# INTERNATIONAL®
# ENGINES

# OPERATOR'S MANUAL

## UD-236 AND UD-282
### ENGINES AND ATTACHMENTS

FORM 1 085 386 R5

October, 1974

An Operator's Manual and a Parts Catalog are packed and shipped with this engine for customer use. Additional technical publications are available for this engine.

These additional publications are strongly recommended for the customer who performs his own maintenance and service on this engine.

It is the policy of International Harvester Company to improve its products whenever it is possible and practical to do so. We reserve the right to make changes or add improvements at any time without incurring any obligation to make such changes on products sold previously.

Due to a continuous program of research and development, some procedures, specifications and parts may be altered in a constant effort to improve engines.

Periodic revisions may be made to this publication and mailed automatically to distributors. It is recommended that customers contact their distributor or dealer for information on the latest revision.

# UD-236 AND UD-282

## ENGINES AND ATTACHMENTS

FORM 1 085 386 R5

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(Supercedes FORM 1 085 386 R4)

## SERVICE MANUAL INFORMATION

Your authorized International Engine Distributor and his factory trained servicemen are best qualified to service your equipment. Up-to-date instructions and adequate special tools are also a part of your distributor's service facilities.

This Operator's Manual was prepared to instruct you in proper operation and maintenance of your engine. If you desire additional information you may purchase Service Manuals.

Cut out this order blank and forward, together with your check or money order in the appropriate amount (U. S. Funds) to:

**International Harvester Company**

**IHC Printing and Distribution Services**

**807 Blackhawk Drive**

**Westmont, Illinois 60559**

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☐ ISS-1040-1 Engine Service Manual . . . . . $7.00

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# CONTENTS





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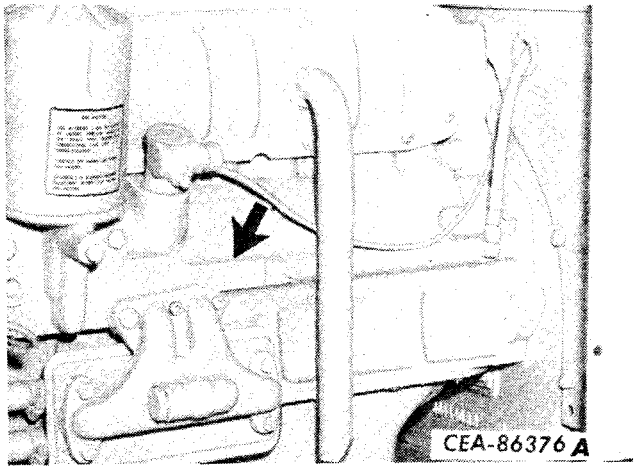
Instructions on operation, lubrication and maintenance for the basic engine and attachments are covered in this manual. Disregard any instructions on attachments that are not applicable to your engine.

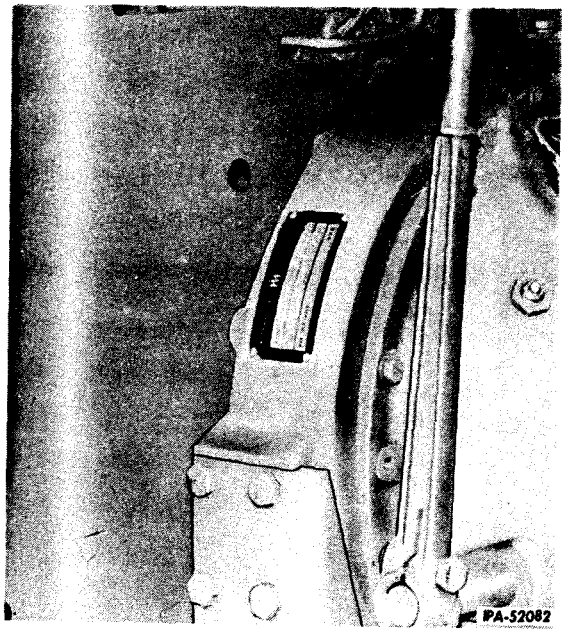
Throughout this manual, the use of the terms "left," "right," "front" and "rear" must be understood to avoid confusion when following instructions. "Left" and "right" indicate the left and right sides of the engine when facing the engine from the flywheel end. The front of the engine is the fan drive pulley end.

## SERIAL NUMBERS

When in need of parts, always specify the chassis and engine serial numbers. The engine serial number is stamped on the left side of the engine crankcase just above the oil cooler.




**Illust. 2**
**Engine Serial Number.**




**Illust. 3**
**Chassis Serial Number.**

(Illust. 2.) The chassis serial number is stamped on a name plate attached to the left side of the flywheel housing. (Illust. 3.) Write these serial numbers in the space provided.

Engine Serial Number:

236DU2U _____

282DU2U _____

Chassis Serial Number:

UD-236 _____

UD-282 _____

## SUGGESTED ENGINE AND FUEL TANK ARRANGEMENT

### Engine Mounting

1. Anchor the engine securely to a level solid foundation, preferably concrete.

2. Mount the engine or driven machine so that the belts may be removed or tightened.

3. Do not support a long exhaust pipe on the exhaust manifold; instead, use a flexible pipe at the engine and support the rigid pipe from the ceiling or floor.

4. Use long-sweep elbows in exhaust pipes.

5. For every 12 feet of exhaust pipe, enlarge the diameter of the pipe one standard pipe size.

6. Install the flexible exhaust piping so the belting may be adjusted without disconnecting any pipes or lines.

7. Install flexible fuel lines between the pipes to the fuel tank and the engine and a fuel shut-off valve at the tank.

NOTE: Diesel fuel tanks and supply lines must never be galvanized, despite the fact that the zinc coating will reduce rust formation. Diesel fuel oil reacts chemically with zinc to form powdery flakes. These flakes can chip off causing damage to the fuel pump.

8. The fuel tank installation must contain water entrapments, drain features and a fuel tank outlet strainer (60 x 60 mesh) between the fuel tank and the fuel pump (if equipped).

### Fuel Supply Line

1. Keep within the minimum and maximum limits when purchasing pipe and equipment.

2. The suggested minimum size for the main fuel supply tank or reservoir is approximately 50 U. S. gallons.

(Continued on next page)



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**Fuel Supply Line - Continued**

3. All piping must slope down from the engine to avoid high pockets in the line which might interfere with the flow of fuel.

4. Install flexible fuel lines between the pipes to the fuel tank and engine. Install flexible exhaust piping so the belting may be adjusted without disconnecting these pipes or lines.

5. The fuel line size recommendations are as follows:

SUPPLY LINE SIZE: Under 10 feet; 5/16 inch ID tubing, over 10 feet; 7/16 inch ID tubing.

RETURN LINE SIZE: Under 10 feet; 3/16 inch ID tubing, over 10 feet; 1/4 inch ID tubing.

Using the size tubing recommended will prevent excessive back pressure.

6. MAXIMUM SUCTION LIFT (ELECTRIC FUEL PUMP ATTACHMENT): The maximum suction lift for the electric fuel pump is twelve feet. Maximum efficiency will result only with clean filters and air-tight piping for long fuel filter life.

7. The return line must be piped back to the supply tank and never back to the inlet. The return fuel cools, lubricates and purges air from the injection pump.

8. The location of the return line, at the tank, should be at the greatest possible distance from the supply line to the engine, permitting a solid supply of fuel to the engine. The line should terminate within the tank below the minimum expected fuel level to prevent air returning to the injection pump when the engine is stopped.

**Fuel Supply Tank Installed Above the Fuel Filters**

1. Locate the fuel tank so that the bottom of the tank is above or at the same level as the top of the fuel filters. This will eliminate the need for an electric fuel pump to vent the air from the fuel system.

2. However, with this fuel tank location, it is suggested that a shut-off valve, of the same size as the fuel pipe, be installed after the fuel tank outlet so that the fuel flow may be stopped while changing fuel filter elements.

**Fuel Supply Tank Installed Below the Fuel Filters**

1. When locating the fuel tank with the bottom of the tank below the top of the fuel filters; the use of an electric fuel pump attachment is recommended. The pump will aid in priming air from the fuel system and supply fuel to the engine while running under load.

2. Installation of a check valve in the supply line will minimize the time required for the fuel pump to prime itself.

## VENTILATION FOR ENGINES INSTALLED INSIDE OF BUILDINGS

Engines installed inside buildings, sheds or cabs should be the open type; that is, with the engine hood and back panel removed to permit free circulation of fresh air around the engine, radiator, etc. Steps must be taken to carry the waste heat to the outside, or to change the air in the engine room rapidly.

The exhaust pipe should be arranged to provide the shortest possible length within the engine room. The part of the exhaust pipe inside the building should be surrounded with a light steel tube, sufficiently large to permit a two inch to four inch air space all around. This space should be ventilated to the outside. Another method of insulation is to cover the exhaust pipe completely with at least two inches of air-cell asbestos.

Ventilate the engine room thoroughly and install the engine so that air can flow freely through the radiator. An opening to the outside, in front of the radiator, is extremely desirable. Ducts should be provided between the radiator and the wall openings. On some installations, it may be necessary to provide a reverse-flow fan to blow the heated air out of the building.

Where the door or window area is restricted, galvanized ducts extending from the ceiling above the engine to the top of the building are recommended to carry off the hot air. Not less than two ducts, 24 x 24 inches in cross section, should be installed. At the same time, as many openings in the sides of the engine room as possible should be provided to let in cool outside air. Openings to a shaded side of the building are preferred.



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## SPECIFICATIONS AND CAPACITIES

**Capacities (U. S. Measure)**

Cooling system:
- Radiator type
  - UD-236 . . . . . 25 qts
  - UD-282 . . . . . 26 qts

Crankcase oil pan:
- With oil filter . . . . . 9 qts
- Without oil filter . . . . . 8 qts

Air cleaner oil cup . . . . . 4 qts

The capacities which appear throughout this manual are specifically for these engines and their special attachments.

**Specifications**

**Engine**

Type . . . . . Direct starting
Cylinders . . . . . 6-in-line
Bore . . . . . 3-11/16 in.
Stroke:
- UD-236 . . . . . 3-11/16 in.
- UD-282 . . . . . 4.390 in.

Fuel injection pump . . . . . Roosa Master
Fan belt tension (Refer to "BELT" in MAINTENANCE).
Valve clearance (intake and exhaust):
- Engine cold . . . . . .030 in.

**Engine Speeds**

Full load governed . . . . . (*)
Low idle . . . . . 650 ± 25 rpm

(*) - The full load governed speed for which this engine is equipped and adjusted is stamped on the serial number plate located on the flywheel housing.

**Torques (Threads Lubricated Lightly With Engine Oil)**

Engine oil filter case hold-down bolt . . . 45-50 ft-lbs
Fuel filter case cover bolts . . . . . 15-20 ft-lbs
Glow plugs . . . . . 60-80 in-lbs
Radiator and air cleaner hose clamps . . . 20-25 in-lbs
Valve cover bolt . . . . . 10-12 ft-lbs

**Dimensions**

Length (over-all including power take-off):
- UD-236 . . . . . 64-1/5 in.
- UD-282 . . . . . 65-4/5 in.

Height (over-all) . . . . . 42-3/4 in.
Width (over-all) . . . . . 28 in.

Specifications subject to change without notice.

## DIESEL FUEL SPECIFICATIONS

The following table shows the limiting requirements for diesel fuels recommended for use in International diesel engines:

(These are equivalent to ASTM Spec. D-975)

| Requirements | Grade 2-D‡ (Preferred) | Grade 1-D‡ |
|---|---|---|
| Flash Point, degrees F, min. | 125 or legal | 100 or legal |
| Pour Point, degrees F, max. | 10 below ambient ∔ | 10 below ambient ∔ |
| Cloud Point, degrees F, max. | Ambient ∔ | Ambient ∔ |
| Water and Sediment, percent by volume, max. | 0.05 | Trace |
| Carbon Residue on 10 percent Residuum, percent, max. | 0.35 | 0.15 |
| Ash, percent by weight, max. | 0.01 | 0.01 |
| Distillation Temperatures, degrees F: | | |
| 90 percent Point, min. | 540 | ——— |
| 90 percent Point, max. | 640 | 550 |
| Sulphur, percent by weight, max. | 0.5 | 0.5 |
| Cetane Number, min. | 40 | 40 |
| Copper Strip Corrosion, max. | No. 3 | No. 3 |
| Viscosity, Kinematic at 100F, centistokes, min. | 2.0 | 1.4 |
| Viscosity, Kinematic at 100F, centistokes, max. | 4.3 | 2.5 |

NOTES: ‡ Grade 2-D is preferred but 1-D should be used at temperatures below 10 degrees F or for operations entailing considerable idling.

∔ Ambient refers to lowest temperature at which the engine is to be operated.

## OPERATING CONTROLS AND INSTRUMENTS

The operator must thoroughly familiarize himself with the instruments and controls provided for operation of this engine. There are important differences between various engines; therefore, regardless of previous experience with other machines, the operator should fully understand what each control is for and how to use it before starting to operate the engine.

(Continued on next page)



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## OPERATING CONTROLS AND INSTRUMENTS - Continued

### Instruments (Illust. 4 or 5)

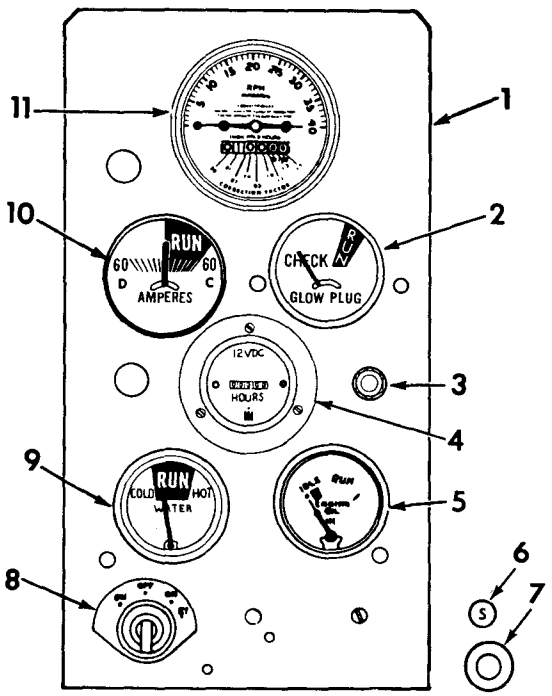
This section describes the purpose or function of each instrument. For detailed information on correct operating indications or ranges, refer to "Instrument Check" on page 10.

#### Ammeter

This instrument indicates the rate at which the battery is being charged or discharged.

#### Engine Oil Pressure Gauge (Illust. 4)

This instrument registers the pressure of the lubricating oil circulating through the engine.




CEA-86379B

**Illust. 4**
**Instrument Panel (Regular Gauges).**

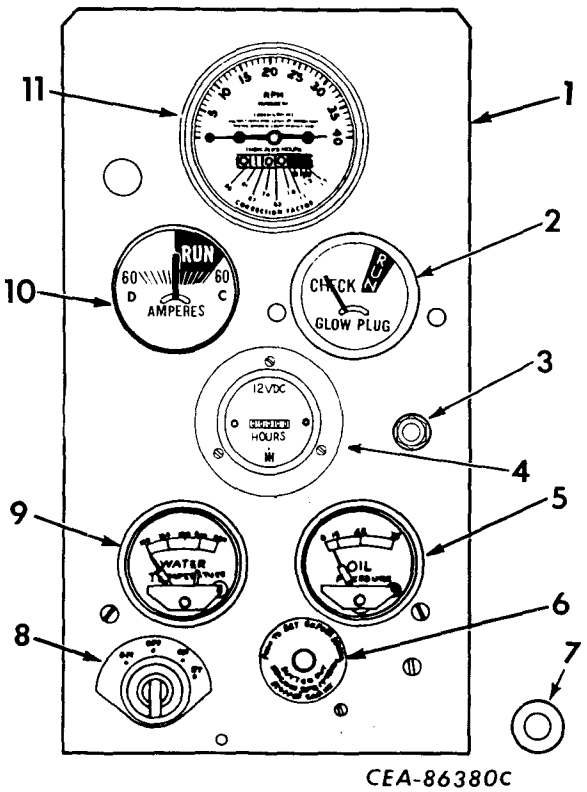
1. PANEL, instrument.
2. METER, glow plug.
3. SWITCH, glow plug.
4. HOURMETER.
5. GAUGE, engine oil pressure.
6. BUTTON, fuel shut-off control.
7. KNOB, engine throttle control.
8. SWITCH, ignition and starter.
9. GAUGE, engine coolant temperature.
10. AMMETER.
11. TACHOMETER.

