

CLARK

RANGER

667 FORWARDER G.M. & CUMMINS

FOR SERIAL NUMBERS

667 FWD G.M. — 521A-101-CAC thru 9999-CAC
667 FWD Cummins — 522A-101-CAC thru 9999-CAC

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

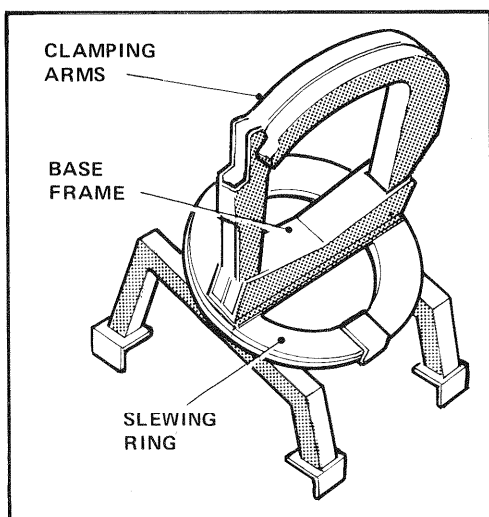
Machine Serial _____

Engine Model _____

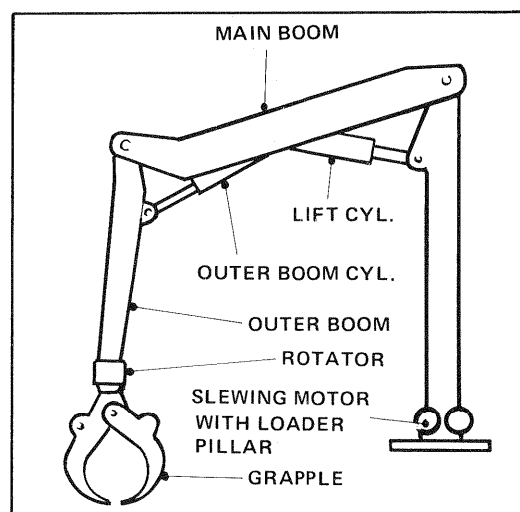
Engine Serial _____

OPERATORS MANUAL

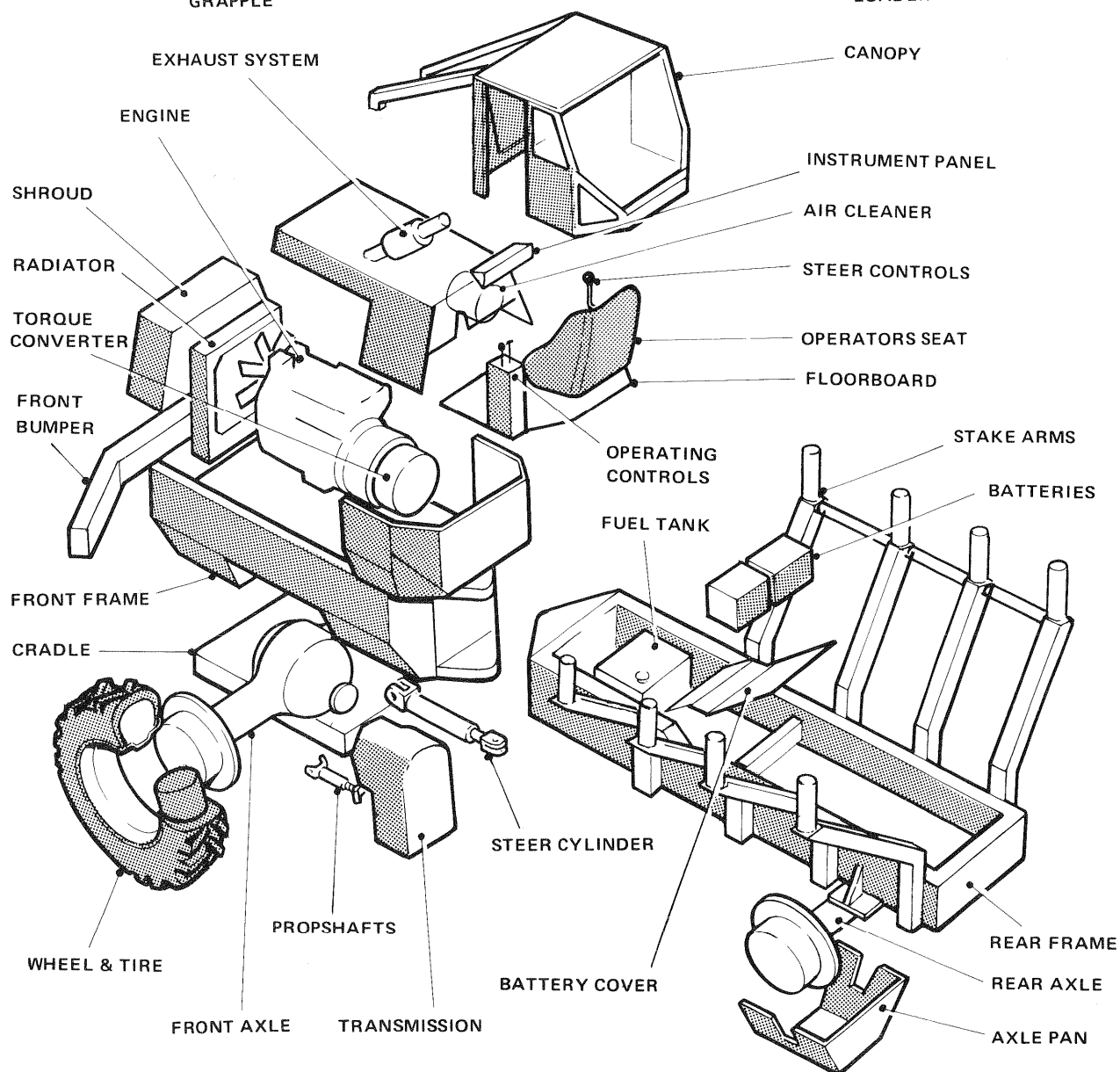
No. 3144



GRAPPLE



LOADER



5023 - TP

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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NOTES

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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.

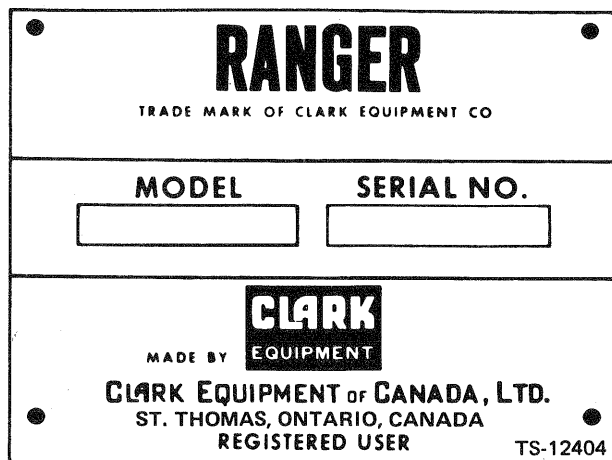


Fig. 1-1 Machine Serial Number Plate

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.

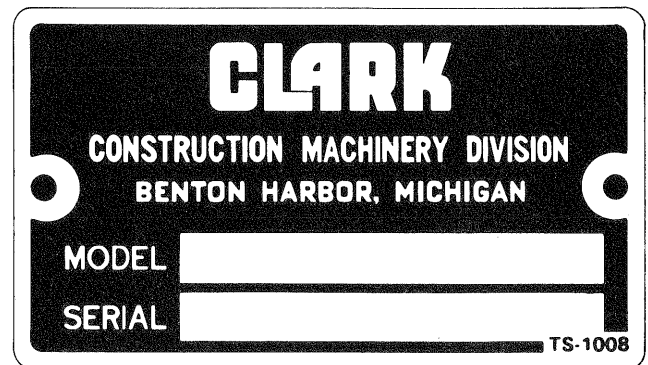
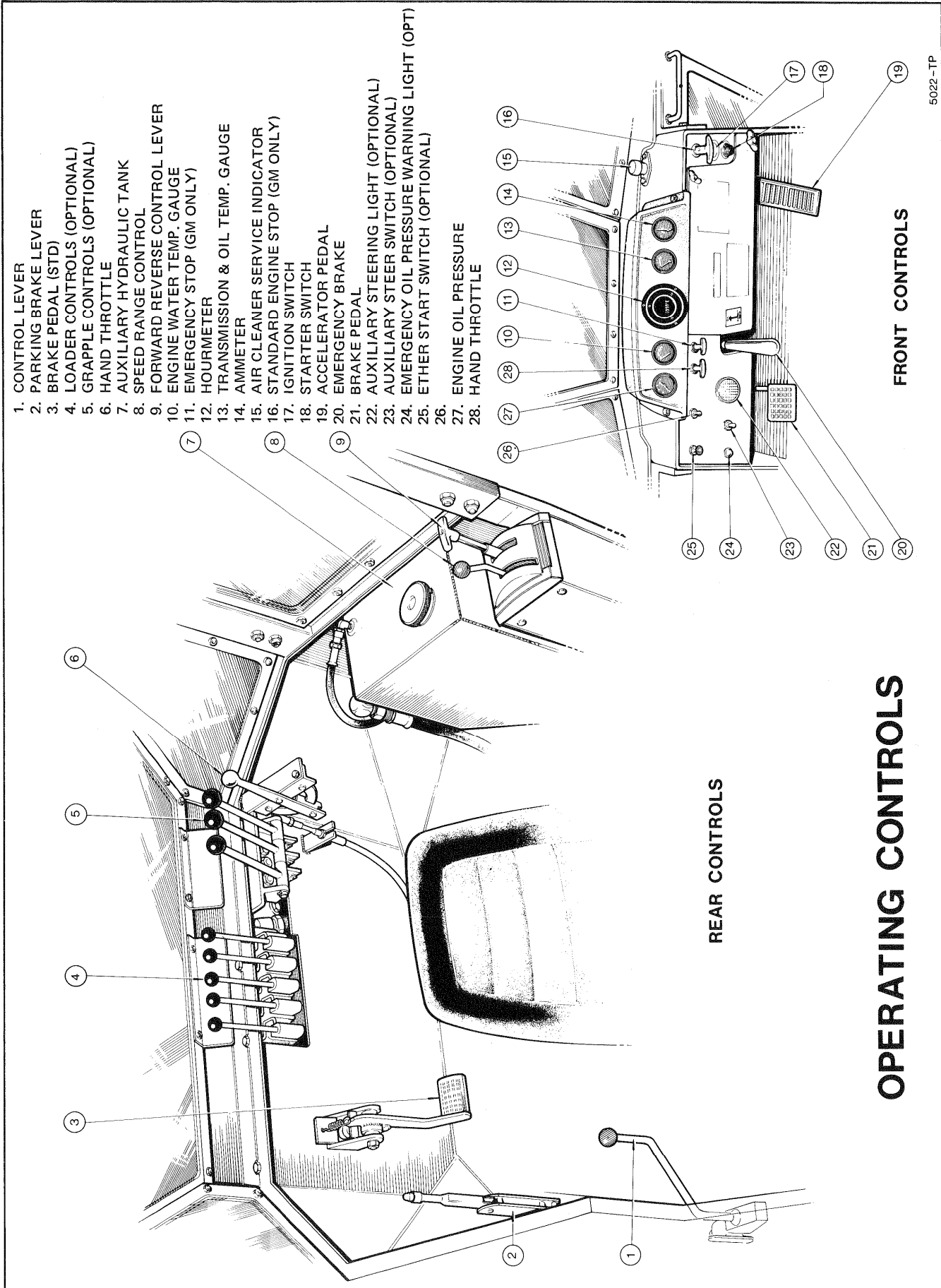


Fig. 1-2 Transmission or Torque Converter Serial Number Plate

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.



1. CONTROL LEVER
2. PARKING BRAKE LEVER
3. BRAKE PEDAL (STD)
4. GRAPPLE CONTROLS (OPTIONAL)
5. LOADER CONTROLS (OPTIONAL)
6. HAND THROTTLE
7. AUXILIARY HYDRAULIC TANK
8. SPEED RANGE CONTROL
9. FORWARD REVERSE CONTROL LEVER
10. ENGINE WATER TEMP. GAUGE
11. EMERGENCY STOP (GM ONLY)
12. HOURMETER
13. TRANSMISSION & OIL TEMP. GAUGE
14. AMMETER
15. AIR CLEANER SERVICE INDICATOR
16. STANDARD ENGINE STOP (GM ONLY)
17. IGNITION SWITCH
18. STARTER SWITCH
19. ACCELERATOR PEDAL
20. EMERGENCY BRAKE
21. BRAKE PEDAL
22. AUXILIARY STEERING LIGHT (OPTIONAL)
23. AUXILIARY STEER SWITCH (OPTIONAL)
24. EMERGENCY OIL PRESSURE WARNING LIGHT (OPT)
25. OTHER START SWITCH (OPTIONAL)
- 26.
27. ENGINE OIL PRESSURE
28. HAND THROTTLE

OPERATING CONTROLS

OPERATING CONTROLS

1. STEER CONTROL LEVER

Controls the turning of the machine to the left and right. Tilting the lever to the right will steer the machine to the right, and tilting the lever to the left will steer the machine to the left.

