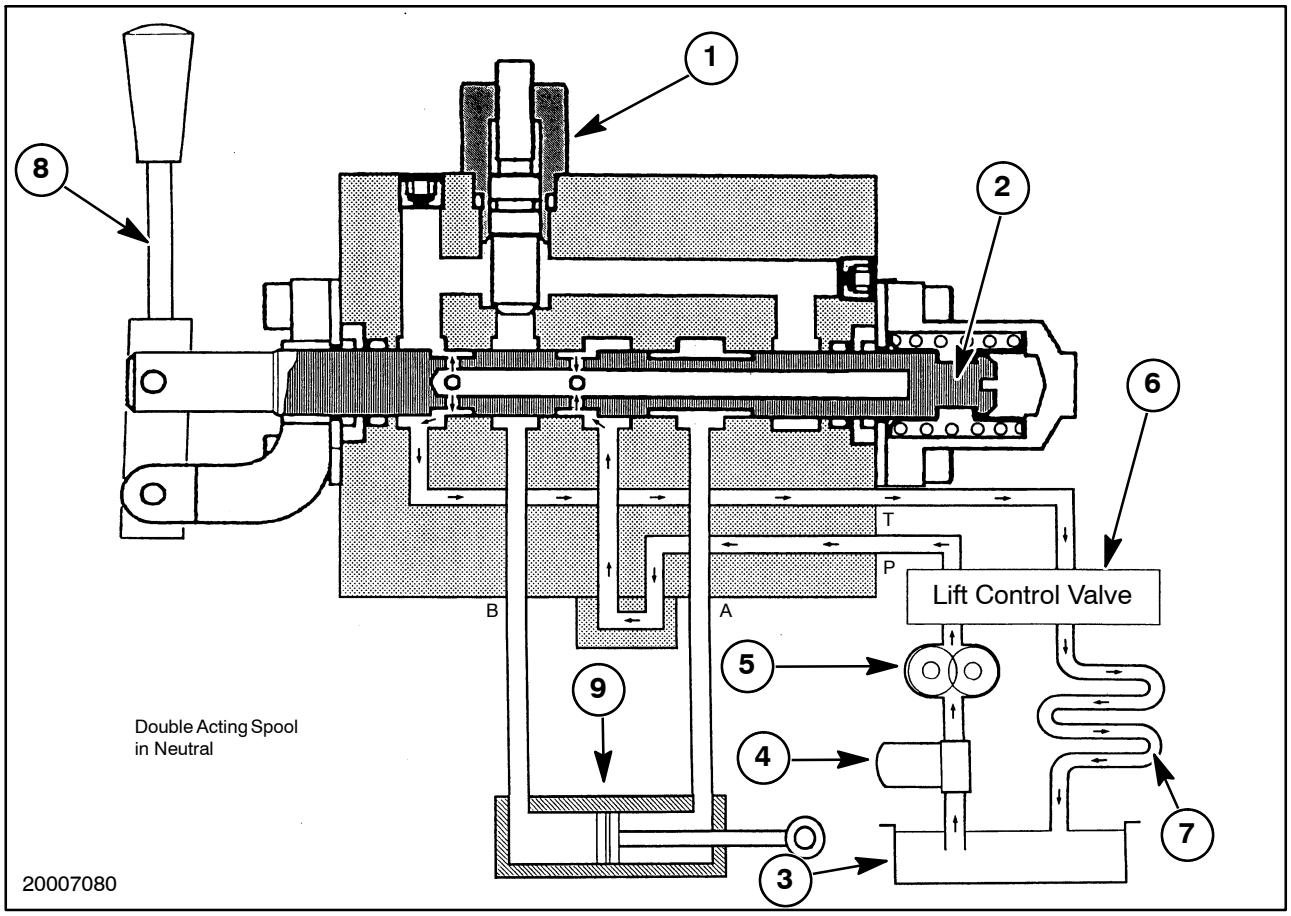

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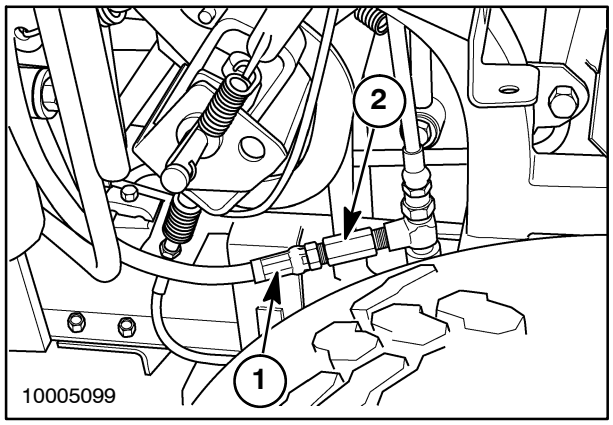
1. Changeover Valve
2. Valve Spool
3. Hydraulic Fluid Reservoir
4. Hydraulic Fluid Filter
5. Hydraulic Fluid Pump
6. Lift Control Valve
7. Hydraulic Fluid Cooler
8. Control Lever
9. Cylinder

DOUBLE ACTING - NEUTRAL

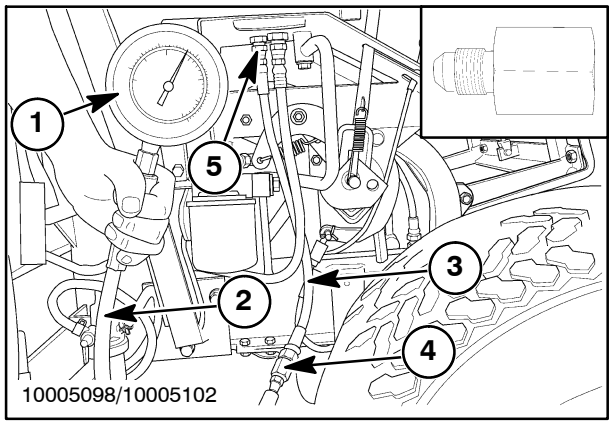
When the changeover valve, 1, is in the double acting position and the spool, 2, is in the neutral position, hydraulic fluid is suctioned from the hydraulic fluid reservoir, 3, and the through the hydraulic fluid filter, 4, by the hydraulic pump, 5. The hydraulic pump pressurizes fluid and directs the fluid to the lift control valve, 6. From the lift control valve, fluid is directed into the remote valve through the “P” port to the remote valve spool, 2. The spool directs fluid through the valve, out of the valve through the “T” port and back to the hydraulic fluid reservoir, 3, through the hydraulic fluid cooler, 7.

4. Disconnect the lift arm supply line, 1, at the flow restrictor, 2.



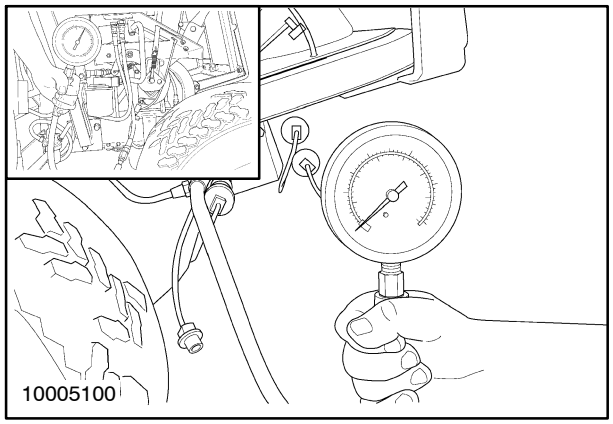
121

5. Connect a 0 – 207 bar (0 –3000 psi) pressure gauge, 1, and test line, 2, to the lift cylinder supply line, 3, using special tool #NH01420, 4, between the supply line and test line. Be sure to tighten the lift cylinder supply line fitting, 5, at the lift control valve.
6. Start the tractor engine and operate the hydraulic system to warm the hydraulic fluid to normal operating temperature.
7. Increase the engine speed to full throttle.



122

8. Operate the lift control valve or remote valve and observe the pressure gauge for the indicated system relief pressure. The pressure gauge should show approximately 100 bar (1450 psi). If the pressure reading is not as specified, adjust the system relief pressure accordingly.



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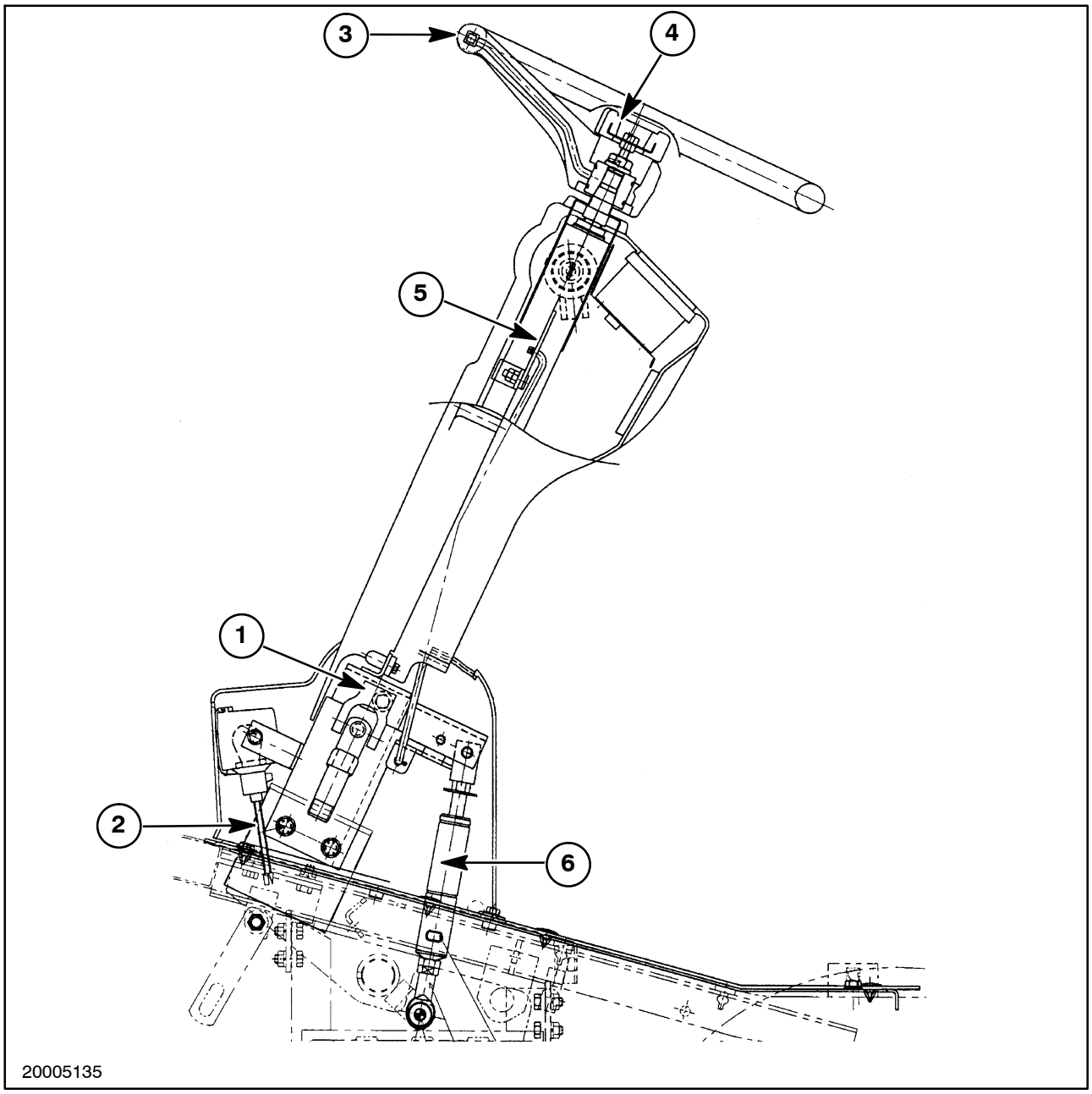

7

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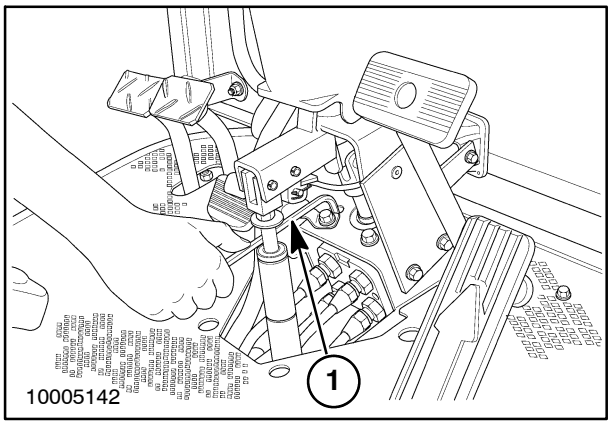
STEERING COLUMN AND WHEEL

The steering column contains a shaft, 1, that is splined to the steering motor, 2, on the bottom and connected to the steering wheel, 3, at the top. All MC tractors are equipped with tilt/telescoping steering columns. The steering column also houses the instrument panel, key switch, and lighting control, which are covered in Section 55.

