

6

CYLINDER  
OVER-HEAD  
VALVE  
ENGINES



*Continental Motors Corporation*

MUSKEGON, MICHIGAN

# **Operation and Maintenance *Instructions***

## **OVER-HEAD VALVE GASOLINE ENGINES 6 CYLINDER**

### **INDUSTRIAL**

K363  
T371-T427  
U501  
R513-R572-R602  
S749-S820

### **TRANSPORTATION**

K6271-K6290-K6330-K6363  
T6371-T6427  
U6501  
R6513-R6572-R6602  
S6749-S6820  
FO6226

**Continental Motors Corporation**  
**Muskegon, Michigan**

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## FOREWORD

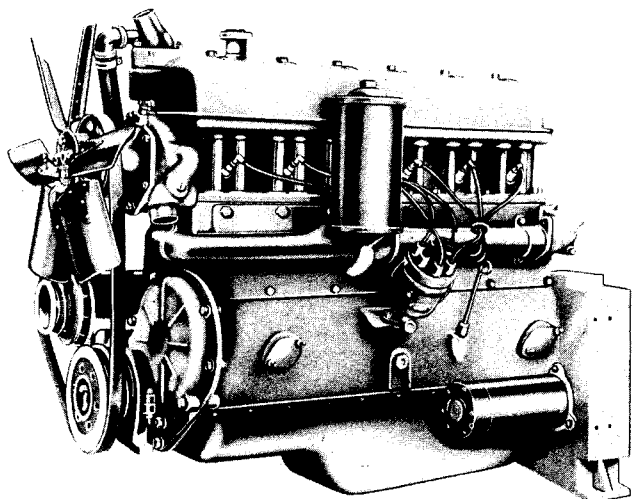
Gasoline engines have, over the years, maintained a position of importance in the field of power development. Because of their inherent characteristics of dependable and economical service, they have been the answer to a long standing demand for power. CONTINENTAL MOTORS CORPORATION, with their extensive research, maintain a reputation earned in over 58 years of leadership in the internal combustion engine industry.

Continental gasoline engines are designed for rugged service and are simple to service and maintain; they are capable of producing smooth dependable power, with excellent fuel economy.

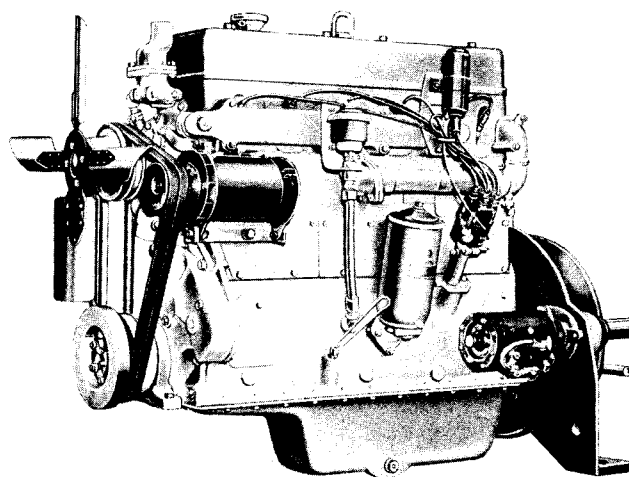
Good operation and a **planned** maintenance program as outlined in this manual are of vital importance in obtaining maximum engine performance, and long engine life. The instructions on the following pages have been written with this in mind, to give the operator a better understanding of the various problems which may arise, and the manner in which these problems can best be solved or avoided.

The operator is cautioned against the use of any parts, other than **Genuine Continental Parts** for replacement or repair. Genuine Continental parts have been engineered and tested for their particular job, and the use of any other parts may result in unsatisfactory performance and short engine life. Likewise, Continental distributors and dealers, because of their close factory relations, can render the best and most efficient service.

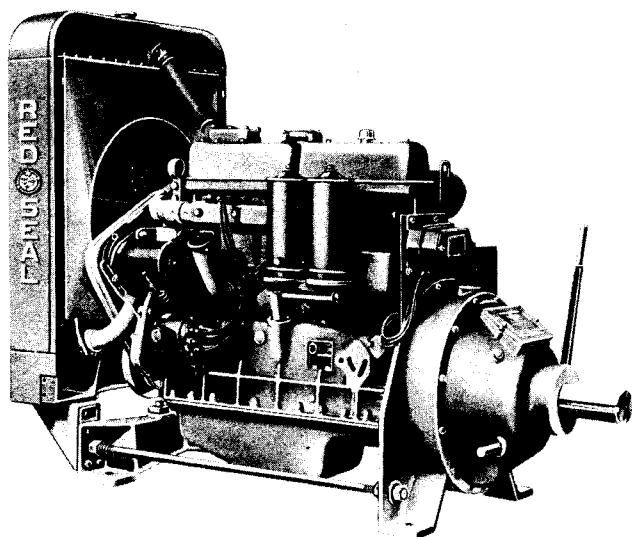
## **INDUSTRIAL ENGINES**



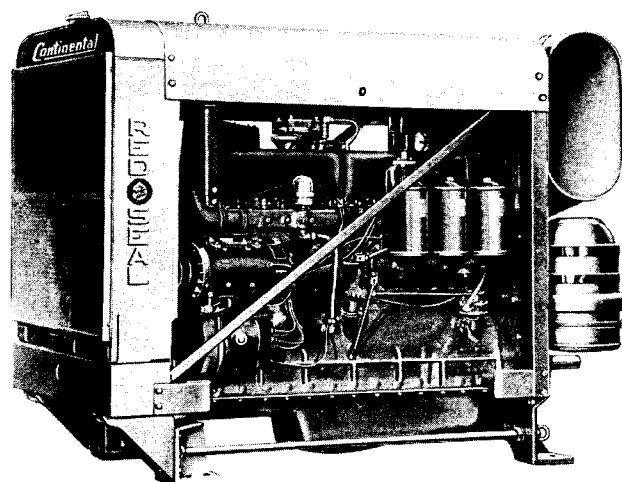
**Figure 1 — T427**



**Figure 2 — U501**



**Figure 3 — R602 — Open Power Unit**



**Figure 4 — S820**

## TRANSPORTATION ENGINES

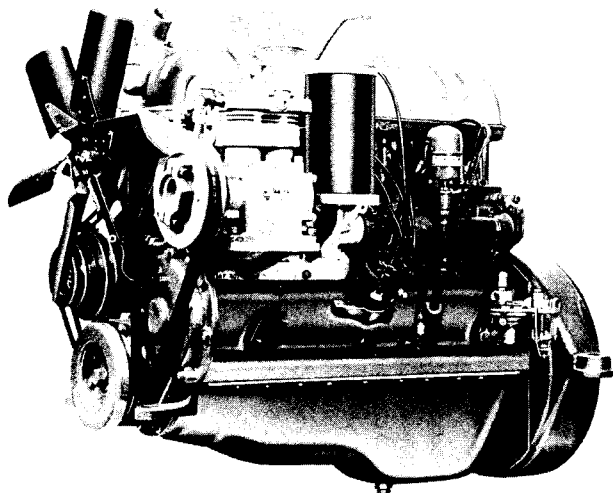


Figure 5 — K-6330

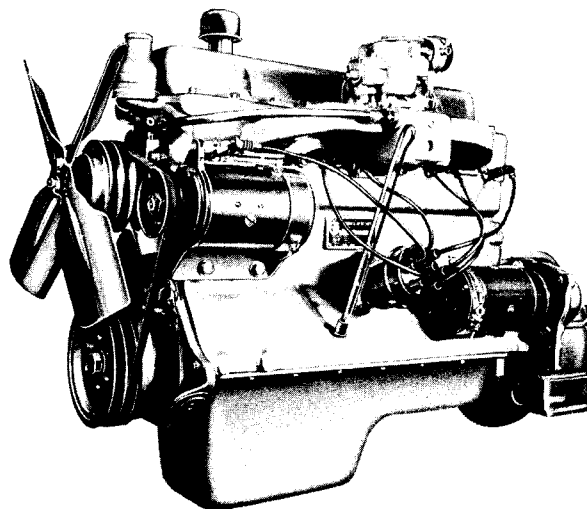


Figure 6 — FO6226

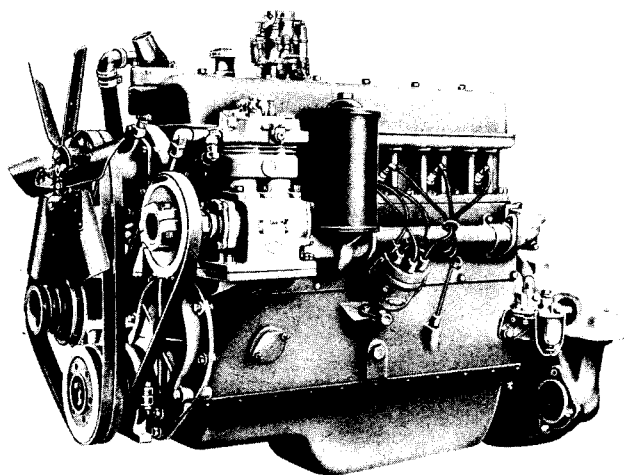


Figure 7 — T6427

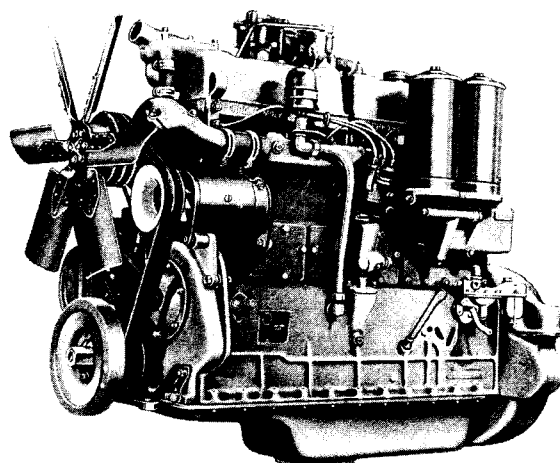


Figure 8 — R6572

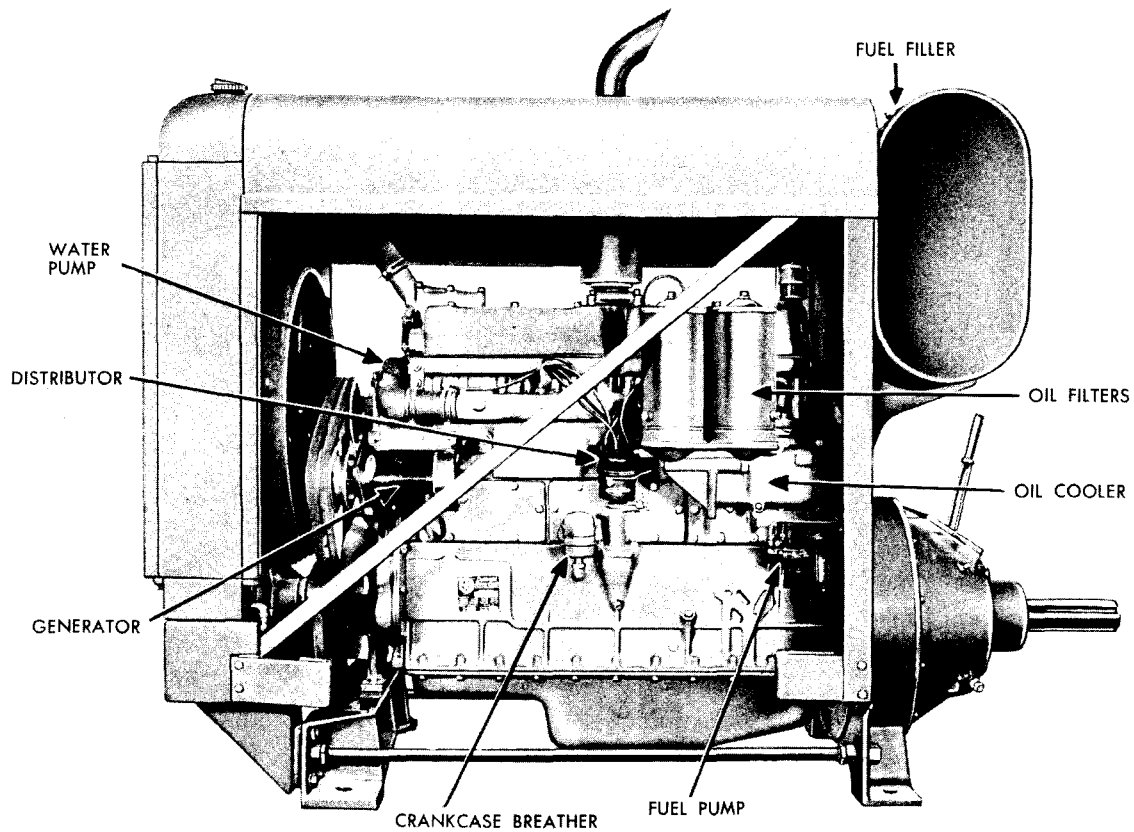


Figure 9 — R602 Power Unit (left side)

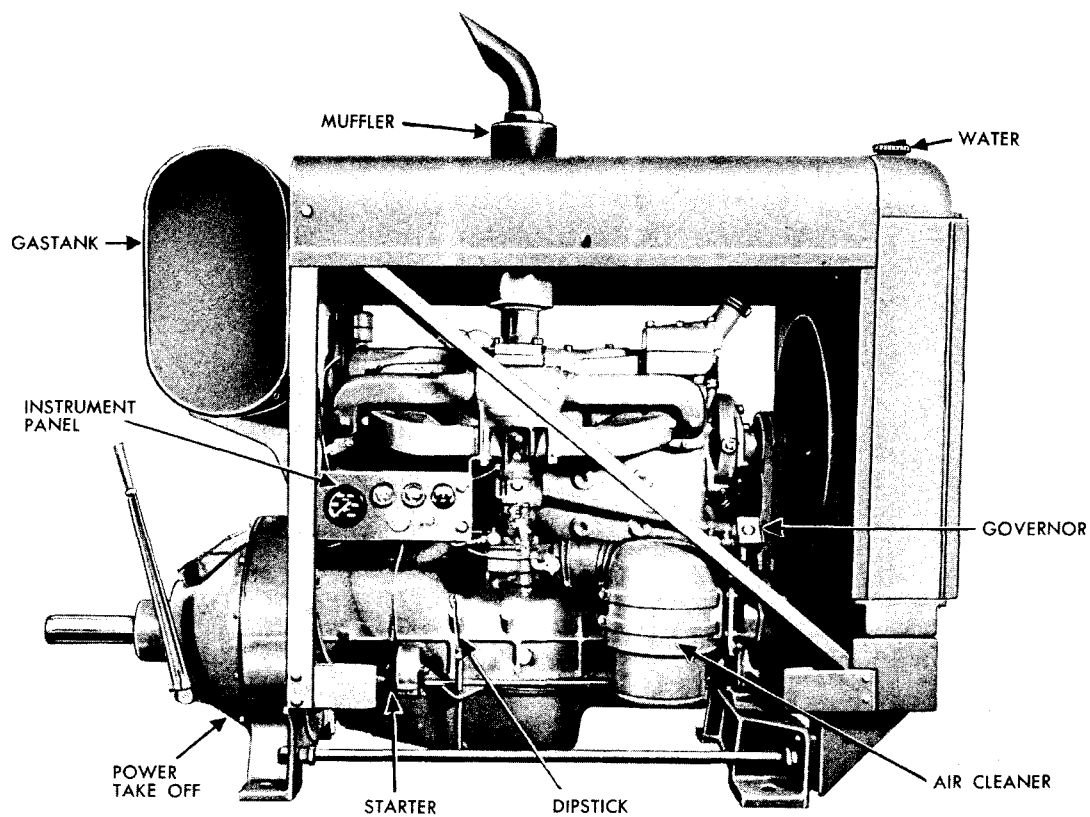


Figure 10 — R602 Power Unit (right side)



## SIX CYLINDER OVER-HEAD VALVE INDUSTRIAL GASOLINE ENGINES

MODEL	K-363	T-427 <sup>①</sup>	U-501	R-602 <sup>② ③</sup>	S-749	S-820
No. of Cylinders	6	6	6	6	6	6
Bore and Stroke	4 x 4 <sup>1</sup> / <sub>16</sub>	4 <sup>5</sup> / <sub>16</sub> x 4 <sup>7</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>2</sub> x 5 <sup>1</sup> / <sub>4</sub>	4 <sup>7</sup> / <sub>8</sub> x 5 <sup>3</sup> / <sub>8</sub>	5 <sup>3</sup> / <sub>8</sub> x 5 <sup>1</sup> / <sub>2</sub>	5 <sup>5</sup> / <sub>8</sub> x 5 <sup>1</sup> / <sub>2</sub>
Displacement Cu. In.	363	427	501	602	749	820
Compression Ratio	6.5	6.40	6.14	5.78	5.75	6.00
Oil Pressure at 1800 RPM	40-50	40-50	55-65	55-65	55-65	55-65
Min. at Idling	7	7	7	7	7	7
Firing Order	1 - 5 - 3 - 6 - 2 - 4					
Main Brg.—Front	2 <sup>5</sup> / <sub>8</sub> x 1 <sup>17</sup> / <sub>32</sub>	2 <sup>7</sup> / <sub>8</sub> x 1 <sup>3</sup> / <sub>4</sub>	2 <sup>3</sup> / <sub>4</sub> x 1 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub> x 1 <sup>5</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>4</sub> x 1 <sup>7</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>4</sub> x 1 <sup>7</sup> / <sub>8</sub>
Main Brg.—(4) Int.	2 <sup>5</sup> / <sub>8</sub> x 1 <sup>1</sup> / <sub>2</sub>	2 <sup>7</sup> / <sub>8</sub> x 1 <sup>5</sup> / <sub>8</sub>	2 <sup>3</sup> / <sub>4</sub> x 1 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub> x 1 <sup>1</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>4</sub> x 2 <sup>1</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>4</sub> x 2 <sup>1</sup> / <sub>8</sub>
Main Brg.—Center	2 <sup>5</sup> / <sub>8</sub> x 2 <sup>5</sup> / <sub>16</sub>	2 <sup>7</sup> / <sub>8</sub> x 2 <sup>5</sup> / <sub>8</sub>	2 <sup>3</sup> / <sub>4</sub> x 2 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub> x 2 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>4</sub> x 3	3 <sup>3</sup> / <sub>4</sub> x 3
Main Brg.—Rear	2 <sup>5</sup> / <sub>8</sub> x 2 <sup>3</sup> / <sub>16</sub>	2 <sup>7</sup> / <sub>8</sub> x 2 <sup>23</sup> / <sub>32</sub>	2 <sup>3</sup> / <sub>4</sub> x 2 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub> x 2 <sup>23</sup> / <sub>32</sub>	3 <sup>3</sup> / <sub>4</sub> x 3 <sup>1</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>4</sub> x 3 <sup>1</sup> / <sub>8</sub>
Conn. Rod Brg. Dia. and Length	2 <sup>1</sup> / <sub>4</sub> x 1 <sup>1</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>2</sub> x 1 <sup>1</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>4</sub> x 1 <sup>1</sup> / <sub>16</sub>	3 x 1 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>2</sub> x 2 <sup>7</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>2</sub> x 2 <sup>7</sup> / <sub>16</sub>
Oil Capacity (Qts.) Crankcase Only	7	8	12	14	18	18
Oil Filter	1	2	2	8	4	8
Total	8	10	14	22	22	26
Water Capacity (Gal.)	8 <sup>1</sup> / <sub>2</sub>	8 <sup>1</sup> / <sub>2</sub>	10	16	17 <sup>1</sup> / <sub>2</sub>	17 <sup>1</sup> / <sub>2</sub>
Valve Clearances (Hot and Idling)						
Intake	.018	.018	.016	.020	.020	.020
Exhaust	.022	.022	.024	.030	.024	.024
Weight—Bare Engine	780	1075	1290	1600	1850	1875

Note 1 Data for T371 same as T427 except 4<sup>1</sup>/<sub>8</sub> Bore—371 Cu. In. Displ.

Note 2 Data for R513 same as R602 except 4<sup>1</sup>/<sub>2</sub> Bore—513 Cu. In. Displ.

Note 3 Data for R572 same as R602 except 4<sup>3</sup>/<sub>4</sub> Bore—572 Cu. In. Displ.

## SIX CYLINDER OVER-HEAD VALVE TRANSPORTATION GASOLINE ENGINES

MODEL	FO-6226	K-6363 <sup>①</sup>	T-6427 <sup>②</sup>	U-6501	R-6602 <sup>③④</sup>	S-6749	S-6820
No. of Cylinders	6	6	6	6	6	6	6
Bore and Stroke	3 $\frac{3}{16}$ x 4 $\frac{3}{8}$	4 x 4 $\frac{13}{16}$	4 $\frac{5}{16}$ x 4 $\frac{7}{8}$	4 $\frac{1}{2}$ x 5 $\frac{1}{4}$	4 $\frac{7}{8}$ x 5 $\frac{3}{8}$	5 $\frac{3}{8}$ x $\frac{1}{2}$	5 $\frac{5}{8}$ x 5 $\frac{1}{2}$
Displacement Cu. In.	226	363	427	501	602	749	820
Compression Ratio	8.0	6.5	6.4	6.14	5.78	5.75	6.00
Oil Pressure @ 1800 RPM	30-40	40-50	40-50	55-65	55-65	55-65	55-65
Min. @ Idling	7	7	7	7	7	7	7
Firing Order	1 - 5 - 3 - 6 - 2 - 4						
Main Brg.—Front	2 $\frac{3}{8}$ x 1 $\frac{1}{32}$	2 $\frac{5}{8}$ x 1 $\frac{17}{32}$	2 $\frac{7}{8}$ x 1 $\frac{3}{4}$	2 $\frac{3}{4}$ x 1 $\frac{3}{4}$	3 $\frac{1}{4}$ x 1 $\frac{59}{64}$	3 $\frac{3}{4}$ x 1 $\frac{7}{8}$	3 $\frac{3}{4}$ x 1 $\frac{7}{8}$
Main Brg.—(4) Int.	(2)2 $\frac{3}{8}$ x 1 $\frac{17}{32}$	2 $\frac{5}{8}$ x 1 $\frac{1}{2}$	2 $\frac{7}{8}$ x 1 $\frac{5}{8}$	2 $\frac{3}{4}$ x 1 $\frac{11}{16}$	3 $\frac{1}{4}$ x 1 $\frac{13}{16}$	3 $\frac{3}{4}$ x 2 $\frac{1}{8}$	3 $\frac{3}{4}$ x 2 $\frac{1}{8}$
Main Brg.—Center	None	2 $\frac{5}{8}$ x 2 $\frac{5}{16}$	2 $\frac{7}{8}$ x 2 $\frac{5}{8}$	2 $\frac{3}{4}$ x 2 $\frac{13}{16}$	3 $\frac{1}{4}$ x 2 $\frac{3}{4}$	3 $\frac{3}{4}$ x 3	3 $\frac{3}{4}$ x 3
Main Brg.—Rear	2 $\frac{3}{8}$ x 1 $\frac{1}{4}$	2 $\frac{5}{8}$ x 2 $\frac{3}{16}$	2 $\frac{7}{8}$ x 2 $\frac{23}{32}$	2 $\frac{3}{4}$ x 2 $\frac{13}{16}$	3 $\frac{1}{4}$ x 2 $\frac{25}{32}$	3 $\frac{3}{4}$ x 3 $\frac{1}{8}$	3 $\frac{3}{4}$ x 3 $\frac{1}{8}$
Conn. Rod Brg. Dia. and Length	2 $\frac{1}{16}$ x 1 $\frac{1}{16}$	2 $\frac{1}{4}$ x 1 $\frac{1}{16}$	2 $\frac{1}{2}$ x 1 $\frac{1}{16}$	2 $\frac{3}{4}$ x 1 $\frac{1}{16}$	3 x 1 $\frac{1}{16}$	3 $\frac{1}{2}$ x 2 $\frac{7}{16}$	3 $\frac{1}{2}$ x 2 $\frac{7}{16}$
Oil Capacity (Qts.) Crankcase	5	7	8	12	14	18	18
Filter	1	1	2	2	4	4	4
Total	6	8	10	14	18	22	22
Valve Clearances (Hot and Idling)							
Intake	.017	.018	.018	.016	.020	.020	.020
Exhaust	.023	.022	.022	.024	.030	.024	.024
Weight—Std. Engine	580	780	990	1290	1525	1865	1875

Note 1 Data for K6330 same as K6363 except 4" Bore—4 $\frac{3}{8}$  Stroke—330 Cu. In. Displ.

Note 2 Data for T6371 same as T6427 except 4 $\frac{7}{8}$  Bore—371 Cu. In. Displ.

Note 3 Data for R6513 same as R6602 except 4 $\frac{1}{2}$  Bore—513 Cu. In. Displ.

Note 4 Data for R6572 same as R6602 except 4 $\frac{3}{4}$  Bore—572 Cu. In. Displ.

**INFORMATION FOR ORDERING PARTS**

When ordering parts, refer to the engine name plate attached to side of the cylinder block, which lists the **model** and **serial number**. In most cases a **specification** number is listed. This data is of vital importance in obtaining the correct parts: always include this information on your parts order.

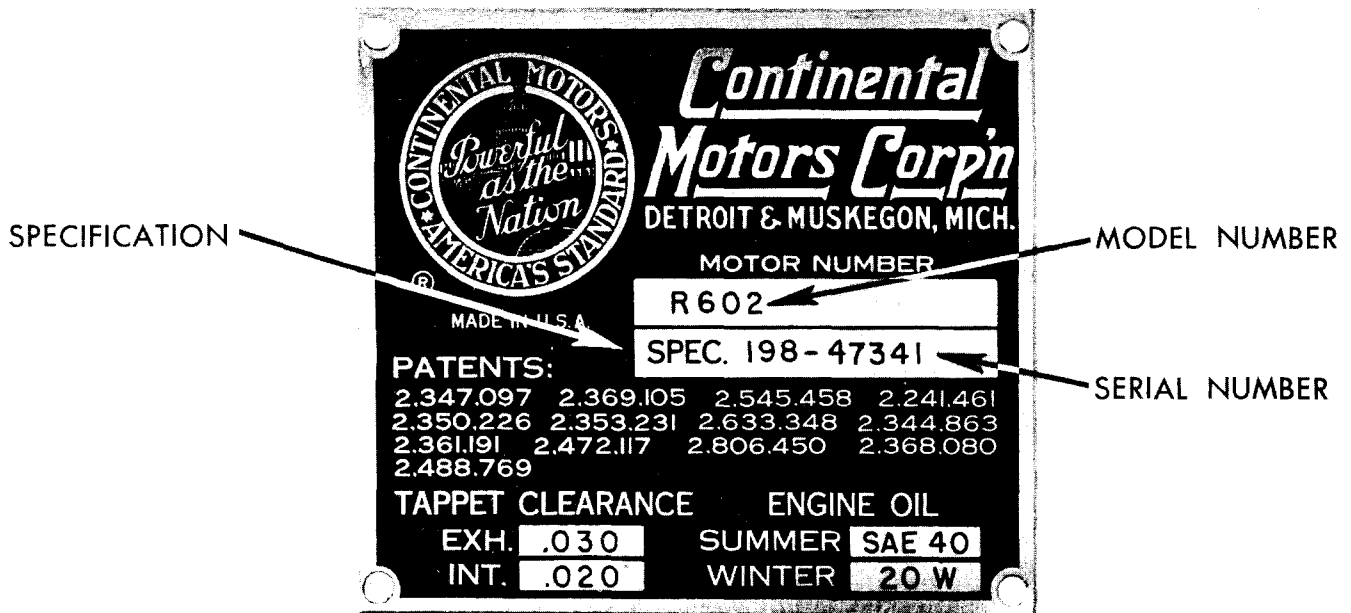


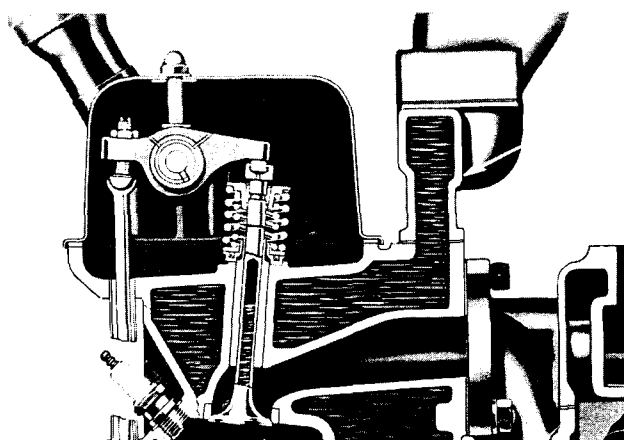
Figure 11 — Nameplate

## SECTION 1 GENERAL INFORMATION

Overhead valve engine design provides the highest power output and operating efficiency.