2. PARKING BRAKE LEVER

To set the brake, pull back on the lever. This applies the brake located on the transmission output shaft. To release the brake push the lever forward and down.

3. BRAKE PEDAL

It is located on the right rear side of the cockpit. Application of this brake will provide braking to the driveline. (*Note: All locations are when operator is in normal driving direction facing front of vehicle.*)

4. LOADER CONTROLS (Optional)

They are located in the centre, rear of the cockpit. Application of loader control levers will provide the operation of the loader assy.

5. GRAPPLE CONTROLS (Optional)

They are located left rear side of the cockpit. Application of the grapple controls will provide the operation of the grapple assy.

6. HAND THROTTLE

Located on left rear side of the cockpit. Pull lever forward, (towards operator) to override the accelerator pedal. When desired speed is reached, release lever and desired engine speed will be maintained. To return engine speed to idle, push lever (back) to its closed position.

7. AUXILARY HYDRAULIC TANK

Provides desired hydraulic oil capacity.

8. SPEED RANGE CONTROL LEVER

Provides three positions, low gear, second gear, and high gear, to control travel speed of the machine. Pulling back on the control handle engages low gear. Pushing forward from low gear engages second & high gear.

9. 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 backward. **CAUTION: Do not use the engine as a downhill brake by operating the vehicle with transmission in reverse.**

NOTE: Lever will lock in neutral position. May be unlocked by sliding collar upwards. Can be operated easily by fingers.

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 will not have any braking power.

CLARK SHALL NOT BE LIABLE FOR ANY CONTINGENT OR SPECIAL DAMAGES OR LIABILITIES OR ANY FAILURES IN, OR DAMAGE TO, OR DEFECTS IN ANY PRODUCTS, ARISING OUT OF THE USE OF THE TRANSMISSION IN REVERSE FOR BRAKING THE MACHINE.

10. WATER TEMPERATURE GAUGE

Indicates the engine water temperature. Under normal operating conditions, the gauge should register between 170° F and 185° F.

11. EMERGENCY ENGINE STOP (G.M. Only)

Is only to be used in case of an emergency. Misuse of this control may result in damage to the engine.

12. HOURMETER

Shows the number of hours the engine has run.

13. TRANSMISSION OIL TEMPERATURE GAUGE

Indicates the temperature of the oil in the torque converter and transmission. When the temperature approaches 250° F. shift to a lower operating range.

14. AMMETER

Indicates the charge or discharge rate of the electrical system.

15. 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.

16. 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.

17. IGNITION SWITCH

Energizes all gauges and switches on instrument panel, and starting motor circuit. Turn switch to right for ON position.

18. STARTER SWITCH

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 Sec. 4, under Cold Weather Starting.

19. ACCELERATOR PEDAL

This pedal will control the engine speed.

20. EMERGENCY BRAKE LEVER (Optional)

Is applied by pulling the handle back, and is released by letting go of the spring returned handle.

21. BRAKE PEDAL

Is located on the left side of the cockpit. Application of the brake will provide braking to the drive line.

22. AUXILIARY STEERING LIGHT (Optional)

When turned ON, indicates the Auxiliary Steering has been activated.

23. 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.

24. ENGINE OIL PRESSURE WARNING LIGHT (Optional)

Warns operator of low oil pressure in engine lubrication system. If warning light remains on for over 10 to 15 seconds stop the engine immediately and determine cause.

25. 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.

26. OPTION**27. OIL PRESSURE GAUGE**

Indicates the oil pressure in the engine. Operating pressures are found in the rear of this manual.

28. HAND THROTTLE (Optional)

Pull lever out to override the accelerator pedal. When the desired engine speed is reached, turn the hand throttle lever one-quarter turn clockwise to lock. To return the engine speed to idle, turn the hand throttle control one-quarter turn counter-clockwise and push to its closed position.

29. CIRCUIT BRAKER RESET BUTTON

Is located inside the operator's compartment behind the firewall. 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.

30. DISCONNECT SWITCH

Is located on the left front side of the rear frame outside the battery compartment. This switch, when in the "OFF" position will cut off the electrical supply from the battery to the starter solenoid.

WARNING — Do not turn off position while the machine is running, or serious damage to the alternator and electrical system may result.

31. SEAT ADJUSTMENT LEVERS

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. This machine, equipped with a rotating seat, has a hand lever located at the front of the seat to lock-in the front position. Oiling of the release mechanism, track assemblies and pivot points will keep them operating freely.

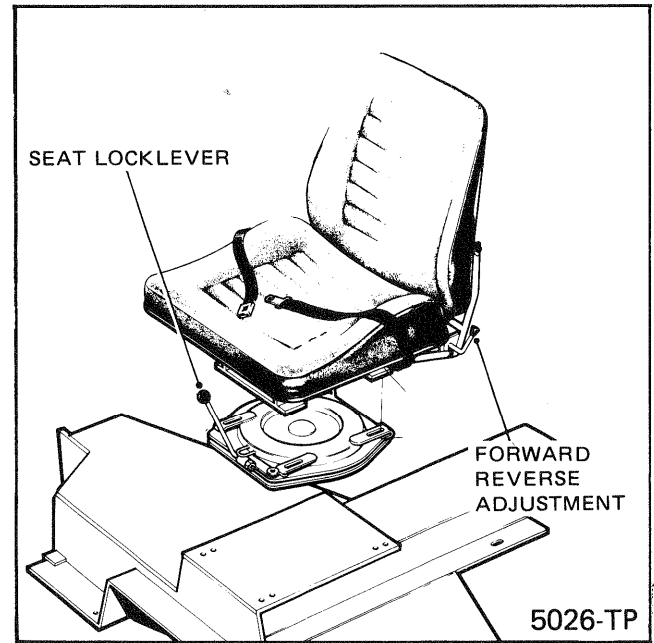


Fig. 2-2

CAUTION

THIS STRUCTURE DESIGN HAS BEEN TESTED TO MEET PERFORMANCE CRITERIA LISTED ON NOTICE OF CERTIFICATION. ANY MODIFICATION, ALTERATION OR STRUCTURAL DAMAGE DUE TO ABUSE OR ROLLOVER MAY RENDER STRUCTURE UNSAFE AND WILL VOID ALL CERTIFICATES PERTAINING TO THIS STRUCTURE.

1922794

WARNING

- NO ROOM FOR MAN IN THIS AREA WHEN VEHICLE IS TURNING OR MOVING
- MAN IN THIS AREA NOT VISIBLE TO OPERATOR
- DO NOT STAND OR WORK IN THIS AREA WHEN ENGINE IS RUNNING
- USE SAFETY LINK WHEN SERVICING, LIFTING OR TRANSPORTING

1922797

CAUTION NEGATIVE GROUND

CAUTION

ENGINE CONTAINS 20-20 W OIL. CHANGE TO OIL RECOMMENDED BY ENGINE MFR. FOR APPLICABLE AMBIENT TEMP.

REMOVE DECAL AFTER OIL CHANGE.

CAUTION

KEEP VEHICLE CLEAN

TO REDUCE FIRE HAZARDS REMOVE DEBRIS FROM ALL COMPARTMENTS AFTER EACH 8 HOURS OF OPERATION, OR MORE OFTEN IF WARRANTED BY WORKING CONDITIONS.

IN CASE OF FIRE

- STOP VEHICLE
- LOWER ALL HYDRAULIC ACCESSORIES
- STOP ENGINE
- TURN BATTERY DISCONNECT SWITCH OFF
- APPLY PARKING BRAKE
- EXTINGUISH FIRE

1922792



**EMERGENCY
BRAKE**

WARNING

DO NOT TURN BATTERY DISCONNECT SWITCH TO "OFF" POSITION WHILE ENGINE IS RUNNING

CAUTION

TRAINED PERSONNEL ONLY MAY OPERATE THIS VEHICLE. REFER TO OPERATORS MANUAL FOR DETAILED OPERATING AND MAINTENANCE INSTRUCTIONS.

BEFORE OPERATING VEHICLE

CHECK

- SAFETY LINK REMOVED AND PROPERLY RETAINED
- ALL GUARDS AND COMPARTMENT COVERS IN PLACE
- FIRE EXTINGUISHER CHARGED
- SEAT BELT ON
- PARKING BRAKE OFF
- BRAKE AND STEERING CONTROLS OPERABLE

BEFORE LEAVING VEHICLE

- LOWER ALL HYDRAULIC ACCESSORIES
- ENGAGE PARKING BRAKE
- ENGAGE NEUTRAL LOCK
- TURN ENGINE OFF
- TURN BATTERY MASTER SWITCH OFF
- CLEAN DEBRIS FROM ALL GUARDS AND COMPARTMENTS

1922795

CAUTION

THIS MACHINE EQUIPPED WITH AUXILIARY STEERING. IF ENGINE OR MAIN STEER PUMP FAILS.

- TURN AUXILIARY STEERING SWITCH ON
- BRING MACHINE TO IMMEDIATE STOP
- USE ONLY WHILE BRINGING MACHINE TO IMMEDIATE AND SAFE STOP. OTHERWISE STEERING MAY BECOME DEPLETED
- TURN SWITCH OFF WHEN NOT IN USE
- ENSURE BATTERIES ARE PROPERLY MAINTAINED
- TEST AUXILIARY STEERING FREQUENTLY

TEST PROCEDURE

- SHUT ENGINE OFF
- TURN AUXILIARY STEERING ON
- STEER MACHINE LEFT AND THEN RIGHT TO HYDRAULIC RELIF.
- TURN AUXILIARY STEERING SWITCH OFF

1922793

CAUTION

ONLY APPROVED TRANSMISSION FLUID IS TO BE USED TO FILL THE MASTER CYLINDER. REFER TO MACHINE OPERATOR'S MANUAL.



WARNING

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

Fig. 3-1

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.
8. Disregarding instructions on safety decals. See Fig. 3-1.

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 machine.
 - 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 Dismounting:

- 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, and 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. Remove or secure all maintenance or personal items such as lunch boxes, chains, shovels, etc.
- b. Start the engine only from operators seat.
- 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 in 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; 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. 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, pedestal, stake-arms, 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.

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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 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 and lock.
2. Make sure that the engine stop control is properly set. (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 charge, 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. Check indicator when engine is at high idle.
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 latter 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.

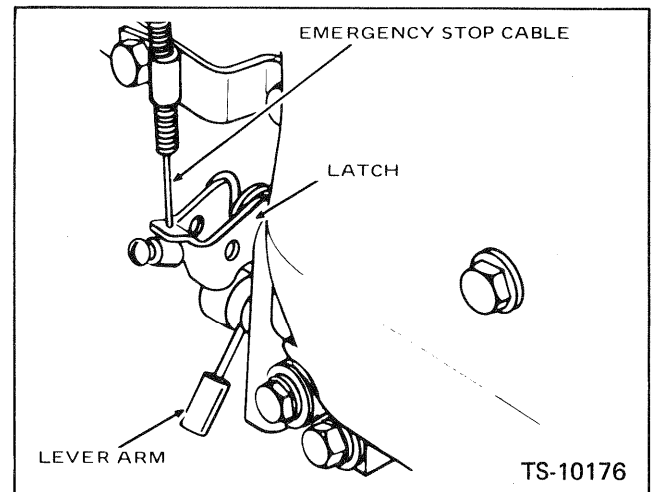


Fig. 4-1 Latch Handle Rotated

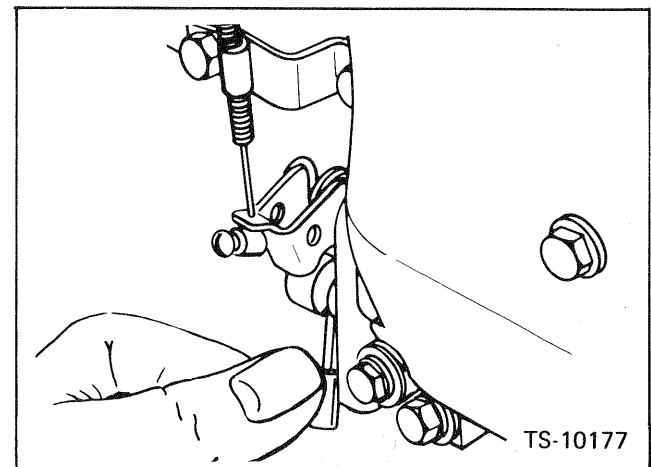


Fig. 4-2 Resetting the Latch Handle

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. 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.
3. 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.
4. 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.
5. Release the mechanical parking brake.
6. Depress the accelerator pedal slowly.

Working the Machine

As the unit now moves out to the stump area with the operator taking care to notice any obstructions, i.e. stumps, rocks, dead falls, etc., that might cause the machine 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 machine 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).

After gathering logs shift the forward/reverse lever into forward position, release hand brake, and begin the return trip to the landing. On the return to the deck, short turns must be avoided, along with stumps, rocks or windfalls which might slow the forwarder down. The forwarder could become immobile if care is not taken to avoid these obstructions. As the forwarder 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.

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 midmount 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.

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.

