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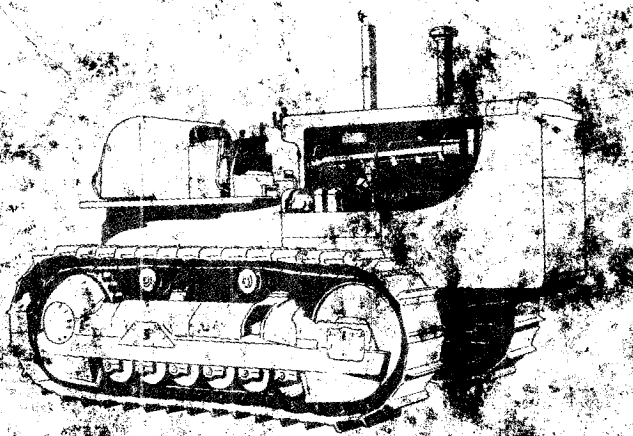
ERATION AND
MAINTENANCE
INSTRUCTIONS

CATERPILLAR
D8 TRACTOR



SERIAL NUMBERS

36A1-UP

36A1-UP

Caterpillar Tractor Co., Peoria, Illinois, U.S.A. • Caterpillar Americas Co., Peoria, Illinois, U.S.A. • Caterpillar Overseas S.A., Geneva, Switzerland • Caterpillar C.A., Maracay, Venezuela • Caterpillar of Australia Pty. Ltd., Melbourne • Caterpillar Brasil S.A., Sao Paulo • Caterpillar Tractor Co. Ltd., Glasgow, Scotland • Caterpillar of Canada Ltd., Toronto, Ontario

Warranty

The Manufacturer warrants its products for six (6) months after the date of delivery to the initial user. This warranty is limited to the repair or replacement, as the Manufacturer may elect, at one of its factories designated by it, of such parts as shall appear to the Manufacturer upon inspection to have been defective in material or workmanship but does not include any installation or transportation costs. No warranty is made with respect to items made by others when such items are warranted by their respective makers or when they are supplied by the Manufacturer on special order. This warranty is in lieu of all other warranties, express or implied, and no other warranty of any kind is made or authorized by the Manufacturer. No recommendation by the Manufacturer of items made by others shall imply or constitute any warranty with respect to such items.

T25495

Foreword

Caterpillar products are a result of advanced engineering, skilled manufacturing, and the finest materials metallurgical science can select. Thousands of satisfying, economical working hours are built into each machine.

Whether or not the owner derives the maximum service from his machine depends largely on the care exercised in its operation and maintenance. This book is written to give the operator essential information regarding the day-to-day operation, lubrication and adjustment of the machine. Careful adherence to these instructions will result in assured economy.

More and more Caterpillar owners are depending upon their dealer for service other than the care and adjustments described in this book. This practice is recommended because Caterpillar dealers have stocks of genuine Caterpillar parts and are equipped with tools designed and built by Caterpillar. Their servicemen are factory-trained and are kept closely informed by the factory regarding advanced methods of servicing Caterpillar products — thus, in all ways they are equipped to render the best of service.

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Railroad Loading Rules

For domestic customers within continental limits of the United States.

The loading rules and specifications published in Association of American Railroads Pamphlet No. MD-6, must be complied with when shipping Tractors, Road Grading, Road Making, and Farm Equipment Machinery, on open top cars. Contact the local railroad agent or inspector for these specifications.

Avoid Accidents

Most accidents, whether they occur in the air, in industry, on the farm, at home, on the highways, or at sea, are caused by someone's failure to follow simple and fundamental safety rules or precautions. For this reason most accidents can be prevented by recognizing the real cause and doing something about it before the accident occurs.

Regardless of the care used in the design and construction of any type of equipment, there are many conditions that cannot be completely safeguarded against without interfering with reasonable accessibility and efficient operation.

A careful operator is the best insurance against an accident.

The complete observance of one simple rule would prevent many thousands of serious injuries each year. That rule is: "Never attempt to clean, oil or adjust a machine while it is in motion."

T24352

Turbocharger Operation

WARNING

THE ENGINE HAS BEEN CORRECTLY SET TO OPERATE AT THE ALTITUDE LIMIT SHOWN.

[ ]	FT. OR BELOW	[ ]	FT. OR BELOW
[ ]	FT. OR BELOW	[ ]	FT. OR BELOW
[ ]	FT. OR BELOW	[ ]	FT. OR BELOW

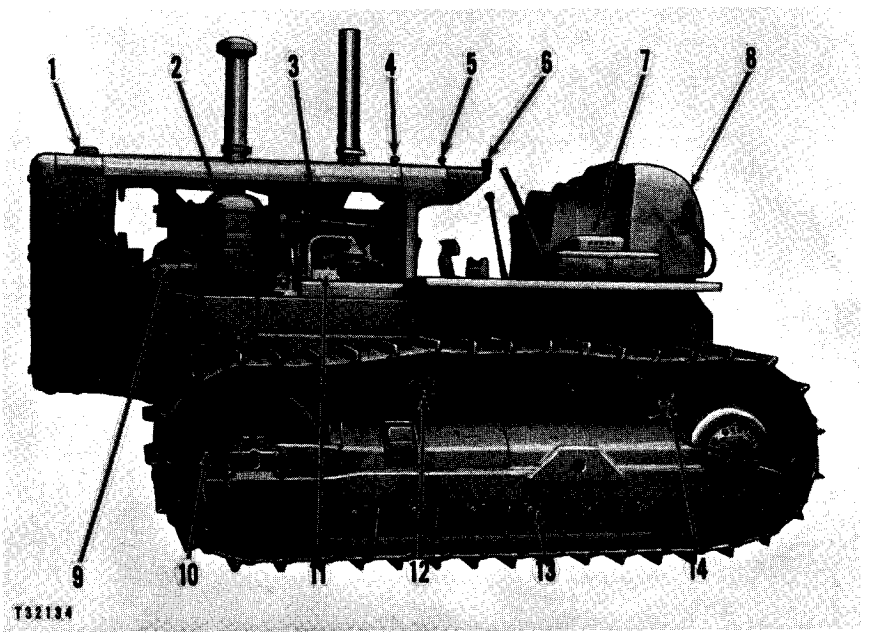
THE RACK SETTING MUST BE CHANGED BY YOUR CATERPILLAR DEALER BEFORE OPERATING AT A HIGHER ALTITUDE AS SERIOUS DAMAGE OR INJURY MAY RESULT DUE TO TURBOCHARGER OVERSPEEDING.

T27377

WARNING PLATE LOCATED ON INSTRUMENT PANEL

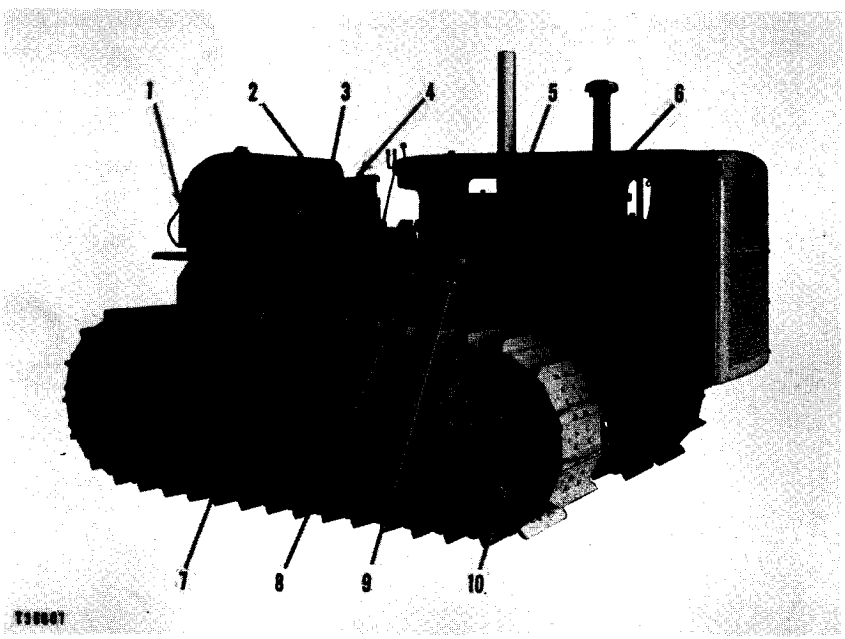
See page 34 for additional information about safe altitude operation.

Table of Contents



D8 TRACTOR — LEFT VIEW

1–Radiator filler cap. 2–Diesel engine air cleaner. 3–Turbocharger. 4–Starting engine fuel tank filler cap. 5–Governor control lever. 6–Steering clutch control lever. 7–Battery box. 8–Fuel tank. 9–Generator. 10–Front idler. 11–Starting engine. 12–Track carrier roller. 13–Track roller. 14–Sprocket.



D8 TRACTOR — RIGHT VIEW

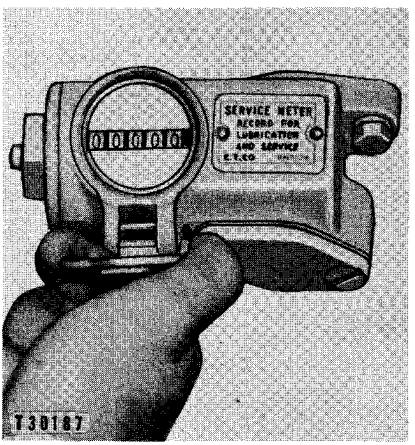
1–Handle. 2–Gear selector lever. 3–Steering clutch brake lock control. 4–Forward and reverse control lever. 5–Diesel engine crankcase filler cap. 6–Fuel filter. 7–Track roller. 8–Transmission oil pump. 9–Diesel engine crankcase lubricating oil filter. 10–Track roller frame.

Lubrication Instructions

SERVICE METER

The Service Meter is located on the right side of the engine near the bottom of the governor housing. It is geared to the engine, and when the crankshaft turns as many revolutions as are made in an hour at normal operating speed, the dial advances one number. There are many applications that will result in a lower than normal average engine speed. Under this condition, the advance in the Service Meter reading will be less than the number of clock hours of operation.

The purpose of the Service Meter is to indicate when to perform the recommended maintenance and lubrication operations. The established intervals in the lubrication chart and maintenance instructions are given in service hours, so daily readings will tell when to service the tractor. Rely on the Service Meter and not on the clock to measure service intervals.



COVER ON SERVICE METER RAISED TO OBSERVE DIAL READING

◆

GENERAL LUBRICATING INFORMATION

Careful attention to the following information on lubricants and their proper selection will add much to performance, economy and long life of your tractor. The lubrication chart specifies the lubricants to be used, the points to be serviced and the intervals of servicing according to service hours. Lubricate all miscellaneous points, not equipped with fittings, with crankcase lubricating oil every 50 service hours.

CRANKCASE LUBRICATING OIL
(Abbreviated CO)

Type of Oils

(CO) Superior Lubricants (Series 3): Only those lubricating oils known as Superior Lubricants (Series 3) for Caterpillar Diesel Engines should be used in the diesel engine crankcase, the starting engine crankcase, the

transmission, bevel gear and steering clutch compartments and the track rollers, carrier rollers and front idlers. For recommended oil change periods, see the topic, CRANKCASE LUBRICATING OIL CHANGE PERIODS.

NOTE

Detergent type oils that are recommended for use in Caterpillar Diesel Engines will, within a short period of operation, become much darker in color. This should not be any cause for concern. The darkening of the oil is due to minute particles of carbon, resulting from the combustion process, being held in suspension in the oil. This ability to hold carbon particles in suspension is one of the primary functions of a detergent type lubricant. Otherwise, these particles would settle out, eventually leading to objectionable deposits in the engine. When the oil darkens, therefore, it is an indication that it is keeping the engine clean and insuring satisfactory lubrication performance.

(CO) Straight Mineral, MIL-L-2104A Oils or Superior Lubricants (Series 3): In compartments other than the diesel and starting engine crankcases, transmission, bevel gear and steering clutch compartments, and track rollers, carrier rollers and idlers, where crankcase oil is recommended (such as starting engine transmission, starting engine air cleaner† and flywheel clutch compartment on tractors with direct drive 36A1-up) use either straight mineral crankcase lubricating oil, an oil conforming to the requirements of MIL-L-2104A specifications or Superior Lubricants (Series 3), whichever is most convenient and economical.

S.A.E. Grade of Oil

At temperature above freezing, S.A.E. No. 30 oil should be used in all compartments.

At temperatures below freezing, S.A.E. No. 10W oil should be used in all compartments to provide better lubrication at low temperatures and to make cranking easier.

S.A.E. No. 10W oil should be fluid enough for easy cranking at temperatures down to at least —10°F. In lower temperatures it may be necessary to dilute S.A.E. No. 10W oil with kerosene (except air cleaners) so it will be fluid enough to insure free circulation. Evaporation under steady operation may make it necessary to again add kerosene to maintain proper fluidity. This should be done before stopping, then operate the tractor for a few minutes to mix the kerosene and oil.

† For the starting engine air cleaner it is permissible to use clean undiluted reclaimed oil or the most inexpensive straight mineral oil. Be sure to change oil in the air cleaner regularly.

For an approximate check to determine if the oil will flow, remove the oil level gauge before starting the machine and if the oil on it will flow off, the oil is fluid enough to properly circulate and lubricate the engine, flywheel clutch and transmission, bevel gear and steering clutches.

Crankcase Lubricating Oil Change Periods

The crankcase lubricating oil change periods for these engines have been carefully established for the purpose of protecting the service life of the engine as economically as possible.

Change the oil and filter elements after the first 10 service hours of operation of a reconditioned engine.

DIESEL ENGINE CRANKCASE LUBRICATING OIL CHANGE PERIOD CHART
USE ONLY SUPERIOR LUBRICANTS (Series 3)

FUEL SULPHUR CONTENT	OIL CHANGE PERIOD*	FILTER CHANGE PERIOD
0.4% or less	250 Service Hrs.	250 Service Hrs.
0.4% to 1.0%**	125 Service Hrs.	125 Service Hrs.

***Regardless of time operated, the crankcase oil and filter elements should be changed at least every six months.**

****Reduce change period one half when sulphur content is greater than 1.0%.**

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BALL AND ROLLER BEARING LUBRICANT (Abbreviated BR)

(BR) This lubricant is a mixture of mineral oil and metallic soaps. Use No. 2 grade for most temperatures. For extremely low temperatures use No. 0 or No. 1 grade.

This grease can be applied to all bearing points — plain bushings, ball bearings and roller bearings — where equipped with hydraulic pressure fittings or when bearings are hand packed.

Use only a high grade Ball and Roller Bearing Grease of short fiber. This grease must be satisfactory in anti-friction bearings at speeds up to 3000 RPM at a maximum temperature of 300° F. It is a grease with sufficient adhesive qualities to cling to the bearings in all extremes of high and low operating temperatures.

TRANSMISSION OIL (Abbreviated TO)

(TO) MIL-L-2105 Oil: Use an oil conforming to the requirements of MIL-L-2105 specification in the final drives. Be sure your oil supplier furnishes a MIL-L-2105 oil that is filterable. If the final drive oil filter becomes plugged, damage to the final drive may result.

At temperatures above freezing use S.A.E. No. 90 oil, but when operating continuously in extremely hot temperatures, use S.A.E. No. 140 oil.

Below freezing S.A.E. No. 80 oil will be required, however, in extremely cold weather S.A.E. No. 80 oil should be diluted with sufficient kerosene to provide fluidity.

CAUTION

Under no circumstances should the track be lubricated. The stiffness noted between the links of a new track is not caused by a lack of clearance between the track pins and bushings and it will disappear as the track wears in.

LUBRICATION CHART

CATERPILLAR

D8 TRACTOR

The folded page is arranged to serve two purposes:

First, it is a complete outline of all the information required to lubricate the tractor.

Second, the illustration and identification of points of lubrication can be used with the detailed illustrations and information on the pages following the chart as a reference for lubricating and service information.

D8 TRACTOR LUBRICATION

SEE OPERATION AND MAINTENANCE INSTRUCTIONS FOR DETAILED INFORMATION

Point	Point and Identification	Lubricant	Approximate Quantity (U.S. Measure)	No. of Service Points	SERVICE HOURS 10	50	125	250	500	1000	2000	Point
1	STEERING CLUTCH CONTROL LEVER BEARINGS	BR	NOTE A	6							L	1
2	BRAKE & CLUTCH CONTROL SHAFT BEARINGS	BR	NOTE A	6							L	2
3	†FLYWHEEL CLUTCH COMPARTMENT	CO	4 GAL.	1	X					C		3
	BREATHER			1				WO				
	SCREEN			1						WO		
4	‡TORQUE CONVERTER & CLUTCH RELEASE BEARINGS	BR	5 STROKES	4	L							4
5	STARTING ENGINE PINION AND CLUTCH CONTROL LEVER	BR	NOTE A	2			L					5
6	STARTING ENGINE TRANSMISSION	CO	1¼ QT.	1	X					CW		6
	BREATHER			1				WO				
7	STARTING ENGINE CHOKE AND THROTTLE CONTROL SHAFT	BR	NOTE A	1			L					7
8	STARTING ENGINE AIR CLEANER	CO	¾ QT.	1		††CW				WO		8
9	STARTING ENGINE CRANKCASE	CO	2½ QT.	1	X			*C				9
10	FAN & ADJUSTING PULLEY BEARINGS	BR	5 STROKES	2				L				10
11	DIESEL ENGINE CRANKCASE OIL SYSTEM	CO	35 QT.	1	X			*C				11
	OIL FILTER ELEMENTS			2				*C				
	BREATHER			1				WO				
12	†FLYWHEEL CLUTCH BELLCRANK	BR	3 STROKES	1	L							12
13	UNIVERSAL JOINT & †CLUTCH BRAKE LEVER	BR	NOTE A	3						L		13
14	RECOIL SPRING HOUSING	CO	5 GAL. (EACH)	2						X		14
15	TRANSMISSION, BEVEL GEAR & STEERING CLUTCH COMPARTMENT	CO	35 GAL.‡ 34 Gal.†	1	X					C		15
	BREATHER			1				WO				
	FILTER ELEMENT			1		†††C	I	C				
	SUCTION SCREEN			1						WO		
16	FINAL DRIVE	TO	9 GAL. (EACH)	2			X		**CW	CW		16
	FILTER ELEMENT			2		†††C			**C	C		
17	TRACK ROLLER FRAME INNER BEARING	BR	NOTE A	2	**L	L						17
	TRACK ROLLERS, TRACK CARRIER ROLLERS AND FRONT IDLERS		NOTE B									

Key to Lubricants CO CRANKCASE OIL BR BALL AND ROLLER BEARING LUBRICANT TO TRANSMISSION OIL

Key to Symbols

C — CHANGE
CW — CHANGE AND WASH COMPARTMENT
X — CHECK, ADD OIL WHEN NEEDED
I — INSPECT
L — LUBRICATE
WO — WASH AND OIL
† — OIL CLUTCH (DIRECT DRIVE) MODELS
‡ — TORQUE CONVERTER MODELS
†† — MORE OFTEN IN DUSTY CONDITIONS

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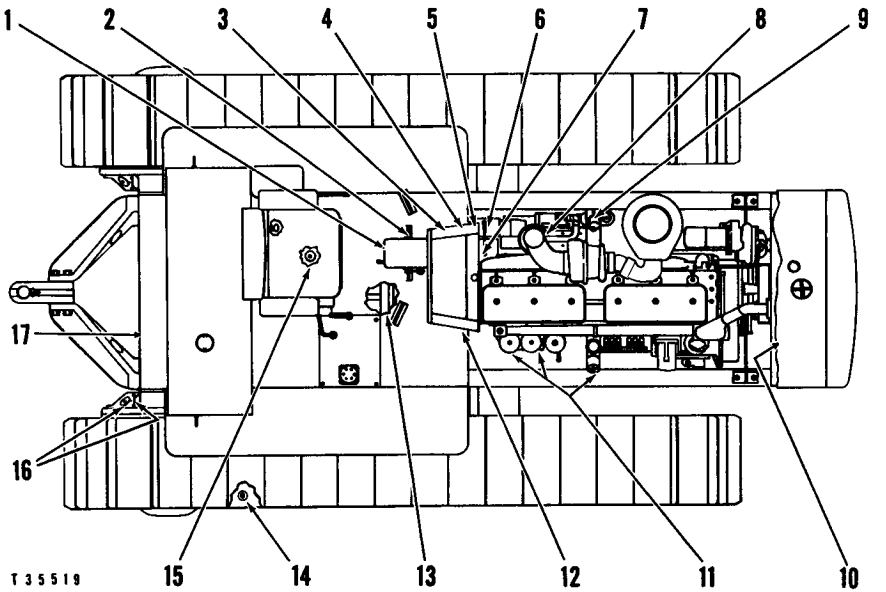

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STROKES SHOWN IN THE QUANTITY COLUMN OF CHART ARE TO BE INTERPRETED AS THE AMOUNT OF GREASE REQUIRED FROM THE LEVER TYPE GREASE GUN PROVIDED IN THE TOOL EQUIPMENT.

NOTE A: LUBRICATE SLOWLY UNTIL EXCESS LUBRICANT IS OBSERVED.

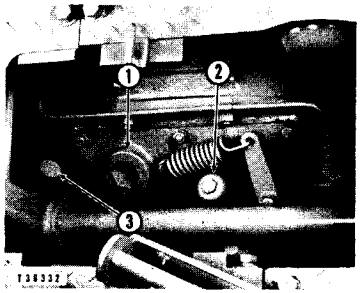
NOTE B: TRACK ROLLERS, TRACK CARRIER ROLLERS AND FRONT IDLERS ARE LUBRICATED FOR LIFE WITH CRANKCASE OIL. AFTER RECONDITIONING USE 9H7450 LUBRICATOR NOZZLE FOR REFILLING WITH SUPERIOR LUBRICANTS (SERIES 3) SAE 30 OIL.

*WHEN FUEL SULPHUR CONTENT IS 0.4% OR LESS. WHEN FUEL SULPHUR CONTENT IS 0.4% TO 1.0% CHANGE EVERY 125 SERVICE HOURS — ABOVE 1.0% REDUCE CHANGE PERIOD ONE HALF. USE SUPERIOR LUBRICANTS (SERIES 3) IN THE DIESEL ENGINE AND STARTING ENGINE CRANKCASES.

**WHEN OPERATING IN EXTREMELY DUSTY CONDITIONS OR DEEP MUD OR WATER.

†††AFTER THE FIRST 50 SERVICE HOURS OPERATION OF A NEW TRACTOR OR OF A RECONDITIONED FINAL DRIVE, TRANSMISSION OR STEERING CLUTCH, CHANGE THE FILTER ELEMENT.

CO Crankcase Lubricating Oil



3

FLYWHEEL CLUTCH COMPARTMENT

(Tractors with direct drive 36A1-up)

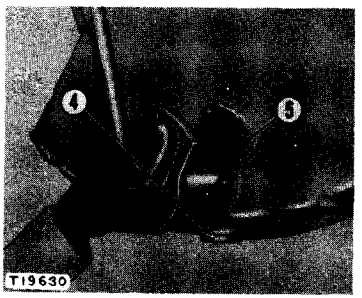
Remove clutch inspection floor plate and check oil level in the clutch compartment every 10 service hours with the engine stopped. Oil should be kept up to the full mark on gauge (3). If the oil level is above the full mark on the gauge, remove the plug on the left side of the flywheel housing and allow excess oil to drain. See the topic, "Daily Care".

