



# **CLARK**

# **RANGER**

## **OPERATOR'S MANUAL**

**P/N R2835R-1**

**INTENTIONALLY BLANK**

# CLARK EQUIPMENT

## ***Ranger***

### **668 G.M. & CUMMINS**

FOR SERIAL NUMBERS

668 G.M. — 505B-101-CAC thru 9999-CAC

668 Cummins — 507B-101-CAC thru 9999-CAC

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

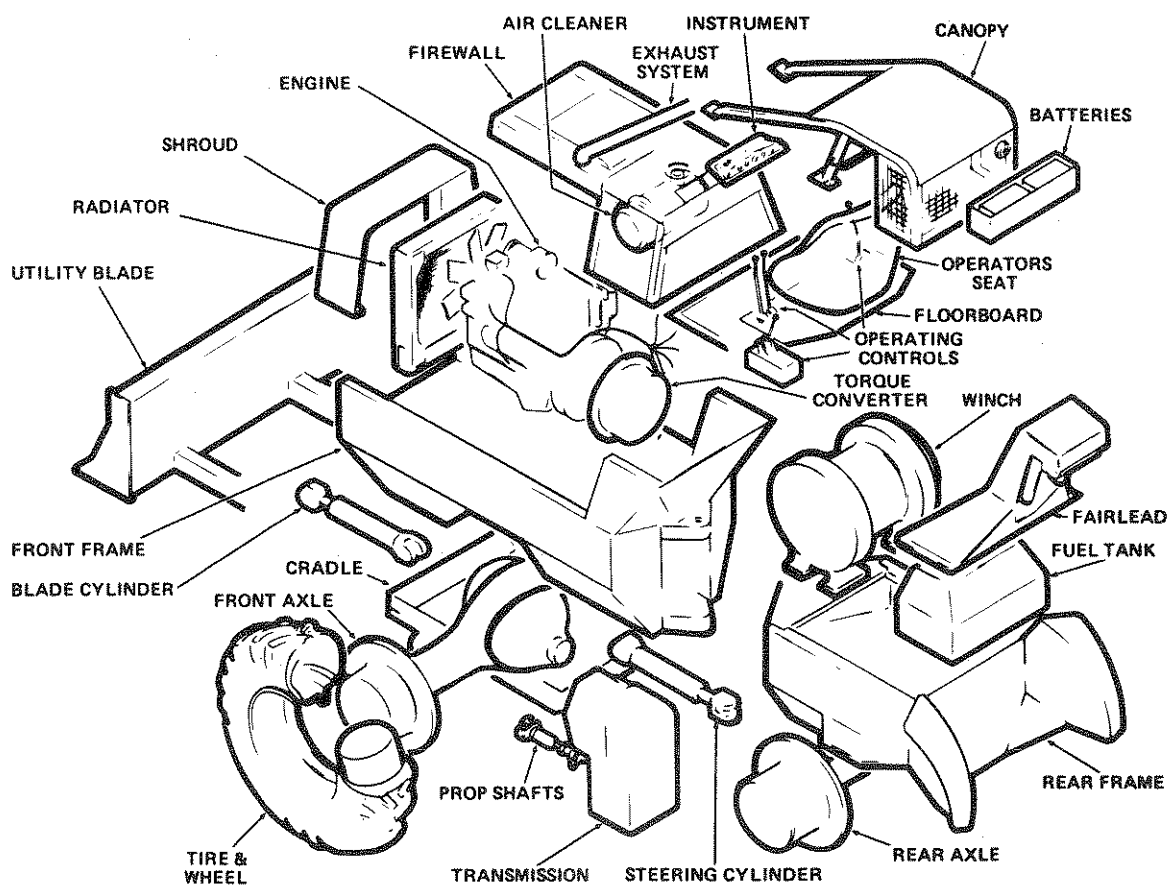
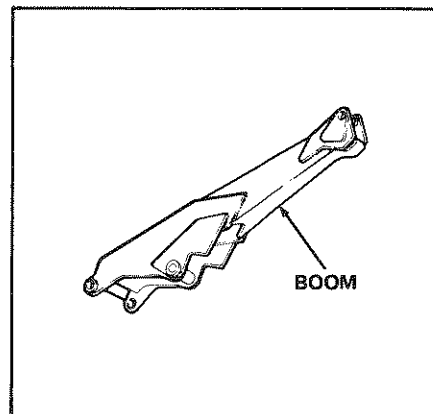
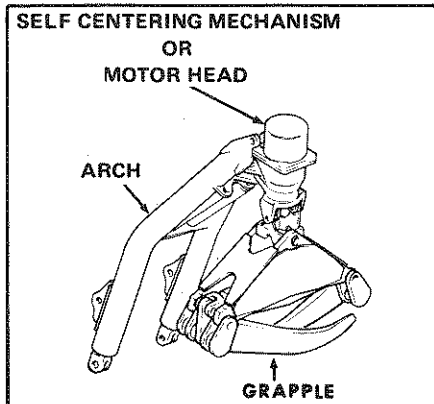
Machine Serial \_\_\_\_\_

Engine Model \_\_\_\_\_

Engine Serial \_\_\_\_\_

## **OPERATORS MANUAL**

### **P/N R2835R-1**



# WARRANTY

Clark Equipment Company (CLARK) has warranted to the Distributor (Seller) who, pursuant to agreement with CLARK, hereby, on its own behalf, warrants to the Buyer each new CLARK product to be free from defects in material and workmanship under normal use and maintenance as herein provided.

Distributor's sole obligation under this warranty shall be limited to repairing, replacing or allowing credit for, at Distributor's option, any part which under normal and proper use and maintenance proves defective in material or workmanship within six (6) months after delivery to or one thousand (1000) hours of use by Buyer, whichever shall occur first, provided, however, that (i) the product is placed in use not later than one year after shipment from CLARK'S plant; (ii) that notice of any such defect and satisfactory proof thereof is promptly given by Buyer to Distributor; and (iii) such material shall have been returned to Distributor, with transportation charges prepaid and found by Distributor to have been defective.

This warranty does not apply in respect of damage to or defects in any product caused by overloading or other misuse, neglect or accident, nor does this warranty apply to any product which has been repaired or altered in any way which, in the sole judgment of Distributor, affects the performance, stability or general purpose for which it was manufactured.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES (EXCEPT OF TITLE), EXPRESSED OR IMPLIED, AND THERE ARE NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL DISTRIBUTOR BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES.

This warranty does not apply to parts of trade accessories not manufactured by CLARK, or attachments not manufactured or sold by CLARK, Buyer shall rely solely on the existing warranties, if any, of the respective manufacturers thereof.

## IMPROVEMENTS

It is CLARK'S policy to constantly strive to improve its products. The right therefore is reserved to make changes in design and improvements whenever it is believed the efficiency of the product will be improved thereby, but without incurring any obligation to incorporate such improvements in any product which has been shipped or is in service.

## TO OWNERS

The purpose of the manual is to serve as a guide to the proper operation, lubrication and minor adjustment of the CLARK RANGER Skidder. 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 CLARK RANGER Skidder 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.

Your CLARK RANGER Skidder will always respond at its best with considerate treatment and care. The slight outlay in personal attention and cost required to give regular and proper lubrication; inspection at stated intervals, and such adjustments as may be indicated, will repay you many times in low cost operation and trouble-free service.



This safety alert symbol indicates important safety messages in this manual. When you see this symbol, be alert to the possibility of personal injury and carefully read the message that follows.

**CLARK EQUIPMENT OF CANADA LIMITED**  
ST. THOMAS, ONTARIO, CANADA, N5P 1H2

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## GENERAL DESCRIPTION

Clark machines are constructed for rugged, heavy duty industrial and commercial applications. They are specifically engineered for maximum ease of operation to move the greatest amount of material in the shortest possible time.

Power comes from the engine through a Clark torque converter having a 3 to 1 torque multiplication factor, to a power shifted, 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.

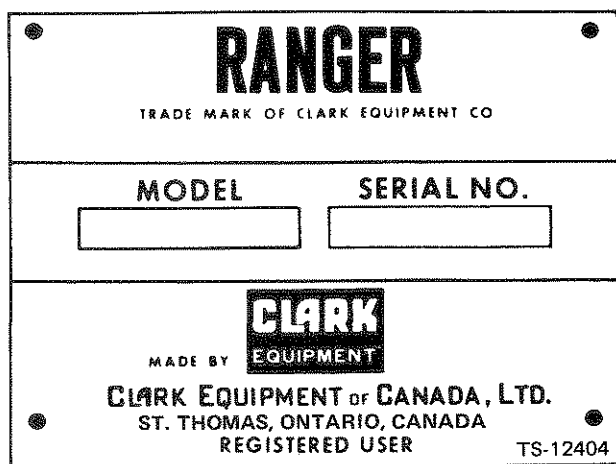


Fig. 1-1 Machine Serial Number Plate

For more complete specifications, refer to the Specifications in Section 15 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. Fig. 1-1.

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.

**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. 1-2.

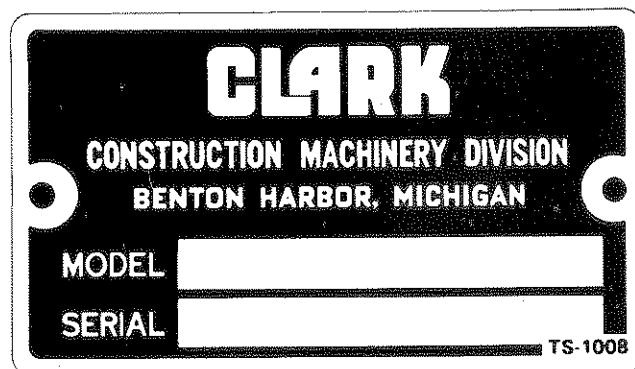
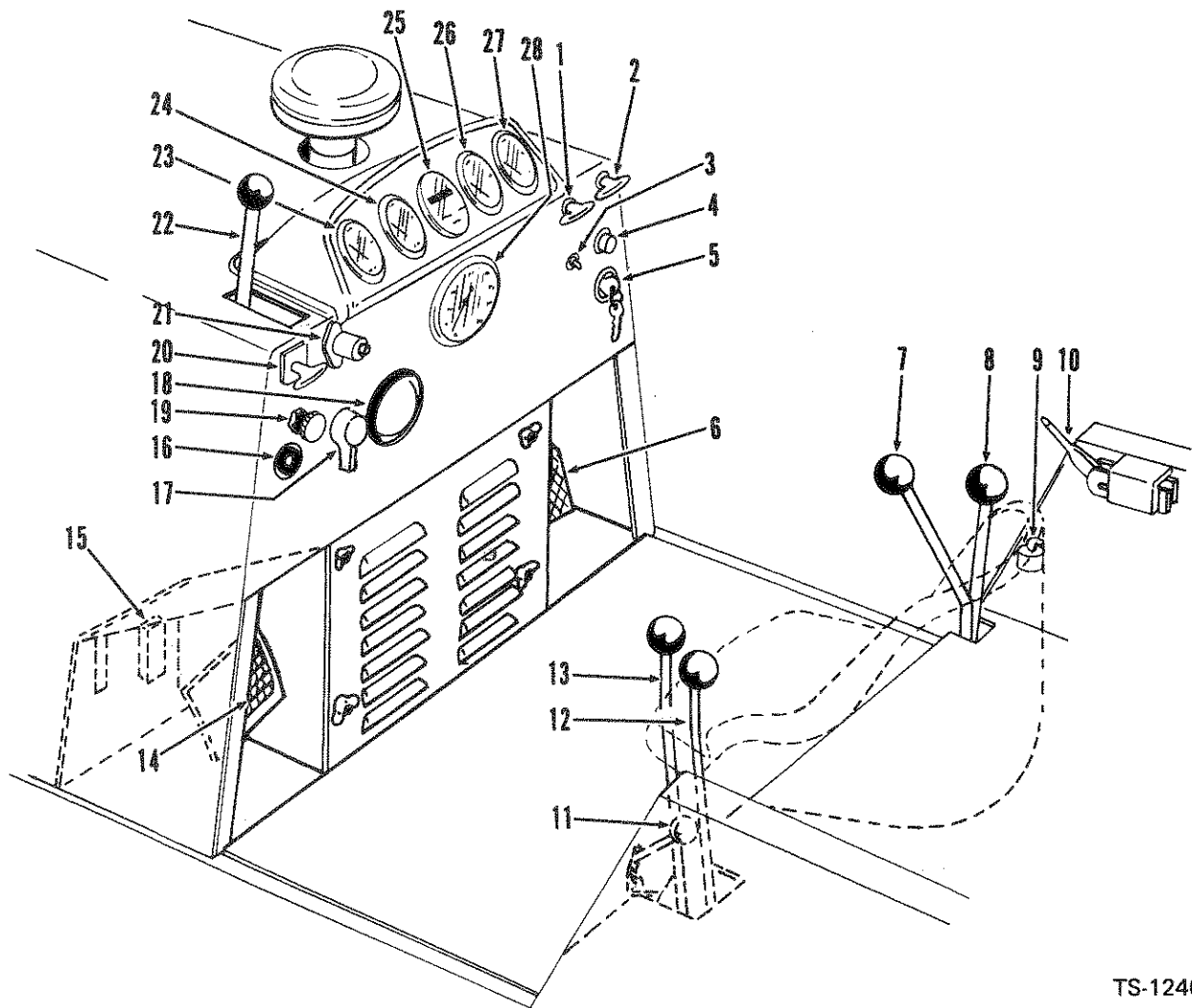


Fig. 1-2 Transmission or Torque Converter Serial Number Plate

Data plates and decals used throughout the machine aid in its safe, efficient operation; others give service instructions. Read all instruction plates and decals before starting and operating the machine.

