SERVICE MANUAL

for

CATERPILLAR®

D6 TRACTOR

SERIAL NUMBERS 37A1-UP AND 44A1-UP

Caterpillar Tractor Co., General Offices, Peoria, Illinois. • Caterpillar Americas Co., Peoria, Illinois. • Caterpillar Overseas S.A., Geneva. • Caterpillar of Australia Pty. Ltd., Melbourne. • Caterpillar Brasil S.A., São Paulo. • Caterpillar Tractor Co. Ltd., Glasgow. • Caterpillar of Canada Ltd., Toronto. • Caterpillar France S.A., Grenoble. • Caterpillar (Africa) (Pty.) Ltd., Johannesburg. • Caterpillar Mexicana S.A. de C.V., Monterrey.

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General Instructions

These general instructions will be extremely helpful in following the detailed instructions in the manual. They should be read and kept in mind while assembling or disassembling the machine.

SYMBOLS

Throughout this Service Manual, symbols are used on the illustrations to point out parts which are to be removed or disconnected. These removals or disconnections are indicated by the following code:

☐ **Remove** ◗ **Disconnect**

The part to be removed or disconnected is pointed out by a number in the symbol and this number corresponds to the part description listed in the caption copy beneath the picture. The disconnect arrow points as close as possible to point of disconnection.

SAFETY AND WORKMANSHIP SUGGESTIONS

There are certain practices which should be followed in the interest of safety and good workmanship when working around machinery.

Always show proper respect for weight. Do not attempt to lift heavy parts when a hoist should be used. Never leave heavy parts in an unstable position. When raising a portion of a machine, be sure the machine is blocked securely at front and rear. The weight should be supported by blocks rather than lifting equipment.

When using a hoist, follow the recommendations outlined in the manual. Fabricate and use the illustrated lifting devices in conjunction with the hoist to achieve the proper balance of the assemblies being lifted and to assure safe handling. (See special topic, GENERAL INSTRUCTIONS, DIESEL ENGINE REMOVAL).

Tools

All service tools should be kept in first-class condition. Use the proper tool for the job at hand. Special service tools are available for specific jobs and should be used when recommended. The use of these tools will save time and prevent damage to parts.

In the manual, puller arrangements are illustrated for separating tightly fitted parts. However, if the machine is being reconditioned in a shop, it might be easier and faster to use a press. When pulling a bearing or gear from a shaft, always use a centering spacer between the forcing screw and end of shaft.

Disassembly

If a part offers unexpected resistance to removal, check carefully to see that all nuts and bolts have been removed before using force. Possibly some other part is interfering and should be removed first. Parts which are fitted together with tapered splines are always very tight. If they are not tight when disassembled, inspect the tapered splines and discard the part if the splines are worn.

Identical parts should be kept in order or marked so they can be reinstalled in the same position from which they were removed.

When shims are used, be sure to remove all of them. Tie the shims together and identify them as to their location. Keep them clean and flat until they are reinstalled.

INSPECT FREQUENTLY AND CORRECT MINOR TROUBLES

A bearing changed in time will save a shaft. An oil leak, corrected, prevents loss of lubricant and an overheated bearing. A nut tightened in time will prevent the loss or breakage of an associated part.

MAINTAIN ADJUSTMENTS

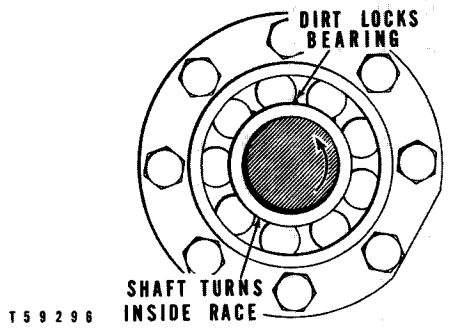
Operating adjustments have been kept to a minimum on Caterpillar-built machines but they are important and should be carefully maintained.

Follow the recommendations in the Operation and Maintenance Instructions.

KEEP DIRT OUT

The most important single item in preserving the long life of the machine is to keep dirt out of vital working parts. Caterpillar Tractor Co. has taken precautions to safeguard against dirt entering working parts. Enclosed compartments, seals and filters have been provided to keep the supply of air, and lubricants clean. It is important that the effectiveness of these safeguards be maintained. Filters should be replaced or cleaned regularly. Worn seals or broken gaskets should be replaced immediately. Be sure seal lips are facing in the correct direction.

Anti-friction bearings, properly lubricated with clean lubricant, will last indefinitely. Abrasives in the lubricant will cause rapid wear on the extremely hard races and balls or rollers. Dirt in an anti-friction bearing can cause the bearing to lock resulting in the shaft turning in the inner race or the outer race turning within the cage. Dirt and abrasives in lubricants will embed in sleeve bearings and act like fine sandpaper against the shaft causing extremely rapid wear.



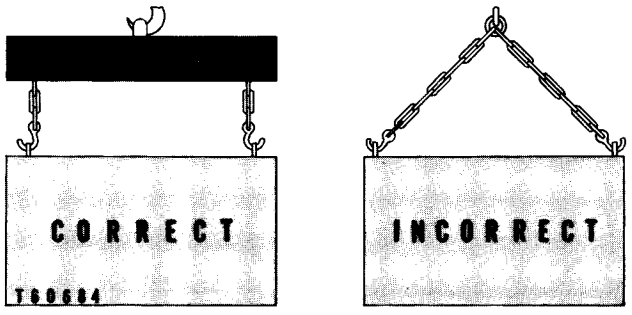
EFFECT OF DIRT IN BEARING

Lubricant must be changed at recommended intervals. Use clean containers. Before removing the filler cap, brush away the dirt.

Whenever hydraulic, fuel, lubricating oil, air or brake lines are to be disconnected, clean the point of disconnection as well as the adjacent area. As soon as a disconnection is made, cap, plug or tape the line or opening to prevent entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.

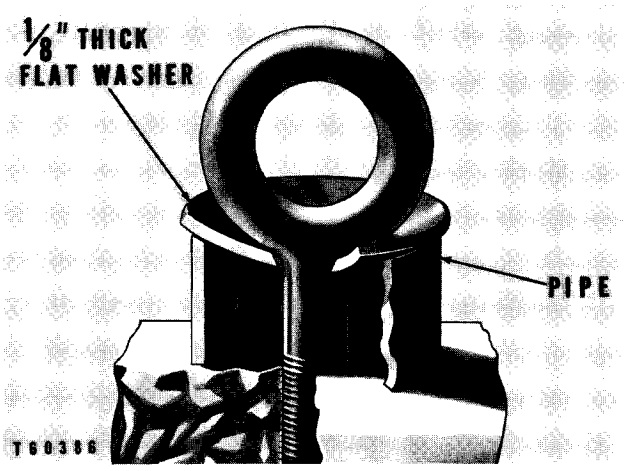
DIESEL ENGINE REMOVAL

Unless otherwise specified, all engine removals should be accomplished using an adjustable lifting beam. For maximum efficiency of the lifting apparatus, all supporting members (chains and cables) should be parallel to each other and as near perpendicular as possible to the top of the cylinder head. See the illustration.



LIFTING ENGINE

In cases where it is necessary to remove the engine on an angle, it must be remembered that the lifting capacity of the lifting eyes on the engine diminishes as the angle between the supporting members and cylinder head becomes less than 90°. Lifting eyes and brackets should never be bent and should only have stress in tension. A length of pipe and a washer can be utilized, as shown, to help relieve these stresses on lifting eyes.



LIFTING EYE

CLEANING AND INSPECTION

Clean all parts thoroughly after they are removed and inspect them. Be sure all lubricant passages and oil holes are open. Badly worn or damaged parts should not be reinstalled on the machine. Cover all parts to keep them clean until they are installed and leave the new parts in the container.

Anti-friction bearings should receive special handling. As soon as a bearing is removed, cover it to keep dirt and abrasives out. Wash bearings in non-flammable cleaning solution and allow bearings to drain dry. Do not blow dry with air pressure or spin the bearings. Inspect the races and balls or rollers. Discard the bearings if they are pitted, scored or burned. If the bearing is serviceable, coat it with light oil and wrap it in clean paper. Do not unwrap new bearings until time of installation.

Replace all damaged O-rings and gaskets. In some assemblies and systems, it is recommended that O-rings be replaced when components are being reassembled.

Inspect parts carefully. Refer to the topic, SPECIFICATIONS, as a guide for parts replacement.

SPECIFICATIONS

The manual SPECIFICATIONS sections contain dimensions for new parts and a suggested guide for amount of wear that might normally be considered a reasonable figure to use in determining when to replace parts. These wear dimensions are shown after the description, "permissible clearance". The specifications are provided to help determine when new parts should be installed. This information should not be regarded as the only factor in determining when to replace parts. Past performance should be the governing factor for part replacement. Even

though parts are worn they may still be satisfactory. The remaining service life of these parts must be considered when deciding if parts should be replaced. If a machine is disassembled for reconditioning, it is well to replace parts not completely worn out if the remaining service life is deemed short.

ASSEMBLY

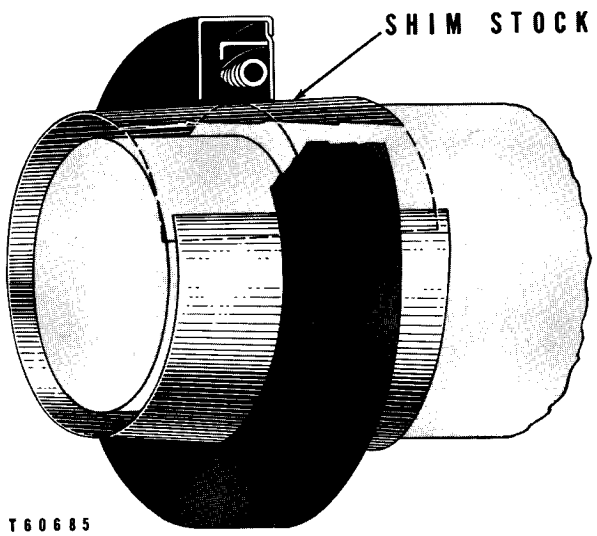
Clean the rust preventive compound from all machined surfaces of new parts before installing them. Be sure to install parts in the proper location and position.

Bearings which have a shrink fit should be heated in oil not to exceed 250° Fahrenheit, before attempting to install them. Other parts which require a shrink fit can be heated to a higher temperature in an electric oven or by other suitable means, but not to exceed a temperature which would remove hardness.

Parts which are heated to facilitate assembly must sometimes be allowed to cool and then pressed together again. Often the parts will separate as they cool and shrink.

When one part is pressed into another, use white lead or a suitable prepared compound to lubricate the mating surfaces. Tapered parts, however, should be assembled dry. Before assembling parts with tapered splines be sure the splines are clean, dry and free from burrs. Then press the parts together tightly.

When installing new bearings or reinstalling used bearings, lubricate the bearings liberally. Bearings that are to be preloaded must have a liberal film of oil over the entire assembly before the preloading procedure is carried out.



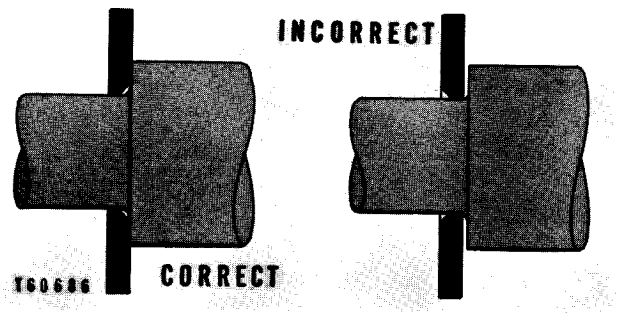
PROTECTING SEAL DURING INSTALLATION

Lubricant should be applied to the lip of all lip-type rubber seals before installation. This will prevent damage to the seal during the initial running until the oil being sealed has contacted the sealing face. Apply lubricant to an O-ring seal before installation to prevent rolling and twisting of the seal.

Silicone seals are subject to swelling when cleansed or immersed in kerosene or diesel fuel.

Packing-type seals should always be renewed if the contacting part is removed.

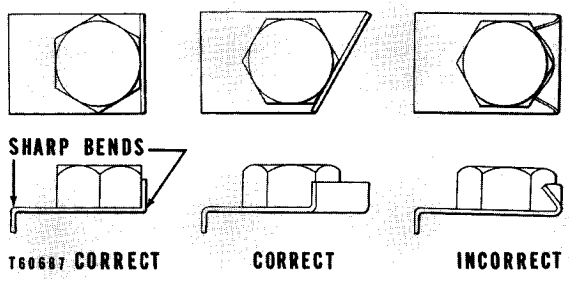
When installing a bearing, spacer or washer against a shoulder on a shaft, be sure the chamfered side is toward the shoulder. If the washer is turned in the wrong direction the radius may interfere and prevent washer from seating against the shoulder.



HOW TO INSTALL SPACER AGAINST SHOULDER ON SHAFT

Do not install sleeve bearings by driving them in with a hammer. Use a press if possible and be sure to apply the pressure directly in line with the bore. If a bearing must be driven in, use a bearing driver or a bar with a smooth flat end. If the sleeve bearing has an oil hole, be sure it is aligned with the oil hole in the part into which it is assembled.

Install gaskets where required and use new ones if necessary. Never use cork or felt gaskets or seals a second time. Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If it is necessary to make gaskets, select stock of the proper type and thickness and be sure to cut sufficient holes in the right places. Blank gaskets can cause serious damage.

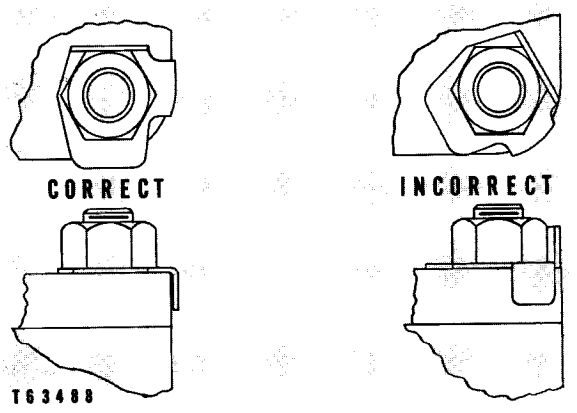


HOW TO INSTALL FLAT METAL LOCKS

Use bolts of the correct length. A bolt which is too long may "bottom" before the head is tight against the part it is to hold, and in addition the threads may be damaged when the bolt is removed.

If a bolt is too short, there may not be enough threads to hold the part securely.

Lockwashers, cotter pins or flat metal locks should be used to lock each nut and bolt. Flat metal locks must be installed properly to be effective. Bend one end of the lock sharply around the edge of the part. Bend the other end sharply against one flat surface of the nut or bolt head. Do not bend the lock against more than one side of the nut.



METHOD FOR LOCK POSITIONING AND BENDING

When assembling a machine, complete each step in turn. Do not leave one part partially assembled and start assembling some other part. Make all adjustments as recommended. Always check the job after it is completed to see that nothing has been overlooked.

PREPARATION FOR STARTING

After assembling a machine, lubricate it thoroughly. Fill the various compartments with the type and grade of lubricant recommended in the Operation and Maintenance Instructions.

Recheck the various adjustments by operating the machine before returning it to the job.

TORQUE VALUES

Unless reference is made in the copy to the topic, SPECIFICATIONS, the standard torque values listed in the chart should be used for standard heat-treated bolts and studs and steel nuts when assembling Caterpillar Equipment.

GENERAL USAGE

(Tightening Torques)

SIZE (NC and NF)	TORQUE (Pound Feet)	SIZE (NC and NF)	TORQUE (Pound Feet)
1/4"	6-12	3/4"	230-300
5/16"	13-23	7/8"	360-480
3/8"	27-37	1"	560-720
7/16"	40-60	1 1/8"	700-900
1/2"	65-85	1 1/4"	880-1120
9/16"	95-125	1 3/8"	1050-1350
5/8"	130-170	1 1/2"	1300-1700

HYDRAULIC VALVE BODIES

(Tightening Torques)

SIZE (NC and NF)	TORQUE (Pound Feet)
5/16"	13-17
3/8"	24-30
7/16"	39-47
1/2"	60-70
5/8"	118-142

DECIMAL EQUIVALENTS

The decimal dimensioning system provides a more accurate means of specifying dimensions and tolerances .The following table includes the standard conversions from fractions to decimals. Decimals are shown in the standard two, three and four place designation.

1/64	.02	.016	.0156	33/64	.52	.516	.5156
1/32	.03	.031	.0312	17/32	.53	.531	.5312
3/64	.05	.047	.0469	35/64	.55	.547	.5469
1/16	.06	.062	.0625	9/16	.56	.562	.5625
5/64	.08	.078	.0781	37/64	.58	.578	.5781
3/32	.09	.094	.0938	19/32	.59	.594	.5938
	.10				.60		
7/64	.11	.109	.1094	39/64	.61	.609	.6094
1/8	.12	.125	.1250	5/8	.62	.625	.6250
9/64	.14	.141	.1406	41/64	.64	.641	.6406
5/32	.16	.156	.1562	21/32	.66	.656	.6562
11/64	.17	.172	.1719	43/64	.67	.672	.6719
3/16	.19	.188	.1875	11/16	.69	.688	.6875
13/64	.20	.203	.2031	45/64	.70	.703	.7031
7/32	.22	.219	.2188	23/32	.72	.719	.7188
15/64	.23	.234	.2344	47/64	.73	.734	.7344
1/4	.25	.250	.2500	3/4	.75	.750	.7500
17/64	.27	.266	.2656	49/64	.77	.766	.7656
9/32	.28	.281	.2812	25/32	.78	.781	.7812
19/64	.30	.297	.2969	51/64	.80	.797	.7969
5/16	.31	.312	.3125	13/16	.81	.812	.8125
21/64	.33	.328	.3281	53/64	.83	.828	.8281
11/32	.34	.344	.3438	27/32	.84	.844	.8438
23/64	.36	.359	.3594	55/64	.86	.859	.8594
3/8	.38	.375	.3750	7/8	.88	.875	.8750
25/64	.39	.391	.3906	57/64	.89	.891	.8906
	.40				.90		
13/32	.41	.406	.4062	29/32	.91	.906	.9062
27/64	.42	.422	.4219	59/64	.92	.922	.9219
7/16	.44	.438	.4375	15/16	.94	.938	.9375
29/64	.45	.453	.4531	61/64	.95	.953	.9531
15/32	.47	.469	.4688	31/32	.97	.969	.9688
31/64	.48	.484	.4844	63/64	.98	.984	.9844
1/2	.50	.500	.5000	1	1.00	1.000	1.0000

ISSUED 9-62

ENGINE

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ENGINE

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ENGINE

ISSUED 9-62

SPECIFICATIONS

See the topic, SPECIFICATIONS, in the GENERAL INSTRUCTIONS.

Number of cylinders	6
Bore and stroke	4.5 x 5.5
Firing order	1-5-3-6-2-4

Accessory Drive

Backlash between accessory drive gear and accessory drive idler gear	.002 - .011 in.
Gear retaining nut torque	190 - 210 lb. ft.
Idler gear:	
Backlash between accessory drive idler gear and camshaft gear	.002 - .011 in.
End clearance	.002 - .009 in.
Permissible end clearance	.018 in.
Bearing bore	1.000 - 1.001 in.
Bearing clearance	.001 - .003 in.
Permissible bearing clearance	.007 in.

Camshaft

Backlash between camshaft gear and crankshaft gear	.001 -.009 in.
Bearing journal diameter	2.3105 - 2.3115 in.
Bearing clearance	.001 - .005 in.
Permissible bearing clearance	.010 in.
End clearance	.004 - .009 in.
Permissible end clearance	.025 in.
Retaining nut torque	165 - 185 lb. ft.

Connecting Rod

Bearing clearance	.0032 - .0061 in.
Permissible bearing clearance	.012 in.
Bolt nut torque	85 lb. ft.
Center-to-center distance	8.999 - 9.001 in.
Piston pin bearing bore	1.5014 - 1.5020 in.

Crankshaft

Main journal diameter	3.499 - 3.500 in.
Permissible main journal wear	.008 in.
Main bearing clearance (Earlier)	.0053 - .0082 in.
Permissible bearing clearance (Earlier)	.013 in.
Main bearing clearance (Later—with lead-tin overlay)	.0030 - .0059 in.
Permissible bearing clearance (Later)	.010 in.
End clearance	.0110 - .0180 in.
Permissible end clearance	.035 in.
Main bearing nut torque	155 lb. ft.
Connecting rod journal diameter	2.999 - 3.000 in.
Permissible journal wear	.007 in.
Permissible out-of-round	.004 in.
Pulley retaining bolt torque	210 - 250 lb. ft.

Cylinder Block

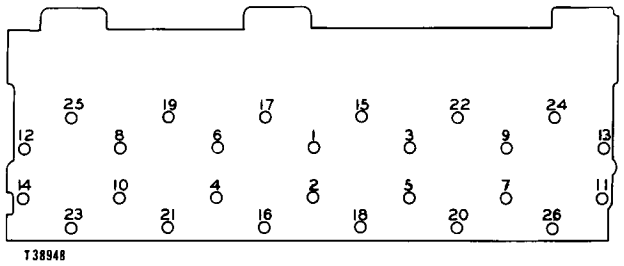
Main bearing original bore dimension	3.8155 - 3.8165 in.

Cylinder Head

Tighten bolts in sequence shown in illustration:	
Initial	85 lb. ft.
Final	120 - 130 lb. ft.

Cylinder Liner (Use 5F7362 Adapter Plate for Removal)

Inside diameter	4.500 - 4.501 in.



CYLINDER HEAD BOLT TIGHTENING SEQUENCE

Permissible liner wear (increase in diameter at top of ring travel)	.015 in.
Counterbore dimension in block	.400 - .402 in.
Flange thickness	.403 - .405 in.

Engine Support

Bolt torque	175 - 225 lb. ft.

Fan Belt Tension

Slack at point midway between pulley	9/16 - 13/16 in.

Flywheel

Retaining bolt torque	118 - 142 lb. ft.

Flywheel Housing

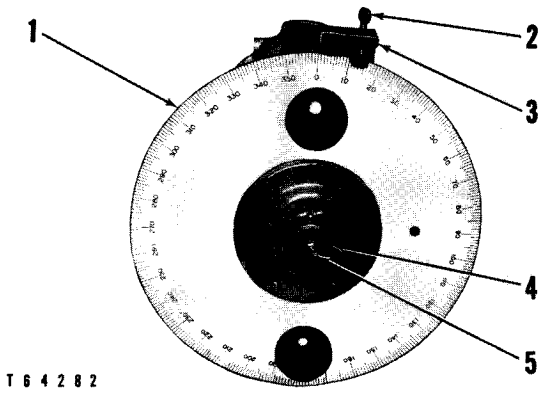
Retaining bolt torque	60 - 70 lb. ft.

Fuel Injection Equipment

Fuel injection pump timing (before top center)	11°
Fuel injection pump timing dimension setting (off engine using 2M5219 Gauge)	4.2655 - 4.2695 in.

LIFTER SETTINGS IN DEGREES (OFF ENGINE)	
LIFTER NO. (Numbered consecutively front to rear)	**TIMING PLATE DEGREES**
1	180°
2	60°
3	300°
4	120°
5	240°
6	0°

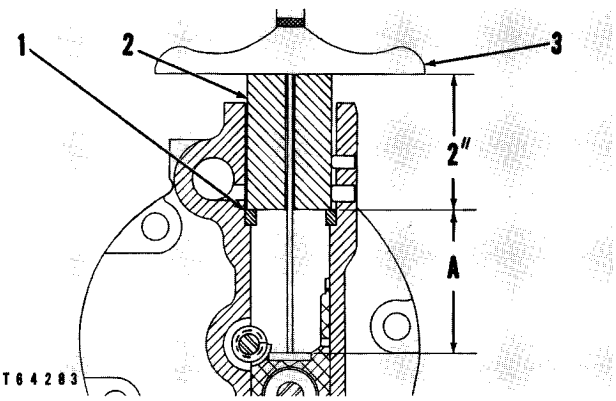
Fuel injection pump timing dimension setting (on engine with pistons at top center using 2M5219 Gauge)	4.2264 - 4.2304 in.
Fuel pump plunger length	2.5935 - 2.5937 in.
Permissible wear (decrease in length of plunger)	.005 in.
Injection pump retaining bushing torque	140 - 160 lb. ft.



TIMING DIMENSION SETTING (OFF ENGINE)
1–1F8747 Plate Assembly.* 2–Lockscrew. 3–2M5220 Pointer Assembly. 4–Washer. 5–Bolt.

***On earlier 1F8747 Plate Assemblies the drive shaft must be replaced with a 2M5218 Shaft Assembly.**

Injection nozzle orifice (use 5B2178 Drill for cleaning) ..... .025 in.
Nozzle retaining nut torque ..... 100 - 110 lb. ft.



CHECKING TIMING DIMENSION SETTING
1–Spacer. 2–2M5219 Gauge. 3–4-5" depth micrometer. A–Timing dimension setting.

If the reading is less than 4.2655 inches (off engine) replace the spacer (1) with a .004 inch thicker spacer.
If the reading is greater than 4.2695 inches (off engine) replace the spacer (1) with a .004 inch thinner spacer.

Fuel rack:
Bearing bore ..... .5007 - .5013 in.
Bearing clearance ..... .002 - .003 in.
Permissible clearance ..... .005 in.
Camshaft:
Bearing bore ..... 1.8750 - 1.8760 in.
Bearing clearance ..... .0015 - .0035 in.
Permissible clearance ..... .010 in.

Fuel Transfer Pump

Clearance between gears and covers, total ..... .0010 - .0022 in.
Permissible clearance ..... .0035 in.
Bearing bore ..... .4950 - .4956 in.
Shaft diameter ..... .4936 - .4938 in.
Bearing clearance ..... .0012 - .0019 in.
Permissible bearing clearance ..... .003 in.
Plunger spring:
Free length ..... 1 41/64 in.
Pounds force ..... 2.16 - 2.54
When compressed to ..... 1 1/32 in.
Drive gear retaining nut torque ..... 10 lb. ft.
Retainer ..... Flush within .002 in.

Generator

Generator	12V-24A DR1105129	24V-15A DR1105213
Brush spring tension	16 oz.	16 oz.
Rotation (viewing driving end)	clockwise	clockwise
Circuit	A	A
Field current (80°F)		
Volts	12	24
Amps	1.54-1.67	.94-1.02
Output (cold)		
Volts	14.0	28.5
Amps	24	15
Approximate RPM	1760	1800

Generator Belt Tension

Slack at point midway between pulleys ..... 9/16 - 13/16 in.

Generator Regulator

Generator Regulator	12V-24A DR1119625	24V-15A DR1119626
Circuit	A	A
Polarity	Neg. ground	Neg. ground
Cut-out relay:		
Armature-yoke air gap (in.)	.020	.017
Point opening (in.)	.020	.032
Closing voltage range	11.8-13.0	22.8-25.2
Voltage regulator:		
Armature-yoke air gap (in.)	.067	.067
Point opening (in.)	.016	.016
Voltage setting range	14.1-14.9	27.4-29.4
Current regulator:		
Armature-yoke air gap (in.)	.075	.075
Current setting range (amps)	22-26	14-16

Governor

Backlash between drive gear and driven gear ..... .002 - .006 in.

Oil Pump

Clearance between the gears and covers, total ..... .002 - .004 in.
Shaft diameter ..... .7404 - .7410 in.
Bearing bore ..... .7420 - .7430 in.
Bearing clearance ..... .0010 - .0026 in.
Permissible bearing clearance ..... .005 in.
Idler gear:
Backlash between idler gear and crankshaft gear ..... .001 - .006 in.
Bearing bore ..... 1.2505 - 1.2515 in.
Bearing clearance ..... .0020 - .0036 in.
Permissible clearance ..... .008 in.
Drive gear:
Backlash between drive gear and idler gear ..... .001 - .007 in.
Retaining nut torque ..... 60 lb. ft.

Piston Pins

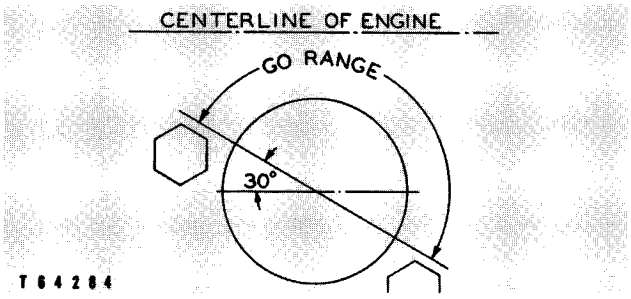
Clearance in rod bearing	.0009 - .0019 in.
Permissible clearance in rod	.006 in.
Permissible clearance in piston	.006 in.

Piston Rings

Piston ring side clearance:	
Top ring	.0030 - .0041 in.
Intermediate ring	.0025 - .0036 in.
Oil control ring	.0015 - .0035 in.
Permissible clearance (top compression ring)	.010 in.
Ring gap:	
Top ring	.017 - .023 in.
Intermediate ring	.018 - .024 in.
Oil control ring	.013 - .023 in.

Precombustion Chamber

Torque	140 - 160 lb. ft.
Glow plug torque	8 - 10 lb. ft.



PRECOMBUSTION CHAMBER POSITIONING DIAGRAM

The precombustion chamber gasket is supplied in two different thicknesses. With the proper thickness gasket and the recommended torque to tighten the chambers into the head, the glow plugs and electrical connections will be positioned in the "go" range. The "go" range is the position in which the glow plugs will be clear of fuel lines and other points of interference, when installed in the precombustion chamber.

The diagram can be used to position the precombustion chambers if new gaskets are installed.

Rocker Arm

Bearing bore	.7260 - .7266 in.
Clearance between shaft and bearing	.0010 - .0026 in.
Permissible clearance	.008 in.
Retaining bolt torque	120 lb. ft.

Starting Motor (24V — Delco-Remy 1113818)

Brush spring tension (minimum)	80 oz.
Rotation (viewing drive end)	Clockwise
No load test:	
Volts	23.0
Minimum Amps	60
Maximum Amps	90
Minimum RPM	7000
Maximum RPM	10,700
Lock test:	
Approximate volts	3.5
Amps	500
Minimum torque	26 lb. ft.

Timing Gear Housing

Retaining bolt torque	27 - 37 lb. ft.

Turbocharger (Schwitzer 4D used on normalized engines)

Torque on turbine housing and compressor cover band clamp bolts	10 lb. ft.
Torque on compressor back plate to bearing housing bolts	17 lb. ft.
Torque on impeller nut (cold)	30 lb. ft.
Torque on thrust bearing retaining bolts	5 lb. ft.
Clearance between impeller and compressor back plate	.020 - .022 in.
End clearance	.004 - .006 in.
Permissible end clearance	.008 in.
Bearing diameter (ID)	.6880 - .6883 in.
Bearing diameter (OD)	1.0585 - 1.0590 in.
Permissible bearing clearance (satisfactory if compressor wheel and/or turbine wheel have not rubbed housing or housings)	
Journal diameter	.6862 - .6865 in.
Housing bore diameter	1.0625 - 1.0630 in.
Thickness of thrust bearing	.025 - .026 in.
Thickness of thrust rings	.099 - .100 in.
Width of groove in sleeve	.128 - .130 in.
Side clearance in groove of sleeve with two piston rings installed	.002 - .006 in.
Maximum piston ring width	.062 in.
Maximum piston ring groove width (turbine)	.068 in.

Valves

Exhaust:	
Clearance (hot)	.025 in.
Stem clearance in bushing	.003 - .005 in.
Permissible clearance with new valve	.009 in.
Inlet:	
Clearance (hot)	.015 in.
Stem clearance in bushing	.003 - .005 in.
Permissible clearance with new valve	.009 in.

Valve Lifters

Lifter diameter	1.1225 - 1.1235 in.
Bore diameter	1.125 - 1.126 in.
Permissible clearance	.012 in.

Valve Spring

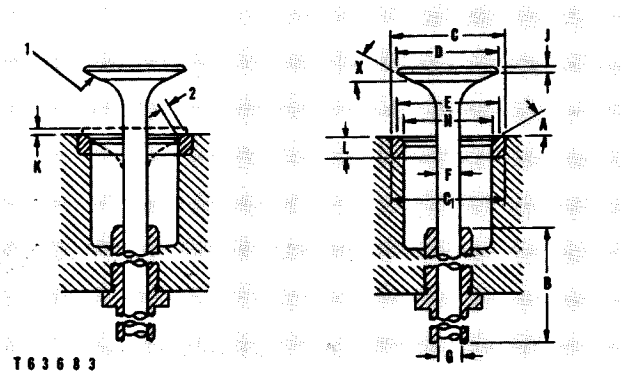
Pounds force	53.25 - 58.75
When compressed to	2 5/16 in.

Valve Timing

With valve clearances set correctly hot, dial indicator mounted above valve stem, reading taken with valve .075 in. off its seat.

Exhaust opens (before bottom center) ..... 20° 58′
Exhaust closes (before top center) ..... 2° 19′
Inlet opens (after top center) ..... 0° 15′
Inlet closes (after bottom center) ..... 8° 31′

Valve and Valve Seat Specifications



VALVE AND VALVE SEAT SPECIFICATIONS

1–Valve face. 2–Valve seat. A–Valve seat angle. B–Valve guide length. C–Valve seat insert diameter. C_1–Bore for valve seat insert. D–Valve head diameter. E–Outside diameter of valve seat face. F–Valve stem diameter. G–Valve guide bore. H–Inside diameter of valve seat face. J–Valve lip thickness. K–Measurement from top of valve to face of head with valve seated. L–Depth of bore for valve seat inserts. X–Valve face angle.

	INLET	EXHAUST
A	30°	30°
B	3.36″	3.36″
C	2.0030″– 2.0040″	1.8780″– 1.8790″
C_1	2.0000″– 2.0010″	1.8750″– 1.8760″
D	1.890″– 1.900″	1.766″– 1.776″
E	1.849″– 1.859″	1.725″– 1.735″
F	.3715″– .3725″	.3715″– .3725″
G	.3755″– .3765″	.3755″– .3765″
H	1¾″	1⅝″
J	3/64″ MIN.	3/64″ MIN.
K	.128″	.117″
L	.448″–.450″	.448″–.450″
X	29¼°	29¼°

Maximum permissible valve seat width **(2)** ..... .095 in.

Water Pump

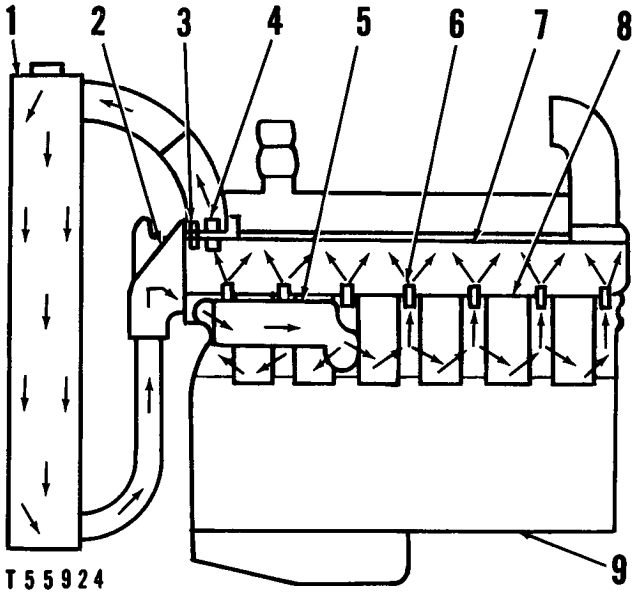
Impeller retaining nut torque ..... 30 lb. ft.
Pulley retaining nut torque ..... 118 - 142 lb. ft.

Water Temperature Regulator

Opening temperature for testing (at atmospheric pressure) ..... 175° - 186°

Cooling System

A centrifugal-type pump is mounted on the front face of the cylinder block. The pump and fan pulley are mounted on the same shaft and are belt driven from the crankshaft pulley.



COOLING SYSTEM

1–Radiator core. 2–Water pump. 3–By-pass. 4–Regulator. 5–Oil cooler. 6–Water director. 7–Cylinder head. 8–Cylinder liner. 9–Cylinder block.

Coolant flow from the outlet side of the centrifugal pump **(2)** is delivered directly to the oil cooler **(5)**. After passing through the oil cooler, the coolant is directed to the cylinder block **(9)**. Here the coolant flows around the cylinder liners **(8)** and through water directors **(6)** into the cylinder head **(7)**. The water directors direct coolant to the area around the exhaust valves and precombustion chambers.

From the areas around the valves and precombustion chambers, the coolant flows through a cored passage in the head to the water temperature regulator **(4)**. After the coolant becomes sufficiently warm, the regulator opens to permit flow into the radiator core **(1)**. Coolant flows down through the radiator core during which time it is cooled by air flowing around the core. Then the coolant returns to the suction side of the pump. Thus, the cycle is completed with the regulator in the open position.

A limited amount of coolant continuously flows from the forward end of the cylinder block to the suction side of the water pump through the by-pass **(3)** to assure circulation when the regulator is closed and improve regulator response.

When the engine is equipped with a gasoline starting engine, some coolant is directed from the cylinder block to the starting engine water jacket and returns to the diesel engine cylinder head.

OVERHEATING

If difficulty is experienced with the engine overheating, check the following possible causes:

1. Coolant Level.

   Insufficient coolant in the cooling system. If the coolant level has been allowed to fall so low that the coolant is no longer properly circulating the engine should be stopped immediately and allowed to cool before adding coolant. If there is still good circulation, add make-up coolant slowly while the engine is running. These precautions will minimize the possibility of cracking the cylinder head.

2. Fan.

   Loose fan belt.

3. Radiator Clogging — (External)

   Accumulation of leaves, mud and debris around the radiator core. In some cases, these accumulations can be removed by flushing with water or compressed air from the back of the radiator. It may become necessary, eventually, to remove the radiator to clean the core effectively.

4. Water Temperature Regulator.

   Failure of water temperature regulator to open. Check the regulator for opening temperature as described in the topic, TESTING TEMPERATURE REGULATOR. Observe the amount of scale deposited on the regulator. Too much scale will obstruct operation. The engine should not be operated with the regulator removed.

5. Water Pump.

   A badly corroded or worn water pump impeller, or loose drive gear.

6. Internal Clogging.

   Excessive scale or sediment deposits in the heat exchanger, cylinder head or block. Such deposits can cause serious damage to the engine, by retarding the transfer of heat from the head and cylinders to the coolant. In such cases, the water temperature may not be above normal. However, loose scale and sediment may deposit in water passages to such an extent that circulation will be retarded, in which case the water temperature may go above normal.

To check for lime and scale in the cooling system, remove one of the precombustion chambers and inspect the surface which comes in contact with the coolant. To remove hard scale, follow the directions in accordance with the Operation and Maintenance Instructions.

7. Continuous Overload.

   Operating a machine at full governed speed under a continuous overload, which lugs the engine speed down below its rated speed, may also cause overheating. As a correction, the load should be reduced to allow the engine to operate at rated speed.

8. Altitude.

   The altitude at which the machine is operating should be considered when boiling is encountered. The horsepower of the engine is decreased as the altitude increases. Also, the boiling point of water is lower at higher altitudes.

9. Water Temperature Indicator.

   It may be that the indicator is not registering correctly. If the indicator is suspected of giving a false reading, install a new one and check the reading.

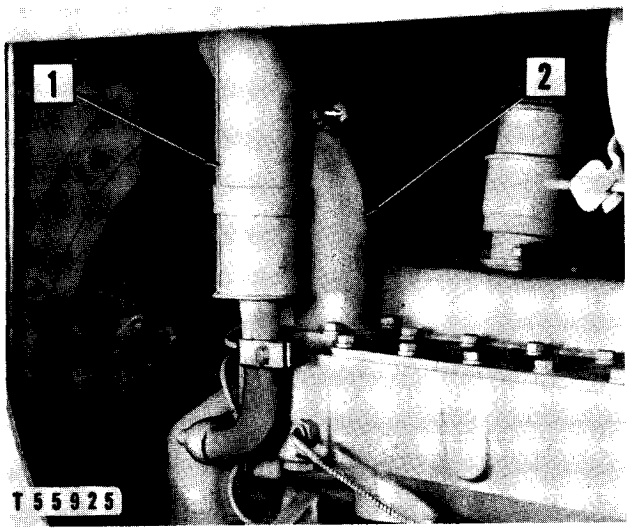
10. Overheating can also be caused by combustion gases escaping by the precombustion chamber gaskets or cylinder head gaskets and water ferrules and seals. The gases can accumulate in the cylinder head and block or restrict the flow of coolant through the cooling system. Thus, the coolant temperature rises rapidly and hot spots will exist in the cylinder head. The easiest method of checking for this condition is to carefully remove the filler cap and check for air bubbles. If air bubbles are present in the cooling system, check the precomustion chambers for tightness and, if necessary, replace the gaskets.

Water Temperature Regulator

A water temperature regulator is used to restrict the flow of water through the radiator until the engine is at operating temperature. After this, the function of the regulator is to maintain an efficient engine operating temperature.

The temperature regulator within the diesel engine cooling system is designed to give an approximate minimum coolant temperature of 160° F. The maximum operating temperature will vary according to the air temperature and load factor, but should never exceed boiling temperature at the prevailing altitude.

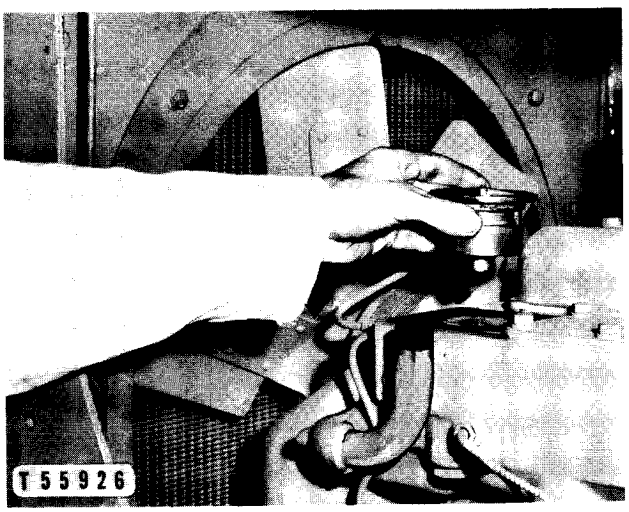
REMOVAL AND INSTALLATION



REGULATOR HOUSING COVER

☐ **Remove**

1–Starting engine muffler. 2–Elbow.



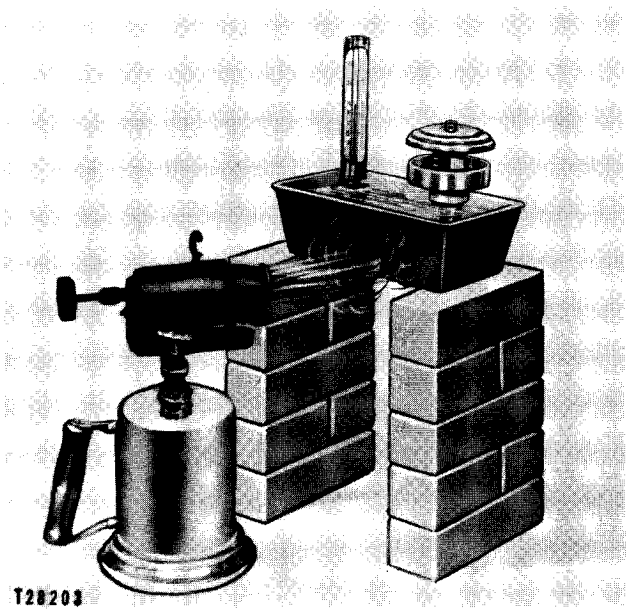
REMOVING TEMPERATURE REGULATOR

1. Drain engine coolant to a level below the regulator.
2. Loosen the clamp securing the hose to the elbow **(2)**.
3. Lift out the water temperature regulator.
4. When installing the regulator, be sure it is properly seated in the bore.
5. Replace the gasket if it is damaged.

TESTING TEMPERATURE REGULATORS

The opening temperature of the regulator should be approximately 175° F., and the regulator should be fully open at 186° F. The regulator can be tested in the following manner:

1. Remove the regulator from the regulator housing.
2. Suspend the regulator in a pan of water as shown.
3. Apply heat to the pan and stir the water to maintain uniformity.
4. Observe the opening temperature of the regulator.



TYPICAL SET-UP FOR TESTING WATER TEMPERATURE REGULATORS

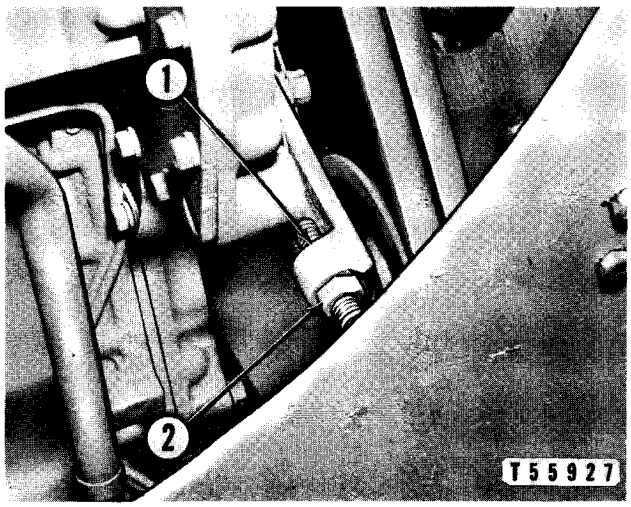
Fan Group

The fan is driven by two V-belts from a pulley on the crankshaft. The belts and pulleys should be kept clean. Accumulations of dirt and grease will cause overheating and excessive wear.

FAN BELT REPLACEMENT (Engine Not Equipped With Generator)

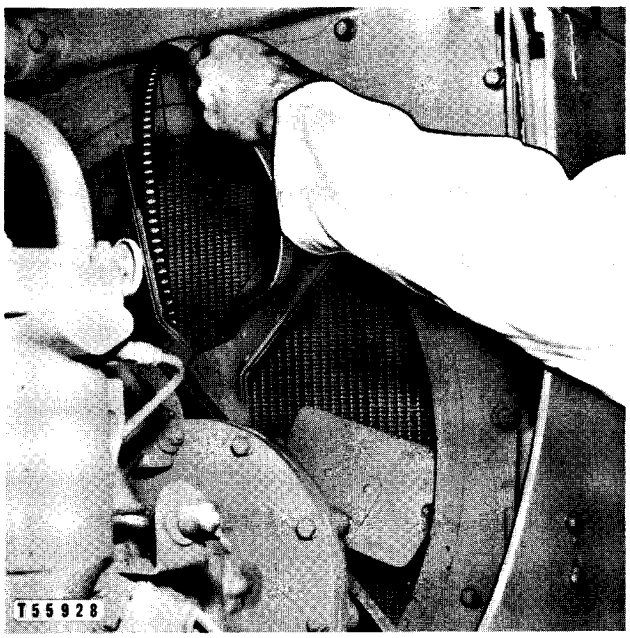
Loosen the bolts on the idler pulley adjusting bracket **(1)**.

Loosen the locknut **(2)**, unscrew the adjusting screw and slide the idler pulley toward the engine.



PREPARING TO REMOVE THE FAN BELT
1–Adjusting bracket. 2–Locknut.

Remove the old belts and install the new ones as shown.

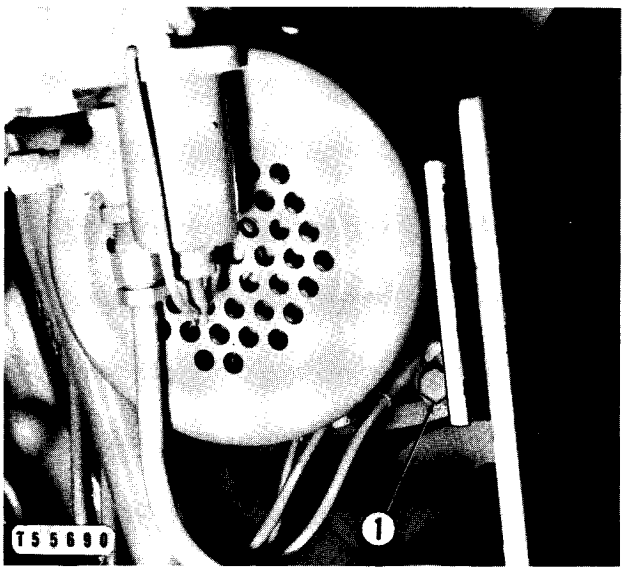


REPLACING THE FAN BELT

Adjust the fan belt tension as described in the Operation and Maintenance Instructions. See the topic, SPECIFICATIONS, for the correct fan belt tension.

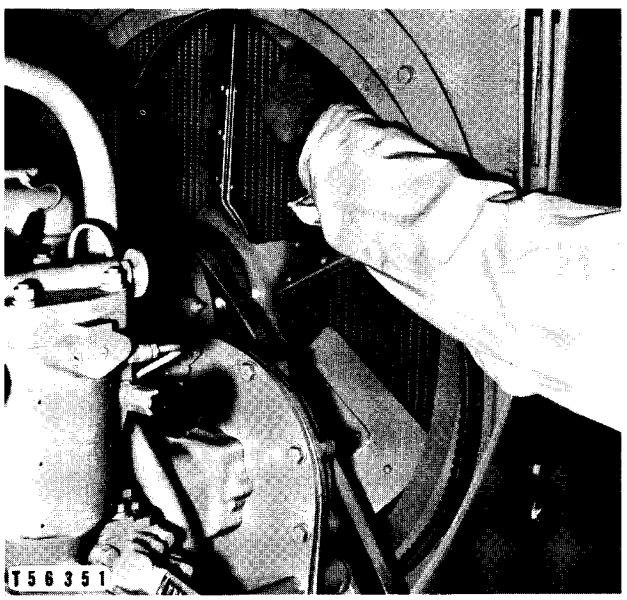
FAN BELT REPLACEMENT (Engine Equipped With Generator)

Loosen the bolt **(1)** and slide the generator toward the engine.



PREPARING TO REMOVE FAN BELT
1–Bolt.

Remove the old belts and install the new ones as shown.



REPLACING THE FAN BELT

Adjust the fan belt tension as described in the Operation and Maintenance Instructions. See the

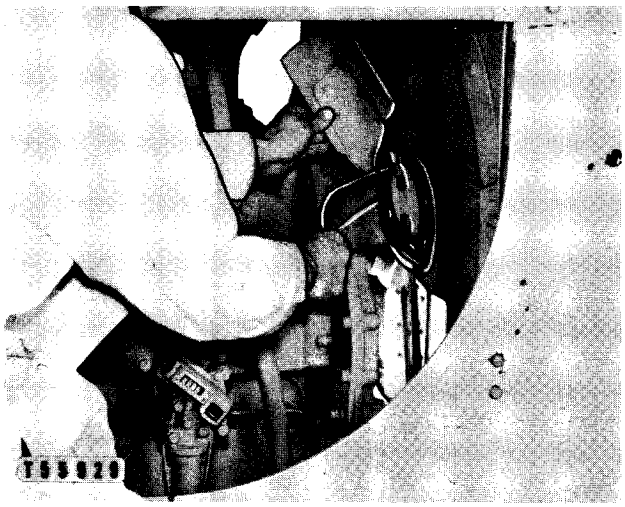
topic, SPECIFICATIONS, for the correct fan belt tension.

FAN ASSEMBLY REMOVAL AND INSTALLATION

The fan is bolted to the water pump pulley.

Remove the fan belts. See the covering topic.

Remove the bolts securing the fan to the water pump pulley and remove the two halfs of the fan as illustrated.



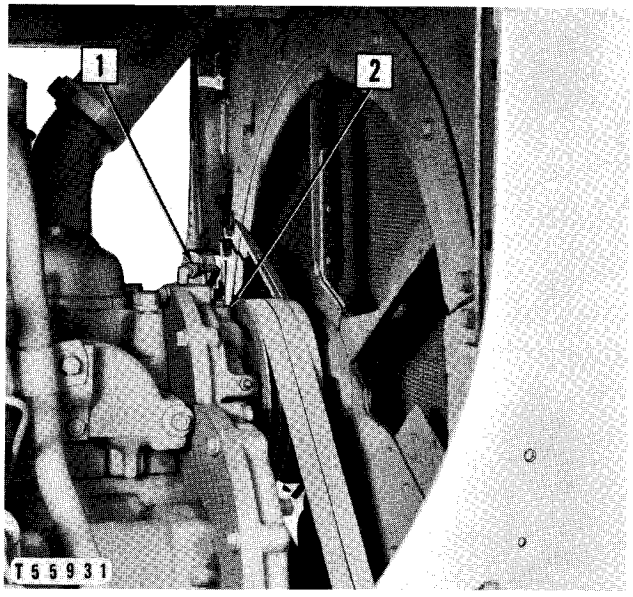
REMOVING FAN

Water Pump

The centrifugal type water pump is mounted on the front face of the cylinder block. The water pump is driven by two V-belts which also drive the fan.

REMOVAL AND INSTALLATION

1. Drain the coolant from the cooling system.
2. Remove the fan. See the topic, FAN REMOVAL AND INSTALLATION.

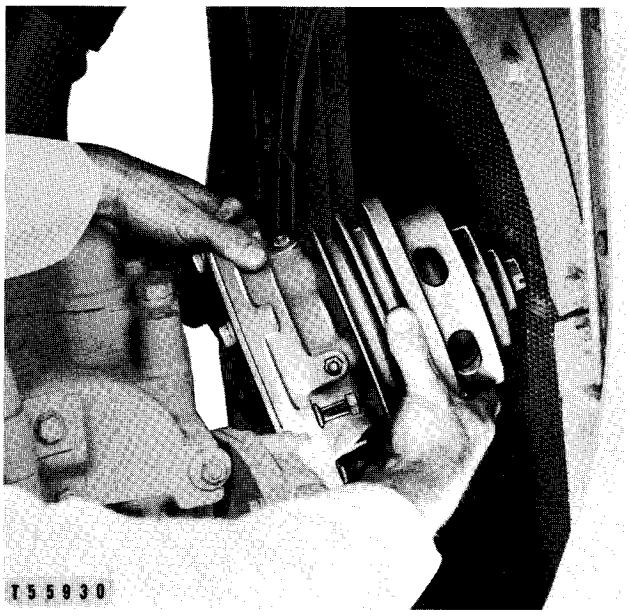


PREPARING TO REMOVE WATER PUMP

☐ **Remove**

1–Tube. 2–Water pump.

3. Disconnect the radiator lower hose from the water pump **(2)**.

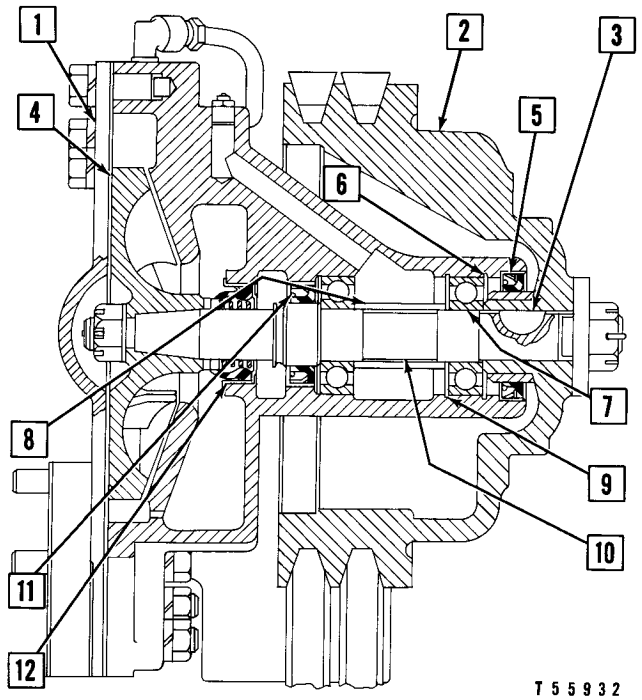


REMOVING WATER PUMP

4. Remove the bolts which secure the water pump to the cylinder block and remove the water pump as illustrated.
5. Prior to installation, inspect and replace all damaged gaskets.
6. See the topics, FAN BELT REMOVAL AND INSTALLATION, and SPECIFICATIONS, for the correct fan belt installation and adjustment.

DISASSEMBLY AND ASSEMBLY

1. Use an 8H695 Puller and an 8B7560 Step Plate to pull the pulley **(2)** from the impeller shaft as shown.
2. Use an 8H695 Puller and an 8B7560 Step Plate to pull impeller assembly **(4)** from the impeller shaft as shown.
3. Using a soft hammer, tap on the impeller end of the impeller shaft until the front bearing **(7)** is out of the housing.
4. Use an 8B7548 Push Puller with an 8H663 Bearing Puller Attachment and 8B7560 Step Plate to pull the front bearing from the shaft as shown.
5. After the bearing and shaft assembly has been removed, the bearing can be pressed off the shaft.



PREPARING TO DISASSEMBLE THE WATER PUMP

☐ **Remove**

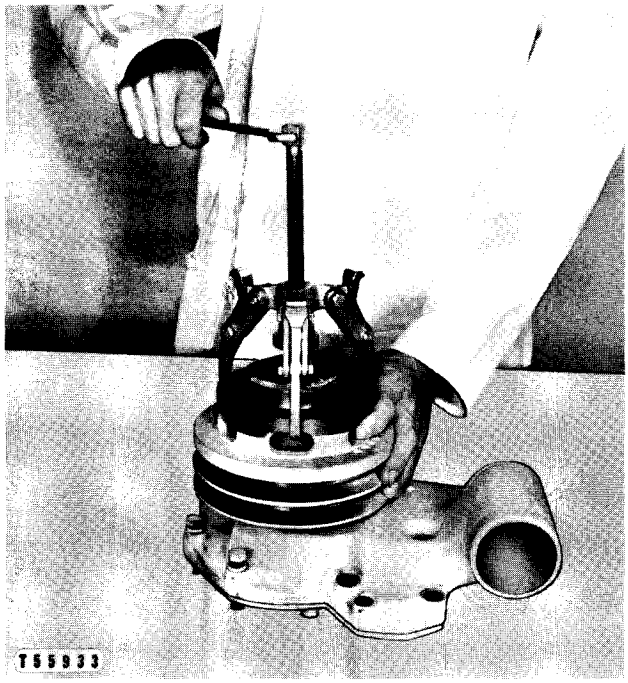
1–Plate. 2–Pulley. 3–Key. 4–Impeller assembly. 5–Seal. 6–Lock ring. 7–Bearing. 8–Spacer. 9–Lock ring. 10–Shaft and bearing assembly. 11–Seal. 12–Carbon faced seal.

6. When pressing the bearing onto the shaft, place the shielded side of the bearing so it will be toward the outside of the water pump housing.

NOTE

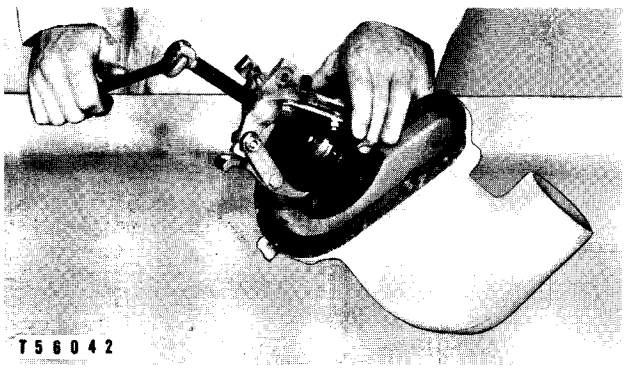
To avoid damaging the carbon-faced, self-adjusting seal, it should be installed after the shaft and bearings are assembled in the housing.

7. Install the seal **(11)** in the housing. Install the seal so the lip will be toward the impeller.



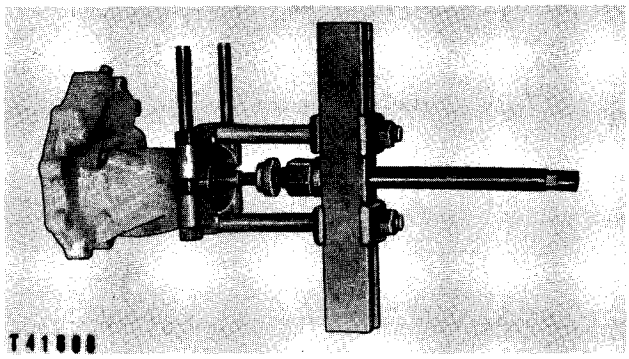
PULLEY REMOVAL

8. Pack the rear bearing with ball and roller bearing lubricant and install the shaft and bearing assembly into the water pump housing.



IMPELLER REMOVAL

9. Pack the bearing compartment with ball and roller bearing lubricant.



WATER PUMP BEARING REMOVAL

10. Install the seal **(5)** with the wiping edge toward the inside.

11. Prior to installing the pulley make certain the key is in the shaft. Also make certain the mounting bolts are in place in the water pump housing.

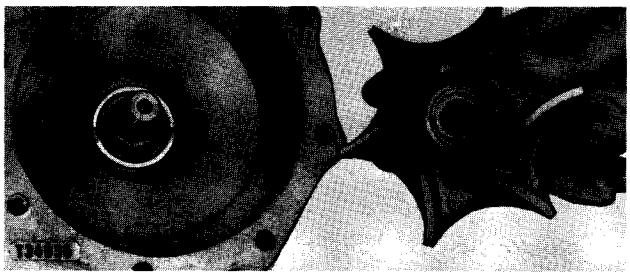
12. See the topic, SPECIFICATIONS, for the proper pulley retaining nut torque.

13. To install the impeller **(4)**, place it on the shaft and torque the retaining nut. See the topic, SPECIFICATIONS, for the correct torque.

WATER PUMP SEAL REPLACEMENT

Water leaking from the drain opening on the bottom of the pump housing indicates that the water seal assembly should be replaced.

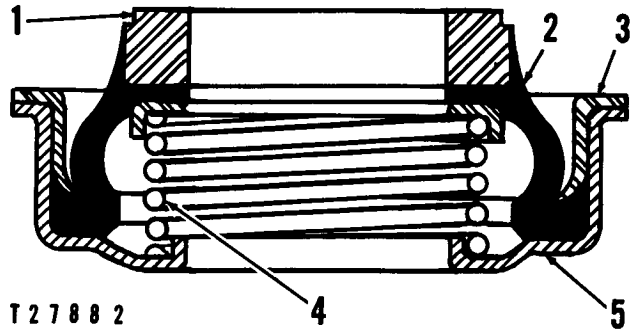
Inspect the ceramic bearing surface on the impeller which contacts the carbon thrust washer. The contact surface must be smooth and free of roughness or nicks.



INSPECTING BEARING SURFACE ON IMPELLER

The seal assembly consists of a carbon thrust washer **(1)**, a flexible seal **(2)**, and a seal spring **(4)** all retained in a seal cup **(5)** by the seal retainer **(3)**. The carbon thrust washer **(1)** is cemented to the flexible seal **(2)**. The entire assembly must be replaced as a unit and is pressed in the water pump housing.

It is not necessary to completely disassemble the pump to replace the water seal. The seal can be re-



SEAL ASSEMBLY
1–Carbon thrust washer. 2–Flexible seal. 3–Seal retainer. 4–Seal spring. 5–Seal cup.

moved by bending the flange on the seal and prying out, being careful not to damage the shaft or the bore in the housing.

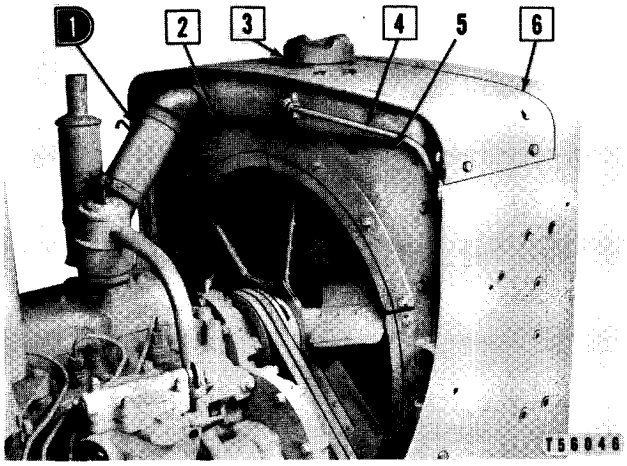
When installing a new seal assembly, coat the seal cup and housing bore with a suitable compound or lubricant to avoid shearing the brass cup and also to provide a positive seal against water leakage. Make sure the brass cup bottoms squarely in the bore so the carbon washer will bear evenly against the ceramic seal on the impeller.

After the seal is installed, see that the carbon thrust washer moves freely under finger pressure.

Radiator

REMOVAL AND INSTALLATION

1. Drain the coolant from the radiator.
2. Remove the hood. See the topic, HOOD REMOVAL.
3. Remove the fan. See the topic, FAN REMOVAL.



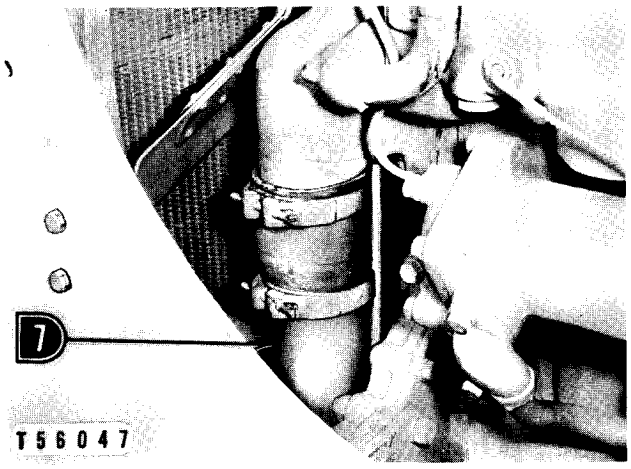
PREPARING TO REMOVE RADIATOR

☐ **Remove** ◗ **Disconnect**

1–Hose. 2–Left shield assembly. 3–Cap. 4–Tube. 5–Right shield assembly. 6–Radiator top guard.

NOTE

Remove the right shield assembly **(5)** before the left shield assembly **(2)**.

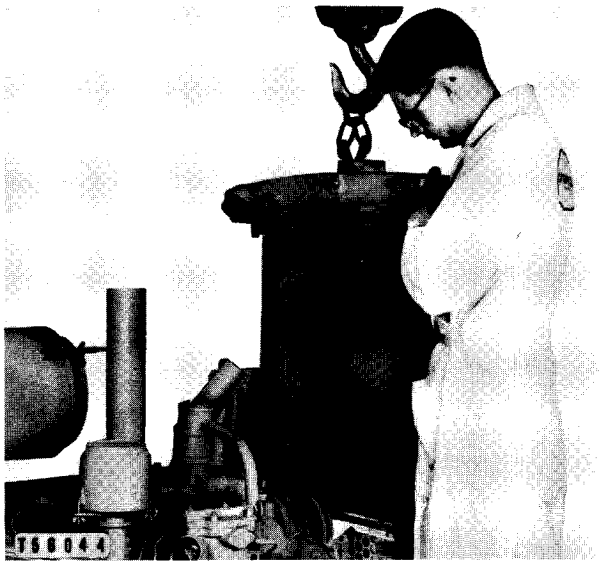


DISCONNECTING LOWER PORTION OF RADIATOR

◗ **Disconnect**

7–Elbow.

4. Remove the bolts that secure the upper tank to the radiator guard.
5. Attach a suitable lifting hoist and lift out the radiator as illustrated.



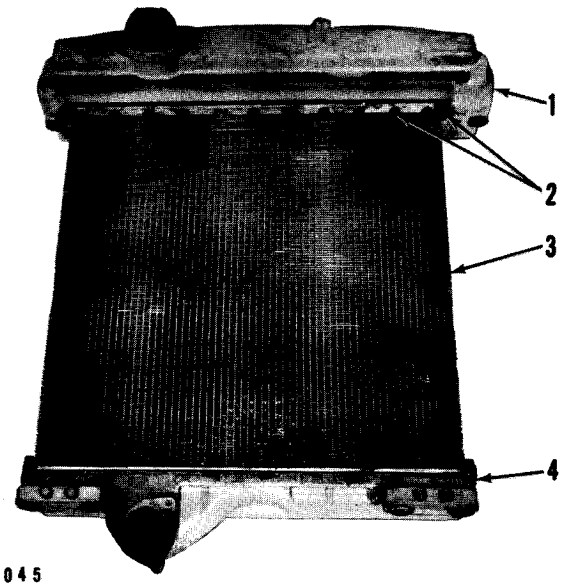
REMOVING THE RADIATOR

DISASSEMBLY AND ASSEMBLY

With the radiator removed from the engine, the radiator can be disassembled in the following manner:

1. Remove the top tank **(1)** by removing the bolts holding the reinforcing strip **(2)** and the radiator core **(3)** to the top tank.
2. Remove the bottom tank **(4)** in the same manner as the top tank.
3. Hole spacing in the header plates of the radiator core is such that the core can be reversed to extend the service life.

Clean the radiator core of all accumulations of debris between the fins and tubes with water or compressed air. Such accumulations decrease the efficiency of the cooling system and may cause the engine to overheat.



RADIATOR ASSEMBLY

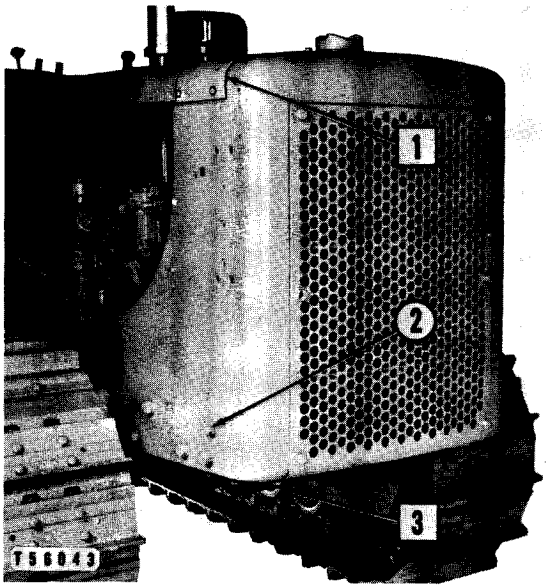
1–Tank. 2–Strips. 3–Core. 4–Tank.

The inside of the radiator cores, bottom tank, and top tank should be cleaned with commercial radiator cleaner according to the instructions furnished by the manufacturer.

Care should be taken, when assembling the radiator, to see that a perfect seal exists between the radiator core and the top and bottom tanks.

RADIATOR AND GUARD REMOVAL

1. Drain the coolant from the radiator.
2. Remove the hood. See the topic, HOOD REMOVAL.

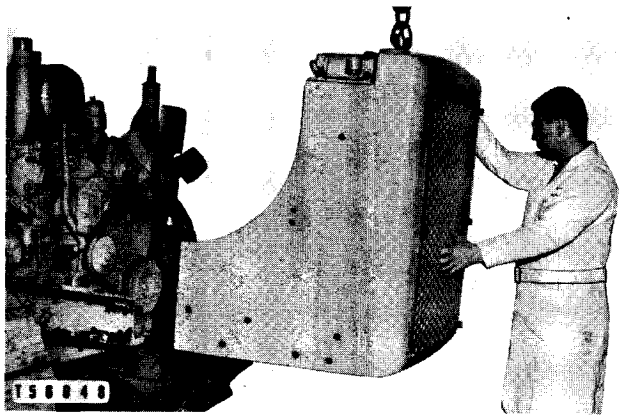


PREPARING TO REMOVE RADIATOR AND GUARD

☐ **Remove**

1–Radiator top guard. 2–Radiator guard bolts (twelve). 3–Radiator bottom guard.

3. Disconnect the radiator inlet and outlet elbows from the radiator.
4. Attach a suitable lifting device and hoist and support the weight of the guard and radiator. The guard and radiator weigh approximately 600 lbs.



REMOVING THE RADIATOR AND GUARD

5. Remove the bolts **(2)** that secure the radiator guard assembly to the frames.
6. Move the radiator guard assembly forward to remove it.

SEALED PRESSURE OVERFLOW

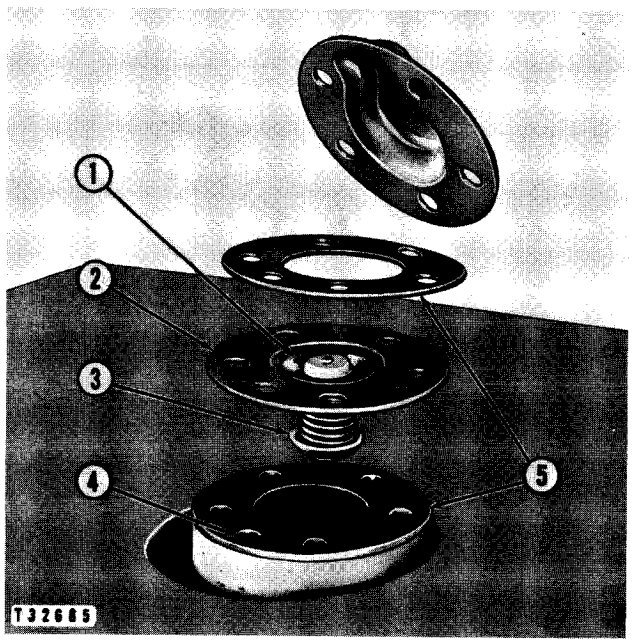
A sealed pressure overflow assembly is used to prevent loss of coolant through the radiator overflow tube when operating at an angle.

Due to expansion of the coolant by rising temperature, a pressure will be built up in the cooling system each time the engine is started. When the pressure rises above 6 PSI, the pressure relief valve **(1)** opens to relieve the pressure, or, if the cooling system has been overfilled, allow some coolant to escape through the radiator overflow tube. The valve closes when the temperature of the coolant levels off and remains closed unless there is a further increase in pressure.

When the temperature of the coolant falls, a vacuum will result in the cooling system. The vacuum release valve **(3)** opens when the vacuum reaches 1 PSI and lets in air through the overflow tube. This vacuum release valve also functions when draining the cooling system.

The relief assembly can be removed by taking out the machine screws that hold the seal **(2)** in place and removing the housing and seal plate. The gaskets **(5)** should be replaced if leaking.

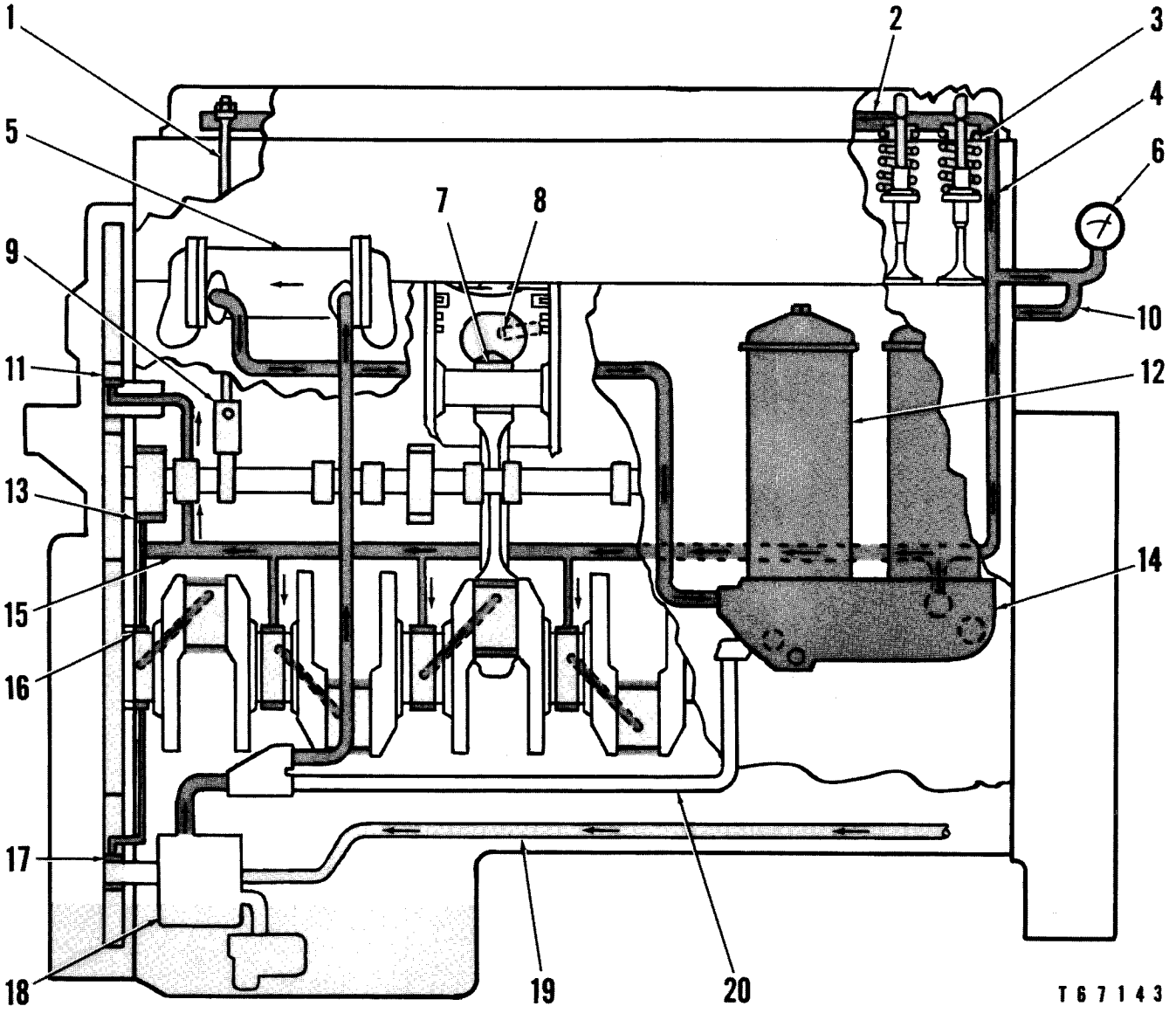
When reinstalling the gaskets **(5)**, one on each side of the seal, make sure the correct hole in the gaskets aligns with the opening **(4)** to the overflow tube.



SEALED PRESSURE OVERFLOW

1–Pressure relief valve. 2–Seal. 3–Vacuum release valve. 4–Opening to overflow tube. 5–Gaskets.

Lubricating System



FLOW OF LUBRICATING OIL (SCHEMATIC)
(Left Side View of Engine)

1–Push rod.
2–Passage in rocker arm shaft.
3–Valve spring.
4–Passage to rocker arm shaft.
5–Oil cooler.
6–Oil pressure gauge.
7–Piston pin bearing.
8–Oil control ring passage.
9–Valve lifter.
10–External supply line to governor and fuel injection pump.
11–Accessory drive idler gear stub shaft bearing.
12–Oil filter (two).
13–Camshaft front bearing.
14–Oil filter base.
15–Oil manifold.
16–Crankshaft main bearings (seven).
17–Oil pump idler gear bearing.
18–Oil pump.
19–Oil scavenge tube.
20–Oil cooler by-pass line.

The oil pump **(18)** contains a scavenge pump and a pressure pump. Oil that does not return to the oil pan is collected through the scavenge tube **(19)** and dumped into the oil pan.

Oil is pumped from the oil pan to the oil cooler **(5)** and to the oil filters **(12)**, except on initial starting where the oil is by-passed through the external line **(20)**. See the topic, OIL FILTER. After the oil passes through the filters **(12)**, it enters the oil distribution manifold **(15)**. The oil manifold supplies lubricating oil to the main bearings **(16)**, camshaft front bearing **(13)**, and to the passage **(4)**.

The intermediate and rear camshaft bearings are splash lubricated. The connecting rod bearings receive lubrication from the same source as the main bearings, through drilled passages in the crankshaft.

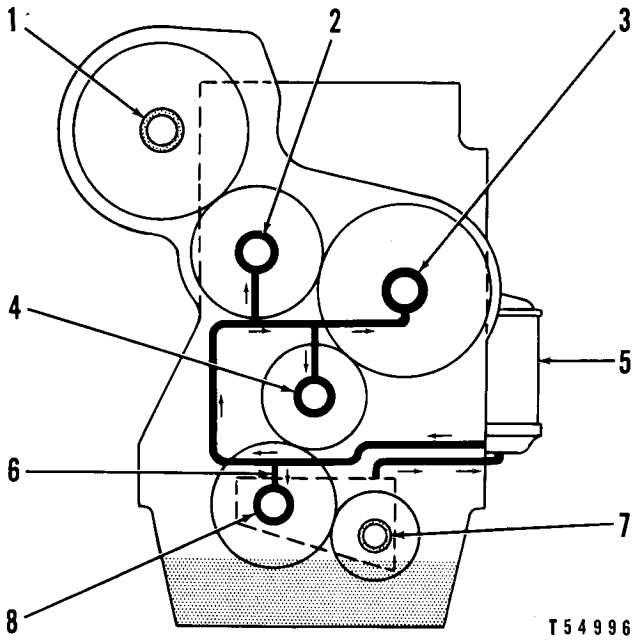
The passage **(4)**, which supplies oil to the rocker arm shaft from the oil distribution manifold **(15)**, is located in the rear of the cylinder block. Pressure oil to the oil pressure gauge **(6)** is supplied by this passage. The fuel injection pump and governor, which are mounted on the right side of the engine, receive lubrication through the external line **(10)**.

TIMING GEAR LUBRICATION

All of the timing gear bearings are lubricated by passages in the block with the exception of the oil pump idler gear bearing **(8)** and the accessory drive gear bearing **(1)**.

The oil pump idler gear bearing **(8)** is lubricated by pressure filtered oil through the supply line **(6)**.

The accessory drive gear bearing **(1)** is lubricated by drainage from the governor housing, fuel pump housing and the accessory drive housing.



TIMING GEAR LUBRICATION

1–Accessory drive gear bearing. 2–Accessory drive idler gear bearing. 3–Camshaft gear bearing. 4–Crankshaft gear bearing. 5–Oil filter. 6–Oil pump idler gear bearing supply line. 7–Oil pump drive gear bearing. 8–Oil pump idler gear bearing.

OIL PRESSURE

When the engine is warm and running at rated speed, the gauge should register in the "operating range." A lower pressure reading is normal at low idling speeds.

If for any reason the oil gauge registers no pressure, the engine should be stopped immediately un- until the difficulty can be determined and corrected.

A small orifice in the gauge connection prevents rapid gauge fluctuation. This orifice should be checked for dirt, in the event the gauge becomes inoperative.

If the oil pressure gauge indicates low or no oil pressure, check for the following:

1. Low oil level.
2. Clogged oil filter.
3. Defective oil gauge, or a clogged or broken tube to the gauge.
4. Clogged suction bell screen.
5. Leaking connections.
6. Loose bearings.
7. Pressure regulating valve worn or stuck open, thus allowing oil to be by-passed into the oil pan.
8. Worn oil pump gears.
9. Clogged oil cooler, possibly causing excessively high oil temperatures, resulting in low viscosity and consequently low oil pressure.

Oil Pan and Oil Pan Plate

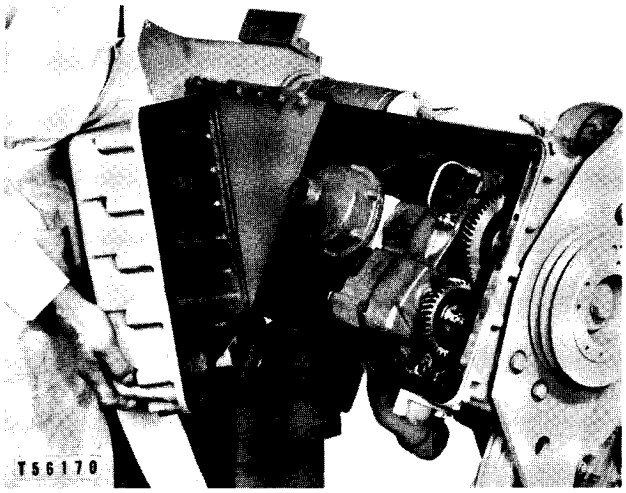
OIL PAN REMOVAL AND INSTALLATION

The oil pan can be removed without removing the engine from the tractor. The engine is shown mounted on the 9F3829 engine positioning stand.

NOTE

In order to remove the oil pan plate, the engine must be removed from the tractor.

1. Drain the lubricant from the oil pan.
2. Loosen the bolts which secure the pan to the cylinder block, plate and timing gear cover.
3. Separate the oil pan gasket from the pan so that the gasket will remain with the oil pan plate.

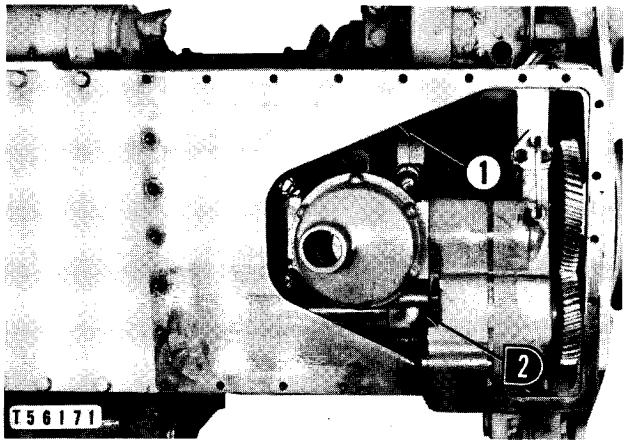


REMOVING THE OIL PAN

4. Inspect the gasket for damage.
5. Install the pan and complete the installation.
6. Refill the oil pan with lubricant in accordance with the Operation and Maintenance Instructions.

OIL PAN PLATE REMOVAL AND INSTALLATION

1. Remove the engine from the tractor. See the covering topic. The engine is shown mounted on the 9F3829 engine positioning stand.
2. Remove the oil pan. See the covering topic.

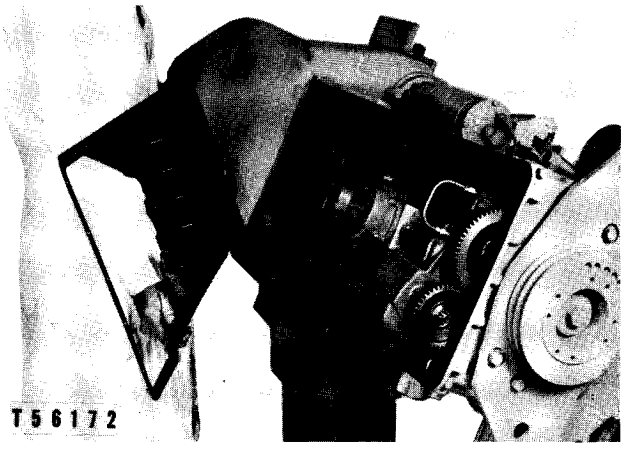


PREPARING TO REMOVE OIL PAN PLATE

D Disconnect

1–Oil pan plate. 2–Scavenge elbow.

3. Remove the bolts which secure the oil pan plate **(1)** to the cylinder block.
4. Remove the oil pan plate as shown.
5. Prior to installation, inspect and replace all damaged gaskets.



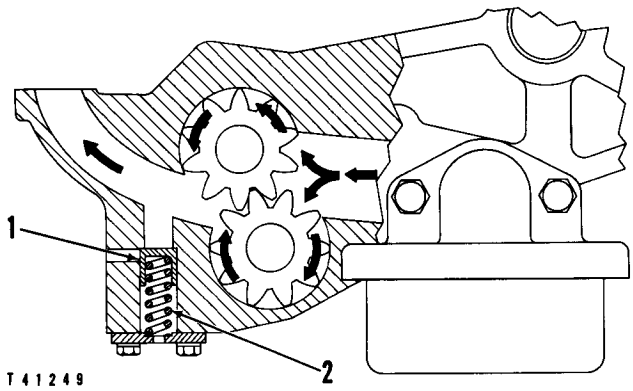
REMOVING THE OIL PAN PLATE

Oil Pump

INTRODUCTION

The oil pump is mounted on the bottom face of the cylinder block at the front of the engine. The pump is a two-section, positive displacement, gear-type pump. The rear set of gears scavenges oil from the rear of the engine and dumps it into the oil pan sump. The front set of gears supplies pressure lubrication to the engine through passages in the cylinder block.

The pump is the outlet pressure control by-pass valve type. A by-pass valve is contained in the pump support body. This valve consists of a spring **(2)** and plunger **(1)** which limit the maximum oil pressure to 35-45 PSI. When the pressure of the oil overcomes the force of the spring, the plunger is unseated, dumping oil, thus maintaining a uniform maximum oil pressure.

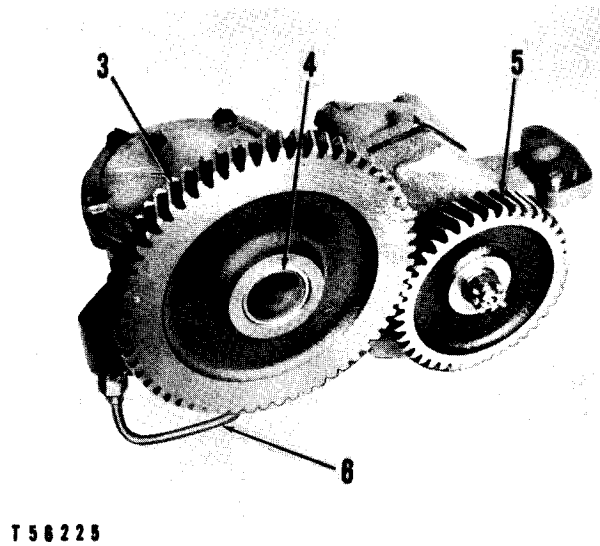


BY-PASS VALVE (SCHEMATIC)
1–Plunger. 2–Spring.

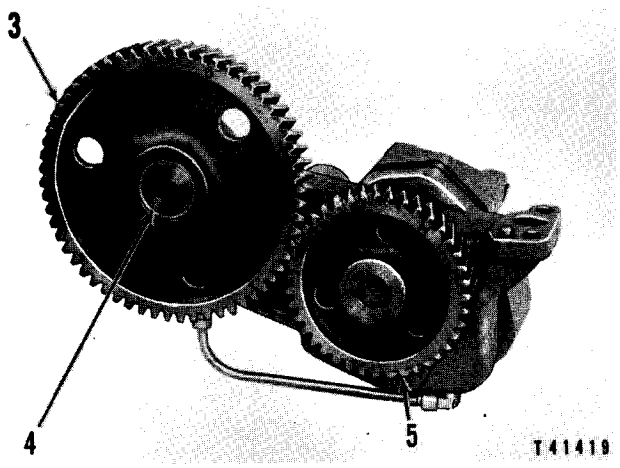
NOTE

On later engines, a tube **(6)**, connected to an oil passage in the cylinder block and to the oil pump idler gear stub shaft, furnishes lubrication for the idler gear bearings.

The oil pump drive gear **(5)** is driven by the idler gear **(3)** which is a slip fit on the stub shaft **(4)**. The stub shaft is pressed into the oil pump body assembly. The idler gear **(3)** is held in place on the stub shaft by a boss on the inside of the timing gear housing. The idler gear is driven by the crankshaft gear.



OIL PUMP DRIVE
(Later engines)
3–Idler gear. 4–Stub shaft. 5–Oil pump drive gear. 6–Tube.

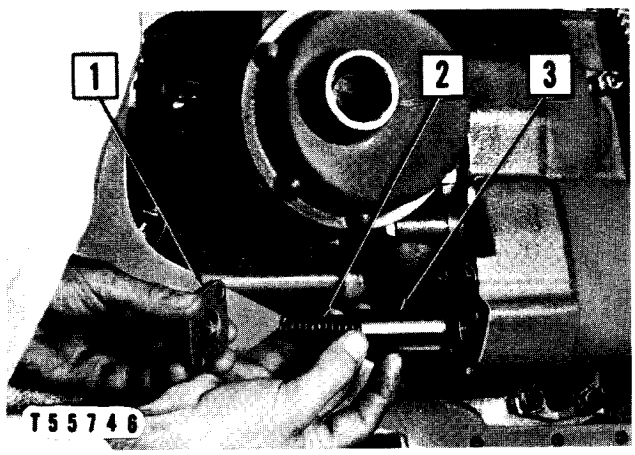


OIL PUMP DRIVE
(Earlier engines)
3–Idler gear. 4–Stub shaft. 5–Oil pump drive gear.

NOTE

On earlier engines, a tube from the pressure side of the pump to the oil pump idler gear stub shaft furnishes lubrication for the idler gear bearings.

BY-PASS VALVE



REMOVING BY-PASS VALVE

☐ **Remove**

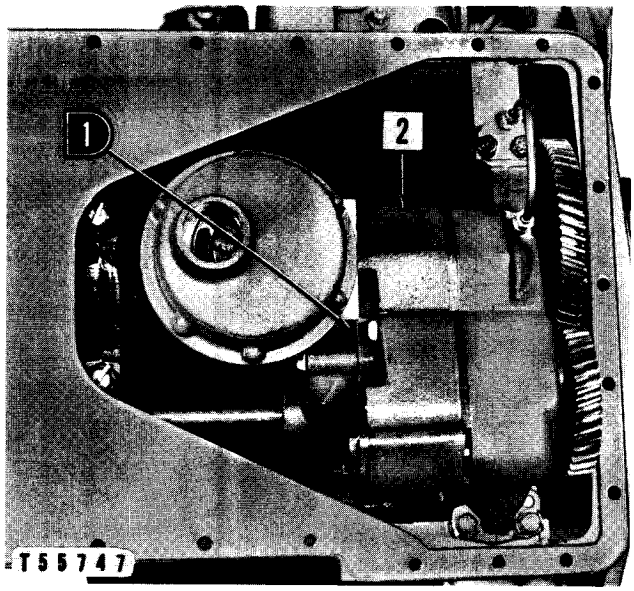
1–Flange. 2–Spring. 3–Plunger.

The by-pass valve can be removed without removing the oil pump. Drain the oil and remove the oil pan.

The valve may fail to function properly if foreign material gets between the plunger and the seat. After cleaning the contact surfaces, check that the seat is smooth and flat, and that the sealing surfaces of the plunger are in good condition. If the valve is functioning properly, the oil pressure should vary only slightly as the engine speed changes.

REMOVAL AND INSTALLATION

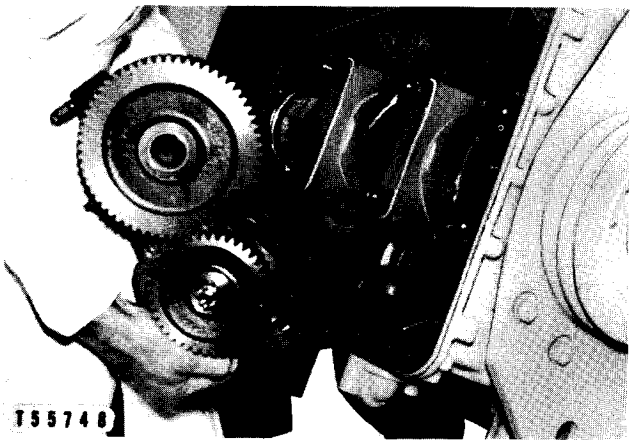
1. Drain the oil and remove the oil pan.
2. Install a new scavenge inlet elbow O-ring seal upon assembly.



PREPARING TO REMOVE THE OIL PUMP

Disconnect ☐ **Remove**

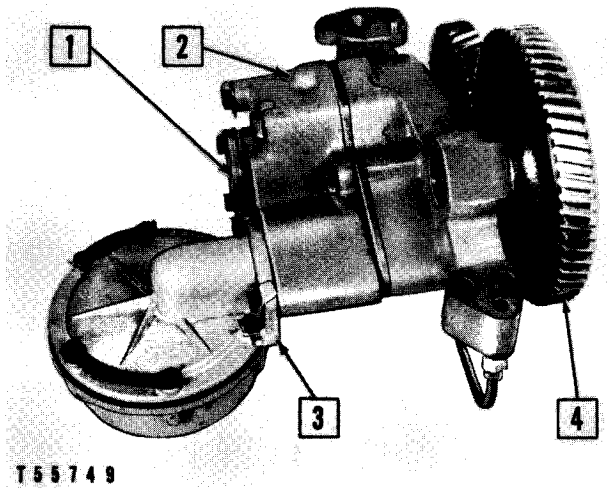
1–Scavenge inlet elbow. 2–Oil pump.



REMOVING OIL PUMP

DISASSEMBLY

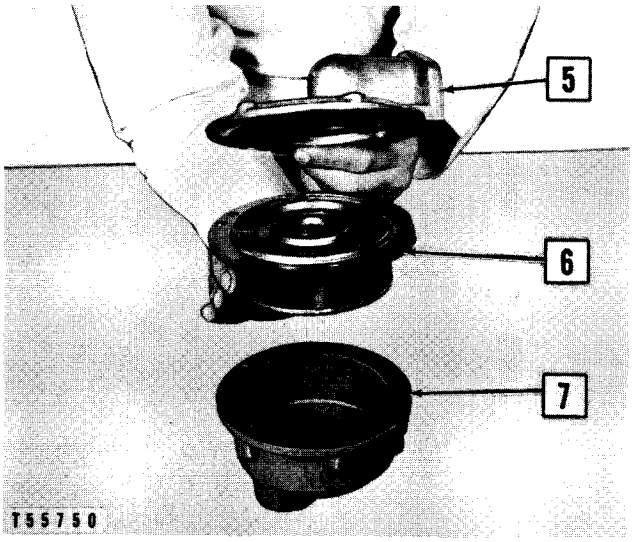
See the topic, BY-PASS VALVE, for an alternate removal of the flange **(1)**, spring and plunger **(8)**.



PREPARING TO DISASSEMBLE OIL PUMP

☐ **Remove**

1–Flange over by-pass plunger and spring. 2–Scavenger pump body. 3–Suction bell and adapter. 4–Idler gear.

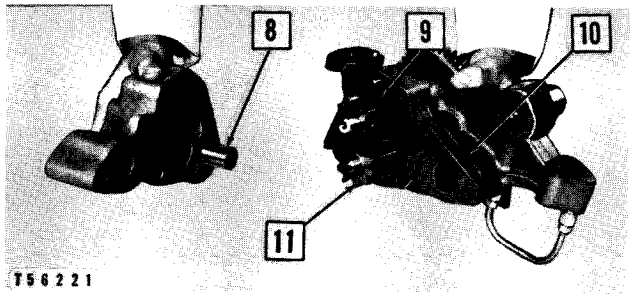


DISASSEMBLY OF SUCTION BELL

☐ **Remove**

5–Bell. 6–Screen assembly. 7–Cover.

1. Clean the screen **(6)** and inspect for damage.

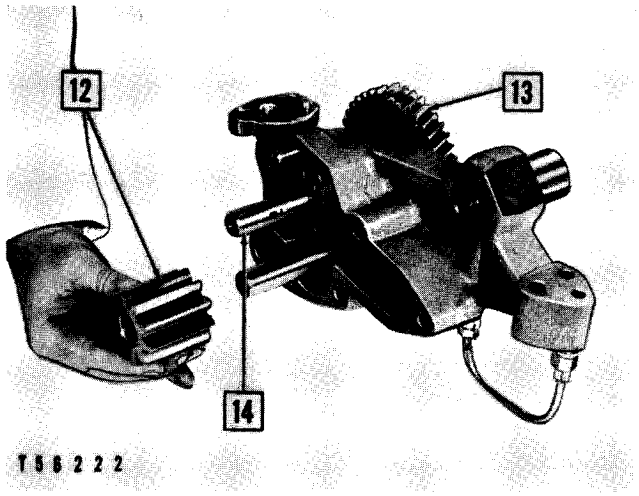


DISASSEMBLY OF SCAVENGE OIL PUMP

☐ **Remove**

8–Plunger. 9–Drive gear. 10–Spacer. 11–Driven gear.

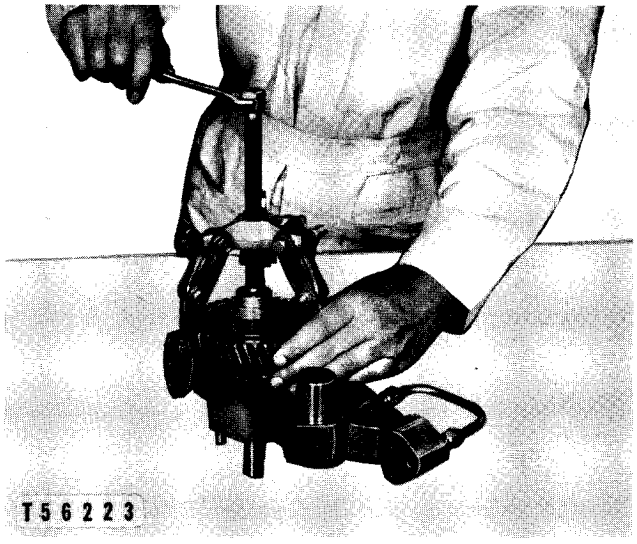
2. Prior to installation, place new gaskets on either side of the screen.



DISASSEMBLY OF OIL PUMP

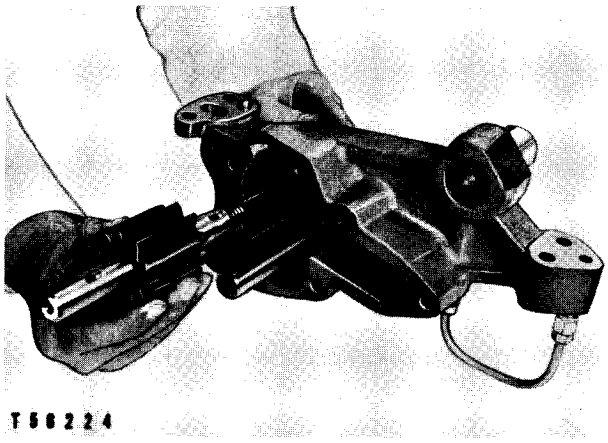
☐ **Remove**

12–Driven gear. 13–Drive gear. 14–Shaft assembly.



PULLING THE OIL PUMP DRIVE GEAR

3. Use an 8H695 Puller and 8B7560 Step Plate to remove the drive gear. When replacing the gear, torque the retaining nut to the value given in the topic, SPECIFICATIONS.
4. Before the shaft assembly can be removed from the pump body, it is necessary to remove the key.
5. Inspect the bearings in the pump body assembly for excessive wear and replace if necessary. See the topic, SPECIFICATIONS.
6. Ordinarily, oil pump gears should not have to be replaced unless they have worn sufficiently to cause a considerable drop in oil pressure or unless they have been damaged.



REMOVING THE SHAFT ASSEMBLY

7. Replace all worn or damaged parts, and assemble the pump in reverse order of disassembly. Check that the shafts turn freely with no binding or drag on the gears.

NOTE

If the gears bind, loosen the nuts and bolts slightly and relocate the pump bodies by tapping them lightly until the shafts turn freely.

Oil Coolers

ENGINE OIL COOLER

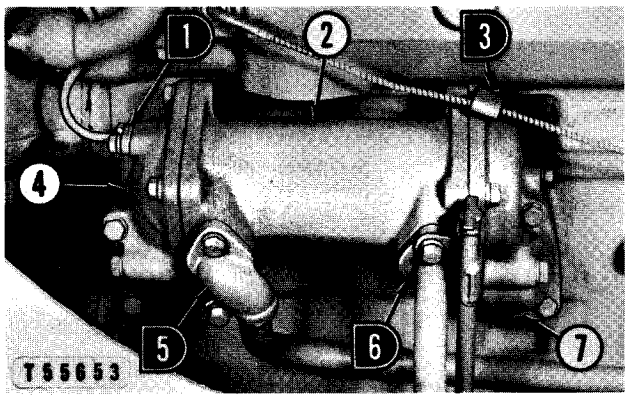
The engine oil cooler is mounted horizontally on the left front of the diesel engine block.

A portion of the coolant from the water pump circulates through the core of the cooler before entering the engine block.

Oil enters the cooler at the bottom, circulates around the tubes in the core and returns to the engine.

Removal and Installation

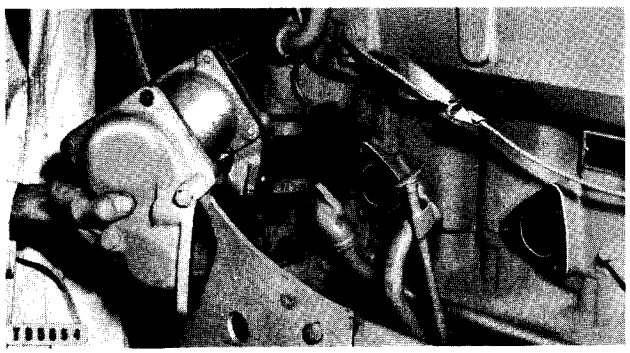
Drain the cooling system.



PREPARING TO REMOVE OIL COOLER

☐ Remove ◗ Disconnect

1–Air vent line. 2–Engine oil cooler. 3–Clip. 4–Bonnet. 5–Oil inlet tube. 6–Oil outlet tube. 7–Bonnet.



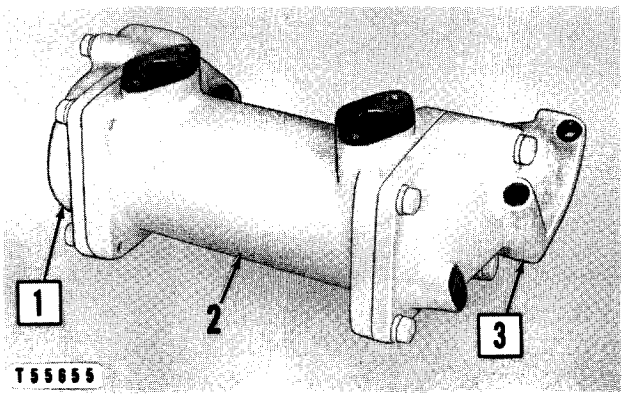
REMOVING THE OIL COOLER

Remove the bolts securing the bonnets **(4)** and **(7)** to the diesel engine block and remove the oil cooler as shown.

Check and replace, if necessary, all gaskets before installing the oil cooler on the engine.

Disassembly and Assembly

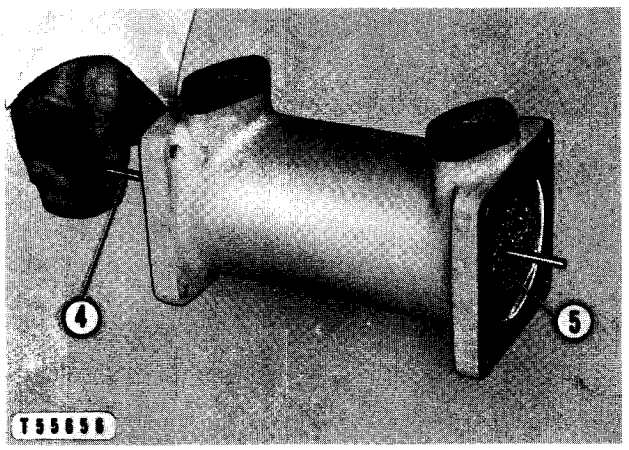
Remove the bonnets **(1)** and **(3)** from the engine oil cooler **(2)**.



OIL COOLER DISASSEMBLY

☐ Remove

1–Bonnet. 2–Cooler assembly. 3–Bonnet.

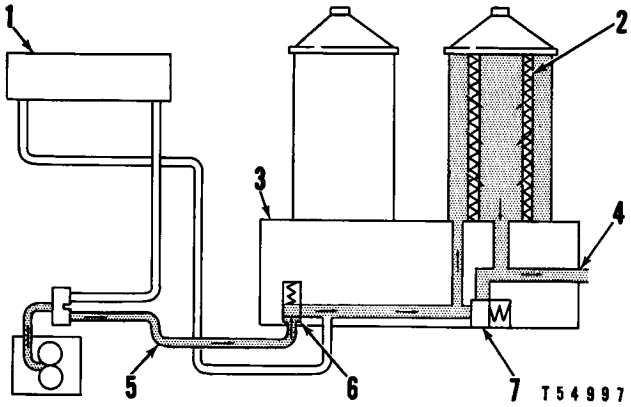


CLEANING OIL COOLER TUBES
4–Rod. 5–Tubes.

Accumulations of sediment can be removed from the tubes in the core **(5)** with a rod **(4)** 13/64" in diameter as shown.

Oil Filter

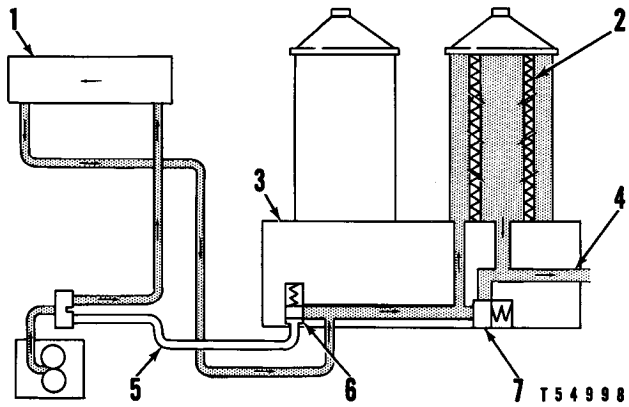
FLOW OF OIL THROUGH THE OIL COOLER, BASE AND OIL FILTER



FLOW OF OIL (COLD START)
1–Oil cooler. 2–Oil filter. 3–Oil filter base. 4–Outlet passage to engine manifold. 5–External oil cooler by-pass line. 6–Oil cooler by-pass valve. 7–Oil filter by-pass valve.

An oil filter by-pass valve **(7)** and oil cooler by-pass valve **(6)** are incorporated into the oil filter base. An external oil cooler by-pass line **(5)** is provided.

On cold starts, the oil cooler by-pass valve **(6)** opens, eliminating the oil cooler **(1)** restriction. The oil from the pump is directed through the external line **(5)**, past the oil cooler by-pass valve **(6)** and into the oil filter base **(3)**. The oil then passes through the oil filters **(2)** and on through the outlet passage **(4)** to the engine oil manifold, providing lubrication to the engine components.



FLOW OF OIL (NORMAL OPERATION)
(Nomenclature same as previous illustration)

As the oil temperature increases, the oil cooler by-pass valve **(6)** closes, and the oil is then forced to flow through the oil cooler **(1)** before entering the filter base **(3)**.

The oil filter by-pass valve **(7)** opens when the filters **(2)** become restricted and allows oil to by-pass the filters **(2)** and flow directly to the outlet passage **(4)**. Unless the filters are restricted or oil viscosity is extremely high, only filtered oil is furnished to the engine bearings.

The by-pass valves assure a supply of lubricating oil to the engine anytime the filter, cooler, or both become clogged.

NOTE

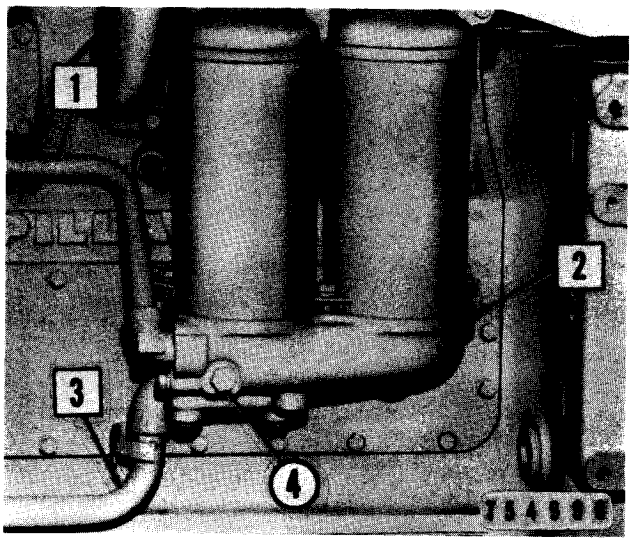
Earlier machines did not have the oil cooler by-pass valve **(6)** or the external oil cooler by-pass line **(5)**.

REMOVAL AND INSTALLATION

Drain the filter housing by removing the drain plug **(4)**.

Inspect the O-ring seal at the oil distribution manifold and replace if damaged.

Replace any damaged gaskets or seals. Coat the O-ring seals on the oil distribution manifold, oil cooler outlet line, and oil cooler by-pass line with liquid soap to ease installation.



OIL FILTER REMOVAL

☐ **Remove**

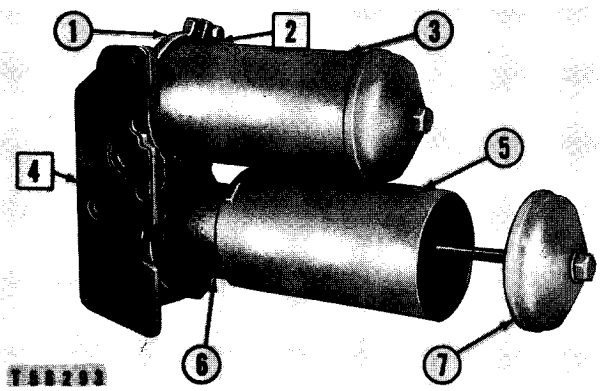
1–Oil cooler outlet line. 2–Oil filter base assembly. 3–Oil cooler by-pass line. 4–Drain plug.

DISASSEMBLY AND ASSEMBLY

NOTE

Earlier machines used an O-ring seal in place of the gasket **(4)** to provide a seal between the filter base and the side of the engine.

1. Unscrew the cover assembly **(7)** and remove the filter element **(6)** and case **(5)** from the filter base **(1)**.



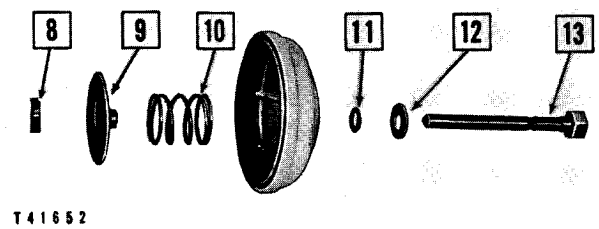
OIL FILTER DISASSEMBLY

☐ Remove

1–Filter base. 2–Bolt and clamp. 3–Case assembly. 4–Gasket. 5–Case. 6–Element. 7–Cover assembly.

NOTE

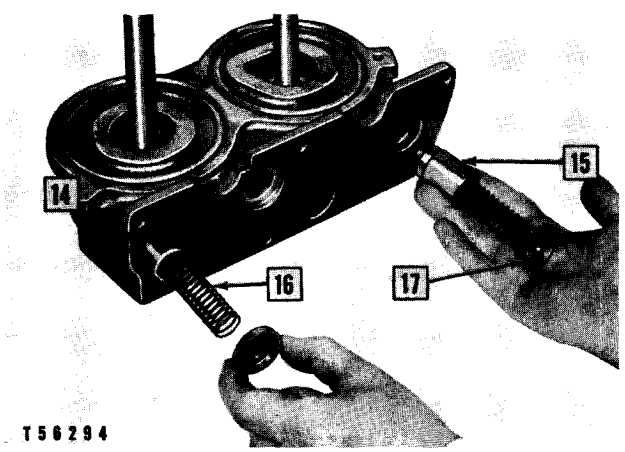
The case assembly **(3)** is disassembled in the same manner.



COVER DISASSEMBLY

☐ Remove

8–Clip. 9–Retaining plate. 10–Spring. 11–O-ring seal. 12–Gasket. 13–Screw.



FILTER BASE DISASSEMBLY

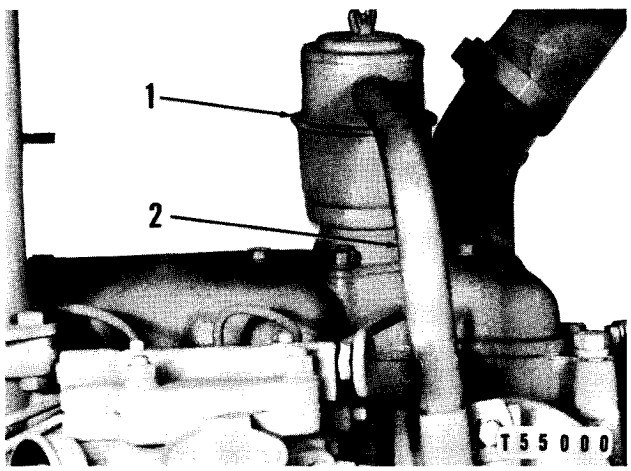
☐ Remove

14–Oil cooler by-pass valve plunger. 15–Oil filter by-pass valve plunger. 16–Springs (two). 17–Plugs (two).

2. Clean the filter parts thoroughly.
3. Inspect the oil cooler and oil filter by-pass valve plungers **(14)** and **(15)** and the surfaces against which they seat in the filter base. Replace the plungers if they worn or damaged.
4. Replace any damaged seals or gaskets.
5. Assemble in the reverse procedure of disassembly.

CRANKCASE BREATHER

The crankcase breather **(1)** is located on the valve cover of the diesel engine. A screen under the crankcase breather cap can be removed for cleaning. The breather assembly can be removed by removing the nuts which secure the base to the valve cover and by removing the bolts which hold the crankcase fumes disposal tube **(2)** to the cylinder head. Replace the gasket if it is damaged.



CRANKCASE BREATHER

1–Crankcase breather. 2–Crankcase fumes disposal tube.

Fuel System

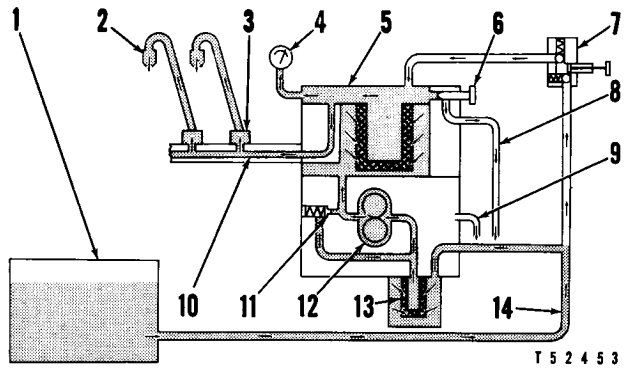
The fuel transfer pump **(12)** delivers fuel from the supply tank **(1)** to the fuel filter housing **(5)**. The fuel is filtered prior to reaching the fuel filter housing by the primary fuel filter **(13)**.

A spring-loaded by-pass valve **(11)** in the fuel transfer pump limits the maximum pressure of the fuel within the fuel filter housing **(5)**. When the pressure of the fuel within the housing exceeds the valve setting, the by-pass valve is forced open thus allowing the fuel to be by-passed to the inlet side of the fuel transfer pump **(12)**.

A drain line **(9)** is provided to drain, from the fuel transfer pump **(12)**, any leakage along the shaft in the pump.

After passing through the fuel filter, the fuel flows into the fuel manifold **(10)** which distributes fuel to the fuel injection pumps **(3)**.

A cam-actuated injection pump for each cylinder forces fuel through an injection line to the proper injection nozzle **(2)**. A definite quantity of fuel is forced into the precombustion chamber by the injection pump at the proper time.

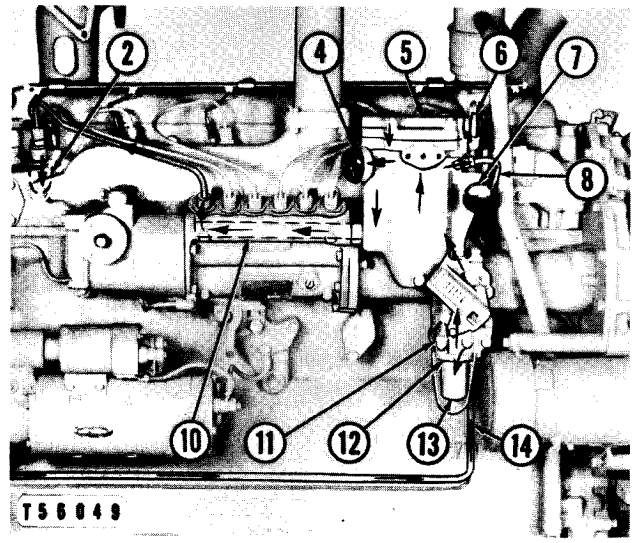


FLOW OF FUEL (SCHEMATIC)

1–Fuel supply tank.
2–Fuel injection nozzle.
3–Fuel injection pump.
4–Fuel pressure gauge.
5–Fuel filter housing.
6–Vent valve.
7–Fuel priming pump.
8–Vent line.
9–Drain line.
10–Fuel manifold.
11–By-pass valve.
12–Fuel transfer pump.
13–Primary fuel filter.
14–Fuel supply line.

One air vent valve **(6)** is provided to vent the air from the fuel system. It is located on the filter housing cover between the filter and the injection pumps. When the vent valve is opened and fuel is caused to flow through the system by the action of either the transfer pump **(12)** or a priming pump **(7)**, air escapes through the vent line **(8)**.

When the fuel system is vented, the vent valve **(6)** should be left open until a solid stream of fuel flows out the vent line **(8)**, indicating that all air has been bled from the system.



FUEL SYSTEM
(Nomenclature Same as Previous Illustration)

The fuel pressure gauge **(4)** is connected to the fuel filter housing. Lack of pressure on the gauge indicates difficulty in the supply side of the system. This could be caused by an empty diesel fuel tank, a closed shut-off valve at the tank, clogged filter, dirt under the by-pass valve, open vent valve, a faulty transfer pump or gauge.

To eliminate the possibility of a clogged filter causing a low fuel pressure gauge reading, install a new filter element.

Air in the system or water in the fuel can also be responsible for the engine firing irregularly or failing to start.

If, after eliminating the above possibilities, there still seems to be something wrong with the fuel system, check the injection side of the system. Fuel injection pumps and fuel injection valves can be checked as described later.

Many times the fuel system is blamed when the fault lies elsewhere. A smoky exhaust may be caused by faulty fuel injection valves. It can also be caused by a dirty air cleaner, overloading at high altitude, or badly worn piston rings.

Irregular firing can be caused by faulty fuel injection valves. It can also be caused by the burning of excessive lubricating oil escaping past worn piston rings, or new rings which have not become fully seated.

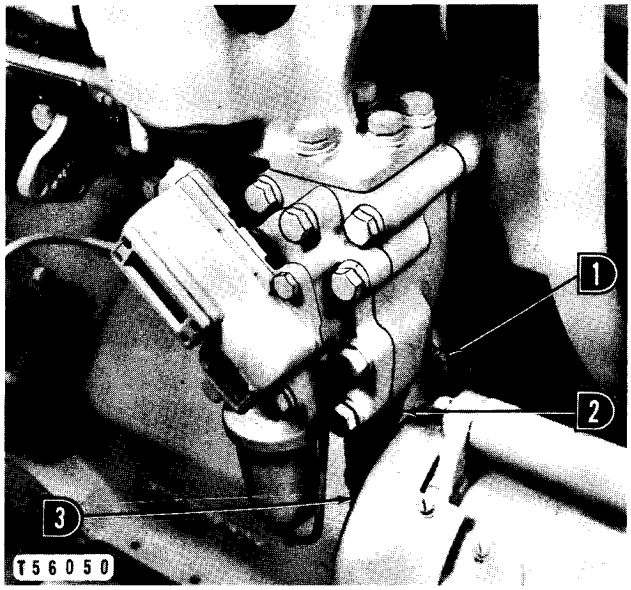
Fuel Supply Equipment

FUEL TRANSFER PUMP

The gear-type fuel transfer pump is driven by a gear machined on the accessory drive shaft.

Removal and Installation

1. Shut off the fuel at the fuel supply tank.
2. Remove the Service Meter. See the topic, SERVICE METER REMOVAL AND INSTALLATION.

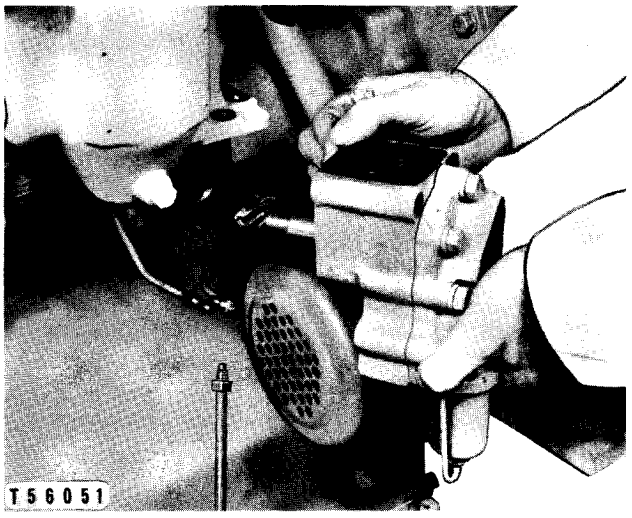


PREPARING TO REMOVE THE FUEL TRANSFER PUMP

Disconnect

1–Drain line. 2–Priming pump supply line. 3–Fuel supply line.

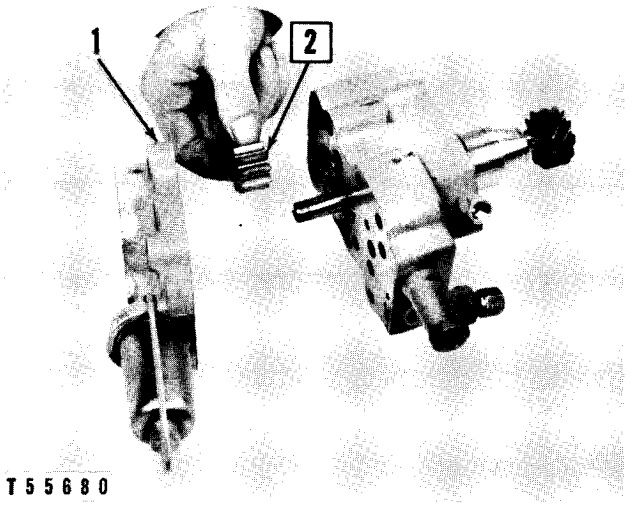
3. Remove the bolts which secure the fuel transfer pump to the adapter housing and the bolts which secure the fuel filter housing to the pump.



REMOVING THE FUEL TRANSFER PUMP

4. Pull the fuel transfer pump outward from the accessory drive housing as illustrated.
5. Prior to installation, inspect the gaskets and replace if damaged.

Disassembly and Assembly

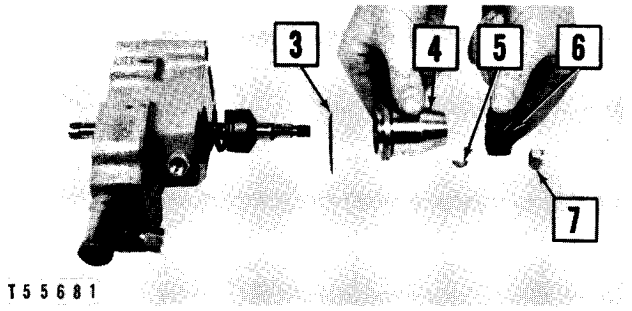


DISASSEMBLY OF FUEL TRANSFER PUMP

Remove

1–Cover. 2–Idler gear.

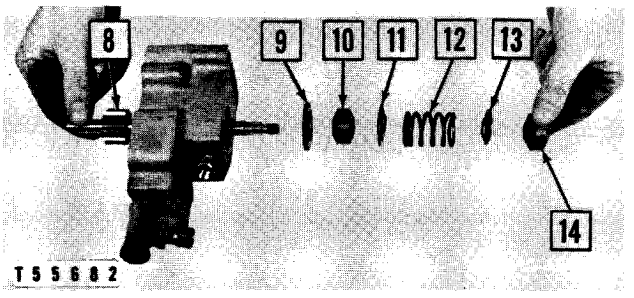
1. Use an 8H695 Puller and a suitable step plate to remove the gear **(6)** from the shaft.



FUEL TRANSFER PUMP DISASSEMBLY

Remove

3–Gasket. 4–Seat assembly. 5–Key. 6–Gear. 7–Nut.



FUEL TRANSFER PUMP DISASSEMBLY

Remove

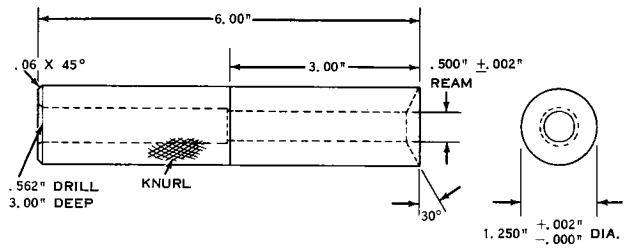
8–Drive shaft assembly. 9–Gasket. 10–Seal. 11–Retainer. 12–Spring. 13–Retainer. 14–Seal.

2. The bearing **(16)** in the pump body and the bearing **(17)** in the seat assembly can be pressed out and replaced if worn or damaged. Install the bearings with tapered edges toward the seal.
3. The seals **(10)**, **(14)** and **(20)** should be soaked prior to installation in a solution of ½ SAE 30 oil and ½ diesel fuel long enough to soften them. The seals should be tamped firmly into the pump body bore and around the shaft with a tamping tool machined as illustrated. A guide should be used over the end of the transfer pump shaft to guide the seals over the threads and sharp corners of the shaft. The guide should be machined as illustrated. The guide also should remain in place when using the tamping tool.
4. When assembling the pump, install the gear with the grooved side facing the nut **(7)** and tighten the nut. See the topic, SPECIFICATIONS, for proper nut torque.
5. When assembling the pump, apply a thin film of Permatex No. 3 or equivalent to the surface between the pump body and pump cover.

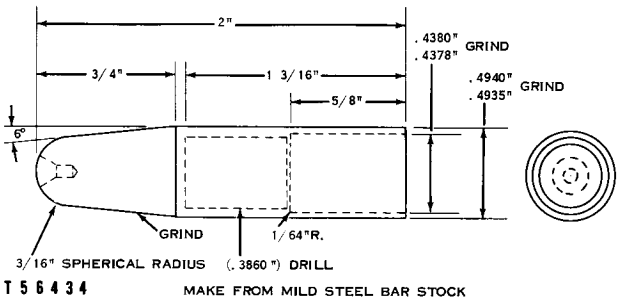
CAUTION

Do not allow Permatex to enter pump.

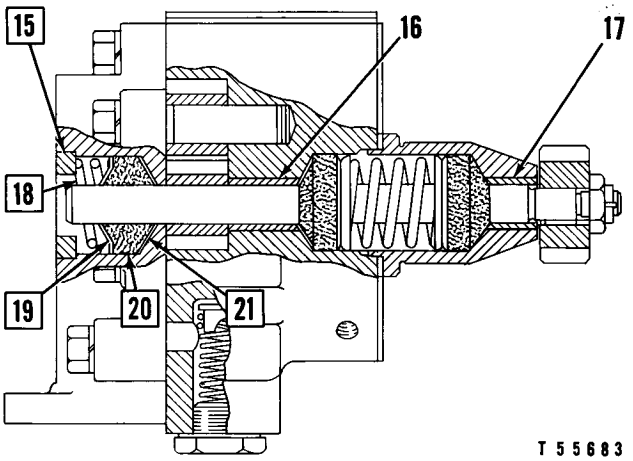
6. Apply a thin film of Permatex No. 3 or equivalent to the outside diameter of the spring retainer **(15)**. The retainer must be flush with the cover to the tolerance given in the topic, SPECIFICATIONS.



SEAL TAMPING TOOL



SEAL AND TAMPING TOOL GUIDE



FUEL TRANSFER PUMP BEARINGS

☐ Remove

15–Retainer. 16–Bearing. 17–Bearing. 18–Spring. 19–Retainer. 20–Seal. 21–Gasket.

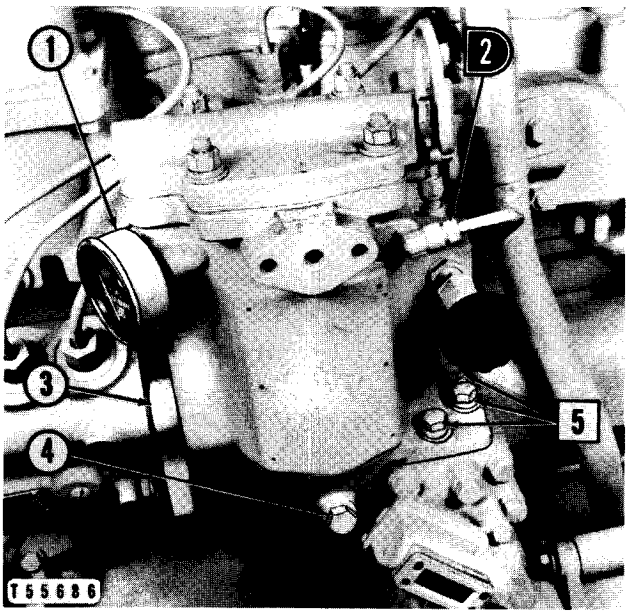
FUEL FILTER HOUSING

Removal and Installation

Drain the fuel filter housing by removing the drain plug **(4)**.

NOTE

If the engine is equipped with a fuel priming pump, the pump and filter housing are removed as a unit.



PREPARING TO REMOVE FUEL FILTER HOUSING

☐ Remove ◗ Disconnect

1–Fuel pressure gauge. 2–Drain line. 3–Adapter. 4–Drain plug. 5–Fuel filter housing retaining bolts.

Remove the fuel filter housing by sliding it toward the front of the engine to clear the adapter **(3)**.

Inspect and replace all damaged seals and gaskets.

FUEL BY-PASS

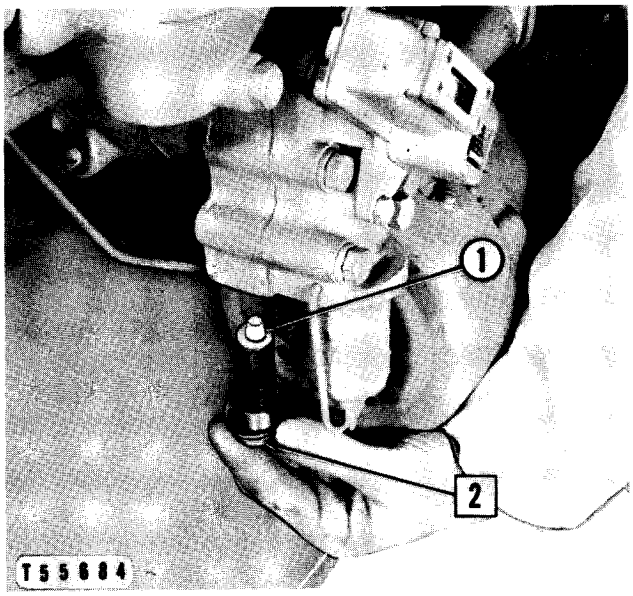
The fuel transfer pump supplies more fuel than is required for engine operation. The fuel by-pass valve prevents excessive pressure within the fuel system. The by-pass valve may fail to function properly if dirt gets between the plunger and the seat. If the plunger is not seating properly, there will be little, if any, fuel pressure. If the plunger sticks closed, the pressure will be excessive but will not show on the gauge.

The by-pass valve is installed in the fuel transfer pump body.

Removal and Installation

Clean the contact surfaces. See that the seat is smooth and flat, and that the sealing surface of the plunger **(1)** is in good condition.

See the topic, SPECIFICATIONS for correct spring length and pressure.



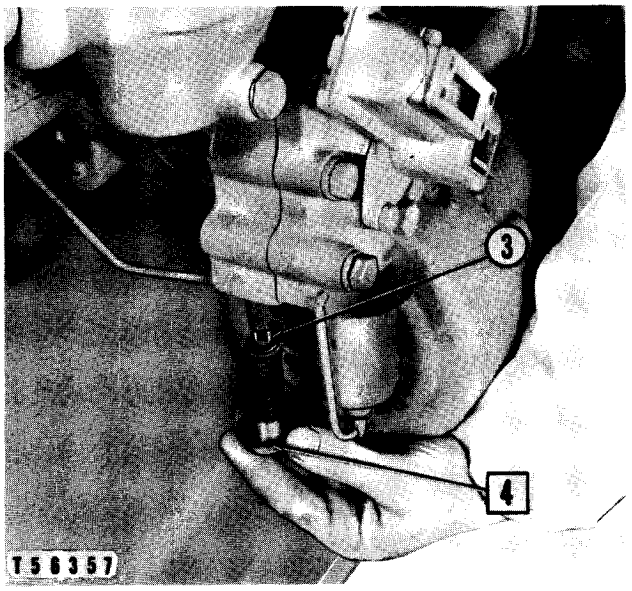
REMOVING THE BY-PASS VALVE

☐ **Remove**

1–Plunger. 2–Bolt.

Carefully install the plunger and spring into the fuel transfer pump body.

A resilient sealing ring is molded to the shoulder of the plunger to form the sealing surface of the new style plunger. The new plunger is adaptable to all earlier models. When converting to the new style plunger, add a slight chamfer to the edge of the housing bore that accepts the nose of the by-pass valve plunger.



REMOVING NEW STYLE BY-PASS VALVE

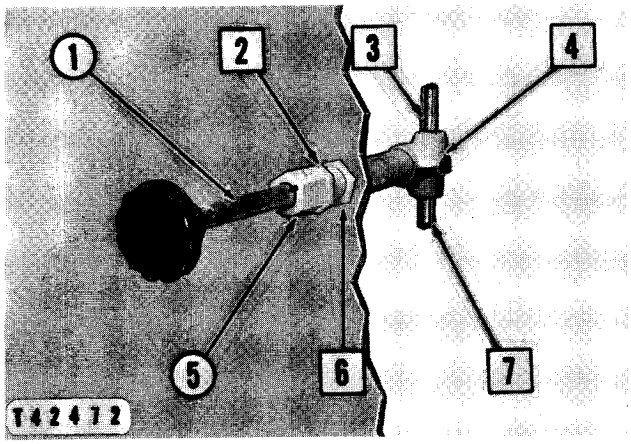
☐ **Remove**

3–Plunger assembly. 4–Bolt.

FUEL PRIMING PUMP

Removal and Installation

Loosen the nut **(5)** and remove the nut and plunger **(1)** as an assembly.



FUEL PRIMING PUMP REMOVAL

☐ **Remove**

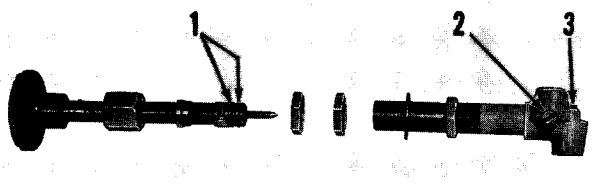
1–Plunger. 2–Nut. 3–Outlet line. 4–Pump housing. 5–Nut. 6–Nut. 7–Inlet line.

Disassembly and Assembly

The outlet check valve may be removed by removing screw **(3)**.

The inlet check valve may be removed by removing screw **(2)**.

When assembling the plunger to the pump housing, inspect the O-ring seals **(1)** and check valves and replace if necessary.



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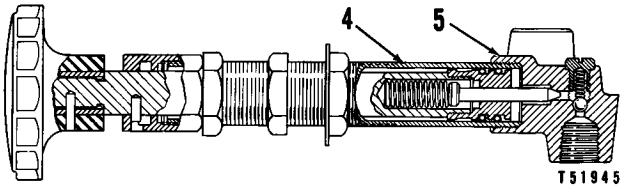
FUEL PRIMING PUMP DISASSEMBLY
1–O-ring seals. 2–Screw. 3–Screw.

Other parts can be replaced if necessary. The barrel **(4)** is threaded into the body **(5)**.



FUEL PRIMING PUMP DISASSEMBLY
4–Barrel. 5–Body.

PRIMARY FUEL FILTER

Removal and Installation

1. Shut off the fuel valve at the fuel supply tank.

PREPARING TO REMOVE THE PRIMARY FUEL FILTER
1–Element assembly. 2–Bowl.