#### Engine Coolant Temperature Gauge (Illust. 4)

This gauge shows the temperature of the coolant circulating the engine.

#### Safety Engine Oil Pressure Gauge (Illust. 5)

This indicator is part of the instrument panel (safety gauges) attachment. The safety engine oil pressure gauge shows the pressure of the lubricating oil circulating through the engine. If the oil pressure drops below minimum operating pressure, the engine will automatically stop.




CEA-86380C

**Illust. 5**
**Instrument Panel (Safety Gauges).**

1. PANEL, instrument.
2. METER, glow plug.
3. SWITCH, glow plug.
4. HOURMETER.
5. GAUGE, safety engine oil pressure.
6. SWITCH, ignition relay.
7. KNOB, engine throttle control.
8. SWITCH, ignition and starter.
9. GAUGE, engine coolant temperature safety.
10. AMMETER.
11. TACHOMETER.

#### Engine Coolant Temperature Safety Gauge (Illust. 5)

This gauge is part of the instrument panel (safety gauges) attachment. This gauge indicator registers the temperature of the coolant circulating in the engine. If the temperature of the coolant reaches 195°F, the engine will automatically stop.

#### Glow Plug Meter

This meter indicates glow plug failure. The meter has a "CHECK" and a "RUN" zone. When the pointer is in the "RUN" zone (glow plug switch depressed), all the glow plugs are functioning.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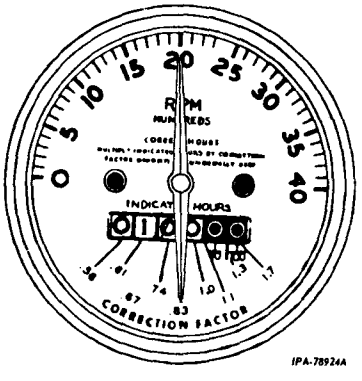
### Hourmeter

The hourmeter indicates the actual hours of engine operation. Its range is from zero to 10,000 hours. When the hourmeter reaches 10,000 hours, it automatically starts again at zero.

### Tachometer (Illust. 6)

The upper half of this gauge shows the engine RPM; the lower half of the indicator shows the indicated hours of engine operation.

This indicator has a correction factor to determine the actual hours of engine operation from the indicated hours. Refer to example following.




Illust. 6
Tachometer.

EXAMPLE:

Engine rpm – 2000

Indicated hours – 100

To determine the actual hours of operation, multiply the indicated hours (100) by the correction factor (.83). The actual hours: 83 hours.

## Controls

### Ignition and Starter Switch

This switch has four positions; "OFF," "ST" (start) and two "ON" positions. Turning the switch all the way to the right to the "ST" or start position completes the electrical circuit between the batteries and the cranking motor to crank the engine. Turning the switch all the way to the left to the "ON" position provides a source of electrical power to operate auxiliary electrical equipment while the engine is idle.

### Ignition Relay Switch (Illust. 5)

This switch is part of the instrument panel (safety gauges) attachment. It is a pushbutton type switch.

### Engine Throttle Control Knob (Illust. 4 and 5)

This knob controls the speed of the engine and, when set in given position, maintains a uniform engine speed under variable loads.

To obtain a specified engine rpm, depress the button in the center of the control knob and pull on the knob. When the approximate engine rpm is reached, release the button and the knob will automatically lock in place. If a finer adjustment is necessary, the knob can be rotated in a counterclockwise (to increase engine rpm) or clockwise (to decrease engine rpm) direction.

### Fuel Shut-off Control Button (Illust. 4)

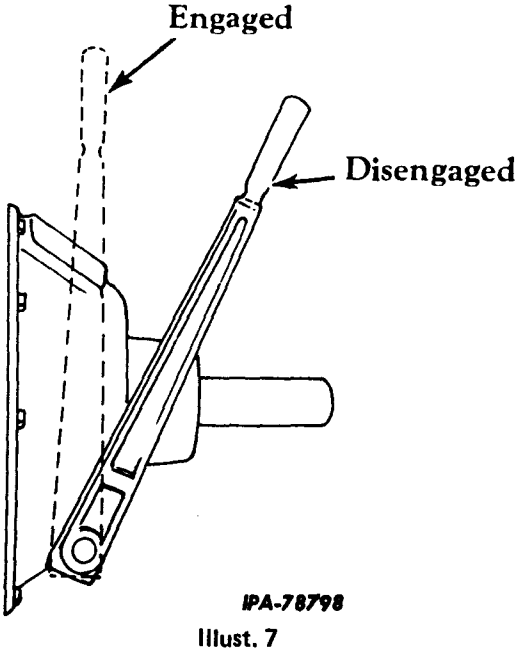
The fuel shut-off control button is used when starting or stopping the engine. Push the button in when starting the engine. Pull it out when stopping the engine.

### Glow Plug Switch (Illust. 4 and 5)

Depress the glow plug switch before cranking the engine in order to bring the glow plugs up to igniting temperature. Release the glow plug switch a few seconds after the engine starts.

### Power Take-Off Clutch Shaft Outer Bearing Housing Temperature Switch

This switch is part of the power take-off attachment. The switch is located at the bottom of the clutch shaft outer housing. If the temperature of the lubricant in the housing reaches 250°F, the engine will automatically stop.




Illust. 7
Power Take-Off Clutch Lever Positions
(Left Hand Lever Installation Shown).

### Power Take-Off Clutch Lever (Illust. 7)

This lever is used to engage or disengage the engine from the load.



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## BEFORE STARTING A NEW ENGINE

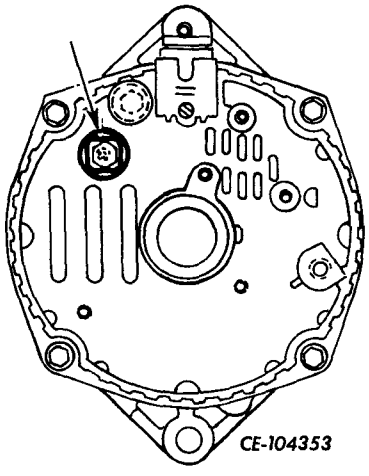
This engine has been given predelivery and delivery service by your distributor or dealer.

As an added precaution, the following steps must be observed:

1. Check the oil in the engine crankcase, the air cleaner oil cup (wet type - if equipped) and power take-off (If equipped) to be sure they are filled to the correct levels with the proper grades of oil for the prevailing temperature. Refer to "LUBRICATION WHEN SHIPPED" on this page.

2. Check the cooling system level and fill if necessary. Refer to "Filling the Cooling System" on page 21.

3. Check the clutch lever for ease of movement. If the clutch lever doesn't move freely, lubrication of the cross shaft, release bearing and overcenter clutch linkage may be necessary.




**Illust. 8**
**Alternator Connection.**

4. Be sure the "BAT" terminal on the alternator is clean and the red cable, from the negative (-) terminal of the ammeter is securely fastened to it.

NOTE: BE SURE BATTERY IS CONNECTED PROPERLY.

5. Connect the battery cable to the "BAT" terminal on the cranking motor solenoid and to the positive (+) terminal on the battery. Connect the ground strap to the negative (-)teriminal on the battery. (Refer to the "Wiring Diagrams" on pages 31 and 33 for proper connections.

6. Service the battery as instructed on the tag attached to the battery.

## LUBRICATION WHEN SHIPPED

### Engine

The crankcase is filled with approved oil that can be used for a maximum of 100 hours of operation. This oil will allow the engine to operate in temperatures reading from -10°F to +90°F. Refer to "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on pages 14 to 16 for proper type and viscosity of oil to be used for the prevailing air temperatures and drain periods.

### Air Cleaner

#### Wet Type (If Equipped)

The oil in the air cleaner (wet type only) may be used in 0°F to +90°F temperature range until the normal change period occurs. If the prevailing air temperature is above +90°F or below 0°F, change to the proper viscosity of oil specified on the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14.

#### Dry Type (If Equipped)

DO NOT OIL THE AIR CLEANER ELEMENT.

### Power Take-Off

Some engine power take-offs have a compartment of engine oil for lubrication of the clutch shaft outer bearing. If your power take-off has this compartment, use this lubricant until the normal change period occurs.

### Export

The preceding information applies, except: The air cleaner is drained before shipment, and must be filled before operation. Refer to the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14.

## PRECAUTIONS

The power take-off clutch must be adjusted several times within the first 10 hours of operation. Refer to "Adjustment" on page 36 for the correct adjusting procedure.

Do not pour cold coolant into the radiator if the engine is very hot unless conditions make it absolutely necessary. Under such conditions, start the engine and let it idle while pouring the coolant slowly into the radiator. Be sure the radiator cap is tightened securely for efficient pressure cooling.

Never operate the engine under load before it is thoroughly warmed up.

Never operate the engine at more than the rated governed speed shown on the serial number plate on the flywheel housing. Excessive speeds are harmful.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Do not attempt to adjust the injection pump. The injection pump was set at the factory. If the injection pump does not function properly, consult your authorized International Engine distributor or dealer for repair or replacement.

◆ CAUTION: FOR PERSONAL PROTECTION, OBSERVE THE FOLLOWING SAFETY PRECAUTIONS.

Never operate the engine at more than the regular governed speed shown on the serial number plate. Excessive speeds are harmful and dangerous. Do not rework or modify engine flywheel.

Never operate an engine in and enclosed building without proper ventilation. Refer to "VENTILATION FOR ENGINES INSTALLED INSIDE OF BUILDINGS" on page 4.

Do not use gasoline for cleaning parts, especially when service is performed inside buildings. A less flammable fluid, such as a commercial solvent or kerosine, should be used.

Never attempt to clean or oil the engine while the engine is operating.

## PREPARING THE ENGINE FOR EACH DAY'S WORK

1. Check the coolant level. (One inch above the baffle.)

2. Check the crankcase oil level. Refer to the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14 for complete lubrication requirements.

3. Check the oil level in the air cleaner (wet type) oil cup. If 1/4 inch of dirt has accumulated, refer to "Cleaning the Oil Cup" on page 24.

4. Clean the air intake cap. Refer to "Air Intake Cap" on page 26.

## OPERATING THE ENGINE

### Starting the Engine

Read and observe the "PRECAUTIONS" on page 8.

1. Open the main fuel supply shut-off valve (if equipped).

2. POWER TAKE-OFF (IF EQUIPPED): Place the clutch lever in the disengaged position. (To disengage, pull the clutch lever backwards.)

3. FUEL SHUT-OFF CONTROL BUTTON (IF EQUIPPED): Push the fuel shut-off control button in all the way.

4. THROTTLE CONTROLS (IF EQUIPPED): Depress the button in the center of the engine throttle control knob, and pull the knob all the way out; then push it back in until it is about one quarter of the way out. Release the button.

5. Depress the glow plug switch for a minimum of 30 to 45 seconds to allow glow plugs to pre-heat. For cold weather operation (+32°F or below), glow plugs are to be pre-heated for a minimum of 1-1/2 minutes.

NOTE: If the glow plug meter registers in the "CHECK" zone, one or more glow plugs are defective. For procedure on checking for glow plug failure, refer to "Checking for Defective Glow Plugs" on page 30.

6. INSTRUMENT PANEL (REGULAR GAUGES) (IF EQUIPPED): Turn the ignition and starter switch all the way to the right to the "ST" position.

6. INSTRUMENT PANEL (SAFETY GAUGES) (IF EQUIPPED): Simultaneously push in the ignition relay switch button, while holding the glow plug switch in (refer to step 7 and turning the ignition and starter switch all the way to the right to the "ST" position and hold until the engine has started. Release the ignition and starter switch.

Continue to hold the ignition relay switch button in until the pointer has separated from the contact in the safety engine oil pressure gauge. Release this button.

NOTE: Crank engine for 15 seconds at a time; allow the cranking motor to cool 30 seconds before cranking again. Keep the glow plug switch depressed at all times (cranking and waiting).

7. After the engine starts, keep the glow plug switch depressed for several seconds until certain all cylinders are igniting; then release the switch.

If the engine runs rough or will not start, this may be due to one of the following:

a. The glow plugs, assuming they are functioning correctly, were not pre-heated a sufficient length of time. Repeat the starting procedure, allowing the glow plugs to pre-heat for the proper length of time before cranking.

b. Air may be in the fuel system and the system must be vented. Refer to "Priming and Venting the Fuel System on page 33.

NOTE: Allow the engine to run at 800 to 1200 rpm for 5 to 10 minutes to allow thorough distribution of the lubricating oil. The engine must not be placed under load until normal oil pressure is reached.

8. THROTTLE CONTROLS (IF EQUIPPED): Adjust the throttle control knob to meet the load requirements.

9. POWER TAKE-OFF (IF EQUIPPED): Place the power take-off clutch lever in the "engaged" position (Illust. 7).

10. Check all instruments for the proper readings. Refer to "Instrument Check" on page 10.

(Continued on next page)



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## OPERATING THE ENGINE - Continued

### Instrument Check

Check all gauges (Illust. 4 or 5) immediately after starting, again upon reaching operating temperature and at frequent intervals during operation to assure proper care through prompt detection of irregularities. If any of the gauges do not register properly; stop the engine, and locate and correct the cause immediately. If unable to find the cause consult your authorized International Engine Distributor or Dealer.

If your unit is equipped with a safety engine oil pressure gauge and an engine coolant temperature safety gauge, the engine will stop automatically if the oil pressure drops below the minimum or if the coolant temperature reaches 195°F.

### Engine Coolant Temperature Gauge

The temperature gauge shows the temperature of the coolant circulating through the engine. After the engine has operated a sufficient length of time, the pointer of the gauge must be in the "RUN" (green) range and should remain there during regular operation.

### Ammeter

The ammeter indicates the rate at which the batteries are being charged or discharged. The pointer of the gauge must register charge or in the "RUN" (green) range when the engine is operating faster than low idle speed. If it shows discharge or a high rate of charge continuously while the engine is operating at this speed, investigate the cause immediately. If unable to find the cause, consult your authorized International Engine distributor or dealer.

### Engine Oil Pressure Gauge

This gauge shows the pressure at which the lubricating oil is circulating through the engine. This gauge must register in the "IDLE" range immediately upon starting. When the engine is operated at full load speed, the pointer must be in the "RUN" (green) range. Stop the engine immediately and investigate the cause if little or no pressure is indicated.

### Stopping the Engine

1. POWER TAKE-OFF (IF EQUIPPED): Place the clutch lever in the disengaged position (Illust. 7).

2. Operate the engine at half throttle (no load) for three to five minutes. This will aid in cooling the engine before final shut-down.

> NOTE: Serious damage can result to the engine if the above step is neglected.

3. THROTTLE CONTROL (IF EQUIPPED): Push the throttle control knob all the way in.

4. IGNITION AND STARTER SWITCH (IF EQUIPPED): Turn the switch to the "OFF" position.

5. FUEL SHUT-OFF CONTROL BUTTON (IF EQUIPPED): Pull the button out all the way.

> NOTE: On engines not equipped with a rain cap, be sure the exhaust stack is covered after the engine is stopped to prevent water from entering the engine.



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## SCHEDULED MAINTENANCE

Scheduled maintenance and periodic inspections are very important functions which every owner and/or operator must follow to assure the maximum performance of the engine.

To assure mechanical efficiency, it is necessary that this ur be systematically inspected and maintained at the interv outlined below.