Every 250 service hours remove clutch inspection floor plate, then remove, wash and oil the breather (2).

Extreme care should be taken to prevent dirt getting into the clutch compartment when removing the filler plug (1) for filling.

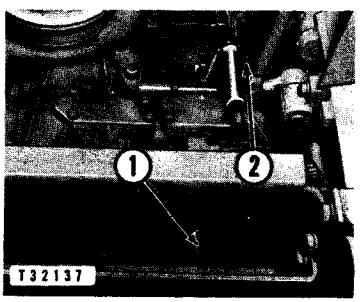
Remove clutch inspection floor plate. Remove filler plug (1) and fill compartment to full mark on gauge. Approximately 4 gallons of oil is required to fill the compartment. Install filler plug tightly.

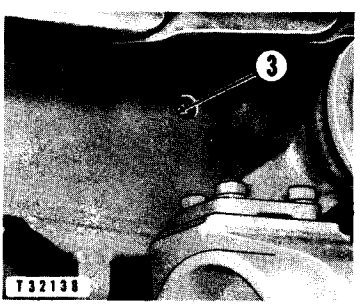
Every 1000 service hours, drain the clutch compartment by removing drain plug (4). Engaging and disengaging clutch will force oil out of hydraulic booster cylinder.



When extreme usage of the flywheel clutch and high temperatures are encountered it may be necessary to change the oil more often. This can be determined by examining the oil on the oil level gauge and if it appears to be extremely thick and black, the oil should be changed.

If sludge is noticed in the oil when draining, remove, disassemble and wash oil pump suction screen assembly (5). Clean the magnetic drain plug. When removing the suction screen assembly be careful not to damage the gasket. Reassemble and install the suction screen assembly and drain plug. See the topic, "Flywheel Clutch".





6

STARTING ENGINE TRANSMISSION

Every 10 service hours check oil level. Oil should be up to "full" mark on gauge (1). Remove, wash and oil the breather.

Every 1000 service hours drain at (3). Wash and refill at (2) to "full" mark on gauge. See the topic, "Washing Gear Compartments".

CO Crankcase Lubricating Oil

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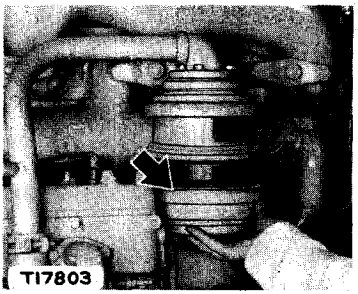
STARTING ENGINE AIR CLEANER

Inspect the oil in the air cleaner cup every 50 service hours. Wash and refill cup to oil level bead when oil will not flow freely or if the sediment in the cup is 1/4 inch deep. See the topic, "Air Cleaners".

Refill the cup with the same S.A.E. grade of oil as is used in the diesel engine crankcase and the same type of oil may also be used. However, it is permissible to use clean, undiluted reclaimed oil or the most inexpensive straight mineral oil.

See the topic, "Crankcase Lubricating Oil".

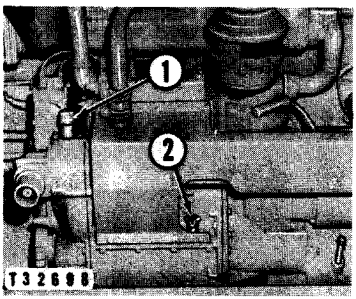


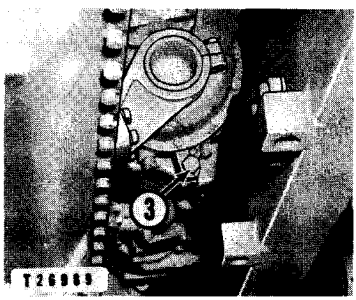
9

STARTING ENGINE CRANKCASE

Check the oil level every 10 service hours before starting the engine. Oil should be up to full mark on gauge (2).

Drain the starting engine crankcase each time the diesel engine crankcase is drained by loosening the drain plug (3). When draining be sure the engine is level so the starting engine clutch compartment will drain. Tighten the drain plug and refill the crankcase at (1) with 4 quarts of oil of the same type and grade as is used in the diesel engine crankcase. Check the oil level, which should be up to the "full" mark on the gauge. See the topic, "Crankcase Lubricating Oil".



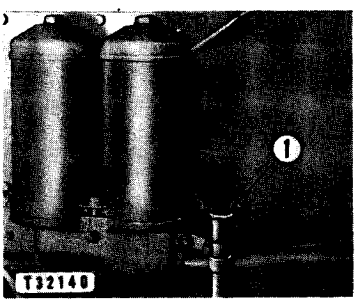


11

DIESEL ENGINE CRANKCASE LUBRICATING OIL SYSTEM

Check oil level with engine running every 10 service hours. Oil level should be between the "full" and "low" marks on gauge (1). The oil level maintained at the "full" mark is more desirable, however, any level above the "low" mark is permissible.

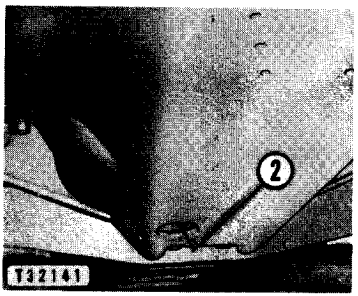
The oil level may be considerably higher than the "full" mark on the gauge if the full capacity of crankcase oil is checked after the engine has been stopped for several minutes. See the topic, "Crankcase Lubricating Oil"—Also see Notes A and B.



NOTE A: Caterpillar Diesel Engines are built in a clean modern diesel engine factory and each crankcase is filled with a good quality of new crankcase oil. For these reasons the initial crankcase oil change period for this engine should be at the usual crankcase oil change period. See the "Crankcase Lubricating Oil Change Period Chart."

NOTE B: The diesel engine has a guard to protect the gauge from spray so the oil level should be checked with the engine running. Always check the oil level with the engine in a level position.

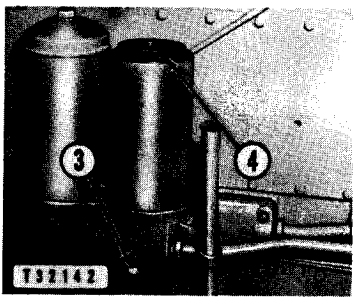
CO Crankcase Lubricating Oil



11

DIESEL ENGINE CRANKCASE LUBRICATING OIL SYSTEM

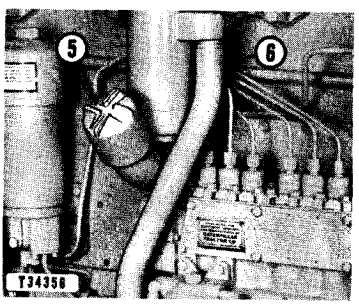
Drain crankcase at (2) while the engine is hot. For recommended oil change periods see the "Diesel Engine Crankcase Lubricating Oil Change Period Chart". Also see the topics, "Crankcase Lubricating Oil" and "Crankcase Lubricating Oil System".



11

DIESEL ENGINE CRANKCASE LUBRICATING OIL SYSTEM

Remove the plug (3) from the filter base to drain the unfiltered oil from the base and replace the filter elements (4) with new elements at each oil change period. See the topic, "Crankcase Lubricating Oil System".



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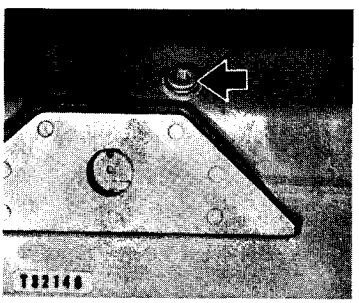
DIESEL ENGINE CRANKCASE LUBRICATING OIL SYSTEM

After draining crankcase refill at (5) and start the diesel engine. Run engine for two minutes then add oil to bring level to full mark on gauge while engine is running.

Disassemble breather (6) and wash elements each time crankcase oil is drained.



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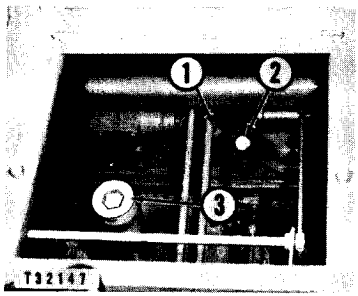
RECOIL SPRING HOUSING

Check oil level every 1000 service hours. Oil should be visible in the filler opening.

CO Crankcase Lubricating Oil

15

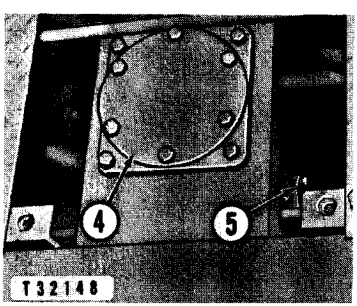
TRANSMISSION, BEVEL GEAR AND STEERING CLUTCH COMPARTMENT



Remove the seat cushion and check the transmission oil level every 10 service hours with the engine running at low idle speed, transmission in neutral, the clutch engaged and the tractor level. Oil should be up to the full mark on the gauge (2).

Wash and oil the breather (1) every 250 service hours.

After the first 50 service hours operation of a new tractor or of a reconditioned transmission or steering clutch, change the filter element. Every 125 service hours inspect the element and replace it if excessive sludging is noticed. Every 250 service hours replace the element as instructed in the following three paragraphs.

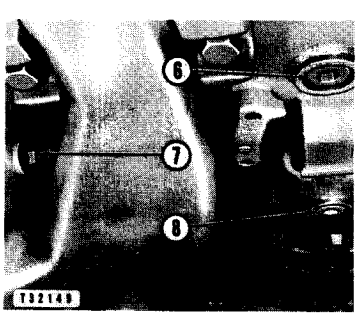


Remove the drain cover (5) and drain the transmission oil filter housing. The drain cover may be reached after removing the right middle floor plate. Remove the cover (4) to facilitate draining; install a new Caterpillar element, then install both covers. See the topic "Transmission, Bevel Gear and Steering Clutch Compartment Lubrication Oil System."

Before driving the tractor, start the diesel engine and run it for two minutes at low idle speed with the gear selector lever in neutral position, flywheel clutch engaged and tractor level. This will fill the filter housing.

Add oil at (3) to raise the oil level to the full mark on the gauge.

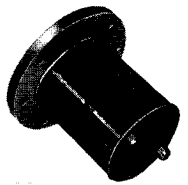
Drain the compartments every 1000 service hours under normal conditions or every 500 service hours when extreme loads and high temperatures are encountered. This can be determined by examining the oil on the oil level gauge and if it appears to be extremely thick and black the oil should be changed. Drain the compartments by removing the transmission drain plug (8), the bevel gear compartment drain plug (6) and the steering clutch compartment drain plug (7) one plug on each side of machine.



Remove any metal particles from the magnetic drain plugs and install the drain plugs.

Fill the compartment at (3) until the oil level reaches the full mark on the gauge. Then, with the engine running at low idle speed, the transmission in neutral and the flywheel clutch engaged add oil until the level reaches the full mark on the oil level gauge.

CO Crankcase Lubricating Oil

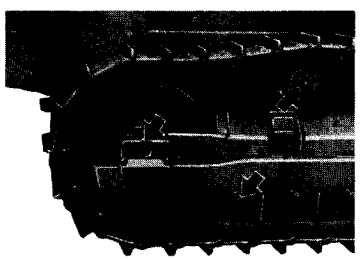


T32784

15

TRANSMISSION, BEVEL GEAR AND STEERING CLUTCH COMPARTMENT

When the transmission is drained, remove, disassemble and wash the suction screen assembly. Reassemble and install the suction screen assembly. Replace the gasket if it is damaged. See the topic, "Transmission, Bevel Gear and Steering Clutch Lubrication System."

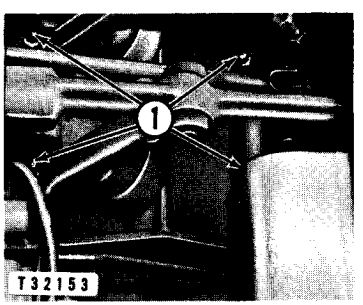


T32880

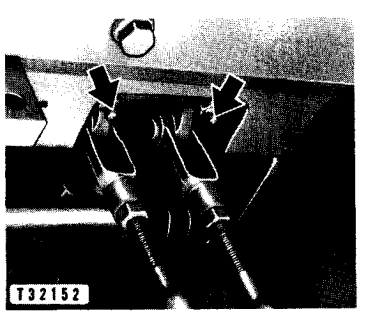
TRACK ROLLERS, TRACK CARRIER ROLLERS AND FRONT IDLERS

Track rollers, track carrier rollers and front idlers are lubricated with crankcase lubricating oil when assembled and do not require additional lubrication except when they have been disassembled for reconditioning. A lubricator nozzle complete with instructions is available from your Caterpillar dealer.

BR Ball And Roller Bearing Lubricant



T32153



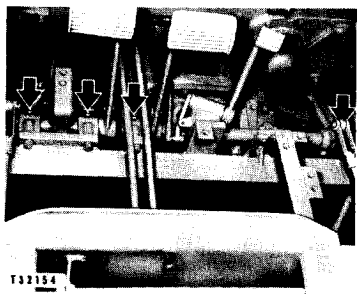
T32152

1

STEERING CLUTCH CONTROL LEVER BEARINGS

Every 2000 service hours, lubricate the four points (1) in the control tower at the top of the dash and the two points at the bottom.

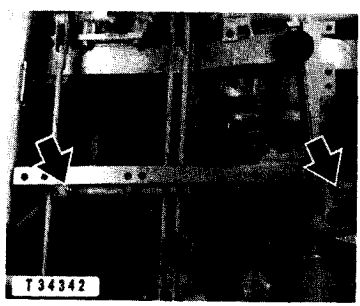
BR Ball And Roller Bearing Lubricant



2

BRAKE AND CLUTCH CONTROL SHAFT BEARINGS

Every 2000 service hours, remove the floor plates and lubricate four points on the brake control shafts and two points on the flywheel clutch control shaft.

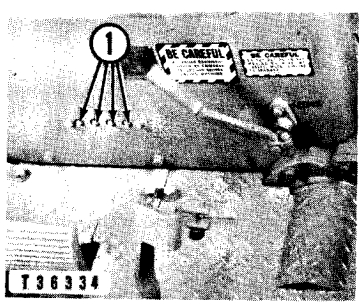


4

TORQUE CONVERTER AND CLUTCH RELEASE BEARINGS

(Tractors with Torque Converter Drive 35A1-up)

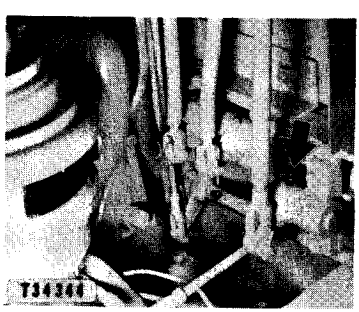
Lubricate the torque converter shaft bearings, clutch yoke and release bearings through four fittings (1) with five strokes from the grease gun every 10 service hours.



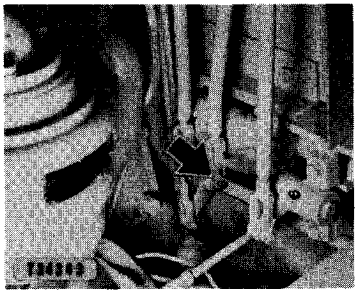
5

STARING ENGINE PINION AND CLUTCH CONTROL LEVER

Lubricate every 50 service hours through two fittings, one at the top of the linkage (not shown) and one at the bottom.



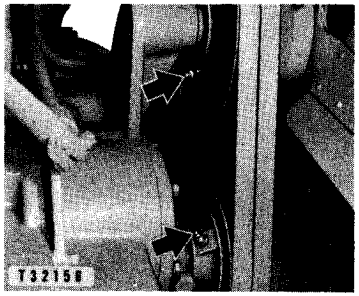
BR Ball and Roller Bearing Lubricant



7

STARTING ENGINE CHOKE AND THROTTLE CONTROL SHAFT

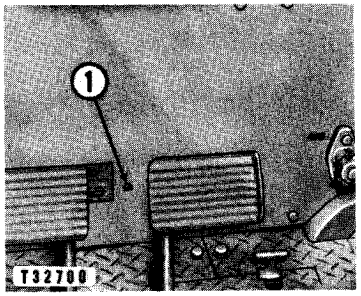
Lubricate every 50 service hours.



10

FAN AND ADJUSTING PULLEY BEARINGS

Every 250 service hours, lubricate through two fittings with 5 strokes from the grease gun.

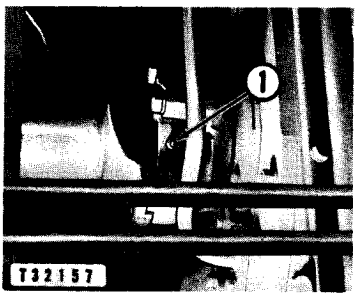


12

FLYWHEEL CLUTCH BELLCRANK

(Tractors with Direct Drive 36A1-up)
Lubricate the clutch brake bellcrank every 10 service hours through fitting (1) with three strokes from grease gun.

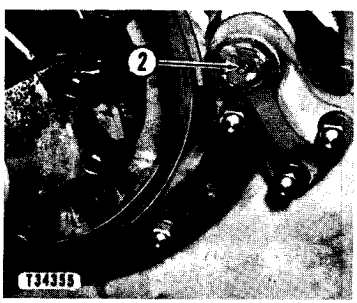
BR Ball and Roller Bearing Lubricant



13

UNIVERSAL JOINT AND CLUTCH BRAKE LEVER

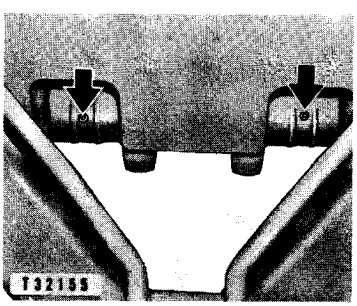
Every 1000 service hours remove the floor plate and lubricate the universal joint through two fittings (1) and on tractors with direct drive 36A1-up lubricate the flywheel clutch brake lever through fitting (2). Care must be taken when lubricating the universal joint bearing so that the internal seals are not damaged by excessive pressure.



17

TRACK ROLLER FRAME INNER BEARINGS

Lubricate two bearings every 50 service hours. When operating in deep mud or water, lubricate every 10 service hours.



TO Transmission Oil

16

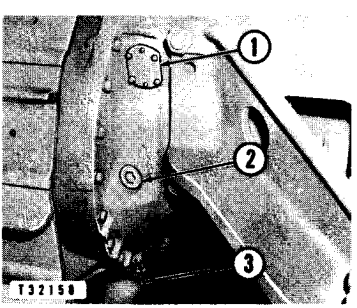
FINAL DRIVES

Check oil level at (2) by removing two filler plugs, one for each side, every 125 service hours. Keep lubricant to level of filler opening.

Remove and replace final drive oil filter element (1) with new Caterpillar elements at each oil change period or after the first 50 service hours operation of a new or reconditioned final drive.

Service the final drive oil filters completely as described in the topic "Final Drive Lubricating Oil System."

Drain compartment at (3), wash and refill it every 1000 service hours (500 service hours when operating in either extremely dusty conditions or deep mud or water). See the topic, "Washing Gear Compartments".



Operation Instructions

PREPARING THE TRACTOR FOR USE

New Tractor Initial Service: The first duty of anyone charged with the care and operation of a tractor is to give it a detailed inspection, and to lubricate all parts as directed in the LUBRICATION INSTRUCTIONS section of this book.

Fill the diesel fuel tank, taking care no dirt, water, or other foreign substances are admitted with the fuel. Give particular attention to the details of fuel handling as outlined under the topic, CARE OF THE FUEL SUPPLY. Fill the starting engine fuel tank with gasoline.

Fill the cooling system with clean soft water, or with the correct antifreeze solution if temperatures below freezing are likely to be encountered. See the topic, COOLING SYSTEM.

During the initial operation of the tractor, the track roller end collar bolts, track shoe bolts, inlet and exhaust manifold stud nuts, and turbocharger mounting bolts and nuts should be checked and tightened if necessary. Since these parts are subject to continued stress, daily checks should be made to prevent forced stops. See the topic, DAILY CARE.

New Tractor Recheck: After the first 100 to 125 service hours of operation, tighten the diesel engine cylinder head stud nuts, starting engine cylinder head bolts, inlet manifold stud nuts **(2)**, exhaust manifold stud nuts **(3)**, carburetor elbow bolts and the turbocharger mounting bolts and nuts **(1)** if necessary.

When the diesel engine cylinder head stud nuts are tightened the cylinder head gasket is compressed and the valve clearances are changed. Adjust the valve clearance as described in the topic, VALVE CLEARANCE ADJUSTMENT.

POINTS TO BE SERVICED AT RECHECK PERIOD

1–Turbocharger mounting bolts and nuts. 2–Inlet manifold stud nuts. 3–Exhaust manifold stud nuts.

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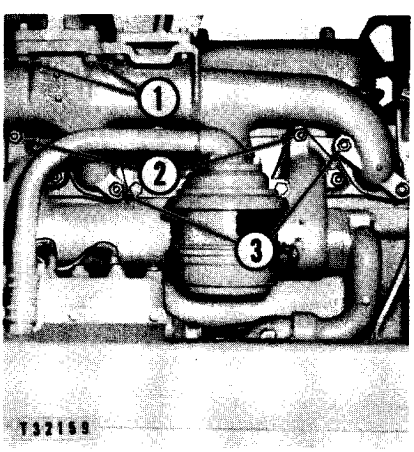


New Operator's Responsibility: The operator who is given the responsibility of care and operation of a tractor already in service, should first, check it for necessary lubrication, fuel supply and coolant in the radiator, and secondly, the tractor should have any necessary adjustments made to obtain satisfactory performance.

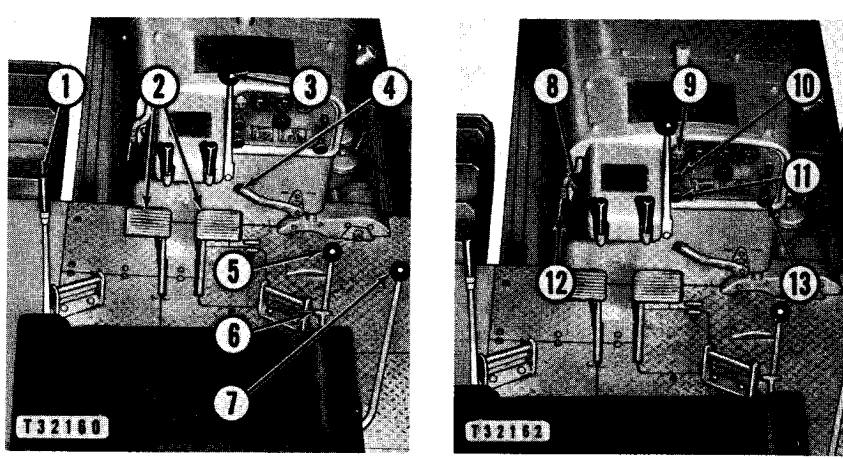
STARTING THE ENGINES

Before attempting to start the starting engine check the diesel engine and tractor controls as well as the starting engine controls to see that they are in the correct position for starting.

Before Starting: Check the diesel engine crankcase oil level to be sure it is considerably above the "low" mark on the gauge. Check the oil level in the starting engine crankcase to be sure it is to the "full" mark on the gauge. Make certain the oil is to the proper level in the flywheel clutch compartment for tractors with direct drive 36A1-up.