2. Unscrew the nut on the bail, and remove the bowl **(2)**.
3. The element assembly **(1)** can be removed by unscrewing it from the cover on the fuel transfer pump.
4. Prior to installation, inspect the gasket between the bowl and the fuel transfer pump, and replace if damaged.

Fuel Injection Equipment

The most likely causes for faulty fuel injection performance are:

1. Air in the fuel system.
2. Low fuel supply.
3. Water in the fuel.
4. Clogged fuel filter.
5. Insufficient fuel transfer pump pressure.

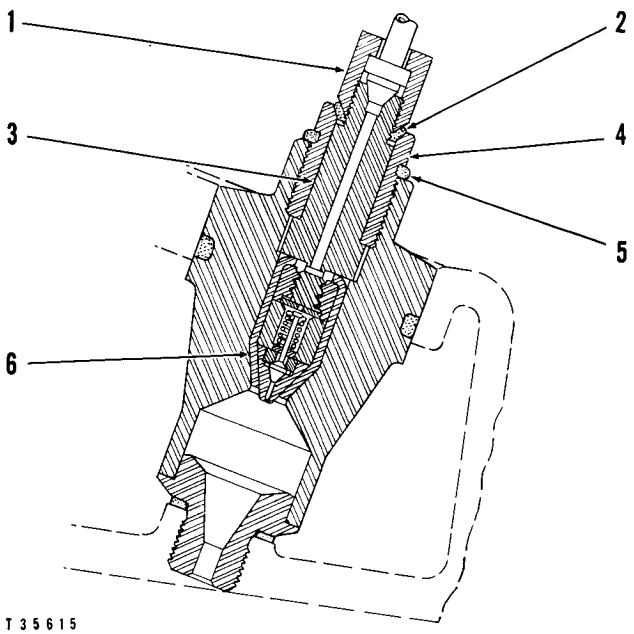
If these conditions are checked and corrected and the engine still does not perform properly, the fuel injection equipment should be checked.

CHECKING FUEL INJECTION EQUIPMENT

Before removing a fuel injection pump or valve for testing on an engine that is missing or puffing black smoke at the exhaust, a simple check can be made to determine which cylinder is causing the difficulty. With the engine operating at a speed which makes the defect most pronounced, momentarily loosen the fuel line nut on the injection pump sufficiently to "cut out" the cylinder. Check each cylinder in the same manner. If one is found where loosening makes no difference in the irregular operation of the engine, or causes puffing of black smoke at exhaust to cease, probably the pump and valve for only that cylinder need be tested.

FUEL INJECTION VALVE

The function of the fuel injection valves is to inject and atomize the fuel from the fuel injection pumps into the precombustion chambers. Irregular engine operation and smoking may be caused by an improperly operating injection valve.



FUEL INJECTION VALVE CROSS SECTION
1–Fuel line assembly. 2–Seal. 3–Body. 4–Nut. 5–Seal. 6–Nozzle assembly.

The fuel injection valve assembly is installed in the precombustion chamber. The fuel injection valve assembly consists of the body **(3)**, nut **(4)**, and the capsule type nozzle assembly **(6)**. Only the nozzle assembly need be replaced.

The nozzle assembly **(6)** and body **(3)** are held in place by the nut **(4)**, and they can be removed by disconnecting the fuel line assembly **(1)** and removing the nut and seals **(2)** and **(5)**.

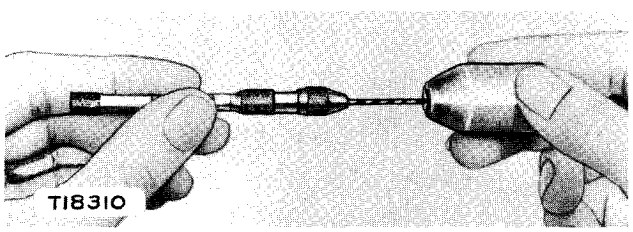
The body and the nozzle assembly can then be lifted out. The nozzle assembly is only finger-tight on the body.

When installing a fuel injection valve, always check the seats of both the nozzle and the precombustion chamber.

Tighten the nut **(4)** to the torque value listed in the topic, SPECIFICATIONS, to assure proper seating of the nozzle assembly. Excessive tightness will damage the nozzle. Excessive looseness will allow the nozzle to leak and in some instances cause the nozzle case to bulge or split.

Cleaning Fuel Injection Valve

The operation of the engine will be affected if the orifice in the nozzle becomes partially filled with carbon. To correct this, remove the nozzle assembly from the valve body and clean the fuel discharge hole using the drill given in the topic, SPECIFICATIONS, and a 5B1254 Chuck, which are part of the 5B1401 Cleaning Tool Group. If the valve does not operate properly after cleaning, the nozzle should be checked for leakage.



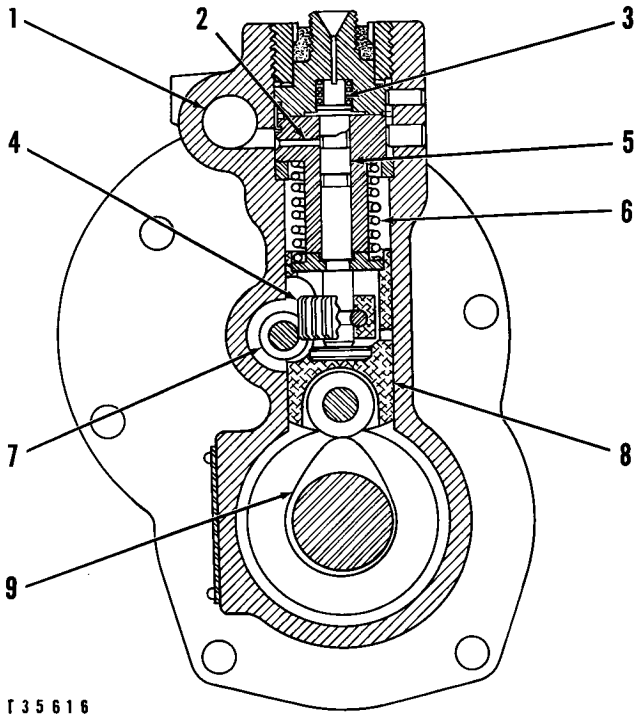
CLEANING FUEL INJECTION NOZZLE ASSEMBLY

Checking Fuel Injection Valve

The condition of a capsule-type nozzle assembly can be tested out of the engine on the Caterpillar Diesel Fuel Injection Test Apparatus. The spray characteristic, valve unseating pressure, and the rate of leakage of the nozzle assembly can be determined.

FUEL INJECTION PUMPS

Fuel enters the fuel injection pump housing through passage **(1)** and enters the fuel injection pump body through the inlet port **(2)**. The injection pump plungers **(5)** and the lifters **(8)** are lifted by the cam lobes on the camshaft **(9)** and always make a full stroke. The lifters are held against the cam lobes by the springs **(6)**. Each pump measures the amount of fuel to be injected into its respective cylinder and delivers it to the fuel injection nozzle.



FUEL INJECTION PUMP
1–Fuel passage. 2–Inlet port. 3–Check valve. 4–Gear segment. 5–Pump plunger. 6–Spring. 7–Fuel rack. 8–Lifter. 9–Camshaft.

The amount of fuel pumped per stroke is varied by turning the plunger in the barrel. The plunger is turned by the governor action through the circular rack **(7)** which turns the gear segment **(4)** on the bottom of the pump plunger.

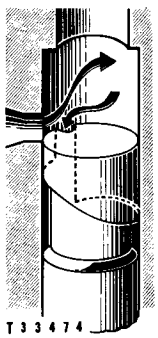


FIG. A
Port Uncovered Fuel Enters Barrel

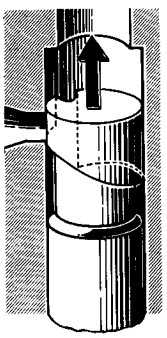


FIG. B
Port Covered Injection Begins

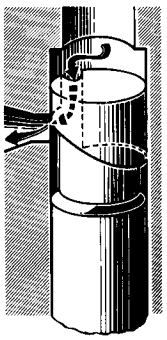


FIG. C
Port Uncovered Injection Ends

Figures A, B and C illustrate the functioning of an injection pump as the plunger makes a stroke.

In Fig. A the plunger is down and the inlet port **(2)** is uncovered. Fuel flows into the space above the plunger through the slot and into the recess around the plunger.

In Fig. B the plunger has started up and the port is covered. The fuel is trapped and will be forced through the check valve **(3)**, fuel line, and injection valve as the plunger moves upward.

In Fig. C the plunger has risen until the port is uncovered by the recess in the plunger. The fuel can now escape back through the port into the fuel manifold and injection will cease.

It will be noted that the recess in the pump plunger forms a helix around the upper end of the plunger. Figures D, E and F illustrate how rotating the pump plunger affects the quantity of fuel injected.

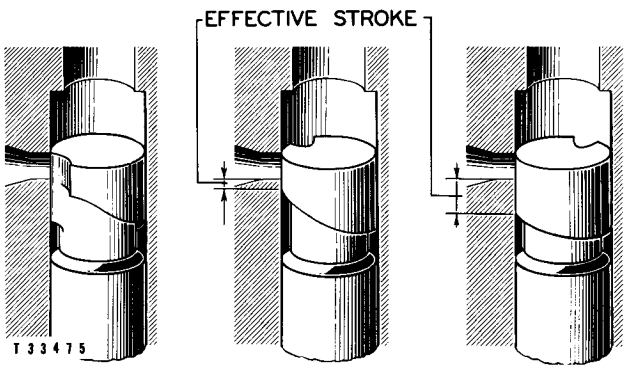


FIG. D
SHUT OFF

FIG. E
IDLING POSITION

FIG. F
FULL LOAD POSITION

In Fig. D the plunger has been rotated into the shut-off position. The slot connecting the top of the plunger with the recess is in line with the port; therefore, no fuel can be trapped and injected.

In Fig. E the plunger has been rotated into the idling position. The narrow part of the plunger formed by the helix will cover the port for only a short part of the stroke. This permits only a small amount of fuel to be injected per stroke.

In Fig. F the plunger has been rotated into the full load position. The wide part of the plunger formed by the helix covers the port for a longer part of the stroke. This permits a larger amount of fuel to be injected per stroke.

Worn fuel injection pumps will result in loss of power and hard starting. These same conditions may be present if the piston rings and cylinder liners are badly worn. However, in the case of worn piston rings and liners, the hard starting and loss

of power will be accompanied by poor compression, a smoky exhaust and excessive blow-by gases from the crankcase breather.

Ordinarily, if one fuel injection pump on an engine is worn, it will be found that all of the injection pumps are worn and need replacing. Failure to replace all of the worn injection pumps may result in erratic and irregular engine operation.

FUEL INJECTION PUMP HOUSING

The fuel injection pump housing is bolted to the accessory drive housing. The fuel injection camshaft is mounted in the lower section of the housing and is driven by an off-center tang on the end of the accessory drive shaft.

The fuel injection pump camshaft turns in three bearings, one at each end of the camshaft, and one at the center. The camshaft determines the vertical movement of the fuel pump plungers and also drives the governor weights.

The fuel injection pump camshaft is splash lubricated by the oil from the governor housing. The cam lobes dip into the oil and in turn lubricate the lifters. Lubricating oil drains forward through the accessory drive housing and into the diesel engine crankcase.

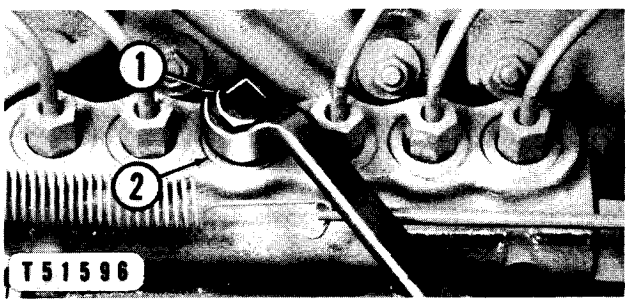
Removal and Installation

The fuel injection pump housing and the governor can be removed as a unit, or the governor can be removed separately. See the topic, ACCESSORY DRIVE REMOVAL.

When installing the pump housing, align the off center tang on the accessory drive shaft with the slot in the end of the camshaft.

Fuel Injection Pump Removal

Disconnect or remove the fuel injection line.

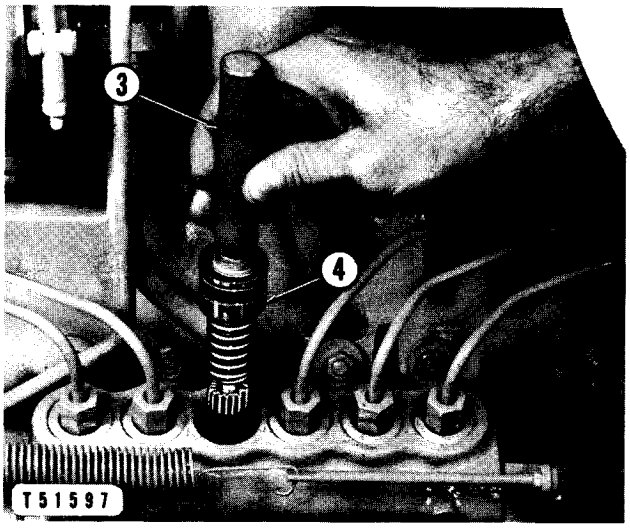


PREPARING TO REMOVE INJECTION PUMP
1–1M6952 Wrench. 2–Bushing.

Remove the cap and the felt washer under the cap.

Use a 1M6952 Wrench **(1)** to remove the fuel injection pump retaining bushing **(2)** from the fuel injection pump housing.

Use a 1M6954 Extractor **(3)** to remove the fuel injection pump **(4)** from the housing.



REMOVING INJECTION PUMP
3–1M6954 Extractor. 4–Fuel injection pump.

Fuel Injection Pump Disassembly and Assembly

1. Remove the seal **(1)**.

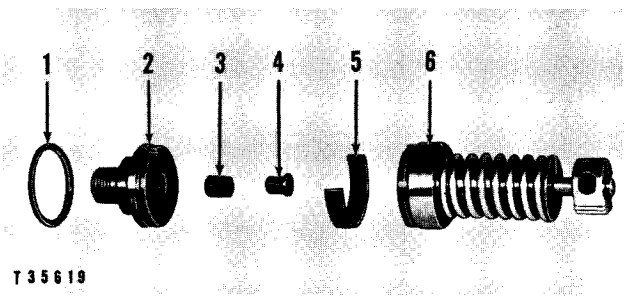
CAUTION

All disassembly and assembly should be done with clean hands on a clean, lint free cloth.

2. Remove the retaining ring **(5)** and separate the bonnet **(2)** and barrel assembly **(6)**.

NOTE

Considerable care should be taken not to drop and lose the check valve **(4)** and spring **(3)** retained in the bonnet.



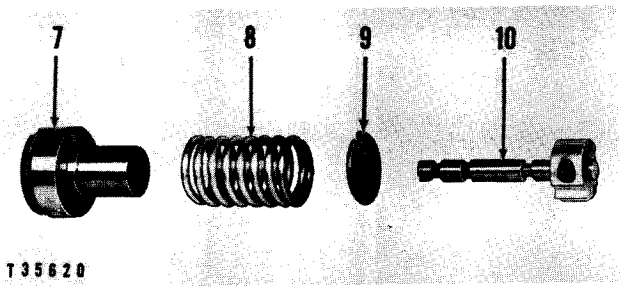
FUEL INJECTION PUMP DISASSEMBLY
1–Seal. 2–Bonnet. 3–Spring. 4–Check valve. 5–Ring. 6–Barrel assembly.

3. Separate the spring **(8)**, washer **(9)** and plunger **(10)** from the barrel **(7)**.

4. Remove washer and spring from the plunger.

CAUTION

Considerable care should be exercised when removing the spring and washer to prevent damage to the plunger surfaces.



FUEL INJECTION PUMP DISASSEMBLY
7–Barrel. 8–Spring. 9–Washer. 10–Plunger assembly.

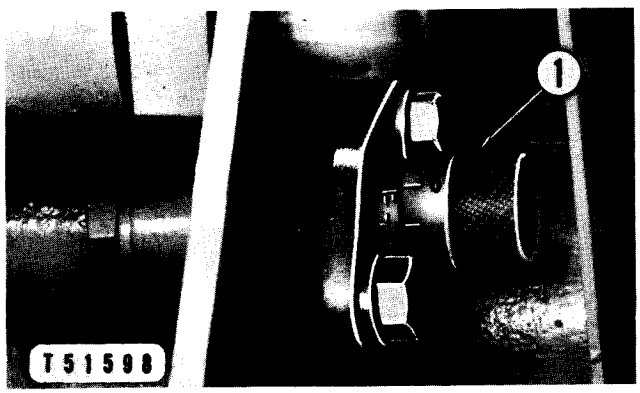
5. Clean all parts with clean diesel fuel and assemble, replacing any worn or damaged parts.

CAUTION

The barrel and the plunger assembly are matched, and the individual parts are not interchangeable with other barrels or plunger assemblies. Use extreme care in inserting the plunger into the bore of the barrel.

Fuel Injection Pump Installation

1. Remove the cover on the end of the accessory drive housing and position the fuel rack by using the 8M530 Rack Setting Gauge **(1)**. Bolt the gauge to the fuel injection pump housing as shown. When the rack is properly positioned, the reading on the gauge should be .000".

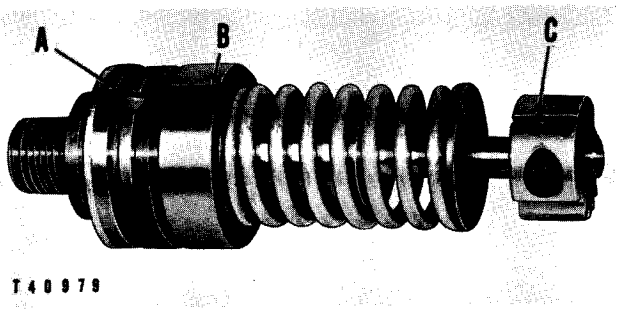


POSITIONING RACK
1–8M530 Rack Setting Gauge.

2. Align the notches **(A)** and **(B)** on the bonnet and the barrel with slot **(C)** on the gear segment.

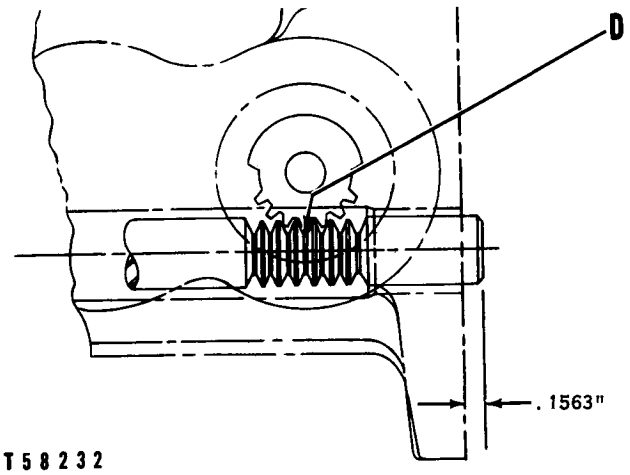
NOTE

The procedure thus far has aligned the center notch on the rack for each pump with the center tooth of the gear segment on the injection pump plunger.



ALIGNING THE INJECTION PUMP
A–Notch in bonnet. B–Notch in barrel. C–Slot in gear segment.

3. Insert the assembly into the bore of the housing with the extractor. The notches in the bonnet and the barrel must engage with the two locating dowels in the bore of the pump housing. These dowels align the pump barrel fuel inlet port with the fuel manifold outlet port.



CORRECT POSITION OF GEAR SEGMENT AND RACK
D–Fourth notch on fuel rack.

4. After each plunger and barrel assembly is installed, place a new rubber seal over the bonnet and start the retainer bushing into the housing. Push the plunger and barrel assembly into the housing until the dowel is engaged with the bonnet and screw the retainer bushing finger tight.

CAUTION

After the plunger and barrel assembly is installed, leave the 1M6954 Extractor in position to hold the barrel from turning until the retainer bushing has been screwed in finger tight. If the retainer bushing will not screw down and seat properly in the housing, do not force it by using a wrench. The bushing will not seat because the notches in the barrel are not properly aligned with the dowels in the pump housing. Damage

to the dowel pins can result from forcing the bushing.

5. Tighten the bushing to the torque value listed in the topic, SPECIFICATIONS.

NOTE

Prior to installation of the plunger and barrel assembly, make certain the lifter for the assembly to be installed is at the bottom of its stroke.

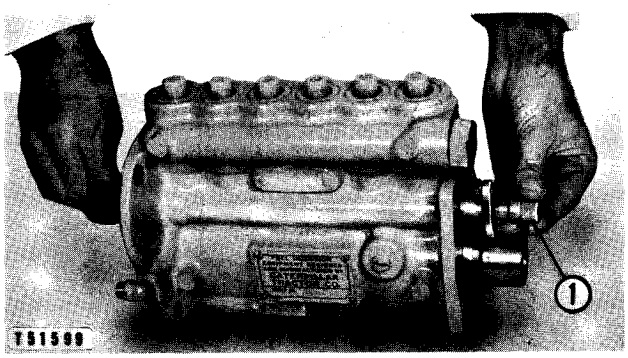
CAUTION

With a torque value of less than that listed in the specifications, the pump will leak. If the torque value is greater, the housing can be damaged.

6. The rack travel must be measured to make certain that the plunger gear segment is properly meshed with the fuel rack. The gear segment and rack are so constructed that the maximum travel of the rack in either direction can be obtained only when the 4th tooth of the gear segment is meshed with the 4th notch on the rack. If the gear segment is misplaced in either direction, the rack travel will be reduced in both directions. It is, therefore, necessary to measure the rack travel in only one direction to make certain that the gear segment is properly meshed with the fuel rack. This is measured by using the 8M530 Rack Setting Gauge **(1)**. The rack is moved to its extreme fuel on position. A minimum reading of + .312" on the gauge indicates that the gear segment is properly positioned with the rack. The rack collar must be removed in order to obtain this much rack travel.

CAUTION

An injection pump improperly installed in the "fuel ON" side position of its gear segment can cause an engine to overspeed with resultant serious damage to the engine and driven equipment.



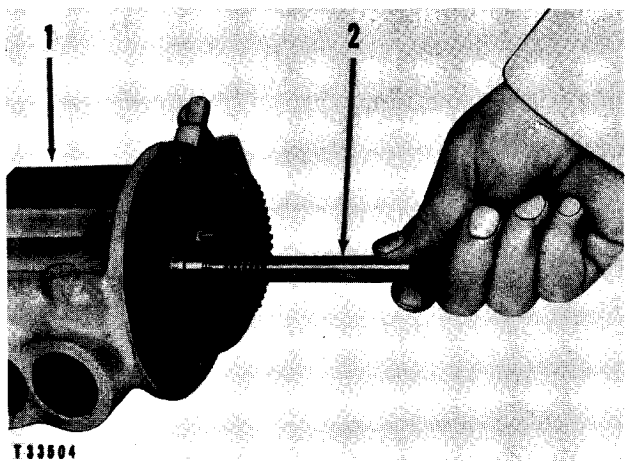
CHECKING RACK TRAVEL
1–8M530 Rack Setting Gauge.

7. If this measurement is not obtained, the gears are improperly positioned and the procedure must be repeated.
8. Remove the Rack Setting Gauge, install the felt washers and connect the fuel injection lines.

Fuel Rack Removal and Installation

The fuel rack can be removed from the fuel injection pump housing with the pump housing on the engine if desired.

Remove the fuel injection pumps and the governor weights. See the covering topics.



FUEL RACK REMOVAL
1–Fuel injection pump housing. 2–Fuel rack.

Remove the fuel rack **(2)** from the injection pump housing **(1)** as shown.

Install in the reverse order of removal.

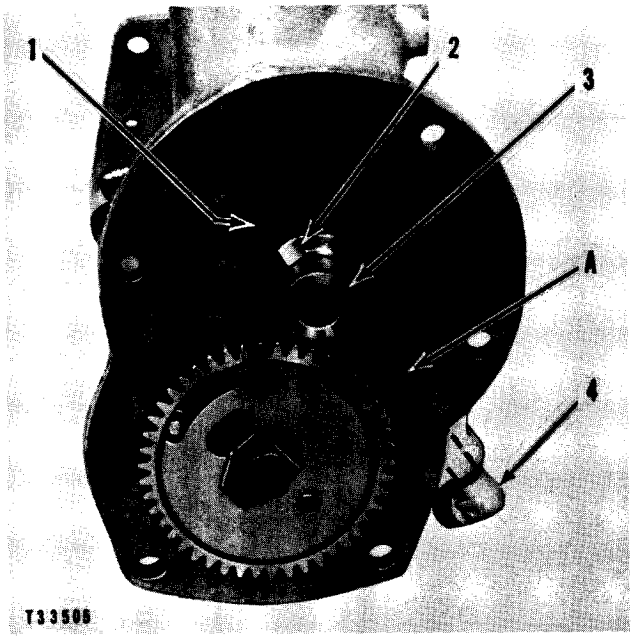
Fuel Rack Bearing Removal and Installation

The fuel rack moves in two bearings, one pressed into each end of the fuel injection pump housing.

See the topic, SPECIFICATIONS, for bearing clearances.

The bearing on the accessory drive end of the fuel injection pump housing is a straight-type bearing and can be replaced if worn or damaged without following any marking procedure. The bearing on the governor end of the pump housing must be installed as illustrated.

1. Remove the fuel injection pump housing, governor, fuel injection pumps and fuel rack. See the covering topics.
2. Place two scribed marks **(1)** as shown above the groove **(2)** on the bearing **(3)** to align the groove on the bearing with the drilled lubrication passage **(A)** from the fitting **(4)**.



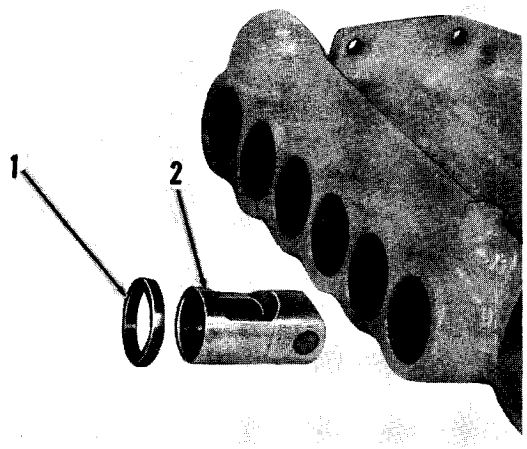
FUEL RACK BEARING REMOVAL
1–Scribe marks. 2–Lubrication groove. 3–Bearing. 4–Fitting. A–Lubrication passage.

3. Remove the bearing **(3)**.
4. Remove the bearing on the accessory drive end of the fuel injection pump housing by driving it out with a punch inserted through the housing bore for the bearing **(3)**.

Fuel Pump Lifter Removal and Installation

The fuel pump lifters can be removed with the fuel injection pump housing installed on the engine if desired.

1. Remove the fuel injection pumps and the fuel rack. See the covering topics.
2. Remove the spacer **(1)** and lift out the lifter assembly **(2)**.



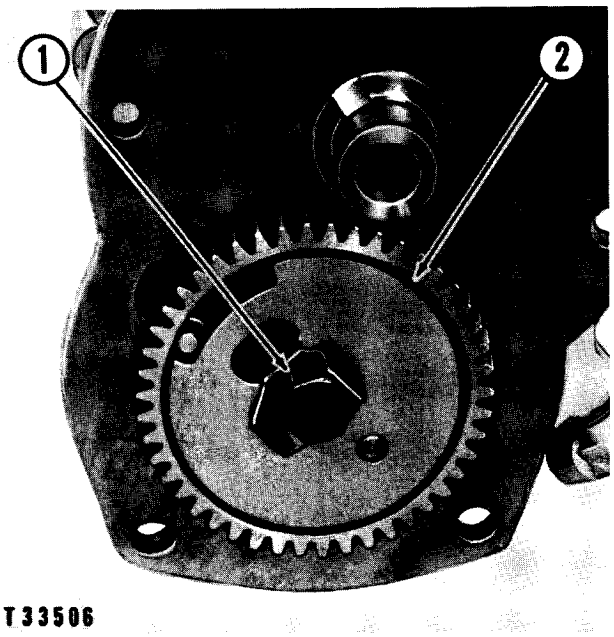
LIFTER REMOVAL
1–Spacer. 2–Lifter assembly.

NOTE

Wire the spacer and the lifter together and tag them to identify with the pump bore from which they were removed.

3. Install the lifter assembly and the spacer, tilting the spacer to one side of the pump bore to clear the pump locating dowels in the fuel injection pump housing.
4. For timing dimension setting, see the topic, FUEL PUMP TIMING DIMENSION SETTING.

Fuel Injection Pump Camshaft

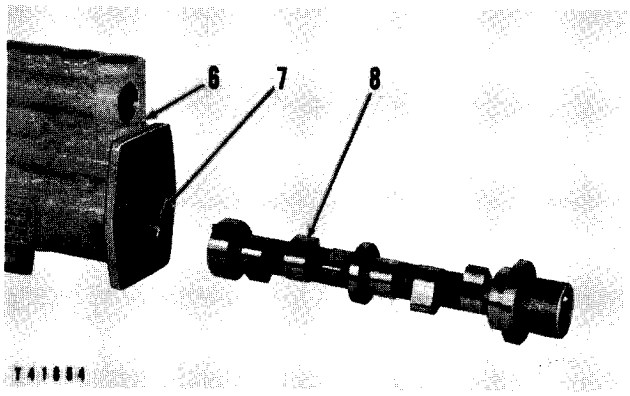


PREPARING TO REMOVE CAMSHAFT
1–Bolt. 2–Plate.

1. Remove the fuel injection pump housing, governor weights, fuel injection pumps, fuel rack, and lifters. See the covering topics.
2. Bend the lock and remove the bolt **(1)** and the plate **(2)**.
3. Remove the spring **(3)**, floating pin **(4)** and the ring gear **(5)**.
4. Carefully remove the camshaft **(8)** from the fuel injection pump housing **(6)** at the accessory drive end of the housing.
5. Inspect the camshaft bearing **(7)** and replace if worn or damaged. See the topic, SPECIFICATIONS, for bearing clearance. Install the bearings flush with the housing face.

GEAR REMOVAL
3–Spring. 4–Pin. 5–Gear.

6. Install the camshaft in the reverse order of removal.



CAMSHAFT REMOVAL
6–Pump housing. 7–Bearing. 8–Camshaft.

FUEL PUMP TIMING DIMENSION SETTING (ON ENGINE)

The timing dimensions should be checked and reset, if necessary, to account for worn timing gears or worn pump lifters. See the topic, FUEL INJECTION PUMP LIFTER WASHER AND PUMP PLUNGER INSPECTION.

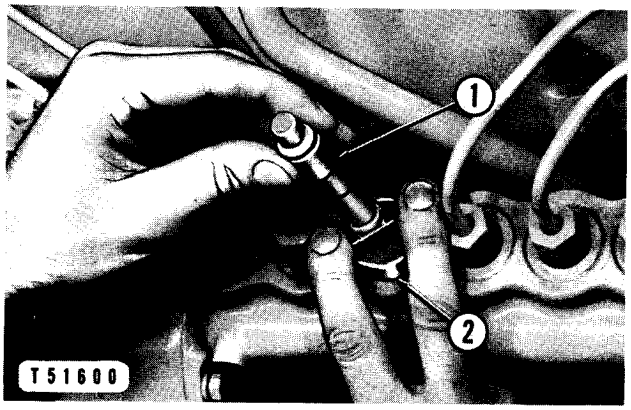
The timing dimensions can be set in the following manner:

1. Remove the fuel injection line.
2. Remove the fuel injection pump for the respective timing dimension to be checked. See the topic, FUEL INJECTION PUMP REMOVAL.
3. Turn the crankshaft in the direction of engine rotation to top center (TC) on the compression stroke of the cylinder for which the timing dimension is to be checked. For the location of the flywheel pointer, see the topic, FLYWHEEL AND FLYWHEEL HOUSING.

NOTE

If the top center mark on the flywheel is turned past the pointer, turn the flywheel backward approximately 60°. Then turn the crankshaft again in the direction of crankshaft rotation until the top center mark aligns with the pointer.

4. Install the 2M5219 Gauge **(2)** in the pump bore. Check the timing dimension using a depth micrometer **(1)** with a 4" - 5" rod. See the topic, SPECIFICATIONS, for correct timing dimension.



CHECKING TIMING DIMENSION SETTING
1–Depth micrometer. 2–2M5219 Gauge.

5. See the topic, SPECIFICATIONS.

NOTE

It is important when checking and setting the timing dimension that the crankshaft be turned in the direction of engine rotation. After the timing dimension has been checked or set according to specifications, turn the crankshaft a few degrees in the direction of engine rotation. Again check the reading on the micrometer. This reading should be less than the measurement when checked with the crankshaft at top center thus indicating the lifter is rising and was checked at the correct position.

6. If all the timing dimensions are to be checked or reset, continue the procedure in the normal firing order of the engine.
7. After checking the timing dimensions, see the topic, FUEL INJECTION PUMP INSTALLATION.

FUEL PUMP TIMING DIMENSION SETTING (OFF ENGINE)

The following procedure for checking the timing dimensions with the pump housing off the engine will result in correct fuel injection timing if the pump housing is installed on a new engine, or, an engine with new timing gears and coupling. This method does not compensate for wear that may be present on timing gears and coupling in an engine that has seen considerable service, Therefore, to insure correct fuel injection timing, it is very important to recheck one of the timing dimensions with the pump housing installed on the engine on which it is intended to remain. Follow the procedure described under the topic, FUEL PUMP TIMING DIMENSION SETTING (ON ENGINE).

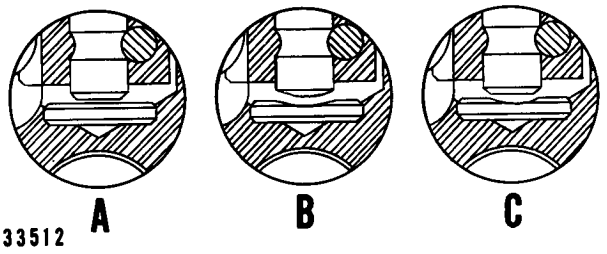
1. Install the 2M5220 Pointer Assembly by placing the two dowels on the pointer assembly in the dowel holes on the fuel injection pump housing.
2. Place the timing plate on the drive end of the camshaft and align the coupling with the camshaft. Use a bolt and washer to secure the plate and coupling to the camshaft. This allows the camshaft to be rotated by rotating the timing plate.
3. Refer to the table in the topic, SPECIFICATIONS, and select the timing plate setting for the timing dimension being checked or set. Set the timing plate to this setting by rotating it counterclockwise until the proper degree setting lines up with the edge of the boss on the pointer assembly. Lock in position with the lockscrew.
4. If all the timing dimensions are to checked or reset, continue the same procedure in the firing order of the engine. Recheck each timing dimension after the adjustment has been made to make sure the dimension is correct.

FUEL INJECTION PUMP LIFTER WASHER AND PUMP PLUNGER INSPECTION

The timing dimension should be checked to compensate for wear in the timing gears or lifters to assure that the point of the fuel injection is correct. If the timing dimension is too small, injection will begin early, and, if too great, injection will be late.

When pump plunger wear becomes excessive, the lifter washer may also be worn in such a manner that it will not make full contact with the end of a new plunger. To avoid rapid wear on the end of the new plunger, lifter washers showing visible wear should always be replaced.

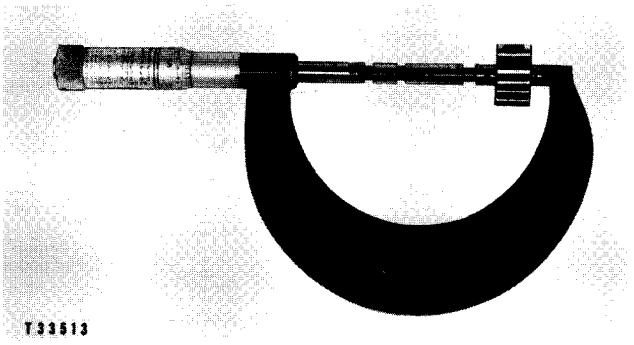
Fig. A illustrates the contact surfaces of a new pump plunger and a new lifter washer. In Fig. B the pump plunger and lifter washer have worn considerably. Fig. C shows how the flat end of a new plunger makes poor contact with a worn lifter washer, resulting in rapid wear to both parts.



WEAR BETWEEN WASHER AND PLUNGER

A pump can maintain a satisfactory discharge rate and yet be unserviceable because of delayed timing resulting from wear on the lower end of the plunger. When testing a pump which has been in use for a long time, the length of the plunger should be checked and the pump discarded if the plunger wear exceeds the value listed in the topic, SPECIFICATIONS. The length of new plungers is also given in the specifications. The length should be checked with a micrometer as shown.

Also, inspect the plunger for wear on its upper diameter. The performance of pumps worn in this manner can be checked in the Instructions for Fuel Injection Test Apparatus.



CHECKING LENGTH OF PLUNGER

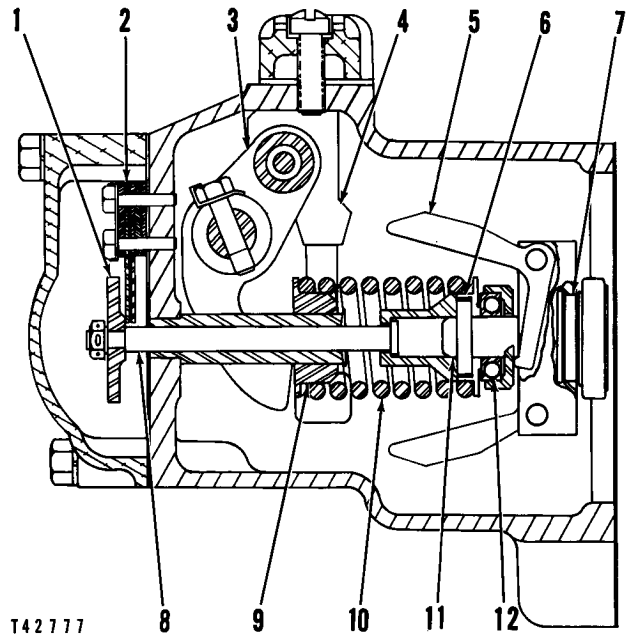
Governor

The governor is located on the right side of the engine and is mounted on the rear face of the fuel injection pump housing. It is driven by a gear on the fuel injection pump camshaft.

OPERATION AND LUBRICATION

The operator selects a desired engine speed by moving the governor control lever. The governor maintains this speed nearly constant even though the load varies.

The governor regulates the amount of fuel injected into the cylinders. The force of the governor spring **(10)** tends to move the fuel rack **(11)** forward in the direction of more fuel. The centrifugal force of the rotating weights **(5)** tends to move the rack to the rear in the direction of less fuel.



GOVERNOR CROSS SECTION – RIGHT SIDE VIEW
1–Collar. 2–Torque spring. 3–Lever assembly. 4–Shoulder. 5–Weight. 6–Spring seat. 7–Bearing. 8–Bolt. 9–Spring seat. 10–Governor spring. 11–Fuel rack. 12–Thrust bearing.

When the operator moves the governor control lever to increase the engine speed setting, the lever assembly **(3)** rotates and pushes against the spring seat **(9)**, compressing the governor spring. The spring force moves the fuel rack to increase the engine speed.

As the engine speed increases, the centrifugal force of the rotating weights **(5)** causes their levers to act against the thrust bearing **(12)** and governor spring seat **(6)**, thus relieving the force of the governor spring and moving the rack in the direction of less fuel until a state of equilibrium is reached.

When the engine encounters a load, the speed decreases. The centrifugal force of the governor weights decreases. The spring, opposed by a lesser force, moves the rack in the direction to give the engine more fuel which increases the power. The engine speed will then increase until the force of the governor weights again balances the force of the compressed governor spring.

This sequence is reversed when the load on the engine is decreased.

A torque spring **(2)** and collar **(1)** limit the distance the rack assembly can travel. The collar is secured to the bolt **(8)** which acts against the spring seat **(6)** which is fastened to the fuel rack **(11)**. As the rack moves forward to increase the fuel being delivered to the cylinders, the collar makes contact with the torque spring and the full load position is reached. Under conditions of lugging, the rack continues to move forward a slight amount and compresses the torque spring, thus delivering an additional quantity of fuel to the cylinders in an attempt to bring the engine out of the lug condition.

See the topic, ADJUSTMENTS, for the high and low idle speed adjustments.

A spring-loaded plunger within the lever assembly bears against the shoulder **(4)** of the low idle adjusting screw when the governor control lever is in the lower idle position. In order to shut the engine down, it is necessary to force the plunger to ride over the shoulder on the screw.

The governor is lubricated by the engine lubricating system. Oil from the diesel engine oil manifold is directed to a passage in the cylinder block. An external line directs the oil from the passage in the rear of the block to a passage in the fuel injection pump housing which mates with a drilled passage in the governor bearing **(7)**. The various other parts of the governor are lubricated by splash.

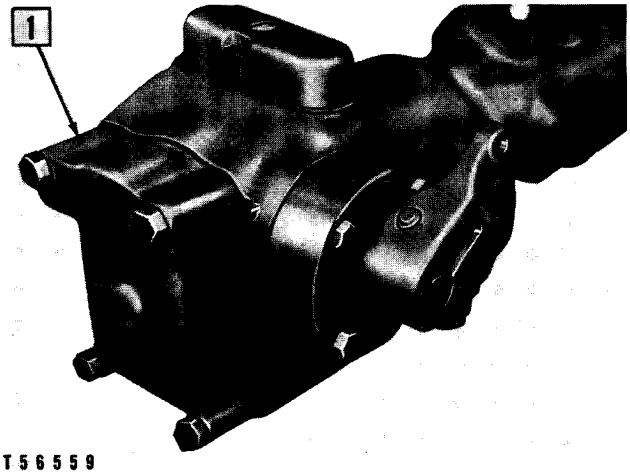
The oil drains through a passage in the fuel injection pump housing mounting bracket into the diesel engine crankcase.

REMOVAL AND INSTALLATION

Governor Housing and Control Mechanism

The governor can be disassembled mounted on the engine or removed from the engine.

Remove the governor and fuel injection pump housing as a unit as outlined in the topic, ACCESSORY DRIVE REMOVAL AND INSTALLATION.

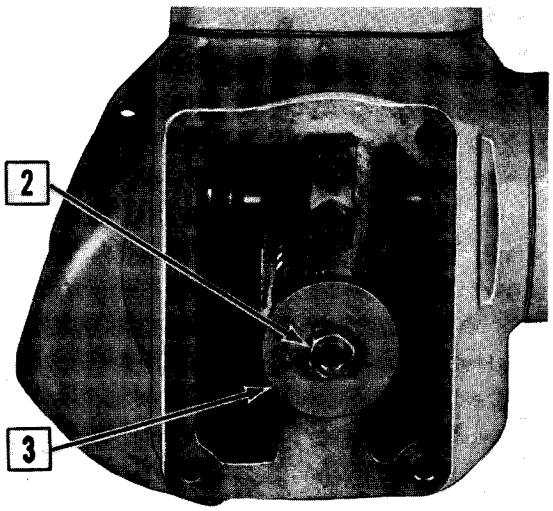


T56559

PREPARING TO REMOVE GOVERNOR HOUSING

☐ Remove

1–Cover.



T43715

PREPARING TO REMOVE GOVERNOR HOUSING

☐ Remove

2–Nut. 3–Collar.

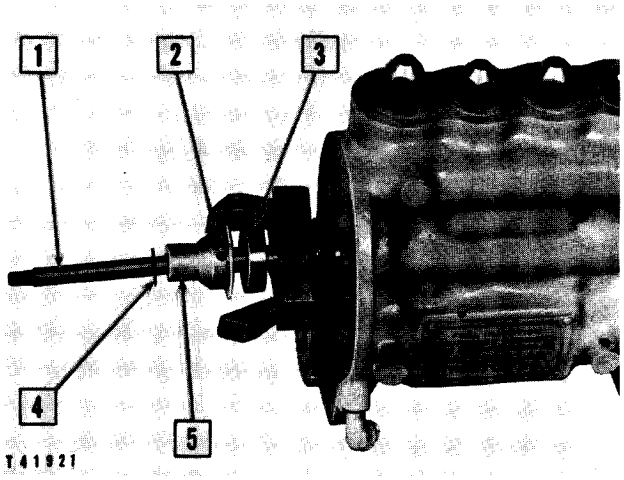
NOTE

Insert a pin through the hole in the full load stop bolt to prevent the bolt from turning while removing and installing the nut **(2)** and collar **(3)**.

Remove the bolts securing the governor to the fuel injection pump housing and slide the governor housing away from the fuel injection pump housing.

Governor Weight Removal

Separate the governor housing from the fuel injection pump housing as outlined in the covering topic.



T41921

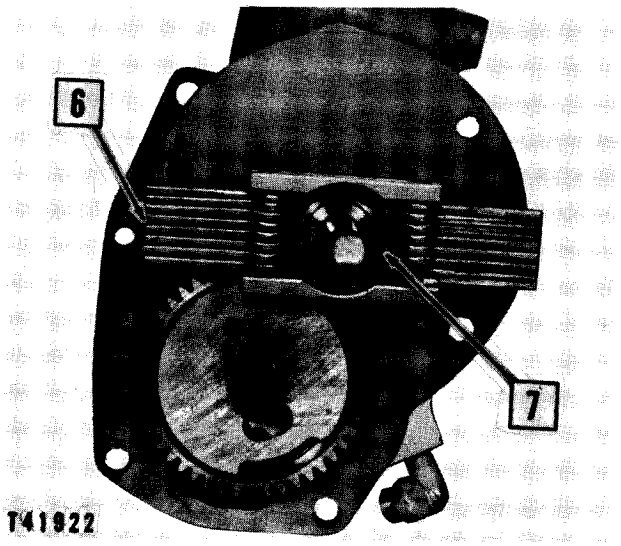
PREPARING TO REMOVE GOVERNOR WEIGHT

☐ Remove

1–Bolt. 2–Pin. 3–Thrust bearing. 4–Bumper spring. 5–Seat.

NOTE

The bumper spring **(4)** is installed with the concave face toward the seat **(5)**. This arrangement permits the outside edge of the spring to contact the seat **(5)**.



T41922

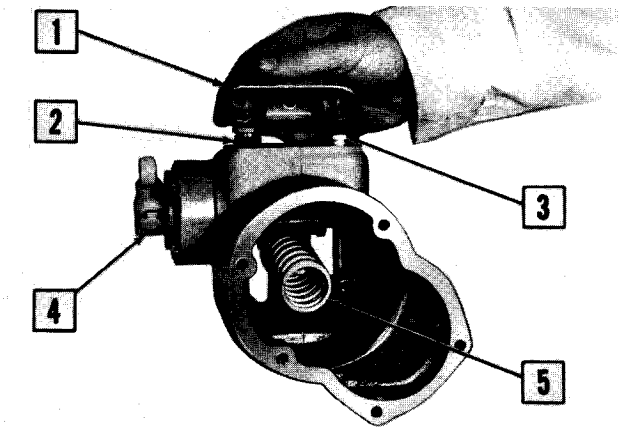
WEIGHT REMOVAL

☐ Remove

6–Weight assembly. 7–Snap ring.

GOVERNOR DISASSEMBLY

1. Remove the seat behind the spring **(5)**.
2. Remove the bolts securing the cover assembly **(6)** to the governor housing and remove the cover assembly **(6)**, control shaft assembly **(9)** and the governor shaft assembly **(10)**.
3. The gasket between the cover assembly **(6)** and the governor housing should be inspected, and replaced if damaged.

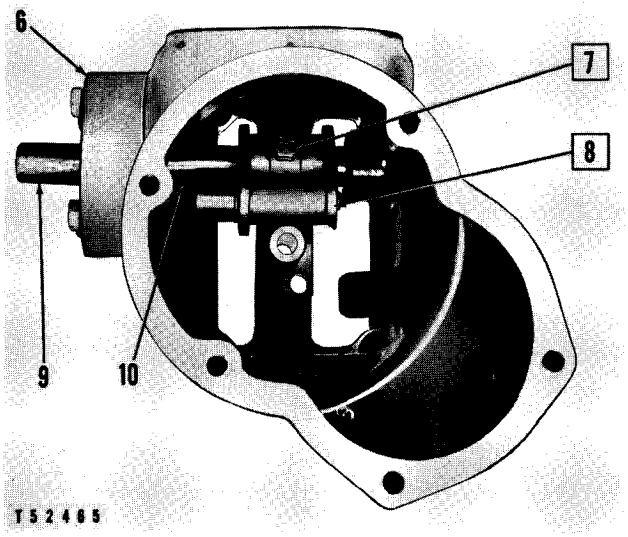


T56560

DISASSEMBLING THE GOVERNOR

☐ Remove

1–Cover. 2–High idle screw. 3–Low idle screw. 4–Lever. 5–Governor spring.

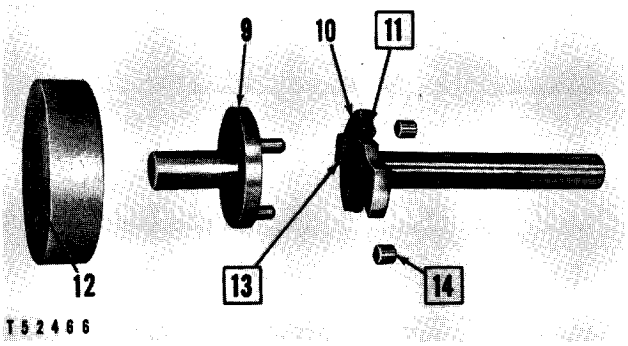


T52465

COVER ASSEMBLY AND LEVER ASSEMBLY REMOVAL

☐ Remove

6–Cover assembly. 7–Bolt. 8–Lever assembly. 9–Control shaft assembly. 10–Governor shaft assembly.



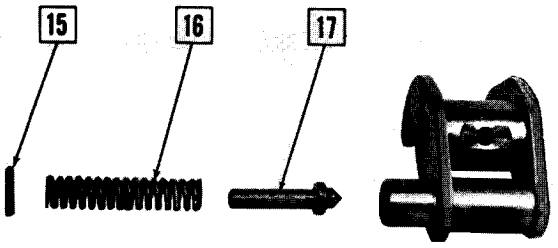
T52466

DISASSEMBLING COVER AND SHAFT ASSEMBLIES

☐ Remove

9–Control shaft assembly. 10–Governor shaft assembly. 11–Roller springs (two). 12–Seal. 13–Locating spring. 14–Rollers (two).

4. Separate the shaft assemblies **(9)** and **(10)** and remove the seal **(12)** from the cover assembly.
5. Replace the seal **(12)**, with the lip facing in, if it is damaged.



T52764

DISASSEMBLING LEVER ASSEMBLY

☐ Remove

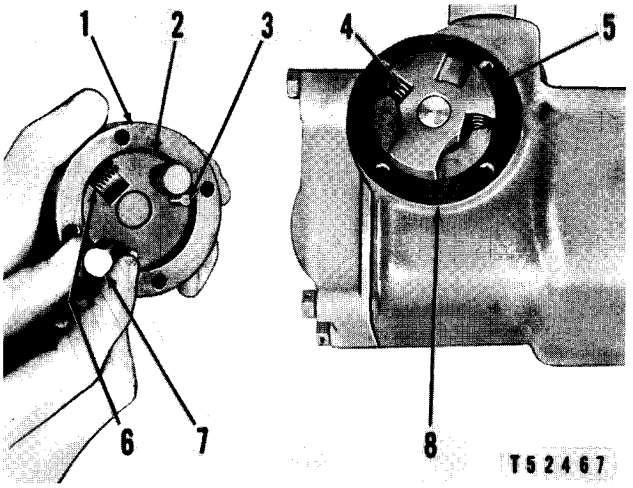
15–Pin. 16–Spring. 17–Plunger.

Control Mechanism Assembly and Installation

NOTE

Apply a light oil to the parts of the control mechanism during assembly.

1. Inspect the inside surface of the cover assembly **(1)**. If the ramp is excessively worn, the assembly should be replaced.
2. Install the control shaft assembly **(2)** into the cover assembly **(1)**.
3. Insert the roller springs **(4)** into the governor shaft assembly **(5)** as shown, using a small amount of grease to hold them in place.
4. Position the rollers **(7)** on the dowels **(3)** as shown.

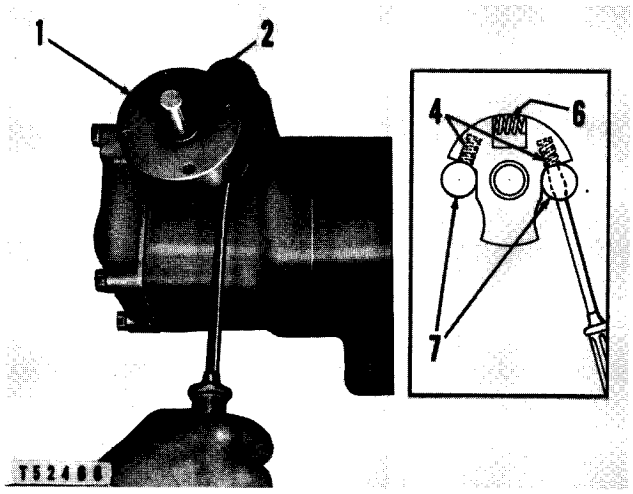


T52467

PREPARING TO INSTALL COVER ASSEMBLY

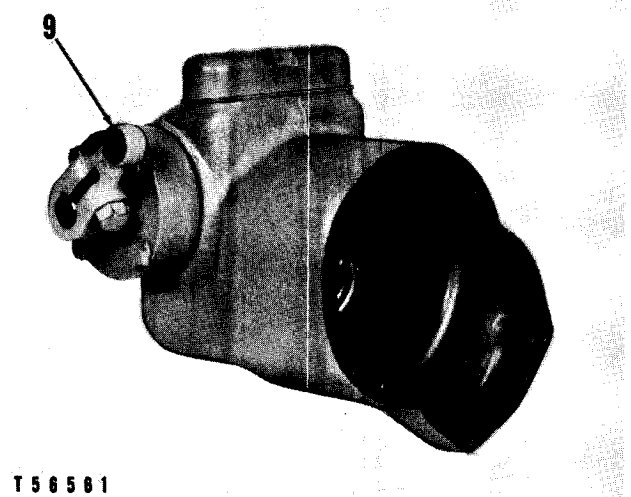
1–Cover assembly. 2–Control shaft assembly. 3–Dowel (two). 4–Roller springs (two). 5–Governor shaft assembly. 6–Locating spring. 7–Rollers (two). 8–Gasket.

5. Insert the locating spring **(6)** into the groove in the control shaft assembly.
6. Install the gasket **(8)** on the governor housing as shown.
7. Install the cover assembly **(1)** over the governor shaft assembly **(5)** until the rollers **(7)** contact the roller springs **(4)**.
8. Using a screwdriver inserted between the cover assembly **(1)** and the governor housing as shown, compress the roller springs **(4)** to allow the rollers **(7)** to position properly in front of the roller springs **(4)** and to permit the cover assembly to fit in place.



INSTALLING COVER ASSEMBLY
1–Cover assembly. 2–Control shaft assembly. 4–Roller springs. 6–Locating spring. 7–Rollers.

9. Turn the control shaft assembly **(2)** back and forth slightly to seat the locating spring **(6)** in its groove properly.



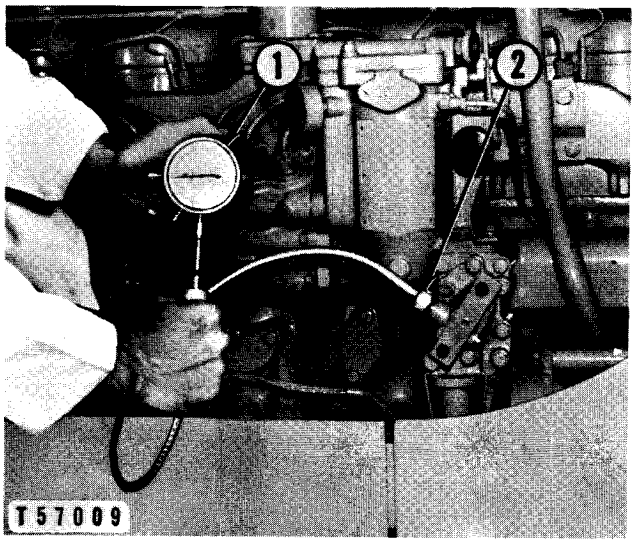
LEVER ASSEMBLY INSTALLATION
9–Lever.

10. Insert and tighten the bolts securing the cover assembly to the governor housing.
11. When assembling the lever assembly to the shaft assembly, rotate the shaft so the lever **(9)** will be in the position shown, before installing the bolt into the lever assembly.

ADJUSTMENTS

High and Low Idle Speed

To check the speed of the engine, remove the service meter and install a 7M6001 Tachometer Drive **(2)** as shown.



CHECKING ENGINE IDLE SPEED
1–Tachometer. 2–7M6001 Tachometer Drive.

Install a 1:1 ratio tachometer on the flexible coupling of the tachometer drive and start the engine. The reading observed will be actual engine speed.

CAUTION

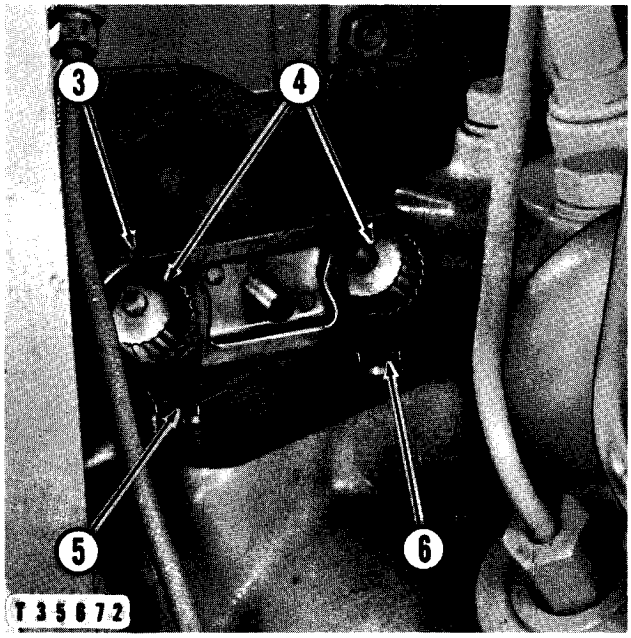
Do not attempt to install or remove the flexible coupling with the engine running.

The high and low idle speeds can be adjusted by removing the cover **(3)** on the top of the governor housing and turning the adjusting screws **(5)** and **(6)**. The screw **(6)** nearest the diesel engine adjusts the low idle speed. The holes **(4)** in the cover are shaped to act as retainers to prevent the screws from turning after the adjustment is made.

To adjust the idle speed settings, remove the cover and turn the desired adjusting screw. Turning either adjusting screw in a clockwise direction will decrease the idling speeds.

After setting the idle speed, move the governor control lever to change the engine speed. Return it

to the desired idle position and recheck the idle speed. Repeat this procedure until the desired idle speed is obtained.

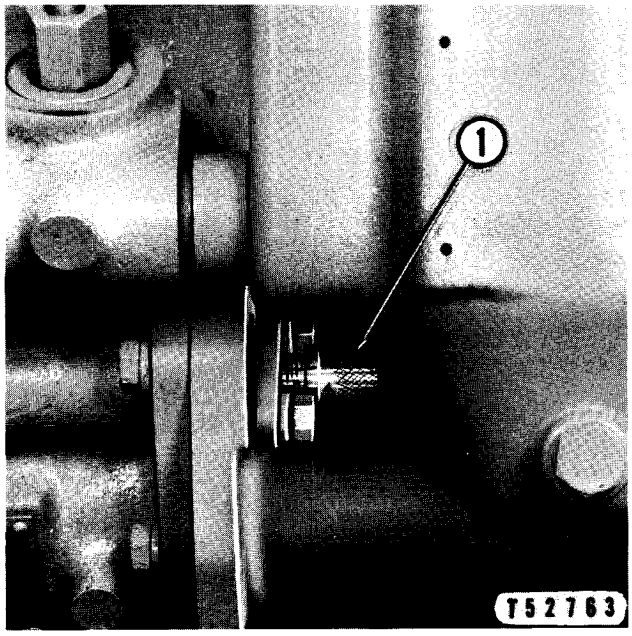


GOVERNOR ADJUSTMENTS
3–Cover. 4–Retainer holes. 5–High idle adjusting screw. 6–Low idle adjusting screw.

Fuel Rack Setting

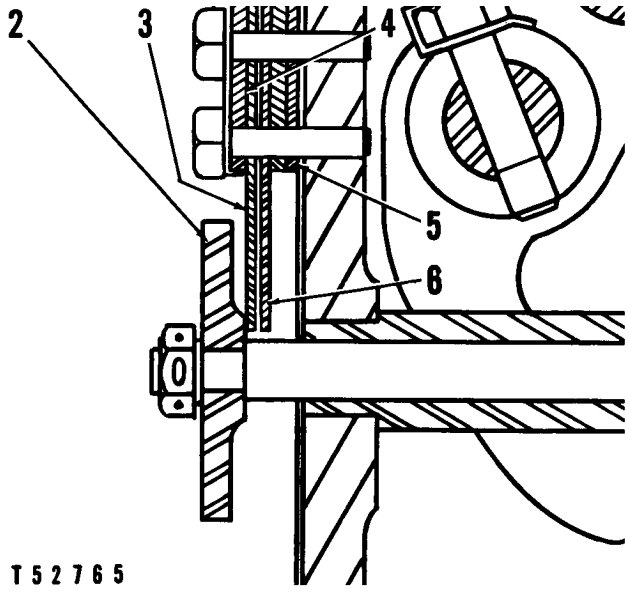
The fuel rack setting can be checked and adjusted with the fuel injection pump housing either removed or installed on the engine.

1. Remove the rack cover from the front of the fuel injection pump housing and the cover from the rear of the governor housing.



CHECKING FUEL RACK SETTING
1–8M530 Rack Setting Gauge.

2. Install an 8M530 Rack Setting Gauge **(1)** over the front end of the fuel rack.
3. Adjust the position of the fuel rack to obtain the desired full load rack setting. With the fuel rack in the full load position, the collar **(2)** should just contact the torque spring **(3)**.
4. If the collar **(2)** is compressing the torque spring **(3)**, remove shims **(5)**, until the collar just contacts the torque spring when the fuel rack is at the full load setting for the engine. Place all shims removed from behind the stop bar **(6)** between the spacer **(4)** and spring **(3)** where they will be available for future use.



ADJUSTING FUEL RACK SETTING
2–Collar. 3–Torque spring. 4–Spacer. 5–Shims. 6–Stop bar.

NOTE

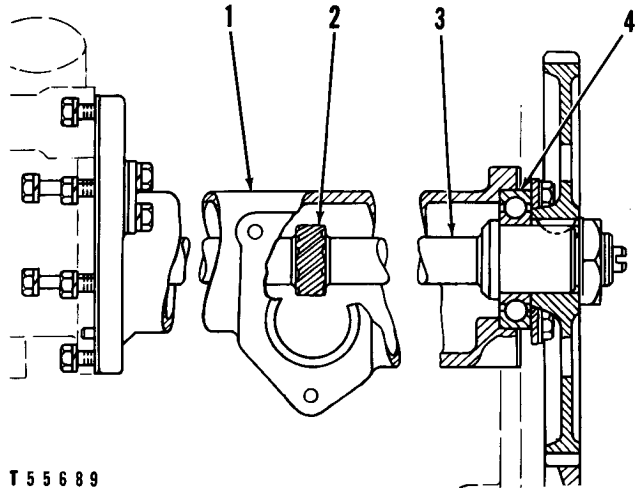
Do not place any of the removed shims between the torque spring **(3)** and the stop bar **(6)** as this will affect the torque characteristics of the engine during lug conditions. The spacer between the torque spring and the stop bar must remain in place.

5. If the collar does not contact the torque spring when the fuel rack is in the full load position, add shims **(5)** to obtain the proper setting.

Accessory Drive

The accessory drive is the assembly used to drive the governor, fuel injection pump camshaft, service meter and fuel transfer pump.

The accessory drive shaft **(3)** is supported by a ball bearing **(4)** at the front and enclosed by an adapter housing **(1)** on the right side of the engine. The adapter bolts to the timing gear housing plate at the front. The fuel injection pump housing is bolted to the rear of the adapter housing.



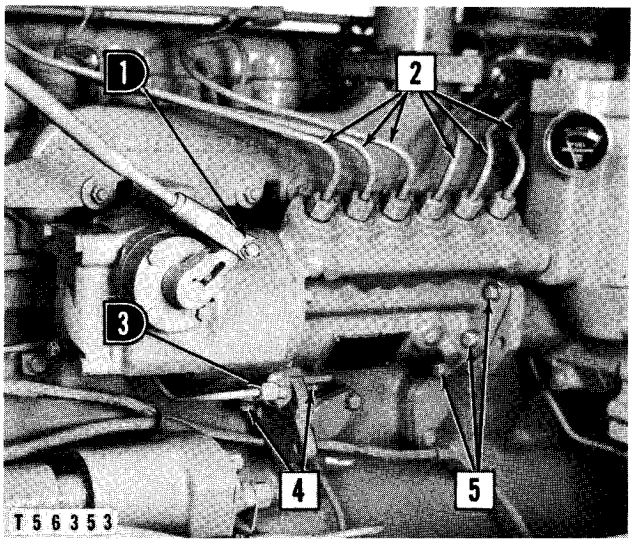
ACCESSORY DRIVE (PARTIAL CROSS-SECTION)
1–Adapter housing. 2–Gear. 3–Accessory drive shaft. 4–Bearing.

The fuel transfer pump is driven by a helical gear **(2)** machined on the accessory drive shaft. The service meter is mounted on the fuel transfer pump cover and is driven by the transfer pump drive shaft. The fuel injection pump camshaft is coupled to the rear of the accessory drive shaft and the governor is driven from the rear of fuel pump camshaft.

REMOVAL AND INSTALLATION

The accessory drive shaft can be removed without removing the timing gear cover. The accessory drive gear is accessible after removing the cover on the timing gear cover assembly.

1. Install caps over the fuel injection pumps, and plugs in the fuel injection lines to prevent the entry of dirt into the fuel injection system.
2. Remove the fuel injection pump housing and the governor as an assembly by sliding the assembly toward the rear of the engine.
3. Remove the fuel transfer pump and fuel filter. See the covering topics.

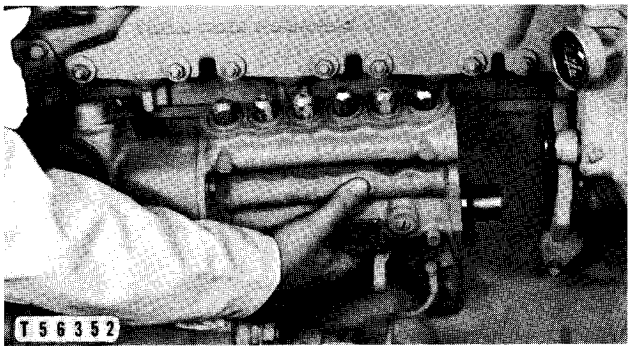


PREPARING TO REMOVE THE FUEL INJECTION PUMP HOUSING AND GOVERNOR

Remove **Disconnect**

1–Governor control linkage. 2–Fuel injection lines. 3–Lubricant supply line. 4–Retaining bolts. 5–Fuel injection pump housing retaining bolts.

4. Remove the fan belts. See the topic, FAN BELT REPLACEMENT.
5. Remove the accessory drive gear cover which is located on the timing gear cover.
6. Position the accessory drive gear to allow access to the bolts which secure the accessory drive housing to the timing gear plate and remove the bolts.

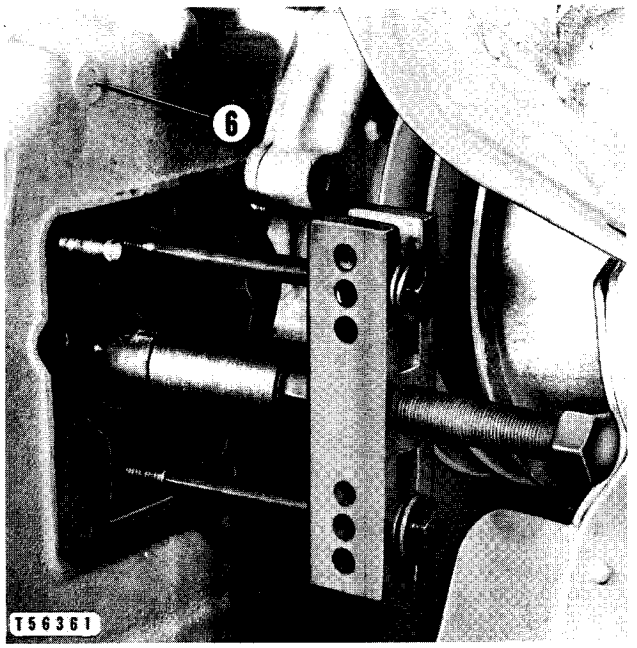


GOVERNOR AND FUEL INJECTION PUMP HOUSING REMOVAL

7. Remove the accessory drive gear retaining nut.
8. Use a 5F7465 Puller and 4M3251 Adapter to push the accessory drive shaft out of the accessory drive gear.

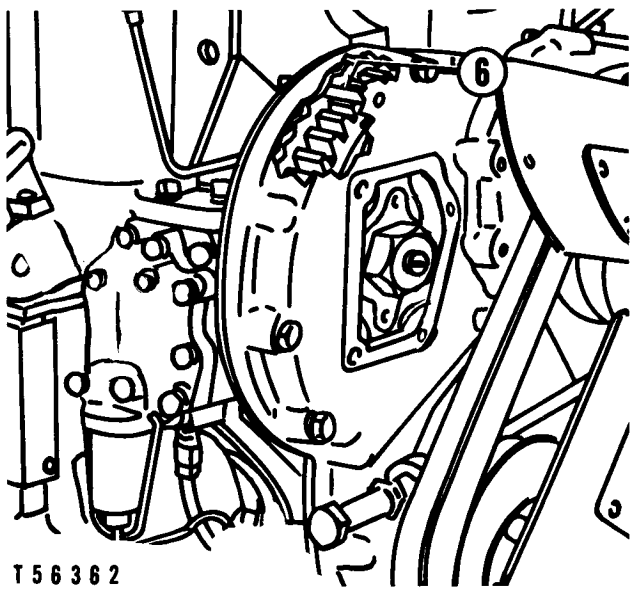
NOTE

The pin **(6)** in the timing gear cover prevents the accessory drive gear from moving out of



REMOVING THE ACCESSORY DRIVE SHAFT 6-Pin.

engagement with the accessory drive idler gear by limiting the distance between the centers of the two gears after the accessory drive shaft has been removed.

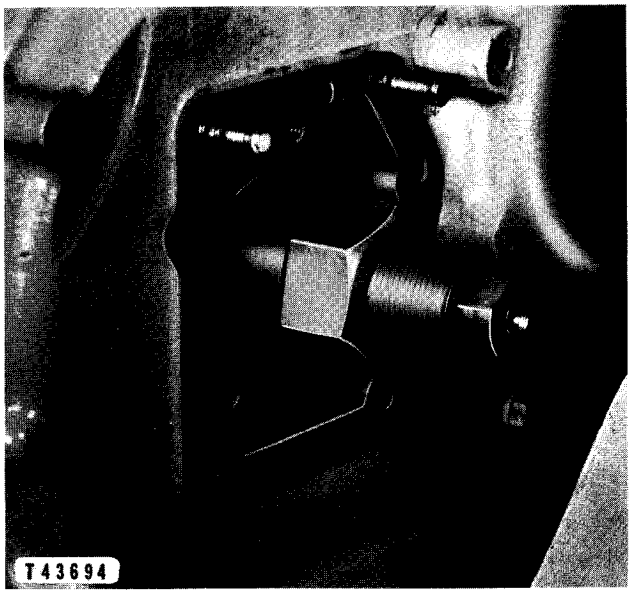


GEAR LOCATING PIN 6-Pin.

9. Remove the accessory drive housing and shaft.
10. Prior to installation of the accessory drive housing, inspect and replace the gasket between the timing gear plate and the accessory drive housing if it is damaged.
11. Use the 4M3250 Camshaft Gear Installation Group to pull the accessory drive shaft through the accessory drive gear.

CAUTION

Use care to prevent the bearing retainer from falling down inside the timing gear cover.

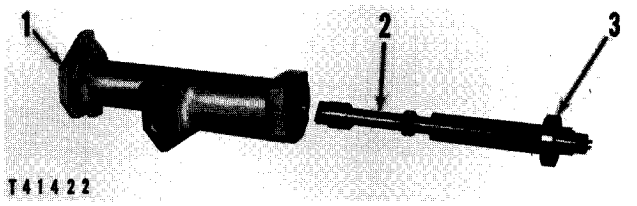


INSTALLING THE ACCESSORY DRIVE SHAFT

DISASSEMBLY AND ASSEMBLY

Remove the accessory drive shaft **(2)** from the adapter housing **(1)**.

Press the bearing **(3)** off the shaft.



ACCESSORY DRIVE DISASSEMBLY
1-Adapter housing. 2-Accessory drive shaft. 3-Bearing.

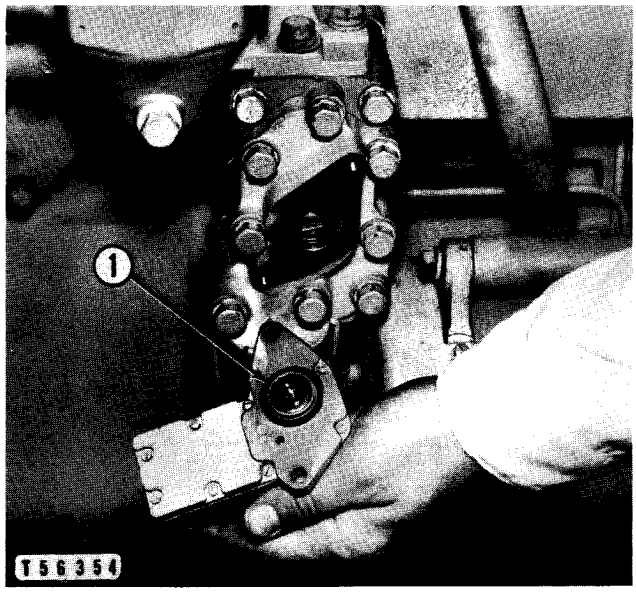
Assemble the accessory drive.

SERVICE METER

The service meter is mounted on the fuel transfer pump cover and is driven by the transfer pump drive shaft. It provides a means of determining time periods for lubrication and maintenance.

The end of the transfer pump drive shaft is grooved to drive the service meter. A tachometer drive group can be installed between the service meter and the transfer pump cover. Engine speed can be checked at this point by using a speed indicator. The speed obtained in this manner will be actual engine speed.

To remove the service meter, remove the bolts which secure the service meter to the transfer pump cover. Replace the seal **(1)** if damaged.



REMOVING THE SERVICE METER
1–Seal.

Air Induction and Exhaust System

INLET MANIFOLD

The inlet manifold is cast as an integral part of the cylinder head. It is located within the left side of the cylinder head. The inlet manifold has an external opening at the upper front of the cylinder head for mounting the air inlet elbow.

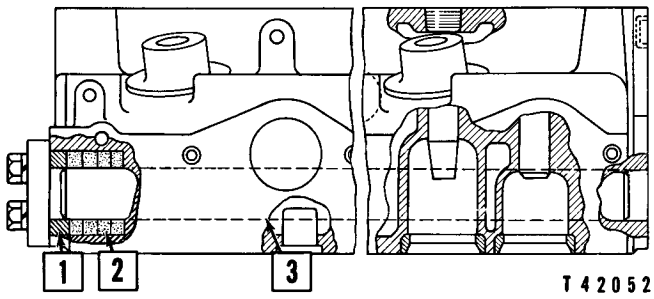
A passage (pipe) which carries starting engine exhaust gases through the inlet manifold has openings at either end of the cylinder head. The starting engine exhaust gases enter through the rear opening and are expelled from the front opening into the starting engine exhaust pipe.

The heat from these exhaust gases heats the incoming air to the diesel engine. This aids in starting the diesel engine.

INLET AIR HEATER PIPE REMOVAL AND INSTALLATION

If the inlet air heater pipe should require replacement, it can be removed in the following manner.

1. Disconnect the starting engine exhaust pipe at the rear of the diesel engine inlet manifold.
2. Disconnect the starting engine exhaust outlet pipe at the front of the diesel engine inlet manifold.



REPARING TO REMOVE INLET AIR HEATER PIPE

☐ **Remove**

1–Washer. 2–Packing. 3–Inlet air heater pipe.

3. The inlet air heater pipe can be driven from the front of the cylinder head toward the rear by using a bushing driver with a maximum shoulder diameter of 1.120 inches and a pilot diameter of 0.990 inch.
4. Install new packing at the time of installation.

EXHAUST MANIFOLD

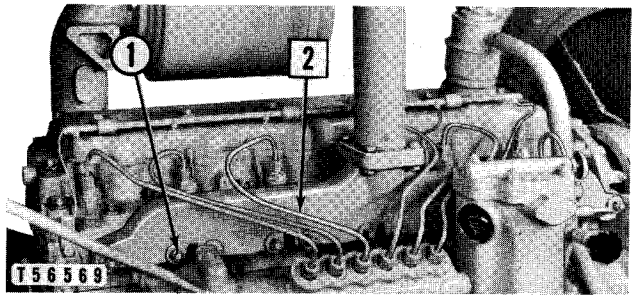
The exhaust manifold is of one-piece construction and is bolted directly to the cylinder head. Gaskets form the seal between the manifold and the cylinder head.

Removal and Installation

Place caps over the fuel injection pumps and nozzles, and plugs in each end of the fuel injection lines to prevent the entry of dirt or other foreign matter into the fuel injection system.

Remove the nuts **(1)** which secure the exhaust manifold to the cylinder head.

New gaskets should be used when installing the exhaust manifold.



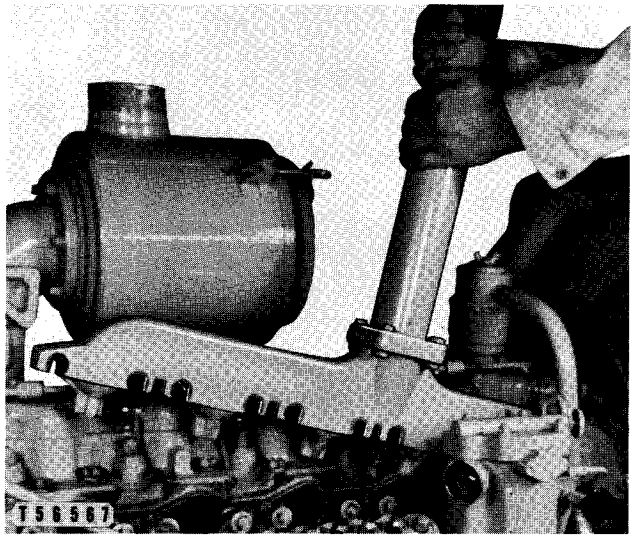
PREPARING TO REMOVE EXHAUST MANIFOLD

☐ **Remove**

1–Nuts (twelve). 2–Fuel injection lines (six).

NOTE

The exhaust manifold cannot be removed by lifting it straight up from the engine. It must be rotated about the stud on the right end. Then by moving the manifold towards the rear of the engine, it can be removed.

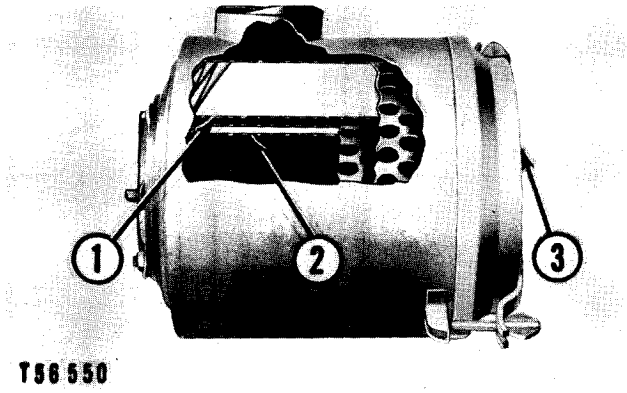


REMOVING EXHAUST MANIFOLD

AIR CLEANER

A horizontally-mounted, dry-type air cleaner containing two separate air cleaner elements, is used on this engine. The primary element **(1)**, can be re-

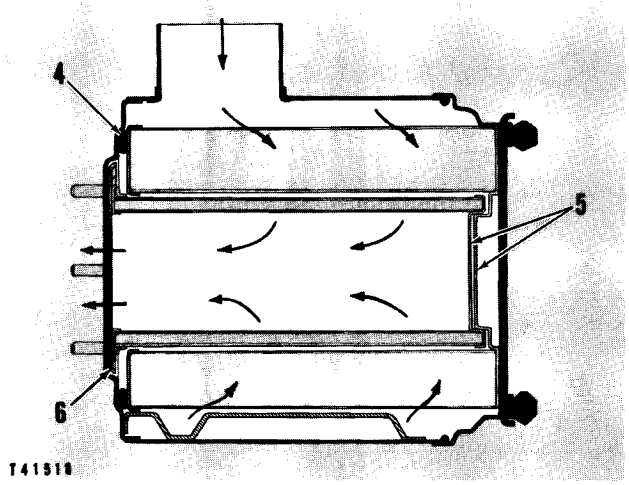
moved and cleaned with air pressure, or by washing as recommended in the Operation and Maintenance Instructions. A secondary element **(2)** is provided in case of a rupture in the primary element.



AIR CLEANER
1–Primary element. 2–Secondary element. 3–Body.

The secondary element should be removed and serviced periodically in accordance with the Operation and Maintenance Instructions. Both elements should also be replaced periodically as covered in the Operation and Maintenance Instructions.

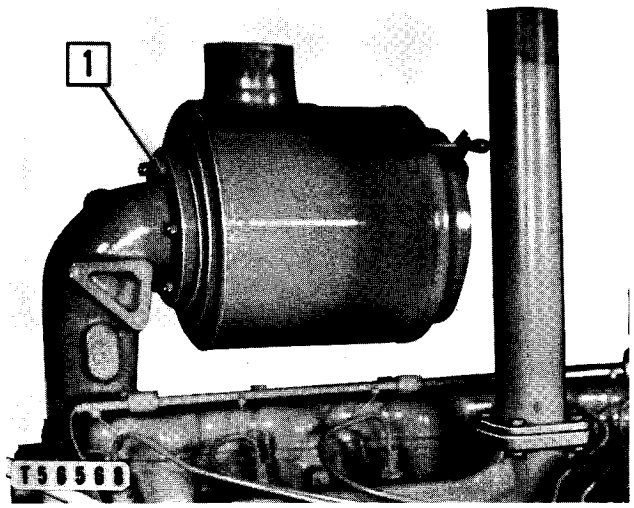
During operation, air from the prescreener flows around the outside and through the elements to the center of the air cleaner and from there to the inlet manifold. Air is prevented from by-passing the primary element by a seal **(4)** which is bonded to the end of the primary element. Steel plates **(5)** cover and seal one end of each element. Gaskets **(6)** between the secondary element, body assembly and air transfer pipe prevent unfiltered air from being drawn into the engine at these points.



AIR CLEANER AIR FLOW
4–Seal. 5–Plates. 6–Gaskets.

Removal and Installation

Remove the prescreener from the extension on the body assembly and remove the hood.



PREPARING TO REMOVE AIR CLEANER
☐ Remove
1–Nut (six).

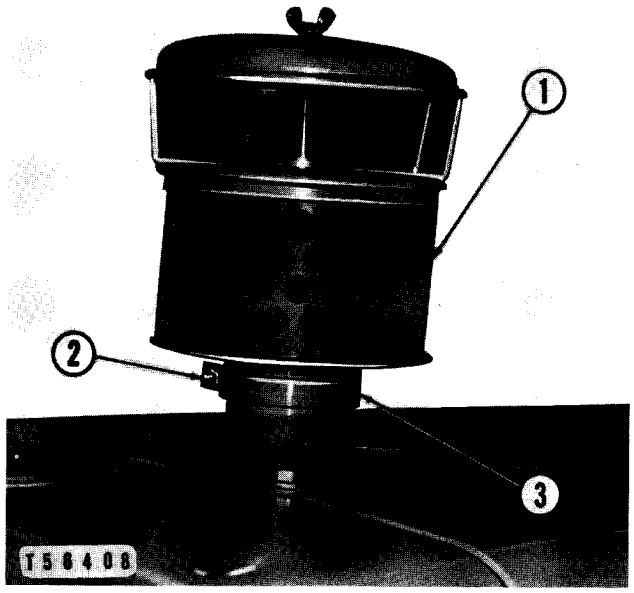
Remove the air cleaner and cover the opening in the inlet elbow.

Install in the reverse order of removal, using new gaskets between the air cleaner and the elbow.

PRESCREENER

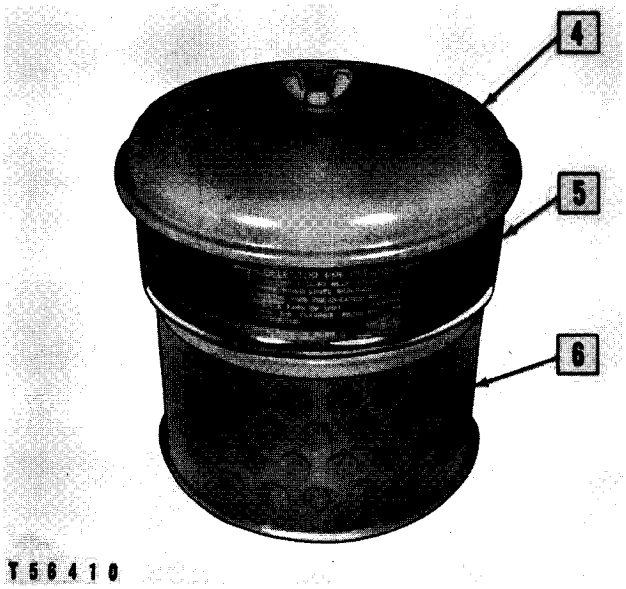
Either a precleaner assembly or a vertically mounted dry-type air prescreener can be used on this engine. The prescreener filters atmospheric air and directs the pre-filtered air to the air cleaner. The prescreener is mounted on an extension of the air cleaner body assembly.

Removal and Disassembly



PREPARING TO REMOVE PRESCREENER
1–Prescreener. 2–Bolt. 3–Clamp.

Loosen the bolt **(2)** on the clamp **(3)** and remove the prescreener.



PREPARING TO DISASSEMBLE PRESCREENER

☐ **Remove**

4–Cover assembly. 5–Body. 6–Screen assembly.

PRESCREENER DISASSEMBLED

The body **(5)** and screen **(6)** can be cleaned with air pressure or by washing as recommended in the Operation and Maintenance Instructions.

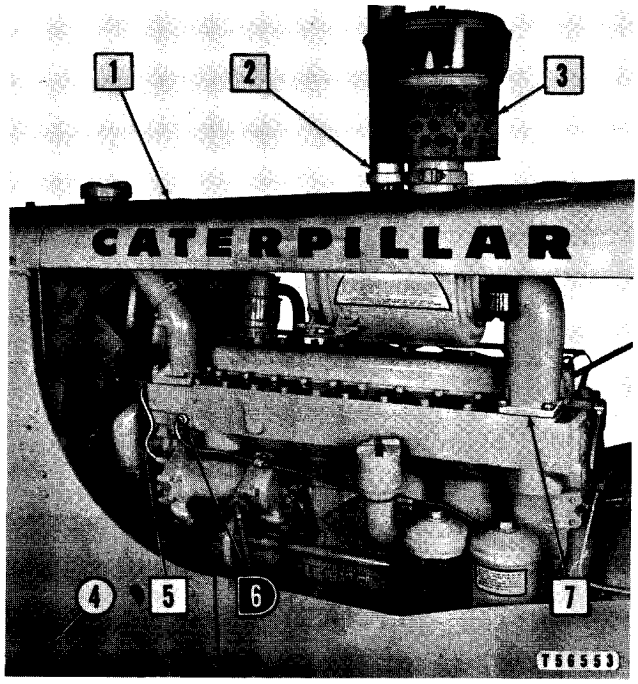
Cylinder Head

The inlet manifold is cast integral with the cylinder head on the left side. Water directors direct the flow of coolant toward the valve ports and precombustion chambers.

Rubber seals and ferrules seal the water and lubrication passages between the cylinder head and cylinder block.

CYLINDER HEAD REMOVAL
(Electric Start)

1. Drain the coolant from the engine. The drain plug can be reached through the hole **(4)**.



PREPARING TO REMOVE CYLINDER HEAD

☐ **Remove** ◗ **Disconnect**

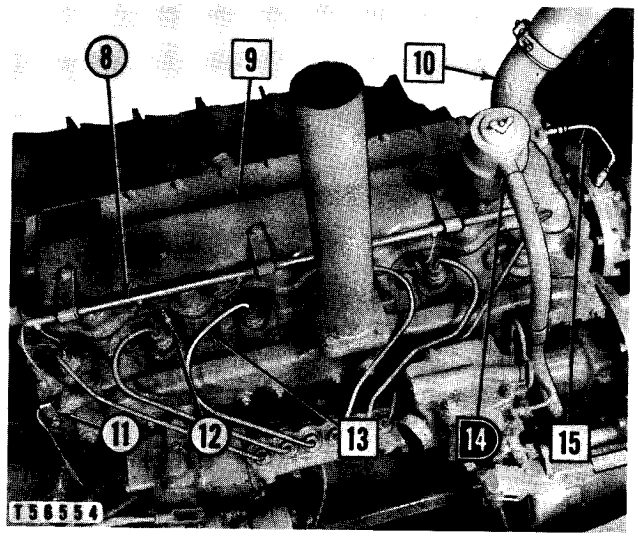
1–Hood. 2–Exhaust pipe. 3–Prescreener. 4–Hole. 5–Line. 6–Heat indicator. 7–Air cleaner and air transfer pipe.

2. Disconnect wiring harness **(8)** from glow plugs **(12)** and the clip **(11)**. After removing the lines **(13)**, cap the injectors, pumps and lines to prevent dirt or other foreign matter from entering.

3. Remove the exhaust manifold **(17)**. See the covering topic.

NOTE

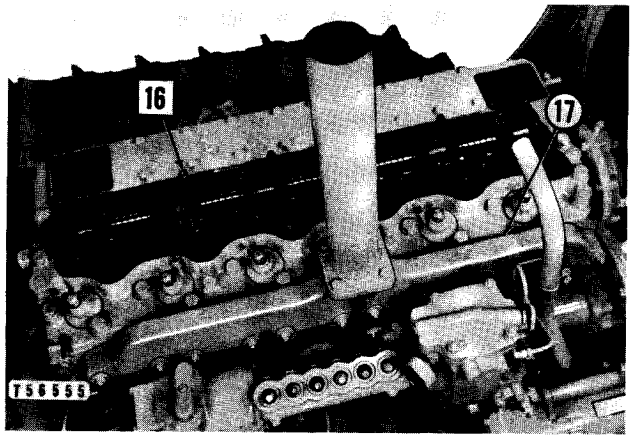
It is necessary to remove the exhaust manifold in order for one of the head bolts to be tightened to the proper torque value. Remove any glow plugs necessary to provide easier access to the bolt heads.



PREPARING TO REMOVE CYLINDER HEAD

☐ **Remove** ◗ **Disconnect**

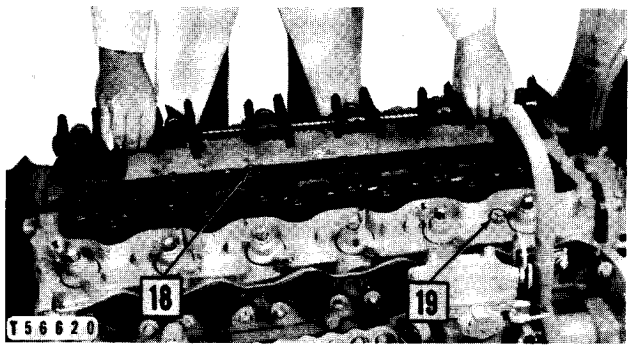
8–Wiring harness. 9–Valve cover. 10–Water line. 11–Clip. 12–Glow plug (six). 13–Fuel injection line (six). 14–Oil breather line. 15–Vent line.



PREPARING TO REMOVE CYLINDER HEAD

☐ **Remove**

16–Rocker arm assembly. 17–Exhaust manifold.



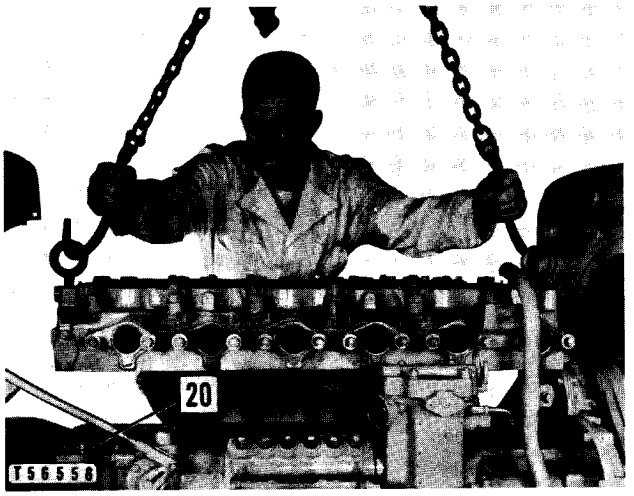
REMOVING ROCKER ARM ASSEMBLY

☐ **Remove**

18–Push rods. 19–Head bolt.

4. Install two 3/4" - 10 (NC) eyebolts in the cylinder head as shown.

5. Use a suitable hoist to remove the cylinder head from the cylinder block. The approximate weight of the cylinder head is 325 pounds.



REMOVING CYLINDER HEAD

☐ **Remove**

20–Seals and ferrules.

CYLINDER HEAD INSTALLATION

A new cylinder head gasket should be installed.

1. Place the gasket on the cylinder block.
2. Install the ferrules and seals.
3. Carefully lower the head on the block. Proper head alignment is assured by dowel pins located in the block.

CAUTION

When installing the head on the cylinder block, see that the ferrules and seals are properly installed and started properly into the recessed holes in the head. Rock the head gently until it seats flat on the head gasket.

4. Install the head bolts and tighten them in the numerical sequence as illustrated. See the topic, SPECIFICATIONS, for torque values.
5. Install the push rods and valve rocker arm assembly.

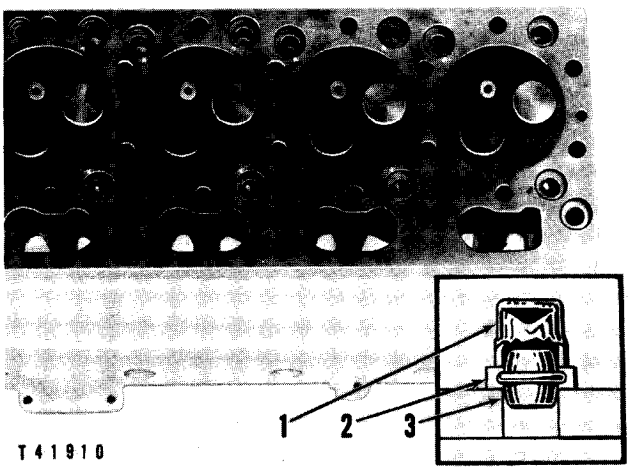
If, after engine run-in, the bolt torque has dropped below the value given in the topic, SPECIFICATIONS, the bolts should be retightened.

6. Set the valve clearance as given in the topic, SPECIFICATIONS.

WATER DIRECTORS

Water directors **(1)** are provided to direct the flow of coolant to critical areas for maximum cooling effectiveness. They are pressed into place in the head, after aligning the notch on the director with the V-mark on the head.

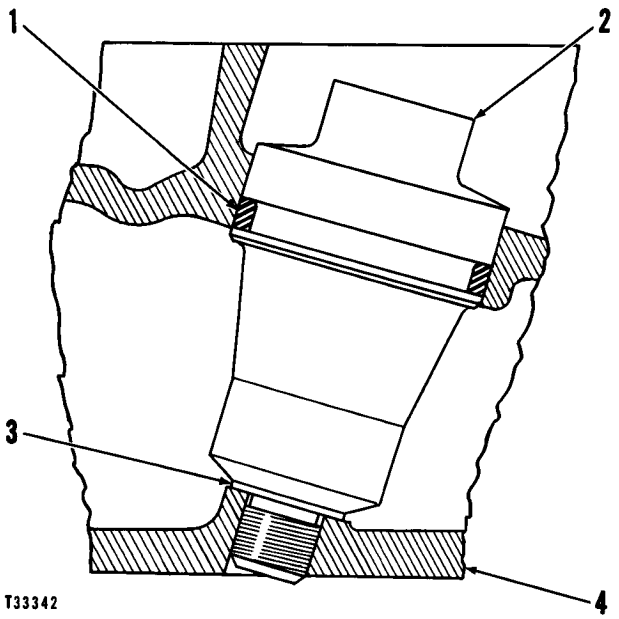
The seals **(2)** and copper ferrules **(3)**, which seal the water passage between the head and top of the block, are replaceable. The seal is installed over the flange on the ferrule. This can be done easily if the inner surface of the seal is first coated with liquid soap.



CYLINDER HEAD SHOWING WATER DIRECTORS
1–Director. 2–Seal. 3–Ferrule.

When installing the ferrules and seals, the rolled edge of the ferrule should be toward the head to facilitate installation of the head.

PRECOMBUSTION CHAMBERS



PRECOMBUSTION CHAMBER
1–O-ring seal. 2–Precombustion chamber. 3–Gasket. 4–Cylinder head.

The precombustion chamber **(2)** is threaded into the cylinder head **(4)** and sealed at the top of the head with an O-ring seal **(1)**.

The O-ring seal prevents leakage of coolant.

The gasket **(3)** prevents combustion gases from entering the cooling system, as well as preventing leakage of coolant into the cylinder.

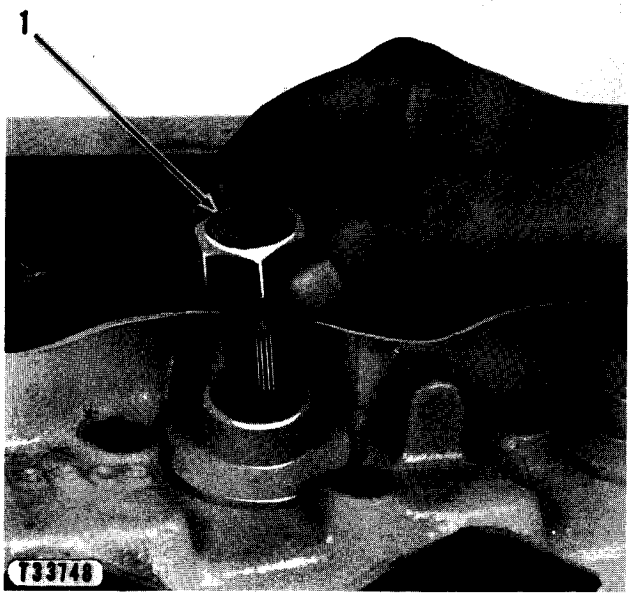
Removal and Installation

1. Remove the fuel injection valve assembly.
2. Place the 5F8353 Wrench Adapter **(1)** in the serrations of the precombustion chamber and remove the precombustion chamber from the head.

NOTE

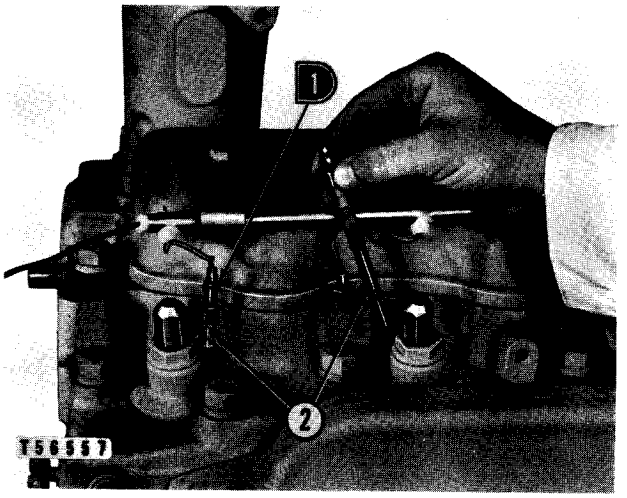
If a cylinder head has collected an excessive amount of scale or rust within the water jacket, remove the cylinder head and clean it thoroughly. This is also an indication that the entire cooling system should be cleaned.

3. Place a new gasket, coated on the bottom side with a thin layer of grease, in the head. The grease will help retain the washer while installing the precombustion chamber.
4. Coat the chamfered portion of the cylinder head and the new rubber seal with soap.
5. Insert the precombustion chamber in the head and tighten with the 5F8353 Wrench Adapter. See the topic, SPECIFICATIONS, for the correct torque value when installing the precombustion chamber.



REMOVING PRECOMBUSTION CHAMBER
1–5F8353 Wrench Adapter.

Removal and Installation of Precombustion Chambers Equipped with Glow Plugs



REMOVING GLOW PLUG
D Disconnect
1–Electrical lead. 2–Glow plugs.

1. Remove the glow plugs **(2)** as shown.

NOTE

The precombustion chambers **(3)** and the gaskets **(4)** must be marked so they can be installed in their original locations unless new gaskets are to be installed.

2. Remove the precombustion chambers **(3)**. See the topic, PRECOMBUSTION CHAMBER REMOVAL AND INSTALLATION.

REMOVING PRECOMBUSTION CHAMBER EQUIPPED WITH GLOW PLUG
3–Precombustion chamber. 4–Gasket.

NOTE

If new gaskets are to be installed, see the topic, SPECIFICATIONS, for proper positioning of the precombustion chambers.

3. Install the precombustion chamber, using the thinnest gasket, and tighten it to the torque value specified in the topic, SPECIFICATIONS.
4. Insert the glow plug. If it cannot be installed because of interference, remove the precombustion chamber and discard the gasket.
5. Reinstall the precombustion chamber using the thicker gasket and tighten it to the specified torque value.
6. Install the glow plugs and tighten to the torque value shown in the specifications.
7. Connect the electrical leads.

Valves and Valve Mechanism

The valves and the valve mechanism admit inlet air and release exhaust gases at precisely timed intervals during engine operation.

The engine is of the four-stroke cycle, having four separate strokes required for each cylinder to complete one cycle. The camshaft is timed to the crankshaft and turns at one-half engine speed.

The inlet valve is open during the inlet stroke of the piston to permit air to enter the cylinder. After the compression and power strokes, the exhaust valve is opened to permit the piston, in moving up on the exhaust stroke, to force the burned gases from the cylinder.

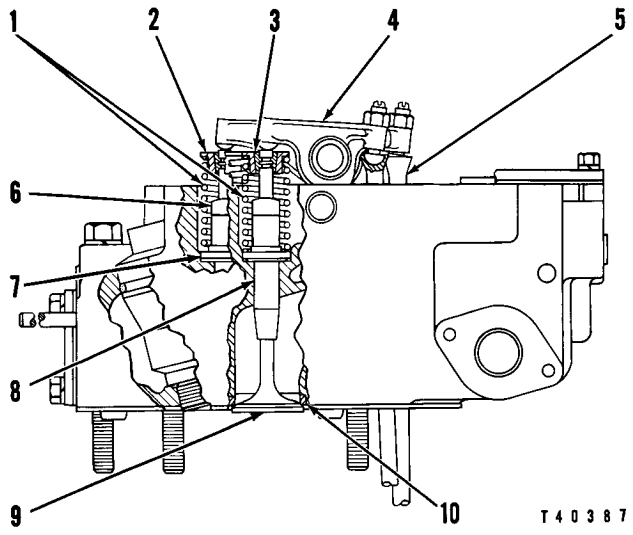
Properly adjusted valves will operate for many hours before they need to be reconditioned. Eventually, however, the valve faces and seats can become pitted which ultimately allows compression pressure losses.

Valve rotators cause the valves to rotate while the engine is operating. The rate of rotation is approximately three degrees each time the valve is opened.

This rotation decreases the possibility of excessive carbon deposit build up on the valves.

NOTE

Naturally aspirated engines have no valve stem guide seals **(6)** and the valve rotators **(7)** are replaced by spacers.



VALVES AND VALVE MECHANISM

1–Valve springs. 2–Retainer. 3–Lock. 4–Rocker arm. 5–Push rod. 6–Valve guide seal. 7–Valve rotator. 8–Valve guide. 9–Valve. 10–Valve seat insert.

To determine whether a valve rotator is operating, observe the valve spring retainer. If the retainer does not rotate during operation, replace the valve rotator as a unit.

VALVE ROCKER ARM ASSEMBLY

Removal

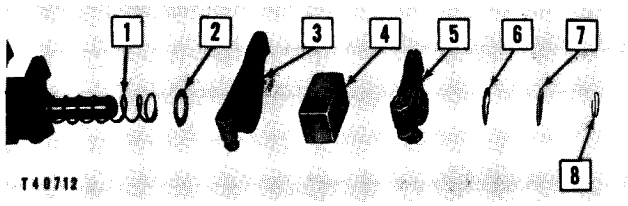
Remove the rocker arm cover.

NOTE

When replacing the rocker arm cover, torque the retaining bolts to 5 lb. ft.

Remove the bolts which secure the rocker arm assembly to the cylinder head. Remove the rocker arm assembly.

Disassembly



VALVE ROCKER ARM DISASSEMBLY

☐ **Remove**

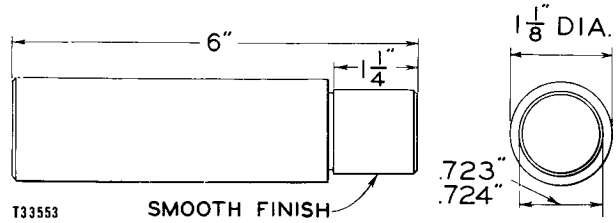
1–Spring. 2–Washer. 3–Rocker arm. 4–Bracket. 5–Rocker arm. 6–Spring. 7–Washer. 8–Ring.

Remove the remaining brackets and rocker arms from the rocker arm shaft.

The bearings in the rocker arms should be replaced if the clearance between the bearings and the shaft exceeds the value listed in the topic, SPECIFICATIONS.

Assembly

In order to properly install new rocker arm bearings, a driver similar to the one shown in the illustration should be used.



TOOL FOR ALIGNING ROCKER ARM BEARINGS

NOTE

Be sure to align the oil holes in the bearing and the rocker arm before pressing the bearing into the rocker arm.

Assemble the rocker arm shaft.

Installation

Install the rocker arm assembly. Make sure the compression release shaft is located properly to al-

low the pin in the rocker arm bracket to locate properly.

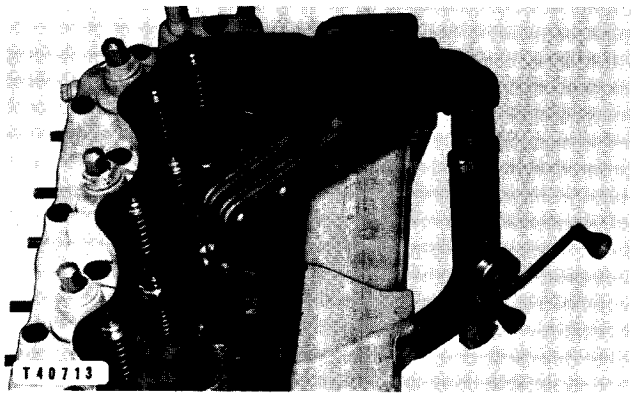
Tighten the rocker arm bolts to the torque values listed in the specifications.

VALVES

Removal

Remove the cylinder head as described in the covering topic.

Compress the valve springs and remove the locks. Release the compressor and remove the retainers, springs, and the valve rotators or spacers if so equipped. The valves can then be removed.



COMPRESSING VALVE SPRING

The illustration shows a standard valve spring compressor being used.

Cleaning

After removing a cylinder head from the diesel engine and the valve assemblies from the head, carefully scrape all carbon accumulations from the parts. Be sure to clean the valves thoroughly, as well as the valve stems, valve guides and valve ports.

Valve Inspection and Reconditioning

The valves should always be carefully inspected. If the valve faces are pitted or making poor contact with the valve seat, they should be refaced in a valve refacing machine. If the valves are deeply pitted, badly warped or worn, they should be replaced.

In refacing, be sure there is sufficient metal left on the head of the valve to prevent "dishing" of the valve in service.

The wear of the valve stems can be checked by the use of a 0" to 1" micrometer. The valve stem should be measured in three places. Use the measurement near the top of the valve stem, where the valve stem does not touch the guide, as the original valve stem diameter.

CAUTION

In handling valves, caution should be exercised to prevent nicking or scratching the radius between the valve face and stem. A very small nick can cause the valve head to break off during service.

See the topic, SPECIFICATIONS.

Checking Valve Seats

Coat the valve face with Prussian blue and rotate the valve in the valve seat. Remove the valve and examine the contact pattern on both valve and seat. A line of contact near the top and around the entire circumference of the valve seat should indicate line contact with the valve.

The valve seats can be ground with a valve seat grinding tool. Care should be exercised in its use, as too much material may be removed quickly and unknowingly.

After the valve seats have been ground until they are smooth and concentric with the valve guides, all parts should be cleaned thoroughly.

Valve Installation

Exhaust valves marked "EX" on the valve head should be installed in the exhaust ports. Inlet valves marked "IN" on the valve head should be installed in the inlet ports.

Lubricate the stems, guides and seals for initial starting.

Insert the valve through the valve guide and install the spring and the spring retainer. Compress the spring with a compressor, such as shown in the topic, VALVE REMOVAL. Insert the locks, large end down, and tap the retainer lightly as the spring compressor is removed, to make sure the locks are seated properly in the retainer.

NOTE

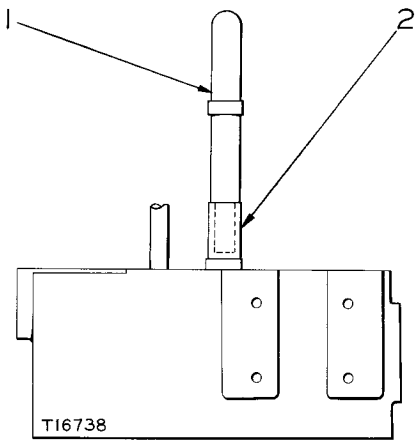
Install the spring with the painted end up.

VALVE GUIDES

The inlet and exhaust valves operate in replaceable valve guides. After the valves have been removed, clean the valve stems and the valve guides and inspect the valve guide seal, if so equipped.

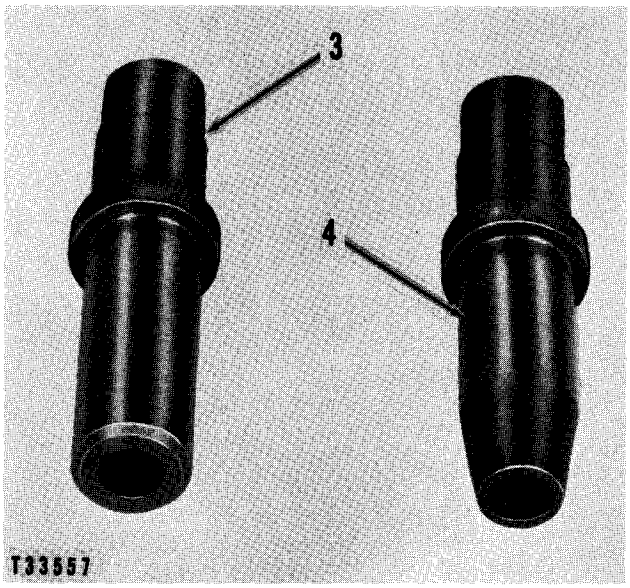
The valve guide wear should be checked with a gauge or by the pilots furnished with some makes of valve seat regrinding equipment. Generally the pilots are supplied in graduated sizes. Use a micrometer to measure the diameter of the largest pilot

that will pass through the guide. This dimension will indicate the wear in the guide, excluding possible out-of-roundness.



INSTALLING VALVE GUIDE
1–4H447 Driver. 2–Valve guide.

The valve guide **(2)** can be pressed or driven in or out of the head by the 4H447 Driver **(1)** after removing the valve guide seal. On earlier engines, the inlet valve guide **(4)** can be identified from the exhaust valve guide **(3)** by the tapered end as shown. On later engines, the same guide is used for both inlet and exhaust valves.



VALVE GUIDES
3–Exhaust valve guide. 4–Inlet valve guide.

The guides should be pressed into place carefully with the type of driver or inserting tool shown in the accompanying illustration, to prevent damage to the guides. A reamer run through the guides after they are installed will insure correct valve stem clearance. See the topic, SPECIFICATIONS, for the correct reamer size. Install the seals after the guides are in place.

VALVE TIMING

The valve timing is controlled by the setting of the timing gears. Timing is shown in the topic, TIMING GEARS.

VALVE LIFTERS

The valve lifters are located in the left side of the cylinder block. Valve lifters for all cylinders except No. 1 can be removed from the engine in the following manner.

NOTE

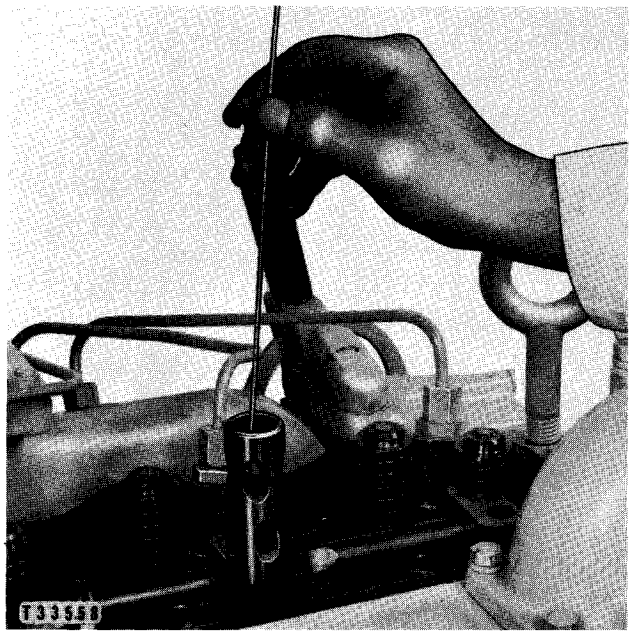
It is necessary to remove the cylinder head to remove the valve lifters for cylinder No. 1 on some engines.

Some lifters have a wider base and are not removable from the top of the engine. The camshaft must be removed prior to their removal.

Remove the valve rocker arm assembly. See the topic, VALVE ROCKER ARM REMOVAL.

Remove the push rods.

Using a suitable piece of wire, approximately 15" long with a ½" hook bent in one end, remove the valve lifters as shown.

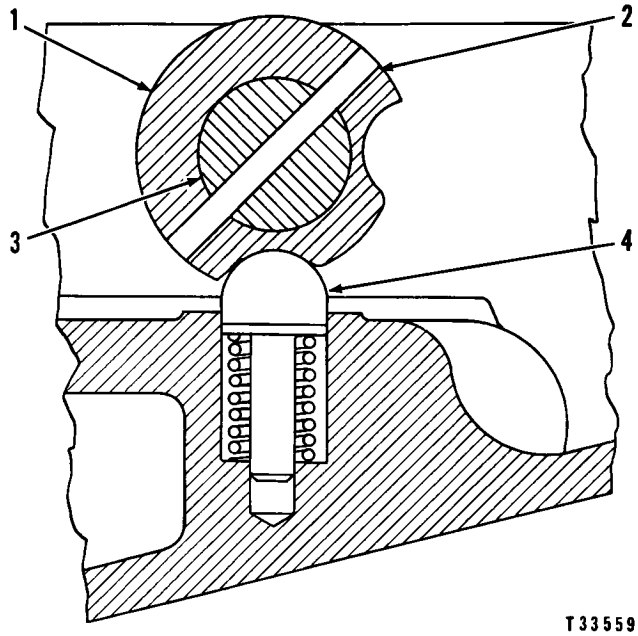


REMOVING VALVE LIFTER

COMPRESSION RELEASE MECHANISM

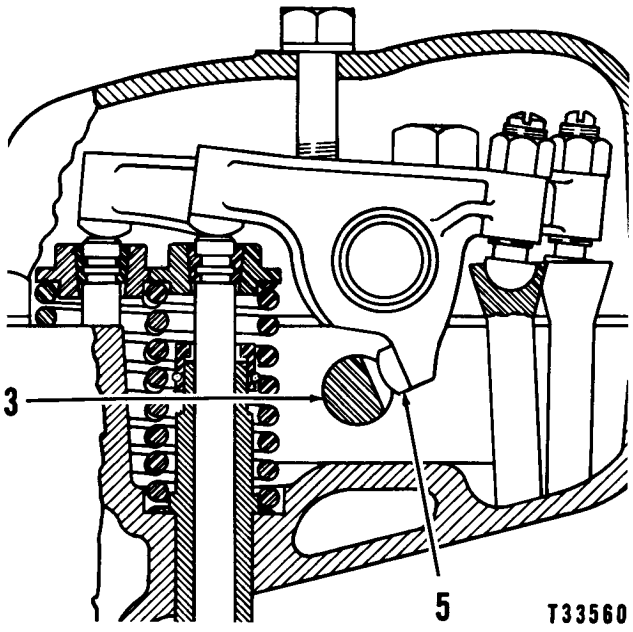
The compression release mechanism opens the inlet valve on each cylinder, allowing the diesel engine to be easily cranked.

The compression release shaft is locked in the RUN or START position by a spring loaded plunger **(4)** which engages in a stop **(1)** held in place by spring pin **(2)** on the compression release shaft **(3)**.



COMPRESSION RELEASE MECHANISM
1–Stop. 2–Spring pin. 3–Shaft. 4–Plunger.

Each inlet valve rocker arm has a button **(5)** which comes in contact with the compression release shaft **(3)** when the inlet valve is closed and the compression release is in the START position. When the compression release is in the RUN position, flat sections on shaft allow normal operation of the rocker arms.



COMPRESSION RELEASE MECHANISM
3–Shaft. 5–Rocker arm button.

When the shaft is rotated to the START position, the high portions of the shaft contact the inlet valve rocker arm buttons and hold the inlet valves open.

Removal and Installation

1. Remove the rocker arm assembly.
2. Disconnect the compression release lever.
3. Remove the spring pin from the stop on the compression release shaft.
4. Slide the shaft out of the head.
5. Prior to installation inspect the seal on the shaft and replace it if it is damaged.

Front Support

REMOVAL AND INSTALLATION

Remove the crankshaft pulley. See the covering topic.

Support the front of the engine by some means other than the front support itself.

Remove the bolts which secure the front support to the bushing assembly.

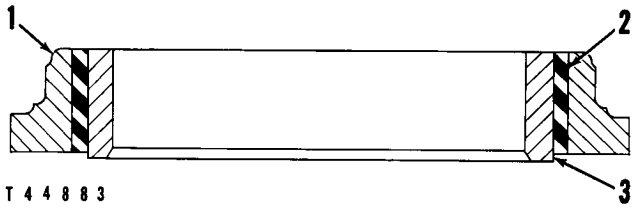
NOTE

Tag the shims from each side of the front support so they will be installed in the same position.

BUSHING ASSEMBLY REMOVAL AND INSTALLATION

The bushing assembly is installed by a special process that gives a very tight fit between the rubber ring **(2)**, support **(1)** and steel inner ring **(3)**. The bushing assembly is serviced only as a unit.

The steel inner ring **(3)** is a .003" to .006" press fit on the timing gear cover. Should it become necessary to replace the bushing assembly for any reason, it is necessary to ruin the three parts of the assembly in the process.



BUSHING ASSEMBLY
1–Support. 2–Rubber ring. 3–Steel inner ring.

Pull, burn off or cut off the support **(1)**, remove the rubber ring **(2)**, and then burn or cut the steel inner ring off the timing gear cover.

As the new bushing assembly is pressed on the timing gear cover, it should be kept in its proper position relative to the engine front support.

CAUTION

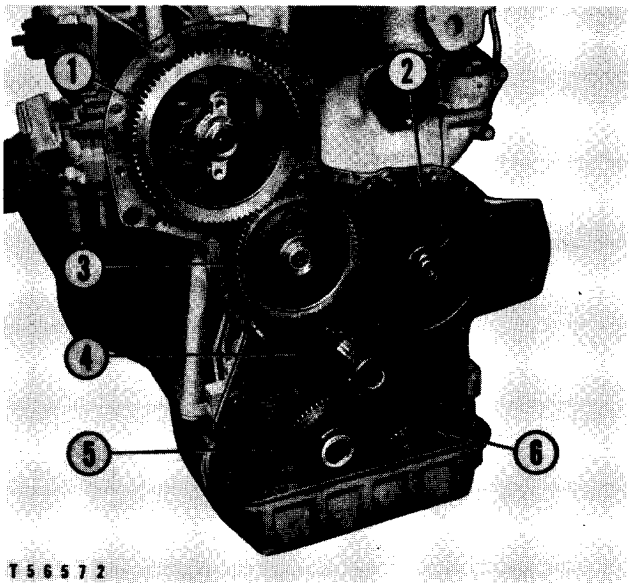
Be sure the inside of the timing gear cover is adequately supported prior to installation of the bushing assembly.

NOTE

If excessive heat is applied to the timing gear cover during the cutting operation, the oil seal in the timing gear cover should be replaced. See the topic, TIMING GEAR COVER REMOVAL AND INSTALLATION.

Timing Gears

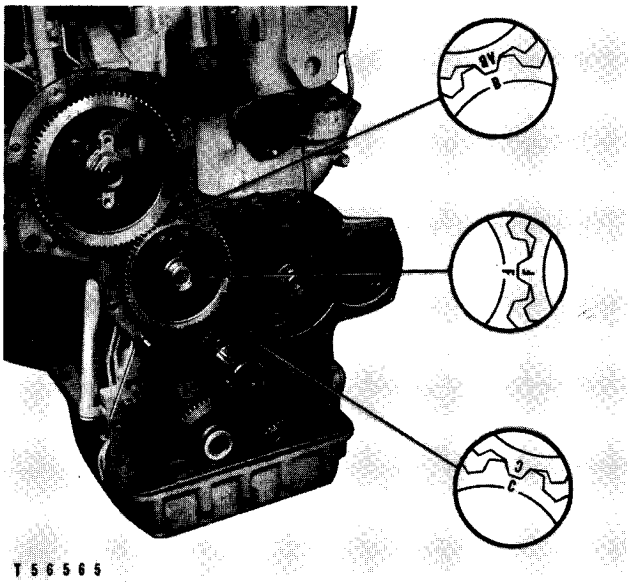
The timing gears are located at the front of the engine and drive the accessories and keep the rotation of the crankshaft, camshaft and fuel injection pump camshaft in correct relationship to each other.



TIMING GEARS
1–Accessory drive gear. 2–Camshaft gear. 3–Accessory drive idler gear. 4–Crankshaft gear. 5–Oil pump idler gear. 6–Oil pump drive gear.

TIMING GEARS AND TIMING MARKS

1. Remove the timing gear cover. See the topic, TIMING GEAR COVER REMOVAL.

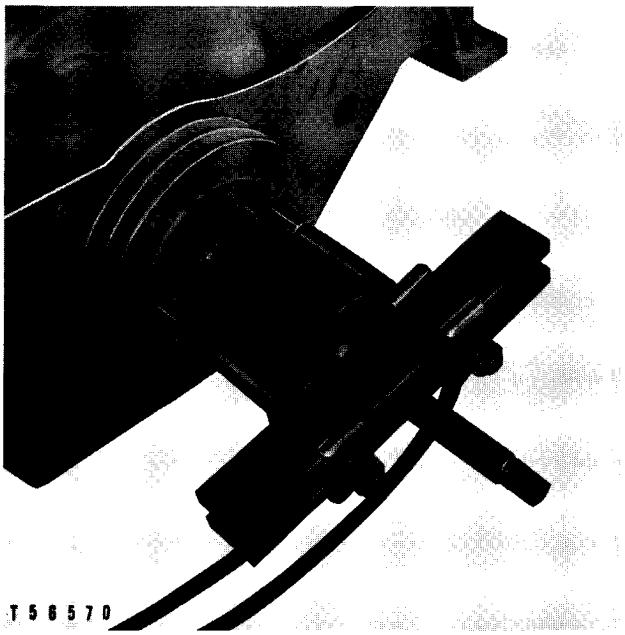


TIMING MARKS

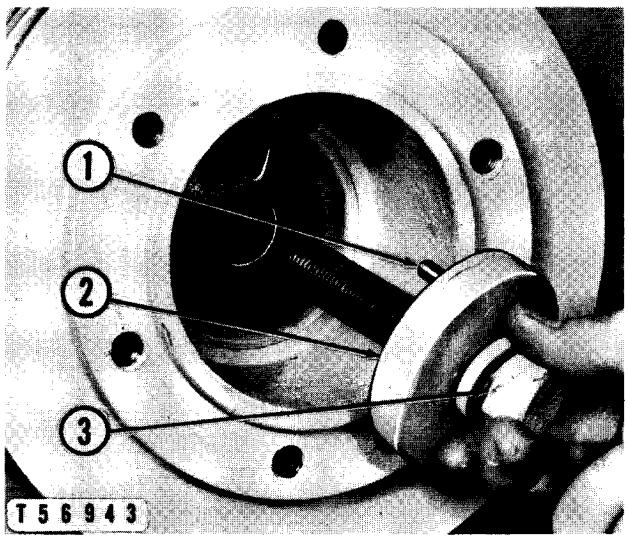
2. Remove the flywheel pointer cover on the flywheel housing and turn the flywheel in the direction of engine rotation until No. 1 piston is at top center on the compression stroke. See the topic, FUEL INJECTION PUMP LIFTER SETTING.
3. The timing marks on the gears should be matched as follows:
   (a.) C on crankshaft drive gear with C on camshaft gear.
   (b.) F on camshaft gear with F on accessory drive idler gear.
   (c.) AB on accessory drive gear with B on accessory drive idler gear.
4. If the timing marks are not properly aligned, see the covering topics for the removal and installation of the particular gears.

CRANKSHAFT PULLEY AND FRONT SUPPORT REMOVAL AND INSTALLATION

1. Loosen the bolt **(3)** about five turns.



REMOVING CRANKSHAFT PULLEY



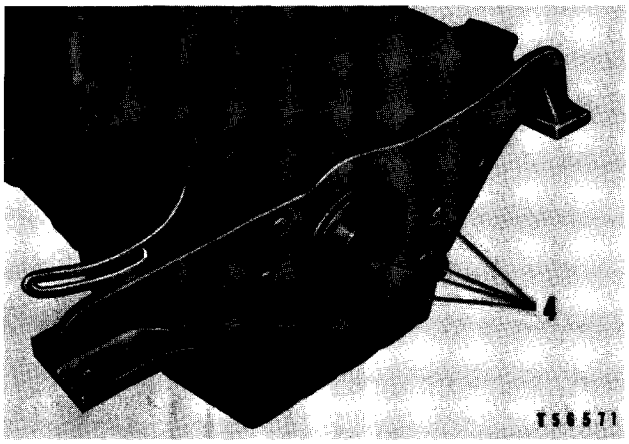
REMOVING RETAINING PLATE
1–Dowel. 2–Plate. 3–Bolt.

2. Use an 8B7548 Push Puller, 8B7550 Legs, 8B7557 Adapters, a 5F7353 Washer, a 5F7366 Screw, an 8B7560 Step Plate, a 6F25 Pump Group and a 7F9540 Hydraulic Puller to loosen the crankshaft pulley as shown.
3. Remove the retaining bolt **(3)**, plate **(2)** and crankshaft pulley.

CAUTION

Be careful not to damage the dowel **(1)** when installing the plate **(2)** and bolt **(3)**.

4. Remove the bolts **(4)** which secure the front support to the timing gear cover, and remove the front support.

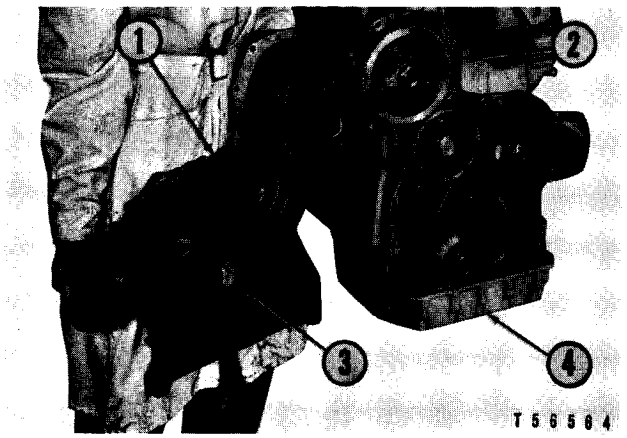


PREPARING TO REMOVE FRONT SUPPORT
4–Bolts.

NOTE

If the front support bushing assembly is to be replaced, see the topic, FRONT SUPPORT.

TIMING GEAR COVER REMOVAL AND INSTALLATION



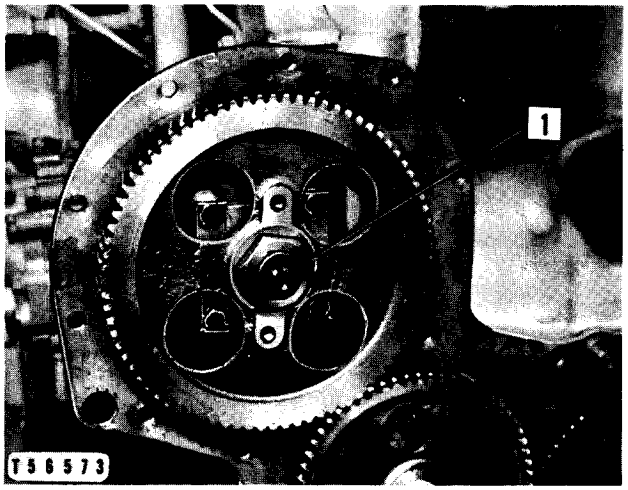
TIMING GEAR COVER REMOVAL
1–Timing gear cover. 2–Timing gear plate. 3–Seal. 4–Oil pan.

1. Mount the engine on an engine positioning stand, if available.
2. Remove the crankshaft pulley as previously described.
3. Remove the bolts that secure the oil pan **(4)** to the timing gear cover **(1)**.
4. Loosen the bolts which secure the oil pan to the cylinder block.
5. Separate the oil pan from the timing gear cover.
6. Using a putty knife, carefully separate the gasket from the cover.
7. Remove the bolts which secure the timing gear cover to the engine block and plate **(2)**, and remove the timing gear cover.
8. Inspect the seal **(3)** in the front cover and replace it if it is damaged.
9. If the crankshaft seal has been removed, do not replace the seal until the cover has been installed. Install the seal with the spring-loaded lip in and the dust seal lip out.

ACCESSORY DRIVE SHAFT AND GEAR

Accessory Drive Gear Removal and Installation

1. Remove the timing gear cover. See the topic, TIMING GEAR COVER REMOVAL.



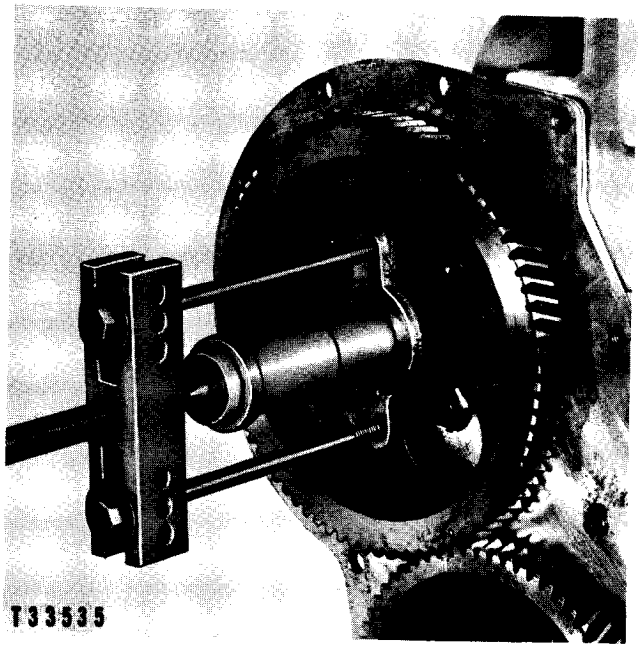
PREPARING TO REMOVE ACCESSORY DRIVE GEAR

☐ **Remove**

1–Nut.

2. Using a 5F7465 Puller, two 3/8" - 16 (NC) bolts 7 1/2" long, two 3/8" washers, 8B7561 Step Plate and 8F3668 Sleeve, pull the accessory drive gear as shown.

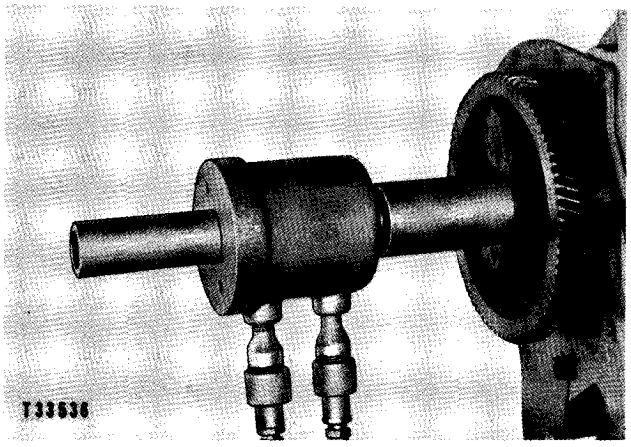
3. Using the 7F9540 Hydraulic Puller Group, 8F3670 Stud, 8F3667 Sleeve, 8F3668 Sleeve and 8F3669 Sleeve, install the accessory drive gear on the shaft as shown.



ACCESSORY DRIVE GEAR REMOVAL

NOTE

When installing the gear on the shaft, check to see that the gear is properly sliding over the key in the shaft and that the timing mark on the gear is aligned with the timing mark on the idler gear. See the topic, TIMING GEARS AND TIMING MARKS.



ACCESSORY DRIVE GEAR INSTALLATION

4. Install the lock and nut.

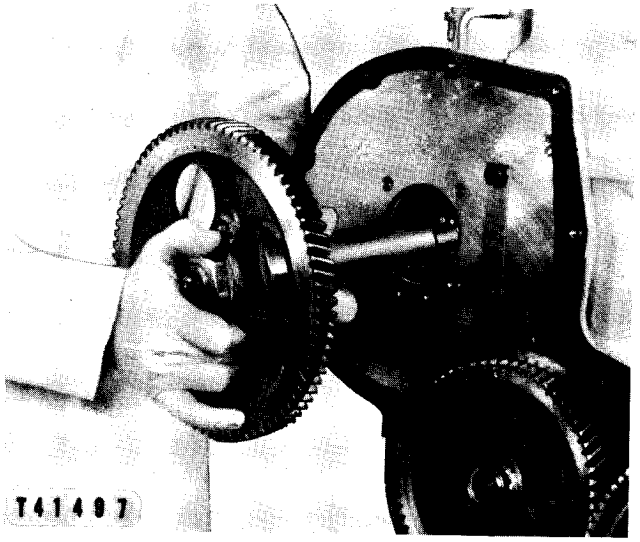
NOTE

Accessory drive gear backlash is listed in the topic, SPECIFICATIONS.

Removal and Installation as a Unit

The accessory drive gear and shaft can be removed as a unit if desired.

With the timing gear cover removed, and the timing marks aligned, remove the bolts which secure the bearing retaining plate to the timing gear plate. See the topic, ACCESSORY DRIVE HOUSING REMOVAL AND INSTALLATION.



REMOVING ACCESSORY DRIVE SHAFT AND GEAR

Remove the shaft and gear as a unit.

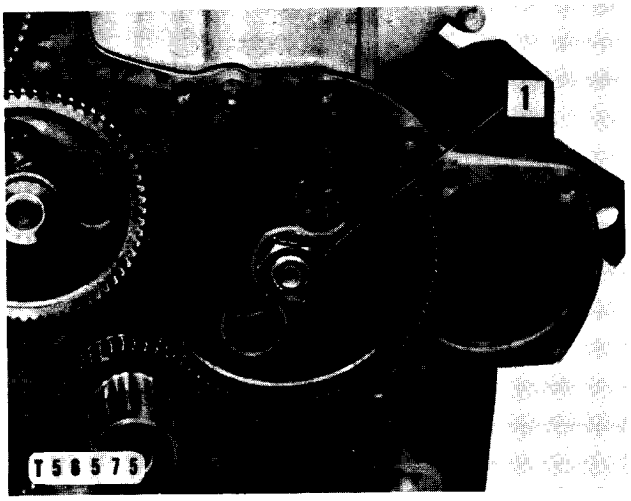
When installing the shaft, be sure to turn the shaft until the off-center tang on the shaft engages with the slot in the fuel injection pump camshaft, and the timing marks on the gear align with the timing marks on the idler gear.

CAMSHAFT

The camshaft is located on the upper left side of the cylinder block and is driven by the camshaft gear. The camshaft is supported in the block by four bearings. The camshaft is positioned by a thrust washer secured to the cylinder block. The cams which actuate the inlet and exhaust valves are forged integrally with the shaft. The camshaft and camshaft gear can be removed as a unit if desired after the timing gear cover has been removed.

Camshaft Gear Removal and Installation

1. Using the identical puller set-up as used to remove the accessory drive gear, pull the gear from the camshaft. See the topic, ACCESSORY DRIVE GEAR REMOVAL AND INSTALLATION.
2. Heat the gear, preferably in oil. Align the keyway on the gear with the key on the camshaft and install the gear. Be sure to align the timing marks.



PREPARING TO REMOVE CAMSHAFT GEAR

☐ Remove

1–Nut.

NOTE

If no suitable means of heating the gear is available, install the camshaft gear as instructed in the topic, ACCESSORY DRIVE GEAR REMOVAL AND INSTALLATION.

3. Install the lock and nut.
4. Check the gear backlash. See the covering topic.

Camshaft Removal and Installation

1. Remove the pushrods and lift the valve lifters clear of the camshaft.
2. Remove the timing gear cover as described in the covering topic.

NOTE

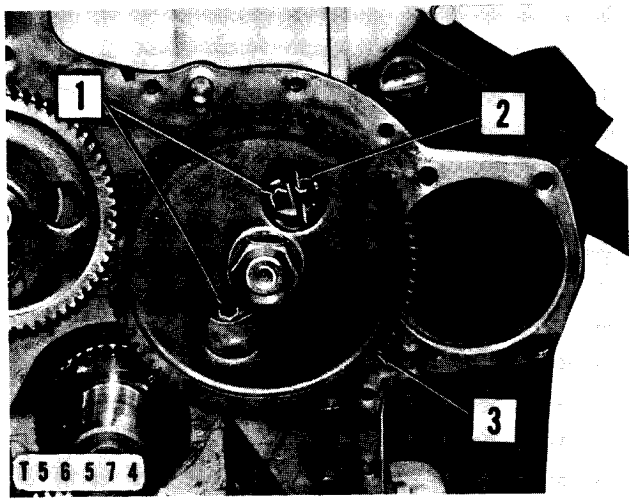
Care should be taken when removing the camshaft and gear not to damage the bearings as the cam lobes pass through them.

3. Check the bearing clearance. For the permissible bearing clearance, see the topic, SPECIFICATIONS.
4. Install the camshaft and gear.