10 Hour or Daily

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 or Weekly

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 cracks, glazing or fraying due to incorrect 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

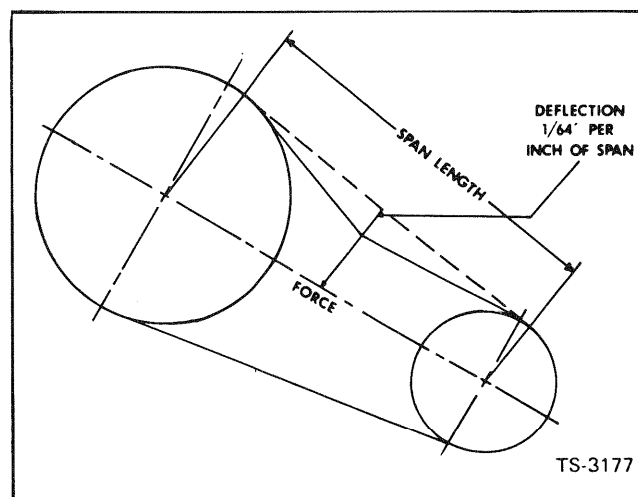


Fig. 4-1 Check Belt Tension

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
7" to 11"
11-1/2" to 16"

Deflection force
8 to 12 lbs.
10 to 15 lbs.

Periodically belts should be cleaned to remove any grease and glaze, by wiping with a clean cloth and applying belt dressing. This in most instances will eliminate any squeak and will extend the service life of the belts.

10 Hour Operations (Or Daily)

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 would be removed using a solvent nonharmful to hoses and wiring insulation. Straighten bent fins, being careful not to puncture or enlarge the openings.

250 Hour (Or Monthly)

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.

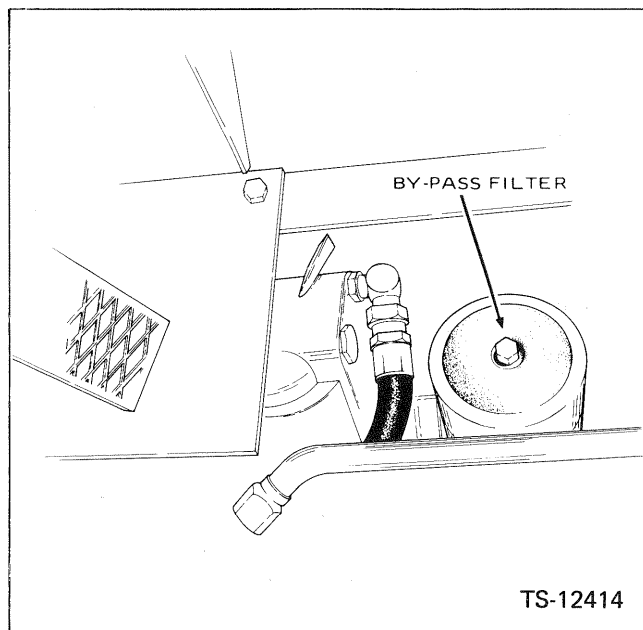


Fig. 6-2 By-Pass Filter Location

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

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 relief valve setting is correct.

1. Put the machine into a full right turn.
2. Apply the parking brake, block the wheels, and place the directional and speed range levers in NEUTRAL.
3. Start the engine.
4. **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.

5. **Transmission & Converter oil warm up procedure.**
 - a. Shift levers into Forward and Speed 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 converter oil

temperature registers between 180° to 200° F.

6. **Steer 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.
7. Check the Main Relief Pressure on the steer control valve. Refer to Sec. 11 under 500 hour operations for instructions.
8. Shift levers into FORWARD, and SPEED 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.

9. 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 500 ft. and ambient temperature of 85° 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 or Two Months

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 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.

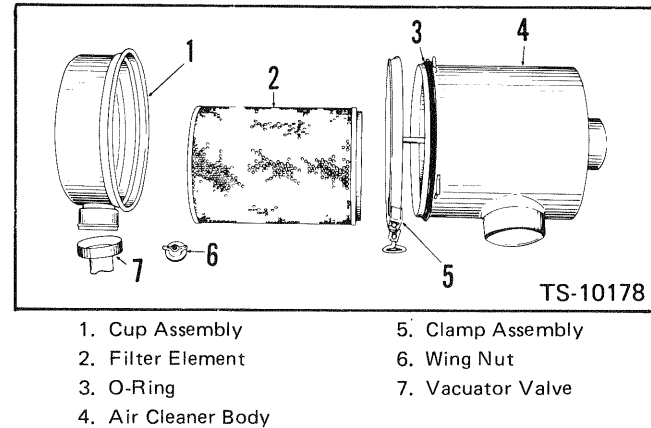


Fig. 6-3 Air Cleaner Assembly

1000 Hour or Six Months

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.

10 Hour or Daily

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 located at the front of the rear frame. Wipe with a clean, lint free cloth. 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.

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 at the end of the shift 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 or Weekly

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 when required.

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 or Two Weeks

———— NIL ————

250 Hour or Monthly

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 or Two Months

———— NIL ————

1000 Hour or Six Months

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 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.

10 Hour (Or Daily)

Torque Converter — Check the fluid level daily, observing the following conditions: As per Sec. 9 under 8 hour operations.

50 Hour (Or Weekly)

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

100 Hour (Or Two Weeks)

———— NIL ————

250 Hour (Or Monthly)

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 has evidence of 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 hose located under the floorboard tied to the hydraulic hoses to the left of the transmission. Fig. 8-1.

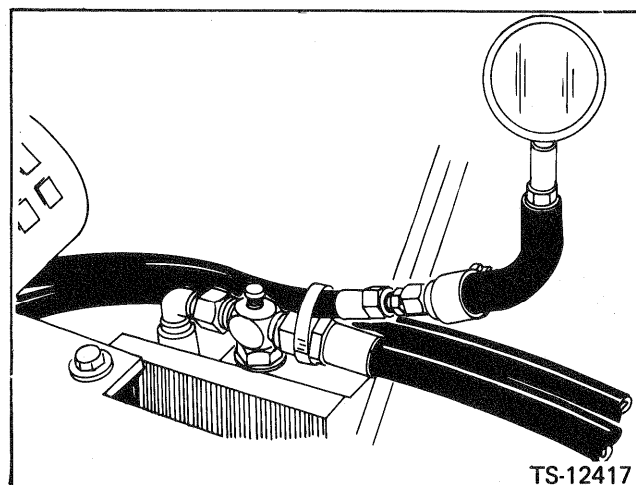


Fig. 8-1 Check Converter Out Pressure

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 (Or Two Months)

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.

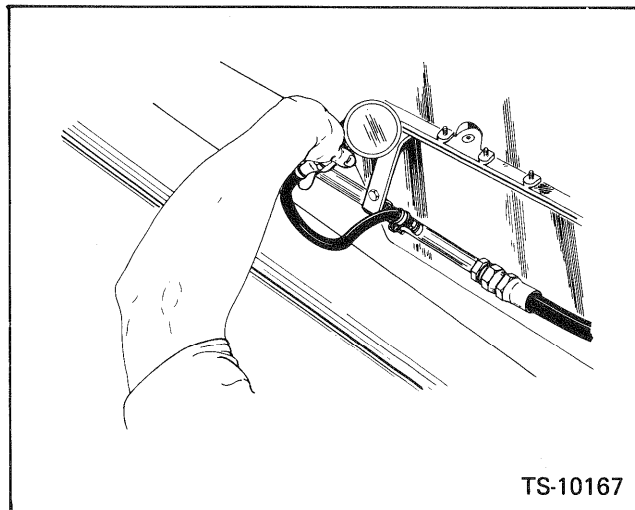


Fig. 8-2 Oil cooler "OUT" pressure check.

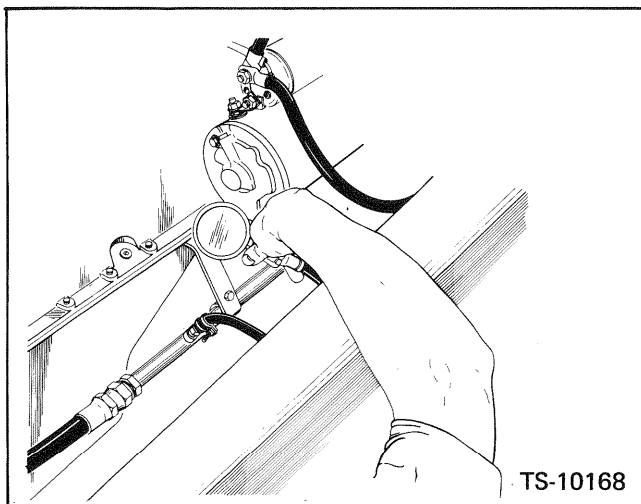


Fig. 8-3 Oil Cooler in Pressure Check

1. Install a tachometer on the engine (Disregard this operation if the machine is equipped with a tachometer). Install a gauge at the oil cooler IN pressure check point located on the oil cooler supply tube on the left side of the engine compartment. Fig. 8-3. Install a gauge at the oil cooler OUT pressure check point located on the oil cooler supply tube on the right hand side of the engine compartment. Fig. 8-2.
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, 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.

NOTE: When this pressure check is made, the brake pedal must not be depressed as this will interfere with the pressure readings. If the brake is to be applied, apply the mechanical hand brake only.

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 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.

10 Hour or Daily

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.

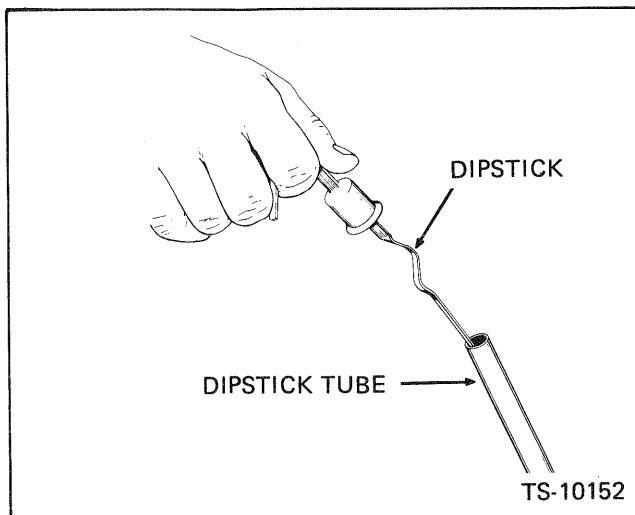


Fig. 9-1 Dipstick — Transmission

Check, using the dipstick located to the left of operator's seat. 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 or Weekly

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

100 Hour or Two Weeks

—————NIL—————

250 Hour or Monthly

Torque Converter, Transmission — The torque converter, transmission hydraulic system is protected by a full flow 55 micron replacement element type filter assembly. The filter is mounted below the air cleaner. 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 is repaired or overhauled for any reason. Thoroughly clean the filter case and base casting, before inserting a new element. Use new gaskets in the base casting, tighten the center bolts to 25-35 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.

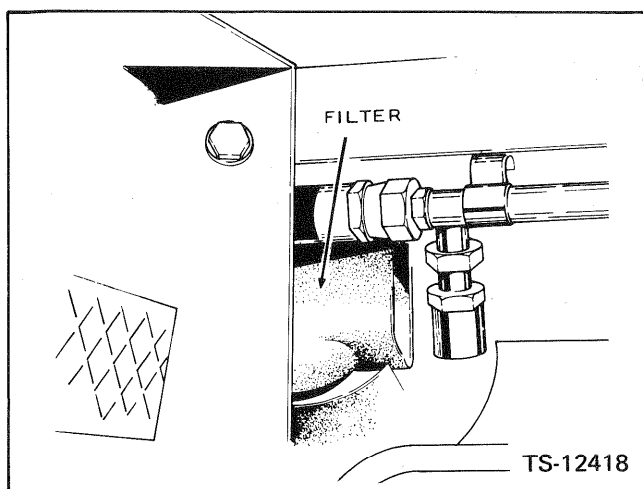


Fig. 9-2 Filter — Transmission and Torque Converter (G.M.)

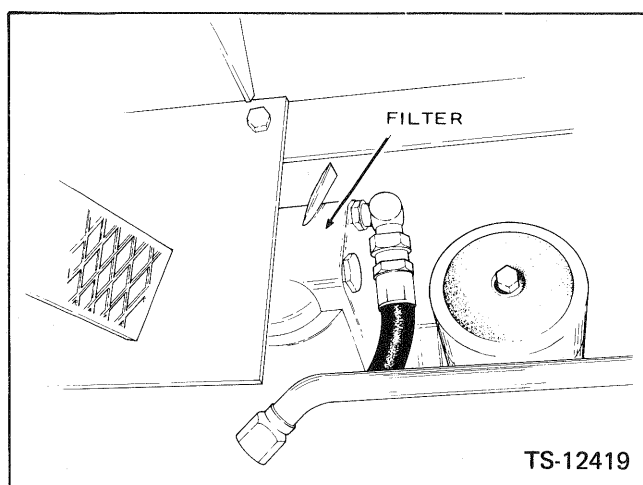


Fig. 9-3 Filter — Transmission and Torque Converter (Cummins)

500 Hour (Or Two Months)

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.**

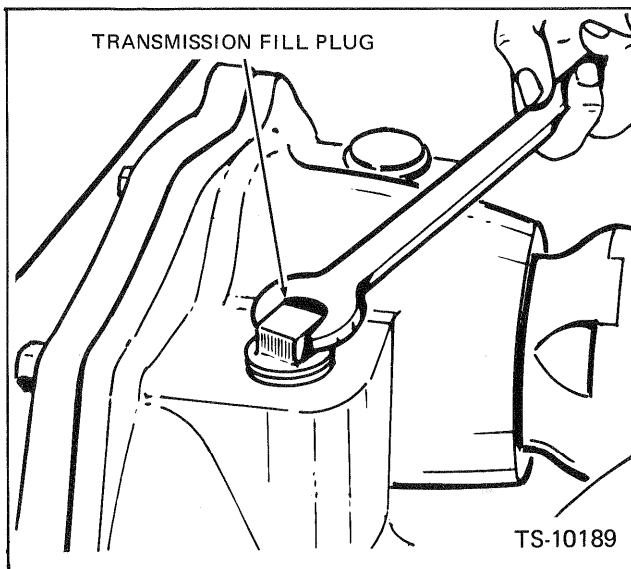
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Fig. 9-4 Transmission Fill Plug

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 cables 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 direction, a check of the clutch operating pressures should be made.

