

## Service Manual Compact Tractors

7000, 7192, 7193, 7194, 7195, 7200, 7205, 7232, 7233,  
7234, 7235, 7260, 7265, 7272, 7273, 7274, 7275, 7300, 7305.

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## SECTION 1

### GENERAL

### SAFETY



*This symbol means ATTENTION ! BECOME ALERT! YOUR SAFETY IS INVOLVED. The message that follows the symbol contains important information about safety. Carefully read the message. Make sure you fully understand the causes of possible injury or death.*

11 C

To prevent injury always follow the Warning, Caution and Danger notes in this section and throughout the manual.



**WARNING :** Read the operators manual to familiarize yourself with the correct control functions.

46 27



**WARNING :** Operate the machine and equipment controls from the seat position only. Any other method could result in serious injury.

48 55



**WARNING :** This is a one man machine, no riders allowed.

38 5



**WARNING :** Before starting the engine, study the Operators Manual safety messages. Read all safety signs on the machine. Clear the area of other persons. Learn and practice safe use of controls before operating. It is your responsibility to understand and follow manufacturers instructions on machine operation, service, and to observe pertinent laws and regulations.

45 2



**WARNING :** If you wear clothing that is too loose or do not use the correct safety equipment for your job, you can be injured. Always wear clothing that will not catch on objects. Extra safety equipment that can be required includes hard hats, safety shoes, ear protection, eye or face protection, heavy gloves and reflector clothing.

45 3 A



**WARNING :** When working in the area of the fan belt with the engine running avoid loose clothing if possible, and use extreme caution.

35 4



**WARNING :** When doing checks and testing on the equipment hydraulics, follow the procedures as they are written. DO NOT change the procedure

47 44



**WARNING :** When putting the hydraulic cylinders on this machine through the necessary cycles to check operation or to remove air from a circuit, Make sure all people are out of the way.

47 45





**WARNING:** Always use heat protective gloves when handling heated parts.

47 41A



**CAUTION :** Lower all attachments to the ground or use stands to safely support the attachments before you do any maintenance or service.

49 11



**CAUTION :** Pin sized and smaller streams of hydraulic oil under pressure can penetrate the skin and result in serious infection. If hydraulic oil under pressure does penetrate the skin, seek medical treatment immediately. Maintain all hoses and tubes in good condition. Make sure all connections are tight. Make a replacement of any tube or hose that is damaged or thought to be damaged. DO NOT use your hand to check for leaks, use a piece of cardboard or wood.

40 6 A



**CAUTION :** When removing hardened pins such as a pivot pin, or a hardened shaft, use a soft head (brass or bronze) hammer or use a driver made from brass or bronze and use a steel hammer.

46 17



**CAUTION :** When using a hammer to remove and install pivot pins or separate parts using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protection).

46 13



**CAUTION :** Use suitable floor (service) jacks or chain hoists to raise wheels off the floor. Always block machine in place with suitable safety stands.

40 7 A



**CAUTION :** When servicing or repairing the machine. Keep the shop floor and operator's compartment and steps free of oil, water, grease, tools etc. Use an oil absorbing material and or shop cloths as required. Use safe practices at all times.

40 8



**CAUTION :** Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in this Service Manual.

40 10



**DANGER :** Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust tube extension. Open the doors and get outside air into the area.

48 56



**DANGER :** When the battery electrolyte is frozen, the battery can explode if (1), you try to charge the battery or (2), you try to jump start and run the engine. To prevent battery electrolyte from freezing, try to keep the battery at full charge. If you do not follow these instructions you or others in the area can be injured.

48 35



**DANGER :** Batteries contain acid and explosive gas. Explosions can result from sparks, flames or wrong cable connections. To connect the jumper cables correctly to the battery of this machine refer to the Operators Manual. Failure to follow these instructions can cause serious injury or death.

## GENERAL INFORMATION

### CLEANING

Clean all metal parts except bearings, in mineral spirits or by steam cleaning. Do not use caustic soda for steam cleaning. After cleaning, dry and put oil on all parts. Clean oil passages with compressed air. Clean bearings in kerosene, dry the bearings completely and put oil on the bearings.

### INSPECTION

Check all parts when the parts are disassembled. Replace all parts that have wear or damage. Small scoring or grooves can be removed with a hone or crocus cloth. Complete visual inspection for indications of wear, pitting and the replacement of parts necessary, will prevent early failures.

### BEARINGS

Check bearings for easy action. If bearings have a loose fit or rough action, replace the bearings. Wash bearings with a good solvent or kerosene and permit to air dry. **DO NOT DRY BEARINGS WITH COMPRESSED AIR.**

### NEEDLE BEARINGS

Before you press needle bearings in a bore, always remove any metal protrusions in the bore or edge of the bore. Before you press bearings into position, put petroleum jelly on the inside and outside diameter of the bearings.

### GEARS

Check all gears for wear and damage. Replace gears that have wear or damage.

### OIL SEALS, O-RINGS AND GASKETS

Always install new oil seals, o-rings and gaskets. Put petroleum jelly on seals and o-rings.

### SHAFTS

Check all shafts that have wear or damage. Check the bearing and oil seal surfaces of the shafts for damage.

### SERVICE PARTS

Always install genuine Mitsubishi service parts. When ordering, refer to the Parts Catalog for the correct part number of the genuine replacement items. Failures due to the use of other than genuine Mitsubishi replacement parts are not covered by warranty.

### LUBRICATION

Only use the oils and lubricants specified in the Operator's and Service Manuals. Failures due to the use of non-specified oils and lubricants are not covered by warranty.

## STANDARD BOLT TORQUES

Bolt Size	Bolt Grade (Indicated on Bolt Head)			
	4T	6T	7T	8T
5 mm	2 to 3 Nm (1.5 to 2 lb ft)	4 to 5 Nm (3 to 4 lb ft)	5 to 6 Nm (4 to 4.5 lb ft)	6 to 7 Nm (4.5 to 5 lb ft)
6 mm	5 to 7 Nm (4 to 5 lb ft)	8 to 10 Nm (6 to 7.5 lb ft)	10 to 12 Nm (7.5 to 9 lb ft)	12 to 14 Nm (9 to 10.5 lb ft)
8 mm	12 to 17 Nm (9 to 12.5 lb ft)	20 to 25 Nm (15 to 18.5 lb ft)	25 to 29 Nm (18.5 to 21.5 lb ft)	29 to 34 Nm (21.5 to 25 lb ft)
10 mm	20 to 29 Nm (15 to 21.5 lb ft)	39 to 49 Nm (29 to 36 lb ft)	49 to 59 Nm (36 to 43.5 lb ft)	59 to 69 Nm (43.5 to 50 lb ft)
12 mm	44 to 54 Nm (32.5 to 40 lb ft)	69 to 78 Nm (50 to 58 lb ft)	83 to 93 Nm (61 to 68.5 lb ft)	93 to 107 Nm (69 to 79 lb ft)
14 mm	64 to 78 Nm (47 to 58 lb ft)	98 to 118 Nm (72.5 to 87 lb ft)	118 to 132 Nm (87 to 97.5 lb ft)	132 to 147 Nm (97.5 to 108.5 lb ft)
16 mm	88 to 108 Nm (65 to 80 lb ft)	127 to 147 Nm (94 to 108.5 lb ft)	152 to 172 Nm (112 to 127 lb ft)	176 to 196 Nm (130 to 144.5 lb ft)
18 mm	118 to 137 Nm (87 to 101 lb ft)	167 to 185 Nm (123 to 136.5 lb ft)	206 to 235 Nm (152 to 173.5 lb ft)	245 to 275 Nm (181 to 203 lb ft)
20 mm	147 to 167 Nm (108.5 to 123 lb ft)	196 to 216 Nm (144.5 to 159.5 lb ft)	235 to 275 Nm (173.5 to 203 lb ft)	314 to 353 Nm (231 to 260.5 lb ft)

## STANDARD TORQUE DATA FOR REPLACEMENT NUTS AND BOLTS

Torque Specifications +/- 10%		
SIZE	GRADE 8.8	GRADE 10.9
5 mm	5.5 Nm (4 lb ft)	7.5 Nm (5.5 lb ft)
6 mm	9 Nm (7 lb ft)	12.5 Nm (9 lb ft)
8 mm	22.5 Nm (17 lb ft)	31.5 Nm (23 lb ft)
10 mm	44 Nm (32.5 lb ft)	62 Nm (46 lb ft)
12 mm	77.5 Nm (57 lb ft)	110 Nm (81 lb ft)
14 mm	120 Nm (88.5 lb ft)	170 Nm (125.5 lb ft)
16 mm	190 Nm (140 lb ft)	265 Nm (196 lb ft)
18 mm	260 Nm (192 lb ft)	365 Nm (269.5 lb ft)

## GENERAL SPECIFICATIONS

### Capacities

Engine oil capacity with filter change

719 *	3.5 litres	3.7 US Quarts
723 *	3.5 litres	3.7 US Quarts
727 *	4.7 litres	5.0 US Quarts

**NOTE:** Oil filter capacity is 0.5 litres (0.13 US Galls).

Cooling System

719 *	5.7 litres	6.0 US Quarts
723 *	5.3 litres	5.6 US Quarts
727 *	6.4 litres	6.8 US Quarts

Transmission & Hydraulic Oil

719 *		
Gear Drive	19 litres	20.1 US Quarts
Hydrostatic Drive	18 litres	19.0 US Quarts

723 \* and 727 \*

Gear Drive	24 litres	25.4 US Quarts
Hydrostatic Drive	22 litres	23.2 US Quarts

MFD Axle

719 *	3.7 litres	3.9 US Quarts
723 * and 727 *	5 litres	5.3 US Quarts

Fuel Tank

719 *	20 litres	5.2 US Gal
723 * and 727 *	30 litres	7.9 US Gal

**NOTE:** Use the capacities listed above only as a guide. Always use the dipstick or level plug to make sure the units are filled to the correct level.

### Fuel Specifications

A.P.I. Gravity (Min)	34
Flash Point (Min)	60°C 140°F
Cloud Point (Wax Appearance Point) (Max)	-21°C -5.8°F
Pour Point (Max)	-26°C -14.8°F
Distillation Temperature, 90% Point	282 to 338°C 539 to 640°F

Viscosity at 38°C

Centistokes	2.0 to 4.3
Saybolt seconds Universal	32 to 40
Cetane Number (Min)	43 (45 to 55 for winter or high altitudes)

Water and Sediment by Volume (Max)	0.05 of 1%
Sulfur, by weight (Max)	0.50 of 1%
Copper Strip Corrosion (Max)	No. 2
Ash, by weight (Max)	0.01 of 1%

Fuel Filter Cup Service Interval ..... Every 10 Hours  
Fuel Filter Element Change ..... Replace when loss of power or misfiring occurs

Fuel Injectors  
Valve Leakage Rate ..... No Leakage Permissible, Slight Moistening of the Nozzle Tip Is Allowed

## Clutch Specifications

Type  
Single ..... Diaphragm Type  
Dual ..... Belleville Spring Type with Double Dry Plate

Plate Diameter  
Single ..... 200 mm ..... 7.87 inch  
Dual ..... 215 mm ..... 8.46 inch

## Transmission Specifications

719 \*

Gear Drive  
Type ..... Partial Synchromesh, Selective Sliding Gear Type  
Number of Gears ..... 6 forward, 2 reverse  
Controls ..... 2 levers

Hydrostatic Drive  
Type ..... Hydrostatic Transmission with two Selective Sliding Gear Type Range Shift Section  
Number of Gears ..... 2 Speed Ranges  
Controls ..... 1 Lever, 1 Pedal

723 \* and 727 \*

Gear Drive  
Type ..... Synchromesh on Gear Shift with Three Ranges of Selective Sliding Gears  
Number of Gears ..... 9 Forward, 3 Reverse  
Controls ..... 2 Levers

Hydrostatic Drive  
Type ..... Hydrostatic with Three Ranges of Selective Sliding Gears  
Number of Gears ..... 3 Speed Ranges  
Controls ..... 1 Lever, 1 Pedal

## Hydraulic System Specifications

Hydraulic Pump Type ..... Front Mounted, Engine Driven, Pressure Loaded Gear Type

Maximum System Pressure

Steering Pump ..... 13700 kPa ..... 1987 psi

(Main Pump) ..... 14700 kPa ..... 2133 psi

Steering Pump Output at Rated Engine Speed

719 \* ..... 11.9 L/min ..... 3.1 US gpm

723 \* and 727 \* ..... 12.4 L/min ..... 3.3 US gpm

Main Pump Output at Rated Engine Speed

719 \* ..... 20.4 L/min ..... 5.4 US gpm

723 \* and 727 \* ..... 27.6 L/min ..... 7.3 US gpm

Remote Hydraulic Control Valve ..... One Double Acting Auxiliary Valve With Float Position

## Electrical Specifications

Type of System ..... 12 Volts, Negative Ground

Batteries

Number of Batteries Required ..... 1

Voltage of the Battery ..... 12 Volts

Reserve Capacity ..... 70 Minutes

Cold Cranking Capacity

719 \* ..... 410 Amperes

723 \* and 727 \* ..... 480 Amperes

Starter Motor

Manufacturer ..... Mitsubishi

No Load Test at 20°C (68° F)					
	Voltage	Current Draw (Amps)	Armature Speed (rpm)	Minimum Brush Length	Armature End Play
719 * and 723 *	11	130	3850	13 mm (0.51 inch)	0 to 0.5 mm (0 to 0.02 inch)
727 *	11.5	100	3000	13 mm (0.51 inch)	0 to 0.5 mm (0 to 0.02 inch)

Alternator

Manufacturer ..... Mitsubishi

Output ..... 12 Volts at 40 Amperes

## Steering Specifications

Type .....	Hydrostatic Type	
Front Axle - MFD		
Toe-in adjustment .....	0 to 5 mm	0 to 0.20 inch
Steering Hand Pump		
Type .....	Eaton	
Model		
719 * .....	261-9023-502	
723 * and 727 * .....	261-9009-502	
Displacement		
719 * .....	40 cm <sup>3</sup> /rev	2.44 in <sup>3</sup> /rev
723 * and 727 * .....	51 cm <sup>3</sup> /rev	3.11 in <sup>3</sup> /rev

## ENGINE SPECIFICATIONS

### Cylinder Block

Type .....	Sleeved	
Material .....	Cast Iron	
Bore		
719 * .....	76 mm	2.99 inch
723 * .....	82 mm	3.22 inch
727 * .....	84 mm	3.30 inch
Stroke		
719 * .....	78 mm	3.07 inch
723 * .....	78 mm	3.07 inch
727 * .....	90 mm	3.54 inch
Cylinder Liner out of Round (Maximum) .....	0.01 mm	0.0004 inch

### Piston

Type .....	Solid	
Material .....	Aluminium Alloy	
Outside Diameter at Piston Skirt		
719 * .....	76 mm	2.99 inch
723 * .....	82 mm	3.22 inch
727 * .....	84 mm	3.30 inch

### Piston Pin

Type .....	Full Floating	
Diameter		
719 * and 723 * .....	23 mm	0.90 inch
727 * .....	27 mm	1.06 inch



## Piston Ring Gap

### Compression Rings

719 *	0.15 to 0.4 mm	0.006 to 0.016 inch
723 * and 727 *	0.2 to 0.4 mm	0.008 to 0.016 inch

### Oil Control Ring

719 *	0.15 to 0.4 mm	0.006 to 0.016 inch
723 * and 727 *	0.3 to 0.45 mm	0.011 to 0.017 inch

## Cylinder Head

Warpage (Maximum)	0.10 mm	0.004 inch
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## Connecting Rods

### Connecting Rod Bushing ID

719 * and 723 *	23 mm	0.90 inch
727 *	27 mm	1.06 inch

### Connecting Rod Bearing ID

719 * and 723 *	42 mm	1.65 inch
727 *	48 mm	1.89 inch

Bearing Oil Clearance	0.15 mm	0.006 inch
Connecting Rod Bend and Distortion (Maximum)	0.15 mm	0.006 inch

## Camshaft

### Valve Camshaft

Journal to Cylinder Block or Bush Clearance (Maximum)	0.15 mm	0.006 inch
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### Fuel Pump Camshaft

Camshaft Lobe Height	44 mm	1.73 inch
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## Gear Train

### Backlash

Crankshaft Gear to Idler Gear	0.01 to 0.14 mm	0.0004 to 0.005 inch
Idler Gear to Valve Camshaft	0.01 to 0.14 mm	0.0004 to 0.005 inch
Idler Gear to Injection Pump Camshaft	0.01 to 0.14 mm	0.0004 to 0.005 inch

## Intake Valve

Tappet Clearance (Cold) .....	0.25 mm	0.009 inch
Face Angle .....		45 degrees
Valve Head Edge Thickness (minimum) .....	0.5 mm	0.019 inch
Valve Recession Below Head Surface .....	0.5 mm	0.019 inch
Maximum Service Limit .....	1.5 mm	0.05 inch
Valve Stem to Guide Clearance .....	0.10 mm	0.003 inch

## Exhaust Valve

Tappet Clearance (Cold) .....	0.25 mm	0.009 inch
Face Angle .....		45 degrees
Valve Head Edge Thickness (minimum) .....	0.5 mm	0.019 inch
Valve Recession Below Head Surface .....	0.5 mm	0.019 inch
Maximum Service Limit .....	1.5 mm	0.05 inch
Valve Stem to Guide Clearance .....	0.15 mm	0.005 inch

## Valve Springs

Free Length		
719 * and 723 * .....	43 mm	1.69 inch
727 * .....	45.5 mm	1.79 inch

## Crankshaft

Crankshaft Main Journals		
719 * and 723 * .....	52 mm	2.04 inch
727 * .....	58 mm	2.28 inch
Maximum Wear .....	0.85 mm	0.033 inch

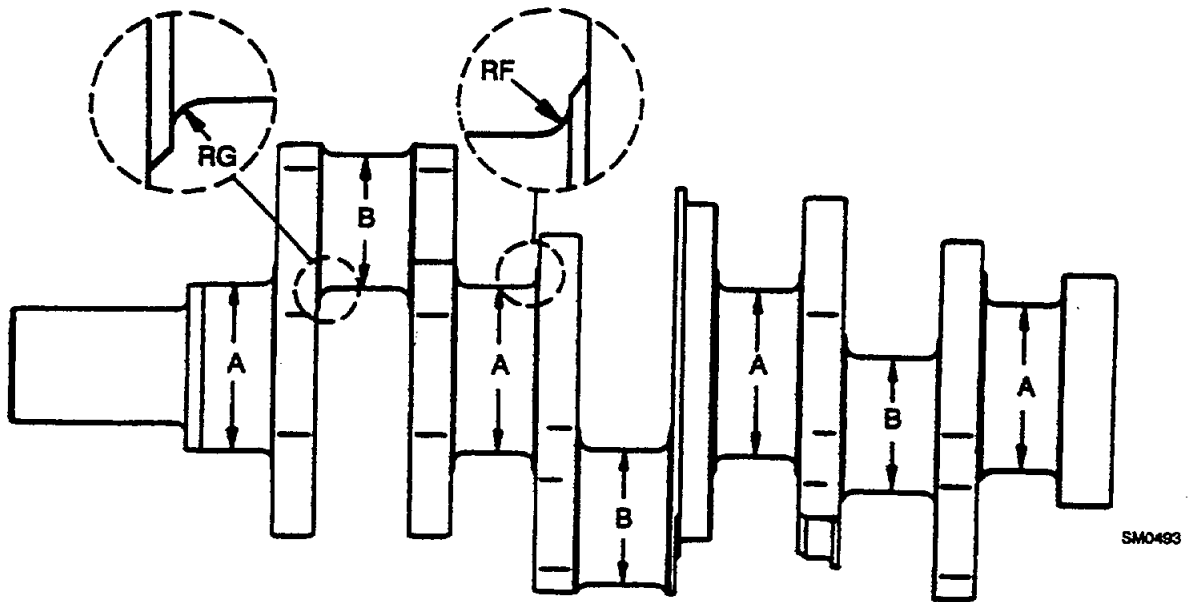
Crankshaft Connecting Rod Journals		
719 * and 723 * .....	42 mm	1.65 inch
727 * .....	48 mm	1.88 inch
Maximum Wear .....	0.90 mm	0.035 inch

Crankshaft Main Bearing Clearance		
Service Limit .....	0.10 mm	0.003 inch

Crankshaft End Play		
719 * /723 * /727 * .....	0.05 to 0.205 mm	0.0019 to 0.008 inch

Connecting Rod Bearing Clearance		
Service Limit .....	0.15 mm	0.005 inch

## Crankshaft Reconditioning Dimensions



Description	Limits for Undersize Crankshaft Grinding			
	719 * and 723 *		727 *	
	A	B	A	B
1st Undersize	51.750 mm (2.0374 inch)	41.750 mm (1.6437 inch)	56.710 mm (2.2327 inch)	47.750 mm (1.8799 inch)
0.25 mm (0.0098 inch)	51.650 mm (2.0334 inch)	41.735 mm (1.6431 inch)	56.695 mm (2.2321 inch)	47.600 mm (1.8740 inch)
2nd Undersize	51.500 mm (2.0275 inch)	41.500 mm (1.6338 inch)	56.460 mm (2.2228 inch)	47.500 mm (1.8700 inch)
0.50 mm (0.0196 inch)	51.400 mm (2.0236 inch)	41.485 mm (1.6332 inch)	56.445 mm (2.2222 inch)	47.350 mm (1.8641 inch)
3rd Undersize	51.250 mm (2.0177 inch)	41.250 mm (1.6240 inch)	56.210 mm (2.2130 inch)	47.250 mm (1.8602 inch)
0.75 mm (0.0295 inch)	51.150 mm (2.0137 inch)	41.235 mm (1.6234 inch)	56.195 mm (2.2124 inch)	47.100 mm (1.8543 inch)

Radius RF (Journals) ..... 2.5 mm ..... 0.098 inch  
 Radius RG (Crankpins) ..... 2.5 mm ..... 0.098 inch

## SPECIAL TORQUES

Axle Support Bolts .....	49 to 59 Nm	36 to 43.5 lb ft
Clutch Cover Retaining Bolts .....	25 to 29 Nm	18.5 to 21.5 lb ft
Connecting Rod Nuts		
719 * .....	31 to 34 Nm	23 to 25 lb ft
723 * .....	31 to 34 Nm	23 to 25 lb ft
727 * .....	39 to 42 Nm	29 to 31 lb ft
Crankshaft Pulley Retaining Nut .....	197 to 245 Nm	145 to 181 lb ft
Cylinder Head Retaining Bolts		
M10 .....	64 to 78 Nm	47 to 57.5 lb ft
M12 .....	98 to 108 Nm	72 to 80 lb ft
M14 .....	146 to 157 Nm	108 to 116 lb ft
Delivery Valve Holders .....	40 to 50 Nm	29.5 to 37 lb ft
Fender Support Bolts .....	83 to 93 Nm	61 to 69 lb ft
Fender Support to Axle Bolts .....	118 to 132 Nm	87 to 97.5 lb ft
Flywheel Retaining Bolts .....	112 to 122 Nm	82.5 to 90 lb ft
Front Wheel Bolts .....	118 to 132 Nm	87 to 97.5 lb ft
Fuel Injection Pump Retaining Bolts .....	10 to 13 Nm	7.5 to 9.5 lb ft
Fuel Tank Drain Bolt .....	12 to 17 Nm	9 to 12.5 lb ft
Glow Plug .....	13 to 19 Nm	9.5 to 14 lb ft
Injection Tube Nuts .....	24 to 34 Nm	18 to 25 lb ft
Injector Clamp Bolts .....	15 to 20 Nm	11 to 15 lb ft
Hitch Control Valve Retaining Bolts .....	19 to 24 Nm	14 to 18 lb ft
Hydraulic Lift Housing Retaining Bolts .....	49 to 59 Nm	36 to 43.5 lb ft
King Pin Lever Bolt .....	30 to 40 Nm	22 to 29.5 lb ft
Lift Cylinder Head Retaining Bolts		
719 * .....	83 to 93 Nm	61 to 68.5 lb ft
723 * and 727 * .....	206 to 225 Nm	152 to 166 lb ft
Main Bearing Cap Retaining Bolts .....	49 to 54 Nm	36 to 40 lb ft
MFD Differential Gear Retaining Bolts .....	41 to 49 Nm	30 to 36 lb ft
MFD Hub Retaining Bolts .....	49 to 59 Nm	36 to 43.5 lb ft
MFD Swivel Housing Retaining Bolts .....	49 to 59 Nm	36 to 43.5 lb ft
Power Arm Retaining Bolt .....	10 to 12 Nm	7.5 to 9 lb ft
Rear Axle Retaining Bolts		
719 * .....	83 to 93 Nm	61 to 69 lb ft
723 * and 727 * .....	118 to 132 Nm	87 to 97.5 lb ft
Remote Hydraulic Control Valve Retaining Bolts .....	19.5 Nm	14.5 lb ft
ROPS Bracket Bolts .....	83 to 93 Nm	61 to 69 lb ft
ROPS Frame Pivot Bolts .....	44 to 54 Nm	32.5 to 40 lb ft
ROPS Frame Lock Bolts .....	44 to 54 Nm	32.5 to 40 lb ft
Solenoid Locknut .....	40 to 50 Nm	29.5 to 37 lb ft
Starter Motor Mounting Bolts .....	49 to 59 Nm	36 to 43.5 lb ft
Steering Hand Pump End Cover Bolts .....	20 Nm	15 lb ft
Tie Rod Ball Joint Nut .....	30 to 40 Nm	22 to 29.5 lb ft
Tie Rod Locknuts .....	60 to 90 Nm	44 to 66.5 lb ft
Wrist Pin Retaining Bolts .....	10 to 12 Nm	7.5 to 9 lb ft

## SECTION 2

## ENGINE

### GENERAL ENGINE SPECIFICATIONS

#### Engine Type

719 \* ..... K3E-14R 3 Cylinder Diesel Indirect Injection

723 \* ..... K3G-D14R 3 Cylinder Diesel Direct Injection

727 \* ..... K3M-D14R 3 Cylinder Diesel Direct Injection

Number of Cylinders ..... 3

#### Compression Ratio

Direct Injection ..... 18:1

Indirect Injection ..... 23:1

Compression Between Each Cylinder ..... 250 kPa 36 psi

#### Static Timing Advance

Direct Injection - 723 \* and 727 \* ..... 20° B T D C

Indirect Injection - 719 \* ..... 17° BTDC

#### Valve Clearance

Cold ..... 0.25 mm 0.0098 inch

Injection Order ..... 1,3,2

#### Cylinder Head Gasket Material

Direct Injection ..... Grafoil

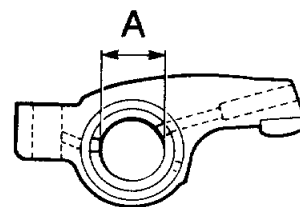
Indirect Injection ..... Carbongraphite with Stainless Steel Grommets

### SPECIFICATIONS

#### Rocker and Rocker Shaft

Dimension 'A' ..... 18.8 to 18.9 mm  
0.740 to 0.744 inch

Dimension 'B' ..... 18.9 to 18.8 mm  
0.744 to 0.740 inch



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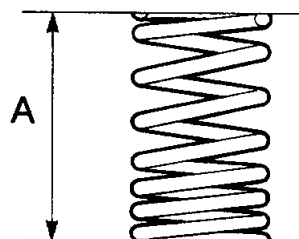
#### Valve Springs

##### 719 \* and 723 \*

Free Length 'A' ..... 42 mm 1.65 inch

##### 727 \* only

Free Length 'A' ..... 44.5 mm 1.75 inch

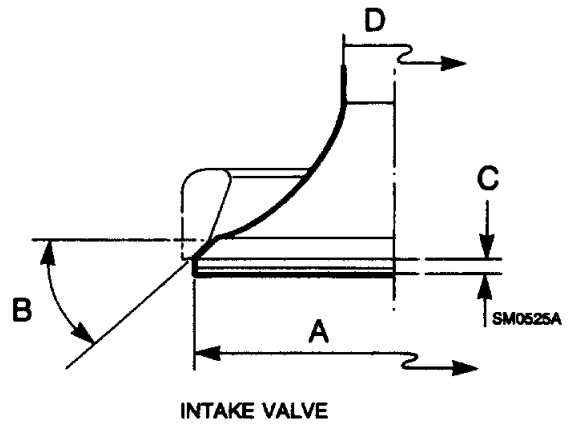


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## Valves

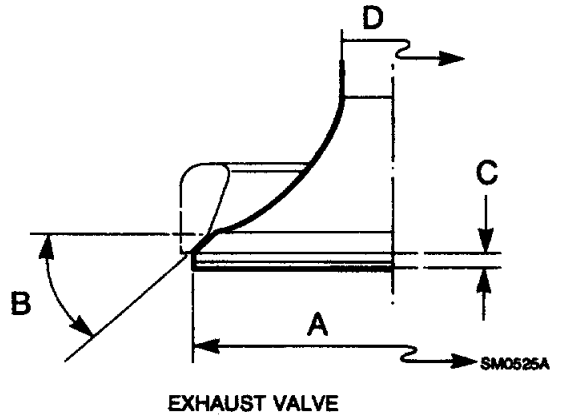
### Dimension

'A'(719 * and 723 * )	32.2 mm	1.27 inch
'A'(727 * )	34.0 mm	1.34 inch
'B'	45°	
'C'	1.0 to 0.5 mm	0.039 to 0.020 inch
'D'(719 * and 723 * )	6.0 to 6.55 mm	0.24 to 0.26 inch
'D'(727 * )	8.0 to 7.95 mm	0.314 to 0.312 inch



### Dimension

'A'(719 * and 723 * )	27.2 mm	1.07 inch
'A'(727 * )	29.0 mm	1.14 inch
'B'	45°	
'C'	1.0 to 0.5 mm	0.039 to 0.020 inch
'D'(719 * and 723 * )	6.0 to 6.55 mm	0.24 to 0.26 inch
'D'(727 * )	8.0 to 7.95 mm	0.314 to 0.312 inch

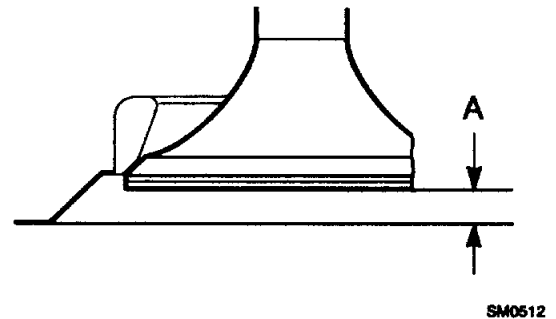


### Valve Head Depth

Dimension 'A'	0.5 to 1.5 mm
	0.019 to 0.059 inch

**NOTE:** To measure the valve seat dimension 'A' use a straight edge between the cylinder head surface and valve. A new valve must be used to achieve a correct measurement.

## Valve Seats



## Oil Pump

Type	Trochoid Pump	
Drive	by the injection pump camshaft	
Oil filter by-pass pressure	98 kPa	14.22 psi
Relief valve pressure	390 kPa	57 psi
Oil switch closing pressure	48 kPa	7 psi
Outer rotor to body clearance		
Dimension	0.15 to 0.3 mm	0.006 to 0.011 inch
Outer rotor to inner rotor clearance		
Dimension	0.05 to 0.24 mm	0.002 to 0.009 inch
Rotor to cover clearance		
Dimension	0.03 to 0.20 mm	0.001 to 0.007 inch

## Pistons

### Piston Ring End Gap

#### Compression Ring

719 \* ..... 0.15 to 1.5 mm  
0.006 to 0.060 inch

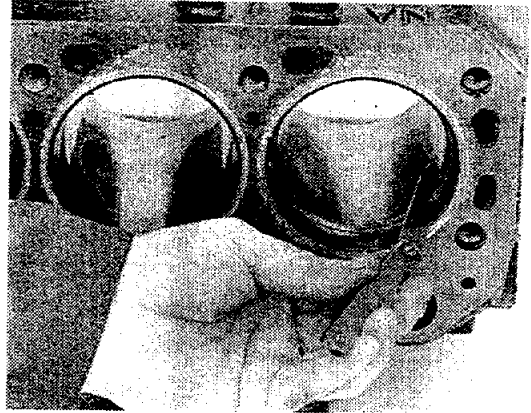
723 \* and 727 \* ..... 0.2 to 1.5 mm  
0.007 to 0.060 inch

#### Oil Control Ring

719 \* ..... 0.15 to 1.5 mm  
0.006 to 0.060 inch

723 \* and 727 \* ..... 0.3 to 1.5 mm  
0.011 to 0.060 inch

**NOTE:** Make the measurement with new piston rings.



E05022

### Piston Ring Groove

#### 719 \*

1st compression ring groove 0.20 to 0.30 mm  
0.0078 to 0.011 inch

2nd compression ring groove 0.05 to 0.20 mm  
0.0019 to 0.0078 inch

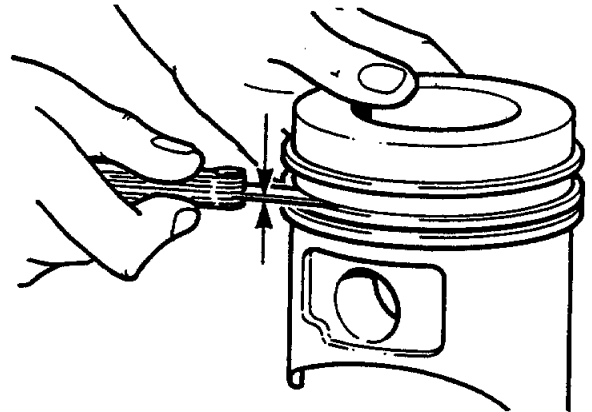
Oil control ring groove ..... 0.03 to 0.20 mm  
0.0011 to 0.0078 inch

#### 723 \* and 727 \*

1st compression ring groove 0.06 to 0.30 mm  
0.0023 to 0.011 inch

2nd compression ring groove 0.07 to 0.20 mm  
0.0027 to 0.0078 inch

Oil control ring groove ..... 0.05 to 0.20 mm  
0.0019 to 0.0078 inch

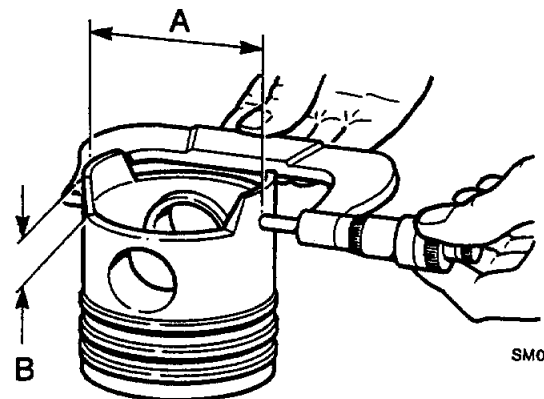


SM0527

### Piston Diameter Wear

Out of round tolerance 'A' ..... 0.30 mm  
0.011 inch

Measuring point 'B' ..... 10.0 mm  
0.39 inch



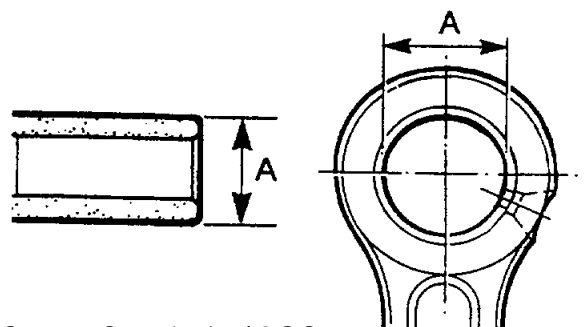
SM0528

### Piston Pin and Small End Bushing

#### Dimension 'A'

719 \* and 723 \* ..... 23.041 to 22.991 mm  
0.907 to 0.905 inch

727 \* ..... 27.041 to 26.991 mm  
1.064 to 1.062 inch



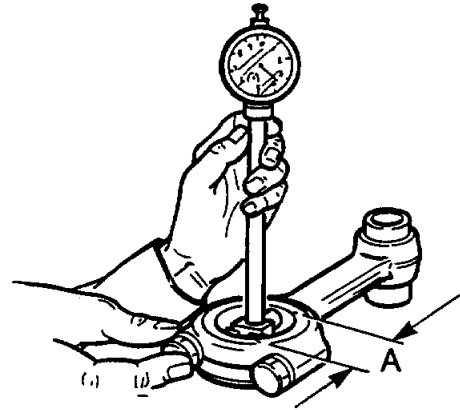
SM0554



## Connecting Rod

### Connecting Rod Bearings (with bearings 'A' installed)

719 * and 723 *	42.0 to 42.15 mm 1.653 to 1.659 inch
727 *	48.0 to 48.15 mm 1.889 to 1.895 inch



SM0535

## Crankshaft

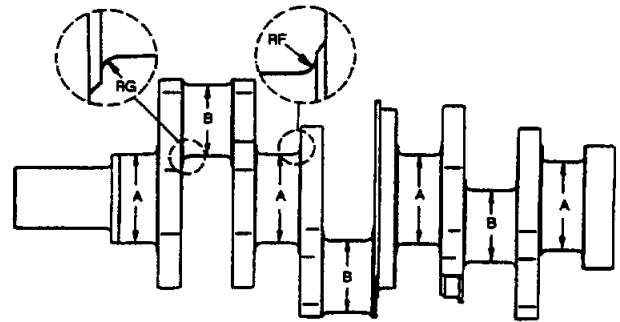
### Material

Standard Crank: Made of carbon steel with journals, pins and oil seal areas induction hardened to improve wear resistance and durability.

### Machining

Use the table showing the grinding tolerance to service the crankshaft.

**NOTE:** All fillet radii (RG and RF) should be ground to 2.5 mm.



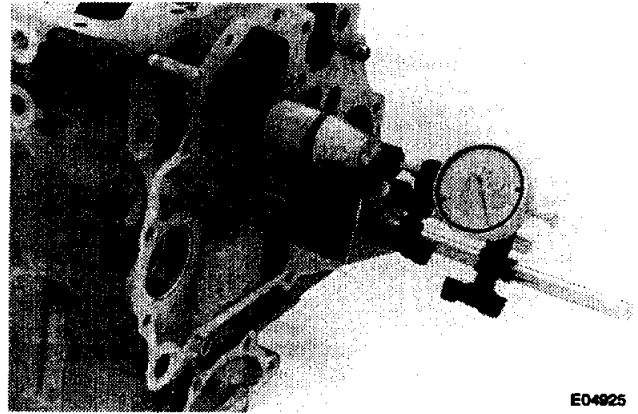
SM0493A

**NOTE:** When checking for crankshaft wear measure as shown using a micrometer.

Description	Limits for Undersize Crankshaft Grinding			
	719 * and 723 *		727 *	
	A	B	A	B
1st Undersize	51.750 mm (2.0374 inch)	41.750 mm (1.6437 inch)	56.710 mm (2.2327 inch)	47.750 mm (1.8799 inch)
0.25 mm (0.0098 inch)	51.650 mm (2.0334 inch)	41.735 mm (1.6431 inch)	56.695 mm (2.2321 inch)	47.600 mm (1.8740 inch)
2nd Undersize	51.500 mm (2.0275 inch)	41.500 mm (1.6338 inch)	56.460 mm (2.2228 inch)	47.500 mm (1.8700 inch)
0.50 mm (0.0196 inch)	51.400 mm (2.0236 inch)	41.485 mm (1.6332 inch)	56.445 mm (2.2222 inch)	47.350 mm (1.8641 inch)
3rd Undersize	51.250 mm (2.0177 inch)	41.250 mm (1.6240 inch)	56.210 mm (2.2130 inch)	47.250 mm (1.8602 inch)
0.75 mm (0.0295 inch)	51.150 mm (2.0137 inch)	41.235 mm (1.6234 inch)	56.195 mm (2.2124 inch)	47.100 mm (1.8543 inch)

## Crankshaft End Play

End Play Tolerance ..... 0.05 to 0.50 mm  
0.0019 to 0.019 inch



E04925

## Camshaft

### Engine Camshaft

INTAKE and EXHAUST cam lift.

New

719 \* ..... 35.76 to 34.76 mm  
1.407 to 1.368 inch

723 \* and 727 \* ..... 35.72 to 34.72 mm  
1.406 to 1.366 inch

Camshaft Journal Tolerance

Front (bushing)..... 45.0 to 44.95 mm  
1.771 to 1.769 inch

Center..... 44.0 to 43.925 mm  
1.732 to 1.729 inch

Rear..... 34.0 to 33.925 mm  
1.338 to 1.335 inch

### Injection Pump Camshaft

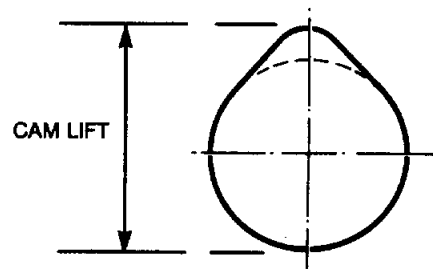
Injection Pump Cam Lift..... 44.0 to 43.0 mm  
1.732 to 1.692 inch

Camshaft Journal Tolerance

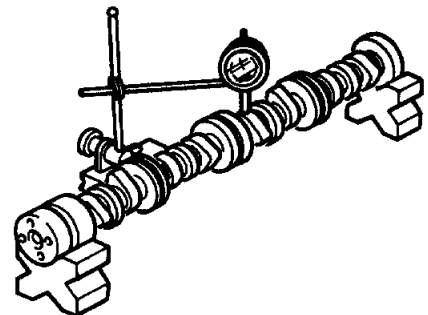
Rear..... 25.0 to 24.925 mm  
0.984 to 0.981 inch

Coupling Groove Tolerance

Width..... 5.0 to 4.5 mm  
0.196 to 0.177 inch



SM0555



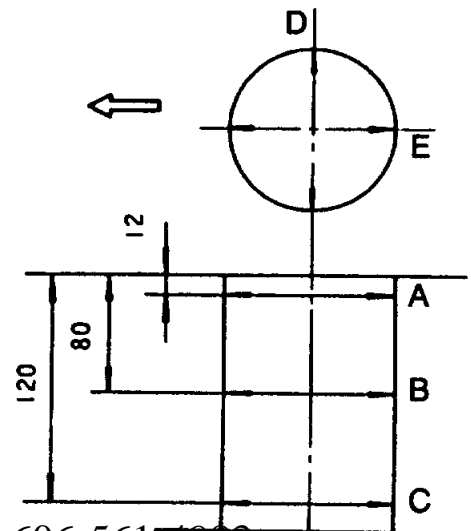
CHECKING CAMSHAFT WEAR

SM0530

## Cylinder Block

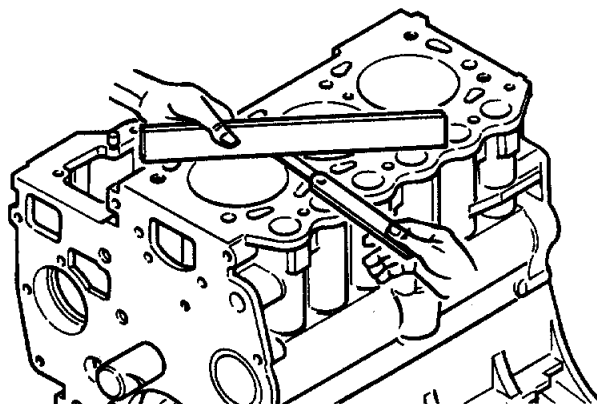
(A), (B), (C) to be within ..... 0.01 to 0.20 mm  
0.00039 to 0.00787 inch

D & E Out of round ..... 0.01 mm  
0.00039 inch



## Cylinder Block (Cont.)

Cylinder Block Distortion ..... 0.05 to 0.10 mm  
0.0019 to 0.0039 inch



SM0489

## Cooling System

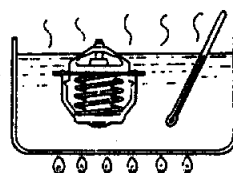
### Thermostat (A) Wax Type

Start to open .....  $82.0 \pm 1.5^{\circ}\text{C}$  .....  $179 \pm 2.7^{\circ}\text{F}$

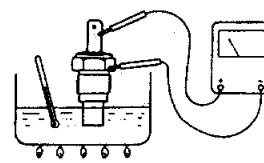
Fully open ..... 8 mm lift at  $95^{\circ}\text{C}$   
0.135 inch lift at  $203^{\circ}\text{F}$

### Sender unit (with water above $70^{\circ}\text{C}$ ( $158^{\circ}\text{F}$ ))

Temperature	Resistance
$70^{\circ}\text{C}$ ( $158^{\circ}\text{F}$ ) .....	$104 \pm 13.5$ ohms
$115^{\circ}\text{C}$ ( $239^{\circ}\text{F}$ ) .....	$23.8 \pm 2.5$ ohms



SM0507A



SM0570

Cooling Fan ..... 5 blades  
Fan belt deflection with 10 Kg  
(22 inch pounds) pull ..... 10 to 12 mm  
0.39 to 0.47 inch

## Fuel System

### FUEL SYSTEM

Injection Order .....	1, 3, 2
Fuel Tank Capacity (719 * ) .....	20 litres 5.28 U.K. gal
Fuel Tank Capacity (723 * and 727 * ) .....	30 litres 7.93 U.K. gal

### FUEL PUMP

Type .....	Electromagnetic Diaphragm Type
Pump Delivery .....	370 cm <sup>3</sup> /min 22.57 in <sup>3</sup> /min

### INJECTION PUMP

Type .....	Bosch M type
Model .....	ND-PFR3M
Pump Timing (719 * ) .....	17° B.T.D.C.
Pump Timing (723 * and 727 * ) .....	20° B.T.D.C.

### INJECTOR

Nozzle Opening Pressure (719 * ) .....	11800 to 12700 kPa	1706 to 1848 psi
Nozzle Opening Pressure (723 * and 727 * ) .....	16700 to 17700 kPa	2418 to 2560 psi

## SPECIAL TORQUES

### Cylinder Head Retaining Bolt

M14 .....	146 to 157 Nm	107.7 to 115.8 lb ft
M12 .....	98 to 108 Nm	72.3 to 79.7 lb ft
Crankshaft pulley retaining bolt .....	197 to 245 Nm	145.3 to 180.8 lb ft
Main bearing cap retaining bolt .....	49 to 54 Nm	36.1 to 39.8 lb ft
Connecting rod end cap retaining nut		
719 * and 723 * .....	31 to 34 Nm	22.8 to 25.0 lb ft
727 * .....	39 to 42 Nm	28.7 to 30.9 lb ft
Flywheel retaining bolt .....	127 to 135 Nm	93.7 to 99.6 lb ft
Glow plug .....	13 to 19 Nm	9.5 to 14.0 lb ft
Fuel Tank Drain Plug .....	12 to 17 Nm	9 to 12.5 lb ft
Fuel Injection Pump Retaining Bolts .....	10 to 13 Nm	7.5 to 9.5 lb ft
Delivery Valve Holders .....	40 to 50 Nm	29.5 to 37 lb ft
Fuel Injection Tube Nuts .....	24 to 34 Nm	18 to 25 lb ft
Injector Clamp Bolts .....	15 to 20 Nm	11 to 15 lb ft
Solenoid Locknut .....	40 to 50 Nm	29.5 to 37 lb ft

## SAFETY RULES

**IMPORTANT :** When testing or adjusting fuel injectors, do not place your hands or arms in front of the injector nozzles.



**WARNING :** The fuel spray from an injector has sufficient penetrating power to puncture the flesh and destroy tissue. Should the fuel enter the blood stream, it may cause blood poisoning.

In the event of the skin being punctured from the discharge of an injector, apply the following first aid immediately, then have the injury examined by a physician as quickly as possible.

Wash the injured part with a boric acid solution, support the injured finger or hand with a splint and sling so the injured part will remain absolutely at rest until a physician can examine it.

## ENGINE REMOVAL

### HOOD, PANELS, INSTRUMENT PANEL AND INSTRUMENT CLUSTER

#### Removal and Installation

##### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

##### [ 2 ]

Disconnect the battery, negative (–) terminal first.

**NOTE :** *For Installation, install and tighten the positive (+) terminal first.*

##### [ 3 ]

Raise the hood and remove the side panels (1).

##### [ 4 ]

Remove nut (2) and remove the hood (3).

**NOTE:** *For Installation, tighten nut (2) and then back the nut off 1/4 of a turn.*

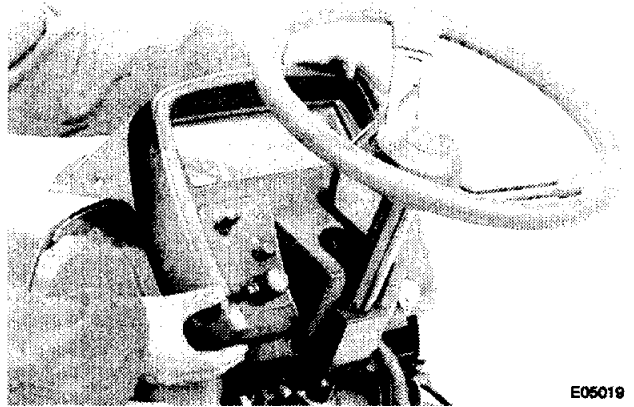
##### [ 5 ]

Remove bolts (4), disconnect the headlamps connectors from the front grille and remove the front grille (5).

##### [ 6 ]

Remove screws (6) and remove cover (7).

##### [ 7 ]



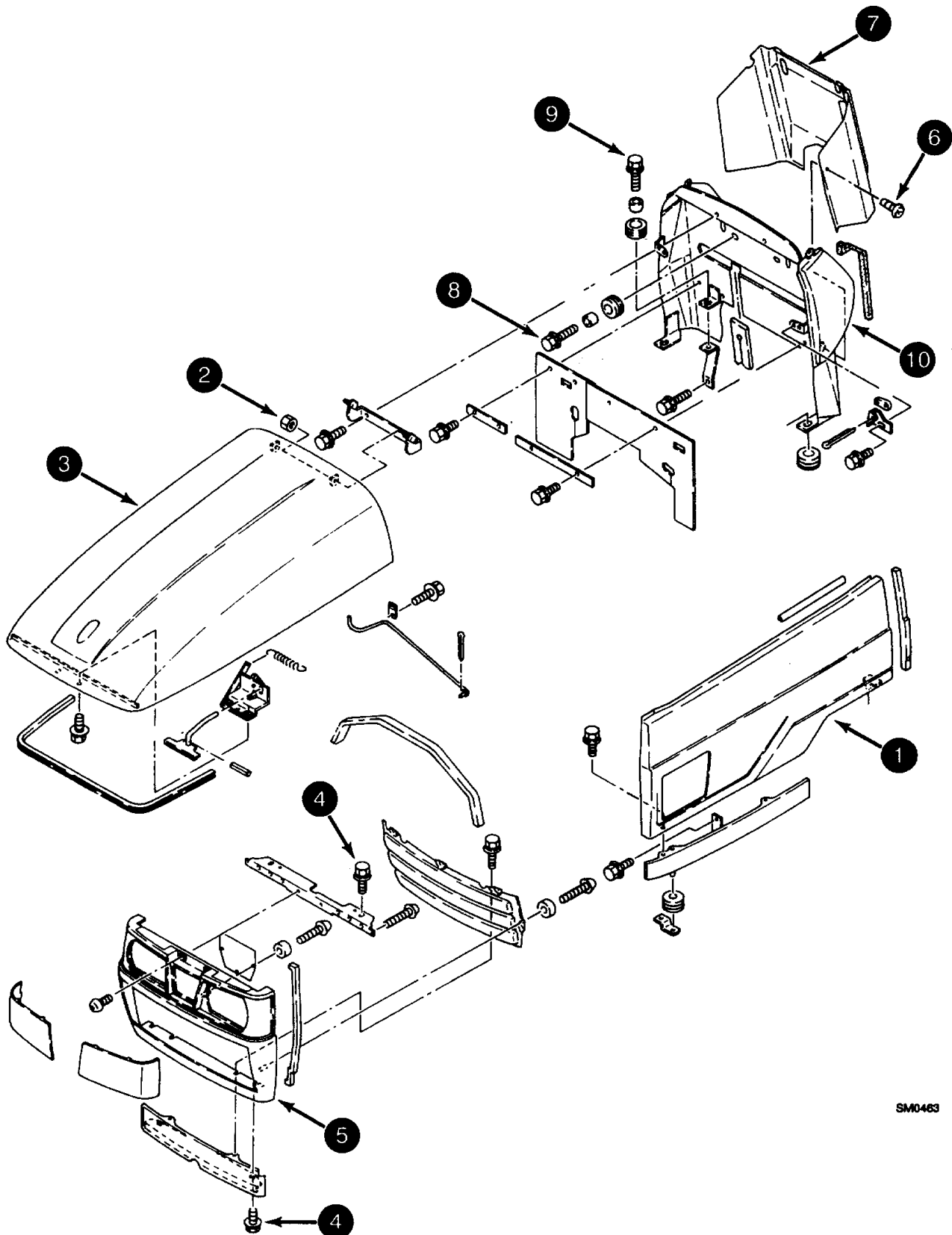
Remove the instrument cluster retaining screws and raise the instrument cluster slightly. Disconnect the tachometer cable and the engine harness. Remove the instrument cluster.

##### [ 8 ]

Remove the bolts (8 and 9) and remove the steering column cover (10).

**NOTE:** *For Installation, follow the same procedure in reverse order.*

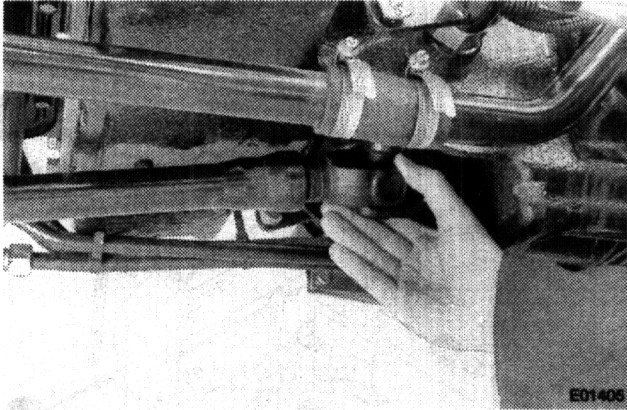
NOTE: Items are numbered in order of Disassembly.



SM0463

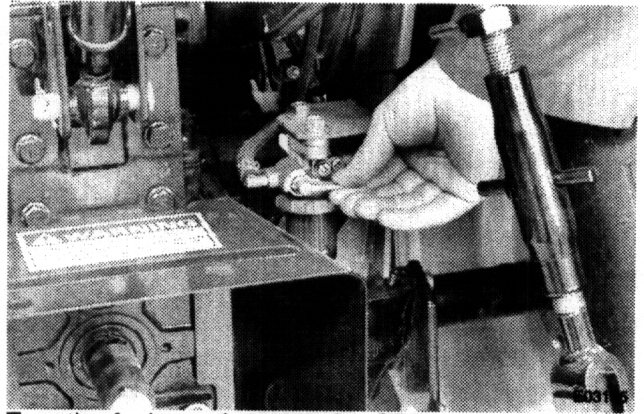
## Separating the Engine from the Transmission

[ 1 ]



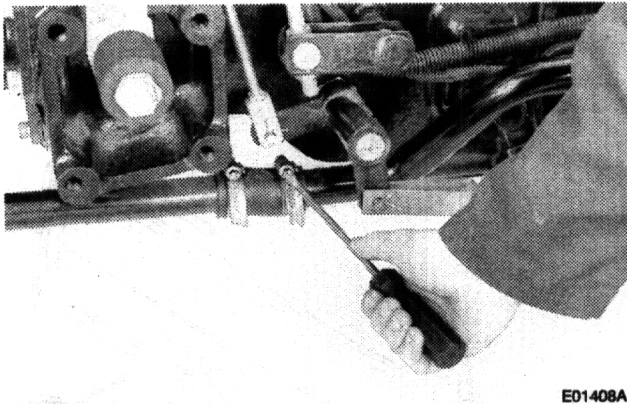
Remove the MFD drive shaft, refer to Section 6, Page 134.

[ 4 ]



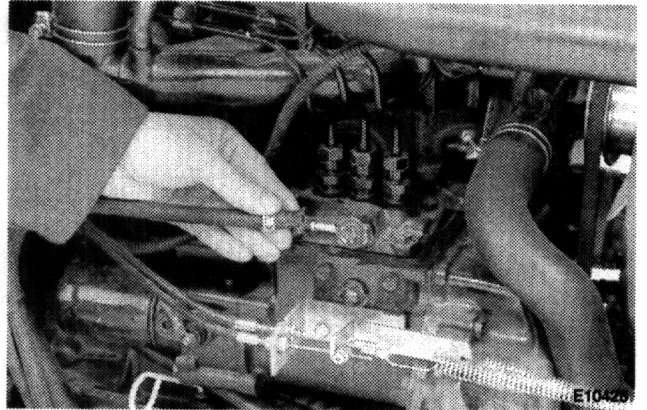
Turn the fuel supply tap to the OFF position.

[ 2 ]



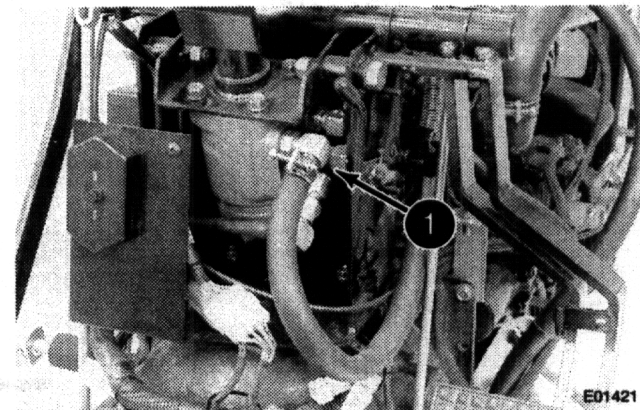
Disconnect and cap the hydraulic pump supply tube.

[ 5 ]



Disconnect and cap the fuel supply hose.

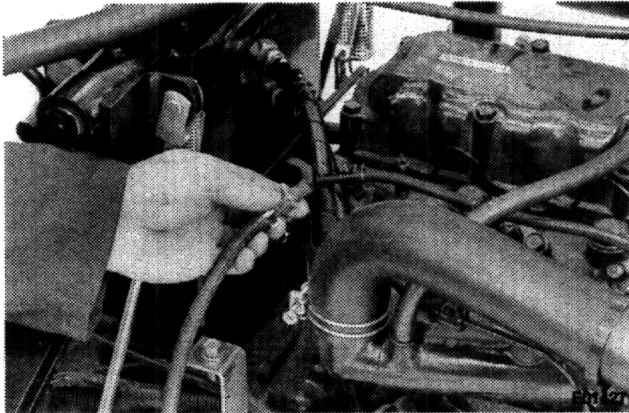
[ 3 ]



Put identification marks on the power steering hoses (1). Disconnect and cap the power steering hoses.

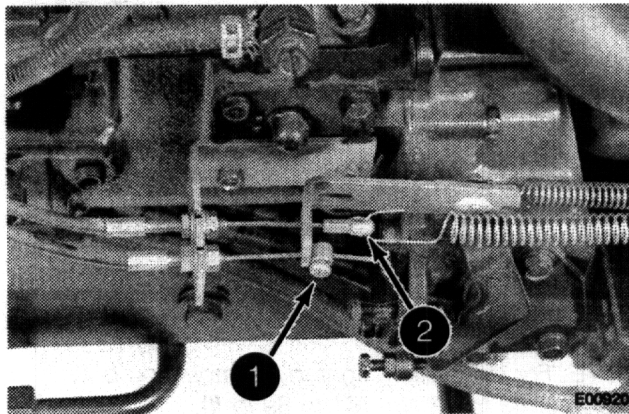


[ 6 ]



Disconnect and cap the fuel return hose.

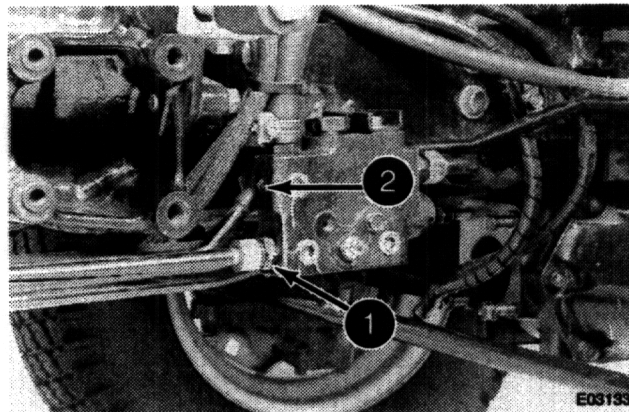
[ 7 ]



Disconnect and remove the foot (1) and hand throttle (2) cables.

**NOTE:** For Installation, refer to Section 8 for Cable Adjustments.

[ 8 ]



Disconnect and cap the tractor hydraulic line (1) and return tube (2).

[ 9 ]

Disconnect the main harness from the tractor engine.

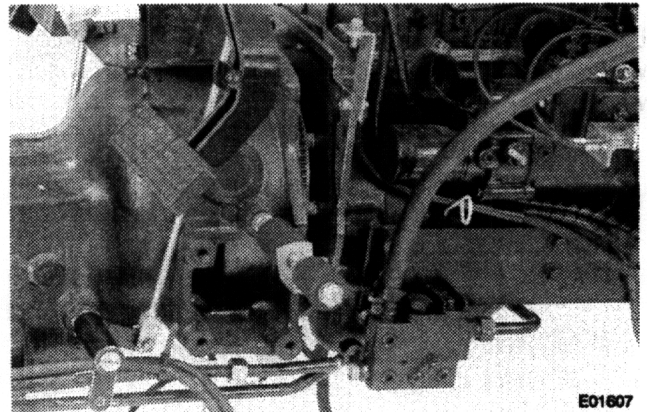
[ 10 ]

Put wooden wedges in between the front axle and the front bolster.

[ 11 ]

Support the tractor on suitable splitting stands.

[ 12 ]



Remove the clutch housing to engine retaining bolts and carefully separate the tractor.

[ 13 ]

Support the two halves of the tractor on suitable stands.

[ 14 ]

For Assembly, follow the same procedure in reverse order.

**NOTE:** For Assembly, clean the engine and transmission mounting faces and apply a continuous bead of Loctite 515 to the engine mounting face.

## ENGINE

**[ 1 ]**

Remove the air inlet hose and the exhaust.

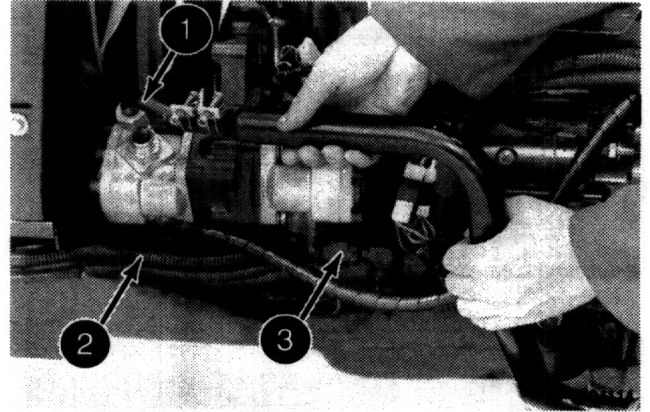
**[ 2 ]**

Remove the radiator, refer to Page 46.

**[ 3 ]**

Label and disconnect the starter motor, alternator, water temperature sender and oil pressure switch wires.

**[ 4 ]**



Disconnect and cap the hydraulic pump supply hose (1) and feed hoses (2) and (3).

**[ 5 ]**

Put blocks under the engine side rails and support the engine using suitable lifting equipment. Remove the two front and the four left hand and four right hand mounting bolts. Carefully remove the engine.

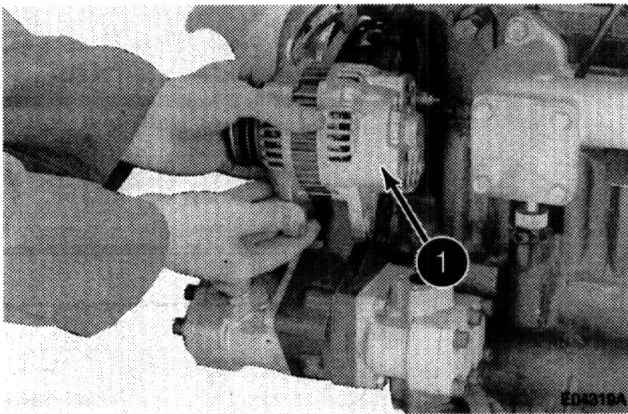
**NOTE:** For Installation, tighten the mounting bolts to a torque of 83 to 93 Nm (61 to 69 lb ft).

**NOTE:** For Installation, follow the same procedure in reverse order.

## CYLINDER HEAD

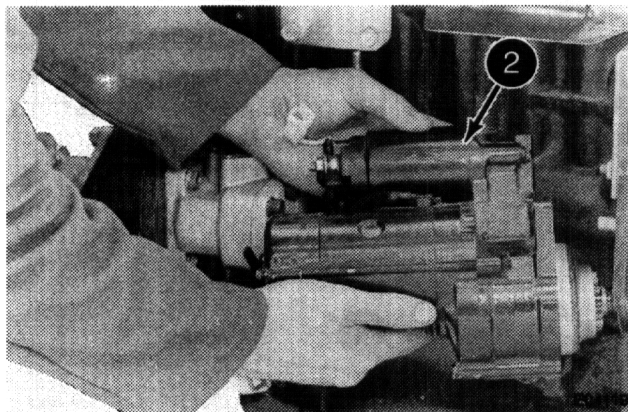
### Removal and Installation

[ 1 ]



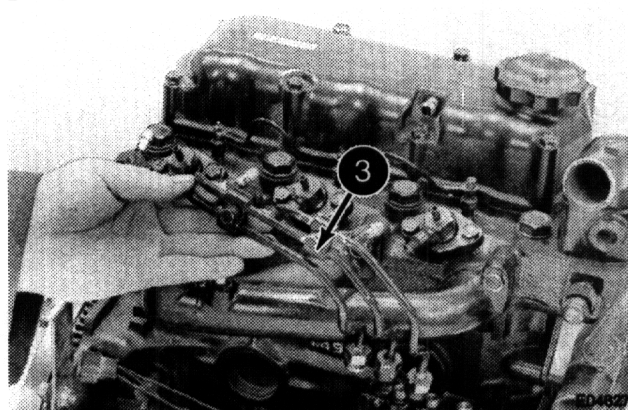
Remove the alternator (1), refer to Section 6.

[ 2 ]



Remove the starter motor (2), refer to Section 6.

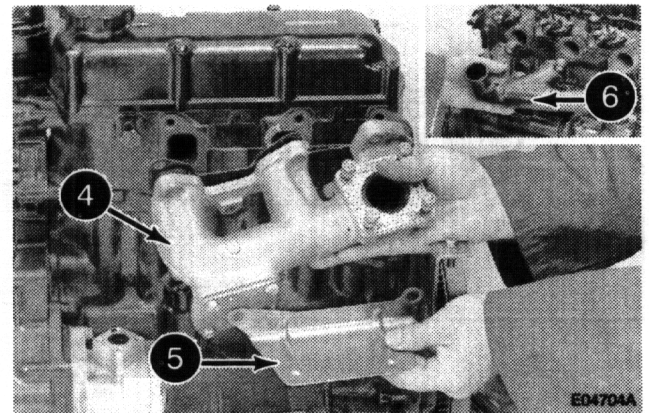
[ 3 ]



Remove and cap the injector tubes (3).

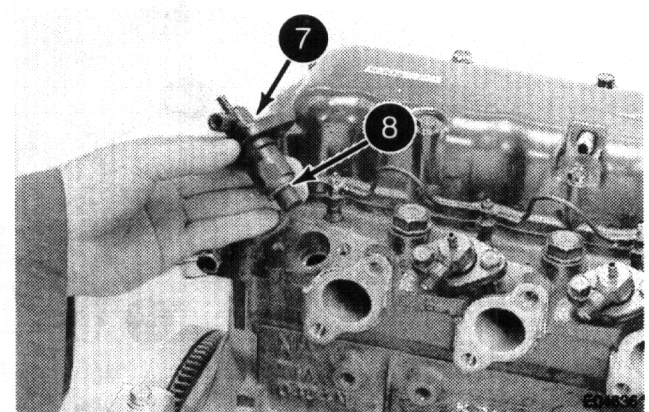
**NOTE :** For Installation, tighten the injector tube nuts to a torque of 24 to 34 Nm (18 to 25 lb ft).

[ 4 ]



Remove the inlet manifold (4), heat shield (5) and exhaust manifold (6).

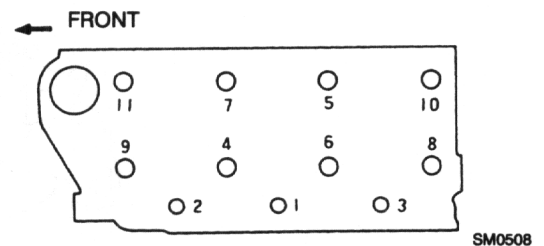
[ 5 ]



Remove the injectors (7) and sealing washers (8).

**NOTE:** For Installation, install new sealing washers (8).

[ 6 ]

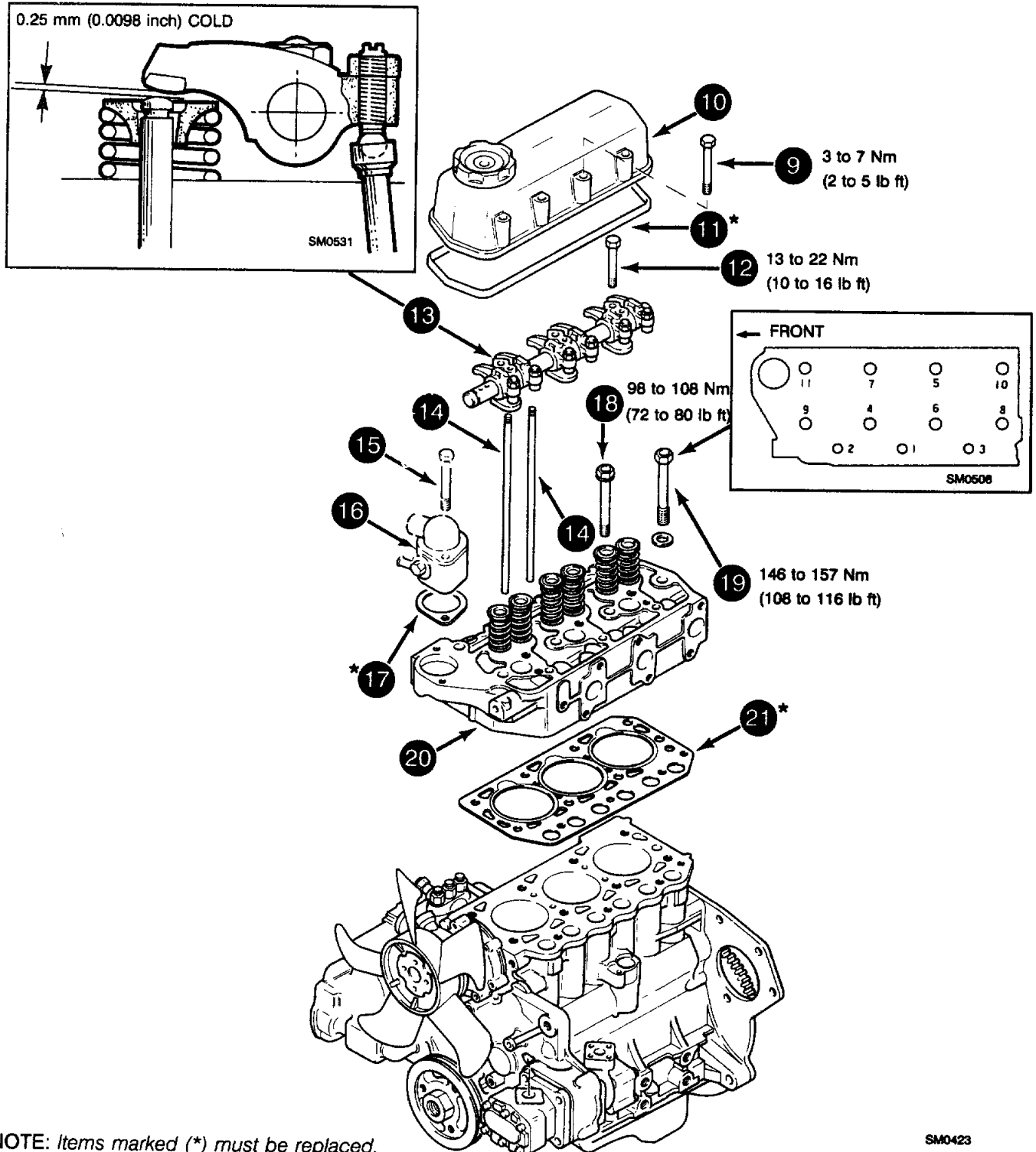


Remove items (9) to (21).

**NOTE:** Tighten items (18) and (19) in the sequence shown.

**NOTE:** For Installation, tighten the cylinder head bolts (18) to a torque of 98 to 108 Nm (72 to 80 lb ft) and cylinder head bolts (19) to a torque of 146 to 157 Nm (108 to 116 lb ft).

**NOTE:** For Installation, follow the same procedure in reverse order.

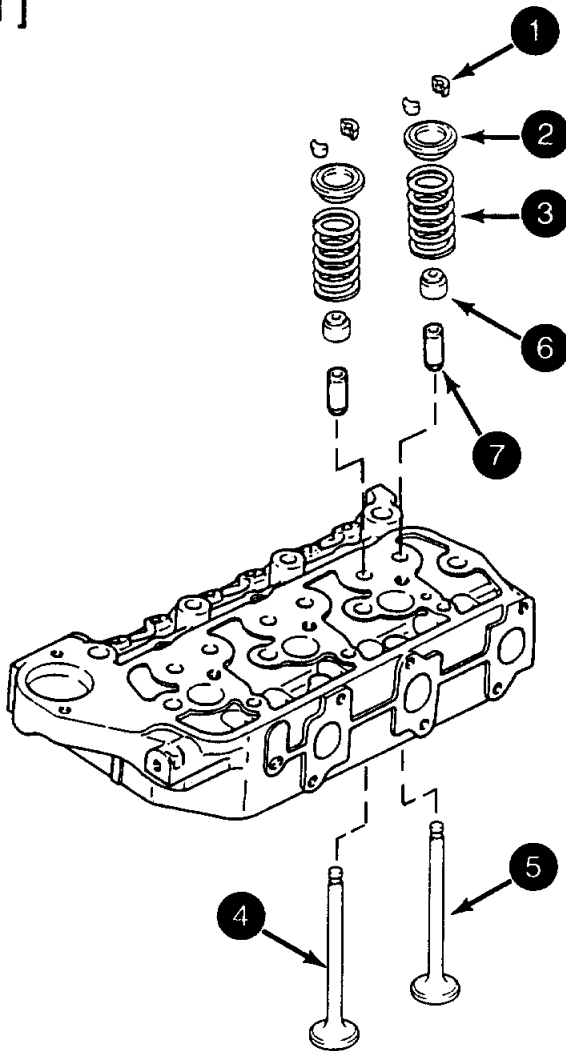


- 9. RETAINING BOLT
- 10. ROCKER COVER
- 11. GASKET
- 12. RETAINING BOLT
- 13. ROCKER ARM ASSEMBLY
- 14. PUSH RODS
- 15. RETAINING BOLT

- 16. THERMOSTAT HOUSING
- 17. GASKET
- 18. CYLINDER HEAD BOLT
- 19. CYLINDER HEAD BOLT
- 20. CYLINDER HEAD
- 21. CYLINDER HEAD GASKET

## SERVICING THE CYLINDER HEAD

[ 1 ]

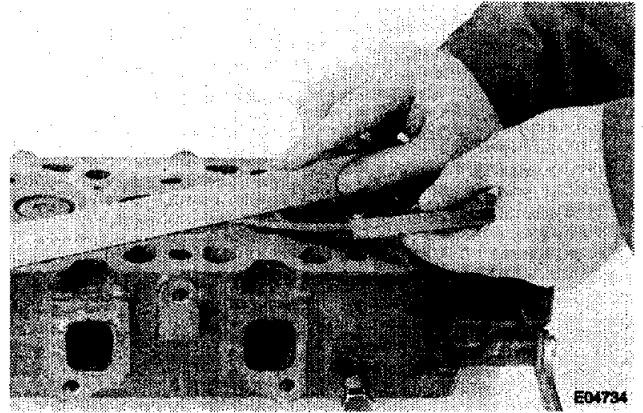


1. SPRING COLLETS
2. SPRING RETAINER
3. SPRING
4. INTAKE VALVE
5. EXHAUST VALVE
6. VALVE STEM OIL SEAL
7. VALVE GUIDE

Remove items (1 to 7). Use a valve spring compressor to remove item (3).

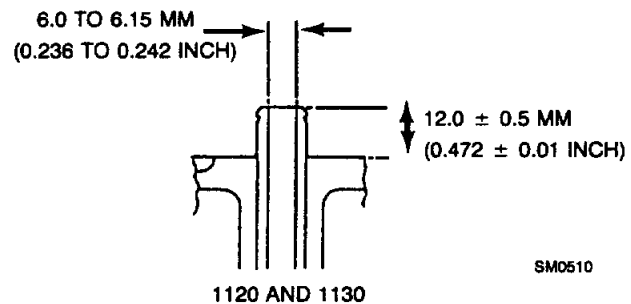
**NOTE:** Repeat this procedure for the other valves.

[ 2 ]

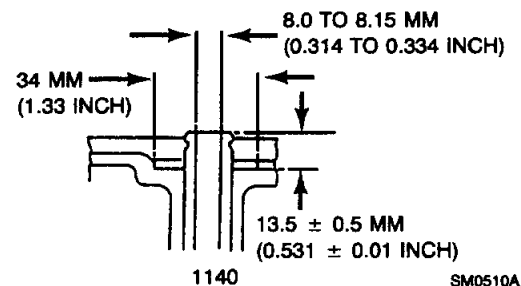


Using a straight edge and a feeler gauge check the cylinder head for warpage. If the warpage is more than 0.10 mm (0.0039 inch), replace the cylinder head.

[ 3 ]



SM0510



SM0510A

If the valve guides are damaged or worn replace the valve guides.

**IMPORTANT:** For valve guide installation, follow the procedure below.

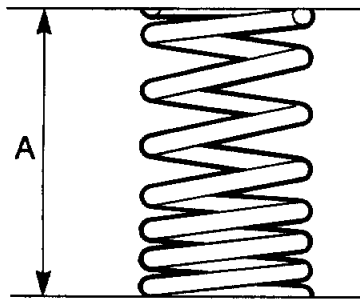
719 \*

Use a hydraulic press, press in new valve guides to the dimensions shown above from the bottom of the cylinder head to the top of the valve guide.

723 \* and 727 \*

Use a hydraulic press, press in new valve guides to the dimensions shown above from the top of the cylinder head to the bottom of the valve guide.

[ 4 ]

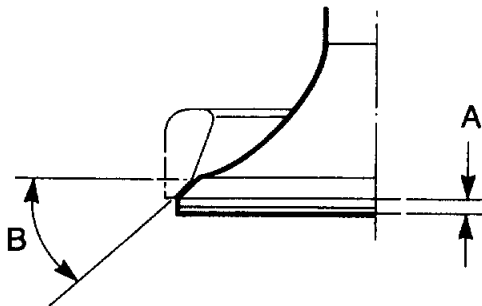


SM0553

Check the free length of the valve springs dimension 'A', replace the valve springs if the measurement is less than:

719 * and 723 *	..... 42 mm	1.65 inch
727 *	..... 44.5 mm	1.75 inch

[ 5 ]

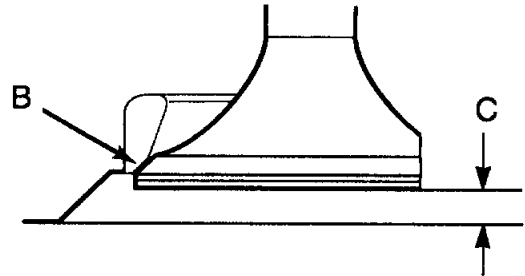


SM0525

Check the intake and exhaust valves for damage or wear. The valves can be cut to an angle of 45° 'B' using a valve cutting tool.

If after cutting the valve tolerance 'A' is 0.5 mm (0.01 inch) or less, the valve must be replaced.

[ 6 ]



SM0512B

Check the valve seat 'B' for wear, cut the valve seat to an angle of 45° using a valve seat cutter.

Using a new valve check measurement 'C'. If measurement 'C' is more than 1.5 mm (0.060 inch), the cylinder head must be replaced.

**NOTE:** For Assembly, follow the same procedure in reverse order.

[ 7 ]



SM0598

With the piston at TDC use a dial gauge to check the piston protrusion 'A'. If the piston protrusion is more than 1.25 mm (0.049 inch), check the connecting rod liners, refer to Page 27, piston pin and piston pin bushing for wear, refer to Page 39.

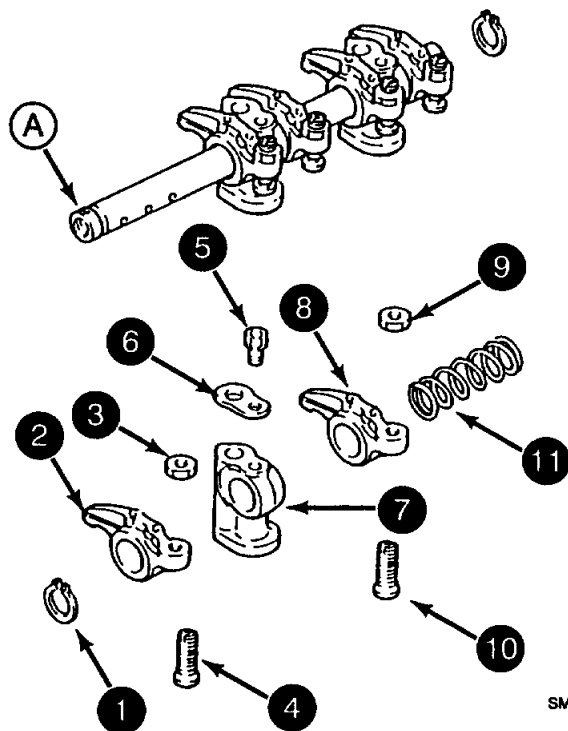
**NOTE:** Use the same procedure to check each piston for protrusion.

## ROCKER SHAFT

### Disassembly and Assembly

[ 3 ]

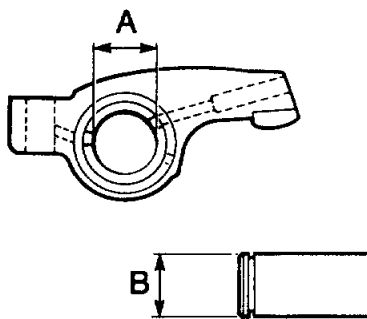
[ 1 ]



SM0513

Make a note of the position of the identification mark (A) on the rocker shaft and remove items (1) to (11). Repeat the procedure for all the rocker arms.

[ 2 ]



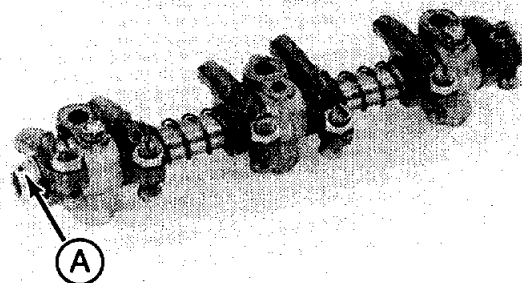
SM0552

Check the rocker arm dimension 'A' and the rocker shaft dimension 'B'.

Dimension 'A' ..... 18.8 to 18.9 mm  
0.740 to 0.744 inch

Dimension 'B' ..... 18.9 to 18.8 mm  
0.744 to 0.740 inch

If dimensions 'A' or 'B' are out of tolerance, the worn parts must be replaced.



E04736

The rocker shaft identification mark (A) must be at the front on assembly as shown.

[ 4 ]



SM0556

Replace the push rod if it is found to be bent, damaged or worn.

**NOTE:** For Assembly, follow the same procedure in reverse order. Use clean engine oil to lubricate all parts on assembly.



## FLYWHEEL

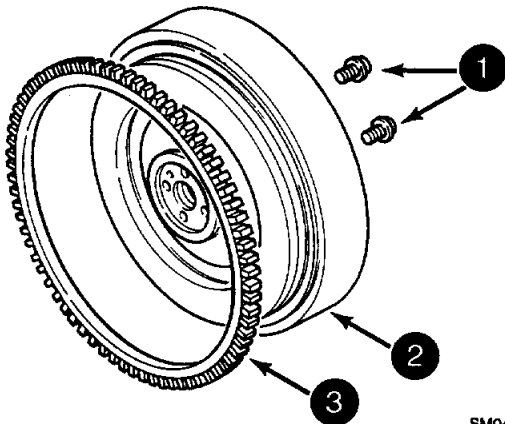
### Removal and Installation

[ 4 ]

[ 1 ]

Remove the clutch, refer to Section 6001.

[ 2 ]

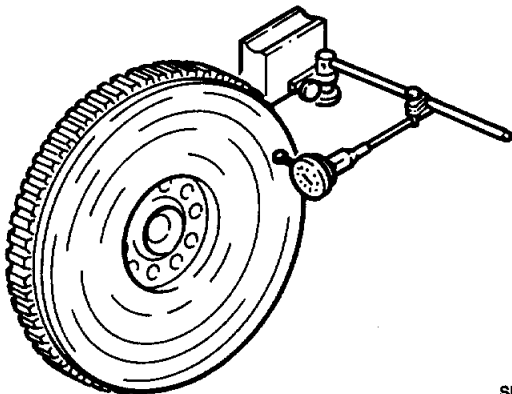


SM0443

Remove bolts (1) and carefully remove the flywheel (2) from the engine. Check the teeth on the ring gear (3) for damage or wear and replace if necessary.

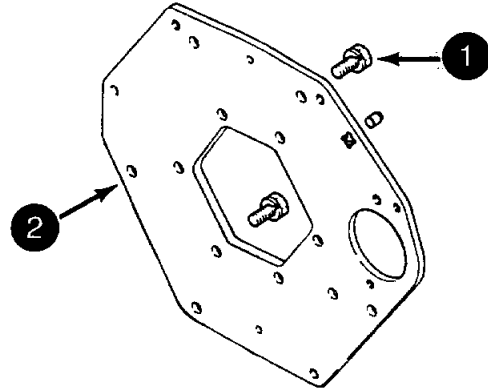
**NOTE :** For Installation, tighten the flywheel retaining bolts to a torque of 127 to 135 Nm (93.7 to 99.6 lb ft).

[ 3 ]



SM0532

Check the clutch face run out as shown. Maximum run out is 2 mm (0.078 inch). The maximum depth of wear marks should not be more than 2 mm (0.078 inch).

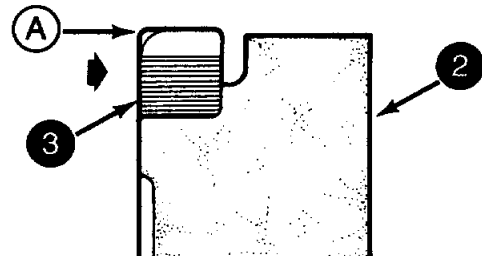


SM0569

Remove the bolts (1) and the backing plate (2).

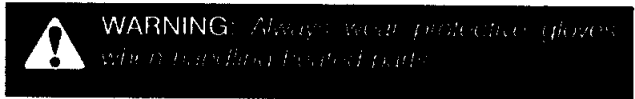
**NOTE:** For Installation, tighten the retaining bolts (1) to a torque of 54 Nm (40 lb ft).

[ 5 ]



SM0533

To install the ring gear (3) onto the flywheel (2) heat the new ring gear (3) in a bearing oven to a temperature of 200°C (392 °F). Make sure the leading edge of the teeth (A) are facing away from the flywheel.



**NOTE :** For Installation, follow the same procedure in reverse order.

## TIMING COVER

### Removal and Installation

#### [ 1 ]

Remove items (1 to 6)

**NOTE:** Refer to cooling system, Page 46.

#### [ 2 ]

Remove items (7 to 10).

**NOTE:** For Installation, tighten item (7) to a torque of 147 Nm (108 lb ft).

#### [ 3 ]

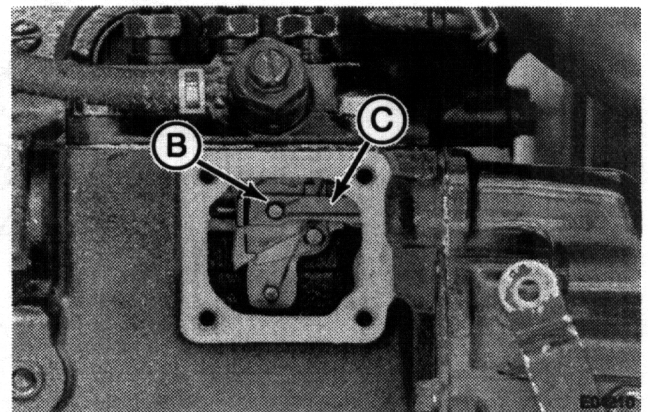
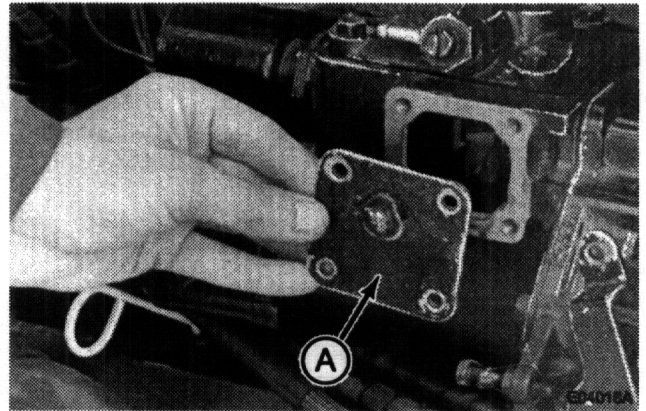
Remove the hydraulic pumps, refer to Section 8002.

#### [ 4 ]

Remove items (11 to 16). Use a bearing puller to remove items (15) and (16).

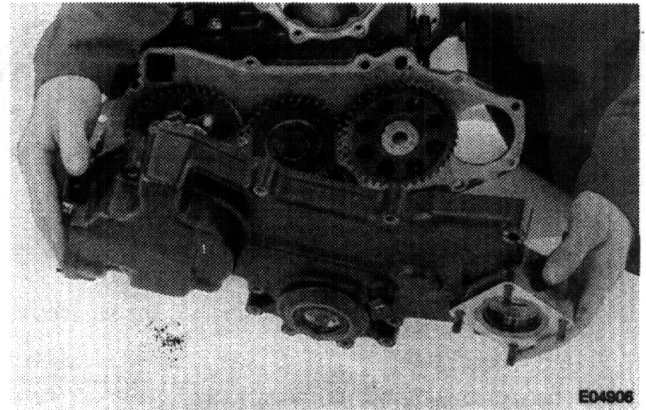
**NOTE:** For Installation, tighten item (11) to a torque of 19 Nm (14 lb ft).

#### [ 5 ]



Remove the fuel pump inspection plate (A). Remove the retaining spring (B) and governor linkage (C).

#### [ 6 ]

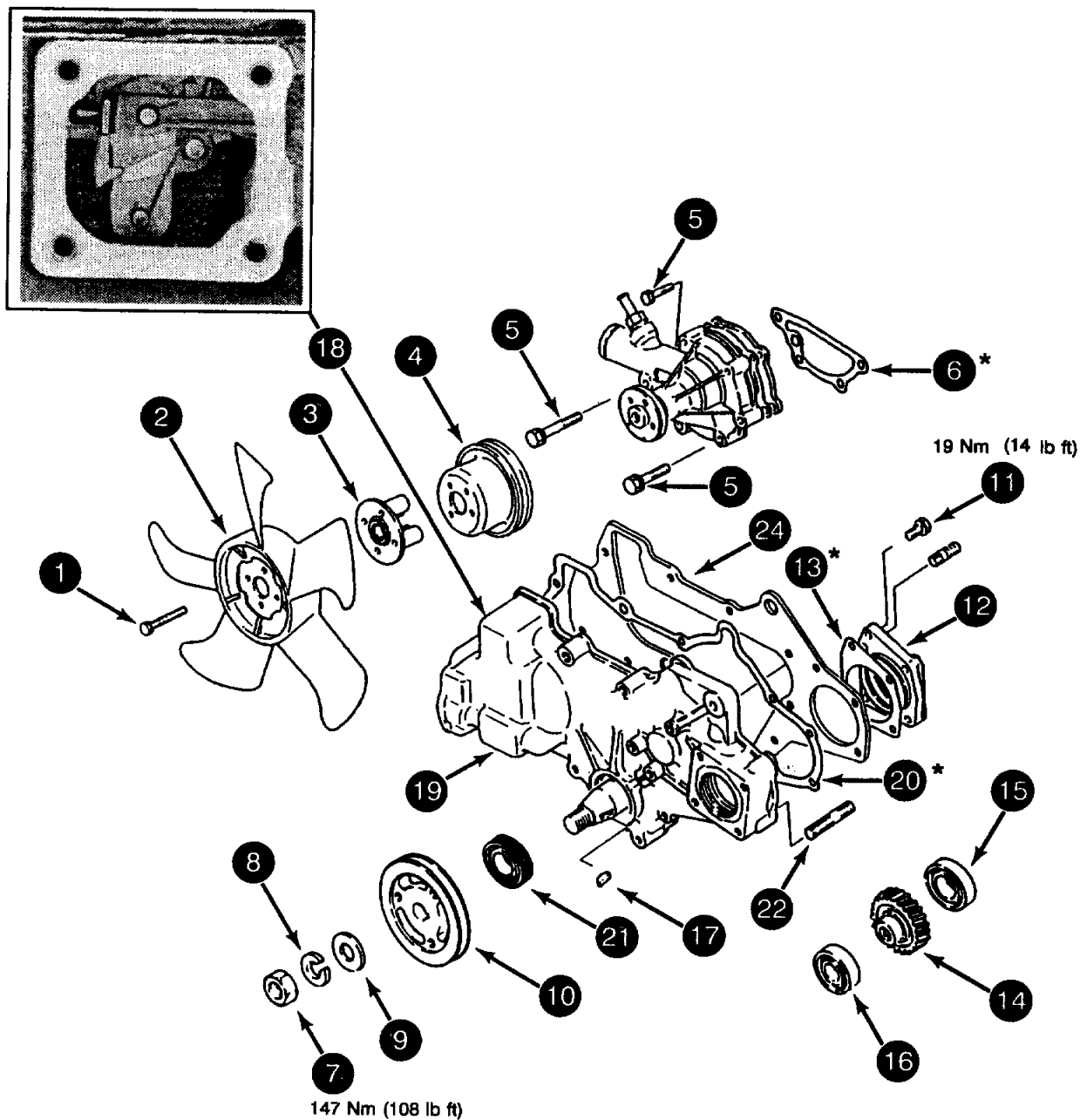


Remove items (18 to 23).

**NOTE:** For Installation, lubricate oil seal (22) with petroleum jelly.

**NOTE :** For Installation, follow the same procedure in reverse order.

NOTE: Items are numbered in order of Removal.



NOTE: Items marked (\*) must be replaced.

SM0514

NOTE: For Removal and Installation of item (18), refer to Page 29 – [ 5 ].

NOTE: 723 \* Tractors are fitted with two spacers, item (3).

- |           |                       |                |                       |
|-----------|-----------------------|----------------|-----------------------|
| 1. BOLT   | 7. RETAINING NUT      | 13. GASKET     | 18. FUEL PUMP LINKAGE |
| 2. FAN    | 8. WASHER             | 14. DRIVE GEAR | 19. TIMING COVER      |
| 3. SPACER | 9. WASHER             | 15. BEARING    | 20. GASKET            |
| 4. PULLEY | 10. CRANKSHAFT PULLEY | 16. BEARING    | 21. OIL SEAL          |
| 5. BOLT   | 11. RETAINING BOLT    | 17. KEY        | 22. RETAINING STUD    |
| 6. GASKET | 12. RETAINING PLATE   |                |                       |

## ENGINE GOVERNOR

### Removal and Installation

#### [ 1 ]

Remove the timing case refer to Steps 30 to 35.

#### [ 2 ]

Remove items (1 to 22). Do not remove items (23 to 26) unless required.

**NOTE:** If items (23 to 26) are removed, make a note of the number of turns to remove items (25) and (26).

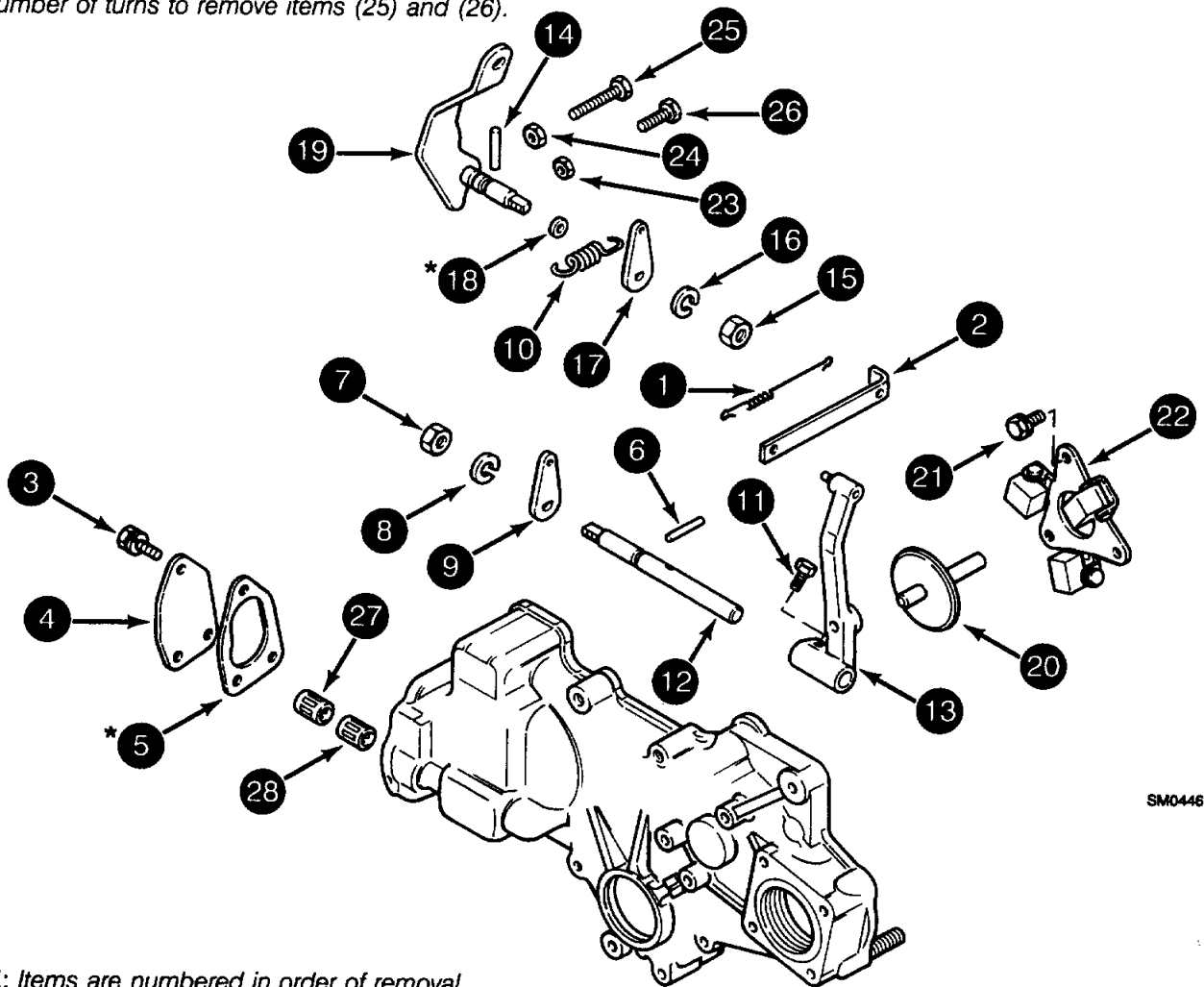
#### [ 3 ]

Remove items (27) and (28).

#### [ 4 ]

Check all items for damage, wear or distortion and replace if required.

**NOTE:** For Installation, use the same procedure in reverse order.



SM0446

**NOTE:** Items are numbered in order of removal.

**NOTE:** Items marked (\*) must be replaced.

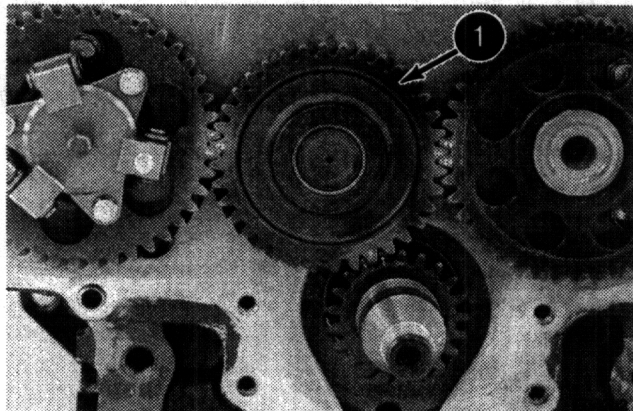
- |                   |                    |                         |                        |
|-------------------|--------------------|-------------------------|------------------------|
| 1. SPRING         | 8. WASHER          | 15. RETAINING NUT       | 22. GOVERNOR           |
| 2. TIE ROD        | 9. SPRING ARM      | 16. WASHER              | 23. LOCKING NUT        |
| 3. RETAINING BOLT | 10. SPRING         | 17. SPRING ARM          | 24. LOCKING NUT        |
| 4. COVER          | 11. RETAINING STUD | 18. O-RING              | 25. HIGH IDLE SET BOLT |
| 5. GASKET         | 12. GOVERNOR SHAFT | 19. SPEED CONTROL LEVER | 26. LOW IDLE SET BOLT  |
| 6. GROOVED PIN    | 13. GOVERNOR ARM   | 20. SLIDING SHAFT       | 27. ROLLER BEARING     |
| 7. RETAINING NUT  | 14. GROOVED PIN    | 21. RETAINING STUD      | 28. ROLLER BEARING     |

## TIMING GEARS

### Removal and Installation

**NOTE:** The timing gear on the crankshaft is a press fit. The crankshaft must be removed to install the timing gear.

[ 1 ]



Check the timing gear backlash. The backlash is measured between the idler gear (1) and all other gears. The maximum backlash should be 0.3 mm (0.01 inch).

[ 2 ]

Check the idler gear (1) bushing I.D. tolerance this must be 28.0 to 28.1 mm (1.102 to 1.106 inch). If the tolerance is more than 28.1 mm (1.106 inch), replace the idler gear bushing.

[ 3 ]

If any timing gears are worn or damaged, the camshaft and injection pump camshaft can be removed using a suitable bearing puller. Refer to Page 28 for the removal and installation of the crankshaft timing gear.

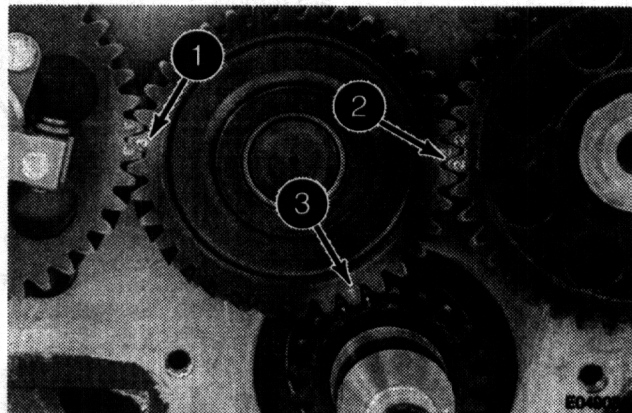
[ 4 ]

Using the bearing oven, heat the camshaft and injection pump camshaft timing gears to a temperature of 150°C (302°F). Install the timing gears with the longer hub of the gear facing the engine.



**WARNING:** Always wear protective gloves when handling heated parts.

[ 5 ]



Turn the crankshaft until No. 1 piston is at T.D.C. on the compression stroke. Turn the injection pump camshaft and camshaft timing marks to face each other. Install the idler gear making final adjustments until the timing marks (1, 2 and 3) are correctly aligned as shown.

## INJECTION PUMP CAMSHAFT

### Removal and Installation

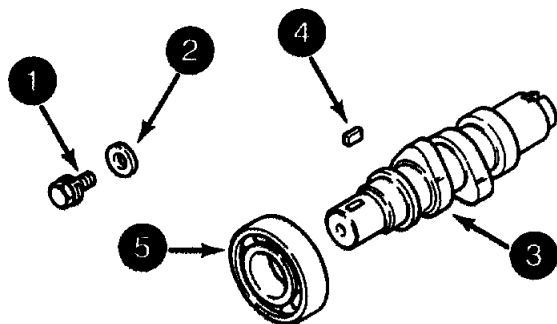
#### [ 1 ]

Remove the timing case backplate.

#### [ 2 ]

Remove the fuel injection pump, refer to Section 3000.

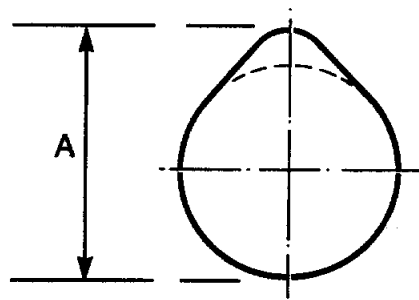
#### [ 3 ]



SM0462

Remove the injection pump camshaft retaining bolt (1) and washer (2). Remove the injection pump camshaft (3), locating key (4), using a suitable bearing puller remove bearing (5).

#### [ 4 ]

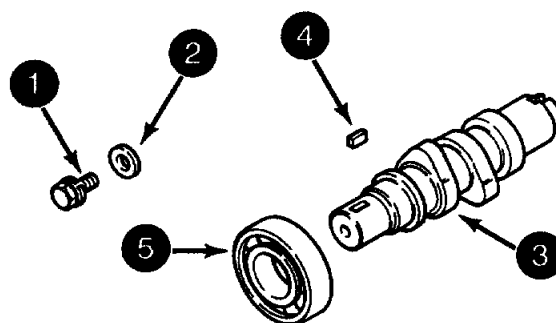


SM0555

Check the camshaft for wear or damage and replace if required. Check dimension 'A' this must be:

Dimension 'A' ..... 44.0 to 43.0 mm  
1.732 to 1.692 inch

#### [ 5 ]



SM0462

Using a hydraulic press install bearing (5) onto the injection pump camshaft. Install the injection pump camshaft (3), retaining washer (2) retaining bolt (1) and locating key (4).

**NOTE:** For Installation, lubricate the injection pump camshaft with clean engine oil.

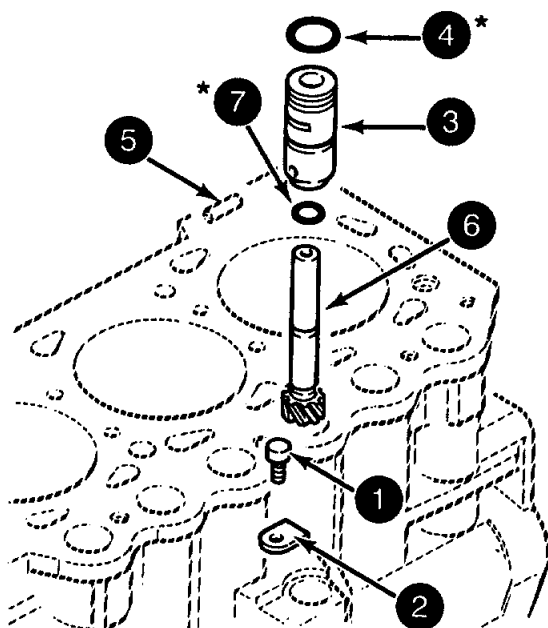
**NOTE:** For Installation, follow Steps 39 and 40.

## CAMSHAFT

## Removal and Installation

[ 3 ]

[ 1 ]



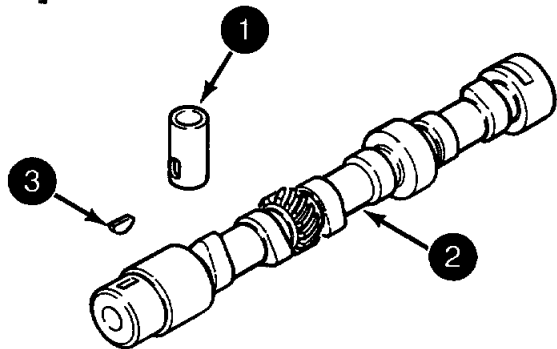
SM0488

Remove the tachometer drive assembly items (1 to 7).

**NOTE:** Items marked (\*) must be replaced.

**NOTE:** For Installation, lubricate the o-rings and drive shaft with petroleum jelly.

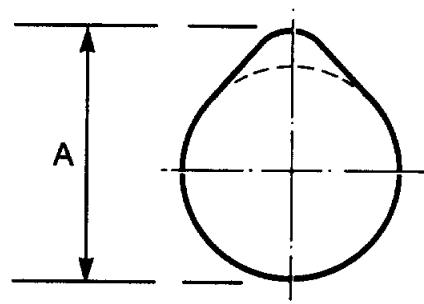
[ 2 ]



SM0461

Remove the cam followers (1), camshaft (2) and locating key (3).

**NOTE:** For Installation, lubricate the camshaft and cam followers with clean engine oil.



SM0555

Check the camshaft for wear and damage and replace if required. Check dimension 'A' this must be:

719 \* ..... 35.76 to 34.76 mm  
1.407 to 1.368 inch

723 \* and 727 \* ..... 35.72 to 34.72 mm  
1.406 to 1.366 inch

Camshaft Journal Tolerance:

Front ..... 45.0 to 44.925 mm  
1.771 to 1.769 inch

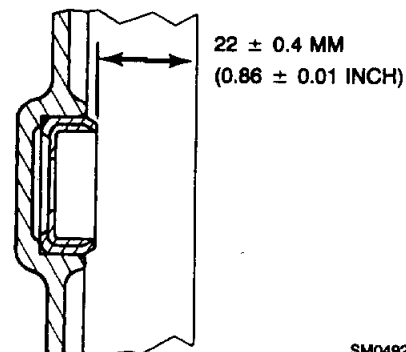
Center ..... 44.0 to 43.925 mm  
1.732 to 1.729 inch

Rear ..... 34.0 to 33.925 mm  
1.338 to 1.335 inch

[ 4 ]

Check the cam followers for wear and damage and replace if required. The cam follower to cylinder block clearance must be 0.01 to 0.015 mm (0.00039 to 0.00059 inch).

[ 5 ]



SM0492

Check the camshaft thrust plug, located in the timing case, for wear or damage and replace if required using a suitable blind hole puller.

**NOTE:** For Installation, install the thrust plug to the dimension shown.

**NOTE:** For Installation, follow the same procedure in reverse order.

## OIL PUMP

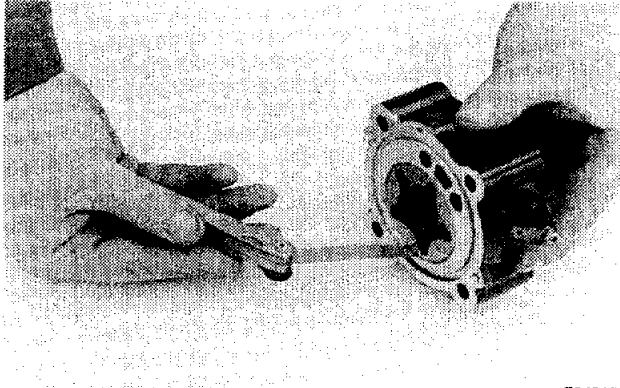
### Disassembly and Assembly

**NOTE:** If the oil pump is found to be worn out of specification or damaged then the oil pump must be replaced.

[ 1 ]

Remove items (1 to 15).

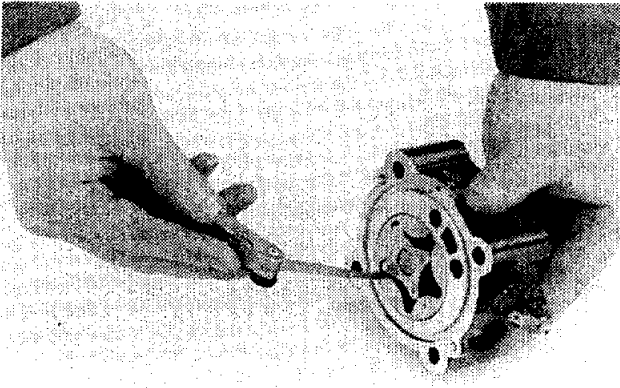
[ 2 ]



E04915

Check the outer rotor to body clearance. The wear tolerance is 0.15 to 0.3 mm (0.0059 to 0.0118 inch).

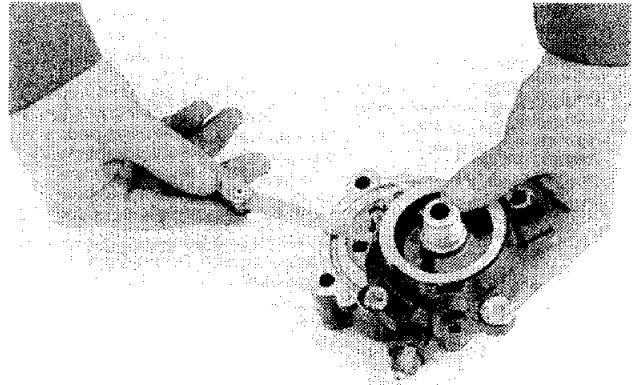
[ 3 ]



E04912

Check the inner to outer rotor clearance. The wear tolerance is 0.05 to 0.24 mm (0.0019 to 0.0094 inch).

[ 4 ]



E04910

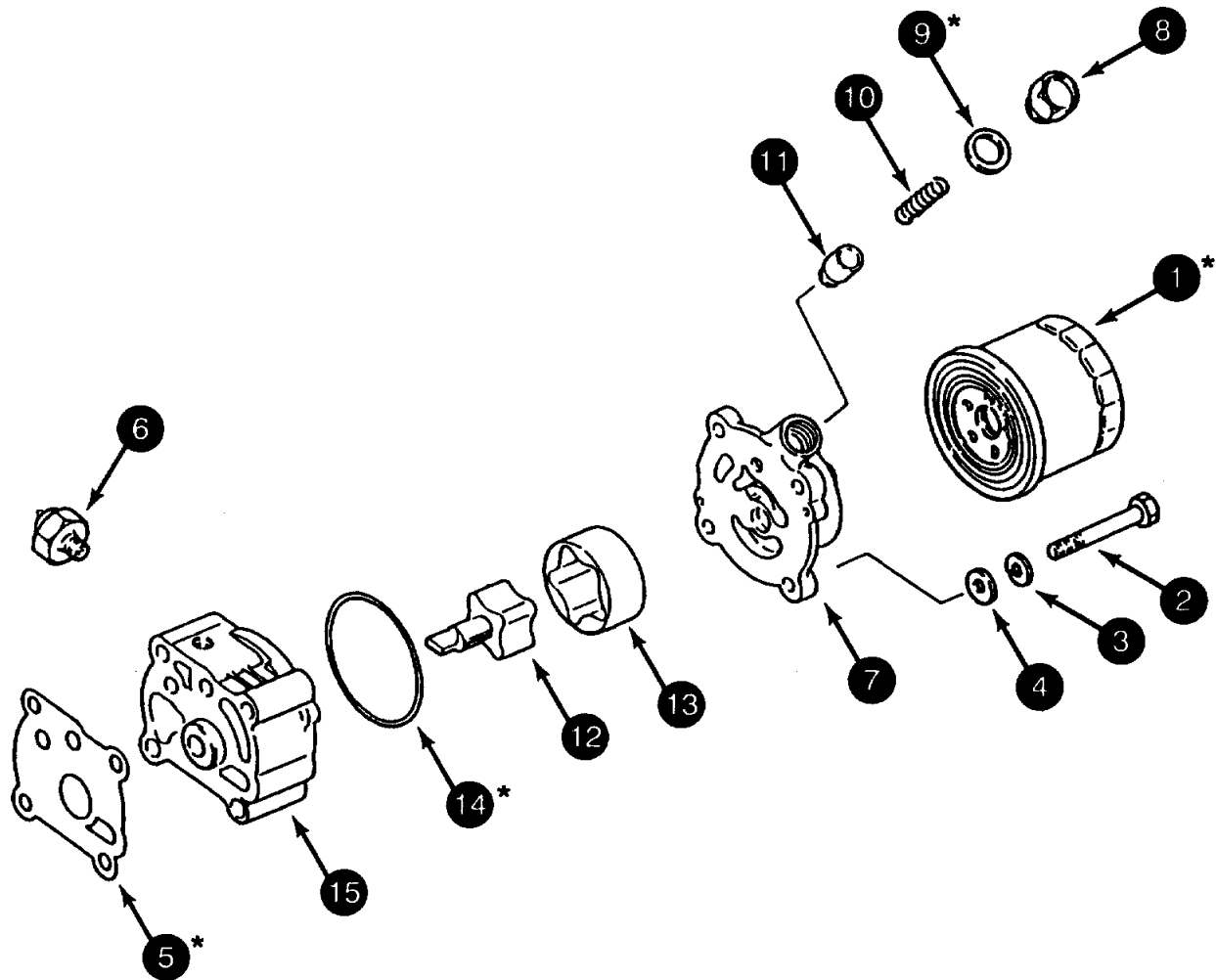
Check the rotor to end cover clearance. The wear tolerance is 0.03 to 0.20 mm (0.0011 to 0.0078 inch).

**NOTE:** For Assembly, lubricate parts in clean engine oil.

**NOTE:** For Assembly, follow the same procedure in reverse order.



**NOTE:** Items are numbered in order of Removal.



SM0506

**NOTE:** Items marked (\*) must be replaced.

- 1. FILTER
- 2. BOLT
- 3. WASHER
- 4. WASHER
- 5. GASKET

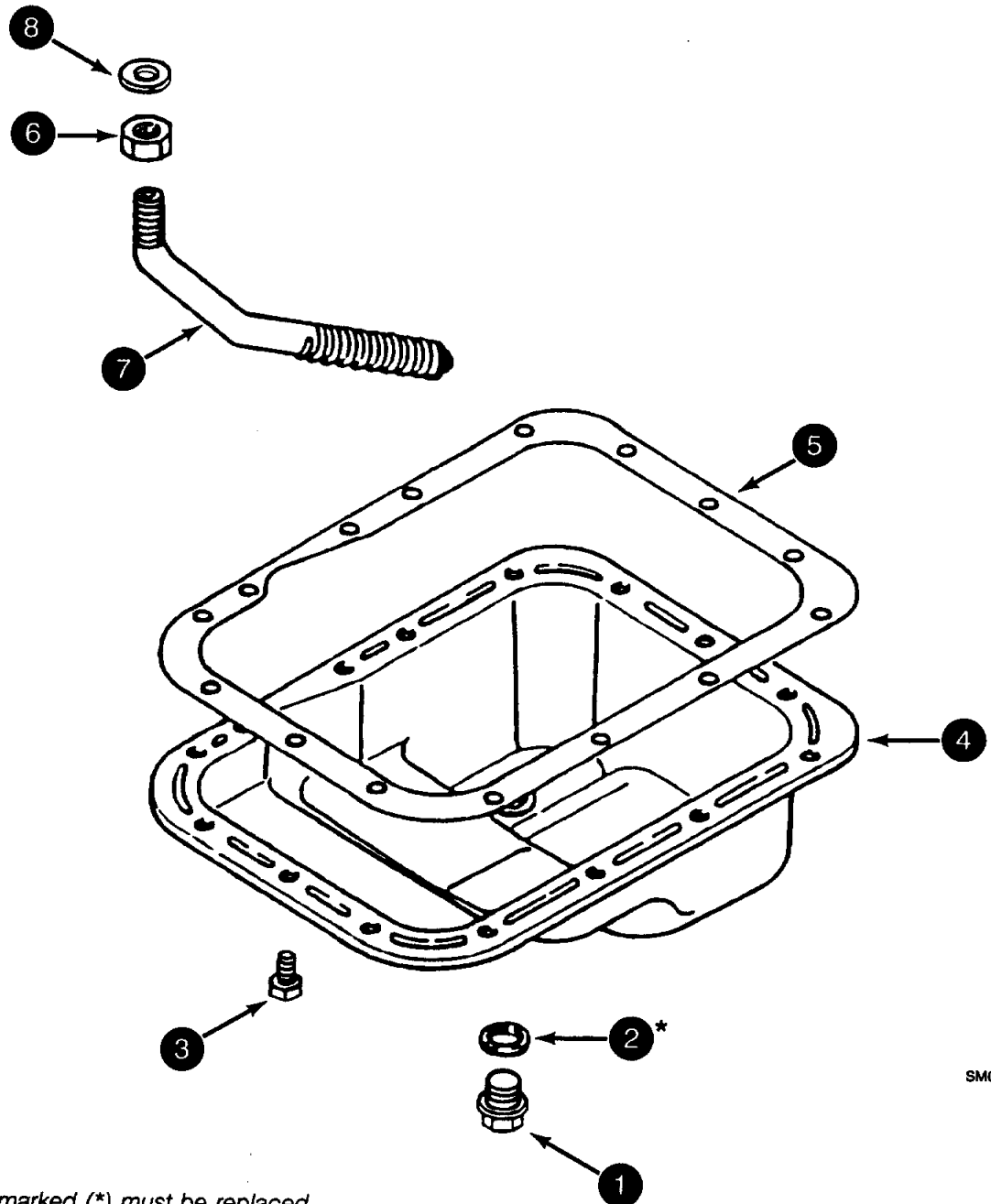
- 6. PRESSURE SWITCH
- 7. END COVER
- 8. RELIEF PLUG
- 9. SEALING WASHER
- 10. SPRING

- 11. RELIEF VALVE
- 12. INNER ROTOR
- 13. OUTER ROTOR
- 14. O-RING
- 15. OIL PUMP BODY

## OIL PAN

### Removal and Installation

NOTE: Items are numbered in order of Removal.



SM0517

NOTE: Items marked (\*) must be replaced.

- 1. DRAIN PLUG
- 2. SEALING WASHER
- 3. BOLT
- 4. OIL PAN

- 5. GASKET
- 6. LOCKNUT
- 7. SCREEN TUBE
- 8. SEALING WASHER

## PISTONS

### [ 1 ]

Put identification marks on the connecting rod (11) and bearing cap (2). Remove the nut (1), cap (2) and bearing shell (3). Carefully remove the piston assembly items (4 to 12) from the engine and remove the bearing liner (4), snap ring (5), piston pin (6), piston (7), compression piston ring (8), compression piston ring (9), oil control ring (10), connecting rod (11) and retaining bolt (12).

**NOTE:** Repeat this procedure for each piston assembly.

**NOTE:** For Removal and Installation of piston pin (6), heat the piston (7) to a temperature of 80°C (176°F) and install piston pin (6).

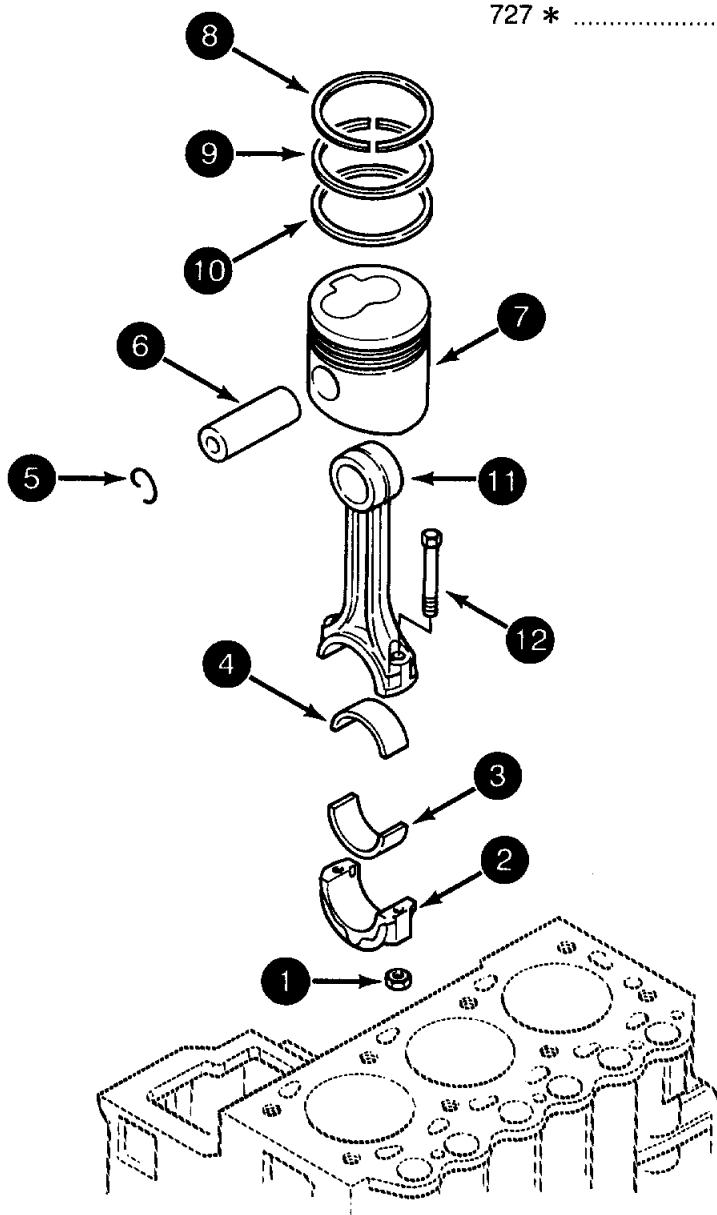


**WARNING:** Always wear protective gloves when handling treated parts.

**NOTE:** For Installation, follow the same procedure in reverse order.

**NOTE:** For Installation, use the piston ring compressor to install the piston (7) into the engine block. Tighten the nut (1) to a torque of:-

719 * and 723 *	.....31 to 34 Nm	23 to 25 lb ft
727 *	..... 39 to 42 Nm	29 to 31 lb ft



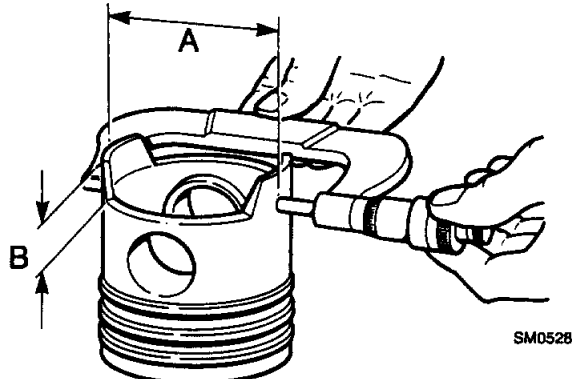
SM0491

**NOTE:** Items are numbered in order of Removal.

## [ 2 ]

Check the piston for wear:

### 1. Piston Diameter

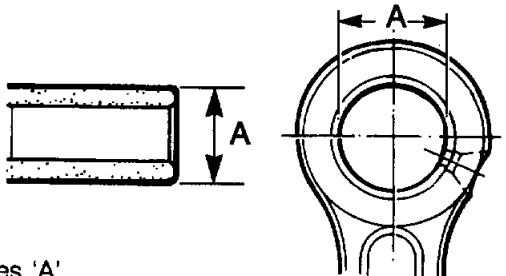


SM0528

Wear Tolerance 'A' (Standard Pistons)

719 *	76.0 to 75.7 mm	2.99 to 2.98 inch
723 *	82.0 to 81.7 mm	3.22 to 3.21 inch
727 *	84.0 to 83.7 mm	3.30 to 3.29 inch
Measure point 'B' .....	10 mm	0.39 inch
Out of round tolerance .....	0.30 mm	0.011 inch

### 2. Piston Pin and Piston Pin Bushing

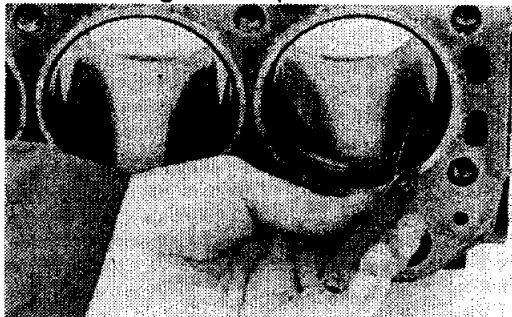


SM0554

Sizes 'A'

719 * and 723 *	23.041 to 22.995 mm	0.907 to 0.905 inch
727 *	27.041 to 26.995 mm	1.064 to 1.062 inch

### 3. Piston Ring End Gaps



E06022

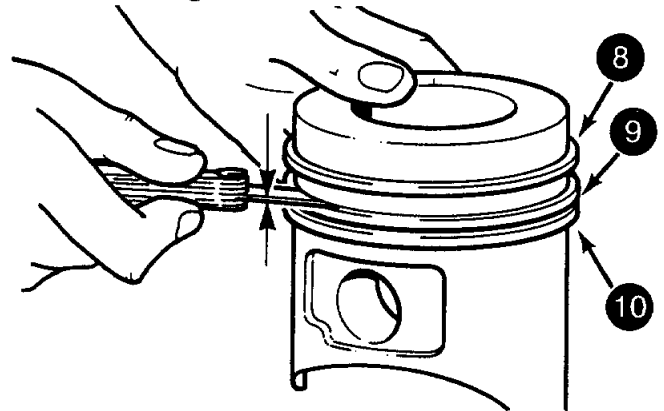
Compression piston rings

719 *	0.15 to 1.5 mm	0.0059 to 0.0590 inch
723 * and 727 *	0.2 to 1.5 mm	0.0078 to 0.0590 inch

Oil control ring

719 *	0.15 to 1.5 mm	0.0059 to 0.0590 inch
723 * and 727 *	0.3 to 1.5 mm	

### 4. Piston Ring Grooves



Wear Tolerance

SM0527

719 \*

Compression piston ring (8) ... 0.20 to 0.30 mm  
0.0078 to 0.0118 inch

Compression piston ring (9) ... 0.05 to 0.20 mm  
0.0019 to 0.0078 inch

Oil control ring (10) ..... 0.03 to 0.20 mm  
0.0011 to 0.0078 inch

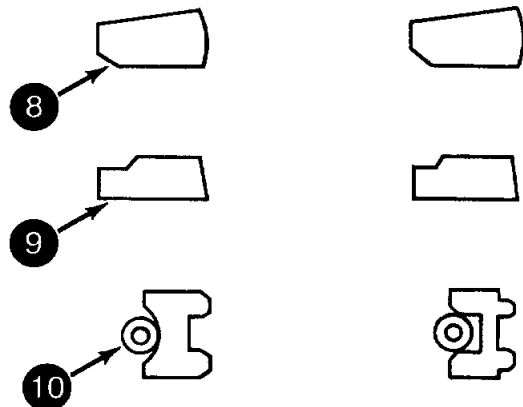
723 \* and 727 \*

Compression piston ring (8) ... 0.60 to 0.30 mm  
0.0236 to 0.0118 inch

Compression piston ring (9) ... 0.70 to 0.20 mm  
0.0275 to 0.0078 inch

Oil control ring (10) ..... 0.05 to 0.20 mm  
0.0019 to 0.0078 inch

## [ 3 ]



SM0490

Using the piston ring expander, install the oil control ring (10), compression ring (9) and compression ring (8).

**NOTE:** Repeat this step for each piston.

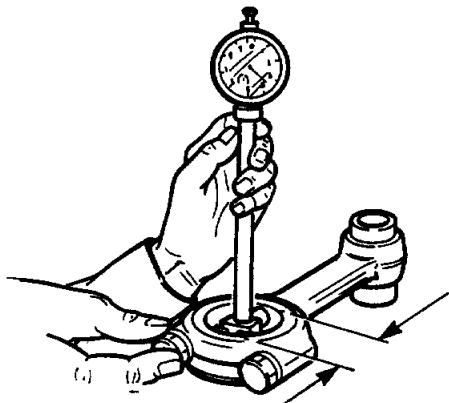
## CONNECTING RODS

[ 1 ]

Install the connecting rod liners into the connecting rod and tighten the nuts to the following torques.

719 * and 723 *	..... 31 to 34 Nm	23 to 25 lb ft
727 *	..... 39 to 42 Nm	29 to 31 lb ft

[ 2 ]



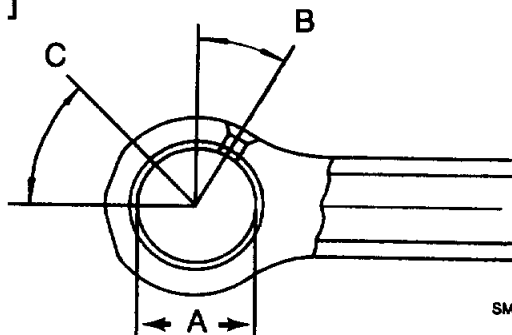
SM0535

Using an internal dial gauge measure the connecting rod liners. The wear tolerance must be:

719 * and 723 *	..... 42.0 to 42.15 mm	1.653 to 1.659 inch
727 *	..... 48.0 to 48.15 mm	1.889 to 1.895 inch

**NOTE:** After measuring the connecting rod liners, calculate the difference between the connecting rod journal O.D. (Step 68) and the connecting rod liner I.D. If this is more than 0.15 mm (0.0059 inch) with either the worn or new liners installed, then the crankshaft rod journals must be machined.

[ 3 ]

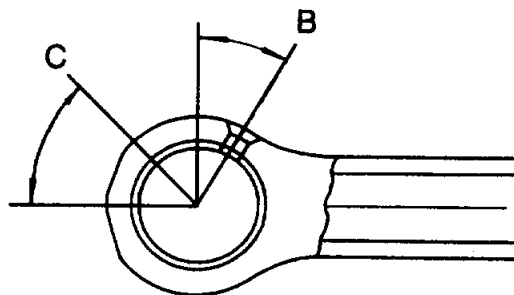


SM0518A

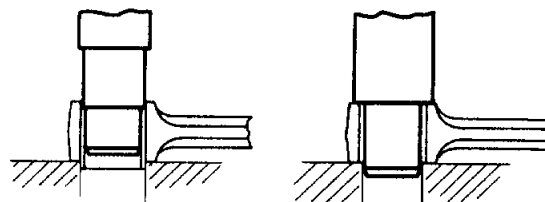
Using an internal dial gauge measure the connecting rod bushings 'A'. The wear tolerance must be:

719 * and 723 *	..... 23.041 to 22.99 mm	0.907 to 0.905 inch
727 *	..... 27.041 to 26.99 mm	1.064 to 1.062 inch

[ 4 ]



SM0518



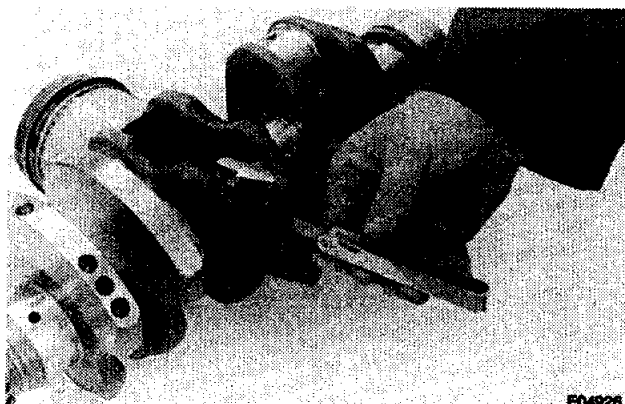
SM0519

Using a hydraulic press remove and install the connecting rod bushing. If after installation of the connecting rod bushing the internal diameter is smaller than the standard tolerance, a reamer can be used to achieve the correct measurement.

719 * and 723 *	..... 23.0 mm	0.905 inch
727 *	..... 27.0 mm	1.062 inch

**NOTE:** For Installation, install the connecting rod bushing with the oil holes aligned 'B' and the bushing joint aligned at 'C'.

[ 5 ]



E04826

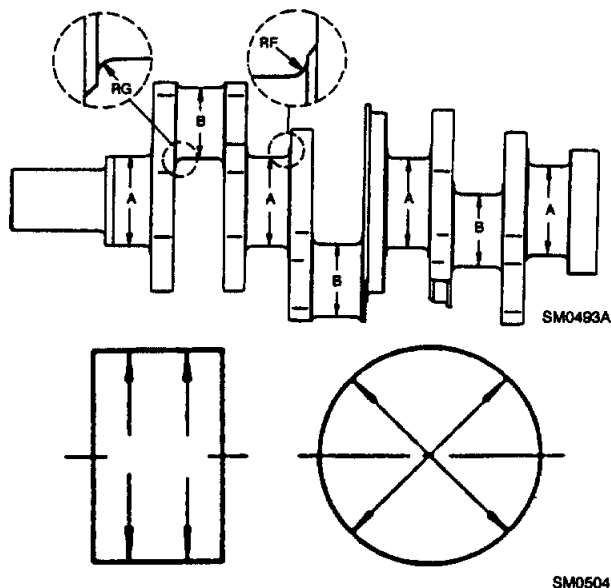
Using feeler gauges measure the connecting thrust clearance this must be 0.03 to 0.05 mm (0.0011 to 0.0019). If the clearance is more than 0.05 mm (0.0019 inch) replace the connecting rod.

## CRANKSHAFT, MAIN BEARINGS AND REAR OIL SEAL

[ 1 ]

Put identification marks on the main bearing caps (6), (7), (8) and (9) and the engine block (22). Remove items (1 to 15). Use a suitable bearing puller remove item (16). Remove items (17 to 21).

[ 2 ]



SM0504

Using a micrometer measure the crankshaft main journals 'A' and connecting rod journals 'B' in two positions as shown above. The wear tolerance on a standard crankshaft must be :

719 \* and 723 \*

Main journals 'A' ..... 52.0 to 51.90 mm  
2.047 to 2.043 inch

Connecting rod journals 'B' ..... 42.0 to 41.85 mm  
1.653 to 1.647 inch

727 \*

Main journals 'A' ..... 58.0 to 57.90 mm  
2.283 to 2.279 inch

Connecting rod journals 'B' ..... 48.0 to 47.85 mm  
1.889 to 1.883 inch

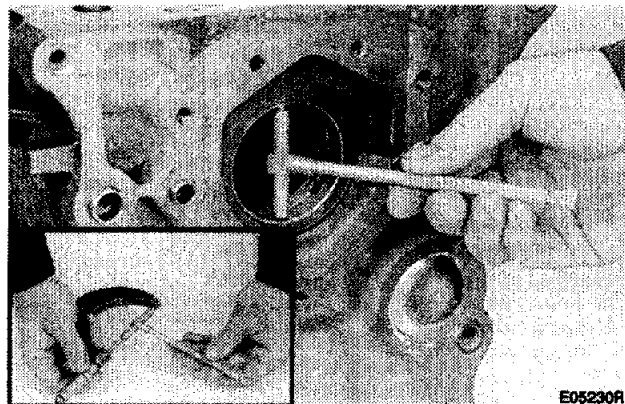
If the crankshaft is found to be worn it can be machined, refer to specifications on Page 16.