The valves are located in the cylinder head, which permits larger valves to assure improved combustion and engine output. The ease of servicing the valves coupled with the improved cooling of the exhaust valves and ports are important features of engine maintenance. Overhead valve design minimizes the tendency to impose thermal deformation on the cylinder structure.

Engines of this type being narrower in frontal elevation, lend themselves to a more favorable arrangement of the engine accessories, such as carburetor, magneto, starter, generator and filters for transportation and industrial applications.



**Figure 12**

### CONTINENTAL OVER-HEAD VALVE ENGINES

Continental has nine six cylinder overhead valve industrial engines and thirteen transportation engines — which range in size from 226 to 820 cubic inches displacement.

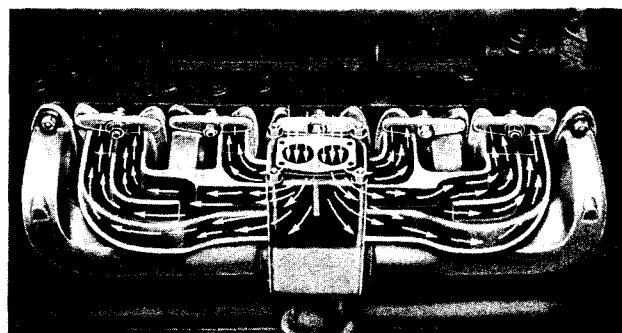
The combustion chamber design is a result of much research and includes the very latest developments to ensure dependable and economical heavy duty service.

Some of the principal design features are:

1. **Individual Porting** — of the intake manifold whereby each cylinder is fed with the fuel-air mixture individually and not influenced by other cylinders of the engine.

This is accomplished by casting the cylinder block with individual intake valve passages for each cylinder and connecting these passages to an intake manifold which also has individualized passages for each cylinder.

This equal distribution results in maximum power, smooth operation, easy starting and longer engine life.



**Figure 13**

**2. Directional Cooling**—The large capacity water pump directs the coolant flow through a distribution manifold into the cylinder head to carry away heat from the combustion chamber and valve seats.

A smaller portion is directed to the oil cooler after which it enters the cylinder block.

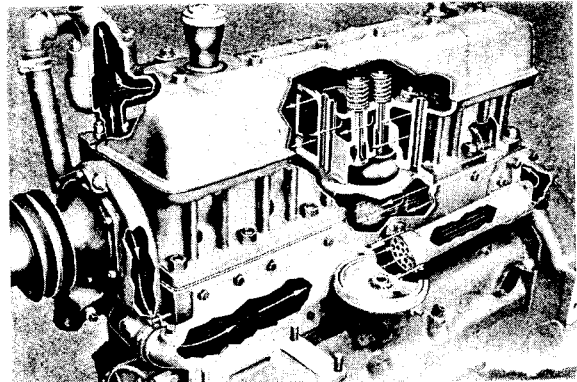


Figure 14

**3. Full Length Water Jackets**—Completely surround all cylinder bores the full length of the piston travel.

This insures uniform cooling with minimum bore distortion—resulting in lower oil consumption; less blow-by and minimum tendency to sludge—which is so detrimental to engine life.

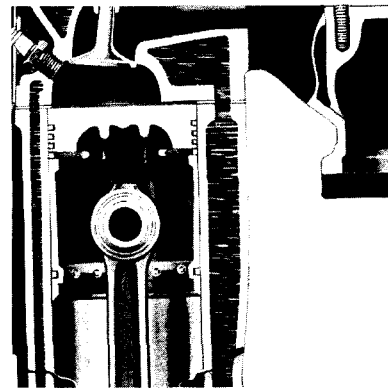


Figure 15

**4. Oil Cooler and Filter**—For heavy duty service, the oil cooler will regulate the oil temperature in relation to the water temperature and maintain a normal operating temperature range.

The oil cooler is designed integrally with the cylinder block and a large partial flow oil filter with easily replaceable filter elements.

As a safety feature, a by-pass valve is provided allowing all the oil to circulate through the engine, should the cooler or filter become clogged.

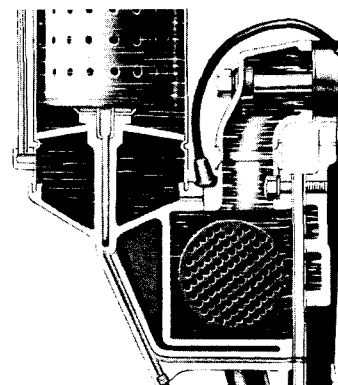


Figure 16

**5. Removable Tappets**—The simple tappet design allows tappets to be easily removed and replaced through the tappet chamber on all models except the "S" series—which requires removal of the camshaft.

Lubrication is provided by the overflow from the rocker arms.

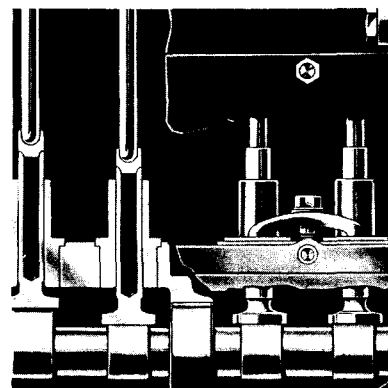
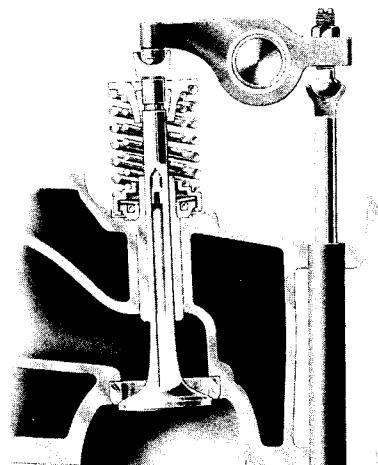


Figure 17

**6. Sodium Cooled, Positive Rotating Exhaust Valves** are standard in many models and optional when desired.

A positive roto exhaust valve mechanism rotates the exhaust valve a predetermined amount each time it opens. This increases valve life and prevents deposit build-up on the contact surfaces.

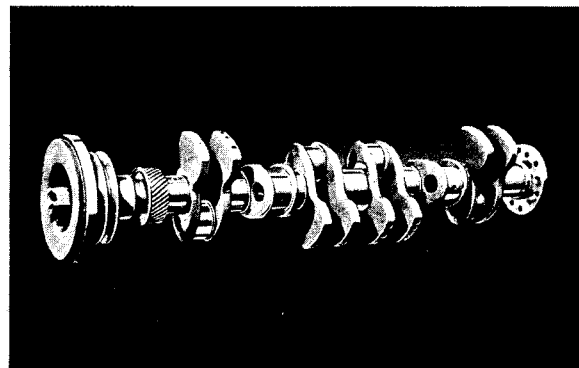
Sodium cooling reduces valve temperatures by drawing the heat away from the valve head by the action of the fluid sodium and transfers this heat from the stem to the cooling water in the head.



**Figure 18**

**7. Counterweighted and Dynamically Balanced Crankshaft** — Drop-forged, scientifically heat-treated crankshafts, with Tocco-hardened journals on the larger engines, are fully counterweighted and dynamically balanced to within one-half ounce.

This reduces the main bearing loads materially, eliminates objectionable vibration and is largely responsible for the smooth operation and longer life of Continental engines.



**Figure 19**

**8. Choice of Fuels** — Gasoline — LPG — Natural Gas — Fuel Oil — Continental overhead valve engines have been tailored for heavy-duty operation using these fuels.



**Figure 20**

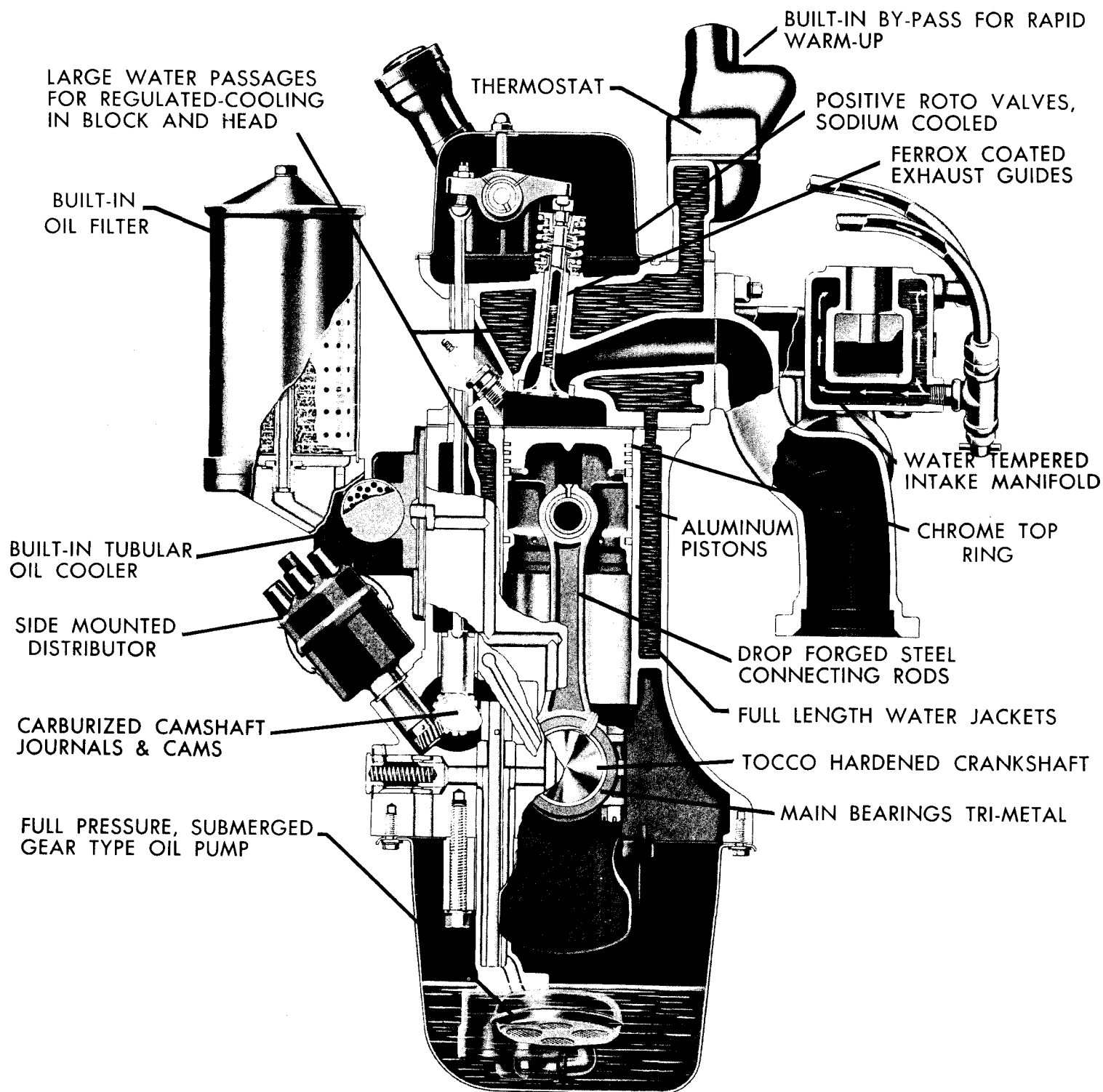


Figure 21 — Typical Sectional View of an Overhead Valve Engine (T-6427)

## SECTION II LUBRICATION

### ENGINE LUBRICATION SYSTEM

CONTINENTAL OVERHEAD VALVE ENGINES have full pressure lubrication through drilled passages in the cylinder block and crankshaft to all main and connecting rod bearings as well as to the timing gears, with "forced feed" to overhead valve rocker arms, the overflow from which lubricates the tappets. The oil pressure is automatically regulated by a spring loaded relief valve.

The gear type oil pump is driven by a gear cut on the camshaft and has several times the capacity required by the engine — the excess being by-passed or returned to the sump.

Oil is supplied the pump by a floating screen which picks up clean oil from the upper portion of oil in the crankcase.

To insure piston pin lubrication and prevent piston scuffing during the warm-up period — the large end of the connecting rods have drilled spurt holes pointing toward the thrust side of the pistons. These line up with the oil hole in the crank pin so that once each revolution, oil is sprayed on the cylinder wall for lubrication. Rocker arm lubrication is of the "forced-feed" type fed from the crankshaft intermittently on the K and T series and from the camshaft on the FO - R - S and U series.

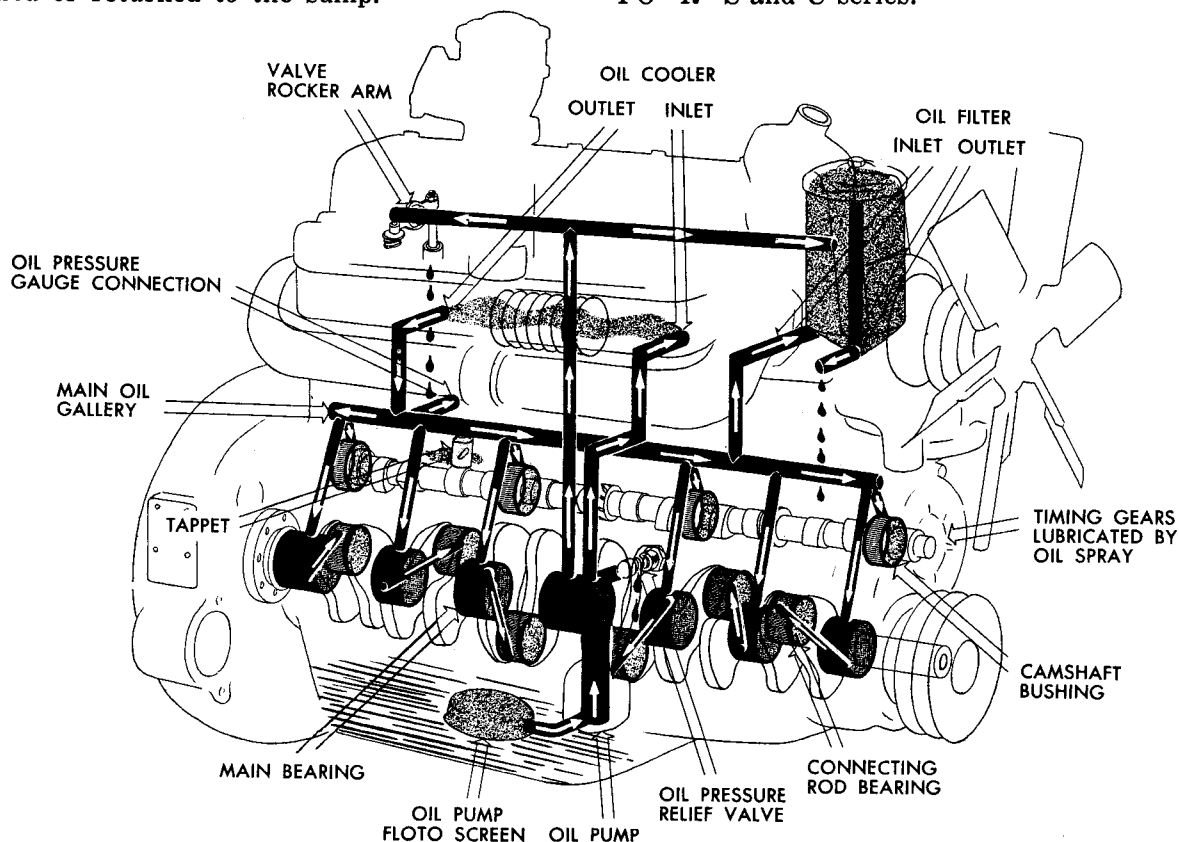
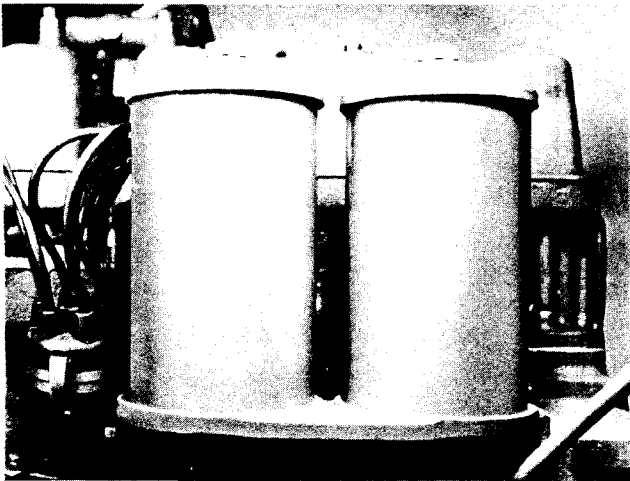


Figure 22 — Lubrication Diagram  
(T-6427)



## OIL FILTER

A lubricating oil filter is provided to separate and remove the grit, sludge and foreign particles from the oil to prevent these injurious materials from being circulated in the engine. This will prevent operating failures, prolong bearing life and reduce maintenance expense.



**Figure 23**  
**Oil Filter**

This by-pass type filter allows only a part of the oil to circulate through the filter at one time; however, all the engine oil eventually passes through and is cleaned. It also includes a replaceable element which collects and retains all the foreign matter.

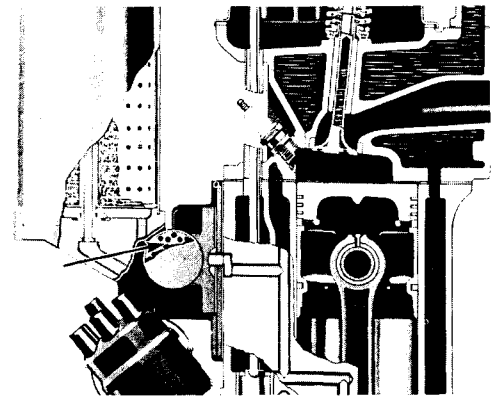
Eventually the minute passages in the element become clogged and unless replaced at regular intervals, ceases to pass oil through and will by-pass the oil around it. This results in abrasive particles remaining in the oil and circulating to the bearings. To prevent this, replace the filter element every 100 hours or 4000 miles.

## OIL COOLER

With the exception of the FO series, all have built-in oil coolers or oil temperature regulators which control the oil temperature in direct relation to the cooling water.

In each instance the oil, under pressure, from the pump passes through the oil cooler before entering the main gallery line leading to the bearings and other parts of the engine.

## ENGINE LUBRICATION SYSTEM



**Figure 24**  
**Oil Cooler and Filter**

While this is specifically designated as an oil cooler, it actually serves to bring the oil up to a more satisfactory operating temperature along with the temperature rise of the cooling water, and at the same time limits this increase, to hold it in direct relation to the cooling water, thus preventing it from reaching too high a temperature to satisfactorily lubricate the engine and help to cool the parts with which it comes in contact.

## OIL PUMP

The oil pump on the six cylinder over-head valve engines is mounted on the center main bearing cap — except the "FO" series which is externally mounted on the block.

It is a gear type pump, with a helical gear on the upper end of the shaft driven by a mating gear cut on the camshaft.

The suction screen is of the floating (Float-O) type and must be free to follow the level of oil in the crankcase.

The pump supplies a quantity of oil under pressure, well in excess of the engine requirements, and is very rarely a source of trouble. If, for any reason it does not operate satisfactorily, it can be removed and repaired or replaced, without difficulty.

Normal oil pressures under operating conditions are:

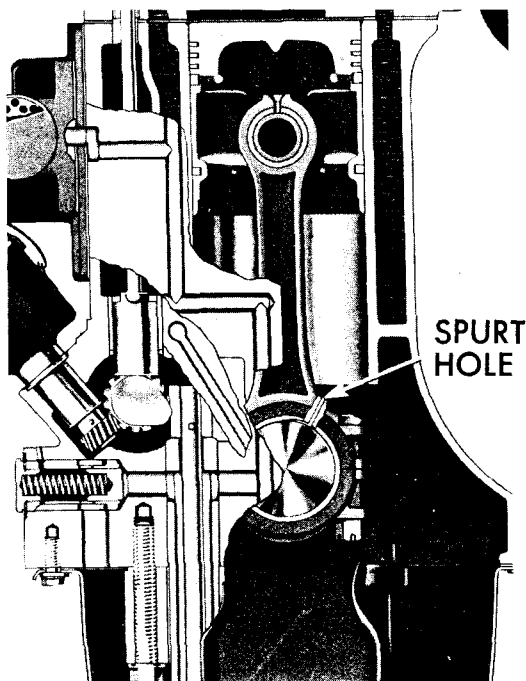
FO Series — 30-40 pounds

K-T Series — 40-50 pounds

U-R-S Series — 55-65 pounds

At idle, the oil pressure should not fall below 7 pounds.

**CAUTION:** If the oil pressure is erratic or falls below these limits, stop the engine IMMEDIATELY and find the cause of the trouble. Refer to trouble shooting section for this information.



**Figure 25**  
Sectional View Showing  
Connecting Rod Spurt Hole

### **OIL CHANGE FREQUENCY**

Engine oil does not "wear out". However, the lubricating oil in internal-combustion engines becomes contaminated from the by-products of combustion: dirt, water, unburned fuel entering the crankcase, and the detergents holding the carbon particles in suspension in the crankcase.

The frequency with which engine oil should be changed depends upon (1) The quality of the oil, (2) Type of operation, (3) Mechanical condition of the engine and (4) The type of contaminants from the engine operation and the surrounding atmosphere.

In normal operation, the Continental over-head valve engines should have the oil changed after every 50 hours, or 2000 miles of operation. The oil filter should be changed every 100 hours or 4000 miles. The oil should be drained when the engine is at normal operating temperature.

### **BREAKING-IN NEW OR RECONDITIONED ENGINES**

New or reconditioned engines have very small clearances. To assure adequate oil distribution to these closely fitted surfaces during the first week of engine operation, the use of a lighter bodied oil is desirable.

1. Fill crankcase with SAE 10W-30 oil to high level mark — regardless of outdoor temperature.
2. Start engine and run-in at following schedule:

#### **INDUSTRIAL**

$\frac{1}{2}$  hour warm-up period at 800 RPM (no load). Check for leaks, oil pressure and water temperature.

$\frac{1}{2}$  hour at 1000 RPM — no load.

$\frac{1}{2}$  hour at 1200 RPM —  $\frac{1}{4}$  load.

$\frac{1}{2}$  hour at 1500 RPM —  $\frac{1}{4}$  load.

$\frac{1}{2}$  hour at 1800 RPM —  $\frac{1}{2}$  load.

During the first 10 hours, do not operate at more than  $\frac{3}{4}$  load and then for only short periods. And for the next 10 hours it may be operated under full load intermittently only, for periods of not more than 10 minutes at a time.

#### **TRANSPORTATION**

##### **First 500 miles operation**

1. When pulling — use a gear lower than normal — **Don't lug.**
2. Keep under governed speed in all gears.
3. Accelerate gradually.

##### **3. At end of first day's operation — while warm:**

- (1) Torque down cylinder head studs to specifications.
- (2) Adjust intake and exhaust valve to specified clearances.
- (3) Check cooling system hoses and fan belt tension and make needed adjustments from initial settings.

##### **4. After 25 hours or 1000 miles operation**

- (1) Change crankcase oil in accordance with recommendations.

**DO NOT FLUSH CRANKCASE WITH KEROSENE**

Some operators unwisely put kerosene in the crankcase after draining the engine oil, then turn the engine over with the starter — in the belief they are doing a better job of crankcase cleaning.

In doing this, kerosene is circulated through the oil pump, the main oil header and the branches leading into the engine bearings — thereby washing away the protective oil film. In addition, some of the kerosene will be trapped and remain to thin out the new oil, reducing its lubricating qualities.

**Do not put kerosene into the crankcase.** The best method is to drain the oil when the engine is thoroughly heated — which will carry off most of the sediment.

**AIR CLEANER**

All engines, when operating, consume several thousand cubic feet of air per hour. Since dusty air is full of abrasive matter, the engine will soon wear **excessively** if the air cleaner does not remove the dust before entering the cylinders.

Two basic types of air cleaners are normally used — the oil bath type and the dry replaceable element type.

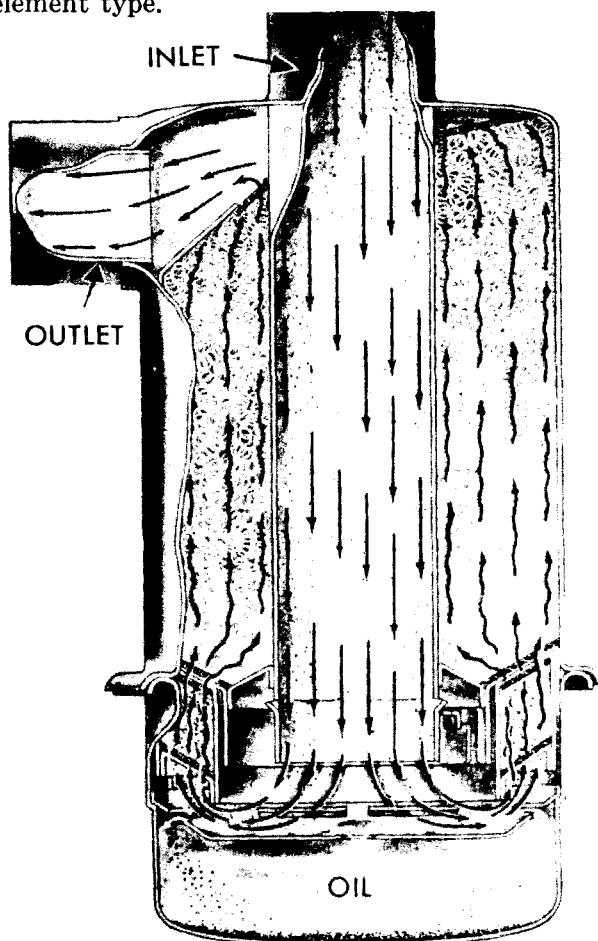


Figure 26 — Sectional View of Oil Bath Air Cleaner

*A planned air cleaner servicing program will increase the effective life of your engine.*

Operating conditions determine the air cleaner service periods. In extremely dusty operations, this may be once or twice daily. In dust protected areas, the air cleaner should be serviced when changing oil.

As the dirt is strained from the air flowing through the cleaner, it thickens the oil in the cup and raises the level. If the level is too high, agitation of the oil on the screen is affected and gritty oil is carried over into the air stream, through the carburetor and into the engine cylinders. This would actually introduce a grinding compound with resulting very rapid wear.

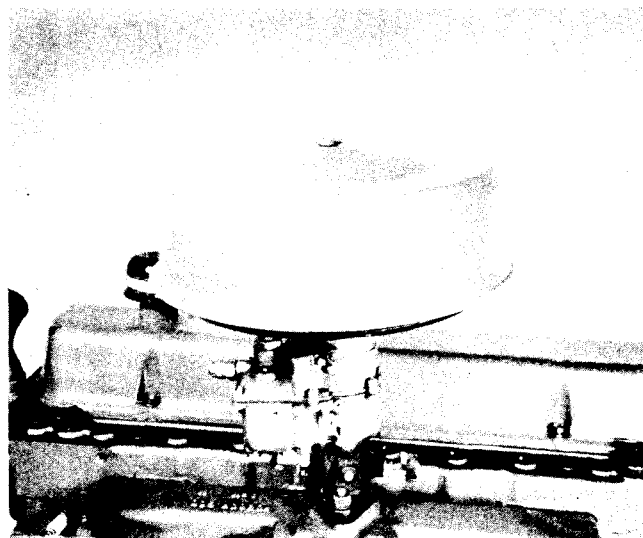


Figure 27 — Dry Replaceable Element Type Air Cleaner

By actual measurement, the amount of dust shown below, when admitted in the volume shown every hour, will completely ruin an engine in an eight hour day.