## NOTES

[illegible]




TS-12403

**Fig. 2 - 1 OPERATING CONTROLS**

- |  |  |
|--|--|
| 1. Hand Throttle (Optional)              | 16. Engine Oil Pressure Warning Light (Optional) |
| 2. Standard Engine Stop                  | 17. Auxiliary Steering Switch (optional)         |
| 3. Light Switch (Optional)               | 18. Auxiliary Steering Light (Optional)          |
| 4. Starter Button                        | 19. Ether Starting Control (Optional)            |
| 5. Ignition Switch                       | 20. Emergency Engine Stop (G.M. Only)            |
| 6. Accelerator Pedal                     | 21. Air Cleaner Service Indicator                |
| 7. Steer and Blade Control Lever         | 22. Emergency Brake (Optional)                   |
| 8. Tilt-dozer Blade Control Lever (Opt.) | 23. Engine Oil Pressure Gauge                    |
| 9. Battery Disconnect Switch             | 24. Engine Water Temperature Gauge               |
| 10. Parking Brake Lever                  | 25. Hourmeter                                    |
| 11. Winch Control Lever                  | 26. Transmission & Converter Temperature Gauge   |
| 12. Speed Range Control Lever            | 27. Ammeter                                      |
| 13. Forward & Reverse Control Lever      | 28. Tachometer                                   |
| 14. Brake Pedal                          | 29. Seat Adjustment Lever (Not Illustrated)      |
| 15. Circuit Breaker Reset Button         |  |

## OPERATING CONTROLS

1. **Hand Throttle (Optional)** — is located to the right of the standard engine stop control. Pull out to override 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.
  2. **Standard Engine Stop (G.M. only)** — 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 handle in and return the ignition switch to the "OFF" position. Before restarting the engine, always make sure the engine stop handle has been pushed completely in.
  3. **Light Toggle Switch (Optional)** — Lift up the switch to operate the head and tail lights.
  4. **Starter Button** — energizes cranking motor to start engine. Press to operate; release when engine starts. Do not crank engine continuously for more than 30 seconds to avoid damage to cranking motor. Pause a few minutes between cranking cycles. If difficulty is encountered, refer to Section 4, under Cold Weather Starting.
  5. **Ignition Switch** — energizes all gauges and switches on instrument panel, and starting motor circuit. Turn switch to right for ON position.
  6. **Accelerator Pedal** — this pedal will control the engine speed.
  7. **Steering and Blade Control Lever** — controls the turning of the machine to the left and right and controls the up and down movement of the utility blade. Tilting the lever to the right will steer the machine right, tilting the lever to the left will steer the machine left. Pulling back on the lever will raise the blade, pushing the lever forward will lower the blade.
  8. **Tilt-Dozer Blade Control Lever (Optional)** — controls the tilting of the blade to the left and right. Pushing the lever forward will tilt the blade right and pulling back the lever will tilt the blade left.
  9. **Disconnect Switch** — is located inside the operator's compartment to the left of the operator's seat below the Clark winch control lever. This switch, when in the "OFF" position, will cut off the electrical supply from the battery to the starter solenoid.
-  **WARNING** — Do not turn to off position while the machine is running, or serious damage to the alternator and electrical system may result.
10. **Parking Brake Lever** — To set the brake pull up and back on the lever. This applies the brake located on the transmission output shaft. To release the brake push the lever forward and down.
  11. **Winch Control** — has three positions. Handle down is the "Free Spooling" position necessary for paying out the main line. Handle in neutral is "Skidding" position; handle up is the "Winching In" position.
  12. **Speed Range Control Lever** — provides three positions, low gear, second gear and high to control the travel speed of the machine. Pulling back on the control handle engages low gear. Pushing forward from low gear engages second and high gear.
  13. **Forward and 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 downhill brake by operating the vehicle with transmission in reverse.
- If this precaution is not adhered to, there is a good possibility the engine will stall. When the engine stalls, the hydraulic pump stops; thus, you will not be able to control the steering and, on some Ranger models, you may not have any braking power.*
- CLARK SHALL NOT BE LIABLE FOR ANY CONTINGENT OR SPECIAL DAMAGES OR LIABILITIES, OR ANY FAILURES, OR DAMAGES TO ANY PRODUCTS, ARISING OUT OF OPERATING THE MACHINE DOWNHILL WITH THE TRANSMISSION IN REVERSE FOR BRAKING THE MACHINE.**

14. **Brake Pedal** — is located on the left side of the cockpit. Application of the brake will provide braking to the drive line.
15. **Circuit Braker Reset Button** — is located inside the operator's compartment behind the fire-wall. It is used to protect the electrical wiring and components, by interrupting short circuits or overloads. Its operation is similar to that of a fuse, except the circuit breaker can be reset and used repeatedly. If there is a short circuit or an electrical component malfunctioning causing an overload, the circuit breaker reset button will spring out cutting off the electrical power to the starter solenoid. When this occurs, wait until the system has cooled down then reset the circuit breaker button by pushing the button in. If the reset button springs out again after starting the machine, further trouble shooting of the electrical system will be required to determine the cause of failure.
16. **Engine Oil Pressure Warning Light (Optional)** — warns operator of low oil pressure in engine lubricating system. If warning light remains on for over 10 to 15 seconds, stop the engine immediately and determine cause.
17. **Auxiliary Steering Switch (Optional)** — should the engine or main steering pump fail, turn the auxiliary steering switch to the ON position, and bring the machine to a safe stop immediately, otherwise the auxiliary steering may become depleted. Switch OFF the auxiliary steering switch when it is not in use.  
  
NEVER use the Auxiliary Steering for other than during EMERGENCY STOPPING.
18. **Auxiliary Steering Light (Optional)** — when turned ON, indicates the Auxiliary Steering has been activated.
19. **Ether Starting Kit Control (Optional)** — is used in cold weather operations when difficulty in normal starting is encountered. To operate, refer to Section 4, under Cold Weather Starting.
20. **Emergency Engine Stop** — (GM ONLY) is only to be used in case of an emergency. Misuse of this control may result in damage to the engine.
21. **Air Cleaner Service Indicator** — indicates when to service the air cleaner element.  
  
Dirt trapped by the filter element gradually increases the pressure drop across the cleaner. As the resistance increases, the Red Flag of the indicator gradually rises in the window. When the flag reaches the top position it will lock in place regardless of whether or not the engine is running. Service filter element at this time.
22. **Emergency Brake Lever (Optional)** — is applied by pulling the handle back, and is released by letting go of the spring returned handle.
23. **Oil Pressure Gauge** — indicates the oil pressure in the engine. Operating pressures are 10 to 25 P.S.I. minimum at low idle.
24. **Water Temperature Gauge** — indicates the engine water temperature. Under normal operating conditions, the gauge should register between 170° F. and 185° F.
25. **Hourmeter** — shows the number of hours the engine has run.
26. **Transmission Oil Temperature Gauge** — indicates the temperature of the oil in the torque converter — transmission and Clark winch. When the temperature approaches 250° F. shift to a lower operating range.
27. **Ammeter** — indicates the charge or discharge rate of the electrical system.
28. **Engine Tachometer** — registers the rpm (speed in revolutions per minute) of the engine. This tachometer is designed to assist the operator selecting and maintaining the power requirements necessary to obtain maximum operating efficiency of the machine for any operating conditions.

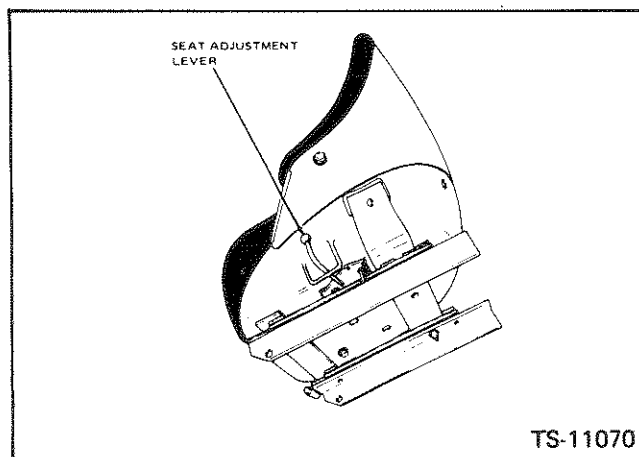


Fig. 2-2 Operators Seat Adjust Lever

29. **Seat Adjustment Lever** — The operator's seat can be shifted forward or backwards 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. Fig. 2-2. An additional adjustment in the height of the seat is offered. This can be done by removing the seat bracket

mounting bolts and raising or lowering the seat to the desired position. Machines equipped with a rotating seat, have a hand screw located at the front of the seat to lock-in the desired position. Oiling of the release mechanism, track assemblies and pivot points will keep them operating freely.

## OPERATING SAFETY PRECAUTIONS

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.

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.

1. Personal:
  - a. Avoid loose clothing particularly cuffs and scarves.
  - b. Know the safety equipment required for the job and use it.
  - c. Know the hand signals used on the job and who has responsibility for signaling.
  - d. Allow only trained operators to use the skidder.
  - e. Read this manual thoroughly prior to attempting to start and operate the machine.

### 2. Prepare Machine For Starting:

- a. Warn all personnel who may be in machine area. Walk completely around machine before entering operators compartment.
- b. Correct or report all apparent machine defects.
- c. Note all hazards and obstructions such as ditches, overhead electrical wires, wheel blocks, etc.
- d. Insure proper ventilation if machine is started indoors.
- e. Be particularly careful if this is not the machine you would normally operate.

### 3. Mounting and Demounting:

- a. Maintain all steps and grab handles free from grease and mud. Keep hands, floor and all controls free from water, grease and mud.
- b. Never leave machine unattended with engine running.
- c. Always place the control levers in neutral, lower the blade and/or grapple, apply parking brake before dismounting.
- d. Always apply a parking brake when you park machine. If on a slope block wheels also.
- e. Never get on or off a machine in motion.

### 4. Starting and Stopping:

- a. Start the engine only from operators seat.
- b. Remove or secure all maintenance or personal items such as lunch boxes, chains, shovels, etc.
- c. Always place controls in neutral and lock brakes before starting the machine.
- d. Do not operate the machine without instruments. Each gauge on the instrument panel serves as an important check point for operating condition of the machine.

### 5. Machine Control Check:

- a. Test steering both left and right while moving slowly.
- b. Test brakes against engine power.
- c. Check function of safety devices; lights, back up alarms, emergency brake, auxiliary steering, etc.


### 6. Operation:

- a. Do not permit riders on machine.
- b. Operate the machine at speeds consistent with the conditions on the particular job.

Extra caution should be used if wet or icy conditions exist.

- c. Do not use the blade as a brake when negotiating a slope.
- d. Always keep skidder in gear when going down hill. Do not coast.

#### 7. Maintenance:

- a. Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.
- b.  **WARNING** — Service personnel must stay out of the hinge area between the front and rear frames when the engine is running or the machine is in motion as there is not enough space for a man when machine is turned.
- c. When airing tires stand away to the side of the tire.
- d. Use extreme caution in removing radiator caps, drain plugs, grease fittings or pressure taps.
- e. Wear gloves when handling cable.
- f. Shut off engine before refueling. Never smoke while filling tank.
- g. Block wheels and axles securely when working under machine.
- h. Do not attempt repairs you do not understand. There is no disgrace in asking for help.

#### 8. Fire Prevention:

- a. Your skidder is equipped with a fire extinguisher. Know how to use it and keep it charged.
- b. Check electrical wiring and connections frequently for exposed wires and loose connections which could short out and cause a spark.
- c. Check hydraulic and fuel lines and connections frequently for worn hoses and leaking components.
- d. Clean out accumulation of inflammable material daily.
- e. Disengage parking brake before moving machine.

#### 9. Seat Belts:

- a. Under almost all operating conditions the use of a seat belt is recommended.

#### 10. Miscellaneous:

- a. 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 are 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.

- b. Keep the machine clean and free from dirt. Whenever the machine is working in muddy or swampy areas, or whenever it begins to collect broken branches, pine needles or excessive dirt, this debris should be cleaned out. Remove the access covers, where available, and remove all such foreign material, by using a rake, hoe or any other type of tool that will accommodate. Particular attention should be taken to maintain clean areas around the front frame, front axle and cradle, engine compartment, hinge, rear frame and fuel tank.

If dirt or other foreign material is allowed to accumulate, it will find its way into the various systems when plugs, covers or caps are removed, or during a unit replacement. Such problems can and will eventually cause premature failure of the units components and will result in costly downtime.

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

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

- c. Check and repair drive line noises. 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 all speed ranges with the hydraulic controls (forward and reverse control shaft lever) in neutral. Engage the control lever 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.

- d. 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.


## NOTES

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# STARTING INSTRUCTIONS

## PRE-STARTING CHECKS

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


 **WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE: Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.*

1. Engine oil level.
2. Engine air cleaner indicator.
3. Hydraulic system oil level. (Refer to Sec. 11)
4. Cooling system.
5. Fuel supply.
6. Tire pressures.
7. Battery electrolyte levels.

Service units at this time if inspection indicates the necessity.

Normal Starting (Above 40° F. [4-5° C] G.M. & 50° F [10° C] Cummins)

 **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 lever (forward and reverse control lever) in NEUTRAL.
2. Make sure that the engine stop control is pushed in. (GM only)
3. Turn the ignition switch to the on position, then press the starter button 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 or less than 10 P.S.I. is indicated within 15 seconds, shut down the engine and determine the cause. Refer to your Engine Service Manual.
5. Allow the engine to reach operating temperature before driving or operating the machine.

## Cold Weather Starting

Extensive preparation is not required for cold weather operation beyond addition of a permanent type anti-freeze to the cooling system, and a change of engine oil to a viscosity suitable for anticipated temperatures in which the machine is to operate. At temperatures below 0° F. a change of oil in the main hydraulic system to lubricant recommended on Lubrication Charts will aid starting by reduction of resistance in the main pump. Probably the most important item to insure prompt starting is proper maintenance of the electrical system, especially the batteries.

Batteries must be kept fully charged at all times, since in cold weather the capacity to deliver full power is greatly reduced. A full charged battery at 15° F. (-9.3° C.) is capable of delivering only 70% of its rated amperage, and at lower temperatures becomes even less efficient. Service 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 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. Refer to Sec. 15 for charge test.

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.

Cold Starting (Below 40° F. [4.5° C] For G.M., and 50° F (10° C) for Cummins.)

*NOTE: Starting aids are available from your Engine Distributors as explained in your engine part and Service manuals.*

Remember: starting aids are not intended to correct for low battery, heavy oil, or other conditions which cause hard starting. They are to be used only when all other conditions are normal, but the air temperature is too cold for the heat of compression to ignite the fuel-air mixture.

The following procedures are to be used when an Ether spray can is used for the G.M., and the optional Quick start kit is used for the Cummins machines.

1. Set all the control levers in their NEUTRAL positions and turn the ignition switch ON.
2. Depress the accelerator to the full throttle position.
3. G.M. only — press the starter button and simultaneously direct the starting fluid into the air intake.

Cummins Only — Press the starter button and simultaneously pull out the Quick Start knob, which will direct the starting fluid into the air intake manifold.

*Note: Only one shot of starting fluid is to be used per start, (hold the knob out for one or two seconds maximum) excessive use of the fluid will damage the engine.*

*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 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 down 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: (Refer to Sec. 6, under 250 hours Operations for Warm-up procedures.

1. Engine Oil Pressure Gauge — 10 to 25 P.S.I. at engine idle. If less than 10 P.S.I. is registered after 15 seconds of running, shut down the engine and refer to your Engine Service manual to correct.
2. Ammeter — high rate of charge to the Battery at engine start; charging rate will decline as the charge is restored in the batteries.
3. Air Cleaner Indicator — Check that the red flag indicator is not at its top position, or a new filter or cleaning of this filter is required. Refer to Sec. 6 under 500 hour Operations for cleaning instructions.
4. Converter & Transmission oil temperature gauge — 130° to 200° F. is operating temperature.
5. Engine Water Temperature Gauge — 170° to 185° F is operating temperature.
6. Converter & Transmission Fluid level — checked at operating temperature as per instructions in Sec. 9 under 8 hour operations.

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 later suffer from gums and deposits remainings after vaporization 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 is stopped, replace the control to its original position.

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. (Fig. 4-1 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. 4-1.

To re-set, push the latch handle clockwise toward the engine, thus rotating the latch until the lever arm springs into place on the latch, as shown in Fig. 4-2.

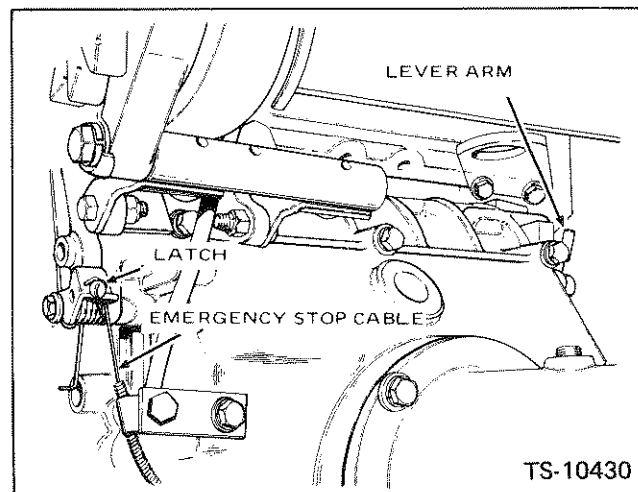


Fig. 4-1 Latch Handle Rotated

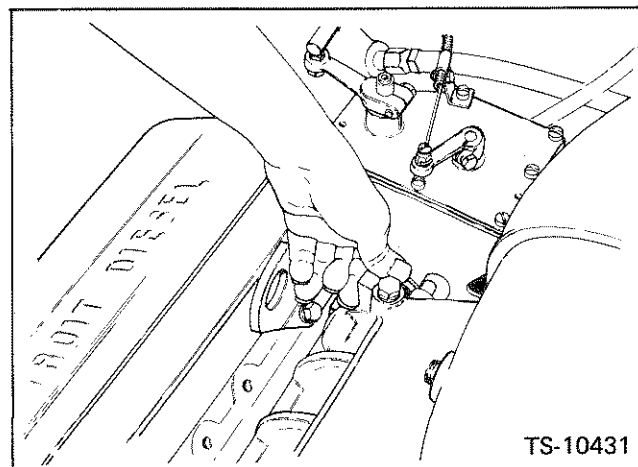


Fig. 4-2 Resetting the Latch Handle

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

### Cummins Diesel

To shut down a Cummins Diesel engine, turn the ignition key to its OFF position.