The telescoping feature can be adjusted by loosening the knob, 4, in the center of the steering wheel. Once the desired height of the steering wheel has been reached, tightening the knob will lock the steering wheel in place.

The tilt feature is adjusted by lifting on the adjustment lever, 5. This depresses an adjustment button on a gas charged strut, 6, allowing the strut to move. The strut supports the steering column and makes adjustment of the tilt feature smooth. When the desired tilt has been reached, releasing the adjustment lever will lock the steering column in place.

14. Use a 6 mm hex wrench, 1, or socket to adjust the relief valve pressure setting. Turning the adjusting screw 1/8 turn clockwise will increase relief pressure by approximately 3.5 bar (50 PSI). Turning the adjusting screw 1/8 turn counterclockwise will decrease relief pressure by 3.5 bar (50 PSI).
15. Return to step 4 and test the steering system relief pressure to be sure relief setting is properly adjusted.



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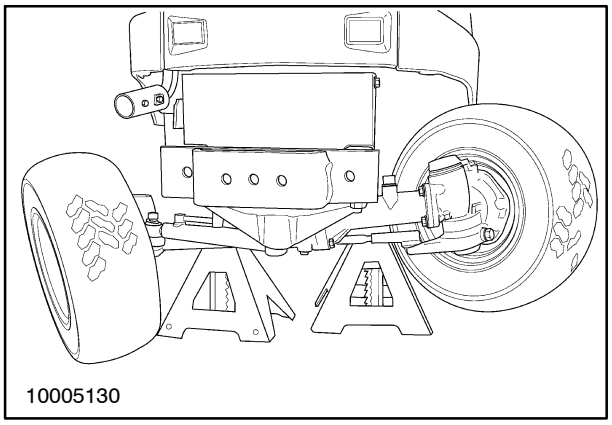
STEERING CYLINDER TEST

NOTE: *Before performing the steering cylinder test, check the steering system relief pressure to ensure accurate results for the steering cylinder test.*

The steering cylinder test will assure that the steering cylinder is working properly and efficiently. This test will also indicate if the steering cylinder is damaged or has leaking seals/O rings.

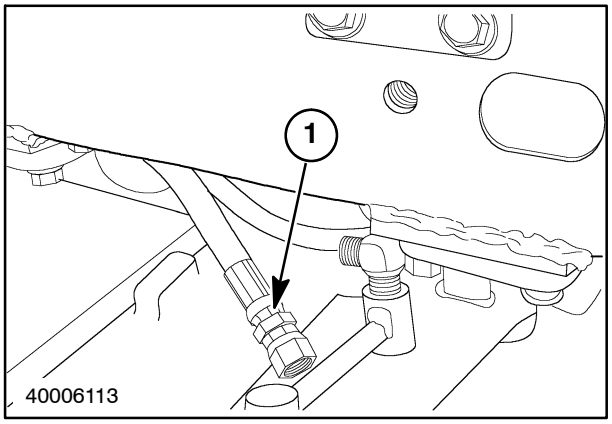
NOTE: *Do not use the rear axle to support the tractor, as the rear axle will need to be able to move. Only lift the rear axle several inches.*

1. Apply the parking brake and place wheel stops at the front wheels of the tractor. Raise and support the rear of the tractor on jack stands.



20

2. Place a hydraulic fluid catch pan under the steering cylinder. Disconnect the rod side hydraulic line, 1, from the steering.



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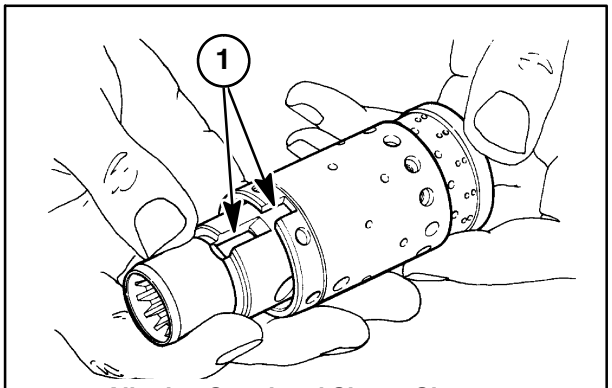
Assembly

1. Lubricate the steering motor components in clean AMBRA Multi G 134 hydraulic fluid before assembly.
2. Use new seals and O rings when assembling the steering motor. Lubricate the O rings with petroleum jelly before installing into the steering motor.
3. Slide the spool into the sleeve and align the spring slots, 1, in the sleeve and spool.



Aligning Spool and Sleeve Slots

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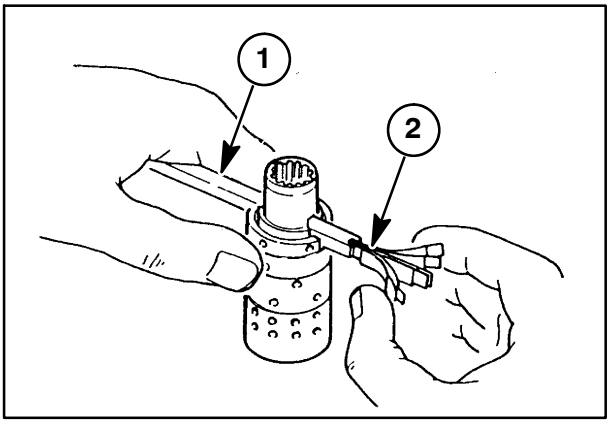
NOTE: *Specifications for the manufacture of the return spring installation tool, 1, are listed under "Special Tools" in this section.*

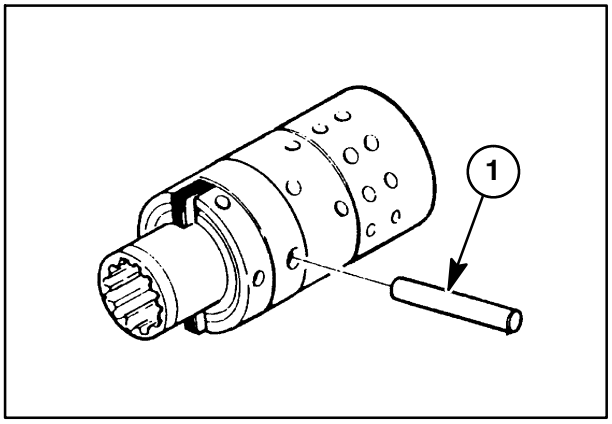
NOTE: *Be sure the notched ends of the springs face away from the input splines when installing into the sleeve and spool assembly.*

4. Manufacture the special tool, 1, for the return spring installation. Slide the tool through the sleeve and spool assembly. Place the two (2) flat leaf springs between the four (4) centering springs. Put the springs, 2, in the slot of the special tool and install the springs into the sleeve and spool assembly.



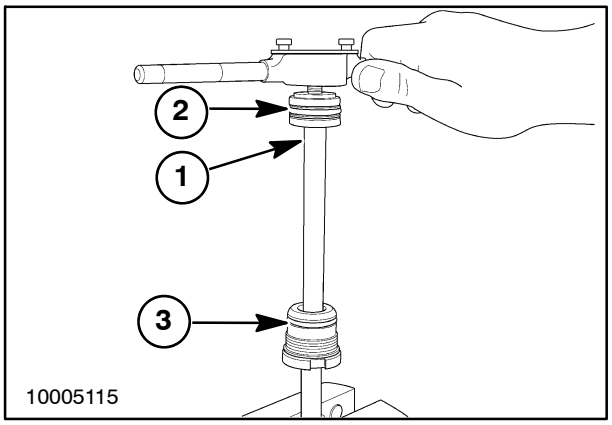
42

5. Install the pin, 1, through the diameter of the sleeve and spool assembly. Petroleum jelly may be used to hold the pin in place.



43

4. The tip of the piston rod, 1, is staked and the piston, 2, may not readily come off. If this is the case, use a 10 mm x 1.5 die to clean the threads of the piston rod.
5. Remove the piston, 2, from the piston rod, 1.
6. The cylinder head, 3, may also be removed at this time.



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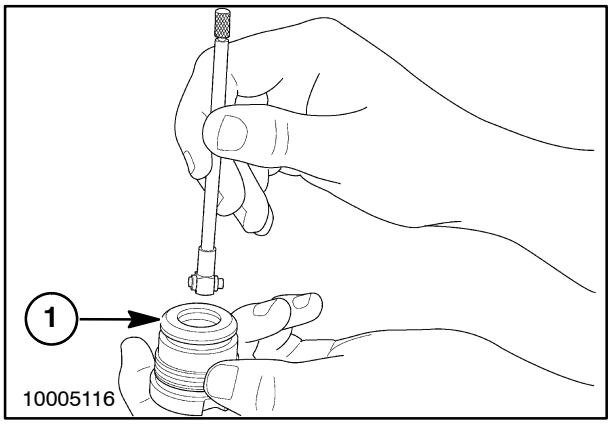
Inspection

1. Remove all seals and O rings from the steering cylinder components and discard.
2. Clean the steering cylinder components in a suitable solvent and allow to air dry.
3. Inspect the cylinder bore, the cylinder head, the piston, and the piston rod, for pitting, scoring, excessive wear, dents, or any other damage and replace parts as necessary.
4. Inspect the clevis joint and grease fittings on the end of the cylinder barrel and piston rod. Replace parts as needed.
5. Use a suitable measuring device (i.e. bore gauge) to measure the inside diameter of the cylinder head, 1. Take several measurements at different locations on the inside bushing to check the inside diameter for uniformity. The inside diameter at the bushing should be approximately 13.9 mm (0.547″). If the cylinder head is not within these specifications, replace the cylinder.



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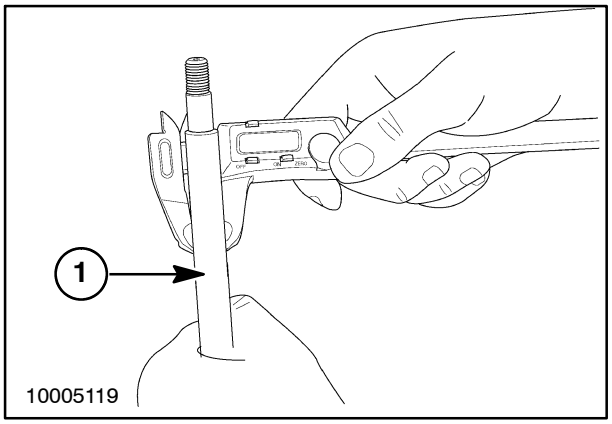
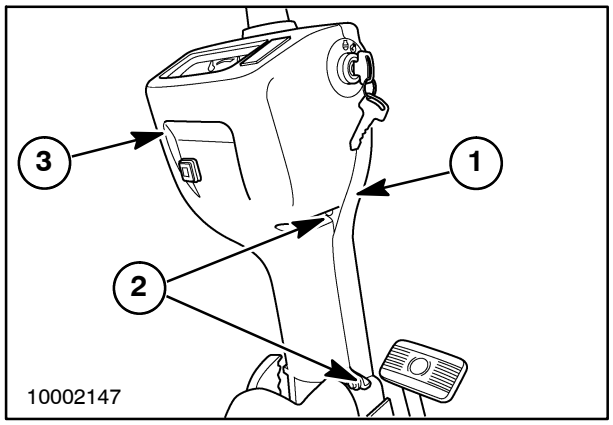
6. Use a suitable measuring device to measure the outside diameter of the cylinder rod, 1. Take several measurements at different locations to check the outside diameter for uniformity. The outside diameter should be approximately 13.8 mm (0.543″).
7. Compare the inside diameter of the cylinder head bushing with the outside diameter of the cylinder rod. The clearance between the cylinder head and cylinder rod should be no more than 0.3 mm (0.012″) If the clearance is above what is specified, replace the rod and cylinder assembly.