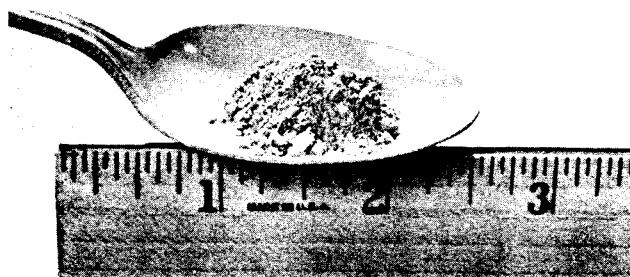


Figure 28

Proper servicing means **Cleaning Thoroughly and Refilling with New Engine Oil, and Maintaining Air-Tight Connections** between the air cleaner and intake manifold so that **All Air Entering The Engine Is Filtered.**

**THE AIR CLEANER ARRANGEMENT SHOULD NOT HAVE RESTRICTIONS GREATER THAN 10" WATER.**

## LUBRICATION RECOMMENDATIONS

Motor oils used for internal-combustion engine lubrication perform many useful functions including: dissipating heat; sealing piston rings; preventing metal to metal contact wear and reducing power loss through friction.

The lubricating oil recommendation is based upon engine design; type of service and the atmospheric temperature prevailing. High quality oils are required to assure maximum performance, long engine life and minimum cost of operation.

Overhead-valve gasoline engines operate in a wide range of service conditions and seasonal temperatures, so our recommendations are given for various types of service and ambient temperatures.

The American Petroleum Institute (API) has established new service classifications so that the engine operator can properly select the best type of oil.

They have the following three classifications of engine oils relating to the different operating conditions for gasoline or other spark-ignition engines:

**SERVICE ML** — (Former API Designation: Regular)

**Light or Easy Service Conditions** — Such as moderate operating speed at normal engine temperatures — especially where the engine is relatively insensitive to promote deposit formation and bearing corrosion.

**SERVICE MM** — (Former API Designation: Premium)

**Moderate Severe Service Conditions** — Involving higher speeds and operating temperatures; particularly when the higher temperatures tend to promote deposit formation and bearing corrosion.

**SERVICE MS** — (Former API Designation: Heavy-Duty Type)

**Severest Service Conditions** — include:

**Start-Stop Operation** — which leads to emulsion sludge and corrosive wear; involves essentially a low-temperature condition, and one which gets worse in colder weather.

**Severe High Temperature Operation** — Resulting from high loads or overloads or high operating speed which tends to result in carbon, lacquer and sludge deposits.

### S.A.E. OIL BODY GRADES

The oil body grades recommended from the lightest SAE 5W) to the heaviest (SAE 40) are:

5W	10W	20W	20	30	40
← 5W - 20 →					
	← 10W - 30 →				

**MULTI-GRADE OILS** — Such as SAE 5W-20 and SAE 10W-30 have the starting grade characteristics of the lighter oil and after it warms up it has the running characteristic of the heavier grade.

The following SAE grades are general recommendations for Continental Overhead-valve engines during changing seasonal atmospheric temperatures:

ENGINE SERIES	*SEVERE WINTER Below 0°F	NORMAL WINTER 0°F to 32°F	SPRING-FALL 32°F to 75°F	SUMMER Above 75°F
FO	10W	10W	20W	SAE 30
K	10W	20W	SAE 30	SAE 40
T	10W	20W	SAE 30	SAE 40
U	10W	20W	SAE 30	SAE 40
R	10W	20W	SAE 30	SAE 40
S	10W	20W	SAE 30	SAE 40

\*Below -10° F, use SAE 5W-20 Grade

The Multi-Grade oil used should cover the single grade recommendation for the atmospheric temperature involved, e.g. SAE 10W-30 covers SAE-10W, SAE 20W, SAE 20 and SAE 30.

Use High Grade MS Oils such as Socony Mobile Oil Company Mobiloil or Delvac 900-series. Favorable conditions may warrant oils listed under ML and MM service; however our above general recommendations are listed under SERVICE MS Oils such as:

Mobiloil AF (SAE 40)	Delvac 940 (SAE 40)
Mobiloil A (SAE 30)	Delvac 930 (SAE 30)
Mobiloil Arctic (SAE 20-20W)	Delvac 920 (SAE 20W)
Mobiloil 10W (SAE 10W)	Delvac 910 (SAE 10W)
Mobiloil 5W (SAE 5W-20)	Delvac Special (SAE 10W-30)
Mobiloil Special (SAE 10W-30)	

**Generators - Starters - Distributors** — Add 3-5 Drops of engine oil to the generator and starter oil cups every 50 hours and to the distributor every 250 hours.

**AIR COMPRESSORS (ENGINE MOUNTED)** normally are engine lubricated — however, if lubricated separately from the engine, use the same type and grade as used in the engine.

**Clutches** — Use a high temperature bearing grease such as Mobilgrease No. 5 or Mobilgrease MP. Do not over-lubricate.

**Conventional Transmissions** — For the greatest efficiency over the life of the transmission, use a high quality straight mineral oil such as the "Mobilube C" line. The oil should be changed seasonally.

Use the following proper grades:

	SUMMER	WINTER
Clark	SAE 90	SAE 90
Fuller	SAE 140	SAE 90
Twin Disc	SAE 40	SAE 40
Warner	SAE 140	SAE 90

**Torque Converters and Hydraulic or Automatic Transmissions** — These units employ a fluid medium to transmit power which must be very stable

to resist formation of harmful deposits or change in body in use. The correct fluid must be selected to obtain maximum efficiency of the transmission. All fluids should be changed seasonally.

Type "A" Automatic Transmission fluid is most widely used. There are many widely distributed brands of this type, such as Socony Mobil Oil Company's Mobilfluid 200.

For some models of Twin Disc Clutch Company's torque converters, a Special Fluid having a viscosity of 35 Saybolt seconds @ 100° F. is required — other models use SAE 10W engine oil. The Special low viscosity fluid may be obtained from Twin Disc Clutch Company Dealers. To satisfy the SAE 10W requirement, we recommend the use of MS type oils, such as, Socony Mobil Oil Company's Delvac 910 or Mobiloil 10W.

Allison Division torque converters and Torqmatic transmissions require a type C-1 fluid, which is on their approved list, such as, Delvac 910.

**TRANSMISSION AND CONVERTER LUBRICATION RECOMMENDATIONS**

The following grades are generally recommended for hydraulic torque converters and transmissions for Summer and Winter operation:

MANUFACTURER	SUMMER	WINTER
<b>Continental Motors Corp.</b> Co-Matic Drive Fluid Coupling HC15	Type A Type A	Type A Type A
<b>Clark Equipment Co.</b> Torcon (converter only) Torcon Converter and Transmission	SAE 10W Type A	Type A (below 10° F.) Type A
<b>Fuller Mfg. Co.</b> Torque Converter	SAE 10W	Type A (below 0° F.)
<b>Borg-Warner</b> Borg & Beck & Long Mfg. Co. All converters and hydraulic transmissions	Type A	Type A
<b>Allison Division</b> Torque Converters and Torqmatic Transmissions	Type C-1	Type C-1
<b>Twin Disc Clutch Co.</b> Hydraulic Reverse Gears Coupling or Power Take-off	SAE 10W	SAE 10W
Hydraulic Converter Transmissions Input shaft & impeller bearings (C, FC)	Same as Engine	
Fluid Medium except Two speed transmission and converter transmission combinations (Models T-DRR-FT-IT)	Special Twin-Disc Fluid  Type A	Type A
Reverse Transmissions Models RR-CRR-ICRR	SAE 40	SAE 20
<b>NOTE:</b> For all Grease applications on the above units a good high temperature grease, such as, Socony Mobil Oil Company's Mobilgrease No. 5 or MP should be used.		

## SECTION III OPERATION

### OPERATING INSTRUCTIONS

The person operating the engine naturally assumes responsibility for its care while it is being operated. This is a very important responsibility since the care and attention given the engine goes a long way in determining how long a period it will operate satisfactorily before having to be shut down for repairs.

The operating and preventive maintenance instructions for the Overhead Valve type engines are simple and should be followed without deviation.

The entire aim in setting forth these instructions is to give you the benefit of the knowledge and experience gained over a long period of collaboration between Engineering Research and Field Service.

#### PREPARATION OF NEW ENGINE FOR OPERATION

Before placing a new engine in operation, it must be thoroughly inspected for external damage and particular attention paid to the following items:

1. **Inspect Engine Hold Down Bolts** — To make certain that they are firmly set.

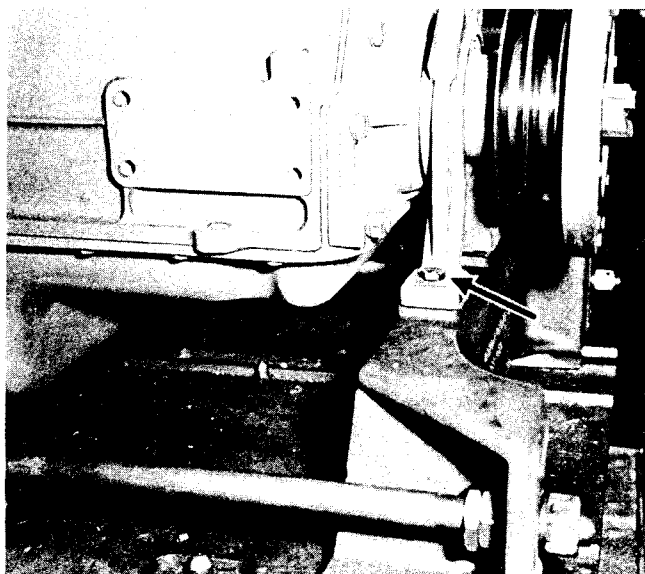


Figure 29 — Engine Mounting Bolts

2. **Open Fuel Tank Shut Off Valve** — By turning handle counter-clockwise as far as it will go.

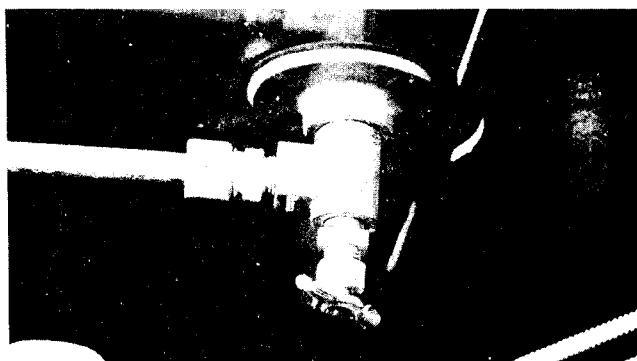


Figure 30 — Fuel Shut-off Valve

3. **Close water drain cock** — in lower radiator connection, also on the side of the block. (In some cases, this may be a pipe plug.)

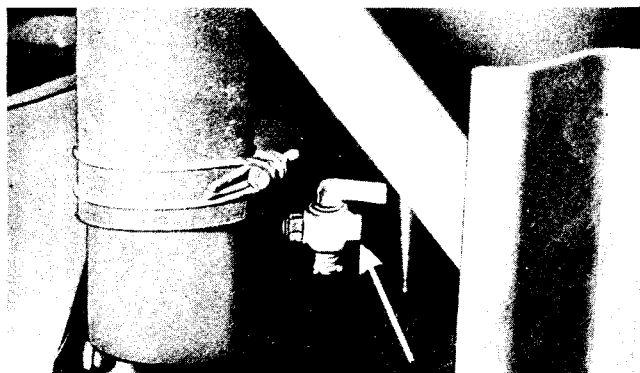


Figure 31 — Water Drain Cock

4. **Examine Oil Drain Plug** — to make certain that it is tightly closed.

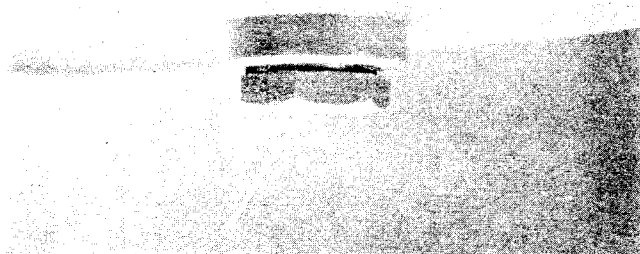


Figure 32 — Oil Drain Plug

5. Fill Crankcase with SAE 10W-30 Oil — for the first week or 50 hours operation — then follow lubrication recommendations in Section II.

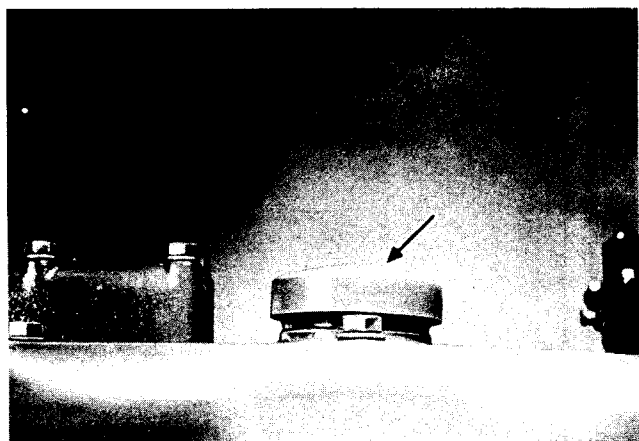


Figure 33

6. Fill Radiator with Clean Water — during freezing weather, use a sufficient amount of anti-freeze to protect the system for the lowest anticipated temperature — refer to Section V.

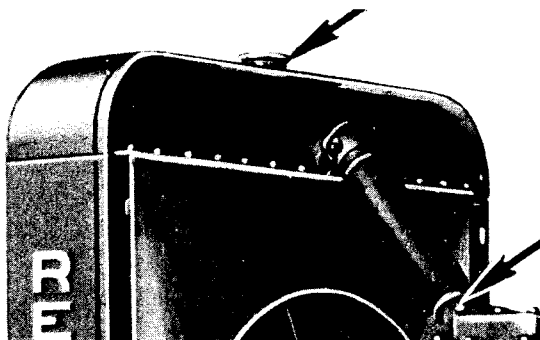


Figure 34

7. FILL GASOLINE TANK FULL — All new engines are shipped with a treated tank which should be completely diluted with a full tank of gasoline to eliminate any tendency to clog.

Be sure that the container used for filling is clean and free from dirt. Replace cap securely.

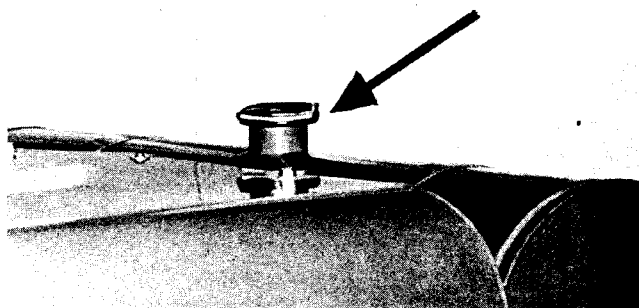


Figure 35

8. Engine Accessories — see that all points requiring lubrication are properly supplied.

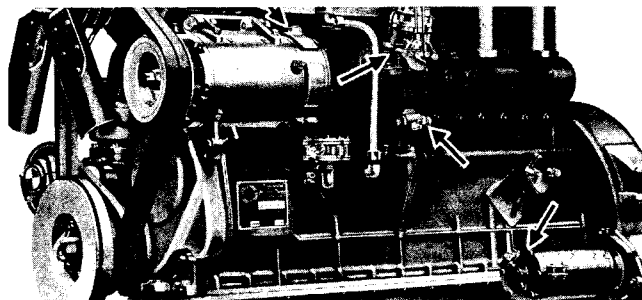


Figure 36

9. Electrical Connections — check storage battery terminals and all electrical connections. Check each spark plug wire for tightness.

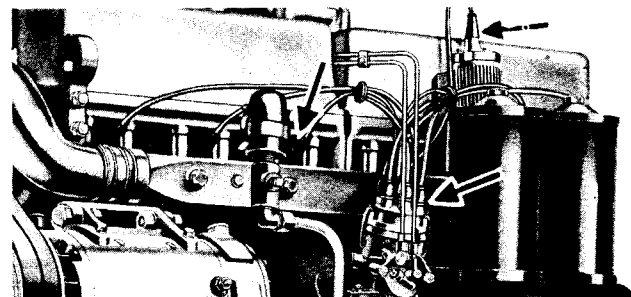


Figure 37

10. RADIATOR COOLANT CAPSULE — The radiator coolant capsule, which comes with the engine, should not be removed: this is a water conditioner and anti rust inhibitor to protect the cooling system.

### STARTING THE ENGINE

Normally check daily preventive maintenance schedule before starting. — (See Section IV).

1. Safety Control Switch — (If supplied) Turn Manual control knob with arrow pointing toward "on" position. When oil pressure builds up to normal, control knob will automatically release and arrow will point to "run" position.

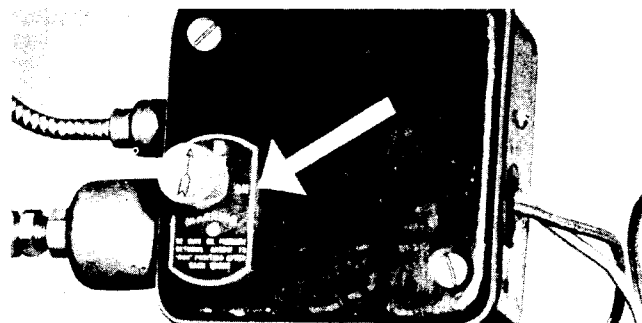


Figure 38 — Safety Switch



2. Disengage Power Take-Off — (if equipped)  
Starting engine under load throws overload on starter and battery.

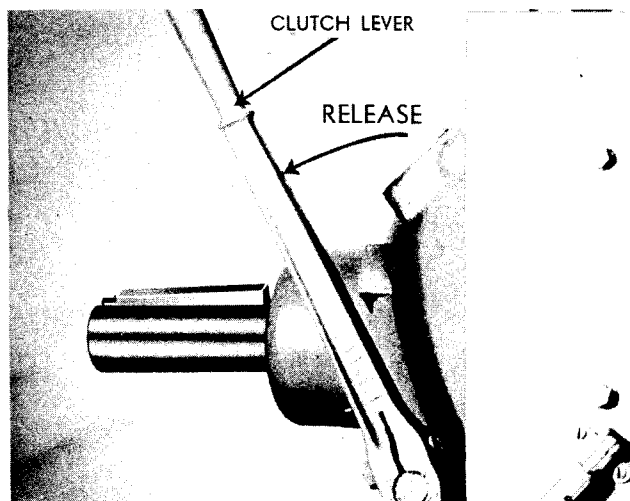


Figure 39 — Power Take-off

3. Open throttle Control about 1/3 open

4. Turn on Ignition Switch

5. Pull Out Choke (if manually operated)  
But avoid flooding the engine. Operate the engine without choking as soon after starting as possible.

6. Push Starter Button In

Keep on until engine starts; but not longer than 15 seconds at a time.

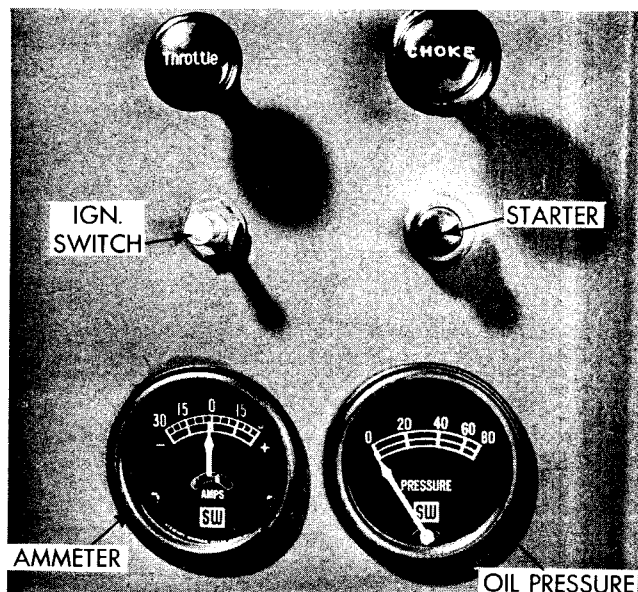


Figure 40 — Instrument Panel

7. Warm-up Before Applying Load

Idle the engine about 700 R.P.M. for a few minutes to circulate and warm oil — then increase the speed to approximately half throttle until the engine water reaches 100° F. This procedure will prolong the engine life.

8. Check Oil Pressure

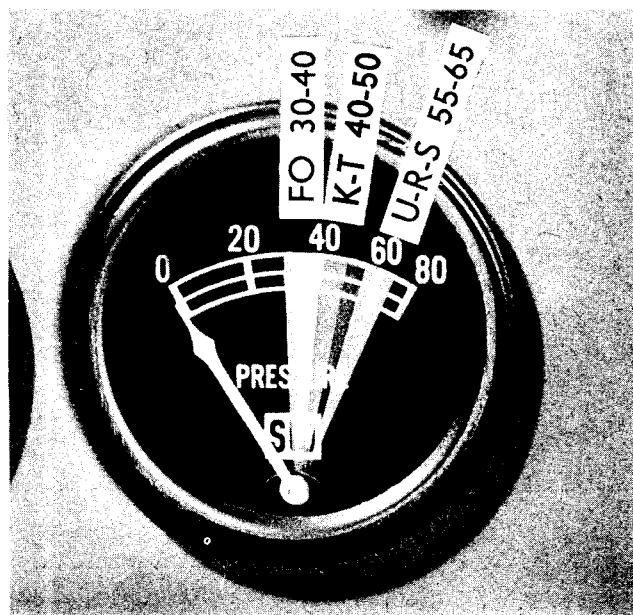


Figure 41 — Oil Pressure Gauge

(Other pressures available for special Applications)

9. Check Water Temperature

Water temperatures should be maintained at 150°-185°F.

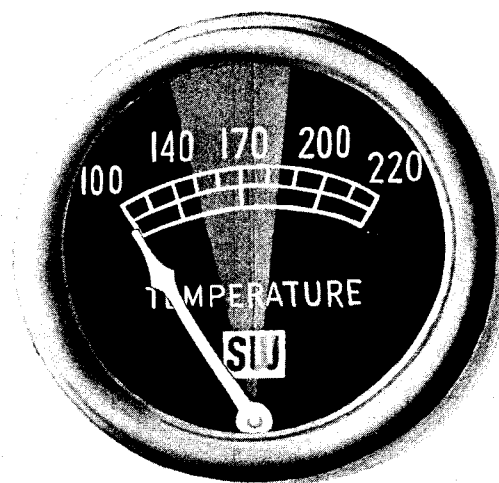


Figure 42 — Water Temperature Gauge

### CAUTION:

After starting new engine — run it at idle for 5 minutes, then stop engine and recheck oil level in crankcase — then bring oil level to high mark on dipstick.

## STOPPING THE ENGINE

### IF INDUSTRIAL UNITS — FIRST DISENGAGE POWER TAKE-OFF

1. Reduce engine Speed to Idle — If hot, run engine at idle (400-600) for several minutes to cool.

2. Turn Off Ignition Switch — if engine continues to run due to high combustion chamber temperatures, either continue idling to further cool or shut off fuel supply.

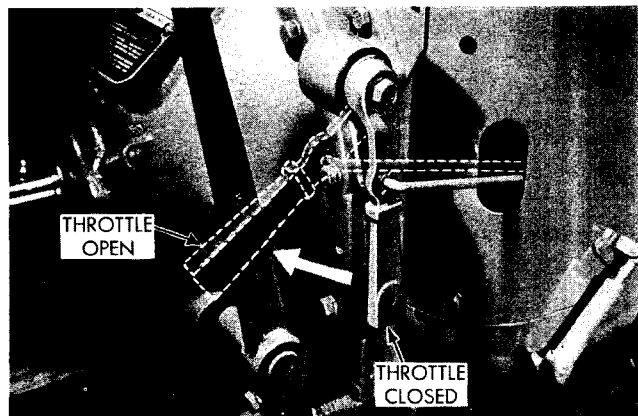


Figure 43 — Hand Throttle Control

#### CAUTION:

**NEVER PULL OUT CHOKE WHEN STOPPING ENGINE — BECAUSE RAW GASOLINE WILL WASH LUBRICANT FROM CYLINDER WALLS.**

## 10 OPERATING PRECAUTIONS

1. **Oil Pressure** — should be up to recommended pressure at operating speed and over 7 pounds at idle (400-600 R.P.M.)

2. **Ammeter** — should register "Charging" at all times engine is running. (A voltage regulator, if used, may limit it to a very low reading).

3. **Water temperature** — should be maintained 150-185° F. — continued overheating may cause internal damage. "Frequent Readings of Gauge should become a Habit".

4. **Muffler Restriction** — should not exceed 20" water or 1½" Mercury. Inspect mufflers periodically for restrictions to prevent burned valves.

5. **Clean and Service Air Cleaner** — as recommended to maintain its efficiency. The rapidity that dirt collects in the oil cup indicates how often the air cleaner should be serviced.

6. **When engine is Over-Heated** — do not add water — allow engine to cool so as to prevent cracking the cylinder head.

7. **Engine Load Indication** — a manifold vacuum of 6 inches of Mercury indicates

the recommended maximum continuous full load operation and a vacuum of 18-20 inches of Mercury indicates normal idling vacuum. Between full load and idling, vacuum gauge readings may be used to approximate the percent of load. Any reading below 6" HG indicates engine is overloaded for continuous duty.

8. **Avoid Cold-Sludge Condensation** — by protecting unit to maintain crank case temperature over 135° F.

9. **Breaking in a new or rebuilt engine** — for peak performance and economical operation, the following adjustments should be made at end of first day's operation:

- 1) Torque down cylinder head studs to specifications.
- 2) Adjust valve tappets to specified clearances.
- 3) Adjust idle mixture and idle speed to 400-600 R.P.M.

10. **Follow Preventive Maintenance Schedules Recommended** — This will avoid troubles which might cause expensive breakdowns and maintain your engine for dependable and economical operation.

## COLD WEATHER OPERATION

The oil used during cold weather should have a cold test below the lowest anticipated temperatures that will be encountered during its use. The new multigrade lubricating oils 5W-20 and 10W-30 are ideal for cold starting with its reduced initial drag until warmed up, when it assumes the characteristics of the heavier oil.

Sludge formation at low temperatures is a close second to dirt in causing engine damage and wear. This is formed by the piston combustion gases mixing with the fine oil mist in the crankcase and condensing on a cold surface. This condensation forms both a sulphuric and sulphurous acid which combines with the oil to become a highly injurious sludge. This dew point is about 135° F. — when crankcase temperatures are higher, the contaminated gases remain in gaseous form and the engine operates clean as long as breather system is kept clean — however temperatures below this will result in injurious sludge formation. It is vitally important therefore to maintain oil and crankcase temperatures above 135° F., as shown on the following chart:

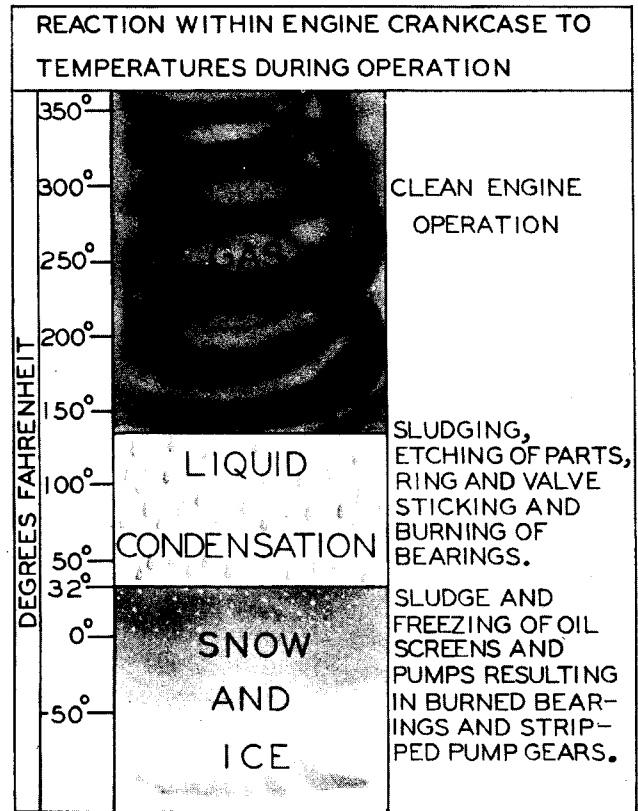


Figure 44

When sludging conditions prevail, the oil should be examined daily and changed as it may freeze, or clog the inlet strainer and cause bearing failures.

**High Altitude Operation** — High Altitude operation reduces the power output approximately 3½% for every 1000 feet of altitude above sea level.