NOTE

If the camshaft bearings are to be removed, see the topic, CAMSHAFT BEARING REMOVAL AND INSTALLATION.

5. Check the camshaft end clearance as described in the topic, CAMSHAFT END CLEARANCE.



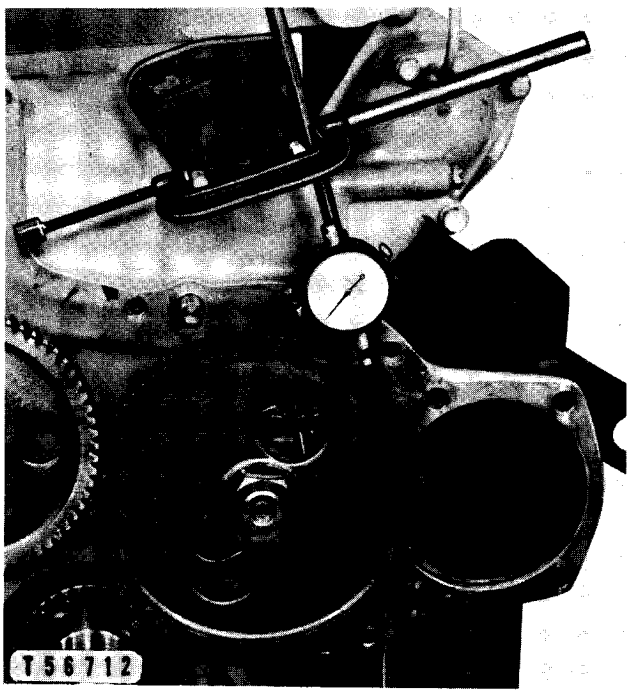
PREPARING TO REMOVE CAMSHAFT

☐ Remove

1–Bolts. 2–Thrust plate. 3–Camshaft and gear.

Checking Camshaft Gear Backlash

The backlash between the camshaft gear and the crankshaft gear can be checked by installing a dial indicator as illustrated. The backlash between the camshaft gear and the crankshaft gear is listed in the topic, SPECIFICATIONS.



CHECKING CAMSHAFT GEAR BACKLASH

When a dial indicator reading of a value greater than the permissible backlash is shown, a further check must be made to determine the cause. Excessive backlash indicates that either the timing gears, the main bearings or the camshaft bearings are badly worn.

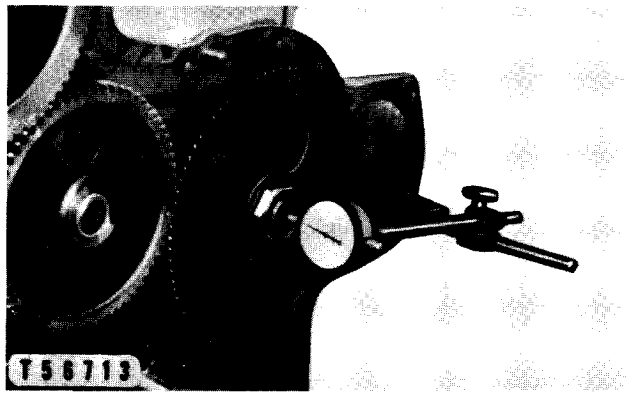
Timing gear wear can be compensated for by adjusting the fuel injection pump lifters. See the topic, FUEL PUMP LIFTER SETTING.

If either the main bearings or the camshaft bearings are badly worn, they should be replaced with new ones.

If a reading of less than the minimum backlash is shown, it is an indication of incorrect assembly, or a burr or rough spot on one of the gears. In this case, take readings every 90° around the camshaft gear to determine the cause. A burr can be removed from a gear tooth, by using a gear file or fine stone, without removing the gear from the camshaft. When removing a burr, cover the remaining exposed parts to keep them clean.

Camshaft End Clearance

The end thrust of the camshaft is taken by the thrust plate.



CHECKING CAMSHAFT END CLEARANCE

The correct end clearance is listed in the topic, SPECIFICATIONS. The thrust plate should be replaced if the end clearance exceeds the permissible end clearance.

The end clearance can be checked by installing a dial indicator as illustrated. After checking the end clearance, if it is necessary to replace the thrust plate, it can be removed as described in the topic, CAMSHAFT REMOVAL AND INSTALLATION.

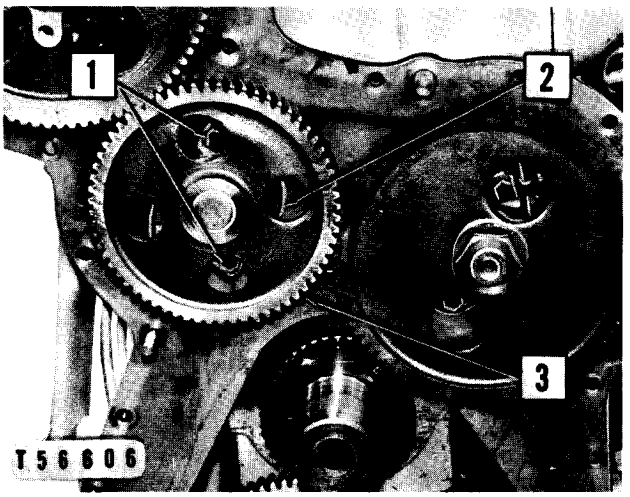
If the camshaft and camshaft gear were removed as a unit, the thrust plate should be inspected for wear. The end clearance can be checked in the following manner. Push the thrust plate against the gear. Using a thickness gauge, measure the clearance between the thrust plate and the end of the camshaft bearing journal.

Camshaft Bearing Removal and Installation

1. Place the engine on an engine stand.
2. Remove the camshaft, oil pan, oil pump, oil pan plate, and flywheel housing. See the covering topics.
3. Press the bearings out of the cylinder block.
4. When installing the camshaft front bearing, be sure that the oil hole in the bearing is aligned with the oil hole in the cylinder block.
5. Install the camshaft front and rear bearings so there is $\frac{1}{8}$" clearance from the face of the cylinder block to the bearing edge.

ACCESSORY DRIVE IDLER GEAR REMOVAL AND INSTALLATION

Inspect the idler gear bearing and the thrust plate and replace if necessary.



ACCESSORY DRIVE IDLER GEAR REMOVAL

☐ **Remove**

1–Bolts. 2–Thrust plate. 3–Gear.

NOTE

Accessory drive idler gear end clearance is listed in the topic, SPECIFICATIONS.

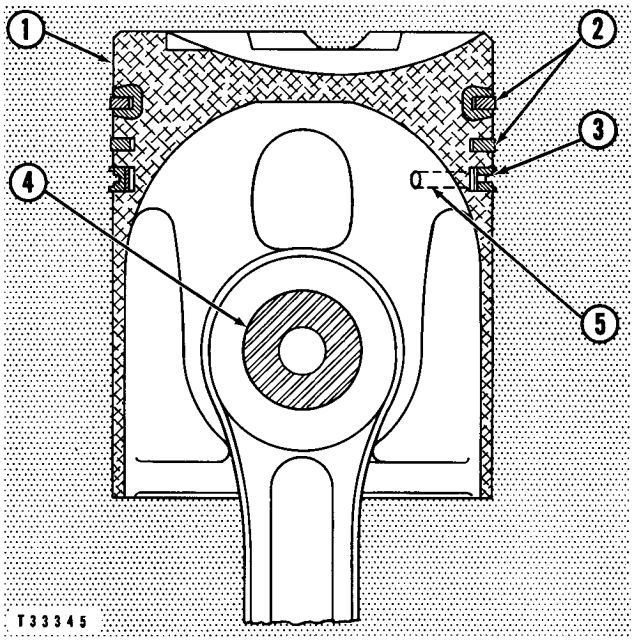
Pistons, Rings and Connecting Rods

PISTONS AND RINGS

The first noticeable symptoms of worn piston rings and cylinder liners are increased oil consumption and excessive vapor from the crankcase breather. Extreme wear will result in poor compression, loss of power and hard starting. See the topic, CYLINDER LINERS.

The cam-shaped aluminum alloy piston **(1)** has three rings; two compression ring **(2)** and one oil ring **(3)**. All rings are located above the piston pin bore. The top compression ring seats in an integral cast iron band. The intermediate compression ring has a taper face to provide quick break-in. Holes **(5)** in the groove for the oil ring above the pin boss provide for the return of oil to the crankcase.

The full floating piston pin **(4)** is retained by two snap rings which fit in grooves in the pin bore.

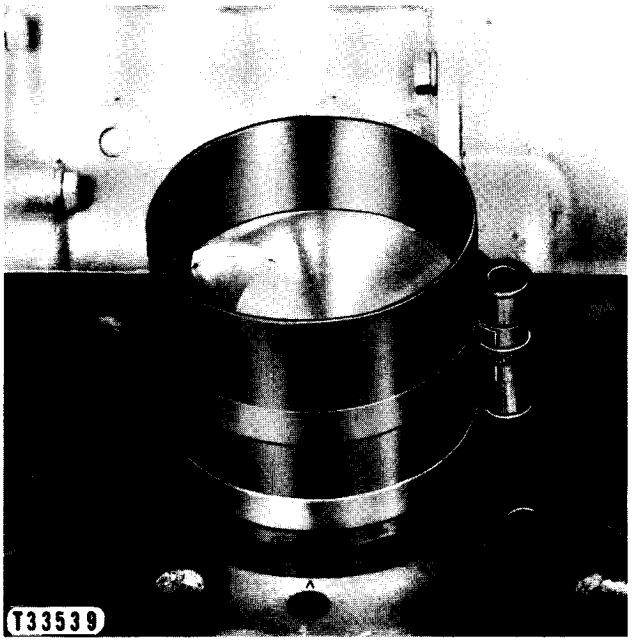


PISTON AND RINGS
1–Piston. 2–Compression rings. 3–Oil ring. 4–Piston pin. 5–Oil hole.

PISTONS

Removal and Installation

1. Drain the lubricating oil and the engine coolant.
2. Remove the cylinder head as described in the topic, CYLINDER HEAD REMOVAL.
3. Remove the carbon from the inside top surface of the cylinder liner.
4. Remove the cylinder block inspection covers or the oil pan and remove the connecting rod bearing caps as described in the topic, CONNECTING ROD BEARING REMOVAL.
5. Rotate the crankshaft until the piston to be removed is at top dead center. Carefully push the connecting rod upward until the piston rings are out of the cylinder.
6. Lift out the piston and connecting rod assembly.
7. Before installing the piston, be sure the liners and pistons are clean and free of carbon.
8. Place the piston ring compressor tool over the cylinder into which the piston is to be installed.
9. Oil the piston and rings and place the piston and connecting rod assembly into the cylinder liner until the ring rests on the compressor tool. Position the V-mark on top of the piston in alignment with the V-mark on top of the cylinder block. This will place the recess for the valves in the piston in the correct relationship to the valves and precombustion chamber in the cylinder head. Push the piston through the compressor and into the cylinder liner.



PISTON INSTALLATION

Cleaning and Inspecting Piston

Pistons which are not worn excessively or scored badly should be cleaned and used again. The ring grooves should be square and smooth. The side clearance between a new ring and the top ring groove should not exceed the value listed in the topic, SPECIFICATIONS.

There are a number of good carbon solvents available for cleaning pistons. A carbon softener for use on diesel engine pistons is fresh, cold water.

Soak pistons in cold water overnight and let them dry (preferably in the sunlight), and most of the carbon including that in the ring grooves can be easily removed.

The use of broken rings or carbon scrapers on ring grooves should be avoided, as grooves can be cut. A stick of hard wood does a good job and will not scratch the piston.

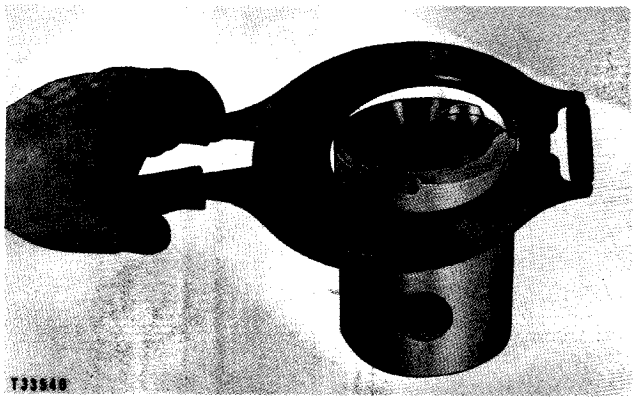
The bottom of each ring groove must be clean and the oil return holes in the oil ring grooves must be open before the installation of new rings.

The area above the top ring can be filed smooth, but pistons badly scored below the top ring groove should be replaced.

RINGS

Piston rings seal compression and control the amount of oil on the cylinder walls. If oil consumption is not excessive and compression is satisfactory, pistons should not be removed nor new rings installed when an engine is dismantled for some other reason.

To avoid damage to the piston, remove the rings with a 5F9059 Piston Ring Expander.



RING EXPANDER

The rings should be placed on the piston in the proper groove. Use the 5F9059 Piston Ring Expander when placing the rings in the grooves. The ring expander is not only a time saver but will also prevent breaking or distorting rings and damaging ring grooves.

CAUTION

The intermediate compression ring has a ½° taper face and has TOP marked. Be sure to install this ring correctly.

When new piston rings are to be used in worn cylinder liners, the ridge at the top of the liner should be raised.

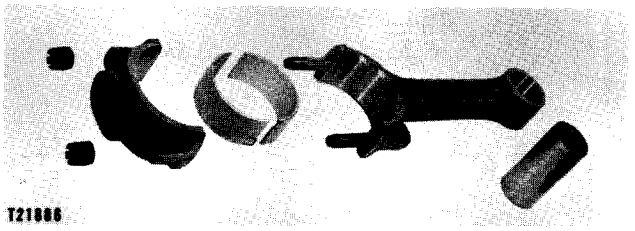
Whenever new rings, piston assemblies or piston and liner groups are installed, be sure to run-in the engine on a conditioning schedule before operating at normal load and speed. Do not run the engine idle for a long period after installing new rings or liners. Rings will not seat during idle operation. See the topic, RUNNING-IN SCHEDULE.

RUNNING-IN SCHEDULE

For the correct running-in procedures, follow the information that accompanies piston rings, piston assemblies and piston and liner groups sent from the Caterpillar Parts Department.

CONNECTING RODS

Connecting rod bearings are located in the crankshaft end of the connecting rod. The bearing caps and rods are numbered consecutively, 1-up, from the front of the engine on the left side so the numbers can be seen through the inspection opening on the left side of the cylinder block. The rods should be reassembled with the numbers in this position.



CONNECTING ROD AND PISTON PIN

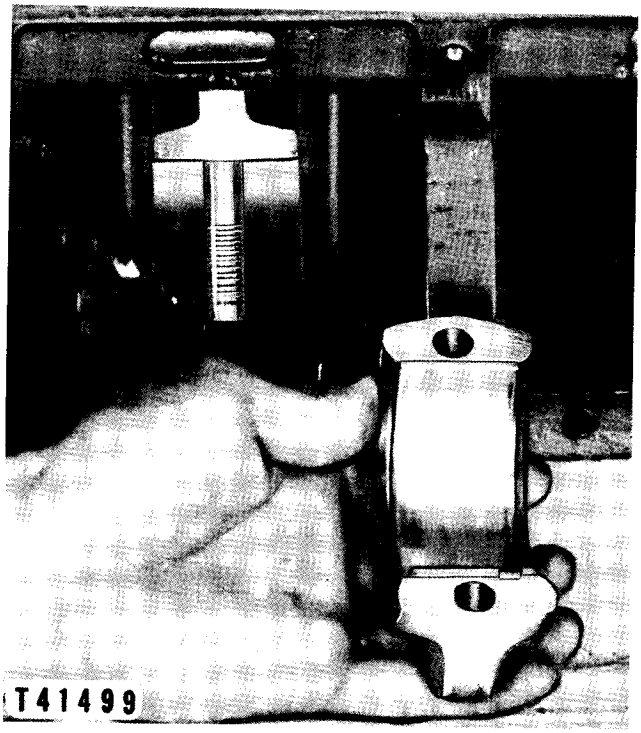
See the topic, PISTONS, for information on connecting rod and piston removal.

Connecting Rod Bearing Removal

Connecting rod bearings are the precision type and are to be installed without fitting or scraping. The bearing halves can be removed, inspected and replaced through the inspection opening without removing the rod from the engine.

1. Drain the diesel engine crankcase and cooling system.
2. Remove all items which interfere with the removal of the inspection cover.
3. Remove the inspection cover.
4. With the inspection cover removed, turn the crankshaft until the bearing to be removed is accessible.
5. Remove the cotter pins and nuts from the connecting rod bolts and take out the cap and bearing lower half.

6. To remove the bearing upper half, turn the crankshaft or push the rod up slightly.



REMOVING CONNECTING ROD BEARING CAP

Connecting Rod Bearing Inspection

Connecting rod bearings are steel-backed, aluminum-lined. Larger particles of dirt and abrasives in the oil do not tend to embed in aluminum bearings. Such particles roll around between the bearing and crankshaft journal causing scratches in the aluminum bearing without actually becoming embedded in the aluminum. Such scratches are not necessarily harmful and do not indicate that the bearings should be replaced.

If there is any question about the surface of a bearing, wash it with cleaning solvent to remove the oil. If the surface feels rough and abrasive, install a new bearing. Another indication of dirt in the bearing is excessive crankshaft wear.

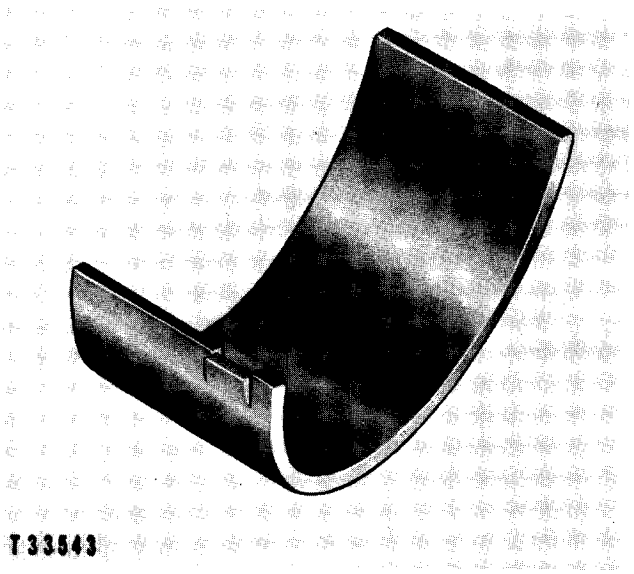
New standard connecting rod bearing size and clearances are listed in the topic, SPECIFICATIONS. Bearings .030" undersize are serviced for reground crankshafts.

Bent rods should be discarded. Do not attempt to align the connecting rods by bending them.

Connecting Rod Bearing Installation

When replacing the bearings, see that the protruding tab on the back of each bearing half lines up with its corresponding recess in the connecting rod and bearing cap. This locks the bearing in place and keeps it from rotating.

Tighten the nuts to the torque value listed in the specifications. It is permissible to exceed this value by the amount necessary to turn the nut to the next slot for alignment with cotter pin hole.



BEARING HALF

Piston Pin Bearing

It is not always necessary to replace piston pin bearings at each engine reconditioning. They may last many thousands of hours if the oil has been kept clean.

After the oil has been cleaned from the pin and bearing, it is possible to feel the clearance between them. This normal oil clearance must not be mistaken for wear.

A new bearing, pin, or both, should be installed only when the clearance between the bearing and pin exceeds the value listed in the topic, SPECIFICATIONS.

New connecting rods have the piston pin bearing bored in a special machine which maintains the proper center-to-center distance and parallelism of the connecting rod bearing. Reconditioned rods should be machined in the same manner. A new connecting rod makes a good templet for center-to-center distance which is listed in the specifications.

After pressing a new bearing into place, it should be machined accurately to the inside diameter listed in the topic, SPECIFICATIONS. A 2H6782 Rod Boring Machine is available for this operation.

Cylinder Liners

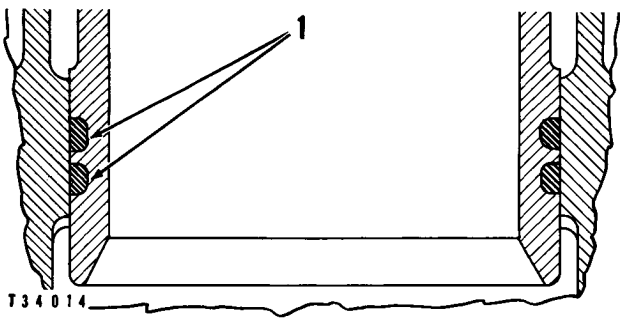
Cylinder liner surfaces are machined, hardened, ground, honed, and chemically treated to assure proper break-in. The resultant surface is so hard that ordinary boring tools will not machine it. Liners, pistons and rings are available from the factory in standard sizes only and require no fitting when they are installed.

CHECKING LINER WEAR

Cylinder liners should be replaced when they are either worn at the top of the ring travel to a value greater than that listed in the topic, SPECIFICATIONS, or, if they are scratched or scored.

Liner wear should be checked with an inside micrometer as shown.

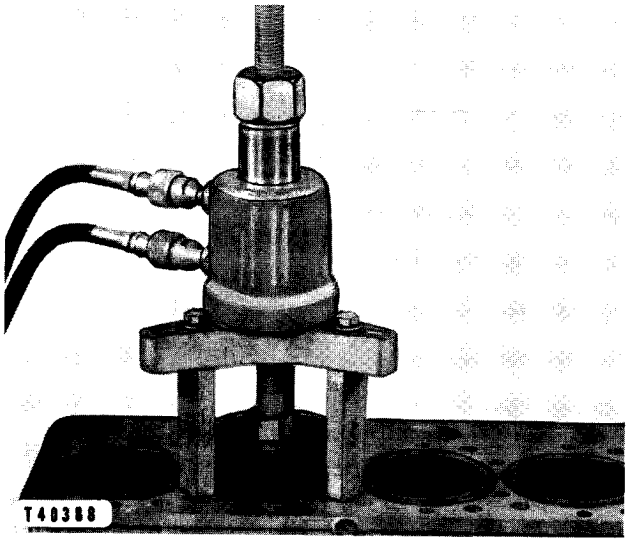
Two O-ring seals **(1)** fit in grooves on the lower end of each liner as shown to prevent leakage of coolant into the diesel engine lubricating system.



LINER SEALS
1–O-ring seals.

REMOVING AND INSTALLING CYLINDER LINERS

1. Drain the cooling system.
2. Remove the cylinder head, the connecting rods and the pistons as outlined in their respective topics.
3. Place a piece of cardboard or heavy gasket material through the inspection opening to protect the inside of the engine.
4. Install the 7F1857 Puller, the 5F7362 Adapter Plate and the 7F9540 Hydraulic Puller.
5. Remove the cylinder liner and clean the water jacket sediment from the cylinder block.
6. When installing the cylinder liner, always use new rubber seals. Coat the rubber seals with liquid soap to ease installation.



PULLING CYLINDER LINER

7. Lower the cylinder liner carefully into the block. The liners can be driven into place by using a suitable driver, or by placing the puller adapter on the top of the liner. A block of hard wood, to be used as a driving block, is then placed on the puller adapter.
8. Drive the liner into the cylinder block until it bottoms. Then hit the block of wood several light taps, to assure that the liner is in. If the last blow bottoms the liner too hard, the liner may bounce back slightly.

NOTE

Properly installed liners should extend slightly above the face of the cylinder block. This insures proper holding and sealing of the cylinder liner against the cylinder head gasket when the

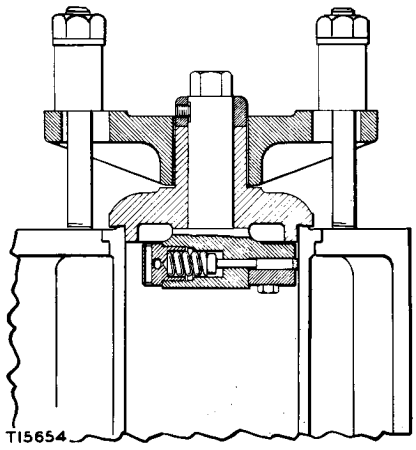
cylinder head is drawn down. Some liners may feel slightly loose in the cylinder block, yet serve satisfactorily without water or antifreeze leaking past the rubber seals.

9. Remove the cardboard and assemble the parts.

RECONDITIONING CYLINDER LINERS

Removing Ridge from Worn Cylinder Liners

When new piston rings are to be used in worn cylinder liners, the ridge in the liner at the top of the ring travel should be raised to provide clearance for the new top ring. Since the liners are too hard for ordinary tools, a liner ridge boring tool should be used. The illustration shows how the tool is installed. Information regarding the tool illustrated is available upon request.



LINER RIDGE BORING TOOL

Use the head bolts or studs and suitable washers as illustrated, to secure the liner ridge boring tool to the cylinder block.

The tungsten carbide tool bit is spring-loaded and specially ground so it will follow the worn contour of the liner and will not cut deeper than the worn surface. Instructions for its use accompany the tool.

CAUTION

Be careful not to rotate the tool counterclockwise when the tool bit is against the liner wall. Doing so will break the cutting edge.

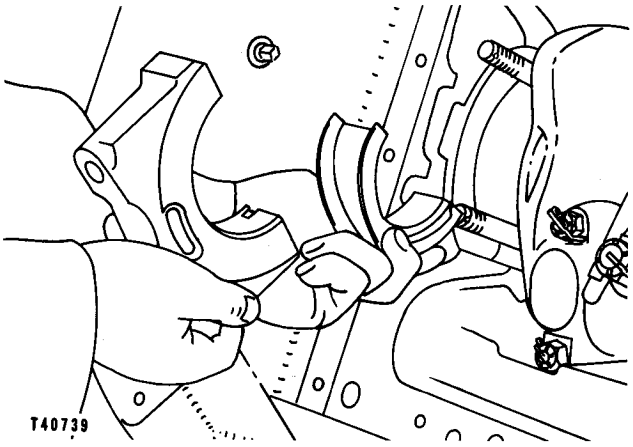
If the engine does not break in properly, follow the information that accompanies piston rings, piston assemblies and piston and liner groups sent from the Caterpillar Parts Department.

Main Bearings

The main bearings and caps support the crankshaft in place in the cylinder block.

The main bearings are of the steel-backed aluminum-lined precision type. Tabs are punched outward on the bearing half at the parting line, and fit into recesses in the cylinder block and bearing cap, securing the bearing and preventing it from rotating. This provides an uninterrupted bearing surface in the most highly-loaded area, improving the loading conditions and giving maximum resistance to fatigue failures.

The crankshaft thrust is taken on the flange of the lower half of the rear main bearing as illustrated. The upper half of the rear main bearing does not include a flange.



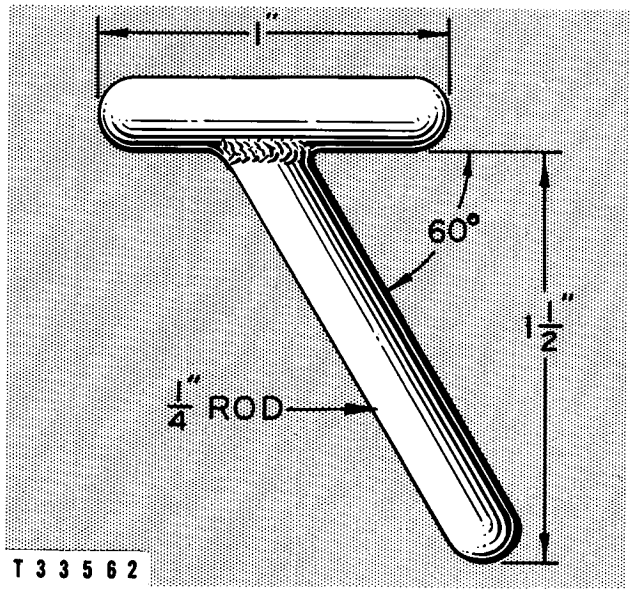
REAR MAIN BEARING AND CAP

REMOVING AND INSTALLING MAIN BEARING

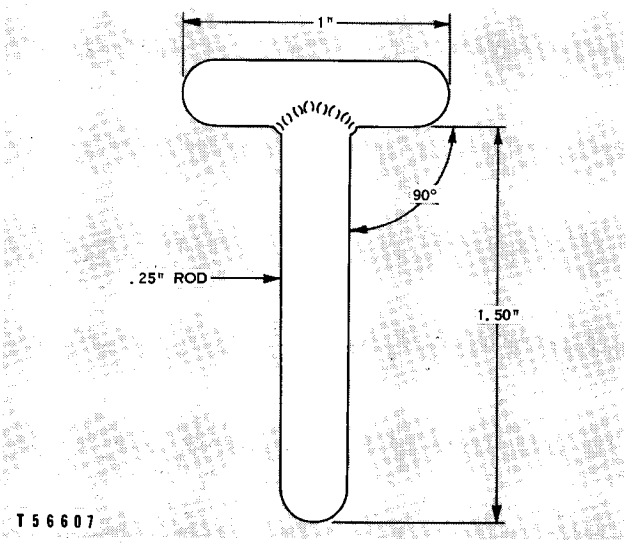
The main bearing caps are identified by numbers stamped on the sides of the caps and the cylinder block. Always return the bearing caps to their proper locations in the block with part number toward front face of block.

All the main bearing caps are held in place by two studs. The rear main bearing also has a dowel to help locate the bearing cap.

1. To remove the main bearings, remove the oil pan, oil pump and plate assembly. See the covering topics.
2. Remove the nuts that secure the bearing caps to the block.
3. Grasp the bearing cap **(4)** at the recessed portion and pull outward, tapping the cap gently with a soft hammer.
4. The main bearing upper halves can be removed by use of the tool shown in the illustration.



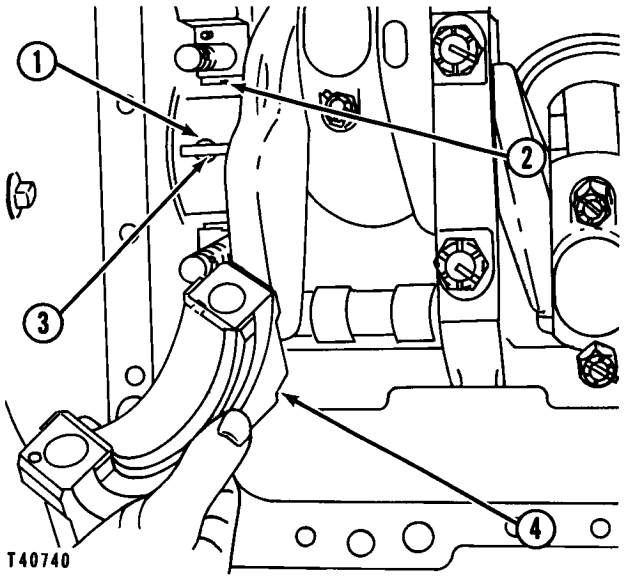
TOOL FOR REMOVING AND INSTALLING MAIN BEARINGS
(Earlier Engines)



TOOL FOR REMOVING AND INSTALLING MAIN BEARINGS
(Later Engines)

5. Place the tool **(3)** in the drilled oil hole **(1)** as shown, and roll the bearing half **(2)** out by rotating the crankshaft.

Before installing a bearing, wash it thoroughly and wipe the outer surface dry. Rotate the upper half into position in the same manner in which it was removed. Make certain the bearing tab is aligned with the recess in the block. Remove the tool from the oil hole in the crankshaft. Since only the lower half of the rear main bearing takes the thrust, full contact between the bearing and crank thrust surfaces is assured. Place the lower half in the cap and install the cap. Refer to the topic, SPECIFICATIONS, for the main bearing stud nut torque. It is



REMOVING MAIN BEARING
1–Oil hole. 2–Upper half of main bearing. 3–Bearing tool. 4–Bearing cap.

permissible to exceed the specified nut torque by the amount necessary to turn to the next slot for alignment with cotter pin hole. Complete the assembly.

MAIN BEARING INSPECTION

Abrasive materials may roll around between the bearing and crankshaft journal causing scratches in the bearing without actually becoming embedded in the aluminum. Such scratches are not necessarily harmful and do not indicate that the bearings should be replaced.

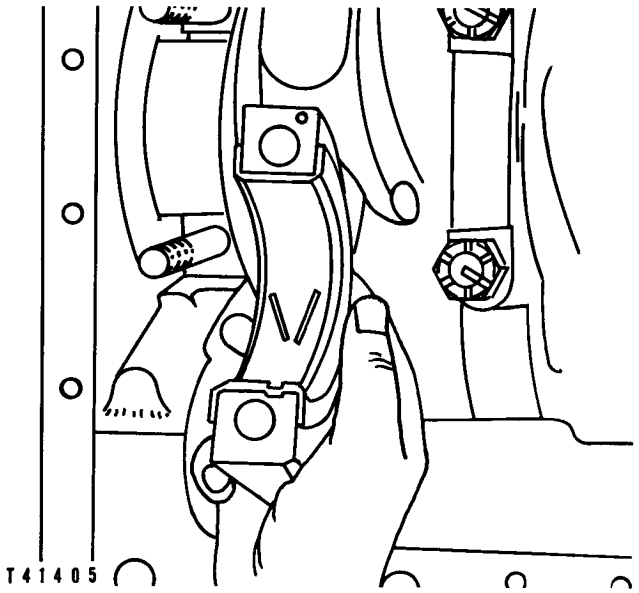
Make certain that the cylinder block and bearing caps are perfectly clean and free from burrs and high spots. Handle the bearings carefully to avoid marring them. Leave them dry except for the grease holding the lead wire when checking clearances, and lubricate them generously for final installation.

If there is any question about the surface of a bearing, wash it with cleaning solvent to remove oil. If the surface feels rough and abrasive, install a new bearing. Another indication of dirt in the bearing is excessive crankshaft wear.

CHECKING MAIN BEARING CLEARANCE

Refer to the topic, SPECIFICATIONS for the proper main bearing clearance and crankshaft wear limits.

The clearances of the main bearings can be measured without removing the crankshaft if the engine is in an upright position. However, the crankshaft must be held against the upper halves of the main bearings; otherwise the weight of the crankshaft will compress the lead wire slightly and indicate a lesser clearance than really exists.



CHECKING MAIN BEARING CLEARANCE

The bearing clearance can be checked by placing soft lead wire between the lower bearing half and the crankshaft. Coat two one-inch lengths of the wire with soft grease and place them diagonally on the bearing. The soft grease will keep the wires in position while installing and tightening the cap. Turn the crankshaft one complete revolution. Remove the cap and measure the thickness of the compressed wire with a 0" to 1" micrometer to determine the bearing clearance. Lead wire for the purpose can be obtained from the Parts Department by ordering part number 5B1161.

REPLACEMENT MAIN BEARINGS

Precision main bearing halves, machined to provide proper clearance, are obtainable in complete sets and are to be installed without further machining or hand fitting. Single replacement bearings (both upper and lower half) can also be obtained and installed without special fitting. As a rule, however, it is good practice to replace the complete set if any one of the bearings needs to be replaced. If only one new bearing is installed and the other bearings are worn to any extent, the new bearing will carry more than its normal share of the load and might be damaged as a result.

Precision main bearings are also obtainable for use with crankshafts reground to .030" undersize.

Crankshaft

The crankshaft main bearing journal and the connecting rod bearing journal diameters are given in the topic, SPECIFICATIONS. Steel-backed, aluminum-lined bearings are used. The lower half of the rear main bearing has flanges which take the end thrust of the crankshaft. The crankshaft timing gear is pressed on the front of the crankshaft.

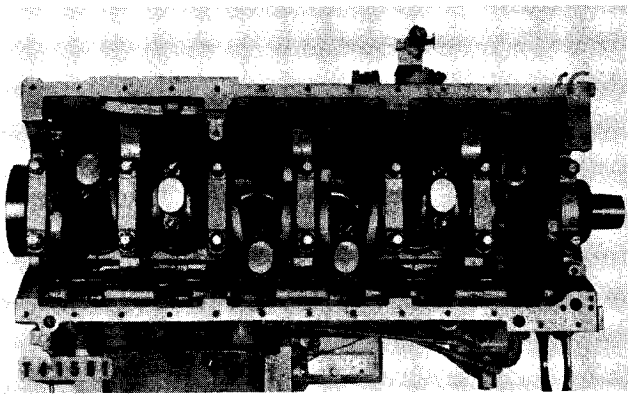
An oil seal pressed into the timing gear housing cover prevents leakage at the front. An oil seal pressed into the flywheel housing and bearing against the crankshaft flange prevents leakage into the flywheel housing. Counter-weights are forged integrally with the shaft and are drilled for balance.

The crankshaft should be reground or replaced if either the wear on the main bearing journals or the wear and out-of-round on the connecting rod journals is greater than the values listed in the topic, SPECIFICATIONS.

Undersize main and connecting rod bearings are available for use with crankshafts reground to .030" undersize.

CRANKSHAFT REMOVAL AND INSTALLATION

1. Remove the radiator. See the topic, RADIATOR REMOVAL AND INSTALLATION.
2. Mount the engine on a 9F3829 Engine Positioning Stand, if available.
3. Remove the water pump, timing gear housing cover and flywheel housing. See the covering topics.

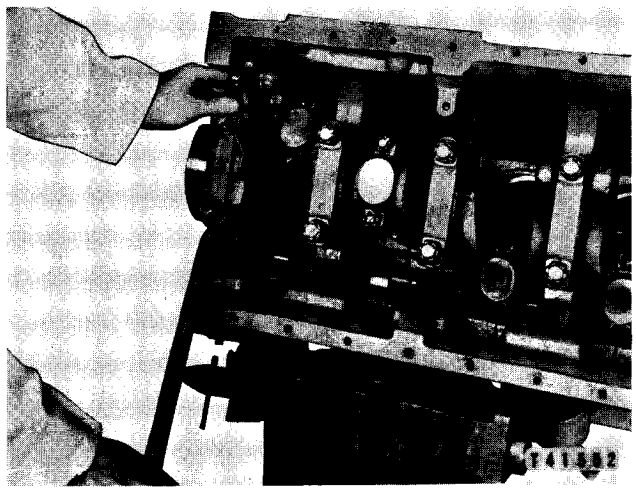


PREPARING TO REMOVE CRANKSHAFT

4. Position the engine on its side as shown and remove the oil pan, plate assembly and oil pump.
5. Remove the connecting rod bearings and caps and push the piston and rod assemblies upward into the cylinders to clear the crankshaft.
6. Wrap the bearing surface on the crankshaft for number two and number five connecting rods with a clean heavy cloth.
7. Place a cable around the cloth and attach the cable to a suitable hoist. Tighten the cable just enough to prevent the crankshaft from moving when the main bearing caps are removed.
8. Cover the bearing cap studs with pieces of rubber hose or something similar to prevent nicking or scratching the crankshaft during removal and installation.
9. Remove the main bearing caps and lift the crankshaft from the engine.
10. Lubricate and wrap the bearing surfaces.
11. Prior to installing the crankshaft, see the topic, TIMING GEARS AND TIMING MARKS, for proper timing of the crankshaft gear.
12. Lubricate the bearings, install the crankshaft and check the bearing clearances. See the covering topic.
13. See the topic, SPECIFICATIONS, for the proper torque on the bearing cap stud nuts.

CRANKSHAFT END CLEARANCE

The crankshaft end thrust is taken on the flanges of the lower half of the rear main bearing described in the topic, MAIN BEARINGS.



CHECKING CRANKSHAFT END CLEARANCE

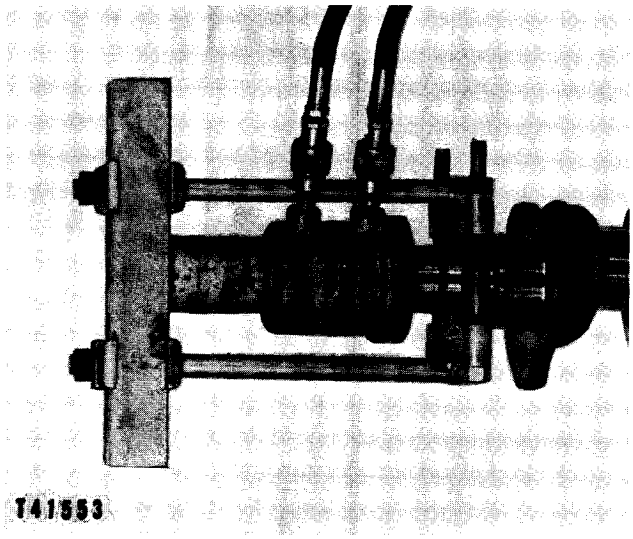
End clearance can be checked by pushing the crankshaft as far as it will go to one end of the cylinder block and using a thickness gauge to measure the clearance between the machined face of the crankshaft flange and the flange of the lower half of the rear main bearing.

See the topic, SPECIFICATIONS, for the proper end clearance.

CRANKSHAFT GEAR REMOVAL AND INSTALLATION

Remove the crankshaft. See the covering topic.

Use an 8B7548 Puller, 8B7551 Attachment, 6F25 Pump, 7F9540 Hydraulic Puller and a suitable spacer with the approximate dimensions 2⅞ inch by 3½ inch to pull the crankshaft gear as shown.



CRANKSHAFT GEAR REMOVAL

NOTE

To install the crankshaft gear, heat it in oil to a temperature of 600°F. and push it onto the crankshaft. Make certain the keyway in the gear is aligned with the key in the crankshaft. Be sure the timing marks are to the outside of the gear.

Flywheel and Flywheel Housing

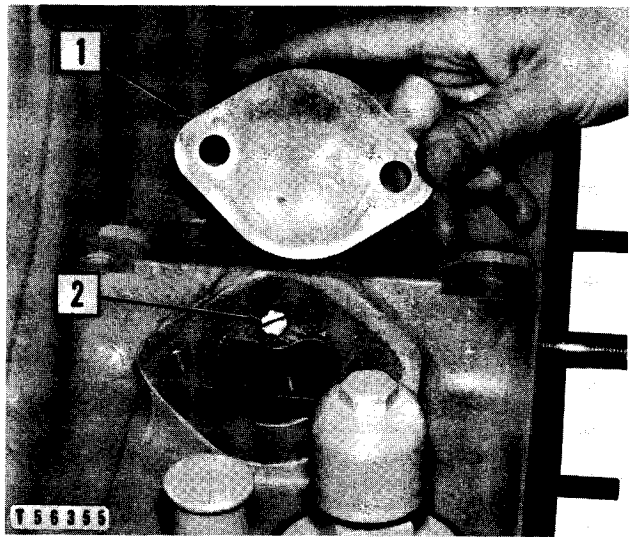
FLYWHEEL AND RING GEAR

Removal and Installation

The flywheel and ring gear can be removed with the diesel engine in the machine. For the purpose of clarity, the removal is shown with the engine mounted on a 9F3829 Positioning Stand.

If the engine is removed, the engine should be blocked securely or placed on an engine positioning stand.

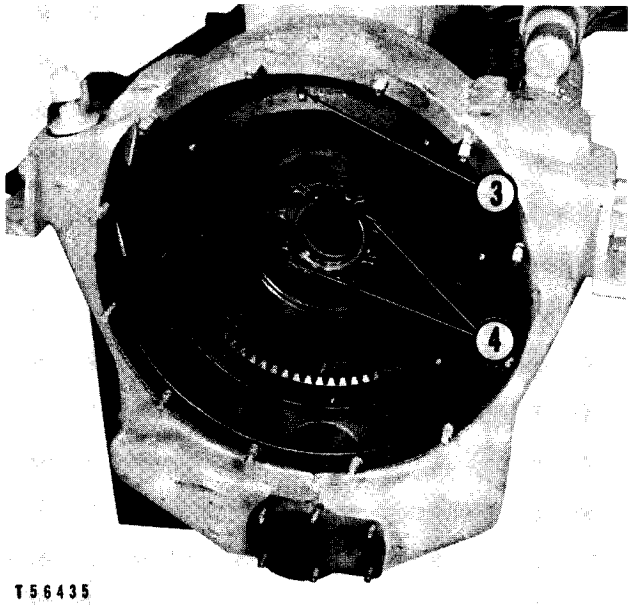
Prior to removing the flywheel, make certain the alignment marks on the flywheel and crankshaft are visible for easier alignment at the time of installation.



POINTER REMOVAL

☐ **Remove**

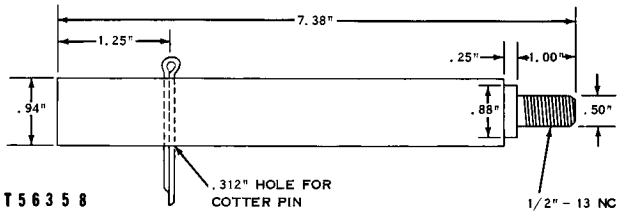
1–Cover. 2–Pointer.



PREPARING TO REMOVE FLYWHEEL

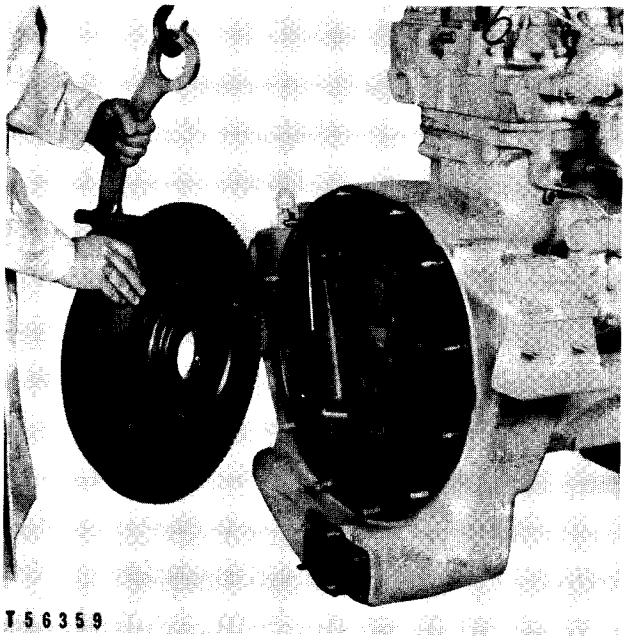
3–Clutch mounting hole. 4–Two diagonally opposed bolts.

1. Remove the flywheel clutch. See the covering topic.
2. Remove two diagonally opposed flywheel retaining bolts **(4)** and install two 5/8" - 18 NF guide pins.
3. Fabricate a lifting pin of the dimensions shown and install it in the top clutch mounting hole **(3)**.



LIFTING PIN

4. Use an 8F4423 Lifting Bracket and a suitable hoist to support the weight of the flywheel. The flywheel weighs approximately 140 pounds.
5. Remove the remaining flywheel retaining bolts and remove the flywheel as shown.



REMOVING THE FLYWHEEL

6. Press the ring gear off the flywheel.
7. Prior to installing the ring gear, clean both the ring gear and flywheel and remove all burrs.
8. Heat the ring gear in oil, to a temperature not to exceed 600° F., and install it on the flywheel.

Make certain the chamfered portion of the teeth on the ring gear are toward the cylinder block when installed.

NOTE

When installing the flywheel, use guide pins as previously described.

9. Align the marks on the flywheel and crankshaft and move the flywheel into position on the crankshaft.
10. Tighten the flywheel bolts evenly and diametrically to the torque value given in the topic, SPECIFICATIONS.

FLYWHEEL HOUSING

The diesel engine must be removed from the machine in order to remove the flywheel housing.

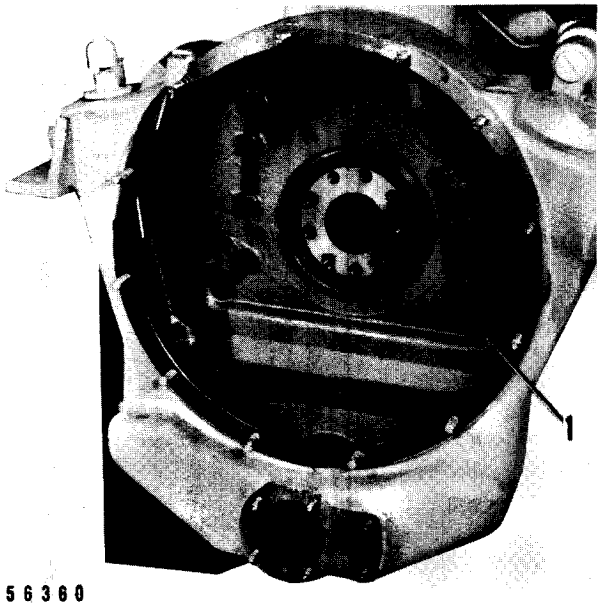
Removal and Installation

1. Remove the diesel engine electric starting motor, if so equipped.

NOTE

It is not necessary to remove the gasoline starting engine to remove the flywheel housing.

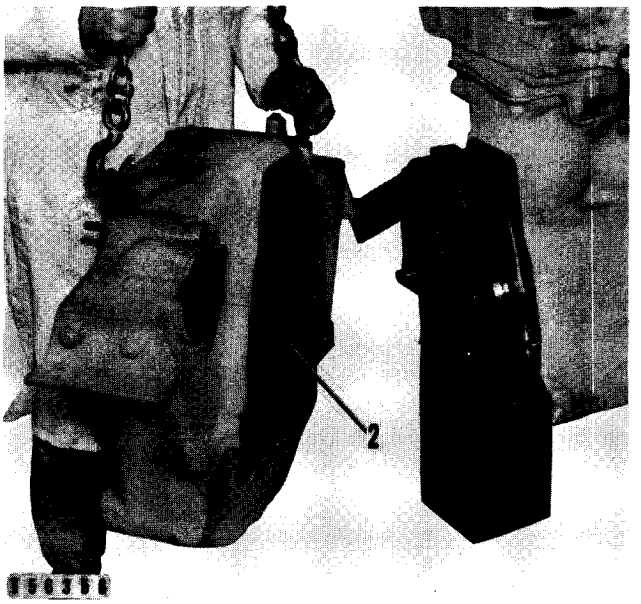
2. Remove the flywheel. See the topic, FLYWHEEL AND RING GEAR.



T56360

PREPARING TO REMOVE FLYWHEEL HOUSING
1–Flywheel housing retaining bolts (thirteen).

3. Remove the bolts which secure the oil pan plate to the flywheel housing.
4. Loosen the bolts which secure the oil pan and oil pan plate to the cylinder block.
5. If the engine is being supported by the oil pan and oil pan plate, raise the cylinder block and insert two 1/4" shims between the cylinder block and oil pan plate at the rear of the diesel engine. Be careful not to damage the oil pan plate gasket.
6. Attach a suitable hoist to support the weight of the flywheel housing, and remove the flywheel housing retaining bolts **(1)**. The flywheel housing weighs approximately 250 pounds.
7. Remove the flywheel housing as shown.



T56359

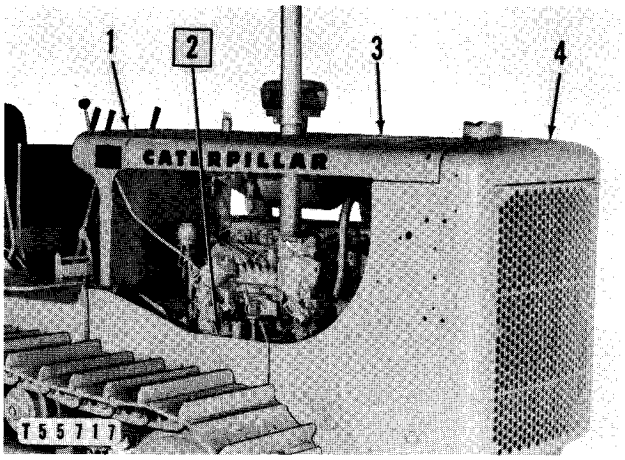
REMOVING THE FLYWHEEL HOUSING
2–Seal.

8. Remove and clean the oil strainer screen in the bottom of the flywheel housing. Replace the screen if it is damaged.
9. Prior to installation of the strainer screen, clean the oil return passage.
10. Inspect the gasket between the flywheel housing and cylinder block and replace it if it is damaged.
11. Prior to installation of the flywheel housing, replace any damaged gaskets, and check the oil seal **(2)**. Replace if necessary. The seal is installed with the lip facing the crankshaft flange.
12. Secure the flywheel housing in place. See the topic, SPECIFICATIONS, for correct retaining bolt torque value.

Diesel Engine Removal and Installation

The diesel engine, together with the starting engine and the flywheel clutch, weighs approximately 3000 pounds.

1. Drain the coolant from the radiator.
2. Close the fuel shut-off at the tank.

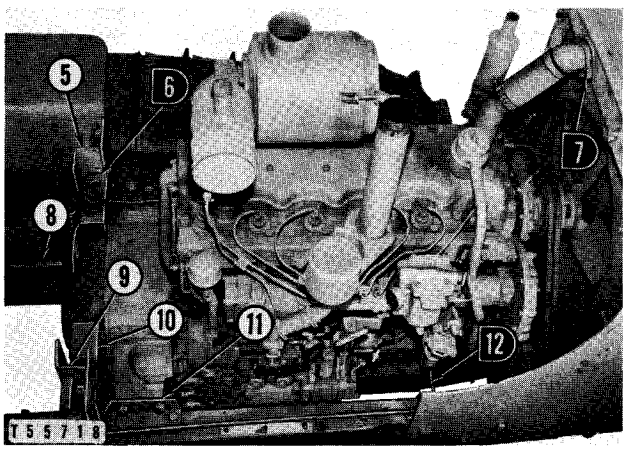


PREPARING TO REMOVE DIESEL ENGINE

☐ Remove

1–Dash. 2–Side plate. 3–Hood. 4–Radiator guard.

3. Remove the hood **(3)** and the dash **(1)**. See the covering topics.



PREPARING TO REMOVE DIESEL ENGINE

◗ Disconnect

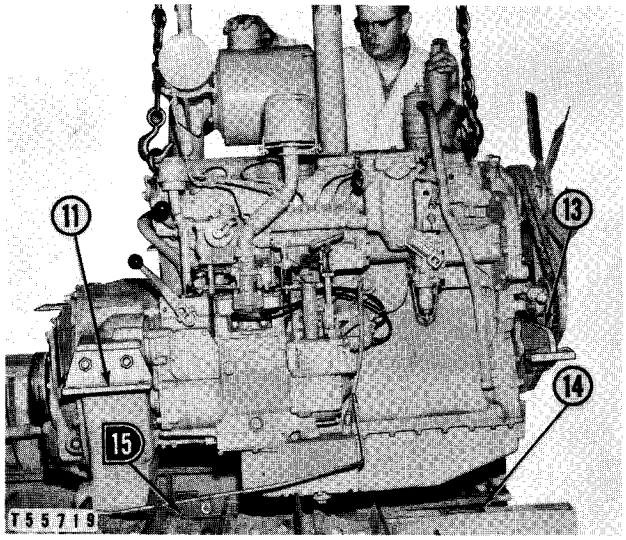
5–Fender support assembly. 6–Plate. 7–Radiator inlet elbow. 8–Flywheel clutch yoke arm. 9–Fender support assembly. 10–Plate. 11–Engine rear support. 12–Fuel line.

4. Remove the universal joint. See the covering topic.

CAUTION

Seal the end of the fuel line and the fuel filter inlet to prevent the entry of any foreign material.

5. Disconnect the plates **(6)** and **(10)** from the fender support assemblies **(5)** and **(9)**.
6. Disconnect the radiator outlet elbow and inlet elbow **(7)** at the radiator.
7. Remove the radiator guard and radiator. See the covering topic.



REMOVING DIESEL ENGINE

◗ Disconnect

11–Engine rear support. 13–Engine front support. 14–Shims. 15–Equalizer spring pivot pin lubrication tube.

8. Disconnect the equalizer spring pivot pin lubrication tube **(15)** from the diesel engine crankcase.
9. Remove the bolts that secure the engine supports **(11)** and **(13)** to the frame.
10. Install two 3/4" - 10 (NC) eyebolts in the cylinder head.
11. Attach a lifting beam and suitable hoist to the eyebolts.
12. Raise the engine slightly and check for any points of interference.
13. The shims which are under the engine supports should be wired together in individual groups and replaced in their original positions when installing the engine.
14. After the engine has been placed in position, its alignment should be checked as recommended in the topic, ALIGNING ENGINE.

ALIGNING ENGINE

Place the amount of shims needed between the engine supports and the tractor frame in order to align the universal joint as closely as possible.

After installation of the engine and universal joint is complete, a visual check of the alignment can be made while rotating the universal joint. If the universal joint wobbles perceptibly closer alignment is needed.

Misalignment

Normally misalignment can be corrected by adding or removing shims as necessary between the frame and the engine supports.

If it is necessary to shift the engine from one side to the other in the frame, loosen the hold-down bolts and shift the engine accordingly.

If the holes for the hold-down bolts are enlarged, dowels should be installed to hold the engine in the proper location after it is bolted down.

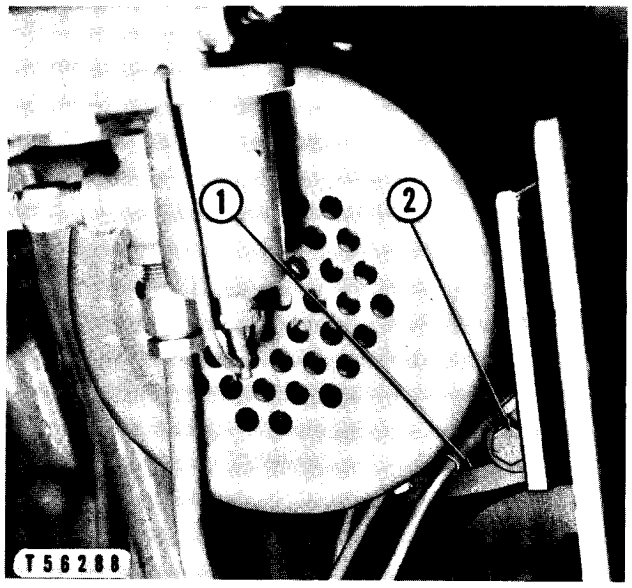
Extreme misalignment is probably the result of bent main frame channels, in which case they should be straightened. Extreme wear in the engine front support will also cause misalignment.

Electrical System

Always disconnect the battery from the system prior to working on any of the electrical components.

GENERATOR REMOVAL AND INSTALLATION

The generator is located on the front right side of the engine and is belt driven from the crankshaft pulley.

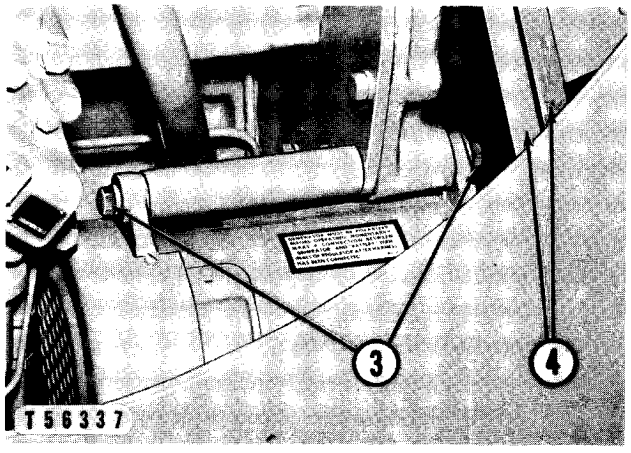


PREPARING TO REMOVE GENERATOR
1–Strap. 2–Bolt.

1. Remove the bolt **(2)** from the belt tension adjusting strap **(1)**.

NOTE

There is a spacer behind the strap **(1)** which will fall out when the bolt **(2)** is removed. Be sure that the spacer is installed upon assembly.

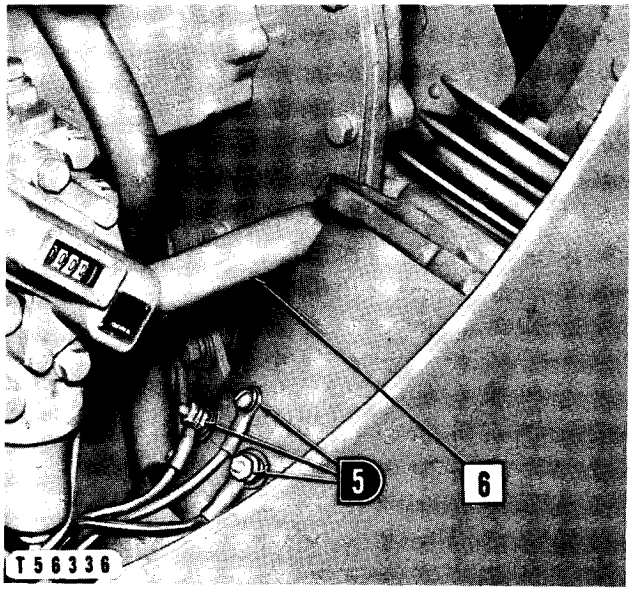


PREPARING TO REMOVE GENERATOR
3–Bolts. 4–Fan belts.

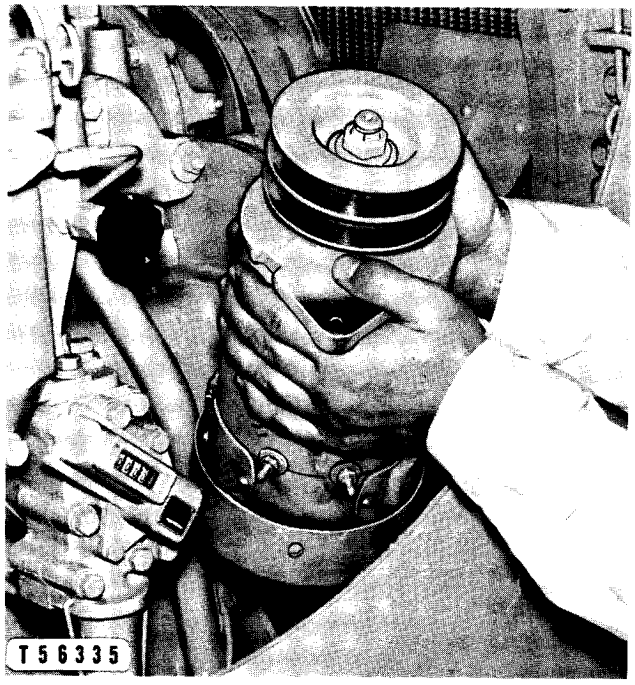
2. Remove the fan belts **(4)**. See the covering topic.
3. Support the generator in some manner to keep it from falling and remove bolts **(3)**.

NOTE

Mark the terminals and wires so they can be correctly connected when the generator is installed.



PREPARING TO REMOVE GENERATOR
□ Remove ◗ Disconnect
5–Wires. 6–Spacer.



GENERATOR REMOVAL

4. Remove the generator as shown.
5. Install in reverse order of removal.

Polarization

Whenever a DC generator is installed, or reconnected to the generator regulator, it must be polarized before starting the engine. To prevent damage to the generator or generator regulator, the following procedure for polarizing should be used when installing the generator.

Polarizing 24V and 12V generators:

Connect a jumper momentarily between the regulator terminals marked BAT and GEN.

GENERATOR REGULATOR REMOVAL AND INSTALLATION

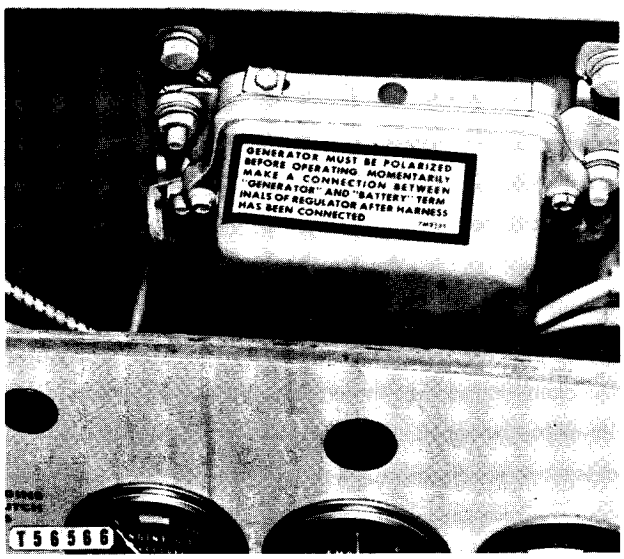
The generator regulator is mounted inside the dash assembly.

Remove the cover from the dash assembly.

Disconnect all wiring leads to the regulator.

NOTE

Mark the terminals and wires so they can be correctly connected when the regulator is installed.



PREPARING TO REMOVE REGULATOR

Install in reverse order of removal.

ELECTRIC STARTING MOTOR REMOVAL AND INSTALLATION

A 24 volt starting motor is used to start the engine if electric starting is used. The starting motor contains an overrunning clutch drive mechanism. It functions in a similar manner as other starting drive mechanisms. The clutch thus serves to protect the pinion and ring gear and also the starting motor when the diesel engine starts.

A heavy duty magnetic switch is used on the starting motor.

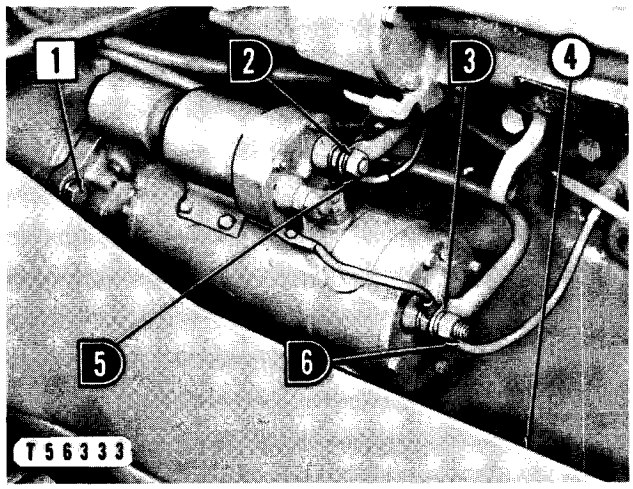
For the wiring diagrams, see the Operation and Maintenance Instructions.

WARNING

Extremely high current flows through the circuit when the starting motor is operating. Therefore, care must be taken to prevent grounding the terminals accidentally because serious damage and injury could result.

NOTE

Mark the cables, wires and terminals so they can be correctly connected when installing the starting motor.



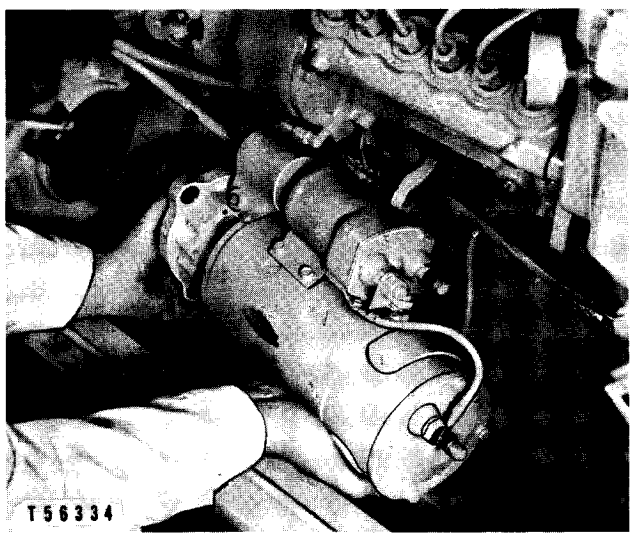
PREPARING TO REMOVE ELECTRIC STARTING MOTOR

□ Remove ◗ Disconnect

1–Bolts (three). 2–Cable. 3–Cable. 4–Plate assembly. 5–Wire. 6–Wire.

NOTE

The approximate weight of the starting motor is 72 pounds. To facilitate in the removal of the starting motor, the plate assembly **(4)** can be removed.



STARTING MOTOR REMOVAL

ISSUED 2-63

STARTING ENGINE

TABLE OF CONTENTS

STARTING ENGINE

INDEX

STARTING ENGINE

ISSUED 7-64

SPECIFICATIONS

Bore and Stroke	2⅜ in. x 2⅜ in.
Brake horsepower	12 - 15 @ 4500 RPM
High idle speed	5050 RPM
Low idle speed	2200 RPM

Camshaft

Journal diameter	1.498 - 1.499 in.
Bearing bore	1.500 - 1.503 in.
Bearing clearance	.001 - .005 in.
Permissible clearance	.006 in.
End clearance	.001 - .005 in.
Permissible end clearance	.010 in.

Check Valve Spring (Common lubrication system)

Free length	½ in.
Lbs. force	2.19
When compressed to	5/16 in.

Clutch

Clutch springs:	
Free length	2 11/64 in.
Lbs. force	69 - 81
When compressed to	1¾ in.
Adjustment:	
Clearance between spherical head of adjusting screw in release lever and the clutch spring retaining plate	.030 - .040 in.
Clearance between brake backup plate and rollers	.030 in.
Free travel in linkage assembly	.030 in.

Connecting Rod

Connecting rod bearing clearance (Earlier)	.0017 - .0039 in.
Connecting rod bearing clearance (Later—with lead-tin overlay)	.0009 - .0031 in.
Permissible bearing clearance	.005 in.
Bolt nut torque	180 - 220 lb. ft.
Center-to-center distance	3.839 - 3.841 in.
Bore in piston pin bearing	.5409 - .5414 in.

Crankshaft

Main journal diameter	1.7497 - 1.7503 in.
Permissible main journal wear	.0065 in.
Main bearing clearance	
Front (earlier)	.001 - .0055 in.
Front (later with lead-tin overlay)	.0005 - .005 in.
Rear (earlier—clearance to be measured vertically)	.0027 - .0043 in.
Rear (later with lead-tin overlay—clearance to be measured vertically)	.0022 - .0035 in.
Permissible bearing clearance (front)	.007 in.
Permissible bearing clearance (rear)	.008 in.
End clearance	.002 - .013 in.
Permissible end clearance	.019 in.
Main bearing bolt torque (rear)	28 - 30 lb. ft.
Connecting rod journal diameter	1.3747 - 1.3753 in.
Permissible rod journal wear	.0045 in.
Permissible out-of-round	.0025 in.
Gear and sprocket retaining bolt torque	118 - 142 lb. ft.

Cylinder Bore

Diameter	2.376 - 2.377 in.
Cylinder bore wear limit (out-of-round)	.003 in.
Cylinder bore wear limit (taper)	.005 in.
Cylinder diameter for .020" oversize piston	2.396 - 2.397 in.
Cylinder diameter for .040" oversize piston	2.416 - 2.417 in.

Cylinder Head

Bolt torque	31 - 39 lb. ft.

Magneto

Point gap	.015 in.

Oil Pump

Clearance between gears and end covers (total)	.001 - .003 in.
Shaft diameter	.4919 - .4925 in.
Bearing bore	.4930 - .4936 in.
Bearing clearance	.0005 - .0017 in.
Permissible bearing clearance	.006 in.
Pressure relief spring:	
Free length	1.045 in.
Lbs. force	8.29 - 9.73
When compressed to	.750 in.
Oil pressure, minimum PSI at high idle	40

Pinion Mechanism

Gear backlash between pinion drive gear and clutch gear (through idler)	.004 - .021 in.
Idler gear bearing diameter (ID)	1.1255 - 1.1275 in.
Bearing clearance	.0225 - .0255 in.
Permissible bearing clearance	.030 in.
Overrunning clutch gear bearing diameter (ID)	1.9488 - 1.9494 in.
Bearing clearance	.0005 - .004 in.
Permissible clearance	.006 in.
Plunger spring (Earlier):	
Free length	1.38 in.
Lbs. force	14.2 - 15.8
When compressed to	.97 in.
Plunger spring (Later—plunger guided in cover):	
Free length	1.235 in.
Lbs. force	28.71 - 30.29
When compressed to	.739 in.
Pinion shaft bearing bore (inner)	.8755 - .8775 in.
Bearing clearance	.0015 - .0045 in.
Permissible clearance	.012 in.
Pinion return springs (Earlier):	
Outer spring free length	3.69 in.
Lbs. force	5.00 - 5.52
When compressed to	2.35 in.
Inner spring free length	3.23 in.
Lbs. force	3.87 - 4.27
When compressed to	2.41 in.
Pinion return spring (Later—conical):	
Free length	2.375 in.
Lbs. force	60 - 70
When compressed to	.560 in.

STARTING ENGINE

SPECIFICATIONS

Piston Pins

Clearance in rod bearings	.0007 - .0017 in.
Permissible clearance in rod	.0030 in.
Clearance in piston	.0004 - .0012 in.
Permissible clearance	.0025 in.

Piston Rings

Compression ring gap	.007 - .017 in.
Oil ring gap	.007 - .017 in.
Compression ring side clearance	.0020 - .0035 in.
Oil ring side clearance	.0015 - .0031 in.
Permissible side clearance	.005 in.

Rocker Arm

Clearance between shaft and bearing	.0005 - .0029 in.
Permissible clearance	.005 in.

Spark Plug

Gap	.025 in.
Torque	30 lb. ft.

Starting Motor (12 V—Delco-Remy 1107741, 1107213 and 1107788)

Brush spring tension (minimum)	35 oz.
Rotation (viewing drive end)	Counterclockwise
No load test:	
Volts	10.3
Maximum amps	75
Minimum RPM	6900
Lock test:	
Volts	5.8
Maximum amps	435
Minimum torque	10.5 lb. ft.

Valves

Exhaust valves:	
Clearance (cold)	.010 in.
Stem clearance in head	.0015 - .0035 in.
Permissible clearance with new valve	.0065 in.
Valve face angle	44¼°
Valve seat angle	45°
Inlet valves:	
Clearance (cold)	.010 in.
Stem clearance in head	.0015 - .0035 in.
Permissible clearance with new valve	.0050 in.
Valve face angle	44¼°
Valve seat angle	45°

Valve Lifters

Lifter diameter	.3729 - .3735 in.
Bore diameter	.375 - .376 in.
Clearance	.0015 - .0031 in.
Permissible clearance	.0075 in.

Valve Spring

Free length (Earlier—small diameter)	1.5 in.
Lbs. force	25.6 - 28.4
When compressed to	1 11/32 in.
Free length (Parts service for earlier machines—small diameter, higher rate)	1.500 in.
Lbs. force	26.4 - 29.2
When compressed to	1.351 in.
Free length (Later—large diameter, higher rate)	1.528 in.
Lbs. force	25.6 - 28.4
When compressed to	1.351 in.

Valve Timing

With valve clearances set correctly cold, dial indicator mounted above valve stem, readings taken with valve .075" off its seat:	
Exhaust opening (before bottom center)	31° 38′
Exhaust closing (before top center)	26° 30′
Inlet opening (after top center)	1° 22′
Inlet closing (after bottom center)	6° 30′

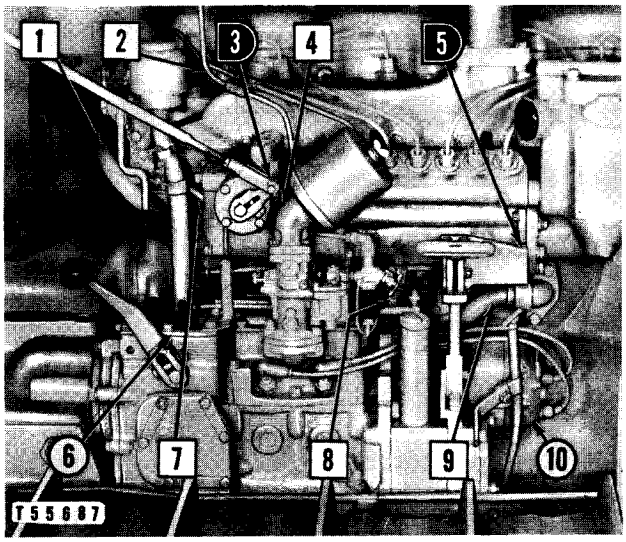
Removal and Installation

1. Drain the diesel engine cooling system.

NOTE

Earlier models incorporated a common lubrication system between the starting engine and the diesel engine. Later models contain a separate lubrication system for each engine. On engines with common lubrication, the diesel engine oil system must also be drained.

2. Shut off the diesel fuel supply and the starting engine gasoline supply at their respective tanks.
3. Drain the fuel filter housing. See the topic, DRAINING FUEL FILTER HOUSING, in the Operation and Maintenance Instructions.
4. Remove the hood. See the topic, HOOD REMOVAL.
5. Remove the right side plate.
6. Remove the fuel injection pump housing and governor as a unit. See the topic, FUEL INJECTION PUMP HOUSING REMOVAL. Cap all connections to prevent dirt from entering the system.



PREPARING TO REMOVE STARTING ENGINE

□ **Remove** ◗ **Disconnect**

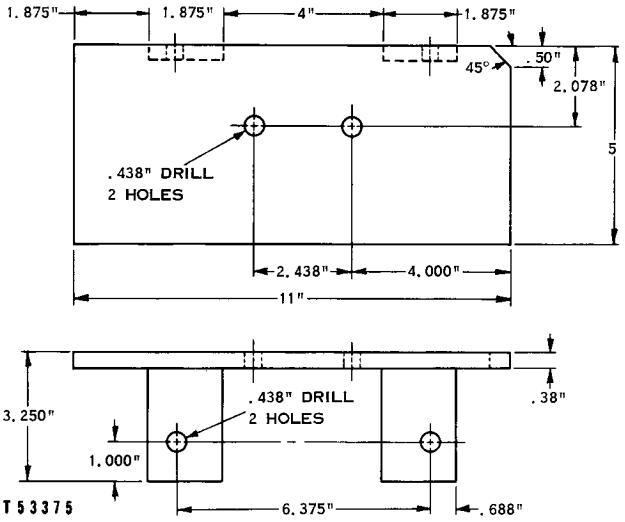
1–Starting engine exhaust pipe.
2–Starting engine fuel supply line.
3–Governor control linkage.
4–Starting engine air cleaner.
5–Recoil starter cable mounting bracket.
6–Cover assembly.
7–Starting engine coolant outlet pipe.
8–Starting engine mounting bracket.
9–Starting engine coolant inlet pipe.
10–Magneto.

7. Remove the cover assembly **(6)** and cover the opening in the block to prevent the entry of dirt or other foreign material.
8. Remove the magneto **(10)**. See the topic, MAGNETO REMOVAL AND INSTALLATION.

NOTE

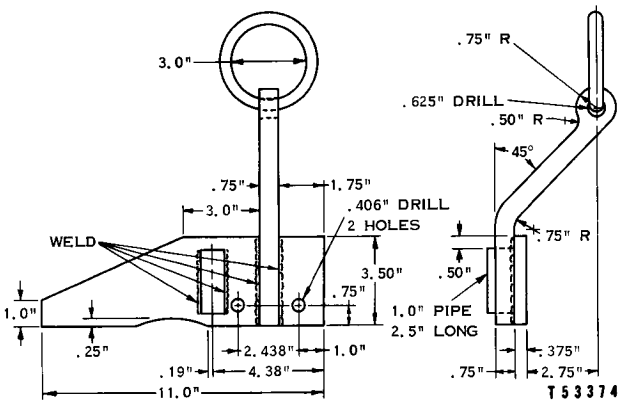
On engines with common lubrication, remove the lubricant elbow from the diesel engine cylinder block to the bottom of the starting engine cylinder block.

9. Attach the starting engine lifting bracket adapter of the dimensions shown to the starting engine.



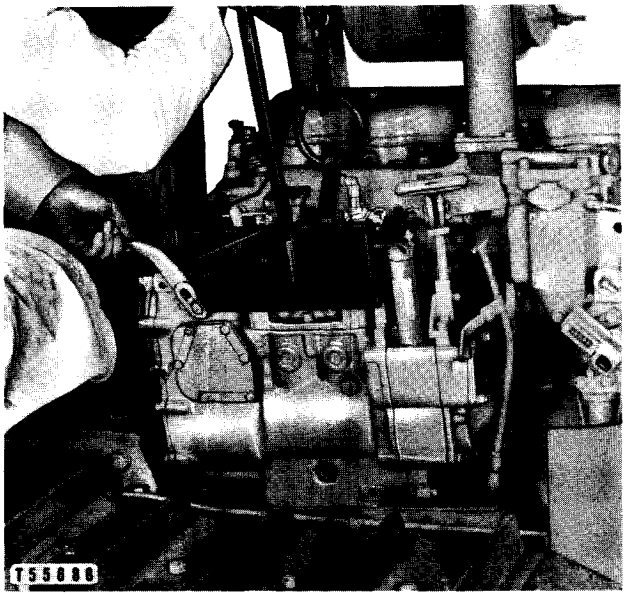
STARTING ENGINE LIFTING BRACKET ADAPTER

10. Attach the lifting bracket of the dimensions shown to the lifting bracket adapter.



LIFTING BRACKET

11. Attach a suitable hoist to the lifting bracket and support the weight of the engine.
12. Remove the bolts securing the starting engine to the diesel engine.
13. Move the starting engine forward until the pinion housing clears the diesel engine flywheel housing.

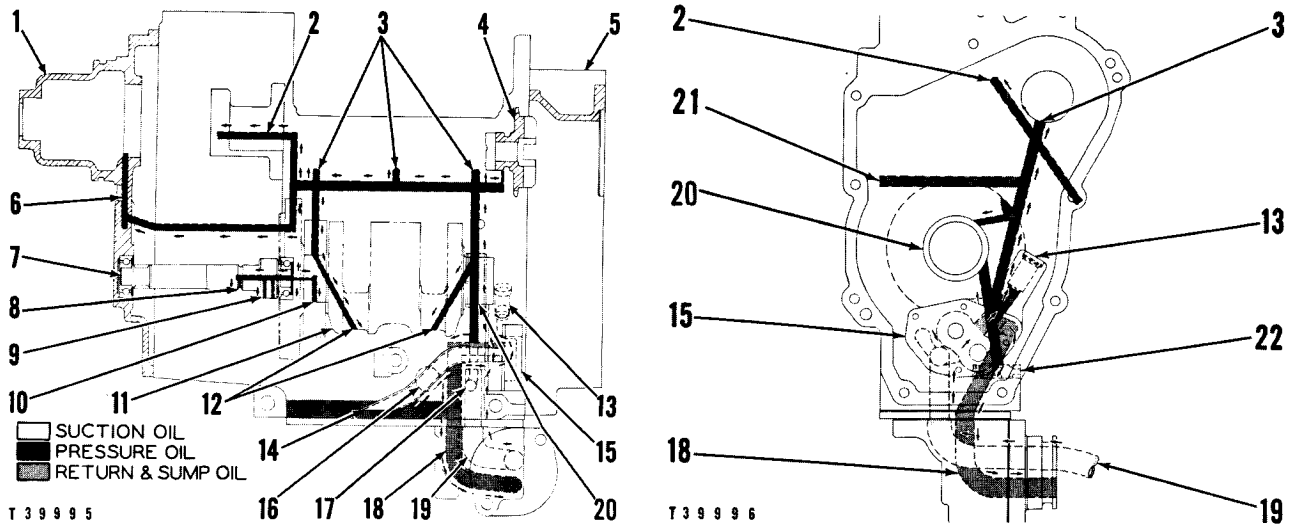


REMOVING STARTING ENGINE

14. Prior to installation of the starting engine, replace all damaged gaskets or seals.
15. Start the starting engine pinion housing into the flywheel housing.
16. Position the pinion housing in the flywheel housing and secure the starting engine to the cylinder block.
17. Complete the installation in the reverse order of removal.

Lubrication System

FLOW OF LUBRICATING OIL



(Right Side View) (Front View)

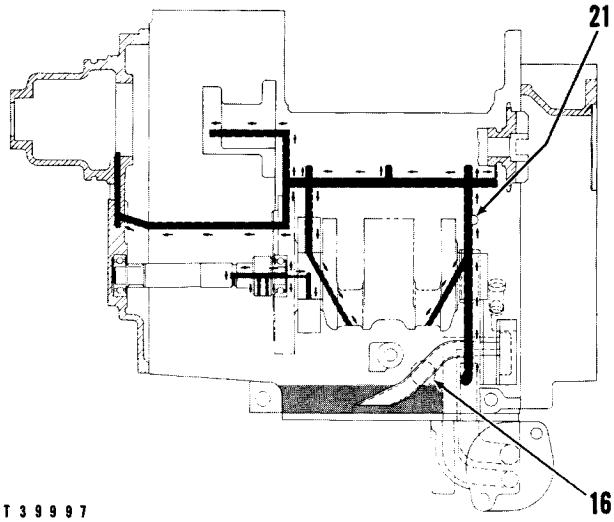
COMMON LUBRICATION SYSTEM (STARTING ENGINE OPERATING - DIESEL ENGINE INOPERATIVE)

1–Pinion housing. 2–Oil passage to pinion shaft support bearing. 3–Oil passages to camshaft bearings. 4–Camshaft sprocket. 5–Timing chain housing. 6–Oil passage to idler gear stub shaft. 7–Clutch shaft. 8–Oil passage to thrust bearing. 9–Oil passage to clutch plates. 10–Rear main bearing. 11–Crankshaft. 12–Passages in crankshaft to connecting rod bearings. 13–Oil pump pressure relief valve. 14–Oil pump scavenge tube. 15–Oil pump. 16–Starting engine sump drain. 17–Lubricating inlet passage from diesel engine. 18–Oil return line. 19–Oil supply line from diesel engine. 20–Front main bearing. 21–Oil pressure check passage. 22–Check valve.

The starting engine oil pump **(15)** is a two stage pump. When the starting engine is operating, the first stage draws oil from the diesel engine through the oil supply line **(19)**. The oil is then pumped under pressure to the lubricant passages in the starting engine. A pressure relief valve **(13)** prevents the pump from building up excessive pressure.

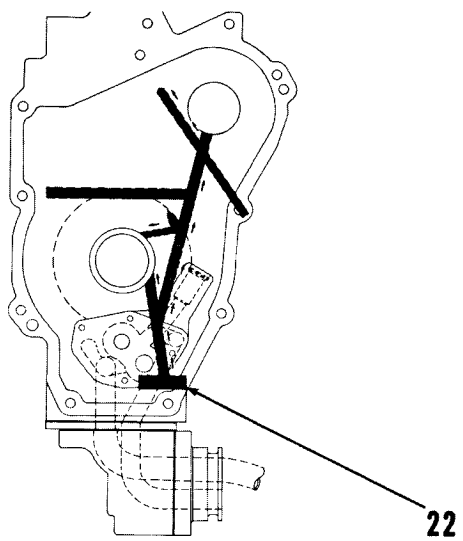
The second stage of the oil pump acts as a scavenge pump for the starting engine sump. Oil enters the pump through the tube **(14)** and is returned to the diesel engine sump through line **(18)**.

The cylinder walls, piston pins, rocker arms and valve mechanism are lubricated by oil vapors and splash oil.



COMMON LUBRICATION SYSTEM (STARTING ENGINE INOPERATIVE - DIESEL ENGINE OPERATING)

16–Starting engine sump drain. 21–Oil pressure check passage.



COMMON LUBRICATION SYSTEM (STARTING ENGINE INOPERATIVE - DIESEL ENGINE OPERATING)

22–Check valve.

When the diesel engine is operating with the starting engine inoperative, pressure oil from the diesel engine enters the starting engine through the check valve **(22)**. This valve prevents oil from entering the diesel engine when the starting engine is operating. The passage from the check valve by-passes the oil pump. The starting engine is pressure-lubricated through the same passages while it is inoperative. This provides an oil cushion for the various components of the starting engine while the diesel engine is operating.

When the oil in the starting engine sump reaches the level of the drain **(16)**, the oil drains into the diesel engine.

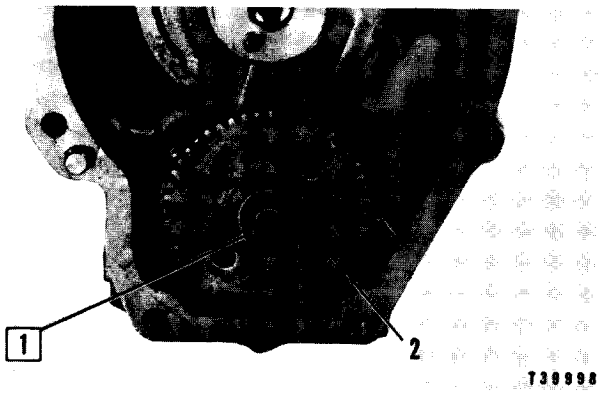
The presence of oil or starting engine oil pressure can be checked by removing the plug in the end of the oil pressure check passage **(21)**. The minimum pressure should be 40 PSI at high idle speed.

OIL PUMP

The oil pump is a two-stage gear-type pump that is gear driven from the crankshaft at the front of the engine. Four bolts secure the oil pump to the cylinder block in the timing chain compartment.

Removal and Installation

Remove the recoil starter housing, timing chain housing and crankshaft gear. See the covering topics.



REMOVING OIL PUMP DRIVE GEAR

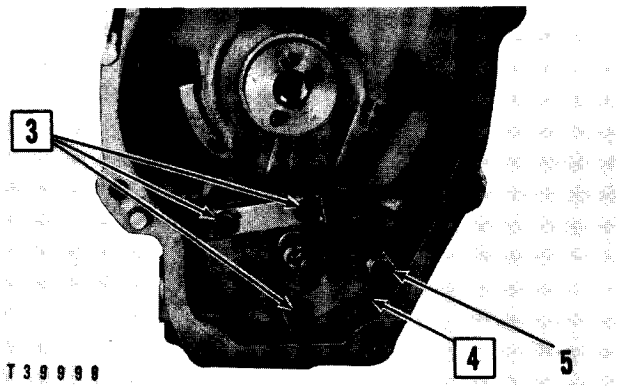
☐ **Remove**

1–Bolt. 2–Gear.

Pull the gear **(2)** by using two 3/8" - 24 (NF) bolts 3" long and a 5F7465 No. 5 Puller.

NOTE

Leave bolt **(5)** in the oil pump to act as an aligning pin.

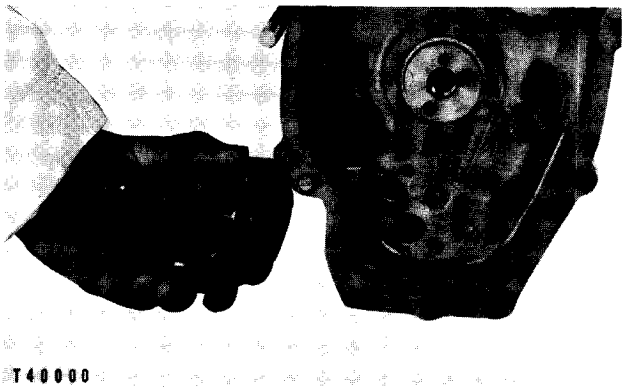


PREPARING TO REMOVE OIL PUMP

☐ **Remove**

3–Bolts. 4–Oil pump. 5–Bolt.

When installing the oil pump, make certain the gasket between the cylinder block and the oil pump is properly aligned.

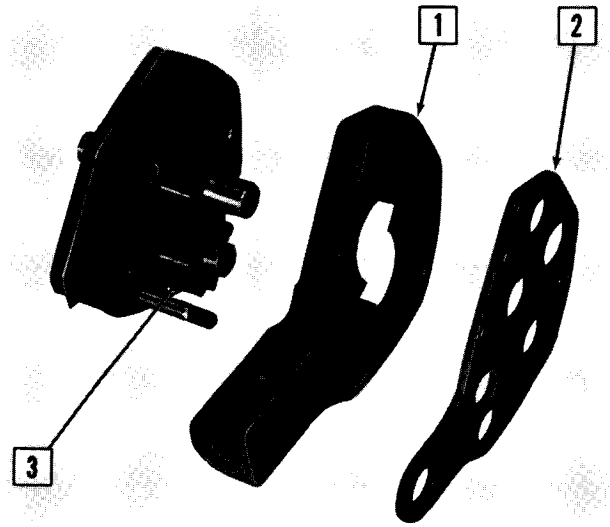


OIL PUMP REMOVAL

Disassembly and Assembly

1. Remove the plate **(7)** and shaft assembly **(6)** by moving the shaft out of the second stage pump housing **(8)**.
2. Remove the housing **(8)** from the plate **(4)**.
3. Inspect all gears, bearings and shafts and replace if necessary.
4. The gear **(9)** can be removed by sliding it off the shaft **(6)**. When replacing the gear, make certain the key is in place in the shaft **(6)**.
5. The gear **(10)** can be removed from the shaft **(6)** by removing the spring pin that is driven through the gear into the shaft. The gear can then be slid off the shaft. If a new gear is to be installed on a new or used shaft, place the gear in the correct position on the shaft with the key in place. Drill a .125 - .129 inch hole .69 inch

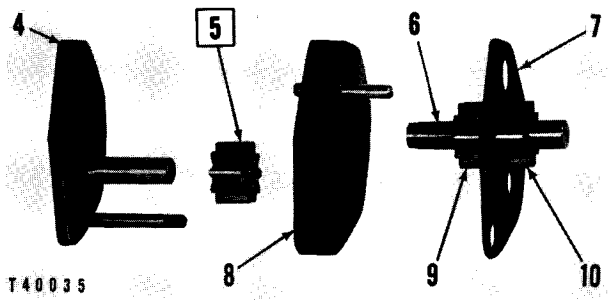
deep through the gear at the root diameter into the shaft. Be sure to locate the hole so the drill will not hit the key.



OIL PUMP DISASSEMBLY

☐ Remove

1–First stage pump housing. 2–Plate. 3–Driven gear.



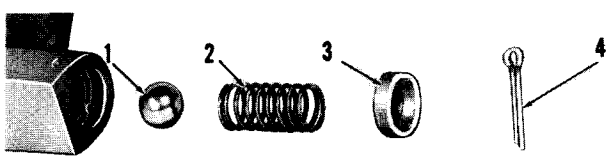
OIL PUMP DISASSEMBLY

☐ Remove

4–Plate. 5–Driven gear. 6–Drive shaft. 7–Plate. 8–Second stage pump housing. 9–Driving gear. 10–Driving gear.

PRESSURE REGULATING VALVE

1. The pressure regulating valve consists of a ball **(1)**, spring **(2)**, core plug **(3)** and cotter pin **(4)**.



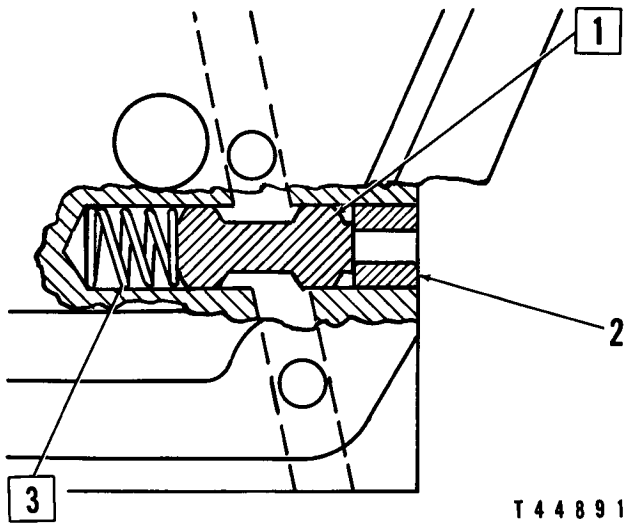
PRESSURE REGULATING VALVE
1–Ball. 2–Spring. 3–Core plug. 4–Cotter pin.

2. To remove the valve assembly, remove the cotter pin **(4)** and core plug **(3)**.
3. Inspect the ball and its seat and replace if necessary.

CHECK VALVE

Removal and Installation

1. Insert a hooked instrument through the adapter **(2)** and pull it out of the starting engine cylinder block.



CHECK VALVE

☐ Remove

1–Check valve. 2–Adapter. 3–Spring.

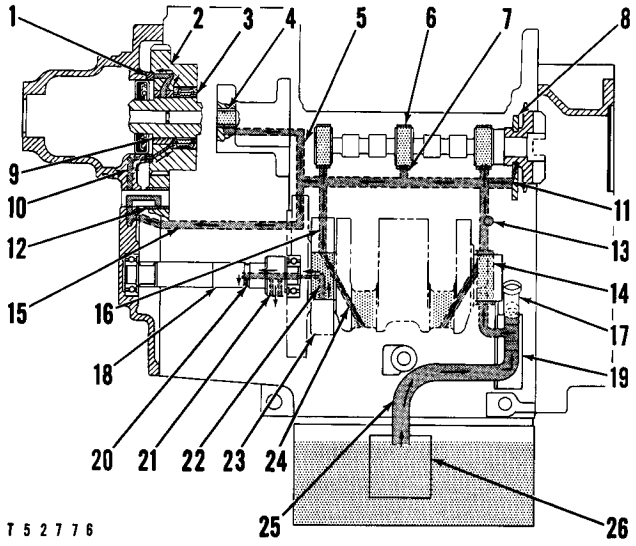
2. Inspect the check valve **(1)** for any sign of wear or damage. Replace if necessary.
3. Inspect the seating surface of the adapter **(2)**. Replace if necessary.
4. Inspect the spring **(3)**. See the topic, SPECIFICATIONS.
5. Install the spring **(3)**, check valve **(1)** and adapter **(2)** into the starting engine cylinder block.

NOTE

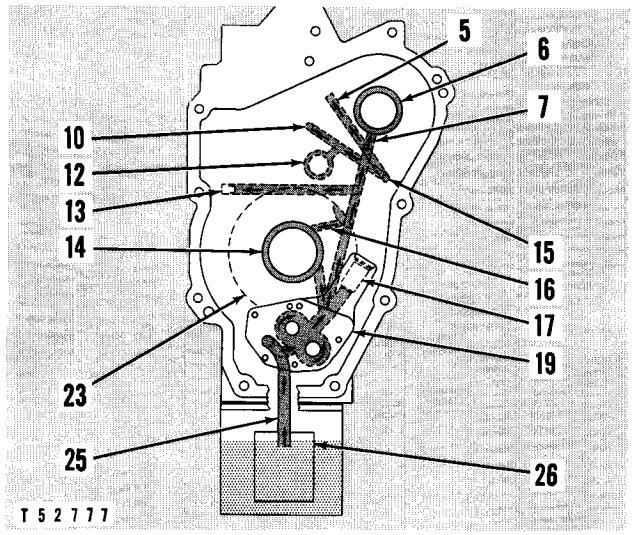
Install the adapter with the chamfered edge toward the plunger. When the adapter is properly installed, the outside edge should be flush with the starting engine cylinder block.

Lubrication System

FLOW OF LUBRICATING OIL



(Right Side View)



(Front View)

STARTING ENGINE LUBRICATION SYSTEM

1–Thrust washer.
2–Pinion drive gear.
3–Overrunning clutch.
4–Support bearing.
5–Oil passage to support bearing.
6–Camshaft bearing.
7–Oil passage to camshaft bearing.
8–Camshaft thrust plate.
9–Pinion drive gear bearing.
10–Oil passage to starter mechanism.
11–Oil passage in camshaft thrust washer.
12–Idler gear bearing.
13–Oil pressure check passage.
14–Crankshaft front main bearing.
15–Oil passage to pinion housing.
16–Oil passage in crankshaft rear main bearing.
17–Oil pump pressure regulating valve.
18–Clutch shaft.
19–Oil pump.
20–Oil passage to clutch thrust bearing.
21–Oil passage to clutch plates (two).
22–Oil passage in crankshaft to clutch shaft.
23–Crankshaft rear main bearing.
24–Oil passage in crankshaft to connecting rod bearings.
25–Oil supply tube.
26–Suction bell.

The starting engine oil pump **(19)** is a single section pump. When the starting engine is operating, oil is drawn through the supply tube **(25)**, through the oil pump **(19)** and into the lubricant passages within the starting engine. A pressure regulating valve **(17)** prevents the pump from creating too much pressure.

Pressure oil is supplied to the starter pinion mechanism housing through the passage **(15)**. The idler gear bearing **(12)** is pressure lubricated. Two passages are drilled in the pinion drive gear **(2)**. When each passage, respectively, is aligned with the passage in the starter pinion housing and thrust washer **(1)**, lubricant is supplied to the overrunning clutch **(3)** and the pinion drive gear bearing **(9)** respectively.

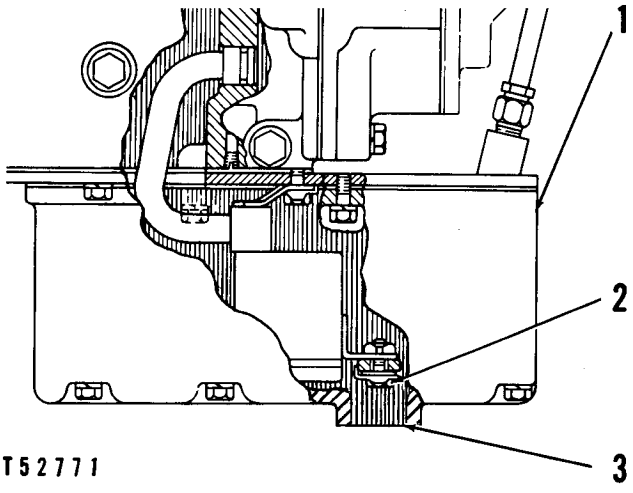
The cylinder walls, piston pins, rocker arms and valve mechanism are lubricated by oil vapors and splash oil.

Starting engine oil pressure can be checked by removing the plug in the end of the oil pressure check passage **(13)**. Refer to the topic, SPECIFICATIONS, for the minimum oil pressure at high idle RPM.

OIL PAN, OIL PAN PLATE AND SUCTION BELL

Removal and Installation

1. Drain the oil from the oil pan.



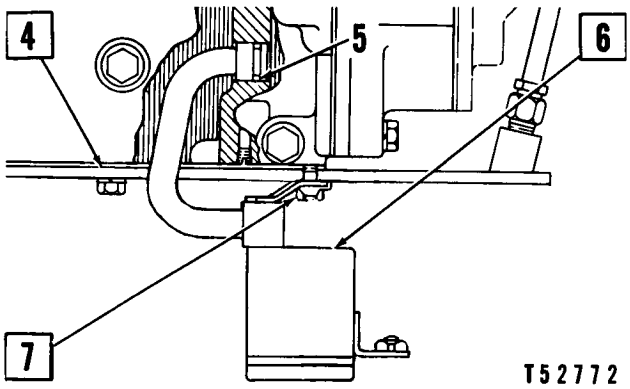
PREPARING TO REMOVE OIL PAN
(D4 Illustrated)
1–Oil pan. 2–Bolt and lock. 3–Opening.

2. Remove the bolt and lock **(2)** by working through the opening **(3)**.

3. Remove the remaining bolts securing the oil pan **(1)** to the plate assembly and remove the oil pan.

NOTE

On 944, 955 and 966 models, there are no bolt and lock **(2)**. On D330 and D333 industrial, electrical and marine applications, the opening **(3)** has a core plug installed in it and there is an O-ring seal connection between the tube assembly and the suction bell. The bolt and lock **(2)** need be removed only if the suction bell is to be removed from the oil pan. Caution should be used to avoid damaging the O-ring seal when removing and installing the suction bell. The D6, 561, No. 12, No. 14, No. 112, and 977 are similar in construction to the D4.



PREPARING TO REMOVE OIL PAN PLATE AND SUCTION BELL (D4 Illustrated)

☐ **Remove**

4–Oil pan plate assembly. 5–O-ring seal. 6–Suction bell assembly. 7–Bolt and lock.

4. Inspect the seal **(5)** and replace if necessary.

NOTE

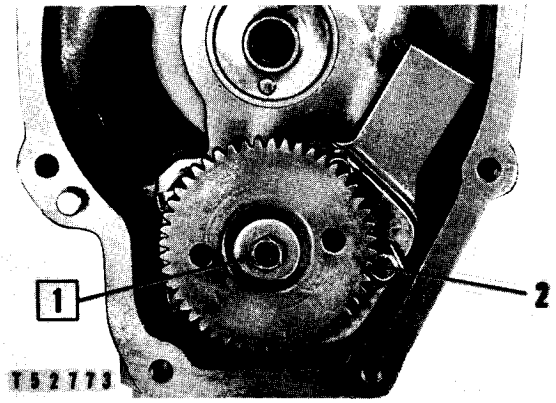
When installing the suction bell assembly **(6)** into the block, use caution to avoid damaging the seal **(5)**.

OIL PUMP

The oil pump is a single element gear-type pump that is gear driven from the crankshaft gear at the front of the engine. Four bolts secure the oil pump to the cylinder block in the timing chain compartment.

Removal and Installation

Remove the recoil starter housing, timing chain housing and crankshaft gear. See the covering topics.

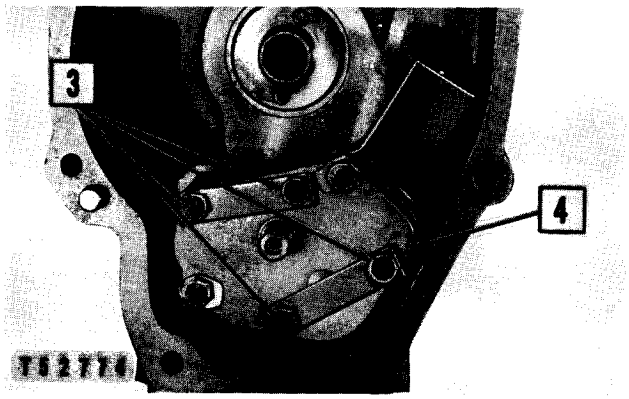


REMOVING OIL PUMP DRIVE GEAR

☐ **Remove**

1–Bolt. 2–Gear.

Pull the gear **(2)** by using two 3/8" - 24 (NF) bolts 3" long and a 5F7465 No. 5 Puller.

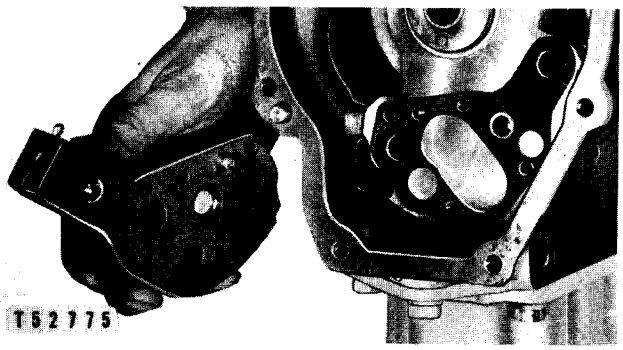


PREPARING TO REMOVE OIL PUMP

☐ **Remove**

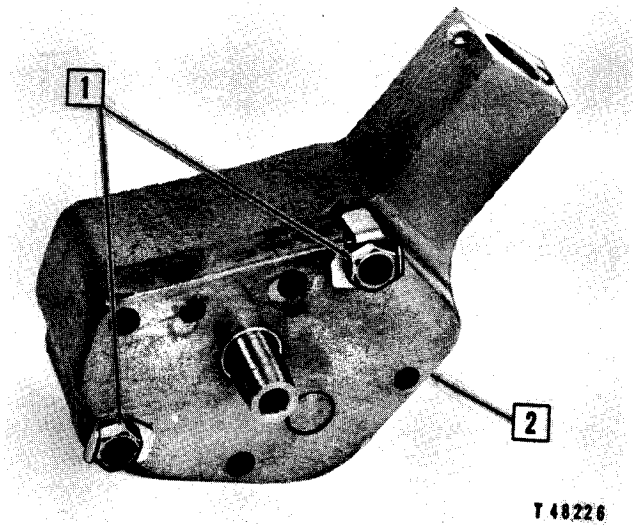
3–Bolts and locks. 4–Oil pump.

When installing the oil pump, make certain the gasket between the cylinder block and the oil pump is properly aligned.



OIL PUMP REMOVAL

Disassembly and Assembly

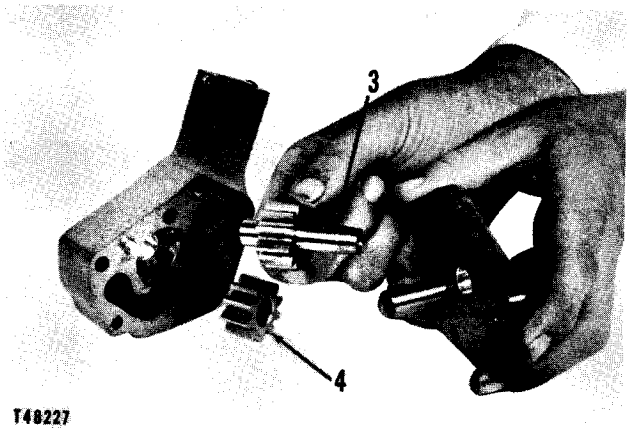


PREPARING TO DISASSEMBLE OIL PUMP

☐ **Remove**

1–Bolts. 2–Cover.

Remove the oil pump drive shaft assembly **(3)** and idler gear **(4)** from the cover as illustrated.



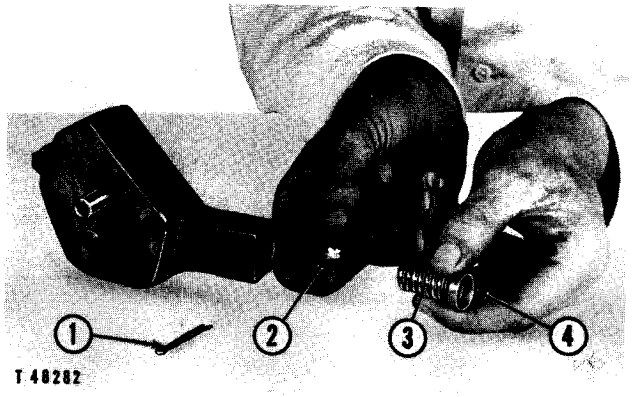
DRIVE SHAFT AND IDLER GEAR REMOVAL
3–Shaft assembly. 4–Gear.

Check the clearance between the gears and cover. See the topic, SPECIFICATIONS, for the correct clearance.

Inspect the gear, shaft, shaft assembly, and bearings for wear or damage and replace if necessary. See the topic, SPECIFICATIONS, for the proper clearances and dimensions.

PRESSURE REGULATING VALVE

1. The pressure regulating valve consists of a ball **(2)**, spring **(3)**, core plug **(4)** and cotter pin **(1)**.



PRESSURE REGULATING VALVE
1–Cotter pin. 2–Ball. 3–Spring. 4–Core plug.

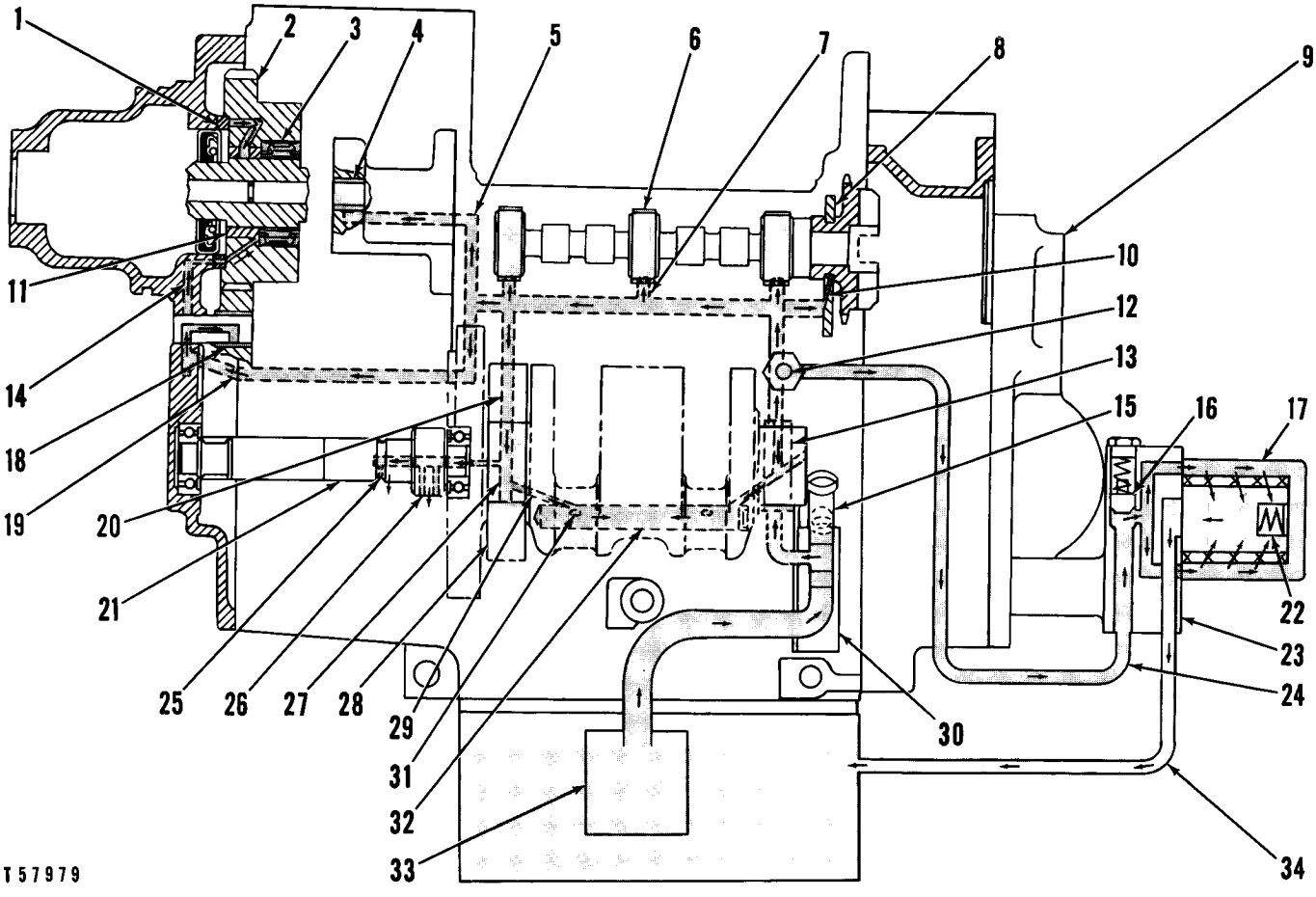
2. To remove the valve assembly, remove the cotter pin **(1)** and core plug **(4)**.
3. Inspect the ball for signs of grooving. Replace if necessary.
4. Inspect the spring. See the topic, SPECIFICATIONS.

NOTE

When installing a new core plug, a hole must be drilled in it for the cotter pin. Install the plug flush with the outer surface of the housing and, using the existing holes in the pump body as a guide, drill the necessary hole.

Lubrication System

FLOW OF LUBRICATING OIL



STARTING ENGINE LUBRICATION SYSTEM
(Right Side View)

1–Thrust washer.
2–Pinion drive gear.
3–Overrunning clutch.
4–Support bearing.
5–Oil passage to support bearing.
6–Camshaft bearing.
7–Oil passage to camshaft bearing.
8–Camshaft thrust plate.
9–Recoil starter housing.
10–Oil passage in camshaft thrust plate.
11–Pinion drive gear bearing.
12–Oil pressure check point plug.
13–Front main bearing.
14–Oil passage to starter mechanism.
15–Oil pump pressure regulating valve.
16–Valve.
17–Oil filter.
18–Idler gear bearing.
19–Oil passage to pinion housing.
20–Oil passage in rear main bearing.
21–Clutch shaft.
22–Bypass valve.
23–Oil filter base.
24–Oil filter supply line.
25–Oil passage to clutch thrust bearing.
26–Oil passage to clutch plates (two).
27–Oil passage in main bearing journal.
28–Rear main bearing.
29–Oil supply passage.
30–Oil pump.
31–Connecting rod bearing oil supply passage.
32–Sludge pocket.
33–Suction bell and tube assembly.
34–Oil filter outlet line.

The starting engine oil pump **(30)** is a single section pump. When the starting engine is operating, oil is drawn through the suction bell and tube assembly **(33)**, through the oil pump **(30)** and into the lubricant passages within the starting engine. A pressure regulating valve **(15)** limits the maximum pressure in the oil system.

Pressure oil is supplied to the starter pinion mechanism housing through the passage **(19)**. The idler gear bearing **(18)** is pressure lubricated. Four passages are drilled in the pinion drive gear **(2)**. When each passage is aligned with the passage in the starter pinion housing and thrust washer **(1)**, lubricant is supplied to the overrunning clutch **(3)** and pinion drive gear bearing **(11)**, respectively.

The passages **(25)** and **(26)** provide lubrication to the clutch plates and thrust bearing.

The connecting rod bearings are lubricated from drilled passages **(31)** in the connecting rod bearing journals. This oil is supplied through the passage **(29)** from the oil passage **(27)** in the rear main bearing journal and from similar passages in the front main bearing. The centrifugal force of the rotating

crankshaft keeps foreign material in the oil from going through the passages to the connecting rod bearings. These particles are collected in the sludge pocket **(32)** in the crankshaft bearing journals. A plug in the end of the journals can be removed and the pocket cleaned. See the topic, CRANKSHAFT AND MAIN BEARINGS.

The cylinder walls, piston pins, rocker arms and valve mechanism are lubricated by oil vapors and splash oil.

The starting engine contains a bypass type lubricating oil filter. A portion of the pressure oil in the camshaft oil manifold is diverted through the oil filter supply line **(24)** to the starting engine oil filter base **(23)**. The oil filter base is mounted on the front of the recoil starter housing **(9)**. A valve **(16)** in the base prevents oil from going through the filter **(17)** until the system pressure is high enough to open the valve. Filtered oil is passed through the oil filter outlet line **(34)** to the starting engine oil pan.

If the oil filter **(17)** becomes plugged, a filter bypass valve **(22)** in the filter element opens and allows the oil to bypass the filter element and flow directly to the oil pan.

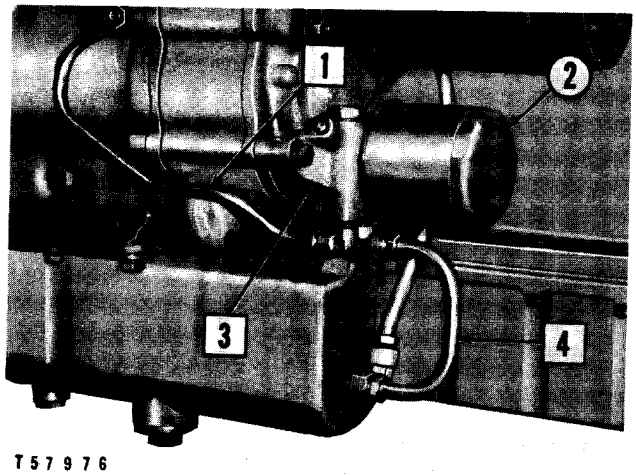
Starting engine oil pressure can be checked by removing the plug **(12)** from the head of the bolt which secures the oil filter supply line to the cylinder block.

OIL FILTER

Removal and Installation

NOTE

A 9M9852 Wrench is available, if needed, to aid in removing and installing the oil filter.



T57976

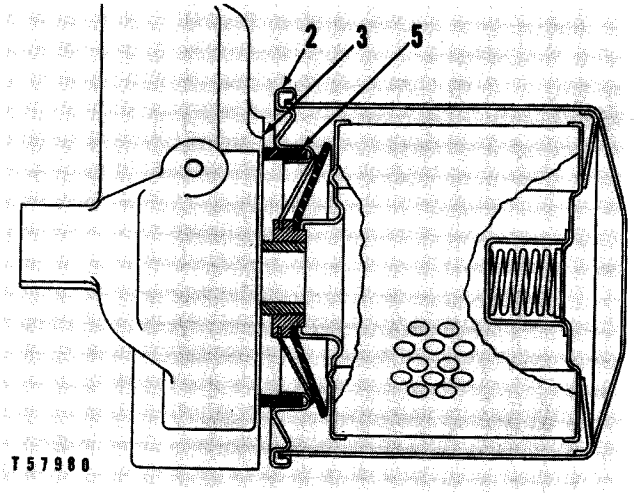
PREPARING TO REMOVE OIL FILTER
☐ **Remove**
1–Oil filter inlet tube. 2–Oil filter. 3–Oil filter base. 4–Oil filter outlet tube.

1. Drain the oil from the oil pan.
2. Remove the filter **(2)** by turning counterclockwise. The oil filter **(2)** is the throw-away type and should be discarded if the gasket **(5)** is damaged or at the suggested service interval. See the Operation and Maintenance Instructions.

NOTE

On the 977 Traxcavator the oil filter outlet tube **(4)** enters the oil pan on the side, but is removed in the same manner.

3. Inspect all parts for damage and replace if necessary.
4. Install in the reverse procedure of removal.
5. Seat the gasket properly in the end of the filter and apply a film of clean light oil to the end of the gasket **(5)** which contacts the filter base.
6. Install the filter **(2)** by turning it clockwise.



T57980

INSTALLING OIL FILTER
2–Oil filter. 3–Oil filter base. 5–Gasket.

7. Turn the filter until the gasket **(5)** just contacts the base **(3)**. Tighten the filter one additional turn from this point.

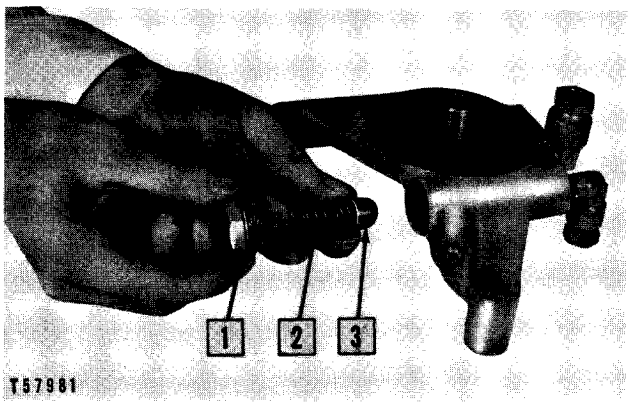
CAUTION

Do not overtighten the filter. Damage may result to the gasket which could result in oil leakage.

8. Fill the crankcase with oil to the specified level. See the covering topic in the Operation and Maintenance Instructions.

Disassembly and Assembly

Inspect all parts for wear or damage and replace if necessary.



REMOVING VALVE FROM FILTER BASE

☐ Remove

1–Plug. 2–Spring. 3–Plunger.

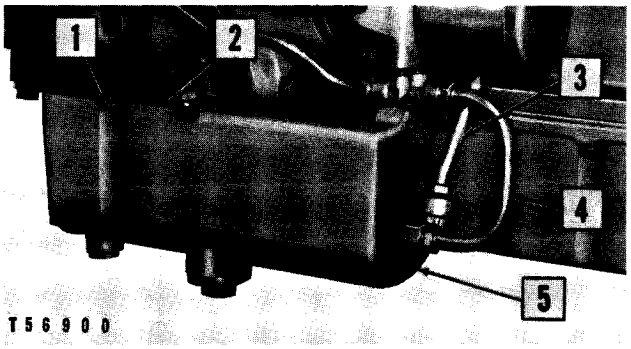
Inspect the spring. See the topic, SPECIFICATIONS.

Assemble in the reverse order of disassembly.

OIL PAN, OIL PAN PLATE AND SUCTION BELL

Removal and Installation

1. Drain the oil from the starting engine.



PREPARING TO REMOVE OIL PAN

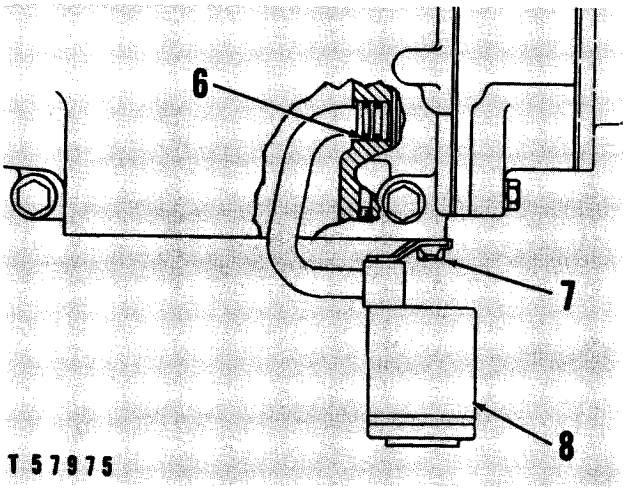
☐ Remove

1–Bolts. 2–Oil pan plate. 3–Oil level gauge tube assembly. 4–Oil filter outlet tube. 5–Oil pan.

2. Remove the bolt **(7)** which secures the suction bell assembly to the cylinder block.
3. Remove the suction bell assembly **(8)**.
4. Inspect all parts for wear or damage and replace if necessary.
5. Inspect the O-ring seals **(6)** and replace if necessary.

NOTE

Use caution when installing the suction bell assembly **(8)** into the cylinder block to avoid damaging O-ring seals **(6)**.



REMOVING SUCTION BELL ASSEMBLY
6–O-ring seals (two). 7–Bolt. 8–Suction bell assembly.

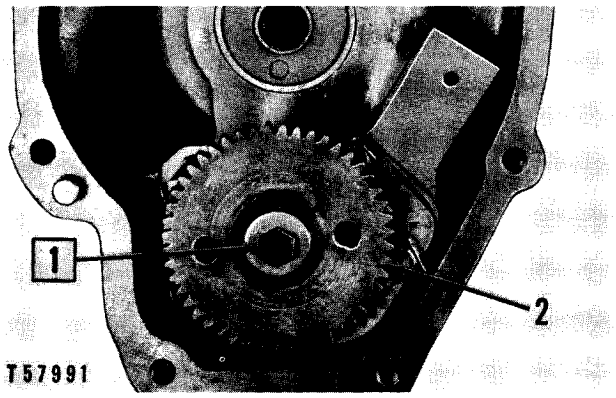
6. Install in the reverse order of removal.

OIL PUMP

The oil pump is a single element gear-type pump that is gear driven from the crankshaft gear at the front of the engine. Four bolts secure the oil pump to the cylinder block in the timing chain compartment.

Removal and Installation

Remove the recoil starter housing, timing chain housing and crankshaft gear. See the covering topics.



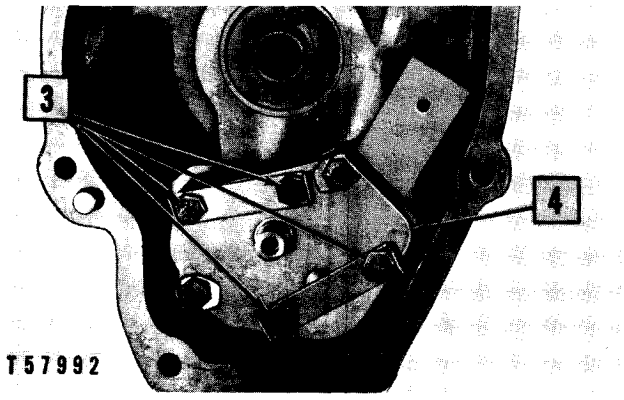
REMOVING OIL PUMP DRIVE GEAR

☐ Remove

1–Bolt. 2–Gear.

Pull the gear **(2)** by using two 3/8" - 24 (NF) bolts 3" long and a 5F7465 No. 5 Puller.

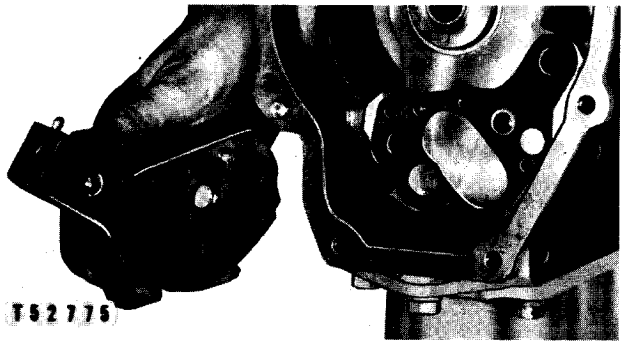
When installing the oil pump, make certain the gasket between the cylinder block and the oil pump is properly aligned.



PREPARING TO REMOVE OIL PUMP

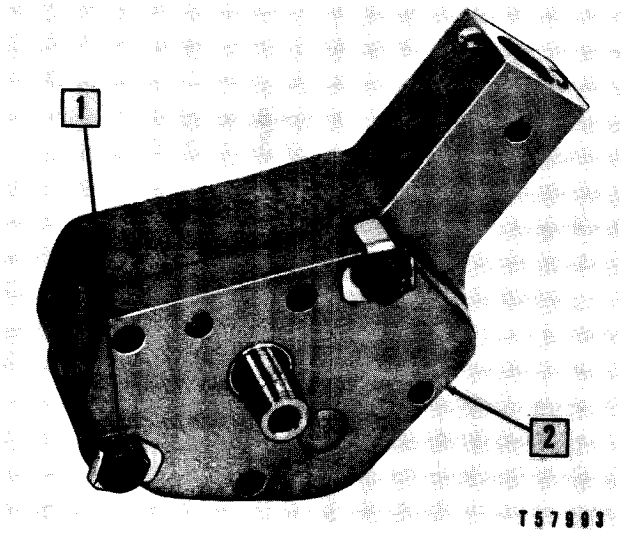
☐ Remove

3–Bolts and locks. 4–Oil pump.



OIL PUMP REMOVAL

Disassembly and Assembly



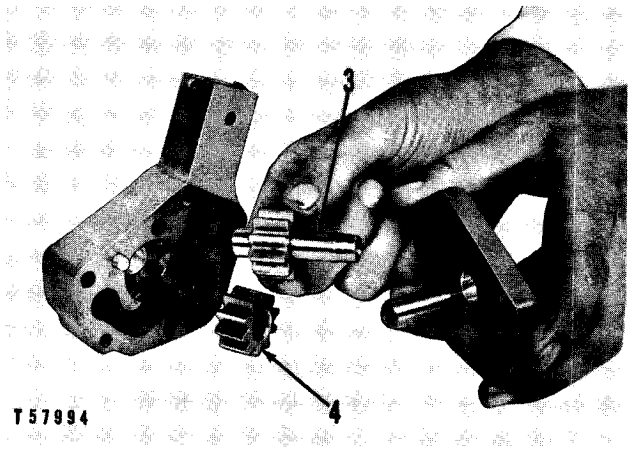
PREPARING TO DISASSEMBLE OIL PUMP

☐ Remove

1–Bolts. 2–Cover.

Remove the oil pump drive shaft assembly **(3)** and idler gear **(4)** from the cover as illustrated.

Check the clearance between the gears and cover. See the topic, SPECIFICATIONS, for the correct clearance.

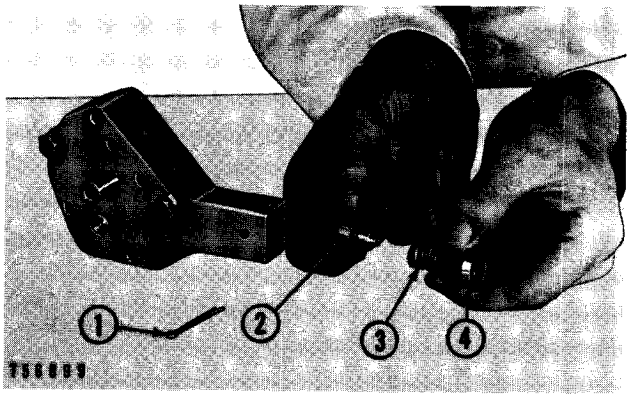


DRIVE SHAFT AND IDLER GEAR REMOVAL
3–Shaft assembly. 4–Gear.

Inspect the gear, shaft, shaft assembly, and bearings for wear or damage and replace if necessary. See the topic, SPECIFICATIONS, for the proper clearances and dimensions.

PRESSURE REGULATING VALVE

1. The pressure regulating valve consists of a plunger **(2)**, spring **(3)**, core plug **(4)** and cotter pin **(1)**.



PRESSURE REGULATING VALVE
1–Cotter pin. 2–Plunger. 3–Spring. 4–Core plug.

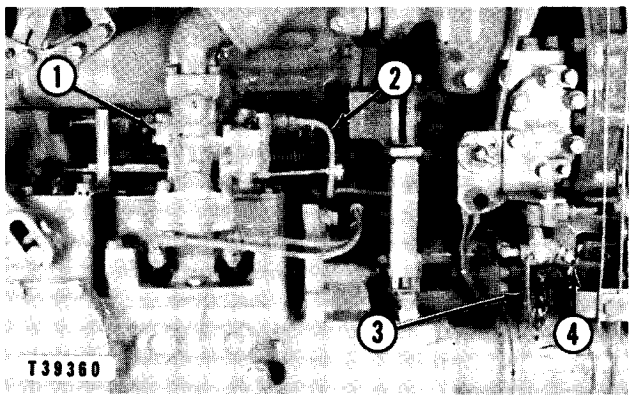
2. To remove the valve assembly, remove the cotter pin **(1)** and core plug **(4)**.
3. Inspect the plunger for signs of grooving. Replace if necessary.
4. Inspect the spring. See the topic, SPECIFICATIONS.

NOTE

When installing a new core plug, a hole must be drilled in it for the cotter pin. Install the plug flush with the outer surface of the housing and, using the existing holes in the pump body as a guide, drill the necessary hole.

Fuel System

The fuel system consists of the fuel tank, not shown, sediment bowl **(3)**, carburetor supply line **(2)** and a down-draft-type carburetor **(1)**. The sediment bowl is equipped with a hand-operated valve **(4)** to stop the flow of fuel to the carburetor.

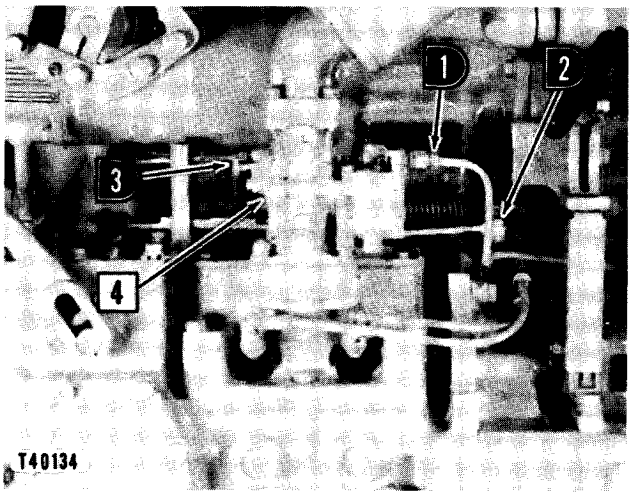


FUEL SYSTEM
1–Carburetor. 2–Supply line. 3–Sediment bowl. 4–Shut-off valve.

CARBURETOR

Removal

Remove the air cleaner.



CARBURETOR REMOVAL

☐ Remove ◗ Disconnect

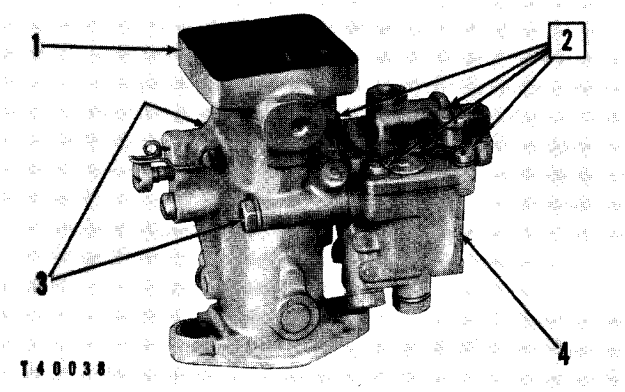
1–Supply line. 2–Governor control rod. 3–Choke linkage. 4–Carburetor.

Disassembly

1. If the bowl assembly **(4)** is to be removed from the throttle body assembly **(1)**, remove the two screws **(3)**.
2. Lift the cover slightly and separate the gasket from the bowl assembly.

NOTE

The following illustrations show carburetor disassembly with the bowl assembly secured to the throttle body.



CARBURETOR

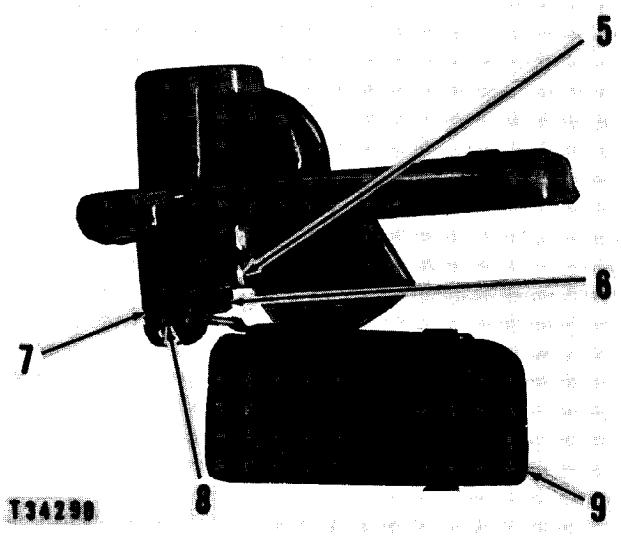
☐ Remove

1–Throttle body assembly. 2–Screws. 3–Screws. 4–Bowl assembly.

3. Remove the cover, gasket, and float assembly from the body. Use care not to damage the float assembly.
4. If the float needle valve **(6)** leaks or the engine performance does not respond to normal carburetor adjustment, inspect the needle valve **(6)** and seat **(5)**.

NOTE

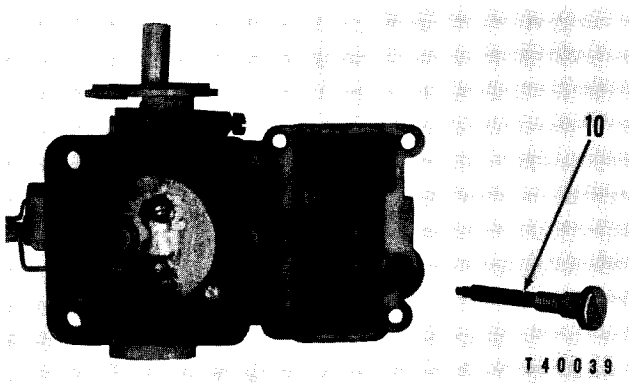
Care should be taken to prevent damage to the bracket **(7)**.



FLOAT REMOVAL

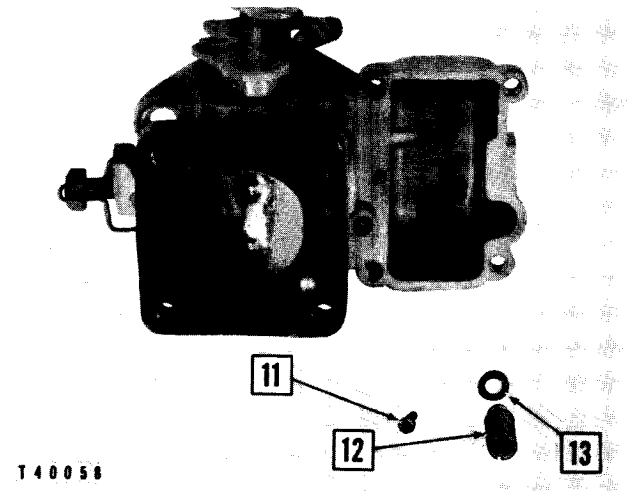
5–Seat assembly. 6–Needle valve. 7–Bracket. 8–Axle. 9–Float.

5. The float needle valve is removed after removing the float axle **(8)** and float **(9)**.
6. Remove the seat and washer from the cover.



PREPARING TO REMOVE MAIN JET AND COMPENSATING JET
10–Main jet needle.

7. Remove the main jet needle assembly **(10)** from the cover.



MAIN AND COMPENSATING JETS REMOVED

☐ **Remove**

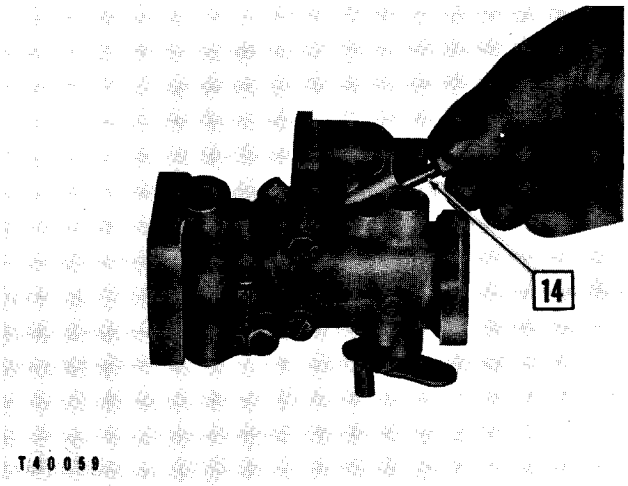
11–Compensating jet. 12–Main jet. 13–Gasket.