### SCHEDULED

| Point of Inspection | Remarks |
|---|---|
| **After Every 10 Hours of Operation** | |
| *Air intake cap | Remove dirt and chaff. Refer to "Air Intake Cap" o page 26. |
| *Air cleaner oil cup (wet type) | Check oil level. Clean and fill when 1/4 inch of dirt has a cumulated. Refer to "Cleaning the Oil Cup" on page 24. |
| Cooling system | Check level of coolant in the radiator. Refer to "Filling th Cooling System" on page 21. |
| Fuel tank | Fill the tank. |
| Lubrication points | Refer to the "LUBRICATION GUIDE" on pages 15 to 17. |
| **After Every 50 Hours of Operation** | |
| *Air cleaner element (dry type) | Clean. Refer to "Filter Element Service" on page 24. |
| Fan belt | Check tension; replace when necessary. Refer to "Belt" o page 22. |
| Flexible rubber connections between air cleaner, turbocharger and intake manifold | Inspect for loose fit or damage and correct. |
| Flo-matic control linkage | Apply two or three drops of oil to the Flo-matic contro linkage. |
| **Power take-off clutch | Check and adjust if necessary. Refer to "Adjustment" on page 36. |
| Radiator core | Clean spaces. Refer to "Cleaning the Radiator Core" on page 21. |
| Radiator and connections | Inspect for leaks and loose connections. If anti-freeze is used, check its strength. |
| Lubrication points | Refer to the "LUBRICATION GUIDE" on pages 15 to 17. |
| **After Every 100 Hours of Operation** | |
| Automatic dust unloader (dry type) | Empty. Refer to "Automatic Dust Unloader" on page 24. |
| Air cleaner (tray assembly) (wet type) | Remove and clean. Refer to "Cleaning the Tray Assembly" on page 24. |
| ***Battery liquid level | Check fluid level. Refer to "Liquid Level" on page 30. |
| Lubrication points | Refer to the "LUBRICATION GUIDE" on pages 15 to 17. |

* When unusual dust or dirt conditions are encountered during operation, it may be necessary to service these points more frequently.

** This interval specified for clutch adjustment must be used only as a guide or reminder for checking the engagement. Experience will indicate if this adjustment can be checked less frequently.

*** When the ambient temperature is continuously +90°F or higher, the liquid level must be checked every 50 hours.

(Continued on next page)



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## SCHEDULED - Continued

| Point of Inspection | Remarks |
|---|---|
| **After Every 200 Hours of Operation** | |
| Lubrication points | Refer to the "LUBRICATION GUIDE" on pages 15 to 17. |
| **After Every 500 Hours of Operation** | |
| Engine valves | Check clearance. Refer to "Valve Clearance Adjustment" on page 29. |
| Primary and final fuel filters | Replace elements if necessary. Refer to "Fuel Filter Elements" on page 33. |
| Lubrication points | Refer to the "LUBRICATION GUIDE" on pages 15 to 17. |
| **After Every 1000 Hours of Operation** | |
| *Air cleaner (complete) (wet type) | Remove and clean. Refer to "Air Cleaner" on pages 24 to 26. |
| Lubrication points | Refer to the "LUBRICATION GUIDE" on pages 15 to 17. |
| **Periodic** | |
| Battery terminal | Clean terminals with steel wool or brush. |
| Cooling system | Clean. Refer to "Cooling System" on page 18. |
| Oil pump screen | Clean this screen whenever the oil pan is removed. |
| Wiring | Check for worn, cracked or frayed insulation, broken wires, loose or corroded connections. |

* When unusual dust or dirt conditions are encountered during operation, it may be necessary to service these points more frequently.



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## LUBRICATION

For information about the lubrication of a new engine, refer to "LUBRICATION WHEN SHIPPED" on page 8.

The life and performance of an engine depends on the care that it is given and proper lubrication is probably the most important maintenance service for your engine.

Thorough lubrication service performed at the scheduled intervals and according to an established routine will aid greatly in prolonging the life of the engine and in reducing operating expense.

The type of work being done, load and weather conditions are all factors to consider in the frequency of lubrication. The scheduled intervals of lubrication shown on the "LUBRICATION GUIDE" are approximate, being based on average operating conditions.

It may be necessary to lubricate after shorter working periods under severe operating conditions such as extremely dusty conditions, low engine temperatures, intermittent operation, excessively heavy loads with high oil temperatures, or when diesel fuel with a high sulphur content is used. However, the time intervals between lubrication periods must never exceed those indicated in this manual.

## SELECTION OF LUBRICANTS


The selection of the proper type (specification) and grade (weight or viscosity) of lubricant is not guess work. Many tests have been made to determine the correct lubricants for this engine and its equipment. For detailed information regarding lubricants, refer to "LUBRICANT SPECIFICATIONS AND CAPACITIES" on this page.

### Lubricant Viscosities

During cold weather, base the selection of a crankcase lubricating oil viscosity on the lowest anticipated temperature for the day to make starting easier. For hot weather operation, base the selection on the highest anticipated temperature. Refer to "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14.

When the temperature changes, even though the regular interval of lubrication has not been reached, the lubricants must be altered to agree with the temperature.

## PRECAUTIONS

After changing engine oil, operate the engine at low idle, without load, for at least five to ten minutes. This will allow the oil to work into the bearings and onto the cylinder walls.

## LUBRICANT SPECIFICATIONS AND CAPACITIES

It is not the policy of the International Harvester Company to approve lubricants or to guarantee oil performance in service. The responsibility for the quality of the lubricant must remain with the supplier of the lubricant. When in doubt, consult your authorized International Engine distributor or dealer for information given in the latest service bulletin on crankcase lubricating oils or gear lubricants. The specified type and viscosity of lubricants recommended for use with this engine are shown in the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14.

(Continued on next page)



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## LUBRICANT SPECIFICATIONS AND CAPACITIES CHART (U.S. MEASURE)

LUBRICANT KEY: EO - Engine Oil

MPG - Multi-purpose Grease

| Lubrication Point | Capacity | ANTICIPATED AIR TEMPERATURE | | |
|---|---|---|---|---|
| | | Above +120 to 20°F | +70°F to -10°F | +10°F to -30°F |
| Crankcase | 9 qts. (With filter)<br>8 qts. (Less filter) | EO – IH No. 1 Engine Oil or API CD/CC or CD oil or MIL-L-2104C oil or MIL-L-45199B (Series 3) | | |
| | | Grade-30 | Grade-10W | Grade-10W Diluted w/10% kerosine |
| Air Cleaner (wet type) | 4 qts. | EO – IH No. 1 Engine Oil or API CD/CC or CD oil or MIL-L-2104C oil or MIL-L-45199B (Series 3) | | |
| | | Grade-30 | Grade-10 | Grade-10W Diluted w/10% Kerosine |
| Power take-off | Fill as instructed | EO – IH No. 1 Engine Oil or API CD/CC or CD oil or MIL-L-2104C oil or MIL-L-45199B (Series 3) | | |
| | | Grade-30 | Grade-20 | Grade-10 |
| All lubrication fittings | Fill as instructed | MPG – IH 251H EP or an equivalent #2 multi-purpose lithium base grease. | | |



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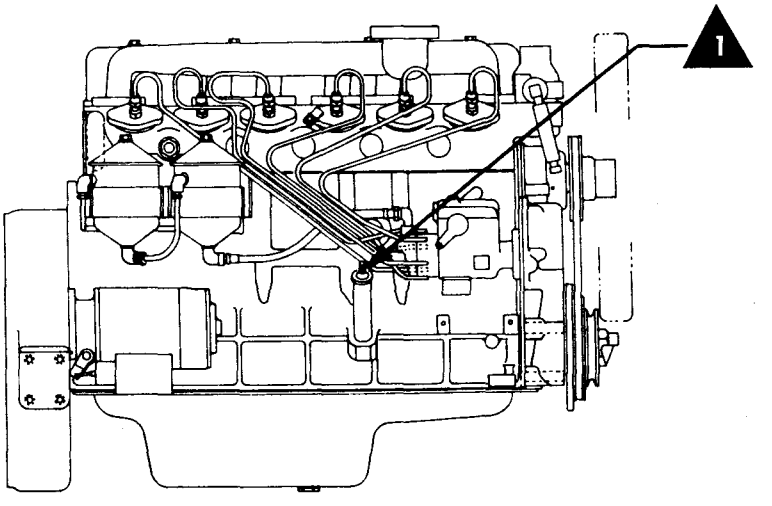
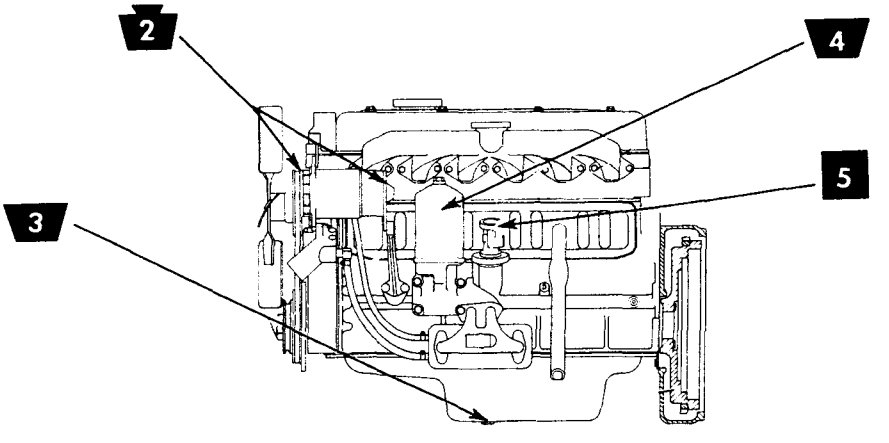
## LUBRICATION GUIDE

Always use clean containers. Keep lubricants clean. Wipe dirt from fittings before fresh lubricant is added. Occasionally apply a few drops of engine of engine oil to the engine speed control linkage and flo-matic control linkage.

Item No. Item No.




LUBRICATION POINTS ON RIGHT SIDE




LUBRICATION POINTS ON LEFT SIDE

The symbols around the reference numbers indicate the intervals of lubrication.

-10 hours -100 hours -200 hours -500 hours

(Continued on next page)



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## LUBRICATION GUIDE - Continued

### Key to Lubrication Guide

The symbols shown around the reference numbers shown in the illustrations on page 15 indicate the intervals of lubrication. Paragraph numbers correspond to reference numbers shown on these illustrations.

▲ — **Daily or After Every 10 Hours of Operation**

1. Engine oil filter and oil level gauge.

Check the oil (with the engine stopped) and add sufficient new oil to bring it to the "FULL" mark on the gauge. Do not check the oil level while the engine is operating or operate the engine if the oil level is below the "ADD" mark on the gauge.

NOTE: The proper method of checking the oil level with the oil level gauge (1) is: Turn the cross piece on the gauge counterclockwise to release it, remove the gauge from the oil filler tube and wipe it clean. Reinsert the gauge all the way without turning it, then remove the gauge and check the oil level. After checking, and adding oil if necessary, reinsert the gauge all the way, and turn the cross piece clockwise to tighten it.

▼ — **After Every 200 Hours of Operation**

3. Oil filter drain plug.

Remove the crankcase and oil filter drain plugs and drain all the oil from the crankcase and oil filter while the engine is warm; then replace the plugs and refill with the new oil to the "FULL" mark on the oil level gauge. Refer to the "Lubricant Specification and Capacities Chart" on page 15.

4. Engine oil filter.

Replace the oil filter. Remove the oil filter drain plug (3) and allow all the oil to drain. Remove the oil filter center tube and case and remove the element. Refer to page 26 for additional instructions.

■ — **After Every 500 Hours of Operation**

5. Tachometer drive.

Remove the grease plug and insert a lubrication fitting. Apply four or five strokes of the lubricator (approx. 1/4 oz.) to the fitting using IH 251H EP grease or equivalent #2 multi-purpose lithium grease (M.P.G.).

### Miscellaneous

2. Alternator

The alternator requires no lubrication since its bearings are factory lubricated for long periods of operation. If the alternator fails to operate properly, consult your authorized International Engine Distributor or Dealer.

Electric Fuel Pump

Apply an equivalent multi-purpose lithium grease (M.P.G.) to the areas at the connecting rod needle bearing and at the push rod sleeve bearing. Refer to "Electric Fuel Pump" on page 34 for additional instructions.



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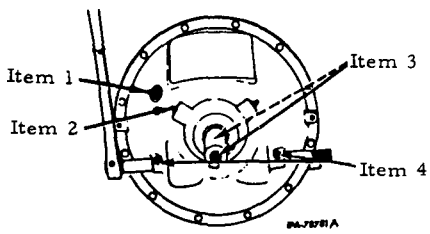
## SCHEDULED MAINTENANCE

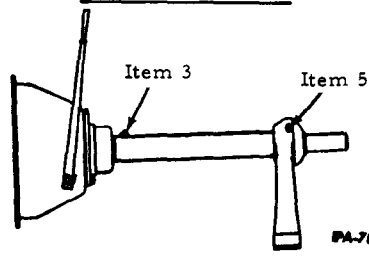
### POWER TAKE-OFF LUBRICATION POINTS

Points of lubrication are individually explained under "LUBRICATION INSTRUCTIONS" below.

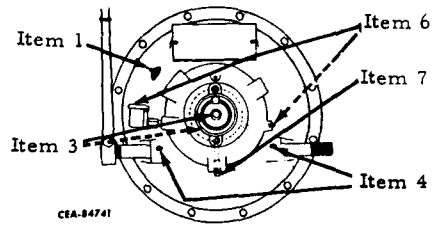
ROCKFORD AND TWIN DISC




EXTENDED SHAFT AND OUTBOARD BEARING




TWIN DISC WITH OIL LUBRICATED OUTER BEARING




### LUBRICATION INSTRUCTIONS

| Item No. | Description | Lubricant | Hours |
|---|---|---|---|
| 1 | Clutch Throwout Bearing * | MPG | |
| | Day-in and day-out full speed operation | | 10 |
| | Less than 10 engagements per day-normal daily usage | | 50 |
| | Over 10 engagements per day-normal daily usage | | 10 |
| | Apply one or two strokes from a hand operated grease gun. | | |
| 2 | Clutch Shaft Outer Bearing * | MPG | |
| | Day-in and day-out full speed operation-in-line and side load drivers | | 50 |
| | In-line drives – normal daily usage | | 100 # |
| | Heavy side load drives – daily usage | | 50 |
| | Apply four or five strokes from a hand operated grease gun (on some clutches, the fitting is located on the opposite side). | | |
| 3 | Clutch Pilot Bearing * | MPG | |
| | Day-in and day-out full speed operation | | 200 ¢ |
| | Less then 10 engagements per day-normal daily usage | | 100 # |
| | Over 10 engagements per day-normal daily usage | | 50 |
| | Apply one or two strokes from a hand operated grease gun. Refer to NOTES 1 and 2. | | |
| 4 | Clutch Lever Shaft Greased Type | | |
| | Apply two or three strokes of the lubricator oiled type | MPG | 100 |
| | Apply five or six drops of oil in each cup | EO | 100 |
| 5 | Outboard Bearing, Extended Shaft | | |
| | Apply four strokes from a hand operated grease gun | MPG | 50 |
| 6 | Clutch Shaft Outer Bearing Filler and Level Plugs | EO | 100 |
| | Remove either filler plug (indicated by solid arrows) and the level plug (indicated by dotted arrows) and fill until oil runs out of level hole. Reinstall the plugs. | | |
| 7 | Clutch Shaft Outer Bearing Drain Plug | EO | 500 |
| | Remove drain plug while lubricant is still warm. After allowing time for complete draining reinstall plug and refill at filler. | | |

* – If excessive amount of grease accumulates inside the clutch housing and/or engine flywheel housing resulting from over greasing or too frequent greasing of clutch outer bearing, throwout bearing and pilot bearing, reduce the amount of grease utilized or extend the period of lubrication interval.

\# – Certain light duty application may permit greasing intervals up to 200 hours.

¢ – Certain light duty application may permit greasing intervals up to 500 hours.

NOTE 1–If the P.T.O. output shaft does not have end or cross (side) drilled grease fitting hole provision, P.T.O. attachment is, or may be equipped with sealed-for-life type pilot bearing. For applications where pilot bearing is subjected to severe rotational service check pilot bearing status.

