



Ranger

SERIES 660

Record Your Machine Serial Number and Engine
Model Specification and Serial Number Here

Machine Model

Machine Serial

Engine Serial

OPERATORS MANUAL

No. 2169

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TO OWNERS

The purpose of the manual is to serve as a guide to the proper operation, lubrication and minor adjustment of the RANGER. Study this manual carefully before starting or operating the machine for the first time. Become familiar with all the controls and procedures, and keep the manual on the machine for handy reference.

You have purchased this RANGER with the expectation that it would give you long and faithful service. In its construction we have taken every precaution to see that you get an efficient, long lived, satisfactory machine. It is our sincere hope that you derive from its operation the full measure of value and utility which you looked forward to when purchasing it.

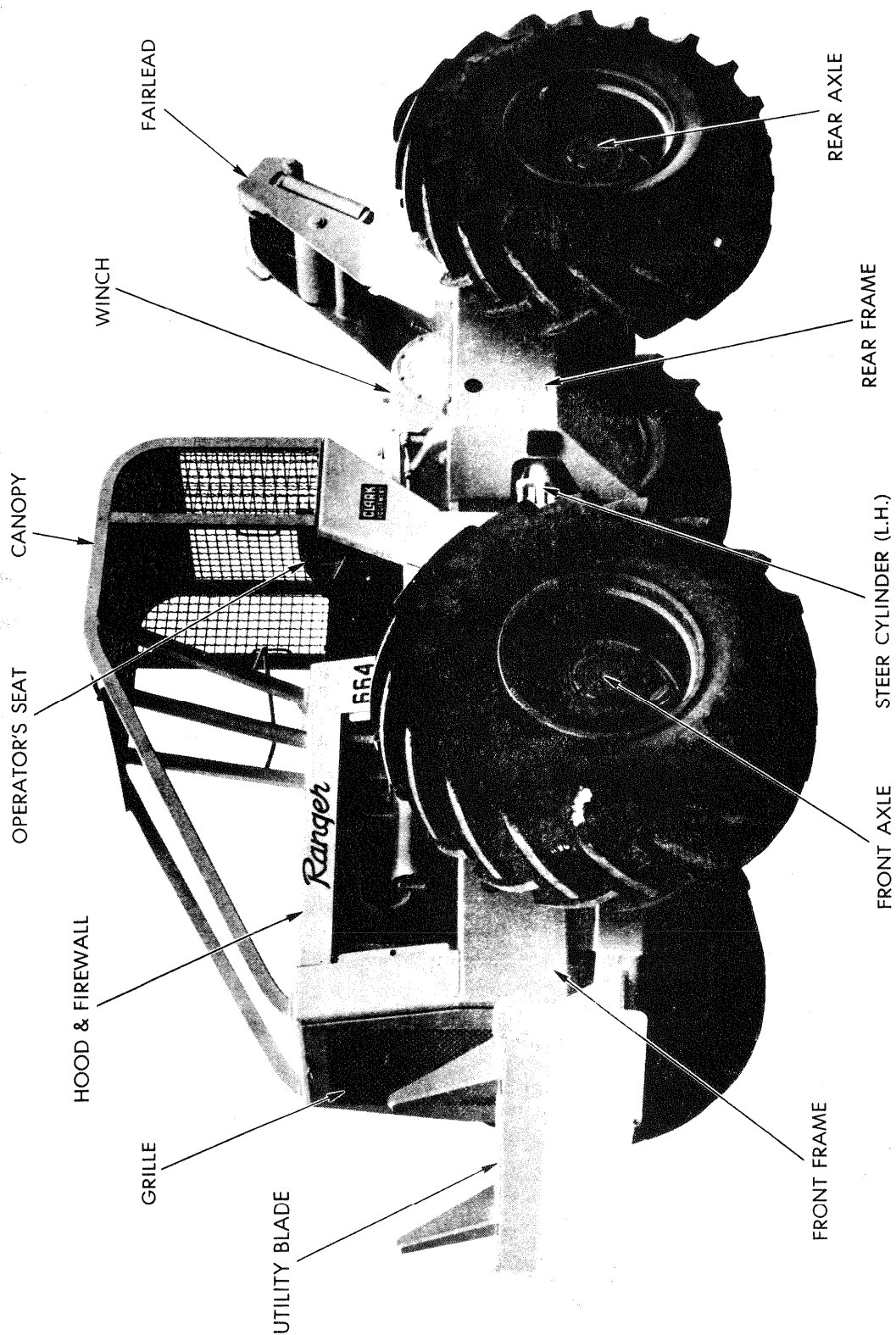
Whenever repair or replacement of component parts is required, only Clark-approved parts as listed in the applicable parts manual should be used. Use of "will-fit" or non-approved parts may endanger the proper operation and performance of the equipment. The Clark Equipment Company does not warrant repair or replacement parts, nor failures resulting from the use thereof, which are not supplied by or approved by the Clark Equipment Company.



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TS-7230

CLARK RANGER 660 SERIES



GENERAL DESCRIPTION

The Clark Ranger 660 series log skidder has been designed with the logger in mind. It has been tested and proven under the roughest terrain which nature has to offer. It underwent test in Northern and Western Canada and also in the Southern United States.

Power comes from the engine through a Clark torque converter having a 3-1 torque multiplication factor, to a power shifted, four speed, full reversing type transmission, to the axle assemblies. Universal slip joint drive shaft assemblies are used between the power transfer units.

The axle assemblies are Clark all wheel drive, full floating, spiral bevel ring gear and pinion, with further reduction provided by planetary gear sets within the wheel hubs.

The Ranger has an articulated type frame which provides the steering of the machine. The steering is accomplished by the actuation of two 3½" diameter hydraulically opposed cylinders.

An internal expanding shoe type brake, drive shaft mounted, provides four wheel braking of the machine.

For more complete specifications, refer to the Specifications on page 39 of this manual.

MACHINE SERIAL NUMBER PLATE

The machine serial number plate is mounted on the right hand side of the seat support below the operator's seat. This plate gives the model number and serial number of the machine. See Fig. 1.



Fig. 1 Machine Serial Number Plate

The serial number of the machine is also stamped in half inch numerals on the right hand side at the rear of the front frame.

Example: C-9014-106

The serial number above is a typical number used throughout the Ranger 660 Series. Each number and letter in the serial number has its own significance. The first letter and number will always be C-9, this signifies the machine is Canadian built and was built at St. Thomas. The next two digits specify the lot release. The next determines the machine being either 664 or 666. The last three digits specifies the number of machines built in the specified Lot Release starting at 101.

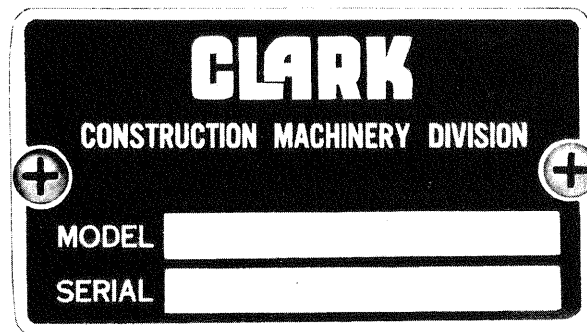
Therefore the above serial number specifies Canadian built of lot #1 release, it is a 664 and the sixth machine built; in the lot #1 release.

IMPORTANT: ALWAYS GIVE THE SERIAL NUMBER OF THE MACHINE WHEN ORDERING PARTS.

TRANSMISSION AND TORQUE CONVERTER SERIAL NUMBER PLATE.

The transmission serial number plate is located on the right hand side at the rear of the transmission. The torque converter serial number plate is centrally located at the top side of the converter.

Both plates are identical except for the model number and serial number stamped on each plate to correctly identify the units. The plate is shown in Fig. 2.



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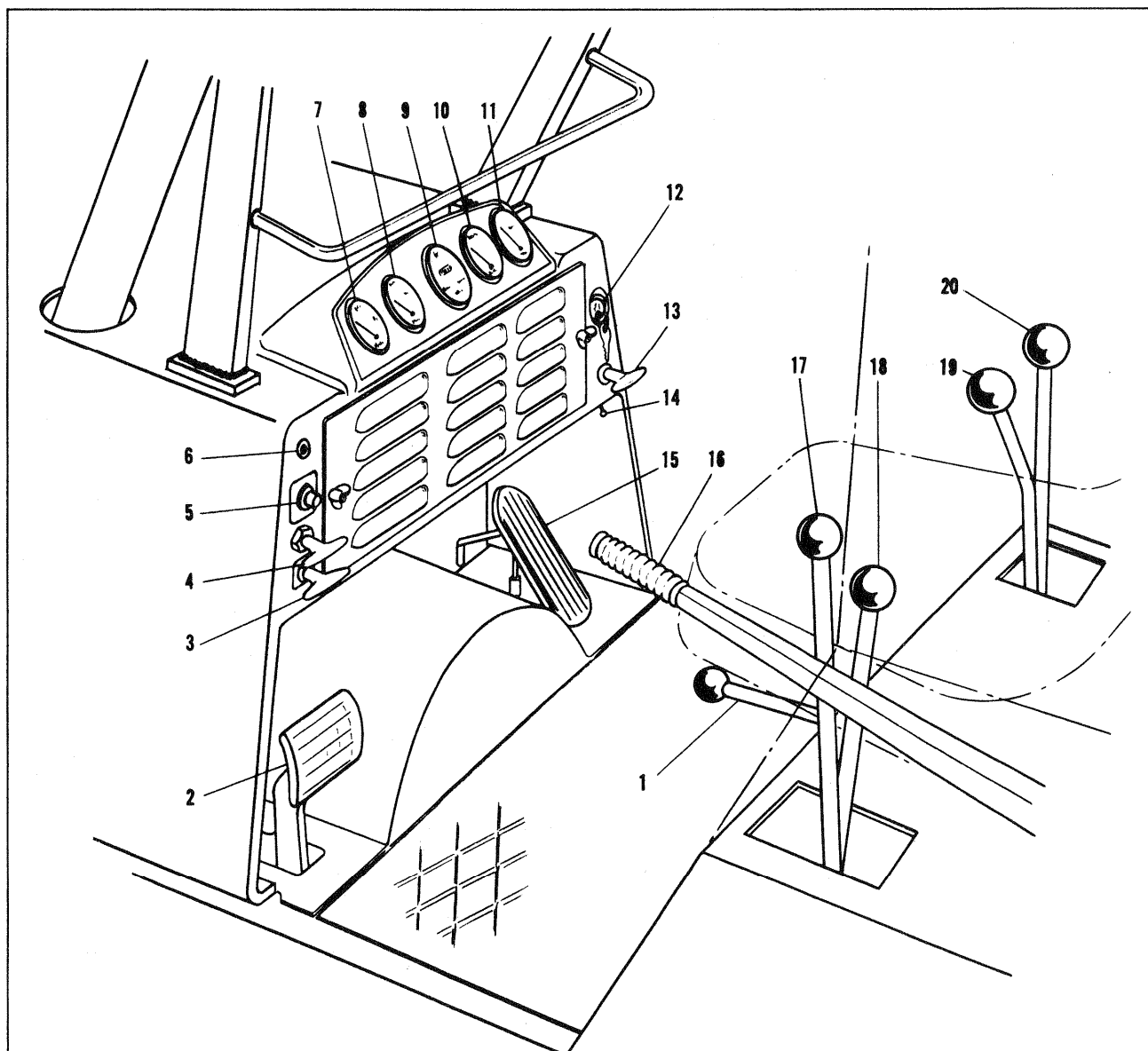
Fig. 2 Transmission or Torque Converter Serial Number Plate

PREPARATION FOR OPERATION

It is essential that the following points be checked with the machine in a level position before operating the Clark Ranger 660 Series Skidder.

Refer to the lubrication charts to locate the items referred to below.

1. Check the entire machine for damages in transit or storage.
2. Check the oil levels on the following to the specifications outlined in the lubrication section.
 - a. Engine crankcase.
 - b. Transmission case (with the engine idling).
 - c. Front drive axle differential.
 - d. Front axle planetary hubs.
 - e. Rear drive axle differential.
 - f. Rear axle planetary hubs.
 - g. Hydraulic system reservoir.
 - h. Winch housing and adapter.
 - i. Brake master cylinder.
 - j. Winch control unit.
3. Check the cooling system to make sure that the radiator is filled and that the radiator drain cock and the engine block drain cock are closed. When there is a danger of the water freezing in the cooling system, use a permanent type of anti-freeze according to the manufacturer's instructions. For further information, please refer to the operation and maintenance manual of the engine manufacturer.
4. Check that the battery plates are covered with water. Add only clean distilled water.
5. Check the fuel level in the fuel tank. Handle the fuel in clean containers. Use No. 1 or 2 diesel fuel oil, cetane 40 minimum.
6. Check that all the drain plugs, drain cocks, filler openings, fuel lines, hydraulic lines, cooling system and the air cleaner connections are tight, and do not leak.
7. Check the tire pressures. See the specifications section for the proper air pressure. Be sure that the valve caps are in place to prevent dirt, moisture and foreign material from damaging the valve core.
8. Grease all the lubrication points of the entire unit. Refer to the lubrication section as a guide for the location, type and quantity of lubricant.



OPERATING CONTROLS

- | | |
|-----------------------------|---------------------------------|
| 1. Work and Travel Control | 11. Ammeter |
| 2. Brake Pedal | 12. Ignition |
| 3. Emergency Engine Stop | 13. Standard Engine Stop |
| 4. Hand Throttle (Optional) | 14. Light Switch (Optional) |
| 5. Brake Lock Switch | 15. Accelerator Pedal |
| 6. Brake Lock Light | 16. Winch Control |
| 7. Oil Pressure Gauge | 17. Forward and Reverse Control |
| 8. Water Temperature Gauge | 18. High and Low Gear Control |
| 9. Hourmeter | 19. Blade Control |
| 10. Oil Temperature Gauge | 20. Steering Control |

Fig. 3 Operating Controls

TS-7172

OPERATING CONTROLS

1. **Work and Travel Control Lever**—is located under and in front of the operator's seat assembly. The lever has three positions: Working range, Neutral and Travel range. These positions control high and low range in the transmission. Pulling the lever up engages the Travel range (transmission in high range). Pushing the lever down engages the Working range (transmission in low range).

It is important that when shifting the range control, the machine should be stationary and the forward-reverse control and the high-low control levers in the neutral position.

The Working range should be used when the machine is under load. The Travel range should be used when driving the machine without a load.

2. **Brake Pedal**—is located on the left side of the cockpit. Application of the brake pedal will provide braking to the drive line.
3. **Emergency Engine Stop**—is only to be used in case of an emergency. Misuse of this control may result in damage to the engine.
4. **Hand Throttle**—is located above the emergency stop control. Pull out to over-ride the accelerator pedal. When the desired engine speed is reached, pull out the hand throttle control and turn it one-quarter turn clockwise, to lock the engine speed at the desired setting. To return the engine speed to idle, turn the hand throttle control one-quarter turn counter-clockwise and push to its closed position.
5. **Brake Lock Switch**—will lock brake in the engaged position. To lock the brake, the following procedure must be followed:
 - a. Depress the brake pedal.
 - b. Push the lock-up button and release the brake pedal while still pushing the lock-up button. This will operate the shut-off valve, thus locking the brake.
 - c. Remove foot from the brake pedal.
 - d. Brake lock light will show the brake "On" signal.
 - e. To release the brake lock-up, depress the brake pedal sharply.

- f. Brake lock light must be off to indicate complete release of the brake.

DO NOT OPERATE THE MACHINE WHILE THE BRAKE LOCK LIGHT IS ON.

6. **Brake Lock Light**—located above the brake lock switch and will be on when the brake is applied.
7. **Oil Pressure Gauge**—indicates the oil pressure in the engine. Operating pressures are indicated in the rear of this manual.
8. **Water Temperature Gauge**—indicates the engine water temperature. Under normal operating conditions, the gauge should register between 170°F. and 185°F.
9. **Hourmeter**—shows the number of hours the engine has run.
10. **Oil Temperature Gauge**—indicates the temperature of the oil in the torque converter-transmission. When the temperature approaches 250°F. shift to a lower operating range.
11. **Ammeter**—indicates the charge or discharge rate of the electrical system.
12. **Ignition Switch**—is located on the right hand side of the firewall assembly. The switch has two positions. The first position will energize the electrical circuit; the second position will energize the starting motor.

Do not crank the engine for more than 30 seconds to avoid damage to the cranking motor. Pause a few minutes between each cranking if hard starting is encountered.
13. **Standard Engine Stop**—should be used to stop the engine in normal circumstances. To stop the engine, pull the stop handle out and hold until the engine has stopped. Then push the stop handle in and return the ignition switch to the "Off" position. Before re-starting the engine, always make sure the engine stop handle has been pushed completely in.
14. **Light Toggle Switch**—is located under the instrument panel, at the right of the operator's compartment. Lift up the switch to operate the head and tail lights.