**IMPORTANT:** If the crankshaft main or connecting rod journal bearings are seized due to the lack of oil etc., the crankshaft must be replaced.

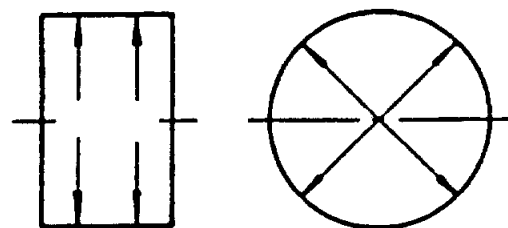
[ 3 ]

To measure the wear of the main bearing liners, install the liners in the engine block and tighten the main bearing cap retaining bolts to a torque of 49 to 54 Nm (36 to 40 Nm).

[ 4 ]



E05230R



SM0504

Measure the main bearing liners in two positions as shown above. The wear tolerance must be:

719 \* and 723 \*

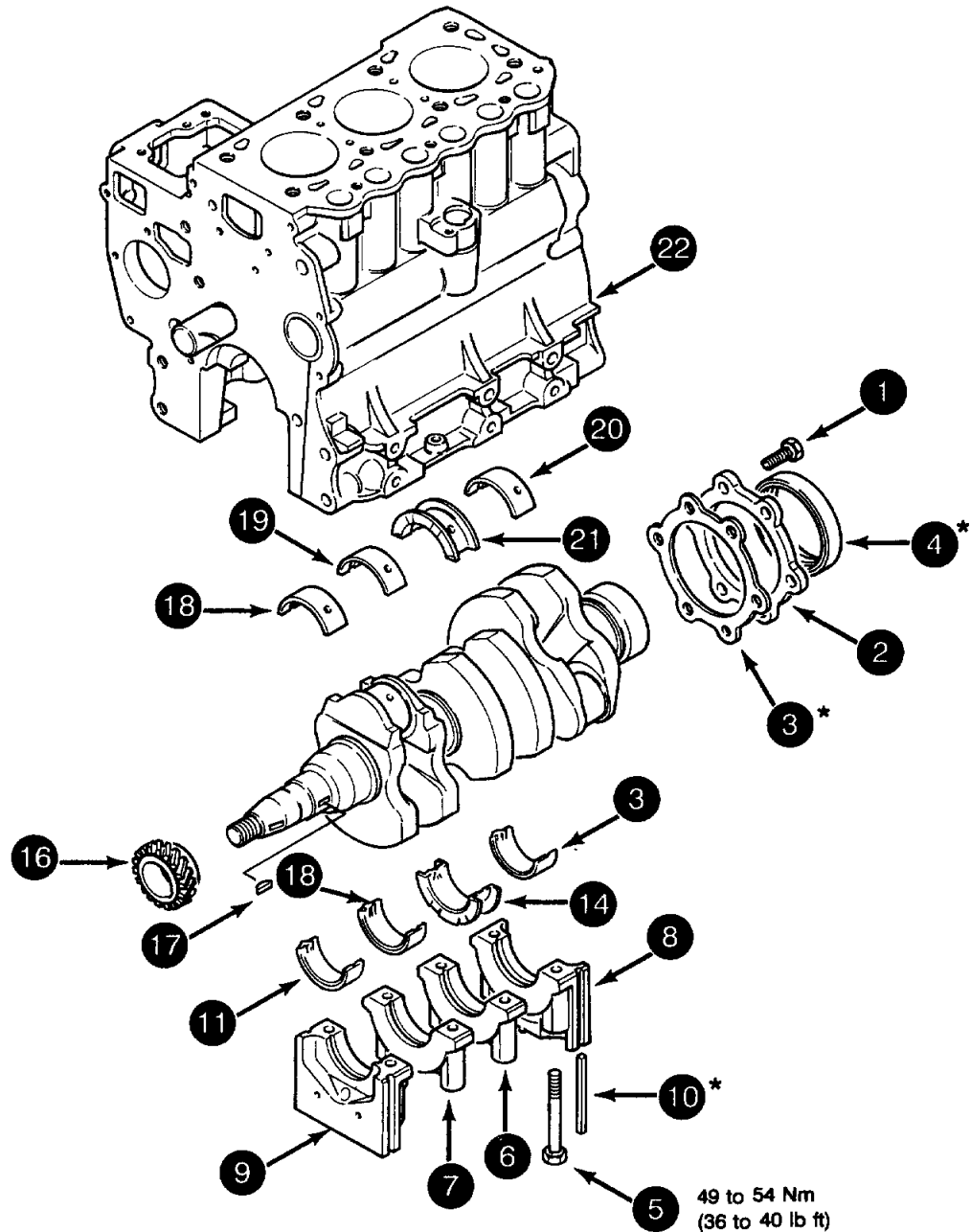
Main bearing liners..... 52.0 to 52.10 mm  
2.047 to 2.051 inch

727 \*

Main bearing liners..... 58.0 to 58.10 mm  
2.283 to 2.287 inch

**NOTE:** After measuring the main bearing liner wear tolerance, calculate the difference between the main bearing journal O.D. (Step 68) and the main bearing liner I.D. If this is more than 0.10 mm (0.0039 inch) with either worn or new liners installed, then the crankshaft main bearing journals must be machined, refer to specifications on Page 16.

NOTE: Items are numbered in order of Removal.



SM0468

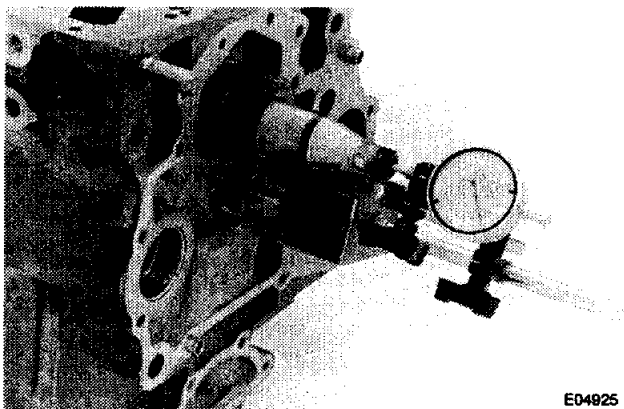
NOTE: Items marked (\*) must be replaced.

- |                                |   |                         |
|--------------------------------|---|-------------------------|
| 1. RETAINING BOLT              | 9. FRONT MAIN BEARING CAP                       | 16. TIMING GEAR         |
| 2. OIL SEAL HOUSING            | 10. FRONT AND REAR<br>MAIN BEARING CAP OIL SEAL | 17. LOCATING KEY        |
| 3. GASKET                      | 11. FRONT MAIN LINER                            | 18. FRONT MAIN BEARING  |
| 4. CRANKSHAFT REAR OIL SEAL    | 12. MAIN BEARING                                | 19. MAIN BEARING        |
| 5. MAIN BEARING RETAINING BOLT | 13. REAR MAIN LINER                             | 20. REAR MAIN BEARING   |
| 6. MAIN BEARING CAP            | 14. MAIN/THRUST LINER                           | 21. MAIN/THRUST BEARING |
| 7. MAIN BEARING CAP            | 15. CRANKSHAFT                                  | 22. ENGINE BLOCK        |
| 8. REAR MAIN BEARING CAP       |   |                         |

## [ 5 ]

Install the locating key (17) and using a hydraulic press carefully install the timing gear (16) with the long boss facing rearwards. Install the main bearing liners (21 to 18), (14 to 11) and lubricate them with clean engine oil. Install the crankshaft (15) and main bearing caps (6), (7), (8) and (9), applying Loctite B502221 to the front and rear main bearing cap outer mating surfaces (8) and (9). Install and tighten the main bearing retaining bolts (5) to a torque of 49 to 54 Nm (36 to 40 lb ft).

## [ 6 ]



Using a dial gauge measure the crankshaft end play. The end play tolerance must be 0.05 to 0.50 mm (0.0019 to 0.019 inch). If the end play is more than 0.50 mm (0.019 inch), replace the No. 3 main bearing/thrust washer.

**NOTE:** To check the crankshaft end play all the main bearings and crankshaft are to be installed with the main bearing retaining bolts tightened to a torque of 49 to 54 Nm (36 to 40 lb ft).

## [ 7 ]

Install the main bearing cap oil seal (10).

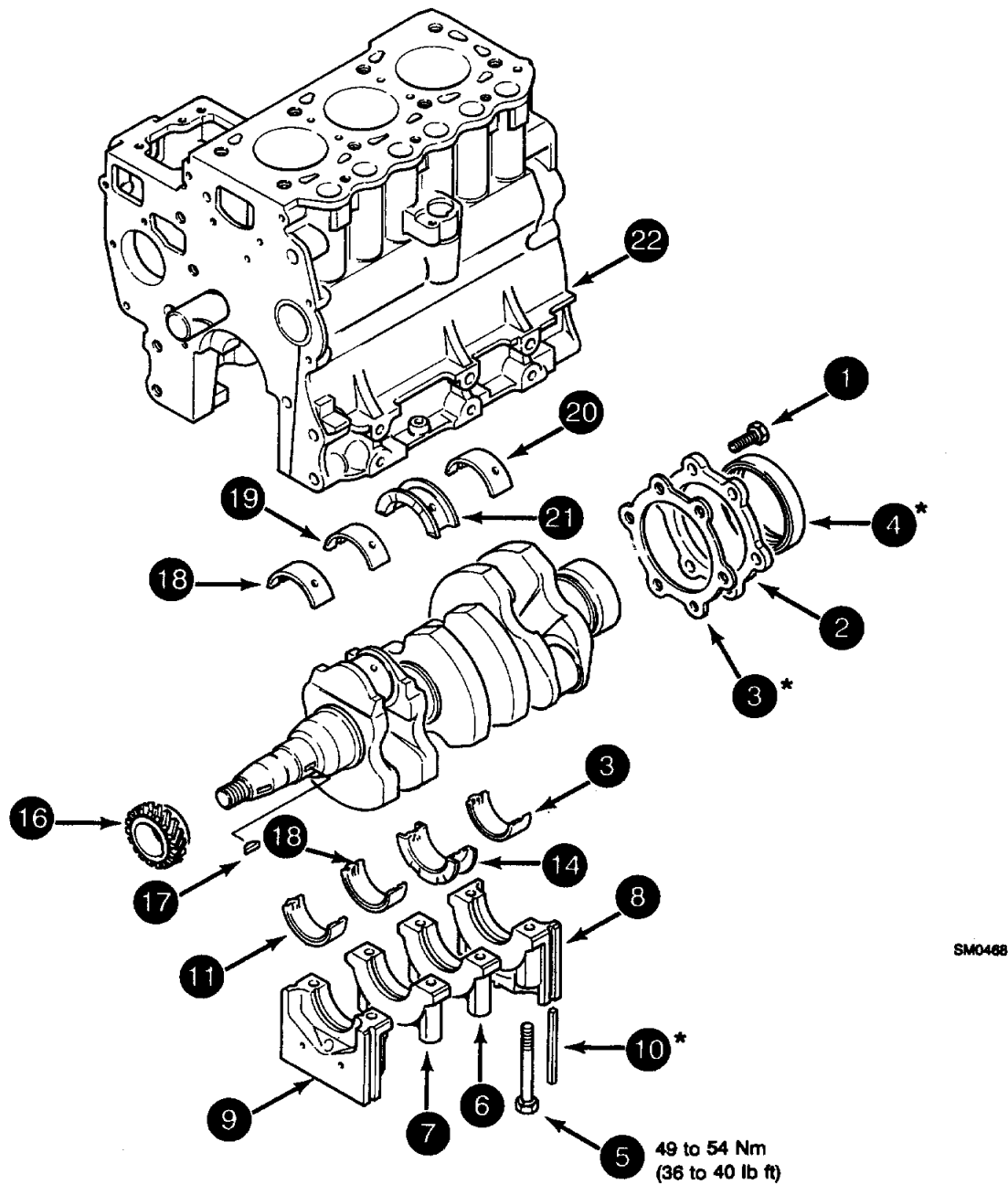
**NOTE:** Apply Loctite B502221 to the oil seals (10) before installation.

## [ 8 ]

Install the crankshaft rear oil seal (4) evenly in the oil seal housing (2) and install on to the engine block (22) using a new gasket (3).



NOTE: Items are numbered in order of Removal.



SM0468

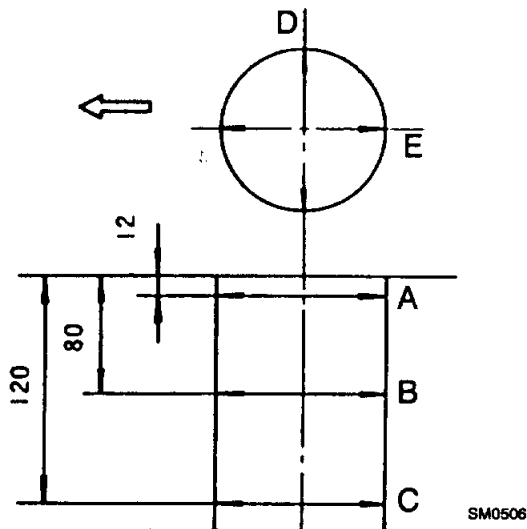
NOTE: Items marked (\*) must be replaced.

- |                                |   |                         |
|--------------------------------|---|-------------------------|
| 1. RETAINING BOLT              | 9. FRONT MAIN LINER CAP                         | 16. TIMING GEAR         |
| 2. OIL SEAL HOUSING            | 10. FRONT AND REAR<br>MAIN BEARING CAP OIL SEAL | 17. LOCATING KEY        |
| 3. GASKET                      | 11. FRONT MAIN LINER                            | 18. FRONT MAIN BEARING  |
| 4. CRANKSHAFT REAR OIL SEAL    | 12. MAIN BEARING                                | 19. MAIN BEARING        |
| 5. MAIN BEARING RETAINING BOLT | 13. REAR MAIN LINER                             | 20. REAR MAIN BEARING   |
| 6. MAIN BEARING CAP            | 14. MAIN/THRUST LINER                           | 21. MAIN/THRUST BEARING |
| 7. MAIN BEARING CAP            | 15. CRANKSHAFT                                  | 22. ENGINE BLOCK        |
| 8. REAR MAIN BEARING CAP       |   |                         |

## ENGINE BLOCK

### Inspection

[ 1 ]



Using internal dial gauge check the cylinder bores as shown at A, B and C and at 90° in each position to check for out of round measurement.

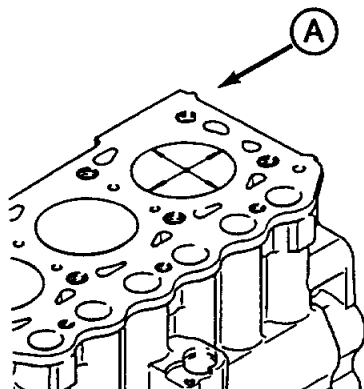
'A', 'B' and 'C' to be within ..... 0.01 to 0.20 mm  
0.00039 to 0.0078 inch

'D' and 'E' out of round within ..... 0.01 mm  
0.00039 inch

**NOTE:** The cylinder bores can be machined oversize 0.25 mm (0.00984 inch), 0.50 mm (0.01968 inch) and 0.75 mm (0.02952 inch).

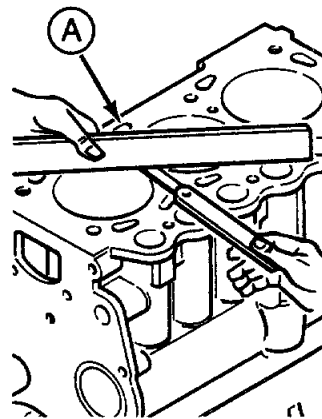
**NOTE:** If the cylinder bores are within tolerance and new piston rings are to be installed, remove the glaze from the cylinder bore using a honing tool.

[ 2 ]



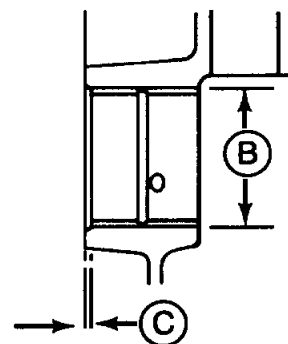
When machining the cylinder bores for oversize pistons the determined size (A) is calculated by the outside diameter of the oversize piston + clearance - honing allowance 0.02 mm (0.0078 inch).

[ 3 ]



Check for cylinder block face distortion (A) this must be 0 to 0.10 mm (0 to 0.0039 inch).

[ 4 ]



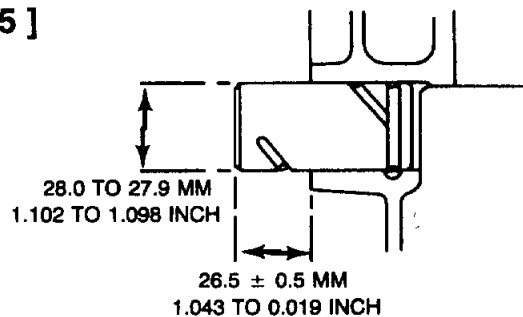
Using an internal dial gauge measure the I.D. of the camshaft bushing (B).

Bushing tolerance (B) ..... 45.0 to 45.8 mm  
1.771 to 1.803 inch

Bush Clearance (C) ..... 0.050 to 0.125 mm  
0.0019 to 0.0049 inch

Use a suitable bushing driver to remove and install the camshaft bushing.

[ 5 ]



Use a hydraulic press and a suitable bushing driver to remove the timing gear idler bushing by pressing it through into the engine block.

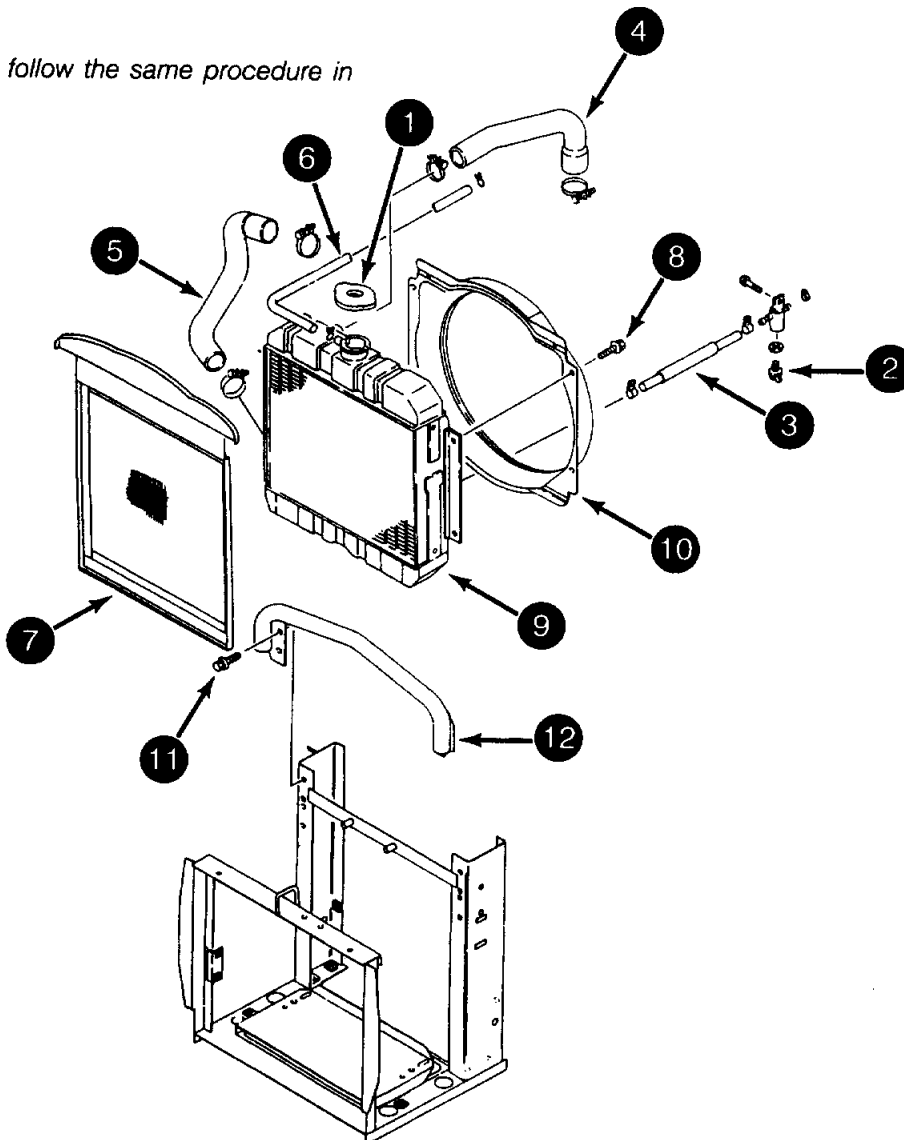
**NOTE:** For Installation, use a hydraulic press and install the idler shaft into the engine block using the dimensions as shown.

## COOLING SYSTEM

[ 1 ]

Remove the radiator cap (1), using a suitable container with a capacity of at least 7.0 litres (6.2 U.K. Quarts) remove the coolant drain plug (2) and drain the cooling system. Remove the radiator drain hose (3), upper radiator hose (4), lower radiator hose (5), expansion tank hose (6), radiator screen (7), retaining bolts (8), radiator (9) and fan shroud (10). Remove items (11) and (12) if required.

**NOTE:** For Installation, follow the same procedure in reverse order.

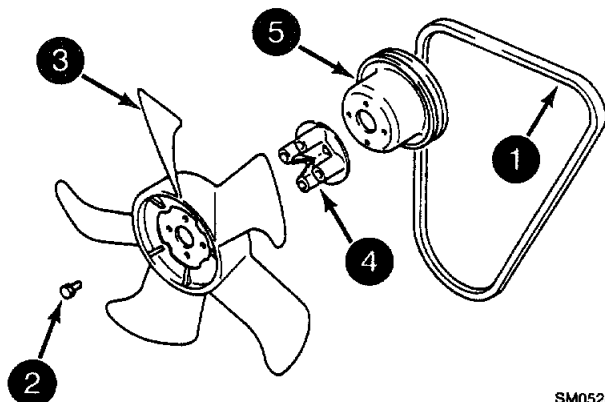


SM0523

**NOTE:** Items marked (\*) must be replaced.

**NOTE:** Items are numbered in order of Removal.

## [ 2 ]



SM0524

Remove the fan belt (1), retaining bolt (2), cooling fan (3), spacer (4) and pulley (5).

**NOTE:** For Installation, follow the same procedure in reverse order.

**NOTE:** 723 \* Tractors are fitted with two spacers, item (4).

**NOTE:** Adjust the fan belt (1) with a 10 to 12 mm deflection using 10 kg (22 inch pounds) pull.

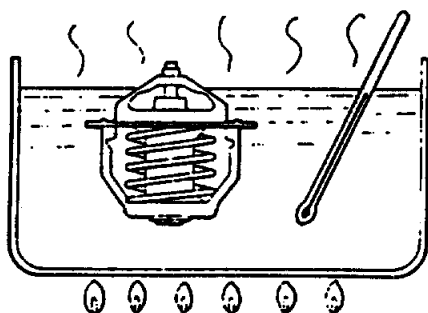
## [ 3 ]

Remove the by-pass hose (6), retaining bolts (7), water pump (8) and gasket (9).

**NOTE :** For Installation, install a new gasket (9).

**NOTE:** Check the water pump (8) for damage, wear or cracks and replace if required.

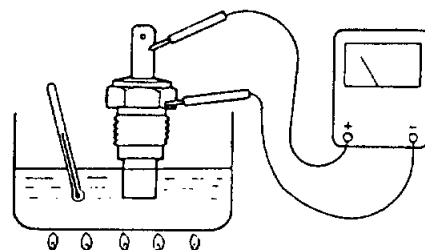
## [ 4 ]



SM0507

Remove the retaining bolts (10) thermostat housing (11), gasket (12), thermostat (13), thermostat housing (14) gasket (15), fitting (16) and coolant temperature sender (17). To check the thermostat (13) for correct operation place in heated water the thermostat (13) should start to open at  $82^{\circ}\text{C} \pm 1.5^{\circ}\text{C}$  ( $180^{\circ}\text{F} \pm 2.7^{\circ}\text{F}$ ) and be fully open at  $95^{\circ}\text{C} \pm 2.0^{\circ}\text{C}$  ( $203^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ).

## [ 5 ]



SM0570A

To check the coolant temperature sender (17) place in heated water above  $70^{\circ}\text{C}$ . Using a multimeter (using the OHMS position) take two readings:

$70^{\circ}\text{C}$  ( $158^{\circ}\text{F}$ ) ..... Resistance  $104 \pm 13.5\Omega$   
 $115^{\circ}\text{C}$  ( $239^{\circ}\text{F}$ ) ..... Resistance  $23.8 \pm 2.5\Omega$

**NOTE:** For Installation, use the same procedure in reverse order.

## [ 6 ]

Tractor	Coolant Level including bottle	
719 *	5.7 litres	6.0 US Quarts
723 *	5.3 litres	5.6 US Quarts
727 *	6.4 litres	6.8 US Quarts

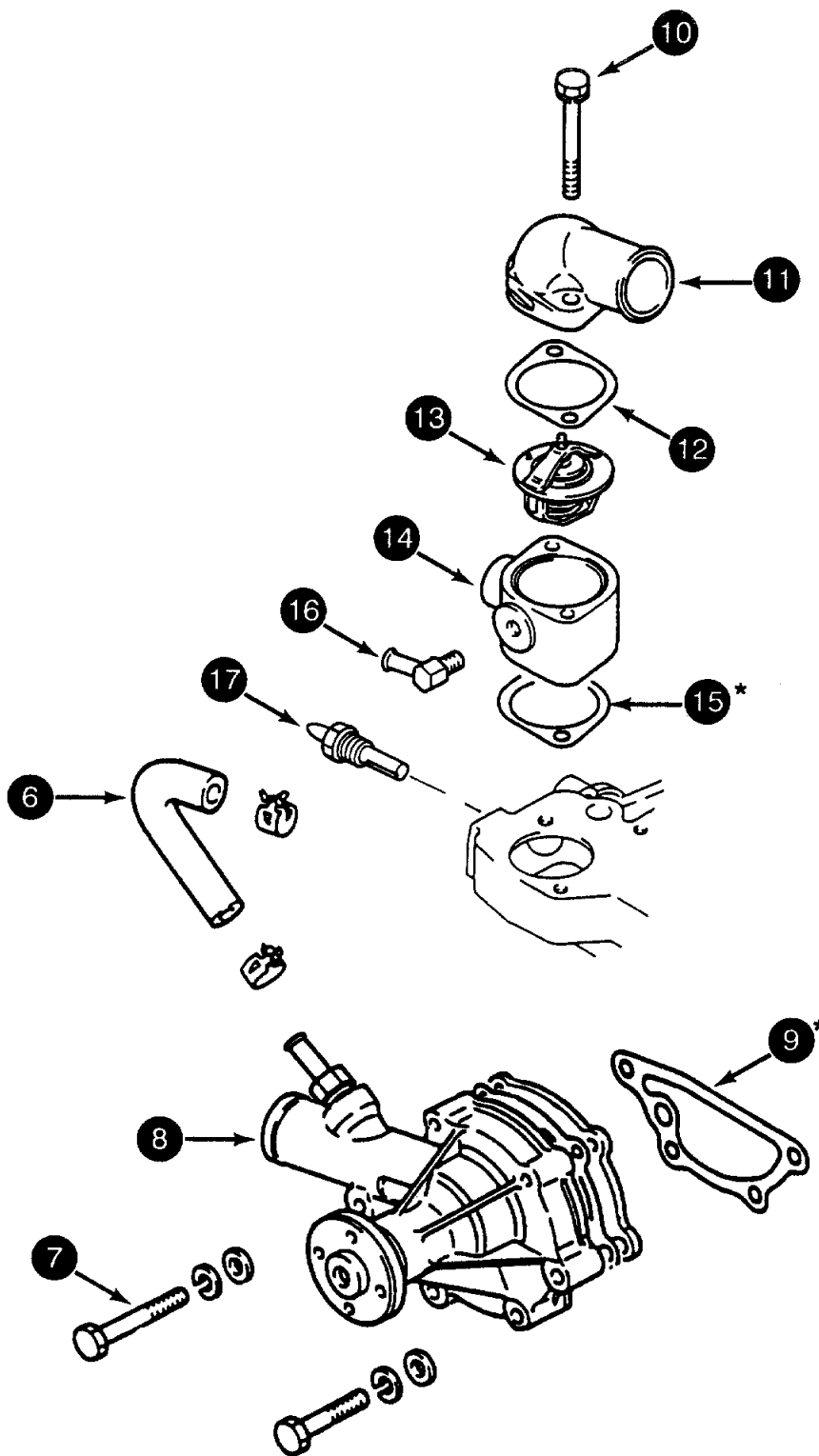
Install the coolant to the correct level using the table as a guide.

**NOTE:** Run the engine for approximately five minutes to remove all the air from the cooling system. Check the coolant level and add coolant if required.



**WARNING:** Never operate the engine in a closed building. Proper ventilation is required under all circumstances.

NOTE: Items are numbered in order of Removal.



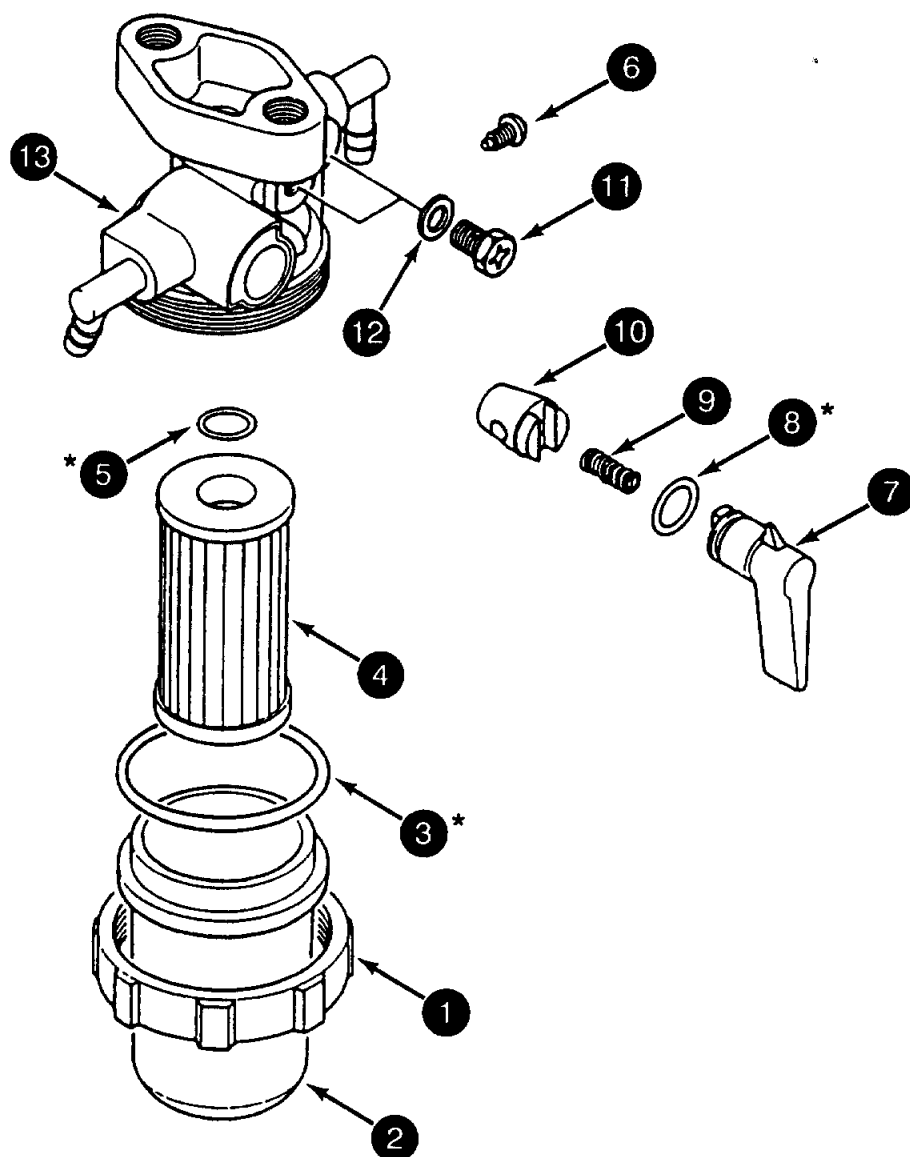
SM0551

NOTE: Items marked (\*) must be replaced.

## FUEL FILTER

### Disassembly and Assembly

NOTE: Items are numbered in order of Disassembly.



NOTE: Items marked (\*) must be replaced.

SM0411

- |           |           |                 |
|-----------|-----------|-----------------|
| 1. NUT    | 5. O-RING | 9. SPRING       |
| 2. BOWL   | 6. SCREW  | 10. VALVE       |
| 3. O-RING | 7. LEVER  | 11. BLEED SCREW |
| 4. FILTER | 8. O-RING | 12. WASHER      |
|           |           | 13. FILTER BODY |

## FUEL INJECTION PUMP

### Removal and Installation

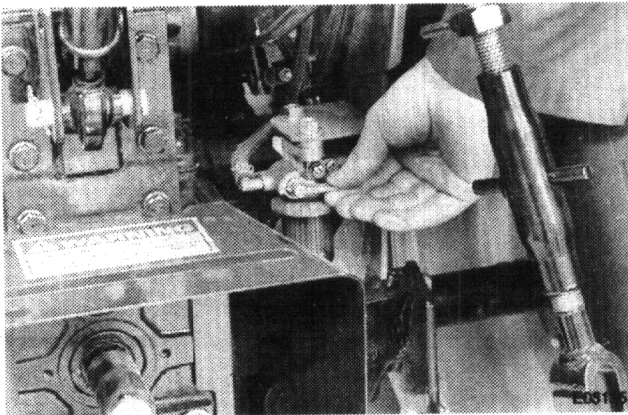
[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

[ 2 ]

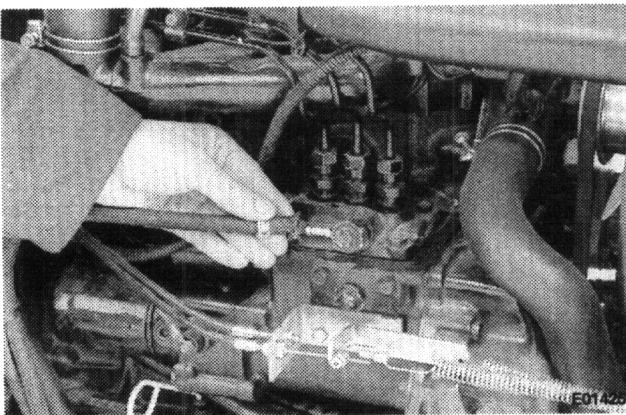
Raise the hood sheet and remove the right hand engine panel.

[ 3 ]



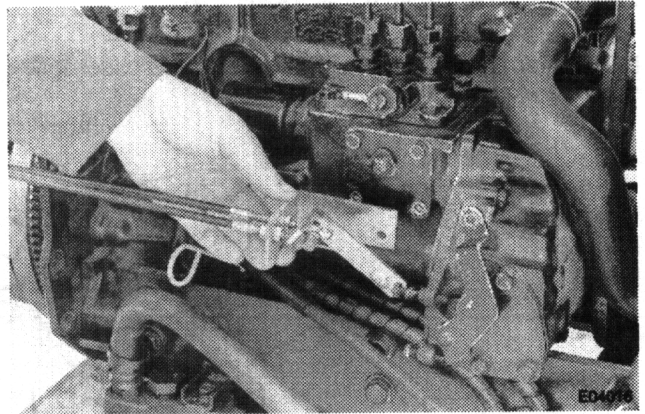
Turn the fuel supply tap to the off position.

[ 4 ]



Disconnect and cap the fuel supply hose.

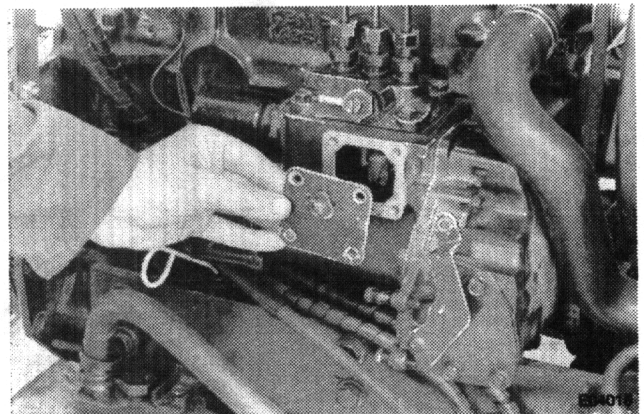
[ 5 ]



Disconnect the throttle linkage and remove the throttle support bracket.

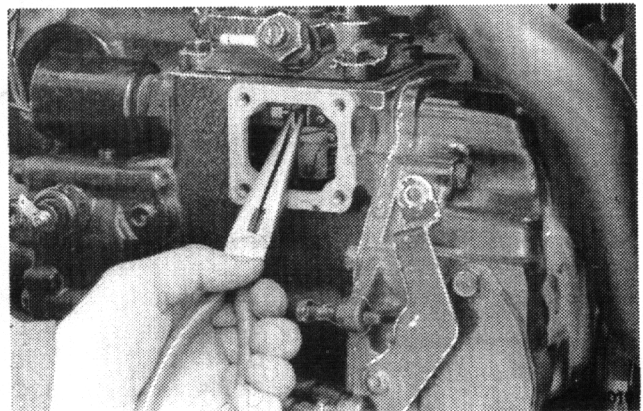
*NOTE: For Installation, refer to Section 9001 for throttle linkage adjustment.*

[ 6 ]



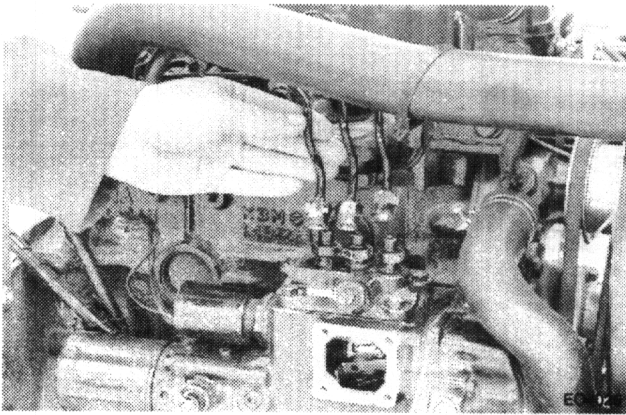
Remove the governor cover. Remove and discard the gasket.

[ 7 ]



Disconnect the governor tie rod spring and tie rod from the injection pump control rack.

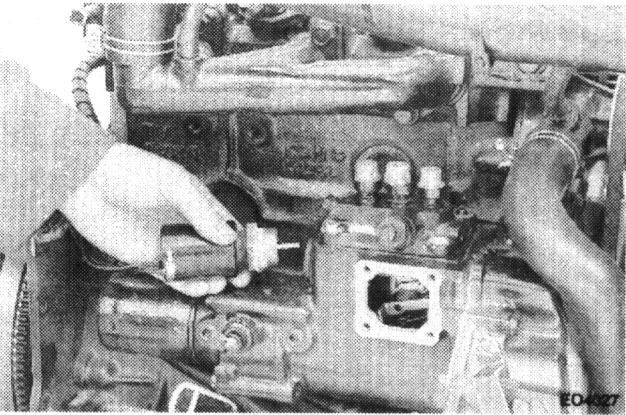
[ 8 ]



Disconnect cap and remove the injection tubes.

**NOTE:** For Assembly, tighten the tube nuts to a torque of 24 to 34 Nm (18 to 25 lb ft).

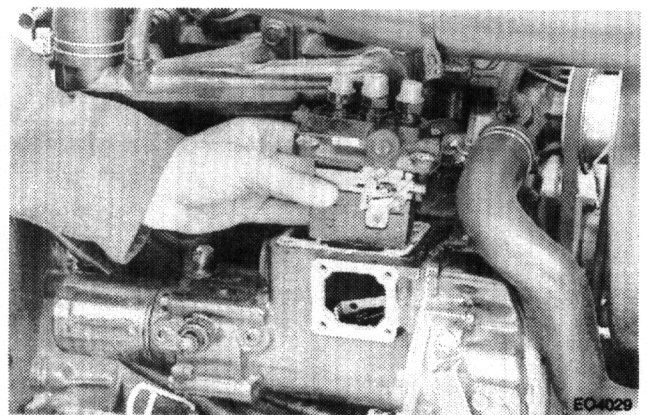
[ 9 ]



Put identification marks on the solenoid valve and valve housing. Disconnect the solenoid from the main harness and remove.

**NOTE :** For Installation, refer to Fuel Shut-off Solenoid Adjustment, Page 62.

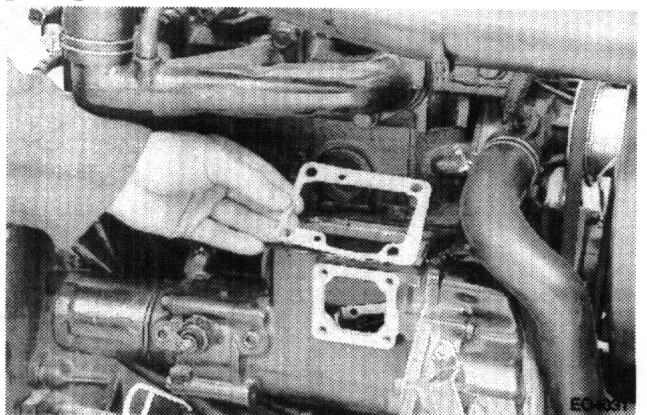
[ 10 ]



Remove the retaining bolts and remove the fuel pump.

**NOTE:** For Assembly, tighten the bolts to a torque of 10 to 13 Nm (7.5 to 9.5 lb ft).

[ 11 ]



Remove the fuel pump adjusting shims.

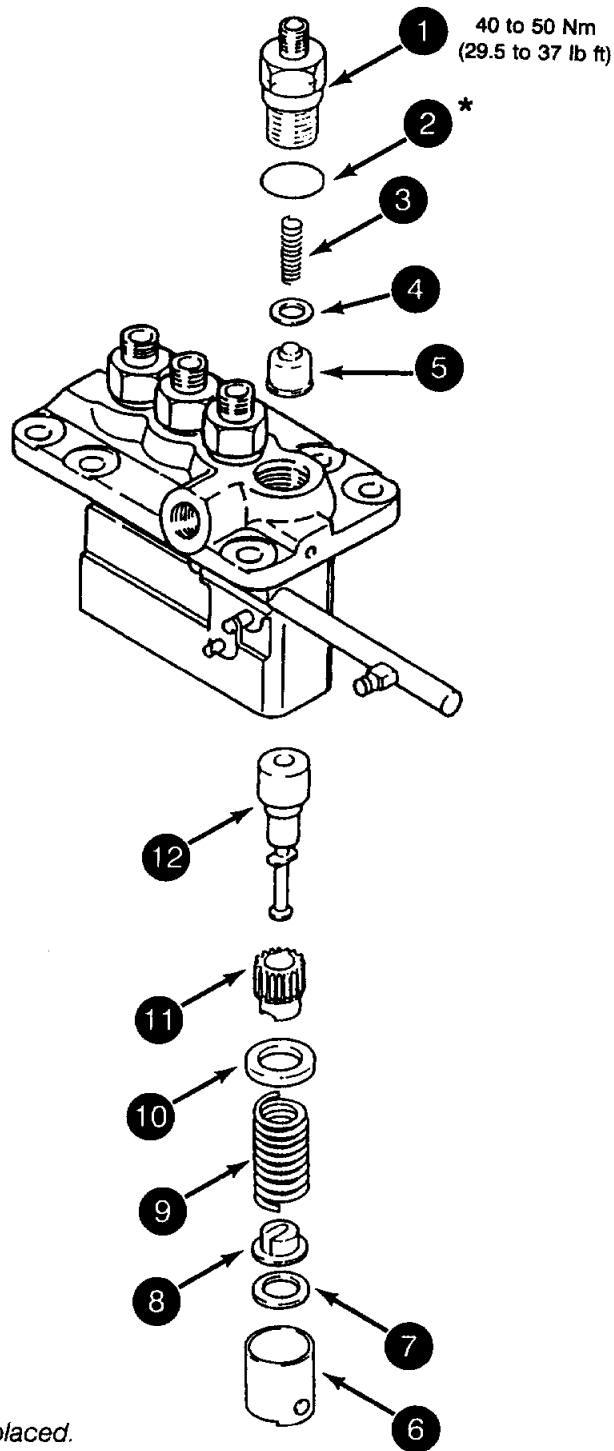
**NOTE:** Keep the shims together for assembly.

**NOTE:** For Assembly, follow the same procedure in reverse order, if new parts have been installed, check the fuel injection pump timing, refer to Page 9.



## Disassembly and Assembly

NOTE: Items are numbered in order of Disassembly.



SM0407

NOTE: Items marked (\*) must be replaced.

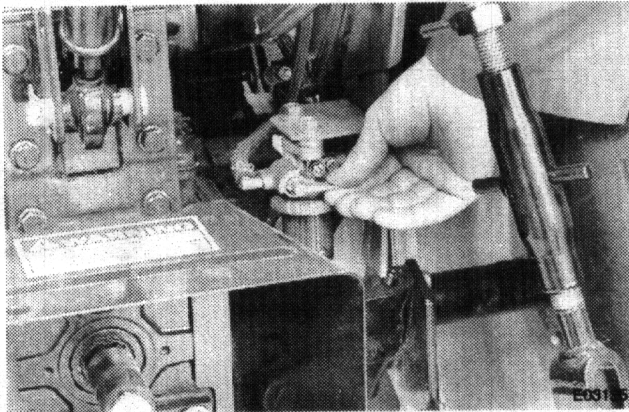
- 1. DELIVERY VALVE HOLDER
- 2. O-RING
- 3. SPRING
- 4. GASKET

- 5. DELIVERY VALVE AND HOLDER
- 6. TAPPET
- 7. SHIM
- 8. SPRING SEAT

- 9. SPRING
- 10. SPRING SEAT
- 11. SLEEVE
- 12. PLUNGER

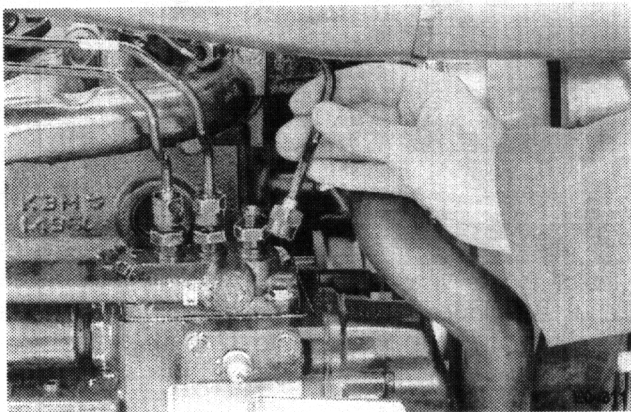
## FUEL INJECTION PUMP TIMING

[ 1 ]



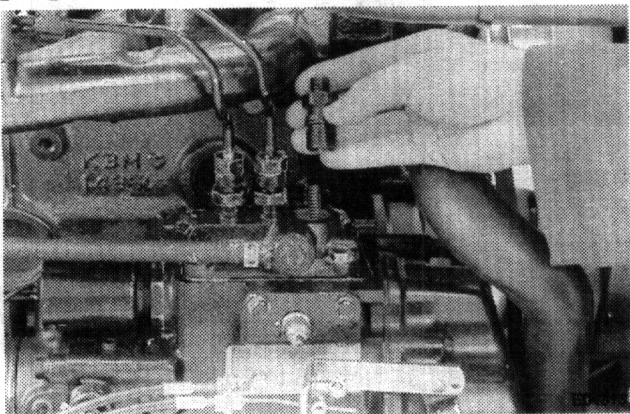
Turn the fuel supply tap to the Off position.

[ 2 ]



Disconnect, cap and remove Number 1 injection tube.

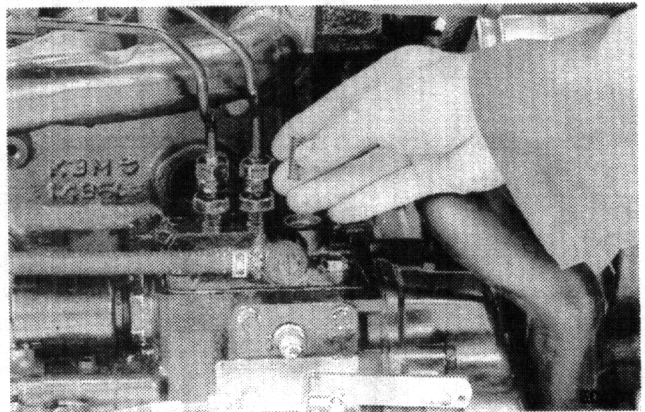
[ 3 ]



Remove the fuel delivery valve holder.

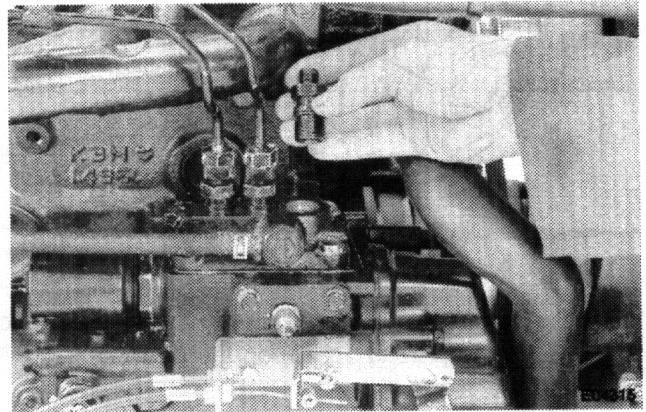
**IMPORTANT:** Do Not allow foreign material to enter the fuel pump.

[ 4 ]



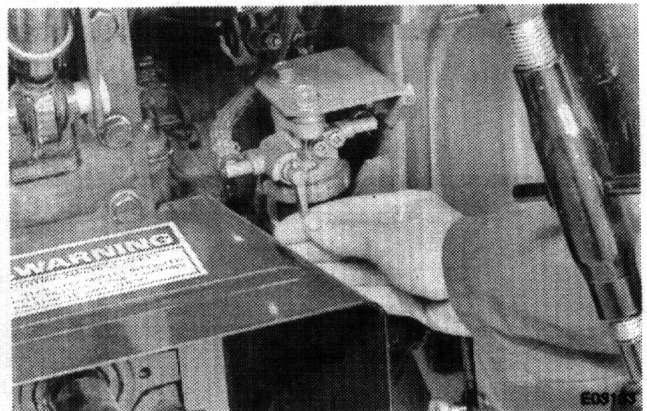
Remove the delivery valve spring.

[ 5 ]



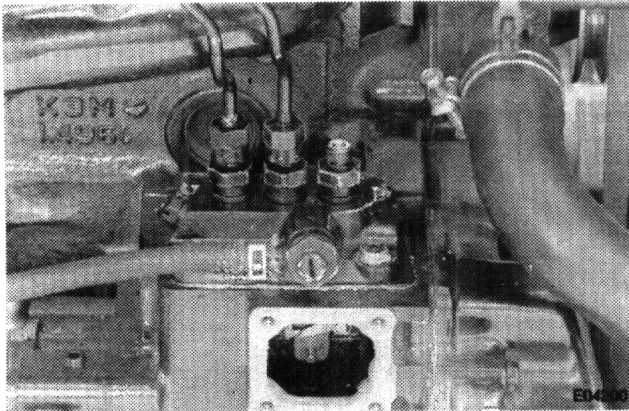
Install the delivery valve holder and tighten.

[ 6 ]



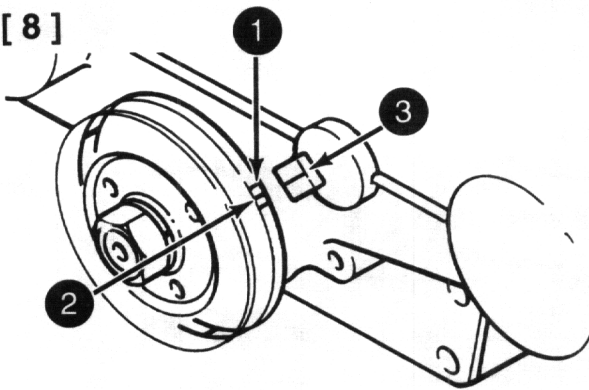
Put the throttle control in the half idle position and turn the fuel supply tap to the On position. Turn the keyswitch On.

[ 7 ]



Turn the crankshaft pulley clockwise until the fuel flow just stops.

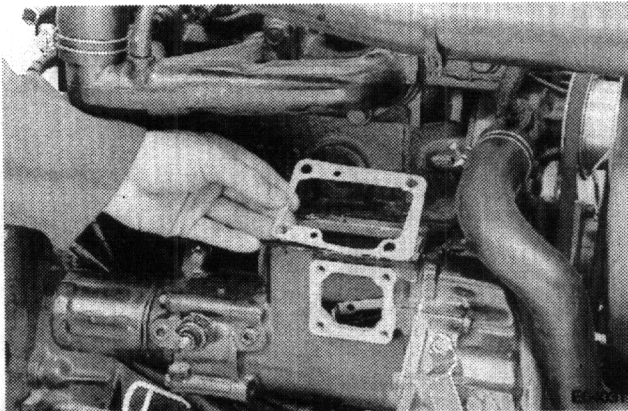
[ 8 ]



524LS

The injection timing mark (1) for (719 \* ) or (2) for (723 \* and 727 \* ) on the crankshaft pulley should align with the index mark (3) on the gear case when the fuel flow stops.

[ 9 ]

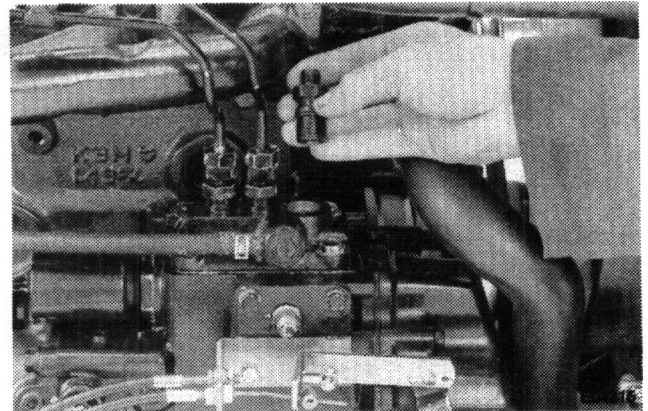


If the fuel injection pump is not to specification, adjust by adding or removing shims between the fuel pump and the housing.

Adding a 0.1 mm (0.004 inch) shim will advance the timing by approximately 1 degree.

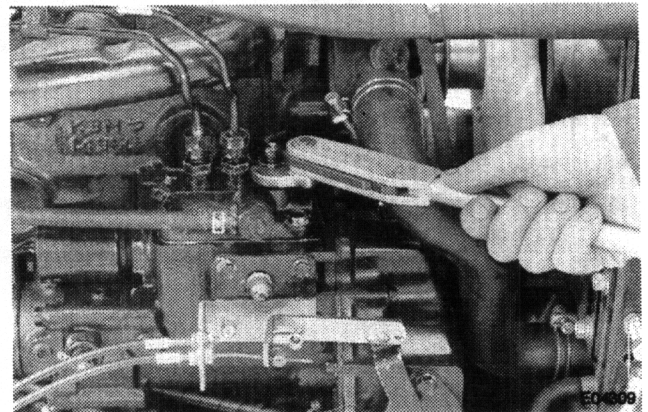
Removing a 0.1 mm (0.004 inch) shim will retard the timing by approximately 1 degree.

[ 10 ]



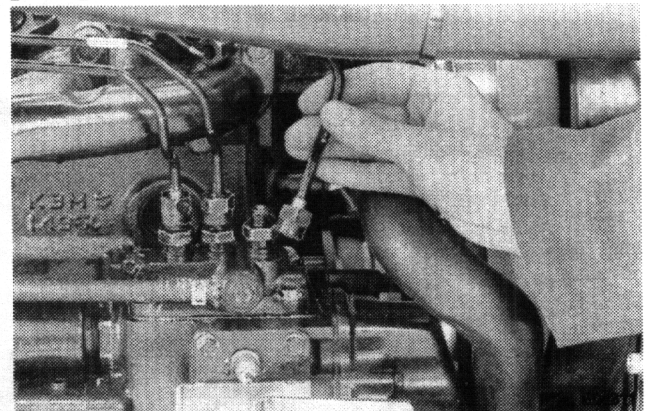
Remove the delivery valve holder.

[ 11 ]



Install the delivery valve spring, delivery valve holder and new copper gasket. Tighten the delivery valve to a torque of 40 to 50 Nm (29.5 to 37 lb ft).

[ 12 ]



Install the fuel injection tube. Tighten the tube nuts to a torque of 24 to 34 Nm (18 to 25 lb ft).



## FUEL INJECTORS

### Removal and Installation

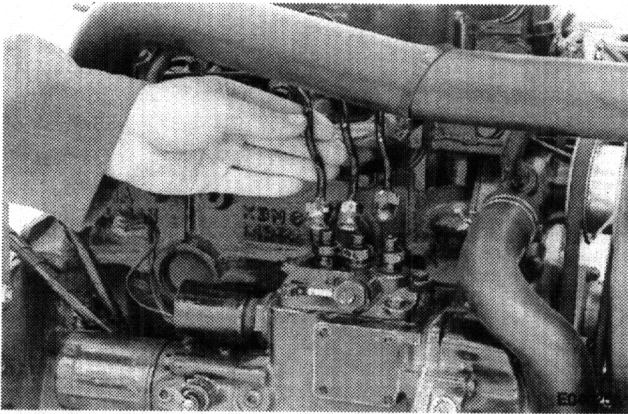
[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

[ 2 ]

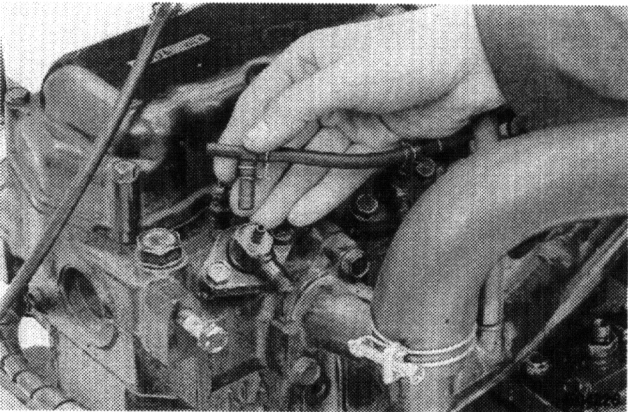
Raise the hood sheet and remove the right hand engine panel.

[ 3 ]



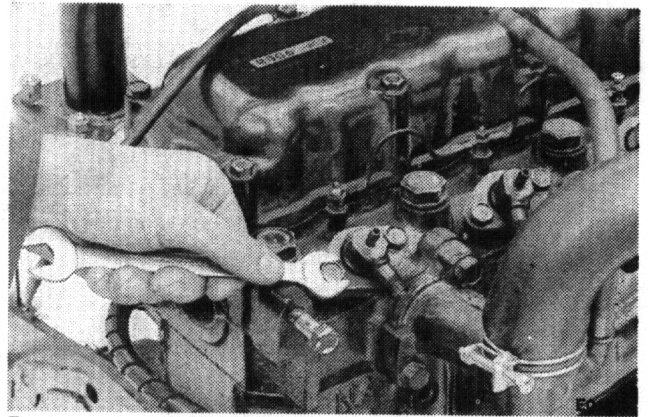
Disconnect cap and remove the fuel injector tubes.

[ 4 ]



Remove the leak off hose.

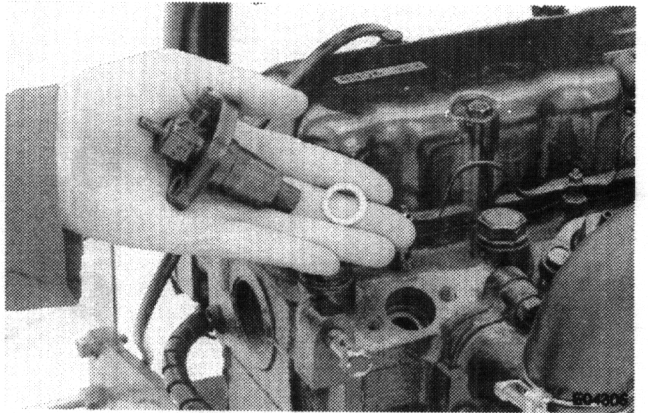
[ 5 ]



Remove the retaining bolts.

**NOTE:** For Assembly, tighten the retaining bolts to a torque of 15 to 20 Nm (11 to 15 lb ft).

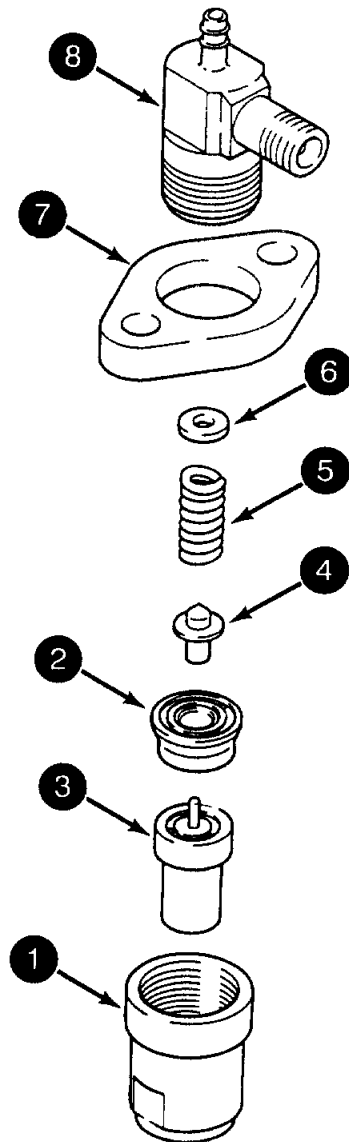
[ 6 ]



Remove the fuel injector and sealing gasket.

## Disassembly and Assembly (719 \* )

NOTE: Items are numbered in order of Disassembly.



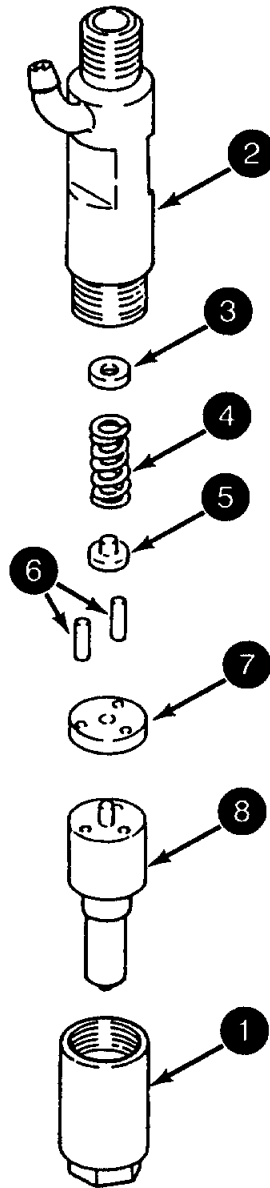
612L8

NOTE: The injector is a non-servicable item, disassemble to clean only.

- |                 |                  |
|-----------------|------------------|
| 1. CAP NUT      | 5. SPRING        |
| 2. STOP VALVE   | 6. SHIM          |
| 3. NOZZLE BODY  | 7. FLANGE        |
| 4. PRESSURE PIN | 8. INJECTOR BODY |

## Disassembly and Assembly (723 \* and 727 \* )

NOTE: Items are numbered in order of Disassembly.

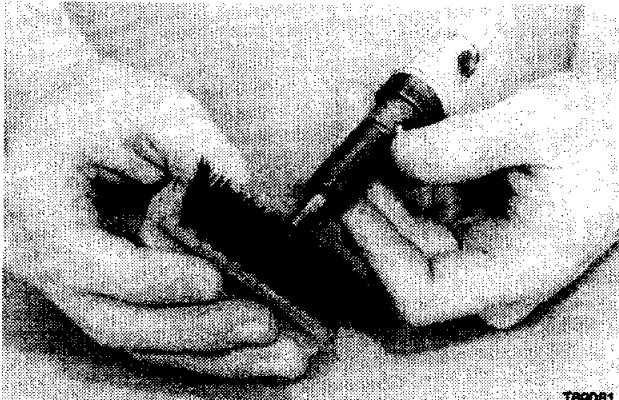


- |           |               |
|-----------|---------------|
| 1. NUT    | 5. SEAT       |
| 2. BODY   | 6. PIN        |
| 3. SHIM   | 7. VALVE STOP |
| 4. SPRING | 8. TIP        |

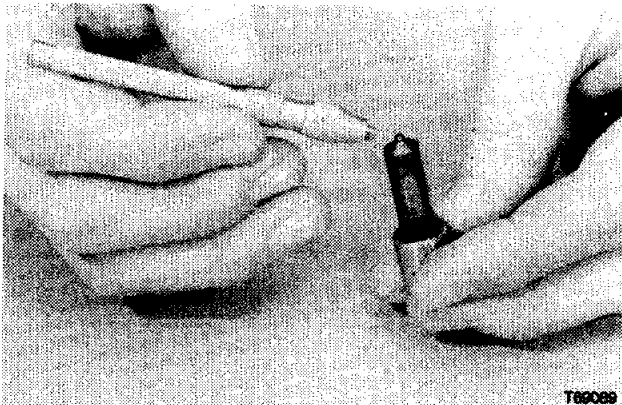
**IMPORTANT:** The nozzle is held in position with the cap nut (1). To prevent damage to the dowel pins (6), valve stop (7) and body (2), the nozzle must not turn with the cap nut (1). Wet the nozzle with cleaning solution until the nozzle is free in the cap nut (1). Replace the valve stop assembly if there is damage to the dowel pins or valve stop.

## Cleaning and Inspection

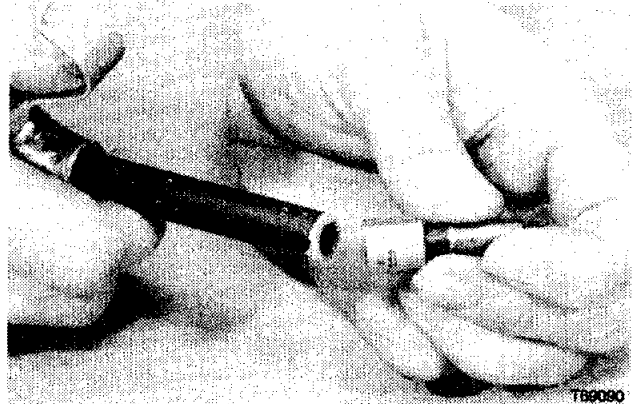
1. All parts must be put in a solvent to loosen the carbon deposits.



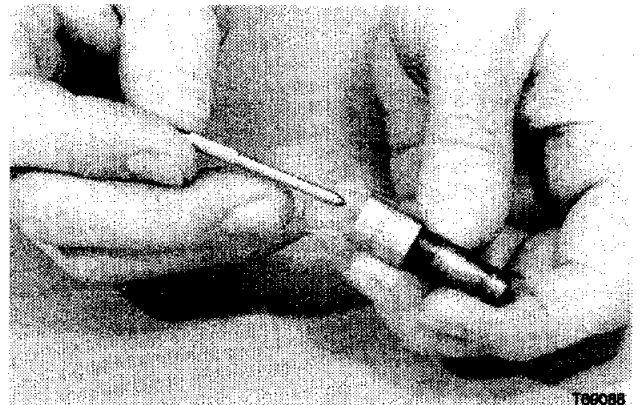
2. Use the Nozzle Cleaning Kit, to clean the injectors. A brass wire brush must be used to clean the outside of the tip body. Use cleaning wires to remove the carbon from the spray orifices. Use cleaning wires that are 0.0127 to 0.0254 mm (0.0005 to 0.001 inch) smaller in diameter than the spray orifice. Put the cleaning wire in a pin vise, the end of the wire must extend 0.79 mm (0.031 inch) past the tip of the pin vise. A longer length of pin will hit the opposite side of the sac hole and will break.



3. Use a stone to remove sharp edges from the end of the wire. A small flat on one side of the wire will make it easier to cut the carbon from the orifice. Put the cleaning wire in the spray orifice and turn the wire until the wire is free. Wash the body with clean solvent and look at the tip. The nozzle tip must be replaced if the orifice in the tip shows damage at the edges. Damage to the orifice will change the spray pattern.

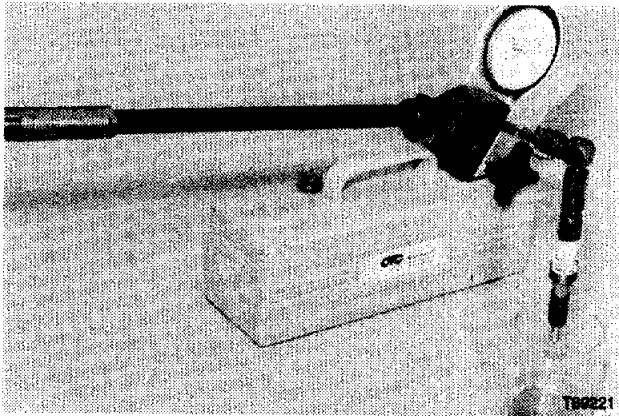


4. Clean all channels with compressed air. Direct the air through both ends of the nozzle tip assembly. All Carbon deposits must be removed.



5. Make sure that the nozzle valve slides freely in the nozzle body.
6. Carefully clean the nozzle valve and the inside diameter of the body to remove all dirt, varnish and other foreign deposits.
7. The injector valve must be cleaned with a brass brush to remove deposits from the seat location. Varnish must be removed with a solvent and a cleaning pad made of felt. Do not put the valve in a motor driven lathe to clean the valve. This method can remove too much material from the valve which can change valve lift. Look at the valve for pitting or damage which can cause leakage.
8. Replace all parts that show damage.

## FUEL INJECTOR TESTER



A Diesel Fuel Injection Nozzle Tester is needed for checking and adjusting the injectors. The following instructions will work for all models of testers except for descriptions on adjustments to the tester. Operating instructions are given with the tester.

The tester is used to make the following checks:

1. Check the injector opening pressure.
2. Check the injector assembly for fuel leakage.
3. Check the injector for accurate spray pattern.

Fuel injectors must be checked on the tester when making the following service operations:

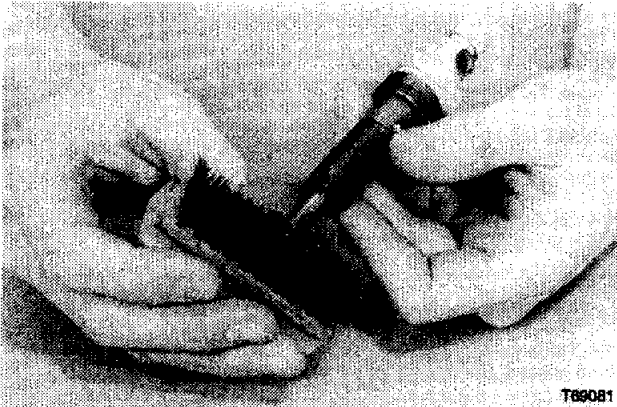
1. An injector that has been removed from the engine for cleaning, must be checked on the tester before the injector can be installed in the engine.
2. A new injector assembly must be checked on the tester before the injector can be installed in the engine.
3. All the injectors must be removed and checked on the tester during an engine overhaul.
4. An injector must be removed and checked on the tester before the injector is disassembled, if the injector is the cause of engine performance that is not acceptable.

### Nozzle Tester Preparation

1. Fill the reservoir with clean fuel.
2. Connect the correct connectors to the connection tube .
3. Connect the injector to the tester.
4. To remove the air that is in the system, close the pressure release valve and the gauge protection valve, open the pump. Operate the pump rapidly to remove the air from the system.

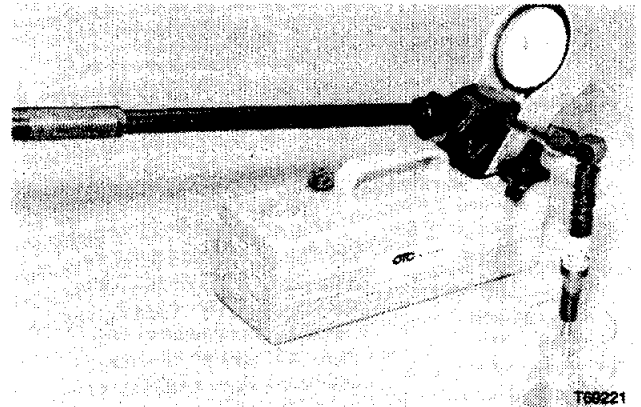


## TESTING INJECTORS



The injector must be cleaned before testing the injector. Wash the body, nozzle tip and the cap nut in a solvent to remove external dirt, grease and carbon deposits from the cap, body and outside diameter of the tip.

**IMPORTANT:** Do not permit the brass brush to contact the tip (spray hole area) of the nozzle.



Connect the injector to the nozzle tester. The nozzle tip must be facing down.



**WARNING:** When testing or adjusting fuel injectors, do not place your hands or arms in front of the injector nozzle.

Fuel from the spray orifices can enter clothing and skin, causing serious damage. The tip must always be put in a container to contain the spray.

## Checking Opening Pressure

Close the pressure release valve and the gauge protection valve, operate the pump rapidly to flush the injector. Open the gauge protection valve and raise the pressure slowly until the injector valve opens (the gauge reading will fall quickly at this point). Check the opening pressure against the Specifications, refer to Page 3.

**NOTE:** There must not be more than 1034 kPa (150 PSI) difference between any of the injectors that have been removed from the engine.

If the injectors do not meet the given opening pressure:

1. Injectors in use must be disassembled and cleaned, refer to Page 15.
2. Check for broken or weak opening pressure control springs.

For **719 \*** Tractors the opening pressure must be 11800 to 12700 kPa (1706 to 1848 PSI), refer to Page 12.

For **723 \*** / **727 \*** Tractors the opening pressure must be 16700 to 17700 kPa (2418 to 2560 PSI), refer to Page 13.

## Checking Seat Leakage

Close the pressure release valve and the gauge protection valve. Open the pump valve and operate the pump rapidly to flush the injector.

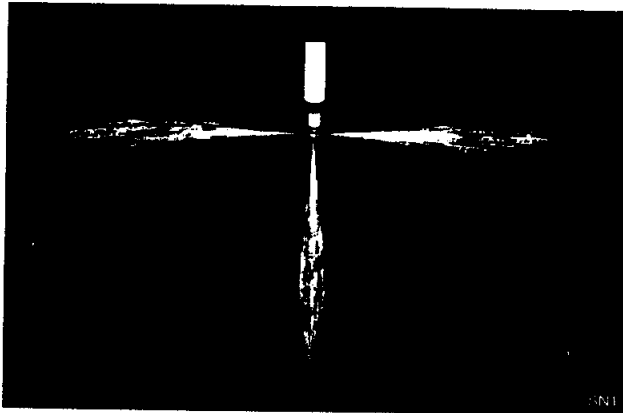
1. Dry the injector tip completely. Open the gauge protection valve.
2. Raise the pressure at the injection to 690 kPa (100 PSI) under the opening pressure.
3. Close the pump valve for five seconds and check the nozzle tip (spray hole location). The nozzle leaks if drops of fuel are seen on the nozzle tip. A small amount of moisture on the nozzle tip is permitted.

4. Open the pressure release valve and remove the injector.
5. If drops of fuel are seen on the nozzle tip, disassemble and clean the injector, refer to Pages 12 and 13.
6. Assemble the injector, refer to Pages 12 and 13. Test the injector, refer to Pages 15 and 16.

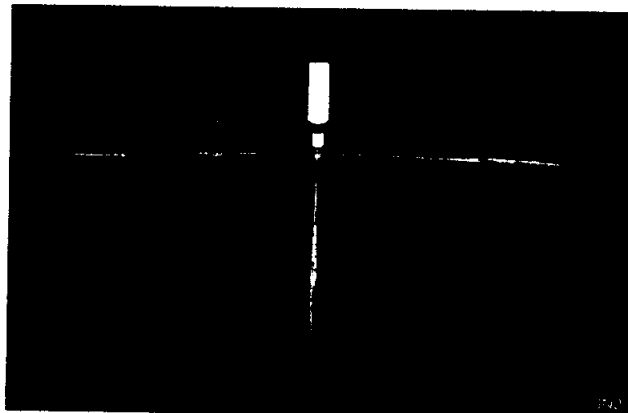
## Spray Pattern

Close the pressure release valve and the gauge protection valve. Open the pump valve and operate the tester at 60 strokes a minute, check the spray pattern. The nozzle must have a spray pattern that will atomize the fuel. The nozzle must not have a solid spray pattern.

723 \* and 727 \*



SPRAY PATTERN THAT WILL ATOMIZE FUEL



SOLID TYPE SPRAY PATTERN

719 \*



GOOD



BAD



BAD

SM0538

The injector will make a very clear noise when the test stand is operated rapidly. This noise will not necessarily occur in the operation of the injector in the engine. The noise is an indication of good seat width and interference angles. This noise can change between nozzles. The noise in the nozzles must not be compared for purpose of making nozzles acceptable or not acceptable.

If this injector makes a solid type spray pattern, do the following:

1. Check the orifices that are not open and check orifices for scratches and heavy damage.
2. Disassemble and clean the injector.
3. Check for pitting of the valve seat, wear of valve interference angles, bent valve and distortion in the body. Replace the complete injector assembly if there is distortion in the body.

## FUEL SHUTOFF SOLENOID ADJUSTMENT

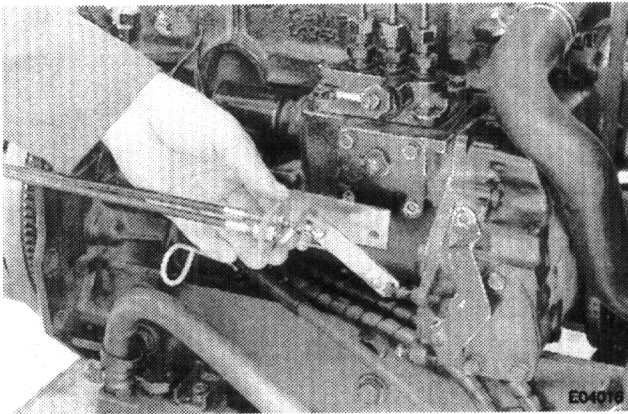
[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

[ 2 ]

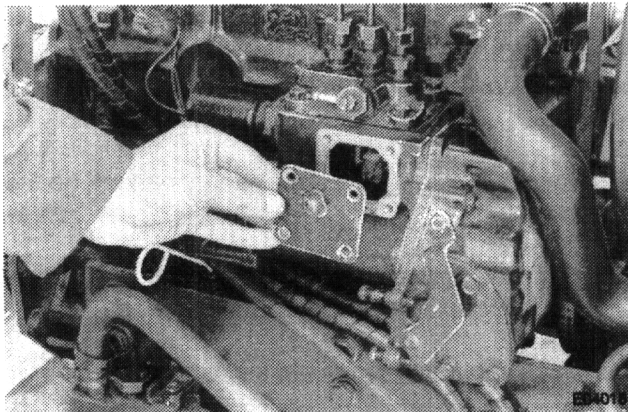
Raise the hood sheet and remove the right hand engine panel.

[ 3 ]



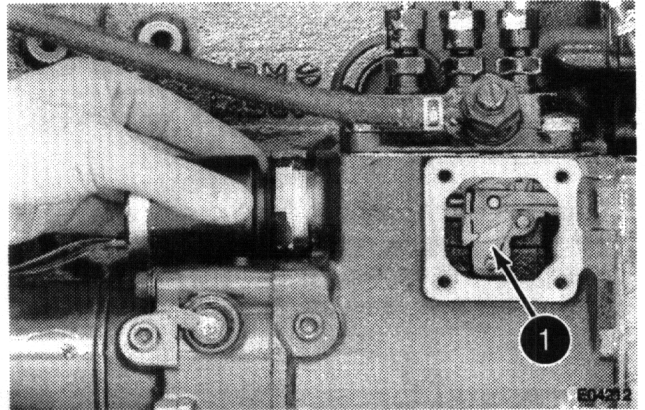
Disconnect the throttle linkage and remove the throttle support bracket.

[ 4 ]



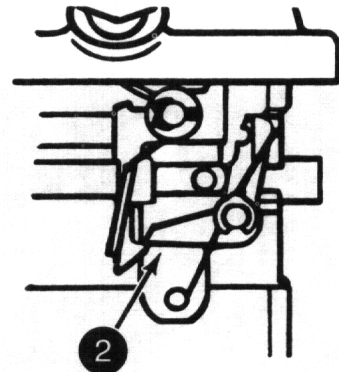
Remove the governor damper spring cover. Remove and discard the gasket.

[ 5 ]



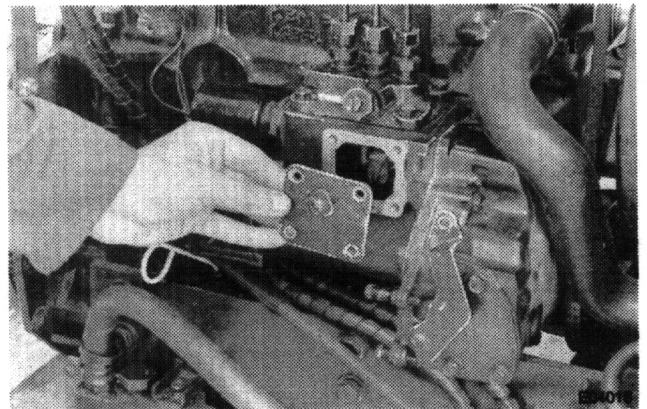
Disconnect the solenoid from the main harness. turn the solenoid counter clockwise until the fuel pump stopper is in the run position (1).

[ 6 ]



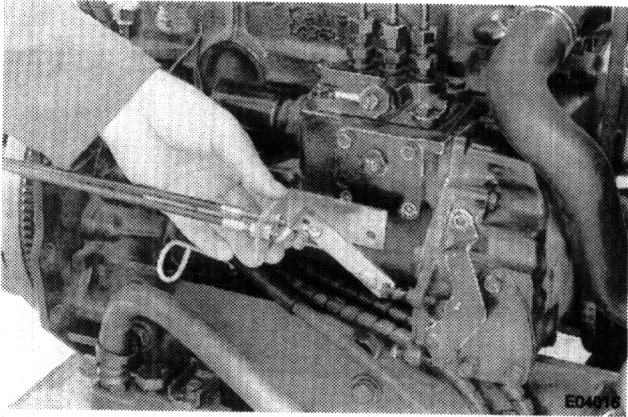
Turn the solenoid clockwise until the fuel pump stopper is in the stop position (2). Turn the solenoid in an extra 1/2 a turn. Without moving the solenoid tighten the locknut to a torque of 40 to 50 Nm (29.5 to 37 lb ft).

[ 7 ]



Install a new gasket to the governor cover and install the cover.

[ 8 ]



Install the throttle support bracket and the throttle linkage.

**NOTE:** Refer to Section 9001 for Throttle Linkage Adjustment.

[ 9 ]

Start the tractor and check the operation of the fuel shut off solenoid.



**WARNING :** *Never operate the engine in a closed building. Proper ventilation is required under all circumstances.*

[ 10 ]

Install the right hand engine panel and lower the hood.

## SECTION II

### ENGINE (720 \* AND 726 \*)

### 《SL SERIES ENGINE》

### GENERAL ENGINE SPECIFICATIONS

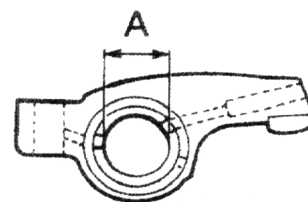
Engine Type		
720 *	.....	S3L 3 Cylinder Diesel Indirect Injection
726 *	.....	S3L2 3 Cylinder Diesel Indirect Injection
Number of Cylinders .....		
3		
Compression Ratio		
Direct Injection	.....	18:1
Indirect Injection	.....	22:1
Compression Between Each Cylinder .....		
292 kPa		42 psi
Static Timing Advance		
Indirect Injection - 720 * and 726 *	.....	17° BTDC
Valve Clearance		
Cold	.....	0.25 mm                      0.0098 inch
Injection Order .....		
1,3,2		
Cylinder Head Gasket Material		
Direct Injection	.....	Grafoil
Indirect Injection	.....	Carbongraphite with Stainless Steel Grommets

### SPECIFICATIONS

#### Rocker and Rocker Shaft

Dimension 'A' ..... 18.91 to 18.93 mm  
0.744 to 0.745 inch

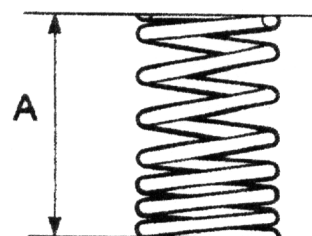
Dimension 'B' ..... 18.88 to 18.90 mm  
0.743 to 0.744 inch



SM0552

Free Length 'A' ..... 47 mm                      1.85 inch

#### Valve Springs



SM0553

## Valves

### Dimension

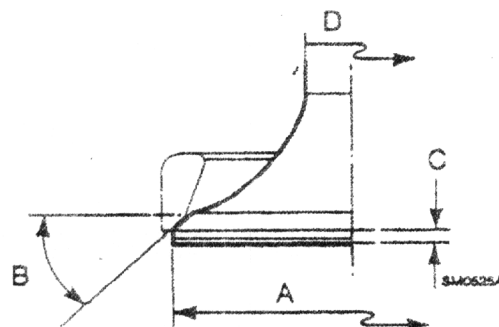
'A'	32.2 mm	1.27 inch
'B'	45 °	
'C'	1.0 to 0.5 mm	0.039 to 0.020 inch

'D'	6.50 to 6.58 mm	0.25 to 0.26 inch
-----	-----------------	-------------------

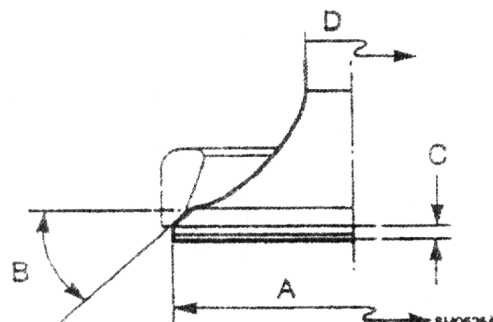
### Dimension

'A'	27.2 mm	1.07 inch
'B'	45 °	
'C'	1.0 to 0.5 mm	0.039 to 0.020 inch

'D'	6.50 to 6.55 mm	0.25 to 0.26 inch
-----	-----------------	-------------------



INTAKE VALVE



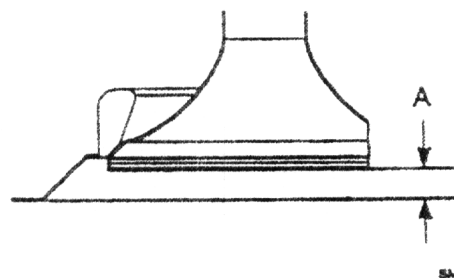
EXHAUST VALVE

## Valve Seats

### Valve Head Depth

Dimension 'A'	0.25 to 1.5 mm	0.010 to 0.059 inch
---------------	----------------	---------------------

**NOTE:** To measure the valve seat dimension 'A' use a straight edge between the cylinder head surface and valve. A new valve must be used to achieve a correct measurement.



SM0612

## Oil Pump

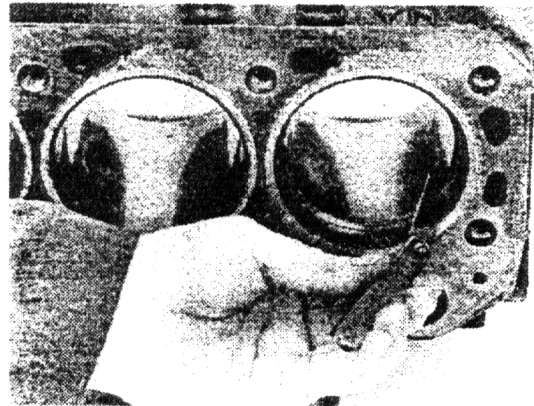
Type	Trochoid Pump	
Drive	by the injection pump camshaft	
Oil filter by-pass pressure	98 kPa	14.22 psi
Relief valve pressure	342 kPa	50 psi
Oil switch closing pressure	48 kPa	7 psi
Outer rotor to body clearance		
Dimension	0.15 to 0.3 mm	0.006 to 0.011 inch
Outer rotor to inner rotor clearance		
Dimension	0.05 to 0.24 mm	0.002 to 0.009 inch
Rotor to cover clearance		
Dimension	0.03 to 0.20 mm	0.001 to 0.007 inch

## Pistons

### Piston Ring End Gap

Compression Ring	0.15 to 1.5 mm
	0.006 to 0.060 inch
Oil Control Ring	0.15 to 1.5 mm
	0.006 to 0.060 inch

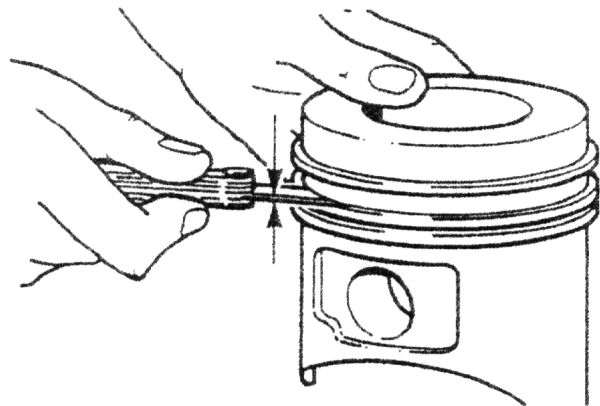
**NOTE:** Make the measurement with new piston rings.



E05022

### Piston Ring Groove

1st compression ring groove	0.06 to 0.30 mm
	0.0023 to 0.011 inch
2nd compression ring groove	0.05 to 0.20 mm
	0.0019 to 0.0078 inch
Oil control ring groove	0.03 to 0.20 mm
	0.0011 to 0.0078 inch



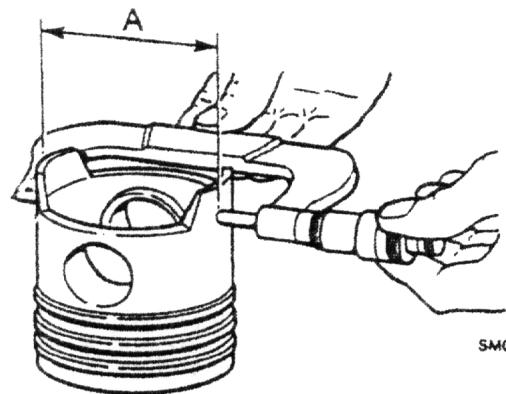
SM0527

### Piston Diameter Wear

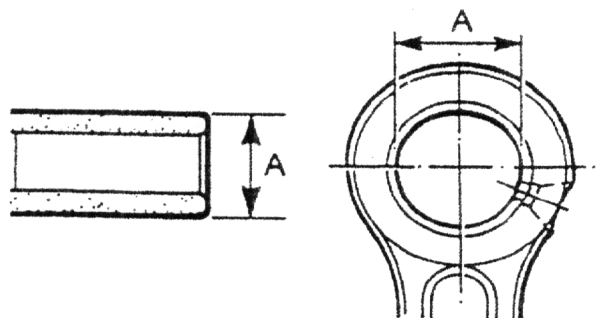
Out of round tolerance 'A'	0.20 mm
	0.008 inch

### Piston Pin and Piston

Diameter of piston pin	22.994 to 23.000 mm
	0.90527 to 0.90551 inch
Clearance between piston pin and piston	0.006 to 0.050 mm
	0.00024 to 0.00197 inch



SM0528

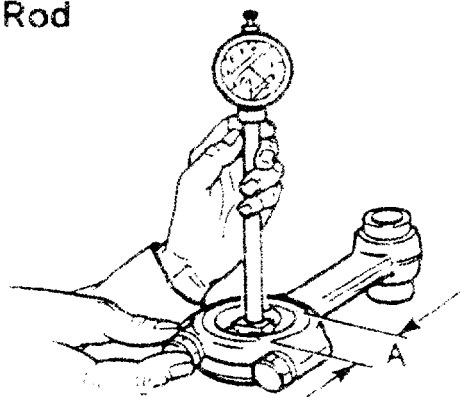


SM0554

## Connecting Rod

### Connecting Rod Bearings (with bearings 'A' installed)

42.0 to 42.15 mm  
1.653 to 1.659 inch

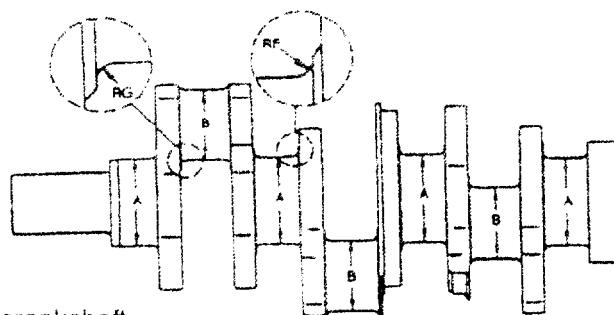


SM0535

## Crankshaft

### Material

Standard Crank: Made of carbon steel with journals, pins and oil seal areas induction hardened to improve wear resistance and durability.



SM0493A

### Machining

Use the table showing the grinding tolerance to service the crankshaft.

**NOTE:** All fillet radii (RG and RF) should be ground to 2.5 mm.

**NOTE:** When checking for crankshaft wear measure as shown using a micrometer.

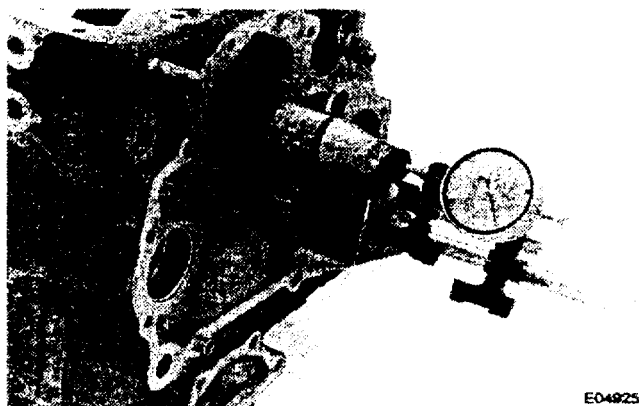
Description	Limits for Undersize Crankshaft Grinding	
	A	B
1st Undersize	51.750 mm (2.0374 inch)	47.750 mm (1.8799 inch)
0.25 mm (0.0098 inch)	51.650 mm (2.0334 inch)	47.600 mm (1.8740 inch)
2nd Undersize	51.500 mm (2.0275 inch)	47.500 mm (1.8700 inch)
0.50 mm (0.0196 inch)	51.400 mm (2.0236 inch)	47.350 mm (1.8641 inch)
3rd Undersize	51.250 mm (2.0177 inch)	47.250 mm (1.8602 inch)
0.75 mm (0.0295 inch)	51.150 mm (2.0137 inch)	47.100 mm (1.8543 inch)



as shown using a micrometer.

## Crankshaft End Play

End Play Tolerance ..... 0.05 to 0.50 mm  
0.0019 to 0.019 inch



EO4925

## Camshaft

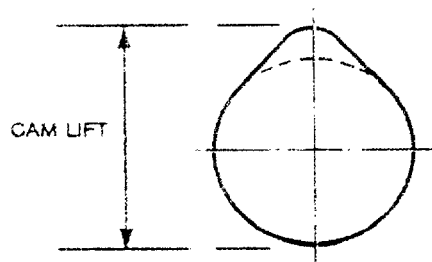
### Engine Camshaft

INTAKE and EXHAUST cam lift.

New ..... 35.72 to 34.72 mm  
1.407 to 1.368 inch

Camshaft Journal Tolerance

Front (bushing) ..... 45.0 to 44.95 mm  
1.771 to 1.769 inch  
Center ..... 44.0 to 43.925 mm  
1.732 to 1.729 inch  
Rear ..... 34.0 to 33.925 mm  
1.338 to 1.335 inch



SM0555

### Injection Pump Camshaft

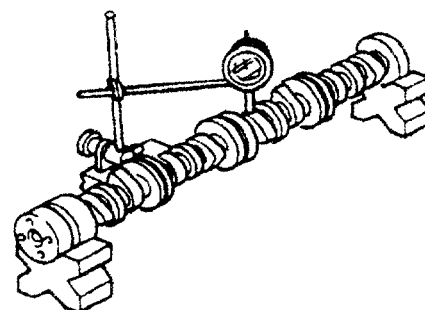
Injection Pump Cam Lift ..... 44.0 to 43.0 mm  
1.732 to 1.692 inch

Camshaft Journal Tolerance

Rear ..... 25.0 to 24.925 mm  
0.984 to 0.981 inch

Coupling Groove Tolerance

Width ..... 5.0 to 4.5 mm  
0.196 to 0.177 inch



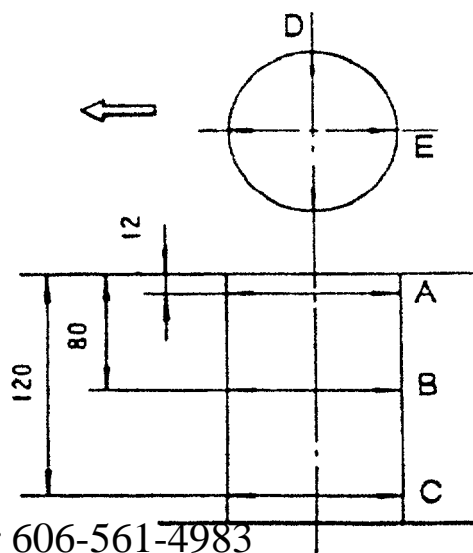
CHECKING CAMSHAFT WEAR

SM0530

## Cylinder Block

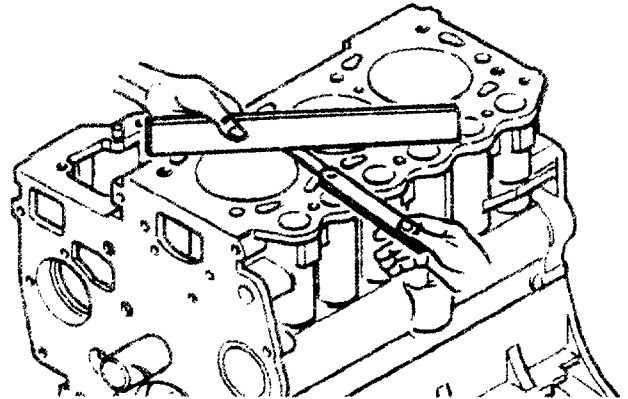
(A), (B), (C) to be within ..... 0.01 to 0.20 mm  
0.00039 to 0.00787 inch

D & E Out of round ..... 0.01 mm  
0.00039 inch



## Cylinder Block (Cont.)

Cylinder Block Distortion ..... 0.05 to 0.10 mm  
0.0019 to 0.0039 inch



SM0489

## Cooling System

### Thermostat (A) Wax Type

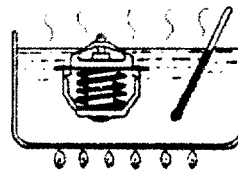
Start to open ...  $82.0 \pm 1.5^{\circ}\text{C}$   $179 \pm 2.7^{\circ}\text{F}$

Fully open ..... 8 mm lift at  $95^{\circ}\text{C}$

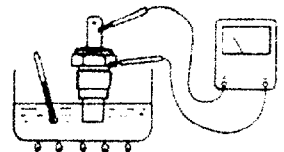
0.135 inch lift at  $203^{\circ}\text{F}$

Sender unit (with water above  $70^{\circ}\text{C}$  ( $158^{\circ}\text{F}$ ))

Temperature	Resistance
$70^{\circ}\text{C}$ ( $158^{\circ}\text{F}$ )	$104 \pm 13.5$ ohms
$115^{\circ}\text{C}$ ( $239^{\circ}\text{F}$ )	$23.8 \pm 2.5$ ohms



SM0507A



SM0570

Cooling Fan ..... 5 blades

Fan belt deflection with 10 Kg

(22 inch pounds) pull ..... 10 to 12 mm

0.39 to 0.47 inch

## Fuel System

### FUEL SYSTEM

Injection Order ..... 1,3,2

Fuel Tank Capacity (720 \*) ..... 20 litres 5.28 U.K.gal

Fuel Tank Capacity (726 \*) ..... 30 litres 7.93 U.K.gal

### FUEL PUMP

Type ..... Electromagnetic Diaphragm Type

Pump Delivery .....  $370 \text{ cm}^3/\text{min}$  22.57 in<sup>3</sup>/min

### INJECTION PUMP

Type ..... Bosch M type

Model ..... ND-PFR3M

Pump Timing ..... 17°B.T.D.C.

### INJECTOR

Nozzle Opening Pressure ..... 13771 to 14171 kPa 1991 to 2062 psi

## SPECIAL TORQUES

### Cylinder Head Retaining Bolt

M10 .....	83 to 93 Nm	61 to 69 lb ft
Crankshaft pulley nut .....	147 to 197 Nm	109 to 145 lb ft
Main bearing cap retaining bolt .....	49 to 54 Nm	36.1 to 39.8 lb ft
Connecting rod end cap retaining nut .....	33 to 37 Nm	24.3 to 27.2 lb ft
Flywheel retaining bolt .....	127 to 137 Nm	93.7 to 101.0 lb ft
Glow plug .....	15 to 19 Nm	10.9 to 14.0 lb ft

Fuel Tank Drain Plug .....	12 to 17 Nm	9 to 12.5 lb ft
Fuel Injection Pump Retaining Bolts .....	10 to 13 Nm	7.5 to 9.5 lb ft
Delivery Valve Holders .....	39 to 49 Nm	28.8 to 36 lb ft
Fuel Injection Tube Nuts .....	24 to 34 Nm	18 to 25 lb ft
Injector Clamp Bolts .....	15 to 20 Nm	11 to 15 lb ft
Solenoid Locknut .....	39 to 49 Nm	28.8 to 36 lb ft

## SAFETY RULES

**IMPORTANT:** *When testing or adjusting fuel injectors, do not place your hands or arms in front of the injector nozzles.*



**WARNING:** *The fuel spray from an injector has sufficient penetrating power to puncture the flesh and destroy tissue. Should the fuel enter the blood stream, it may cause blood poisoning.*

In the event of the skin being punctured from the discharge of an injector, apply the following first aid immediately, then have the injury examined by a physician as quickly as possible.

Wash the injured part with a boric acid solution, support the injured finger or hand with a splint and sling so the injured part will remain absolutely at rest until a physician can examine it.

## ENGINE REMOVAL

### HOOD, PANELS, INSTRUMENT PANEL AND INSTRUMENT CLUSTER

#### Removal and Installation

##### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

##### [ 2 ]

Disconnect the battery, negative (–) terminal first.

**NOTE :** *For Installation, install and tighten the positive (+) terminal first.*

##### [ 3 ]

Raise the hood and remove the side panels (1).

##### [ 4 ]

Remove nut (2) and remove the hood (3).

**NOTE:** *For Installation, tighten nut (2) and then back the nut off 1/4 of a turn.*

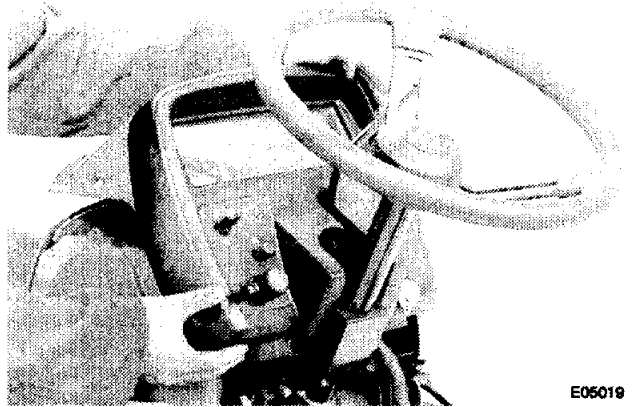
##### [ 5 ]

Remove bolts (4), disconnect the headlamps connectors from the front grille and remove the front grille (5).

##### [ 6 ]

Remove screws (6) and remove cover (7).

##### [ 7 ]



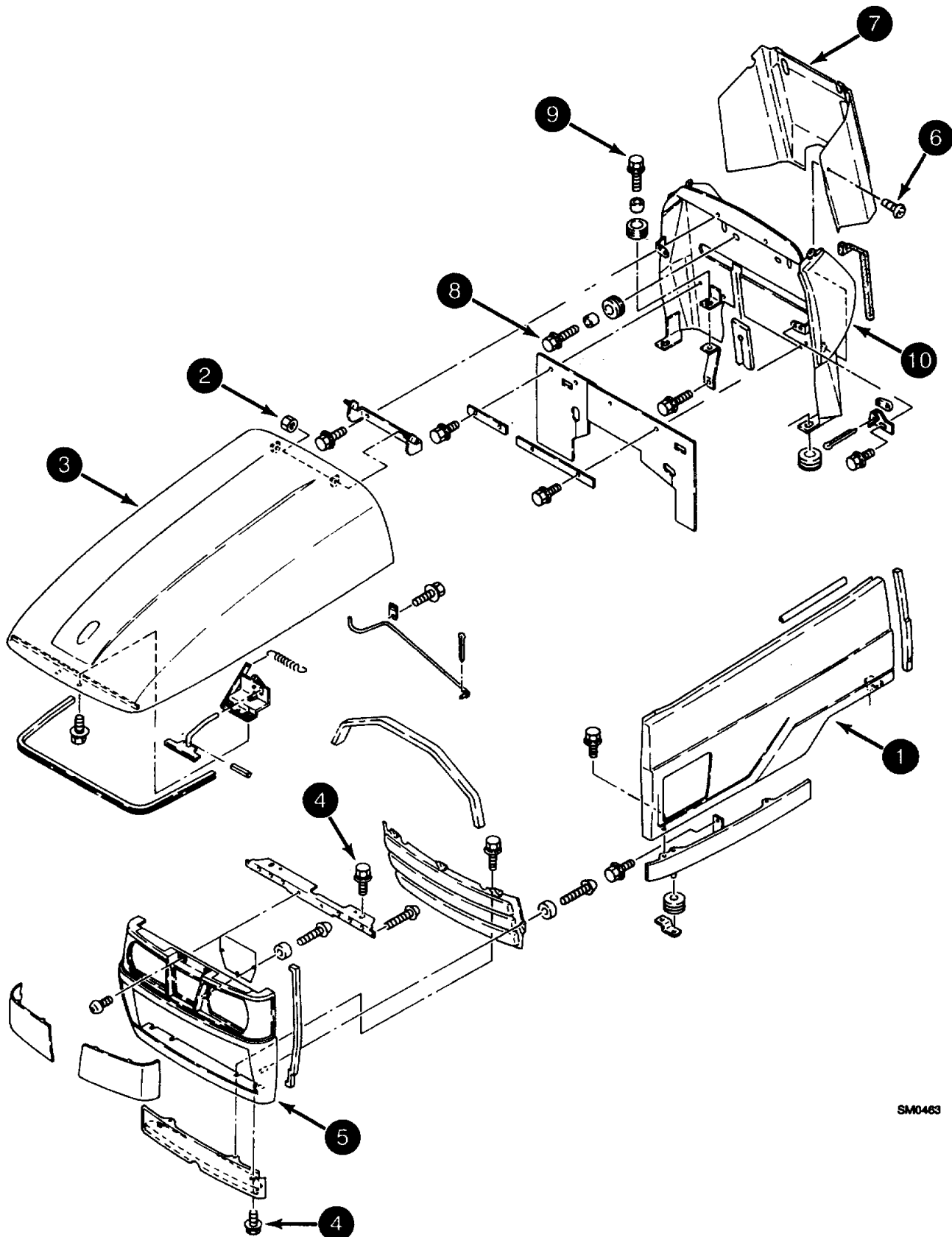
Remove the instrument cluster retaining screws and raise the instrument cluster slightly. Disconnect the tachometer cable and the engine harness. Remove the instrument cluster.

##### [ 8 ]

Remove the bolts (8 and 9) and remove the steering column cover (10).

**NOTE:** *For Installation, follow the same procedure in reverse order.*

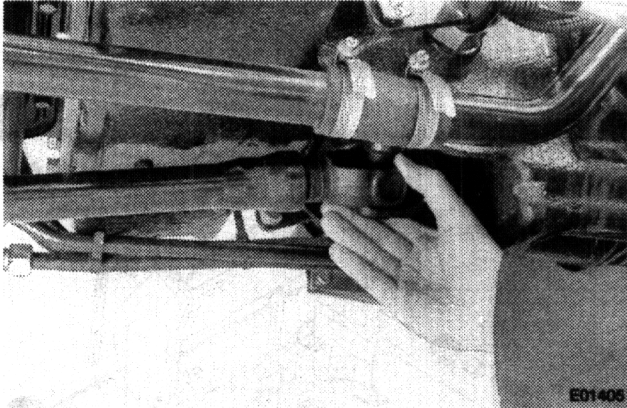
NOTE: Items are numbered in order of Disassembly.



SM0463

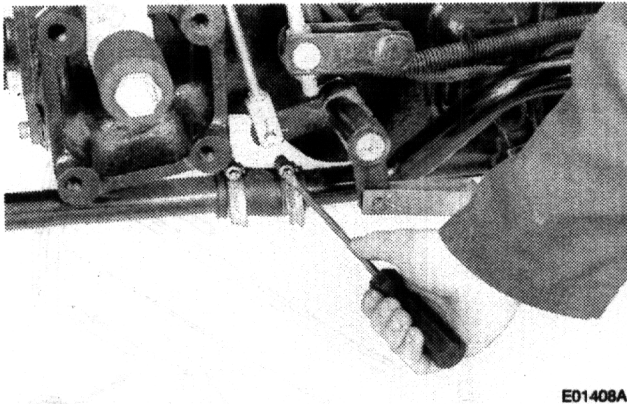
## Separating the Engine from the Transmission

[ 1 ]



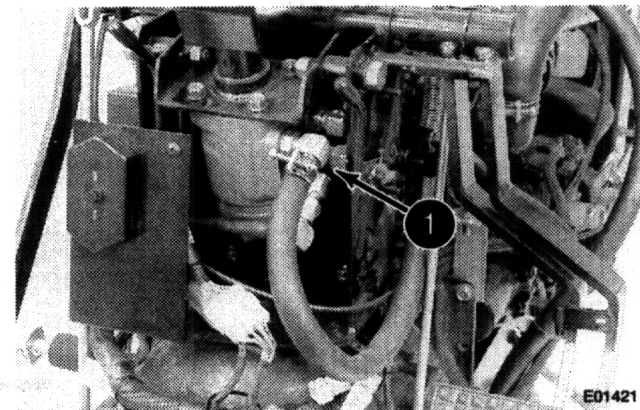
Remove the MFD drive shaft, refer to Section 6, Page 134.

[ 2 ]



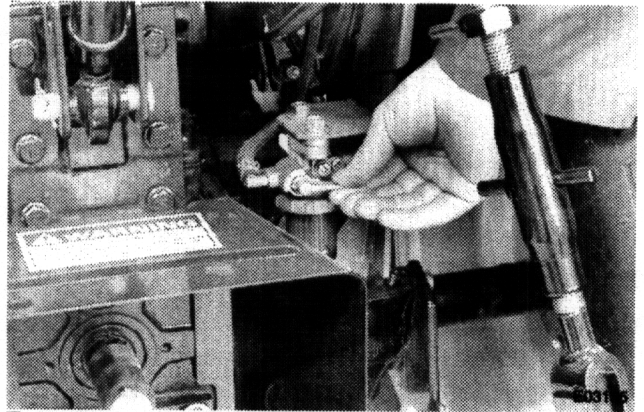
Disconnect and cap the hydraulic pump supply tube.

[ 3 ]



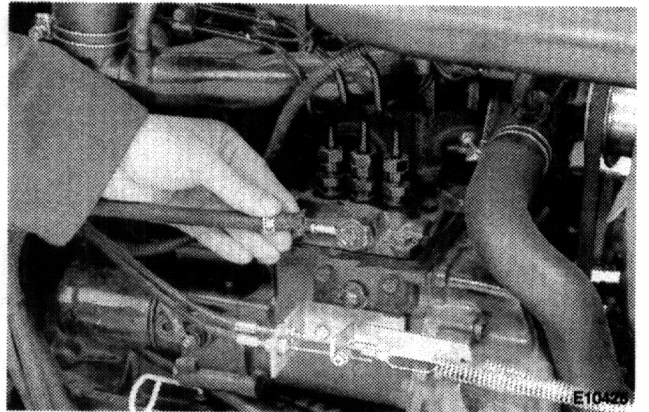
Put identification marks on the power steering hoses (1). Disconnect and cap the power steering hoses.

[ 4 ]



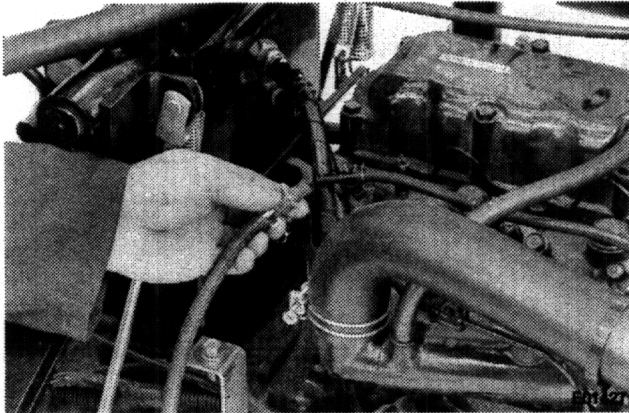
Turn the fuel supply tap to the OFF position.

[ 5 ]



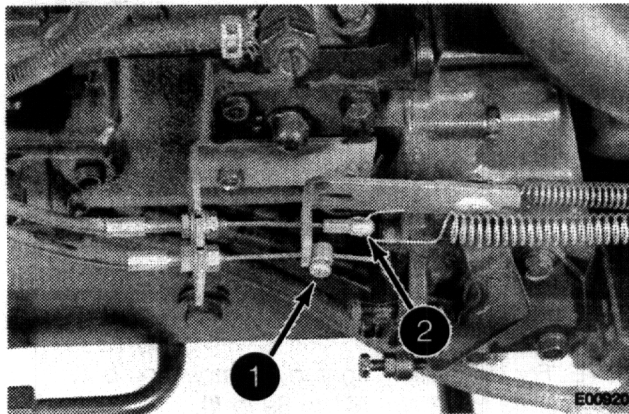
Disconnect and cap the fuel supply hose.

[ 6 ]



Disconnect and cap the fuel return hose.

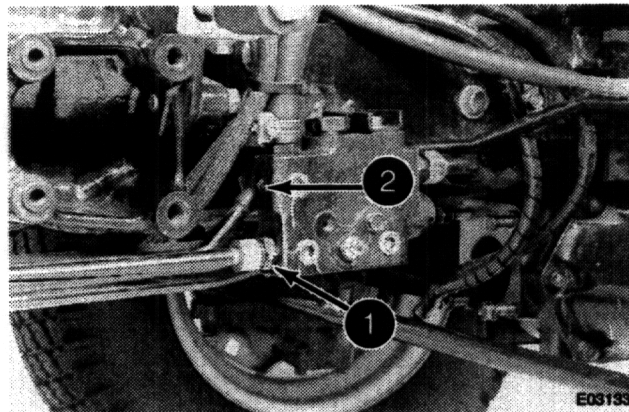
[ 7 ]



Disconnect and remove the foot (1) and hand throttle (2) cables.

**NOTE:** For Installation, refer to Section 8 for Cable Adjustments.

[ 8 ]



Disconnect and cap the tractor hydraulic line (1) and return tube (2).

[ 9 ]

Disconnect the main harness from the tractor engine.

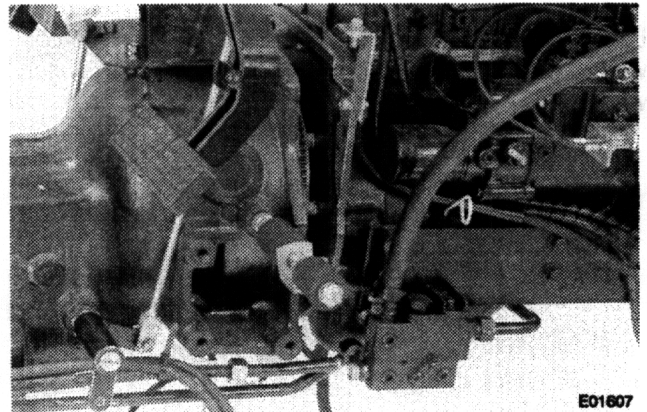
[ 10 ]

Put wooden wedges in between the front axle and the front bolster.

[ 11 ]

Support the tractor on suitable splitting stands.

[ 12 ]



Remove the clutch housing to engine retaining bolts and carefully separate the tractor.

[ 13 ]

Support the two halves of the tractor on suitable stands.

[ 14 ]

For Assembly, follow the same procedure in reverse order.

**NOTE:** For Assembly, clean the engine and transmission mounting faces and apply a continuous bead of Loctite 515 to the engine mounting face.

## ENGINE

**[ 1 ]**

Remove the air inlet hose and the exhaust.

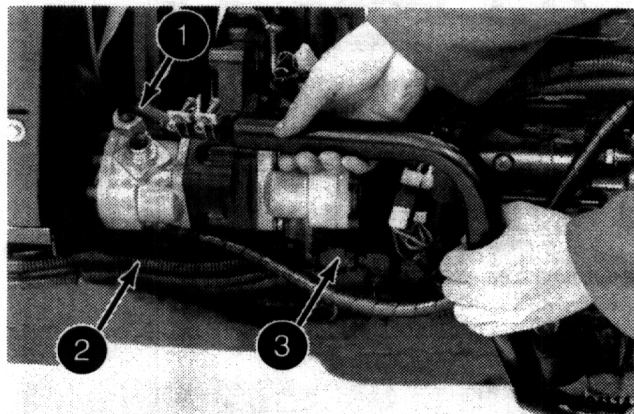
**[ 2 ]**

Remove the radiator, refer to Page 46.

**[ 3 ]**

Label and disconnect the starter motor, alternator, water temperature sender and oil pressure switch wires.

**[ 4 ]**



Disconnect and cap the hydraulic pump supply hose (1) and feed hoses (2) and (3).

**[ 5 ]**

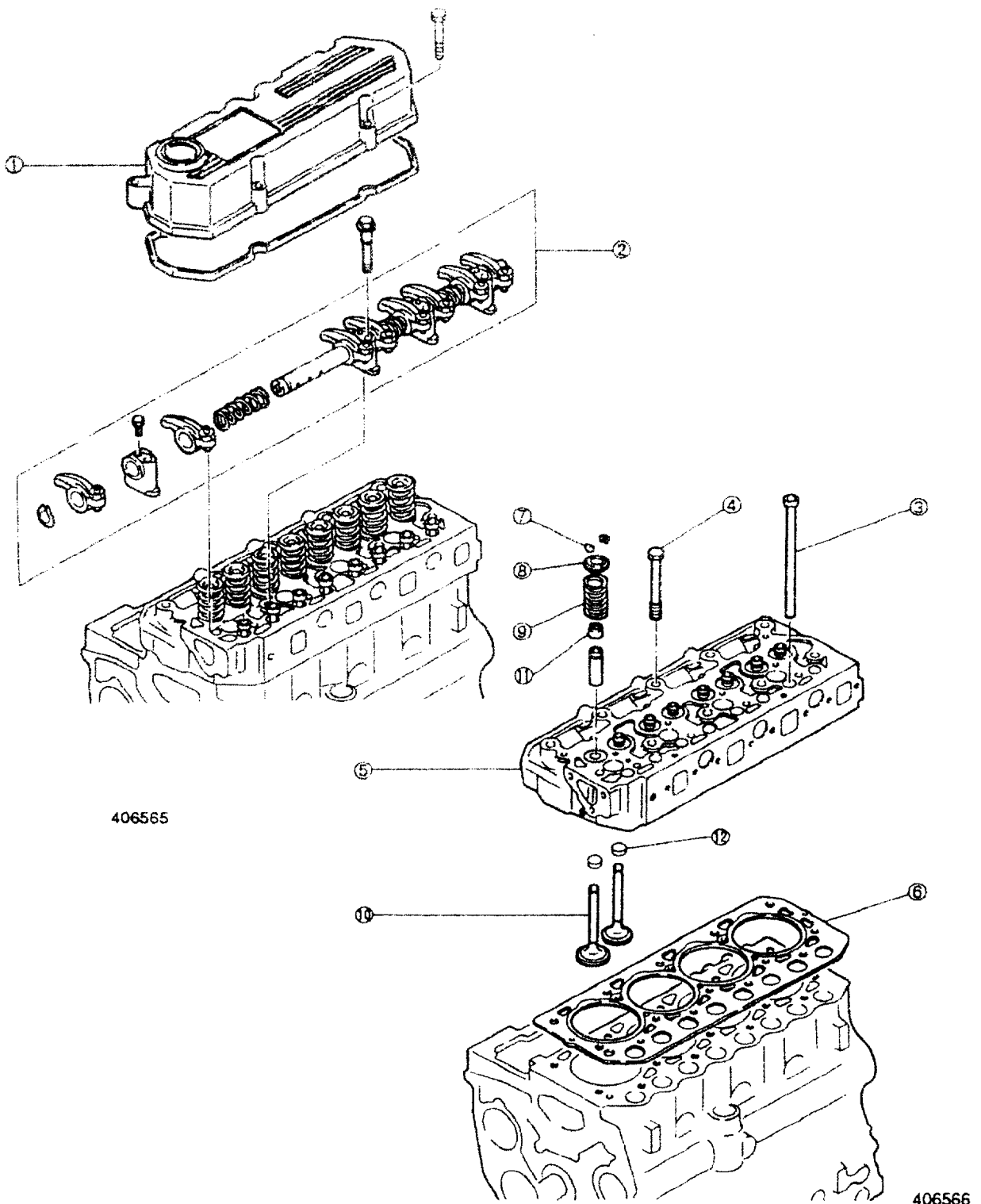
Put blocks under the engine side rails and support the engine using suitable lifting equipment. Remove the two front and the four left hand and four right hand mounting bolts. Carefully remove the engine.

**NOTE:** For Installation, tighten the mounting bolts to a torque of 83 to 93 Nm (61 to 69 lb ft).

**NOTE:** For Installation, follow the same procedure in reverse order.



# CYLINDER HEAD AND VALVE MECHANISM



- |                         |                        |                   |
|-------------------------|------------------------|-------------------|
| ① Rocker cover          | ⑤ Cylinder head        | ⑨ Valve spring    |
| ② Rocker shaft assembly | ⑥ Cylinder head gasket | ⑩ Valve           |
| ③ Valve push rod        | ⑦ Valve lock           | ⑪ Valve stem seal |
| ④ Cylinder head bolt    | ⑧ Valve regulator      | ⑫ Valve cap       |

## DISASSEMBLY

### 1. Rocker shaft assembly removal

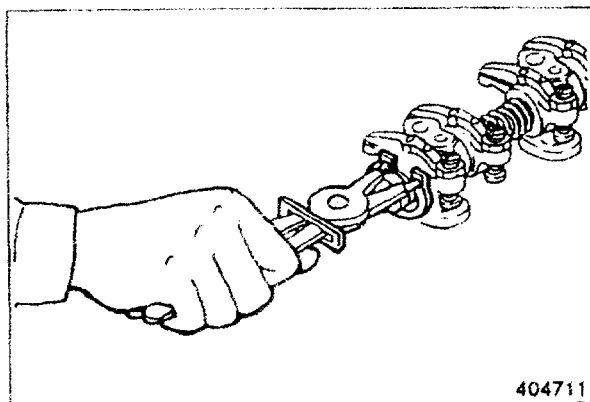
- (1) Remove the bolts that hold the rocker stays in position and remove the rocker shaft assembly.
- (2) Remove the valve caps.



Removing rocker shaft assemblies

### 2. Rocker shaft disassembly

Put identification on each rocker arm as to its location on the rocker shaft.



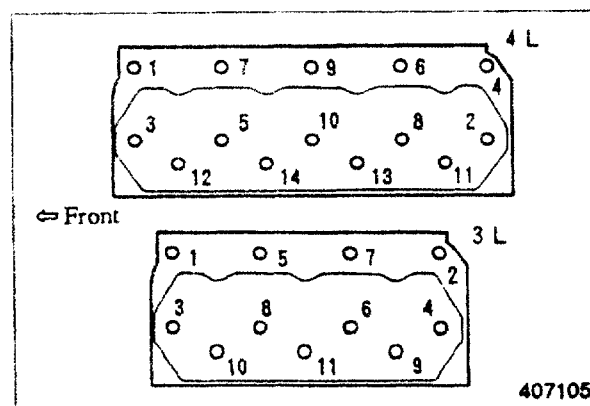
Disassembling rocker shaft assembly

### 3. Cylinder head bolt removal

Loosen the cylinder head bolts in two or three steps in the sequence shown

#### NOTE

If any parts on the cylinder head are faulty, check the cylinder head bolts for tightness with a torque wrench before loosening them.



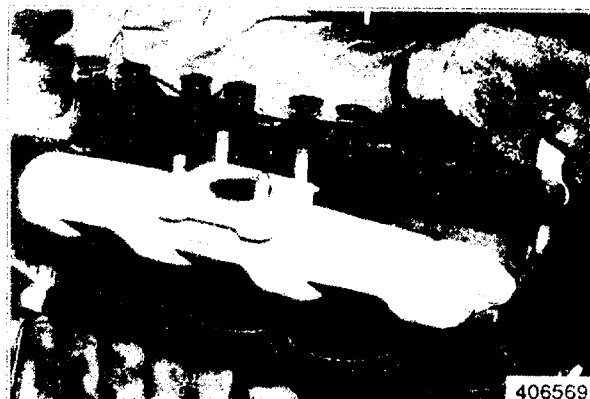
Cylinder head bolt loosening sequence

#### 4. Cylinder head assembly removal

Lift the cylinder head straight up with a hoist.

##### NOTE

If the gasket is seized and the cylinder head cannot be separated from the cylinder block, tap around the thick side portion of the cylinder head with a plastic hammer.



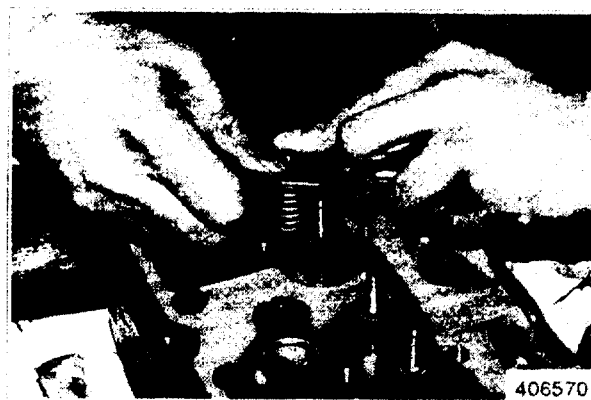
Removing cylinder head assembly

#### 5. Valve and valve spring removal

- (1) Compress the valve spring with a valve lifter and remove the valve lock.
- (2) Remove the retainer, spring and valve.

##### NOTE

The valves, retainers, springs and valve locks must be set aside separately in groups, each tagged for cylinder number, for correct installation.



Removing valve springs

#### 6. Valve stem seal removal

Remove the valve stem seals with a pliers.

##### NOTE

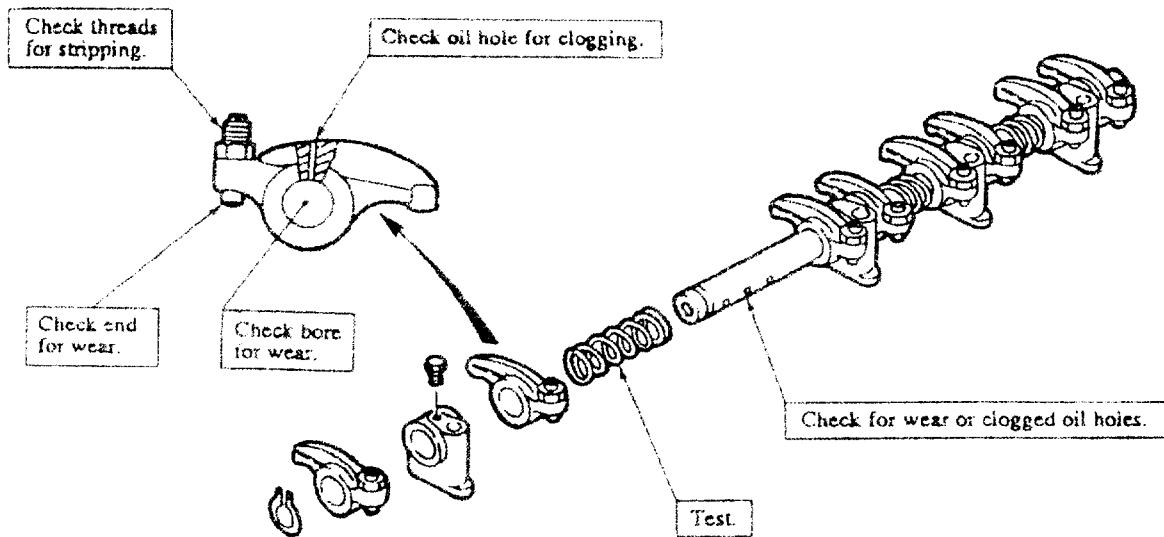
Do not reuse the valve stem seals.



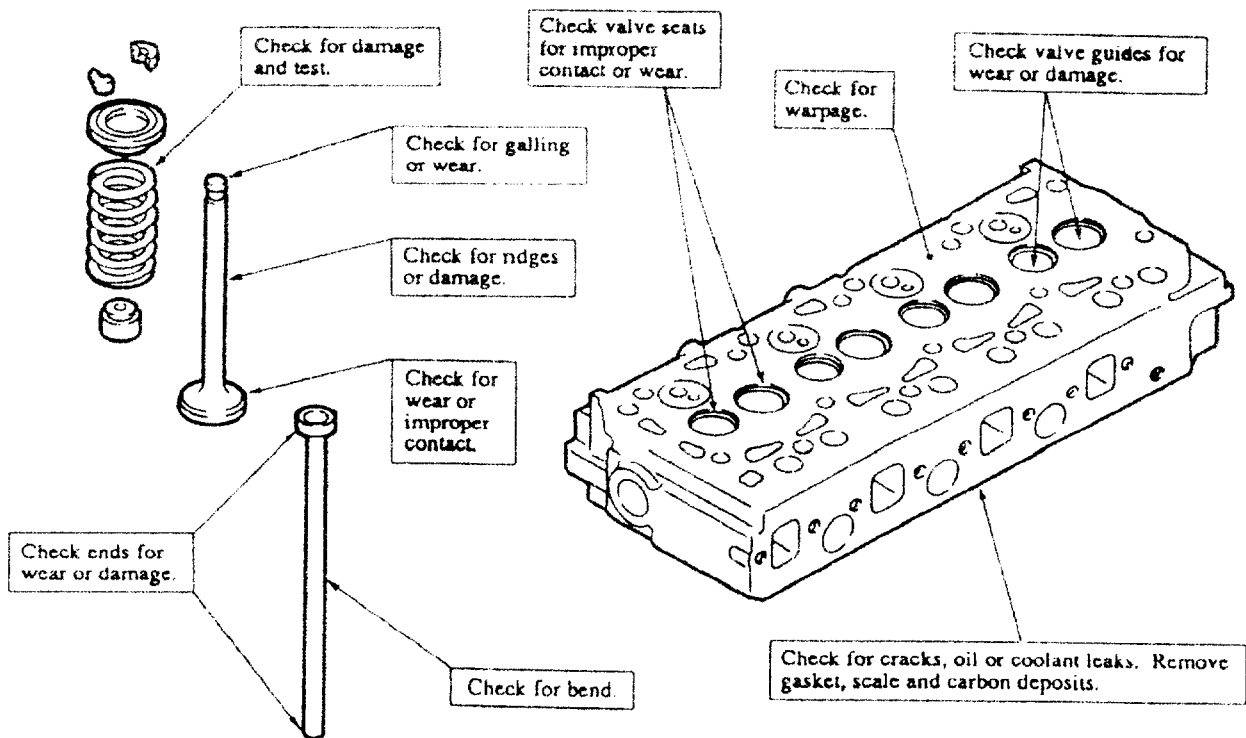
Removing valve stem seals

INSPECTION

INSPECTION POINTS



406594

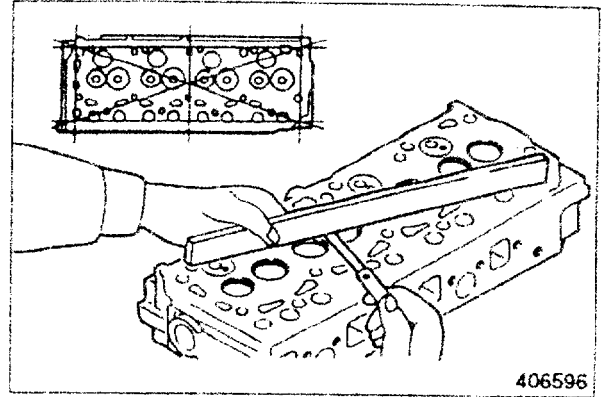


### 1. Cylinder head

Using a heavy accurate straight edge and a feeler gauge, check the bottom face for warpage in three positions lengthwise, two crosswise and two widthwise as shown in the illustration. If warpage exceeds the limit, reface the bottom face with a surface grinder.

Unit: mm (in.)

Item	Standard	Limit
Warpage of cylinder head bottom face	0.05 (0.002 0) maximum	0.10 (0.003 9)



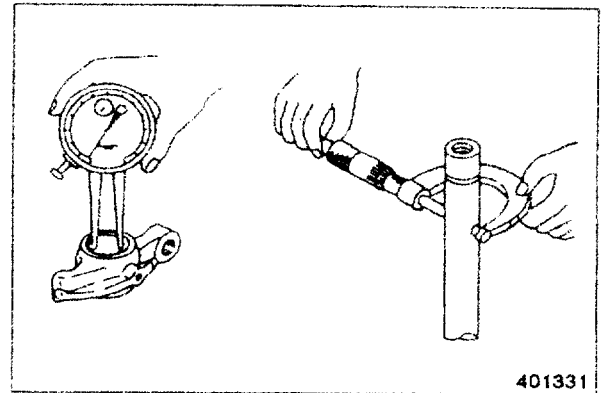
Checking cylinder head bottom face for warpage

### 2. Rocker arms and rocker shaft

Measure the bore in the rocker arm for the rocker shaft and the diameter of the rocker shaft to find the clearance between the arm and shaft. If the clearance has reached the limit, replace the rocker arm. If it exceeds the limit, replace both arm and shaft.

Unit: mm (in.)

Item	Nominal size	Standard	Limit
Bore in rocker arm for shaft	18.9 (0.744)	18.910 to 18.930 (0.744 49 to 0.745 27)	—
Diameter of shaft for arm	18.9 (0.744)	18.880 to 18.898 (0.743 31 to 0.744 01)	—
Clearance between rocker arm and shaft	—	0.012 to 0.050 (0.000 47 to 0.001 97)	0.200 (0.007 87)



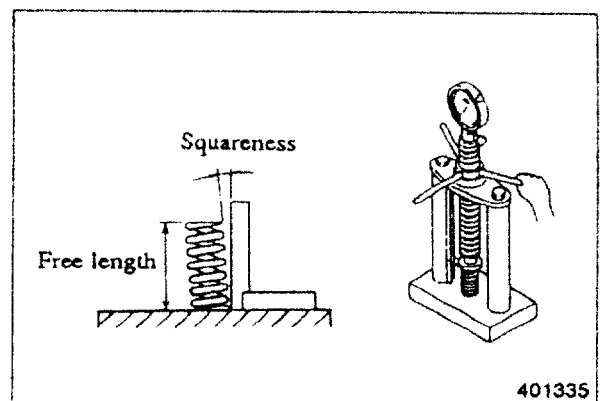
Measuring rocker arm and rocker shaft

### 3. Valve springs

Check the squareness and free length. If the squareness and/or free length exceeds the limit, replace the spring.

Unit: mm (in.)

Item		Standard	Limit
Free length		47 (1.85)	46 (1.81)
Squareness		1.5° maximum	
Test force, kgf (lb) [N]	Length under test force: 39.1 (1.54)	13.9 ± 0.7 (30.6 ± 1.5) [136 ± 7]	-15%
	Length under test force: 30.5 (1.20)	29 ± 2 (64 ± 4.4) [284 ± 20]	



Testing valve spring

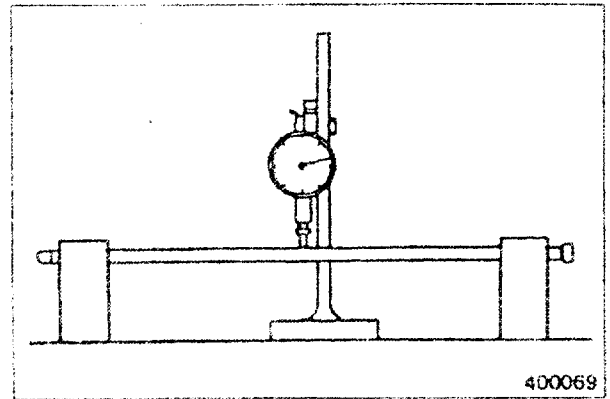
## INSPECTION

### 4. Valve push rods

Using V-blocks and a dial indicator, check for bend. If the bend exceeds the limit, replace the push rod.

Unit: mm (in.)