**High Temperature Operation**—for every 10° above 60° F. carburetor air temperature — a power loss of 1% results.

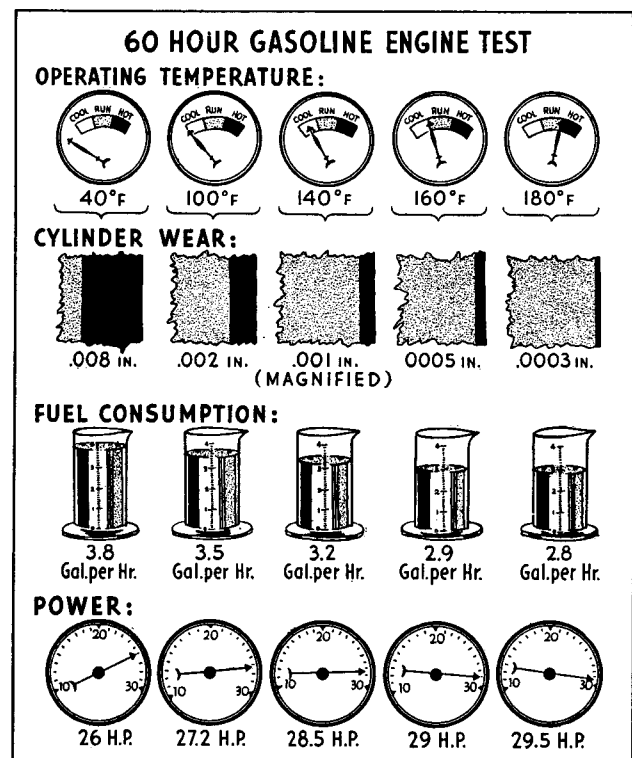


Fig. 44A — The Effects of Operating Temperature on Engine Wear, Fuel Consumption and Power.

## **PREPARATION OF ENGINE FOR SEASONAL STORAGE**

### **CAUTION**

Before starting the processing, engine must be cooled down to the surrounding temperature, since oil will adhere much better to cold metal surfaces.

1. **Drain Oil from Oil Pan** — and replace drain plug.
2. **Refill Oil Pan** — with high grade SAE 50 engine oil to  $\frac{1}{2}$  its normal capacity.
3. **Start up Engine** — and run at above 600 R.P.M. for 2 minutes to complete oil distribution on all surfaces — **Do Not Run Longer Than 2 Minutes.**
4. **Stop Engine**—Remove all Spark Plugs.
5. **Pour 3 Ounces of SAE 50 Engine Oil** — into each Spark Plug Hole.
6. **With Ignition Cut Off** — Crank engine with Starter — for at least a dozen revolutions to distribute this oil over the cylinder walls and valve mechanism.
7. **Drain Oil from Pan and Reassemble Plug.**
8. **Drain Cooling System and Close Drain Cocks.**
9. **Drain All Gasoline** — from tank, lines and carburetor bowl.
10. **Replace All Spark Plugs.**
11. **Seal Air Cleaner Inlet** — exhaust outlet — **Crankcase Breather Tube** — with weather proof masking tape.
12. **Check Oil Filler Cap** — **Gas Tank Cap** and **Radiator Cap** to make certain they are securely in place.

## SECTION IV PREVENTIVE MAINTENANCE

In order to obtain maximum efficiency from your gasoline engine, a definite maintenance program should be set-up and followed. Haphazard maintenance will only lead to faulty engine performance and shorten engine life.

All moving parts in the engine are subject to wear; however, wear can be retarded by careful operation and a planned maintenance program.

In general, gasoline engine operation demands careful attention to the cleanliness of **air, fuel** and **oil** and maintaining operating temperatures of 150°-185° F.

The following pages, covering **daily, 50-250 and 500 hour** maintenance, have been worked out with our field service division as "Minimum Requirements" to keep your engine in dependable operating condition.

### ▶ DAILY ◀

#### PREVENTIVE MAINTENANCE SCHEDULE

##### 1. OVERALL VISUAL INSPECTION OF ENGINE

Look for evidence of fluid leaks on floor, cylinder head and block, indicating loose fuel, oil or water connections — **tighten if found.**

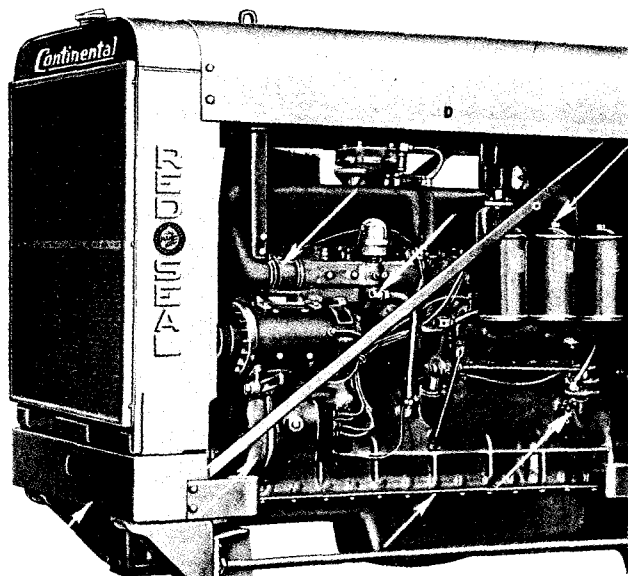


Figure 45 — Check for Possible Leakage

##### 2. CHECK OIL LEVEL OF ENGINE

The dipstick indicates the high and low oil level in the crankcase—make allowance for additional oil drainage back into oil pan if engine has not been stopped 15 minutes. The most efficient oil level is between the two dipstick levels.

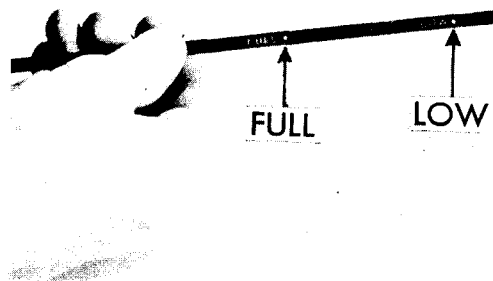


Figure 46 — Check Oil Level of Engine

*Do not add oil until oil level approaches the low mark — then add only enough to bring it to high level — NEVER above.*

*Do not operate the engine with oil below low level mark.*

### 3. CHECK RADIATOR

Fill radiator with clean water or anti-freeze to normal level maintained due to expansion when heated. Visually inspect fan and belt for condition and adjustment.

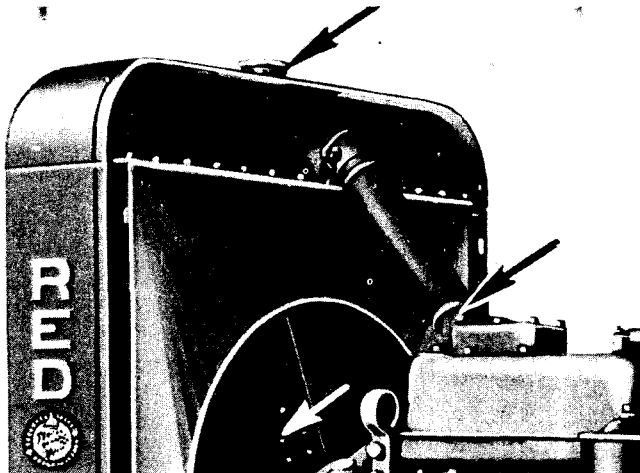


Figure 47

### 4. FILL FUEL TANK

Should be done at end of day's operation to prevent condensation forming in tank. Clean filler cap and area around spout before filling to prevent entrance of dust into fuel system.

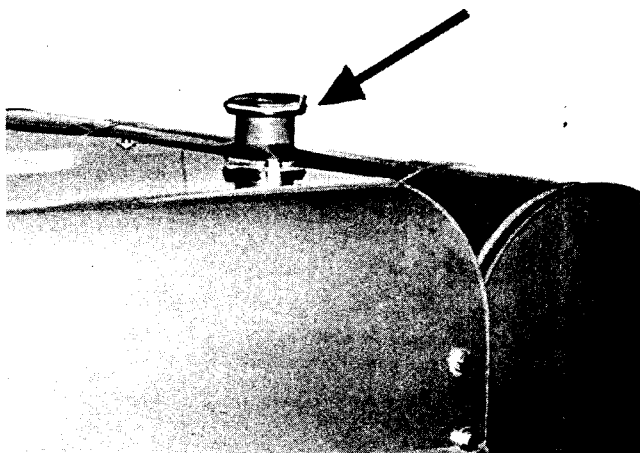


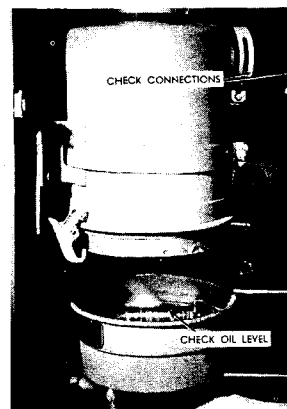
Figure 48

### 5. CHECK AIR CLEANER

Remove air cleaner oil cup and note amount of sediment—if required, clean and refill with engine oil to level. Visually inspect air cleaner connections to manifold.

Extremely dusty conditions may require servicing the air cleaner daily or even twice daily.

Some oil bath cleaners have a removable screen unit above the oil cup which can be removed for cleaning—others with built-in screens require removal of entire cleaner, after the oil cup is removed, to wash in a good cleaning solvent.



Oil Bath Air Cleaner



Dry Type

Figure 49 — Air Cleaner

#### Dry replaceable element type service

Remove filter element and apply a reverse flow of low pressure air on the inside to blow off the accumulated dirt on the outside. This can only be repeated a few times as the element will finally clog and restrict the air flow causing a loss of power.

*Caution:* Never wash a dry element in a liquid tank

### 6. CHECK OIL PRESSURE\*

Note oil pressure gauge which should indicate the following pressure range at full throttle and a minimum of 7 pounds pressure at idling speed (400-600 R.P.M.):

30-40 lbs. pressure —	Model FO	Engines
40-50 lbs. pressure —	Models K-T	Engines
55-65 lbs. pressure —	Models R-S-U	Engines

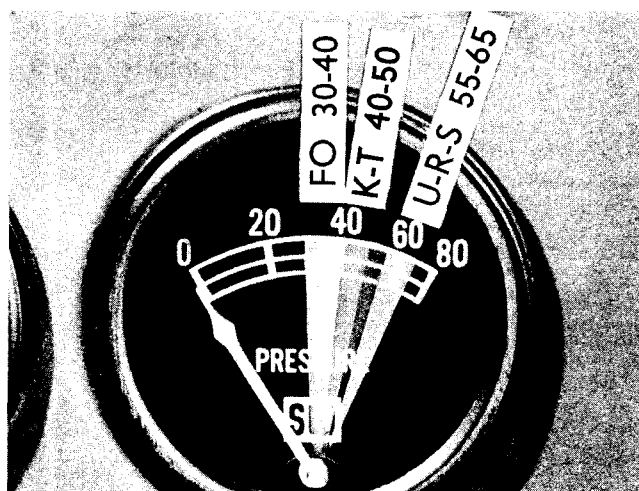


Figure 50 — Operating Oil Pressures

\*Standard Engines: on some special customer specifications, this may change.

**7. NOTE ANY UNUSUAL NOISE**

Operators familiar with daily engine operation soon become alert to any noise not normally present. This is very valuable in correcting defects in the early stages and preventing expensive repairs or delays.

**1. REPEAT DAILY OPERATIONS OUTLINED**

Follow previous instructions.

**2. CHANGE CRANKCASE OIL**

Engine life is dependent upon clean oil being circulated to all moving parts; therefore, the frequency of oil changes and oil filter replacement is very important and should be made at regular, scheduled periods.

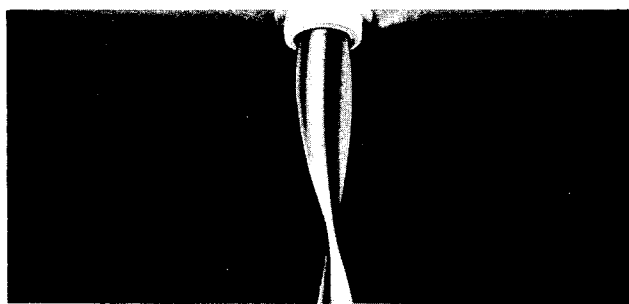


Figure 51

The crankcase oil should be changed after 50 hours or 2000 miles service and when the oil is at operating temperatures so that complete drainage will result.

Replace the oil filter element every 100 hours or 4000 miles unless extremely unfavorable operating conditions indicate that filter replacements should be made at every oil change period.

Thoroughly clean the filter, cover and sealing surfaces before replacing new element and gasket.

**3. SERVICE AIR CLEANER**

If oil-bath air cleaner is used, remove bottom half of air cleaner — clean thoroughly and fill with engine oil to oil level mark on cup, avoid overfilling. Replace cup and check all connections to manifold. Be sure that no unfiltered air can enter the engine intake manifold.

If a dry type air cleaner is used, clean element with compressed air — *Never wash in a liquid.*



Figure 52 — Air Cleaner

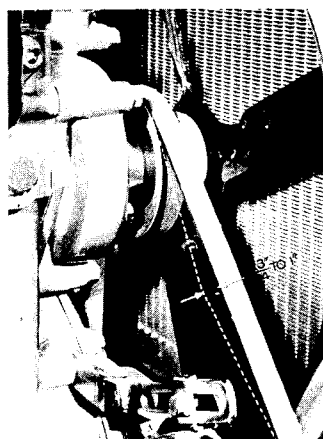
**4. CHECK FAN BELT TENSION**

Figure 53 — Fan Belt Tension

Inspect wear condition of fan belt; note alignment and check belt tension which should allow  $\frac{3}{4}$ " to 1" deflection on long span.

**5. CHECK BATTERY**

Check specific gravity of each cell — which should be at least 1.250. Add distilled water, if required, to raise level  $\frac{3}{8}$ " above the separators.

Particular attention should be given battery during cold weather. The cranking power of a fully charged battery @ 80° F. is reduced 60% @ 0° F. — yet the power required to crank the engine is  $2\frac{1}{2}$  times greater @ 0° F. than @ 80° F.



Figure 54 — Checking Battery

**6. LUBRICATE GENERATOR AND STARTER**

Apply 3-5 drops of engine oil to each cup on the generator and if required on the starter (Many starters have sealed bearings).



Figure 55 — Generator Lubrication

**8 TO 10 DROPS OF ENGINE OIL**

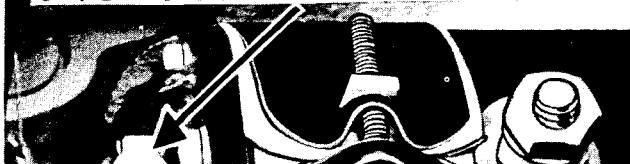


Figure 56 — Starter Lubrication Point

### 7. LUBRICATE POWER TAKE OFF

Using grease gun, lubricate the clutch throw-out bearing and output shaft bearing with approved ball bearing grease.

Operations requiring frequent de-clutching should be lubricated daily.

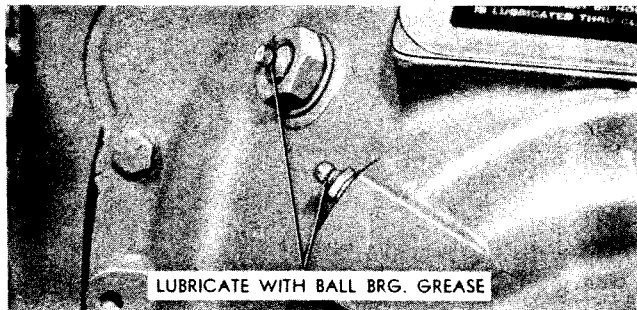


Figure 57



### 1. REPEAT DAILY AND 50-HOUR SCHEDULES

Follow previous instructions.

### 2. CLEAN EXTERIOR OF ENGINE

Use steam if available, otherwise any good commercial engine cleaner to wash down the engine.

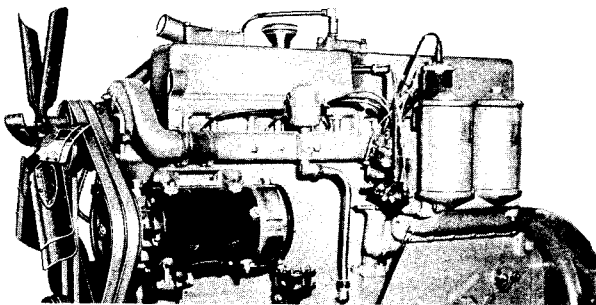


Figure 58

### 3. CHECK GOVERNOR CONTROL

Clean and lubricate all governor linkage to insure free operation of governor. Free-up any joints that may be binding or rods or levers that may be twisted. Check for full throttle opening.

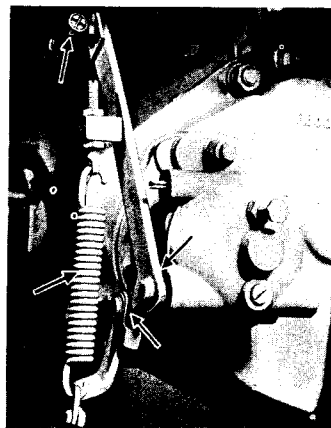


Figure 59

### 4. CLEAN SPARK PLUGS

Clean depression around plugs before removing them — then clean and re-set point to .025 on standard plugs and .035 on resistor plugs.

Install spark plugs and tighten to following torque:

FO Series — 14 MM — 30 pounds  
K-T-U-R-S Series — 18 MM — 34 pounds



Figure 60

### 5. CHECK DISTRIBUTOR

Clean distributor cap inside and outside with solvent without removing wires and blow off with compressed air — inspect cap and rotor for cracks.

Examine contact surfaces of points — replace if burned or pitted and adjust to .020 gap.

Lubricate distributor cam sparingly with a lubricant such as Mobilgrease Special (with Moly).

Check distributor clamp bolts and if found loose — retiming the engine is necessary.

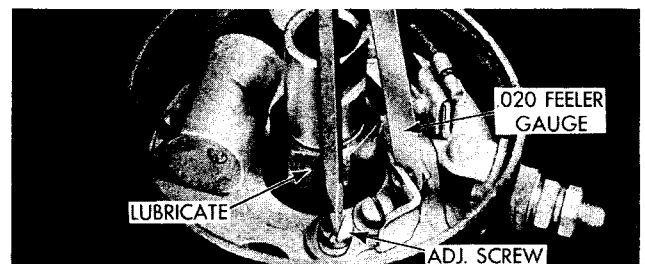


Figure 61

### 6. INSPECT IGNITION WIRES AND CONNECTIONS

Examine ignition wires for breaks in insulation, chafing and loose connections. Replace if defective.

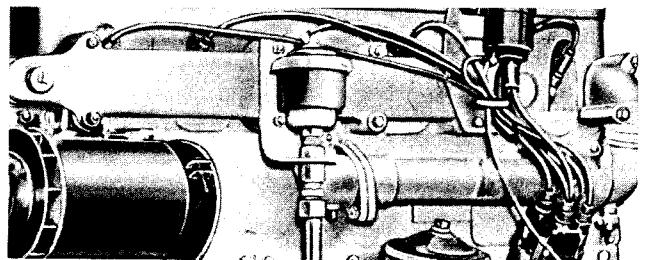


Figure 62

7. IF DRY REPLACEABLE ELEMENT AIR CLEANER IS USED, REPLACE ELEMENT.



## EVERY 500 HOURS

### 1. REPEAT DAILY — 50 HOUR AND 250 HOUR SCHEDULES

### 2. COOLING SYSTEM

Clean radiator core by blowing out with compressed air.

Inspect radiator mounting.

Inspect water pump and connections for leaks.

Check fan and accessory drive belts.

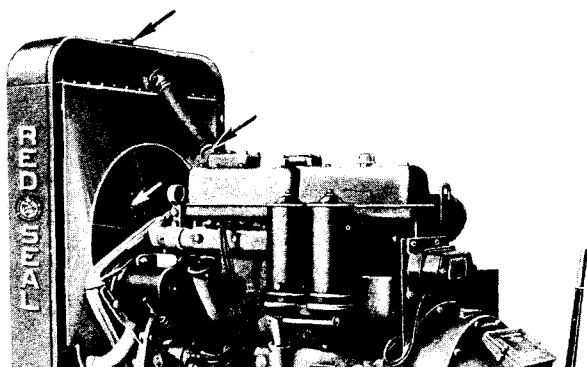


Figure 63

### 3. ADJUST VALVE TAPPET CLEARANCE

Check and adjust intake and exhaust valve tappets to following clearances at idling speed and running temperature:

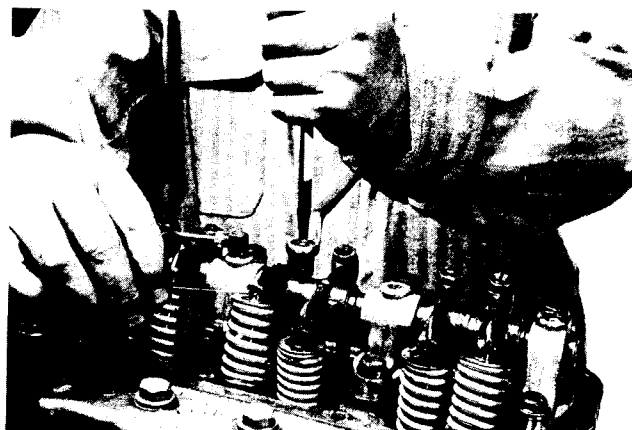


Figure 64 — Adjusting Valve Tappet Clearance

	INTAKE	EXHAUST
FO Series	.017	.023
K Series	.018	.022
T Series	.018	.022
R Series	.020	.030
U Series	.016	.024
S Series	.020	.024

### 4. CARBURETOR

Clean exterior and check mounting to manifold.

Adjust carburetor air adjustment for even running and adjust idle speed to 400-600 R.P.M. minimum.

Inspect throttle and choke linkage for free operation.

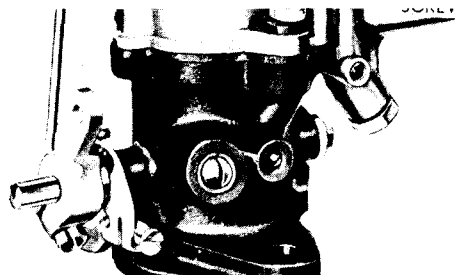


Figure 65

### 5. FUEL PUMP

Clean Filter bowl and screen.

Inspect mounting and gasket.

Check all connections for leaks.

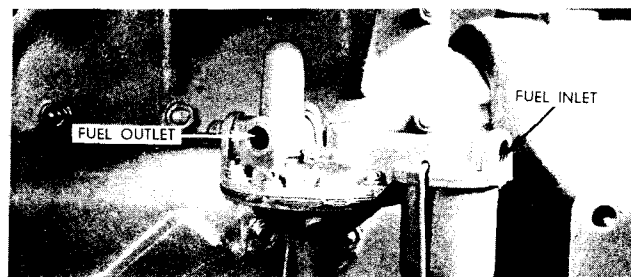


Figure 66 — Fuel Pump Mounting

### 6. MAGNETO (when equipped)

Spark test with engine operating by checking firing with each high tension cable held about 1/16" away from spark plug terminal.

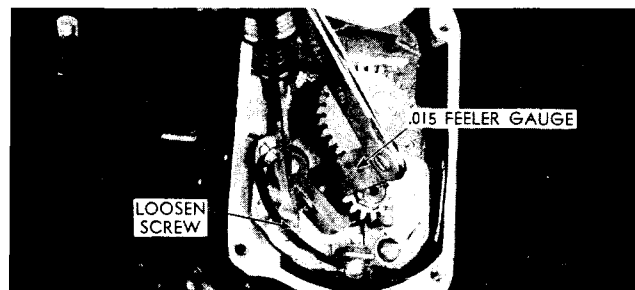


Figure 67

Remove end cap and examine carbon brushes for free-movement and inspect breaker points for wear and gap. Gap should be .015-.018.

### 7. SAFETY AND THERMAL CONTROLS

Inspect control wires and connections.

Examine armored capillary tubing on water temperature element for visual damage that may cause faulty operation.

## SECTION V

### COOLING SYSTEM

The function of the cooling system is to prevent the temperatures in the combustion chamber, which may reach as high as 3500°F, from damaging the engine and at the same time keep the operating temperatures within safe limits.

Maintaining the cooling system efficiency is important, as engine temperatures must be brought up to and maintained within satisfactory range for efficient operation, in order to prevent damage to valves, pistons and bearings.

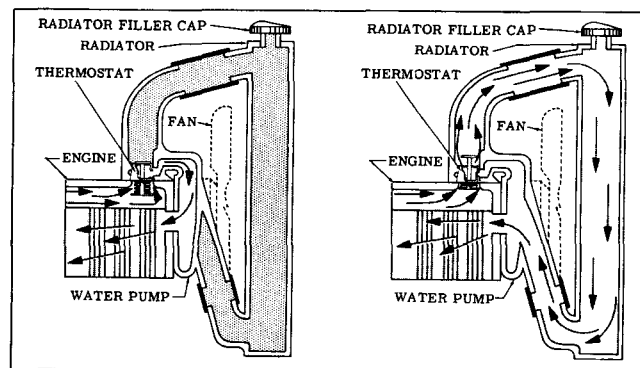
#### CONTINENTAL COOLING SYSTEM

Continental over-head valve engines operate most efficiently with water temperatures of 150°-185°F — a thermostat is used to control these temperatures. All over-head valve engines have one thermostat except the R and S series — which have two thermostats.

The FO series engines have a choke-type thermostat without a by-pass system. When the thermostat is closed, by-pass circulation is provided by water circulation in the water tempered intake manifold and water circulated accessories such as heater or air compressor. When the desired temperature is reached, the thermostat valve opens and allows the water to circulate through both the engine and radiator.

The K-T-R-U and S series engines have a thermostat and by-pass system to control these temperatures.

The thermostat valve remains closed and only allows the water to recirculate within the engine itself until normal operating temperatures are reached. This provides for both rapid and even temperature increase of all engine parts during the warm up period.



**Figure 68**  
Thermostat Flow Control  
Thermostat Closed, Water Re-Circulating through Engine ONLY

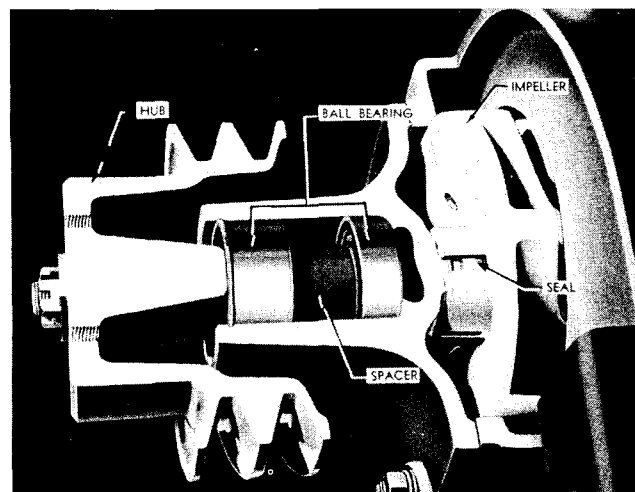
**Figure 69**  
Thermostat Open, Water Circulating through BOTH Engine and Radiator

#### THERMOSTAT AND BY-PASS SYSTEM

When desired temperature is reached, the thermostat valve opens and allows the water to circulate

late through both the engine and radiator or heat exchanger.

The cooling water is circulated by a water pump located at the front of the engine block.

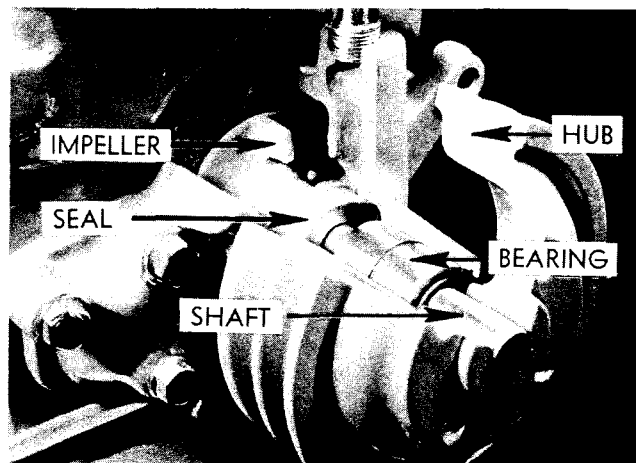


**Figure 70**  
Water Pump — R Series

On the FO series — the main portion of the coolant enters the front of the cylinder block and then distributes evenly through the cylinder block and head.

