

INTERNATIONAL® ENGINES




UC-221 AND UC-263 ENGINES AND ATTACHMENTS

**FORM
1 085 201 R2**

JANUARY, 1972

INTERNATIONAL HARVESTER COMPANY
401 NORTH MICHIGAN AVE. CHICAGO, ILLINOIS 60611, U.S.A.



INTERNATIONAL[®] ENGINES



OPERATOR'S MANUAL

UC-221 AND UC-263 ENGINES AND ATTACHMENTS

**FORM
1 085 201 R2
JANUARY, 1972**

INTERNATIONAL HARVESTER COMPANY
401 NORTH MICHIGAN AVE. CHICAGO, ILLINOIS 60611, U.S.A.

TECHNICAL PUBLICATIONS

An Operator's Manual and a Parts Catalog are packed and shipped with this machine for customer use. Additional technical publications are available for this machine, at a nominal cost, through your authorized International Engine distributor or dealer. This material includes Service Manuals and Technical Training Courses.

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

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.

UC-221 AND UC-263

ENGINES AND ATTACHMENTS

**FORM
1 085 201 R2**

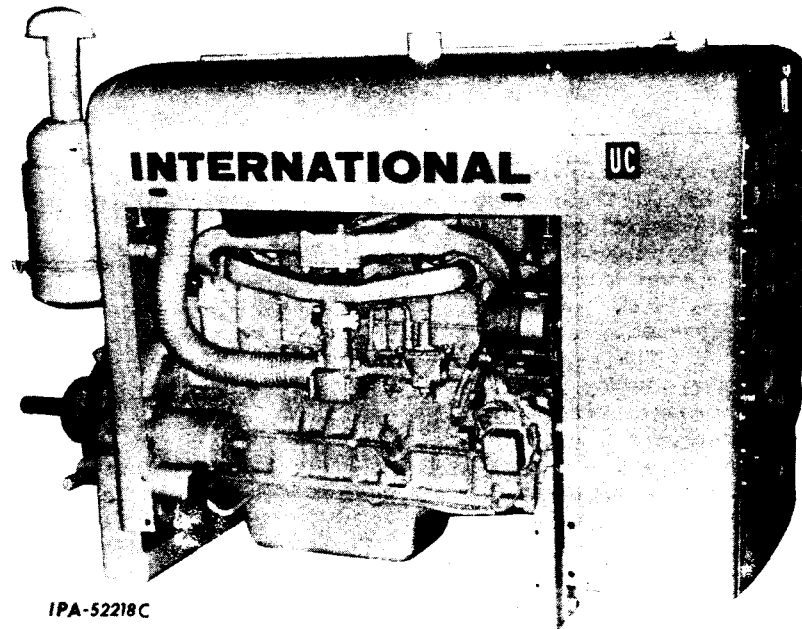
JANUARY, 1972

CONTENTS

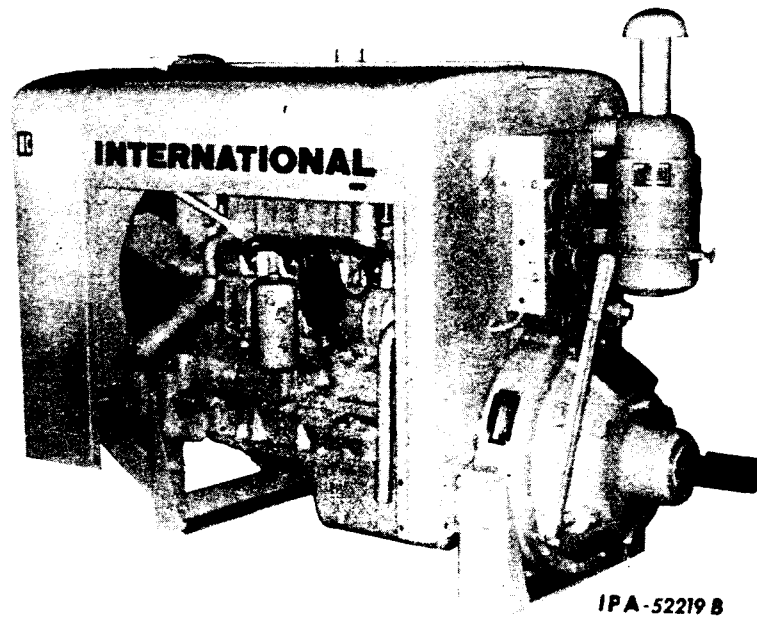
	Pages
INTRODUCTION	3 to 5
Ventilation for engines installed inside of buildings	4
Suggested engine and fuel tank arrangements	4, 5
DESCRIPTION	6 to 10
Specifications and capacities	6, 7
Operating controls and instruments	7 to 10
OPERATION	11 to 15
Before starting a new engine	11
Lubrication when shipped	11, 12
Precautions	12
Liquefied petroleum gas or natural gas engines	12
Preparing the engine for each day's work	13
Operating the engine	14
Starting the engine	14, 15
Instrument check	15
Stopping the engine	15
SCHEDULED MAINTENANCE	16 to 24
Scheduled	16, 17
Periodic	17
Lubrication	18 to 24
Lubrication specifications and capacities chart	19
Lubrication guide (engine)	20, 21
Lubrication guide (transmission)	24
Lubrication guide (power take-off)	23
MAINTENANCE	25 to 57
Preparing for cold weather	25
Preparing for hot weather	26
Cooling system	26 to 31
Radiator type	26
Flo-matic type	26
Radiator cap	27
Cleaning the radiator core	28
Thermostat	29, 30
Water pump	30
Flo-matic valve	30, 31
Belt	32, 33
Air cleaner (wet type)	33, 34
Cleaning the oil cup	33
Washing the air cleaner	34
Air cleaner (dry type)	34
Automatic dust unloader	34
Filter element service	34 to 36
Air intake cap	36
Crankcase breather	36
Lubricating oil filter	37
Hand cranking	37
Valve clearance adjustment	38
Oil level sight gauge	38, 39
Electrical system	39 to 45
Alternator	40
Regulator	40
Cranking motor	40
Ignition coil	40
Spark plugs	40, 41
Spark plug cables	41
Storage battery	41
Distributor	41, 42

CONTENTS

	Pages
Wiring diagram	43 to 45
Regular gauges	43
Safety gauges	44
Fuel system (gasoline)	46 to 48
Carburetor	46, 47
Fuel pump (mechanical)	47
Fuel pump (electric)	48
Cleaning the filter screen	48
Fuel system (natural gas)	49
Adjusting the carburetor and regulator	49, 50
Fuel system (liquefied petroleum gas)	50 to 52
Adjusting the carburetor and regulator	50
Fuel filter	50
Mechanical governor adjustment	52
Power take-off clutch	52 to 55
Transmission clutch	55
Storing the engine	55, 56
Preparing stored engine for service	56, 57



Illust. 1
Right Front View of the UC-221 and UC-263 Engines
with Various Attachments.



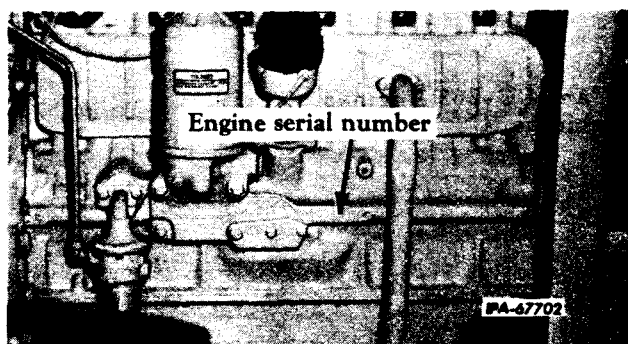
Illust. 2
Left Rear View of the UC-221 and UC-263 Engines
with Various Attachments.

INTRODUCTION

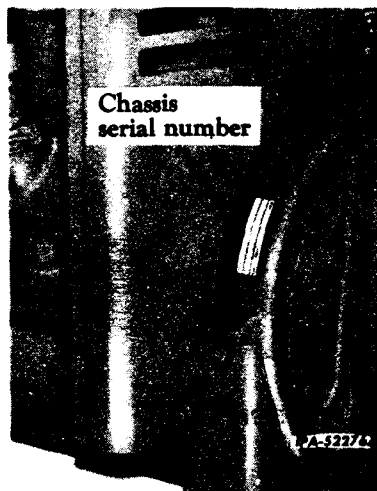
Instructions on operation, lubrication and maintenance for the basic engine and attachments are covered in this manual. Disregard any instructions on attachments that are not applicable to your engine.

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.

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 below the distributor. (Illust. 3.) The chassis serial number is stamped on a name plate attached to the left side of the flywheel housing. (Illust. 4.)



Illust. 3
Engine Serial Number



Illust. 4
Chassis Serial Number

Engine Serial Number:

C-221 _____

C-263 _____

Chassis Serial Number:

UC-221 _____

UC-263 _____

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.

SUGGESTED ENGINE AND FUEL TANK ARRANGEMENT

1. Anchor the engine securely to a level solid foundation, preferably concrete.
2. Mount the engine or driven equipment so that the belts may be removed or tightened.

INTRODUCTION

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.

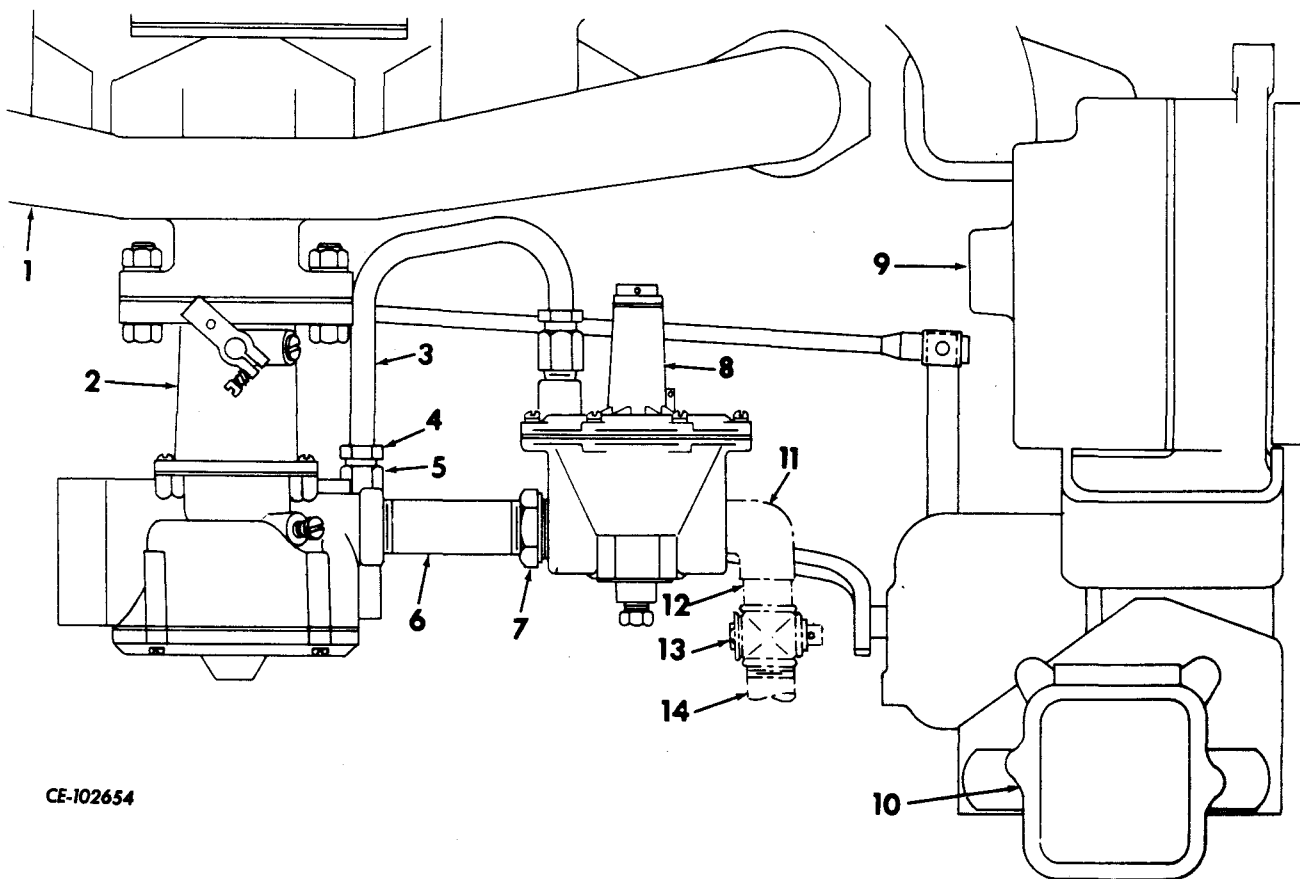
6. Install the flexible exhaust piping so the belting may be adjusted without disconnecting any pipes or lines.

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

8. Natural Gas Engines: Refer to Illust. 5 for suggested fuel supply installation.



CAUTION: GAS INLET PIPE (14) MUST BE FLEXIBLE PIPE CONNECTION TO PREVENT INLET PIPING FROM TRANSFERRING WEIGHT TO THE REGULATOR AND CARBURETOR.



CE-102654

Illust. 5
Suggested Fuel Supply Installation.

1. MANIFOLD, intake.
2. CARBURETOR.
3. TUBE, balance.
4. NUT, tube.
5. CONNECTOR, tube.
6. NIPPLE, 1/2 NPT.
7. REDUCER, 3/4 to 1/2 NPT (in valve).

8. VALVE, pressure reducer.
9. ALTERNATOR.
10. REGULATOR, voltage.
11. ELBOW, 3/4 NPT*.
12. NIPPLE, 3/4 NPT*.
13. VALVE, gas*.
14. PIPE, gas inlet*.

NOTE: All parts in the legend marked with an asterisk (*) must be furnished by the customer.

DESCRIPTION

SPECIFICATIONS AND CAPACITIES

Capacities (U.S. Measure)

Air cleaner oil cup (wet type)	2-3/4 pts.
Cooling system:	
Radiator type	25 qts.
Flo-matic type	69 qts.
Crankcase oil pan:	
Without filter	8 qts.
With filter	9 qts.
Transmission case:	
Four speed selective sliding gear	5 pts.
Four speed synchromesh	7 pts.

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

Specifications

<u>Engine</u>	
Cylinders	6
Bore	3.562 in.
Stroke:	
UC-221	3.688 in.
UC-263	4.390 in.
Displacement:	
UC-221	220.5 cu. in.
UC-263	262.5 cu. in.
Carburetor:	
Gasoline	IH
LPG	Impco
Natural Gas	Impco
Distributor:	
Dwell	31° to 37°
Point gap019 to .023 in.
Engine speeds:	
Full load governed	*
High idle	*
Low idle (gasoline)	500 RPM
Low idle (LPG or natural gas)	650 ± 50 RPM
Spark plug gap:	
Gasoline023 to .028 in.
LPG or natural gas015 to .020 in.
Fan belt tension at midpoint between:	
Alternator and fan pulleys:	
New	13/32 in.
Used	7/16 in.
Fan and crankshaft pulleys:	
New	1/2 in.
Used	17/32 in.
Valve clearance:	
Engine cold030 in.
Electrical system	12 volt, negative ground
Firing order	1, 5, 3, 6, 2, 4

*Optional engine speeds are available. The high idle and full load governed speeds for which this engine is equipped and adjusted is stamped on the serial number plate located on the flywheel housing.

DESCRIPTION

Torques (Foot Pounds)

All torques are given with bolts, studs and nuts lubricated with SAE-30 engine oil unless otherwise specified.

Radiator and air cleaner hose clamps	20 to 25 in.-lbs.
Spark plugs	27 to 34*
Valve cover bolts	2 to 4
Oil pan drain plug	30 to 35

*Dry Torque

Dimensions and Weights (Approximate)
(Enclosed Engine w/o PTO).

Length	50-5/64 in.
Height	38-1/2 in.
Width	28 in.
Weight	1260 lbs.

Fuel (Gasoline)

These engines are shipped with the ignition timing set for maximum power on the average regular grade of gasoline of 93 Research octane number as domestically available in the U.S.A. For fuels of lower Research octane number, the timing may require retarding (approximately one degree retard from factory setting for each decrease of one octane number). Overseas fuels may, in many areas, be considerably lower in Research octane number than regular grade fuels obtainable in the U.S.A. Clear, unleaded fuels should never be used. Advancing the timing beyond the initial factory setting is not recommended and may only result in adverse effects. There is no particular advantage in using a fuel having a higher anti-knock value than the engine requires.

Fuel (LPG)

NOTE: It is recommended that LP Gas fuel meeting the National Gas Processor's Association (NGPA) specification for Propane HD5 be used.

Specifications Subject to Change Without Notice

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.

Safety shut-off gauges have been pre-set at the factory. If any of these gauges fail to operate properly, consult your authorized International Engine Distributor or Dealer.

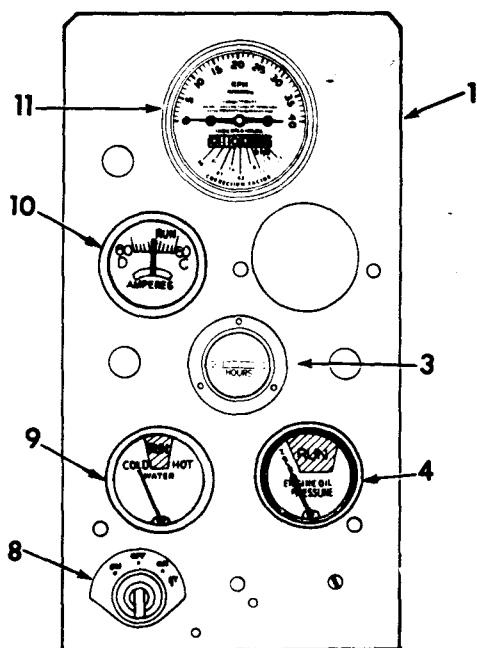
Instruments (Illust. 6 or 7)

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 15.

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.

Continued on next page.



CEA-84738 B

Illust. 6
Instrument Panel (Regular Gauges).

1. PANEL, instrument.
3. HOURMETER.
4. GAUGE, engine oil pressure.
5. KNOB, governor control.
6. BUTTON, choke control.
8. SWITCH, ignition and starter.
9. GAUGE, engine coolant temperature.
10. AMMETER.
11. TACHOURMETER.

Engine Oil Pressure Gauge

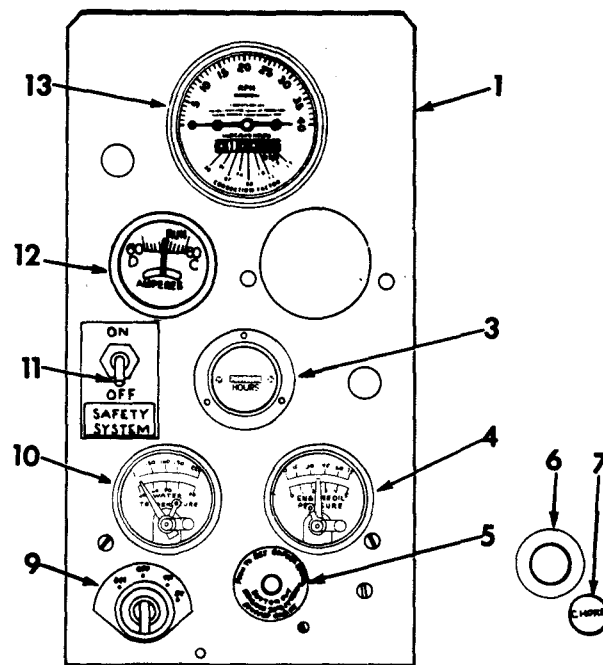
This instrument registers the pressure of the lubricating oil circulating through the engine.

Safety Engine Oil Pressure Gauge

This gauge 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.

Engine Coolant Temperature Gauge

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



CEA-84739 B

Illust. 7
Instrument Panel (Safety Gauges).

1. PANEL, instrument.
3. HOURMETER.
4. GAUGE, safety engine oil pressure.
5. SWITCH, ignition relay.
6. KNOB, governor control.
7. BUTTON, choke control.
9. SWITCH, ignition and starter.
10. GAUGE, engine coolant temperature safety.
11. SWITCH, safety control toggle.
12. AMMETER.
13. TACHOURMETER.

Engine Coolant Temperature Safety Gauge

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

Ammeter

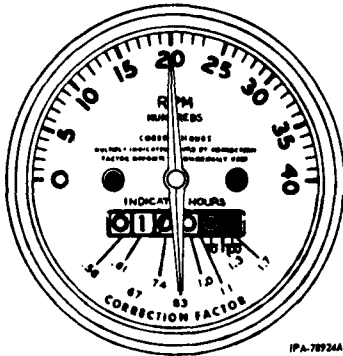
This instrument indicates the rate at which the battery is being charged or discharged.