Item	Limit
Bend (dial indicator reading) of valve push rod	0.3 (0.012) maximum



Checking bend of valve push rod

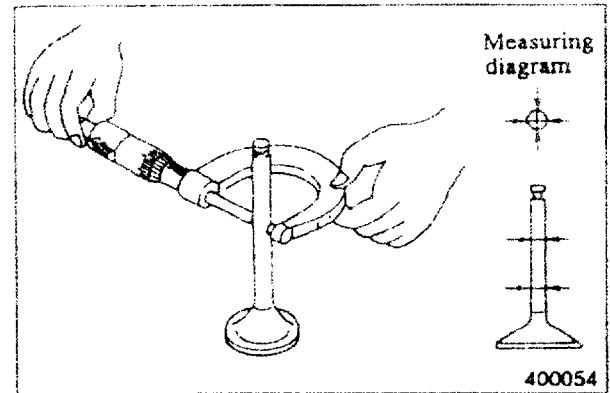
### 5. Valves, valve guides and valve seats

#### (1) Diameter of valve stem

Measure the diameter of the valve stem as shown in the illustration. If the stem is worn beyond the limit, or if it is abnormally worn, replace the valve.

Unit: mm (in.)

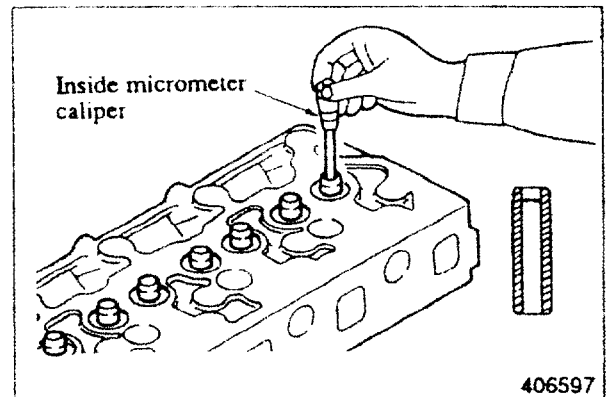
Item		Nominal size	Standard	Limit
Diameter of valve stem	Inlet valve	6.6 (0.260)	6.565 to 6.580 (0.258 46 to 0.259 05)	6.500 (0.255 91)
	Exhaust valve	6.6 (0.260)	6.530 to 6.550 (0.257 09 to 0.257 87)	



Measuring valve stem

#### (2) Clearance between valve stem and valve guide

The valve guide wears more rapidly at its both ends than at any other parts. Measure the bore in the guide for the stem at its ends with an inside micrometer caliper to find the clearance between the stem and guide. If the clearance exceeds the limit, replace the guide or valve whichever is badly worn.



Measuring valve guide

Unit: mm (in.)

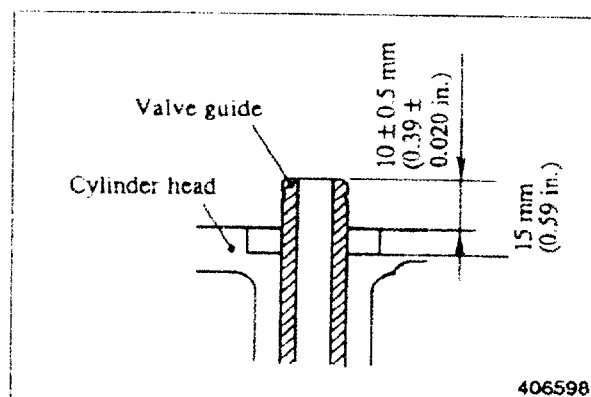
Item		Nominal size	Standard	Limit
Clearance between valve stem and valve guide	Inlet valve	—	0.02 to 0.05 (0.000 8 to 0.002 0)	0.10 (0.003 9)
	Exhaust valve	—	0.05 to 0.085 (0.002 0 to 0.003 35)	0.15 (0.005 9)
Height to top of valve guide		10 (0.39)	9.5 to 10.5 (0.374 to 0.413)	—

**NOTE**

Before measuring the valve guides, clear the guides of lacquer and carbon.

**(3) Valve guide replacement**

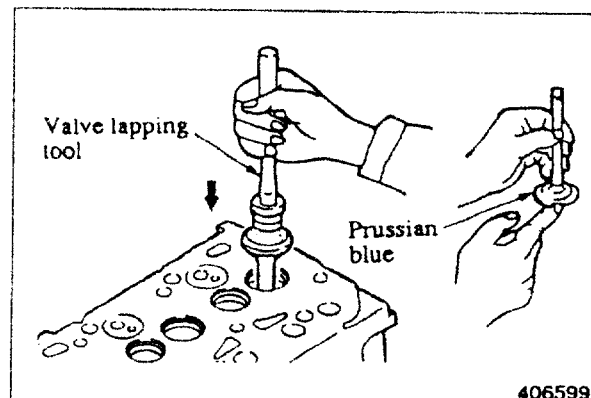
- Remove the guide from the cylinder head by pushing it with a tool and an arbor press from the bottom side of the head.
- Install a new guide into the cylinder head by pushing it with an arbor press from the upper side of the head until the specified height to the top of the guide is obtained.
- Insert a new valve into the guide and make sure the valve slides in the guide freely.
- After the valve guide has been replaced, check the valve contact with its seat.



Height to top of valve guide

**(4) Valves**

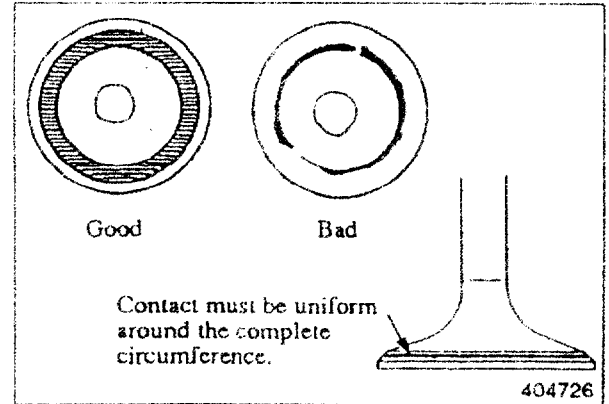
- Put a small amount of Prussian blue or read lead on the valve face. Hold the valve with a valve lapping tool (commercially available) and press it against the seat to check its contact.



Checking valve contact with seat

## INSPECTION

- (b) The width of contact must be uniform all the way around both seat and valve. If the contact is bad, reface the valve and seat.



Valve and valve seat contact

- (c) If the valve margin (valve lip thickness) exceeds the limit, replace the valve.

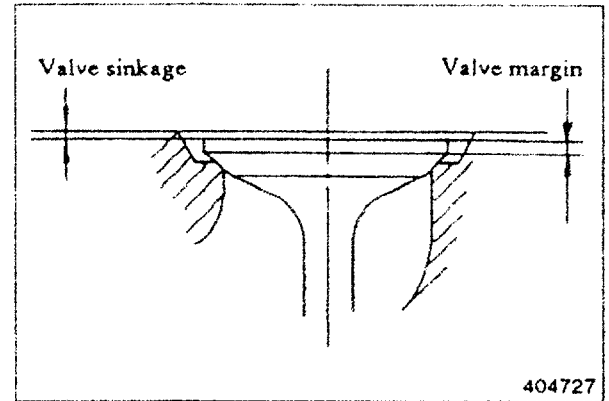
Unit: mm (in.)

Item	Standard	Limit
Valve margin (lip thickness)	1.0 (0.039)	0.5 (0.020)

- (d) If the valve sinkage (the dimension from the top of a closed valve to the face of cylinder head) exceeds the limit, recondition the valve seat or replace the cylinder head assembly.

Unit: mm (in.)

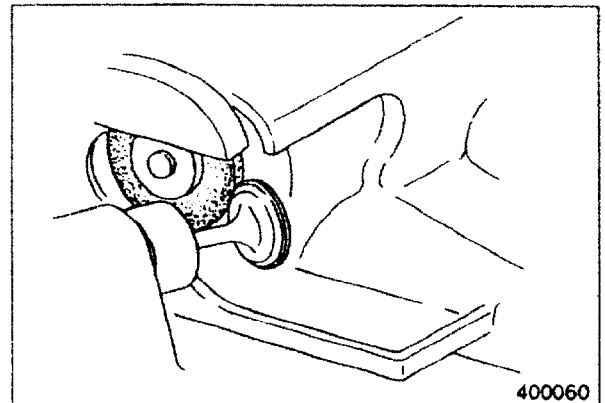
Item	Standard	Limit
Valve sinkage (dimension from top of closed valve to face of head)	$0.5 \pm 0.25$ ( $0.020 \pm 0.0098$ )	1.5 (0.059)



Valve margin and sinkage

## (5) Valve refacing

- (a) Set the valve refacer at an angle of  $45^\circ$  and grind the valve.
- (b) The valve margin must be not less than the limit. If the margin seems to be less than the limit when the valve is refaced, replace the valve.

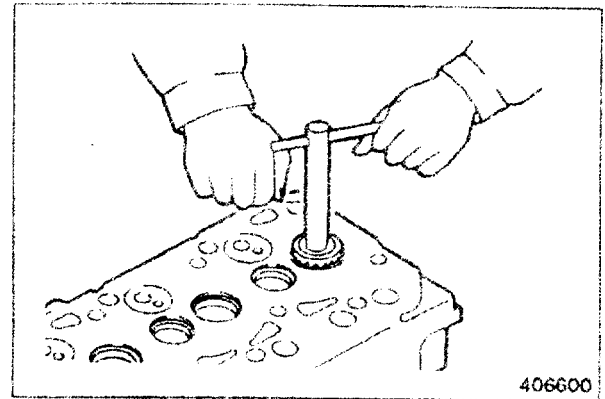


Refacing valve face



## (6) Valve seat refacing

- (a) Before refacing the valve seat, check the clearance between the valve and guide, and replace the guide if necessary.
- (b) Cut the valve seat with a valve seat cutter (commercially available), or grind it with a valve seat grinder, and finish the width of valve seat and the angle of seat face to the correct values.

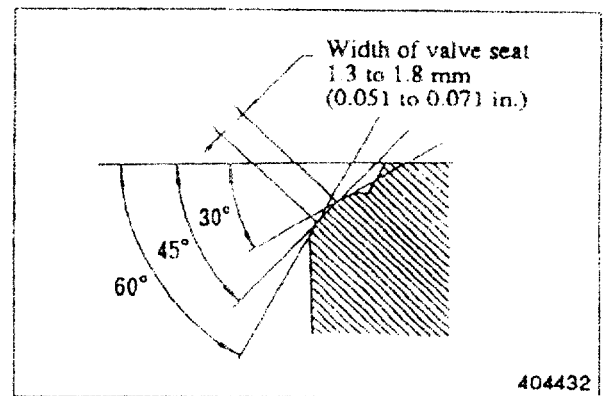


Refacing valve seat

Unit: mm (in.)

Item	Standard	Limit
Angle of seat face	45°	—
Width of valve seat	1.3 to 1.8 (0.051 to 0.071)	2.5 (0.098)

- (c) After refacing the valve seat, put lapping compound on the valve face and lap the valve in the valve seat.



Valve seat width and valve face angle

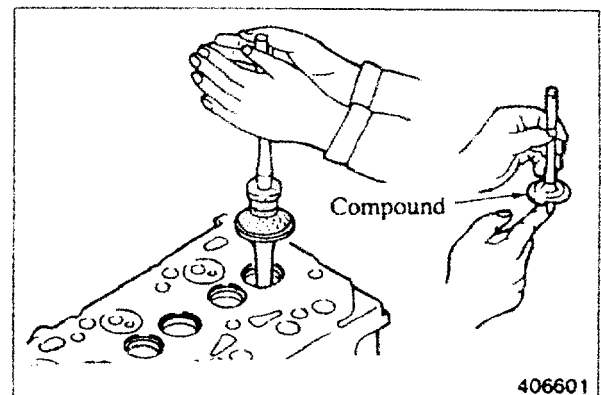
## (7) Valve lapping

Be sure to lap the valves in the seats after refacing or replacing the valves or valve seats.

- (a) Put a small amount of lapping compound on the valve face.

**NOTE**

- a) Do not put lapping compound on the valve stem.
- b) Use a lapping compound of 120 to 150 mesh for initial lapping and a compound of finer than 200 mesh for finish lapping.
- c) Mixing the compound with a small amount of engine oil will help put the compound on the valve face uniformly.



Lapping valve in seat

- (b) Using a lapping tool, hold the valve against the seat and rotate it only a part of a turn, then raise the valve off its seat,

## INSPECTION

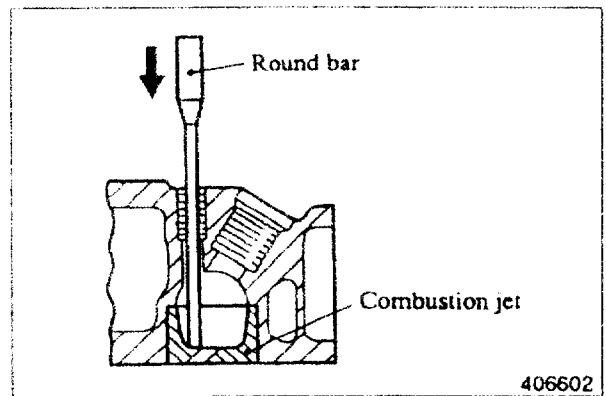
rotating it to a new position. Press the valve against the seal for another part of a turn. Repeat this operation until the compound wears and loses its cutting property.

- (c) Wash the valve and valve seat with dry cleaning solvent.
- (d) Apply engine oil to the valve and lap it in the seat.
- (e) Check the valve face for contact

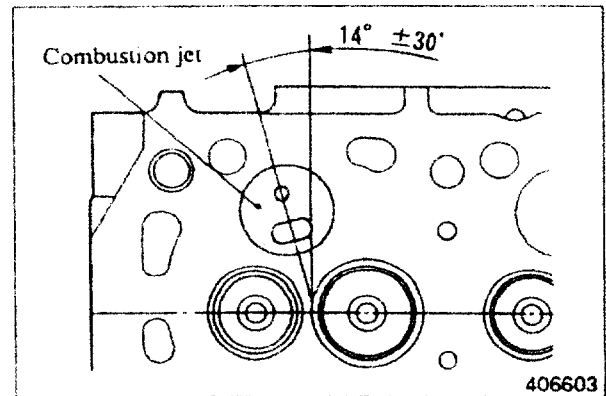
## 6. Combustion jet replacement

Replace the combustion jets only when they are cracked or defective.

- (1) To remove the jet, insert a 6 mm (0.24 in.) diameter round bar through the bore in the cylinder head for the glow plug and tap around the jet.
- (2) To install a new jet, put the jet in position in the head with its tangential orifice in alignment with the center of the main chamber and tap it with a plastic hammer.



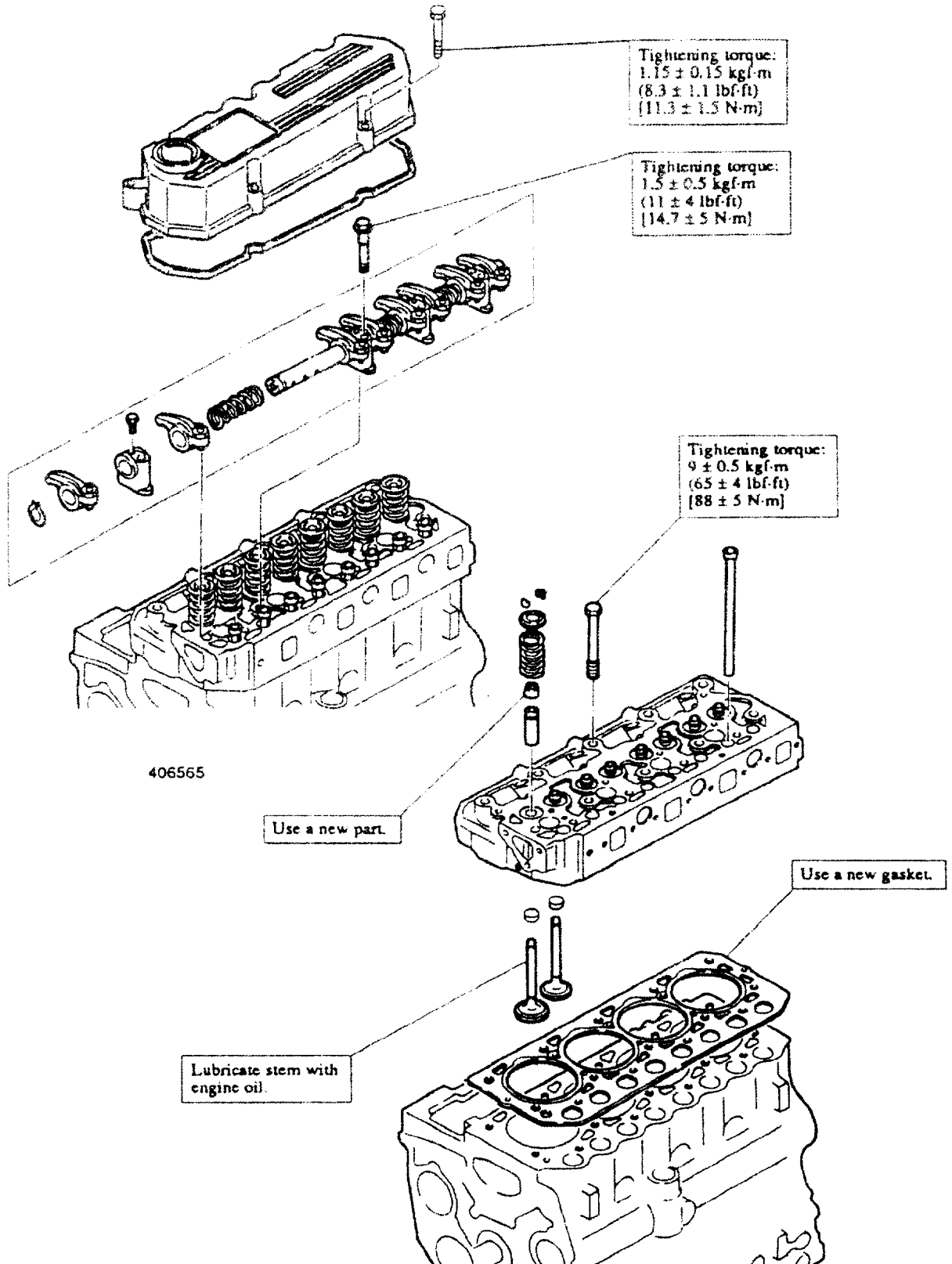
Removing combustion jet



Installing combustion jet

ASSEMBLY

TIGHTENING TORQUES

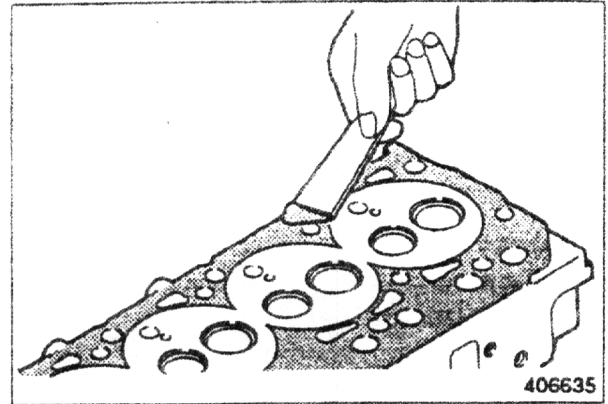


### 1. Cylinder head bottom face cleaning

Scrape the gasket from the bottom face of the cylinder head.

**NOTE**

After scraping the gasket, rub off gasket remnants from the face with an oilstone smeared with engine oil and thoroughly clean the face.



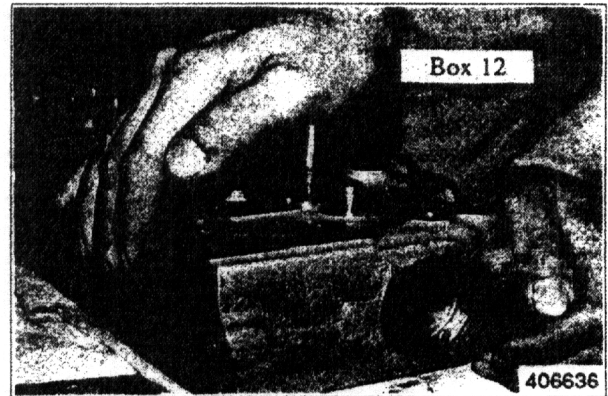
Removing cylinder head gasket

### 2. Valve stem seal installation

Using Box 12, install the valve stem seal in position in the valve guide. After installation, make sure the seal is in its correct position.

**NOTE**

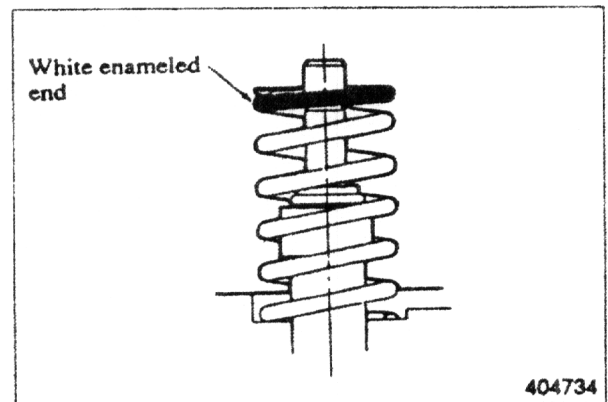
Improper stem seal installation can cause a failure to seal against downward flow of oil along the stem.



Installing valve stem seal

### 3. Valve spring installation

Install the valve spring with the white enameled end up.



Installing valve spring

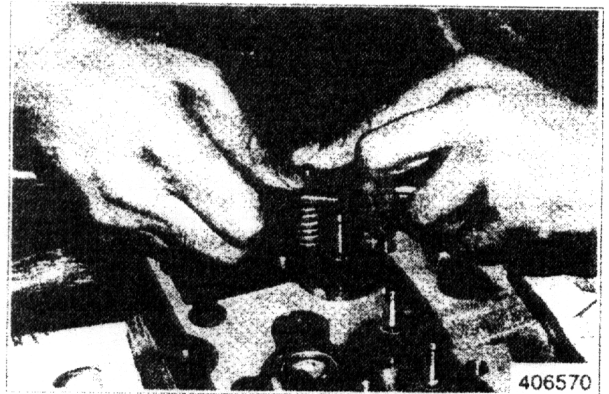
## ASSEMBLY

### 4. Valve block installation

Put compression on the valve spring with a valve lifter and install the block in position on the valve top.

#### CAUTION

Do not put excessive compression on the valve spring. This can cause the retainer to hit and damage the stem seal.



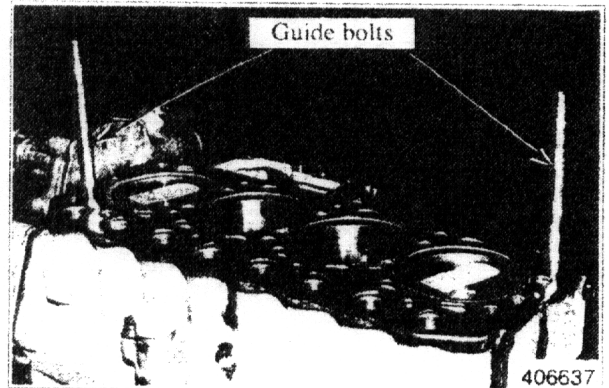
Installing valve block

### 5. Cylinder head gasket installation

- (1) Thoroughly clean the top faces of the cylinder block and pistons.
- (2) Install two guide bolts (M10 x 1.25) in the bolt holes in the cylinder block.
- (3) Put a new cylinder head gasket in position on the cylinder block, making sure the guide bolts are all in alignment with their respective holes in the gasket.

#### CAUTION

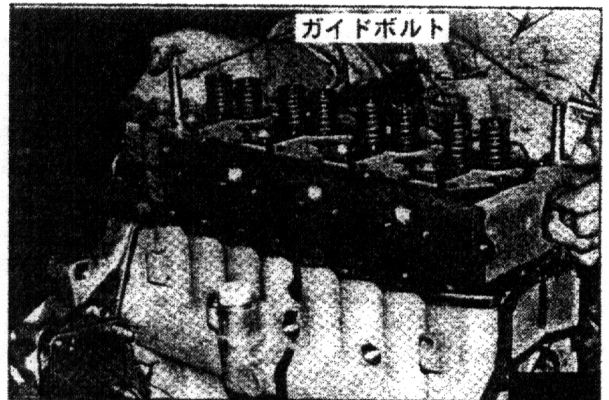
Do not use any gasket adhesive or other substances on the top face of the cylinder block.



Putting cylinder head gasket

### 6. Cylinder head installation

Put the cylinder head in position on the cylinder block, making sure the guide bolts are all in alignment with their respective bolt holes in the head.

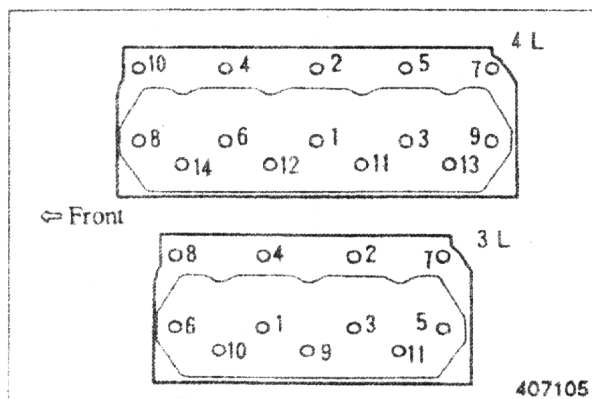


Installing cylinder head

## 7. Cylinder head bolt tightening

- (1) Remove the guide bolts and install the bolts that hold the cylinder head to the cylinder block.
- (2) Tighten the bolts in number sequence in two or three steps to the specified torque.

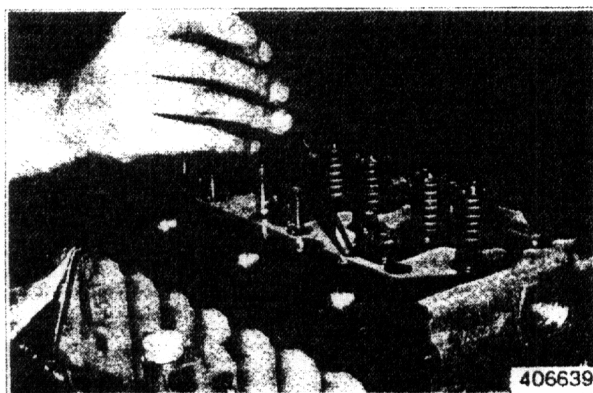
Tightening torque	$9 \pm 0.5 \text{ kgf-m}$ $(65 \pm 4 \text{ lbf-ft})$ $[88 \pm 5 \text{ N-m}]$
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Tightening sequence

## 8. Valve push rod installation

- (1) Put the valve push rod into position through the bore in the cylinder head.
- (2) Make sure the ball end of the push rod has been put into position over the top of the tappet.



Installing valve push rods

## 9. Rocker shaft assembling

- (1) Install the rocker arms, brackets and springs on the rocker shaft. Secure the brackets to the shaft by tightening the bolts.
- (2) Make sure the rocker arms move freely.



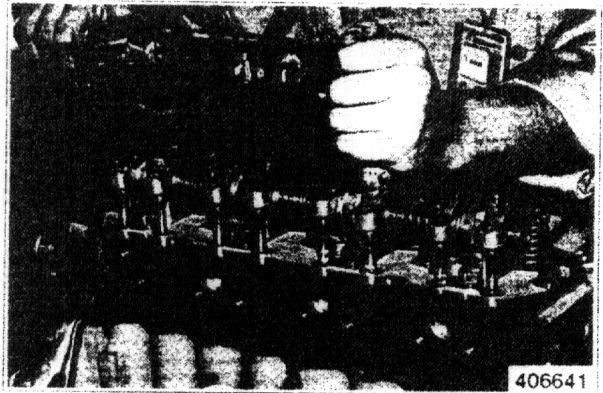
Assembling rocker arms

## ASSEMBLY

### 10. Rocker shaft assembly installation

- (1) Install the valve caps in position on the top of the valves.
- (2) Put the rocker shaft assembly in position on the cylinder head. Tighten the bolts that hold the rocker shaft assembly to the specified torque.

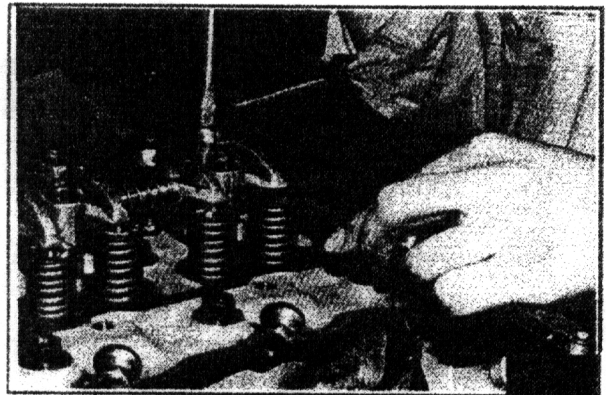
Tightening torque	$1.5 \pm 0.5 \text{ kgf}\cdot\text{m}$ $(11 \pm 4 \text{ lbf}\cdot\text{ft})$ $[14.7 \pm 5 \text{ N}\cdot\text{m}]$
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Installing rocker shaft assembly

### 11. Valve clearance adjustment

Make reference to "VALVE CLEARANCE" (page 159).

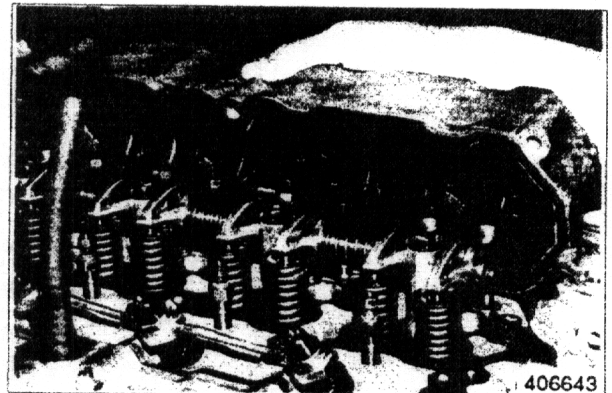


Adjusting valve clearance

### 12. Rocker cover installation

- (1) Make sure the gasket is put on the rocker cover.
- (2) Tighten the bolts that hold the rocker cover to the specified torque.

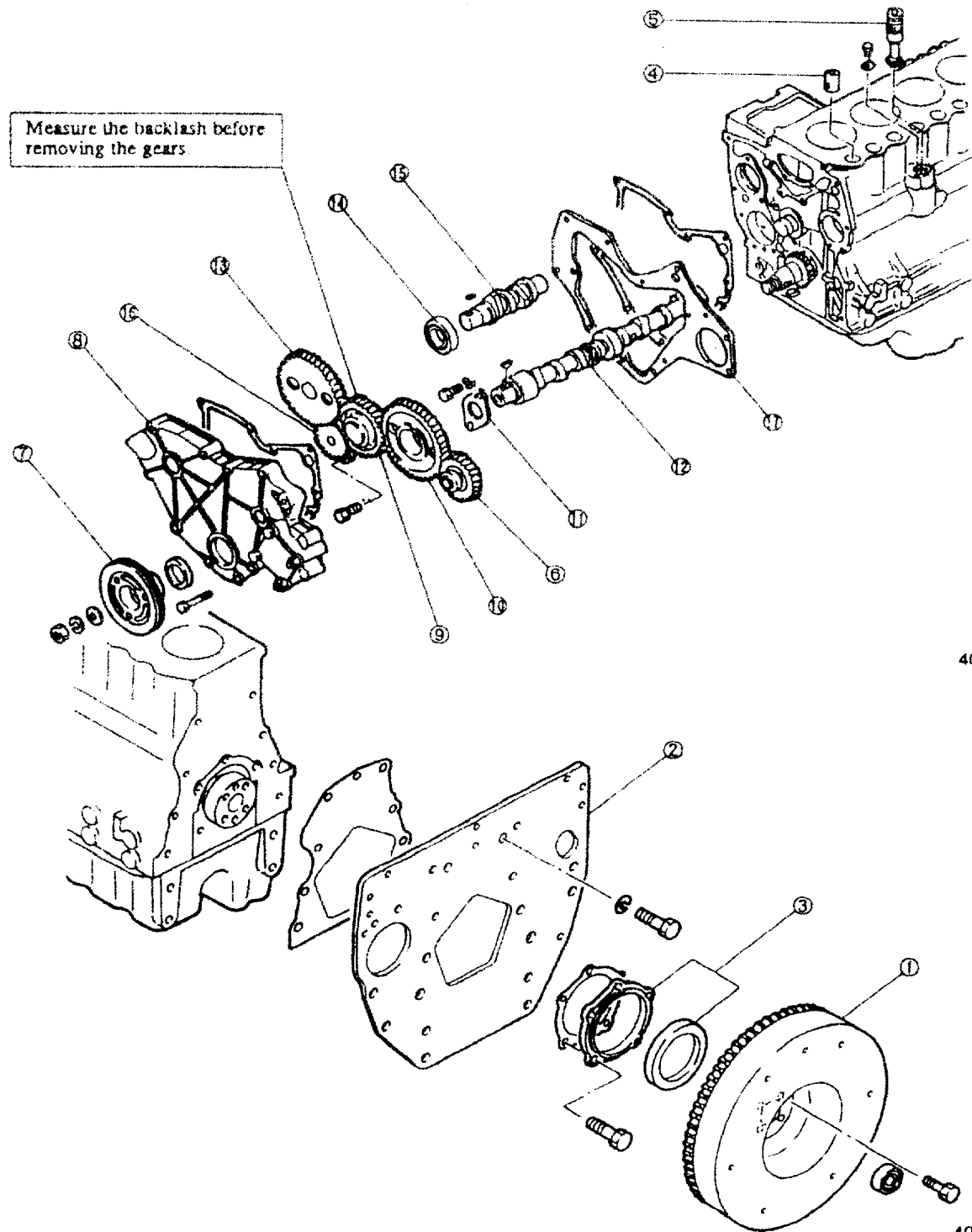
Tightening torque	$1.15 \pm 0.15 \text{ kgf}\cdot\text{m}$ $(8.3 \pm 1.1 \text{ lbf}\cdot\text{ft})$ $[11.3 \pm 1.5 \text{ N}\cdot\text{m}]$
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Installing rocker cover

DISASSEMBLY

TIMING GEARS AND FLYWHEEL



406572

406573

- ① Flywheel
- ② Rear plate
- ③ Oil seal case; oil seal
- ④ Tappet
- ⑤ Speedometer driven gear
- ⑥ P.T.O. gear

- ⑦ Crankshaft pulley
- ⑧ Timing gear case
- ⑨ Idler gear
- (Remove ⑩ thru ⑫ as an assembly.)
- ⑩ Camshaft gear
- ⑪ Thrust plate

- (Remove ⑬ thru ⑮ as an assembly.)
- ⑬ Fuel injection pump camshaft gear
- ⑭ Bearing
- ⑮ Fuel injection pump camshaft
- ⑯ Oil pump
- ⑰ Front plate



## 1. Flywheel removal

- (1) Have someone hold the crankshaft pulley with a wrench to prevent the flywheel from rotating.
- (2) Remove one of the bolts that hold the flywheel in position.

### **! WARNING**

Always signal each other to prevent possible personal injury.



Holding flywheel

- (3) Install a safety bar (M12 x 1.25) into the threaded hole in the flywheel from which the bolt was removed in Step (2). Remove the remaining bolts.
- (4) Hold the flywheel by hands and withdraw it from the crankshaft. Joggling the flywheel back and forth will facilitate removal.

### **! WARNING**

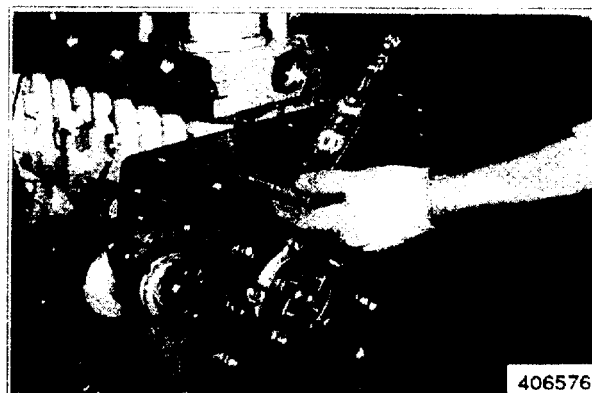
When removing the flywheel, wear heavy gloves to avoid hand injury.



Removing flywheel

## 2. Rear plate removal

The rear plate is doweled in position. Pull the plate as straight as possible when removing it.



Removing rear plate

## DISASSEMBLY

### 3. Oil seal case removal

Remove the bolts that hold the oil seal case in position. Remove the case from the cylinder block with a screwdriver or the like.

#### CAUTION

Do not cause damage to the oil seal.



Removing oil seal case

### 4. Tappet removal

Remove the tappets from the cylinder block with a valve push rod.

#### NOTE

The tappets will fall into the oil pan if the camshaft is removed before the tappets are removed.



Removing tappets

### 5. Speedometer driven gear removal

Remove the lock plate and speedometer driven gear in that order.

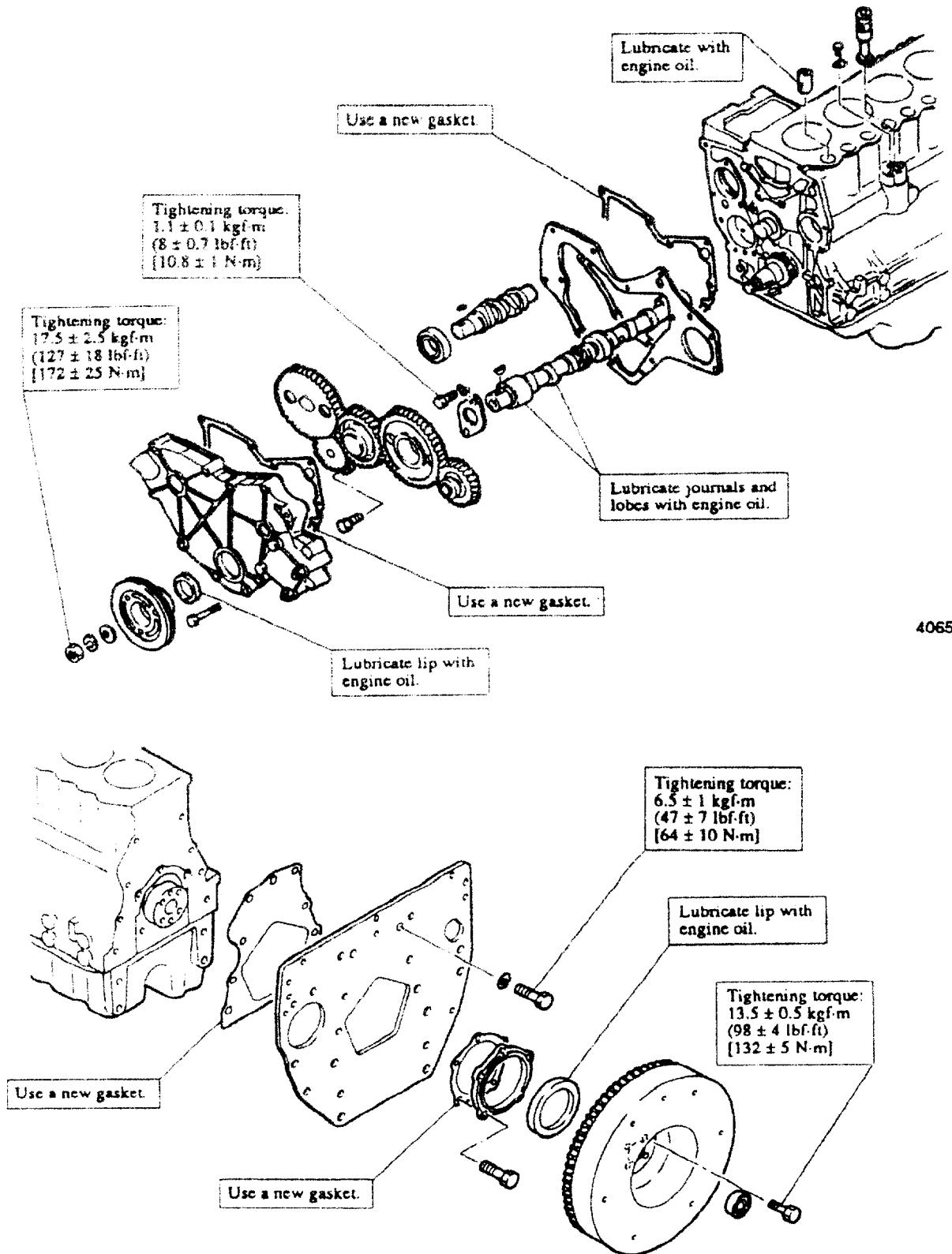
#### NOTE

Unless the speedometer driven gear is removed, the camshaft cannot be removed.



Removing speedometer driven gear

## TIGHTENING TORQUES



406572

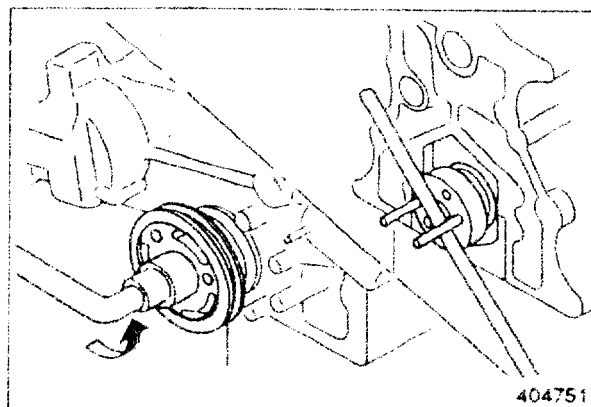
406573

## 6. Crankshaft pulley removal

- (1) Install two safety bars (M12 x 1.25) into the threaded holes in the rear end of the crankshaft. Put a bar between the safety bars to hold the crankshaft to prevent it from rotating.
- (2) Remove the crankshaft pulley.

### **! WARNING**

When removing the crankshaft pulley, be prepared to stop the job in case the bar slips off the crankshaft to prevent injury.



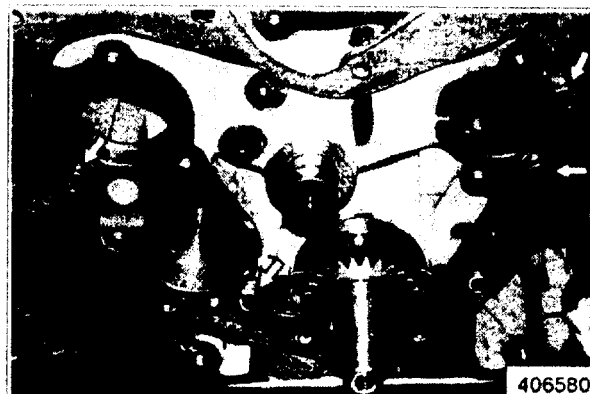
Removing crankshaft pulley

## 7. Timing gear case removal

Remove the bolts that hold the timing gear case in position and remove the case.

### **! CAUTION**

The front plate is bolted inside the timing gear case. Do not attempt to remove this plate along with the timing gear case by tapping.



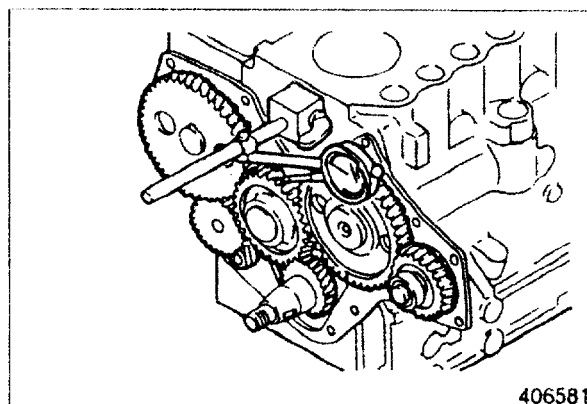
Front plate attaching bolts

## 8. Timing gear backlash measurement

Measure the backlash of each gear and keep a record of it for correct installation. Replace the gears if the backlash exceeds the limit.

Unit: mm (in.)

Item		Standard	Limit
Timing gear backlash	Crankshaft gear and idler gear		
	Idler gear and camshaft gear	0.04 to 0.12 (0.001 6 to 0.004 7)	
	Idler gear and fuel injection pump camshaft gear		0.30 (0.011 8)
	Camshaft gear and P.T.O. gear	0.08 to 0.19 (0.003 1 to 0.007 5)	
	Fuel injection pump camshaft gear and oil pump gear	0.07 to 0.20 (0.002 8 to 0.007 9)	



Measuring timing gear backlash

## DISASSEMBLY

### 9. Idler gear removal

To remove the idler gear, rotate the gear in a direction of the helix of the teeth to pull it out of mesh.



Removing idler gear

### 10. Camshaft removal

- (1) Remove the bolts that hold the thrust plate.
- (2) Pull the camshaft out of the cylinder block.

#### CAUTION

Do not cause damage to the lobes or bearing journals when removing the camshaft.



Removing camshaft

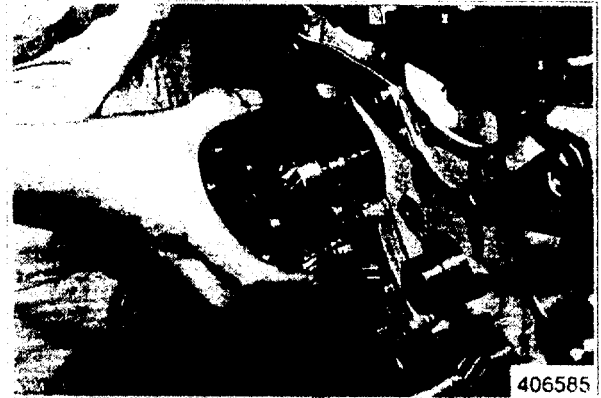
### 11. Fuel injection pump camshaft removal

- (1) Remove the stopper bolt.



Removing camshaft stopper bolt

- (2) Tap the rear end of the camshaft with a copper bar to push it out of the front side of the cylinder block.



Removing fuel injection pump camshaft

#### 12. Gear removal (when required)

To remove the gears from the camshaft and fuel injection pump camshaft, use an arbor press.

#### 13. Oil pump removal

Remove the bolts that hold the oil pump to the cylinder block and remove the pump.



Removing oil pump

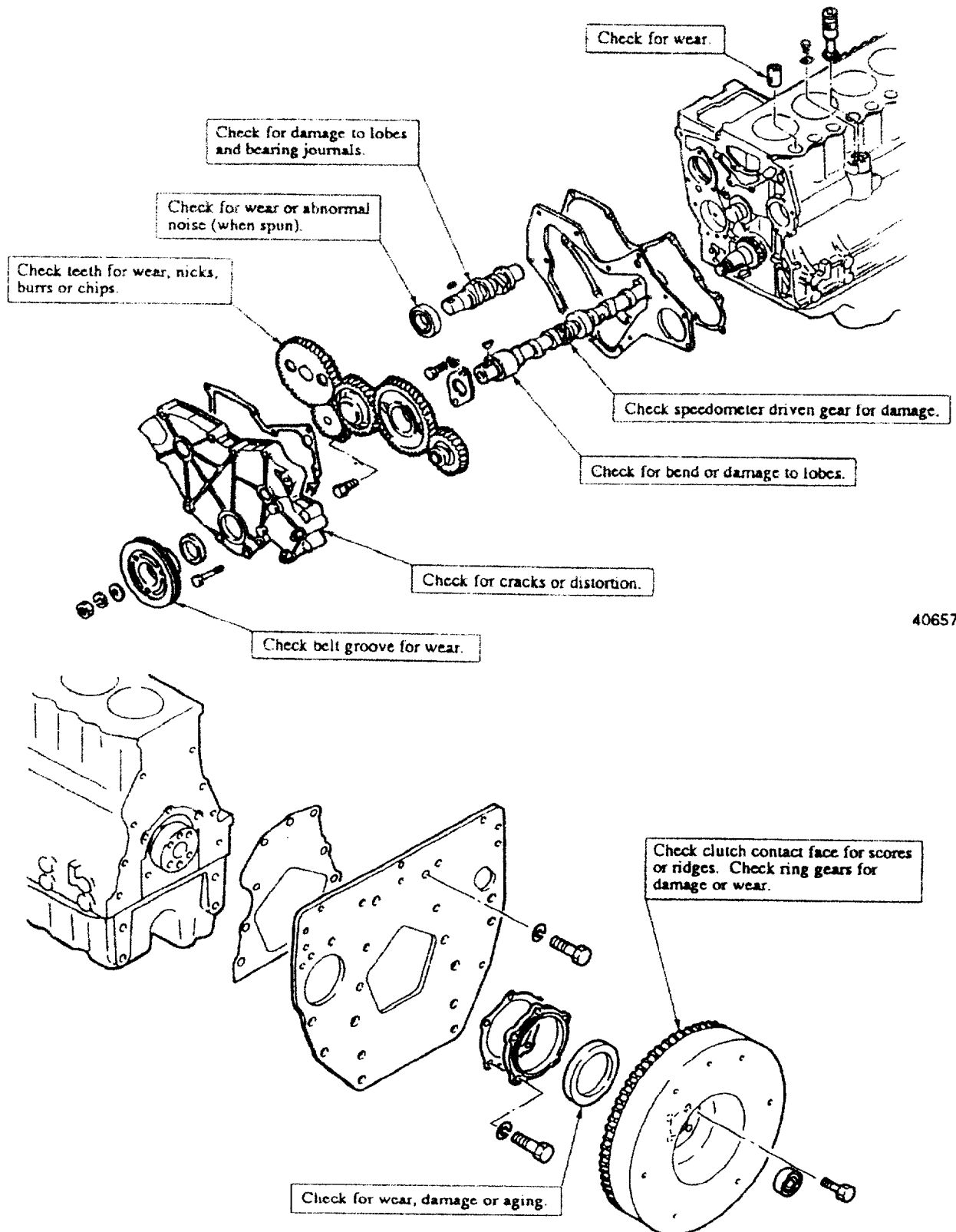
#### 14. Front plate removal

Remove four bolts that hold the front plate in position. Tap the plate lightly with a plastic hammer to separate the gasket.



Removing front plate

## TIMING GEARS AND FLYWHEEL



406572

406573

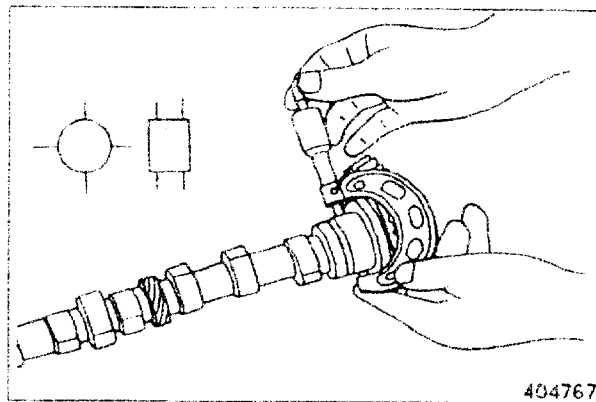
## INSPECTION

**1. Camshaft****(1) Clearance between journal and bushing**

Measure the diameter of the journal and the bore in the bushing for the shaft to find the clearance as shown in the illustration. If the clearance exceeds the limit, replace the bushing.

Unit: mm (in.)

Item	Standard
Clearance between camshaft journal and bushing	0.15 (0.005 9)



Measuring camshaft journal



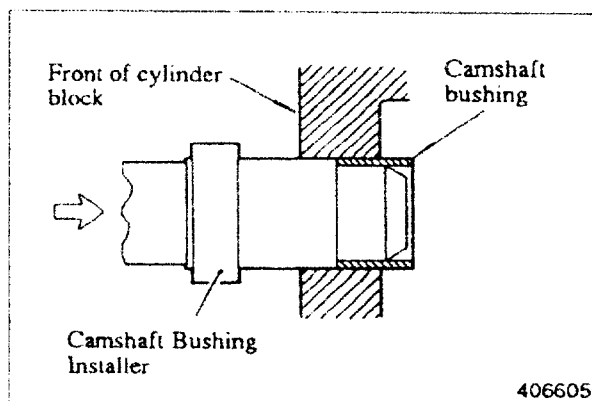
Measuring bore in camshaft bushing

**(2) Bushing replacement**

Use Camshaft Bushing Installer (ST332340) (special tool) for camshaft bushing replacement.

**(a) Removal**

Remove the oil pan. Using a "remover" end of the Installer, push out the bushing into the cylinder block. Crush and take out the bushing from the block.

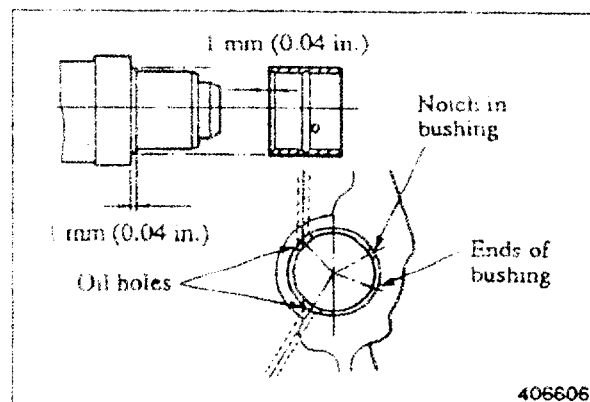


Removing camshaft bushing



**(b) Installation**

Install a new bushing in position with its oil holes in alignment with those of the oil gallery.



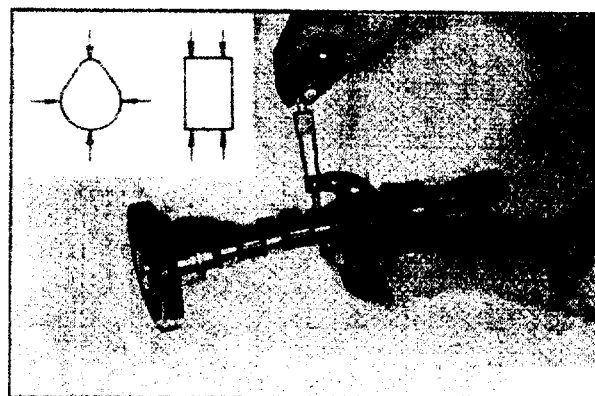
Installing camshaft bushing

**(3) Lobe lift**

Measure the lobe height and base circle as shown in the illustration. Subtract the base circle from the lobe height to find the lobe lift. If the lobe lift exceeds the limit, replace the camshaft.

Unit: mm (in.)

Item	Standard	Limit
Lobe height of camshaft	35.72 (1.406 3)	34.72 (1.366 9)



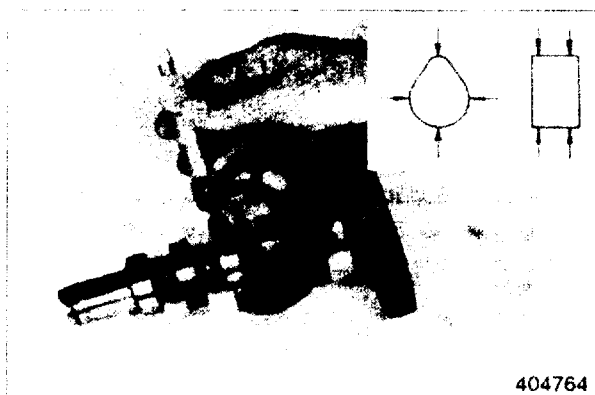
Measuring lobe height of camshaft

**2. Fuel injection pump camshaft**

Measure the lobe height and base circle as shown in the illustration. Subtract the base circle from the lobe height to find the lobe lift. If the lobe lift exceeds the limit, replace the camshaft.

Unit: mm (in.)

Item	Standard	Limit
Lobe height of fuel injection pump camshaft	44 (1.73)	43 (1.69)



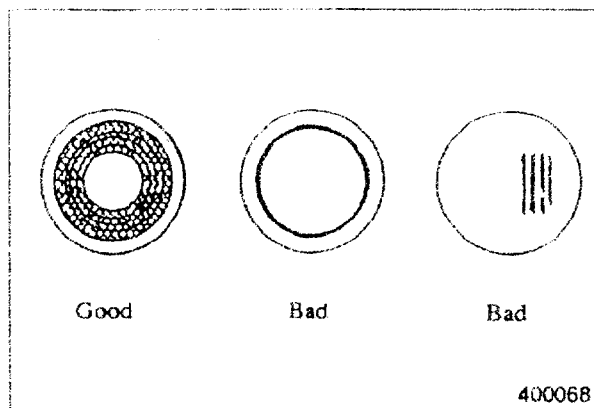
Measuring lobe height of fuel injection pump camshaft

## INSPECTION

### 3. Tappets

#### (1) Cam contact face

Check the cam contact face of each tappet for abnormal wear. Replace the tappet if the face is defective.



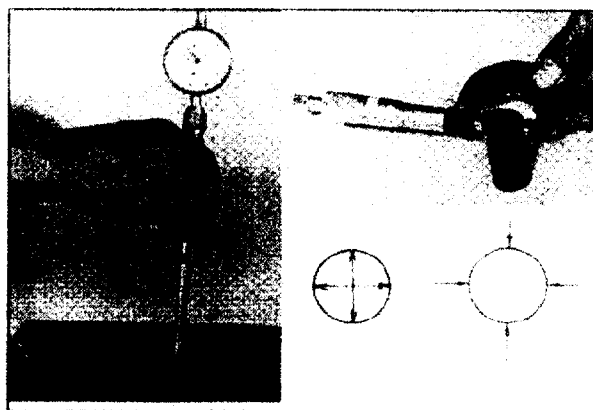
Cam contact face of tappet

#### (2) Clearance between tappet and cylinder block

Measure the diameter of the tappet and the bore in the cylinder block for the tappet to find the clearance. If the clearance exceeds the limit, replace the tappet.

Unit: mm (in.)

Item	Standard
Clearance between tappet and cylinder block	0.15 (0.005 9)



Measuring tappet and bore in cylinder

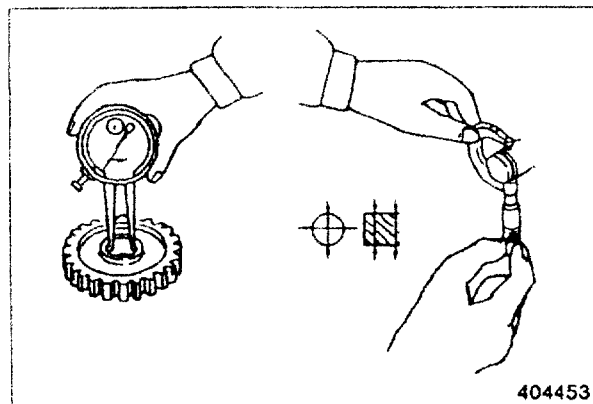
### 4. Idler gear

#### (1) Clearance between idler gear and shaft

Measure the bore in the idler gear for the shaft and the diameter of the shaft to find the clearance. If the clearance exceeds the limit, replace the gear or shaft whichever is badly worn.

Unit: mm (in.)

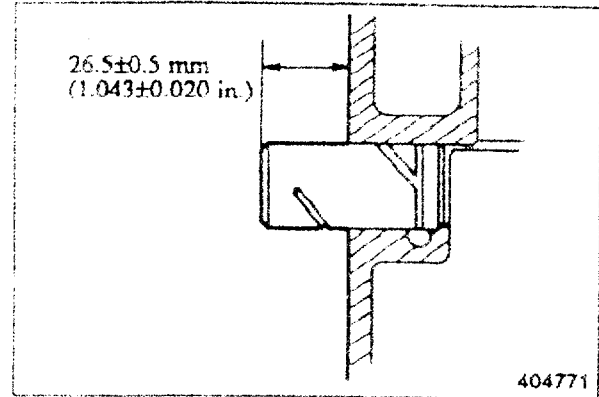
Item	Standard	Limit
Clearance between idler gear and shaft	0.03 to 0.07 (0.001 2 to 0.002 8)	0.20 (0.007 9)



Measuring idler gear and shaft

**(2) Idler shaft replacement**

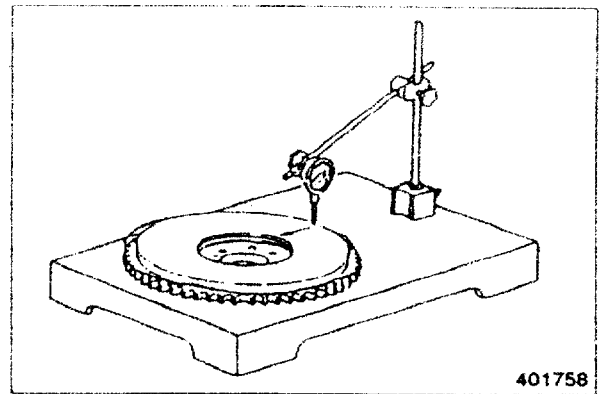
Install a new idler shaft to the cylinder block so that its dimension from the face of the block is  $26.5 \pm 0.5$  mm ( $1.043 \pm 0.020$  in.).



Idler shaft dimension

**5. Flywheel and ring gear****(1) Flatness (difference between lower and higher measurements) of flywheel**

Put the flywheel on the surface plate. Set a dial indicator at one side of the friction (clutch contact) face and move it over to the opposite side of the face as shown in the illustration to find the flatness. If the flatness exceeds the limit, grind the face.



Measuring flywheel flatness

Unit: mm (in.)

Item	Standard	Limit
Flatness of flywheel	0.15 (0.005 9) maximum	0.50 (0.019 7)

**(2) Ring gear replacement**

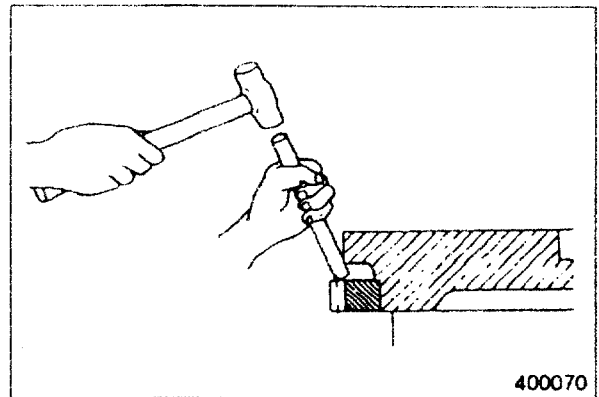
Check the ring gear and replace it if its teeth are abnormally worn or chipped.

**(a) Removal**

Heat the ring gear evenly with an acetylene torch. Tap the ring gear all the way around with a bar and a hammer as shown in the illustration to remove it from the flywheel.

**(b) Installation**

Heat a new ring gear up to a temperature of  $150^{\circ}\text{C}$  ( $302^{\circ}\text{F}$ ) with a piston heater and install it to the flywheel with its unchamfered side foremost.

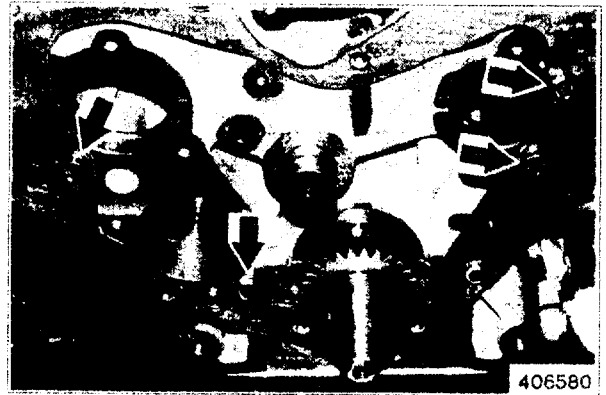


Removing ring gear

## ASSEMBLY

### 1. Front plate installation

- (1) Scrape the gasket from the cylinder block and front plate.
- (2) Coat the gasket contact surface of cylinder block with adhesive and put a new gasket in position, making sure the holes in the gasket are all in alignment with the holes in the cylinder block.
- (3) Put the front plate in position. Install four bolts and tighten them.



Installing front plate

### 2. Oil pump installation

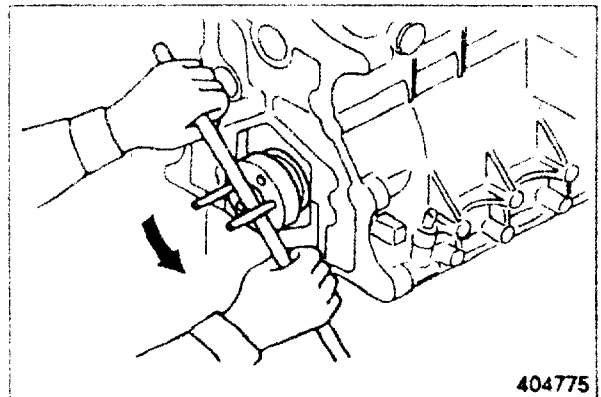
- (1) Make sure the packing has been put in position on the oil pump.
- (2) Put the oil pump in position on the cylinder block. Install three bolts and tighten them evenly.
- (3) Make sure the oil pump gear rotates freely.



Installing oil pump

### 3. Engine turning

- (1) Install two bolts (M12 x 1.25) in the flywheel bolt holes in the crankshaft.
- (2) Put a bar between the bolts and turn the crankshaft to bring No. 1 piston to the top center as shown in the illustration.



Turning engine

#### 4. Fuel injection pump camshaft installation

- (1) Put the camshaft (with bearing and gear) in position in the cylinder block.
- (2) Hit the gear with a plastic hammer to fit the bearing in position.
- (3) Make sure the camshaft rotates freely.
- (4) Tighten the stopper bolt.



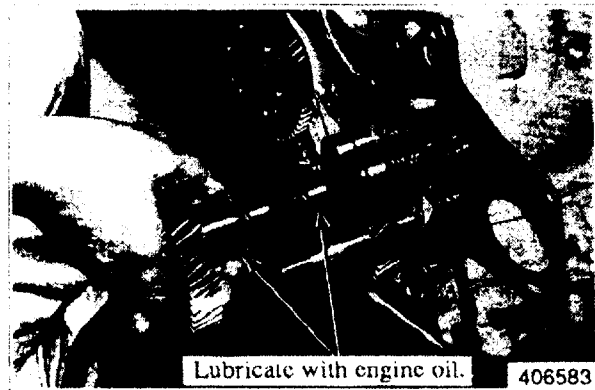
Installing fuel injection pump camshaft

#### 5. Camshaft installation

- (1) Lubricate the lobes and journals with engine oil.
- (2) Put the camshaft (with gear) in position in the cylinder block.



Do not cause damage to the lobes and journals when the camshaft is installed.



Installing camshaft

- (3) Tighten the bolts that hold the thrust plate to the specified torque.

Tightening torque	$1.1 \pm 0.1 \text{ kgf}\cdot\text{m}$ $(8 \pm 0.7 \text{ lbf}\cdot\text{ft})$ $[10.8 \pm 1 \text{ N}\cdot\text{m}]$
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- (4) Make sure the camshaft rotates freely. Check the end play for the camshaft.

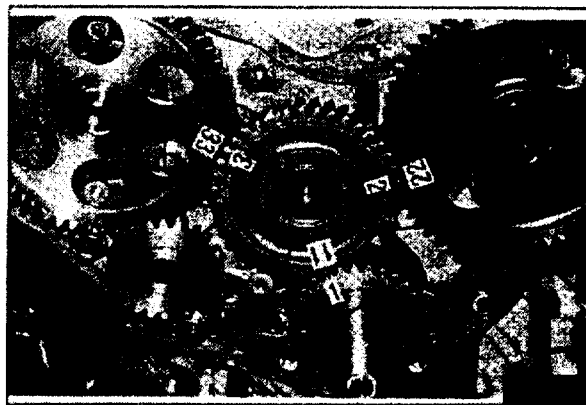


Installing thrust plate

## ASSEMBLY

### 6. Idler gear installation

- (1) Lubricate the idler gear with engine oil.
- (2) Install the idler gear in position with its "3," "2" and "11" marks in alignment with the "33" mark on the fuel injection pump camshaft gear, the "22" mark on the camshaft gear and the "1" mark on the crankshaft gear respectively.
- (3) Check the backlash of the gears. Make reference to "Timing gear backlash measurement" (page SL-32).



Marks on timing gears

### 7. Timing gear case installation

- (1) Coat the gasket with adhesive and put it in position on the front plate.
- (2) Lubricate the oil seal lip with engine oil.
- (3) Tighten the bolts that hold the timing gear case.



Installing timing gear case

### 8. Crankshaft pulley nut tightening

- (1) Install two bolts (M12 x 1.25) in the flywheel bolt holes in the crankshaft and hold the crankshaft.
- (2) Tighten the crankshaft pulley nut to the specified torque.

Tightening torque	$17.5 \pm 2.5 \text{ kgf}\cdot\text{m}$ $(127 \pm 18 \text{ lbf}\cdot\text{ft})$ $[172 \pm 25 \text{ N}\cdot\text{m}]$
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#### **WARNING**

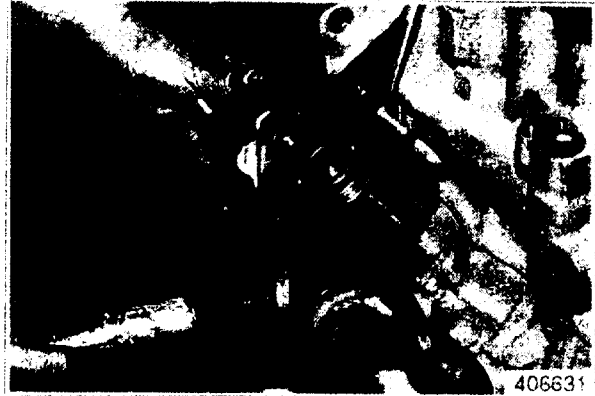
Check the strength of the bolts and bar used for holding the crankshaft.



Tightening crankshaft pulley nut

### 9. P.T.O. gear installation

Install the P.T.O. gear in position in the timing gear case with the side that has no oil hole toward the rear of the engine.



Installing P.T.O. gear

### 10. Speedometer driven gear installation

- (1) Install the O-ring in the groove in the driven gear sleeve.
- (2) Install the speedometer driven gear in position in the cylinder block while rotating it or the camshaft.



Installing speedometer driven gear

### 11. Tappet installation

Lubricate the tappets with engine oil and put them in position in the cylinder block.

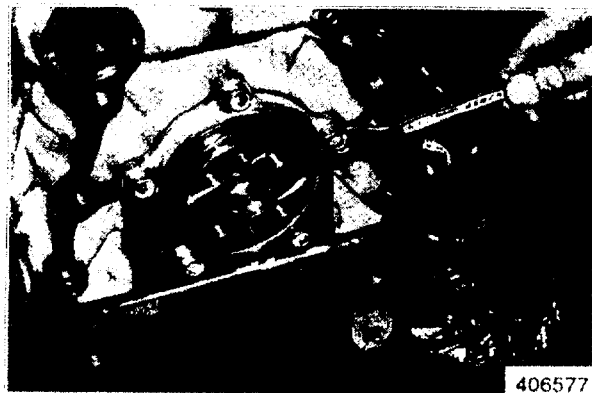


Installing tappets

## ASSEMBLY

### 12. Oil seal case installation

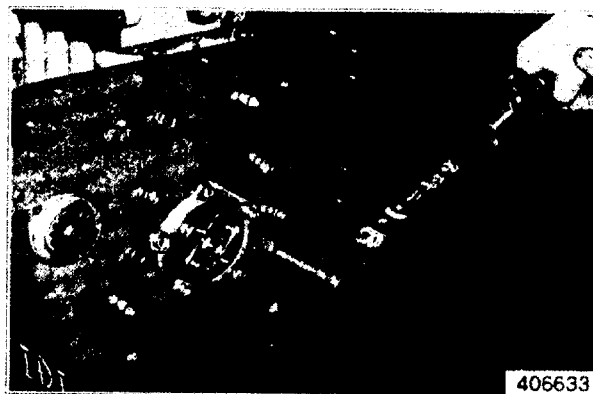
- (1) Put a new gasket in position on the oil seal case.
- (2) Lubricate the oil seal lip with engine oil and install the oil seal in position in the cylinder block.



Installing oil seal case

### 13. Rear plate installation

- (1) Put a new gasket in position on the rear plate.
- (2) Put the rear plate in position on the cylinder block with its dowel holes in alignment with the dowels. Tighten the bolts that hold the rear plate to the specified torque.



Installing rear plate

Tightening torque	$6.5 \pm 1 \text{ kgf}\cdot\text{m}$ $(47 \pm 7 \text{ lbf}\cdot\text{ft})$ $[64 \pm 10 \text{ N}\cdot\text{m}]$
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#### NOTE

Install the starter to the rear plate before installing the plate to the cylinder block for convenience of rear plate installation.

### 14. Flywheel installation

- (1) Install a safety bar (M12 x 1.25) in the rear end of the crankshaft.
- (2) Put the flywheel in position in alignment with the safety bar.
- (3) Install three of four bolts in the flywheel and tighten them finger tight only.
- (4) Remove the safety bar. Install the last bolt in the flywheel and tighten it finger tight only.



Safety bar



- (5) Have someone hold the crankshaft pulley with a wrench to prevent the flywheel from rotating.
- (6) Tighten the four bolts that hold the flywheel to the specified torque.

Tightening torque	$13.5 \pm 0.5$ kgf·m ( $98 \pm 4$ lbf·ft) ( $132 \pm 5$ N·m)
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**⚠ WARNING**

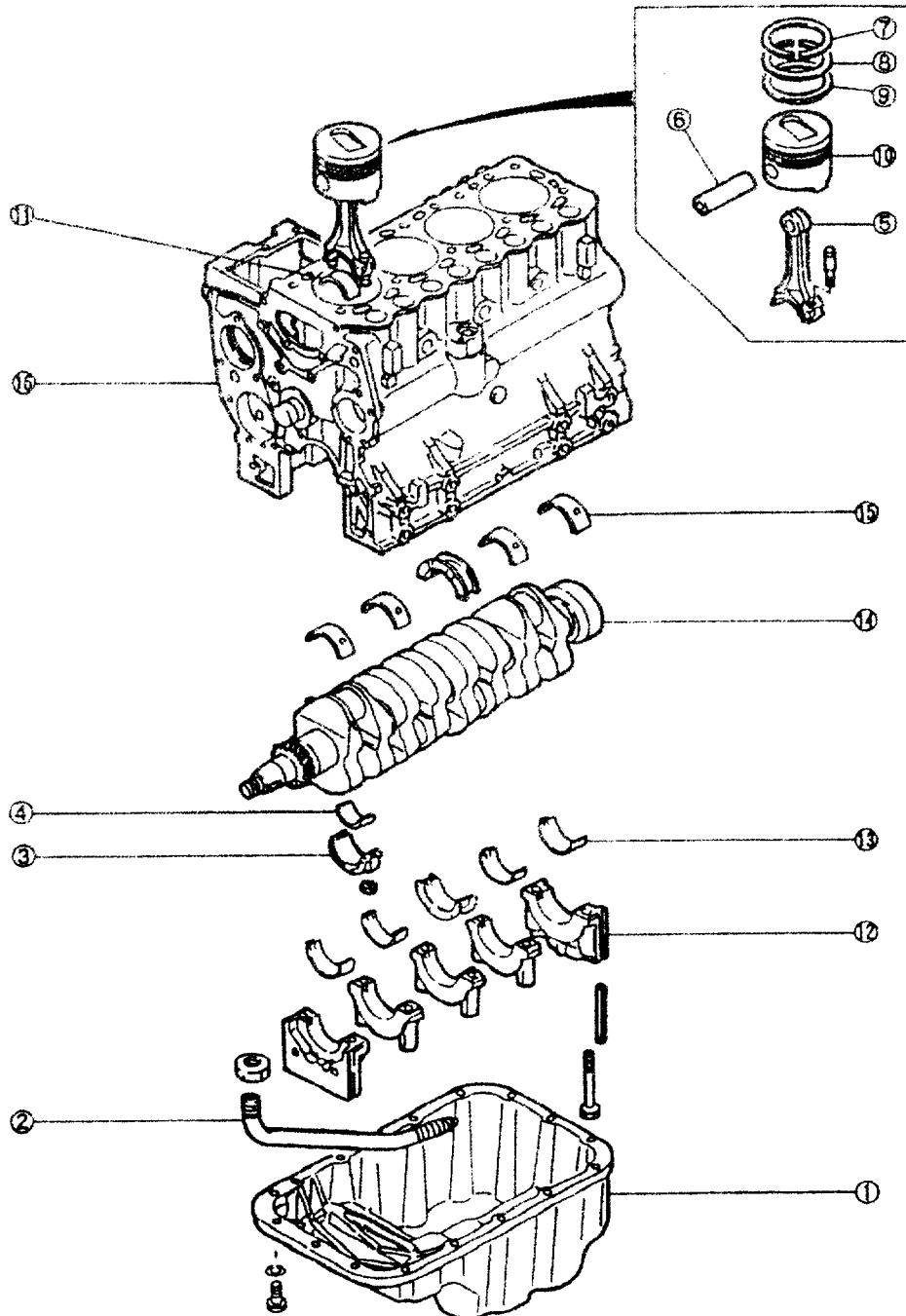
Always signal each other to prevent possible personal injury.



Tightening flywheel bolts

DISASSEMBLY

CYLINDER BLOCK, CRANKSHAFT, PISTONS AND OIL PAN



406588

- |                                       |              |                                       |
|---------------------------------------|--------------|---------------------------------------|
| ① Oil pan                             | ⑥ Piston pin | ⑪ Connecting rod bearing (upper half) |
| ② Oil screen                          | ⑦ No. 1 ring | ⑫ Main bearing cap                    |
| ③ Connecting rod cap                  | ⑧ No. 2 ring | ⑬ Main bearing (lower half)           |
| ④ Connecting rod bearing (lower half) | ⑨ Oil ring   | ⑭ Crankshaft                          |
| (Remove ⑤ thru ⑩ as an assembly.)     | ⑩ Piston     | ⑮ Main bearing (upper half)           |
| ⑤ Connecting rod                      |              | ⑯ Cylinder block                      |

NOTE: When the cylinder block is to be discarded, remove the components (pressure relief valve etc.) from Shop block 606-678-9623 or 606-561-4983

### 1. Oil pan removal

- (1) Turn the engine upside down.
- (2) Tap the bottom corners of the oil pan with a plastic hammer to remove the oil pan.

#### CAUTION

Do not attempt to pry off the oil pan by inserting a screwdriver or a chisel between the oil pan and cylinder block. Damage to the oil pan can be the result.



Removing oil pan

### 2. Oil screen removal

Loosen the nut that holds the oil screen in position and remove the screen.



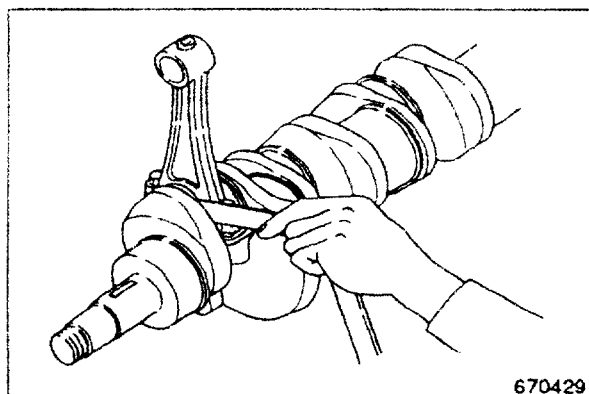
Removing oil screen

### 3. Thrust clearance measurement for connecting rod big end

Install the connecting rod to its crankpin and tighten the cap nuts to the specified torque. Measure the thrust clearance with a feeler gauge. If the clearance exceeds the limit, replace the connecting rod.

Unit: mm (in.)

Item	Standard	Limit
Thrust clearance for connecting rod big end	0.10 to 0.35 (0.003 9 to 0.013 8)	0.50 (0.019 7)

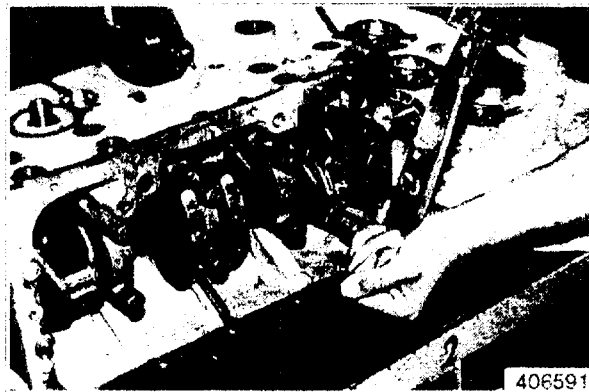


Measuring thrust clearance for connecting rod big end

## DISASSEMBLY

### 4. Connecting rod cap removal

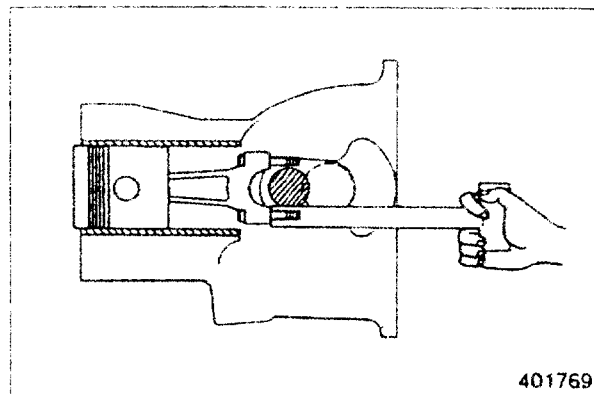
- (1) Lay the cylinder block on its side.
- (2) Put identification on each connecting rod and cap combination as to its location in the engine.
- (3) Remove the caps.



Removing connecting rod caps

### 5. Piston removal

- (1) Turn the crankshaft until the piston is at top center.
- (2) Push the piston and connecting rod away from the crankshaft with the handle of a hammer or the like until the piston rings are above the cylinder. Remove the piston and connecting rod. Do Steps (1) and (2) for the removal of the other pistons.



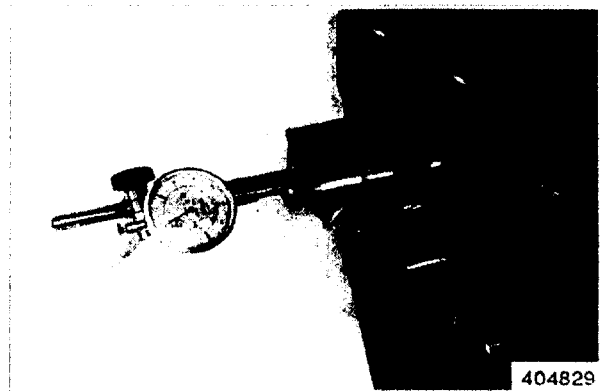
Removing piston

### 6. End play measurement for crankshaft

Set a dial indicator so that it will touch the end of the crankshaft and measure the end play. If the end play exceeds the limit, replace No. 3 flanged bearing.

Unit: mm (in.)

Item	Standard	Limit
End play for crankshaft end play	0.050 to 0.175 (0.001 97 to 0.006 89)	0.500 (0.019 69)



Measuring end play for crankshaft

### 7. Main bearing cap removal

- (1) Lay the cylinder block with its bottom (oil pan) side up.
- (2) Remove the bolts that hold the main bearing caps in position. Remove the caps.
- (3) Remove the front and rear bearing caps with a sliding hammer.



Removing main bearing caps

### 8. Crankshaft removal

Remove the crankshaft.

**CAUTION**

Do not cause damage to the bearings.

**NOTE**

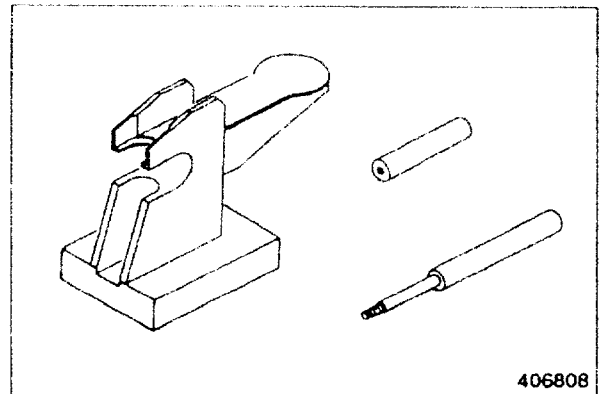
Put identification on each main bearing as to its location in the engine.



Removing crankshaft

### 9. Piston separation from connecting rod

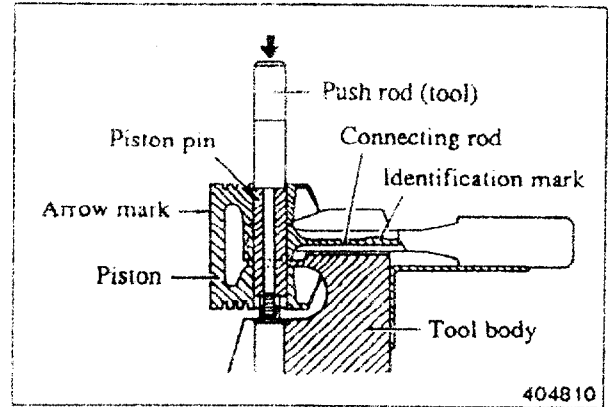
- (1) Use Piston Pin Setting Tool (31A91-00100) (special tool) to separate the piston from the connecting rod.



Piston pin setting tool

DISASSEMBLY

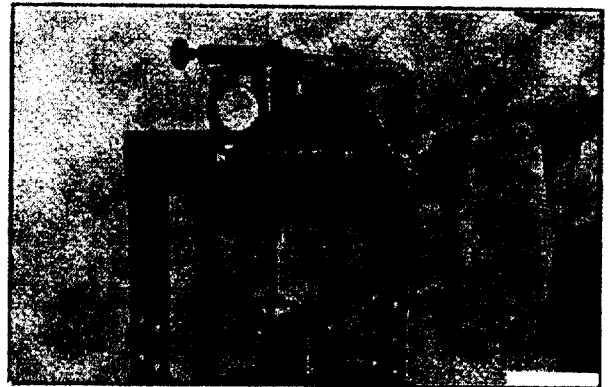
- (2) Insert the push rod of the tool into the bore in the piston for the piston pin and, using an arbor press, remove the piston pin.
- (3) Use this Piston Pin Setting Tool to install the connecting rod to the piston.



Removing piston pin (1)

**CAUTION**

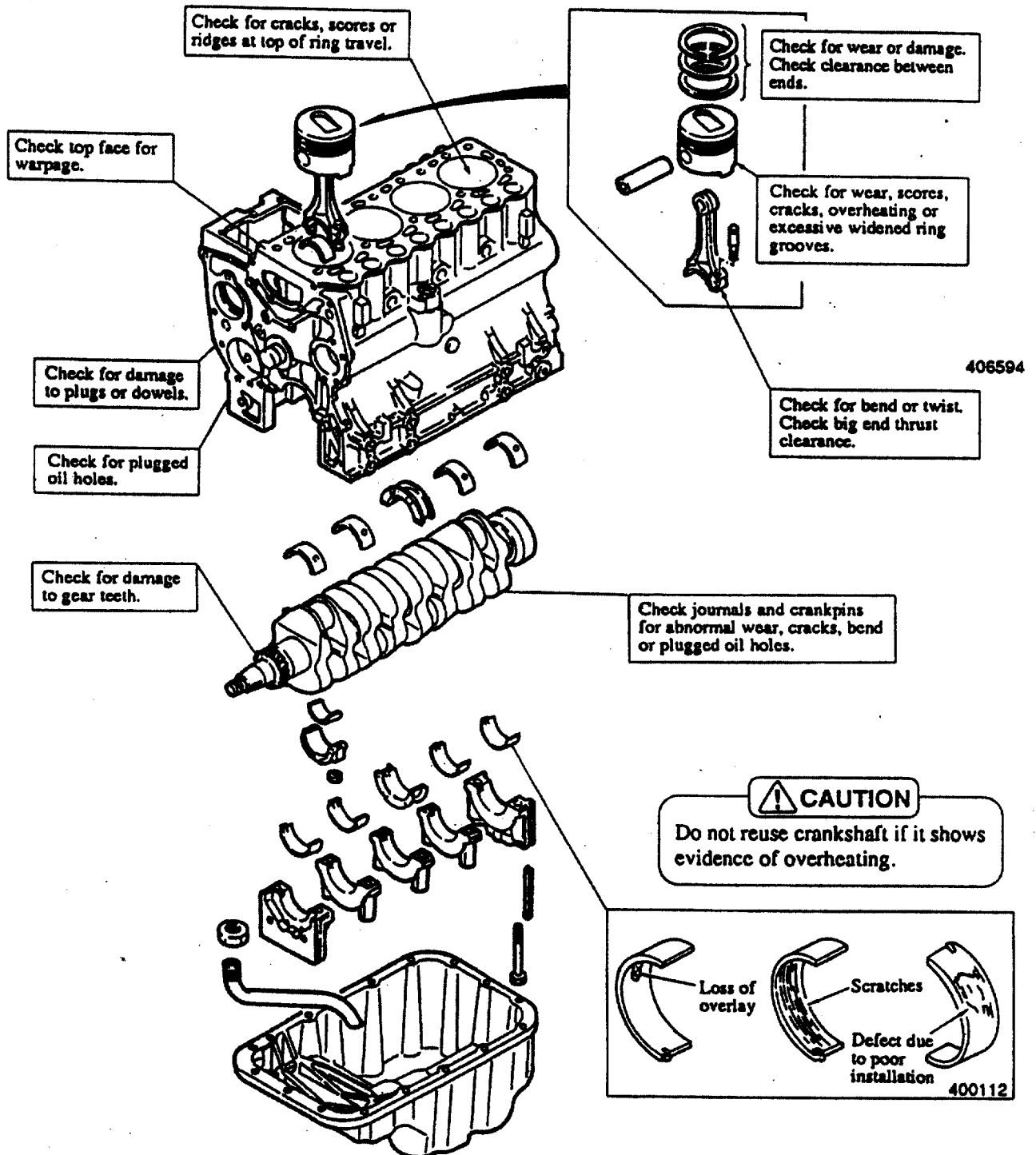
Do not attempt to remove the piston pin by tapping. Replace a piston pin which needs a greater force for removal.



Removing piston pin (2)

# INSPECTION

## INSPECTION POINTS



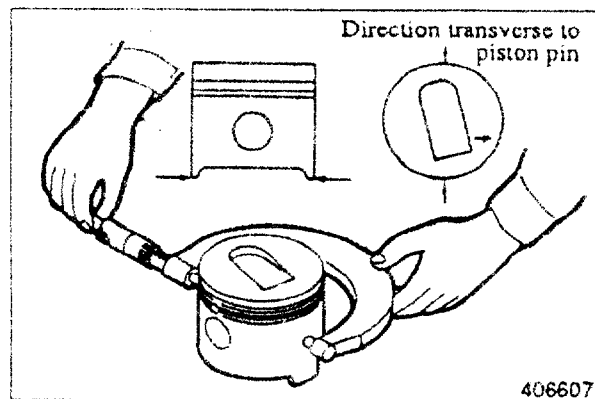
## 1. Pistons, Piston Rings and Piston Pins

### (1) Diameter of piston

Measure the diameter of the piston at its skirt in a direction transverse to the piston pin with a micrometer as shown in the illustration. If the diameter exceeds the limit, replace the piston. Select a new piston so that the difference between average weight of all pistons in one engine does not exceed the standard.

Unit: mm (in.)

Item		Nominal size	Standard	Limit
Diameter of piston	Standard	78.00 (3.070 9)	77.93 to 77.95 (3.068 1 to 3.068 9)	77.80 (3.063 0)
	0.25 (0.009 8) oversize	78.25 (3.080 7)	78.18 to 78.20 (3.077 9 to 3.078 7)	78.05 (3.072 8)
	0.50 (0.019 7) oversize	78.50 (3.090 5)	78.43 to 78.45 (3.087 8 to 3.088 6)	78.30 (3.082 7)
Maximum permissible difference between average weight of all pistons in one engine, g (oz)			5 (0.18)	—



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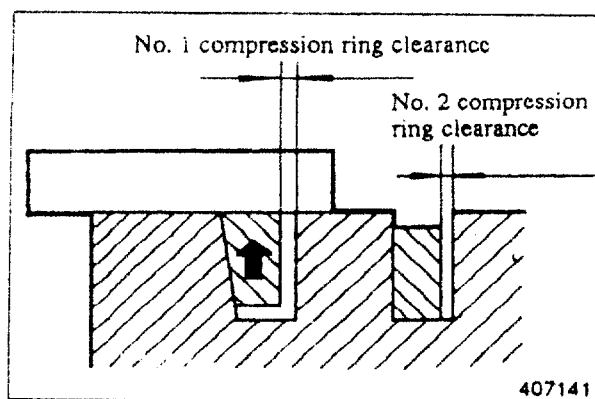
Measuring diameter of piston

### (2) Clearance between piston ring and groove

- (a) Measure the clearance between the groove and piston with a straight edge and a feeler gauge as shown in the illustration. If the clearance exceeds the limit, replace the ring.

Unit: mm (in.)

Item	Standard	Limit
No. 1 compression ring	0.06 to 0.10 (0.002 4 to 0.003 9)	0.30 (0.011 8)
No. 2 compression ring	0.05 to 0.09 (0.002 0 to 0.003 5)	0.20 (0.007 9)
Oil ring	0.03 to 0.07 (0.001 2 to 0.002 8)	0.20 (0.007 9)



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Measuring clearance between piston ring and groove

- (b) If the clearance still exceeds the limit after new piston rings have been installed, replace the piston.



# INSPECTION

## (3) Clearance between ends of piston ring

Put the piston ring in a gauge or in the bore in a new cylinder block and measure the clearance between the ends of the ring with a feeler gauge as shown in the illustration. If the clearance exceeds the limit, replace all the rings.

Inside diameter of gauge

Standard:  $78^{+0.03}_0$  mm ( $3.07^{+0.0012}_0$  in.)

0.25 mm (0.0098 in.) oversize:

$78.25^{+0.03}_0$  mm ( $3.08^{+0.0012}_0$  in.)

0.50 mm (0.0197 in.) oversize:

$78.50^{+0.03}_0$  mm ( $3.09^{+0.0012}_0$  in.)

### NOTE

Put the piston ring in the gauge or cylinder squarely with the piston.

Unit: mm (in.)

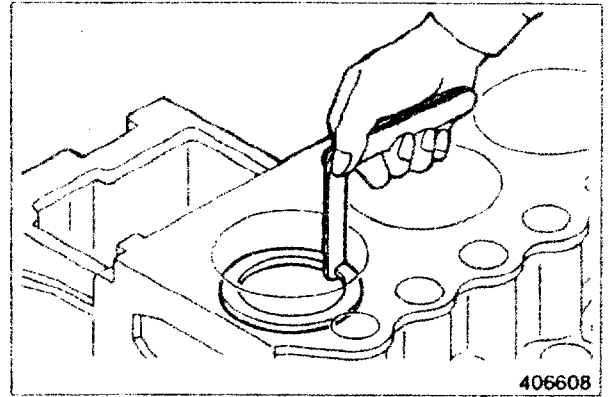
Item		Standard	Limit
Clearance between ends of piston ring	No. 1 compression ring	0.15 to 0.30 (0.005 9 to 0.011 8)	1.50 (0.059 1)
	No. 2 compression ring	0.15 to 0.35 (0.005 9 to 0.013 8)	
	Oil ring	0.20 to 0.40 (0.007 9 to 0.015 7)	

## (4) Clearance between piston pin and piston

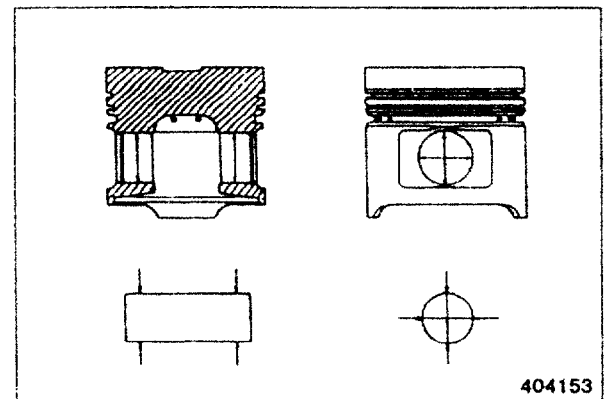
Measure the diameter of the piston pin and the bore in the piston for the pin as shown in the illustration to find the clearance. If the clearance exceeds the limit, replace the piston or pin whichever is badly worn.

Unit: mm (in.)

Item	Nominal size	Standard	Limit
Diameter of piston pin	23 (0.91)	22.994 to 23.000 (0.905 27 to 0.905 51)	
Clearance between piston pin and piston	—	0.006 to 0.018 (0.000 24 to 0.000 71)	0.050 (0.001 97)



Measuring clearance between ends of piston ring



Measuring piston pin and bore in piston for pin

## 2. Connecting rods

Check the connecting rod for bend or twist as follows:

- (a) Measure "C" and "L." If "C" exceeds 0.05 mm (0.0020 in.) per 100 mm (3.94 in.) of "L," straighten the connecting rod with a press.

Unit: mm (in.)

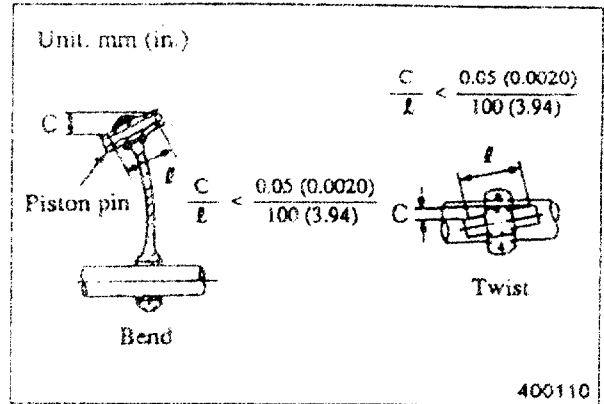
Item	Standard	Limit
Bend or twist of connecting rod	0.05/100 (0.002 0/3.94) maximum	0.15/100 (0.005 9/ 3.94)

- (b) Generally, a connecting rod aligner is used to check the connecting rod for bend or twist.

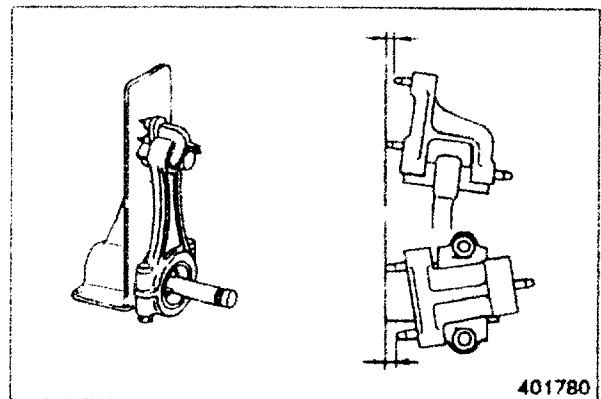
### NOTE

To check the rod for bend, install the cap to the connecting rod and tighten the cap nuts to the specified torque.

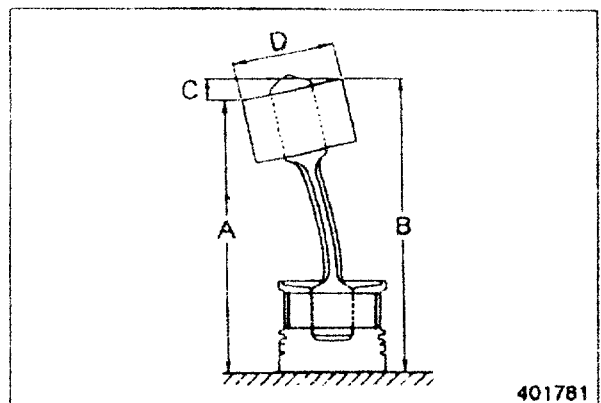
- (c) To check the connecting rod fitted to the piston for bend, put the connecting rod and piston on the surface plate as shown in the illustration, insert a round bar having a diameter equal to that of the crankpin into the bore in the big end of the rod and measure "A" and "B" with a dial indicator. Subtract "A" from "B" to find the bend ("C").



Checking connecting rod for bend or twist



Check connecting rod on a connecting rod aligner



Checking connecting rod for bend with a dial indicator

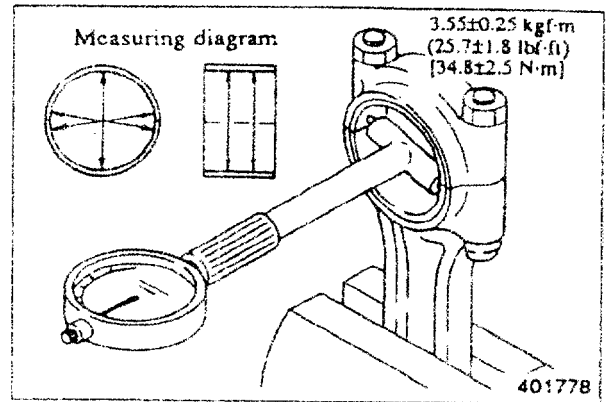
## INSPECTION

### 3. Crankshaft

#### (1) Clearance between crankpin and connecting rod bearing

- (a) Install the bearing (upper and lower halves) and cap to the big end of the connecting rod and tighten the cap nuts to the specified torque. Measure the bore in the bearing for crankpin as shown in the illustration.

Tightening torque	$3.55 \pm 0.25 \text{ kgf-m}$ ( $25.7 \pm 1.8 \text{ lbf-ft}$ ) ( $34.8 \pm 2.5 \text{ N-m}$ )
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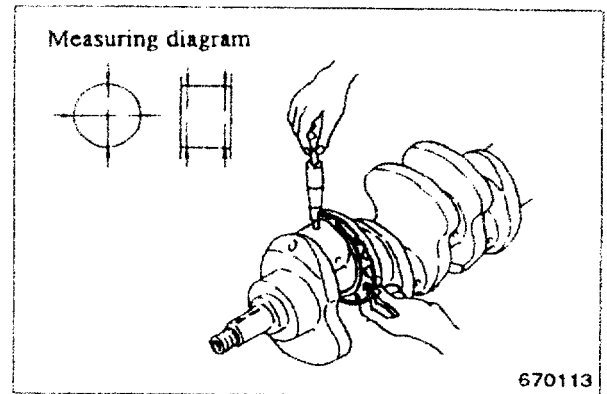


Measuring bore in connecting rod bearing

- (b) Measure the diameter of the crankpin as shown in the illustration to find the clearance between the crankpin and connecting rod bearing.

Unit: mm (in.)

Item	Nominal size	Standard	Limit
Diameter of crankpin (standard)	48 (1.89)	47.950 to 47.965 (1.887 79 to 1.888 38)	—
Clearance between crankpin and connecting rod bearing	—	0.025 to 0.072 (0.000 98 to 0.002 83)	0.150 (0.005 91)



Measuring diameter of crankpin

- (c) If the clearance exceeds the limit, install a new bearing and check the clearance again.
- (d) If the clearance still exceeds the limit, grind the crankpin to 0.25 mm (0.0098 in.), 0.50 mm (0.0197 in.) or 0.75 mm (0.0295 in.) undersize and use undersize connecting rod bearing.

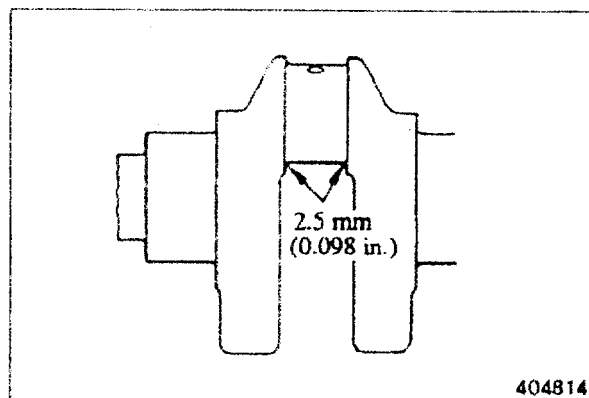
#### Crankpin undersizes

Unit: mm (in.)

Item	Undersize	Finish
Crankpin	0.25 (0.009 8)	47.75 <sup>-0.035</sup> <sub>-0.050</sub> (1.879 9 <sup>-0.001 38</sup> <sub>-0.001 97</sub> )
	0.50 (0.019 7)	47.50 <sup>-0.035</sup> <sub>-0.050</sub> (1.870 1 <sup>-0.001 38</sup> <sub>-0.001 97</sub> )
	0.75 (0.029 5)	47.25 <sup>-0.035</sup> <sub>-0.050</sub> (1.860 2 <sup>-0.001 38</sup> <sub>-0.001 97</sub> )

**CAUTION**

- a) Grind all the crankpins of one crankshaft to the same undersize.
- b) Finish the crankpin fillets to a radius of 2.5 mm (0.098 in.).

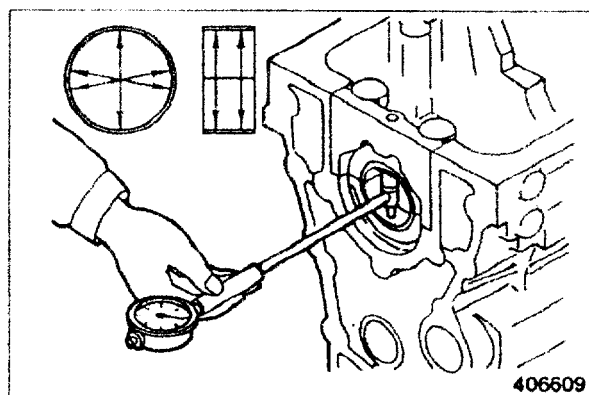


Crankpin fillet radius

## (2) Clearance between journal and main bearing

- (a) Install the main bearing (upper and lower halves) and cap to the cylinder block and tighten the cap bolts to the specified torque. Measure the bore in the bearing for the journal as shown in the illustration.

Tightening torque

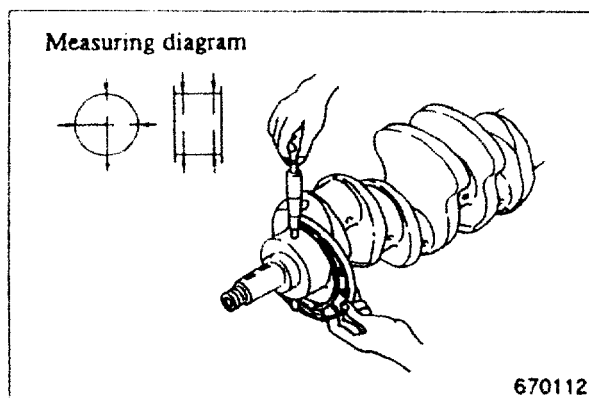
 $5.25 \pm 0.25 \text{ kgf}\cdot\text{m}$   
 $(38 \pm 1.8 \text{ lbf}\cdot\text{ft})$   
 $[51.5 \pm 2.5 \text{ N}\cdot\text{m}]$ 


Measuring bore in main bearing

- (b) Measure the diameter of the journal as shown in the illustration to find the clearance between the journal and main bearing.

Unit: mm (in.)

Item	Nominal size	Standard	Limit
Diameter of journal (standard)	52 (2.05)	51.985 to 52.000 (2.046 65 to 2.047 24)	—
Clearance between journal and main bearing	—	0.030 to 0.077 (0.001 18 to 0.003 03)	0.100 (0.003 94)



Measuring diameter of journal

- (c) If the clearance exceeds the limit, install a new bearing and check the clearance again.

## INSPECTION

- (d) If the clearance still exceeds the limit, grind the journal to 0.25 mm (0.009 8 in.), 0.50 mm (0.019 7 in.) or 0.75 mm (0.029 5 in.) undersize and use undersize main bearing.

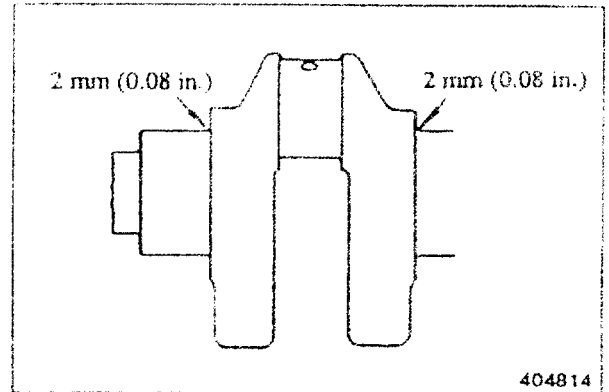
### Journal undersizes

Unit: mm (in.)

Item	Undersize	Finish
Journal	0.25 (0.009 8)	51.75 <sup>0</sup> <sub>-0.015</sub> (2.037 4 <sup>0</sup> <sub>-0.000 59</sub> )
	0.50 (0.019 7)	51.50 <sup>0</sup> <sub>-0.015</sub> (2.027 6 <sup>0</sup> <sub>-0.000 59</sub> )
	0.75 (0.029 5)	51.25 <sup>0</sup> <sub>-0.015</sub> (2.017 7 <sup>0</sup> <sub>-0.000 59</sub> )

### CAUTION

- Grind all the journals of one crankshaft to the same undersize.
- Finish the journal fillets to a radius of 2 mm (0.08 in.).



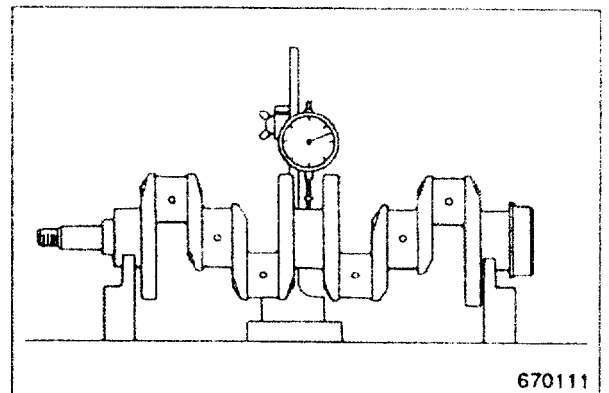
Journal fillet radius

### (3) Runout

Support the crankshaft on its front and rear journals in V-blocks or in a lathe and check runout at the center journal with a dial indicator as shown in the illustration. Depending on the amount of runout, repair the crankshaft by grinding or by straightening with a press. If runout exceeds the limit, replace the crankshaft.

Unit: mm (in.)

Item	Standard	Limit
Crankshaft runout	0.025 (0.000 98)	0.05 (0.002 0)



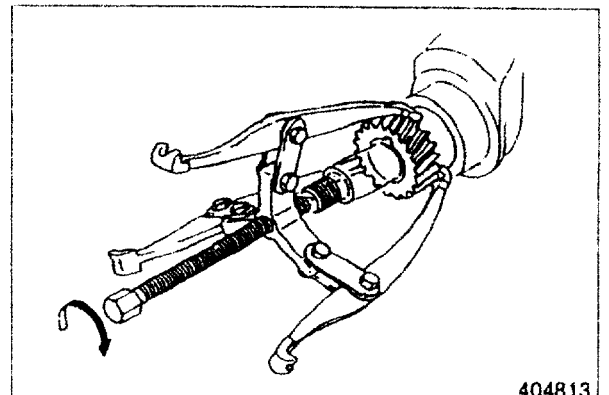
Checking crankshaft runout

### (4) Crankshaft gear removal

Use a gear puller to remove the gear from the crankshaft.

### NOTE

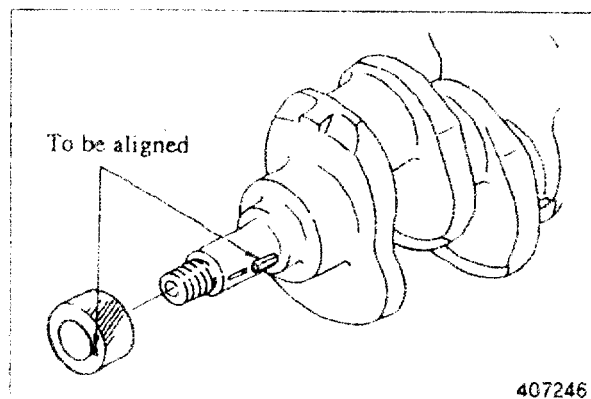
Do not remove the gear unless the gear or crankshaft is defective.



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## (5) Crankshaft gear installation

- Install the key in position on the crankshaft.
- Install the gear in position with its keyway in alignment with the key as shown in the illustration.



Installing crankshaft gear

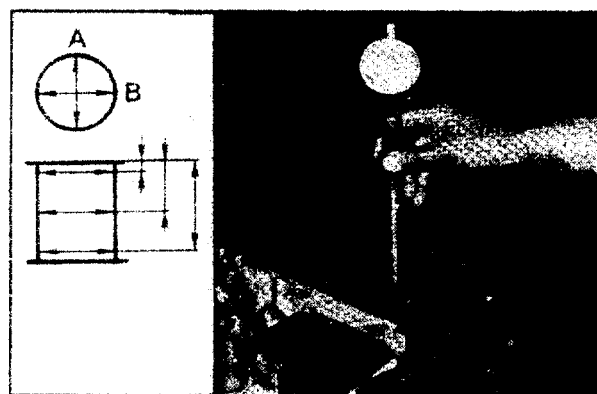
## 4. Cylinder block

### (1) Bore

Measure the bore at the top, middle and bottom points on axes A and B with a cylinder bore gauge as shown in the illustration. If any one of the cylinders exceeds the limit, hone out all the bores for oversize pistons.

Unit: mm (in.)

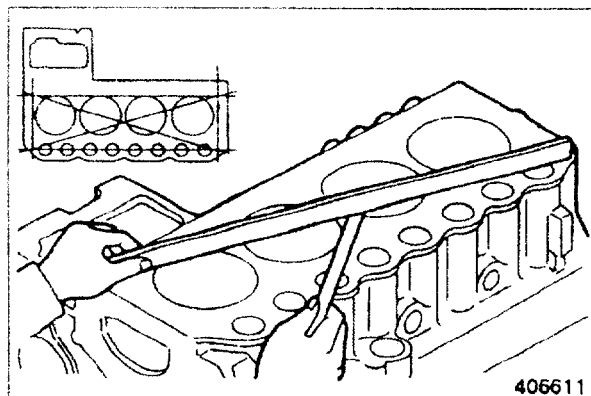
Piston and piston ring		Bore	
Size	Size code	Standard	Limit
Standard	STD	$78^{+0.03}_0$ ( $3.07^{+0.001}_0$ 2)	
0.25 (0.009 8) oversize	25	$78.25^{+0.03}_0$ ( $3.080 7^{+0.001}_0$ 2)	Standard: +0.2 (+0.008)
0.50 (0.019 7) oversize	50	$78.50^{+0.03}_0$ ( $3.090 5^{+0.001}_0$ 2)	
Taper and out-of-round		0.01 (0.000 4) maximum	—



Measuring bore in cylinder block

### (2) Warpage of top face

Using a heavy accurate straight edge and a feeler gauge, check the top face for warpage in two positions lengthwise, two crosswise and two widthwise as shown in the illustration. If warpage exceeds the limit, reface the top face with a surface grinder.



Checking cylinder block top face for warpage

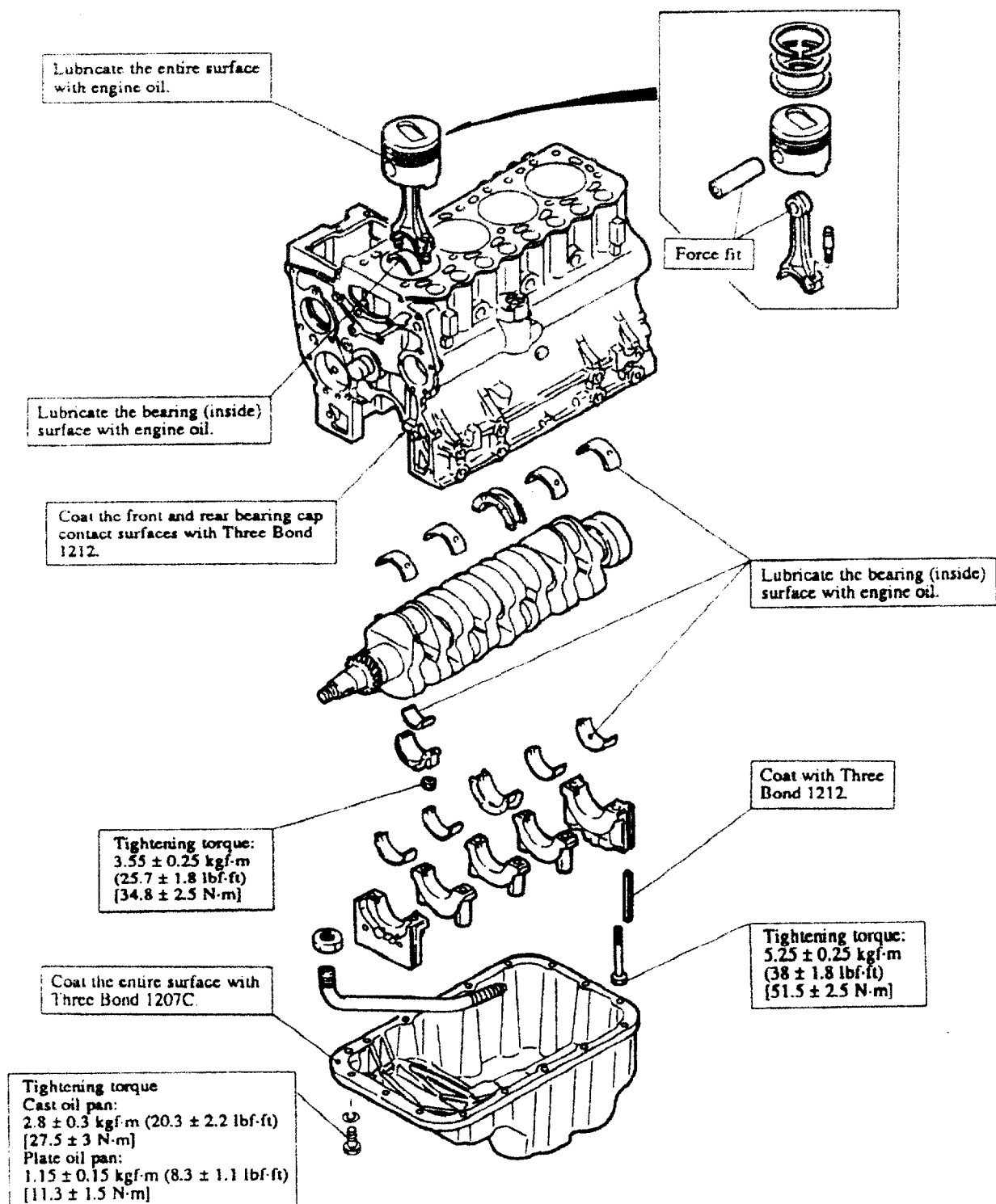
Unit: mm (in.)

Item	Standard	Limit
Warpage of cylinder block top face	0.05 (0.002 0) maximum	0.10 (0.003 9)

**CAUTION**  
The maximum permissible amount of stock to be removed from the cylinder head and block by grinding is 0.2 mm (0.008 in.) in total.

ASSEMBLY

TIGHTENING TORQUES



### 1. Main bearing installation

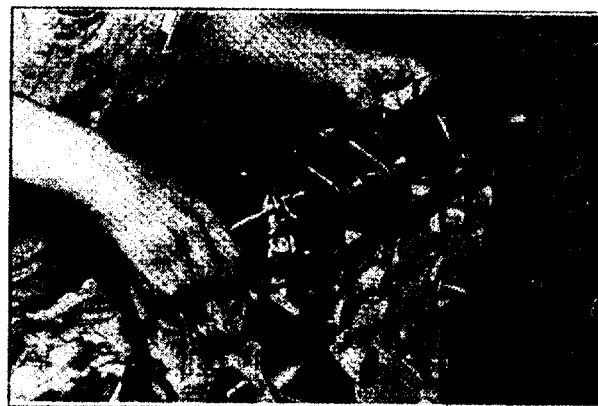
- (1) Install the upper halves of the main bearings in the cylinder block and the lower halves in the main bearing caps so their tabs fit into the notches in the cylinder block and the main bearing caps.
- (2) Install the flanged bearing in the No. 3 journal.
- (3) Lightly lubricate the inside surfaces of the bearings with engine oil.



Installing main bearings

### 2. Crankshaft installation

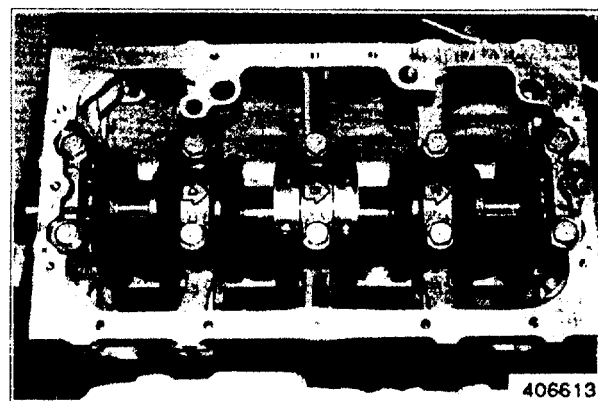
- (1) Clean the crankshaft with cleaning solvent and blow dry with compressed air.
- (2) Fasten a hoist to the crankshaft and hold it in horizontal position. Carefully put the crankshaft in position in the cylinder block.
- (3) Lightly lubricate the crankshaft journals with engine oil.



Installing crankshaft

### 3. Main bearing cap installation

- (1) Coat the mating surfaces of the rear bearing cap and cylinder block with Three Bond 1212.
- (2) Install the main bearing caps in position. Make sure the number (arrow head) on the main bearing cap is toward the front of the engine.
- (3) Tighten the main bearing cap bolts finger tight only.



Main bearing caps installed



# ASSEMBLY

## CAUTION

Install the front and rear bearing caps in position so their end faces are even with the end faces of the cylinder block.



Installing front and rear bearing caps

- (4) Tighten the bolts holding the main bearing caps in steps to the specified torque.

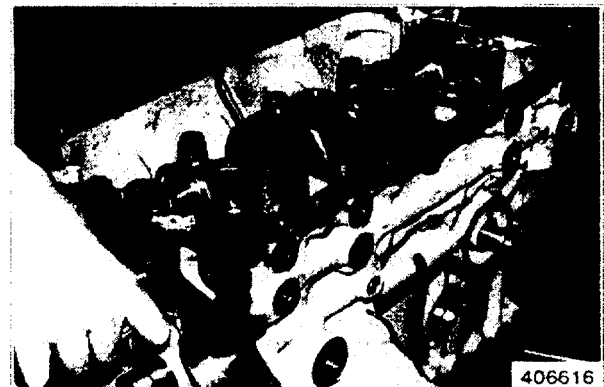
Tightening torque

$5.25 \pm 0.25 \text{ kgf}\cdot\text{m}$   
( $38 \pm 2 \text{ lbf}\cdot\text{ft}$ )  
[ $51.5 \pm 2.5$ ]



Tightening bolts holding main bearing caps

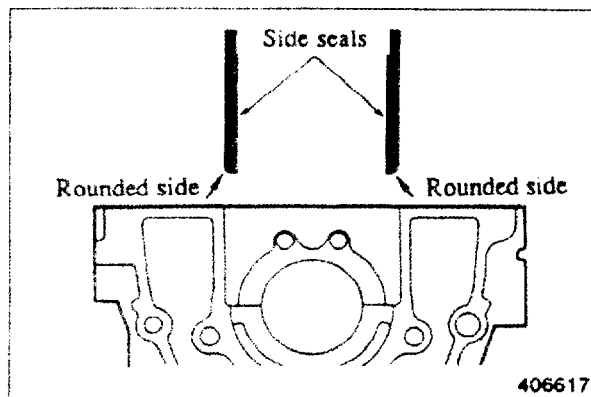
- (5) Make sure the crankshaft rotates freely without binding or catching.
- (6) Measure the end play for the crankshaft. Make reference to "End play measurement for crankshaft" (page 42). If the end play is incorrect, loosen the bolts holding the main bearing caps once and tighten them again.



Checking crankshaft for rotation

#### 4. Side seal installation

- (1) Coat the side seals with Three Bond 1212.
- (2) Insert the side seals between the cylinder block and the front and rear caps and push in them by hand as far as possible, with their rounded side toward the outside of the cylinder block.



Side seals

- (3) Using a flat plate, push the seals into position, taking care not to bend them.



Installing side seals

#### 5. Piston assembling to connecting rod

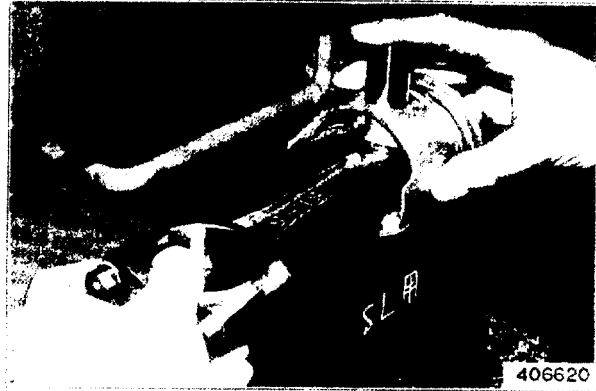
- (1) Set Piston Setting Tool (31A91-00100) (special tool) in a hydraulic press.
- (2) Put the connecting rod on the Tool and lubricate the bore in the rod for the piston pin with engine oil.



Connecting rod on Piston Setting Tool

ASSEMBLY

- (3) Put the piston in position on the connecting rod, making sure the model identification on the rod is on the same side as the arrow head on the top of the piston. Put the piston pin in position.

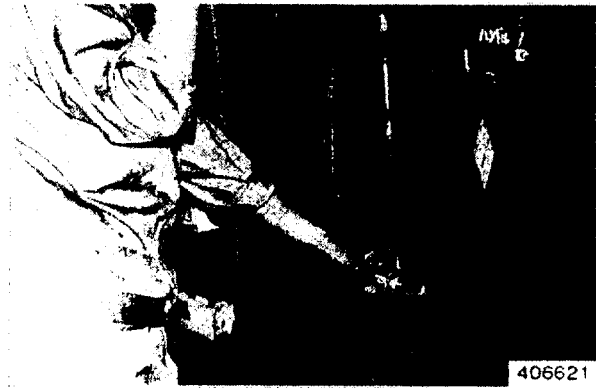


Installing piston pin

- (4) Insert the push rod of the Tool into the bore in the piston for the piston pin and press the pin with the press.

**CAUTION**

Observe the indicator of the press when pressing the piston pin. If the force of the press is ready to exceed 50 kgf (110 lbf) [490 N], stop pressing the pin and check the bores in the piston and connecting rod for alignment.



Pressing piston pin

- (5) After assembling the piston and connecting rod, make sure the connecting rod moves freely.



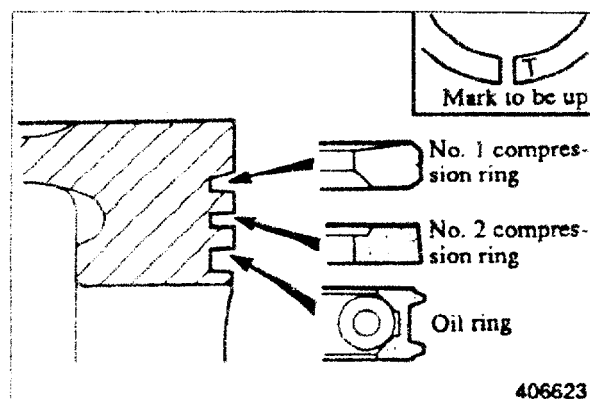
Checking piston and connecting rod

## 6. Piston ring installation

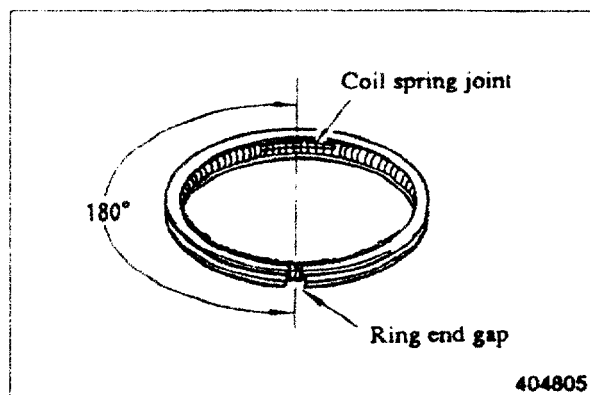
Using a piston ring pliers, install the piston rings on the piston.

### NOTE

- The piston rings must be installed with the side that has the mark "T" toward the top of the piston.
- The oil ring must be installed with the ring end gap 180° apart from the coil spring joint.



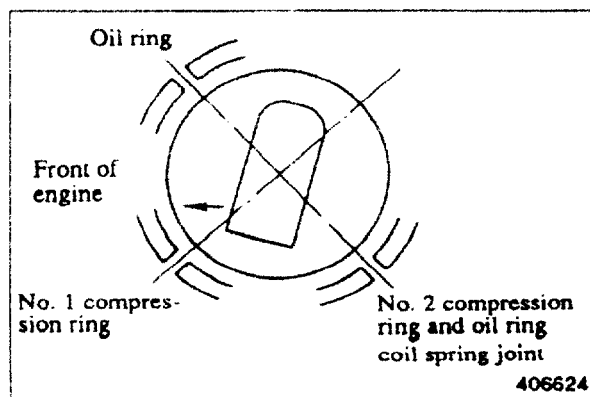
Piston rings



Oil ring

## 7. Piston and connecting rod installation

- Lubricate the piston and piston rings with engine oil.
- Move the piston rings on the piston so that the end gaps are apart from a direction parallel to, or transverse to, the piston pin.
- Install the connecting rod bearing (upper half) to the rod, making sure the tab in the back of the bearing is in the notch of the connecting rod.
- Turn the crankshaft until the crankpin for the piston and connecting rod to be installed is at the top center.
- Hold the piston and connecting rod with "FRONT" mark (arrow head) on the top of the piston toward the front (timing gear case side) of the engine.



Relative location of piston ring end gaps

## ASSEMBLY

- (6) Using a piston guide (commercially available), put the piston and connecting rod into the cylinder from the top of the cylinder block.

### CAUTION

Do not hit the piston with a hammer to install the piston and connecting rod. This will put force on the piston and connecting rod and cause damage to the piston rings and crankpin.



Installing piston and connecting rod

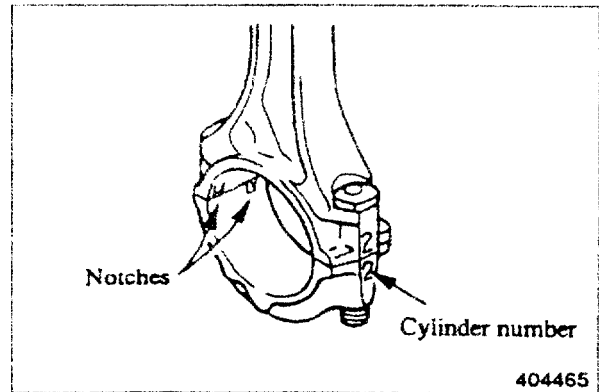
## 8. Connecting rod cap installation

- (1) Push the piston into position until the big end of the connecting rod is put into position over the crankpin. Then turn the crankshaft 180° while pushing on the top of the piston.
- (2) Install the lower half of the connecting rod bearing in the connecting rod cap, making sure the tab in the back of the bearing is in the notch of the cap.
- (3) Install the bearing cap to the connecting rod.

### NOTE

- a) Make sure the number on the cap is the same as the number on the connecting rod.
  - b) In case of a new connecting rod having no cylinder number, install the cap to the rod with the notches on the same side.
- (4) Tighten the connecting rod cap nuts in steps to the specified torque.

Tightening torque	$3.55 \pm 0.25 \text{ kgf}\cdot\text{m}$ $(25.7 \pm 2 \text{ lbf}\cdot\text{ft})$ $[34.8 \pm 2.5 \text{ N}\cdot\text{m}]$
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Installing connecting rod cap



Tightening connecting rod cap nuts

- (5) Check the thrust clearance for the connecting rod big end.

### 9. Oil screen installation

- (1) Lay the cylinder block with the bottom (oil pan side) up.
- (2) Install the oil screen in position.

**NOTE**

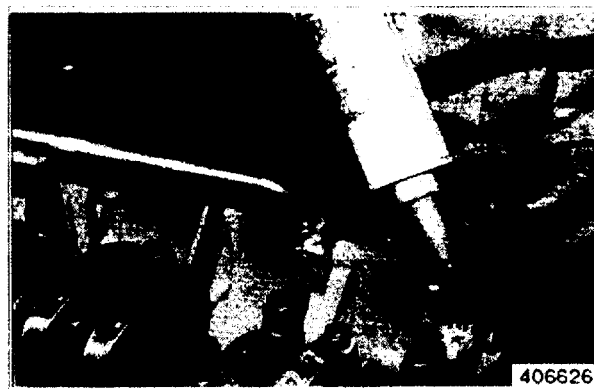
The oil screen must be installed in position so that it is below the oil level line and away from the oil pan.



Installing oil screen

### 10. Oil pan installation

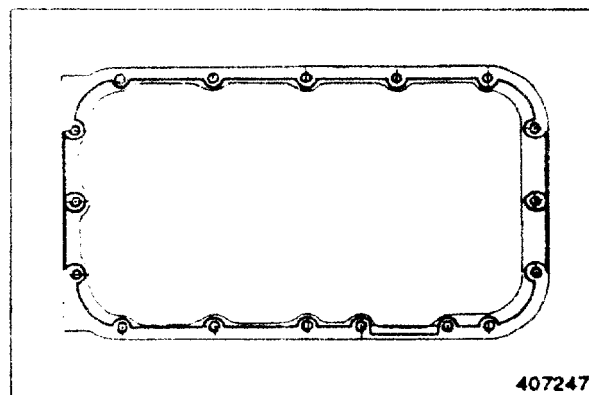
- (1) Clean the mating surfaces of the oil pan and cylinder block and coat them with Three Bond 1207C.



Coating mating surfaces with adhesive

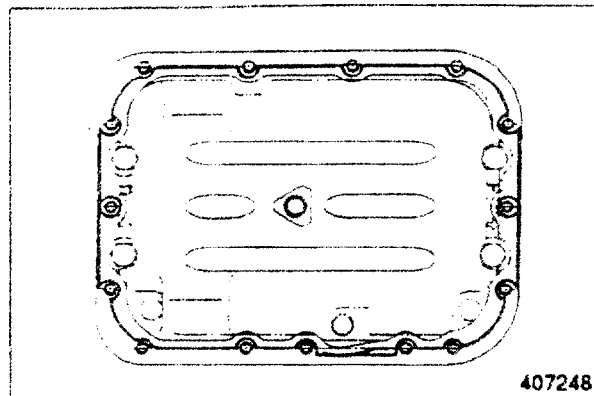
**NOTE**

Squeeze out a 4 mm (0.2 in.) thick bar of sealing compound (Three Bond) from the tube and put it on the flange of the oil pan as shown.



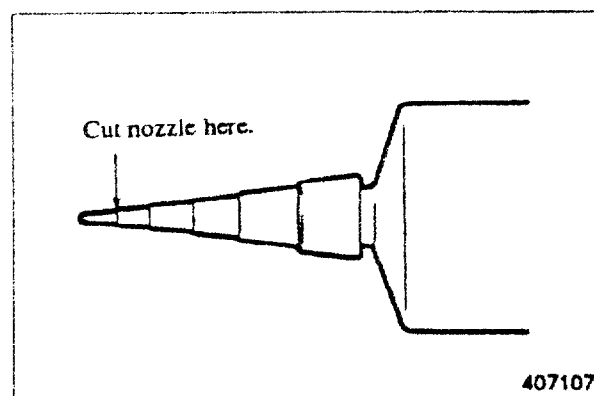
Oil pan for S4L and S4L2 engines

## ASSEMBLY



Oil pan for S3L and S3L2 engines

To squeeze out a 4 mm (0.2 in.) thick bar, cut the nozzle of the tube as shown.



Cutting sealing compound tube nozzle

- (2) Tighten the bolts that hold the oil pan to the cylinder block in a crisscross pattern to the specified torque.

Tightening torque	<p>Cast oil pan:  <math>2.8 \pm 0.3</math> kgf·m  <math>(20.3 \pm 2.2</math> lbf·ft)  <math>[27.5 \pm 3</math> N·m]</p> <p>Plate oil pan:  <math>1.15 \pm 0.15</math> kgf·m  <math>(8.3 \pm 1.1</math> lbf·ft)  <math>[11.3 \pm 1.5</math> N·m]</p>
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Tightening oil pan bolts

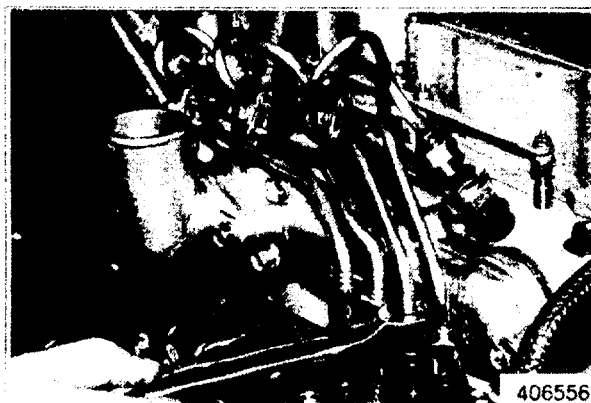
## FUEL SYSTEM

### 1. Fuel injection pipe removal

Disconnect the fuel injection pipes and fuel leak-off pipe from the fuel injection pump and nozzles.

**NOTE**

Put plugs or caps on the openings of the injection pump and nozzle connectors.



Removing fuel injection pipes

### 2. Fuel injection nozzle removal

Loosen the fuel injection nozzles with a wrench. Remove the nozzles and gaskets from the cylinder head.

**NOTE**

Remove the gaskets from the cylinder head with a screwdriver or the like. Discard defective gaskets.



Removing fuel injection nozzles

### 3. Governor assembly removal

- (1) Remove the tie rod cover.
- (2) Remove the spring from the tie rod with a pliers to disconnect the tie rod from the fuel injection pump.
- (3) Remove the governor assembly.



Removing governor assembly



DISASSEMBLY

4. Governor weight removal

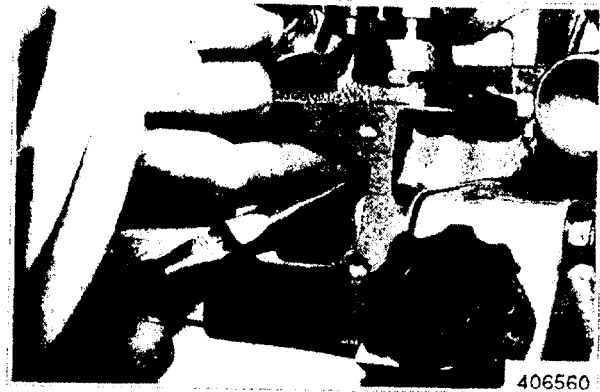
- (1) Remove the sliding sleeve.
- (2) Remove the sliding sleeve shaft and governor weights.