Position Controls for Starting

1. Push down the steering clutch brake pedals **(2)** and push down the brake lock control lever **(6)**.
2. Disengage the flywheel clutch (control lever **(1)** pushed forward).
3. Shift the gear selector lever **(7)** to the neutral position.
4. Move the forward and reverse lever **(5)** to the neutral position.



POSITION CONTROLS FOR STARTING

1–Flywheel clutch control lever. 2–Steering clutch brake pedals. 3–Governor control lever. 4–Compression release lever. 5–Forward and reverse lever. 6–Brake lock control lever. 7–Gear selector lever. 8–Electric starter switch. 9–Ignition switch. 10–Throttle control. 11–Choke control. 12–Starting engine clutch and starter pinion control lever. 13–Starting engine fuel valve control.

5. Push the governor control lever **(3)** forward as far as possible.

6. Move the compression release control lever **(4)** to the START position.

STARTING ENGINE TRANSMISSION CONTROL LEVER IN HIGH SPEED POSITION

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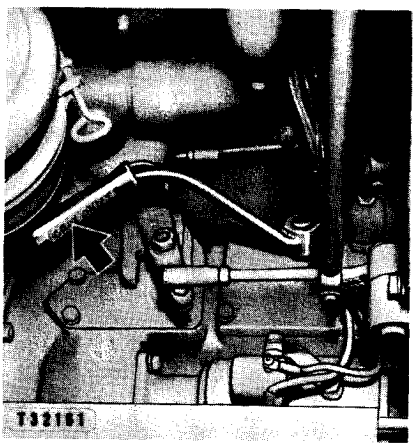


7. See that the starting engine transmission control lever is in HIGH speed position.

8. Disengage the starting engine clutch by pushing forward the clutch and starter pinion control lever **(12)**.

9. Open the starting engine fuel valve by unscrewing the starting engine fuel valve control **(13)**.

10. Pull out the starting engine choke control **(11)**.

11. Push in the starting engine throttle control **(10)**.

12. Turn the ignition switch **(9)** to the ON position.

Starting Engine

Press the starting engine electric starter switch **(8)**.

As soon as the engine starts, release the starter button.

Do not run the starter more than thirty seconds at a time. Then, allow two minutes intermission for cooling before using it again.

When the engine starts keep the speed low until the crankcase lubricating oil has a chance to warm up and better lubricate the engine.

If the electric starter pinion disengages for any reason before the engine starts, release the starter switch, wait until the starter stops rotating, and again press the starter switch.

If it is necessary for any reason to start the starting engine manually, insert the crank in position and crank until the engine starts.

Pull the crank through a compression stroke. Do not attempt in any manner to spin or push the crank through a cranking arc.

Push in the choke control as soon as the engine will run with the choke off. Temperature and altitude will vary the length of time it is necessary to have the choke on. Actual experience in starting will determine this interval.

Helpful suggestions for starting the starting engine in cold weather are in the topic, OPERATING IN COLD WEATHER.

Diesel Engine

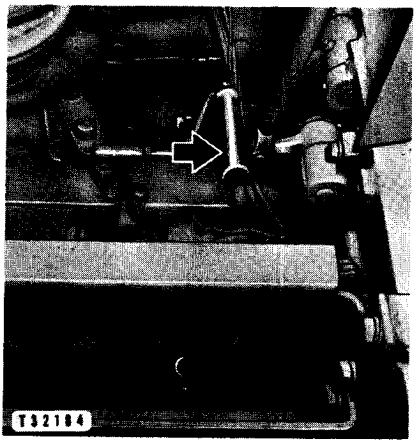
The following steps should be carefully followed to prevent damage to the starter pinion or flywheel ring gear.

1. Check to see that the starting engine is running at high idle speed.
2. Apply sufficient pressure to the starting engine clutch brake to **stop the starter pinion from rotating** by pushing the clutch and starter pinion control lever all the way forward, then hold it in the brake applied position for 5 seconds.
3. Engage the starter pinion with the flywheel ring gear and engage the clutch by quickly pulling on the clutch and starter pinion control lever until the clutch snaps over center.
4. If the engine slows to the stalling point when the clutch is engaged, as it might in cold weather, disengage the clutch and let the engine pick up speed again. See the topic, OPERATING IN COLD WEATHER.

During cold weather, or whenever the normal cranking speed cannot be reached with the transmission control lever in high ratio position, the use of the low ratio position in the starting engine transmission will be found beneficial.

To use the starting engine transmission for starting a cold engine proceed as follows:

1. Disengage the starting engine clutch.
2. Shift the starting engine transmission into LOW.
3. Engage the starting engine clutch and after the cranking effort required is reduced, move the compression release lever to the RUN position.
4. Allow the starting engine to turn the diesel engine for several minutes as the heat of compression will assure easy starting.



STARTING ENGINE TRANSMISSION CONTROL LEVER IN LOW RATIO POSITION

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5. Move the compression release lever to the START position, disengage the starting engine clutch, shift the starting engine transmission to HIGH and engage the clutch.

Move the compression release lever to the RUN position as soon as the starting engine is cranking the diesel engine at normal cranking speed. The heat generated when the starting engine is cranking the diesel engine against compression, and the circulation of the starting engine exhaust through the tube in the diesel engine inlet manifold warms the cylinders, pistons, and combustion chambers to the starting temperature. Actual experience will determine the length of time necessary to crank the diesel engine to warm it sufficiently to assure easy starting.

After the starting engine has cranked the diesel engine against compression until the diesel engine is sufficiently warm, move the governor control lever to approximately half engine speed position. If the diesel engine does not start after it has turned several revolutions, move the governor control lever to the shut-off position and let the starting engine turn the diesel engine a little longer to raise its temperature.

GOVERNOR CONTROL LEVER IN APPROXIMATE HALF ENGINE SPEED FOR STARTING

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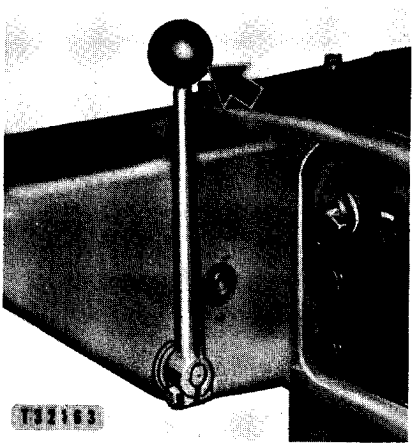


If the diesel engine is thoroughly heated but does not start, make an inspection to see that everything is correctly set for starting. If smoke has been coming from the diesel engine exhaust, fuel has been reaching the cylinders. If no smoke has been evident when the governor control lever was in approximate half engine speed position, check the fuel supply. If the diesel fuel tank is empty or the fuel tank valve is closed, it will be necessary to prime the system as outlined under the topic, PRIMING THE FUEL SYSTEM. In case there may be water or dirt in the fuel system, or if the fuel injection equipment is suspected, see the topic, FUEL INJECTION EQUIPMENT.

When the diesel engine starts the starting engine clutch and starter pinion automatically disengage.

Stop the starting engine by closing the starting engine fuel valve, allowing the engine to burn all the fuel in the carburetor. Then turn OFF the ignition switch.

After the engine has started it should be allowed to warm up for five minutes with governor control lever in approximately half speed position before applying the load. During this warm-up period the engine gauges should be observed for proper readings as explained in the topic, GAUGES.

GAUGES

After the engine has started, and at frequent intervals while the engine is operating, the engine gauges should be observed for proper readings as explained in the following paragraphs:

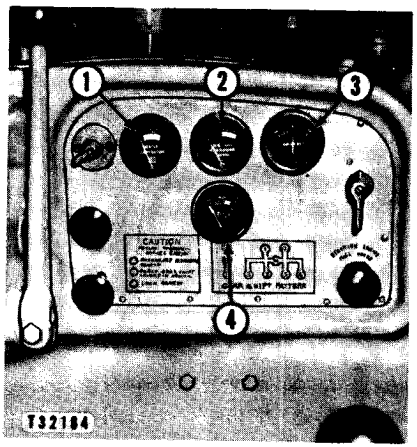
Direct Drive Tractors and Torque Converter Drive Tractors

Oil Pressure Gauge: Immediately after the engine has started, check the crankcase lubricating oil pressure gauge **(2)** to see that it is registering pressure. When the engine is running at rated engine speed the gauge should register in the "Operating Range". A lower pressure reading is normal at low idling speeds. If no pressure is indicated, investigate at once.

Water Temperature Gauge: After the engine has warmed up the indicator on the water temperature gauge **(1)** should register in the "Operating Range". The water temperature regulators within the diesel engine cooling system are designed to give an approximate minimum coolant temperature of 160°F. (71° C.). The maximum operating temperature will vary according to the air temperature and load factor, but should never exceed boiling temperature at the prevailing altitude.

Fuel Pressure Gauge: The indicator on the fuel pressure gauge **(4)** should register in the NORMAL (white) range. See the topic, CARE OF THE FUEL FILTER.

Ammeter: Check the ammeter **(3)** to see that the indicator is registering in the charging range (indicator on the + side of zero). If the indicator registers in the discharging range (indicator on the — side of zero) investigate at once. See the topic, GENERATOR.



GAUGES
(Direct drive models 36A1-up)
1–Water temperature gauge. 2–Crankcase lubricating oil pressure gauge. 3–Ammeter. 4–Fuel pressure gauge.

GAUGES
(Torque converter models 35A1-up)
1–Water temperature gauge. 2–Crankcase lubricating oil pressure gauge. 3–Ammeter. 4–Fuel pressure gauge. 5–Torque converter temperature gauge. 6–Torque converter pressure gauge.

Torque Converter Drive Tractors

Torque Converter Pressure Gauge: When the engine is running at high idle speed the indicator on the torque converter pressure gauge **(6)** should be in the NORMAL (white) range. If the indicator does not register in this range, see the topic, TORQUE CONVERTER FLUID SYSTEM.

Torque Converter Temperature Gauge: When the torque converter is operating satisfactorily, the indicator on the torque converter temperature gauge **(5)** should register in the NORMAL (white) range (160° F. to 220° F.). It is permissible to operate the tractor with the torque converter temperature gauge registering in the HOT (red) range (250° F.) for short periods of operation, however, the engine coolant temperature will also rise because the torque converter fluid cooler is cooled with engine cooling system coolant. Should it be anticipated that the torque converter temperature will exceed 250° F. or continue to operate in the HOT (red) range, the transmission should be shifted to a lower gear, if already in first gear reduce the load or if the load is very light, shift to a higher gear. In high gear without load, reduce the engine speed.

Air in the torque converter may also cause overheating. A check for air in the system can be made by stopping the diesel engine and observing the torque converter pressure gauge. If air is present in the torque

converter, the indicator will move slowly to the left. If air is not present the indicator will move rapidly to the left.

Loss of power accompanied with high torque converter temperature may be an indication that the fuel supply is exhausted.

Operational Range Indicator Attachment: This attachment is available to measure torque converter output shaft speed. It will assist the operator in determining the most efficient point of torque converter operation for any load or tractor speed.

DRIVING THE TRACTOR

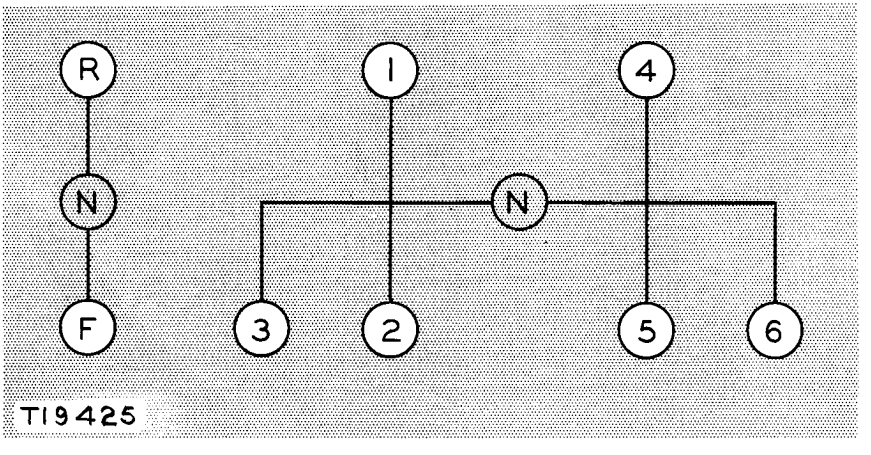
The tractor is equipped with a constant mesh transmission which is pressure lubricated by an engine driven pump.

The clutch lever controls a locking mechanism which holds the sliding collars in the transmission in position so the collars cannot be shifted into or out of mesh when the clutch is engaged. Always shift the collars completely into mesh before engaging the clutch.

The forward and reverse lever controls the direction of travel. Shifting from forward to reverse, or reverse to forward, in all gears is accomplished without moving the gear selector lever; simply disengage the flywheel clutch and move the forward and reverse lever to either forward or reverse position.

CAUTION

Before driving the tractor after transmission oil drain and fill periods, the transmission oil lubricating system should be completely filled. To do this, start the diesel engine and run it at half engine speed for 2 minutes.



(Tractors 36A1-up)
GEAR SELECTOR AND FORWARD AND REVERSE LEVER POSITION DIAGRAM

Before applying load, allow the diesel engine to warm up by idling 5 minutes with the governor control lever in half engine speed position. During the warm up period the diesel flywheel clutch should be engaged on the direct drive models 36A1-up, but disengaged on the torque converter models 35A1-up. Idling the torque converter model with the clutch engaged will overheat the fluid in the converter fluid system.

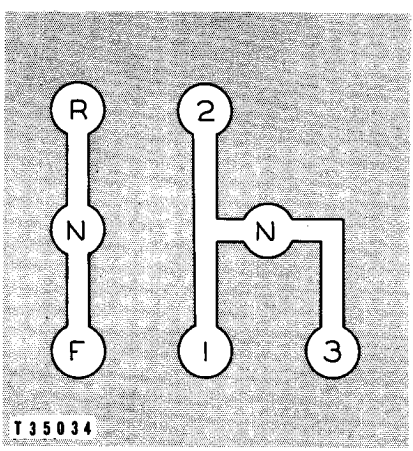
Gear selector and forward and reverse lever positions are illustrated here and on the instruction plate located on the gauge panel.

When the diesel engine has been running long enough to warm up, move the governor control lever to the idling position. Unlock the steering clutch brake lock.

Tractors With Direct Drive, 36A1-up: Disengage the flywheel clutch and press the clutch control lever forward as far as it will go. This applies the clutch brake. Continue to press forward on the lever until the clutch stops turning. Move the gear selector lever into position for the gear desired and the forward and reverse shift lever in the desired direction.

Move the governor control lever to the high speed position and carefully engage the flywheel clutch until the slack is taken up between the tractor and the load. Then, as soon as the tractor begins to move the load, pull the clutch lever all the way back so that it will snap over center and remain fully engaged. Never move a load with the flywheel clutch only partially engaged as this causes heating and rapid unnecessary wear on the clutch plates.

Tractors With Torque Converter Drive, 35A1-up: The flywheel clutch is not equipped with a clutch brake on torque converter drive tractors, therefore the flywheel clutch control lever should be moved forward no more than enough to disengage the clutch. With engine running at low idle speed, move the gear selector lever into position for the speed desired and the forward and reverse lever in the desired direction. The



GEAR SELECTOR AND FORWARD AND REVERSE LEVER POSITION DIAGRAM

(Tractors 35A1-up)

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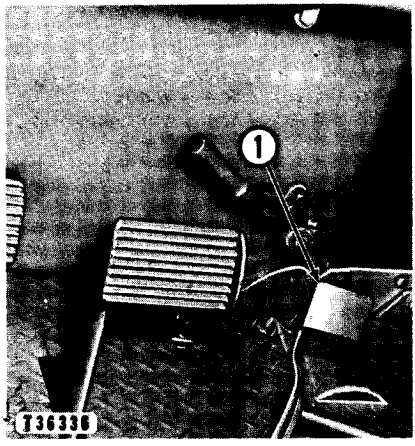
clutch should be engaged with a rapid movement of the control lever until it snaps over center. This can be done because the torque converter acts as a cushion to absorb some of the shock load from the engine when the clutch is engaged. Never move a load with the flywheel clutch only partially engaged as this causes heating and rapid unnecessary wear on the clutch plates.

During operation when the machine stalls, the output shaft of the torque converter is stationary. Operation at or near the stall point should be avoided except for short periods to prevent overheating of the torque converter fluid. Heating of the torque converter can also occur when traveling without load at high engine speeds. See the topic, GAUGES.

Decelerator: Torque converter drive tractors 35A1-up are equipped with a foot operated decelerator. This provides the operator with a foot control pedal to change the engine speed. Direct drive tractors 36A1-up may be equipped with the decelerator as an attachment.

Pressing down on the decelerator pedal **(1)** reduces the engine speed to meet varying operating and travel conditions and makes it easier to change gears with the governor control lever in any position above low idle speed. Reducing engine speed before engaging the clutch will greatly reduce flywheel clutch overheating and will appreciably extend clutch life.



DECELERATOR

1-Decelerator pedal.

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STEERING THE TRACTOR

The tractor is steered by hand levers that actuate control valves in the hydraulic control, which in turn operates the steering clutches. Pedals control the steering clutch brakes to aid in steering. The hydraulic control reduces the effort required to release the clutches during operation of the tractor. The steering clutch brakes can be applied mechanically in the event the engine is stalled, although greater effort will be required. Re-

lease the steering clutch on the side toward which the turn is to be made by pulling back on that steering clutch control lever. Apply the brake on the same side by pressing down on the pedal just hard enough to turn at the desired radius. Both controls should be handled smoothly so the turn will be made evenly and not in a series of jerks. Just before the turn is completed, release the brake. Then engage the steering clutch by releasing the control lever smoothly.

When the tractor is pulling a load it is seldom necessary to use the brakes in steering, except for sharp turns, since the load acts as a brake. The brakes may also be used to hold the tractor back when going down grade. The pedals may be locked in brake applied position to hold the tractor on slopes or when doing stationary work.

The pedals must be in the fully released position during normal operation of the tractor. **Keep the feet off the pedals except when it is necessary to apply the brakes.**

Operating Down Grade: When going down grade with the tractor pulling the load, steer in the usual manner. If the load is pushing the tractor, the operation of the steering clutches is reversed. For example, to turn to the right under these conditions, release the steering clutch on the left, but do not apply the brake. This allows the left track to travel faster while the right track is held back by the engine which acts as a brake.

Do not disengage the flywheel clutch when operating downgrade except to change gears. When the tractor speed increases, due to down hill operations, excessively high engine speeds can be encountered regardless of the transmission gear selection. To avoid overspeeding the engine, both steering clutch brakes should be applied at the same time.

OPERATING OVER AN OBSTRUCTION

The fact that the steering clutches are controlled by separate levers may be used to advantage in running over an obstruction, such as a log or a ditch bank. Both of the clutches may be released slightly until the tractor balances on top of the obstruction. Then one clutch may be engaged gradually so that the tractor moves forward at an angle, over and down. If the tractor is being operated without a load it may be necessary to use the brakes.

OPERATING IN DEEP MUD OR WATER

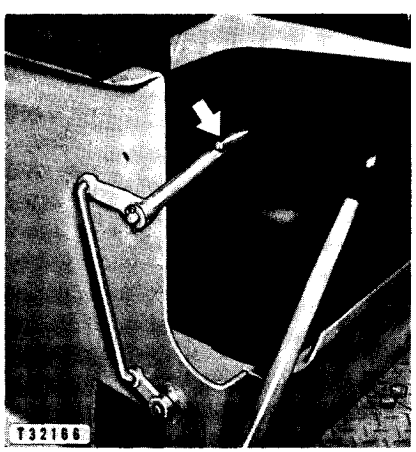
If the tractor must be operated for any length of time in deep mud or water, certain precautions are necessary. On tractors with torque converter drive, 35A1-up, remove the drilled plug from the bottom of the flywheel housing and install a solid plug, having no hole, to prevent any mud or water from entering the clutch compartment. See the topic,

DRAINING THE FLYWHEEL CLUTCH COMPARTMENT. Inspect the oil in the final drives frequently for mud or water and drain, wash and refill if the oil shows the presence of any mud or water. The presence of mud in the final drives or the excessive leakage of oil indicates the seals should be repaired or replaced. See the topic, LUBRICATION CHART.

STOPPING THE TRACTOR

To stop the tractor when it is desired to allow the engine to run, disengage the flywheel clutch, move the governor control lever to reduce the engine speed, and place the **gear selector lever and the forward and reverse shift lever in neutral position.** Engage the flywheel clutch on tractors with direct drive, 36A1-up. On tractors with torque converter drive, 35A1-up, **do not** engage the flywheel clutch if the tractor is to stand with the engine running for over two minutes.

A brake lock control is provided to lock both steering clutch brakes in the applied position to hold the tractor on slopes or when doing stationary work. Either the right or left brake pedal or both may be locked in the applied position by applying the brake and pushing down the brake lock control lever. To release the brake push down on the brake pedals **before** pulling up on the brake lock control lever.



BRAKE LOCK CONTROL

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STOPPING THE DIESEL ENGINE

After the normal load is removed from the engine allow it to idle five minutes with the governor control lever at half engine speed position and the flywheel clutch engaged on tractors with direct drive 36A1-up before stopping. On tractors with torque converter drive 35A1-up the flywheel clutch should be disengaged.

If the tractor must stand without shelter, cover the exhaust pipes to exclude rain or snow. Rain traps for this purpose may be obtained from

your Caterpillar dealer. If the temperature is below freezing, or if freezing weather is expected before the engine will be started again, drain the cooling system or protect it with an anti-freeze solution. See the topic, COOLING SYSTEM.

DAILY CARE

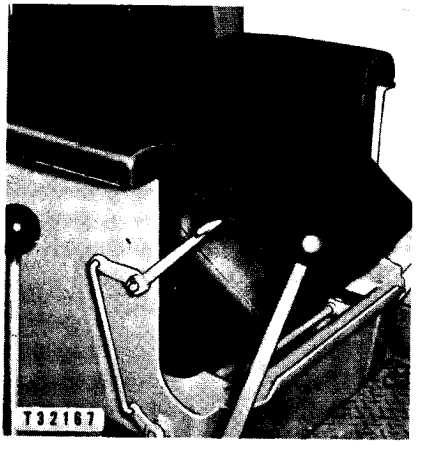
Attention should be given to the operations mentioned in this topic every 10 service hours or daily, whichever occurs first.

A daily check of the tractor should be made to see if there are any loose nuts, bolts, or parts worn to such an extent that they are no longer serviceable. Points to be checked daily for tightness or leaks are listed as follows:

1. Gasketed joints of final drive cases, track shoe bolts, track roller end collar bolts, equalizer bar mounting bolts, exhaust and inlet manifold stud nuts, air cleaner connections and turbocharger mounting bolts are some of the points that should be checked daily for tightness.
2. Diesel engine, starting engine, transmission, final drives and hydraulic oil systems should be checked for oil leaks.
3. Cooling system, clean trash from radiator and add coolant if necessary.
4. Fuel pressure gauge, inspect with engine running to see that the indicator is not in the red range.
5. Diesel engine dust collector cup, inspect for dirt in the dust collector cup when operating in extremely dusty conditions.
6. Turbocharger, check to see that no vibration or excessive noise is present. The "muffled high pitch whine" is the normal sound. If turbocharger is defective it will usually be noisy only under load.
7. Oil type flywheel clutch and torque converter.
   a. Flywheel clutch, on tractors with direct drive 36A1-up, check for excessively high oil level when continually working on uphill operations. If an excessively high oil level is found remove the oil level plug on the lower left side of the flywheel compartment to drain any excess oil from the clutch compartment.
   b. Torque converter, on tractors equipped with torque converter drive, 35A1-up, check for excessive leakage of fuel from the seal drain tube when the engine is running, the clutch is engaged and the torque converter is at normal operating temperature. See the information on seal drains in the topic, TORQUE CONVERTER FLUID SYSTEM.
8. Flywheel clutch housing drain plug, on tractors with torque converter drive, 35A1-up, check to see that cotter pin is free to turn in the hole in the drain plug. If the tractor is to be operated in deep mud or water, see the topic, OPERATING IN DEEP MUD OR WATER.