DESCRIPTION

Tachourmeter (Illust. 8)

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

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



Illust. 8
Tachourmeter.

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 (Illust. 6 or 7)

Ignition and Starter Switch

This switch has four positions: 1. Switch to the left ("ON" position) for accessories; 2. "OFF" position; 3. "ON" position to the right to energize the electrical system; 4. switch all the way to the right ("ST" position) for cranking the engine.

Ignition Relay Switch

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

Governor Control Knob

This knob controls the engine speed.

To obtain a specified engine rpm, depress the button in the center of the control knob and pull out on the knob until the approximate engine rpm is reached. Release the button and the knob will automatically lock in place. For a finer adjustment rotate the knob in a counterclockwise direction (to increase engine rpm) or clockwise (to decrease engine rpm).

Choke Control Button

The choke control button aids in starting a cold engine. On gasoline engines, the choke control button can be used to put the choke valve in intermediate positions.

Safety Control Toggle Switch

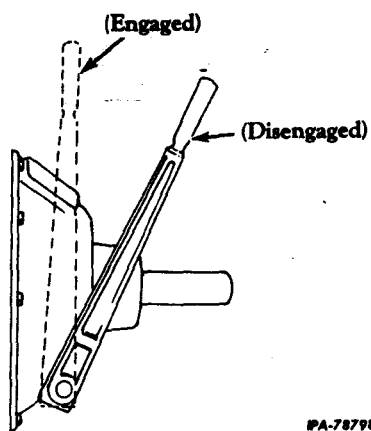
This switch is part of the instrument panel (safety gauges) attachment. The switch has an "OFF" and "ON" position. Before starting the engine, move the switch to the "OFF" position. When the engine has started and after the load is applied, move the switch to the "ON" position.

Power Take-Off Clutch Lever (Illust. 9)

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

Continued on next page.

DESCRIPTION



PA-78798

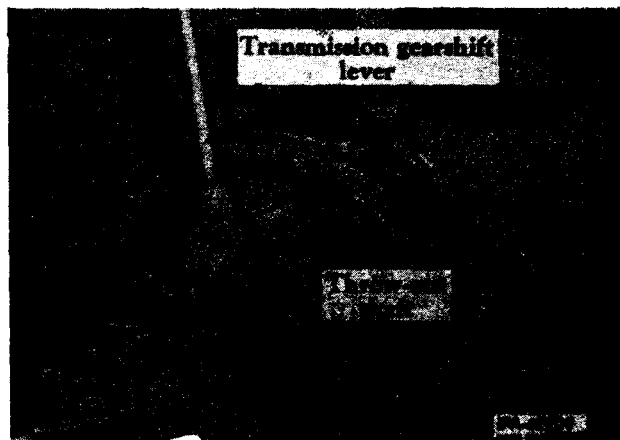
Illust. 9
Power Take-Off Clutch Lever Positions
(Left Hand Lever Installation Shown).

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.

Transmission Gearshift Lever (Illust. 10).

The transmission gearshift lever is used to select the various gear ratios provided in the transmission.



Illust. 10
Transmission Gearshift Lever.

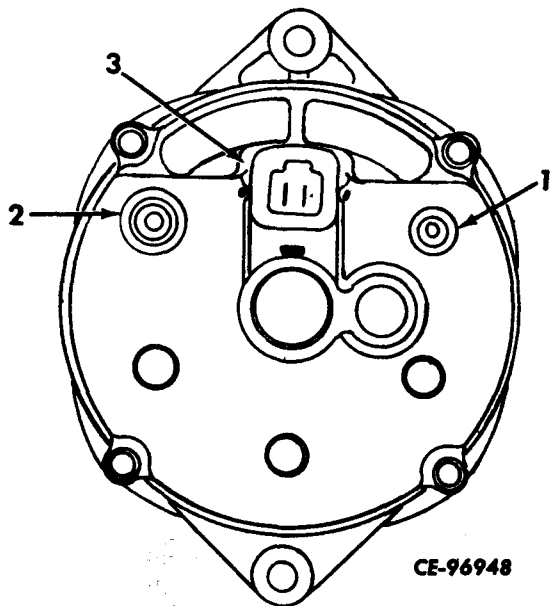
OPERATION

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 cooling system level and fill if necessary. (Refer to "Filling the Cooling System" on page 28.)
2. Check the oil in the engine crankcase, the air cleaner oil cup (wet type - if equipped), power take-off (if equipped) and transmission (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.
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 over-center clutch linkage may be necessary.



Illust. 11
Alternator Connections.

4. Be sure the terminals on the back of the alternator are clean and the cables are fastened securely to the proper terminals as follows (Illust. 11):

- a. The black cable is connected to the "GRD" (ground) screw (1).
- b. The red cable is connected to the "BAT" (battery) terminal (2).
- c. The "FIELD" connector is fully depressed and locked into the alternator receptacle (3).

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 (-) terminal on the battery. (Refer to the "Wiring Diagrams" on pages 43 and 44 for proper connections.
6. Service the battery as instructed on the tag attached to the battery.
7. Remove the spark plugs and put about one teaspoonful of engine oil into each cylinder. Install and tighten the spark plugs (refer to "Torques" on page 7) and crank the engine to distribute the oil over the cylinder walls.

NOTE: The lubrication procedure above is necessary only in starting a new engine or one that has been idle for a long time. For the procedure in starting an engine that has been removed from storage, refer to "PREPARING STORED ENGINE FOR SERVICE" on page 56.

8. Operate a new engine with light loads only for the first 20 to 30 hours at wide open throttle.

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 +120°F. Refer to "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 19 for proper type and viscosity of oil to be used for the prevailing air temperatures and drain periods.

OPERATION

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 in the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 19.

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.

Transmission

The lubricant in the transmission can be used 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 19.

PRECAUTIONS

General

Your engine is designed to operate on one of the following fuels: gasoline, liquefied petroleum or natural gas. Do not attempt to operate this unit on a fuel other than that for which it is equipped.

The power take-off clutch must be adjusted several times within the first 10 hours of operation. Refer to "Adjustment" on page 53 for the correct adjusting procedure.

Do not pour cold coolant into the radiator or expansion tank 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 or expansion tank. Tighten the cap securely.

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.

Do not attempt to adjust the governor. The governor is set at the factory. If the governor 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 an engine in an enclosed building unless the exhaust is properly ventilated. Refer to "VENTILATION FOR ENGINES INSTALLED INSIDE OF BUILDINGS" on page 4.

Because of fire hazards and insurance regulations, 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.

Liquefied Petroleum Gas or Natural Gas Engines



CAUTION: SAFETY PRECAUTIONS IN THE HANDLING OF BUTANE-PROPANE CANNOT BE OVER-EMPHASIZED. THERE ARE STATE, COUNTY OR CITY LAWS, ORDINANCES, AND FIRE REGULATIONS COVERING THE UTILIZATION OF LIQUEFIED PETROLEUM GAS OR NATURAL GAS. SUCH LAWS, ORDINANCES AND FIRE REGULATIONS ON THIS SUBJECT MUST BE ADHERED TO IN ADDITION TO THE SAFETY RULES GIVEN BELOW.

Where local rules are more stringent than these given, the local rules are to be given priority.

These rules apply to servicing any engine using liquefied petroleum gas (butane-propane) or natural gas for engine fuel regardless of the nature of the work to be performed.

Select a location for servicing these engines where there will be good air circulation. This is to avoid accumulation of gas-air mixtures in and about the engine caused by undetected leaks.

OPERATION

Such location must be as far as possible from steam cleaners, hot water cleaners, hot dip tanks, etc., and any other device operating with an open flame.

Shut off the main valves at the fuel tanks and allow the engine to run until all fuel in the system, from the tank to the engine, is exhausted. In the event the engine is inoperative, shut the valve at the tank. Vent the fuel system of liquefied petroleum or natural gas outside the building before moving the engine into the shop.

"DANGER" signs must be placed on both sides of the engine. There is to be no smoking in the vicinity. No work is to be performed on this engine or on others in a nearby zone involving open flames, such as cutting, welding, grinding, chiseling or any similar operation which may produce sparks.

A fire extinguisher (dry powder or carbon dioxide, CO₂) must be placed adjacent to the mechanic's working area, handy for immediate use. When liquefied petroleum gas ignites, it should be allowed to burn, if possible, until the source of fuel is shut off. Extinguishing the fire before this is accomplished can result in dangerous accumulations of gas which might cause a more serious flash or explosion.

After completing service work and before starting the engine, allow air to circulate around the engine to remove any possible gas accumulation.

Never use liquefied petroleum gas from the fuel tanks for cleaning parts. This is mentioned because inspections have revealed that operators have used it as a substitute for solvents and compressed air, not realizing the extreme danger of this practice.

Whenever the nature of service work requires any operation on the fuel system, the following must be observed:

- a. All threaded connections should be treated with an insoluble lubricant (Permatex or aviation gasket maker). Replace worn or defective fittings.
- b. After connecting the fuel system, check it for leaks. Leaks are not permissible. Odorants, which are strong smelling compounds (an odor similar to spoiled cabbage), are added to liquefied petroleum gas as warning agents to indicate the leakage of even small quantities of gas.
- c. A lather of soap, brushed on with a soft brush, will indicate the presence of leaks, which are dangerous and wasteful. Never use an open flame to check for leakage.

Pay particular attention to short lengths of rubber hose used anywhere in the piping system to relieve stress and vibration.

Any necessary work on liquefied petroleum gas or natural gas fuel tanks must be performed by qualified concerns who normally service such containers and who are familiar with local regulations, inspections and tests after any repairs are made.

It is important to remember that all liquefied petroleum gas systems are pressurized. Be certain that the tank valves are tightly closed and all fuel has been exhausted from the lines before starting any repair work on the fuel system.

PREPARING THE ENGINE FOR EACH DAY'S WORK

Fuel System (Gasoline)

Fill the fuel tank. Use a gasoline conforming to the specifications as shown on page 7. DO NOT USE DIRTY FUEL.

◆ CAUTION: NEVER FILL THE FUEL TANK WHEN NEAR AN OPEN FLAME OR WHEN THE ENGINE IS OPERATING. KEEP THE FUNNEL OR HOSE NOZZLE, USED FOR POURING IN THE FUEL, IN CONTACT WITH THE METAL OF THE TANK TO AVOID THE POSSIBILITY OF AN ELECTRIC SPARK IGNITING THE GAS. DO NOT LIGHT MATCHES NEAR GASOLINE, AS THE AIR WITHIN A RADIUS OF SEVERAL FEET IS PERMEATED WITH A HIGHLY EXPLOSIVE VAPOR.

Cooling System

NOTE: Do not start the engine until the cooling system is filled with coolant.

Remove the radiator cap or the expansion tank filler cap and check to be sure the coolant comes to a level approximately one inch below the filler neck. Add coolant if necessary. Install the filler cap or the radiator cap and tighten it securely.

Lubrication

Check the air cleaner to be sure the oil is up to the "OIL LEVEL" head marking on the inside of the oil cup.

Be sure that the oil level in the crankcase is up to the "FULL" mark on the crankcase oil level gauge. Refer to the "LUBRICATION GUIDE" on pages 20 to 24 for complete lubrication requirements.

OPERATING THE ENGINE

Starting the Engine

Read and observe the "PRECAUTIONS" on pages 12 and 13.

1. Open the shut-off valve on the fuel supply line.
2. POWER TAKE-OFF (IF EQUIPPED): Place the clutch lever in the "Disengaged" position (Illust. 9).
3. TRANSMISSION CLUTCH (IF EQUIPPED): Disengage the clutch.
4. TRANSMISSION (IF EQUIPPED): Place the transmission gearshift lever (Illust. 10) into "neutral" (N). Release the clutch release shaft lever.

5. GOVERNOR CONTROL KNOB (IF EQUIPPED): Move the knob until it is about one-quarter advanced.

NOTE: LIQUEFIED PETROLEUM AND NATURAL GAS ENGINES ONLY: Set the knob at one-half advanced.

6. GASOLINE ENGINES ONLY: Pull the choke control button out part way. (In cold weather pull it out all the way.)

7. INSTRUMENT PANEL (SAFETY GAUGES) (IF EQUIPPED):

- a. Move the safety control toggle switch to the "OFF" position.
- b. Push in the ignition relay switch.

8. Turn the ignition and starter switch all the way to the right to the "ST" position.

NOTE: Never operate the cranking motor for more than 30 seconds at one time. If the engine does not start, allow the cranking motor to cool two or three minutes before cranking again.

9. If the engine will not start in cold or damp weather, remove and dry the spark plugs. Check the spark plug gap. Refer to "SPECIFICATIONS" on pages 6 and 7. Reinstall and tighten the plugs. Refer to "Torques" on page 7 for the specified torque.

10. GASOLINE ENGINES ONLY: After the engine starts, push the choke control button in to a point where the engine runs without missing

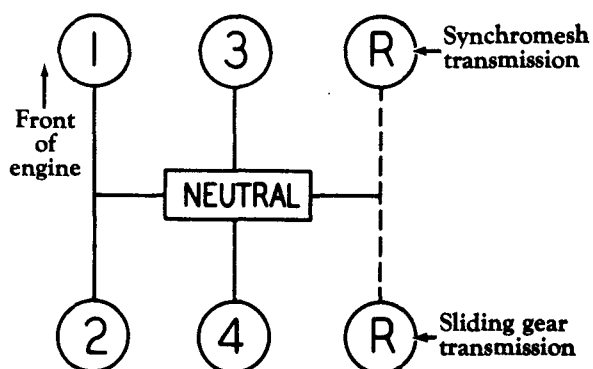
and, as the engine warms up, gradually push the choke all the way in.

11. GOVERNOR CONTROL KNOB (IF EQUIPPED): Adjust the knob to meet the load requirements.

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

13. TRANSMISSION CLUTCH (IF EQUIPPED): Disengage the clutch.

14. TRANSMISSION (IF EQUIPPED): Move the transmission gearshift lever to the correct position for the speed desired (Illust. 12). Slowly release the clutch release shaft lever to pick up the load.



IPA-56338

Illust. 12
Transmission Gearshift Shift Pattern.

15. INSTRUMENT PANEL (SAFETY GAUGES) (IF EQUIPPED): Move the safety control toggle switch to the "ON" position.

16. Check all instruments for the proper readings. Refer to the "Instrument Check" on page 15.

Transmission Gear Ratios

SPEED	REDUCTION
1st.	6.4 to 1
2nd.	3.1 to 1
3rd.	1.7 to 1
4th.	1.0 to 1
Rev.	7.8 to 1

Instrument Check

Check all gauges (Illust. 6 or 7) 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.

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 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" range and should remain there during regular operation.

Engine Coolant Temperature Safety Gauge

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.

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.

Safety Engine Oil Pressure Gauge

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.

Stopping the Engine

1. POWER TAKE-OFF (IF EQUIPPED): Place the clutch lever in the "disengaged" position (Illust. 9).
2. TRANSMISSION CLUTCH (IF EQUIPPED): Disengage the clutch.
3. TRANSMISSION (IF EQUIPPED): Place the transmission gearshift lever in neutral (N). Engage the transmission clutch.
4. INSTRUMENT PANEL (SAFETY GAUGES) (IF EQUIPPED): Move the safety control toggle switch to the "OFF" position.
5. GOVERNOR CONTROL KNOB (IF EQUIPPED): Move the knob to the "low idle" position.

Operate the engine at low idle for a minimum of three minutes to avoid excessive loss of coolant due to "afterboil" or heat surge.

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

6. Turn the ignition and starter switch to the "OFF" position.

SCHEDULED MAINTENANCE

Scheduled and periodic maintenance and 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 engine be systematically inspected and maintained at the intervals outlined below.

SCHEDULED

Point of Inspection

Remarks

After Every 10 Hours of Operation

*Air cleaner intake cap	Remove and clean. Refer to "Air Cleaner Intake Cap" on page 36.
*Air cleaner oil cup (wet type)	Check to be sure the oil is up to the "OIL LEVEL" mark on the oil cup. Clean and refill the oil cup when 1/2 inch of dirt has accumulated in the cup. Refer to "Cleaning the Oil Cup" on page 33.
Cooling system	Check the coolant level in the radiator. Refer to "Cooling System" on page 25.
Lubrication points	Refer to the "LUBRICATION GUIDE" on pages 20 to 24.

After Every 50 Hours of Operation

*Air cleaner element (dry type)	Clean. Refer to "Filter Element Service" on pages 34 to 36.
Flexible rubber connections between air cleaner and intake manifold	Inspect for loose fit or damage.
Flo-matic control linkage	Apply two or three drops of oil to the Flo-matic control linkage.
Fan belt	Check the tension. Refer to "BELT" on page 32.
**Power take-off clutch	Check and adjust if necessary. Refer to "Adjustment" on page 53.
Radiator core	Clean the core. Refer to "Cleaning the Radiator Core" on page 28.
Lubrication points	Refer to the "LUBRICATION GUIDE" on pages 20 to 24.

After Every 100 Hours of Operation

Automatic dust unloader (dry type air cleaner only)	Empty. Refer to "Automatic Dust Unloader" on page 34.
***Battery liquid level	Check. Refer to "Liquid Level" on page 41.
Lubrication points	Refer to the "LUBRICATION GUIDE" on pages 20 to 24.

*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 equipment can be checked less frequently.

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

SCHEDULED MAINTENANCE

SCHEDULED

Point of Inspection	Remarks
<u>After Every 150 Hours of Operation</u>	
****Spark plugs	Gasoline Engines: Remove and clean. Check gap. Refer to "Spark Plugs" on page 40.
<u>After Every 250 Hours of Operation</u>	
*Crankcase breather	Remove and clean. Refer to "Crankcase Breather" on page 36.
Distributor contact points	Check the gap. Refer to "Checking the Breaker Chamber and Breaker Points" on page 42.
Electric fuel pump	Clean the filter screen. Refer to "Cleaning the Filter Screen" on page 48.
Fuel pump sediment bowl (mechanical fuel pump).	Remove and clean. Refer to "Cleaning the Fuel Pump Filter" on page 47.
Lubrication points	Refer to the "LUBRICATION GUIDE" on pages 20 to 24.
<u>After Every 500 Hours of Operation</u>	
Carburetor fuel screen (gasoline)	Remove and clean. Refer to "Carburetor" on page 46.
Cooling system	Clean. Refer to "Cleaning the Cooling System" on page 28.
Distributor cap	Remove and clean. Refer to "Distributor Cap" on page 41.
Engine valves	Check clearances. Refer to "Valve Clearance Adjustment" on page 38.
Lubrication points	Refer to "LUBRICATION GUIDE" on pages 20 to 24.
<u>After Every 1000 Hours of Operation</u>	
Lubrication points	Refer to "LUBRICATION GUIDE" on pages 20 to 24.

PERIODIC

Battery terminals	Clean the terminals. Refer to "Cleaning and Servicing the Battery" on page 41.
Fuel filter (LPG)	Change filter. Refer to page 52.
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 this point more frequently.

****The spark plug maintenance hourly interval can be extended on engines using straight natural gas or LPG as fuel.

SCHEDULED MAINTENANCE

For information about the lubrication of a new engine, refer to "LUBRICATION WHEN SHIPPED" on page 9.

LUBRICATION

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 and excessively heavy loads with high oil temperatures. 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 19.

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.

NOTE: It is not necessary to change the lubrication in the different compartments when the temperature falls into a different range during a working day. For example: Grade-30 oil may be used instead of Grade-10 oil in temperatures below +32°F if no starting difficulty is experienced; Grade-10 oil, that is specified for use in temperatures of +32°F to -10°F, may be used in temperatures as high as +40°F, except when operating under continuously heavy loads.

Thinning the Crankcase Oil

In LPG or natural gas engines there may be a tendency for the oil in the crankcase, to gradually become thicker. In such cases, it may be desirable to use a lighter grade oil or in cold weather to add one quart of kerosine to the crankcase between specified oil changes in order to maintain easy cranking.

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 19.