Removing governor weights

5. Fuel injection pump removal

- (1) Remove the tie rod cover.
- (2) Remove the spring from the tie rod with a pliers to disconnect the tie rod from the fuel injection pump.



Removing tie rod

- (3) Remove the fuel injection pump.

**NOTE**

Keep a record of the thickness of shims for installation.



Removing fuel injection pump

## SECTION 3

## POWER LINE

## SPECIFICATIONS

### Clutch

PTO Clutch Adjusting Bolt Clearance .....	0.9 to 1.00 mm	0.035 to 0.039 inch
Clutch Release Finger Height .....	97.8 to 99.2 mm	3.85 to 3.9 inch
Clutch Friction Plate Thickness .....	1.3 to 1.9 mm	0.05 to 0.07 inch

### Transmission

Drop Shaft End Play .....	0.05 to 0.2 mm	0.002 to 0.008 inch
Counter Shaft End Play .....	0.05 to 0.2 mm	0.002 to 0.008 inch
Synchronizer Assembly End Play (719 * only) .....	0.05 to 0.2 mm	0.002 to 0.008 inch
Pinion Shaft Pre-load .....	1.0 to 1.3 Nm	0.74 to 0.96 lb ft
Crown Wheel and Pinion Backlash .....	0.1 to 0.3 mm	0.004 to 0.012 inch
Differential Housing End Play .....	0.0 to 0.1 mm	0.0 to 0.004 inch

### Hydrostatic Transmission

	7195	7235 and 7275
Pump Discharge .....	0 to 16.4 cm <sup>3</sup> /rev (0 to 1.0 in <sup>3</sup> /rev)	0 to 23.4 cm <sup>3</sup> /rev (0 to 1.4 in <sup>3</sup> /rev)
Motor Discharge .....	16.4 cm <sup>3</sup> /rev (1.0 in <sup>3</sup> /rev)	23.4 cm <sup>3</sup> /rev (1.4 in <sup>3</sup> /rev)
Tilt Angle of Pump Swashplate .....	0 to 16 degrees	0 to 18 degrees
Tilt Angle of Motor Swashplate .....	16 degrees	18 degrees
Charge Pump Discharge .....	4.0 cm <sup>3</sup> /rev (0.2 in <sup>3</sup> /rev)	6.0 cm <sup>3</sup> /rev (0.4 in <sup>3</sup> /rev)
Maximum Operating Pressure .....	25000 kPa (3626 psi)	28000 kPa (4061 psi)
Maximum Output Torque at 250 bar (3626 psi) ..	65 Nm (47.9 lb ft)	N/A
Maximum Output Torque at 280 bar (2935 psi) ..	N/A	104 Nm (76.7 lb ft)
Charge Circuit Pressure .....	390kPa (57 psi)	390 kPa (57 psi)
Weight of Hydrostatic Transmission .....	16 kg (35.3 lb)	23 kg (50.7 lb)

### Rear Axle

Depth of Bearing from the Face of the Transmission (719 * ).....	39.65 to 39.85 mm	1.56 to 1.57 inch
Depth of Bearing from the Face of the Transmission (723 * and 727 * ) ..	2.65 to 12.85 mm	0.5 to 0.51 inch

### P.T.O.

Drive Shaft End Play .....	0.05 to 0.2 mm	0.002 to 0.008 inch
Counter Shaft End Play .....	0.05 to 0.2 mm	0.002 to 0.008 inch

## Front Axle

### 719 \*

Hub Reduction Gear Shim Height .....	3.45 to 3.55 mm	0.136 to 0.139 inch
Hub Reduction Gear Backlash .....	0.2 to 0.4 mm	0.008 to 0.016 inch
Axle Clearance .....		N/A
Swivel Housing Bottom Bearing Height .....	17.95 to 18.05 mm	0.707 to 0.711 inch
Swivel Housing Top Bearing Height .....	11.95 to 12.05 mm	0.470 to 0.474 inch
Differential Shaft Gear Height .....	35.95 to 36.05 mm	1.41 to 1.42 inch
Differential Shaft Gear Bearing Height .....		N/A
Pinion Bearing Height .....	20.5 mm	0.81 inch
Pinion to Differential Backlash .....	0.25 to 0.35 mm	0.010 to 0.014 inch
Differential Assembly End Play .....	0.0 to 0.1 mm	0.0 to 0.004 inch
Pinion Bearing Pre-load .....	4 to 6 kgf cm	3.5 to 5.2 lbf in

### 723 \* and 727 \*

Hub Reduction Gear Shim Height .....	2.95 to 3.05 mm	0.116 to 0.120 inch
Hub Reduction Gear Backlash .....	0.2 to 0.4 mm	0.008 to 0.016 inch
Axle Clearance .....	0.0 to 0.2 mm	0.0 to 0.008 inch
Swivel Housing Bottom Bearing Height .....	17.85 to 17.95 mm	0.703 to 0.707 inch
Swivel Housing Top Bearing Height .....	10.85 to 10.95 mm	0.427 to 0.431 inch
Differential Shaft Gear Height .....		N/A
Differential Shaft Gear Bearing Height .....	20.95 to 21.05 mm	0.82 to 0.83 inch
Pinion Bearing Height .....	16 mm	0.63 inch
Pinion to Differential Backlash .....	0.25 to 0.35 mm	0.010 to 0.014 inch
Differential Assembly End Play .....	0.0 to 0.1 mm	0.0 to 0.004 inch
Pinion Bearing Pre-load .....	4 to 6 kgf cm	3.5 to 5.2 lbf in

## Brakes

Type (719 * ) .....		Dry Internal Expansion
Type (723 * and 727 * ) .....		Wet Disc Plate
Lining Minimum Thickness (719 * ) .....	2.5 mm	0.10 inch
Lining Minimum Thickness (723 * and 727 * ) .....	2.3 mm	0.09 inch

## SPECIAL TORQUES

### Clutch

Clutch Cover Retaining Bolts .....	25 to 29 Nm	18.5 to 21.5 lb ft
------------------------------------	-------------	--------------------

## Hydrostatic Transmission

MFD Drop Box Retaining Bolts .....	39 to 44 Nm	29 to 32.5 lb ft
Section Transmission to Speed Transmission Retaining Bolts .....	39 to 44 Nm	29 to 32.5 lb ft
Hydrostatic Transmission Retaining Bolts .....	39 to 44 Nm	29 to 32.5 lb ft
Hydrostatic Cover Retaining Bolts .....	39 to 44 Nm	29 to 32.5 lb ft
Port Block Retaining Screws .....	31 to 38 Nm	23 to 28 lb ft
Charge Pump Retaining Screws .....	16 to 19.5 Nm	12 to 14.5 lb ft
Clutch Housing to Speedbox Retaining Bolts .....	83 to 93 Nm	61 to 68.5 lb ft

### Port Block

#### 7193

High Pressure Relief Valve .....	49 to 59 Nm	36 to 43.5 lb ft
Neutral Valve .....	34 to 39 Nm	25 to 29 lb ft
Low Pressure Relief Valve Retaining Screws .....	10 to 12 Nm	7.5 to 9 lb ft

#### 7233 and 7273

High Pressure Relief Valve .....	49 to 59 Nm	36 to 43.5 lb ft
Neutral Valve .....	34 to 39 Nm	25 to 29 lb ft
Low Pressure Relief Valve Retaining Screws .....	10 to 12 Nm	7.5 to 9 lb ft

## Rear Axle

Fender Support Bolts .....	83 to 93 Nm	61 to 69 lb ft
Axle Support Bolts .....	49 to 59 Nm	36 to 44 lb ft
Rear Axle Retaining Bolts (719 * ) .....	83 to 93 Nm	61 to 69 lb ft
Rear Axle Retaining Bolts (723 * and 727 * ) .....	118 to 132 Nm	87 to 97 lb ft
Rear Wheel Bolts .....	118 to 132 Nm	87 to 97 lb ft

## Front Axle

Differential Gear Retaining Bolts .....	41 to 49 Nm	30 to 36 lb ft
---	-------------	----------------

## Brakes

Rear Wheel Bolts .....	118 to 132 Nm	87 to 97.5 lb ft
Brake Cover Retaining Bolts (719 * ) .....	30 Nm	22 lb ft
Brake Cover Retaining Bolts (723 * and 727 * ) .....	39 to 44 Nm	29 to 32.5 lb ft
Hook Plate Retaining Bolts .....	29 Nm	21.5 lb ft

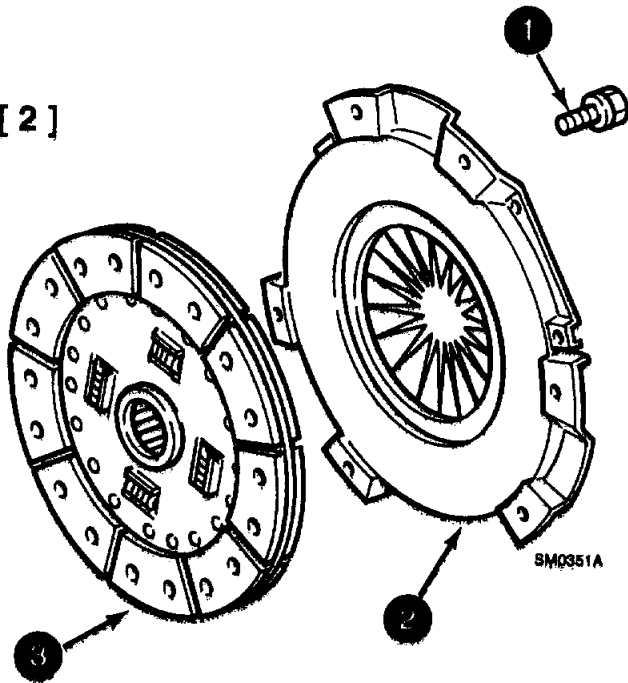
## SINGLE CLUTCH

### Removal

[ 1 ]

Separate the Engine from transmission.  
(Refer to Page 21).

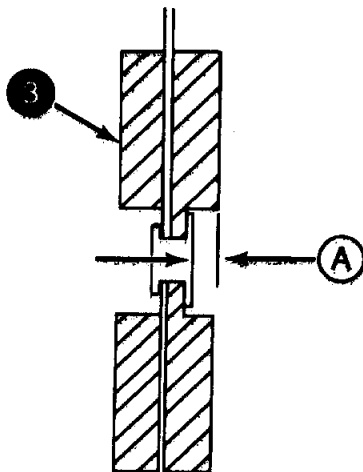
[ 2 ]



Remove the clutch retaining bolts (1) and remove the clutch assembly. Remove the pressure plate (2) and the friction disc (3).

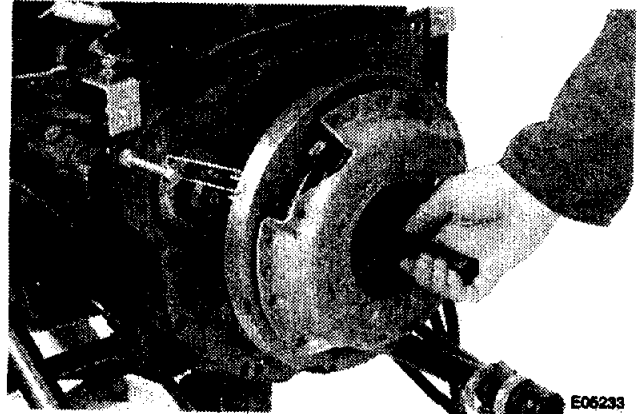
### Installation

[ 1 ]

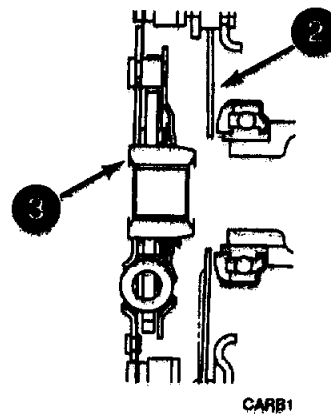


Check all items for wear or damage and replace as necessary. Check dimension (A) from the top of the rivet to the surface of the friction plate (3). If the dimension (A) is less than 0.3 mm (0.012 inch) replace the friction plate.

[ 2 ]



Install the CAS 2169 alignment tool through items (3 and 2).



**NOTE :** Install friction plate (3) with the boss towards the cover plate (2). Install lithium grease to the splines on the friction plate (3).

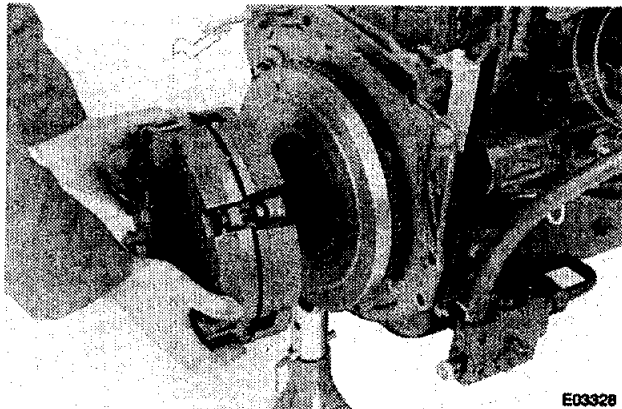
[ 3 ]

Install the clutch assembly, install and tighten bolts (1) to a torque of 25 to 29 Nm (18.5 to 21.5 lb ft).

## DUAL CLUTCH

### Disassembly

[ 1 ]



Remove the clutch retaining bolts (1) and remove the clutch assembly. Remove the friction disc (2).

[ 2 ]

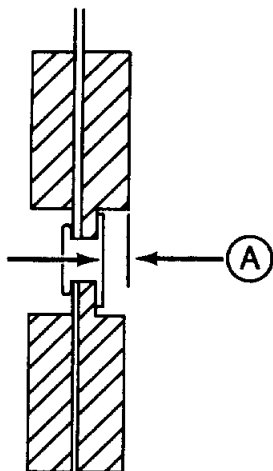
Put the assembly on a clean work bench. Put identification marks on items (5,7,16 and 20) for assembly.

[ 3 ]

Remove items (3 to 20).

**NOTE :** Loosen bolts (3) equally.

[ 4 ]



Check all items for wear or damage and replace as necessary. Check dimension (A) from the top of the rivet to the surface of the friction plates (2 and 8). If dimension (A) is less than 0.3 mm (0.012 inch) replace the friction plate.

### Assembly

[ 1 ]

Install items (20 to 5).

**NOTE :** Install the bevel spring (17) with the concave side facing the flywheel.

**NOTE :** Install the friction plate (8) with the boss towards the transmission. Install lithium grease to the splines on friction plate (8).

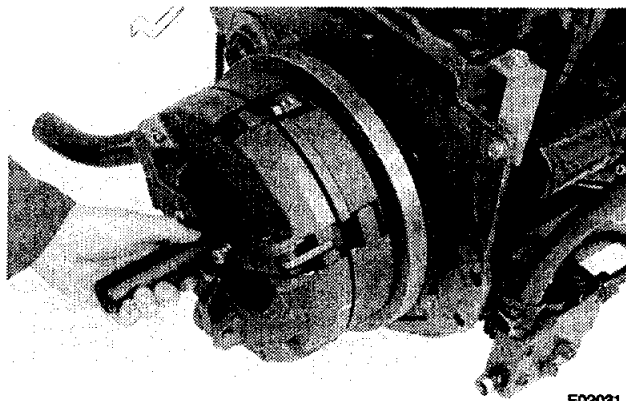
[ 2 ]

Install items (4 and 3).

**NOTE :** Do not tighten bolts (3) at this stage.

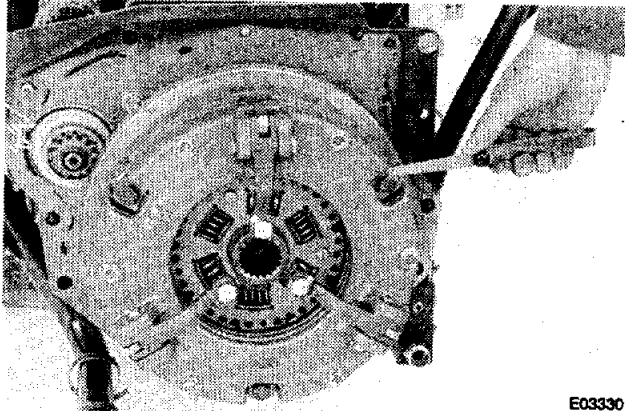
**NOTE :** Install the friction plate (2) with the boss towards the transmission. Install lithium grease to the splines on friction plate (2).

[ 3 ]



Install the CAS 2168 clutch alignment tool and the friction plate (2). Install the clutch assembly, install and tighten bolts (1) to a torque of 25 to 29 Nm (18.5 to 21.5 lb ft).

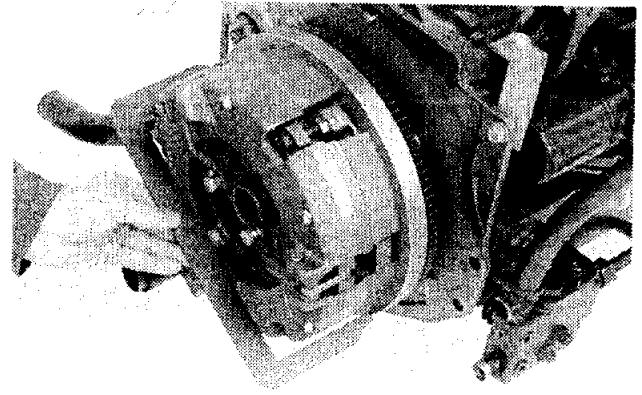
[ 4 ]



E03330

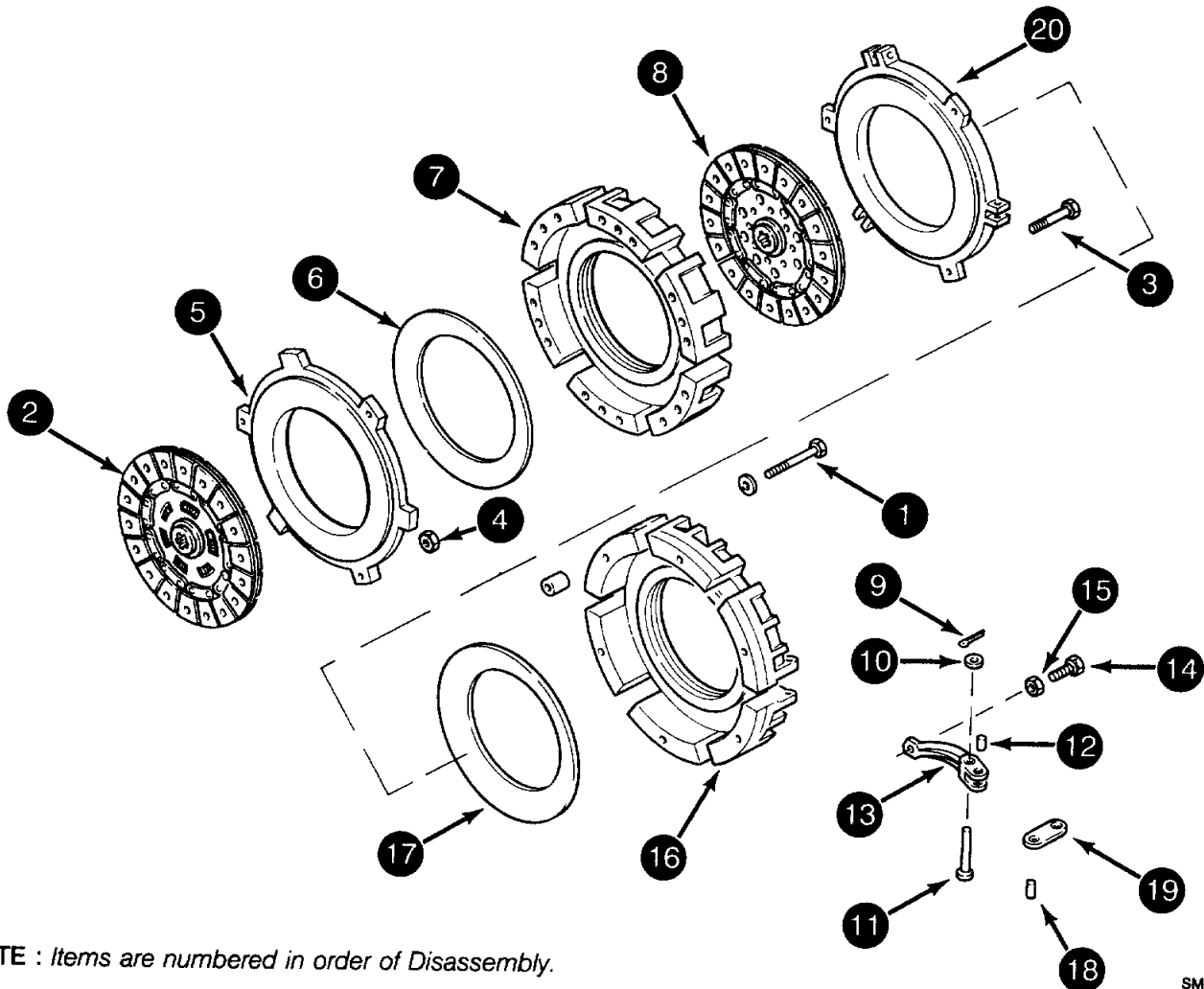
Adjust bolts (3) until a gap of 0.9 to 1.00 mm (0.035 to 0.039 inch) is measured between the bolt head and the pressure plate (20), tighten locknuts (4).

[ 5 ]



E02027

Remove the CAS 2168 alignment tool and install the CAS 2170 height gauge. Adjust bolts (14) until there is no clearance between the head of the bolt and the height gauge, tighten the nuts (15).



NOTE : Items are numbered in order of Disassembly.

1. BOLT
2. FRICTION PLATE
3. BOLT
4. NUT
5. PRESSURE PLATE

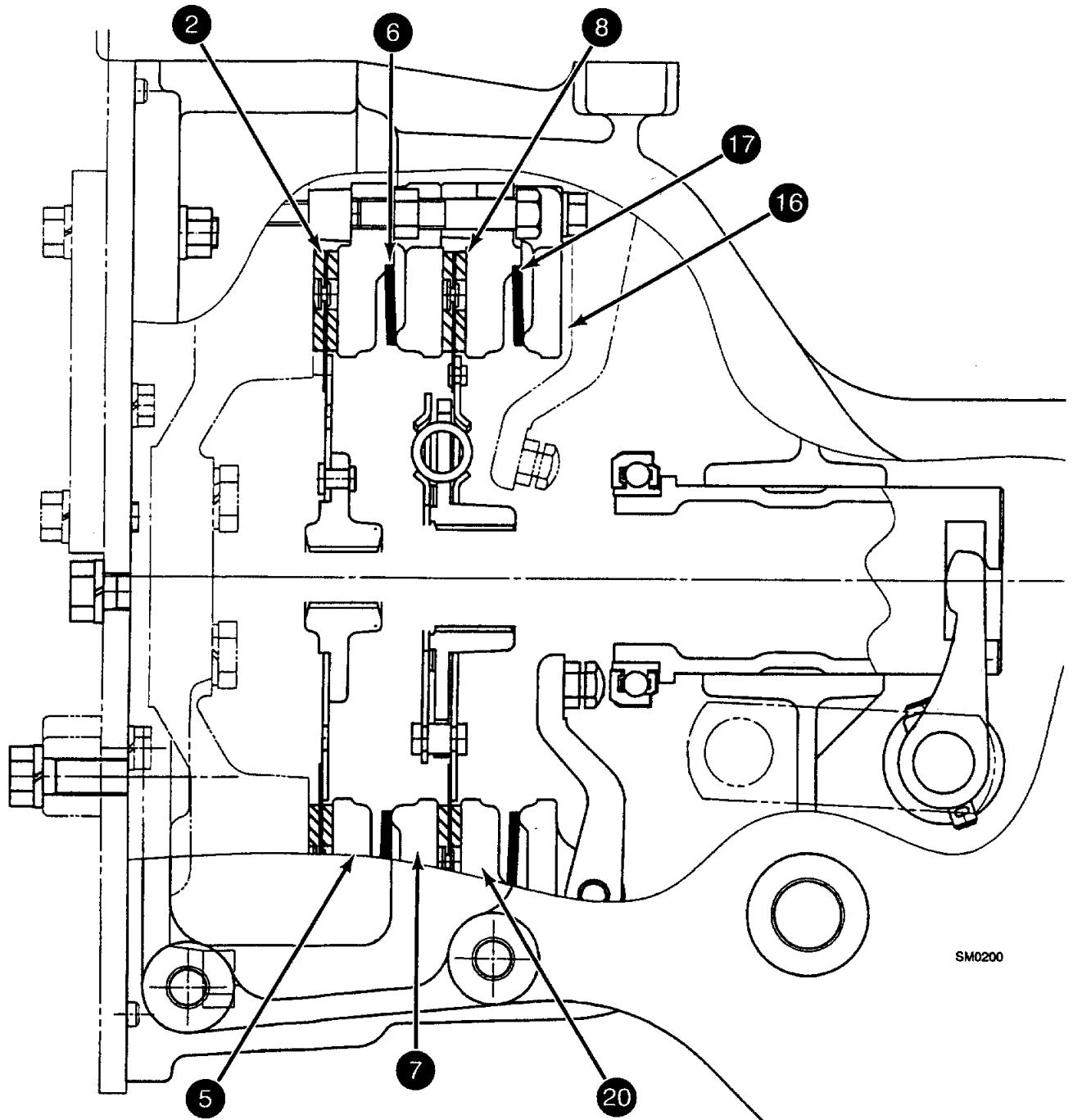
6. BEVEL SPRING
7. COVER
8. FRICTION PLATE
9. COTTER PIN
10. WASHER

11. PIN
12. PIN
13. LEVER
14. BOLT
15. NUT

16. COVER
17. BEVEL SPRING
18. PIN
19. ROD
20. PRESSURE PLATE

SM0351

## Cross Sectional Drawing of the Dual Clutch



SM0200

- 2. FRICTION PLATE
- 5. PRESSURE PLATE
- 6. BEVEL SPRING
- 7. COVER

- 8. FRICTION PLATE
- 16. COVER
- 17. BEVEL SPRING
- 20. PRESSURE PLATE



## SERVICING THE CLUTCH HOUSING

### [ 1 ]

Remove items (1 and 2) from the shaft (6).

### [ 2 ]

Use a bearing puller and step plate to remove bearing (3).

### [ 3 ]

Remove items (4 and 5) from the clutch housing (A).

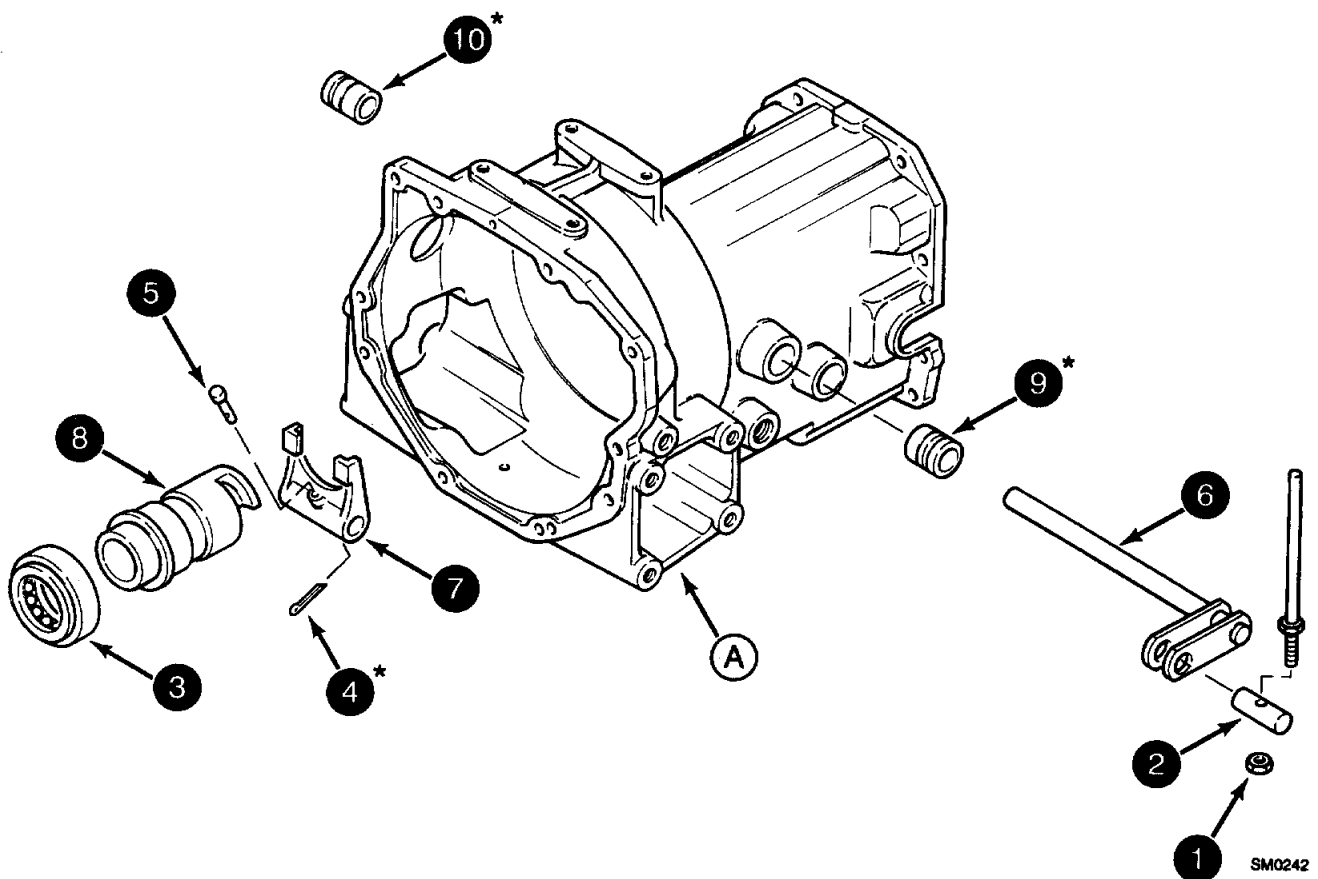
### [ 4 ]

Remove items (6 to 8).

### [ 5 ]

Use a bearing driver and remove items (9 and 10).

**NOTE:** For Assembly, follow the same procedure in reverse order.



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

- 1. NUT
- 2. BAR
- 3. BEARING
- 4. COTTER PIN
- 5. PIN

- 6. CLUTCH RELEASE SHAFT
- 7. FORK
- 8. SLEEVE
- 9. BUSHING
- 10. BUSHING

## SEPARATING THE SPEED BOX FROM THE CLUTCH HOUSING

[ 1 ]

Park the machine on hard level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

[ 2 ]

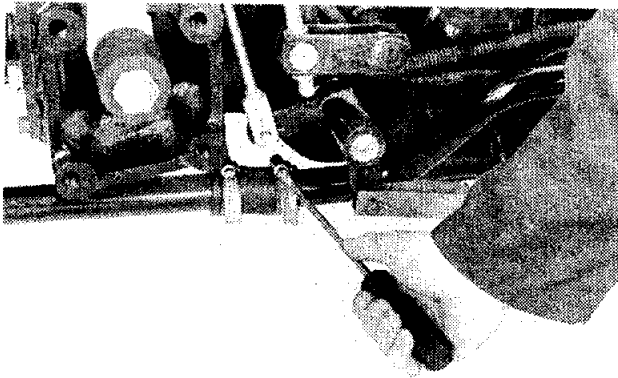
Remove the operators platform, refer to Section 7.

[ 3 ]

Put a container with a capacity of at least 25 litres (6.6 US gal) under the transmission drain plug. Remove the drain plug and drain the oil. Install and tighten the drain plug.

**NOTE:** For Installation, install 19 litres (5.0 US gal) (719 \* ) or 24 litres (6.3 US gal) (723 \* and 727 \* ) of clean TOU or STOU oil into the transmission.

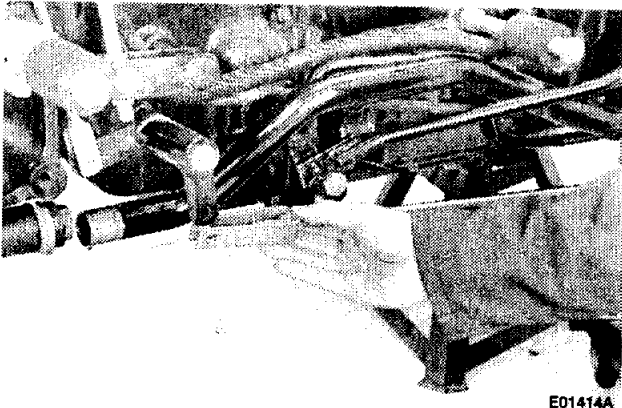
[ 4 ]



E01408A

Disconnect and cap the hydraulic pump supply tube.

[ 5 ]

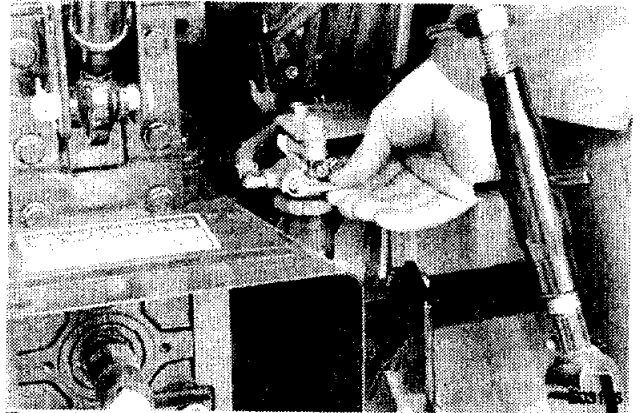


E01414A

Disconnect the left hand brake linkage.

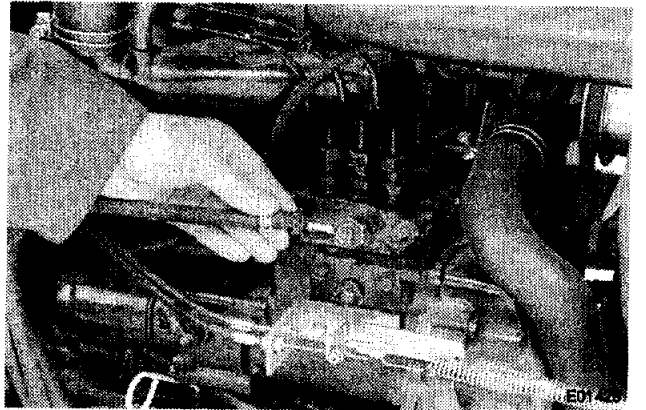
**NOTE:** For Installation, adjust the brake linkage, refer to Section 9001.

[ 6 ]



Turn the fuel supply tap to the OFF position.

[ 7 ]



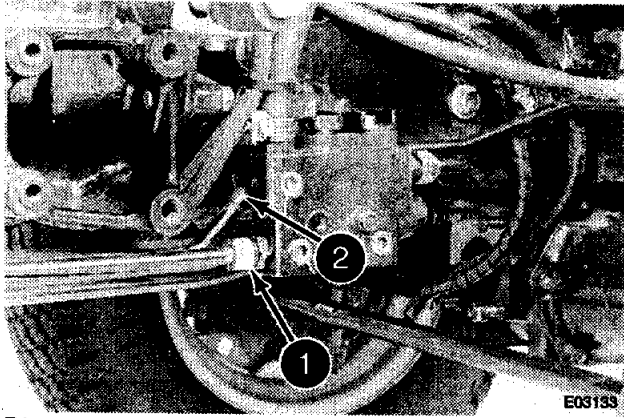
Disconnect and cap the fuel supply hose.

[ 8 ]



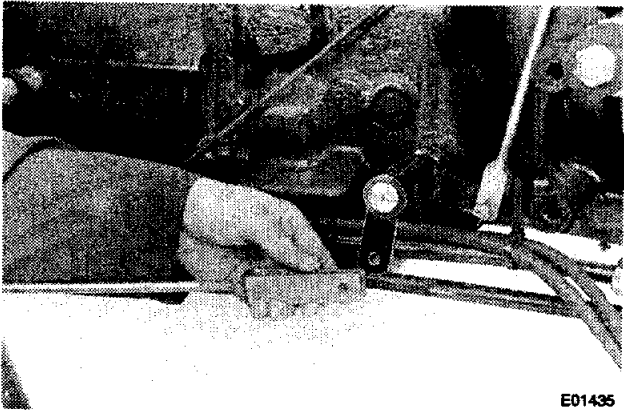
Disconnect and cap the fuel return hose.

[ 9 ]



Disconnect and cap the power beyond supply tube (1) and return tube (2).

[ 10 ]



Disconnect the right hand brake linkage.

**NOTE:** For Installation, adjust the brake linkage, refer to Section 8.

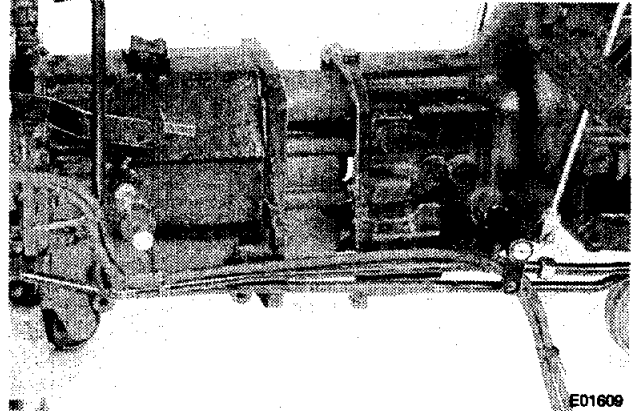
[ 11 ]

Put wooden wedges between the front axle and the front bolster.

[ 12 ]

Support the tractor on suitable splitting stands.

[ 13 ]



Remove the clutch housing to transmission retaining bolts and carefully separate the tractor.

[ 14 ]

Support the two halves of the tractor on suitable stands.

**NOTE:** For Installation apply a continuous bead of Loctite 515 to the range transmission mounting face.

**NOTE:** For Installation, follow the same procedure in reverse order.

## DUAL CLUTCH INPUT SHAFT

### Disassembly and Assembly

[ 3 ]

[ 1 ]

Remove items (1 to 4) from the transmission housing (A). Use a bushing driver to remove items (3 and 4).

**NOTE:** For Assembly, install seal (4) as shown.

**NOTE:** For Assembly, apply a continuous bead of Loctite 515 sealant to the housing (2).

Remove items (9 and 10). Use a blind hole puller to remove item (10).

**NOTE:** For Assembly, install items (9 and 10) using a bushing driver.

**NOTE:** For Assembly, follow the same procedure in reverse order.

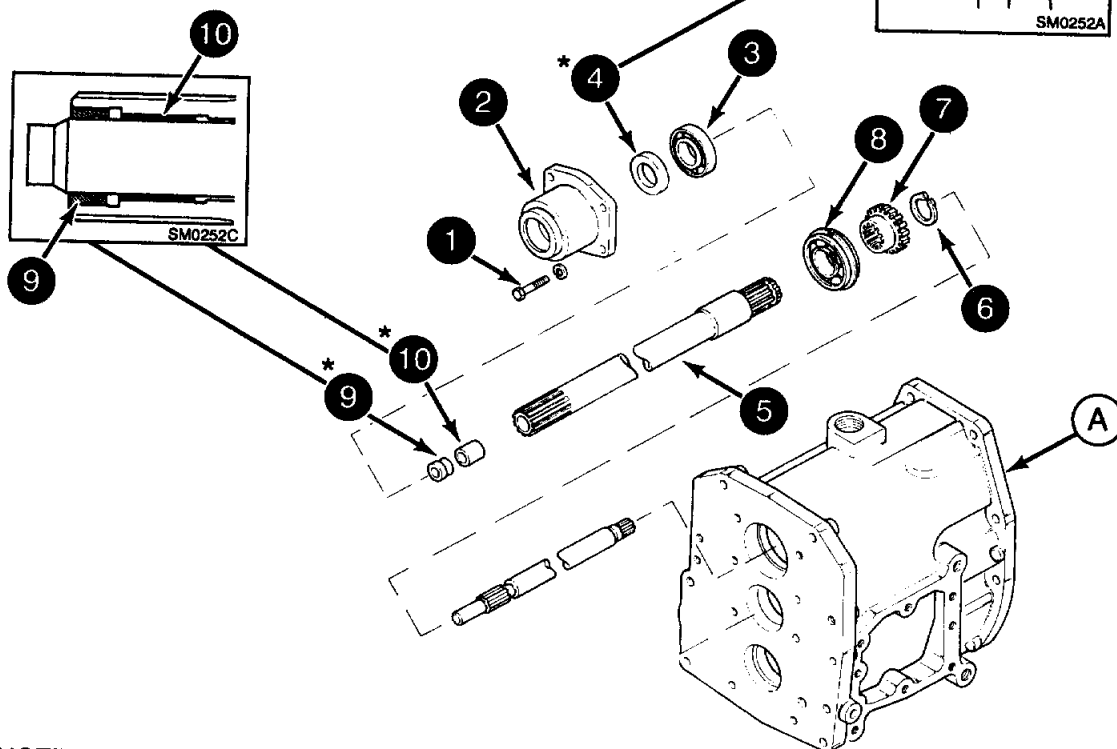
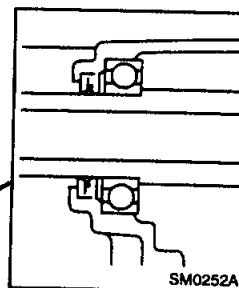
[ 2 ]

Remove the drive shaft assembly (5) from the transmission housing (A) and remove items (6 to 8).

**NOTE:** For Assembly, heat bearing (8) in a bearing oven to a temperature of 121°C (250°F).



**WARNING:** Always wear heat protective gloves when handling heated parts.



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

SM0252

- |            |                |            |             |
|------------|----------------|------------|-------------|
| 1. BOLT    | 4. SEAL        | 7. GEAR    | 10. BUSHING |
| 2. HOUSING | 5. DRIVE SHAFT | 8. BEARING |             |
| 3. SEAL    | 6. INPUT SHAFT | 9. SEAL    |             |

## MFD DROP BOX

### Disassembly and Assembly

#### [ 1 ]

Remove items (1 to 3) and carefully remove housing (4).

**NOTE:** For Assembly, apply a continuous bead of Loctite 515 sealant to the housing (4).

#### [ 2 ]

Remove items (5 to 11) from the housing (4). Use a bushing driver to remove items (9,10,11).

**NOTE:** For Assembly, install seals (9 and 11) as shown.

#### [ 3 ]

Remove the drive shaft assembly (12) and remove items (13 to 15).

**NOTE:** For Assembly, heat bearings (13 and 15) in a bearing oven to a temperature of 121°C (250°F).

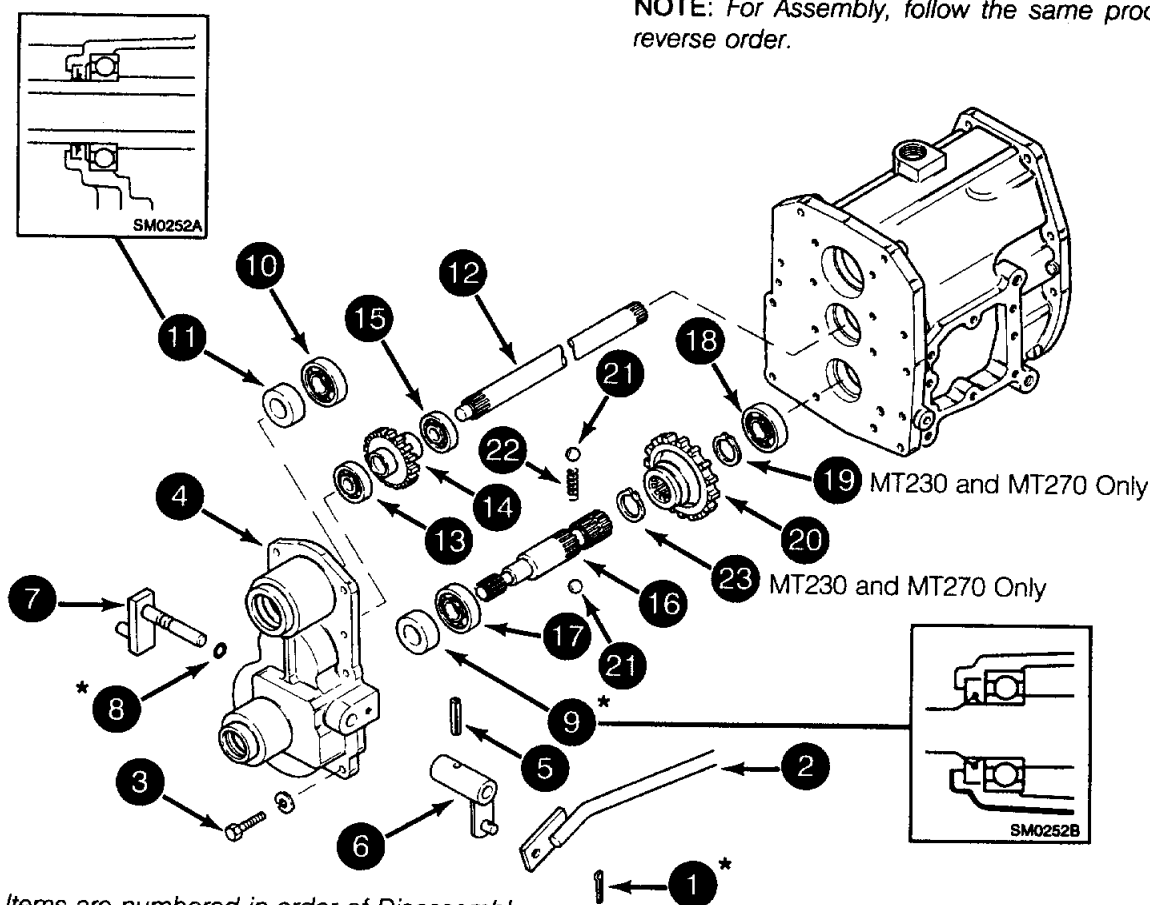


**WARNING** - Always wear heat protective gloves when handling heated parts.

#### [ 4 ]

Remove the driven shaft assembly (16) and remove items (17 to 22).

**NOTE:** For Assembly, follow the same procedure in reverse order.



**NOTE :** Items are numbered in order of Disassembly.

**NOTE :** Items marked (\*) must be replaced.

SM0227

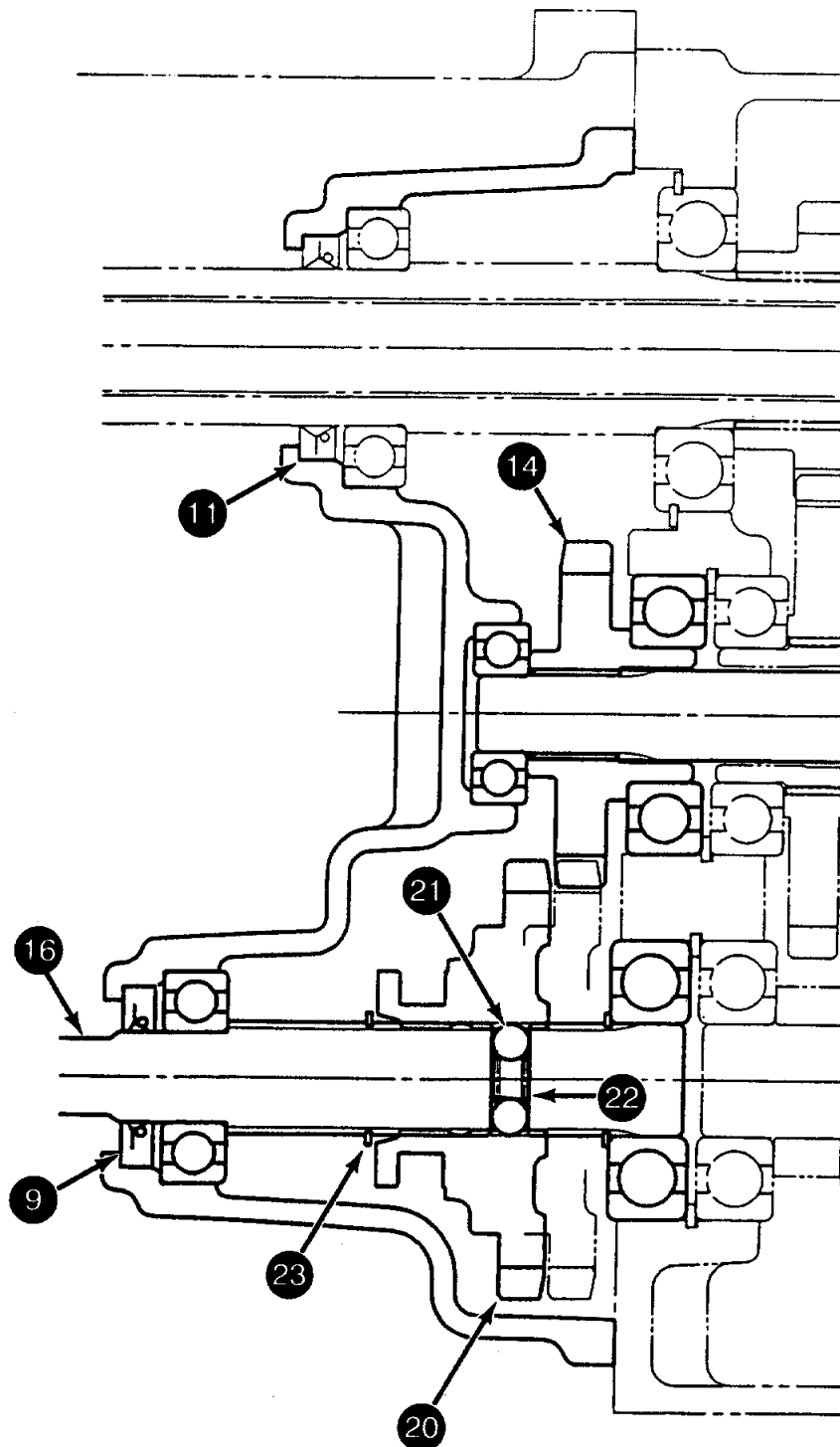
1. COTTER PIN
2. ROD
3. BOLT
4. HOUSING
5. ROLL PIN
6. LEVER

7. SELECTOR FORK
8. O-RING
9. SEAL
10. BEARING
11. SEAL
12. DRIVE SHAFT

13. BEARING
14. GEAR
15. BEARING
16. DRIVEN SHAFT
17. BEARING
18. BEARING

19. SNAP RING
20. GEAR
21. BALL
22. SPRING
23. SNAP RING

## Cross Sectional Drawing of the MFD Drop Box



SM0203

- 9. SEAL
- 11. SEAL
- 14. GEAR
- 16. DRIVEN SHAFT

- 20. GEAR
- 21. BALL
- 22. SPRING
- 23. SNAP RING

## SEPARATING THE SPEED BOX FROM THE RANGE BOX

### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

### [ 2 ]

Put a container with a capacity of at least 25 litres (6.6 US gal) under the transmission drain plug. Remove the drain plug and drain the oil. Install and tighten the drain plug.

**NOTE:** For Installation, install 19 litres (5.0 US gal) (719 \* ) or 24 litres (6.3 US gal) (723 \* and 727 \* ) of clean Cub Cadet hydraulic transmission oil into the transmission.

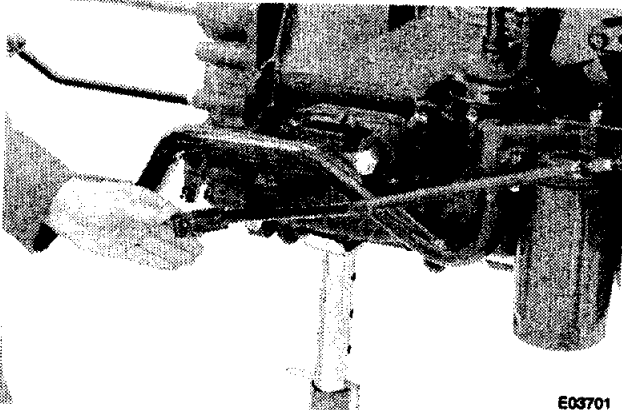
### [ 3 ]

Remove the fuel tank, refer to Section 7 .

### [ 4 ]

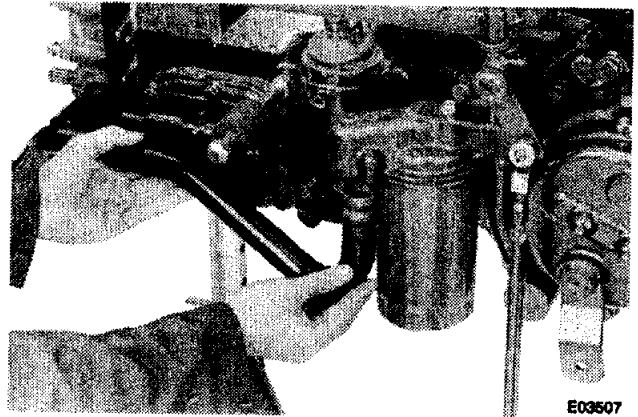
Remove the platform and fenders, refer to Section 7.

### [ 5 ]



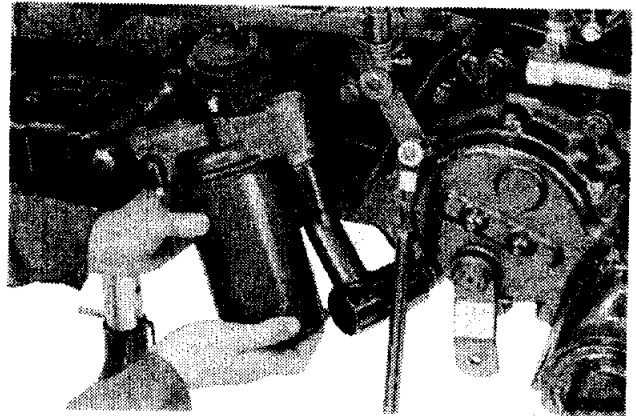
Disconnect the MFD linkage (if equipped).

### [ 6 ]



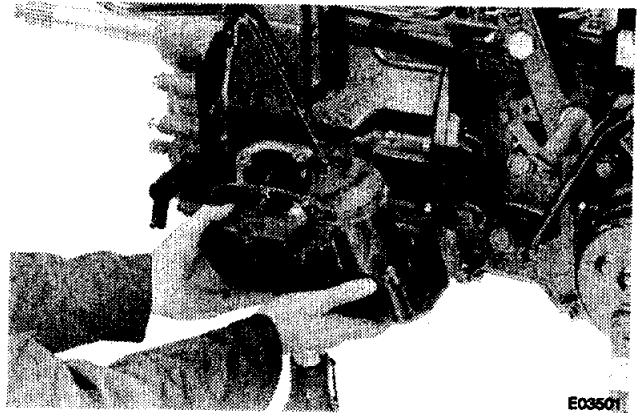
Disconnect and cap the hydraulic supply tube from the oil filter head.

### [ 7 ]



Remove the hydraulic filter and housing.

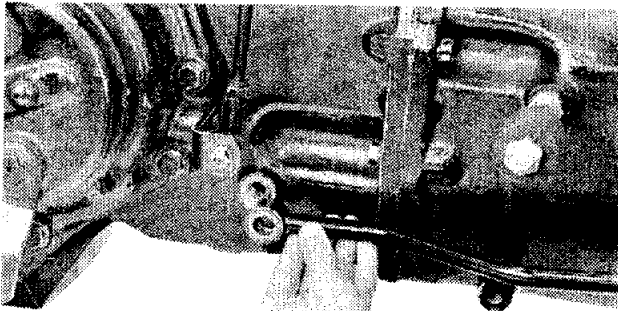
### [ 8 ]



Remove the gear lever assembly.

**NOTE:** For Installation, apply a continuous bead of Loctite 515 to the sealing edge of the gear lever assembly.

[ 9 ]

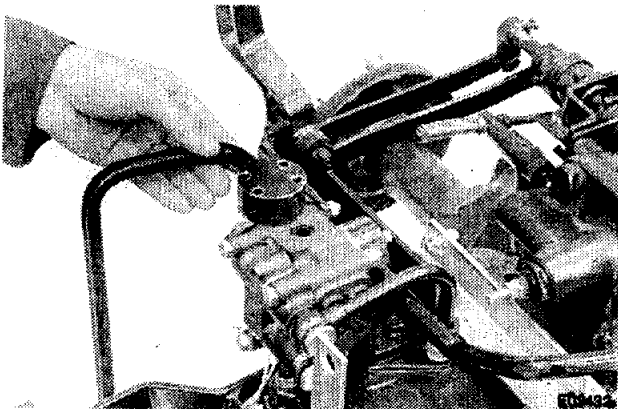


E03427

Disconnect and cap the power beyond supply tube. Discard the seals.

**NOTE :** For Installation, install new seals.

[ 10 ]



E03428

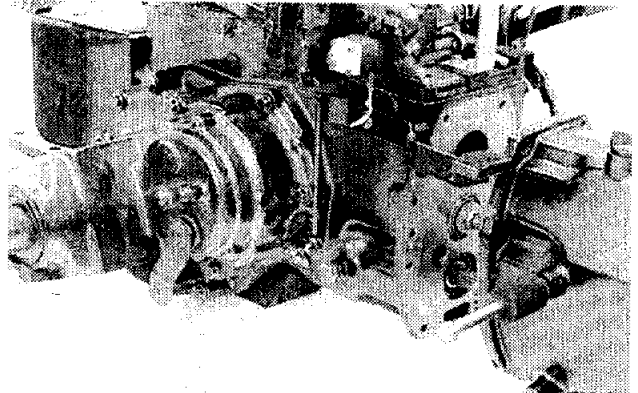
Disconnect and cap the hydraulic lift housing supply tube. Discard the o-ring.

**NOTE:** For installation, install a new o-ring.

[ 11 ]

Support the two halves of the transmission on suitable splitting stands and remove the speed to range box retaining bolts.

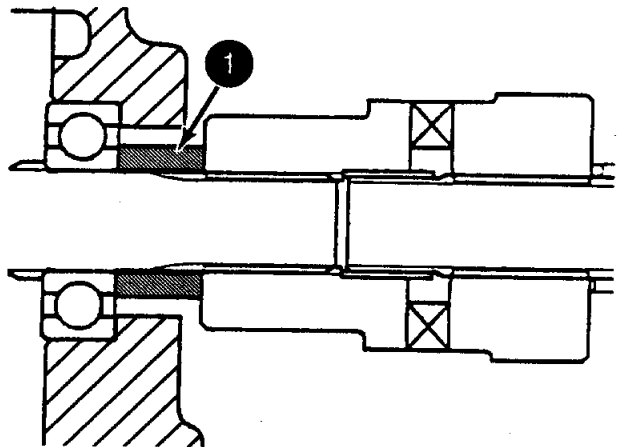
[ 12 ]



E03429

Separate the two halves of the transmission and support on suitable stands.

**NOTE:** For Installation, apply a continuous bead of Loctite 515 sealant to the two halves of the transmission.



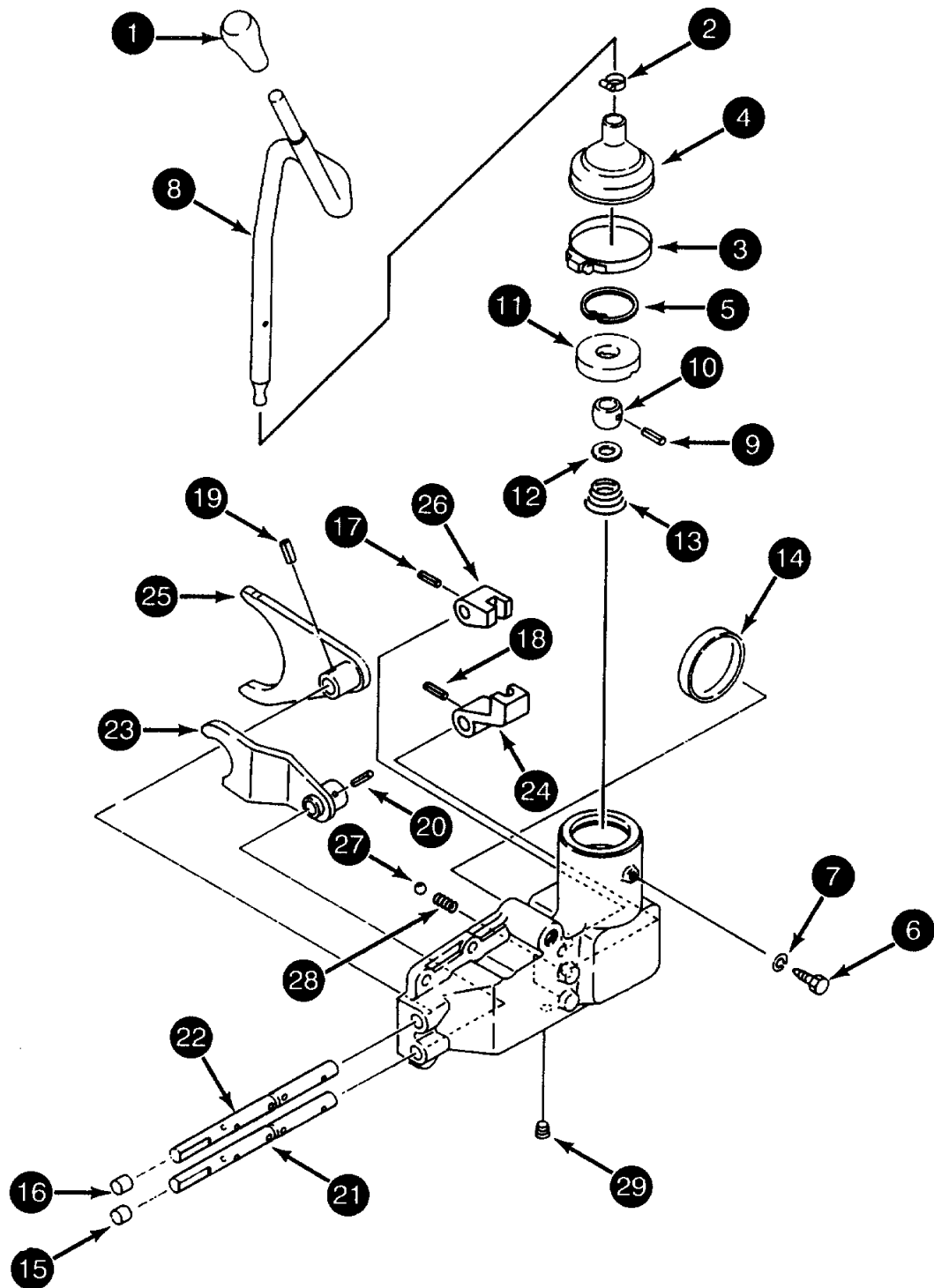
**NOTE:** For Installation, make sure the PTO shaft spacer (1) (if equipped) is installed onto the speed transmission output shaft.

**NOTE:** For Installation, make sure the PTO drive coupling or overrun clutch, pinion shaft coupling and countershaft coupling are installed onto the range transmission shafts.



## Gear Lever Disassembly and Assembly (719 \* )

NOTE: Items are numbered in order of Disassembly.



SM0251A

- |              |             |            |              |                   |             |
|--------------|-------------|------------|--------------|-------------------|-------------|
| 1. KNOB      | 6. BOLT     | 11. BOSS   | 16. CAP      | 21. SELECTOR RAIL | 26. ADAPTER |
| 2. CLAMP     | 7. WASHER   | 12. WASHER | 17. ROLL PIN | 22. SELECTOR RAIL | 27. BALL    |
| 3. CLAMP     | 8. LEVER    | 13. SPRING | 18. ROLL PIN | 23. SELECTOR FORK | 28. SPRING  |
| 4. BOOT      | 9. ROLL PIN | 14. CAP    | 19. ROLL PIN | 24. ADAPTER       | 29. PLUG    |
| 5. SNAP RING | 10. BALL    | 15. CAP    | 20. ROLL PIN | 25. SELECTOR FORK |             |



## SERVICING THE SPEED BOX 719 \*

### Disassembly

#### [ 1 ]

Remove bolts (1) and remove the speed box assembly (B) from the transmission housing (A).

#### [ 2 ]

Put the assembly (B) on a clean work bench.

#### [ 3 ] (Single Clutch Tractors Only)

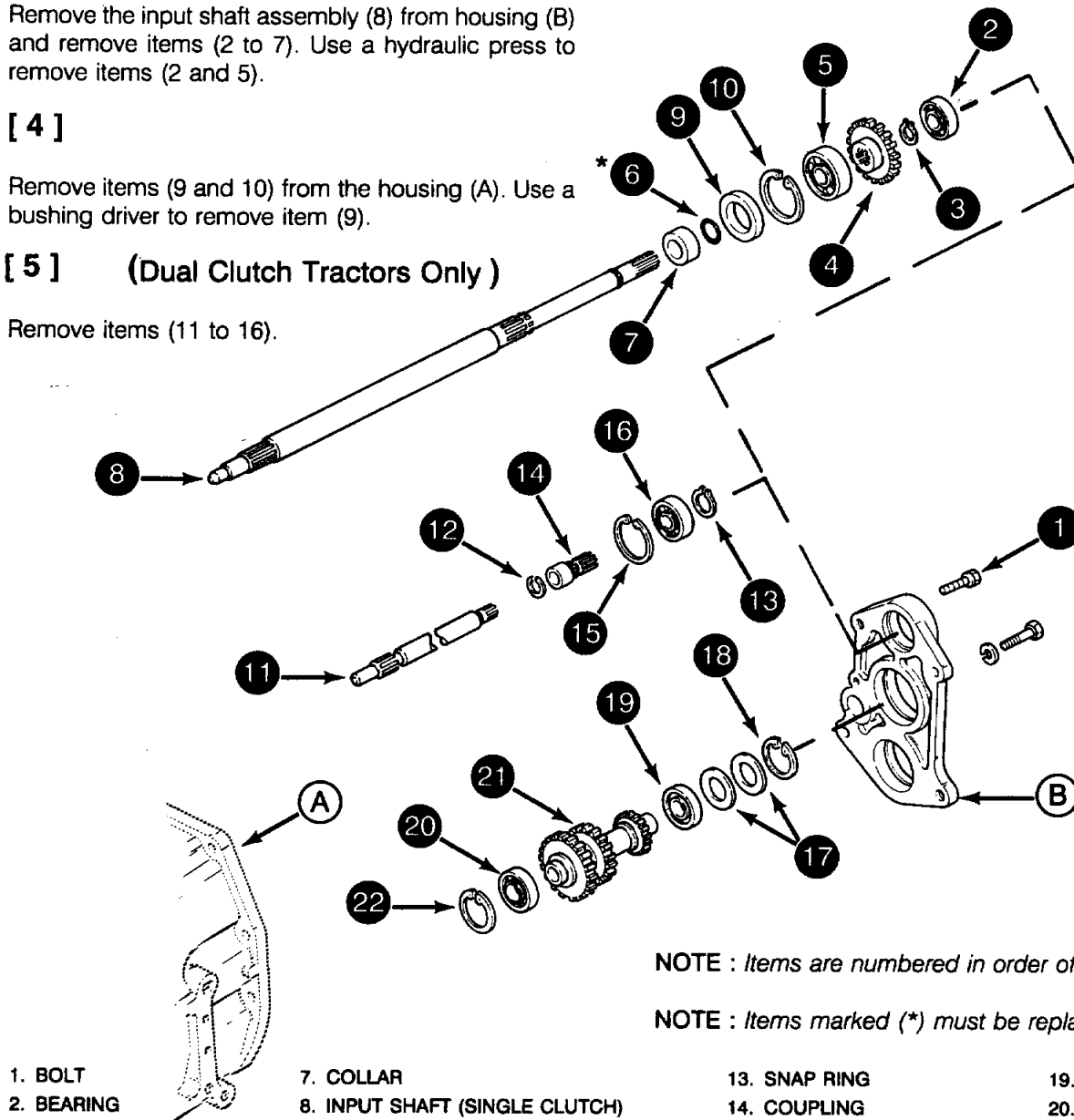
Remove the input shaft assembly (8) from housing (B) and remove items (2 to 7). Use a hydraulic press to remove items (2 and 5).

#### [ 4 ]

Remove items (9 and 10) from the housing (A). Use a bushing driver to remove item (9).

#### [ 5 ] (Dual Clutch Tractors Only)

Remove items (11 to 16).



SM0260B

NOTE : Items are numbered in order of Disassembly.

NOTE : Items marked (\*) must be replaced.

- 1. BOLT
- 2. BEARING
- 3. SNAP RING
- 4. GEAR
- 5. BEARING
- 6. O-RING

- 7. COLLAR
- 8. INPUT SHAFT (SINGLE CLUTCH)
- 9. SEAL
- 10. SNAP RING
- 11. INPUT SHAFT (DUAL CLUTCH)
- 12. RETAINING RING

- 13. SNAP RING
- 14. COUPLING
- 15. SNAP RING
- 16. BEARING
- 17. SHIM
- 18. SNAP RING

- 19. BEARING
- 20. BEARING
- 21. DROP SHAFT
- 22. SNAP RING

[ 8 ]

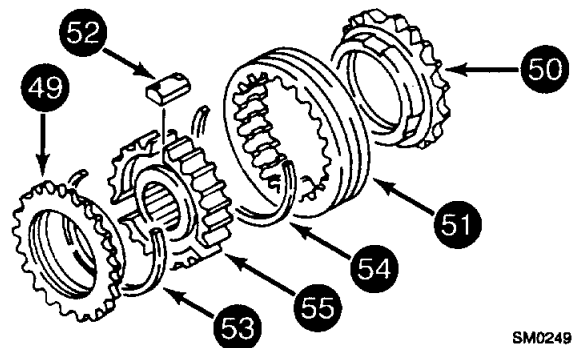
Remove the countershaft assembly (38) from the housing (B) and remove items (23 to 39). Use a bearing puller and a step plate to remove items (25 to 36) and a hydraulic press to remove item (32).

NOTE : Keep shims (23 and 29) together for assembly.

[ 9 ]

Remove items (40 to 48).

[ 10 ]

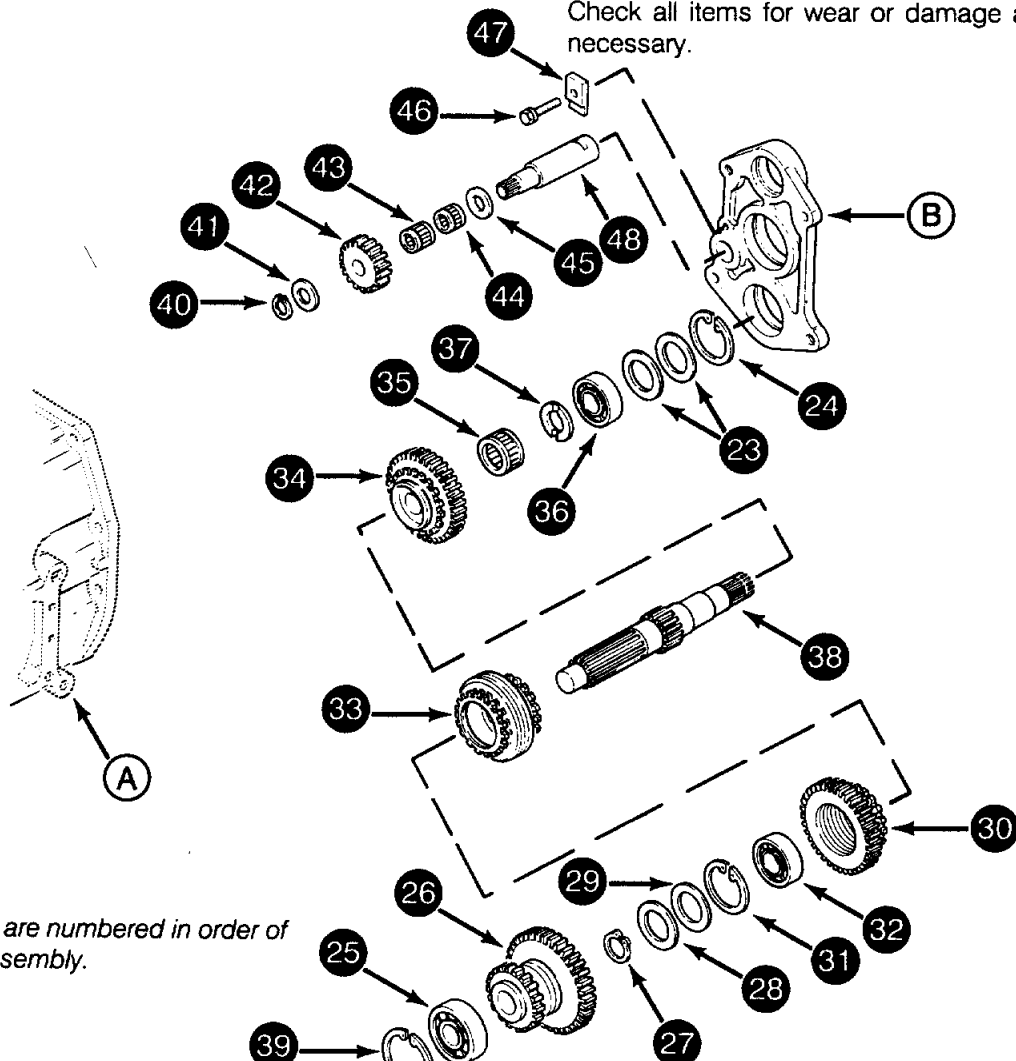


SM0249

Remove items (49 to 55) from synchronizer (33).

[ 11 ]

Check all items for wear or damage and replace as necessary.



NOTE : Items are numbered in order of Disassembly.

SM0260C

- 23. SHIM
- 24. SNAP RING
- 25. BEARING
- 26. GEAR
- 27. SNAP RING
- 28. COLLAR
- 29. SHIM
- 30. GEAR
- 31. SNAP RING

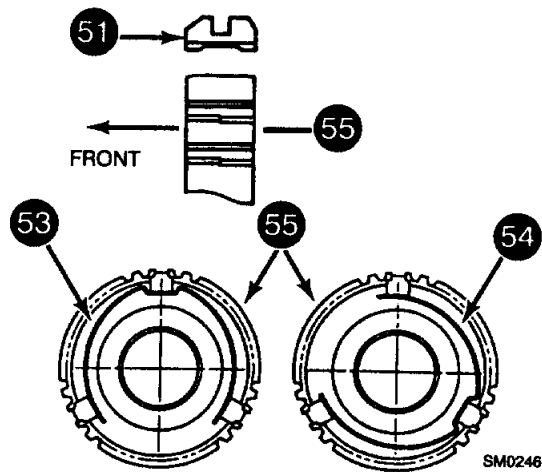
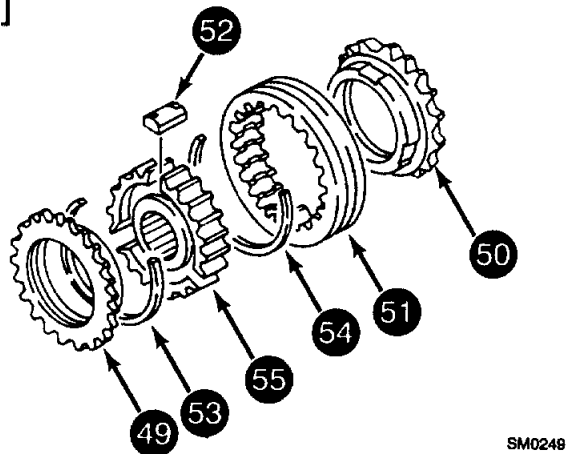
- 32. BEARING
- 33. SYNCHRONIZER
- 34. GEAR
- 35. NEEDLE BEARING
- 36. BEARING
- 37. THRUST WASHER
- 38. COUNTER SHAFT
- 39. SNAP RING

- 40. SNAP RING
- 41. WASHER
- 42. GEAR
- 43. NEEDLE BEARING
- 44. NEEDLE BEARING
- 45. WASHER
- 46. BOLT
- 47. SPRING
- 48. REVERSE IDLER SHAFT

- 49. SYNCHRONIZER RING
- 50. SYNCHRONIZER RING
- 51. SHIFT COLLAR
- 52. PRESSURE PLATE
- 53. SPRING
- 54. SPRING
- 55. HUB

## Assembly

[ 1 ]



Install items (55 to 49) to assemble synchronizer (33).

[ 2 ]

Install items (48 to 40).

[ 3 ]

Heat bearing (36) in a bearing oven to a temperature of 121°C (250°F). Install items (39 to 33).



**WARNING** *Always wear heat protective gloves when handling heated parts.*

[ 4 ]

Install items (32 to 27).

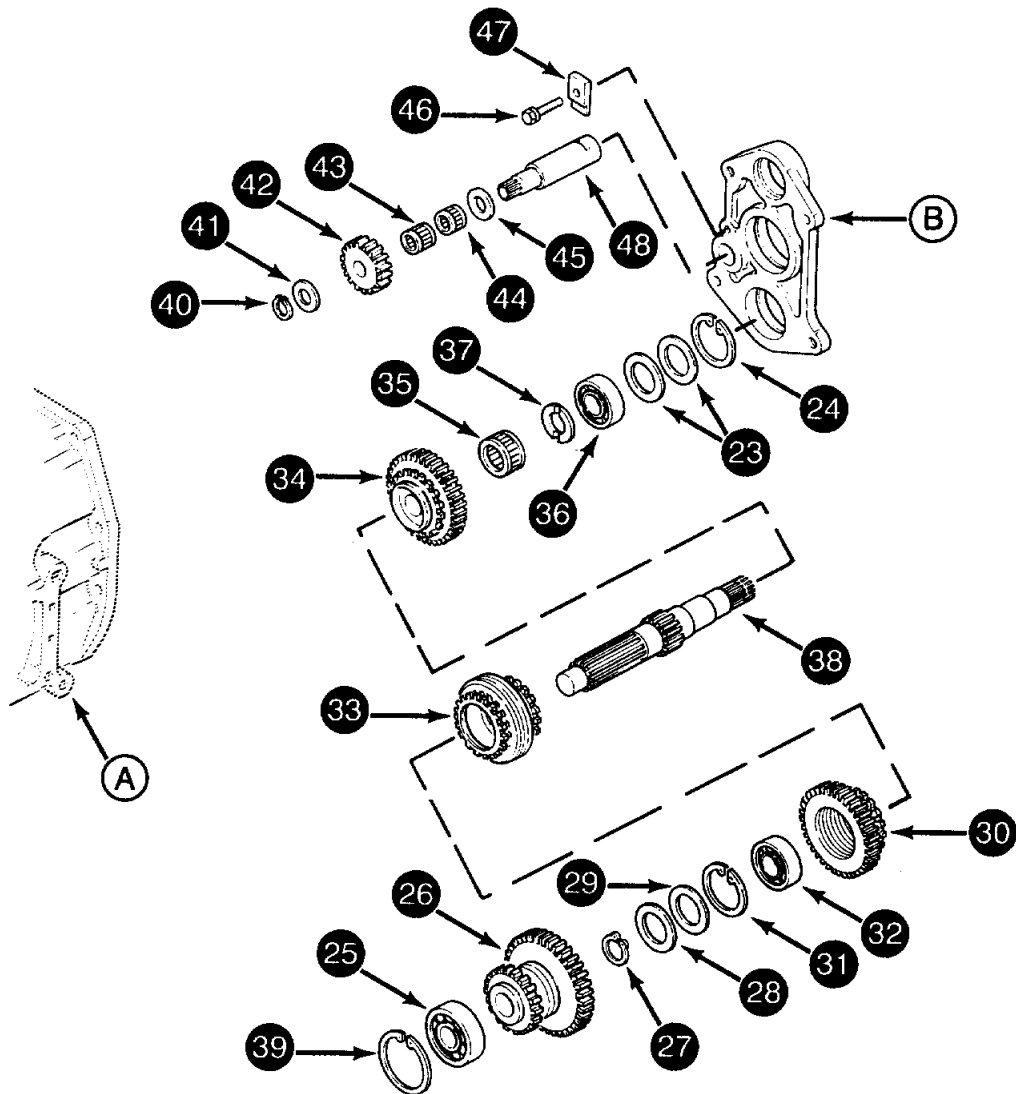
[ 5 ]

Measure the end play of the assembled shaft (38). The end play must be 0.05 to 0.2 mm (0.002 to 0.008 inch). Add or remove shims (29) until the end play is correct.

[ 6 ]

Install items (26 to 23) and install the assembly into housing (B).

NOTE : Items are numbered in order of Disassembly.



SM0280C

23. SHIM  
24. SNAP RING  
25. BEARING  
26. GEAR  
27. SNAP RING  
28. COLLAR  
29. SHIM  
30. GEAR

31. SNAP RING  
32. BEARING  
33. SYNCHRONIZER  
34. GEAR  
35. NEEDLE BEARING  
36. BEARING

37. THRUST WASHER  
38. COUNTER SHAFT  
39. SNAP RING  
40. SNAP RING  
41. WASHER  
42. GEAR

43. NEEDLE BEARING  
44. NEEDLE BEARING  
45. WASHER  
46. BOLT  
47. PLATE  
48. REVERSE IDLER SHAFT

## [ 7 ]

Using a bearing oven, heat bearings (20 and 19) to a temperature of 121°C (250°F) and install onto shaft (21). Install items (22 and 18) and install shaft assembly into the housing (B). Install snap ring (22) into housing (A).

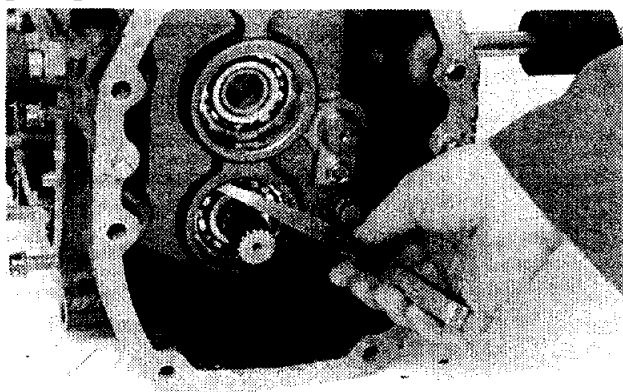
## [ 8 ] Dual Clutch Tractors

Install items (16 to 11).

## [ 9 ] Single Clutch Tractors

Install items (10 to 2).

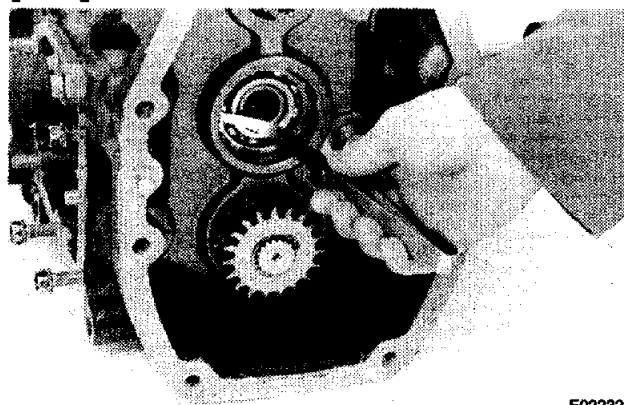
## [ 10 ]



E02236

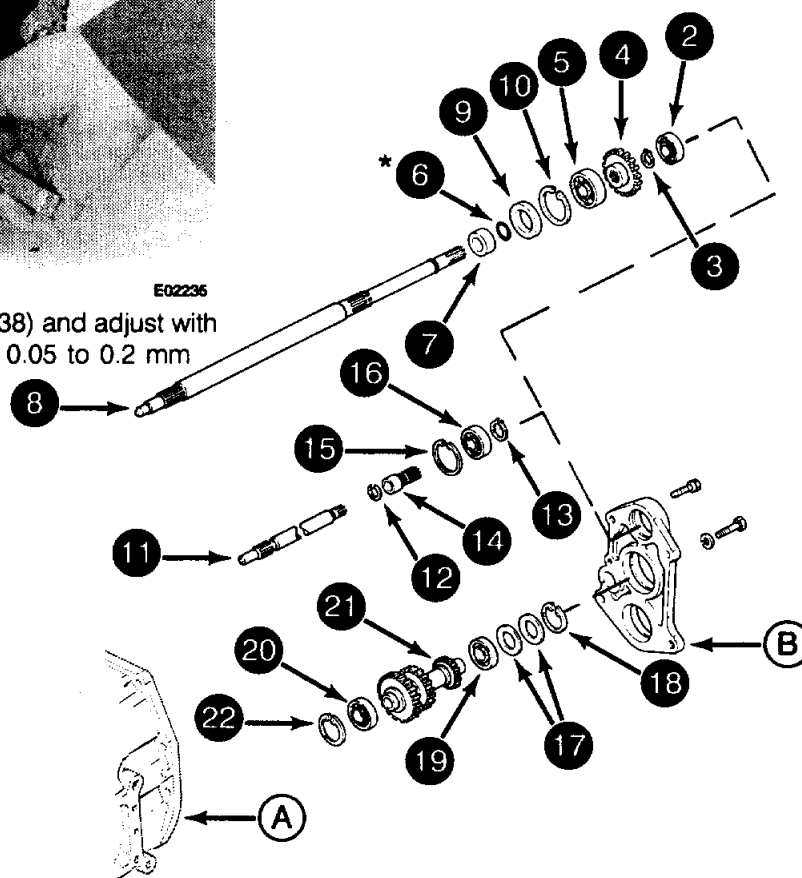
Measure the end play of the shaft (38) and adjust with shims (23) to give an end play of 0.05 to 0.2 mm (0.002 to 0.008 inch).

## [ 11 ]



E02232

Measure the end play of the shaft (21) and adjust with shims (17) to give an end play of 0.05 to 0.2 mm (0.002 to 0.008 inch).

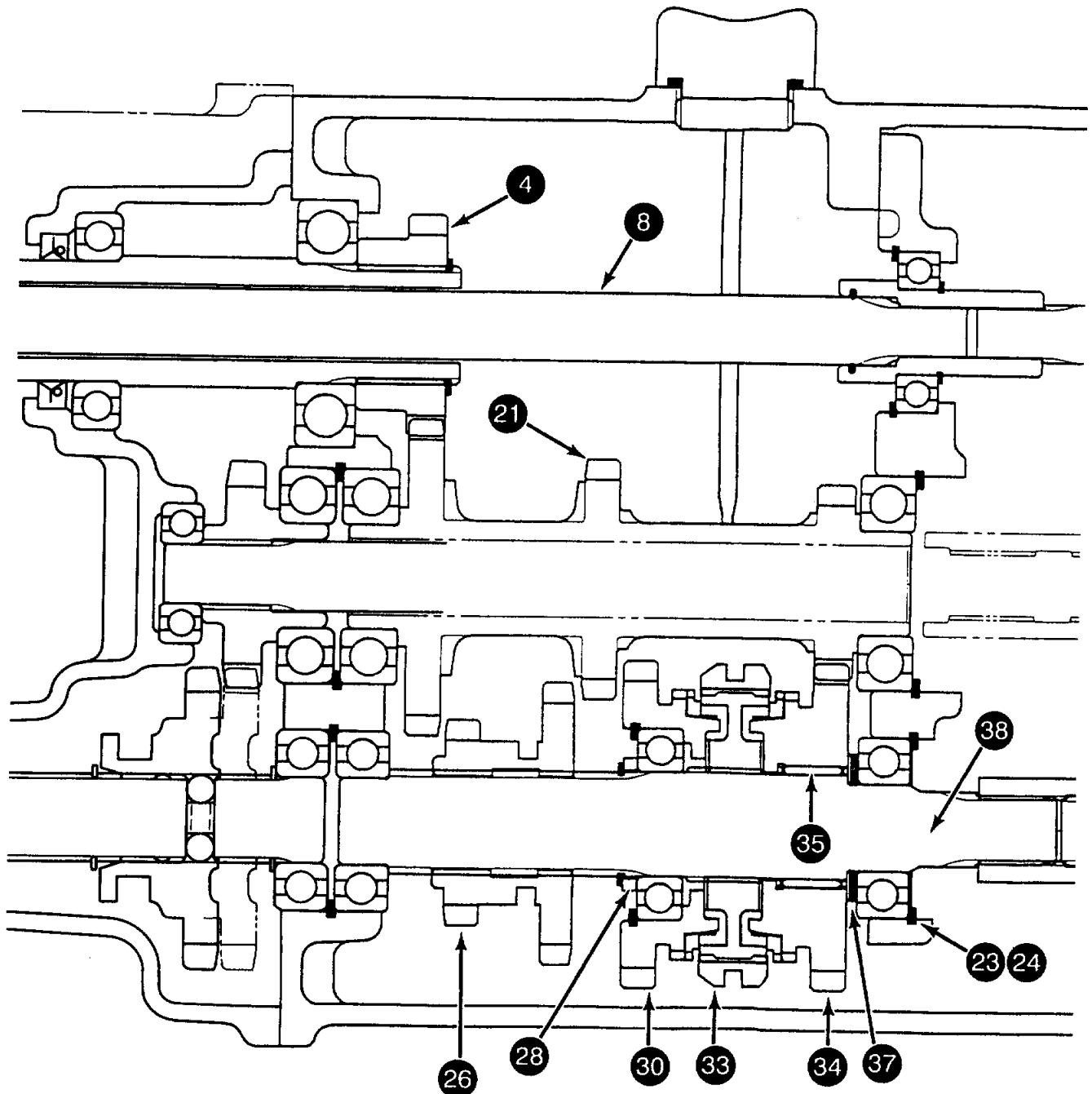


**NOTE :** Items are numbered in order of Disassembly.

**NOTE :** Items marked (\*) must be replaced.

- |              |                                |               |                |
|--------------|--------------------------------|---------------|----------------|
| 1. BOLT      | 7. COLLAR                      | 13. SNAP RING | 19. BEARING    |
| 2. BEARING   | 8. INPUT SHAFT (SINGLE CLUTCH) | 14. COUPLING  | 20. BEARING    |
| 3. SNAP RING | 9. SEAL                        | 15. SNAP RING | 21. DROP SHAFT |
| 4. GEAR      | 10. SNAP RING                  | 16. BEARING   | 22. SNAP RING  |
| 5. BEARING   | 11. INPUT SHAFT (DUAL CLUTCH)  | 17. SHIM      |                |
| 6. O-RING    | 12. RETAINING RING             | 18. SNAP RING |                |

# Cross Sectional Drawing of the Speed Transmission (719 \* )



4. GEAR  
8. INPUT SHAFT  
21. DROP SHAFT  
23. SHIM

24. SNAP RING  
26. GEAR  
28. COLLAR

30. GEAR  
33. SYNCHRONIZER  
33. GEAR

35. NEEDLE BEARING  
37. THRUST WASHER  
38. COUNTER SHAFT



## Servicing the Speed Transmission (723 \* and 727 \* )

### Disassembly

[ 1 ]

Remove bolts (1) and remove the speed box assembly (B) from the transmission housing (A).

[ 2 ]

Put the assembly on a clean work bench. Remove items (2 to 7).

[ 3 ]

Remove the drop shaft assembly (11) and remove items (8 to 14). Use a bearing puller to remove items (8 and 12).

**NOTE :** *Keep shims (13) together for assembly.*

[ 4 ]

Remove the Counter Shaft assembly (32). Remove items (15 to 16).

**NOTE :** *Keep shims (15) together for assembly.*

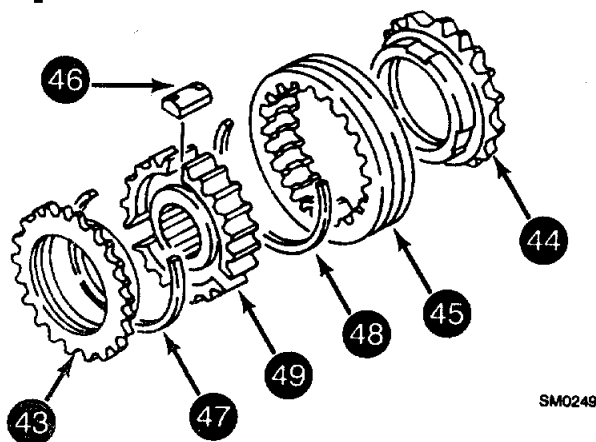
[ 5 ]

Remove items (17 to 32). Use a bearing puller to remove items (17 and 29).

[ 6 ]

Remove items (33 to 42).

[ 7 ]



SM0249

Remove items (43 to 49) from synchronizers (21 and 27).

[ 8 ]

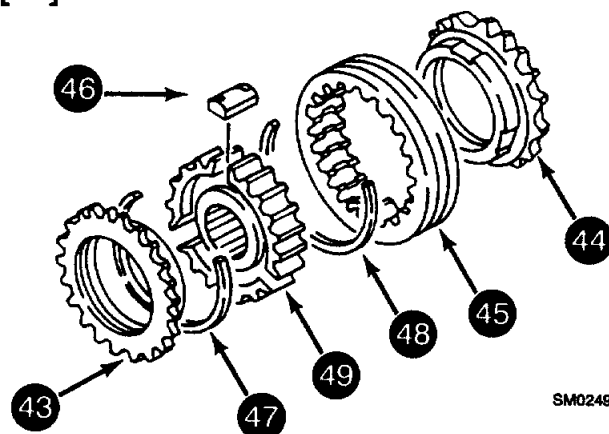
Remove items (50 and 51) from housing (A).

[ 9 ]

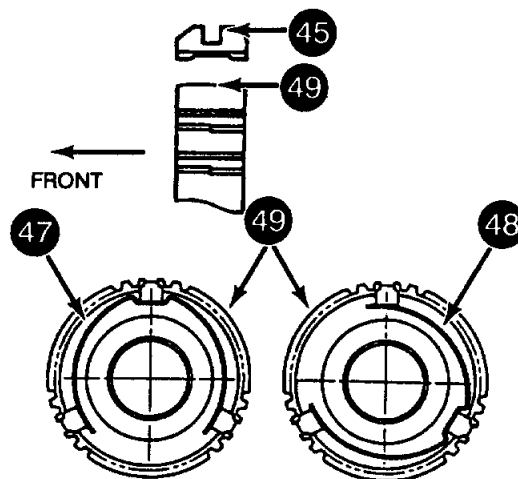
Check all items for wear or damage and replace as necessary.

### Assembly

[ 1 ]



SM0248

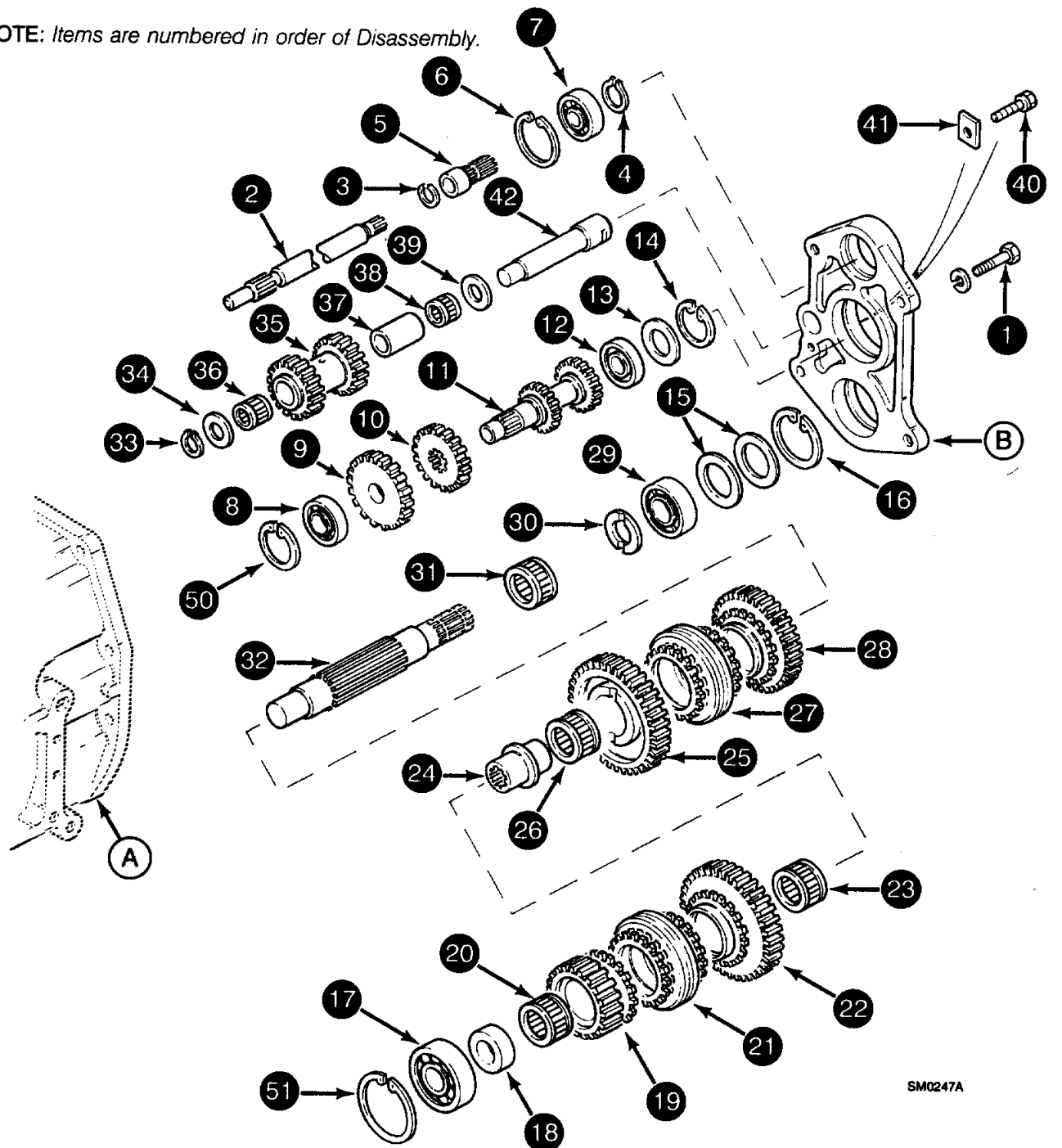


SM0246

Install items (49 to 43) to assemble synchronizers (27 and 21).

**NOTE :** *It is important that items 45, 47, 48 and 49 are installed as shown.*

NOTE: Items are numbered in order of Disassembly.



SM0247A

- |                    |                           |                           |                       |
|--------------------|---------------------------|---------------------------|-----------------------|
| 1. BOLT            | 14. SNAP RING             | 27. SYNCHRONIZER ASSEMBLY | 40. BOLT              |
| 2. PTO INPUT SHAFT | 15. SHIM                  | 28. GEAR                  | 41. PLATE             |
| 3. RETAINER RING   | 16. SNAP RING             | 29. BEARING               | 42. SHAFT             |
| 4. SNAP RING       | 17. BEARING               | 30. THRUST WASHER         | 43. SYNCHRONIZER RING |
| 5. COUPLING        | 18. COLLAR                | 31. NEEDLE BEARING        | 44. SYNCHRONIZER RING |
| 6. SNAP RING       | 19. GEAR                  | 32. COUNTER SHAFT         | 45. SHIFT COLLAR      |
| 7. BEARING         | 20. NEEDLE BEARING        | 33. SNAP RING             | 46. PRESSURE PLATE    |
| 8. BEARING         | 21. SYNCHRONIZER ASSEMBLY | 34. WASHER                | 47. SPRING            |
| 9. GEAR            | 22. GEAR                  | 35. REVERSE IDLER         | 48. SPRING            |
| 10. GEAR           | 23. NEEDLE BEARING        | 36. NEEDLE BEARING        | 49. HUB               |
| 11. DROP SHAFT     | 24. COUPLING              | 37. SPACER                | 50. SNAP RING         |
| 12. BEARING        | 25. GEAR                  | 38. NEEDLE BEARING        | 51. SNAP RING         |
| 13. SHIM           | 26. NEEDLE BEARING        | 39. WASHER                |                       |

## [ 2 ]

Install items (42 to 33).

## [ 3 ]

Install items (32 to 30). Using a bearing oven, heat bearing (29) to a temperature of 121°C (250°F) and install it onto shaft (32).



**WARNING** Always wear protective gloves when handling heated parts.

## [ 4 ]

Install items (28 to 18). Using a bearing oven, heat bearing (17) to a temperature of 121°C (250°F) and install to shaft (32).

**NOTE :** Install the thrust washer (30) with the groove towards the bearing (31).

## [ 5 ]

Install snap ring (16) and install the counter shaft assembly (32).

## [ 6 ]

Install snap ring (14). Assemble items (12 to 8) and install.

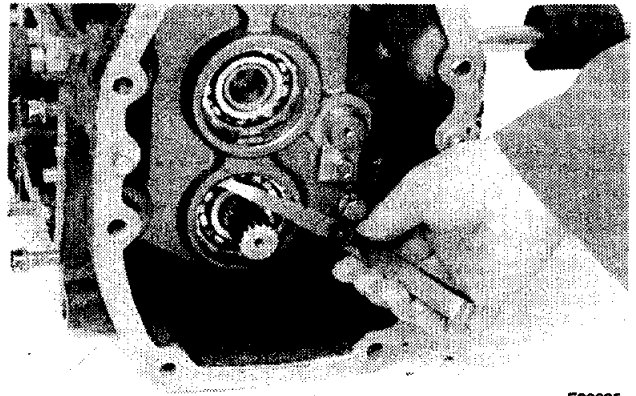
## [ 7 ]

Install item (7 to 2).

## [ 8 ]

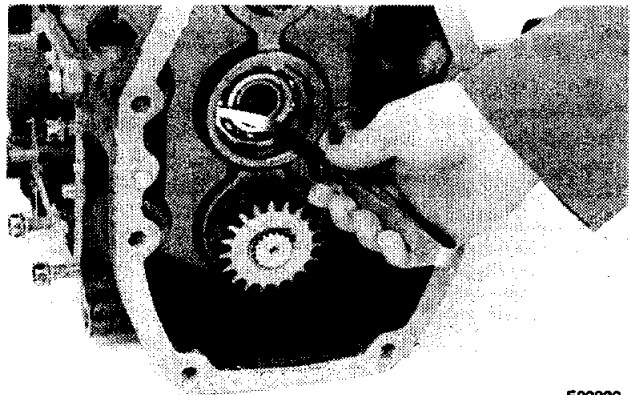
Install the speed box assembly into the housing (A). Install and tighten bolts (1).

## [ 9 ]



Measure the end play of shaft (32). The end play must be 0.05 to 0.2 mm (0.002 to 0.008 inch). Add or remove shims (15) until the end play is correct.

## [ 10 ]

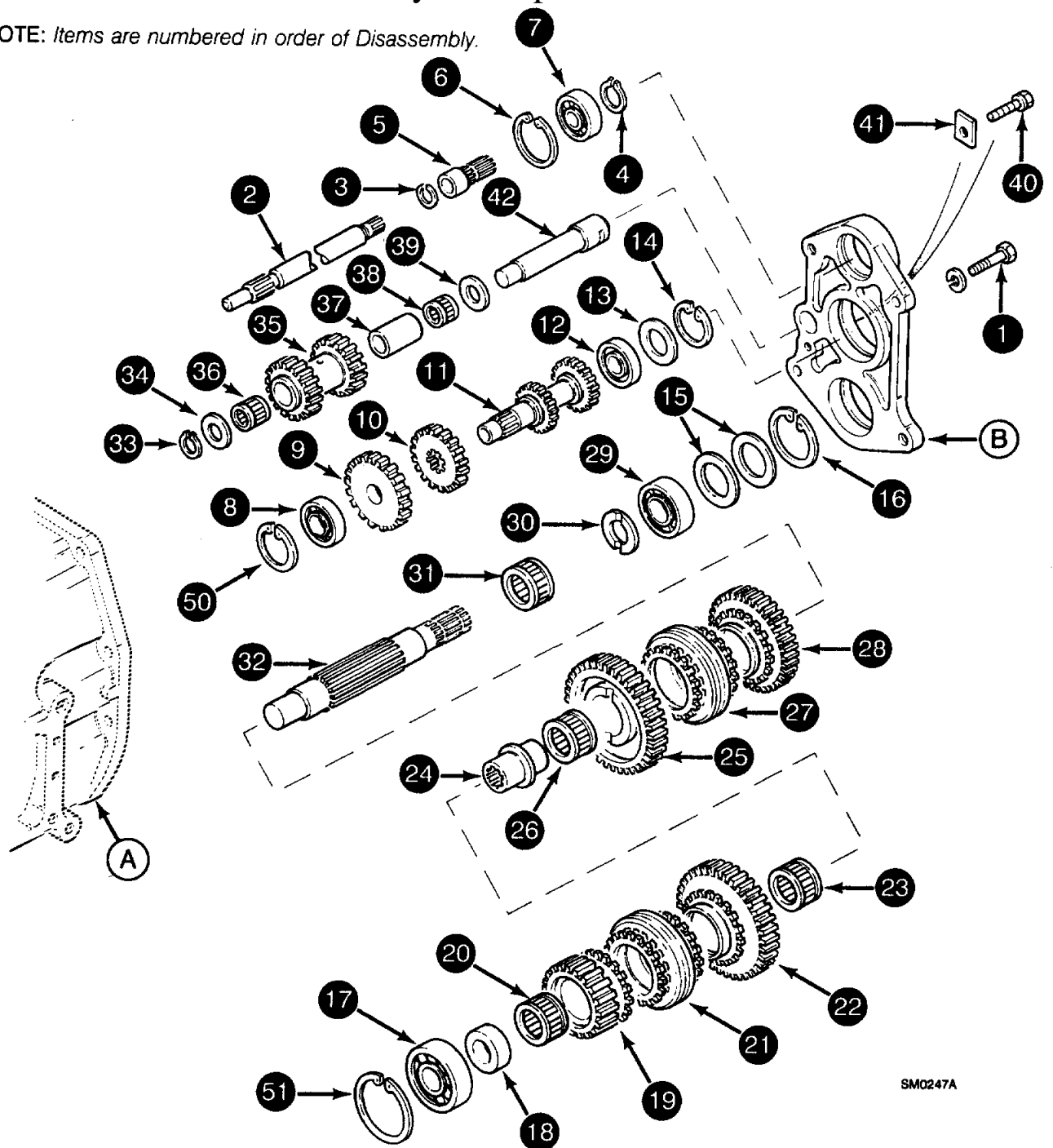


Measure the end play of shaft (11). The end play must be 0.05 to 0.2 mm (0.002 to 0.008 inch). Add or remove shims (13) until the end play is correct.

## [ 11 ]

Install item (2).

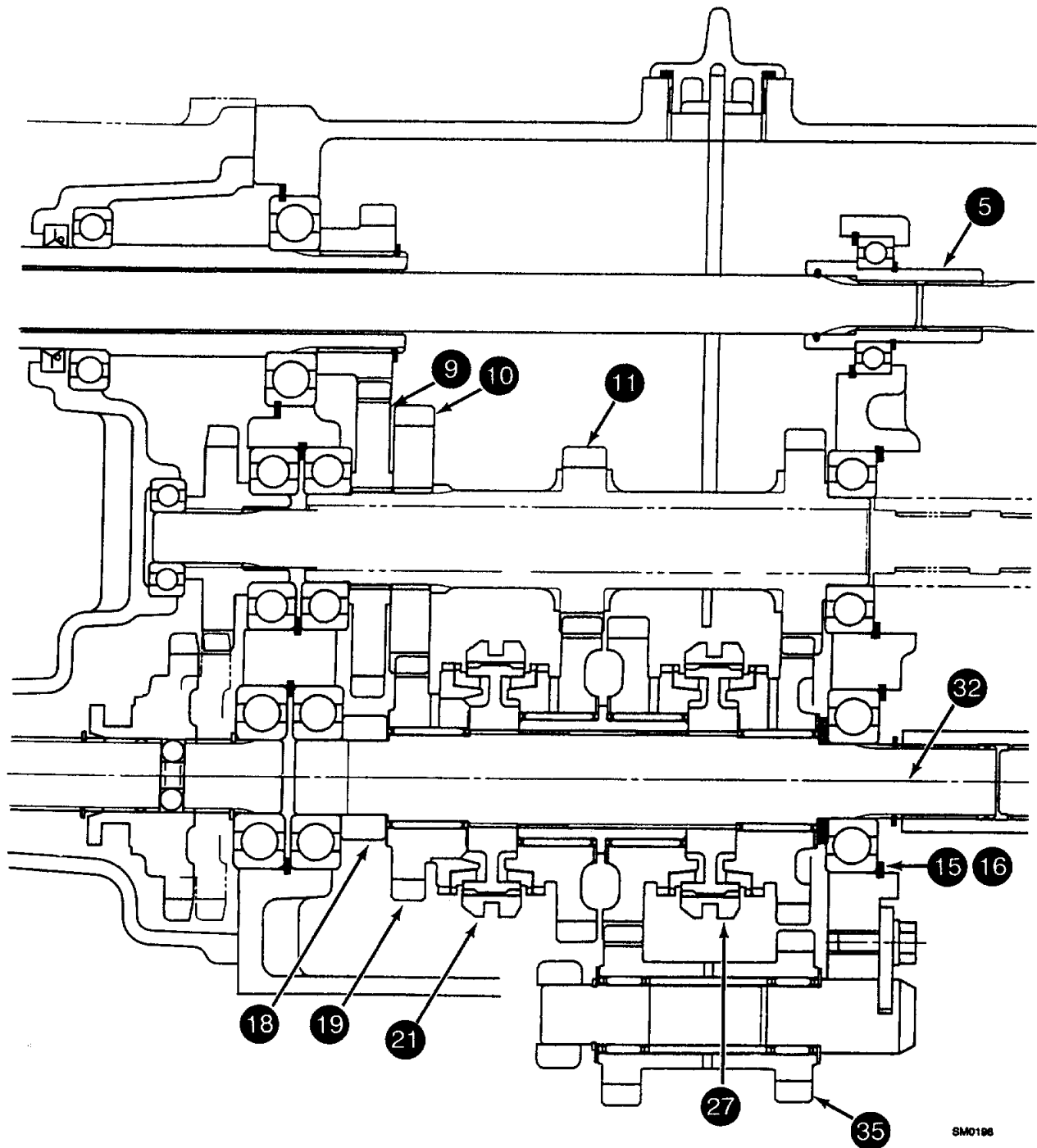
NOTE: Items are numbered in order of Disassembly.



SM0247A

- |                    |                           |                           |                       |
|--------------------|---------------------------|---------------------------|-----------------------|
| 1. BOLT            | 14. SNAP RING             | 27. SYNCHRONIZER ASSEMBLY | 40. BOLT              |
| 2. PTO INPUT SHAFT | 15. SHIM                  | 28. GEAR                  | 41. PLATE             |
| 3. RETAINER RING   | 16. SNAP RING             | 29. BEARING               | 42. SHAFT             |
| 4. SNAP RING       | 17. BEARING               | 30. THRUST WASHER         | 43. SYNCHRONIZER RING |
| 5. COUPLING        | 18. COLLAR                | 31. NEEDLE BEARING        | 44. SYNCHRONIZER RING |
| 6. SNAP RING       | 19. GEAR                  | 32. COUNTER SHAFT         | 45. SHIFT COLLAR      |
| 7. BEARING         | 20. NEEDLE BEARING        | 33. SNAP RING             | 46. PRESSURE PLATE    |
| 8. BEARING         | 21. SYNCHRONIZER ASSEMBLY | 34. WASHER                | 47. SPRING            |
| 9. GEAR            | 22. GEAR                  | 35. REVERSE IDLER         | 48. SPRING            |
| 10. GEAR           | 23. NEEDLE BEARING        | 36. NEEDLE BEARING        | 49. HUB               |
| 11. DROP SHAFT     | 24. COUPLING              | 37. SPACER                | 50. SNAP RING         |
| 12. BEARING        | 25. GEAR                  | 38. NEEDLE BEARING        | 51. SNAP RING         |
| 13. SHIM           | 26. NEEDLE BEARING        | 39. WASHER                |                       |

# Cross Sectional Drawing of the Speed Transmission (723 \* and 727 \* )



SM0196

5. COUPLING

9. GEAR

10. GEAR

11. DROP SHAFT

15. SHIM

16. SNAP RING

18. COLLAR

19. GEAR

21. SYNCHRONIZER ASSEMBLY

27. SYNCHRONIZER ASSEMBLY

35. REVERSE IDLER

## SERVICING THE RANGE TRANSMISSION

### Differential Disassembly

[ 6 ]

[ 1 ]

Separate the range box from the speed box, refer to Page 10.

[ 2 ]

Remove the rear axles, refer to Page 128.

[ 3 ]

Remove the hydraulic lift housing, refer to Section 4.

[ 4 ]

Remove the PTO drive shaft and coupling.

[ 5 ]

Remove items (1 to 5).

NOTE : Keep shims (3) together for assembly.

[ 7 ]

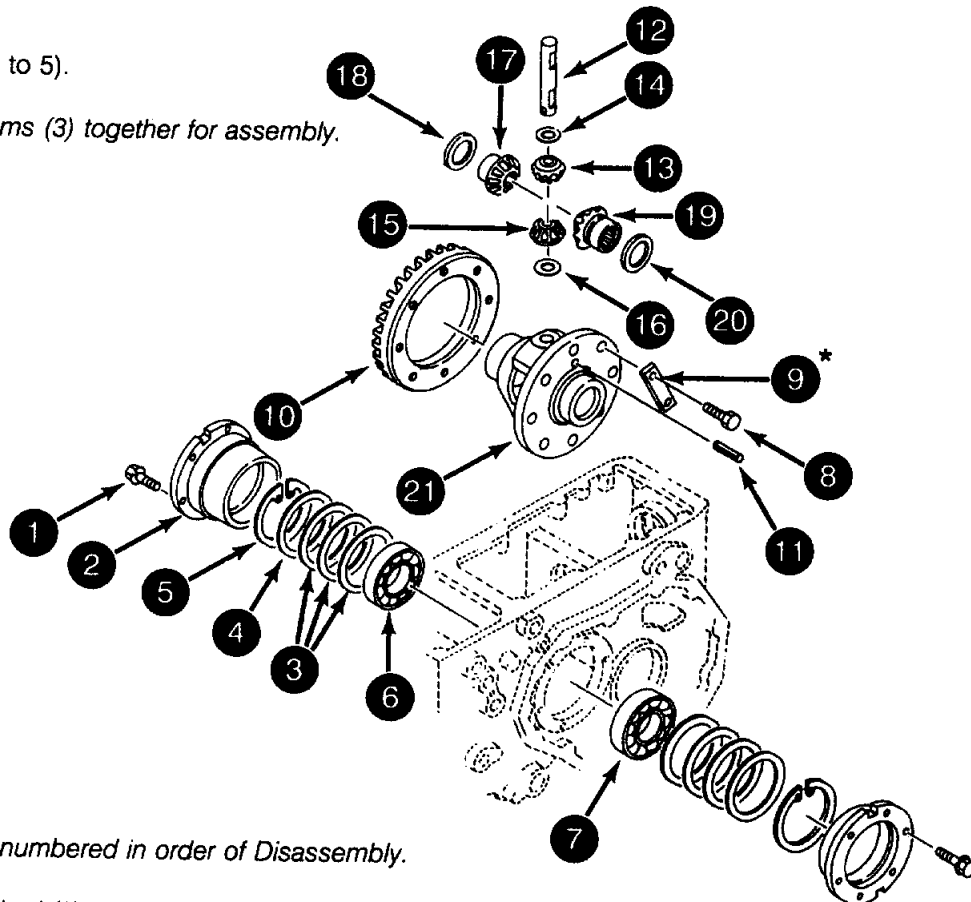
Use a bearing puller and a step plate to remove items (6 and 7).

[ 8 ]

Remove items (8 to 21). Put alignment marks on items (10 and 21).

[ 9 ]

Check all items for wear or damage and replace as necessary.



NOTE : Items are numbered in order of Disassembly.

NOTE : Items marked (\*) must be replaced.

SM0255

- 1. BOLT
- 2. HOUSING
- 3. SHIM
- 4. SHIM LINER
- 5. SNAP RING
- 6. BEARING

- 7. BEARING
- 8. BOLT
- 9. PLATE
- 10. CROWN WHEEL
- 11. ROLL PIN

- 12. SHAFT
- 13. SUN GEAR
- 14. THRUST WASHER
- 15. SUN GEAR
- 16. THRUST WASHER

- 17. SIDE GEAR
- 18. THRUST WASHER
- 19. SIDE GEAR
- 20. THRUST WASHER
- 21. DIFFERENTIAL HOUSING

## Assembly

### [ 1 ]

Install items (20 to 8). Make sure items (10 and 21) are aligned correctly.

**NOTE :** Bend the plate (9) over the bolts (8).

### [ 2 ]

Put bearings (7 and 6) in a bearing oven and heat to a temperature of 121°C (250°F) and install onto the differential housing (21).



**WARNING** Always wear heat protective gloves when handling heated parts.

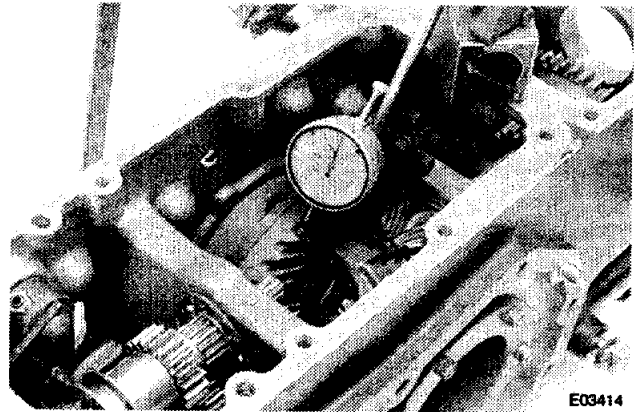
### [ 3 ]

Install the differential assembly into the range box housing.

### [ 4 ]

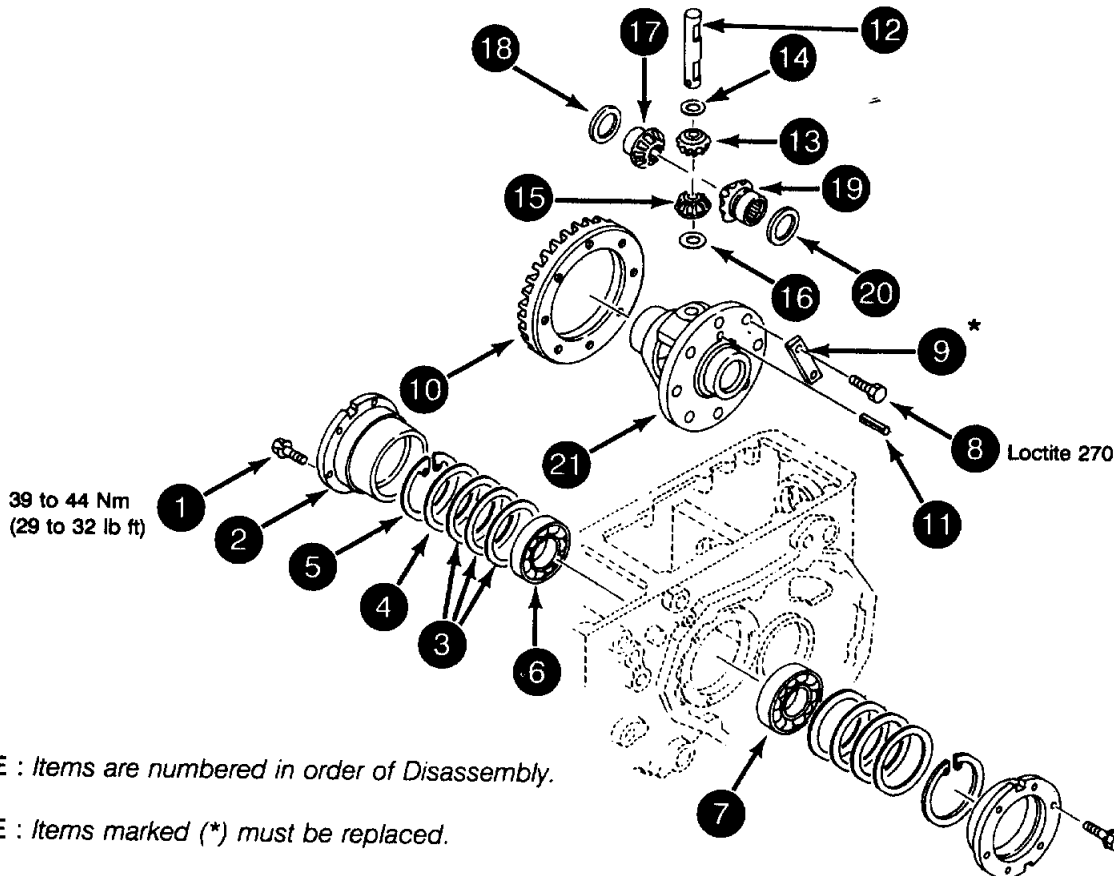
Install items (5, 4, 2 and 1) on both sides. Tighten bolts (1) to a torque of 39 to 44 Nm (29 to 32 lb ft).

### [ 5 ]



E03414

Install a dial test indicator to the edge of the crown wheel tooth and measure the backlash of the crown wheel and pinion. Add shims (3) to the left hand housing (2) until a backlash of 0.1 to 0.3 mm (0.004 to 0.012 inch) is measured.



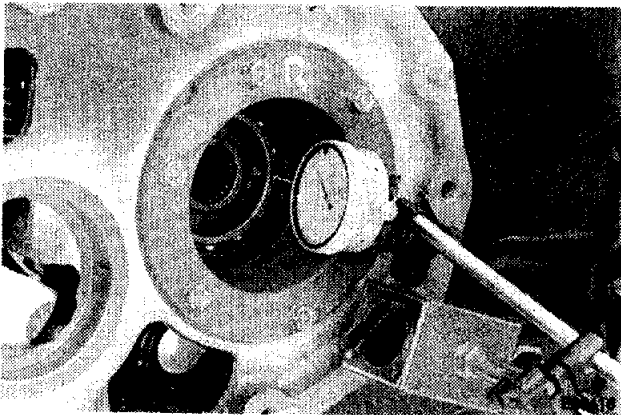
SM0255

**NOTE :** Items are numbered in order of Disassembly.

**NOTE :** Items marked (\*) must be replaced.

- |               |                 |                   |                          |
|---------------|-----------------|-------------------|--------------------------|
| 1. BOLT       | 7. BEARING      | 12. SHAFT         | 17. SIDE GEAR            |
| 2. HOUSING    | 8. BOLT         | 13. SUN GEAR      | 18. THRUST WASHER        |
| 3. SHIM       | 9. PLATE        | 14. THRUST WASHER | 19. SIDE GEAR            |
| 4. SHIM LINER | 10. CROWN WHEEL | 15. SUN GEAR      | 20. THRUST WASHER        |
| 5. SNAP RING  | 11. ROLL PIN    | 16. THRUST WASHER | 21. DIFFERENTIAL HOUSING |
| 6. BEARING    |                 |                   |                          |

[ 6 ]



Install a dial test indicator to the differential housing (21). Measure the end play of the differential housing (21). Add shims (3) to the right hand housing (2) until a backlash of 0.0 to 0.1 mm (0.0 to 0.004 inch) is measured.

[ 7 ]

Repeat Steps 15 and 16.

[ 8 ]

Install the hydraulic lift housing, refer to Section 8003.

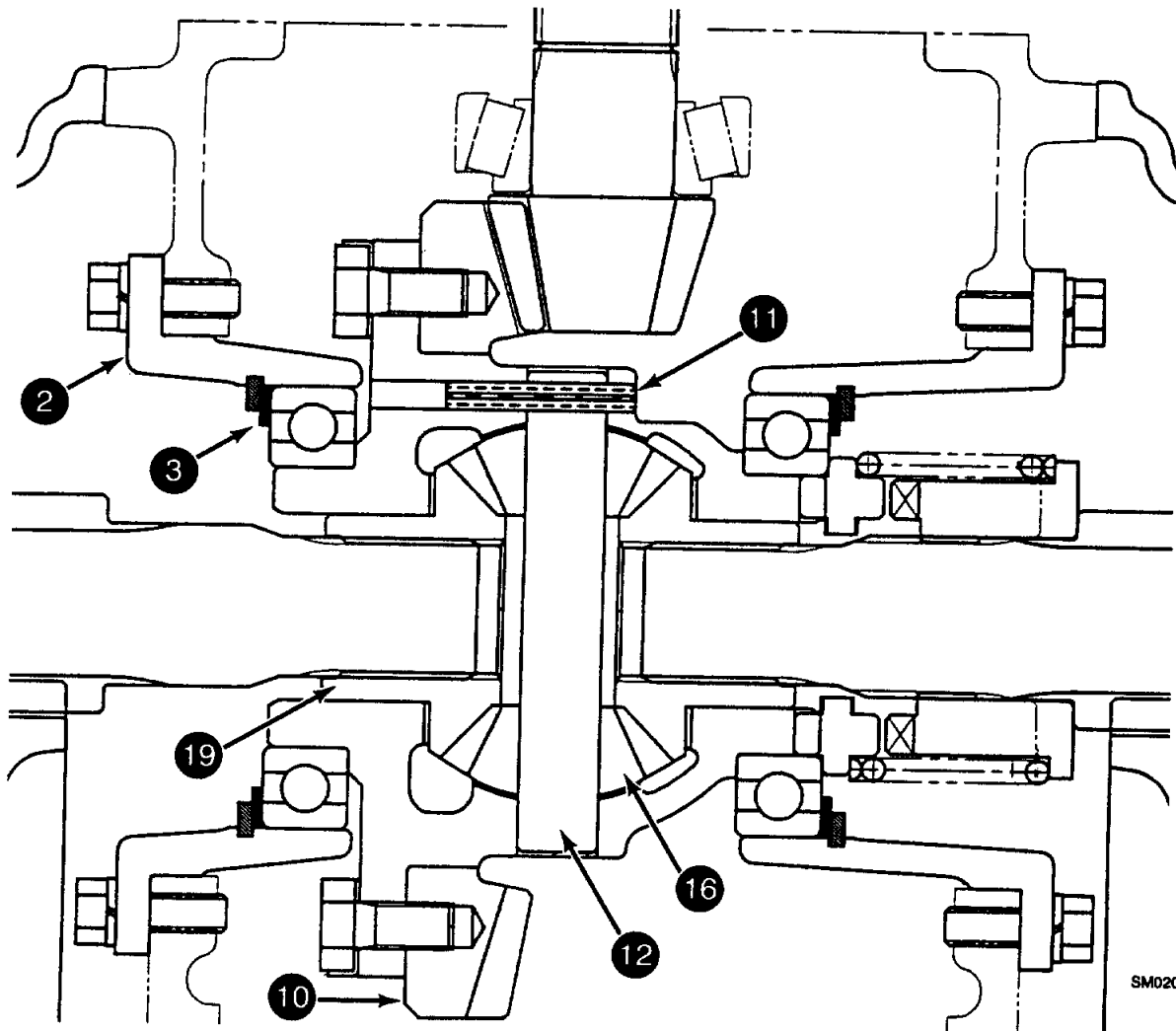
[ 9 ]

Install the rear axles, refer to Section 6018.

[ 10 ]

Install the range box to the speed, refer to Page 10.

### Cross Sectional Drawing of the Differential Assembly



SM0204

2. HOUSING  
3. SHIM  
10. CROWN WHEEL

11. ROLL PIN  
12. SHAFT

16. THRUST WASHER  
19. SIDE GEAR



## Pinion Disassembly (719 \* )

### [ 1 ]

Remove nut (1). Use a soft faced hammer to drive the pinion shaft (5) rearwards while removing items (2 and 3).

### [ 2 ]

Use a bearing puller and attachment to remove bearing (4) from the pinion shaft (5).

### [ 3 ]

Remove items (6 to 10).

**NOTE :** *Keep shims (9) together for assembly.*

### [ 4 ]

Remove items (11 and 12). Use a soft faced hammer and drive shaft (16) forwards.

### [ 5 ]

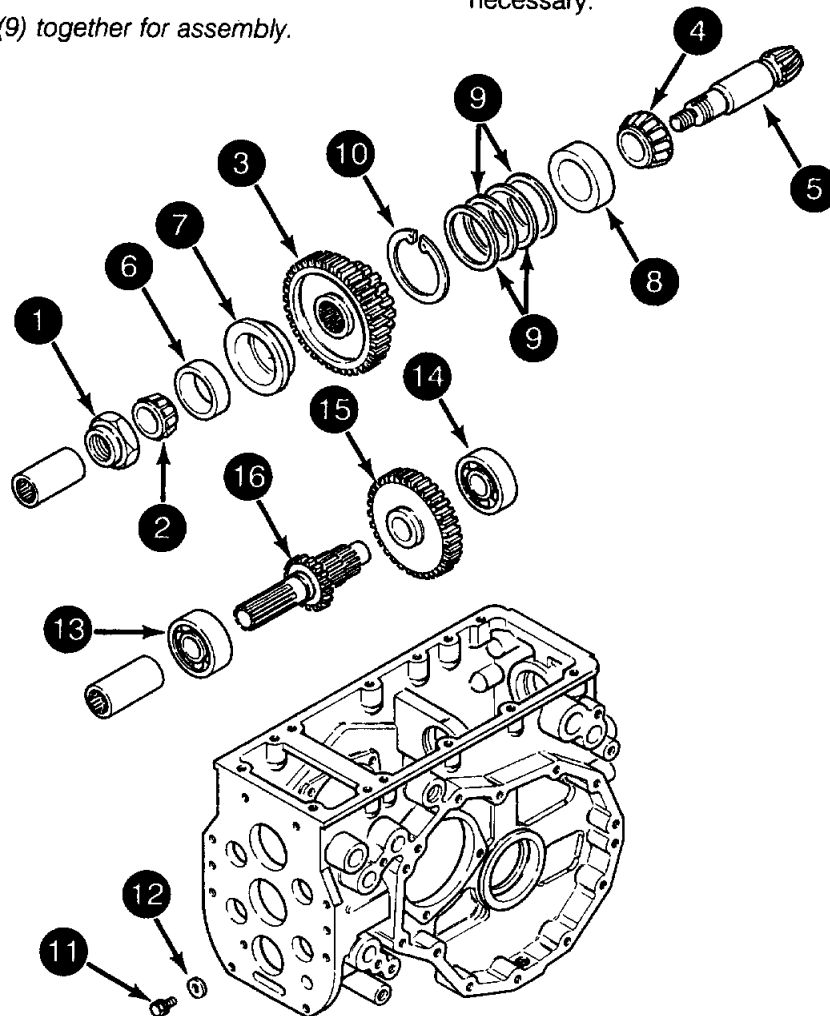
Use a bearing puller to remove item (13).

### [ 6 ]

Remove items (14 to 16).

### [ 7 ]

Check all items for wear or damage and replace as necessary.



SM0262

**NOTE :** *Items are numbered in order of Disassembly.*

- 1. NUT
- 2. BEARING RACE
- 3. GEAR
- 4. BEARING RACE

- 5. PINION
- 6. BEARING CUP
- 7. HOLDER
- 8. BEARING CUP

- 9. SHIM
- 10. SNAP RING
- 11. BOLT
- 12. WASHER

- 13. BEARING
- 14. BEARING
- 15. GEAR
- 16. SHAFT

## Assembly

### [ 1 ]

Install items (14 and 15) into the housing. Slide shaft (16) into gear (15). Use a soft faced hammer and drive the shaft (16) into bearing (14).

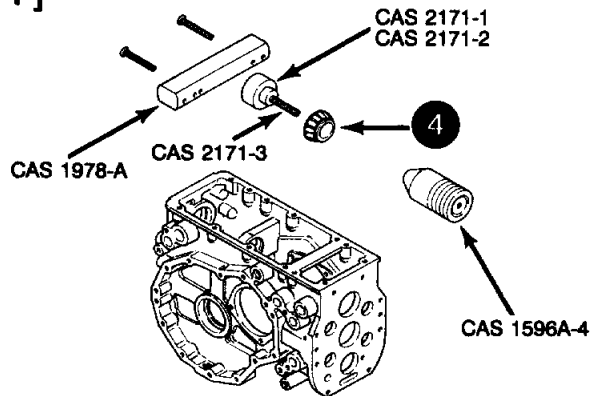
### [ 2 ]

Use a soft faced hammer and install bearing (13). Install items (12 and 11).

### [ 3 ]

Install snap ring (10) and items (8 to 6).

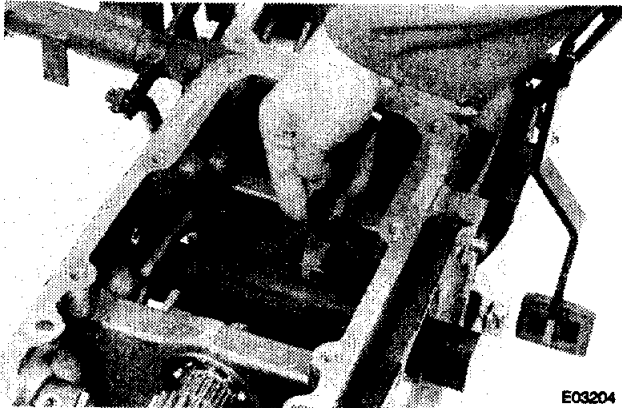
### [ 4 ]



SM0352

Install the pinion height gauge, CAS 2171 and bearing race (4) into the transmission.

### [ 5 ]



E03204

Measure the distance between the gauge block and the gauge tube.

### [ 6 ]

Remove the pinion height gauge and bearing cup (8). Install shims (9) equal to the distance measured in Step 12. Install bearing cup (8).

### [ 7 ]

Put bearing (4) in a bearing oven and heat to a temperature of 121°C (250°F) and install the pinion (5).

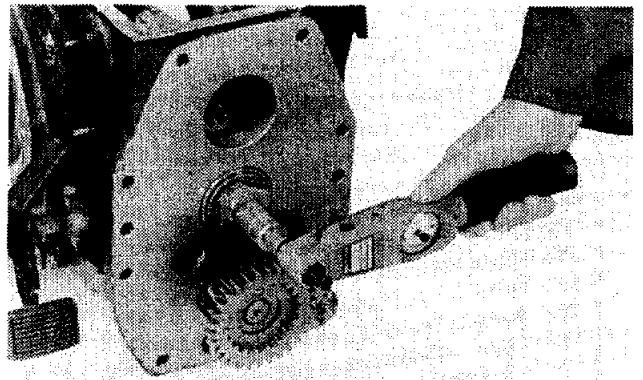


**WARNING** Always wear heat protective gloves when handling heated parts.

### [ 8 ]

Install the pinion shaft (5) and items (3 to 1).

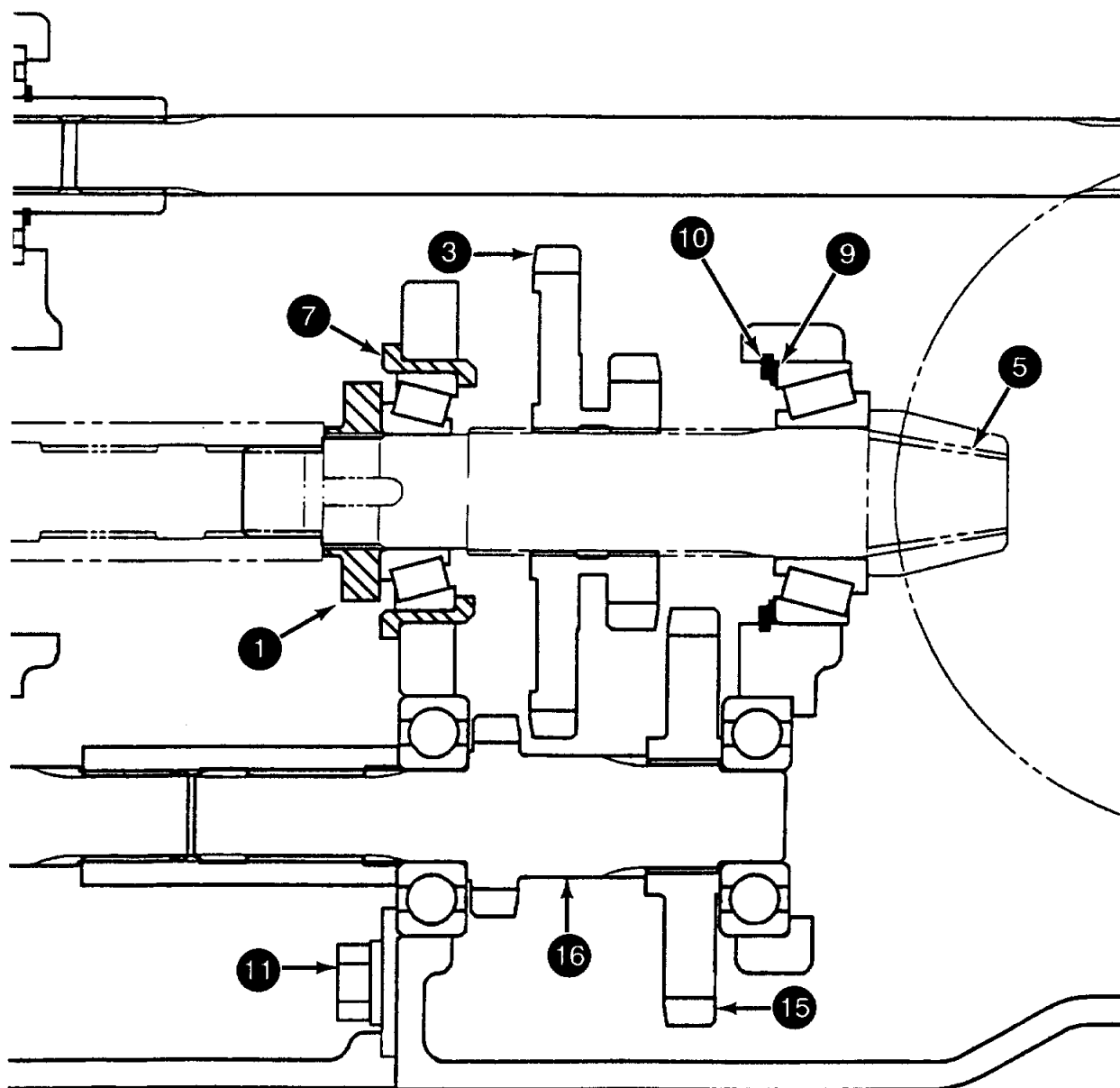
### [ 9 ]



E03410

Tighten nut (1) until a rolling torque of 1.0 to 1.3 Nm (0.74 to 0.96 lb ft) is measured on the pinion shaft (5). Secure nut (1) to the pinion shaft (5).