NOTE

The main jet and the compensating jet are the principal fuel metering jets. The main jet feeds fuel through a channel into the metering well and the jet regulates the fuel supply at all but slow speeds.

The compensating jet controls the rate of fuel flow into the metering well reservoir and provides fuel for good acceleration from low speeds. The fuel in the reservoir provides a reserve for accelerating. The size of the jet affects the mixture ratio at part throttle operation. Too large a jet causes richness and too small a jet causes leanness in this range.

8. Remove the plug at the base of the bowl.



METERING WELL REMOVAL

☐ **Remove**

14–Metering well.

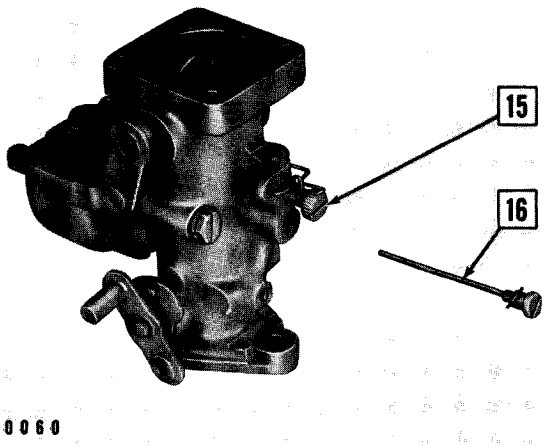
9. The washer can be removed after removing the metering well by using a piece of wire with a small hook at the end.

CAUTION

Do not remove the lead channel plug.

NOTE

The metering well controls the mixture characteristics at all speeds except idling. The holes in the side of the well influence the flow from the main jet at low speeds.



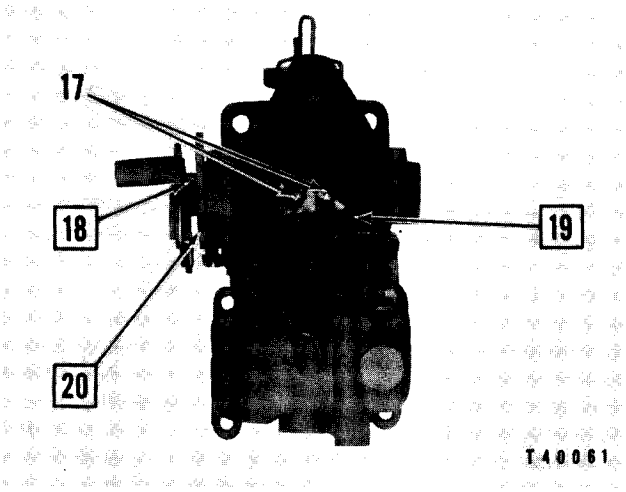
IDLING JET

☐ **Remove**

15–Idling adjustment screw. 16–Idling jet.

10. If the throttle shaft bearings are excessively worn and require replacement, melt the solder

around the screws **(17)** that secure the throttle plate to the shaft.



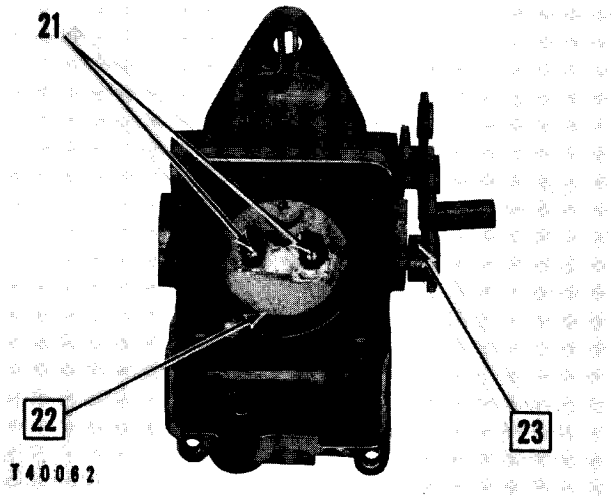
THROTTLE REMOVAL

☐ **Remove**

17–Screws. 18–Pin. 19–Throttle plate. 20–Stop assembly.

NOTE

The carburetor idling system consists of the idling jet which meters the fuel, idling adjusting screw which controls the air, and channels which carry the air and fuel to the edge of the throttle plate. Since the idling adjusting screw controls the air, a richer mixture is obtained by turning the screw clockwise and a lean mixture is obtained by turning counterclockwise.



CHOKE REMOVAL

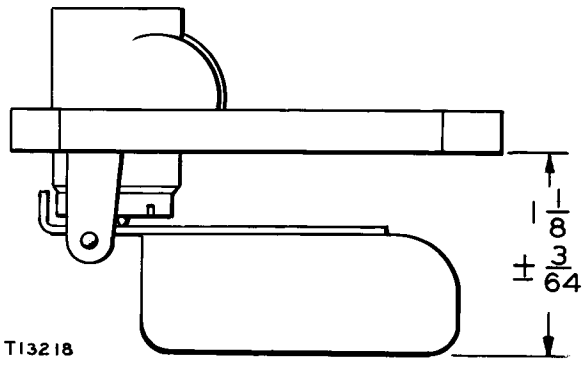
☐ **Remove**

21–Screws. 22–Plate. 23–Pin.

11. Remove the throttle shaft.
12. If the choke shaft packing is worn, melt the solder around the screws **(21)** that secure the choke plate to the shaft.
13. Clean all parts in a solvent, but do not boil in a caustic solution.
14. Blow through all channels with compressed air.

Assembly

1. Install new bearings in the throttle housing.
2. Install the throttle shaft in the throttle body so the milled portion will be toward the mounting flange.
3. Install the throttle plate with the shorter side toward the priming hole and the bevelled edges parallel to the throttle body walls. Secure the screws with solder.
4. Install the choke shaft with the control lever on the same side as the throttle control lever.
5. Be sure the choke plate is installed with the bevelled edge parallel to the inner walls.
6. Check the float position in relation to the cover. The float level is correct when a measurement of $1\frac{1}{8}$" $\pm$ 3/64" exists between the face of the cover (without gasket) and the float as shown.



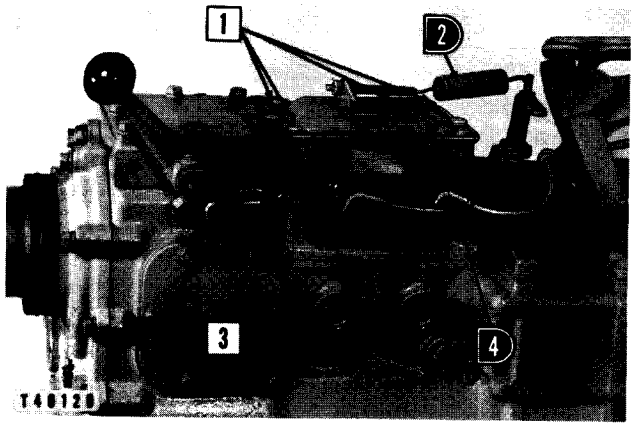
FLOAT ASSEMBLY LEVEL

Cylinder Head and Valves

CYLINDER HEAD

Removal

The starting engine cylinder head can be removed with the starting engine installed on the diesel engine if desired.

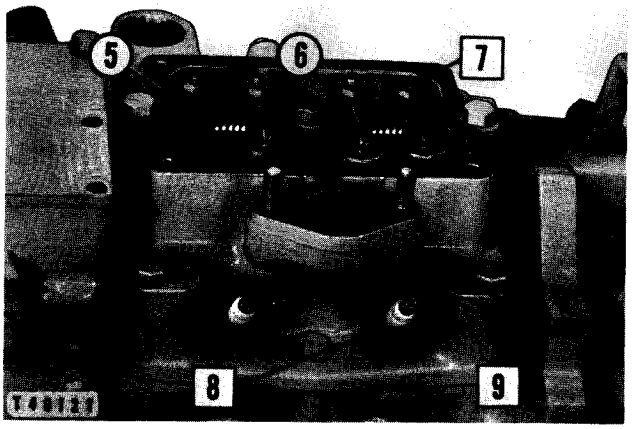


PREPARING TO REMOVE CYLINDER HEAD

□ **Remove** ◗ **Disconnect**

1–Bolts. 2–Spring. 3–Rocker arm cover. 4–Spark plug wires.

1. Loosen the locknuts **(6)** on the rocker arms **(5)**.
2. Remove the push rods.
3. Remove the cylinder head and gasket.
4. Remove all carbon from the head and block assembly.



CYLINDER HEAD REMOVAL

□ **Remove**

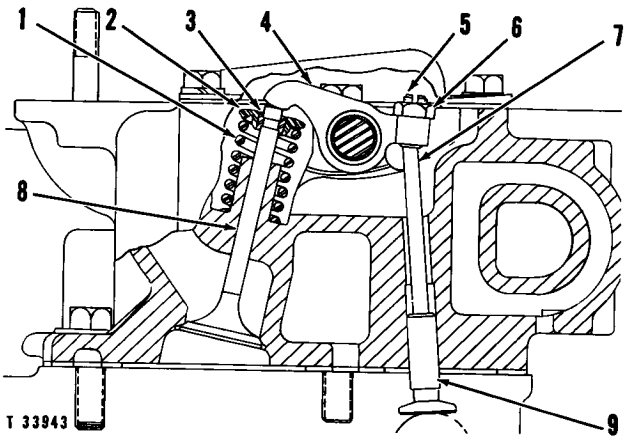
5–Rocker arm. 6–Locknut. 7–Adjusting screw. 8–Spark plugs. 9–Bolt.

Installation

1. Install a new cylinder head gasket.
2. Use two 3/8" - 16 NC guide pins, or suitable studs to install the cylinder head. Make certain the valve lifters are in place prior to installation of the cylinder head.
3. Install the head bolts and tighten to the torque value listed in the topic, SPECIFICATIONS.
4. Install the push rods, adjusting screws and locknuts. Set the valve clearance as outlined in the topic, VALVE CLEARANCE ADJUSTMENT.

VALVES AND VALVE MECHANISM

Compression pressure losses occur when the valve faces and seats become pitted. Valves should be checked occasionally to see that they are seating properly. This can be done by rocking the starting engine against compression. If the cylinder head gasket and piston rings are in good condition and the engine does not rock back against compression, it is likely that the valves and seats should be refaced and reground.



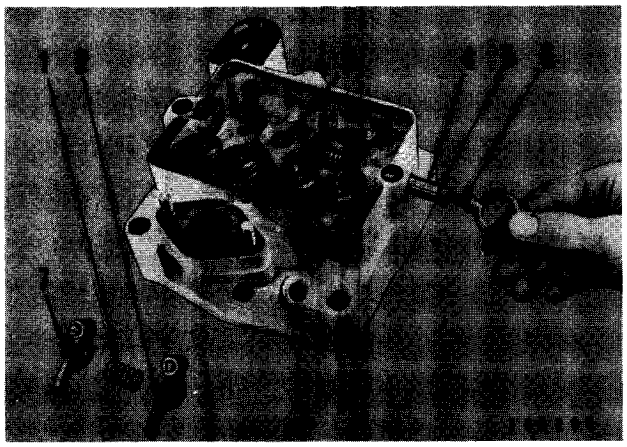
VALVES AND VALVE MECHANISM

1–Spring. 2–Retainer. 3–Lock. 4–Rocker arm. 5–Adjusting screw. 6–Locknut. 7–Push rod. 8–Valve. 9–Lifter.

VALVE ROCKER ARM MECHANISM

Disassembly and Assembly

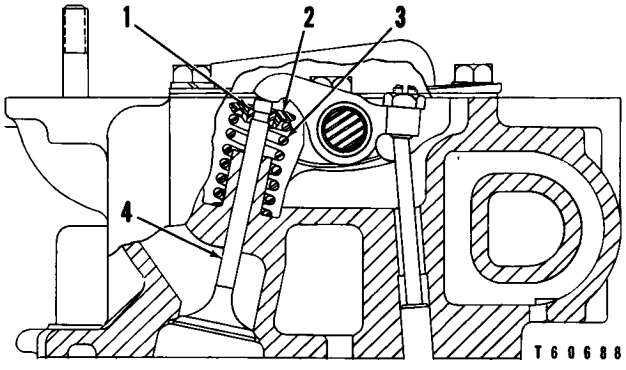
1. Remove the cylinder head as outlined in the covering topic.
2. Using a 1/4" - 20 NC lifting eye bolt **(6)** as shown, partially remove the rocker arm shaft **(4)** from the cylinder head.
3. Remove the rocker arm **(7)**, spring **(1)** and rocker arm **(2)**. The other rocker arms and spring can be removed in the same manner.
4. Inspect the rocker arm shaft and the O-ring seal **(5)** and replace if damaged.
5. Assemble the rocker arm assembly in the reverse order of disassembly, making sure that the slot in the rocker arm shaft is aligned with the head bolt hole **(3)**.



ROCKER ARM REMOVAL
1–Spring. 2–Rocker arm. 3–Hole. 4–Rocker arm shaft. 5–O-ring seal. 6–Lifting eye bolt. 7–Rocker arm.

VALVES

Removal



VALVE REMOVAL
1–Lock. 2–Retainer. 3–Spring. 4–Valve.

1. Remove the cylinder head. See the topic, CYLINDER HEAD REMOVAL.
2. Remove the rocker arm shaft, rocker arms and springs. See the topic, VALVE ROCKER ARM MECHANISM.
3. Using a valve spring compressor tool, compress the spring **(3)** until the locks **(1)** can be removed from the retainer **(2)**.
4. Remove the retainer, spring and valve **(4)**.

Cleaning

After removing the cylinder head from the engine and the valve assemblies from the head, carefully scrape all carbon accumulations from the parts. Be sure to clean the valves thoroughly, as well as the valve stems, valve stem guides and valve ports.

Valve Inspection and Reconditioning

The valves should always be carefully inspected. If the valve faces are pitted or making poor contact with the valve seat, they should be refaced at an angle of 44¼° with a valve refacing machine. If the valves are deeply pitted, badly warped or worn, they should be replaced.

The wear of the valve stems can be checked by the use of an 0" to 1" micrometer. The valve stem should be measured in three places. Use the measurement near the top of the valve stem, where the valve stem does not touch the guide, as the original valve stem diameter.

See the topic, SPECIFICATONS, for clearance and tolerances.

Checking Valve Seats

The 45° valve seats can be ground with a valve seat grinding tool.

After the valve seats have been ground until they are smooth and concentric with the valve guides, all parts should be cleaned thoroughly.

Valve Installation

Exhaust valves marked "EX" on the valve head should be installed in the exhaust ports; inlet valves marked "IN" on the valve head should be installed in the inlet ports.

Lubricate the stems for initial starting.

Insert the valve through the valve stem guide and install the springs and the spring retainer.

NOTE

Install the valve springs with the red end up to insure proper function of the damper coil.

Compress the springs with a compressor, such as outlined in the topic, VALVE REMOVAL.

Insert the locks and tap the retainer lightly as the spring compressor is removed, to make sure the locks are seated properly in the retainer.

VALVE LIFTER REMOVAL AND INSTALLATION

The valve lifters can be removed after the cylinder head has been removed. The lifters must travel freely in the guide bore of the cylinder head.

VALVE CLEARANCE ADJUSTMENT

A correct valve clearance adjustment can be made only while the engine is cold. If the valve mechanism has been removed or changed in any way, the clearance should be adjusted before operating the engine. See the topic, SPECIFICATIONS, for the clearance. Valve adjustment procedure is found in the Operation and Maintenance Instructions.

Pistons, Rings and Connecting Rods

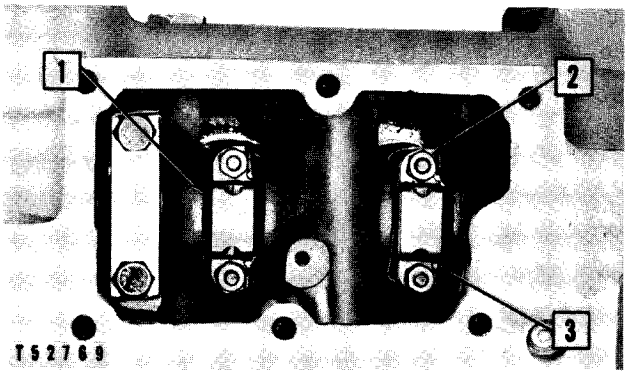
CONNECTING RODS

Removal and Installation

1. Remove the starting engine from the diesel engine and remove the cylinder head. See the covering topics.
2. Lay the starting engine on its side and remove the oil pan and oil pan plate, and the suction bell assembly. See the covering topics.

NOTE

Common lubrication engines use a cover and a tube assembly in place of the oil pan and suction bell.



CONNECTING ROD, BEARING AND PISTON REMOVAL

☐ **Remove**

1–Connecting rod bearing cap (two). 2–Bolt and nut (four). 3–Lock (two).

CAUTION

When installing the suction bell assembly or the oil tube assembly into the cylinder block, care must be exercised to avoid damaging the O-ring seal.

3. Push the connecting rod and piston assembly upward in the cylinder bore and remove.
4. When installing the piston and rod assembly, use a suitable ring compressor to prevent damage to the piston rings and insert the assembly in the appropriate bore according to the number stamped on the connecting rod and cap.

NOTE

The numbers should be placed toward the camshaft side of the engine with No. 1 nearest the magneto.

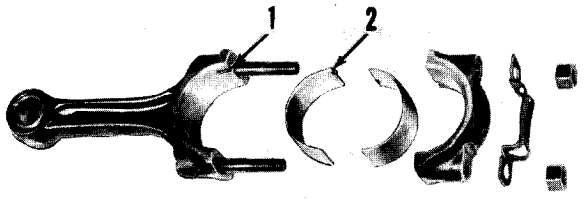
5. Replace the metal locks **(3)** with new ones. As a reminder, the words DO NOT RE-USE are stamped on the bottom of this lock.
6. Tighten the bearing nuts to the value listed in the topic, SPECIFICATIONS.

Connecting Rod Bearings

Steel backed aluminum bearings are used. These bearings do not require fitting and can be removed and replaced through the opening in the bottom of the cylinder block. See the topic, SPECIFICATIONS for bearing clearances.

When replacing the bearings, be sure the protruding portion **(2)** on the back of each bearing half lines up with its corresponding groove **(1)** in the connecting rod and bearing cap. This locks the bearing in place and keeps it from rotating.

Connecting rod bearings .020" undersize are available.



CONNECTING ROD ASSEMBLY

1–Groove. 2–Protruding portion on back of bearing.

Piston Pin Bearing

It is not always necessary to replace piston pin bearings when new bearings are installed in a connecting rod. In many cases, bearings may be serviceable even though the second replacement of connecting rod bearings has been made.

CHECKING PISTON PIN FIT

After the oil has been removed from the pin and bearing, it is possible to feel the clearance between them. A new bearing should be installed only when the clearance exceeds the value listed in the topic, SPECIFICATIONS.

A piston pin bearing furnished from stock must be finished to the correct size after it is pressed into the connecting rod.

New connecting rods have the piston pin bearing bored in a special machine which maintains the proper center-to-center distance and parallelism of the connecting rod bearing and piston pin bore. Reconditioned rods should be machined in the same manner. A new connecting rod makes a good templet for center-to-center distance.

The piston pin should be a thumb push fit in the piston pin bearing and piston at normal room temperature (70° F.). The piston pin should never be forced into the piston.

NOTE

The piston pin retaining rings must be seated into the grooves in the piston. If the rings are distorted during removal, new retainers should be installed.

PISTONS

The piston surfaces and ring grooves should be thoroughly cleaned before installing rings or replacing the piston in the cylinder. The most satisfactory method of cleaning pistons is outlined in the diesel engine topic, INSPECTING AND CLEANING PISTONS.

An engine that has shown a loss of power, excessive oil consumption and loss of compression may need to have the cylinder bores reconditioned.

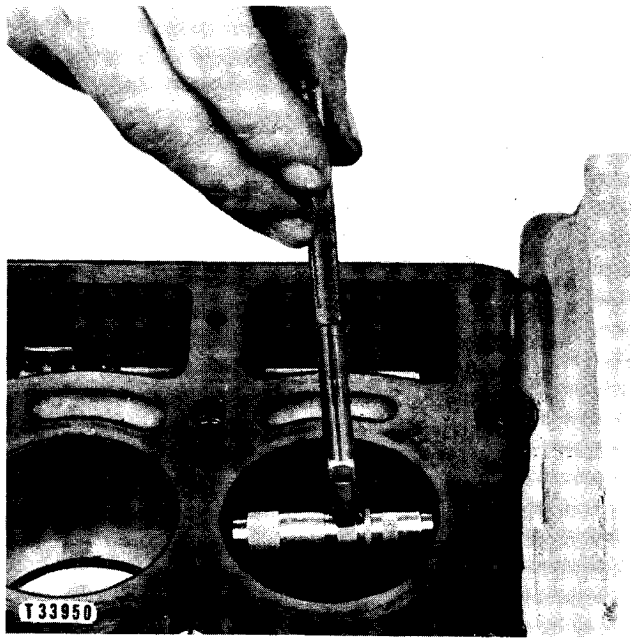
While a piston is removed it is a good practice to measure the cylinder bore for possible out-of-roundness (eccentricity) and wall taper. If the values measured exceed those listed in the topic, SPECIFICATIONS, the cylinder bore should be reconditioned and new oversize pistons and rings installed.

Pistons .020" and .040" oversize are available.

RINGS

Piston ring side clearance and ring gap are listed in the topic, SPECIFICATIONS.

Ring gap should be measured at the smallest diameter of the cylinder bore.



CHECKING CYLINDER BORE

After the rings have been installed on the pistons, they should be free in the grooves so they can be rotated without binding.

NOTE

Assemble the top ring with the counterbore toward the top of the piston.

Timing Chain Housing

The timing chain housing is located at the front of the starting engine cylinder block. Mounted on, or within it, are the recoil starter and electric starting mechanism, magneto, magneto drive, governor, governor drive assembly, timing chain, sprockets and oil pump.

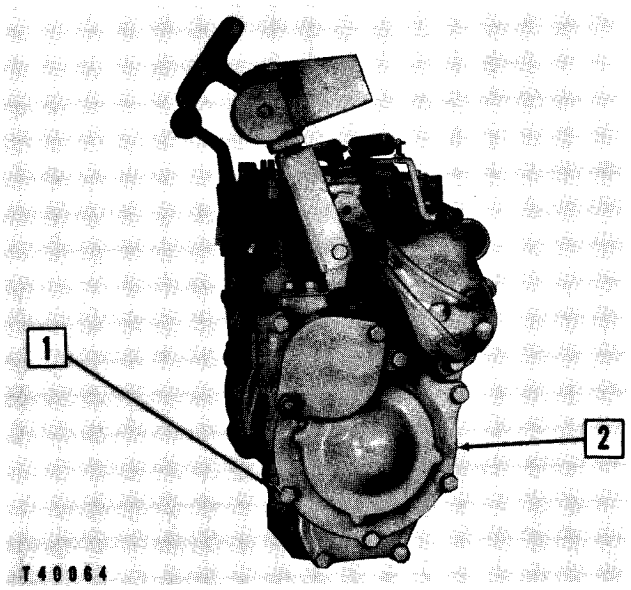
RECOIL STARTER MECHANISM

Removal and Installation

NOTE

The gasket between the recoil starter cover assembly and the starter mechanism plate can be installed without disconnecting the cable.

When installing the recoil starter, turn the plate in a counterclockwise direction until the cable is tight and the holes in the plate and the housing are aligned. See the topic, STARTER CABLE REPLACEMENT.

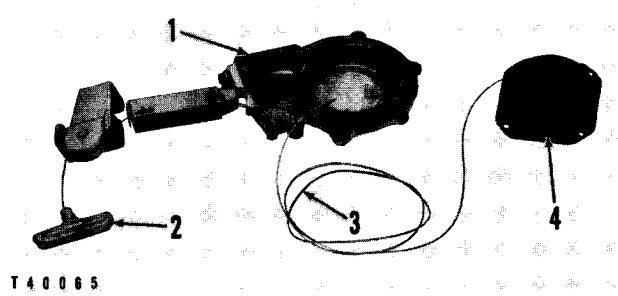


RECOIL STARTER MECHANISM

☐ Remove

1–Retaining bolts. 2–Recoil starter.

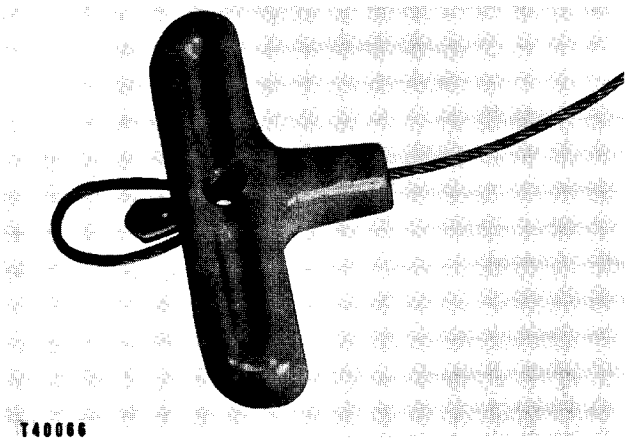
Starter Cable Replacement



CABLE REPLACEMENT

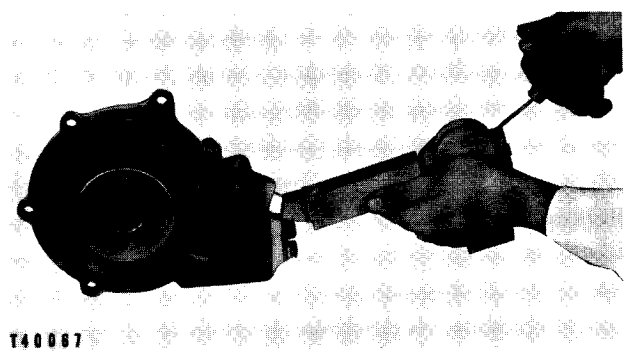
1–Cover assembly. 2–Handle. 3–Cable. 4–Sheave.

1. Remove the recoil starter mechanism from the starting engine. See the topic, RECOIL STARTER MECHANISM REMOVAL AND INSTALLATION.
2. Remove the cable from the handle **(2)**, cover assembly **(1)** and sheave **(4)**.
3. Start the cable **(3)** through the sheave **(4)**, making sure that the anchor end of the cable does not extend above the sheave.
4. Thread the cable through the cover and fasten to the handle as shown.



FASTENING CABLE TO HANDLE

5. Wind the cable counterclockwise on the sheave, being careful to keep the windings even and tight.
6. With the cable wound on the sheave, install the plate assembly in the cover assembly.



TESTING RECOIL STARTER CABLE

7. Before fastening the plate assembly to the cover assembly, turn the plate one-half turn counterclockwise to set the cable tension.
8. While holding the recoil starter mechanism as shown, pull on the cable to make sure that it will not bind and will operate properly.

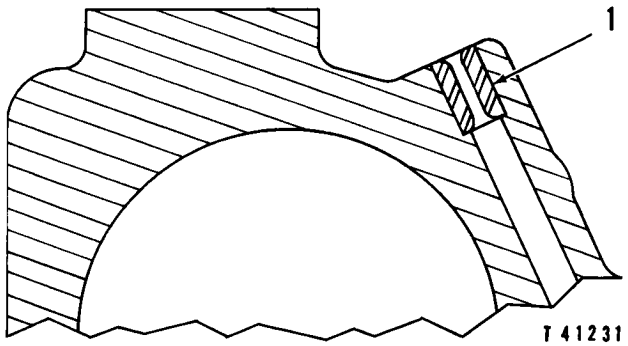
Cover Disassembly and Assembly

A wear guide **(1)** is pressed into the cover to provide a guide and wearing surface for the recoil starter cable. The guide can be replaced if it is worn or damaged in the following manner:

Disconnect the cable from the handle and remove the plate assembly from the cover. See the topic, STARTER CABLE REPLACEMENT.

The guide **(1)** can be removed from the outside by pulling it with a hooked tool or by driving it out from the inside with a punch.

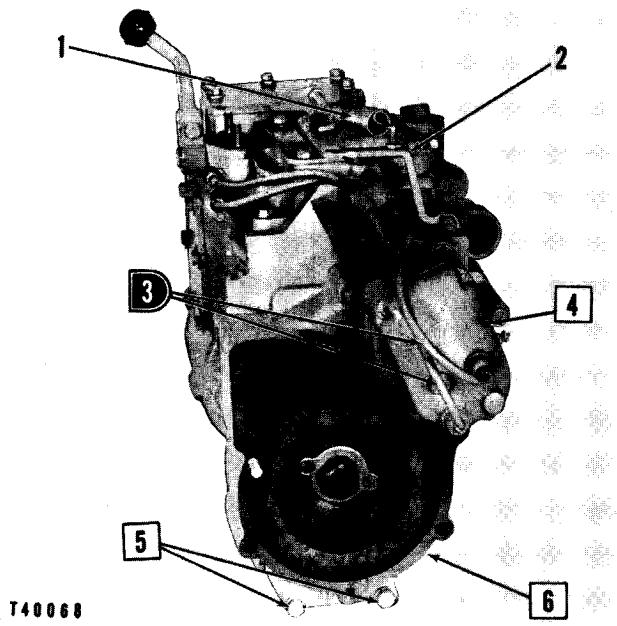
Press the new guide into the housing until it bottoms on the shoulder within the housing.



COVER DISASSEMBLY
1–Guide.

TIMING CHAIN HOUSING

Removal



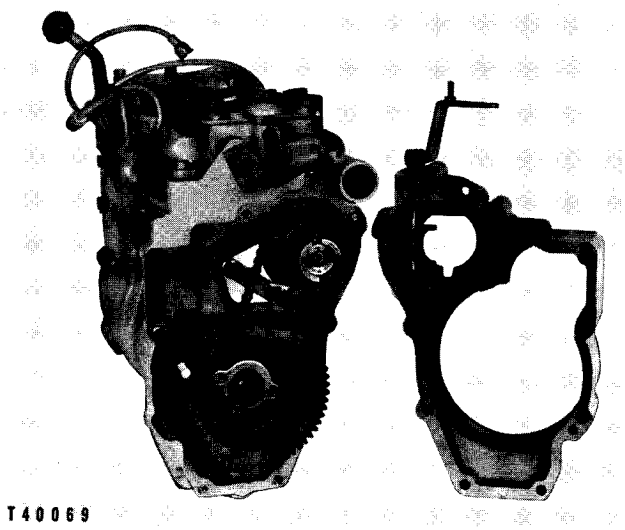
PREPARING TO REMOVE TIMING CHAIN HOUSING

□ Remove ■ Disconnect

1–Governor spring. 2–Terminal lever. 3–Spark plug wires. 4–Magneto. 5–Bolts. 6–Housing.

Remove the starting engine from the diesel engine and remove the recoil starter mechanism. See the covering topics.

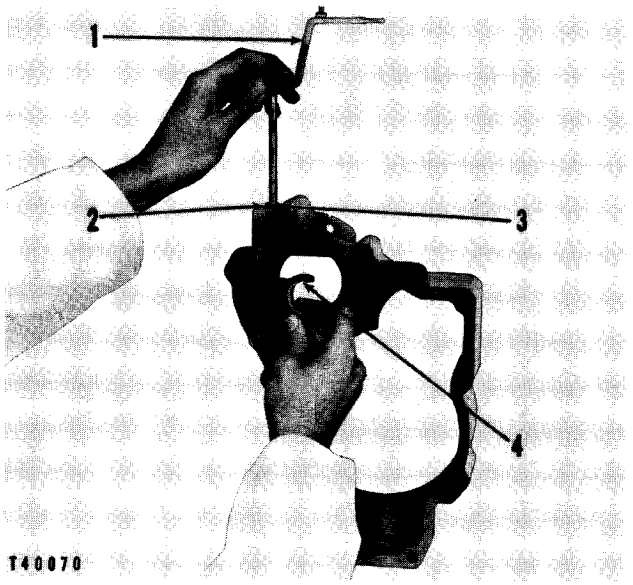
Disconnect the governor spring **(1)** from the governor terminal lever **(2)**.



TIMING CHAIN HOUSING REMOVAL

Disassembly and Assembly

1. Remove the magneto drive shaft. See the covering topic.
2. Drive out the pin that secures the governor fork **(4)** to the lever assembly **(1)**.
3. Remove the lever assembly and fork. Inspect parts for wear or damage and replace if necessary.



TIMING CHAIN HOUSING DISASSEMBLY
1–Lever assembly. 2–Washer. 3–Felt washer. 4–Fork.

4. Inspect the washers **(2)** and **(3)** and replace if damaged.

5. Inspect the lever assembly bearings in the timing chain housing and replace if worn or damaged.

GOVERNOR

The governor consists of four balls, which ride in a slotted carrier, a saucer-shaped retainer and a governor spring.

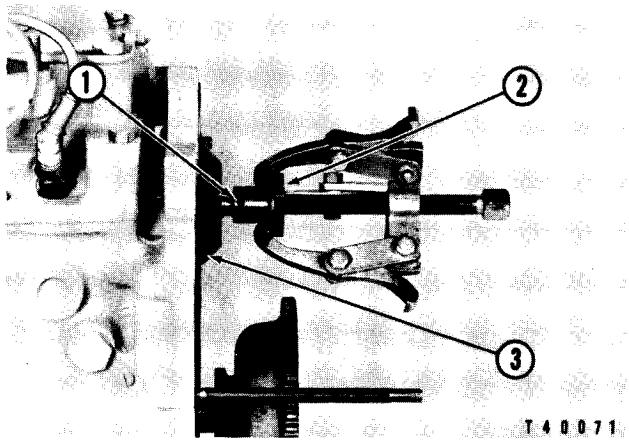
The tension of the governor spring tends to open the carburetor throttle plate and the force of the balls acting on the saucer-shaped retainer tends to close the throttle plate.

When the opposing governor forces are equal, a constant amount of fuel mixture is admitted to the engine causing it to operate at a constant speed. See the topic, STARTING ENGINE OPERATION, for further information on governor operation.

Removal and Disassembly

1. Remove the recoil starting mechanism and the timing chain housing. See the covering topics.

2. Drive out the pin **(1)** and remove the magneto drive trunnion **(2)** with an 8H695 3-way Puller.



REMOVING MAGNETO DRIVE TRUNNION
1–Pin. 2–Trunnion. 3–Retainer.

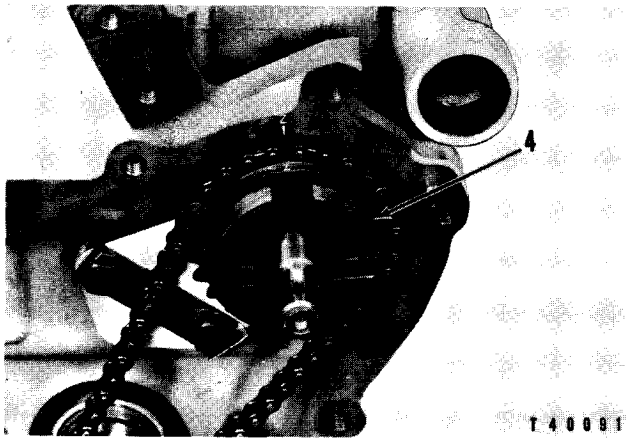
NOTE

Care should be taken when removing the pin not to damage the cam bearings or to bend the end of the camshaft.

3. Remove the retainer **(3)** and the four balls.

4. Inspect the retainer and balls and replace if necessary.

5. If the sprocket **(4)** is to be replaced, the cam must be removed. See the covering topic.



GOVERNOR AND CAM DRIVE SPROCKET
4–Sprocket.

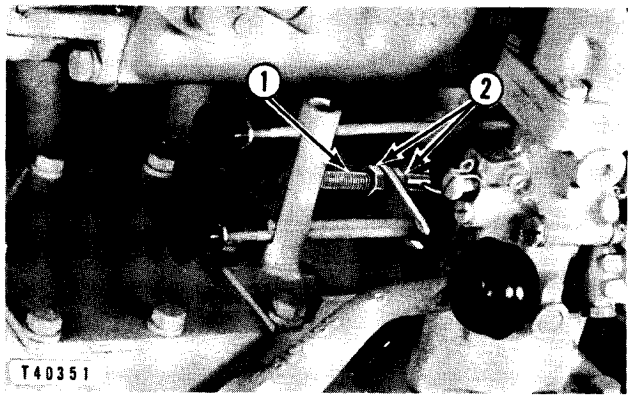
6. Heat the magento trunnion and tap it lightly onto the shaft. Be sure the dowel hole is aligned.

NOTE

Later machines do not use the pin **(1)**.

Adjustment

High idle adjustment is made by tightening or loosening the nuts **(2)** on the governor adjusting screw **(1)** to obtain the desired engine speed.



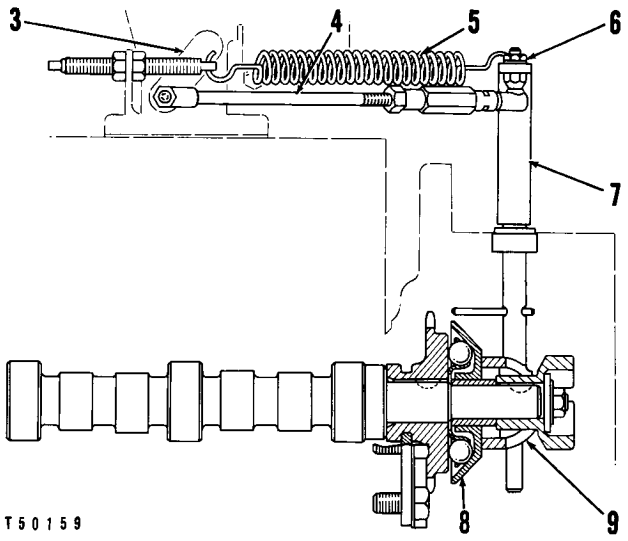
GOVERNOR ADJUSTMENT
1–Screw. 2–Nut.

The high idle speed can be check by installing a 4L8393 Tachometer Drive on the diesel engine. With the starting engine running at full throttle and with the starting engine clutch and pinion engaged, adjust the governor until the diesel engine is turning at 260 RPM with the compression released.

NOTE

When the diesel engine is operating at 260 RPM, this corresponds to about 5500 RPM high idle on the starting engine.

The governor control rod assembly **(4)** is adjusted by first removing the nut **(6)** and disconnecting the rod assembly from the lever assembly **(7)**. With the governor spring **(5)** attached to the lever assembly as shown and the carburetor throttle lever **(3)** held in the full open position, adjust the length of the control rod assembly to align with the hole in the lever assembly. This will insure the correct positioning of the fork **(9)** in relation to the governor ramp **(8)** thus insuring correct speed regulation by the governor. Insert the rod assembly **(4)** into the lever assembly **(7)** and install the lockwasher and nut **(6)**.



ADJUSTING GOVERNOR CONTROL ROD ASSEMBLY
(Right Side View of Starting Engine)
3–Carburetor throttle lever. 4–Governor control rod assembly. 5–Governor spring. 6–Nut. 7–Lever assembly. 8–Governor ramp. 9–Fork.

CAMSHAFT

The camshaft is located in the left side of the cylinder block and is driven by the timing chain.

The camshaft is supported by three bearings in the cylinder block.

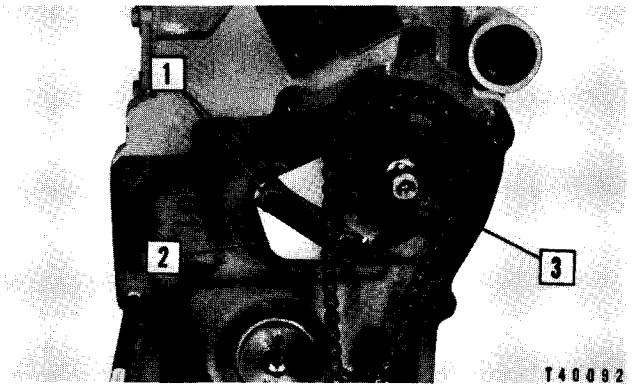
Removal and Installation

1. Remove the crankshaft gear. See the covering topic.

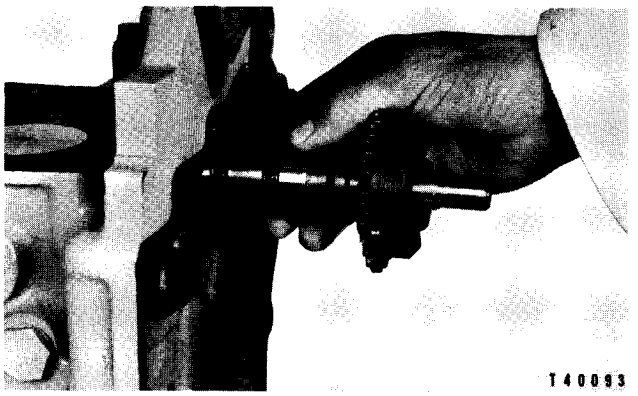
NOTE

Care should be taken not to damage the camshaft bearing bores when removing and installing the camshaft.

2. Before installing the camshaft, measure the bearing journals on the camshaft and the bearing bores into which the camshaft fits. For camshaft bearing clearances see the topic, SPECIFICATIONS.



CAMSHAFT REMOVAL
☐ **Remove**
1–Bolts. 2–Thrust plate. 3–Camshaft.



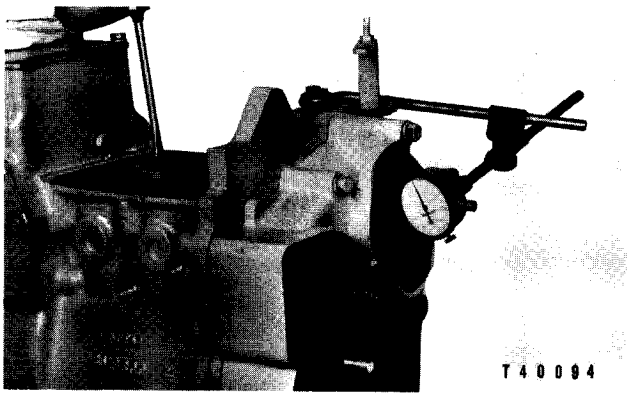
REMOVING CAMSHAFT

3. If new bearings are to be installed, align the oil holes in the bearings with the oil holes in the cylinder block and press them into place.

4. When installing the camshaft and governor assembly in the cylinder block, align the timing marks as outlined in the topic, TIMING THE ENGINE.

Camshaft End Clearance

The camshaft end clearance is determined by the difference in thickness between the groove in the



CHECKING CAMSHAFT END CLEARANCE

camshaft sprocket and the thickness of the thrust plate. If excessive end play exists the thrust plate should be replaced.

1. With the timing chain housing installed on the engine, position a dial indicator against the end of the camshaft as shown.
2. Pry the camshaft toward the rear of the cylinder block.
3. Remove the pry bar and set the indicator dial at "0."
4. Pry the camshaft toward the indicator and note the reading.
5. For camshaft end clearance, see the topic, SPECIFICATIONS.

When installing the magneto, see the topic, TIMING THE MAGNETO TO THE ENGINE, in the Operation and Maintenance Instructions.

TIMING THE ENGINE

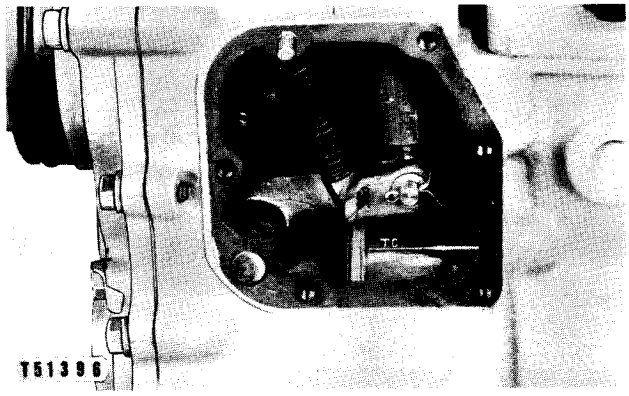
The starting engine can be timed in the following manner:

1. With the starting engine removed from the diesel engine, remove the recoil starter mechanism, timing chain housing and crankshaft sprocket. See the covering topics for removal and installation.

NOTE

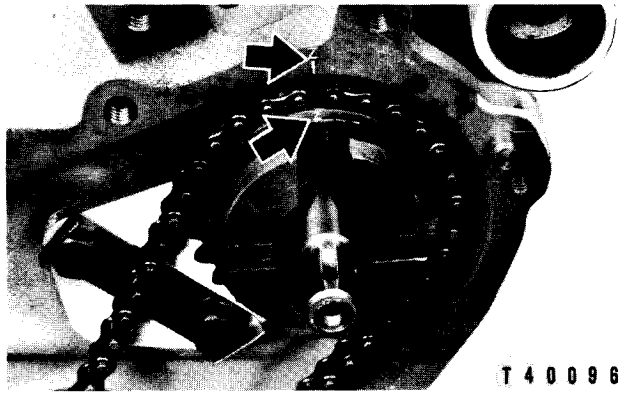
Leave the chain on the camshaft sprocket.

2. Remove the clutch mechanism cover. The cover is located on the side of the engine near the rear.
3. Turn the starting engine flywheel in the direction of engine rotation until the pointer on the cylinder block is aligned with the TC mark on the flywheel as shown.



FLYWHEEL TIMING MARK

4. Align the Z on the camshaft sprocket with the Z stamped on the cylinder block as shown.
5. Position the crankshaft sprocket so the off center dowels line up.
6. Position the timing chain on the sprocket and install the sprocket.



CAMSHAFT TIMING MARKS

7. Check the timing marks on the flywheel and camshaft sprocket.
8. Assemble the engine and install it on the diesel engine.

NOTE

For magneto timing, see the Operation and Maintenance Instructions.

Timing Chain Housing

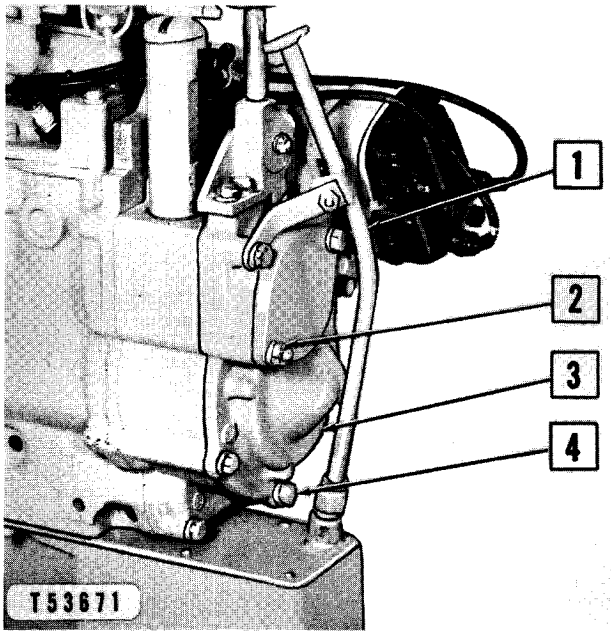
The timing chain housing is located at the front of the starting engine cylinder block. Mounted on, or within it, are the recoil starter and electric starting mechanism, magneto, magneto drive, governor, governor drive assembly, timing chain, sprockets and oil pump.

RECOIL STARTER MECHANISM

Removal and Installation

NOTE

The gasket between the recoil starter cover assembly and the starter mechanism plate can be installed without disconnecting the cable.

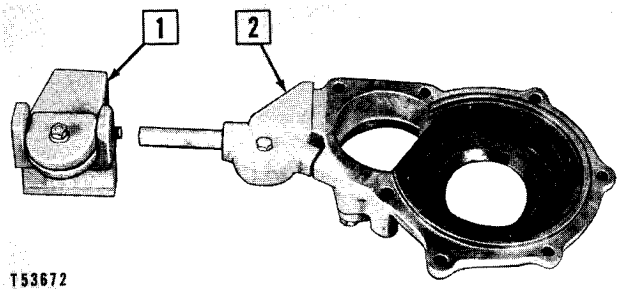


RECOIL STARTER MECHANISM
(D4 Illustrated)

☐ **Remove**

1–Oil level gauge assembly. 2–Nut. 3–Recoil starter assembly. 4–Bolts (six).

Disassembly and Assembly

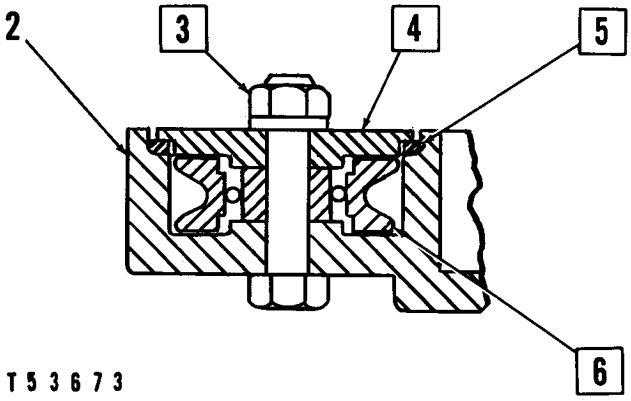


DISASSEMBLING COVER ASSEMBLY

☐ **Remove**

1–Bracket assembly. 2–Housing assembly.

1. Remove the handle, cable and sheave. See the topic, STARTER CABLE REPLACEMENT.
2. Replace the gasket **(5)** if necessary.

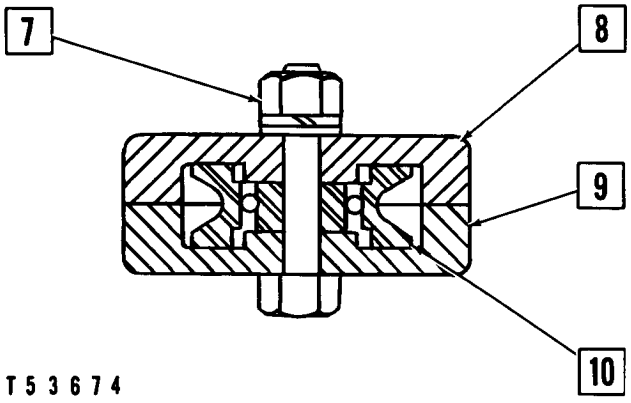


DISASSEMBLING HOUSING ASSEMBLY

☐ **Remove**

2–Housing assembly. 3–Nut. 4–Cover. 5–Gasket. 6–Pulley.

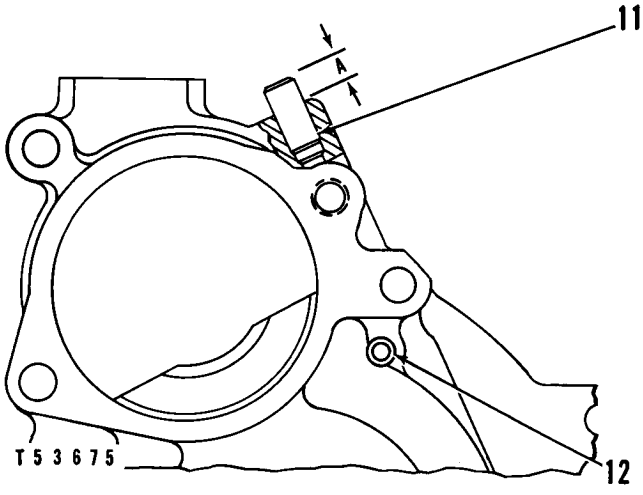
3. Inspect both pulleys **(6)** and **(10)** and replace if necessary.



DISASSEMBLING BRACKET ASSEMBLY

☐ **Remove**

7–Nut. 8–Housing. 9–Housing. 10–Pulley.



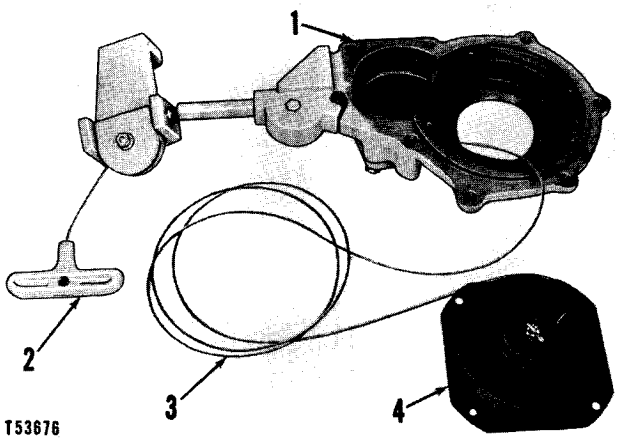
DISASSEMBLING COVER ASSEMBLY

11–Shield. 12–Dowel. A–Dimension of .38 inch.

4. Inspect the dowel **(12)** and replace if worn or damaged. The dowel should be installed with one end flush with the inside surface of the cover.
5. If the shield **(11)** is to be replaced, install it to the dimension **(A)** as shown.

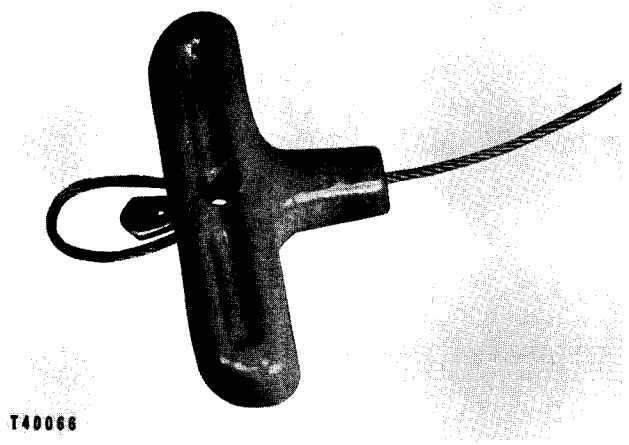
Starter Cable Replacement

1. Remove the recoil starter mechanism from the starting engine. See the topic, RECOIL STARTER MECHANISM REMOVAL AND INSTALLATION.
2. Remove the four screws and remove the sheave **(4)** from the cover assembly **(1)**.



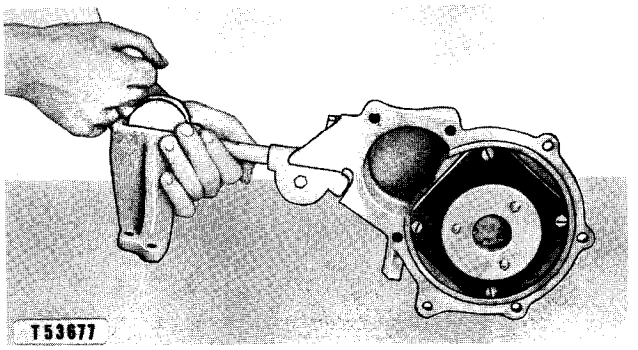
CABLE REPLACEMENT
1–Cover assembly. 2–Handle. 3–Cable. 4–Sheave.

3. Remove the handle **(2)** from the cable **(3)**, disconnect the cable from the sheave and remove the cable from the cover assembly.
4. Start the new cable through the sheave, making sure that the anchor end of the cable does not extend above the sheave.
5. Thread the cable through the cover assembly and fasten to the handle as shown.



FASTENING CABLE TO HANDLE

6. Wind the cable counterclockwise on the sheave, being careful to keep the windings even and tight.
7. With the cable wound on the sheave, install the plate assembly in the cover assembly.



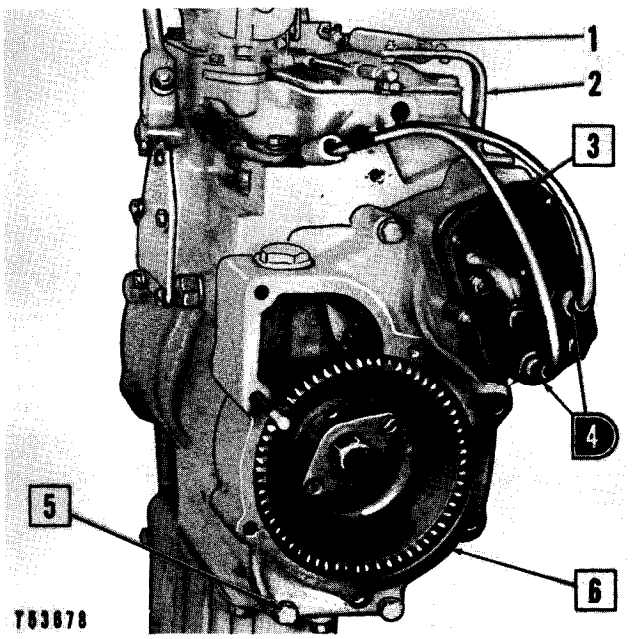
TESTING RECOIL STARTER CABLE

8. Before fastening the plate assembly to the cover assembly, turn the plate one-half turn counterclockwise to set the cable tension.
9. While holding the recoil starter mechanism as shown, pull on the cable to make sure that it will not bind and will operate properly.

TIMING CHAIN HOUSING

Removal and Installation

Remove the recoil starter mechanism. See the covering topic.

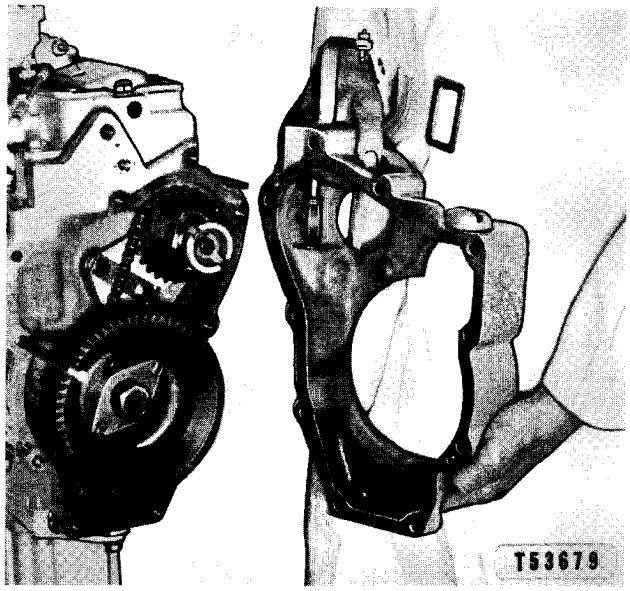


PREPARING TO REMOVE TIMING CHAIN HOUSING
(D330 Illustrated)

□ **Remove** ■ **Disconnect**

1–Governor spring. 2–Terminal lever. 3–Magneto. 4–Spark plug wires. 5–Bolts (three). 6–Timing chain housing.

Disconnect the governor spring **(1)** from the terminal lever **(2)**.

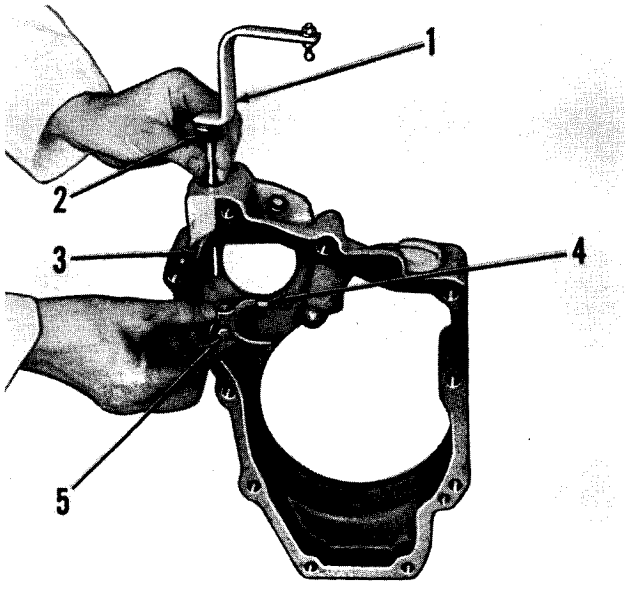


TIMING CHAIN HOUSING REMOVAL
(D330 Illustrated)

Inspect the gasket between the timing chain housing and starting engine cylinder block and replace if damaged.

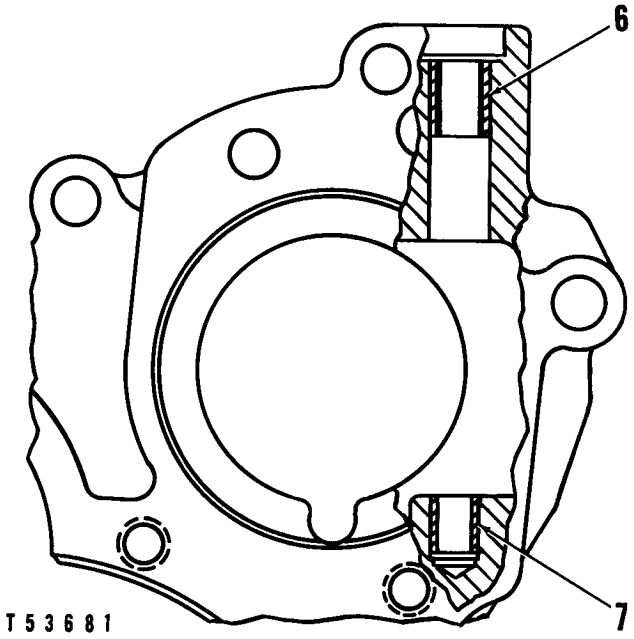
Disassembly and Assembly

1. Loosen the bolt **(5)** on the fork **(4)**.
2. Drive out the pin **(3)** which secures the lever assembly in the timing chain housing.



TIMING CHAIN HOUSING DISASSEMBLY
(D330 Illustrated)
1–Terminal lever assembly. 2–Felt washer. 3–Pin. 4–Fork. 5–Bolt.

3. Remove the terminal lever assembly **(1)** and fork as shown.
4. Inspect the felt washer **(2)**, and metal washer above it, and replace if damaged.
5. Inspect the lever assembly bearings **(6)** and **(7)** and replace if worn or damaged.



LEVER ASSEMBLY BEARINGS
6–Bearing. 7–Bearing.

NOTE

If the bearings **(6)** and **(7)** are to be replaced, install the bearing **(6)** flush with the bottom of the counterbore, and the bearing **(7)** flush with the top of the boss.

GOVERNOR

The governor consists of four balls, which ride in a slotted driver, a saucer-shaped ramp and a governor spring.

The tension of the governor spring tends to open the carburetor throttle plate and the force of the balls acting on the saucer-shaped ramp tends to close the throttle plate.

When the opposing governor forces are equal, a constant amount of fuel mixture is admitted to the engine causing it to operate at a constant speed. See the topic, STARTING ENGINE OPERATION, for further information on governor operation.

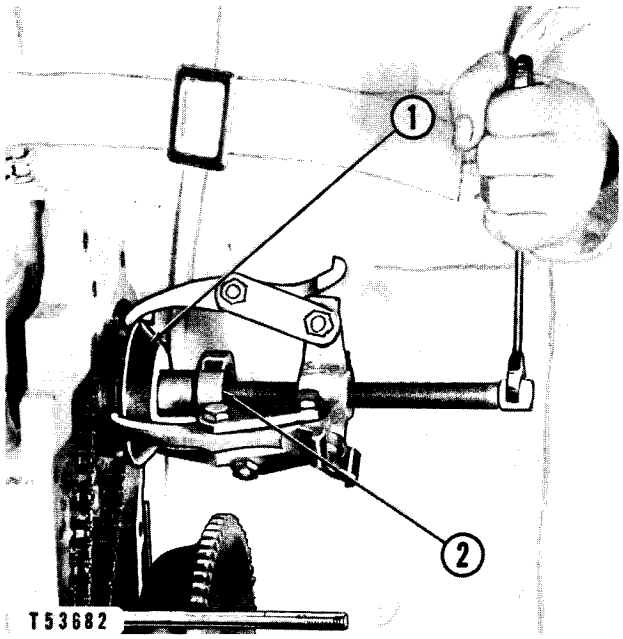
Removal and Installation

1. Remove the recoil starting mechanism and timing chain housing. See the covering topics.

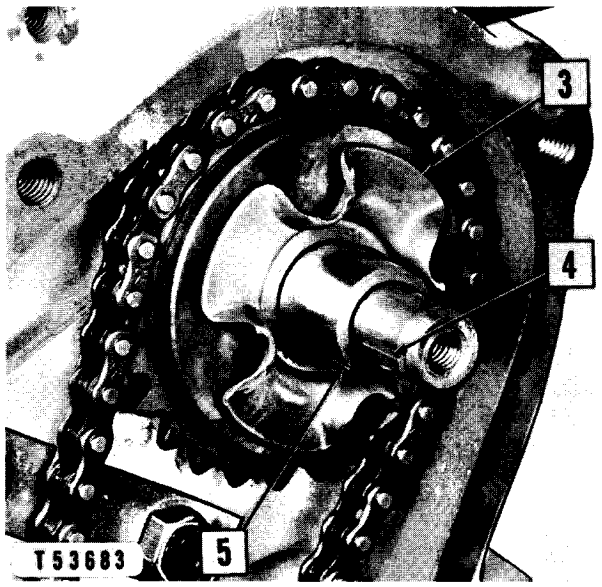
2. Remove the bolt, lock and washer that secures the magneto drive coupling to the camshaft.
3. Remove the ball ramp **(1)** and magneto drive coupling **(2)**, using an 8H695 Puller as shown.

NOTE

The ball ramp **(1)** should be moved out far enough to permit removal of the governor balls. Care should be taken not to damage or scratch them in any way.



MAGNETO DRIVE COUPLING REMOVAL
1–Ball ramp. 2–Coupling.

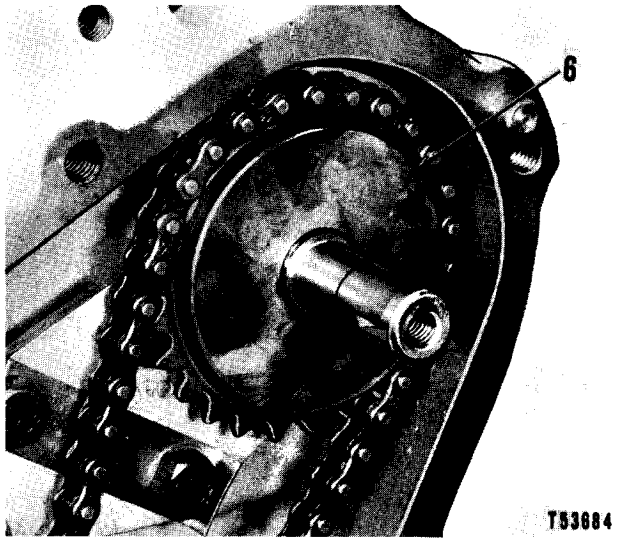


REMOVING DRIVER

☐ **Remove**

3–Driver. 4–Key. 5–Sleeve.

4. Inspect and replace any damaged parts.
5. If the sprocket **(6)** is to be replaced, the camshaft must be removed. See the covering topic.



GOVERNOR AND CAM DRIVE SPROCKET
6–Sprocket.

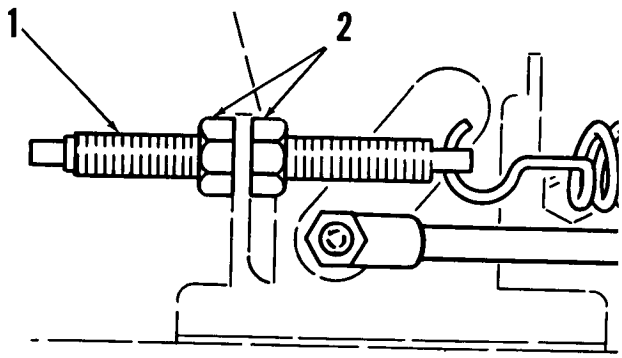
7. Install the driver, balls and ramp in the reverse order of removal.
8. Install the key in the camshaft.
9. Press the magneto drive coupling on the camshaft.

CAUTION

Use extreme care when installing the magneto drive coupling on the camshaft. Failure to do so may result in damage to the camshaft thrust plate.

Adjustment

The high idle adjustment is made by tightening or loosening the nuts **(2)** on the governor adjusting screw **(1)** to obtain the desired engine speed.



T53685

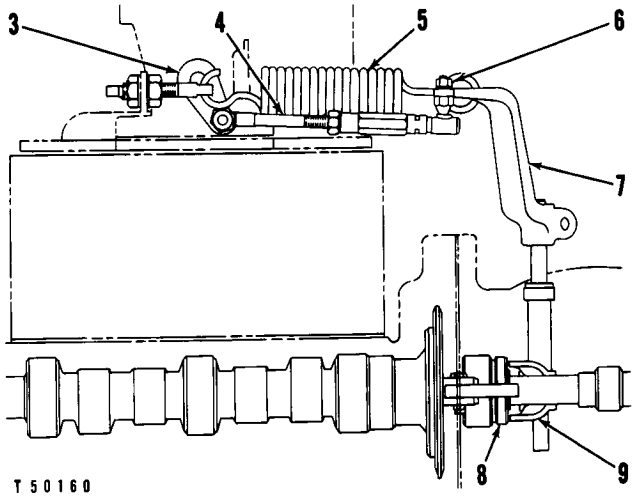
GOVERNOR ADJUSTMENT
1–Screw. 2–Nut.

A 9M478 Ignition Tachometer should be used to adjust the high idle speed properly. Idle speeds should be adjusted to the values given in the topic, SPECIFICATIONS. Readings should be taken only after the starting engine crankcase oil has been allowed to warm.

NOTE

Normally, the tachometer should be connected to the No. 2 spark plug to obtain proper polarity. However, if no reading can be observed switch to the No. 1 spark plug. Attachment of the tachometer to a lead with opposite polarity will not harm the tachometer but a reading cannot be obtained.

The governor control rod assembly **(4)** is adjusted by first removing the nut **(6)** and disconnecting the rod assembly from the lever assembly **(7)**. With the governor spring **(5)** attached to the lever assembly as shown and the carburetor throttle lever **(3)** held in the full open position, adjust the length of the control rod assembly to align with the hole in the lever assembly. This will insure the correct positioning of the fork **(9)** in relation to the governor ramp **(8)** thus insuring correct speed regulation by the governor. Insert the rod assembly **(4)** into the lever assembly **(7)** and install the lockwasher and nut **(6)**.



ADJUSTING GOVERNOR CONTROL ROD ASSEMBLY
(Right Side View of Starting Engine)
3–Carburetor throttle lever. 4–Governor control rod assembly. 5–Governor spring. 6–Nut. 7–Lever assembly. 8–Governor ramp. 9–Fork.

CAMSHAFT

The camshaft is located in the left side of the cylinder block and is driven by the timing chain.

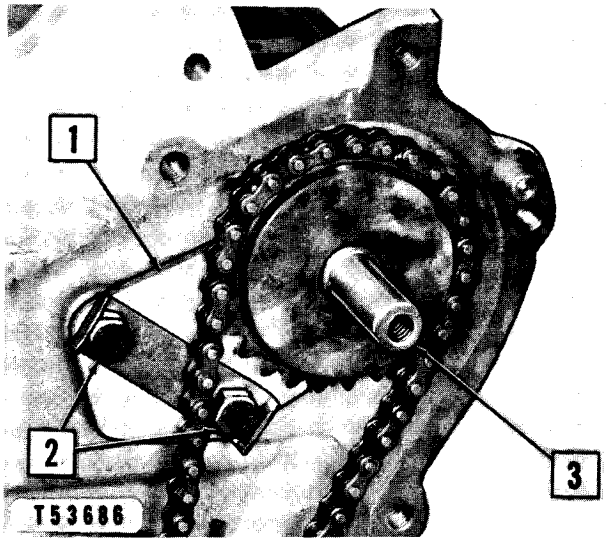
The camshaft is supported by three bearings in the cylinder block.

Removal and Installation

1. Remove the cylinder head. See the covering topic.
2. Remove the pushrods and lift the valve lifters clear of the camshaft.
3. Remove the crankshaft gear, magneto drive coupling and governor components.

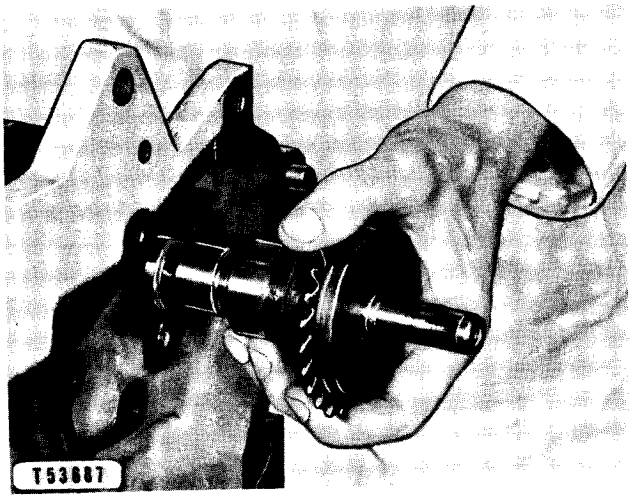
NOTE

Care should be taken not to damage the camshaft bearing bores when removing and installing the camshaft.



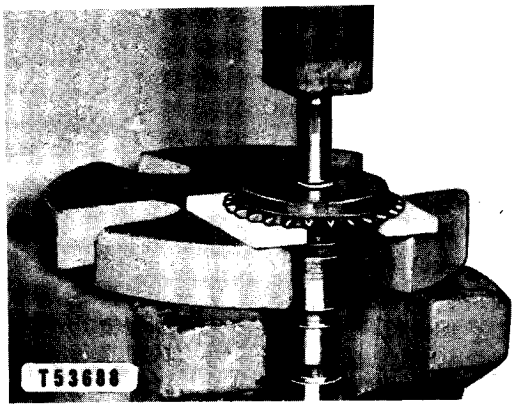
CAMSHAFT REMOVAL
☐ Remove
1–Thrust plate. 2–Bolts. 3–Camshaft.

4. Before installing the camshaft, measure the bearing journals on the camshaft and the bearing bores into which the camshaft fits. For camshaft bearing clearances see the topic, SPECIFICATIONS.



REMOVING CAMSHAFT

5. If new bearings are to be installed, align the oil holes in the bearings with the oil holes in the cylinder block and press them into place.
6. If necessary, the sprocket may be removed as shown.

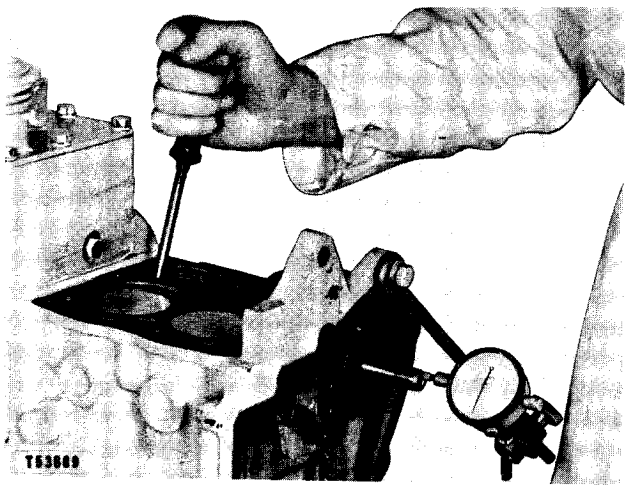


SPROCKET REMOVAL

7. When installing the camshaft and governor assembly in the cylinder block, align the timing marks as outlined in the topic, TIMING THE ENGINE.

Camshaft End Clearance

The camshaft end clearance is determined by the difference in thickness between the groove in the camshaft sprocket and the thickness of the thrust plates. If excessive end play exists the thrust plate should be replaced.



CHECKING CAMSHAFT END CLEARANCE

1. Position the dial indicator against the end of the camshaft as shown.
2. Pry the camshaft toward the rear of the cylinder block.
3. Remove the pry bar and set the indicator dial at "0."
4. Pry the camshaft toward the indicator and note the reading.
5. For camshaft end clearance, see the topic, SPECIFICATIONS.

NOTE

The end clearance may be checked without removing the crankshaft gear, governor components and magneto drive coupling.

When installing the magneto, see the topic, TIMING THE ENGINE.

TIMING THE ENGINE

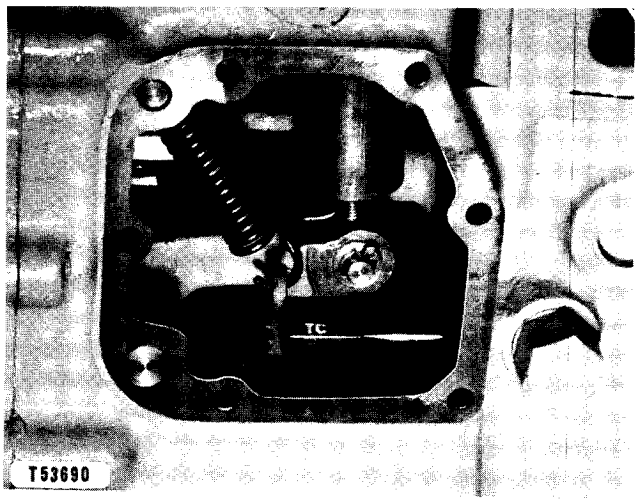
The starting engine can be timed in the following manner:

1. With the starting engine removed from the diesel engine, remove the recoil starter mechanism, timing chain housing and crankshaft sprocket. See the covering topics for removal and installation.

NOTE

Leave the chain on the camshaft sprocket.

2. Remove the clutch mechanism cover. The cover is located on the side of the engine near the rear.
3. Turn the starting engine flywheel in the direction of engine rotation until the pointer on the cylinder block is aligned with the TC mark on the flywheel as shown.



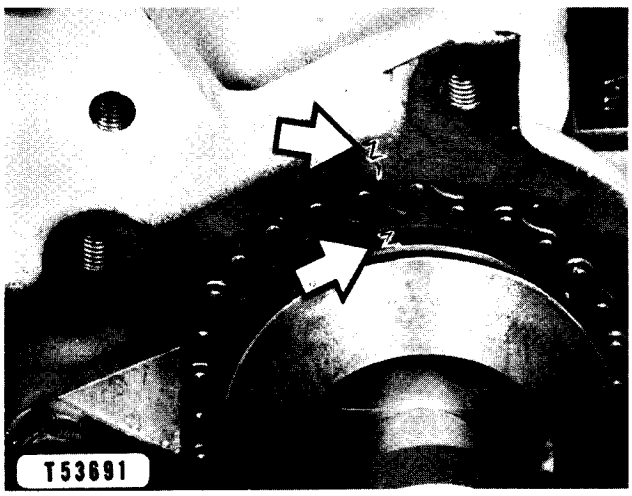
FLYWHEEL TIMING MARK

4. Align the Z on the camshaft sprocket with the Z stamped on the cylinder block as shown.
5. Position the crankshaft sprocket so the off center dowels line up.

6. Position the timing chain on the sprocket and install the sprocket.

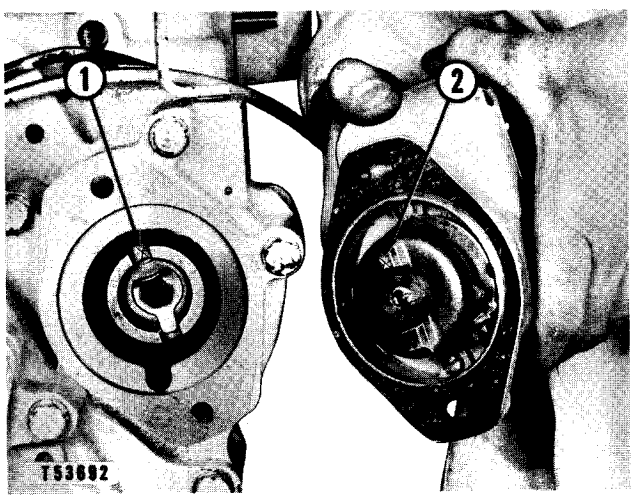
NOTE

Before installing the crankshaft sprocket retaining bolt, coat the threads with 9M3710 Antisiezure Thread Compound.



CAMSHAFT TIMING MARKS

7. Check the timing marks on the flywheel and camshaft sprocket.
8. Install the timing chain housing.
9. Locate the X-mark **(1)** on the starting engine magneto drive.
10. Turn the magneto impulse coupling until the X-mark **(2)** on the tang is in such a position as to line up with the mark on the mangeto drive.
11. Install the magneto with the X-marks together and tighten the bolts.



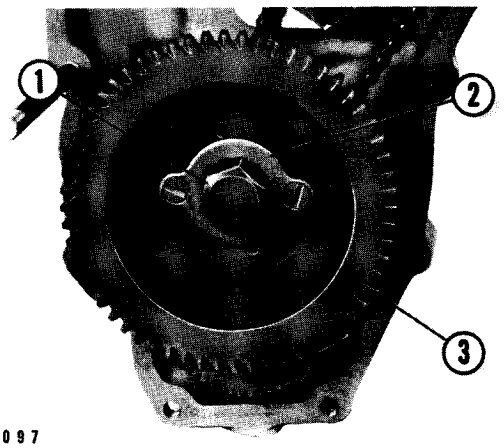
TIMING THE MAGNETO
1–X-mark on magneto drive. 2–X-mark on magneto impulse coupling.

Crankshaft and Main Bearings

STARTING ENGINE RING GEAR

The starting engine ring gear is located at the front of the crankshaft in the timing chain housing. Machined on the hub of the ring gear is the sprocket to drive the camshaft and the gear to drive the oil pump.

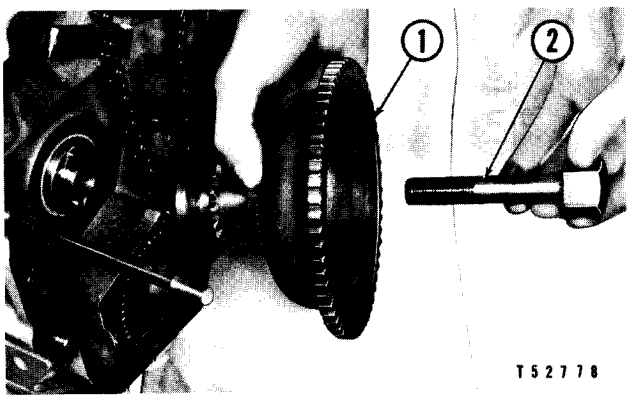
The recoil starter mechanism engages with the bolt **(1)** to rotate the crankshaft. When the starting engine is equipped with an electric starter the pinion engages with the gear **(3)**. The starting engine ring gear is positioned on the crankshaft by two dowels and secured by the bolt **(1)**. The bolt **(1)** is locked in position by lock **(2)**.



STARTING ENGINE RING GEAR
1–Bolt. 2–Lock. 3–Gear.

The starting engine ring gear must be removed to remove the timing chain, camshaft and governor assembly, crankshaft, or oil pump.

Removal and Installation



STARTING ENGINE RING GEAR
1–Ring gear. 2–Bolt.

Remove the timing chain housing. See the topic, TIMING CHAIN HOUSING.

Remove the lock which secures the bolt **(2)** and ring gear **(1)** to the crankshaft and remove the bolt and ring gear.

NOTE

Earlier models have a washer beneath the bolt head. This washer is used only with ring gears that have a counterbore in which the washer is installed.

Inspect the sprocket, oil pump drive gear and ring gear for damage. If any part is damaged, it is necessary to replace the complete unit.

See the topic, TIMING THE ENGINE. Coat the threads of the bolt **(2)** with 9M3710 Antisieze Thread Compound and tighten to the value listed in the topic, SPECIFICATIONS.

When installing the lock, stake the retaining screws in place.

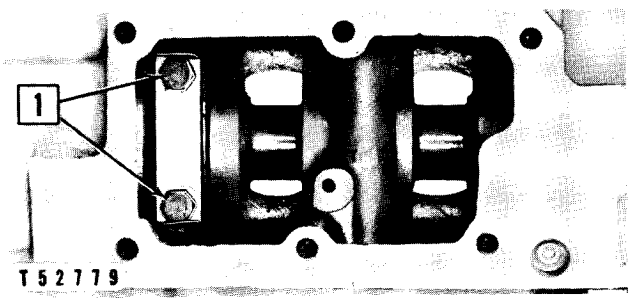
CRANKSHAFT

Removal

Remove the crankshaft sprocket and gear, cylinder head and valve mechanism, pistons and connecting rods, and starter pinion and clutch mechanism. See the covering topics.

NOTE

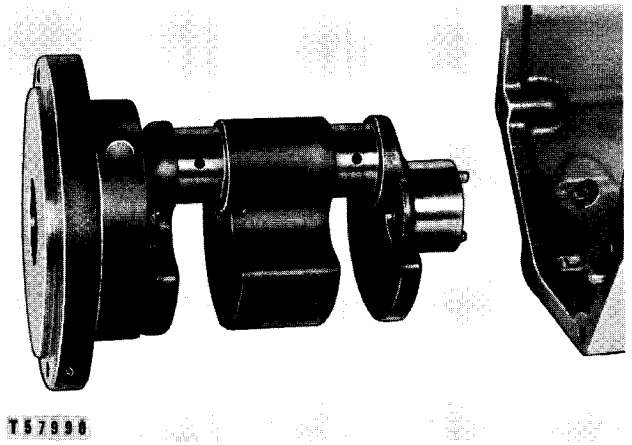
It is possible to remove the crankshaft from the cylinder block without removing the clutch and flywheel. However, it is recommended that the clutch and flywheel be removed before removing the crankshaft to prevent damage to the crankshaft and clutch and for ease of disassembly.



PREPARING TO REMOVE CRANKSHAFT

☐ **Remove**

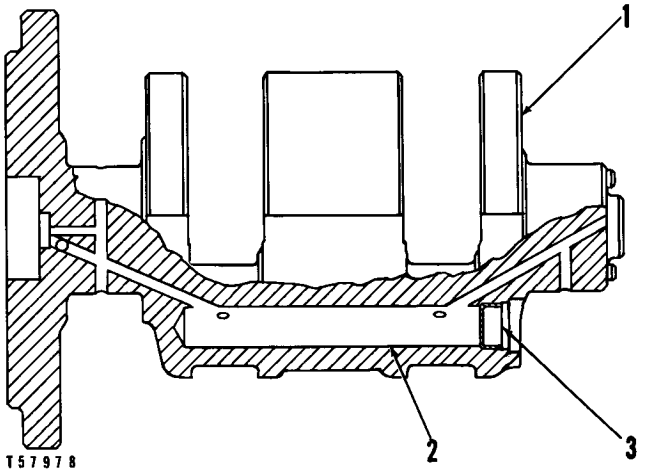
1–Bolts.



CRANKSHAFT REMOVAL

Remove the crankshaft and the rear main bearing from the cylinder block as an assembly.

Disassembly and Assembly



CRANKSHAFT (CROSS SECTION)
(Later Crankshaft Illustrated)
1–Crankshaft. 2–Sludge pocket. 3–Plug.

1. Remove the plug **(3)**.

NOTE

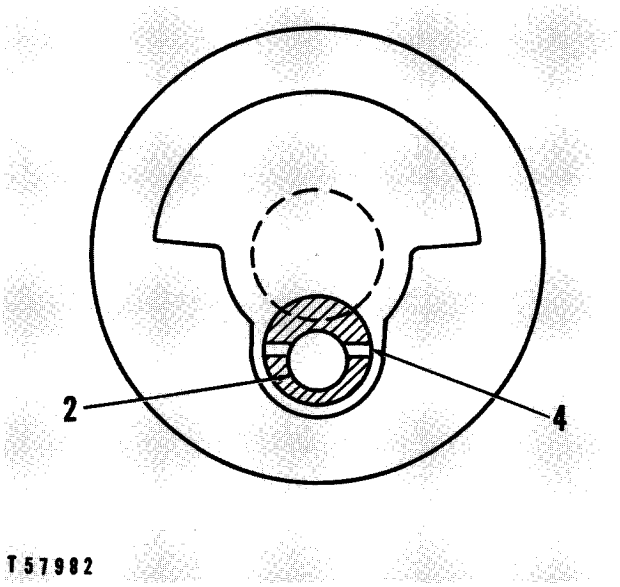
Earlier crankshafts do not have the plug **(3)** and the sludge pocket **(2)**.

2. Remove any accumulation of foreign material from the sludge pocket **(2)**.

NOTE

It may be necessary to drill or chip out foreign material that has become packed in the sludge pocket **(2)**.

3. On both earlier and later crankshafts, the oil passages in the main bearings, connecting rod bearing journals **(4)**, and to the clutch shaft should be cleaned, inspected and free from obstructions.

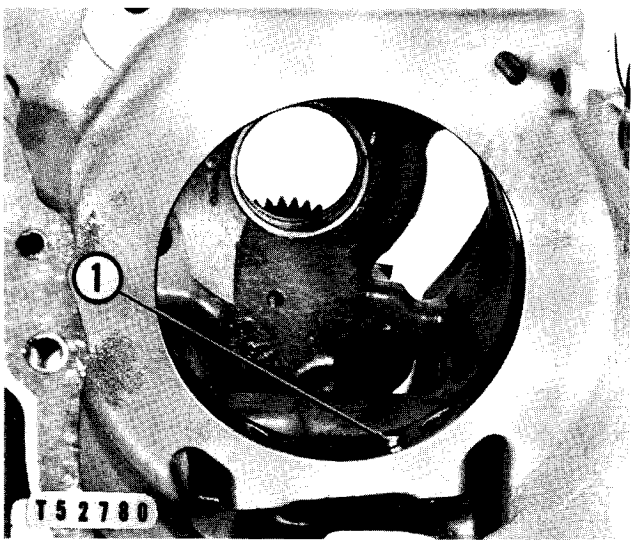


CRANKSHAFT (CROSS SECTION)
2–Sludge pocket. 4–Oil passage in rod bearing journal.

4. Inspect all bearing surfaces for wear or damage. See the topic, SPECIFICATIONS.

5. On crankshafts with a sludge pocket, install a new plug **(3)**. The plug will bottom in the bore with the lip slightly below flush. Stake the edge of the bore in the crankshaft over the lip of the plug in four places (equally spaced) to securely hold the plug in the bore.

Installation



CRANKSHAFT INSTALLATION
1–Dowel.

Install the rear main bearing halves on the crankshaft after it has been checked for wear. See the topic, MAIN BEARINGS.

NOTE

The slot on the bottom half of the rear main bearing must be aligned with the dowel **(1)** in the cylinder block when installing the crankshaft.

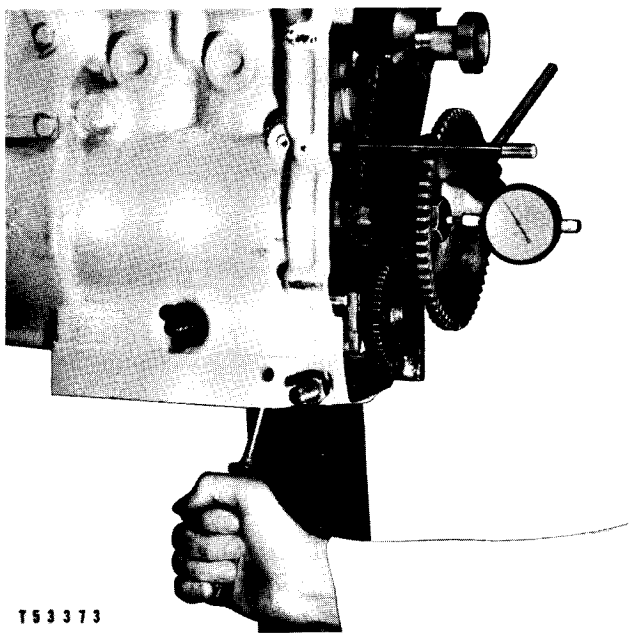
Holding the rear main bearing halves together on the crankshaft, place the crankshaft and bearing into the cylinder block.

Install the rear main bearing retaining bolts and tighten them to the torque value listed in the topic, SPECIFICATIONS.

End Clearance

Crankshaft end clearance is controlled by the width of the rear main bearing and the width of the rear main bearing journal.

1. Install a dial indicator as shown.
2. Pry the crankshaft toward the front of the cylinder block.
3. Adjust the dial indicator to read "0".
4. Pry the crankshaft toward the rear of the cylinder block and note the reading on the dial indicator.



CRANKSHAFT END CLEARANCE

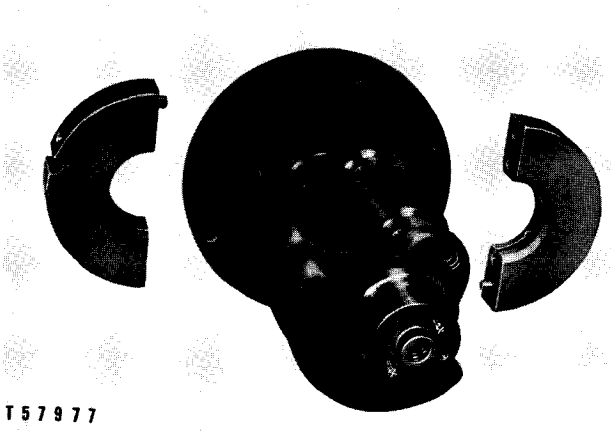
5. See the topic, SPECIFICATIONS, for the correct end clearance.

NOTE

After installing the clutch and brake mechanism, recheck the crankshaft end clearance at the front of the crankshaft to be sure that clutch and brake mechanism were not improperly installed.

MAIN BEARINGS

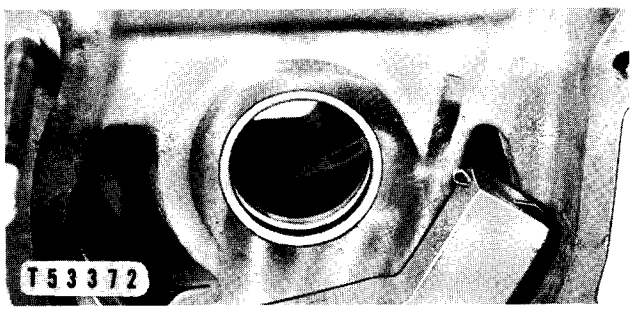
The starting engine rear main bearing is a two-piece aluminum bearing as shown. The rear main bearing takes the thrust of the crankshaft and is removed from the cylinder block along with the crankshaft. See the topic, CRANKSHAFT.



CRANKSHAFT REAR MAIN BEARING

The front main bearing is a one-piece solid aluminum bearing and can be pressed from the cylinder block after the crankshaft has been removed.

When installing the front main bearing, align the oil hole in the bearing with the oil hole in the cylinder block.

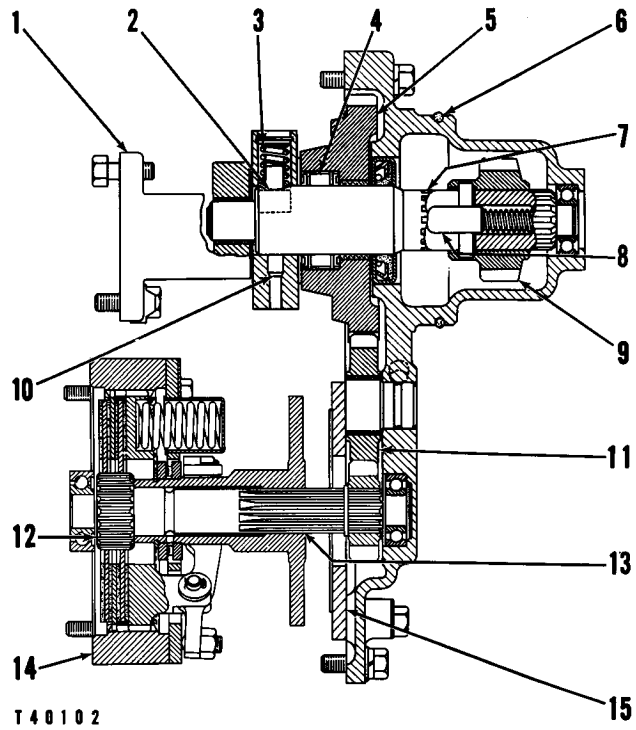


FRONT MAIN BEARING

For crankshaft and main bearing clearances and permissible clearances, see the topic, SPECIFICATIONS.

Starting Mechanism

The starting engine transmits its power through a clutch and gears to a sliding pinion. The pinion is engaged with the diesel engine flywheel ring gear by a hand lever controlled linkage. When the diesel engine starts, the pinion is automatically released by the action of centrifugal force upon the pinion release plunger.



STARTING MECHANISM

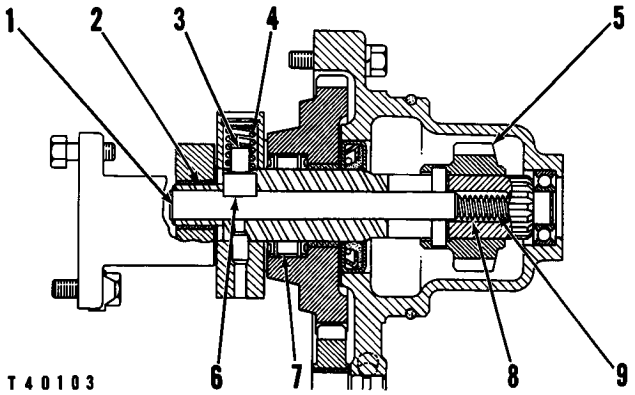
1–Support bracket. 2–Pinion release plunger. 3–Spring. 4–Overrunning clutch. 5–Pinion shaft drive gear. 6–O-ring seal. 7–Pinion outer shaft. 8–Pinion inner shaft. 9–Pinion. 10–Dowel. 11–Idler gear. 12–Clutch shaft gear. 13–Clutch shaft. 14–Clutch and flywheel assembly. 15–Brake plate.

STARTER PINION

See the topic, CLUTCH, PINION AND BRAKE CONTROL MECHANISM OPERATION.

To engage the pinion **(5)**, the control lever is moved toward the front of the engine. This action causes the control linkage to contact the end of the inner pinion shaft **(1)**. Further movement of the control lever moves the inner shaft and pinion toward the rear and also compresses the pinion return springs **(8)** and **(9)**.

The inner shaft must be moved far enough into the outer shaft **(2)** to permit the plunger **(3)** to engage with the notch **(6)** cut in the inner shaft. The pinion is then engaged with the ring gear of the diesel engine flywheel. The plunger is held in the engaged position with the shaft by pressure exerted by the spring **(4)**. The plunger remains engaged with the pinion shaft until centrifugal force, acting on the plunger, overcomes the spring force holding the plunger in the notch. The return springs **(8)** and **(9)** then return the pinion to the disengaged position.



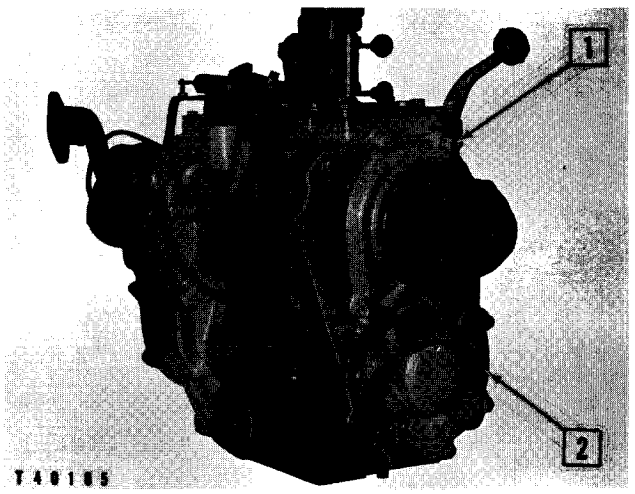
STARTER PINION MECHANISM

1–Inner shaft. 2–Outer shaft. 3–Plunger. 4–Spring. 5–Pinion. 6–Notch. 7–Overrunning clutch. 8–Spring. 9–Spring.

An overrunning clutch **(7)** is located between the drive gear and the pinion outer shaft **(2)**. This clutch prevents the starting engine from being driven by the diesel engine. When the speed of the pinion shaft tends to exceed that of the gear assembly, the clutch overruns thus allowing movement relative to the two parts. This prevents any damage to the starting engine should there be failure in the pinion kick-out mechanism.

Removal and Installation

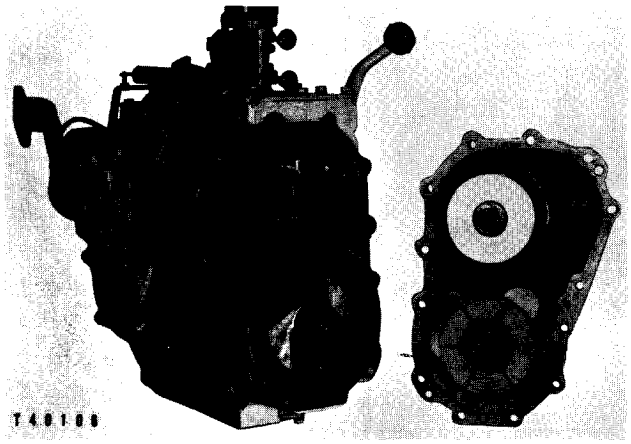
Remove the starting engine from the diesel engine. See the topic, STARTING ENGINE REMOVAL AND INSTALLATION.



STARTER PINION HOUSING

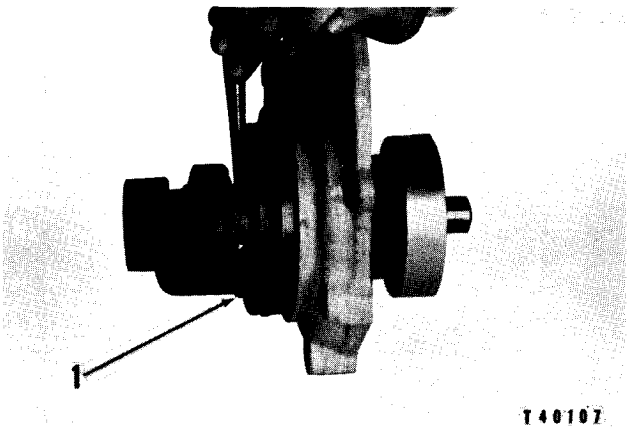
☐ **Remove**

1–Bolt. 2–Housing.



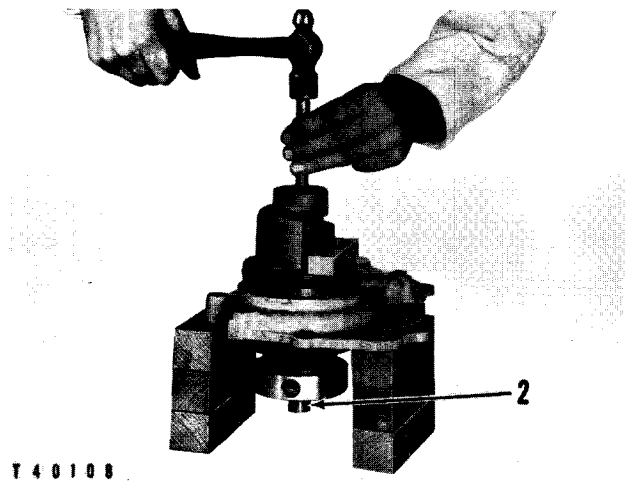
STARTER PINION HOUSING REMOVAL

Disassembly



REMOVING PINION DOWEL
1–Dowel.

1. Move the inner pinion shaft to the engaged position and drive the dowel **(1)** through the hole in the pinion housing.

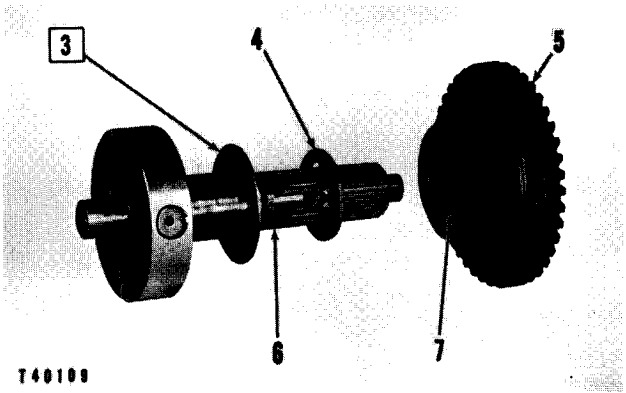


REMOVING SHAFT ASSEMBLY
2–Shaft.

WARNING

Handle the shaft carefully. After the dowel is removed, the plunger could be jarred causing the inner shaft to be ejected.

2. Block the assembly as shown. Use a 5/8 inch brass drift to drive the shaft **(2)** out of the bearing.

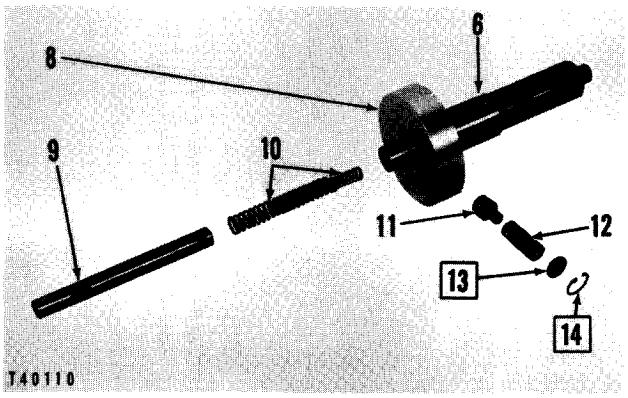


SHAFT DISASSEMBLY

☐ Remove

3–Washer. 4–Bearing. 5–Gear assembly. 6–Outer shaft. 7–Overrunning clutch.

3. Remove the gear assembly **(5)** and bearing **(4)** from the outer shaft **(6)**.
4. Remove the overrunning clutch **(7)** from the gear assembly **(5)**.
5. Remove the bearing, same as bearing **(4)**, from inside the gear assembly.



PINION RELEASE MECHANISM DISASSEMBLY

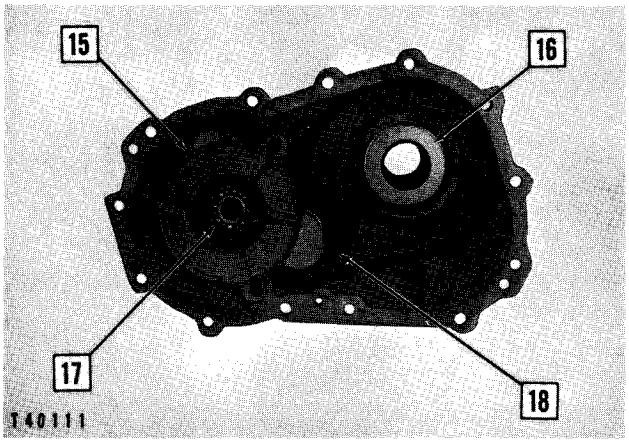
☐ Remove

6–Outer shaft. 8–Carrier. 9–Inner shaft. 10–Pinion return springs. 11–Plunger. 12–Spring. 13–Washer. 14–Snap ring.

NOTE

Later carriers utilize a plate and two bolts to retain the plunger **(11)** and spring **(12)**.

6. Prior to removing the plunger **(11)**, hold the shaft **(9)** so it will not eject from the outer shaft **(6)**.
7. If it is necessary to remove the carrier **(8)**, drive the dowel that secures the carrier to the outer shaft inward toward the center of the shaft until the dowel is clear of the carrier. Press the shaft out of the carrier.
8. Inspect and replace all parts that show signs of damage or excessive wear.
9. Check the springs **(10)** and **(12)**. See the topic, SPECIFICATIONS.



BRAKE PLATE AND IDLER GEAR REMOVAL

☐ **Remove**

15–Brake plate. 16–Seal. 17–Bearing. 18–Idler gear.

10. Inspect the bearing, seal, brake plate facing, and idler gear. Replace any parts which show signs of excessive wear or damage.
11. If necessary, the idler gear shaft can be removed by pressing it out of the pinion housing.

Assembly

1. Press the seal into the pinion housing with the wiping edge of the seal toward the starting engine. Press the seal to a depth of .06 inch from the machined face of the housing.
2. If the carrier has been removed, be certain the dowel is in place after replacing the carrier on the outer shaft.
3. Replace the inner bearing in the gear assembly. Install the bearing with the cupped end away from the overrunning clutch.
4. Replace the overrunning clutch in the gear assembly.
5. Replace the outer bearing in the gear assembly. Install the bearing with the cupped end away from the overrunning clutch.

CAUTION

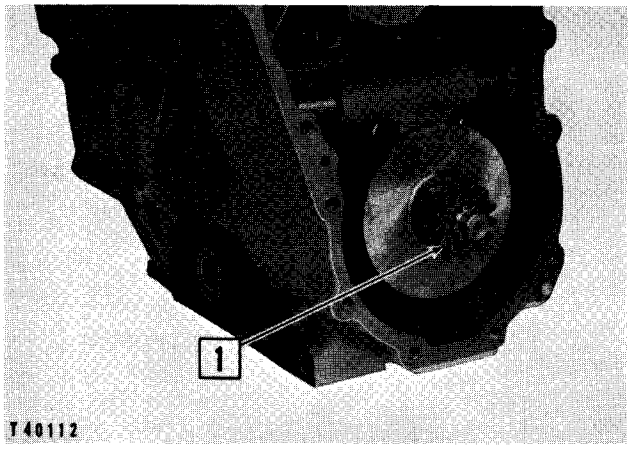
Assemble the overrunning clutch so the copper drag strips are toward the carrier.

6. Make certain the plunger spring retainer snap ring is properly seated in its groove.

STARTER PINION BRAKE

Removal and Disassembly

1. Remove the starter pinion housing. See the topic, STARTER PINION REMOVAL AND INSTALLATION.

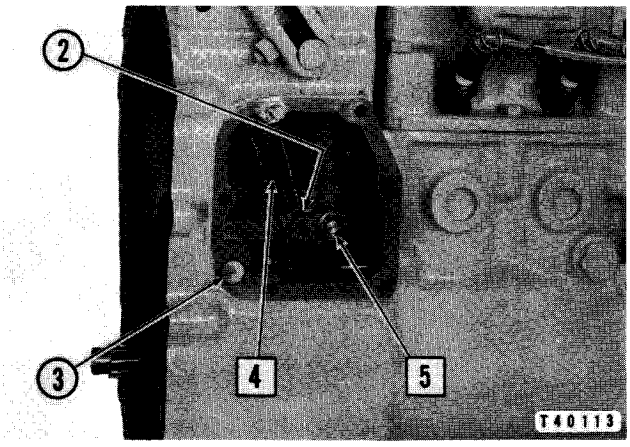


DRIVE GEAR REMOVAL

☐ **Remove**

1–Gear.

2. Remove the lock ring behind the gear.



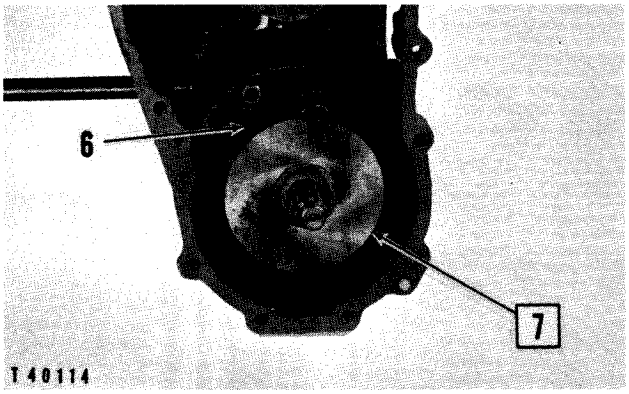
STARTER PINION BRAKE LINKAGE REMOVAL

☐ **Remove**

2–Yoke. 3–Shaft. 4–Spring. 5–Pin.

3. Drive out the shaft **(3)** and remove the yoke **(2)**.
4. Remove the pins **(6)** that secure the clutch release levers to the clutch plate.

5. Remove the clutch release levers.
6. Inspect and replace all parts which show signs of excessive wear or damage.



BRAKE PRESSURE PLATE REMOVAL

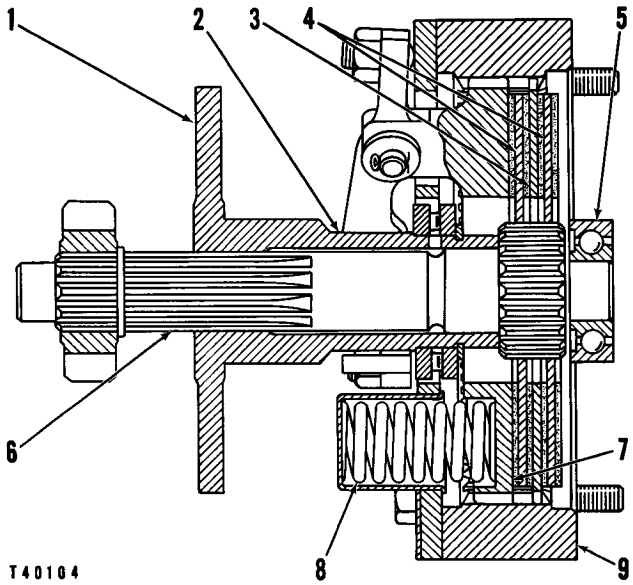
☐ **Remove**

6–Pin. 7–Brake pressure plate.

CLUTCH

Operation

The starting engine clutch is the automotive oil-type with two outer discs **(4)** and one inner disc **(3)**. Power is transmitted from the flywheel **(9)** to the plate **(7)** and inner disc **(3)**. When the clutch is engaged, the springs **(8)** force the discs together, and power is transmitted to the clutch shaft **(6)** through the discs **(4)**.



CLUTCH OPERATION

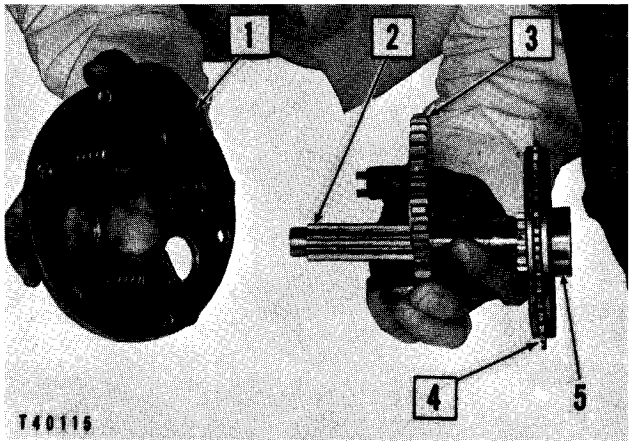
1–Brake pressure plate. 2–Clutch release collar. 3–Inner clutch disc. 4–Outer clutch discs. 5–Bearing. 6–Clutch shaft. 7–Plate. 8–Spring. 9–Flywheel.

When the clutch is disengaged, the clutch release collar **(2)** is moved toward the rear. The brake pressure plate **(1)** contacts the lined brake plate, which is mounted on the pinion housing. The engaging of these two components stops the clutch shaft from rotating.

Bearing **(5)** pilots the clutch in the crankshaft flange.

Removal and Disassembly

1. Remove the starter pinion brake assembly. See the topic, STARTER PINION BRAKE.
2. Remove the cover from the side of the engine.
3. Remove the bolts which secure the flywheel to the crankshaft.



CLUTCH DISASSEMBLY

☐ **Remove**

1–Retainer plate. 2–Shaft. 3–Pressure plate. 4–Clutch discs. 5–Bearing.

4. Inspect the clutch discs and the pilot bearing **(5)** for signs of excessive wear or damage.
5. The bearing can be removed by pulling it off the clutch shaft.

NOTE

Install the bearing **(5)** with the shield toward the clutch discs.

6. Inspect the clutch springs in the retainer plate, and replace if necessary. See the topic, SPECIFICATIONS.

Assembly and Installation

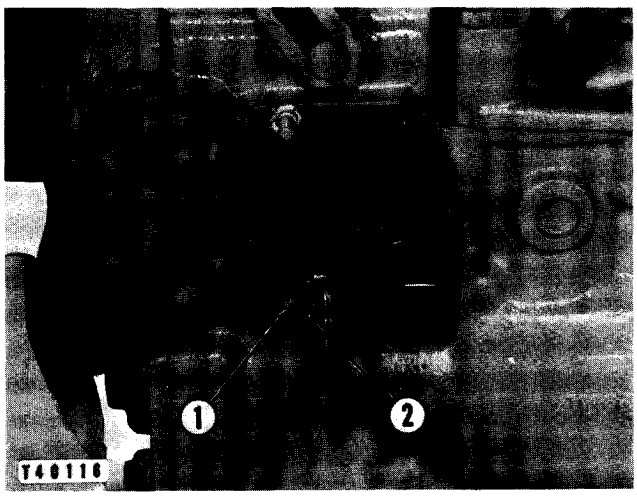
1. Install the flywheel on the crankshaft flange.
2. When installing the clutch driving plate in the flywheel, make certain the tooth marks on the driving plate and the flywheel are aligned.
3. When installing the retainer plate on the flywheel make certain the alignment mark on the

retainer plate is aligned with that on the flywheel.

4. Inspect the clutch release levers, and replace if necessary.
5. Adjust the control linkage and the clutch. See the covering topics.

Clutch Adjustment

1. With the side cover removed from the starting engine cylinder block, engage the clutch.
2. Slide the clutch release collar as far forward as possible toward the crankshaft until the collar butts the splines on the clutch shaft.
3. Loosen the locknuts **(2)** on the setscrews **(1)**.

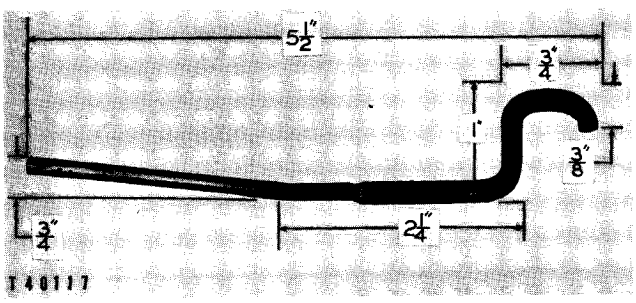


CLUTCH ADJUSTMENT
1–Setscrew. 2–Locknut.

4. With the tips of the clutch release arms against the thrust washer, adjust the setscrews until the clearance between the setscrews and the clutch retainer plate is .030 inch.

NOTE

Clutch adjustment is simplified if a 3/16 inch hexagonal wrench of the dimensions shown is used.



CLUTCH ADJUSTMENT TOOL

5. Tighten the locking nuts and recheck the adjustment.

CLUTCH, PINION AND BRAKE CONTROL MECHANISM

Operation

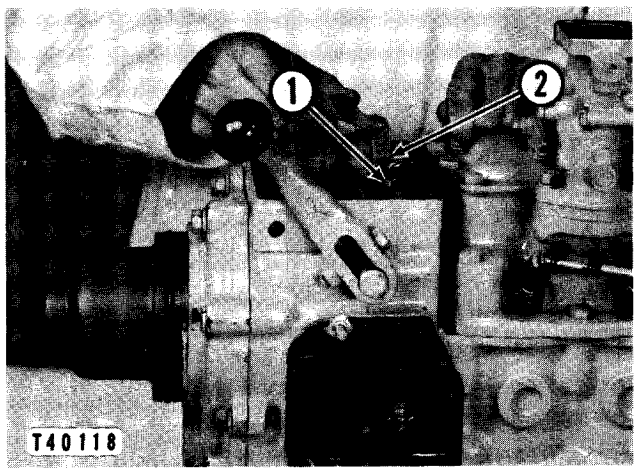
The clutch and brake engagement and disengagement and the starter pinion engagement is controlled by a single control lever.

When the control lever is toward the rear, or pinion end of the starting engine, the clutch is engaged, the brake disengaged, and the pinion disengaged from the diesel engine ring gear. As the control lever is moved forward, the brake is engaged. At the extreme forward position, the brake is fully engaged, and the pinion is engaged with the diesel engine flywheel ring gear. As the control lever is moved to the rear, the brake is disengaged and the clutch is engaged; the starting engine pinion rotates the diesel engine ring gear.

Adjustment

The adjustment of the clutch, pinion and brake control mechanism is made in the following manner with the starting engine on or off the diesel engine.

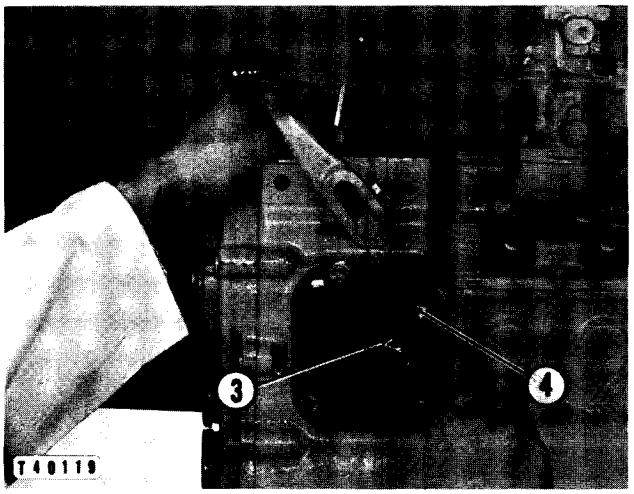
1. Make certain the brake and pinion are disengaged.
2. Adjust the clutch. See the topic, CLUTCH.



PINION CONTROL ADJUSTMENT
1–Jam nut. 2–Screw.

3. Loosen the nut **(1)** and turn the screw **(2)** until there is approximately .12 inch between the pinion control lever and the pinion engaging shaft.
4. Slide the clutch release collar to the rear until it contacts the release arms.

5. Adjust nut **(3)** on the link **(4)** so that the rollers on the brake engaging yoke are 1/16 inch from the brake plate.



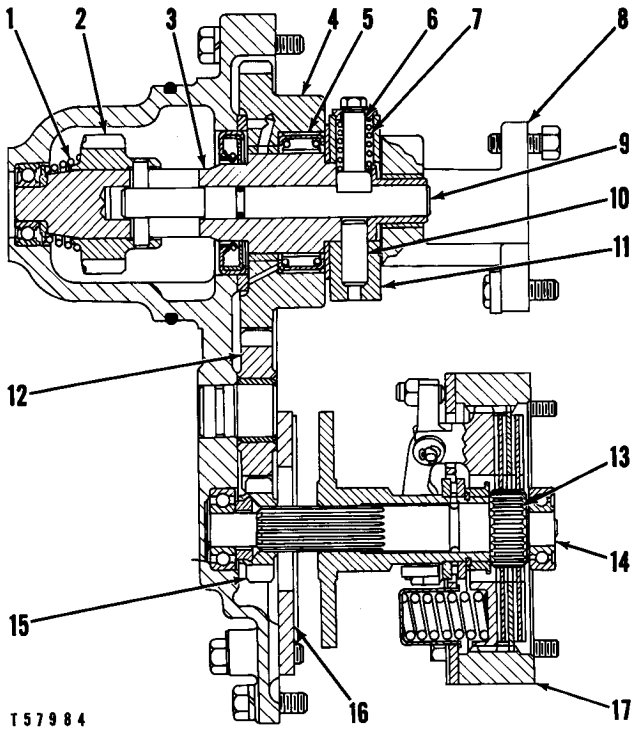
ADJUSTING BRAKE CONTROL
3–Nut. 4–Spring loaded linkage assembly.

NOTE

A 1/16 inch piece of shim stock can be soldered to a piece of copper tubing to make a suitable tool for checking the roller clearance.

Starting Mechanism

The starting engine transmits its power through a clutch and gears to a sliding pinion. The pinion is engaged with the diesel engine flywheel ring gear by a hand lever controlled linkage. When the diesel engine starts, the pinion is automatically released by the action of centrifugal force upon the pinion release plunger.



STARTING MECHANISM — RIGHT SIDE VIEW
(Later type illustrated)

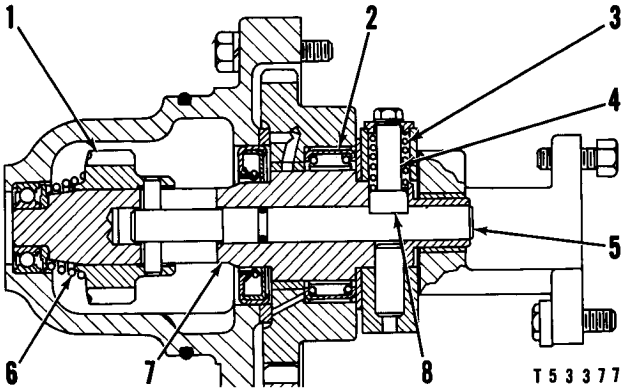
1–Pinion return spring.
2–Pinion (engaged position shown).
3–Pinion outer shaft.
4–Pinion shaft drive gear.
5–Overrunning clutch.
6–Plunger.
7–Spring.
8–Support bracket.
9–Pinion inner shaft.
10–Dowel.
11–Carrier.
12–Idler gear.
13–Clutch shaft gear.
14–Clutch shaft.
15–Starting mechanism drive gear.
16–Brake plate.
17–Clutch and flywheel assembly.

STARTER PINION

See the topic, CLUTCH, PINION AND BRAKE CONTROL MECHANISM OPERATION.

To engage the pinion **(1)**, the control lever is moved toward the front of the engine. This action causes the control linkage to contact the end of the pinion inner shaft **(5)**. Further movement of the control lever moves the inner shaft and pinion toward the rear and also compresses the pinion return spring **(6)**.

The inner shaft must be moved far enough into the outer shaft **(7)** to permit the plunger **(4)** to engage with the notch **(8)** cut in the inner shaft. The pinion is then engaged with the ring gear of the diesel engine flywheel. The plunger is held in the engaged position with the shaft by pressure exerted by the spring **(3)**. The plunger remains engaged with the pinion shaft until centrifugal force, acting on the plunger, overcomes the spring force holding the plunger in the notch. The return spring **(6)** then returns the pinion to the disengaged position.

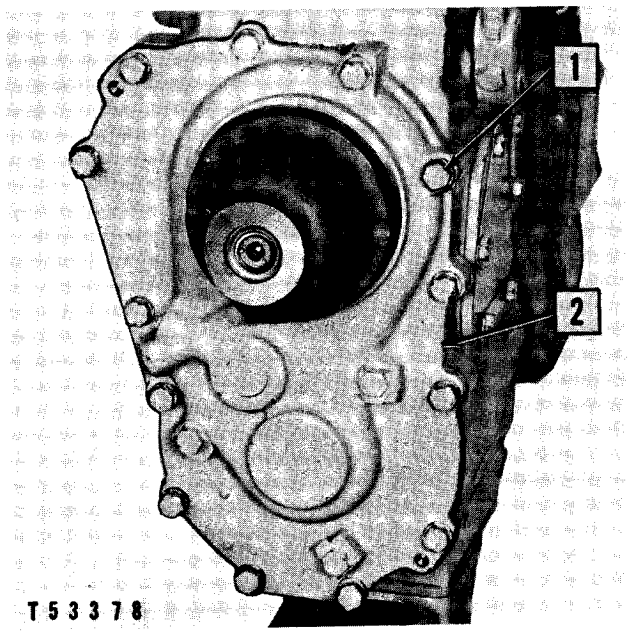


STARTER PINION MECHANISM

1–Pinion. 2–Overrunning clutch. 3–Spring. 4–Plunger. 5–Pinion inner shaft. 6–Pinion return spring. 7–Pinion outer shaft. 8–Notch.

An overrunning clutch **(3)** is located between the drive gear and the pinion outer shaft **(7)**. This clutch prevents the starting engine from being driven by the diesel engine. When the speed of the pinion shaft tends to exceed that of the gear assembly, the clutch overruns thus allowing movement relative to the two parts. This allows quicker acceleration of the diesel engine on starting and prevents any overspeeding of the starting engine prior to the plunger kick-out.

Removal and Installation

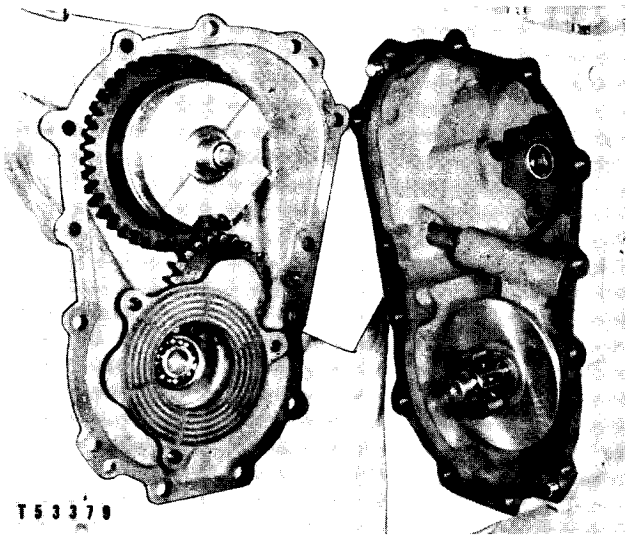


PREPARING TO REMOVE STARTER PINION HOUSING

☐ **Remove**

1–Bolts (thirteen). 2–Housing.

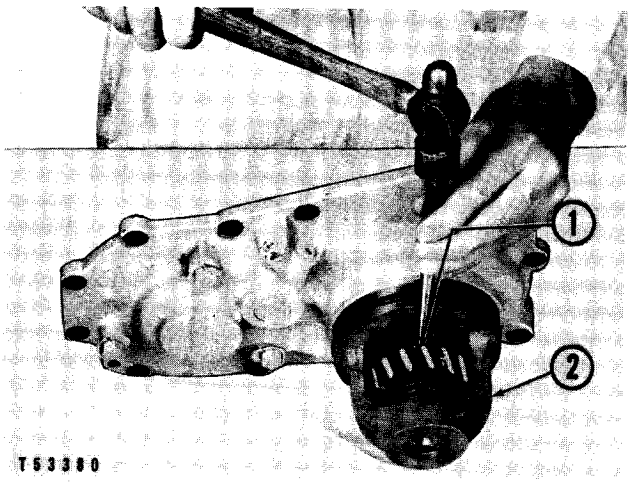
Remove the starting engine from the diesel engine. See the topic, STARTING ENGINE REMOVAL AND INSTALLATION.



STARTER PINION HOUSING REMOVAL

Disassembly and Assembly

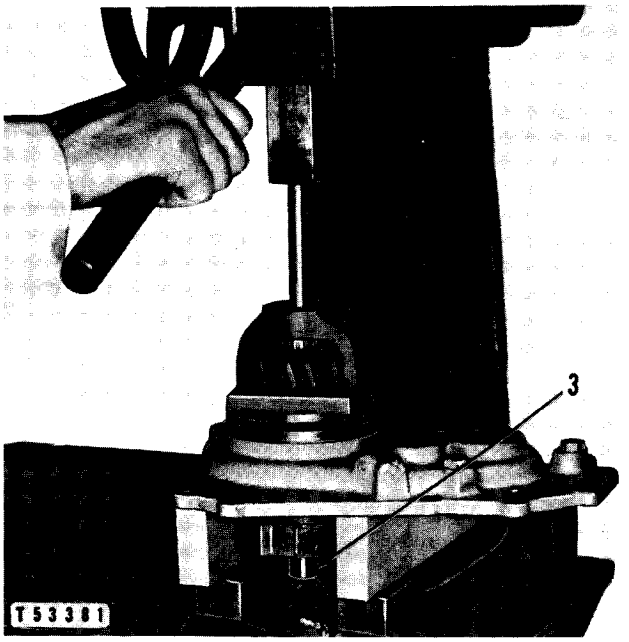
1. With the pinion inner shaft in the engaged position, drive the dowel **(1)** from the pinion and shaft, out through the hole in the back side of the pinion housing **(2)**.



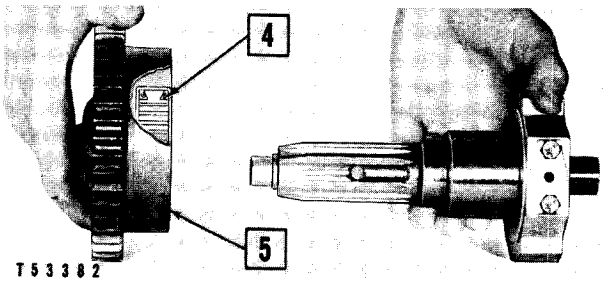
REMOVING PINION DOWEL
1–Dowel. 2–Pinion housing.

2. Block the assembly as shown. Using a suitable length of 5/8 inch bar stock, press the shaft assembly **(3)** from the bearing.

3. The carrier **(12)** and washer **(11)** can be removed from the pinion shaft by using a suitable punch to drive out the dowel which seccures the position of the carrier relative to the pinion shaft.



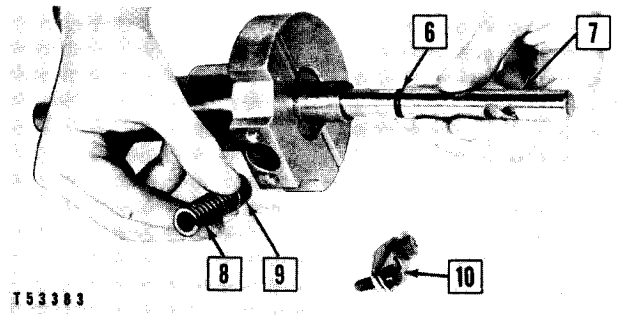
REMOVING SHAFT ASSEMBLY
3–Shaft assembly.



SHAFT DISASSEMBLY

☐ **Remove**

4–Overrunning clutch. 5–Gear.



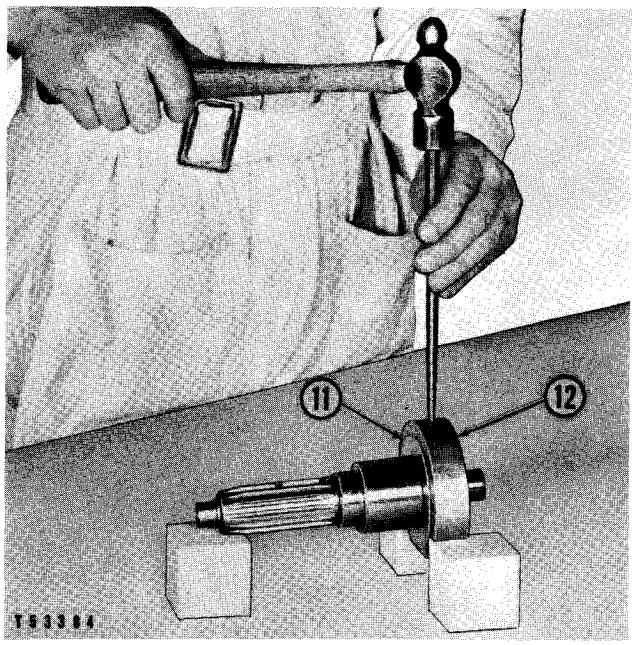
PINION RELEASE MECHANISM DISASSEMBLY

☐ **Remove**

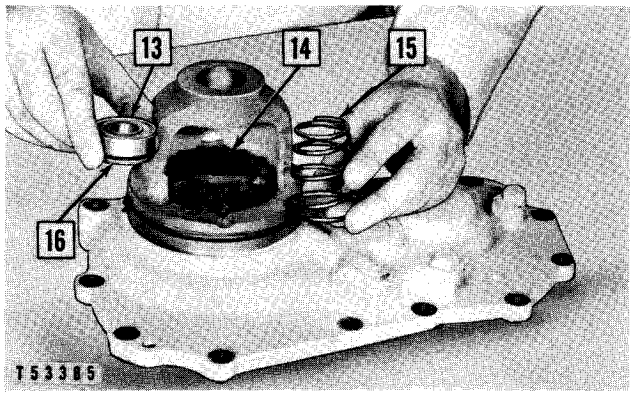
6–O-ring seal. 7–Pinion inner shaft. 8–Spring. 9–Plunger. 10–Cover, bolt and lock.

NOTE

On intermediate engines in which the washer **(16)** has a shoulder on one side only, the washer must be installed with the shoulder facing the bearing **(13)**.



CARRIER REMOVAL
11–Thrust washer. 12–Carrier.



PINION REMOVAL

☐ **Remove**

13–Bearing. 14–Pinion. 15–Pinion return spring. 16–Washer.

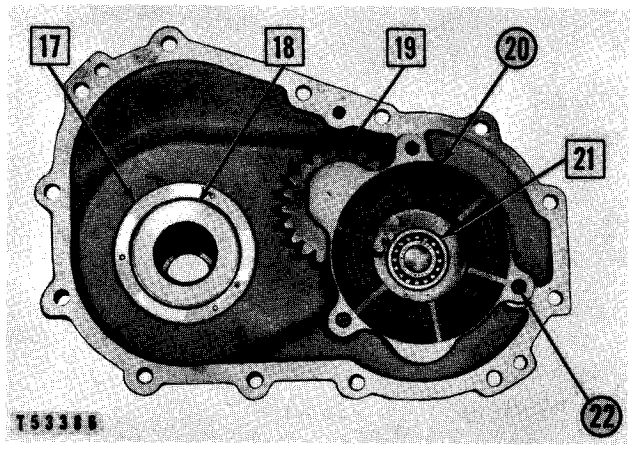
4. The brake plate **(20)** can be removed by removing the three bolts **(22)**.

5. If necessary, the idler gear shaft can be removed by pressing it from the pinion housing.

6. Inspect the inner race of the bearing **(13)** for damage after removing from the shaft. When installing the bearing, the shaft should be staked to the inner race in three places.

7. Inspect the springs **(8)** and **(15)**. See the topic, SPECIFICATIONS.

8. Thoroughly clean all parts and inspect for excessive wear or damage. Refer to the topic, SPECIFICATIONS, for permissible clearances.

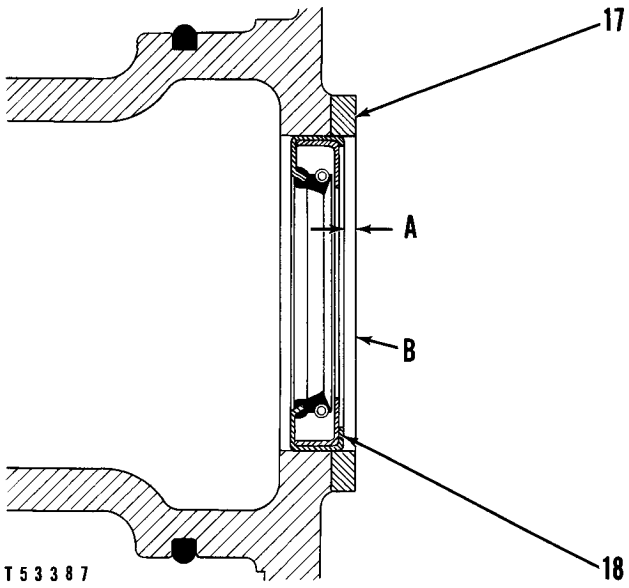


BRAKE PLATE, IDLER GEAR AND SEAL REMOVAL

☐ **Remove**

17–Thrust washer. 18–Seal. 19–Idler gear. 20–Brake plate. 21–Bearing. 22–Bolt (three).

9. Press the seal **(18)** into the pinion housing with the spring-loaded lip of the seal facing the overrunning clutch and gear assembly. Press the seal to the specified dimension **(A)** from face **(B)**.



INSTALLING SEAL
17–Thrust washer. 18–Seal. A–.12" Dimension B–Outer face of thrust washer.