15. **Accelerator Pedal**—this pedal will control the engine speed.
16. **Winch Control**—has three positions. Handle down is the “Free-Spooling” position necessary for paying out the main line. In this position both the winch brake and clutch are released. Handle in neutral is “Skidding” position; the brake is on and the clutch is off. Handle up is “Winching In” position; the brake is off and the clutch is on.
17. **Forward-Reverse Control Lever**—Provides three positions, Forward, Neutral and Reverse to control the direction of the machine travel. Pushing the lever forward permits the machine to travel forward; pulling the lever backwards permits the machine to travel backwards.

Caution: Do not use the engine as a down-hill brake by operating the vehicle with the transmission in reverse.

When the down-hill speed critically over-runs the torque converter input speed, the converter changes from a maximum 3:1 ratio to a 1:1 ratio and causes the engine to stall. No operator can determine when this occurs.

CLARK SHALL NOT BE LIABLE FOR ANY CONTINGENT OR SPECIAL DAMAGES OR LIABILITIES, OR FOR FAILURES IN, NOR DAMAGE TO, OR DEFECTS IN, ANY PRODUCT, ARISING OUT OF THE USE OF THE ENGINE AS A DOWN-HILL BRAKE.

18. **High and Low Gear Control Lever**—provides three positions, Low, Neutral and High to control

the travel speed of the machine. Pushing the lever forward engages the lower speed range, pulling the lever backward engages the higher speed range. The combination of high-low control and the work and travel control makes available a choice of four speed ranges providing selection of power requirements for any operating condition. First and second speed ranges are obtained by selecting Work range and shifting the high-low control lever from low to high. Third and fourth are obtained by selecting Travel range and shifting the high-low control lever from low to high.

19. **Blade Control Lever**—controls the up and down movement of the utility blade. Pushing the lever forward will lower the blade. Pulling the lever backward will raise the blade. By letting the lever return to the neutral position, any desired position of the blade will be maintained.

Caution: Do not hold the blade control in the open position after the blade has reached its full travel limits either up or down.

20. **Steering Control Lever**—controls the turning of the machine to the left and right. To steer to the right, pull the lever backward. To steer to the left, push the lever forward. The steering valve incorporates “fine metering” for sensitive steering control during the first one inch of lever travel in either direction. Full lever travel will provide full pump delivery for fast turning.

Caution: Do not hold the steering lever in the open position after the vehicle has reached its full turn position.

OPERATING INSTRUCTIONS

After the machine has been properly checked, and the operator has familiarized himself with the location and function of the various controls, the machine should be operated according to the instructions in the following paragraphs.

SAFETY PRECAUTIONS

A careful and efficient operator of equipment of this nature must be guided by simple and fundamental rules of safety. He must take the necessary precautions to insure the safety of others as well as himself, and must avoid careless operating habits which cause damaging accidents to the machinery and equipment.

The use of this machine is subject to certain hazards that cannot be met by mechanical means, but only by the exercise of intelligence, care, and common sense.

The following are a few of the primary sources of injury to operators and other workmen.

1. Repairing and servicing the equipment in dangerous positions.
2. Striking other persons or vehicles with the machine.
3. Unexpected violent tipping of the equipment.
4. Unexpected violent shocks or jars to the machine.
5. Uncontrolled traffic involving other vehicles.
6. Hazards from limbs of trees or overhead obstructions.
7. Leaving equipment in dangerous positions, unattended.

In order to help prevent accidents the following safety rules should be observed at all times.

Do Not Park the Machine Unattended—Do not park the machine unattended with the engine running. Always place the control levers in neutral, lower the blade, apply the brake lock-up, and shut down the engine before leaving the operator's seat.

Never Park the Machine With the Blade In the Air—Never park the machine without first lowering the blade so that it rests on the ground. Make sure all the control levers are in the neutral position and the engine shut down.

Avoid Greasy Hands and Floors—Keep hands, floor, and controls free from water, grease, and mud to insure non-slip control.

Never Get On or Off a Machine in Motion—Never get off or on a machine that is in motion. Positively in no case should anyone ride on the blade, or on the outside of the machine.

Stop the Machine to Lubricate or Adjust—Stop all operation and shut down the engine when cleaning, adjusting or lubricating the machine. Tie a red WARNING tag on the steering control lever and remove the key from the ignition switch.

Always Apply the Brake Lock-Up to Hold the Machine when Parked—Set the brake lock-up button when parking the machine. If on a grade, block the wheels.

Maintain the Correct Tire Inflation—Check the tire inflation pressure daily to provide the best operation and the longest tire life. Particular attention must be emphasized when checking hydro-inflated tires as there is less volume of air to provide cushioning.

Select the Correct Speed Range—Operate the machine at speeds consistent with the conditions on the particular job. Extra caution should be used if wet or icy conditions exist.

Do Not Use the Blade as a Brake—When going down a steep slope, do not use the blade as a brake.

Caution: *Do not use the engine as a down-hill brake by operating the vehicle with the transmission in reverse.*

Check Before Moving the Machine—Walk around the machine to make certain that no one is in the "danger area" before entering the operator's compartment.

Do Not Operate the Machine Without Instruments—Each gauge and warning light on the instrument panel serves as an important check point for operating conditions of the machine. Do not operate the machine if the gauges are not functioning properly.

Be Courteous—Always give loaded equipment the right of way.

PRE-STARTING CHECKS

Before starting the engine at the beginning of the work shift, or at any time the machine has been shut down for adjustment or time-off period, perform the following checks:

1. Engine oil level.
2. Engine air cleaner.
3. Hydraulic system oil level.
4. Cooling system.
5. Fuel supply.
6. Transmission fluid level.
7. Tire pressures.
8. Battery electrolyte levels.

Service units at this time if inspection indicates the necessity.

NORMAL STARTING (Above 40°F.)

Caution: Walk around the machine. Make certain that no one is in the "danger area" before entering the operator's compartment.

1. Set the control levers (forward and reverse and high and low gear control levers) in NEUTRAL.
2. Make sure that the engine stop control is pushed in.
3. Turn the ignition switch to the first position, then turn again to start the engine. Do not crank the starting motor more than 30 seconds at a time to avoid overheating the motor.

Caution: If the engine fails to start, wait until the cranking motor stops rotating before repeating the starting operation. Serious damage may result if this precaution is not followed. If the engine fails to start after four periods of cranking, refer to the operation and maintenance manual of the engine manufacturer.

4. After the engine starts, check the oil pressure gauge. If no pressure is indicated within 15 seconds, shut off the engine and determine the cause.
5. Allow the engine to reach operating temperature before driving or operating the machine.

COLD WEATHER STARTING

The Ranger does not require extensive preparation for cold weather operation beyond the addition of a permanent type anti-freeze to the cooling system. The batteries must be kept fully charged at all times, since in cold weather the capacity of a battery to deliver full power is greatly reduced. A fully charged battery at 15°F. is capable of delivering only 70% of its rated amperage, and at lower temperatures becomes even more inefficient. Service the batteries weekly as follows:

1. Add distilled water to cover the plates but do not overfill. Overfilling causes dilution of the electrolyte, and sputtering during the charging cycle. This may result in the battery freezing and the terminals corroding.
2. Keep the terminals clean and the connections tight. Dirty or loose connections offer high resistance.
3. Keep the vent plugs in place, and tight, to prevent the entrance of foreign material into cells.
4. Check the specific gravity regularly with a hydrometer, and recharge or replace batteries that continually show a low reading.

Service the other electrical components as follows:

1. Visually check all the wiring for worn or cracked insulation and loose terminal connections.
2. Clean the connections of the cranking motor, alternator, voltage regulator, solenoid switch, relays and sender units.
3. Clean and tighten the external ground straps and replace if badly frayed or corroded.

To avoid unnecessary cranking because of air locks in cold fuel oil, change the fuel filters only when the engine is hot; then start and run the engine after the filter change, and check that there is no fuel restriction nor leakage.

When not in use, the machine should be parked or stored in a closed garage or building during cold weather to reduce the cranking effort when starting a cold engine. It is particularly important in starting the engine, that it is not accelerated to the governed speed, or a load applied until the oil has become warm enough to circulate to all bearing surfaces.

G.M. DIESEL (Below 40° F.)

G.M. Diesels are not equipped with cold weather starting aids. However, an ether dispenser kit can be obtained from either your Clark distributor or any authorized G.M. Diesel distributor.

1. Set all the control levers in **NEUTRAL** position and turn the ignition switch **ON**.
2. Depress the accelerator to the full throttle position.
3. Turn the ignition key starter switch and simultaneously direct the starting fluid into the air cleaner intake.

Do not operate the cranking motor for more than 30 seconds at a time to avoid overheating the motor.

Caution: If the engine fails to start, wait until the cranking motor stops rotating before repeating the starting operation. Serious damage may result if this precaution is not followed. If the engine fails to start after four periods of cranking, refer to the operation and maintenance manual of the engine manufacturer.

4. After the engine starts, check the oil pressure gauge. If no pressure is indicated within 15 seconds, shut off the engine and determine the cause.
5. Allow the engine to reach operating temperature before driving or operating the machine.

WARM-UP CHECKS

Hold the engine at idle speed for approximately two minutes after starting; then while the engine continues to warm up for the next few minutes, perform the following checks:

1. Engine oil pressure gauge.
2. Transmission fluid level (with the engine idling).
3. Ammeter.
4. Engine temperature gauge.
5. Fuel level.
6. Torque converter temperature gauge.
7. Water temperature gauge.
8. Hydraulic oil level.

Visually check for leaks at the drain and fill plugs in the axle assemblies, torque converter and transmission, and at all hose couplings and fittings in the hydraulic, fuel, air intake, brake and cooling systems. Correct all leaking conditions, and repair or replace the gauges that are not functioning before continuing the operation of the machine.

SHUTTING DOWN THE ENGINE

It is important to idle the engine 3 to 5 minutes before shutting it down. This will allow the lubricating oil and water to carry heat away from the

combustion chambers, cylinder head, bearings, and shafts.

Residual heat can damage many parts, ranging from valves to fuel pumps. The latter suffer from gums and deposits remaining after vapourization of the lighter ends. In addition, the physical stresses from expansion and contraction can cause distortion, permanent warping, and gasket failures. In some cases, the oil seals and the cylinder sleeve seals suffer badly, although the results may not appear until much later.

IT IS GOOD PRACTICE TO IDLE ANY ENGINE LONG ENOUGH TO REDUCE EXTREME TEMPERATURES.

G.M. DIESEL

To shut down a G.M. Diesel, turn the ignition switch off; then pull the standard engine stop control, (this operation cuts off the fuel supply). Hold this control out until the engine stops operating. After the engine has stopped, replace the control to its original position. (Refer to Fig. 3 on page 3 for the position of the standard engine stop.)

If after pulling the standard engine stop control, the engine continues to operate the emergency engine stop must be used.

By pulling the emergency engine stop control, the air supply to the engine is cut off, thus choking and stopping it. (Refer to Fig. 3 on page 3 for the position of the emergency engine stop.)

When this operation has been performed, it will be necessary to re-set the butterfly plate located in the engine air intake. To do this, the right hand side panel, (looking from the operator's seat), must be removed, thus exposing the emergency stop cable, lower arm, and latch. After the emergency engine stop control has been used, the latch handle will have rotated in a counter-clockwise direction to the position shown in Fig. 4.

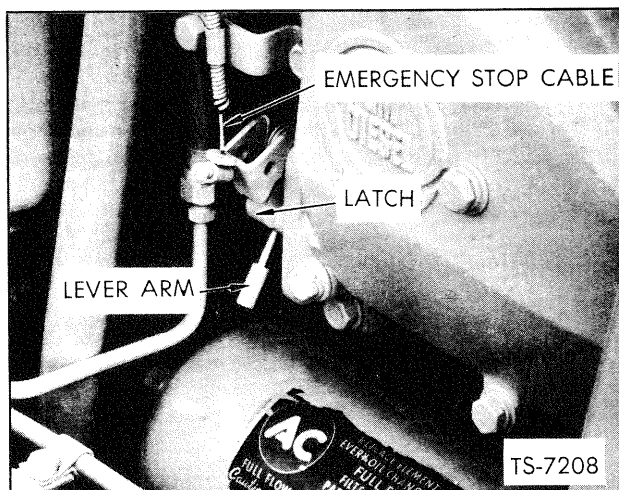


Fig. 4 Latch Handle Rotated

To re-set, push the latch handle clock-wise towards the engine thus rotating the latch until the lever arm springs into place on the latch, as shown in Fig. 5.

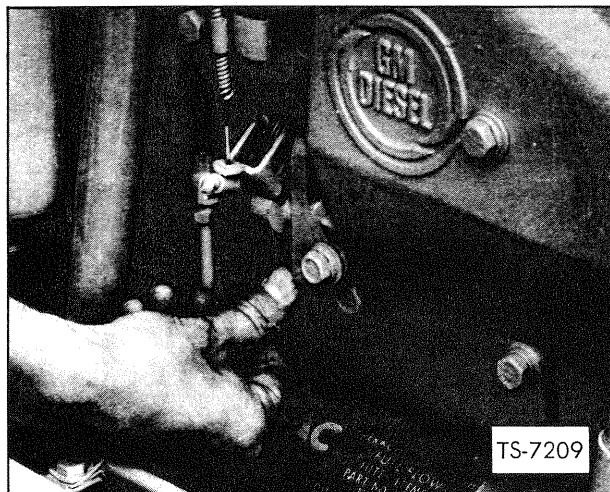


Fig. 5 Resetting the Latch Handle

This operation re-opens the butterfly plate, allowing air to pass through to the engine.

OPERATING THE RANGER

The steps below give the correct procedure for setting the machine into motion:

1. Raise the blade to its maximum height, by pulling backward on the blade control lever.
2. When operating the machine without a load, the travel range should be selected. This gear should be selected with the machine stationary and the directional and high and low gear control lever in neutral.
3. Place the Forward and Reverse control lever in position for the desired travel direction. When shifting from forward into reverse, or vice-versa, always decrease the engine rpm. and stop the machine momentarily while making the shift.
4. Depending on the terrain, the operator should select either high or low gear.

High range should be used when roading the machine on smooth pavement for comparatively long distances without a load.

A shift from low range to high range can be made while the machine is in motion, by momentarily letting up on the accelerator, making the shift, and again depressing the accelerator.

When making a downshift, accelerate the engine to synchronize the engine and drive shaft speeds when the transmission clutch re-engages.

There are available to the operator a selection of four speeds in both the forward and reverse direction. This is accomplished by use of the range shift lever and the speed range shift lever. A choice of low or high speed is possible in both working range and in travel range.

5. Release the brake lock-up. This is done by depressing the brake pedal sharply and releasing, making sure that the brake light goes out.
6. Depress the accelerator pedal.

TOWING THE MACHINE

If at any time it is necessary to tow the machine any appreciable distance, observe the following precautions:

1. Set all the control levers in neutral.
2. Remove both the propeller shafts from the transmission to the front axle assembly and from the transmission to the brake.

Important: Note the correct assembly of the propeller shafts before removing them. Reassemble them in the same position. (The tubular end is always the driving end.) Do not separate the two ends of the assembly due to the wear pattern and balancing characteristics. Wire the spider and bearing assemblies to the propeller shaft flanges and wrap the assemblies in a lint free cloth.

When the machine is being towed, the torque converter charging pump is not operating. There is a danger of bearing or gear damage in the torque converter and transmission if the propeller shafts are not removed.

When replacing the propeller shafts, use only the special heat treated nuts and bolts provided. Tighten the attaching bolts to 55 ft. lbs. torque.

LUBRICATION AND MAINTENANCE

This section of the manual is divided into two major categories—LUBRICATION and MAINTENANCE.

The lubrication portion contains the Chassis lubrication chart, the Drive Line lube chart, and the recommended intervals at which the machine should be serviced such as daily or shift, weekly or 50 operating hours, up through a 1,000 operating hour schedule.

Lubrication is maintenance, but the items described in the lubrication portion are only those that pertain to the actual greasing or oiling of the machine, including the level checks and the drain and refill procedures.

The importance of correct lubrication cannot be over-emphasized. It is the most essential single factor in a well planned preventive maintenance program. Refer to the lubrication diagrams to locate the various points to be serviced. Before servicing the machine, always wipe the dirt and foreign material from the grease fittings, clips, plugs or covers to prevent dirt, grit or foreign material from entering the system.

The lubrication diagrams are divided into two groups covering:

1. General Chassis.
2. Drive Line.

Frequency of servicing the chassis is indicated as required every 8, 50, 100, 250, 500 and 1,000 hours of operation. Frequency of servicing the drive line is indicated as required every 8, 50, 100, 250, 500 and 1,000 hours of operation.

Be sure the machine is level when checking the various lubricant levels.

The maintenance portion contains recommended mechanical checks and adjustments over and above those listed in the lubrication portion.