Using 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 250 p.s.i.
Maximum 300 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.

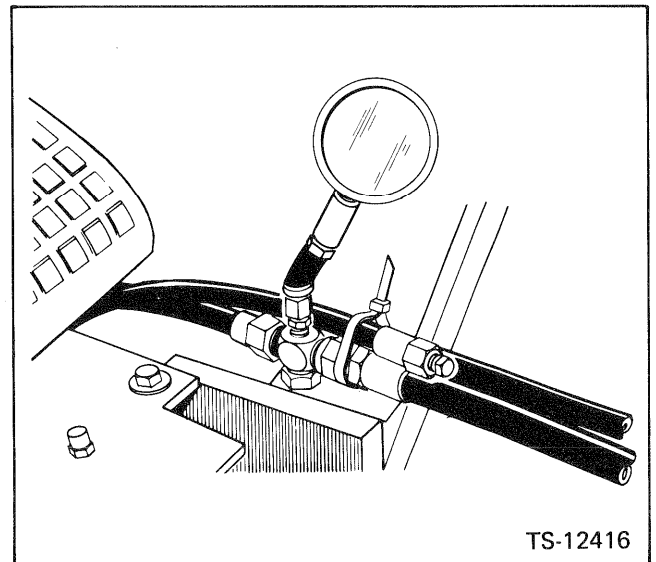


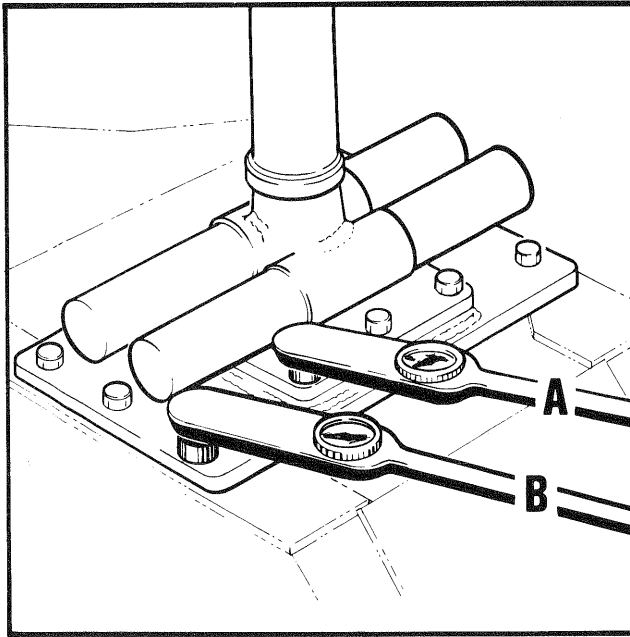
Fig. 9-5 Check Transmission Clutch Pressures

INTENTIONALLY BLANK

JONSERED LOADER

General

In order to avoid unnecessary stoppages due to repairs, etc., make it a daily routine to check that all bolts and nuts are properly tightened. It is particularly important that the bolted joint between the crane foot and crane mounting should be checked regularly. Fig. 10-1.



A) 433 Ft.Lb. B) 1000 Ft.Lb.

Pivot pins in the linkage system between the loader boom and grapple should be carefully checked, tightened up and lubricated every work shift.

Also make sure that all hydraulic hoses and couplings are undamaged, and always carry out regular lubrication in accordance with the lubrication chart.

Slewing Motor

The upper slide bearing on the slewing motor should be lubricated regularly. *N.B. — Do not pump in too much grease at each lubrication. A suitable quantity is 2-3 strikes with a lever operated grease gun.*

On delivery the slewing motor gearbox is filled with oil, but the oil level should always be checked before taking a new loader into use.

The rotating speed of the slewing motor must not be altered without first obtaining approval. Hard slewing up against the stop positions may cause damage.

Loader Boom

If any repairs are necessary on the loader boom, or if any of the boom components require welding, Clark should be contacted for instructions.

Rotator

In order to keep the fully rotating rotator free from dirt, the oil should be drained and changed in accordance with the instructions in the lubrication chart. The oil drain plug is fitted on the wall of the rotator housing.

Rotators with a limited slewing arc must not be run up against the stop positions at high speed as this results in heavy stresses which could damage the rotator.

Hydraulic Hoses and Couplings

The loader is provided with high-pressure hoses which have two braided steel wire inserts and detachable couplings which can be fitted without having to strip the hose. Use the special fitting tool supplied with each loader for this purpose. *N.B. — Lubricate carefully before starting up a new loader. If the lubricating passage in a pivot pin, for example, has become blocked up so that grease is unable to enter, stop all further operation immediately! Knock out the pivot pin and screw out the grease nipple. Then clean out the lubrication hole in the shaft and lubricate in accordance with the lubrication chart. Make sure that the stop dog which prevents the shaft from turning always functions properly.*

THE WARRANTY DOES NOT COVER ANY MALFUNCTIONS CAUSED BY INCORRECT MAINTENANCE OR POOR LUBRICATION.

Hydraulic System

The loader control valve is particularly adapted for mobile use. The control valve is characterised by low operating force and good control properties, giving quick and precise load handling response.

The valve sections are connected in parallel, meaning that several movements can be performed at the same time, but the oil flows to the working point at which the lowest backpressure exists.

Pressure relief valves of the insert type are used for regulating the working pressure. The valve insert also serves as a shockload valve, (safety valve) to protect the loader against any shock pressures which might occur through external action. The

valve inserts also act as refill valves. They have a fixed pressure setting which cannot be altered by external adjustment.

A double shock-load valve is included as a separate unit in the hydraulic circuit to the slewing motor and protects the slewing motor against hydraulic shock pressures and shock loads. There are restriction and non-return valves on the valve for limiting the slewing speed and to ensure that the slewing motor is always filled with oil.

Slewing Motor

The slewing motor is integrally built to form a robust and compact unit. It is provided with double, parallel tooth racks and four cylinder tubes, meaning that the transmission forces are evenly distributed. There is a plastic hose leading from the slewing motor gear housing which acts as a breather line.

Loader Boom

The main boom and outer boom are made of high-strength steel plate box sections.

Hydraulic Cylinders

The hydraulic cylinders of the loader are made of tubular steel with a very fine surface finish and are provided with hard chromed piston rods.

- a. **The Lifting Cylinder** is of the double acting type but is used as a single acting cylinder when using the machine as a grapple loader. The piston rod side of the cylinder is connected to the return oil port of the valve so that any leak-off oil is returned to the hydraulic system.
- b. **The Outer Boom Cylinder** is double acting. It is protected by a robust, patented armoured guard which runs on steel rollers in the guide-ways of the main boom.

Rotator

The rotator, which turns the grapple, is supplied with unlimited slewing in both directions. The rotators are provided with robust guards for the hose attachment.

Checking Functions of Hydraulic System

Alternation of pressure settings may only be done by persons having a thorough knowledge of the hydraulic system functions. In no case must a higher pressure setting be used than that specified as maximum for the loader. A pressure gauge must always be used when checking or adjusting the pressure. After adjustment has been completed, new sealing must always be applied.

The Control Valve is provided with a pressure relief valve of the insert type, the setting of which is made at the factory. The valve insert is non-adjustable and must be replaced complete if it does not produce the specified pressure value. *N.B. — The Warranty will not be valid if the working pressure is set at too high a value.*

There is a plugged outlet on the valve block with a 3/8" BSP thread and which is intended for connecting a pressure gauge when checking the working pressure. The pressure gauge can also be connected on any of the hydraulic circuits if connections can be made without difficulty.

Troubleshooting

Fault — The loader remains stationary or only moves slowly in all functions.

Action

1. Check that there is oil in the hydraulic system.
2. Check that oil reaches the pump (pumps) rotate. If not, this may be due to a blocked strainer.
3. Check that the pump (pumps) rotate. If not, this may be due to disengagement of the pump, broken drive shaft, broken draw key or similar problem.
4. If the control valve of the loader is connected in series with another control valve earlier in the system, the O-ring of the series-connection nipple may be damaged.
5. Dirt may have entered the pressure relief valve causing leakage between the valve and its seat in the valve block. Take out the valve insert and remove any dirt.
6. Defective pressure relief valve. Change the valve insert.

Fault

Loader is weak in one or more functions.

Action

1. If the loader is weak in several functions, this may be due to excessively low oil pressure. Check the pressure with a pressure gauge. Low oil pressure may be due to a faulty pressure relief valve, see points 5 and 6 above, but may also be caused by a worn-out pump.
2. If the loader is weak on only one function, this is probably due to a faulty shock-load valve or worn-out seals on the function concerned.

Fault

Slewing motor runs unevenly or only produces a low slewing force.

Action

Uneven running may be due to air in the hydraulic oil or to too low a pressure setting on the separate shock-load valve. Check whether the oil is foaming. If so, change the oil. If there is oil leakage from the breather hose, this is a sign of defective sealing on one or more of the cylinder tubes.

Fault

Loader boom sinks down or grapple opens under normal loading.

Action

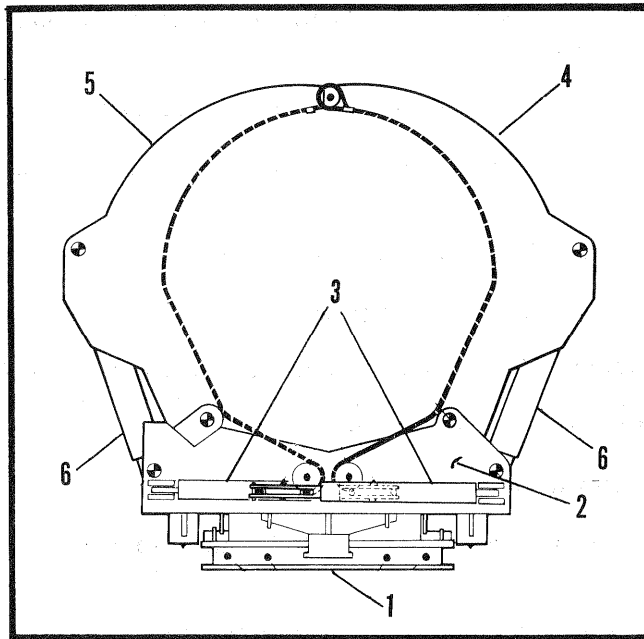
Leakage on shock-load valve for the functions concerned. Remove the shock-load valve and clean the valve seat and its seat in the valve block. Also check that the sealing surfaces are undamaged. Change the valve if no external reasons for the trouble can be found.

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NOTES

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

INVERTED GRAPPLE



General Description:

The model 820 bunk jaw, consisting of the following main parts, has been designed for mounting on a suitable forwarder chassis.

1. Slewing ring
2. Base frame
3. Cable tightening cylinders
4. Clamping arm right
5. Clamping arm left
6. Clamping arm cylinder

The *slewing ring* is mounted in ball bearings fitted with bolts onto the base frame. The base frame should have a tilt of from 4° to 8° angle. Which will automatically make the bunk jaw take a loading position. In order to decrease stresses in the slewing ring horizontal support bearing have been installed which allows a 40° angular deflection. The support bearing is welded onto the slewing ring and is attached with bolts to the frame of the bunk.

The *base frame* consists of a welded box type structure containing the cable tensioning cylinders rope pulley, and rope pulley guideways.

The *clamping arms and cable tensioning cylinders* are manufactured of honed steel tubes with chrome plated piston rods and compact seals of fabric reinforced nitril rubber with derline guide rings. The cylinders for the jaw arms are equipped with decelerating or cushion valves. When fully re-

tracted or extended severe cylinder stresses are eliminated.

The *clamping arms* have a gripping area of 2 square metres or approximately $21\frac{1}{2}$ square feet and an opening width of 2700 m.m. or approximately 110 inches (9 ft. 2 in.).

The steel cables are not used not only to lock individual trees or logs but also to secure the load within the clamping arms. One end of each cable is equipped with a rope coupling eye ring and attached onto the end of the clamping arm. The other end of the cable is secured and fitted with a locking sheave to the base frame.

Cable specification:

Diameter: 19 m.m. approx $\frac{3}{4}$ "
 Number of strands: 265
 Number of steel core strands: 31
 Cable length: 4400 m.m. or approx. $14\frac{1}{2}$ '

Controls

The hydraulic cylinders used for clamping arms and cable tensioning are connected by way of manually operated hydraulic spool valve to the carrier hydraulic system.