**INTENTIONALLY BLANK**

## OPERATING THE MACHINE

### SETTING MACHINE IN MOTION

The steps below give the correct procedure for setting the machine in motion. Once the engine has warmed up, the articulation lock is in the "off" position, and personnel around the area are clear.

1. Fasten the seat belt.
2. Raise the blade to its maximum height, by pulling backward on the steer and blade control lever.
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 R.P.M. and stop the machine momentarily while making the shift.
4. Select the speed range for operating the machine. The speed selector lever has three positions, Low, Second and High. Selection of the speed range depends upon the terrain, and load conditions.
5. A shift from one speed range to a higher speed range can be made when the machine is in motion even at full throttle ("POWER SHIFTING"). When making a down shift, decelerate the engine R.P.M. before shifting to a lower speed range.
6. Release the mechanical parking brake.
7. Depress the accelerator pedal slowly.

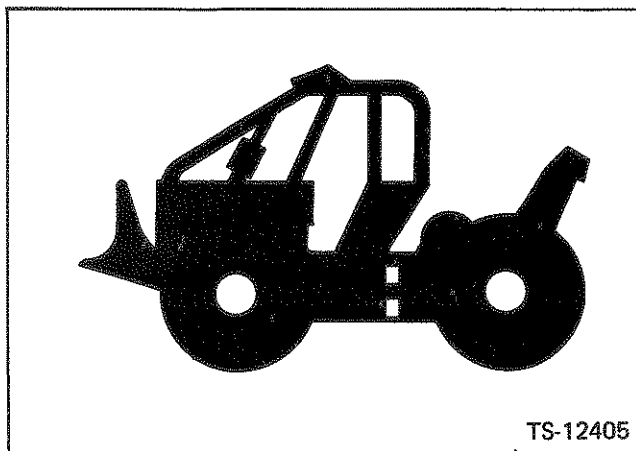


Fig. 5-1 Machine in motion position.

### WORKING THE MACHINE

As the unit now moves out to the stump area with the operator taking care to notice any obstruc-

tions, i.e. stumps, rocks, dead falls, etc., that might cause the skidder to upset; as he may have to maneuver around them. The operator should notice at a glance all the instruments as he moves along, to see if all systems are still operating properly. Also he should notice the general direction at which he approaches the stump area, with the thought in mind that there is a quicker and better way back. Remember, once the skidder has the load, the mobility factor changes greatly. (Definition, Mobility Factor: Steer, traverse, or maneuverability on the terrain.)

Once in the stump area a slow turn should be made so that the operator is able to spot the best position to place his machine to gather logs in the least amount of delay and effort (look out for stems that are blocked by large stumps, windfalls, rocks, or that are cross-felled on each other).

Shift the forward/reverse lever to neutral; place the winch control in free spool; then the hand brake is set and the seat belt removed to enable the operator to dismount. Then pull the mainline and chokers to the butt of the trees to be skidded. Very often a full load can be hooked (or choked) in one "set", however, if the slash is heavy or the snow too deep, the operator should move the unit along side the next few logs rather than spend a great deal of time and energy fighting the mainline and chokers. The chokers are attached about 24" from the butt, or end of the logs. It would not be appropriate to try to tell you how many trees must be hooked each time, however, once you operate for a few days you can begin to determine what the payload should be. The payload might be greater for the skidder in the latter part of the day if it is wet and muddy, or better in the early morning if it is still frozen. Only time and experience can help you get the most economical production from your unit.

The operator now remounts the skidder to begin the return trip to the deck. As he mounts the unit, buckling the seat belt and releasing the hand brake, he should notice the general line of travel the logs will take when the mainline is "run in" and have his machine paralleled to the line pull. The foot brake is held as the winch control lever is moved from the "free spool" through the neutral position, to the winch-in position toward the rear of the skidder. The mainline will begin to "run in" slowly. It is important to remember that the mainline "run in" is controlled by the engine speed — a few R.P.M.'s on the engine will give instant response on the winch mainline, and as the "drag" from the load builds up from the logs being "bunched" together, more engine R.P.M. will be required to bring in the load. Care should be taken to ensure that the butts of the logs are "bunched"

enough to be snugged up near the rear fenders. Once the logs are winched up to the rear fenders, place the winch control to neutral and you are ready to proceed to the landing. Shift the forward/reverse lever into forward position and begin the return trip to the deck. On the skid-way to the deck, short turns must be avoided, along with stumps, rocks or windfalls which might slow the skidder down. The skidder could become immobile if care is not taken to avoid these obstructions, and drop-winning would be required which will, of course, waste a great deal of time. Winning techniques will be discussed a little later. As the skidder approaches the landing, care should be taken during the approach if co-workers are present, or any other bystander who might be struck by logs if they jam up or jackstraw beneath the skidder wheels.

Once the pile is started the operator should travel to the butt end of the logs and release the winch mainline while moving forward slowly a few feet to enable the chokers to slack off to facilitate their release. The operator shifts the forward/reverse lever into neutral, sets the park brake to dismount, releases the seat belt and proceeds to detach the chokers. After all the chokers are released he then mounts the skidder, fastens the seat belt, releases the brake and runs in the mainline until the chokers are just onto the fairlead main roller. He shifts into forward and makes a short turn to blade up the last skid of logs. The pile should be approached in first gear to enable the engine to speed up so that the hydraulics for the blade will provide plenty of lift to build a high deck. The butts should be evened up with the blade to facilitate the loading operation. The operator is now ready to make another "turn" to the stump area.

## WINCHING TECHNIQUES

### 1. Bunching

When winching the skid of logs in for the first time, it is important to remember that a little "speed" on the main cable will allow the logs to "hop" over high stumps or rocks; however, if suddenly the bunched logs hang up, the results will be a broken main cable/chokers, or even worse yet — tip the unit on it's side; particularly if care has not been taken to ensure that the skidder has been properly "lined up" with the logs you are trying to move. In bunching a reasonable load the unit can sometimes move ahead and winch in at the same time. This technique allows a few seconds gained on the cycle time, but also helps the logs to "bundle" together just as they are snugged up to the fenders.

### 2. Drop-Winching

As previously mentioned, dropwinching on the skid trail can be quite an advantage, and necessary under operating conditions; however when this technique is necessary a lot of valuable productive time is lost.

- a. As the skidder begins to slow down its forward movement due to soft underfooting or a large rock or stump, the winch control lever should be quickly pushed into the free spool (detent) position to enable the mainline and chokers to "run-out" as the unit moves to a better and more stable area.
- b. Once good ground conditions are found or if it is more than 50 to 60 feet away the unit should be stopped and the payload "run in" in a similar manner as "bunching" described in Step # 1 of our previous discussion. It is important to remember that the unit should always be in a straight line with the payload because side winching can sometimes tip the skidder on it's side.

### 3. Reverse Winching

This technique is normally used when you can no longer go in either direction under power from the wheels. Select a good size tree, or any object to act as an anchor. The mainline and chokers will have to be pulled out and hooked. By placing the forward/reverse lever in the neutral position and skidder can be "winched" out in the normal manner for winching; however, it is usually easier if the wheels turned under power to help free the stuck unit. The torque converter matches power for the winch and wheels. This feature allows the skidder to back up and winch in at the same time. By moving the forward/reverse lever to the reverse position while at the same time move the winch lever from the free spool position to the "run in" position, the unit will back up and winch in. The engine speed is turned up and the winch line speed will match the wheel speed as the skidder is moved backwards from the immobile area.



### WARNING — 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 front axle assembly and from the transmission to the mid-mount bearing.

3. Attach articulation lock.

**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 torque specified in the bolt torque chart.

4. When towing an articulated machine, do not use a chain, use a solid tow-bar, or it may be best to raise one end of machine with articulation attached since machine cannot be steered without engine operating.

**INTENTIONALLY BLANK**

## ENGINE

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE:* Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.

### 8 Hour 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.

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

### 50 Hour Operations

**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.

**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 (170° F. to 180° 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 bypass 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 1/64 of an inch per inch of span. Fig. 4-1

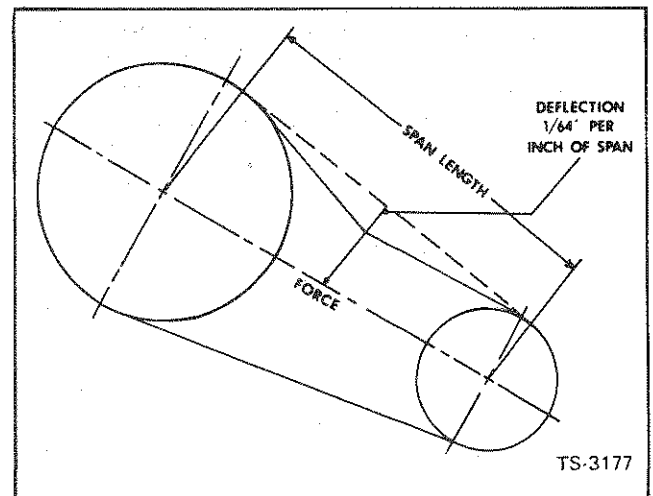


Fig. 4-1 Check Belt Tension

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	Deflection force
7" to 11"	8 to 12 lbs.
11-1/2" to 16"	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.

### 100 Hour Operations

**Clean and Tighten the Air Cleaner Connections —** Tighten all hose clamps and air cleaner mounting parts. Note any sign of damage that might impair the operating efficiency.

The re-usable filter element is very efficient and its service life will be governed by the operating conditions. A service indicator is provided and will show when the air cleaner element should be serviced.

**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 nonharmful to hoses and wiring insulation. Straighten bent fins, being careful not to puncture or enlarge the openings.

### 200 Hour Operations

**Engine BY-PASS Filter (For Cummins Machines Only) —** Replace the filter element every 200 operating hours and whenever the engine is repaired or overhauled for any reason. Thoroughly clean the filter case before inserting a new element. The By-Pass filter is located next to the Full Flow filter. Fig. 6-2.

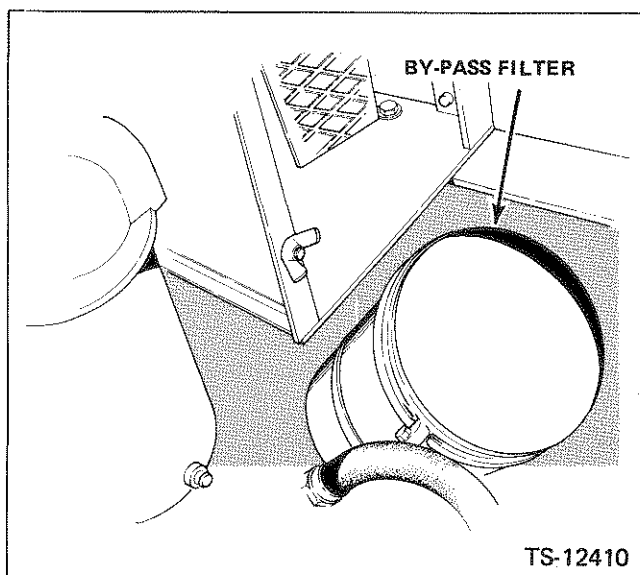


Fig. 6-2 By-Pass Filter Location

*Note: For servicing instructions on the engine Full Flow filter, refer to the operation and maintenance manual of the engine manufacturer.*

### 250 Hour Operations

**Check the throttle linkage —** to ensure a wide open throttle when the accelerator is fully depressed, also a closed throttle when the accelerator is 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 GOVERNOR ASSEMBLY WITHOUT CONSULTING THE OPERATION AND MAINTENANCE MANUAL OF THE ENGINE MANUFACTURER.**

The linkage adjustment for the engine is as follows:

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.
3. Rotate the governor throttle control lever to the extreme (full throttle) position and adjust the ball joint at the front of the accelerator rod, 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 at the other end of the accelerator rod.
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.

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

**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 Date in Section 15.

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

(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 correct.

1. Install a tachometer on the engine.
2. Put the machine into a full right turn.
3. Apply the parking brake, 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. **Engine Warm-Up Procedures** — No Engine stall, or acceleration checks, nor any acceleration to maximum R.P.M. to be performed until the engine is properly warmed up.
  - a. Start the Engine and Operate at low idle R.P.M. for three (3) to five (5) minutes.
  - b. Increase the R.P.M. to 1000 and hold for three (3) minutes.
  - c. Increase the R.P.M. to 1800 and hold for three (3) minutes.

The Engine water temperature gauge should now register approximately 150° F.

6. **Transmission & Converter oil warm up procedure.**
  - a. Shift levers into Forward, Hi and Work Range. Accelerate the Engine to 1400 — 1500 R.P.M. and stall the converter for thirty (30) seconds minimum. Then shift transmission to neutral for fifteen (15) seconds minimum and repeat until the con-

verter oil temperature registers between 180° to 200° F.

#### 7. Steer & Blade oil Warm up Procedure.

- a. Operate the Engine at 1400-1500 R.P.M.
- b. Operate hydraulic system by extending or retracting the various cylinders and holding them closed or open while operating against the relief valve for five (5) seconds maximum every ten (10) seconds until the system reaches between 150° to 170° F.

*NOTE: As there is no gauge to record hydraulic oil temperatures, immerse a recording device in the oil at the hydraulic oil reservoir.*

8. Check the Main Relief Pressure on the steer and blade control valve. Refer to Sec. 11 under 500 hour operations for instructions.

9. Shift levers into FORWARD, HI and WORK RANGE (and accelerate to full throttle) holding converter stall torque with both the parking and service brake and blocked wheels. The converter stall speed is the maximum engine R.P.M. obtainable in this condition.

*NOTE: The stall condition is never to be held for more than thirty (30) seconds or if the converter temperature exceeds 250° F. always idle engine after stall check long enough to bring converter temperature down to 200° F.*

10. The stall speed with the main pump over relief is obtained by activating a hydraulic cylinder to its full closed position and hold with the machine in the converter stall condition. The stall speed with the main pump over relief is the maximum engine R.P.M. obtained in this situation.

**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 Data in Section 15.

*NOTE: The stall RPM specified in Section 15 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.*

### 500 Hour Operations

**Tighten all Mounting Bolts** — the mounting bolts will occasionally work loose and cause the supports and brackets to wear rapidly. Alignment difficulty may also develop. (Refer to Sec. 15 for torque specs.)

**Service the Air Cleaner Element** — It should be understood that no set rule can be established to service the filter element, because its service life is governed by the operating conditions. The service indicator will show the condition of the element and establish when to service.