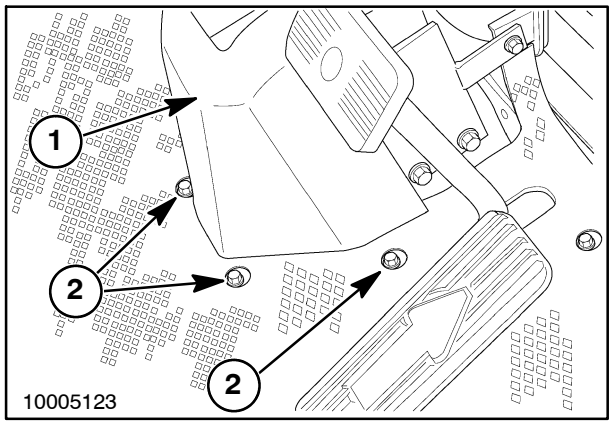
73

8. Place the front steering column cover, 1, up to the tractor and install the four retaining screws, 2, which secure the front steering column cover, 1, to the rear steering column cover, 3.



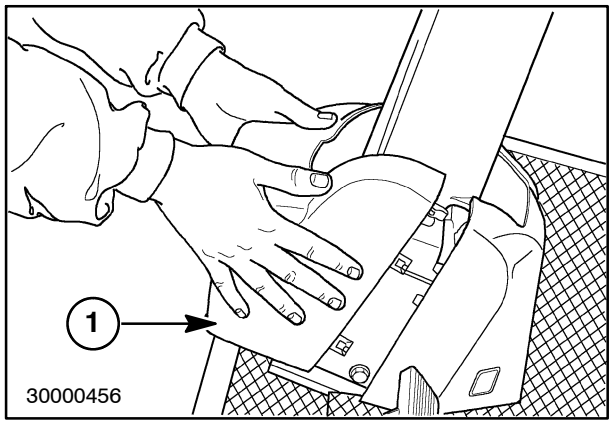
92

9. Install the lower steering column cover, 1, to the tractor and secure the cover to the tractor using the four M6x16 retaining bolts, 2.

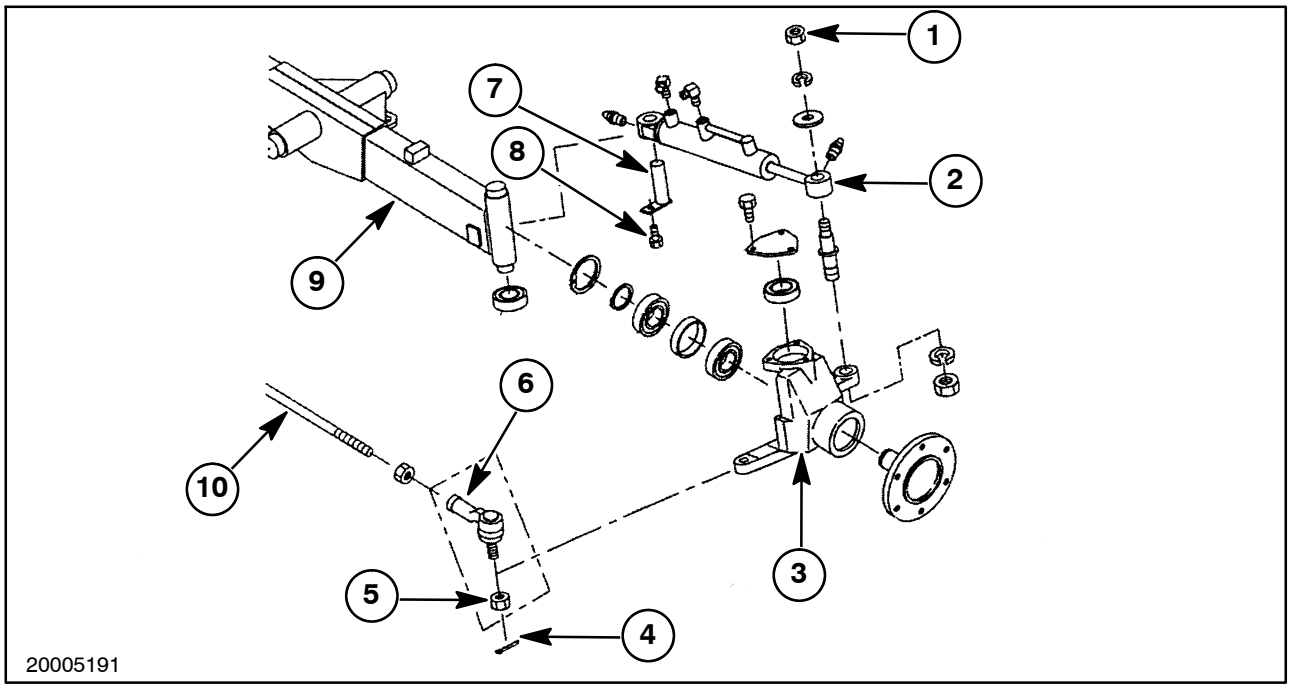


93

10. Push the front light cover, 1, onto the tractor.



94



10

1. Anchor Nut
2. Steering Cylinder
3. Drop Box
4. Cotter Pin
5. Castle Nut
6. Tie Rod End
7. Anchor Pin
8. Retaining Bolt (M8x16)
9. Rear Axle Housing
10. Tie Rod

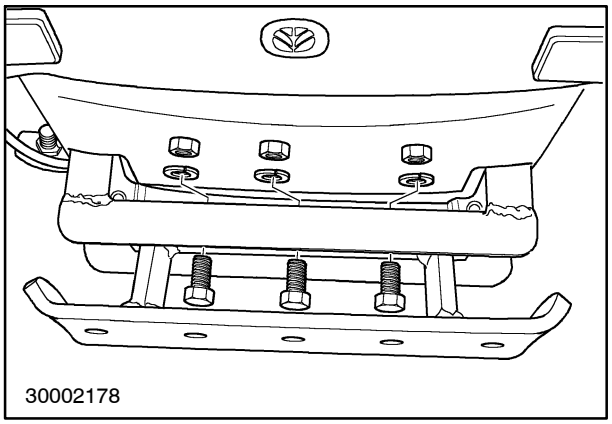
1. Remove the anchor nut, 1, that retains the rod side of the steering cylinder, 2, to the left drop box, 3.
2. Remove the steering cylinder from the rear axle.
3. Remove the cotter pin, 4, and castle nut, 5, that secures the tie rod end, 6, to the left drop box, 3. Repeat for the right side of the axle.

REAR WEIGHTS

To increase traction and stability and to counter-balance the weight of a front implement, a rear weight bracket (#716795006) and suitcase style weights (#710215013) are available for the MC mower. Each suitcase weight weighs 60 lbs. (26kg). A maximum of three suitcase weights can be installed onto the rear weight bracket.

NOTE: *When adding weight to the tractor, tire pressure may need to be increased. Refer to the Tire Inflation Section found in this manual.*

Rear Weight Bracket (#716795006)
Holds a maximum of three 60 lbs.(26kg) suitcase weights.



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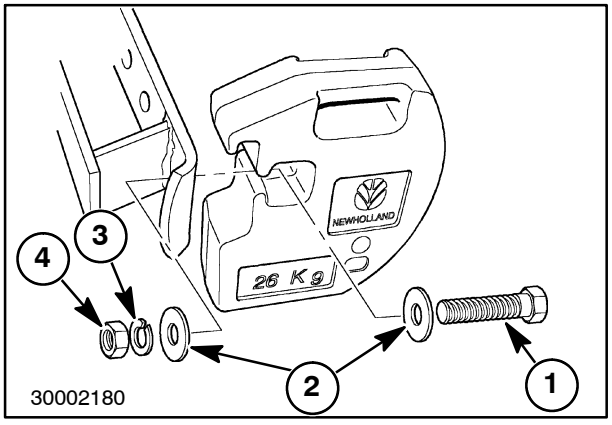
Rear Weight (#710215013)
Suitcase Weights (#710215013) 60 lbs.(26kg) each.

NOTE: *Weight Bracket (#716795006) required.*

Required Hardware (obtain locally)

1 - 5/8″ x 2-1/4″ carriage bolt
2 - 5/8″ flat washer
3 - 5/8″ lock washer
4 - 5/8″ nut N.C.



5

ELECTRICAL SYSTEM COMPONENTS - DESCRIPTION AND TESTING

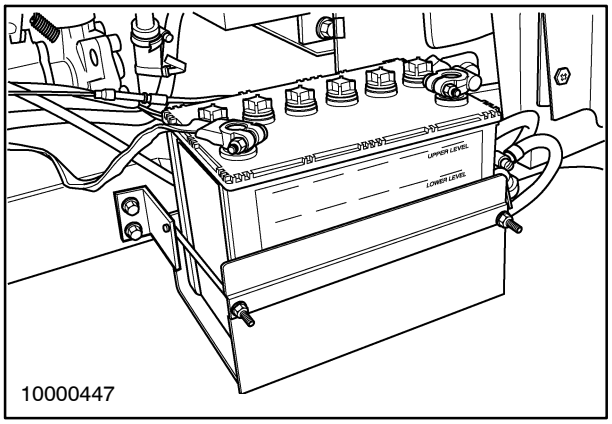
⚠ WARNING ⚠

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.

BATTERY

Description

The MC22, MC28, and MC35 tractors are equipped with a BCI group 35, 12-volt, 54Ah battery with a minimum CCA of 490 amps at -18°C (0°F). The battery is located under the engine cover on the right side of the tractor frame.



3

The battery connections must be tight and free of corrosion. If necessary, wash the battery's outside surface and terminals with a solution of baking soda and water, making sure the cleaning solution does not get inside the battery. After cleaning, wash the battery with clean water, and 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 will become weak and possibly freeze. This may result in damage to the battery case. If water must be added, use distilled water, adding 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.

To determine the battery charge, use a battery electrolyte tester to test the electrolyte in the battery.

Checking the Battery Electrolyte Level

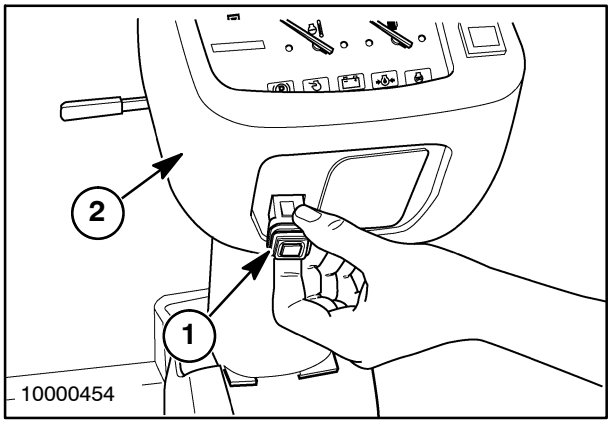
NOTE: *Check the battery electrolyte level after every 50 hours of operation.*

⚠ WARNING ⚠

Always check the battery electrolyte level with the tractor engine stopped, as an explosive gas is produced inside the battery when the alternator is charging the battery. Do not use an exposed flame and do not smoke when checking the battery electrolyte level.

Removal

1. Disconnect the negative (-) battery cable from the battery.
2. Grasp the light switch, 1, at the base, and pull the switch out of the steering column, 2.



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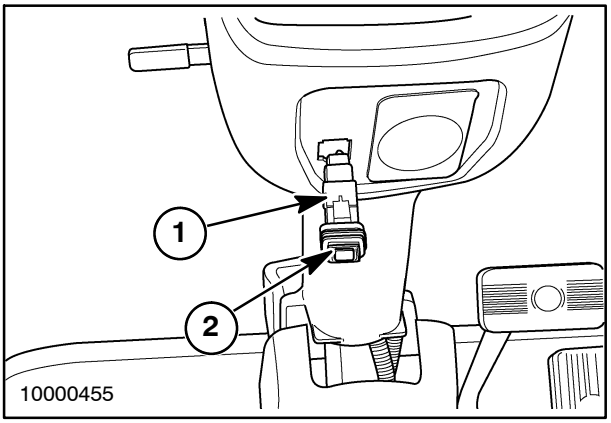
3. Disconnect the electrical connector, 1, from the light switch, 2. Be sure the electrical connector does not fall back into the steering column or the steering column cover will need to be removed.