SCHEDULED MAINTENANCE

LUBRICANT SPECIFICATIONS AND CAPACITIES CHART (U.S. MEASURE)					
LUBRICANT KEY: EO - Engine Oil MPL - Multi-purpose Type Gear Lubricant MPG - Multi-purpose Grease					
Lubrication Point	Capacity	ANTICIPATED AIR TEMPERATURE			
		Above +32°F	+32°F to +10°F	+10°F to -10°F	Below -10°F
Crankcase		<u>EO</u> - MIL-L-2104B, Sup. 1, DEF-2101D, or Service "MS" (*) (See Chart Below)			
With Filter	9 qts.	SAE 30 or	SAE 10W or	SAE 10W w/	SAE 10W w/
Less Filter	8 qts.	SAE 20W-40	SAE 10W-30	10% kerosine	20% kerosine
Air Cleaner Oil Cup (Wet Type): Donaldson	2-3/4 pts.	Use the same type and grade lubricant as in the crankcase			
Transmission:		<u>MPL</u> - IH B-22 Grade 135H EP or MIL-L-2105B (NOTE 1)			
Sliding Gear Synchromesh	5 pts. 7 pts.	Grade-90 (Note 2)	Grade-80 (Note 2)	MIL-L-10324A	
Power Take-off	Fill as instructed	<u>EO</u> - MIL-L-2104B, Sup. 1, DEF-2101D, Service "MS" (*) Series 3 or MIL-L-45199B			
		SAE 30	SAE 20	SAE 10	
All Lubrica- tion Fittings	Fill as in- structed	<u>MPG</u> - IH 251H EP or equivalent #2 multi-purpose lithium grease			

(*) - If an oil for service "MS" is used, it should have been performance tested in accordance with the "Engine Operating Test Sequences for MS Service" as published in the current hand book of the SAE (Society of Automotive Engineers, Inc.). These sequences are sometimes referred to as the "ASTM G-IV Test Sequences". Oil so tested should have their containers marked with a closely related qualifying phrase.

NOTE 1 - For specifications consult your authorized International Engine Distributor or Dealer.

NOTE 2 - A multigrade SAE 80-90 gear lubricant may be used at temperatures between 90°F and -10°F as an option to grades 80 and 90. An SAE 140 viscosity grade may be used at temperatures above 90°F.

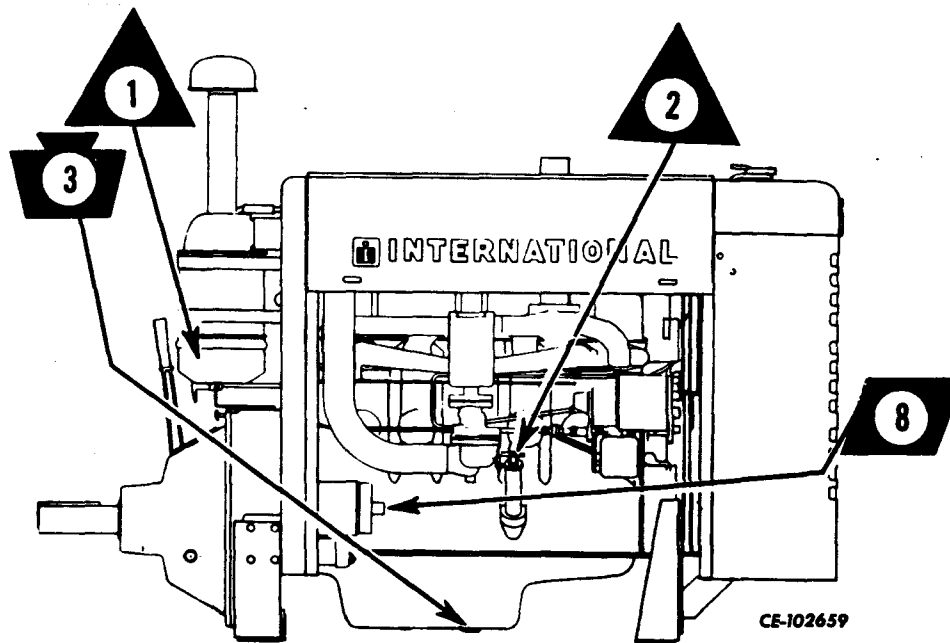
Gasoline engines	MS designated as qualified MIL-B (Note 3)
Natural gas and LPG engines	Low-ash or Ashless oils of Sup. 1 (Notes 3 and 4) or MIL-B Level
NOTES: (3) All oils must also pass the wear test sequences specified API "For Service MS" oils. MIL-B refers to oils qualified against the new MIL-L-2104B specification. (4) Ashless oils refer to oils containing complete Ashless additive formulations; low-ash oils to those oils containing Ashless dispersants and metal-organic oxidation inhibitors.	

SCHEDULED MAINTENANCE

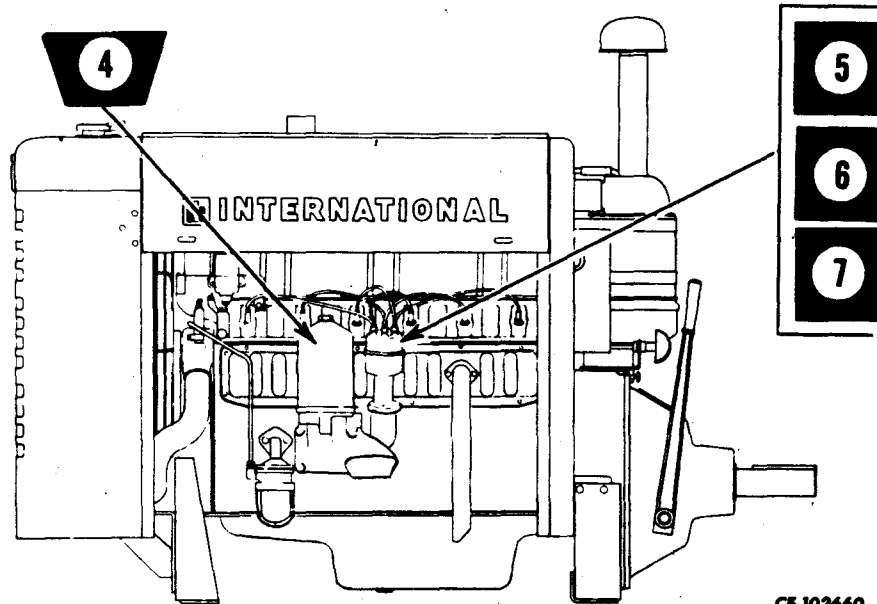
LUBRICATION GUIDE

Always use clean containers. Keep the lubricator clean. Wipe dirt from the fittings before installing fresh lubricant.

Occasionally apply a few drops of engine oil to the engine control linkage and flo-matic control linkage.



LUBRICATION POINTS RIGHT SIDE



LUBRICATION POINTS LEFT SIDE

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

▲ - 10 hours ▮ - 100 hours ▮ - 200 hours ■ - 500 hours ▮ - 1000 hours

SCHEDULED MAINTENANCE

Key to Lubrication Guide

The symbols shown around the reference numbers shown in the illustrations on page 20 indicate the intervals of lubrication. Paragraph numbers correspond to reference numbers shown on these illustrations.



- Daily or After Every 10 Hours of Operation

1. Air Cleaner

— Check oil level. Clean and fill when 1/4 inch of dirt has accumulated or when oil will not flow freely.

2. Engine oil filler 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 100 Hours of Operation

3. Oil filter drain plug.

— Remove the crankcase oil pan drain plug and drain completely while the oil is warm; refill to the "FULL" mark on the gauge (on power units equipped with an oil level sight gauge, remove the drain plug from the nipple). (On LPG or natural gas engines drain after 500 hours of operation.)



- After Every 200 Hours of Operation

4. Engine oil filter.

— Drain the filter and replace the filter element. For correct procedure refer to "LUBRICATING OIL FILTER" in the "MAINTENANCE" section. (On LPG or natural gas engines replace the filter element after 500 hours of operation.)

Continued on next page.

SCHEDULED MAINTENANCE

Key to Lubrication Guide

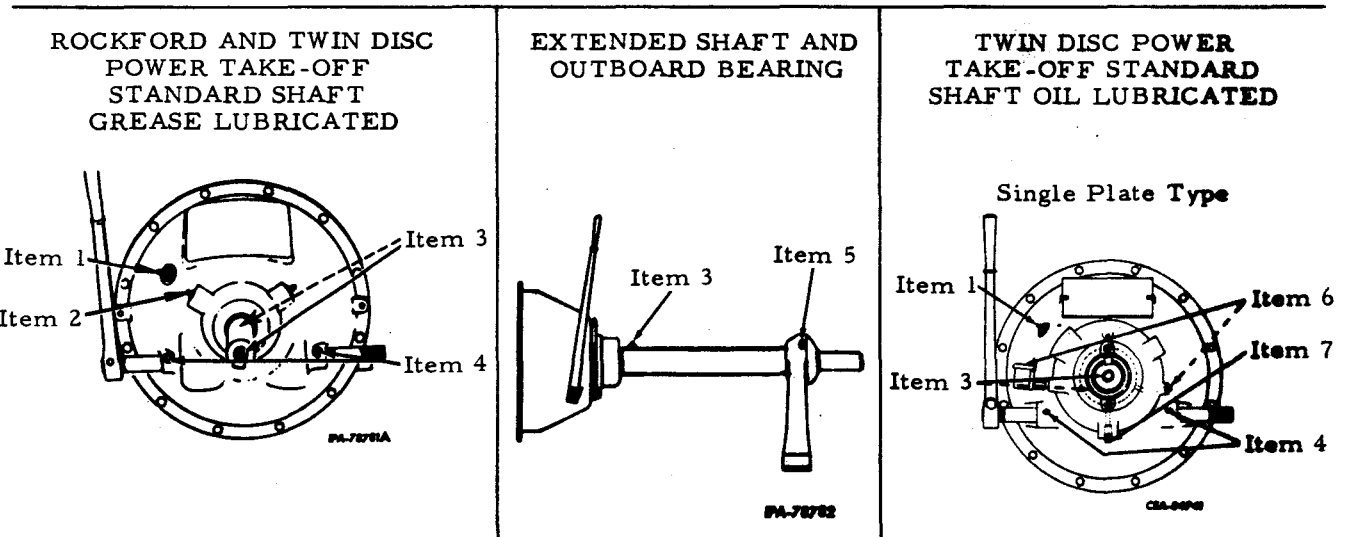
- After Every 500 Hours of Operation

- | | | |
|-------------------------------|---|---|
| 5. Distributor rotor. | — | Remove the distributor cap and rotor. Apply 1 or 2 drops of oil to felt in end of rotor shaft. |
| 6. Distributor rotor shaft | — | Remove the grease plug and insert a lubrication fitting. Apply four or five strokes of the lubricator (approx. 1/4 oz.) to the distributor fitting using IH 251H EP grease or equivalent #2 multi-purpose lithium grease (MPG). |
| 7. Breaker arm rubbing block. | — | Pack a small quantity of Amogrease 4X or Chevron OHT grease back of the block. |

- After Every 1000 Hours of Operation

- | | | |
|------------------------|---|--|
| 8. Cranking motor. | — | Remove cranking motor from the engine. Remove drive end housing plug and saturate wick with engine oil. Reinstall plug. |
| Oil level sight gauge. | — | (If equipped.) This gauge allows the oil level to be checked with the engine running. Always check the oil level with the engine running at its normal operating speed. To set this gauge after changing the crankcase oil, refer to "OIL LEVEL SIGHT GAUGE" in the "MAINTENANCE" section. |
| 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 (MPG). |

Points of lubrication are individually explained under "LUBRICATION INSTRUCTIONS" on page 23.



SCHEDULED MAINTENANCE

LUBRICATION INSTRUCTIONS

em No.	Description	Lubri- cant	Hrs.	Item No.	Description	Lubri- cant	Hrs.
1	Clutch Throwout Bearing* Day-in and day out full speed operation Less than 10 engagements per day-normal daily usage Over 10 engagements per day-normal daily usage Apply one or two strokes from a hand operated grease gun	MPG	10 50 10	4	Clutch Hand Lever Shaft (or Cross Shaft) depending on the type of lubrication. <u>Greased Type</u> Apply two or three strokes of the lubricator <u>Oiled Type</u> Apply five or six drops of oil in each cup	MPG EO	100 100
2	Clutch Shaft Outer Bearing* Day-in and day-out full speed operation-in-line and side load drives In-line drives-normal daily usage Heavy side load drives-daily usage Apply four or five strokes from a hand operated grease gun (on some clutches, the fitting is located on the opposite side)	MPG	50 100# 50	5	Outboard Bearing, Extended Shaft Apply four or five strokes from a hand operated grease gun	MPG	50
				6	Clutch Shaft Outer Bearing Filler and Level Plugs 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.	EO	100
3	Clutch Pilot Bearing* <u>Grease Type</u> Day-in and day-out full speed operation Less than 10 engagements per day-normal daily usage Over 10 engagements per day-normal daily usage Apply one or two strokes from a hand operated grease gun Refer to NOTES 1 and 2 <u>Sealed-for-Life Type</u> Requires no greasing.	MPG	200¢ 100# 50	7	Clutch Shaft Outer Bearing Drain Plug Remove drain plug while lubricant is still warm. After allowing time for complete draining, reinstall plug and refill at filler.	EO	500
		Replace every 4000 hrs. or two years.		8	Miscellaneous (Not illustrated) Remove P. T. O. name plate and lubricate Overcenter Clutch Release Linkage Joints and Pins Apply slight amount of grease or one or two drops of oil Clutch Throwout Collar (or bearing) Bosses and Yoke Forks Apply slight amount of grease to each boss.	MPG or EO MPG	500 500

* - 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.

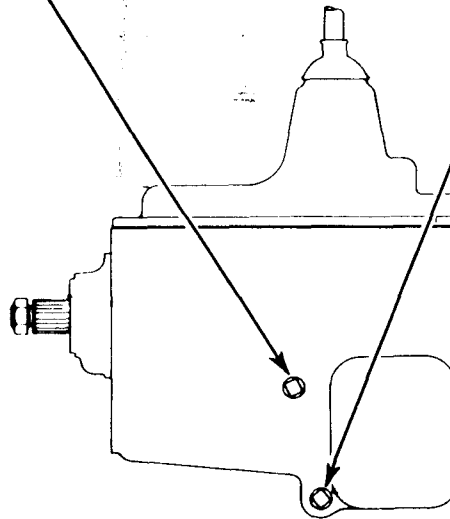
NOTE 2 - On applications where the end of the output shaft is covered with a universal joint or flexible coupling, transfer the lubrication fitting from the end of the shaft to the cross drilled location (indicated by dotted arrow). Use the pipe plug removed from the cross drilled hole to close the opening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

LUBRICATION GUIDE

Point of Lubrication Lubricant Hours

Transmission level . . . MPL
Remove the filler and level plug. Check to be sure the level is at the bottom of the filler opening. Install the filler and level plug.

50



CEA-84740

Hours Lubricant Point of Lubrication

250

MPL

Transmission drain
Remove the drain plug; also remove the filler and level plug while the lubricant is still warm. Drain and flush the transmission case. Install the drain plug. Fill to the bottom of the filler opening. Install the filler and level plug.

SCHEDULED MAINTENANCE

LUBRICATION POINTS FOR THE TRANSMISSION

SCHEDULED MAINTENANCE

LUBRICATION INSTRUCTIONS

em No.	Description	Lubri- cant	Hrs.	Item No.	Description	Lubri- cant	Hrs.
1	Clutch Throwout Bearing* Day-in and day out full speed operation Less than 10 engagements per day-normal daily usage Over 10 engagements per day-normal daily usage Apply one or two strokes from a hand operated grease gun	MPG	10 50 10	4	Clutch Hand Lever Shaft (or Cross Shaft) depending on the type of lubrication. <u>Greased Type</u> Apply two or three strokes of the lubricator <u>Oiled Type</u> Apply five or six drops of oil in each cup	MPG EO	100 100
2	Clutch Shaft Outer Bearing* Day-in and day-out full speed operation-in-line and side load drives In-line drives-normal daily usage Heavy side load drives-daily usage Apply four or five strokes from a hand operated grease gun (on some clutches, the fitting is located on the opposite side)	MPG	50 100# 50	5	Outboard Bearing, Extended Shaft Apply four or five strokes from a hand operated grease gun	MPG	50
3	Clutch Pilot Bearing* <u>Grease Type</u> Day-in and day-out full speed operation Less than 10 engagements per day-normal daily usage Over 10 engagements per day-normal daily usage Apply one or two strokes from a hand operated grease gun Refer to NOTES 1 and 2 <u>Sealed-for-Life Type</u> Requires no greasing.	MPG	200¢ 100# 50	6	Clutch Shaft Outer Bearing Filler and Level Plugs 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.	EO	100
				7	Clutch Shaft Outer Bearing Drain Plug Remove drain plug while lubricant is still warm. After allowing time for complete draining, reinstall plug and refill at filler.	EO	500
				8	Miscellaneous (Not illustrated) Remove P. T. O. name plate and lubricate Overcenter Clutch Release Linkage Joints and Pins Apply slight amount of grease or one or two drops of oil Clutch Throwout Collar (or bearing) Bosses and Yoke Forks Apply slight amount of grease to each boss.	MPG or EO MPG	500 500

* - 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 the opening in the end of the output shaft. This fitting is the only means of lubricating the clutch pilot bearing.

LUBRICATION GUIDE

Point of Lubrication Lubricant Hours

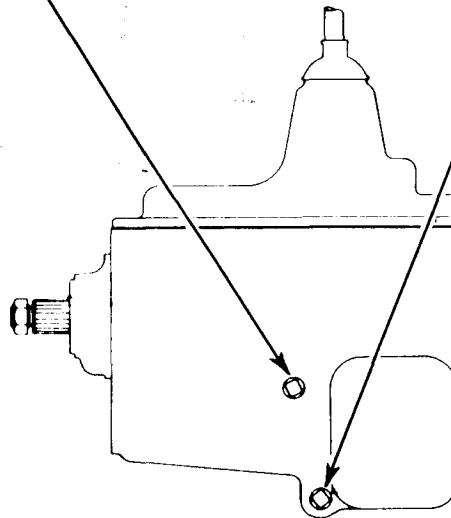
Transmission level . . . MPL
Remove the filler and level plug. Check to be sure the level is at the bottom of the filler opening. Install the filler and level plug.

50

Hours Lubricant Point of Lubrication

250

MPL Transmission drain
Remove the drain plug; also remove the filler and level plug while the lubricant is still warm. Drain and flush the transmission case. Install the drain plug. Fill to the bottom of the filler opening. Install the filler and level plug.



CEA-84740

LUBRICATION POINTS FOR THE TRANSMISSION

SCHEDULED MAINTENANCE

PREPARING FOR COLD WEATHER

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

Fuel System

Use only a fuel conforming to the proper specifications as shown under fuel specifications on page 7.

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

Lubrication

Lubricate the engine completely with lubricants specified for operation below +32°F as outlined in the "LUBRICATION GUIDE" on pages 20 to 24.

Cooling System

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

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

1. Check the system for leaks.
2. Inspect all hoses and tighten all hose clamps. Install new hoses if necessary.
3. Drain and clean the system. Refer to "Draining the Cooling System" and "Cleaning the Cooling System" on pages 27 and 28.
4. Check the operating condition of the thermostat. Refer to "Thermostat" on page 29.
5. Check the condition and tension of the fan belt. Replace the belt if necessary. Refer to "BELT" on pages 32 and 33.
6. Be sure all drain valves are closed, and all connections securely tightened.
7. Install the required amount of anti-freeze (refer to the following paragraph "Anti-Freeze Solutions") into the engine and fill the system with coolant as outlined under "Filling the Cooling System" on page 28.

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

Anti-Freeze Solutions

IH Premium anti-freeze (permanent type) is the recommended solution to be used in this engine. Do not use Menthanol or alcohol as an anti-freeze.

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.

Check the solution frequently to be sure the cooling system has sufficient protection against freezing.

NOTE: When testing the solution be sure the system is at normal operating temperature. This is necessary to obtain an accurate reading.

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

Freezing Point (Fahrenheit)	USE IN COOLING SYSTEM
	IH Premium (Ethylene Glycol-Permanent Type)
+20°	15%
+10°	25%
0°	33-1/3%
-10°	40%
-20°	45%
-30°	50%
-40°	54%
-50°	58%

Battery

When the air temperature drops to +32°F or lower, the efficiency of the battery decreases rapidly. At temperatures of -20°F or lower, do not try to start the engine unless the battery has been heated. Immersion in warm water to

Continued on next page.

within an inch or two of the top of the battery case is a satisfactory means of warming a battery.

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 FLAME NEAR THE BATTERIES. AVOID SPILLING ANY ELECTROLYTE ON HANDS OR CLOTHING.

PREPARING FOR HOT WEATHER

Lubrication

Lubricate the engine completely with the lubricants specified for operation above +32°F as outlined in the "LUBRICATION GUIDE" on pages 20 to 24.