All bunk jaw operations are controlled by manually operated levers.

Operation

When travelling without a load the crane should be folded and placed between the clamping arms resting on the base plate. Close the clamping arms and tighten the tensioning cables thus immobilizing the crane.

Attention must be taken not to over tighten the cables and the clamping arms must just come to rest on each other.

When transporting a load the crane should be lowered and the grapple layed on the load just ahead of the clamping arms.

Faster loading times can be obtained by parallel loading and only opening both clamping arms the desired amount to compensate for three size.

Replacement of Steel Tensioning Cables

When installing new cables proceed as follows: —

1. Close the clamping arms and extend the cable tensioning cylinders fully.

2. Remove yoke found above the roller of the hydraulic cylinder.
3. Push down on one end of the cable, draw it into the bunk jaws and put it around roller. The hook at the end of the cable aids the attaching.
4. Draw the cable back moving it in the frame and pull it out through the side using slot provided.
5. Refit the new cable and yoke in it's proper position.
6. Attach the cable to the outside of the frame using a guide to make the free end of the cable find its way level with the left hand edge of the slot.
7. Reattach the cable to the clamping arm pin assembly.
8. Remove and install the corresponding cable in the same manner.

NOTE: After cable replacement if the cable will not hold an individual tree open the clamping arms slightly, length of cables may be adjusted by pushing the cable to frame lock key out and pulling out or in on the cables. The cables must not be tensioned when the cable tensioning cylinders and clamping arm cylinders are fully extended.

Trouble Shooting

1. A function fails to operate.
 - a. Check hydraulic cylinders and valves for possible bypass.
 - b. Check system pressure repump failure.
2. The clamping arms move slowly:
 - a. Operate each clamping individually from fully closed to fully open and note operation times.
- b. If one arm should cycle slower than the other check manual hydraulic spool valve for complete travel function.
3. The trees are not being held within the bunk jaw.
 - a. Check cylinders for internal leakage.
 - b. Check hydraulic spool valve for internal leakage.
 - c. Check pressure relief valve.
 - d. Check system pressure.

NOTE: If hydraulic oil is discharged from air vent valves of one or both cable tensioning cylinders this indicates seal failure.

Specifications

Opening width	2700 m.m. approx. 110" or 9' 2".
Grip area	2 sq. metres or approx. 21-1/2 sq. ft.
Angle of rotation	180 degrees
Angle of tilt	40 degrees
Slewing rim tilt	4 to 8 degrees
Opening time (arms)	2.5 seconds
Minimum pump capacity	110 litres/minute approx. 24.2 imp- erial gals./minute
Maximum hydraulic oil pressure	140 kp. per sq. cm. approx. 2000 lbs./ sq. in. gauge
Complete weight	1350 kilograms or approx. 2977 lbs.

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.

10 Hour or Daily

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.

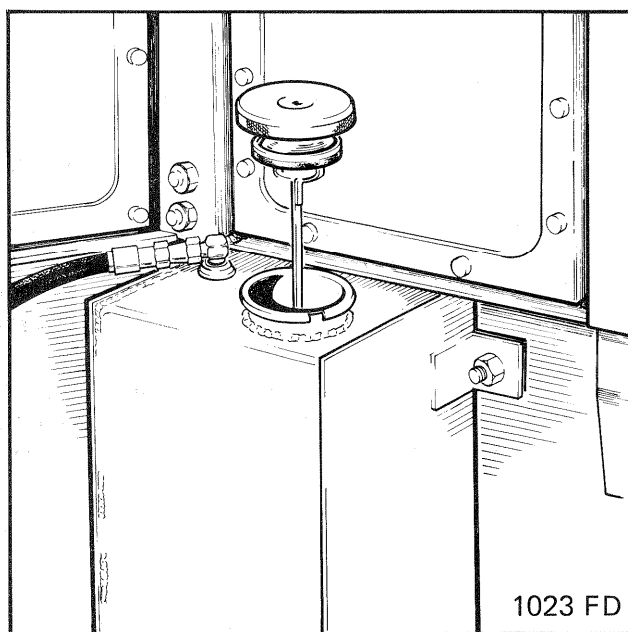


Fig. 11-1 Hydraulic Reservoir, Cap and Strainer

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 or Weekly

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 when required.

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.

100 Hour (Or Two Weeks)

————— NIL —————

250 Hour (Or Monthly)

————— NIL —————

500 Hour (Or Two Months)

Service the Hydraulic Reservoir Filter — The main hydraulic system is protected by a full flow 25 micron replaceable element type filter, located on the front side of the hydraulic reservoir. All fluid being drawn from the reservoir passes through the filter, providing clean fluid to the hydraulic pump, to be distributed through the system.

Replace the element every 500 operating hours. Thoroughly clean the cover before inserting a new 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 cause costly repairs and down time.

Check the Main Relief Pressure on the Steer 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 (main) control valve.

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

1. Shut down the engine.
2. Move the steering control lever 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 fitting on the control valve supply tube located under the floor panel, next to the frame. Fig. 11-2.
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 2,000 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 top of the main control valve assembly until 2,000 p.s.i. registers on the gauge. Fig. 11-2.

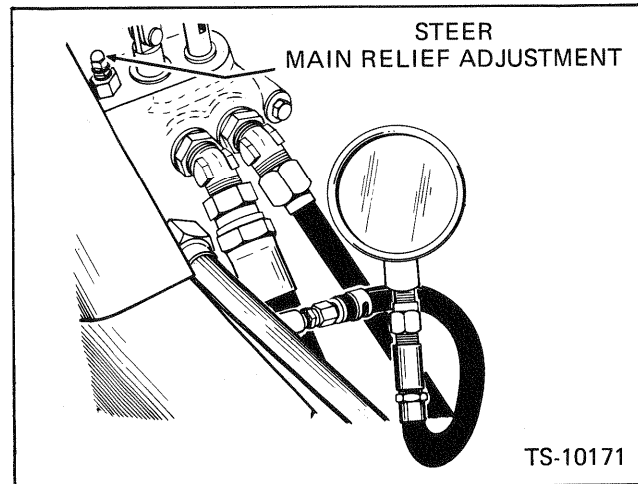


Fig. 11-2 Adjust and Check — Main Relief Valve

1000 Hour (Or Six Months)

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. Remove the drain plug at the bottom of the reservoir and drain the reservoir.
3. Disconnect the steer cylinder hose at their lowest points to drain these cylinders.
4. Remove and replace the hydraulic reservoir filter element as specified under "Service the Hydraulic Reservoir Filter Assembly".
5. 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.

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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.

6. Reconnect all hoses and unions.
7. 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.
8. Be sure all the control levers are in NEUTRAL position. Start the engine and run it at idle speed for a few minutes.

9. 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.

10. 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.

10 Hour Or Daily

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 Or Weekly

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 Or Two Weeks

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 "Extreme Pressure Molybdenum Disulphide Grease" (EPMD)". Care must be taken not to blow the seals; grease sparingly until the grease is visible all four bearing caps.

250 Hour Or Monthly

—————NIL—————

500 Hour Or Two Months

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 Or Six Months

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. When greasing use a hand gun and apply "Extreme Pressure Molybdenum Disulphide Grease (EPMD)", 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.

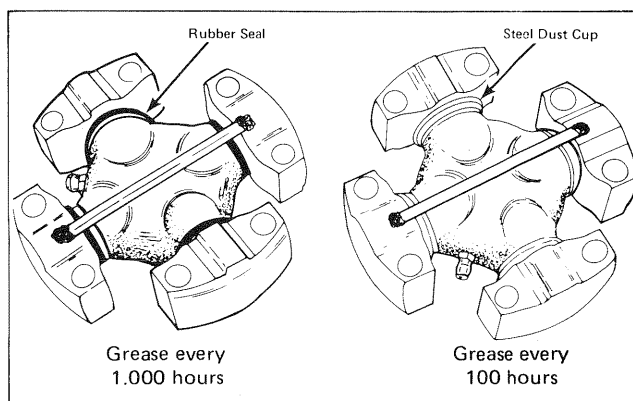


Fig. 12-1 Spider & Bearing Greasing

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.

- 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.

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

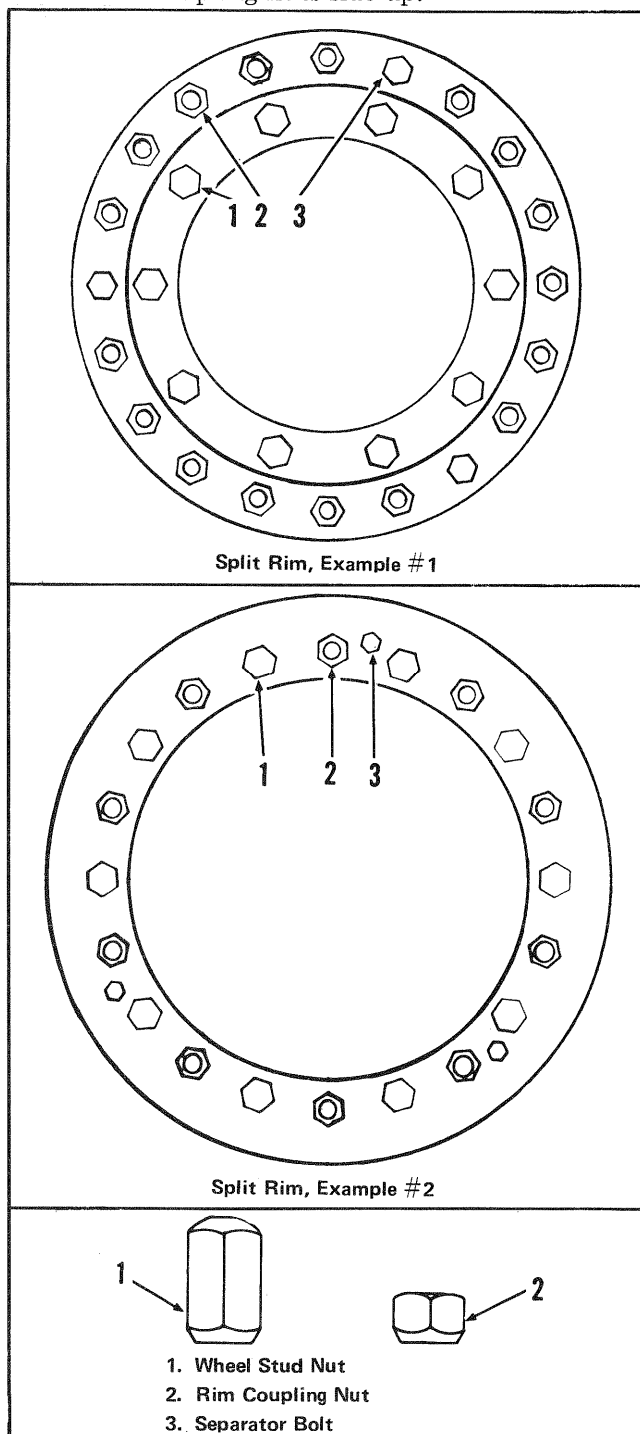


Fig. 12-3 Split Rims

- Punch mark the two halves of the split rim assembly to facilitate correct reassembly.

- Place the wheel assembly into an inflation cage, or use safety cables or chains before removing the split rim coupling nuts.

- Remove the split rim coupling nuts.

CAUTION: The tire must be deflated before removing these nuts.

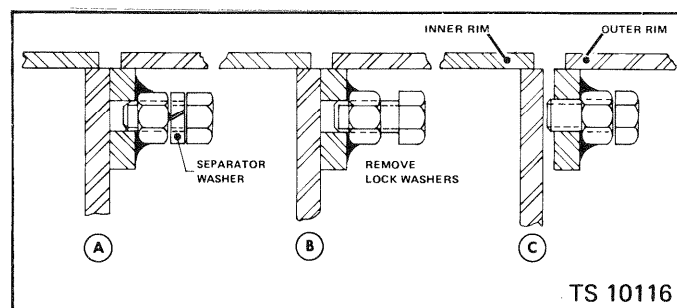


Fig. 12-2 Separator Bolt Operation

- With the separator bolt lock washers removed, alternately thread in the separator bolts to brake the rim halves apart. Fig. 12-2.

- Service the rim, tire and tube as required.

Wheel Assembly Procedure — Split Rims

- Lay the rim half containing the welded rim coupling bolts on a flat surface.
- 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.
- Place the second rim half on the first making certain the punch marks made in disassembly on each rim half are lined up.
- 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.*
- Place the wheel assembly back in the tire inflation cage.
- Add approved hydro-inflation as specified in Section 15, if required.
- 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 PILLOW BLOCK

⚠ 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 engaged cannot be steered.

10 Hour (Or Daily)

Grease the fitting on the pillow block.

50 Hour (Or Weekly)

———— NIL ————

100 Hour (Or Two Weeks)

———— NIL ————

250 Hour (Or Monthly)

Brake Master Cylinders — Access to both service and emergency brake master cylinders is provided by removal of a cover from the top of the firewall shroud — Left hand side. The dual rear brake master cylinder is located on the right hand rear of the operators cab and may be serviced from outside the cab.

Maintain fluid level to within .25 inch from the top of the reservoir. Add fluid 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 cylinders, adjust the pedals free travel, or to bleed the brake lines.