The maintenance schedule is based on the recorded hours of a normal operation. A more practical schedule should be developed for each job application. Make the appropriate changes in the fundamental schedule as required based on the type of conditions the machine has to encounter, the rate at which it is worked, and how it is being worked.



NOTES

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CHASSIS LUBRICATION

		HOURS						KEY
		1000	500	250	100	50	8	
1	Steer Cylinder Pin — Rear					•		LBG
2	Steer Cylinder Pin — Front					•		LBG
3	Pivot Hinge Pin — 1 each top and bottom					•		LBG
4	Transmission Levers — 2					•		LBG
5	Winch Control					•		BA
6	Transmission Work — Travel Range Lever Bushing				•			LBG
7	Brake Pedal Bushing				•			LBG
8	Master Cylinder					•		BA
9	Engine Governor Lever					•		LBG
10	Utility Blade Pins — 2					•		LBG
11	Utility Blade Cylinder Pins — Front					•		LBG
12	Axle Cradle Bushings — 2					•		LBG
13	Utility Blade Cylinder Pins — Rear — 2					•		LBG
14	Oil Reservoir	*	•	•			•	TA
15	Steering and Blade Control Levers					•		LBG

LUBRICATION KEY

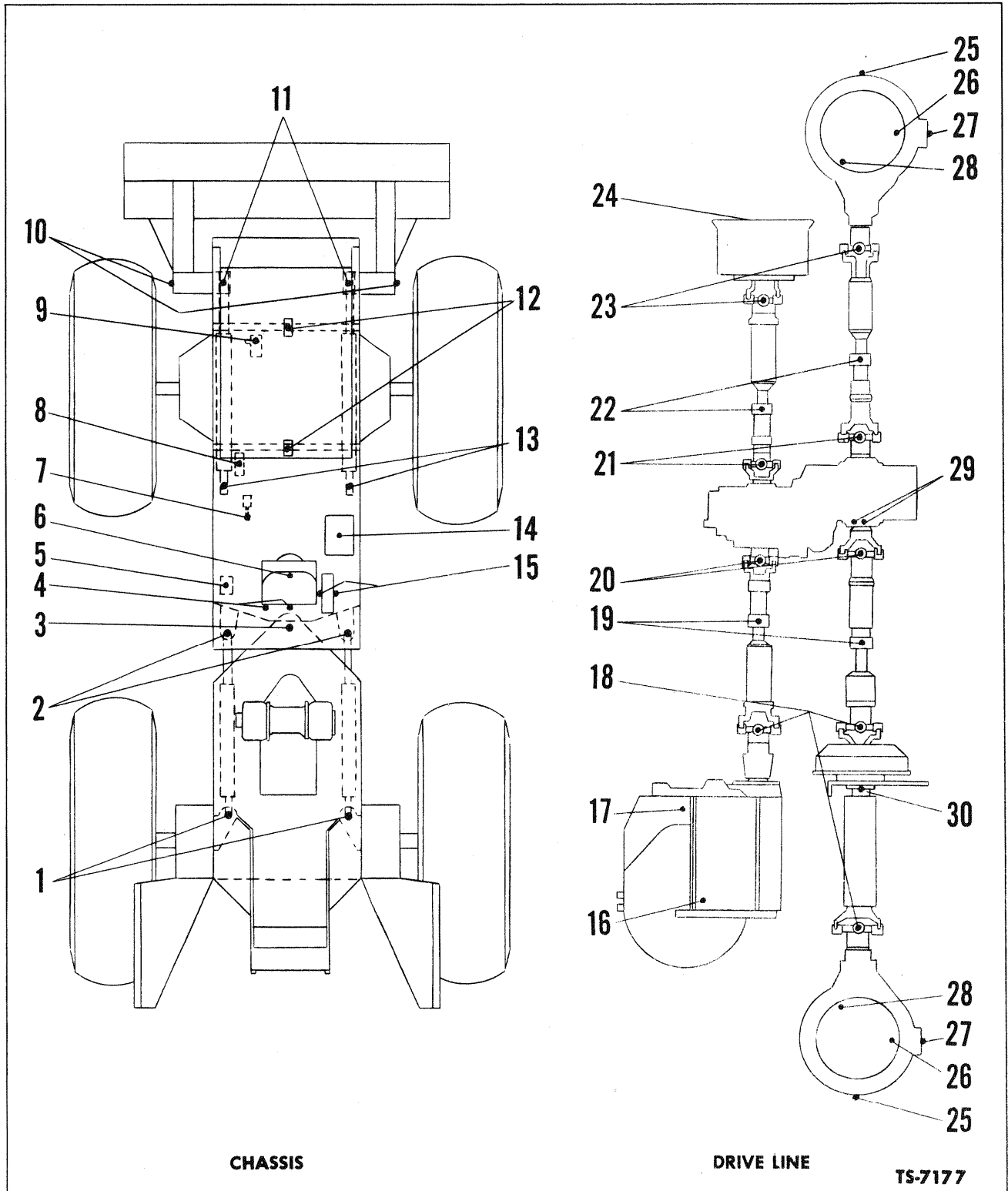
LBG	Lithium Base Multi-Purpose Grease 0°F. and Above — Grade 2 Below 0°F. Grade 0		
EPGL	Extreme Pressure Gear Lube (**SCL Type)		
TA	Ambient Temp. Range	Lubricant to be used	
		SAE Grade	API Class Military Spec.
	1) Above 0°F.	10W	+ MS DM MIL-L-2104A, Supp. 1 or New MIL-L-2104B
	2)	Type A, Suffix A, Automatic Trans. Fluid	
	Below 0°F.	Type A, Suffix A, Automatic Trans. Fluid	
		† Sequence Tested	
BA	Heavy Duty Brake Fluid		
DA	Shell Darina "AX" Grease		

**"SCL" signifies Sulfo-Chloro-Lead type. Factory fill is made with SCL type lube and it is recommended that the same type be used when adding or refilling.

DRIVE LINE LUBRICATION

		HOURS						KEY
		1000	500	250	100	50	8	
16	Winch	*	•				•	EPGL
17	Winch Adapter	*	•				•	EPGL
18	Universal Joint				•			LBG
19	Slip Joint				•			LBG
20	Universal Joint				•			LBG
21	Universal Joint				•			LBG
22	Slip Joint				•			LBG
23	Universal Joint				•			LBG
24	Torque Converter	*	•	•			•	TA
25	Differential Check Plug	*	•			•		EPGL
26	Planetary Check Plug	*	•			•		EPGL
27	Differential Drain Plug	*	•					EPGL
28	Planetary Drain and Fill Plug	*	•			•		EPGL
29	Transmission		•	•			•	TA
30	Pillow Block	*	•					DA

* — See Text.



LUBRICATION

8 Hour Lubrication Operations

Grease Fittings: Lubricate all points indicated on the Chassis and Drive Line Lubrication charts for 8 hour intervals with Lithium Base Multi-Purpose Grease. Use the grade of lubricant specified below according to ambient temperatures.

Temp. Range	Grease Consistency
0°F. and Above	Heavy oil base—Grade 2
Below 0°F.	Light oil base —Grade 0

Engine and Accessories: Refer to the Operation and Maintenance Manual of the engine manufacturer for lubrication and maintenance instructions of the engine and its accessories.

Hydraulic Reservoir: Check the oil level daily observing the following conditions:

1. Machine must be LEVEL.
2. Blade must be on the GROUND.
3. Engine must be SHUT DOWN.
4. Area around the reservoir cap must be CLEAN.

Remove the reservoir cap and dipstick and wipe with a clean, lint-free cloth. Replace the cap and dipstick to check the oil level. Maintain the oil level to the FULL mark on the dipstick. See Fig. 6.

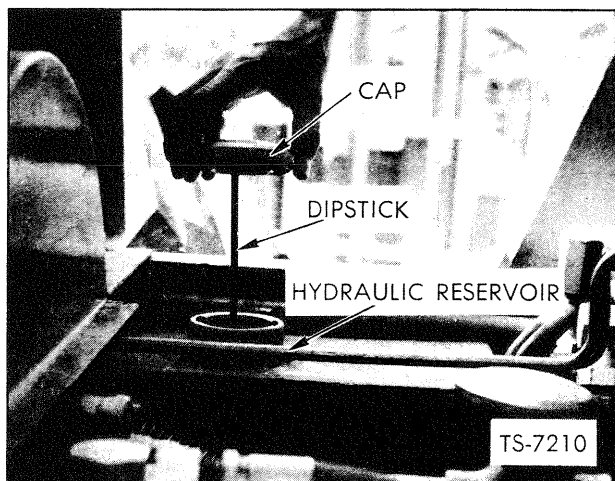


Fig. 6 Hydraulic Reservoir, Cap and Dipstick

NOTE: The same type of combination cap and dipstick is used on both the fuel tank and hydraulic oil reservoir. One side of the dipstick is graduated for oil, the other side for fuel. Make sure the correct side is read for each reservoir.

Type A suffix A automatic transmission fluid is applicable in all temperatures. In order to prevent pump wear at high speeds and high pressures, anti-scuff or anti-wear additives are contained in this lubrication specification.

See "500 Hour Lubrication Operations" for replacing the Hydraulic Filter Assembly Element, and "1,000 Hour Lubrication Operation" for the Drain and Refill of the reservoir.

Radiator: Check daily and refill as required with clean, soft water. See "Every 1,000 Operating Hours" for Drain and Refill of the radiator.

Torque Converter and Transmission: Check the fluid level daily, observing the following conditions:

1. Machine must be LEVEL.
2. Fluid must be HOT (operating temperature of 180°F. to 200°F.).
3. Engine must be IDLING (550 to 600 rpm.).
4. Area around the filler opening must be CLEAN.
5. Transmission must be in NEUTRAL.
6. Brake lock must be ON.

- a. On Ranger 664, serial numbers C-9014-101 through 150 and Ranger 666 serial numbers C-9016-101 through 111.

Turn the machine sharply to the left. Remove the lower of the two plugs located on the lower right hand side of the transmission case. If the fluid is below the plug opening, refill the torque converter and transmission with Type A automatic transmission fluid, through the fill plug opening in the converter housing, until the fluid level is at the lower edge of the high level plug in the transmission case. The approximate capacity is 4.5 galls (Imperial measure), 5.4 gallons (U.S. measure).

- b. On Ranger 664 serial numbers C-9024-101 and beyond and Ranger 666 serial numbers C-9026-101 and beyond.

Remove the floorboard in the operator's compartment and pull out the dipstick, (See Fig. 7 for the position of the dipstick.). Wipe the dipstick with a clean, lint-free cloth and re-insert to check the fluid level, pushing the dipstick down firmly. The fluid level must be at the FULL mark on the dipstick. If the fluid level is below the FULL mark, refill as necessary.

Use only type "A" Automatic Transmission Fluid. See "250 Hour Lubrication Operations" for filter change, and "500 Hour Lubrication Operations" for Drain and Refill.

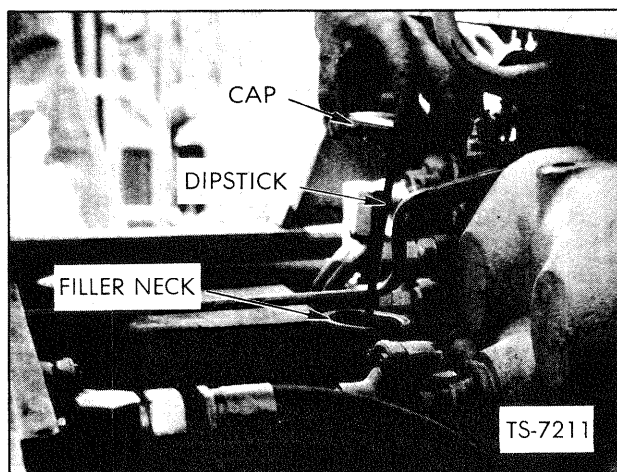


Fig. 7 Transmission Filler Neck, Cap and Dipstick

Fuel Tank: Check the fuel level several times each day observing the following conditions:

1. Machine must be **LEVEL**.
2. Engine must be **SHUT DOWN**.
3. Area around the fuel cap must be **CLEAN**.

Remove the fuel tank cap and dipstick located at the rear of the machine below the fair-lead. Wipe with a clean, lint-free cloth and reinsert to check the fuel level. Refill as necessary to the **FULL** mark on the dipstick using a good brand of fuel procured from a reliable company. For the most operating conditions No. 1 or 2 Diesel Fuel Oil, Cetane 40 minimum is recommended. For unusual operating conditions with regard to the load, speed, idling time or ambient air temperature refer to the fuel oil specifications recommended by the engine manufacturer.

NOTE: The same type of combination cap and dipstick is used for both the Fuel tank and Hydraulic Oil reservoir. One side of the dipstick is graduated for oil, the other side for fuel. Make sure the correct side is read for each reservoir.

When operating in temperatures of 32°F. and below, the fuel tank should be filled when the machine is shut down, to prevent condensation.

It is advisable to drain a pint of fuel from the fuel tank and approximately one quarter pint of fuel from the filters daily to remove the sediment and water. Drain cocks are provided at the fuel tank and at the bottom of the fuel filters.

In temperatures above 32°F. the fuel tank should be filled at the end of the shift. Before starting the engine at the beginning of the shift, similar amounts as described above should be drained from the tank and filters.

Tires: Check air pressure in all tires. See the Specifications and Service Data on Page 40 for the correct air pressures. Be sure the valve caps and protector caps are replaced securely.

Keep the tires free from oil and grease, and repair any cuts immediately to prolong the tire life. Check the tire pressure in the morning when the tires are cold. Do not remove the increased pressure caused by operation.

Winch: Check the oil level daily. When adding oil, remove the filler plug, located on the top left hand side of the winch. Also remove the oil level plug, located on the bottom left hand side of the winch. Fill to the bottom of the oil level plug hole. Use SAE 75 EP gear lube or SAE 90 EP gear lube. See "500 Hour Lubrication Operations" for Drain and Refill.

Winch Adapter: Check the oil level daily. When adding oil, remove the filler and check plug located on the front right hand side of the winch. Fill to the bottom of the fill plug hole, use SAE 75 EP gear lube or SAE 90 EP gear lube. See "500 Hour Lubrication Operations" for Drain and Refill.

SERVICE WEEKLY

50 Hour Lubrication Operations

Grease Fittings: Lubricate all points indicated on the Chassis and Drive Line Lubrication Charts for 50 hour intervals with Lithium Base Multi-Purpose Grease. Use the grade of lubricant specified below according to ambient temperatures.

Temp. Range	Grease Consistency
0°F. and Above	Heavy oil base—Grade 2
Below 0°F.	Light oil base —Grade 0

Engine and Accessories: Refer to the Operation and Maintenance Manual of the engine manufacturer for lubrication and maintenance instructions of engine accessories.

Air Cleaner: A Farr Pamic dry type air cleaner is installed under the instrument panel. This air cleaner is a high efficiency single stage dry type, consisting of a moisture eliminator, and a strainer type filter element. The moisture eliminator and filter element are held together in a steel housing complete with mounting brackets, fasteners, and outlet air connections. The element is equipped with a seal to provide positive sealing between the moisture eliminator and filter element. The air enters the moisture eliminator through a slotted panel located under the instrument panel. Any entrained

moisture is removed before the air enters the element. The air is filtered as it passes through the pleats of the impregnated paper element before entering the engine air intake housing.

It is essential that a weekly check be made of all hoses and pipes between the air cleaner and engine for cracks or leaks, which will permit dust-laden air to by-pass the air cleaner and enter directly into the engine. Serious and costly damage will result.

Tighten all hose clamps and air cleaner mounting bracket bolts. Note any sign of damage that might impair the operating efficiency and keep the cleaner panel free of obstructing material such as leaves, twigs or rags.

The impregnated paper filter element is very efficient and its service life will be governed by the operating conditions. The element should be changed every 500 hours. But, again, under severe conditions, its life will be reduced. A service indicator is available for the filter and can be ordered as an accessory.

Batteries: Batteries are located in the battery compartment below the floorboard at the left side of the machine. Keep the terminals clean and the connections tight, and be sure that when distilled water is added, all the plates are covered. Do not overfill.

Front Axle Differential: Check the lubricant level each 50 operating hours at the differential fill and level plug in the left center of the axle assembly. Add SAE 90 or SAE 75 Extreme Pressure Gear Lube (*SCL Type) until the lubricant is level with the plug opening.

See "1,000 Hour Lubrication Operations" for Drain and Refill.

Front Axle Planetary Hubs: Check the lubricant level each 50 operating hours at fill and level plug located slightly off center of the thrust cap. The drain plug is located in the external diameter of the hub and drum assembly. Rotate the wheel until the drain plug is at the top center; this will position the fill and level plug in the thrust cap slightly below the center of the wheel.

Remove the fill and level plug and check the lubricant level. If necessary, add SAE 90 EP or SAE 75 EP gear lube (*SCL Type) through the fill and level plug opening.