To change the element, remove the air cleaner access cover on the side of the firewall assembly. Loosen the clamp assembly on the air cleaner and remove the cup assembly. Unscrew the wing nut in the center of the filter element and remove the element. Fig. 6-3. Blow out the element with compressed air (pressure should not exceed 100 p.s.i.), to remove dust, blow in the opposite direction of air flow. Wash the element in a non-sudsing detergent, for about 15 minutes and rinse both the inside and outside surfaces of the element until the run off water is clear. The air cleaner element should be air dried or oven dried at 160° F. (71.3 degrees C) or less.

Clean inside the air cleaner housing, cup assembly and cap removing all dust and foreign material. Inspect the O-ring making sure that it is not damaged in any way, replace if necessary.

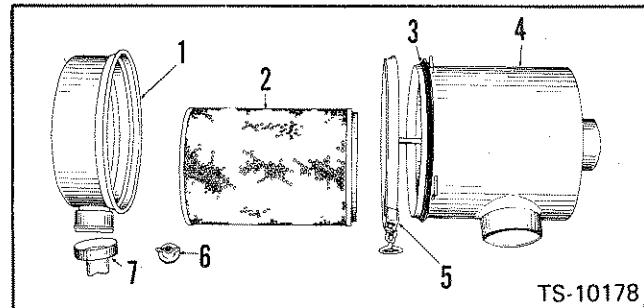
Careful final inspection is recommended after the element has dried, check top sealing gasket for looseness or damage. A loose gasket may be re-cemented. Inspect the element for damage by placing a bright light inside the element. Thin spots, pin holes, or the slightest rupture will render

the element unfit for use. Discard any Damaged Element.

Re-insert the filter element in the housing and assemble the cup assembly. Tighten all clamps and check all hoses.

Reset the service indicator by pushing down on the reset button located on the top of the indicator.

**NOTE: REPLACE THE FILTER ELEMENT AFTER SIX CLEANINGS OR ONE YEAR OF SERVICE — WHICHEVER OCCURS FIRST.**



- |                     |                   |
|---------------------|-------------------|
| 1. Cup Assembly     | 5. Clamp Assembly |
| 2. Filter Element   | 6. Wing Nut       |
| 3. O-Ring           | 7. Vacuator Valve |
| 4. Air Cleaner Body |                   |

Fig. 6-3 Air Cleaner Assembly

### 1000 Hour Operations

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

## FUEL SYSTEM

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE: Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.*

### 8 Hour Operations

**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 round the fuel cap must be CLEAN.

Remove the fuel tank cap and dipstick located at the rear of the machine below the fairlead. Wipe with a clean, lint free cloth and reinsert to check the fuel level. Refill as necessary, making sure before filling that the strainer in the fuel tank filler neck is clean and free from foreign material, clean if necessary. Refill to the FULL mark on the dipstick using a good brand of fuel procured from a reliable company.

**Fuel Oil** — For all 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.

The fuel tank should be filled when the machine is shut down, to prevent condensation.

Before starting the engine at the beginning of the shift, 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. Fuel should be drained into a container and disposed of in a safe place.

Check all the fuel lines, fuel pumps, filters and shut-off cocks for leaks and correct where necessary.

### 50 Hour Operations

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

**Fuel Tank and Hydraulic Reservoir Breathers** — The fuel and hydraulic systems are equipped with breathers. The breathers are incorporated in the filler caps to admit only clean filtered air.

Each 50 operating hours — Remove the filler cap, wash in a solvent, blow dry with compressed air and reinstall the cap in the reservoir.

### 100 Hour Operations

———— NIL ————

### 250 Hour Operations

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

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

The linkage adjustment for the engine is as found in Sec. 6 under 250 hour operation.

### 500 Hour Operations

———— NIL ————

### 1000 Hour Operations

**Fuel Tank** — Every 1,000 operating hours or more often 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 reinstall the cover and close the drain cock.
4. Clean the fuel tank strainer screen.

5. 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 all operating conditions with regard to load, speed, idling time or ambient air temperature refer to the fuel oil specifications recommended by the engine manufacturer.



## TORQUE CONVERTER

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE: Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.*

### 8 Hour Operations

**Torque Converter** — Check the fluid level daily, observing the conditions, as per Sec. 9 under 8 hour operations.

### 50 Hour Operations

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

### 100 Hour Operations

————— **NIL** —————

### 250 Hour Operations

Replace the filter element each 250 operating hours. Refer to Transmission, Sec. 9 under 250 hours.

Check Converter Stall R.P.M. Refer to Stall R.P.M. in Sec. 6 under 250 hour operations.

**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 located below the sender unit on the rear of the converter. Fig. 8-1.

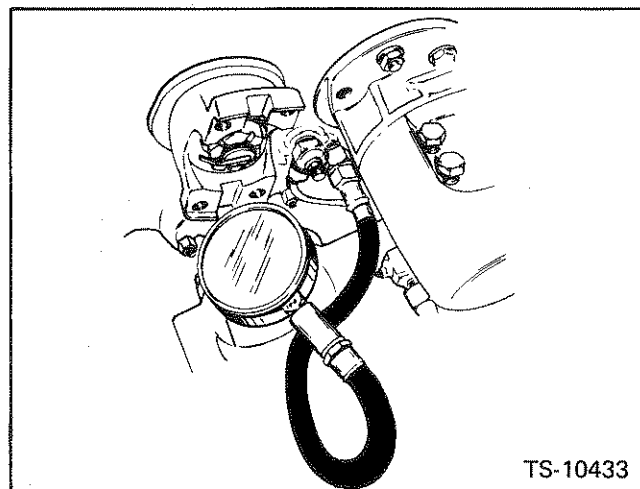


Fig. 8-1 Check Converter OUT Pressure

3. Apply the parking brake; shift the forward and reverse into NEUTRAL position.
4. With the aid of a helper, read the gauge at a steady 2,000 rpm. The gauge reading must not exceed 40 p.s.i.

If the pressure reading exceeds 40 p.s.i. it will be necessary to clean or replace the hoses, the oil cooler, and/or the radiator assembly. To further pinpoint the problem, see "oil cooler pressure drop", under 500 Hours Operation.

### 500 Hour Operations

#### 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 cooler hose has or is becoming plugged with foreign material, causing overheating.

*NOTE: For checking the oil cooler IN pressure refer to the procedure for checking the converter OUT pressure, as these two pressure readings are the same. See Fig. 8-1 for the position of the check point.*

1. Install a tachometer on the engine. Install gauges at the converter OUT pressure check point, (this reading is the same as the oil cooler IN pressure, see NOTE above) and at the oil cooler OUT pressure check point located behind the operator's seat on the right hand cooler hose at the back of the transmission. Fig. 8-2.

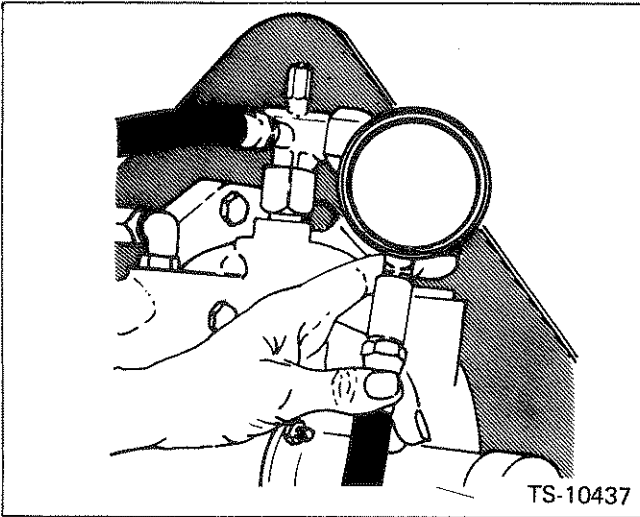


Fig. 8-2 Oil Cooler Out Pressure Drop Check

2. Apply the parking brake and shift the forward and reverse lever into NEUTRAL.
3. With the aid of a helper, read the gauges at a steady 2,000 rpm, and subtract the oil cooler OUT pressure from the oil cooler IN, (Converter OUT), to get the pressure drop. The pressure drop should be between 5 p.s.i. and 20 p.s.i.

If the pressure difference equals or exceeds 20 p.s.i. it will be necessary to thoroughly clean or replace the cooler hose, oil cooler and/or the radiator assembly.

Drain and refill the torque converter hydraulic system every 500 operating hours and whenever, for any reason, the torque converter or any other component within the torque converter system is repaired or overhauled. (Refer to Section 9.)

**Tighten all Mounting Bolts** — the mounting bolts will occasionally work loose and cause the supports and brackets to wear rapidly. Alignment difficulty may also develop.

# TRANSMISSION

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

**NOTE:** Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.

## 8 Hour Operations

**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
4. Area around the filler opening must be CLEAN.
5. Transmission must be in NEUTRAL.
6. Parking Brake must be engaged.

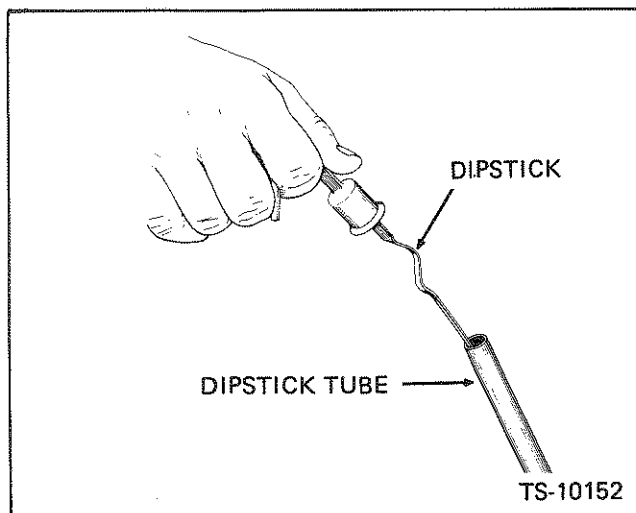


Fig. 9-1 Dipstick — Transmission

Check, using the dipstick located to the left, below the operator's seat for the position of the dipstick. Fig. 9-1. Pull out the dipstick and wipe with a

clean, lint free cloth. Re-insert to check the fluid level, pushing dipstick down firmly. The fluid level must be at the FULL mark on the dipstick. If the fluid level is below the FULL mark, re-insert the dipstick, making sure that it is clean and free from foreign material. Fill if necessary.

*Use only the type of fluid specified in this manual. See "250 Hour Operations" for filter change.*

## 50 Hour Operations

**Clean the Transmission Breather** — The transmission hydraulic system is equipped with a breather located on top of the transmission.

## 100 Hour Operations

—————NIL—————

## 250 Hour Operations

**Torque Converter, Transmission and Winch** — The torque converter, transmission and Clark winch hydraulic system is protected by a full flow 55 micron replacement element type filter assembly. The filter is mounted under the floorboard of the operator's 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, torque converter or winch is repaired or over-hauled 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 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.

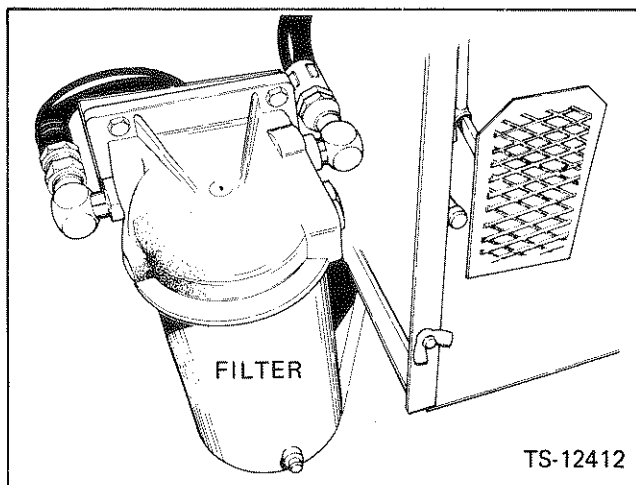


Fig. 9-2 Filter — Transmission and Torque Converter (G.M.)

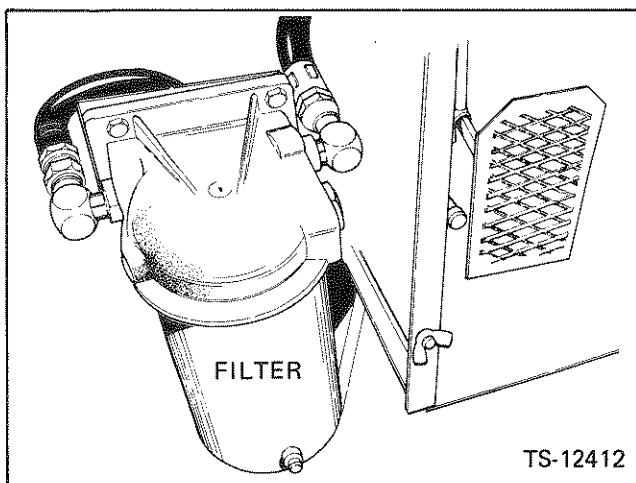


Fig. 9-3 Filter — Transmission and Torque Converter (Cummins)

### 500 Hour Operations

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

1. Securely block the wheels of the machine and apply the parking brake. Place the gear control lever in high speed range and the forward and reverse control lever in FORWARD.
2. 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.
3. Remove the drain plug from the transmission housing and torque converter and drain both the torque converter and transmission housings thoroughly.

4. Remove the transmission suction screen, clean in a solvent, dry, and reinstall using a new O-Ring. Reinstall the reducing bushing to the dipstick and transmission.
5. Replace the element in the transmission and torque converter filter assembly. The filter is mounted under the floorboard of the operator's compartment. 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.
6. Remove the breathers from the top of the torque converter, transmission and winch. Wash in a solvent, blow dry with compressed air and reinstall.
7. Refill the transmission and torque converter with the type of fluid specified in this through the filler neck until the correct level shows on the dipstick. Fig. 9-1
8. Disconnect the return oil cooler hose from the radiator (located 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).

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

9. Start the engine and maintain an idling speed 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 4 gallons (Imperial measure), 4.8 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 (Fig. 9-4) 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 fluid as necessary.

This check is to be performed with the engine idling. **UNDER NO CIRCUMSTANCES USE ANY FLUSHING OIL OR COMPOUNDS FOR CLEANING THE SYSTEM.**

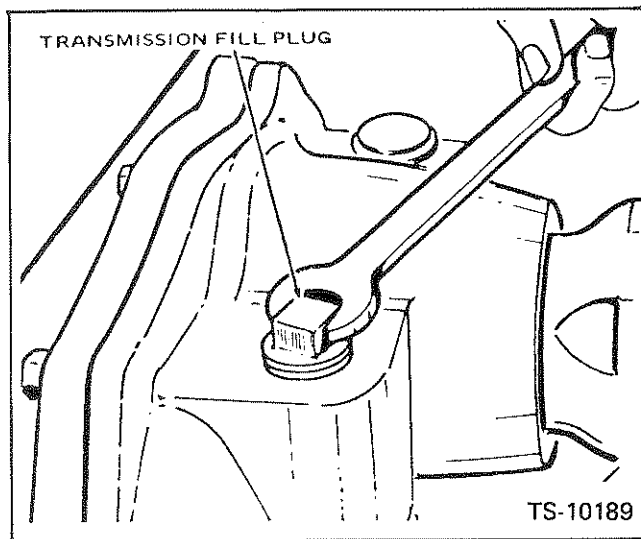


Fig. 9-4 Transmission Fill Plug

**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 shift linkages are as follows:

**Forward and Reverse and Speed Range Control Levers** — Check and adjust the forward and reverse and speed range gear control levers to ensure full engagement into all detent positions without interference.

1. Place the Forward and Reverse control lever 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.
3. Tighten the locknuts and check that the levers will shift into all detent positions without interference from the floorboard or transmission.