## Cross Sectional Drawing of the Range Transmission (719 \* )



SM0353

- 1. NUT
- 3. GEAR
- 5. PINION

- 7. HOLDER
- 9. SHIM
- 10. SNAP RING

- 11. BOLT
- 15. GEAR
- 16. SHAFT ASSEMBLY

## Pinion Disassembly (723 \* and 727 \* ) [ 6 ]

### [ 1 ]

Remove nut (1). Use a soft faced hammer to drive the pinion shaft (10) rearward while removing items (2 to 7).

### [ 2 ]

Remove items (8 and 9) from the pinion shaft (10). Use a bearing puller and attachment to remove item (8).

**NOTE :** *Keep shims (9) together for assembly.*

### [ 3 ]

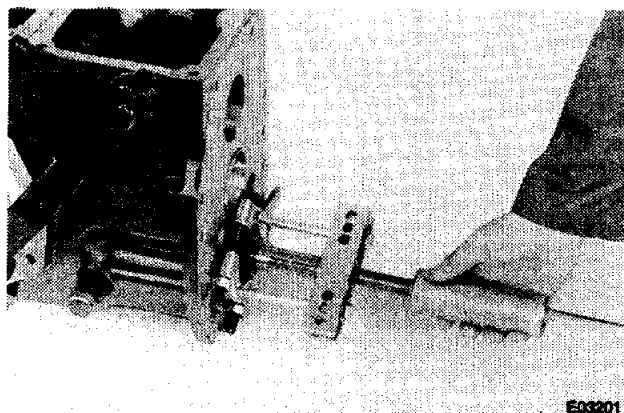
Remove items (11 to 14).

### [ 4 ]

Remove the snap ring (15). Use a soft faced hammer and drive shaft (17) forwards.

### [ 5 ]

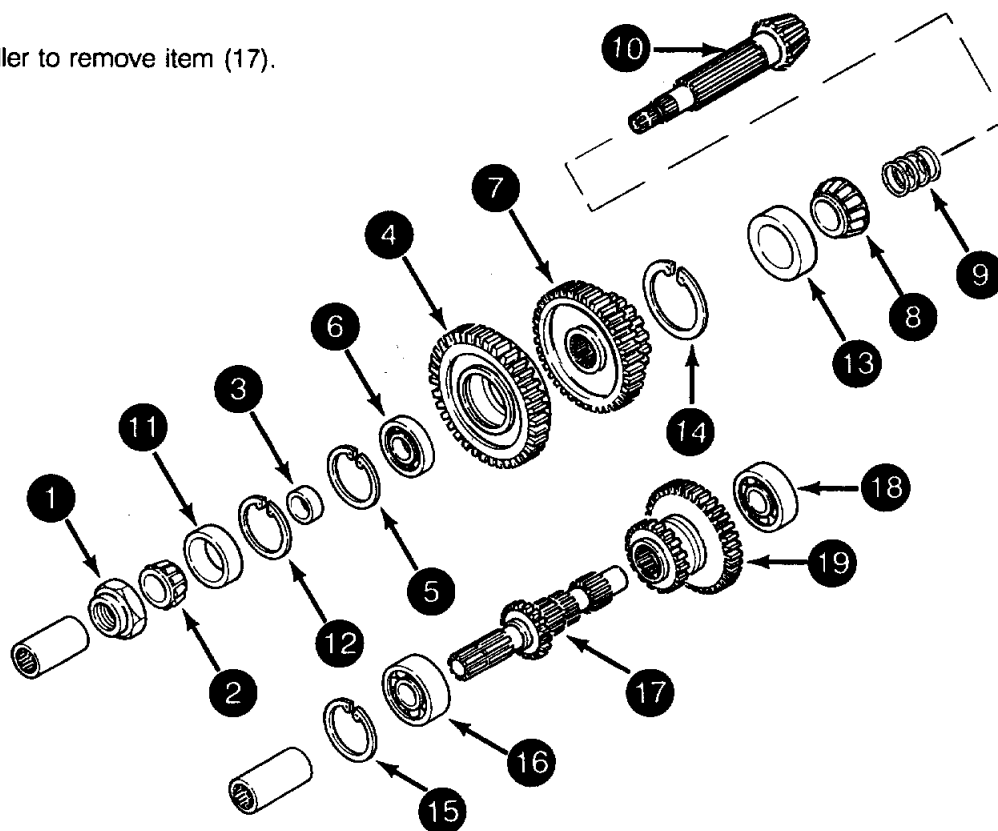
Use a bearing puller to remove item (17).



Install the special tool to be made (refer to Page 4), in between the gear box casting and gear (19). Remove items (17 to 19).

### [ 7 ]

Check all items for wear or damage and replace as necessary.



SM0257

**NOTE :** *Items are numbered in order of Disassembly.*

- |                 |                 |                 |             |
|-----------------|-----------------|-----------------|-------------|
| 1. NUT          | 6. BEARING      | 11. BEARING CUP | 16. BEARING |
| 2. BEARING RACE | 7. GEAR         | 12. SNAP RING   | 17. SHAFT   |
| 3. COLLAR       | 8. BEARING RACE | 13. BEARING CUP | 18. BEARING |
| 4. GEAR         | 9. SHIM         | 14. SNAP RING   | 19. GEAR    |
| 5. SNAP RING    | 10. PINION      | 15. SNAP RING   |             |

## Assembly

### [ 1 ]

Install items (19 and 18) into the housing. Side shaft (17) into gear (19). Use a soft faced hammer and drive shaft (17) into bearing (18).

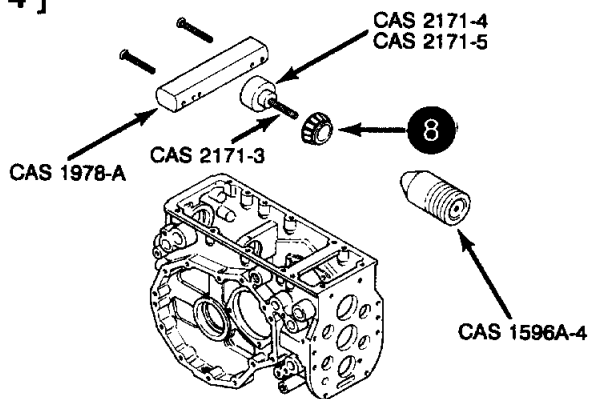
### [ 2 ]

Install items (16 and 15). Use a soft faced hammer to install bearing (16).

### [ 3 ]

Install items (14 to 11).

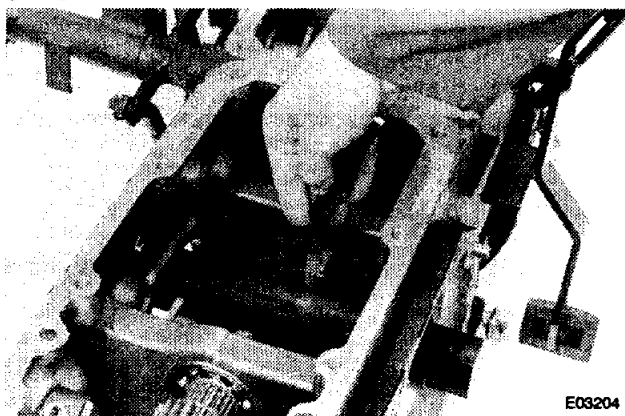
### [ 4 ]



SM0352

Install the pinion height gauge CAS 2171 and bearing (8) into the housing.

### [ 5 ]



E03204

Measure the distance between the gauge block and the gauge tube.

### [ 6 ]

Install shims (9) to the pinion shaft (10) equal to the distance measured in Step 12.

### [ 7 ]

Put bearing (8) in a bearing oven and heat to a temperature of 121°C (250°F) and install to pinion shaft (10).



**WARNING** : Always wear heat protective gloves when handling heated parts

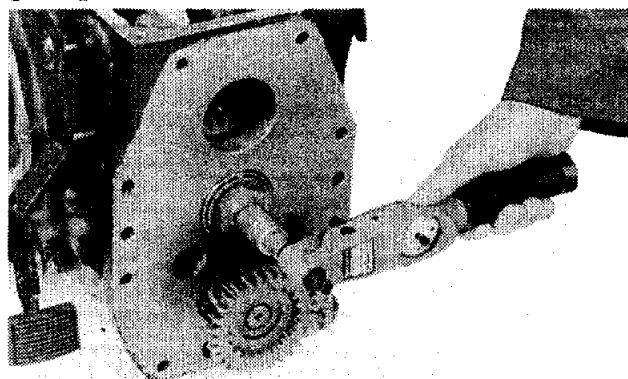
### [ 8 ]

Install items (6 and 5) to gear (4).

### [ 9 ]

Install the pinion shaft (10) and items (7, 4, 3, 2 and 1).

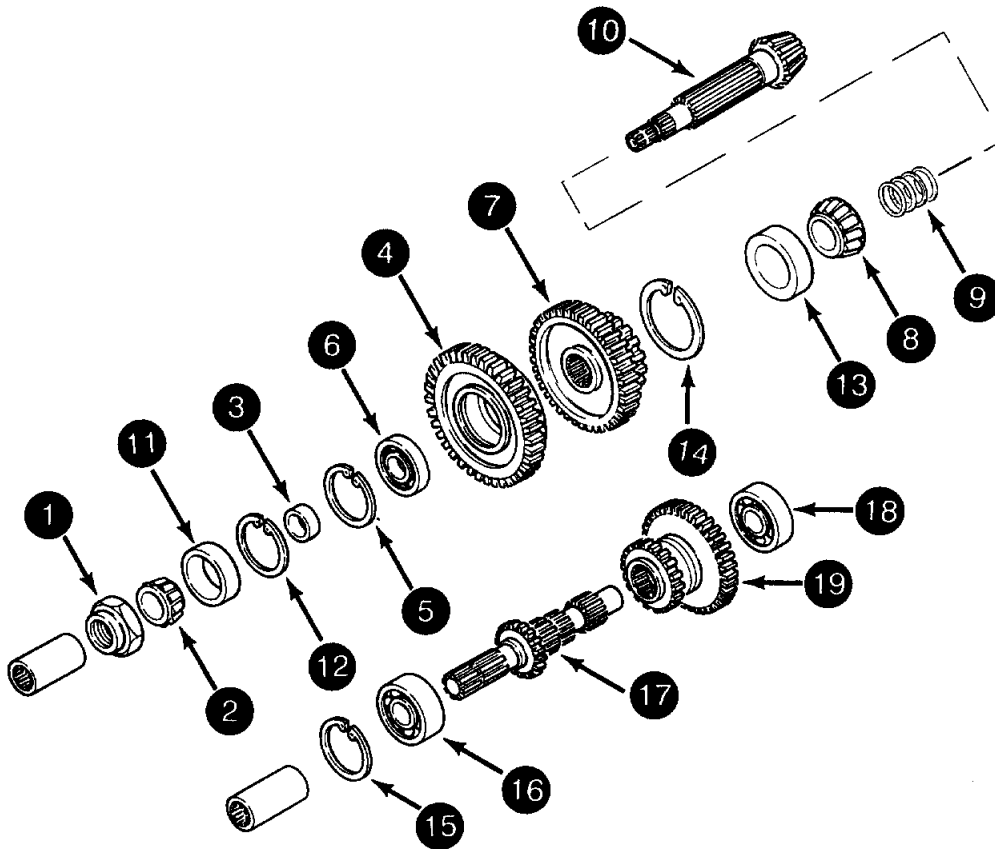
### [ 10 ]



E03410

Tighten nut (1) until a rolling torque of 1.0 to 1.3 Nm (0.74 to 0.96 lb ft) is measured on the pinion shaft (10). Secure nut (1) to the pinion shaft (10).

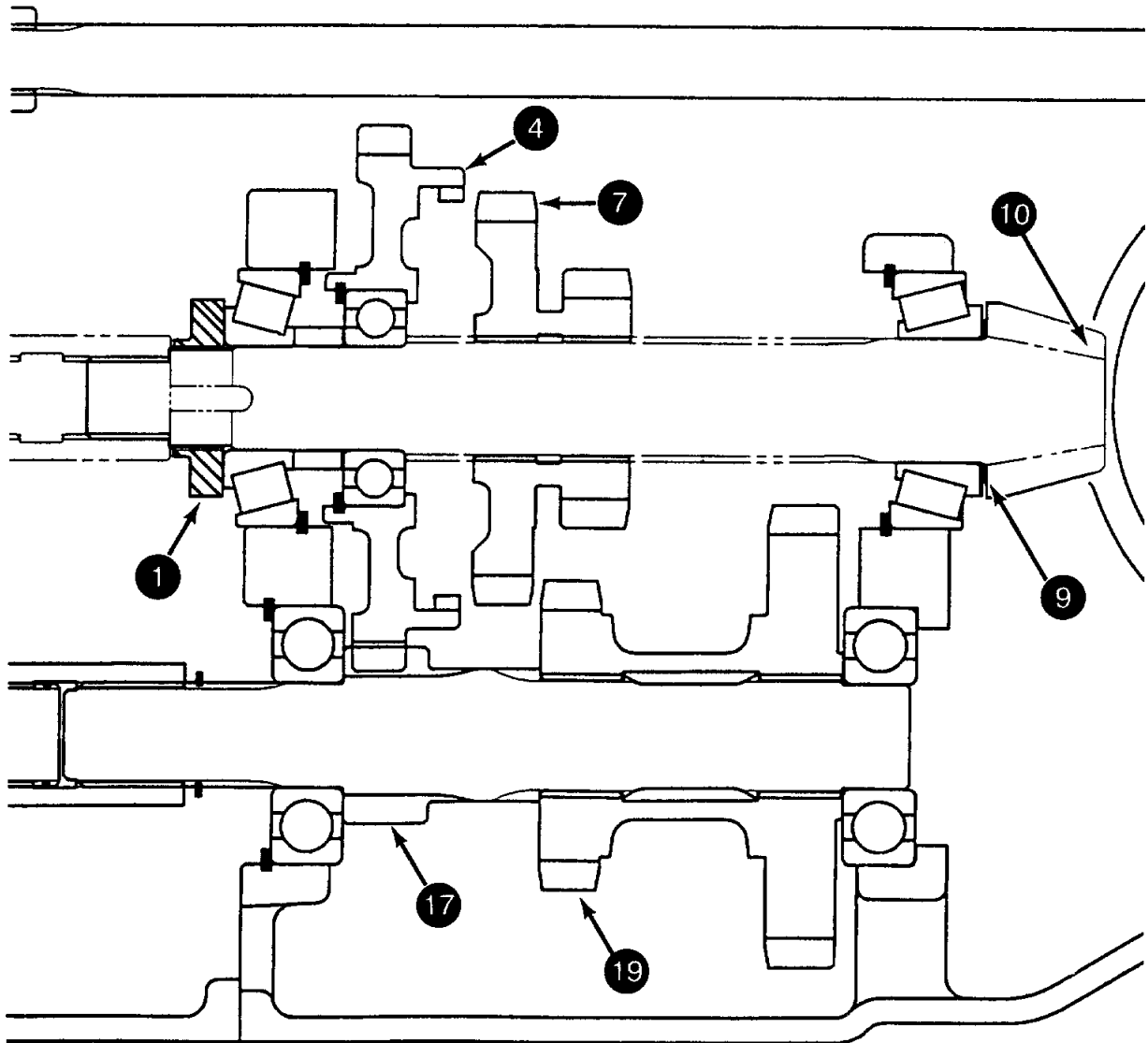
NOTE : Items are numbered in order of Disassembly.



SM0257

- |                 |                 |                 |             |
|-----------------|-----------------|-----------------|-------------|
| 1. NUT          | 6. BEARING      | 11. BEARING CUP | 16. BEARING |
| 2. BEARING RACE | 7. GEAR         | 12. SNAP RING   | 17. SHAFT   |
| 3. COLLAR       | 8. BEARING RACE | 13. BEARING CUP | 18. BEARING |
| 4. GEAR         | 9. SHIM         | 14. SNAP RING   | 19. GEAR    |
| 5. SNAP RING    | 10. PINION      | 15. SNAP RING   |             |

## Cross Sectional Drawing of the Range Transmission ( 723 \* and 727 \* )



SM0354

1. NUT  
4. GEAR

7. GEAR  
9. SHIM

10. PINION  
17. SHAFT

19. GEAR

## SERVICING THE HYDROSTATIC TRANSMISSION

### Separating the Hydrostatic Transmission from the Clutch Housing

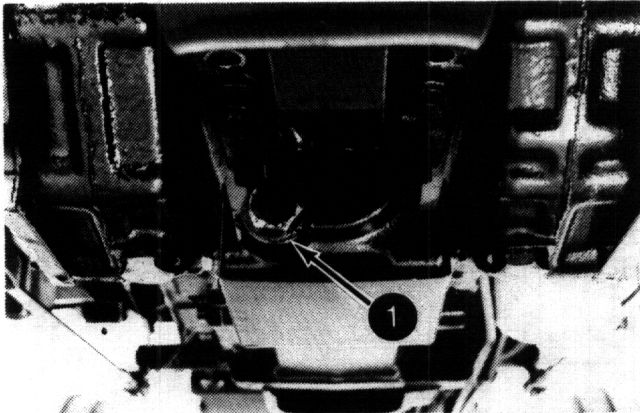
[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

[ 2 ]

Remove the operators platform, refer to Section 7 .

[ 3 ]



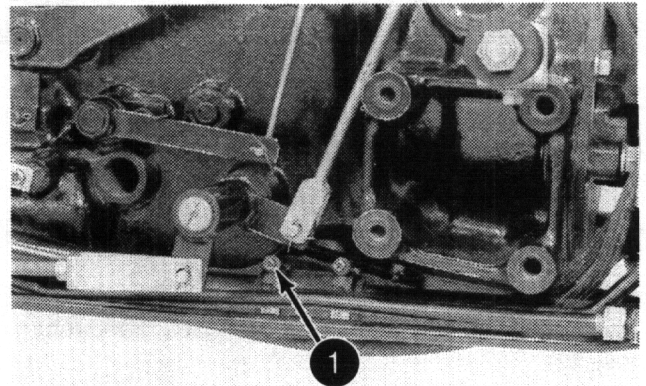
Put a container with a capacity of at least 25 litres (6.6 US gal) under the transmission drain plug (1). Remove the drain plug and drain the oil. Install and tighten the drain plug.

**NOTE:** For Installation, install 18 litres (4.8 US gal) (7195) or 22 litres (5.8 US gal) (7235 and 7275) of Cub Cadet hydraulic transmission fluid.

[ 4 ]

Put wooden blocks in between the front axle and bolster.

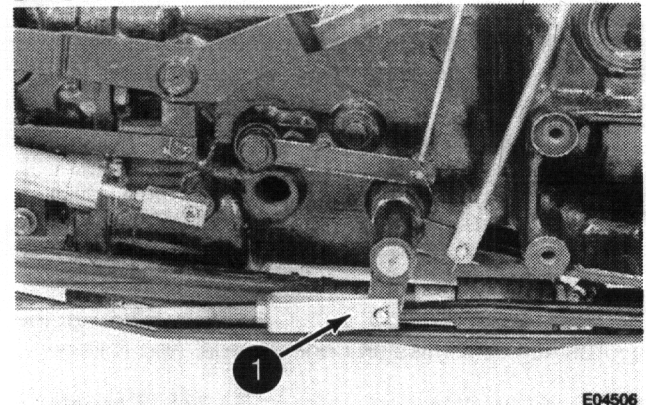
[ 5 ]



E04500

Disconnect and cap the hydraulic pump supply tube (1).

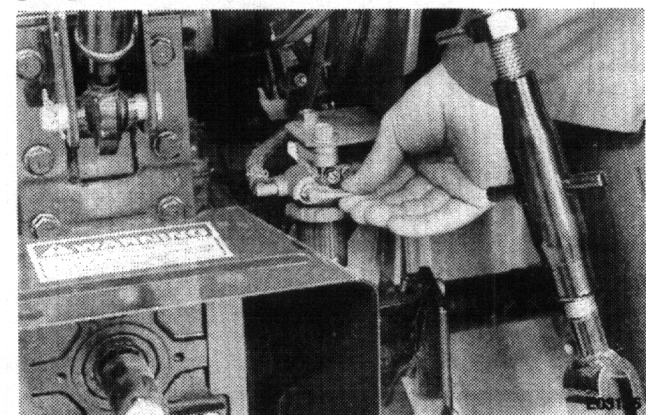
[ 6 ]



E04506

Remove the cotter pin and clevis pin and disconnect the brake linkage (1) (both sides).

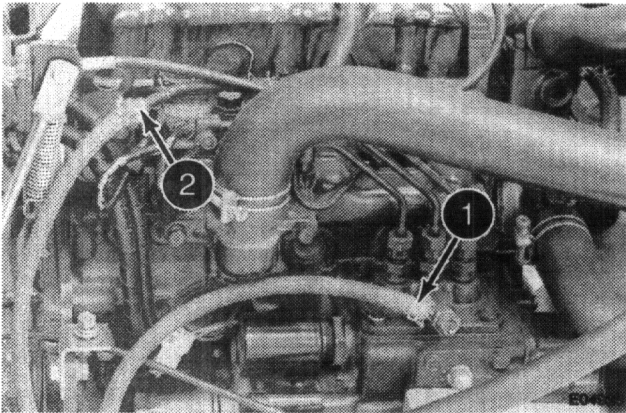
[ 7 ]



Turn the fuel supply tap to the OFF position.

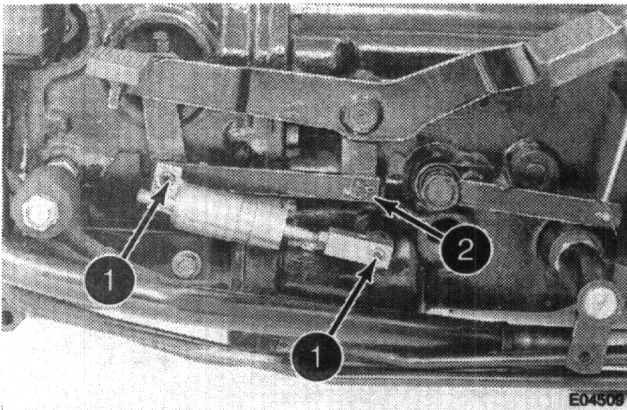


[ 8 ]



Disconnect and cap the fuel supply hose (1) and return hose (2).

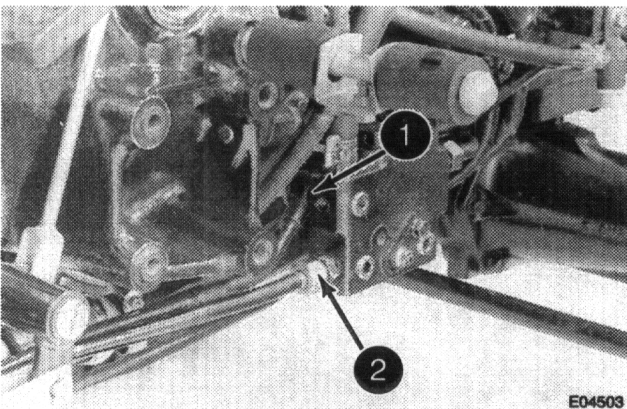
[ 9 ]



Remove clips (1) and cotter pin (2). Remove the hydrostatic transmission control pedal and linkage.

**NOTE:** For Installation, refer to Section 8 to adjust the control pedal linkage.

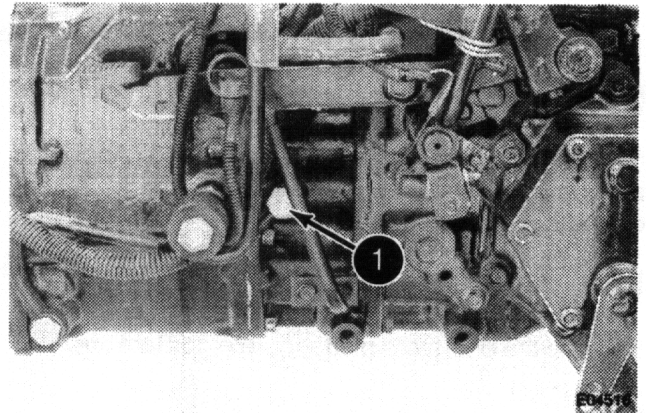
[ 10 ]



Disconnect and cap the power beyond tubes (1 and 2).

**NOTE:** For Installation, tighten (1) to a torque of 39 to 44 Nm (29 to 32.5 lb ft) and (2) to a torque of 49 to 59 Nm (36 to 43.5 lb ft).

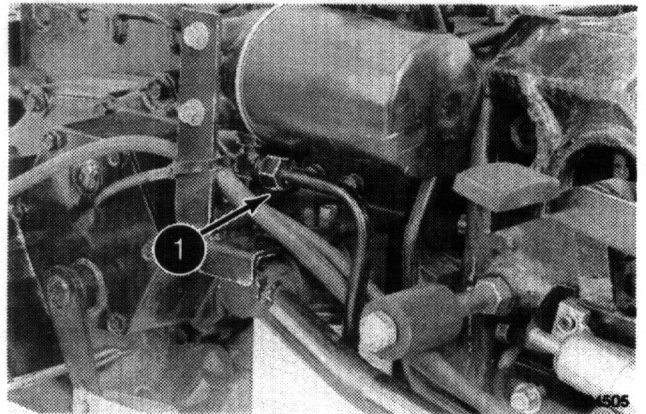
[ 11 ]



Disconnect and cap oil cooler tube (1) (both sides).

**NOTE:** For Installation, tighten (1) to a torque of 39 to 44 Nm (29 to 32.5 lb ft).

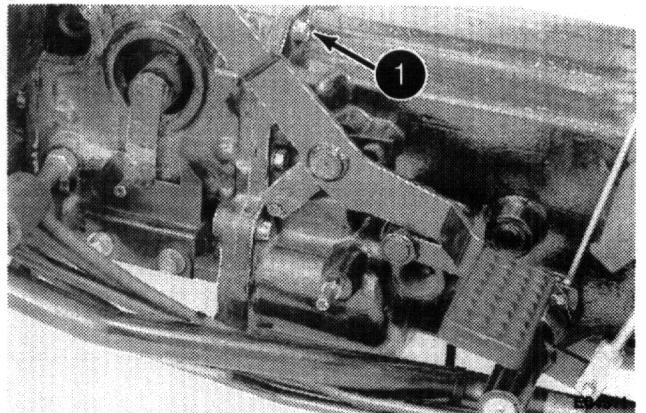
[ 12 ]



Disconnect and cap oil filter tube (1).

**NOTE:** For Installation, tighten (1) to a torque of 49 to 59 Nm (36 to 43.5 lb ft).

[ 13 ]



Support the tractor on suitable stands. Remove the clutch housing to hydrostatic transmission retaining bolts (1) and carefully separate the tractor. Support the two halves of the tractor on suitable stands.

**NOTE:** For Installation, apply a continuous bead of Loctite 515 to the hydrostatic transmission mounting face and tighten the retaining bolts (1) to a torque of 83 to 93 Nm (61 to 68.5 lb ft).

## MFD DROP BOX

### Disassembly and Assembly

#### [ 1 ]

Remove items (1 to 6) from the hydrostatic cover.

**NOTE:** For Assembly, apply a continuous bead of Loctite 515 to the surface of the MFD drop box (5) and tighten (4) to a torque of 39 to 44 Nm (29 to 32.5 lb ft).

#### [ 2 ]

Remove items (7 to 12). Use a bushing driver to remove items (11 and 12).

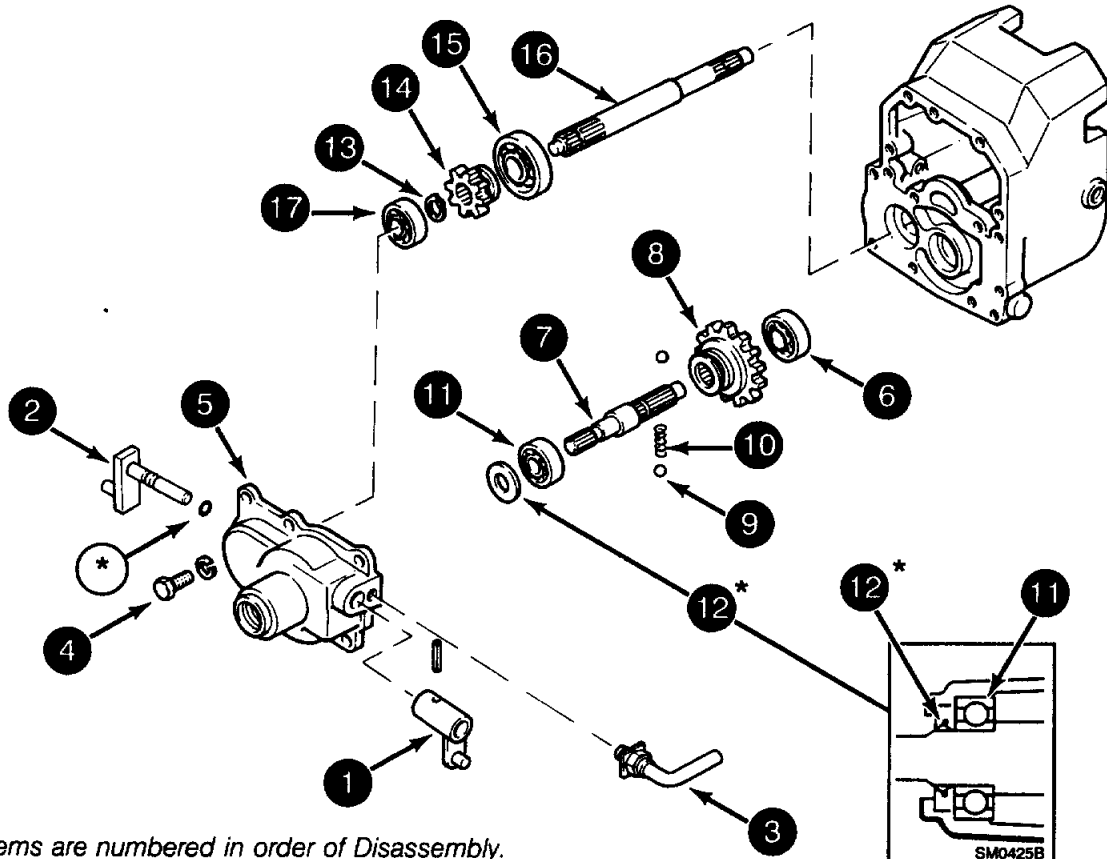
**NOTE:** For Assembly, install seal (12) as shown.

#### [ 3 ]

Remove items (13 to 16) as an assembly. Remove (13 to 15) from the shaft (16) and press bearing (15) from the gear (14). Using a blind hole puller remove bearing (17).

**NOTE:** For Assembly, press bearing (15) onto the shoulder of the gear (14).

**NOTE:** For Assembly, follow the same procedure in reverse order.



SM0425

**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** For Assembly, lubricate new seals and moving parts with clean hydraulic oil.

**NOTE:** Items marked (\*) must be replaced.

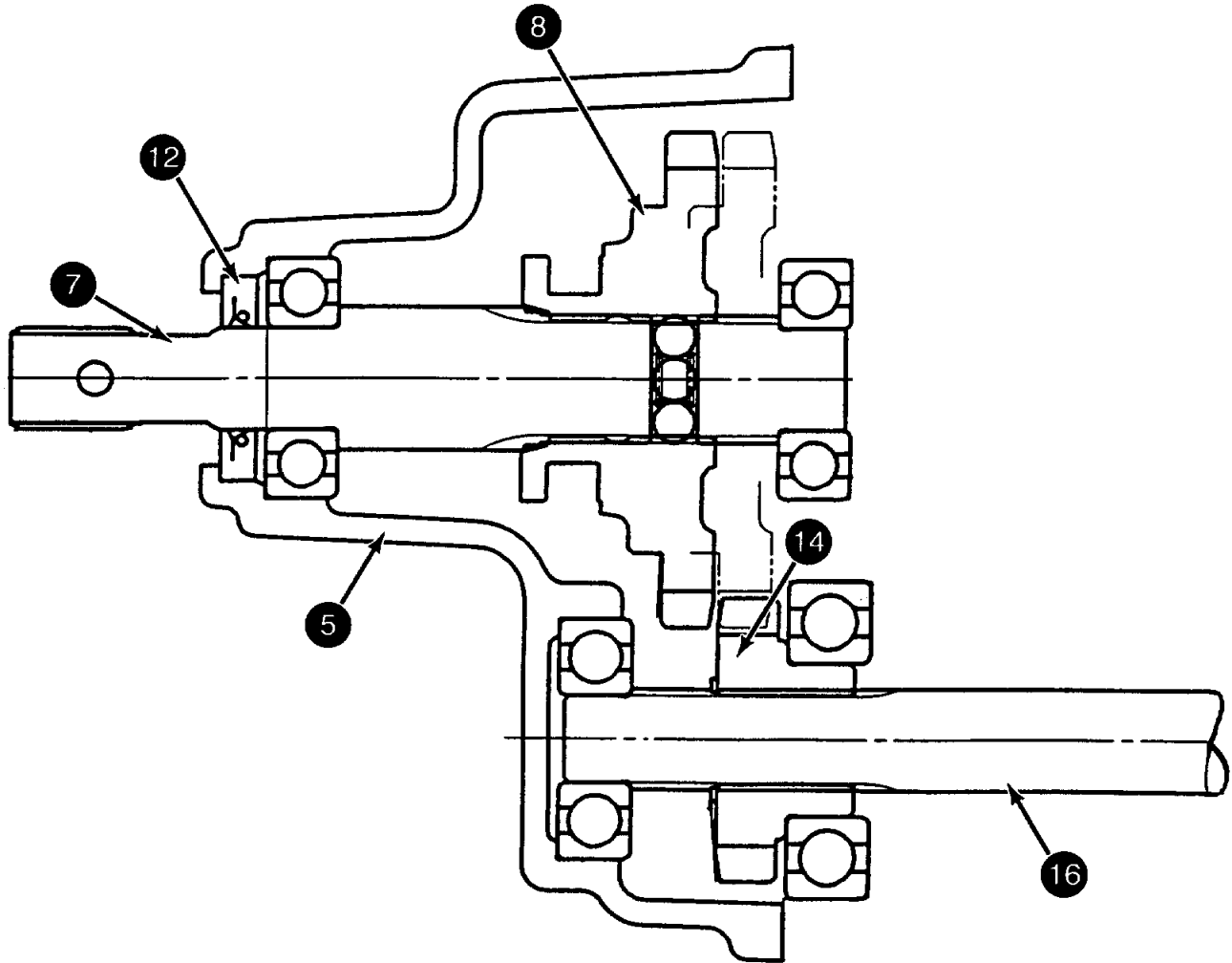
- 1. LEVER
- 2. SELECTOR FORK
- 3. TUBE
- 4. SCREW
- 5. MFD DROP BOX

- 6. BEARING
- 7. DRIVEN SHAFT
- 8. DRIVEN GEAR
- 9. STEEL BALL

- 10. SPRING
- 11. BEARING
- 12. OIL SEAL
- 13. SNAP RING

- 14. DRIVE GEAR
- 15. BEARING
- 16. DRIVE SHAFT
- 17. BEARING

## Cross Sectional Drawing of the MFD Drop Box



5. MFD DROP BOX

7. DRIVEN SHAFT

8. DRIVEN GEAR (35 TEETH - 7194/7195)  
(31 TEETH - 7234/7235 and 7274/7275)

12. OIL SEAL

14. DRIVE GEAR (22 TEETH - 7194/7195)  
(16 TEETH - 7234/7235 and 7274/7275)

16. DRIVE SHAFT

SM0444

## HYDROSTATIC TRANSMISSION (7193 and 7195)

### Removal and Installation

#### [ 1 ]

Remove items (1 to 6) and remove the hydrostatic transmission cover (7).

#### [ 2 ]

Remove items (8 to 12) and remove the hydrostatic transmission (13) and transmission section (14) as an assembly.

**NOTE:** The assembly weighs approximately 30 kg (66 lb).

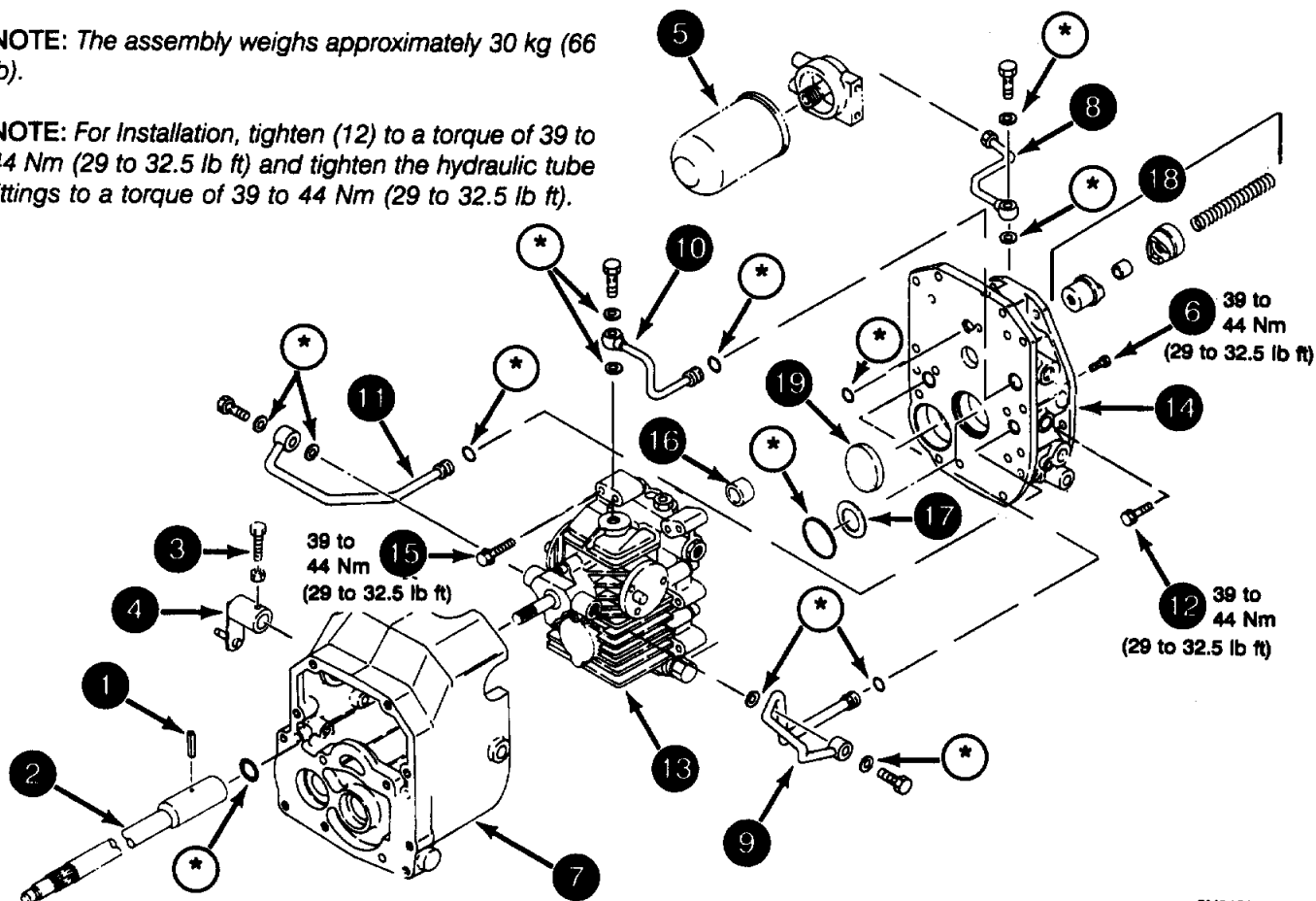
**NOTE:** For Installation, tighten (12) to a torque of 39 to 44 Nm (29 to 32.5 lb ft) and tighten the hydraulic tube fittings to a torque of 39 to 44 Nm (29 to 32.5 lb ft).

#### [ 3 ]

Remove screws (15) and separate the transmission (13) from the housing (14). Remove items (16 to 18) and (19) if equipped.

**NOTE:** For Installation, make sure that the chamfered edge of spacer (16) is facing the hydrostatic transmission (13) and tighten (15) to a torque of 39 to 44 Nm (29 to 32.5 lb ft).

**NOTE:** For Installation, follow the same procedure in reverse order.



SM0421

**NOTE:** Items marked (\*) must be replaced.

**NOTE:** Items are numbered in order of Removal.

**NOTE:** For Installation, lubricate new o-rings and sealing washers with clean hydraulic oil.

1. ROLL PIN
2. INPUT SHAFT
3. SCREW
4. PIVOT ARM
5. CHARGE PUMP FILTER
6. SCREW
7. HYDROSTATIC COVER

8. HYDRAULIC TUBE  
(FILTER TO TRANSMISSION SECTION)
9. HYDRAULIC TUBE  
(CHARGE PUMP SUPPLY)
10. HYDRAULIC TUBE  
(DRAIN TO TRANSMISSION SECTION)
11. HYDRAULIC TUBE  
(CHARGE PUMP TO OIL COOLER)

12. SCREW
13. HYDROSTATIC TRANSMISSION
14. TRANSMISSION SECTION
15. SCREW
16. SPACER
17. LINER
18. OVER-RUNNING PTO CLUTCH
19. PLUG (2WD)

## HYDROSTATIC TRANSMISSION (7233, 7235, 7273 and 7275)

### Removal and Installation

#### [ 1 ]

Remove items (1 to 6) and remove the hydrostatic transmission cover (7).

**NOTE:** For Installation, tighten (6) to a torque of 39 to 44 Nm (29 to 32.5 lb ft).

#### [ 2 ]

Remove items (8 to 11) and remove the hydrostatic transmission (12) and housing (13) as an assembly.

**NOTE:** The assembly weighs approximately 37 kg (81.6 lb).

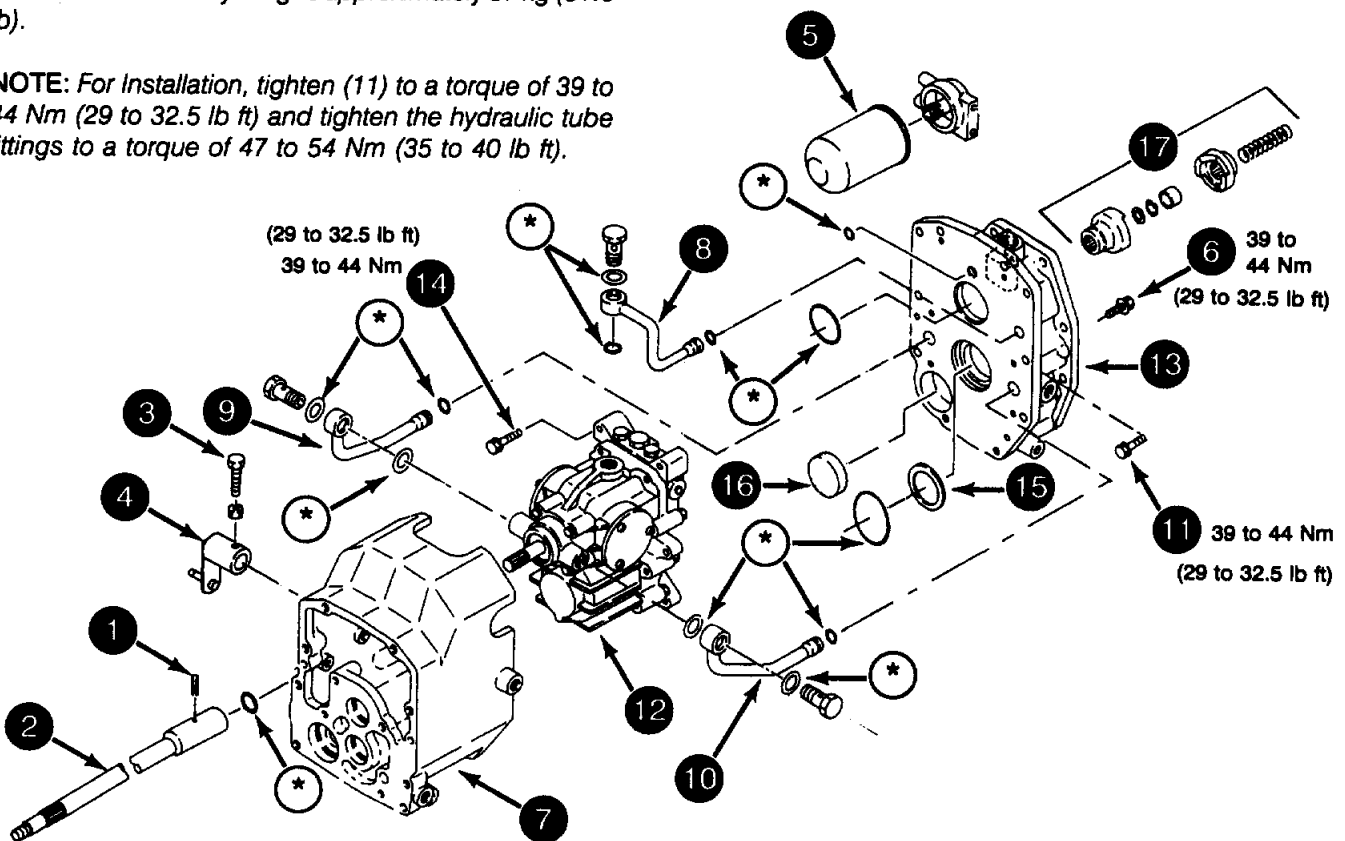
**NOTE:** For Installation, tighten (11) to a torque of 39 to 44 Nm (29 to 32.5 lb ft) and tighten the hydraulic tube fittings to a torque of 47 to 54 Nm (35 to 40 lb ft).

#### [ 3 ]

Remove screws (14) and separate the hydrostatic transmission (12) from the housing (13). Remove (15) and (16) if equipped.

**NOTE:** For Installation, tighten (14) to a torque of 39 to 44 Nm (29 to 32.5 lb ft).

**NOTE:** For Installation, follow the same procedure in reverse order.



**NOTE:** Items marked (\*) must be replaced.

**NOTE:** Items are numbered in order of Removal.

**NOTE:** For Installation, lubricate new o-rings and sealing washers with clean hydraulic oil.

- |                       |  |                              |
|-----------------------|--|------------------------------|
| 1. ROLL PIN           | 8. HYDRAULIC TUBE<br>(DRAIN TO TRANSMISSION SECTION) | 12. HYDROSTATIC TRANSMISSION |
| 2. INPUT SHAFT        | 9. HYDRAULIC TUBE<br>(CHARGE PUMP SUPPLY)            | 13. TRANSMISSION SECTION     |
| 3. SCREW              | 10. HYDRAULIC TUBE<br>(CHARGE PUMP TO OIL COOLER)    | 14. SCREW                    |
| 4. PIVOT ARM          | 11. SCREW  | 15. LINER                    |
| 5. CHARGE PUMP FILTER | 12. HYDROSTATIC TRANSMISSION                         | 16. PLUG (2 W.D.)            |
| 6. SCREW              | 13. TRANSMISSION SECTION                             | 17. OVER-RUNNING PTO CLUTCH  |
| 7. HYDROSTATIC COVER  | 14. SCREW  |                              |

SM0422

## SECTION TRANSMISSION

### Disassembly and Assembly

#### [ 1 ] (MFD Tractors Only)

Use a bushing driver to remove items (1 to 6) as on assembly. Remove o-rings (7 and 8). Press bearings (2 and 4) from coupler (3).

#### [ 2 ]

Remove the snap ring (9) and remove items (10 to 12) as an assembly. Press bearings (10 and 12) from gear (11).

#### [ 3 ]

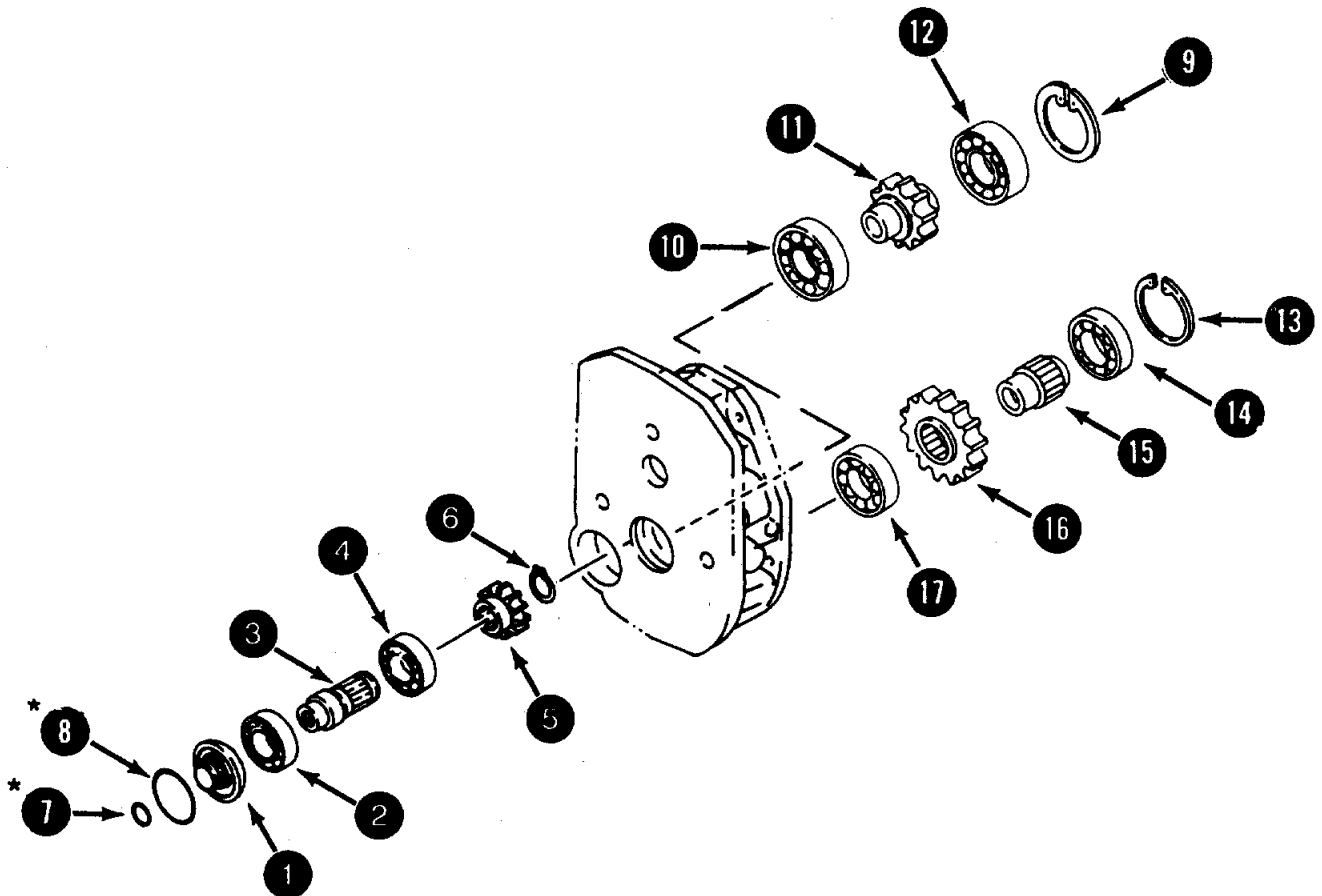
Remove snap ring (13) and use a pilot bearing puller to remove items (14 and 15). Remove items (16 and 17).

**NOTE:** For Assembly, put bearings (14, 12, 10, 4 and 2) in a bearing oven and heat to a temperature of 121°C (250°F).



**WARNING** Do not use a bearing puller to remove bearings (14 and 15) as it may damage the bearings.

**NOTE:** For Assembly, follow the same procedure in reverse order.



**NOTE :** Items marked (\*) must be replaced.

**NOTE :** Items are numbered in order of Disassembly.

**NOTE :** For Assembly, lubricate new o-rings and moving parts with clean hydraulic oil.

- 1. RETAINER
- 2. BEARING
- 3. COUPLER
- 4. BEARING

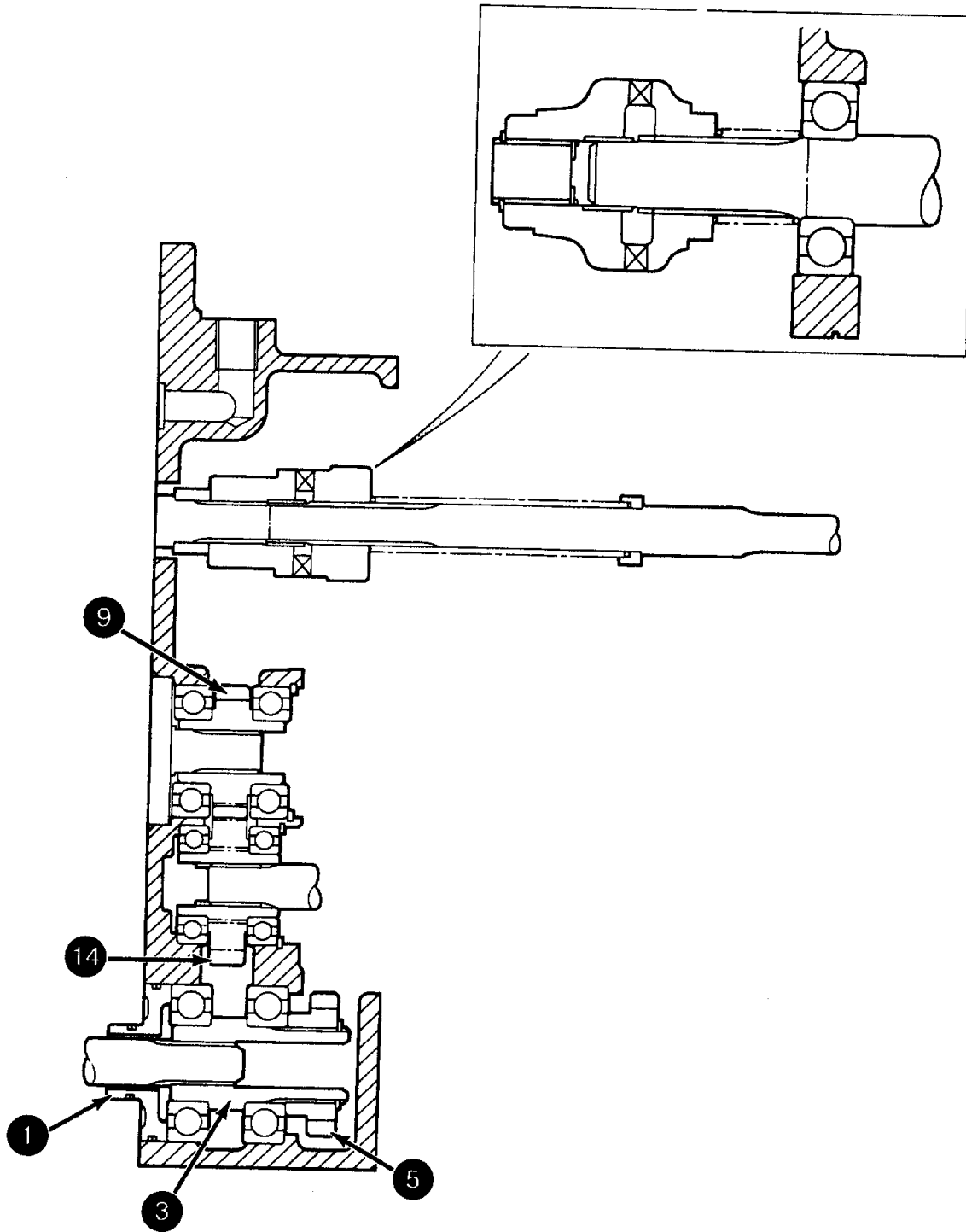
- 5. GEAR
- 6. SNAP RING
- 7. O-RING
- 8. O-RING

- 9. SNAP RING
- 10. BEARING
- 11. GEAR
- 12. BEARING

- 13. SNAP RING
- 14. BEARING
- 15. COLLAR
- 16. GEAR
- 17. BEARING

## Cross Sectional Drawing of the Section Transmission

7233, 7235, 7273 and 7275 (HST ONLY)



SM0427

## HYDROSTATIC TRANSMISSION

### Disassembly

#### [ 1 ]

Remove the cap screws (1) and remove the charge pump (2). Remove items (3 to 6) from the charge pump (2).

#### [ 2 ]

Remove the cap screws (8) and remove the port block (9) and gasket (10).

**NOTE:** *Lift the port block (9) away from the housing carefully because the valve plates (11) may be stuck to the bottom of the port block (9). If the valve plates (11) did not come away with the port block (9) then remove them.*

**IMPORTANT:** *Keep the valve plates (11) separate for correct assembly.*

**NOTE:** *For Disassembly and Assembly of the Port Block (9), refer to Pages 14 and 16.*

#### [ 3 ]

Hold the end of the motor shaft (12) and hit the housing with a plastic hammer to remove items (13 to 18) as an assembly.

#### [ 4 ]

Drive the shaft (12) from the assembly and press bearing (18) from the shaft (12).

#### [ 5 ]

Release snap ring (19). Place your hand on the cylinder barrel (20) and turn the housing upside down. Remove items (19 to 23).

#### [ 6 ]

Drive the shaft (24) and bearing (25) out of the housing. Drive the bearing (25) from the shaft (24) and remove snap ring (26).

#### [ 7 ]

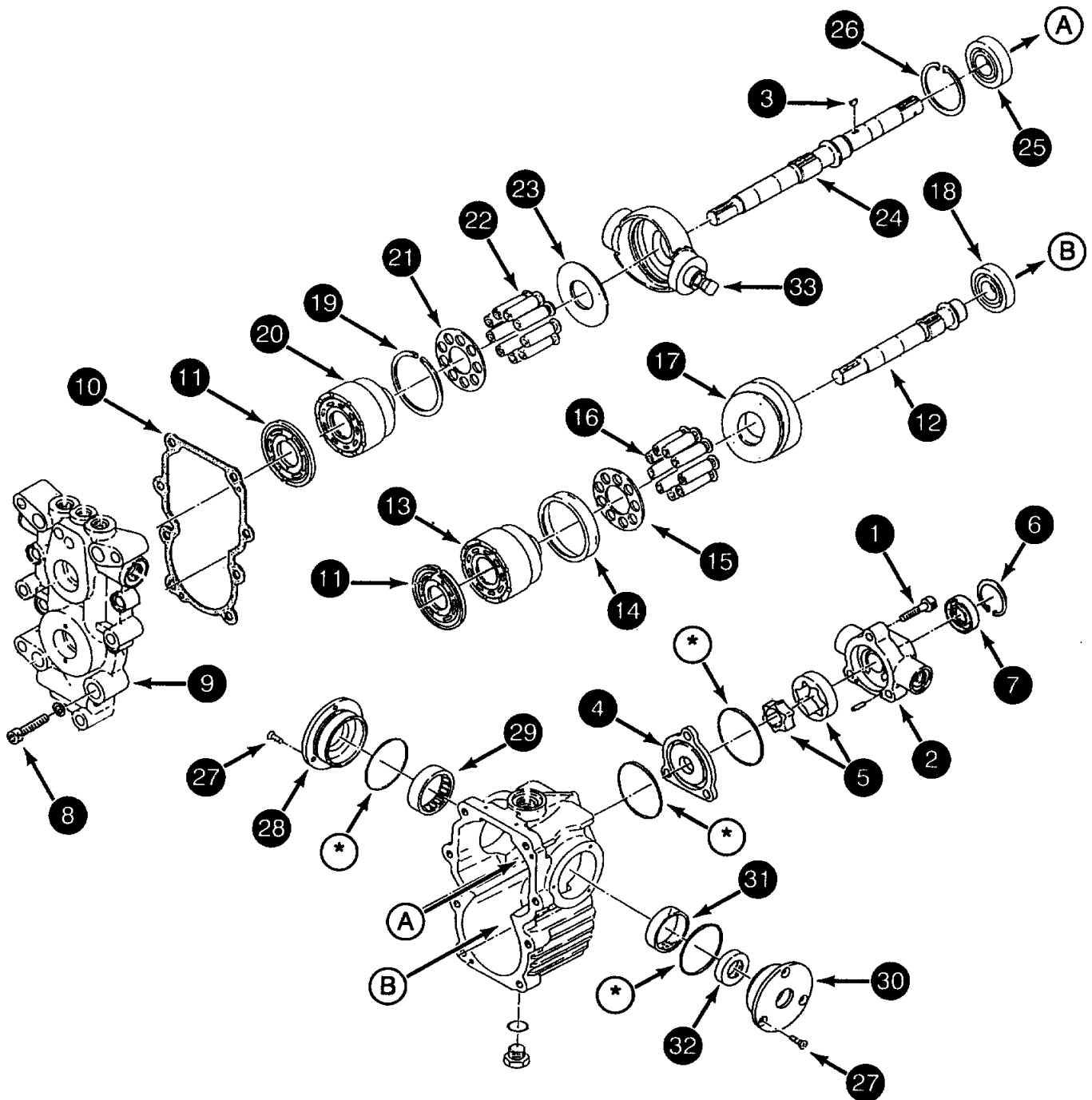
Remove screws (27) (both sides). Using a soft hammer tap the shaft of the swashplate (33) to remove trunnion cap (28). Remove bearing (29) from the trunnion cap (28). Tap the other end of the swashplate (33) to drive out trunnion cap (30). Remove bushing (31) and seal (32). Remove the swashplate (33).

#### [ 8 ]

Clean all parts in a cleaning solvent and dry using compressed air. DO NOT use cloths to dry hydraulic components.



NOTE: Items are numbered in order of Disassembly.



SM0432

1. CAP SCREW
2. CHARGE PUMP
3. KEY
4. SPACER
5. STATOR
6. SNAP RING
7. OIL SEAL
8. CAP SCREW

9. PORT BLOCK
10. GASKET
11. VALVE PLATE
12. MOTOR DRIVE SHAFT
13. CYLINDER BARREL
14. PISTON RETAINER
15. SLIPPER RETAINER
16. PISTON

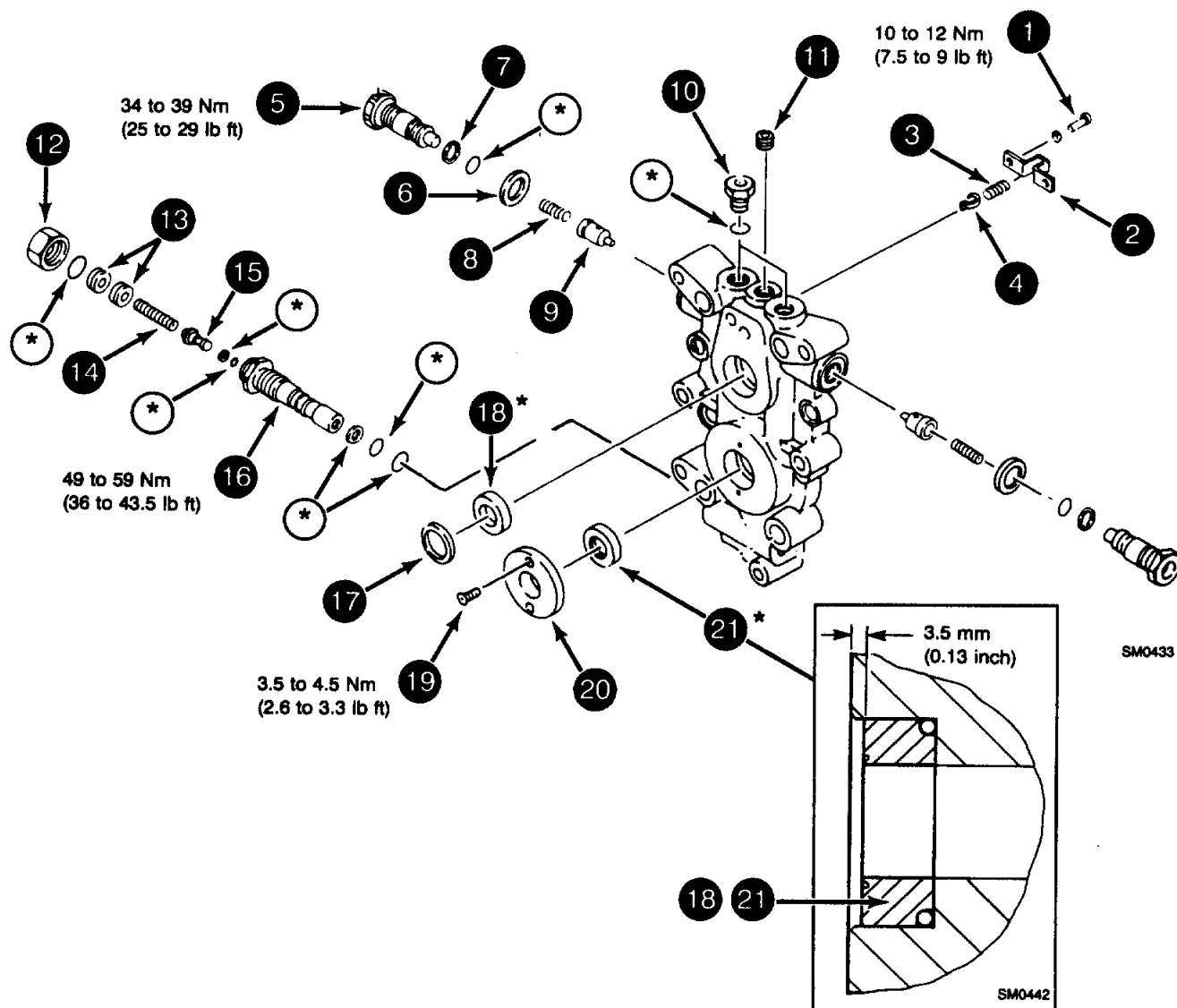
17. SWASHPLATE
18. BEARING
19. SNAP RING
20. CYLINDER BARREL
21. SLIPPER RETAINER
22. PISTON
23. THRUST PLATE
24. PUMP SHAFT

25. BEARING
26. SNAP RING
27. SCREW
28. TRUNNION CAP
29. BEARING
30. TRUNNION CAP
31. BUSHING
32. OIL SEAL
33. SWASHPLATE

## PORT BLOCK (7193 and 7195)

### Disassembly and Assembly

**NOTE :** Items are numbered in order of Disassembly.



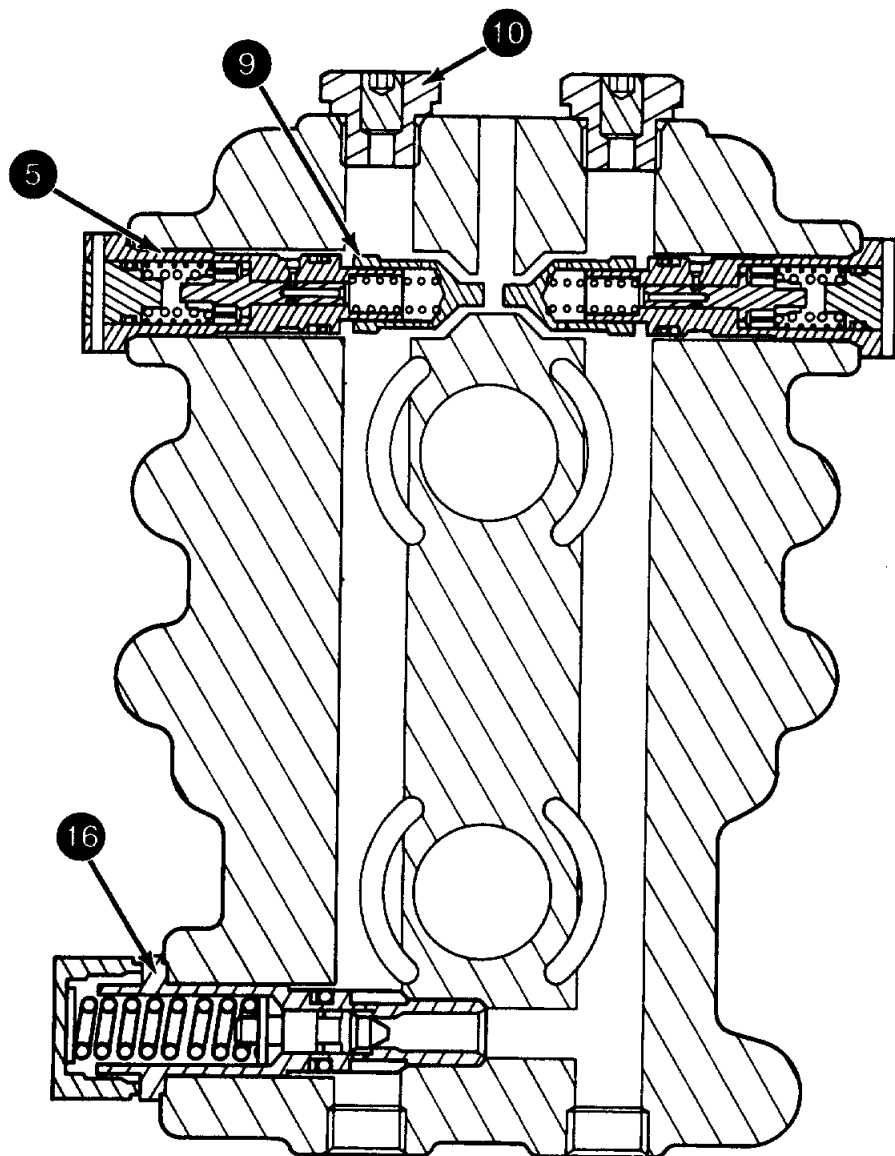
**IMPORTANT:** A 1.00 mm (0.0394 inch) shim (13) will cause a change in opening pressure of 40.6 bar (588 psi).

**NOTE :** Items marked (\*) must be replaced.

**NOTE :** For Assembly, lubricate new o-rings, sealing washers, oil seals and moving parts with clean hydraulic oil.

- |                                 |                   |                                   |              |
|---------------------------------|-------------------|-----------------------------------|--------------|
| 1. CAP SCREW                    | 6. SEALING WASHER | 12. CAP                           | 17. BUSHING  |
| 2. BRACKET                      | 7. BACK UP RING   | 13. SHIMS                         | 18. OIL SEAL |
| 3. SPRING                       | 8. SPRING         | 14. SPRING                        | 19. SCREW    |
| 4. LOW PRESSURE<br>RELIEF VALVE | 9. CHECK VALVE    | 15. POPPET                        | 20. CAP      |
| 5. NEUTRAL VALVE                | 10. PLUG          | 16. HIGH PRESSURE<br>RELIEF VALVE | 21. OIL SEAL |
|                                 | 11. PLUG          |                                   |              |

## Cross Sectional Drawing of the Port Block



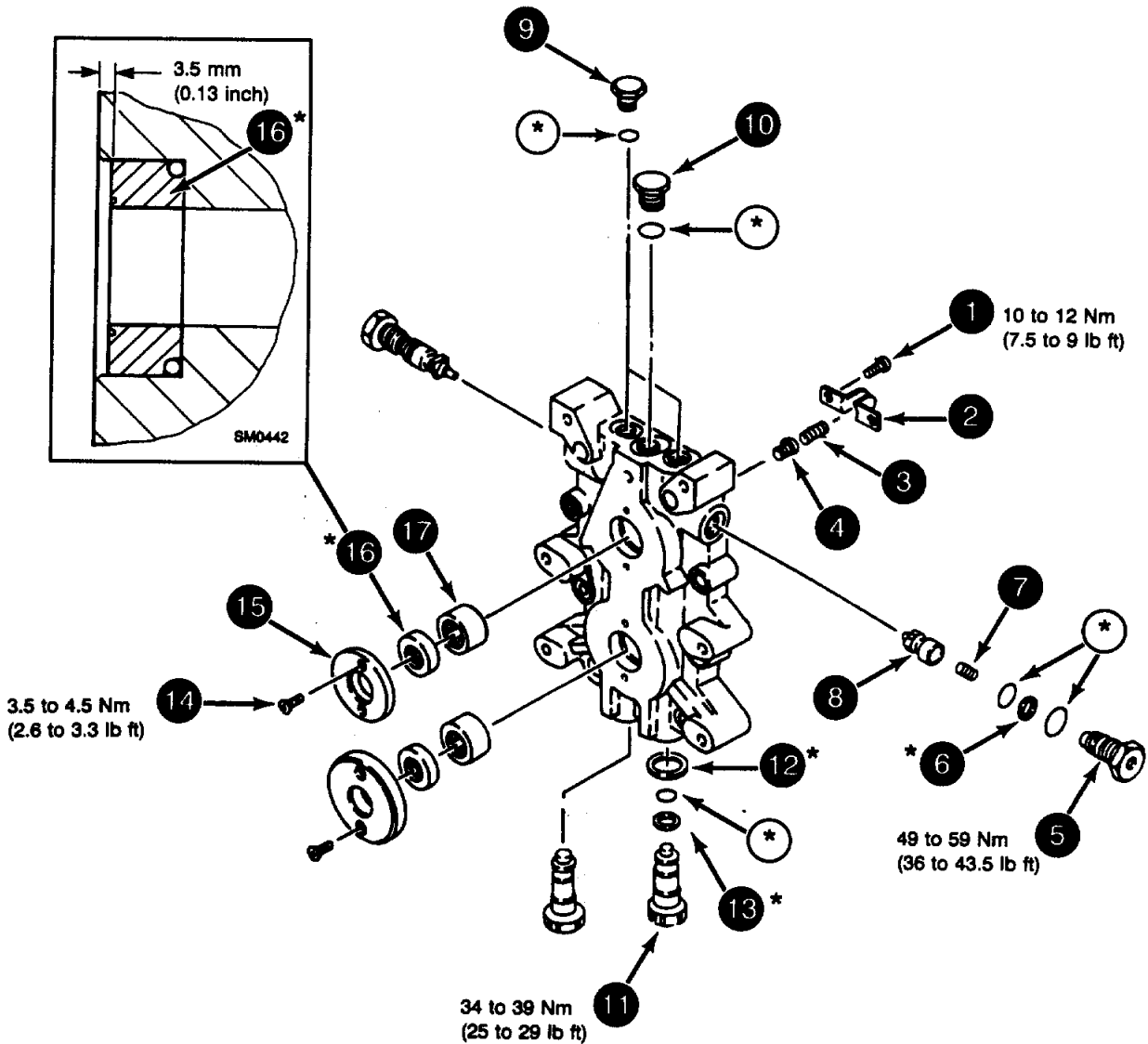
SM0434

- 5. NEUTRAL VALVE
- 9. CHECK VALVE
- 10. PLUG
- 16. HIGH PRESSURE RELIEF VALVE

## PORT BLOCK (7233, 7235, 7273 and 7275)

### Disassembly and Assembly

**NOTE:** Items are numbered in order of Disassembly.

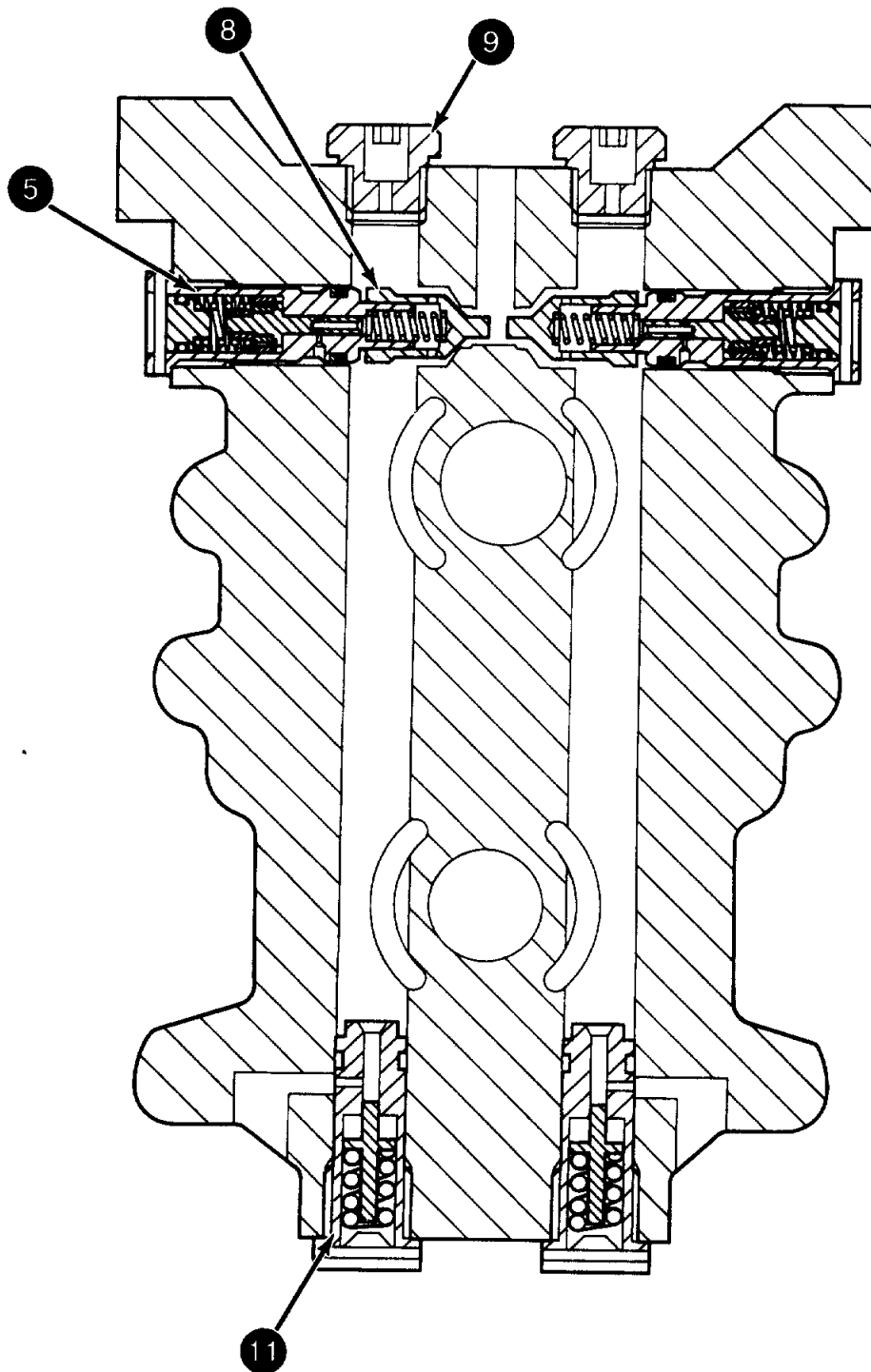


**NOTE:** Items marked (\*) must be replaced.

**NOTE:** For Assembly, lubricate new o-rings, sealing washers, oil seals and moving parts with clean hydraulic oil.

- |                                 |                                 |                    |              |
|---------------------------------|---------------------------------|--------------------|--------------|
| 1. CAP SCREW                    | 5. HIGH PRESURE<br>RELIEF VALVE | 9. PLUG            | 14. SCREW    |
| 2. BRACKET                      | 6. BACKUP RING                  | 10. PLUG           | 15. CAP      |
| 3. SPRING                       | 7. SPRING                       | 11. NEUTRAL VALVE  | 16. OIL SEAL |
| 4. LOW PRESSURE<br>RELIEF VALVE | 8. CHECK VALVE                  | 12. SEALING WASHER | 17. BEARING  |
|                                 |                                 | 13. BACKUP RING    |              |

## Cross Sectional Drawing of the Port Block



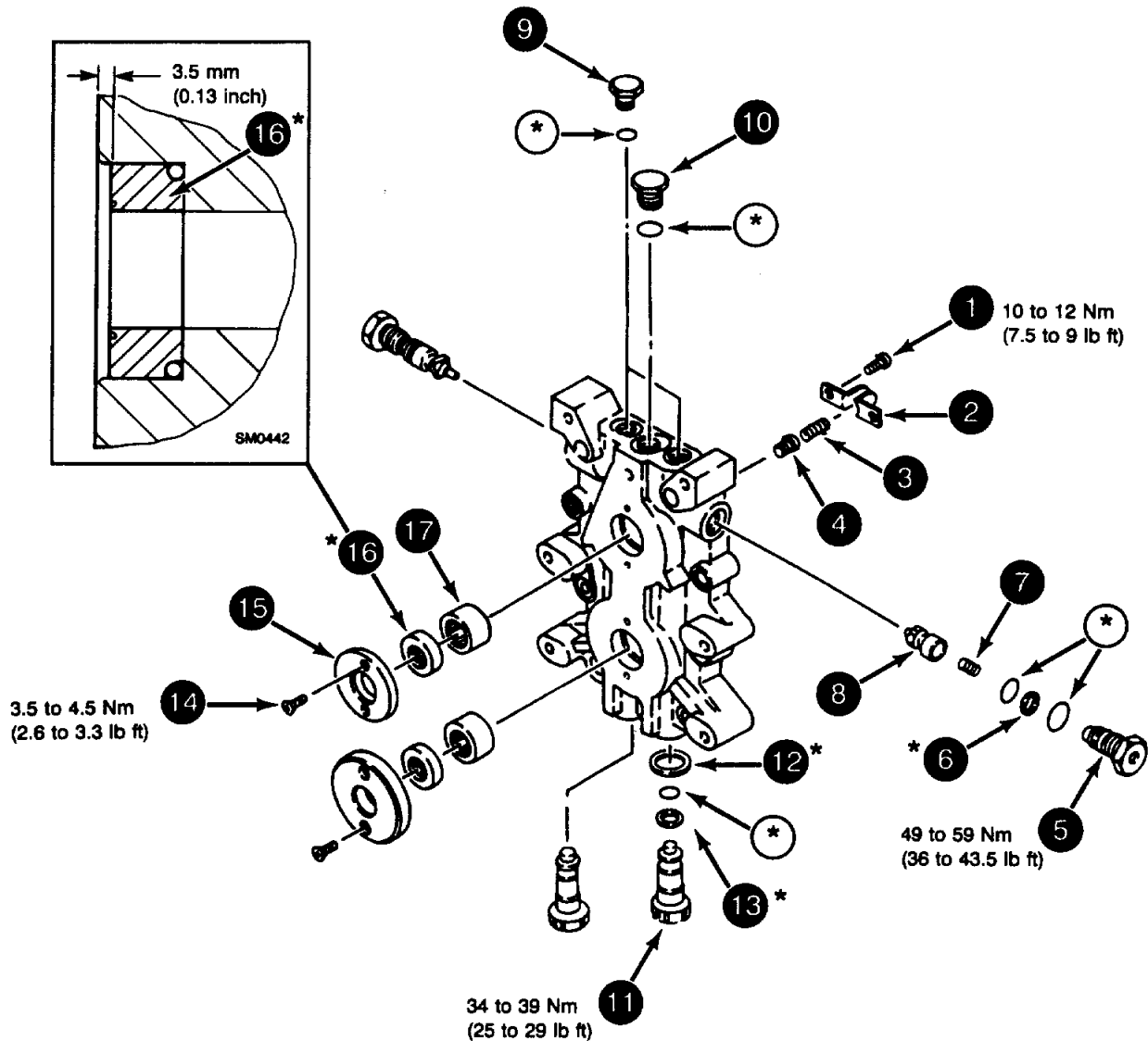
SM0436

- 5. HIGH PRESSURE  
RELIEF VALVE
- 8. CHECK VALVE
- 9. PLUG
- 11. NEUTRAL VALVE

## PORT BLOCK (7233, 7235, 7273 and 7275)

### Disassembly and Assembly

**NOTE:** Items are numbered in order of Disassembly.

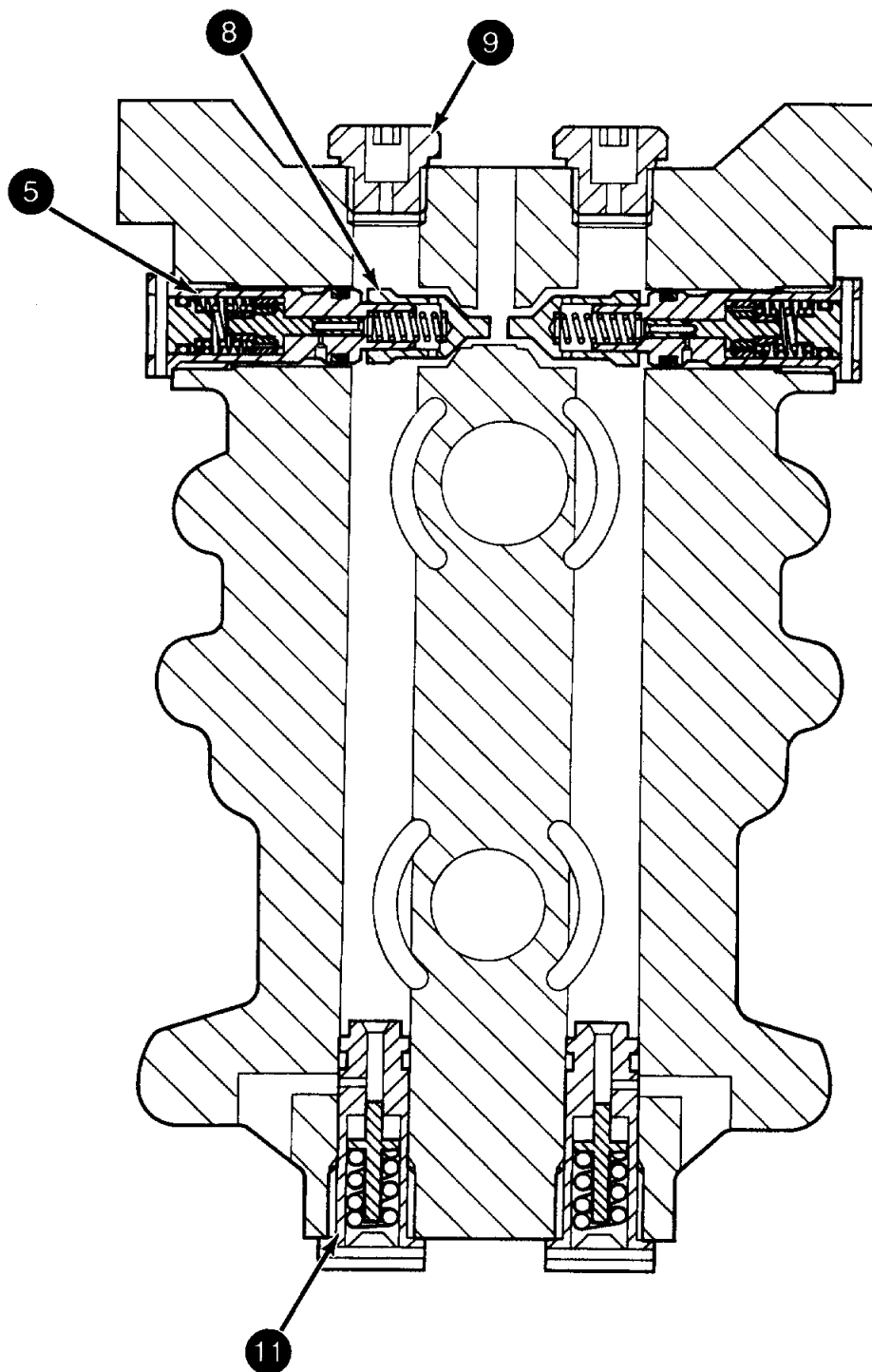


**NOTE:** Items marked (\*) must be replaced.

**NOTE:** For Assembly, lubricate new o-rings, sealing washers, oil seals and moving parts with clean hydraulic oil.

- |                              |                              |                    |              |
|------------------------------|------------------------------|--------------------|--------------|
| 1. CAP SCREW                 | 5. HIGH PRESURE RELIEF VALVE | 9. PLUG            | 14. SCREW    |
| 2. BRACKET                   | 6. BACKUP RING               | 10. PLUG           | 15. CAP      |
| 3. SPRING                    | 7. SPRING                    | 11. NEUTRAL VALVE  | 16. OIL SEAL |
| 4. LOW PRESSURE RELIEF VALVE | 8. CHECK VALVE               | 12. SEALING WASHER | 17. BEARING  |
|                              |                              | 13. BACKUP RING    |              |

## Cross Sectional Drawing of the Port Block



SM0436

- 5. HIGH PRESSURE  
RELIEF VALVE
- 8. CHECK VALVE
- 9. PLUG
- 11. NEUTRAL VALVE

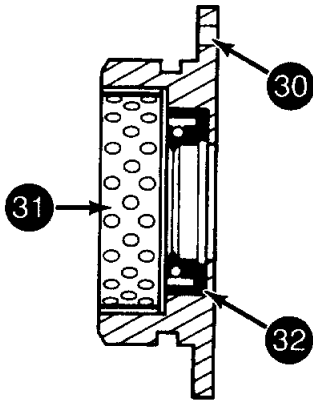
## HYDROSTATIC TRANSMISSION

### Assembly

#### [ 1 ]

Install the swashplate (33) into the housing.

#### [ 2 ]



Using bushing, bearing and seal drive set, OEM 6231 and disc number 27505 (1-3/8 inch), install a new oil seal (32) up to the shoulder of the trunion cap (30). Install bushing (31) and a new o-ring.

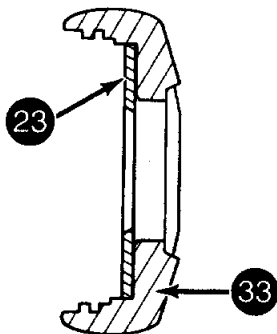
#### [ 3 ]

Install bearing (29) and a new o-ring onto the trunion cap (28). Install and tighten screws (27) to a torque of 3.5 to 4.5 Nm (2.6 to 3.3 lb ft).

#### [ 4 ]

Install snap ring (26) into the housing. Press bearing (25) up to the shoulder of shaft (24) and install the shaft (24) into the housing.

#### [ 5 ]



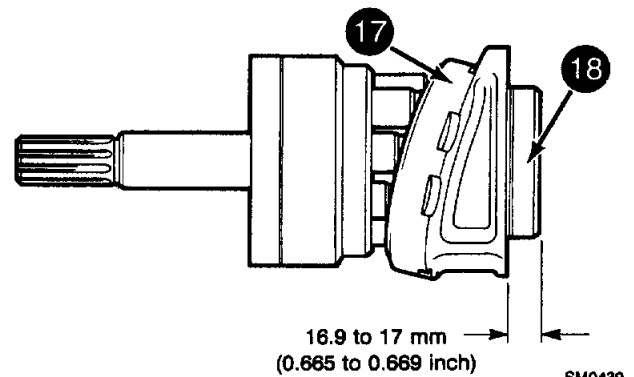
Install the thrust plate (23) onto the swashplate (33) as shown.

#### [ 6 ]

Assemble items (22 to 19) and install them onto the swashplate (33). Install snap ring (19) into the groove in the swashplate (33).

**NOTE:** Make sure that the snap ring (19) is fully seated.

#### [ 7 ]



Press bearing (18) up to the shoulder of the shaft (12). Install items (17 to 13) onto the shaft (12) and press the bearing (18) into the swashplate (17) as shown.

#### [ 8 ]

Install the assembly into the housing, matching the dowel in the housing with the hole in the swashplate (17). Press the shaft (12) into the housing.

#### [ 9 ]

Apply petroleum jelly to the valve plates (11) and install them onto the port block (9).

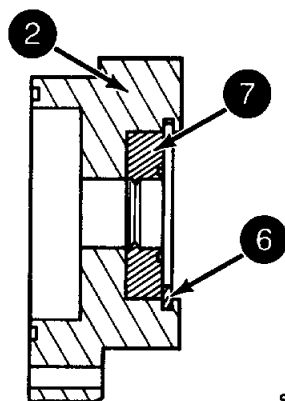
**IMPORTANT:** Make sure that the valve plates are installed into the same position as removed in *Hydrostatic Transmission Disassembly, Page 12, Step 2*.

#### [ 10 ]

Install items (10 to 8) and tighten (8) to a torque of 31 to 38 Nm (23 to 28 lb ft).



[ 11 ]

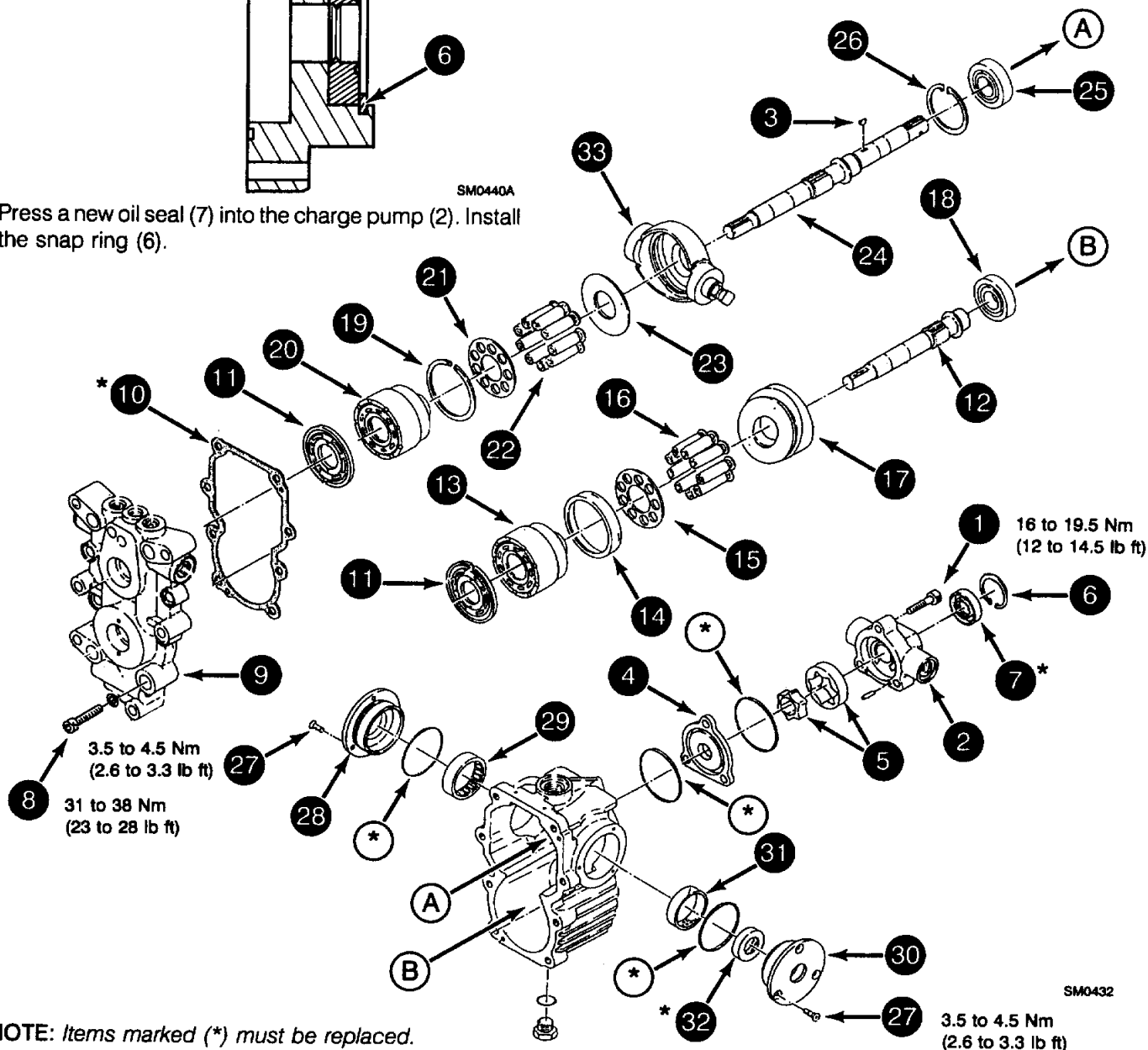


Press a new oil seal (7) into the charge pump (2). Install the snap ring (6).

SMO440A

[ 12 ]

Install items (5 and 4) and new o-rings into the charge pump (2) and install items (3 to 1) onto the housing and tighten (1) to a torque of 16 to 19.5 Nm (12 to 14.5 lb ft).



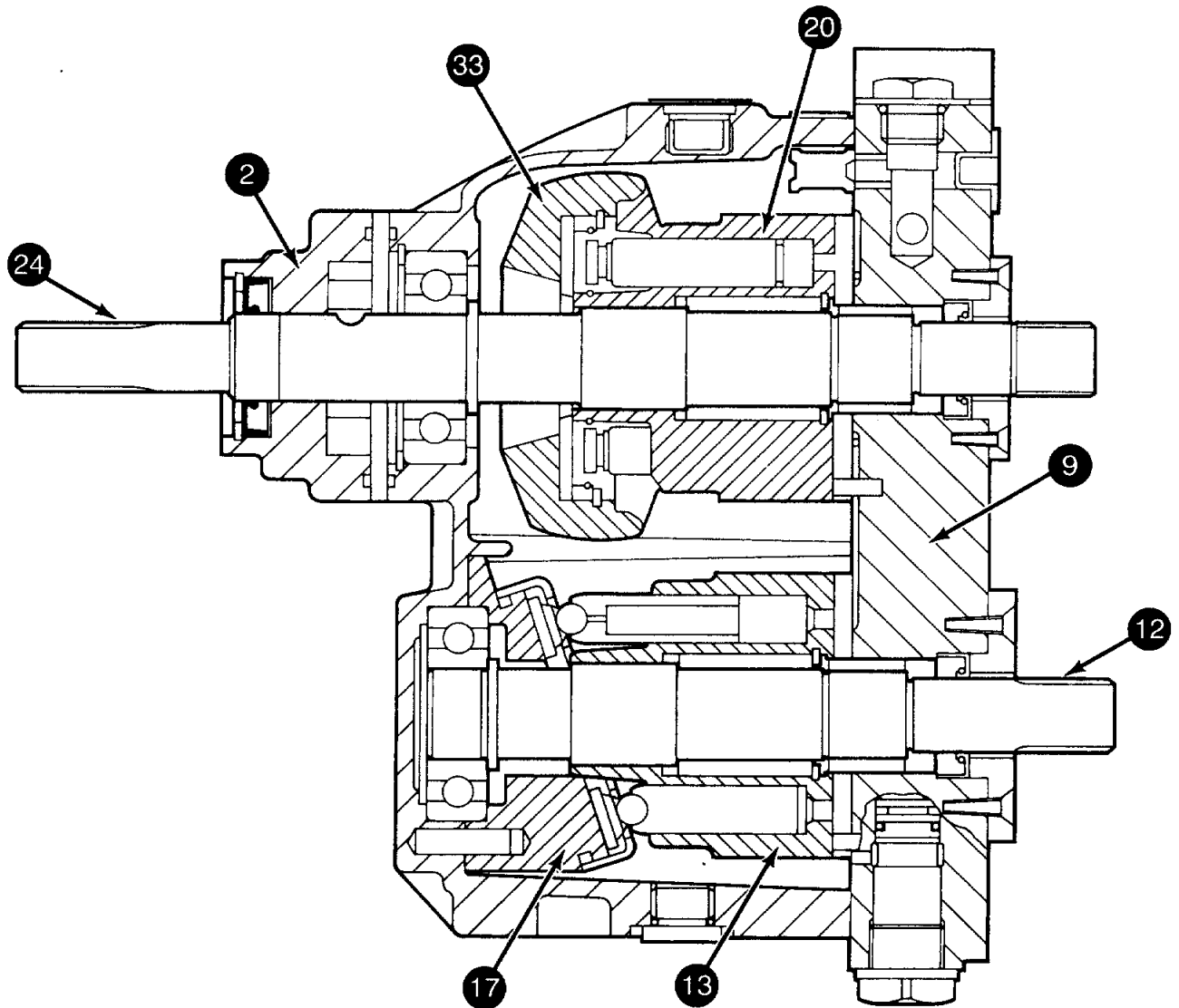
SMO432

NOTE: Items marked (\*) must be replaced.

NOTE: For Assembly, lubricate new o-rings, gaskets, seals and all moving parts with clean hydraulic oil.

- |                |                       |                      |                  |
|----------------|-----------------------|----------------------|------------------|
| 1. CAP SCREW   | 9. PORT BLOCK         | 17. SWASHPLATE       | 25. BEARING      |
| 2. CHARGE PUMP | 10. GASKET            | 18. BEARING          | 26. SNAP RING    |
| 3. KEY         | 11. VALVE PLATE       | 19. SNAP RING        | 27. SCREW        |
| 4. SPACER      | 12. MOTOR DRIVE SHAFT | 20. CYLINDER BARREL  | 28. TRUNNION CAP |
| 5. STATOR      | 13. CYLINDER BARREL   | 21. SLIPPER RETAINER | 29. BEARING      |
| 6. SNAP RING   | 14. PISTON RETAINER   | 22. PISTON           | 30. TRUNNION CAP |
| 7. OIL SEAL    | 15. SLIPPER RETAINER  | 23. THRUST PLATE     | 31. BUSHING      |
| 8. CAP SCREW   | 16. PISTON            | 24. PUMP SHAFT       | 32. OIL SEAL     |
|                |                       |                      | 33. SWASHPLATE   |

## Cross Sectional Drawing of the Hydrostatic Transmission



SM0441

- 2. CHARGE PUMP
- 9. PORT BLOCK
- 12. MOTOR DRIVE SHAFT
- 13. CYLINDER BARREL

- 17. SWASHPLATE
- 20. CYLINDER BARREL
- 24. PUMP SHAFT
- 33. SWASHPLATE

## PTO LEVER AND MID PTO LEVER

### Disassembly and Assembly

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

[ 2 ]

Remove the hydraulic lift housing, refer to Section 4.

[ 3 ]

Put identification marks on the levers and selector forks for assembly.

[ 4 ]

Remove items (1 to 8).

**NOTE:** Tractors not equipped with mid PTO will have a washer replacing item (2).

[ 5 ]

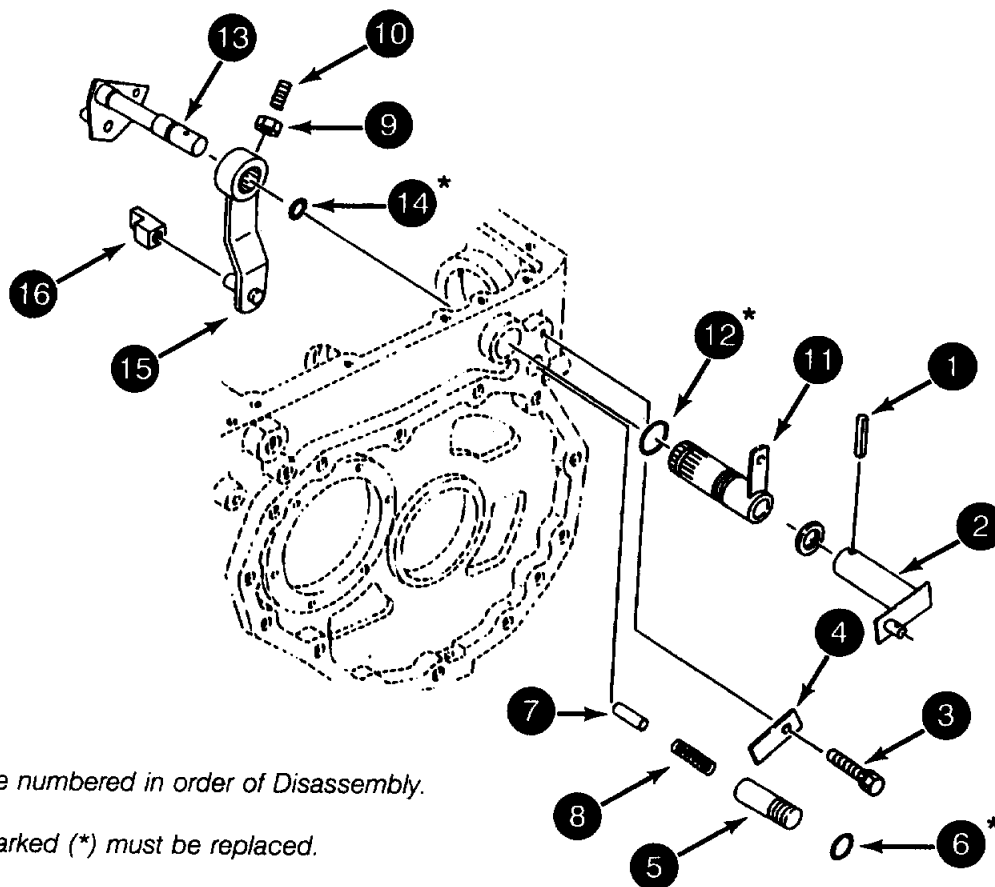
Remove items (9 to 16).

**NOTE:** For Assembly, make sure item (16) is installed with the tapered side facing forwards.

[ 6 ]

Check items (13 and 16) for wear or damage and replace necessary.

**NOTE :** For Assembly, follow the same procedure in reverse order.



SM0370

**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

- 1. ROLL PIN
- 2. MID PTO LEVER
- 3. BOLT
- 4. PLATE

- 5. BOSS
- 6. O-RING
- 7. PIN
- 8. SPRING

- 9. NUT
- 10. SCREW
- 11. PTO LEVER
- 12. O-RING

- 13. MID PTO SHIFTER
- 14. O-RING
- 15. PTO SHIFTER
- 16. SHIFTER FINGER

## SERVICING THE PTO

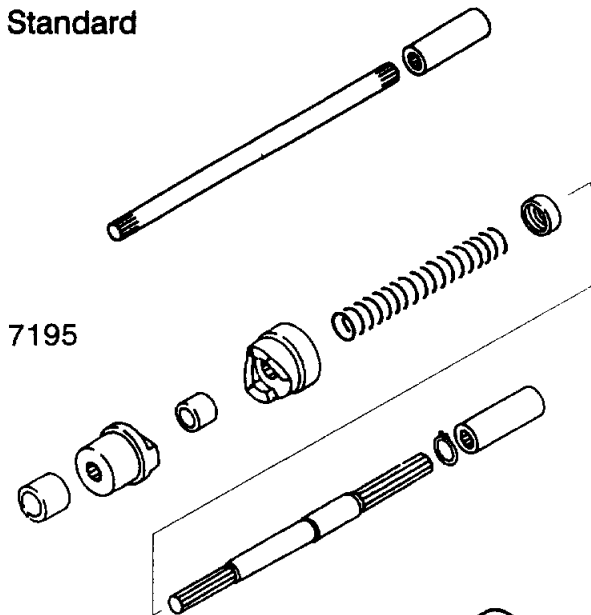
### Disassembly

#### [ 1 ]

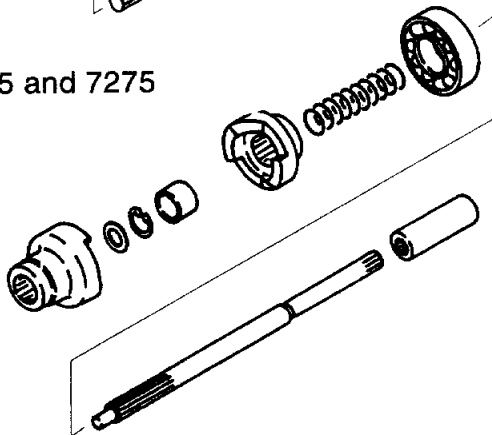
Separate the speed transmission from the range transmission, refer to Page 72, 77 and 102.

#### [ 2 ]

#### Standard



#### 7235 and 7275



SM0369A

Remove the PTO drive shaft, coupling and over-running clutch assembly.

#### [ 3 ]

Remove the differential assembly, refer to Page 92.

#### [ 4 ]

Remove items (1 to 3).

**NOTE :** *Keep shims (3) together for assembly.*

#### [ 5 ]

Use a soft faced hammer and drive shaft (4) rearwards out of bearing (8) and remove the shaft assembly out of the housing.

#### [ 6 ]

Remove items (5 to 8). Use a hydraulic press to remove item (6) from shaft (4).

#### [ 7 ]

Remove nut (9). Support the counter shaft assembly and drive shaft (10) rearward from the housing. Remove items (11 and 12).

#### [ 8 ]

Remove items (13 to 15) and lift out the countershaft assembly items (17 to 28). Remove item (16) (7235 and 7275 only).

**NOTE :** *Keep shims (15) together for assembly.*

#### [ 9 ]

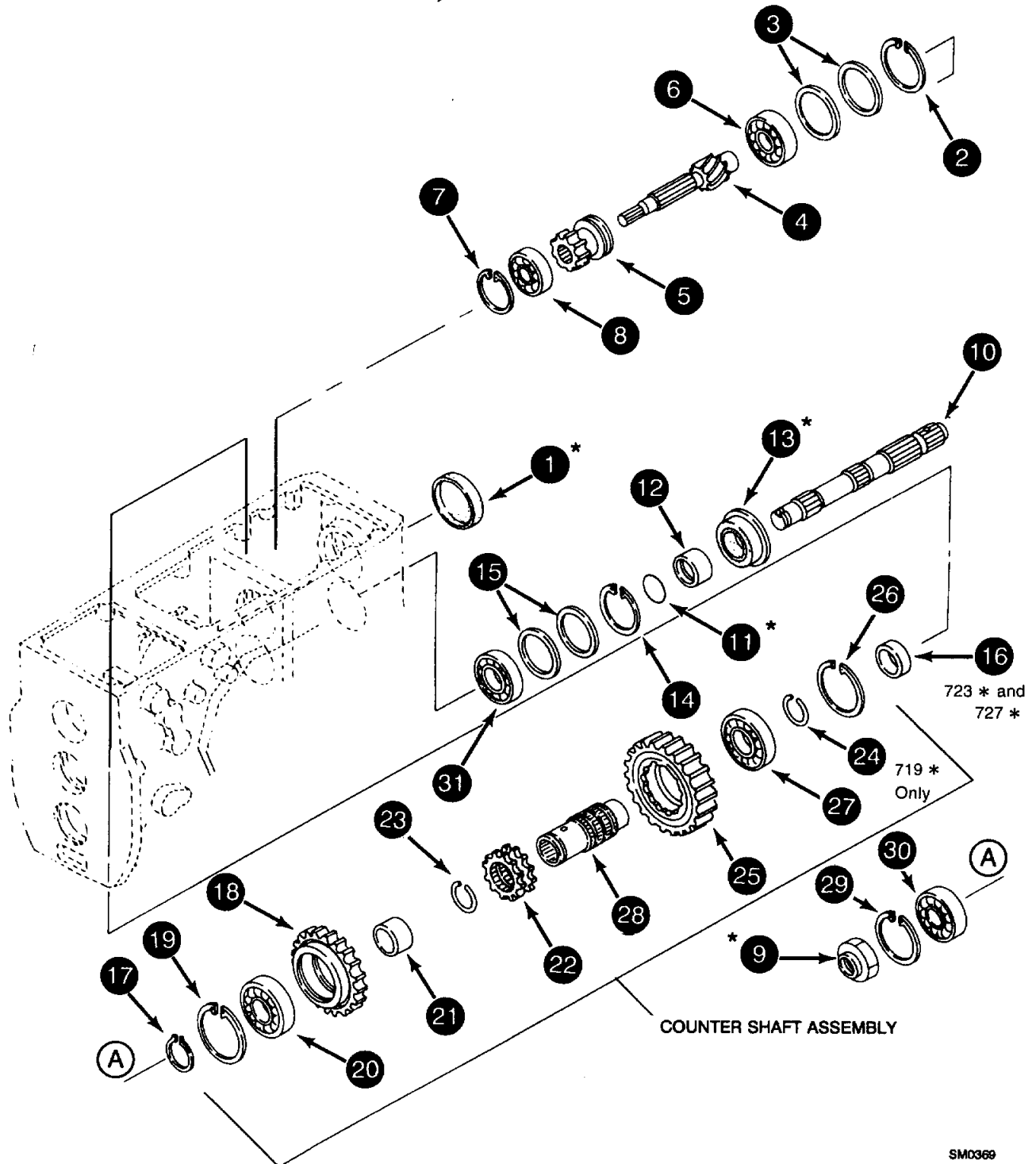
Remove items (17 to 28). Use a hydraulic press to remove items (18, 20, 25 and 27) from shaft (28).

**NOTE:** *Item (24) is fitted to the 7195 only.*

#### [ 10 ]

Remove items (29 to 31). Use a slide hammer to remove items (30 and 31).

NOTE: Items are numbered in order of Disassembly.



SM0369

NOTE: Items marked (\*) must be replaced.

- |                 |               |                    |                   |
|-----------------|---------------|--------------------|-------------------|
| 1. SEAL CAP     | 9. NUT        | 17. SNAP RING      | 25. GEAR          |
| 2. SNAP RING    | 10. PTO SHAFT | 18. GEAR           | 26. SNAP RING     |
| 3. SHIM         | 11. O-RING    | 19. SNAP RING      | 27. BEARING       |
| 4. SHAFT        | 12. COLLAR    | 20. BEARING        | 28. COUNTER SHAFT |
| 5. SHIFT COLLAR | 13. SEAL      | 21. COLLAR         | 29. SNAP RING     |
| 6. BEARING      | 14. SNAP RING | 22. GEAR           | 30. BEARING       |
| 7. SNAP RING    | 15. SHIM      | 23. RETAINING RING | 31. BEARING       |
| 8. BEARING      | 16. SPACER    | 24. SNAP RING      |                   |

## Assembly

### [ 1 ]

Install items (31 to 29).

Install items (27 and 26) to item (25). Use a hydraulic press and install the assembly to shaft (28).

### [ 2 ]      719 \* Only

Install item (24).

### [ 3 ]

Install items (23 to 21).

**NOTE:** Install item (21) with the cut outs towards item (20).

### [ 4 ]

Install items (20 to 18). Use a hydraulic press and install the assembly to shaft (28). Install item (17).

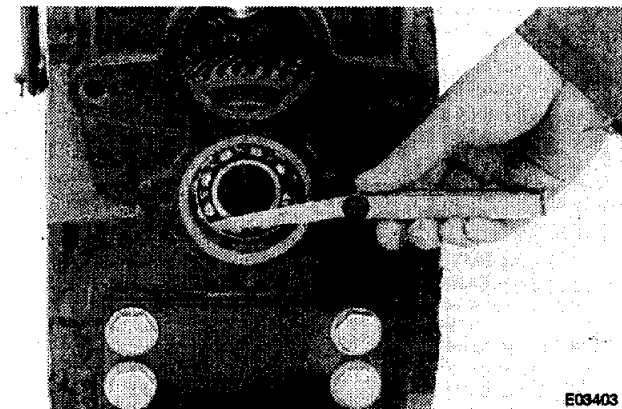
### [ 5 ]      723 \* and 727 \* Only

Install item (16). Use petroleum jelly to hold item (16) in place.

### [ 6 ]

Install the counter shaft assembly into the transmission housing. Install item (14).

### [ 7 ]



E03403

Measure the gap between items (31 and 14). The end play must be 0.05 to 0.2 mm (0.002 to 0.008 inch). Add or remove shims (15) until the end play is correct.

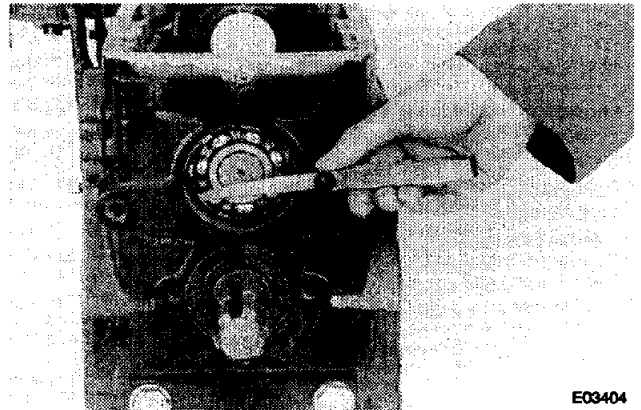
### [ 8 ]

Install items (11 to 9). Tighten nut (9) to a torque of 29 to 39 Nm (21 to 29 lb ft). Install item (13). Secure nut (9) to the shaft.

### [ 9 ]

Install items (7 and 8) into the housing. Press bearing (6) onto shaft (4). Install item (5) onto shaft (4) and install the shaft assembly into the housing. Use a soft faced hammer to drive shaft (4) into bearing (8). Install item (2).

### [ 10 ]



E03404

Measure the gap between items (6 and 2). The end play must be 0.05 to 0.2 mm (0.002 to 0.008 inch). Add or remove shims (3) until the end play is correct.

### [ 11 ]

Install item (1).



## SERVICING THE MID PTO

### Disassembly and Assembly

#### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

#### [ 2 ]

Place a container with a capacity of at least 25 litres (6.6 US Galls) under the transmission drain plug (1). Remove the drain plug and drain the oil. Install and tighten the drain plug.

**NOTE:** For Assembly, install 24 litres (6.3 US Galls) (723 \* and 727 \* ) or 19 litres (5.0 US Galls) (719 \* ) of clean Cub Cadet hydraulic transmission fluid.

#### [ 3 ]

Remove items (2 and 3).

#### [ 4 ]

Support the mid PTO assembly (A), remove bolts (4) and remove the assembly (A).

#### [ 5 ]

Remove items (5 to 11). Use a slide hammer puller to remove items (8 and 9).

#### [ 6 ]

Remove items (12 and 13).

#### [ 7 ]

Pull the shaft out of the housing. Remove items (14 and 15) from the housing.

#### [ 8 ]

Remove items (16 to 19). Use a hydraulic press to remove item (18).

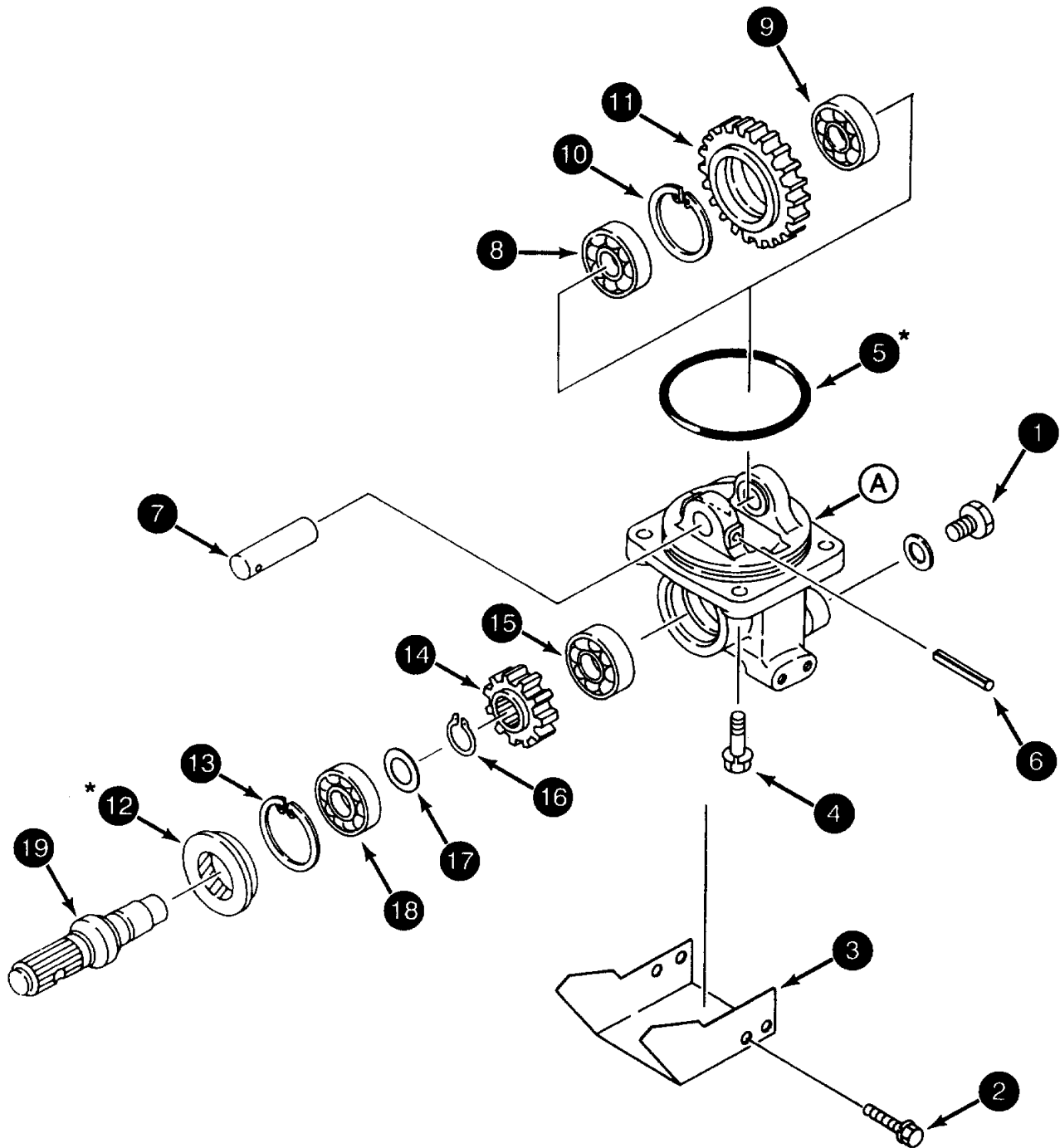
**NOTE:** For Assembly, use a bearing oven to heat bearing (18) to a temperature of 121°C (250°F) and install to shaft (19).



**NOTE :** For Assembly, follow the same procedure in reverse order.



NOTE : Items are numbered in order of Disassembly.

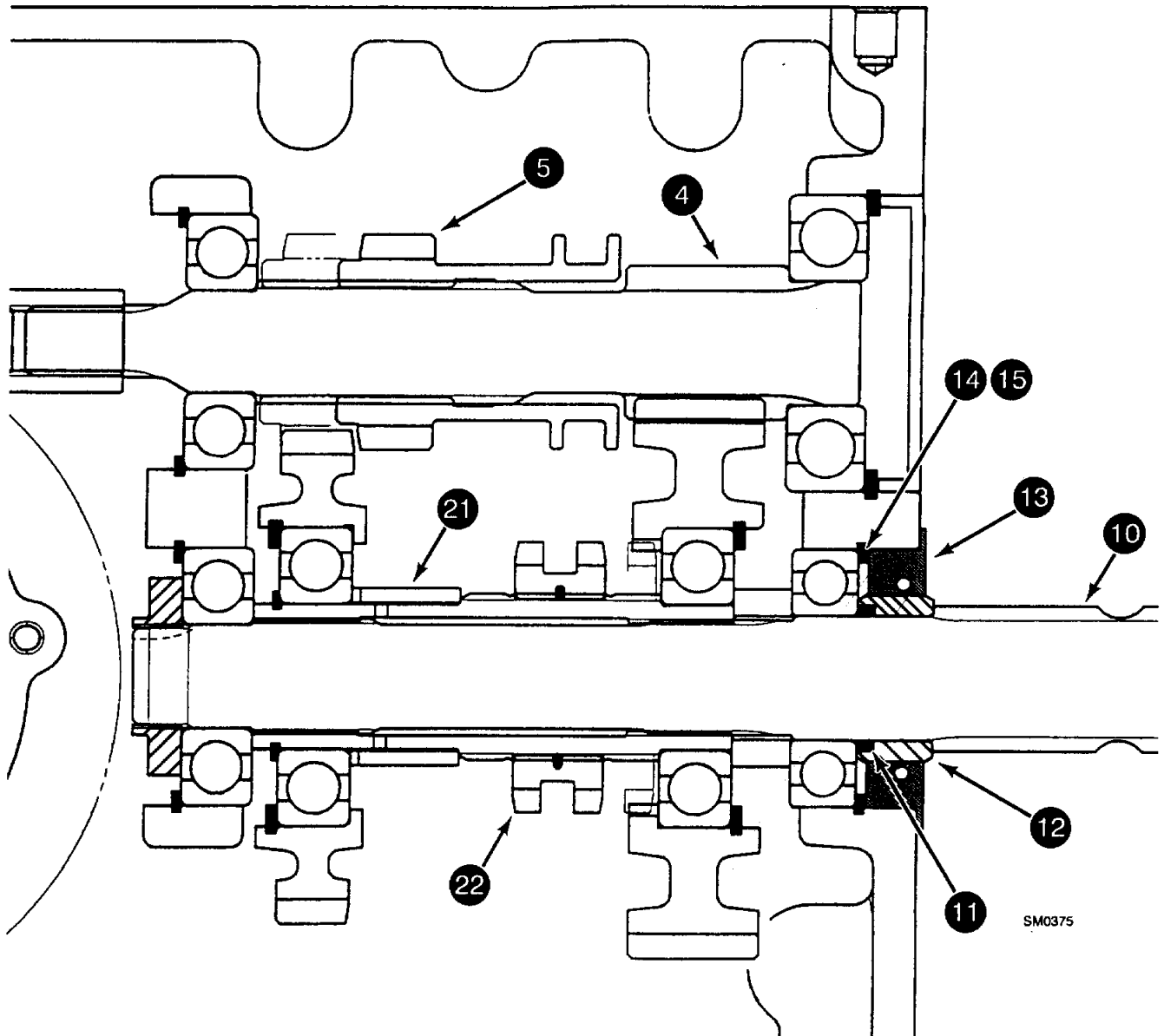


NOTE : Items marked (\*) must be replaced.

SM0373

- |               |               |               |                   |
|---------------|---------------|---------------|-------------------|
| 1. DRAIN PLUG | 6. ROLL PIN   | 11. GEAR      | 16. SNAP RING     |
| 2. BOLT       | 7. SHAFT      | 12. SEAL      | 17. THRUST WASHER |
| 3. SHEILD     | 8. BEARING    | 13. SNAP RING | 18. BEARING       |
| 4. BOLT       | 9. BEARING    | 14. GEAR      | 19. SHAFT         |
| 5. O-RING     | 10. SNAP RING | 15. BEARING   |                   |

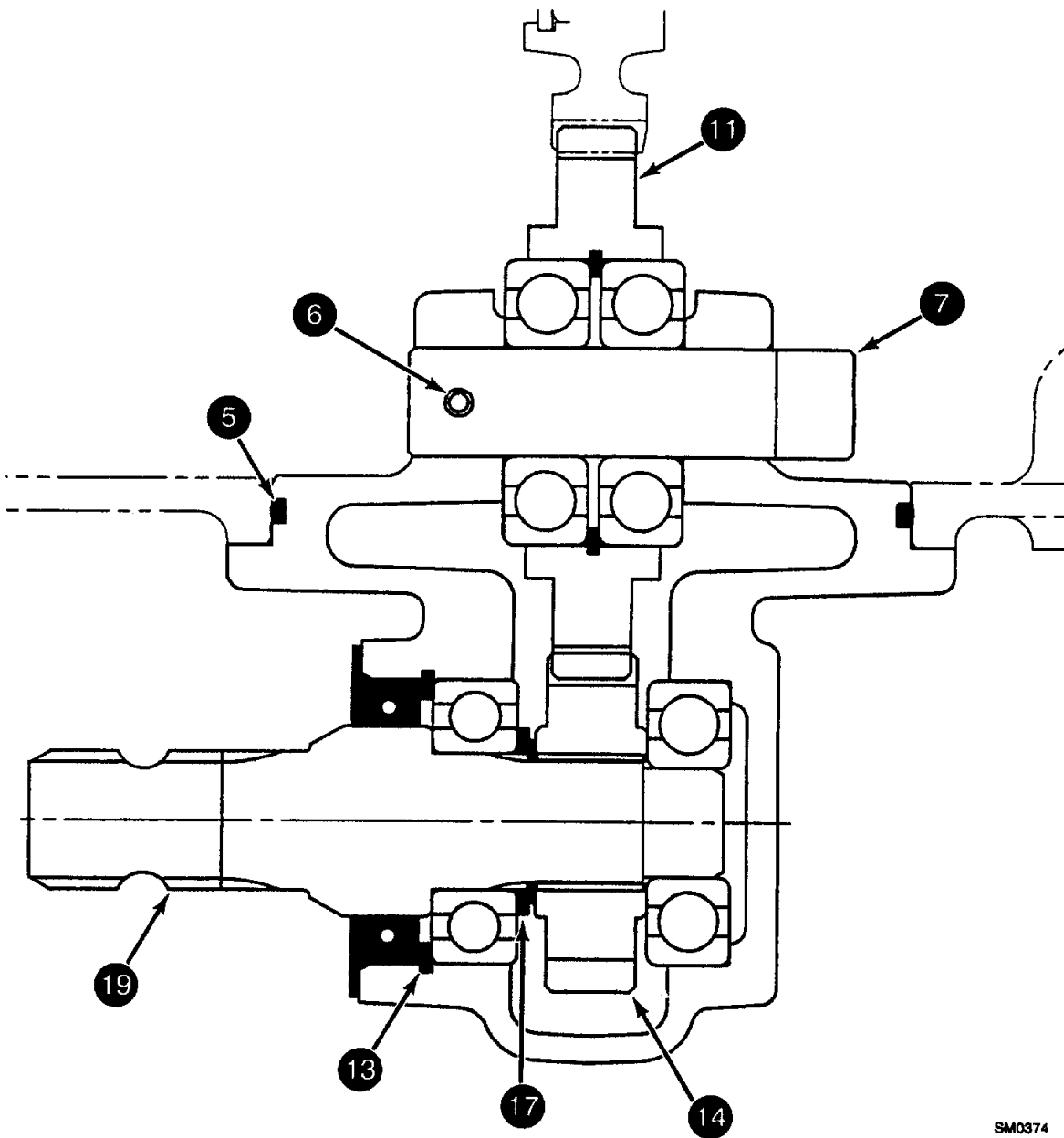
## Cross Sectional Drawing of the PTO



- 4. SHAFT
- 5. SHIFT COLLAR
- 10. PTO SHAFT
- 11. O-RING
- 12. COLLAR

- 13. SEAL
- 14. SNAP RING
- 15. SNAP RING
- 21. COLLAR
- 22. GEAR

## Cross Sectional Drawing of the Mid PTO



SM0374

- 5. O-RING
- 6. ROLL PIN
- 7. SHAFT
- 11. GEAR

- 13. SNAP RING
- 14. GEAR
- 17. THRUST WSHER
- 19. SHAFT

## REAR AXLE

### Removal and Installation

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels. Disengage the parking brake.

[ 2 ]

Put a container with a capacity of at least 25 litres (6.6 US gal) under the axle drain plug. Remove the drain plug and drain the oil. Install and tighten the drain plug.

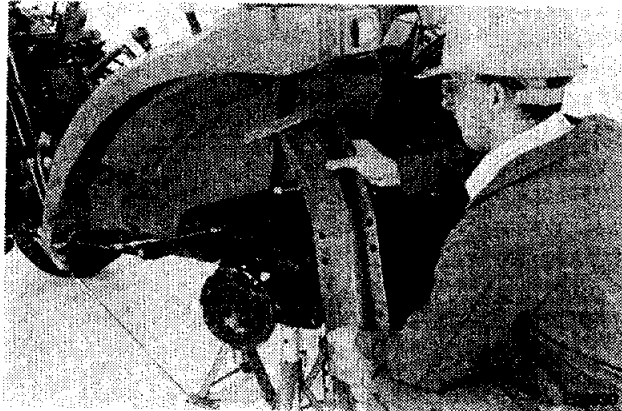
**NOTE:** For Assembly, install 19 litres (5.0 US gal) (719 \*) or 24 litres (6.3 UK gal) (723 \* and 727 \*) of clean Cub Cadet hydraulic transmission fluid.

[ 3 ]

Remove the rear wheels and support the tractor on axle stands.

**NOTE:** For Installation, tighten the rear wheel bolts to a torque of 118 to 132 Nm (87 to 97 lb ft).

[ 4 ]

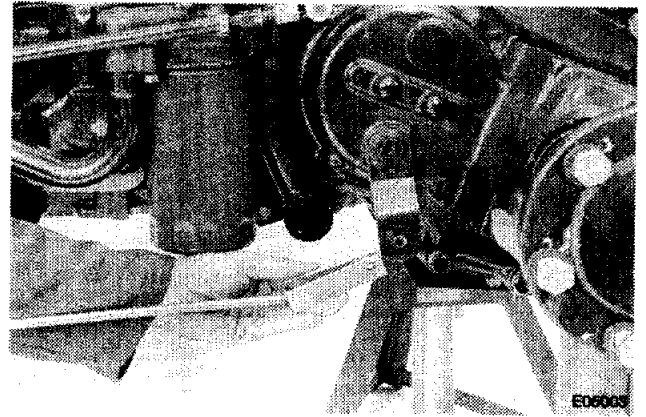


Support the ROPS frame and remove the fender support.

**NOTE:** For Assembly, tighten the fender support bolts to a torque of 83 to 93 Nm (61 to 69 lb ft) and the axle support bolt to a torque of 118 to 132 Nm (87 to 97 lb ft).

**NOTE:** Follow the same procedure as in [ 11 ] and [ 12 ] to remove the right hand axle.

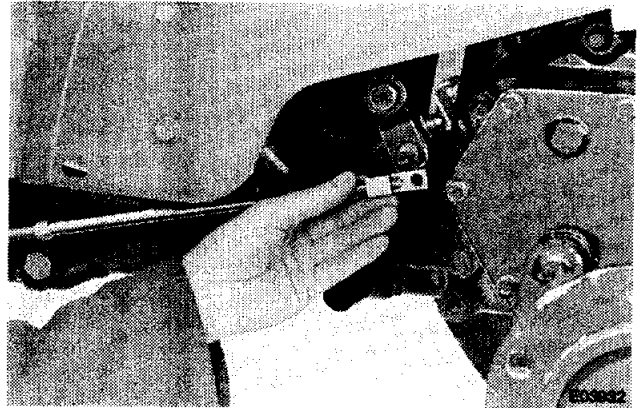
[ 5 ]



Disconnect the brake rod.

[ 6 ]

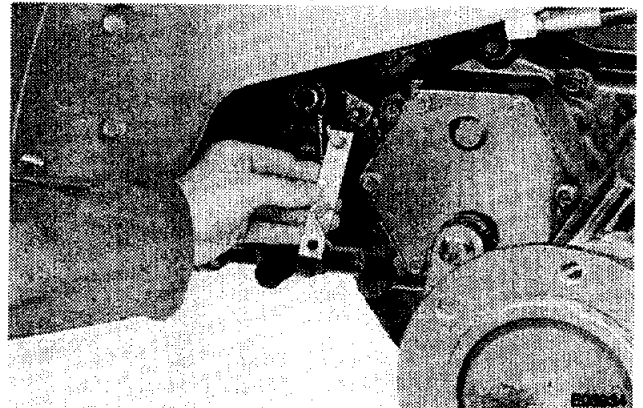
719 \* Only



Disconnect the MFD lever (if equipped).

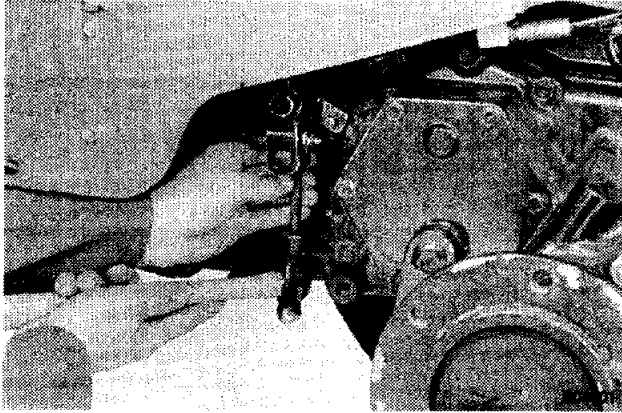
[ 7 ]

719 \* Only



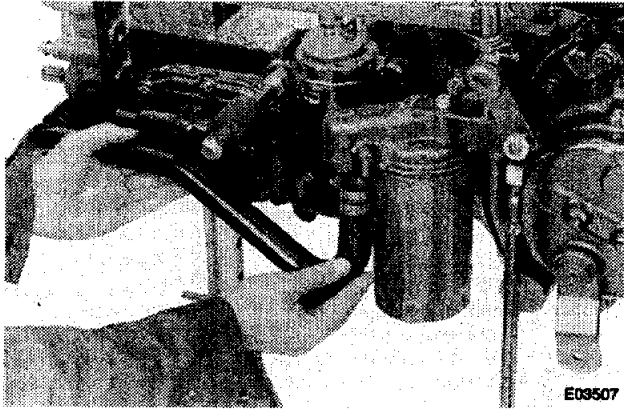
Disconnect and remove the range lever connector.

**[ 8 ]** 719 \* Only



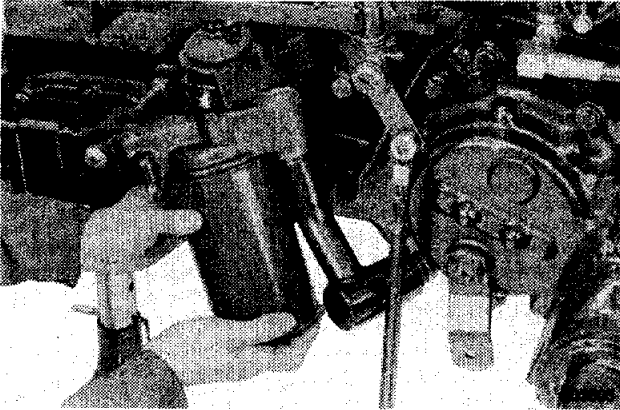
Remove the roll pin on the range lever and turn the lever away from the axle.

**[ 9 ]** 723 \* and 727 \* Only



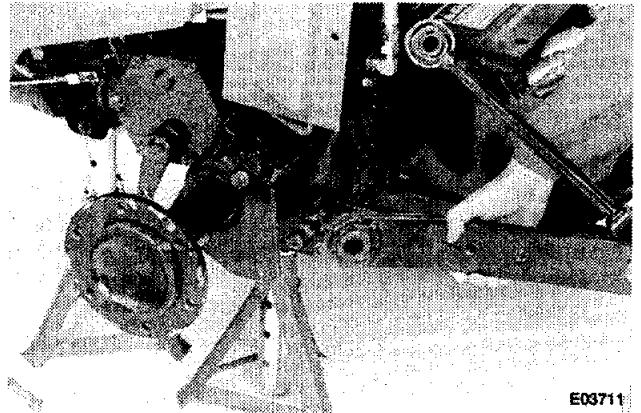
Disconnect and cap the hydraulic filter supply tube.

**[ 10 ]** 723 \* and 727 \* Only



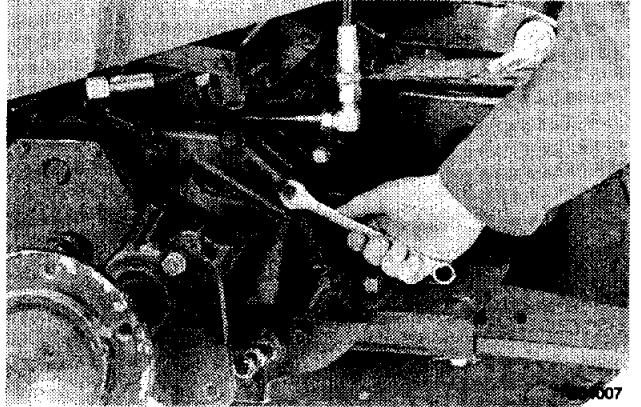
Remove the hydraulic filter assembly.