Fuel System

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

Battery

Inspect the battery frequently to be sure the electrolyte is at the correct level. (Refer to "Liquid Level" on page 41.)

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 28.) When filling the cooling system, follow the method described under "Filling the Cooling System" on page 28.
2. Insects and dirt must be cleaned from the external part of the radiator. (Refer to "Cleaning the Radiator Core" on page 28.)
3. Check the condition and tension of the fan belt. Replace the belt if necessary. Refer to "BELT" on pages 32 and 33.
4. Check the operating condition of the thermostat. Refer to "Thermostat" on page 29.

COOLING SYSTEM

The following maintenance procedures cover two types of cooling systems; the radiator type and the Flo-matic type. These procedures are the same for both types except as indicated.

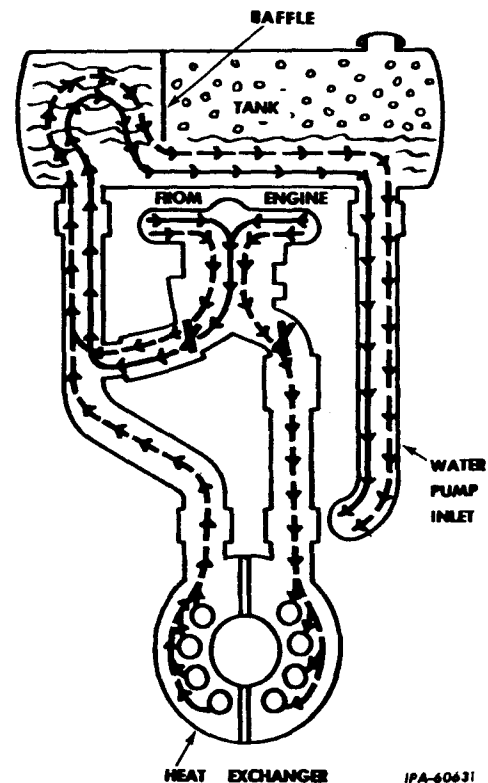
Radiator Type

The radiator type is a pressure-cooled system and will not operate properly unless the cooling system is tight. The filler cap must be properly tightened to the stop. The gasket surface of the cap must be in good condition. 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.

Flo-matic Type (Illust. 13)

The Flo-matic type cooling system automatically maintains the proper engine temperature under normal conditions of operation. A positive centrifugal pump circulates the coolant through the engine block, engine heads and expansion tank.

NOTE: This system is not a pressurized system and is equipped with a vented filler cap.



Illust. 13
Cooling System Circulation.

When the coolant in the cooling system begins to get warm, the double acting Flo-matic valves direct coolant from the engine through the expansion tank and back to the engine. (Solid line).

As the coolant temperature rises, the valves function in unison. One valve starts to open and the other valve starts to close to permit the flow of greater amounts of coolant through the heat exchanger. (Dotted line).

After the engine warm-up, the Flo-matic control maintains coolant temperature automatically by modulating flow to the heat exchanger circuit while sustaining a full flow through the engine cooling system.

Care of the Cooling System

To keep the cooling system free of rust and sludge during warm weather operation, add a cooling system conditioner that is compatible with aluminum. Instructions for its use are printed on each container.

Radiator Cap

A regulating pressure valve, built into the radiator cap, is designed to open at a pressure of approximately 6-1/2 to 8 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.

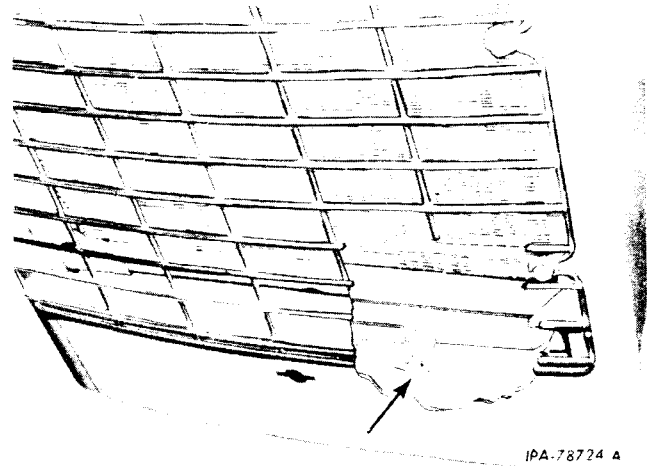
NOTE: Do not attempt to repair or replace any of the regulating valve parts. If the valve is faulty, replace it with a new radiator cap of the same type.

Draining the Cooling System

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

Radiator Type

1. Remove the radiator cap.
2. Open the radiator drain valve (Illust. 14) and the crankcase drain valve (Illust. 15).

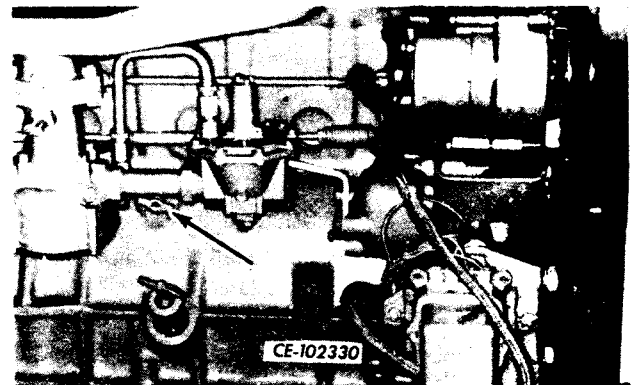


Illust. 14
Radiator Drain Valve.

3. LIQUEFIED PETROLEUM GAS ENGINES: Open the water drain valve located in the bottom of the tee at the L.H. side of the converter regulator.

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

5. Close all of the drain outlets.



Illust. 15
Crankcase Drain Valve.

Flo-matic Type

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

1. Remove the expansion tank cap.

Continued on next page.

2. Open the flo-matic vent valve (Illust. 18) and the crankcase drain valve (Illust. 15). Open the drain valve on the underside of the water outlet tube and the drain valves on the heat exchanger.

3. LIQUEFIED PETROLEUM GAS ENGINES: Open the water drain valve (12)(refer to Illust. 39).

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

5. Close all of the drain outlets.

Cleaning the Cooling System

Drain and thoroughly flush the cooling system twice a year or more often if necessary. The appearance of rust in the radiator, expansion tank or in the 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 27).

2. Close the drains. 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

Radiator Type

1. Close the drain valves.

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

3. Add a cooling system corrosion inhibitor (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."

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.

Flo-matic Type

1. Close the drain valves.

2. Pour or run coolant into the expansion tank slowly until partly full.

3. Add a cooling system corrosion inhibitor (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."

4. Continue to fill the expansion tank until the coolant reaches a level approximately one inch below the bottom of the filler neck.

5. Open the vent valve (Illust. 18) to permit the escape of air. Close the vent valve, then add coolant if needed.

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

Adding Coolant to an Overheated Cooling System

Use caution when removing the radiator or expansion tank cap when adding coolant. Do not pour cold coolant into the radiator or the expansion tank if the engine is very hot, unless conditions make it absolutely necessary. In this case, start the engine and let idle; then slowly pour the coolant into the radiator or the expansion tank.

Thermostat (Radiator Type Only)

The thermostat is the nonadjustable type and is incorporated in the cooling system for the purpose of retarding or restricting circulation of coolant to achieve rapid engine warm-up. The thermostat operating range is $+170^{\circ}\text{F}$ to $+190^{\circ}\text{F}$.

NOTE: Permanent type anti-freeze must be used with this thermostat.

Engine overheating and loss of coolant is sometimes due to an inoperative thermostat. When this condition exists, remove and check the thermostat. Refer to "Removing and Checking the Thermostat" on this page.

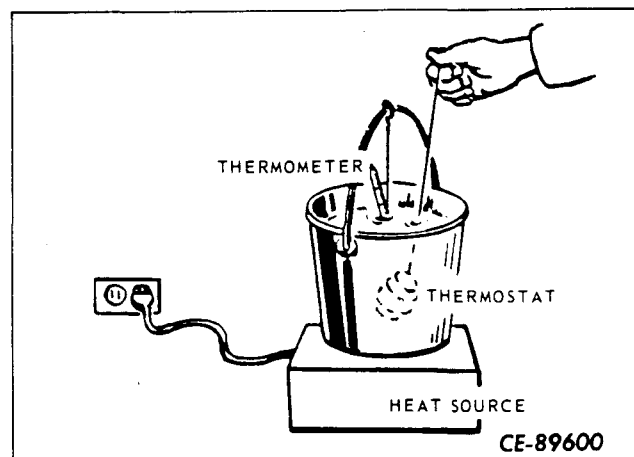
Removing and Checking the Thermostat (Illust. 16 and 17)

1. Remove the hood sheets and hood side doors (if equipped).
2. Drain the cooling system to a point below the housing (3), Illust. 17.
3. Remove the cap screw with lock washer (1). Loosen the cap screw (4) and move the brace (5) down and away from the housing (3).
4. Loosen the clamp and remove the radiator inlet hose from the housing (3).
5. Unscrew the two cap screws (2) and remove the housing (3).
6. Remove the thermostat and housing gasket. Discard the gasket.
7. Clean the thermostat. If the thermostat is coated with scale, it must be replaced. Scale will not allow the thermostat to function correctly.

8. 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. 16
Checking the Thermostat.

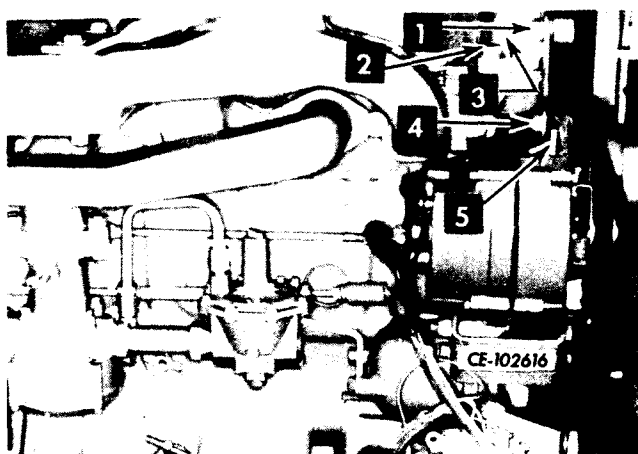
- b. Heat water and carefully note temperature when thermostat starts to open (approx. $+170^{\circ}\text{F}$) and when fully open (approx. $+190^{\circ}\text{F}$).
- c. If thermostat does not function as described, replace it.

Installing the Thermostat (Illust. 17)

1. Clean the housing gasket surface on the cylinder head to assure proper sealing when reassembled.
2. Apply sealer to the gasket surface of the thermostat housing.
3. Install the new gasket and thermostat (valve end up) onto the cylinder head.
4. Position and secure the housing (3) to the cylinder head with the two cap screws (2) and lock washers.

Continued on next page.

5. Install the radiator inlet hose on the housing (3) and tighten the hose clamp. Refer to "TORQUES" on page 7 for specific torques.
6. With the cap screw (1) and lock washer connect the brace (5) to the housing (3). Tighten the cap screws (1 and 4) finger-tight.
7. Adjust the fan belt tension. Refer to "BELT" on pages 32 and 33.
8. Fill the cooling system. Refer to "Filling the Cooling System" on page 28.
9. Operate the engine for correct thermostat performance and observe all cooling system hoses and points of connections for leaks. Correct all leaks, no matter how minor.
10. Install the hood sheets and hood side doors.



Illust. 17
Checking the Thermostat.

1. SCREW, cap.
2. SCREW, cap.
3. HOUSING, thermostat.
4. SCREW, cap.
5. BRACE, alternator adjusting.

Water Pump

The water pump housing is packed with grease at the factory and requires no attention other than replacing the bearings when they show excessive looseness or if a water leak develops, which indicates that a damaged or badly worn seal needs replacement.

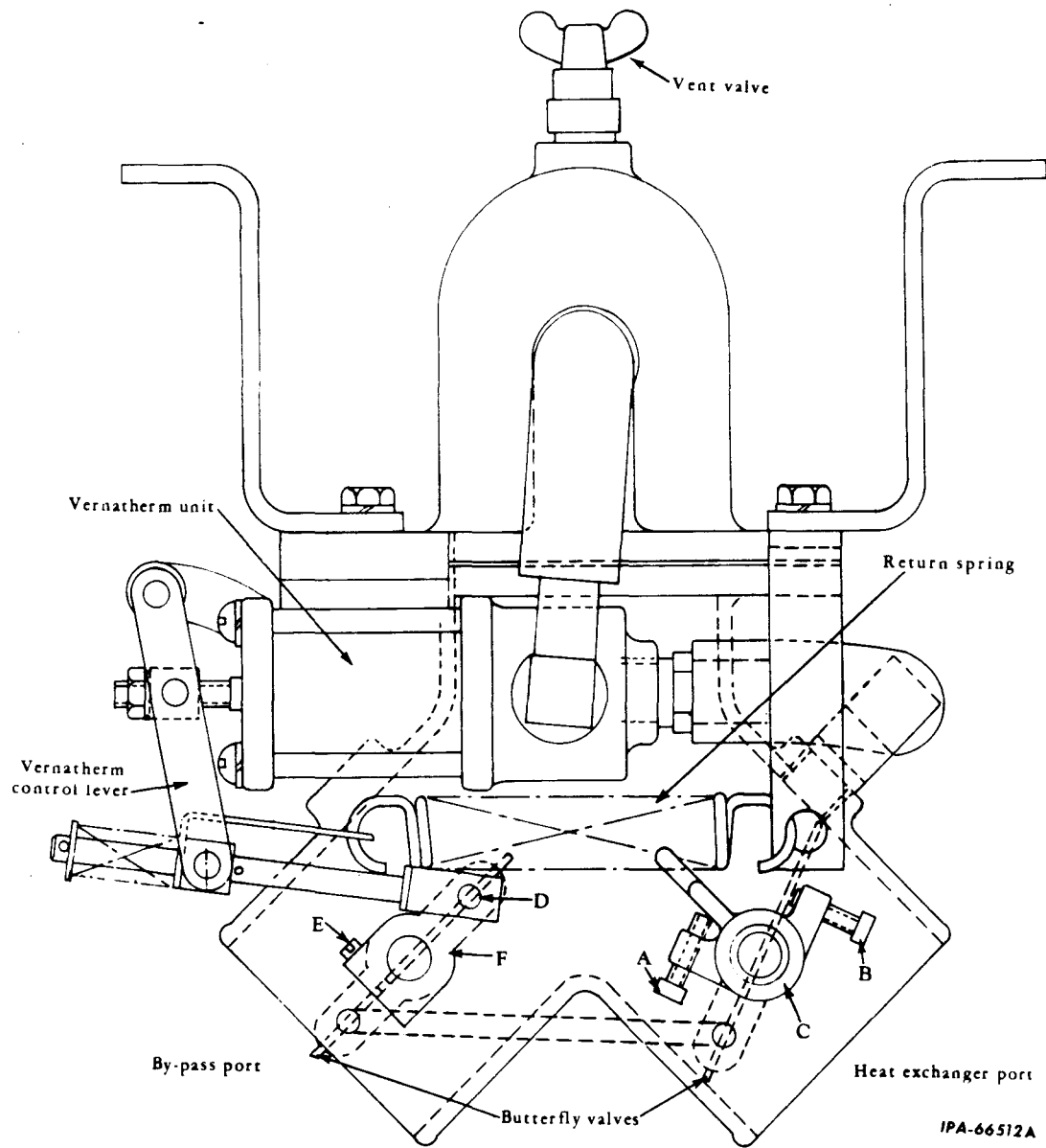
Flo-matic Valve

No adjustment can be made to the Vernatherm unit to increase or decrease operating temperatures. The following adjustments establish only the proper relationship of the Vernatherm control unit and the butterfly valves to provide full opening and complete closing of the by-pass and heat exchanger circuit.

Flo-matic Valve Adjustment (Illust. 18)

1. Drain the cooling system. (Refer to "Flo-matic Type" under "Draining the Cooling System" on page 27.)
2. Remove the by-pass and heat exchanger hoses.
3. Remove Vernatherm return spring.
4. The purpose of the two set screws (A and B) on lever (C) is to prevent butterfly valves from binding and must just make contact with the stop as the valves reach full open and full closed positions. Adjust if required.
5. Remove the pin (D) holding the Vernatherm control lever in (toward Vernatherm control unit). The pin (D) must fall in place without binding. The by-pass port valve must be in full open position and the heat exchanger port valve must be fully closed. If correction is required, proceed as follows:
 - a. Loosen the screw (E) on the lever (F).
 - b. Position the lever (F) as outlined in step 5.
 - c. Tighten the screw (E) (40-45 inch pounds).
 - d. Operate the valve assembly by hand, being sure all linkage operates freely.
 - e. Install the Vernatherm control return spring.
6. Install the by-pass and heat exchanger hoses.
7. Fill the cooling system. (Refer to "Flo-matic Type" under "Filling the Cooling System" on page 28.)

NOTE: If the above adjustments have been made and the satisfactory temperatures are not maintained, consult your authorized International Engine Distributor or Dealer.



Illust. 18
Flo-matic By-Pass Control Valve.

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. 19)

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

The tension is correct when the belt can be depressed by the thumb (approx. 25 lb. load), at points "A" or "B" (Illust. 19), to the deflection values shown in the chart below.

BELT TENSION CHART		
Condition	Fan and Alternator Belt	
	Point A	Point B
New Belt Installation	13/32	1/2
Used Belt (one that has been run 5 minutes or longer)	7/16	17/32

NOTE: Do not allow belt deflection to exceed 5/8 inch for "B" or 1/2 inch for "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 during the oil change period.

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

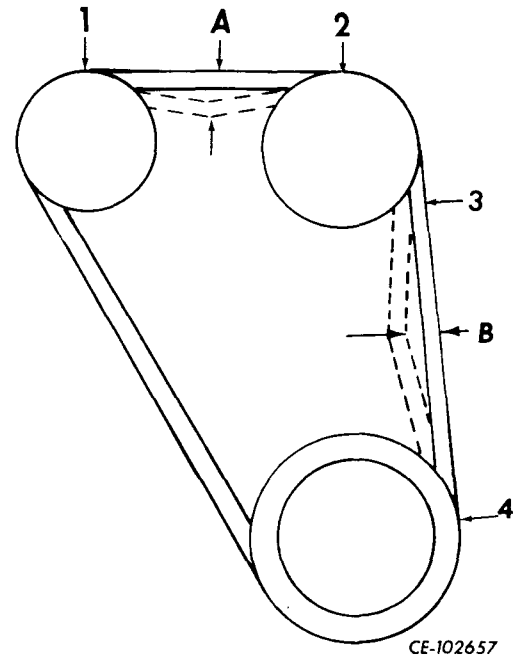
Adjustment (Illust. 20)

Adjust the belt as follows:

1. Loosen the brace bolts (A and B) and the mounting bolt (C).
2. Move the alternator out to tighten the belt, in to loosen the belt to get the correct tension.

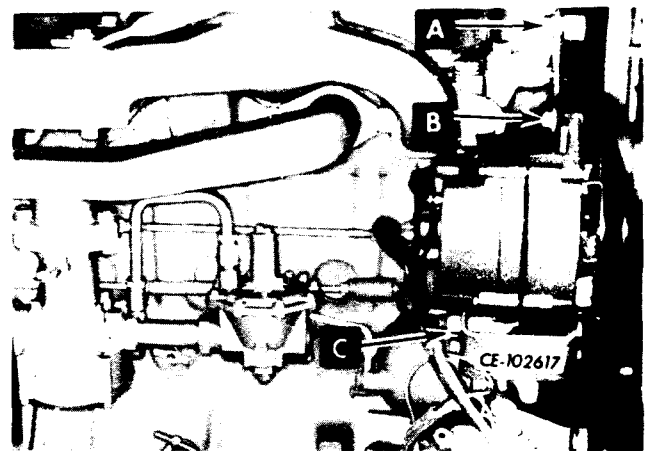
NOTE: Never use a pry bar on the alternator to adjust belt tension; alternator bearing damage will result.

3. Tighten brace bolts (A and B) and mounting bolt (C).



Illust. 19
Belt Tension.

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



Illust. 20
Belt Adjustment, Removal and Replacement.

Removal and Replacement (Illust. 20)

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. 20)

1. Loosen the brace bolts (A and B) and mounting bolt (C).
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 page 32.