### Transmission Clutch Pressure

Periodically or whenever the machine has evidence of incorrect operation in any one of the speed ranges in forward or reverse directions, 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 check plug on the pressure regulator valve. Remove the check plug and attach the test gauge as shown in Fig. 9-5.

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 applied. The pressure check should be made in all the speed ranges in both forward and reverse. With the engine idling and at the operating temperature (180° F. to 200° F.) pressure should be as follows:

Minimum 240 p.s.i.  
 Maximum 280 p.s.i.

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

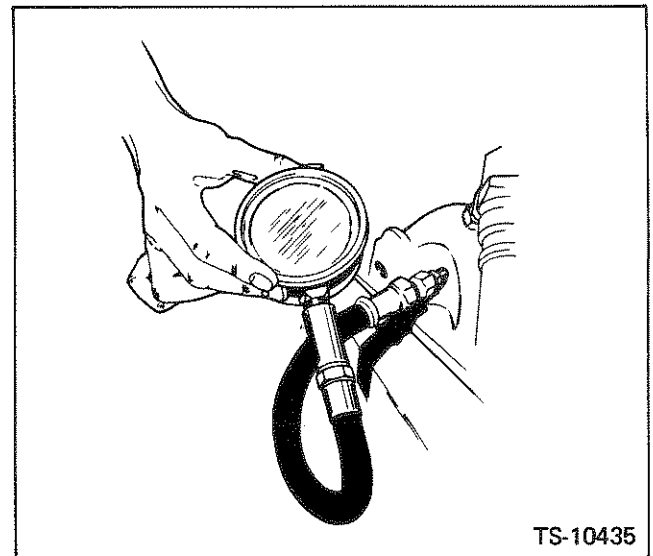


Fig. 9-5 Check Transmission Clutch Pressures

**INTENTIONALLY BLANK**

## WINCH - CLARK

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE: Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.*

### 8 Hour Operations

**Grease Fitting** — Grease the fitting on the winch control lever.

### 50 Hour Operations

Clean the Winch Breather. The winch is equipped with a breather located on top of the housing.

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

### 100 Hour Operations

Adjust, if necessary, the mechanical free spool adjustment. An adjustment should be performed whenever unsatisfactory spooling is encountered.

To adjust the tension on the cable drum, turn the adjusting handle, located on the right hand side of the winch. To increase tension, turn the adjusting handle clockwise; to decrease tension, turn the adjusting handle counter clockwise.

### 250 Hour Operations

Replace the filter element each 250 operating hours. See the section on the transmission for removal and replacing the filter. (Section 9)

Check the wear button in the mechanical free spool adjustment every 250 hours, or whenever unsatisfactory spooling is encountered.

1. Remove the set screw, set screw spring and set screw lock bolt.
2. Remove adjusting handle, spring and wear button.
3. Check the wear button for cracks and wear.
4. Reassemble and adjust for proper spooling tension.

### 500 Hour Operations

Drain and refill the hydraulic system every 500 operating hours and whenever, for any reason, the winch or any component within the winch system is repaired or overhauled.

Refer to the transmission Section (9) for drain and refill.

### 1000 Hour Operations

————— NIL —————

*NOTE: For disassembly of the winch, refer to the disassembly instructions in the winch shop manual. **DO NOT** attempt to disassemble or make any repairs inside the winch, before first reading and understanding the disassembly and reassembly instructions.*

## NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



## HYDRAULICS

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE: Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.*

### 8 Hour Operations

**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. Fig. 11-1

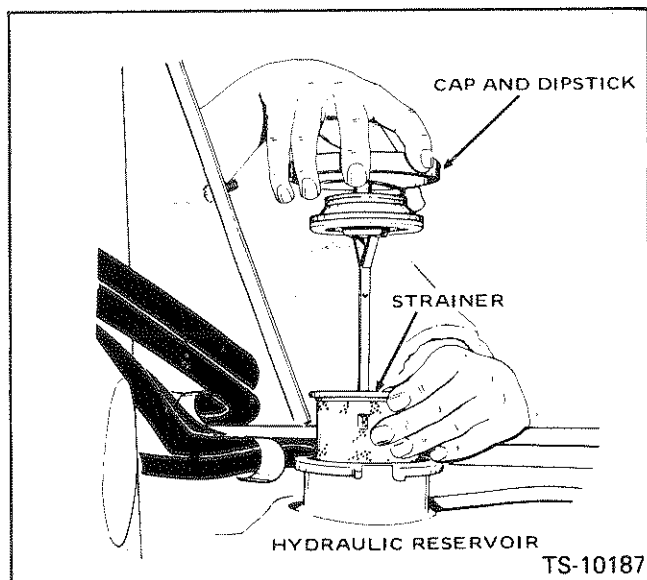


Fig. 11-1 Hydraulic Reservoir, Cap, Dipstick and Strainer

Use the type of fluid specified in this manual. In order to prevent pump wear at high speeds and high pressures, anti-scurf and anti-wear additives are contained in these specifications.

See "500 Hour Operations" for replacing the Hydraulic Filter Assembly Element, and "1,000

Hour Operations" for the Drain and Refill of the reservoir.

**CAUTION:** When replacing oil in the hydraulic system do not interchange Dexron Automatic Transmission fluid with military spec., MIL-L-2104A, Supp. 1 or New MIL-L-2104B. The system must be drained and flushed, using only the oil to be added as the flushing agent.

DO NOT flush with a cleaning or flushing oil before adding a different oil as some converter units cannot be completely drained and a considerable amount of oil remains trapped in the converter elements. Entrapped flushing oil will contaminate the refill.

### 50 Hour Operations

#### Auxiliary Steering Test

1. Place the machine on a clean level area.
2. With the engine "OFF" and the ignition switch "ON", turn the auxiliary switch to the "ON" position.
3. Steer the machine left, and right, full against the steer stops, then turn the auxiliary steer switch to the "OFF" position.

**NOTE:** The total running time of the auxiliary steer system should not exceed two minutes, (to minimize battery drain).

If the auxiliary steering fails to respond satisfactory to the above test, check the condition of your battery; all hydraulic connections, and main relief pressures. If a problem still exists, have a mechanic check out the system.

**Fuel Tank and Hydraulic Reservoir Breathers** — The fuel and hydraulic systems are equipped with breathers. The breathers are incorporated in the filler caps to admit only clean filtered air.

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

**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.

element. Check all gaskets and replace if necessary. The filter mounting bolts are to be torqued to 40 to 50 inch lbs. only, or distortion may occur causing 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.

**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.

Procedure for checking and adjusting the relief valves.

1. Shut down the engine.
2. Move the steering control lever from side to side or backwards and forward to relieve the pressure in the system.
3. Attach a hydraulic gauge of at least 3,000 p.s.i. capacity to the hose fitting on the main control valve. Fig. 11-3
4. Start the engine and accelerate to 2,000 rpm.
5. Put the machine into a full left hand turn and hold the lever in the full turn position. The gauge should register 1,600 p.s.i. at 2,000 rpm. If not, adjust the main relief by removing the acorn nut, loosening the jam nut and adjusting the set screw located on the right hand side of the main control valve assembly until 1,600 p.s.i. registers on the gauge. Fig 11-2

#### Optional Steering and Blade Control Valve

6. Machines equipped with a tilt-dozer blade have the optional steer blade control valve. The main relief pressure of this valve must be set at 2,200 p.s.i. instead of 1,600 p.s.i. for a standard valve.

To set the optional tilt-dozer blade control valve, the optional steer blade control valve must be temporarily set at 2,300 p.s.i.

7. Put the tilt blade into a full tilt position and hold. The gauge should register 2,200 p.s.i. at 2,000 rpm. Fig. 11-3. If not, adjust the main relief valve by removing the acorn nut loosening the jam nut and adjusting the set screw

located on the top of the tilt blade control valve until 2,200 p.s.i. registers on the gauge. Release the control lever.

**NOTE:** The tilt blade control valve is located under the floorboard, below the tilt blade control lever.

8. Put the machine into a full left hand turn and hold. Re-adjust the main relief pressure on the steer and blade control valve to 2,200 p.s.i. at 2,000 rpm. Fig. 11-2 and 11-3. Release the control lever.

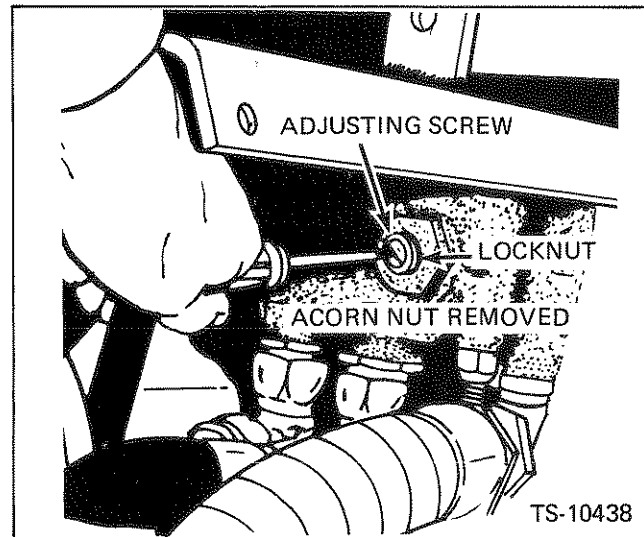


Fig. 11-2. Adjust Pressure — Main Relief Valve

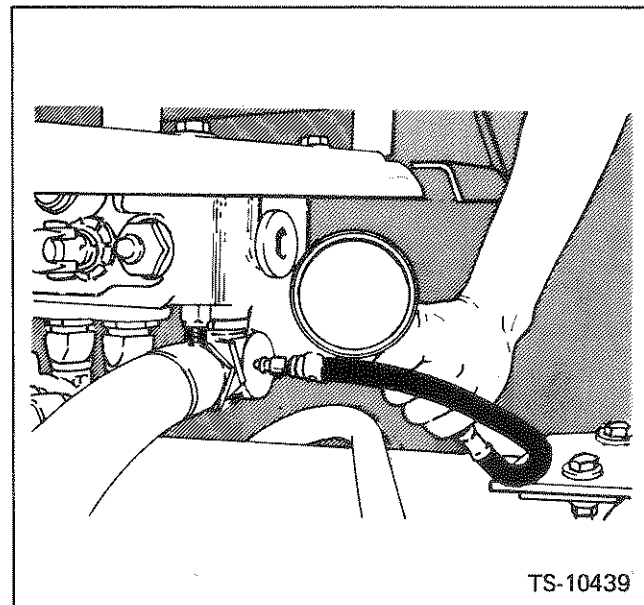


Fig. 11-3. Main Relief Valve Pressure Check

9. Shut down the engine. Tighten the lock nuts on the valves and replace the acorn nuts. Remove the gauge and replace the pressure check plug fitting.

### 1000 Hour Operations

**Hydraulic Reservoir** — Drain, clean, and refill the hydraulic oil system every 1,000 hours of operation, or more often 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 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 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.**

**INTENTIONALLY BLANK**

## AXLE, PROP SHAFTS & WHEELS

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE: Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.*

### 8 Hour Operations

**Check the Tire Pressures and Casings** — Check the air pressure in all the tires. See specifications and service data in this manual 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.

### 50 Hour Operations

**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.

**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 Operations" for Drain and Refill.

**Front Axle Planetary Hubs** — Check the lubricant level each 500 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 check 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 Operations" for Drain and Refill.

**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.

**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.

*\*"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.*

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

### 100 Hour Operation

**PROP SHAFTS** — Grease the slip yoke tube on all prop shafts every 100 hours.

On machines equipped with 100 hour spider and bearing assemblies, Fig. 12-1, grease every 100 hours.

*NOTE: When greasing use a hand gun and apply Lithium base Multi-Purpose Grease, (LBG). Care must be taken not to blow the seals; grease sparingly until the grease is visible at all four bearing caps.*

### 250 Hour Operations

————— **NIL** —————

### 500 Hour Operations

**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.

### 1000 Hour Operations

**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.

**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.

**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 lub (\*SCL Type) through the fill and level plug opening in the thrust cap until the lubricant is level with 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.*

**PROPELLER SHAFTS** — Double propeller shafts used on the Ranger machines have three points of lubrication, one on each spider and bearing assembly and one on the slip yoke assembly. Single propeller shafts used on the Ranger machines have only one lubrication point, the spider and bearing assembly. When greasing 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  
0°F. and Above  
Below 0°F.

Grease Consistency  
Heavy oil base — Grade 2  
Light oil base — Grade 0

**PROP SHAFTS** on machines equipped with 1000 hour spider and bearing assemblies grease every 1000 hours.

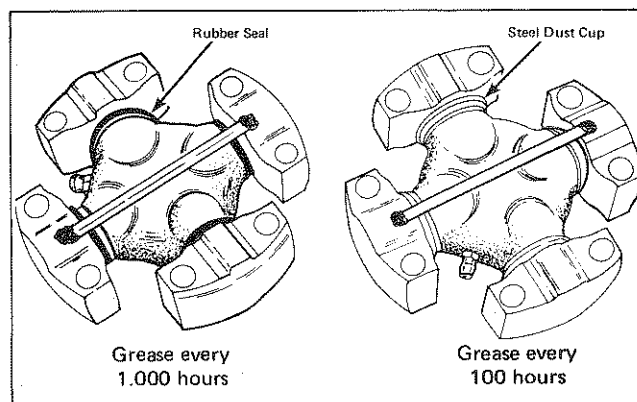


Fig. 12-1 Spider & Bearing Greasing

### Wheel Removal Procedure For Split Rims

1. Shut down the engine. When the engine has completely stopped, turn the battery disconnect switch to the "OFF" Position. Place transmission control levers in neutral and apply a holding brake.
2. Before placing a hydraulic jack in position, **BLOCK THE WHEELS OF THE MACHINE.**
3. Take off the valve protection cap, then remove the valve core carefully and exhaust all the air from the tire. Run a piece of wire through the valve stem to make sure it is not plugged. *NOTE: If the tire is hydro-inflated, stand clear of the spray.*



**WARNING:** You must deflate the tire and drain as much hydro-inflation as possible before any further work can be done. This step is especially important in the case of split rims.

4. Attach tire tongs to the rim, to facilitate hoisting the wheel assembly off the axle end, when the rim stud nuts are removed.