Fill the fuel tank at the end of the day's run. See the topic, CARE OF THE DIESEL FUEL TANK for other periodic care.

Dirt should not be allowed to accumulate on the tractor. A few minutes spent daily in keeping it clean are well repaid in improved appearance, and greater ease and safety in operation, lubrication and maintenance.



SEAT CUSHION TIPPED TO PROTECT PADDING

If the tractor must stand without shelter the operators seat cushion should be tipped as shown. When this is done the water proof covering prevents moisture entering the padding under the covering. If the cushion is turned bottom side up in rainy weather the padding under the water proof covering may become damp. This moisture with accumulated dirt and heat will shorten the life of the cushion.

OPERATING IN COLD WEATHER

If the starting engine and the diesel engine are both in good mechanical condition, and precautions necessary for cold weather operation are taken, ordinary cold weather will not cause difficulty in starting or loss of efficiency.

Lubricants: As the atmospheric temperatures become lower, where warm housing facilities are not available, lubricants of lower viscosity should be used. See the LUBRICATION INSTRUCTIONS section of this book.

Coolant: When the temperature is below freezing, sufficient anti-freeze solution should be used in the cooling system to prevent freezing. See the topic, COOLING SYSTEM.

The liquid in the cooling system may be warmed to make starting easier and quicker. When warming anti-freeze solutions, keep away from flames, as some of these solutions may be inflammable. Avoid getting the solution hot, and even a warm solution should be poured very slowly into a cold cooling system to prevent damage by sudden expansion.

Fuel: Fuel must be "free flowing" enough to flow readily through the fuel lines at the lowest temperature at which the tractor will be started and operated. For additional information, see the topics, FUELS and CARE OF THE DIESEL FUEL TANK.

Electrical Equipment: During cold weather, more attention should be given the condition of the battery. It should be tested frequently and charged as often as necessary to insure sufficient power for starting. All switches and connections in the electrical system should be inspected and kept in good condition to prevent losses through improper contacts. See the topic, BATTERY CARE.

Starting the Starting Engine: If the tractor has been standing without shelter in extremely cold weather, the following suggestions will materially assist starting.

It is very important to keep low viscosity crankcase lubricating oil up to the full mark on the gauges, in the diesel engine crankcase, starting engine crankcase and flywheel clutch compartment to provide proper lubrication when starting. Refer to the topic, CRANKCASE LUBRICATING OIL.

Crank the starting engine several revolutions with the ignition switch OFF, and the starting engine clutch disengaged. This will better distribute oil to the bearings and cylinder walls.

Sometimes moisture, or fuel which has not vaporized, collects on the starting engine spark plugs. They may be dried out by removing them and pouring gasoline over the electrodes. Ignite the gasoline and allow it to burn. **Use care to prevent fire.**

Pouring a small amount of gasoline on the electrodes before they are replaced in the engine is more effective in promoting combustion than priming the cylinders with gasoline. A small amount of gasoline in the cylinders will remove the film of oil from the cylinder walls and interfere with compression.

Avoid over-choking and over-priming the starting engine when attempting to start it.

Sometimes the starting engine can be started more quickly by pulling out the throttle control. **When the engine starts push in the throttle control to keep the engine speed low until the crankcase lubricating oil has a chance to warm up and better lubricate the engine.**

STORAGE

Lubricate all points mentioned in the lubrication chart if the tractor is to be stored or left standing for any length of time. This will protect against rusting.

Starting Engine and Diesel Engine: If the tractor is to be stored or left standing for a long period of time, the lubricating oil may drain away from the cylinder walls and piston rings. This lack of lubricant permits the rings and liners to rust. It also permits unnecessary wear caused by metal-to-metal contact between the pistons, rings and liners when the engine is started before fresh oil has reached these surfaces. The lack of lubricant may not cause any noticeable change in engine operation after it has been started but it does contribute to shorter engine life.

The oil film should be renewed once a week by running the starting engine and diesel engine until they are thoroughly warm. This will circulate the oil and prevent rusting from condensation.

Transmission and Final Drive Compartments: Drive the tractor every 30 days a short distance to renew the oil film on shafts, gears, and bearings and to prevent the final drive seal gaskets from sticking to the wear washer. A convenient time to do this would be when starting the engine to renew the oil film on the cylinder walls and piston rings.

Cooling System: If the temperature will be below freezing, the cooling system should be drained if it has not been serviced as instructed in the topic, COOLING SYSTEM.

Battery: Periods of two weeks or more when the engine is not operated necessitates provisions being made to keep the battery charged. This may be done by running the engine once a week or taking the battery to your Caterpillar dealer for charging.

ALTITUDE OPERATION

The maximum turbocharger speed is determined by the fuel rack setting, the high idle speed, the turbine nozzle and the altitude at which the engine is operated. The rack and high idle speed settings have been established to permit the engine to be operated at the altitude marked on the warning plate on the dash plate. The turbine nozzle is the same for all altitudes, but the engine fuel rack setting and high idle speed vary with altitude. If the fuel rack setting is greater than specified for the altitude at which the engine is being operated or the high idle speed is too high, **serious damage or injury due to turbocharger overspeeding may result.**

The maximum altitude at which the engine may be operated at the present setting is marked on the warning plate on the dash plate. The governor housing and turbocharger are sealed for your protection. **Changes to the turbocharger, fuel rack setting, or high idle speed should be made only by your Caterpillar dealer.**

The engine can be operated at a lower altitude than marked on the warning plate without danger of turbocharger overspeeding, but with

slightly less than maximum performance, however the fuel rack setting must be changed when operated at a lower altitude to get full power. **When operated at a higher altitude, the fuel rack setting must be changed by your Caterpillar dealer.** After making any changes, new altitude limit will be marked on the warning plate and the governor housing will be re-sealed for your protection. This will assure you that correct settings have been made.

IMPORTANT: Consult your Caterpillar dealer before operating at a higher altitude than marked on the warning plate.

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Maintenance Instructions

The foregoing paragraphs have been devoted to instructions which are necessary for day-to-day operation of the tractor. The following topics give detailed instructions regarding the care and adjustment of the various parts.

AIR CLEANERS

Diesel Engine Dry Type Air Cleaner

This dry type air cleaner is to be used without oil.

Operation: The dry type air cleaner consists of a dust collector cup **(12)**, a lower body **(8)** which houses the cyclone tubes **(10)**, and an upper body **(1)** which houses the filter element **(6)**.

Seal **(9)** between the upper body and the lower body prevents outside air from entering the upper body, thus by-passing the lower body separating action, and mixing with the partially cleaned air, thereby shortening the service period of the element. Another seal **(14)** between the dust collector cup and the lower body prevents the entrance of outside air which would upset the separating action within the tubes in the lower body.

A gasket **(5)** prevents the leakage of dust laden air into the upper body from the inlet tube **(2)**. The seals **(4)** and **(7)**, which are part of the filter element, prevent partially cleaned air from by-passing the filter element.

DRY TYPE AIR CLEANER

1–Upper body. 2–Inlet tube. 3–Passage. 4–Seal. 5–Gasket. 6–Filter element. 7–Seal. 8–Lower body. 9–Seal. 10–Cyclone tubes. 11–Vanes. 12–Dust collector cup. 13–Smaller tube. 14–Seal.

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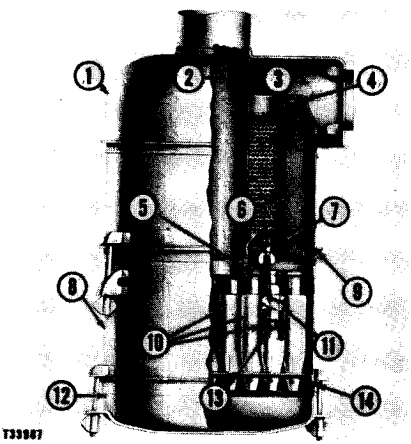


Dust laden air enters the air cleaner through an inlet air tube **(2)** in the upper body and travels downward to the lower body **(8)** where it is distributed to the cyclone tubes **(10)**.

Vanes **(11)** at the top of each tube impart a rotary motion to the air entering the tubes. The dust particles are thrown against the sides of the

tubes, slowing their action and permitting the dust to fall into the collector cup **(12)**. Additional dirt particles are extracted from the partially cleaned air as the air rapidly changes direction and is drawn up through the smaller tubes **(13)** into the upper body.

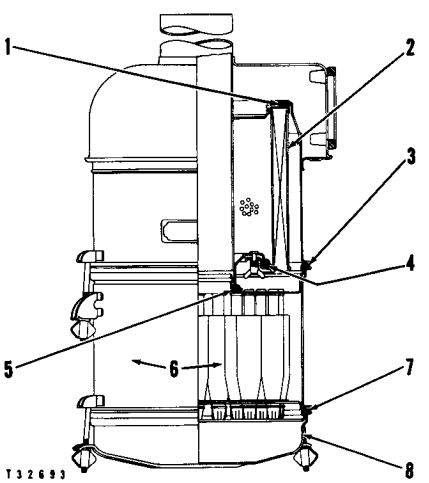
The remaining dirt in the partially cleaned air is filtered out as the air passes through the filter element **(6)**. The clean filtered air then passes into the air inlet manifold of the engine through the passage **(3)**.

Maintenance: Regular service intervals, along with close visual inspection of the dry type air cleaner is necessary for proper cleaning of the engine inlet air. The service interval will vary with the weather and working conditions. During dry, dusty months where dust conditions are severe, it will be necessary to service the air cleaner frequently. In damp weather and other conditions of little or no dust, the service interval can be extended.

To extend the service life of the element, the exhaust and air cleaner inlet pipes should be arranged so that exhaust and/or oil fumes do not enter the engine air cleaner.

Visual inspection of the seals is important in keeping dust from bypassing the air cleaner. Air leakage at any of the seals can upset proper air cleaner action. If the condition of any of the replaceable seals and gasket is questionable, replace them. If the upper and lower seals on the filter element or the element are damaged, replace the element .

These service instructions are divided into three topics, which are: dust collector cup, lower body and filter element.



AIR CLEANER

1–Element upper seal. 2–Filter element. 3–Upper body seal. 4–Element lower seal. 5–Lower body gasket. 6–Lower body. 7–Lower body seal. 8–Dust collector cup.

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Dust Collector Cup: Every 10 to 50 service hours remove the dust collector cup.

1. Loosen the wing nuts and remove the dust collector cup **(8)**.

2. Empty the dust from the dust collector cup.
3. Inspect the lower body seal **(7)**, replace if necessary, and install the dust collector cup. Use no oil in the dust collector cup.

Lower Body: Inspect the lower body every 10 to 50 service hours when the dust collector cup is removed. If an accumulation of dirt is found in the tubes, they should be cleaned by pushing a round bottle brush through the tubes from the bottom. It is not necessary to remove the lower body except when filter element inspection and cleaning is desired. When the lower body is removed it should be thoroughly cleaned.

1. Loosen the wing nuts and remove the lower body **(6)**.
2. Thoroughly clean the tubes.
3. While the lower body is removed for cleaning inspect the air cleaner inlet tube and remove any accumulation of dust.
4. Inspect the upper body seal **(3)** and lower body gasket **(5)**, replace them if they are damaged, then install the lower body.

Filter Element: Every 125 to 250 service hours, in average operating conditions, remove the filter element in the upper body for inspection and cleaning. This period may be extended in clean atmosphere and can only be determined by experience.

Excessive engine exhaust smoke and/or loss of power may indicate the need for servicing the air cleaner.

1. Remove the dust collector cup and lower body.
2. Remove the wing nuts and the filter element **(2)**.
3. Clean the filter element using one of the following methods:

   a. Using clean, dry air, at a pressure not to exceed 40 psi, proceed as follows:

      Direct air against the inside of the element to loosen any imbedded dirt. Best results can be obtained by moving the air hose so that air is directed along the complete length of each pleat. Blow off loose dirt by directing air against the outside of the element.

      Repeat this procedure until the element is clean. Make certain that no dirt is inside the element.

   b. Using clean water, at a pressure not to exceed 40 psi, proceed as follows:

      Direct water against the inside of the element to loosen any imbedded dirt. Best results can be obtained by using a water hose without a nozzle and moving it so that water is directed along the complete length of each pleat.

      Wash off loose dirt by directing water against the outside of the element.

Repeat this procedure until the element is clean. Make certain that no dirt is inside the element.

c. Some oily and/or sooty deposits can be removed by washing the element in a solution of warm water and a good household non-sudsing detergent. Rinse with clean water as in "b" above.

4. Inspect the element. If the upper seal **(1)** and lower seal **(4)** which are on the element or the element is damaged, install a new Caterpillar element.
5. Thoroughly clean all parts of the air cleaner. Inspect all replaceable seals **(2)** and **(7)** and gasket **(5)** and replace with new ones if they are damaged.
6. Assemble the air cleaner. This air cleaner requires no oil.

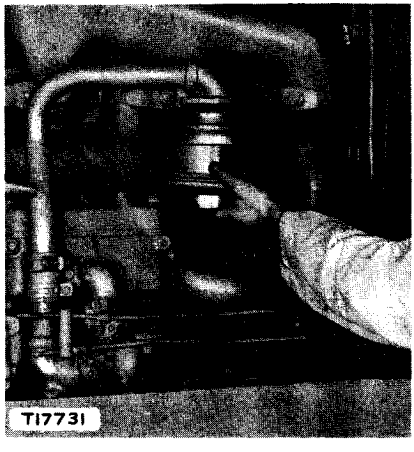
If after cleaning, the engine exhaust smoking and/or loss of power has not been corrected, replace the element.

Starting Engine Oil Bath Air Cleaner

Inspect the Oil in the Starting Engine Air Cleaner Cup: Every 50 service hours, inspect the oil in the starting engine air cleaner cup. The air cleaner cup should be washed and refilled every 50 service hours or when the sediment is 1/4 inch deep, whichever occurs first.

Wash Starting Engine Air Cleaner: Every 1000 service hours wash the starting engine air cleaner.

1. Loosen the screw clamp and remove the oil cup.
2. Remove the cleaner body by taking out the bolts at the top of the cleaner
3. Wash the filter by shaking the air cleaner body in a pan of kerosene or some non-inflammable cleaning fluid.



REMOVING STARTING ENGINE AIR CLEANER

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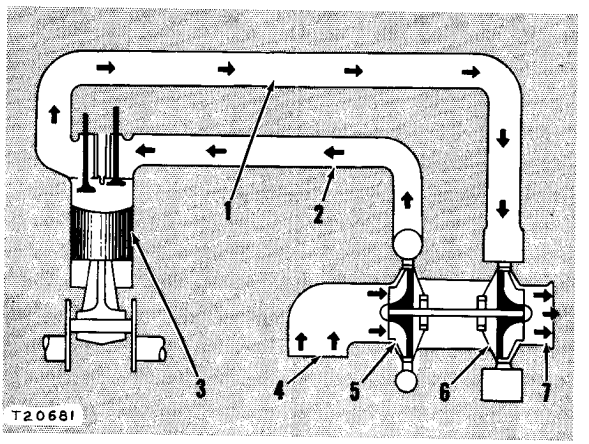
4. Wash and refill the oil cup.
5. Assemble and install the air cleaner, but be sure the mating faces of the air cleaner and the cleaner pipe are clean, the gasket between them is in place and all connections are air tight.

TURBOCHARGER

General: The engine is equipped with a turbocharger which is driven by exhaust gases. The turbocharger is located on top of the center section of the diesel engine exhaust manifold.



SCHEMATIC OF EXHAUST GAS TURBOCHARGING SYSTEM

1–Exhaust manifold. 2–Inlet manifold. 3–Engine cylinder. 4–Air inlet. 5–Compressor. 6–Turbine. 7–Exhaust gas discharge.

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On engines not equipped with turbochargers air enters the cylinder under approximately atmospheric pressure when the piston travels downward on the inlet stroke. When the turbocharger is used, the air in the inlet manifold is under greater pressure than atmospheric, and air is

TURBOCHARGER EXHAUST GAS AND AIR FLOW

1–Exhaust gas outlet. 2–Turbine nozzle. 3–Compressed air discharge. 4–Air inlet. 5–Turbine wheel. 6–Exhaust gas inlet. 7–Compressor impeller.

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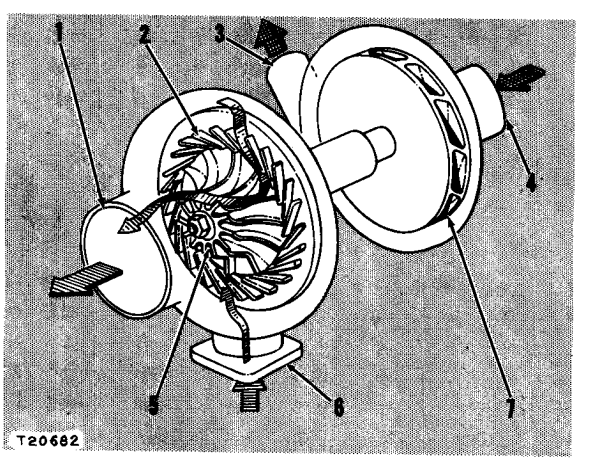


forced into the cylinders, thus permitting more fuel to be burned. This results in greater horsepower output than from an engine of the same dimension that is not equipped with a turbocharger.

The turbocharger is constructed with such close limits of balance and clearances that foreign particles may affect its operation. If any unusual sound or vibration resulting from the turbocharger operation is noticed, the engine should be stopped and the turbocharger inspected by your Caterpillar dealer. Whenever a turbocharger is removed from an engine, the exhaust and inlet manifolds and oil line openings should be covered to prevent entrance of dirt.

Lubrication: The turbocharger is lubricated with oil supplied from the diesel engine crankcase lubricating oil system. The oil passes through a tube from the crankcase lubricating oil filters to the turbocharger. After lubricating the turbocharger bearings, the oil then returns to the diesel engine crankcase by gravity.

CRANKCASE LUBRICATING OIL SYSTEM

The crankcase lubricating oil flows from the oil pump, located in the crankcase, to the oil cooler where it is cooled; then flows to the oil filter base, through the filters and then is distributed to the bearings and all points of lubrication in the diesel engine and starting engine.

When the diesel engine is running, oil is pumped through a tube from the diesel engine lubricating oil system to the starting engine lubricating oil system. Oil accumulates in the starting engine crankcase to the level of a standpipe cast in the crankcase. Excess oil is returned to the diesel engine crankcase through a passage in the rear starting engine support.

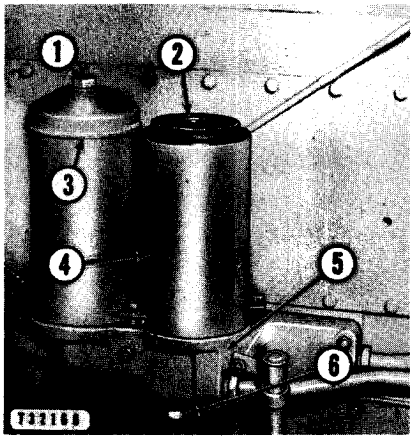
The starting engine crankcase must not be drained while the diesel engine is running. If draining the starting engine is attempted while the diesel engine is running, the oil level in the diesel engine crankcase will become too low for safe operation.

The oil is cleaned by a full-flow filtering system incorporating two filter elements. These filters, located on the right side of the engine, are installed in the main pressure line so that the entire pump capacity is put through these units.

Servicing the crankcase lubricating oil filter, as described, should be performed each time the crankcase lubricating oil is changed, or after 10 service hours of operation of a reconditioned engine.

Crankcase Lubricating Oil Filter: The filter elements should be replaced with new Caterpillar elements at each filter service period as follows:

1. Remove the drain plug **(6)** from the oil filter base **(5)**. Then loosen the clamp bolt **(1)** and remove the cover **(3)** and bolt as a unit.
2. Lift out the elements **(2)** and discard them.



CRANKCASE LUBRICATING OIL FILTER

1–Clamp bolt. 2–Filter element. 3–Cover. 4–Housing. 5–Filter base. 6–Drain plug.

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3. Install new Caterpillar elements in the housings **(4)**.
4. Reinstall the cover, tighten the clamp bolts and replace the drain plug.

Crankcase Lubricating Oil Filter Element: The filter element is of the resin impregnated cellulose material type. The resin impregnated cellulose material **(1)** is pleated around a center core and encased within a perforated cover **(2)**.

The filter housing, cover and element are designed to seal unfiltered oil from the filtered oil side of the element. Sealing is accomplished by a spring loaded flat plate in the cover which holds the element against the flat plate at the bottom of the housing.

FILTER ELEMENT

1–Resin impregnated cellulose material. 2–Perforated cover.

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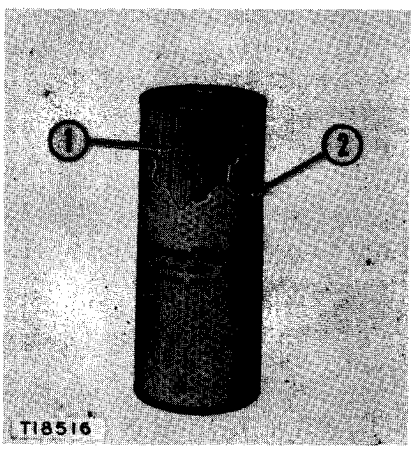


Washing the Crankcase: Whenever the diesel or starting engine oil pan is removed for any reason it should be thoroughly cleaned before it is re-installed. The oil pump screen should also be cleaned while the oil pan is off the engine.

FUELS

As a source of power the diesel engine has two outstanding advantages over the gasoline engine. The first is its lower rate of fuel consumption — and second its ability to use cheaper fuels. Always buy the **lowest priced fuel giving satisfactory operation.**

Your Caterpillar dealer is familiar with fuels that are giving good results in Caterpillar Diesel Engines in his territory. If necessary, consult him for his recommendations. He will be glad to advise you.

Because of the lack of world-wide standardization of diesel fuel classifications, it is not possible to make specific recommendations for export territories. For best results see your Caterpillar dealer for brand names of satisfactory fuels in your particular area.

In the United States and Canada, diesel fuels are available under two general classifications. One is "premium" fuel and the other is "domestic furnace oil", No. 2 grade. Caterpillar Diesel Engines are designed to operate on the less expensive domestic furnace oils, known as No. 2 grade. Fuels falling within this general class are widely available, giving satisfactory results and cost considerably less than "premium" fuels.

There is appreciable variation in the composition of fuels furnished under the domestic furnace oil classification. For desirable engine service, it is most important to give special attention to two properties of the fuel which are; pour point and sulphur content.