On the T and K series engines a major portion of the coolant passes through the oil cooler entering the water jacket at the rear of the cylinder block; the balance enters the front directly from the water pump. It is distributed to the cylinder head through cast passages.

On the R-S and U series engines, the major portion of the coolant is directed through a distribution manifold into the cylinder head where it



**Figure 71**  
Water Pump — FO Series

carries away heat from the combustion chamber and valve seats. A smaller portion is directed to the oil cooler after which it enters the water jacket at the rear of the cylinder block.

On the TK and FO series the cylinder walls are cooled by direct flow, while the R-S and U series are cooled by a combination of direct flow and convection currents. This keeps the cylinder barrels at a uniform temperature and thereby greatly reduces crankcase oil dilution and sludge formation.

Upon leaving the cylinder head, the water enters the thermostat housing in which is mounted the by-pass type thermostat which controls the opening to the radiator or heat exchanger. Upon being discharged from the thermostat housing, the water enters the radiator or heat exchanger, depending upon the application, where it is cooled before re-entry into the engine.

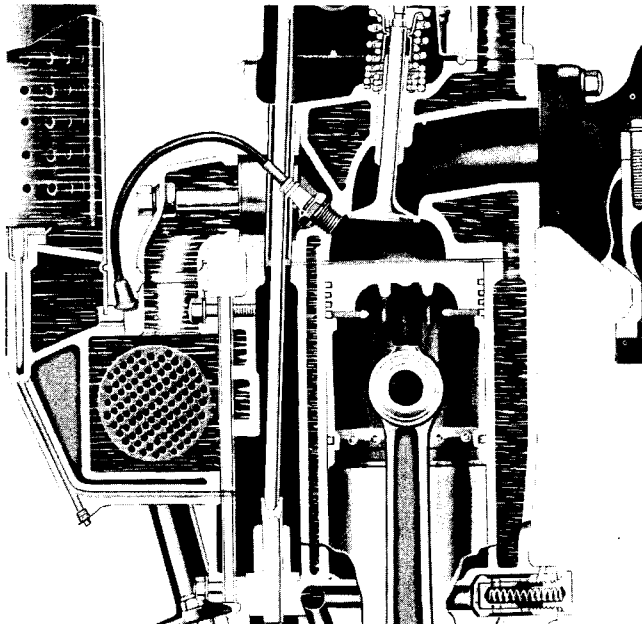


Figure 72 — Sectional View Showing Water Passages in head and block, and manifold

### EXPANSION OF WATER

Water has always been the most commonly used coolant for internal combustion engines because it has excellent heat transfer ability and is readily obtained everywhere. Like all liquids it expands when heated, the rate of expansion being  $\frac{1}{4}$  pint per gallon when the temperature is raised from 40° to 180° F.

For example: If a 4 gallon cooling system is filled completely full of water at 40° F, 1 pint will be lost through the radiator overflow pipe by the time the water temperature reaches 180° F.

### WATER FILTERS

In some areas, the chemical content of the water is such, that even the best of rust inhibitors will not protect the cooling system from the formation of rust and scale.

There are instances where this corrosive element has eaten holes through cast iron parts such as water pump impellers and bodies. This condition is caused by electrolysis taking place in the parts involved.

Where these conditions exist, water filters, such as those made by the Perry Co. and the Fram Corp., should be incorporated in the assembly to remove these troublesome elements and offset the electrolytic action.

### EFFECT OF ALTITUDE ON COOLING

Water boils at 212° F under atmospheric pressure at sea level. This pressure becomes less at higher altitudes and the reduced pressure causes water and other liquids to boil at a lower temperature. The following chart shows the effect on boiling point of water and anti-freeze solution:

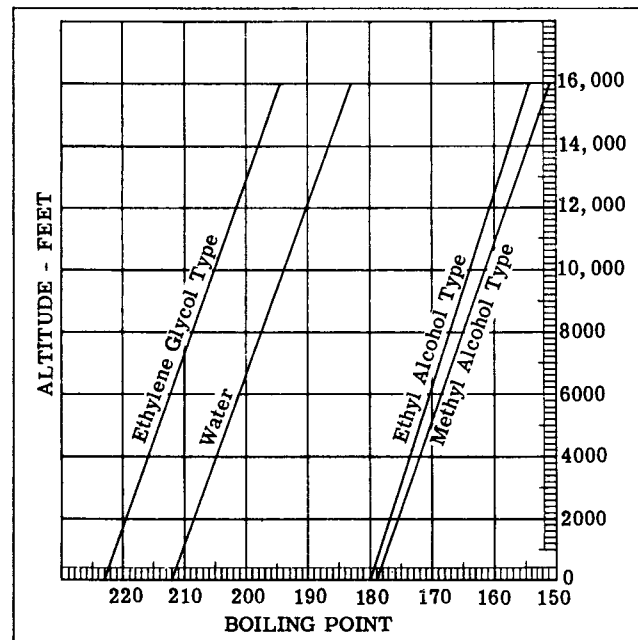


Figure 72A — Effect of Altitude on Boiling Point of Coolant

### ANTI-FREEZES

Water freezes at 32° F., forms solid ice and expands about 9% in volume — which causes tremendous pressure and serious damage when allowed to freeze inside the cooling system.

When operating temperatures are below 32° F. an anti-freeze liquid must be added which will lower the freezing point a safe margin below the anticipated temperature of outside air.

Anti-freeze solutions come in 3 general types and may be used in the following proportions by volume to withstand the temperatures indicated: for example, 1 quart of alcohol to 3 quarts of water for 10° F.

TYPES OF ANTI-FREEZE	OPERATING TEMPERATURE RANGE		
	32° to 10° F	+10° to —10° F	—10° to —30° F
PLAIN ALCOHOL — (evaporates easily) — Check with Hydrometer and replenish often. — If spilled on paint wash thoroughly immediately.....	1 to 3*	4 to 9	5 to 8
METHYL ALCOHOL COMPOUNDS — such as Mobil Freezone, etc., (evaporates less easily) — Check and replenish occasionally. ....	1 to 4	2 to 5	1 to 1
ETHYLENE GLYCOL — such as Mobil Permazone, (permanent type) — When there are no leaks add water only to make up for evaporation.....	1 to 4	2 to 5	1 to 1

\*Example: 1 qt. of alcohol to 3 qts. of water.

**NOTE:** While the above list includes information on three types of generally used Anti-Freeze, the Ethylene Glycol or Permanent Type will be found to be the most desirable and likewise the most economical because of the temperatures desirable to maintain for efficient operation.

### CORROSION INHIBITORS

Water forms rust due to its natural tendency to combine chemically with iron and air in the system. Rust inhibitors for water are inexpensive, simple to use and make cleaning and flushing necessary only after long periods of operation.

The most commonly used are either a 3% addition of soluble oil or commercial corrosion inhibitors such as Mobil Hydrotone that are readily available at low cost. The addition of corrosion inhibitors are not necessary if an anti-freeze containing a rust inhibitor is used.

### RADIATOR

The radiator consists of a series of copper tubes through which the cooling water is circulated. In standard radiator design fins are connected to the copper tubes to give an extended surface through which heat can be dissipated. It is important that these tubes be kept clean on the inside and the fins free of dirt on the outside so that maximum heat transfer can take place in the radiator.

Blowing out between the fins of the radiator, using compressed air, in a direction opposite to that of the fan circulated air, will serve to keep the cooling surfaces of the core free of dirt and other particles.

Every 500 hours of operation the radiator and cooling system should be well cleaned and flushed with clean water.

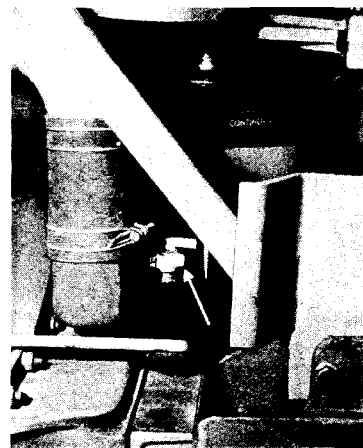


Figure 73 — Radiator Drain

Wherever possible, only soft clean water should be used in the cooling system. Hard water will cause scale to form in the radiator and the engine water jackets and cause poor heat transfer. Where the use of hard water cannot be avoided an approved water softener can be used.

### CLEANING COOLING SYSTEM

Deposits of sludge, scale and rust on the cooling surfaces prevent normal heat transfer from the metal surfaces to the water and in time render the

## COOLING SYSTEM

cooling system ineffective to properly maintain normal operating temperatures. The appearance of rust in the radiator or coolant is a warning that the corrosion inhibitor has lost its effectiveness and should be cleaned before adding fresh coolant.

Dependable cleaning compounds should be used. Follow the procedure recommended by the supplier. This is of prime importance because different cleaners vary in concentration and chemical compositions. After cleaning and flushing, the system should be filled with an approved anti-freeze compound containing a rust and corrosion inhibitor or water with a corrosion inhibitor.

### REVERSE FLOW FLUSHING

Whenever a cooling system is badly rust-clogged as indicated by overflow loss or abnormally high operating temperatures, corrective cleaning by reverse flow flushing will most effectively remove the heavy deposits of sludge, rust and scale. The reverse flow flushing should be performed immediately after draining the cleaning solution and it is advisable to flush the radiator first, allowing the engine to cool as much as possible.

#### Reverse flush the radiator, as follows:

1. Disconnect the hoses at the engine.
2. Put radiator cap on tight.
3. Clamp the flushing gun in the lower hose with a hose clamp.

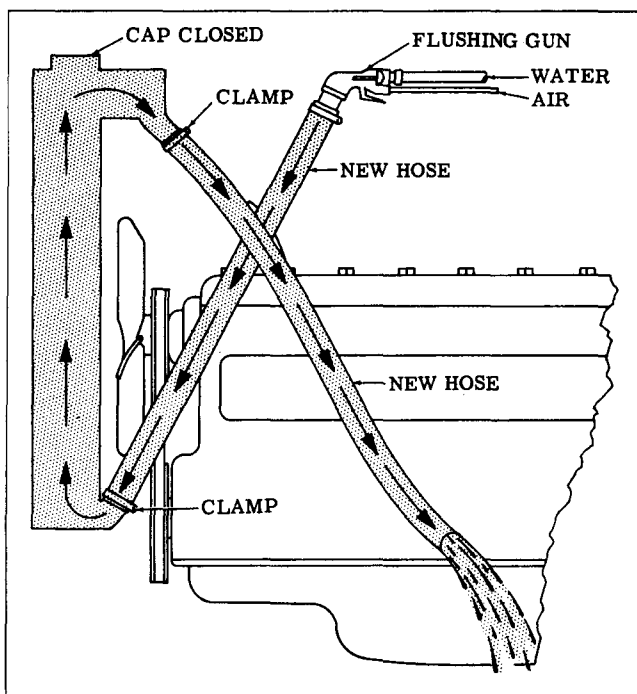


Figure 74 — Reverse Flushing Radiator  
(Schematic Drawing Shown)

4. Turn on the water and let it fill the radiator.
5. Apply air pressure gradually, to avoid radiator damage.
6. Shut off the air, again fill the radiator with water and apply air pressure — repeat until the flushing stream runs out clear.
7. Clean and inspect radiator cap.

#### To Reverse flush the engine water Jacket

1. Remove the thermostat.
2. Clamp the flushing gun in the upper hose.
3. Partly close the water pump opening to fill the engine jacket with water before applying the air.
4. Follow the same procedure outlined above for the radiator by alternately filling the water jacket with water and blowing it out with air (80# pressure) until the flushing stream is clear.

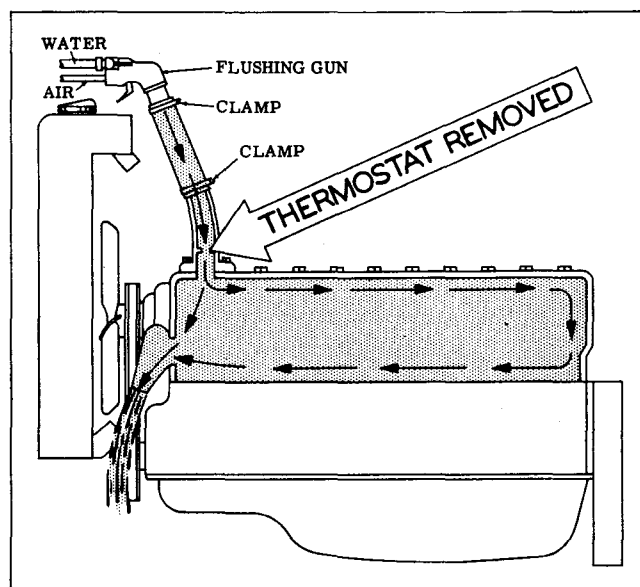


Figure 75 — Reverse Flushing Engine

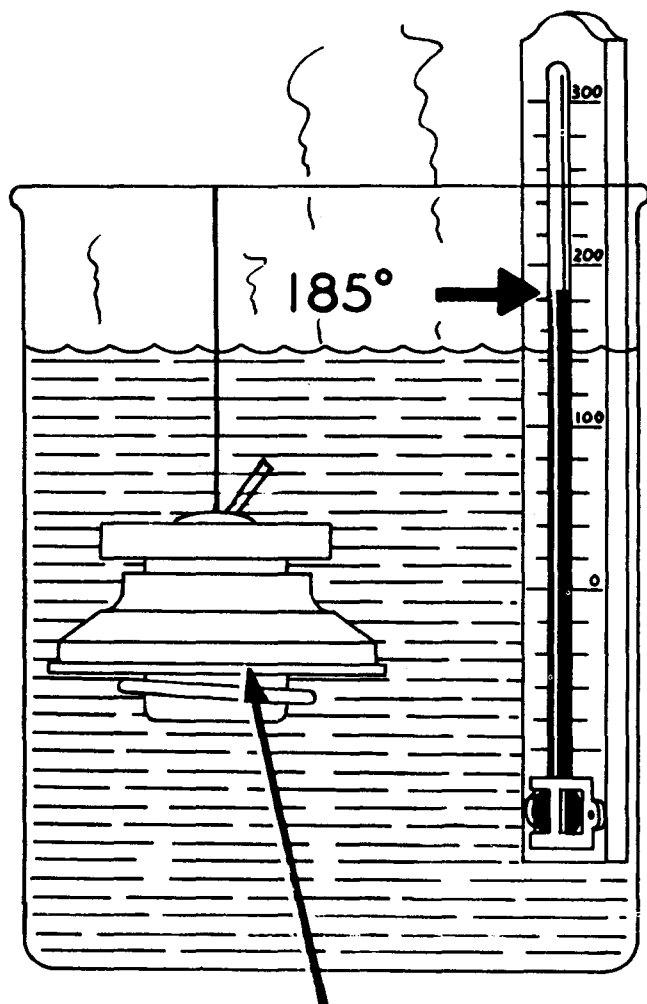
### TESTING THERMOSTAT

Remove Water Pump Header as shown in illustration. Before testing, clean and examine the bellows for rupture or distortion. If the valve can be pulled or pushed off its seat with only a slight effort when cold or it does not seat properly, the unit is defective and should be replaced.

The thermostatic operation can be checked in the following method:

1. Hang thermostat by its frame in a container of water so that it does not touch the bottom.
2. Heat the water and check temperature with a thermometer.

3. If the valve does not start to open at temperatures of 150-185° F or if it opens well before the 150° point is reached the thermostat should be replaced.



## THERMOSTAT

Figure 76 — Checking Thermostat

When replacing the thermostat in the water outlet elbow, be sure seal is in place, and seal seat as well as the counterbore is clean.

Assemble new gasket to pump body or spacer. Thermostat flange must seat in counterbore with gasket sealing contact between it and the pump body.

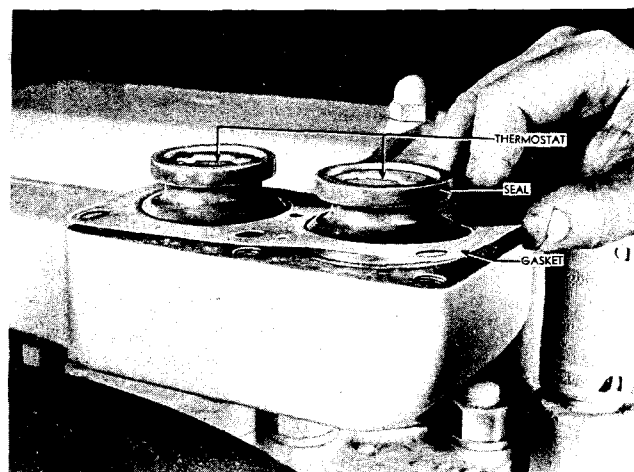


Figure 77 — Dual Thermostats (R-S Type)

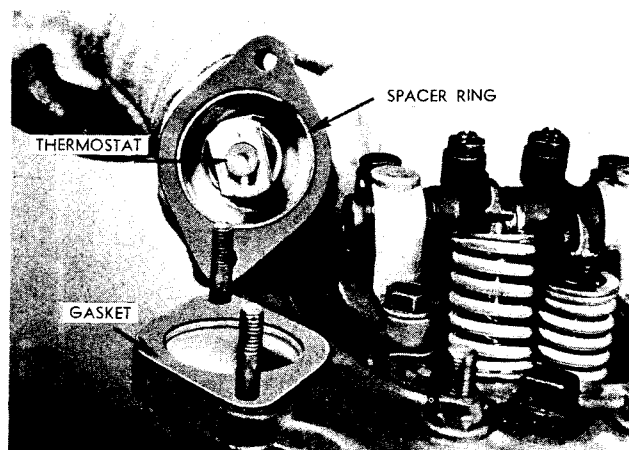


Figure 78 — Replacing Thermostat, FO6226 Engine

## RADIATOR PRESSURE CAP

Many operations use a pressure cap on the radiator to prevent overflow loss of water during normal operation. This spring loaded valve in the cap closes the outlet to the overflow pipe of the radiator and thus seals the system, so that pressure developing within the system raises the boiling point of the coolant and allows higher temperatures without overflow loss from boiling. Most pressure valves open at 4½ or 7 pounds, allowing steam and water to pass out the overflow pipe, however, the boiling point of the coolant at this pressure is 224°F or 230°F at sea level. When a pressure cap is used an air tight cooling system is necessary with particular attention to tight connections and a radiator designed to withstand the extra pressure.

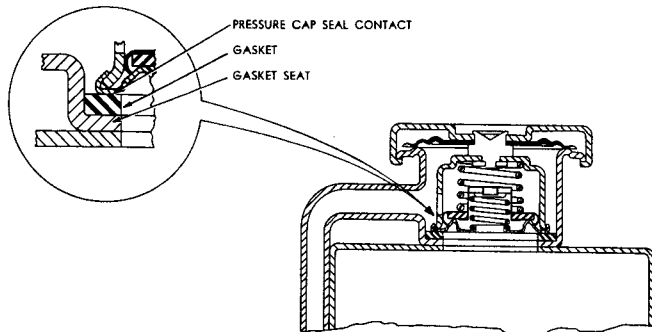


Figure 79

### FAN BELT TENSION

When tightening fan belts, loosen the generator adjusting bolts and pull out on the generator by hand until the belt is just snug. Under no circumstances should a pry bar be used on the generator to obtain fan belt tension or damage to the bearings will result. Some engines have an adjustable fan pulley flange for belt adjustment.

When adjusted correctly the fan belt should have between  $\frac{3}{4}$ " to 1" deflection on the long side.

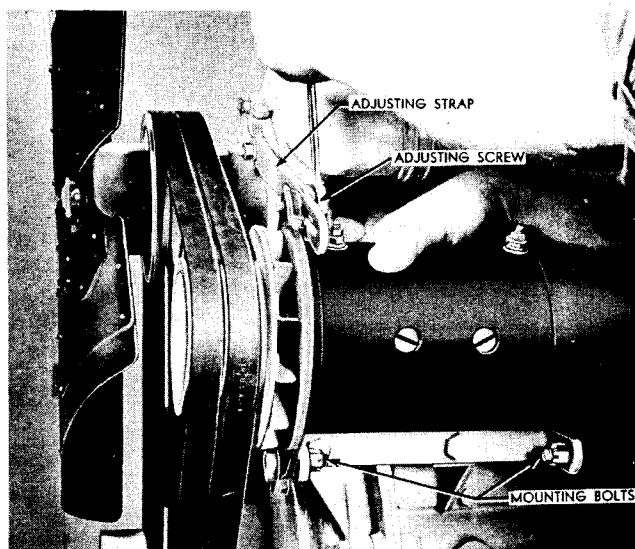


Figure 80 — Adjusting Fan Belt Tension

### CYLINDER BLOCK WATER DRAINS

When the cooling system is to be completely drained, there are one or two drain plugs on the right hand side of the cylinder block depending upon engine models, which drain all cooling water which might be trapped in the base of the block.

### DRAINING WATER-JACKETED AND WATER-TEMPERED INTAKE MANIFOLDS

The "FO" series engines all have water-tempered intake manifolds which provides positive seasonal control; equalizes gas mixture temperatures and reduces the tendency to vapor-lock.

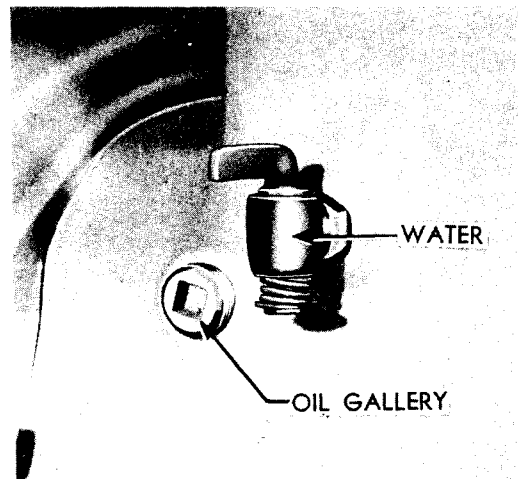


Figure 81 — Water Drain

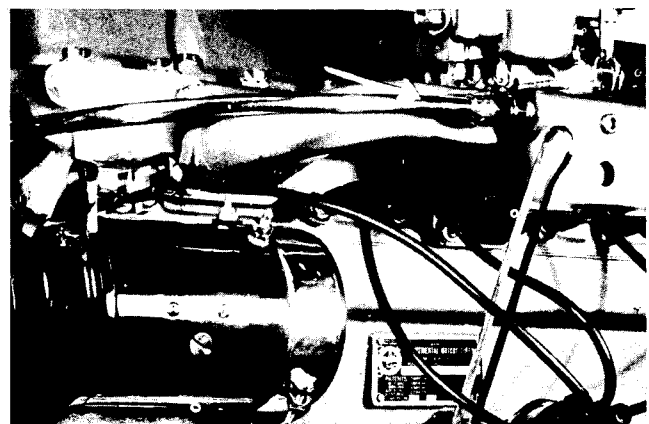


Figure 82 — Water-Tempered Intake Manifold FO6226

Many other Continental six-cylinder over-head valve transportation engines are equipped with water-tempered intake manifolds which circulate water from the cooling system into the jacket around the intake manifold riser, which maintains an equalized temperature of the gas mixture entering the engine.

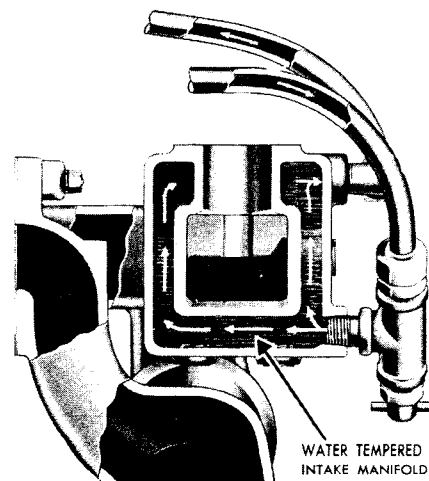


Figure 82A — T-6427  
Water-Tempered Intake Manifold

All water-cooled intake manifolds have either drain-plugs or drain-cocks to drain the water when it is necessary to completely drain the cooling system or when servicing the manifold.

It is just as important to drain the water-cooled manifold as it is to drain the cylinder block water jacket by removing the lower drain plug on the side of the block.

**IMPORTANT:** When drain is blocked—open with wire so that all the water is drained.

#### CAUTION: OVERHEATED ENGINE

*Never pour cold water or cold anti-freeze into the radiator of an overheated engine. Allow the engine to cool and avoid the danger of cracking the cylinder head or block. Keep engine running while adding water.*

#### OVERCOOLING

Continuously low operating temperature wastes fuel, increases engine wear and causes oil sludge and corrosion of engine parts.

Overcooling may be caused by operating conditions such as excessive idling, low speeds and light loads during cold weather. Partly covering the radiator or use of a thermostatic or manually controlled shutter will improve this condition. Improper thermostat or shutter operation should also be regulated to maintain 150° - 185° operating temperature.

#### WATER PUMP

The water pump is located in the front of the cylinder block and is driven by the fan belt from the crankshaft pulley. The inlet of the water pump is connected to the lower radiator connection and the outlet flow from the pump is through integral passages cast in the block.

No lubrication of the pump is required on the FO series engines as the bearings are of the per-

manently sealed type and are packed with special lubricant for the life of the bearing.

The K - T - U - R and S series engines require lubrication every 50 hour period with a good ball bearing grease such as Mobilgrease No. 5.

The water pump requires no attention other than bearing replacement when they show excessive looseness or if a water leak develops which shows a damaged or badly worn seal that needs replacement.

The FO series engines have integral water pump assemblies mounted on the cylinder block.

The K - T - U - R and S series engines have the water pump body mounted on the engine and the support assembly consisting of the impeller, shaft and seal assembly is assembled to the body with studs.

The FO - K and T series engines have the water pump body bolted to the cylinder block — while the R - S and U series engines are mounted on both the cylinder head and block.

#### SERVICING THE FO WATER PUMP

##### REMOVAL AND DISASSEMBLY

1. Using puller, remove fan hub from shaft.
2. Remove cap screws attaching pump to engine.
3. Remove cover by removing countersunk screws.
4. Remove impellor with puller — using care to prevent damage to the casting.

**CAUTION:** Do not attempt to drive the water pump shaft out through the rear of the housing — which will damage the housing beyond repair.

5. Remove seal and water shedder.
6. Remove lock-ring holding bearing and shaft assembly in body after which the shaft can be forced out **through the frame** with an arbor press or lead hammer.

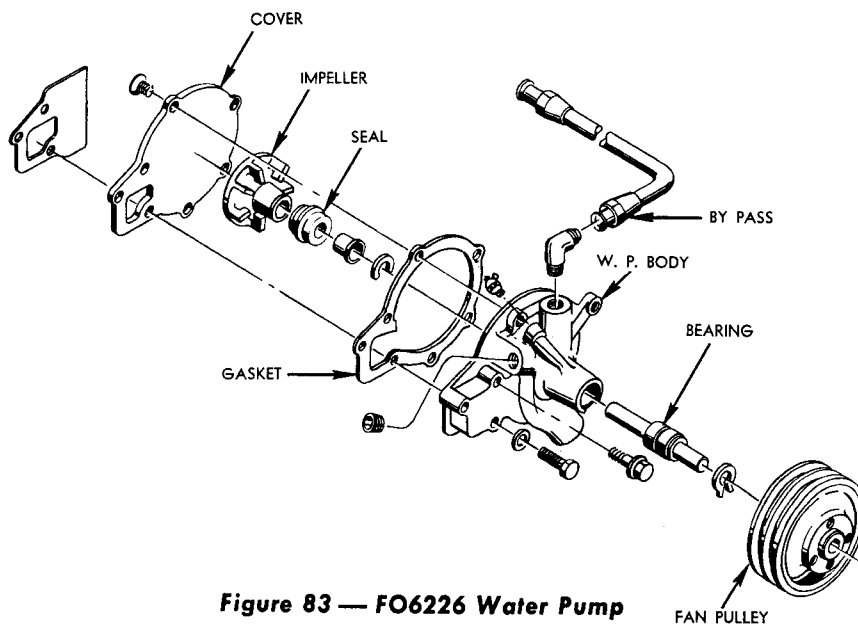


Figure 83 — FO6226 Water Pump



**REASSEMBLY AND INSTALLATION**

1. Reassemble pump, replacing worn or failed parts and reverse above instructions.

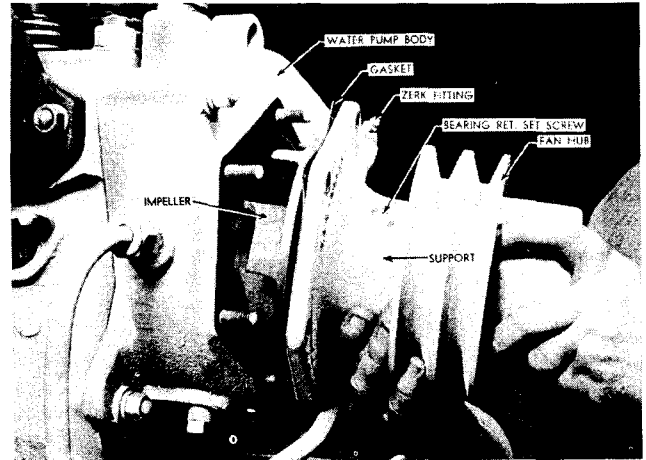
Seal contact surface must be smooth and flat. The bushing should be replaced, if scored or cut, but may be refaced and polished for further use, if not excessively worn or grooved.