AIR CLEANER (WET TYPE)

Precautions

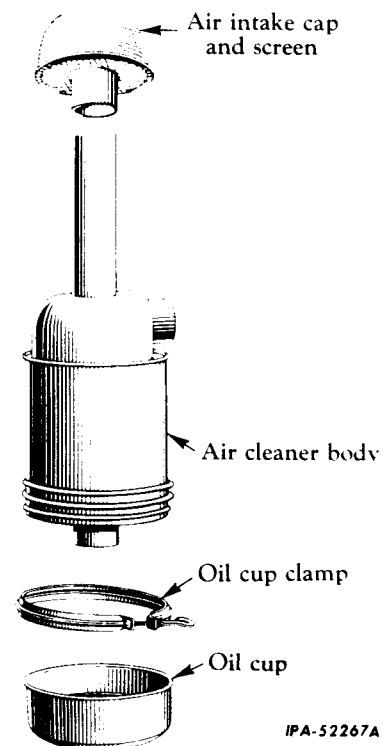
Frequently inspect the flexible rubber hoses between the carburetor and the air cleaner. If they show any sign of deterioration, replace them.

All the joints between the air cleaner and the carburetor and between the manifold and the

cylinders of the engine must be tight. All the gaskets must be in good condition and the bolts must be drawn up tight.

Cleaning the Oil Cup (Illust. 21)

1. Clean or wipe the outer surface of the body before removing the oil cup.
2. Loosen the wing nut assembled to the oil cup clamp and, with a downward movement, separate the cup from the body.
3. Pour out the old oil and thoroughly clean the inside of the oil cup with kerosine.
4. Fill the cup to the "OIL LEVEL" mark with the proper grade of oil. Refer to "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 19.
5. Lift the cup into place on the body. Place the clamp around the cup and the body. Tighten the wing nut assembly thumb tight.



Illust. 21
Air Cleaner Disassembled.

Continued on next page.

Washing the Air Cleaner (Illust. 21)

1. Loosen the air pipe hose clamp and disconnect the hose from the air cleaner.
2. Loosen the wing nut assembled to the oil cup clamp, grasp the oil cup at the sides and with a downward movement, separate the oil cup from the air cleaner body.
3. Empty the oil from the cup, then clean the cup in kerosine.
4. Remove and clean the air intake cap. Refer to "Air Intake Cap" on page 36.
5. Loosen the nut on each mounting bracket and remove the body.
6. Wash the body in kerosine or diesel fuel. Be sure to clean out the air intake pipe.

Installing the Air Cleaner Complete (Illust. 21)

1. Install the air cleaner body into the mounting brackets and tighten the nuts.
2. Fill the cup to the "OIL LEVEL" mark with the proper grade of oil. Refer to "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 19.
3. Lift the cup into place on the body. Place the clamp around the cup and the body. Tighten the wing nut assembly thumb tight.
4. Install the air intake cap.
5. Install and secure the air pipe hose to the air cleaner with the hose 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 carburetor and the air cleaner. If it shows any sign of leakage, correct it.

To eliminate strain on the pipe connection be sure the pipe lines up.

All the joints between the air cleaner and the carburetor and between the manifold and the cylinder of the engine must be tight. All the gaskets must be in good condition and the bolts must be drawn up tight.

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 (6, Illust. 22) 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 17, 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.

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 engine down-time to only a few minutes and will allow sufficient time to service the restricted element properly. (Refer to "Washing" on page 35.)

NOTE: A filter element must be replaced after six 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. Use this method only as a temporary measure until sufficient time is available to clean the element by "Washing." (Refer to "Compressed Air" on page 36.)

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.

MAINTENANCE

Removal and Cleaning (Illust. 22)

1. Stop the engine. Wipe off any accumulation of dust from the element removal end of the body (2). 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 or clean air side must be cleaned up before installing an element.)

2. Loosen the element lock nut and remove the element retainer (4). Remove the element (3).

NOTE: Inspect the "clean air side" of the element (3) and body (2) for unusual accumulation of dust. Dust accumulation on the "clean air side" of the element usually means a rupture in the paper and 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 dirt.

NOTE: Do not tap the 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 non-sudsing detergent added to the water will facilitate the removal of soot.

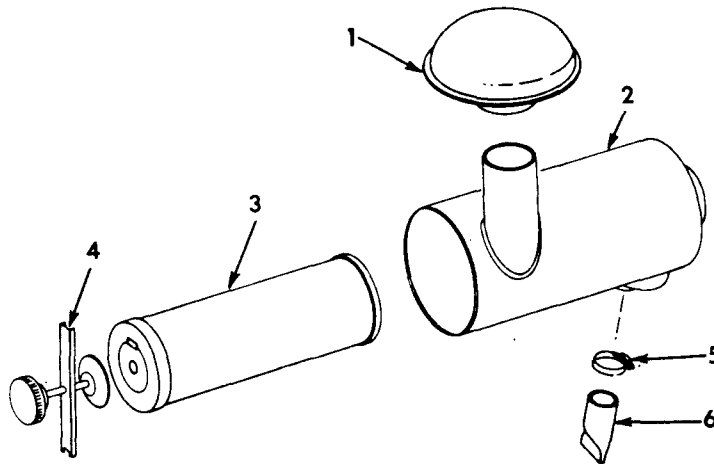
3. Rinse the element in clear water (if a hose is used, do not exceed 40 psi). Shake the element carefully to remove excess water.

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 it 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 36.



CEA-84743

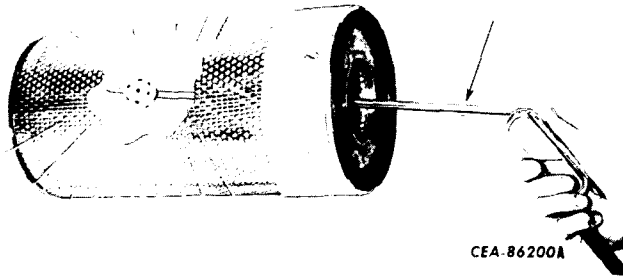
Illust. 22
Air Cleaner Components (Dry Type).

1. CAP, air intake.
2. BODY, air cleaner.
3. ELEMENT, air cleaner.

4. RETAINER, air cleaner element.
5. CLAMP, dust unloader.
6. UNLOADER, dust.

Compressed Air

An element cleaning tool (IH Part No. 407 073 R1, Illust. 23) for use with compressed air, is available from your authorized International Construction Engine distributor or dealer, and will do a faster and more efficient job of removing dust than a regular air gun or nozzle.



Illust. 23
Using Element Cleaning Tool.

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

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

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 test.

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

3. Remove all dirt from the inside of the air cleaner body with a damp cloth. A small amount of non-sudsing detergent added to the water will remove the soot.

4. Check the condition of the dust unloader (6, Illust. 22). If found faulty or damaged, replace it.

Installation (Illust. 22)

1. Install the open end of the element (3) into the body (2). Install the element retainer (4) 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 this page.

3. After the element has been installed, but before resuming operation, inspect and tighten all air cleaner and air induction system connections.

AIR INTAKE CAP (Illust. 21 or 22)

Keep the air intake cap screen clean and free of all restrictions. A twist and an upward pull will remove the 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.

CRANKCASE BREATHER

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 engine is operating under severe conditions, such as extreme dust or excessively heavy loads.

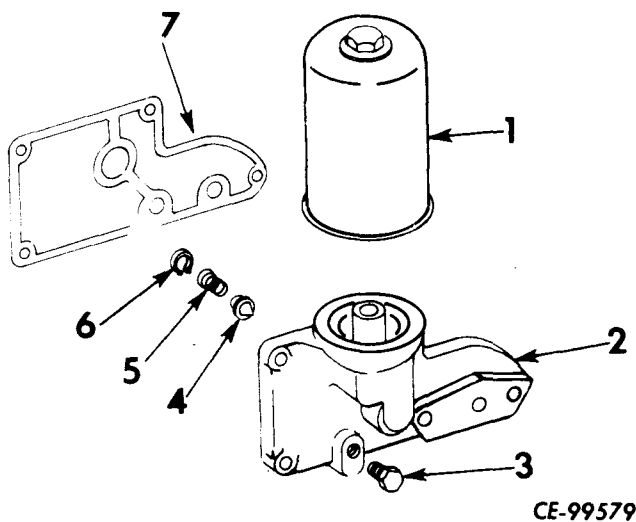
To clean the elements, remove the push rod chamber cover from the engine. Wash the cover and elements in kerosine or diesel fuel oil; then dry thoroughly. Check the breather pipe to be sure it is not plugged or restricted. Reinstall the elements, the push rod chamber cover and the breather pipe, using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

LUBRICATING OIL FILTER (Illust. 24)

The lubricating oil filter is a spin-on type filter. This filter can not be cleaned and should not be disturbed except when it becomes necessary to replace it.

Replacement

1. After reaching operating temperature, stop the engine and drain the crankcase.
2. Clean the outside of the filter to prevent dirt from entering the system while servicing.
3. Remove the spin-on filter by turning it counterclockwise. Discard the filter.



Illust. 24
Spin-on Oil Filter.

1. ELEMENT, spin-on oil filter.
2. BASE, oil filter.
3. PLUG, oil filter base.
4. VALVE, pressure regulating.
5. SPRING, pressure regulating.
6. RING, spring snap.
7. GASKET, oil filter base.

4. Install a new filter by applying a little engine oil to the seal and thread the filter on by hand by turning it clockwise until hand tight. Do not use tools to tighten the filter.

5. Reinstall and tighten the crankcase drain plug.

6. Fill the crankcase with fresh oil. Refer to the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 20 for quantity and grade of oil specified.

7. Operate the engine at low idle for 5 to 10 minutes, do not operate under load until normal oil pressure and temperature are reached. During warm-up check the filter for leaks.

HAND CRANKING

This procedure is used for adjustments.

◆ **CAUTION: WHEN HAND CRANKING THE ENGINE FOR ADJUSTMENT PURPOSES, DISCONNECT THE COIL-TO-DISTRIBUTOR CABLE (A, ILLUSTR. 30) FROM THE COIL TO PREVENT ACCIDENTAL STARTING OF 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. **UNITS EQUIPPED WITH AN AUXILIARY PULLEY ONLY:** Remove the auxiliary pulley.
3. Install the four cap screws in the tapped holes in the vibration damper.
4. With the use of a bar (position between the cap screws), crank the engine as required.
5. Remove the four cap screws from the vibration damper.
6. **UNITS EQUIPPED WITH AN AUXILIARY PULLEY ONLY:** Install and secure the auxiliary pulley.

VALVE CLEARANCE ADJUSTMENT

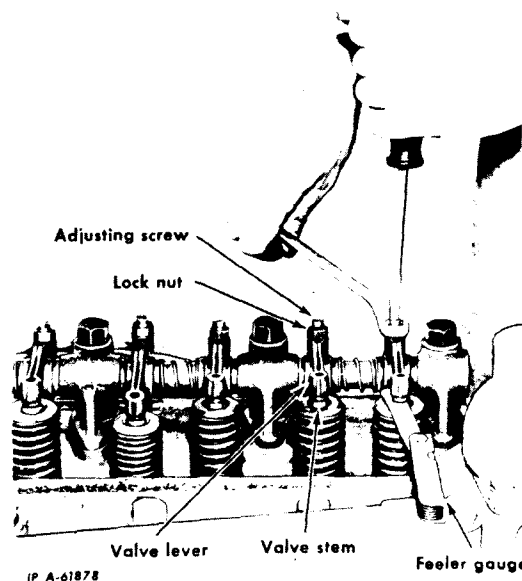
The numbers in Illust. 25 are cylinder numbers. The exhaust valves are identified by the letter (E), and the intake valves by the letter (I). For valve clearance dimensions (lash), refer to "Specifications" on page 6. BE ACCURATE - USE A FEELER GAUGE WHEN ADJUSTING VALVE CLEARANCE.

NOTE: DO NOT ADJUST VALVES WITH THE ENGINE RUNNING.

1. Disconnect the coil-to-distributor cable.
2. Remove the valve cover.
3. Turn crankshaft clockwise (viewed from front) until No. 1 piston is on the compression stroke and the timing pointer on the crankcase front cover aligns with the "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. The valves are closed when the push rods are loose and can be turned easily.

4. Adjust the cylinder Nos. 1, 2 and 4 intake (I) valves, and the Nos. 1, 3 and 5 exhaust (E) valves. Refer to Illust. 25 and 26. Turn the adjusting screw in or out to get correct clearance; then tighten lock nut. Adjust and lock each valve before proceeding to the next.
5. Turn the crankshaft one complete revolution, and again align the "TC" mark with the timing pointer.
6. Adjust the cylinder Nos. 3, 5 and 6 intake (I) valves, and the Nos. 2, 4 and 6 exhaust (E) valves.
7. Install the gasket and valve cover. The gasket must provide an oil-tight seal.
8. Connect the coil-to-distributor cable.

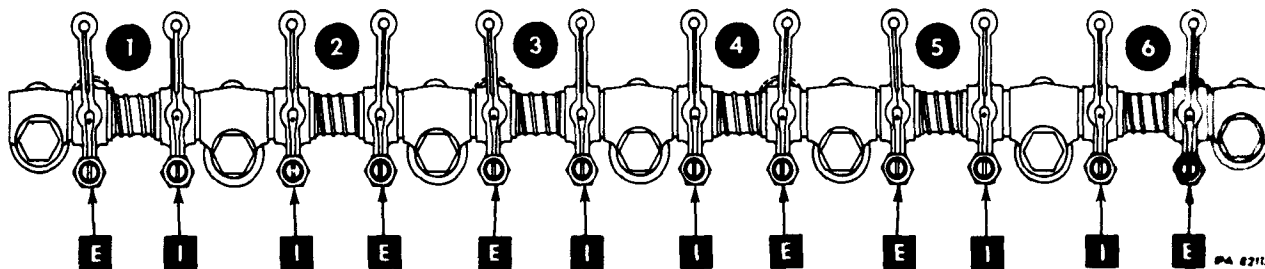


Illust. 26
Adjusting the Valve Clearance.

OIL LEVEL SIGHT GAUGE (Illust. 27)

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.



Illust. 25
Engine Valve Rocker Arms.

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.

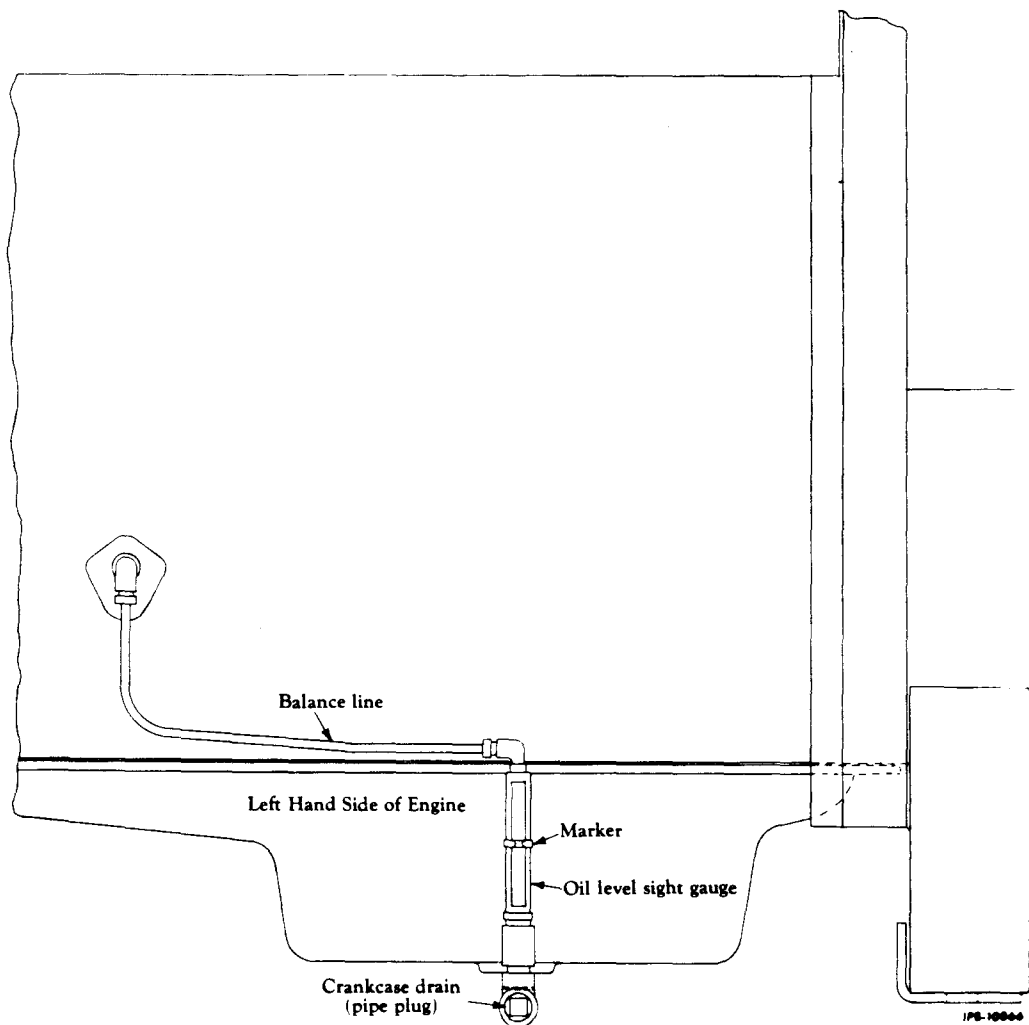
ELECTRICAL SYSTEM

Precautions

The electrical generating system now incorporates a direct diode rectified generator (alternator) 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.

Continued on next page



Illust. 27
Oil Level Sight Gauge.

MAINTENANCE

All terminals must be clean and fastened securely. Never paint electrical connections or the alternator. Repair or replace all broken wires immediately. Surface under all terminals must be clean and good electrical connections must be established after reassembly. Also all clips must grip cables tightly to prevent vibrations and rapid cable wear. All clips and straps must be closed in a workman-like manner, so as not to damage the insulation.

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.

Do not run alternator without batteries in the circuit. Where it is necessary to run the engine without batteries for test periods only, disconnect the field cable "Plug In" connector on the alternator.

DO NOT POLARIZE THE ALTERNATOR.

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

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.

Regulator

The regulator is adjusted and sealed by the manufacturer. If the regulator fails to operate properly, consult your authorized International Engine Distributor or Dealer.

Cranking Motor

If the cranking motor fails to operate properly consult your authorized International Engine Distributor or Dealer.

Lubricate the cranking motor at the interval shown on the "LUBRICATION GUIDE" on page 20.

Ignition Coil

The ignition coil does not require special service other than to keep all terminals and connections clean and tight.

Spark Plugs

For the recommended spark plugs, consult your authorized International Engine Distributor or Dealer.

USE ONLY A COMPLETE SET OF THE SAME TYPE OF SPARK PLUGS.

NOTE: Before removing a spark plug from the cylinder head, remove all dirt around the base of the plug.

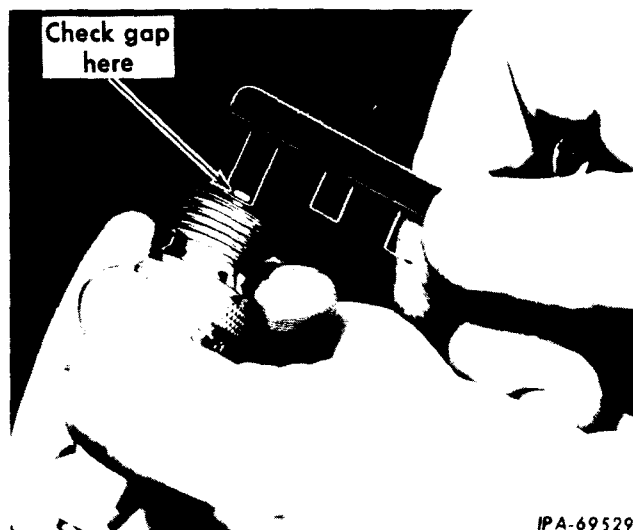
Use a spark plug wrench to remove the plugs. After the plugs have been removed, remove each spark plug gasket. Do not re-use these gaskets.

If the plugs are greasy or oily when removed, wash them with a petroleum solvent and dry them thoroughly. After drying the plugs, hard deposits can best be removed with an abrasive or by the use of a sand-blasting machine. DO NOT USE A WIRE BRUSH; wire brushing the spark plug electrodes will simply load the firing bore with electrically conductive metal particles from the brush and can cause misfiring when the plugs are reinstalled.

When cleaning spark plugs with a conventional sand-blasting machine, THE PLUG SHOULD NOT BE EXPOSED TO THE SAND BLAST FOR MORE THAN THREE OR FOUR SECONDS. If longer exposure is needed to clean the plug, the insulator will be damaged, rendering the plug either inoperative or very undependable. Use compressed air to remove any sand from inside the plug shell. Before setting the gap on a used plug, file the center electrode until it is flat.