NOTE 2–On applications where the end of the output shaft is covered with a universal joint or flexible coupling, transfer the lubrication fitting from the end of the shaft to the cross drilled location (indicated by dotted arrow). Use the pipe plug removed from the cross drilled hole to close to the opening in the end of the output shaft. This fitting is the only means of lubricating the clutch pilot bearing.



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## PREPARING FOR COLD WEATHER

In order to operate the engine in temperatures of +32 degrees F or lower, observe the following instructions.

### Lubrication

Lubricate the engine completely with lubricants specified for operation below +32 degrees F as outlined on the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14.

### Fuel System

Fill the fuel tank at the end of each day's work to prevent condensation of moisture in the tank.

Refer to "Diesel Fuel Specifications" on page 5 for diesel fuels which will give the most satisfactory performance for your International engine.

### Cooling System

When the air temperature is consistently at the freezing point (+32 degrees F) and lower, install anti-freeze in the cooling system.

Before installing anti-freeze in the system, make the following checks:

1. Check the system for leaks.

2. Inspect all hoses and tighten all hose clamps. Install new hoses if necessary.

3. Drain and flush the system. Refer to "Draining the Cooling System" and "Cleaning the Cooling System" on page 21.

4. Check the operating condition of the thermostat. Refer to "Thermostat" on page 21.

5. Check the condition and the tension of the fan belt. Refer to "BELT" on page 22.

6. Close all drain valves and tighten all connections securely.

7. Install the required amount of anti-freeze (refer to "Anti-freeze Solutions" on page 19) into the radiator and fill the system with coolant as outlined under "Filling the Cooling System" on page 21.

8. Start the engine. After normal operating temperature has been reached, check the system to be sure there are no leaks.

### Batteries

When the air temperature drops to +32 degrees F and lower, the efficiency of a battery decreases rapidly. At temperatures of 20 degrees F or lower, it may be necessary to raise battery temperature by applying heat from a suitable source.

It is especially important to keep the battery at full charge for cold weather operation. Check the specific gravity of the battery electrolyte at frequent intervals, and keep the battery as fully charged as possible. Add distilled water to the battery in freezing temperatures only when the engine is to operate for several hours, to thoroughly mix the water and the electrolyte, or damage to the battery will result from the water freezing.

◆ CAUTION: BATTERIES GIVE OFF HIGHLY INFLAMMABLE GAS. NEVER ALLOW SPARKS OR OPEN FLAMES NEAR THE BATTERY. AVOID SPILLING ANY ELECTROLYTE ON HANDS OR CLOTHING.

## PREPARING FOR HOT WEATHER

### Lubrication

Lubricate the engine completely with lubricants specified for operation above +32 degrees F as outlined on the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14.

### Fuel System

Fill the fuel tank at the end of each day's work to prevent condensation of moisture in the tank.

Refer to "Diesel Fuel Specifications" on page 5 for diesel fuels which will give the most satisfactory performance for your International engine.

### Battery

Inspect the battery frequently to be sure the electrolyte is at the correct level. (Refer to "Battery Liquid Level" on page 30).

### Cooling System

To prevent overheating, these steps must be followed:

1. Clean and flush the internal parts of the cooling system. Refer to "Cleaning the Cooling System" on page 21.

2. Clean insects and dirt from the external part of the radiator. Refer to "Cleaning the Radiator Core" on page 21.

3. Check the operating condition of the thermostat. Refer to "Thermostat" on page 21.

4. Check the coolant level frequently, and be sure the filler cap is on tight.

5. Check the condition and the tension of the fan belt. (Refer to "BELT" on page 22).



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## COOLING SYSTEM

The pressure-cooled system will not operate properly unless the cooling system is tight. The radiator cap must be properly tightened to the stop. The gasket surface of cap must be in good condition. The radiator cap regulating valve and the thermostat must operate properly. The system must not have loose connections or leaks. Unless these instructions are followed, pressure will not be maintained and loss of coolant and consequent overheating will result.

### Care of the Cooling System

To keep the cooling system free of rust and sludge during warm weather, add a cooling system conditioner; or to keep it from freezing during cold weather, add anti-freeze in accordance with the following information.

### Anti-freeze Solutions

1. IH Anti-freeze permanent type (ethylene glycol) is recommended. This product, specifically formulated for IH equipment, contains all necessary and proper inhibitors and has been thoroughly evaluated for optimum effectiveness. DO NOT use methanol or alcohol as an anti-freeze.

2. IH Anti-freeze is now compatible with both chromate and non-chromate corrosion resistors.

3. Do not use anti-freeze year-round where ambient temperatures exceed 100°F except on units equipped with an automotive type, combination air conditioner-heater coil in the cab. Seasonal changes are recommended to replace inhibitors which may become exhausted and to flush out the system. When inhibitors become depleted, the anti-freeze becomes a corroding agent which attacks and coats the metallic surfaces of the cooling system, thus reducing heat transfer.

The boiling point of ethylene glycol solutions is higher than plain water, but their ability to transfer heat is less. In hot weather, this difference will result in coolant temperatures running hotter than with water and where oil-to-water coolers are used, the transmission oil temperatures will run hotter.

4. Do not use anti-freeze with sealer or anti-leak additives. These additives may cause plugging problems throughout various areas of the cooling system and will restrict coolant flow.

5. A minimum volume of 30% anti-freeze is required to provide suitable corrosion protection. A concentration greater than 68% will adversely affect freeze protection and heat transfer rates.

The following table shows the percentage of anti-freeze solution required for the various temperatures.

NOTE: Do not mix brands of anti-freeze solutions. Mixed solutions make it impossible to determine if the cooling system has adequate protection against freezing. When testing the solution, be sure the system is at normal operating temperature. This is necessary to obtain an accurate reading.

| Freezing Point (Fahrenheit) | USE IN COOLING SYSTEM<br>IH Premium (Ethylene Glycol-Permanent Type) |
|---|---|
| +20° | 16% |
| +10° | 25% |
| 0° | 33-1/3% |
| -10° | 40% |
| -20° | 45% |
| -30° | 50% |
| -40° | 54% |
| -50° | 58% |
| -60° | 62% |
| -70° | 65% |

Check the solution frequently and at normal operating temperature, to be sure the cooling system has sufficient protection against freezing.

### Cooling Conditioners

All cooling system inhibitors become depleted through normal operation and additional cooling conditioner must be added to the coolant every 500-1000 hours of engine operation at the rate of one pint for each eight gallons of cooling capacity to maintain original strength levels.

The use of new IH Cooling System Conditioner is recommended. This product is a complete inhibitor system, of a non-chromate type, which provides corrosion protection, pH control for maintaining an acid-free coolant, and water softening to prevent the formation of mineral deposits. It is suitable for use in all systems being compatible with both water and ethylene glycol anti-freeze solutions.

Do not use soluble oil as a corrosion inhibitor. It requires careful control of concentration level to prevent adverse effects on heat transfer.

Do not use additives or solutions that claim to improve heat transfer and prevent engine overheating. Tests indicate that none perform as claimed; in fact, some may do severe damage. There are no miracle additives that will increase heat transfer; conditioned water is still the best coolant.

### Water

1. Use clean water inhibited with IH Cooling System Conditioner to minimize corrosion and scale deposits. Never use water alone.

2. Clean water should comply with the following requirements before addition of conditioner;

a. Total hardness - Not to exceed 170 parts per million (10 grains/gal. max.) to prevent scale deposits; if greater, the water should be softened.

(Continued on next page)



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Water — Continued

b. Chlorides - Not to exceed 40 parts per million (2.5 grains/gal. max.) and sulfates not to exceed 100 parts per million (5.8 grains/gal. max.) to prevent corrosion. If greater, the water should be distilled, deionized or demineralized.

c. Dissolved solids - Not to exceed 340 parts per million (20 grains/gal. max.) to minimize sludge deposits, scale deposits, corrosion, or a combination of these; if greater, treat as noted above.

### Preventive Maintenance

The best way to avoid overheating problems is through preventive maintenance; keeping the components in top operating condition. This includes keeping the inside as well as the outside of the engine and radiator clean and:

1. Thoroughly flush the system with water before installing anti-freeze or cooling conditioner. If the system has been permitted to become rusty or dirty, use IH Cooling System Cleaner and Neutralizer carefully following cleaning recommendations on container.

2. For rust prevention during winter, a fresh filling of IH permanent type anti-freeze is recommended. In the spring, drain and discard the old anti-freeze solution, as the rust inhibitor may be exhausted from contamination and continued use.

3. During warm weather, it is necessary that IH Conditioner be added to the coolant (water) to protect the cooling system after draining the anti-freeze. This inhibitor solution should be drained and discarded in the fall before installing anti-freeze.

4. Draining the Cooling System in Freezing Temperature.

The cooling system of all engines, when drained, will retain some coolant in pockets. This is especially true in engines equipped with oil coolers or heat exchangers having a tube bundle. If only water is used, and these engines are drained and then exposed to freezing temperatures, the water retained in the cooler tubes will freeze, possibly rupturing one or more of the tubes. The resulting leak will be difficult to locate and could eventually damage the engine by mixing water in the crankcase oil.

Important

To avoid possible damage in engines equipped with oil coolers or heat exchangers, take one of the following precautions when draining for shipment or storage in freezing temperatures:

a. Fill the cooling system with anti-freeze solution, operate until the thermostat opens or until circulation is observed in the radiator or heat exchanger circuit, then drain.

b. If only water is used, drain the engine then blow out the residual water in the cooler tubes with compressed air through one of the drain cocks or plugs, preferably the one on the cooler. Do not rely upon only draining the water.

### Radiator Cap

A regulating pressure valve, built into the radiator cap, is designed to open at a pressure of approximately 6-1/4 pounds per square inch.

Removal

◆ CAUTION: THE PRESSURE TYPE CAP IS PROVIDED WITH A SAFETY STOP TO ALLOW THE PRESSURE OR ANY STEAM TO ESCAPE WHILE THE CAP IS BEING REMOVED, SHOULD THE ENGINE RUN VERY HOT.

Turn the cap to the left (counterclockwise) to the safety stop until pressure is released; then press down on the cap and continue to turn until the cap is free to be removed.

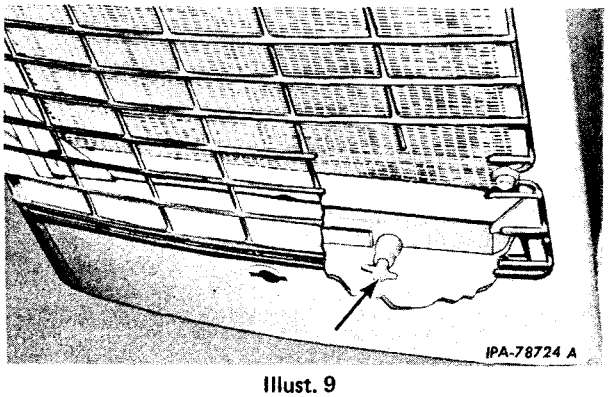
NOTE: Do not attempt to repair or replace any of the regulating valve parts. If the valve is faulty, replace it with a new radiator cap of the same type.

### Draining the Cooling System

Drain the cooling system immediately after stopping the engine while most of the sediment is in suspension.

1. Remove the radiator cap.

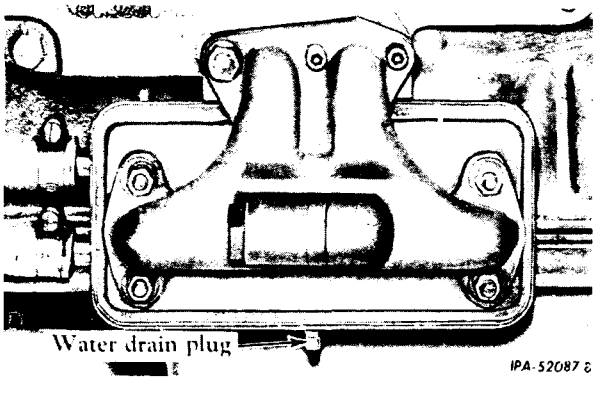
2. Open the radiator drain valve (Illust. 9), the crankcase drain valve and the oil cooler drain plug (Illust. 10).




**Illust. 9**
**Radiator Drain Valve.**

3. Allow the system to drain completely. Be sure that the drain valves do not plug up during the draining.

4. Close all of the drain outlets.




**Illust. 10**
**Engine Oil Cooler.**

### Cleaning the Cooling System

Drain and thoroughly flush the cooling system once a year or more often if necessary. The appearance of rust in the radiator or coolant is an indication that the inhibitor has become weakened and it is possible that some sludge has accumulated in the system. When this condition exists, proceed as follows:

1. Run the engine until it reaches normal operating temperature; then stop the engine and drain the cooling system refer to "Draining the Cooling System" on page 20.

2. Fill the cooling system with clean coolant refer to "Filling the Cooling System" on this page.

3. Add a flushing compound, that is compatible with aluminum, to the cooling system in accordance with the instructions furnished with the compound.

4. Start the engine and flush the system as directed by the instructions furnished with the compound.

5. After the system has been flushed and thoroughly cleaned of the compound, refill with clean coolant (refer to "Filling the Cooling System" on this page).

### Cleaning the Radiator Core

Blow out insects and dirt from the radiator core air passages, using air or water under pressure. Engine overheating is often caused by bent or clogged radiator fins. When straightening bent fins, be careful not to injure the tubes or to break the bond between the fins and tubes.

### Filling the Cooling System

1. Close the drain valves.

2. Remove the radiator cap. Pour coolant into the radiator slowly until partly full.

3. Add IH cooling system conditioner for warm weather operation or IH anti-freeze when the air temperature is consistently at the freezing point (+32°F) and lower, according to instructions printed on each container.

NOTE: Use only a corrosion inhibitor that is compatible with aluminum. Do not use inhibitors labeled as "acid neutralizers." Use only a permanent type anti-freeze in this engine.

4. Continue to fill the radiator until the coolant reaches a level approximately one inch below the filler neck. Wait a few minutes to allow any air to escape, then add coolant if needed.

5. Install the radiator cap. Start and run the engine until the operating temperature is reached. Stop the engine, remove the radiator cap and recheck the level. Add coolant, if needed, to fill to the required one inch level below the filler neck. Install the radiator cap.

### Adding Coolant to an Overheated Cooling System

◆ CAUTION: USE CAUTION WHEN REMOVING THE RADIATOR CAP TO ADD COOLANT. BE SURE ALL PRESSURE IS RELEASED BEFORE REMOVING THE CAP.

Do not pour cold coolant into the radiator if the engine is very hot unless conditions make it absolutely necessary. In this case, start the engine and let it idle; then slowly pour the coolant into the radiator.

### Thermostat

The thermostat has two functions; gain rapid engine warm-up; control coolant temperature. The thermostat is the non-adjustable type, designed to maintain a coolant operating temperature of +170°F to +190°F.

#### Removing and Checking the Thermostat (Illust. 11)

Engine overheating is sometimes due to a faulty thermostat. Remove and check the thermostat as follows:

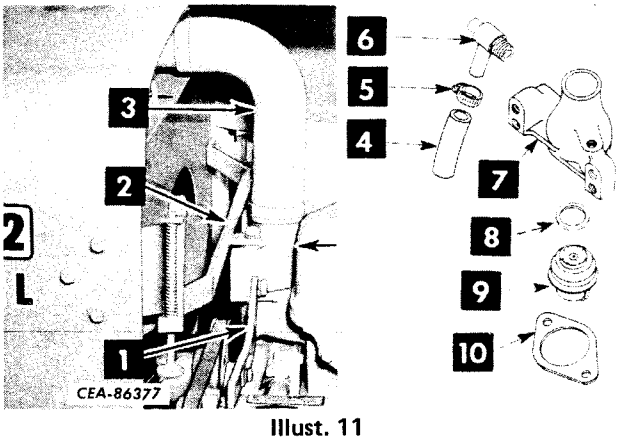
1. Drain the cooling system to a level below the thermostat housing. Refer to "Draining the Cooling System" on page 20.