See "1,000 Hour Lubrication Operations" for Drain and Refill.

*"SCL" signifies Sulfo-Chloro-Lead type. Factory fill is made with SCL type lube and it is recommended that the same type be used when adding or refilling.

Rear Axle Differential: Check the lubricant level each 50 operating hours at the differential fill and level plug in the left center of the axle assembly. Add SAE 90 EP or SAE 75 EP gear lube (*SCL type) until the lubricant is level with the plug opening.

See "1,000 Hour Lubrication Operations" for Drain and Refill.

Rear Axle Planetary Hubs: Check the lubricant level each 50 operating hours at the fill and level plug located slightly off center of the thrust cap. The drain plug is located in the external diameter of the hub and drum assembly. Rotate the wheel until the drain plug is at the top center; this will position the fill and level plug in the thrust cap slightly below the center of the wheel.

Remove the fill and level plug and check the lubricant level. If necessary, add SAE 90 EP or SAE 75 EP gear lube (*SCL Type) through the fill and level plug opening until the lubricant is level with the plug opening.

See "1,000 Hour Lubrication Operations" for Drain and Refill.

Torque Converter and Transmission Breathers: The torque converter and transmission hydraulic system is equipped with breathers at two points. The breathers are located on the right hand side of the torque converter and on the transmission control valve.

Each 50 operating hours unscrew the breathers, wash in a solvent, blow dry with compressed air and reinstall.

Fuel Tank and Hydraulic Reservoir Breathers: The fuel and hydraulic systems are equipped with breathers. The breather for the fuel tank is located on the inside of the right hand side of the fairlead. The breather for the hydraulic reservoir is located next to the torque converter-transmission hydraulic filter.

Each 50 operating hours, unscrew the breathers, wash in a solvent, blow dry with compressed air and reinstall.

Fuel System: Check all fuel lines, fuel pump, filters and shut off cocks for leaks and correct where necessary.

Brake Master Cylinder: Remove the left hand engine compartment side panel. The master cylinder is located just ahead of the firewall. Maintain the fluid level to within 1/4 inch from the top of the reservoir. Add only, do not change the fluid.

The vent hole in the filler cap must be open at all times.

SERVICE PERIODICALLY

Check and service the following items at intervals as specified.

100 Hour Lubrication Operations

Grease Fittings: Lubricate all points indicated on the Chassis and Drive Line Lubrication Chart for 100 Hour intervals with Lithium Base Multi-Purpose Grease. Use the grade of lubricant specified below according to ambient temperatures.

Temp. Range	Grease Consistency
0°F. and Above	Heavy oil base—Grade 2
Below 0°F.	Light oil base —Grade 0

Propeller Shafts: There are five propeller shafts in the Ranger's drive line assembly, one from the torque converter to the transmission, one from the transmission to the brake, one from the brake to the rear drive axle, one from the transmission to the front drive axle and one from the transmission to the winch. Each shaft has three points of lubrication, one on each spider and bearing assembly, and one on the slip yoke assembly, except the shaft from the brake to the rear drive axle which has only one lubrication point (the spider and bearing assembly). Use a hand gun and apply Lithium base Multi-Purpose Grease, (LBG), be careful not to blow the seals; grease sparingly until the grease is visible at all the four bearing caps on each spider and bearing assembly. Use the grade of lubricant specified below according to ambient temperatures.

Temp. Range	Grease Consistency
0°F. and Above	Heavy oil base—Grade 2
Below 0°F.	Light oil base —Grade 0

250 Hour Lubrication Operations

Engine and Accessories: Refer to the Operation and Maintenance Manual of the engine manufacturer for the lubrication and maintenance instructions of the engine and its accessories.

Torque Converter and Transmission Filters: The torque converter and transmission hydraulic system is protected by a full flow 55 micron replaceable element type filter assembly. The filter is bracket mounted on the right hand side at the rear of the engine compartment. All fluid leaving the converter pump passes through the filter providing clean fluid to the torque converter and transmission.

Replace the filter element every 250 operating hours and whenever the converter pump, transmission or torque converter is repaired or overhauled for any reason. Thoroughly clean the filter case and

base casting, before inserting a new element. Use new gaskets in the base casting, tighten the center bolts to 50 ft. lbs. torque.

Run the engine 5 minutes at approximately 1,500 rpm. checking the assembly, hoses and connections for leaks. Re-check the transmission fluid level when it is at operating temperature (180°F. to 200°F.) as described under "8 Hour Lubrication Operations".

Note: The filter element is especially designed to withstand the pressure and flow rate requirements. Use only the replacement filter element called for in the applicable Parts Manual. Use of a "will-fit" or a substitute element will endanger the correct operation of the transmission and torque converter and cause costly repairs and down time.

500 Hour Lubrication Operations

Engine and Accessories: Refer to the Operation and Maintenance Manual of the engine manufacturer for the lubrication and maintenance instructions of the engine and its accessories.

Axle Breathers: The breather for the front axle housing is located at the top on the left hand side. The rear axle housing breather is located at the top on the right hand side. The housing breathers have a loose fitting cap that should be rotated so that the breather air passages are unobstructed by foreign material.

Oil leakage past the breathers, thrust caps, carrier housing or pinion cap seals indicates that the breathers may be clogged. Unscrew the breathers, wash in a solvent, dry and reinstall.

Transmission and Torque Converter: Drain and refill the transmission and torque converter hydraulic system every 500 operating hours and whenever, for any reason, the converter pump, transmission or torque converter is repaired or overhauled.

1. Always drain the system while the fluid is at the operating temperature (180°F. to 200°F.). Hot oil flows more freely and carries more foreign material with it.
2. Remove the drain plug from the transmission housing and torque converter and drain both the torque converter and transmission housings thoroughly.
3. Remove the transmission suction screen, clean in a solvent, dry, and reinstall using a new "O" ring. Clean the magnetic drain plug and reinstall.

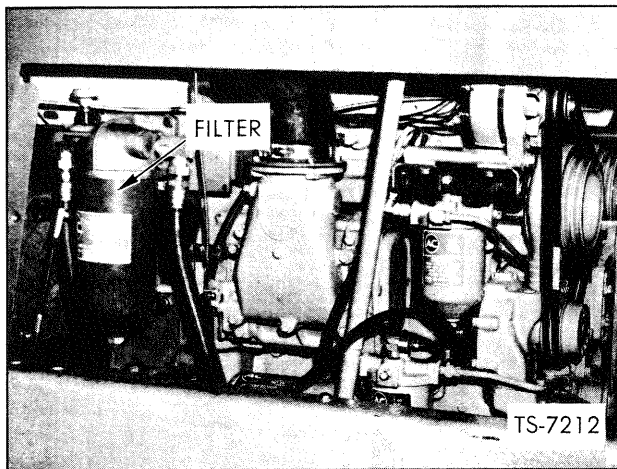


Fig. 8 Transmission and Torque Converter Filter Position

4. Replace the element in the transmission and torque converter filter assembly. (See Fig. 8 for the position of the filter assembly.) Thoroughly clean the filter case and base casting before installing a new element. Use a new gasket in the base casting and tighten the center bolt to 50 ft. lbs. torque.
5. Remove the breathers from the left hand side of the torque converter and the transmission top right distributor bearing cap. Wash in a solvent, blow dry with compressed air and reinstall.
6. (a) On Ranger 664 serial numbers C-9014-101 through 150 and Ranger 666 serial numbers C-9016-101 through 111.

Refill the transmission and torque converter with Type A automatic transmission fluid through the fill plug opening in the converter housing until the fluid level is at the lower edge of the high level plug in the transmission case. Approximate capacity: 4.5 gallons (Imperial Measure); 5.4 gallons (U.S. Measure).

6. (b) On Ranger 664 serial numbers C-9024-101 and beyond and Ranger 666 serial numbers C-9026-101 and beyond.

Refill the transmission and torque converter with Type A Automatic transmission fluid through the filler neck (See Fig. 7 on page 15) until the correct level shows on the dipstick. Approximate capacity—4.5 gallons (Imperial measure), 5.4 gallons (U.S. measure).

7. Disconnect the return oil cooler line hose from the cooler line (located behind the radiator on the right hand side of the machine) and direct

the open end into a waste drum with a capacity of at least 3 gallons (Imperial measure); 3.6 gallons (U.S. measure).

8. Securely block the wheels of the machine and apply the brake lock-up. Place the high and low gear control lever in high speed range and the forward and reverse control lever in FORWARD.

Caution: Draining the trapped oil in the converter cavity and oil cooler can be accomplished within 60 seconds with the return oil cooler line disconnected. Serious damage to the transmission will result if this precaution is not complied with.

9. Start the engine and maintain an idling speed (550 to 600 rpm.) to force any trapped oil in the torque converter and oil cooler out through the open end of the return oil cooler hose. Drain approximately 3 gallons (Imperial measure), 3.6 gallons (U.S. measure) of fluid to insure clean fluid flow; then shut down the engine immediately and reconnect the return oil cooler hose.
10. Refill the transmission, restart and run the engine for 5 minutes at approximately 1,500 rpm., checking the filter assemblies, drain plug, hoses and connections for leaks. Recheck the transmission fluid level when it is at operating temperature (180°F. to 200°F.). Add Type A Automatic Transmission Fluid as necessary.

This check is to be performed with the engine idling (550 to 600 rpm.). NEVER UNDER ANY CIRCUMSTANCES USE ANY FLUSHING OIL OR COMPOUNDS FOR CLEANING THE SYSTEM.

Service the Hydraulic Reservoir Filter: The main hydraulic (steering and blade) system is protected by a full flow 8 to 10 micron replaceable element type filter, located in the return line, at the bottom of the hydraulic reservoir. All fluid returning to the reservoir passes through the filter, providing clean fluid to the tank, to be distributed through the system.

Replace the element every 500 operating hours. Thoroughly clean the filter case and base casting, before inserting a new element. Use a new gasket in the base casting, tighten the center bolt to 50 ft. lb. torque. Run the engine 5 minutes, at approximately 1,500 rpm. and operate the steering and blade to check the filter assembly hoses and connections for leaks.

Note: The filter element is specially designed to withstand pressure and flow rate requirements. Use only the replacement filter called for in the applicable parts manual. Use of "will-fit" or substitute elements will endanger the correct operation of the steering and blade and cause costly repairs and down time.

Winch: Drain and refill the winch every 500 operating hours and whenever, for any reason, the winch is repaired or overhauled.

Remove the drain plug located at the bottom left hand side of the winch housing and drain the oil. Replace the drain plug securely and refill the winch through the filter plug located on the top left hand side of the winch, with SAE 75 EP gear lube or SAE 90 EP gear lube. Fill to the bottom of the oil level plug hole.

Winch Adapter: Drain and refill the winch adapter every 500 operating hours and whenever, for any reason, the winch adapter is repaired or overhauled.

Remove the drain plug located at the bottom right hand side of the winch adapter and drain the oil. Replace the drain plug securely and refill the adapter through the filler-check plug located at the front right hand side of the winch adapter, with SAE 75 EP gear lube or SAE 90 EP gear lube. Fill to the bottom of the filler check plug hole.

Service the Air Cleaner Filter Element: It should be understood that no set rule can be established to change the filter element because its service life is governed by the operating conditions. The optional warning signal will indicate the condition of the element and establish the change point. In severe dust conditions, it is recommended that the optional Roto-Pamic cleaner be installed.

NOTE: Extended operation of the machine without replacing the filter element will create excessive restriction resulting in high fuel consumption, excessive smoke, lower horsepower and poor acceleration.

Replacement of the paper filter element is described below:

Note: Do not attempt to clean or re-use the dirty filter element.

1. Loosen the fasteners that secure the air intake panel and remove the panel.
2. Remove the moisture eliminator.
3. Carefully remove the dirty filter element from the air cleaner housing and discard. Do not clean or re-use the dirty filter element.
4. Inspect the inside of the air cleaner housing for any foreign material and wipe clean if necessary.
5. Install a new filter element inside the air cleaner housing.
6. Position the moisture eliminator flush against the filter element and replace the air intake panel. Secure the assembly with the fasteners.

If the warning signal is used, manually reset the warning signal button by pushing up at the bottom center of the protective rubber boot. This will return the warning signal (red band) to its out-of-sight position.

1,000 Hour Lubrication Operations

Radiator: Twice a year, drain, flush and refill the cooling system. Add permanent type anti-freeze according to the manufacturer's instructions when the air temperature is 32°F. or lower, or when there is danger of the water freezing in the system. Always use a hydrometer to check the freezing point of solution when it is at operating temperature.

Hydraulic Reservoir: Drain, clean, and refill the hydraulic oil system every 1,000 hours of operation, or oftener if required. When operating under severe dusty and dirty conditions, clean the system more often to prevent excessive wear or premature failure of valve, pump, or cylinder parts.

1. Always drain the system after working the machine, and while the oil is at operating temperature. Hot oil flows more freely and carries more foreign material with it.
2. Raise the dozer blade to its maximum position and **SECURELY BLOCK IN PLACE** to facilitate draining of these cylinders.
3. Remove the drain plug in the handhole cover at the bottom of the reservoir and drain the reservoir.
4. Disconnect the steer and blade cylinder hoses at their lowest points to drain these cylinders.
5. Remove and replace the hydraulic reservoir filter element as specified under "Service the Hydraulic Reservoir Filter Assembly".
6. Remove the handhole cover from the bottom of the reservoir and clean all foreign material from the bottom of the tank. Remove the magnet inside the reservoir and clean thoroughly. Replace the magnet, then reinstall the handhole cover and drain plug securely.
7. Reconnect all hoses and unions.
8. Refill the reservoir to the indicated FULL mark on the dipstick. Make sure the reading is taken on the correct side of the dipstick. Reinsert the dipstick and secure the reservoir cap.
9. Be sure all the control levers are in **NEUTRAL** position. Start the engine and run it at an idling speed (550 to 600 rpm.) for a few minutes.
10. Place the blade control lever in maximum raise position to pump oil into the blade cylinders.

11. After the oil has ceased to aerate, add oil to the reservoir to bring the level to the indicated FULL mark on the dipstick. This will replace the oil drawn into the cylinders and hoses.
12. Check all connections for leaks and make certain the reservoir cap is properly secured.

NEVER UNDER ANY CIRCUMSTANCES USE ANY FLUSHING OIL OR COMPOUND FOR CLEANING THE SYSTEM.

Front Axle Differential: Drain the differential every 1,000 operating hours through the drain plug opening in the bottom center of the axle assembly. Refill the differential with SAE 90 EP or SAE 75 EP gear lube (*SCL Type) through the fill and gear level plug opening at the center of the axle assembly until the lubricant is level with the plug opening.

Front Axle Planetary Hubs: Drain the planetary hubs every 1,000 operating hours through the drain plug opening in the external diameter of the hub and drum assembly.

Rotate the wheel until the drain plug in the external diameter of the hub and drum assembly is at the top center; this will position the fill and level plug in the thrust cap slightly below center of the wheel.

Refill the planetary hubs with SAE 90 EP or SAE 75 EP gear lube (*SCL Type) through the fill and level plug opening in the thrust cap until the lubricant is level with the plug opening.

Rear Axle Differential: Drain the differential every 1,000 operating hours through the drain plug opening in the bottom center of the axle assembly. Refill the differential with SAE 90 EP or SAE 75 EP gear lube (*SCL Type) through the fill and level plug opening at the center of the axle assembly until the lubricant is level with the bottom of the plug opening.

*"SCL" signifies Sulfo-Chloro-Lead type. Factory fill is made with SCL type lube and it is recommended that the same type be used when adding or refilling.

Rear Axle Planetary Hubs: Drain the planetary hubs every 1,000 operating hours through the drain plug opening in the external diameter of the hub and drum assembly. Rotate the wheel until the drain plug in the external diameter of the hub and drum assembly is at the top center; this will position the fill and level plug in the thrust cap slightly below center of the wheel.

Refill the planetary hubs with SAE 90 EP or SAE 75 EP gear lube (*SCL Type) through the fill and level plug opening in the thrust cap until the lubricant is level with the plug opening.

Fuel Tank: Every 1,000 operating hours or often-er if required, drain and clean the fuel tank. The fuel tank should be drained and cleaned when the tank is relatively low on fuel.

1. Open the drain cock at the bottom of the filters, when provided, and drain off any accumulated water or sediment. Close the drain cock.
2. Open the drain cock at the bottom of the fuel tank, and drain.
3. Remove the cover and clean any foreign material from the bottom of the fuel tank. Remove the magnet from the bottom of the fuel tank and clean thoroughly. Replace the magnet and re-install the cover and close the drain cock.
4. Refill the fuel tank to the full mark on the dipstick with clean fuel handled in clean containers as specified under "Service Daily". Use a good brand procured from a reliable company. For most operating conditions, a No. 1 or 2 Diesel Fuel Oil, Cetane 40 Minimum is recommended. For unusual operating conditions with regard to load, speed, idling time or ambient air temperature refer to the fuel oil specifications recommended by the engine manufacturer.