If the center electrode is shorter than the shell skirt before or after filing or if the porcelain is chipped, scratched or broken, replace the plug.

When adjusting the spark plug gap, bend the outer electrode only. Never bend the center electrode as this will damage the insulator. If the gap between the electrodes is too great (refer to "Specifications" on page 6) due to improper setting or burning off the end, the engine will misfire and will be hard to start.



Illust. 28
Checking Spark Plug Gap.

Ignition Requirements When Using Natural Gas

Ignition requirements are greatly increased on engine using straight natural gas as fuel. Because of the dry nature of the fuel, spark plugs run hotter and have a tendency to burn more rapidly. If missing or pre-ignition occurs when the engine is operating at low speeds and with heavy loads, reset the spark plug gap, as shown in "Specifications" on page 6. Inspect spark plugs regularly and maintain this gap setting.

Spark Plug Cables

If the spark plug cables are removed for any reason, note the position of each cable on the distributor (Illust. 30).

A minimum clearance of 1/4 inch between the spark plug cables and the cylinder head is recommended. By maintaining this clearance, shorting out the spark plugs will be prevented and the cable will be away from the heat of the cylinder head. If the cable touches the cylinder head, the heat will soon cause the rubber to become soft and will ruin the cable.

Storage Battery

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 vibration.

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

Cleaning and Servicing the Battery

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 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 hydrant 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.

Distributor

Distributor Cap

Remove the distributor cap and examine the inside. If any dust, moisture, or oil deposits are present, thoroughly clean and wipe dry. To assure long life of the distributor, care must be taken to keep the ventilator flats, at the inside edge of the distributor cap, open at all times. Keep the distributor rotor clean.

MAINTENANCE

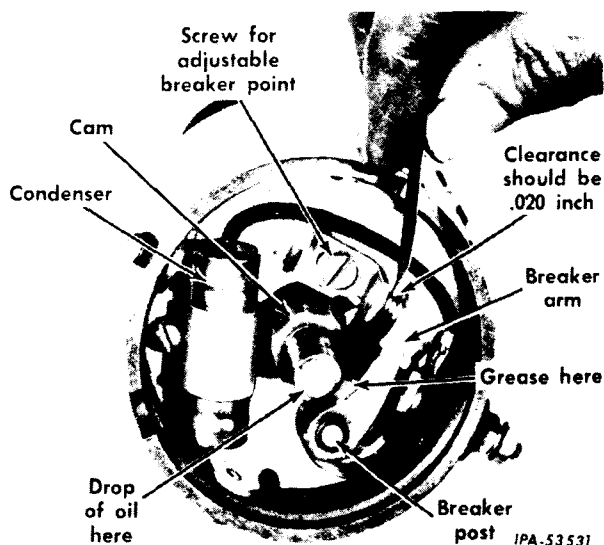
If the terminal nipples are removed, be sure the distributor cap terminals and coil terminal are clean and dry. The distributor is equipped with these nipples to prevent any external electrical leakage when the engine is operating under adverse conditions.

Checking the Breaker Chamber and Breaker Points

It is important that the breaker chamber be kept clean because oil on the breaker points will cause rapid burning. Remove the distributor cap, distributor rotor, and the breaker cover for breaker chamber inspection. Care must be taken, when removing the breaker cover, to prevent dirt from entering the breaker chamber. Be sure the chamber is clean and the breaker points are in good condition and have the proper opening.

Check the condition of the breaker points for build-up or lip formation. If present, the points must be dressed before the point opening can be checked or set. NEVER USE EMERY CLOTH OR SANDPAPER TO CLEAN THE POINTS. IF THE POINTS ARE WORN EXCESSIVELY, REPLACE BOTH POINTS. Check the opening between the breaker points with a feeler gauge when the rubbing block is on the high part of the cam. (Illust. 29.) (Refer to "Specifications" on page 6.) If the gap is not correct, adjust it by loosening the screw holding the adjustable point. Move the point toward or away from the breaker arm until the gauge slips snugly into the opening. After the adjustment has been made, tighten the screw.

NOTE: When replacing breaker points grease the recess in the pivot post with a small amount of Amo grease 4X or Chevron OHT grease.



Illust. 29
Adjusting Breaker Points.

Install the distributor cap to the housing with the tang in the cap in line with the slot in the distributor housing.

NOTE: If the cap is incorrectly positioned on the housing, it will usually result in a broken rotor when attempting to start the engine.

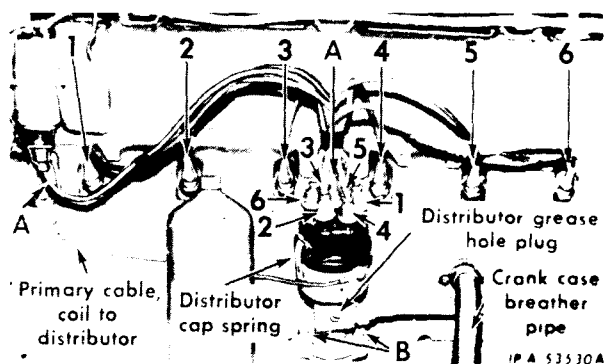
Ignition Timing

1. Be sure that the distributor cap is properly located on the distributor housing and that both bail clips are in place.

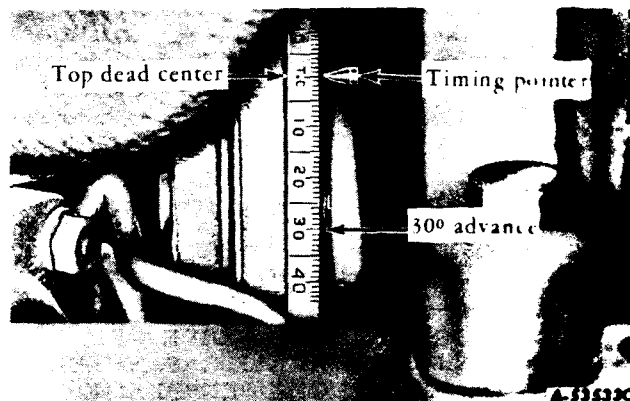
NOTE: If the distributor cap is incorrectly positioned on the distributor housing, it will usually result in a broken rotor when attempting to start the engine.

The firing order is 1, 5, 3, 6, 2, 4 (Illust. 30) and the spark plug cables must be assembled in the distributor cap in this order in a counterclockwise rotation.

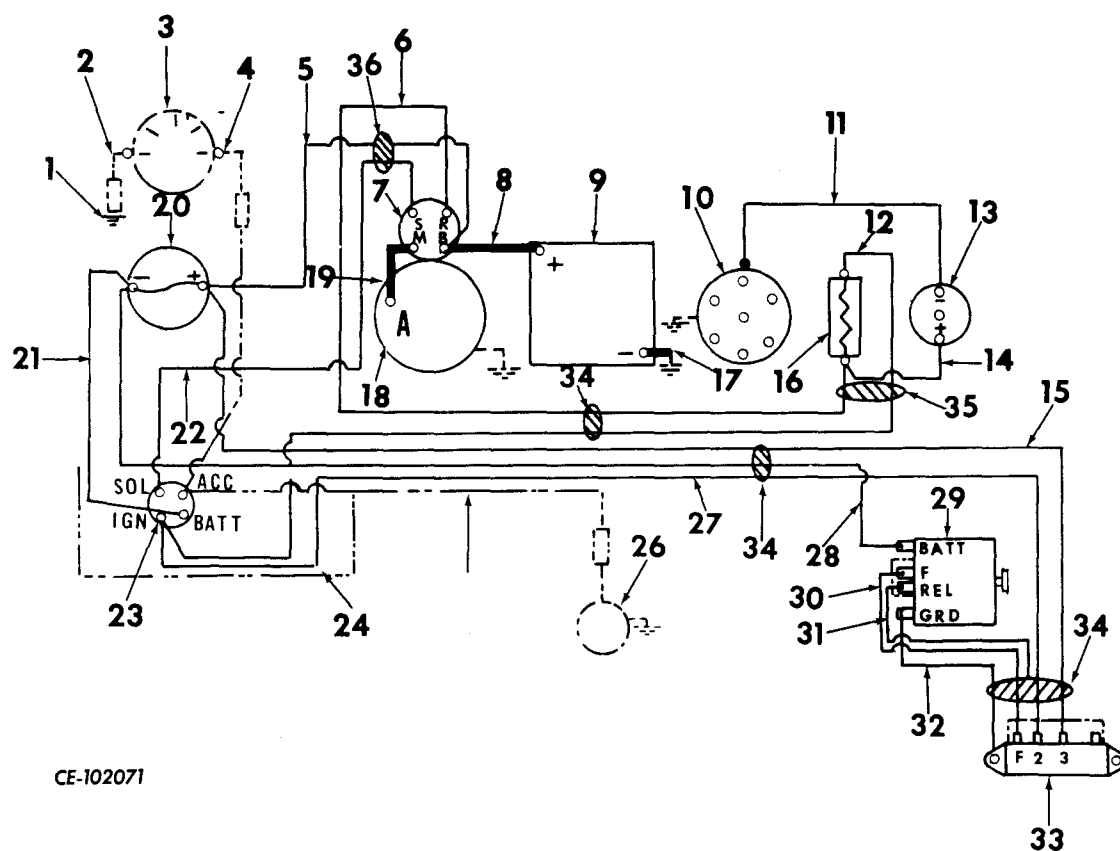
Continued on page 46



Illust. 30
Spark Plug Wiring.



Illust. 31
Timing Pointer and Timing Marks on the Fan Drive Pulley.



CE-102071

Illust. 32
Wiring Diagram for Engines Equipped with Regular Gauges.

CABLE COLOR CODE - All cables are black unless otherwise specified.

CABLE GAUGE - All cables are 16 gauge except battery cables and those noted below.

Cable Ref. 5, 28 10 gauge

Cable Ref. 21, 22 12 gauge

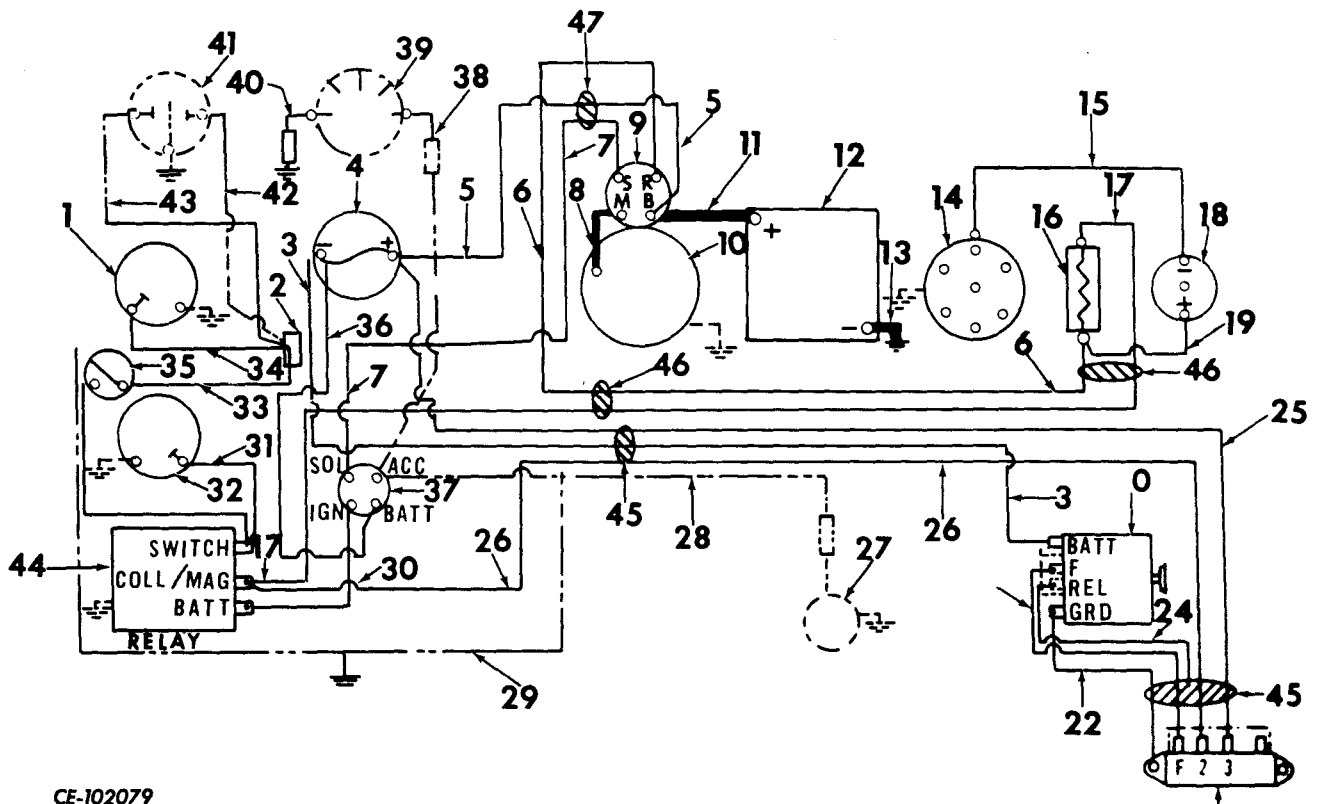
Cable Ref. 15, 27, 30, 32 14 gauge

Ref. No.	Description	Ref. No.	Description
1.	CABLE, hourmeter to ground.	14.	CABLE, plus (+) terminal on coil to resistor (red).
2.	CABLE, hourmeter.	15.	CABLE, voltage regulator No. 3 terminal to plus (+) terminal on ammeter (green).
3.	HOURLMETER, electric.	16.	RESISTOR, ignition coil.
4.	CABLE, hourmeter to cable for "ACC" on ignition and starter switch.	17.	CABLE, battery to ground.
5.	CABLE, plus (+) on ammeter to "B" on solenoid (red).	18.	MOTOR, cranking
6.	CABLE, "R" on solenoid to resistor (pink).	19.	CABLE, cranking motor to "M" terminal on solenoid.
7.	SOLENOID.	20.	AMMETER.
8.	CABLE, plus (+) on battery to "B" on solenoid.	21.	CABLE, minus (-) on ammeter to "BATT" terminal on ignition and starter switch.
9.	BATTERY.	22.	CABLE, "S" terminal on solenoid to "SOL" terminal on ignition and starter switch (green).
10.	DISTRIBUTOR.	23.	SWITCH, ignition and starter.
11.	CABLE, minus (-) on coil to distributor (red).		
12.	CABLE, resistor to "ign" on ignition and starter switch (orange).		
13.	COIL.		

Continued on next page.

MAINTENANCE

Ref. No.	Description	Ref. No.	Description
24.	PANEL, instrument.	32.	CABLE, alternator "GRD" terminal to voltage regulator bolt.
25.	CABLE, fuel pump to "ACC" terminal on starting and ignition switch.	33.	REGULATOR, voltage.
26.	PUMP, electric fuel.	34.	CABLE, hourmeter connector to "ACC" terminal on ignition and starting switch.
27.	CABLE, No. 2 terminal on voltage regulator to "IGN" terminal on ignition and starting switch (light blue).		HARNESS, cranking motor cable (consists of Ref. Nos. 5 and 22).
28.	CABLE, minus (-) terminal on ammeter to "BATT" terminal on alternator (red).		HARNESS, ignition cable (consists of Ref. Nos. 6 and 12).
29.	ALTERNATOR.		HARNESS, alternator cable (consists of Ref. Nos. 15, 27, 28, 30, 31, 32).
30.	CABLE, "F" terminal on regulator to "F" terminal on alternator (yellow).		
31.	CABLE, dummy lead.		



CE-102079

Illust. 33
Wiring Diagram for Engines Equipped with Safety Gauges.

CABLE COLOR CODE - All cables are black unless otherwise specified.
 CABLE GAUGE - All cables are 16 gauge except battery cables and those noted below.

Cable Ref. 3, 5	10 gauge
Cable Ref. 7, 30, 36	12 gauge
Cable Ref. 21, 22, 25, 26	14 gauge

MAINTENANCE

Ref. No.	Description	Ref. No.	Description
1.	GAUGE, safety oil pressure.	27.	PUMP, electric fuel.
2.	BLOCK, junction.	28.	CABLE, fuel pump to "ACC" on ignition and starter switch.
3.	CABLE, minus (-) on ammeter to "BATT" on alternator (red).	29.	PANEL, instrument.
4.	AMMETER.	30.	CABLE, "BATT" terminal on relay to "IGN" terminal on ignition and starter switch.
5.	CABLE, plus (+) on ammeter to "B" on solenoid (red).	31.	CABLE, engine coolant temperature gauge to "S" terminal on relay switch.
6.	CABLE, "R" on solenoid to resistor (pink).	32.	GAUGE, engine coolant temperature.
7.	CABLE, "S" on solenoid to "SOL" on ignition and starter switch (green).	33.	CABLE, safety control toggle switch to junction block.
8.	CONNECTOR, cranking motor to "M" on solenoid.	34.	CABLE, safety oil pressure gauge to junction block.
9.	SOLENOID.	35.	SWITCH, safety control.
10.	MOTOR, cranking.	36.	CABLE, minus (-) terminal on ammeter to "BATT" terminal on ignition and starter switch.
11.	CABLE, plus (+) on battery to "B" on solenoid.	37.	SWITCH, ignition and starter.
12.	BATTERY.	38.	CABLE, hourmeter to cable for "ACC" on ignition and starter switch.
13.	CABLE, battery to ground.	39.	HOURLMETER, electric.
14.	DISTRIBUTOR.	40.	CABLE, hourmeter to ground.
15.	CABLE, minus (-) on coil to distributor (red).	41.	NOT USED.
16.	RESISTOR, ignition coil.	42.	NOT USED.
17.	CABLE, resistor to "COIL/MAG" on relay (orange).	43.	NOT USED.
18.	COIL.	44.	SWITCH, relay.
19.	CABLE, plus (+) on coil to resistor (red).	45.	CABLE, hourmeter connector to "ACC" terminal on ignition and starting switch.
20.	ALTERNATOR.		HARNESS, cranking motor cable (consists of Ref. Nos. 5 and 7).
21.	CABLE, "F" terminal on regulator to "F" terminal on alternator (yellow).		HARNESS, ignition cable (consists of Ref. Nos. 6 and 17).
22.	CABLE, alternator "GRD" terminal to voltage regulator mounting bolt.		HARNESS, alternator cable (polarized connections) (consists of Ref. Nos. 3, 21, 22, 24, 25 and 26).
23.	REGULATOR, voltage.		
24.	CABLE, dummy lead.		
25.	CABLE, voltage regulator No. 3 terminal to plus (+) terminal on ammeter (green).		
26.	CABLE, voltage regulator No. 2 terminal to "COIL/MAG" terminal on relay (light blue).		

2. Connect a timing light to the No. 1 spark plug.

NOTE: Follow the manufacturer's instructions on the use of the timing light.

3. Slowly crank the engine until the timing pointer on the crankcase front cover aligns with the "TC" mark on the fan drive pulley for gasoline engines or the 5° BTDC for liquefied petroleum and natural gas engines. White chalk or paint will highlight the timing mark for easier recognition.

4. Start the engine and check the timing light operation.

5. Rotate the throttle stop screw on the carburetor to reduce the idle speed of the engine to approximately 500 rpm for timing purposes.

6. Direct the light to the timing location on the fan drive pulley. Each light flash should be fast and accurate, and the timing marks should be readily seen in line with the timing pointer.

7. Loosen the manual advance arm locking plate bolt on the distributor housing. Rotate the distributor housing until the timing mark is in alignment with the pointer (when the timing light flashes).

8. Tighten the manual advance arm locking plate bolt. Recheck to be certain that tightening the bolt did not disturb the timing setting.

9. Stop the engine. Disconnect the timing light.

FUEL SYSTEM (GASOLINE)

General

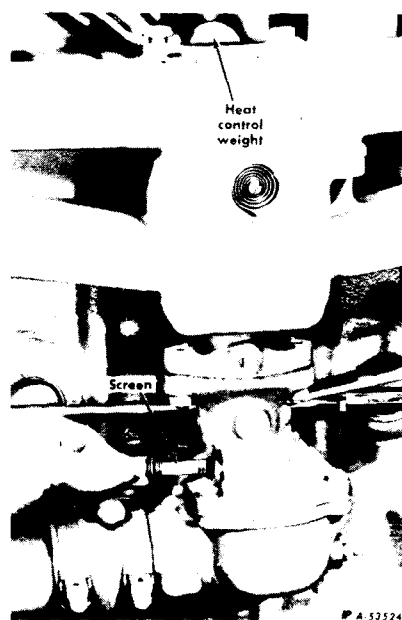
When excessive fuel consumption or inefficient engine performance is encountered, be careful in determining the exact cause before assuming the carburetor to be at fault. Consider engine compression, ignition timing, defective wiring, improperly gapped or fouled plugs, fuel pump. These are all factors in obtaining maximum fuel economy and must be within the limits specified by the manufacturer.