2. Disconnect the hose (3) and hose (4).

3. Remove the cap screws securing the braces (1 and 2).

4. Remove the cap screws securing the housing (7) to the cylinder head; remove the housing (7), gasket (10), and thermostat (9).

NOTE: Check the condition of the seal (8) pressed in the housing (7). If seal is worn or damaged, remove and replace with new.




**Illust. 11**
**Thermostat and Thermostat Housing.**

1. BRACE, alternator.
2. BRACE, radiator.
3. HOSE, radiator inlet.
4. HOSE, water pump by-pass.
5. CLAMP, hose.
6. VALVE, by-pass.
7. HOUSING, thermostat.
8. SEAL, thermostat.
9. THERMOSTAT.
10. GASKET, housing.

(Continued on next page)



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**Removing and Checking the Thermostat (Illust.11) - Continued**

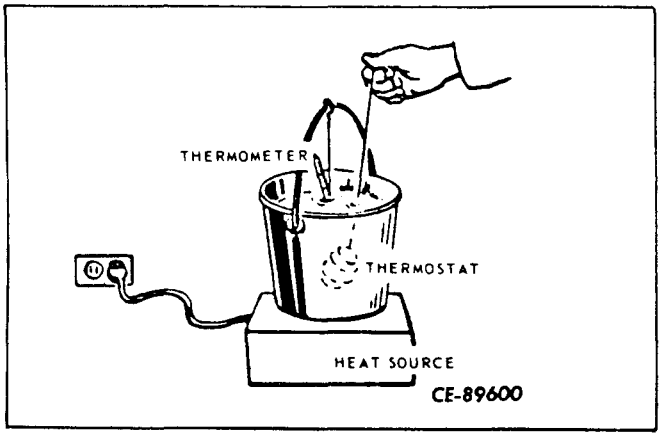
5. Clean the thermostat housing, removing all scale and rust.

6. Clean the thermostat. Replace the thermostat if coated with scale as this will not allow proper operation.

7. Check the thermostat as follows:

a. Suspend the thermostat and a thermometer in a container of water.

NOTE: Do not allow either one to contact the container sides or bottom.




**Illust. 12**
**Checking the Thermostat.**

b. Heat water and carefully note temperature when thermostat starts to open (approx. +170°F) and when fully open (approx. +190°F).

c. If thermostat does not function as described, replace it.

**Installing the Thermostat**

1. Clean the gasket surface of the cylinder head to assure proper sealing when reassembled.

2. Install the new gasket (10) on the cylinder head.

3. Place the large end of the thermostat (9) into the housing (7).

NOTE: Do not damage the ring in the seal (8) when installing the thermostat.

4. Install and secure the housing (7) onto the cylinder head.

5. Secure the braces (1 and 2).

6. Connect the hoses (3 and 4).

7. Fill the cooling system, refer to "Filling the Cooling System" on page 21.

**BELT**

A new belt loses its tension as it seats into the pulleys. Check and adjust a new belt at 1, 10 and 50 hours to stabilize its tension. After the tension has been stabilized, it may be checked at intervals of 200 hours. The belt tension must be watched during the break-in period.

**Tension (Illust. 13)**

The tension applied to a new belt (initial installation only) is different than the retension applied to a used belt.

The tension is correct when the belt can be depressed by the thumb (approx. 25 lb. load), at point "A" (Illust. 13), to the deflection values shown in the chart below.

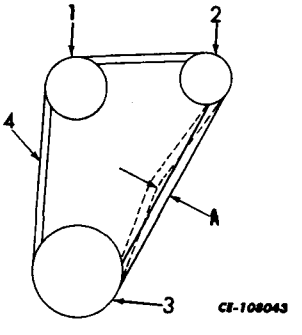
**BELT TENSION CHART**

| Condition | Fan and Alternator Belt Point A |
|---|---|
| New Belt Installation | 11/16 |
| Used Belt (One that has been run 5 minutes or longer) | 3/4 |

NOTE: Do not allow belt deflection to exceed 7/8 inch at "A". Check the belt tensions more often if necessary.

NOTE: When operating in abrasive environment, check the belt tension before reaching 200 hours, preferably at 100 hours intervals.

The fan and alternator belt tension should be checked midway between the pulleys.




**Illust. 13**
**Belt Tension.**

1. PULLEY, fan and water pump.
2. PULLEY, alternator.
3. PULLEY, crankshaft.
4. BELT, fan and water pump.



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**Adjustment (Illust. 14)**

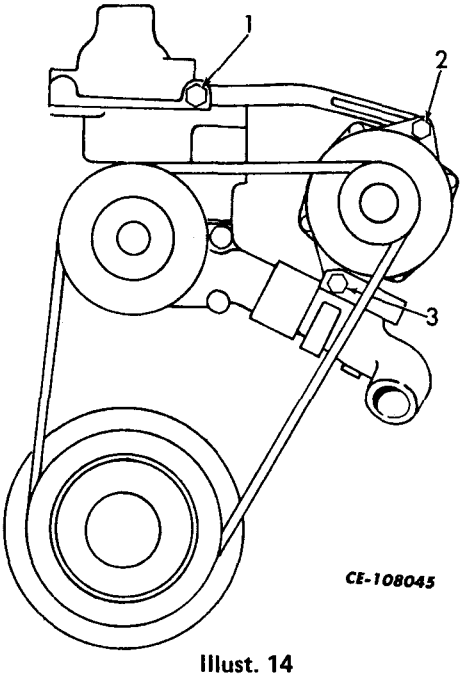
Adjust the belt as follows:

1. Loosen alternator brace bolts (1 and 2) and mounting bolt (3).

2. Move the alternator out to tighten the belt, or in to loosen the belt to get the correct tension.

NOTE: Excess belt tension will damage the alternator bearings. If a pry bar is used, DO NOT OVER TENSION.

3. Tighten alternator brace bolts (1 and 2) and mounting bolt (3).




**Illust. 14**
**Adjusting the Belt.**

**Removal and Replacement (Illust. 14)**

Replace badly worn or severely cracked belt immediately.

Prior to installing the new belt, inspect all pulley grooves for wear and the presence of grease, oil, dirt, etc. If foreign material is present, it should be removed. If a pulley is damaged or grooves worn, it should be replaced. When replacing belt and pulleys, pulley alignment must be checked. A misalignment that can be detected by the naked eye is detrimental.

During assembly, do not force the belt into the pulley grooves by prying with a screw driver, pry bar, etc. This will damage the belt side cords which will cause the belt to turn over in the pulley grooves and will end in complete destruction of the belt in operation.

If the belt is disturbed for any reason, it must be adjusted to the correct belt tension.

**Removing the Fan Belt (Illust. 14)**

1. Loosen brace bolts (1 and 2) and mounting bolt (3).

2. Move the alternator in toward the engine.

3. Slip the old belt over the fan blades and remove it.

**Installing the Fan Belt**

1. Work the new belt over the fan blades and over top of the fan pulley.

2. Slide the belt over the crankshaft pulley.

3. Push in on the alternator, if necessary, and slide the belt over the alternator pulley.

4. Adjust the belt tension. Refer to "Adjustment" on this page.

## AIR CLEANER (WET TYPE)

**Precautions**

Inspect the flexible rubber hose connections between the engine and the air cleaner. If they show any sign of deterioration, replace them.

To eliminate strain on the rubber hose connections, be sure that the pipes line up.

All the joints between the air cleaner and the engine must be tight.

**Cleaning the Oil Cup (Illust. 15)**

1. Clean or wipe the outer surface of the oil cup and body.

2. Loosen the screw on the retaining clamp and remove the oil cup from the air cleaner body.

3. Pour out the old oil and thoroughly clean the oil cup with kerosine.

4. Fill the cup to the oil level bead with the proper grade of oil. Refer to the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 14.

5. Lift the oil cup into place on the air cleaner body and secure in place with the clamp (4).

**Cleaning the Tray Assembly (Illust. 15)**

1. Remove and clean the oil cup as previously described under "Cleaning the Oil Cup" on this page.

2. Loosen the wing nuts which secure the tray assembly to the air cleaner body. Turn the tray to the left or right to release the tray locks, and remove the tray from the air cleaner body.

(Continued on next page)



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### Cleaning the Tray Assembly (Illust. 15) - Continued

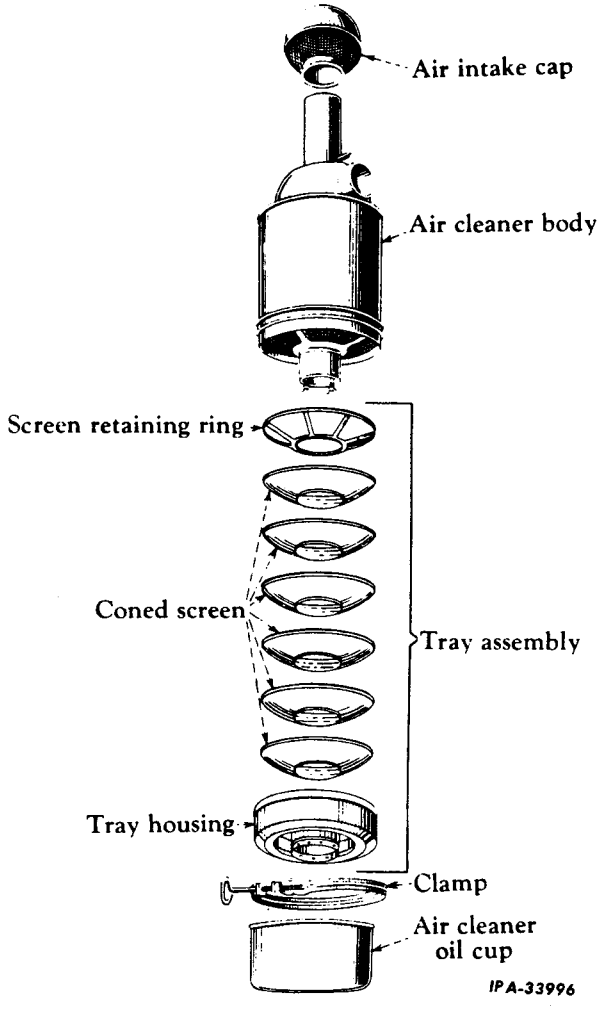
3. Remove the four wing bolts and screen retaining ring. Remove the six screens from the tray housing.

4. Clean the housing, six screens and retainer ring with kerosine or diesel fuel.

5. Install the six screens in the housing. Insert the ring and four wing bolts.

6. Install the tray assembly on the air cleaner body by turning the tray slightly and tighten the air cleaner body wing nuts.

7. Install the oil cup.




**Illust. 15**
**Air Cleaner Components (Wet Type).**

### Air Cleaner Complete

1. Remove the air cleaner from the unit and disassemble it (Illust. 15). Refer to the procedures outlined under "Cleaning the Oil Cup" on this page and "Cleaning the Tray Assembly" on this page. Be sure to clean out the air intake pipe and the inside of the air cleaner body.

2. Clean the air intake cap screen. Refer to "AIR INTAKE CAP" on page 26.

3. After the parts have been cleaned thoroughly, install the air cleaner body on the engine. Be sure that all the joints are air-tight; then replace the tray assembly and air intake cap. Fill the oil cup to the proper level with the specified grade of oil (refer to the "LUBRICANT SPECIFICATIONS CAPACITIES CHART" on page 14) and install it on the air cleaner body. Be sure it is held securely in place by the clamp.

## AIR CLEANER (DRY TYPE)

The air cleaner is the "dry-type" with replaceable filter element and automatic dust unloader features. The element may be cleaned several times before requiring replacement (additional information can be found in the following text).

### Precautions

As an added precaution against dirt getting into the engine, frequently inspect the flexible pipe connection between the manifold and the air cleaner. If it shows any sign of leakage, correct it.

Never operate the engine unless the filter element is in place in the air cleaner body and/or the dust unloader is in place.

Never remove the element from the air cleaner body while the engine is running.

### Automatic Dust Unloader

The dust unloader (5, Illust. 16) automatically allows the accumulated dirt in the air cleaner body to drop out when the weight of the dirt overcomes the vacuum that keeps the unloader lips closed. At the interval specified under "SCHEDULED MAINTENANCE" on page 11, stop the engine and squeeze the dust unloader lips to be sure they are not blocked.

### Filter Element Service

The element can be cleaned by either of two methods; washing or compressed air.



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Washing is the preferred method as it removes more dust and soot and restores the element to an almost new condition. The result being better performance and longer intervals between required element service. It is suggested that a spare element be available for use while the serviced element is drying. This will reduce unit down-time to only a few minutes and will allow sufficient time to service the restricted element properly. (Refer to "Washing" on this page.)

NOTE: A filter element must be replaced after 6 washings.

Cleaning the element with compressed air is not considered an entirely satisfactory method. Some dust will remain in the element causing more frequent servicing of the element. This method should be used only as a temporary measure until sufficient time is available to clean the element by "washing." (Refer to "Compressed Air" on page 26.)

NOTE: After cleaning, if an element is to be stored for later use, place it in a plastic bag and store in an element shipping container to protect against dirt and damage.

**Removal (Illust. 16)**

1. Stop the engine. Wipe off any accumulation of dust from the element removal end of the air cleaner body. Be careful not to dislodge dust from the dirty element into the clean air side or outlet of the air cleaner. (Any dust accidentally dislodged into the outlet clean air side must be cleaned up before installing an element.)

2. Loosen the element thumb screw and remove the element retainer (1). Remove the element (2).

3. Inspect the "clean air side" of the element and air cleaner body for unusual accumulation of dust. Dust accumulation on the "clean air side" of the element usually means a rupture in the paper and the element must be discarded.

**Washing**

NOTE: Never wash elements in fuel oil, gas or solvent. DO NOT OIL ELEMENTS. Do not attempt to take elements apart.

1. Before washing, tap the side or end of the element against the palm of your hand to remove loose dust.

NOTE: Do not tap element against a hard surface; this will damage the element.

2. Wash the element in clean, warm water (+70°F to +100°F). A small amount of nonsudsing detergent added to the water will facilitate removal of soot.

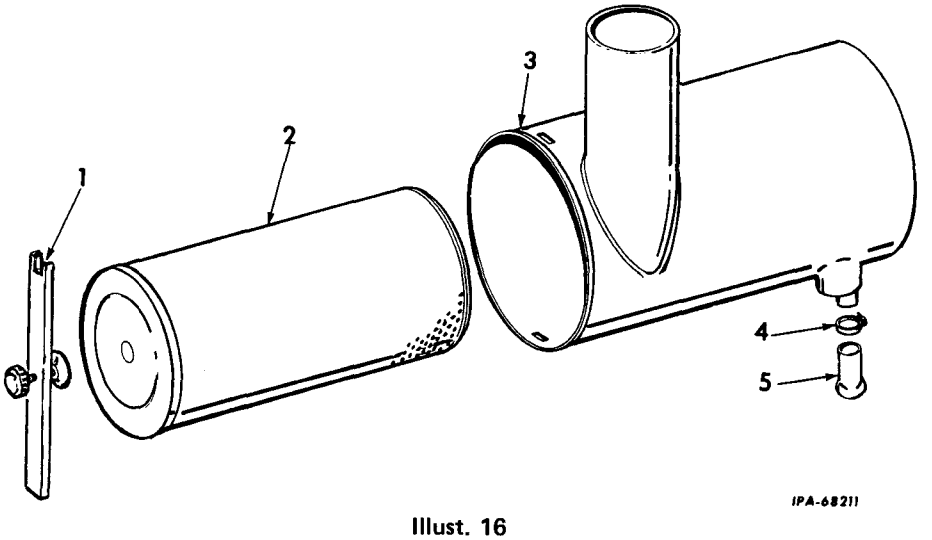
3. Rinse the element in clear water (if a hose is used, do not exceed 40 psi). Shake the element carefully to remove excess water.

NOTE: Do not use compressed air to speed the drying of the element; the air pressure will rupture the wet element.

4. Lay the element on its side and allow to air dry before reinstalling. Overnight drying is usually sufficient. When drying the element protect it from dirt and/or freezing.