Wheel Nuts: Wheel nuts should be checked regularly and kept tight. Apply lubricant on threads of wheel studs only and tighten wheel nuts to 475 ft. lbs. torque.



NOTES

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MAINTENANCE SCHEDULE

SYSTEM	OPERATION	TIME INTERVAL (Hours)					
		8	50	100	250	500	1000
Engine controls, cooling system and accessories	Engine maintenance	See Engine Manual					
	Check the cooling system for leaks		•	•	•	•	•
	Drain the fuel tank sediment		•	•	•	•	•
	Check the anti-freeze protection		•	•	•	•	•
	Check and adjust the belt tension		•	•	•	•	•
	Clean the air cleaner connections			•	•	•	•
	Check the engine RPM				•	•	•
	Change the air cleaner element					•	•
	Check the radiator core					•	•
	Flush the radiator						•
Torque Conv. and Transmission Systems	Check the hydraulic systems for leaks		•	•	•	•	•
	Check the trans. torque conv. breathers		•	•	•	•	•
	Check and adjust the trans. linkage					•	•
	Check the trans. clutch, conv. out pressures and oil cooler pressure drop					•	•
Steering and Blade System	Check the hydraulic systems for leaks		•	•	•	•	•
	Clean the hydraulic reservoir breather		•	•	•	•	•
	Check the main relief pressure in the steering and blade control valve					•	•
	Check and adjust the steering and blade levers					•	•
Electrical System	Check the lights		•	•	•	•	•
	Service the batteries		•	•	•	•	•
	Clean and tighten the electrical connections					•	•
	Inspect, test and lubricate the electrical units						•
Axles, Drive Shafts, Wheels and Tires Brake System	Check the tire pressures and casings	•	•	•	•	•	•
	Tighten the wheel nuts and inspect the rims		•	•	•	•	•
	Check and repair drive line noises						•
	Check and adjust the brake pedal linkage				•	•	•
	Change the grease in the Pillow Block						•
General Maintenance	Visually inspect the machine	•	•	•	•	•	•
	Clean the cylinder rods		•	•	•	•	•
	Adjust and lubricate the operator's seat				•	•	•
	Tighten all mounting bolts					•	•
	Steam clean the machine					•	•
	Inspect the frames						•

MAINTENANCE

The maintenance schedule lists checks or adjustments within the machine or related components.

The procedures from each system listed at a specified interval are described in sequence. They should be performed at the same time as the lubrication intervals.

8 HOUR MAINTENANCE OPERATIONS

- ENGINE MAINTENANCE
- CHECK THE TIRE PRESSURES AND CASINGS
- VISUALLY INSPECT THE MACHINE

Engine Maintenance: Refer to the Operation and Maintenance manual of the engine manufacturer for maintenance instructions of the engine and accessories.

Check the Tire Pressures and Casings: Check the air pressure in all the tires. See specifications and service data on Page 40 for the correct air pressures. Particular attention must be emphasized when checking hydro-inflated tires as there is less volume of air to provide cushioning. Be sure that the valve caps are in place to prevent dirt, moisture, and foreign material from damaging the valve core.

Keep all tires free from oil and grease and repair any cuts immediately to prolong the tire life. Check the tire pressures in the morning when the tires are cold. Do not remove increased pressures caused by the operation of the machine.

Visually Inspect the Machine: Visually inspect the general condition of the machine, the operating controls, instruments and switches, control rods and linkage, fuel pumps, filters and the radiator for any noticeable damage.

Special attention must be emphasized when inspecting the components of the oil system, fuel system and cooling system. If any unusual or unexplained traces of oil, fuel or water is found on or below the components of the respective systems, locate and correct any such leaks immediately.

Unexplained oil streaks on or below the engine, transmission, torque converter and axle assemblies must be carefully investigated. Such indications may be the evidence of cracks, loose mounting bolts, damaged seals or gaskets, which (if neglected) may result in complete failure and major damage to the engine and drive line.

50 HOUR MAINTENANCE OPERATIONS

- ENGINE MAINTENANCE
- CHECK THE COOLING SYSTEM FOR LEAKS
- DRAIN THE FUEL TANK SEDIMENT
- CHECK THE ANTI-FREEZE PROTECTION
- CHECK AND ADJUST THE BELT TENSION
- CHECK THE HYDRAULIC SYSTEMS FOR LEAKS
- CLEAN THE TRANSMISSION AND TORQUE CONVERTER BREATHERS
- CLEAN THE HYDRAULIC RESERVOIR BREATHER
- CHECK THE LIGHTS AND FUSE
- SERVICE THE BATTERIES
- TIGHTEN THE WHEEL NUTS AND INSPECT THE RIMS
- CLEAN THE CYLINDER RODS

Engine Maintenance: Refer to the operation and maintenance manual of the engine manufacturer for maintenance instructions of the engine and accessories.

Check the Cooling System for Leaks: Check the radiator, hoses, oil cooler, water pump and drain cocks for leaks and correct where necessary. Loss of coolant due to ruptured hoses, loose clamps, leaking pump or drain cocks can and will result in expensive repairs or replacement of the engine components.

Drain the Fuel Tank Sediment: Open the drain cock at the bottom of the fuel tank to drain the accumulated water and sediment.

Check all the fuel lines, fuel pump, filters and shut-off cocks for leaks and correct where necessary. Open the drain cock at the bottom of the filters, and drain off the accumulated water and sediment.

Check the Anti-Freeze Protection: At specified intervals, or whenever anticipating extremely cold weather, use a hydrometer to check the freezing point of the solution (permanent type anti-freeze) when it is at the operating temperature (180°F. to 200°F.). If necessary add additional anti-freeze according to the manufacturer's instructions to maintain a safe level beyond the freezing point.

Tighten the Air Cleaner Connections: Tighten the elbow clamps and air cleaner mounting bracket bolts. Check the elbow between the air cleaner and

the engine for cracks or leaks, which will permit dust-laden air to by-pass the air cleaner, entering into the engine, causing severe and costly damage to the engine.

Check and Adjust the Belt Tension: Each 50 operating hours, inspect all the drive belts for serviceable condition and the correct tension. Neglect and incorrect tension often leads to inadequate cooling, ball bearing failures, as well as short belt life.

Note: Due to older belts having been stretched, through use, beyond their original length thus causing the newer belts to carry most of the load, it will be necessary to replace all the belts as a matched set when one belt in a set is worn or damaged beyond a serviceable condition.

Whenever new belts are installed, and at specified intervals, check and re-tension the belts as follows:

1. Measure the span length.
2. At the center of the span, apply a force with a spring scale (at right angles to the span) large enough to deflect the belt $\frac{1}{64}$ of an inch per inch of span. Refer to Fig. 9.

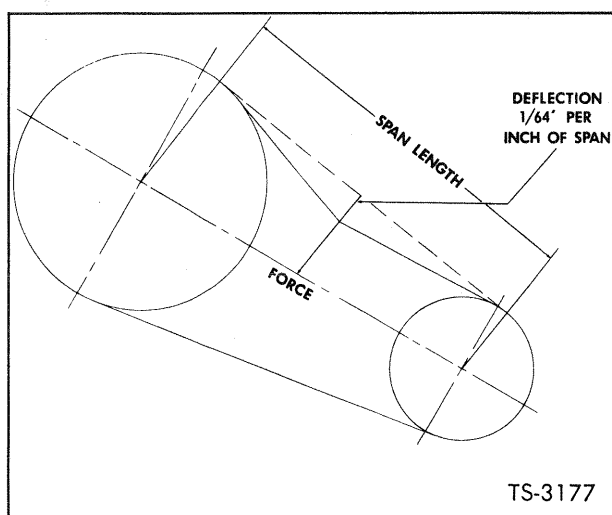


Fig. 9 Check Belt Tension

3. For a correct tensioned drive, the force should be within the listed range. New belts should initially be tensioned to the upper limit of the range. All new belts will loosen after operating for a day or two and must be re-checked and re-tensioned (if necessary).

**Outside diameter of
small sheave**

7" to 11"
11½" to 16"

Deflection force

8 to 12 lbs.
10 to 15 lbs.

Periodically belts should be cleaned to remove any grease and glaze, by wiping them with a cloth saturated with brake fluid. This in most instances will eliminate any squeak and will extend the service life of the belts.

Check the Hydraulic Systems for Leaks: Check the oil reservoir, valve, pumps, cylinder, all hydraulic hose lines and connections for leaks, correcting where necessary. Particular attention should be paid to hoses employed on the intake or suction side of the pumps. Hose clamps and connections employed must be securely tightened to prevent entrance of foreign material or air into the system. Air drawn into the system at this point will cause cavitation of the pump with resultant malfunctioning and early failure. All hoses should be checked for abrasions which could result in ruptures of same. Replace any hoses that are found in this condition.

Clean the Transmission and Torque Converter Breathers: The transmission and torque converter hydraulic system is equipped with two mesh type breathers. One is located on the left hand side of the torque converter and the other is located on the top right distributor bearing cap.

Each 50 operating hours, unscrew the breather caps, clean in a solvent, blow dry with compressed air and reinstall.

Clean the Hydraulic Reservoir Breather: The Steering and Blade hydraulic systems draw oil from a common reservoir. The reservoir, open to atmospheric pressure, is protected by a push type breather to admit only clean filtered air. The breather is located next to the Transmission-Torque Converter hydraulic filter.

Each 50 operating hours remove the breather cap, wash in a solvent, blow dry with compressed air and reinstall.

Check the Lights and Fuses: One 20 ampere fuse provides protection for the light circuit, and one 4 ampere fuse provides protection for the main wiring in the machine. The 20 ampere fuse for the lights is located in the wire between the ignition switch and the toggle switch. The 4 ampere fuse for the main wiring is located in the wire between the starter solenoid and the Hourmeter oil pressure switch.

A. Floodlamps: The machine is equipped with two floodlamps that disperse light in a gradual downward pattern. Both of these floodlamps are located underneath the top of the canopy, and are mounted with bevelled washers.

1. Loosen the locknut that secures the floodlamp to the canopy.
2. Rotate the bevelled washers to adjust the angle of the beam, then retighten the locknut securely.

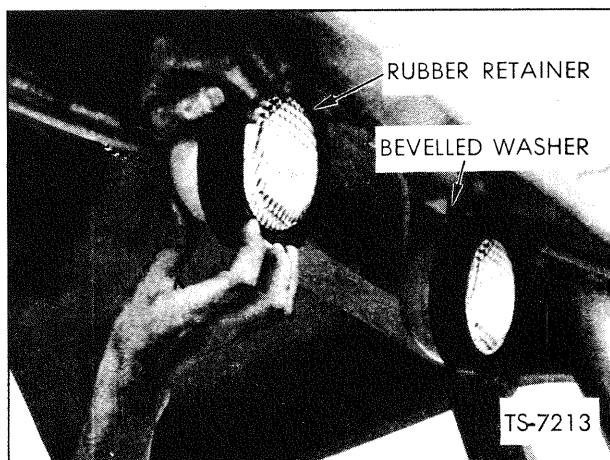


Fig. 10 Lamp Replacement

If it is necessary to replace the floodlamps, depress the lamp and spread the lip of the rubber retainer outward, forcing the lamp out as shown in Fig. 10 and disconnect the terminals. Reconnect the terminals on the lamp and reinstall the retainer.

B. Tail Lamp: The tail lamp is the same assembly as the floodlamps, and is mounted at the back right hand side of the canopy on a welded bracket. To replace the tail lamp, follow the same instructions as the floodlamps.

Service the Batteries: The Batteries are located in the battery compartment below the floorboard at the left side of the machine. Keep the terminals clean and the connections tight, and be sure that when distilled water is added, all the plates are covered. Do not overfill.

To prevent damage to the electrical system components when recharging or replacing the batteries in the charging system:

REMEMBER

1. When installing the batteries, **MAKE SURE** the batteries and polarities are the same.
2. Booster batteries **MUST BE** paralleled.
3. Battery-charger and battery polarities **MUST AGREE**.

4. Before doing any welding, **DISCONNECT THE GROUND CABLE FROM THE BATTERIES AND THE ELECTRICAL LEAD FROM THE BATTERY TERMINAL ON THE ALTERNATOR.**

WARNING

ALWAYS CONNECT POSITIVE TO POSITIVE — NEGATIVE TO NEGATIVE WHEN USING A BATTERY CHARGER OR BOOSTER, TO PREVENT DAMAGE TO THE ELECTRICAL SYSTEM.

Tighten the Wheel Nuts and Inspect the Tires: All wheel nuts should be checked regularly and kept tight. Loose wheel nuts will cause undue tire wear, strain the axle assemblies, and affect the steering load distribution. Apply a lubricant on the threads of the wheel studs only and tighten the wheel nuts to 475 ft. lbs. torque. Do not lubricate the spherical seat on the threaded portion of the wheel nuts.

Check the rims for bent or damaged flanges and repair or replace as needed.

Clean the Cylinder Rods: Wipe the blade and steering cylinder rods with a clean cloth saturated in hydraulic oil. Check the rods for nicks or burrs which would damage the packings or seals. Remove any such nicks or burrs with a fine grained hand stone or crocus cloth.

100 HOUR MAINTENANCE OPERATIONS

- **ENGINE MAINTENANCE**
- **CLEAN AND TIGHTEN THE AIR CLEANER CONNECTIONS**

Engine Maintenance: Refer to the operation and maintenance manual of the engine manufacturer for maintenance instructions of the engine and accessories.

Clean and Tighten the Air Cleaner Connections: Tighten all hose clamps and air cleaner mounting bracket bolts. Note any sign of damage that might impair the operating efficiency and keep the air cleaner panel free of obstructing material such as leaves, twigs, or rags.

The impregnated paper filter element is very efficient and its service life will be governed by the operating conditions. The element should be changed every 500 hours. But again, under severe conditions, its life will be reduced. A service indicator is available for the filter and can be ordered as an accessory.

250 HOUR MAINTENANCE OPERATIONS

- ENGINE MAINTENANCE
- CHECK THE ENGINE RPM
- ADJUST AND LUBRICATE THE OPERATOR'S SEAT
- CHECK AND ADJUST THE BRAKE PEDAL AND LINKAGE

Engine Maintenance: Refer to the operation and maintenance manual of the engine manufacturer for maintenance instructions of the engine and accessories.

Check the Engine RPM: The engine speeds should be checked regularly against the specifications to determine the engine efficiency and the machine performance. Correct speeds insure safe operating limits for the engine and maintain correct operating speeds for the torque converter and transmission.

- (a) **Low Idle and High Idle RPM:** These speeds are the free operating limits of the engine under no load conditions. They are determined by the amount of fuel delivered to the engine. See the Specifications and Service Data on Page 39.

Caution: Do not accelerate to maximum RPM until the engine is at its operating temperature.

Check the throttle linkage to insure a wide open throttle when the accelerator is fully released. The accelerator and linkage should operate freely in all positions.

Occasionally the control rods, control levers or bell cranks loosen or become damaged, impairing the operating efficiency of the engine. Insufficient power is frequently caused by the throttle linkage being out of adjustment.

Fuel controls are accurately calibrated at the factory to insure the correct low idle and high idle speeds.

DO NOT ADJUST THE G.M. GOVERNOR ASSEMBLY WITHOUT CONSULTING THE OPERATION AND MAINTENANCE MANUAL OF THE ENGINE MANUFACTURER.

The linkage adjustment for the engine is as follows:

G.M. Diesel

1. Unhook the spring from the accelerator linkage and disconnect the ball joint assembly from the governor throttle control lever. This will enable the governor throttle lever to return to the spring loaded idle position.

2. Depress the accelerator until it contacts the stop in the floorboard.

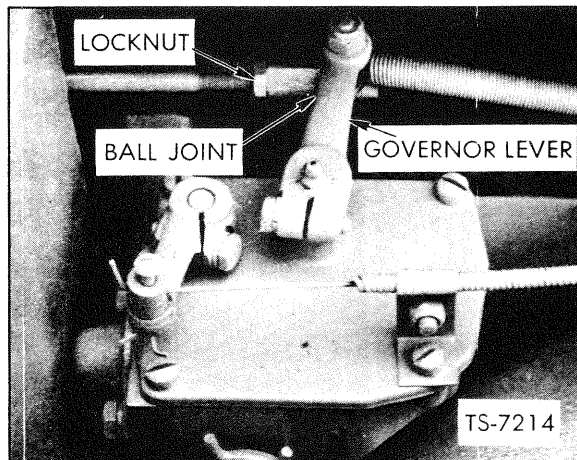


Fig. 11 Accelerator Linkage at the Governor Housing

3. Rotate the governor throttle control lever to the extreme forward (full throttle) position and adjust the ball joint to obtain a slip fit in the governor throttle lever just before the accelerator bottoms. If a slip fit cannot be obtained, adjust the clevis and ball joints at the accelerator crank arm. See Figs. 11 and 12.