Pour Point

In subzero (—18°C.) weather, where warm storage is not provided, fuels with unusually low pour points may be required. It is necessary that it be fluid enough to flow from the diesel fuel tank to the engine transfer pump at the lowest temperature at which the engine must start and operate.

Sulphur Content

As the sulphur content of the fuel increases, the oil change periods should be reduced as indicated in the topic, CRANKCASE LUBRICATING OIL.

CARE OF THE FUEL SUPPLY

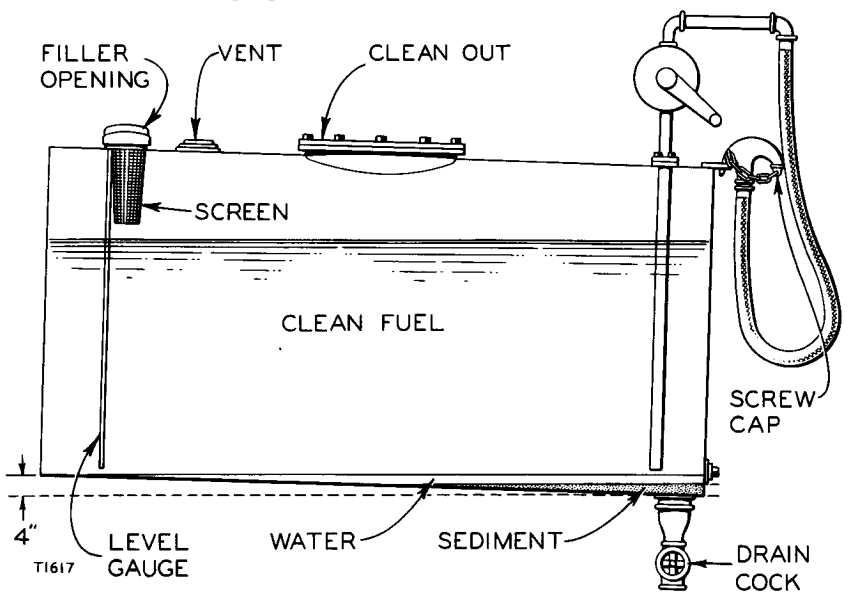
Keep The Fuel Clean: Too much emphasis cannot be placed on the importance of using only clean diesel fuel. In selecting a fuel, it should be pointed out that distillates are especially desirable because, in refining, they are heated to a vaporous state and condensed in another container; thus, all the sediment and residue remain in the still.

It is important to buy clean fuel, and keep it clean. The best fuel can be rendered unsatisfactory by inadequate storage facilities or careless

handling. The clearance between the fuel injection pump plunger and the barrel is very small, actually less than .0001 inch (0.00254 mm.), which makes it evident that the invisible particles of dirt which might pass through the filters can damage these finely finished parts.

Effort should be constantly expended to prevent contamination of the fuel. Important steps are to use clean containers and funnels and to reduce the number of times the fuel must be handled. When the fuel can be delivered by the distributor to storage tanks and then pumped from the storage tank to the diesel fuel tank, the handling is reduced to a minimum.

The illustration of a fuel storage tank is a typical, satisfactory installation. Since natural settling is an effective method of cleaning diesel fuel, the fuel should be allowed to stand at least 24 hours in the storage tank after it has been filled before fuel is transferred to the diesel fuel tank. Be sure to drain all water and sediment that has settled to the bottom of the tank before the tank is refilled. Occasionally, drain all of the fuel and clean the tank thoroughly.



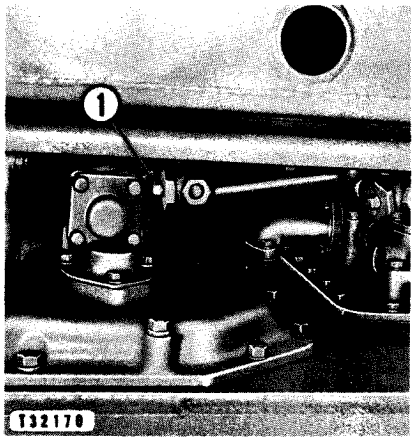
RECOMMENDED FUEL STORAGE TANK

CARE OF THE DIESEL FUEL TANK

The fuel level in the diesel fuel tank may be checked with the plunger gauge in the filler opening. The strainer in the diesel fuel tank filler opening should be removed and cleaned regularly. Remove the snap ring and lift out the strainer.

Fill the diesel fuel tank at the end of the day, because the incoming fuel will drive out the moisture-laden air and help prevent condensation.

Drain Diesel Fuel Tank Sediment Accumulation: Open the drain cock **(1)** and drain off any sediment or water which may accumulate in the



DIESEL FUEL TANK DRAIN
1–Drain cock.

◆

fuel tank every 125 service hours (drain every 50 service hours when operating in temperatures below freezing or in climates where a great amount of condensation occurs). In temperatures above freezing drain the water and sediment before starting the engine. In temperatures below freezing, drain shortly after the machine has stopped to prevent water freezing in the bottom of the tank and other low points in the system.

Diesel Fuel Tank Filler Cap: The diesel fuel tank filler cap elements should be washed every 50 to 250 service hours depending upon the amount of dust in the air. To do this, remove the bolt and take out the baffle plate and gaskets. Wash the cap and elements in kerosene or some non-inflammable cleaning fluid. After the cap is washed pour a small amount of crankcase lubricating oil on the filter elements.

FUEL SYSTEM

The fuel flows from the diesel fuel tank through the fuel line, thru the primary fuel filter to the fuel transfer pump. The fuel transfer pump supplies the fuel under pressure to the fuel filter housing, the filter removes the dirt and other foreign particles. From here the fuel is supplied to the fuel pump manifold for the individual fuel injection pumps. The fuel injection pumps meter and force the fuel through the fuel injection lines and the fuel injection valves in the cylinder head, into the pre-combustion chamber where it is ignited and passed into the main combustion chamber or cylinder.

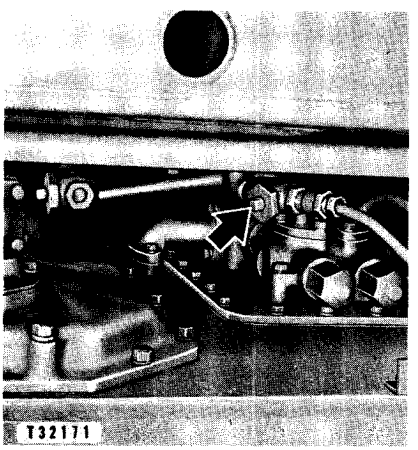
A primary fuel filter is provided in the fuel system for the purpose of straining out foreign material from the fuel before it enters the fuel transfer pump.

As the metallic filter element in the primary filter or the resin impregnated cellulose material type fuel filter elements in the fuel filter housing gradually become clogged with foreign material, the fuel gauge indicator will work back from its original position in the NORMAL (white) range, to the CAUTION (green) range and later into the OUT (red) range. When the indicator shows in the OUT (red) range, the metallic element should be removed and washed. If the indicator still shows in the OUT (red) range, the resin impregnated cellulose material type fuel filter elements should be replaced. See the topic, CARE OF THE FUEL FILTER.

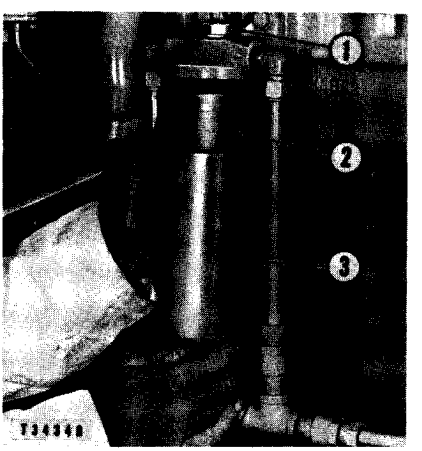
In addition to the diesel engine fuel supply system, diesel fuel is also used as fluid for the torque converter on tractors with torque converter drive, 35A1-up. See the topic, TORQUE CONVERTER FLUID SYSTEM.

Primary Fuel Filter

To remove the filter element **(2)**, stop the engine and shut off the diesel fuel tank valve. Loosen the nut **(1)**, on the filter cover and lower the case **(3)**. Remove the element and wash in clean kerosene or diesel fuel. Replace the element.



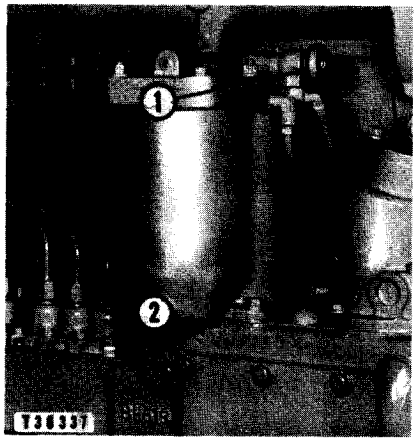
FUEL LINE VALVE



PRIMARY FUEL FILTER
1–Nut. 2–Filter element. 3–Filter case.

Care Of The Fuel Filter

Draining Fuel Filter Housing: Every 50 service hours, drain the filter housing of sediment and water which settles to the bottom of the compartment. Close the diesel fuel line valve located under the fuel tank, remove the filter housing drain plug **(2)** and open the vent **(1)** in the housing. Replace the drain plug and prime the system. See the topic, PRIMING THE FUEL SYSTEM.



DRAINING FUEL FILTER HOUSING

1–Vent. 2–Drain plug.

◆

Fuel Filter Elements: The fuel filter elements are of the resin impregnated cellulose material type. When the pleated elements have collected enough contamination to interfere with engine performance, they must be replaced with new elements. These elements will continue to collect particles until fuel will no longer flow through them at a rate to maintain maximum engine performance. They will not discharge their burden into the clean fuel; this is prevented by the fine grade filter media around the perforated metal core.

The resin impregnated cellulose material type filter elements collect and hold contaminants and cannot be washed or otherwise restored.

Removing Used Filter Elements: To remove the used filter elements, proceed as follows:

1. Close the diesel fuel line valve.
2. Remove the filter housing drain plug.
3. Open the vent in the filter housing.
4. Thoroughly clean the top of the cover and around the edges of the gasket joint between the filter housing and cover to prevent dirt dropping into the filter housing when it is removed.
5. Remove the cover from the filter housing.
6. Lift the filter elements out of the housing.

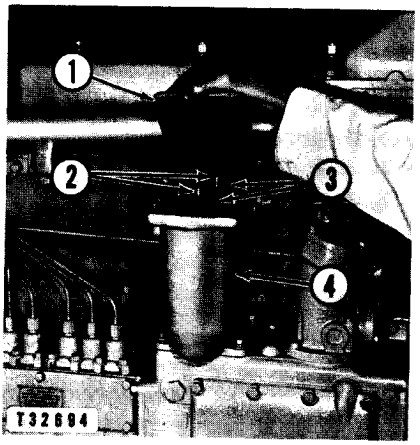
The rods and rod springs may be lifted out of the housing to permit the inside of the housing to be thoroughly cleaned if so desired.

Installing Filter Elements In Housing: To install the elements in the housing proceed as follows:

1. If the rods and rod springs have been removed from the housing, replace the springs and then the rods **(2)** in the housing. Make certain

the rod ends enter the drilled holes in the bottom of the housing and that the springs are piloted on the bosses of the housing and rods.

2. Place the filter elements **(3)** over the rods.



INSTALLING FUEL FILTER ELEMENTS
1–Cover. 2–Rods. 3–Elements. 4–Housing.

◆

3. Place a new gasket on the filter housing.
4. Install the cover **(1)** on the housing **(4)**, making certain that the rods enter the drilled holes in the cover.

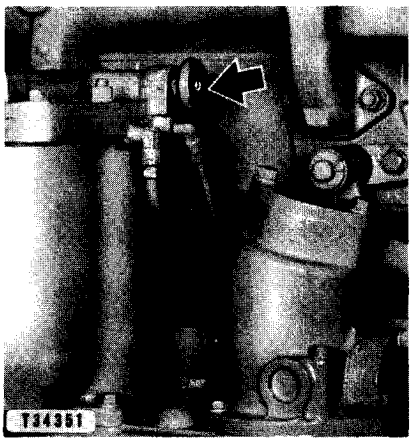
Keep New Filter Elements On Hand: An extra set of filter elements should be kept on hand for replacement. Always keep the elements wrapped in their original cartons to insure against dust and dirt accumulation which will shorten the life of the elements if it gets on the outside or may cause damage to the fuel injection equipment if it gets on the inside.

PRIMING THE FUEL SYSTEM

Any time the fuel flow is broken and air is allowed to get into the fuel system, the fuel system must be primed. If air is left in the lines, the fuel system may become air bound, resulting in inability to start the diesel engine or the mis-firing of one or more cylinders.

Priming The Fuel System: Priming the fuel system will allow the fuel transfer pump to force air and fuel through the fuel filters and the fuel injection pump vents if the engine is level. Prime the system as follows:

1. Check to see that the diesel fuel tank valve is open.
2. Move the governor control lever to the stop position, so the fuel injection pumps are closed.
3. Move the compression release lever to the START position.
4. Start the starting engine, engage the starter pinion and clutch. Allow the starting engine to crank the diesel engine at starting engine low idle speed.



FUEL FILTER VENT VALVE

FUEL INJECTION PUMP VENTS

5. Open the fuel filter vent valve and fuel injection pump vents. When the flow of fuel from the vents is continuous and contains no air bubbles, close the vent valves.
6. Open and close the vent valves several times in succession to be sure all air is bled from the system.

When tractor with torque converter drive 35A1-up have the fuel supply exhausted, air will enter the torque converter. After priming the fuel system, as instructed in the previous steps, it may require approximately three minutes of running the engine at high idle speed before normal pressure is indicated by the torque converter pressure gauge.

FUEL INJECTION EQUIPMENT

When improper fuel injection is affecting the diesel engine operation, a systematic check should be made to determine the cause. The most likely cause is dirt or water in the fuel. Drain the sediment from the diesel fuel tank and drain the fuel filter housing. Check the fuel pressure gauge as mentioned in the topic, CARE OF THE FUEL FILTER. Replace the filter element if necessary. Then prime the fuel system until clean fuel passes through the vents on the fuel injection pumps. If the fuel system is air bound, priming the system will overcome the difficulty.

When the engine is running irregularly, and smoking, a fuel injection valve may not be spraying the fuel properly.

As the clearance between the plunger and the barrel of a fuel injection pump increases, due to wear, fuel leakage occurs. When the leakage increases to the point where insufficient fuel is injected into the cylinder, a loss of power is noticeable. With the loss of power, hard starting is also encountered.

Fuel Injection Valves

Testing Fuel Injection Valves: Whenever an engine performs in such a manner that a fuel injection valve is suspected of causing trouble, test all fuel injection valves. To test the injection valves, loosen the fuel injection line nuts at the fuel injection pumps, one at a time, while the engine is running. When a nut is loosened and the exhaust smoking is

LOOSENING FUEL INJECTION LINE NUT TO TEST VALVE

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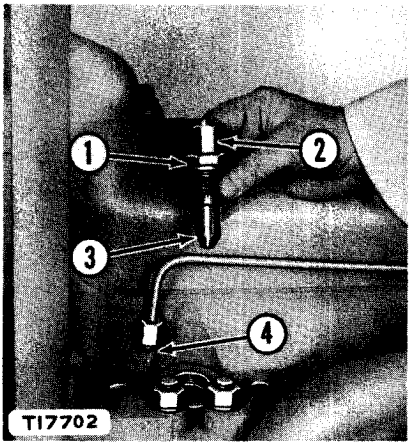
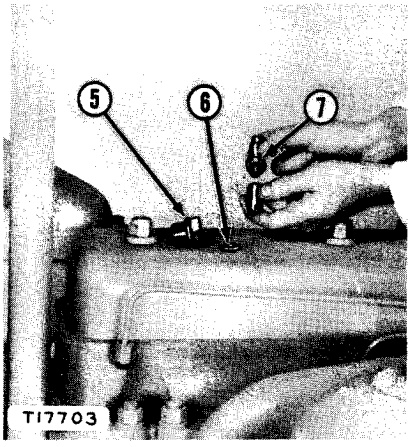
completely or partially eliminated and the irregularity in running is not affected, this identifies the defective valve and a new one should be installed in that cylinder. These valves can be checked by your Caterpillar dealer.

Removing Fuel Injection Valves: Before removing a valve clean the dirt from around the valve and connections.



REMOVING FUEL INJECTION VALVE

1–Retainer nut. 2–Cover. 3–Fuel injection valve nozzle assembly. 4–Plug.



INSTALLING FUEL INJECTION VALVE

5–Large seal. 6–Small seal. 7–Injection valve body.

Disconnect the fuel injection line from the injection valve and pump. Install the plug **(4)** and cover **(2)**. Remove the valve retainer nut **(1)** and lift out the nozzle assembly **(3)** and body as a unit.

Installing Fuel Injection Valves: Before installation of a fuel injection valve, be sure the wrench is clean. Put the dust cover on the valve body as soon as possible to prevent dirt entering the fuel passage. Install the fuel injection valve in the following manner:

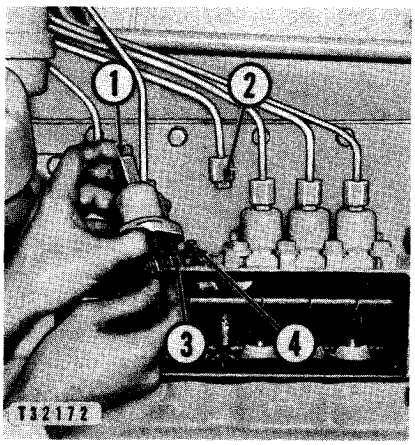
1. Screw the valve body **(7)** into the fuel injection valve nozzle assembly only finger tight. The threads of the body and nozzle assembly are made to fit loosely. The clearance between the threads provides a passage for fuel to enter the nozzle assembly from the body.
2. Insert the nozzle assembly and valve body as a unit into the precombustion chamber opening. Turning the body in a clockwise direction and at the same time pressing down will assure alignment of the serrations.
3. Install a new large seal **(5)** on the retainer nut. A light coating of lubricant on the seal will permit it to seat properly.
4. Tighten the retainer nut good and tight to prevent leaks between the nozzle assembly and the nozzle assembly seats. For proper installation of the valve use one of the following methods.
   a. Tighten with a torque wrench from 100 to 110 pounds feet.
   b. Tighten good and tight with a steady pull.
5. Place a new small seal **(6)** over the threads on the top of the valve body and on the retainer nut.
6. Connect the fuel injection line and tighten the nuts.

Fuel Injection Pumps

Testing Fuel Injection Pumps: It is not usual for one pump on an engine to require replacement unless all the pumps are worn. Worn fuel injection pumps will result in loss of power and hard starting. When loss of power and hard starting is accompanied with a clear exhaust, good compression and no blow-by gases from the crankcase breather it indicates worn injection pumps. These pumps can be checked by your Caterpillar dealer.

Removing Fuel Injection Pumps: Every precaution should be taken to prevent dirt from getting into the fuel injection pumps or housing. Clean the top of the housing and around the inspection plate before removing the plate. When fuel injection pumps are removed the pump plungers must not be taken from the barrels as any dust or dirt will scratch these finely finished parts.

After cleaning the top of the housing, and around the inspection plate, remove the fuel injection lines from the pumps and immediately cap and plug the openings with covers **(1)** and plugs **(2)** provided in the tool equipment. Remove the inspection plate.



REMOVING FUEL INJECTION PUMP

1–Cover. 2–Fuel line plug. 3–Stopper. 4–Ferrule cap seal.

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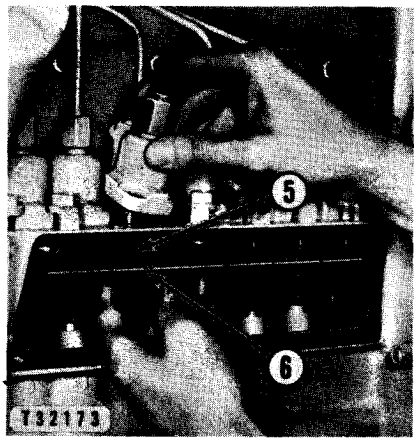
Remove the bolts and clamps that hold the fuel injection pump to the housing and lift the pump straight up only enough to clear the dowel. Insert a finger through the inspection hole to hold the plunger from dropping out and shift the pump to one side so the end of the pump plunger will free itself from the slot in the lifter, then remove the pump. Place the ferrule cap seal **(4)** and stopper **(3)**, furnished in the tool equipment, over the fuel outlet of the fuel housing and in the inlet of the pump to keep out dirt.

Should the plunger accidentally be removed from the pump barrel, take every precaution to avoid nicking or scratching it since the slightest rough spot will cause undue wear in the barrel and shorten the life of the pump. The plunger should be rinsed in clean fuel before putting it back in the barrel. Be sure the plunger is replaced in the barrel from which it was withdrawn. **Each fuel injection pump assembly (plunger and barrel) is machined as a unit and finished to such exact limits that it must be used, removed, and replaced as a unit.**

Installing Fuel Injection Pumps: Remove the ferrule cap seal and the stopper, and lower the pump and plunger into the housing. Line up the marked tooth **(5)** of the injection pump plunger gear with mark **(6)** on the rack. Slide the end of the plunger into the slot in the lifter. Lower the pump on the dowel and fasten it in place. Remove the fuel line plug and the cap and connect the fuel line to the injection pump.



INSTALLING FUEL INJECTION PUMP

5–Marked tooth on gear.
6–Mark on rack.

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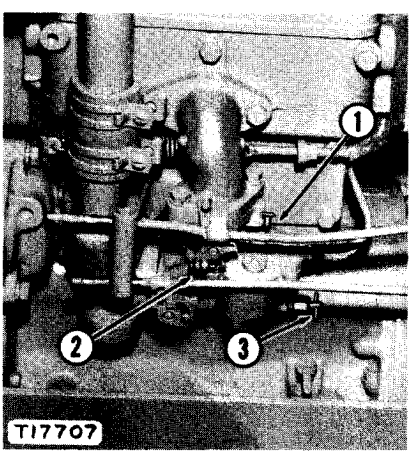
STARTING ENGINE FUEL SYSTEM

Keeping the starting engine fuel tank filled will prevent condensation in the tank. Periodically drain any water which may have accumulated in the starting engine fuel tank sediment bowl. Check the carburetor for proper adjustment every 500 service hours.

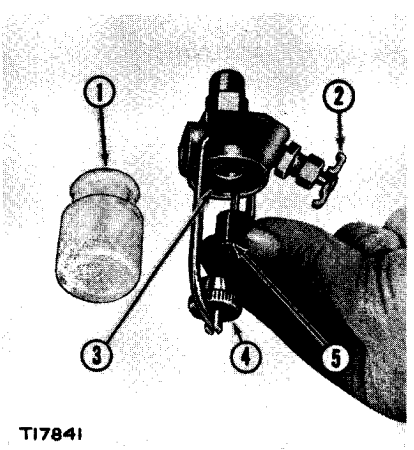
Occasionally remove the drain filter from the starting engine air inlet tube and inspect the filter element. If it is deteriorated, replace it.

Carburetor Adjustment: To obtain an approximate carburetor adjustment, turn the adjusting screws gently against their seats. Then back off the high speed screw **(3)** one turn from the closed position and the idling speed adjusting screw **(1)** one-half turn from the closed position.



CARBURETOR ADJUSTMENT

1–Idling speed adjusting screw. 2–Idling speed control screw. 3–High speed adjusting screw.