(a) Pedal Free Travel

The brake pedal free travel is the distance the pedal moves before the push rod touches the master cylinder piston. Excessive free motion reduces the effective travel, may cause blocking of the compensating port and prevents the brake from releasing.

Always check and adjust the pedal free travel as follows: 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.

2. Loosen the locknut and turn the adjusting nut clockwise to decrease the travel, counter-clockwise to increase the travel.
3. Tighten the locknut securely and recheck the pedal free travel.

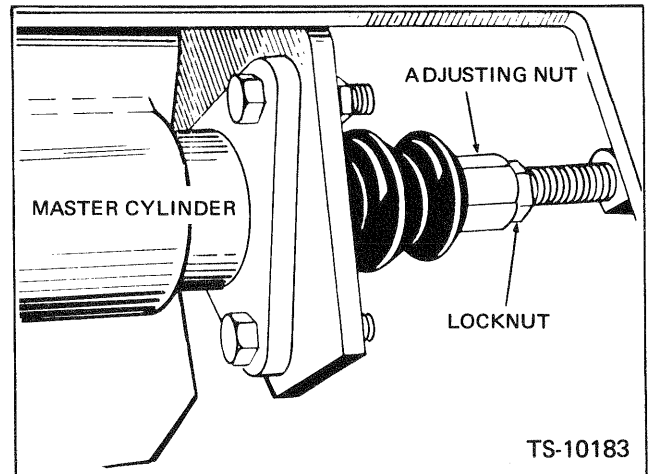


Fig. 13.1 Adjust Brake Pedal Free Travel

(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.

- i. The service brake system is to be bled in the following manner:
 1. fill master cylinder with fluid. (refer to Fig. 13-2)
 2. With the aid of a helper open the bleed screw on the remote actuator (located on the inside of the firewall opposite the front brake pedal) and depress the brake pedal to expel any air and fluid from the lines and actuator.
 3. When the pedal reaches its maximum stroke, close the bleed screw before releasing the pedal.
 4. Repeat the above procedure until solid fluid, free from bubbles, comes from the bleed screw.

5. The above procedure is to be repeated to bleed the two caliper heads located on the front and rear axles.
 6. After the remote actuator and the caliper heads have been bled as above, repeat steps 1, 2, 3, and 4 using the rear brake pedal and master cylinder and bleeding the other end of the remote actuator.
- ii. In general the same procedure is to be used to bleed the emergency brake system. See Fig. 13-3.

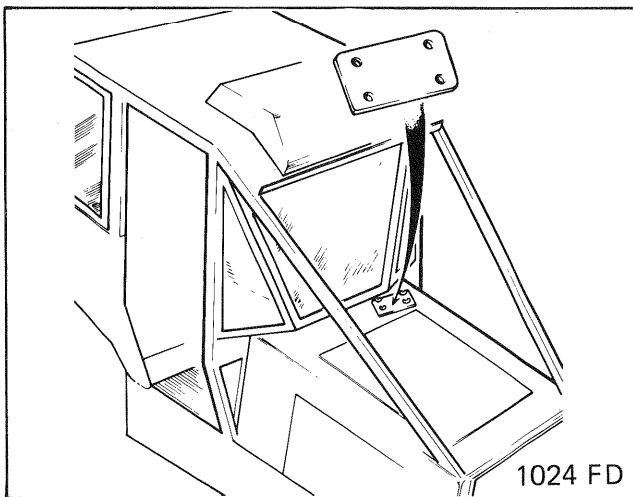


Fig. 13-2 Master Cylinder Locations

CAUTION

USE the same type of fluid in the brake master cylinders as in the torque converter, transmission and winch hydraulic system. Under no circumstances use brake fluid in forwarder master cylinder. (Service, emergency, dual rear brake units.)

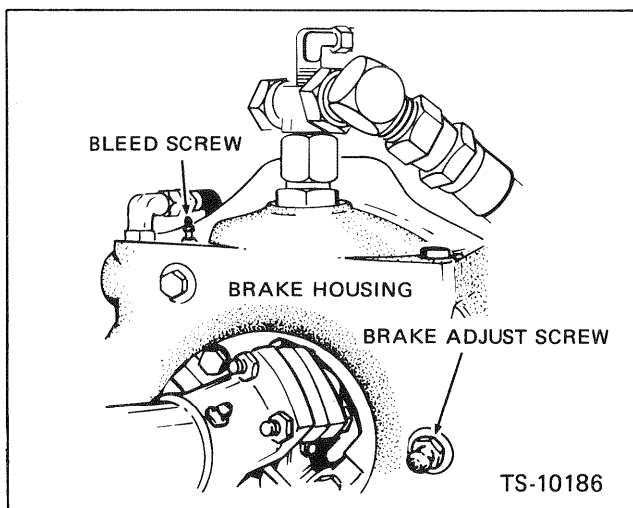


Fig. 13-3 Bleed and Adjust the Brake

Brake Adjustment

a. Emergency Brake

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.

b. Service Brakes are Self Adjusting

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

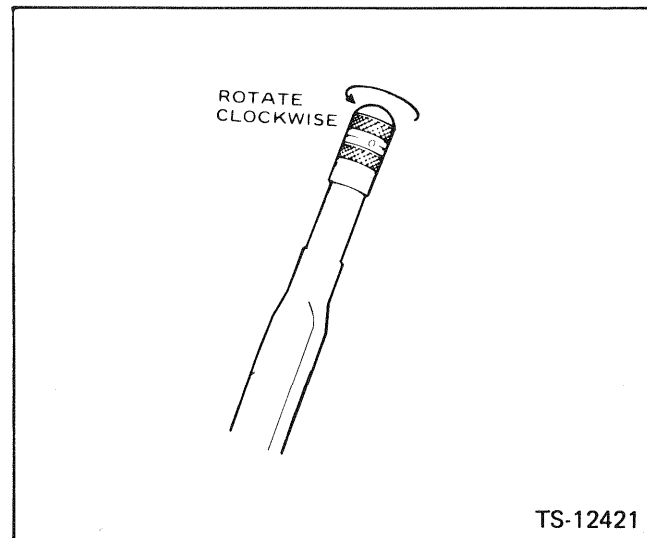


Fig. 13-4 Parking Brake

c. 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 is handle is pulled up to applied position.

1000 Hour (Or Six Months)

Change the Grease in the Pillow Block — Every 1,000 hours change the grease in the pillow block to lubricate the pillow block flange seal and to prevent foreign material getting into the pillow block bearing.

CLARK

1. Remove the pillow block input drive shaft from the flange.
2. Punch position — identification marks on the slip joint and on the tube assembly of the pillow block input drive shaft and disassemble the slip joint from the tube assembly to permit ease of access to the flange bolt. (In some units, disassembly of this drive shaft may not be necessary).
3. Remove the seal from inside the pillow block and remove all the old grease.
4. Pack the area behind the above remove seal with Darina AX grease. See Fig. 13-5 which illustrates the area to be greased.
5. Reassembly the pillow block input drive shaft.

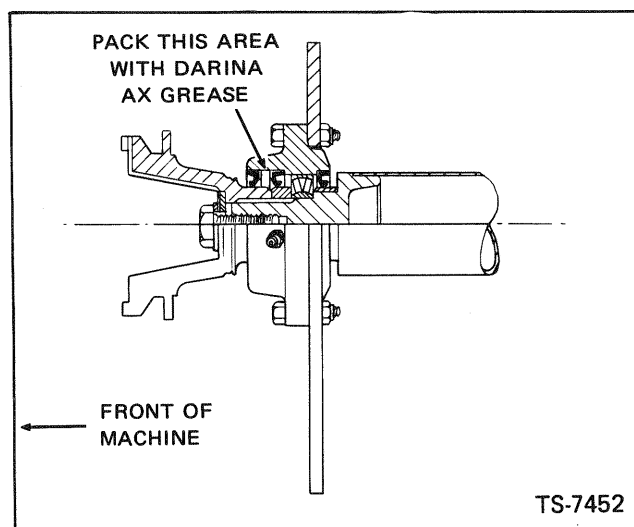


Fig. 13-5 Pillow Block

NOTE: *BE SURE* that the flange on the slip joint is parallel to the flange on the tube assembly by lining up the punch marks, (Item 2).

INTENTIONALLY BLANK

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.

10 Hour or Daily

————— NIL —————

50 Hour or Weekly

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.

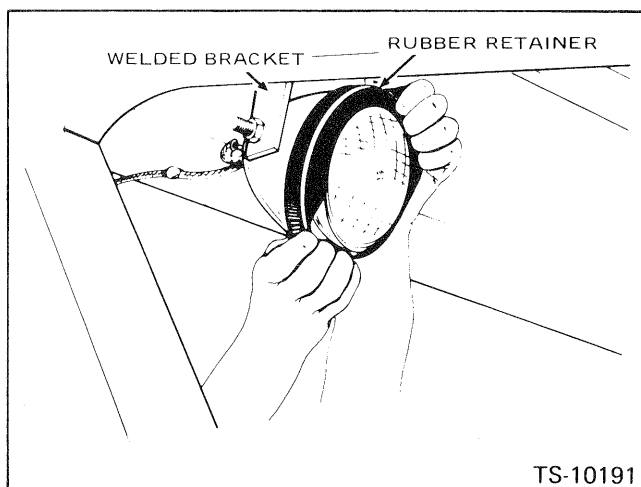


Fig. 14-1 Lamp Replacement

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.

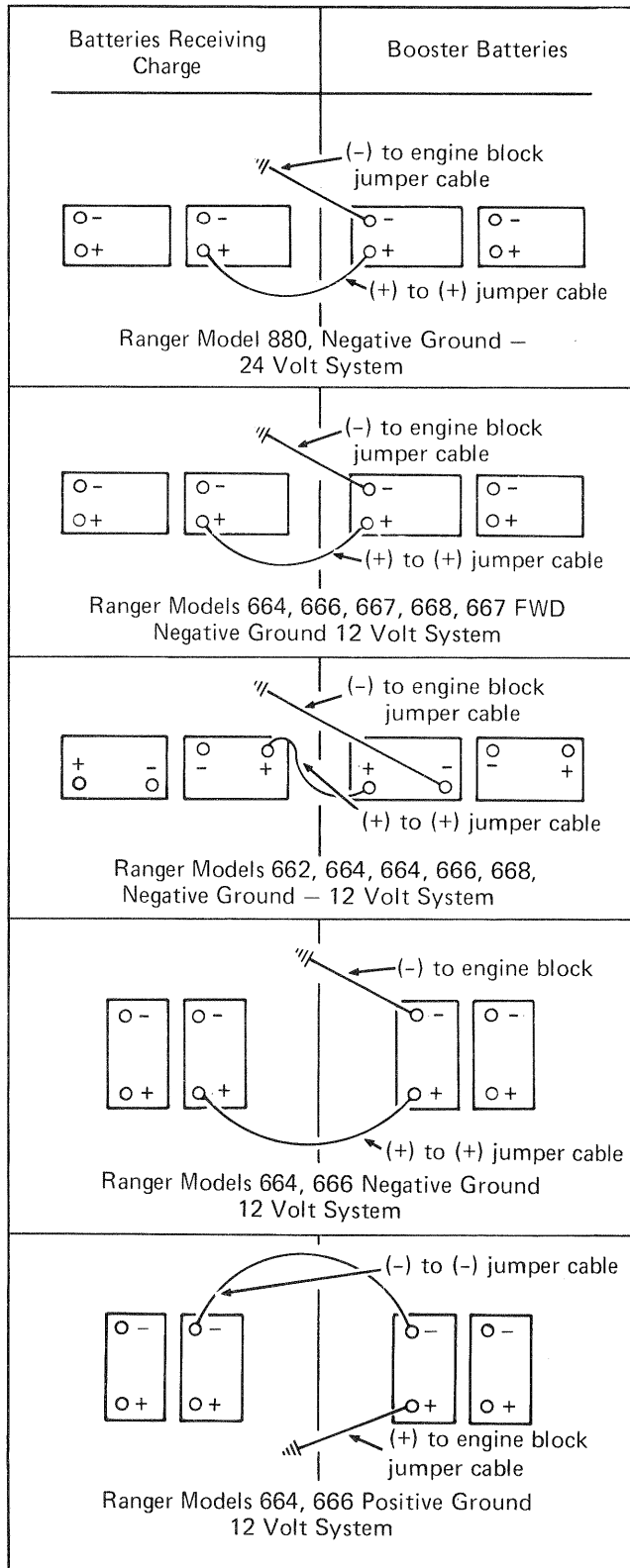


Fig. 14-2 Battery Jump-Start

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 Or Two Weeks

— NIL —

250 Hour Or Monthly

— NIL —

500 Hour Or Two Months

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.