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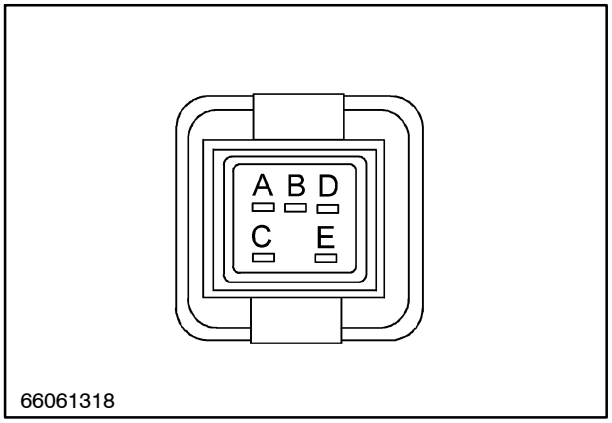
Light Switch Troubleshooting - Continuity Test

Using an ohmmeter, test the light switch in the "OFF" (out) and "ON" (in) positions. If the test results are NOT as slisted in the chart, the switch is defective and needs to be replaced.

Switch Position	Terminals w/Continuity
"OFF" (out)	B & C
"ON" (in)	A & C
Switch Indicator Light across terminals D & E	13.3 ohms across copper colored D & E terminals
	Place 12 volts across terminals D & E indicator light should illuminate



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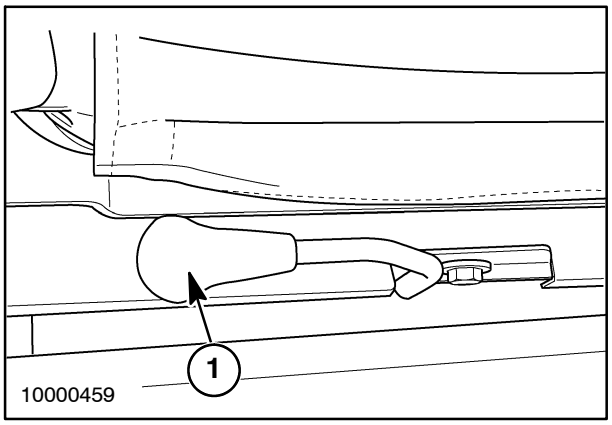
Adjustment

If the HST safety start switch is suspected of being defective, check the adjustment of the switch before replacing. The HST safety switch also needs adjusted if removed from the tractor. To adjust the switch, use the following procedure:

1. Raise the seat deck by pulling up on the deck lever, 1.



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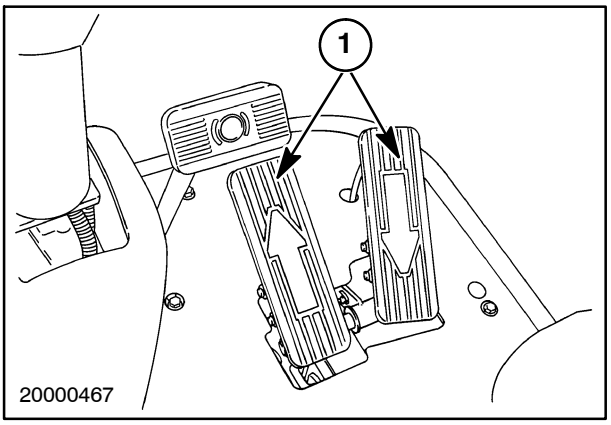
2. While observing the switch action, depress one of the tractor directional pedals, 1.



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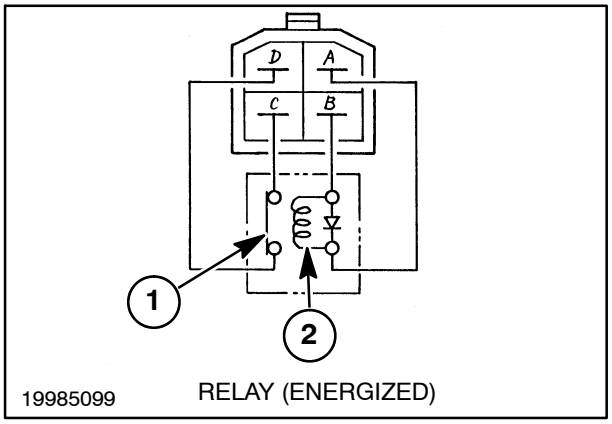
The function circuits, 1, are normally open when no current is being supplied to the coil, 2. If a circuit with an SPST relay is energized with current on the MC series tractor, the switch becomes closed and the circuit is completed. The relay is then said to be latched. The relays for these circuits are the same part and are interchangeable.



19985099 RELAY (ENERGIZED)

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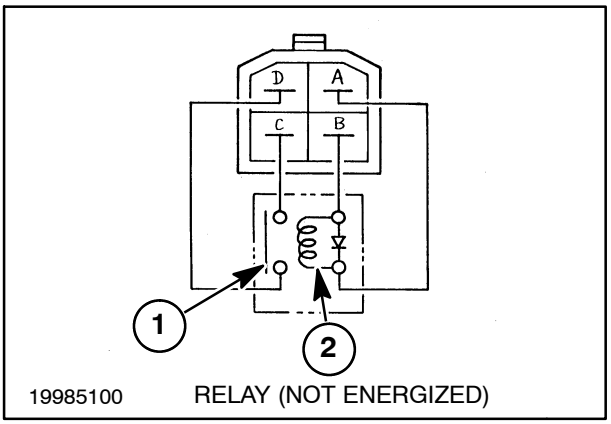

19985100 RELAY (NOT ENERGIZED)

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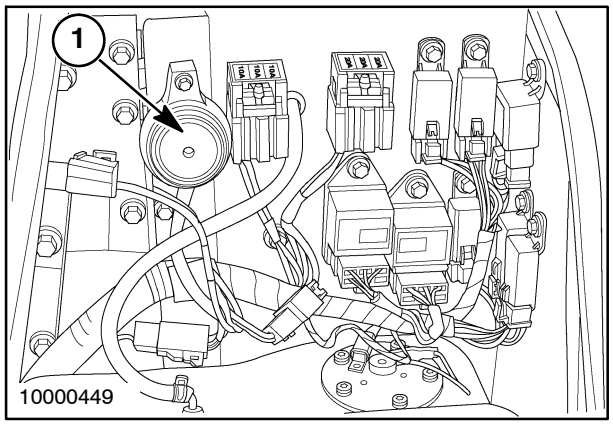
Op. 55 408

ENGINE OIL PRESSURE AND OVERHEAT WARNING ALARM

Description and Location

The engine oil pressure and overheat warning alarm, 1, is located under the engine cover on the left side of the tractor firewall. The warning alarm alerts the operator of low oil pressure (below 29.6 kPa or 4.3 psi) or when engine operating temperature exceeds 110°C (230°F). The warning alarm is triggered by the coolant temperature relay and oil pressure relay, which are triggered by the coolant temperature switch and the oil pressure switch. If the warning alarm sounds when the key switch is turned from the STOP position to the RUN position (engine stopped), the alarm is functioning properly, as there is no oil pressure when the engine is stopped.



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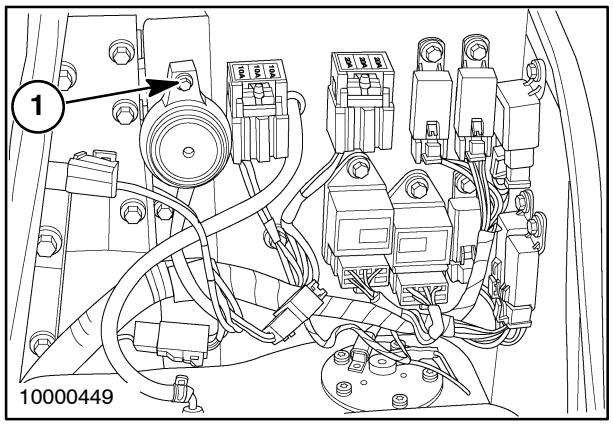
Warning Alarm Testing

1. Disconnect the negative (-) battery cable from the battery.
2. Remove the screw retaining the warning alarm, 1, to the tractor firewall.
3. Disconnect the alarm from the tractor wiring harness.



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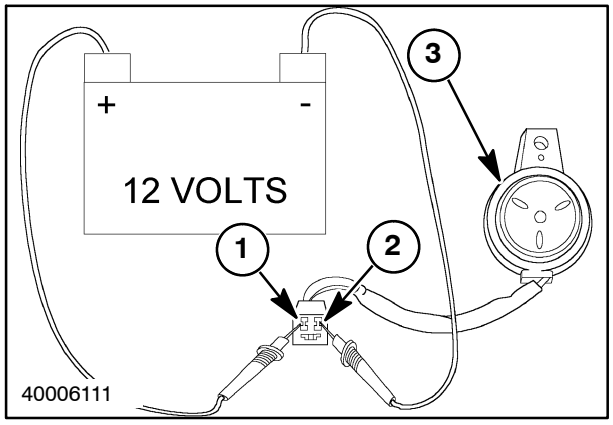
4. Connect a jumper wire from the positive (+) terminal of a 12-volt power supply to red wire terminal, 1, of the warning alarm connector.
5. Connect a jumper wire from the negative (-) terminal of a 12-volt power supply to the black wire terminal, 2, of the warning alarm connector.
6. If the warning alarm, 3, emits a loud, clear, beeping sound, the alarm is functioning properly. If the alarm does not, the alarm is defective and needs replaced.
7. Connect the alarm to the main wiring harness and secure the alarm to the tractor firewall using the retaining screw.
8. Connect the negative (-) battery cable to the battery.



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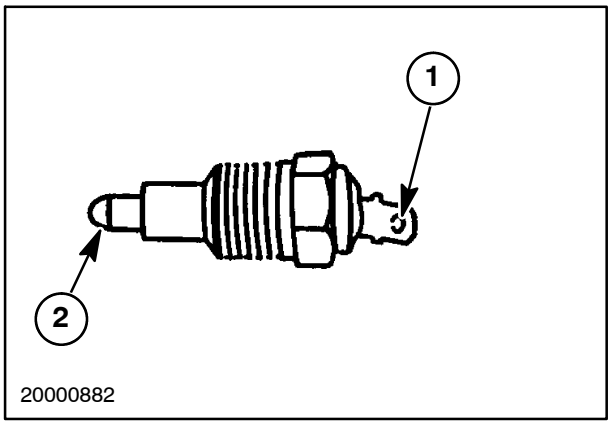
Engine Coolant Temperature Switch Testing

NOTE: *The engine coolant temperature switch can only be tested when cold, do not attempt to heat the coolant switch.*

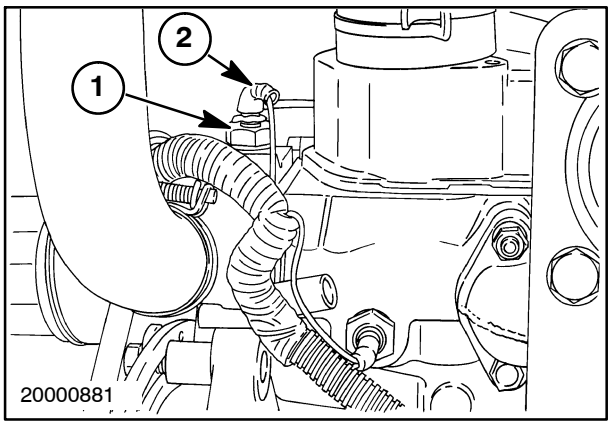
1. Using an ohmmeter touch one test lead to the switch terminal, 1. Touch the other test lead to the temperature switch probe, 2.
2. Observe the ohmmeter, there should be high resistance, indicating the switch contacts are open. If there is low resistance, indicating continuity (contacts closed), the switch is defective and needs replaced.



120

Installation

1. Apply Loctite® - 567 thread sealant on the coolant temperature switch threads and install the switch, 1, into the engine.
2. Clip the wire harness terminal, 2, onto the coolant switch.
3. Fill the radiator with the recommended coolant mixture.
4. Connect the negative (–) battery cable onto the battery.