Due to the technical knowledge and skill required and the special equipment needed to make the necessary tests and corrections, we recommend the work be done by your authorized International Engine Distributor or Dealer.

Use clean fuel. The presence of dirt and water will disturb the functioning of the carburetor.

Carburetor

At the interval shown under "SCHEDULED MAINTENANCE" on page 17, disconnect the fuel supply lines at the carburetor and unscrew the fuel line fitting from the carburetor (Illust. 34). Clean the screen and reinstall. Reconnect the fuel supply line.



Illust. 34
Removing the Fuel Line Screen.

The flange nuts which hold the carburetor to the intake manifold must be checked periodically for tightness.

Occasionally check the cover screws which fasten the fuel bowl to the fuel bowl cover. They should be kept tight to avoid any air leakage past the fuel bowl cover gasket.

Carburetor Adjustments

NOTE: The manifold is equipped with a heat control valve controlled by a spring thermostat. No adjustment is required but be sure the valve opens freely by moving the heat control weight back and forth. (Illust. 34.)

The engine and carburetor are correctly set when shipped from the factory. If this setting has been disturbed for any reason, proceed as follows:

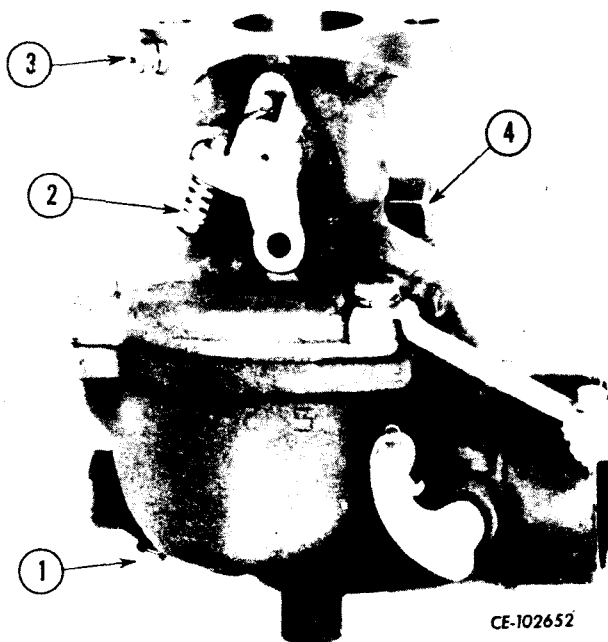
Start the engine and allow it to operate until thoroughly warm before making any adjustments.

Adjusting the idle adjusting screw (Illust. 35)

Close the idle adjusting screw to its seat by turning to the right (or in); then open one turn. Caution - excessive tightening of adjusting screw will damage the seat. Operate the engine at a fast idling speed of 1000 to 1500 rpm (without any load) until thoroughly warm.

While the engine is running at fast idle speed, it is advisable to screw in the throttle stop screw a few turns to prevent the engine from stopping when the throttle is closed. Now close the throttle by pushing the engine speed control knob all the way in. The engine will then be idling at a fairly high speed and the throttle stop screw can be backed out a little at a time until the desired idle speed is obtained. If the engine misses or rolls while backing out the throttle stop screw, the idle adjusting screw may be adjusted either in or out until the engine operates smoothly.

NOTE: Turning the adjusting screw in makes the idle mixture leaner. Speed up the engine for a few seconds; then recheck the idle adjustment. A slight adjustment in or out will give the smoothest idle.



Illust. 35
Gasoline Carburetor.

1. PLUG, drain.
2. SCREW, throttle idle stop.
3. SCREW, idle adjusting.
4. RETAINER, fuel line fitting and screen.

Fuel Pump and Filter

The fuel pump and filter are an integral unit. The sediment bowl and filter element are provided to prevent the entry of foreign materials into the carburetor and, thus, cause engine failure.

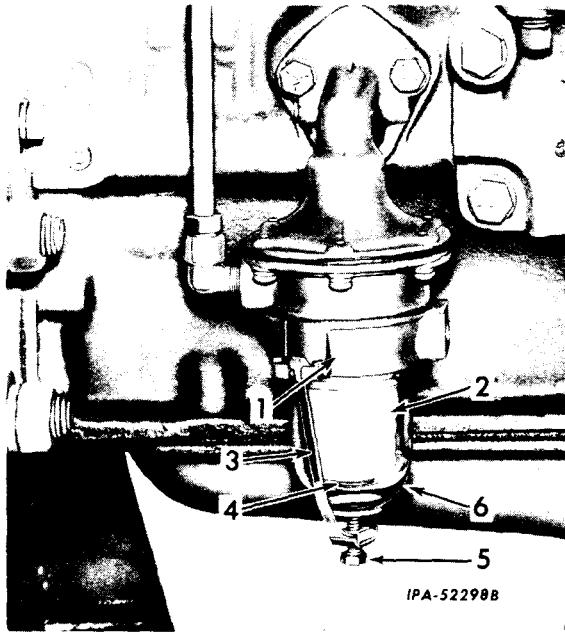
Do not attempt to disassemble the fuel pump diaphragm. If a sufficient amount of fuel is not being delivered to the carburetor, make a careful check for the cause. Usually the cause will be from such sources as bent, leaky or clogged fuel lines, loose fuel bowl, dirty ceramic filter or fuel bowl. If servicing these parts does not correct the problem, consult your authorized International Engine Distributor or Dealer.

Cleaning the Fuel Pump Filter (Illust. 36)

Disassemble and clean the filter as follows:

1. Loosen the screw (5) at the bottom of the bowl (6) to relieve the tension on the retainer (3).
2. Remove the bowl (6) from the filter head (1). Remove the filter (2) and the spring (4) from the bowl. Separate the spring from the filter. The oil filter should not be re-used. Dump out the gasoline in the bowl.
3. Remove the bowl gasket from the filter head. This gasket should not be re-used.
4. Wash the bowl (6) and the spring (4) in a commercial carburetor cleaning solvent.
5. Thoroughly dry these parts using compressed air.
6. Install the spring (4) in the bowl. Install a new ceramic filter (2) so the spring fits in the recess in the bottom of the filter.
7. Place a new bowl gasket in the filter head (1). Position the bowl (6) to the filter head. Be sure the bowl and the gasket make an air-tight seal at the filter head. Tighten the retainer screw (5) finger-tight.

Continued on next page.



Illust. 36
Fuel Pump and Filter.

1. HEAD, filter.
2. FILTER.
3. RETAINER, bowl (with screw).
4. SPRING, filter.
5. SCREW (part of retainer).
6. BOWL.

Fuel Pump (Electric)

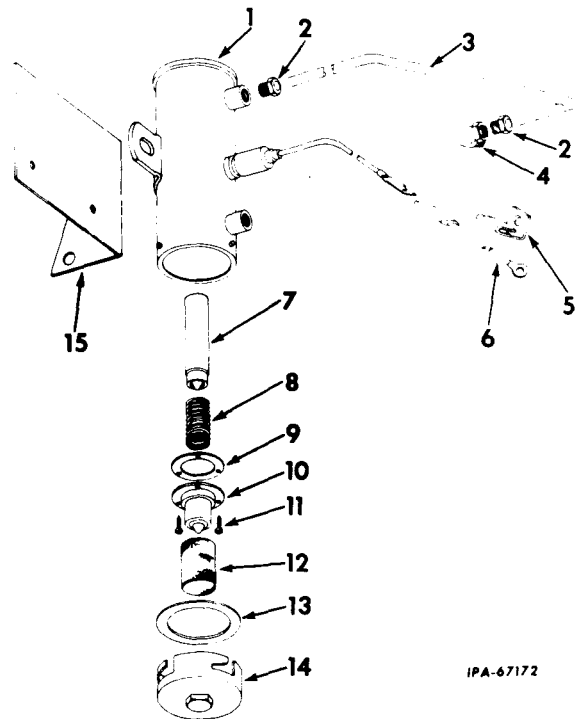
Engines operating on gasoline and equipped with a hydraulic pump have an electric fuel pump bracket mounted on the right hand front cover of the engine.

The electric fuel pump operates immediately when the ignition switch is turned to the right to the "ON" position.

Cleaning the Filter Screen (Illust. 37)

1. Using a wrench on the hex head underneath the cover (14), rotate and release the cover from the body (1).
2. Remove the gasket (13) from the body. If this gasket has taken a "set" or if it has become brittle or cracked, replace it with a new gasket.
3. Carefully remove the screen (12) from the cup (10). If the screen is damaged, replace it with a new screen. If the screen is not damaged, clean the screen by using compressed air or by washing in a commercial solvent or clean kerosene.

4. Use compressed air to thoroughly clean the magnet on the inside of the cover (14).
5. Install the gasket (13) in place on the inside of the cover (14). Center the screen (12) over the magnet on the inside of the cover. Install the cover on the pump body (1), being sure the inside diameter of the screen (12) does not bind on the outside diameter of the plunger cup (10).
6. Apply a 5/8 inch wrench on the cover hex head. Turn the cover (14) until the bayonet fittings on the body (1) are fully engaged in the cover slots.



Illust. 37
Electric Fuel Pump Components.

1. BODY, pump.
2. NUT.
3. TUBE, pump to carburetor.
4. ELBOW.
5. CLIP.
6. CABLE.
7. PLUNGER, pump.
8. SPRING, plunger.
9. GASKET, spring cup.
10. CUP, plunger.
11. SCREW.
12. SCREEN, filter.
13. GASKET, cover.
14. COVER.
15. BRACKET, mounting.

FUEL SYSTEM (NATURAL GAS)

General

When excessive fuel consumption or inefficient engine performance is encountered, be careful in determining the exact cause before assuming the carburetor to be at fault. Consider engine compression, ignition timing, defective wiring, improperly gapped or fouled plugs, distributor contact points, condenser and coil. These are all factors in obtaining maximum fuel economy and must be within the limits specified by the manufacturer.

Due to the technical knowledge and skill required and the special equipment needed to

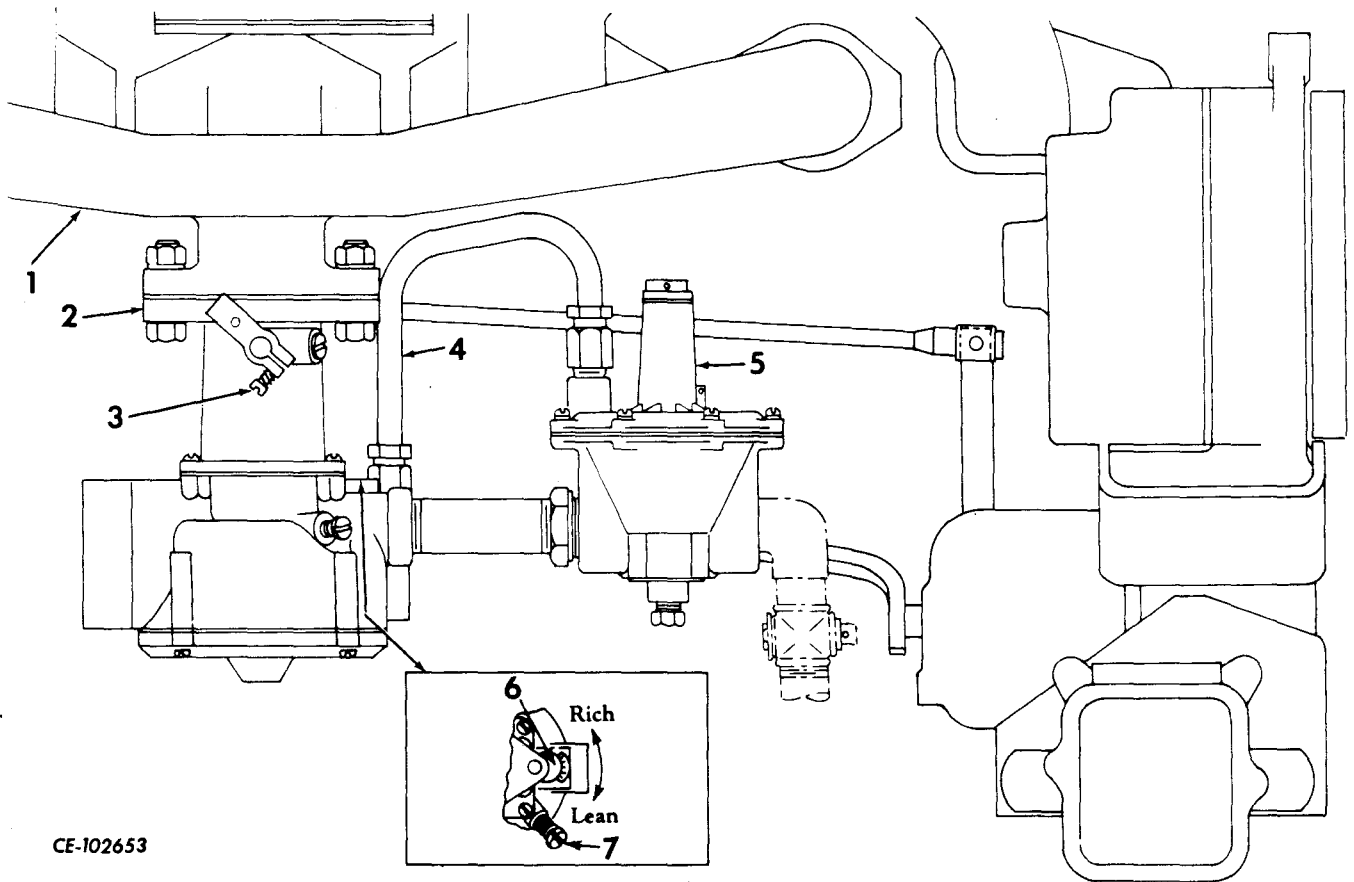
make the necessary tests and corrections, we recommend the work be done by your authorized International Engine Distributor or Dealer.

Carburetor and Regulator

The regulator controls the fuel flow and pressure to the carburetor and is factory set for proper performance.

The carburetor is used to accurately mix the correct proportion of fuel with air to satisfy the speed and load demand of the engine.

Continued on next page.



Illust. 38
Carburetor Adjustments (Natural Gas).

- | | |
|--------------------------|----------------------------------|
| 1. MANIFOLD, intake. | 5. VALVE, pressure reducer. |
| 2. CARBURETOR. | 6. ADJUSTER, carburetor mixture. |
| 3. SCREW, throttle lever | 7. SCREW, idle adjusting. |
| 4. TUBE, balance. | |

Adjusting the Carburetor (Illust. 38)

1. The carburetor adjustments are factory set for LHV (Low-Heat-Value) 936 BTU cu. ft. of natural gas at the top rated speed stamped on the serial number plate. The carburetor adjuster (6) is normally set at one notch toward "R" (rich) when the engine is equipped with a dry type air cleaner and at "O" or midway between "R" and "L" for oil bath air cleaners.

2. Should low idle adjustment be necessary, start the engine and using the throttle control, run the engine at 800 rpm (no load).

3. Adjust the screw (3) to obtain a low idle of 650 ± 50 rpm. Turn the screw (7) in or out to give the best idle, then readjust the screw (3) for proper idle speed (if required).

**FUEL SYSTEM (LIQUEFIED
PETROLEUM GAS)**

General

When excessive fuel consumption or inefficient engine performance is encountered, care should be exercised in determining the exact cause before assuming the carburetor to be at fault. Consider engine compression, ignition timing, defective wiring, improperly gapped or fouled plugs, distributor contact points, condenser, coil and fuel filter. These are all factors in obtaining maximum fuel economy and must be within the limits specified by the manufacturer.

Carburetor and Regulator

The regulator controls the flow and pressure of fuel to the carburetor.

The carburetor is used to accurately mix the correct proportion of fuel with air to satisfy every speed and load demand of the engine.

The carburetor is correctly set at the factory and should require no alteration. If these adjustments have been disturbed in some manner, however, they can be correctly reset by following the instructions outlined on this page.


Adjusting the Carburetor (Illust. 39)

1. Set the carburetor mixture adjuster (13) midway between R (rich) and L (lean) calibrations stamped on the carburetor gas inlet housing.

2. Start the engine and using the throttle control, run the engine at 800 rpm (no load).

3. Adjust the throttle lever screw (15) to obtain a low idle of 650 ± 50 rpm. Turn the idle adjusting screw (14) in or out to give the best idle, then readjust the throttle lever screw for proper idle speed (if required).

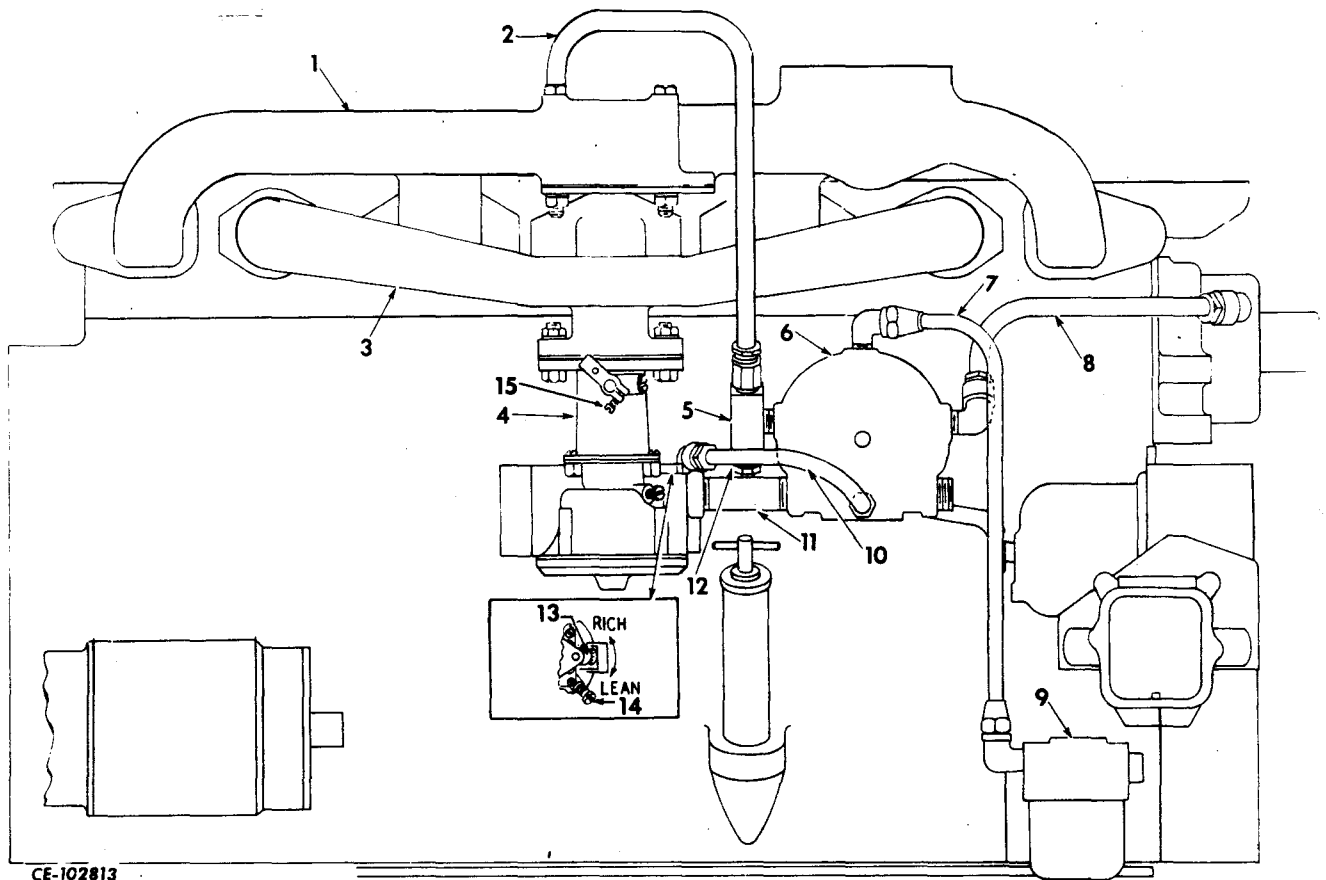
Fuel Filter (Illust. 40)

 **CAUTION: THE PRECAUTIONS OUTLINED ON PAGES 12 TO 13 MUST BE CLOSELY FOLLOWED TO AVOID INJURY AND DAMAGE WHEN CHANGING THE FUEL FILTER.**

The fuel filter element must be changed when it becomes clogged sufficiently to restrict the flow of fuel. A clogged filter element causes a pressure drop within the filter with consequent vaporization of the fuel which may cause freezing at the filter and engine starvation for fuel. Remove the filter as follows:

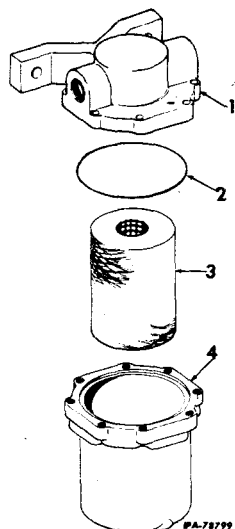
1. Close the supply valve on the gas supply line.
2. Clean the head (1) to prevent dirt from falling into the housing during disassembly.
3. Loosen the eight screws securing the head (1) to the housing (4).
4. Separate the housing from the head; remove the element (3) and "O" ring (2) from the housing. Discard the element and "O" ring.
5. Wash the housing in kerosine, and dry thoroughly.
6. Install the new "O" ring (2) and element (3) into the housing; secure the housing to the head with the screws previously loosened.
7. Open the supply valve on the gas supply line.