A light film of lubricant applied to the face of the seal will facilitate seating and sealing.

2. Use thick soapsuds on both the seal and shaft when assembling in order to prevent damage to the seal.

3. Mount pump assembly on block using a new housing gasket.

4. Install fan belt and adjust belt tension to have  $\frac{3}{4}$ " to 1" deflection on long side. Pull out the generator by hand, as bearing damage will result with a pry bar; in some cases this may be adjusted by the adjustable fan pulley.



**Figure 84**  
**Removing Fan Hub and Works Assembly**

## SERVICING THE K-T-U-R-S SERIES WATER PUMPS

**REMOVAL AND DISASSEMBLY**

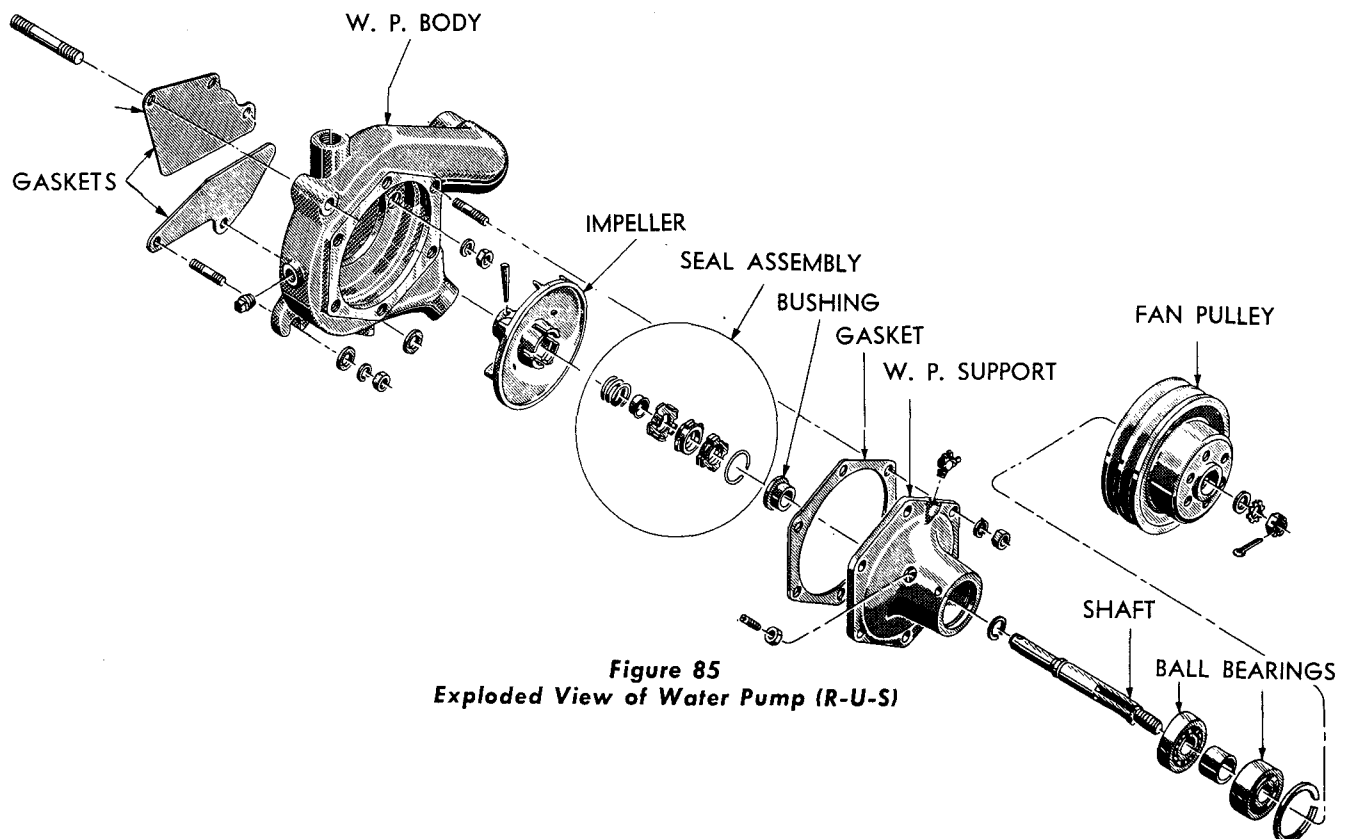
To service or rebuild the pump, as the case may be, follow the procedure outlined:

1. Remove screws holding fan to hub, and remove fan.

2. Remove the 6 nuts and lockwashers holding the support assembly to the water pump body. This assembly may then be lifted off and taken to the bench for inspection and further repairs.

3. The impeller and seal can be removed from the shaft by first removing the pin which holds the impeller to the shaft, after which the shaft can be pressed out of the impeller which will carry the seal with it.

4. Next, remove the fan hub or fan pulley from the forward end of the shaft, then the internal snap ring which holds the forward bearing in place, after which the entire shaft and bearing assembly can be removed from the support housing.



**Figure 85**  
**Exploded View of Water Pump (R-U-S)**

## REASSEMBLY AND INSTALLATION

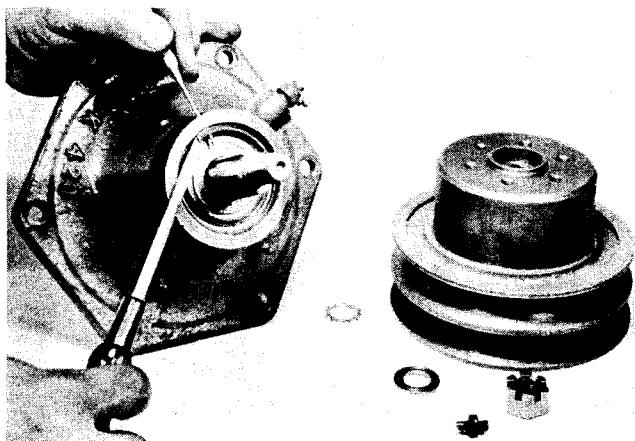


Figure 86  
Removing Snap Ring

5. This pump is equipped with a carbon graphite seal which rides on a stainless steel bushing, the face of which is comparatively broad which permits wide area contact of the seal on this bushing flange.

6. The face of the bushing must be smooth and square with the hole so that the seal, though it is spring loaded, can maintain satisfactory contact with the bushing.

7. If the bushing has been replaced or if a worn and scored bushing is to be remachined and used again, the face must be machined after assembly, and the simplest method to use, is to insert the support in a lathe probably on an arbor which fits the bearing counterbore, and turn the contact face of the bushing absolutely square and polish it to a smooth finish.

8. When reassembling a new carbon seal a light film of lubricant should be placed on the contact area so as to provide immediate lubrication for the beginning of operation.

9. Ball bearings in this water pump operating entirely free from any water require only a good grade of ball bearing lubricant. *Never, under any circumstances, use any of the special water pump greases which, when not subjected to water, will harden and have no lubricating effect whatever.*

10. There is a relief hole cast in the support so that any water that may leak through the seal will drain off and this is where you will first notice any water pump leaks, at this cast opening in the support on the underside.

## SECTION VI FUEL SYSTEM

The basic purpose of the fuel system is to store, convey, mix fuel with air, then vaporize and introduce the mixture into the engine.

Fuel is stored in the gasoline tank; it is filtered and flows through the fuel supply line to the carburetor — either by gravity or under pressure of a fuel pump. The carburetor mixes the fuel with proper proportions of air and at the same time breaks it into very fine spray particles. This atomized spray changes to vapor, by absorbing heat as it travels through the intake manifold to the combustion chamber. Fuel must be vaporized since it will not burn well as a liquid.

### GRAVITY FUEL SYSTEM

This is the most simple fuel system and is generally used on power units as it eliminates the need of a fuel pump — it only requires the fuel tank located higher than the carburetor.

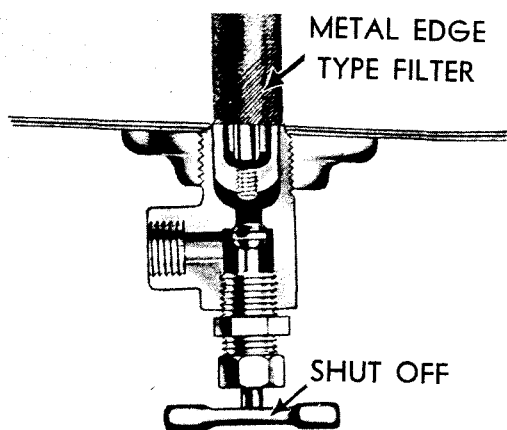


Figure 88 — Edge Type Filter

All power units with fuel tank have a combination shut-off valve and an efficient metal edge type filter. This filter prevents all foreign particles and water from entering the carburetor.

With reasonable care in filling the tank with clean fuel, this filter will require only seasonal cleaning of both the filter and tank.

### MECHANICAL FUEL PUMP

The Mechanical Fuel Pump is generally used when the fuel supply is below the level of the carburetor. They are of several models dependent upon the diaphragm diameter and assembly arrangement with fuel strainer bowl, air dome and manual primer.

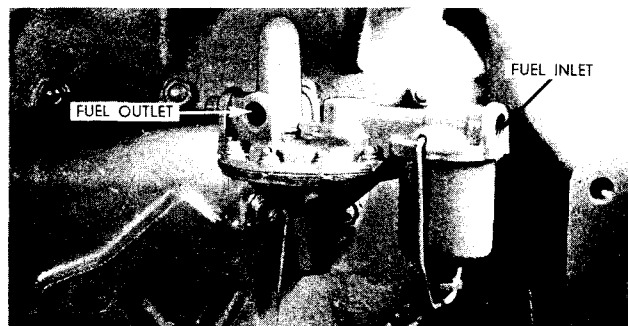


Figure 89 — Fuel Pump

This mechanical fuel pump mounts on the cylinder block pad and is driven by an eccentric on the engine camshaft contacting the fuel pump rocker arm.

Constant fuel pressure is maintained by an air dome and a pulsating diaphragm operated and controlled by linkage which adjusts itself to pressure demands.

**Fuel Pump Tests** — The fuel pressure may be measured by installing the pressure gauge between the fuel pump and carburetor.

The AC fuel pump size and static pressures @ 1800 R.P.M. for the six cylinder overhead valve engines are:

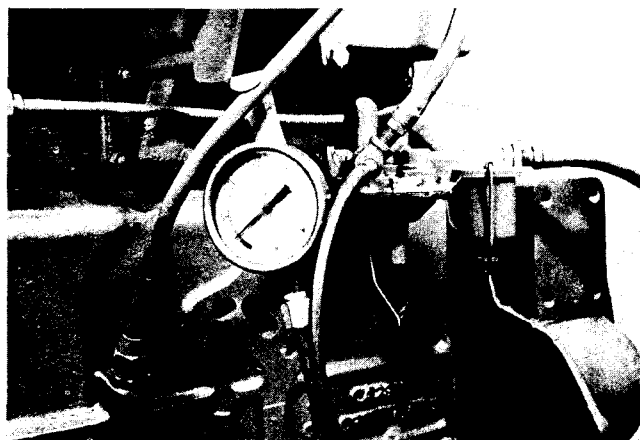
ENGINE MODEL	DIAPHRAGM DIAMETER	FUEL PRESSURE
FO	3 <sup>3</sup> / <sub>16</sub>	4-5
K	3 <sup>7</sup> / <sub>8</sub>	4-5 <sup>1</sup> / <sub>2</sub>
T	3 <sup>7</sup> / <sub>8</sub>	4-5 <sup>1</sup> / <sub>2</sub>
U	3 <sup>7</sup> / <sub>8</sub>	4-5 <sup>1</sup> / <sub>2</sub>
R	3 <sup>7</sup> / <sub>8</sub>	4-5 <sup>1</sup> / <sub>4</sub>
S	3 <sup>7</sup> / <sub>8</sub>	4-5 <sup>1</sup> / <sub>4</sub>

When pressures are below the range, pump should be disassembled and reconditioned with the special overhaul kits available.

**Maintenance** — Fuel pump trouble is of only two kinds — either the pump is supplying too little gas or, in rare cases, too much.

If the pump is supplying too little gas, the engine either will not run or it will cough and falter. If too much gas — it will not idle smoothly or you will see gasoline dripping from the carburetor.

If the engine is getting too little gas — the trouble may be in the pump, fuel line or the gas tank. First, be sure there is gas in the tank, then disconnect the pump to carburetor line at the pump or carburetor, and turn the engine over a few times with the ignition off. If gas spurts from the pump or open end of the line — the pump, gasoline and tank are OK.



**Figure 90 — Checking Fuel Pressure**

**If there is little or no Flow**—check the following:

1. Look for leaky bowl gasket or line connections — tighten them.
2. Remove and clean with solvent the gas strainer or screen inside the pump bowl.
3. Look for clogged fuel line — Blow out with compressed air.
4. Make sure that all pump cover screws and external plugs are tight.
5. Inspect flexible fuel line for deterioration, leaks, chafing, kinks or cracks. If none of the items restore proper flow — remove the pump for replacement or overhaul.

**If getting too much gas** — an oversupply of gasoline is generally caused by trouble other than the fuel pump — so first check the following:

1. Defective Automatic Choke.
2. Excessive use of hand choke.
3. Loosely connected fuel line, or loose carburetor assembly screws.
4. Punctured carburetor float.
5. Defective carburetor needle valve.
6. Improper carburetor adjustment.

If none of the items corrects flooding, remove the fuel pump for replacement or overhaul.

## **ELECTRIC FUEL PUMP**

Many Over-head Valve engines use electric fuel pumps operated from the storage battery supply. The pumps should be mounted close to the fuel tank so as to provide fuel pressure at all points along the fuel line to eliminate vapor lock.

The electric fuel pump is energized in the ignition circuit — which assures quick filling of the carburetor and fuel lines to effect easy starting.

When fuel pump trouble is suspected, disconnect the fuel line at the carburetor and turn on the ignition switch. Pump fuel into a small container, then place your finger on the outlet side of the fuel line. If the pump stops or ticks very infrequently, the pump and fuel line connections are satisfactory. Remove your finger from the outlet side of the fuel

line and if ample fuel flows — the pump is satisfactory.

If fuel does not flow and all connections are tight, the pump should be replaced or repaired. Always be sure of a good ground and check for faulty flexible fuel lines and poor electrical connections.

## **CARBURETOR**

Continental Over-head Valve gasoline engines normally use various models of Zenith carburetors — of both the updraft and downdraft types.

The carburetor mixes fuel with air and meters the mixture into the engine as the power is demanded. Most carburetors incorporate the following systems to provide the flexibility and sensitive requirements of varying loads and conditions:

- 1 — **Float System** — Controls the level and supply of fuel.
- 2 — **Idle or Low Speed** — Furnishes the proper mixture for the engine idle, light load and slow speeds, until the main metering system functions.
- 3 — **Main Metering System** — Controls the fuel mixture from part throttle operation to wide open throttle.
- 4 — **Power or Economizer System** — Provides a richer mixture for maximum power and high speed operation. This system ceases to function when the manifold vacuum is above 6" Hg.
- 5 — **Compensating System** — Provides a mixture which decreases in richness as the air speed increases.
- 6 — **Choke System** — Delivers additional fuel to the manifold for cold engine starting.

## **ZENITH CARBURETORS FOR FO SERIES**

The FO series engines use a Zenith series 28 or 228 carburetor with single throat, of the downdraft type.

This carburetor is of the plain-tube balanced type and fully sealed against dirt. It also has all fixed jets except the idle adjustment.

Both the series 28 and 228 carburetors are similar except the series 28 has the idle adjustment on the air supply and the 228 series on the fuel supply.

The following adjustments are required in normal service:

- 1 — **Idle Speed Adjustment** — Controls the idling speed — which should normally be 350-500 RPM.

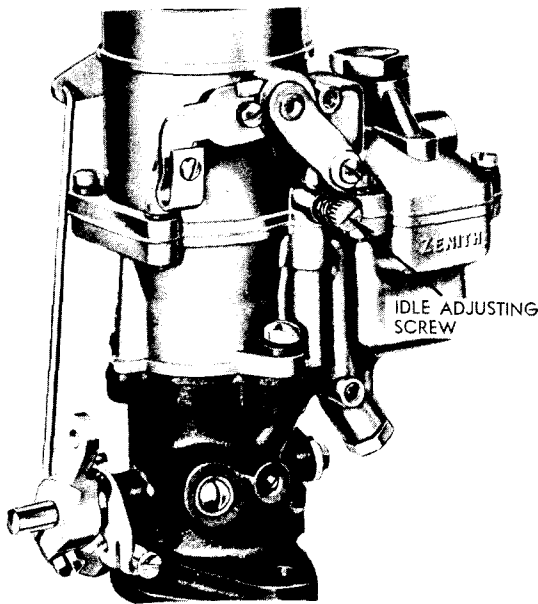


Figure 91  
Zenith Series 28 Carburetor

## 2 — Idle Mixture Adjustment

**Series 28** — Turn idle air adjusting screw clockwise or "IN" to provide a richer mixture and counter-clockwise or "OUT" for a leaner mixture.

**Series 228** — (idle mixture adjusting screw is located in throttle body).

Turn idle mixture adjusting screw clockwise or "IN" to provide a leaner mixture and counter-clockwise or "OUT" for a richer mixture.

THE NORMAL FLOAT LEVEL IS 1 1/2".

## ZENITH 63 SERIES CARBURETORS

All K - T - U - R and S series industrial engines normally use Zenith 63 Series updraft carburetors with double venturi.

The fuel bowl is semi-concentric and has a double float which allows operation at extreme angles without flooding or starving the various metering systems.

This carburetor has the following adjustments:

**1 — Main Adjustment Screw** — is provided in many cases when needed — when provided, adjustment is made as follows:

Open the throttle 1/4 open.

Turn the adjusting screw clockwise, shutting off the fuel until the engine speed decreases or starts to miss due to the lean mixture.

Now open the adjustment until the engine reaches its maximum speed and runs smoothly without missing.

**2 — Idle Mixture Adjustment Needle**—Controls the amount of air admitted to the idling system, which functions only at low speeds.

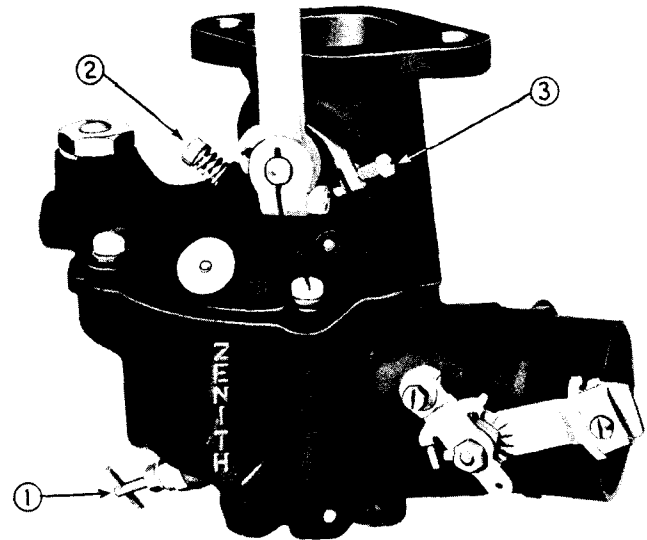


Figure 92  
Zenith 63 Series Carburetor

Turning the screw clockwise cuts off the air, making the mixture richer — while unscrewing it admits more air making the mixture leaner. The idling adjustment needle should be set for the smoothest running of the engine; or, if a vacuum gauge can be attached to the manifold, set the adjustment for higher manifold vacuum.

**3 — Idle Speed Adjustment Screw** — controls the idling speed — which should be 400-600 R.P.M. for most industrial applications.

The normal carburetor float level for:

K & T Series — 1 19/32"

U - R & S Series — 2 1/4"

## ZENITH 28 SERIES DUPLEX CARBURETOR

Continental K and T series transportation engines as well as some industrial applications use the Zenith 28 series duplex carburetors. This carburetor is of the down-draft type of double venturi design.

It is a balanced carburetor in that all air for fuel bowl ventilation and idling must come through the air cleaner.

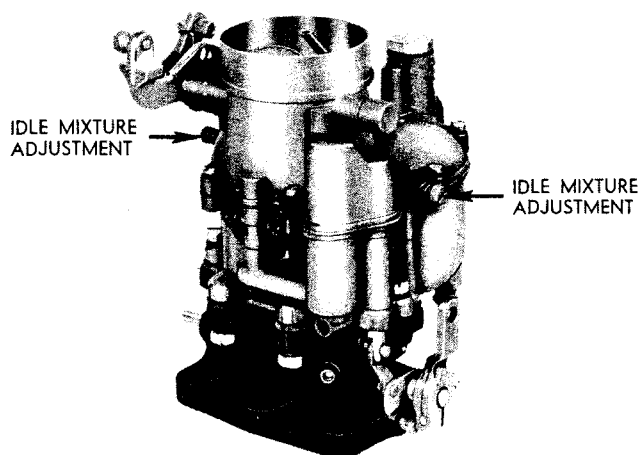
The following adjustments are required:

**1 — Idle Speed Adjustment**—controls the idling speed — which should normally be 400 - 600 RPM.

**2 — Idle Mixture Adjustment** — (Two idle adjusting screws)

(a) Turn both idle air adjustment screws to the seat — **Do not force**.

(b) Back each screw out 1 turn and start engine.



**Figure 93**  
**Zenith 28 Duplex Carburetor**

(c) With engine idling 400-600 RPM — back out both screws evenly until engine falters or slows down.

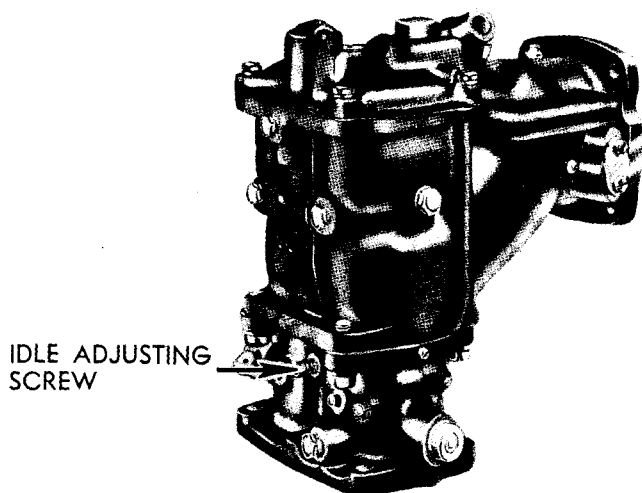
(d) Then turn screws in evenly until engine runs smooth. If vacuum gauge is used adjust to highest vacuum reading.

The Normal Float Level is  $1\frac{1}{2}$ "

## ZENITH 29D SERIES CARBURETOR

Continental U - R and S series overhead valve transportation engines normally use the Zenith 29D series carburetor.

This carburetor is of the down-draft, duplex type with a concentric float bowl design — which helps to properly meter air and fuel to the engine without flooding, when operated at extreme angles.



**Figure 94 — Zenith 29-D Series**

It is a "sealed" and "balanced" type carburetor as all the air for fuel bowl chamber ventilation and idling must come through the air cleaner. Two venturi are used to aid in the complete vaporization of the fuel. The power jet and accelerating pump systems are operated by engine vacuum and are completely enclosed and protected from dirt.

The Zenith 29D duplex carburetor has only one external adjustment other than the high and low speed throttle setting: and that is the idle adjusting needle."

This idle adjusting needle controls the mixture flow to the idle ports where it is discharged into the air stream admitted by the throttle plates. Turning the idle adjusting needle **clockwise** towards the seat, restricts the flow of the mixture to the idle ports and **leans** the mixture.

Turning the idle adjusting needle **counter-clockwise** away from the seat permits a larger volume of the mixture to reach the air stream and makes the final mixture **richer**.

The Normal Float Level for the Zenith 29D 13 and 14 Series Carburetor is  $1\frac{1}{64} \pm \frac{1}{32}$ .

## CARBURETOR CHOKES

**Manually Operated Choke** — is operated by a flexible cable control from the instrument panel or rear house panel. While this is the most simple type, it is most important that the operator have the choke valve in wide open position when engine operating temperature is reached.

## ZENITH ELECTRIC CHOKE CONTROL

Is made as part of the carburetor assembly. It is directly connected to the choke shaft and automatically controls the opening during the entire engine operation.

Manifold vacuum is used to open the choke shaft partially after the initial firing of the engine, and heat is used on the thermostat spring to control the amount of opening during the warming up period. This heat is provided by an electric element in the thermostat chamber. Fast idling during the warm-up period is also provided by a throttle advance mechanism which is actuated from the choke shaft.

The heating element which is energized when the ignition is "on" gradually warms the thermostat, decreasing its resistance to the pull of the

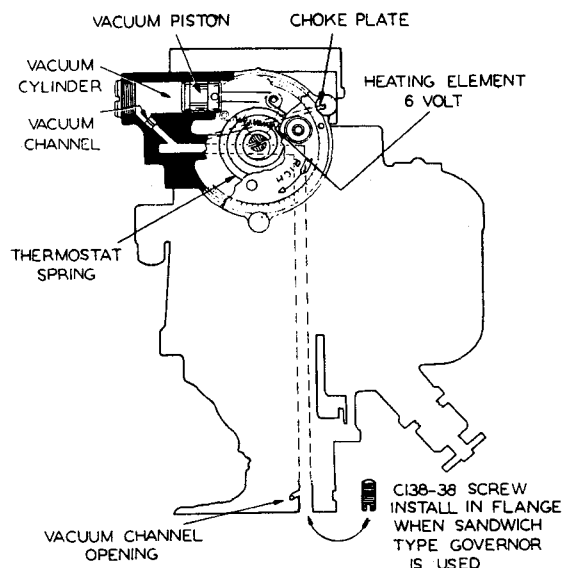


Figure 95 — Zenith Electric Choke

vacuum piston, which gradually causes the choke to open and moves the throttle advance to the warm idle position.

All units are initially set with the thermostat 15 notches rich for 70° F. ambient temperature. Temperature corrections can be made by allowing one notch on the cover for each 5 degrees variation — making certain that the choke valve is fully open when operating temperatures are reached.

## SISSON AUTOMATIC CHOKE

Uses an electro-magnet and a thermostat to automatically close the carburetor choke valve for cold starting and regulates its degree of opening as the engine warms.

The unit is mounted on the exhaust manifold and a small rod connects it to the carburetor choke lever. The electro-magnet is energized by the starter circuit which pulls an armature lever down, closing the choke valve.

As soon as the engine starts, the electro-magnet circuit is broken and then the thermostat provides automatic adjusting of the choke valve during the warming-up period.

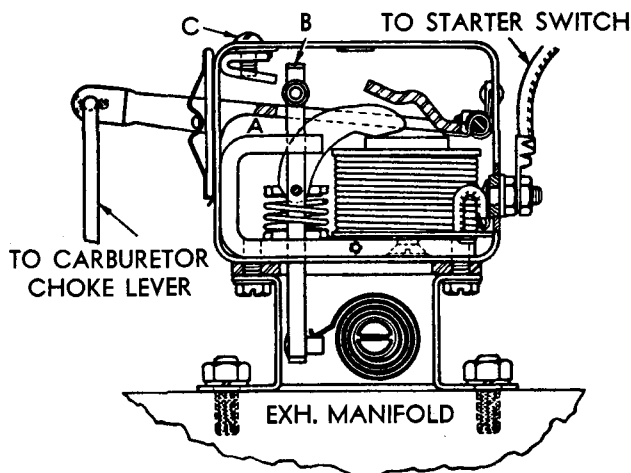


Figure 96 — Sisson Automatic Choke

The carburetor choke lever should be adjusted so that when the carburetor choke valve is closed tight, there will be .015" to .020" clearance between the automatic choke lever and the field pole that serves as a stop. This measurement is taken at "A" and must be made with thermostatic control "B" pushed down as far as it will go.