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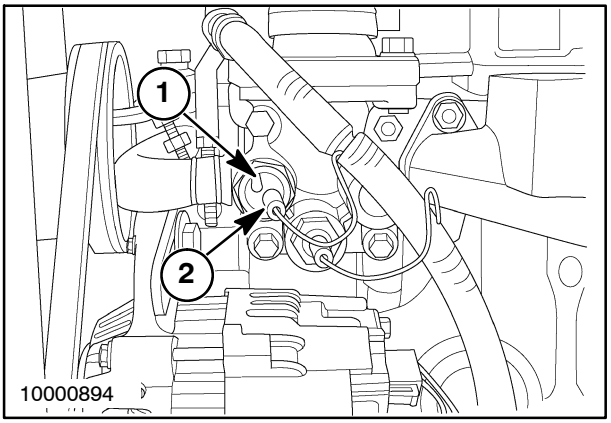

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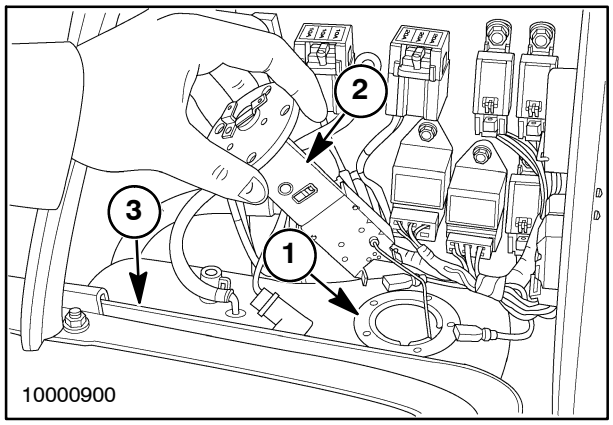
Installation

1. Install a new sealing gasket, 1, between the sending unit, 2, and the fuel tank, 3. Place the sending unit into the fuel tank.



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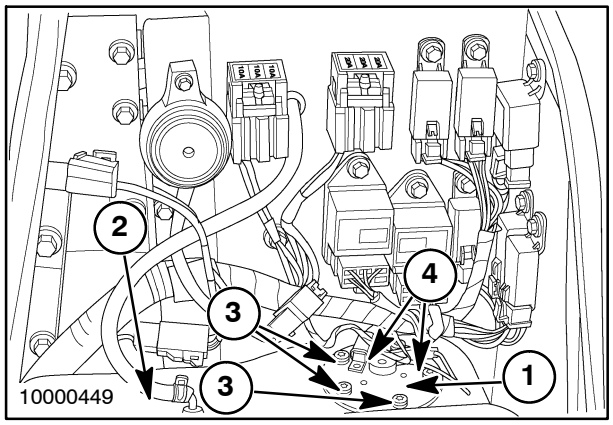
2. Secure the sending unit, 1, to the fuel tank, 2, using the five retaining screws, 3.

NOTE: *When attaching the wiring harness leads to the fuel level sending unit, be sure the white wire is connected to the insulated terminal on the sending unit.*

3. Connect the two wiring harness leads, 4, to the terminals on the fuel level sending unit, 1.
4. Connect the negative (-) battery cable to the battery.



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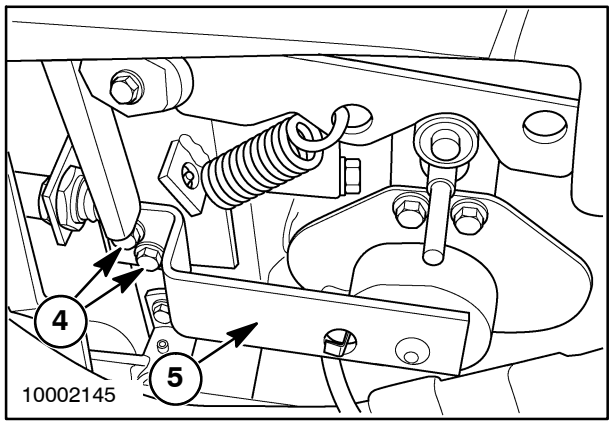
4. Remove the two bolts, 4, which secure the cruise control magnet mounting bracket, 5, to the transmission. Remove the magnet from the tractor.



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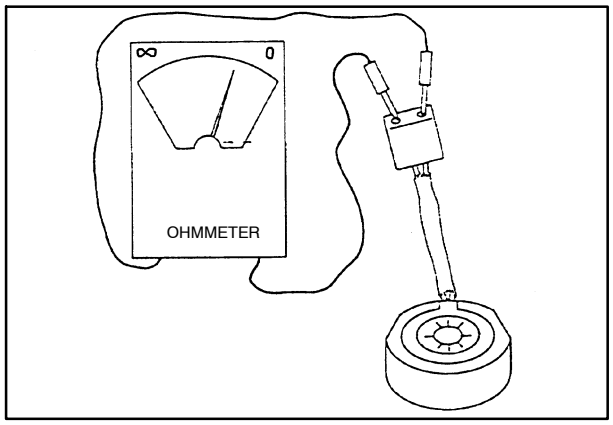
Cruise Control Magnet Testing

1. Using an ohmmeter, connect test leads to each terminal on the cruise control magnet connector.
2. Observe the ohmmeter. The ohmmeter should indicate a resistance of 11 - 12 ohms. If the resistance of the magnet is not as specified, the magnet is defective and needs replaced.



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OPERATOR PRESENCE CIRCUIT

The MC22, MC28 and MC35 operator presence circuit includes all circuits that keep the tractor engine running while the operator is seated and all circuits that automatically stop the engine, should the operator leave the tractor without manually shutting the tractor engine off using the key switch.

The operator presence circuit includes all circuits used to allow the tractor to remain running.

1. Current flow starts at the positive (+) terminal of the tractor battery. From the battery, the current flows to the engine starter motor through the positive (+) battery cable.
2. From the starter motor, current flows through the fusible link wire to the #30 terminal of the key switch. When the key switch is turned to the "ACC/RUN" position, current is supplied to terminal "ACC/RUN"
3. From the "ACC/RUN" terminal of the key switch, current flows to the middle 10-amp fuse of the fuse block. The 10-amp fuse sends current to:
   - Safety stop relay
   - Seat safety switch timer
   - Brake relay
4. **Safety Stop Relay**

   The 10-amp fuse supplies both the coil and switch sides of the safety stop relay.

   The safety stop relay becomes energized when the seat safety switch is closed, (operator in seat).The seat safety switch completes the ground circuit for the seat safety switch timer. The timer completes the ground circuit for the safety stop relay. When the stop relay has current and ground provided to the coil side of the relay, the relay energizes, allowing the contacts of the relay to close and supply current to the engine stop solenoid, that allows the engine to remain running.

   Alternate Circuit - Operator Not Present

   The coil circuit of the safety stop relay may also be grounded by:

   - Engaging the park brake
   - Disengage the PTO
   - Place HST in neutral

   This will allow the engine to remain running without the operator in the seat. Should the operator get off the seat without the park brake applied, or PTO "ON" and HST not in "Neutral" the engine will shutoff after one second, as no ground is available to the coil side of the safety stop relay.
5. **Seat Safety Switch Timer**

   The seat safety switch timer provides a one second delay before opening the ground circuit to the safety stop relay coil, should the operator get off the seat without engaging the park brake and disengaging the PTO while the engine is running.
6. **Brake Relay**

   The 10-amp fuse supplies current to the coil side of the brake relay. The other side of the brake relay coil is grounded by:

   - Master or Park Brake switches

   When the master brake or park brake switch is closed the brake relay is energized. The energized brake relay completes the ground path for the PTO and HST safety switches and safety stop relay.

   When the safety stop relay becomes energized the contacts of the relay close, completing the circuit from the 10-amp fuse to the fuel shutoff solenoid.
7. **Engine Stop Solenoid**

   When the engine stop solenoid is energized, the plunger of the solenoid is retracted allowing the fuel to flow the injection pump, enabling the tractor engine to remain running. When the current is disrupted to the engine stop solenoid, the solenoid is not energized, which allows the solenoid plunger to extend and shutoff the flow to the injection pump and stop the engine.

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ENGINE OIL PRESSURE AND ALARM CIRCUIT

The engine oil pressure and alarm circuit includes all circuits and components used to monitor engine oil pressure and alert the operator when the engine oil pressure is less than 29.4 kPa (4.3 psi).

1. Current flow starts at the positive (+) terminal of the tractor battery. From the battery, the current flows to the engine starter motor through the positive (+) battery cable.
2. From the starter motor, current flows through the fusible link wire to the #30 terminal of the key switch. When the key switch is turned to the "ACC/RUN" position, current is supplied to terminal "ACC/RUN".
3. From the "ACC/RUN" terminal of the key switch, current flows to the first 10-amp fuse of the fuse block. The 10-amp fuse sends current to:
   - Terminal #1 of the instrument panel

Oil Pressure Warning Light

1. The oil pressure warning light has current supplied by terminal #1 of the instrument panel. The ground circuit is controlled by the oil pressure switch located on the engine cylinder head.
2. The engine oil pressure switch closes when the engine oil pressure is less than 29.4 kPa (4.3 psi). The closed switch completes the ground circuit to terminal #9 of the instrument panel. Terminal #9 completes the ground circuit for the oil pressure warning light. When current and ground supplied to the warning light, the light illuminates, alerting the operator of a low engine oil pressure condition.

Alarm

1. Current from the 10-amp fuse is also directed to the coil and switch sides of the oil pressure relay.
2. 2When the engine oil pressure is less than 29.4 kPa (4.3 psi) the engine oil pressure switch closes. The oil pressure switch completes the ground circuit for the oil pressure relay.
3. When the relay has current and ground to the coil side of the relay, the relay energizes and latches the relay contacts. The latched relay sends current to the warning alarm. The alarms sounds, alerting the operator of an unsafe engine oil pressure condition.

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HST ELECTRONIC CRUISE CONTROL CIRCUIT (OPTIONAL)

The cruise control circuit includes all circuits and components of the tractor's HST cruise control system.

1. Current flow starts at the positive (+) terminal of the tractor battery. From the battery, the current flows to the engine starter motor through the positive (+) battery cable.
2. From the starter motor, current flows through the fusible link wire to the #30 terminal of the key switch. When the key switch is turned to the "ACC/RUN" position, current is supplied to terminal "ACC/RUN".
3. From the "ACC/RUN" terminal of the key switch, current flows to the middle 10-amp fuse of the fuse block.
4. From the 10–amp fuse, current flows to a junction in the wiring harness.
5. From the junction current flows to another junction in the wiring harness. This second junction sends current to terminal "D" of the cruise control relay and terminal "B" of the brake relay. Terminal "D" is on the switch side of the cruise control relay. Terminal "B" is on the coil side of the brake relay.

Cruise Control Switch

NOTE: *The cruise control switch is a momentary type switch.*

1. Current also is directed from the junction to terminal #5 of the cruise control switch. When the cruise control switch is placed in the "SET" position current flows from terminal #5 to terminal #6 of the switch.
2. From terminal #6 current flows to another junction in the wiring harness. From this junction, current flows back into the cruise control switch at terminal #8 and terminal "A" of the cruise control relay. Terminal #8 supplies current to the cruise control switch internal indicator light and terminal #7 supplies the ground source to the light. The light will illuminate when the cruise control is engaged.
3. When the cruise control switch is released from the "SET" position, the switch will rocker to the "ON" position. When the cruise control switch is in the "ON" position, current is continually supplied to the coil circuit of the cruise control relay. This is achieved by the use of a diode that supplies current coming from the switch side circuit of the cruise control relay to the coil circuit of the cruise control relay. This current loop will remain active until the cruise control switch is placed in the "OFF" position or the master or park brake is engaged.

Cruise Control and Brake Relays

1. From the junction out of terminal #6 of the cruise control switch, current is supplied to terminal "A" coil side of the cruise control relay. The coil circuit, terminal "B", is completed when the ground circuit is supplied by terminal #2 of the cruise control switch, through the internal contact "C" and out terminal #3 of the switch. Ground source for terminal #3 of the switch is supplied by terminal "A" of the brake relay.
2. Terminal "A" is part of the first function circuit for the brake relay. This function circuit is normally closed in the brake relay because the brake relay is not energized until the park brake or the master brake is engaged.
3. When the brake relay is not energized the ground circuit is completed by terminal "C" of the brake relay to the tractor frame.
4. With the cruise control relay energized the switch side of the relay is latched. When the relay is latched current flows into terminal "D" and out of terminal "C".
5. From terminal "C" current flows to a junction in the wiring harness, from this junction current is directed to a diode, which creates a loop to terminal "A" of the cruise control relay. This loop circuit keeps the cruise control relay energized, when the cruise control switch is in the "ON" position.