CAUTION

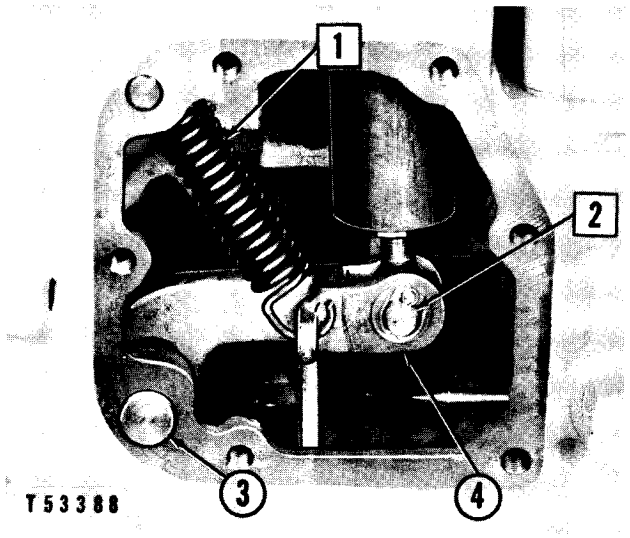
Assemble the overrunning clutch with the arrows on the gear and clutch pointing in the same direction.

STARTER PINION BRAKE

Removal and Disassembly

1. Remove the starter pinion housing. See the covering topic.

2. Remove the clutch compartment side cover.



PREPARING TO REMOVE CLUTCH BRAKE

☐ **Remove**

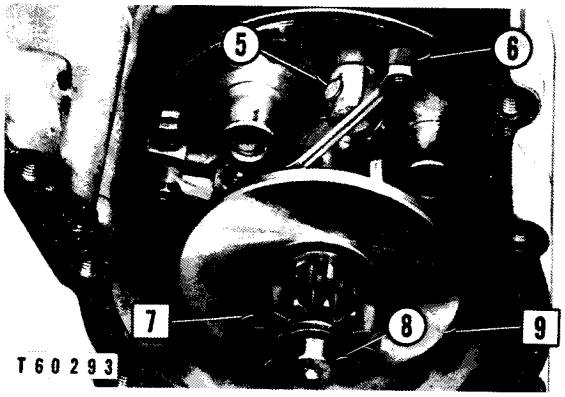
1–Spring. 2–Cotter pin, washer and pin. 3–Shaft. 4–Yoke assembly.

3. Drive out the shaft **(3)** and remove the yoke assembly **(4)**.

4. Remove the pins **(5)** that secure the clutch release levers **(6)** to the clutch plate and remove the levers.

NOTE

Intermediate engines used a lock ring to retain gear on shaft **(8)**. The gear and lock ring must be removed before collar assembly **(9)** can be removed.



COLLAR ASSEMBLY REMOVAL
(Later type illustrated)

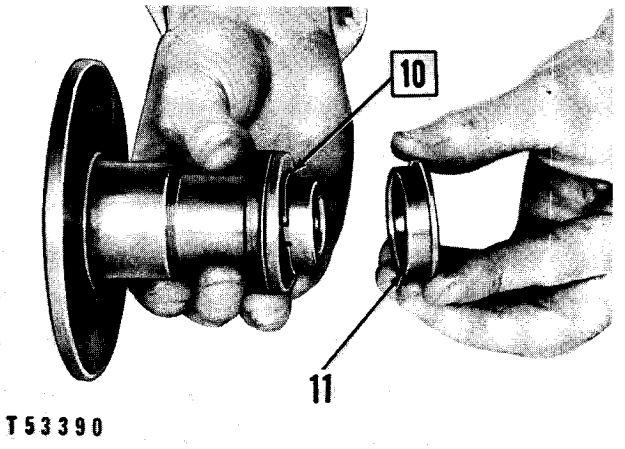
☐ **Remove**

5–Pins (three). 6–Release levers (three). 7–Drive gear. 8–Clutch shaft. 9–Collar assembly.

5. Press the retainer **(11)** from the collar assembly.

CAUTION

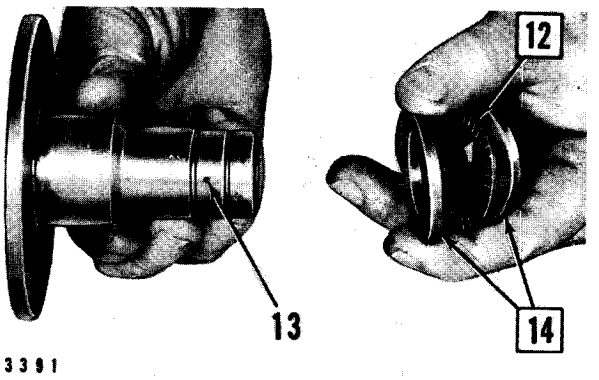
Do not press against the thrust washer to remove the retainer.



DISASSEMBLING COLLAR ASSEMBLY

☐ **Remove**

10–Lock ring. 11–Retainer.



DISASSEMBLING COLLAR ASSEMBLY

☐ **Remove**

12–Bearing. 13–Oil passage. 14–Thrust washer.

6. Inspect the thrust washers **(14)**, bearing **(12)** and the collar assembly. Replace any damaged or worn parts.

7. Inspect and clean the oil passage **(13)** to remove any foreign particles.

8. Assemble in the reverse order of disassembly.

9. Press the retainer **(11)** onto the collar assembly until the end of the retainer is flush with the end of the collar assembly. For the proper end clearance of the bearing, see the topic, SPECIFICATIONS. The bearing **(12)** must spin free on the clutch shaft.

CAUTION

When installing the retainer **(11)** onto the collar assembly, guide the lock ring **(10)** into the counterbore in the retainer.

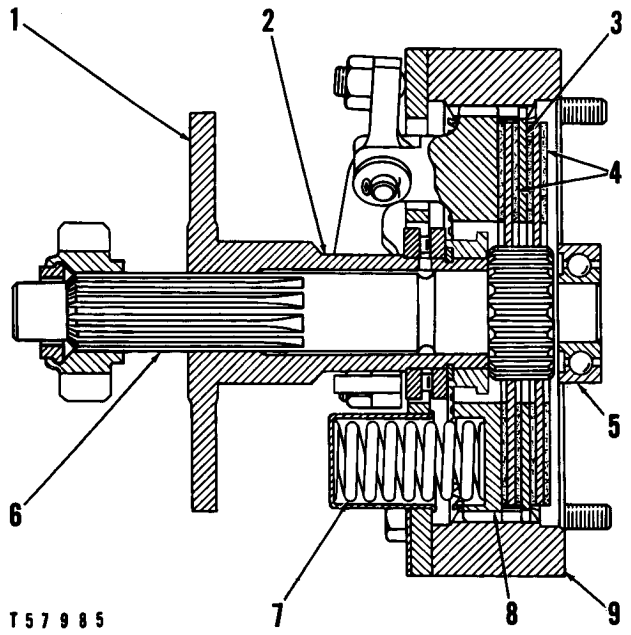
10. Complete the installation.

11. Adjust the clutch. See the covering topic.

CLUTCH

Operation

The starting engine clutch is the automotive oil-type with two outer discs **(4)** and one inner disc **(3)**. Power is transmitted from the flywheel **(9)** to the plate **(8)** and inner disc **(3)**. When the clutch is engaged, the springs **(7)** force the discs together, and power is transmitted to the clutch shaft **(6)** through the discs **(4)**.



CLUTCH OPERATION
(Later type illustrated)

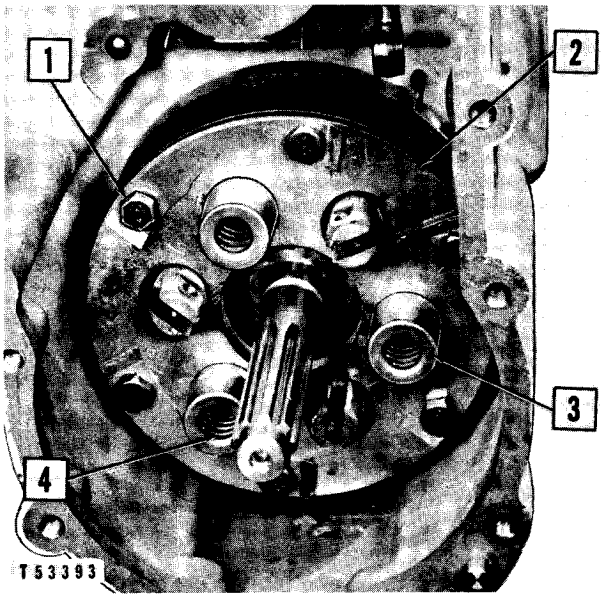
1–Brake pressure plate. 2–Clutch release collar. 3–Clutch inner disc. 4–Clutch outer discs. 5–Bearing. 6–Clutch shaft. 7–Spring. 8–Plate. 9–Flywheel.

When the clutch is disengaged, the clutch release collar **(2)** is moved toward the rear. The brake pressure plate **(1)** contacts the lined brake plate, which is mounted in the pinion housing. The engaging of these two components stops the clutch shaft from rotating.

Bearing **(5)** pilots the clutch in the crankshaft flange.

Removal and Installation

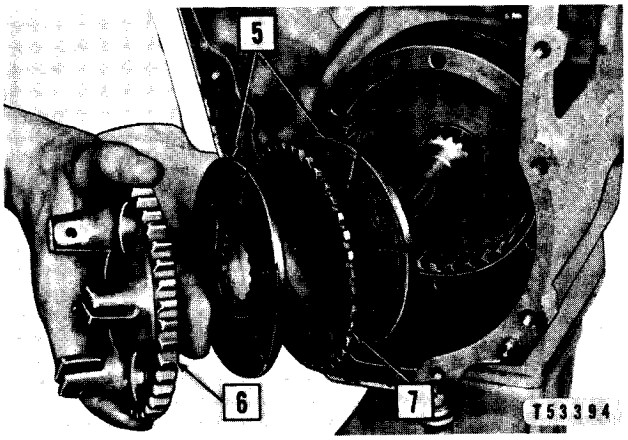
1. Remove the starter pinion brake assembly. See the covering topic.
2. Inspect the springs **(4)**. See the topic, SPECIFICATIONS.
3. If the bearing **(10)** is to be replaced, install it with the shielded side toward the crankshaft.
4. Inspect all parts for wear or damage and replace if necessary.



PREPARING TO REMOVE CLUTCH

☐ **Remove**

1–Bolt (six). 2–Retainer plate. 3–Clutch spring retainer (three). 4–Clutch spring (three).



PRESSURE PLATE AND CLUTCH DISC REMOVAL

☐ **Remove**

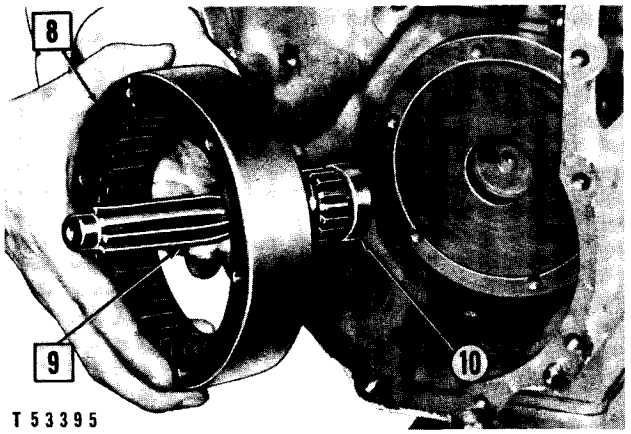
5–Outer discs (lined). 6–Pressure plate. 7–Inner disc (unlined).

5. If new clutch outer discs **(5)** are to be installed, soak in oil.

NOTE

When installing the clutch pressure plate **(6)** and the retaining plate **(2)** align the marks on the pressure plate and retaining plate with the alignment mark on the flywheel.

6. Complete the installation.
7. Adjust the clutch. See the covering topic.



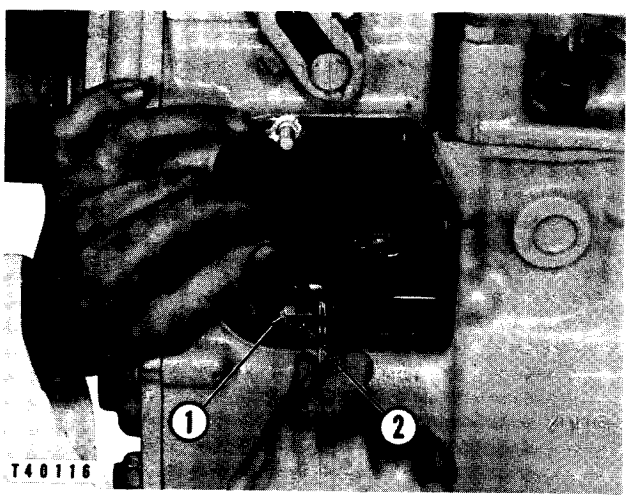
FLYWHEEL AND CLUTCH SHAFT REMOVAL

☐ Remove

8–Flywheel. 9–Clutch shaft. 10–Bearing.

Clutch Adjustment

1. With the side cover removed from the starting engine cylinder block, engage the clutch.
2. Slide the clutch release collar assembly as far forward as possible toward the crankshaft until the collar butts on the spline of the clutch shaft.
3. Loosen the locknuts **(2)** on the setscrews **(1)**.

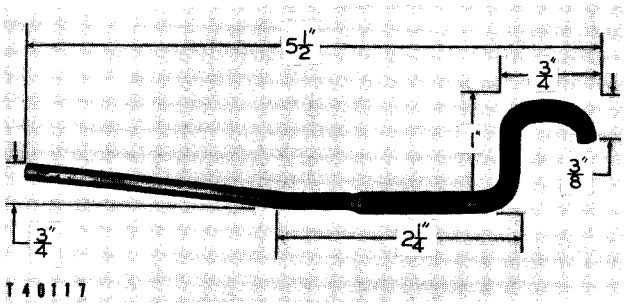


CLUTCH ADJUSTMENT
1–Setscrew. 2–Locknut.

4. With the tips of the clutch release arms against the thrust washer, adjust the setscrews until the specified clearance between the setscrews and and the clutch retainer plate is obtained. See the topic, SPECIFICATIONS.

NOTE

Clutch adjustment is simplified if a 3/16 inch hexagonal wrench of the dimensions shown is used.



CLUTCH ADJUSTMENT TOOL

5. Tighten the locking nuts and recheck the adjustment.

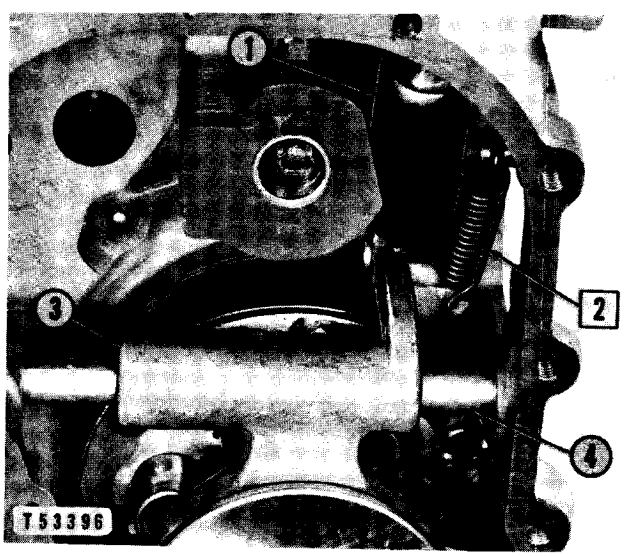
CLUTCH, PINION AND BRAKE CONTROL MECHANISM

Operation

The clutch and brake engagement and disengagement and the starter pinion engagement is controlled by a single control lever.

When the control lever is toward the rear, or pinion end of the starting engine, the clutch is engaged, the brake disengaged, and the pinion disengaged from the diesel engine ring gear. As the control lever is moved forward, the brake is engaged. At the extreme forward position, the brake is fully engaged, and the pinion is engaged with the diesel engine flywheel ring gear. As the control lever is moved to the rear, the brake is disengaged and the clutch is engaged; the starting engine pinion rotates the diesel engine ring gear.

Removal and Installation

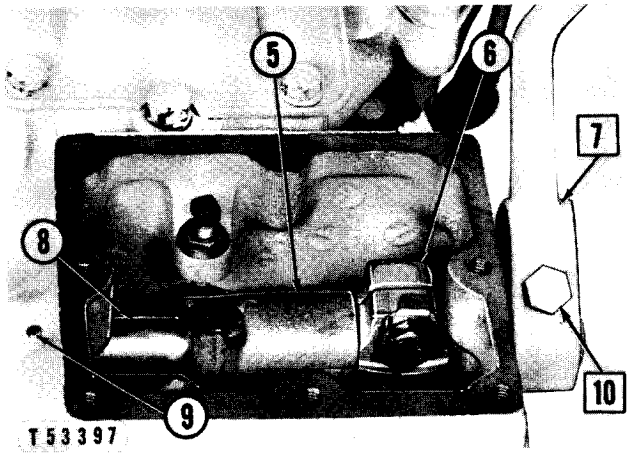


PREPARING TO REMOVE CONTROL MECHANISM

☐ Remove

1–Linkage assembly. 2–Spring. 3–Yoke assembly. 4–Shaft.

1. Remove the starter pinion housing. See the covering topic.
2. Remove the clutch compartment top and side covers.
3. Remove the linkage assembly **(1)** by removing the pins at either end of it.
4. Drive out the shaft **(4)** and remove the yoke assembly **(3)**.



CONTROL MECHANISM REMOVAL

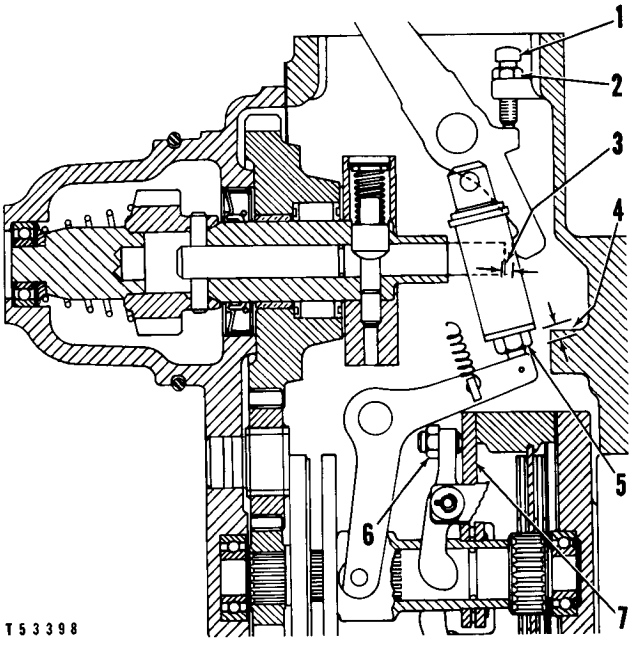
☐ **Remove**

5–Lever. 6–Lever. 7–Lever. 8–Shaft. 9–Dowel. 10–Bolt.

5. Loosen the bolts that secure the levers **(5)** and **(6)** to the shaft **(8)**.
6. Remove the dowel **(9)** by pressing it on out through the housing and remove the shaft **(8)**.
7. Inspect all parts for wear or damage and replace if necessary.
8. Install in the reverse order of removal and adjust the mechanism as outlined in the covering topic.

Clutch Brake and Pinion Adjustment

1. Engage the starting engine clutch.
2. Remove the top and side covers from the cylinder block.
3. Through the opening in the top of the housing, loosen the locknut **(2)** and turn the screw **(1)** until the pinion engagement lever touches the shaft and there is no clearance at **(3)**. To obtain the correct clearance at **(3)** turn the screw **(1)** counterclockwise one and one-half turns. Tighten the locknut **(2)**.



CLUTCH BRAKE AND PINION ADJUSTMENT

1–Screw. 2–Locknut. 3–Clearance. 4–Free travel. 5–Locknut. 6–Adjusting screw. 7–Retainer plate.

4. Rotate the crankshaft as required to move the flywheel and clutch to a position where a thickness gauge can be placed between the spherical head of the adjusting screw **(6)** and the plate **(7)** to remove only the clearance of the clutch arms.
5. Move the starter pinion and clutch control lever from the engaged position upward until spring resistance is encountered, and measure the vertical travel **(4)** of the linkage assembly. For the correct vertical travel or play of this linkage, see the topic, SPECIFICATIONS.
6. The vertical travel **(4)** can be adjusted by turning the locknut **(5)** clockwise to decrease or counterclockwise to increase the amount of linkage assembly travel.

ISSUED 4-64

POWER TRANSMISSION UNITS

TABLE OF CONTENTS

NOTE: The use of the explanatory information — "☐ Remove" and "◗ Disconnect" — below each illustration is being discontinued. The symbols, which appear in some groups and not in others, are explained in the Service Manual General Instructions, Group 1A-5-30.

POWER TRANSMISSION UNITS

INDEX

Specifications

Universal Joint

Bolt torque, bearing cap to transmission upper shaft	35 - 45 lb. ft.
Bolt torque, bearing cap to flywheel clutch shaft flange	35 - 45 lb. ft.
Bolt torque, bearing cap to drive shaft	35 - 45 lb. ft.

Flywheel Clutch

Pounds pull required to engage	50 - 60
Adjusting locknut torque	30 lb. ft.
Brake loading spring dimension (see text)	3.44 in.
Dimension from centerline of flywheel clutch control lever to front edge of battery box with clutch engaged (see text)	2.62 in.

Transmission

Bearing race to idler gear press fit, tons	5 - 10
Idler gear bearing end clearance	.002 in. loose—.002 in. tight
Pinion shaft rear race projection beyond transmission case	.31 in.
Dimension from face of the transmission case to face of shifter lever (see text)	2.22 in.
Dimension from center of pin to shoulder of rod on interlock linkage (see text)	4.656 in.

Bevel Gear

Bevel gear and pinion backlash as marked on bevel gear or	.008 - .010 in.
Bevel gear bearing preload:	
Shims to be removed after end clearance take up, approximately	.022 in.
Or, torque to rotate	7 - 8 lb. ft.
Bevel gear to shaft retaining bolt, nut torque	118 - 142 lb. ft.
Steering clutch drive coupling to bevel gear shaft press fit, tons	20 - 25
Dimension between face of drive coupling and shoulder on bevel gear when pressed on with 20-25 tons force	.094 - .156 in.
Steering clutch drive coupling to bevel gear shaft retaining bolt torque	500 - 600 lb. ft.

Steering Clutch

Pressure plate bearing minimum inside diameter	2.370 in.
Bevel gear shaft diameter at pressure plate bearing	2.362 - 2.363 in.
Clearance between bevel gear shaft and pressure plate bearing (minimum)	.007 in.
Permissible clearance	.020 in.
Clearance between the face of the steering clutch inner drum hub and the shoulder on the clutch shaft (see text)	.094 - .156 in.
Clutch springs:	
Outer:	
Pounds force	199.5 - 220.5
When compressed to	4.53 in.
Inner:	
Pounds force	118.5 - 131.5
When compressed to	4.22 in.
Steering clutch inner drum to clutch shaft press fit, tons	15 - 20
Steering clutch:	
Over-all width of 12 new lined plates and 12 driving discs	3.232 - 3.480 in.
Minimum over-all width of 12 lined plates and 12 driving discs (worn)	2.938 in.

Steering Clutch Hydraulic Control

Hydraulic pump:	
Mounting location — Bottom side of steering clutch hydraulic control	
Type	Gear
Capacity at 600 RPM with discharge pressure of 300 PSI	2.5 GPM
Adjustments:	
Steering clutch control levers free movement	3.75 in.
Clearance between actuating lever and cylinder with steering clutch lever in engaged position	.19 in.
Clearance between steering clutch control rod and push rod at front end of steering clutch hydraulic control with steering clutch in engaged position	.02 in.

Brakes

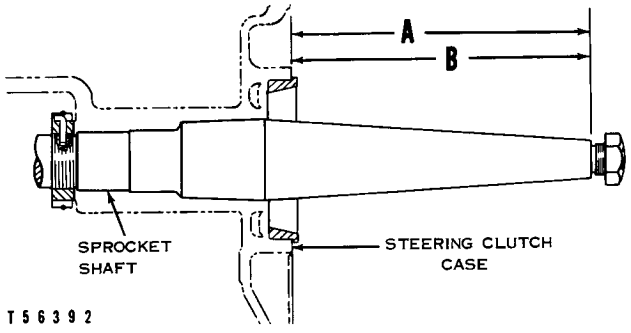
Adjustment:	
Pedal travel	4.5 - 5.5 in.
Turns to back off support screw beneath case	1.5
Brake pedal control rod, distance between the centers of the holes in the rod ends (see text)	18.79 - 18.83 in.
Turns to back off adjusting nut	3

Final Drive

Flange-to-final drive pinion press fit, tons	25 - 30
Dimension between face of flange and the shoulder of the pinion shaft when pressed on to 25-30 tons	.09 - .16 in.
Sprocket-to-hub press fit, tons	35 - 40
Dimension between face of sprocket hub and the end of the splines on the final drive hub when pressed on to 35-40 tons	.06 - .19 in.
Final drive gear to hub retaining bolt torque	210 - 250 lb. ft.
Final drive bearing adjusting nut torque, with a force of 180-240 lbs. on the end of a five foot extention on the 7F9306 Spanner Wrench	900 - 1200 lb. ft.
Shaft must be straight within	1/8 in.
Sprocket shaft nut torque	500 - 600 lb. ft.

Dimension from shoulder on sprocket shaft to machined face of steering clutch and bevel gear case:

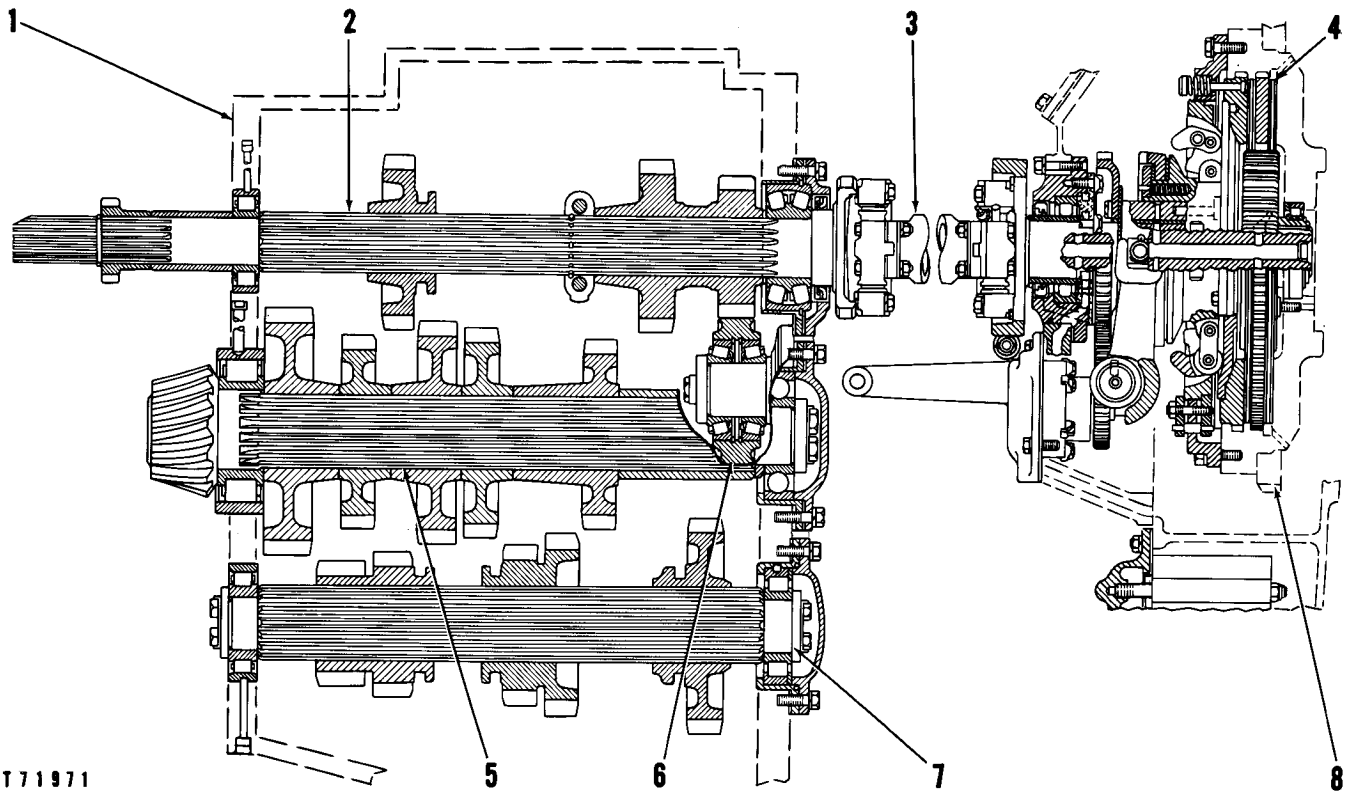
A—60″ gauge machines	15 5/32 in.
B—74″ gauge machines	22 5/32 in.



DIMENSIONS WITH SPROCKET SHAFT PROPERLY INSTALLED

A–Dimension from shoulder on sprocket shaft to machined face of steering clutch and bevel gear case (60″ gauge machines). B–Dimension from shoulder on sprocket shaft to machined face of steering clutch and bevel gear case (74″ gauge machines).

OPERATION



POWER FLOW

1–Transmission. 2–Upper shaft. 3–Universal joint. 4–Flywheel clutch. 5–Bevel pinion shaft. 6–Forward idler gear. 7–Countershaft. 8–Flywheel.

Power from the diesel engine is transmitted by flywheel **(8)** through flywheel clutch **(4)** and universal joint **(3)** to the sliding gear transmission **(1)**. For a detailed discussion of the flywheel clutch operation see the covering topic.

From the transmission upper shaft **(2)**, power is transmitted through forward idler gear **(6)** and countershaft **(7)** to bevel pinion shaft **(5)** to provide four forward and four reverse speeds. A fifth speed forward results from a flow of power directly to the bevel pinion shaft from the upper shaft. The splined rear end of shaft **(2)** can be used as a power take-off shaft.

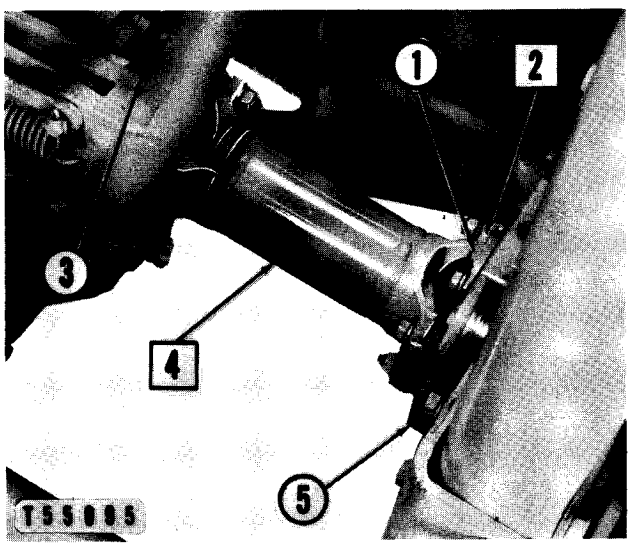
Gear selection and direction is accomplished by two transmission shift levers which are used in conjunction with the flywheel clutch control lever. See the topic, TRANSMISSION INTRODUCTION, for a detailed description of transmission operation.

From the bevel pinion shaft, the power is transmitted through the bevel gear to the steering clutches, then through the final drives to the tracks.

Universal Joint

REMOVAL AND INSTALLATION

1. Remove the floor plates.
2. With the transmission in neutral and the flywheel clutch disengaged, rotate the universal joint as necessary and remove the bolts **(2)** securing the bearing caps **(1)** to the transmission upper shaft flange **(3)** and flywheel clutch shaft flange.
3. Slide the clutch shaft **(5)** forward and remove the universal joints and drive shaft **(4)** as a unit.



UNIVERSAL JOINT REMOVAL

☐ **Remove**

1–Bearing caps. 2–Bolts. 3–Transmission upper shaft flange. 4–Drive shaft. 5–Flywheel clutch shaft flange and brake drum.

NOTE

Do not cut the small metal straps securing the bearing caps to the spider. If they are cut or missing, temporarily fasten the bearing caps to the universal joint to prevent them from sliding off or dirt entering the bearings.

4. Install the universal joint in the reverse order of removal.
5. Tighten the bolts **(2)** to the torque value as given in the topic, SPECIFICATIONS.

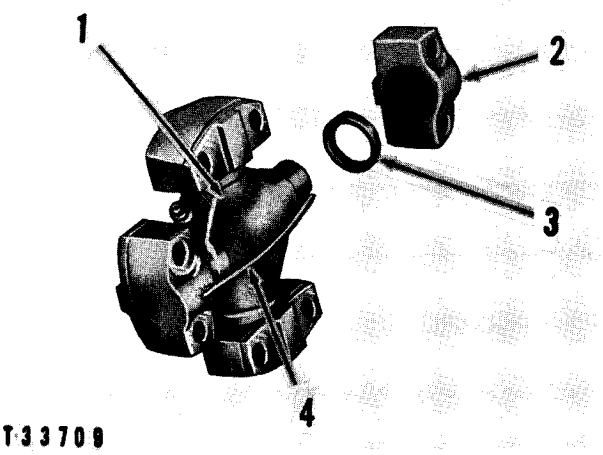
DISASSEMBLY

1. Remove the bolts which secure the bearings to the drive shaft.
2. Remove the strap **(4)** from both of the bearings **(2)** with a small chisel.

NOTE

The small straps connecting the bearing caps on each of the spider and bearing assemblies prevent the bearing caps from falling off the spider during installation and removal from the tractor. These straps should not be welded to the bearing caps after the unit has been assembled.

3. Remove the bearing **(2)** and seals **(3)** from the spider **(1)**.
4. Inspect the spider journal bearing surfaces for roughness or needle bearing grooves.



UNIVERSAL JOINT (EXPLODED VIEW)
1–Spider. 2–Bearing. 3–Seal. 4–Strap.

5. Carefully inspect each bearing for wear and for broken or missing needle bearings.
6. Replace the spider and bearing assembly if either the spider or the bearings show excessive wear.
7. Light brinelling of the spider bearing area is not harmful.

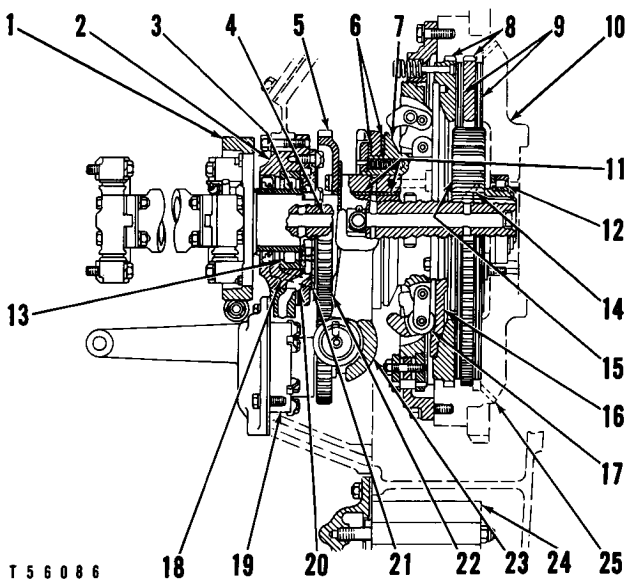
Flywheel Clutch

OPERATION AND LUBRICATION

The oil clutch transmits torque from the diesel engine flywheel **(10)** to the transmission input shaft. When the clutch is engaged, the clutch actuating mechanism forces the pressure plates **(8)** and driven disc assemblies **(9)** together to rotate as a unit. The clutch is maintained in the engaged position by the over-center cam action of the cam link and roller assemblies **(17)** against the clutch loading plate **(16)**.

When the flywheel clutch control lever is moved to the disengaged position, the yoke assembly **(23)**, sliding collar assembly **(7)** and cam link and roller assemblies **(17)**, move away from the clutch loading plate **(16)**. This allows the diesel engine flywheel **(10)** and pressure plates **(8)** to rotate relative to the driven disc assemblies **(9)**, clutch hub **(15)** and clutch shaft **(3)**.

After the clutch is disengaged, rotation of the drive shaft and clutch shaft can be stopped by moving the flywheel clutch control lever forward. This action moves a brake shoe, which is mounted on a spring loaded lever, in contact with the brake drum **(1)**, which is bolted to the clutch shaft.



FLYWHEEL CLUTCH OPERATION AND LUBRICATION

1–Brake drum
2–Bearing cage.
3–Clutch shaft.
4–Oil passage in clutch shaft.
5–Oil pump drive gear.
6–Thrust washers.
7–Sliding collar assembly.
8–Pressure plates.
9–Driven disc assemblies.
10–Diesel engine flywheel.
11–Loading plate bearings.
12–Pilot bearing.
13–Clutch shaft rear bearing.
14–Oil passage in clutch hub.
15–Clutch hub.
16–Clutch loading plate.
17–Cam link and roller assembly.
18–Oil return passage in bearing cage.
19–Oil pump.
20–Oil inlet passage in bearing cage.
21–Rear bearing retainer.
22–Oil pump driven gear.
23–Yoke assembly.
24–Oil pump screen.
25–Oil drain holes in flywheel.

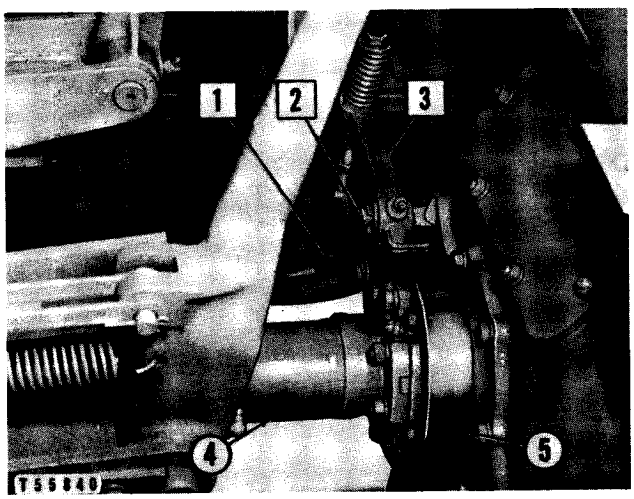
A single-section gear-type pump **(19)** provides pressure oil for lubrication and cooling of the oil clutch. The oil pump is mounted on the flywheel clutch cover assembly. The pump is always in operation when the diesel engine is running. Oil is supplied to the pump from the bottom of the flywheel housing through the screen **(24)** and a passage in the flywheel clutch housing. After the oil passes through the pump, it is forced through the passage **(20)** to the drilled passage **(4)** in the clutch shaft. An oil drain-back passage **(18)** prevents the build-up of pressure oil against the seal at the rear of the flywheel clutch housing.

The pilot bearing **(12)** is lubricated by oil which seeps past the spline on the clutch shaft and clutch hub. The pressure plates **(8)** and driven disc assemblies **(9)** are cooled by oil which is thrown by centrifugal force of the rotating clutch shaft and hub. The oil then passes through passages **(25)** in the flywheel and returns to the bottom of the flywheel housing where the lubrication cycle is repeated.

CLUTCH BRAKE

Removal and Disassembly

1. Remove the floor plates.

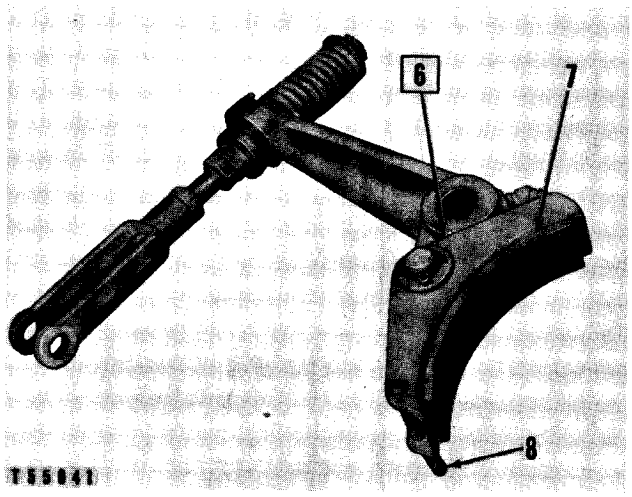


PREPARING TO REMOVE CLUTCH BRAKE

☐ **Remove**

1–Pin. 2–Cotter pin. 3–Lever assembly. 4–Drive shaft. 5–Brake drum.

2. The brake drum **(5)** can be removed after the drive shaft **(4)** has been removed and the four bolts which secure the brake drum to the clutch shaft have been removed.
3. The facing **(7)** can be removed after the four rivets which secure it to the shoe assembly have been removed.



PREPARING TO DISASSEMBLE CLUTCH BRAKE

☐ **Remove**

6–Shoe assembly. 7–Facing. 8–Pin.

4. Assemble and install in the reverse order of removal.

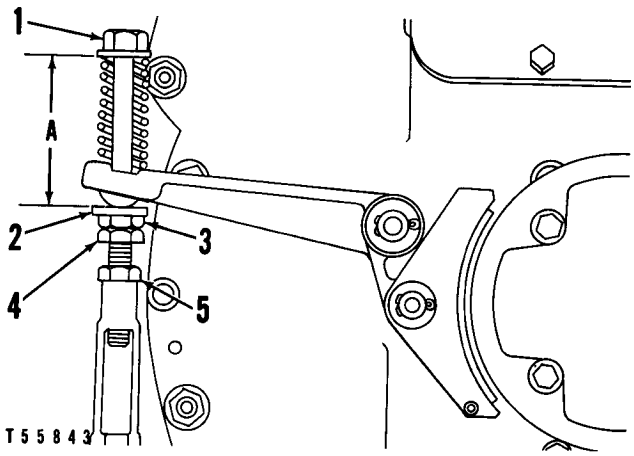
NOTE

Make certain the pin **(8)** on the shoe assembly **(6)** is engaged with the aligning hole in the cover assembly.

5. See the topic, CLUTCH BRAKE ADJUSTMENT, for the correct adjustment procedure.

Clutch Brake Adjustment

1. Place the flywheel clutch control lever in the disengaged position.
2. Loosen the locknut **(4)** and move the nut **(3)** in the direction to obtain the dimension **(A)** given in the topic, SPECIFICATIONS. Secure the locknut **(4)**.



CLUTCH BRAKE ADJUSTMENT
1–Adjusting bolt. 2–Washer. 3–Adjusting nut. 4–Locknut. 5–Locknut. A–Brake loading spring dimension.

NOTE

The dimension **(A)** to be measured is the distance from the top of the spring to the top of the washer **(2)**.

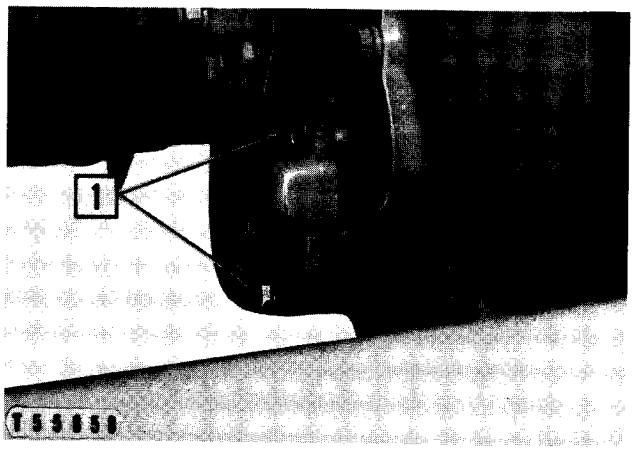
3. Loosen the locknut **(5)** and, with the flywheel clutch control lever in the most forward position, turn the adjusting bolt **(1)** until the brake facing just touches the brake drum.
4. Release the flywheel clutch control lever and turn the adjusting bolt two complete revolutions in a clockwise direction.
5. Secure the locknut **(5)**.

OIL PUMP

Removal and Installation

NOTE

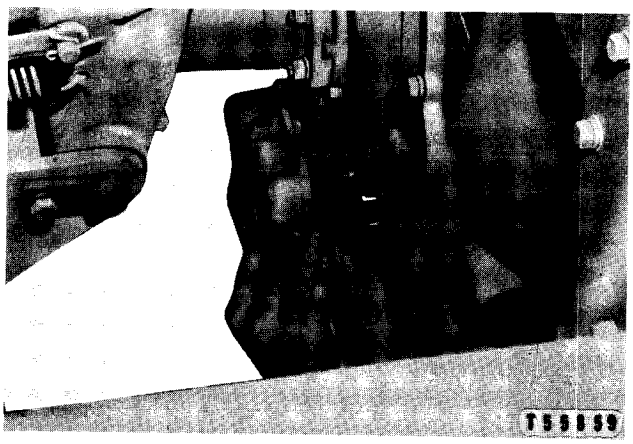
The oil pump can be removed from either the top or bottom of the tractor, whichever is the most convenient.



PREPARING TO REMOVE OIL PUMP

☐ **Remove**

1–Bolts (five).



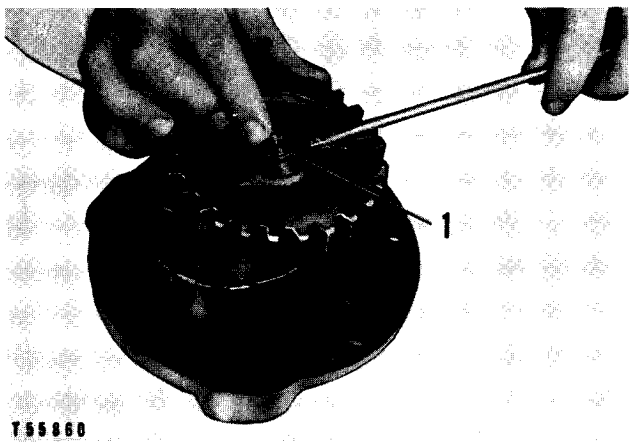
REMOVING OIL PUMP

Move the oil pump toward the rear of the tractor until the pump driven gear is clear of the flywheel clutch cover assembly, and remove the oil pump as shown.

Use a new gasket at the time of installation.

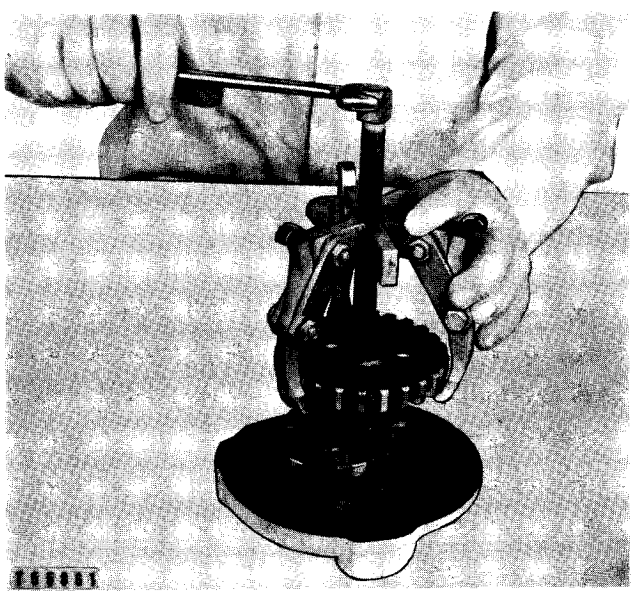
Disassembly and Assembly

1. Remove the outer retaining ring from the oil pump drive shaft **(1)** as shown.



PREPARING TO DISASSEMBLE OIL PUMP
1–Oil pump drive shaft.

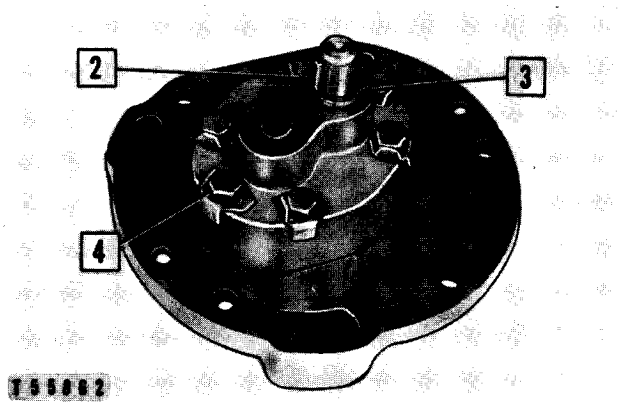
2. Using an 8H695 Puller, pull the driven gear from the oil pump drive shaft **(1)** as shown.



REMOVING DRIVEN GEAR

3. Lift the pump body assembly and gears from the support assembly.

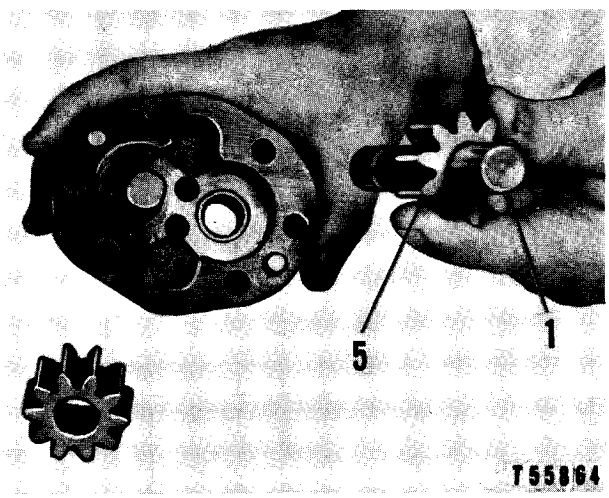
4. Remove the pump drive shaft **(1)** and gear from the pump body as shown.



PREPARING TO REMOVE PUMP BODY ASSEMBLY

☐ **Remove**

2–Key. 3–Retaining ring. 4–Bolts (six).



REMOVING DRIVE SHAFT AND GEAR
1–Oil pump drive shaft. 5–Gear.

5. Inspect the bearings in the support assembly and the oil pump body and replace if worn.

6. To remove the gear **(5)** from the shaft **(1)**, remove the retaining rings on either side of the gear and press the shaft out of the gear.

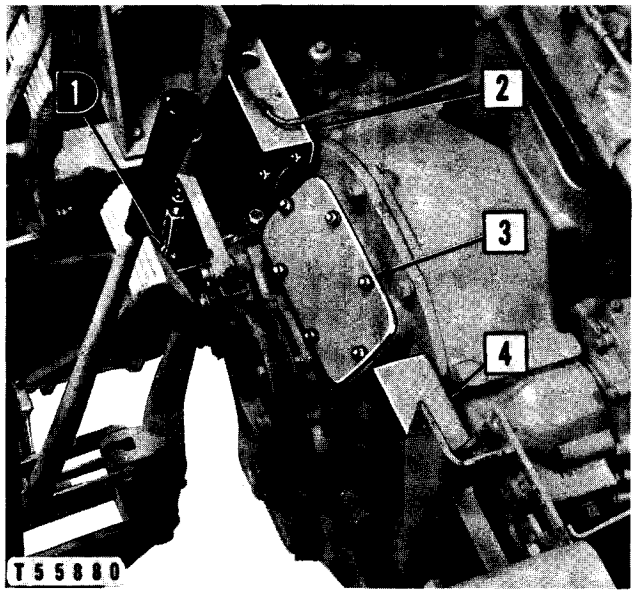
7. Assemble in the reverse order of disassembly.

CAUTION

The pump must rotate freely by hand. If it does not it must be disassembled to correct the cause of binding.

CLUTCH REMOVAL AND INSTALLATION

1. Remove the floor plates.
2. Remove the drive shaft.
3. Remove the dash.
4. Drain the oil from the flywheel housing.

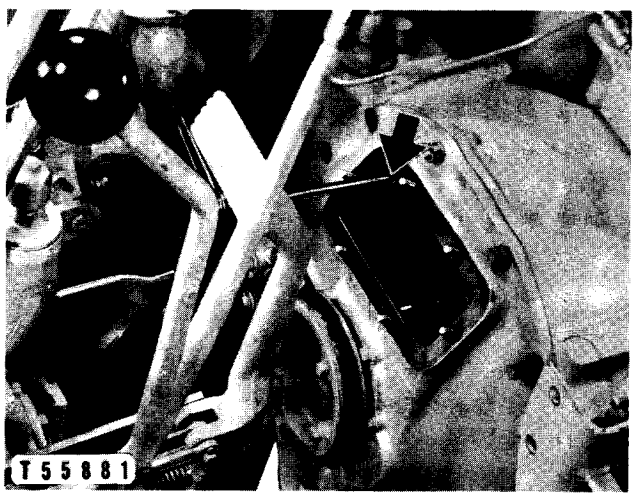


PREPARING TO REMOVE FLYWHEEL CLUTCH

☐ **Remove** ◗ **Disconnect**

1–Clutch lever. 2–Bracket. 3–Cover. 4–Bracket.

5. Remove the eight bolts which secure the adjusting ring bracket to the flywheel as shown.



REMOVING ADJUSTING RING BRACKET RETAINING BOLTS

6. Attach a chain and suitable hoist to the top two studs at the inspection cover opening.

NOTE

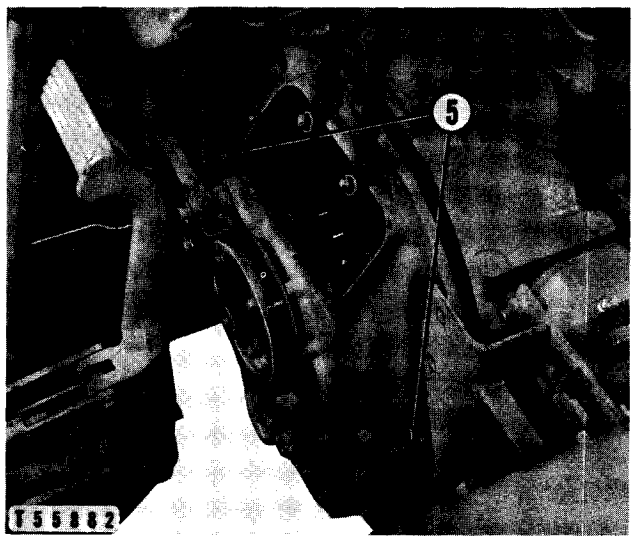
The flywheel clutch weighs approximately 200 lbs.

7. Remove the nuts which secure the flywheel clutch cover assembly to the flywheel housing.

NOTE

It may be necessary to use 1/2" - 13 (NC) forcing screws to remove the adjusting ring bracket from the recess in the flywheel.

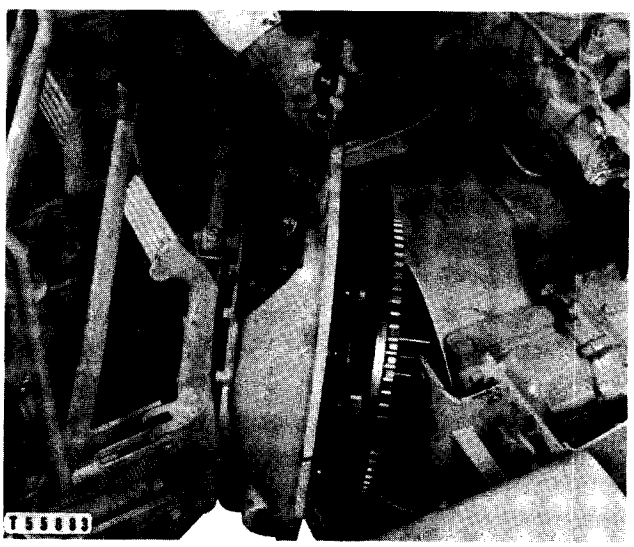
8. Install two 3/8" - 16 (NC) forcing screws **(5)** in the cover assembly as shown.



PREPARING TO REMOVE FLYWHEEL CLUTCH AND COVER ASSEMBLY

5–Forcing screws.

9. Remove the flywheel clutch and cover assembly as shown.

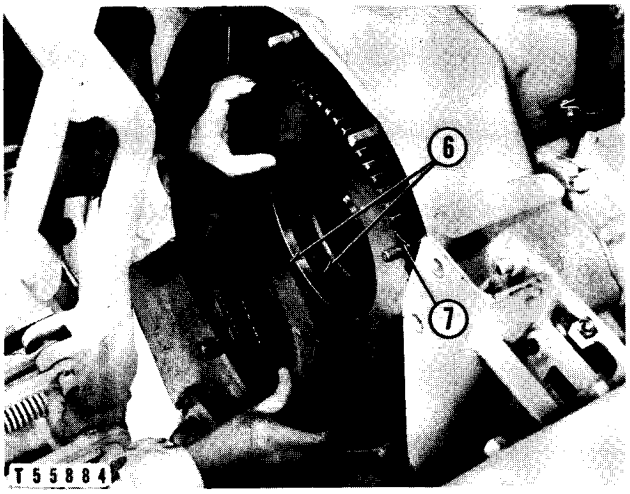


REMOVING FLYWHEEL CLUTCH AND COVER ASSEMBLY

CAUTION

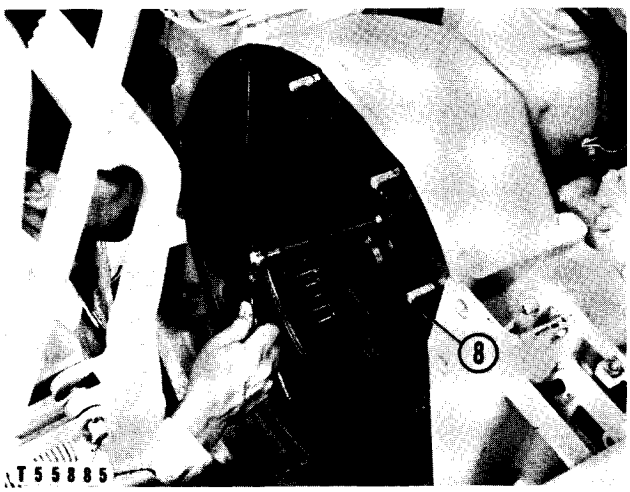
Secure the clutch and disc assembly to the cover assembly to prevent the clutch assembly from sliding off the clutch shaft.

10. Remove the disc assemblies **(6)** and pressure plate **(7)** as shown.

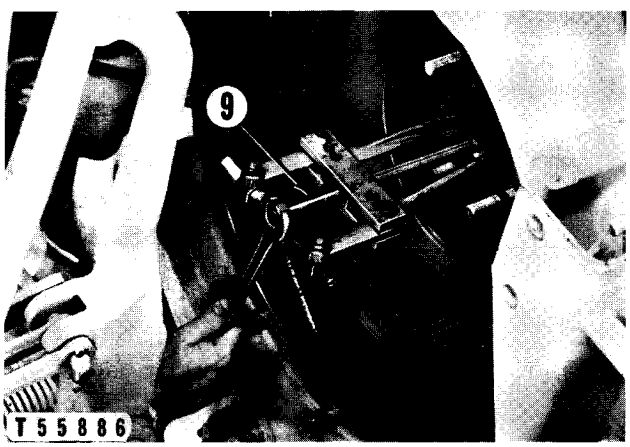


REMOVING DISC ASSEMBLIES AND PRESSURE PLATE
6–Disc assemblies. 7–Pressure plate.

11. The flywheel clutch hub **(8)** can be removed from the flywheel after removal of the three retaining bolts.



RETAINING BOLT REMOVAL
8–Flywheel clutch hub.



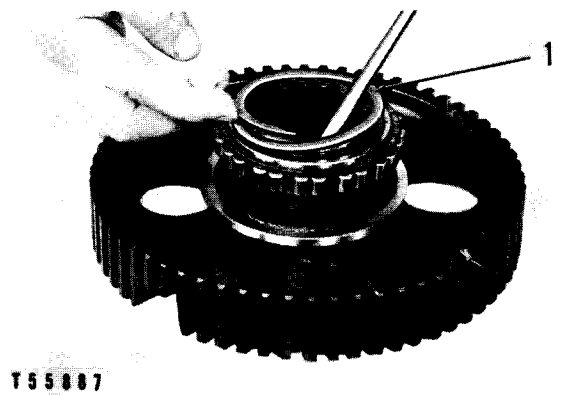
REMOVING PILOT BEARING OUTER RACE
9–5F7345 Forcing Screw.

12. The pilot bearing outer race can be removed by using an 8B7554 Bearing Cup Pulling Attachment with a 5F7345 Forcing Screw **(9)** and an 8B7560 Step Plate.
13. Inspect the disc assemblies **(6)** and replace if excessively worn or damaged.
14. Install in the reverse order of removal using new locks on the pilot bearing retaining bolts.
15. Refer to the topic, FLYWHEEL CLUTCH ADJUSTMENT, for the correct flywheel clutch adjustment procedure.

CLUTCH MECHANISM DISASSEMBLY AND ASSEMBLY

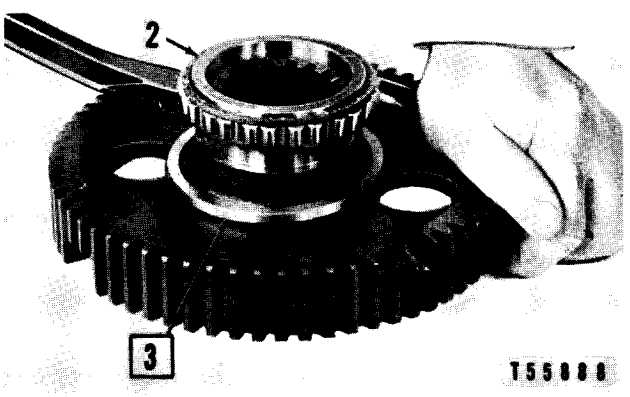
Flywheel Clutch Hub

Remove the retaining ring **(1)** as shown.



RETAINING RING REMOVAL
1–Retaining ring.

Remove the bearing assembly **(2)** as shown.



BEARING ASSEMBLY REMOVAL

☐ **Remove**

2–Bearing assembly. 3–Retainer ring.

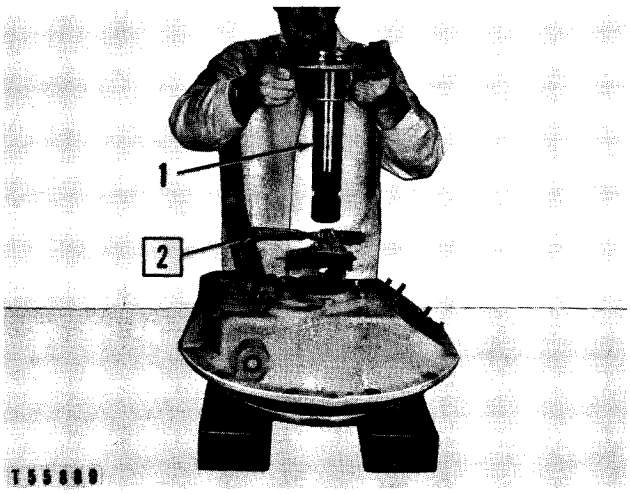
Inspect all parts and replace any that are worn or damaged.

NOTE

The retainer ring **(3)** must be installed prior to the bearing assembly **(2)**.

Flywheel Clutch Cover

1. Place the flywheel clutch and cover assembly on blocks as shown.
2. Lift the clutch shaft **(1)** from the flywheel clutch and cover assembly.

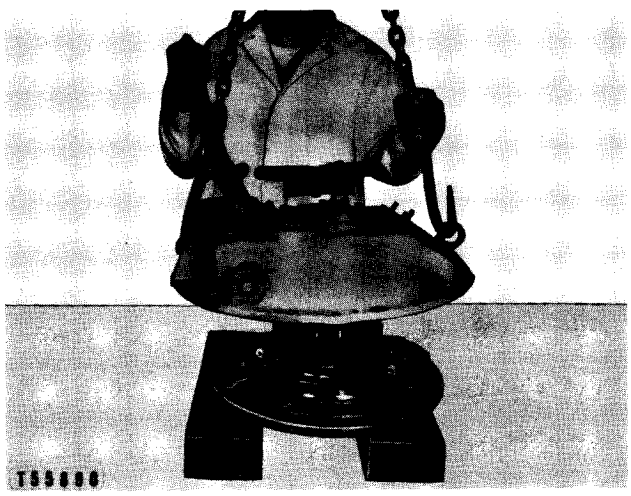


REMOVING CLUTCH SHAFT

☐ **Remove**

1–Clutch shaft. 2–Pin.

3. Inspect the race on the clutch shaft and replace if worn or damaged.
4. Install lifting eyes in two diametrically opposed holes in the cover assembly and remove the cover assembly as shown.



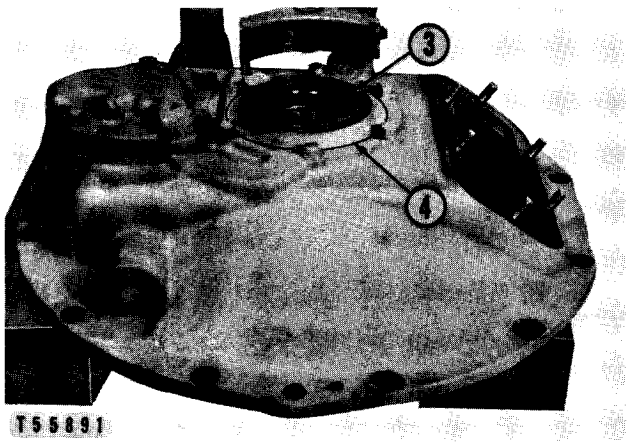
CLUTCH COVER ASSEMBLY REMOVAL

5. If the seal **(3)** shows sign of leakage, it should be replaced.

NOTE

Install the new seal with the spring loaded lip toward the bearing.

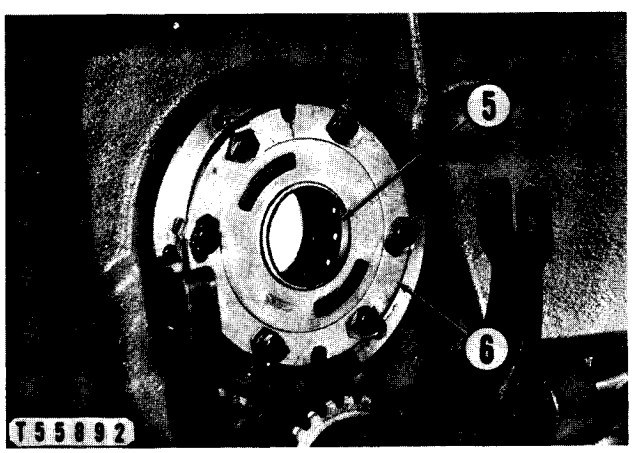
6. Removal of the cage **(4)** can be accomplished by removing the six retaining bolts and pressing the cage out of the flywheel clutch housing.



BEARING CAGE AND SEAL

3–Oil seal. 4–Bearing cage.

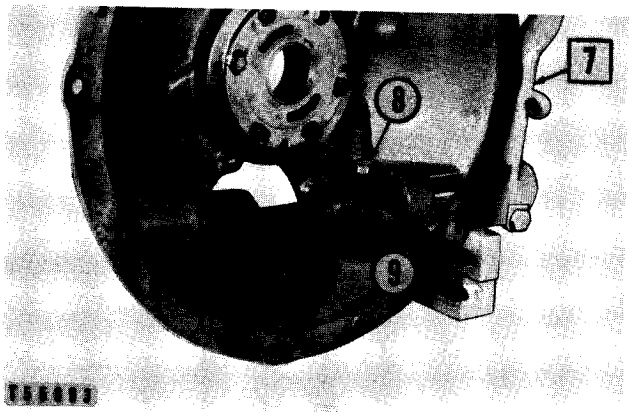
7. Install a new gasket and O-ring seal at the time of installation and make certain the oil passage in the cage mates with the oil passage in the flywheel clutch housing.
8. Coat the threads of the cage retaining bolts with sealing cement prior to installation.
9. The bearing **(5)** can be removed after the retainer **(6)** has been removed.



CLUTCH SHAFT REAR BEARING

5–Clutch shaft rear bearing. 6–Retainer.

10. Install a new gasket and new locks at the time of installation.
11. Remove the key which secures the shaft **(9)** to the lever **(7)**.
12. Loosen the bolt **(8)**.

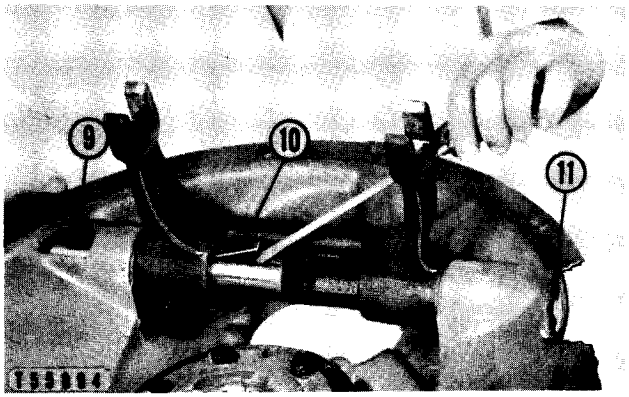


PREPARING TO REMOVE FLYWHEEL CLUTCH CONTROL YOKE

☐ **Remove**

7–Control lever. 8–Bolt. 9–Control shaft.

13. Drive the control shaft **(9)** toward the center of the housing and remove the key **(10)**.

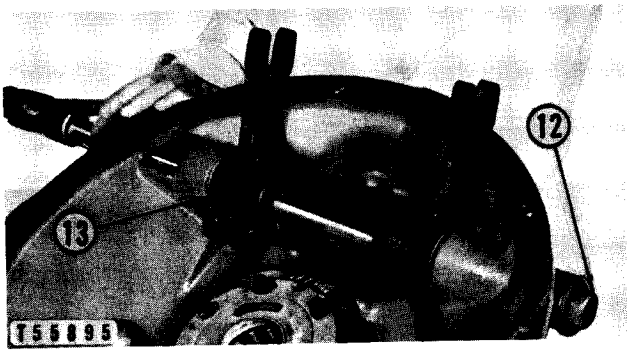


REMOVING CONTROL SHAFT
9–Control shaft. 10–Key. 11–Shaft.

14. Drive the control shaft **(9)** out through the control yoke and cover assembly.

NOTE

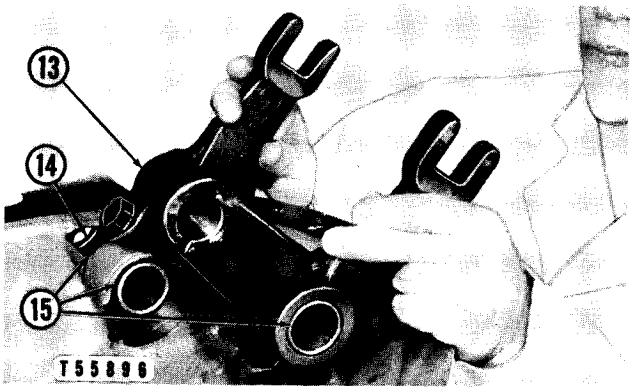
The shaft **(11)** is a press fit in the cover assembly and can be removed by using a 3/4" - 10 (NC) bolt **(12)** 3" long, a 2 1/2" sleeve with a 1 3/8" I.D. and a 3/4" washer set up as shown.



REMOVING YOKE SHAFT
12–Bolt. 13–Flywheel clutch control yoke.

15. Tighten the bolt **(12)** and, by using a punch of suitable length, tap the shaft **(11)** toward the outside of the housing. Repeat this procedure until the shaft is clear of the yoke **(13)**.

16. Remove the control yoke **(13)** as shown.



REMOVING FLYWHEEL CLUTCH CONTROL YOKE
13–Flywheel clutch control yoke. 14–Oil seal. 15–Bearings.

17. Inspect the seal **(14)** and replace if it shows sign of leakage.

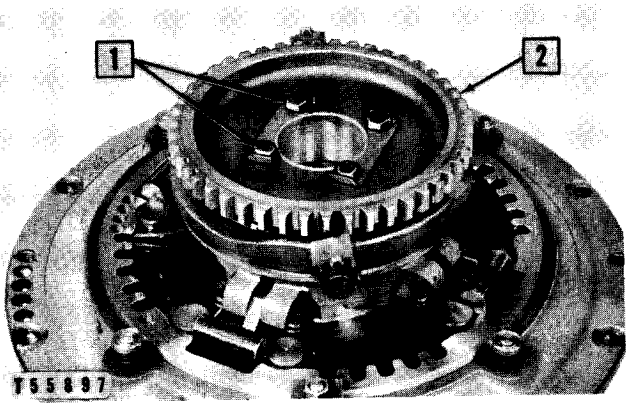
NOTE

Install the new seal with the spring loaded lip toward the bearing.

18. Inspect the bearings **(15)** and replace any that show sign of wear or damage.

19. Assemble in the reverse order of disassembly, making certain the keys are installed in the control shaft **(9)**.

Removing Clutch Sliding Collar and Adjusting Ring Bracket

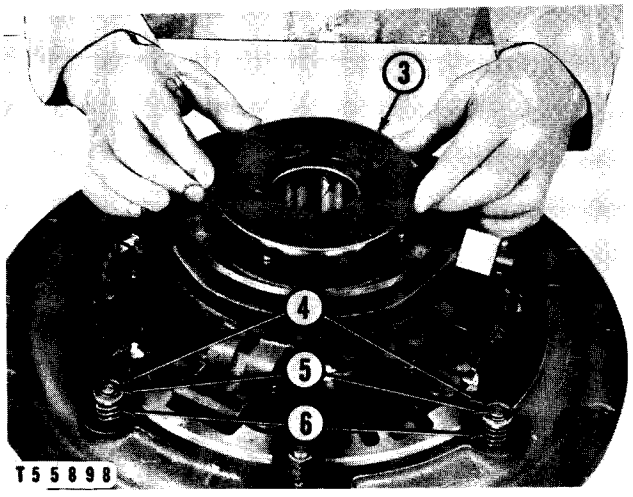


PREPARING TO REMOVE OIL PUMP DRIVE GEAR

☐ **Remove**

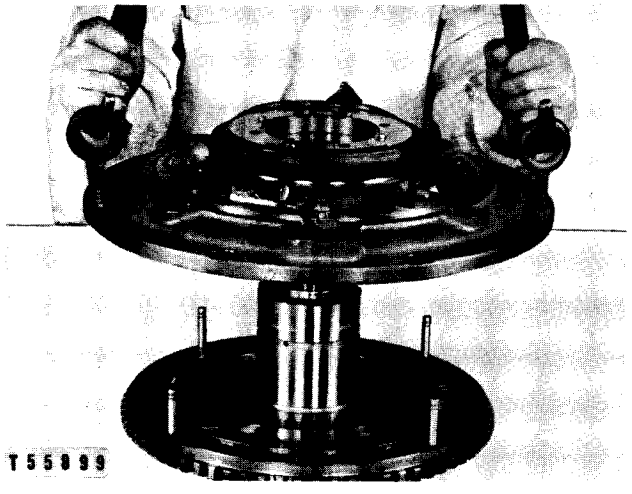
1–Bolts (four). 2–Oil pump drive gear.

1. Remove the washer **(3)**.
2. Depress the retainers **(4)** and remove the locks **(5)**, retainers **(4)** and springs **(6)**.



RETAINER REMOVAL
3–Washer. 4–Retainers (four). 5–Locks (eight). 6–Springs (four).

3. Install two ½" - 13 (NC) lifting eyes in the adjusting ring bracket, attach a suitable hoist, and remove the bracket and collar assembly as shown.

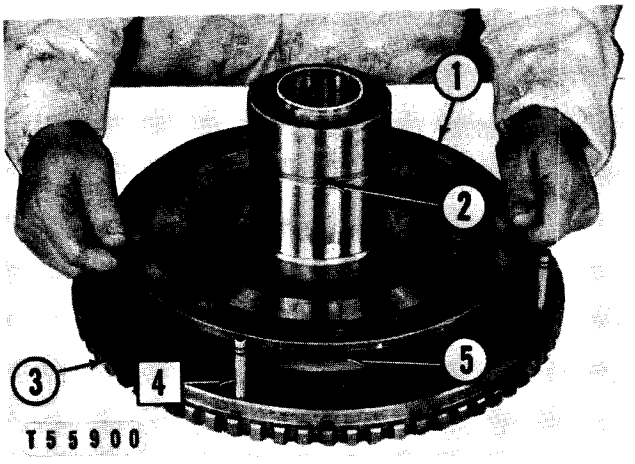


REMOVING ADJUSTING RING BRACKET AND SLIDING COLLAR ASSEMBLY

4. At the time of assembly, tap each retainer **(4)** to make certain the locks **(5)** are secure.

Pressure Plate and Clutch Loading Plate

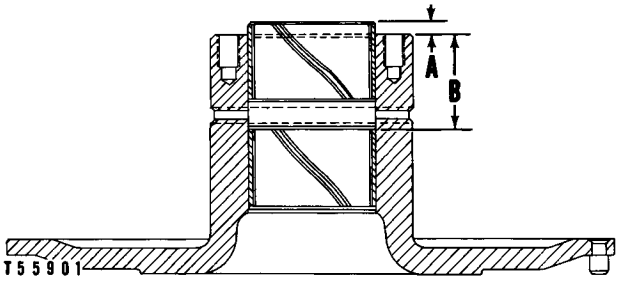
1. Lift the clutch loading plate **(1)** from the pressure plate **(3)**.
2. Inspect the bearings in the loading plate **(1)** and replace if worn or damaged.



REMOVING CLUTCH LOADING PLATE
☐ **Remove**
1–Clutch loading plate. 2–Oil passage. 3–Pressure plate. 4–Studs (four). 5–Pin.

NOTE

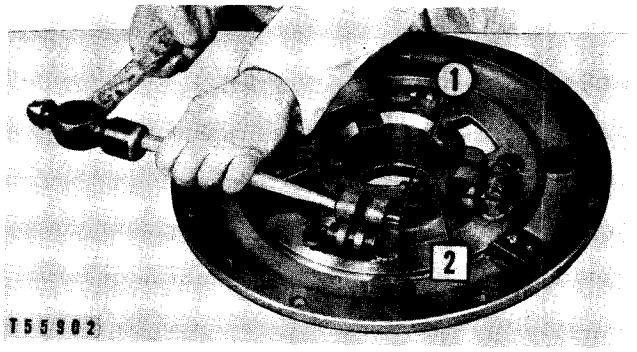
When installing new bearings, make certain they are installed in accordance with the dimensions shown. This will preclude the possibility of obstruction of the oil passage **(2)**.



BEARING INSTALLATION DIMENSIONS
A–¼" dimension. B–1 13/16" dimension.

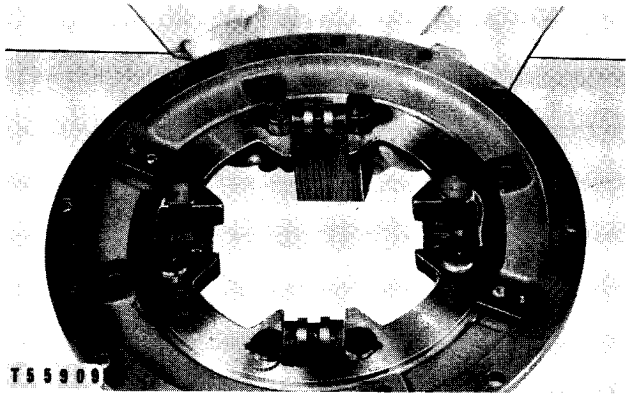
3. Inspect the studs **(4)** and replace if necessary.
4. At the time of assembly, make sure the pin **(5)** is engaged with its mating hole in the pressure plate **(3)**.

Adjusting Ring and Adjusting Ring Bracket

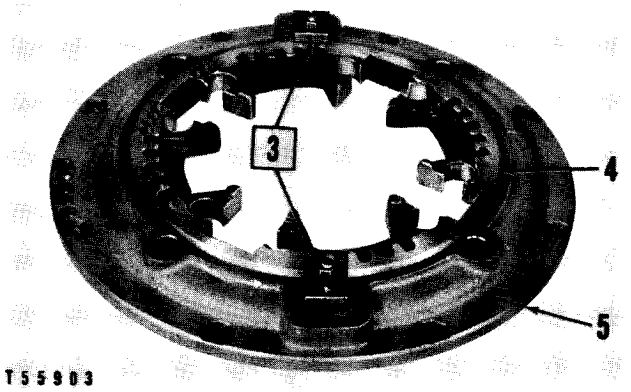


PREPARING TO REMOVE ADJUSTING RING AND ADJUSTING RING BRACKET
☐ **Remove**
1–Shaft (four). 2–Sliding collar assembly.

1. Drive the shaft **(1)** out of each link assembly.
2. Remove each one of the four link and bushing assemblies by pushing them upward as shown.



REMOVING LINK AND BUSHING ASSEMBLY



PREPARING TO REMOVE ADJUSTING RING LOCKS

☐ **Remove**

3–Adjusting ring locks. 4–Adjusting ring. 5–Adjusting ring bracket.

CAUTION

Care should be taken to protect the threaded surfaces of the adjusting ring and adjusting ring bracket.

3. The adjusting ring **(4)** can be removed from the adjusting ring bracket **(5)** by turning the adjusting ring in a counterclockwise direction.
4. Assemble in the reverse order of disassembly.

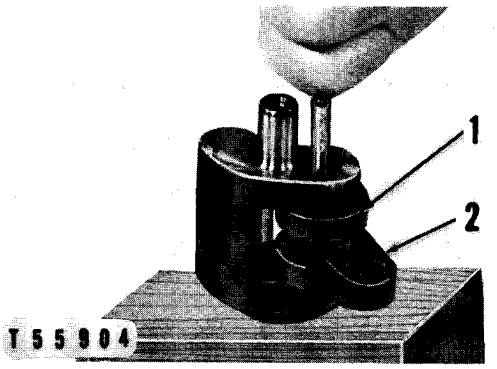
NOTE

Make certain the ends of the shafts **(1)** are flush with the machined surfaces on the outside of the lugs on the sliding collar **(2)**.

Disassembling Cam Link and Roller Assembly

Using a suitable punch, drive the shaft which retains the rollers **(1)** and links **(2)** out of each cam link assembly.

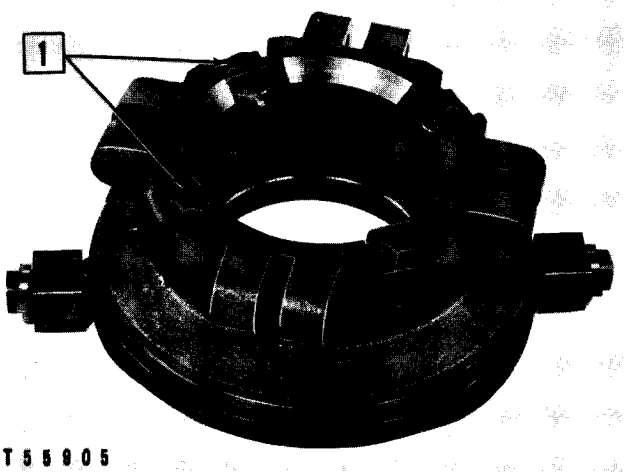
Inspect all parts and replace any that are worn or damaged.



REMOVING ROLLERS AND LINKS
1–Rollers. 2–Links.

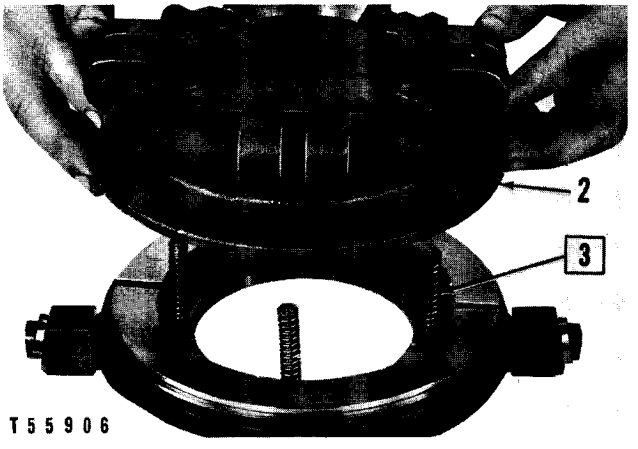
When assembling the cam link assemblies make certain the roller and link retaining shaft is installed so its ends are flush with the machined outside surface of the cam links.

Disassembling The Sliding Collar Assembly



PREPARING TO REMOVE SLIDING COLLAR

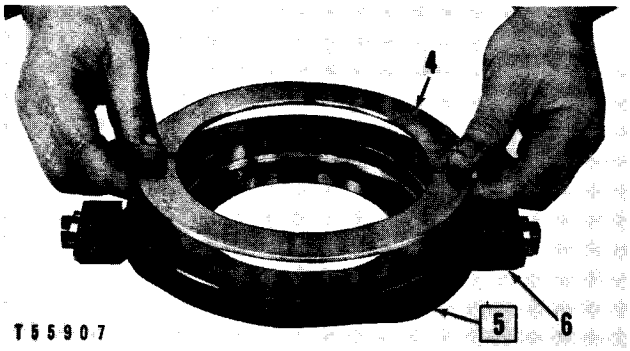
☐ **Remove**
1–Bolts (four).



REMOVING CLUTCH SLIDING COLLAR

☐ **Remove**
2–Clutch sliding collar. 3–Springs and pins (four of each).

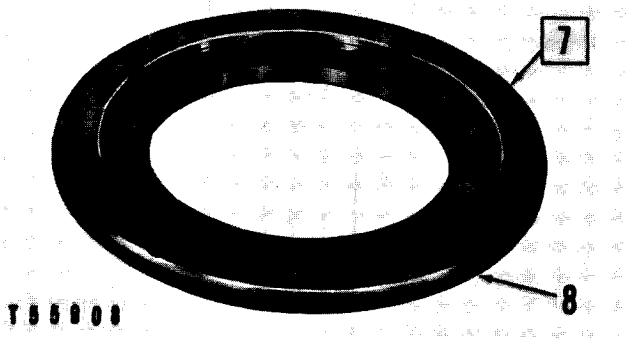
1. Remove the collar **(2)**.
2. Remove the front thrust washer **(4)**.



REMOVING FRONT THRUST WASHER

☐ **Remove**

4–Front thrust washer. 5–Clutch collar. 6–Block.



INTERMEDIATE AND REAR THRUST WASHERS

☐ **Remove**

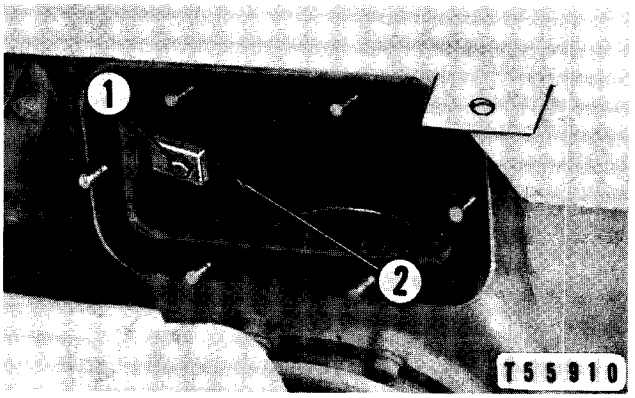
7–Intermediate thrust washer. 8–Rear thrust washer.

3. Inspect all parts and replace any that are worn or damaged.
4. The service life of the blocks **(6)** can be prolonged by rotating them 90° from their original position.
5. When installing the springs **(3)** in the rear thrust washer **(8)**, make certain the aligning pins are in place and properly engaged with the holes in the rear thrust washer.
6. Assemble in the reverse order of disassembly.

FLYWHEEL CLUTCH ADJUSTMENT

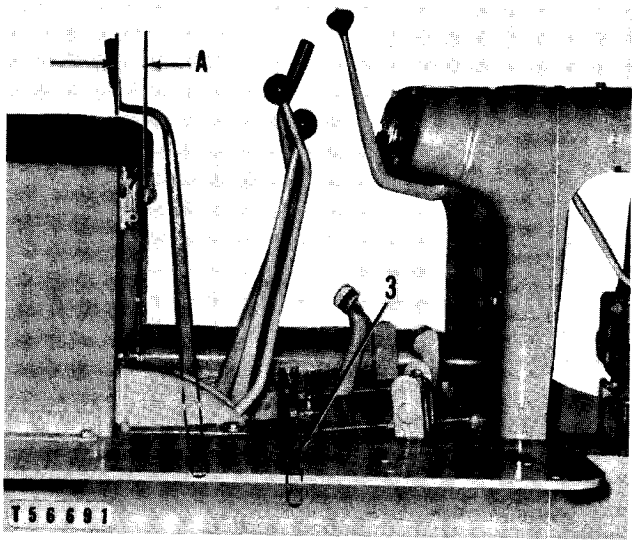
Clutch Adjustment

1. Remove the clutch inspection cover.
2. Turn the flywheel until one of the adjustment locknuts **(1)** is accessible. Loosen the locknut about two turns. Tap the plate slightly to be sure it is free on the stud. Rotate the flywheel 180° and loosen the other locknut in the same manner.
3. Turn the adjusting ring **(2)**, with the notches provided, until the correct amount of pull is obtained on the clutch lever. See the topic, SPECIFICATIONS.



ADJUSTING CLUTCH
1–Locknut. 2–Adjusting ring.

4. Tighten the locknut **(1)** to the torque value given in the topic, SPECIFICATIONS.
5. With the clutch engaged, adjust the linkage **(3)** so the distance from the centerline of the flywheel clutch control lever at the base of the handle to the front edge of the battery box will be equal to dimension **(A)**. See the topic, SPECIFICATIONS.

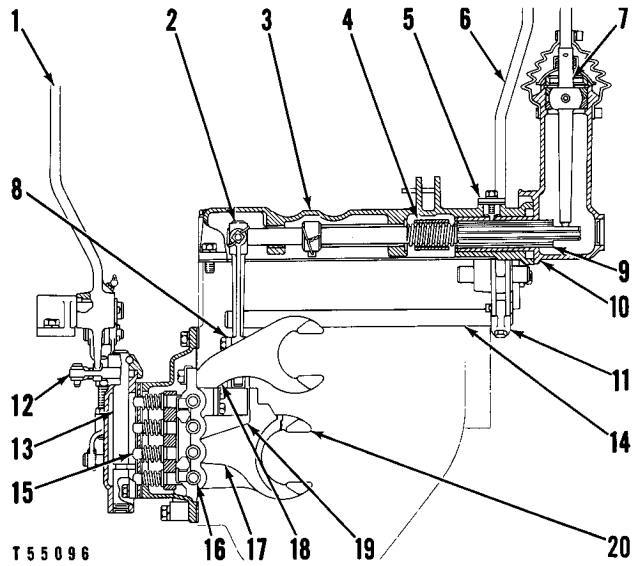


FLYWHEEL CLUTCH CONTROL LEVER ADJUSTMENT
3–Linkage. A–Dimension from control lever to front edge of battery box.

Gear Shift and Interlock Mechanism

OPERATION

There are two transmission shift levers and one flywheel clutch lever to control the gear shift and interlock mechanism. The speed selector lever **(7)** housing is bolted to the top of the transmission case. The forward and reverse lever **(6)** is located at the right front of the transmission and is keyed to a shaft supported by the transmission case. The flywheel clutch lever **(1)** is mounted to a bracket which is bolted to the left front of the transmission case.



GEAR SHIFT AND INTERLOCK MECHANISM
(Viewed from Rear)

1–Flywheel clutch lever.
2–Speed selector shaft lever.
3–Housing.
4–Spacer.
5–Retainer.
6–Forward and reverse lever.
7–Speed selector lever.
8–Gate lock.
9–Shaft.
10–Housing.
11–Forward and reverse shift lever arm.
12–Interlock lever.
13–Interlock shaft.
14–Forward and reverse lever shaft.
15–Plunger.
16–Shifter fork shaft.
17–First and second speeds shifter fork.
18–Fifth speed shifter fork.
19–Third and fourth speeds shifter fork.
20–Forward and reverse shifter fork.

By moving the two control levers, various combinations of gears can be selected to give five forward and four reverse speeds. The forward or reverse direction is selected by the forward and reverse lever **(6)** while the speed selector lever **(7)** is used to select the desired speed.

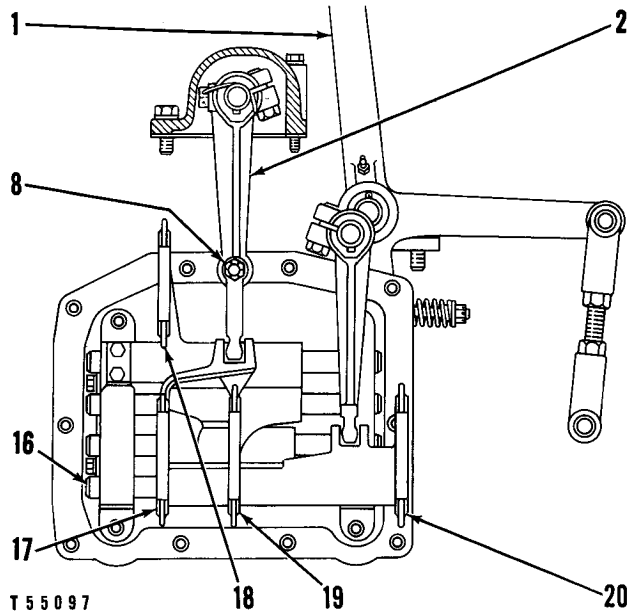
A swinging "gate" lock **(8)**, which follows the lateral movement of the speed selector lever, prevents any but the desired fork from shifting when the gears are shifted rapidly.

When the tractor is used in fifth gear or for belt work or other stationary work, or when idling with the flywheel clutch engaged, the forward and reverse lever should be kept in the forward position, toward the operator. This will keep the countershaft rotating and furnish lubricant to the transmission upper shaft bearings.

The three forks **(17)**, **(18)**, and **(19)** are controlled by the speed selector lever **(7)**. The fork **(20)** is controlled by the forward and reverse lever **(6)**.

The gear shift interlock mechanism, attached to the left side of the transmission case, holds the shifter forks and transmission gears in position when the flywheel clutch is engaged.

The interlock mechanism consists of spring-loaded plungers **(15)**, which fit into notches on the shifter shafts, and an interlock shaft **(13)**, which is connected by a lever and rod to the flywheel clutch control lever. The cam on the interlock shaft locks the plungers in the notches on the shifter shafts when the flywheel clutch is engaged, thereby preventing the transmission gears from sliding out of position. When the clutch is disengaged, the interlock shaft is rotated, allowing the plungers to be forced out of the notches as the gears are shifted. Only a small load, created by the spring-loaded plungers, need be overcome to make a shift change.

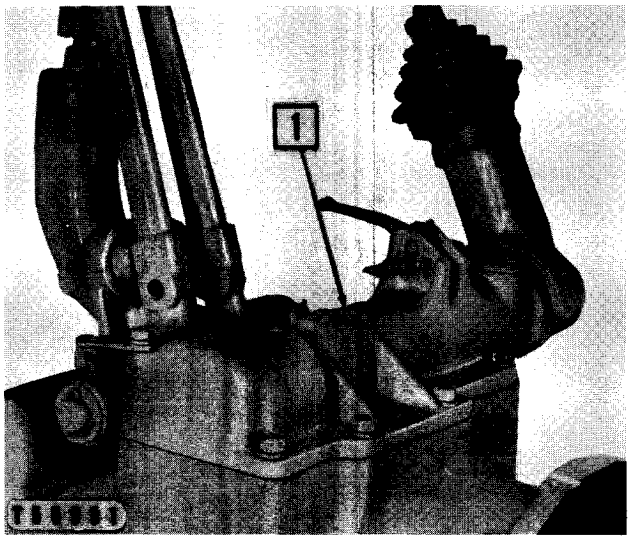


GEAR SHIFT AND INTERLOCK MECHANISM
(View from Right)
Same nomenclature as GEAR SHIFT AND INTERLOCK MECHANISM (Viewed from Rear)

REMOVAL

Some of the components of the gear shift and interlock mechanism can be serviced with the transmission installed in the machine. Complete disassembly can be done only with the transmission removed as illustrated.

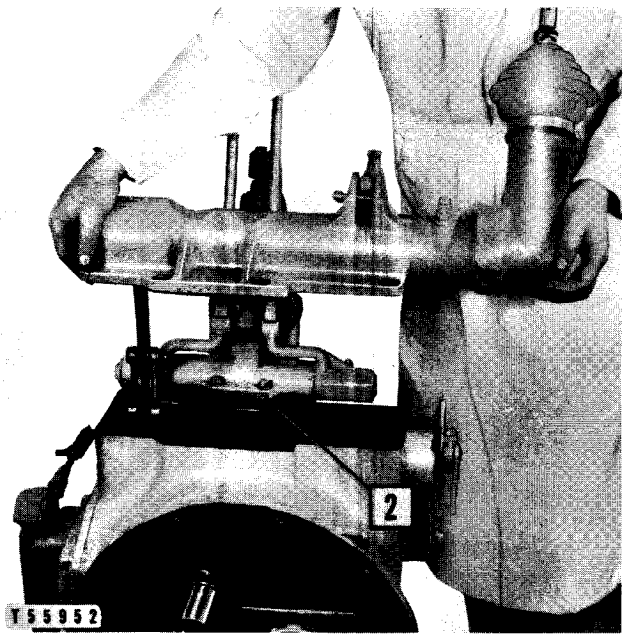
1. Remove the transmission as outlined in the covering topic.



SPEED SELECTOR LEVER HOUSING REMOVAL

☐ **Remove**

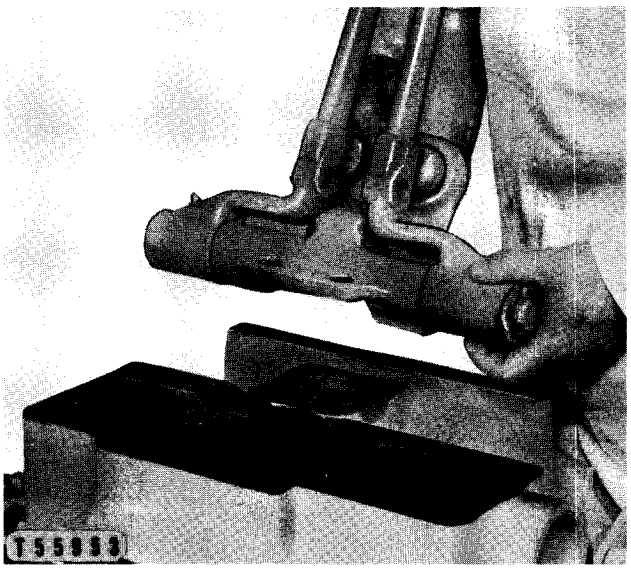
1–Speed selector lever housing.



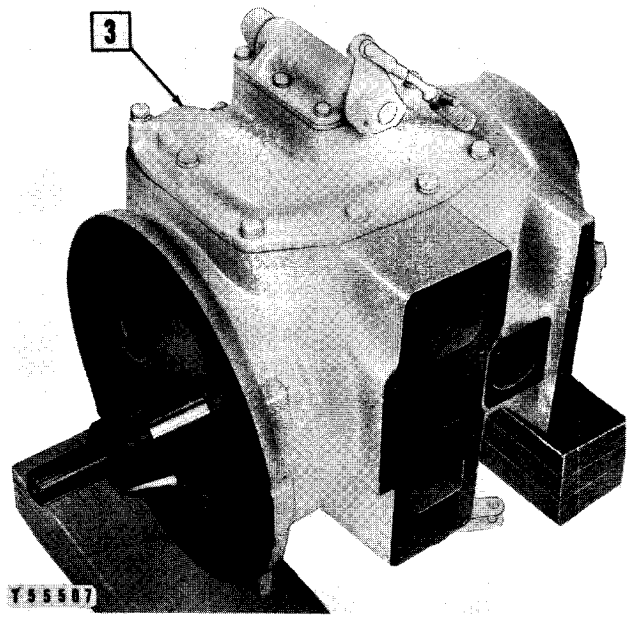
REMOVING SPEED SELECTOR LEVER HOUSING

☐ **Remove**

2–Steering clutch lever bracket.



REMOVING STEERING CLUTCH LEVER BRACKET

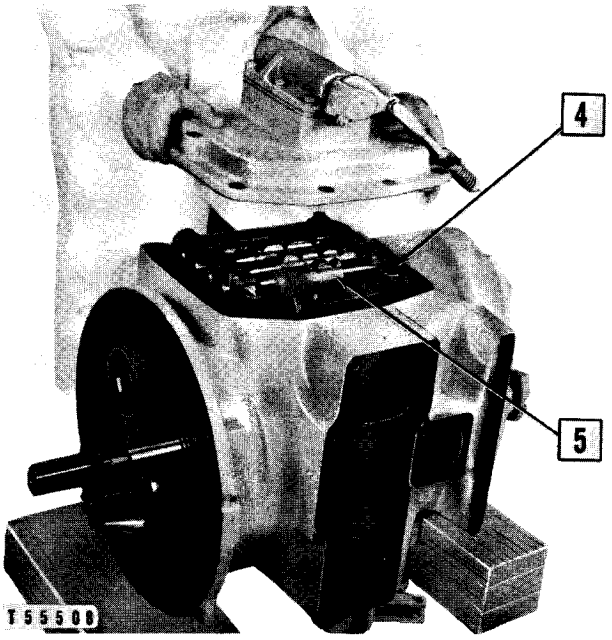


COVER REMOVAL

☐ **Remove**

3–Cover assembly.

2. Block the transmission in the position shown.
3. Tilt the shifting fork assembly **(5)** forward as shown to provide clearance for removal of the shifting forks from the case.



REMOVING COVER

☐ Remove

4–Bolts (four). 5–Shifting forks.

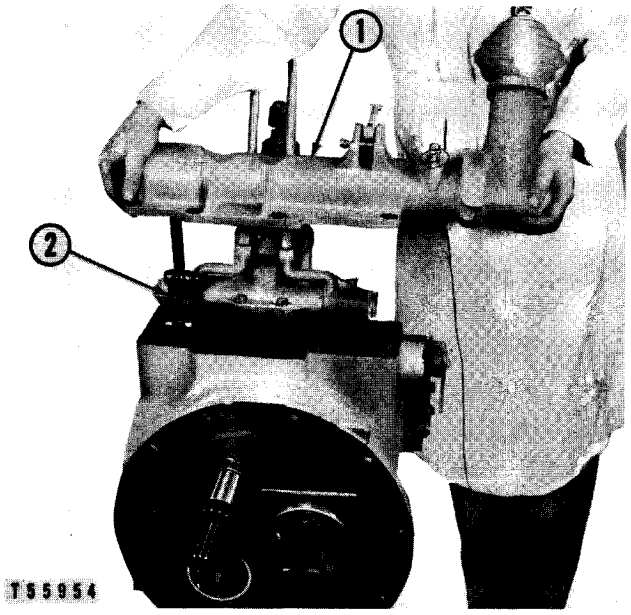
REMOVING SHIFTING FORKS

INSTALLATION

1. Install the speed selector lever housing.
2. Install the shifting fork assembly.

NOTE

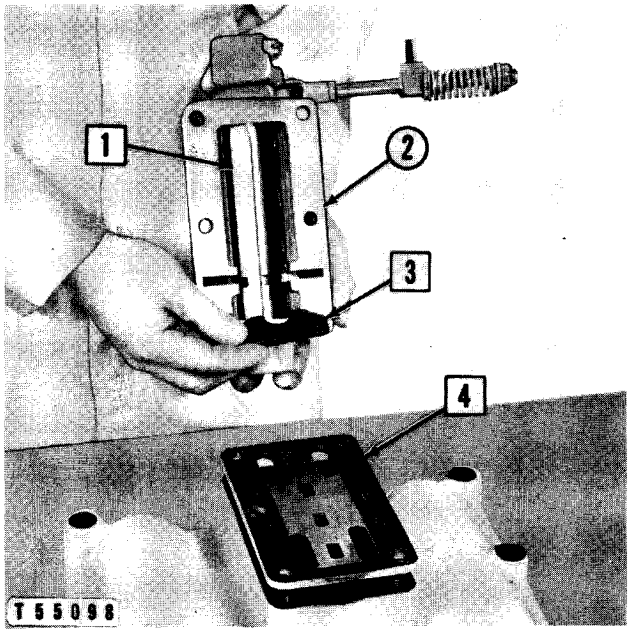
Installation of the shifting fork assembly requires the assembly to be in the same position as it was removed. The gears on the counter shaft and the gear on the upper shaft should be in the neutral position as well as the shifter forks which engage the respective gears. The forward-reverse lever arm must also be positioned in the forward-reverse shifting fork slot before securing the assembly to the case.



INSTALLING SPEED SELECTOR LEVER HOUSING
1–Speed selector lever housing. 2–Gate lock.

3. Install the interlock mechanism and cover.
4. Install the steering clutch lever bracket.

INTERLOCK MECHANISM DISASSEMBLY AND ASSEMBLY



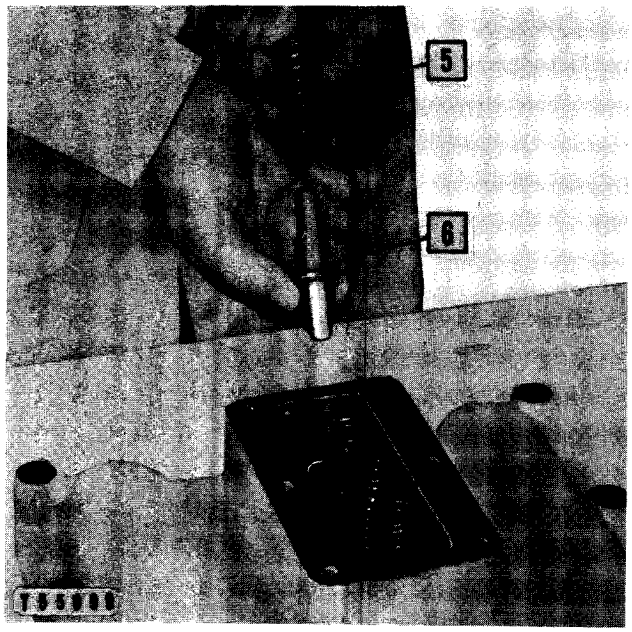
DISASSEMBLING GEAR SHIFT INTERLOCK MECHANISM

☐ Remove

1–Interlock shaft. 2–Housing. 3–Plate. 4–Plate.

1. Remove the bolts which hold the housing **(2)** to the cover and remove the housing.

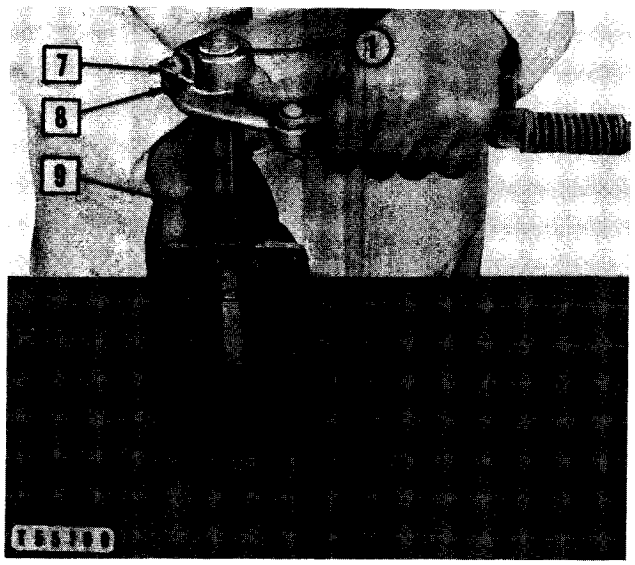
2. Remove the plate **(4)**, and take out the springs **(5)** and plungers **(6)**.



DISASSEMBLING GEAR SHIFT INTERLOCK MECHANISM

☐ **Remove**

5–Springs. 6–Plungers.



REMOVING SHAFT

☐ **Remove**

1–Interlock shaft. 7–Pin. 8–Interlock shaft lever. 9–Seal.

3. The lever **(8)** can be removed from the interlock shaft **(1)** after removing the nut and driving out the taper pin **(7)**.

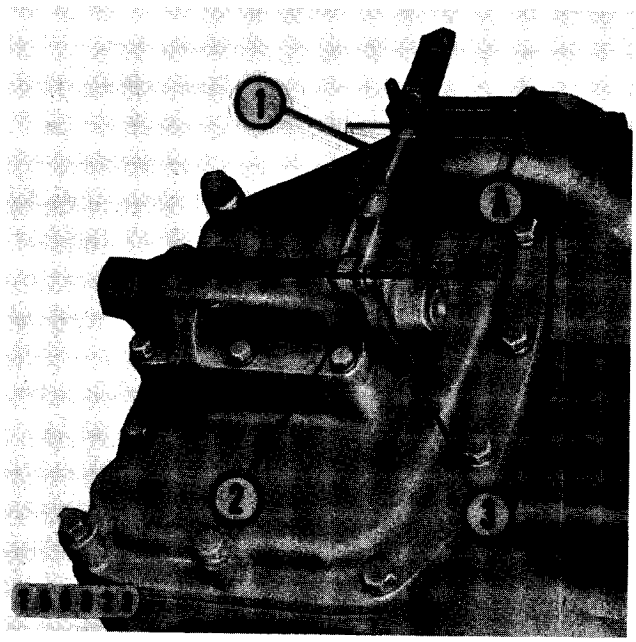
4. The interlock shaft can be withdrawn from the housing after sliding out the plate **(3)**. However, the shaft should not be removed unless it is necessary to replace it or the seal **(9)** under the lever **(8)**.

NOTE

Always install a new seal **(9)** if the interlock shaft is removed. To avoid damaging the seal, install the shaft in the housing. Then, place the seal over the end of the shaft with the wiping edge up and press the seal into the counterbore in the housing.

5. Place the lever on the shaft and install the taper pin.

INTERLOCK LINKAGE ADJUSTMENT



INTERLOCK LINKAGE

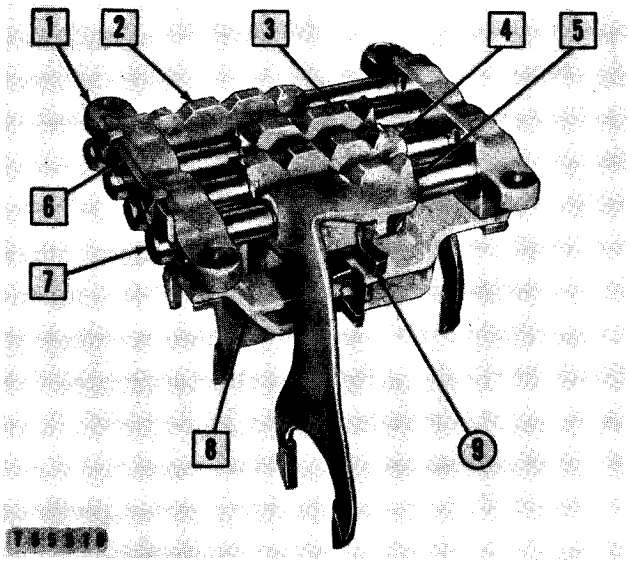
1–Rod. 2–Interlock lever. 3–Pin. A–Dimension between centerline of the pin and shoulder on the rod.

Adjust the rod **(1)** so the dimension **(A)**, between the centerline of the pin **(3)** and the shoulder of the rod **(1)**, is equal to the value given in the topic, SPECIFICATIONS.

With the linkage correctly adjusted the interlock lever **(2)** will move to a perpendicular position in relation to the rod **(1)** as the flywheel clutch is released.

If the adjustable link is too long the interlock mechanism will not release; if the link is too short the interlock mechanism will not lock.

SHIFTER FORK MECHANISM



DISASSEMBLING SHIFTER FORKS

☐ **Remove**

1–Bracket. 2–Forward-reverse shifter fork. 3–First and second speeds shifter fork. 4–Third and fourth speeds shifter fork. 5–Fifth speed shifter fork. 6–Lock. 7–Shafts (four). 8–Bar. 9–Shifter fork notches.

NOTE

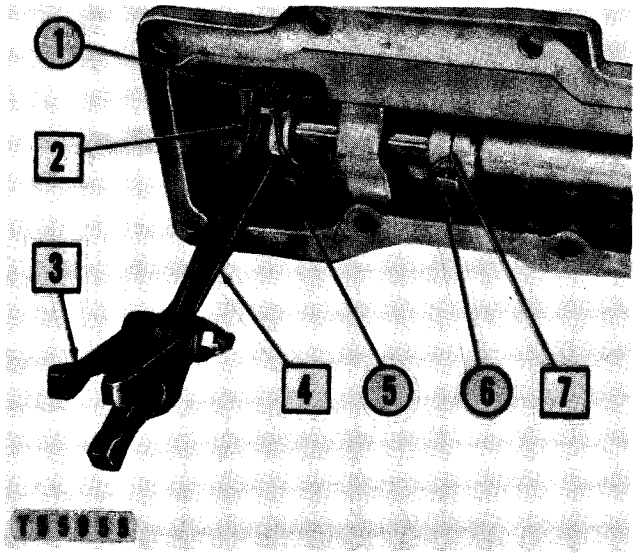
Assemble the shifter forks **(3)**, **(4)** and **(5)** on their respective shafts with the shifter fork notches **(9)** toward the bar **(8)**. The forward-reverse shifter fork **(2)** slides on the shaft farthest from the bar **(8)**. The first and second speeds shifter fork **(3)** slides on the shaft next to the forward-reverse shifter fork. The third and fourth speeds shifter fork **(4)** slides on the shaft next to the fifth speed shifter fork **(5)** which slides on the shaft nearest the bar **(8)**.

SPEED SELECTOR LEVER DISASSEMBLY AND ASSEMBLY

1. Remove the lockwire **(2)** and **(7)**.
2. Loosen the screw **(1)** and the bolt **(5)**.
3. Slide the lever **(4)** off the shaft and remove the key from the shaft.
4. Loosen the screw **(6)**.

NOTE

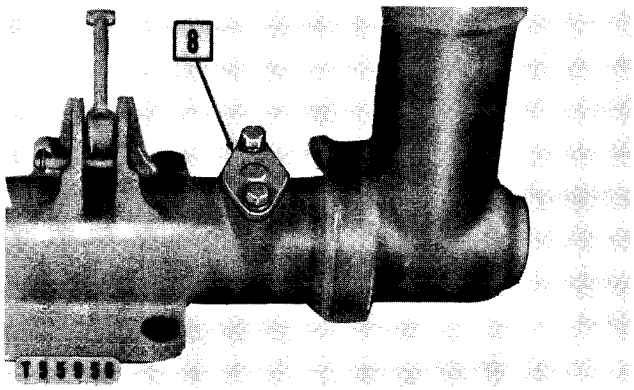
The slot **(9)** must be in alignment with the retainer bore at assembly before the retainer **(8)** is secured to the housing.



PREPARING TO DISASSEMBLE SPEED SELECTOR LEVER

☐ **Remove**

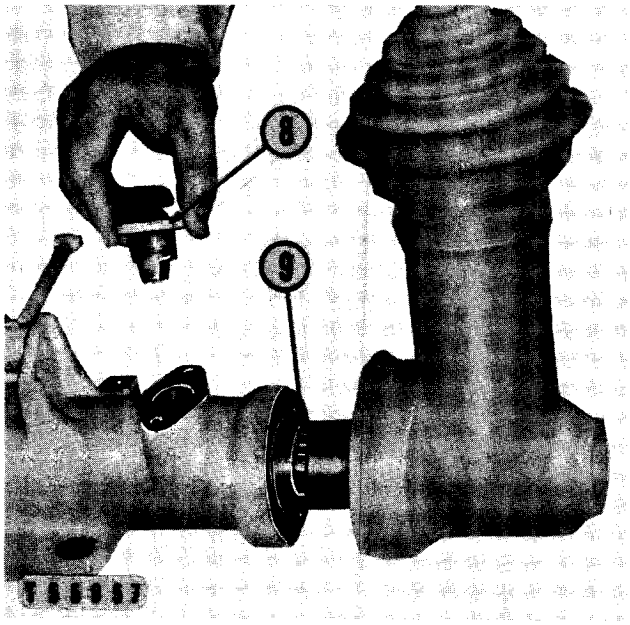
1–Screw. 2–Lockwire. 3–Gate lock. 4–Lever. 5–Bolt. 6–Screw. 7–Lockwire.



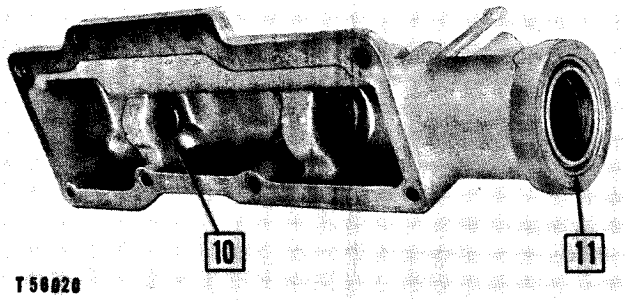
PREPARING TO REMOVE SPEED SELECTOR LEVER AND SHAFT

☐ **Remove**

8–Retainer.



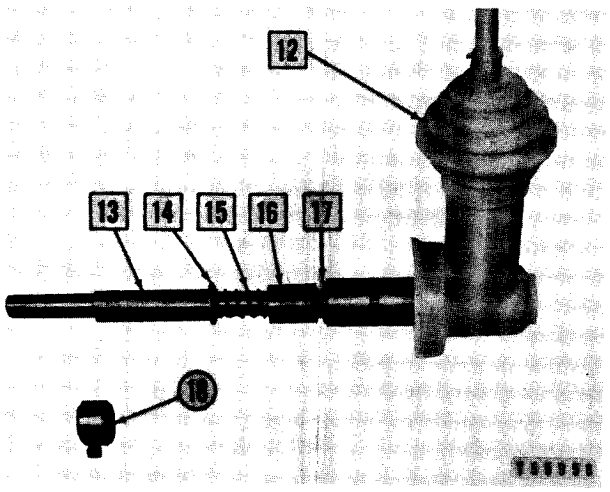
REMOVING SPEED SELECTOR LEVER AND SHAFT
8–Retainer. 9–Slot.



SPEED SELECTOR SHAFT HOUSING

☐ Remove

10–Bearing. 11–Seal.



PREPARING TO REMOVE SPEED SELECTOR LEVER

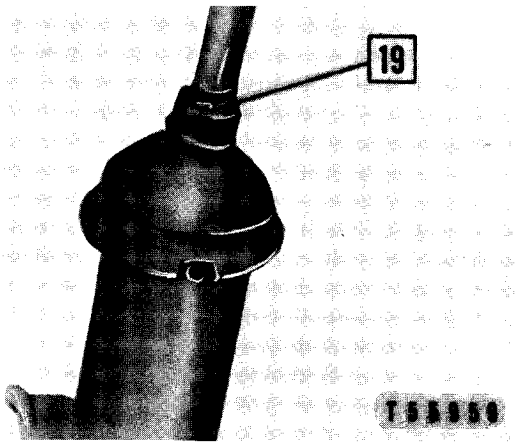
☐ Remove

12–Boot. 13–Tube. 14–Washer. 15–Spring.
16–Spacer. 17–Washer. 18–Collar.

5. Inspect the bearing **(10)** and the seal **(11)** and replace if they are worn or damaged.

NOTE

The seal **(11)** is installed with the wiping edge toward the inside of the housing.



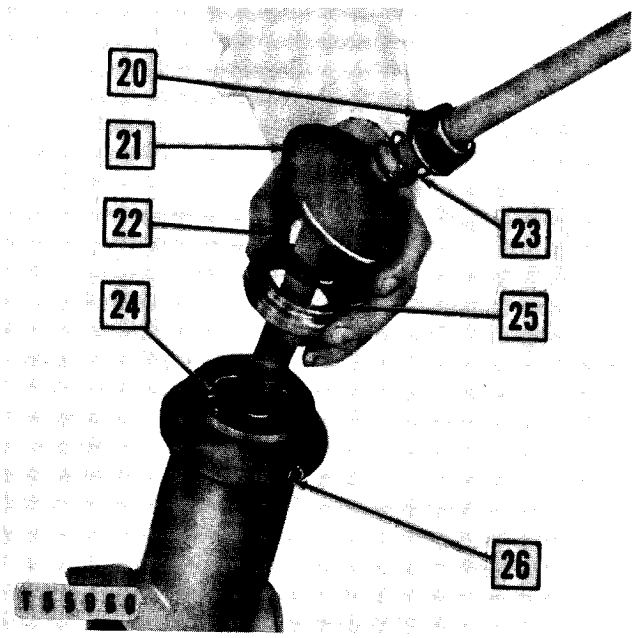
PREPARING TO REMOVE SPEED SELECTOR LEVER

☐ Remove

19–Cotter pin.

NOTE

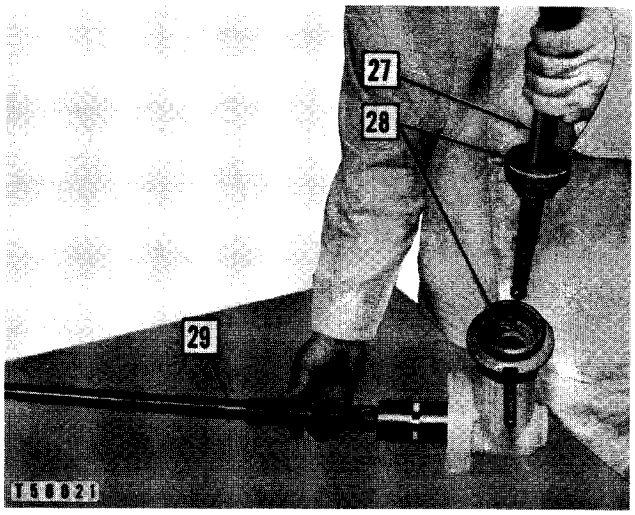
The collar **(18)** will fall out of the assembly as the speed selector lever and shaft are removed from the housing.



PREPARING TO REMOVE SPEED SELECTOR LEVER

☐ Remove

20–Cover. 21–Cover. 22–Packing. 23–Spring.
24–Ring. 25–Ring. 26–Pin.

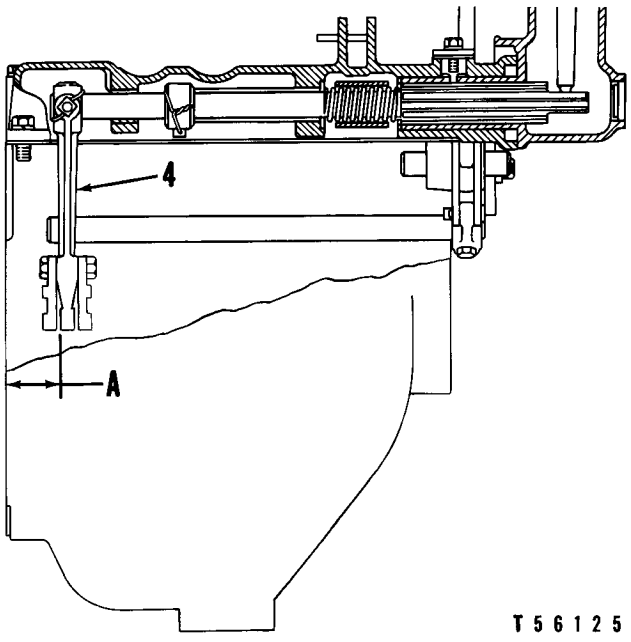


REMOVING SELECTOR LEVER AND SHAFT

☐ **Remove**

**27–Selector lever. 28–Sockets (two).
29–Selector lever shaft.**

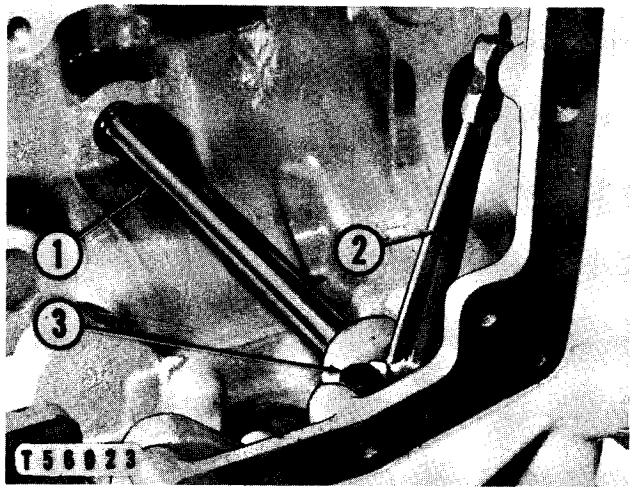
6. Assemble the shaft **(29)** and the lever **(27)** so the flat on the left end of the shaft is toward the rear of the transmission as the lever is installed in the hole on the opposite end of the shaft.
7. Assemble in the reverse order of disassembly.
8. Install the collar **(18)** on the shaft **(29)** before the shaft enters the bearing **(10)**.



INSTALLING LEVER
4–Lever. A–Dimension for installing lever from face of transmission case.

9. Install the lever **(4)** on the shaft so the dimension **(A)**, between the face of lever and face of the transmission case is equal to the value given in the topic, SPECIFICATIONS.

FORWARD-REVERSE LEVER

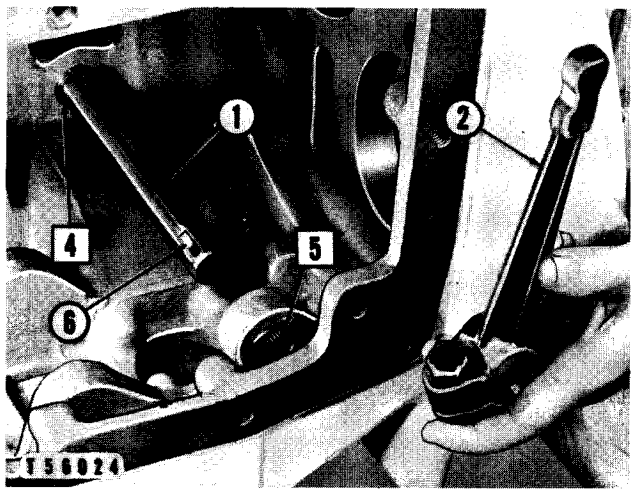


**PREPARING TO REMOVE LEVER
(Gears Removed for Illustration Purposes)
1–Shaft. 2–Forward-reverse lever. 3–Bolt.**

Loosen the bolt **(3)** and slide lever **(2)** off the shaft **(1)** until the key under the lever can be removed from the keyway **(6)**. Remove the key and then remove the lever.

NOTE

The key must be removed to provide clearance for the lever to be removed.



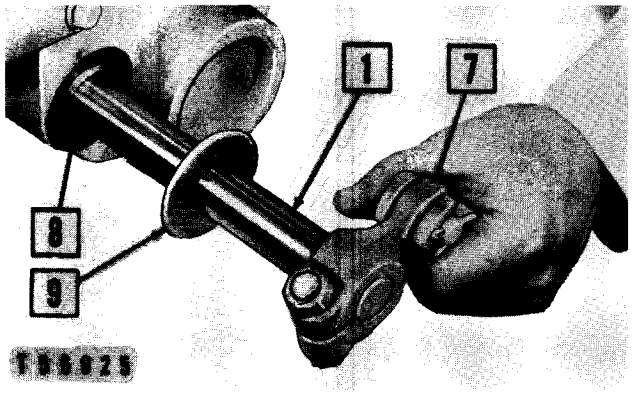
REMOVING LEVER

☐ **Remove**

1–Shaft. 2–Forward-reverse lever. 4–Bearing. 5–Bearing. 6–Keyway.

Inspect the bearing **(4)**, the seal **(8)** and the bearing **(5)** for damage or wear and replace if necessary.

Install in reverse order of removal.



REMOVING SHAFT

☐ **Remove**

1–Shaft. 7–Lever. 8–Seal. 9–Washer.

NOTE

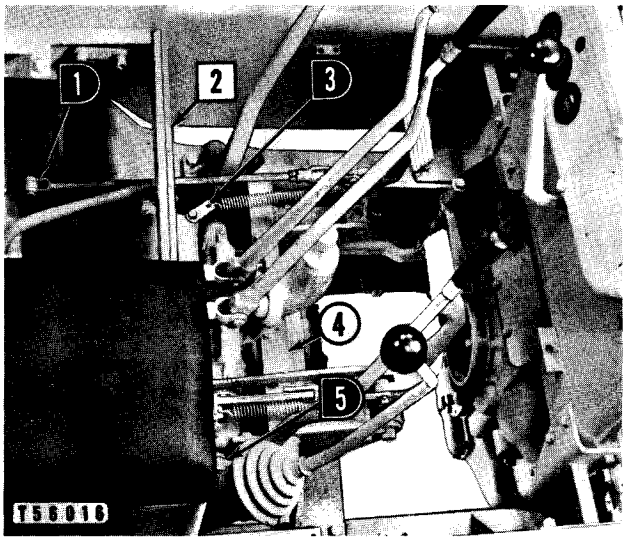
The seal **(8)** is installed with the wiping edge toward the washer **(9)**.

Transmission Removal

1. Drain the oil from the transmission and the bevel gear compartment.
2. Remove the seat cushion, floor plates and drive shaft. See the respective covering topics.

NOTE

On tractors equipped with direct electric starting, it is necessary to remove the tool box prior to removing the transmission.

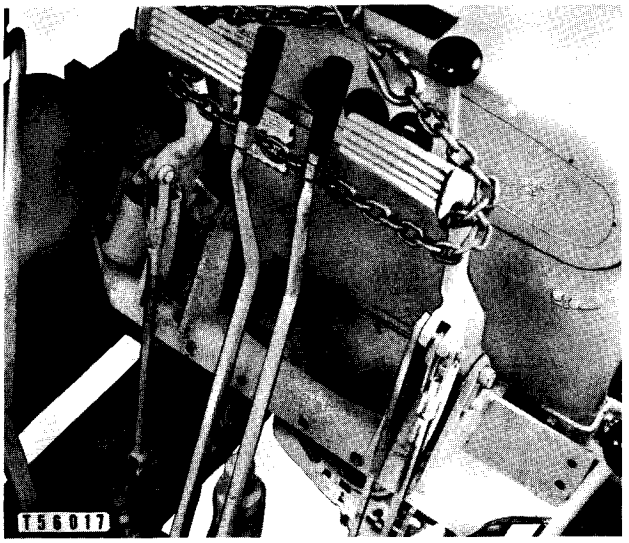


PREPARING TO REMOVE TRANSMISSION

☐ **Remove** ◗ **Disconnect**

1–Brake linkage (two). 2–Support assembly. 3–Brake return spring (two). 4–Brake pedals and support assembly. 5–Directional shift lever linkage.

3. Remove the bolts which secure the brake pedals and support assembly **(4)**, to the transmission case and tractor main frame.

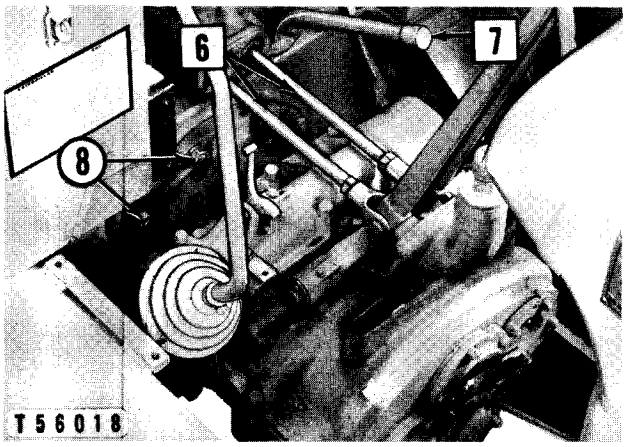


REMOVING BRAKE PEDALS AND SUPPORT ASSEMBLY

4. Attach a chain to the brake pedals, and remove the brake pedals and support assembly as shown.

NOTE

Wire the shims located at each end of the support assembly **(4)** to the support assembly so they can be used at the time of installation.



PREPARING TO REMOVE TRANSMISSION

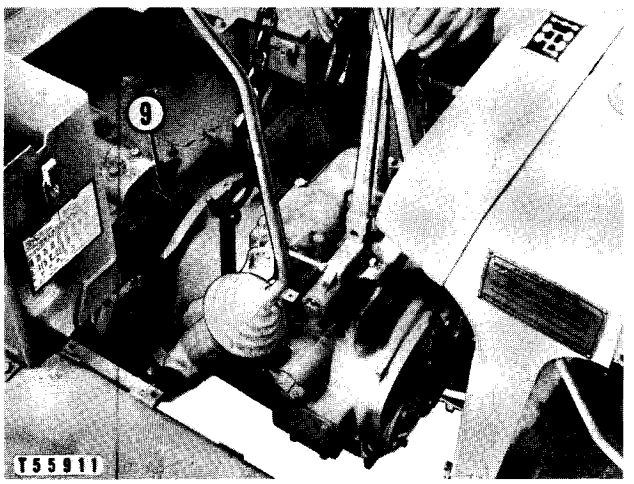
☐ **Remove**

6–Steering clutch control rods. 7–Oil level gauge and tube. 8–Nuts (ten).

5. Disconnect the interlock linkage at the base of the flywheel clutch control lever.
6. Attach a suitable hoist to the transmission. Attach the hoist in such a manner that the transmission will hang level.

NOTE

The transmission weighs approximately 550 lbs.



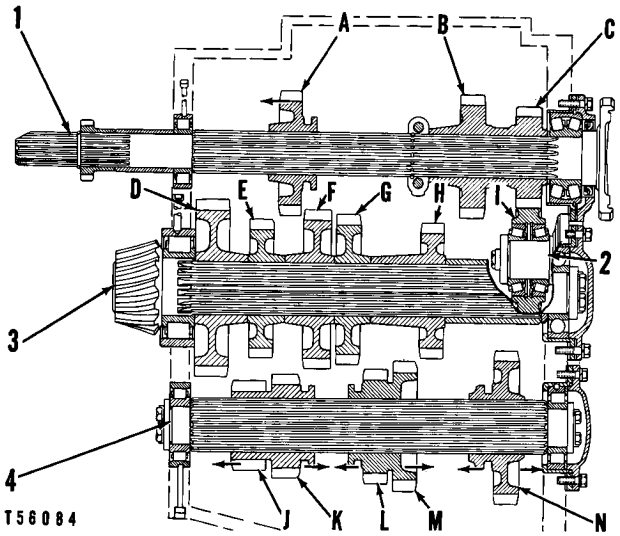
REMOVING TRANSMISSION
9–Transmission upper shaft.

7. Remove the slack from the lifting hoist, and remove the nuts **(8)** around the flange at the rear of the case which secure the transmission to the steering clutch and bevel gear case.
8. Move the transmission forward until the end of the upper shaft **(9)** clears the steering clutch and bevel gear case, and remove as shown.
9. Install in the reverse order of removal, using a new cork seal.
10. Place the brake pedals and support assembly **(4)** in position, and bolt the support assembly to the top of the transmission case.
11. Use a thickness gauge to determine the clearance between the support assembly **(4)** and the tractor main frame.
12. Loosen the bolts which secure the support assembly to the transmission case, and install shims .010" thicker than the clearance obtained in step 11.
13. Install and secure the bolts in the end of the support assembly and the bolts securing the support assembly to the transmission case.

Transmission

INTRODUCTION

The transmission is of the sliding gear type and is enclosed in a separate case. Two gear selector levers are provided to obtain speed and directional selection. One selector lever controls the shifter fork for selecting forward or reverse, with the exception of when the speed selection lever is in fifth speed. When the speed selection lever is in fifth speed position, the machine will operate in a forward direction regardless of the position of the directional selector lever. The other selector lever controls three shifter forks for selection of different speeds, as shown in the chart.



TRANSMISSION GEAR ARRANGEMENT

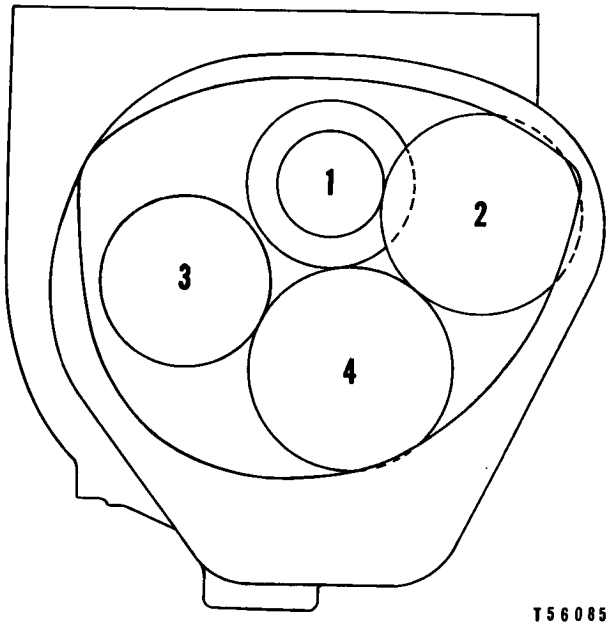
1–Transmission upper shaft.
2–Idler gear trunnion.
3–Bevel pinion shaft.
4–Transmission countershaft.
A–Fifth speed sliding gear.
B–Reverse drive pinion.
C–Forward drive pinion.
D–First speed gear.
E–Fifth speed gear.
F–Second speed gear.
G–Third speed gear.
H–Fourth speed gear.
I–Forward idler gear.
J–First speed sliding gear.
K–Second speed sliding gear.
L–Third speed sliding gear.
M–Fourth speed sliding gear.
N–Forward and reverse sliding gear.

A locking mechanism actuated by the flywheel clutch control lever locks the sliding gears in position when the flywheel clutch is engaged.

1st Forward	C-I	I-N	N-J	J-D
2nd Forward	C-I	I-N	N-K	K-F
3rd Forward	C-I	I-N	N-L	L-G
4th Forward	C-I	I-N	N-M	M-H
5th Forward	A-E			
1st Reverse	B-N	N-J	J-D	
2nd Reverse	B-N	N-K	K-F	
3rd Reverse	B-N	N-L	L-G	
4th Reverse	B-N	N-M	M-H	

POWER FLOW

The forward idler gear **(I)** is always in mesh with the forward drive pinion **(C)**.



TRANSMISSION SHAFT LOCATIONS (FRONT VIEW)
1–Transmission upper shaft. 2–Idler gear trunnion. 3–Bevel pinion shaft. 4–Transmission counter shaft.

DISASSEMBLY AND ASSEMBLY

The transmission gears and shafts are all splined to provide a sliding fit. The front bearings are contained in cages and the rear bearing outer races are pressed into the transmission case and secured with dowels.

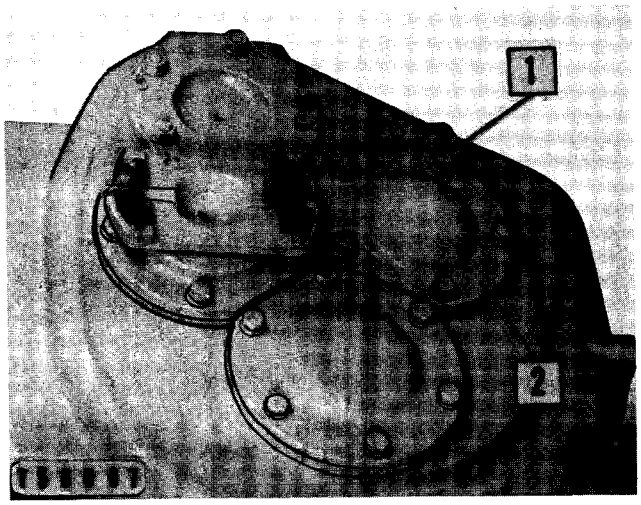
If the transmission is to be disassembled completely, it is recommended that the gears and shafts be removed in the order described in the following topics.

Remove the transmission case from the machine as described in the topic, TRANSMISSION REMOVAL.

Remove the cover from the left side of the case and remove the shifter fork group as described in the topic, GEAR SHIFT AND INTERLOCK MECHANISM.