NOTE: If no spare element is available, the wet element, after excess water has been shaken out, may be installed in the air cleaner and the engine operated at low idle for 10 minutes before operating.

5. Inspect for damage. Refer to "Inspection" on page 26.




**Illust. 16**
**Air Cleaner Components (Dry Type).**

1. RETAINER, element.
2. ELEMENT, filter.
3. BODY, air cleaner.
4. CLAMP.
5. UNLOADER, dust.



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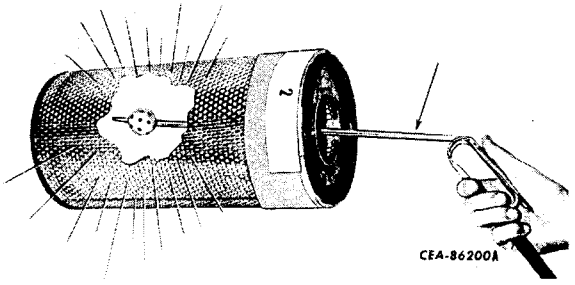
### Compressed Air

An element cleaning tool (IH Part No. 407 073 R1, Illust. 17) for use with compressed air, is available from your authorized International Engine distributor or dealer. This tool will do a faster and more efficient job of removing dust than a regular air gun nozzle.




**Illust. 17**
**Using Element Cleaning Tools.**

1. Carefully tap side or end of the element against the palm of your hand to remove loose dust.

NOTE: Do not tap the element against a hard surface; this will damage the element.

2. Direct clean, dry compressed air up and down the pleats on the "CLEAN SIDE" of the element. Always direct the compressed air opposite the normal operating air flow through the element.

NOTE: Air pressure at the nozzle must not exceed 100 psi. Keep a reasonable distance between the air nozzle and the element.

3. Inspect the element for damage. Refer to "Inspection" as outlined in the following text.

### Inspection

1. Inspect the filter element for leaks or damage by placing a bright light inside the element. Inspection of the element on the outside will disclose any holes where concentrated light shines through. The slightest rupture requires replacement of the filter element.

2. Inspect all gaskets and gasket contact surfaces of the element and the air cleaner body. If faulty or damaged gaskets or surfaces are noted, correct these conditions immediately.

3. Remove any dirt found inside the air cleaner body with a damp cloth before reinstalling the element. A small amount of nonsudsing detergent added to the water will facilitate removal of soot.

4. Squeeze or remove and clean the dust unloader to be sure it is open and contains no obstructions.

### Installation (Illust. 16)

1. Install the element (2) (open end first) into the air cleaner body (3). Install the element retainer (1) and tighten the thumb screw in the retainer so that the element is air-tight.

NOTE: Under no circumstances, should the engine be operated without the element in the air cleaner and the dust unloader in place.

2. Clean the air intake cap screen. Refer to "AIR INTAKE CAP" on page 26.

3. Inspect and tighten all air cleaner and air induction system connections before resuming operation.

## AIR INTAKE CAP (1, Illust. 15)

Keep the air intake cap screen clean and free of all restrictions. A twist and an upward pull will remove cap. Use compressed air to clean the screen. If compressed air is not available, wash in clean hot water or preferably water containing a small amount of non-sudsing detergent.

## LUBRICATING OIL FILTER

### Changing the Filter Element (Illust. 18)

1. Drain the oil immediately after stopping the engine, when complete circulation has been established and while most of the sediment is in suspension.

2. Remove both the crankcase oil pan drain plug and filter base drain plug (10). Allow the system to drain completely. Install the crankcase oil pan drain plug.

3. Clean the outside of the filter case (3) to prevent dirt from dropping into the base (9).

4. Unscrew the center tube (1).

5. Lift up and remove the center tube (1) and case (3).

6. Remove the old element (7).

7. Wipe out the base (9) and case (3) with a cloth dampened with kerosine.

8. Install the new element (7) as follows:

   a. Install the drain plug (10) in the filter base (9).

   b. Install the new filter element (7).

   c. Inspect the center tube (1) and make sure it is clean. Remove any dirt in the threaded center of the base.



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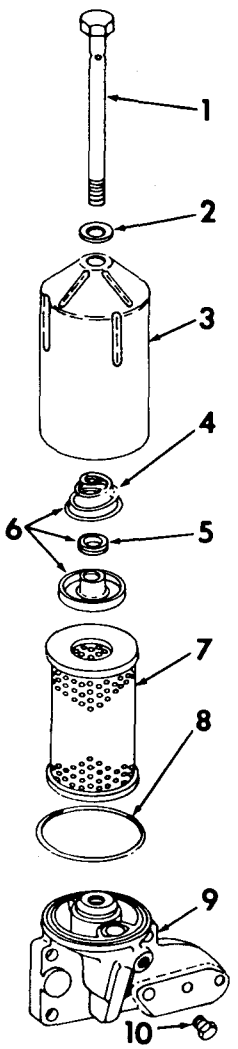


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**Illust. 18**
**Exploded View of Oil Filter.**

1. TUBE, center.
2. GASKET, center tube.
3. CASE, oil filter.
4. SPRING, element hold-down.
5. GROMMET.
6. RETAINER ASSEMBLY, element.
7. ELEMENT.
8. GASKET, oil filter case.
9. BASE, oil filter.
10. PLUG, drain.

d. Check that the case gasket (8) and center tube gasket (2) are in good condition. Replace with new ones if necessary. Refer to "Installing New Center Tube Gasket" on page 27.

9. Fill the crankcase oil pan with new oil as instructed under the "LUBRICATION GUIDE" on page 16.

**Installing New Center Tube Gasket (Illust. 18)**

1. Reach up inside the filter case (3) and remove the element retainer assembly (6) from the center tube (1).

2. Remove the center tube (1) from the case (3) and replace the gasket (2) with a new one.

3. Install the center tube (1) into the case (3).

4. Slide the element retainer assembly (6) onto the center tube (1) and push it up into the case (3).

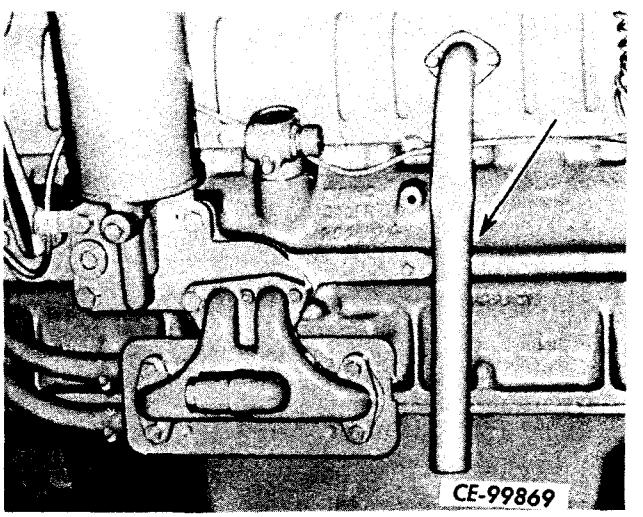
NOTE: The rubber grommet (5) in the element retainer assembly (6) serves as an oil seal. The grommet must be in place in the retainer assembly and in good condition. Replace it with a new one if necessary.

5. Install the new element (7), center tube (1) and case (3) onto the base (9). Carefully screw the center tube into the base and tighten securely (refer to "Torques" on page 5).

**Crankcase Breather (Illust. 19)**

The crankcase breather elements are located in the push rod chamber cover on the left hand side of the crankcase. Normally, the elements need to be cleaned only at the time of a major engine overhaul. However, it may become necessary to clean the elements more frequently when the unit is operating under severe conditions such as excessively heavy loads or dust.

To clean the elements, remove the push rod chamber cover from the engine. Wash the cover and elements in kerosine or diesel fuel oil, then dry thoroughly. Check the breather pipe to be sure that it is not plugged or restricted. Re-install the push rod chamber cover and the breather pipe using a new breather pipe gasket.




**Illust. 19**
**Crankcase Breather.**



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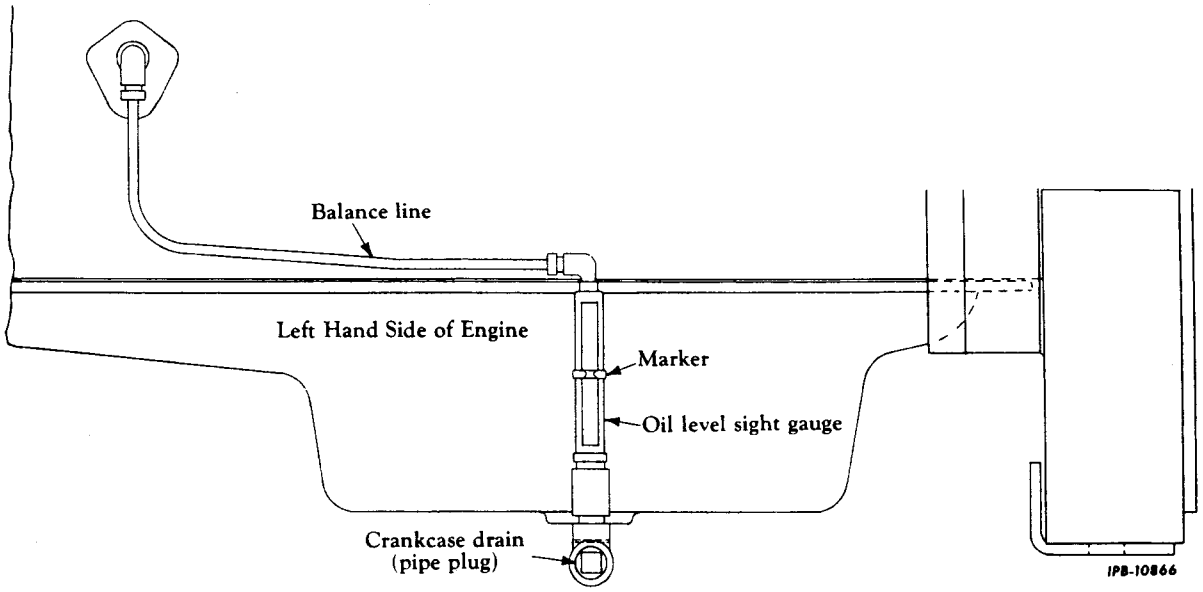


**Illust. 20**
**Oil Level Sight Gauge.**

### OIL LEVEL SIGHT GUAGE (Illust. 20)

To set the oil level sight gauge after changing the crankcase oil, proceed as follows:

1. Operate the engine until it is thoroughly warmed up.

2. Pull the governor control knob out until the normal operating engine rpm is reached.

3. Slide the marker on the level sight gauge up or down so that it is even with the level of the oil in the gauge.

NOTE: To insure an accurate oil level sight gauge reading, the balance line connections and gauge fittings must be kept tight. An air leak, particularly at the upper side of the level gauge column or the balance line fittings, will result in a false level sight reading. Tighten all fittings periodically.

To check for possible air leaks, remove the oil filler cap and note the reaction of the oil column in the level sight gauge will change considerable. If the oil column falls more than 1/8 to 1/4 inch maximum, an air leak exists. Oil trapped in the balance line will also result in incorrect readings.

When there is no trapped oil in the balance line and no leak exists above the oil column, there is only a slight change, if any, in the oil column with the oil filler cap on or off.

### HAND CRANKING

This procedure is used for adjustments.

◆ CAUTION: WHENEVER HAND CRANKING THE ENGINE BE SURE ENGINE IS COLD. NEVER HAND CRANK A WARM OR HOT ENGINE.

The procedure for hand cranking requires the installation of four 3/8" NC high head cap screws.

To crank the engine by hand, proceed as follows:

1. UNITS EQUIPPED WITH A STARTING SWITCH ONLY: Place the starting switch in the "OFF" position.

2. Place the fuel shut-off control button in the "OFF" position.

3. UNITS EQUIPPED WITH AN AUXILIARY PULLEY ONLY: Remove the auxiliary pulley.

4. Install the four cap screws in the tapped holes in the vibration damper.

5. With the use of a bar (position between the cap screws), crank the engine as required.

6. Remove the four cap screws from the vibration damper.

7. UNITS EQUIPPED WITH AN AUXILIARY PULLEY ONLY: Install and secure the auxiliary pulley.



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## VALVE CLEARANCE ADJUSTMENT

◆ CAUTION: BEFORE ADJUSTING THE VALVES, DISCONNECT THE BATTERY GROUND CABLE. THE ENGINE MUST BE COLD.

For valve clearances, refer to "SPECIFICATIONS AND CAPACITIES" on page 5.

1. Disconnect the glow plug wires and remove the glow plugs.

2. Remove the valve cover. Turn the crankshaft (refer to "HAND CRANKING" on this page) until the No. 1 piston is on the compression stroke and the timing pointer, on the front cover, is in line with "TC" mark on the fan drive pulley.

NOTE: Be sure the No. 1 piston is on the compression stroke by turning both push rods by hand to determine that both valves are closed. Valves are closed when push rods are loose and can be turned easily.

3. Turn rocker arm adjusting screws in or out until correct feeler gauge clearance is obtained.

4. Turn the crankshaft 1/3 revolution (120 degrees) at a time. Check the valve clearance of each cylinder and adjust if necessary. Do this on each set of cylinder valves in succession according to the firing order of the engine, which is 1, 5, 3, 6, 2, 4.

NOTE: Be accurate! Use a feeler gauge for checking the valve clearance.

5. Check the condition of the valve cover gasket and replace if necessary. Install the gasket and valve cover. Check to see that the gasket makes an oil-tight seal with the cylinder head.

6. Install the glow plugs and connect the glow plug wires.

7. Reconnect the battery ground cable.

## ELECTRICAL SYSTEM

### Precautions

The electrical generating system now incorporates a direct diode rectified generator (alternator w/integral regulator) which requires special handling and procedures different from those associated with the old style DC generator.

◆ CAUTION: BEFORE WORKING ON ANY PART OF THE ELECTRICAL SYSTEM, DISCONNECT THE BATTERY GROUND CABLE UNTIL ALL ELECTRICAL WORK HAS BEEN COMPLETED.

Repair or replace all broken wires immediately. All terminals must be clean and securely fastened; never paint connections.

## ALTERNATOR w/INTEGRAL REGULATOR

The alternator incorporates a built in transistorized voltage regulator. The alternator requires no lubrication since it's bearings are factory lubricated for life and require attention only at time of major overhaul. The integral regulator is sealed by the manufacturer.

NOTE: The unit electrical system is negative ground. Be CERTAIN the ground polarity is correct when:
- a. Installing a new battery.
- b. Connecting a battery charger.
- c. Using a booster.

Failure to observe proper polarity will result in damage to the alternator.

NEVER use a fast charger as a booster to start the engine.

NEVER unhook a battery terminal while the engine is running.

NEVER disconnect the Alternator cable while the engine is running.

DO NOT POLARIZE THE ALTERNATOR.

DO NOT SHORT ACROSS OR GROUND ANY TERMINALS OF THE ALTERNATOR.

### Voltage Regulator (Illust. 21)

The engine is equipped with a transistor type voltage regulator. This regulator incorporates a voltage adjustment that can be used to maintain the battery in a satisfactory charge condition, thereby obtaining maximum battery life.

### When to Adjust the Regulator

1. If the battery uses too much water at normal setting (position "2" on the cap aligned with the arrow) reduce the voltage setting by aligning position "LO" on the cap (2) with the arrow.

2. If the battery is consistently under charged at the normal setting (position "2" on the cap aligned with the arrow), increase the voltage setting by aligning the "3" position on the cap with the arrow. If further increase is desired, align "HI" position on cap with arrow.

NOTE: If either of the conditions in Steps 1 or 2 persists after making the adjustments; consult your authorized International Engine Distributor or Dealer.