Continued on page 52



Illust. 39
Carburetor Adjustments (LPG).

1. MANIFOLD, exhaust.
2. TUBE, cylinder head to regulator water.
3. MANIFOLD, intake.
4. CARBURETOR.
5. TEE, pipe.
6. REGULATOR, LPG fuel.
7. TUBE, LPG fuel.
8. TUBE, regulator to water pump.
9. FILTER, fuel.
10. TUBE, balance.
11. NIPPLE, 1/2 NPT x 3" pipe.
12. VALVE, drain.
13. ADJUSTER, carburetor mixture.
14. SCREW, idle adjusting.
15. SCREW, throttle lever.



Illust. 40
Fuel Filter.

1. HEAD, filter.
2. "O" RING.
3. ELEMENT.
4. HOUSING, filter.

MECHANICAL GOVERNOR ADJUSTMENT (ILLUST. 41)

Governor action should be smooth and steady without surging. For efficient operation the cause of surging should be determined and corrected.

If the governor linkage bends or the length of the governor-to-carburetor rod has been moved, make the necessary adjustment as follows:

Engine Stopped

1. Pull the engine speed control knob (Illust. 6 or 7) to create tension on the governor spring.

2. With the governor to carburetor control rod (2) connected to the carburetor lever (1) in wide open throttle position, and the governor rockshaft lever (6) in the wide open throttle position, adjust the length of the rod so the clevis pin (5) slides freely into the clevis and governor rockshaft lever hole.

3. Remove the clevis pin (5) and turn the clevis (4) one complete turn shorter.

4. Reassemble the clevis pin and tighten the clevis lock nut.

5. Check to be sure there is no binding by moving the engine speed control handle a few times.

6. Start and operate the engine until normal operating temperature is reached.

7. Pull the rod (10) back against the stop.

8. Loosen the nut (9).

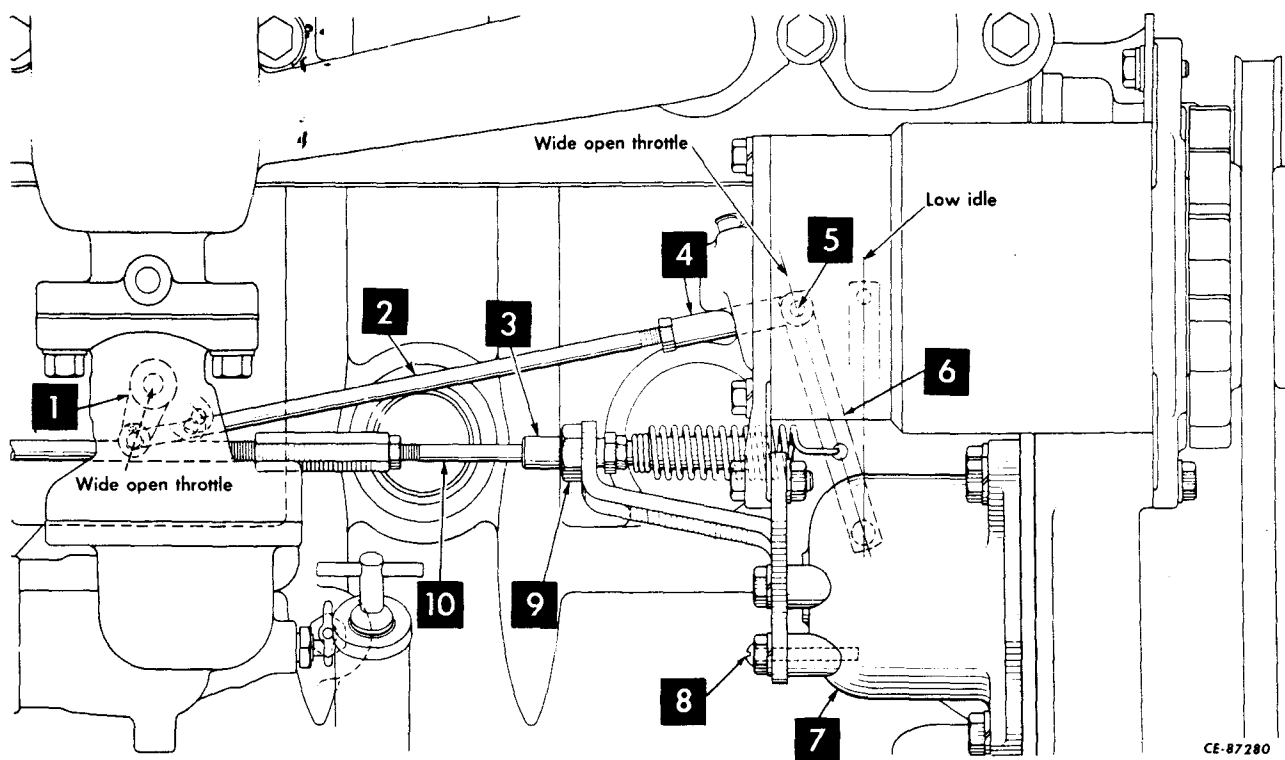
9. Turn the adjuster (3) in or out to produce the required governor fast idle speed which is stamped on the name plate attached to the left side of the flywheel housing.

NOTE: Move the adjuster out (toward the rear) to increase engine speed and in (toward the front) to decrease engine speed.

10. Check the governor action by suddenly moving the rod (10) back against the stop. If the governor surges more than twice, turn in on the bumper screw (8) just enough to stop excessive surging. Lock the screw with the jam nut.

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 23.



Illust. 41
Governor Adjustment.

1. LEVER, carburetor throttle.
2. ROD, governor to carburetor.
3. ADJUSTER, governor spring.
4. CLEVIS.
5. PIN, clevis.
6. LEVER, governor control.
7. GOVERNOR.
8. SCREW, bumper spring.
9. NUT, governor spring adjuster lock.
10. ROD, governor spring retainer.

Adjustment

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

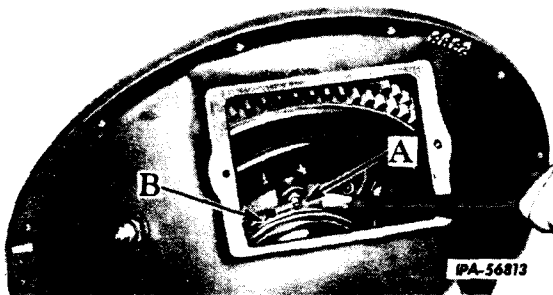
Rapid wear of the clutch facings will result if slippage takes place while the engine is under heavy load.

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.

Continued on next page.

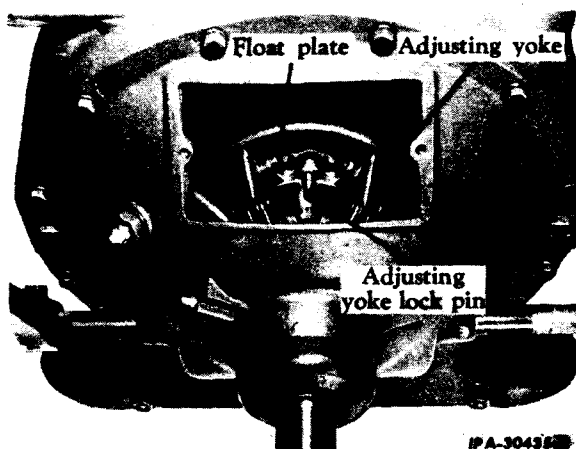
Adjust the clutch as follows:

1. Remove the clutch instruction plate.
2. Disengage the clutch and slowly crank the engine (refer to "HAND-CRANKING" on page 37) until the adjusting points appear in the center of the opening.
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 until a distinct pressure is felt to engage the clutch hand lever (Illust. 42).



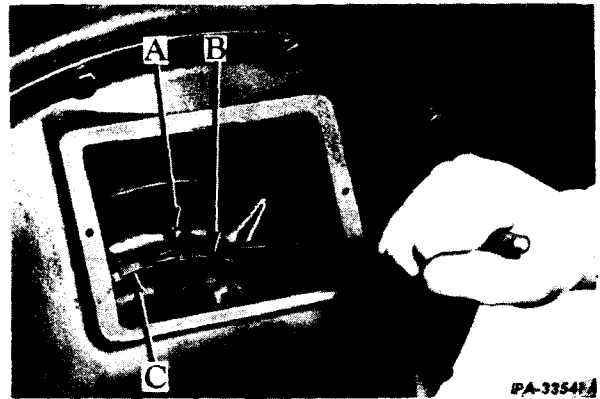
Illust. 42
Adjusting the Twin Disc 11-1/2 inch
Over-Center Clutch.

3. TWIN DISC CLUTCH (8 AND 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. 43).



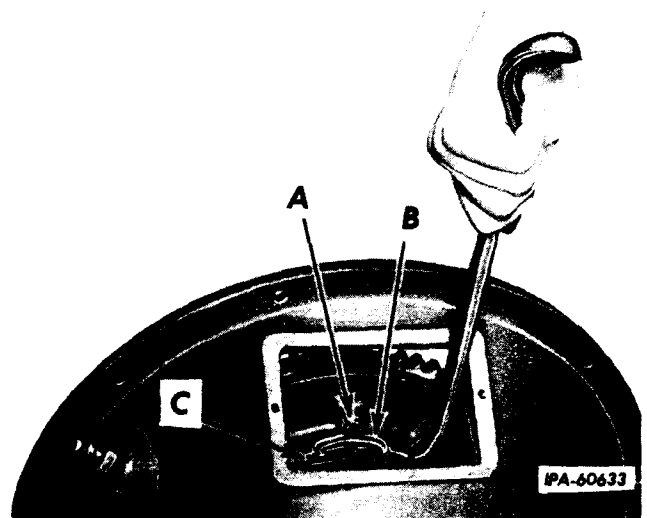
Illust. 43
Adjusting the Twin Disc 8 and 10 inch
Over-Center Clutch.

4. ROCKFORD CLUTCH (8 INCH): 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 until a distinct pressure is felt to engage the clutch hand lever (Illust. 44).



Illust. 44
Adjusting the Rockford 8 inch
Over-Center Clutch.

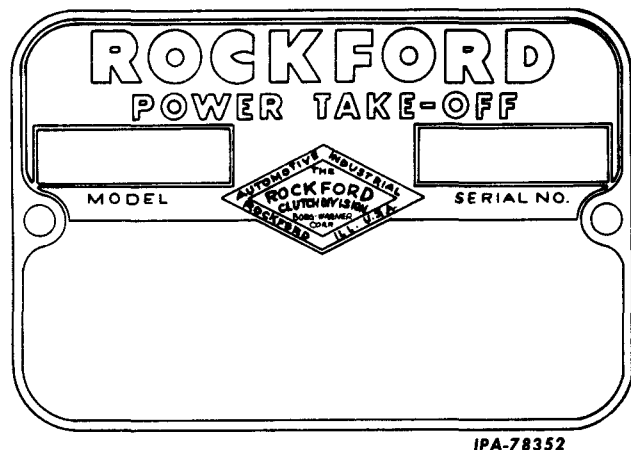
4. ROCKFORD CLUTCH (10 AND 11-1/2 INCH): Loosen the adjusting ring lock screw "A" with an offset screwdriver to free the lock "B." Hold the power take-off shaft to keep the clutch from turning and insert a pry bar into a notch in the adjusting ring "C" for leverage. Turn the ring a notch at a time in a counterclockwise direction until a distinct pressure is felt to engage the clutch hand lever (Illust. 45).



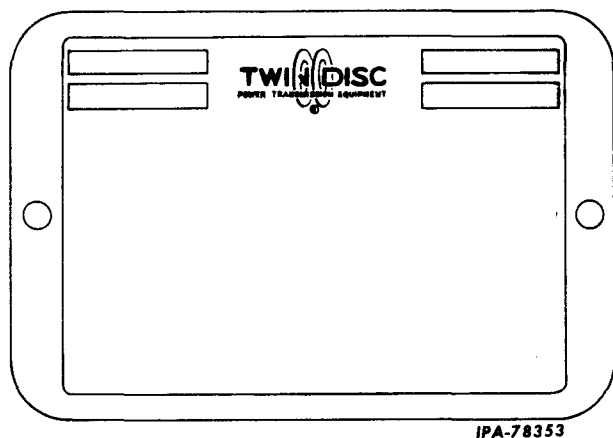
Illust. 45
Adjusting the Rockford 10 and 11-1/2
inch Over-Center Clutch.

MAINTENANCE

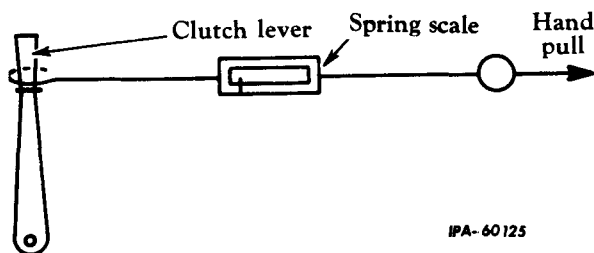
5. Be sure the clutch lever is in the "disengaged" position. To determine the correct amount of hand-pull effort for your engine refer to Illust. 46 or 47 for the IH power take-off number on your engine.



Illust. 46
Rockford Instruction Plate.



Illust. 47
Twin-Disc Instruction Plate.



Illust. 48
Method of Checking Clutch Adjustment.

6. Engage the spring scale hook on the clutch lever as shown in Illust. 48 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
319 500 R91	50
319 503 R91	70
319 519 R91	75
319 524 R91	75

TWIN-DISC

IH Power Take-Off Part Number	Pounds of Effort
321 052 R91	80-90
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.

8. Install the clutch instruction plate.

TRANSMISSION CLUTCH

This clutch is a non-adjustable, dry type and automatically compensates for clutch facing wear.

STORING THE ENGINE

Gasoline Engines

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 and the lubrication procedures repeated every six months.

Continued on next page.

MAINTENANCE

We recommend that caution be taken in starting an engine that has been in storage. Refer to the procedure shown under "PREPARING STORED ENGINE FOR SERVICE" on this page.

1. Thoroughly wash or clean the engine.
2. Run the engine long enough to warm the oil in the crankcase. Drain the crankcase, change the lubricating oil filter element (as described on page 37) and fill the crankcase. (Refer to the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 19, for the correct viscosity of oil used for the prevailing temperature.
3. Completely lubricate the rest of the engine as outlined in the "LUBRICATION GUIDE" on pages 20 to 24.
4. Drain the fuel from the fuel tank and carburetor and clean out the fuel pump filter. (Refer to "Cleaning the Fuel Pump Filter" on page 47).

NOTE: Present-day grades of gasoline have a tendency to form gum; therefore, it is necessary that the gasoline tank and carburetor be completely drained of fuel when the engine is to be out of service for more than two weeks. These gum deposits can be dissolved with a mixture of one part alcohol and one part benzol, or with acetone.

5. Remove the spark plugs and pour one tablespoonful of Grade-30 lubricating oil into each cylinder. Crank the engine two or three times to distribute the oil over the cylinder walls; then reinstall the spark plugs.
6. Remove the valve housing cover and flush 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 cover with Grade-30 lubricating oil. Install the valve housing cover.
7. Drain and clean the cooling system (refer to pages 27 and 28). Install a "RADIATOR DRAINED" tag.
8. Remove the crankcase breather pipe from the valve cover and plug up the hole.
9. Completely service the air cleaner as outlined under "AIR CLEANER" on pages 33 to 36.
10. Remove the air cleaner intake cap and store it in a clean dry place. Cover or plug the exhaust pipe and the air cleaner pipe.

11. Remove the battery and store it in a cool, dry place above freezing (+32°F). The battery must be fully charged at the time of storage. Check the battery liquid level at least once a month for water level and specific gravity. (Refer to "Liquid Level" on page 41.) Never allow the battery to run down below 3/4 full charge while in storage.

Liquefied Petroleum and Natural Gas Engines

Follow the same procedure used for preparing the gasoline engines for storage, except as follows:

1. If the fuel lines are going to be disconnected from the engine; close the supply valve on the fuel line. Run the engine until it stops from lack of fuel, and proceed as follows:

LIQUEFIED PETROLEUM GAS ENGINES:
Disconnect the fuel line at the fuel inlet. Plug the fuel inlet. Cover the end of the fuel inlet line.

NATURAL GAS ENGINES: Disconnect the fuel line at the fuel inlet (Illust. 5). Plug the fuel inlet. Cover the end of the fuel inlet line.

2. **LIQUEFIED PETROLEUM GAS ENGINES:** Remove the drain plug (12, Illust. 39) and drain off any accumulation of water. Install the plug.
3. Replace the fuel filter element on liquefied petroleum gas engines. (Refer to page 50.)

PREPARING STORED ENGINE FOR SERVICE

1. Install a fully charged battery and be sure the proper connections are made. (Refer to the wiring diagrams on pages 43 or 44.)
2. Remove the spark plugs and pour a mixture of one-half gasoline and one-half lubricating oil into each cylinder; one ounce (two tablespoonfuls) per cylinder is enough.
3. Remove the valve housing cover and flush the valve and valve operating mechanism with the same mixture.
4. Crank the engine rapidly until the excess oil has been blown out of the spark plug holes. This operation will loosen any tight piston rings and wash old, gummy oil from valves and pistons.

MAINTENANCE

5. Drain and flush out the crankcase with kerosine or flushing oil and fill with the specified lubricating oil. (Refer to the "LUBRICANT SPECIFICATIONS AND CAPACITIES CHART" on page 19.) Be sure a new element has been installed in the lubricating oil filter.

6. Remove the exhaust pipe, crankcase breather and the air cleaner opening plugs and/or covers.

7. Install the exhaust pipe.

8. Clean the crankcase breather (refer to "CRANKCASE BREATHER" on page 36). Install the crankcase breather.

9. AIR CLEANER (WET TYPE): Remove and clean the oil cup. Refer to "Cleaning the Oil Cup" on page 33.

10. Install the air intake cap.

11. Install the spark plugs after cleaning and setting the gaps (refer to "Spark Plugs" on page 40).

12. Be sure the cooling system drains are closed and fill the cooling system. Check for leaks and loose connections. Remove the "RADIATOR DRAINED" tag.


13. If the fuel lines have been disconnected from the engine, remove the plugs from the fuel inlet. Remove the covers from the fuel

inlet lines. Reconnect the fuel inlet lines being sure the connections are tight.

LIQUEFIED PETROLEUM GAS ENGINES:
Check that a new fuel filter element has been installed as outlined on page 50.

14. Fill the fuel tank or tanks.

15. Start the engine and let it run slowly; observe if any valves are sticking. If so, pour a small quantity of kerosine on the valve stems until loose.

 **CAUTION: DO NOT RUN THE ENGINE AT HIGH SPEED IMMEDIATELY AFTER STARTING. KEEP THE DOORS WIDE OPEN OR MOVE THE ENGINE OUTSIDE THE STORAGE ROOM IMMEDIATELY TO AVOID DANGER FROM EXHAUST GAS.**

16. Install the valve housing cover. Tighten the valve cover bolts (refer to "Torques" on page 7).

17. After the engine has been run long enough to clean the excess oil out of the cylinders, the spark plugs should be removed and checked for oil fouling. If fouled, clean and reinstall them in the engine.

NOTE: When installing the spark plugs, refer to "Torques" on page 7 for the specified torque.