Countershaft Removal and Installation

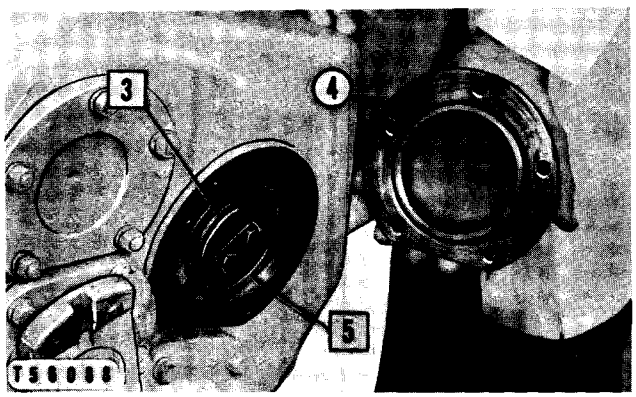
1. Replace the O-ring seal **(4)** in the cover **(2)** at the time of installation.
2. Using a brass drift, tap the countershaft out of the inner race of the bearing **(6)**.
3. Remove the bearing **(6)** and check for signs of wear or damage.



PREPARING TO REMOVE COUNTERSHAFT

☐ **Remove**

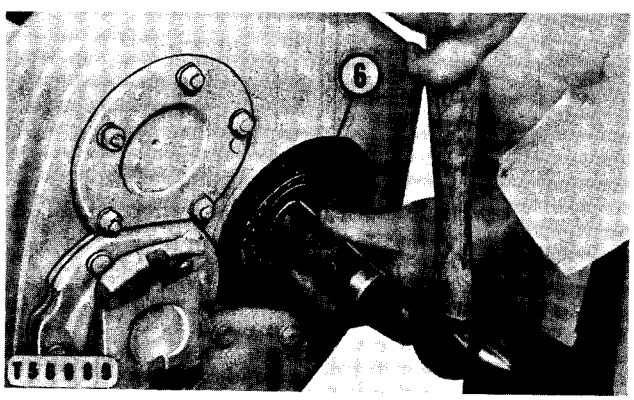
1–Bolts (five). 2–Cover.



PREPARING TO REMOVE COUNTERSHAFT

☐ **Remove**

3–Washer. 4–O-ring seal. 5–End plate.

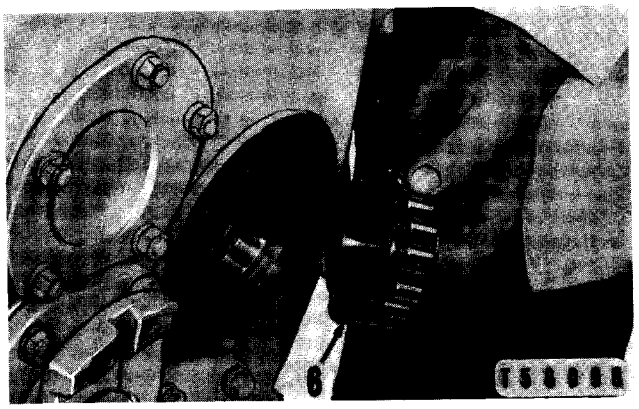


REMOVING COUNTERSHAFT FROM COUNTERSHAFT FRONT BEARING

6–Bearing.

NOTE

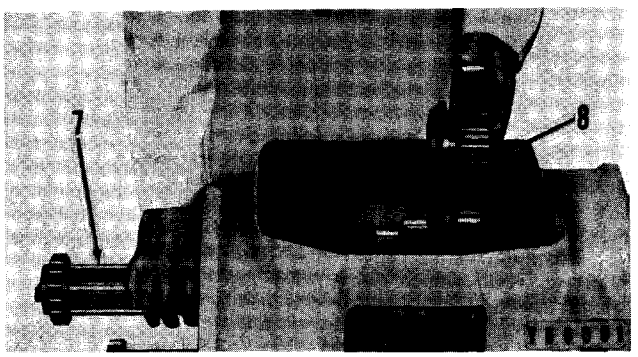
Prior to removing the countershaft, make note of the position of the gears in relation to their position on the shaft and the position of the shifting fork flange of each gear.



REMOVING BEARING

6–Bearing.

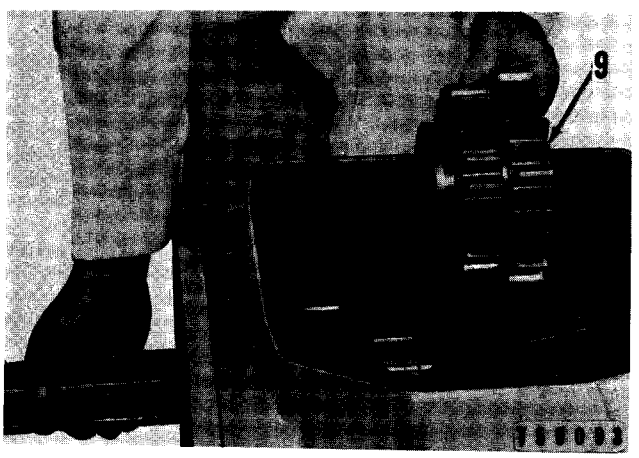
4. Move the countershaft **(7)** to the rear until the forward and reverse sliding gear **(8)** can be removed.



REMOVING FORWARD AND REVERSE SLIDING GEAR

7–Countershaft. 8–Forward and reverse sliding gear.

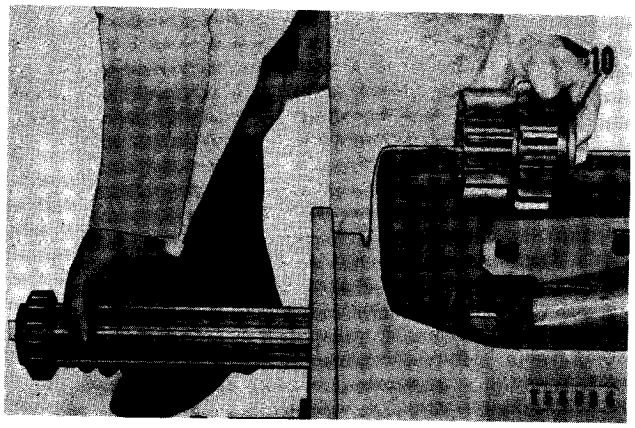
5. Move the countershaft to the rear until the third and fourth speed sliding gear **(9)** can be removed.



REMOVING THIRD AND FOURTH SPEED SLIDING GEAR

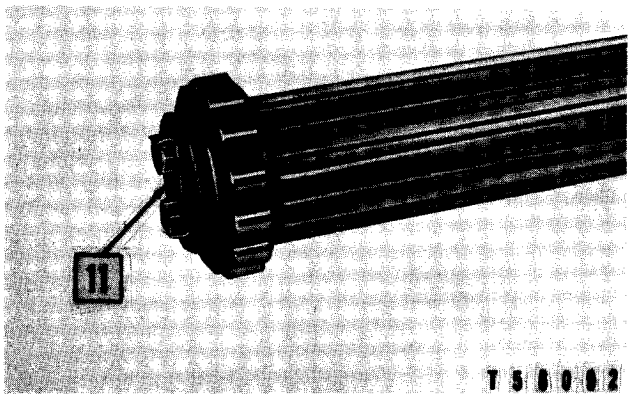
9–Third and fourth speed sliding gear.

6. Move the countershaft **(7)** to the rear until the first and second speed sliding gear **(10)** can be removed.



REMOVING FIRST AND SECOND SPEED SLIDING GEAR
10–First and second speed sliding gear.

7. Remove the countershaft from the transmission case.

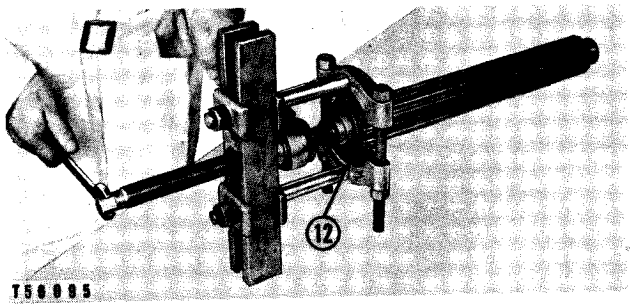


PREPARING TO REMOVE COUNTERSHAFT REAR BEARING

☐ **Remove**

11–Washer.

8. Use an 8B7548 Push Puller (using two 8B7550 Legs in place of the two 5F7369 Legs), 8B7551 Bearing Pulling Attachment, 8B7560 Step Plate and an 8H684 Ratchet Wrench to pull the bearing **(12)** as shown.

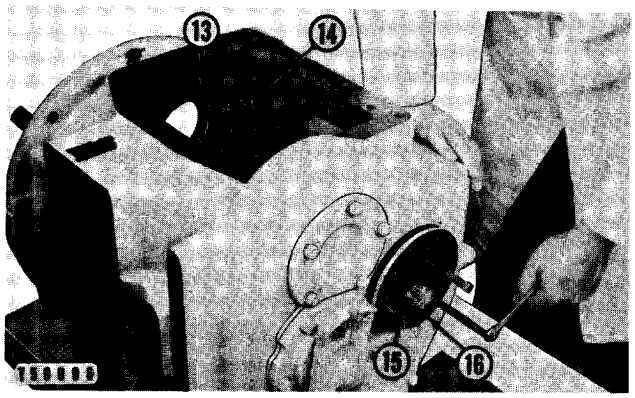


REMOVING COUNTERSHAFT REAR BEARING
12–Bearing.

9. Inspect the countershaft bearing outer races **(13)** and **(15)** and replace if necessary.

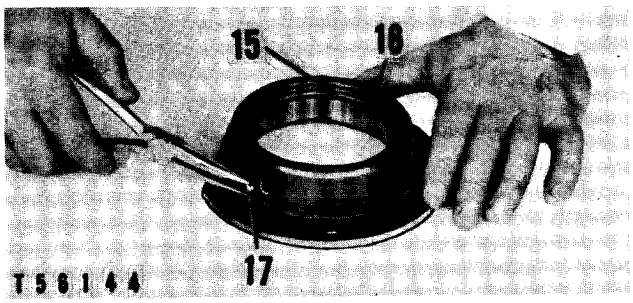
10. The countershaft rear bearing outer race **(13)** can be removed after the locating dowel **(14)** has been removed. For detailed information concerning the removal and installation of the bearing outer race **(13)**, see the topic, BEARING RACE REMOVAL AND INSTALLATION.

11. Remove the bearing cage **(16)** by using two 3/8" - 16 (NC) forcing screws as shown.



PREPARING TO REMOVE COUNTERSHAFT BEARING OUTER RACES
13–Rear bearing outer race. 14–Locating dowel. 15–Front bearing outer race. 16–Bearing cage.

12. Remove the locating dowel **(17)** from the bearing cage **(16)** and remove the bearing outer race **(15)**.



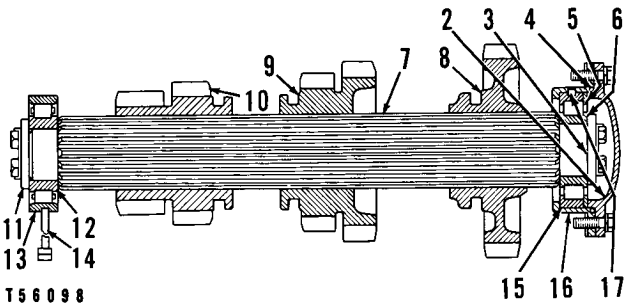
COUNTERSHAFT REAR BEARING OUTER RACE
15–Bearing outer race. 16–Bearing cage. 17–Locating dowel.

13. Replace the bearing outer races **(13)** and **(15)** and locating dowels **(14)** and **(17)** and make certain the locating dowels are properly engaged with their respective bearing race.

14. Install a new gasket with the bearing cage **(16)**.

15. Inspect each gear and replace any that show signs of chipping or excessive wear of the hardened outer surface of the gear teeth.

16. Heat the bearing **(12)** and secure the washer **(11)** and bearing to the countershaft **(7)**.



TRANSMISSION COUNTERSHAFT ASSEMBLY

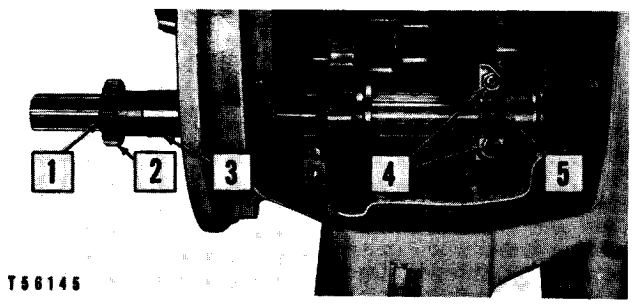
2–Cover.
3–Washer.
4–O-ring seal.
5–End plate.
6–Bearing.
7–Countershaft.
8–Forward and reverse sliding gear.
9–Third and fourth speed sliding gear.
10–First and second speed sliding gear.
11–Washer.
12–Bearing.
13–Bearing outer race.
14–Locating dowel.
15–Bearing outer race.
16–Bearing cage.
17–Locating dowel.

17. Move the countershaft into the transmission case and position the gears **(10)**, **(9)** and **(8)** on the shaft.

18. Heat the bearing **(6)** and secure the end plate **(5)**, bearing **(6)** and washer **(3)** to the countershaft.

19. Install the cover **(2)** with a new O-ring seal **(4)** as previously mentioned.

Upper Shaft Removal and Installation



PREPARING TO REMOVE UPPER SHAFT

☐ Remove

1–Retaining ring. 2–Drive pinion. 3–Spacer. 4–Nuts and bolts. 5–Collar.

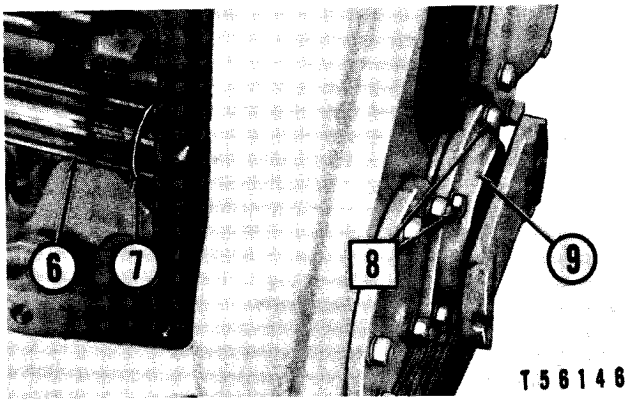
1. Remove the ring **(7)** from its groove, and move it toward the rear of the upper shaft **(6)**.

2. Drive the upper shaft rear bearing **(10)** out of its outer race and off the shaft.

CAUTION

Use extreme care to keep the drift in contact with the inner race.

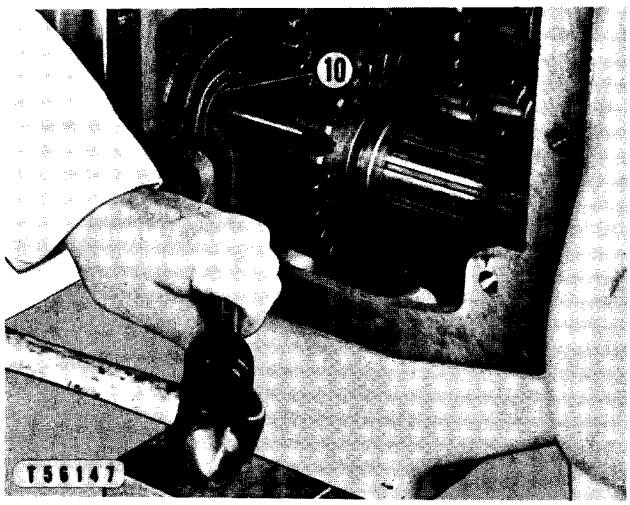
3. Move the upper shaft **(6)** forward until the fifth speed sliding gear **(11)** can be removed.



PREPARING TO REMOVE UPPER SHAFT

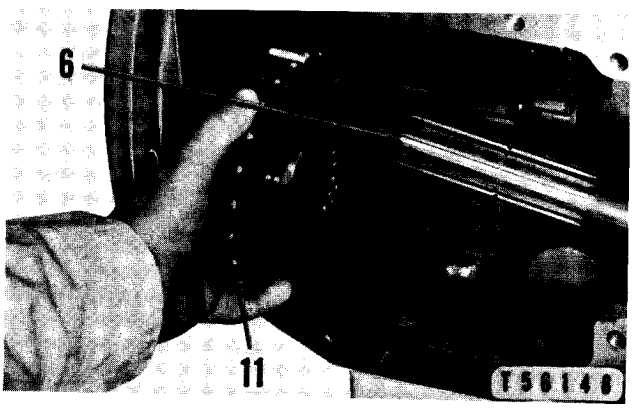
☐ Remove

6–Upper shaft. 7–Retaining ring. 8–Bolts (five). 9–Cover.



REMOVING UPPER SHAFT REAR BEARING

10–Bearing.

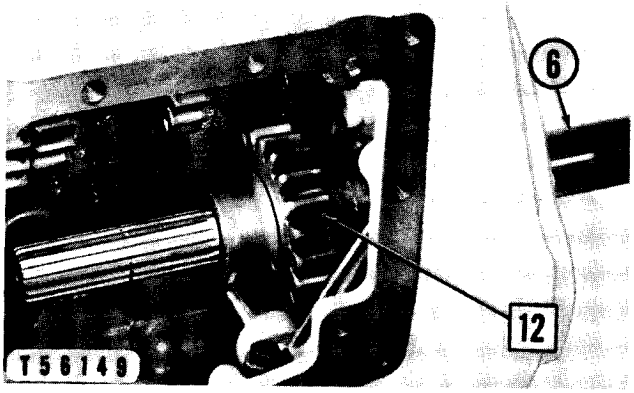


REMOVING FIFTH SPEED SLIDING GEAR

6–Upper shaft. 11–Fifth speed sliding gear.

4. Move the upper shaft **(6)** forward and out of the transmission case.

5. Inspect the bearing outer race **(13)**. If replacement is required, the outer race **(13)** can be removed after the locating dowel **(14)** has been

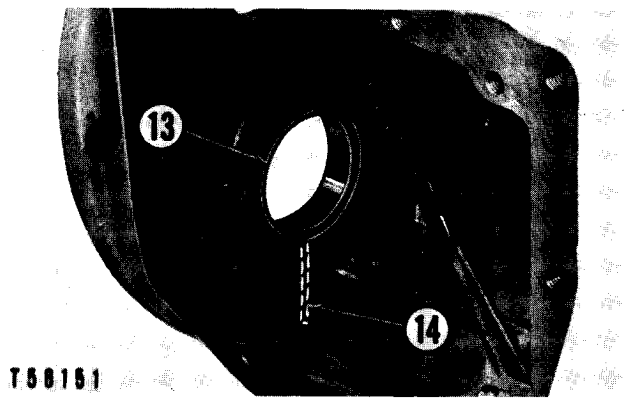


PREPARING TO REMOVE DRIVE PINION

☐ Remove

6–Upper shaft. 12–Drive pinion.

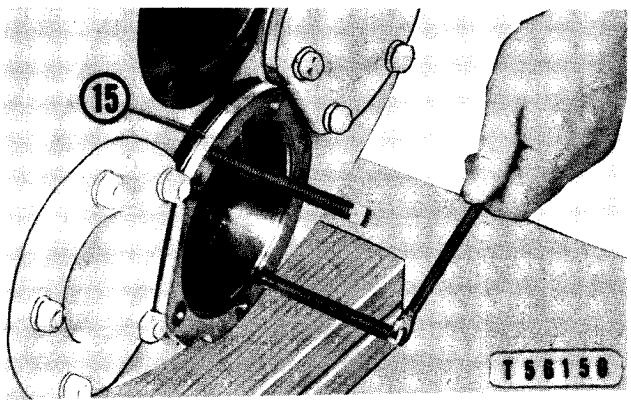
removed. For detailed information concerning the removal of the bearing outer race **(13)** see the topic, BEARING RACE REMOVAL AND INSTALLATION.



PREPARING TO REMOVE UPPER SHAFT REAR BEARING OUTER RACE

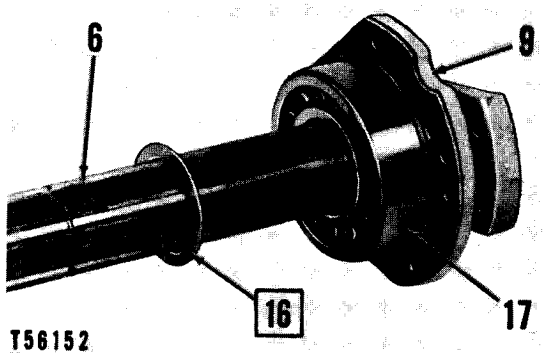
13–Bearing outer race. 14–Locating dowel.

6. The upper shaft front bearing cage **(15)** can be removed by using two 3/8" - 16 (NC) forcing screws.



REMOVING UPPER SHAFT FRONT BEARING CAGE

15–Front bearing cage.

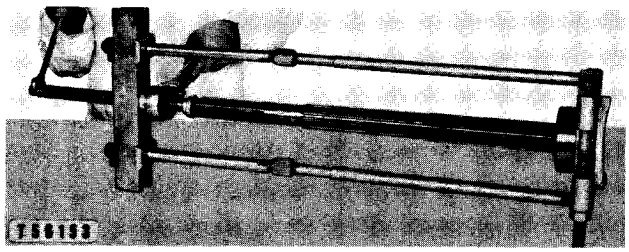


PREPARING TO REMOVE UPPER SHAFT FRONT BEARING

☐ Remove

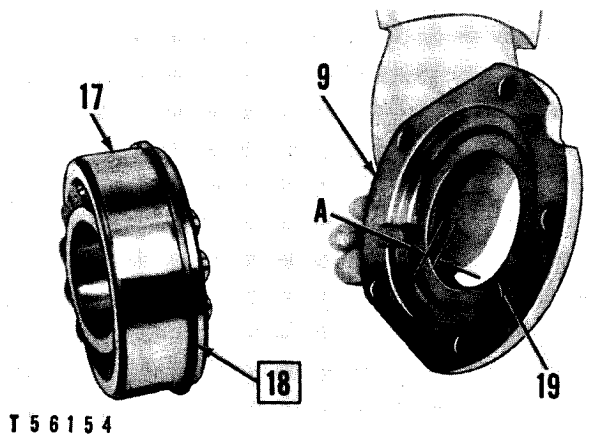
6–Upper shaft. 9–Cover. 16–Spacer. 17–Bearing.

7. The bearing **(17)** and cover **(9)** can be removed from the upper shaft **(6)** by using an 8B7548 Push Puller, 8B7549 Legs, 8B7555 Adapters, 8H684 Ratchet Wrench with an 8B7563 Handle and an 8B7551 Bearing Pulling Attachment set up as shown.



REMOVING UPPER SHAFT FRONT BEARING

8. Inspect the bearing **(17)** and seal **(19)** in the cover **(9)** and replace if necessary.



UPPER SHAFT FRONT BEARING AND COVER

☐ Remove

9–Cover. 17–Bearing. 18–Snap ring. 19–Seal.
A–1/8" Dimension.

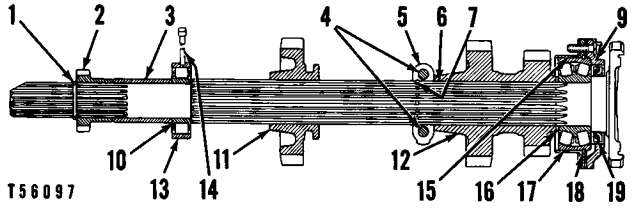
9. Install the seal **(19)** so the spring loaded lip will be toward the bearing. Install the seal to the dimension shown.

10. Lubricate the lip of the seal **(19)** and install the cover **(9)** on the upper shaft **(6)**.

11. Heat the bearing **(17)** and install it on the upper shaft. Tap the inner race to make certain it is bottomed against the shoulder on the upper shaft.

12. Install the bearing cage **(15)** with a new gasket.

13. Install the outer race **(13)** and make certain the locating dowel **(14)** is properly engaged with the outer race.



TRANSMISSION UPPER SHAFT ASSEMBLY

1–Retaining ring.
2–Drive pinion.
3–Spacer.
4–Nuts and bolts.
5–Collar.
6–Upper shaft.
7–Retaining ring.
9–Cover.
10–Bearing.
11–Fifth speed sliding gear.
12–Drive pinion.
13–Bearing outer race.
14–Locating dowel.
15–Front bearing cage.
16–Spacer.
17–Bearing.
18–Snap ring.
19–Seal.

14. Place the spacer **(16)** on the shaft.

15. Move the upper shaft into the transmission case and position the drive pinion **(12)**, retaining ring **(7)** and fifth speed sliding gear **(11)** on the upper shaft **(6)**.

16. Install and secure the collar **(5)**. Use new locks on the nuts and bolts **(4)**.

17. Heat the bearing **(10)** and position it on the upper shaft and into the outer race **(13)**.

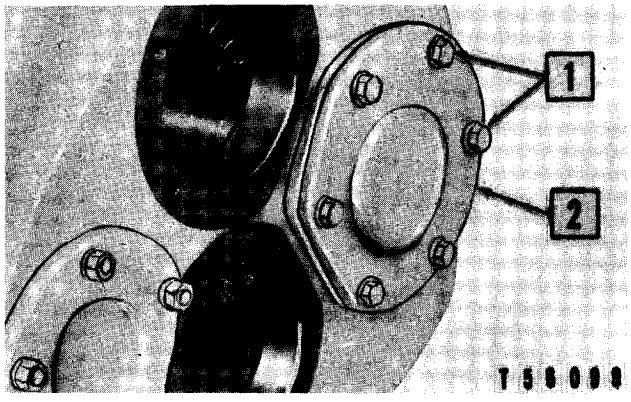
18. Install the spacer **(3)**, drive pinion **(2)** and retaining ring **(1)** as shown.

Pinion Shaft Removal and Installation

1. Use an 8B7548 Push Puller (using two 8B7550 Legs in place of the two 5F7369 Legs), 8B7557 Adapters, 8B7560 Step Plate and an 8H684 Ratchet Wrench to push the pinion shaft out of the bearing **(5)**.

2. Move the pinion shaft to the rear until the spacers **(6)** and **(7)** can be removed.

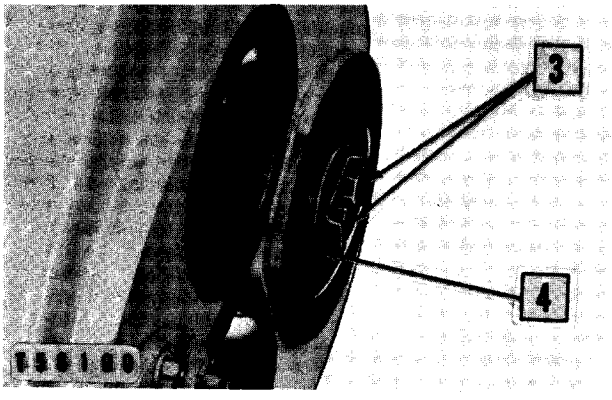
3. Continue to move the pinion shaft **(13)** toward the rear, and remove the fourth speed gear **(8)**, third speed gear **(9)**, second speed gear **(10)**, fifth speed gear **(11)** and first speed gear **(12)** as shown.



PREPARING TO REMOVE PINION SHAFT

☐ **Remove**

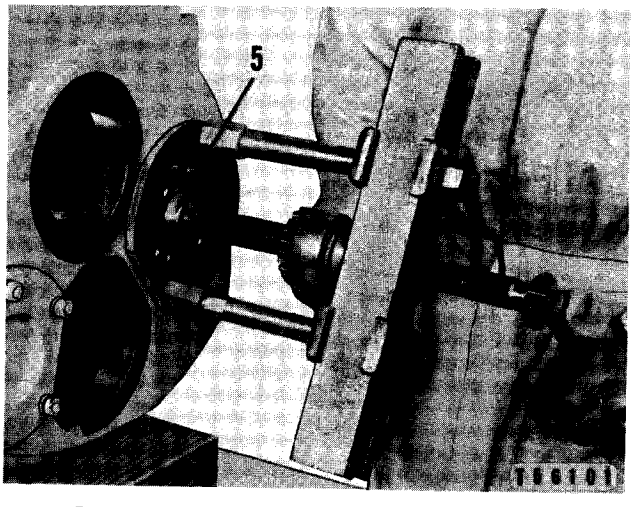
1–Bolts (six). 2–Cover.



PREPARING TO REMOVE PINION SHAFT

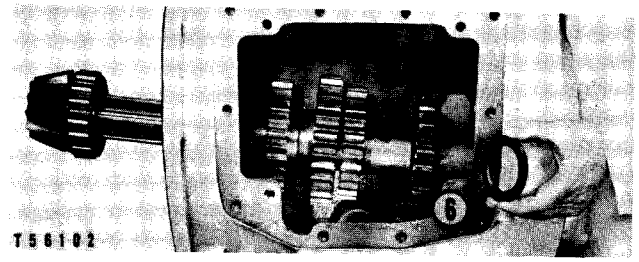
☐ **Remove**

3–Bolts. 4–Retainer.

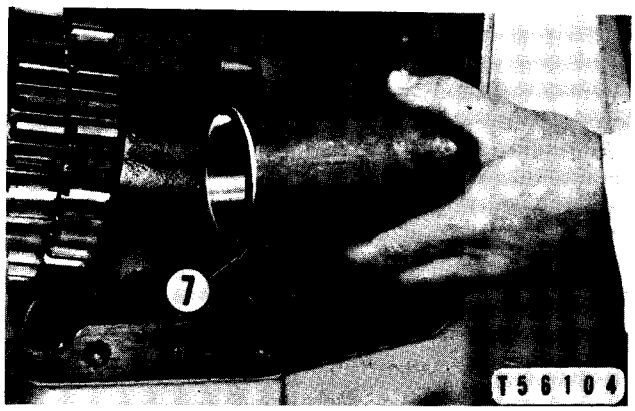


PUSHING PINION SHAFT OUT OF BEARING

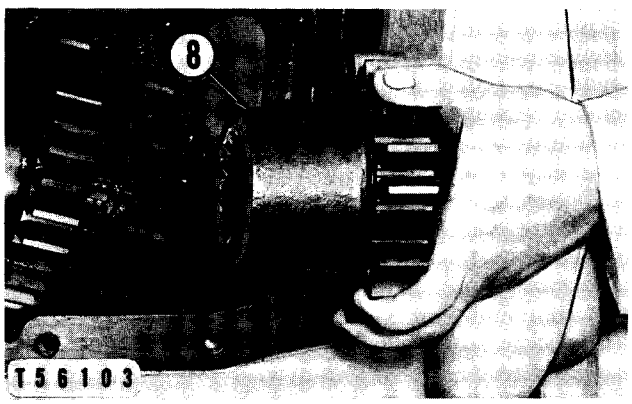
5–Bearing.



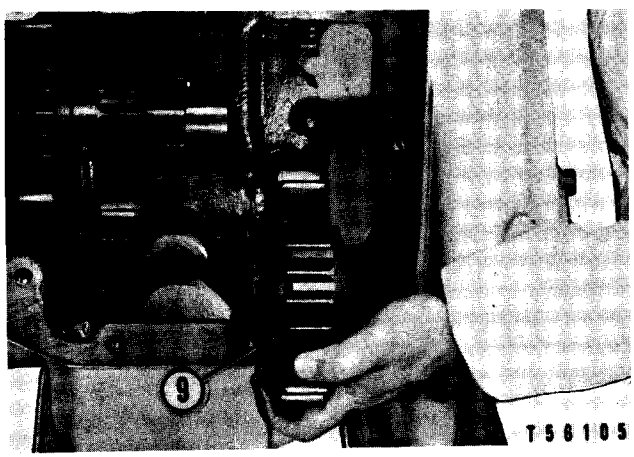
REMOVING SPACER
6–Spacer.



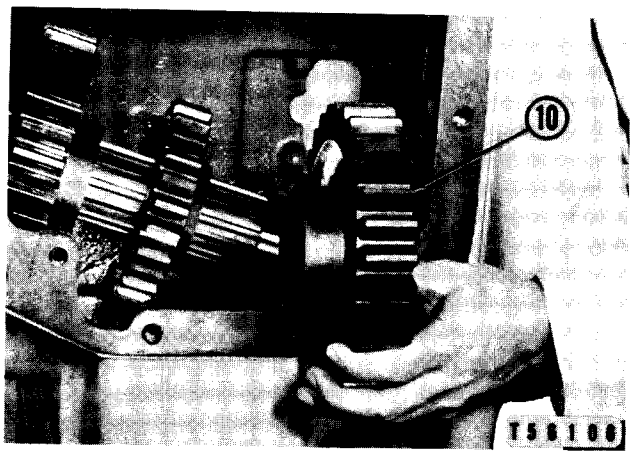
REMOVING SPACER
7–Spacer.



REMOVING FOURTH SPEED GEAR
8–Fourth speed gear.

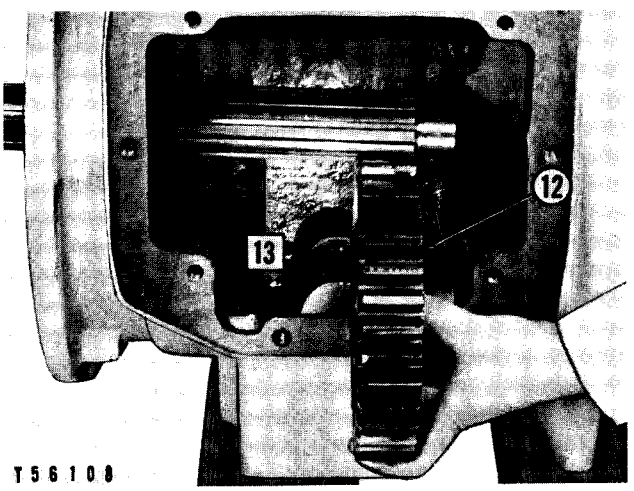


REMOVING THIRD SPEED GEAR
9–Third speed gear.



REMOVING SECOND SPEED GEAR
10–Second speed gear.

REMOVING FIFTH SPEED GEAR
11–Fifth speed gear.



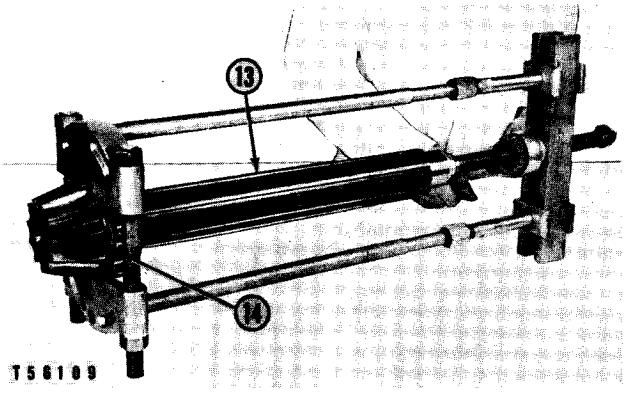
REMOVING FIRST SPEED GEAR

☐ Remove

12–First speed gear. 13–Bevel pinion shaft.

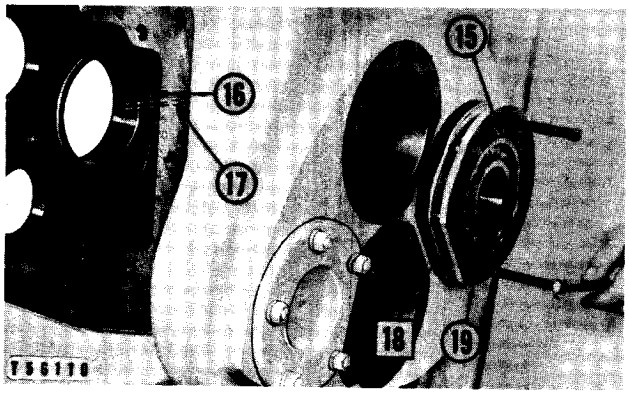
4. The pinion shaft rear bearing **(14)** can be removed from the pinion shaft **(13)** by using an 8B7548 Push Puller, 8B7555 Adapters, 8B7549

Legs, 8B7551 Bearing Pulling Attachment, 8B7560 Step Plate and an 8H684 Ratchet Wrench as shown.



REMOVING BEVEL PINION SHAFT REAR BEARING
13–Bevel pinion shaft. 14–Bevel pinion shaft rear bearing.

5. The pinion shaft front bearing **(15)** and cage **(19)** can be removed by using two 3/8" - 16 (NC) forcing screws as shown.



REMOVING PINION SHAFT FRONT BEARING AND CAGE

☐ **Remove**

15–Pinion shaft front bearing. 16–Pinion shaft rear bearing outer race. 17–Locating dowel. 18–Shims. 19–Bearing cage.

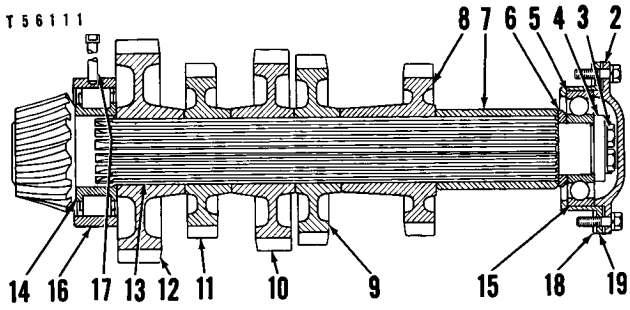
NOTE

Wire the shims **(18)** together so they will not become separated.

6. The bearing **(15)** can be pressed out of the cage **(19)**.

7. Remove the locating dowel **(17)** and race **(16)**. See the topic, BEARING RACE REMOVAL AND INSTALLATION.

8. Replace the race **(16)** in the transmission case as outlined in the topic, BEARING RACE REMOVAL AND INSTALLATION.



TRANSMISSION PINION SHAFT ASSEMBLY

2–Cover.
3–Bolts (two).
4–Retainer.
5–Bearing.
6–Spacer.
7–Spacer.
8–Fourth speed gear.
9–Third speed gear.
10–Second speed gear.
11–Fifth speed gear.
12–First speed gear.
13–Bevel pinion shaft.
14–Bevel pinion shaft rear bearing.
15–Pinion shaft front bearing.
16–Pinion shaft rear bearing outer race.
17–Locating dowel.
18–Shims.
19–Bearing cage.

9. Press the bearing **(15)** into the cage **(19)**, and press the cage **(19)** with the shims **(18)** into its bore in the transmission case. See the topic, BEVEL GEAR AND PINION SETTING, for the correct shim placement procedure.

10. Heat the bearing **(14)** and install it on the pinion shaft **(13)**.

11. Place the pinion shaft into the transmission case and position gears **(12)**, **(11)**, **(10)**, **(9)**, **(8)**, and spacers **(7)** and **(6)** on the pinion shaft.

12. Place the retainer **(4)** over the inner race of the bearing **(15)** and use two 1/2" - 20 (NF) bolts 1 3/4" long to draw the pinion shaft into the bearing **(15)**.

13. Remove the bolts mentioned in step 12 and install new locks and the correct bolts **(3)**.

14. Install the cover **(2)** with a new gasket.

NOTE

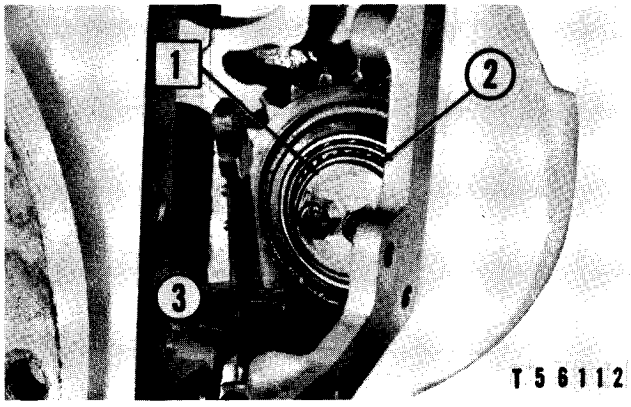
Although it will be necessary to remove the cover to adjust the bevel gear and pinion setting, it is recommended the cover be installed at this point to prevent the entry of dirt into the bearing **(15)** and transmission.

Idler Gear Group Removal and Installation

NOTE

Remove the shims behind the washer and wire them together so they can be used at the time of assembly.

1. Remove the nuts which secure the trunnion **(4)** to the transmission case.

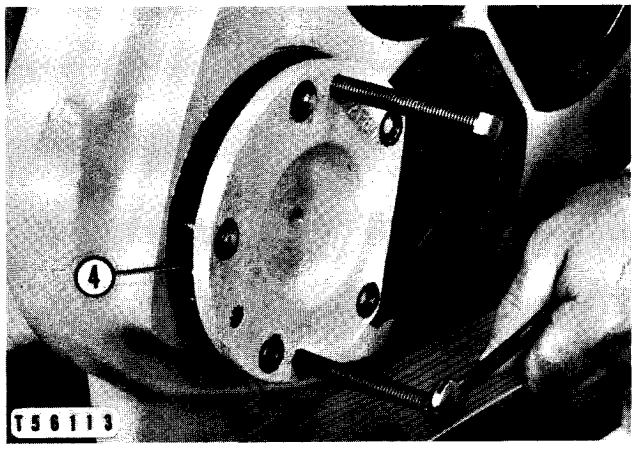


PREPARING TO REMOVE IDLER GEAR AND TRUNNION

☐ **Remove**

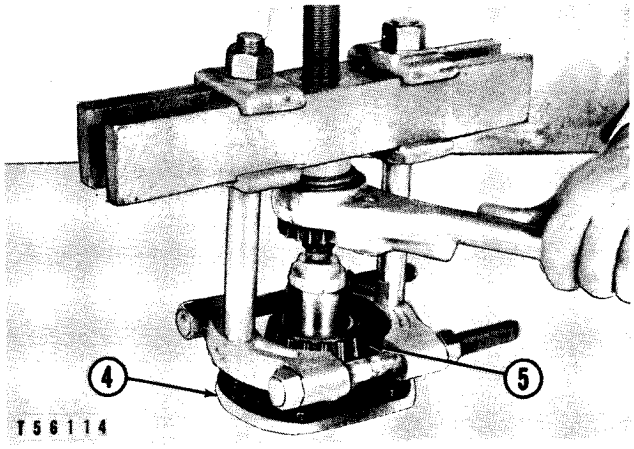
1–Washer. 2–Cone. 3–Idler gear.

2. Install two 3/8" - 16 (NC) forcing screws and remove the trunnion **(4)** as shown.



REMOVING IDLER GEAR AND TRUNNION
4–Trunnion.

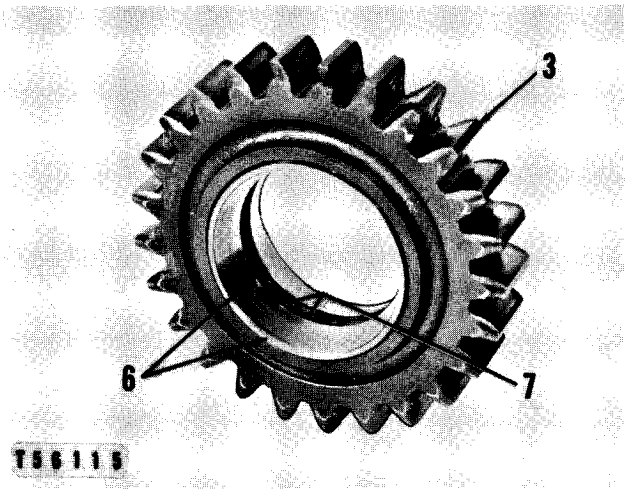
3. As the trunnion **(4)** is moved away from the transmission case, the gear **(3)** and cone **(2)** will be forced off the trunnion shaft. Use the necessary precaution to prevent them from falling into the transmission case.



REMOVING TRUNNION SHAFT INNER CONE
4–Trunnion. 5–Cone.

4. Use an 8B7548 Push Puller (using two 8B7550 Legs in place of the two 5F7369 Legs), 8H663 Bearing Pulling Attachment, 8H684 Ratchet Wrench and an 8B7560 Step Plate to pull the inner cone **(5)** from the shaft on the trunnion **(4)**.

5. Inspect the gear **(3)** and cups **(6)** for damage or excessive wear and replace as necessary.



IDLER GEAR
3–Idler gear. 6–Cups. 7–Snap rings.

6. When installing the cups **(6)** in the gear **(3)**, refer to the topic, SPECIFICATIONS, for the amount of force to apply to the cups against the snap rings **(7)**.

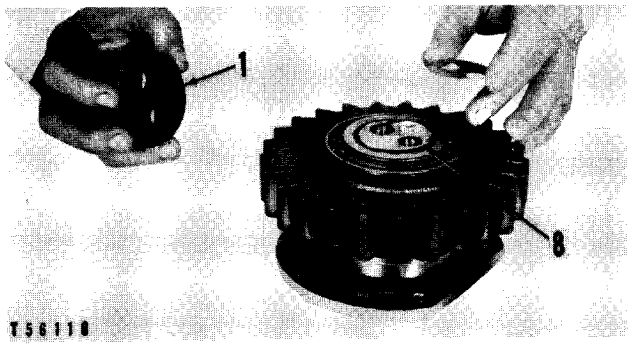
7. Heat the inner cone **(5)** and place it on the trunnion shaft.

8. Place the idler gear on the inner cone.

CAUTION

Install the gear **(3)** so the rounded ends of the teeth will be toward the rear of the transmission case when the trunnion is in the installed position.

9. Heat the outer cone **(2)** and position it on the trunnion shaft.

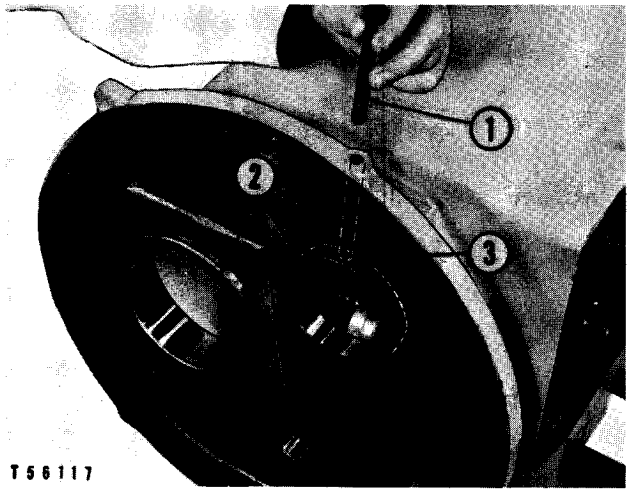


ADJUSTING IDLER GEAR BEARING END PLAY
1–Washer. 8–Shims.

10. Install the shims **(8)** and washer **(1)**.
11. Add or remove shims **(8)** until there is no perceptible end play in the bearings. Refer to the topic, SPECIFICATIONS.
12. Remove the washer **(1)**, shims **(8)** and gear **(3)** from the trunnion.
13. Install a new cork seal on the trunnion **(4)** and position the trunnion in the transmission case.
14. Install the gear as previously mentioned.
15. The cone can be heated and placed on the shaft or drawn onto the shaft by using two 1/2" - 20 (NF) bolts 1 1/2" long.
16. Install the shims as determined in step 11.
17. Install and secure the washer **(1)**.

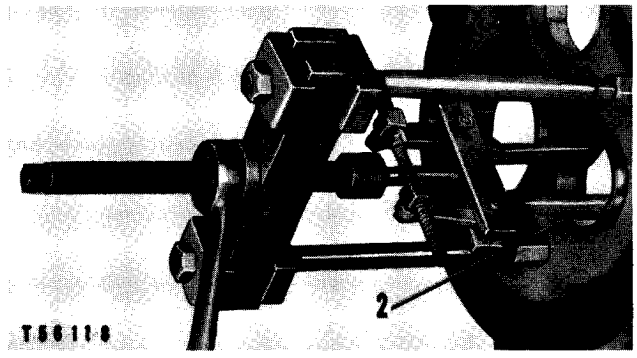
Bearing Race Removal and Installation

1. Remove the plugs which retain the position of the locating dowels **(1)**.
2. Screw a 1/4" - 20 (NC) bolt into the end of the dowel, and remove the dowel as shown.



REMOVING LOCATING DOWEL
1–Locating dowels (three). 2–Bearing outer races. 3–Dowel hole in race.

3. The bearing outer races **(2)** can be removed from the rear of the transmission case by using an 8B7548 Push Puller, 8B7553 Adapter and an 8B7554 Bearing Cup Pulling Attachment.
4. Align the dowel holes in the transmission case and bearing race and use a soft hammer to drive the race into the transmission case.
5. Drive the race into the transmission case until the dowel drops into the dowel hole **(3)** in the race and install the plugs in the bore at the end of the dowel.

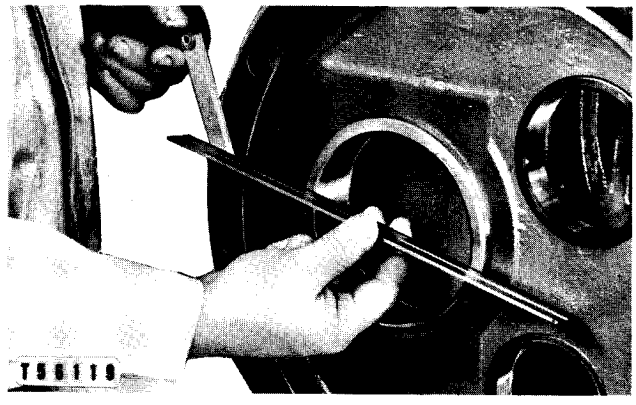


REMOVING BEARING OUTER RACE
2–Bearing outer race.

NOTE

The pinion shaft rear bearing outer race has the dowel hole in the race located off center. The shorter dimension from the dowel hole to the side of the race should be installed to the rear or outside of the transmission case.

6. After the pinion shaft rear bearing outer race is installed, use a straight edge and thickness gauge to check the projection of the race beyond the machined rear outer surface of the transmission case. See the topic, SPECIFICATIONS.



CHECKING PINION SHAFT REAR RACE PROJECTION

NOTE

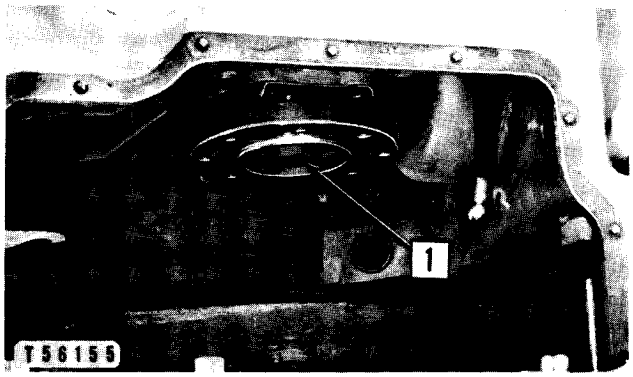
The outer race should be aligned. To check this alignment, lay a two-foot straightedge on the race, and using thickness gauges, carefully measure the distance between the straightedge and the machined face of the transmission case. Turn the straightedge 90° and again measure the distance between the straightedge and the machined face of the case.

The four measurements should be within .002". If the measurements are not within .002", realign the race with a soft hammer. Press the bearing races into the cages.

Bevel Gear

REMOVAL AND INSTALLATION

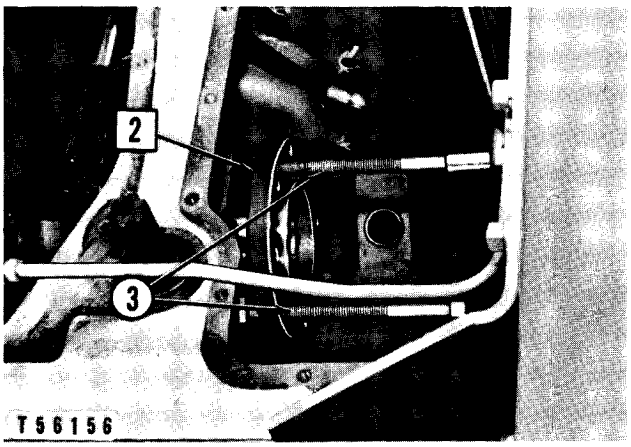
1. Drain the oil from the transmission, bevel gear and steering clutch compartment.
2. Remove the seat, fuel tank, steering clutches and steering clutch hydraulic control as described in the covering topics.



PREPARING TO REMOVE COUPLING

☐ **Remove**

1–Bolt and lock.



REMOVING COUPLING

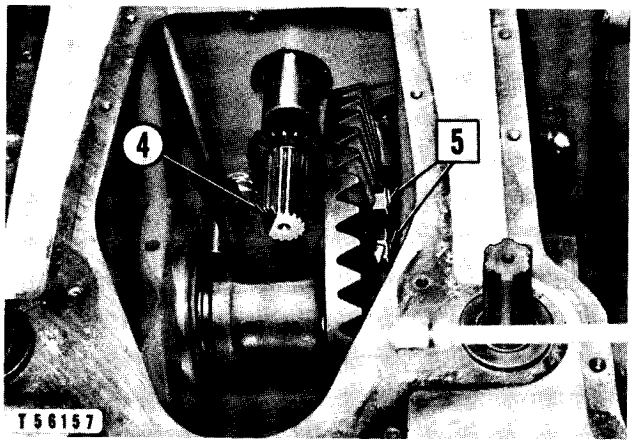
☐ **Remove**

2–Coupling. 3–8B7552 Forcing Bolts (two).

3. Remove the coupling **(2)** using the forcing bolts **(3)**.
4. Remove the coupling on the left side in the same manner.

NOTE

A chamfer **(4)** is provided on the transmission upper shaft to provide the necessary clearance for removal of the bevel gear shaft **(11)** when the transmission is installed in the machine.

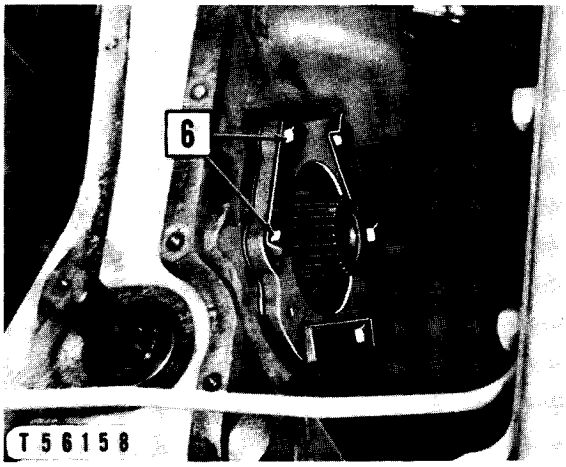


PREPARING TO REMOVE BEVEL GEAR

☐ **Remove**

4–Chamfer. 5–Bolts, nuts and locks.

5. Support the bevel gear and shaft in a suitable manner before removing the bearing cage **(8)**.

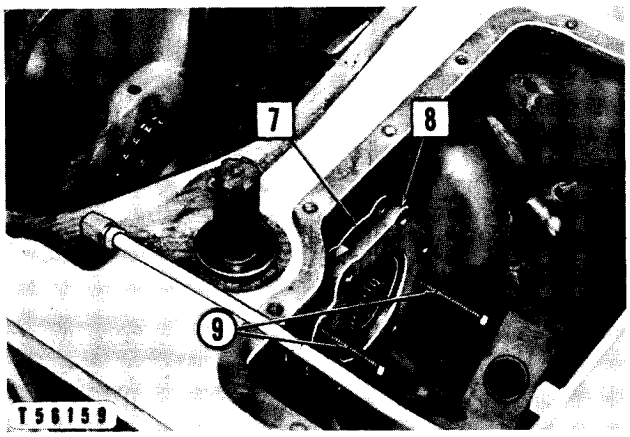


PREPARING TO REMOVE BEARING CAGE

☐ **Remove**

6–Bolts (six) and locks (three).

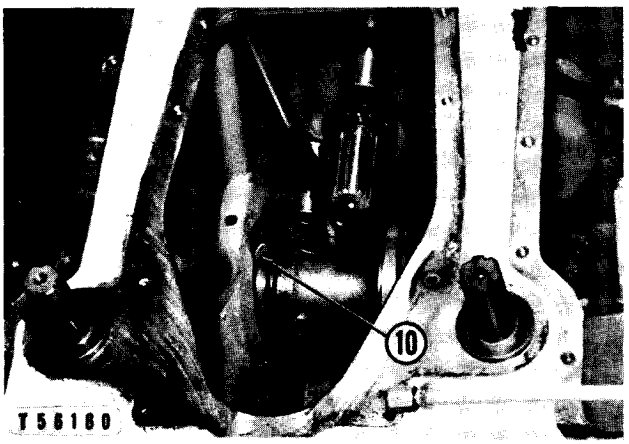
6. Use 3/8" - 16 (NC) forcing screws **(9)** to facilitate removal of the bearing cage **(8)**.
7. Keep the shims **(7)** with the bearing cage **(8)** and do not mix them with shims from the other side.
8. Remove the bearing cage from the left side in the same manner.
9. Turn the transmission upper shaft so the chamfer **(4)** is down and move the bearing cone **(10)** off the left end of the bevel gear shaft far enough to clear the bore for the bearing cage, allowing the shaft to rest on the bottom of the bearing cage bore.



REMOVING BEARING CAGE

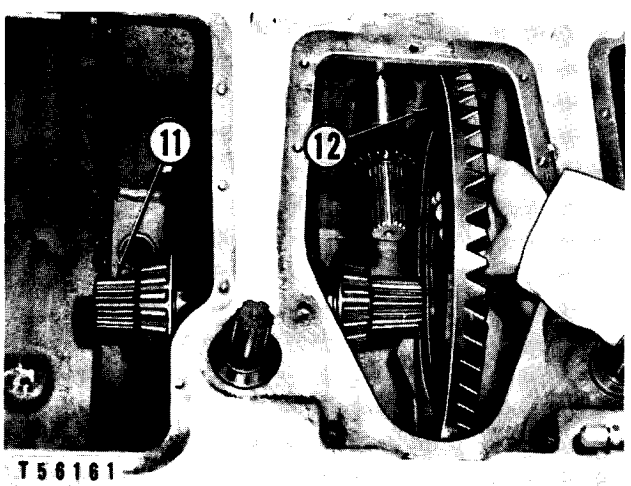
☐ **Remove**

7–Shims. 8–Bearing cage. 9–Forcing screws (two).



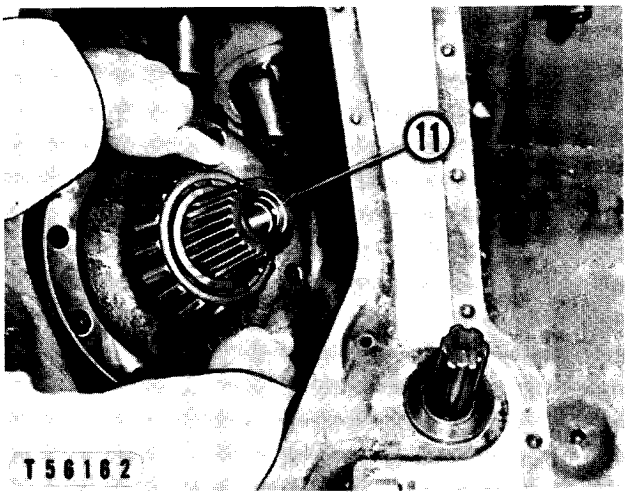
PREPARING TO REMOVE BEVEL GEAR
10–Bearing cone.

10. Move the bevel gear shaft **(11)** to the left into the left steering clutch compartment. Remove the bevel gear **(12)** by moving the top slightly to the left as it is raised from between the bevel gear shaft and the side of the bevel gear compartment.



REMOVING BEVEL GEAR
11–Bevel gear shaft. 12–Bevel gear.

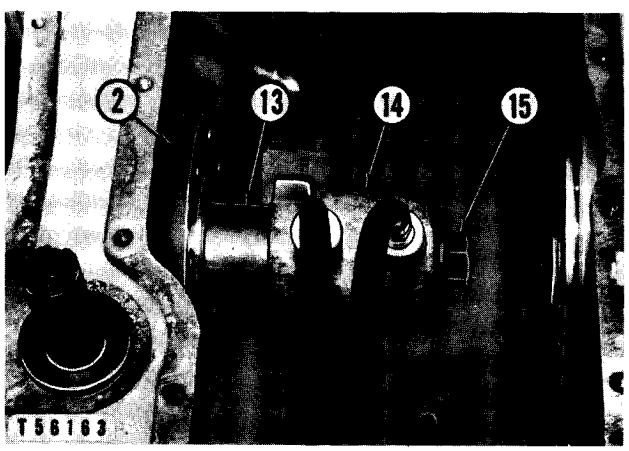
11. Turn the transmission upper shaft so the chamfer is positioned to provide the required clearance and remove the bevel gear shaft **(11)** by lifting it up and out as shown.



REMOVING BEVEL GEAR SHAFT
11–Bevel gear shaft.

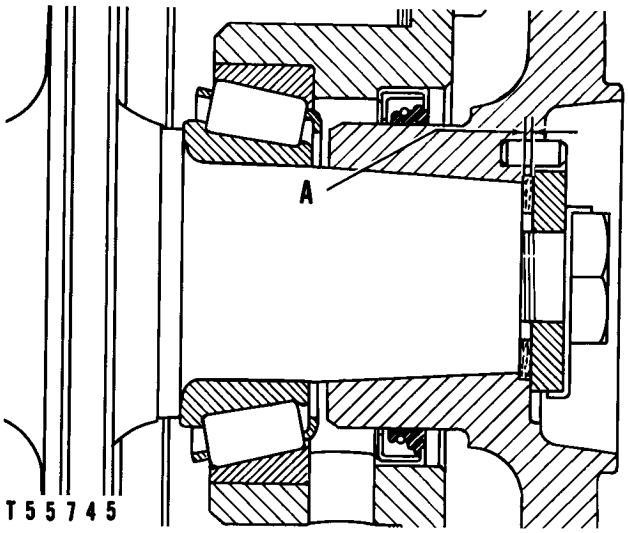
12. Install the bevel gear and bevel gear shaft in the reverse order of removal.

13. Adjust the bevel gear and pinion backlash as described in the covering topic.



PRESSING COUPLING ON BEVEL GEAR SHAFT
2–Coupling. 13–7M7238 Sleeve. 14–7F9540 Hydraulic Puller. 15–7B8363 Bolt.

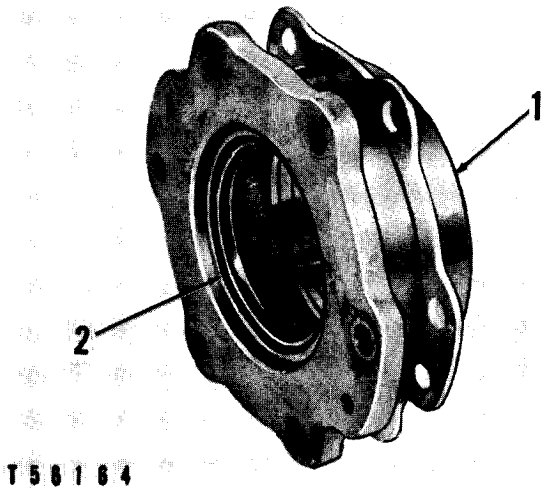
14. Press the coupling **(2)** on the bevel gear shaft **(11)** to the force listed in the topic, SPECIFICATIONS, using the sleeve **(13)**, hydraulic puller **(14)** and bolt **(15)** with the 6F25 Pump Group. The distance **(A)** between the face of the coupling and the shoulder on the bevel gear shaft should be equal to the value given in the topic, SPECIFICATIONS.



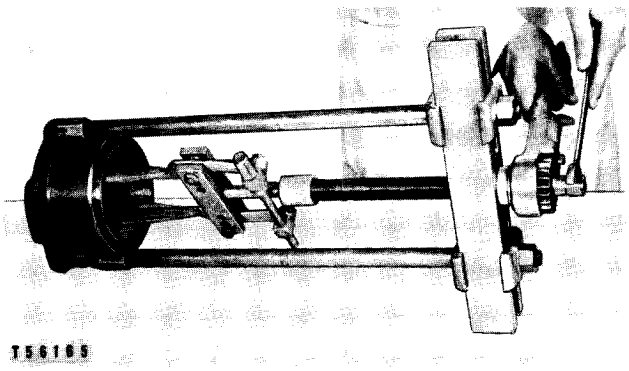
COUPLING TO BEVEL GEAR SHAFT PRESS FIT
A–Dimension to be checked.

DISASSEMBLY AND ASSEMBLY

1. Inspect the oil seal **(2)** in the bearing cage **(1)** and replace if necessary. Install the seal with the lip edge toward the bevel gear.

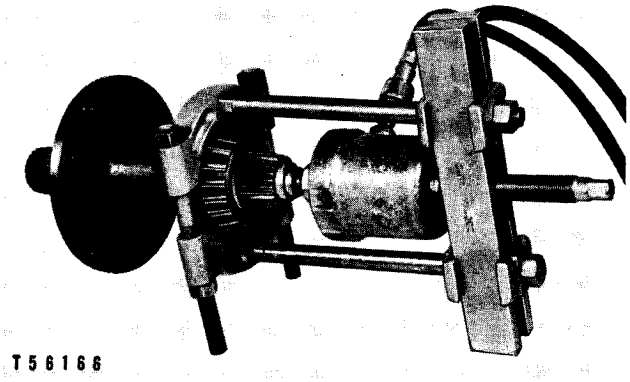


BEARING CAGE AND OIL SEAL
1–Bearing cage. 2–Oil seal.



REMOVING CUP

2. Remove the cups from the bearing cages using an 8B7548 Push Puller (with two 8B7549 Legs in place of the two 5F7369 Legs), an 8B7554 Bearing Cup Pulling Attachment with an 8B7553 Adapter and 8H684 Ratchet Box Wrench.
3. Chill the cups in dry ice prior to installation.
4. Remove the bearing cones from the shaft with the 6F25 Pump Group, a 7F9540 Hydraulic Puller, an 8B7548 Push Puller (with two 8B7549 Legs in place of the two 5F7369 Legs) an 8B7551 Bearing Pulling Attachment and an 8B7560 Step Plate.



REMOVING BEARING CONES

5. Heat the bearing cones in oil before installing them.

BEVEL GEAR AND PINION SETTING

The bevel gear and pinion must be adjusted to the proper location to obtain the correct tooth contact.

Shims are provided between the pinion bearing cage flange and the front cover of the transmission case, so the pinion can be moved toward or away from the centerline of the bevel gear shaft. Other shims are located between the bevel gear shaft bearing cages and the walls of the bevel gear compartment to permit moving the bevel gear toward or away from the centerline of the bevel pinion shaft, thereby changing the backlash. Moving either the bevel gear or the pinion affects both backlash and tooth contact so the two must be adjusted at the same time.

Because of manufacturing tolerances, the relative positions of the bevel gear and the pinion gear will vary with different sets. The correct amount of backlash for each bevel gear and bevel pinion, which are installed at the factory, is marked on the outer surface of the bevel gear. If the gear is not marked, see the topic, SPECIFICATIONS.

After adjusting the bevel gear shaft bearing preload, the backlash should be set as described in the topic, BACKLASH ADJUSTMENT.

Bevel Gear Shaft Bearing Adjustment

It is preferred that the bevel gear shaft bearing preload be set with the transmission removed. This permits adjusting the bearings to a definite preload.

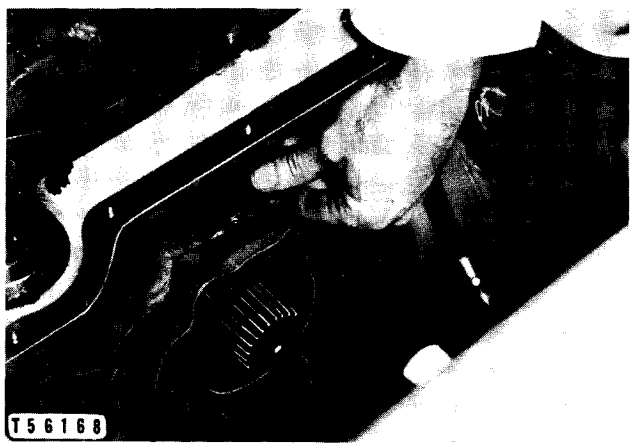
Install a full shim pack under the bearing cage farther from the bevel gear. Tighten all the bolts.

Install the other bearing cage without shims and tighten the bolts evenly while slowly rotating the bevel gear until a torque, given in the topic, SPECIFICATIONS, is required to rotate it.

Rotate the bevel gear shaft bearings several times before making the final adjustment.

To determine the torque required to rotate the bevel gear shaft, install the coupling retaining bolt into the shaft and apply a torque wrench to the bolt.

Use a thickness gauge as shown to determine the clearance between the flange of the bearing cage and the face of the bevel gear case at each bolt location making sure the clearance is the same all around the cage.



MEASURING CLEARANCE

Remove the cage and install shims with a total thickness the same as the measured clearance. Install the cage and tighten the bolts.

Recheck the torque required to rotate the bevel gear shaft.

After the transmission is in place, adjust the backlash as described in the topic, BACKLASH ADJUSTMENT, moving the shims from one cage to the other as required, but not changing the total number of shims.

If the transmission is in place and it is not feasible to remove it, the bevel gear shaft bearings can be preloaded in the following manner. An approximate adjustment for blacklash can be made at the same time.

1. Install enough shims behind the bearing cage nearer the bevel gear to give approximately the amount of backlash indicated on the outer surface of the bevel gear or as given in the topic, SPECIFICATIONS.
2. Install the other bearing cage without shims or lockwashers and tighten the bolts evenly while slowly rotating the bevel gear until a definite preload is noticeable on the bevel gear shaft bearings.
3. Evenly back off the bolts on the bearing cage without shims until approximately .002" end clearance has been reached on the bevel gear shaft, being sure there is backlash between the bevel gear and pinion.

NOTE

To determine end clearance, pry against the ends of the bevel gear shaft.

4. Use a thickness gauge to determine the clearance between the flange of the bearing cage and the face of the bevel gear case at each bolt location making sure the clearance is the same all around the cage.
5. Remove the cage and install the shims with a total thickness the same as the clearance determined in step 4 less .024" to give the required preload to the bevel gear shaft bearings.

NOTE

The .024" shim removal includes .002" end clearance as left in step 3, plus the .022" normal preload.

6. Again install the cage and lockwashers and securely tighten the bolts.

Backlash Adjustment

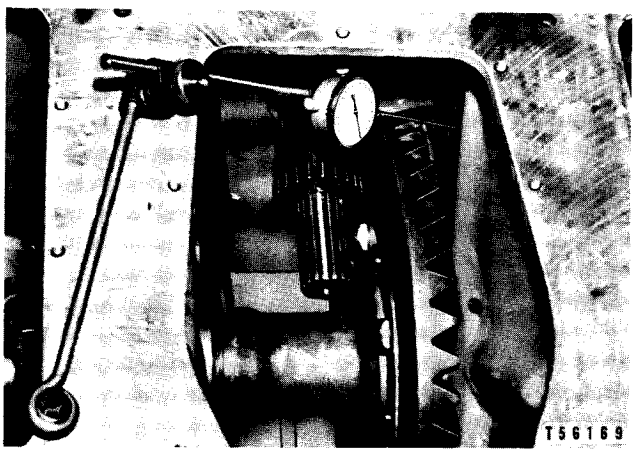
1. Mount a dial indicator on the bevel gear case with a long stem attachment on one of the pinion gear teeth as shown.
2. Block the bevel gear.
3. Rock the pinion gear back and forth. The backlash between the bevel gear and pinion will be the difference in readings on the dial indicator.

4. Check the backlash at four points around the bevel gear to determine the point of least backlash.

NOTE

The correct amount of backlash is marked on the outer surface of the bevel gear which is installed at the factory. If the gear is not marked, see the topic, SPECIFICATIONS.

5. If the reading is too great at the point of least backlash, remove shims from the bearing cage on the left side and install them on the right side.



MEASURING BACKLASH

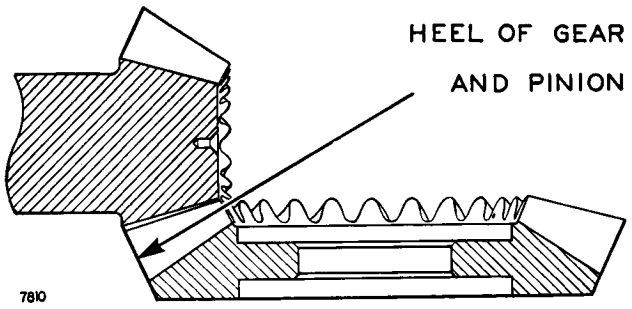
6. To increase the backlash, move shims from the right side to the left side.

NOTE

The preload on the bevel gear shaft bearings will not be changed by moving shims from one side to the other if the same total number of shims is maintained.

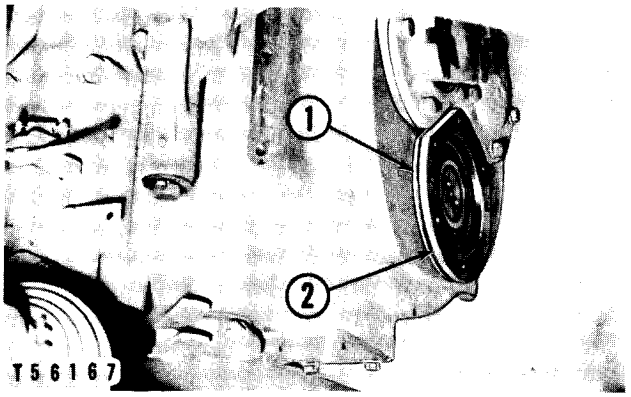
Bevel Pinion Location

If the same pinion shaft is installed in the same transmission case, use the same shims back of the bearing cage flange at the front end of the pinion shaft that were removed when the transmission was disassembled.



ALIGNING BEVEL GEAR AND PINION

When installing a new pinion shaft, use sufficient shims between the front bearing cage flange and the transmission front cover to align the heel ends of the bevel gear and pinion gear teeth. This will place the pinion in nearly the correct relationship with the bevel gear.



BEVEL PINION BEARING CAGE AND SHIMS
1–Shims. 2–Bearing cage flange.

Adding shims will move the pinion gear away from the centerline of the bevel gear shaft. Removing shims will move the pinion toward the centerline of the bevel gear shaft.

Adjust the bevel gear backlash as described in the topic, BACKLASH ADJUSTMENT. This should give a very close adjustment.

To check the adjustment further, brush Prussian blue or red lead sparingly on the bevel gear teeth. When the pinion is rotated, the red lead is squeezed away by the contact of the teeth, leaving bare areas of the contacts. Sharper impressions can be obtained by applying a small amount of resistance to the bevel gear while rotating the pinion. When making adjustments, check the drive side of the bevel gear teeth. The reverse or coast side contact should automatically be correct when the drive side is correct.

With adjustments properly made, the correct tooth contact shown in Figure A will be secured. The area of contact starts near the toe of the gear and extends about 30 per cent of the tooth length. This adjustment results in a quiet running bevel gear and pinion set which, because the load is distributed over the teeth within the proper area, will give maximum service life. It is permissible for the tooth contact area to be slightly greater on the convex face.

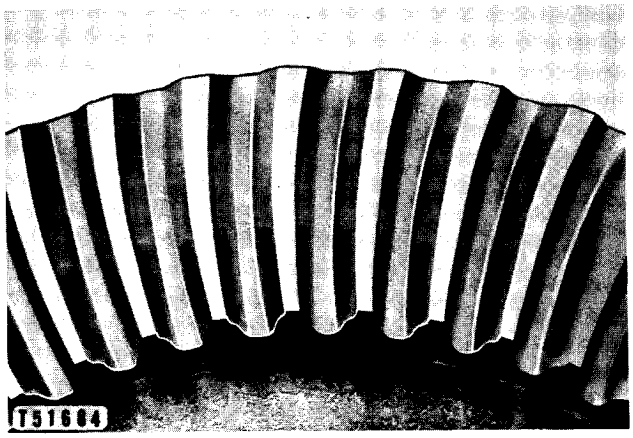


FIG. A
PROPER TOOTH CONTACT PATTERN

In Fig. B, the pinion is too far away from the centerline of the bevel gear shaft causing the teeth to bear on the toe ends of the convex faces and toward the heel end of the concave faces. To correct this, move the pinion toward the gear by removing shims from the bevel pinion bearing cage. Recheck the backlash, changing it if necessary, and again check the tooth contact pattern. To correct the backlash, move the bevel gear away from the pinion.

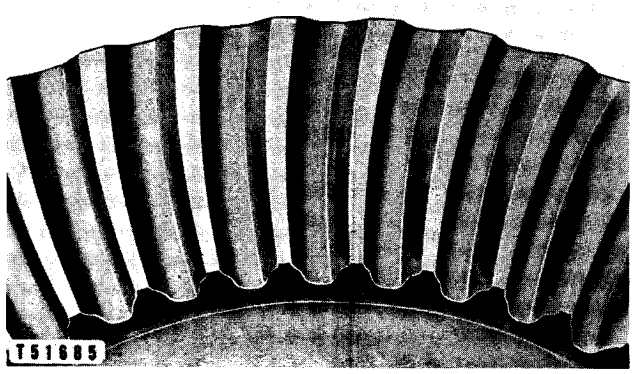


FIG. B
SHORT TOE CONTACT

In Fig. C, the pinion is too close to the centerline of the bevel gear shaft causing the teeth to bear on the toe ends of the concave faces and the heel ends of the convex faces. To correct, add shims to the bevel pinion bearing cage. Then, recheck the backlash and tooth contact patterns. To correct the backlash, move the bevel gear toward the pinion.

Several adjustments of both the pinion and bevel gear may be necessary before correct tooth contact and backlash are secured.

Always remember that the backlash will also affect the tooth contact pattern. Therefore, be sure the backlash is properly adjusted before checking the adjustment of the pinion.

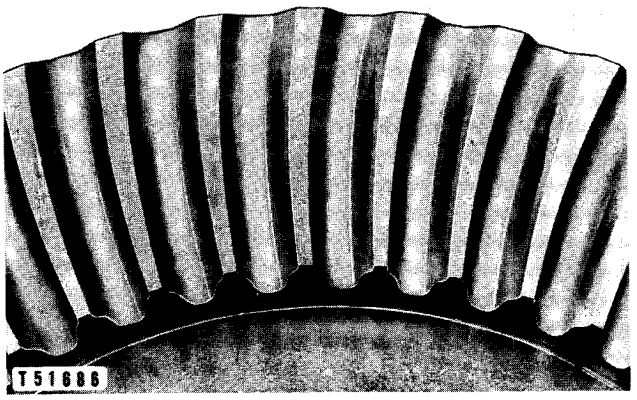


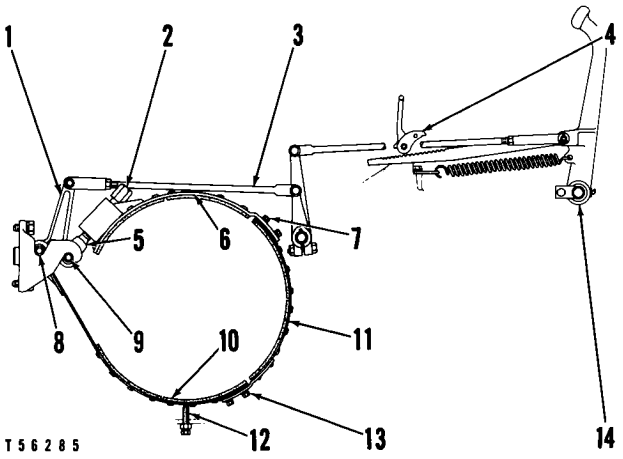
FIG. C
SHORT HEEL CONTACT

Brakes

Two separate foot brakes are used to supplement the action of the steering clutches or to stop the tractor. Each pedal operates a self-energizing brake band on the steering clutch outer drum. The right brake has a hand-operated lock to set the brake in a locked position.

REMOVING AND INSTALLING BRAKE BANDS

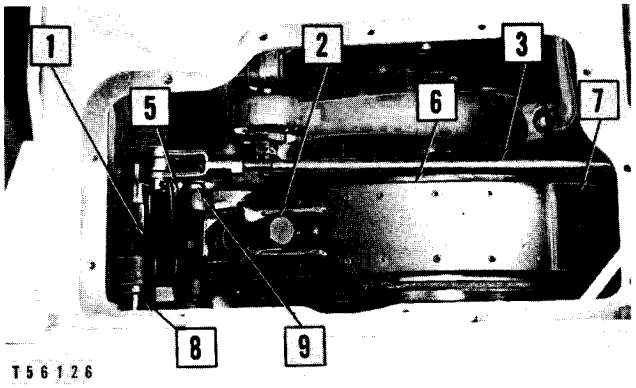
The brake bands can be removed by working through the openings on the top and rear of the steering clutch case.



BRAKE MECHANISM

1–Lever.
2–Brake adjusting nut.
3–Brake rod.
4–Brake lock pawl.
5–Fork.
6–Top section of band.
7–Nuts (six).
8–Anchor pin.
9–Anchor pin.
10–Lower section of band.
11–Front section of band.
12–Support screw.
13–Nuts (six).
14–Brake foot pedal.

1. Remove the larger cover over the steering clutch compartment.

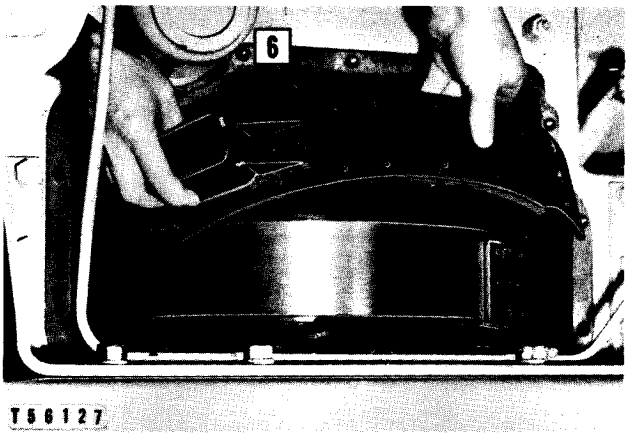


REMOVING BRAKE BAND ASSEMBLY

☐ **Remove**

1–Lever. 2–Brake adjusting nut. 3–Brake rod. 5–Fork. 6–Top section of band. 7–Nuts (six). 8–Anchor pin. 9–Anchor pin.

2. Take out the pins at both ends of the brake rod **(3)** and remove the rod.
3. Loosen or remove the support screw **(12)** on the underside of the steering clutch case.
4. Unscrew the adjusting nut **(2)** from the fork **(5)**.
5. Rotate the lever **(1)** forward about the anchor pin **(9)** and slide out the other anchor pin **(8)**. The anchor pin **(9)**, fork **(5)** and lever **(1)** may then be removed.

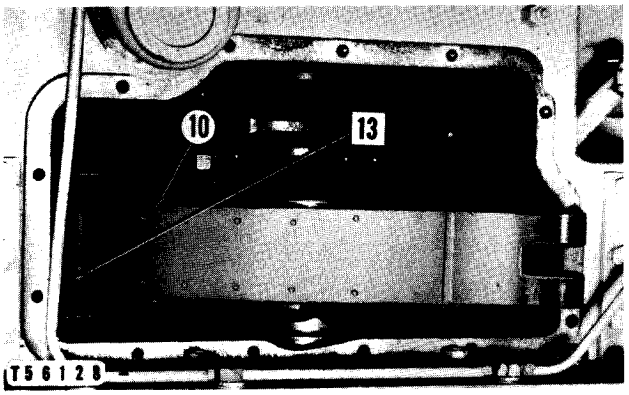


REMOVING TOP SECTION

☐ **Remove**

6–Top section of band.

6. Take off the nuts **(7)** which hold the top section of the band to the front section **(11)** and remove the top section **(6)**.

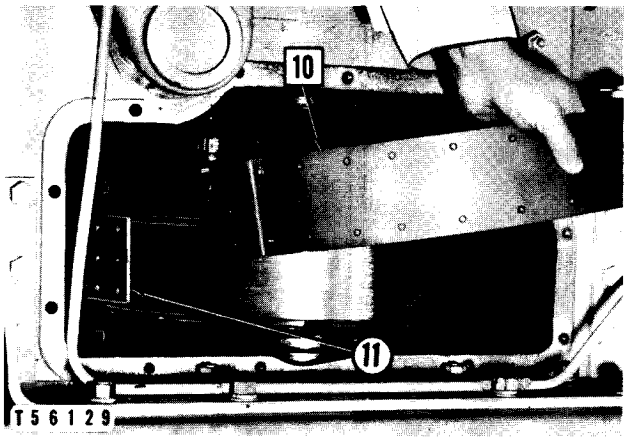


SEPARATING LOWER AND FRONT SECTIONS OF BAND

☐ **Remove**

10–Lower section of band. 13–Nuts (six).

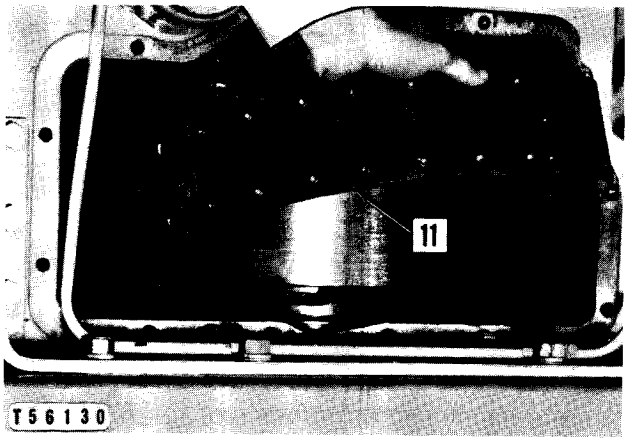
7. Rotate the brake band around the drum, as shown, and remove the nuts **(13)** holding the front section **(11)** and lower section **(10)** together. Both sections of the band may then be removed.



REMOVING LOWER SECTION OF BAND

☐ **Remove**

10–Lower section of band. 11–Front section of band.



REMOVING FRONT SECTION OF BAND

☐ **Remove**

11–Front section of band.

NOTE

The heads of the bolts are countersunk in a spacer between the lining and band, instead of in the lining, thus increasing the usable life of the brake lining.

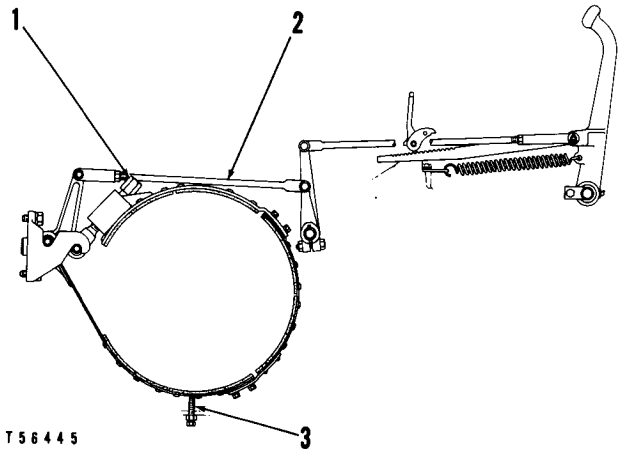
If the drums are badly scored, they should be replaced to insure proper braking. See the topic, STEERING CLUTCHES, for instructions on removing the drums.

New brake lining should be installed, if appreciable wear is present. When installing new lining, make sure the rivets are securely tight. When reinstalling the bands, securely tighten the nuts which hold the three sections together.

8. Assemble the fork **(5)**, lever **(1)** and anchor pins **(8)** and **(9)**. Be sure the washers are in place on the anchor pin **(9)** between the ends of the fork and the anchor.

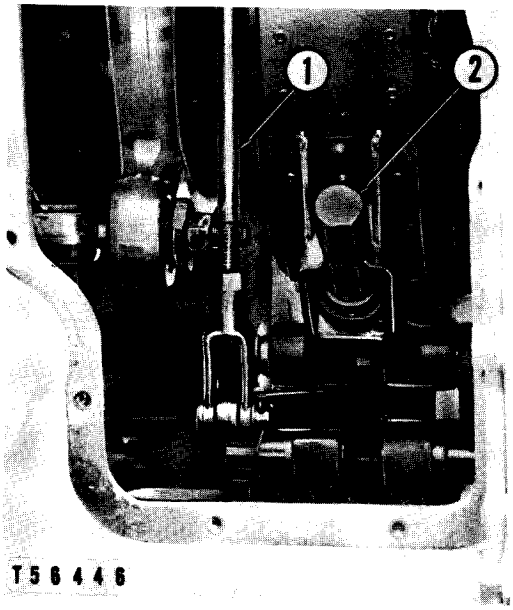
ADJUSTMENT

1. Turn the adjusting nut **(1)** until the brake band is tight on the drum.
2. Turn the support screw **(3)** in against the band.
3. Then back it off the number of turns listed in the topic, SPECIFICATIONS, and tighten the locknut. The support screw is located on the underside of the steering clutch case, directly under the steering clutch drum. This screw supports the band so it will not drag on the top of the drum when the brake is released.
4. Back off the adjusting screw **(1)** the number of turns given in the topic, SPECIFICATIONS.
5. The length of the rod **(2)** should not be changed. However, if a new rod is installed, check to see



BRAKE MECHANISM

1–Adjusting nut. 2–Brake rod. 3–Support screw.

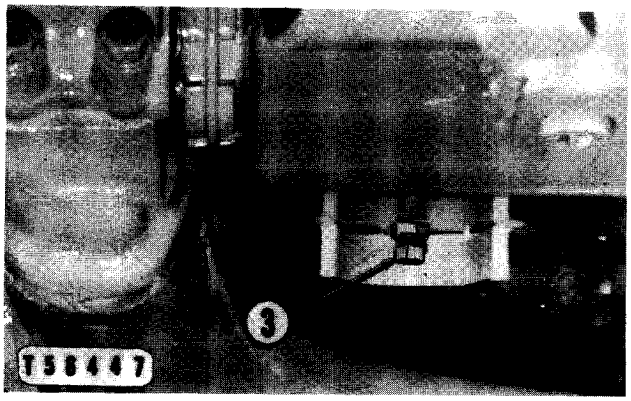


BRAKE ADJUSTING NUT

1–Adjusting nut. 2–Brake rod.

that the brake will release properly and change the length of the new rod if necessary. See the topic, SPECIFICATIONS.

6. The brakes are properly adjusted if they are free when released and if the tractor will turn correctly with the steering clutch released and the brake pedal depressed approximately three-fourths of the way to the floor plates or to the dimension given in the topic, SPECIFICATIONS.



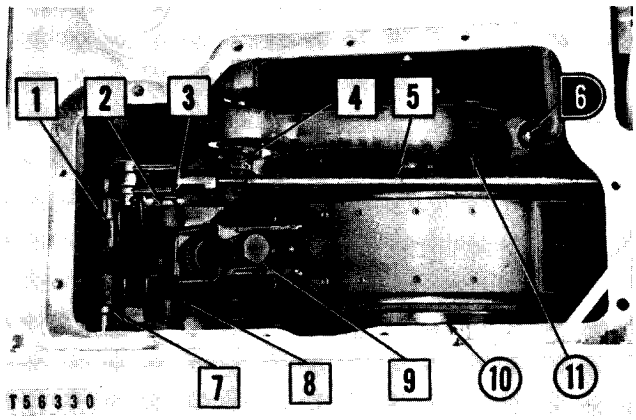
BRAKE BAND SUPPORT
3–Support screw.

Steering Clutches

The steering clutches are located in separate compartments on each side of the bevel gear. These clutches are of the dry, multiple-disc type, held in engagement by springs. Either clutch can be removed without disturbing the bevel gear or final drive.

REMOVAL AND INSTALLATION

1. Remove the seat and fuel tank. See the covering topic.
2. Remove the large plate over the steering clutch compartment.

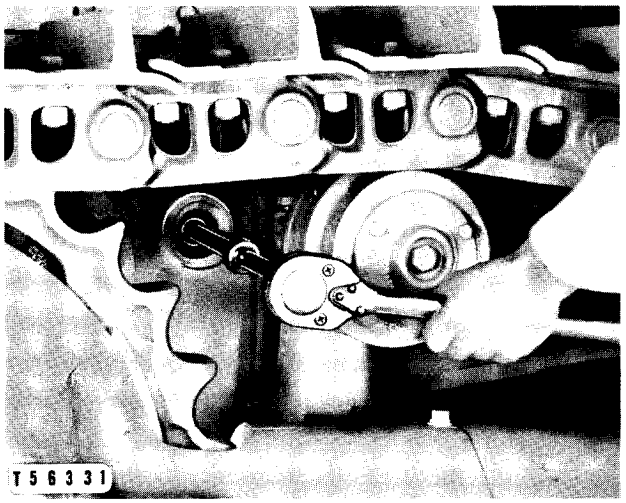


PREPARING TO REMOVE STEERING CLUTCH

☐ **Remove** ◗ **Disconnect**

1–Lever. 2–Anchor pin. 3–Washer. 4–Clutch adjusting nuts. 5–Brake rod. 6–Grease tube. 7–Rear anchor pin. 8–Fork. 9–Brake adjusting nut. 10–Clutch outer drum. 11–Yoke.

3. Remove the brake band support screw from under the steering clutch case.
4. Remove the bolts which secure the clutch outer drum **(10)** to the final drive pinion flange. These can be removed through an opening on the side of the steering clutch case after removing the plug from the opening.
5. Move the tractor or the sprockets to bring each bolt into alignment with the opening and remove as shown, and also remove the bolts which secure the steering clutch shaft coupling to its mating coupling.
6. Utilizing the brake band as a sling, support the clutch by attaching a hoist to the ends of the brake band.
7. Slide the outer drum toward the center of the tractor to free it from the shoulder on the final drive pinion flange.

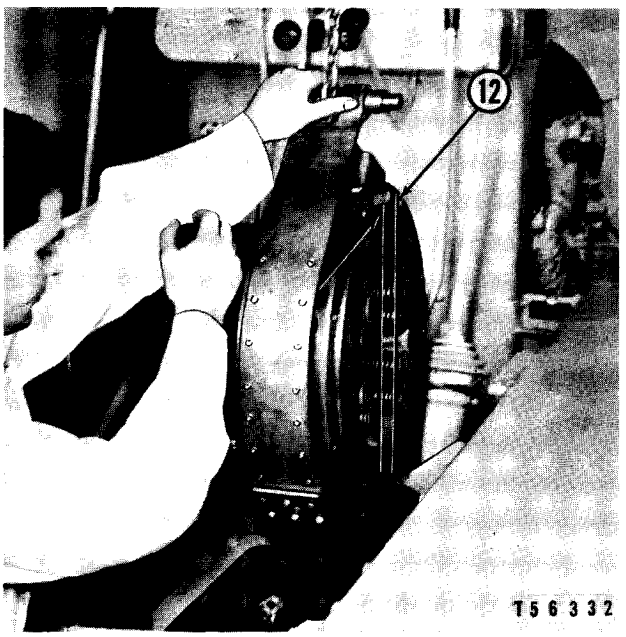


REMOVING STEERING CLUTCH OUTER DRUM FLANGE BOLTS

NOTE

By rotating the steering clutch outer drum until the widest space **(12)** between the springs is in the vertical position, sufficient clearance is provided for the final drive flange retaining bolt.

8. Remove the steering clutch from the compartment.



REMOVING STEERING CLUTCH
12–Widest space between springs.

CAUTION

Hold the steering clutch carefully so it does not slip out of the outer drum.

9. Before installing the steering clutch assembly, inspect the splines of the outer drum and the teeth of the lined plates for roughness and excessive wear. Replace if not reusable.

NOTE

The steering clutch yoke ball must enter the bushing at the bottom of the steering clutch compartment as the steering clutch assembly is lowered into the compartment.

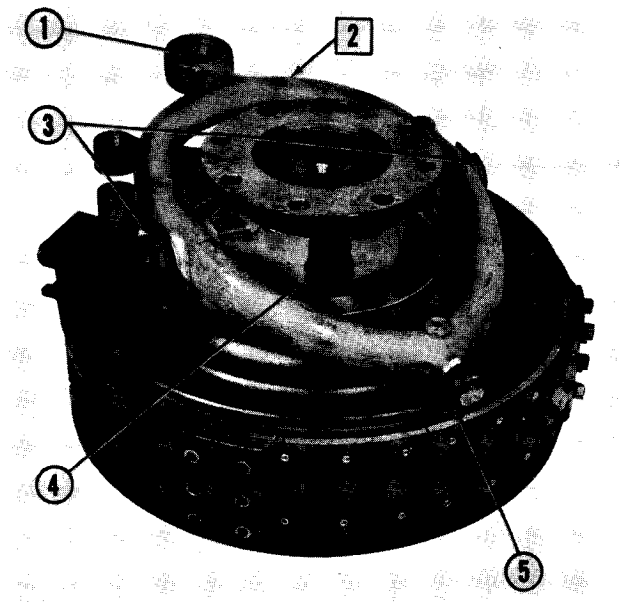
NOTE

The following procedure will permit the flange on the pinion shaft and the steering clutch outer drum to draw together without binding at the time of installation.

10. Install one bolt that secures the outer drum to the flange, but do not tighten the bolt too tight.
11. Rotate the steering clutch 180° by moving the machine or the sprocket.
12. Install a second bolt that secures the outer drum to flange and tighten this bolt securely.
13. Complete the installation in reverse order of removal. Tighten the bolts to the torque value as given in the GENERAL INSTRUCTIONS which are covered in the ENGINE SECTION.
14. Adjust the brakes. See the topic, BRAKE ADJUSTMENT.
15. Adjust the steering clutches. See the topic, STEERING CLUTCH CONTROL ADJUSTMENT.

DISASSEMBLY

1. Loosen the two screws **(3)** until the screw pilots clear the steering clutch release bearing cage assembly **(4)**. Remove the yoke **(2)**.
2. Inspect the pilots on the screws **(3)**. If the pilots are badly worn and they fit too loosely when installed in the steering clutch release bearing cage, replace the screws.
3. Inspect the insert **(1)** and the ball **(5)** on the yoke for wear. Replace if necessary.
4. Replace the seals between the yoke **(2)** and the steering clutch release bearing cage **(4)**.
5. Place the clutch assembly on the shaft flange and remove the outer drum from the clutch assembly by lifting it up off the clutch plate teeth.

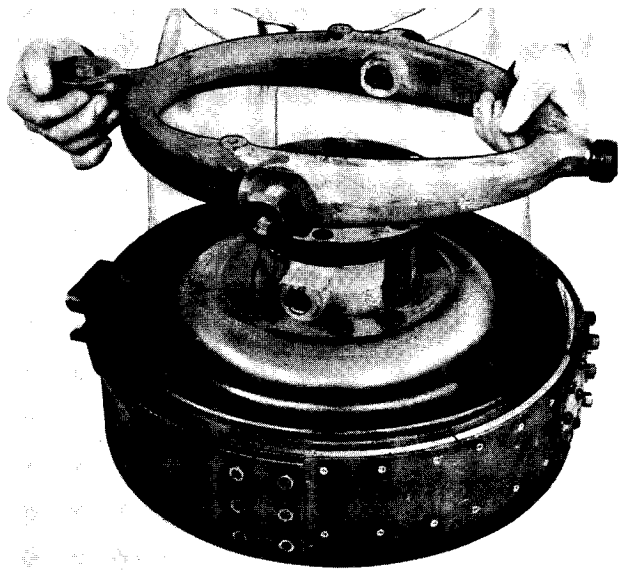


T56263

PREPARING TO REMOVE THE STEERING CLUTCH RELEASE YOKE

☐ **Remove**

1–Insert. 2–Steering clutch release yoke. 3–Screws (two). 4–Steering clutch release bearing cage assembly. 5–Ball.



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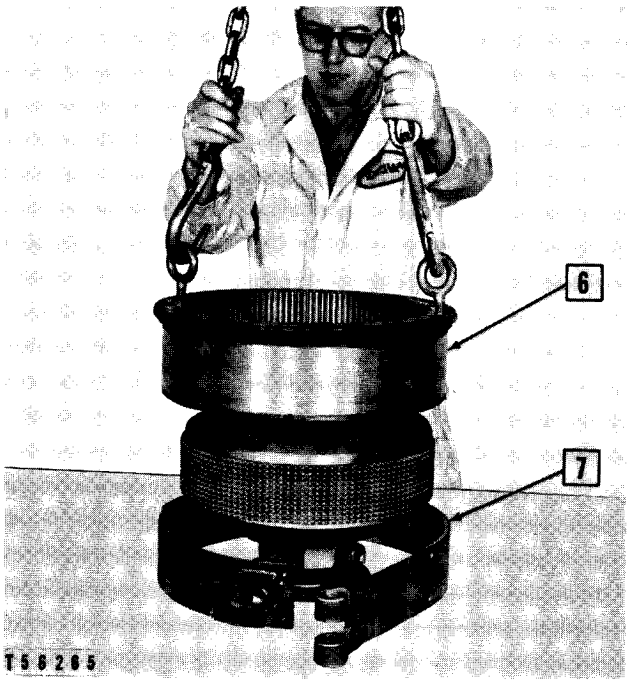
REMOVING THE STEERING CLUTCH RELEASE YOKE

NOTE

The over-all thickness at **(A)** of twelve new lined plates **(16)** and twelve new driving discs **(17)** is given in the topic, SPECIFICATIONS. If the overall thickness of the twelve lined plates and twelve driving discs is less than the minimum

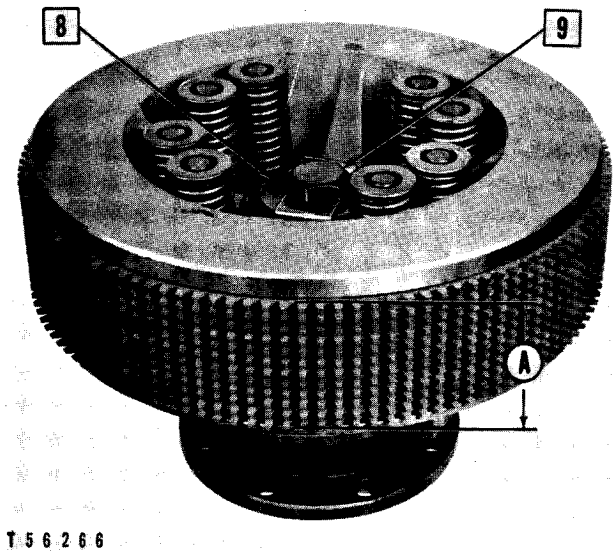
over-all width given in the topic, SPECIFICATIONS, the lined plates should be replaced.



REMOVING OUTER DRUM

☐ **Remove**

6–Outer drum. 7–Brake band.

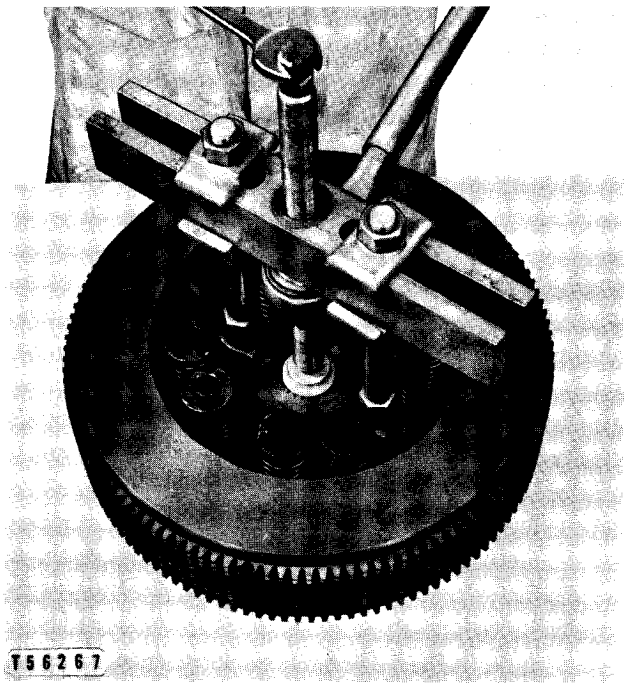


PREPARING TO REMOVE SHAFT

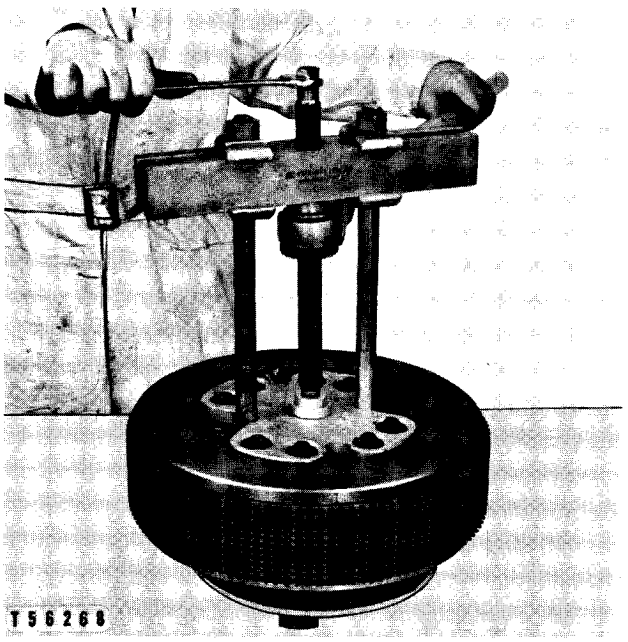
☐ **Remove**

8–Washer. 9–Bolt.
A–Dimension to be checked.

6. The shaft can be removed from the inner drum by using the 8B7548 Push Puller, (with two 8B7550 Legs, in place of the 5F7369 Legs), 8H684 Ratchet Box Wrench, 8B7563 Handle, 8B7560 Step Plate and the 8B7556 Adapters.

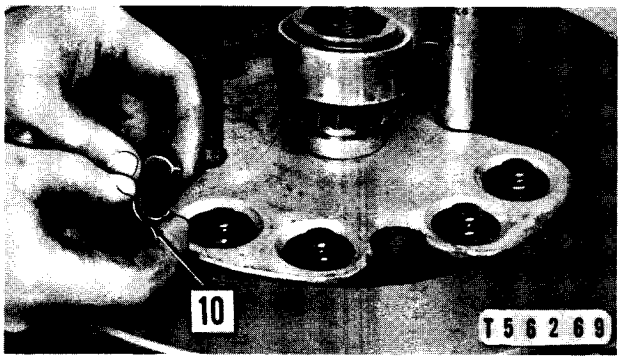


REMOVING SHAFT



COMPRESSING SPRINGS

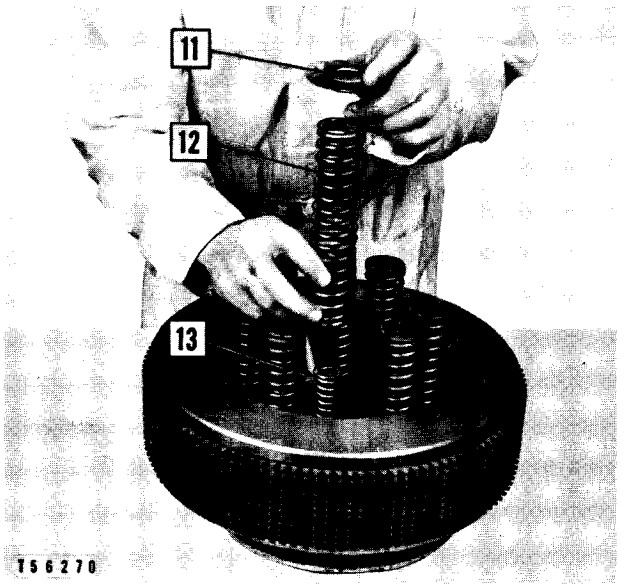
7. The steering clutch springs can be compressed and the locks removed by using the 8B7548 Push Puller, 8H684 Ratchet Box Wrench with the 8B7563 Handle, 5F5034 Plate, 5F5586 Shim, and the 8B7560 Step Plate.



REMOVING LOCKS

☐ Remove

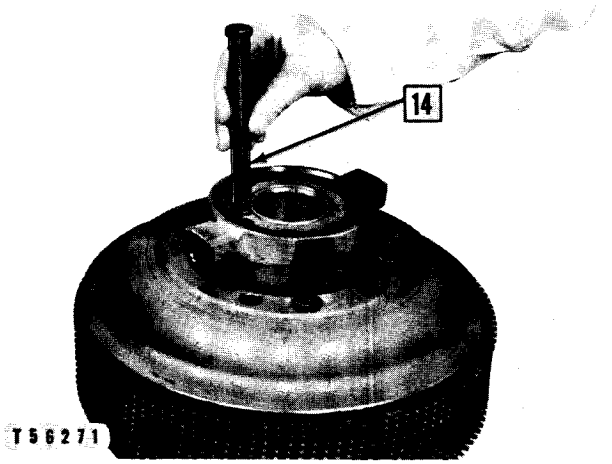
10–Locks (sixteen).



REMOVING SPRINGS

☐ Remove

11–Collar. 12–Outer spring. 13–Inner spring.

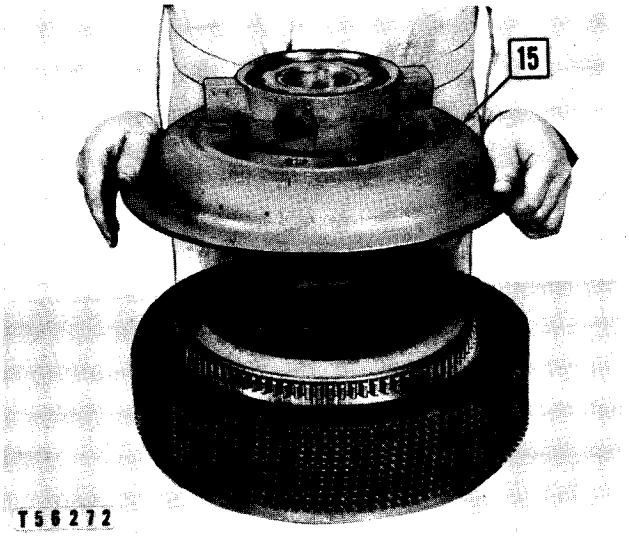


REMOVING STUDS

☐ Remove

14–Studs (eight).

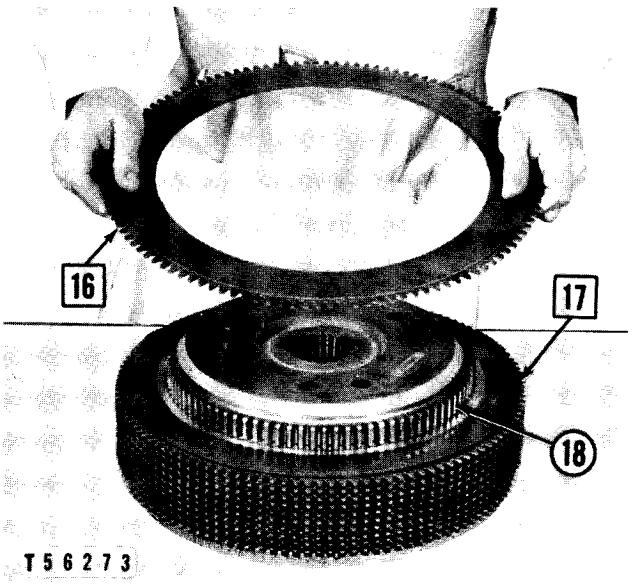
8. With the steering clutch supported by the inner drum flange remove the studs **(14)** and the pressure plate **(15)**.



REMOVING PRESSURE PLATE AND STEERING CLUTCH RELEASE BEARING

☐ Remove

15–Pressure plate.



REMOVING CLUTCH DISCS

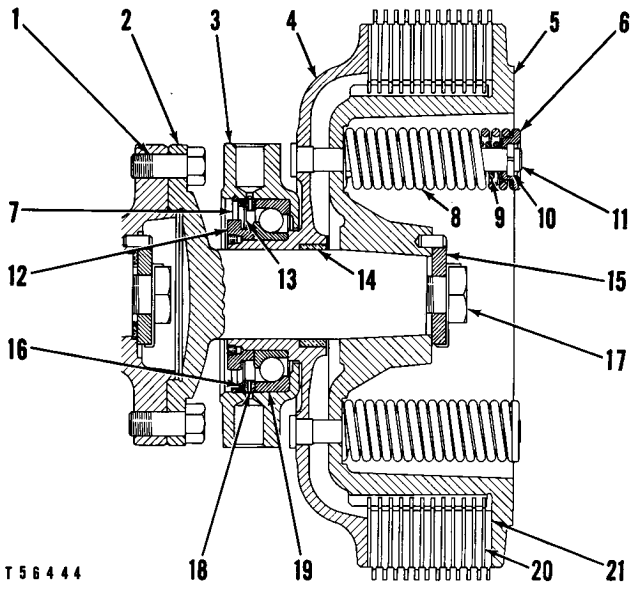
☐ Remove

16–Lined plate (twelve). 17–Driving disc (twelve). 18–Inner drum.

ASSEMBLY

NOTE

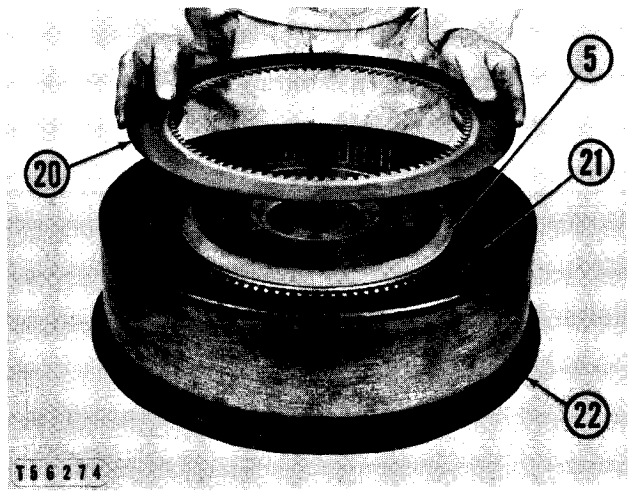
Before assembly, check the discs **(20)** for warping and check, also, the lined plates **(21)** for excessive wear and roughness. Inspect for broken springs and excessive wear on retainer.



STEERING CLUTCH ASSEMBLY

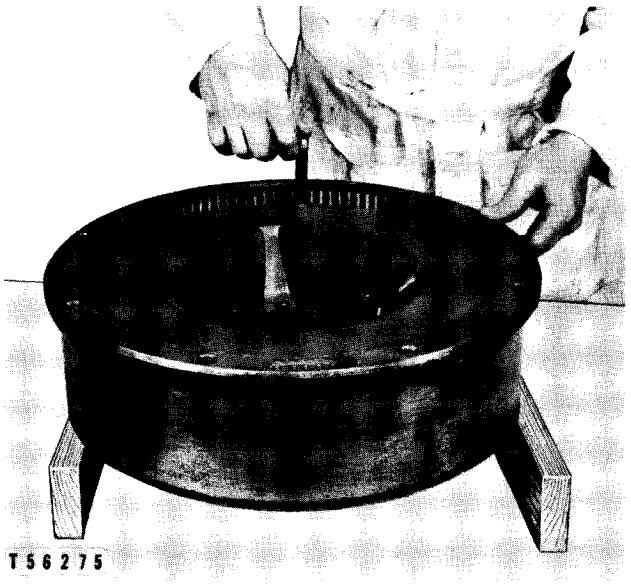
1–Bolts.
2–Shaft.
3–Steering clutch release bearing cage.
4–Pressure plate.
5–Inner drum.
6–Collar.
7–Lock ring.
8–Outer spring.
9–Inner spring.
10–Locks.
11–Stud.
12–Retaining nut.
13–Washer.
14–Bearing.
15–Washer.
16–Seal.
17–Bolt.
18–Ring.
19–Bearing.
20–Driving disc (twelve).
21–Lined plate (twelve).

1. Scored or badly worn plates **(21)** or discs **(20)** should be replaced. If the over-all thickness of the plates and discs of one steering clutch is less than the dimension covered in the topic, SPECIFICATIONS, the lined plates should be replaced.
2. Place the inner drum **(5)** flange downward on a flat surface and place the outer drum **(22)** over it, to assure proper alignment of the teeth of the lined plates **(21)**.



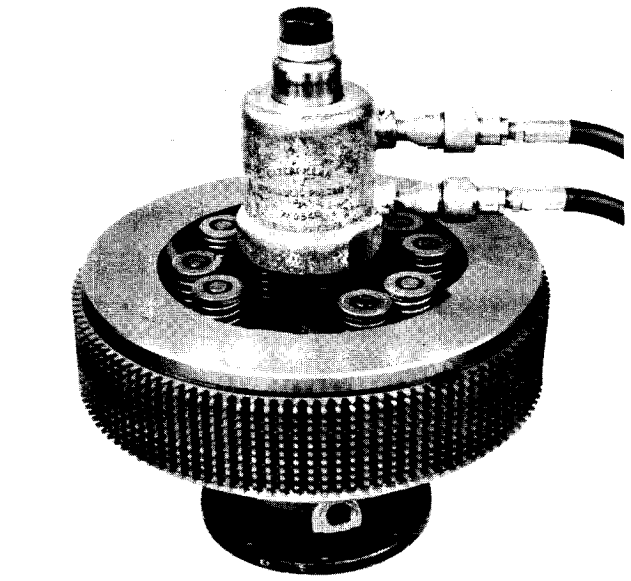
INSTALLING STEERING CLUTCH DISCS
5–Inner drum. 20–Discs (twelve). 21–Lined plate (twelve). 22–Outer drum.

3. Beginning with a lined plate **(21)** against the flange of the inner drum **(5)** alternate the remaining lined plates **(21)** and driving discs **(20)** as they are installed in place.
4. Place the pressure plate **(4)** on top of the discs and drop the spring studs **(11)** in place.
5. Without removing the outer drum **(22)** turn the entire clutch assembly upside down and support it so the inner and outer drums are as nearly concentric as possible.

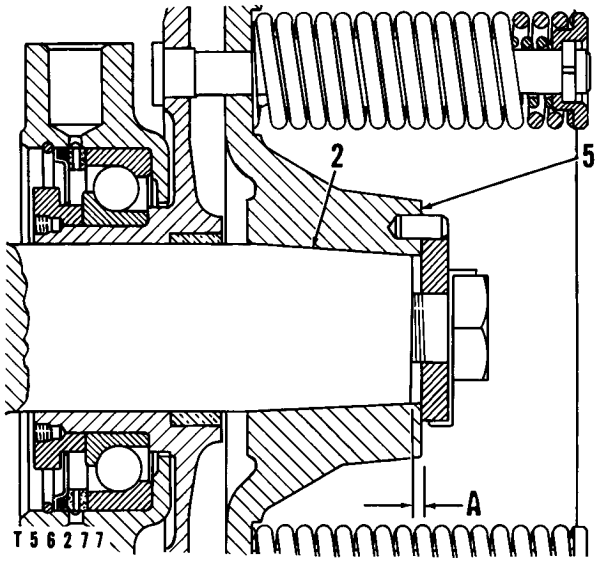


CENTERING INNER AND OUTER DRUMS

6. Install the steering clutch spring **(8)** and **(9)** with the same tools used for removing them.

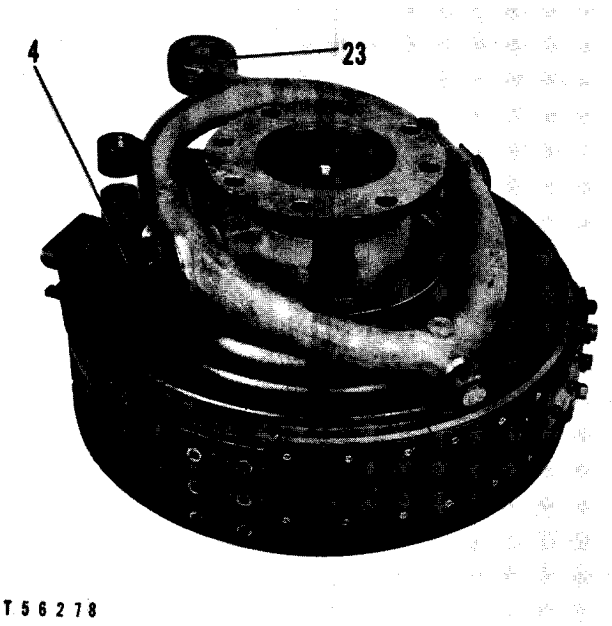


INSTALLING STEERING CLUTCH INNER DRUM ON SHAFT



STEERING CLUTCH ASSEMBLY
2–Shaft. 5–Inner drum. A–Dimension to be checked.

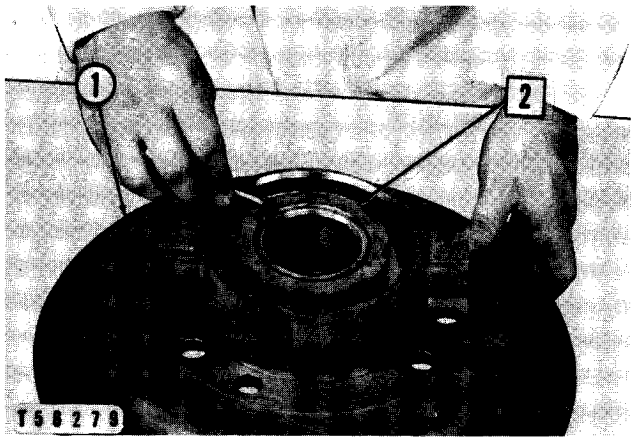
7. Install the inner drum **(5)** on the shaft **(2)** using the 7F9540 Hydraulic Puller, 7B8363 Bolt, 7M7238 Sleeve, 5F7353 Washer.
8. Press the steering clutch inner drum **(5)** onto the clutch shaft **(2)** to the pressure given in the topic, SPECIFICATIONS.
9. Measure the clearance **(A)** from the shoulder on the clutch shaft **(2)** to the face of the steering clutch inner drum **(5)** hub. See the topic, SPECIFICATIONS, for the correct dimension.
10. Securely tighten the retaining bolt **(17)**.



STEERING CLUTCH ASSEMBLY
4–Pressure plate. 23–Insert.

11. Turn the assembly over and install the yoke with the insert **(23)** toward the pressure plate **(4)**.

Steering Clutch Release Bearing Disassembly

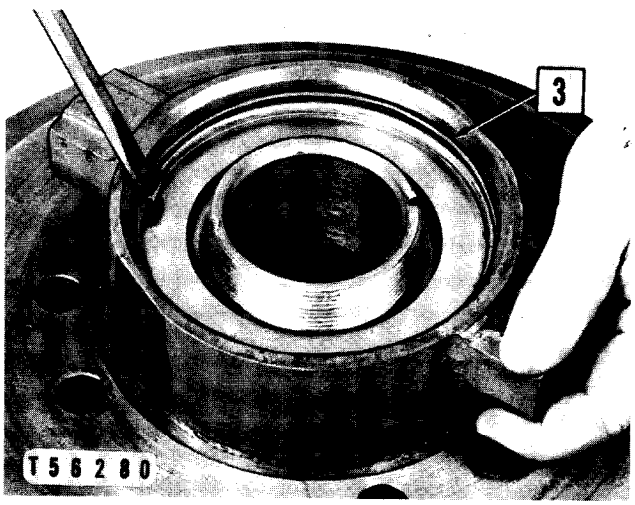


REMOVING LOCK SCREWS

☐ **Remove**

1–Pressure plate. 2–Retaining nut.

Inspect the bearing in the pressure plate **(1)** for excessive wear and replace if necessary.



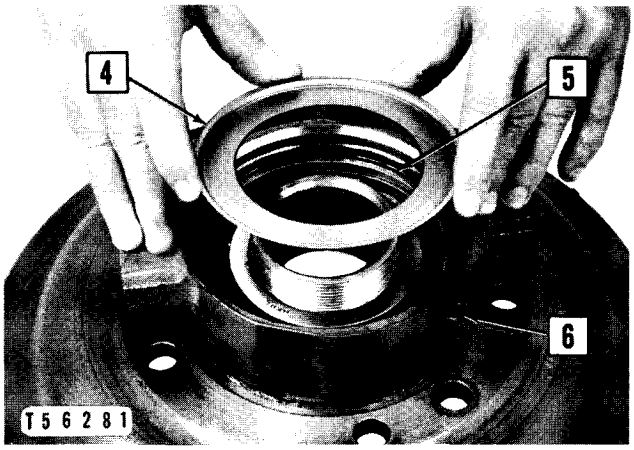
REMOVING LOCK RING

☐ **Remove**

3–Lock ring.

Turn the bearing cage **(6)** over. Place it on a sleeve **(10)** with an inside diameter large enough to accept the bearing as it is driven from the cage.

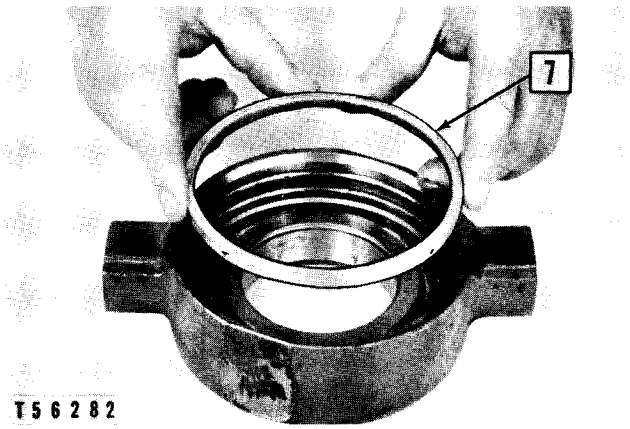
Drive the bearing **(8)** from the cage using the holes **(9)** provided.



REMOVING WASHER

☐ **Remove**

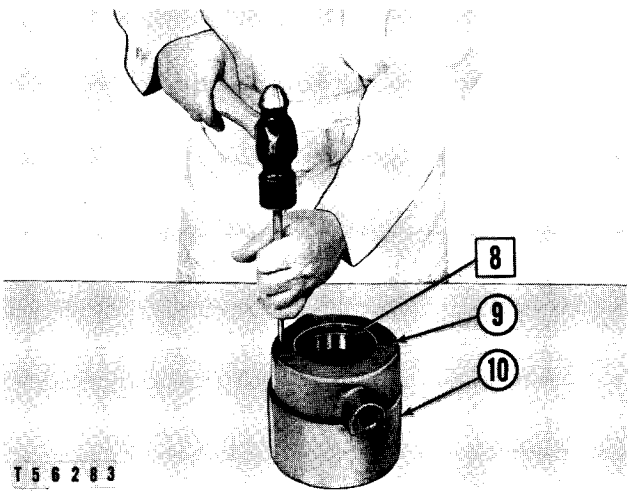
4–Washer. 5–Seal. 6–Bearing cage.



REMOVING RING

☐ **Remove**

7–Ring.



REMOVING BEARING FROM CAGE

☐ **Remove**

8–Bearing. 9–Hole (two). 10–Sleeve.

NOTE

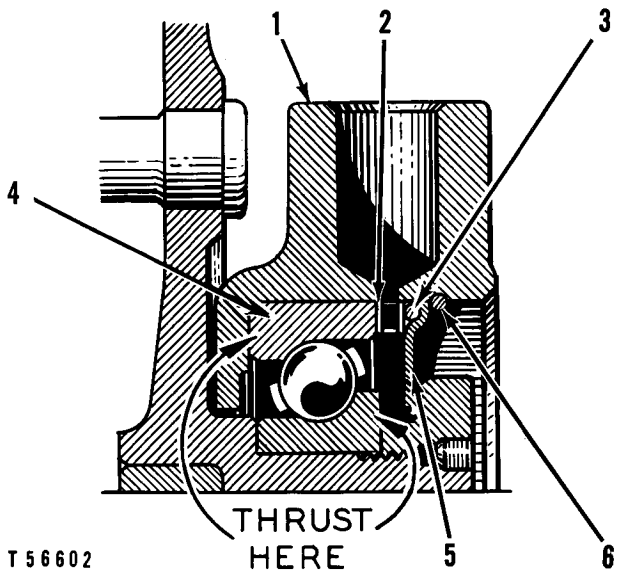
The holes **(9)** contain a core plug which can be driven through the hole and against the bearing as it is being driven from the cage.

Steering Clutch Release Bearing Assembly

NOTE

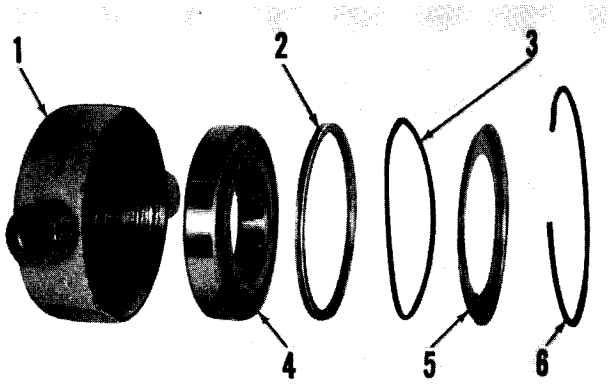
Be sure the side of the bearing marked THRUST HERE on the inner race is toward the bevel gear when assembled in the cage. If the words, THRUST HERE, are marked on the outer race, the marked side should be toward the steering clutch, when assembled.

1. Install the bearing **(4)** into the cage **(1)**, as previously described.
2. Placed the ring **(2)** and then the seal **(5)** into the cage.
3. Install the washer **(3)** so that the cupped portion of the washer fits over the seal **(5)**, as shown.
4. Then install the lock ring **(6)**.



STEERING CLUTCH RELEASE BEARING
1–Bearing cage. 2–Ring. 3–Seal. 4–Bearing. 5–Washer. 6–Lock ring.

5. Install new core plugs in the bearing cage.
6. After the bearing cage **(1)** has been installed on the pressure plate and the nut tightened drill two 13/64 " holes, 3/8" deep, tap 1/4" - 20 (NC) 1/4" deep on the parting line of the pressure plate and nut and install the hollow head setscrews.
7. Prick punch the hub and nut to lock the screw in place.



T 5 6 2 8 4

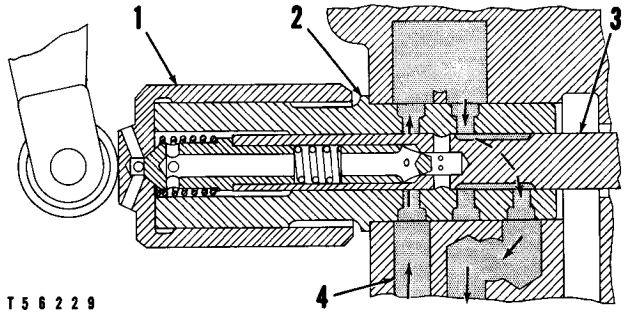
STEERING CLUTCH RELEASE BEARING
1–Bearing cage. 2–Ring. 3–Seal. 4–Bearing. 5–Washer.
6–Lock ring.

Steering Clutch Hydraulic Controls

The hydraulic steering clutch control housing is mounted on top of the steering clutch case. The pump for supplying the oil pressure to actuate the mechanism is attached to the bottom of the control housing and is driven by a gear on the rear end of the transmission upper shaft. The oil supply is contained within the housing.

Each steering clutch is released by a cylinder **(1)** forced out from the end of a stationary piston **(2)** by oil pressure. Each piston contains oil inlet and outlet ports. A sliding valve **(3)**, controlled by a steering clutch lever, fits in the center of the piston.

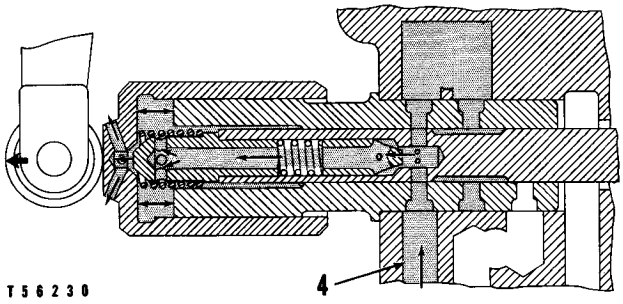
As long as the clutch control lever and valve are forward in the clutch engaged position, the inlet and outlet ports in the piston are open. The oil from the pump enters through the passage **(4)**.



STEERING CLUTCH ENGAGED
1–Cylinder. 2–Piston. 3–Valve. 4–Passage.

When the control lever moves the sliding valve **(3)** back, the outlet port in the piston is closed and the oil is forced through a passage in the sliding valve out into the space between the end of the piston and the end of the cylinder. This forces the cylinder **(1)** outward, and it, in turn, presses against a lever which releases the steering clutch.

The distance the cylinder moves outward is determined by the stroke of the sliding valve. As soon as the sliding valve ceases to move back, the seat in the end of the cylinder moves away from the tapered end of the sliding valve and the oil is permitted to escape.

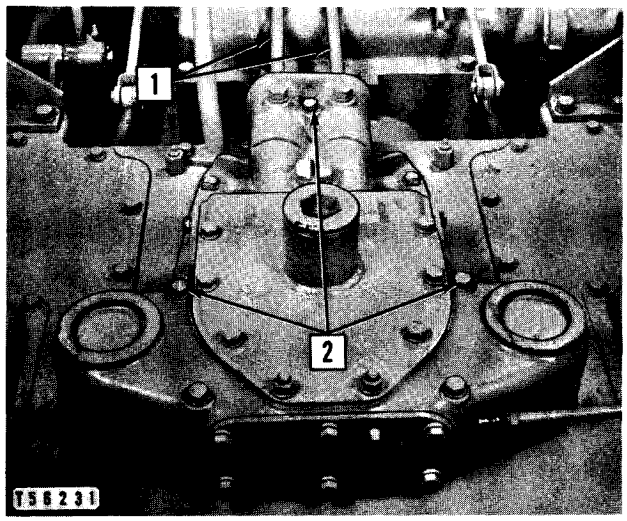


STEERING CLUTCH DISENGAGED
4–Passage.

If the oil pump fails for any reason, the tractor may be manually controlled by the steering clutch levers.

REMOVAL AND INSTALLATION

1. Remove the fuel tank and floor plates as outlined in the covering topics.

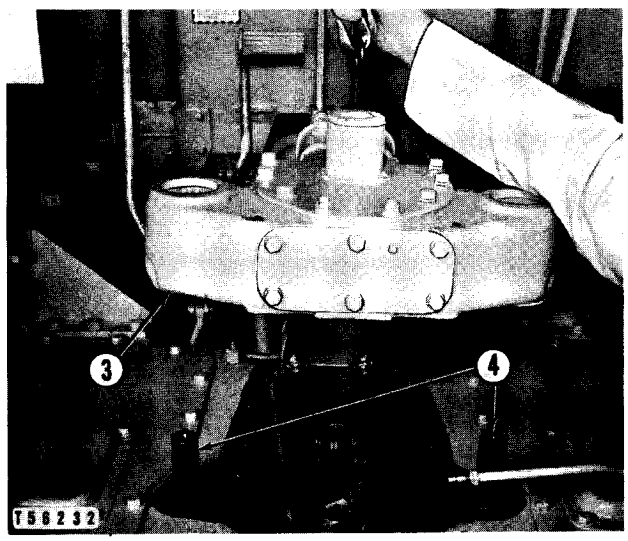


PREPARING TO REMOVE STEERING CLUTCH HYDRAULIC CONTROL

☐ **Remove**

1–Rods (two). 2–Bolts (nine).

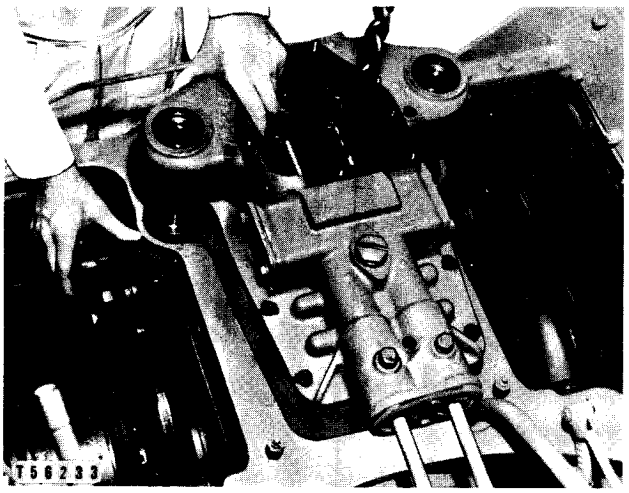
2. Attach a suitable hoist and lift the steering clutch hydraulic control **(3)** straight up off the



REMOVING STEERING CLUTCH HYDRAULIC CONTROL
3–Steering clutch hydraulic control. 4–Splined shafts (two).

stub shafts **(4)** which extend up from the steering clutch compartments.

3. When the unit is lowered onto the splined shafts projecting up from the steering clutch case, the levers inside the control housing must be forward against the cylinders. This insures a correct connection between the levers inside the hydraulic housing and the levers in the steering clutch compartments.

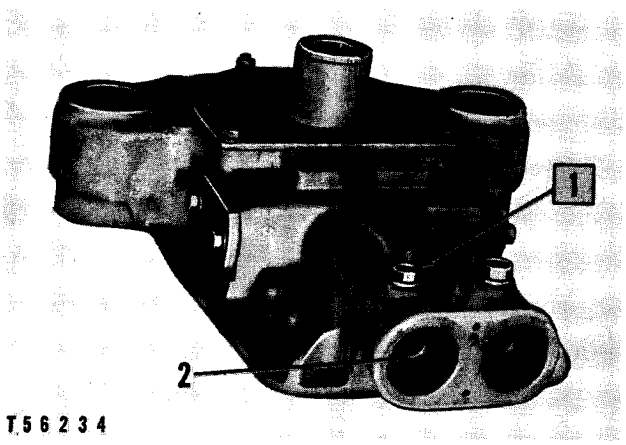


INSTALLING CONTROL UNIT

4. Complete the installation in the reverse order of removal and adjust as given in the covering topic.

DISASSEMBLY AND ASSEMBLY

1. Remove the steering clutch hydraulic oil pump. See the covering topic.



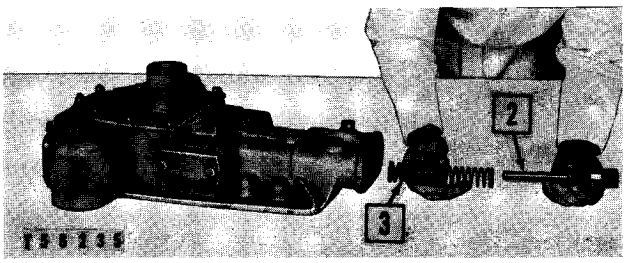
PREPARING TO REMOVE PUSH RODS

☐ **Remove**

1–Bolt. 2–Push rod.

NOTE

The push rod **(2)** is under spring tension.

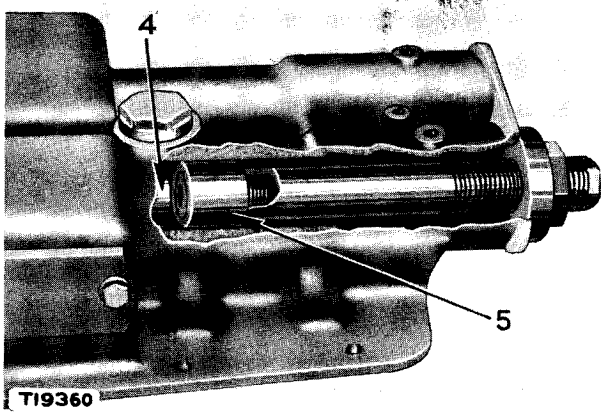


REMOVING PUSH ROD

☐ **Remove**

2–Push rod. 3–Spring.