**[ 11 ]**



Remove the 3 point hitch lift arm.

**[ 12 ]**



Support the axle on suitable lifting equipment, remove the retaining bolts and remove the axle.

**NOTE:** For Installation, apply a continuous bead of Loctite 515 to the axle housing.

**NOTE:** For installation, tighten the retaining bolts to a torque of 49 to 59 Nm (36 to 44 lb ft) (719 \* ) or 83 to 93 Nm (61 to 69 lb ft) (723 \* and 727 \* ).

**NOTE:** For Installation, follow the same procedure in reverse order.

## Disassembly and Assembly (719 \* )

### [ 1 ]

Remove items (1 and 2) (if equipped).

### [ 2 ]

Remove items (3 to 7). Use a bearing puller to remove item (4).

**NOTE :** Keep shims (3) together for assembly.

**NOTE:** For Assembly, use a bearing oven and heat bearing (4) to a temperature of 121°C (250°F).



**WARNING :** Always use heat protective gloves when handling heated parts.

### [ 3 ]

Use a soft faced hammer and drive the axle (8) from the housing.

### [ 4 ]

Remove item (9).

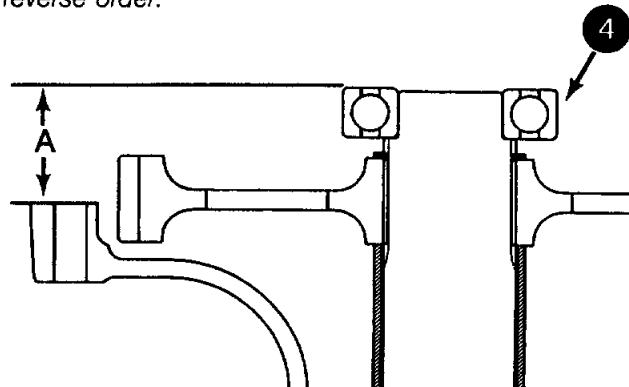
### [ 5 ]

Remove items (10 to 12).

### [ 6 ]

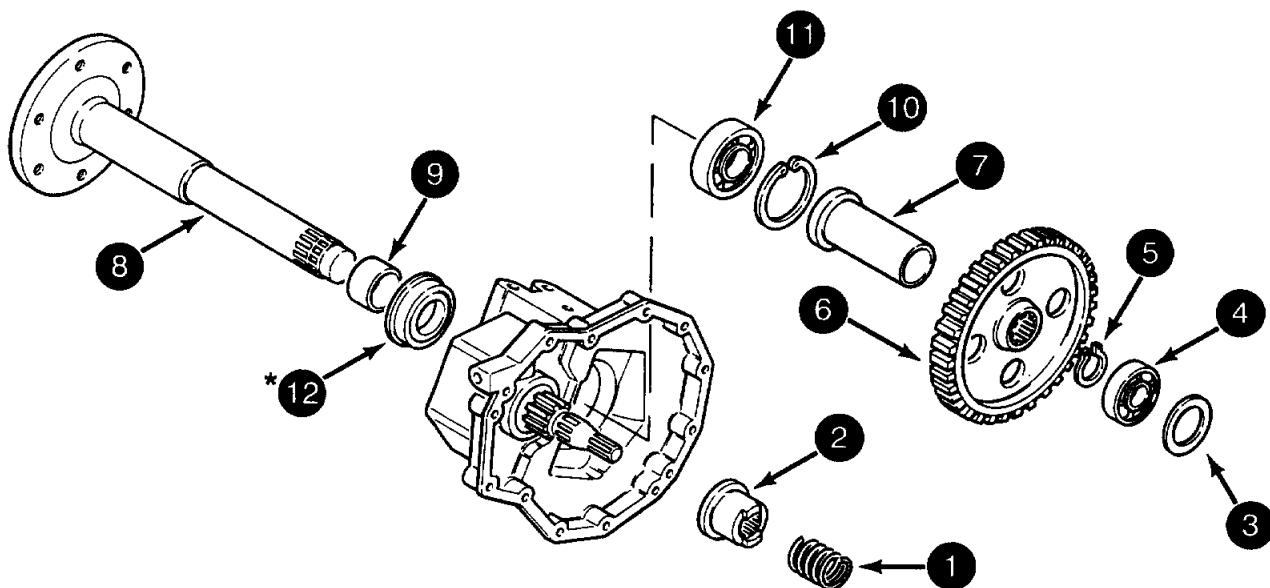
Check all items for wear or damage and replace as necessary.

**NOTE:** For Assembly, follow the same procedure in reverse order.



SM0377A

**NOTE:** If new parts have been installed, add or remove shims (3) on top of bearing (4) until dimension (A) is 39.65 to 39.85 mm (1.56 to 1.57 inch).



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

SM0378

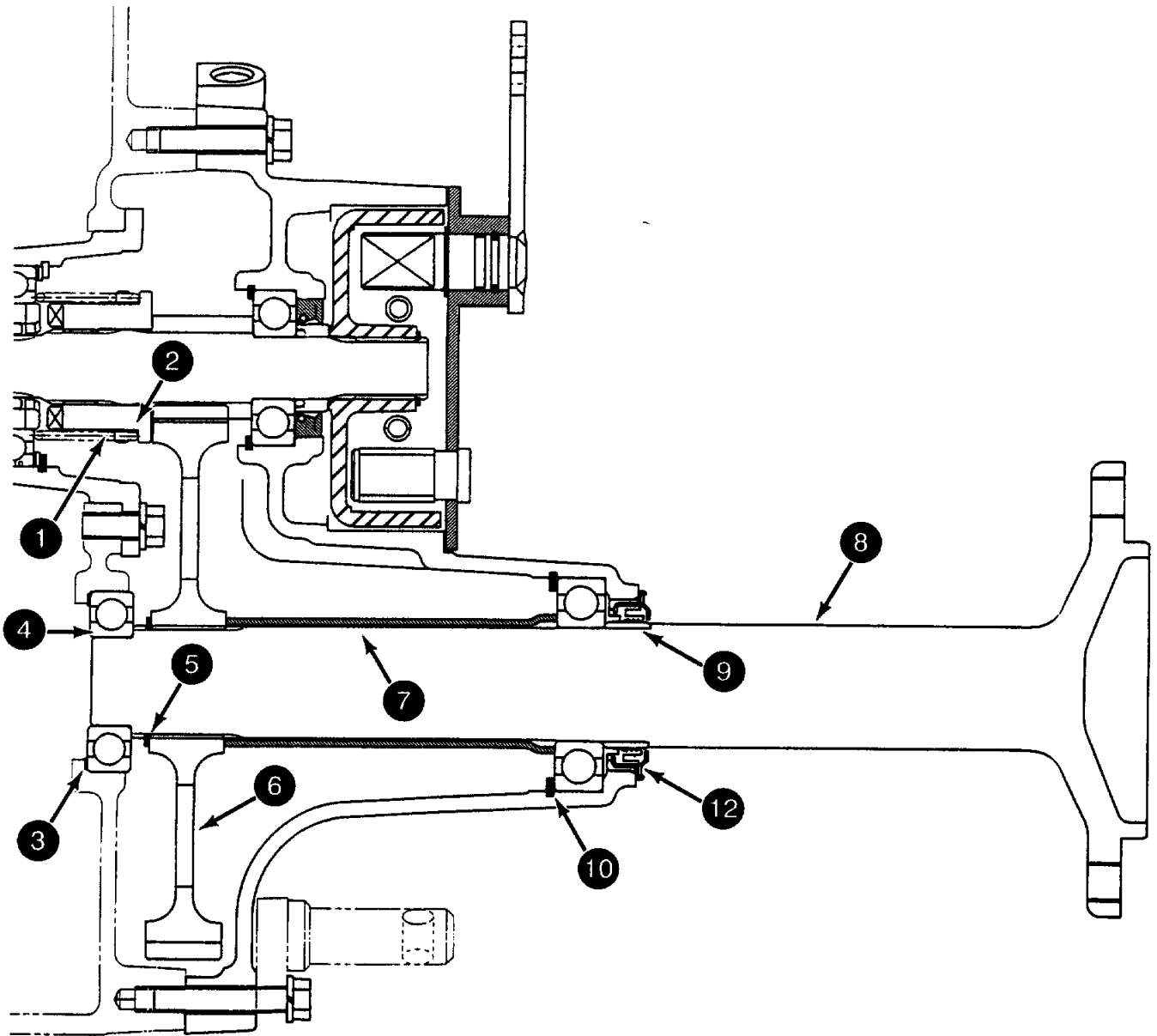
- 1. SPRING
- 2. COLLAR
- 3. SHIM

- 4. BEARING
- 5. SNAP RING
- 6. GEAR

- 7. COLLAR
- 8. AXLE SHAFT
- 9. BUSHING

- 10. SNAP RING
- 11. BEARING
- 12. SEAL

## Cross Sectional Drawing of the Rear Axle (719 \* )



SM0377

1. SPRING  
2. COLLAR  
3. SHIM

4. BEARING  
5. SNAP RING  
6. GEAR

7. COLLAR  
8. AXLE SHAFT  
9. BUSHING

10. SNAP RING  
12. SEAL

## Disassembly and Assembly (723 \* and 727 \* )

### [ 1 ]

Remove items (1 to 3) (if equipped).

### [ 2 ]

Using a bearing puller to remove bearing (4).

**NOTE:** For Assembly, use a bearing oven and heat bearing (4) to a temperature of 121°C (250°F).



**WARNING :** Always use heat protective gloves when handling heated parts.

### [ 3 ]

Remove items (5 to 8).

**NOTE :** Keep shims (5) together for assembly.

### [ 4 ]

Use a soft faced hammer and drive the axle (9) from the housing.

### [ 5 ]

Remove item (10).

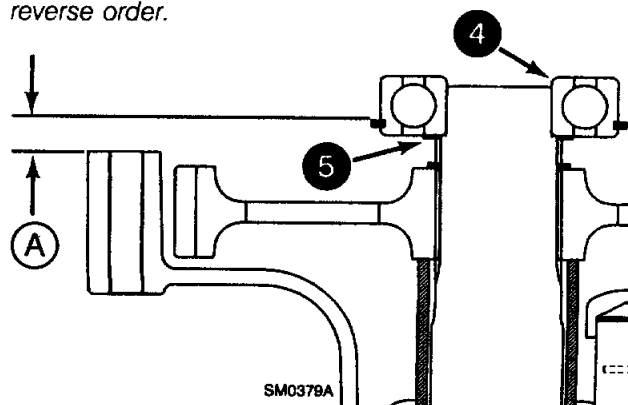
### [ 6 ]

Remove items (11 to 13).

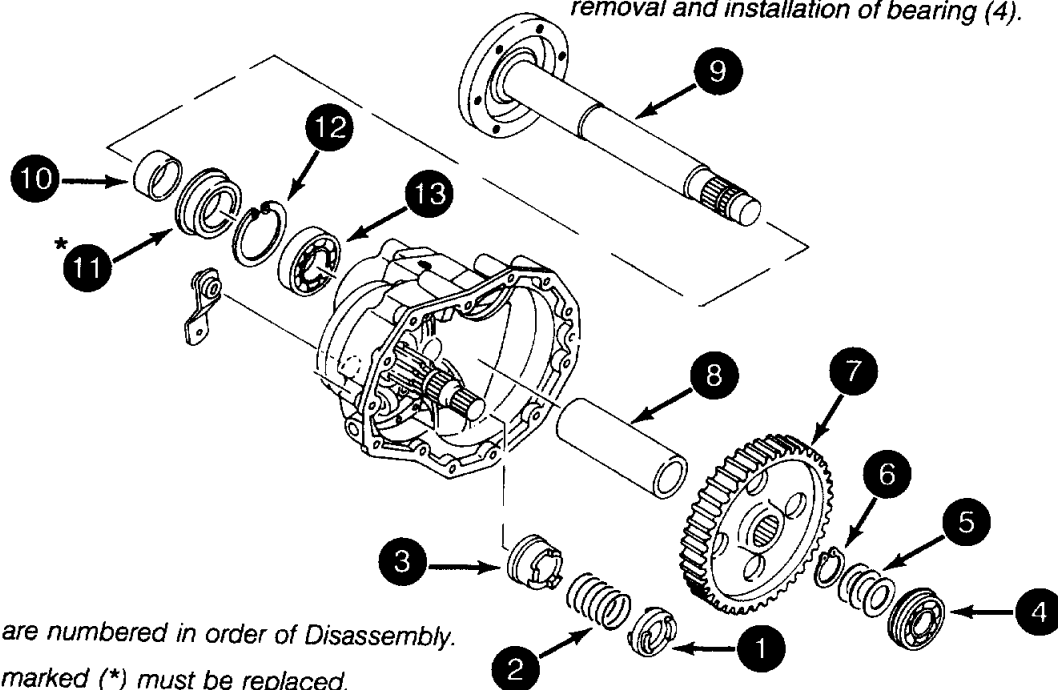
### [ 7 ]

Check all items for wear or damage and replace as necessary.

**NOTE:** For Assembly, follow the same procedure in reverse order.



**NOTE:** If new parts have been installed, add or remove shims (5) until dimension (A) is 12.65 to 12.85 mm (0.5 to 0.51 inch), measured between the housing and the snap ring on bearing (4). Refer to [ 2 ] for the removal and installation of bearing (4).



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

1. SPACER
2. SPRING
3. COLLAR
4. BEARING

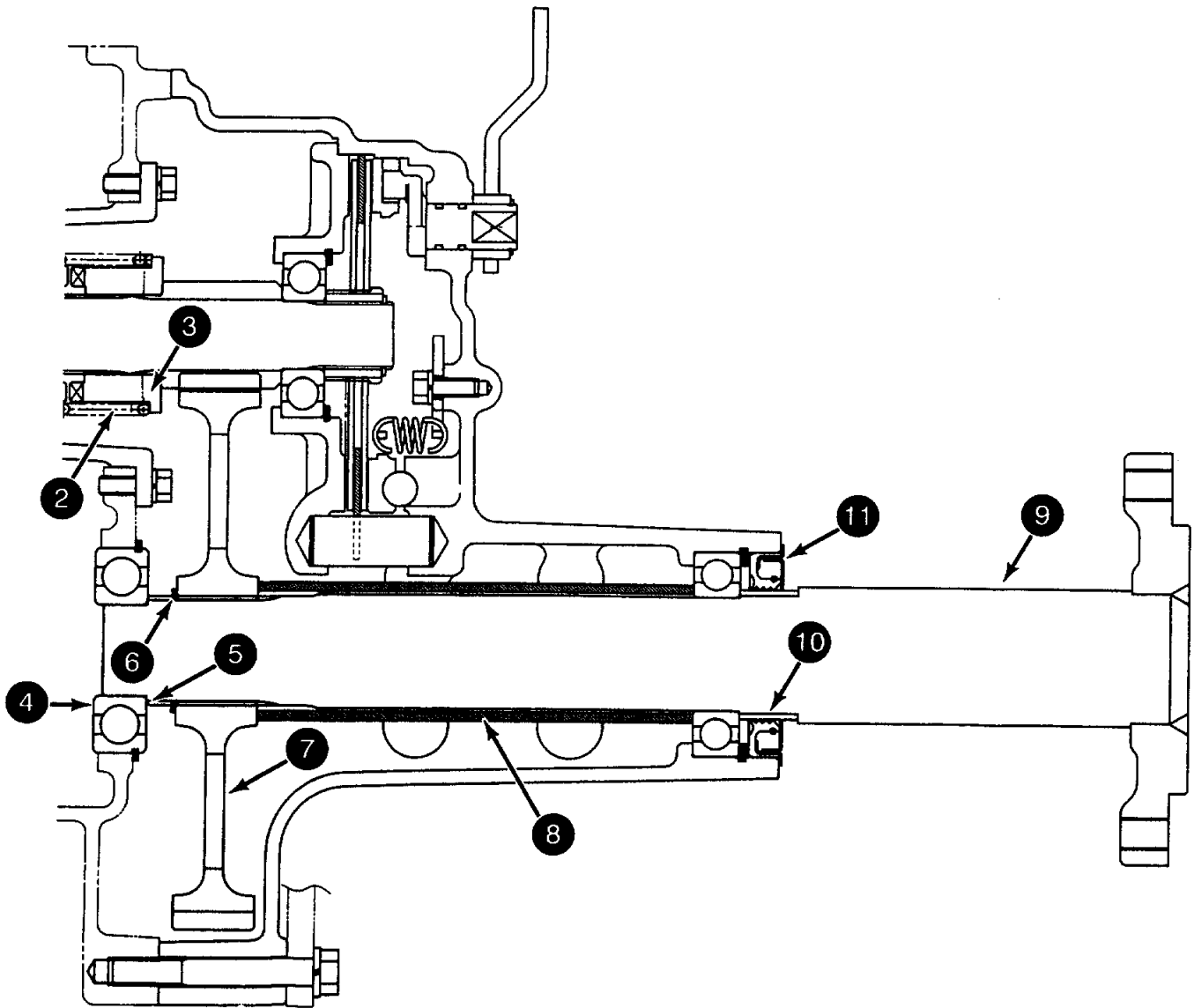
5. SHIM
6. SNAP RING
7. GEAR

8. COLLAR
9. AXLE SHAFT
10. BUSHING

11. SEAL
12. SNAP RING
13. BEARING



## Cross Sectional Drawing of the Rear Axle (723 \* and 727 \* )



- 2. SPRING
- 3. COLLAR
- 4. BEARING
- 5. SHIM
- 6. SNAP RING

- 7. GEAR
- 8. COLLAR
- 9. AXLE SHAFT
- 10. BUSHING
- 11. SEAL

SM0379

## MFD HUB AND REDUCTION GEARS (719 \* )

### Disassembly

#### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

#### [ 2 ]

Support the front axle on axle stands and remove the front wheels.

#### [ 3 ]

Put a container with a capacity of at least 4 litres (1.06 US gal) under the swivel housing drain plug. Remove the drain plug and drain the oil. Install and tighten the drain plug to a torque of 12 to 17 Nm (9 to 12.5 lb ft).

#### [ 4 ]

Remove bolts (1) and remove the hub assembly.

#### [ 5 ]

Remove items (2 to 8). Use a bearing puller to remove item (3).

**NOTE:** *Keep shims (5) together for Assembly.*

#### [ 6 ]

Use a hydraulic press to remove item (9).

#### [ 7 ]

Remove items (10 to 13).

#### [ 8 ]

Check all items for wear or damage and replace as necessary.

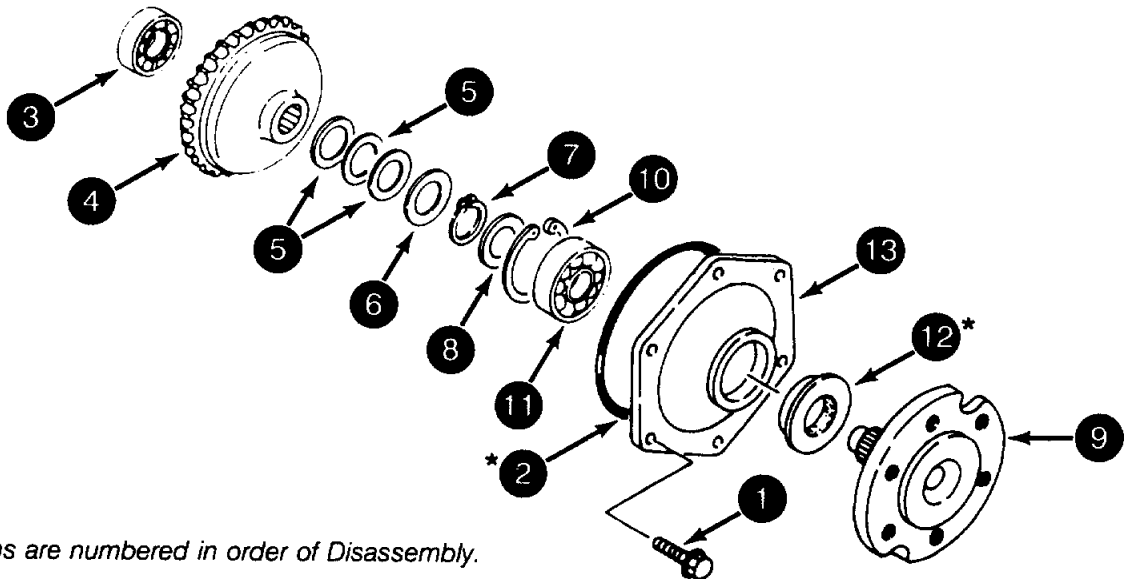
### Assembly

#### [ 1 ]

Install items (13 to 10).

#### [ 2 ]

Use a hydraulic press and install item (9).



**NOTE:** *Items are numbered in order of Disassembly.*

**NOTE:** *Items marked (\*) must be replaced.*

- 1. BOLT
- 2. O-RING
- 3. BEARING
- 4. GEAR

- 5. SHIM
- 6. WASHER
- 7. SNAP RING

- 8. WASHER
- 9. AXLE HUB
- 10. SNAP RING

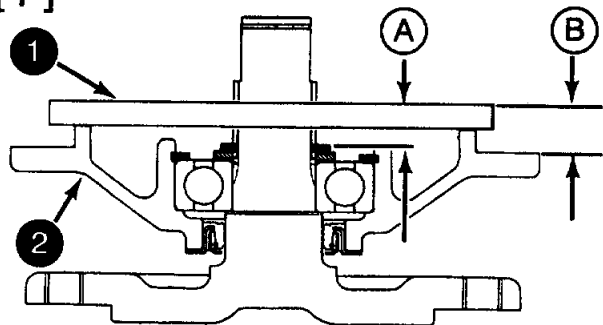
- 11. BEARING
- 12. SEAL
- 13. COVER

SM0220

## [ 6 ]

Install items (8 to 6).

## [ 7 ]



SM0448A

Put a straight edge (1) across the cover (2) as shown. Measure distance (A) and (B). Subtract distance (B) from distance (A), this equals (C). Subtract the given figure of 3.45 to 3.55 mm (0.136 to 0.139 inch) from distance (C), this equals the amount of shims (5) required.

Example:

$$A - B = C$$

$C - 3.45 \text{ to } 3.55 \text{ mm (0.136 to 0.139 inch)} = \text{shims (5) required.}$

$$27 \text{ mm (1.06 inch)} - 23 \text{ mm (0.91 inch)} = 4 \text{ mm (0.16 inch)}$$

$$4 \text{ mm (0.14 inch)} - 3.45 \text{ to } 3.55 \text{ mm (0.136 to 0.139 inch)} = 0.55 \text{ to } 0.45 \text{ mm (0.022 to 0.018 inch)}$$

Therefore shims (5) required equals 0.45 to 0.55 mm (0.018 to 0.022 inch)

## [ 8 ]

Install gear (4). Heat bearing (3) in a bearing oven to a temperature of 121°C (250°F) and install.



**WARNING** - Always wear your seat belt when operating the machine.

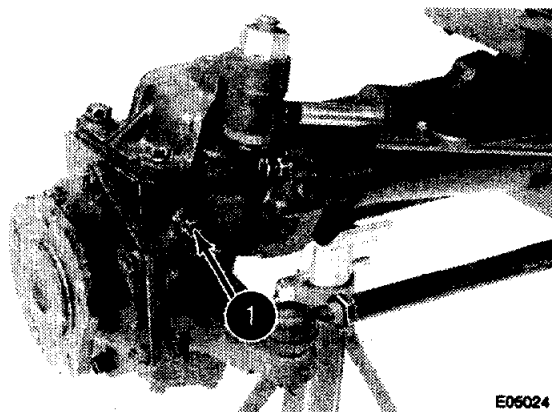
## [ 9 ]

Apply lithium grease to the o-ring (2) and install.

## [ 10 ]

Install the hub assembly. Install and tighten bolts (1).

## [ 11 ]



E06024

Remove the oil level plug (1) in the swivel housing and add Cub Cadet hydraulic transmission fluid oil until oil begins to flow out of the level plug holes to the correct level. Install and tighten the plug.

## [ 12 ]

Install the front wheels and tighten the wheel bolts to a torque of 83 to 93 Nm (61 to 69 lb ft).

## MFD HUB AND REDUCTION GEAR (723 \* and 727 \* )

### Disassembly

#### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

#### [ 2 ]

Support the front axle on axle stands and remove the front wheels.

#### [ 3 ]

Put a container with a capacity of at least 5 litres (1.3 US gal) under the swivel housing drain plug. Remove the drain plug and drain the oil. Install and tighten the drain plug to a torque of 12 to 17 Nm (9 to 12.5 lb ft).

#### [ 4 ]

Remove bolts (1) and remove the hub assembly.

#### [ 5 ]

Remove items (2 to 7). Use a bearing puller to remove item (5).

**NOTE:** Keep shims (4) together for assembly and keep shims (7) together for assembly.

#### [ 6 ]

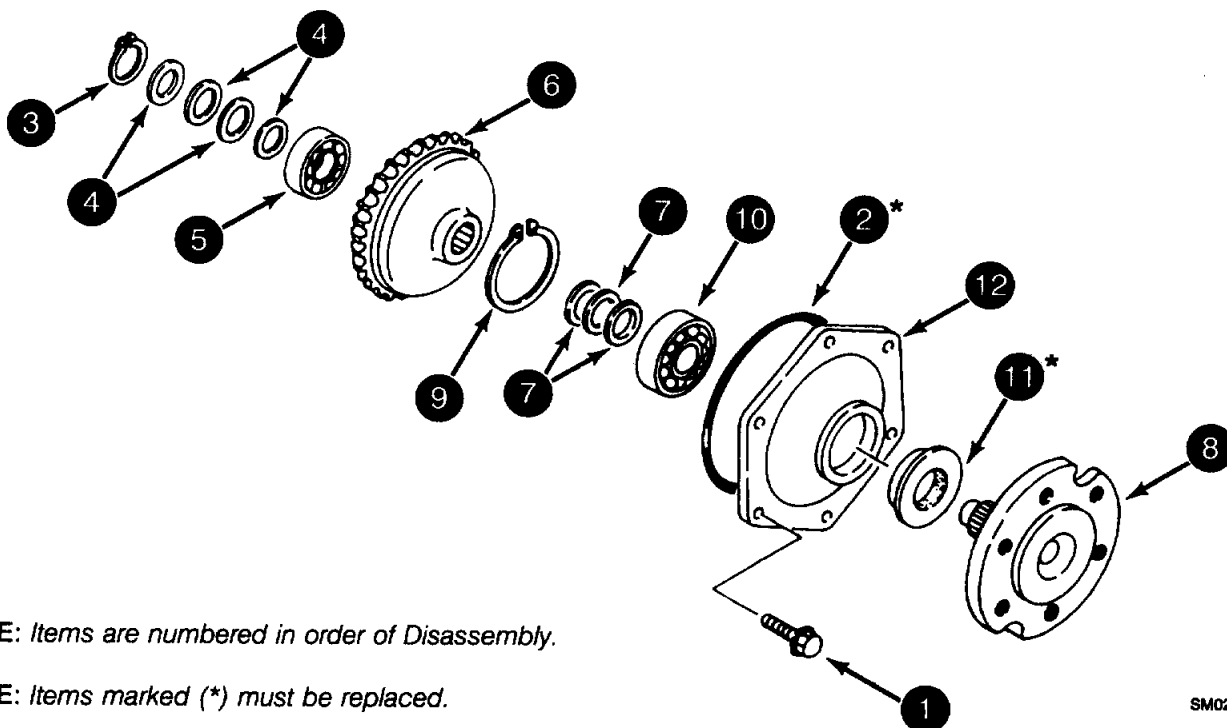
Use a hydraulic press to remove item (8).

#### [ 7 ]

Remove items (9 to 12).

#### [ 8 ]

Check all items for wear or damage and replace as necessary.



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

- 1. BOLT
- 2. O-RING
- 3. SNAP RING

- 4. SHIM
- 5. BEARING
- 6. GEAR

- 7. SHIM
- 8. AXLE HUB
- 9. SNAP RING

- 10. BEARING
- 11. SEAL
- 12. COVER

SM0238

## Assembly

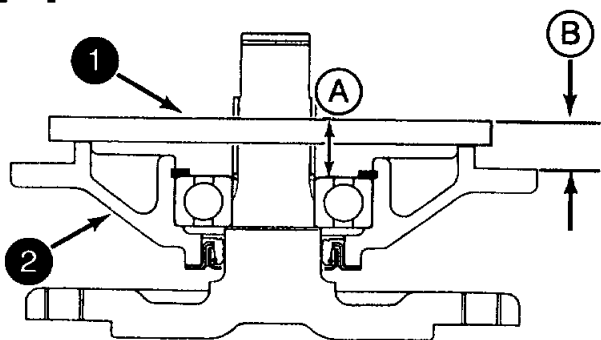
### [ 1 ]

Install items (12 to 9).

### [ 2 ]

Use a hydraulic press and install item (8).

### [ 3 ]



SM0449A

Put a straight edge (1) across the cover (2) as shown. Measure distance (A) and (B). Subtract distance (B) from distance (A), this equals (C). Subtract the given figure of 2.95 to 3.05 mm (0.116 to 0.120 inch) from distance (C), this equals the amount of shims (7) required.

Example

$$A - B = C$$

$C - 2.95 \text{ to } 3.05 \text{ mm (0.116 to 0.120 inch)} = \text{shims (7) required.}$

$$27 \text{ mm (1.06 inch)} - 23 \text{ mm (0.91 inch)} = 4 \text{ mm (0.14 inch)}$$

$$4 \text{ mm (0.16 inch)} - 2.95 \text{ to } 3.05 \text{ mm (0.116 to 0.120 inch)} = 1.05 \text{ to } 0.95 \text{ mm (0.041 to 0.037 inch)}$$

Therefore shims (7) required equals 0.95 to 1.05 mm (0.037 to 0.041 inch).

### [ 4 ]

Install gear (6).

### [ 5 ]

Heat bearing (5) to a temperature of 121°C (250°F) and install the bearing.

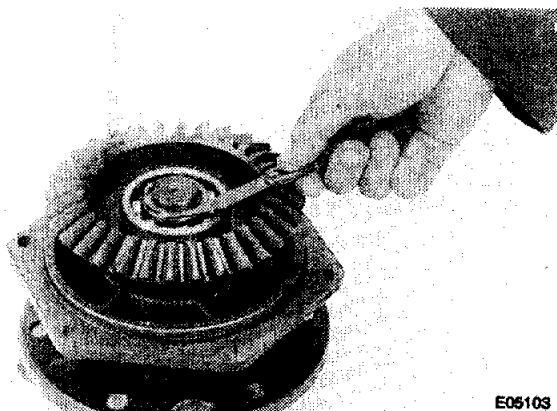


**WARNING:** Always wear heat protective gloves when handling heated parts.

### [ 6 ]

Install snap ring (3).

### [ 7 ]



E05103

Measure the distance between item (3) and the inner bearing race (5). Add or remove shims (4) until a clearance of 0.0 to 0.2 mm (0.0 to 0.008 inch) is measured.

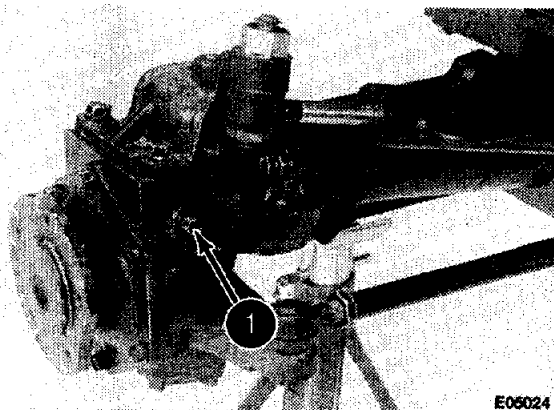
### [ 8 ]

Apply lithium grease to the o-ring (2) and install.

### [ 9 ]

Install the hub assembly. Install and tighten bolts (1).

### [ 10 ]



E05024

Remove the oil filter plug. Add TOU or STOU oil until oil begins to flow out of the level plug hole (1).

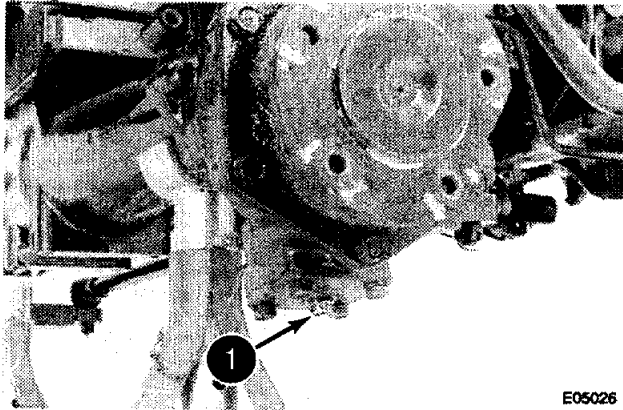
### [ 11 ]

Install the front wheels and tighten the wheel bolts to a torque of 83 to 93 Nm (61 to 69 lb ft).

## SWIVEL HOUSING

### Removal and Installation

[ 1 ]



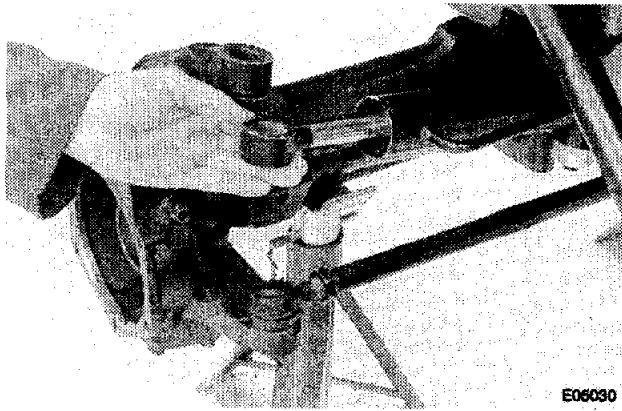
E05026

Put a container with a capacity of at least 5 litres (1.1 UK gal) under the axle drain plug (1). Remove the drain plug and drain the oil. Install and tighten the drain plug to a torque of 39 to 44 Nm (29 to 32 lb ft).

[ 2 ]

Remove the MFD Hub and Reduction Gear, refer to Page 134 (719 \* ) or Page 136 (723 \* and 727 \* ).

[ 3 ]

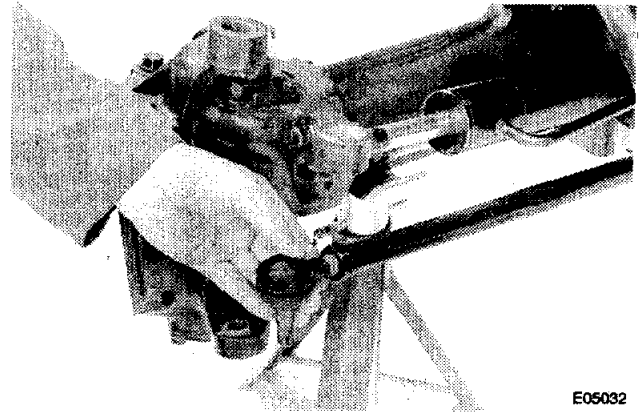


E06030

Disconnect and remove the steering cylinder from the swivel housing.

**NOTE :** For Installation, tighten the steering bolt until there is no clearance between the bolt and swivel housing, then back the bolt off 1 flat or 60 degrees of a turn. Tighten the locknut.

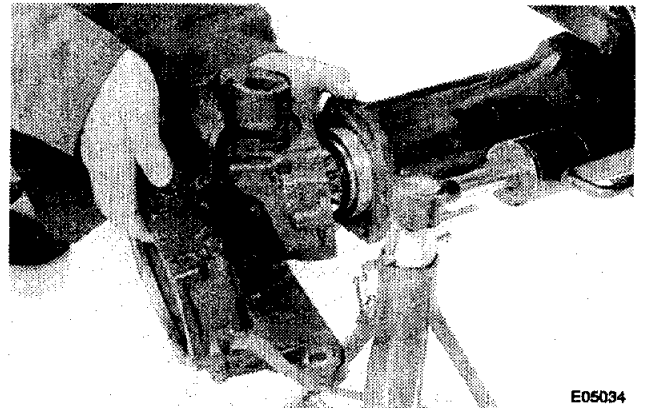
[ 4 ]



E05032

Disconnect and remove the ball joint.

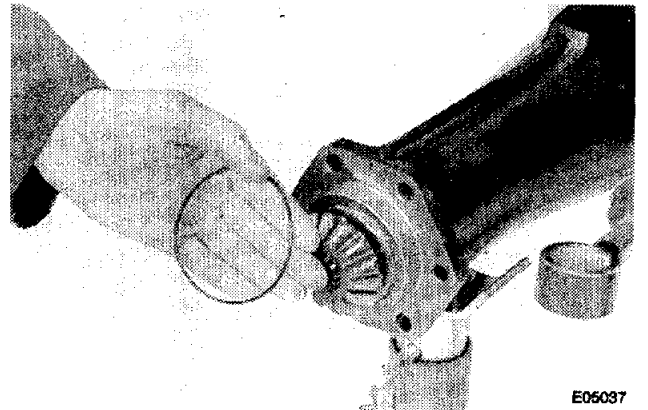
[ 5 ]



E05034

Remove the swivel housing retaining bolts and remove the swivel housing.

[ 6 ]



E05037

Remove and discard the o-ring.

**NOTE :** For Installation, install a new o-ring.

**NOTE :** For Installation, follow the same procedure in reverse order.

## Disassembly (719 \* )

### [ 1 ]

Remove items (1 to 4).

**NOTE:** Keep shims (4) together for assembly.

### [ 2 ]

Remove items (5 to 10).

**NOTE:** Keep shims (7) together for assembly and shims (10) together for assembly.

### [ 3 ]

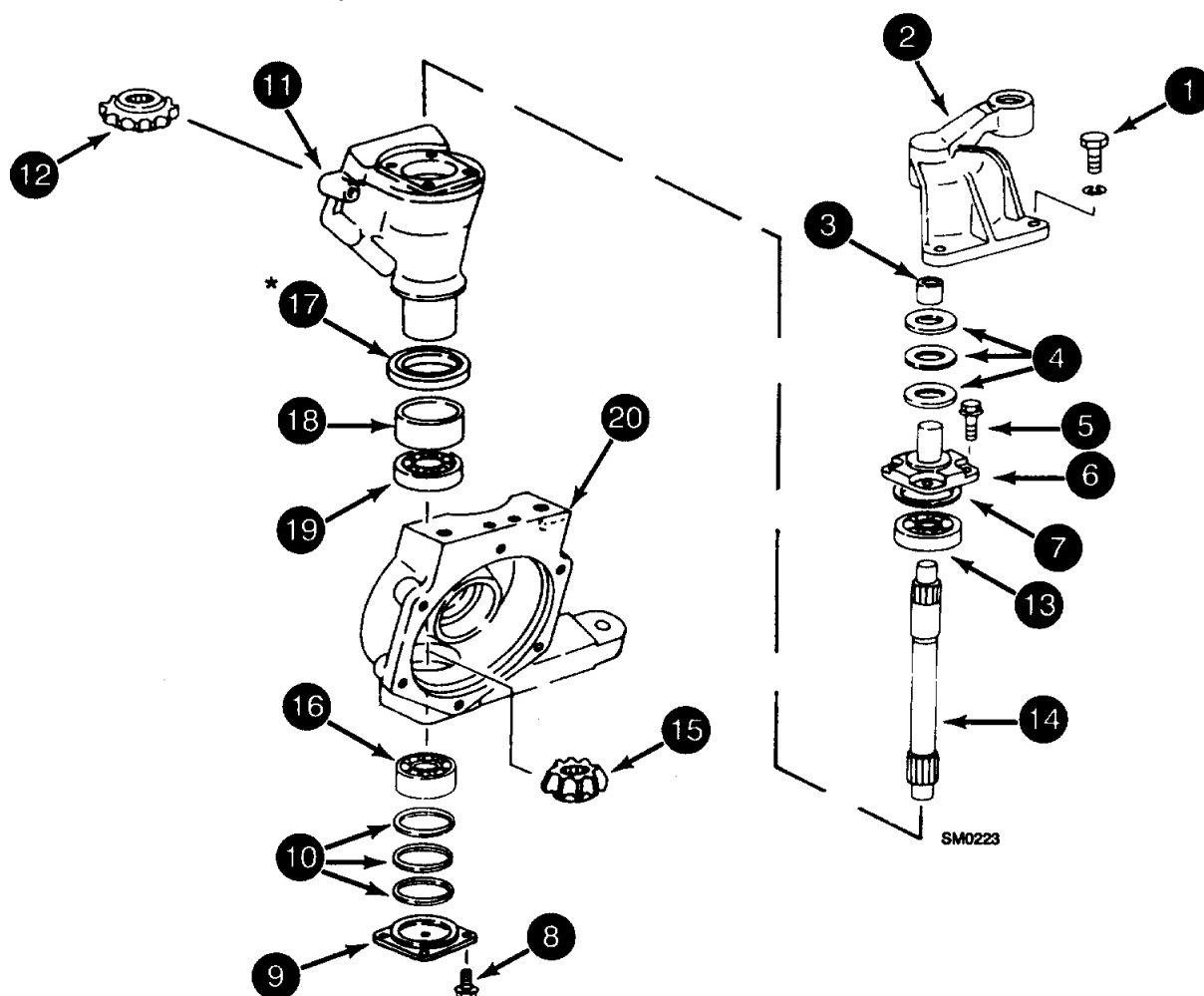
Use a soft faced hammer and remove the housing (11) and gear (12).

### [ 4 ]

Remove items (13 to 20).

### [ 5 ]

Check all items for wear or damage and replace as necessary.



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

1. BOLT	6. CAP	11. HOUSING	16. BEARING
2. ARM	7. SHIM	12. GEAR	17. SEAL
3. BUSHING	8. BOLT	13. BEARING	18. BUSHING
4. SHIM	9. CAP	14. SHAFT	19. THRUST BEARING
5. BOLT	10. SHIM	15. GEAR	20. HOUSING

## Assembly (719 \* )

### [ 1 ]

Install bearing (19) into housing (20). Use a bushing driver to install items (18 and 17).

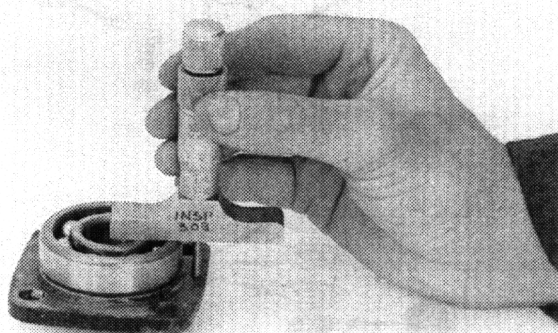
### [ 2 ]

Install items (15 and 14) into housing (20).

### [ 3 ]

Install items (11 and 12).

### [ 4 ]



E04526

Install bearing (16) onto cap (9) and measure the height of the bearing above the face of the cap. Add or remove shims (10) to cap (9) until the height of the bearing is 17.95 to 18.05 mm (0.707 to 0.711 inch).

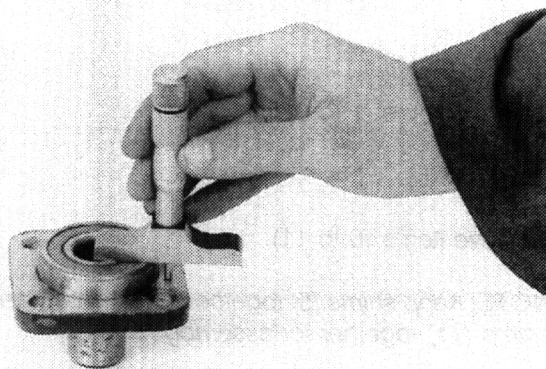
### [ 5 ]

Install bearing (16) into the housing (20).

### [ 6 ]

Install shims (10) as determined in [ 5 ]. Apply a continuous bead of Loctite 515 to cover (9). Install item (9).

### [ 7 ]



E05013

Install bearing (13) onto cap (6) and measure the height of the bearing (13) above the face of the cap (6). Add or remove shims (7) to cap (6) until the height of the bearing is 11.95 to 12.05 mm (0.470 to 0.474 inch).

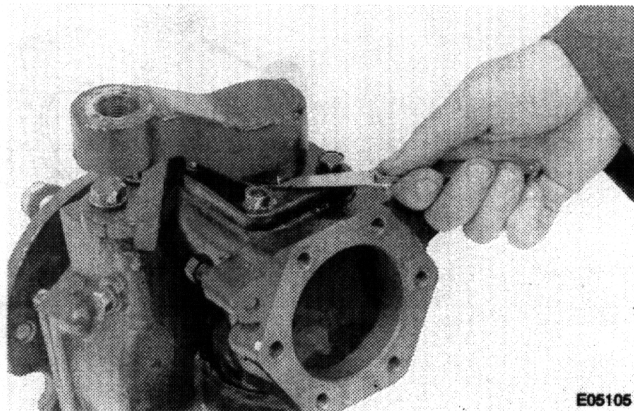
### [ 8 ]

Install bearing (13) into the housing (11).

### [ 9 ]

Apply a continuous bead of Loctite 515 to cap (6) and to bolts (5). Install items (7 to 5).

### [ 10 ]



E05106

Install items (3 to 1). Measure the distance between items (2 and 6). Remove items (1 and 2) and add or remove shims (4) until a clearance of 0.05 to 0.2 mm (0.002 to 0.008 inch) is measured between items (2 and 6). Fill bushing (3) with lithium grease and install items and install items (2 and 1).



## Disassembly (723 \* and 727 \* )

### [ 1 ]

Remove items (1 to 5).

### [ 2 ]

Remove items (6 to 11).

**NOTE:** Keep shims (5) together for assembly and keep shims (11) together for assembly.

### [ 3 ]

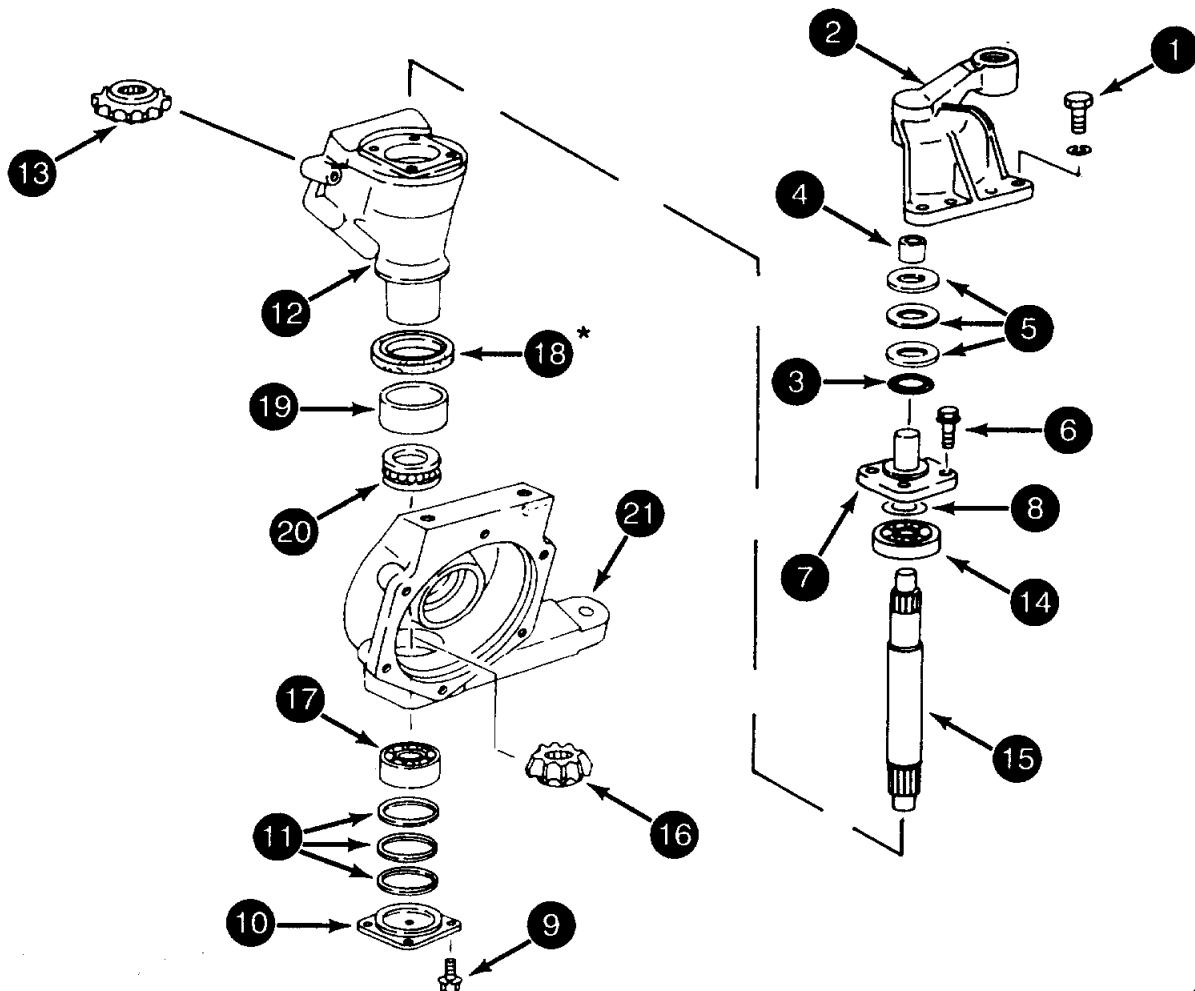
Use a soft faced hammer and remove the housing (12) and gear (13).

### [ 4 ]

Remove items (14 to 21).

### [ 5 ]

Check all items for wear or damage and replace as necessary.



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

1. BOLT	7. CAP	12. HOUSING	17. BEARING
2. ARM	8. SHIM	13. GEAR	18. SEAL
3. O-RING	9. BOLT	14. BEARING	19. BUSHING
4. BUSHING	10. CAP	15. SHAFT	20. BEARING
5. SHIM	11. SHIM	16. GEAR	21. HOUSING
6. BOLT			

SM0223A

## Assembly (723 \* and 727 \* )

### [ 1 ]

Install bearing (20) into housing (21). Use a bearing driver to install items (19 and 18).

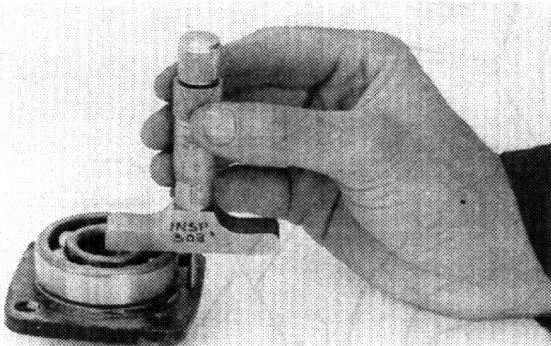
### [ 2 ]

Install items (16 and 15) into the housing (21).

### [ 3 ]

Install items (12 and 13) to housing (21).

### [ 4 ]



E04526

Put the bearing (17) on cap(10) and measure the height of the bearing above the face of the cap. Add or remove shims (11) to cap (10) until the height of the bearing is 17.85 to 17.95 mm (0.703 to 0.707 inch).

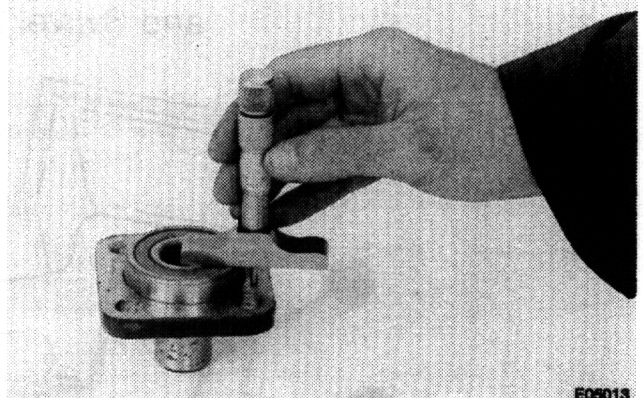
### [ 5 ]

Use a soft faced hammer and install item (17).

### [ 6 ]

Install shims (11) as determined in [ 4 ]. Apply a continuous bead of Loctite 515 to cover (10). Install items (10 and 9).

### [ 7 ]



E09013

Install bearing (14) onto cap (7) and measure the height of the bearing above the face of the cap. Add or remove shims (8) to cap (7) until the height of the bearing is 10.85 to 10.95 mm (0.427 to 0.431 inch).

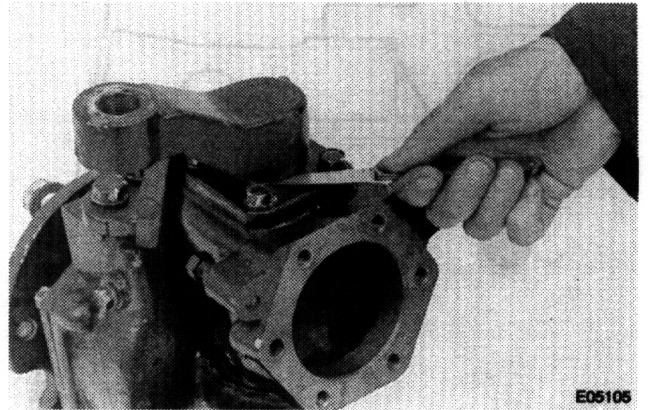
### [ 8 ]

Use a soft faced hammer to install item (14).

### [ 9 ]

Apply a continuous bead of Loctite 515 to the cap (7) and to bolts (6). Install items (8 to 6).

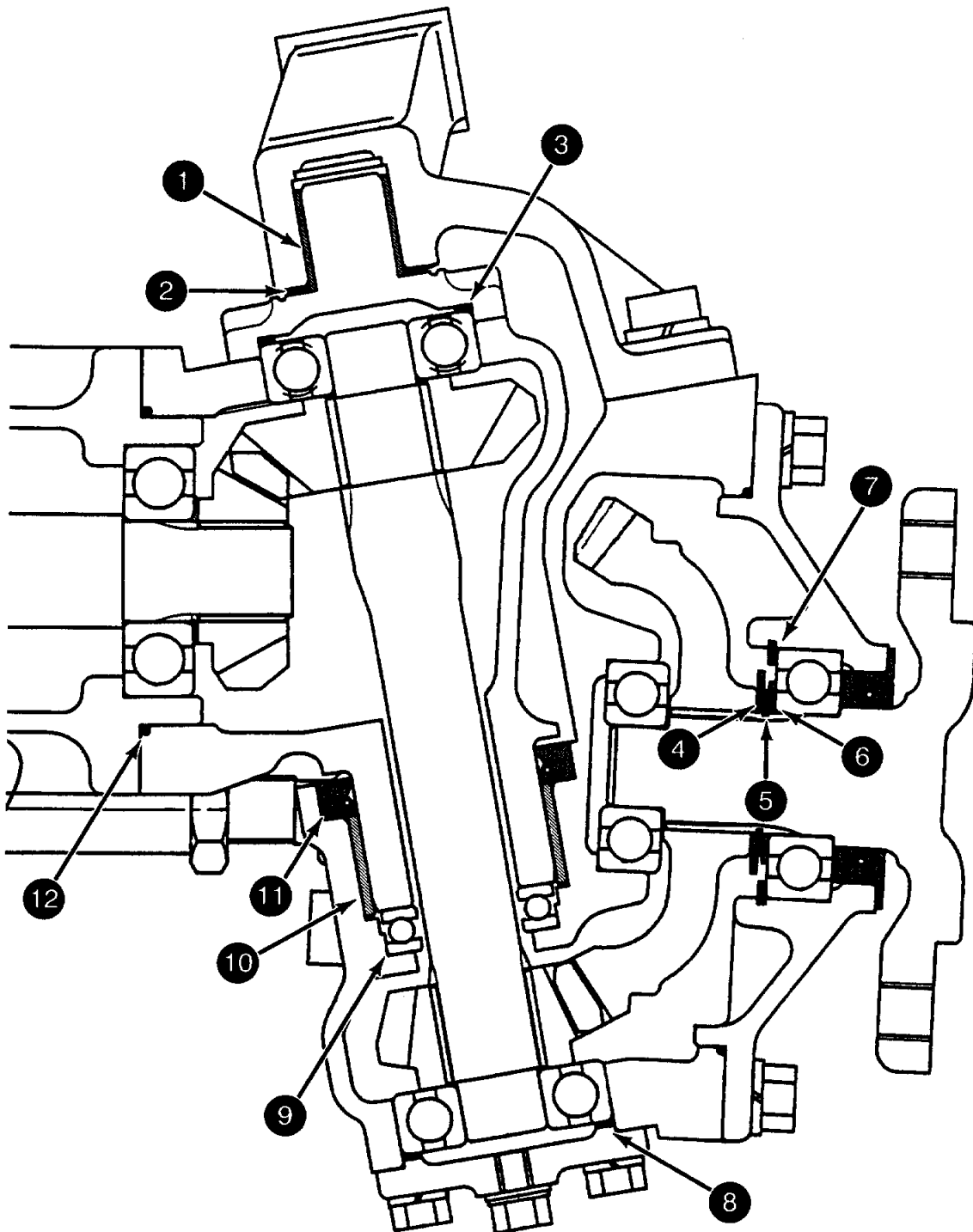
### [ 10 ]



E05105

Install items (4 to 1). Measure the distance between items (2 and 7) and add or remove shims (5) until a clearance of 0.05 to 0.2 mm (0.002 to 0.008 inch) is measured between items (2 and 7). Fill bushing (4) with lithium grease and install items (2 and 1).

# Cross Sectional Drawing of the MFD Hub and Swivel Housing (719 \* )



SM0448

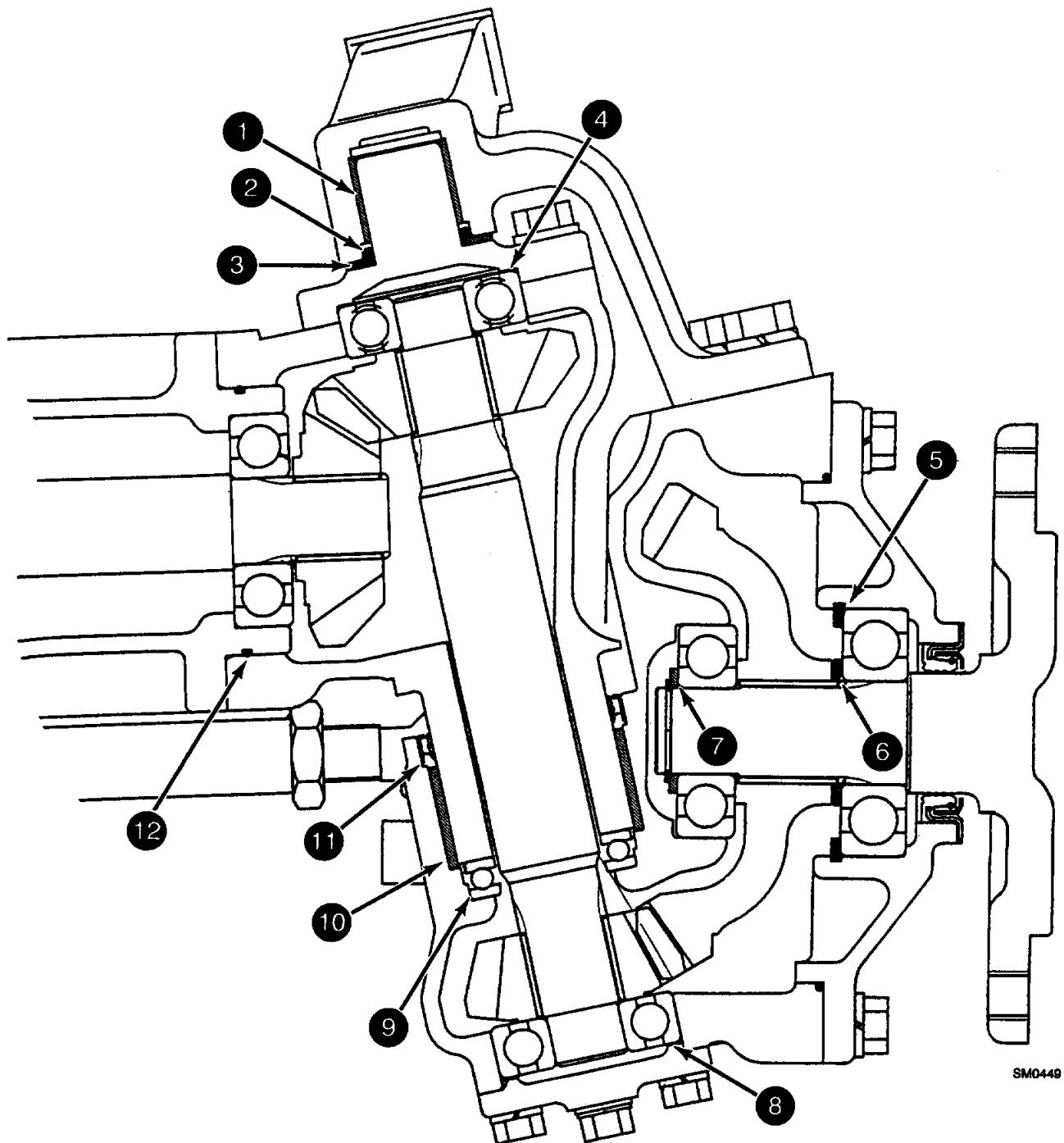
1. BUSHING  
2. SHIM  
3. SHIM

4. SHIM  
5. SNAP RING  
6. WASHER

7. SNAP RING  
8. SHIM  
9. BEARING

10. BUSHING  
11. SEAL  
12. O-RING

# Cross Sectional Drawing of the MFD Hub and Swivel Housing (723 \* and 727 \* )



SM0449

- |            |              |            |             |
|------------|--------------|------------|-------------|
| 1. BUSHING | 4. SHIM      | 7. SHIM    | 10. BUSHING |
| 2. O-RING  | 5. SNAP RING | 8. SHIM    | 11. SEAL    |
| 3. SHIM    | 6. SHIM      | 9. BEARING | 12. O-RING  |

## DIFFERENTIAL SHAFT

### Disassembly

#### [ 1 ]

Remove the Swivel Housing, refer to Page 9.

#### [ 2 ]

Remove items (1 and 2).

**NOTE:** Keep shims (2) together for assembly.

#### [ 3 ]

Remove shaft assembly (3).

#### [ 4 ]

Use a hydraulic press and remove item (4).

### Assembly

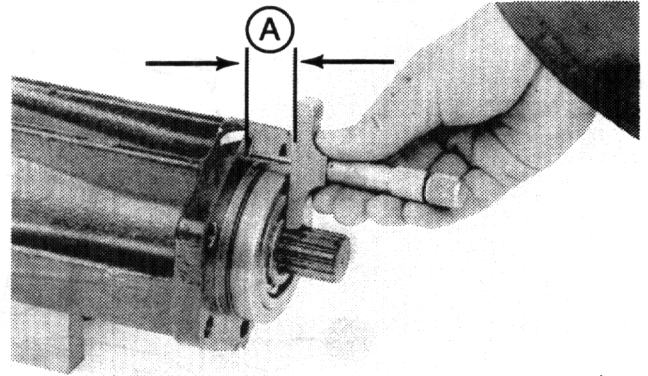
#### [ 5 ]

Heat bearing (4) in a bearing oven to a temperature of 121°C (250°F) and install the bearing.



**WARNING:** Always wear heat protective gloves when handling heated parts.

#### [ 6 ] 723 \* and 727 \* Only



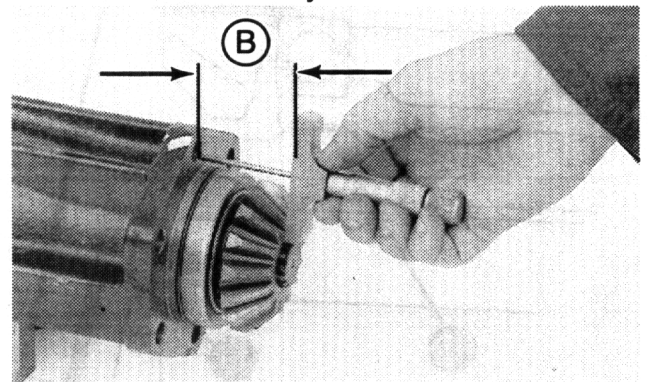
E05107

Install the shaft assembly (3). Measure distance (A). Add or remove shims (2) until distance (A) is  $21 \pm 0.05$  mm ( $0.83 \pm 0.002$  inch).

#### [ 7 ]

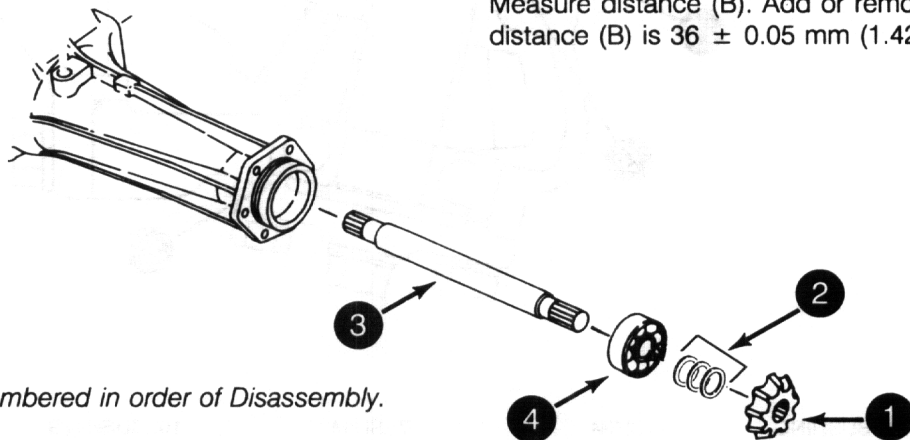
Install items (2 and 1).

#### [ 8 ] 719 \* Only



E05109

Measure distance (B). Add or remove shims (2) until distance (B) is  $36 \pm 0.05$  mm ( $1.42 \pm 0.002$  inch).



SM0219A

**NOTE:** Items are numbered in order of Disassembly.

- 1. GEAR
- 2. SHIMS
- 3. SHAFT
- 4. BEARING

## MFD AXLE

### Removal and Installation

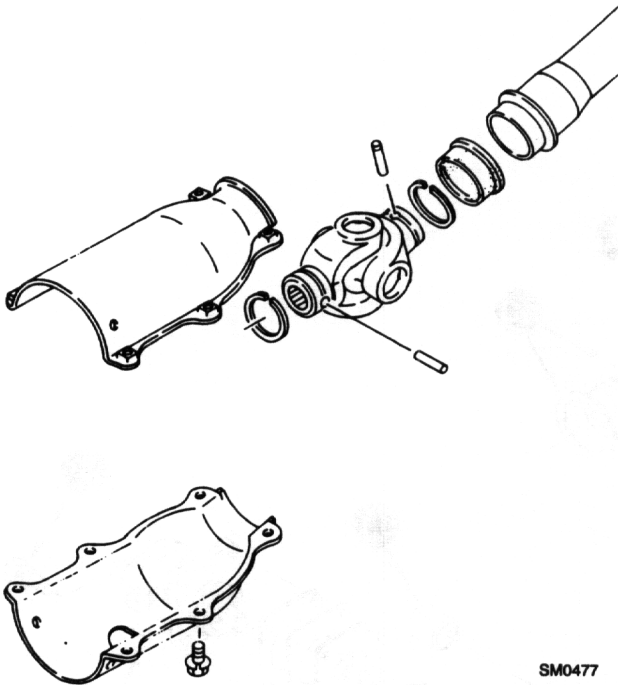
[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

[ 2 ]

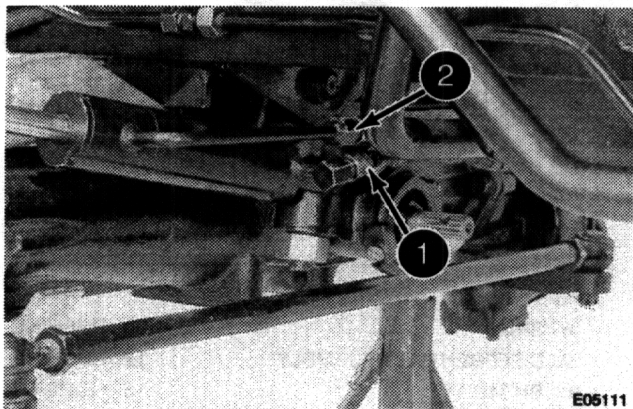
Raise the front of the tractor and support on axle stands.

[ 3 ]



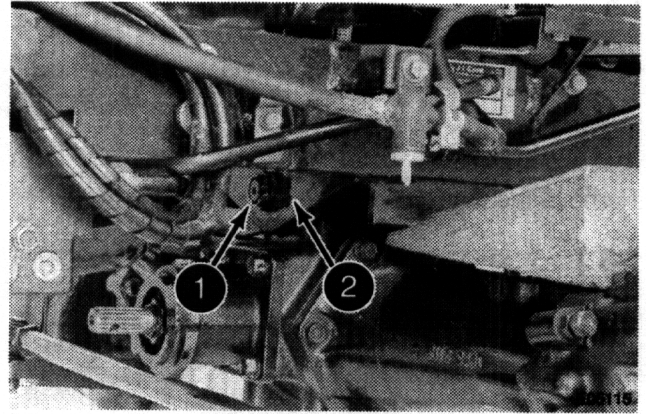
Remove the MFD drive shaft.

[ 4 ]



Disconnect and cap the steering hoses (1 and 2).

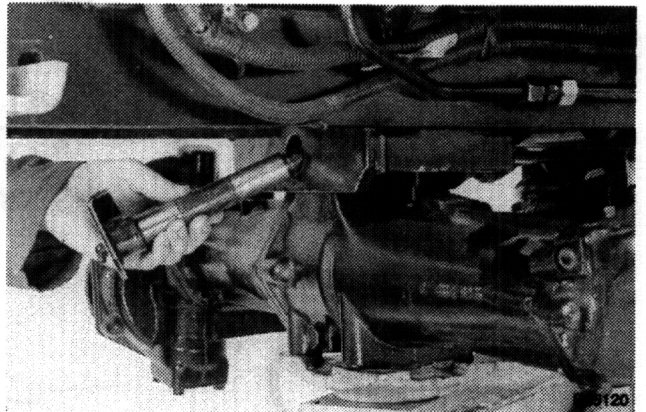
[ 5 ]



Remove the axle pivot nut (1) and washer (2).

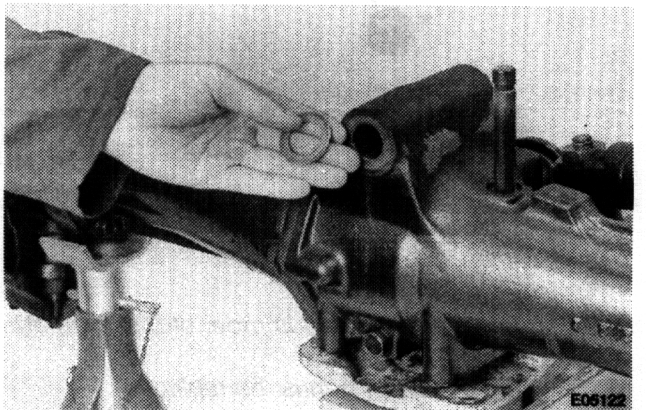
**NOTE:** For Installation, tighten the nut until all end play is removed from the axle and then loosen the nut 1/6 of a turn.

[ 6 ]



Support the axle and remove the pivot pin.

[ 7 ]



Remove the axle. Remove the thrust washer.

**NOTE:** For Installation, follow the same procedure in reverse order.

## Disassembly

[ 1 ]

Remove the Steering Cylinder, refer to Section 5001.

[ 2 ]

Remove the Swivel Housing, refer to Page 138.

[ 3 ]

Remove the Differential Shaft, refer to Page 145.

[ 4 ]

Remove items (1 to 4).

**NOTE:** Keep shims (4) together for assembly.

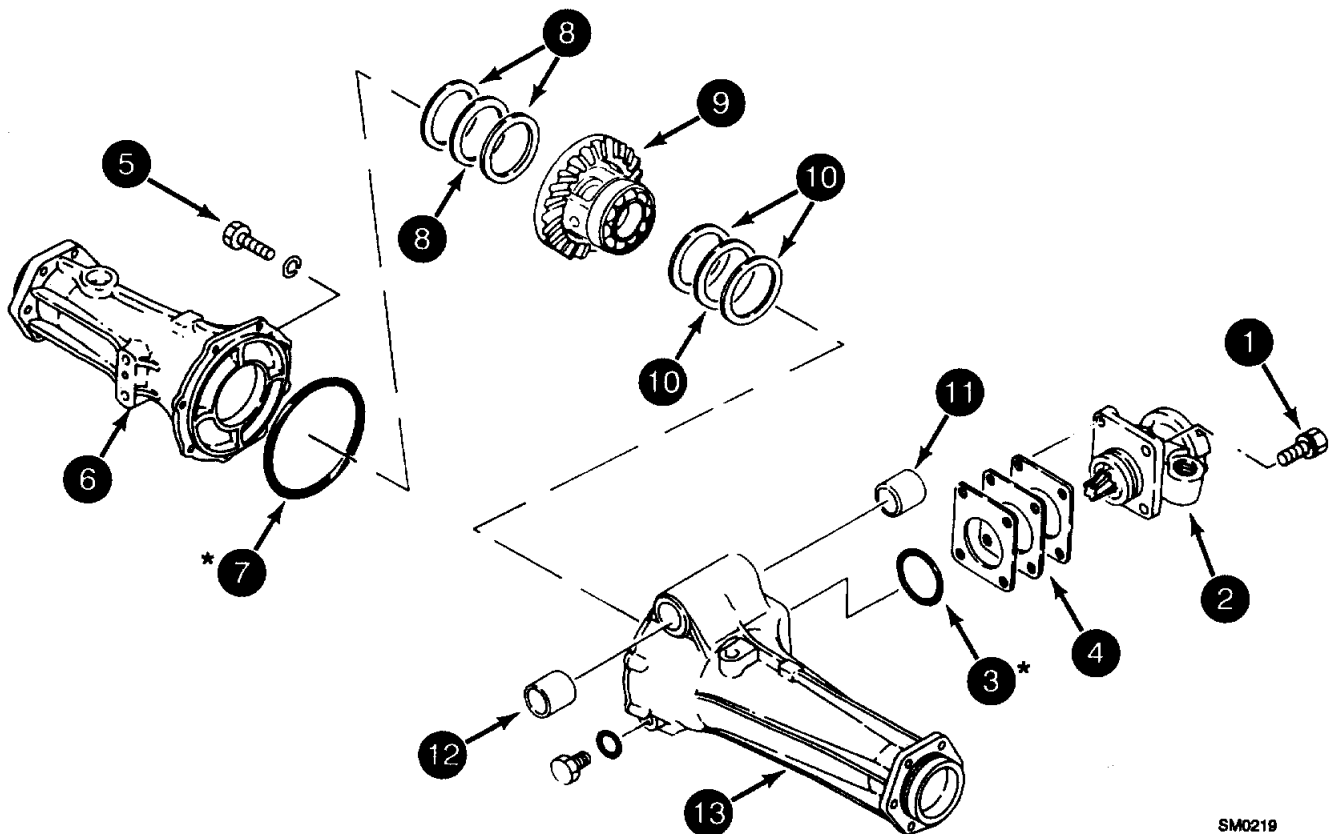
[ 5 ]

Remove items (5 to 10).

**NOTE:** Keep shims (8 and 10) together for assembly.

[ 6 ]

Use a blind hole puller to remove items (11 and 12) from housing (13).



SM0219

**NOTE:** Items are numbered in order of Disassembly.

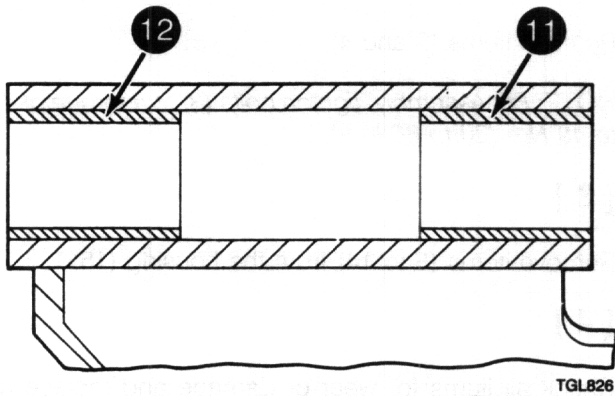
**NOTE:** Items marked (\*) must be replaced.

- |                    |            |                          |             |
|--------------------|------------|--------------------------|-------------|
| 1. BOLT            | 5. BOLT    | 8. SHIM                  | 11. BUSHING |
| 2. PINION ASSEMBLY | 6. HOUSING | 9. DIFFERENTIAL ASSEMBLY | 12. BUSHING |
| 3. O-RING          | 7. O-RING  | 10. SHIM                 | 13. HOUSING |
| 4. SHIM            |            |                          |             |



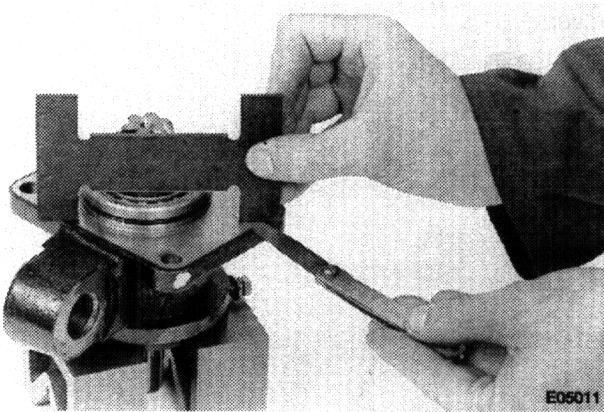
## Assembly

[ 1 ]



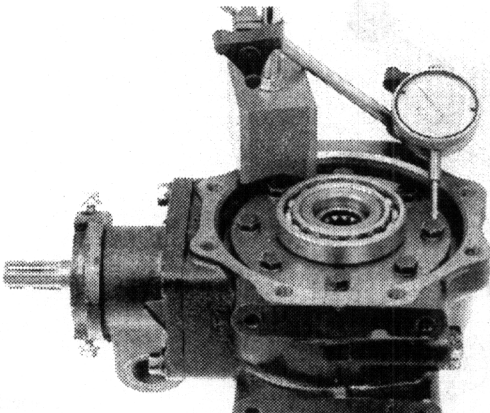
Use a bushing driver to install bushes (12 and 11).

[ 2 ]



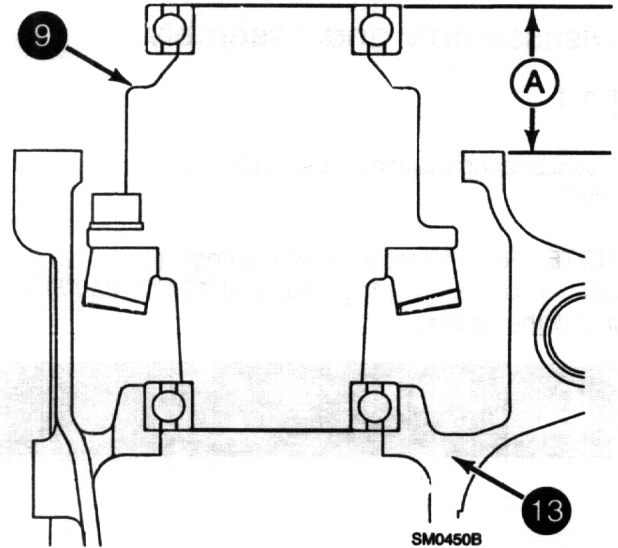
Use special tool CAS 2176, to measure the bearing to mounting face height. Add shims (4) until no clearance is measured between the special tool and the mounting face. Install items (4 to 1).

[ 3 ]



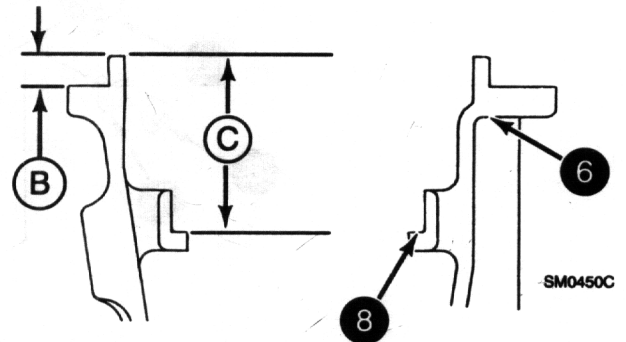
Install items (10 and 9). Measure the backlash between the pinion and the differential. The backlash must be 0.25 to 0.35 mm (0.010 to 0.014 inch). Adjust the backlash by adding or removing shims (10).

[ 4 ]



Measure and make a note of distance (A).

[ 5 ]



Measure distance (B) and distance (C). Subtract distance (B) from distance (C), this equals (D). Subtract distance (A) measured in Step 17 from (D). Add shims (8) until  $(D) - (A) = 0.0$  to  $0.1$  mm ( $0.0$  to  $0.004$  inch).

[ 6 ]

Install shims (8) as determined in [ 5 ]. Install items (7 to 5).



## DIFFERENTIAL

### Disassembly and Assembly

[ 1 ]

Use a bearing puller and a step plate to remove items (1 and 2).

**NOTE:** For Assembly, heat bearings (1 and 2) in a bearing oven to a temperature of 121°C (250°F) and install the bearing.



**WARNING:** Always use heat protective gloves when handling heated parts.

[ 2 ]

Remove items (3 and 4).

**NOTE:** For Assembly, tighten bolts (3) to a torque of 41 to 49 Nm (30 to 36 lb ft).

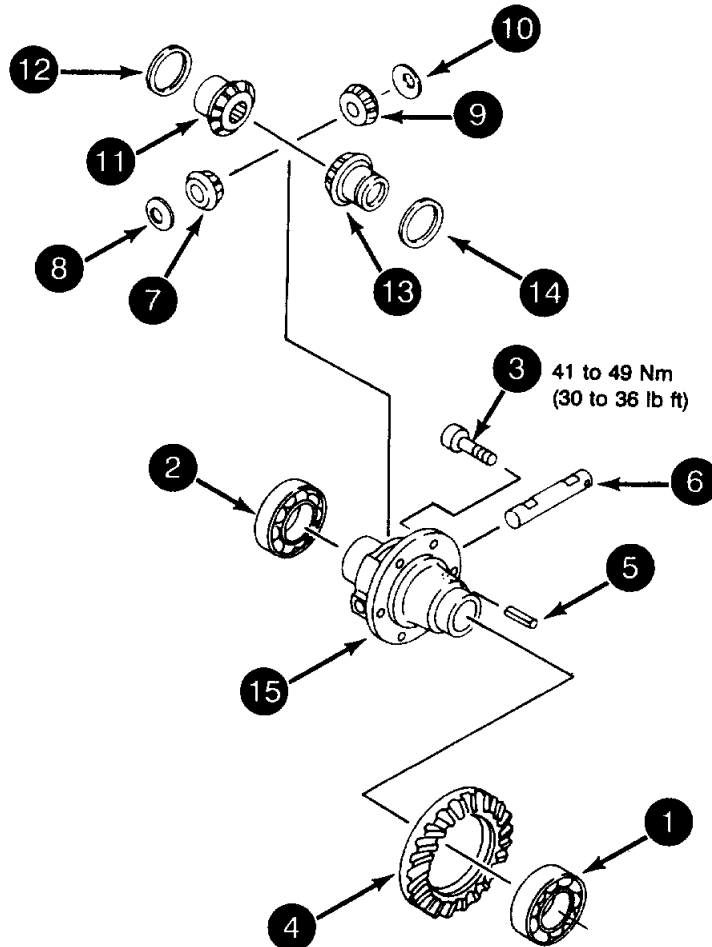
[ 3 ]

Remove items (5 to 14) from the housing (15).

[ 4 ]

Check all items for wear or damage and replace as necessary.

**NOTE:** For Assembly, follow the same procedure in reverse order.



**NOTE:** Items are numbered in order of Disassembly.

- 1. BEARING
- 2. BEARING
- 3. BOLT
- 4. DIFFERENTIAL GEAR
- 5. ROLL PIN

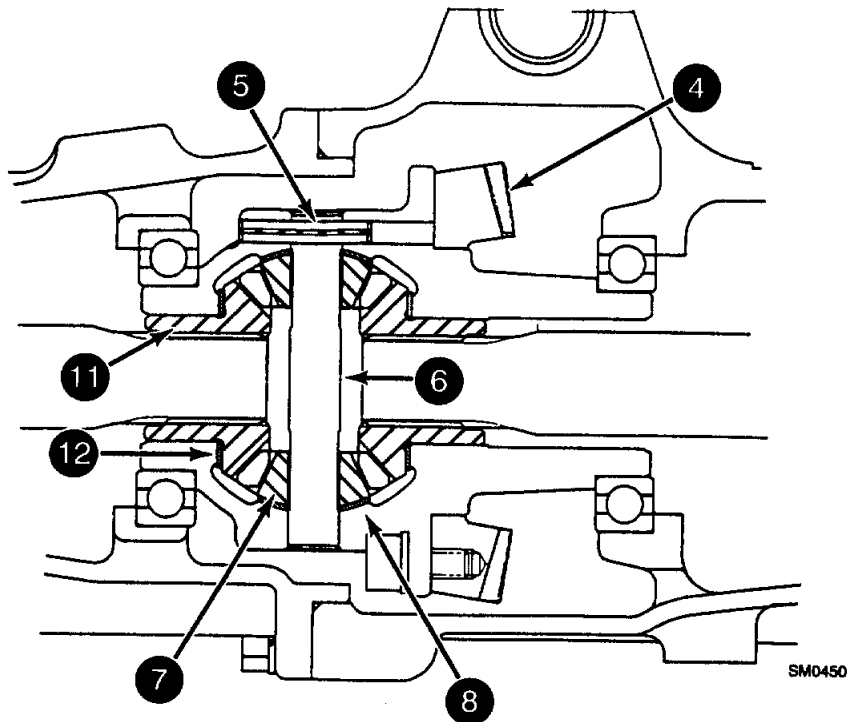
- 6. SHAFT
- 7. PLANETARY GEAR
- 8. THRUST WASHER
- 9. PLANETARY GEAR
- 10. THRUST WASHER

- 11. SUN GEAR
- 12. THRUST WASHER
- 13. SUN GEAR
- 14. THRUST WASHER
- 15. HOUSING

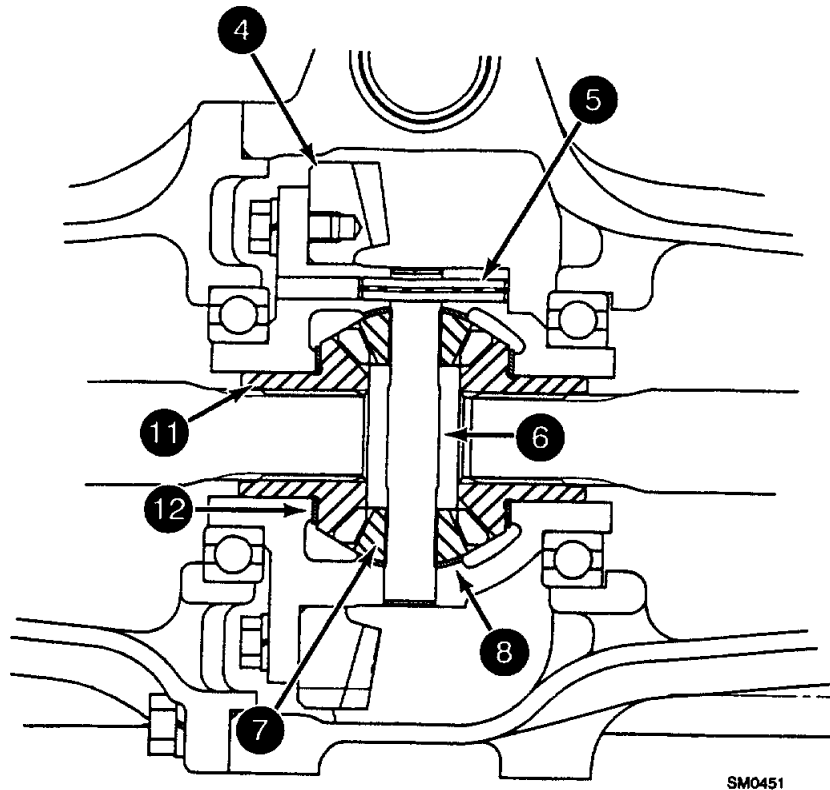
SM0221

## Cross Sectional Drawing of the Differential

719 \*



723 \* and 727 \*



- 4. DIFFERENTIAL GEAR
- 5. ROLL PIN
- 6. SHAFT
- 7. PLANETARY GEAR

- 8. THRUST WASHER
- 11. SUN GEAR
- 12. THRUST WASHER

## PINION

### Disassembly

[ 1 ]

Remove items (1 to 3).

[ 2 ]

Use a soft faced hammer and remove the pinion assembly (4). Use a bearing puller and attachment to remove bearing (5).

[ 3 ]

Remove items (6 to 11) out of housing (12).

[ 2 ]

Install items (6 and 11).

[ 3 ]

Install the pinion assembly (4) into housing (12).

[ 4 ]

Heat bearing (10) in a bearing oven to a temperature of 121°C (250°F).

[ 5 ]

Install items (9 to 7).

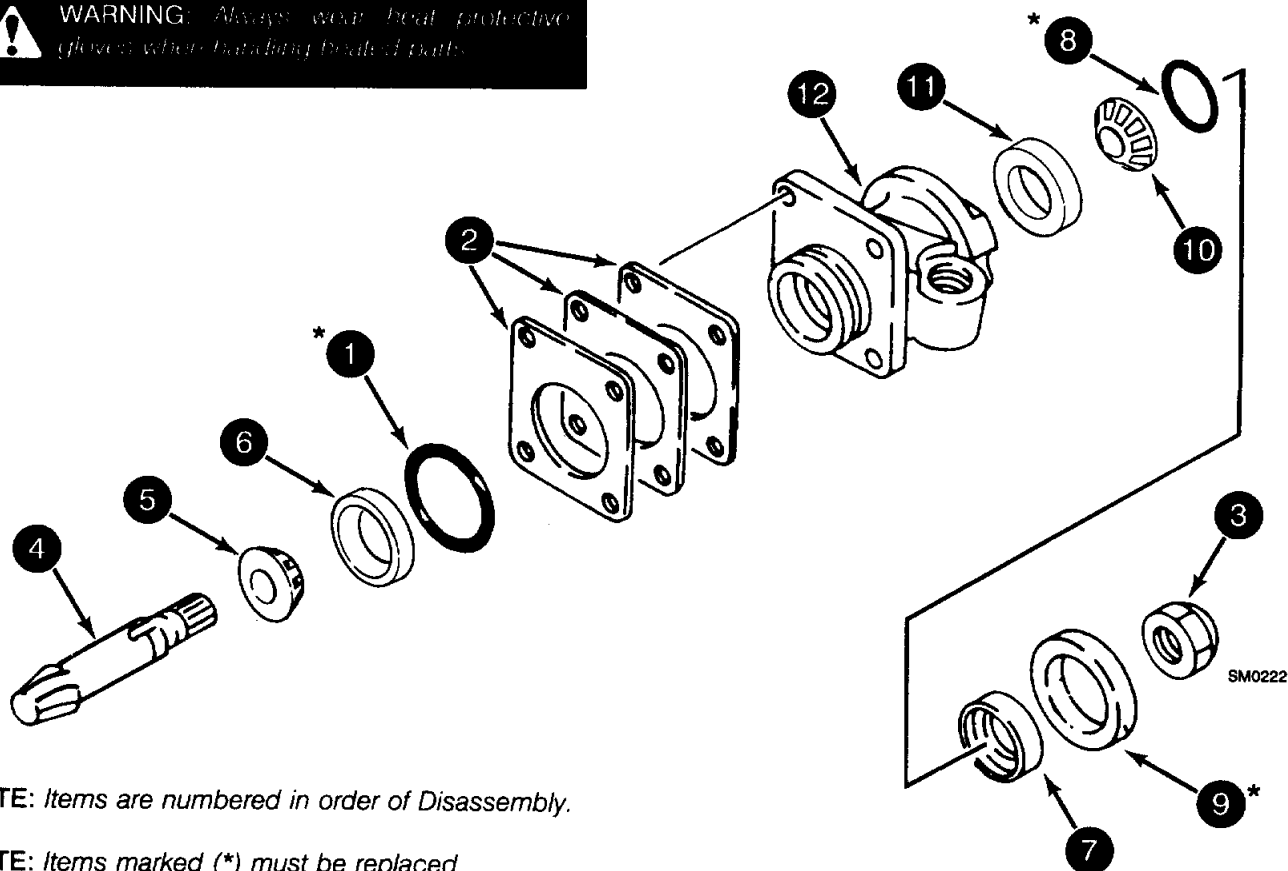
### Assembly

[ 1 ]

Heat bearing (5) in a bearing oven to a temperature of 121°C (250°F) and install the bearing onto the pinion (4).



**WARNING:** Always wear heat protective gloves when handling heated parts.



NOTE: Items are numbered in order of Disassembly.

NOTE: Items marked (\*) must be replaced.

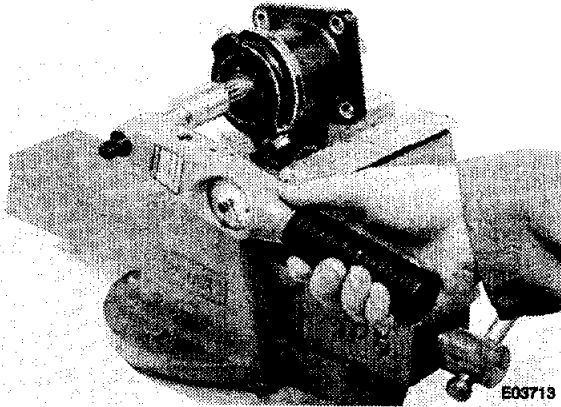
- 1. O-RING
- 2. SHIM
- 3. NUT

- 4. PINION
- 5. BEARING CONE
- 6. BEARING CUP

- 7. SPACER
- 8. O-RING
- 9. SEAL

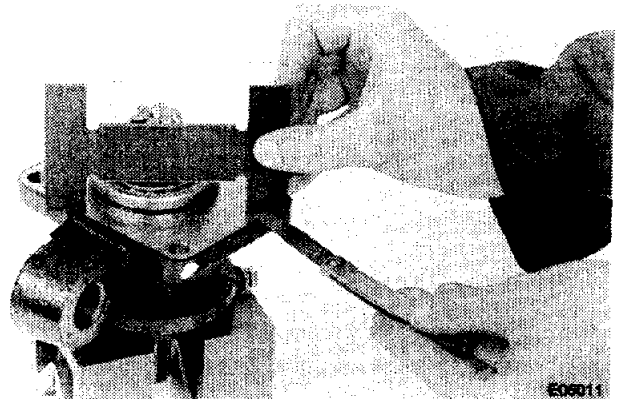
- 10. BEARING CONE
- 11. BEARING CUP
- 12. HOUSING

[ 6 ]



Install and tighten nut (3) until a rolling torque of 4 to 6 kgf cm (3.5 to 5.2 lbf in) is measured on the pinion shaft.

[ 7 ]

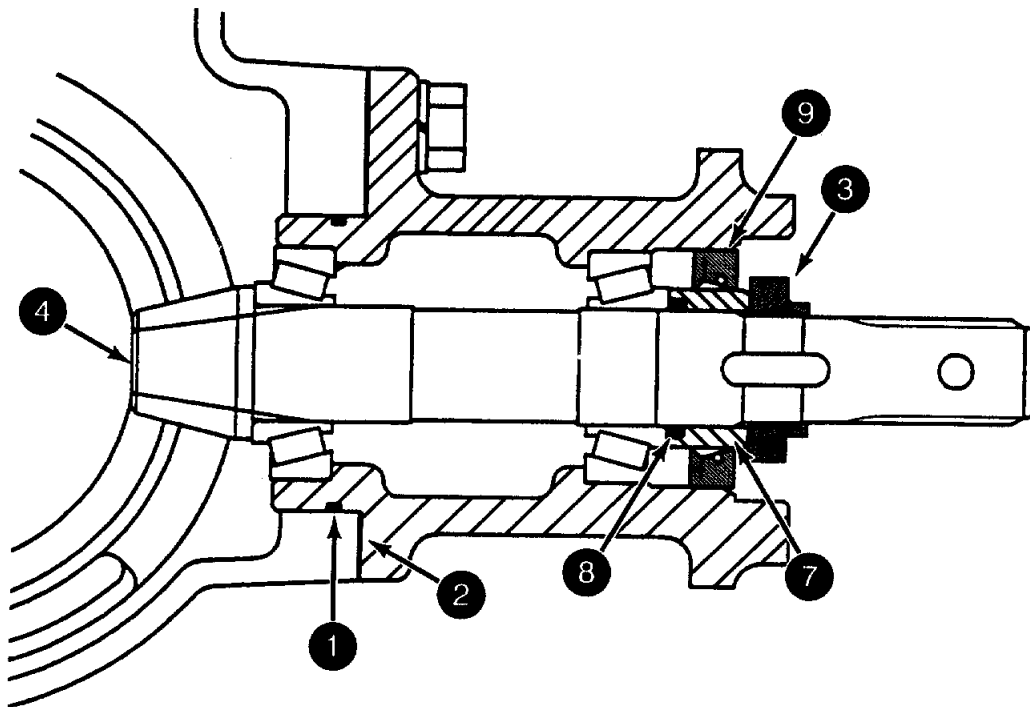


Use the special tool CAS 2176, to measure the bearing to mounting face height. Add shims (2) until no clearance is measured between the special tool and the mounting face.

[ 8 ]

Install item (1).

### Cross Sectional Drawing of the Pinion



1. O-RING  
2. SHIM

3. NUT  
4. PINION

7. SPACER  
8. O-RING

9. SEAL

SM0475

## BRAKES (719 \* )

### Removal and Installation

#### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels. Disengage the parking brake.

#### [ 2 ]

Remove the rear wheels and support the tractor on suitable axle stands.

**NOTE:** For Installation, tighten the rear wheel bolts to a torque of 118 to 132 Nm (87 to 97.5 lb ft).

#### [ 3 ]

Remove items (1, 2 and 3) and remove the brake assembly.

**NOTE:** For Installation, tighten bolts (3) to a torque of 30 Nm (22 lb ft).

#### [ 4 ]

Remove items (4 to 9) from the cover (10).

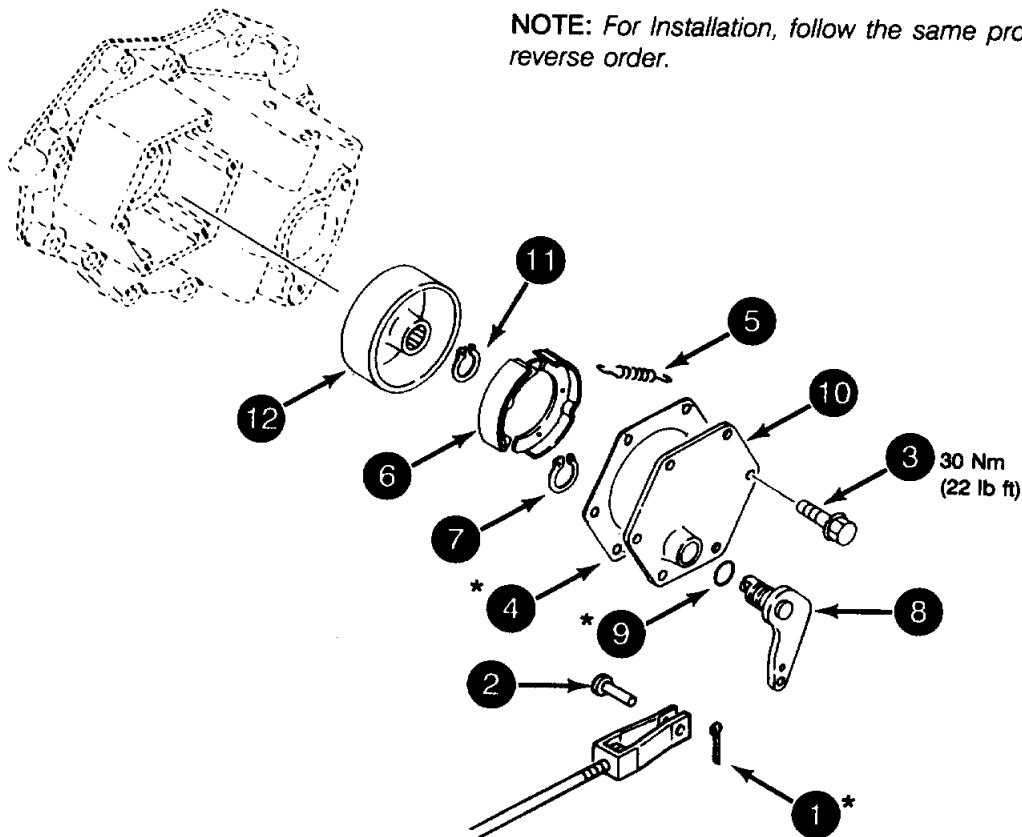
#### [ 5 ]

Remove items (11 and 12) from the axle housing.

#### [ 6 ]

Check all items for wear or damage and replace as necessary.

**NOTE:** For Installation, follow the same procedure in reverse order.



**NOTE:** Items are numbered in order of Removal.

**NOTE:** Items marked (\*) must be replaced.

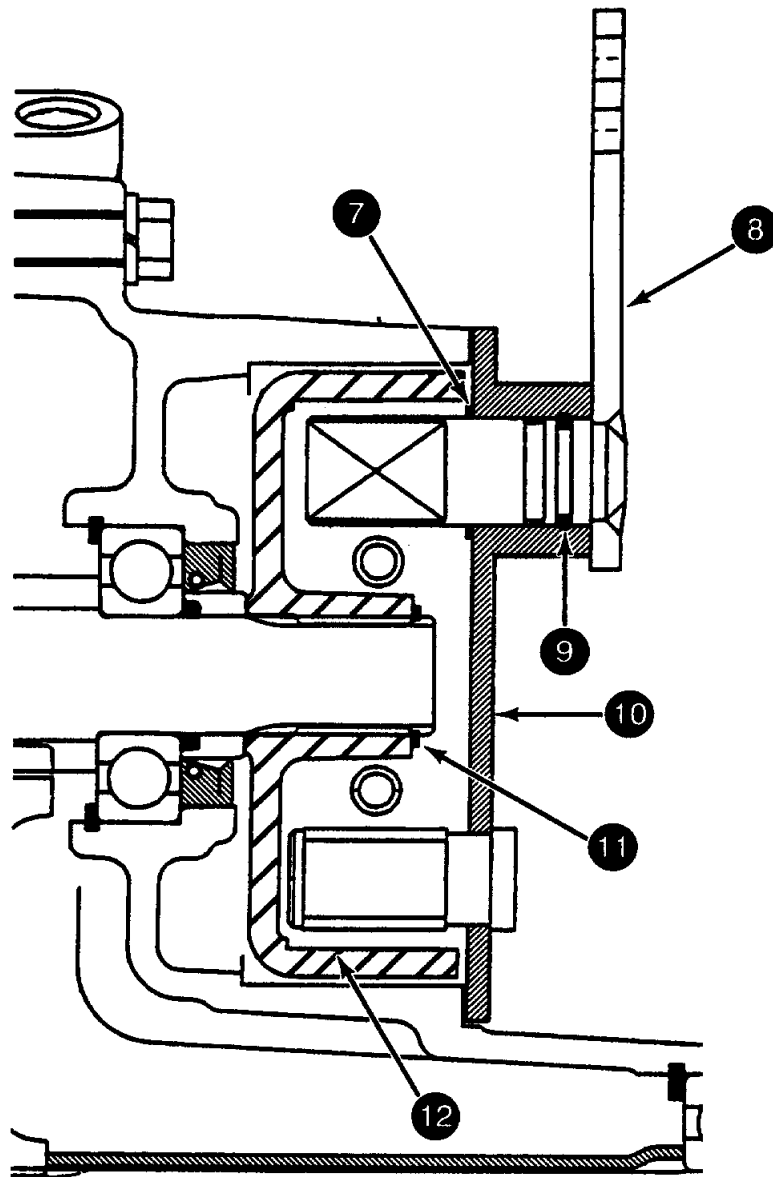
- 1. COTTER PIN
- 2. PIN
- 3. BOLT

- 4. GASKET
- 5. SPRING
- 6. BRAKE SHOE

- 7. SNAP RING
- 8. LEVER
- 9. O-RING

- 10. COVER
- 11. SNAP RING
- 12. HUB

# Cross Sectional Drawing of the Brakes (719 \* )



SM0416C

- 7. SNAP RING
- 8. LEVER
- 9. O-RING

- 10. COVER
- 11. SNAP RING
- 12. HUB

## BRAKES (723 \* and 727 \* )

### Removal and Installation

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels. Disengage the parking brake.

[ 2 ]

Remove the Rear Axles, refer to Section 6018.

[ 3 ]

Using a bearing puller remove item (1). Remove items (2, 3 and 4).

**NOTE:** Keep shims (2) together for Installation.

[ 4 ] (Left Hand Axle Only)

Remove items (5 to 7).

[ 5 ]

Remove bolts (8) and remove the brake assembly items (9 to 17). Remove items (9 to 14).

[ 6 ]

Use a hydraulic press to remove items (15 and 16) from housing (17).

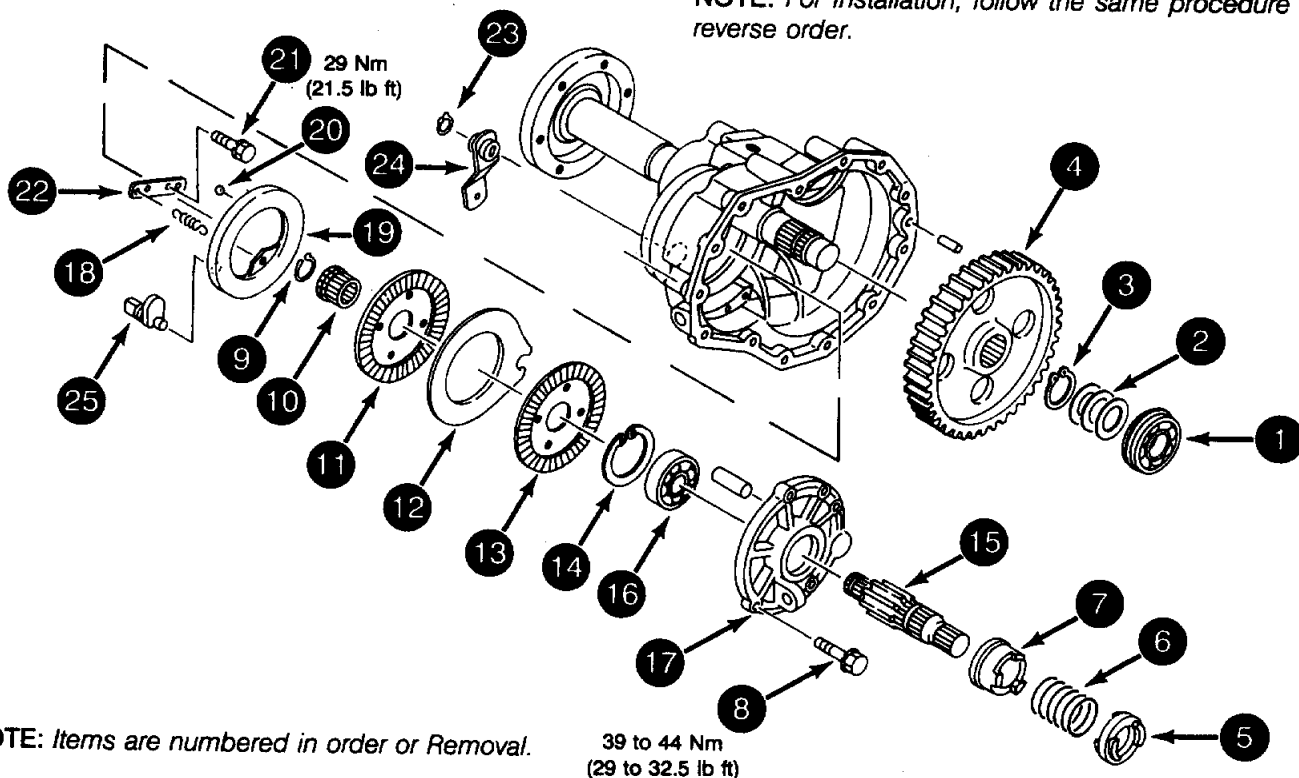
[ 7 ]

Remove items (18 to 25)

[ 8 ]

Check all items for wear or damage and replace as necessary.

**NOTE:** For Installation, follow the same procedure in reverse order.



**NOTE:** Items are numbered in order of Removal.

1. BEARING  
2. SHIM  
3. SNAP RING  
4. GEAR  
5. SPACER

6. SPRING  
7. HUB  
8. BOLT  
9. SNAP RING  
10. HUB

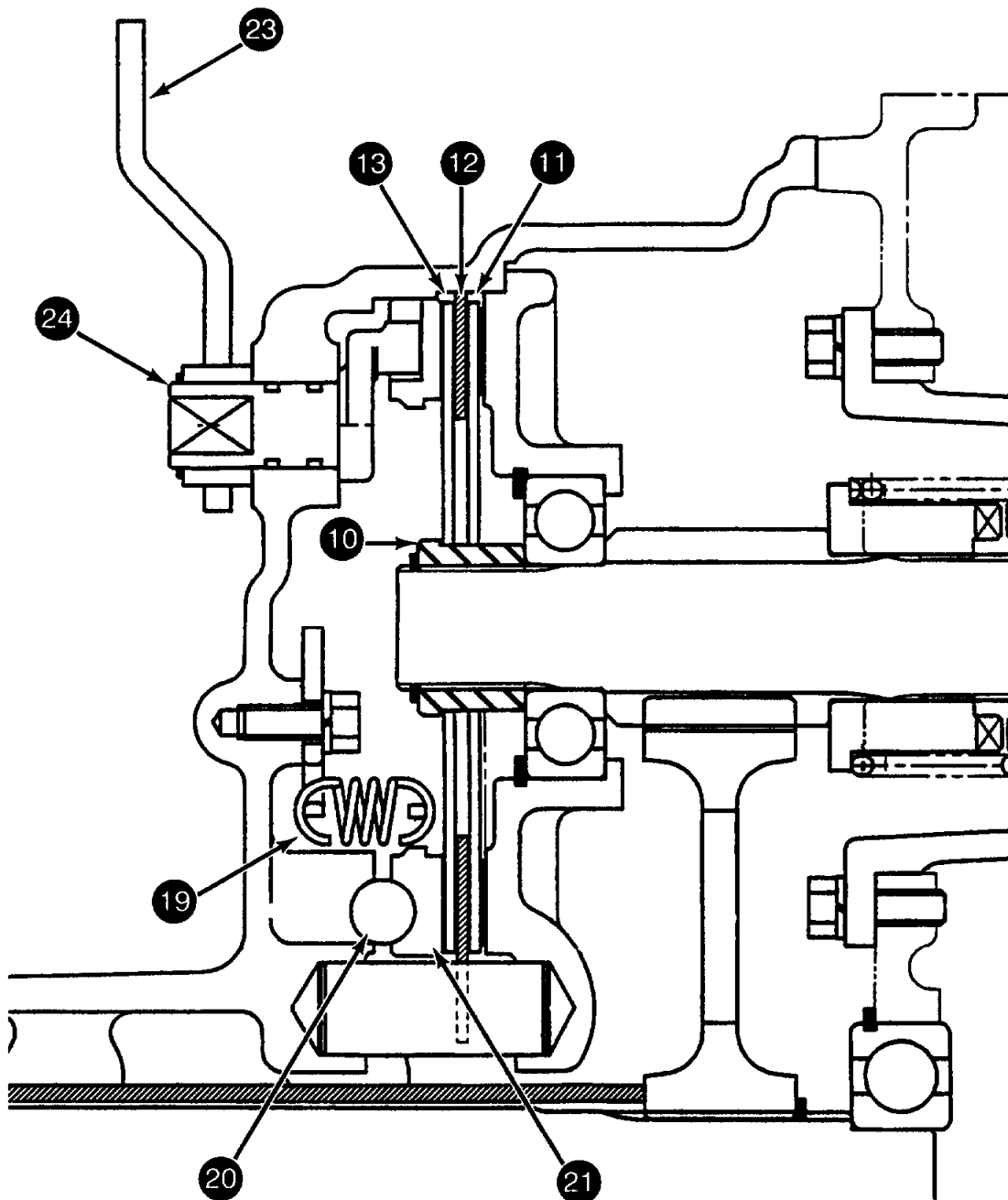
11. FRICTION PLATE  
12. PLATE  
13. FRICTION PLATE  
14. SNAP RING  
15. SHAFT

16. BEARING  
17. COVER  
18. SPRING  
19. CAM PLATE  
20. BALL

21. BOLT  
22. HOOK PLATE  
23. SNAP RING  
24. LEVER  
25. ACTUATOR

SM0224

Cross Sectional Drawing of the Brakes (723 \* and 727 \* )



SM0417

10. HUB  
11. FRICTION PLATE  
12. PLATE

13. FRICTION PLATE  
19. SPRING  
20. BALL

21. CAM PLATE  
23. LEVER  
24. ACTUATOR



## SECTION 4

## HYDRAULICS

### SPECIFICATIONS

#### Hydraulic Lift

719 \*

## Cylinder Head Springs

## Spring (3)

Free Length .....	18.5 mm	0.73 inch
Test Length .....	12.0 mm	0.47 inch
Test Load .....	29.4 N	6.61 lbf

## Spring (6)

Free Length .....	39.0 mm	1.53 inch
Test Length .....	26.5 mm	1.04 inch
Test Load .....	6.0 N	1.35 lbf

723 \* and 727 \*

## Cylinder Head Spring

Free Length .....	18.5 mm	0.73 inch
Test Length .....	12.0 mm	0.47 inch
Test Load .....	29.4 N	6.61 lbf

## Hitch Control Valve Springs

## Spring (7)

Free Length .....	60.4 mm	2.38 inch
Test Length .....	46.0 mm	1.81 inch
Test Load .....	68.7 N	15.46 lbf

## Spring (13)

Free Length .....	32.5 mm	1.81 inch
Test Length .....	21.5 mm	0.85 inch
Test Load .....	20.6 N	4.64 lbf

## Spring (15)

Free Length .....	22.5 mm	0.88 inch
Test Length .....	17.5 mm	0.69 inch
Test Load .....	68.7 N	15.46 lbf

## Spring (20)

Free Length .....	26.0 mm	1.02 inch
Test Length .....	20.5 mm	0.81 inch
Test Load .....	10.8 N	2.43 lbf

#### Hydraulic Pumps

Number of Pumps ..... 2

Type..... Engine Driven Pressure Loaded Gear Type

## Steering Pump (Front)

Flow at Rated Engine RPM (719 * ) .....	12 L/min	3.2 gpm
Flow at Rated Engine RPM (723 * and 727 * ) .....	12.5 L/min	3.2 gpm
Pressure .....	1784 to 1987 psi	12300 to 13700 kPa

## Main Hydraulic Pump (Rear)

Flow at Rated Engine RPM (719 * ) .....	20.5 L/min	5.3 gpm
Flow at Rated Engine RPM (723 * and 727 * ) .....	27.5 L/min	7.2 gpm
System Pressure .....	2133 psi	14700 kPa

## SPECIAL TORQUES

### 719 \*

Hydraulic Lift Housing Retaining Bolts .....	39 to 44 Nm	29 to 32.5 lb ft
Hitch Control Valve Retaining Bolts .....	19 to 24 Nm	14 to 18 lb ft
Lubrication Tube .....	19.5 to 24.5 Nm	14.5 to 18 lb ft
Cylinder Head Retaining Screws .....	72.5 to 82 Nm	53.5 to 60.5 lb ft
Wrist Pin Retaining Screw .....	10 to 12 Nm	7.5 to 9 lb ft
Lowering Control Valve Plug .....	39 to 44 Nm	29 to 32.5 lb ft

### 723 \* and 727 \*

Hydraulic Lift Housing Retaining Bolts .....	39 to 44 Nm	29 to 32.5 lb ft
Hitch Control Valve Retaining Bolts .....	19 to 24 Nm	14 to 18 lb ft
Cylinder Head Retaining Screws .....	122 to 137 Nm	90 to 101 lb ft
Wrist Pin Retaining Screw .....	10 to 12 Nm	7.5 to 9 lb ft
Lowering Control Valve Plug .....	39 to 44 Nm	29 to 32.5 lb ft

## HYDRAULIC LIFT HOUSING

### Removal and Installation

#### [ 1 ]

Park the machine on hard level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

#### [ 2 ]

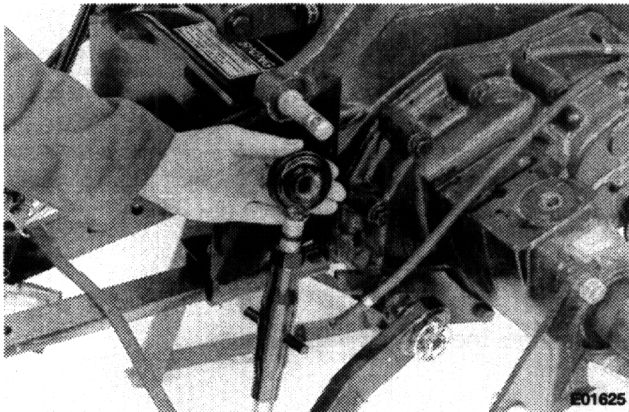
Support the tractor on axle stands and remove the rear wheels.

**NOTE:** For Installation, tighten the rear wheel bolts to a torque of 118 to 132 Nm (87 to 97.5 lb ft).

#### [ 3 ]

Remove the rear fenders and seat platform, refer to Section 9030.

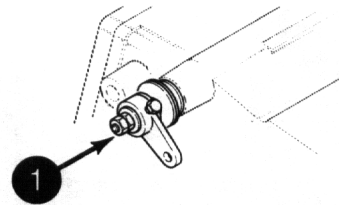
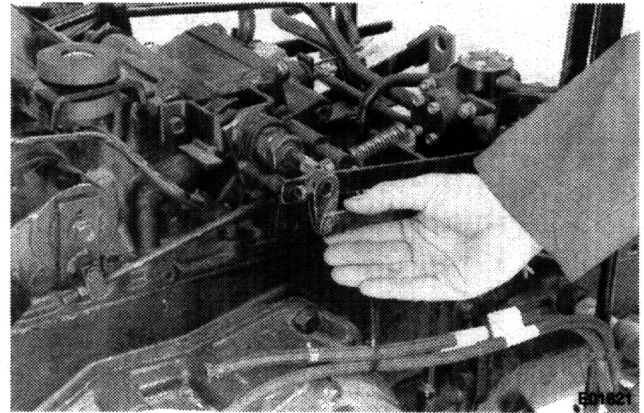
#### [ 4 ]



Disconnect the lift arms from the hydraulic lift housing.

**NOTE:** For Installation, connect the lift arms and then adjust the hitch, refer to Hitch Adjustments on Page 175.

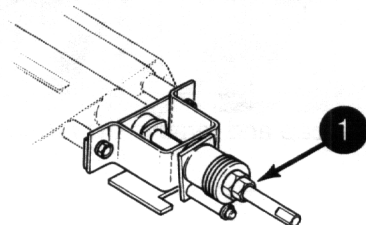
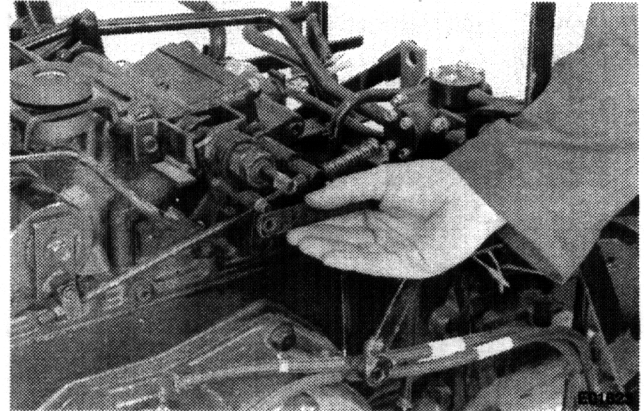
#### [ 5 ]



Disconnect the position control lever.

**NOTE:** For Assembly, tighten locknuts (1) until a pull of 3 to 5 kgf (6.6 to 11 lbf) is measured on the position control lever.

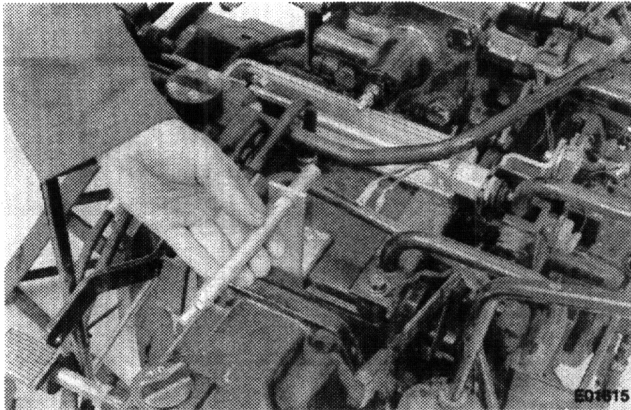
#### [ 6 ]



Disconnect the draft control lever (if equipped).

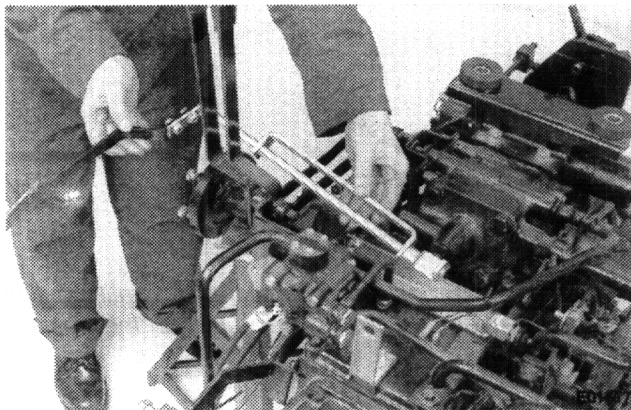
**NOTE:** For Assembly, tighten locknuts (1) until a pull of 3 to 5 kgf (6.6 to 11 lbf) is measured on the position control lever.

[ 7 ]



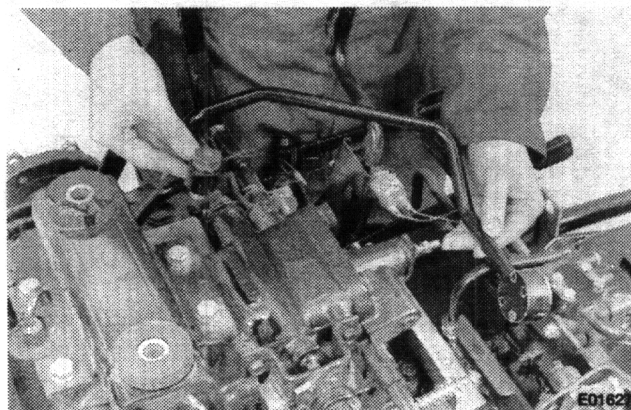
Disconnect and remove the lowering control rod.

[ 8 ]



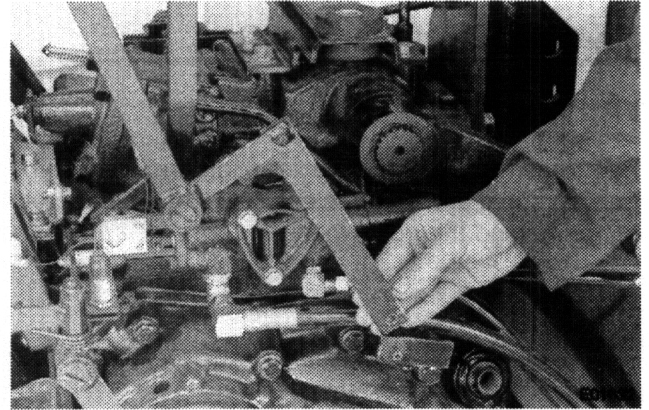
Disconnect and remove the remote valve lever (if equipped).

[ 9 ]



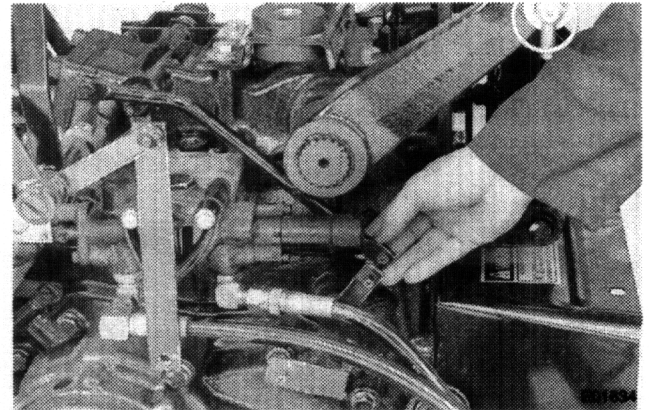
Disconnect, cap and remove the remote valve supply tube.

[ 10 ]



Disconnect the rear PTO lever.

[ 11 ]

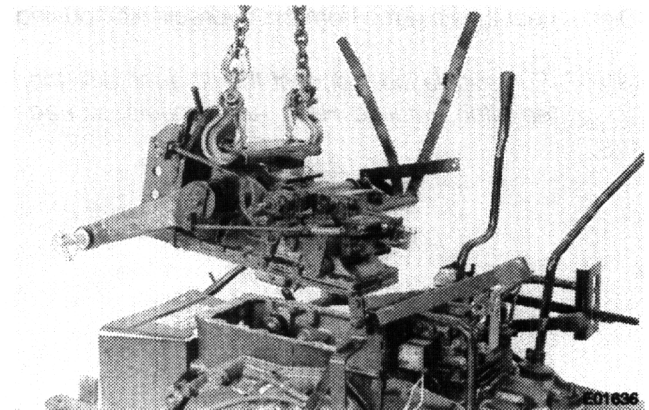


Disconnect the mid PTO lever (if equipped).

[ 12 ]

Disconnect the main wiring harness.

[ 13 ]



Remove the retaining bolts and using suitable lifting equipment remove the hydraulic lift housing.

**NOTE:** For Installation, apply a continuous bead of Loctite 515 to the gearbox top and tighten the retaining bolts to a torque of 39 to 44 Nm (29 to 32.5 lb ft).

**NOTE:** For Installation, follow the same procedure in reverse order.

## SERVICING THE HYDRAULIC LIFT HOUSING POSITION AND DRAFT CONTROL LINKAGE

### Disassembly and Assembly

#### [ 1 ]

Remove the remote valve (if equipped). Refer to Section 8006.

#### [ 2 ]

Remove items (1 to 3). Loosen locknut (4) and remove item (5).

**NOTE:** For Assembly, make a note of the number of turns to remove item (5).

#### [ 3 ]

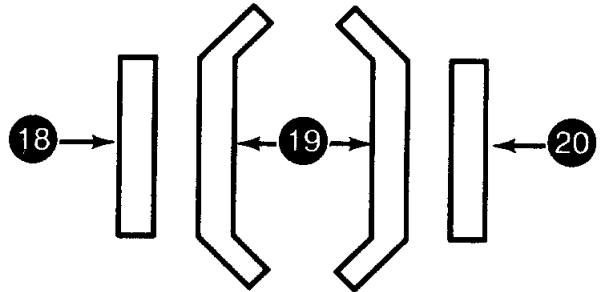
Remove items (6 and 7).

#### [ 4 ]

Remove items (8 to 16).

**NOTE:** For Assembly, adjust the position control linkage (11) and the draft control linkage (16). Refer to Hitch Adjustments on Page 175.

#### [ 5 ]

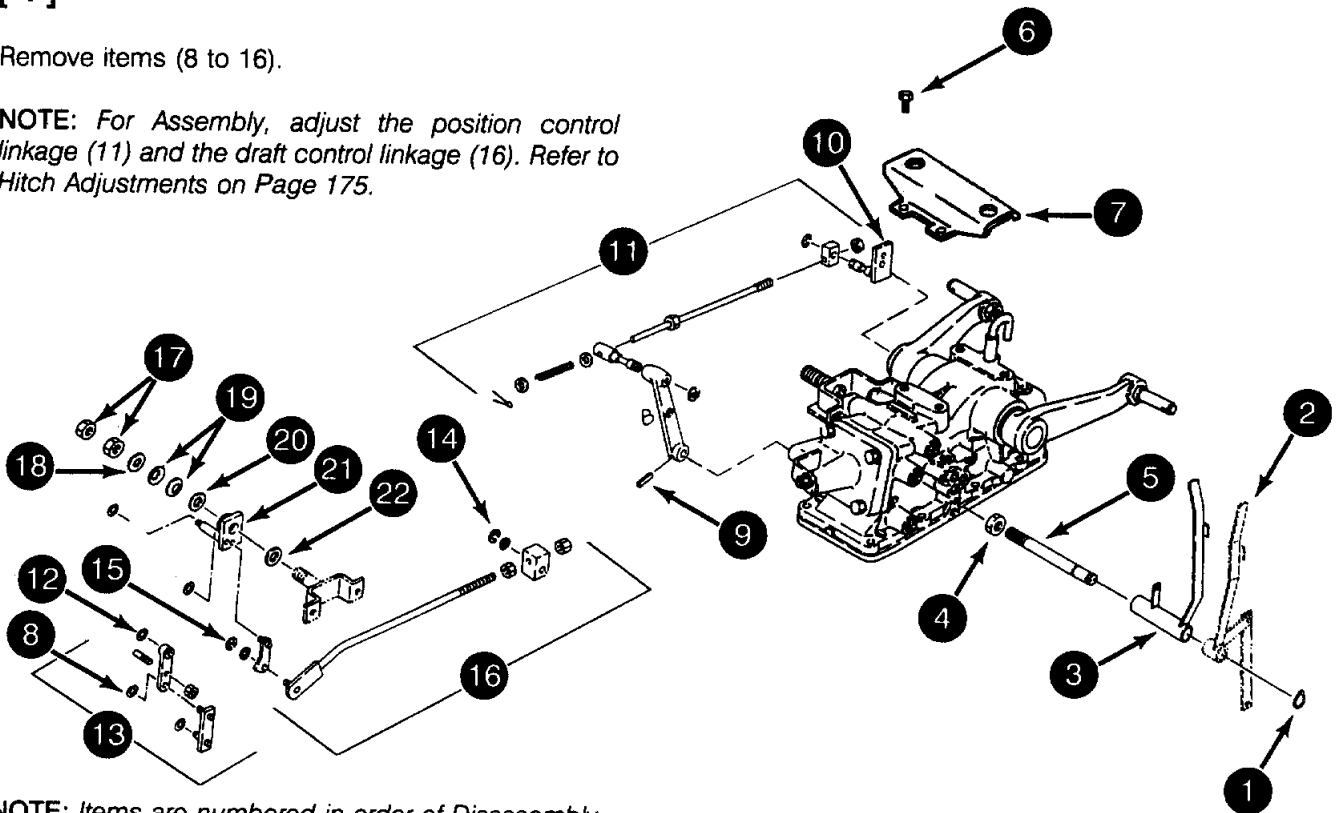


SM0548

Remove items (17 to 22).

**NOTE:** For Assembly, DO NOT tighten item (17) at this stage. Refer to Step 6 on Page 5.

**NOTE:** For Assembly, install the Belleville washers (19) as shown.



SM0498

**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items (8) and (12 to 22) are for Draft Control only.

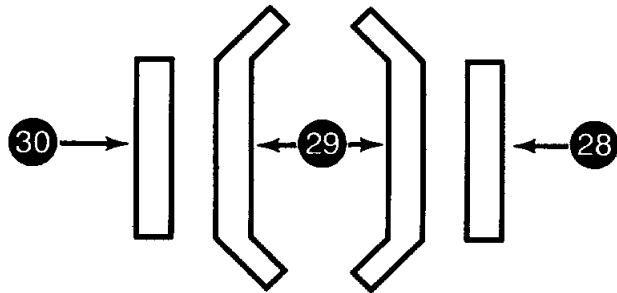
- |                                   |  |                                       |                           |
|-----------------------------------|--|---------------------------------------|---------------------------|
| 1. SNAP RING                      | 7. BRACKET                               | 12. SNAP RING                         | 17. LOCKNUTS              |
| 2. MID PTO LEVER<br>(IF EQUIPPED) | 8. SNAP RING                             | 13. LINKAGE ASSEMBLY                  | 18. WASHER                |
| 3. PTO LEVER                      | 9. ROLL PIN                              | 14. SNAP RING                         | 19. BELLEVILLE WASHERS    |
| 4. LOCKNUT                        | 10. LINKAGE BRACKET                      | 15. SNAP RING                         | 20. WASHER                |
| 5. ROD                            | 11. POSITION CONTROL<br>LINKAGE ASSEMBLY | 16. DRAFT CONTROL<br>LINKAGE ASSEMBLY | 21. DRAFT LINKAGE BRACKET |
| 6. BOLT                           |  |                                       | 22. WASHER                |

[ 6 ]

Remove items (23 and 24).

**NOTE:** For Assembly, do not tighten item (23) at this stage, refer to Step 5 on Page 5.

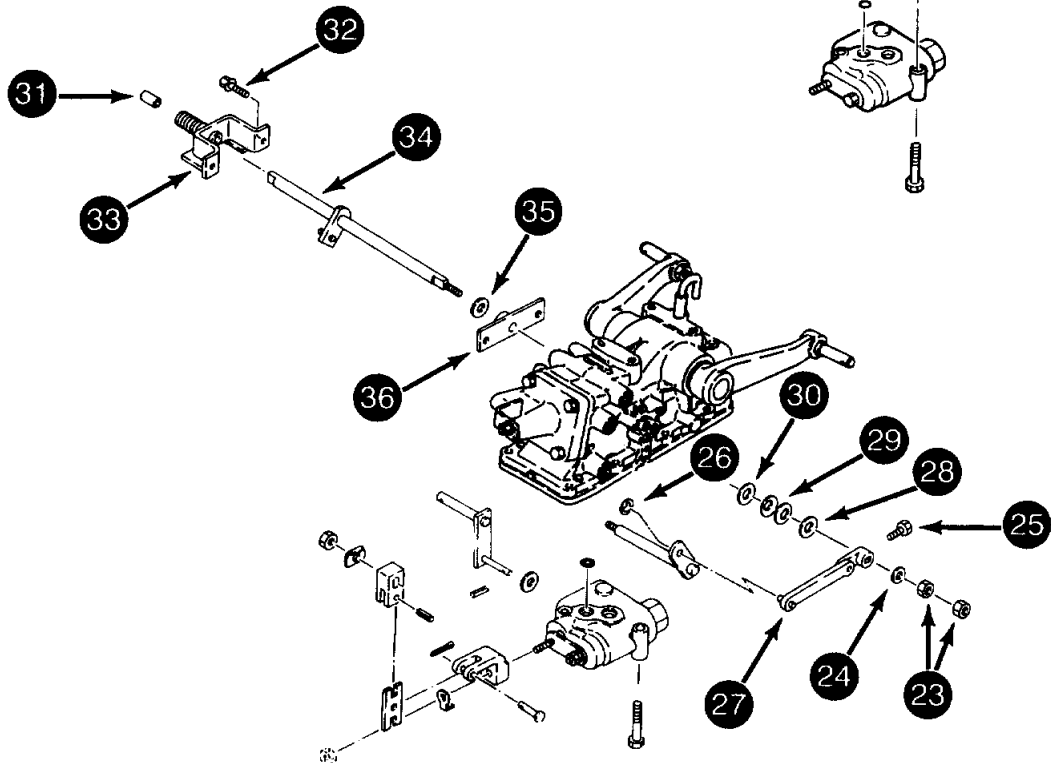
[ 7 ]



SM0548

Loosen item (25) and remove items (26 to 30).

**NOTE:** For Assembly, install the Belleville washers (29) as shown.



**NOTE:** Items are numbered in order of Disassembly.

SM0549

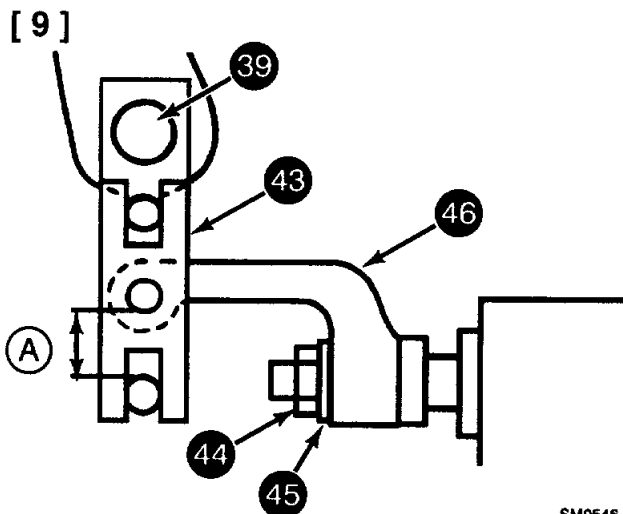
**NOTE:** Items marked (\*) must be replaced.

23. LOCKNUTS  
24. WASHER  
25. SCREW  
26. SNAP RING

27. ARM  
28. WASHER  
29. BELLEVILLE  
WASHERS

30. WASHER  
31. SPACER  
(IF EQUIPPED)  
32. SCREW

33. BRACKET  
34. SHAFT  
35. WASHER  
36. PLATE



Bend back locking tab (38) and remove items (37 to 43).