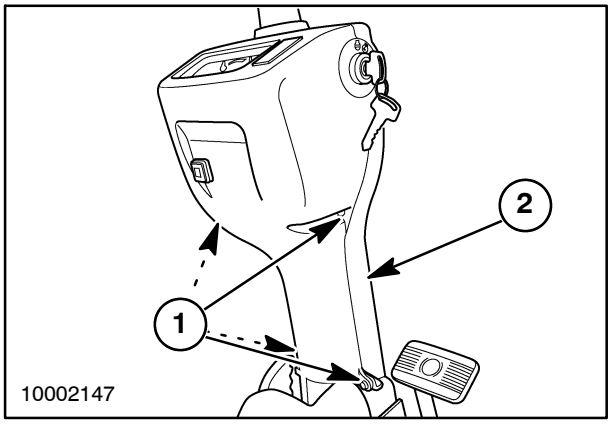
Cruise Control Magnet

1. Terminal "C" of the cruise control relay also supplies current to the cruise control magnet. The magnet ground source is supplied by the tractor frame. When current and ground are supplied to the magnet, the magnet is energized. The energized magnet holds the HST linkage in place, allowing the tractor to be operated at a constant speed.

Master and Park Brake Functions

1. When the master or park brake is engaged the master or park switch close. When either of the switches close, this completes the ground source to coil circuit of the brake relay and energizes the brake relay. The energized relay opens the first function circuit and closes the second function circuit.
2. When the first function circuit of the brake relay is open, the ground circuit for the coil of the cruise control relay is open, which causes the cruise control relay to become energized. When the cruise control relay is not energized, the function circuit no longer supplies current to the diode loop of the cruise control magnet, releasing the HST linkage to the neutral position.

3. Remove the four retaining screws, 1, which secure the front steering column cover, 2, to the tractor. Pull the front steering column cover off of the tractor.



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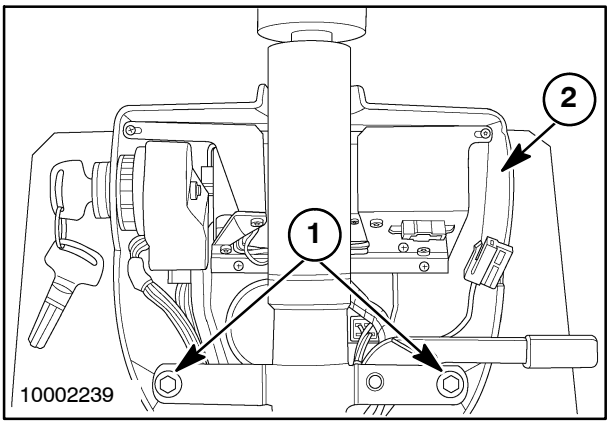
4. Remove the two (2) retaining bolts, 1, which secure the rear steering column cover, 2, to the tractor.



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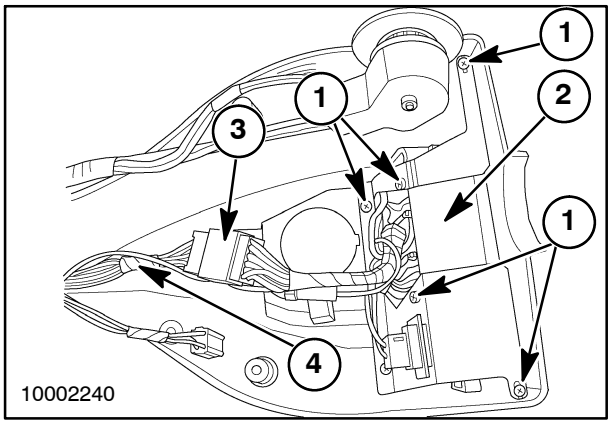
5. Remove the eight screws, 1, which retain the instrument panel, 2, to the steering column cover.
6. Disconnect the instrument panel connector, 3, and the ground connector, 4, from the tractor wiring harness.



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Op. 55 301

CHARGING SYSTEM FOR MC22 TRACTORS

DESCRIPTION AND OPERATION

Alternator

The MC22 tractor is 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.

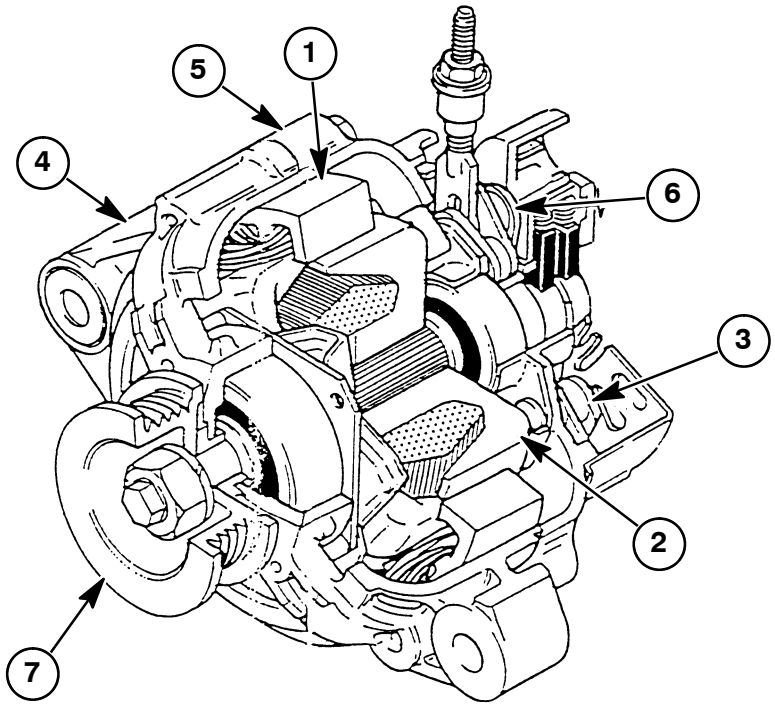
The principle components of the alternator are the stator, 1, the rotor, 2, and the rectifier assembly, 3, and the IC regulator, 6.

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, 6, 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 divided into a drive end (front) frame, 4, and a rear frame, 5. 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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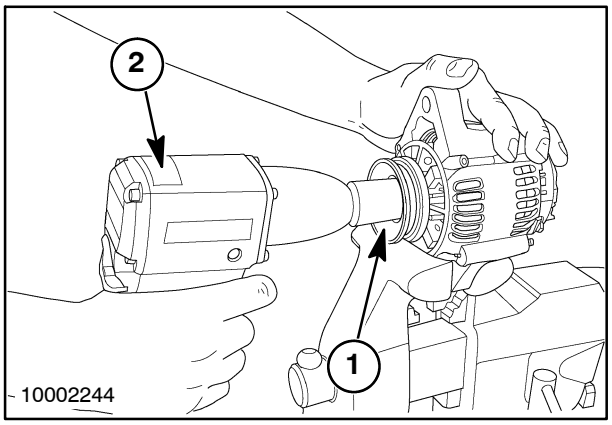
1. Use an impact wrench, 2, to remove the pulley retaining nut, washer, and alternator pulley, 1.



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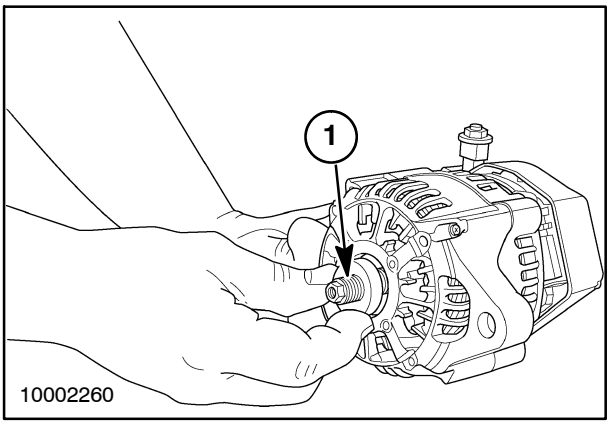
2. Remove the front rotor bushing, 1, from the rotor spindle.



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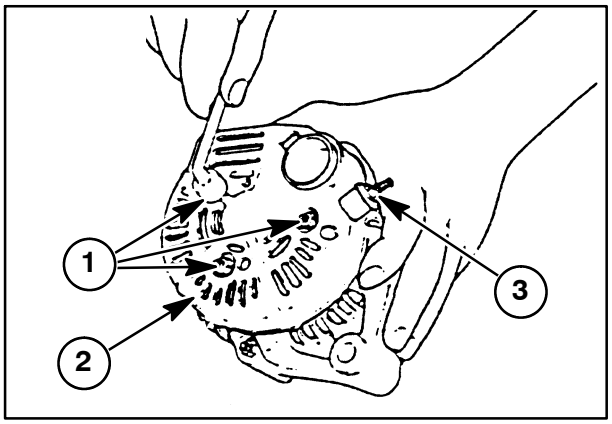
3. Remove the three (3) screws, 1, and the battery terminal nut, 3, from the rear cover of the alternator. Remove the rear cover, 2, from the alternator.



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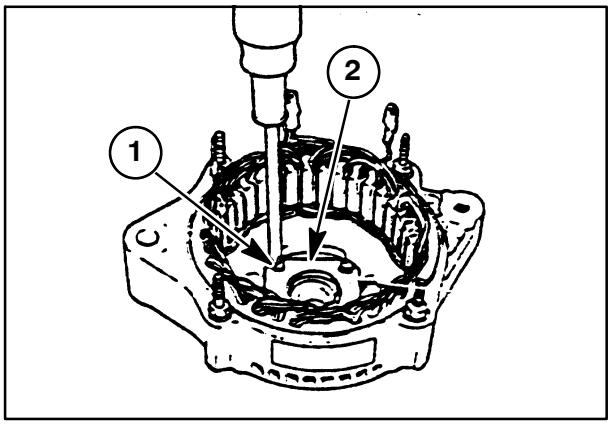
3. Install the front bearing retaining plate, 1, into the front alternator frame and secure using the four (4) retaining screws, 2.



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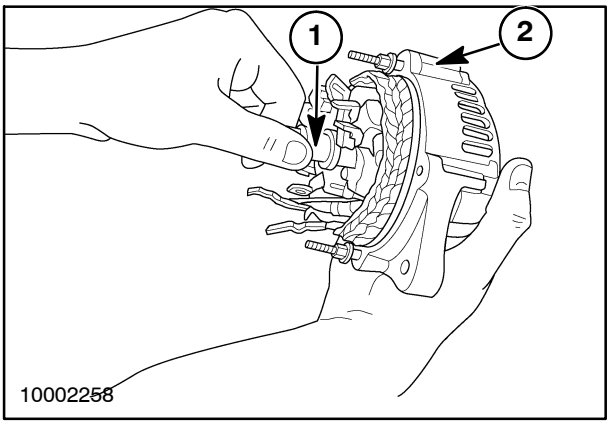
4. Install the rotor, 1, into the front alternator frame, 2.



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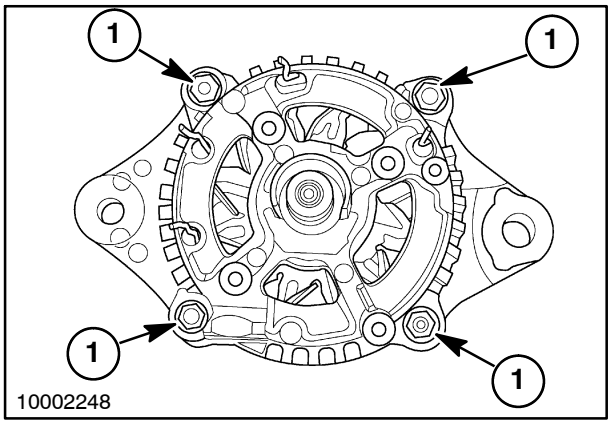
NOTE: *When assembling the front and rear alternator frames, be sure the stator leads are aligned and inserted through the rear alternator frame properly.*

NOTE: *When installing the rear alternator frame onto the rotor, it may be necessary to heat the rear frame (50°-60°C or 122°-140°F) to be able install the frame over the rear rotor bearing.*

5. Assemble the front and rear alternator frames and secure the frames together with the four (4) retaining nuts and bolts, 1.