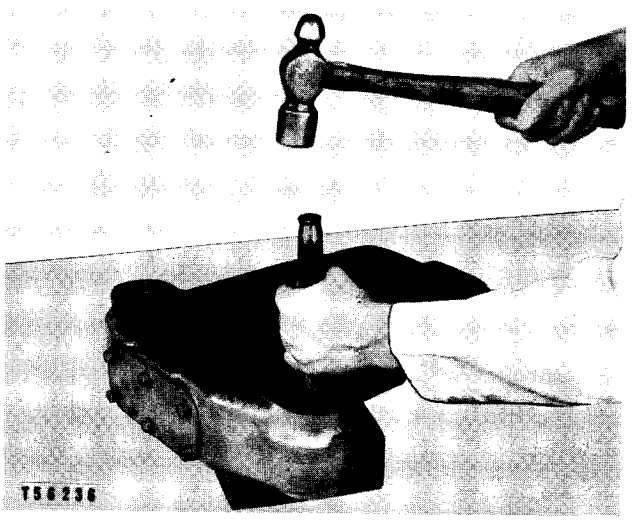
2. Remove the push rod and spring from the left side in a similar manner.



PULLING OIL SEAL RETAINER
4–Small retainer. 5–Oil seal retainer.

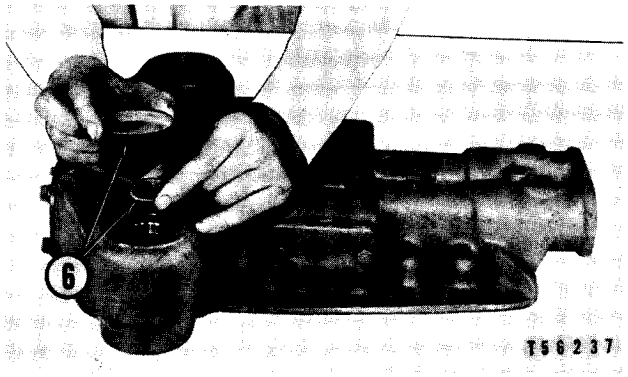
3. The oil seal retainer **(5)** can be removed with the 8B2893 Tool, as shown.

4. The seal inside the retainer should be replaced, if oil is leaking past it. The small retainer **(4)**

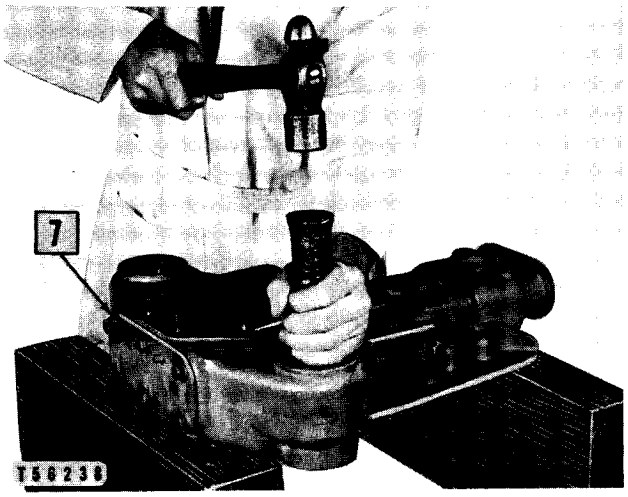


REMOVING PLUGS

is a very tight fit and is pinned in position. There should be no occasion to remove this retainer.



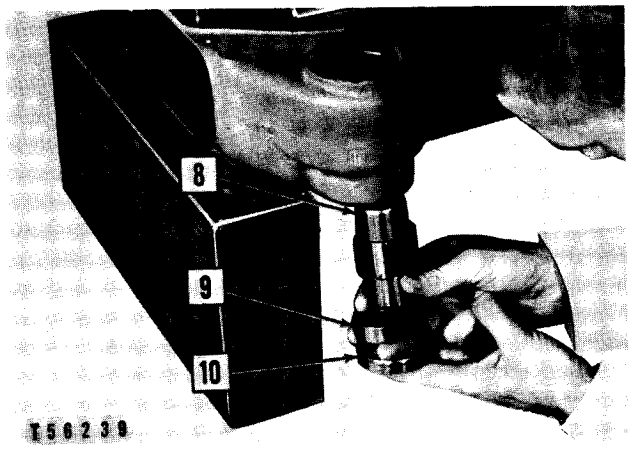
PLUGS REMOVED
6–Plugs.



REMOVING SLEEVE

☐ **Remove**

7–Cover.



SLEEVE, RETAINER AND OIL SEAL REMOVED

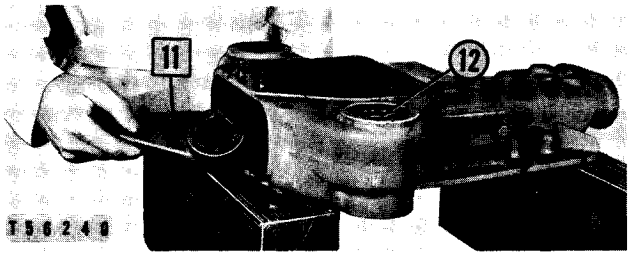
☐ **Remove**

8–Sleeve. 9–Retainer. 10–Oil seal.

5. Drive out the plugs **(6)** with a punch inserted through the center of the sleeve **(8)**.
6. Drive out the sleeve **(8)**. The oil seal **(10)** and retainer **(9)** will come out with the sleeve.

NOTE

Inspect the oil seal **(10)** for damage or evidence of leakage and replace if necessary. Position the wiping edge of the seal toward the inside at the time of installation.

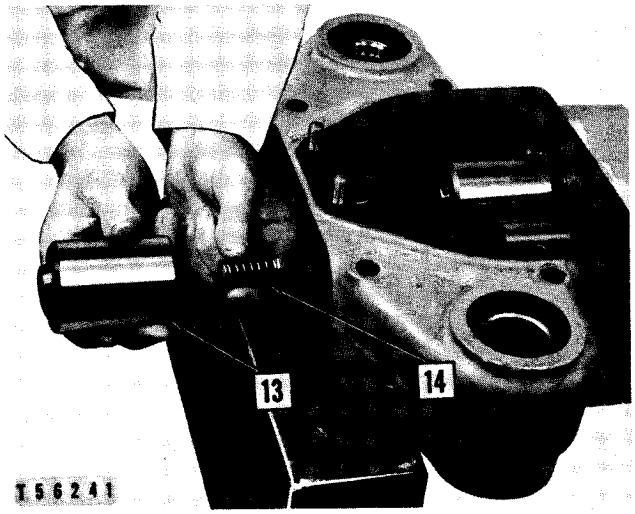


REMOVING LEVER

☐ **Remove**

11–Lever. 12–Bearing.

7. Inspect the bearing **(12)** for wear or damage and replace if necessary.



CYLINDER REMOVAL

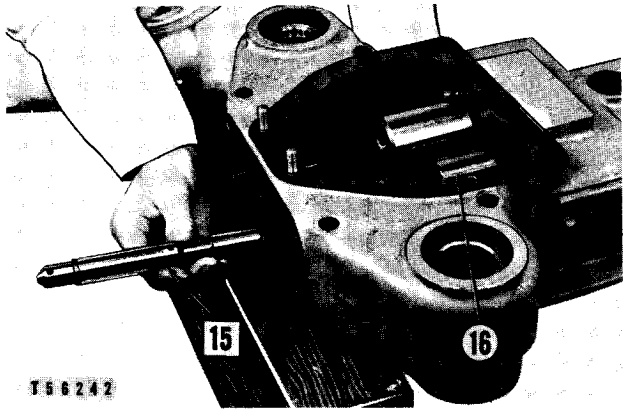
☐ **Remove**

13–Cylinder. 14–Spring.

8. The piston **(16)** is a tight fit in the housing, but can be pulled, using the following tools:

   A 5/8" steel rod, 14 1/2" long, with 5/8" - 18 (NF) threads 5" long on one end and 3/4" long on the other end.

   One 5/8" - 18 (NF) standard hexagon nut and one thin 5/8" - 18 (NF) hexagon nut.



VALVE REMOVAL

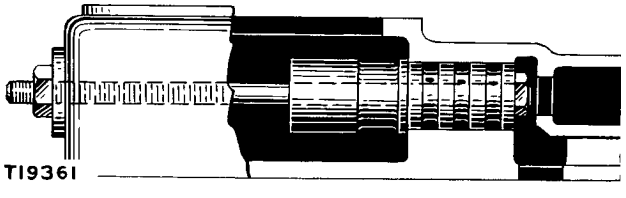
☐ **Remove**

15–Valve. 16–Piston.

One plate, 3½" wide, ¾" thick, 8" long, with a ¾" hole drilled 2½" from one end.

9. Remove the rear cover. Insert the ¾" threaded end of the rod through the bore in the center of the piston. Turn the housing upside down. When the oil pump and sump assembly are removed, an opening will be noted which shows the inner end of the piston. It is possible to place the thin nut on the end of the rod through this opening. Place the plate over the long threaded end of the rod and over the opening at the rear end of the housing.

10. The puller nut can now be screwed on the end of the rod to pull the piston out of the housing.



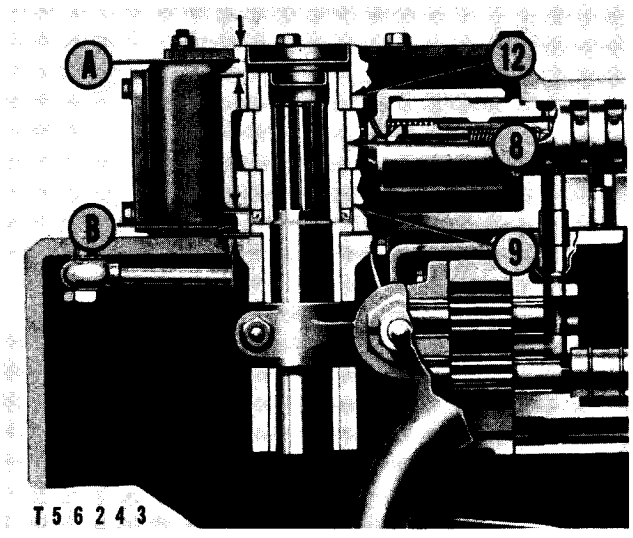
PULLING PISTON

11. Inspect all parts for wear or damage. Assemble in the reverse order of disassembly.

12. Installation of the piston **(15)** can be facilitated by contracting it with dry ice.

13. The bearing **(12)** should be pressed into the housing to a depth equal to dimension **(A)** from the edge of the bore.

14. After installing the sleeve **(8)**, the retainer **(9)** should be pressed into the housing to a depth equal to dimension **(B)** from the bottom edge of the bore. Tolerances may vary this measurement, so always make sure the lever and sleeve will turn freely after the retainer is installed.



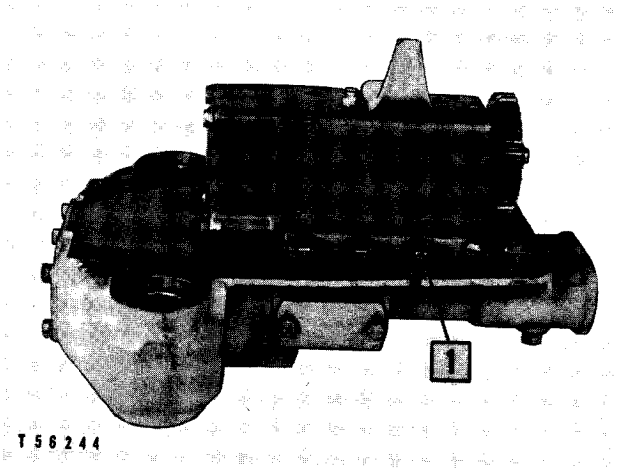
BEARING RETAINER AND SLEEVE INSTALLATION
8–Sleeve. 9–Retainer. 12–Bearing.
A–.44" dimension. B–.84" dimension.

HYDRAULIC PUMP

The steering clutch hydraulic oil pump is located on the bottom of the steering clutch hydraulic control and is driven by a gear on the transmission upper shaft.

Removal and Installation

Remove the steering clutch hydraulic control. See the covering topic.

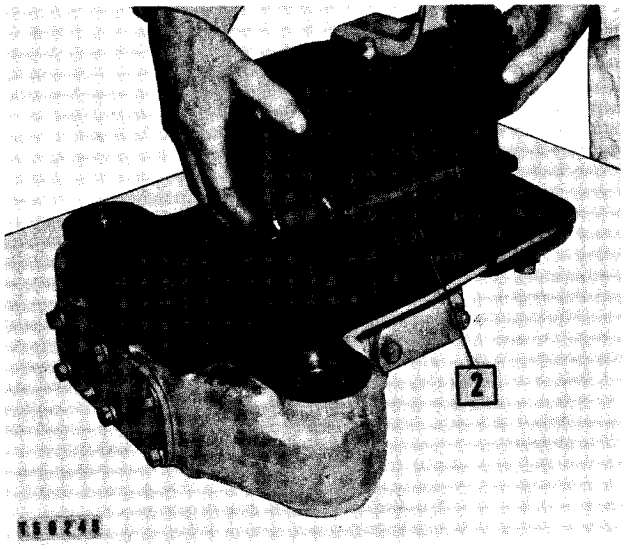


PREPARING TO REMOVE HYDRAULIC PUMP

☐ **Remove**

1–Bolts and locks (eight).

Install the hydraulic pump **(2)** in the reverse order of removal and secure the bolts with locks.

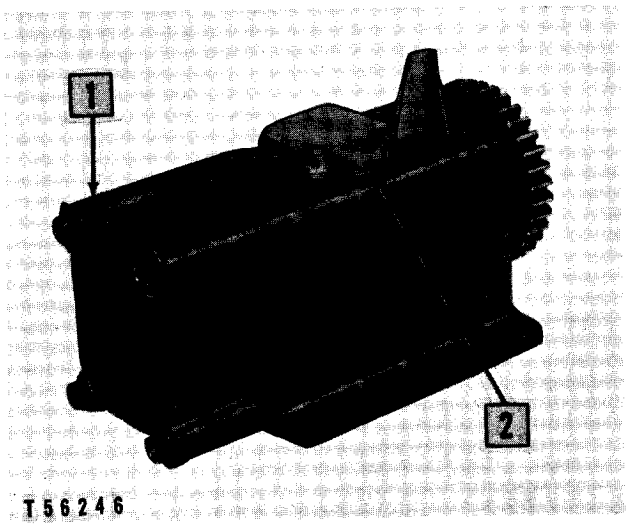


REMOVING HYDRAULIC PUMP

☐ Remove

2–Hydraulic pump.

Disassembly and Assembly



COVER AND TROUGH REMOVAL

☐ Remove

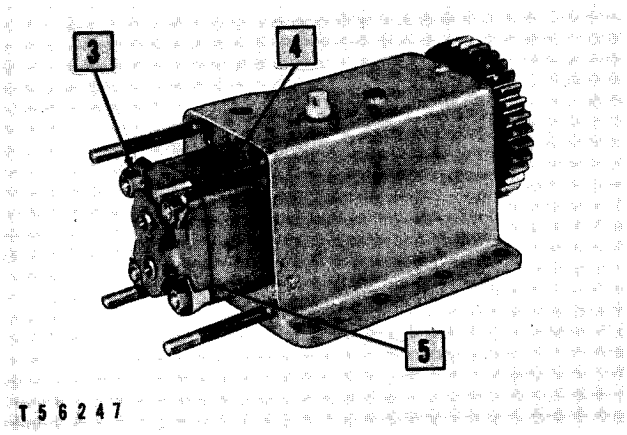
1–Cover. 2–Trough.

1. Inspect the bearings **(6)** in the plate **(5)** for wear or damage and replace if necessary.

NOTE

Removal of the coupling **(8)** and shaft **(9)** can be done after removing the pins **(10)**, which are held in place by the snap rings **(7)**.

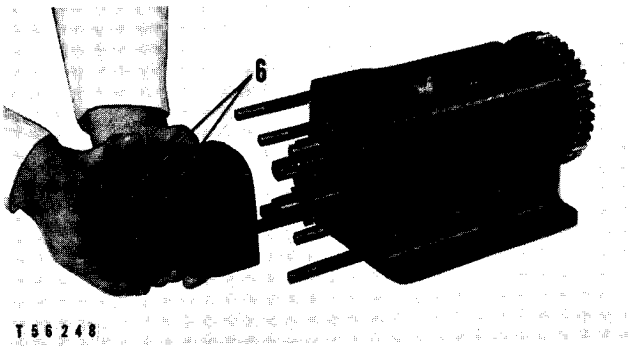
2. Inspect the bearings **(12)** for excessive wear or damage and replace if necessary.



PREPARING TO REMOVE PLATE AND BODY

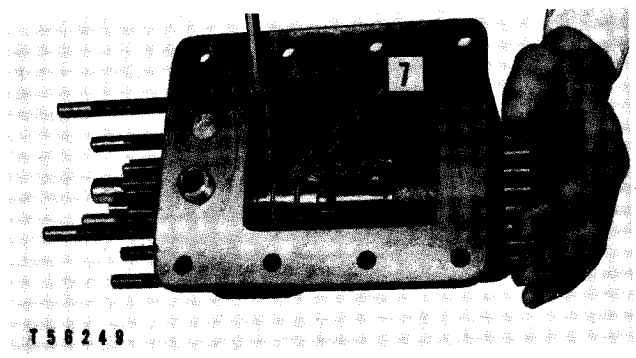
☐ Remove

3–Bolts and locks (four each). 4–Body. 5–Plate.



BEARING INSPECTION

6–Bearings (two).



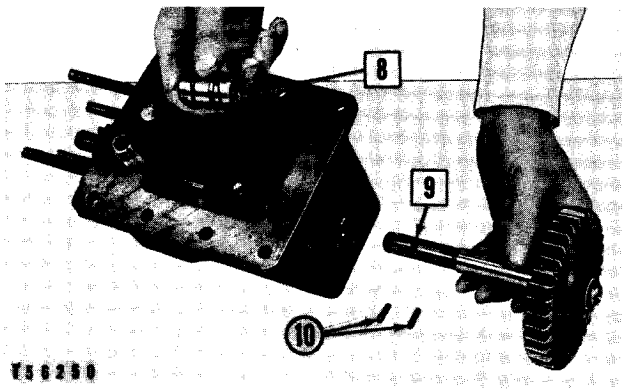
SNAP RING REMOVAL

☐ Remove

7–Snap rings (two).

3. The drive gear **(14)** can be pressed off the shaft **(9)** after removing the snap ring **(13)**.

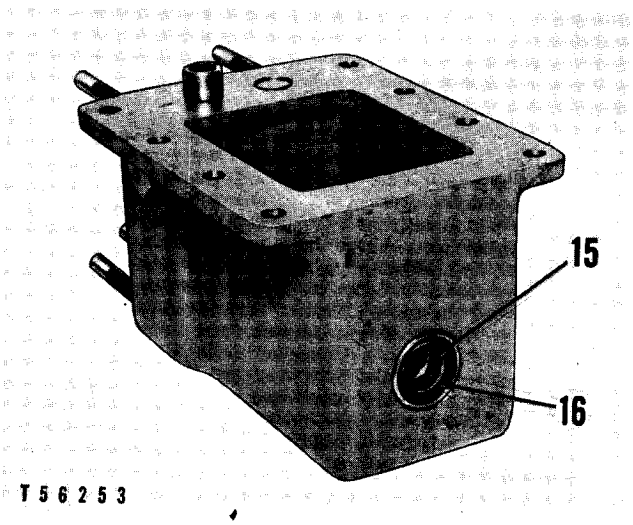
4. Inspect the condition of the bearing **(15)** and oil seal **(16)**. If replacement is necessary they can be pressed from the housing. At the time of assembly, install the seal **(16)** with the lip toward the inside.



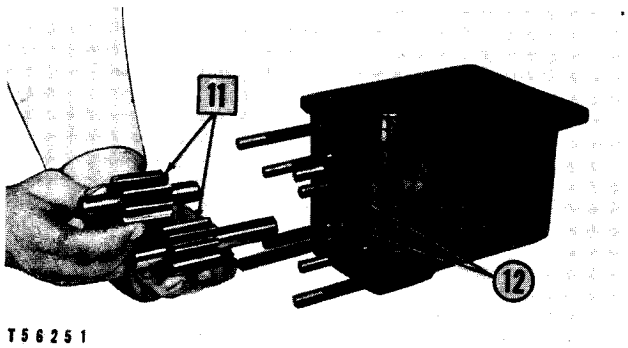
COUPLING AND SHAFT REMOVAL

☐ **Remove**

8–Coupling. 9–Shaft. 10–Pins (two).



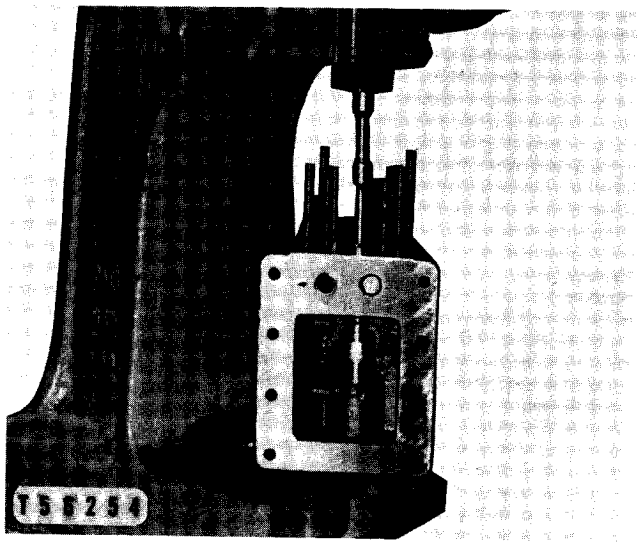
BEARING AND OIL SEAL INSTALLATION
15–Bearing. 16–Oil seal.



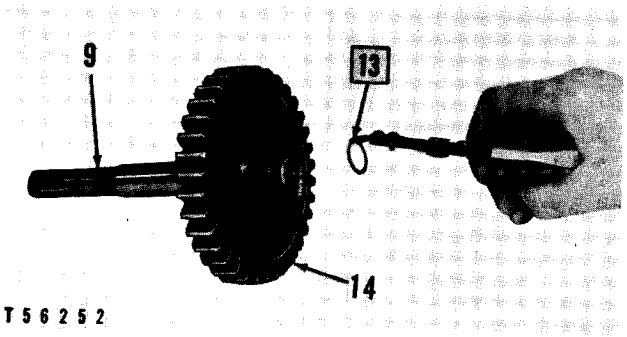
REMOVING OIL PUMP GEARS

☐ **Remove**

11–Gears (two). 12–Bearings (two).



BEARING AND OIL SEAL REMOVAL



DRIVE GEAR REMOVAL

☐ **Remove**

9–Shaft. 13–Snap ring. 14–Gear.

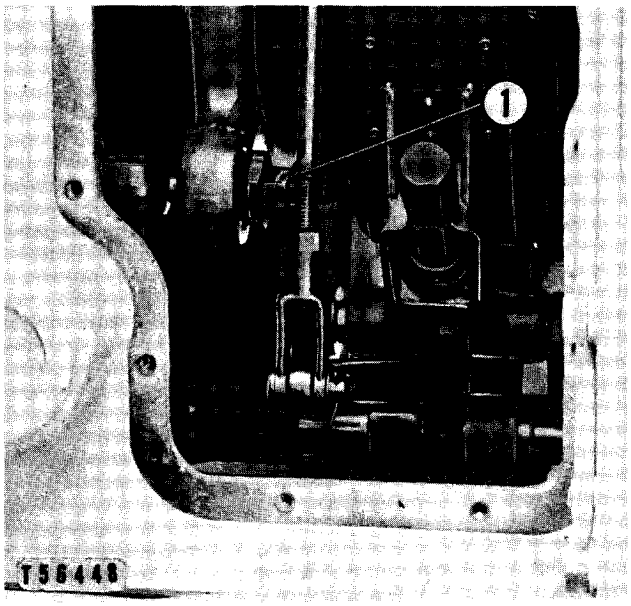
ADJUSTMENTS

Adjust the steering clutches to obtain 3.75″ of free movement at the top of the steering clutch levers, which will allow a clearance of .19″ at **(A)**.

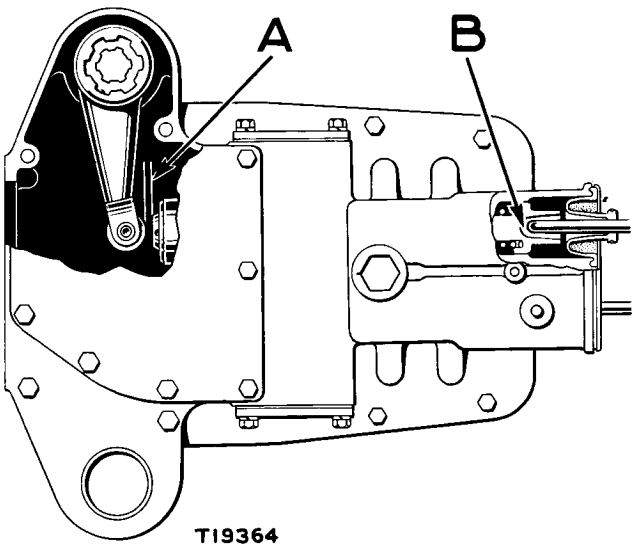
To vary the adjustment, remove the cover over the steering clutch and turn the adjusting nut **(1)** which seats in the steering clutch release yoke.

The adjustment should be checked with the engine stopped or with the flywheel clutch disengaged.

There should be a clearance of .02″ at **(B)** between the rod on the steering clutch control lever and the push rod at the front end of the hydraulic control mechanism. This measurement can be obtained by adjusting the length of the rod from the control lever to the control mechanism.

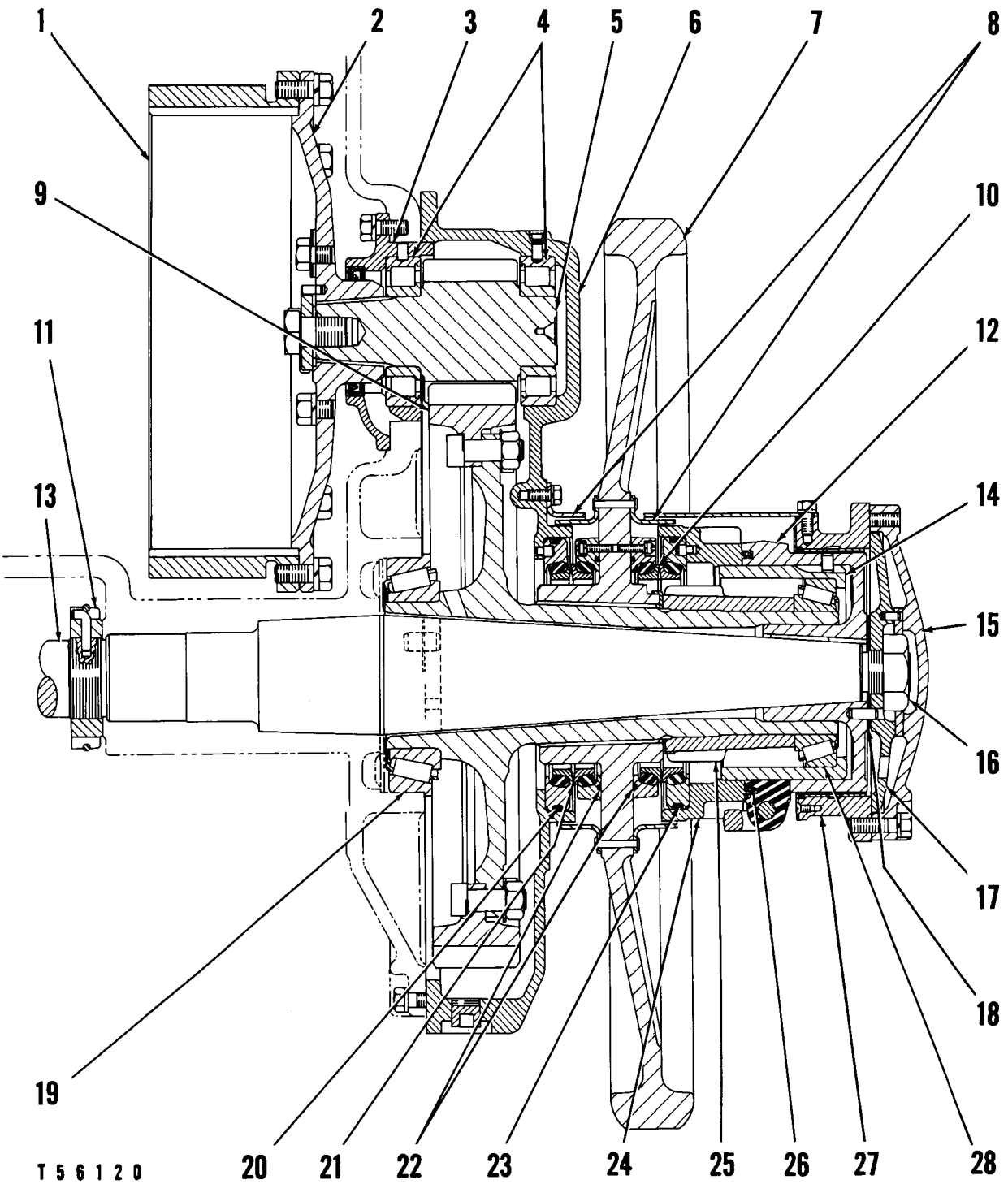


ADJUSTING STEERING CLUTCH
1–Adjusting nut.



ADJUSTING CONTROL UNIT
A–.19" dimension. B–.02" dimension.

Final Drive



FINAL DRIVE – 60" GAUGE ILLUSTRATED
(Rear View – Right Side)

1–Brake drum.
2–Final drive pinion flange.
3–Bearing cage.
4–Final drive pinion bearings.
5–Final drive pinion.
6–Final drive case.
7–Sprocket.
8–Dirt guards.
9–Final drive gear.
10–Metal floating ring seals.
11–Sprocket shaft retaining nut.
12–Bearing cage holder.
13–Sprocket shaft.
14–Bearing cage.
15–Bearing cap.
16–Retaining nut.
17–Retainer.
18–Shims.
19–Hub inner support bearing.
20–O-ring seal.
21–Metal floating ring seals.
22–O-ring seals.
23–O-ring seal.
24–Outer bearing adjusting nut.
25–Sprocket retaining nut.
26–Gasket.
27–Support assembly.
28–Hub outer support bearing.

Over

The information to follow illustrates the 60" gauge tractor. Service procedures for the 74" gauge tractor are the same, except where noted.

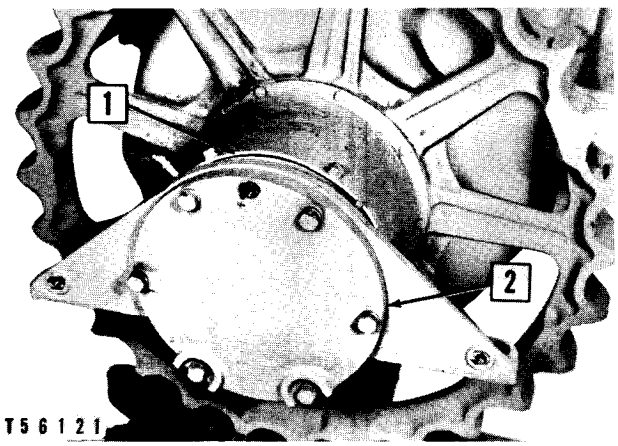
TRACK ROLLER FRAME OUTER BEARING

Removal and Installation

1. Drain the final drive compartment.
2. If only the final drive outer seals are to be replaced, lift the machine off the track roller frame to a sufficient height to allow removal of the support assembly **(9)**.

NOTE

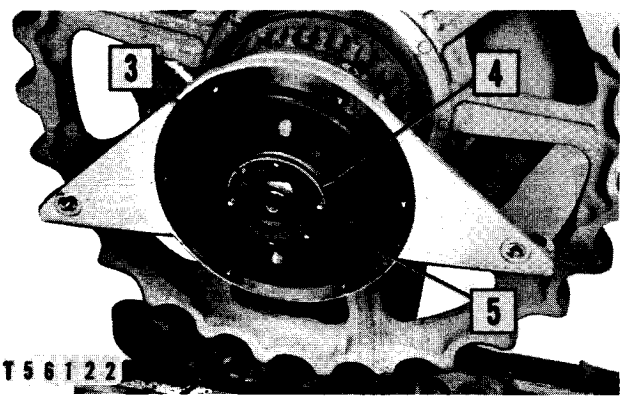
If it is desired to remove the complete final drive, it is necessary to move the roller frame clear of the sprocket.



PREPARING TO REMOVE SUPPORT ASSEMBLY

☐ **Remove**

1–Dirt guard. 2–Bearing cap.

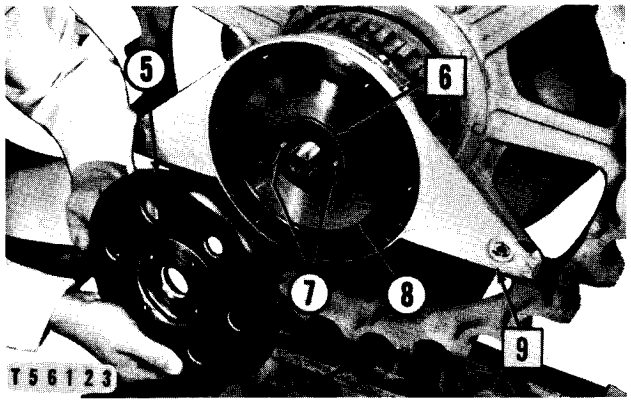


PREPARING TO REMOVE SUPPORT ASSEMBLY

☐ **Remove**

3–Retaining nut. 4–Lock. 5–Retaining.

3. If the clearance between the bearing **(10)** in the support **(9)** and holder **(8)** exceeds the maximum permissible clearance given in the topic, SPECIFICATIONS, the bearing **(10)** and seal **(11)** should be replaced.

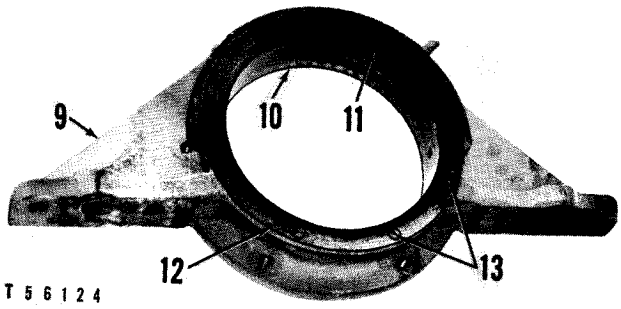


REMOVING RETAINER

☐ **Remove**

5–Retainer. 6–Shims. 7–Dowels. 8–Bearing cage holder. 9–Support assembly.

4. Remove the screws **(13)** and retainer **(12)**.



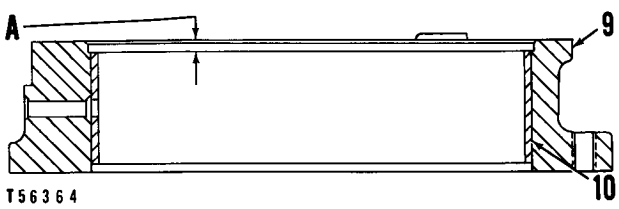
SUPPORT ASSEMBLY AND FINAL DRIVE OUTER BEARING

9–Support assembly. 10–Final drive outer bearing. 11–O-ring seal. 12–Retainer. 13–Screws (eight).

5. Install the bearing **(10)** in the support **(9)** to the dimension **(A)** as shown.

CAUTION

Be sure to align the lubricant passage in the bearing **(10)** and support **(9)**.



FINAL DRIVE OUTER BEARING

9–Support assembly. 10–Final drive outer bearing. A–.175" - .180" Dimension.

6. Install the seal **(11)**, retainer **(12)** and screws **(13)**. Secure the screws **(13)** and stake each one at each end of the slot with a center punch.

NOTE

Coat the seal **(11)** with liquid soap prior to installing the support assembly **(9)**.

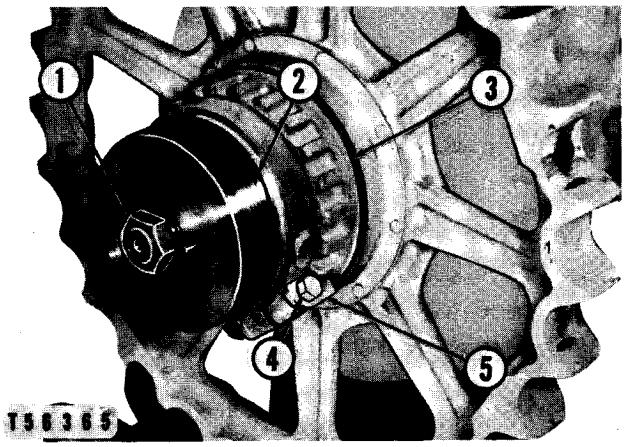
7. Place the support **(9)** in position on the bearing cage holder **(8)**.
8. Place the shims **(6)** on the dowels **(7)**. Refer to the topic, ALIGNING TRACK ROLLER FRAME WITH SPROCKET.
9. Place the retainer **(5)** on the dowels **(7)**, install the nut **(3)** and tighten to the torque value given in the topic, SPECIFICATIONS.
10. Install the lock **(4)** and install the cap **(2)** with a new gasket.
11. Refill the final drive compartment and lubricate the track roller frame outer bearing in accordance with the Operation and Maintenance Instructions.

BEARING CAGE HOLDER ASSEMBLY

Removal and Installation

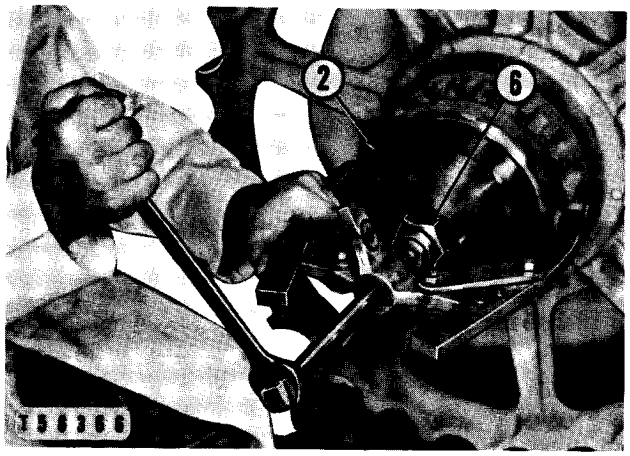
NOTE

Replace the nut **(1)** on the sprocket shaft **(6)** to retain the bearing cage holder assembly **(2)** during removal. Leave approximately ½" clearance between the nut and holder assembly **(2)**.



PREPARING TO REMOVE BEARING CAGE HOLDER ASSEMBLY
1–Retaining nut. 2–Holder assembly. 3–Adjusting nut. 4–Clamping bolt. 5–Lock.

1. Remove the clamping bolt **(4)** and lock **(5)** securing the bearing cage holder assembly **(2)** to the outer bearing adjusting nut **(3)**.
2. Using an 8H705 Puller and an 8B7560 Step Plate, force the holder assembly **(2)** from the taper on the sprocket shaft **(6)**.



REMOVING BEARING CAGE HOLDER ASSEMBLY
2–Holder assembly. 6–Sprocket shaft.

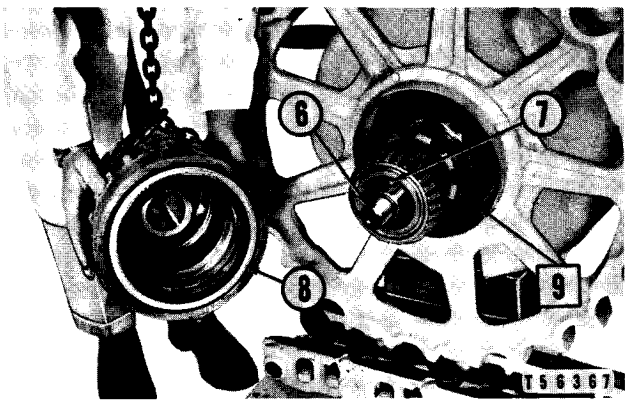
NOTE

It may be necessary to strike the holder assembly with a soft hammer to free it from the taper on the shaft.

3. Attach a suitable hoist to support the holder assembly **(2)**, remove the retaining nut **(1)** and remove the holder assembly as shown.

NOTE

The holder assembly weighs approximately 80 lbs.



REMOVING BEARING CAGE HOLDER ASSEMBLY
(Earlier Tractor Illustrated)

☐ **Remove**

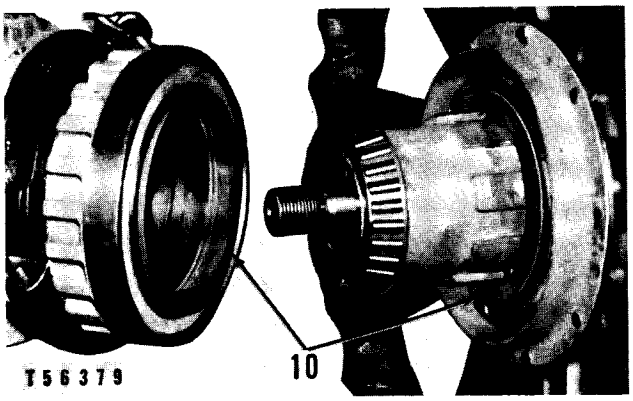
6–Sprocket shaft. 7–Key. 8–Final drive outer seal. 9–Wear washer.

4. On earlier tractors, inspect the final drive outer seal **(8)** and wear washer **(9)**. See the topic, FINAL DRIVE SEALS.

NOTE

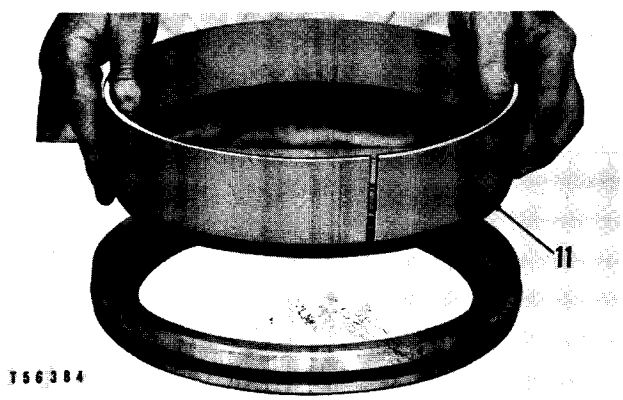
The wear washer **(9)** can be turned over to provide a new wearing surface. If both sides of the washer are worn or damaged, the washer should be replaced.

5. On later tractors equipped with metal floating ring seals, inspect the mating surfaces of the metal floating ring seals **(10)** in the adjusting nut and final drive sprocket for damage or excessive wear. Replace if necessary. See the topic, METAL FLOATING RING SEALS, prior to performing any service work involving the metal floating ring seals.



FINAL DRIVE OUTER METAL FLOATING RING SEALS
(Later Type Seal Illustrated)
10–Metal floating ring seals.

6. Install the metal floating ring seals **(10)** in their respective retainers by using a 9M5143 Metal Seal Installer Assembly as shown.



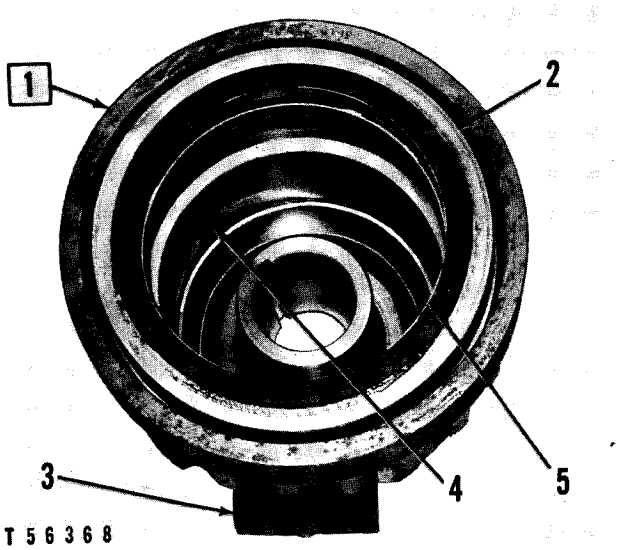
INSTALLING METAL FLOATING RING SEAL IN RETAINER
11–9M5143 Metal Seal Installer Assembly.

7. Install the retainers as outlined in the topic, FLOATING RING SEAL RETAINER REMOVAL AND INSTALLATION.
8. Align the keyway in the holder assembly hub with the key **(7)** on the sprocket shaft **(6)** and install the unit in reverse order of removal.

NOTE

The bearing preload adjustment for the hub support bearings is not made until the track roller frame outer bearing has been installed. To set the bearing preload, see the topic, ADJUSTMENTS.

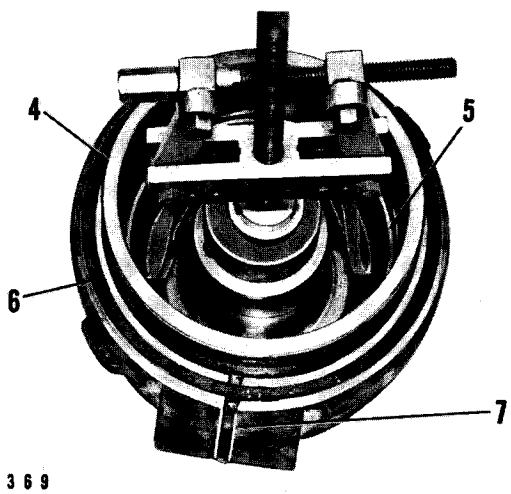
Disassembly and Assembly



PREPARING TO DISASSEMBLE BEARING CAGE HOLDER ASSEMBLY
(Earlier Type Seal Illustrated)
☐ **Remove**

1–Adjusting nut. 2–Final drive seal. 3–Holder assembly. 4–Bearing cage. 5–Bearing cup.

1. Inspect the final drive seal **(2)**. On later machines equipped with metal floating ring seals, refer to the topic, METAL FLOATING RING SEALS, prior to performing any service work involving the metal floating ring seals.
2. Using the 8B7554 Bearing Cup Pulling Attachment with a 5F7345 Forcing Screw, a suitable spacer to cover the hole in the holder assembly hub and an 8B7560 Step Plate, pull the bearing cage **(4)** and cup **(5)** as a unit from the holder assembly **(3)**.



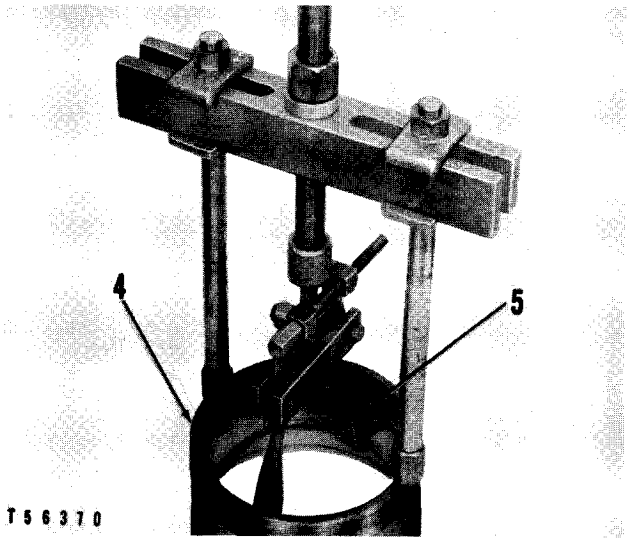
REMOVING BEARING CAGE
4–Bearing cage. 5–Bearing cup. 6–Gasket. 7–Seal.

3. Replace the bearing cage holder gasket **(6)** and seal **(7)**.

NOTE

Dip the seal in soapy water prior to installation.

4. Inspect the bearing cup **(5)** for damage or excessive wear. Replace if necessary. Using an 8B7548 Push Puller, an 8B7553 Adapter and an 8B7554 Bearing Cup Pulling Attachment, remove the cup **(5)** from the bearing cage **(4)** as shown.



REMOVING BEARING CUP FROM CAGE
4–Bearing cage. 5–Bearing cup.

CAUTION

At assembly, align the milled slot in the bearing cage **(4)** with the dowel in the bearing cage holder assembly **(3)**. This is not a press fit and can be assembled by using a soft hammer. Invert the assembly to see that the bearing cage **(4)** has bottomed in the bearing cage holder.

5. Assemble in reverse order of disassembly.

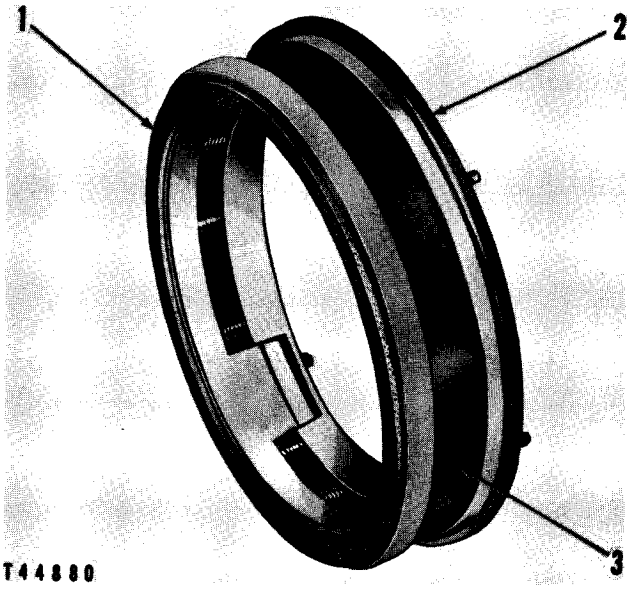
FINAL DRIVE SEALS

1. Remove the final drive seal assemblies from the final drive cases and adjusting nuts.

2. Examine the bellows **(3)**. If damaged, a new final drive seal assembly must be installed.

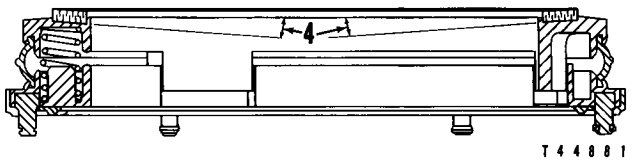
3. Examine the contact surface of the seal **(1)** and the snap-on gasket **(2)** of the final drive seal assembly. These can be replaced if the rest of the seal assembly is in good condition.

4. A new seal can be cemented in place by using 5H2471 Cement. Complete instructions for use of this cement are outlined on the label on the can. These instructions should be followed closely.



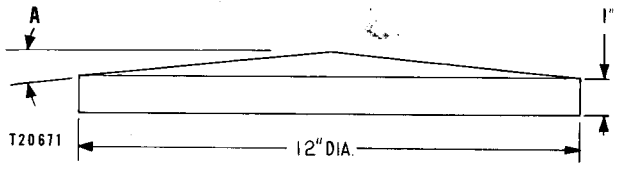
FINAL DRIVE SEAL ASSEMBLY
1–Seal. 2–Gasket. 3–Bellows.

Be sure to stir the cement thoroughly before using.



CROSS-SECTION OF FINAL DRIVE SEAL
4–3° 33′ taper.

5. The seal is assembled on a taper face **(4)** of the final drive seal assembly. When cementing the seal in place, it should be held in position with a hardwood disc such as the one illustrated. This disc, which has a 3° 33′ taper face on one side, will assure even pressure on the seal as it is being cemented to the 3° 33′ taper face of the seal assembly. This disc should be held down with a weight of about five pounds.

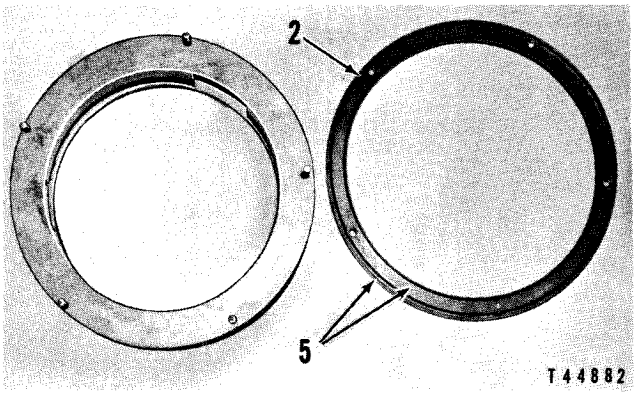


HARDWOOD DISC USED FOR CEMENTING SEALS
A–3° 33′ taper face.

6. The snap-on type gasket **(2)** should not be cemented in place.

NOTE

The ribs **(5)** on the gasket help form the seal on the seal assembly.



SEAL ASSEMBLY AND RUBBER GASKET
2–Gasket. 5–Ribs.

7. Check the seal **(1)** to make sure that it is sealing all the way around. This can be done by placing the seal assembly, seal face down, on a sheet of sandpaper, which is glued or taped to a piece of glass. Rub the seal face lightly on the sandpaper until the seal face indicates full circular contact from .06" to .19" from the outer edge. It is not essential that one hundred per cent of the seal face exhibit contact.
8. Coat the seal **(1)**, which bears against the wear washer, with graphite or grease before installing the seal assembly.

METAL FLOATING RING SEALS

Inspect the metal floating ring seals for damage or evidence of leakage. If there are scratches across the sealing bands or if the sealing band is not clearly defined around the entire circumference of the seal, the seals should be replaced. If either seal is damaged, both metal seals must be replaced.

To remove the outer metal floating ring seal, it is necessary to remove the track roller frame outer bearing, hub outer bearing cage holder and outer bearing adjusting nut. The sprocket must be removed to service or replace the inner metal floating ring seal.

CAUTION

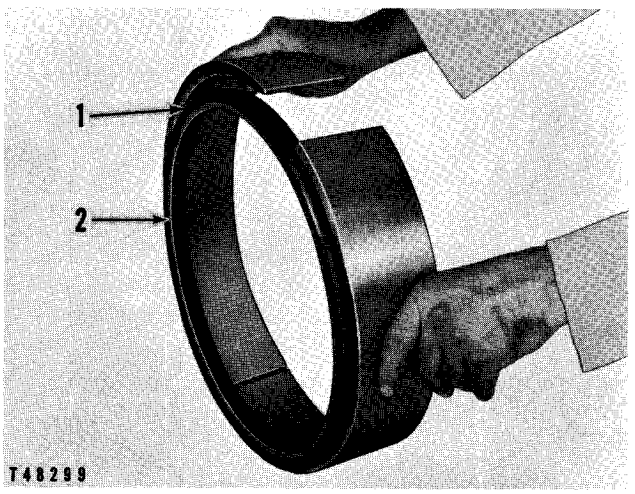
To obtain maximum service, cleanliness must be the rule. Be careful to avoid introducing dirt into the parts during installation or filling with oil.

Installing Metal Floating Ring Seal Into Retainer

1. Handle all parts with care to avoid nicking critical areas. File smooth any parts, other than the sealing faces, that have nicks from operation, disassembly or shipment that may make assembly difficult or questionable.
2. Wash off all dirt accumulation from operation on used parts. It may be necessary to use a wire brush to clean the accumulations of dirt or rust from the bore of the seal retainers to assure they are clean and smooth.
3. Remove all oil or the protective coating from the floating ring seals **(2)** and from the retainers **(4)** with a nonflammable cleaning solvent.
4. Be sure the ramps on the retainers and on the floating ring seal are dry and with no oil present. Check the ramps for rough tool marks and nicks. On used parts, remove all mud or rust deposits from the ramps with a scraper or wire brush and smooth the surface with emery cloth.
5. Always install new rubber toric sealing rings **(1)** on the floating ring seals **(2)**. Never reinstall a toric sealing ring on a new or used floating ring seal. Once it has been used, discard it and replace with a new one.

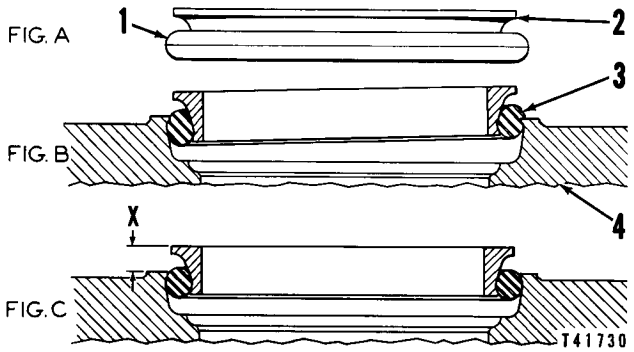
NOTE

There is a metal seal installer assembly available through the Parts Department which can be used to install the metal floating ring seal **(2)** and the toric sealing ring **(1)** into the retainer **(4)**. If the assembly tool is to be used, be sure not to bump the floating ring seal when removing the assembly tool.



METAL FLOATING RING SEAL INSTALLER TOOL
1–Rubber toric sealing ring. 2–Metal floating ring seal.

6. Install the toric sealing ring **(1)** so it seats uniformly in the relief of the floating ring seal **(2)**. Be sure that the toric sealing ring is not twisted and that it sets straight and against the lip that keeps it from falling off the floating ring seal. See Fig. A. and Fig. C.



INSTALLING FLOATING RING SEAL AND TORIC SEALING RING

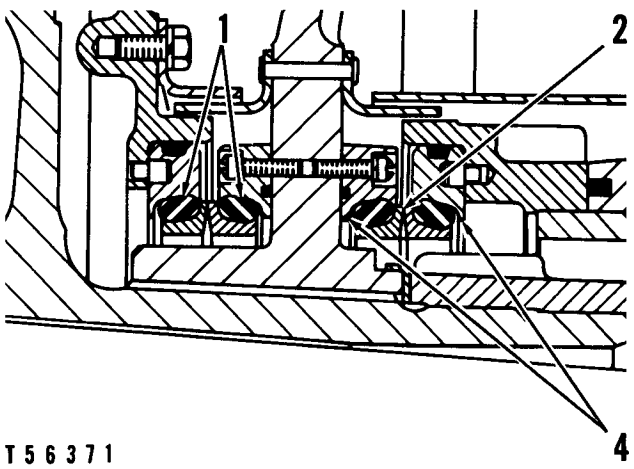
1–Rubber toric sealing ring. 2–Metal floating ring seal. 3–Location to press on toric sealing ring. 4–Toric sealing ring retainer. X–Dimension to be checked.

7. If the assembly tool is not used, install the toric sealing ring **(1)** and floating ring seal **(2)** as an assembly into the retainer **(4)** by pressing on the toric sealing ring at location **(3)**. Fig. B. Be sure the toric sealing ring is seated uniformly in the recess of both the floating ring seal and the retainer. Make sure that it sets in the bore straight and against the lip that keeps it from falling out of the retainer. Fig. C.

CAUTION

If the assembly tool is not used, do not use a screwdriver or stick to assemble the toric sealing ring in the retainer. Use finger pressure only.

8. The floating ring seal should be installed in the retainer to a uniform depth. The dimension **(X)** must be uniform around the entire circumference of the floating ring seal.
9. The floating ring seals should always be installed in pairs, that is, two new seals together or two seals that have previously run together.



METAL FLOATING RING SEALS CORRECTLY INSTALLED

1–Toric sealing ring. 2–Floating ring seal. 4–Toric sealing ring retainers.

Never assemble one new seal and one used seal or two seals that have not previously run together.

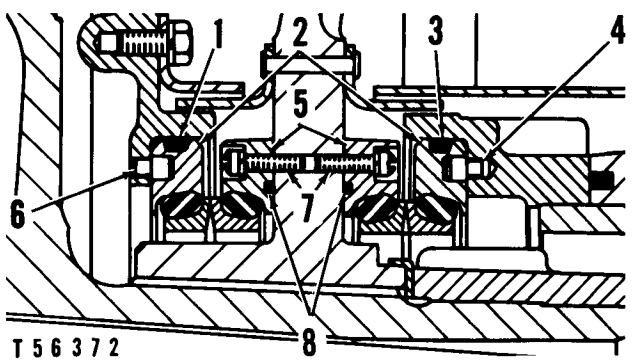
10. Before assembling the floating ring seals together, wipe the face of the seals with lint-free tissue to remove any foreign material and finger prints.
11. Place one drop of light oil on the cleaning tissue and coat the sealing surfaces of the seals. Be careful not to let any oil come in contact with the toric sealing ring or its mating surface.

Floating Ring Seal Retainer Removal and Installation

1. Remove the metal floating ring seals and contained toric sealing rings.
2. Using a wire brush, remove the excess dirt present. Avoid contact with the sealing surface of the toric sealing rings to prevent possible damage.
3. Remove the retainer assemblies **(2)** and inspect the O-ring seals **(1)** and **(3)** on the outside diameter for damage. Replace if necessary.

NOTE

The locating dowels **(4)** and **(6)**, contained in the retainer assemblies **(2)**, are loose slip fits in their mating parts to facilitate ease in removal and installation of the retainer assemblies.



RETAINER INSTALLATION

1–O-ring seal. 2–Retainers. 3–O-ring seal. 4–Dowel. 5–Retainers. 6–Dowel. 7–Screws. 8–O-ring seals.

4. Remove the retainers **(5)** after removing the screws **(7)** and inspect the O-ring seals **(8)** on the inside diameter, for damage. Replace if necessary.
5. Clean the retainers. See the topic, INSTALLING METAL FLOATING RING SEAL INTO RETAINER.

6. When installing the retainers **(2)**, align the dowels **(4)** and **(6)** with the dowel holes in the mating parts and align the holes in the retainers **(5)** with the threaded holes in the sprocket. To facilitate installation, lubricate the O-ring seals **(1)** and **(3)** with liquid soap.

7. Install the screws **(7)**.

CAUTION

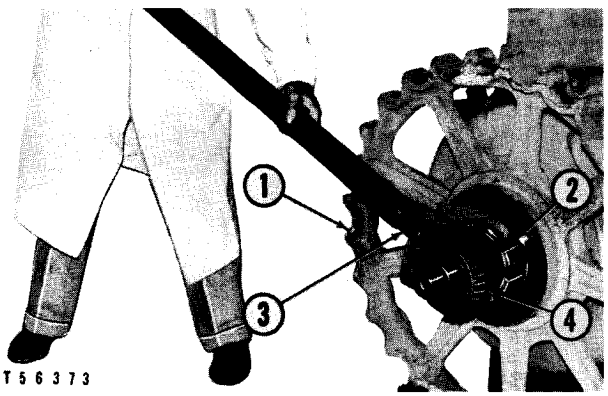
After the retainers have been installed, wipe the lubricant and any foreign material from the retainer so that the toric sealing ring will be seated against a clean and dry surface. See the topic, INSTALLING THE METAL FLOATING RING SEAL INTO THE RETAINER.

FINAL DRIVE SPROCKET

Removal

1. Bend the lock securing the retaining nut **(2)**.

2. The cone **(4)** can be removed by turning the nut **(2)** in a counterclockwise direction with a 7F9306 Spanner Wrench **(3)** and suitable extension.



PREPARING TO REMOVE OUTER BEARING CONE
1–Final drive sprocket. 2–Retaining nut. 3–7F9306 Spanner Wrench. 4–Bearing cone.

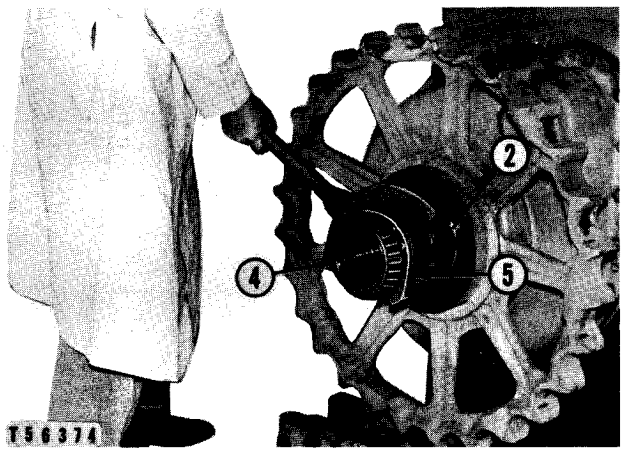
NOTE

Use a 4B6091 Yoke **(5)** as a spacer between the nut **(2)** and cone **(4)** after the nut has forced the cone halfway off the hub.

3. Position the nut **(2)** so there is approximately .25" between it and the final drive sprocket **(1)**.

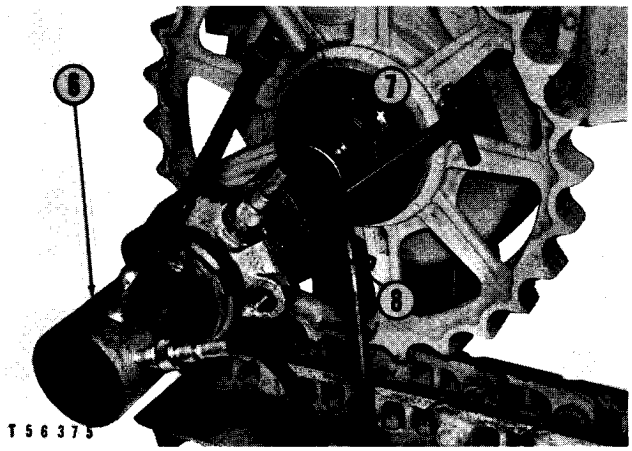
WARNING

It is important that step 3 be observed to prevent the sprocket from jumping off the hub after it is pulled loose from the press fit on the tapered splines.



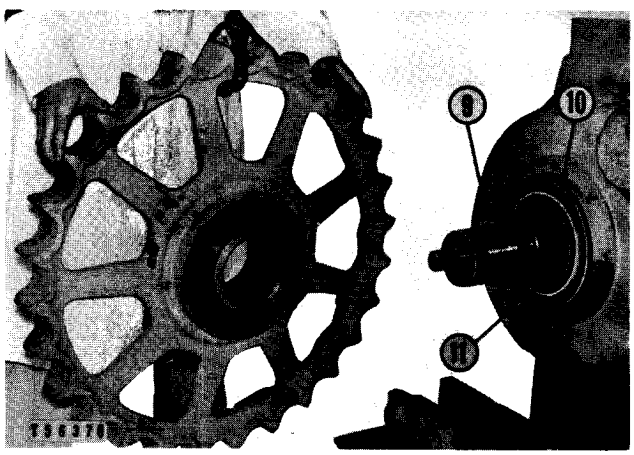
REMOVING NUT WITH YOKE INSTALLED
2–Retaining nut. 4–Bearing cone. 5–4B6091 Yoke.

4. Using a 6F25 Pump Group, cylinder group **(6)**, arms **(7)** and spacer **(8)**, pull the sprocket **(1)** loose from the hub.



PREPARING TO REMOVE FINAL DRIVE SPROCKET
6–7F9831 Cylinder Group. 7–5F9040 Puller Arm Group (three). 8–5F7334 Spacer.

5. Relieve the pressure on the cylinder group and remove the puller arrangement from the sprocket.



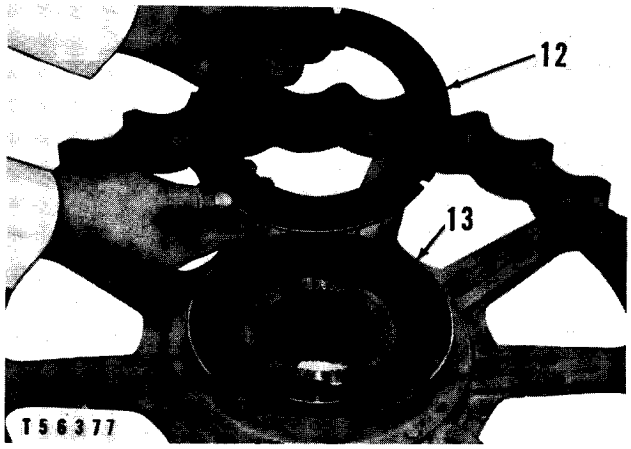
REMOVING FINAL DRIVE SPROCKET
(Earlier Machine Illustrated)
9–Final drive hub. 10–Dirt guard. 11–Final drive seal.

6. Attach a suitable hoist to the sprocket and remove the retaining nut **(2)** and lock.
7. Remove the sprocket. The sprocket weighs approximately 170 pounds.

NOTE

Inspect the splines on the hub **(9)** and the splines in the sprocket for wear if the sprocket pulls off easily.

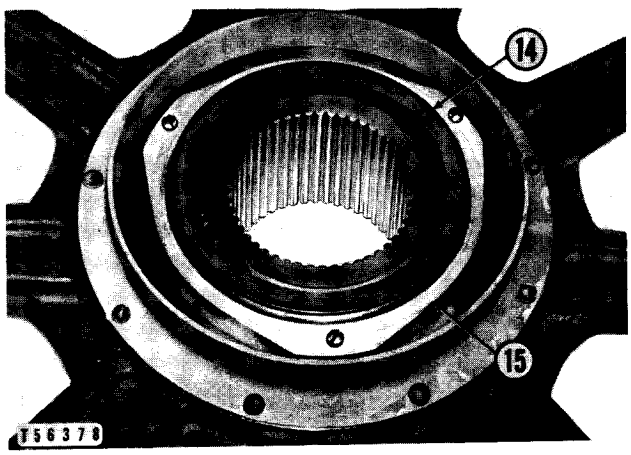
8. Inspect the seal **(11)** between the final drive sprocket and final drive case. See the topic, FINAL DRIVE SEALS.
9. Inspect the wear washer **(12)**.



FINAL DRIVE SPROCKET INNER WEAR WASHER
(Earlier Type Seal Illustrated)
12–Wear washer. 13–Dirt guard.

NOTE

The wear washer **(12)** can be turned over to provide a new wearing surface. If both sides are worn or damaged, the washer should be replaced.



FINAL DRIVE SPROCKET INNER METAL FLOATING RING SEAL
(Later Type Seal Illustrated)
14–Metal floating ring seal. 15–Metal floating ring seal retainer.

10. The dirt guards **(13)** can be removed after cutting the heads of the rivets, if replacement is necessary. Also, inspect the dirt guard **(10)**.
11. On later machines equipped with metal floating ring seals, remove the floating ring seal **(14)** as soon as the sprocket has been removed. Also, remove the floating ring seal from the final drive case. Tie the mating seals together to assure installation of the same mating seal surfaces. See the topic, METAL FLOATING RING SEALS.
12. Remove the retainer **(15)**. See the topic, FLOATING RING SEAL RETAINER REMOVAL AND INSTALLATION.

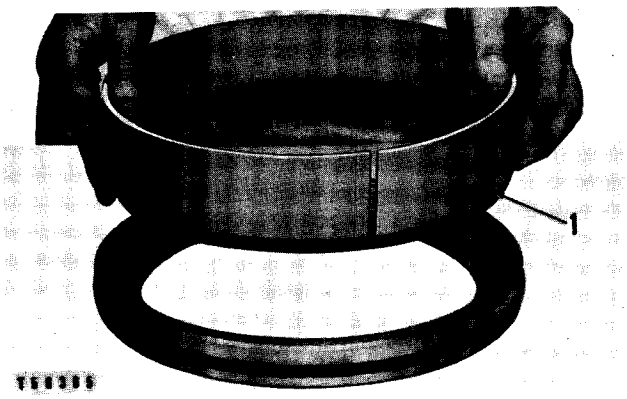
Installation

1. Place the final drive inner seal in the final drive gear case. Make certain the drive pins are properly engaged.

NOTE

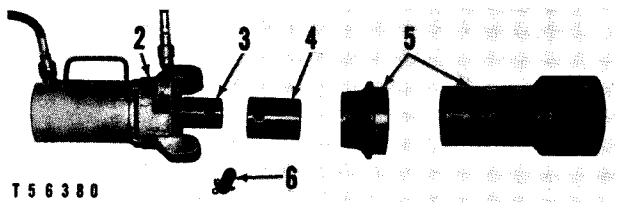
Prior to installation of the seal, make certain the three grommets are on the drive pins.

2. Coat the cork face of the seal with graphite or grease.
3. Scrape the old wear washer gasket from both sides of the sprocket assembly. It is important that this surface be smooth and clean to provide a good sealing surface.
4. Coat both sides of the new gasket with No. 3 Permatex or equivalent.
5. Place the gasket on the inside of the sprocket assembly.
6. Stake the washers in place so that they will not fall off during assembly, but at the same time they should be loose enough to float.
7. On later tractors equipped with metal floating ring seals, install the metal floating ring seals in the retainers by using the 9M5143 Metal Seal Installer Assembly **(1)** as outlined in the topic, INSTALLING METAL FLOATING RING SEAL INTO RETAINER.
8. Install the floating ring seal retainers and seals in the inner side of the sprocket and the final drive case as outlined in the topic, FLOATING RING SEAL RETAINER REMOVAL AND INSTALLATION.
9. Before installing the sprocket, make sure that the splines are clean, dry and free from burrs. Set the sprocket on the hub with the splines in the sprocket meshing with the splines on the hub and push the sprocket on as far as possible by hand.



INSTALLING METAL FLOATING RING SEAL IN RETAINER
(Later Type Seal Illustrated)
1–9M5143 Metal Seal Installer Assembly.

10. Install the adapter **(3)** on the cylinder group **(2)** and extend the ram to its limit with a 6F25 Pump Group.



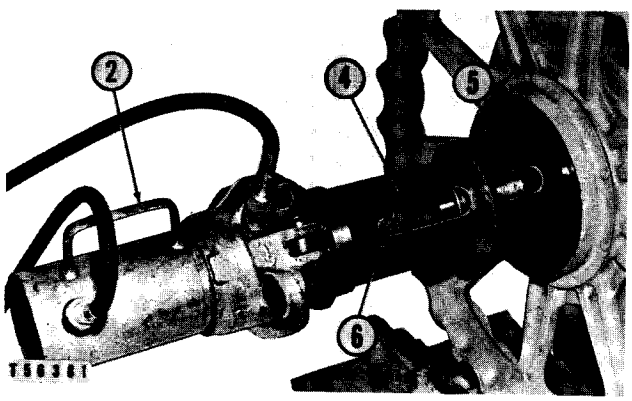
SPROCKET INSTALLATION TOOLS
2–7F9831 Cylinder Group. 3–5F9888 Adapter Coupler. 4–5F9885 Adapter. 5–7F5288 Pusher Group. 6–5F9892 Pin.

11. Assemble the head of the pusher group **(5)** to the cylinder **(2)**.

12. Install the adapter **(4)** onto the sprocket shaft.

13. Place the sleeve of the pusher group **(5)** over the adapter and final drive hub **(9)**.

14. Connect the adapter coupler **(3)** and adapter **(4)** with the pin **(6)**.

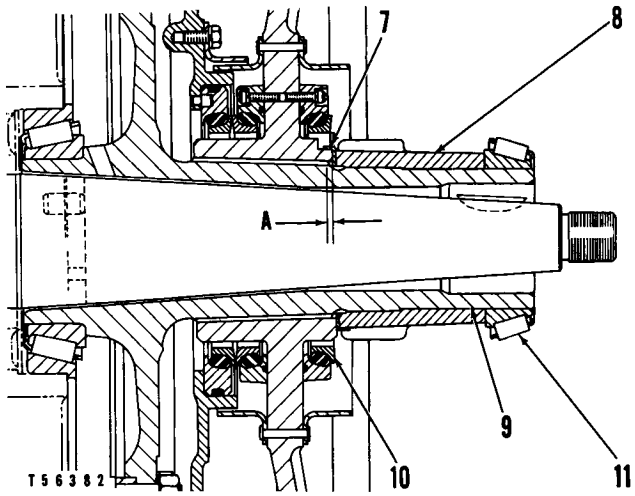


INSTALLING FINAL DRIVE SPROCKET
2–7F9831 Cylinder Group. 4–5F9885 Adapter. 5–7F5288 Pusher Group. 6–5F9892 Pin.

15. Place the pump control in the pulling position and apply a slight press to the sprocket. Rock the sprocket back and forth to equalize the load.

16. Press the sprocket on to the pressure given in the topic, SPECIFICATIONS.

17. When a new sprocket or final drive hub has been installed, measure the distance **(A)** between the face of the sprocket hub and the end of the splines on the final drive hub. See the topic, SPECIFICATIONS, for the correct dimension.



CHECKING SPROCKET LOCATION
(Later Machine Illustrated)
A–Dimension to be checked.
7–Lock. 8–Nut. 9–Hub. 10–Metal floating ring seal. 11–Bearing cone.

18. Remove the installation tools, and on later tractors install the metal floating ring seals **(10)** with its retainer. See the topic, FLOATING RING SEAL RETAINER REMOVAL AND INSTALLATION.

19. Install the lock **(7)**, and using a 7F9306 Spanner Wrench, install the sprocket retaining nut **(8)**.

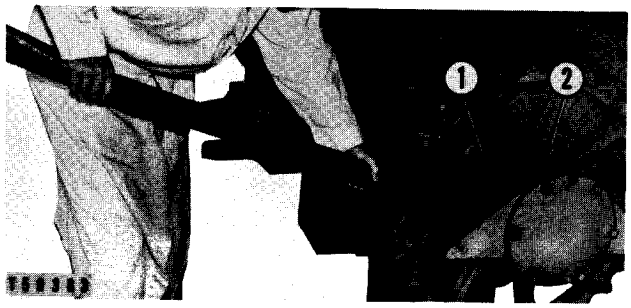
20. After locking the retaining nut, heat the outer bearing cone **(11)**, preferably in oil, and drive it onto the final drive gear hub **(9)** until it seats against the retaining nut **(8)**.

ADJUSTMENTS

Final Drive Bearings

After the final drive has been assembled, the track roller frame outer bearing installed and aligned, adjust the bearing preload on the sprocket support bearings. With the adjusting nut lock and clamping bolt removed, tighten the adjusting nut **(2)** to the torque value given in the topic, SPECIFICATIONS. This can be readily accomplished by using

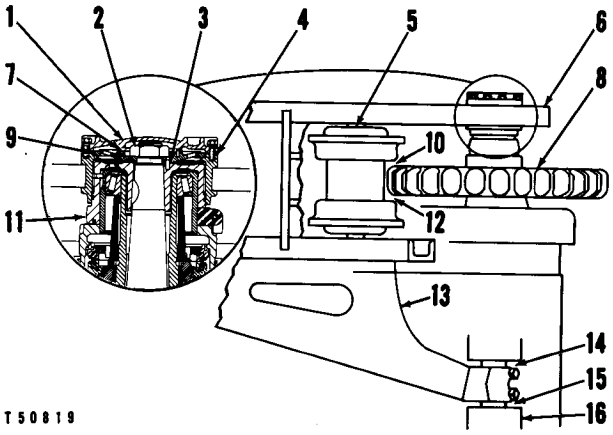
a five foot extension on the 7F9306 Spanner Wrench **(1)**. Continue to tighten the nut **(2)** until the adjusting nut lock can be installed. Install and secure the clamping bolt.



ADJUSTING FINAL DRIVE BEARINGS
1–7F9306 Spanner Wrench. 2–Adjusting nut.

Aligning Track Roller Frame With Sprocket

1. When installing the track roller frame **(6)**, the center of the track rollers should be centered with the drive sprocket **(8)**. The track should lead straight off of the rear roller **(5)** onto the drive sprocket and not rub against either the sides of the sprocket or the rims of the track roller.
2. The drive sprocket **(8)** should be centered in the recess of the rear track roller **(5)** so that the spaces **(10)** and **(12)** between the outer face of the sprocket and the inner edge of the track roller rim are equal.
3. When this is properly adjusted, the diagonal brace **(13)** should be checked to see that there is clearance at **(14)** and **(15)** in the recess in the steering clutch case **(16)**.



ALIGNING TRACK ROLLER FRAME WITH SPROCKET

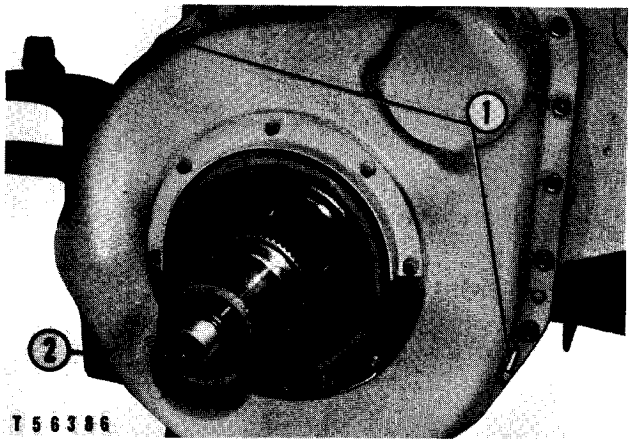
1–Cap.
2–Nut.
3–Shims.
4–Outer bearing assembly.
5–Rear track roller.
6–Track roller frame.
7–Lock ring.
8–Drive sprocket.
9–Retainer assembly.
10–Clearance.
11–Holder assembly.
12–Clearance.
13–Diagonal brace.
14–Clearance.
15–Clearance.
16–Steering clutch case.

4. This adjustment can be made by removing the cap **(1)** from the outer bearing assembly **(4)** and taking off the lock ring **(7)**, nut **(2)** and retainer assembly **(9)**.
5. Add shims **(3)** between the retainer assembly **(9)** and the holder assembly **(11)** to move the roller frame away from the tractor. This will decrease the clearance **(12)** at the roller and at the diagonal brace **(14)** and increase the clearance at **(10)** and **(15)**.
6. Remove shims **(3)** to allow the roller frame to move closer to the tractor. This will decrease the clearance at **(10)** and **(15)** and increase the clearance at **(12)** and **(14)**.

FINAL DRIVE CASE AND GEAR

Removal and Installation

1. Remove the track roller frame outer bearing support assembly, bearing cage holder assembly and final drive sprocket. See the respective covering topics.
2. Remove the bolts which secure the final drive case to the steering clutch and bevel gear case.
3. Use two 3/8" - 16 (NC) forcing screws **(1)** to separate the final drive case **(2)** from the steering clutch and bevel gear case.

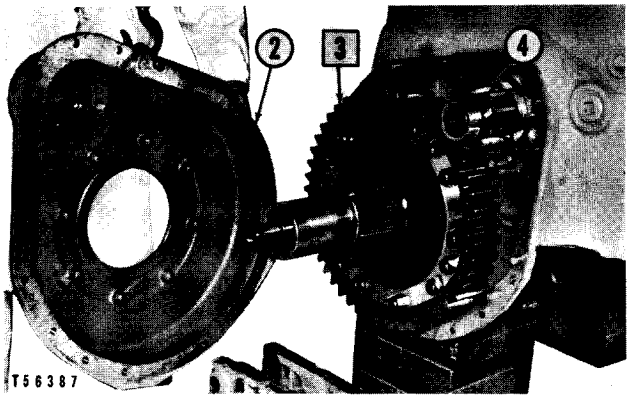


PREPARING TO REMOVE FINAL DRIVE GEAR CASE
1–Forcing screws. 2–Final drive gear case.

4. Install a suitable lifting eye in one of the bolt holes in the top of the final drive case.
5. Attach a suitable hoist and remove the final drive case.

NOTE

The final drive case weighs approximately 115 lbs. and the final drive gear and hub weigh approximately 160 lbs.



REMOVING FINAL DRIVE GEAR CASE

☐ **Remove**

2–Final drive case. 3–Final drive gear and hub. 4–Final drive pinion.

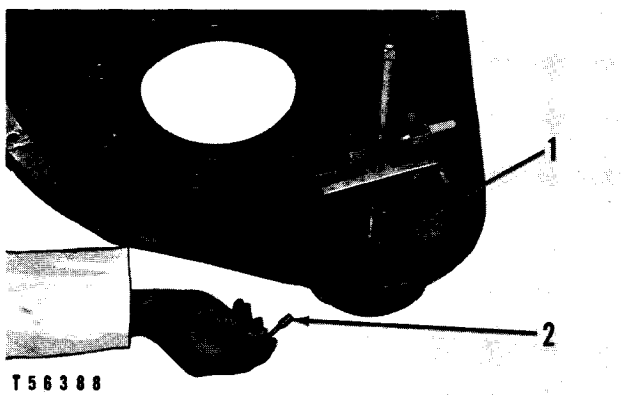
6. See the topic, FINAL DRIVE PINION, for the removal procedure of the final drive pinion **(4)**.
7. Use a new gasket at the time of installation.
8. Install in the reverse order of removal.

FINAL DRIVE PINION OUTER BEARING REMOVAL AND INSTALLATION

If the final drive pinion outer bearing **(1)** is worn or damaged, it should be replaced.

Remove the core plug, insert a ¼" - 20 (NC) bolt into the dowel **(2)** and remove the dowel.

Use an 8B7554 Bearing Cup Pulling Attachment, with an 8B7552 Forcing Bolt and 8B7561 Step Plate to remove the bearing **(1)**.



REMOVING FINAL DRIVE PINION OUTER BEARING
1–Bearing. 2–Locating dowel.

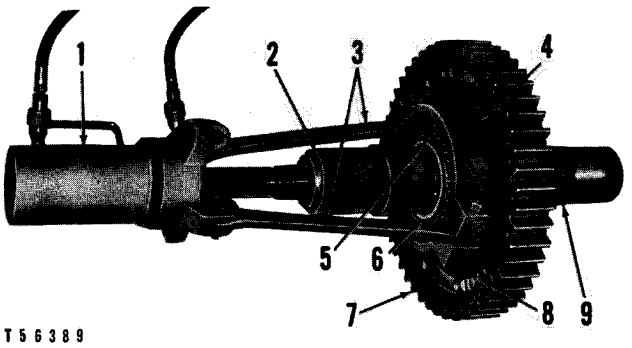
CAUTION

Final drive pinion bearings which have snap rings should be installed with the snap ring next to the gear at the time of assembly.

At the time of assembly, make certain the dowel **(2)**, which prevents the bearing outer race from turning, and the core plug are replaced.

FINAL DRIVE GEAR AND HUB DISASSEMBLY AND ASSEMBLY

1. If the cone **(6)** should require replacement, it can be removed from the hub by using the cylinder group **(1)** with the 6F25 Pump Group, spacer **(2)**, arms **(3)**, yoke **(4)** and shim **(5)**.



REMOVING FINAL DRIVE INNER CONE
1–7F9831 Cylinder Group. 2–5F7334 Spacer. 3–5F9306 Arm (two). 4–2B4206 Yoke. 5–5F5586 Shim. 6–Cone. 7–Final drive gear. 8–Bolts. 9–Final drive gear hub.

2. Heat the cone **(6)** and install it on the hub.
3. The final drive gear **(7)** can be removed from the hub **(9)** after removal of the bolts **(8)**.
4. If the teeth on the final drive gear are not chipped or pitted, but are worn on one side, the final drive gears from each side can be interchanged to lengthen the service life of the gears.
5. Refer to the topic, SPECIFICATIONS, for the correct final drive gear to hub retaining bolt torque.
6. If the cup for the final drive gear inner cone should require replacement, it can be removed from the bevel gear case by arc welding a bead around the inside diameter of the cup. As the bead cools, the cup will contract and can then be removed.

CAUTION

Make certain the ground lead is connected to the bevel gear case to prevent arcing through bearings. Make certain all slag is cleaned from the bevel gear case.

7. The new cup can be installed by chilling it and driving it into the bevel gear case. Make certain it is bottomed in its bore.

SPROCKET SHAFT

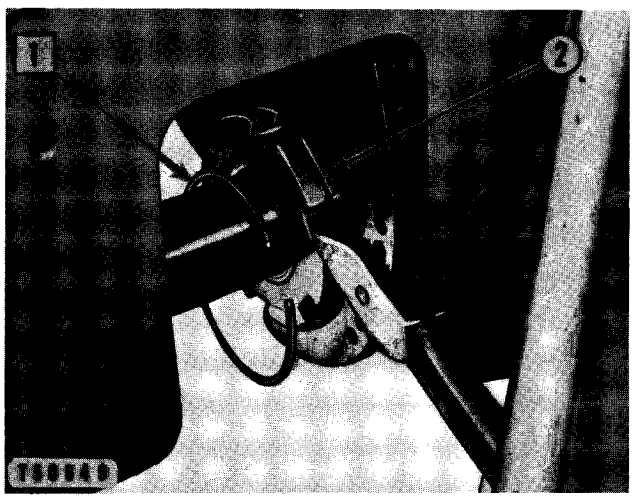
Checking Sprocket Shaft

The final drive sprocket shaft should be checked to determine if it is straight prior to reconditioning the final drive.

NOTE

If the sprocket shaft is bent more than the allowable tolerance, the shaft should be removed and straightened or replaced. See the topic, SPECIFICATIONS.

Removal and Installation

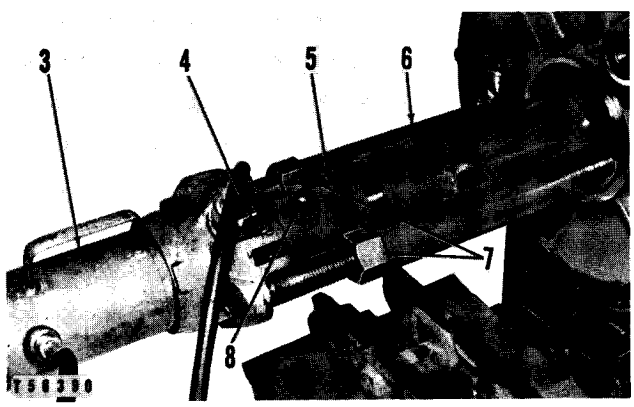


REMOVING RETAINING NUT

☐ **Remove**

1–Lock ring. 2–Retaining nut.

1. Remove the pin securing the sprocket retaining nut **(2)**, to the sprocket shaft.
2. Using a 7F9306 Spanner Wrench, unscrew the retaining nut **(2)**.



REMOVING SPROCKET SHAFT

3–7F9831 Cylinder Group. 4–5F9888 Adapter Coupler. 5–5F9885 Adapter. 6–5F9890 Puller Group. 7–Nuts. 8–5F9892 Coupling Pin.

3. Using a 6F25 Pump Group, cylinder group **(3)**, adapter coupler **(4)**, adapter **(5)**, puller group **(6)** and pin **(8)**, pull the sprocket shaft as shown.

NOTE

On 74" gauge machines, the procedure is the same except the nuts **(7)** must be run down further on their rods to compensate for the difference in the length of the sprocket shafts.

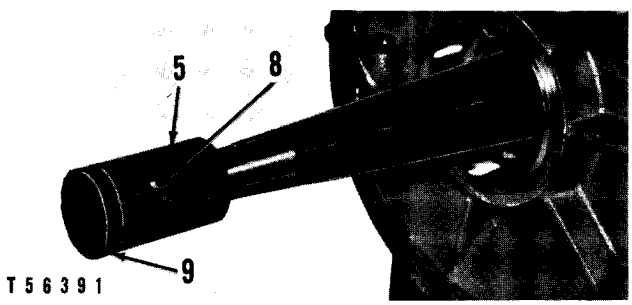
4. If the sprocket shaft is not straight within the amount listed in the topic, SPECIFICATIONS, it should be replaced.
5. Using a plug **(9)**, adapter **(5)** and pin **(8)** drive the sprocket shaft into the bevel gear case until the correct dimension, given in the topic, SPECIFICATIONS, is obtained.

CAUTION

Make certain the adapter is threaded against the shoulder on the sprocket shaft.

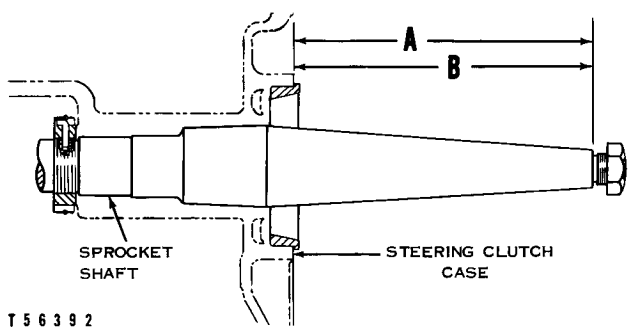
NOTE

Make certain the sprocket shaft is installed with the key slot facing upward.



INSTALLING SPROCKET SHAFT

5–5F9885 Adapter. 8–5F9892 Pin. 9–5F9889 Cap.



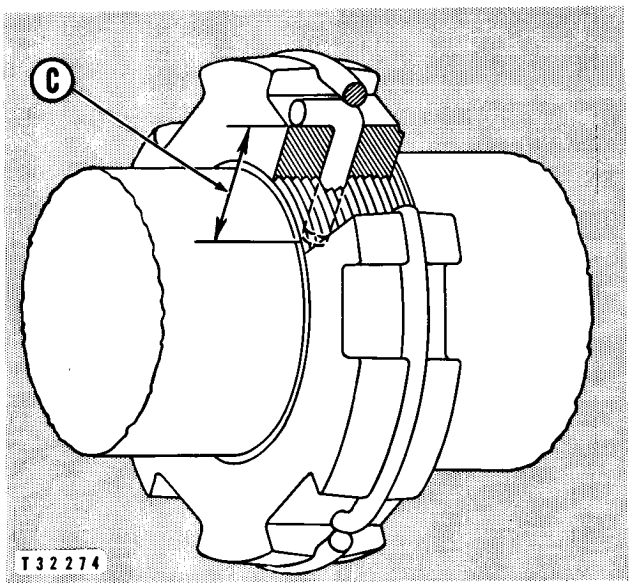
DIMENSIONS WITH SPROCKET SHAFT PROPERLY INSTALLED

A–Dimension from shoulder on sprocket shaft to machined face of steering clutch and bevel gear case (60" gauge machines).

B–Dimension from shoulder on sprocket shaft to machined face of steering clutch and bevel gear case (74" gauge machines).

6. Install the retaining nut **(2)**.

7. When the retainer nut is tightened securely, lock it in the following manner: Drill a .31" hole through one of the notches in the nut, through the nut and into the shaft. The total depth should be 1.38".



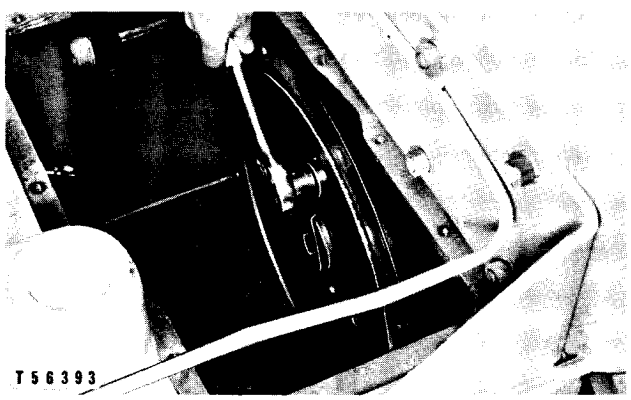
INSTALLING RETAINING NUT LOCK PIN
C–.31" drill, 1.38" deep.

8. Place the pin in the hole and install the lock ring **(1)** to hold the pin in place.

FINAL DRIVE PINION

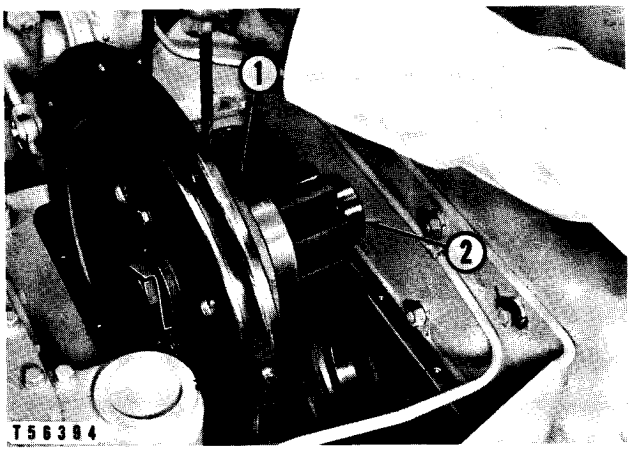
Removal and Installation

1. Remove the steering clutch. See the covering topic.
2. Remove the final drive pinion bearing cage retaining bolts access cover in the pinion flange.
3. Remove each of the five bearing cage retaining bolts in the manner shown.



REMOVING BEARING CAGE RETAINING BOLTS

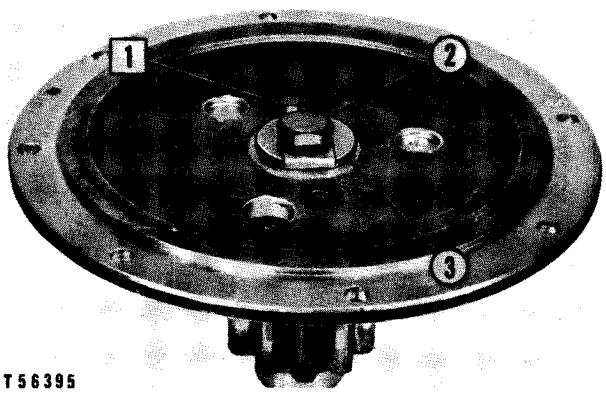
4. Move the pinion and flange toward the center of the tractor until the race **(2)** is clear of the steering clutch and bevel gear case.
5. Attach a suitable hoist and remove as shown.



REMOVING FINAL DRIVE PINION AND FLANGE
1–Bearing cage. 2–Pinion shaft outer bearing inner race.

6. At the time of installation, install a new gasket between the bearing cage **(1)** and steering clutch and bevel gear case.
7. Replace the cover and gasket over the bearing cage retaining bolt access hole in the pinion flange.

Disassembly and Assembly



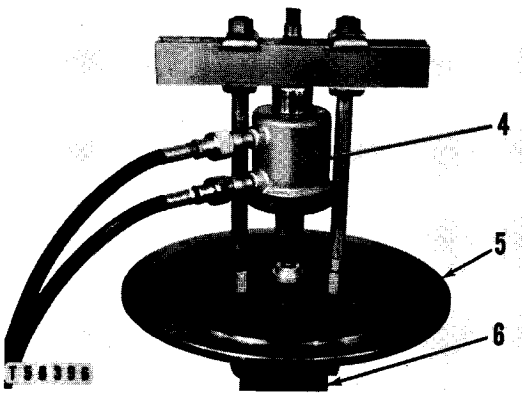
PREPARING TO REMOVE FINAL DRIVE PINION FLANGE
☐ Remove
1–Bolt. 2–Bolt. 3–Washer.

1. Loosen the bolt **(2)** leaving approximately .25" clearance between the bolt **(2)** and washer **(3)**.

WARNING

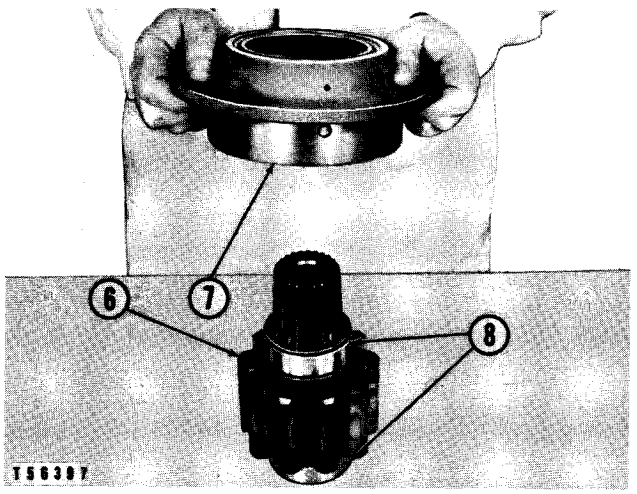
It is important that step 1 be observed to prevent the possibility of personal injury, because the pinion (6) may be ejected from the flange (5) with considerable force after it is broken loose from the press fit on the tapered splines.

2. Remove the flange from the pinion by using the 8B7548 Push Puller, two 8B7556 Adapters, an 8B7560 Step Plate, hydraulic puller **(4)** and a 6F25 Pump Group.



REMOVING FINAL DRIVE PINION FLANGE
4–7F9540 Hydraulic Puller. 5–Pinion flange. 6–Final drive pinion.

3. Remove the bearing cage **(7)** from the final drive pinion **(6)**.



REMOVING BEARING CAGE
6–Final drive pinion. 7–Bearing cage. 8–Final drive pinion bearing inner races.

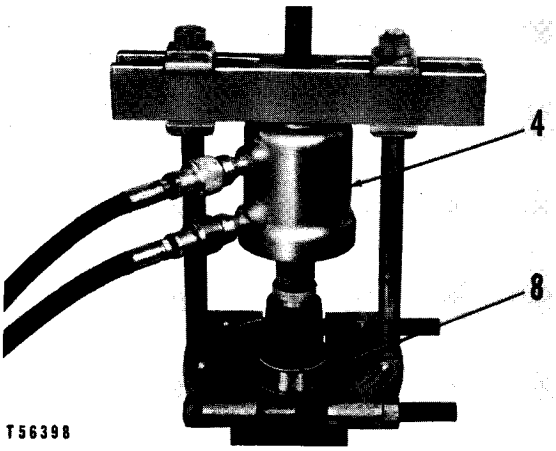
4. Inspect the final drive pinion **(6)** for damage or excessive wear and replace if necessary.

5. The bearing inner races **(8)** can be removed by using the 8B7548 Push Puller, 8B7560 Step Plate, 5F7343 Bearing Pulling Attachment, hydraulic puller **(4)** and a 6F25 Pump Group.

6. Heat the inner races **(8)** and install them on the pinion **(6)**.

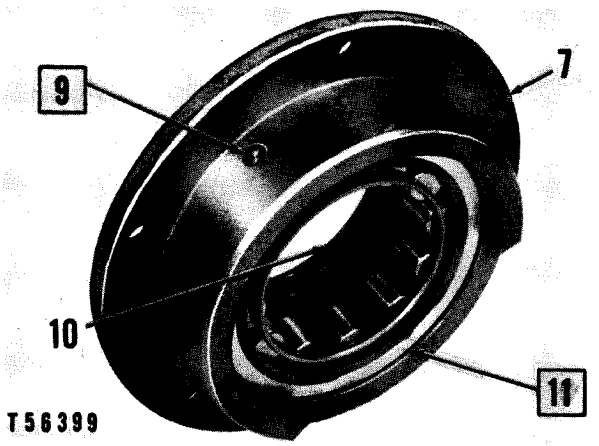
NOTE

Make certain the shoulders on the races are installed next to the gear.



REMOVING BEARING INNER RACE
4–7F9540 Hydraulic Puller. 8–Bearing inner race.

7. Inspect the bearing **(11)** in the cage **(7)** for damage or excessive wear and replace if necessary.



FINAL DRIVE PINION INNER BEARING AND SEAL

☐ **Remove**

7–Bearing cage. 9–Locating dowel. 10–Oil seal. 11–Bearing.

8. Align the dowel hole in the bearing **(11)** with the dowel hole in the cage **(7)** and install the bearing **(11)** and dowel **(9)**.

NOTE

Bearings with snap rings should be installed with the snap rings next to the gear teeth.

9. Inspect the seal **(10)**. If the seal is worn or damaged, it should be replaced.

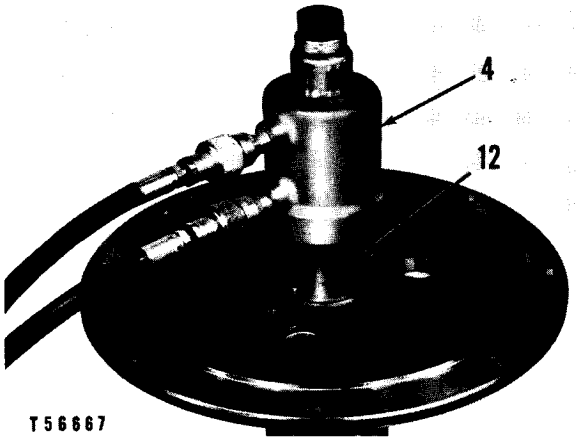
10. Install the seal **(10)** so the spring loaded lip faces the bearing **(11)**.

11. Make certain the splines on the pinion and inside the flange are clean and dry and free of burrs.

12. Lubricate the lips of the seal **(10)** and place the bearing cage assembly **(7)** in position on the pinion **(6)**.

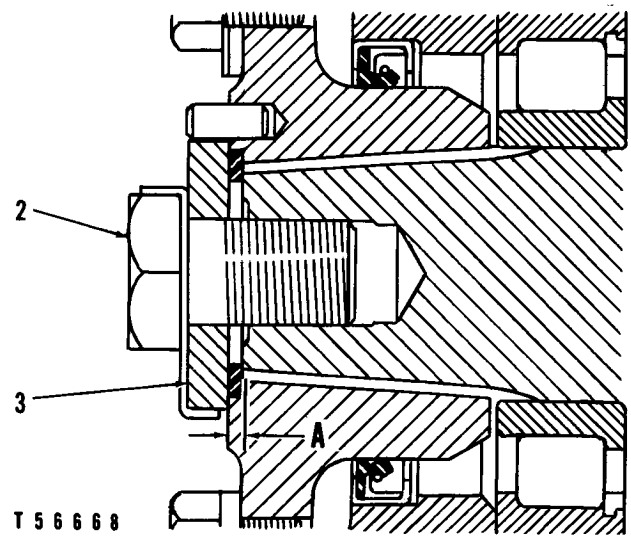
13. Place the flange **(5)** on the pinion **(6)**.

14. The flange can be pressed into place on the pinion by using an adapter group **(12)**, hydraulic puller **(4)** and a 6F25 Pump Group.



INSTALLING PINION FLANGE
4–7F9540 Hydraulic Puller. 12–7M7236 Flange Installation Adapter Group (consisting of a 7B8363 Bolt, 7M7237 Adapter and 7M7238 Sleeve).

15. Press the flange onto the pinion to the force listed in the topic, SPECIFICATIONS. The distance **(A)** between the face of the flange and the shoulder on the pinion should be equal to the value given in the topic, SPECIFICATIONS.



FLANGE TO PINION PRESS FIT
2–Bolt. 3–Washer. A–Dimension to be checked.

16. Install a new gasket beneath the washer **(3)**, install a new lock and secure the bolt **(2)**.

ISSUED 9-62

TRACK ROLLER FRAME

TABLE OF CONTENTS

ISSUED 10-62

TRACK ROLLER FRAME

INDEX

Specifications

These specifications contain dimensions for new parts and a suggested guide for the amount of wear that might normally be considered a reasonable figure to use in determining when to replace parts. These wear dimensions are shown after the description, "permissible clearance." These specifications are provided to help determine when new parts should be installed. This information should not be regarded as the only factor in determining when to replace parts. Past performance should be the governing factor for parts replacement. Even though parts are worn they may still be satisfactory. The remaining service life of these parts must be considered when deciding if parts should be replaced. If a machine is disassembled for reconditioning it is well to replace parts not completely worn out if the remaining service life is deemed short.

Track Roller Frame

Type	6 Roller, oscillating
Outer bearing clearance	.005 - .012 in.
Permissible outer bearing clearance	.030 in.
Minimum thickness of wear strip for front idler	.25 in.

Track Rollers

Shaft-to-bearing clearance	.010 - .014 in.
Permissible shaft-to-bearing clearance	.050 in.
End clearance	.011 - .029 in.
Shaft must be straight within	.005 in.

Track Carrier Rollers

Adjustment: Tighten adjustment nut until resistance is felt when turning roller; then back off nut to nearest locking position.	
End clearance	.0000 - .0045 in.
Permissible end clearance	.020 in.

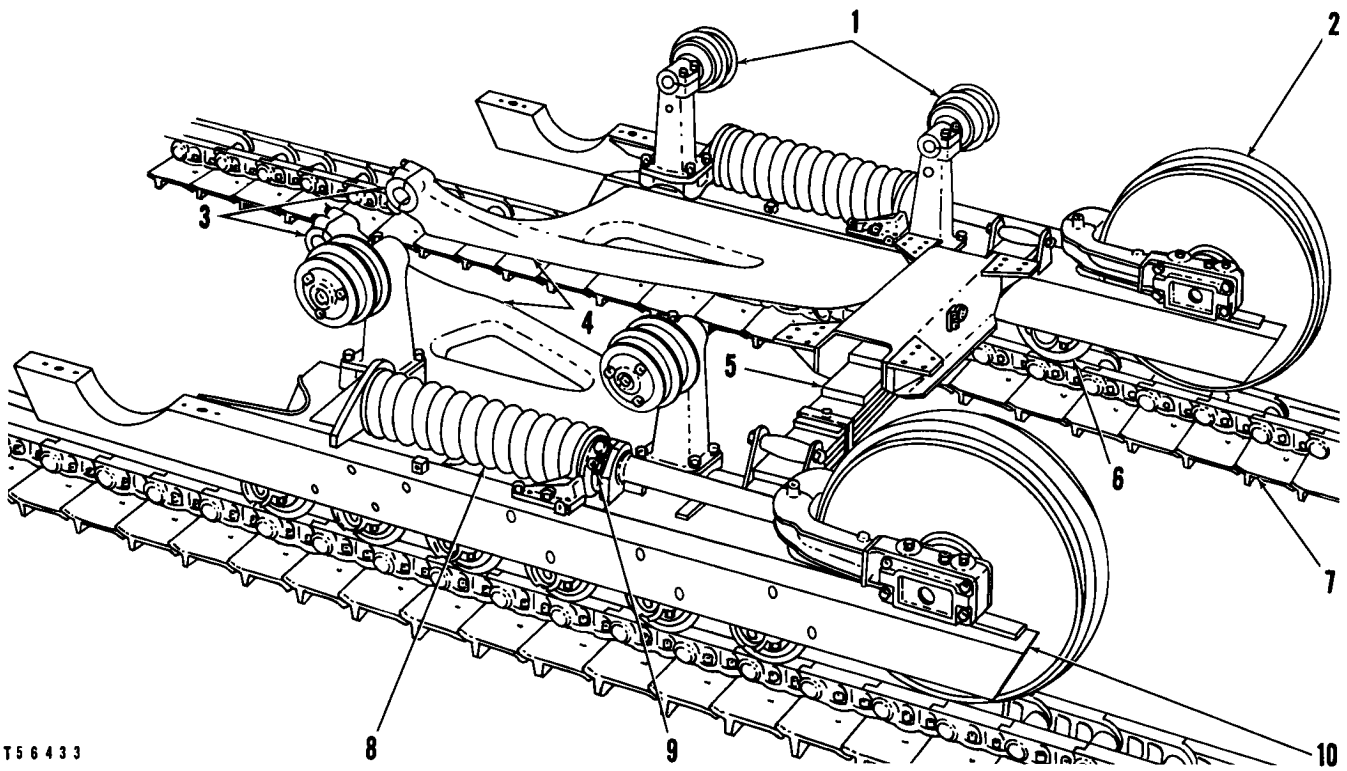
Front Idlers

Shaft-to-bearing clearance	.010 - .014 in.
Permissible shaft-to-bearing clearance	.050 in.
End clearance	.011 - .029 in.
Permissible end clearance	.045 in.
Shaft must be straight within	.005 in.
Clearance between plates and roller frame	.015 - .047 in.
Recoil spring:	
Compressed length for assembly into roller frame	22.50 in.
Installed length	22.75 in.
Pounds force at installed length	16,650 - 19,500
Track adjustment, slack	1.5 in.

Track

Track shoe bolt torque	240 - 320 lb. ft.
Wear (external bushing and pitch increase) on pins and bushings permissible before turning (see text)	1/8 in.

Introduction



TRACK ROLLER FRAME GROUP

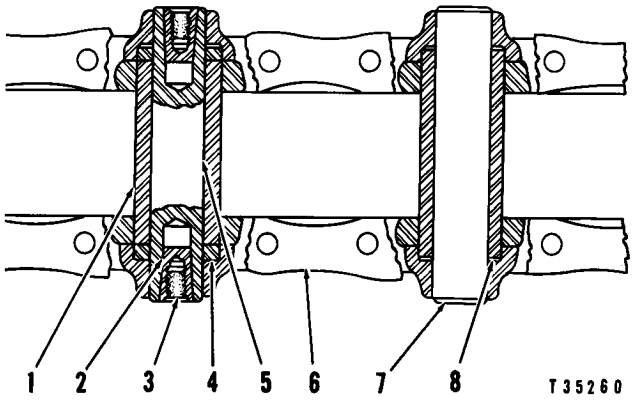
1–Track carrier rollers.
2–Front idler.
3–Diagonal brace bearing caps.
4–Diagonal braces.
5–Equalizer spring.
6–Track roller.
7–Track.
8–Recoil spring.
9–Hydraulic track adjusting mechanism.
10–Track roller frame.

The track roller frame assembly **(10)** provides a mounting for the track rollers **(6)**, track carrier rollers **(1)**, hydraulic track adjusting mechanisms **(9)**, front idlers **(2)**, recoil springs **(8)** and equalizer spring **(5)**. The weight of the tractor is carried through the frame to the rollers **(6)**. The diagonal brace **(4)**, welded to the inside of the frame, maintains correct track roller frame alignment. This construction allows each track frame to operate independently and to move up and down relative to one another by pivoting at the sprocket shaft.

Tracks

The track link assembly consists of links, pins and bushings. As shown, each link **(6)** overlaps the preceding link thus forming a continuous chain. Each link is counterbored in the overlapped portion to provide a tight well sealed joint to reduce the entrance of abrasives.

The bushings **(8)** are all alike except the master bushing **(1)** which is shorter for assembly purposes. With the master bushing, collars **(4)** are inserted in the counterbored space. The pins **(7)** are alike except the master pin **(5)** which is taper reamed and split at each end. This construction permits the tapered plug **(2)** to be driven into the master pin to hold the pin in position in the links. The cork **(3)** protects the threads in the plug.



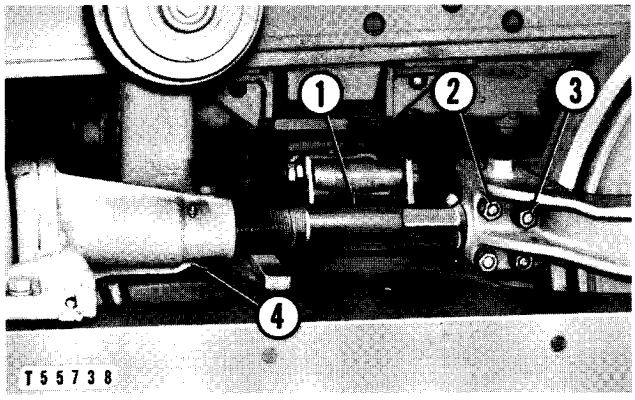
TRACK PIN AND BUSHING
1–Master bushing. 2–Tapered plug. 3–Cork. 4–Collar. 5–Master pin. 6–Link. 7–Pin. 8–Bushing.

SEPARATING TRACKS

The track link assembly is held together with a master pin and can be separated by removing the master pin.

Loosening Track (Screw Adjusting Type)

1. Remove the guard over the track adjusting nut.
2. Remove the clamp bolt **(3)** and loosen the three clamp bolts **(2)**. Turn the screw assembly **(1)** into the pilot **(4)** to loosen the track.



PREPARING TO LOOSEN TRACK
1–Screw assembly. 2–Clamp bolts (three). 3–Clamp bolt (one). 4–Pilot.

Loosening Track (Hydraulic Adjusting Type)

1. Remove the track roller frame guard over the hydraulic track adjuster and release the pressure in the hydraulic track adjuster cylinder, with caution, as given in the following steps.

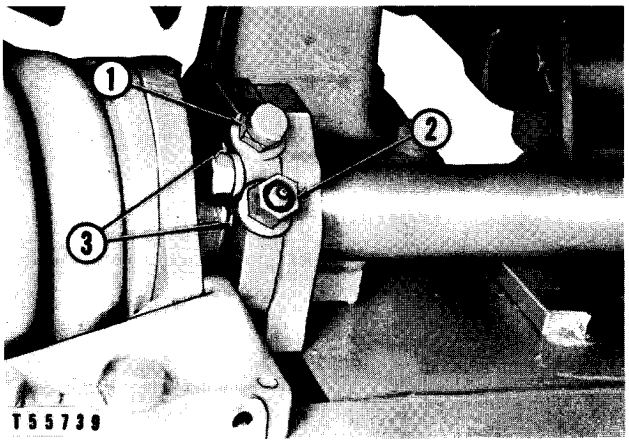
WARNING

Be certain that the hydraulic pressure in the track adjusting mechanism is completely relieved and the cylinder can be moved to the rear into the recoil spring front pilot before attempting to separate the track or remove the track adjusting mechanism. On machines that have badly worn track, it is possible that the hydraulic track adjuster may be adjusted forward to the limit of its travel and be against the stop on the track roller frame. The hydraulic cylinder could have high oil pressure in it even though the track is loose enough to remove the master pin without relieving the hydraulic track adjusting pressure.

2. Turn the relief valve **(1)** one turn in a counterclockwise direction and allow grease to escape from the vent hole **(3)** just below the relief valve. If grease does not appear when the relief valve is backed off one turn, turn the ball check assembly **(2)** one turn in a counterclockwise direction. If grease does not appear at either vent hole and the vent holes **(3)** appear to be open and the track appears to have tension, the machine should be started and moved forward slightly.

NOTE

If loosening both the relief valve and the ball check assembly one turn does not relieve track

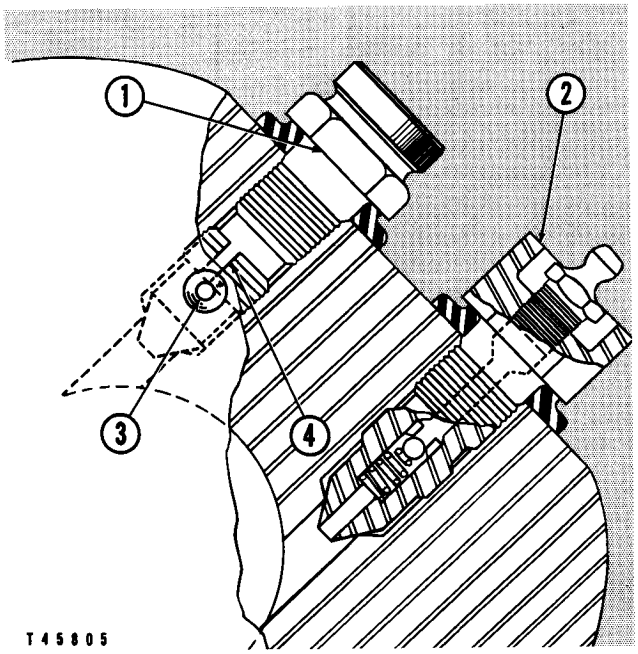


PREPARING TO SEPARATE TRACKS
1–Relief valve. 2–Ball check assembly. 3–Vent holes.

tension, then continue loosening the relief valve until the unthreaded section is exposed. Grease should then relieve through the slot **(4)** in the lower section of the threads.

NOTE

Detailed information concerning the hydraulic track adjusting mechanism can be found in the topic, TRACK ADJUSTING MECHANISM.



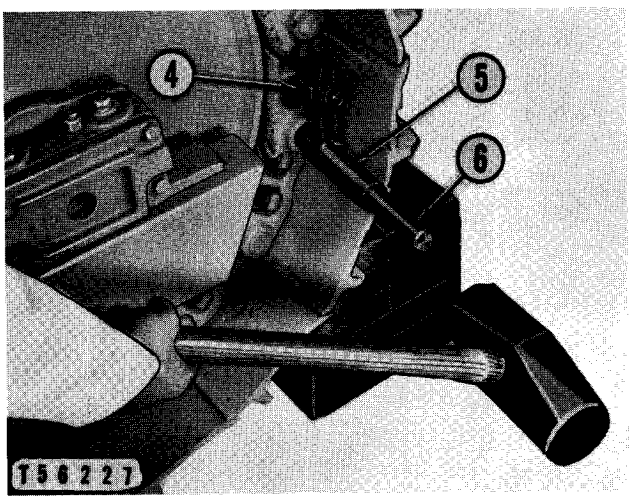
RELIEF VALVE AND BALL CHECK ASSEMBLY
1–Relief valve. 2–Ball check assembly. 3–Vent. 4–Slot.

Removing Master Pin

1. Place a block approximately 12″ high in front of the track and drive the machine forward so the track shoe below the master pin rides on the block and the slack is taken out of the bottom part of the track. The master pin will then be in a position in front of the idler and approximately even with the top of the track roller frame.
2. Set the brake so the slack will remain in the top part of the track.
3. Remove the corks and pull the tapered plugs from the master pin using a sleeve **(1)**, screw **(2)** and nut **(3)**.
4. Using the 4H8765 Master Pin Removal and Installation Group, drive the pin out from the outside of the track.

NOTE

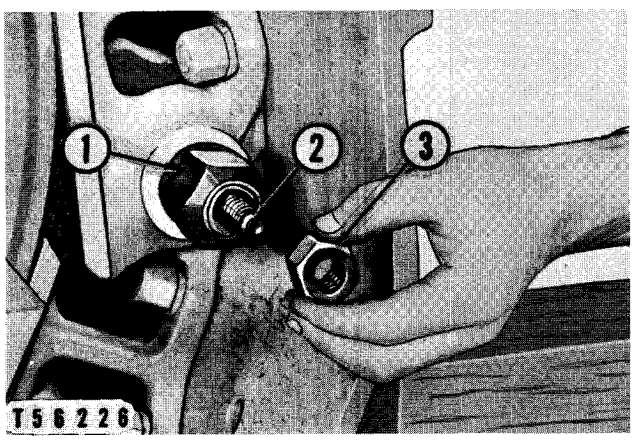
Any looseness in the joint due to master pin and master bushing wear should be taken up so that the wear step in the pin does not lock it to the bushing.



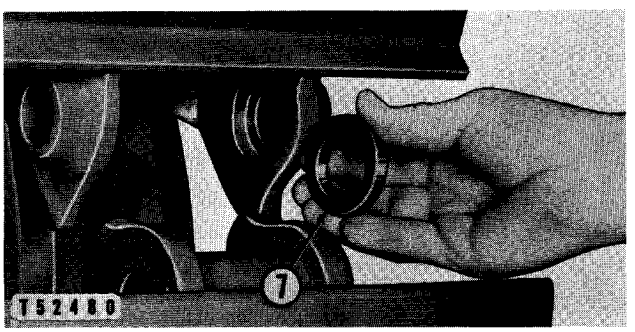
4H8765 MASTER PIN REMOVAL AND INSTALLATION GROUP
4–4H8767 Block, 1A5822 Bolt, 3B4508 Lockwasher, 1D4719 Nut, S1595 Bolt and L1365 Washer. 5–4H8770 Sleeve Assembly. 6–4H8766 Driver Pin.

CAUTION

Avoid damaging the tapered bore in the master pin.



REMOVING THE MASTER PIN
1–2B2108 Sleeve. 2–3B1027 Screw. 3–3B1028 Nut.



REMOVING THE BUSHING COLLAR
7–Bushing collars (two).

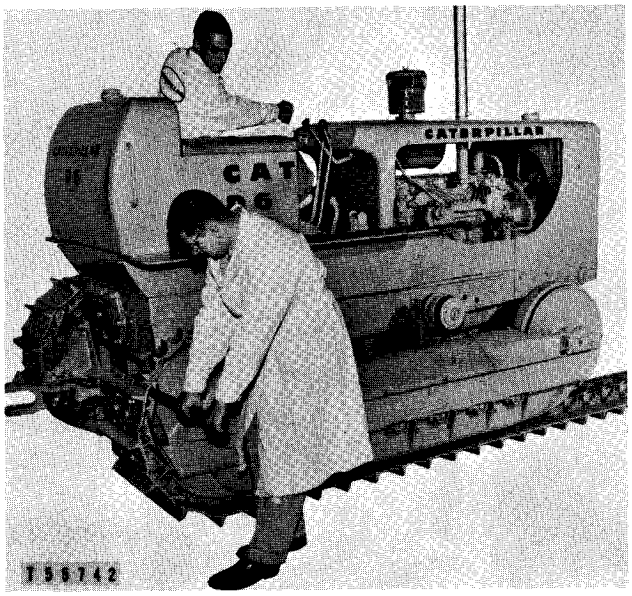
5. Separate the track links, and remove the bushing collars **(7)** from both sides of the track.
6. Back the tractor slowly, allowing the track to ride over the carrier rollers and off the sprocket.

INSTALLING TRACK

1. Back the machine until the sprocket is just ahead of the rear end of the track.
2. Insert a bar into the last link and aid the track to climb over the sprocket, carrier roller and front idler, as the machine is driven forward slowly.

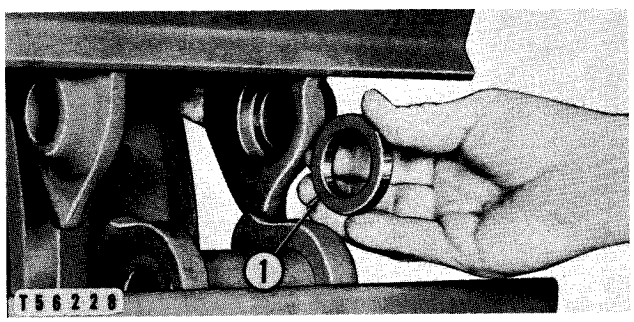
WARNING

In the interest of personal safety, always hold the bar as illustrated.



INSTALLING TRACK

3. With a block under the first shoe, bring the track almost to where it joins.
4. Clean and dry thoroughly all mating surfaces and replace any damaged or worn parts before installing the master pin.



INSTALLING THE BUSHING COLLAR
1-Bushing collars (two).

5. Install the bushing collars **(1)** into the track links and align the bores with the 5F9451 Tapered Pilot Pin.
6. Drive the master pin in from the outside of the tracks, removing the tapered pilot pin as the master pin is installed.

NOTE

Drive the master pin in until its projection from the links on both sides is the same.

7. Install the tapered plugs in the ends of the master pin and insert new corks in the holes of the plugs.

NOTE

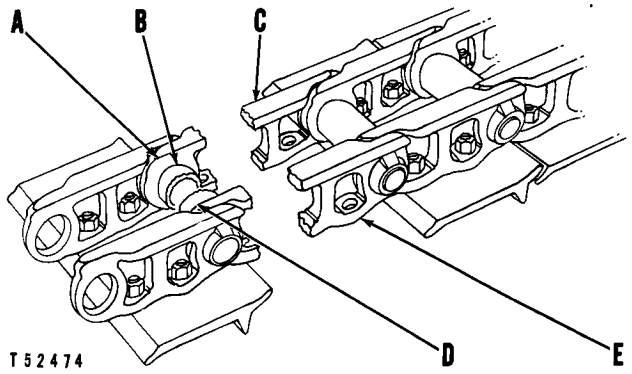
It may be necessary to "back up" or "buck" the master pin with another sledge when driving in either, or both, tapered plugs. Otherwise the master pin may be driven out of location or the tapered plugs may not be properly seated.

8. Adjust the track until there is 1" - 1½" sag in the track between the carrier roller and front idler.
9. Install the dirt guards.
10. Check the alignment of the track roller frame, front idler and carrier roller. If any misalignment exists, refer to the topics, TRACK ROLLER FRAME ALIGNMENT and/or TRACK CARRIER ROLLER ALIGNMENT.

TRACK LINKS

A damaged track link not adjacent to the master pin can be replaced without disassembling the track.

1. Remove the shoe from the track links in question.
2. Press out the pins at both ends of the track link.
3. Cut the broken link in two, and cut a ⅝" section out of the bushing with a torch.
4. Remove the cut link **(A)** and bushing **(B)**, the rest of the link **(C)** and then the other link **(E)** and the remaining part of the bushing **(D)**.
5. Press a master bushing into one new link and install it in place on the track.
6. Press another new link onto the master bushing.
7. Install a standard pin in the overlapping end of the new links.
8. Insert collars furnished with master pins in the counterbore of the mating links and press in a standard track pin or master pin as desired.



REPLACING DAMAGED TRACK LINK
A–Cut link. B–Bushing. C–Cut link. D–Bushing. E–Link.

TRACK PINS AND BUSHINGS

To obtain maximum life of track pins and bushings, they should be turned when either the external wear on the bushing or the pitch increase is 1/8". This figure is good for average operating conditions. However, if a machine is operating in very sandy and abrasive conditions with little or no impact loading, this figure could be extended to 3/16". When operating under heavy impact conditions such as over rocky terrain, the 1/8" figure should not be exceeded.

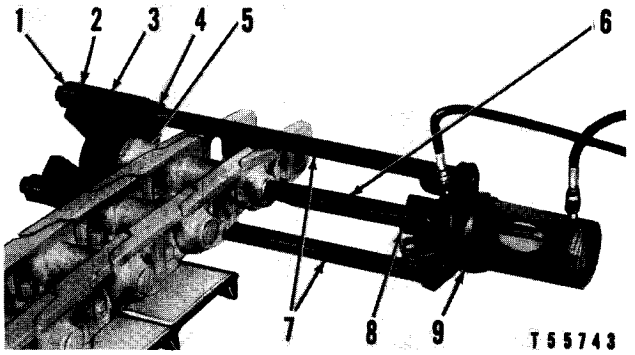
To turn pins and bushing, they should be pressed out, rotated 180 degrees and reinstalled to obtain new contact surfaces.

There are three types of presses for track reconditioning; the heavy duty double ram power press, the heavy duty single ram power press, and the portable hand press.

The following illustrations show the use of the 6F25 Pump Group, the 7F9831 Cylinder Group, and the 5F9426 Track Servicing Attachment Group for track work.

Pin Removal

1. Screw the two tension rods **(7)** evenly into the holes provided in the cylinder **(9)**.
2. Assemble the yoke **(3)** onto the tension rods after first assembling the nuts **(4)** on the tension rods.
3. Install the nuts **(2)** and **(1)**.
4. Install the ram cap adapter **(8)** on the ram of the cylinder.
5. Place the adapter **(5)** in the hole of the yoke **(3)**.
6. Place the track link against the adapter with the boss of the link inserted in the recess in the adapter.



PIN REMOVAL
1–5F9431 Nut. 2–5F9432 Nut. 3–8H3153 Yoke. 4–5F9431 Nut. 5–8H3275 Pin Adapter. 6–5F9451 Pilot Pin and Pusher. 7–8H3152 Tension Rods. 8–5F9438 Ram Cap Adapter. 9–7F9831 Cylinder Group.

7. Place the pin pusher **(6)** against the track pin and with the necessary ram caps (short, long or both) between the pin pusher and the ram cap adapter, force the pin out.

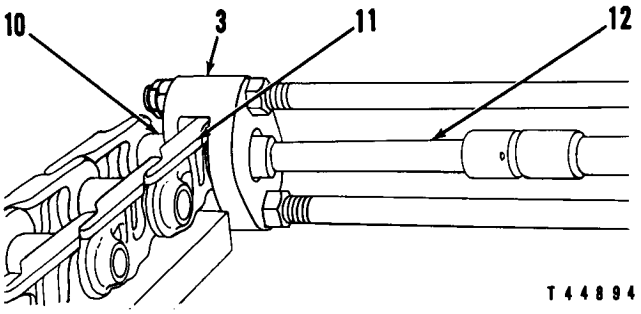
Pin Installation

The track pin is installed in the reverse order of removal, with one exception, the track pin and necessary ram caps are used in place of the pin pusher **(6)**.

Bushing Removal

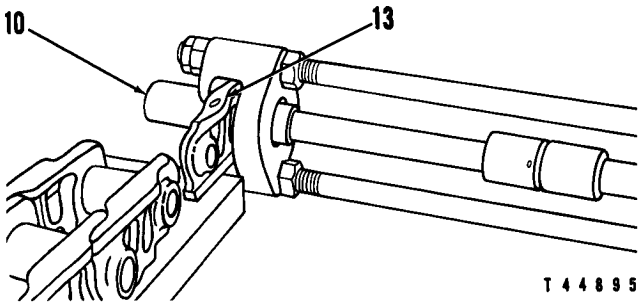
The track pins must be removed from both ends of the track link as outlined in the covering topic.

1. Place the track bushing **(10)** in the slot of the yoke **(3)** as shown.
2. Insert the short end of the bushing pusher **(12)** through the yoke and into the bushing.



REMOVING LINK FROM BUSHING
3–8H3153 Yoke. 10–Bushing. 11–Link. 12–5F9452 Bushing Pusher.

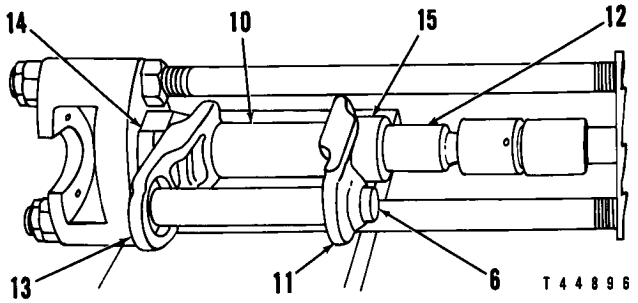
3. Fill this space between the pusher and the ram cap adapter with the necessary ram caps and force the bushing **(10)** out of the link **(11)**.
4. Turn the bushing **(10)** end for end and remove the bushing from the other link **(13)** in the same manner.



REMOVING BUSHING
10–Bushing. 13–Link.

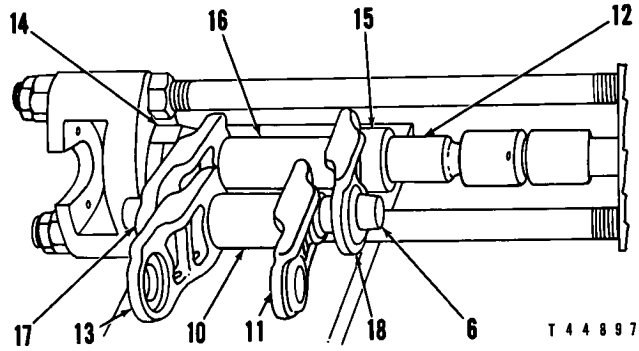
Bushing Installation

1. Place the assembly collar **(15)** over the long end of the bushing pusher **(12)** and insert the long end of the pusher through the link **(11)**, bushing **(10)** and the other link **(13)** and into the adapter **(14)**.



BUSHING INSTALLATION
6–5F9451 Pilot Pin and Pusher. 10–Bushing. 11–Link. 12–5F9452 Bushing Pusher. 13–Link. 14–8H3274 Bushing Adapter. 15–5F9450 Assembly Collar.

2. Insert the pin pusher **(6)** in the other end of the links to align the holes.
3. Fill in the space between the ram and bushing pusher with ram caps, and press both links on the bushing in one operation.
4. To continue the assembly of the track, place the links **(17)** and **(18)** over the ends on the previously assembled links **(13)** and **(11)**, and install the pin pusher **(6)** through the link **(18)**, bushing **(10)** and link **(13)** and continue assembling by installing track links on bushing **(16)**.



TRACK LINK AND BUSHING ASSEMBLY
6–5F9451 Pilot Pin and Pusher. 10–Bushing. 11–Link. 12–5F9452 Bushing Pusher. 13–Link. 14–8H3274 Bushing Adapter. 15–5F9450 Assembly Collar. 16–Bushing. 17–Link. 18–Link.

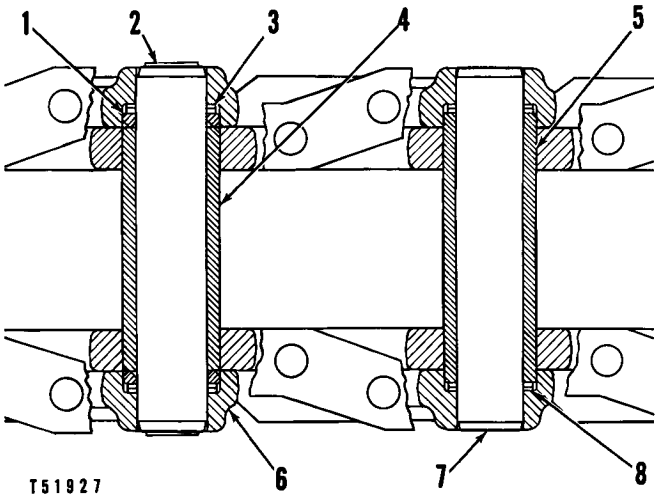
5. After the links and bushings are assembled, install the track pins as outlined in the covering topic.

Tracks

(Sealed Track)

The track link assembly consists of links, pins, seal washers and bushings. As shown, each link **(6)** overlaps the preceding link, thus forming a continuous chain. Each link is counterbored in the overlapped portion and the coned disc seal washers **(8)** between the counterbore and the bushings provide a tight, well-sealed joint to reduce the entrance of abrasives. The bushings **(5)** are all alike, except the master bushing **(4)**, which is shorter for assembly purposes.

Two coned disc seal washers **(3)** and a spacer **(1)** fit into each counterbore of the links at the ends of the short master bushing. The pins **(7)** are all alike, except the master pin **(2)**, which has a machined step on each end for identification.



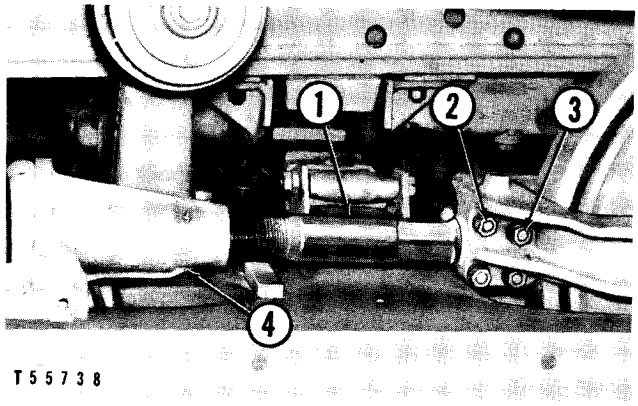
TRACK PIN AND BUSHING CUTAWAY
1–Spacer. 2–Master pin. 3–Coned disc seal washers. 4–Master bushing. 5–Track bushing. 6–Link. 7–Track pin. 8–Coned disc seal washers.

SEPARATING TRACK

The track link assembly is held together with a master pin and can be separated by removing the master pin.

Loosening Track (Screw Adjusting Type)

1. Remove the guard over the track adjusting nut.
2. Remove the clamp bolt **(3)** and loosen the three clamp bolts **(2)**. Turn the screw assembly **(1)** into the pilot **(4)** to loosen the track.



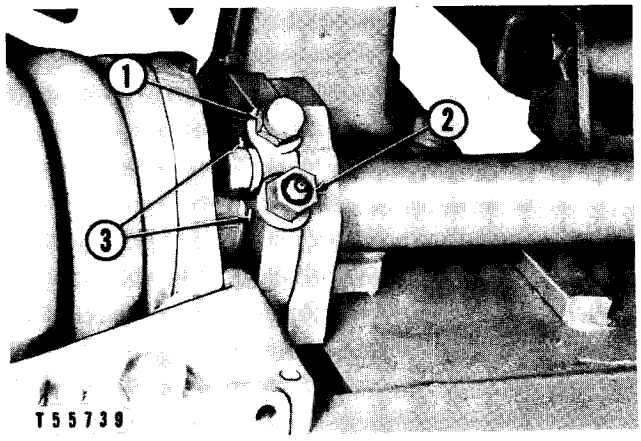
PREPARING TO LOOSEN TRACK
1–Screw assembly. 2–Clamp bolts (three). 3–Clamp bolt (one). 4–Pilot.

Loosening Track (Hydraulic Adjusting Type)

1. Remove the track roller frame guard over the hydraulic track adjuster and release the pressure in the hydraulic track adjuster cylinder, with caution, as given in the following steps.

WARNING

Be certain that the hydraulic pressure in the track adjusting mechanism is completely relieved and the cylinder can be moved to the rear into the recoil spring front pilot before attempting to separate the track or remove the track adjusting mechanism. On machines that have badly worn track, it is possible that the hydraulic track adjuster may be adjusted forward to the limit of its travel and be against the stop on the track roller frame. The hydraulic cylinder could have high oil pressure in it even though the track is loose enough to remove the master pin without relieving the hydraulic track adjusting pressure.



PREPARING TO SEPARATE TRACKS
1–Relief valve. 2–Ball check assembly. 3–Vent holes.