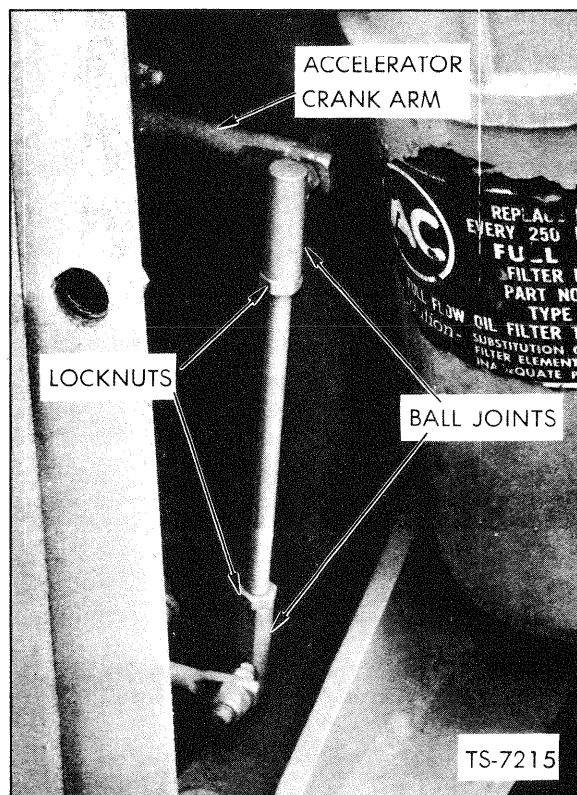


Fig. 12 Accelerator Linkage at the Accelerator Crank Arm

4. Reinstall and secure the clevis to the governor throttle lever and reconnect the accelerator spring.
5. Release and depress the accelerator, and check that the linkage will properly rotate the throttle control lever from the idle to the full throttle position without interference.
6. Additional adjustment can be made at the accelerator pedal assembly lever.

The pressure required to depress the accelerator is controlled by a spring attached from the forward ball joint to the anchor lug. This spring also insures that the engine will return to the idle speed when the accelerator pedal is released.

- (b) **Stall RPM:** The engine and torque converter act as a unit to deliver power to the transmission. A stall check should be performed to insure that the engine is developing the rated power and that the torque converter is operating efficiently.

Caution: Check the stall RPM only when the torque converter fluid is hot (180°F. to 200°F.), the engine is at the operating temperature and the steering and blade relief valve setting is at the correct specification.

1. Install a tachometer on the engine.
2. Put the machine into a full right turn.
3. Apply the brake lock-up, block the wheels, and place the directional and speed range levers in NEUTRAL.
4. Start the engine and raise the blade a few inches above the ground.
5. Shift levers into FORWARD, HI and TRAVEL RANGE and accelerate the engine. When the engine reaches its maximum rpm. pull back on the blade and steering control levers to their full position against the stops. When the engine rpm. drops to its lowest point read the tachometer.

DO NOT STALL THE CONVERTER MORE THAN 30 SECONDS AT ANY ONE TIME.

If the stall rpm. is not within the specifications, trouble shooting of the engine or torque converter by a qualified mechanic is required. See the Specifications and Service Data on Page 39.

Note: The stall RPM specified on Page 39 is applicable to an altitude of 600 ft. and ambient temperature of 70°F. due to the many combinations of altitude and temperature possible in the field. Space does not permit publishing here all the corrections necessary to the stall RPM indicated to accommodate such variation. It is suggested the engine manufacturer's distributor be contacted to determine the correction necessary for the altitude and temperature in your application.

Adjust and Lubricate the Operator's Seat: The operator's seat can be shifted forward or backward to suit the individual by moving the lever on the left hand side of the seat forward and shifting the seat to the desired position. See Fig. 13.

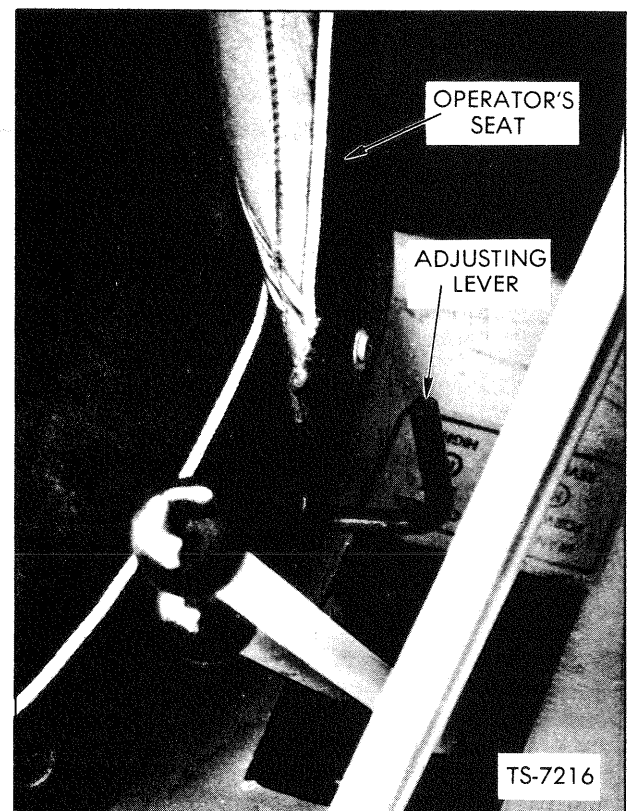


Fig. 13 Adjust the Operator's Seat

Oiling of the release mechanism, track assemblies and pivot points will keep them operating freely.

Tilt the seat over, toward the instrument panel when shutting down the machine at the end of shift. See Fig. 14.

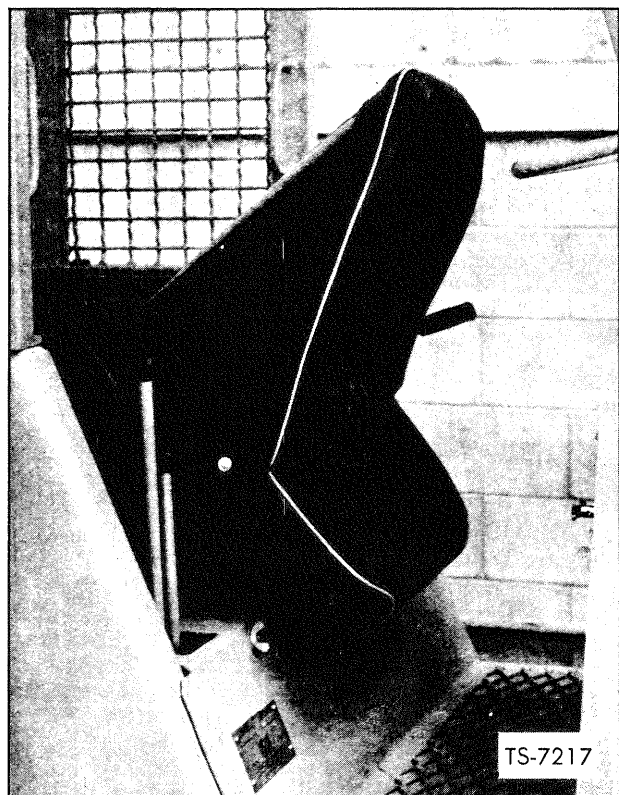


Fig. 14 Tilt the Operator's Seat Over Instruments

Check and Adjust the Brake Pedal and Linkage:

Maintenance Operations of the Brake: The hydraulic double shoe internal-expanding service brake is self-adjusting and is operated by an automotive type foot pedal. The two internal expanding brake shoes operate inside the brake drum, on the brake input drive shaft. The shoes in the brake are expanded by opposed pistons acting in the wheel cylinder and operating directly on each shoe.

The function of the master cylinder assembly (Fig. 15) is to displace fluid for brake applications, to constantly maintain the correct volume of fluid in the system under all temperature conditions, to automatically replace fluid lost through gravity seepage or slight leaks, and to add fluid or supercharge the system on the return stroke of the pedal after each brake application.

Inadequate braking may indicate a need to replenish the fluid in the master cylinder, adjust the pedal free travel, or to bleed the brake lines.

(a) Pedal Free Travel

The brake pedal free travel is the distance the pedal moves before the push rod touches the master cylinder piston. Excessive free motion reduces the effective travel, may cause blocking of the compensating port and prevents the brake from releasing. Always check and adjust the pedal free travel as follows. Refer to Fig. 16.

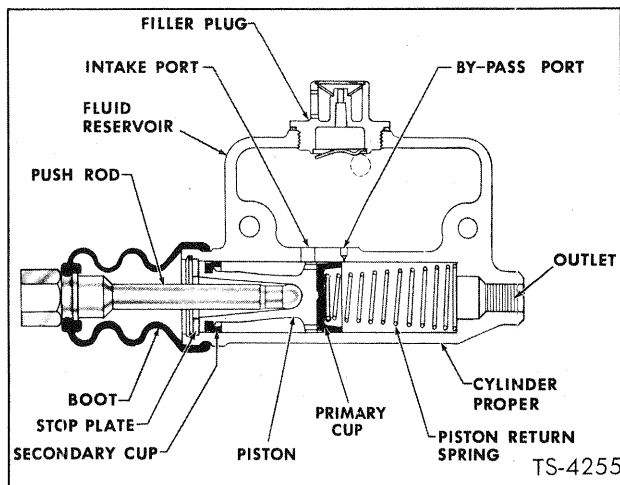


Fig. 15 Master Cylinder—Cutaway

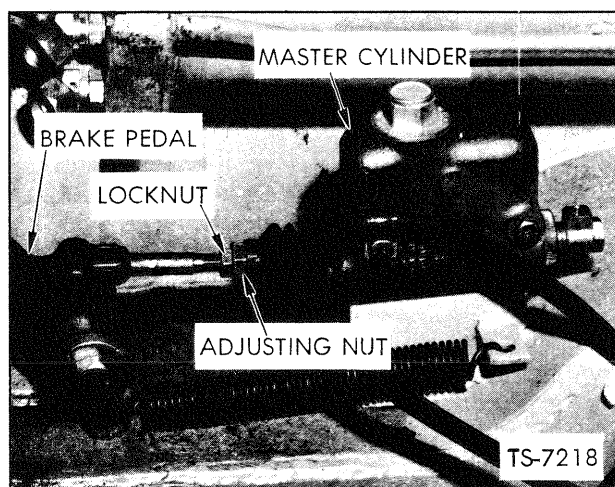


Fig. 16 Adjust Brake Pedal Free Travel

1. Depress the pedal by hand, noting the distance the pedal moves before resistance is offered. The correct travel is $\frac{3}{4}$ inch free travel.
2. Loosen the locknut and turn the adjusting nut clockwise to decrease the travel, counterclockwise to increase the travel.
3. Tighten the locknut securely and recheck the pedal free travel.

(b) Bleed the Brake Lines

The correct operation of hydraulic brakes requires a solid column of fluid without air bubbles at all points in the pressure system. Because of loose fittings, leaking cylinder or low fluid level in the master cylinder, it is necessary to "bleed" the system in order to expel any air bubbles which have become mixed with the fluid. The necessity of bleeding is indicated by a soft or spongy pedal.

The wheel cylinder must be bled in the following order:

1. Fill the master cylinder with fluid.
2. With the aid of a helper, open the bleed screw on the cylinder in Fig. 17 and depress the brake pedal to expel any air and fluid from the lines.

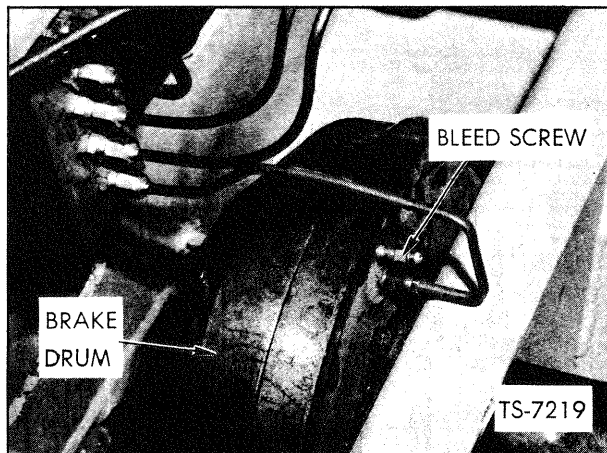


Fig. 17 Bleed the Brake

When the pedal reaches its maximum stroke, close the bleed screw before releasing the pedal.

3. Repeat this procedure until solid fluid, free from bubbles, comes from the bleed screw. Check the master cylinder frequently to insure an ample supply of fluid.

500 HOUR MAINTENANCE OPERATIONS

- ENGINE MAINTENANCE
- REPLACE THE AIR CLEANER ELEMENT
- CLEAN THE RADIATOR CORE
- CHECK AND ADJUST THE TRANSMISSION SHIFT LINKAGE

- CHECK THE TRANSMISSION CLUTCH AND CONVERTER OUT PRESSURES AND THE OIL COOLER PRESSURE DROP
- CHECK THE MAIN RELIEF PRESSURE ON THE STEERING AND BLADE CONTROL VALVE
- CHECK AND ADJUST THE STEERING AND BLADE CONTROL LEVER
- CLEAN AND TIGHTEN THE ELECTRICAL CONNECTIONS
- TIGHTEN ALL MOUNTING BOLTS
- STEAM CLEAN THE MACHINE

Engine Maintenance: Refer to the operation and maintenance manual of the engine manufacturer for maintenance instructions of the engine and accessories.

Replace the Air Cleaner Element: It should be understood that no set rule can be established to change the filter element, because its service life is governed by the operating conditions. The optional warning signal will indicate the condition of the element and establish the change point. In severe dust conditions it is recommended that the optional Roto-Pamic cleaner be installed.

To change the element, remove the two mounting bolts which hold the air cleaner panel on the fire-wall and remove the panel. Loosen the fasteners at the side of the air cleaner and remove the moisture eliminator. See Fig. 18. Carefully remove the dirty filter element from the air cleaner housing and discard. See Fig. 19. Do not clean or re-use the dirty filter element. Inspect the inside of the air cleaner housing for any foreign material, and wipe clean if necessary. Install the new filter element inside the air cleaner housing and position the moisture eliminator flush against the filter element and reassemble the fasteners. Replace the air cleaner panel and secure with the two mounting bolts.

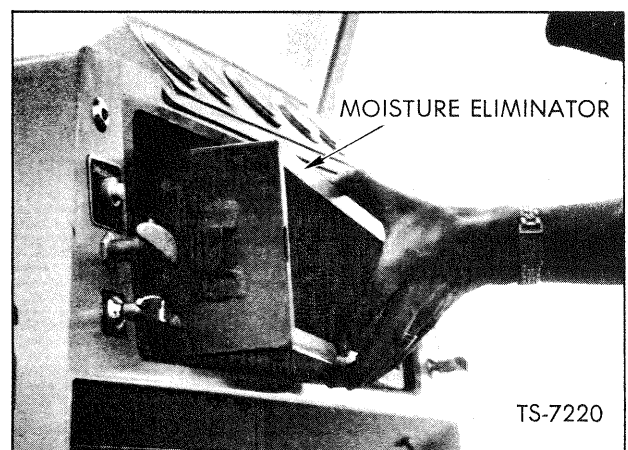


Fig. 18 Air Cleaner Moisture Eliminator

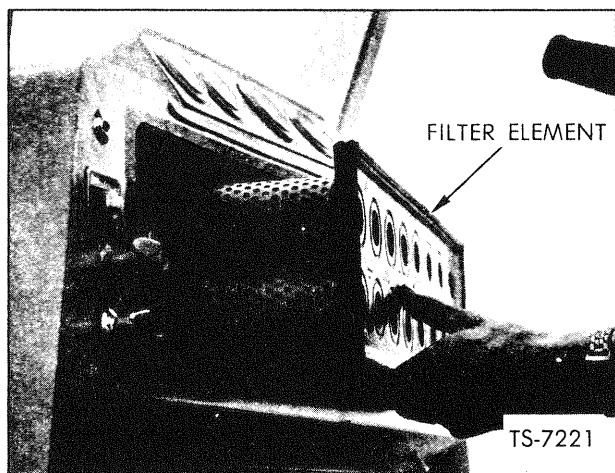


Fig. 19 Air Cleaner Filter Element

NOTE: Extended operation of the machine without replacing the filter element will create excessive restriction resulting in high fuel consumption, excessive smoke, lower horsepower and poor acceleration.

Clean the Radiator Core: External surfaces of the radiator core must be kept clean, straight and unobstructed to prevent blocking the air flow and causing overheating.

Flying objects such as sand, dust, leaves, twigs, bugs or other debris that plug the core or adhere to water or oil streaks, impair the cooling efficiency.

Use compressed air, steam or a high pressure water stream and remove such objects opposite the air flow through the core assembly. Oil streaks should be removed using a solvent non-harmful to hoses and wiring insulation. Straighten bent fins, being careful not to puncture or enlarge the openings.