**CAUTION:** Do not oil the Sisson automatic choke under any circumstance.

**Carburetor Service** — In general any change in carburetor action will usually come gradually, therefore, if the carburetor operated satisfactorily when last used, it can reasonably be assumed that some other part of the engine is at fault — which should be corrected before disturbing the carburetor.

Dirt is the main enemy of good carburetion as it fills up the minute air and gasoline passages and accelerates the wear of delicate parts.

Never use a wire to clean out restrictions in jets as this will destroy the accurate calibrations of these parts — always use compressed air. The jets are made of brass to prevent rust and corrosion and a wire would cut or ream the hole in the jet and ruin it.

Maintaining correct fuel level in the carburetor bowl is important — as the fuel flow through the jets is naturally affected by the amount of fuel in the bowl.

After a carburetor has been in service for some time, the holes in the jets and the float valve and seat become worn from the constant flow of fuel through them and should be overhauled by a competent carburetor service station.

Do not experiment with other size jets or any so-called fuel-saving gadgets as your arrangement has been thoroughly tested on a dynamometer program.

## GOVERNORS

The governor is a device which controls engine speed — either keeping it operating at a constant speed or preventing it from exceeding a predetermined speed. It promotes engine operation economy and eliminates needless engine failures.

Continental six-cylinder over-head valve engines use many types of velocity and centrifugal (mechanical) governors.

### ZENITH GOV-U-RETOR

Continental FO series engines, on some applications, use the Zenith 28 or 228 series carburetors and the Zenith "Gov-U-Retor" combined in an integral unit that is sealed fully against entrance of dust.

This is a velocity type governor which gives the operator full manual control of throttle opening at engine speeds below the governor speed — at which time the governor "takes-over".

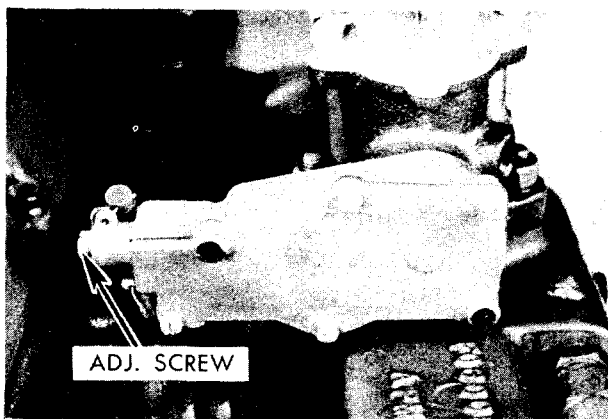
If smooth accurate governor action is to be obtained, friction of the throttle shaft and its bearings must be avoided. Most governor failures

are due to carbon accumulating on the throttle shaft bearings. — Especially if engines are in poor mechanical condition. Many governor failures can be temporarily corrected by application of a good penetrating oil to the throttle shaft bearings.

Lack of sufficient end play in throttle shaft and bearings will cause friction and governor failure when the engine is hot.

## GOV-U-RETOR ADJUSTMENTS

1 — **To Change Governor Speed** — Remove the seal wire and large seal plug, and with small screwdriver turn the main spring adjusting screw **clockwise to increase the speed** and counter-clockwise to decrease the speed.



**Figure 97 — Gov-u-retor Adjustment**

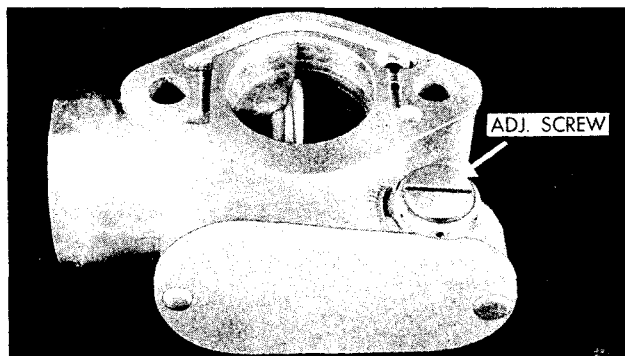
2 — **Performance Adjustment** — If the governor surges or hunts to a higher or lower engine speed — remove the compensating spring adjusting screw seal passage plug and with a narrow screwdriver turn the compensating spring block adjusting screw  $\frac{1}{4}$  turn counter-clockwise until the surge is overcome.

3 — **Recheck Governed Speed** — After making compensating spring adjustment.

4 — **Install Threaded Seal Passage Plugs and seal wire and seal adjustment.**

## VELOCITY GOVERNORS

**Velocity Governors** — are generally used to prevent engine speed from exceeding a predetermined maximum. The governor is mounted between the carburetor and manifold flanges. In its most simple form, it consists of a main body, which contains a throttle shaft, a throttle valve and a main governor spring. The main governor spring is attached by linkage to the governor shaft and the spring force holds the throttle valve open.

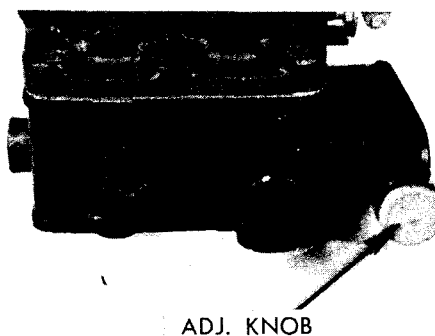


**Figure 98 — Hoof Velocity Governor**

When the engine is started, air flows through the carburetor throat and the governor throat. The velocity of the air creates a pressure above the throttle valve. When this pressure exceeds the force exerted by the spring, the throttle will move toward a closed position. The adjusting screw varies the spring tension.

When this closing action of the valve exactly balances the spring, governing action takes place and maximum speed is fixed at this point.

When load is applied — the engine speed tends to drop — the velocity of the gas through the manifold and the pressure against the governing valve is reduced and the spring opens the valve to feed more gasoline to the engine to handle the increased load demand. Thus an almost constant speed is maintained whether the engine is running with or without load.



**Figure 99 — Handi-Vari-Speed Governor**

**Adjustment** — Both the Handy-Vari-Speed and Hoof Velocity Governors have only one adjustment — which is for adjusting the governor speed.

The Handy Vari-Speed governor is adjusted by removing the seal from the adjusting knob — turning clockwise reduces speed and counter-clockwise increases speed. (See arrow on adjusting knob.)

The Hoof Velocity Governor is adjusted by removing the seal wire and with screwdriver turn clockwise to increase speed and counter-clockwise to reduce speed.

**IMPORTANT** — *Dirt and water entering the governor cover is the main cause of failures.*



## PIERCE CONSTANT SPEED GOVERNOR

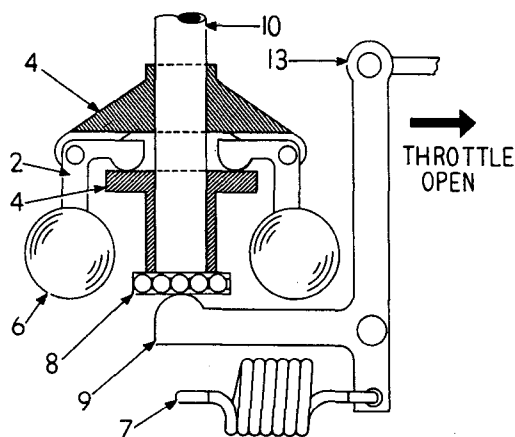


Figure 100 — Schematic Drawing of a Pierce Centrifugal Governor

Continental six-cylinder over-head valve engine uses this type of governor for various types of industrial applications.

Close regulation with a single spring and weights is possible only in a short range of engine speeds — not exceeding 400 R.P.M. The reason for this is that the forces of the governor spring and weights do not increase and decrease at the same rate.

**Operation (See Figs. 100-101)** — Pierce governors operate as follows:

The governor shaft (10) is driven by gears (1). The shaft is mounted on a heavy-duty radial ball bearing (3) to minimize friction and wear. On the main shaft is a spider (4) which supports two governor weights (6). The weight noses (2) rest against a hardened thrust sleeve (14) with thrust bearing (8).

In operation, the governor shaft turns with the engine. As the shaft rotates, the centrifugal energy developed in the weights (6) causes them to swing outward on their pivots — this energy is opposed by the governor spring (7). The tension of this spring is the means of setting the governor to act at a predetermined speed.

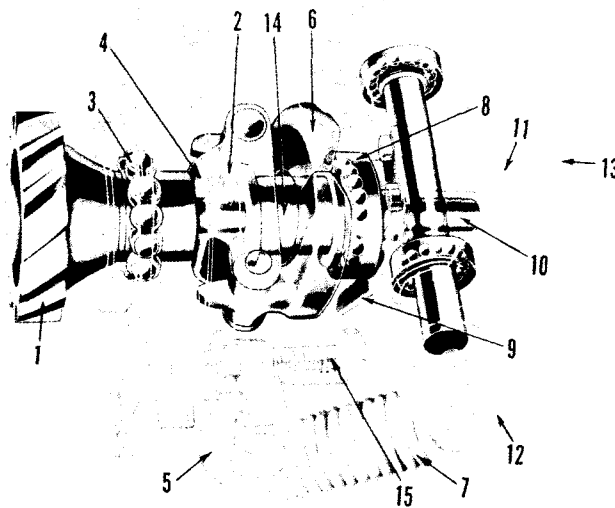


Figure 101 — Sectional Drawing of a Pierce Centrifugal Governor

When the engine is not running, the governor spring holds the throttle valve wide open.

When the engine is started, the weights swing out, moving the thrust sleeve (14) along the drive-shaft. This movement is transmitted through the thrust bearing (8) to the rocker yoke (9) on the throttle lever shaft. This movement, in turn, moves the governor control lever (13) toward the closed throttle position. The weights continue to move out until the weight force and spring force are in balance — when the throttle will be in position to maintain the governed R.P.M.

### Adjustment

1 — The Speed of the Governor is regulated by adjusting screw (15).

2 — **Sensitivity** of the governor can be regulated, by auxiliary adjusting screw (12). Surging or hunting under load conditions can usually be eliminated by broadening the regulation with this adjusting screw.

3 — **No Load Surge** — is eliminated by means of the bumper screw (11).

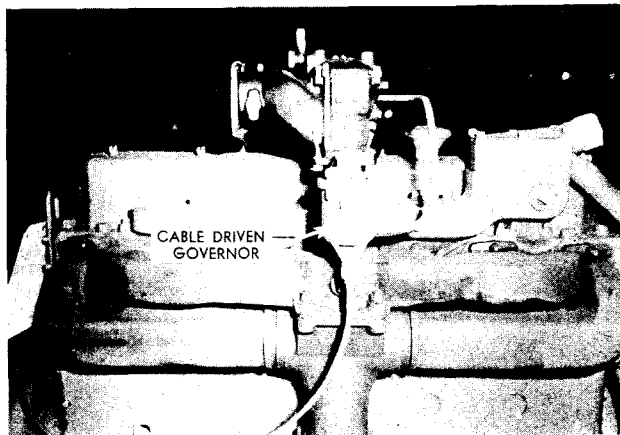
## **PIERCE CABLE-DRIVEN GOVERNOR**

Continental U-R and S series engines use the Pierce Cable-driven Governor on many transportation and special industrial units.

This type of governor is mounted on the carburetor and operates directly on the throttle shaft. The governor is driven by cable which is in turn driven by the distributor drive adapter.

### **Adjustment**

- 1 — Remove the dust cap — break seal wire.
- 2 — Loosen lock-nut and adjust threaded sleeve with screwdriver. Turning this sleeve in or clockwise increases the speed and out or counter-clockwise reduces the speed.

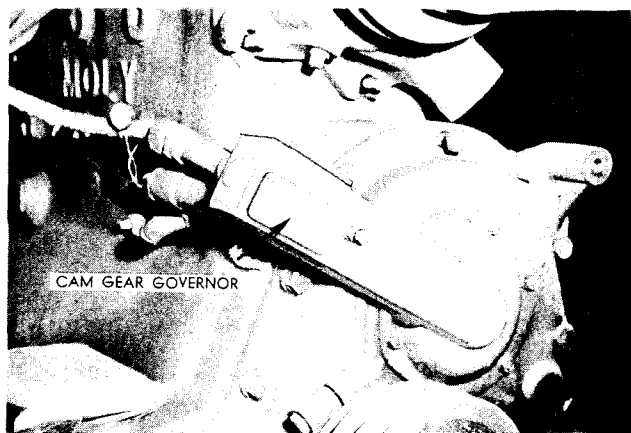


**Figure 102 — Pierce Governor**

## **CONTINENTAL CAM GEAR GOVERNOR**

Continental R-600 series over-head valve engines use the Continental designed "built-in" Cam Gear Governor on many applications.

This governor is sealed, dust proof and engine lubricated and is compact and easily adjusted. The control shaft floats on two needle bearings to remove friction for closer and more accurate control through the whole power range.



**Figure 103**

The governor is of the centrifugal type consisting of steel balls for weights, driven by a spider located in front of the cam shaft gear. The connection from the governor to the carburetor is a flexible cable on the down-draft types and a solid tube and rod assembly on the updraft types.

### **Disassembly:**

- 1 — Remove front cover — from governor lever housing and unscrew ball joint from governor lever.
- 2 — Loosen hose connection — remove governor lever housing from gear cover, and withdraw front ball race from camshaft.
- 3 — To disassemble spider and rear race — from camshaft straighten locking washer and remove camshaft nut.
- 4 — When reassembling governor to engine — use cup grease to hold ball weights in place while installing front race.
- 5 — Test both control rod and governor lever — for freedom of movement before assembling ball joint to lever. Also check for excessive looseness or back lash.
- 6 — With carburetor removed — so governor throttle valve in box can be seen, check for correct length of control rod.

7 — Throttle valve (butterfly) must be wide open — and  $\frac{1}{16}$ " from stop pin when governor lever is in extreme forward position. Be certain that governor lever bumper screw is backed out far enough to obtain full forward position of lever.

#### Governor Adjustments:

1 — **Set Governor** — to prevent engine from exceeding recommended governed speed under load.

2 — **To change setting** — turn governor spring adjusting screw to the **RIGHT** to **INCREASE** the speed: to the **LEFT** to **REDUCE** the speed.

3 — **If engine surges at high speed** — turn governor lever bumper screw in, or to the right until corrected.

**CAUTION:** Do not turn bumper screw in far enough to reduce the maximum governed speed for full throttle.

4 — **Continued surging** — may indicate an excessive looseness or binding of governor leakage and sometimes too lean a fuel mixture.

5 — **Check for binding or worn parts** — of governor by removing speed control spring and testing action of linkage by hand.

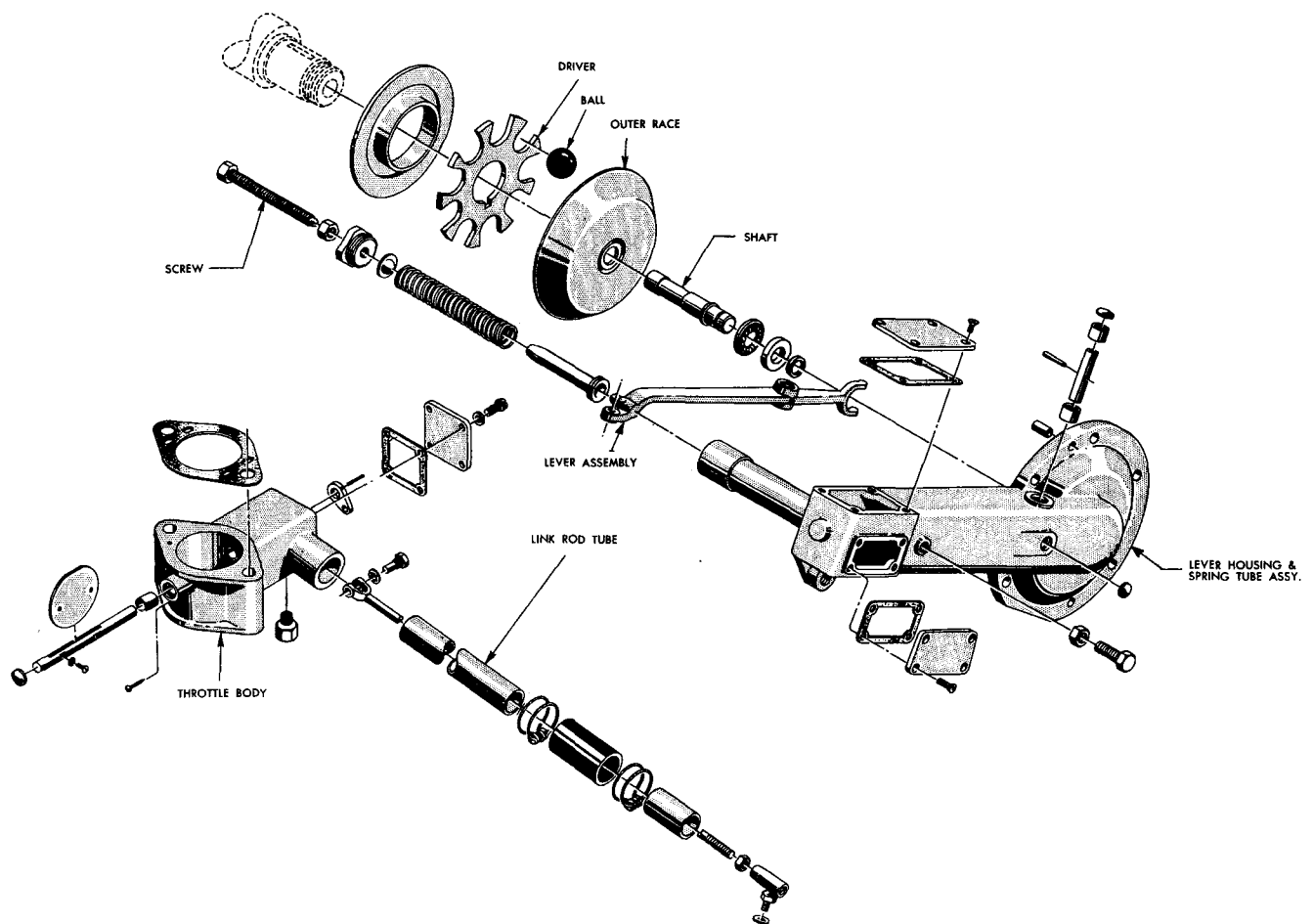


Figure 104 — Cam Gear Governor

## SECTION VII IGNITION

Continental Overhead-Valve engines are equipped with either battery ignition or magneto ignition. Both systems consist of an induction coil; breaker points, with a condenser connected across the points to absorb any arcing, and a distributor which connects to each spark plug. The main difference is that the battery-ignition system requires a storage battery and the magneto system uses the engine to supply energy to rotate a permanent magnet armature.

The ignition system has the job of producing and delivering high voltage surges of about 20,000 volts to the correct spark plug, at the correct intervals and with the correct timing to the engine. Each high voltage surge produces a spark at the spark plug gap to which it is delivered, so that the mixture of air and fuel in the cylinder is ignited.

### BATTERY-IGNITION SYSTEM

This battery-ignition circuit consists of the battery, ammeter, ignition-switch, ignition coil, distributor, spark plugs and low and high tension wiring.

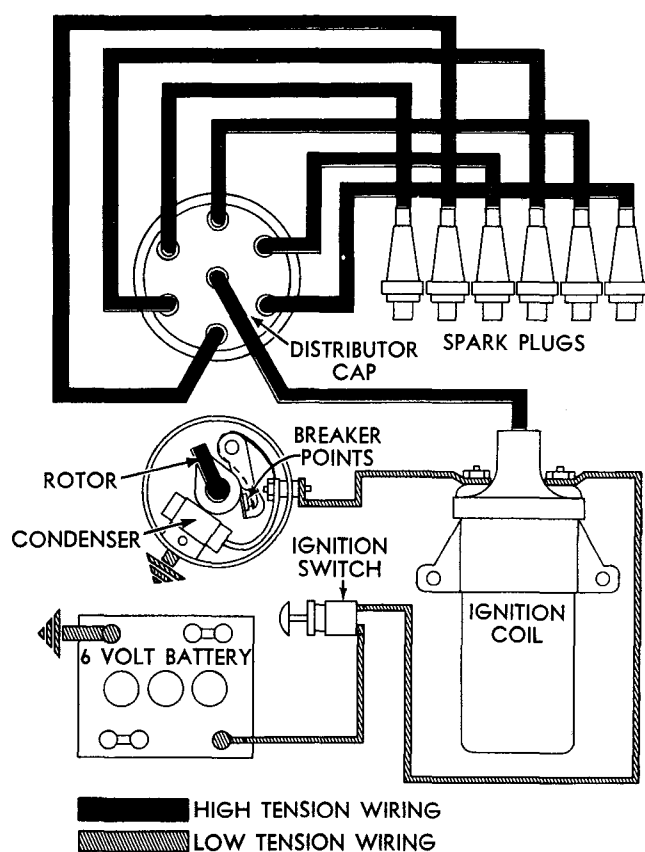


Figure 105 — Schematic drawing of battery ignition system

These parts can be divided into separate circuits consisting of a low tension circuit carrying battery voltage and a high tension spark circuit of about 20,000 volts.

The low tension primary circuit consists of the battery, ammeter, ignition switch, primary winding of the ignition coil, distributor contacts and condenser, and the primary wiring.

The secondary high tension circuit includes the coil secondary winding, distributor cap and rotor, spark plugs, and high tension wiring.

### IGNITION SYSTEM COMPONENTS

The **Battery** supplies the voltage for producing a current flow through the ignition circuit.

The **Ammeter** indicates the amount and direction of current flow.

The **Ignition Switch** is an "Off" and "On" switch and the **Breaker Contacts** function as an intermittent switch. Current flows only when both switches are closed and returns by the ground through the engine or frame. The resistance of the primary winding of the ignition coil restricts the primary current flow.

The **Ignition Coil** consists of two windings, a primary winding and a secondary winding and is a transformer to increase the voltage high enough to jump a spark gap at a spark plug.

The **Condenser** momentarily provides a place for the current to flow until the distributor contacts are safely separated in order to reduce arcing.

The **Distributor** interrupts the primary winding current in the ignition coil and distributes the high tension current to the correct spark plug at the correct time.

The **Spark Plugs** provide a spark gap in the combustion chamber. The compressed air and fuel mixture is ignited when the high voltage jumps across this gap.

The **Low Tension Primary Wiring** conducts battery current through the ignition coil and contacts.

The **High Tension Secondary Wiring** conducts the high voltage, produced by the ignition coil, to the distributor and from the distributor to the spark plugs.

**Operation** — A primary current flows from the battery, through the ammeter and ignition switch to the coil primary winding, then to ground through the distributor contacts.

When the contacts open, the current tends to continue flowing across the contact gap. The condenser, which is connected across the contacts, momentarily absorbs this current and in doing so hastens the collapse of the magnetic field produced by the current in the coil primary winding.

This collapsing field induces a very high voltage in the secondary winding which is carried by the high tension wire to the center terminal of the distributor cap. The rotor connects this center terminal to one of the cap terminals which in turn is connected to the proper spark plug.

The spark produced by this high tension current ignites the fuel in that cylinder. This process is repeated for every power stroke of the engine and at high speeds, an impulse may be required as often as 300 times per second.

**Ignition Coil** — The function of the ignition coil is to transform the low voltage supplied by the battery into the high voltage to jump the spark plug gap.

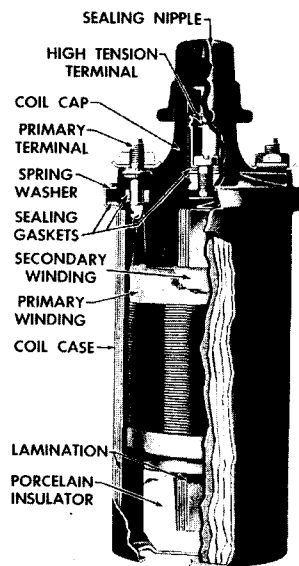


Figure 106 — Cutaway View of an ignition coil

An ignition coil has two windings wound on a soft iron core; the primary winding which consists of a comparatively few turns of heavy wire, and the secondary winding of many thousand turns of very fine wire. The primary winding is wound around the outside of the secondary winding. A soft iron shell encloses the outside of both windings and serves to complete the magnetic circuit.

Ignition coils do not normally require any service except keeping all terminals and connections clean and tight. The coil should be kept reasonably clean; however, it must not be subjected to steam cleaning or similar cleaning methods that may cause moisture to enter the coil.

Ignition coils can be tested for grounded windings by placing one test point on a clean part of the metal container and touching the other point to the primary and high voltage terminals. If tiny sparks appear at the points of contact, the windings are grounded.

If the coil is further suspected of being faulty, remove and check its operation on a coil tester and replace it if inoperative. Most coil testers compare the operation of the coil being tested with one known to be in good condition. This test should be made with the coils at room temperature and then

warming the coils five minutes by connecting the primary to a battery of the same voltage rating as the coils. Recheck the comparison test to see if the expansion due to heating has caused some defect to appear.

**Distributor** — The distributor conducts and interrupts the current through the primary winding of the ignition coil at the correct time and distributes the high tension voltage to the correct spark plug.

There are two separate electrical circuits in a distributor. The breaker contacts and condenser are in the primary circuit and carry low voltage current — while the cap and rotor are in the secondary circuit and carry the high voltage spark current.

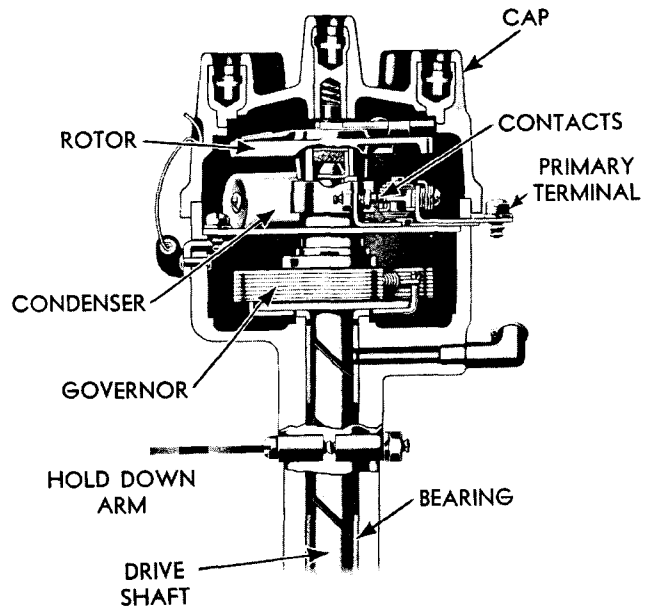


Figure 107 — Cutaway View of a distributor

The breaker contacts are mounted on a plate in the top part of the distributor housing. The grounded contact is stationary and the insulated contact is mounted on a breaker arm which is actuated by a cam near the top of the distributor shaft.

The rotor is mounted above the cam and turns with it to make a connection between the cap center contact and the various side contacts.

Continental Over-head Valve engines have distributors equipped with a centrifugal governor which varies the timing by advancing the breaker cam as the engine speed increases. This mechanism consists of weighted levers which revolve with the distributor rotor and act against a set of springs. As the speed of rotation increases, the weights are moved out and the timing is advanced. With this arrangement it is possible to have a retarded spark for idling and obtain a gradual advance in spark timing as the engine speed is increased.

The condenser in the distributor prevents excessive arcing at the contacts. When the contacts first open, the current tends to continue flowing across the gap. The condenser absorbs this current until it becomes fully charged; but by this time, the contacts have opened far enough to prevent the current flow. If there were no condenser in the circuit, the current would continue to flow and cause an arc that would soon burn the contacts. The capacity of the condenser is designed to be large enough to prevent arcing and burning of the contacts and small enough to reduce the transfer of material from one contact to the other.