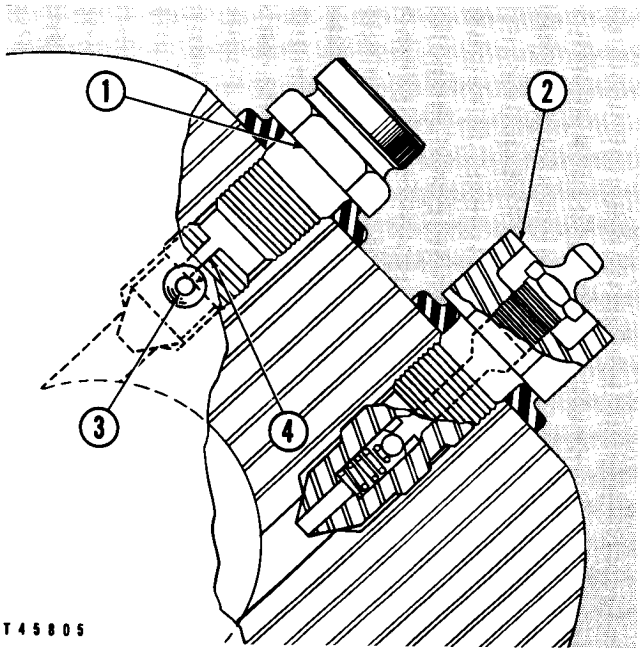
2. Turn the relief valve **(1)** one turn in a counterclockwise direction and allow grease to escape from the vent hole **(3)** just below the relief valve. If grease does not appear when the relief valve is backed off one turn, turn the ball check assembly **(2)** one turn in a counterclockwise direction. If grease does not appear at either vent hole and the vent holes **(3)** appear to be open and the track appears to have tension, the machine should be started and moved forward slightly.

NOTE

If loosening both the relief valve and the ball check assembly one turn does not relieve track tension, then continue loosening the relief valve until the unthreaded section is exposed. Grease should then relieve through the slot **(4)** in the lower section of the threads.

NOTE

Detailed information concerning the hydraulic track adjusting mechanism can be found in the topic, TRACK ADJUSTING MECHANISM.



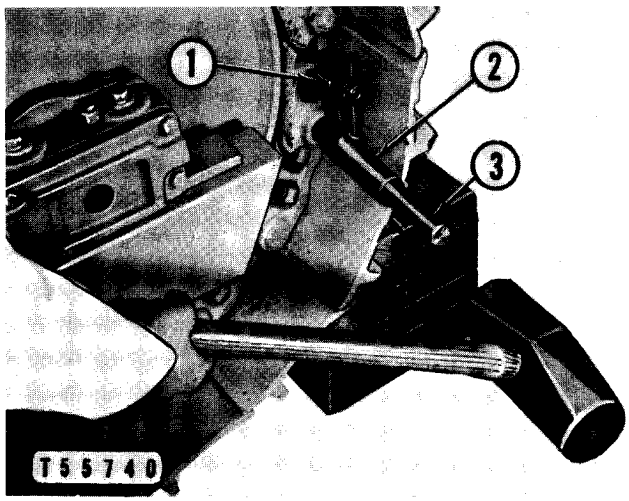
RELIEF VALVE AND BALL CHECK ASSEMBLY
1–Relief valve. 2–Ball check assembly. 3–Vent. 4–Slot.

Removing Master Pin

1. Place a block approximately 12″ high in front of the track and drive the machine forward so the track shoe below the master pin rides on the block and the slack is taken out of the bottom part of the track. The master pin will then be in a position in front of the idler and approximately even with the top of the track roller frame.
2. Set the brake so the slack will remain in the top part of the track.
3. Using the 4H8765 Master Pin Removal and Installation Group, drive the pin out from the outside of the track.

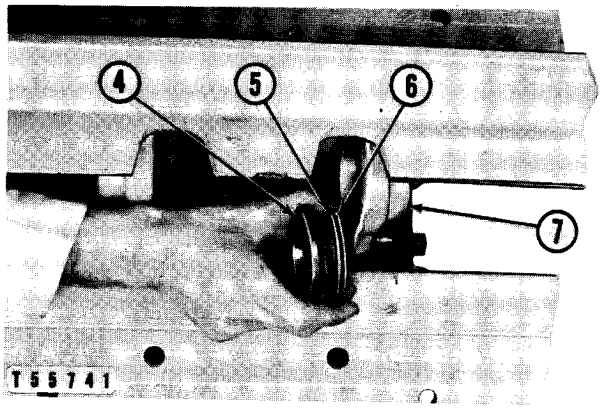
NOTE

Any looseness in the joint due to master pin and master bushing wear should be taken up so that the wear step in the pin does not lock it to the bushing.



4H8765 MASTER PIN REMOVAL AND INSTALLATION GROUP
1–4H8767 Block, 1A5822 Bolt, 3B4508 Lockwasher, 1D4719 Nut, S1595 Bolt and L1365 Washer. 2–4H8770 Sleeve Assembly. 3–4H8766 Driver Pin.

4. Separate the track and remove the spacer **(4)** and coned disc seal washers **(5)** and **(6)** from each master link **(7)**.
5. Back the tractor slowly, allowing the track to ride over the carrier rollers and off the sprocket.



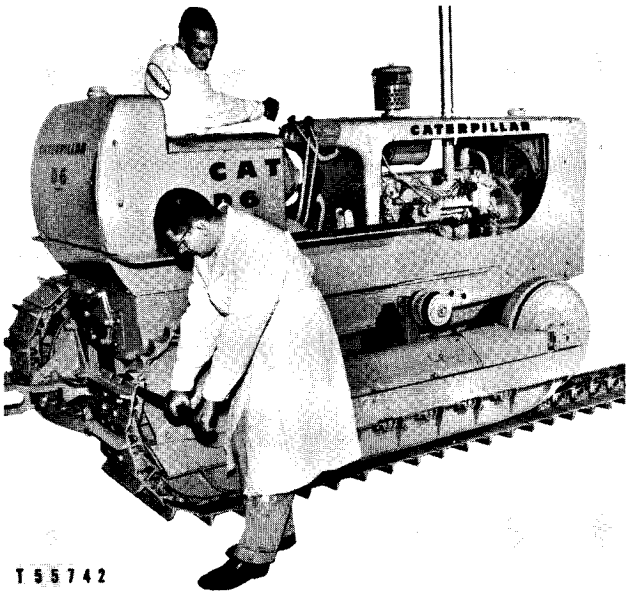
REMOVING SPACER AND WASHERS
4–Spacer. 5–Coned disc seal washer. 6–Coned disc seal washer. 7–Master link.

INSTALLING TRACK

1. Back the machine until the sprocket is just ahead of the rear end of the track.
2. Insert a bar into the last link and aid the track to climb over the sprocket, carrier roller and front idler, as the machine is driven forward slowly.

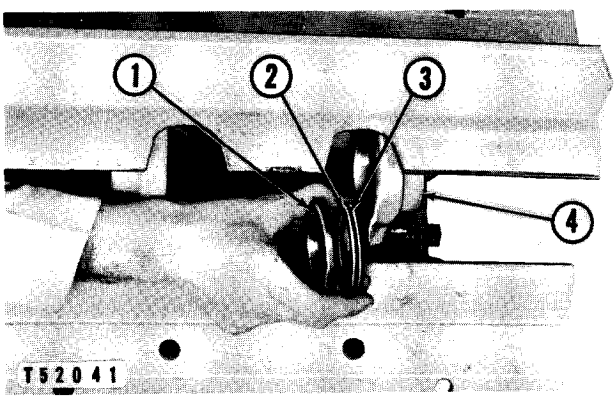
WARNING

In the interest of personal safety, always hold the bar as illustrated.



INSTALLING TRACK

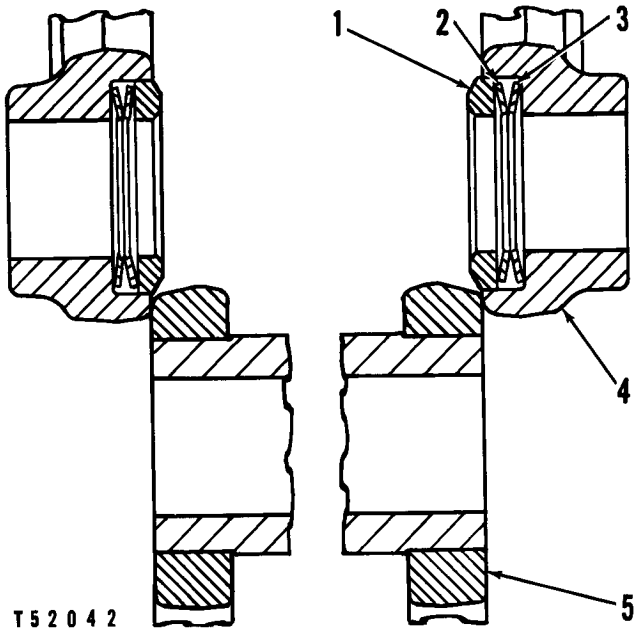
3. Clean and dry thoroughly all mating surfaces and replace any damaged or worn parts before installing the master pin.
4. With a block under the first shoe, drive forward until the links **(4)** and **(5)** are approximately an inch apart and install the coned disc seal washers **(2)** and **(3)** and spacer **(1)** in each side of the track links **(4)**.



INSTALLING SEAL WASHERS AND SPACER
1–Spacer. 2–Coned disc seal washer. 3–Coned disc seal washer. 4–Track link.

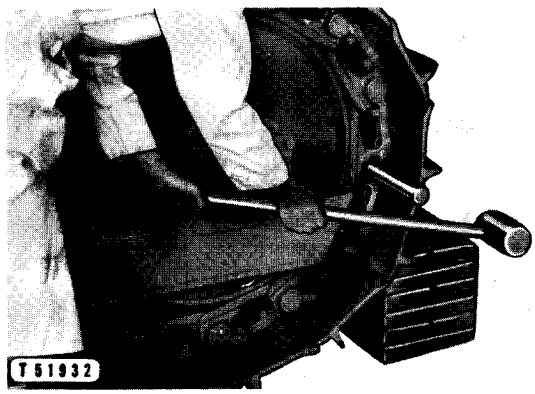
NOTE

Install each set of coned disc seal washers with one outside diameter facing the counterbore in the track link **(4)** and one outside diameter facing the spacer **(1)**, with the inside diameters against each other. Install the spacer **(1)** with the beveled edge toward the center line of the track.



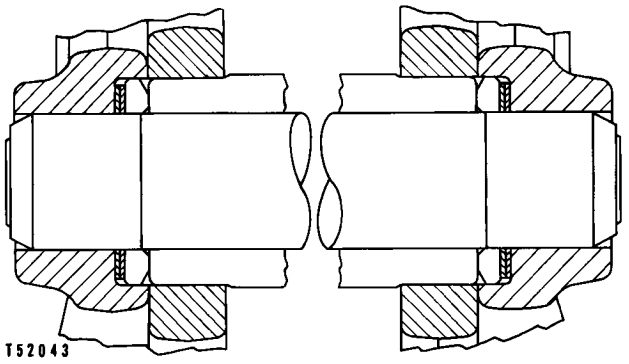
INSTALLING SEAL WASHERS AND SPACER
1–Spacer. 2–Coned disc seal washer. 3–Coned disc seal washer. 4–Track link. 5–Track link.

5. Drive ahead until the holes in the track links **(4)** and **(5)** align, forcing the spacer **(1)** and seal washers **(2)** and **(3)** back into the counterbores of the track link **(4)**, and install the master pin as shown.



INSTALLING MASTER PIN

6. Adjust the track until there is 1" - 1½" sag in the track between the carrier roller and front idler.
7. Install the dirt guards.



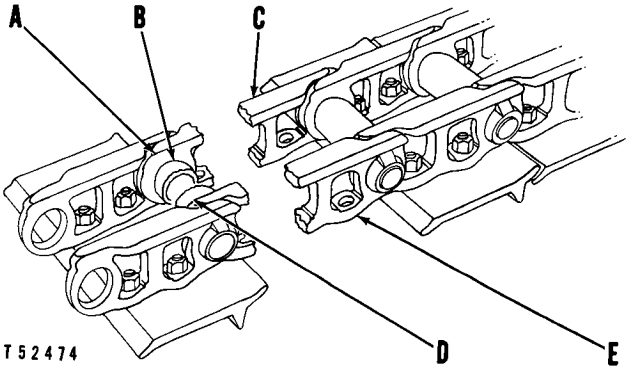
MASTER PIN CORRECTLY INSTALLED

8. Check the alignment of the track roller frame, front idler and carrier roller. If any misalignment exists, refer to the topics, TRACK ROLLER FRAME ALIGNMENT and/or TRACK CARRIER ROLLER ALIGNMENT.

TRACK LINKS

A damaged track link not adjacent to the master pin can be replaced without disassembling the track.

1. Remove the shoe from the track links in question.
2. Press out the pins at both ends of the track link.
3. Cut the broken link in two, and cut a 5/8" section out of the bushing with a torch.
4. Remove the cut link **(A)** and bushing **(B)**, the rest of the link **(C)** and then the other link **(E)** and the remaining part of the bushing **(D)**.
5. Press a master bushing into one new link and install it in place on the track.
6. Press another new link onto the master bushing.
7. Install a standard pin in the overlapping end of the new links.
8. Insert the spacer and coned disc seal washers furnished with master pins in the counterbore of the mating links and press in a standard track pin or master pin as desired.



REPLACING DAMAGED TRACK LINK
A–Cut link. B–Bushing. C–Cut link. D–Bushing. E–Link.

TRACK PINS AND BUSHINGS

To obtain maximum life of track pins and bushings, they should be turned when either the external wear on the bushing or the pitch increase is 1/8". This figure is good for average operating conditions. However, if a machine is operating in very sandy and abrasive conditions with little or no impact loading, this figure could be extended to 3/16". When operating under heavy impact conditions such as over rocky terrain, the 1/8" figure should not be exceeded.

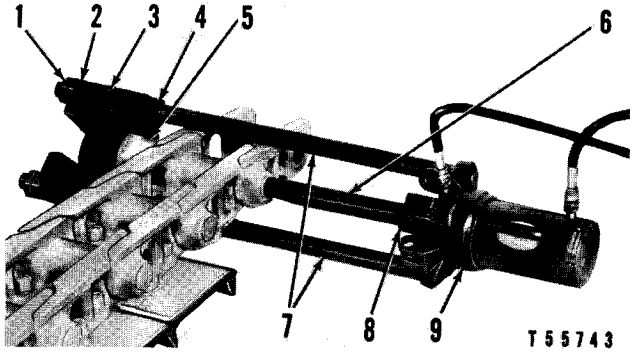
To turn pins and bushings, they should be pressed out, rotated 180 degrees and reinstalled to obtain new contact surfaces.

There are three types of presses for track reconditioning; the heavy duty double ram power press, the heavy duty single ram power press, and the portable hand press.

The following illustrations show the use of the 6F25 Pump Group, the 7F9831 Cylinder Group, and 5F9426 Track Servicing Attachment Group for track work.

Pin Removal

1. Screw the two tension rods **(7)** evenly into the holes provided in the cylinder **(9)**.
2. Assemble the yoke **(3)** onto the tension rods after first assembling the nuts **(4)** on the tension rods.



PIN REMOVAL
1–5F9431 Nut. 2–5F9432 Nut. 3–8H3153 Yoke. 4–5F9431 Nut. 5–8H3275 Pin Adapter. 6–5F9451 Pilot Pin and Pusher. 7–8H3152 Tension Rods. 8–5F9438 Ram Cap Adapter. 9–7F9831 Cylinder Group.

3. Install the nuts **(2)** and **(1)**.
4. Install the ram cap adapter **(8)** on the ram of the cylinder.

5. Place the adapter **(5)** in the hole of the yoke **(3)**.
6. Place the track link against the adapter with the boss of the link inserted in the recess in the adapter.
7. Place the pin pusher **(6)** against the track pin and with the necessary ram caps (short, long or both) between the pin pusher and the ram cap adapter, force the pin out.

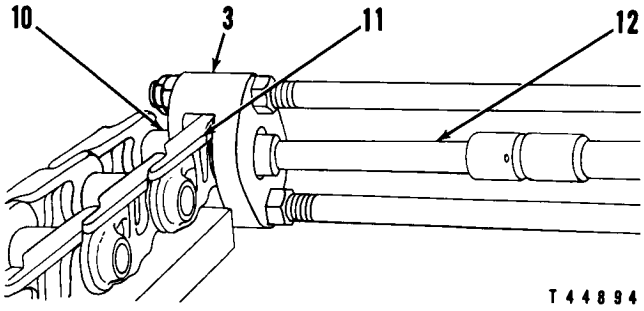
Pin Installation

The track pin is installed in the reverse order of removal, with one exception, the track pin and necessary ram caps are used in place of the pin pusher **(6)**.

Bushing Removal

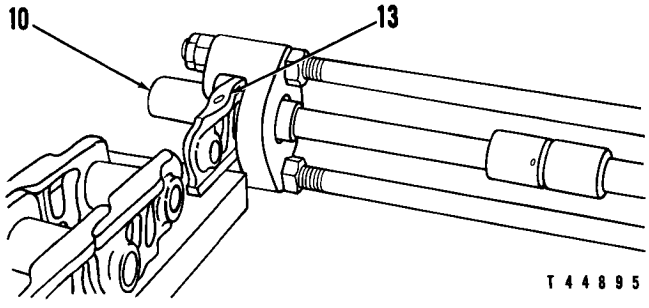
The track pins must be removed from both ends of the track link as outlined in the covering topic.

1. Place the track bushing **(10)** in the slot of the yoke **(3)** as shown.
2. Insert the short end of the bushing pusher **(12)** through the yoke and into the bushing.



REMOVING LINK FROM BUSHING
3–8H3153 Yoke. 10–Bushing. 11–Link. 12–5F9452 Bushing Pusher.

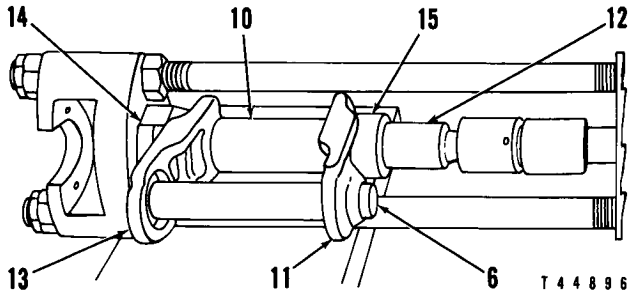
3. Fill this space between the pusher and the ram cap adapter with the necessary ram caps and force the bushing **(10)** out of the link **(11)**.
4. Turn the bushing **(10)** end for end and remove the bushing from the other link **(13)** in the same manner.



REMOVING BUSHING
10–Bushing. 13–Link.

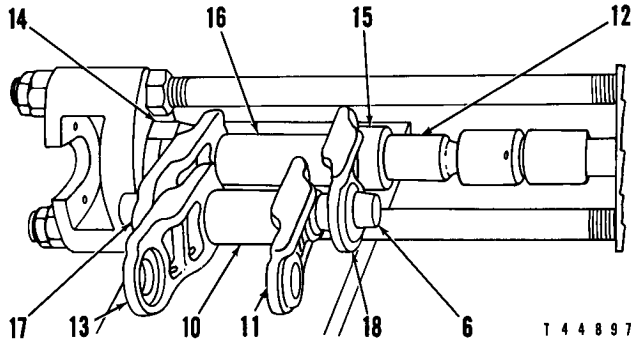
Bushing Installation

1. Place the assembly collar **(15)** over the long end of the bushing pusher **(12)** and insert the long end of the pusher through the link **(11)**, bushing **(10)** and the other link **(13)** and into the adapter **(14)**.



BUSHING INSTALLATION
6–5F9451 Pilot Pin and Pusher. 10–Bushing. 11–Link. 12–5F9452 Bushing Pusher. 13–Link. 14–8H3274 Bushing Adapter. 15–5F9450 Assembly Collar.

2. Insert the pin pusher **(6)** in the other end of the links to align the holes.
3. Fill in the space between the ram and bushing pusher with ram caps, and press both links on the bushing in one operation.
4. To continue the assembly of the track, place the links **(17)** and **(18)** over the ends on the previously assembled links **(13)** and **(11)**, and install the pin pusher **(6)** through the link **(18)**, bushing **(10)** and link **(13)** and continue assembling by installing track links on bushing **(16)**.
5. After the links and bushings are assembled, install the track pins as outlined in the covering topic.



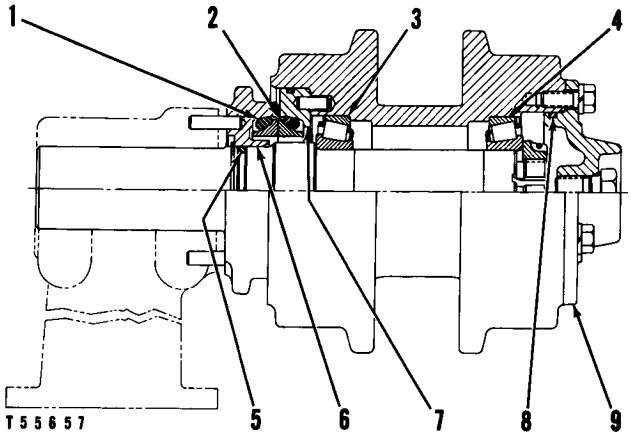
TRACK LINK AND BUSHING ASSEMBLY
6–5F9451 Pilot Pin and Pusher. 10–Bushing. 11–Link. 12–5F9452 Bushing Pusher. 13–Link. 14–8H3274 Bushing Adapter. 15–5F9450 Assembly Collar. 16–Bushing. 17–Link. 18–Link.

Track Carrier Rollers and Track Rollers

TRACK CARRIER ROLLERS

The track carrier rollers support the weight of the track between the sprocket and the front idler. The carrier roller support brackets are of the cantilever type and are bolted to the track roller frame. The carrier roller shafts are held in the support by a split clamp.

The carrier rollers turn on two taper roller bearings **(3)** and **(4)**, which are pressed on the shaft.



CARRIER ROLLER CROSS SECTION
1–Rubber toric sealing ring. 2–Metal floating ring seal. 3–Bearing. 4–Bearing. 5–O-ring seal. 6–End collar. 7–Seal support. 8–O-ring seal. 9–End cover.

Dirt is kept out and lubricant in by metal floating ring seals **(2)**. The highly finished surfaces of the metal floating ring seals **(2)** are held together by the action of the toric sealing rings **(1)** behind each metal floating ring seal **(2)**. The toric sealing rings **(1)** position the metal floating ring seals **(2)** in the end collar **(6)** and the seal support **(7)** and prevent the floating ring seals from turning. The flexibility of the toric sealing rings **(1)** makes the seal self aligning and compensates for any wear on the metal faces.

An O-ring seal **(5)** prevents the lubricant from flowing between the shaft and end collar **(6)**. An O-ring seal **(8)** provides a seal between the roller and the end cover **(9)**. An O-ring seal on the seal support **(7)** prevents leakage between the roller and the seal support.

Lubrication

The carrier rollers are lubricated at the time of installation and need not be lubricated again until they are disassembled.

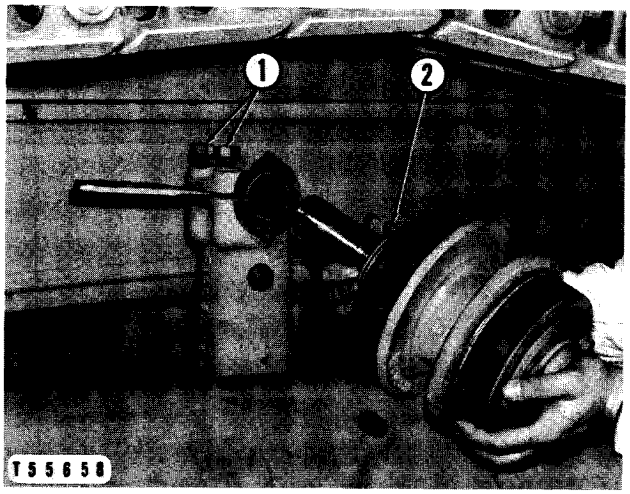
Lubricate the carrier roller with crankcase lubricating oil, using the 5M2080 Nozzle.

NOTE

Be sure the roller is lubricated while in the horizontal position in order to avoid overfilling.

Removal and Installation

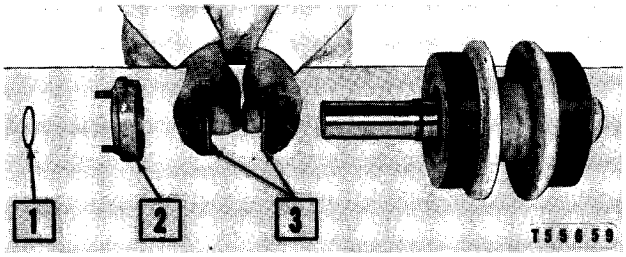
1. Raise the track, loosen the clamping bolts **(1)** and drive a chisel into the slot to free the carrier roller shaft.
2. Remove the carrier roller and shaft as shown.



REMOVING CARRIER ROLLER
1–Clamp bolts (two). 2–Dowels (two).

3. Install the carrier roller shaft in the support bracket. Be sure the dowels **(2)** mate with the holes in the support bracket.
4. Align the carrier roller with the front idler and the sprocket and tighten the clamping bolts.

Disassembly



SEAL REMOVAL
☐ Remove

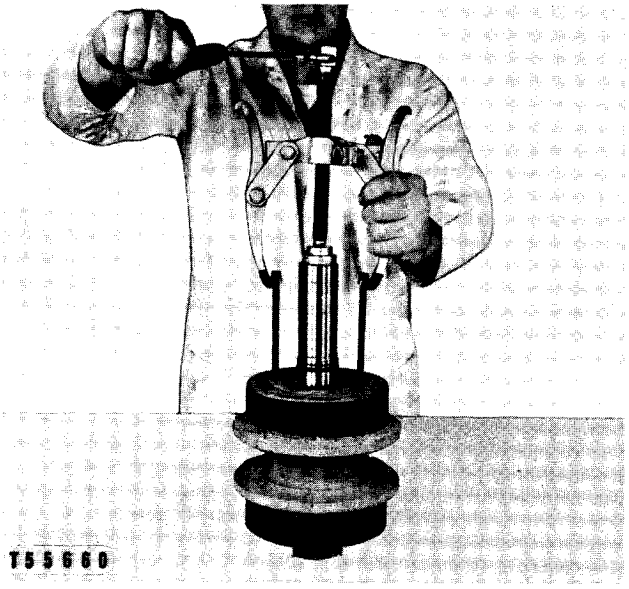
1–Ring. 2–End collar. 3–Metal floating ring seals.

CAUTION

Tape the seals **(3)** together so they will be kept in matched sets. The floating ring seals **(3)** should always be installed in pairs, that is, two new seals together or two seals that have pre-

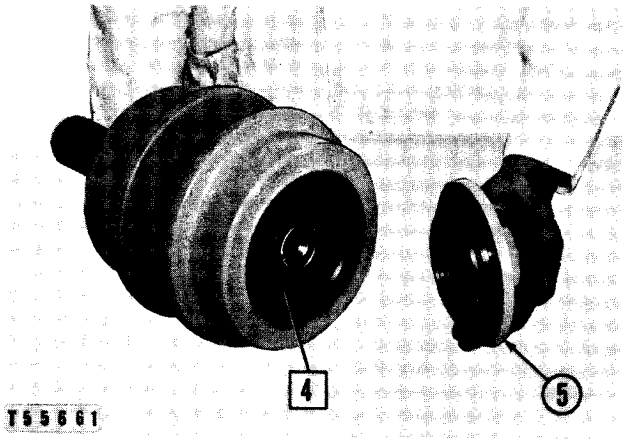
viously run together. Never assemble one new seal and one used seal together or two seals that have not previously run together.

1. Using an 8H700 Puller, a suitable step plate and two 5/16" - 18 (NC) bolts, 5" long, remove the seal support as shown.



SEAL SUPPORT REMOVAL

2. Remove the cover **(5)**.



PREPARING TO REMOVE SHAFT

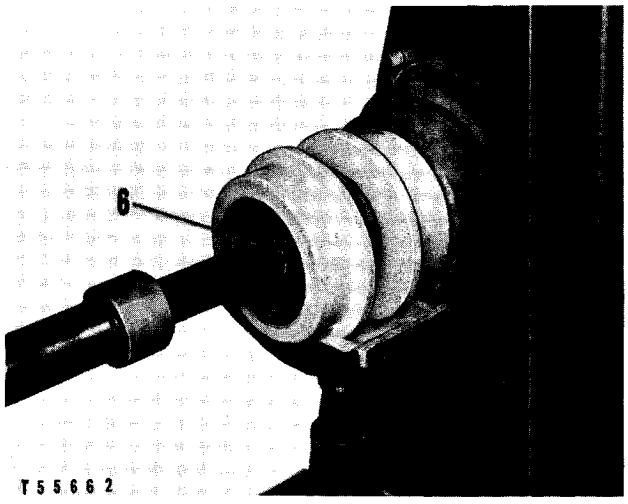
☐ **Remove**

4–Nut. 5–Cover.

3. Using a suitable press and adapters, press the shaft **(6)** out of the cone **(9)**.

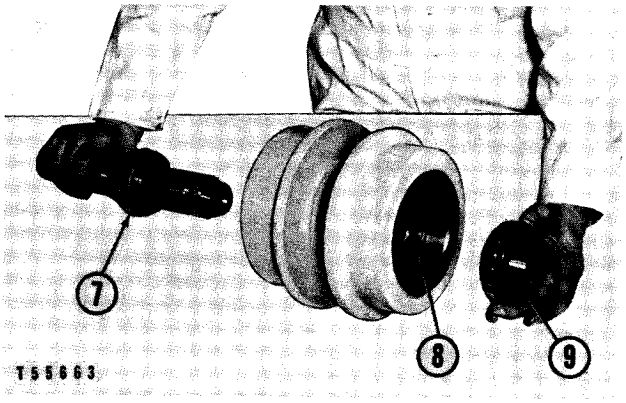
NOTE

Information concerning the hydraulic press and adapters is available upon request from the Service Department.



SHAFT REMOVAL
6–Shaft.

4. Inspect the bearing cups **(8)** in each end of the roller. If they are worn or pitted, they can be removed by using an 8B7554 Bearing Cup Pulling Attachment, 8B7553 Reducing Adapter, and an 8B7548 Push Puller.



REMOVING BEARINGS
7–Cone. 8–Cup. 9–Cone.

5. Inspect the cones **(7)** and **(9)**, and replace if worn or pitted.

6. The cone **(7)** can be pressed from the shaft if replacement is necessary.

Assembly

1. Heat the inner bearing cone **(6)** and install it on the shaft so that the inner race seats on the raised section of the shaft.

2. Install the bearing outer cups **(4)** in the roller.

3. Install the shaft in the roller, heat the outer bearing cone **(7)** and install it on the shaft, and install the spanner nut **(5)**.

4. Tighten the nut **(5)** until all bearing end clearance is removed and a slight drag can be felt on the bearings when the shaft is rotated; then back off the nut until the nearest aligning hole aligns with the slot in the shaft and install the lock ring **(8)**.

5. Install the end cover. Replace the O-ring seal if it is damaged.

CAUTION

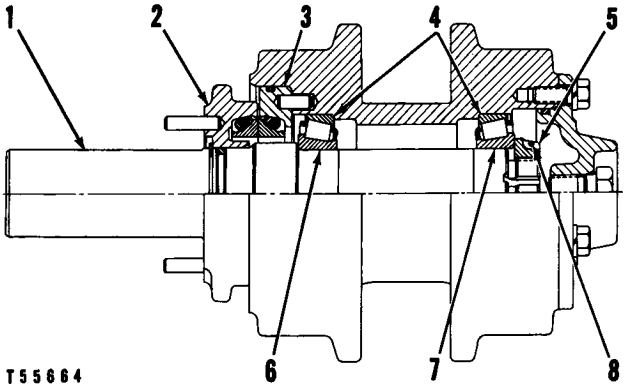
Before installing the end cover, remove any burrs from the bore of the roller to prevent damage to the O-ring seal during installation. Lubricate the O-ring seal before installing the cover.

6. Drive the seal support **(3)** into the roller until it seats in the bore. Lubricate the O-ring seal on support **(3)** with liquid soap to facilitate installation.

NOTE

Be sure the dowel in the support **(3)** lines up with the hole in the roller.

7. Install the metal floating ring seals in the end collar **(2)** and seal support **(3)** as outlined in the topic, METAL FLOATING RING SEAL INSTALLATION.



ASSEMBLING CARRIER ROLLER
1–Shaft. 2–End collar. 3–Seal support. 4–Outer cups. 5–Nut. 6–Inner bearing cone. 7–Outer bearing cone. 8–Lock ring.

8. Replace the O-ring seal on the shaft, install the end collar on the shaft and install the retaining ring.

NOTE

Lubricate the O-ring seal on the shaft **(1)** with liquid soap before installing the end collar **(2)**.

9. Lubricate the carrier roller as outlined in the Operation and Maintenance Instructions.

TRACK ROLLERS

Track rollers ride on the rails formed by the track links and distribute the weight of the tractor along the track.

Two single flange and four double flange track rollers are used on each track roller frame. The single flange rollers are at the front and the rear.

The track rollers are of the center thrust construction in which the flange at the center of the track roller shaft takes the side thrust of the roller. The amount of side movement or end clearance is predetermined and is not adjustable.

The track rollers are sealed with metal floating ring seals at both ends of the shaft.

Lubrication

The track rollers are lubricated at the time of installation and need not be lubricated again until they are disassembled.

Lubricate the track roller with crankcase lubricating oil, using the 5M2080 Nozzle.

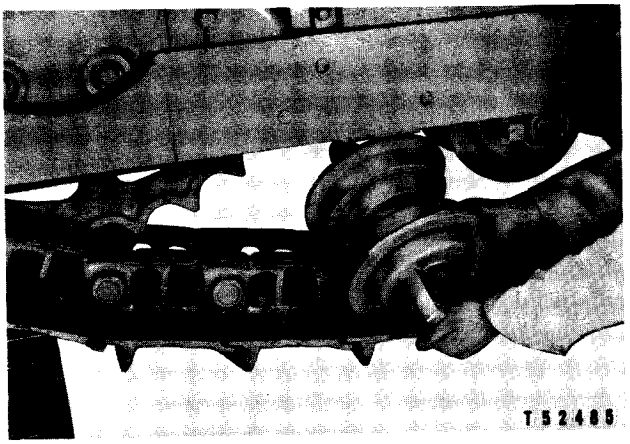
NOTE

If the roller is lubricated off the tractor, be sure it is lying horizontally and that the notch in the shaft is up. This will prevent overfilling or underfilling the roller.

Removal

Loosen the track as outlined in the topic, SEPARATING TRACK.

1. To remove any of the three rear rollers, place a block approximately 12" high behind the track and drive the tractor backward so that the track climbs up on the block far enough to just lift the roller off the track.



REMOVING TRACK ROLLER

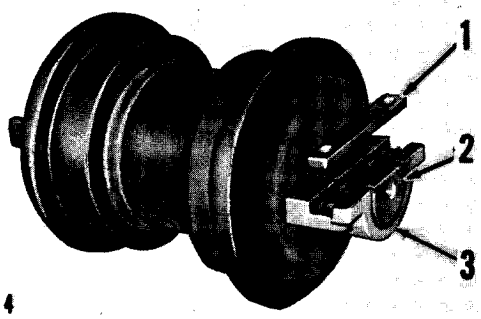
2. Set the parking brake and place a jack or block on the opposite side of the tractor under a track grouser in front of the idler, to prevent the tractor from moving forward off the block.

3. Remove the bolts from the end collars at each end of the roller to be removed.

4. Back the tractor up on the block until it is in the position shown. The roller can then be lifted off the track.

NOTE

A lock **(1)**, which is installed in the notch of the track roller shaft **(2)** and in a notch in the inner end collar **(3)**, is used to transmit the end or the side thrust of the track rollers to the track roller frame. The lock also positions the track roller, on the roller frame, in its proper location in relation to the front idler and the final drive sprocket. Wire the lock **(1)** to the end collar **(3)** so the lock will not be misplaced.



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TRACK ROLLER, END COLLAR AND LOCK
1–Lock. 2–Track roller shaft. 3–End collar.

5. To remove any of the three front rollers, drive the tractor onto a block placed ahead of the idler and proceed in the same manner as described for removal of the rear rollers.

6. Install the rollers so the notched end of the shaft is to the inside of the tractor.

7. Place the roller assemblies on the track in the proper locations. Place the wedge-shaped lock strip in the notch in the end of the shaft and in the notch of the end collar.

CAUTION

Care must be taken to prevent the roller flange from binding as the tractor is lowered off the blocks.

8. Install the bolts which hold the end collar to the track roller frame. Some clearance will remain between the track roller frame and the end collars to insure that the ends of the track roller shaft will be held securely against the track roller frame.

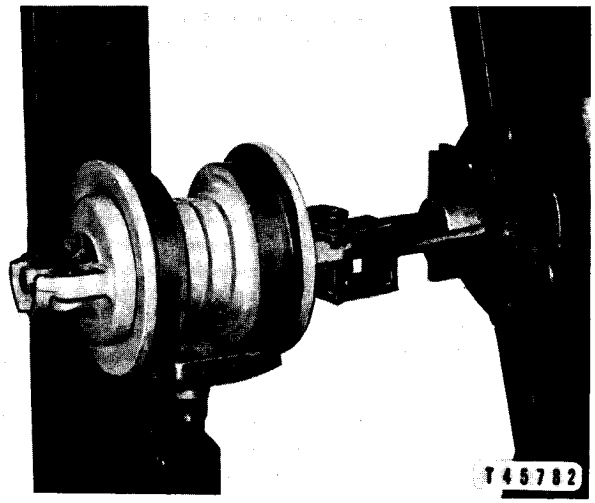
9. Use the special 5M2080 Lubricator Nozzle for refilling.

Disassembly

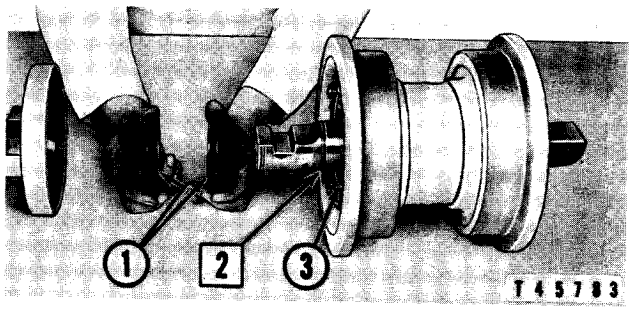
1. Remove the rings from both ends of the shaft and pull the end collars as shown.

NOTE

Information concerning the press and adapters is available upon request from the Service Department.



REMOVING END COLLAR



TRACK ROLLER DISASSEMBLY

☐ **Remove**

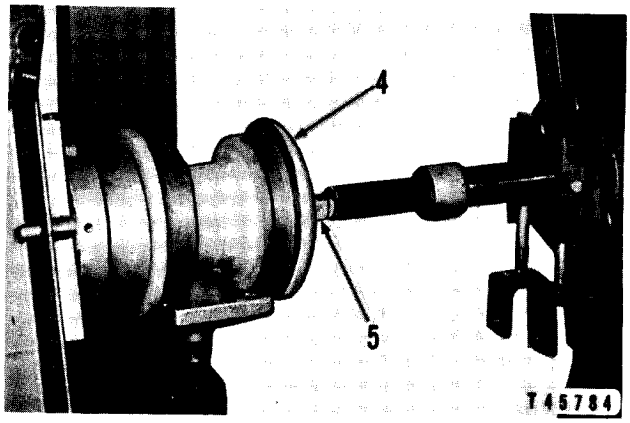
1–Metal floating ring seals. 2–O-ring seal. 3–Bushing assembly.

CAUTION

Tape the seals **(1)** together so they will be kept in matched sets.

2. Remove the bolts which secure the bushing assemblies **(3)** to the roller.

3. The bushing assembly can be removed from the roller **(4)** by pressing on the shaft **(5)**.



REMOVING BUSHING ASSEMBLY
4–Roller. 5–Shaft.

NOTE

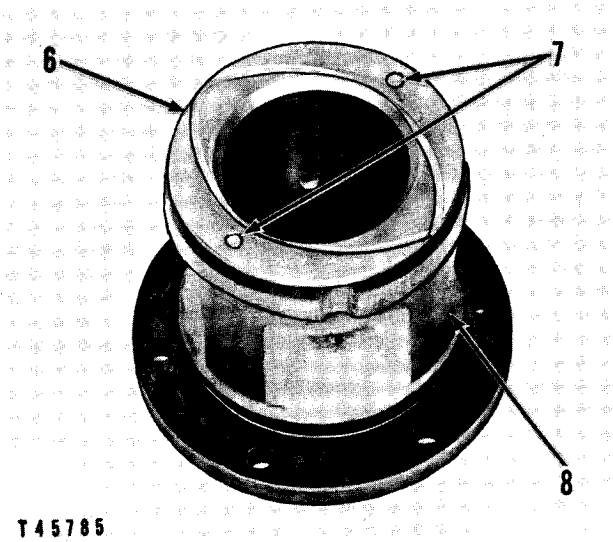
Remove the plug from the end of the shaft to prevent the possibility of damage to the tapered seat.

4. The bushing assembly in the opposite end can be removed in a similar manner.

5. The bearing **(6)** can be replaced, providing the bushing **(8)** is not damaged.

NOTE

See the topic, SPECIFICATIONS, for proper shaft to bearing clearance.



BUSHING ASSEMBLY
6–Bearing. 7–Pins. 8–Bushing.

6. Press the bearing out of the bushing and cut off the projecting dowel pins **(7)** with a hacksaw. Smooth the face of the bushing **(8)** with a file.

7. Press new bearings **(6)** into the bushings **(8)**. Make certain the lubricant holes are aligned.

8. Drill two 19/64" holes 3/4" deep through the flange of the bearing and wall of the cast iron bushing and install the proper dowels, which do not extend above the face of the bushing. Smooth the face of the bushing flange.

CAUTION

Be sure the holes do not interfere with the lubrication grooves in the face of the bearing flange.

9. Smooth the face of the bearing **(6)** with a fine file.

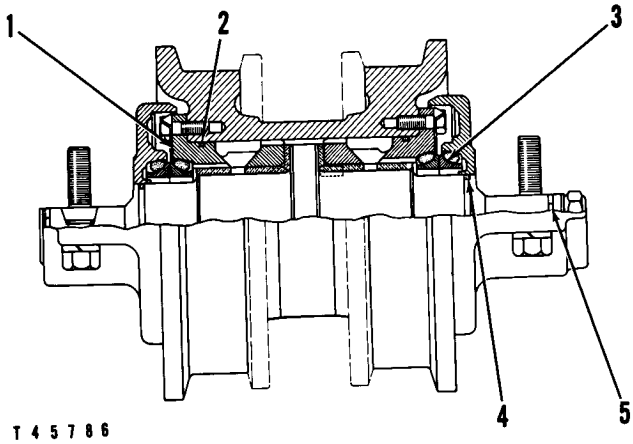
Assembly

Use an installation adapter to install the bushing assemblies in the track rollers. Information concerning this adapter is available from the Service Department.

Install the O-ring seal **(2)** on the bushing **(1)** and remove any burrs from the roller to prevent damage to the O-ring seal.

White lead should be used on the outside diameter of the bushing assembly when pressing it into place.

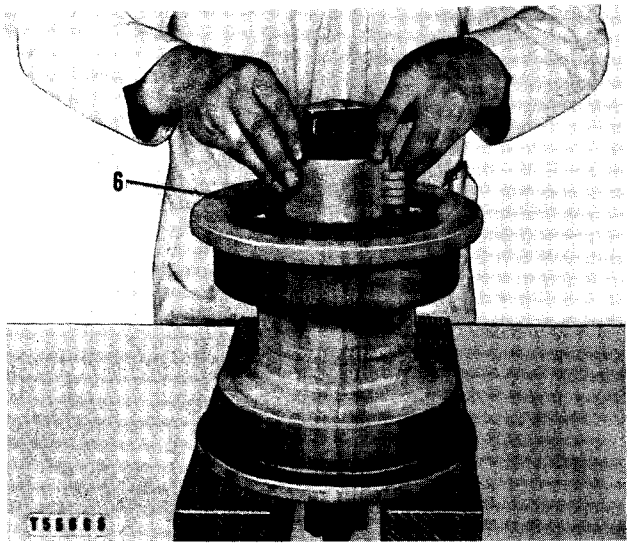
Install the shaft before pressing in the second bushing.



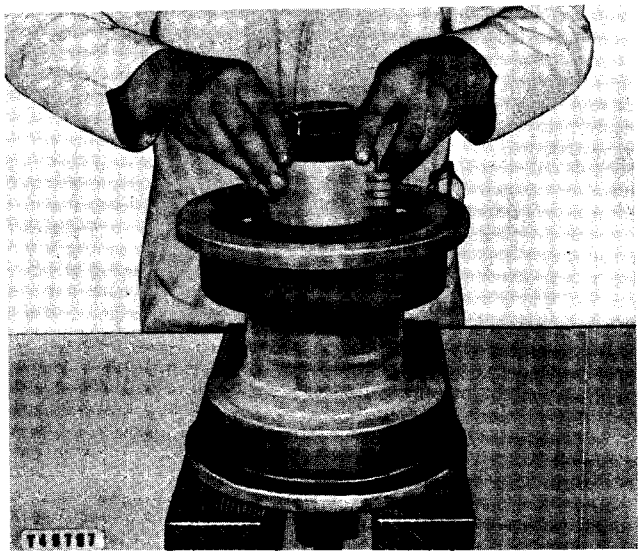
ASSEMBLING TRACK ROLLER
1–Bushing assembly. 2–O-ring seal. 3–Metal floating ring seal. 4–O-ring seal. 5–Retaining ring.

Using a 5M2196 Metal Seal Installer Assembly Tool **(6)**, install the metal floating ring seals **(3)** in the roller and collars as outlined in the topic, METAL FLOATING RING SEAL INSTALLATION.

Install the O-ring seal **(4)** on the track roller shaft and lubricate it to facilitate installation of the end collar.



INSTALLING METAL FLOATING RING SEALS
6–5M2196 Metal Seal Installer Assembly Tool.



METAL FLOATING RING SEAL INSTALLATION TOOL

Remove any burrs, smooth the chamfer in the bore of the end collar and install the end collar and the retaining ring **(5)**.

Metal Floating Ring Seal Installation

Inspect the metal floating ring seals for damage or evidence of leakage. If there are scratches across the sealing bands or if the sealing band is not clearly defined around the entire circumference of the seal, the seals should be replaced. If either seal is damaged, both metal seals must be replaced.

CAUTION

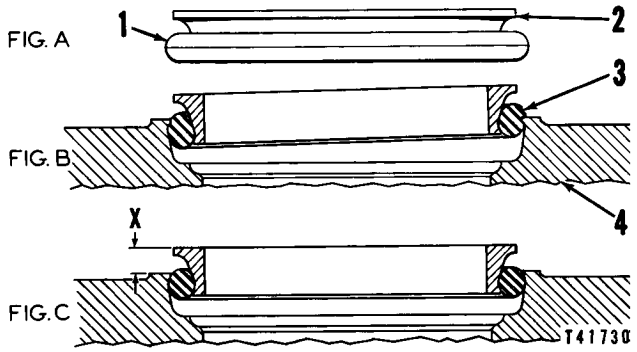
To obtain maximum service, cleanliness must be the rule. Be careful to avoid introducing dirt into the parts during installation or when filling with oil.

1. Handle all parts with care to avoid nicking critical areas. File smooth any parts that have nicks from operation, disassembly or shipment that may make assembly difficult or questionable.
2. Wash off all dirt accumulation from operation of used parts. It may be necessary to use a wire brush to clean the accumulations of dirt or rust from the bore of the seal support to assure they are clean and smooth.
3. Remove all oil or the protective coating from the floating ring seals **(2)** and from the support **(4)** with nonflammable cleaning solvent and dry absolutely dry.
4. Be sure the ramps on the support **(4)** and on the floating ring seal **(2)** are dry and with no oil present. Check the ramps for rough tool marks and nicks. On used parts, remove all mud or rust deposits from the ramps with a scraper or wire brush and smooth the surface with emery cloth.
5. Always install new rubber toric sealing rings **(1)** on the floating ring seals **(2)**. Never reinstall a toric sealing ring on a new or a used floating ring seal. Once it has been used, discard it and replace with a new one.

NOTE

There is a metal seal installer assembly tool available through the Parts Department which can be used to install the metal floating ring seal **(2)** and toric sealing ring **(1)** into the support **(4)**. If the assembly tool is used, be sure not to bump the floating ring seal **(2)** when removing the assembly tool.

6. Install the toric sealing ring **(1)** so that it seats uniformly in the relief of the floating ring seal **(2)**. Be sure that the toric sealing ring **(1)** is not twisted and that it sets straight and against the lip that keeps it from falling off the floating ring seal. See Fig. A and Fig. C.
7. If the assembly tool is not used, install the toric sealing ring **(1)** and floating ring seal **(2)** as an assembly into the support **(4)** by pressing on the toric sealing ring **(1)** at location **(3)**. Fig. B. Be sure the toric sealing ring **(1)** is seated uniformly in the recess of both the floating ring seal **(2)** and the mating part, support **(4)**. Make sure that it sets in the bore straight and against the lip that keeps it from falling out of the support **(4)**. Fig. C.



INSTALLING FLOATING RING SEAL AND TORIC SEALING RING

1–Rubber toric sealing ring. 2–Metal floating ring seal. 3–Location to press on toric sealing ring. 4–Toric sealing ring support. X–Dimension to be checked.

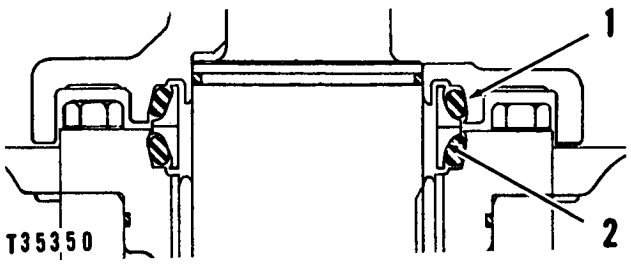
CAUTION

If the assembly tool is not used, do not use a screwdriver or stick to assemble the toric sealing ring into the support **(4)**. Use finger pressure only.

8. The floating ring seal **(2)** should be installed in the mating part to a uniform depth. The dimension **(X)** must be uniform around the entire circumference of the floating ring seal **(2)**.

9. The floating ring seals **(2)** should always be installed in pairs, that is, two new seals together or two seals that have previously run together. Never assemble one new seal and one used seal together or two seals that have not previously run together.

10. Before assembling the floating ring seals **(2)** together, wipe the face of the seals **(2)** with lint-free tissue to remove any foreign material and finger prints.



FLOATING RING SEALS CORRECTLY INSTALLED

1–Toric sealing ring. 2–Floating ring seal.

11. Place one drop of light oil on the cleaning tissue and coat the sealing surface of the seals **(2)** being careful not to let any oil come in contact with the toric sealing ring **(1)** or its mating areas.

NOTE

Before installing the end collars on the shaft be sure the filler plug is not in the shaft.

12. Oil the bore of the end collar that covers the O-ring seal on the shaft.

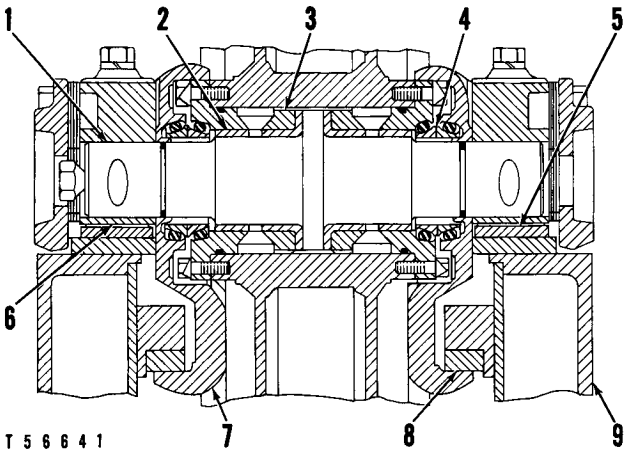
13. Install the end collar, with the floating ring seal and toric sealing ring installed, on the end opposite the filler plug first, then install the end collar assembly on the end of the roller that has the filler plug. This will relieve the air pressure as early as possible when the floating ring seal faces come into contact with each other.

Front Idler and Recoil Spring

FRONT IDLER

The front idler guides the track into position in front of the track rollers. Each front idler rotates on a hardened shaft **(1)** and center thrust bearings **(2)** which are pressed into bushing assemblies **(3)**. Metal floating ring seals **(4)** retain the lubricant and prevent the entry of dirt. The idler shaft **(1)** is mounted in two bearings **(6)** which are supported by two plate assemblies **(5)**.

Two plate assemblies **(5)** are held against the track roller frame **(9)** by rubber covered springs which are inserted in the lower part of each bearing. The collars **(7)** slide on replaceable wear strips **(8)** which are riveted to the track roller frame **(9)**.



FRONT IDLER
(Right Side – Rear View)
1–Shaft. 2–Thrust bearings (two). 3–Bushing assemblies (two). 4–Metal floating ring seals (two). 5–Plate assemblies (two). 6–Bearings (two). 7–Collars (two). 8–Wear strips (two). 9–Track roller frame.

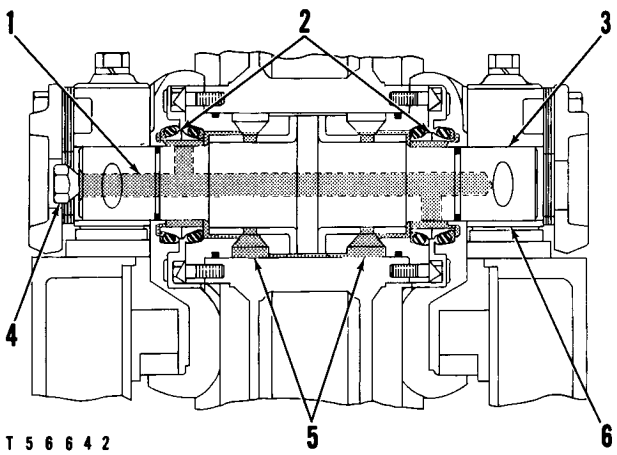
Lubrication

The front idlers are lubricated at the time of installation and need not be lubricated again until they are disassembled.

Lubricant is forced into the passage **(1)** through a 5M2080 Nozzle which is threaded into the shaft **(3)** in place of the plug **(4)**. The lubricant flows through the passage to fill the space between the shaft and the metal floating ring seals **(2)**. As the reservoirs **(5)** in the bushing assemblies are filled with lubricant, air is forced out through a relief in the threads of the nozzle. When lubricant, free of air bubbles, begins flowing out around the nozzle, the nozzle should be removed and the plug installed.

NOTE

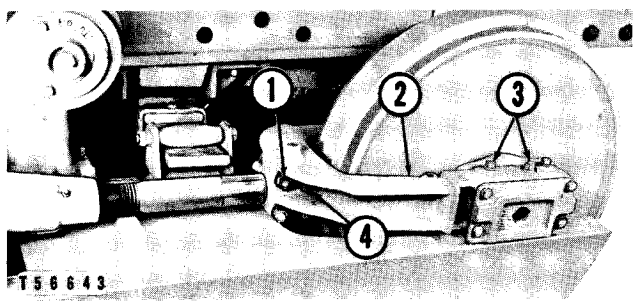
If the front idler is lubricated off the machine, be sure it is in an upright position and the end bearings **(6)** are in the installed position, placing the shaft in the correct horizontal position.



FRONT IDLER LUBRICATION
1–Passage. 2–Metal floating ring seals. 3–Shaft. 4–Plug. 5–Reservoirs. 6–Bearings (two).

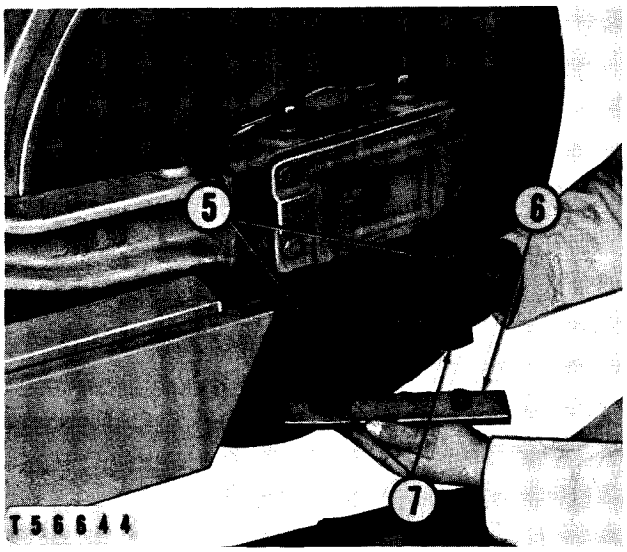
Removal and Installation

1. Separate the track and lay it out flat. See the topic, SEPARATING TRACK.



PREPARING TO REMOVE FRONT IDLER
1–Bolts (three). 2–Bearing. 3–Bolts (four). 4–Bolt.

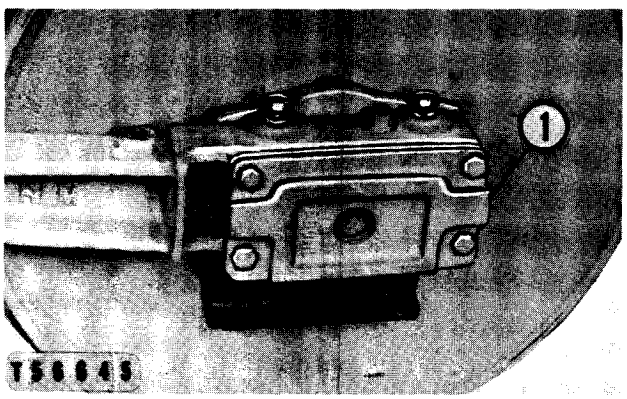
2. Loosen, but do not remove the three bolts **(1)**.
3. Remove the bolt **(4)**.
4. Loosen the bolts **(3)** to relieve the force of the spring assemblies against the track roller frame.
5. Using a suitable hoist, support the weight of the idler and move it forward until the plate assemblies **(6)**, the spring assemblies **(7)**, and the plates **(5)** can be removed.
6. Inspect the plate assemblies **(6)**, spring assemblies **(7)** and plates **(5)** and replace if worn or damaged.
7. Install the front idler assembly in the reverse order of removal.
8. After the front idler has been positioned and secured, tighten the bolts **(3)** on either side of the idler.



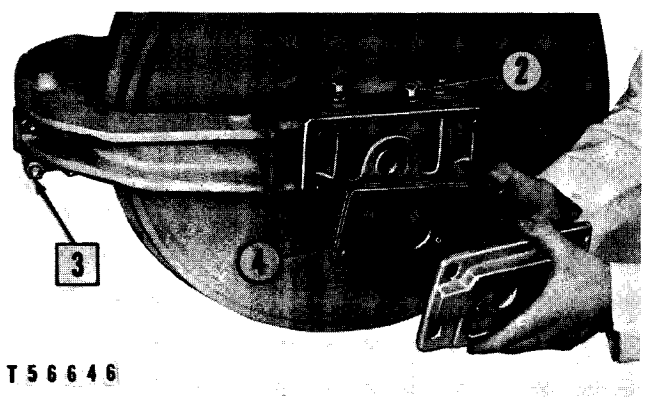
FRONT IDLER REMOVAL
5–Plates (four). 6–Plate assemblies (two). 7–Spring assemblies (four).

9. Align the idler with the track rollers. See the topic, FRONT IDLER ADJUSTMENT.

Disassembly and Assembly



PREPARING TO DISASSEMBLE FRONT IDLER
1–Plate.



REMOVING PLATE AND SHIMS

☐ **Remove**

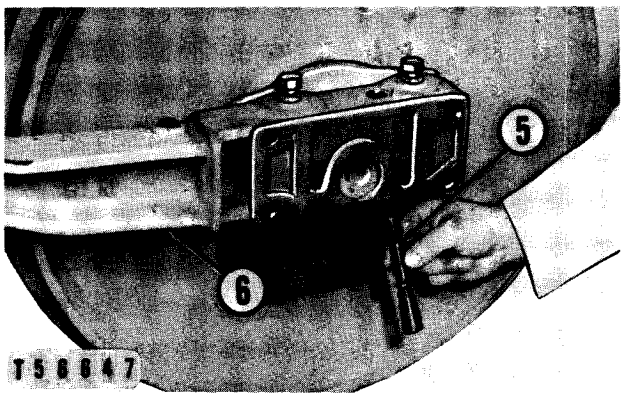
2–Nut. 3–Bolts (three). 4–Shims.

1. Remove the plate **(1)** and shims **(4)**.

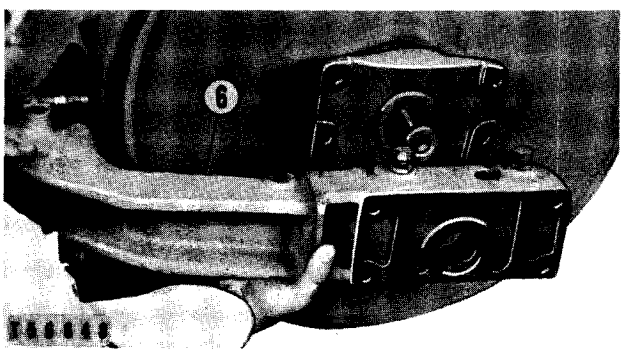
NOTE

The shims **(4)** between the plate **(1)** and the bearing **(6)** should be kept together. The same shims will be used for assembly.

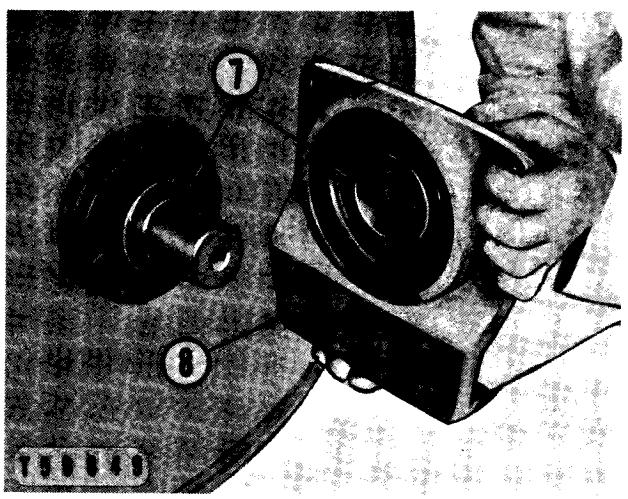
2. Remove the nut **(2)** and drive the taper pin **(5)** out of the bearing **(6)**.



TAPER PIN REMOVAL
5–Taper pin. 6–Bearing.



BEARING REMOVAL
6–Bearing (two).



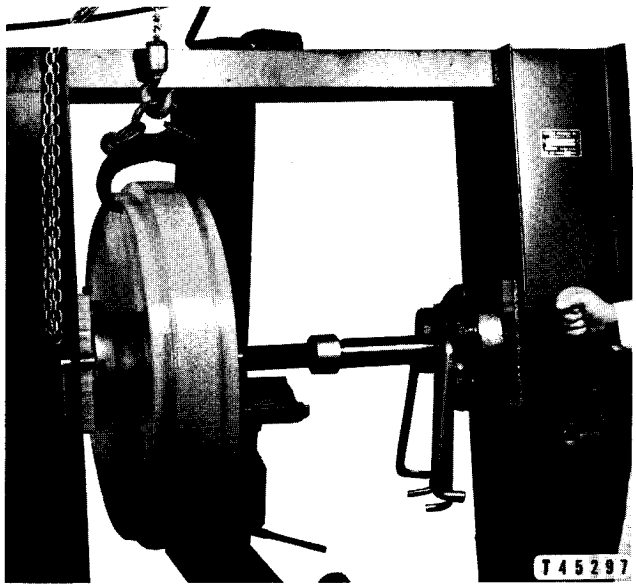
REMOVING METAL FLOATING RING SEALS
7–Metal floating ring seals. 8–Collar.

3. Remove the bearing **(6)** as shown.
4. Remove the metal floating ring seals **(7)** and rubber toric sealing rings from each side of the front idler and the collar **(8)**.

NOTE

Tape the mating seals together so they will be kept in matched sets.

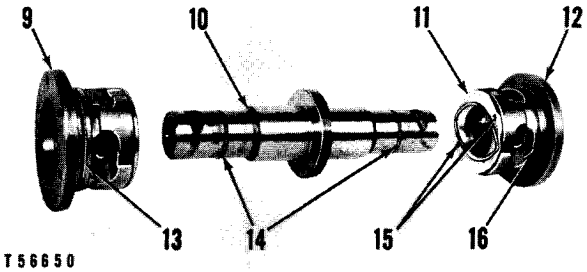
5. Remove the plug from the end of the idler shaft, and remove the bolts which secure the bushing assemblies to the front idler.
6. Place the front idler assembly in a suitable press as shown and push the bushing assemblies out of front idler.



PREPARING TO REMOVE FRONT IDLER BUSHING

NOTE

Information concerning the hydraulic press and fixtures is available upon request from the Service Department.



IDLER SHAFT AND BUSHING ASSEMBLIES
9–Bushing assembly. 10–Idler shaft. 11–Bearing. 12–Bushing assembly. 13–O-ring seal. 14–O-ring seals. 15–Pins. 16–O-ring seal.

7. Inspect the bearings **(11)** in the bushing assemblies **(9)** and **(12)**. See the topic, SPECIFICATIONS.
8. The bearings **(11)** can be replaced by pressing them out of the bushing assemblies **(9)** and **(12)**.
9. Cut off the projecting dowel pins **(15)** with a hacksaw, and smooth the face of the bushings **(9)** and **(12)**.
10. Press the new bearing **(11)** into place, making certain the lubricant holes are aligned.

NOTE

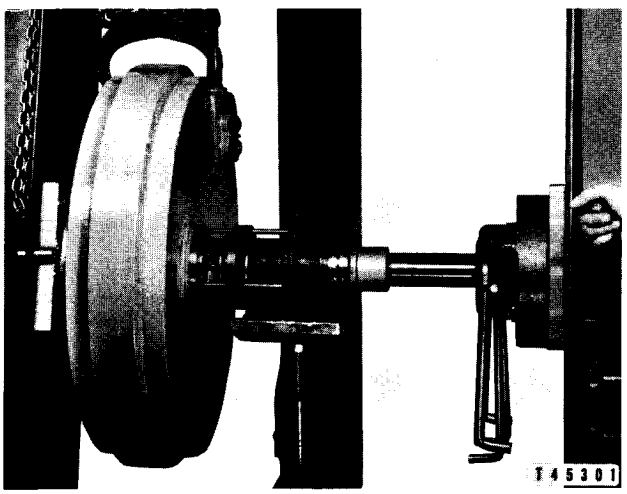
White lead should be used on the outside diameter of the bushing assembly when pressing it into place.

11. Drill two 19/64" holes 3/4" deep through the flange of the bearings and wall of the bushing assembly, and install the proper dowels, which do not extend above the face of the bearing.

CAUTION

Be sure the holes do not interfere with the lubrication grooves in the face of the bearing flange.

12. Smooth the face of the bearing flange.
13. Replace the O-ring seals **(13)**, **(14)** and **(16)**.
14. Lubricate the O-ring seals and install the bushing assembly as shown.



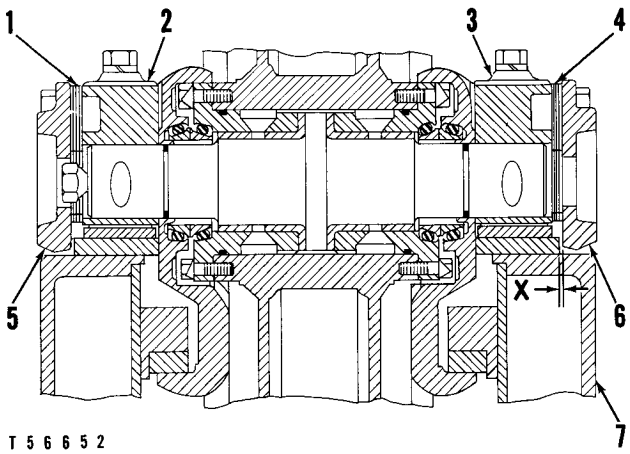
INSTALLING BUSHING ASSEMBLY

15. Place the idler shaft in the previously installed bushing assembly.
16. Install the remaining bushing assembly.

17. Using a 5M2196 Installer Assembly, install the metal floating ring seals and rubber toric sealing rings as outlined in the topic, METAL FLOATING RING SEAL INSTALLATION.
18. Lubricate the O-ring seals on the idler shaft and complete the assembly.
19. Fill the front idler with lubricant as outlined in the Operation and Maintenance Instructions.

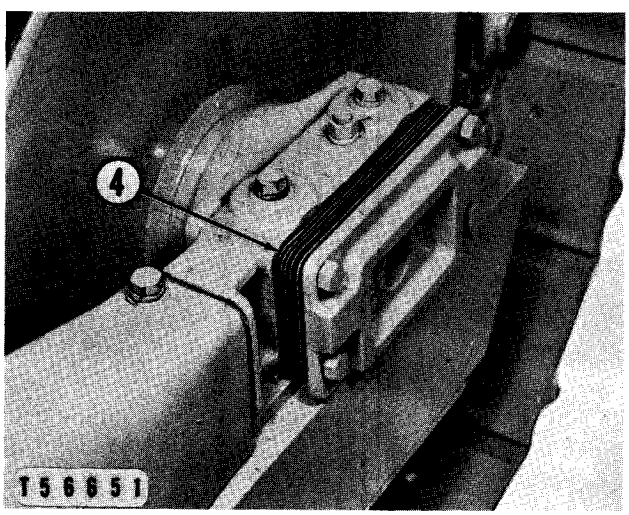
Front Idler Adjustment

The shims **(1)** and **(4)** are used to center the idler in the track roller frame **(7)**, and align the idler with the track rollers.



ALIGNING IDLER WITH TRACK ROLLER
(Right Side – Rear View)
1–Shims. 2–Bearing. 3–Bearing. 4–Shims. 5–Plate. 6–Plate. 7–Track roller frame. X–Dimension to be checked.

Install enough shims **(1)** and **(4)** between the bearings **(2)** and **(3)** and plates **(5)** and **(6)** to provide a clearance **(X)** between the plates **(5)** and **(6)** and the track roller frame **(7)**. The figure for the correct clearance is given in the topic, SPECIFICATIONS.



FRONT IDLER ADJUSTING SHIMS
4–Shims.

NOTE

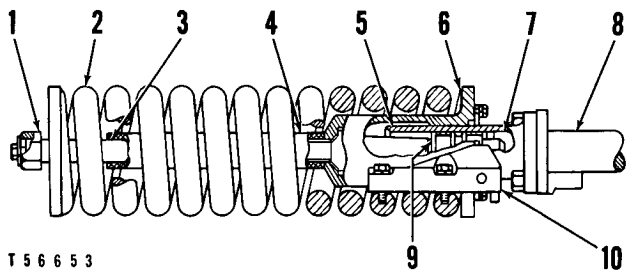
Shims **(1)** and **(4)** can be used to shift the idler from side to side to align the idler with the track rollers after the clearance has been adjusted. Removing shims **(4)** from the right side and adding them to the left side will move the idler to the right. Removing shims **(1)** from the left side and adding them to the right side will move the idler to the left.

As the plates wear, remove shims equal to the wear to prevent excessive side movement of the idler assembly.

RECOIL SPRING

Operation

The recoil spring **(2)** is compressed and held to a definite length by the recoil spring bolt **(3)** and nut **(1)** until the recoil spring is installed in the machine. After installation the nut **(1)** on the recoil spring bolt **(3)** is backed off and the recoil spring is held by stops **(10)** which normally prevent the pressure of the springs from being exerted against the track.



RECOIL SPRING OPERATION
1–Nut. 2–Recoil spring. 3–Recoil spring bolt. 4–Sleeve. 5–Cylinder. 6–Pilot assembly. 7–Cavity. 8–Rod assembly. 9–Piston. 10–Stops.

Track adjustment is obtained by a screw type or hydraulic type track adjusting mechanism as described here. Grease, under pressure, is applied to the cavity **(7)** in the hydraulic track adjusting mechanism to tighten the tracks. Should rocks or other obstructions get between the tracks and rollers, idler or sprocket, the rod assembly **(8)** moves to the rear. Since the grease in the cavity will not compress, the piston **(9)** and bolt **(3)** move to the rear. Bolt **(3)** pushes on pilot **(6)** which compresses the spring **(2)** and prevents the track from being overstressed. The sleeve **(4)** limits spring compression.

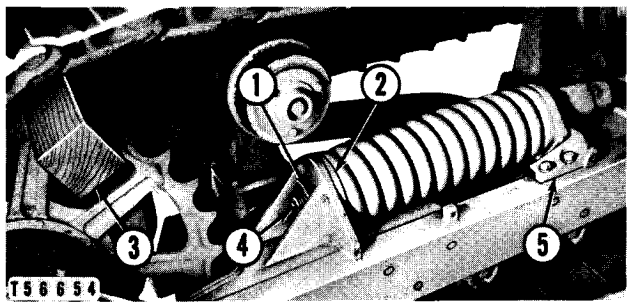
Removal and Installation (Screw Type Illustrated)

NOTE

On machines equipped with the hydraulic track adjusting mechanism, the recoil spring can be

removed without separating the track providing the recoil spring bolt is not broken.

1. Remove the guards over the recoil spring and adjusting screw.
2. Install a hardwood block **(3)** as shown, between the sprocket and the track, and back up the tractor slightly to compress the recoil spring. When all the tension is removed from the recoil spring stop **(5)**, remove the locking bolt and washer **(4)**, and screw the recoil spring bolt nut **(1)** tight against the rear pilot **(2)**. Remove the block.

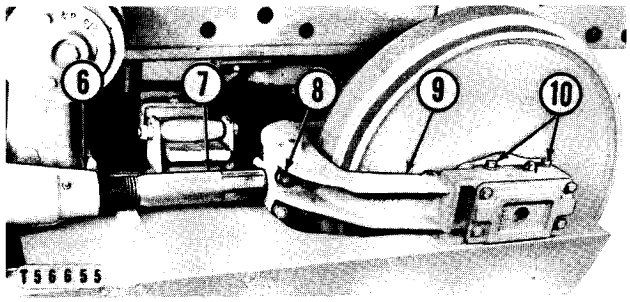


REMOVING TENSION FROM RECOIL SPRING STOPS
1–Recoil spring bolt nut. 2–Recoil spring rear pilot. 3–Block. 4–Locking bolt and washer. 5–Recoil spring stops (two).

WARNING

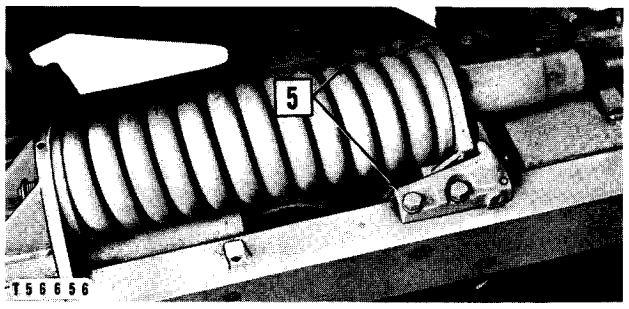
On machines with hydraulic track adjusters, see the topic, SEPARATING TRACKS.

3. Separate the track and lay it out flat. See the topic, SEPARATING TRACK.



DISCONNECTING TRACK ADJUSTING SCREW
6–Recoil spring nut assembly. 7–Track adjusting screw. 8–Bolts (four). 9–Bearings (two). 10–Bolts (four).

4. Loosen the bolts **(8)** which secure the bearings **(9)** to the track adjusting screw **(7)**.
5. Loosen the bolts **(10)** that compress the idler spring assemblies.
6. Turn the track adjusting screw **(7)** until it is free of the recoil spring nut assembly **(6)**.

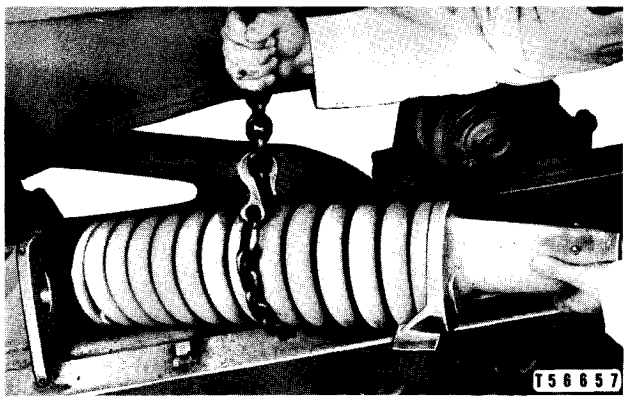


REMOVING RECOIL SPRING STOPS

☐ **Remove**

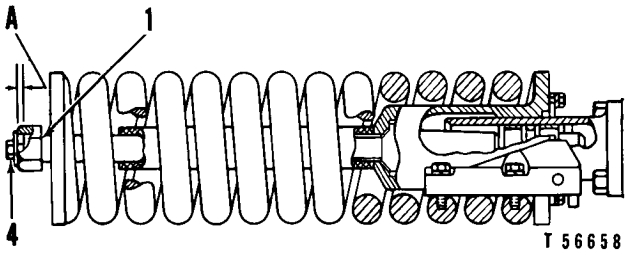
5–Recoil spring stops.

7. Attach a suitable hoist and remove the recoil spring as shown.



REMOVING RECOIL SPRINGS

8. Prior to installation, tighten the nut **(1)** until the compressed length of the recoil spring for assembly into the track roller frame is equal to the dimension given in the topic, SPECIFICATIONS.
9. Install in the reverse order of removal.
10. After the recoil spring, recoil spring stops **(5)** and front idler have been installed, back off the nut **(1)** until dimension **(A)** between the end of the bolt and face of the nut is obtained.
11. Secure the retaining bolt and washer **(4)**.



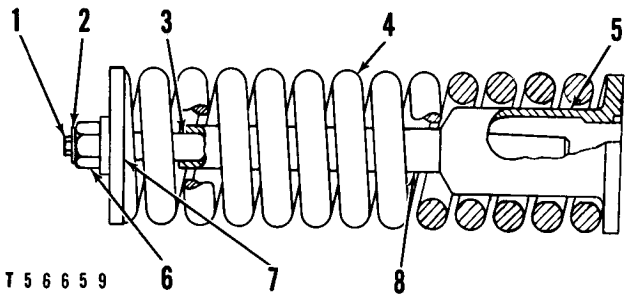
POSITIONING NUT
(Hydraulic type illustrated)
1–Nut. 4–Bolt and washer. A–.06" dimension.

Disassembly and Assembly (Hydraulic Type Illustrated)

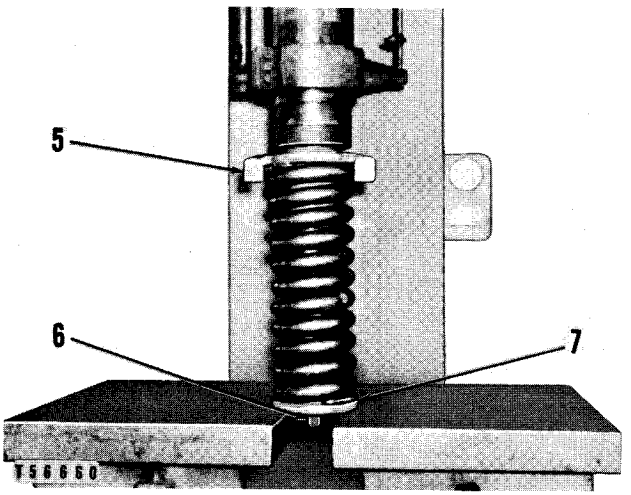
WARNING

The springs in the recoil spring assembly are assembled under a force of several tons. During the process of disassembly and assembly, to prevent possible serious personal injury, it is imperative that the proper tools be used in the correct manner when performing these operations.

1. Remove the bolt **(1)** and washer **(2)** securing the retaining nut **(6)** to the recoil spring bolt **(3)**.



RECOIL SPRING ASSEMBLY
1–Bolt. 2–Washer. 3–Recoil spring bolt. 4–Recoil spring. 5–Recoil spring front pilot. 6–Recoil spring bolt retainer nut. 7–Recoil spring rear pilot. 8–Recoil spring bolt sleeve.



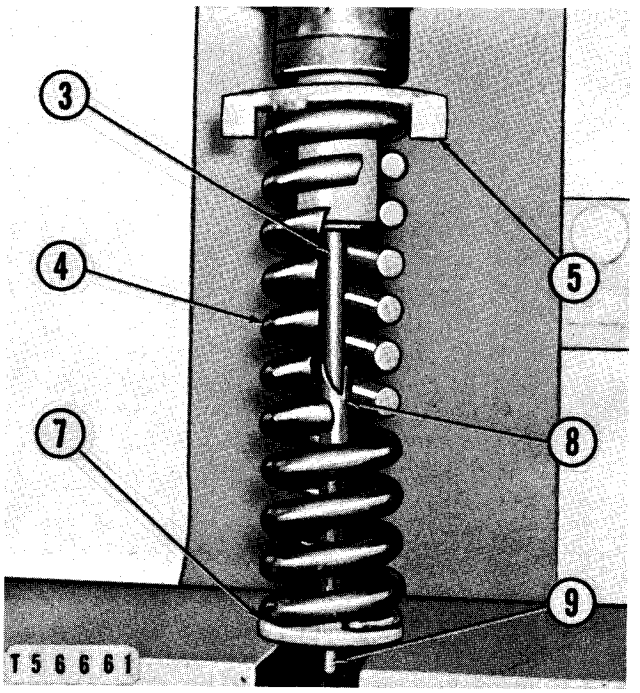
DISASSEMBLING RECOIL SPRING ASSEMBLY
5–Recoil spring front pilot. 6–Recoil spring bolt retaining nut. 7–Recoil spring rear pilot.

2. Install the recoil spring assembly in a suitable service press with the rear pilot **(7)** positioned on the press bed and the front pilot **(5)** centered with the press ram as shown.

NOTE

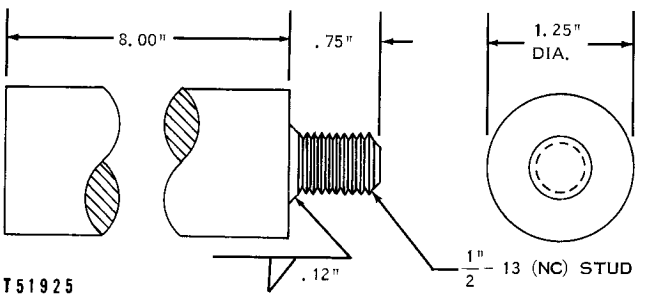
A press with a minimum throat depth of 30″ is required to facilitate disassembly of recoil spring assembly.

3. Apply enough pressure to the recoil spring assembly to facilitate retaining nut **(6)** removal.



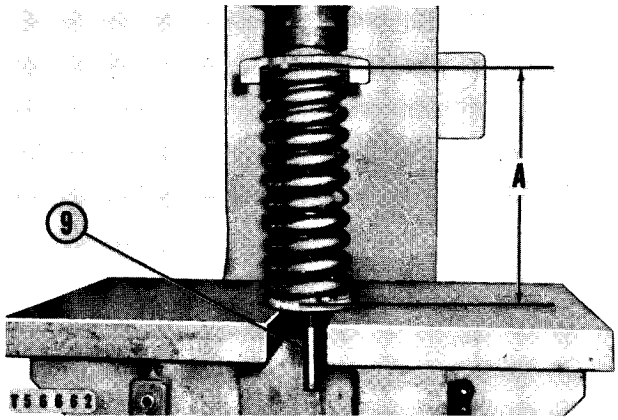
ASSEMBLING RECOIL SPRING ASSEMBLY
3–Recoil spring bolt. 4–Recoil spring. 5–Recoil spring front pilot. 7–Recoil spring rear pilot. 8–Recoil spring bolt sleeve. 9–Guide pin.

4. Remove the retaining nut **(6)**.
5. Decompress the recoil spring **(4)** by backing off the press ram.
6. Remove the recoil spring bolt **(3)**, recoil spring front pilot **(5)** and recoil spring bolt sleeve **(8)**.
7. Attach a suitable hoist and remove the recoil spring **(4)**.
8. Inspect the component parts for damage or excessive wear.
9. At assembly, position the rear pilot **(7)** over the choke in the press bed.
10. Install the recoil spring **(4)**.
11. Install the sleeve **(8)** in the recoil spring **(4)** and install the front pilot **(5)**.



SPRING BOLT GUIDE PIN

12. Screw the guide pin **(9)**, fabricated as illustrated, into the recoil spring bolt **(3)**.
13. Insert the bolt **(3)** and guide pin **(9)**, through the front pilot **(5)**, sleeve **(8)** and rear pilot **(7)**.



RECOIL SPRING ASSEMBLY IN COMPRESSED POSITION
9–Guide pin. A–Dimension to be checked.

14. Center the recoil spring assembly beneath the press ram and compress the assembly to the assembled length **(A)**, measured from the rear face of the front pilot to the front face of the rear pilot. See the topic, SPECIFICATIONS.
15. Remove the guide pin **(9)**. Install the retaining nut **(6)**.

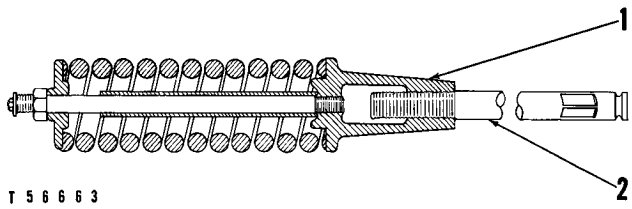
NOTE

Install the bolt **(1)** and washer **(2)** to lock the retaining nut **(6)**, after the recoil spring assembly has been installed in the tractor. See the topic, RECOIL SPRING REMOVAL AND INSTALLATION.

TRACK ADJUSTING MECHANISM

Removal and Installation (Screw Type)

When either the adjusting screw **(2)** or pilot **(1)** assembly must be replaced, remove the recoil spring. See the covering topic.



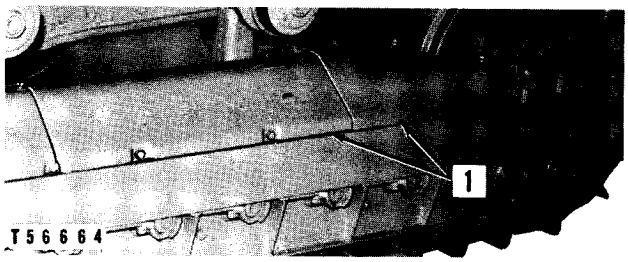
TRACK ADJUSTING MECHANISM
1–Pilot assembly. 2–Adjusting screw.

The recoil spring must be disassembled to replace the pilot **(1)**.

Removal and Installation (Hydraulic Type)

WARNING

Be certain that the hydraulic pressure in the track adjusting mechanism is completely relieved and the cylinder can be moved to the rear into the recoil spring front pilot before attempting to separate the track or remove the track adjusting mechanism. On machines that have badly worn track, it is possible that the hydraulic track adjuster may be adjusted forward to the limit of its travel and be against the stop on the track roller frame. The hydraulic cylinder could have high oil pressure in it even though the track is loose enough to remove the master pin without relieving the hydraulic track adjusting pressure.

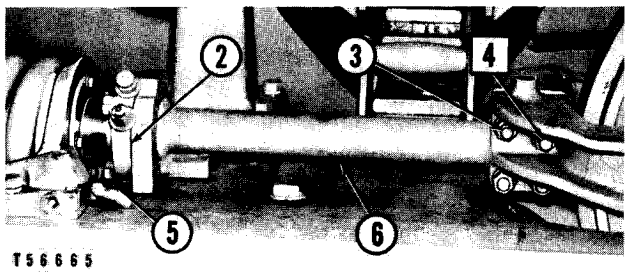


PREPARING TO REMOVE TRACK ADJUSTING MECHANISM

☐ **Remove**

1–Guards.

1. Separate the track and lay it out flat. See the topic, SEPARATING TRACK.

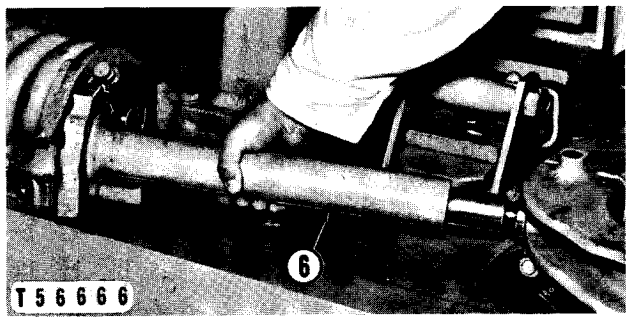


PREPARING TO REMOVE ROD ASSEMBLY

☐ **Remove**

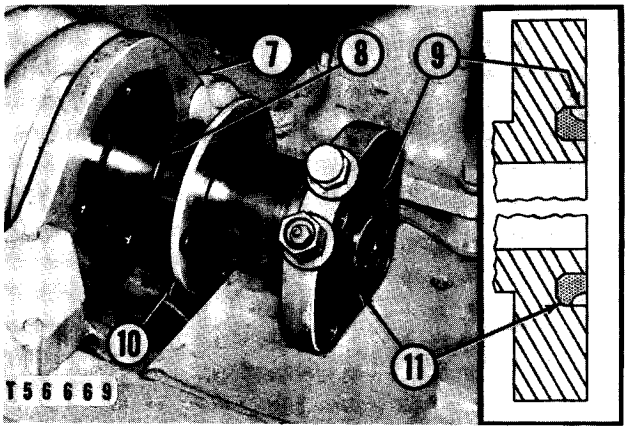
2–Cylinder. 3–Bolts (three). 4–Bolt. 5–Bolts (four). 6–Rod assembly.

2. Loosen the bolts **(3)** and using the hydraulic track adjusting mechanism move the front idler as far forward as possible.

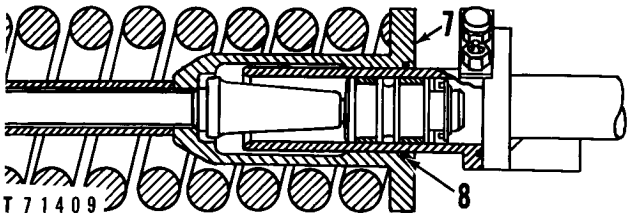


REMOVING ROD ASSEMBLY
6–Rod assembly.

3. Relieve the pressure on the track adjusting mechanism and move the cylinder **(2)** completely to the rear. This will remove the rod assembly **(6)** from the front idler bearings.
4. Remove bolts **(5)** and rod assembly **(6)**.
5. Remove the bolts securing the plate **(10)** to the pilot **(7)** and move the cylinder forward from the bore. The O-ring seal **(8)** will come off with the cylinder **(2)**. Inspect the seal for damage.



REMOVING CYLINDER
(Earlier Machine Illustrated)
7–Pilot. 8–O-ring seal. 9–Anti-extrusion ring. 10–Plate. 11–O-ring seal.



TRACK ADJUSTING MECHANISM
(Later Machines)
7–Pilot. 8–O-ring seal.

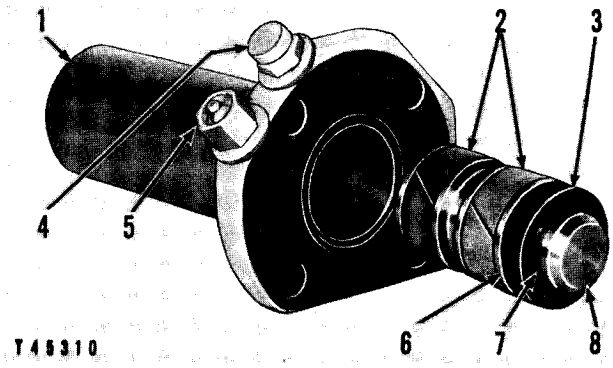
6. On later machines O-ring seal **(8)** is inserted into pilot **(7)** and is not retained by plate **(10)**.
7. Install the O-ring seal **(11)** into the cylinder first, then install the anti-extrusion ring **(9)** into the cylinder with the beveled edge placed toward the O-ring seal **(11)**.
8. Install in the reverse order of removal, rotating the cylinder so that the valves face up and out at a 45° angle. Be sure the relief valve is installed in the top position.

NOTE

To facilitate bleeding the air from the hydraulic track adjusting mechanism and to insure complete filling of the lubricant compartment, follow this recommended procedure. With the pressure relief valve open, force SAE 30 lubricating oil through the fitting in the ball check assembly. When the oil flowing out the vent in the opened relief valve no longer contains air bubbles, close the relief valve and continue filling with crankcase lubricating oil until the correct track adjustment is attained. Subsequent track adjustments should be made as outlined in the Operation and Maintenance Instructions.

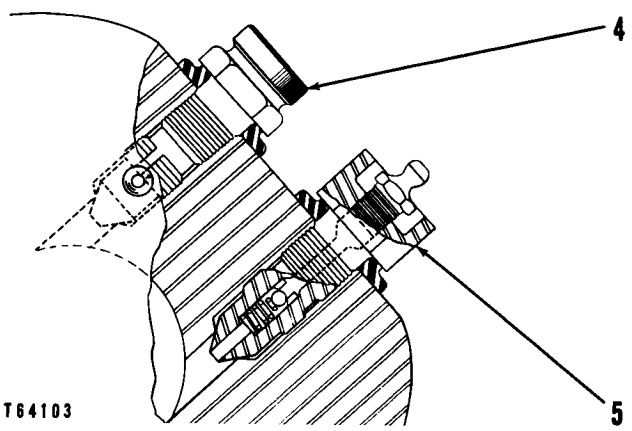
Disassembly and Assembly

1. Push the piston **(8)** out of the cylinder **(1)**.
2. Inspect the packing **(3)** and rings **(2)**, and replace if worn or damaged.



CYLINDER DISASSEMBLY
1–Cylinder. 2–Rings. 3–Packing. 4–Relief valve. 5–Ball check assembly. 6–Washer. 7–Snap ring. 8–Piston.

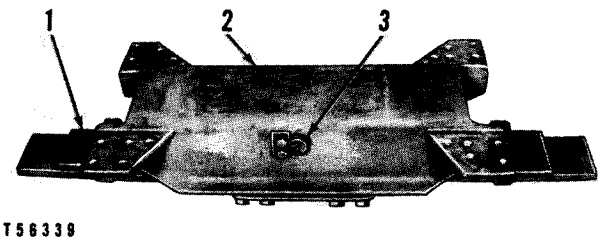
3. Remove snap ring **(7)**, packing **(3)** and washer **(6)**. Install the packing with the lip toward front of piston.
4. Lubricate the inside of the cylinder and install the piston.
5. The relief valve **(4)** and ball check assembly **(5)** provide a means of applying pressure to the hydraulic track adjuster, and relieving pressure from the track adjuster cylinder.



RELIEF VALVE AND BALL CHECK ASSEMBLY
4–Relief valve. 5–Ball check assembly.

Equalizer Spring

The equalizer spring supports the front of the tractor and transfers the weight to the track roller frames. The equalizer spring consists of a bracket assembly **(2)**, which is secured to the tractor frame, and a spring assembly **(1)** which is secured to the bracket assembly **(2)** by the pivot pin **(3)**.



EQUALIZER SPRING
(60" gauge illustrated)
1–Spring assembly. 2–Bracket assembly. 3–Pivot pin.

This mounting arrangement allows the equalizer spring to oscillate as the track roller frames pivot about the sprocket shafts.

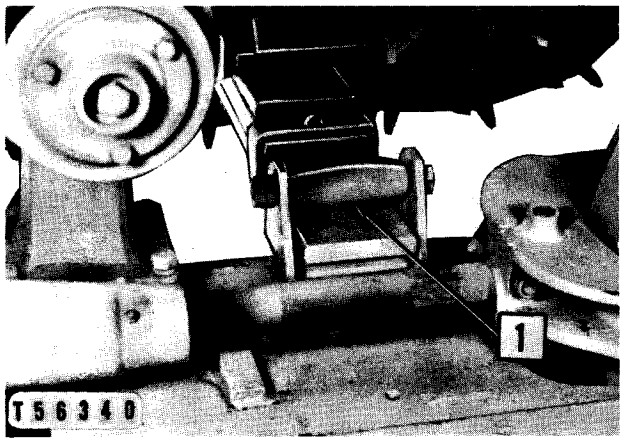
The equalizer springs for the 60" gauge machine and the 74" gauge machine are similar in construction. The spring for the 60" gauge machine is shorter than the spring for the 74" gauge machine. The removal and installation of the spring is similar for the two machines.

REMOVAL AND INSTALLATION

The equalizer spring can be removed by two methods. If it is necessary to replace an individual leaf only, follow the procedure described in the topic, REMOVAL AND INSTALLATION OF INDIVIDUAL LEAVES. However, if the complete equalizer spring assembly must be replaced, follow the procedure described in the topic, REMOVAL AND INSTALLATION OF THE EQUALIZER SPRING ASSEMBLY.

Removal and Installation of Individual Leaves

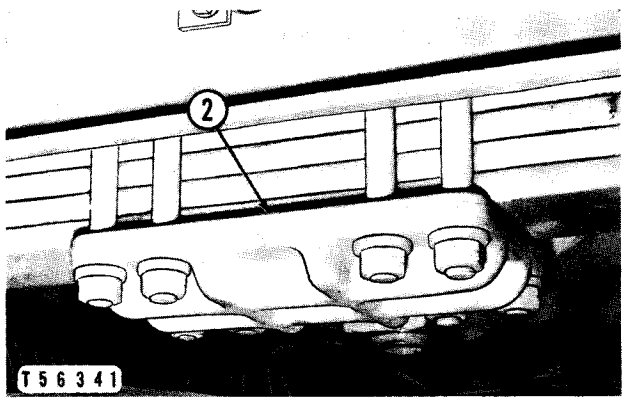
1. Remove the guards over the track adjusting mechanism on the right side of the tractor.
2. Remove the plate **(2)** from the equalizer spring. Leave the U-bolts in place.
3. Raise the front of the tractor until there is sufficient clearance to remove the three upper leaves **(3)**. The front of the tractor weighs approximately 4000 lbs.
4. Block between the tractor frame and track roller frame as shown and lower the tractor until the weight rests on the blocking.



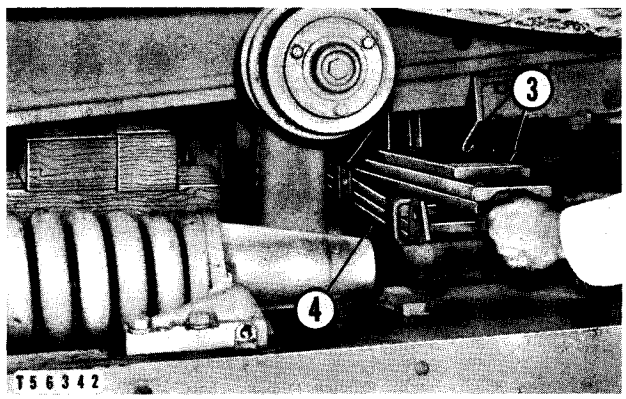
PREPARING TO REMOVE EQUALIZER SPRING LEAVES
(60" gauge illustrated)

☐ **Remove**

1–Sleeve.



PREPARING TO REMOVE EQUALIZER SPRING LEAVES
(60" gauge illustrated, viewed from beneath machine)
2–Plate.



REMOVING LEAVES
(60" gauge illustrated)
3–Leaves (three). 4–Leaf assembly.

5. Remove the leaves **(3)** as shown.

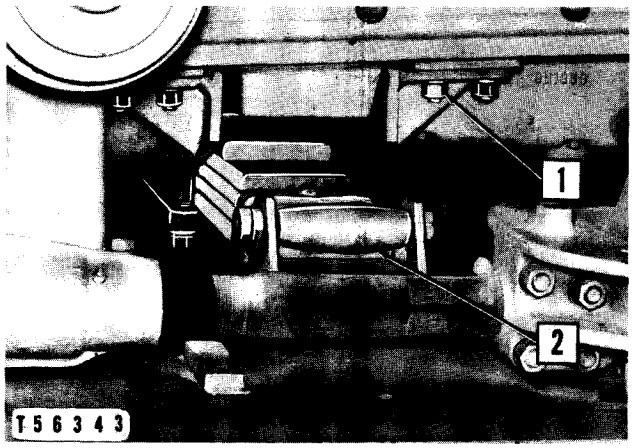
NOTE

The leaf assembly **(4)** weighs approximately 200 pounds on the 60" gauge tractor and 300 pounds on the 74" gauge tractor.

6. Support the leaf assembly **(4)** and remove the assembly far enough to attach a suitable hoist outside the track. Remove the leaf assembly **(4)**.
7. Install the equalizer spring in the reverse order of removal. Tighten the U-bolt nuts to the standard torque value given in the topic, GENERAL INSTRUCTIONS, in the ENGINE SECTION.

Removal and Installation of the Equalizer Spring Assembly

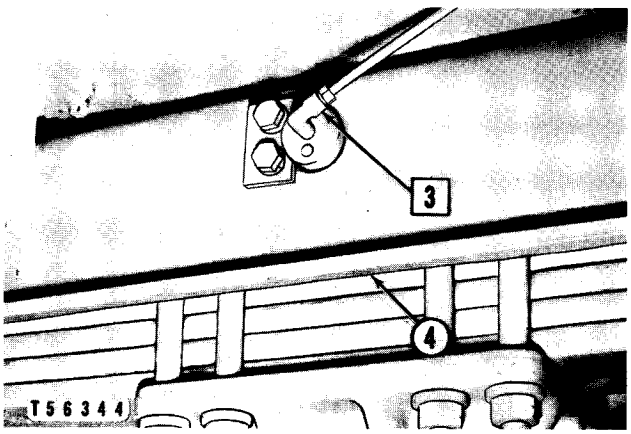
1. Remove the guards over the track adjusting mechanism on both sides of the tractor.



PREPARING TO REMOVE EQUALIZER SPRING ASSEMBLY
(60" gauge illustrated)

☐ **Remove**

1–Bolts (twenty). 2–Sleeves (two).

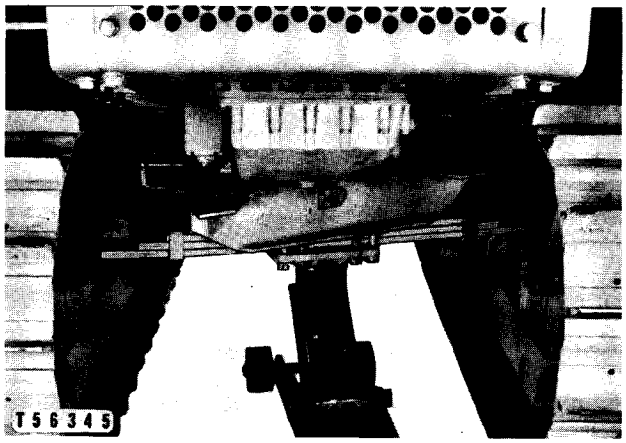


PREPARING TO REMOVE EQUALIZER SPRING ASSEMBLY
(60" gauge illustrated)

☐ **Remove**

3–Fitting. 4–Bracket assembly.

2. Raise the front of the tractor until the engine crankcase clears the bracket assembly **(4)**. The front of the tractor weighs approximately 4000 pounds.
3. Block between the tractor frame and track roller frame as shown and lower the tractor until the weight rests on the blocking.



REMOVING EQUALIZER SPRING ASSEMBLY
(60" gauge illustrated)

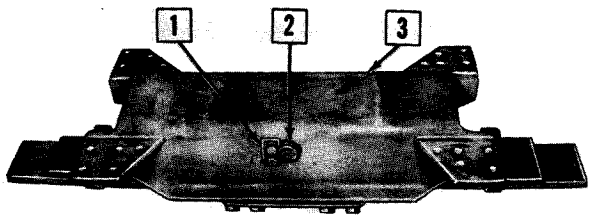
4. Using a floor jack, raise the equalizer spring assembly until the ends of the longest leaf clear the equalizer spring retaining brackets. Turn the equalizer spring assembly enough to clear the track roller frames.

NOTE

The equalizer spring assembly weighs approximately 350 pounds on the 60" gauge tractor and 400 pounds on the 74" gauge tractor.

5. Lower the jack until the equalizer spring assembly clears the engine crankcase and remove the equalizer spring assembly.
6. Install in the reverse order of removal. Tighten the bracket assembly retaining bolts to the standard torque value given in the topic, GENERAL INSTRUCTIONS, in the ENGINE SECTION.

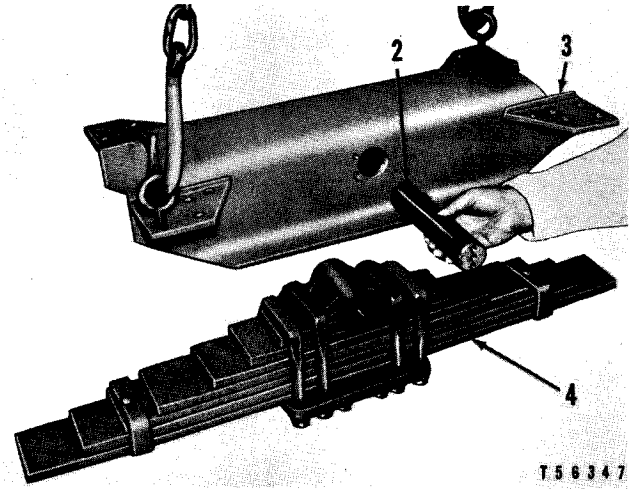
DISASSEMBLY AND ASSEMBLY



EQUALIZER SPRING AND BRACKET ASSEMBLY
(60" gauge illustrated)

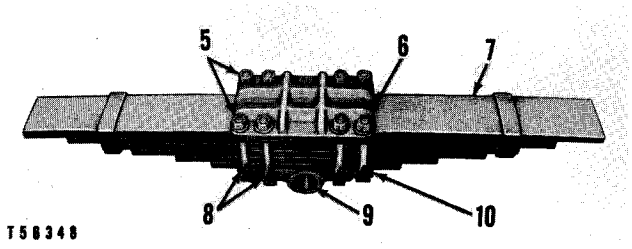
☐ **Remove**

1–Lock. 2–Pivot pin. 3–Bracket assembly.



PIVOT PIN AND BRACKET ASSEMBLY REMOVAL
(60" gauge illustrated)
2–Pivot pin. 3–Bracket assembly. 4–Equalizer spring.

1. Remove the U-bolts **(8)** holding the spring together and remove the plate **(6)** and plate assembly **(10)**. A ball is used between the plate **(6)** and lower spring leaf **(7)** to keep the spring from shifting position in the plate and plate assembly **(10)**. Each spring leaf has a nib **(11)** and a depression **(12)**. The nib **(11)** of each leaf mates with the depression **(12)** of the adjacent leaf. However, the depression of the lower spring leaf **(7)** fits over the ball between the plate **(6)** and the lower spring leaf. When the spring is assembled, the mated nibs and depressions position the individual leaves and prevent shifting.

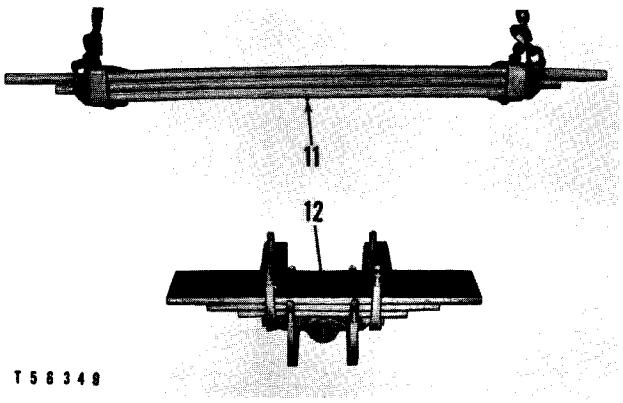


EQUALIZER SPRING DISASSEMBLY
(60" gauge illustrated)
5–Nuts (eight). 6–Plate. 7–Bottom leaf. 8–U-bolts (four). 9–Bearings. 10–Plate assembly.

2. Replace the bearings **(9)** in the plate assembly **(10)** if worn or damaged.

3. Replace any broken or worn parts before assembly.

4. At the time of assembly, tighten the nuts **(5)** on the U-bolts **(8)** to the standard torque value given in the topic, GENERAL INSTRUCTIONS, in the ENGINE SECTION.



LEAF REMOVAL
(60" gauge illustrated)
11–Nib. 12–Depression.

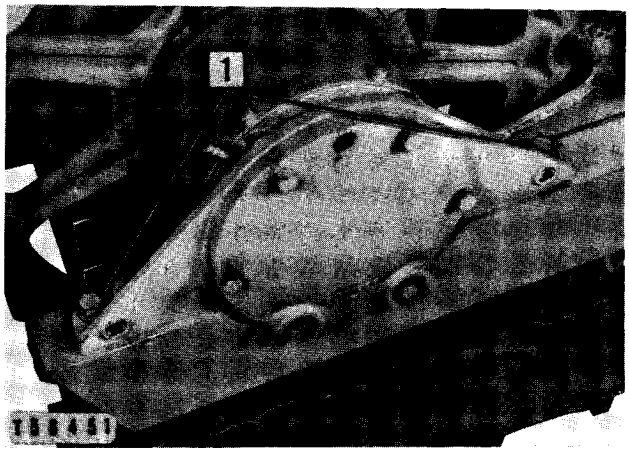
Track Roller Frame Removal

1. Separate the track and lay it out flat. See the topic, SEPARATING TRACK. If the machine is equipped with hydraulic track adjusting mechanism, make sure the pressure is relieved as given in the topic, LOOSENING TRACK (HYDRAULIC ADJUSTING TYPE).

2. Back the machine until the sprocket is over the rear link of the track.

3. Raise and support the front and rear of the tractor to allow the track rollers to clear the track rails.

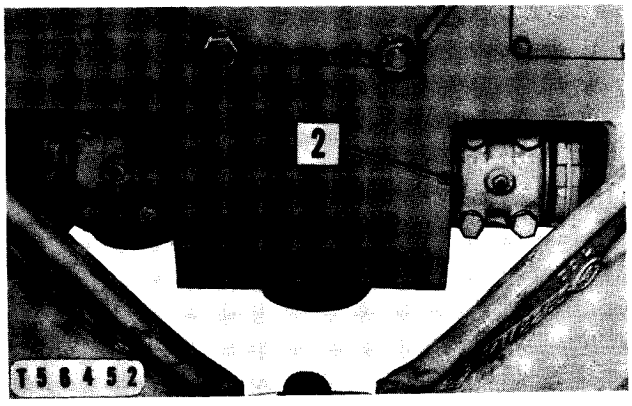
4. Remove the guard from the rear of the track roller frame.



PREPARING TO REMOVE SUPPORT

☐ **Remove**

1–Bolts (four).

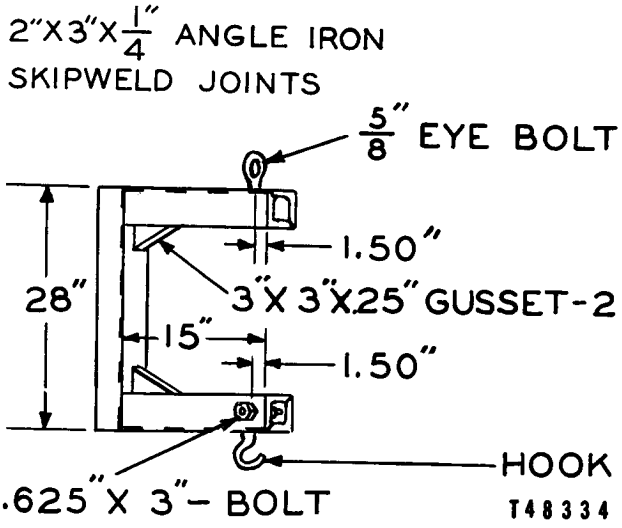


REMOVING DIAGONAL BRACE BEARING CAP

☐ **Remove**

2–Bearing cap.

5. Attach a suitable hoist, with a lifting hook of the dimensions shown, to a sling around the track carrier rollers. The track roller frame weighs approximately 2000 lbs.



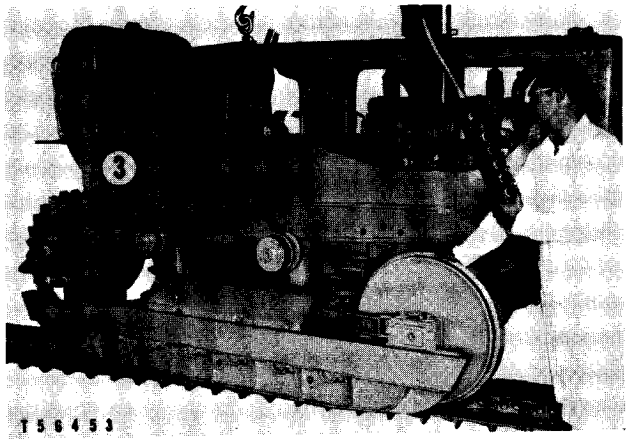
LIFTING HOOK

NOTE

Adjust the hoist sling to position the front of the track roller frame slightly higher than the rear.

6. Raise the track roller frame until the weight of the track roller frame is supported by the hoist.

7. Rock the track roller frame to separate it from the track roller frame support **(3)** and to separate the diagonal brace from the sprocket shaft.

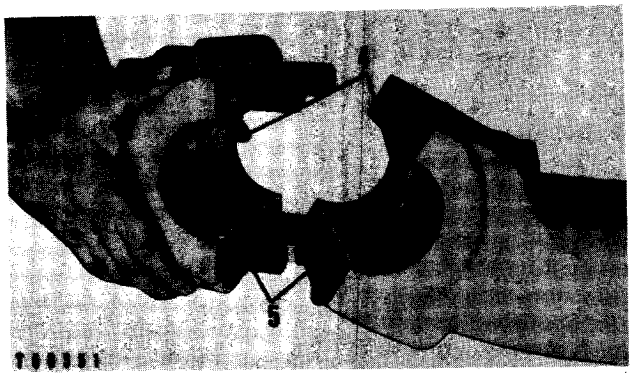


REMOVING TRACK ROLLER FRAME

3–Track roller frame support.

8. Remove the track roller frame by swinging the front of the track roller frame away from the tractor and moving it forward.

9. Inspect the bearings **(5)** for damage or excessive wear. Replace if necessary.



BEARING CAP ASSEMBLY
4–Dowels. 5–Bearings.

NOTE

When replacing the bearings **(5)**, align the dowel holes in the bearings with the dowels **(4)** contained in the bearing cap and diagonal brace.

10. Install the track roller frame in the reverse order of removal.
11. Install and adjust the track.

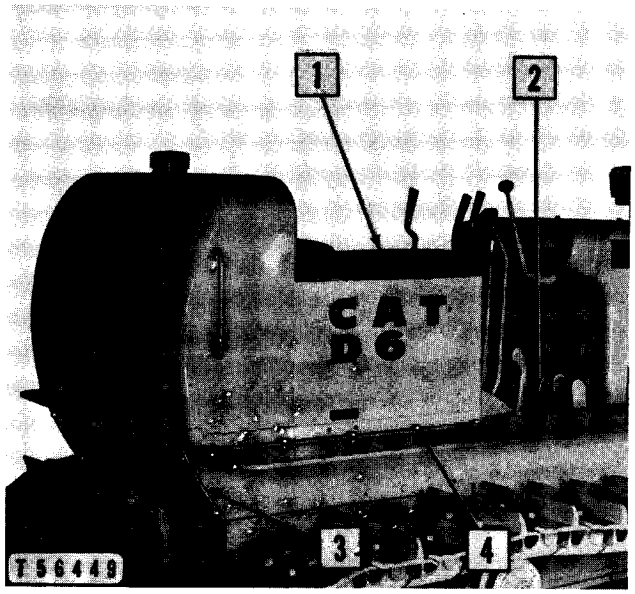
ISSUED 9-62

SEAT, FUEL TANK AND MISCELLANEOUS

TABLE OF CONTENTS

Seat, Fuel Tank and Battery Box Removal

1. Remove the floor plates as described in the covering topic.
2. Remove the seat cushions as described in the covering topic.
3. Disconnect the battery cables (if so equipped).



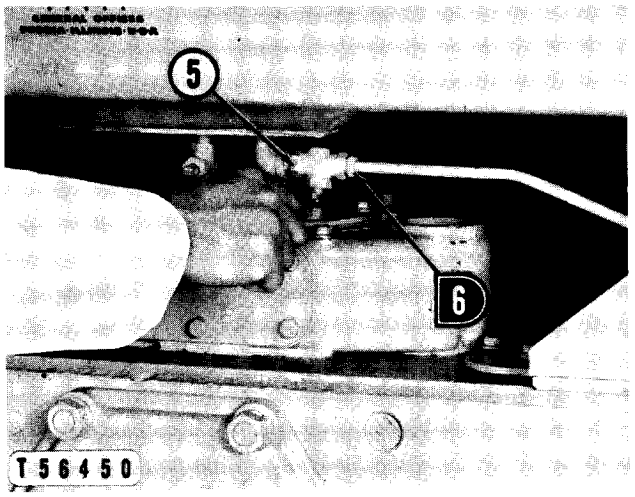
PREPARING TO REMOVE SEAT, FUEL TANK AND BATTERY BOX

☐ **Remove**

1–Seat cushions. 2–Floor plates. 3–Rear plate. 4–Bolts (ten).

CAUTION

One bolt near the top of the left fender and directly to the rear of the flywheel clutch lever must be removed.



FUEL SUPPLY VALVE

D **Disconnect**

5–Fuel supply valve. 6–Fuel supply line.

4. Shut off the fuel supply valve **(5)** at the fuel tank.
5. Attach a suitable sling and hoist to the fuel tank and remove the fuel tank assembly from the tractor.

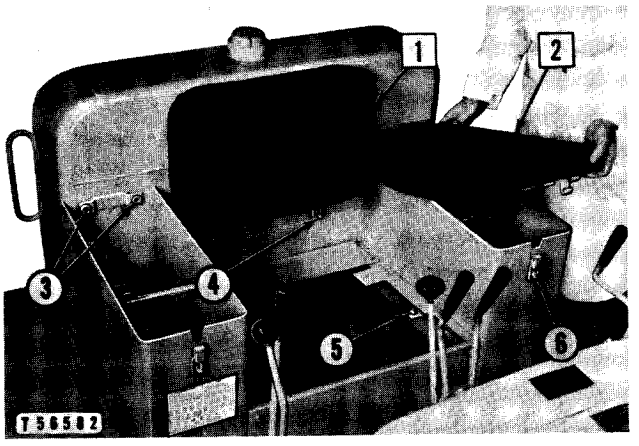
REMOVING FUEL TANK

6. Install in reverse order of removal.

Seat Cushion Removal

The seat cushions are four separate sections. Two arm rest cushions serve as covers for the battery boxes or tool storage area.

The bottom cushion may be removed by lifting it off the dowels **(5)**.



REMOVING SEAT CUSHIONS

☐ **Remove**

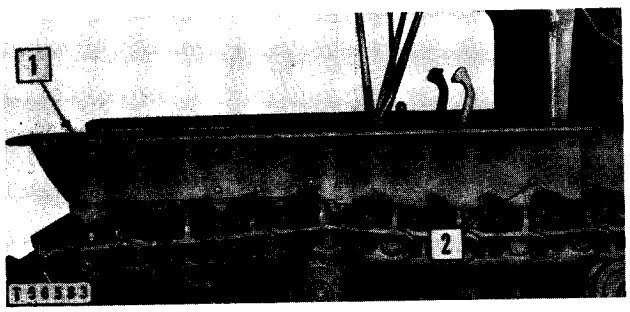
1–Back cushion. 2–Arm rest cushion. 3–Grommets. 4–Bolts (two). 5–Dowel. 6–Fastener.

Loosen the fastener **(6)** and slide the arm rest cushion **(2)** forward until the guide pins clear the grommets **(3)** and remove it from the tractor.

Remove the bolts **(4)** from the back cushion **(1)** and slide it up and lift it out.

Fender Removal

Remove the seat, fuel tank and battery box assembly as described in the covering topic.



PREPARING TO REMOVE FENDER

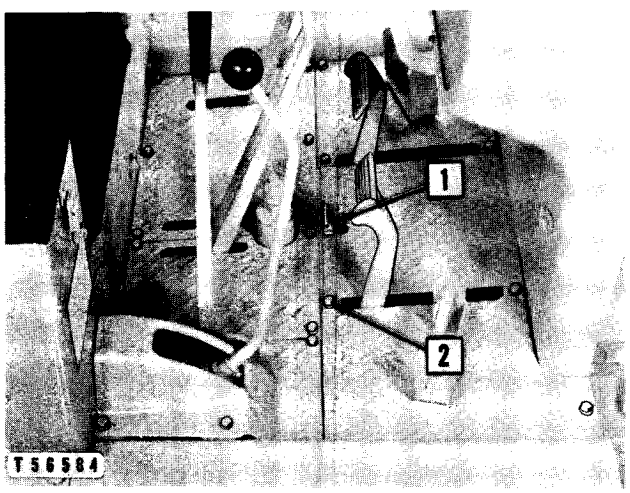
☐ **Remove**

1–Fender. 2–Bolts (twelve).

Floor Plate Removal

Remove the steering clutch lever handles, gear shift lever handles and the flywheel clutch lever handle.

Remove the front center plate by turning the latch **(1)** and sliding the plate toward the seat until it clears the slot in the dash.



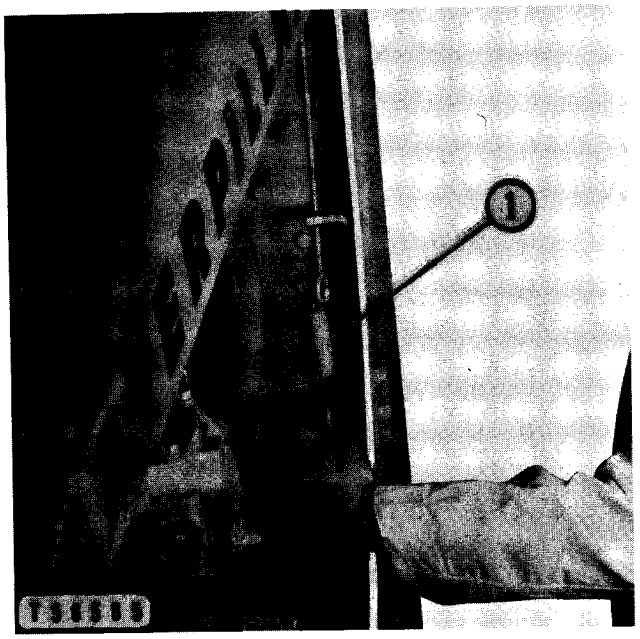
PREPARING TO REMOVE FLOOR PLATES

☐ **Remove**

1–Latch. 2–Bolts (twenty-five).

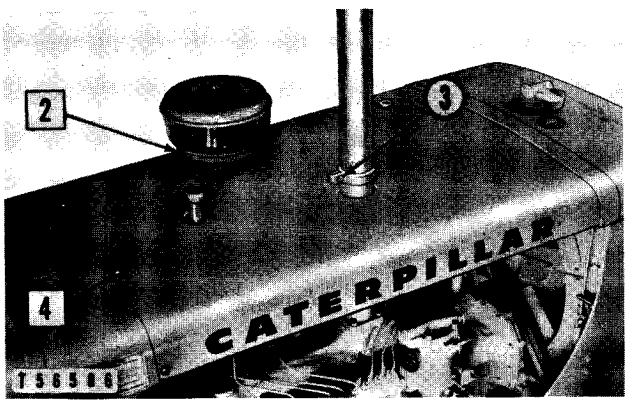
Hood Removal

Release the fastener **(1)** at each side of the radiator guard.



RELEASING HOOD FASTENER

1–Fastener.



PREPARING TO REMOVE HOOD

☐ **Remove**

2–Precleaner. 3–Clamp bolt. 4–Bolts (four).

Loosen the exhaust clamp bolt **(3)** and remove exhaust pipe.

Remove the hood.

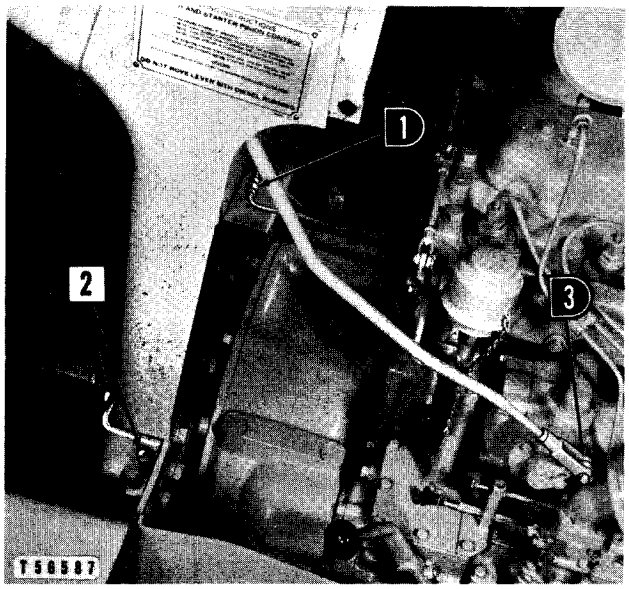
Dash Removal

1. Remove the hood. See the covering topic.
2. Remove the floor plates adjacent to the dash as described in the covering topic.

CAUTION

Disconnect the battery cables on tractors equipped with electric systems.

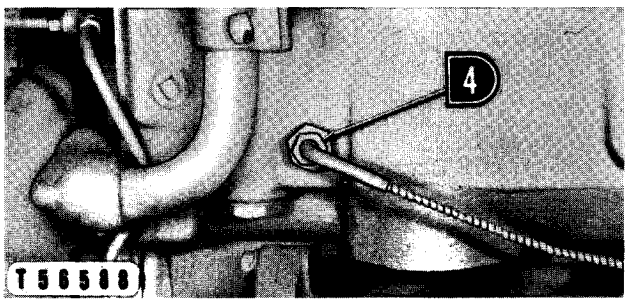
3. Remove the dash panel cover on tractors equipped with electric systems.



PREPARING TO REMOVE DASH

☐ **Remove** ◗ **Disconnect**

1–Oil pressure gauge line. 2–Bolts. 3–Fuel pump and governor control linkage.



PREPARING TO REMOVE WATER TEMPERATURE INDICATOR

◗ **Disconnect**

4–Water temperature indicator.

4. Disconnect the wiring harness from the ammeter, voltage regulator, circuit breaker and disconnect switch.

NOTE

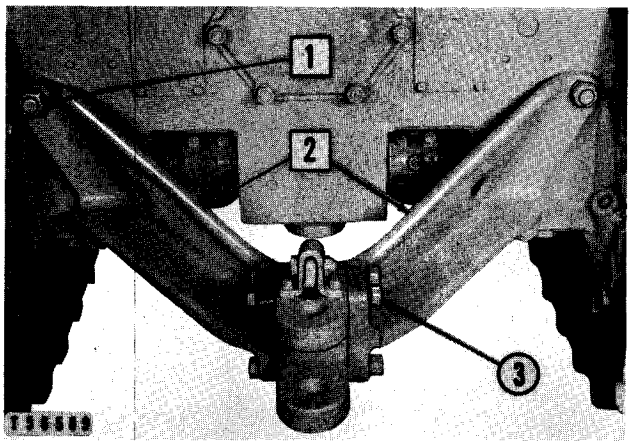
Identify the wiring when disconnecting to assure proper position at installation.

5. Remove the dash.
6. Install in the reverse order of removal.

Stationary Drawbar

The stationary drawbar consists of two brackets and a drawbar clevis. The clevis can be positioned in the high or low position by turning the clevis 180° and remounting the drawbar pin latch and latch plate on the top of the clevis.

Attach a suitable hoist for support.



DRAWBAR REMOVAL

☐ **Remove**

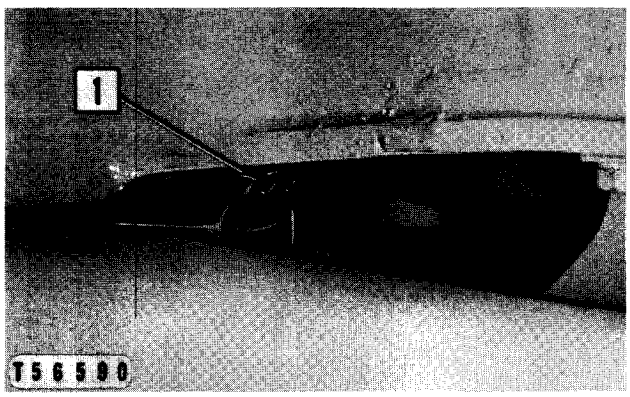
1–Nuts (six). 2–Brackets. 3–Bolts (four).

NOTE

The bolts **(3)** should be loosened to remove the drawbar brackets **(2)** from the studs in the steering clutch case.

Tighten the nuts **(1)** to the torque value given in the GENERAL INSTRUCTIONS, which is covered in the ENGINE SECTION.

Swinging Drawbar



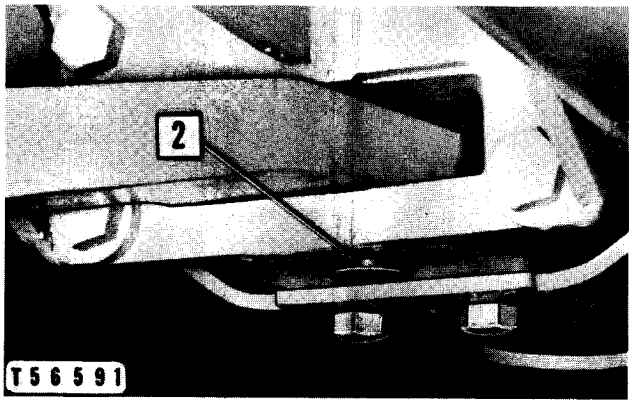
PREPARING TO REMOVE DRAWBAR

☐ **Remove**

1–Lockscrew (two).

NOTE

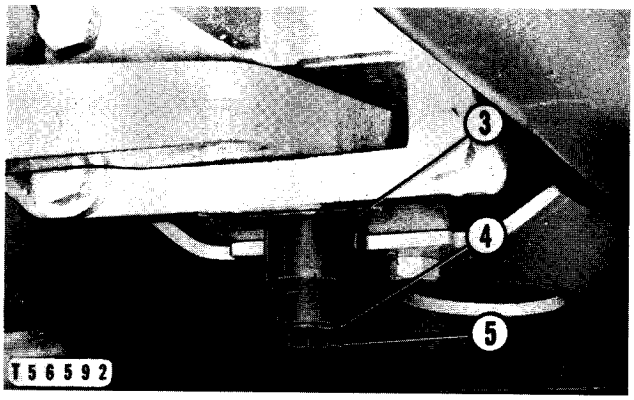
Install the pivot pin **(2)** with the grooves **(6)** in position to receive the lockscrew pilots **(7)** as the lockscrews **(1)** are installed.



DRAWBAR PIVOT PIN

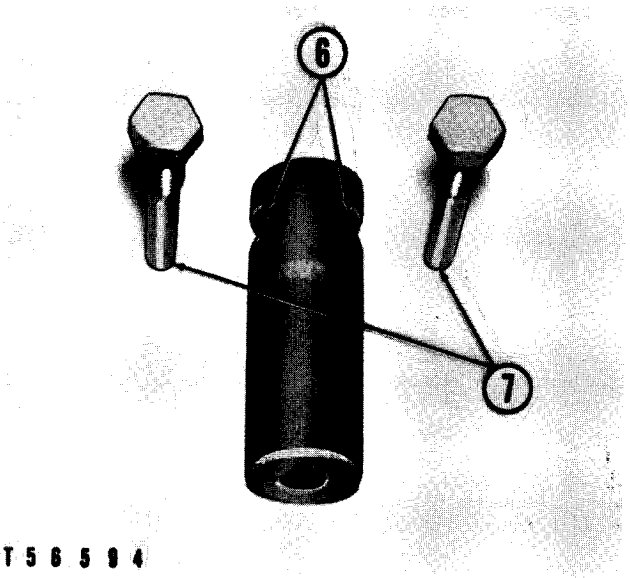
☐ Remove

2–Pivot pin.



REMOVING DRAWBAR PIVOT PIN

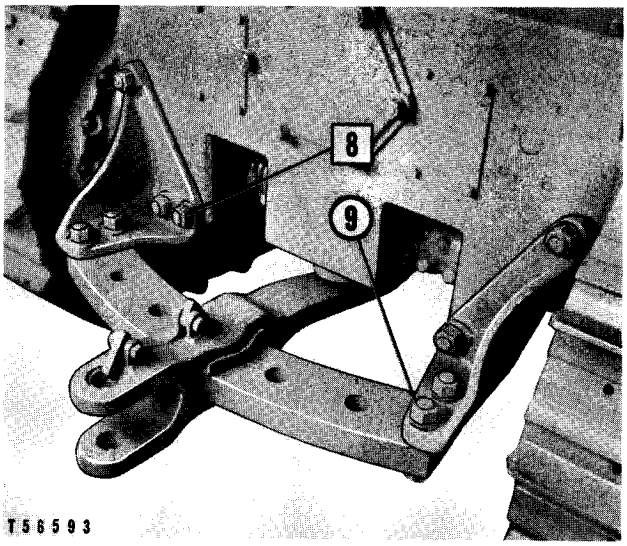
3–1¾" I.D. x 2" long sleeve. 4–Suitable flat washer. 5–⅝" - 11 (NC) x 2¼" long bolt.



PIVOT PIN AND LOCKSCREWS

6–Grooves. 7–Lockscrew pilots.

Tighten the nuts **(8)** and the bolts **(9)** to the torque values given in the GENERAL INSTRUCTIONS, which are covered in the ENGINE SECTION.

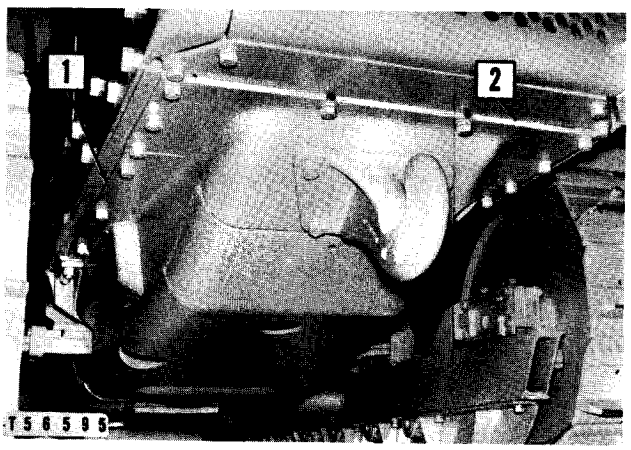


DRAWBAR BRACE REMOVAL

☐ Remove

8–Nuts (six). 9–Bolts (four).

Crankcase Guard

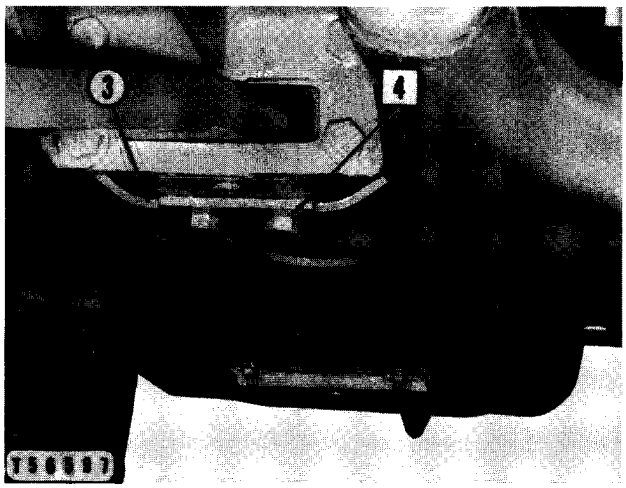


PREPARING TO REMOVE CRANKCASE GUARD

☐ Remove

1–Center guard. 2–Front guard.

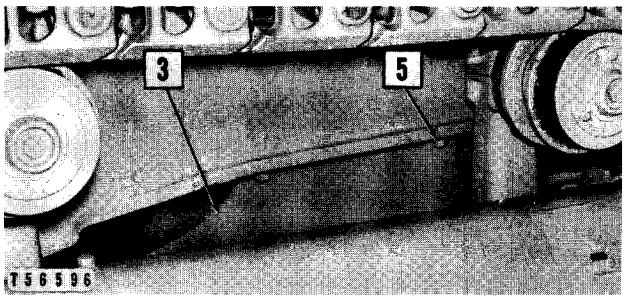
Attach a suitable support to the center guard. Remove the retaining bolts, lower the guard. Slide the guard forward to clear the lip at the rear.



PREPARING TO REMOVE CRANKCASE GUARD

☐ Remove

3–Rear guard. 4–Bolts (two).



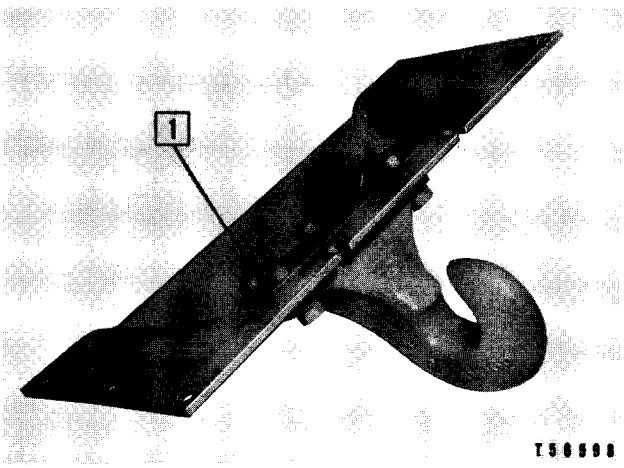
PREPARING TO REMOVE CRANKCASE GUARD

☐ Remove

3–Rear guard. 5–Bolts (four).

Front Pull Hook

Remove the front guard as covered in the topic, CRANKCASE GUARD.

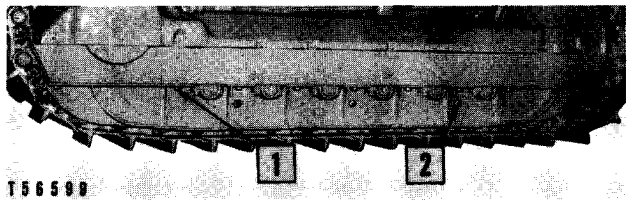


REMOVING FRONT PULL HOOK

☐ Remove

1–Bolts (four).

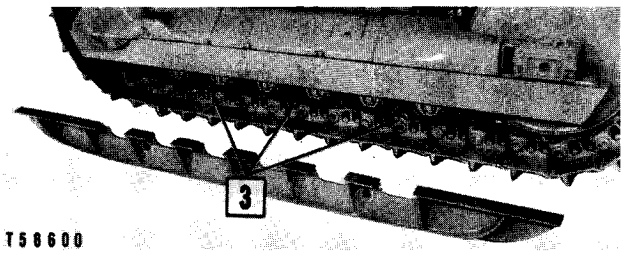
Track Roller Dirt Guard



REMOVING OUTER DIRT GUARD

☐ Remove

1–Bolts (nine). 2–Bolts (three).



OUTER DIRT GUARD REMOVED

☐ Remove

3–Spacers (three).

REMOVING INNER DIRT GUARD

☐ Remove

4–Bolts (eight).

Install in the reverse order of removal. Do not tighten any of the bolts **(1)**, **(2)** and **(4)** until both dirt guards (inner and outer) and the spacer assemblies **(3)** are in place.