Check and Adjust the Transmission Shift Linkage: Inspect all the mechanical control linkages to make sure that all the rods, cross shafts, bell cranks, ball joints and operating arms are in a serviceable condition and are correctly adjusted. Correct any questionable condition such as loose or bent linkage, worn pins or evidence of binding or rubbing of any of the linkage components.

Adjustments for the various shift linkages are as follows:

(a) Forward and Reverse and High and Low Gear Control Shift Levers

Check and adjust the forward and reverse and high and low gear control shift levers to ensure full engagement into all detent positions without interference.

1. Place the High and Low gear control and the Forward and Reverse control levers in the NEUTRAL POSITION.
2. Loosen the locknuts and adjust the clevises and locknuts on the ends of both shift rods as necessary until the levers in the operator's compartment are correctly aligned. See Fig. 20.

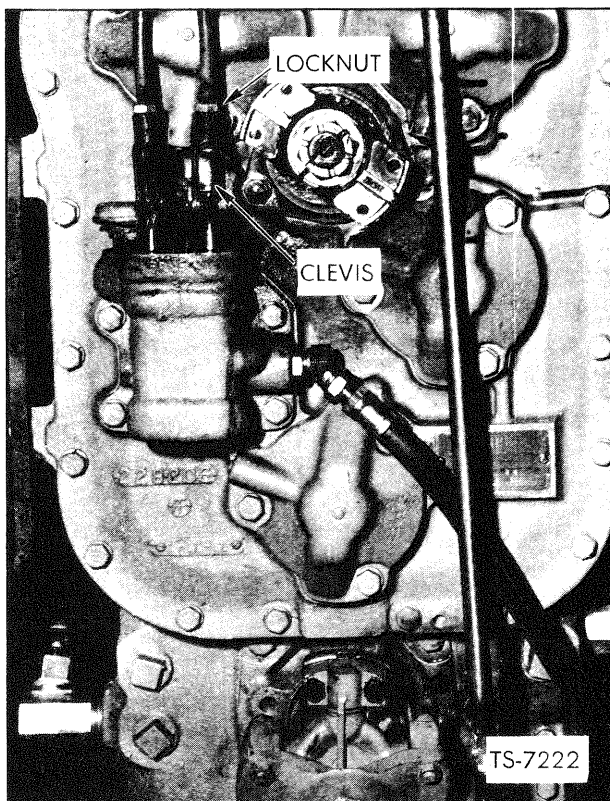


Fig. 20 Adjust Linkages at the Transmission

3. Tighten the locknuts and check that the levers will shift into all detent positions without interference from the floorboard or transmission.

(b) Work and Travel Control Shift Lever

The work and travel control shift lever engages the work range (transmission in low range) and travel range (transmission in high range).

This lever when in the neutral position, is approximately horizontal. It requires the same adjustment as the forward and reverse and high and low gear control shift levers. Check and adjust the work and travel control shift lever to insure full engagement into the detent positions without interference.

Check the Transmission Clutch, Converter Out Pressures and the Oil Cooler Pressure Drop: Check

the transmission clutch and converter out pressures at specified intervals, or whenever the machine evidences over-heating or no power in any one of the four speeds in forward or reverse direction.

Pressure checks must be taken with the fluid hot (180°F. to 200°F.).

(a) Transmission Clutch Pressure

Periodically or whenever the machine evidences incorrect operation in any one of the four speed ranges in forward or reverse direction, a check of the clutch operating pressures should be made.

Using a test gauge of at least 300 P.S.I. capacity, a check should be made at the pressure regulator valve assembly by removing the pipe plug and inserting the test gauge line as shown in Fig. 21 for 664 machines and in Fig. 22 for 666 machine.

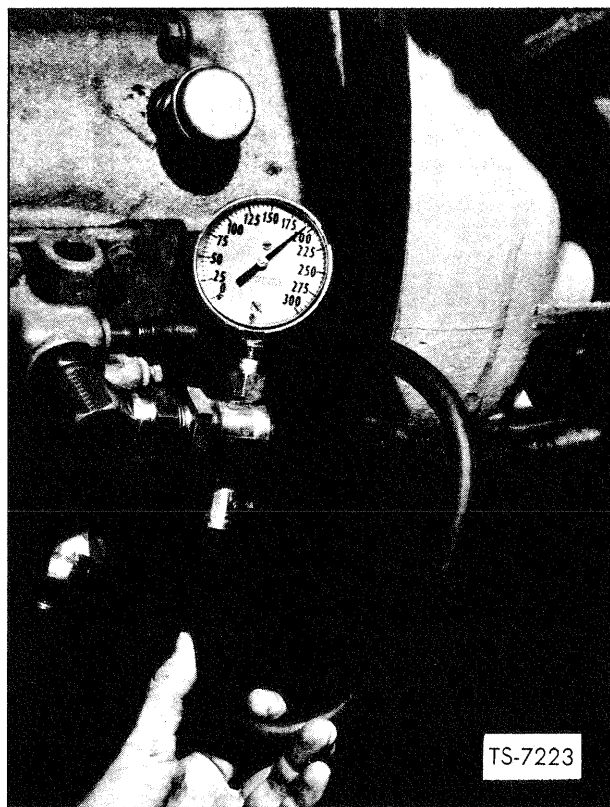


Fig. 21 Check Pressure—Transmission Clutches 664 Only

The pressure check should be taken with the fluid at the operating temperature (180°F. to 200°F.). The wheels of the machine should be securely blocked and the brake lock-up be applied. The pressure check should be made in all the speed

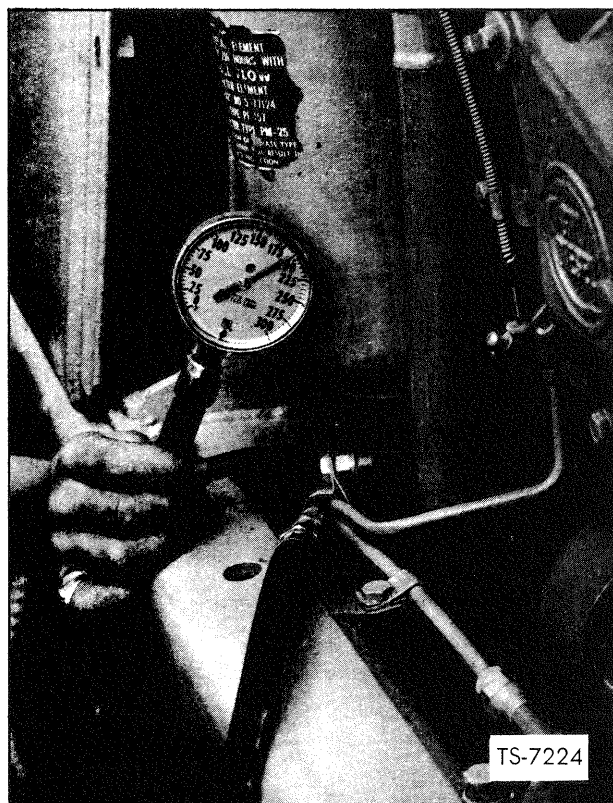


Fig. 22 Check Pressure—Transmission Clutches 666 Only

ranges in both forward and reverse direction. With the engine idling (550 to 600 rpm.) and at the operating temperature (180°F. to 200°F.) pressure should be as follows:

Minimum 180 psi.

Maximum 200 psi.

If the pressure is not within the specifications, further trouble shooting of the transmission and torque converter by a qualified mechanic will be required.

(b) Converter Out Pressure

Periodically or whenever the machine evidences an overheating condition, inspect and check for collapsed or ruptured hoses that might cause overheating. Correct as necessary. If overheating conditions still exist, check the converter OUT pressure to determine whether the oil cooler at the bottom of the radiator has or is becoming plugged with foreign material.

The pressure check must be made with the fluid hot (180°F. to 200°F.) using an accurate gauge at 2,000 rpm.

1. Install a tachometer on the engine.
2. Install a gauge at the converter OUT pressure port as shown in Fig. 23.



Fig. 23 Check Converter OUT Pressure

3. Apply the brake lock-up; shift the forward and reverse and speed range levers in to the NEUTRAL position.
4. With the aid of a helper, read the gauge at a steady 2,000 rpm. The gauge reading must not exceed 80 psi.

If the pressure reading exceeds 80 psi, it will be necessary to clean or replace the hoses, the lines, the oil cooler and/or the radiator assembly. To further pinpoint the problem, see "oil cooler pressure drop" below.

(c) Oil Cooler Pressure Drop

The drop in pressure across the oil cooler at the bottom of the radiator will indicate whether the oil cooler and/or the front cooler hose has or is becoming plugged with foreign material, causing overheating.

1. Install a tachometer on the engine. Install gauges at the pressure ports on the inlet and outlet piping to the oil cooler as shown in Figs. 24 and 25.

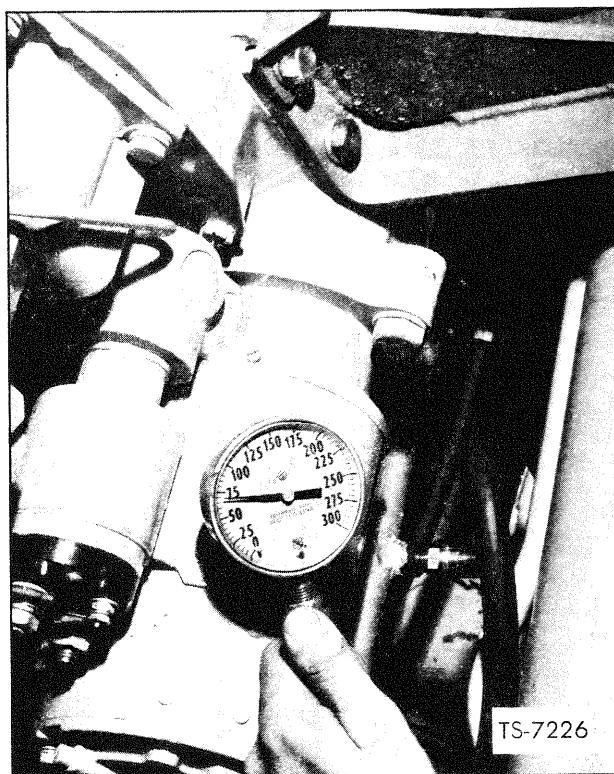


Fig. 24 Check Pressure—Oil Cooler IN

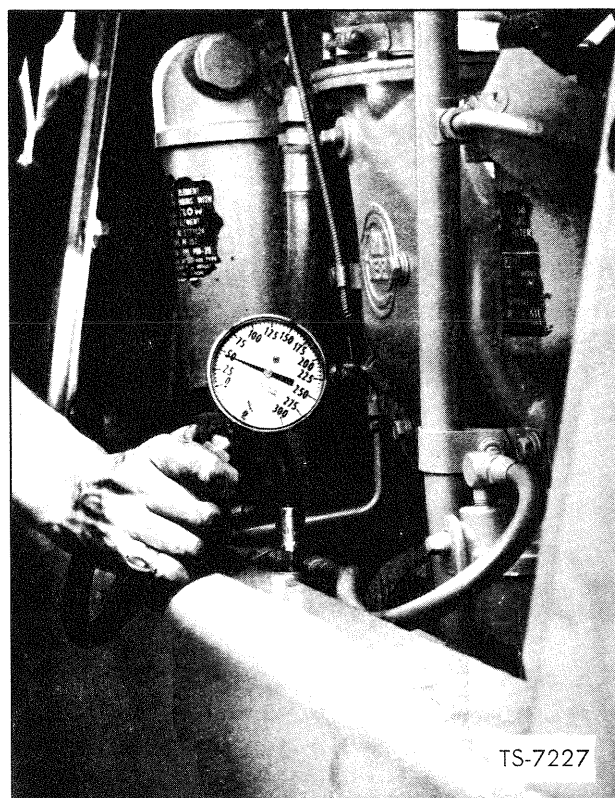


Fig. 25 Check Pressure—Oil Cooler OUT

2. Apply the brake lock-up; shift the directional and speed range levers into NEUTRAL.
3. With the aid of a helper, read the gauges at a steady 2,000 rpm., and subtract the oil cooler OUT from the oil cooler IN to get the pressure drop. The pressure drop should be between 20 psi. and 40 psi.

If the pressure difference equals or exceeds 40 psi., it will be necessary to thoroughly clean or replace the front cooler hose, oil cooler and/or the radiator assembly.

Check the Main Relief Pressure on the Steering and Blade Control Valve: The main hydraulic pump is coupled to the drive line and operates as soon as the engine is started. This pump draws fluid from the reservoir and forces it under pressure into the steering and blade (Main) control valve.

The Ranger is so designed that only one operation is required to check the pressure in the system.

1. Shut down the engine.
2. Move the steering control lever backwards and forwards to relieve the pressure in the system.
3. Attach a hydraulic gauge of at least 3,000 psi. capacity to the lower check plug opening on the left hand side of the cross tube assembly. See Fig. 26.

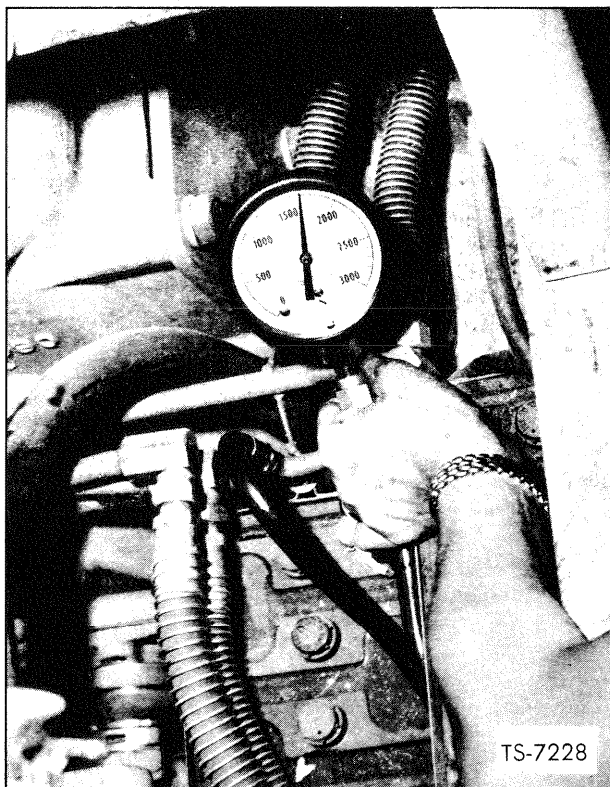


Fig. 26 Check Pressure—Main Relief Valve

4. Put the machine into a full left hand turn and hold the lever in the full turn position. The gauge should register 1,600 psi. If not, adjust the main relief by removing the acorn nut, loosening the jam nut and adjusting the set screw located on the top of the main control valve assembly, until 1,600 psi. registers on the gauge. See Fig. 27.

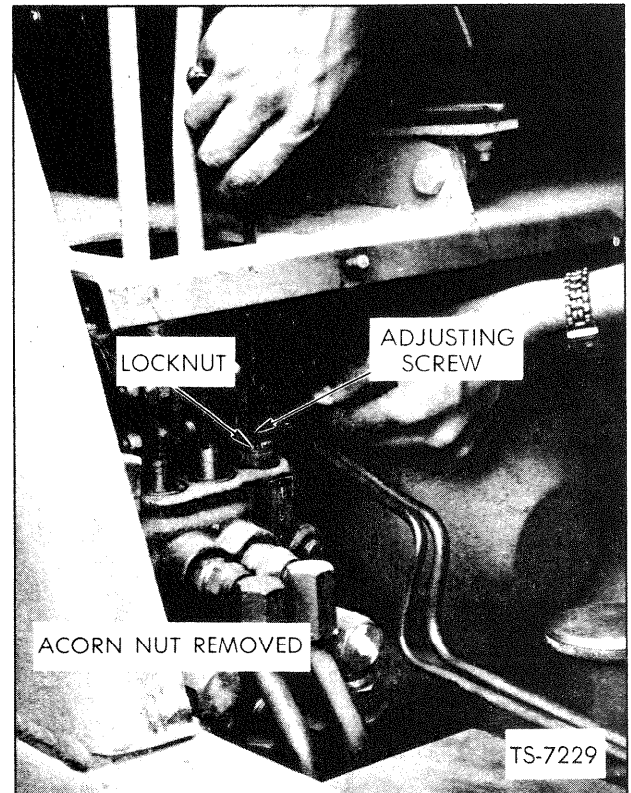


Fig. 27 Adjust Pressure—Main Relief Valve

WARNING: ALWAYS MAKE THIS PRESSURE CHECK WITH THE MACHINE IN A LEFT TURN POSITION. THE MAIN CONTROL VALVE WILL BE SERIOUSLY DAMAGED IF THIS PRESSURE CHECK IS ATTEMPTED WITH THE MACHINE IN A RIGHT TURN POSITION.