STARTING ENGINE SEDIMENT BOWL FILTER

1–Sediment bowl. 2–Valve. 3–Gasket. 4–Nut. 5–Edge-type filter element.

A more accurate adjustment can be made with the engine running at full governed speed by turning the high speed adjusting screw out to make the mixture richer or in to make it leaner. Adjust this screw to a point that will give the greatest amount of power with a clear exhaust. Turn the idling speed adjusting screw until the engine will idle regularly at slow speed without emitting black smoke from the exhaust. Turn this screw out to make the mixture richer or in to make it leaner. Turn the idling speed control screw **(2)** to the left (out) to decrease idling speed or to the right (in) to increase the speed.

Sediment Bowl Filter: The sediment bowl **(1)** collects water and sediment that may be in the fuel. To remove the collected water and sediment, close the valve **(2)** and remove the bowl by unscrewing the nut **(4)** that clamps it to the body of the valve. Unscrew the edge-type filter element **(5)** and shake it in kerosene or some non-inflammable cleaning fluid. When the bowl is replaced see that the gasket **(3)** is clean. is in the correct position and is not broken.

TORQUE CONVERTER FLUID SYSTEM
(Tractors 35A1-up)

Diesel fuel flows from the fuel tank through an open passage within the charging valve assembly to the suction side of the fuel transfer pump.

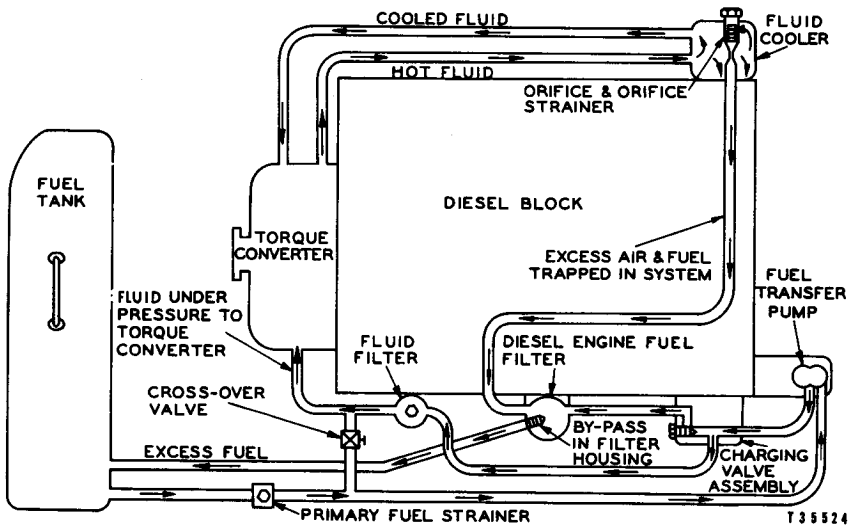
The fuel transfer pump returns fuel under pressure to another passage in the charging valve assembly, then to the torque converter. All of the fuel used in the torque converter must go through the fluid filter.

When the normal fluid pressure within the charging system has been reached, the charging valve is moved off its seat to permit the passage of fuel to the diesel engine fuel filter where it is filtered and consumed by the engine.

The fluid pressure gauge indicates the fluid pressure of the charging system and the indicator on the gauge should register in the NORMAL (white) range when the engine is running at high idle speed.

The orifice assembly located at the front of the engine on the cylinder head is provided to continuously bleed off any entrapped air or excess fuel in the charging system. The excess fuel or air expelled by the orifice assembly is delivered to the engine fuel filter where the fuel and air is forced through the by-pass valve in the filter housing and returned to the fuel tank. A portion of the excess fuel is consumed by the engine during low idle speed operation. See the topic, GAUGES, for the best operating temperatures of the torque converter fluid.

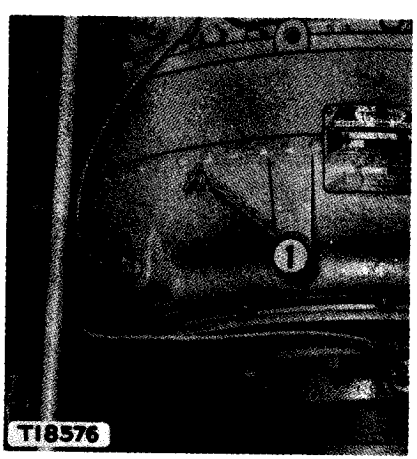
Extra precaution should be taken when operating in temperatures below freezing to minimize condensation entering the torque converter. See the topic, CARE OF THE DIESEL FUEL TANK.



TORQUE CONVERTER FLUID SYSTEM

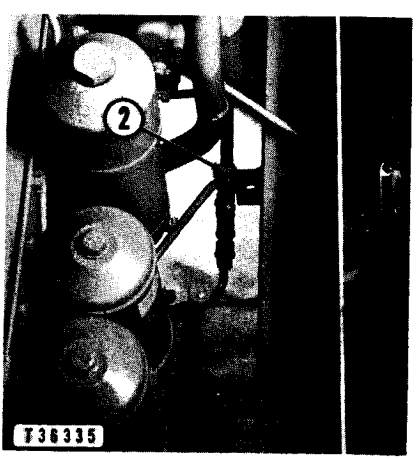
Filling: When the torque converter has been drained for any reason, the system should be filled before starting the diesel engine. To fill the system proceed as follows:

1. Remove the clutch inspection floor plate.
2. Open the vent valve **(1)** on top of the torque converter housing.
3. Loosen the diesel fuel tank filler cap to allow air to enter the tank rapidly.



FILLING TORQUE CONVERTER FLUID SYSTEM

1–Torque converter vent valve.



CROSSOVER VALVE

2–Valve control.

4. Turn the crossover valve control **(2)** until the line on the valve control is parallel with the valve body.
5. When fuel, with no air bubbles, flows from the vent on top of the torque converter, close the vent valve and crossover valve.

If the fuel system requires priming, see the topic, PRIMING THE FUEL SYSTEM.

When the system is properly filled and vented, the indicator on the torque converter pressure gauge moves instantly to the NORMAL (white) range upon starting the diesel engine, and to the left when the engine is stopped. Any sluggishness noted in the indicator movement indicates air in the system. However, normal pressure should be indicated on the pressure gauge after approximately three minutes of engine operation at high idle speed with the flywheel clutch disengaged .

Orifice and Orifice Strainer: At the front of the engine and mounted on the cylinder head is the torque converter fluid strainer adapter which contains a small internal orifice and orifice strainer filter. The orifice continuously bleeds a small amount of fuel and any air from the highest point in the converter fluid system to the diesel engine fuel filter housing. The fuel flow through the orifice supplies the diesel engine with fuel when operating at low idle speed.

ORIFICE STRAINER

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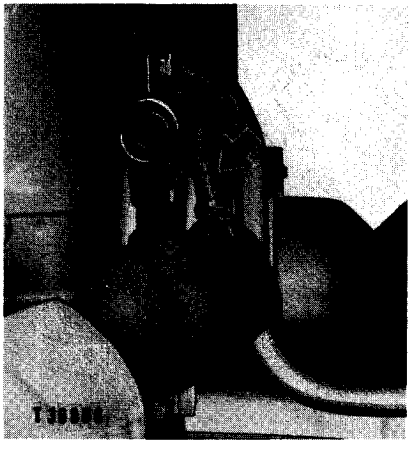


The orifice and orifice strainer should be cleaned after the first 50 service hours of operation and thereafter every 250 service hours as follows:

1. Remove the screw and strainer filter from the adapter which is located at the front of the diesel engine and mounted on the cylinder head.
2. Unscrew the strainer filter from the screw and wash them in kerosene or clean diesel fuel.

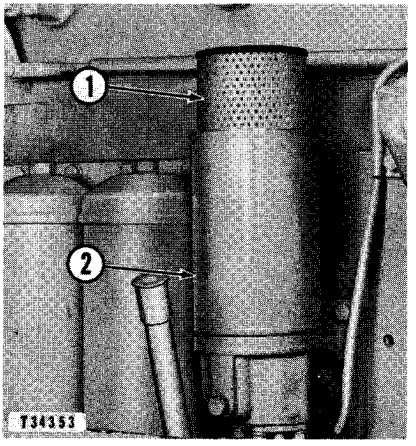
3. Clean the orifice by inserting the end of a wire not exceeding .052 inch in diameter into the orifice. This should be done each time the strainer is removed for cleaning.
4. Install the orifice strainer filter, screw and gasket.

Fluid Filter: The fluid filter housing contains one filter element. The filter element should be replaced with a new Caterpillar element whenever the torque converter pressure gauge indicator registers in the LOW range with the engine running at high idle speed.

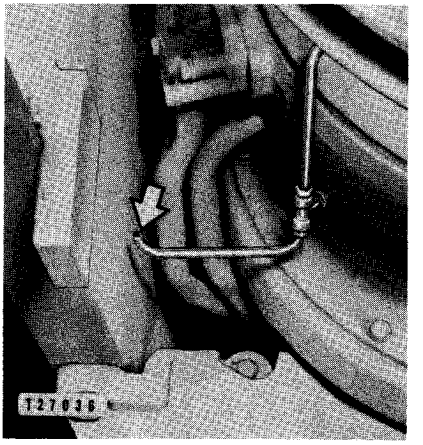
To service the filter proceed as follows:

1. Loosen the clamp screw and remove the cover and screw as a unit.
2. Lift out the filter element **(1)** and discard it.
3. Install a new Caterpillar element in the housing **(2)**.
4. Reinstall the cover and tighten the clamp screw. Vent the system, if necessary, as described in the topic, FILLING.

If the filter has been serviced as instructed in the preceding paragraph, and the indicator on the torque converter pressure gauge still does not register in the NORMAL (white) range, see your Caterpillar dealer.



FLUID FILTER
1–Fluid filter element.
2–Fluid filter housing.



SEAL DRAIN TUBE

Seal Drains: The seal drain tubes should be inspected for leakage every 10 service hours with the engine running and the clutch engaged. Seal leakage may exceed 10 drops a minute when first starting the engine and the torque converter is cold. Leakage should not exceed 10 drops a minute after normal operating temperature of the converter has been reached. If seal leakage is in excess of 10 drops per minute during normal operation, the seals should be replaced. **Do not plug the seal drain tube.**

If excessive leakage of one seal is suspected, it can be determined by disconnecting the tubes at the junction or at the torque converter.

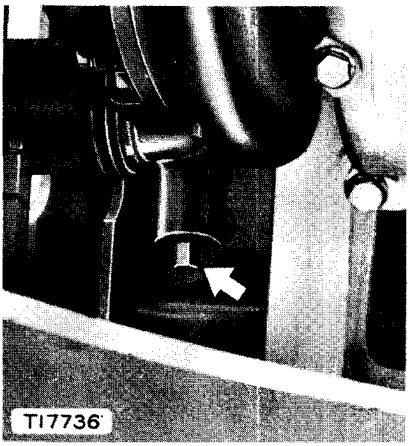
COOLING SYSTEM

Coolants: Water used in the cooling system should be soft, or as free as possible from scale forming minerals. If it is impossible to obtain soft water it is advisable to treat the available water with Caterpillar Rust Inhibitor. The use of this rust inhibitor in the cooling system will prevent the formation of rust. It will also retard, and in some cases completely eliminate mineral deposits within the engine. Most commercial anti-freeze solutions contain rust inhibitors, therefore, it is not necessary to use rust inhibitor with those anti-freeze solutions which do contain rust inhibitor. Your Caterpillar dealer stocks Caterpillar Rust Inhibitor in convenient one quart cans. Directions for its use are printed on each can.

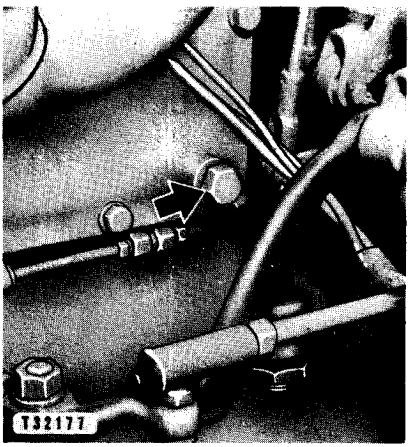
When the temperature is below freezing sufficient anti-freeze should be used in the cooling system to prevent freezing. Various anti-freeze mixtures such as ethylene glycol (Prestone, G. M., Permaguard, Zerex, etc.) denatured ethyl alcohol, methanol (synthetic wood or methyl alcohol) and glycerine are all suitable for use. Alcohol can be used successfully but, because it readily evaporates at the normal operating temperature of the diesel engine, the solution should be tested frequently — even daily — and kept up to correct strength. This loss by evaporation is objectionable **but the temperature regulators should not be removed.** Doing so might make the solution run cooler and save the alcohol, but is not desirable for good performance. It is essential, therefore, that the coolant be tested frequently to assure adequate protection.

Filling: Fill the starting and diesel engine cooling system by pouring the coolant into the radiator.

Draining: The cooling system is drained by opening the valve on the radiator water outlet on the left side and by removing the diesel cylinder block drain plug at the rear of the diesel engine cylinder block. In addition, on tractors with torque converter drive 35A1-up remove the drain

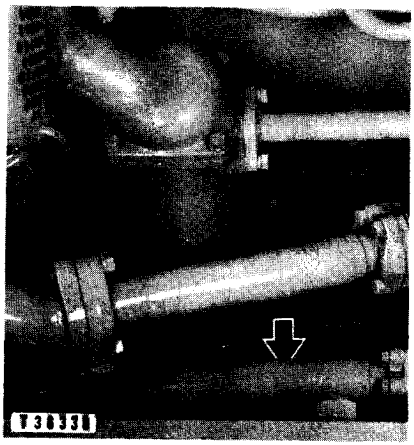


RADIATOR DRAIN VALVE



CYLINDER BLOCK DRAIN PLUG

plug from the transmission oil cooler and torque converter fluid cooler bonnet and on tractors with direct drive 36A1-up remove the drain plug from the transmission oil cooler. This should be done at the end of a day's run when all the foreign material is in suspension and will drain with the liquid.



DRAIN PLUG IN BONNET
(Torque converter tractors 35A1-up)

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Cleaning The Radiator: Every 10 service hours clean dirt and trash from in between the tubes of the radiator which may cause excessively high operating temperature. This dirt may be easily removed by removing the bolts which hold the perforated guards in place. Then wash, brush or blow the dirt out with whichever method is available and most effective.

Cleaning The Cooling System: An occasional washing of the cooling system may be necessary to remove the dirt and sediment which accumlates. The frequency of washing will depend on the amount of foreign material present in the water used in the system.

To wash the system, run the engine until the liquid in the cooling system is at operating temperature, and the loose foreign material is stirred up. Then stop the engine and drain as quickly as possible before the sediment has time to settle. Close the drain and pour in kerosene equal to about one-tenth the capacity of the cooling system and fill the remainder with a solution of one-half pound (226.8 grams) of washing soda to each gallon (3.8 liters or .8 Imp. Gal.) of water. Run the engine for about one-half hour, and again drain and flush the system with clean water. Commercially available cooling system cleaners may be used.

RADIATOR OVERFLOW UNITS

Tractors with direct drive, 36A1-up, have radiators equipped with an overflow valve which should be cleaned every 1000 service hours.

To clean the unit, disassemble by removing the screws which hold the cover in position. Lift off the cover, then remove the seal assembly and brush the parts thoroughly until all of the foreign matter has been removed. **Caution: Do not wash the unit in any kind of cleaning solution because so doing may damage the seal.**

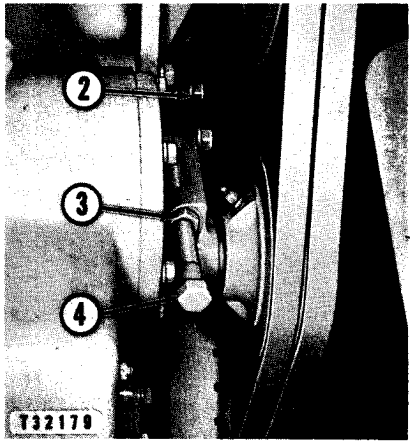
Tractors with torque converter drive, 35A1-up, have radiators equipped with a pressure relief valve. If upon inspection this unit is found not to be seating properly it should be replaced with a new unit.

FAN BELT ADJUSTMENT

The fan belts should be checked every 250 service hours for proper adjustment. If the fan belts are operated too loose, they will slap against the pulleys, causing unnecessary wear to the belts and possibly slipping to the extent that the engine will overheat. If the belts are too tight, unnecessary stresses are placed upon the fan bearings and belts, which might shorten the life of both. Correct adjustment exists when the belts can be pushed inward approximately 11/16 inches (1.75 cm.) as shown at **(1)**.

When a belt (or belts) need replacing, a matched set which is available from your Caterpillar dealer should be used. Always install a matched set — never only one.

CHECKING FAN BELT TENSION
1–Correct adjustment allows approximately 11/16 inch (1.75 cm.) slack at this point.



FAN BELT ADJUSTMENT
2–Retaining nuts. 3–Locknuts. 4–Adjusting screw.

Adjusting Belts: Loosen the three retaining nuts **(2)** which hold the idler hub bracket to the timing gear cover. Loosen the locknut **(3)** on the adjusting screw **(4)** and turn the screw until the belts can be pushed inward approximately 11/16 inches (1.75 cm.). Recheck the adjustment after tightening the locknut and bracket retaining nuts.

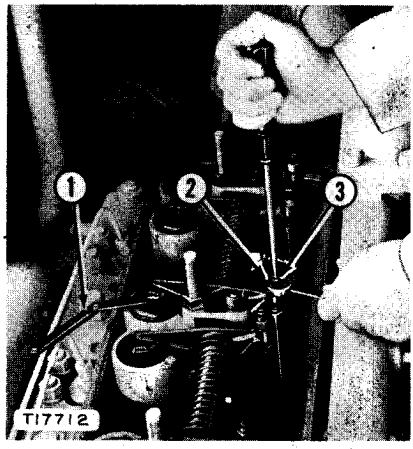
VALVE CLEARANCE ADJUSTMENT

The initial valve clearance adjustment should be made after the first 100 to 125 service hours of operation. Thereafter, the clearance should be checked and adjusted if necessary after every 500 service hour operating interval.

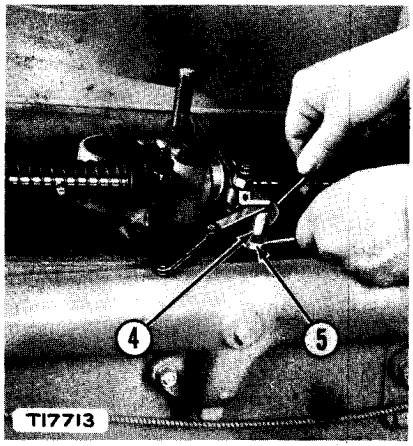
The valve clearance adjustment should be made while the engine is hot, either while the engine is running or before it has been stopped twenty minutes after having run long enough to thoroughly warm up. If the adjustment is made with the engine stopped and is not completed during this twenty minute interval, start the engine and allow it to warm up. The valve clearance adjustment and the compression release clearance adjustment must be made, or the clearances checked, with the compression release lever in the RUN position.

If adjustment is made with the engine stopped, turn the engine until the valve closes and the push rod is at its lowest point.

To Adjust: Loosen the valve adjusting screw locknut **(2)**, turn the adjusting screw **(3)** to allow the thickness gauge **(1)** to pass between the top of the valve sleeve and the end of the valve rocker at the correct clearance. Set the clearance for the inlet and exhaust valves at .016 inch (.41 mm.). Tighten the adjusting screw locknut and check the adjustment.



VALVE CLEARANCE ADJUSTMENT
1–Thickness gauge. 2–Locknut. 3–Adjusting screw.



COMPRESSION RELEASE PUSH ROD ADJUSTMENT
4–Adjusting nut. 5–Locknut.

After adjusting the clearance on the valves, and while the compression release lever is still in the RUN position, with the engine stopped, check the clearance between the upper end of the compression release push rod and the end of the valve rocker. This clearance should be .025 to .030 inch (0.64 to 0.76 mm.). To adjust, loosen the adjusting screw locknut **(5)** on the compression release push rod and turn the adjusting nut **(4)** until the

correct clearance is obtained. If the compression release push rod turns when adjusting, hold the push rod with a wrench on the two flat surfaces below the locknut. Recheck the adjustment after the locknut is tightened. Check this clearance every time the valve clearance is changed or checked.

Check Valve Rotators: Check the valve rotators with the engine running, after the valve clearance adjustment check has been made, to see if the valves rotate. The rotating of valves decreases carbon build up and uneven wear, thereby increasing the life of the valves. To check the rotation of the valves, observe the lines on the spring retainer through one of the three holes in the valve sleeve. If the valves do not turn the valve rotators should be replaced. See your Caterpillar dealer.

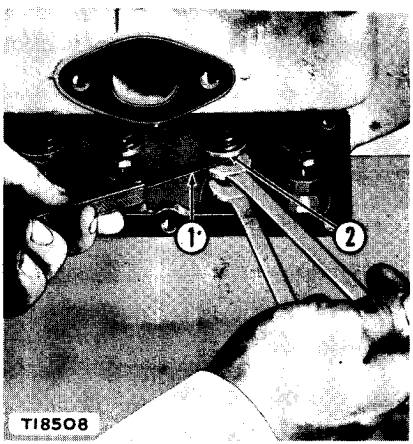
STARTING ENGINE VALVE CLEARANCE ADJUSTMENT

The valve clearance adjustment should be checked every 2000 service hours. To check the adjustment remove the carburetor and valve cover. The valve clearance check or adjustment should be made when the engine is hot. To check, crank the engine until the valve closes and the valve-lifter is at its lowest position.

To Adjust: Turn the adjusting screw until there is .008 inch (0.2 mm.) clearance at **(2)** between the adjusting screw and the end of the valve stem. Check this clearance with a thickness gauge **(1)**.

STARTING ENGINE VALVE CLEARANCE ADJUSTMENT

1–Thickness gauge. 2–There should be .008 inch (0.2 mm.) clearance at this point.



SPARK PLUG ADJUSTMENT

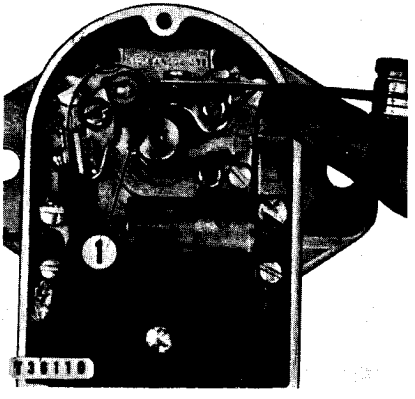
The spark plugs should be examined every 1000 service hours. The gap should be kept at approximately .040 inch (1.016 mm.). Measure this gap with a thickness gauge. To adjust the gap, bend the outer electrode.

STARTING ENGINE MAGNETO

Do Not Lubricate the Magneto at Any Point: The bearings are packed with a ball and roller bearing grease when assembled, and this should be replaced only when the magneto is taken to your Caterpillar dealer for checking or reconditioning.

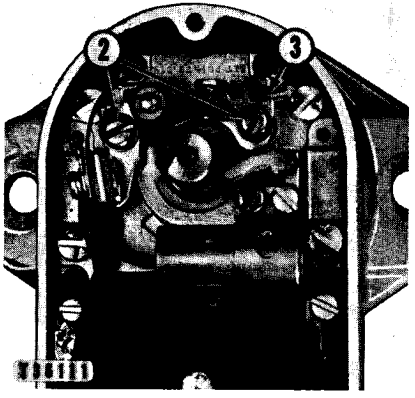
Checking Contact Point Opening: Every 1000 service hours check the contact point opening.