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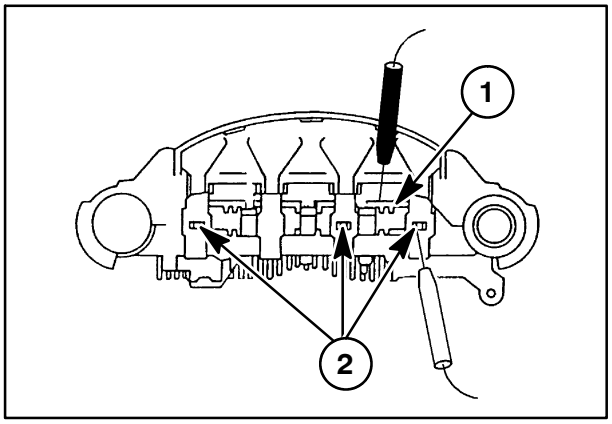
Unstable Charging Circuit

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

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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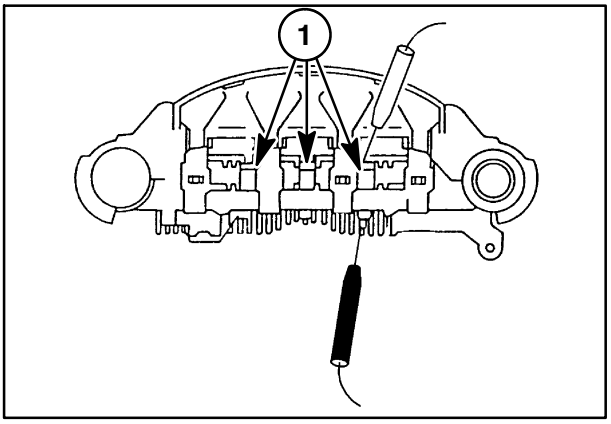
5. Test each of the three small diodes, 1, by touching the positive (+) ohmmeter test probe to one end of a diode and the negative (–) test probe to the opposite end of the diode.
6. Observe the ohmmeter for continuity.
7. Now switch the positions of the test probes and observe the ohmmeter for continuity. 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.



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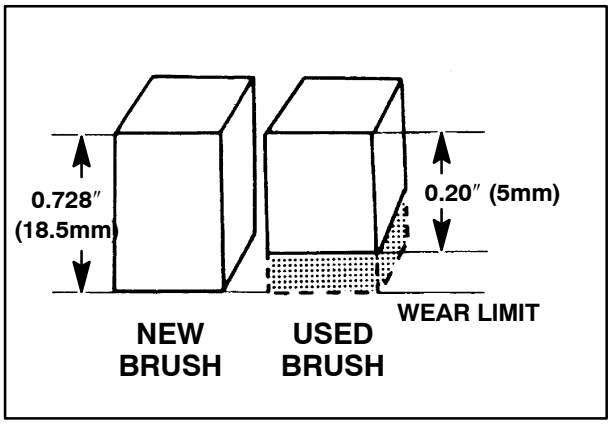
Alternator Brushes

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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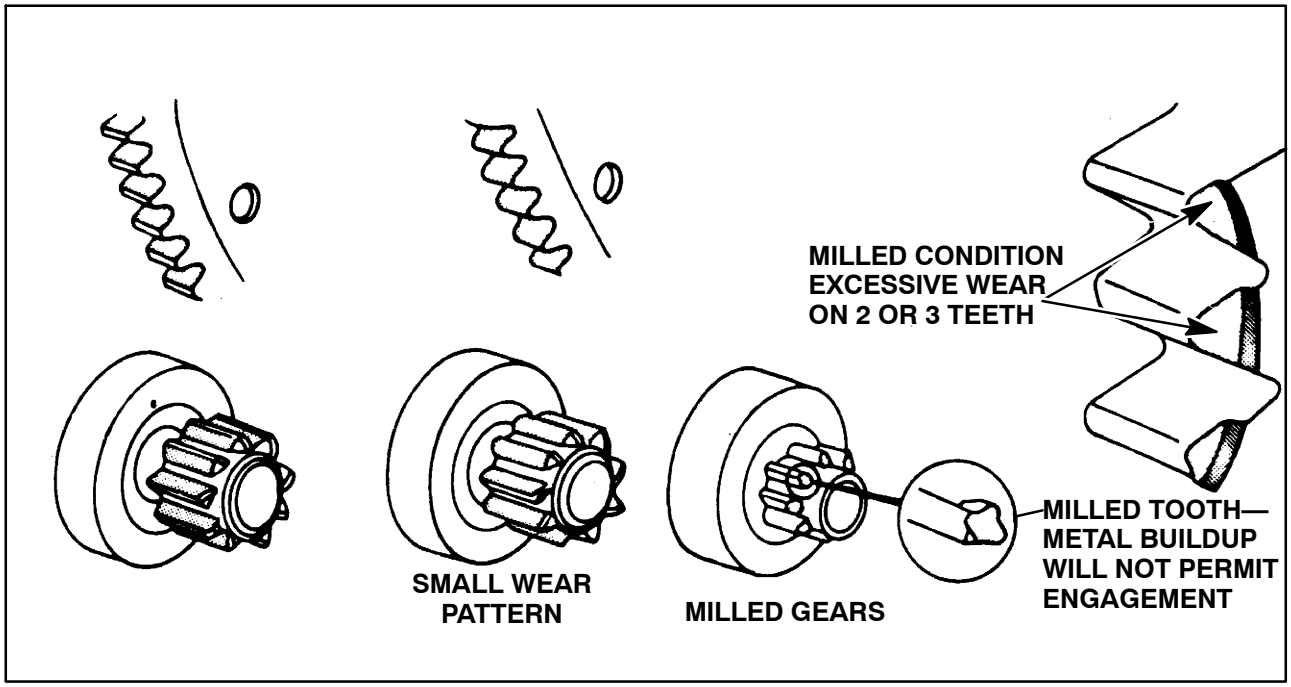
STARTER MOTOR SPECIFICATIONS – MC22

Manufacturer	Denso Corporation
Model	128000-0100
Current Draw	
Under Load	300 amps
No Load	90 amps
Clutch System	Overrunning Pinion Clutch
Brush Length	
New	13.5 mm (0.531 in.)
Wear Limit	9 mm (0.354 in.)
Brush Spring Tension	1.2 - 1.7 kg (2.7 - 3.8 lb.)
Commutator Diameter	
New	30 mm (1.181 in.)
Wear Limit	29 mm (1.142 in.)
Commutator Insulation Depth	0.5 - 0.9 mm (0.020 - 0.035 in.)
Armature Runout	
Commutator	0.2 mm (0.008 in.) max.
Armature Shaft	0.05 mm (0.002 in.) max.

STARTER MOTOR INSPECTION

1. Inspect the gear splines on the pinion clutch, the pinion, the armature, and the intermediate gear 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.
3. Inspect the motor housing, brush cover, gear reduction unit, and starter housing for damage such as cracks, fatigue, wear, etc. Replace any damaged parts.
4. 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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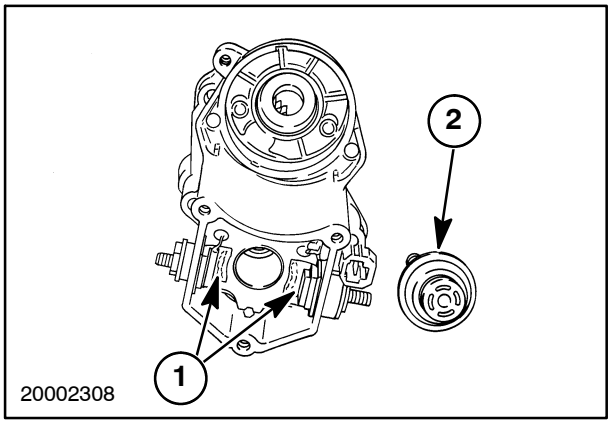
5. Clean and inspect the solenoid plunger contact ring, 1, and solenoid contacts, 2. Dirty contacts or pitting may be cleaned with fine grit sandpaper or a fine abrasive pad.
6. Inspect that all bearings rotate freely when rotated manually by hand and are not damaged or have excessive play. Replace any damaged bearings.



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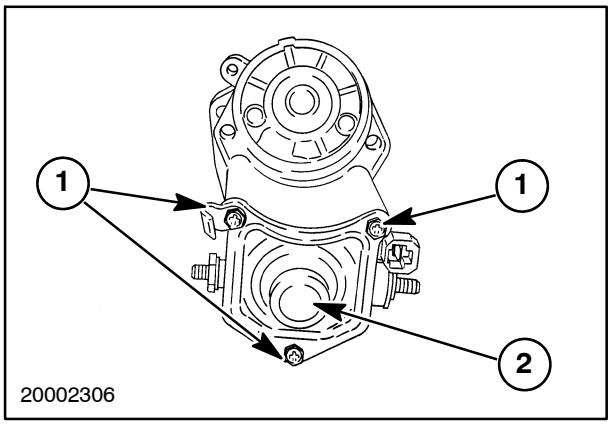
STARTER MOTOR ASSEMBLY

NOTE: *Use white lithium grease to lubricate bearings, gears, etc.*

1. Install the solenoid plunger into the solenoid and secure the solenoid cover, 2, to the starter housing using the three (3) retaining screws, 1.



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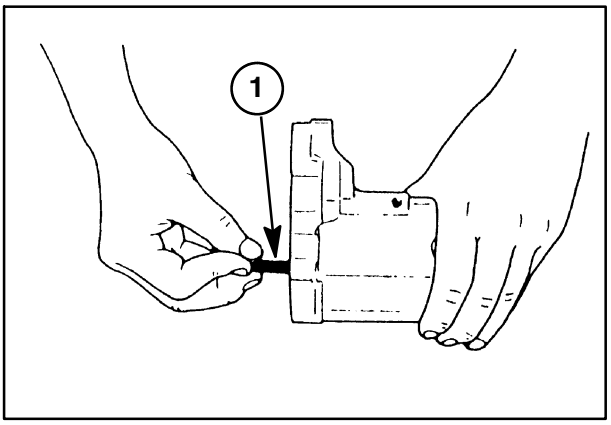
2. Lubricate the return spring, 1, with white lithium grease and install the spring into the solenoid housing and on the plunger.



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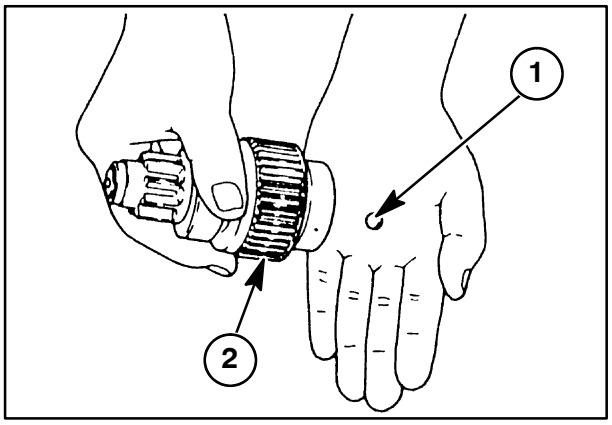
3. Install the steel ball, 1, into the center of the pinion clutch, 2.