5. Remove the rim stud nuts. Refer to Fig. 12-3 for the correct location of the rim stud nuts.

*NOTE: Example 1, in Fig. 12-3 visually shows the Rim coupling nuts facing the outside of the rim. The current rims of this style have the coupling nuts facing the inside of the rim. Both styles have the wheel stud nuts facing the outside of the rim.*

6. Remove and lay the wheel assembly down with the rim coupling nuts side up.

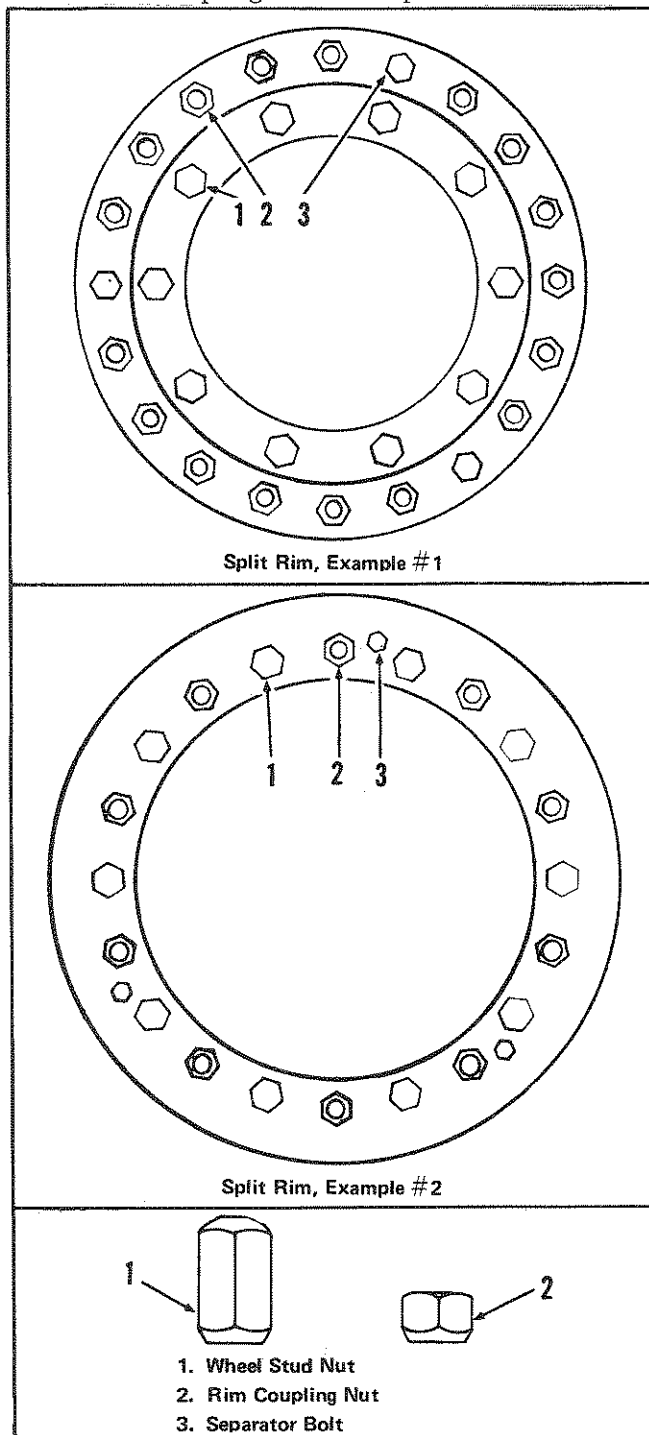


Fig. 12-3 Split Rims

7. Punch mark the two halves of the split rim assembly to facilitate correct reassembly.
8. Place the wheel assembly into an inflation cage, or use safety cables or chains before removing the split rim coupling nuts.
9. Remove the split rim coupling nuts.  
**CAUTION:** The tire must be deflated before removing these nuts.

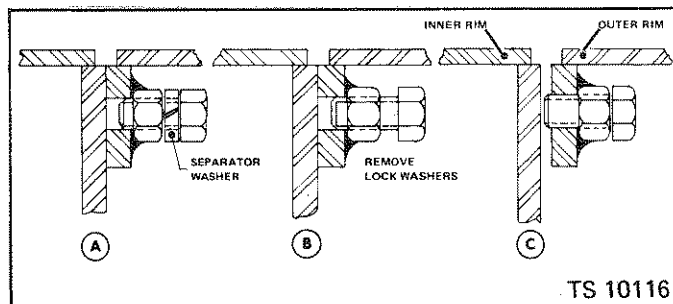


Fig. 12-2 Separator Bolt Operation

10. With the separator bolt lock washers removed, alternately thread in the separator bolts to brake the rim halves apart. Fig. 12-2.
11. Service the rim, tire and tube as required.

#### Wheel Assembly Procedure — Split Rims

1. Lay the rim half containing the welded rim coupling bolts on a flat surface.
2. Place the rubber tire on this half, and insert tube (if the wheel assembly has a tube) in the tire making sure the tube valve will line up with the rim valve opening.
3. Place the second rim half on the first making certain the punch marks made in disassembly on each rim half are lined up.
4. Tighten the split rim coupling nuts to 475 ft. lbs. (65.69 kg. meters) torque. *NOTE: Be certain the separator bolts have the lockwashers back in place to allow the rim halves to fit flush.*
5. Place the wheel assembly back in the tire inflation cage.
6. Add approved hydro-inflation as specified in Section 15, if required.
7. Replace the valve core and with the use of a self locking chuck, inflate the tire to the approved pressure as specified in Section 15.

*NOTE: Inflate a spare tire only enough to keep rim parts in place. A fully inflated tire may explode when it is not installed on a vehicle. Use care if you must transport a fully inflated tire, a safety chain will be required.*

8. Replace the valve protection cap.
9. Place the wheel assembly back on the axle end and torque the wheel stud nuts to 475 ft. lbs. (65.69 kg. meters).
10. Remove the hydraulic jack.



## BRAKE AND MIDMOUNT BEARING

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

**NOTE:** Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.

### 8 Hour Operations

————NIL————

### 50 Hour Operations

**Midmount Bearing** — Every 50 operating hours clean the bearing breather. A hose connects the midmount bearing to the breather which is located, clipped to the right from corner of the rear frame.

### 100 Hour Operations

————NIL————

### 250 Hour Operations

**Brake Master Cylinder** — 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.

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.

**Maintenance Operations of the Brake** — The hydraulic operated multi-disc oil cooled clutch brake operated by an automatic type foot pedal. Clutches operate inside a brake housing located at the rear of the transmission. Three pistons compress the clutches to actuate the brake.

The function of the master cylinder assembly 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.

### (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: Fig. 13-1

1. Depress the pedal by hand, noting the distance the pedal moves before resistance is offered. The correct travel is 1/2 inch free travel.

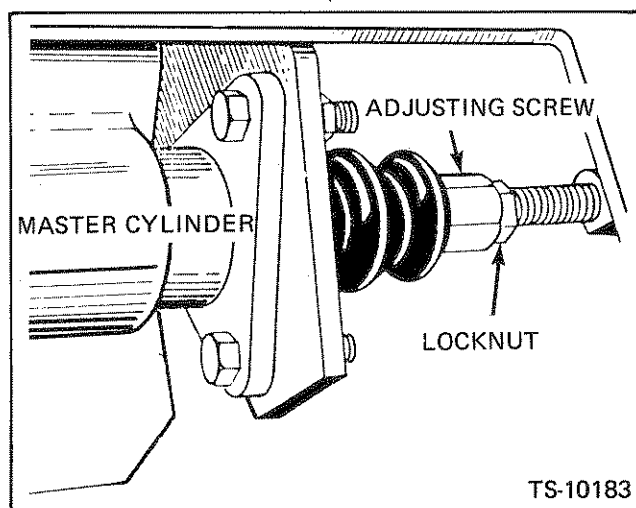


Fig. 13-1 Adjust Brake Pedal Free Travel

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

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 transmission brake must be bled in the following order:

1. Fill the master cylinder with fluid. (Refer to Fig. 13-2)

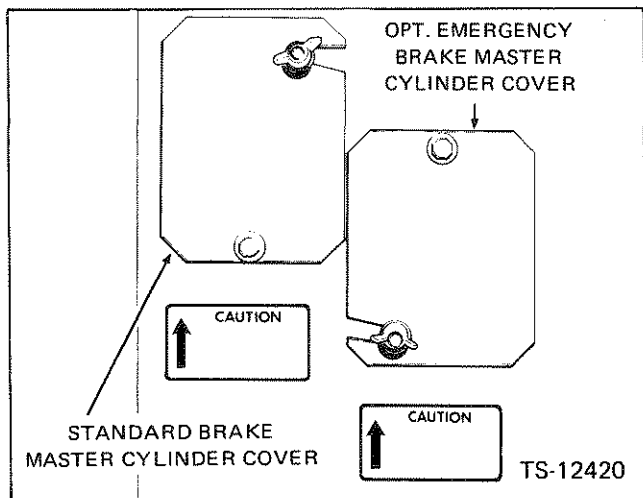


Fig. 13-2 Master Cylinder Locations

## CAUTION

*USE the same type of fluid in the standard brake master cylinder as in the torque converter, transmission and winch hydraulic system. Under no circumstances use brake fluid in this standard brake master cylinder.*

*USE heavy duty brake fluid only in the optional emergency brake master cylinder. Under no circumstances use transmission fluid in the emergency brake master cylinder.*

2. With the aid of a helper, open the bleed screw on the brake housing in Fig. 13-3 and depress the brake pedal to expel any air and fluid from the lines.

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

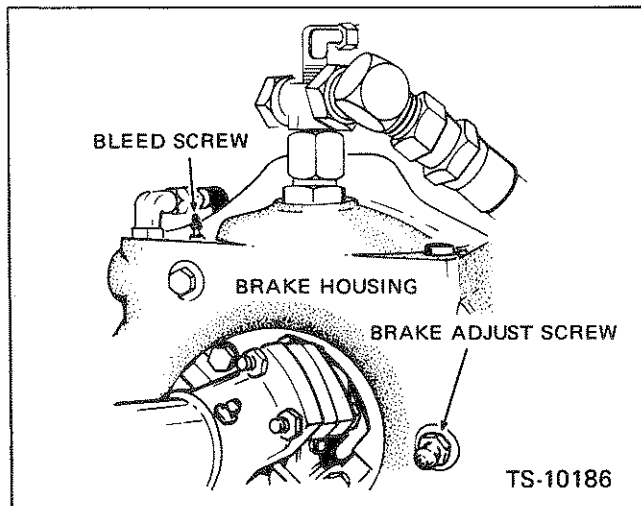


Fig. 13-3 Bleed and Adjust the Brake

Repeat this procedure until solid fluid, free from bubbles, comes from the bleed screw.

### Brake Adjustment

To insure correct and adequate braking pressure the brake should be adjusted periodically or whenever necessary. To adjust the brake loosen the locknut on the adjust screw, Fig. 13-3, tighten the adjust screw clockwise until it is secure. Then loosen the adjust screw counter clockwise one complete turn and secure with the locknut.

### Master Cylinder Adjustment

The master cylinder is equipped with a relief valve. This relief valve is factory set for specific braking applications. Field adjustment of the relief valve should not be attempted.

Check the master cylinder frequently to insure an ample supply of fluid.

**Adjust Parking Brake:** When slack develops in the parking brake cable, perform the following adjustments:

1. With lever in release position turn acorn on end of handle clockwise as shown in Fig. 13-4.
2. Test for good resistance over center as handle is pulled up to applied position.

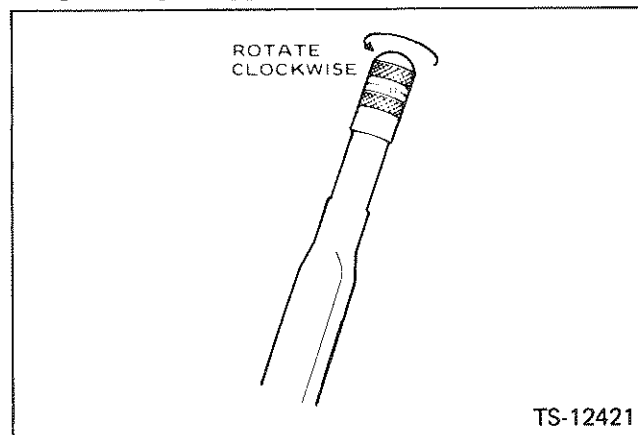


Fig. 13-4 Parking Brake

### 1000 Hour Operations

**Midmount Bearing:** Drain and refill every 1000 operating hours. Remove drain plug located in bottom of midmount bearing and allow all fluid to drain out. Replace drain plug. Remove check plug from side and fill cap from top of midmount bearing. Wash fill cap in solvent and blow dry with compressed air. Fill with fluid recommended on Drive Line Lube Chart until level with bottom of check plug opening. Reinstall check plug and fill cap.

## ELECTRICAL

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

*NOTE: Disengage the articulation lock prior to moving the machine. A machine with the articulation lock engaged cannot be steered.*

### 8 Hour Operations

——— NIL ———

### 50 Hour Operations

**Check the Lights and Fuses** — The 20 ampere fuse for the lights is located on the wire between the ignition switch and the toggle switch. The remaining electrical system is protected by the circuit breaker.

**A. Floodlamps** — The machine may be equipped with floodlamps that disperse light in a gradual downward pattern. These floodlamps are located underneath the top of the canopy, and are mounted on welded brackets.

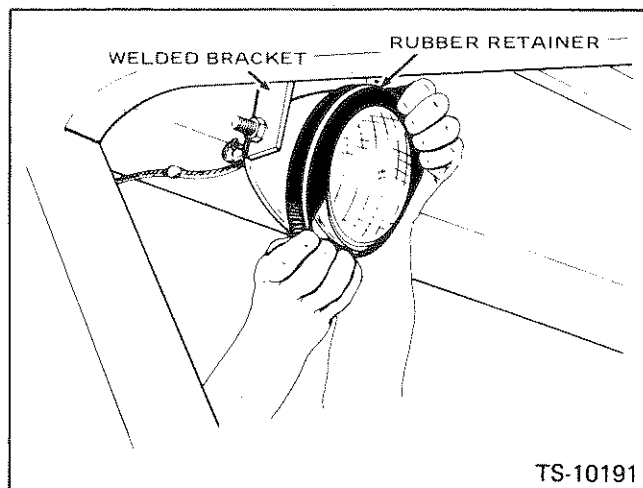


Fig. 14-1 Lamp Replacement

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

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. 14-1 and disconnect the terminals. Reconnect the terminal 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 at the back of the front frame. 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.

Refer to Sec. 15 for battery charge readings and recommendations.

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. **⚠ CAUTION:** Before doing any welding, **DISCONNECT THE GROUND CABLE FROM THE BATTERIES AND THE ELECTRICAL LEAD FROM THE BATTERY TERMINAL ON THE ALTERNATOR, OR SERIOUS DAMAGE TO THE ALTERNATOR MAY RESULT.**

**⚠ CAUTION**  
**ALWAYS CONNECT POSITIVE TO POSITIVE — NEGATIVE TO NEGATIVE WHEN USING A BATTERY CHARGER TO PREVENT DAMAGE TO THE ELECTRICAL SYSTEM.**

## PROCEDURE TO JUMP-START A MACHINE USING A SECOND VEHICLE

1. DO NOT jump batteries of different voltages.
2. DO NOT attempt to jump the batteries on machines with different electrical grounding systems.
3. Drive the second machine up parallel to the disabled vehicle so that both are facing in the same direction. DO NOT permit machines to touch each other as this could cause a ground connection and counteract the benefits of the following procedure.
4. Lower all hydraulic attachments to the ground. Apply parking brake, place all control levers in neutral and shut down engine. When engine has completely stopped switch battery disconnect switch to "OFF" position. Repeat this procedure on the disabled machine.
5. **CAUTION:** Never expose battery to open flame (also cigarettes, cigars, etc.) or electric spark. Battery action generates hydrogen gas which is flammable and explosive. Don't allow battery fluid to contact skin, eyes or fabrics, fluid is a sulfuric acid solution which could cause serious personal injury or property damage. Wear eye protection when working with batteries. Remove rings, metal watchband and other metal jewelry before jump starting or working around a battery and be careful in using metal tools, if such metal should contact the positive battery terminal (or metal in contact with it) and any other metal on the machine a short circuit may occur which could cause personal injury.
6. Make sure that both units have the same voltage rating and have the same grounding system. Otherwise the battery of one of the units may erupt and cause personal or property damage. If you cannot determine how the machine is grounded (negative or positive ground) we recommend that you do not attempt to jump-start the disabled machine.
7. All Clark Ranger Skidders have a 12 volt system (two 12 volt batteries connected in parallel) except the Ranger Model 880 which has a 24 volt system (two 12 volt batteries connected in series). All Clark Ranger Skidders are negative ground except for the 664 and 666 machines with the following serial numbers:—

C9014-101 through C9014-999

C9016-101 through C9016-999

8. Remove vent caps from both the discharged and the booster batteries and insure that the fluid level is at the full mark. Batteries low on water should be replenished. Do not attempt to jump-start a machine with a frozen battery as it may rupture or explode.
9. Place a piece of cloth over the uncapped vent holes of all batteries. The sudden surge of current when the battery is charged might cause the electrolyte to bubble and splash. The material over the vent holes will keep the acid from splashing on your skin and clothes.