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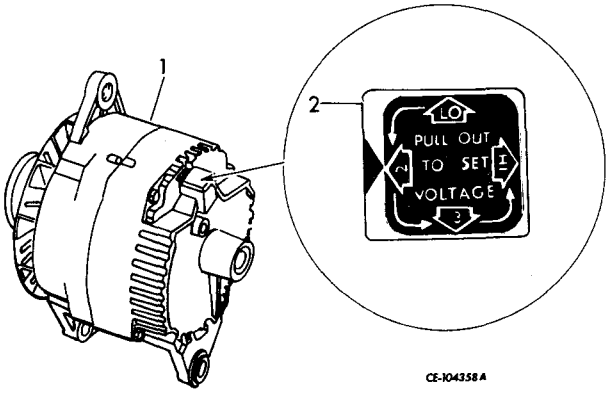
### Adjustment

1. To adjust the regulator setting remove voltage adjustment cap (2) from alternator.

2. Position the cap until the desired setting is aligned with the arrow on the alternator. Refer to Steps 1 and 2 under the "Voltage Regulator" for the desired setting.

3. Reinstall the cap in the alternator.




**Illust. 21**
**Voltage Adjustment Cap.**

1. ALTERNATOR. 2. CAP, voltage adjustment.

### Cranking Motor

The cranking motor must be lubricated every 5000 hours under normal starting conditions, or sooner, should it become necessary to remove the motor in the process of engine servicing. If the application is such that frequent or severe engine starts are required, motor lubrication and maintenance must be made at shorter intervals of 1000 hours or less.

1. Remove the cranking motor for lubrication.

2. At time of lubrication, motor should be cleaned, disassembled and inspected for further maintenance requirements. Consult your International Engine distributor or dealer for procedure to follow.

3. All wicks and oil reservoirs must be saturated with grade-10 engine oil. The splines underneath the clutch should be lightly underneath the clutch should be lightly lubricated with the same oil.

4. Reinstall the cranking motor.

If the cranking motor fails to operate properly, consult your authorized International Engine distributor or dealer.

### Checking for Defective Glow Plugs

If the glow plug meter pointer is in the "CHECK" zone, one or more glow plugs are defective and must be replaced. To check for defective glow plugs, proceed as follows:

1. Press the glow plug switch and note the glow plug meter reading. Release the switch.

2. Disconnect the terminal connector from the glow plug in the No. 1 cylinder.

3. Press the glow plug switch and check the reading on the meter again. If the pointer has moved slightly to the left (further into the "CHECK" zone) from the original reading, the glow plug is functioning. If the reading has stayed the same, the glow plug is defective and must be replaced.

4. Check the remaining glow plugs in the same manner. Be sure that the previously checked or replaced glow plug is connected again before checking the next glow plug.

NOTE: When new glow plugs are installed, they must be tightened to the specified torque (refer to "Torques" on page 5).

### Storage Batteries

Complete instructions for dry-charged batteries are included with the battery.

◆ CAUTION: BATTERIES GIVE OFF HIGHLY INFLAMMABLE GAS. NEVER ALLOW SPARKS OR OPEN FLAME NEAR THE BATTERIES. AVOID SPILLING ANY ELECTROLYTE ON HANDS OR CLOTHING.

### Battery Installation

Never allow the battery to stand on the concrete, ground or a metal support unless proper insulation is provided. A wooden platform or board is sufficient insulation. Be sure the battery is fastened securely to avoid damage from the vibration.

NOTE: If tightened excessively, the battery case could warp or break.

### Cleaning and Servicing the Batteries

If the top of the battery is dirty, it may be cleaned with a brush dipped in ammonia or soda solution. The vent plugs must be tightened to prevent any solution from getting into the battery cells. After the foaming stops, flush off the battery with clean water. Brighten the terminal contact surfaces with steel wool or a stiff brush.

Battery cable terminals must be kept clean and tight.

Check that the vent holes in the filler caps are not clogged. Replace unserviceable cables.

### Liquid Level

The electrolyte in each cell should be 1/4 to 1/2 inch above the plates at all times to prevent battery failure. Check the level of the electrolyte. When the electrolyte is below this level, pure distilled water should be added. Never use hy-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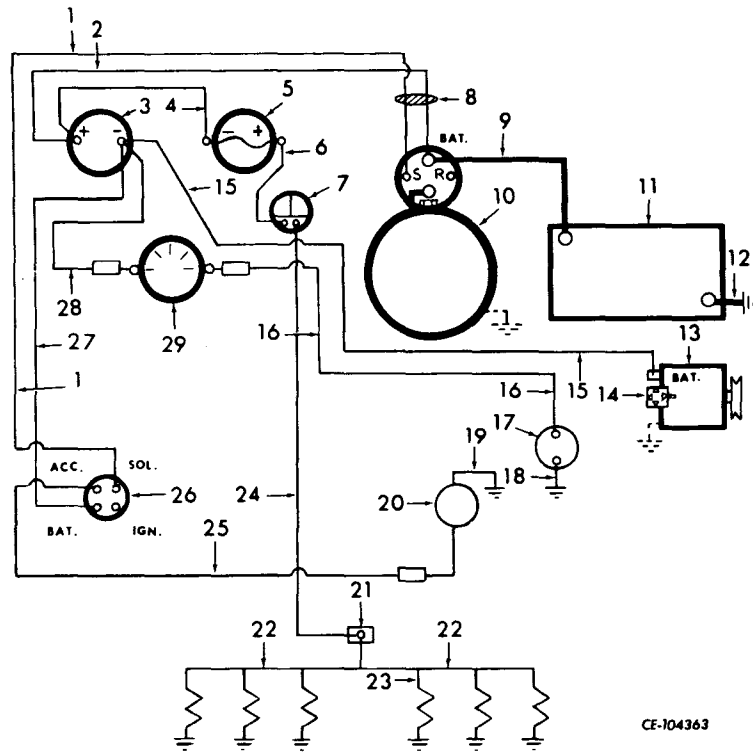
drant water or any water which has been in a metal container. Acid or electrolyte should never be added except by a skilled batteryman. Under no circumstances add any special battery "dopes." solutions or powders.

It is especially important to keep the battery at full charge for cold weather operation. Add distilled water to the battery in freezing temperatures only when the engine is to operate for several hours to thoroughly mix the water and the electrolyte, or damage to the battery will result from the water freezing.




**Illust. 22**
**Wiring Diagram (Regular Gauges)**

CABLE COLOR CODE – All cables are black unless otherwise specified.
CABLE GAUGE – All cables are 14 gauge except battery cables and those noted below:

Cable Ref. 2, 4, 6, 24 . . . . 8 gauge
Cable Ref. 15 . . . 10 gauge

| Ref. No. | Description | Ref. No. | Description |
|---|---|---|---|
| 1 | CABLE, "Sol" on ignition switch to "S" on solenoid. | 16 | CABLE, hourmeter to pressure switch (red) |
| 2 | CABLE, positive (+) on ammeter to "BAT" on solenoid (red) | 17 | SWITCH, pressure |
| 3 | AMMETER | 18 | CABLE, pressure switch to ground |
| 4 | CABLE, positive (+) on ammeter to negative (-) on glow plug meter (Chrome) | 19 | CABLE, electric fuel pump to ground |
| 5 | METER, glow plug | 20 | PUMP, electric fuel |
| 6 | CABLE, flow plug meter to glow plug switch (Chrome) | 21 | BLOCK, junction |
| 7 | SWITCH, glow plug | 22 | HARNESS, glow plug cable |
| 8 | HARNESS, cranking motor solenoid cable | 23 | PLUG, glow |
| 9 | CABLE, battery to cranking motor | 24 | CABLE, junction block to glow plug switch (Chrome) |
| 10 | MOTOR, cranking | 25 | CABLE, electric fuel pump to "ACC" terminal on ignition switch |
| 11 | BATTERY (12 volt) | 26 | SWITCH, ignition |
| 12 | CABLE, battery to ground | 27 | CABLE, "BAT" terminal on ignition switch to negative terminal on ammeter |
| 13 | ALTERNATOR w/REGULATOR | 28 | CABLE, hourmeter to negative (-) terminal on ammeter |
| 14 | ADJUSTER, voltage | 29 | HOURMETER, electric |
| 15 | CABLE, "BAT" terminal on alternator to negative (-) terminal on ammeter (red) | | |



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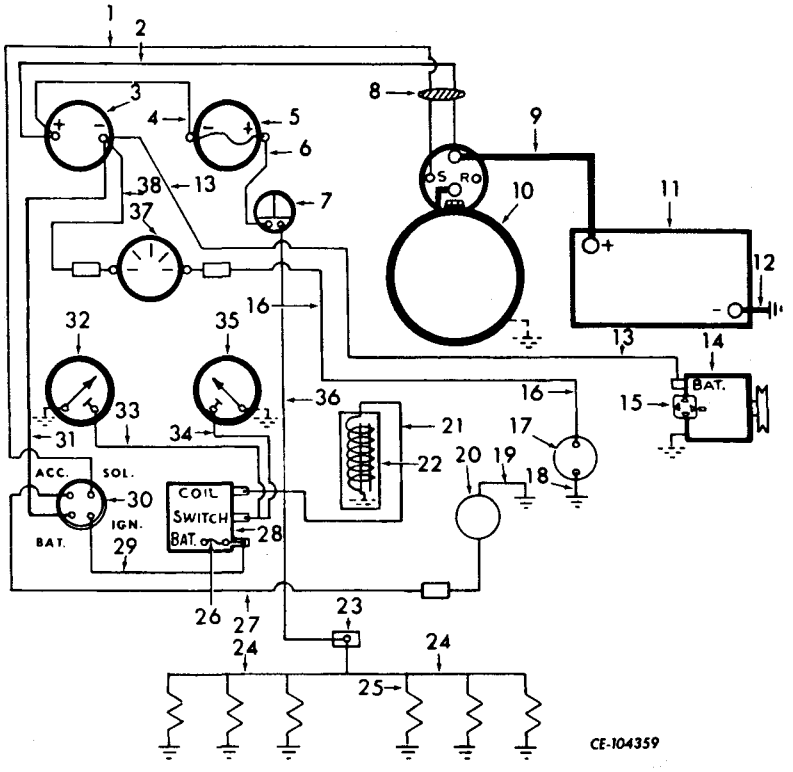


**Illust. 23**
**Wiring Diagram (Safety Gauges).**

CABLE COLOR CODE – All cables are black unless otherwise specified.
CABLE GAUGE – All cables are 14 gauge except battery cables and those noted below:

Cable Ref. 2, 4, 6, 36 . . 8 gauge  Cable Ref. 13 . .10 gauge  Cable Ref. 21 . . 16 gauge

| Ref. No. | Description | Ref. No. | Description |
|---|---|---|---|
| 1 | CABLE, "Sol" on ignition switch to "S" terminal on solenoid | 22 | SOLENOID, injection pump |
| 2 | CABLE, positive (+) terminal on ammeter to "BAT" terminal on solenoid (red) | 23 | BLOCK, junction |
| 3 | AMMETER | 24 | HARNESS, glow plug cable |
| 4 | CABLE, positive (+) terminal on ammeter to minus (-) terminal on glow plug meter (Chrome) | 25 | PLUG, glow |
| 5 | METER, glow plug | 26 | FUSE, SFE-14 AMP |
| 6 | CABLE, glow plug meter to glow plug switch | 27 | CABLE, electric fuel pump to "ACC" terminal on ignition switch |
| 7 | SWITCH, glow plug | 28 | SWITCH, relay |
| 8 | HARNESS, cranking motor solenoid cable | 29 | CABLE, "BAT" terminal on relay switch to "IGN" terminal on ignition switch |
| 9 | CABLE, cranking motor to battery | 30 | SWITCH, ignition and starter |
| 10 | MOTOR, cranking | 31 | CABLE, "BAT" terminal on ignition switch to negative (-) terminal on ammeter |
| 11 | BATTERY (12 volt) | 32 | GAUGE, engine coolant temperature safety |
| 12 | CABLE, battery to ground | 33 | CABLE, switch terminal on relay to engine coolant temperature gauge |
| 13 | CABLE, "BAT" terminal on alternator to negative (-) terminal on ammeter (red) | 34 | CABLE, switch terminal on relay to oil pressure safety gauge |
| 14 | ALTERNATOR w/REGULATOR | 35 | GAUGE, oil pressure safety |
| 15 | ADJUSTER, voltage | 36 | CABLE, junction block to glow plug switch (Chrome) |
| 16 | CABLE, hourmeter to pressure switch (red) | 37 | HOURMETER, electric |
| 17 | SWITCH, pressure | 38 | CABLE, hourmeter to negative (-) terminal on ammeter |
| 18 | CABLE, pressure switch to ground | | |
| 19 | CABLE, electric fuel pump to ground | | |
| 20 | PUMP, electric fuel | | |
| 21 | CABLE, "COIL" terminal on relay to injection pump solenoid | | |



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## FUEL SYSTEM

### Fuel Injection Pump

DO NOT ATTEMPT TO ADJUST THE FUEL INJECTION PUMP. In case of unsatisfactory operation of the engine, due to possible problems in the fuel system, check over the instructions on the following pages for servicing the various units of the fuel system. If the problem is not overcome consult your authorized International Engine distributor or dealer to inspect the fuel injection pump.

### Priming and Venting the Fuel System

All air must be eliminated from the fuel lines before the engine will operate properly. All fuel line connections must be tight to prevent leakage and to prevent air from entering the system.

The system must be primed and vented when:

A new engine is being started for the first time.

An engine, in operation, runs out of fuel.

Fuel filter elements have been changed.

If the fuel pipes have been disconnected.

If air has entered the fuel system, vent the system as follows:

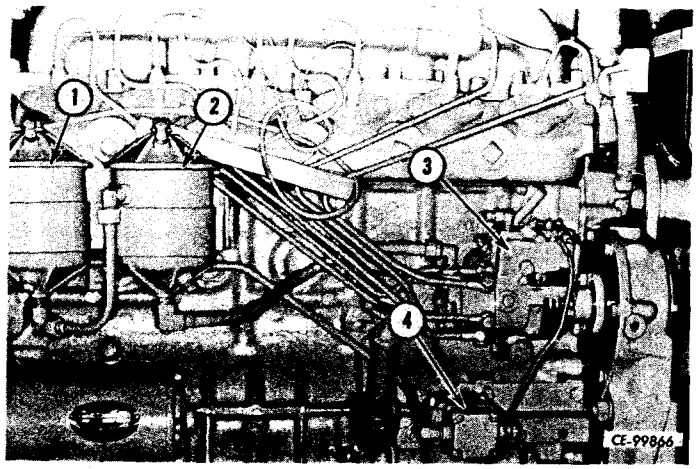
1. Open the fuel shut-off valve at the fuel source and check that there is an adequate supply of fuel in the tank.

2. UNITS EQUIPPED WITH AN ELECTRIC FUEL TRANSFER PUMP ATTACHMENT: Turn the ignition and starter switch to the "ON" position.

3. Open the vent valve located on top of each fuel filter.

4, When clear fuel (no appearance of air) flows from the primary vent valve, close it. Close the remaining final vent valve as soon as clear fuel appears (Illust. 24).

5. Start the engine.




**Illust. 24**
**Fuel System.**

1. FILTER, primary fuel.
2. FILTER, final fuel.
3. PUMP, injection.
4. PUMP, electric fuel transfer.

### Fuel Filter Elements

Fuel filter elements cannot be cleaned and must not be disturbed except when it becomes necessary to replace them.

The primary filter element is the cotton thread type with a controlled density to avoid premature plugging. This element is the first in the system to filter the fuel as it comes from the tank.

NOTE: NEVER USE THE COTTON TYPE ELEMENT IN THE FINAL FILTER.

The final filter element is the paper pleated type. This element will need replacement less often than the primary filter if proper primary element service and water draining procedures are followed.

### When to Replace Filter Elements

Loss of power or misfiring of the engine may indicate the fuel filters have become restricted.

1. Before replacing the primary filter element, drain the water and sediment from the fuel tank.

2. If the engine shows loss of power, replace the primary filter element.

3. If the engine still shows loss of power, replace the final filter element.

### Precautions When Replacing Fuel Filter Element

Cleanliness cannot be overemphasized. Be careful not to allow dirt, water and other foreign materials to get on the element. Keep new elements in the original package until ready for installation.

Before loosening the filter case retaining bolt, clean the outside of the case and cover thoroughly with kerosine or diesel fuel to prevent dirt or foreign material from entering the case when the cover is removed.