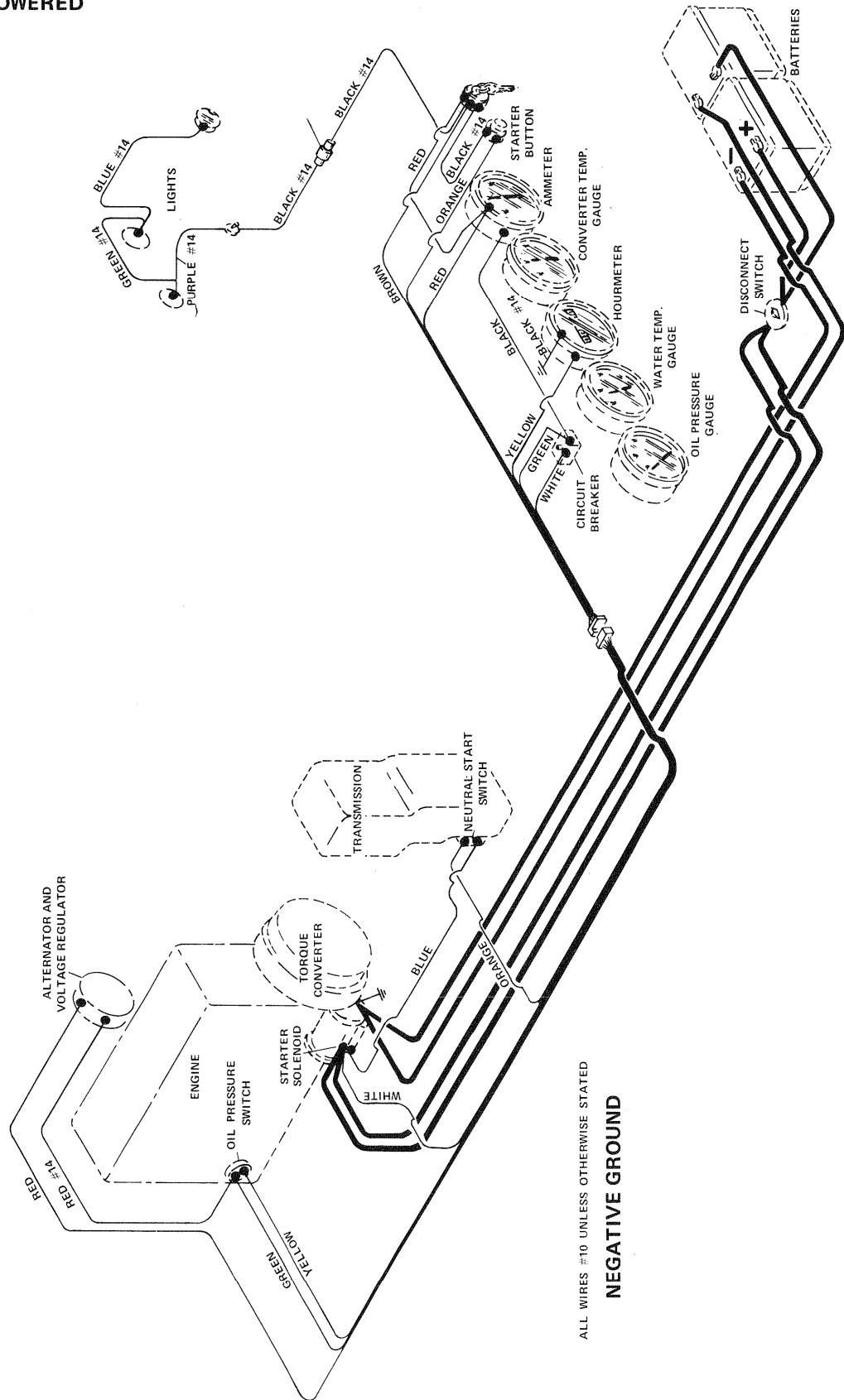
Where inspection reveals dirt, looseness or damage, clean, tighten and adjust or replace as necessary depending on the existing conditions.

1000 Hour or Six Months

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.

WIRING SCHEMATIC 667 G.M. POWERED

TS-10086

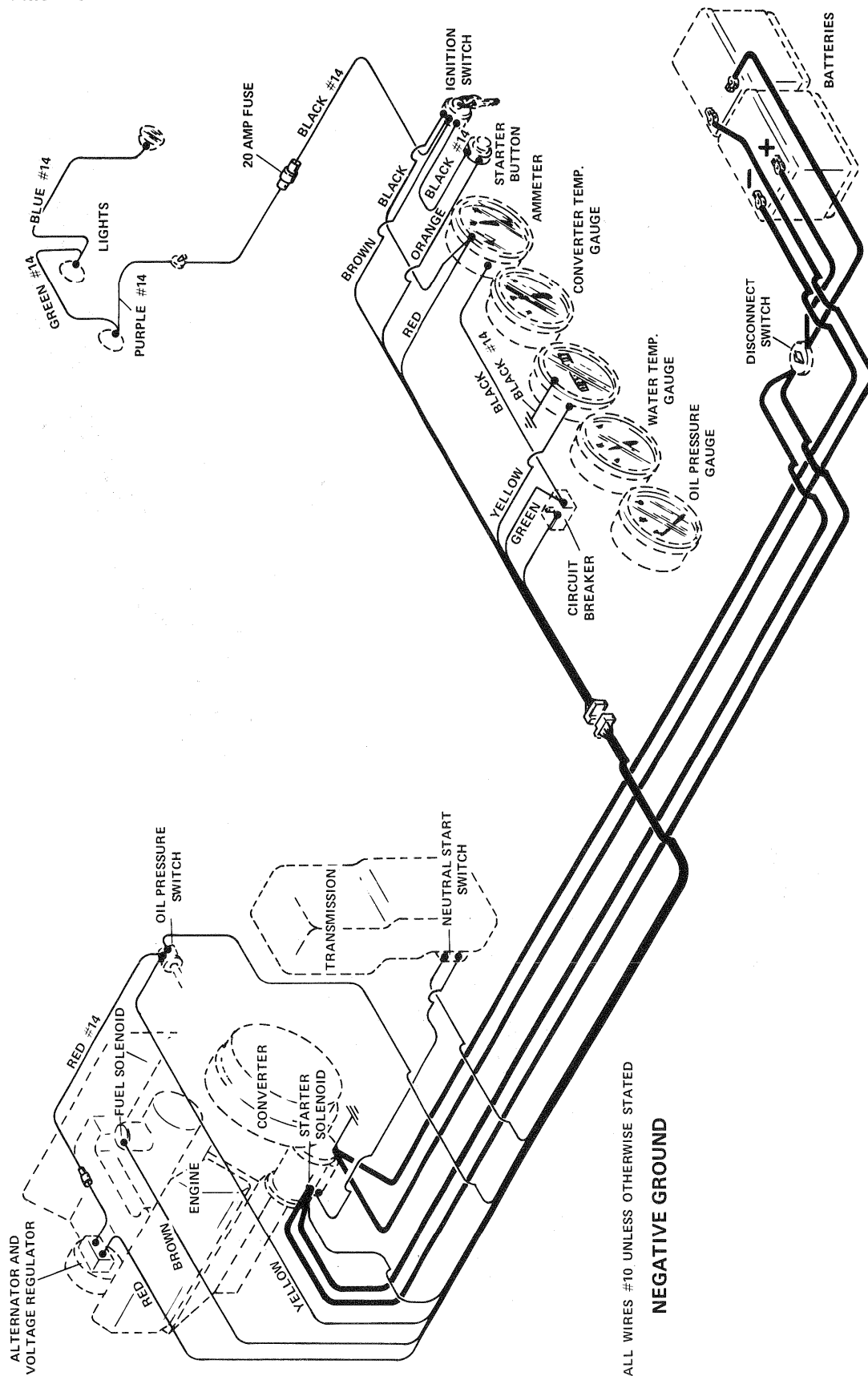


ALL WIRES #10 UNLESS OTHERWISE STATED
NEGATIVE GROUND

WIRING SCHEMATIC

**WIRING SCHEMATIC
667 CUMMINS POWERED**

TS-10087



ALL WIRES #10 UNLESS OTHERWISE STATED
NEGATIVE GROUND

WIRING SCHEMATIC

BOLT TORQUE CHART

FT. - LBS.

FASTENER LOCATION		THREAD SIZE	QTY.	INSTALLATION * TORQUE – LBS.FT.
Engine – Front	Engine to Brkt. G.M.	3/8-16 UNC	4	23-25
	Engine to Brkt. Cum.	1/2-13 UNC	4	57-63
	Bracket to Mount	7/8-14 UNF	1	550-600
	Mount to Support	7/16-20 UNF	2	45-50
	Support to Frame	5/8-11 UNC	4	100-120
Engine – Rear	Engine to Brkts.	1/2-13 UNC	8	57-63
	Brackets to Mounts	7/8-14 UNF	2	400-450
	Mounts to Frame	7/16-20 UNF	4	45-50
Transmission	Trans. to Brackets	3/4-10 UNC	8	282-310
	Brackets to Frame	3/4-10 UNC	4	282-310
Convertor	Ring Gear to Flywheel	3/8-16 UNC	16	See 1517510 23-25
	T.C. to Flywheel Hsg.	3/8-16 UNC	12	
Drive Shafts	Upper – 4C	5/16-28 UNF	16	17-22
	Lower – 6C	3/8-24 UNF	40	32-37
	Lower – 7C	1/2-20 UNF	8	55-65
	Flanges to Centre Shaft	7/8-14 UNF	2	550-600
	Pillow Blocks to Frame	7/16-14 UNC	12	35-40
Front Axle to Cradle		1-14 UNF	8	746-820
Rear Axle to Rear Frame		1-14 UNF	8	746-820
Wheel Nuts	Rim to Axle	3/4-16 UNF	40	450-500
	Rim Half to Rim Half	3/4-16 UNF	68	450-500
Loader Base Plate to Rear Frame		1/14-7 UNC	6	1000
OSA Grapple to Pedestal		5/8-11 UNC	8	100-120
Inv. Gr. Pedestal to Frame		3/4-10 UNC	16	250-300
Rear Frame Extension to Frame		3/4-10 UNC	12	250-300

For Plated or Oiled (SAE 30) Bolts and Fastenings.

Unplated Bolts used with Esna type fasteners to be oiled at assembly.

Bolts not listed above are to be tightened in a workmanlike manner.

CLARK

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.

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 2,300 psi.
 Converter Stall

Diesel	Diesel
G.M.	Cummins
4-53	V-378-C-155
4	6
3.88 x 4.50	4.625 x 3.75
212	378
262 at 1800 rpm	290 at 1900 rpm
125 at 2700 rpm	140 at 2700 rpm
2700	2700
550-600	600-650
2760-2860	2910-3030
1800-1950	1780-1960
2130-2280	2130-2280

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 500 ft. and ambient temperatures of 85° 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

Alternator:

Motorola 8PR-2018F negative ground
12 volt 35 amp.

Fan:

G.M. — Pusher Fan Std.
Cum. — Reversible Fan

Voltage Regulator: 12 volt
Motorola R3-1

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: G.M. — 30 psi minimum. Cummins 45-65 psi minimum. Engine at governed rpm.

Transmission Clutches: 250 psi minimum, 300 psi maximum taken at low idle rpm in all speed ranges in forward and reverse and oil temperature of 180° F. to 200° F.

Steering System: Main relief valve 2,300 psi.

TIRES PRESSURES

Front 20 psi 1.41 kgf/cm²
 Rear 28 psi 1.97 kgf/cm²

MODEL 667 G.M. FORWARDER

CAPACITIES (Approximate)	Imperial	U.S.	Metric
Engine Crankcase and System	14.0 qts.	16.8 qts.	15.9 Litres
Cooling System	36.0 qts.	43.2 qts.	34.1 Litres
Front Drive Axle Differential	10.8 qts.	13.0 qts.	12.3 Litres
Front Drive Axle Planetary Hubs (Ea.)	7.9 qts.	9.5 qts.	9.0 Litres
Fuel Tank	34.0 gal.	41.0 gal.	155.2 Litres
Hydraulic System	13.9 gal.	16.6 gal.	63.0 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	35.3 qts.	42.4 qts.	40.1 Litres

MODEL 667 CUM. FORWARDER

CAPACITIES (Approximate)	Imperial	U.S.	Metric
Engine Crankcase and System	22.0 qts.	26.4 qts.	25.1 Litres
Cooling System	36.0 qts.	43.2 qts.	34.1 Litres
Front Drive Axle Differential	10.8 qts.	13.0 qts.	12.3 Litres
Front Drive Axle Planetary Hubs (Ea.)	7.9 qts.	9.5 qts.	9.0 Litres
Fuel Tank	34.0 gal.	41.0 gal.	155.2 Litres
Hydraulic System	13.9 gal.	16.6 gal.	63.0 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	35.3 qts.	42.4 qts.	40.7 Litres

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					
			10	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					•	
Fuel Tank and Accelerator	Service Air Cleaner Element and Body	Sec. 6					•	
	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				•		
Torque Converter and Transmission	Drain and clean fuel tank	Sec. 7						•
	Check fluid level daily, at the transmission	Sec. 9	•					
	Clean Torque Converter and Transmission Breathers	Sec. 8 & 9		•				
	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, Hydraulic System	Sec. 9					•	
	Check Transmission Clutch Operating Pressures	Sec. 9					•	
	Clean Cylinder Rods	Sec. 11		•				
	Check and Adjust as required Control Valve Relief Pressures	Sec. 11					•	
	Replace Filter Element	Sec. 11					•	
Steer Hydraulic System	Drain, Clean & Refill Hydraulic Oil Reservoir	Sec. 11						•
	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						•
Brake System	Check for and repair Drive Line noises	Sec. 12	•					
	Check and Adjust as Required, Brake Pedal and Linkage	Sec. 12				•		
	Check and Adjust Parking Brake	Sec. 13				•		
Electrical System	Check Fluid Level in Master Cylinder	Sec. 13				•		
	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						•