## 10. NEGATIVE GROUND SYSTEMS

- a. Attach one end of one jumper cable to the positive terminal of the booster battery (identified by a red colour, "+", "P", or "POS" on the battery case, post or clamp), as shown in Figure 14-2. Attach the other end of the same cable to the positive terminal of the discharged battery.
- b. Attach one end of the second jumper cable to the negative terminal of the booster battery (identified by black colour, "-", "N", or "NEG" on the battery case, post or clamp) as shown in Fig. 14-2. Take care that the clamps do not touch the clamps of the other cable. Connect the other end of the cable to the engine block, alternator or any other accessible metallic part attached to the engine block that is not painted, chrome plate, heavily rusted, or covered with grease. This last connection should be made at least a foot or more from the dead battery so that any sparking when the cable is connected or disconnected is away from any hydrogen gas produced by the battery.

## 11. POSITIVE GROUND SYSTEMS

- a. Attach one end of one jumper cable to the negative terminal of the booster battery (identified by black colour "-", "N", or "NEG" on the battery case, post, or clamp) as shown in Fig. 14-1. Attach the other end of the same cable to the negative terminal of the discharged battery.
- b. Attach one end of the second jumper cable to the positive terminal of the booster battery (identified by a red colour "+", "P", or "POS" on the battery case, post or clamp) as shown in Fig. 14-2. Attach the other end of the cable to the engine block, alternator or any other accessible metallic part attached to the engine block that is not painted, chrome plated, heavily rusted

or covered with grease. This last connection should be made at least a foot or more from the dead battery so that any sparking when the cable is connected or disconnected is away from any hydrogen gas produced by the battery.

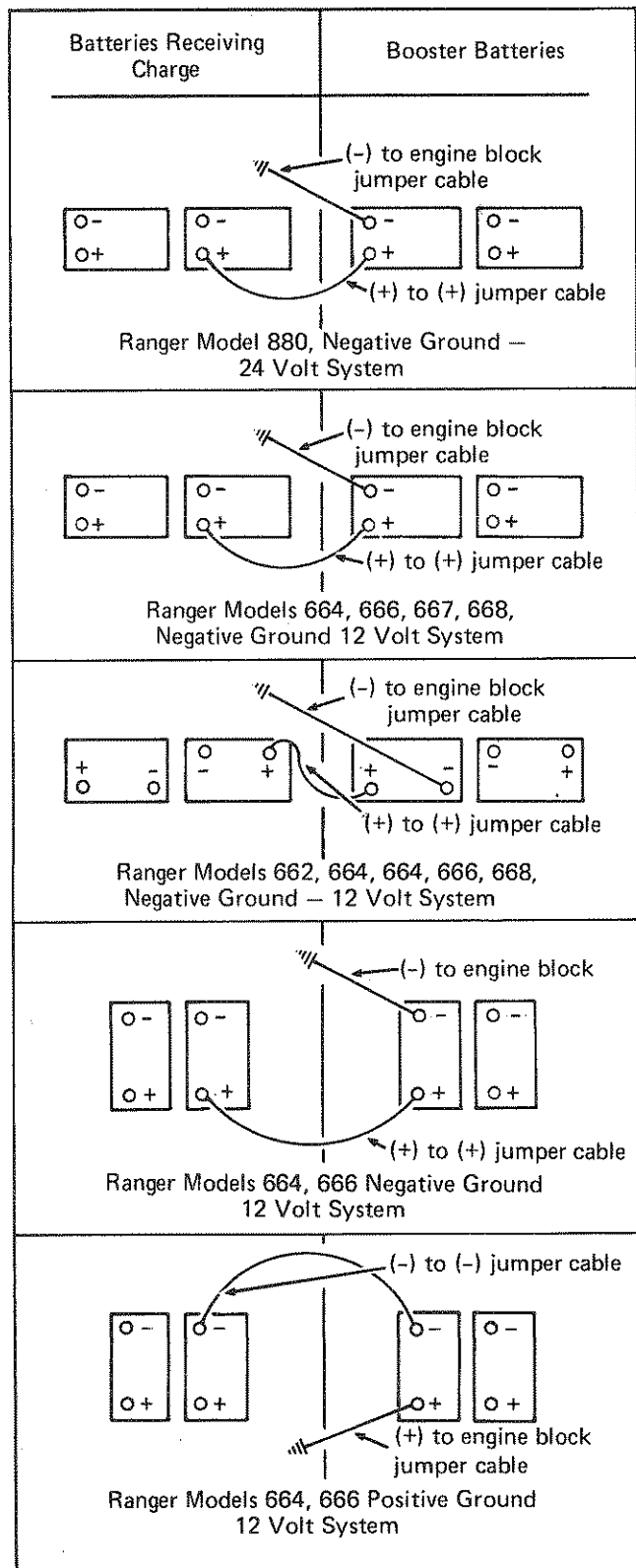


Fig. 14-2 Battery Jump-Start

12. Switch the battery disconnect switch to the "ON" position in the disabled unit.
13. Engage starter of the disabled machine. If it does not start immediately, turn ignition key off. Switch battery disconnect switch in booster unit to "ON" position and start engine to avoid excessive drain on its batteries. Engage starter of disabled machine.
14. After the disabled machine is running normally, remove the cable connection at the engine block first. Disconnect other end of same cable. Disconnect second jumper cable. Replace vent caps and discard cloths covering vent holes as they may be contaminated with corrosive acid.

**WARNING:** If acid should contact eyes, skin or clothing flush immediately with large amounts of water. In case of eye contact see a physician.

*NOTE: If you are unable to obtain a response from the starter do not assume that the battery is dead. In many cases, the problem is only bad connections at the battery terminals. If you keep the terminals clean you may never need to jump the batteries.*

#### 100 Hour Operations

— NIL —

#### 250 Hour Operations

— NIL —

#### 500 Hour Operations

**Clean the Alternator** — Every 500 hours clean the alternator. To clean, use compressed air, (20 p.s.i. to 30 p.s.i.), or a low pressure water spray, (20 p.s.i. to 30 p.s.i.) and direct the flow through the rear of the alternator.

**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.



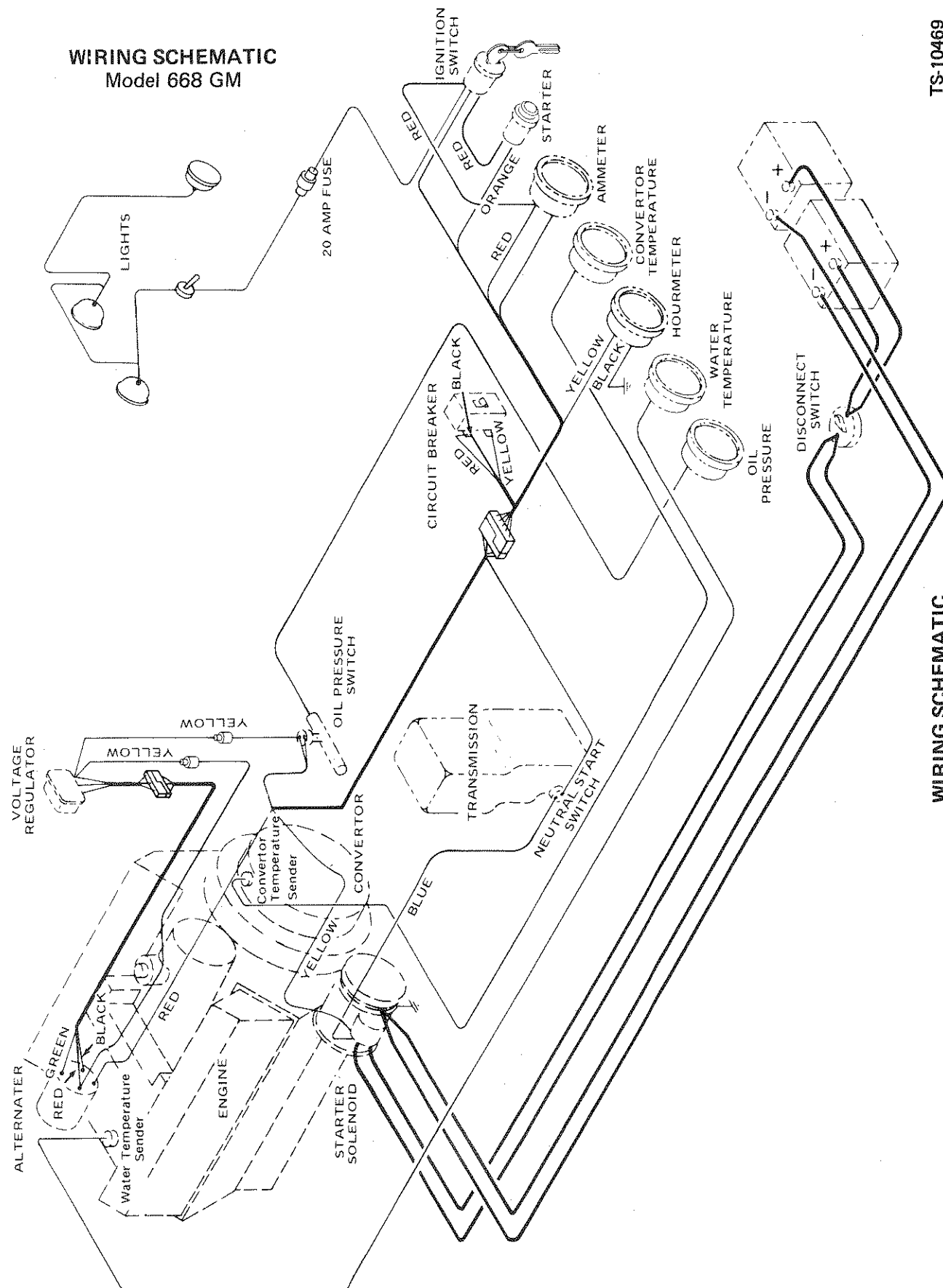
### 1000 Hour Operations

**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.

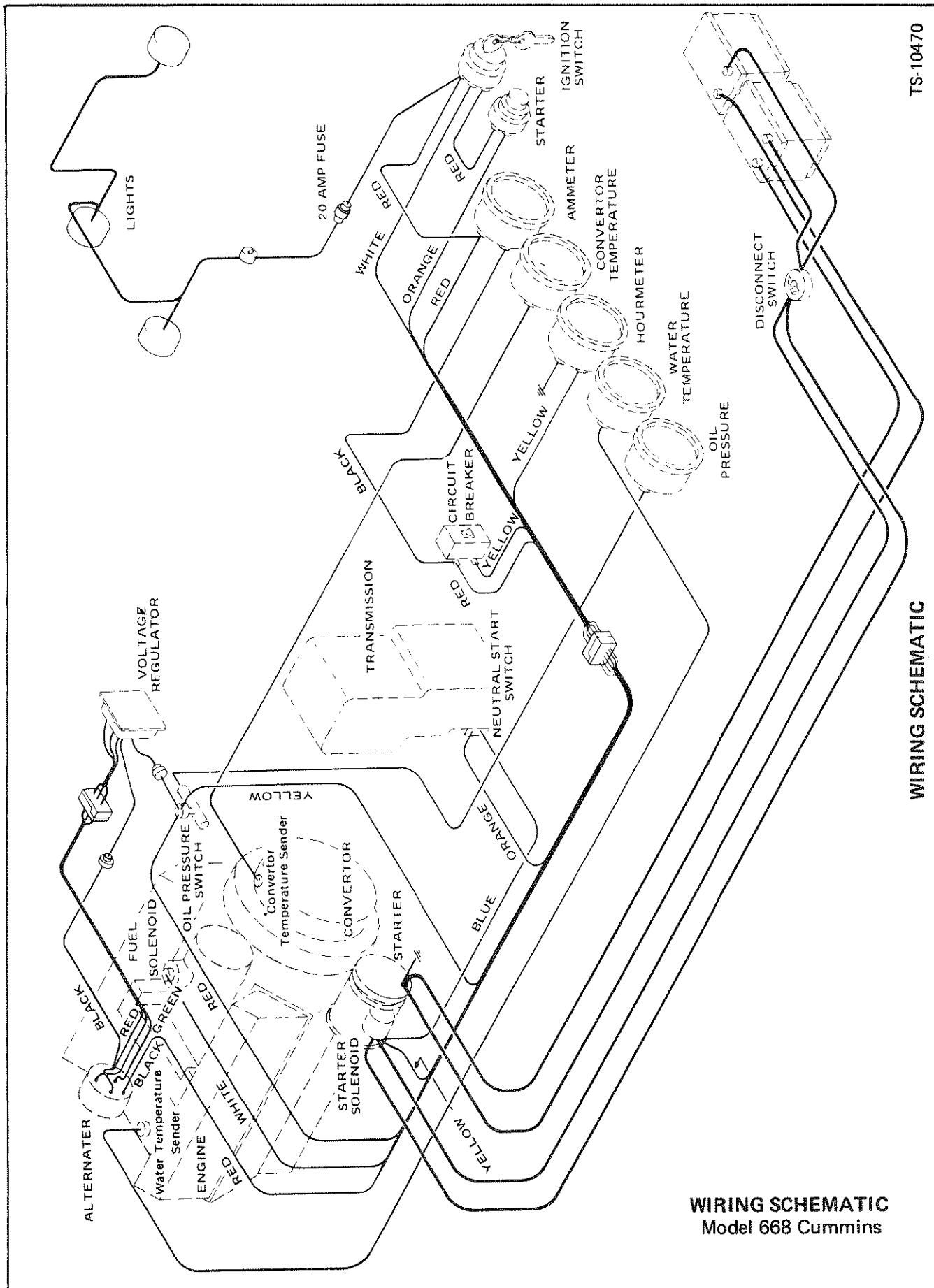
**WIRING SCHEMATIC**  
Model 668 GM



TS-10469

WIRING SCHEMATIC

TS-10470





## SPECIFICATIONS AND SERVICE DATA

Engine  
 Make  
 Model  
 Number of Cylinders  
 Bore and stroke  
 Displacement, cu. inches  
 Maximum torque, ft. lbs.  
 Governed horsepower  
 Governed RPM (Full Load)  
 Low idle RPM  
 High idle RPM  
 Stall, with main pump at 1,600 psi  
 Converter Stall

Diesel	Diesel
G.M.	Cummins
6V-53N	V-504C
6	8
3-7/8 x 4-1/2	4-5/8 x 3-3/4
318.6	504
431 at 1500 RPM	387 at 1900 RPM
185 at 2500 RPM	183 at 2600 RPM
2500	2600
600	625
2650	2800
2000 to 2200	1950 to 2150
2250 to 2450	2200 to 2400

*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 3rd (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

Lamps:  
     Front and rear lamps 12 volt

Instruments:  
     Panel gauges   12 volt  
     Sender Units   12 volt

Alternator:  
     Motorola A-12N-451 negative ground  
     12 volt 35 amp.