The cam is designed so that the breaker points remain closed for a certain number of degrees so as to give the coil a given length of time to build up or become energized. This is called the cam angle, as shown below:

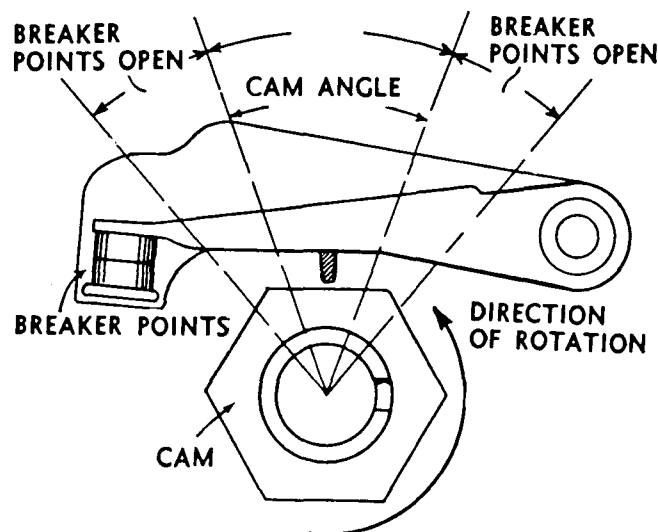


Figure 108 — Diagram illustrating cam angle

The cam is further designed to open the breaker points at a given speed in relation to cam travel to obtain proper point and condensor action. It is therefore important that the breaker points be adjusted to .020 gap so that proper cam angle is obtained.

**DISTRIBUTOR MAINTENANCE** — The distributor operation is vital to the operation of the engine and the following items should be carefully inspected every 250 hours of normal operation; however, dirt, dust, water and high speed operation may cause more rapid wear and necessitate more frequent inspections:

1 — **Remove Distributor Cap** — (without removing wires) — Clean cap and examine for cracks, carbon runners, corroded terminals or if the vertical faces of the inserts are burned — install a new cap.

If the horizontal faces of the inserts are burned — replace the cap and rotor as this is due to the rotor being too short.

2 — **Check Centrifugal Advance Mechanism** — for “freeness” by turning the breaker cam in the direction of rotation and then releasing it. The advance springs should return the cam to its original position.

3 — **Inspect Breaker Points and Gap** — if points are pitted, burned or worn to an unserviceable condition, install a new set of points. Badly pitted points may be caused by a defective or improper condenser capacity.

If the condenser capacity is too high, the crater (depression) will form in the positive contact; and, if condenser is too low, the crater will form in the negative contact as shown on the following sketch.

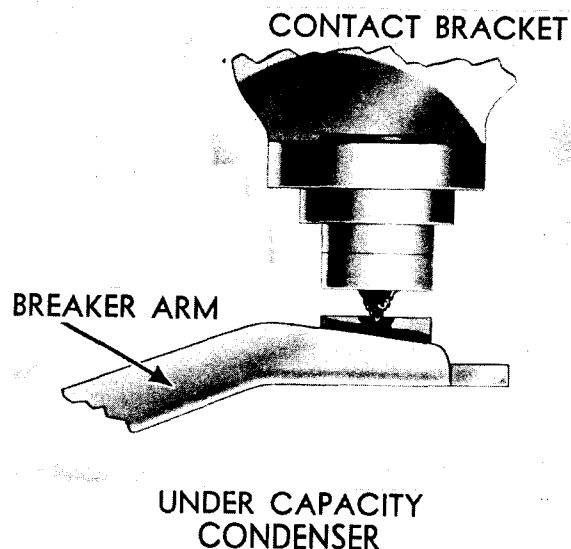
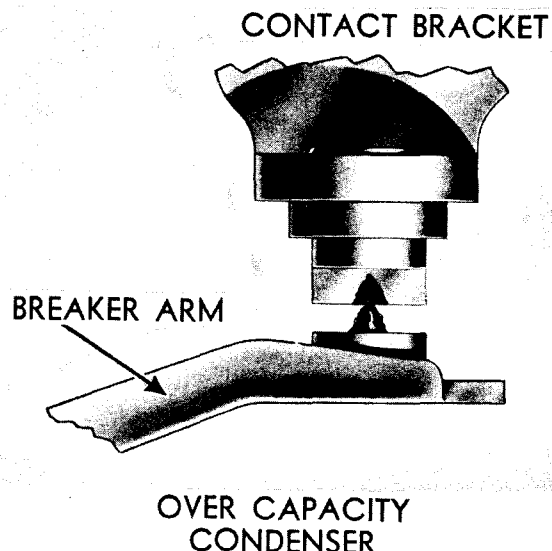


Figure 109 — Badly pitted breaker points caused by arcing due to incorrect condenser capacity

If the points are servicable, they should be dressed down with a fine-cut stone or point file. The file must be clean and sharp — never use emery cloth to clean contact points.

After filing, check the point gap and reset to .020 — the breaker arm must be resting on the high point of the cam during this operation.

When replacing points, make sure they are aligned and that they make full contact. Bend the stationary arm to obtain proper alignment — do not bend the breaker arm.

4 — **Lubrication** — is required at the shaft, advance mechanism, breaker cam and pivot. The shaft may be either oil or grease cup lubricated and should be given attention every oil change. Make sure the breaker arm moves freely on its hinge and apply a drop of light oil. A trace of ball bearing lubricant such as Mobilgrease Special (with Moly) should be used sparingly on the breaker cam unless lubricated by a felt wick with a few drops of oil.

**CAUTION:**

**AVOID EXCESSIVE LUBRICATION — AS THE EXCESS MAY GET ON THE CONTACT POINTS AND CAUSE BURNING.**

**SPARK PLUGS** — A spark plug consists of two electrodes; one grounded to the outer shell of the plug and the other well insulated with a core of porcelain or other heat resistant material. The space between these two electrodes is called the gap which should be set at .025 on standard plugs, and .035 on resistor type plugs for Continental Over-Head Valve Engines. Correct and uniformity of the gaps of all spark plugs in the engine is important for smooth running.

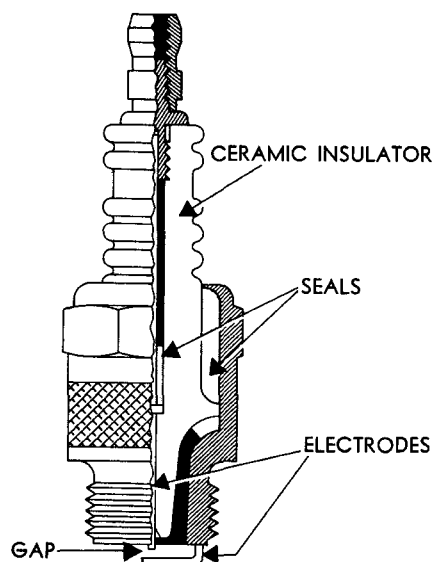


Figure 110 — Sectional view of spark plug

Spark plug gaps are best checked with a wire gauge unless the points are dressed to obtain a correct reading with a flat gauge. The adjustment should always be made on the side electrode and

never on the center electrode which may cause a broken porcelain.

“Gapping” the electrode tip is more easily done with proper tools.

**GAPPING THE SPARK PLUG.** This illustration shows the use of the gapping tool which both measures and adjusts the electrode gap.

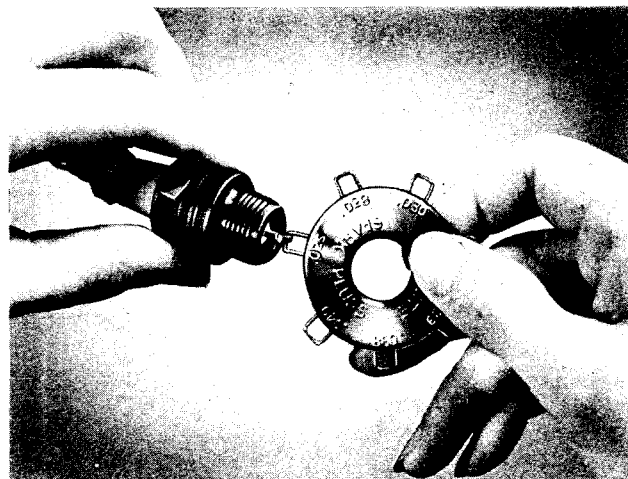


Figure 111 — Checking spark gap

Spark Plugs must operate within a certain temperature range to give good performance — not too hot and not too cold. The ability of a spark plug to conduct heat away from the center electrode and porcelain is controlled by the design of the shell and insulator — so varying the length of the insulator below the gasket shoulder controls the temperature.

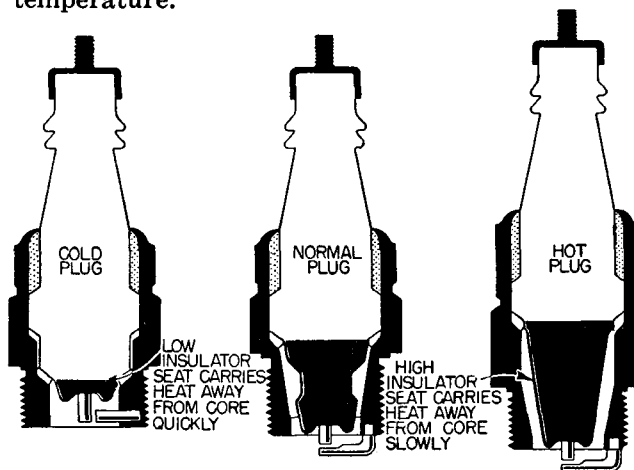


Figure 112 — Cold — Normal — Hot Spark Plugs

**Cold-Normal-Hot Spark Plugs**

Examination of a used spark plug will show if it is in the correct heat range for the operating conditions. If the plug runs too hot, the insulator will blister or crack and the electrodes burn away rapidly. If the plug remains too cool — soot and carbon will deposit on the insulator causing fouling and missing.

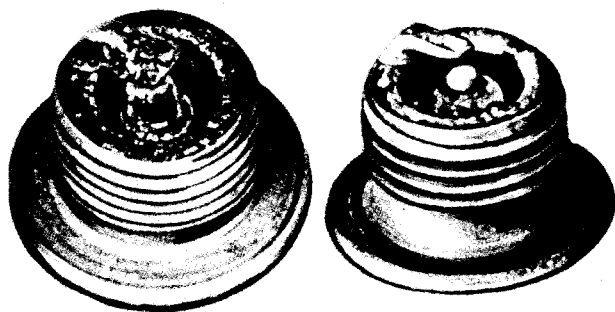


Figure 113 — Faulty spark plugs. Left: cold plug used in an engine that should have a hot plug. Right: hot plug used in an engine that should have a cold plug.

Spark plug electrodes will wear in the course of time and present day fuels have a tendency to form rusty-brown oxide deposits on the insulator tip. Therefore it is necessary to periodically clean the plugs with a plug cleaner and to reset the gaps to specifications.

Spark plugs must be correctly installed in order to obtain good performance from them. It is a simple but important matter to follow the following procedure when installing plugs:

1. Clean the spark plug seat in the cylinder head.
2. Use new seat gasket and screw plug in by hand.
3. Tighten all 14mm plugs to 30# and 18mm to 34# torque with socket wrench of correct size.

## DISTRIBUTOR — IGNITION TIMING With Timing Light

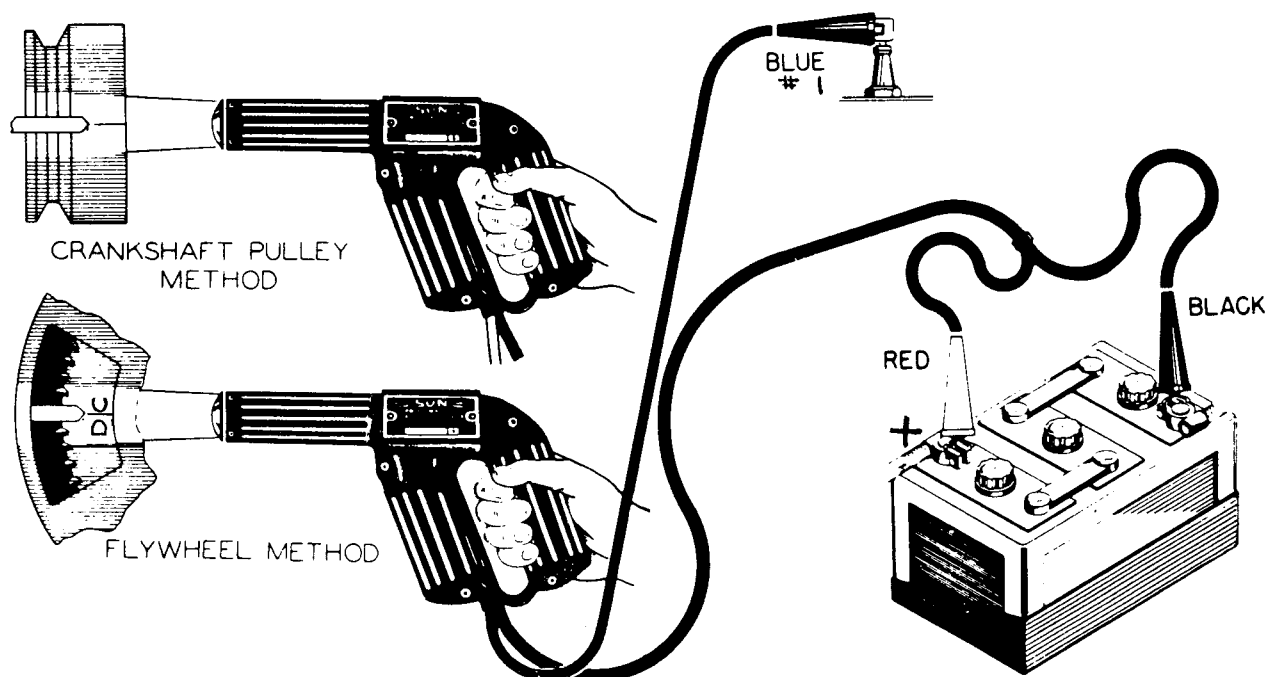


Figure 114 — Schematic diagram showing timing light hookup

Normally Continental Overhead-Valve engines with distributor-ignition are timed to have the distributor points start to open when #1 cylinder is on compression stroke and the flywheel mark "DC" or "IGN" mark lines up with the pointer in the bell housing.

There are two methods of checking ignition timing — *with or without a timing light*.

The *preferred method* is to use a timing light in following sequence:

Paint a line on the flywheel (or in some cases, on the front pulley) so the timing mark will be more legible under the timing light.

1. Clip blue secondary lead of light to the #1 spark plug — leave spark plug wire on plug.
2. Connect primary positive lead (red) to positive terminal of battery.
3. Connect primary negative lead (black) to negative battery terminal.





Figure 115 — Checking flywheel timing with timing light

4. Start engine and run at idle speed, 400 RPM or lower, so the automatic advance of the distributor is completely retarded. **THIS IS VERY IMPORTANT TO OBTAIN CORRECT TIMING.**

5. Direct timing light on the flywheel through opening in bell housing and note timing marks as light flashes.

6. Timing is normally at "D.C." or "IGN" unless specified otherwise on your engine specification sheet.

7. To advance timing, turn distributor body clockwise. To retard timing, turn distributor body counter-clockwise.

8. When timing is correct, tighten distributor clamp screw securely. Then recheck timing again with light.

9. This operation is best performed in shaded area, so timing light is visible.

### DISTRIBUTOR IGNITION TIMING Without Timing Light (Emergency Method)

An alternative method without timing light, is as follows:

1. Remove #1 Spark Plug — put your thumb over the spark plug hole and crank engine by hand until air is exhausting.

2. Set piston on top-dead-center by slowly cranking until "DC" or "IGN" mark on flywheel will line up with the pointer in bell housing.

Note: Some special applications may have timing several degrees before top dead center (BTDC).

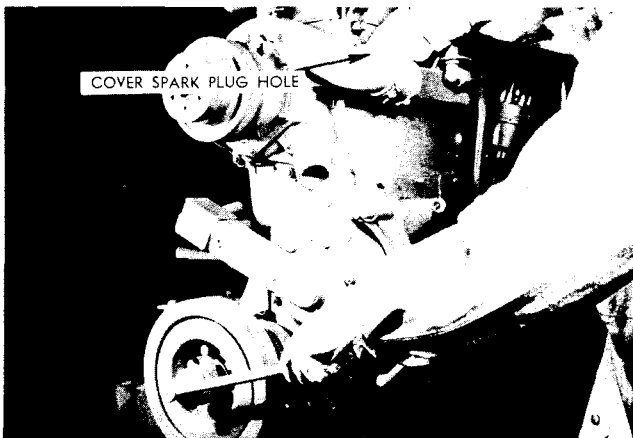


Figure 116 — Checking No. 1 Cylinder on Compression Stroke



Figure 117 — Flywheel timing marks

3. Loosen the distributor clamp bolt and rotate the distributor body until the contact points just *Start to Open*.

This may be more accurately checked by means of a test lamp connected between the distributor primary lead and the negative terminal of the battery — when the points are closed the light will be ON and as soon as the points break the light will go OFF.

#### 4. Tighten distributor mounting bolts.

In high altitudes there is less tendency for sparking as well as low altitudes with premium gasolines. In such cases, improved performance may be obtained by advancing the spark **not to exceed** 4 degrees ahead of specified setting.

**CAUTION:** WHEN ENGINE SPECIFICATIONS HAVE SPECIAL TIMING OTHER THAN TOP-DEAD-CENTER — THEY MUST BE FOLLOWED IN ORDER TO OBTAIN SATISFACTORY SERVICE IN SPECIAL APPLICATIONS OR HIGHER ALTITUDES.

### MAGNETO - IGNITION

Magneto-Ignition is furnished on Continental Over-Head Valve engines on special applications to provide a complete ignition system without requiring a battery.

The magneto comprises all the parts of the battery-ignition system with the exception of the battery, and in addition, means for generating current impulses directly in the primary winding — which is in effect a spark coil.

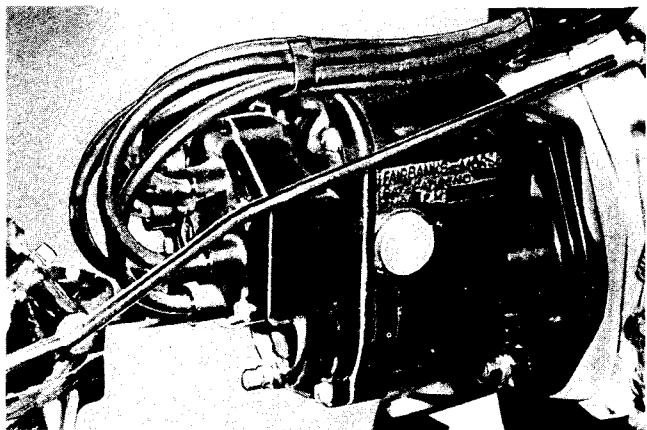


Figure 118 — Magneto installation

The advantage of the magneto is this self-contained character. All the elements of the ignition system are in one compact unit, from which it only requires a low-tension cable to the ignition switch and high-tension cables to the spark plugs.

#### Operation

Magnetos are of the rotating magnet type with jump-spark distributor and are flange mounted to an accessory timing gear drive.

The rotation of the magnetic rotor sets up an alternating magnetic flux which cuts the primary winding each time it rises and falls. This induces electric currents, alternating in direction, to flow in the primary circuit during the intervals the breaker points are closed.

The current in the primary winding of the coil establishes a magnetic field which interlocks the turns of the coil secondary winding, this field reaching its maximum simultaneously with the primary current. Breaker point action at the instant of maximum primary current and field, opens the primary circuit so the primary current can't flow — causing the immediate and complete collapse of the magnetic field existing in the coil.

### SCHEMATIC DRAWING OF MAGNETO IGNITION

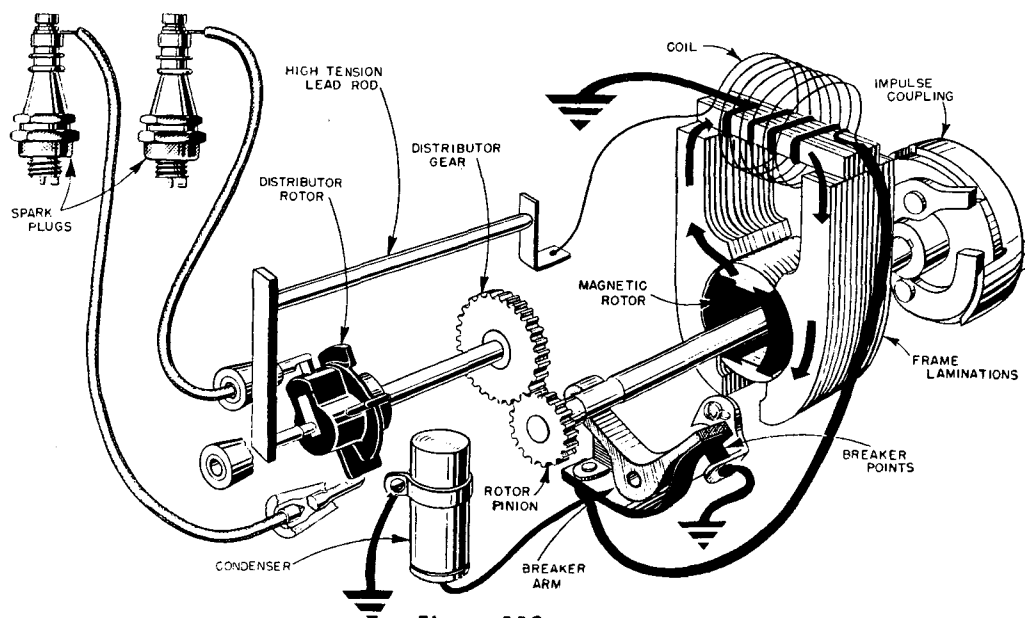


Figure 119

The ratio of turns in the coil secondary winding to those of the primary is very high so the induced voltage in the secondary winding is also very high.

The self-induced voltage occurring in the primary winding, as a result of the quick break of the

primary circuit, is absorbed by the condenser which is shunted across the breaker points. This action promotes a more rapid collapse of the primary field and at the same time reduces contact point burning caused by arcing.

## IMPULSE COUPLING

All magnetos have an impulse coupling which assists starting by automatically retarding the ignition spark during the starting operation and at the same time producing an intense, hot spark — which would otherwise be impossible at very low engine speeds.

This device prevents the rotor of the magneto from turning during the starting operation until the engine piston is about at top-dead-center, at which instant the rotor is snapped forward at very high speed, producing an intense spark which is

automatically retarded to prevent back-firing. Since the point at which the release occurs can be controlled in the coupling construction — it is possible to provide an automatic retard of the ignition spark during the starting period.

Basically the impulse coupling consists of a shell and a hub, connected together by a strong spring. One half of the coupling (shell) is fitted to a drive member on the engine drive shaft — while the other half (hub) is keyed to the magneto rotor shaft.

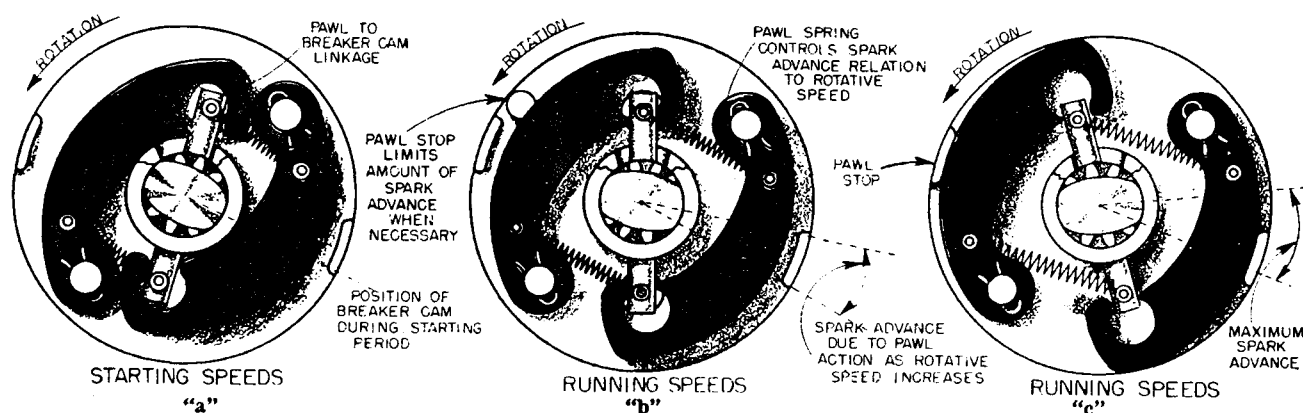


Figure 120 — Operation of Automatic Spark Advance Rotor

## AUTOMATIC SPARK ADVANCE

In slow speed operation, a pawl on the magneto half of the coupling engages a stop pin mounted on the magneto frame — which prevents further movement of the rotor. The engine half of the coupling continues to rotate and the relative change in position winds up the connecting spring.

When the desired point of ignition spark is

reached, the pawl is released and the drive spring snaps the magneto rotor forward at high speed through its firing position.

As the engine speed increases, the centrifugal force acting on the pawls — withdraws them to a position not engaging the coupling stop pin — the impulse coupling then acts as a solid drive member.

## TIMING MAGNETO TO ENGINE

1. Remove rear (#6 spark plug. Put your thumb over the spark plug hole and crank engine by hand until air is exhausting.

2. Set piston on top-dead-center by slowly cranking until "DC" mark on flywheel will line up with the pointer in the flywheel housing.

3. With magneto removed from the engine — put it firmly in a vise lined with soft cloths and turn drive lugs of impulse coupling until lead to rear plug (#6) fires.

Bosch and Wico magneto indicate #1 lead so rear plug is directly opposite — F. M. magnetos are not marked, but rear plug lead is at 5 o'clock position when facing distributor end.

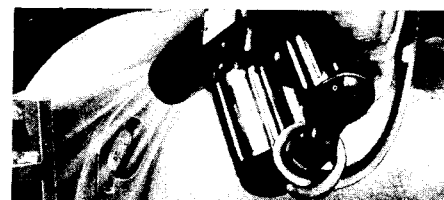
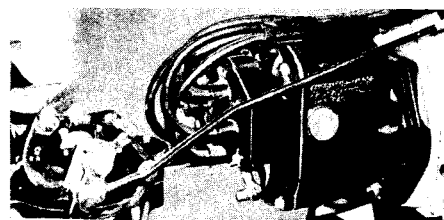
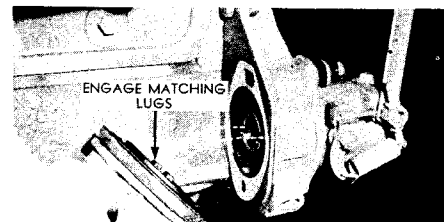
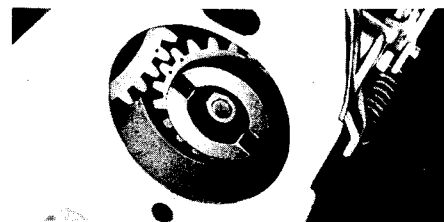
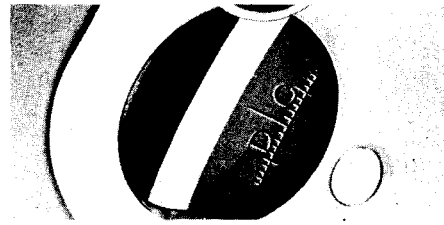
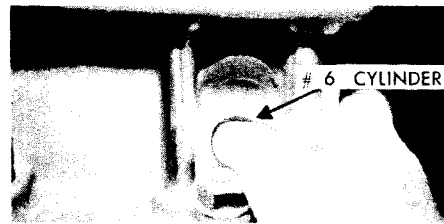
4. Check front end governor drive and make certain that punch-marked tooth of timing gear is meshing between the two punch-marked teeth of the governor drive gear.

5. Turn back magneto drive lugs of impulse coupling counter-clockwise about  $\frac{1}{4}$  turn so as to mesh with the driving slots of the engine drive member.

6. Position magneto on engine and tighten mounting bolts moderately and connect wires to spark plugs.

7. Start and idle engine 600 R.P.M. and using a timing light connected to rear plug and battery source — check to see if timing is directly at "IGN-M" indicated by pointer.

If not, rotate magneto assembly until timing is correct, then tighten magneto mounting bolts.



**IMPORTANT:** Engine specifications require magnetos with the correct amount of "Built-in Lag" — which permits timing the magneto to the engine correctly as outlined.

*Do not substitute other magnetos.*