**NOTE:** For Assembly, lubricate item (39) with lithium base grease.

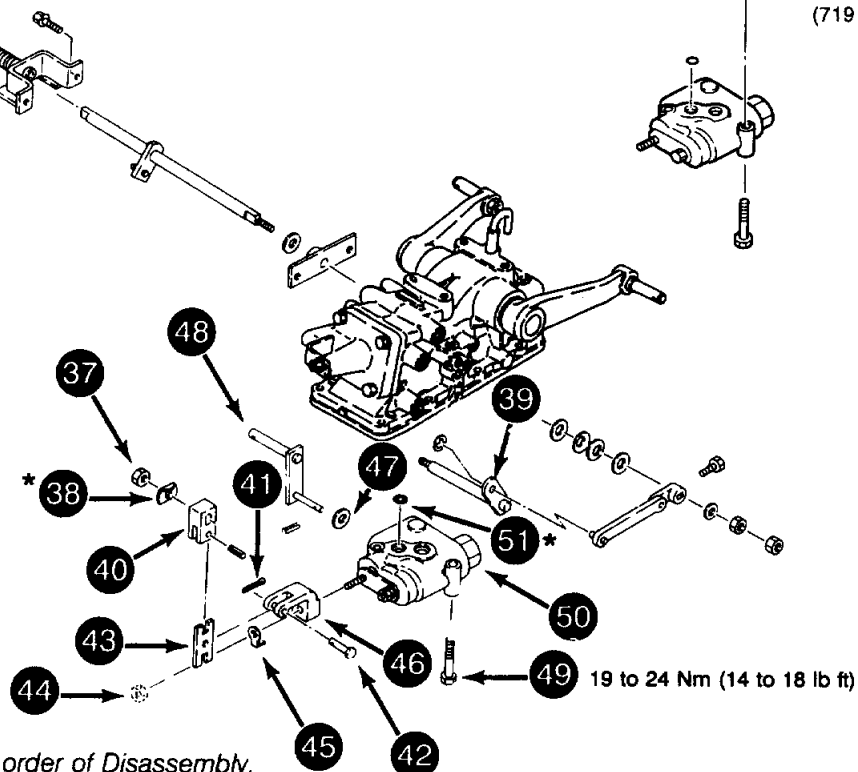
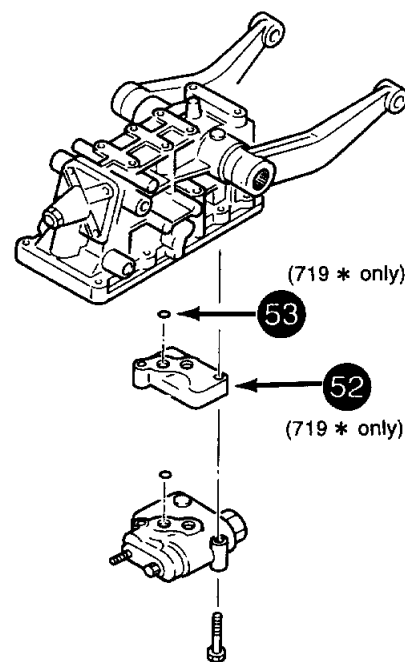
**NOTE:** For Assembly, adjust shaft (39) so that linkage plate (43) is at 90 degrees to yoke (46). Loosen nut (44) and adjust yoke (46) until distance (A) measures 12.5 to 13 mm (0.49 to 0.51 inch). Tighten adjusting nut (44) and secure with locking tab (45).

## [ 10 ]

Bend back locking tab (45) and remove items (44 to 53) (719 \*), remove items (44 to 51) (723 \* and 727 \*).

**NOTE:** For Assembly, tighten bolts (49) to a torque of 19 to 24 Nm (14 to 18 lb ft) and lubricate item (48) with lithium base grease.

**NOTE:** For Disassembly and Assembly of the Hitch Control Valve (50), refer to Page 19.



**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

37. NUT  
38. LOCKING TAB  
39. SHAFT  
40. YOKE

41. COTTER PIN  
42. PIN  
43. LINKAGE PLATE  
44. NUT

45. LOCKING TAB  
46. YOKE  
47. WASHER  
48. FEEDBACK LEVER

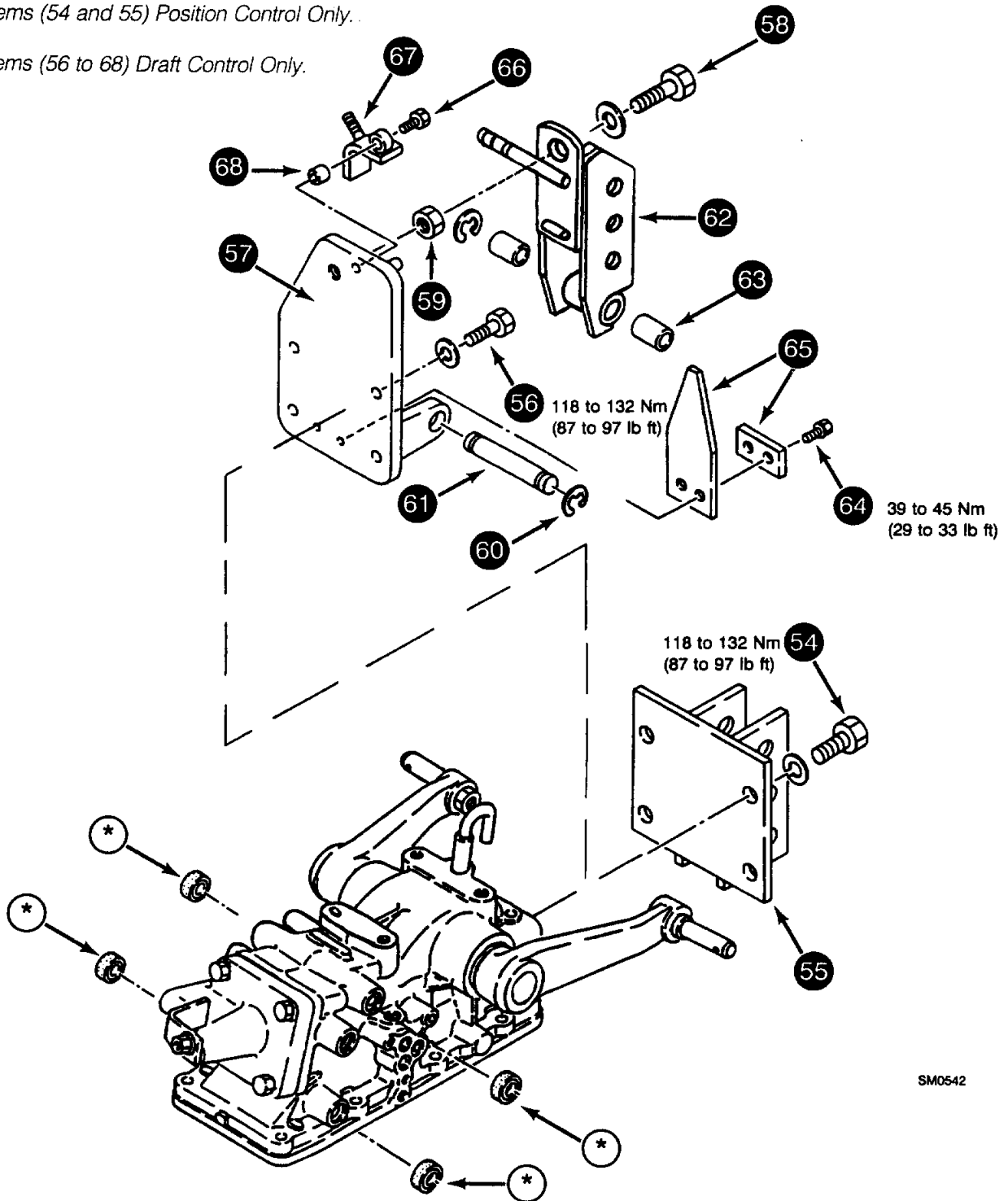
49. BOLT  
50. HITCH CONTROL VALVE  
51. O-RING  
52. BLOCK

53. O-RING

NOTE: Items are numbered in order of Disassembly.

NOTE: Items (54 and 55) Position Control Only.

NOTE: Items (56 to 68) Draft Control Only.



SM0542

NOTE: Items marked (\*) must be replaced.

- 54. BOLT
- 55. UPPER LINK  
MOUNTING BRACKET
- 56. BOLT
- 57. UPPER LINK  
MOUNTING BRACKET

- 58. BOLT
- 59. NUT
- 60. SNAP RING
- 61. PIN
- 62. SENSING BRACKET
- 63. BUSHING

- 64. SCREW
- 65. SPRING PLATE  
AND BRACKET
- 66. SCREW
- 67. STOP
- 68. BUSHING



## HYDRAULIC LIFT CYLINDER AND ARM (719 \* )

### Disassembly and Assembly

#### [ 1 ]

Remove snap ring (1). Remove items (2 to 4).

**NOTE:** *For Assembly, make sure that the timing marks on items (6 and 2) are correctly aligned.*

#### [ 2 ]

Using a soft faced hammer, drive items (5 and 6) out of the housing.

**NOTE:** *For Assembly, use CAS 2173 to install bushing (5).*

#### [ 3 ]

Using a bushing driver, remove item (7).

**NOTE:** *For Assembly, use CAS 2173 to install bushing (7).*

**NOTE:** *For Assembly, make sure that the timing marks on items (6 and 12) are aligned.*

**IMPORTANT:** *For Assembly, install rockshaft (6) before installing bushing (7).*

#### [ 4 ]

Remove screws (8) and remove items (9 to 11).

**NOTE:** *For Assembly, tighten screw (8) to a torque of 72.5 to 82 Nm (53.5 to 60.5 lb ft).*

**NOTE:** *For Disassembly and Assembly of the cylinder head (9), refer to Page 13.*

#### [ 5 ]

Turn the lift housing over and remove the connecting rod assembly items (12 to 16). Disassemble items (12 to 16).

**NOTE:** *For Assembly, tighten screw (13) to a torque of 10 to 12 Nm (7.5 to 9 lb ft).*

#### [ 6 ]

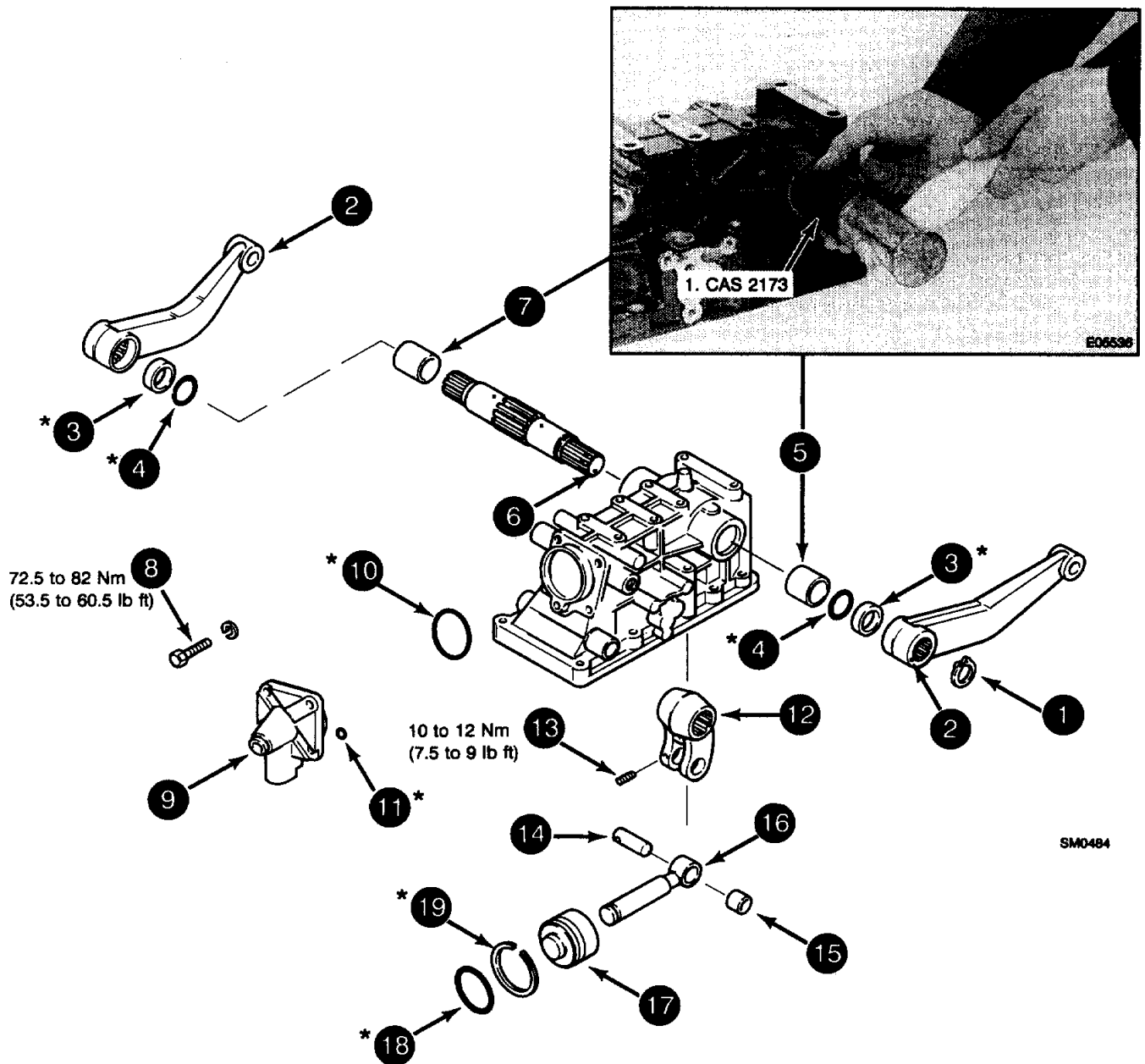
Shock the lift housing against a block of wood and remove the piston (17). Remove items (18 and 19).

#### [ 7 ]

Clean all parts in a cleaning solvent and dry using compressed air. DO NOT use cloths to dry hydraulic components.

**NOTE:** *For Assembly, follow the same procedure in reverse order.*

NOTE: Items are numbered in order of Disassembly.



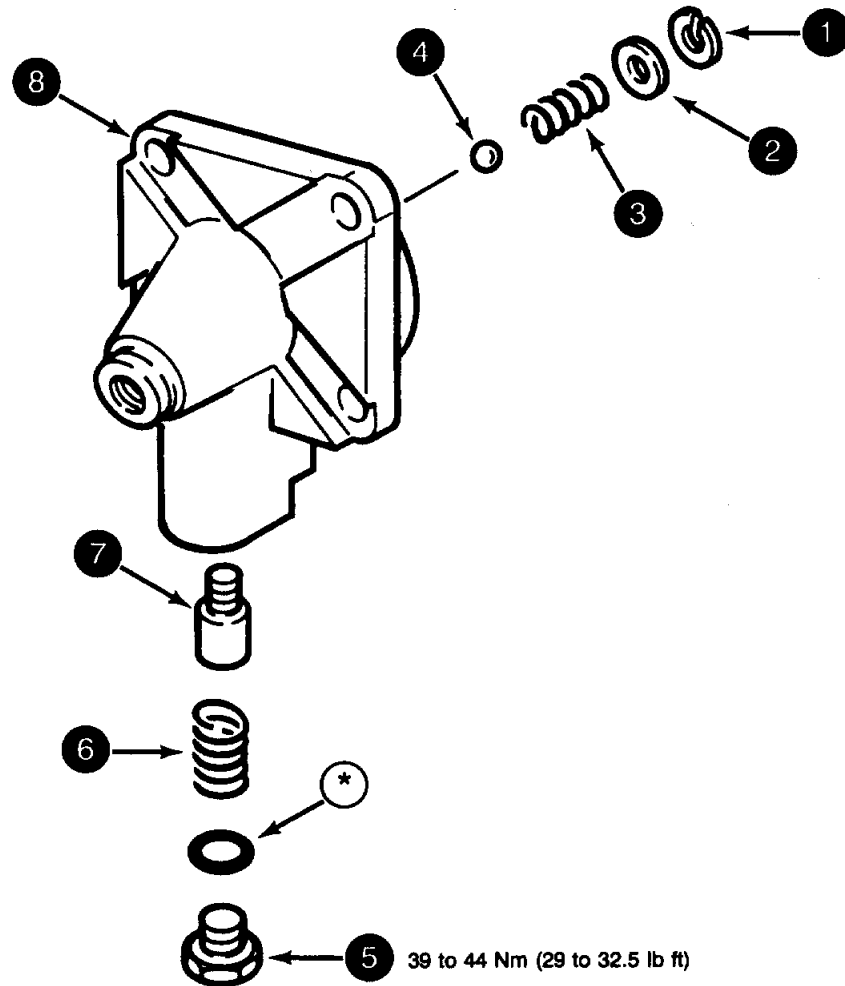
NOTE: Items marked (\*) must be replaced.

- |              |                  |               |                    |
|--------------|------------------|---------------|--------------------|
| 1. SNAP RING | 6. ROCKSHAFT     | 11. O-RING    | 16. CONNECTING ROD |
| 2. LIFT ARM  | 7. BUSHING       | 12. POWER ARM | 17. PISTON         |
| 3. BUSHING   | 8. SCREW         | 13. SCREW     | 18. O-RING         |
| 4. O-RING    | 9. CYLINDER HEAD | 14. WRIST PIN | 19. BACKUP RING    |
| 5. BUSHING   | 10. O-RING       | 15. BUSHING   |                    |

## CYLINDER HEAD (719 \* )

### Disassembly and Assembly

**NOTE:** Items are numbered in order of Disassembly.



SMO485

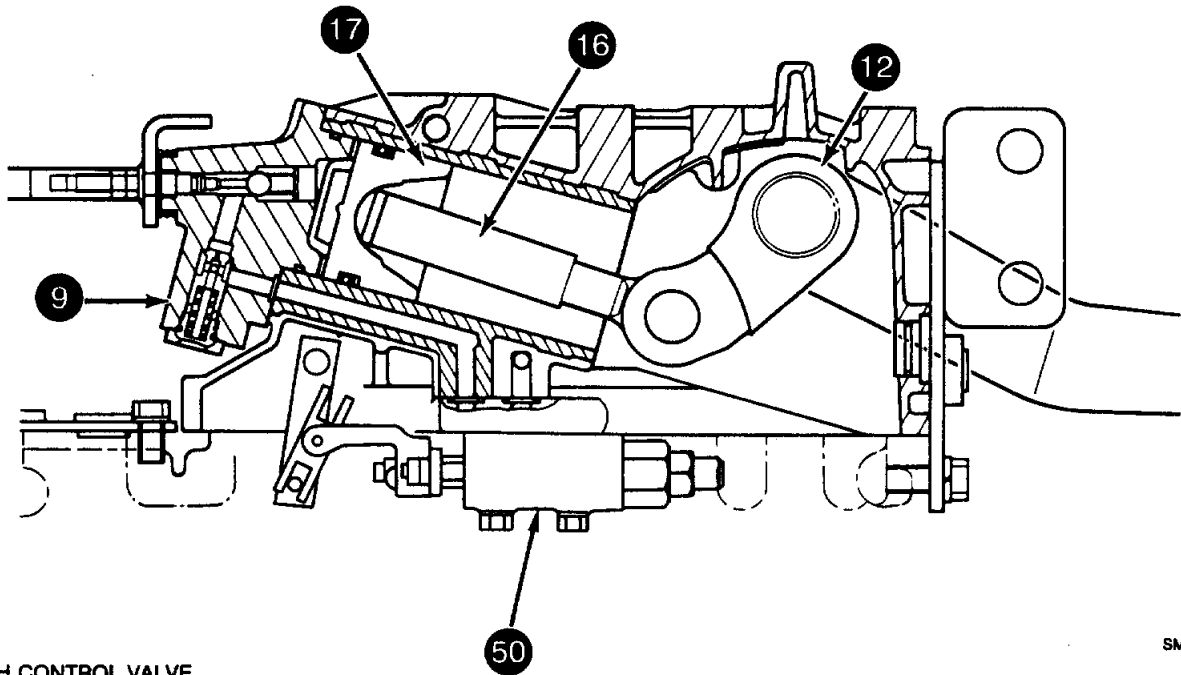
**NOTE:** For Assembly, if replacing the cylinder head (8), the steel ball (4) should be seated by hitting it lightly onto its mating surface.

**NOTE:** Items marked (\*) must be replaced.

- 1. SNAP RING
- 2. WASHER
- 3. SPRING
- 4. STEEL BALL

- 5. PLUG
- 6. SPRING
- 7. POPPET
- 8. CYLINDER HEAD

## Cross Sectional Drawing of the Hydraulic Lift Housing(719 \* )



SM0486

- 50. HITCH CONTROL VALVE
- 9. CYLINDER HEAD
- 12. POWER ARM
- 16. CONNECTING ROD
- 17. PISTON

## HYDRAULIC LIFT CYLINDER AND ARM (723 \* and 727 \* )

### Disassembly and Assembly

#### [ 1 ]

Remove snap ring (1). Remove items (2 to 4).

**NOTE:** For Assembly, make sure the timing marks on items (2 and 7) are aligned.

#### [ 2 ]

Remove screw (5) and, using a soft faced hammer, drive items (6 and 7) out of the housing.

**NOTE:** For Assembly, use CAS 2174 to install bushing (6) and tighten screw (5) to a torque of 10 to 12 Nm.

**NOTE:** For Assembly, use CAS 2174 to install bushing (6) and tighten screw (5) to a torque of 10 to 12 Nm (7.5 to 9 lb ft).

**NOTE:** For Assembly, make sure that the timing marks on items (10 and 7) are aligned.

**IMPORTANT:** For Assembly, install rockshaft (7) before installing bushing (6).

#### [ 3 ]

Remove items (8 to 9).

**NOTE:** For Assembly, tighten screw (8) to a torque of 122 to 137 Nm (90 to 101 lb ft).

**NOTE:** For Disassembly and Assembly of the cylinder head (9), refer to Page 171.

#### [ 4 ]

Turn the lift housing over and remove the connecting rod assembly items (10 to 14). Disassemble items (10 to 14).

**NOTE:** For Assembly, tighten screw (11) to a torque of 10 to 12 Nm (7.5 to 9 lb ft).

#### [ 5 ]

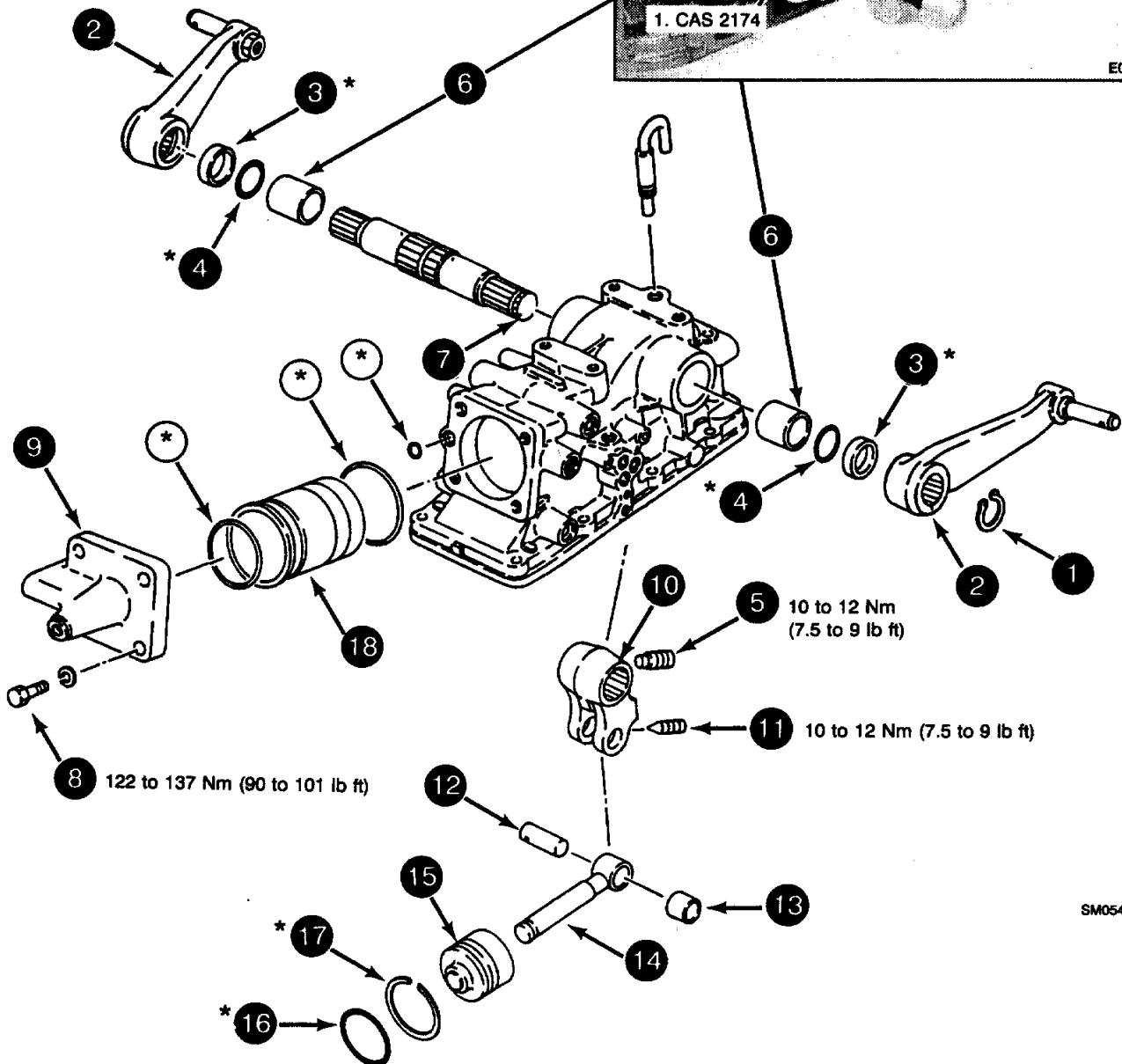
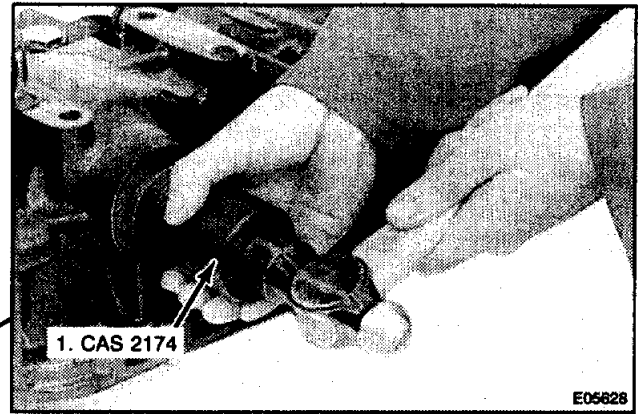
Shock the lift housing against a block of wood and remove the piston (15). Remove items (16 and 18).

#### [ 6 ]

Clean all parts in a cleaning solvent and dry using compressed air. DO NOT use cloths to dry hydraulic components.

**NOTE:** For Assembly, follow the same procedure in reverse order.

NOTE: Items are numbered in order of Disassembly.



SM0543

NOTE: Items marked (\*) must be replaced.

- 1. SNAP RING
- 2. LIFT ARM
- 3. BUSHING
- 4. O-RING
- 5. SCREW
- 6. BUSHING

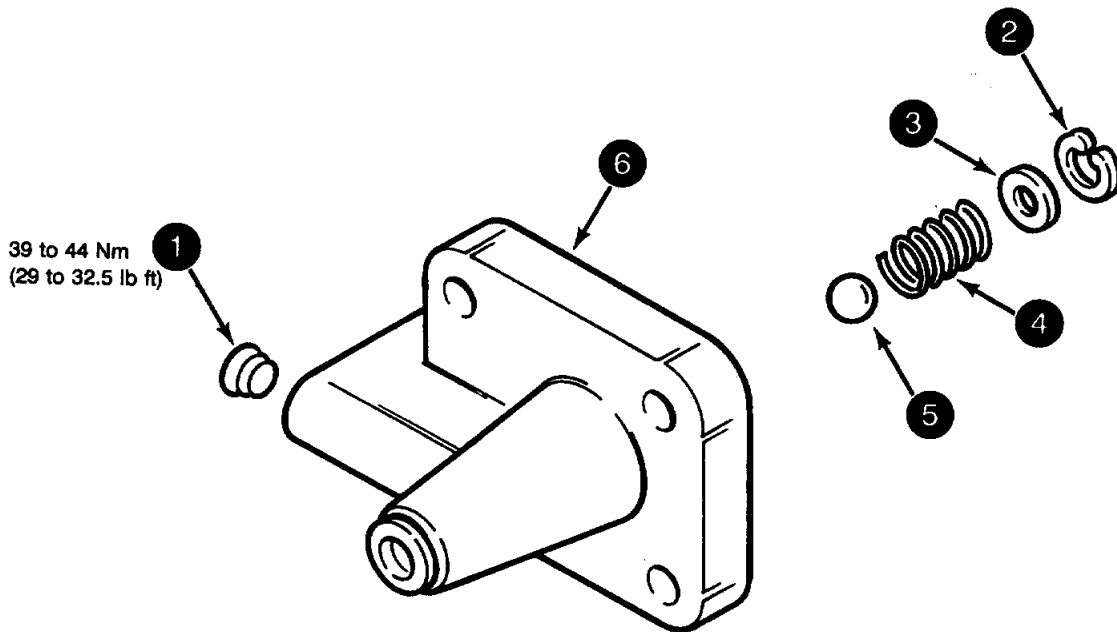
- 7. ROCKSHAFT
- 8. SCREW
- 9. CYLINDER HEAD
- 10. POWER ARM
- 11. SCREW
- 12. WRIST PIN

- 13. BUSHING
- 14. CONNECTING ROD
- 15. PISTON
- 16. O-RING
- 17. BACKUP RING
- 18. CYLINDER SLEEVE

## CYLINDER HEAD (723 \* and 727 \* )

### Disassembly and Assembly

NOTE: Items are numbered in order of Disassembly.



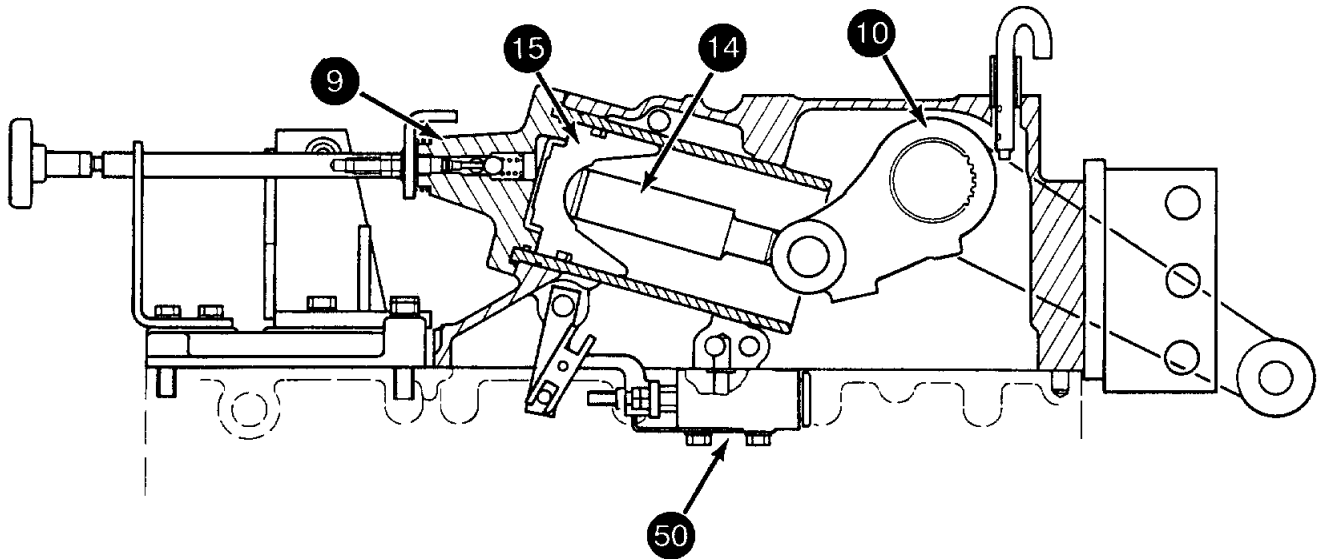
SM0496

NOTE: For Assembly, if replacing the cylinder head (6), the steel ball (5) should be seated by hitting it lightly onto its mating surface.

- 1. PLUG
- 2. SNAP RING
- 3. RETAINING WASHER

- 4. SPRING
- 5. STEEL BALL
- 6. CYLINDER HEAD

## Cross Sectional Drawing of the Hydraulic Lift Housing (723 \* and 727 \* )



SM0539

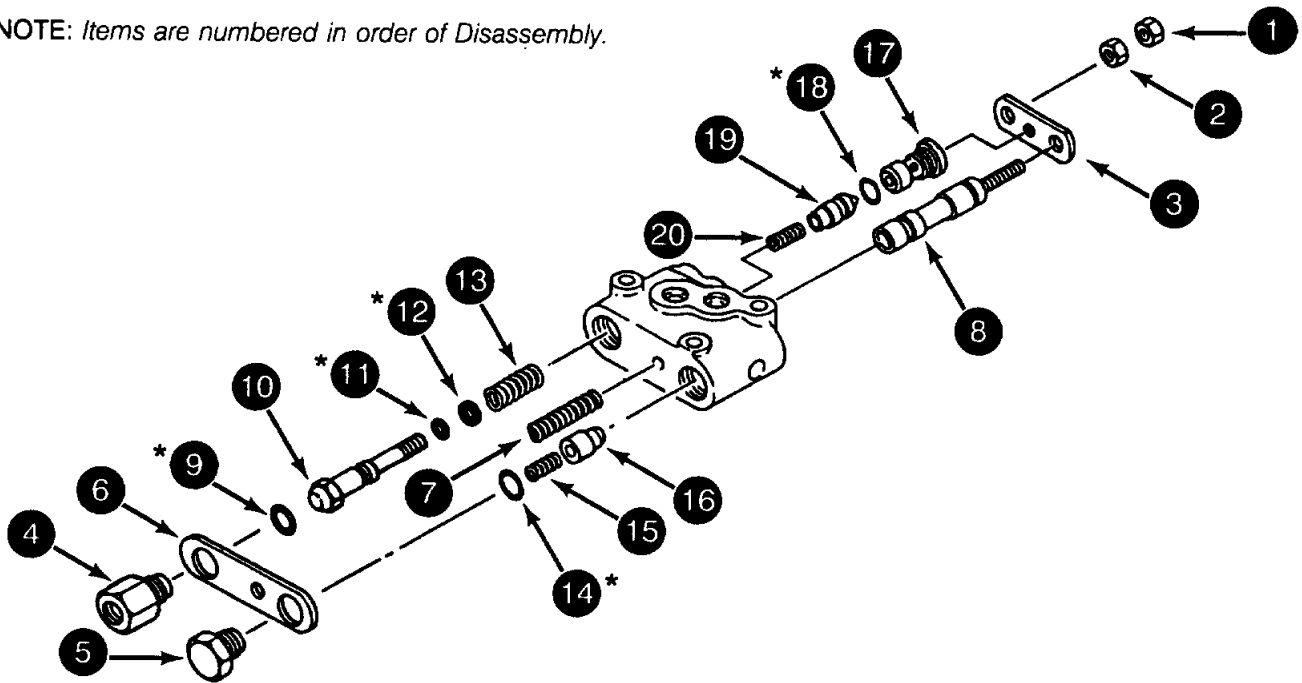
- 50. HITCH CONTROL VALVE
- 9. CYLINDER HEAD
- 10. POWER ARM
- 14. CONNECTING ROD
- 15. PISTON



## HITCH CONTROL VALVE

### Disassembly and Assembly

NOTE: Items are numbered in order of Disassembly.



NOTE: Items marked (\*) must be replaced.

SM0547

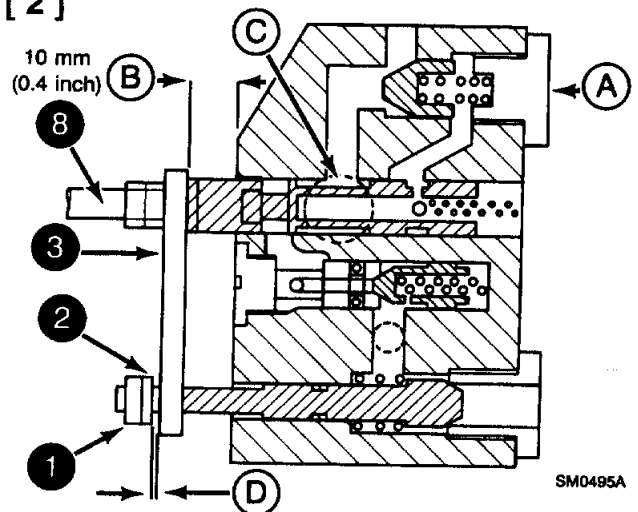
- |                  |                |                 |                    |
|------------------|----------------|-----------------|--------------------|
| 1. LOCKNUT       | 6. PLATE       | 11. O-RING      | 16. UNLOADER VALVE |
| 2. RETAINING NUT | 7. SPRING      | 12. BACKUP RING | 17. VALVE SEAT     |
| 3. PLATE         | 8. SPOOL VALVE | 13. SPRING      | 18. O-RING         |
| 4. PLUG          | 9. O-RING      | 14. O-RING      | 19. CHECK VALVE    |
| 5. PLUG          | 10. POPPET     | 15. SPRING      | 20. SPRING         |

### Adjustments

[ 1 ]

Remove plug (5), o-ring (14) and spring (15).

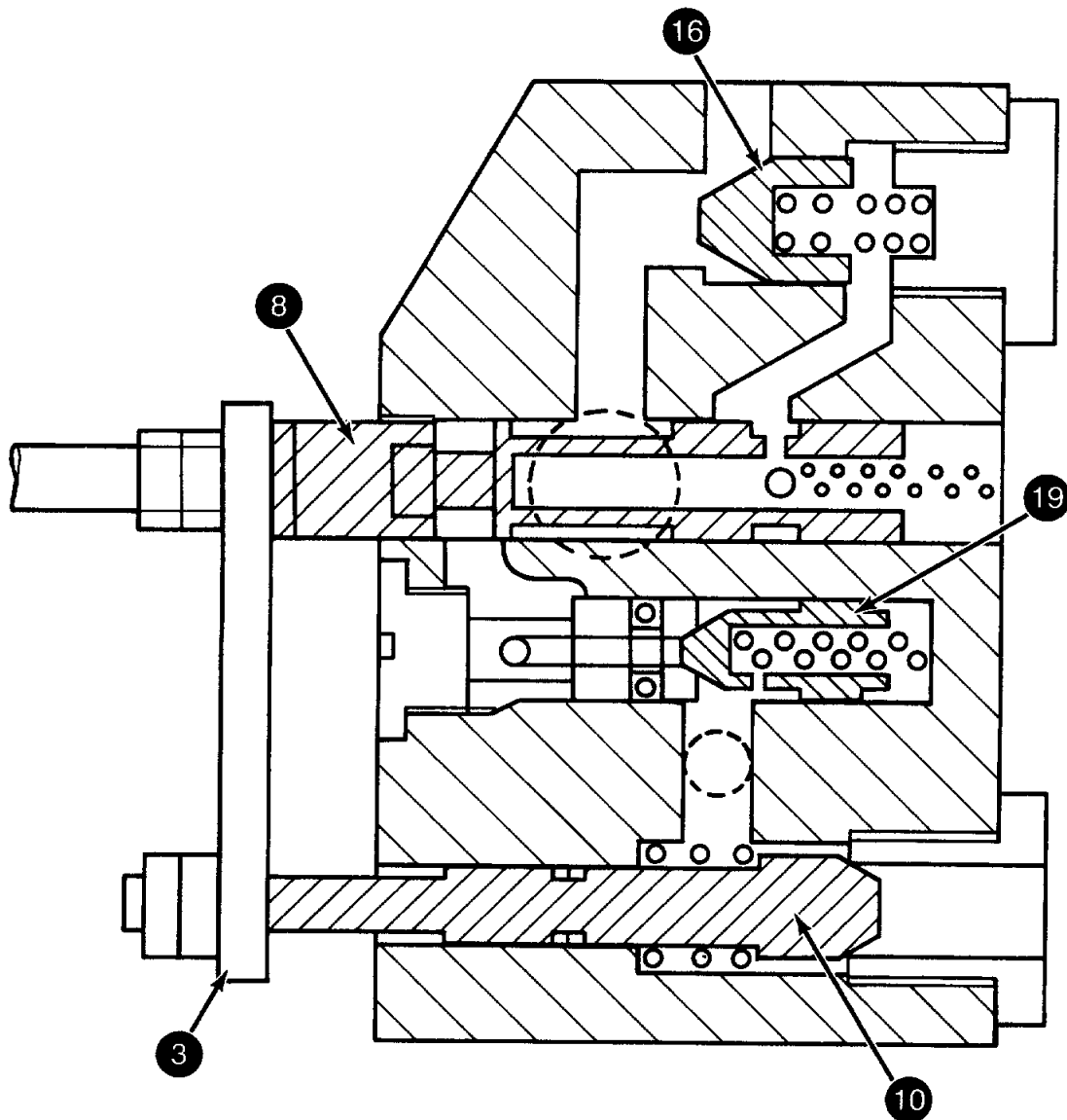
[ 2 ]



SM0495A

Blow low pressure compressed air into plug hole (A), move spool (8) into dimension (B) approximately 10 mm (0.4 inch) neutral position, air should pass through port (C). In this position, adjust the clearance between plate (3) and nut (2) to 0.3 to 0.6 mm (0.01 to 0.02 inch) (D). Tighten locknut (1).

## Cross Sectional Drawing of the Hitch Control Valve



SM0495

- 3. PLATE
- 8. SPOOL VALVE
- 10. POPPET

- 16. UNLOADER VALVE
- 19. CHECK VALVE

## HITCH ADJUSTMENTS

**NOTE:** For tractors equipped with draft control, put the draft control lever fully rearwards.

### [ 1 ]

Start the engine and put the position control lever (1) in the fully raise position, this will fully raise the lift arms (2).

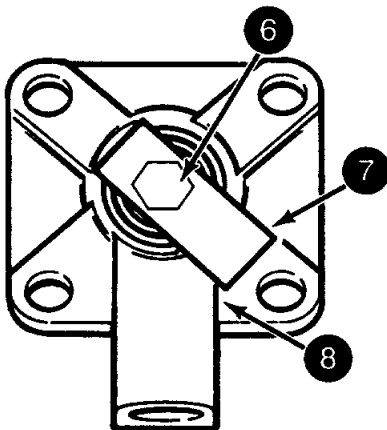


**WARNING:** Never operate the tractor in a closed parking. Proper ventilation is required under all circumstances.

### [ 2 ]

Adjust rod (3) to give lift arms (2) a free play of 5 to 15 mm (0.2 to 0.6 inch). Tighten the locknut (4).

### [ 3 ]



SM0500

Put the position control lever (1) in the lowering position to lower the lift arms (2), turn the spindle (5) clockwise until the lift arms (2) stop lowering. Turn the spindle (5) 1/4 of a turn clockwise. Tighten nut (6) so that the stop bracket (7) touches the cylinder head (8).

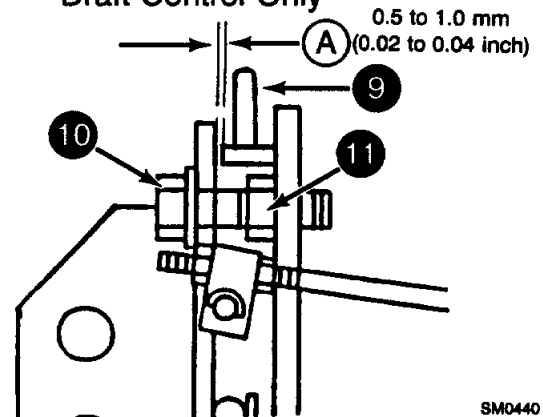
### [ 4 ]

Turn the spindle (5) counterclockwise and the system should start lowering.

**NOTE:** The further the spindle (5) is turned counterclockwise the greater the lowering speed.

### [ 5 ]

#### Draft Control Only



SM0440

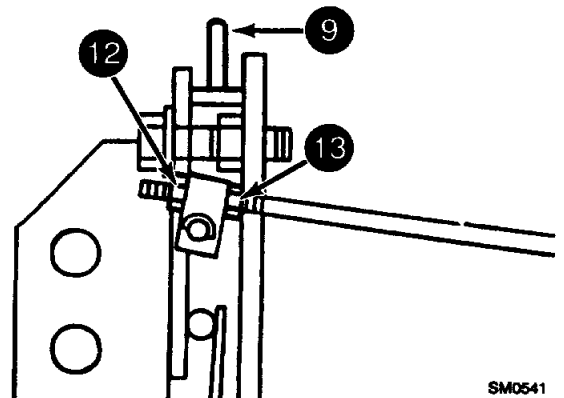
With the stop (9) in the lock position adjust the bolt (10) until a clearance of 0.5 to 1.0 mm (0.02 to 0.04 inch) is obtained at (A). Tighten the locknut (11).

**NOTE:** This alignment is to be made without any implement being attached.

### [ 6 ]

Put the position control lever (1) in the fully lower position. With the lift arms in their lowest position, put the draft control lever in the light load position (fully rearward).

### [ 7 ]



SM0541

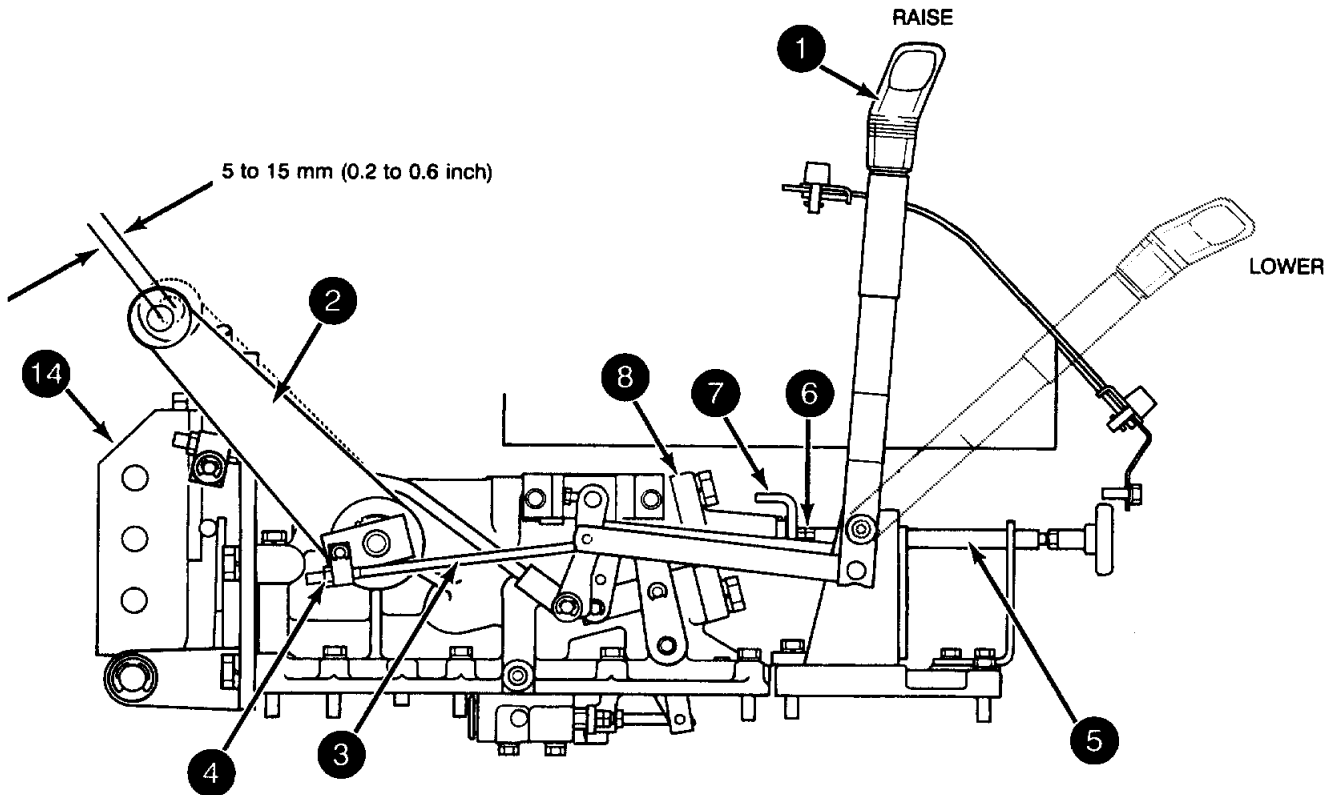
With the stop (9) in the unlocked position, start the engine and set to approximately 1000 rpm. Loosen locknut (12) and adjust locknut (13) until the lift arms start to raise. Adjust both locknuts (12 and 13) until the lift arms begin to lower, tighten locknuts (12 and 13). Move the position control lever (1) to the fully raised position (rearward). If the hydraulic relief valve operates then repeat [ 7 ].



**WARNING:** Never operate the tractor in a closed parking. Proper ventilation is required under all circumstances.

[ 8 ]

The draft control sensing can be tested as follows: put the position control lever (1) in the lowest (forward) position and the draft control lever in the light load (rearward) position. Start the engine, use a bar through the sensing bracket (14) and push forward, this should cause the lift arms to raise.



SM0494

## STEERING AND MAIN HYDRAULIC PUMPS

### Removal and Installation

#### [ 1 ]

Park the machine on hard level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

#### [ 2 ]

Raise the hood and remove the left hand side panel.

#### [ 3 ]

Disconnect the battery, negative (–) terminal first.

**NOTE:** *For Installation, connect the positive (+) terminal first.*

#### [ 4 ]

Remove bolts (1) and remove the muffler tube (2).

#### [ 5 ]

Put a suitable container under the steering and main pumps. Remove bolts (3), harness clamp (4) and disconnect tube (5).

#### [ 6 ]

Disconnect tube (6) and remove elbow (7).

#### [ 7 ]      719 \* and 723 \* Only

Remove bolts (8) and remove tube (9).

#### [ 8 ]      727 \* Only

Disconnect tube (10).

#### [ 9 ]

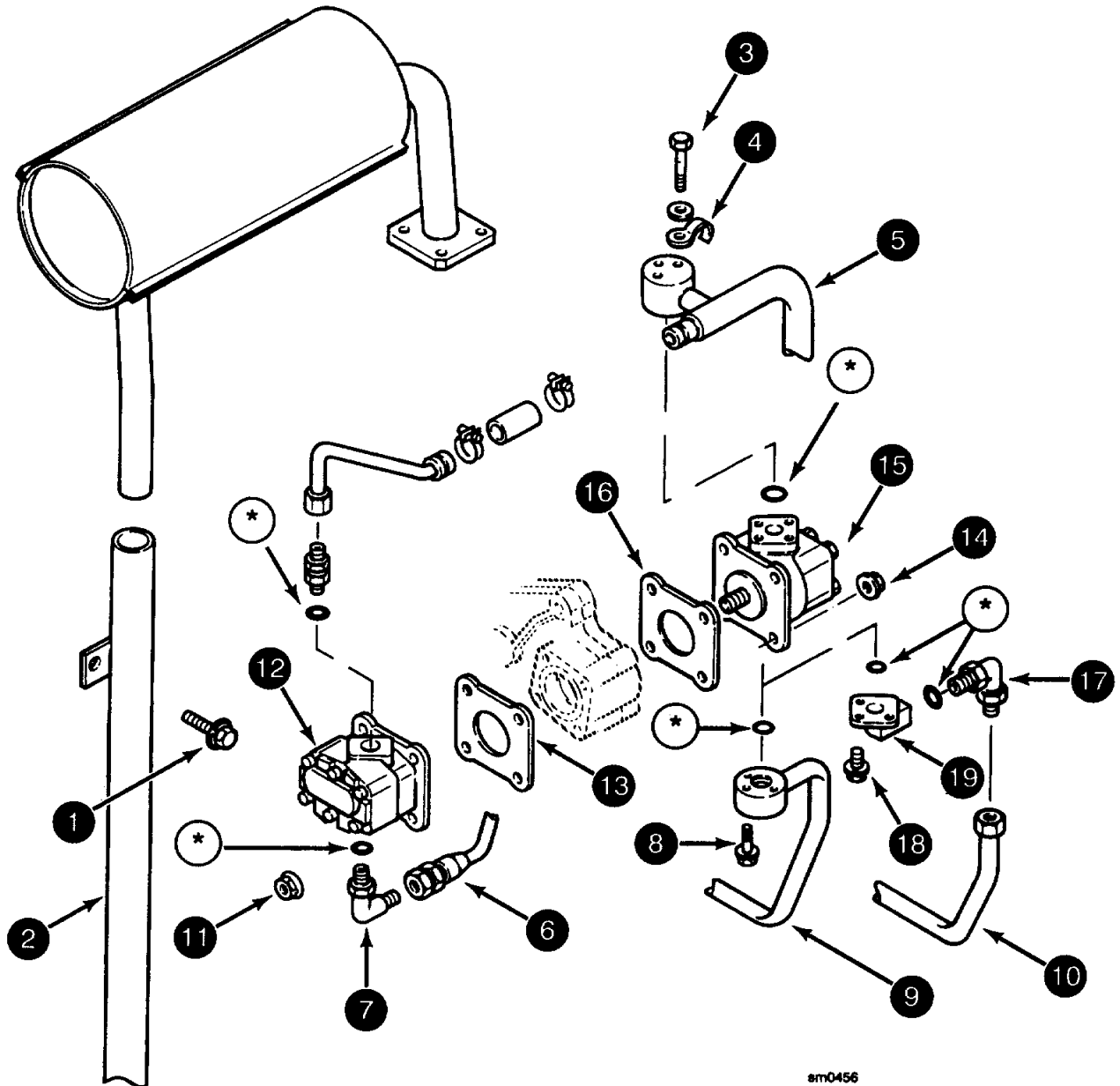
Remove nuts (11), steering pump (12) and gasket (13).

#### [ 10 ]

Remove nuts (14), main pump (15) and gasket (16), elbow (17), bolts (18) and flange (19).

**NOTE:** *The Steering and Main Pumps are non serviceable and must be replaced if found to be damaged or worn.*

**NOTE:** *For Installation, follow the same procedure in reverse order.*



NOTE: Items marked (\*) must be replaced.

## HYDRAULIC BLOCK (Power Beyond)

### Removal and Installation

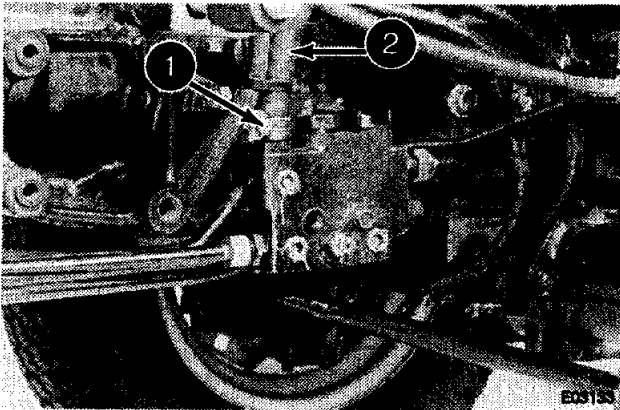
#### [ 1 ]

Park the tractor on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

#### [ 2 ]

Raise the hood and remove the right hand side panel.

#### [ 3 ]



Put a suitable container under the hydraulic block, loosen clamp (1) and remove hose (2).

#### [ 4 ]

Disconnect tubes (3) and (4). Remove tube bolt (5) and seals (6).

**NOTE :** For Installation, install new seals (6).

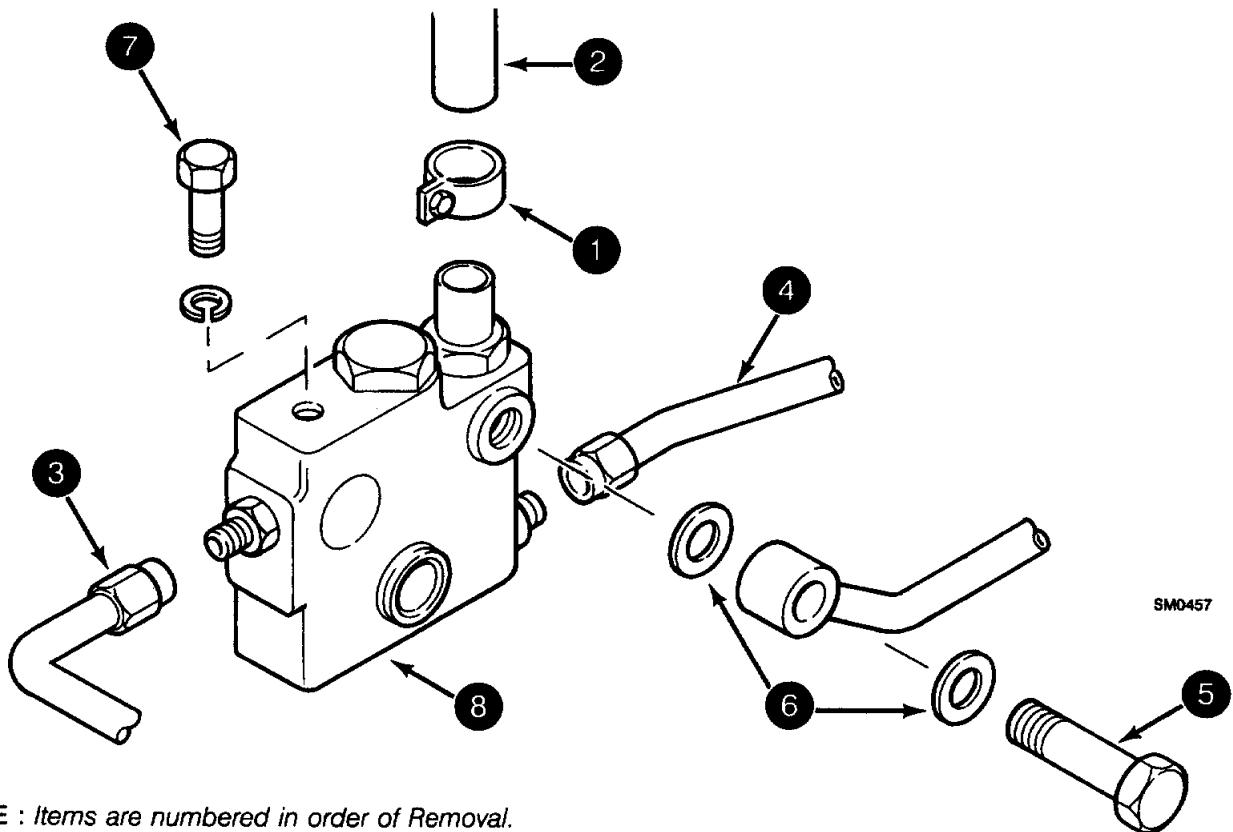
**NOTE:** For Tractors equipped with external hydraulics, put identification marks on the power beyond tubes and remove the tubes from ports 'T', 'N' and 'P' of the hydraulic block. For Installation, make sure the spool lever is in the 'S' position.

#### [ 5 ]

Remove bolt (7) and remove the hydraulic block (8).

**NOTE:** For Installation, follow the same procedure in reverse order.

**NOTE:** Never plug the inlet 'N' and the outlet 'P' of the hydraulic block with the spool lever in the 'S' position. Install a jumper hose on the hydraulic block if the remote attachment is not installed or move the spool lever to the 'O' position. Failure to do this will cause damage to the hydraulic system.



**NOTE :** Items are numbered in order of Removal.

## Disassembly and Assembly

### [ 1 ]

Put the hydraulic block on a clean work surface. Loosen nut (1) and remove bolt (2).

**NOTE:** For Installation, position the spool lever (3) in position 'O' for tractor hydraulic function or position 'S' for power beyond function, refer to Spool Lever Positions on Page 181.

### [ 2 ]

Remove spool lever (3), spool (4) and o-rings (5).

### [ 3 ]

Remove items (6 to 11).

**NOTE:** Keep shims (8) together for installation, adding or subtracting 0.1 mm (0.004 inch) of shims will increase or decrease the system pressure by approximately 20 psi (1.38 bar).

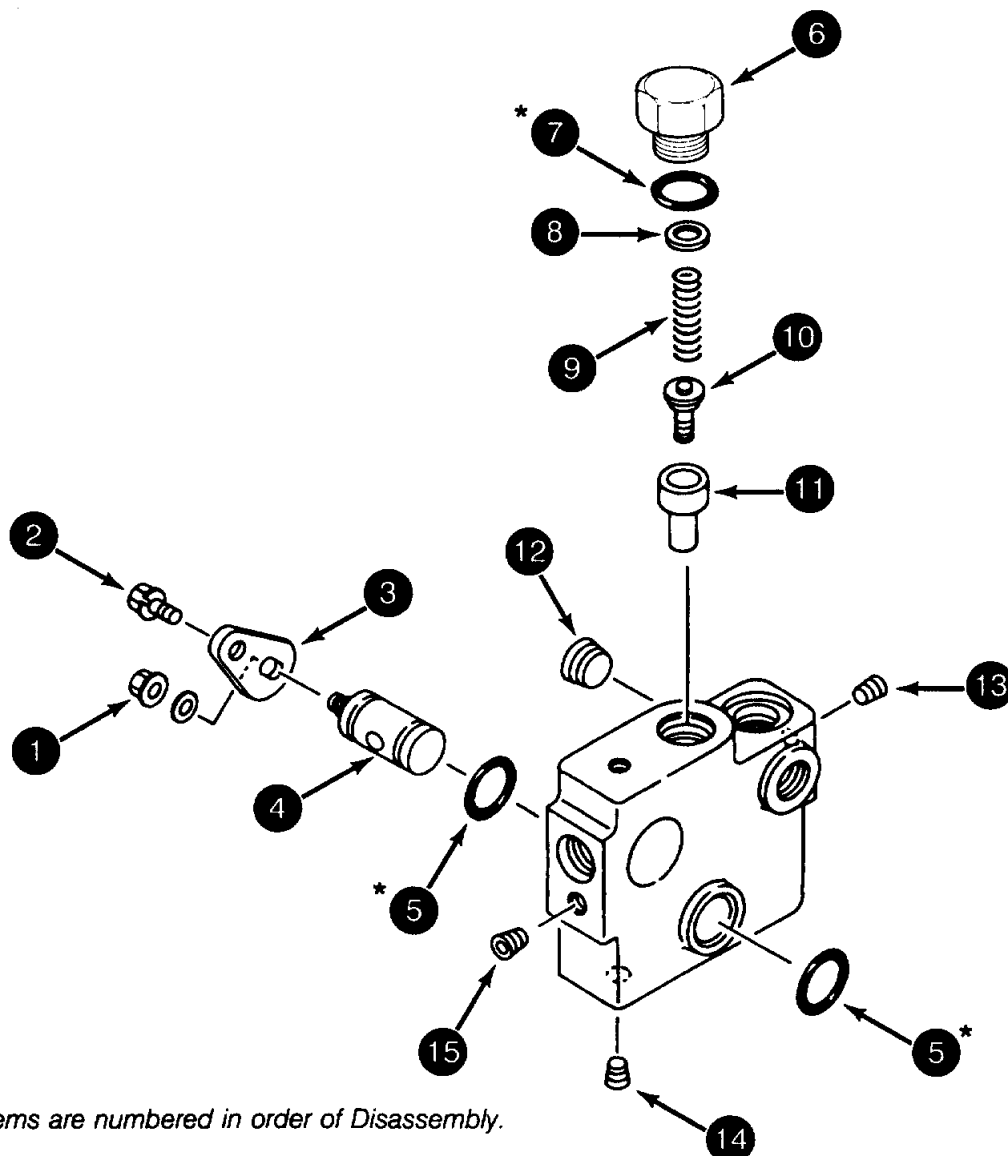
### [ 4 ]

Remove plugs (12 to 15).

### [ 5 ]

Clean all parts in cleaning solvent and dry in compressed air, DO NOT use cloths.

**NOTE:** For Installation, follow the same procedure in reverse order.



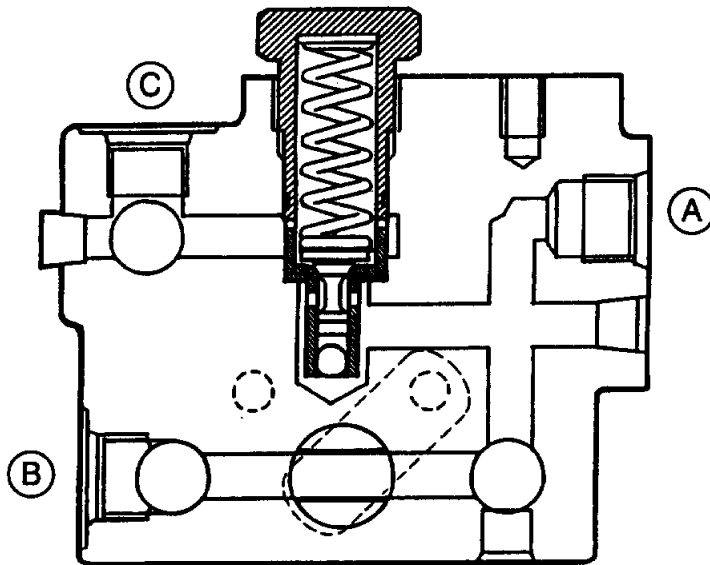
**NOTE :** Items are numbered in order of Disassembly.

**NOTE :** Items marked (\*) must be replaced.

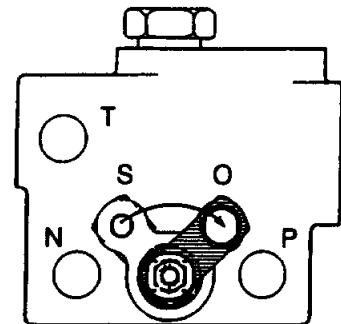
SM0458



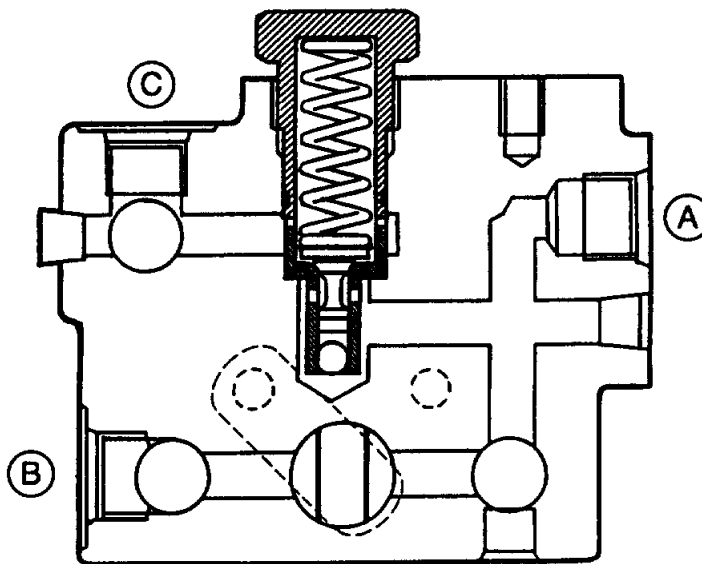
## Cross Sectional Drawing of the Hydraulic Block



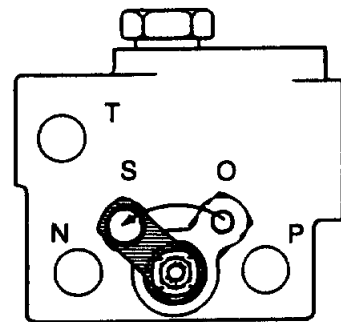
SPOOL LEVER POSITION 'O'



SM0459



SPOOL LEVER POSITION 'S'



SM0460

- A. SUPPLY FROM PUMP
- B. SUPPLY TO TRACTOR HYDRAULICS
- C. TO TANK

- N. RETURN FROM EXTERNAL HYDRAULICS
- P. SUPPLY TO EXTERNAL HYDRAULICS
- T. RETURN FROM EXTERNAL HYDRAULICS  
(FLOAT FUNCTION ONLY)

**NOTE:** Ports 'N' and 'P' are for spool position 'S' only.

## SECTION 5

### FRONT AXLE AND STEERING

#### SPECIFICATIONS

Front Wheel Alignment (Toe-in) MFD .....	0 to 5 mm	0 to 0.20 inch
STEERING HAND PUMP	719 *	723 * and 727 *
Type .....	Eaton	Eaton
Model .....	261-9023-502	261-9009-502
Displacement .....	44 cc (2.7 in <sup>3</sup> )	51 cc (3.1 in <sup>3</sup> )
Relief Pressure .....	12300 to 13700 kPa (1784 to 1987 PSI)	12300 to 13700 kPa (1784 to 1987 PSI)

#### SPECIAL TORQUES

Front Wheel Bolts .....	118 to 132 Nm	87 to 97 lb ft
Tie Rod Locknuts .....	60 to 90 Nm	44 to 66 lb ft
King Pin Lever Bolt .....	30 to 40 Nm	22 to 30 lb ft
Tie Rod Ball Joint Nut .....	30 to 40 Nm	22 to 30 lb ft
Steering Hand Pump End Cover Bolts .....	20 Nm	15 lb ft

## FRONT AXLE

### Removal and Installation

#### [ 1 ]

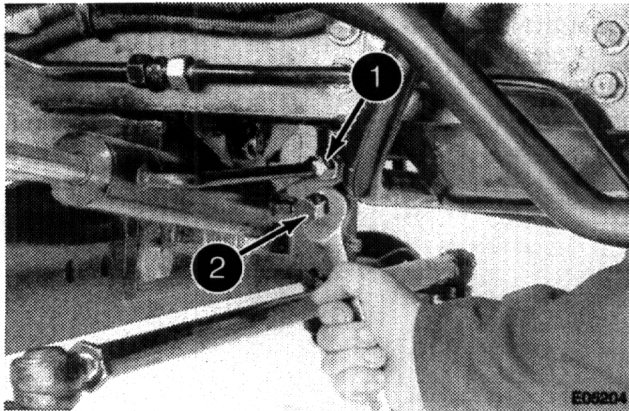
Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

#### [ 2 ]

Raise the front of the tractor and support on axle stands. Remove the front wheels.

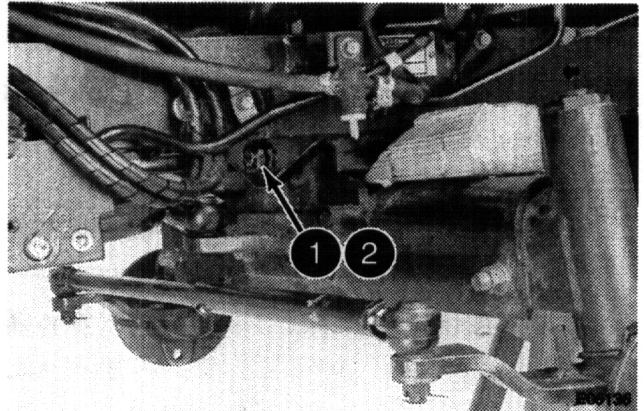
**NOTE:** For Installation, tighten the wheel mounting bolts to a torque of 118 to 132 Nm (87 to 97 lb ft).

#### [ 3 ]



Put identification marks on the steering hoses. Disconnect and cap the steering cylinder hoses (1 and 2).

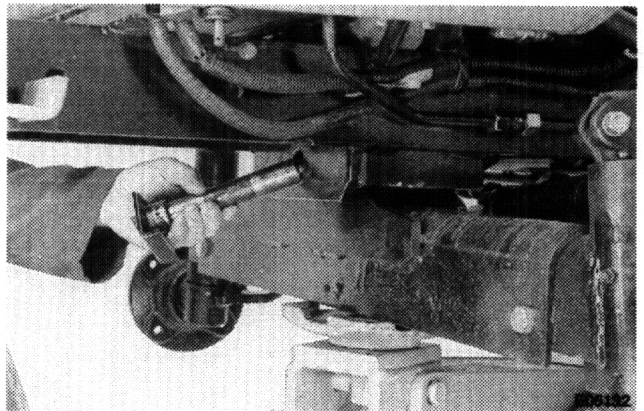
#### [ 4 ]



Remove the cotter pin (1), nut and washer (2).

**NOTE:** For Installation, tighten the nut until all free play is taken up and then back the nut off 1 flat or 60 degrees.

#### [ 5 ]



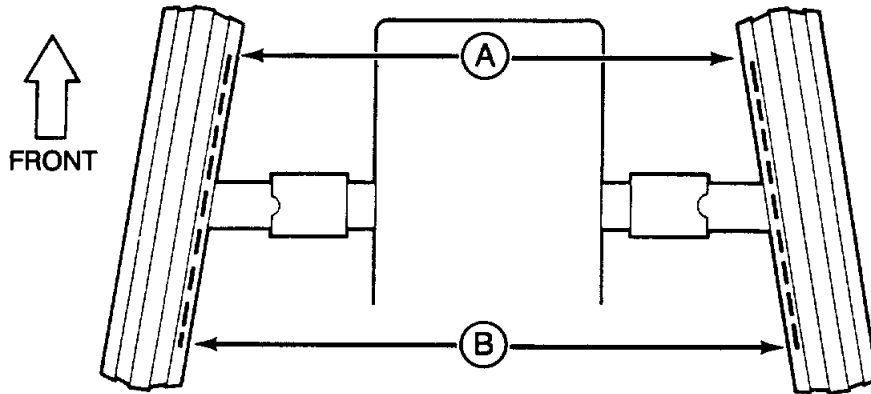
Support the axle on suitable lifting equipment. Remove the pivot pin. Carefully remove the axle.



**WARNING:** Put a suitable bar in the axle pivot hole to prevent the axle from tilting.

**NOTE:** For Installation, follow the same procedure in reverse order.

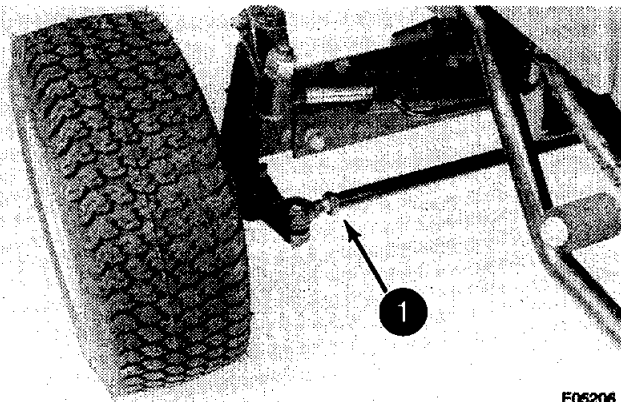
## FRONT WHEEL ALIGNMENT (TOE-IN)



### [ 1 ]

1. Put a mark at the horizontal centre of each wheel rim.
2. Measure the distance between the wheel rims at (A).
3. Rotate the wheels 180° and measure the distance between the wheel rims at (B).
4. The measurement at the front of the wheel rims must be 0 to 5 mm (0 to 0.2 inch) (MFD) less than the measurement at the rear of the wheel rims.
5. If the toe in is not within specification, do the following steps.

### [ 2 ]



Loosen the tie rod locknuts (1) (both sides).

### [ 3 ]

Turn the tie rod in or out to get the correct toe in.

### [ 4 ]

Tighten the tie rod locknuts to a torque of 60 to 90 Nm (44 to 66 lb ft).

### [ 5 ]

Check the toe-in and adjust if necessary.

TGL827

E06206

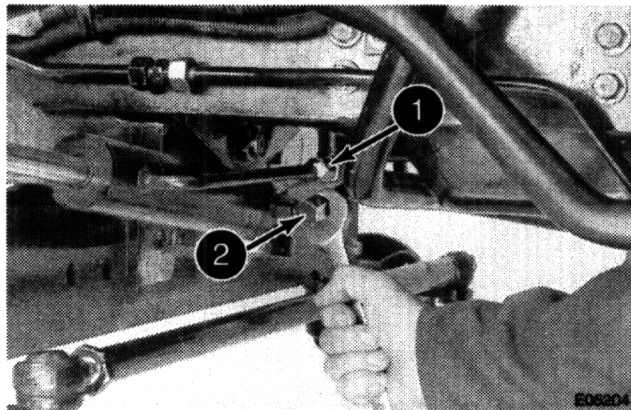
## STEERING CYLINDER

### Removal and Installation

#### [ 1 ]

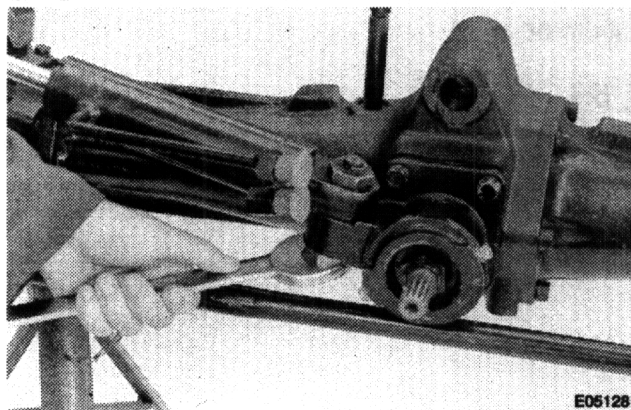
Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

#### [ 2 ]



Put identification marks on the steering cylinder hoses. Disconnect and cap the hoses (1 and 2).

#### [ 3 ]

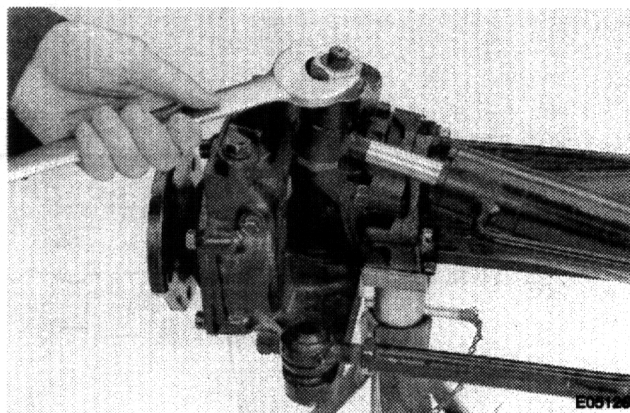


Remove the steering cylinder to axle locknut and bolt.

**NOTE:** For Installation, tighten the bolt to take up any free play and then back the bolt off 1 flat or 60 degrees.

**NOTE :** The axle has been removed for photographic purposes only.

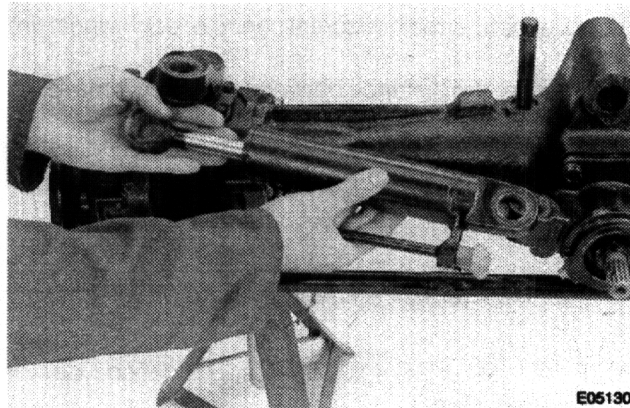
#### [ 4 ]



Remove the steering cylinder to king pin locknut and bolt.

**NOTE:** For Installation, tighten the bolt to take up any free play and then back the bolt off 1 flat or 60 degrees.

#### [ 5 ]

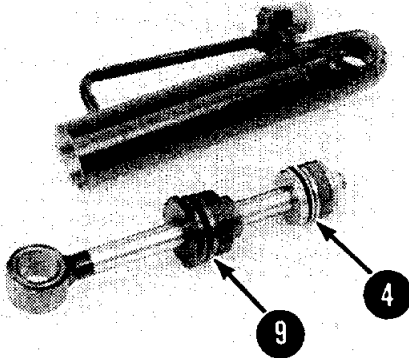


Remove the steering cylinder.

**NOTE:** For Installation, follow the same procedure in reverse order.

## Disassembly and Assembly

[ 1 ]



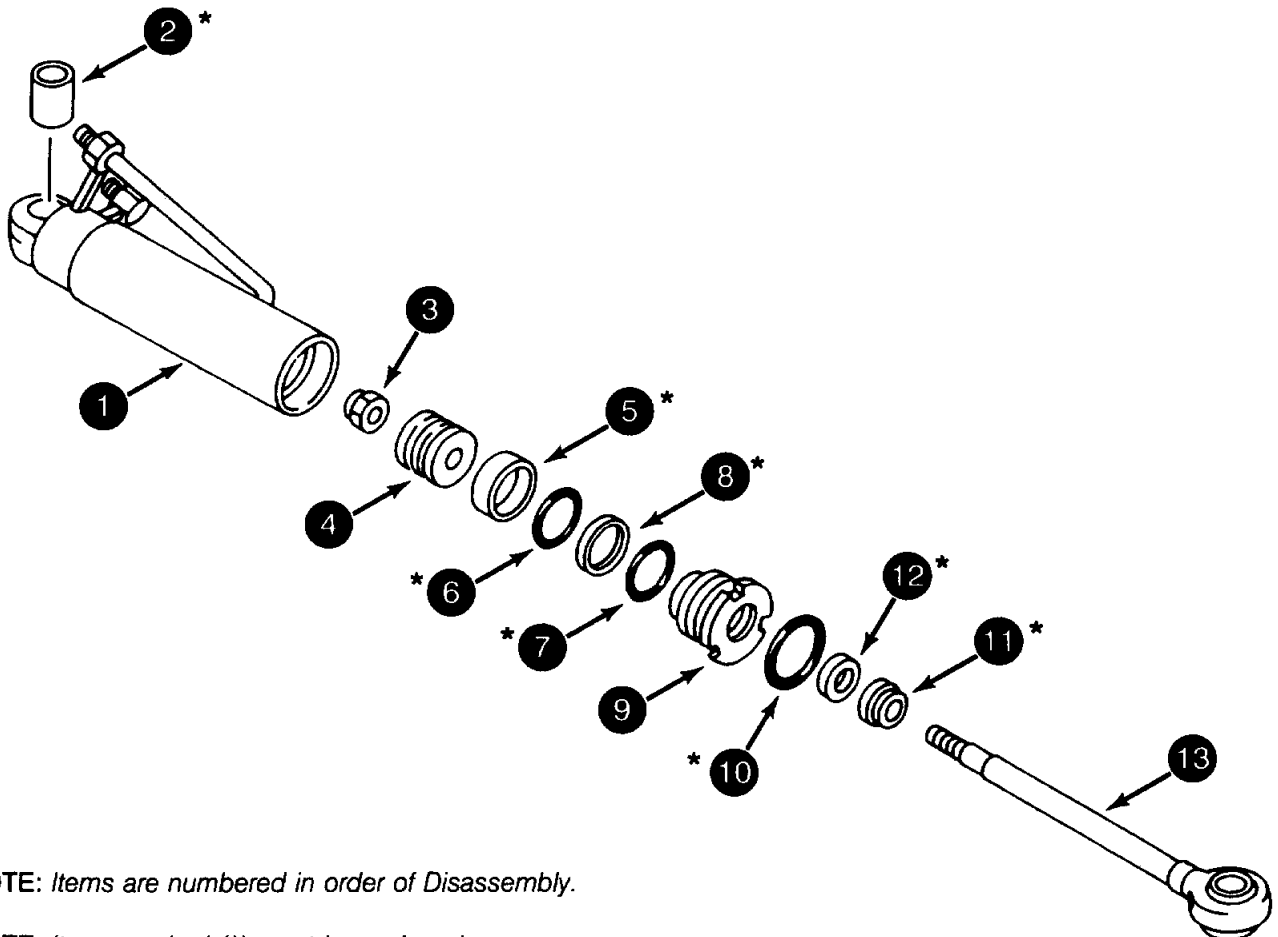
E05533

Screw out the end cap (9) and remove the piston (4) from the cylinder.

[ 2 ]

Remove items (1 to 13).

**NOTE :** For Assembly, follow the same procedure in reverse order.



SM0474

**NOTE:** Items are numbered in order of Disassembly.

**NOTE:** Items marked (\*) must be replaced.

1. CYLINDER  
2. BUSHING  
3. NUT  
4. PISTON

5. WEAR RING  
6. O-RING  
7. O-RING

8. RING  
9. CAP  
10. O-RING

11. SEAL  
12. SEAL  
13. ROD

## STEERING HAND PUMP

### Removal and Installation

[ 1 ]

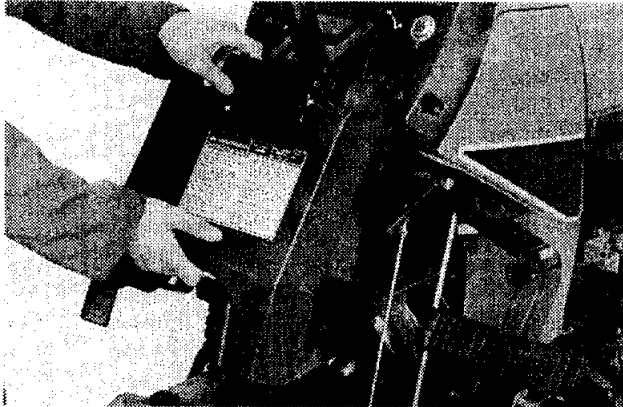
Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

[ 2 ]

Disconnect the battery, negative (–) terminal first.

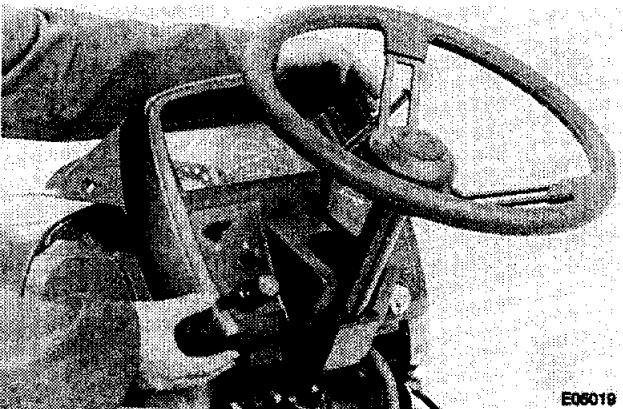
**NOTE :** For Installation, connect and tighten the positive (+) terminal first.

[ 3 ]



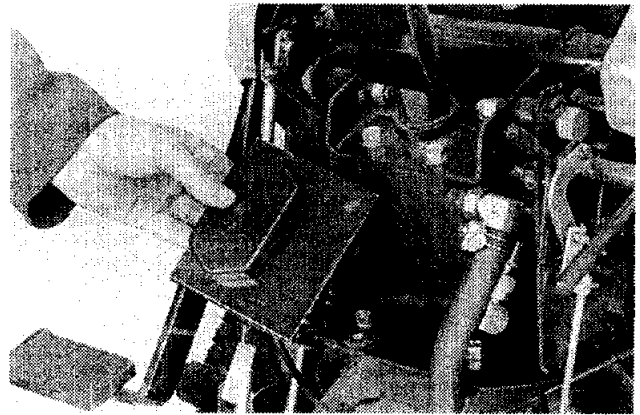
Remove the screws from the steering column cover and remove the cover.

[ 4 ]



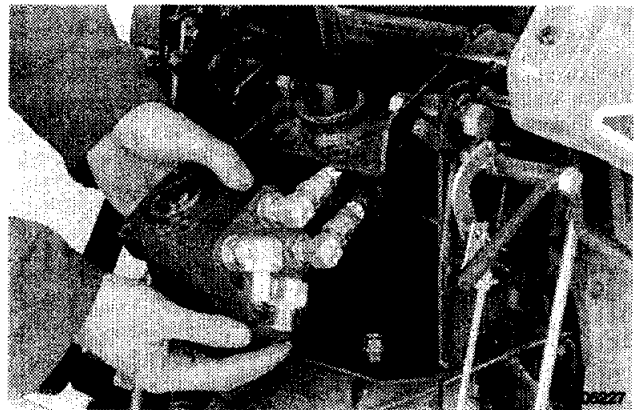
Remove the screws from the instrument cluster and raise the instrument cluster. Label and disconnect the main harness and the tachometer cable. Remove the instrument cluster.

[ 5 ]



Disconnect and remove the fuse holder from the main harness.

[ 6 ]



Support the steering hand pump. Remove the retaining bolts and remove the pump. Label and disconnect the four hydraulic hoses.

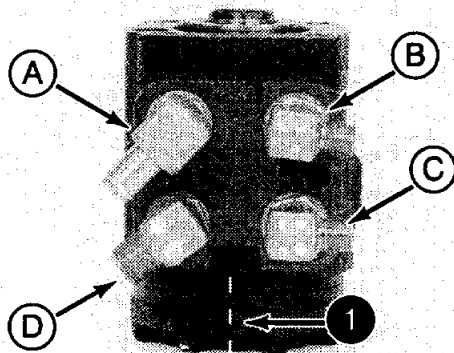
**NOTE :** For Installation, follow the same procedure in reverse order.



**CAUTION :** If the steering hand pump has been removed, it could operate like a hydraulic motor when installed in the tractor. With the engine running the steering wheel will rotate continuously. Keep hands clear of the steering wheel until the steering operation is normal. Stop the engine when checks are completed.

## Disassembly

### [ 1 ]



E06229

Put the assembly on a clean work bench. Put identification marks (1) on the pump body for assembly. Put identification marks on fittings (A, B, C and D) and remove.

**NOTE :** Fitting (D) is equipped with a check valve, which is a non servicable item.

### [ 2 ]

Remove items (1 to 5). Carefully remove the gerotor assembly (6). Remove items (7 to 10).

### [ 3 ]

Turn the assembly over and remove ball (11).

### [ 4 ]

Remove snap ring (12). Turn the spool (23) until pin (20) is horizontal. Push the spool sleeve assembly forward to remove the seal gland bushing (13).

### [ 5 ]

Remove items (14 to 18).

### [ 6 ]

Remove the spool sleeve assembly items (19 to 23).

**IMPORTANT:** Rotate the spool and sleeve assembly slowly when removing from the housing. DO NOT force.

### [ 7 ]

Remove items (20 to 25).

**NOTE :** Item (25) is a non-servicable item.

### [ 8 ]

Check all mating surfaces. Replace any parts that have scratches or burns that could cause leakage. Clean all parts in clean solvent. Dry all parts with compressed air. Do not use a cloth to dry the parts.

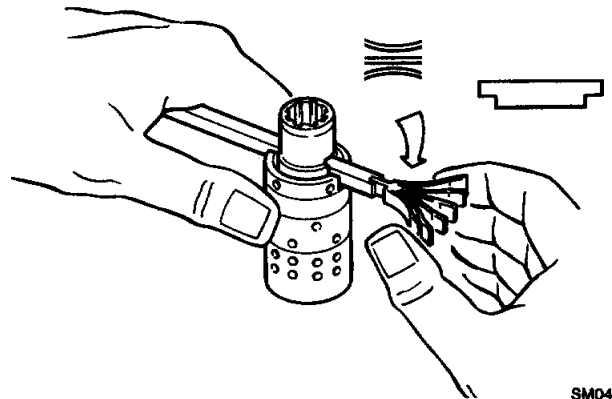
## Assembly

**NOTE:** Lubricate all seals (with exception of new quad ring seal) with clean petroleum jelly.

### [ 1 ]

Assemble spool (23) to the sleeve (19). Rotate the spool (23) during assembly. Some spool and sleeve sets have identification marks, align (A) if equipped. Check for free rotation and movement of the assembly.

### [ 2 ]



SM0455

Install the Special Tool CAS1239 through the spring slots in items (19 and 23). Position 6 springs (21 and 22) on a bench so that the extended edge is down and the arched center section is together.

In this position, install one end of the spring assembly into the special tool, as shown.

### [ 3 ]

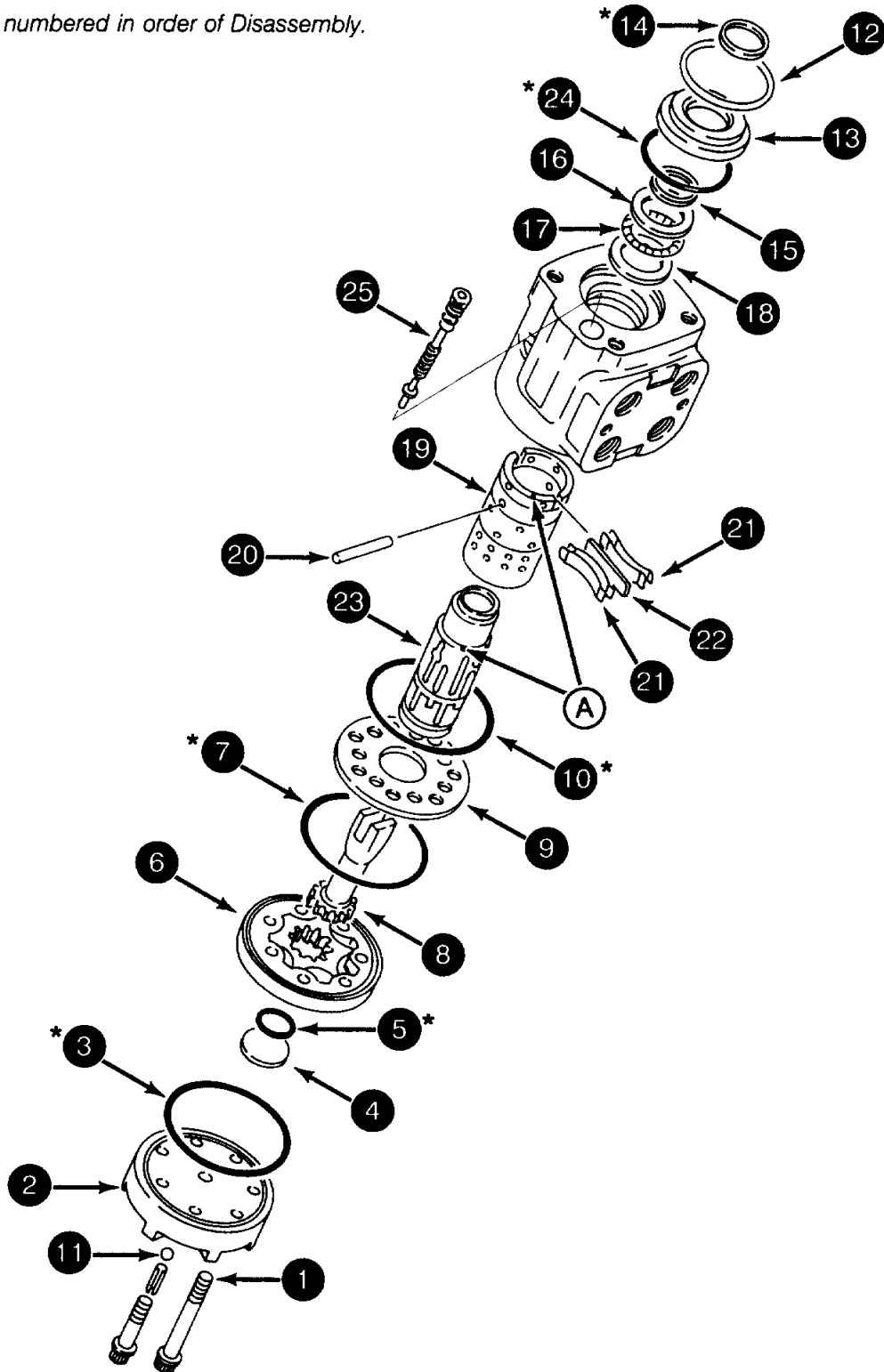
Compress the extended end of the spring set and push into the spool sleeve assembly. Center the spring set in the parts so that they push down evenly and level with the upper surface of the spool and sleeve.

### [ 4 ]

Install pin (20).



NOTE: Items are numbered in order of Disassembly.



SM0437

NOTE: Items marked (\*) must be replaced.

- |              |                |                   |                      |
|--------------|----------------|-------------------|----------------------|
| 1. BOLT      | 8. DRIVE SHAFT | 14. SEAL          | 20. PIN              |
| 2. END COVER | 9. VALVE PLATE | 15. QUAD RING     | 21. CENTERING SPRING |
| 3. O-RING    | 10. O-RING     | 16. THRUST WASHER | 22. FLAT SPRING      |
| 4. PLUG      | 11. BALL       | 17. BEARING       | 23. SPOOL            |
| 5. O-RING    | 12. SNAP RING  | 18. THRUST WASHER | 24. O-RING           |
| 6. GEROTOR   | 13. BUSHING    | 19. SLEEVE        | 25. RELIEF VALVE     |
| 7. O-RING    |                |                   |                      |

## [ 5 ]

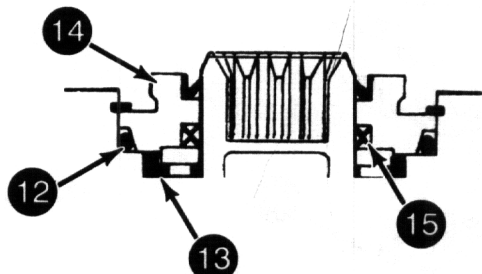
Install the spool sleeve assembly items (23 to 19) flush into the housing.

**NOTE:** Carefully push the spool sleeve assembly gently into position using a rotating action, keep pin (20) horizontal during assembly.

## [ 6 ]

Install items (24, 18 to 16).

## [ 7 ]



Install items (15 to 12).

**IMPORTANT:** DO NOT apply petroleum jelly to seal (15). DO NOT use any seal that falls freely into bushing (13).

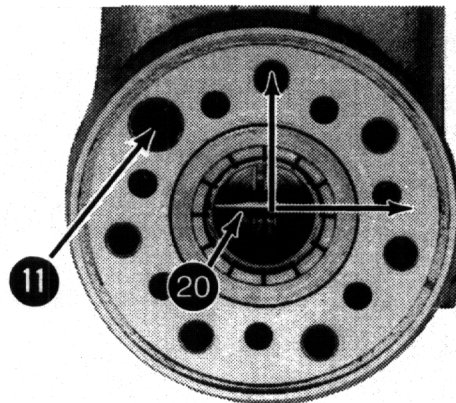
## [ 8 ]

Turn the assembly over and clamp lightly in a softed jaw vise.

## [ 9 ]

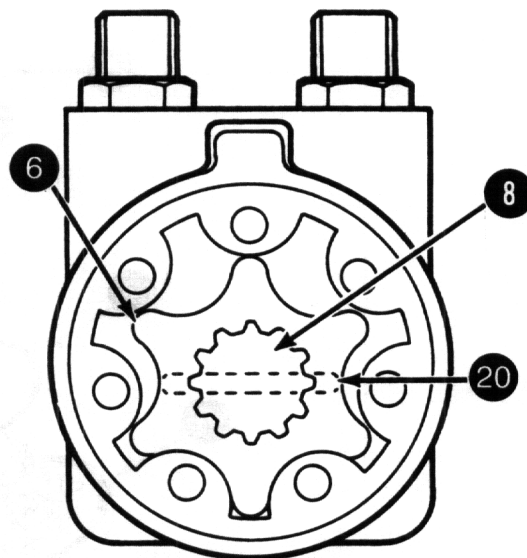
Install items (10 and 9).

## [ 10 ]



Install ball (11). Check that pin (20) is at 90° to the fittings.

## [ 11 ]



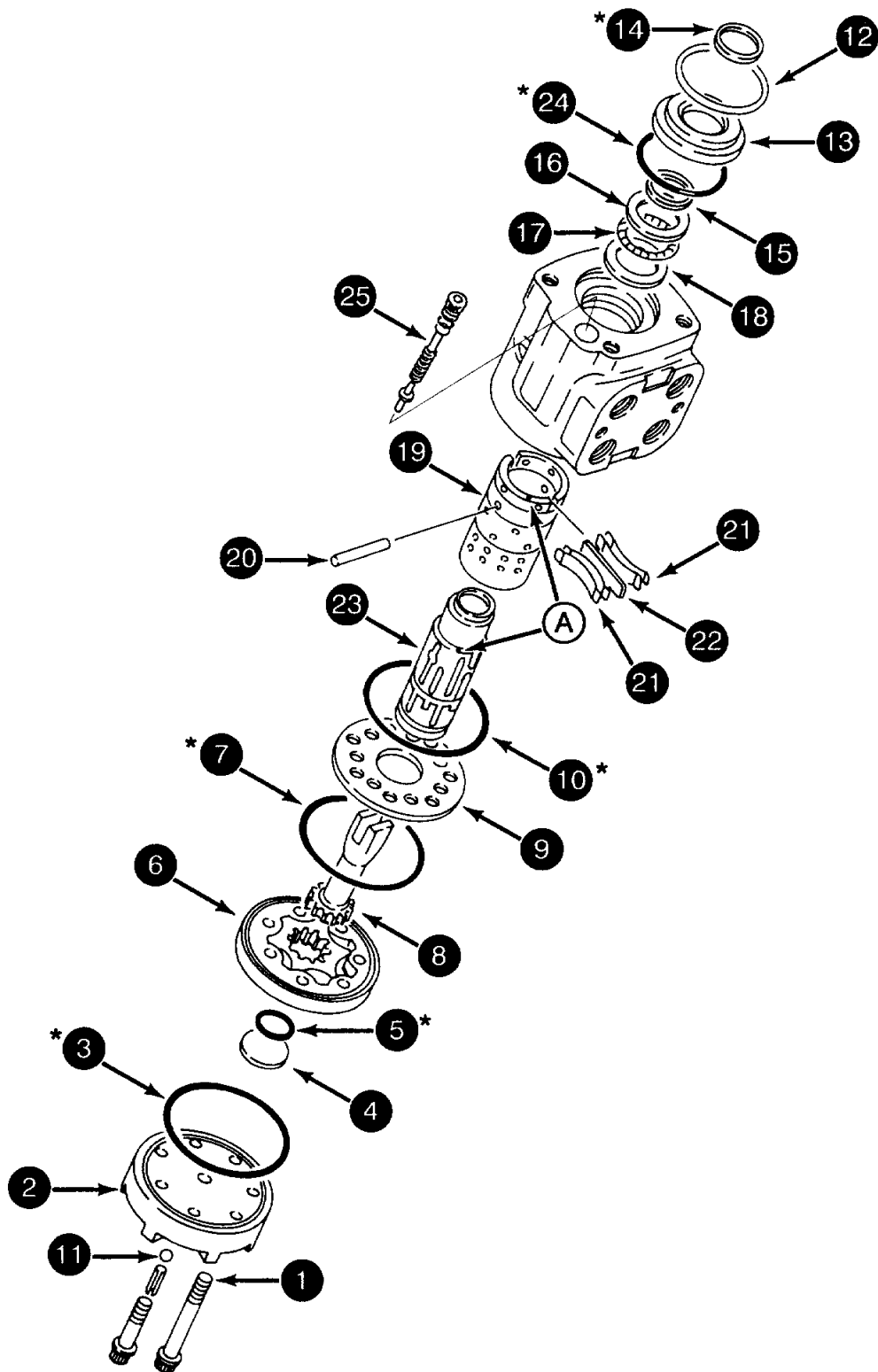
Install drive shaft (8).

Install the gerotor (6) onto the drive shaft (8) so that the curve between two of the teeth are aligned with the pin (20) through the sleeve and spool. If the rotor is in the correct position, one of the teeth will be in the direction of the fittings in the pump body.

**IMPORTANT:** If the steering hand pump is incorrectly aligned it could operate like a hydraulic motor when installed to the tractor.

## [ 12 ]

Install items (5 to 1). Tighten bolts (1) in a diagonal sequence in two stages to a torque of 10 Nm and 20 Nm (7 lb ft and 15 lb ft).



SM0437

NOTE: Items marked (\*) must be replaced.

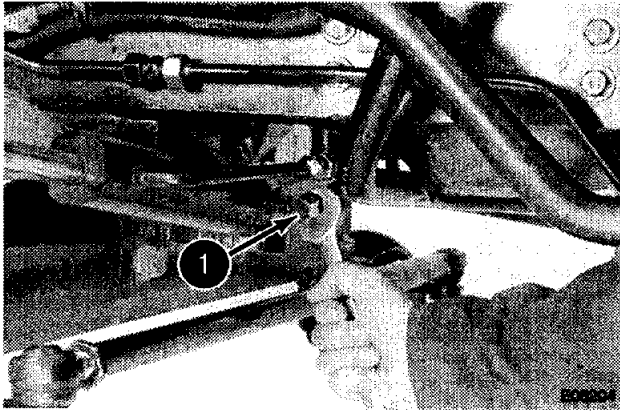
- |              |                |                   |                      |
|--------------|----------------|-------------------|----------------------|
| 1. BOLT      | 8. DRIVE SHAFT | 14. SEAL          | 20. PIN              |
| 2. END COVER | 9. VALVE PLATE | 15. QUAD RING     | 21. CENTERING SPRING |
| 3. O-RING    | 10. O-RING     | 16. THRUST WASHER | 22. FLAT SPRING      |
| 4. PLUG      | 11. BALL       | 17. BEARING       | 23. SPOOL            |
| 5. O-RING    | 12. SNAP RING  | 18. THRUST WASHER | 24. O-RING           |
| 6. GEROTOR   | 13. BUSHING    | 19. SLEEVE        | 25. RELIEF VALVE     |
| 7. O-RING    |                |                   |                      |

## STEERING HAND PUMP RELIEF VALVE ADJUSTMENT

### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

### [ 2 ]



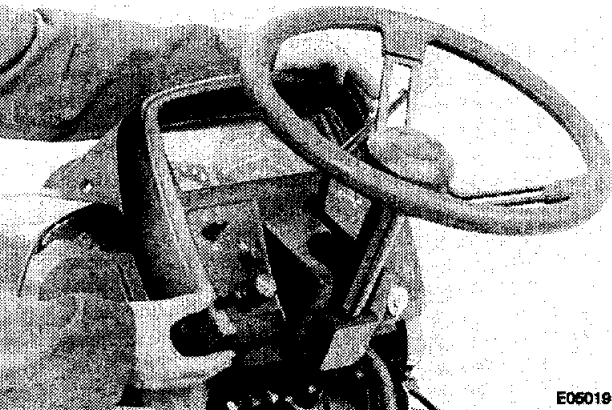
Disconnect the supply steering cylinder hose (1) and cap the steering cylinder. Install a 0 to 20600 kPa (0 to 3000 PSI) pressure gauge to the steering cylinder supply hose (1).

### [ 3 ]

- Run the engine at 2500 RPM
- Continually turn the steering wheel and note the steering pressure.

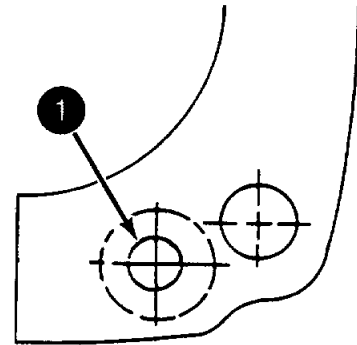
The steering pressure must be 12800 kPa (1849 PSI). If the pressure is not correct rear to [ 4 ] to [ 8 ] .

### [ 4 ]



Remove the screws from the steering column cover and remove the cover. Remove the screws from the instrument cluster and raise the instrument cluster. Label and disconnect the the main harness and tachometer cable. Remove the instrument cluster.

### [ 5 ]



SM0563

Loosen the steering pump mounting bolts and remove the lower right hand bolt. Make a copy of the above template. Install the template; CAREFULLY locate and drill a pilot hole (1) where indicated through the steering hand pump bracket. Finish drilling the hole to 8 mm (0.31 inch) diameter.

**NOTE:** Do not drill too deep or damage to the steering hand pump may occur.

### [ 6 ]

Remove the template and tighten the steering hand pump retaining bolts while rotating the steering wheel so that the input shaft and the steering shaft are correctly aligned.

### [ 7 ]

Install a 6 mm Allen wrench through the hole to the steering hand pump relief valve. Repeat Step 3 and adjust the steering pressure. After correct adjustment has been made, stake the relief valve adjusting screw.

**NOTE:** Turning the relief valve screw clockwise to increase or counter clockwise to decrease steering pressure.

### [ 8 ]

Install the instrument cluster and steering column cover. Remove the pressure gauge and install and tighten the steering cylinder hose.

Number of Batteries Required .....	1
Voltage of the Battery .....	12 Volts
Capacity .....	719 * 45 Amps
	723 * /727 * 60 Amps
Specific Gravity of Electrolyte .....	1,280 Amps

Manufacturer ..... Mitsubishi  
Lubricant for End Cap Bushing and Splines on Armature Shaft ..... GE Silicon grease, G321 Versilube

No Load Test at 20°C (68° F)					
	Voltage	Current Draw (Amps)	Armature Speed (rpm)	Minimum Brush Length	Armature End Play
719 * and 723 *	11	130	3850	13 mm (0.51 inch)	0 to 0.5 mm (0 to 0.02 inch)
727 *	11.5	100	3000	13 mm (0.51 inch)	0 to 0.5 mm (0 to 0.02 inch)

Manufacturer ..... Mitsubishi  
Output ..... 12 Volts at 40 Amperes

Starter Motor Mounting Bolts .....	49 to 59 Nm	35 to 44 lb ft
------------------------------------	-------------	----------------

## BATTERY

### SAFETY RULES



**WARNING:** *Never try to charge the battery if the electrolyte in the battery is frozen.*



**CAUTION:** *Never cause sparks to occur or smoke near batteries that are charging or have been charged.*



**CAUTION:** *Disconnect the ground cable first when the battery cables are disconnected from the battery. Connect the ground cable last when the battery cables are connected to the battery.*



**CAUTION:** *Some batteries have a ventilation tube. If there is battery acid in the ventilation tube, this battery acid can be released when the battery is turned upside down. If you turn the battery upside down, make sure that the end of the ventilation tube is away from you, and away from any other people in the area. Battery acid can cause severe burns.*



**POISON/DANGER:** *Battery acid causes severe burns. Batteries contain sulphuric acid. Avoid contact with skin, eyes or clothing. Avoid fire. EXTERNAL: Flush with water. INTERNAL: Drink large quantities of water or milk. Follow with milk of magnesia. Breathing equipment is required. Call a physician immediately. EYES: Flush with water for 15 minutes and get prompt medical attention.*

*Batteries produce explosive gases. Keep sparks, flames, and cigarettes away. Ventilate when charging or using in an enclosed area. Always check eyes when working near batteries.*

*Keep batteries and battery acid out of the reach of children.*

## MAINTENANCE

### Electrolyte Level

If the battery is a maintenance free battery, check the level of the electrolyte every 2000 hours of operation or six months, whichever occurs first. For all other batteries, check the level of the electrolyte every 250 hours of operation.

**NOTE:** *A maintenance free battery will have words Maintenance Free on the decal on the top of the battery. If the center part of the decal has been removed for access to the battery caps, it is possible that the words Maintenance Free have been removed from the decal.*

Check the level of the electrolyte more often during hot weather. The use of a large amount of water by the battery can be caused by high battery temperature or a voltage regulator setting that is too high. Keep the electrolyte level above the top of the plates in the battery at all times to prevent damage to the battery.

**NOTE:** *On maintenance free batteries it is necessary to remove the center part of the decal for access to the battery caps. Do not discard the center part of the decal. Install the center part of decal after the battery caps have been installed.*

If the level of the electrolyte is low, add distilled water or other clean water until the electrolyte is just below the cell opening. Do not add more water than is needed. Too much water can cause bad performance, a short service life, and corrosion around the battery.

**NOTE:** *Add water only. DO NOT add electrolyte.*

## Inspection and Cleaning a Battery

If damage causes an electrolyte leak, replace the battery.

Inspect the battery at regular intervals for dirt, corrosion, and damage. Electrolyte and dirt on the top of the battery can cause the battery to discharge by making a passage for the current to flow.

If the battery must be cleaned, remove the battery from the battery carrier and clean the battery, cable terminals, and the battery carrier. When available, use Battery Saver and cleaner according to the instruc-

tions on the container. Battery Saver and Cleaner also helps prevent corrosion. If Battery Saver and Cleaner is not available, use baking soda and water as a cleaner. DO NOT permit any type of cleaner to enter the cells of the battery.

Install the battery in the machine and make sure the fasteners are tight. Apply Battery Saver and Cleaner or Urethane Seal Coat to the cable terminals to prevent corrosion. See the Parts counter Catalog. DO NOT apply grease.

## BATTERY TEST

**NOTE:** To correctly test a battery, do each part of the battery test until you know the condition of the battery.

### Visual Checks

1. Make sure the cable connections are clean and tight. Clean foreign material from the top of the battery.
2. Inspect the battery case, battery posts, and cables for damage.
3. Check the electrolyte level. See page 3.
4. If you added water to the battery, the battery must be charged for 15 minutes at 15 to 20 amperes to mix the water with the electrolyte.

### Specific Gravity Check

A hydrometer is used to check the specific gravity (weight) of the electrolyte. The specific gravity is an indication of the level of charge for each cell.

Hydrometers are made to show the correct specific gravity when the temperature of the electrolyte is 20°C (68°F).

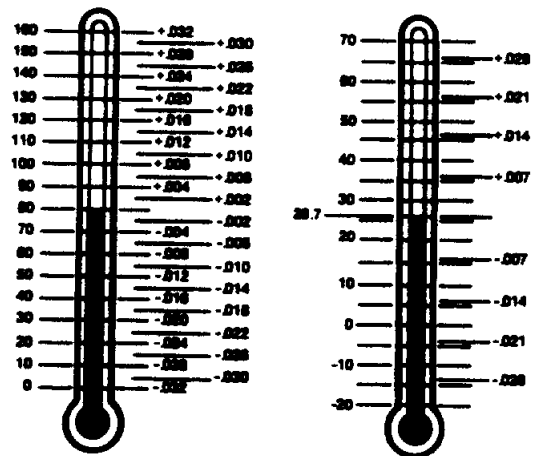
When you check the specific gravity, you must know the temperature of the electrolyte. If your hydrometer does not have a thermometer, get a thermometer to check the temperature of the electrolyte. The thermometer must indicate a high temperature of at least 49°C (120°F).

1. Remove enough electrolyte from a cell so that the float is free in the tube.

**NOTE:** If the specific gravity cannot be checked without first adding water to the cell, the battery must be charged for 15 minutes at 15 to 20 amperes to mix the water with the electrolyte. Then check the specific gravity.

2. Read the float.

3. Read the thermometer. If the reading is above 26.7°C (80°F) add specific gravity points to the reading for specific gravity. If the reading is below 26.7°C (80°F) subtract specific gravity points from the reading for specific gravity. See the following illustration and add or subtract specific gravity points as needed.



79083A

4. Make a record of the corrected specific gravity reading for each cell.

5. If the difference between the high reading and the low reading is .050 or more, charge the battery and check the specific gravity again. If after charging, the difference is still .050 or more, install a new battery.

6. The corrected specific gravity reading shows the level of charge for the cell. The level of charge must be at least 75% in each of the cells. In maintenance free batteries the level of charge is at least 75% if corrected specific gravity reading is 1.280 at 20°C (68°F).

7. If the difference between the high reading and the low reading is less than .050, and the level of charge is more than 75% in all of the cells, do the Capacity (Load) Test.

8. If the difference between the high reading and the low reading is less than .050, but the level of charge is less than 75% in any of the cells, charge the battery and check the specific gravity again. If after charging:

- the level of charge is less than 75% in any of the cells, discard the battery.
- the level of charge is at least 75% in all of the cells, do the Capacity (Load) Test.

## Capacity (Load) Test

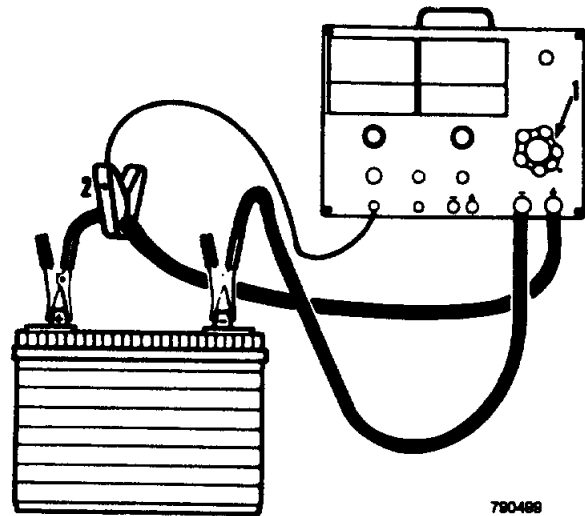
This test can be done using a variable load tester such as the Sun Electric VAT-33. Other test equipment can be used. Connect the test equipment according to the instructions of the manufacturer of the equipment.

1. The level of charge of the battery must be at least 75%. Do the Specific Gravity Check in this section.

2. Prepare the tester (Sun Electric VAT-33 shown) for the test.

- Select the voltmeter range that will measure 1 to 18 volts.
- Make sure the load control knob is in the OFF position.
- Select the ammeter range that will measure 0 to 1000 amperes.
- Move the volt lead switch to the INT. position.

3. Connect the tester to the battery as shown.



1. LOAD CONTROL KNOB

2. AMMETER CLAMP

**NOTE:** Never apply a load for longer than 15 seconds. After each 15 seconds, turn the load control knob to OFF for at least one minute.

4. Apply a 15 ampere load to the battery for 15 seconds. Wait at least three minutes before continuing with the test.

5. Check and make a record of the temperature of the electrolyte.

6. Find the correct load for this test in Specifications.

**NOTE:** The correct load is half of the cold cranking amperes at - 18°C (0°F).

7. Turn the load control knob until the ammeter indicates the specified load. Keep the load for 15 seconds and read the voltmeter. Turn the load control knob to OFF.

8. Compare the test reading and the temperature of the electrolyte to the chart below.

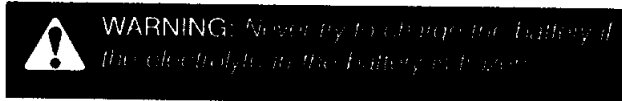
Temperature of electrolyte	Minimum Voltage
21°C (70°F) and above	9.6
16°C (60°F)	9.5
10°C (50°F)	9.4
4°C (40°F)	9.3
- 1°C (30°F)	9.1
- 7°C (20°F)	8.9
- 12°C (10°F)	8.7
- 18°C (0°F)	8.5

a. If the test result is equal to or more than the voltage shown, the battery is in good condition.

b. If the test result is less than the voltage shown, discard the battery.



## CHARGING THE BATTERY



Before you charge the battery, check the level of the electrolyte.

It is difficult to give an exact charging rate because of the following variable conditions: (1) temperature of the electrolyte, (2) level of charge, and (3) condition of the battery. Use the charging guide of the correct charging rate and time.

See Specifications for the reserve capacity of the battery in this machine.

The charging rate must be decreased if:

1. Too much gas causes the electrolyte to flow from the cells.
2. The temperature of the electrolyte rises above 52°C (125°F).

**NOTE:** *For the best charge, use the slow charging rates.*

The battery is fully charged when, over a three hour period at a low charging rate, no cell is giving too much gas, and the specific gravity does not change.



## Our responsibility to the Earth

### BATTERIES

Properly maintained batteries will last for a long time, however, eventually they will need to be replaced.

Remember both LEAD and SULFURIC ACID (components of a battery) are considered hazardous substances, which if improperly handled, can cause significant harm to the environment.

Waste batteries, without exception, must be returned to a recycling facility for reclamation either directly by you or through your authorized servicing dealer.

## CHARGING GUIDE FOR BATTERIES

Recommended Rate\* and Time for Fully Discharged Battery

Battery Capacity - See Reserve Capacity under Specifications	Slow Charge	Fast Charge
80 Minutes or Less	10 Hours at 5 Amperes 5 Hours at 10 Amperes	2.5 Hours at 20 Amperes 1.5 Hours at 30 Amperes
Above 80 to 125 Minutes	15 Hours at 5 Amperes 7.5 Hours at 10 Amperes	3.75 Hours at 20 Amperes 1.5 Hours at 50 Amperes
Above 125 to 170 Minutes	20 Hours at 5 Amperes 10 Hours at 10 Amperes	5 Hours at 20 Amperes 2 Hours at 50 Amperes
Above 170 to 250 Minutes	30 Hours at 5 Amperes 15 Hours at 10 Amperes	7.5 Hours at 20 Amperes 3 Hours at 50 Amperes
Above 250 Minutes	24 Hours at 10 Amperes	6 Hours at 40 Amperes 4 Hours at 60 Amperes

\*Initial rate for standard taper charger.

**NOTE:** A maintenance free battery will have the words Maintenance Free on the decal on the top of the battery. If the center part of the decal has been removed to get access to the battery caps, it is possible the words Maintenance Free will have been removed from the decal.

## PREPARING A DRY CHARGED BATTERY FOR USE

1. Remove the caps from the battery.
2. Fill each cell to the top of the separators with electrolyte. This will permit the volume of electrolyte to increase when heated by charging the battery.
3. Loosely install the caps on the battery.
4. Connect a battery charger to the battery.
5. Charge the battery at 30 amperes until the specific gravity is 1.250 or more and the temperature of the electrolyte is at least 15.5°C (60°F).
6. If necessary, fill each cell with electrolyte until the electrolyte is just below the split ring at the bottom of the cell opening.

## BOOSTER BATTERY CONNECTIONS



When the battery is frozen, the battery can explode if (1), you try to charge the battery, or (2), you try to jump start and run the engine. To prevent the battery electrolyte from freezing, try to keep the battery at full charge. If you do not follow these instructions, you or others in the area can be injured.

### STARTING THE ENGINE

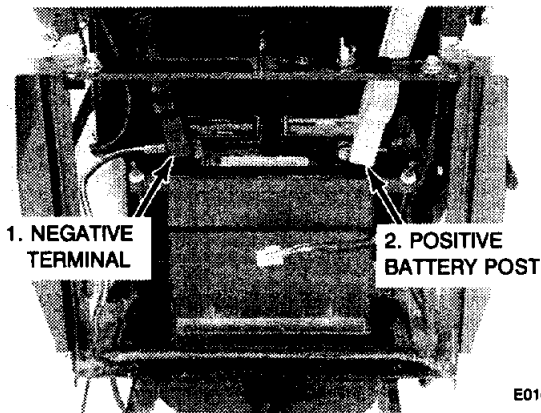
**NOTE:** Two persons are required for this procedure.

1. Make sure the parking brake is engaged.
2. Turn the keyswitch to the ON position.

### CONNECTING A BOOSTER BATTERY

Have the other person do the following:

- a. Connect the positive (+) jumper cable to the positive (+) battery post.
- b. Connect the negative (–) jumper cable to the negative (–) battery post.



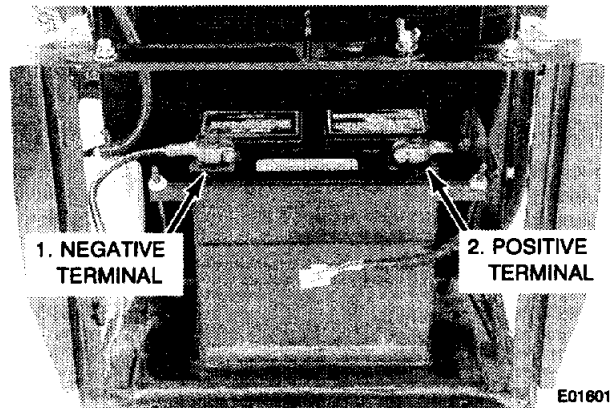
E01601



Batteries contain acid and explosive gas. Explosion can result from sparks, flames, or wrong cable connections. To connect the jumper cables correctly to the battery of this machine, see the correct method shown on this page. Failure to follow these instructions can cause serious injury or death.

3. Turn the key to the start position and release as soon as the engine begins to run. If the engine begins to run and then stops, do not engage the starter motor until the engine has stopped running. Do not actuate the starter for more than 30 seconds at one time. Allow the starter motor to cool 3 minutes before you engage the starter again.
4. When the engine is running, have the other person disconnect the negative jumper cable and then the positive jumper cable.
5. Check the following warning lamps and make sure the lamps are not illuminated. If any of the following warning lamps are illuminated, stop the engine and check for the problem.
  - a. Charge indicator warning lamp
  - b. Engine oil pressure warning lamp
6. Run the engine at 1/2 throttle until the engine temperature is warm. Do not run the engine at low engine speeds for long periods of time. Low engine speeds will cause acids and deposits in the engine oil.

### BATTERY CONNECTIONS



E01601

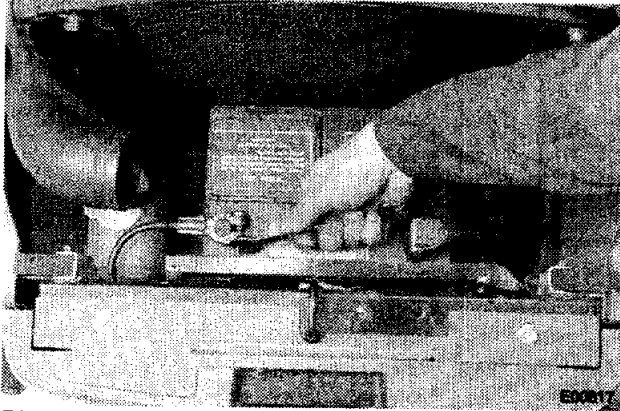
## STARTER MOTOR

### Removal and Installation

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

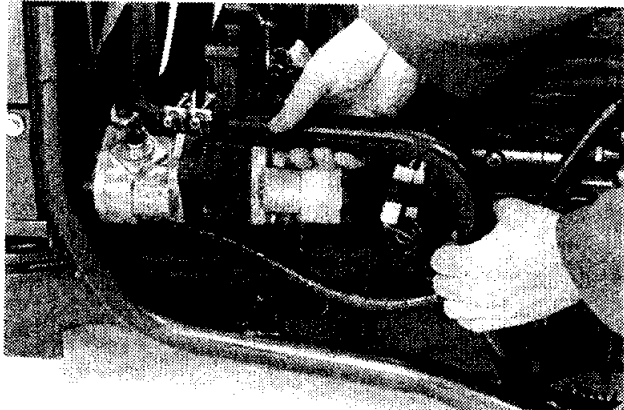
[ 2 ]



Disconnect the battery, negative ( - ) terminal first.

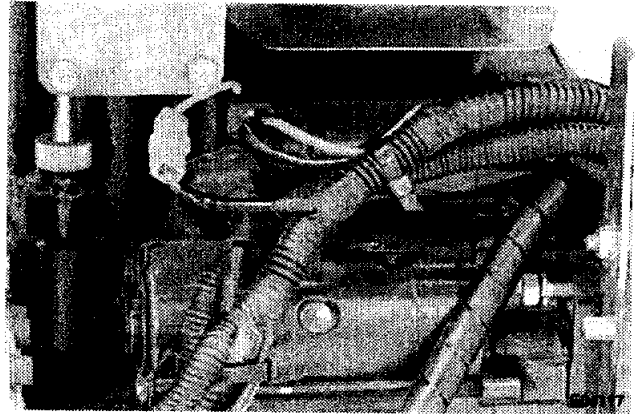
**NOTE:** For Installation, install and tighten the positive ( + ) terminal first.

[ 3 ]



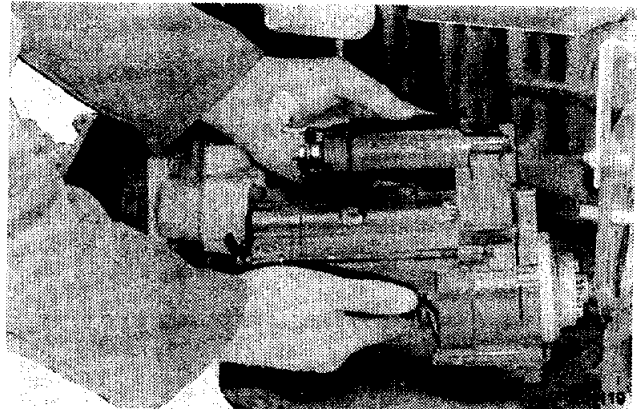
Disconnect, cap and remove the hydraulic pump supply tube.

[ 4 ]



Disconnect the starter motor from the main harness.

[ 5 ]



Remove the retaining bolts and remove the starter motor.

**NOTE:** For Installation, tighten the retaining bolts to a torque of 49 to 59 Nm (36 to 44 lb ft).

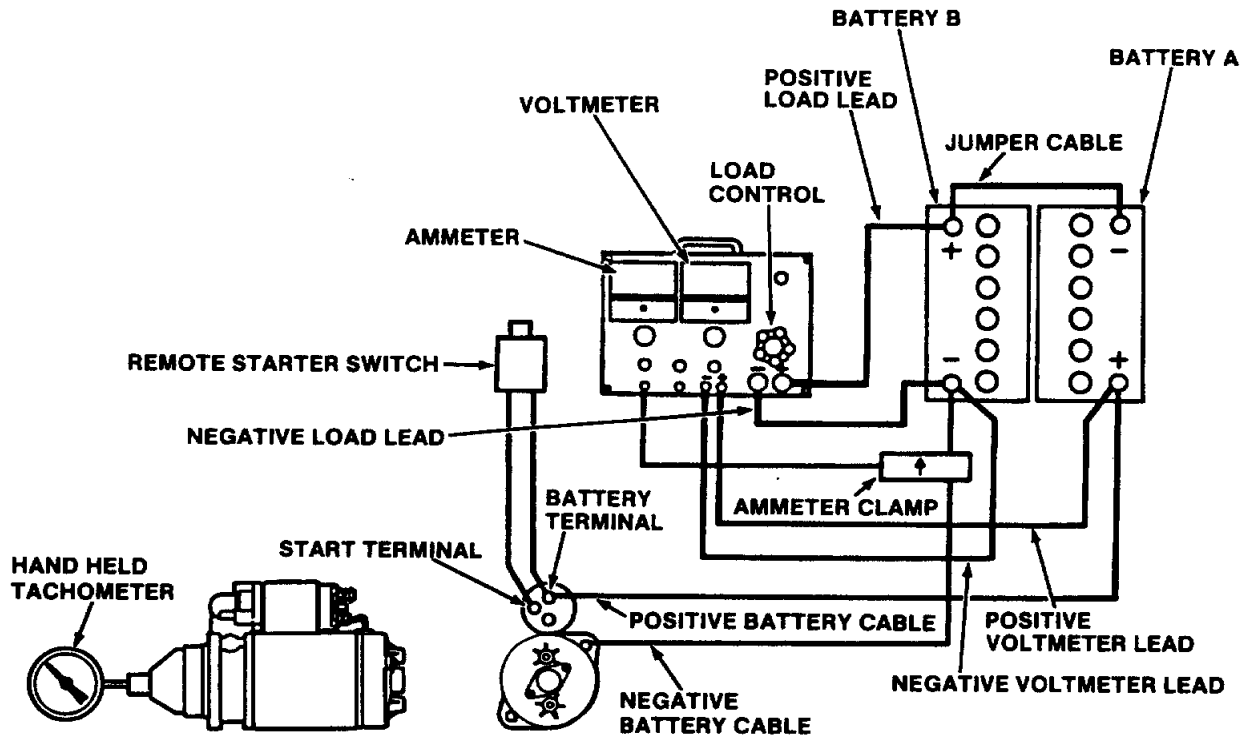
**NOTE:** For Installation, follow the same procedure in reverse order.

## NO-LOAD TEST

The No-Load Test is carried out with the starter motor removed from the machine. Check to make sure the drive clutch slides freely on the armature shaft and the armature rotates freely.

The No-Load Test can be carried out using a Sun Electric VAT-33 Tester or an equivalent tester. A hand held tachometer is required to measure the speed of the armature shaft. A remote starter switch is required to actuate the starter motor and one or two fully charged 12 volt batteries are required to supply the electricity to turn the starter motor.

### Test Procedure



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#### [ 1 ]

Fasten the starter motor in a soft jawed vise. Connect a jumper cable between the two batteries as shown. Connect the positive battery cable to the positive post of battery A and to the battery terminal on the starter solenoid. Connect the negative battery cable to the negative post of battery B and to the mounting flange on the starter.

#### [ 2 ]

Adjust the controls for the Sun Electric VAT-33 tester as follows:

1. Move the load control to the OFF position.
2. Move the volt range control to the 10 to 30 volt range.
3. Move the amp. range control to the 0 to 1000 amperes range.
4. Move the volt lead switch to the EXT. position.

#### [ 3 ]

Connect the voltmeter leads of the tester to the batteries as shown.

#### [ 4 ]

Connect the load leads of the tester to one of the batteries. DO NOT connect the load leads to both of the batteries.

#### [ 5 ]

Fasten the ammeter clamp around the negative battery cable. The point of the arrow on the ammeter clamp must be toward the battery.

## [ 6 ]

Connect the leads of the remote starter switch to the battery terminal and the switch terminal on the starter motor solenoid.

**NOTE:** [ 7 ] to [ 9 ] must be done rapidly. DO NOT apply a load to the battery for more than 15 seconds at one time. After 15 seconds turn the load control to the off position for 60 seconds to allow the tester to cool.

## [ 7 ]

Actuate the remote starter switch and turn the load control until the voltmeter indicates 11 volts.

## [ 8 ]

Make a note of the reading on the ammeter.

## [ 9 ]

Use the hand held tachometer to check the armature shaft speed. Make a note of the armature shaft speed.

## [ 10 ]

Release the remote starter switch and turn the load control to the OFF position.

## [ 11 ]

Disconnect the negative battery cable from the starter. Disconnect the remainder of the test connections.

**NOTE:** Refer to Specifications, Page 193, to check the readings obtained in [ 8 ] and [ 9 ].

## Understanding No-Load Test Results

### [ 1 ]

Low armature shaft speed and high current draw are indications of too much friction. Possible causes of too much friction are:

1. Tight, dirty or worn bearings.
2. A bent armature shaft.
3. Loose pole shoes (pole shoes make contact with the armature).
4. A short circuit in the armature coil. Disassemble the starter motor. Use an armature tester to test the armature.
5. Damaged field coil, refer to the test on Page 206.

### [ 2 ]

If the armature does not rotate and the current draw is high, possible causes are:

1. Field terminal making contact with the field frame. Inspect the insulators for the field terminal.
2. Damaged field coil, refer to the test on Page 206.
3. Damaged bearings.

### [ 3 ]

If the armature does not rotate and the current draw is zero, possible causes are:

1. An open field circuit, disassemble the starter motor and inspect the field coil connections.
2. An open armature coil, disassemble the starter motor and check for burned commutator bars. Use an armature tester to test the armature.
3. Brushes not making good contact with the commutator bars. Check for high insulation between the commutator bars, broken brush springs or worn brushes.

### [ 4 ]

Low armature shaft speed and low current draw are indications of:

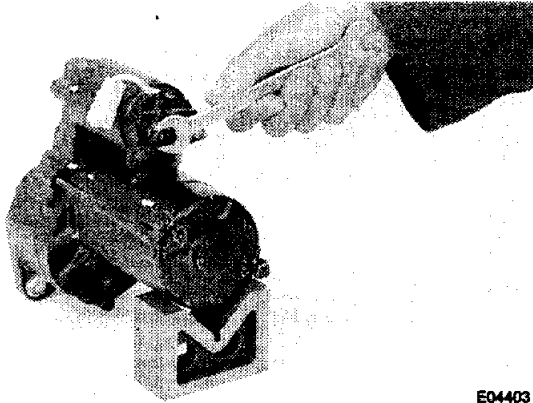
1. Dirt or corrosion on connections.
2. Damaged wiring.
3. Dirty commutator bars.
4. All causes in [ 3 ].

### [ 5 ]

High armature shaft speed and high current draw are indications of a short circuit in the field coil, install a new field coil. Repeat to the No - load Test, Page 202, and check the operation of the starter motor.

## Disassembly

[ 1 ]



E04403

Disconnect the motor lead from the starter solenoid.

[ 2 ]

Remove items (1 to 3).

**NOTE:** *Keep shims (3) together for assembly.*

[ 3 ]

Remove items (4 to 6) and remove the armature/yoke assembly items (7 to 12).

[ 4 ]

Carefully remove the armature (7). Using a bearing puller remove bearings (8 and 9) from the armature (7).

[ 5 ]

Remove items (10 to 12).

[ 6 ]

Remove items (13 to 18) and carefully remove the center bracket (19).

[ 7 ]

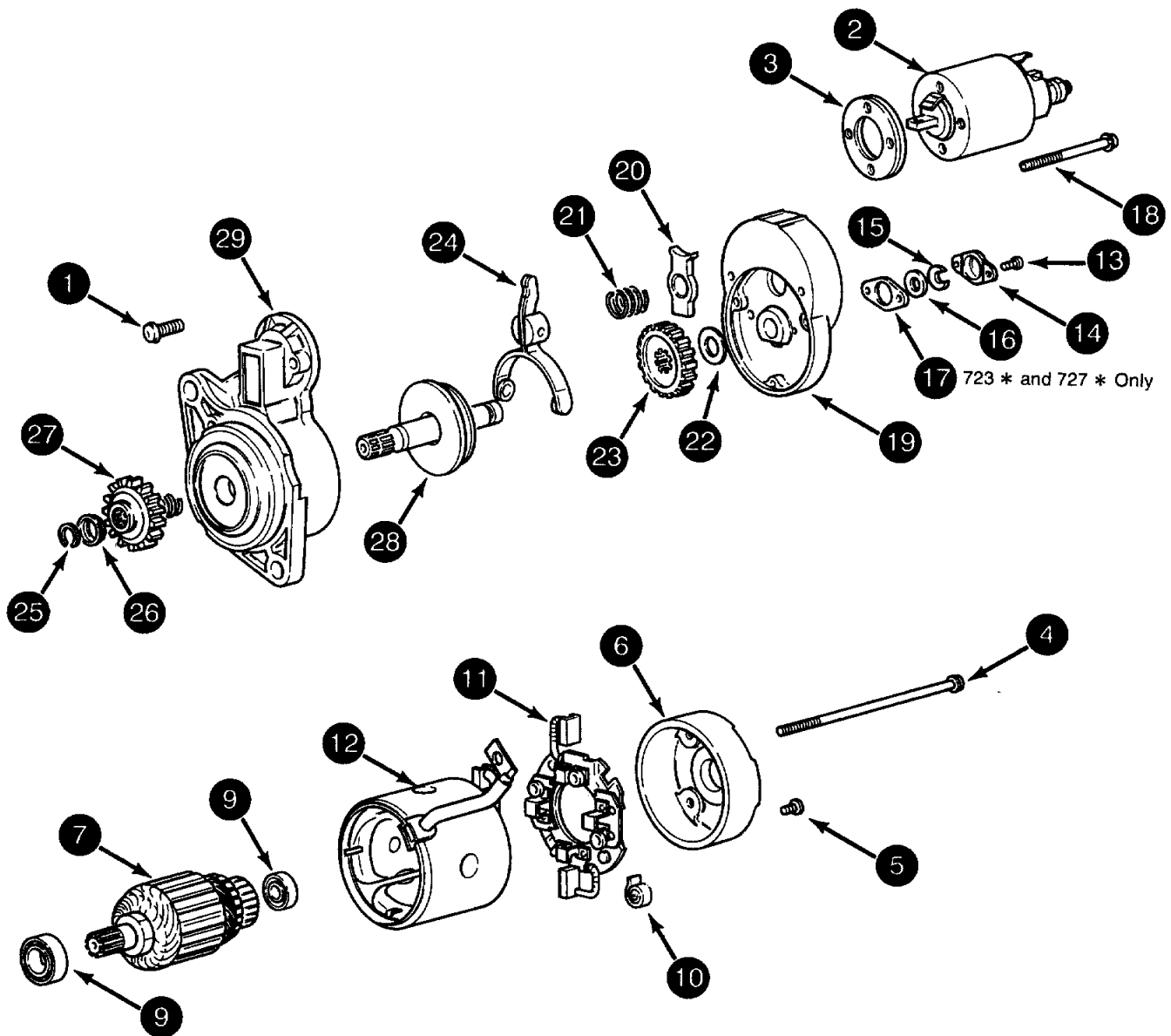
Remove items (20 to 25).