Voltage Regulator: 12 volt  
 Starting Motor:    12 volt

### BATTERIES

Number Required: 2 (parallel connected)  
 Electrical System: 12 volt  
 Grounded Terminal: — Negative

### Battery charge Test

#### Voltage Test Readings —

2.10 volts — Fully charged  
 2.07 volts — 3/4 charge (Fair)  
 2.03 volts — 1/2 charge (recharge)  
 2.00 volts — 1/4 charge (unsatisfactory)

NOTE: Individual cells in the same battery must not vary more than 0.05 volts.

#### Hydrometer test readings —

1.260 — Fully charged  
 1.230 — 3/4 charge (fair)  
 1.200 — 1/2 charge (recharge)  
 1.170 — 1/4 charge (unserviceable)

NOTE: Readings between cells must be within 0.050.

### PRESSURES

Engine Oil: 10-25 PSI minimum at idle (600 to 650 rpm).

Transmission Clutches: 240 to 280 PSI at idle (600 to 650 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.

Optional Steer and Blade Hydraulic System: Main relief valve 2,200 PSI

Tilt Blade Hydraulic System: Main relief valve 2,200 PSI

**TIRES PRESSURES**

Front — 16 PSI 1.12 Kg/sq. Cm.

Rear — 18 PSI 1.26 Kg/sq. Cm.

F.D. & R.D. 33600 Series Axles		
	Tire Size	Hydroinflation per tire
Std.	24.5 x 32	1600 pounds
Opt.	28.1 x 26	1600 pounds
Opt.	30.5 x 32	1600 pounds

**MODEL 668 G.M.****CAPACITIES (Approximate)**

	Imperial	U.S.	Metric
Engine Crankcase and System .....	16.0 qts.	19.2 qts.	18.1 Litres
Cooling System .....	41.0 qts.	49.2 qts.	46.6 Litres
Front Drive Axle Differential .....	14.1 qts.	17.0 qts.	16.1 Litres
Front Drive Axle Planetary Hubs (Ea.).....	7.9 qts.	9.5 qts.	9.0 Litres
Fuel Tank .....	50.0 gal.	60.0 gal.	227.1 Litres
Hydraulic System .....	68.0 qts.	80.0 qts.	77.2 Litres
Rear Drive Axle Differential .....	14.1 qts.	17.0 qts.	16.1 Litres
Rear Drive Axle Planetary Hubs (Ea.) .....	7.9 qts.	9.5 qts.	9.0 Litres
Torque Converter, Transmission and Winch .....	32.0 qts.	38.4 qts.	36.6 Litres

**MODEL 668 CUM.****CAPACITIES (Approximate)**

	Imperial	U.S.	Metric
Engine Crankcase and System .....	28.0 qts.	33.6 qts.	31.8 Litres
Cooling System .....	54.0 qts.	64.8 qts.	61.3 Litres
Front Drive Axle Differential .....	14.1 qts.	17.0 qts.	16.1 Litres
Front Drive Axle Planetary Hubs (Ea.) .....	7.9 qts.	9.5 qts.	9.0 Litres
Fuel Tank .....	50.0 gal.	60.0 gal.	227.1 Litres
Hydraulic System .....	68.0 qts.	80.0 qts.	77.2 Litres
Rear Drive Axle Differential .....	14.1 qts.	17.0 qts.	16.1 Litres
Rear Drive Axle Planetary Hubs (Ea.) .....	7.9 qts.	9.5 qts.	9.0 Litres
Torque Converter, Transmission and Winch .....	32.0 qts.	38.4 qts.	36.6 Litres

# BOLT TORQUE CHART

FT. — LBS.

LOCATION	THREAD	GRADE	TORQUE
Front Engine Mount to Engine — GM	7/16 — 14	8	35
Front Engine Mount to Engine — GM	3/8 — 16	8	26
Front Engine Mount to Engine — Cummins	1/2 — 13	8	66
Front Engine Mount to Frame	1/2 — 13	8	45
Rear Frame Mount to Engine	1/2 — 13	8	66
Rear Engine Mount to Frame	5/8 — 11	8	122
Torque Converter to Flywheel Housing	3/8 — 16	8	26
Transmission Bracket to Transmission	3/4 — 10	8	233
Transmission Bracket to Frame	3/4 — 10	8	203
Steer and Blade Valve to Seat Plate	1/2 — 13	8	57
Upper Drive Shaft	3/8 — 24	8	50
Lower Drive Shaft	1/2 — 20	8	120
Midmount Bearing to Bracket	5/8 — 11	8	128
*Winch to Frame	1-1/4 — 7	8	850-1000
Fairlead to Frame	3/4 — 10	8	203
*Front Axle to Cradle	1 — 14	8	790
*Rear Axle to Frame	1 — 14	8	790
Wheel Nuts	3/4 — 16	8	475
Split Rim Coupling Nuts	3/4 — 16	8	475
Alternator Belt Tension	5/16 — 18	8	14
Hydraulic Pump to Torque Converter	7/16 — 14	8	34
Firewall to Frame	5/8 — 11	8	122
Firewall Rails to Shroud and Firewall	5/8 — 11	8	122
Canopy to Firewall and Frame	5/8 — 11	8	122
Hydraulic Tank Filter Mounting Bolts	5/16 — 24	8	40-50 in lbs.

\*When replacing these mounting bolts, use SAE #30 oil 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 CONSISTANT WITH GOOD WORKMANSHIP.



## NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

# HOURLY LUBRICATION & MAINTENANCE SCHEDULE

**⚠ WARNING:** Except when specified, lower all attachments to the ground, apply the parking brake, shut down the engine, remove the ignition key, turn the disconnect switch to the "OFF" position, block the wheels, engage the articulation lock, and tie a red warning flag on the canopy upright; when servicing the machine.

SYSTEM	OPERATION	TEXT LOCATION	HOUR INTERVALS					
			∞	50	100	250	500	1000
Engine, Controls, Cooling System and Accessories	Engine Maintenance	See Engine	•					
	Check and refill Radiator as required	Sec. 6		•				
	Check Cooling System for Leaks	Sec. 6		•				
	Check Anti-Freeze Protection	Sec. 6		•				
	Check and Adjust Belt Tension	Sec. 6		•				
	Tighten Air Cleaner Connections	Sec. 6			•			
	Engine By-Pass Filter (Cummins Only) 200 hrs.	Sec. 6						
	Check Engine RPM	Sec. 6				•		
	Clean Radiator Core	Sec. 6					•	
	Service Air Cleaner Element and Body	Sec. 6					•	
Fuel Tank and Accelerator	Drain Fuel Tank Sediment	Sec. 7		•				
	Check Fuel System for Leaks	Sec. 7		•				
	Clean Fuel Tank Filter Cap	Sec. 7		•				
	Check Accelerator linkage, adjust as required	Sec. 7				•		
	Drain and clean fuel tank	Sec. 7						•
Torque Converter Transmission and Winch Hydraulic System	Check fluid level daily, at the transmission	Sec. 9	•					
	Clean Torque Converter and Transmission Breathers	Sec. 8 & 9		•				
	Check and Adjust the Clark Winch Free Spool	Sec. 10			•			
	Check Clark Winch Free Spool Wear Button	Sec. 10				•		
	Replace the Filter Element	Sec. 9				•		
	Check System for Leaks	Sec. 9				•		
	Check Converter out pressure	Sec. 8				•		
	Check and Adjust Transmission Shift Linkage	Sec. 9					•	
	Drain and Refill Transmission, Converter, Winch, Hydraulic System	Sec. 9					•	
	Check Transmission Clutch Operating Pressures	Sec. 9					•	
Steer & Blade Hydraulic System	Check Fluid Level Daily	Sec. 11	•					
	Clean Reservoir Breather	Sec. 11		•				
	Clean Cylinder Rods	Sec. 11		•				
	Check and Adjust as required Control Valve Relief Pressures	Sec. 11					•	
	Replace Filter Element	Sec. 11					•	
	Drain, Clean & Refill Hydraulic Oil Reservoir	Sec. 11						•
Axle Prop Shafts and Wheels	Check tire pressures and castings	Sec. 12	•					
	Tighten wheel nuts & inspect rims	Sec. 12		•				
	Check Fluid Level of Differential & Planetary	Sec. 12		•				
	Clean Breathers	Sec. 12					•	
	Drain and Refill Differential & Planetary	Sec. 12						•
	Check for and repair Drive Line noises	Sec. 12	•					
Brake System	Check and Adjust as Required, Brake Pedal and Linkage	Sec. 12				•		
	Check and Adjust Parking Brake	Sec. 13				•		
	Check Fluid Level in Master Cylinder	Sec. 13				•		
Electrical System	Check Lights & Fuses	Sec. 14		•				
	Service the Batteries	Sec. 14		•				
	Clean and Alternator	Sec. 14					•	
	Clean and Tighten the Electrical Connections	Sec. 14					•	
	Inspect, Test, & Lubricate the Electrical Units	Sec. 14						•
	Check Cranking Motor Operation	Sec. 14						•

CHASSIS LUBRICATION		TEXT LOCATION	HOURS						KEY
			1000	500	250	100	50	∞	
1	Pivot Hinge Pin – 1 Each Top and Bottom							●	LBG
2	Winch Control Lever	Sec. 10					●		LBG
3	Forward and Reverse – Control Lever	Sec. 9					●		LBG
4	Transmission Speed Range Lever	Sec. 9					●		LBG
5	Oil Reservoir	*Sec. 11						●	DX
6	Transmission Control Linkage	Sec. 9					●		LBG
7	Brake Pedal Bushing	Sec. 13					●		LBG
8	Master Cylinder Service Brake	Sec. 13					●		DX
9	Master Cylinder Emergency Brake (Opt.)	Sec. 13					●		BA
10	Engine Governor Lever (Grease very sparingly)	See Engine				●			LBG
11	Utility Blade Cylinder Pins – Front							●	LBG
12	Utility Blade Hinge Pins – 2							●	LBG
13	Axle Cradle Bushing – Remote							●	LBG
14	Utility Blade Cylinder Pins – Rear							●	LBG
15	Engine Tachometer Drive					●			LBG
16	Steer and Blade Control Lever					●			LBG
17	Steer Cylinder Pins – Front							●	LBG
18	Steer Cylinder Pins – Rear Remote							●	LBG

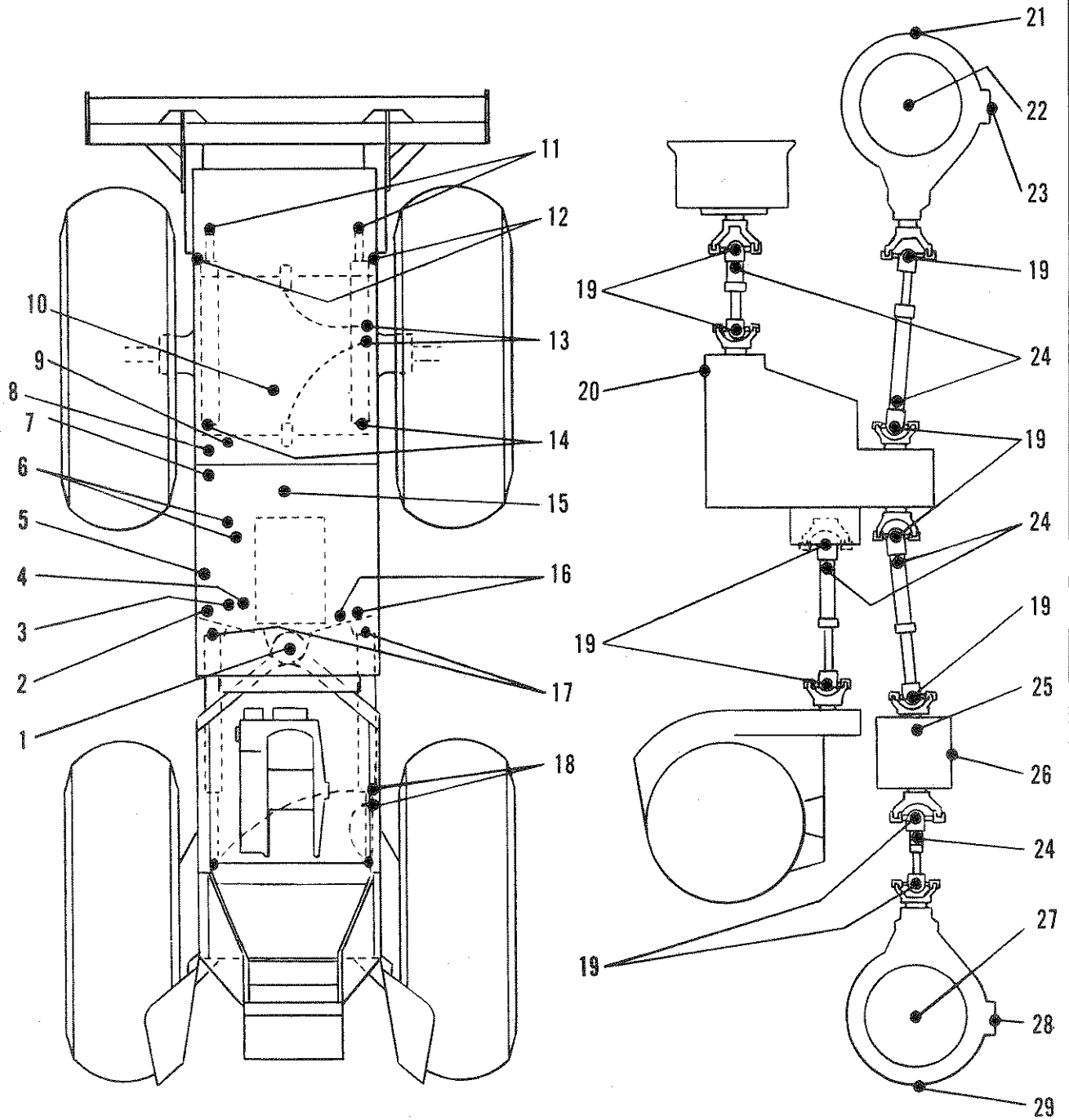
## LUBRICATION KEY

LBG	Lithium Base Multi-Purpose Grease			
	0° F. and above — Grade 2			
	Below 0° F. — Grade 0			
EPGL	Extreme Pressure Gear Lube (**SCL Type) SAE 75 or SAE 90 or H.D. 90			
DX	Ambient Temp. Range	Lubricant to be used		
	1)	SAE Grade	API Class	Military Spec.
		10W	+MS DM	MIL-L-2104A, Supp. 1 or New MIL-L-2104B
	2)	Dexron Automatic Transmission Fluid		
	Below 0°	Dexron Automatic Transmission Fluid		
		+ Sequence Tested		
BA	Heavy Duty Brake Fluid	SAE J 1703 or equivalent		
DA	Shell Darina "AX" Grease — Or Equivalent			

\*\*\*"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		TEXT LOCATION	HOURS						KEY
			1000	500	250	100	50	∞	
19	Universal Joint	Sec. 12	●				●		LBG
20	Transmission, Torque Converter and Winch	*Sec. 8, 9 & 10		●	●			●	DX
21	Differential Check Plug – Front	*Sec. 12	●				●		EPGL
22	Planetary Check & Fill Plug – 2	*Sec. 12	●				●		EPGL
23	Differential Drain Plug	*Sec. 12	●				●		EPGL
24	Slip Joint	Sec. 12				●			LBG
25	Midmount Bearing Check Plug	*Sec. 13		●				●	DX
26	Midmount Bearing Drain Plug	*Sec. 13		●					DX
27	Planetary Check & Fill Plug – 2	*Sec. 12	●				●		EPGL
28	Differential Drain Plug	*Sec. 12	●				●		EPGL
29	Differential Check Plug – Rear	*Sec. 12	●				●		EPGL

\* See Text



CHASSIS

DRIVE LINE

TS-12214

## NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.