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STARTER MOTOR TROUBLESHOOTING - MC28

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

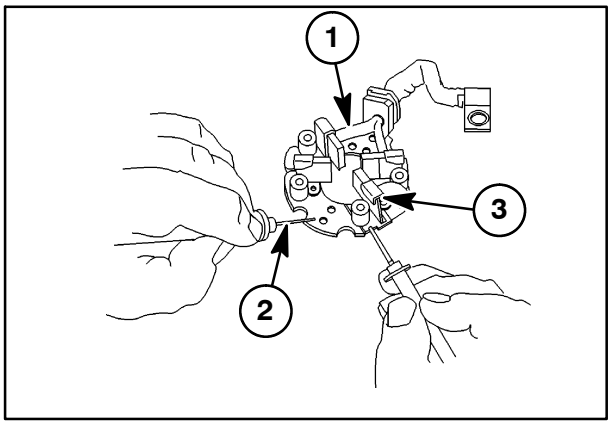
FAULT LOCATION	POSSIBLE CAUSE	CORRECTION
Starting motor	Clutch defective	Replace
	Orbital gear or planetary gears damaged	Replace

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

Brush Holder

1. Use and 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 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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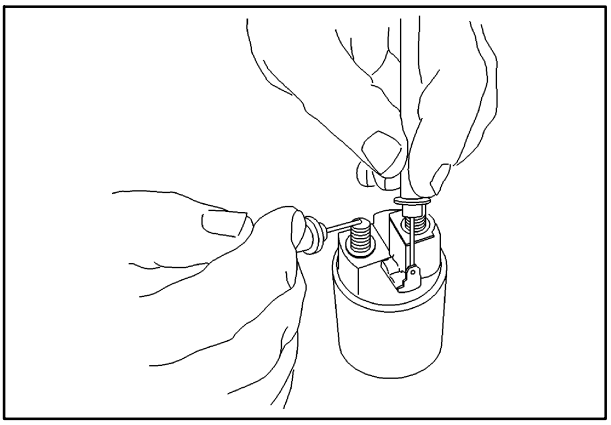
Starter Solenoid

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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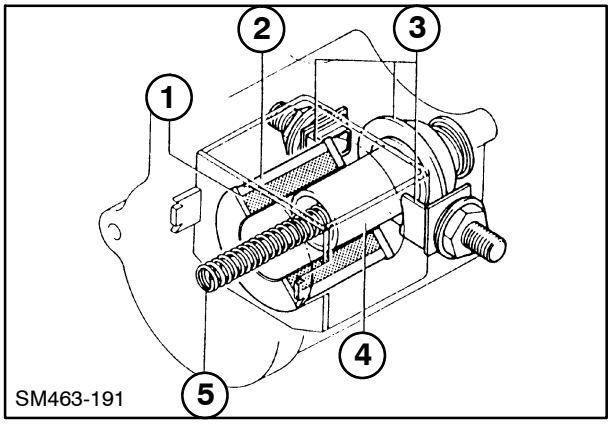
Starter Motor Assembly

The starter motor features a high-speed motor that utilizes a gear reduction unit, an overrunning pinion clutch, 12, and permanent magnets, 4, in a field coil, 5, for magnetic field induction. The reduction unit consists of a small drive gear, 2, on the motor armature, 6, which drives an idler gear, 14, in the reduction unit. The idler gear is splined to the gear on the pinion clutch housing, 12. When the starter solenoid, 10, is energized, the solenoid plunger, 9, pushes the pinion gear, 13, out, engaging with the engine flywheel. The starter motor then is turning the flywheel, which rotates the engine. The use of the gear reduction unit allows use of the compact, high-speed motor and provides more torque and power to turn the engine flywheel. The sliding pinion mechanism is enclosed, resulting in a more durable mechanism.

Starter Solenoid

The starter solenoid is an electromagnetic type solenoid that is located on the bottom of the starter motor assembly. The solenoid contains two coils, a pull-in coil, 1, and a hold-in coil, 2. 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 plunger, 4, pushes a spring, 5, which will then push the pinion gear out to engage the flywheel. At the same time, a set of contacts, 3, 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 non-energized. The hold-in coil continues to engage the pinion gear with the flywheel.



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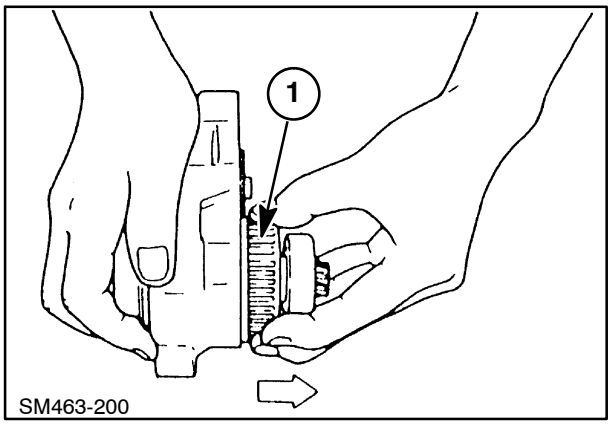
11. Pull the pinion clutch assembly, 1, from the reduction unit cover or the starter motor assembly.



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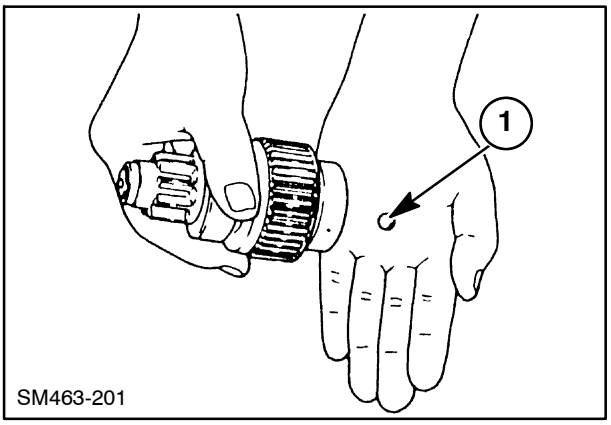
12. Remove the steel ball, 1, from the center of the pinion clutch.



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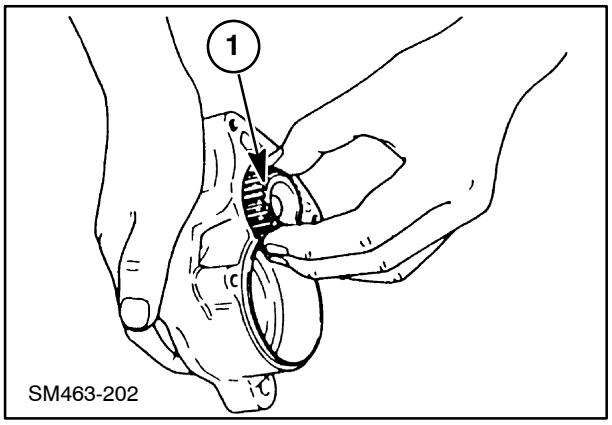
NOTE: *When removing the idler gear and bearing, be careful not to lose the bearing rollers contained in the bearing.*

13. Remove the idler gear and bearing, 1, and pinion gear from the reduction unit cover, if they were not removed when the reduction unit cover and the starter motor housing was separated.



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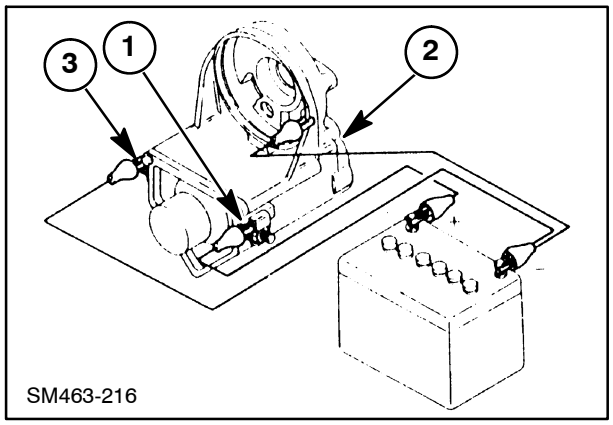
⚠ CAUTION ⚠

Do not perform this test for more than 3 - 5 seconds at a time, as damage may occur to the solenoid or other components.

NOTE: *Be sure to use test leads that have 14 awg wire or thicker for this test.*

9. Connect a test lead from the positive (+) terminal of a 12-volt power source to the starter switch terminal, 1, (spade terminal) of the starter.
10. Use another test lead to connect the negative (-) terminal of the 12-volt power source to the starter housing, 2.
11. Connect a second negative (-) test lead from the 12-volt power source to the field coil terminal, 3. This completes the circuit to send current to the hold-in and pull-in coils of the solenoid.
12. Observe the starter pinion. The solenoid should have caused the pinion to jump forward when the third test lead was connected to the field coil terminal. This indicates the pull-in coil is working properly.
13. Remove the test lead to the field coil terminal, 3, and observe the starter pinion. The solenoid should keep the pinion extended when the third test lead is removed. This indicates the hold-in coil is working properly.
14. If the solenoid fails to perform as described, replace the solenoid assembly.



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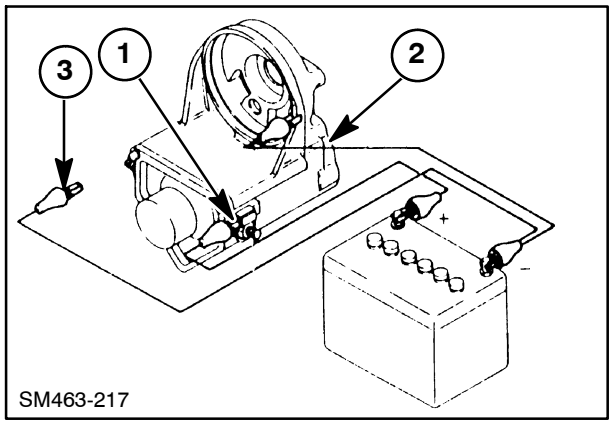

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7. Solenoid housing
8. Return spring
9. Steel ball
10. Pinion clutch
11. Reduction unit housing
12. Idler gear roller bearing
13. Roller
14. Idler gear

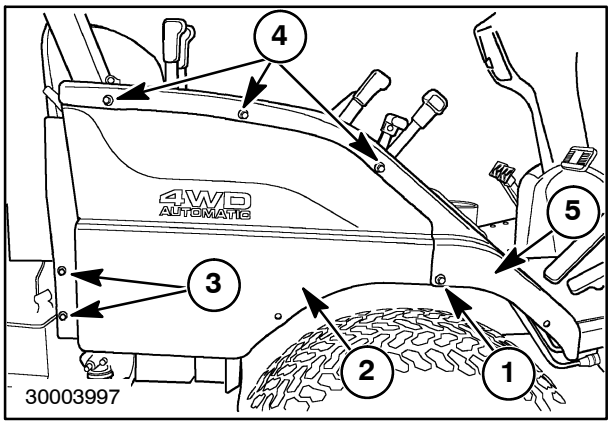
Op. 90 116

FENDERS

Removal

Right Side

1. Remove the retaining bolt, 1, from the right fender side panel, 2.
2. Remove the two screws, 3, from the right fender side cover, 2.
3. Remove the three retaining bolts, 4, to remove the right fender side panel, 2, from the right side fender, 5.



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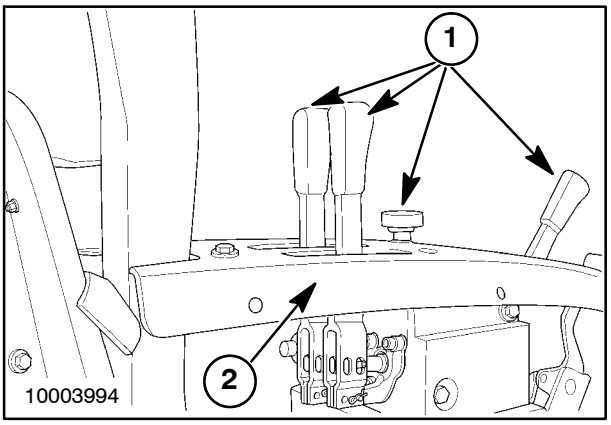
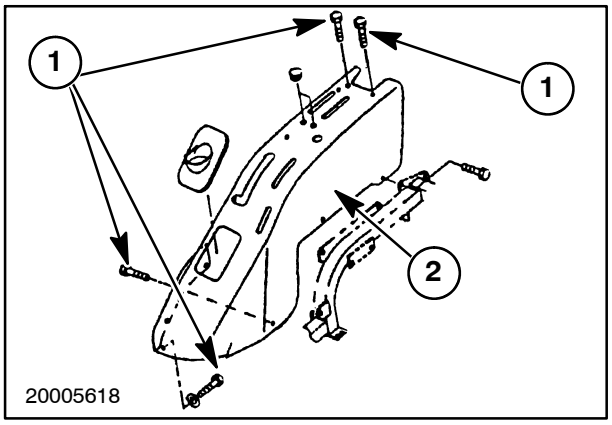
4. Remove any existing control knobs, 1, from the right side fender, 2.



4

NOTE: *Tilt the seat deck forward to gain access to the retaining bolts that are on the inner side of the fender.*

5. Remove the six retaining bolts, 1, which fasten the right fender, 2, to the tractor frame.
6. Remove the right fender, 2, from the tractor.



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Left Side

⚠ CAUTION ⚠

The fuel tank filler cap must be removed to remove the left fender side panel.

- Keep dirt from entering the fuel tank.
- Never remove the fuel cap while the engine is running or hot.
- Never smoke while near fuel.
- Wipe up fuel spills immediately.