CLARK RANGER Drive Line

Chassis

Lubrication Instructions

RANGER

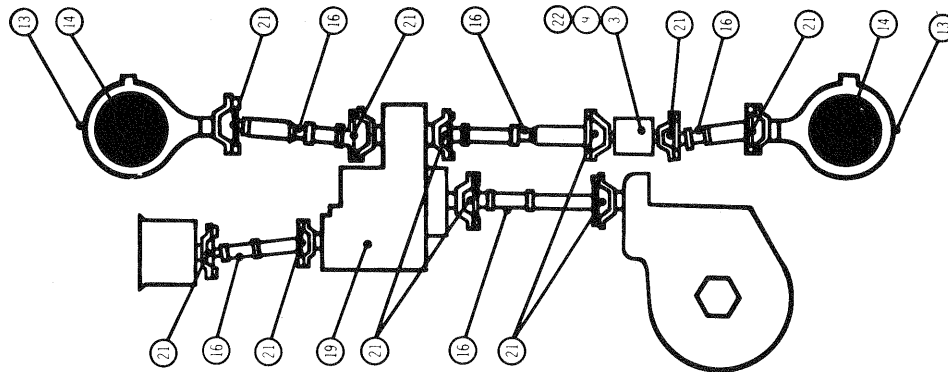
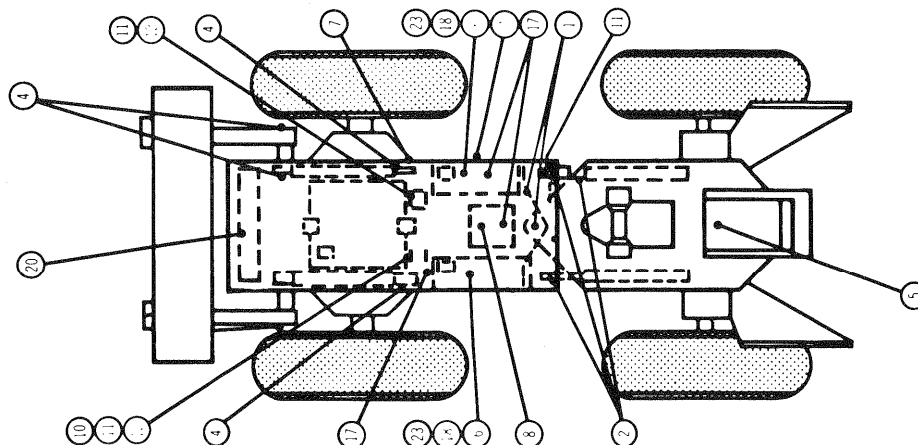
Drive Line

ITEM	10 HOUR OR DAILY SERVICE	664	666	667	668	CHECK	LUBE	CHANGE	KEY
1	CRADLE & HINGE PINS	X	X	X	X				EPMD
2	STEER CYLINDER PINS	X	X	X	X				EPMD
3	MID MOUNT	X	X	X	X				EPMD
5	FUEL TANK	X	X	X	X				DF
6	OIL RESERVOIR	X	X	X	X				DX
7	COOLANT LEVEL	X	X	X	X				
50 HOUR OR WEEKLY SERVICE									
8	TORQUE CONVERTER & TRANSMISSION	X	X	X	X				DX
9	MID MOUNT BEARING								DX
10	MASTER CYLINDER SERVICE								DX
11	MASTER CYLINDER EMERGENCY	X	X	X	X				DX
12	MASTER CYLINDER SERVICE	X	X	X	X				BF
13	DIFFERENTIAL	X	X	X	X				EPGL
14	PLANETARY	X	X	X	X				EPGL
100 HOUR OR 2 WEEKS SERVICE									
16	SLIP JOINT	X	X	X	X				EPMD
250 HOUR OR MONTHLY SERVICE									
17	TORQUE CONVERTER & TRANSMISSION FILTER	X	X	X	X				
500 HOUR OR 2 MONTH SERVICE									
18	HYDRAULIC TANK FILTER	X	X	X	X				
19	TORQUE CONVERTER & TRANSMISSION	X	X	X	X				DX
20	CLEAN RADIATOR CORE	X	X	X	X				
1,000 HOUR OR 6 MONTH SERVICE									
21	UNIVERSAL JOINTS	X	X	X	X				EPMD
22	MID MOUNT BEARING	X	X	X	X				EPMD
23	OIL RESERVOIR	X	X	X	X				DX

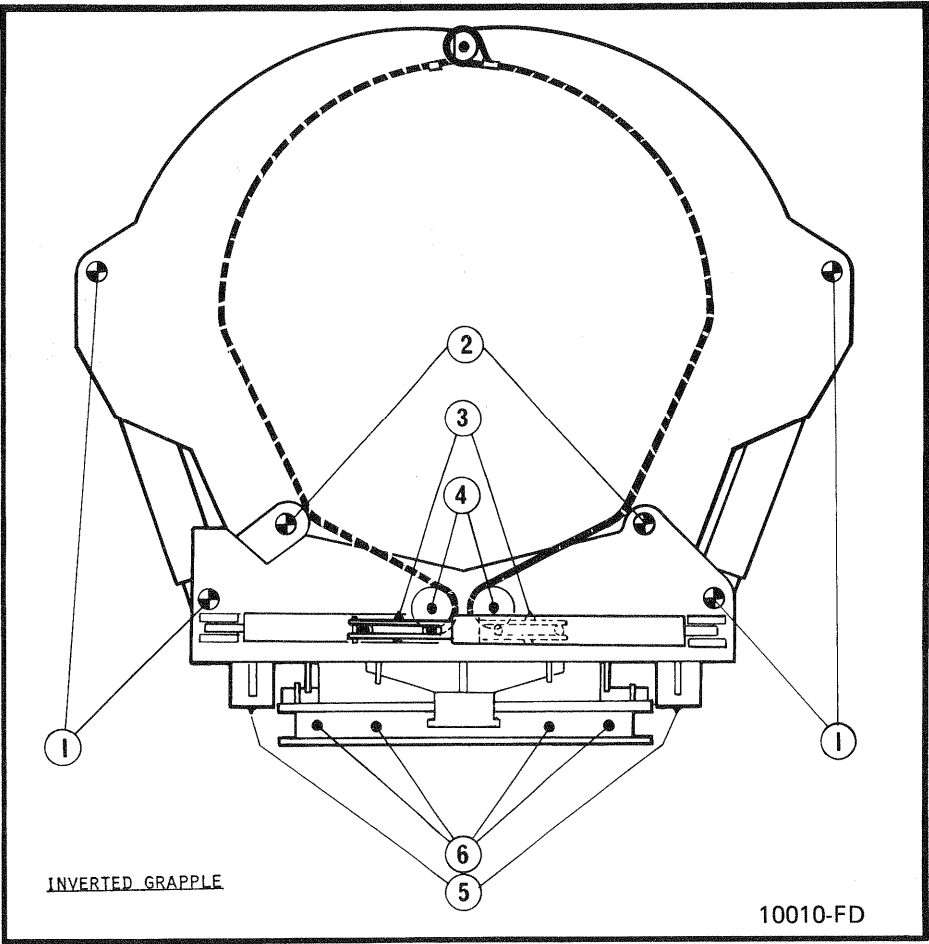
Lubricant Key

EPMD	Extreme Pressure Molybdenum Disulfide Grease		DF	Diesel Fuel — See Engine Manual	
	Ambient Temp Range	Lubricant To Be Used		Ambient Temp Range	Extreme Pressure Gear Lube (**SCL Type)
	SAE Grade API Class	Military Spec			
DX	Above -23° C (-10° F)	10W-CC 10W-CC	EPGL	Below -23° C (-10° F)	SAE Grade 75
				-18° C to -23° C (0° F to (-10° F)	SAE Grade 80
	Above -34° C (-30° F)	DEXRON or DEXRON II Automatic Transmission Fluid		-18° C to +38° C (0° F) to (+100° F)	SAE Grade 90
	Above -54° C (-65° F)	CONOCO UN 600 Fluid		Above 38° C (100° F)	SAE Grade 140
			BF	Heavy Duty Brake Fluid SAE J1703	

**SCL signifies SUELO CHLORO lead type factory fill is made with #90 SCL type lube. It is recommended that the same type be used when adding or refilling.



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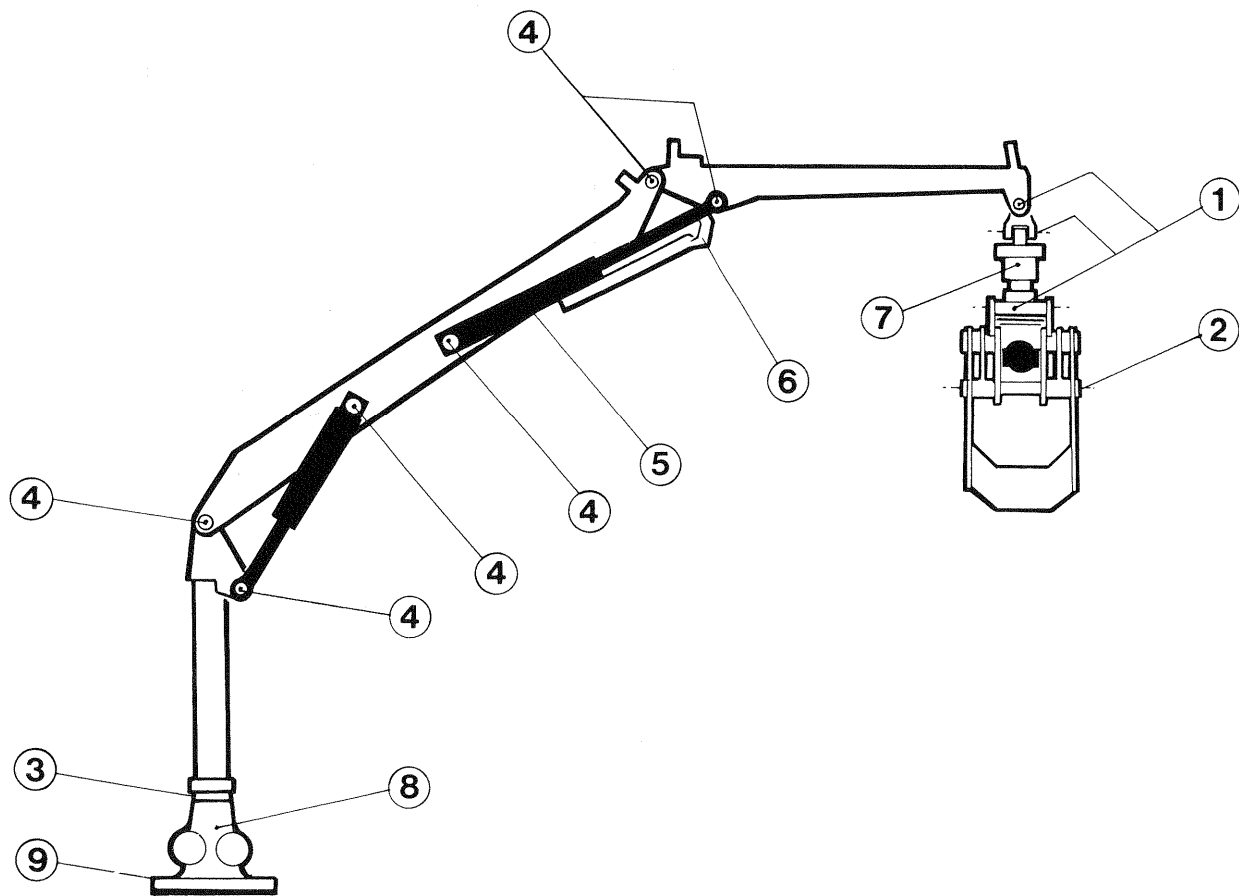


INVERTED GRAPPLE

LUBRICATION:

The inverted grapple should be lubricated every 10 hours or daily, using Extreme Pressure Molybdenum Disulphide grease. (EPMD)

ITEM	LOCATION	NUMBER OF GREASE NIPPLES
1	Clamping arm cylinder each pivot point	4
2	Clamping arms shaft and bushing	2
3	Tensioning cylinder cables pulley bearings	2
4	Base plate cable pulley bearings	2
5	Slewing ring mount pivot bearings	2
6	Slewing ring bearing	4



ITEM NO.	DESCRIPTION	NO. OF LUBE POINTS	LUBE	KEY
10 HOURS OR DAILY				
1	Linkage Pivot Pins	4	•	EPMD
2	Grapple	10	•	EPMD
3	Upper Bearing of Slew Motor	1	•	EPMD
4	Pivot Pins – Loader Boom and Cylinders	7	•	EPMD
5	Telescopic Tube – Piston Guard	6	•	EPMD
50 HOURS OR WEEKLY				
6	Front Pivot on Piston Guards	2	•	EPMD
1,000 HOURS OR 6 MONTHS				
7	Motor Head Grapple	Drain and change oil when changing main hydraulic system changing main hydraulic system		
8	Slew Motor Base			
9	Oil Drain Plug for Slewing Motor for Slewing Motor			

NOTES

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