To check, first remove the distributor cap which is held in place by three screws. Care should be taken in removing the cap not to damage the gasket. Clean any carbon dust from inside the cap and any carbon track from the rotor by using a soft cloth dampened with a non-inflammable cleaning fluid. Remove the distributor rotor, then turn the engine until the contact point bumper block **(1)** is on one of the highest elevations of the cam. Check the clearance with a thickness gauge between the contact points as illustrated. This clearance should be .015 inch (.38 mm.).



CHECKING CONTACT POINT OPENING

1–Contact point bumper block on one of the highest elevations of the cam.

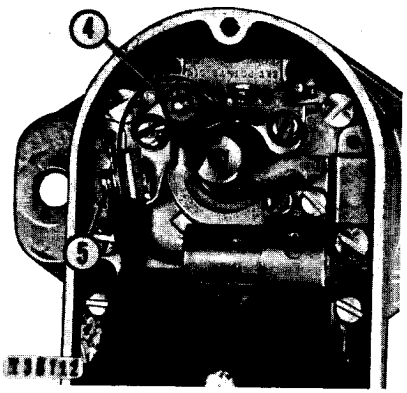


ADJUSTING CONTACT POINT OPENING

2–Bracket fastening screws.
3–Slot.

Adjusting Contact Point Opening: Loosen the screws **(2)** which hold the adjustable contact point bracket and move the bracket by inserting a screwdriver in the slot **(3)** and turn either clockwise or counterclockwise until the correct point opening is obtained. Then tighten the fastening screws and recheck the adjustment.

To Remove The Contact Points: To remove the contact points, remove the spring clamp screws **(5)** and lock and washer **(4)**. Remove the two screws **(2)** used in adjusting the contact point opening.



REMOVING CONTACT POINTS

4–Lock and washer. 5–Spring clamp screw.

◆

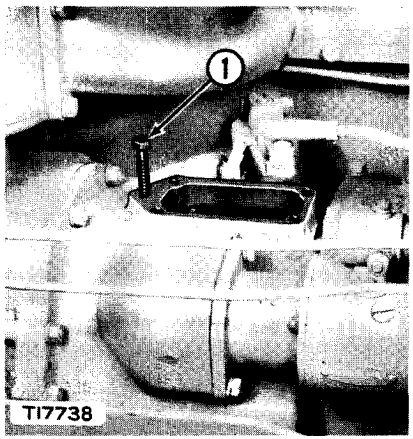
Testing: A magneto may be tested when coupled to the engine by turning the switch, ON, removing the cable from a spark plug, and holding the terminal 1/8 inch (3.17 mm.) away from the metal base of the plug while cranking the engine. If no spark passes from the terminal to the metal base, disconnect the ignition switch wire from the terminal on the magneto and test again. It a spark now occurs with the switch wire removed, the wire from the magneto to the switch has become grounded or the switch requires replacement. If, with the switch wire off, the magneto still does not fire, remove the magneto as instructed in the next paragraph and take it to your Caterpillar dealer for testing.

To Remove the Magneto for Testing: Disconnect the cables from the magneto. One of the cables should be tagged or marked in some convenient manner which will designate the proper position of these cables. Remove the two bolts that hold the magneto to the timing gear cover and lift off the magneto.

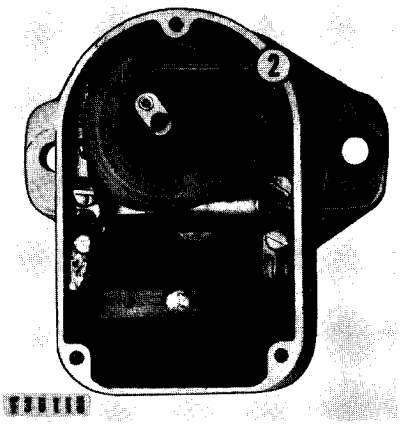
To Time the Magneto to the Engine: Check the adjustment of the contact points. Locate the firing point of No. 1 cylinder by removing the cover from the top of the starting engine clutch housing and the spark plug from the No. 1 (front) cylinder. Crank the engine slowly until air is forced from the spark plug opening. This indicates the piston is coming up on the compression stroke. Place a 3/8 inch x 2 inch bolt **(1)** in the hole in the flywheel housing. Continue to turn the crank slowly until the bolt drops in the hole in the flywheel.

Remove the distributor cap by taking out the three small fastening screws. Turn the magneto shaft to position the rotor approximately as shown in relation to the magneto housing. At this point the rotor contact **(2)** will contact the No. 1 cylinder carbon brush in the cap when the distributor cap is installed.

Install the magneto in the position shown turning the rotor slightly if necessary to align the marked drive tang of the magneto impulse coupling



LOCATING CORRECT POSITION OF FLYWHEEL FOR TIMING MAGNETO TO ENGINE
1–Bolt.



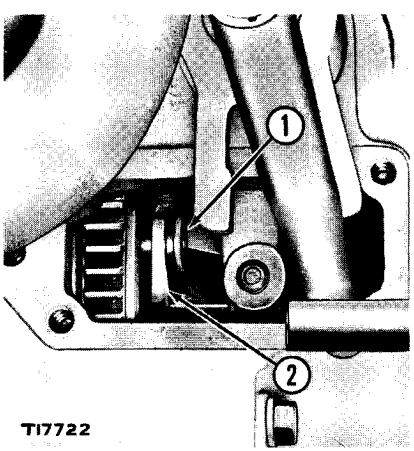
ROTOR POSITION TO TIME MAGNETO TO ENGINE
2–Rotor-contact.

with the marked slot in the magneto drive on the camshaft gear. Check the location of the rotor before replacing the cap to be sure it has not changed its position and then replace the cap on the magneto. Remove the bolt from the flywheel housing and install the cover.

STARTING ENGINE CLUTCH

To Test The Adjustment: Pull the clutch lever to the engaged position. The lever should go into this position with a distinct snap, and should require a reasonably hard pull. The clutch should be checked every 500 service hours for proper adjustment.

To Adjust: Remove the plate from the top of the clutch compartment. Turn the clutch adjusting collar **(2)** until the lock pin **(1)** is accessible.



STARTING ENGINE CLUTCH ADJUSTMENT
1-Lock pin. 2-Adjusting collar.

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Pull the lock pin out and turn the collar to the right until the lock pin drops into the next hole.

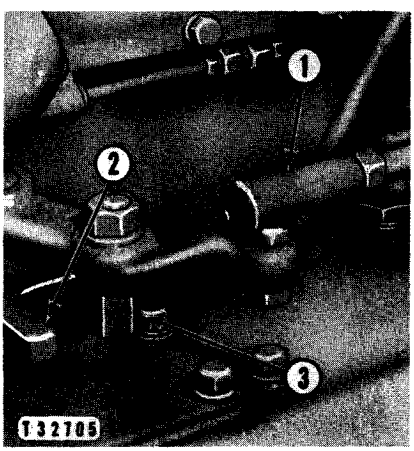
Test the adjustment by engaging the clutch. If one hole gives a slightly loose adjustment and the next gives too tight an adjustment, use the looser adjustment.

STARTING ENGINE CLUTCH AND PINION CONTROL LEVER ADJUSTMENT

The clutch and pinion control lever should be checked every 500 service hours for proper engagement of the starting engine clutch and pinion. Failure to check this adjustment may result in the clutch being engaged before the pinion is engaged with the flywheel ring gear or excessive clutch slippage. After the starting engine clutch has been tested for proper adjustment the control lever adjustment may be checked by grasping the control lever **(1)** and engage the clutch and pinion. With control lever and lever **(2)** held as far toward the front of the engine as it will go, measure the gap between the flat on the block **(3)** and the finished flat, nearest the front of the engine, on the lever **(2)**. The clearance should be 1/64 to 1/32 inch (.40 - .80 mm.) for correct adjustment.

If the clearance is greater or less than 1/64 to 1/32 inch (.40 - .80 mm.) the correct clearance should be obtained as follows:

1. Move the clutch lever **(2)** toward the front of the engine until the clutch snaps into engagement.
2. Remove the nut and block **(3)** from the pinion control lever **(1)**.
3. Engage the pinion by moving the lever **(1)** towards the front of the engine until the latches hold the pinion in engagement.
4. Assemble the nut and block to the lever and rotate the block until a flat on the block has 1/64 to 1/32 inch (.40 - .80 mm.) gap between



STARTING ENGINE CLUTCH AND PINION CONTROL LEVER ADJUSTMENT

1–Starting engine pinion control lever.
2–Clutch control lever.
3–Block and nut.

◆

it and the finished flat nearest the front of the engine on the clutch lever, when both the clutch and pinion control levers are as far toward the front of the engine as they will go.

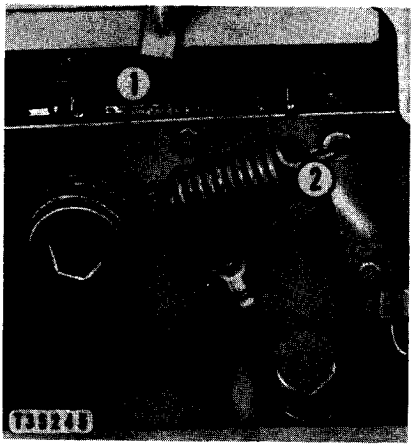
FLYWHEEL CLUTCH
(Tractors With Direct Drive 36A1-up)

The proper initial clutch adjustment will give a clutch lever pull between 170 and 180 pounds. This measurement is made with a spring scale placed at the bottom of the handle on the clutch control lever with the engine stopped, and when the engine is cold. Slightly higher pounds pull may be required when the clutch is warm.

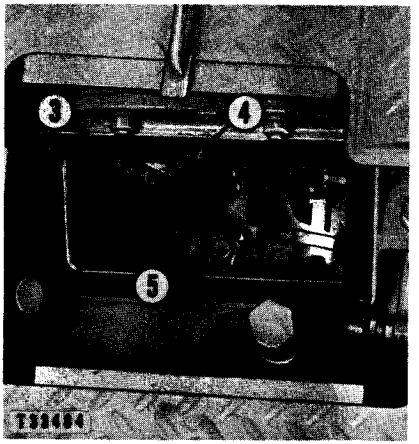
The clutch is equipped with a hydraulic actuating mechanism so lever pull during operation cannot readily be used to determine when the clutch should be adjusted. The clutch adjustment should be checked every 500 service hours and adjusted if necessary. The clutch should be adjusted immediately when it begins to slip, however when the clutch is properly adjusted the lever should go into engaged position with a distinct snap.

To Adjust: When clutch adjustment becomes necessary proceed as follows:

1. Remove the floor plate inspection cover. Care should be exercised to clean any dust or dirt from the top and around the edges of the clutch compartment cover **(1)**. Be sure all tools used to make the adjustment are clean. Remove the flywheel clutch breather **(2)**, then remove the clutch compartment cover being careful not to damage the gasket under the cover.



CLUTCH ADJUSTMENT
1—Clutch compartment cover.
2–Breather.



ADJUSTING CLUTCH
3–Locknuts. 4–Lock plate.
5–Adjusting ring.

2. Turn flywheel until the adjustment locknut **(3)** is accessible. Loosen locknut about two turns. Tap lock plate **(4)** slightly to be sure it is free on stud. Rotate flywheel 180° and loosen the other locknut in same manner.
3. Turn the adjusting ring **(5)** clockwise approximately three inches to tighten.
4. Tighten the locknuts to a torque of approximately 80 pounds feet. This can be accomplished with a steady pull on the end of a 3/4 inch box wrench.
5. Check to see that the clutch compartment cover is clean and the gasket is in good condition, then install the cover and the breather.

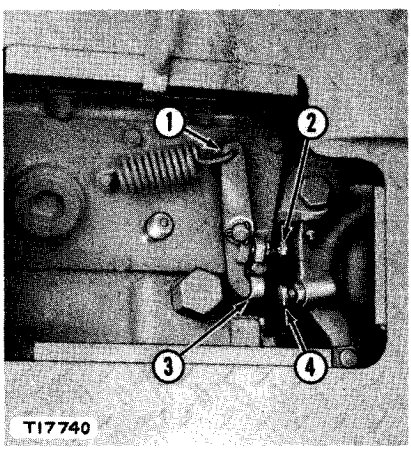
Flywheel Clutch Brake: The tractor is equipped with a clutch brake, which stops the clutch from turning, and permits shifting gears without clashing. To apply the brake, press the flywheel clutch control lever forward as far as it will go. Check the clutch brake adjustment every 250 service hours and adjust if necessary. If the clutch is slow in stopping, the clutch brake should be adjusted.

There are two adjustments for the clutch brake. One adjustment is provided to maintain proper clearance between the brake lining and brake drum when the clutch is engaged.

The other adjustment is provided to adjust the brake applied position of the flywheel clutch control lever.

To Adjust: If the brake lining has become worn and adjustment becomes necessary proceed in the following manner:

1. Engage the clutch.
2. Loosen the locknut on adjusting screw **(4)** and turn the adjusting screw in (clockwise) all the way.



FLYWHEEL CLUTCH BRAKE ADJUSTMENT

1–Brake release lever. 2–Adjusting screw. 3–Brake actuating lever. 4–Adjusting screw.

◆

3. Loosen the locknut on adjusting screw **(2)** and turn the adjusting screw in (clockwise) until there is clearance between the brake release lever **(1)** and the brake actuating lever **(3)**. This clearance should exist when pushing the brake actuating lever **(3)** toward the brake release lever **(1)** as far as possible to place the brake lining against the brake drum.

4. Turn the adjusting screw **(2)** out (counterclockwise) until the brake release lever **(1)** just touches the brake actuating lever **(3)**, then turn the adjusting screw **(2)** out (counterclockwise) one-half turn more, and tighten the locknut.

5. Disengage the clutch and push the control lever to the extreme forward position, then release the control lever.

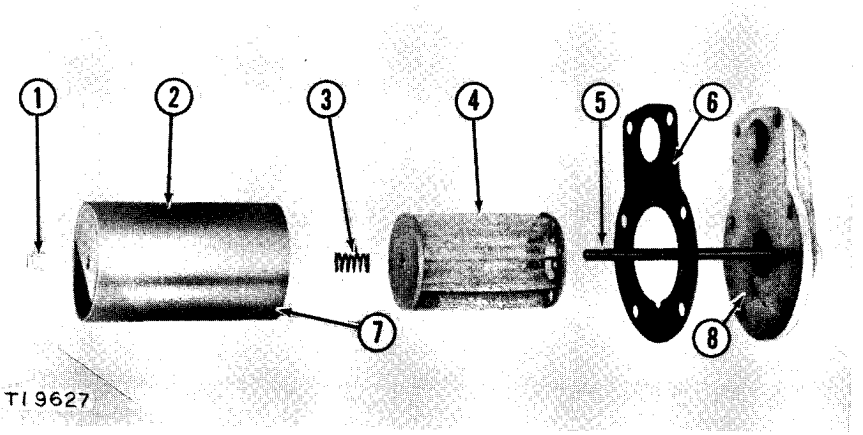
6. With the brake actuating lever **(3)** held against the brake release lever **(1)** turn the adjusting screw **(4)** out (counterclockwise) until it touches the brake actuating lever **(3)** and tighten the locknut.

CAUTION

If brake is adjusted too tight the brake will be applied before the clutch is fully disengaged and difficult shifting and excessive clutch brake lining wear will result.

Oil Pump Screen Assembly: The flywheel clutch oil pump screen assembly located in the rear face at the bottom of the clutch housing should be cleaned every 1000 service hours when the flywheel clutch compartment is drained. Clean the screen as follows:

1. Remove the nuts that hold the screen assembly to the clutch housing.



OIL SCREEN ASSEMBLY
1–Nut. 2–Screen cover. 3–Spring. 4–Screen. 5–Stud. 6–Gasket. 7–Dowel. 8–Cover.

2. Use a knife between the clutch housing and screen assembly to loosen the gasket so it will not stick and become damaged.
3. Remove the oil screen assembly.
4. Remove nut **(1)** and disassemble the oil screen assembly.
5. Wash the screen by shaking it in kerosene or clean diesel fuel.
6. Install oil screen **(4)** over the stud **(5)**, then place the spring **(3)** on the stud.
7. Install screen cover **(2)** over the oil screen, aligning the dowel **(7)** with the drilled hole in the cover **(8)**.
8. Hold the screen cover **(2)** against cover **(8)** and install nut **(1)**.
9. Install the oil screen assembly into the oil clutch and tighten the nuts.

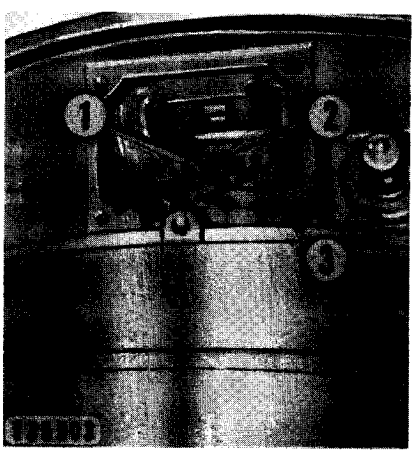
(Tractors With Torque Converter Drive 35A1-up)

The proper clutch adjustment will give a clutch lever pull of 20 to 30 pounds. This measurement is made with a spring scale placed at the bottom of the handle on the clutch control lever when the engine is stopped.

The clutch should be adjusted immediately when above normal engine speed is noticed during normal operation under full load. When the clutch is properly adjusted, the lever should go into the engaged position with a distinct snap.

To Adjust: When clutch adjustment becomes necessary, proceed as follows:

1. Remove the inspection cover.
2. Turn the flywheel until the locking plate **(2)** is accessible.



FLYWHEEL CLUTCH ADJUSTMENT
1–Nut. 2–Locking plate. 3–Adjusting ring.

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3. Loosen the nut **(1)** only enough so that the locking plate **(2)** will clear the notches in the adjusting ring **(3)**.
4. Turn adjusting ring **(3)** clockwise to tighten the clutch.
5. After proper adjustment has been obtained see that the locking plate is in place and tighten the nut.
6. Replace the inspection cover.

Draining The Flywheel Clutch Housing: The clutch plates on torque converter drive tractors are designed to operate dry. The plug on the bottom of the flywheel housing, directly under the flywheel, has a hole drilled in it and a cotter installed in the hole to keep the hole open. This allows any lubricant that may have seeped into the compartment to escape. If the tractor is to be operated in deep mud or water, the plug should be removed and a solid plug having no hole should be installed in its place. If operating continuously in deep mud or water, the solid plug should be removed every 10 service hours to drain any lubricant that may have seeped into the compartment from the engine, or clutch bearings. If lubricant from these points is allowed to accumulate, the clutch plates may become sticky and cause difficult operation of the clutch.

STEERING CLUTCHES AND BRAKES

The steering clutches are hydraulically actuated. The steering clutch brakes have a mechanical linkage with a hydraulic booster to reduce the effort required to apply the brakes when the engine is running.

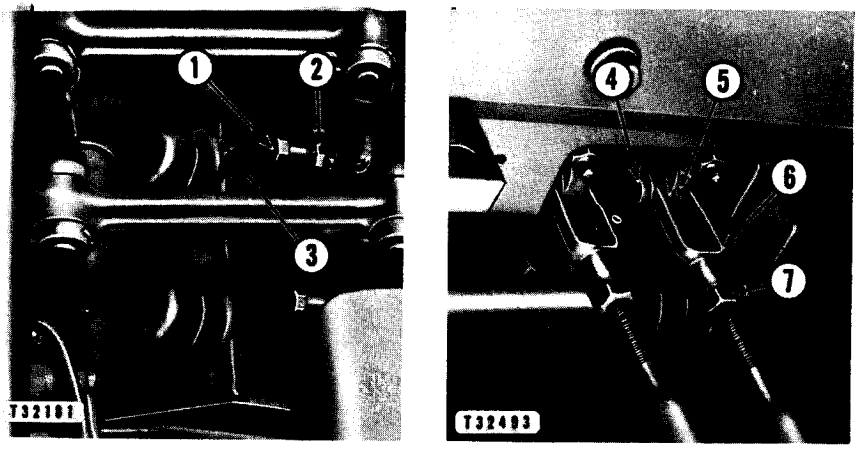
The steering clutches require no adjustment. There is a steering clutch linkage adjustment and a steering clutch brake adjustment.

Steering Clutch Linkage Adjustment: Every 2000 service hours the linkage between the control levers and the hydraulic control should be adjusted as follows:

1. Remove the pins **(4)** from the linkage lever **(5)** and loosen the locknut **(7)** on the control rod end **(6)**.
2. With the steering clutch control levers in the full forward position, move the control rods forward to take up clearance in the linkage. After clearance is removed from the linkage, spring resistance will be felt. **Do not** move the rods forward to the extent that the spring on the hydraulic mechanism valve is compressed.
3. Adjust the rod end on the control rod so the pin can be easily installed in the rod end and linkage lever **(5)**, then turn the rod ends one-half turn clockwise to shorten the rod and install the pins.
4. Loosen the stop bolt locknut **(2)**.
5. Hold the steering clutch control lever to the rear as far as it will go. Turn the stop bolt **(1)** in (clockwise) until there is clearance between the stop bolt and the angle **(3)**. At this point the hydraulic control is

preventing further movement of the control lever to the rear. Hold the lever in this position until step 6 is completed.

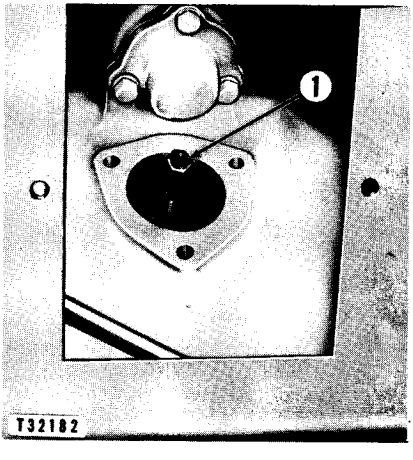
6. Turn the stop bolt out (counterclockwise) until it contacts the angle. Release the control lever and lock the stop bolt with the locknut.



STEERING CLUTCH LINKAGE ADJUSTMENT
1–Stop bolt. 2–Stop bolt locknut. 3–Angle. 4–Pin. 5–Linkage lever. 6–Control rod end. 7–Locknut.

Steering Clutch Brake Adjustment: Every 250 service hours check and adjust the steering clutch brakes as follows:

1. Remove the brake adjusting screw cover, taking care not to damage the gasket.
2. Turn the adjusting screw **(1)** in (clockwise) until the brake band is tight on the brake drum.
3. Turn the adjusting screw out (counterclockwise) 1½ turns to provide proper clearance between the brake lining and the brake drum.



STEERING CLUTCH BRAKE ADJUSTMENT

1–Adjusting screw socket.