### Replacing the Primary or Final Fuel Filter Elements (Illust. 25)

Keep the new element in the package until ready for installation. Clean the outside of the filter case and cover before removing the cover.

1. Drain the water and sediment from the fuel tank.

2. Close the fuel tank shut-off valve.

3. Open the valve (2) and remove the plug (7). Allow the fuel to drain completely.

(Continued on next page)



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**Replacing the Primary or Final Fuel Filter Elements (Illust. 25) - Continued**

4. Unscrew the retaining screw (1) and remove the cover (3).

5. Remove and discard the gasket (4).

6. Remove and discard the element (5).

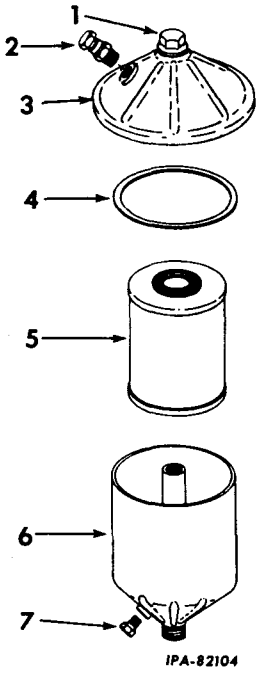
7. Thoroughly clean the inside of the cover and case with diesel fuel or kerosine.

8. Install the new element (5) into the case.

9. Place the new gasket (4) into the cover (3). Place the cover on the case (6). Tighten the retaining screw (1); do not "spin" the cover on, this may shift the gasket (4). Refer to "Torques" on page 5 for the specified torque.

10. Install the plug (7) and close the valve (2).

11. Vent the fuel system. Refer to "Priming and Venting the Fuel System" on page 33.



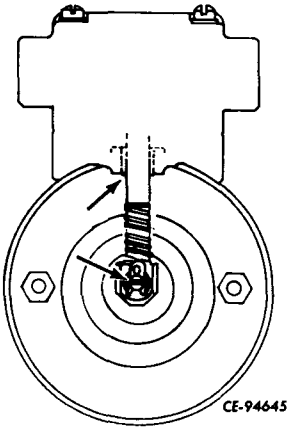

**Illust. 25**
**Fuel Filter Disassembled.**

1. SCREW, retaining.
2. VALVE, bleeder.
3. COVER.
4. GASKET, element cover.
5. ELEMENT.
6. CASE.
7. PLUG, drain.

## ELECTRIC FUEL PUMP (Illust. 26)

Remove the two acorn type nuts holding the pump motor and linkage cover. Remove the cover and gasket and apply a liberal amount of IH #251-H-EP grease or an equivalent multipurpose lithium grease to the areas at the connecting rod needle bearing and at the push rod sleeve bearing. Replace cover and gasket.

NOTE: Clean area thoroughly around the pump cover before removal in order to prevent entrance of dirt into the linkage chamber. Located on RH side behind the fuel tank.




**Illust. 26**
**Electric Fuel Pump.**

## POWER TAKE-OFF CLUTCH

This over-center type clutch is designed to require a minimum of attention. Overlubrication is as detrimental to the clutch as under lubrication. It is important to follow the lubrication instructions as given in "LUBRICATION GUIDE" on page 16.

**Adjustment**

Adjustment is required when a diminished effort is required to "engage" the clutch.

Rapid wear of the clutch facings will result if slippage takes place while the engine is under heavy load.

NOTE: New clutch facings have a series of high spots or feather edges which must be worn away before the lining is capable of transmitting its full torque capacity. Hence, clutch adjustment will be required several times within the first 10 hours of operation. These adjustments will avoid rapid clutch facing wear due to slippage and will allow the clutch to handle full engine power.

Adjust the clutch as follows:

1. Remove the clutch instruction plate.

2. Disengage the clutch and slowly crank the engine (refer to "HAND CRANKING" on page 28) until the adjusting points appear in the center of the opening.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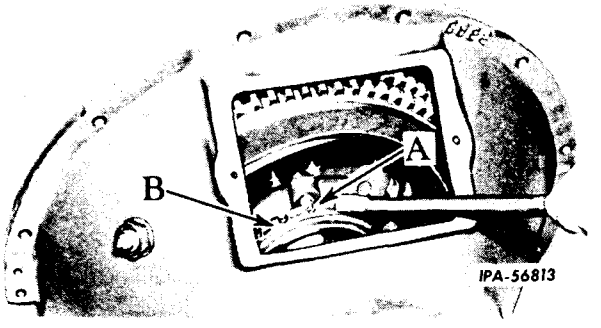
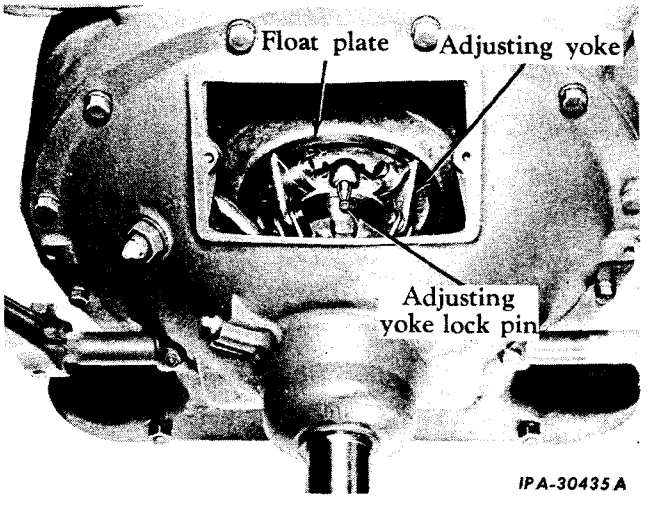
3. TWIN DISC CLUTCH (11-1/2 INCH): Depress the lock pin (A) and hold the power take-off shaft to keep the clutch from turning. Insert a pry bar in the notch in the adjusting yoke (B) and turn the yoke clockwise one notch at a time (Illust. 27).




Illust. 27
Adjusting the Twin Disc 11-1/2 inch Over-Center Clutch.

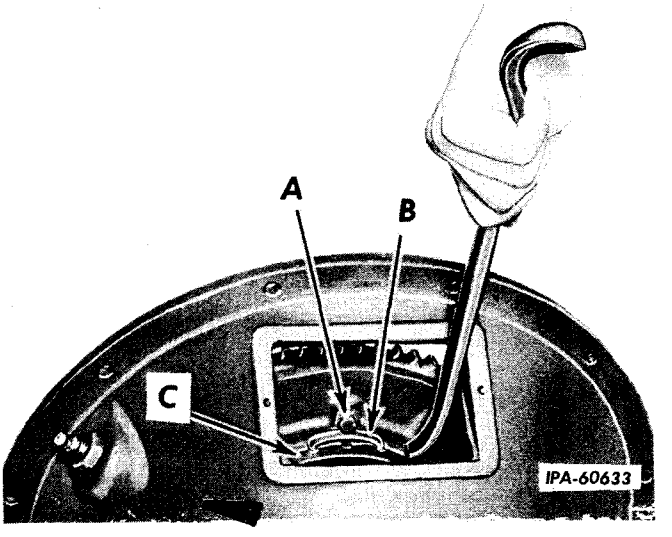
3. TWIN DISC CLUTCH (10 INCH): Pull out the adjusting yoke lock pin so it is disengaged from the floating plate. Hold the power take-off shaft and turn the adjusting yoke clockwise (right); move it one notch or possibly two notches until the clutch hand lever requires a distinct pressure to engage (Illust. 28).



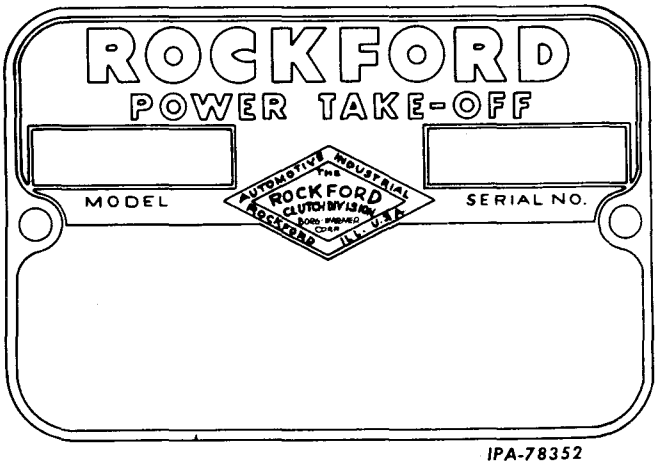

Illust. 28
Adjusting the Twin Disc 10 inch Over-Center Clutch.

4. ROCKFORD CLUTCH: Loosen the adjusting ring lock screw "A" with an offset screwdriver to free the lock "B." Hold the power take-off shaft to keep the clutch from turning and insert a pry bar into a notch in the adjusting ring "C" for leverage. Turn the ring a notch at a time in a counterclockwise direction (Illust. 29).

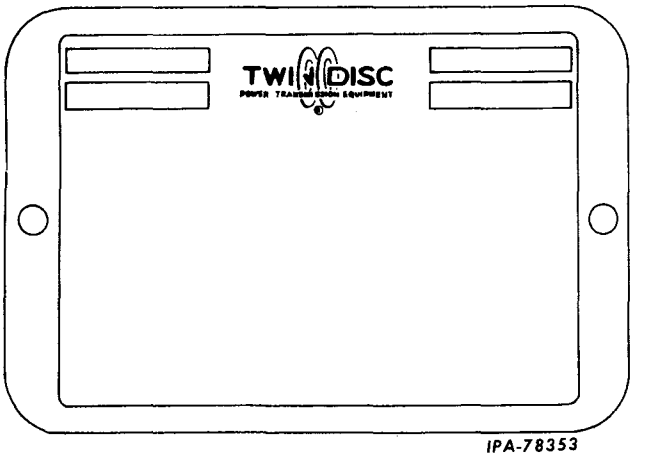
5. Be sure the clutch lever is in the "disengaged" position. To determine the correct amount of hand-pull effort for your engine refer to Illust. 30 or 31 for the IH power take-off number on your engine.




Illust. 29
Adjusting the Rockford Over-Center Clutch.




Illust. 30
Rockford Instruction Plate.




Illust. 31
Twin-Disc Instruction Plate.

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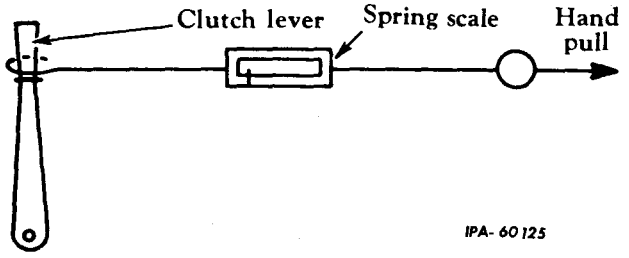
Adjustment - Continued




Illust. 32
Method of Checking Clutch Adjustment.

6. Engage the spring scale hook on the clutch lever as shown in Illust. 32. Refer to the chart on this page for the correct amount of hand-pull effort.

NOTE: These figures, shown in the charts below, are based on the clutch lever originally furnished with the power take-off.

ROCKFORD

| IH Power Take-Off Part Number | Pounds of Effort |
|---|---|
| 319 503 R91 | 70 |
| 319 519 R91 | 75 |
| 319 524 R91 | 75 |

TWIN-DISC

| IH Power Take-Off Part Number | Pounds of Effort |
|---|---|
| 321 054 R91 | 60-65 |
| 321 056 R91 | 70-80 |
| 321 057 R91 | 70-80 |
| 346 882 R91 | 110-120 |

7. ROCKFORD CLUTCH: Tighten the adjusting ring lock screw.

7. TWIN-DISC CLUTCH: Secure the adjusting lock pin.

3. Install the clutch instruction plate.

## STORING THE ENGINE

When the engine is not to be used for a period of time, it must be stored in a dry and protected place. Leaving equipment outdoors, exposed to the elements, will result in materially shortening its life.

The following procedure must be followed when the engine is placed in storage for 30 days or more.

We also recommend that caution be taken in starting an engine that has been in storage. Refer to "PREPARING STORED ENGINES FOR SERVICE" on page 37.

1. Thoroughly wash or clean the engine.

2. Completely lubricate the rest of the unit as outlined in the "LUBRICATION GUIDE" on pages 15 to 17.

3. Drain the fuel from the fuel filters and close the drains.

4. Disconnect the fuel supply line at the fuel inlet. Attach a suitable length of the tubing at the fuel inlet and place the other end in a can of diesel fuel. Use enough approved diesel fuel to run the engine 10 to 15 minutes for flushing operation.

5. Vent the fuel system of air as described under "Priming and Venting the Fuel System" on page 33.

NOTE: Engine must not be operated after the flushing operation.

6. If the cooling system will be exposed to freezing temperatures during storage and water only was used during operation, the cooling system must either be completely drained or refilled with an anti-freeze solution (See NOTE). Refer to the anti-freeze table on page 19 to select a solution suitable for the lowest temperature that the cooling system will be exposed to during storage.

NOTE: If the engine is to be stored with a drained cooling system, the residual water retained by capillary attraction inside the cooler must be blown out with dry compressed air through the drain plug on the cooler (Illust. 10). DO NOT RELY ONLY ON DRAINING THE WATER.

7. Drain the cooling system and install a "RADIATOR DRAINED" tag.

8. Remove the glow plugs. Spray about one ounce of Grade-30 lubricating oil through each glow plug opening into each cylinder. Crank the engine two or three revolutions. Reinstall the glow plugs. Refer to "Torques" on page 5.

9. Clean and remove the valve housing cover; then spray the valves, rocker arms and push rods with Grade-30 lubricating oil. (If any evidence of rust is found, remove it before lubricating.) Use a paint brush to coat the inside of the valve housing cover with Grade-30 lubricating oil. Install valve housing cover.

10. Completely service the air cleaner. Refer to "AIR CLEANER – WET TYPE" on page 23 or "AIR CLEANER – DRY TYPE" on pages 23 and 24.



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11. Plug up the ends of the exhaust pipe and breather pipe. Remove the air cleaner cap and cover the pipe.

12. Remove the batteries and store them in a cool dry place above freezing (+32°F). The batteries must be fully charged at time of storage. Check the batteries at least once a month for water level and specific gravity. Batteries must never be allowed to run down below 3/4 full while in storage.

## PREPARING STORED ENGINES FOR SERVICE

1. Install fully charged batteries and be sure to make the proper connections. (Refer to the wiring diagram on pages 31 or 32.

2. Remove the valve housing cover and flush the valve and valve operating mechanism with a mixture of one-half kerosine and one-half Grade-10 oil.

3. Drain the crankcase and refill the crankcase with the specified lubricating oil. Refer to the "LUBRICATION GUIDE" on page 16.

4. Install new lubricating oil filter element.

5. Remove the coverings from the exhaust pipe, crankcase breather pipe and air cleaner pipe. Install the air cleaner cap.

6. Close all cooling system drains and fill the cooling system as described on page 21. Check for leaks and loose connections. Remove the "RADIATOR DRAINED" tag.

7. Close all fuel drains and fill the fuel tank. Vent the fuel system as described under "Priming and Venting the Fuel System" on page 33.

◆ CAUTION: NEVER OPERATE AN ENGINE IN AN ENCLOSED BUILDING UNLESS THE EXHAUST IS PROPERLY VENTILATED. DO NOT ACCELERATE THE ENGINE RAPIDLY OR OPERATE IT AT HIGH SPEED IMMEDIATELY AFTER STARTING.

8. After the engine has started, observe if any valves are sticking. If so, pour a small quantity of diesel fuel, dry-cleaning solvent, or kerosine on the valve stems until loose. If the engine is misfiring or loss of power is evident after starting the engine, the fuel system is probably clogged. Refer to "When to Replace Filter Elements" on page 33.

9. Allow the engine to run at low idle for 5 to 10 minutes to allow thorough distribution of the lubricating oil. Do not place the engine under load until normal oil pressure is reached.

10. Install the valve housing cover.



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