**NOTE:** *Keep shims (23) together for assembly.*

[ 8 ]

Remove items (26 to 29).

NOTE: Items are numbered in order of Disassembly.



SM0415

- |                 |                  |                    |                   |
|-----------------|------------------|--------------------|-------------------|
| 1. BOLT         | 9. BEARING       | 16. SHIM           | 23. GEAR          |
| 2. SOLENOID     | 10. SPRING       | 17. PLATE          | 24. LEVER         |
| 3. SHIM         | 11. BRUSH HOLDER | 18. BOLT           | 25. SNAP RING     |
| 4. BOLT         | 12. YOKE         | 19. CENTER BRACKET | 26. CAP           |
| 5. SCREW        | 13. SCREW        | 20. SEAT           | 27. GEAR          |
| 6. REAR BRACKET | 14. COVER        | 21. SPRING         | 28. PINION SHAFT  |
| 7. ARMATURE     | 15. CLIP         | 22. SHIM           | 29. FRONT BRACKET |
| 8. BEARING      |                  |                    |                   |

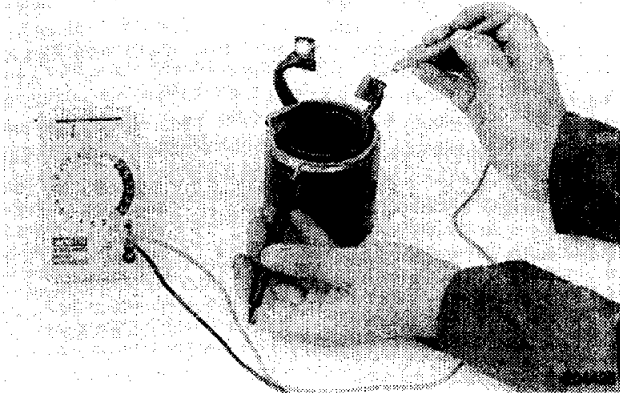


## Inspection

### [ 1 ]

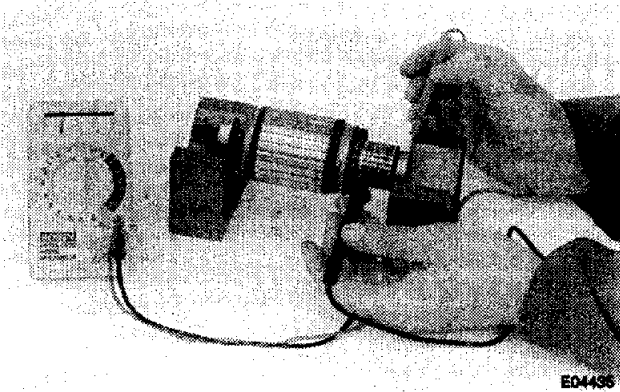
Check the brushes for wear or damage. Check for continuity between each brush and the brush holder base. Replace the brush holder if there is continuity.

### [ 2 ]



Check for continuity between the coil end brushes and the yoke (12). Replace the yoke if there is continuity.

### [ 3 ]



Check for continuity between the commutator and the commutator shaft. Replace the commutator if there is continuity.

## Assembly

### [ 1 ]

Install items (31 to 27).

**NOTE:** Apply GE Silicon grease G321 versilube or equivalent to the pinion (30).

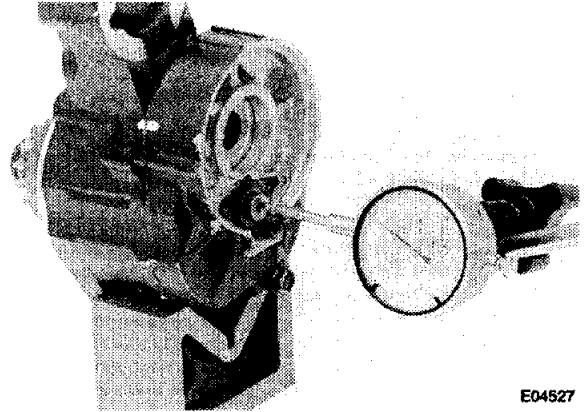
### [ 2 ]

Install items (26 to 16).

**NOTE:** Install the same amount of shims (24) as removed in Page 204 – [ 7 ].

**NOTE:** Apply GE Silicon Grease G321 versilube or equivalent to the gear (25).

### [ 3 ]



Measure the end play of the pinion shaft. The end play must be 0.0 to 0.5 mm (0.0 to 0.02 inch). If the end play is not correct, remove items (16 to 20). Add or remove shims (24) to give the correct end play.

### [ 4 ]

Install items (15 and 14).

### [ 5 ]

Install items (13 to 11). Apply GE Silicon grease G321 versilube or equivalent, to the bearings (10 and 9) and install to the armature (8). Carefully install the armature (8) into the yoke (13).

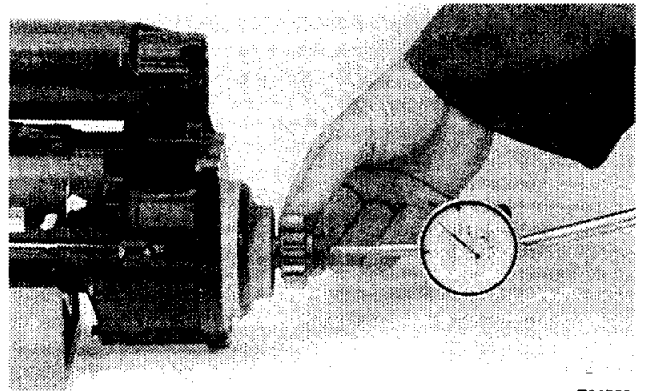
### [ 6 ]

Install the armature/yoke assembly items (7 to 12).

### [ 7 ]

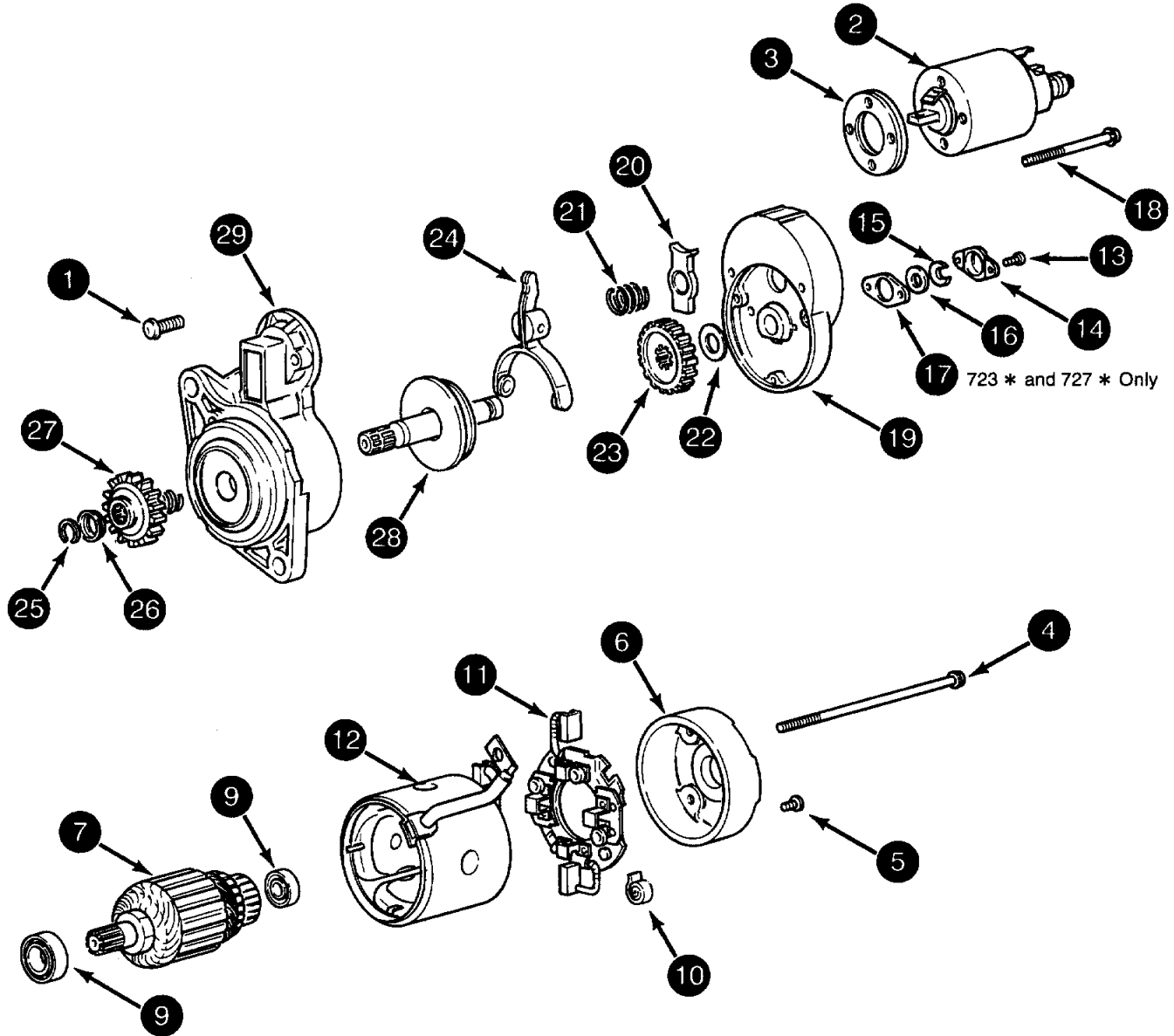
Install items (6 to 1).

### [ 8 ]



Connect the positive (+) terminal of a 12 Volt battery to the "S" terminal of the starter and connect the battery negative (-) terminal to the "M" terminal of the starter to slide out of the pinion. Measure the end play of the pinion shaft. The end play must be 0.5 to 2.0 mm (0.02 to 0.08 inch). If the end play is not correct, add or remove shims (3) to give the correct end play.

**NOTE:** Do not apply voltage for more than 10 seconds.



SM0415

- |                 |                  |                    |                   |
|-----------------|------------------|--------------------|-------------------|
| 1. BOLT         | 9. BEARING       | 16. SHIM           | 23. GEAR          |
| 2. SOLENOID     | 10. SPRING       | 17. PLATE          | 24. LEVER         |
| 3. SHIM         | 11. BRUSH HOLDER | 18. BOLT           | 25. SNAP RING     |
| 4. BOLT         | 12. YOKE         | 19. CENTER BRACKET | 26. CAP           |
| 5. SCREW        | 13. SCREW        | 20. SEAT           | 27. GEAR          |
| 6. REAR BRACKET | 14. COVER        | 21. SPRING         | 28. PINION SHAFT  |
| 7. ARMATURE     | 15. CLIP         | 22. SHIM           | 29. FRONT BRACKET |
| 8. BEARING      |                  |                    |                   |

## ALTERNATOR

### Testing on the Machine

#### [ 1 ]

Park the machine on hard level ground. Apply the parking brake and stop the engine.

#### [ 2 ]

Make sure that all electrical connections are tight and free of corrosion.

#### [ 3 ]

Make sure that the alternator drive belt is tight and is free of oil or grease that could cause the belt to slip.

#### [ 4 ]

Check the operation of the charging indicator lamp, Steps 2 and 3 may have corrected the fault. Check that the charging indicator bulb is good.

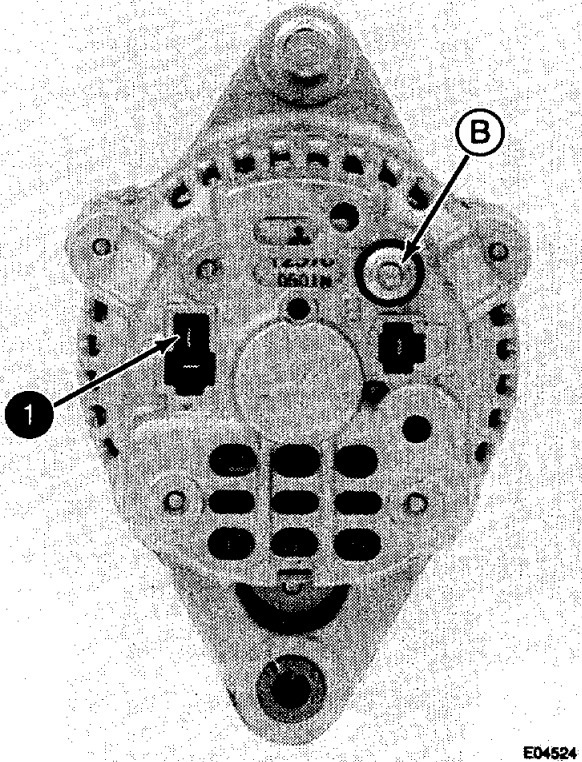
#### [ 5 ]

Test the battery, the battery must be fully charged and have a voltage of at least 12 volts, refer to Page 195 to 200.

## Voltage Test at the Alternator Terminals

### [ 1 ]

Carry out Steps 1 to 5 before doing this test. Use a multimeter set to read DC volts for the test.



### [ 2 ]

Connect the positive multimeter lead to the (B) terminal of the alternator.

Connect the negative multimeter lead to a good ground connection on the engine.

If the multimeter indicates less than 12 volts or indicates zero, refer to [ 3 ].

If the multimeter indicates 12 volts, refer to [ 4 ].

### [ 3 ]

Connect the positive multimeter lead to the battery terminal of the starter solenoid.

Connect the negative multimeter lead to a good ground connection on the engine.

If the multimeter indicates 12 volts, repair or replace the wire between the alternator and the starter solenoid, also check the fusible links.

If the multimeter does not indicate 12 volts, replace the positive battery cable.

### [ 4 ]

Turn the starter key switch to the ON position. Disconnect the 2 pin connector (1) from the alternator. Connect the positive multimeter lead to the terminal in the connector for the Red/Blue wire and the negative multimeter lead to a good ground connection on the engine.

If the multimeter indicates 12 volts, connect the connector to the alternator and refer to the Alternator and Regulator Test, Page 210.

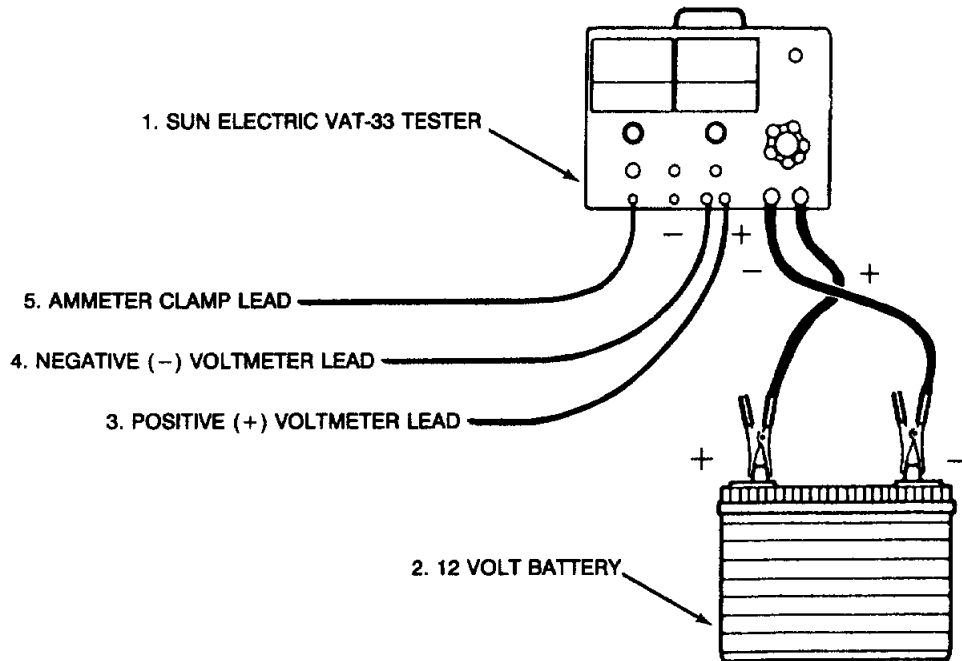
If the multimeter does not indicate 12 volts, check fuse No.2 (20 amps) in the fuse box. If the fuse is good, refer to **Wiring Schematics**

### [ 5 ]

Turn the key switch to the ON position. Connect the positive lead to Yellow/Green wire terminal in the connector. Connect the negative multimeter lead to a good ground. If the multimeter indicates 12 volts, connect the connector to the alternator and refer to the Alternator and Regulator Test, Page 210.

If the multimeter does not indicate 12 volts, refer to **Wiring Schematics**

## Alternator and Voltage Regulator Test



790490M

**NOTE:** Refer to Steps 1 to 10, Page 3, before carrying out this test. Use a Sun Electric VAT-33 or other suitable equipment to carry out the following test.

### [ 1 ]

Adjust the controls for the Sun Electric VAT-33 as follows:

1. Put the load control to the OFF position.
2. Select the volt range that will measure 12 to 30 volts.
3. Select the ampere range that will measure 0 to 100 amperes
4. Put the volt lead select switch to the EXT. position.

### [ 2 ]

Connect the positive load lead of the tester to the positive post of the battery.  
Connect the negative load lead of the tester to the negative post of the battery.

### [ 3 ]

Connect the positive voltmeter lead of the tester to the B+ terminal on the alternator.  
Connect the negative voltmeter lead of the tester to a good ground connection on the engine.

### [ 4 ]

Connect the ammeter clamp around the wire that fastens the B+ terminal on the alternator. The clamp must be at least 50 mm from the alternator. The point of the arrow on the ammeter clamp must be away from the alternator.

### [ 5 ]

Start and run the engine at  $\frac{3}{4}$  throttle.



**WARNING:** Never run the engine in a closed building. Proper ventilation is required under all circumstances.

**NOTE:** Carry out Steps 5 and 6 rapidly. Do not apply a load at the battery for more than 15 seconds at a time. After 15 seconds turn the load control to the OFF position for 60 seconds before applying the load again.

### [ 6 ]

Adjust the load control of the tester to get the maximum ammeter indication, make a note of the ammeter and voltmeter readings.

Turn the load control to the OFF position.

### [ 7 ]

Slowly decrease the engine speed and stop the engine.

### [ 8 ]

The ammeter reading in Step 5 must be more than 40 amperes. The voltmeter reading in Step 5 must be 13 to 15 volts.

If the ammeter and voltmeter readings are correct the alternator and voltage regulator are good.

If the ammeter and voltmeter readings are not correct replace the voltage regulator and brush holder, then repeat the test.

If the ammeter and voltmeter readings are still not correct replace the stator.

## Removal and Installation

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

[ 2 ]

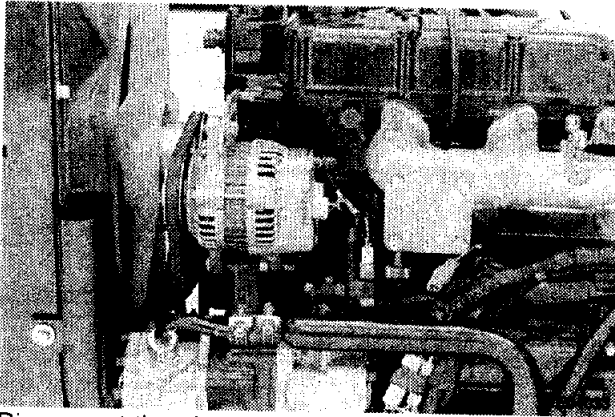
Raise the hood and remove the left hand engine panel.

[ 3 ]

Disconnect the battery, negative (–) terminal first.

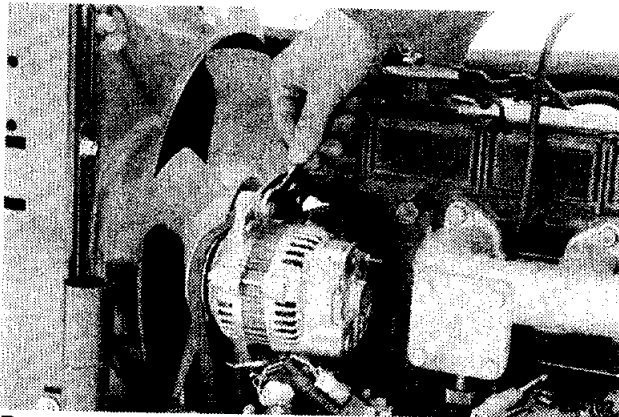
**NOTE:** For Installation, install and tighten the positive (+) terminal first.

[ 4 ]



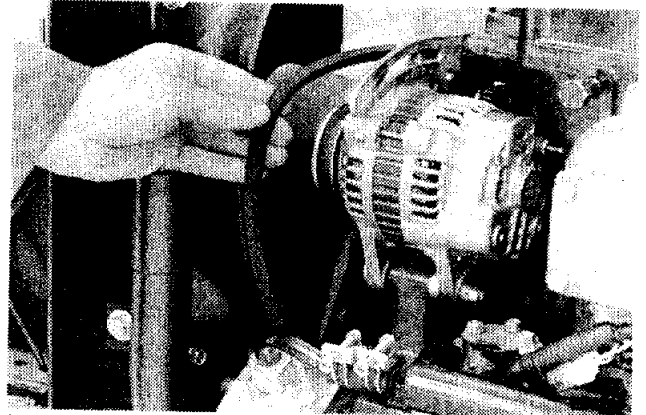
Disconnect the alternator from the main harness.

[ 5 ]



Remove the top mounting bolt.

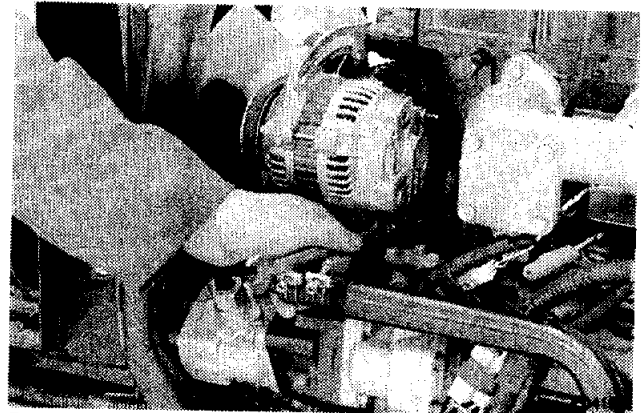
[ 6 ]



Loosen the bottom mounting bolt, move the alternator towards the engine and remove the drive belt.

**NOTE:** For Installation, tension the belt until it deflects 10 to 12 mm (0.4 to 0.5 inch) with a 10 kg (22 lb) load.

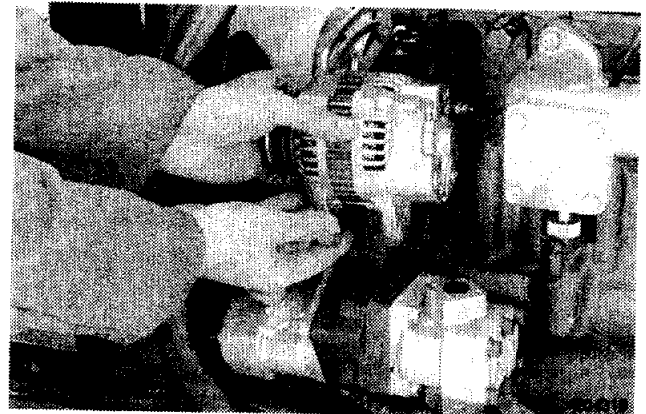
[ 7 ]



Remove the bottom mounting nut, bolt, spacer and shim.

**NOTE:** For Installation, adjust the clearance between the spacer and the alternator bracket to be 0.2 mm (0.008 inch) or less by installing shims.

[ 8 ]

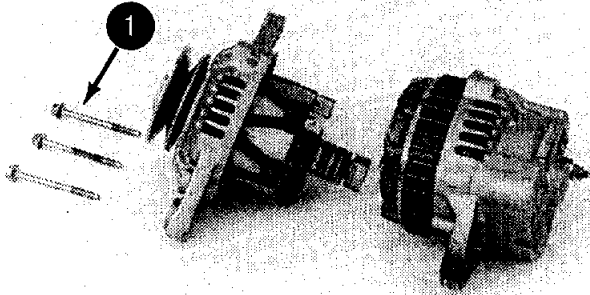


Remove the alternator.

**NOTE:** For Installation, follow the same procedure in

## Disassembly and Assembly

[ 1 ]



E04321

Remove the bolts (1) and carefully separate the two halves of the alternator.

[ 2 ]

Using a soft jawed vice hold the rotor and remove the nut and washer (2).

[ 3 ]

Remove items (3 to 6). Using a soft faced hammer carefully drive the rotor out of the housing (7).

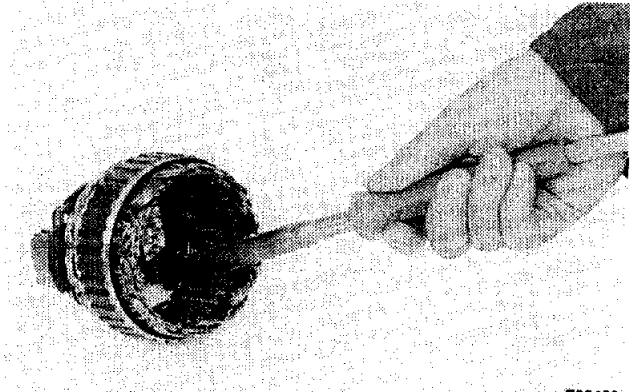
[ 4 ]

Remove items (8 to 12) from the rotor (13).

[ 5 ]

Remove items (14 to 17) and remove the stator assembly from the rear housing (18).

[ 6 ]



E05420

Remove items (19 to 23).

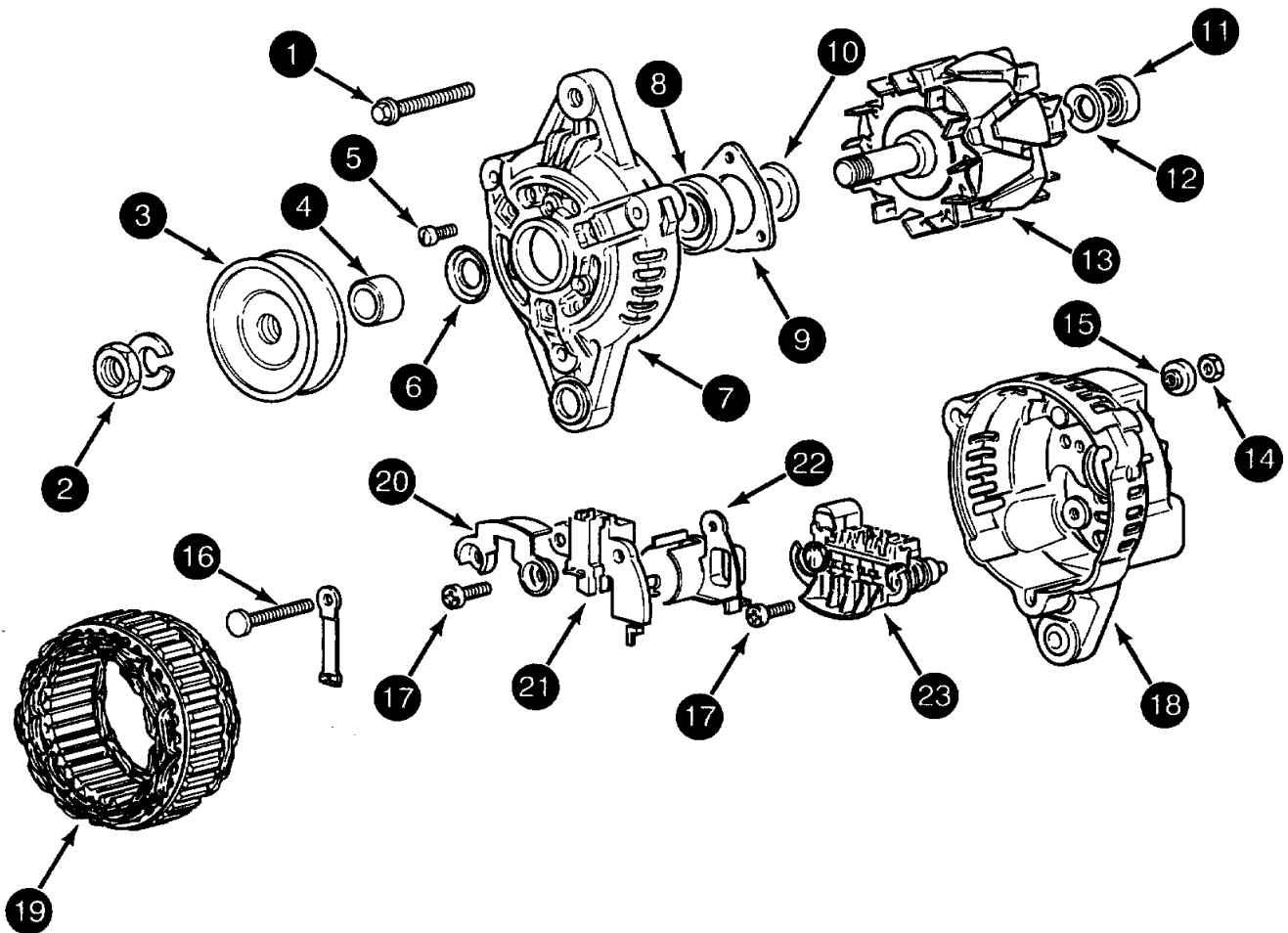
**NOTE :** Use a soldering iron to separate item (19) from item (23). Use a heat setting of least 1000 watts and disconnect the wires quickly to prevent damage to the diodes.

[ 7 ]

Check all items for wear or damage and replace as necessary, refer to Page 8 for Inspection.

**NOTE:** For Assembly, follow the same procedure in reverse order.

**NOTE:** Items are numbered in order of Disassembly.



SM0418

1. BOLT  
2. NUT  
3. PULLEY  
4. SPACER  
5. SCREW  
6. WASHER

7. FRONT HOUSING  
8. BEARING  
9. PLATE  
10. WASHER  
11. BEARING  
12. WASHER

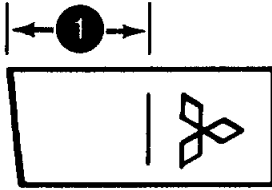
13. ROTOR  
14. NUT  
15. COVER  
16. BOLT  
17. SCREW  
18. REAR HOUSING

19. STATOR  
20. COVER  
21. REGULATOR/BRUSH  
HOLDER ASSEMBLY  
22. COVER  
23. RECTIFIER ASSEMBLY



## Inspection

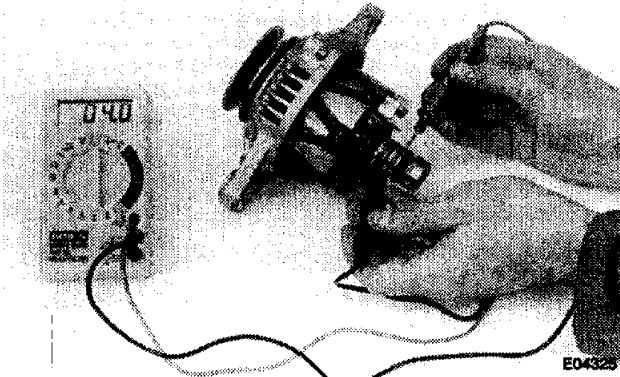
[ 1 ]



SM0418A

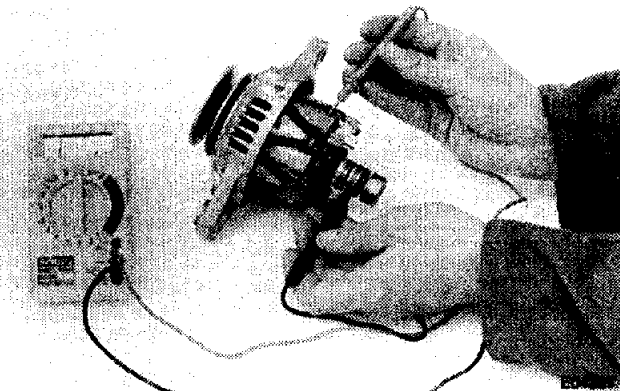
Check the length of the brushes against the wear limit (1). If the brushes are less than the wear limit (1), new brushes must be installed.

[ 2 ]



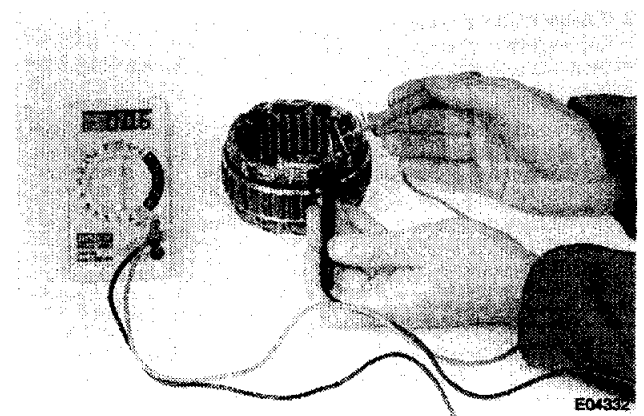
Use a multimeter to check for continuity between the slip rings. If there is no continuity, the field coil is open and the alternator must be replaced.

[ 3 ]



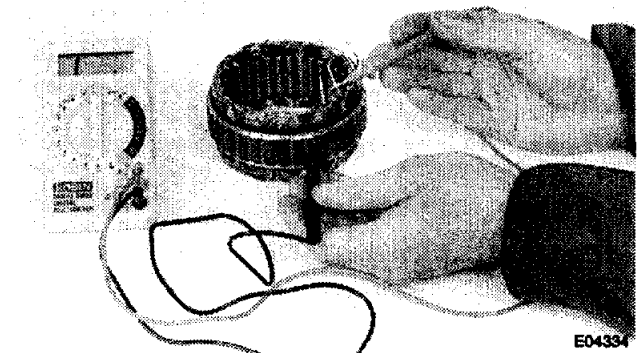
Check for continuity between the slip rings and the shaft or core. If there is continuity the field coil is grounded and the alternator must be replaced.

[ 4 ]



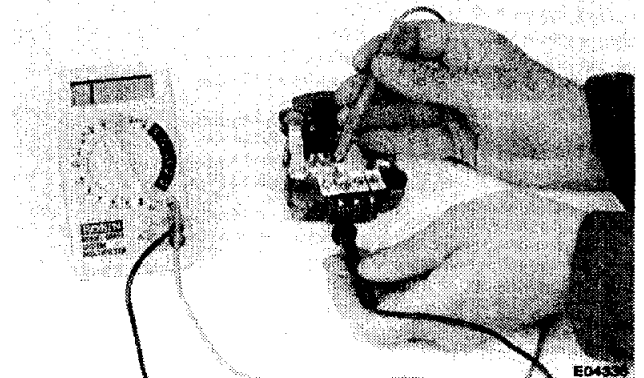
Check the stator coil for continuity between each lead wire. If there is no continuity the stator coil is open and must be replaced.

[ 5 ]



Check for continuity between each lead wire of the stator coil and the stator core. If there is continuity, the stator coil is grounded and must be replaced.

[ 6 ]



Set the multimeter to diode check. Check for continuity between each diode and the diode case. Reverse the multimeter probes and check for continuity.

Resistance must be large in one direction and small in the reverse direction.

If resistance is equal in both directions the rectifier assembly must be replaced.

## SECTION 7

### SHEET METALS, FUEL TANK & ROPS

#### SPECIAL TORQUES

Rear Wheel Bolts .....	118 to 132 Nm	87 to 97.5 lb ft
Fender Support Bolts .....	83 to 93 Nm	61 to 69 lb ft
Fender Support to Axle Bolts .....	118 to 132 Nm	87 to 97.5 lb ft
Rops Bracket Bolts .....	83 to 93 Nm	61 to 69 lb ft
Rops Frame Pivot Bolts .....	44 to 54 Nm	32.5 to 40 lb ft
Rops Frame Lock Bolts .....	44 to 54 Nm	32.5 to 40 lb ft
Rops Frame Lock Bolts Locking Nuts .....	44 to 54 Nm	32.5 to 40 lb ft

## HOOD, PANELS, INSTRUMENT PANEL AND INSTRUMENT CLUSTER

### Removal and Installation

#### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

#### [ 2 ]

Disconnect the battery, negative ( - ) terminal first.

**NOTE :** *For Installation, install and tighten the positive (+) terminal first.*

#### [ 3 ]

Raise the hood and remove the side panels (1).

#### [ 4 ]

Remove nut (2) and remove the hood (3).

**NOTE:** *For Installation, tighten nut (2) and then back the nut off 1/4 of a turn.*

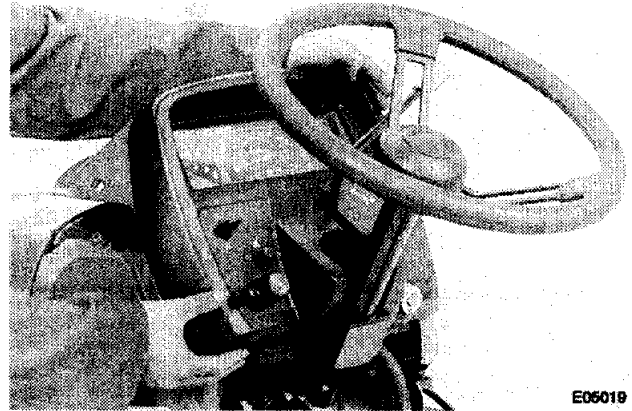
#### [ 5 ]

Remove bolts (4), disconnect the headlamps connectors from the front grille and remove the front grille (5).

#### [ 6 ]

Remove screws (6) and remove cover (7).

#### [ 7 ]



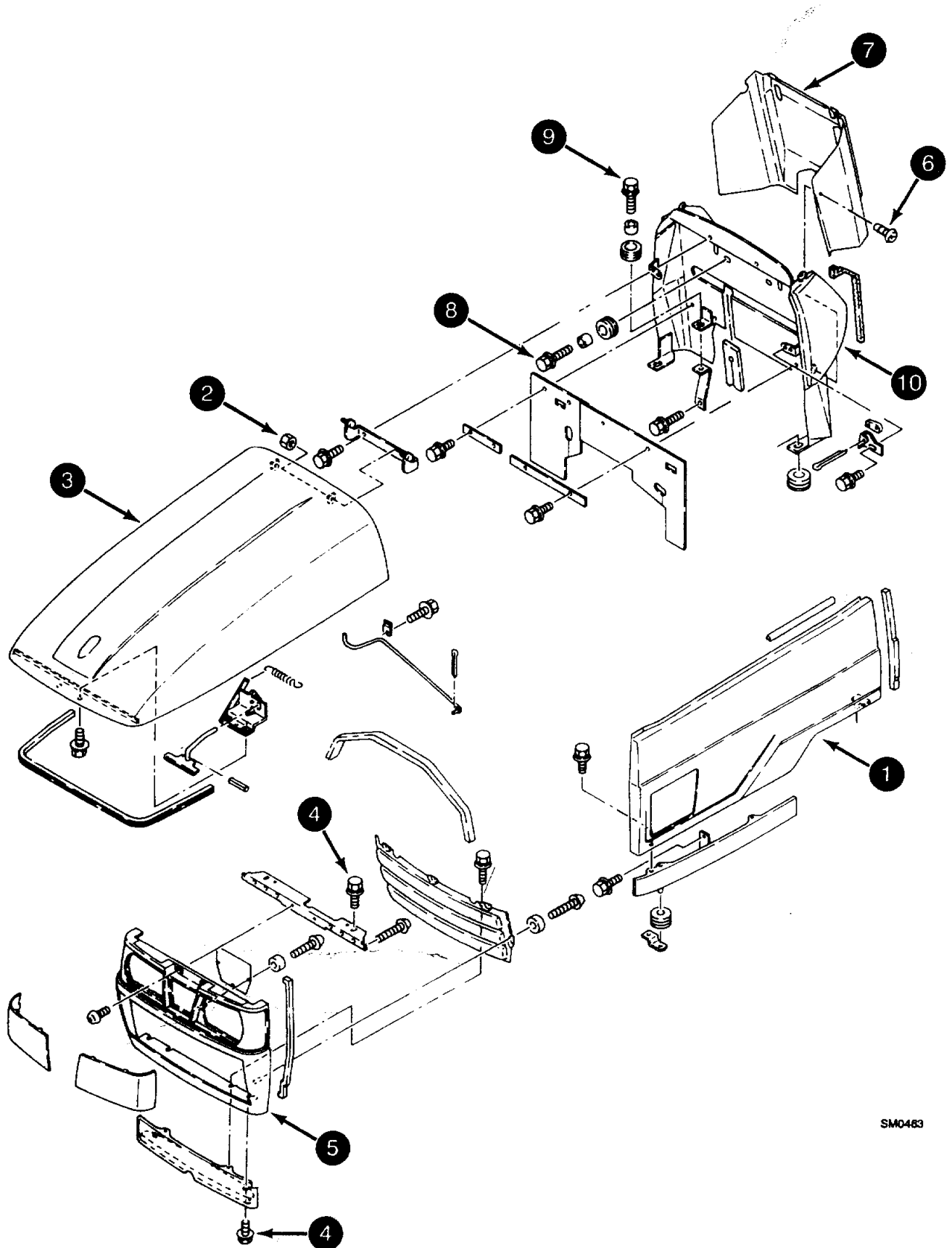
Remove the instrument cluster retaining screws and raise the instrument cluster slightly. Disconnect the tachometer cable and the engine harness. Remove the instrument cluster.

#### [ 8 ]

Remove the bolts (8 and 9) and remove the steering column cover (10).

**NOTE:** *For Installation, follow the same procedure in reverse order.*

NOTE: Items are numbered in order of Disassembly.



SM0483

## FENDER AND PLATFORM

### Removal and Installation

#### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

#### [ 2 ]

Remove the ROPS frame, refer to Page 219.

#### [ 3 ]

Remove the Fuel Tank, refer to Page 220.

#### [ 4 ]

Remove bolts (1 to 4) and remove the platforms (5).

#### [ 5 ]

Remove the rear fenders (6).

#### [ 6 ]

Remove the four retaining bolts and remove the seat.

#### [ 7 ]

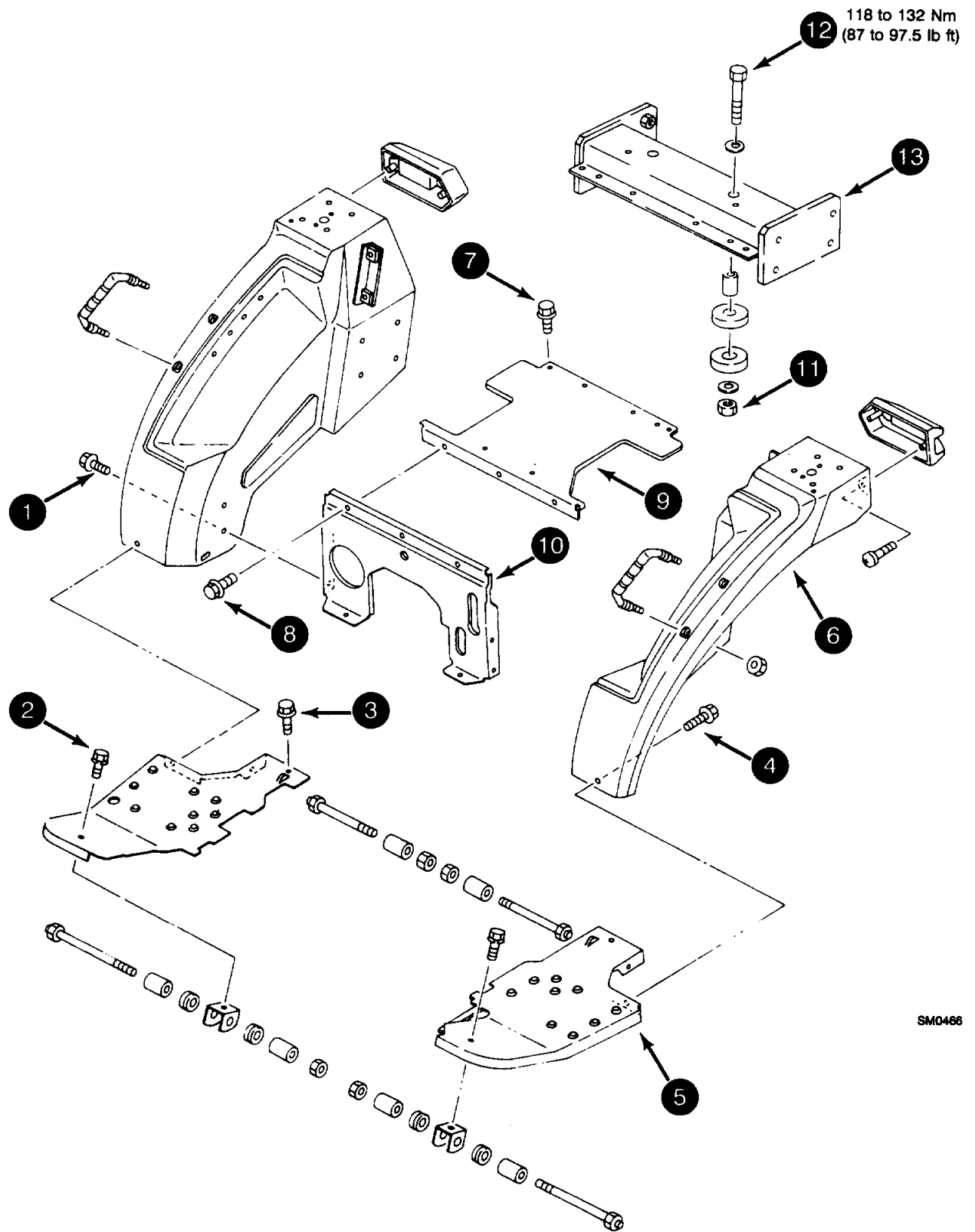
Remove bolts (7 and 8) and remove covers (9 and 10).

#### [ 8 ]

Remove nuts (11), bolts (12) and support (13).

**NOTE:** *For Installation, tighten bolts (12) to a torque of 118 to 132 Nm (87 to 97.5 lb ft).*

**NOTE :** *For Installation, follow the same procedure in reverse order.*



SM0466

## FUEL TANK

### Removal and Installation

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

[ 2 ]

Put a container with a capacity of at least 30 Litres (6.6 UK gal) under the fuel tank drain plug. Remove the drain plug and drain the fuel. Install and tighten the drain plug to a torque of 12 to 17 Nm (9 to 12.5 lb ft).

[ 3 ]

Disconnect and cap the fuel supply hose (1) and fuel return hose (2).

[ 4 ]

Disconnect the fuel sender unit from the main harness.

[ 5 ]

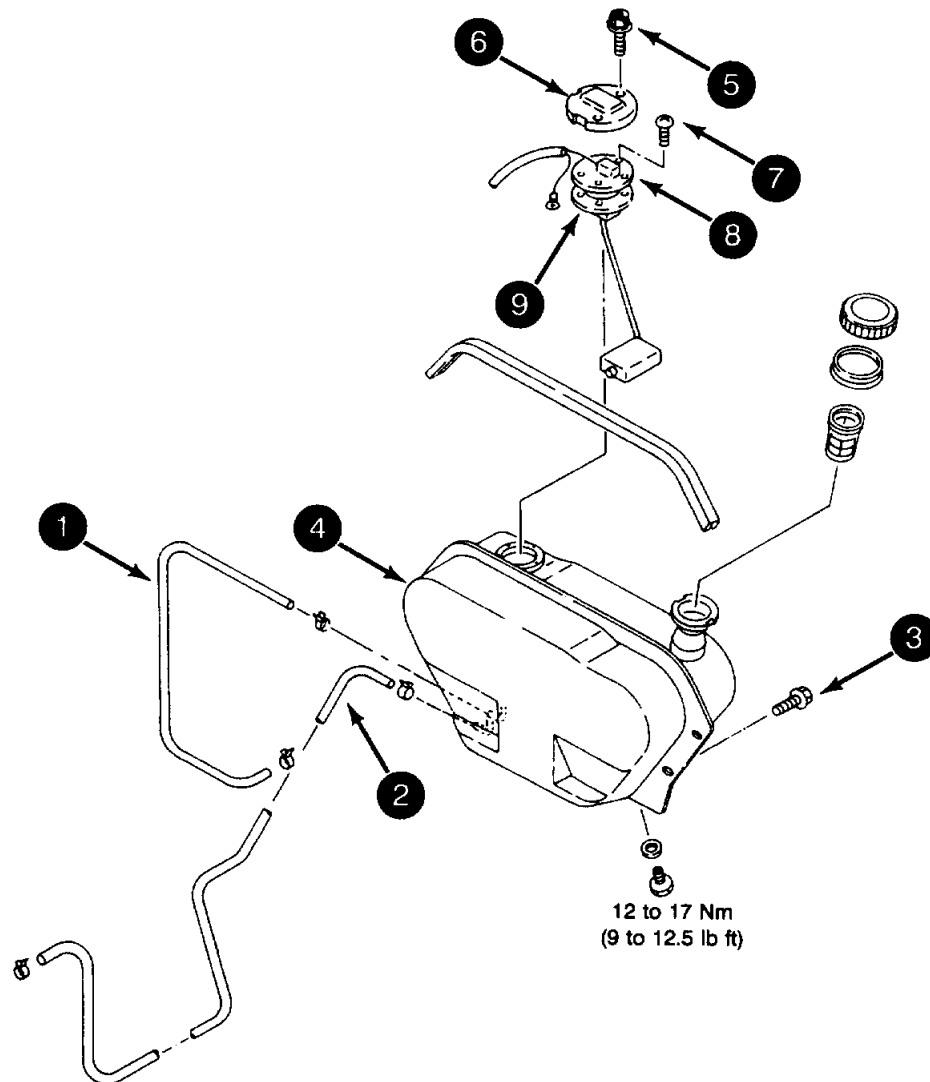
Remove bolts (3) and remove the fuel tank (4).

### Fuel Gauge Sender Unit

[ 6 ]

Remove the screws (5), cover (6) and screws (7). Remove the sender unit (8) and seal (9).

**NOTE:** For Assembly, follow the same procedure in reverse order.



SM0394

**NOTE:** Items are numbered in order of Removal.

## ROPS

### Removal and Installation

#### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

#### [ 2 ]

Remove the rear wheels and support the tractor on axle stands.

**NOTE:** *For Installation, tighten the rear wheel bolts to a torque of 118 to 132 Nm (87 to 97.5 lb ft).*

#### [ 3 ]

Remove nuts (1) and lock pin (2). Loosen the lock nuts (3) and bolts (4). Remove the pin (5) and carefully fold the ROPS frame down.

**NOTE:** *For Installation, tighten items (1, 3 and 4) to a torque of 44 to 54 Nm (32.5 to 40 lb ft).*

#### [ 4 ]

Get an assistant to hold the ROPS frame. Remove bolts (6), pins (7) and remove the ROPS frame (8).

#### [ 5 ]

Disconnect the rear light from the main harness. Remove bolts (9) and brackets (10).

**NOTE:** *For Installation, tighten bolts (9) to a torque of 83 to 93 Nm (61.5 to 69 lb ft).*

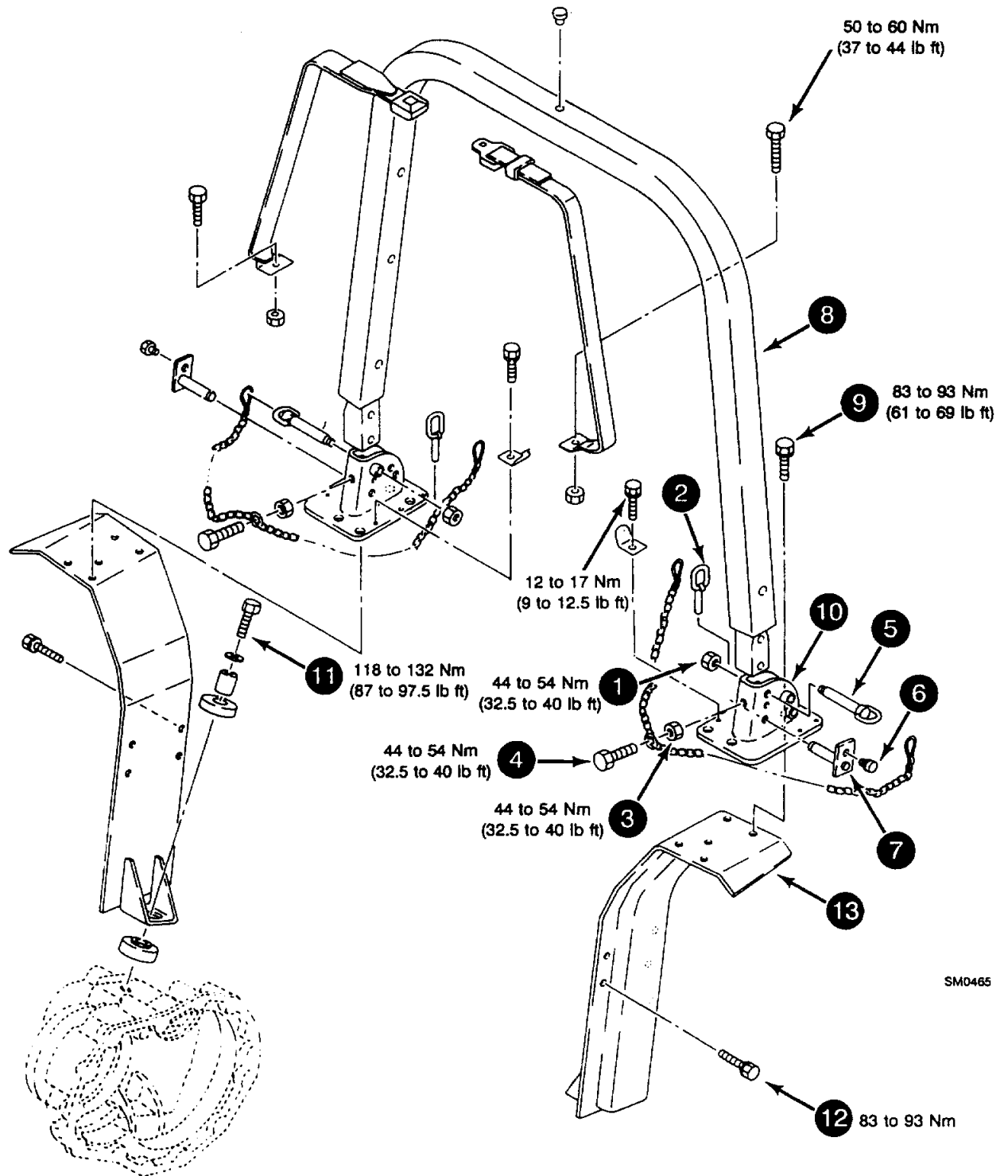
#### [ 6 ]

Remove bolts (11), hold the fender supports (13) remove bolts (12) and remove the fender supports (13).

**NOTE:** *For Installation, follow the same procedure in reverse order.*

**NOTE:** *For Installation, tighten bolts (11) to a torque of 118 to 132 Nm (87 to 97.5 lb ft).*





## SECTION 8

### ADJUSTMENTS

#### SPECIAL TORQUES

Rear Wheel Bolts ..... 118 to 132 Nm

87 to 97 lb ft

### CLUTCH PEDAL ADJUSTMENT

Park the machine on hard level ground. Apply the parking brake. Put blocks in front of and behind the rear wheels.

#### Clutch Pedal Free Movement Adjustment

**[ 1 ]**

Push the clutch pedal down by hand lightly and measure the amount of pedal free movement (A).

**[ 2 ]**

Adjust nuts (1) until the freeplay (A) is 20 to 30 mm (0.8 to 1.2 inch). Tighten nuts (1).

#### Maximum Pedal Movement Adjustment

**NOTE :** *Adjust the maximum pedal movement after adjusting the free pedal movement.*

**[ 1 ]**

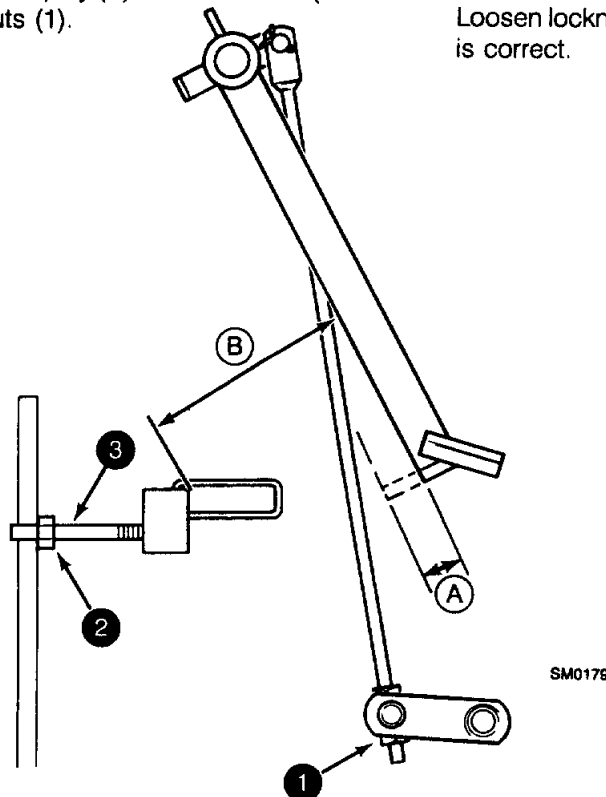
Push the pedal down by hand to take up the pedal free movement (A).

**[ 2 ]**

Measure the distance (B).

**[ 3 ]**

Loosen locknut (2) and adjust bolt (3) until distance (B) is correct.



Distance (A) Clutch Pedal Free Play ..... 20 to 30 mm

0.8 to 1.2 inch

Distance (B) Clutch Pedal Movement (Single Plate Clutch 719 \* ).... 70 to 75 mm

2.75 to 2.95 inch

Distance (B) Clutch Pedal Movement (Dual Clutch 719 \* ) ..... 95 to 100 mm

3.75 to 3.95 inch

Distance (B) Clutch Pedal Movement

(Single Plate Clutch 723 \* and 727 \* ) ..... 85 to 90 Nm

3.35 to 3.55 inch

Distance (B) Clutch Pedal Movement (Dual Clutch 723 \* and 727 \* ) ..... 125 to 130 mm

4.9 to 5.1 inch

## BRAKE PEDAL ADJUSTMENT

### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels, release the parking brake.

### [ 2 ]

Disconnect the brake pedal latch and push the right hand pedal down by hand. Measure the amount of pedal free movement (A).

### [ 3 ]

Loosen the locknut (1) and adjust the rod (2) until the free play is 20 to 30 mm (0.8 to 1.2 inch) ( 719 \* ), 35 to 45 mm (1.37 to 1.77 inch) ( 723 \* and 727 \* ).

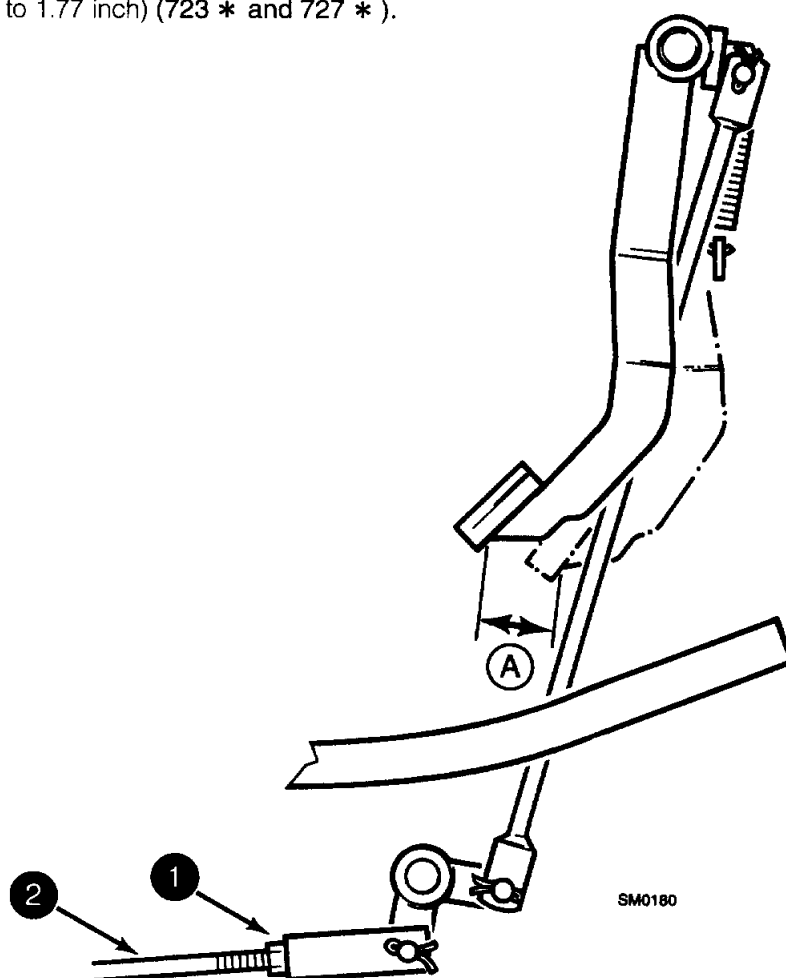
### [ 4 ]

Repeat Steps 2 and 3 for the left hand brake pedal.

**NOTE:** The free play between the two pedals must not be more than 3 mm (0.12 inch).

### [ 5 ]

Connect the brake pedal latch.



Distance (A) Brake Pedal Free Play ( 719 * ).....	20 to 30 mm
Distance (A) Brake Pedal Free Play ( 723 * and 727 * ) .....	35 to 45 mm

0.8 to 1.2 inch
1.37 to 1.77 inch

## HAND AND FOOT THROTTLE ADJUSTMENT

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

[ 2 ]

Raise the hood and remove the right hand engine panel.

[ 3 ]

Hold the hand throttle lever and the governor lever (1) in the high idle position. Adjust the cable clamp (2) until distance (A) is 0 to 1 mm (0 to 0.4 inch).

[ 4 ]

Put the foot throttle in the high idle position (fully down). Adjust the nuts (4) until distance (B) is 0 to 1 mm (0 to 0.4 inch).

[ 5 ]

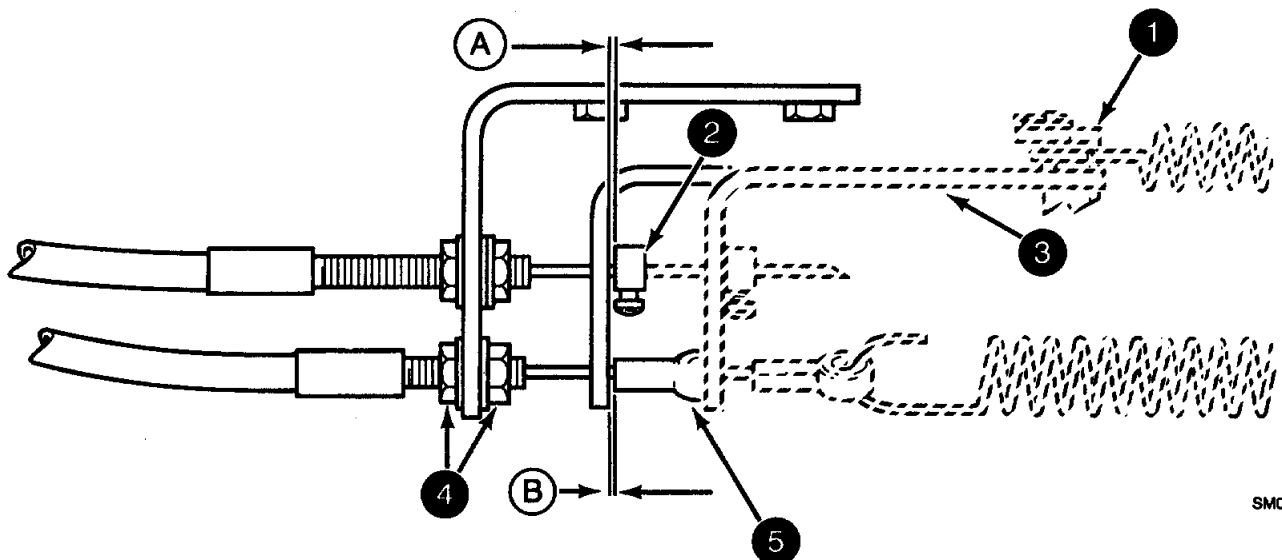
Put the hand and the foot throttle in the low idle position.

[ 6 ]

Start the tractor and check the operation of the hand and foot throttle.



**WARNING:** *Never operate the engine in a closed building. Proper ventilation is required under all operating conditions.*



SM0181

Distance (A) Cable Clamp to Governor Plate ..... 0 to 1 mm  
Distance (B) Cable Eye to Governor Plate ..... 0 to 1 mm

0 to 0.4 inch  
0 to 0.4 inch

## DIFFERENTIAL LOCK PEDAL ADJUSTMENT (719 \* )

### [ 1 ]

Park the machine on hard level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

### [ 2 ]

Remove the right hand rear wheel (for non hydrostatic tractors) or the left hand rear wheel (for hydrostatic tractors) and support the tractor on axle stands.

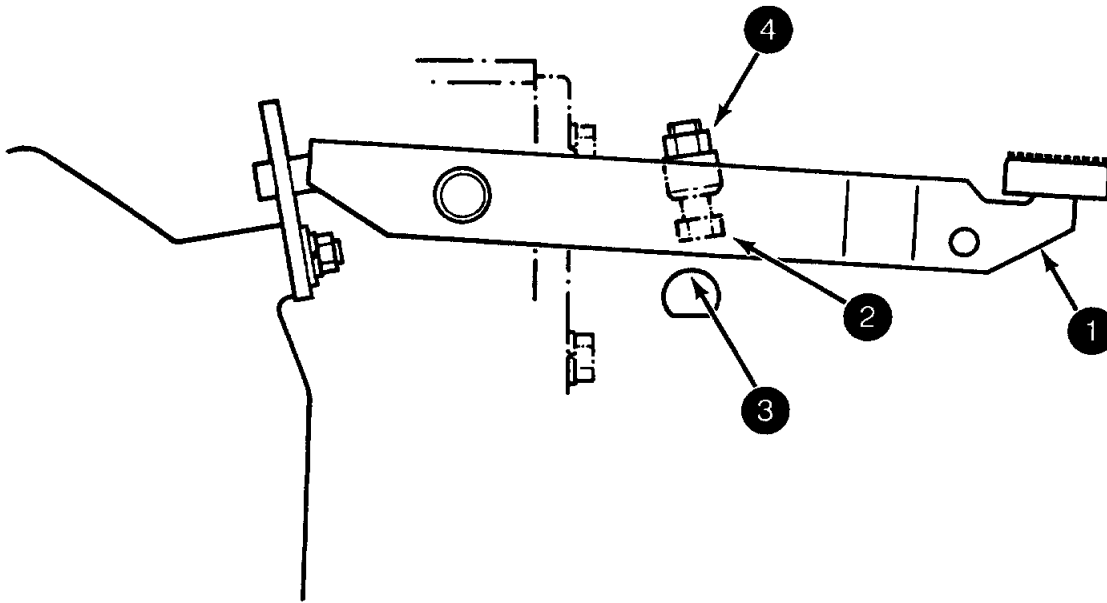
### [ 3 ]

Hold down the differential lock pedal (1), turn the bolt (2) until it makes contact with its stop (3), turn the bolt out an extra  $\frac{1}{4}$  to  $\frac{1}{2}$  turn and tighten the lock nut (4).

### [ 4 ]

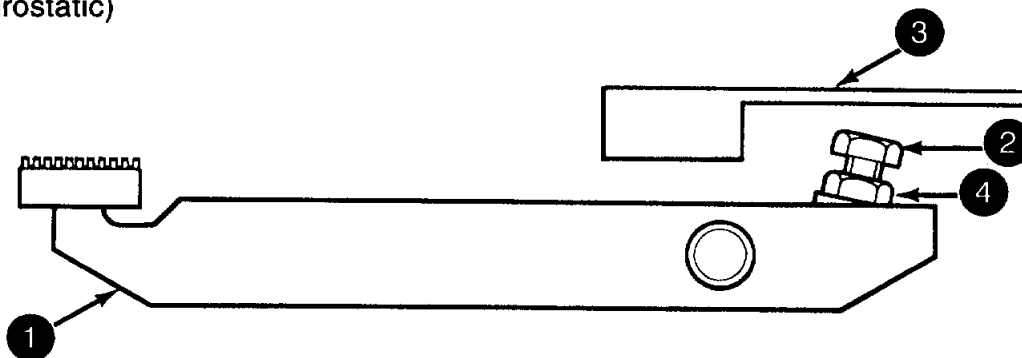
Install the rear wheel and tighten the wheel bolts to a torque of 118 to 132 Nm (87 to 97 lb ft).

7192/7194 (Non Hydrostatic)



SM0341

7195 (Hydrostatic)



SM0340

## DIFFERENTIAL LOCK PEDAL ADJUSTMENT (723 and 727)

**[ 1 ]**

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

**[ 2 ]**

Remove the right hand rear wheel (for non hydrostatic tractors) or the left hand rear wheel (for hydrostatic tractors) and support the tractor on axle stands.

**[ 3 ]**

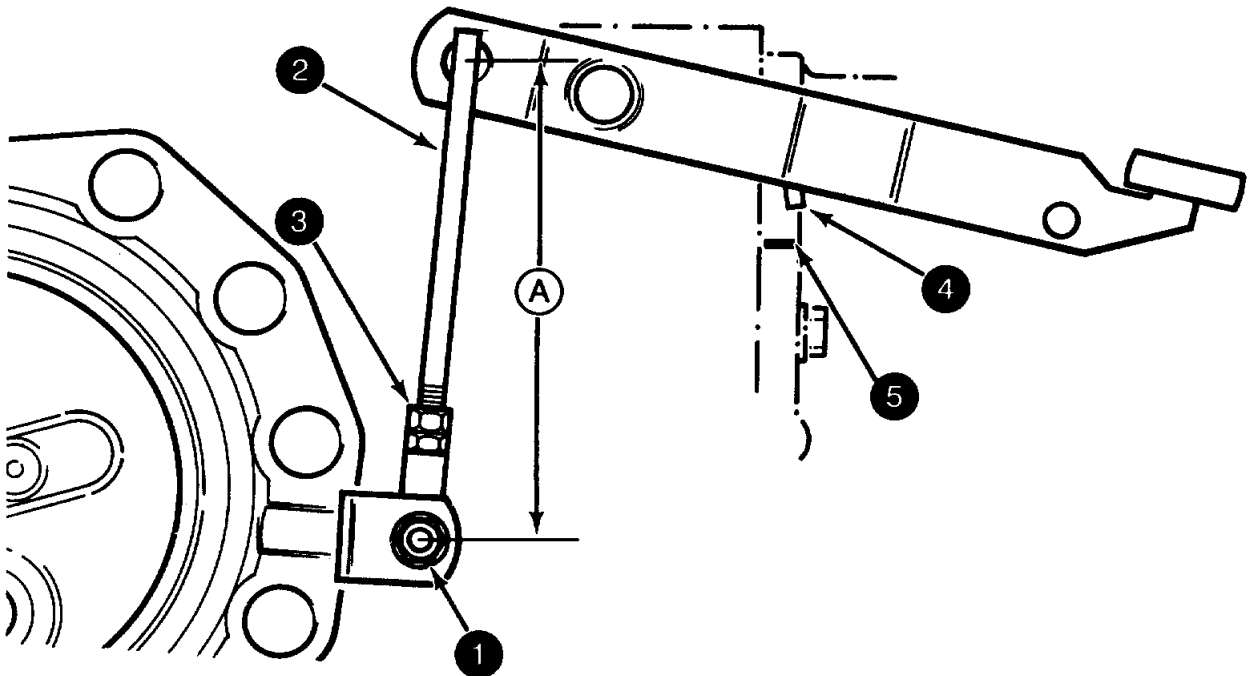
Remove nut (1) and disconnect rod (2). Loosen the locknuts (3) and adjust the rod (2) until distance (A) is 178 mm (7.0 inch). Tighten the locknuts (3), install the rod (2) and tighten the nut (1).

**[ 4 ]**

Hold the differential pedal down, if a clearance is measured between the differential pedal stop (4) and casting (5), repeat [ 3 ] until no clearance is measured.

**[ 5 ]**

Install the rear wheel and tighten the wheel bolts to a torque of 118 to 132 Nm (87 to 97 lb ft).



Distance (A) Rod Length ..... 178 mm

7.0 inch

## HYDROSTATIC PEDAL ADJUSTMENT

[ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the front wheels.

[ 2 ]

Lift rod (1) to take up the free play. Adjust nut (2) until distance (A) is 5 to 6 mm (0.2 to 0.23 inch). Tighten nut (3) against nut (2).

[ 3 ]

Loosen nut (4) and adjust rod (5) until distance (B) is 156 mm (6.15 inch). Tighten nut (4).

[ 4 ]

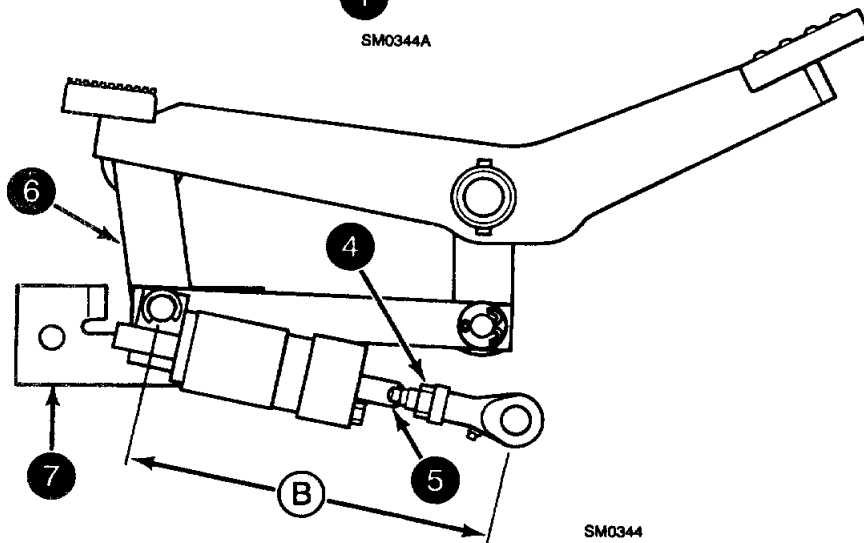
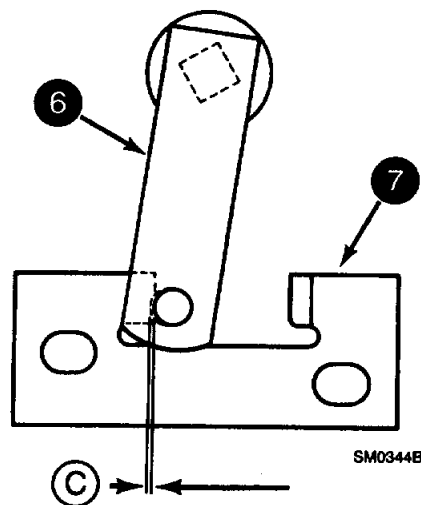
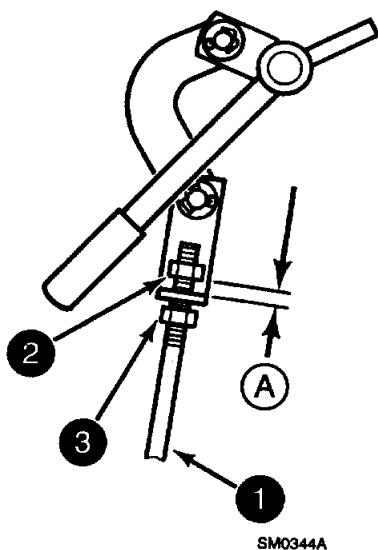
Start the tractor, engage the clutch, put the range lever in the low or high position and the hydrostatic lever in the neutral position then disengage the clutch. If the tractor moves, stop the tractor and adjust distance (B) again.



**WARNING :** Never operate the engine in a closed building. Proper ventilation is required under all circumstances.

[ 5 ]

Put the lever (6) in the maximum forward travel position and then return the lever by 0.5 to 1 mm (0.02 to 0.04 inch) distance (C). Adjust the plate (7) until there is no clearance between the pin on lever (6) and plate (7).



Distance (A) Rod Length .....	5 to 6 mm	0.2 to 0.23 inch
Distance (B) Rod Length .....	156 mm	6.15 inch
Distance (C) Lever Movement .....	0.5 to 1 mm	0.02 to 0.04 inch

## P.T.O. LEVER ADJUSTMENT (719 \* )

### [ 1 ]

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

### [ 2 ] Tractors equipped with mid P.T.O.

Put the mid P.T.O. (1) and the rear P.T.O. (2) in the engaged position.

### [ 3 ]

Remove the retaining pin (3), loosen the lock nut (4) and adjust the clevis (5) until the angle of the rear P.T.O. (2) is the same as the mid P.T.O. lever (1). Shorten the length of the rear P.T.O. rod (6) by turning the clevis (5) by ½ a turn.

### [ 4 ]

Tighten the lock nut (4). Install the retaining pin (3) with a new cotter pin.

### [ 5 ] Tractors without mid P.T.O.

Remove the retaining pin (3), loosen locknut (4) and adjust the clevis (5) until Distance (A) is 240 mm (9.44 inch). Tighten the locknut (4). Install the retaining pin (3) with a new cotter pin.

### [ 6 ]

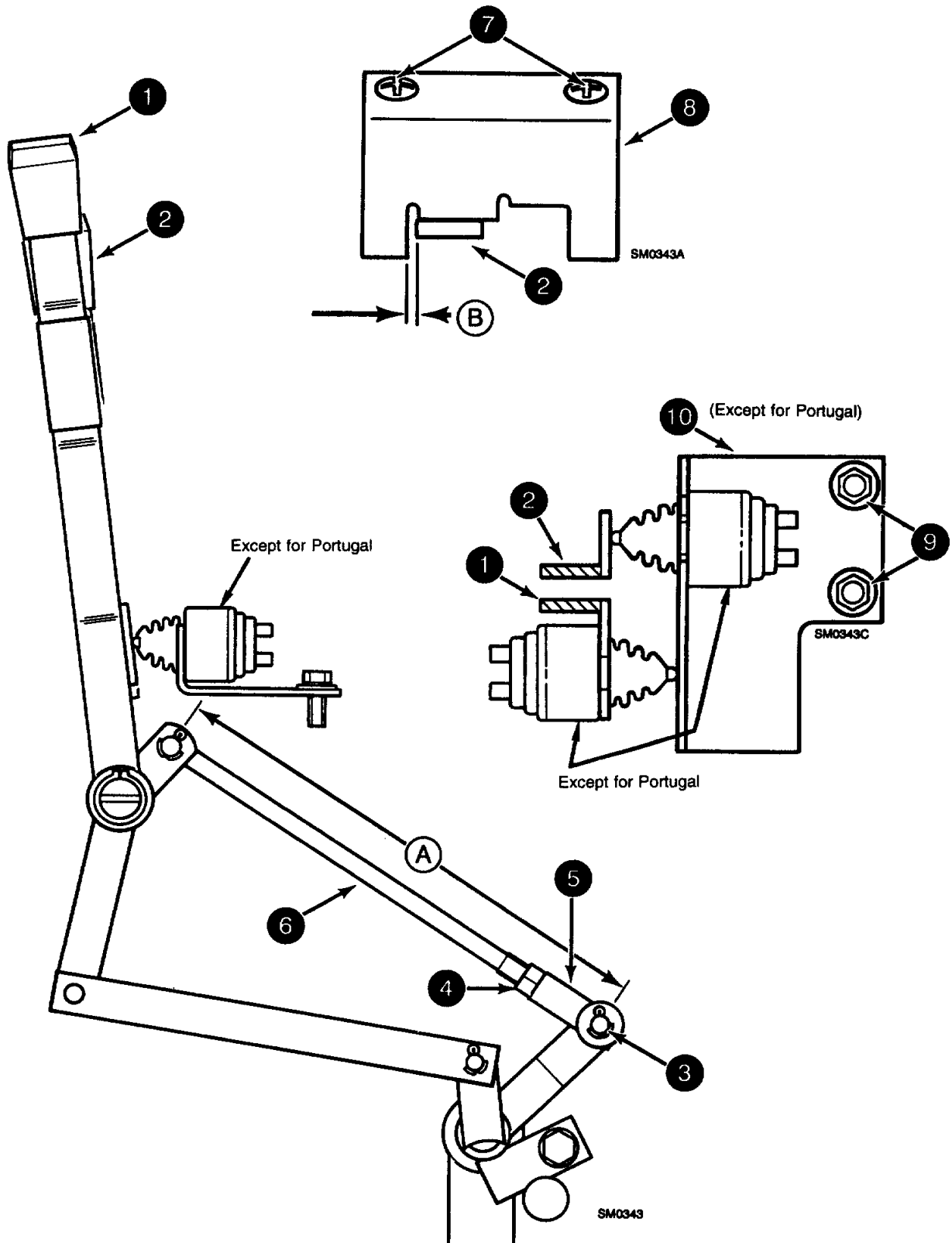
Put the rear P.T.O. (2) in the engaged position, loosen the screws (7) and adjust the plate (8) until Distance (B) is 1 to 5 mm (0.04 to 0.2 inch). Tighten the screws (7).

**NOTE:** *Make sure that the P.T.O. gears do not engage or grind each other when the P.T.O. levers are in the disengaged position.*

### [ 7 ] (If equipped the Switch and Switch Plate)

Put the P.T.O. levers (1 (if equipped) and 2) 10 to 15 mm (0.4 to 0.6 inch) into the engaged position, loosen the bolts (9) and adjust the switch plate (10) so that the end of the switches touch the switch plate and the rear P.T.O. lever. Tighten the bolts (9).





Distance (A) Rear P.T.O. Rod (Tractors Without Mid P.T.O.) ..... 240 mm  
 Distance (B) Rear P.T.O. Plate ..... 1 to 5 mm

9.44 inch  
 0.04 to 0.2 inch

## P.T.O. LEVER ADJUSTMENT (723 \* and 727 \* )

Park the machine on hard, level ground. Apply the parking brake and stop the engine. Put blocks in front of and behind the rear wheels.

### [ 1 ] Tractor equipped with mid P.T.O.

Put the mid P.T.O. (1) and rear P.T.O. (2) in the engaged position.

### [ 2 ]

Remove the retaining pin (3).

### [ 3 ]

Loosen the locknut (4) and adjust the length of rod (5) until distance (A) is 36 mm (1.41 inch). Tighten the locknut (4), install the retaining pin (3) and a new cotter pin.

### [ 1 ] Tractors without mid P.T.O.

Remove the retaining pin (3).

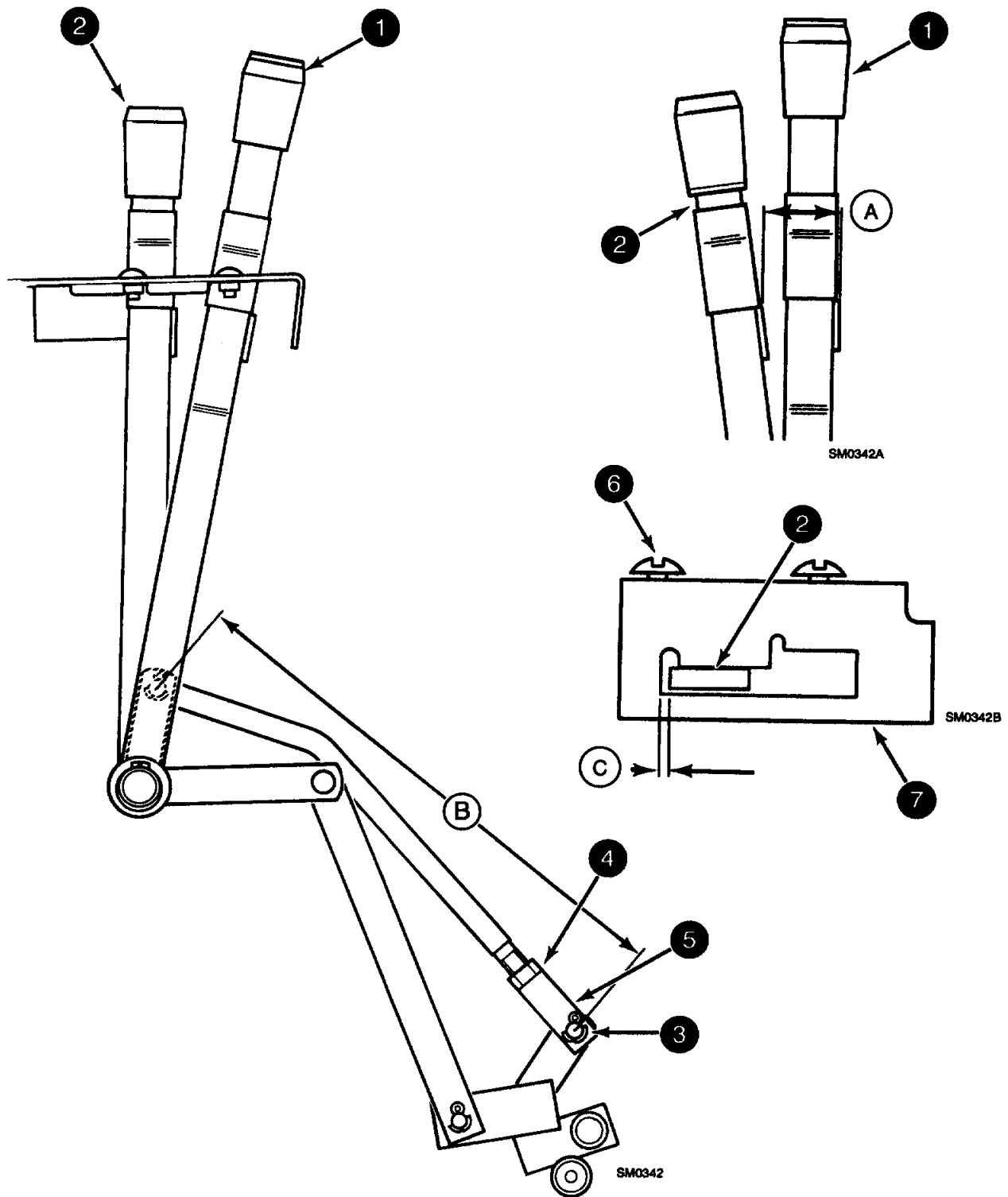
### [ 2 ]

Loosen the locknut (4) and adjust the clevis (5) until distance (B) is 279 mm (10.98 inch). Tighten the locknut (4), install the retaining pin (3) and a new cotter pin.

### [ 3 ]

Loosen the screws (6) and adjust the plate (7) until distance (C) is 1 to 5 mm (0.04 to 0.2 inch). Tighten the screws (6).

**NOTE:** *Make sure that the P.T.O. gears do not engage or grind each other when the P.T.O. levers are in the disengaged position.*



Distance (A) Rear P.T.O. Lever .....	36 mm	1.41 inch
Distance (B) Rear P.T.O. Rod .....	279 mm	10.98 inch
Distance (C) Rear P.T.O. Plate .....	1 to 5 mm	0.04 to 0.2 inch

## SECTION 9

### SCHEMATICS

### SPECIFICATIONS

#### TRANSMISSION HYDRAULIC SYSTEM CAPACITY

719 * with Gear Type Transmission.....	19 Litres (20.1 US Quarts)
719 * with Hydrostatic Transmission.....	15 Litres (15.9 US Quarts)
723 * - 727 * with Gear Type Transmisison.....	24 Litres (25.4 US Quarts)
723 * - 727 * with Hydrostatic Transmisison.....	22 Litres (23.2 US Quarts)

Transmission Hydraulic System Fluid..... HYTRAN® PLUS

#### Main Hydraulic Pump Flow

719 * .....	20.4 L/min at 2500 RPM (5.4 GPM)
723 * - 727 * .....	27.6 L/min at 2500 RPM (7.3 GPM)

Steering Pump Flow..... 12.4 L/min at 2500 RPM (3.3 GPM)

Main Relief Valve Pressure Setting..... 147.1 bar (14 710 kPa)(2133 PSI)

Power Steering Relief Valve Setting.....123 to 137 bar (12300 to 13700 kPa)(1784 to 1987 PSI)

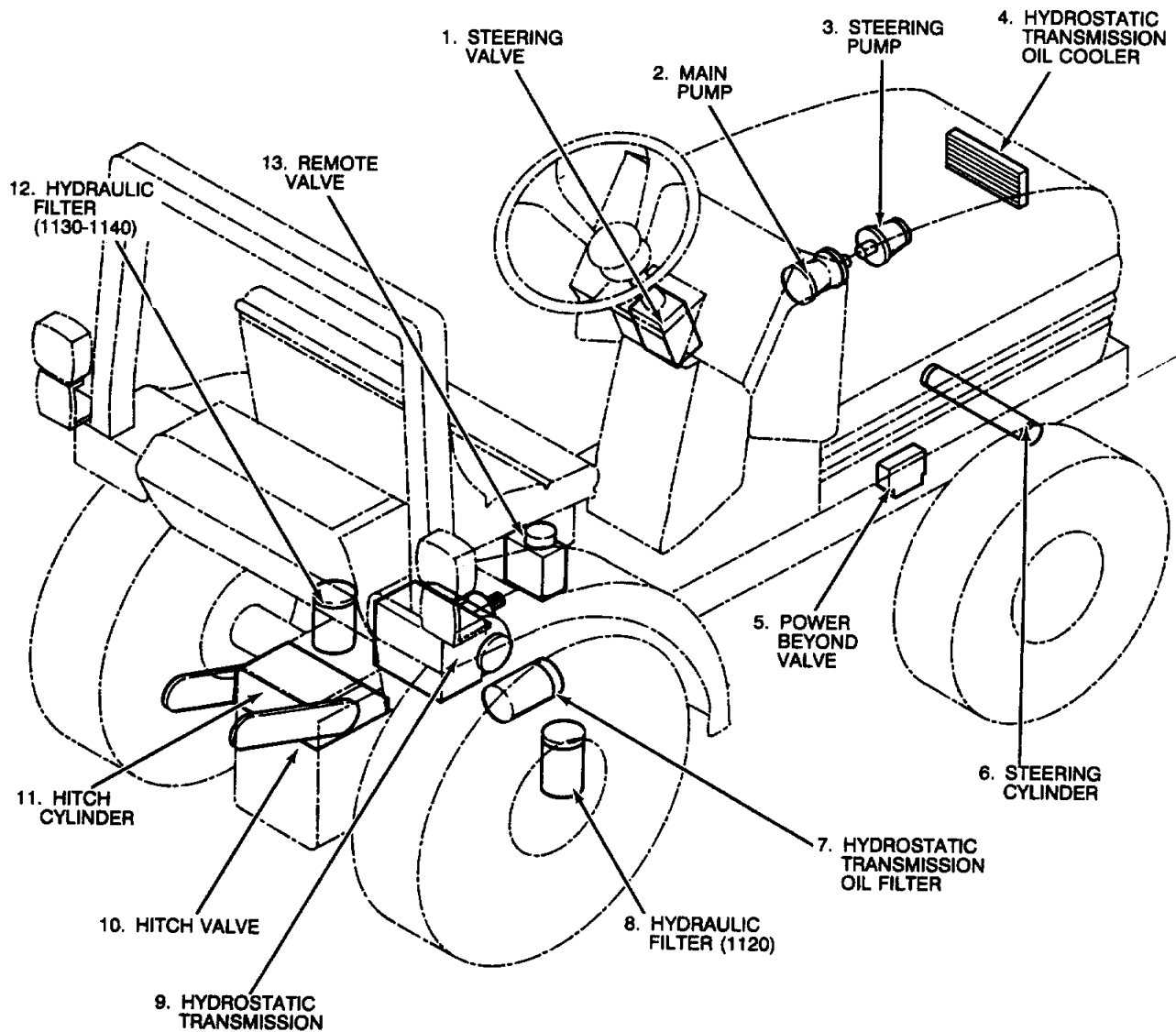
#### 719 \* Hydrostatic Transmission Relief Valve Settings

Charge Relief.....	4.1 to 5.9 bar (414 to 586 kPa)(60 to 85 PSI)
High Pressure Relief (Forward and Reverse).....	241 to 261 bar (24 132 to 26 104 kPa)(3500 to 3786 PSI)
High Pressure Relief (Start to Open Pressure).....	211 bar (21 063 kPa)(3 055 PSI)

#### 723 \* - 727 \* Hydrostatic Transmission Relief Valve Settings

Charge Relief.....	4.1 to 5.9 bar (414 to 586 kPa)(60 to 85 PSI)
High Pressure Relief (Forward and Reverse) .....	271 to 291 bar (27 090 to 29 055 kPa)(3929 to 4214 PSI)
High Pressure Relief (Start to Open Pressure).....	260 bar (25 959 kPa)(3765 PSI)

## HYDRAULIC COMPONENT LOCATIONS



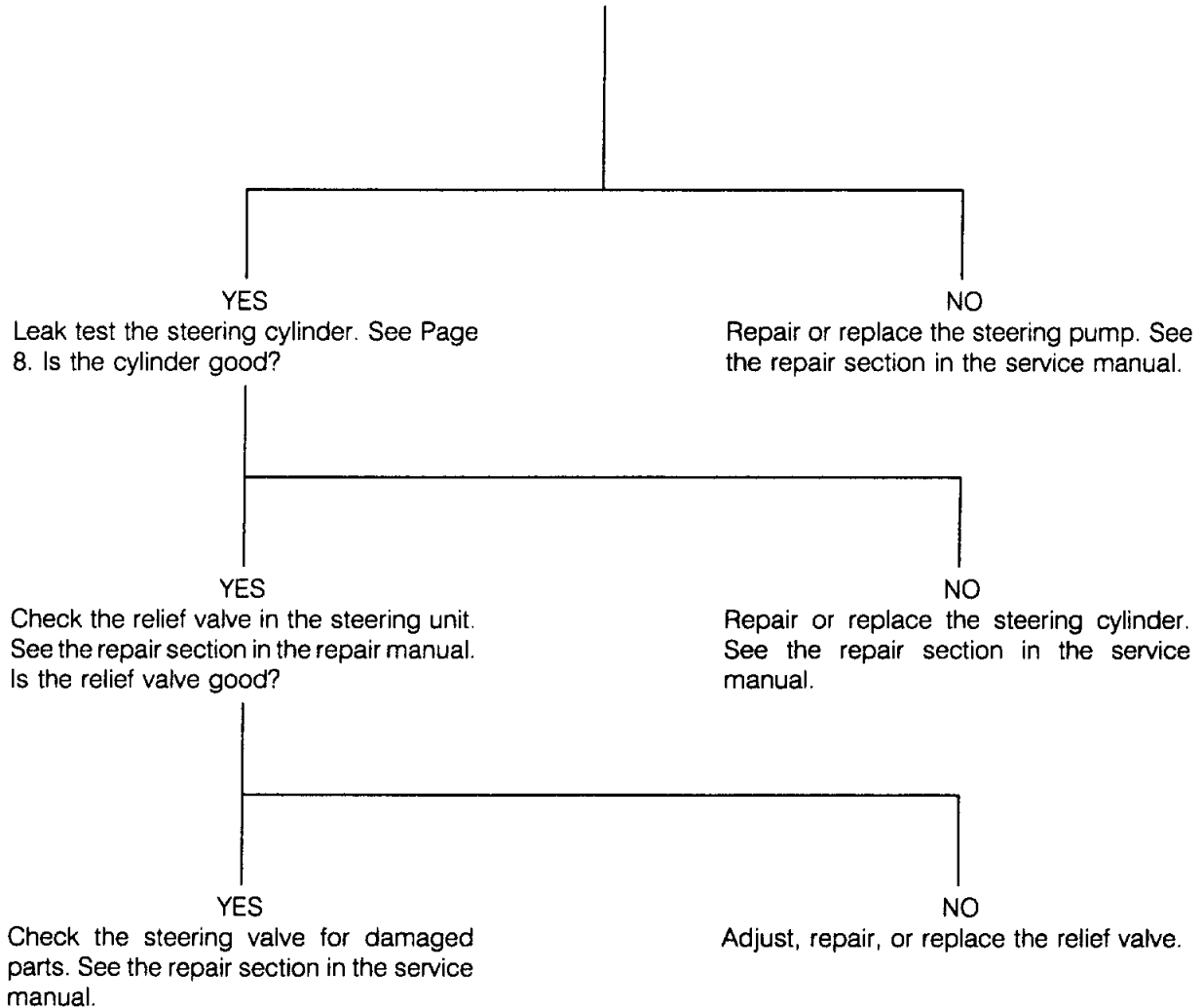
## TROUBLESHOOTING THE POWER STEERING

Before continuing, check the following:

1. Hydraulic oil level.
2. Hydraulic filter (must be new or clean).

Flow and pressure test the steering pump.

See Page 239. Does the pump meet specifications?

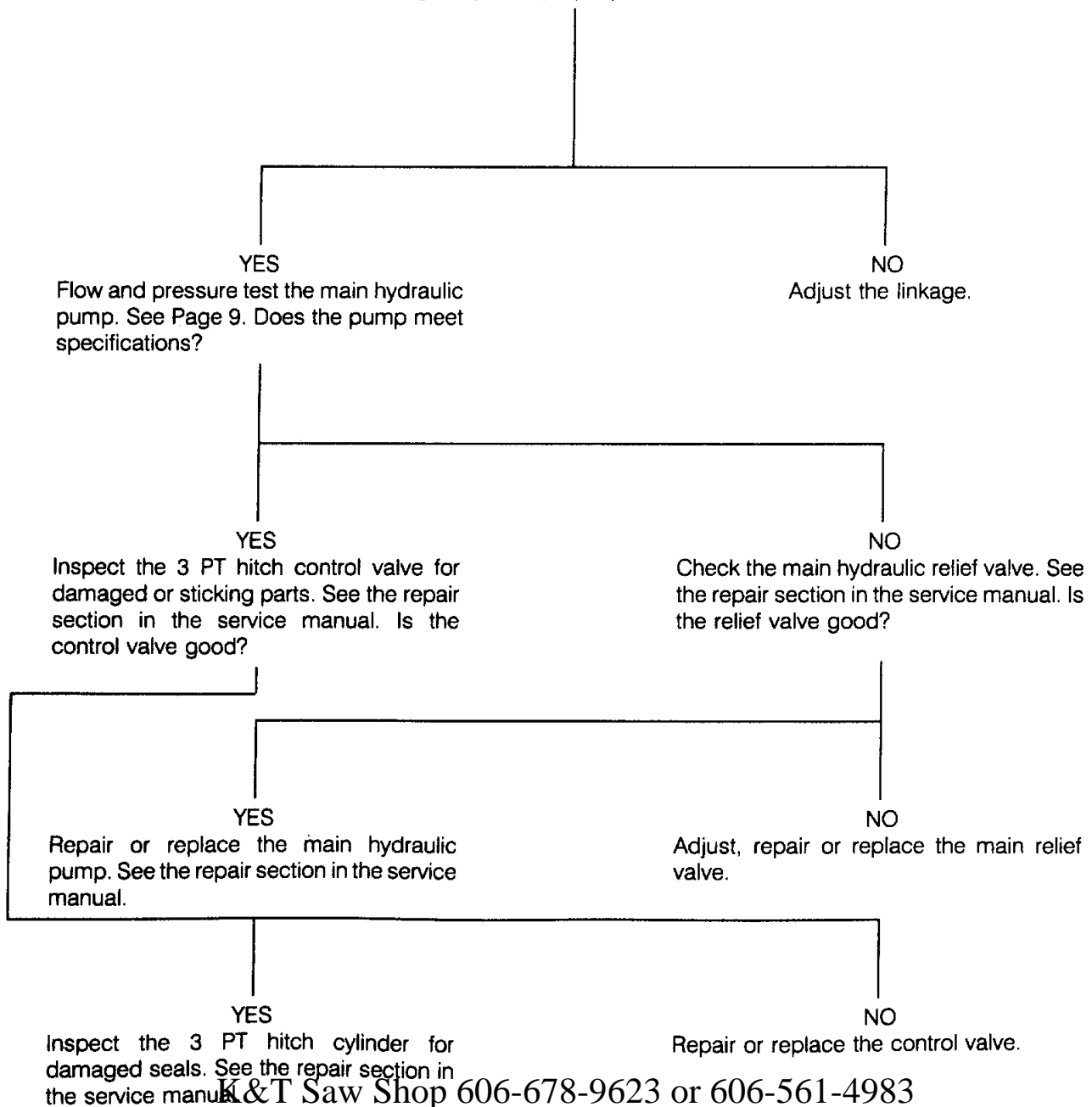


## TROUBLESHOOTING THE 3 PT HITCH

Before continuing, check the following:

1. Hydraulic oil level.
2. Hydraulic filter (must be new or clean).
3. Remote control valve must be centered (if equipped).
4. Rate of lowering valve must be open.
5. Lever on power beyond valve must be in the 0 position.

Check the linkage between the 3 PT hitch control lever and the 3 PT hitch control valve. See the pedal and lever adjustment section in the service manual. Is the linkage adjusted properly?

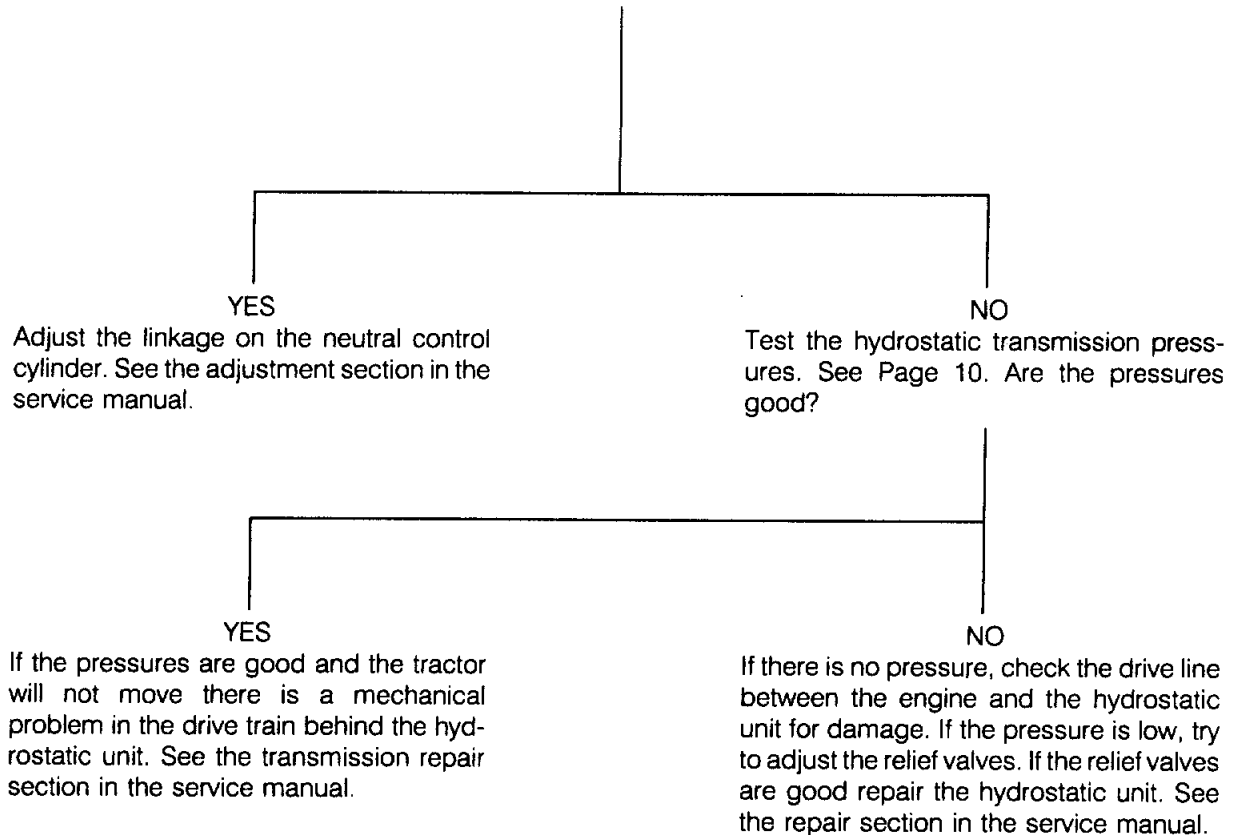


## TROUBLESHOOTING THE HYDROSTATIC TRANSMISSION

Before continuing, check the following:

1. Hydraulic oil level
2. Hydraulic filter (must be new or clean).
3. Hydrostatic filter (must be new or clean).
4. Oil cooler must be clean

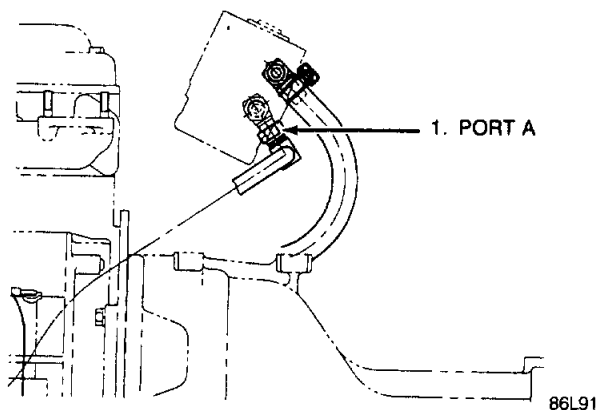
Does the tractor creep when the hydrostatic control is in neutral.





## STEERING PUMP PRESSURE AND FLOW TEST

### STEERING HAND PUMP



1. Disconnect the hose from the steering pump to the steering hand pump at Port A.
2. Connect the disconnected hose to the inlet of the flowmeter and connect the outlet of the flowmeter to Port A. Use the special fitting adapters in the CAS 2166 fitting kit.

**NOTE:** *The flowmeter load valve must be fully open because there is no relief valve in the circuit.*

3. Start and run the engine at 2500 RPM. Read the flow on the flowmeter. The flow must be 12.1 L/min. (2.7 GPM). Record the flow.

**NOTE:** *The hydraulic oil must be heated to 55°C (130°F) before testing.*

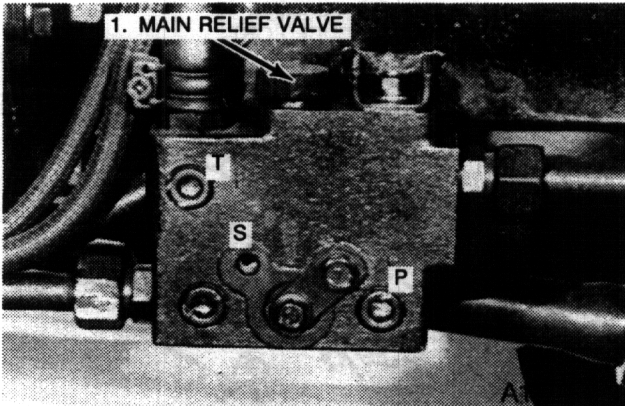
4. Slowly close the load valve on the flowmeter until 137 bar (13 700 kPa)(1987 PSI) is read on the flowmeter pressure gauge. The flow must be within 10% of the recorded flow reading.
5. Turn the load valve on the flowmeter fully open. Turn and hold the steering wheel against the steering stop to test the steering relief valve pressure. The pressure must be 123 to 137 bar (12 300 to 13 700 kPa)(1784 to 1987 PSI).

## STEERING CYLINDER LEAKAGE TEST

1. With the engine running, turn the steering wheel until the cylinder rod extends fully. Stop the engine.
2. Remove the hose that connects to the rod end port on the cylinder, and cap the hose. Put a container under the open port on the cylinder.
3. Start the engine and hold the steering wheel in the direction indicated in Step 1. Watch the open port on the cylinder. If hydraulic oil continues to flow from the port the cylinder is bad.

## MAIN HYDRAULIC PUMP FLOW AND PRESSURE TEST

### POWER BEYOND VALVE TEST PORTS



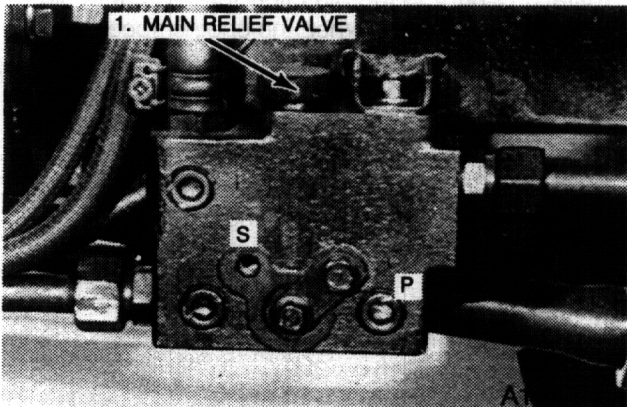
1. Move the power beyond valve lever to the S position.
2. Connect the inlet hose on the flowmeter to the P port on the power beyond valve.
3. Connect the outlet hose on the flowmeter to the T port on the power beyond valve.
4. With the load valve on the flowmeter fully open, start and run the engine at 2500 RPM.

**NOTE:** The hydraulic oil must be heated to 55°C (130°F) before testing.

5. Watch and record the flow reading with the load valve open. The flow reading must be 20.4 L/min (5.4 GPM) for the 719 \* model and 27.6 L/min (7.3 GPM) for the 723 \* and 727 \* models.
6. Slowly close the load valve until a pressure reading of 137.9 bar (13 790 kPa)(2000 PSI) occurs. The flow must be within 10% of the recorded reading.
7. If the flow decreases more than 10% of the recorded reading or the pressure will not increase to 137.9 bar (2000 PSI) the problem is in the main relief valve or the main hydraulic pump.
8. Turn the load valve on the flowmeter fully closed to read the main relief pressure. The main relief pressure must be 147.1 bar (14 707 kPa)(2133 PSI)
9. Put the power beyond valve lever in the 0 position.

## MAIN RELIEF PRESSURE TEST

### POWER BEYOND VALVE TEST PORTS



1. Move the power beyond valve lever to the S position.
2. Connect a 206.8 bar (20 684 kPa)(3000 PSI) gauge to test port P.

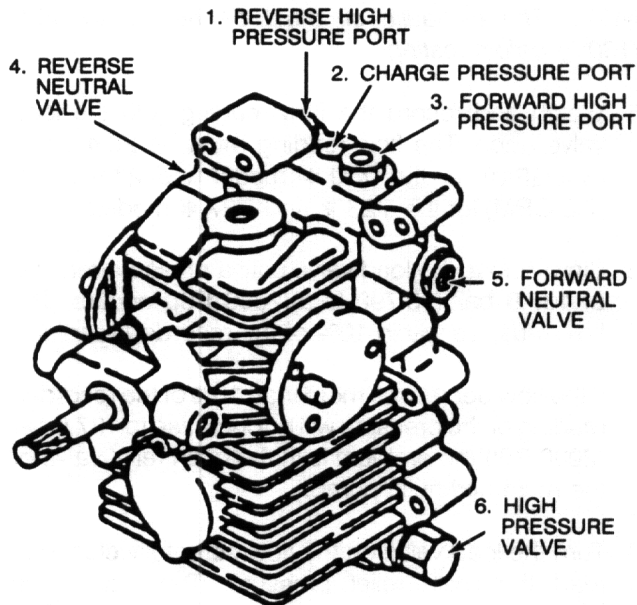
3. Start and run the engine at 1500 RPM. The gauge must read 147.1 bar (14 707 kPa)(2133 PSI).

**NOTE:** The hydraulic oil must be heated to 55°C (130°F) before testing.

4. A low pressure reading indicates a main relief valve that is bad or needs adjusting, or a bad main pump.
5. Put the power beyond valve lever in the 0 position.

## HYDROSTATIC TRANSMISSION PRESSURE TESTS

### 719 \* TEST PORTS



85L91A

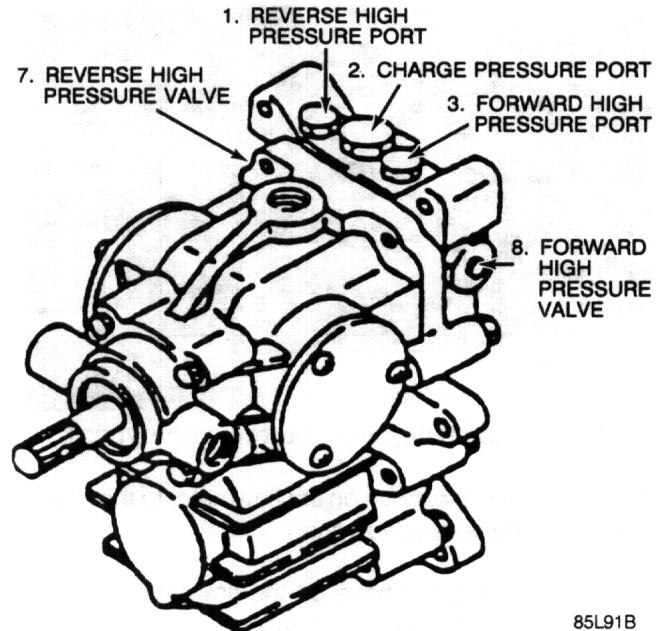
1. Clean the area around the test ports. Remove the test port plugs and install 344.7 bar (34 473 kPa)(5000 PSI) gauges in the forward and reverse high pressure test ports and a 6.9 bar (689 kPa)(100 PSI) gauge in the charge pressure test port. Use the special fittings in the CAS 2166 fitting kit.

2. Apply the parking brake so the tractor cannot move.

**NOTE:** The operator must sit in the operators seat during testing with no other people around the tractor.

3. Operate the tractor engine and hydrostatic transmission until normal operating temperatures are reached.

### 723 \* - 727 \* TEST PORTS

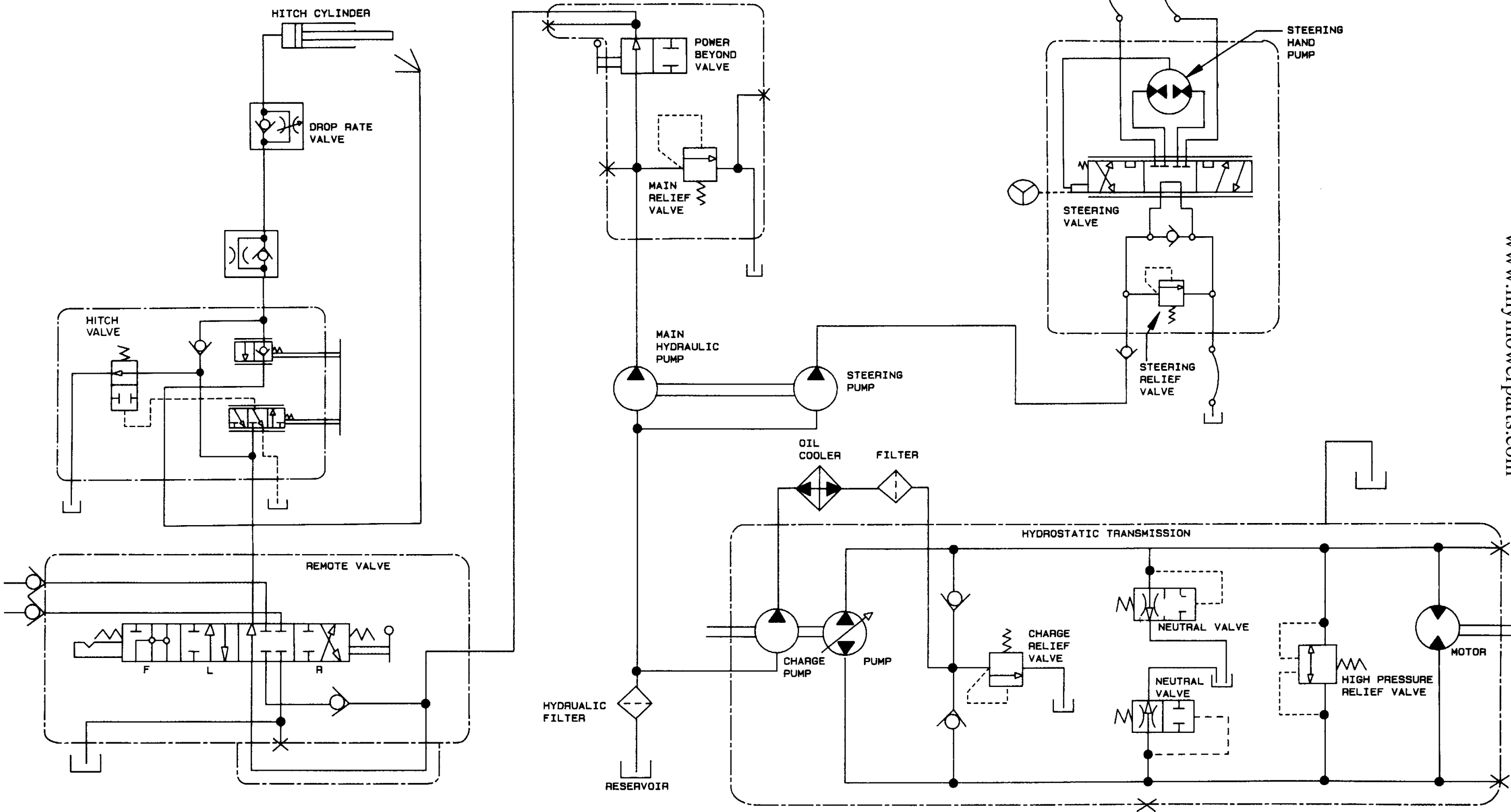


85L91B

4. Sit on the operators seat and put the transmission range lever and the hydrostatic control in neutral, start and run the engine at high idle. The charge pressure must read 4.1 to 5.9 bar (414 to 586 kPa)(60 to 85 PSI).

5. While seated, run the engine at 1500 RPM. Shift the transmission into high range. Slowly move the hydrostatic control in the direction for the test desired (forward or reverse). When the engine speed drops to 1000 RPM read the high pressure gauge. The gauge must read 241 to 261 bar (24 132 to 26 104 kPa) (3500 to 3786 PSI) for the 719 \* model and 271 to 291 bar (27 090 to 29 055 kPa) (3929 to 4214 PSI) for the 723 \* and 727 \* models. Return the hydrostatic control lever to the neutral position.

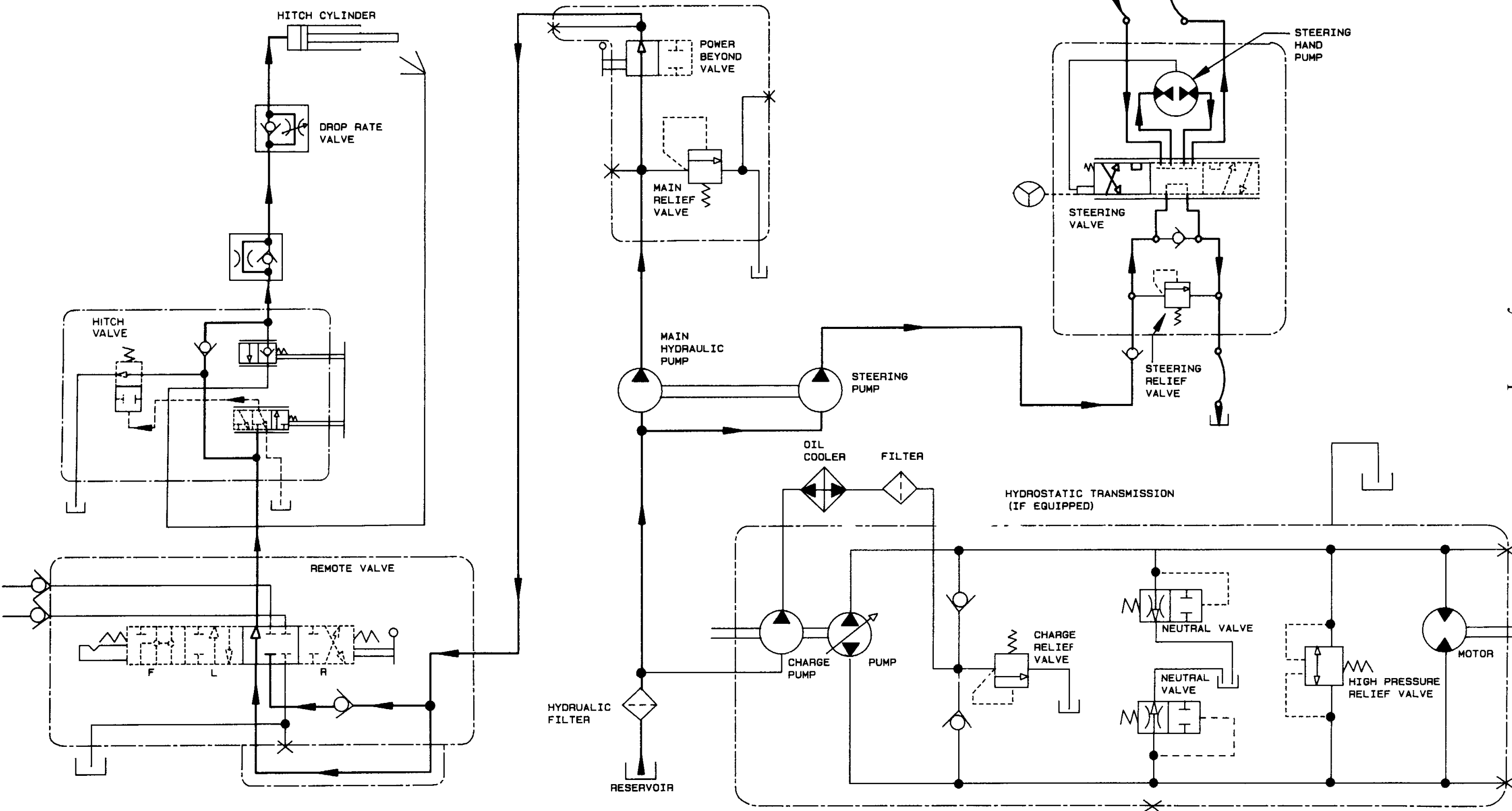
719 \* HYDRAULIC SCHEMATIC  
WITH HYDROSTATIC TRANSMISSION  
AND REMOTE VALVE  
ENGINE STOPPED, NO CONTROLS OPERATED



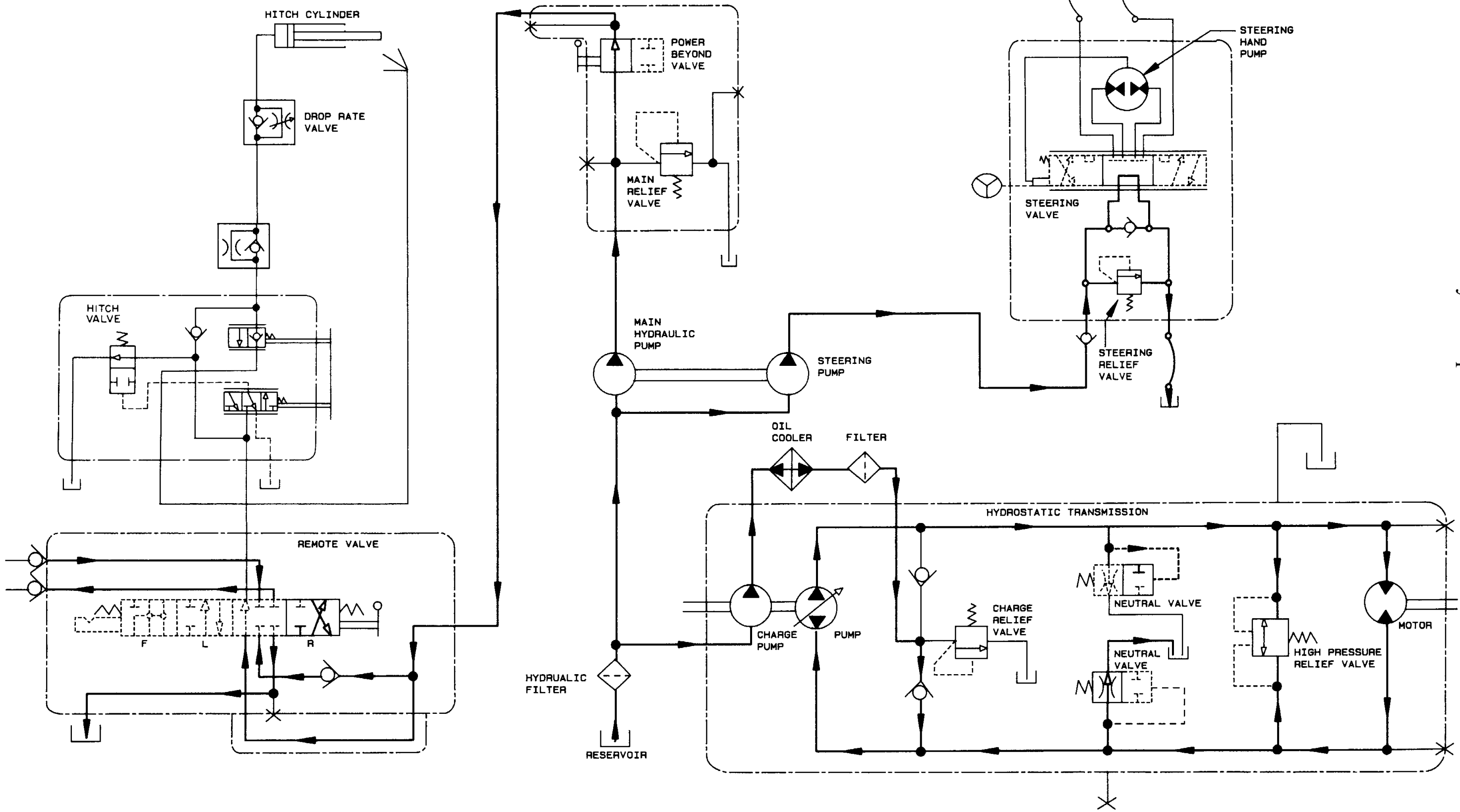
K&T Saw Shop 606-678-9623 or 606-561-4983

www.mymowerparts.com

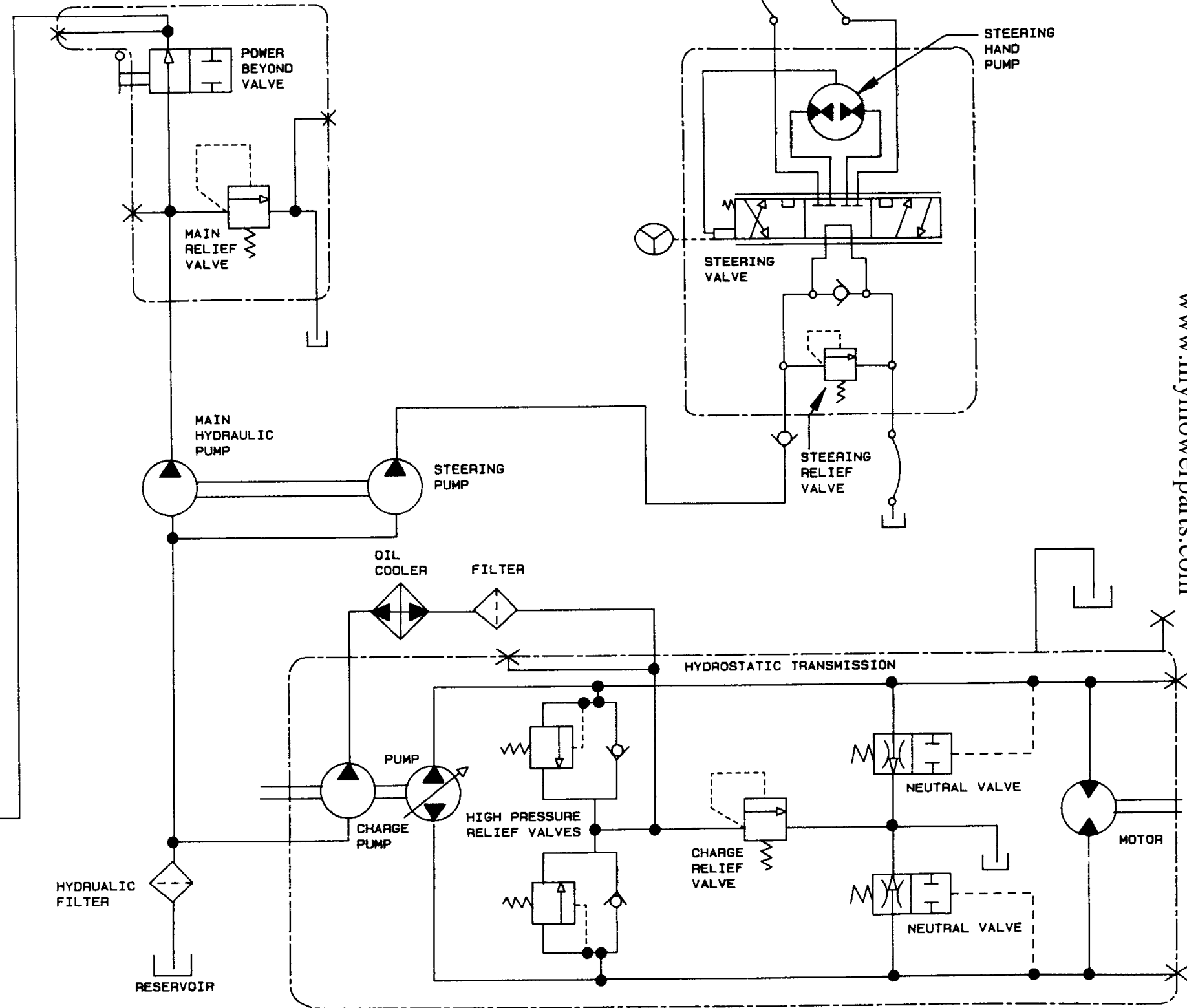
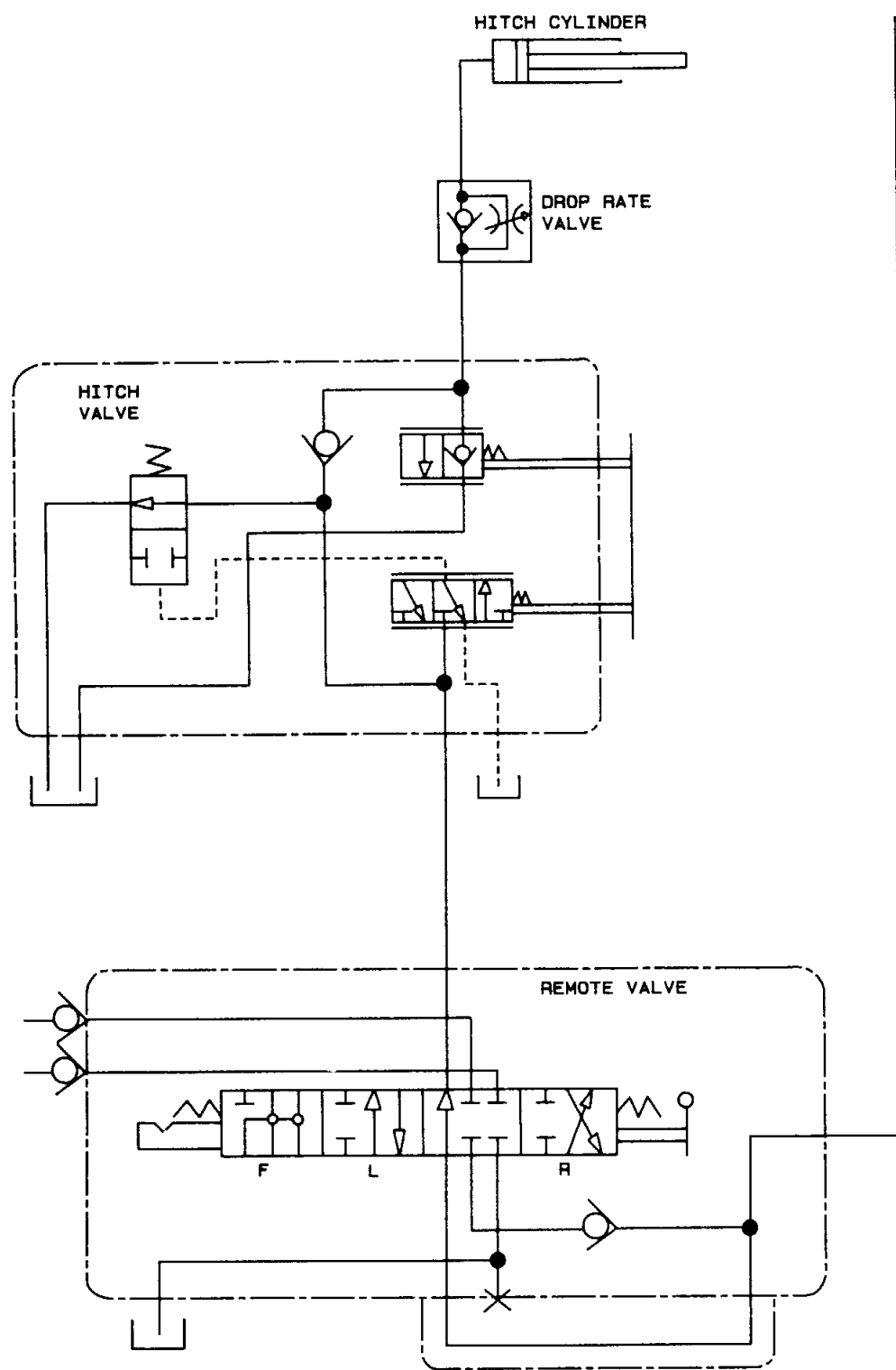
719 \* HYDRAULIC SCHEMATIC  
ENGINE RUNNING, STEERING TURNING,  
HITCH RAISING



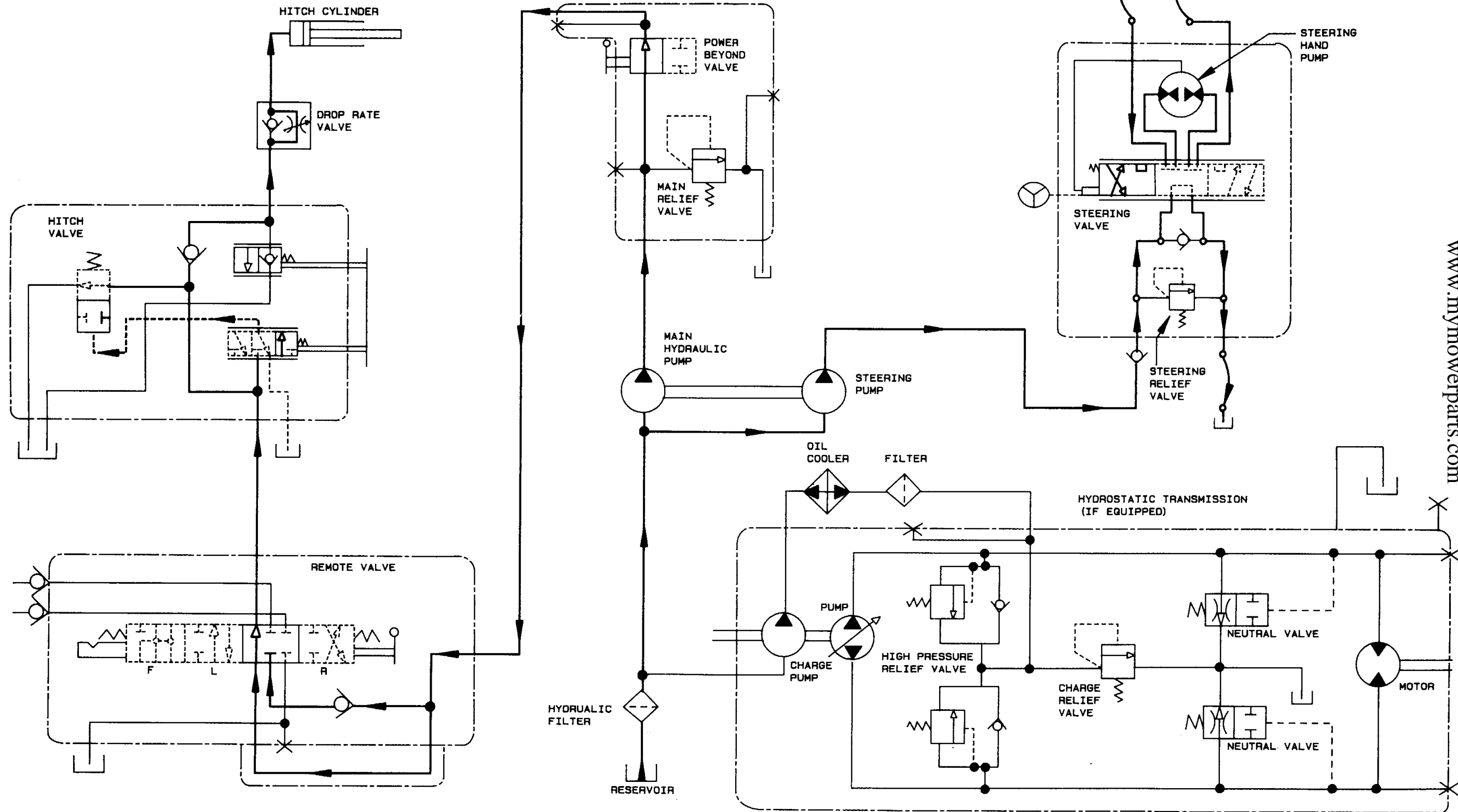
719 \* HYDRAULIC SCHEMATIC  
WITH HYDROSTATIC TRANSMISSION  
AND REMOTE VALVE  
ENGINE RUNNING, TRACTOR MOVING, REMOTE RAISING



723 \*- 727 \* HYDRAULIC SCHEMATIC  
WITH HYDROSTATIC TRANSMISSION  
AND REMOTE VALVE  
ENGINE STOPPED,NO CONTROLS OPERATED



723 \* - 727 \* HYDRAULIC SCHEMATIC  
ENGINE RUNNING,STEERING TURNING,  
HITCH RAISING





723 \* - 727 \* HYDRAULIC SCHEMATIC  
WITH HYDROSTATIC TRANSMISSION  
AND REMOTE VALVE  
ENGINE RUNNING,TRACTOR MOVING,REMOTE LOWERING