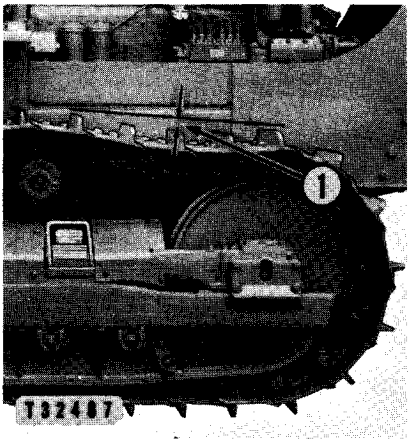
◆

TRACKS

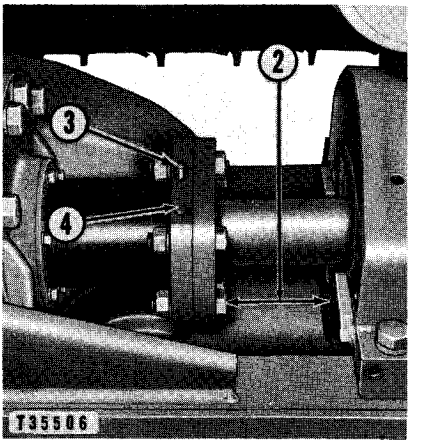
Proper care of the tracks, especially when operating the machine under adverse conditions, will greatly extend their service life.

After operating in mud or slush and below freezing temperatures are anticipated, park the machine on solid dry ground, planks, logs or brush to prevent the machine from freezing to the ground. Snow or mud should also be cleaned from around the track links, sprockets, idlers, rollers, and guards to prevent freezing of the tracks.

The tracks should be operated without tension, to avoid undue wear of moving parts. When properly adjusted, there should be no less than 1 to 1½ inches (2.5 to 3.8 cm.) slack measured at a point half way between the carrier roller and front idler as shown at **(1)**. Looser adjustment may be required to prevent tension on the tracks when operating in material which will pack around the track parts and between pins and bushings.



CHECKING TRACK ADJUSTMENT
1–There should be 1 to 1½ inches (2.5 to 3.8 cm.) sag at this point.



ADJUSTING TRACK
(Plate removed for illustration purposes.) 2–Minimum measurement. 3–Relief valve. 4–Fitting.

To Adjust:

1. Raise the inspection plate on the track roller frame guard.
2. Apply ball and roller bearing lubricant, with a grease gun, into the fitting **(4)** until the track is at the correct adjustment.
3. Operate the tractor backward and forward to equalize the adjustment.
4. Recheck the adjustment.

As continued track adjustment becomes necessary through service, the following precaution should be observed to prevent damage to the equalizer bar support. Do not attempt to make an adjustment if the

minimum measurement at **(2)** is less than 1 inch (2.54 cm.) after the adjustment is made.

To Loosen Track Adjustment: If the track is too tight, release some of the pressure in the hydraulic track adjuster cylinder with caution as given in the following steps:

1. Loosen the knurled cap in the track adjuster release valve **(3)** no more than **one-half turn** and allow grease to escape from the passage on the side of the valve.

WARNING

To avoid the possibility of personal injury, do not loosen the knurled cap of the release valve more than one-half turn.

2. Tighten the knurled cap.
3. Check the track adjustment.
4. Repeat the above steps until the adjustment is correct.

The tractor is equipped with a two position idler. The high position can be used successfully for practically all types of work. The low position is used when the tractor is performing fine grading or finishing work. The idler will be set in the low position when leaving the factory unless otherwise specified. For further information, see your Caterpillar dealer.

WASHING GEAR COMPARTMENTS

Washing the Final Drives: Remove the drain plugs from both cases after a run, when the oil is warm, and allow the old oil to drain. Replace the plugs and fill the compartments to the proper level with kerosene or clean diesel fuel. Drive the tractor back and forth for five minutes. Replace the final drive oil filter every 1000 service hours and after the final drive has been washed. Drain the cleaning fluid, replace the drain plugs and refill the final drives with fresh lubricant as instructed in the LUBRICATION INSTRUCTIONS section of this book.

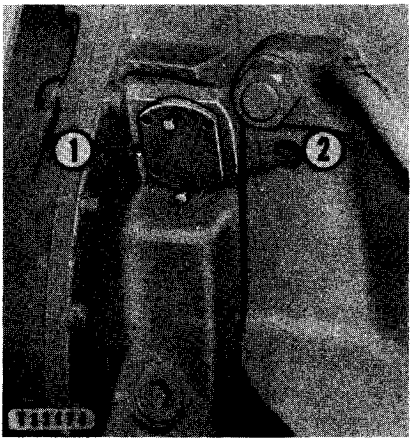
Washing the Starting Engine Transmission: The starting engine transmission should be washed every 1000 service hours. Open the drain valve after the starting engine has been turning the transmission gears and has warmed the oil. After the oil has drained, close the drain valve and fill the compartment to the proper level with kerosene or clean diesel fuel. Set the starting and diesel engine controls in the positions as outlined in the topic, STARTING THE ENGINES, then start the starting engine and engage the starting engine clutch and pinion. Allow the starting engine to turn the transmission gears and the diesel engine for several minutes. Disengage the starting engine clutch, stop the starting engine and open the transmission drain valve. After all the cleaning fluid has drained, close the drain valve and fill the transmission with fresh oil to the correct level as instructed in the LUBRICATION INSTRUCTIONS section of this book.

FINAL DRIVE LUBRICATING OIL SYSTEM

Each final drive lubricating oil system includes an oil pump and a filter. The oil passes from the suction bell, through the pump and filter, and then to the bearings. The pump is driven from the intermediate final drive gear. A check valve in the system prevents the pump from picking up oil from the dirty side of the filter when the tractor is operated in reverse.

Final Drive Lubricating Oil Filter: The filter element should be replaced every 1000 service hours (500 service hours when operating in either extreme dusty conditions or deep mud and water) or after the first 50 service hours on a new or a reconditioned final drive. Remove the oil filter as follows:

1. Remove the bolts that hold the filter assembly **(1)**.



REMOVING FINAL DRIVE FILTER ASSEMBLY

1–Filter assembly. 2–Puller screws.

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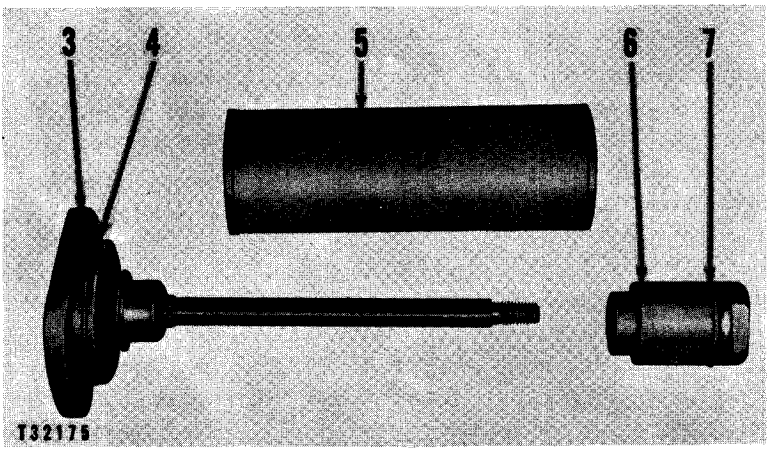
2. Install two of the bolts removed in Step 1, in the tapped holes in the cover **(3)** and use as puller screws **(2)** until the filter assembly can be removed.



FILTER ELEMENT REPLACEMENT

3–Cover. 4–Seal. 5–Filter element. 6–Body. 7–Seal.

3. Unscrew body **(6)** and remove the filter element.
4. Inspect the ring seals **(4)** and **(7)**. Replace them if necessary.
5. Install a new element **(5)** and assemble the filter assembly.
6. Install the filter assembly in the final drive case, care must be taken so that the seals are not damaged.

TRANSMISSION, BEVEL GEAR AND STEERING CLUTCH COMPARTMENT LUBRICATING OIL SYSTEM

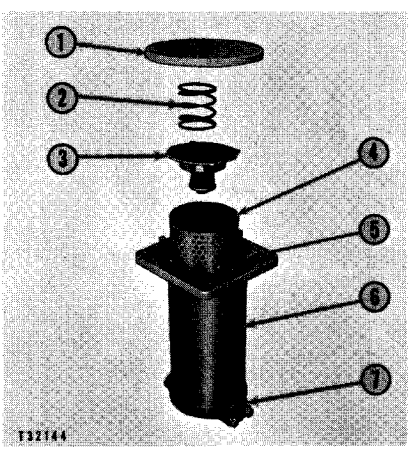
The transmission, bevel gear and steering clutch compartments are lubricated with a single lubricating system. The steering clutch hydraulic controls and the steering clutch brake booster also use oil from this lubricating oil system.

The two section oil pump is mounted on the accessory drive housing, at the right rear of the engine. The large and the small section of the oil pump have a common suction line from a suction screen in the transmission sump.

Oil from the large section of the pump passes through the filter to the steering clutch hydraulic control valve. Some of the oil flows to the bevel gear oil system, and the rest of the oil flows through the transmission oil cooler and then to the transmission oil system. When the steering clutches are actuated this oil is momentarily used to disengage the steering clutches.

Oil from the small section of the pump supplies oil to the steering clutch brake hydraulic booster. This oil also flows over the steering clutch brakes.

Replacing Oil Filter Element: After the first 50 service hours operation of a new tractor or of a reconditioned transmission or steering clutch, change the filter element. (Every 125 service hours inspect the element and re-



OIL FILTER REPLACEMENT

1–Cover. 2–Spring. 3–Retainer assembly. 4–Filter element. 5–Seal. 6–Housing. 7–Drain cover.

◆

place it if excessive sludging is noticed.) Every 250 service hours replace the element as instructed in the following three steps.

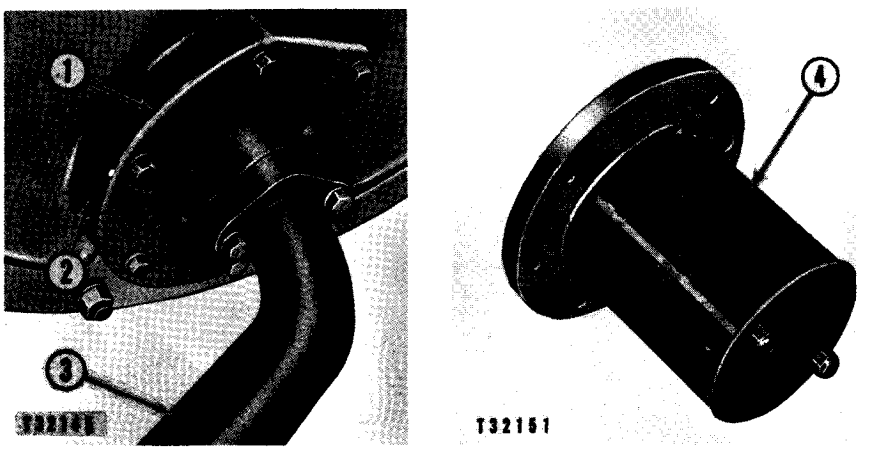
1. Remove the center right floor plate.
2. Remove the drain cover **(7)** to drain the oil from the housing **(6)**. Be careful not to damage the ring seal located behind the cover.
3. Remove the stud nuts holding the cover **(1)** to the housing and remove the cover, spring **(2)** and retainer assembly **(3)**.
4. Replace the filter element **(4)** with a new Caterpillar element. Replace the seal **(5)** if damaged.
5. Install the retainer assembly, spring and cover. Install the drain cover and the floor plate.

Suction Screen: Clean the suction screen every 1000 service hours, when the transmission, bevel gear and steering clutch compartments are drained.

1. Remove the oil line **(3)** from the transmission.
2. Remove the cover **(1)** and the suction screen flange **(2)**.
3. Remove the screen **(4)** and wash in kerosene or clean diesel fuel.
4. Reassemble the screen to the flange and reinstall the assembly in the transmission. Reinstall the oil line. Replace any gaskets that are damaged.

CAUTION

When assembling the screen to the flange match the dowel hole in the open end of the screen with the dowel in the flange. If the screen should be assembled in reverse, the oil flow will be blocked and will not be circulated through the screen.



CLEANING SUCTION SCREEN
1–Cover. 2–Suction screen flange. 3–Oil line. 4–Screen.

ELECTRICAL SYSTEM

The basic electrical system is composed of the following:

1. Battery.
2. Generator.
3. Generator regulator.
4. Wiring.

These components function together to produce and store electricity for the electrical equipment on the machine and each is dependent upon the others for satisfactory operation. In the event of failure or improper operation it is essential to check the entire electrical system, as a defect in one component can cause damage to another.

The topics which follow describe the proper maintenance of the components to assure satisfactory operation of the electrical system.

Battery

Every 50 service hours, or more often when continuous operation without the use of the battery is encountered, the following attention should be given to the battery to insure high efficiency and maximum operating life.

Testing: The battery should be tested with a hydrometer and kept to a specific gravity of 1.250 or above. Always test a battery for degree of charge before adding water. The specific gravity between the cells should be within .025. A dangerously low point of charge is indicated by a hydrometer reading of 1.150 which will permit the battery to freeze. A specific gravity of 1.250 will permit the battery to withstand temperatures as low as —60°F. without freezing.

Water Addition: Water that escapes by evaporation should be replaced with distilled water or "approved water" (water free from impurities by analysis). The level should be maintained 3/8 inch (9.5 mm.) above the top of the separators or insulators. Do not overfill or underfill the cells of the battery as either has a detrimental effect on battery life.

Charging: The charging rate is correct when the battery maintains a minimum specific gravity of 1.250 and does not require the addition of more than 1 ounce of water per cell per week or 50 service hours.

When there is evidence of either overcharging or undercharging, the cause should be found and corrected as soon as possible to protect the service life of the battery. See the topics, GENERATOR, GENERATOR REGULATOR and WIRING.

Cleanliness: Keep the top of the battery clean and dry to prevent current losses and keep the terminals clean and tight. To clean corrosion from the battery terminals, scrub them with a weak solution of bicarbonate of soda (baking soda) and water. Dry the battery thoroughly,

then coat the terminals with lubricant to prevent corrosion. Keep the battery securely fastened in its compartment at all times.

Installation: When replacing a battery that has been removed, make certain the cables are attached to the correct battery terminals. Improper connections will damage the generator regulator.

Generator

Never operate a generator with an open circuit between it and the battery.

General Reconditioning: Every 2000 service hours, the generator should be removed and the commutator and brushes checked for glaze or darkening. At the same time the generator should be completely disassembled, washed and have all worn parts replaced. It is suggested that this cleaning and reconditioning be entrusted to your Caterpillar dealer.

Generator Removal: Remove all wires from the generator and tag them so that they may be connected correctly when the generator is reinstalled. Remove the bolts or stud nuts that hold the generator in position and lift off the generator.

Generator Installation: Whenever a generator is installed, or reconnected to the generator regulator, it must be polarized **before** starting the engine. Follow the instructions carefully to prevent damage to the generator, generator regulator, or both, due to incorrect polarizing.

1. Place the generator in position and install the bolts or stud nuts.
2. Connect all wires to the generator, regulator and battery. See the topic, WIRING.
3. Polarize the generator.

Polarizing American-Bosch Generator

1. Remove the wire from the generator regulator terminal marked FIELD.
2. Touch the wire which was removed from the FIELD terminal momentarily to the generator regulator terminal marked BAT.
3. Reconnect the wire to the generator regulator terminal marked FIELD.

CAUTION

Always disconnect the wire from the generator regulator terminal marked FIELD. **Never** use a jumper wire between the terminals on the generator regulator or generator marked FIELD, ARM or BAT.

Make sure all connections are clean and tight. See the topics, BATTERY, GENERATOR REGULATOR and WIRING.

Generator Regulator

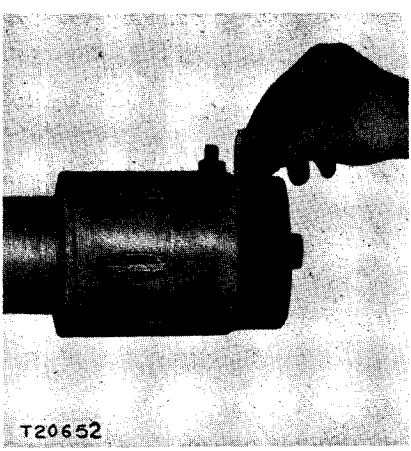
The generator regulator is adjusted at the factory for average operating conditions. The regulator may have to be readjusted to provide the proper charging rate for the particular operating conditions of the machine. In case of failure of either the regulator or generator, both units should be taken to your Caterpillar dealer, where the output of the generator can be checked and the regulator adjusted accordingly.

Charging Rate: The normal function of the generator regulator is to adjust the generator charging rate by sensing the degree of charge in the battery. As the battery becomes fully charged, the charging rate should be reduced until the ammeter indicates a rate only perceptibly above zero.

When improper charging of the battery is encountered, the entire electrical system should be carefully checked. Loose or dirty connections, worn or broken wires, or a faulty generator can prevent a good regulator from functioning properly. See the topics, BATTERY, GENERATOR, and WIRING.

ELECTRIC STARTER

Cleaning Electric Starter: Every 2000 service hours, the inspection covers should be removed from the starter and a check made of the commutator. If it is glazed or burned, polish it with "00" sandpaper. To polish, hold the sandpaper on the commutator with a stick while the commutator is turning. The polishing should be done on the starter by pressing the starter switch. With gasoline starting engine be sure the magneto switch is turned OFF. Turn the sandpaper over to clean the contact surface of the brushes. The commutator should not be turning when the brushes are being cleaned. Make sure all trace of sand particles is removed from the commutator, brushes and brush holders by blowing out with air or an equally effective method.



SANDING STARTER COMMUTATOR AND BRUSHES

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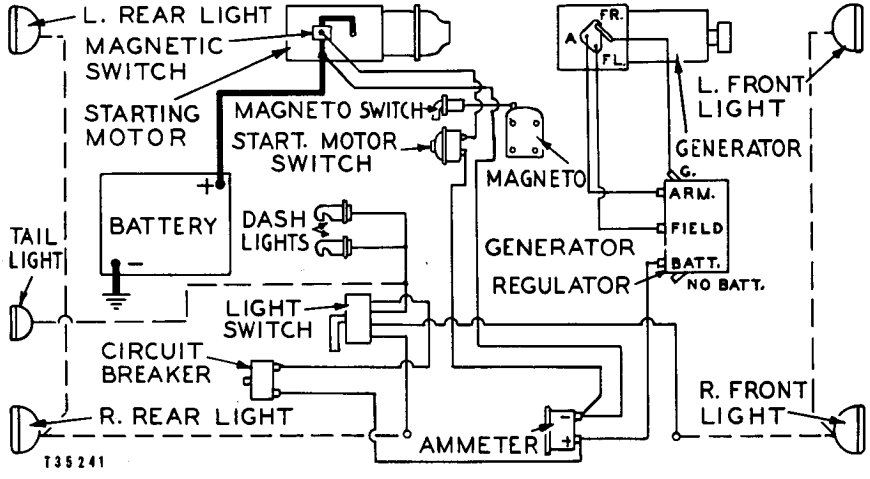
Brush Replacement: Brushes should be inspected and replaced if badly worn. When a new brush is installed, seat it properly with the contour of the commutator by using "00" sandpaper. See the preceding topic. Remove all sand particles and make certain the connections are all tight.

General Reconditioning: Approximately every 4,000 service hours, the starter should be removed so that it may be completely disassembled, washed and have all parts replaced that show evidence of being unsatisfactory for reason of wear. It is suggested that this cleaning and reconditioning be entrusted to your Caterpillar dealer.

Wiring

The wiring forms an important part of the electrical system and care should be used to protect it from damage. When the electrical system is being serviced, check the wiring for loose or dirty connections, worn insulation or broken wires. Inspect the battery terminals and cables. Poor connections or wiring can cause trouble or damage in other parts of the electrical system. See the topics, BATTERY, GENERATOR and GENERATOR REGULATOR.

Wiring Diagrams. The diagrams are furnished so that when it becomes necessary to disturb the electricl equipment for purpose of reconditioning or parts replacement, reassembling may be accomplished without difficulty.

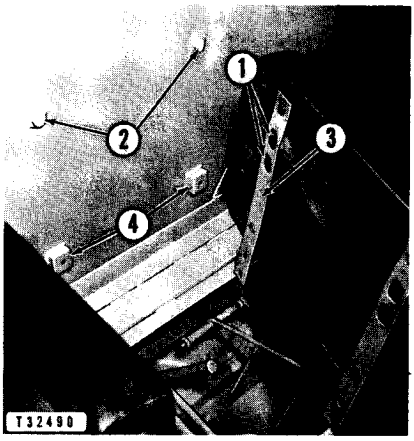


WIRING DIAGRAM
The dotted lines indicate the connections for lighting groups that are available as attachments.

SEAT BACK CUSHION ADJUSTMENT

The seat back cushion may be adjusted to two different heights for the operator's comfort. To do this, remove the seat cushion; then remove

the bolts that hold the lower end of fastener strips **(3)** in place. Then lift the seat back cushion off buttons **(2)** located on the fuel tank. Relocate the seat back cushion in the position desired by placing the cushion over



ADJUSTING SEAT BACK CUSHION

1–Adjusting holes. 2–Buttons. 3–Fastener strips. 4–Lugs.

◆

the buttons. Make certain that the button heads are fastened securely in the adjusting holes **(1)**, then install the bolts that hold the lower end of fastener strips to the lugs **(4)**.

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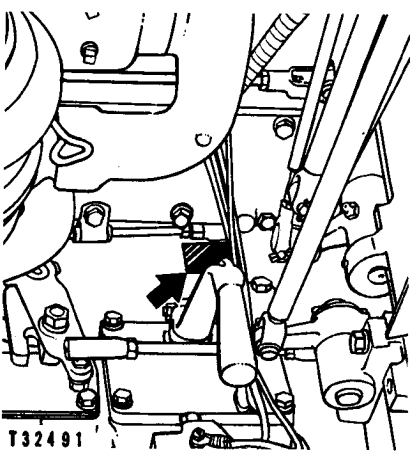
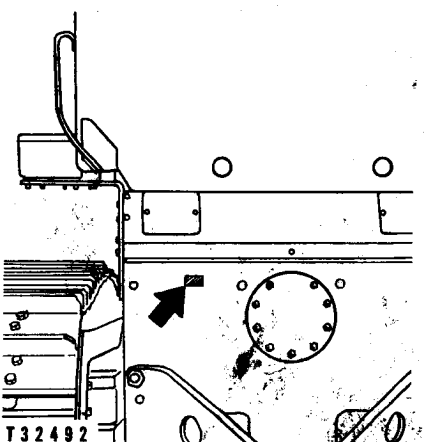
Capacities

Approximate Quantities

	U.S. Measure	Metric Measure (Liters)	Imperial Measure
Crankcase Lubricating Oil System,			
Diesel Engine	35 qt.	33	29.0 qt.
Starting Engine	2½ qt.	2,4	2.1 qt.
Flywheel Clutch (Tractors 36A1-UP)	4 gal.	15	3.3 gal.
Air Cleaner, Starting Engine	¾ qt.	0,8	0.7 qt.
Fuel Tank, Diesel	134 gal.	507	112 gal.
Fuel Tank, Starting Engine	5 qt.	4,7	4.2 qt.
Cooling System	27 gal.	101,3	22.3 gal.
Final Drive (each)	9 gal.	33	7.3 gal.
Transmission, Bevel Gear and Steering Clutch Compartment			
(Tractors 36A1-UP)	34 gal.	127	29.5 gal.
(Tractors 35A1-UP)	35 gal.	130,8	28.6 gal.
Transmission, Starting Engine	1¼ qt.	1,2	1.1 qt.
Recoil Spring Housing (each)	5 gal.	19	4.2 gal.

Location of Serial Number





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