Note: DO NOT attempt to adjust the steering relief valves, as these are factory set.

Check and Adjust the Steering and Blade Control Levers: The control levers for the steering and blade do not require an adjustment but should be kept free from all dirt and foreign material.

Clean and Tighten the Electrical Connections: Periodically inspect and check all wiring and connections on the electrical components such as the batteries, cranking motor, voltage regulator, alternator, solenoid switch, relays, instruments and

switches for worn, cracked, broken or frayed insulation and loose terminal connections. Check for frayed or corroded external ground straps and corrosion on the battery posts.

Where inspection reveals dirt, looseness or damage, clean, tighten and adjust or replace as necessary depending on the existing conditions.

Tighten All Mounting Bolts: The mounting bolts on such components as the engine, torque converter, transmission, axles and prop shafts will occasionally work loose and cause the supports and brackets to wear rapidly. Alignment difficulty may also develop.

Steam Clean the Machine: Periodically or whenever working the machine in muddy or swampy areas or when the machine begins to cake up with excessive dirt, the entire machine should be steam cleaned. If allowed to accumulate, dirt will find its way into the various systems when plugs, covers or caps are removed or during a unit replacement, eventually causing serious damage and downtime.

Dirt packed on or around the axle, transmission, torque converter, engine and reservoir breather will cause oil losses.

Steam is the most effective and recommended method of cleaning a dirty machine. If unavailable, use a spray of mineral spirits or a similar solvent non-harmful to exposed hoses, lines and electrical wiring.

NOTE: PRIOR TO STEAM CLEANING COVER ALL ALTERNATOR AND CRANKING MOTOR OPENINGS TO PROTECT THEM FROM THE FORCE OF THE STEAM JET.

1,000 Hour MAINTENANCE OPERATIONS

- **ENGINE MAINTENANCE**
- **FLUSH THE RADIATOR**
- **CHANGE THE GREASE IN THE PILLOW BLOCK**
- **INSPECT, TEST AND LUBRICATE THE ELECTRICAL UNITS**
- **CHECK AND REPAIR DRIVE LINE NOISES**
- **INSPECT THE FRAMES**

Engine Maintenance: Refer to the operation and maintenance manual of the engine manufacturer for maintenance instructions of the engine and accessories.

Flush the Radiator: Twice a year, drain, flush and refill the cooling system. Add permanent type

anti-freeze according to the manufacturer's instructions when the air temperature is 32°F. or lower, or when there is danger of the water freezing in the system. Always use a hydrometer to check the freezing point of the solution when it is at the operating temperature.

Check for evidence of foreign material plugging the external core of the radiator and blow out with compressed air.

Change the Grease in the Pillow Block: Every 1,000 hours change the grease in the pillow block, to prevent the failure of the pillow block bearing.

1. Remove the brake input drive shaft from the flange.
2. Punch position-identifying marks on the slip joint and on the tube assembly of the brake input drive shaft and dis-assemble the slip joint from the tube assembly to permit ease of access to the flange bolt. (In some units, dis-assembly of this drive shaft may not be necessary.)
3. Remove the single bolt and washers in the center of the flange to release the brake drum and attached flange.
4. Slide the brake drum (with the flange attached) out of the pillow block.
5. Remove the spacer and the seal from the inside of the pillow block.
6. **CLEAN** the pillow block of **ALL** grease. **BE CAREFUL** not to allow grease into the brake area.
7. Install the spacer on the rear axle input drive shaft.
8. Install a new seal in the pillow block with the shiny side (the side with the Part Number stamped into it) towards the rear axle.
9. Reinstall the brake drum (with the flange attached) over the splined shaft, tight against the spacer.
10. Using the grease line and Darina AX grease, re-grease the pillow block until the grease oozes out under the seal at the rear of the pillow block.
11. Again remove the brake drum (with the flange attached) and check the new seal to ensure that no grease has leaked into the brake area from under the front seal.
12. Again reinstall the brake drum (with the flange attached).

13. Reinstall the bolt from the flange to the rear axle input shaft with new washers.

NOTE: This bolt **MUST** be torqued to 590 ft. lbs.

14. Re-assemble the brake input drive shaft.

NOTE: BE SURE that the flange on the slip joint is parallel to the flange on the tube assembly by lining up the punch marks. See item 2.)

15. Reinstall the brake input drive shaft on the flange.

Inspect, Test and Lubricate the Electrical Units: Maintenance performed on the various electrical components usually consists of cleaning, lubricating, minor testing and adjusting, and replacing defective or worn out parts.

At specified intervals lubricate the alternator and cranking motor sparingly. Excessive lubrication can result in premature failure.

Check the cranking motor operation with a substitute battery source known to be fully charged and in good condition.

In general, correct functioning of the alternator and voltage regulator can usually be determined by the following battery conditions:

- (1) If the batteries are fully charged, except when under unusually severe loads; and
- (2) If no more than the usual amount of water is required to keep them filled.

When testing the alternator charging rate, use accurate test meters.

Inspect all wires, cables and terminals for tight connections, cleanliness and check for evidence of deterioration or corrosion.

Blow out the accumulated dust and dirt, and clean exterior surfaces of all electrical units.

Check and Repair Drive Line Noises: Unusual operating noises in the drive line components can usually be found by a process of elimination. In general the unit cause or source of most noises will be quite evident.

When any such noise develops, note the travel speed of the machine. Did it occur going forward or in reverse? Was the machine travelling straight or in a turn? Was the machine being braked, coasting, under acceleration, or being worked stationary? Did any gauges indicate overheating? Was the noise progressive, or did it just happen? Was there any vibration, chattering or shaking of the machine? Did the machine pull to one side?

Prop shaft failures are generally indicated by excessive noise or vibration only at certain speeds. Above or below these speeds the noise lessens or completely disappears.

The transmission can be checked by disconnecting the prop shaft to the front axle. Check the gear train in both work and travel ranges with the hydraulic controls (high and low and forward and reverse control shift levers) in neutral. Engage the control levers one at a time to apply the clutches and connect them to the gear train.

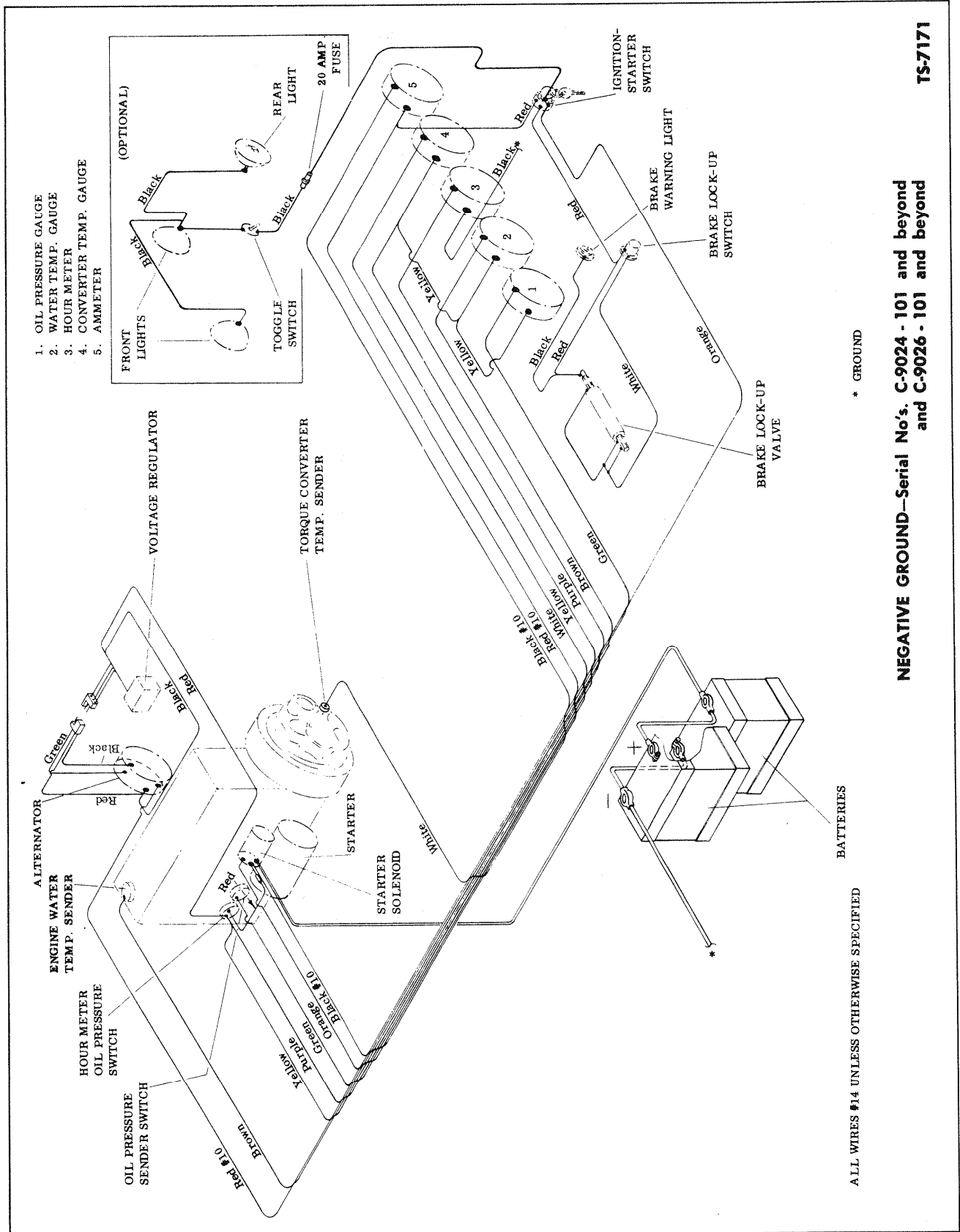
The engine and torque converter noises can be isolated by removing the prop shaft from the torque converter to the transmission. Most engine and torque converter problems are generally preceded by low power and overheating. These indications should be observed at the time and corrected before mechanical difficulties arise.

Inspect the Frames: The frames are the basic backbone of the entire machine and provide structural support directly or indirectly for completely mounting all assemblies, sub-assemblies and individual components necessary for the machine construction and operation.

The frame structures and all supporting assemblies such as cradle, blade, fairlead, crossmembers, reinforcing gussets and brackets should be periodically inspected for cracks, bends, broken welds, warping or any other signs of damage that would endanger the correct operation.

Frame damage should be immediately repaired or corrected as necessary to maintain the frame assembly in a good serviceable condition.





NEGATIVE GROUND—Serial No's. C-9024 - 101 and beyond
and C-9026 - 101 and beyond

TS-7171

BOLT TORQUE CHART

FT. — LBS.

Location	Thread	Grade	Torque
Front Engine Mount	3/8" — 16	8	46
Front Engine Mount to Frame	5/16" — 18	8	25
Side Engine Mount	1/2" — 13	8	100
Side Engine Mount to Frame	1/2" — 13	8	125
Torque Converter Bolts	5/16" — 18	8	23
Transmission to Bracket	3/4" — 16	8	250
Transmission Bracket to Frame	5/8" — 11	8	225
Main Valve	5/16" — 24	8	46
Rear Axle	3/4" — 10	8	400
Top Driveshaft	5/16" — 24	8	23
Lower Driveshafts	3/8" — 24	8	50
Brake Drum to Rear Axle Input Shaft	7/8" — 14	8	590
Brake Drum to Flange	1/2" — 20	8	115
Pillow Block to Rear Frame Crossmember	7/16" — 14	8	75
Fairlead Mounting Bolts	3/4" — 10	8	400
Winch Mounting Bolts to Frame	3/4" — 10	8	400
Winch Mount to Winch	3/4" — 10	8	300
Wheel Nuts	3/4" — 10	8	475

When replacing any mounting bolts, use Loctite "B" on the threads.

The wheel nut spherical seat in the wheel disc must be concentric with the stud — ream if necessary.

BOLTS NOT LISTED ARE TO BE DRAWN UP TIGHT IN MANNER CONSISTENT WITH GOOD WORKMANSHIP.

SPECIFICATIONS AND SERVICE DATA

	664	666
Engine	Diesel	Diesel
Make	G.M.	G.M.
Model	3-53	4-53
Number of cylinders	3	4
Bore and stroke	3 7/8 x 4 1/2	3 7/8 x 4 1/2
Displacement, cu. inches	159.2	212.3
Maximum torque, ft. lbs.	202	271
Governed horsepower	93	125
Governed RPM.	2700	2700
Low idle RPM.	600	600
High idle RPM.	2840	2840
Stall, with main pump at 1,600 psi.	1980	1980
Converter stall	2390	2230

NOTE: The stall RPM. is the maximum obtainable RPM. with oil at the operating temperature of (180°F. to 200°F.) brake applied, the wheels blocked, the directional and speed range shift levers in forward—4th (high) and the machine turned full against stops.

The stall speed is applicable to an altitude of 600 ft. and ambient temperatures of 70°F. Due to the many combinations of altitude and temperature possible in the field, space does not permit publishing here all the corrections necessary to the stall RPM. indicated to accommodate such variations. It is suggested that the engine manufacturer's distributor be contacted to determine the correction necessary for the altitude and temperature in your application.

ELECTRICAL SYSTEM

Fuses:

Lights	20 amp
Solenoid	4 amp

Lamps:

Front and rear lamps	12 volt
Brake lock-up light	12 volt

Instruments:

Panel gauges	12 volt
Sender units	12 volt

Alternator:

Motorola A-12P-451 positive ground—
S/N C-9014-101 through 150
and C-9016-101 through 111

Motorola A-12N-451 negative ground—
S/N C-9024-101 and beyond
and C-9026-101 and beyond
12 volt 35 amp.

Voltage Regulator: 12 volt

Starting Motor: 12 volt

BATTERIES

Make and Part Number: Prestolite H14A-90 (wet type)

Clark Number: 1900212

Number Required: 2

Electrical System: 12 volt

Grounded Terminal:

Serial numbers C-9014-101 through C-9014-150,
Positive.

Serial numbers C-9016-101 through C-9016-111,
Positive.

Serial numbers C-9024-101 and beyond, Negative.

Serial numbers C-9026-101 and beyond, Negative.

Specific Gravity: 1.230-1.260

(Not over 0.050 variance between the adjacent cells.)

PRESSURES

Engine Oil: 9 PSI. minimum at idle (550 to 600 rpm.)

Transmission Clutches: 200 PSI. maximum at idle (550 to 600 rpm.) in all speed ranges in both forward and reverse directions and at an oil temperature of 180°F. to 200°F.

Steering and Blade Hydraulic System: Main relief valve 1,600 PSI.

CAPACITIES

	664		
	Imperial	U.S.	Metric
Engine Crankcase	14 qt.	16.8 qt.	15.96 litres
Cooling System	20 qt.	24 qt.	22.8 litres
Axle Differentials	15 pt.	18 pt.	8.55 litres
Axle Planetaries (each)	13 pt.	15.6 pt.	7.4 litres
Fuel Tank	20 gal.	24 gal.	91 litres
Hydraulic System	8 gal.	9.6 gal.	36.4 litres
Torque Converter and Transmission	4.5 gal.	5.4 gal.	20.5 litres

	666		
	Imperial	U.S.	Metric
Engine Crankcase	17 qt.	20.4 qt.	19.4 litres
Cooling System	20 qt.	24 qt.	22.8 litres
Axle Differentials	15 pt.	18 pt.	8.55 litres
Axle Planetaries (each)	13 pt.	15.6 pt.	7.4 litres
Fuel Tank	20 gal.	24 gal.	91 litres
Hydraulic System	8 gal.	9.6 gal.	36.4 litres
Torque Converter and Transmission	4.5 gal.	5.4 gal.	20.5 litres

TIRES

	664	666
Standard	16.9 x 30 - 10 ply	18.4 x 34 - 10 ply
Optional	18.4 x 26 - 10 ply	18.4 x 26 - 10 ply
	18.4 x 34 - 10 ply	23.1 x 20 - 10 ply
	23.1 x 26 - 10 ply	

Tires with shredded wire and steel guard construction are also available.

TIRE PRESSURES

Front Tires — 16 psi. Rear Tires — 18 psi.

HYDROINFLATED TIRES (Front Only)

The following table gives 650 lbs. of hydroinflation per tire.

Imperial Measure:

Min. Temp.	Calcium Chloride (lbs.)	Water (gal.)	Specific Gravity at 62° F.
-10° F.	141	51	1.150
-30° F.	192	46	1.218
-42° F.	218	43	1.250

U.S. Measure:

-10° F.	141	63.8	1.150
-30° F.	192	57.5	1.218
-42° F.	218	53.8	1.250

Metric Measure:

-10 F.	64.4 kg.	232.1 litres	1.150
-30° F.	87.2 kg.	209.3 litres	1.218
-42 F.	98.97 kg.	195.7 litres	1.250

