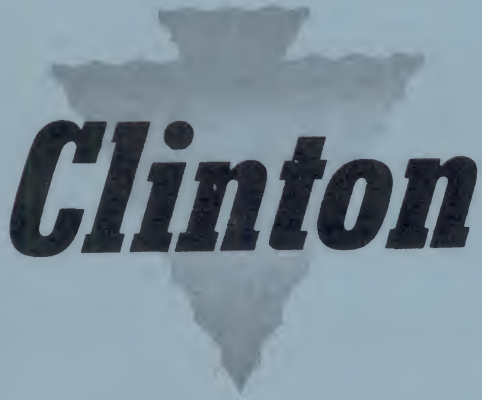


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2 1/4" x 1 1/2" 3



Clinton

**FIELD
SERVICE
CLINIC
MANUAL**

Presented to

JOE VAN VACTOR

by

CLINTON ENGINES CORPORATION

MAQUOKETA, IOWA

BASIC MODELS OF CLINTON ENGINES

Model Number	Block Construction	Piston Displace.	Type	Model Number	Block Construction	Piston Displace.	Type
E 65	Aluminum	5.76	2 Cycle	VS2100-1000	Aluminum	7.2	4 Cycle
100	Aluminum	7.2	4 Cycle	VS2100-2000	Aluminum	7.2	4 Cycle
100-1000	Aluminum	7.2	4 Cycle	VS2100-3000	Aluminum	7.2	4 Cycle
100-2000	Aluminum	7.2	4 Cycle	2500	Long Life Cast Iron	25	4 Cycle
V100-1000	Long Life Cast Iron	7.2	4 Cycle	A2500	Long Life Cast Iron	25	4 Cycle
VS100	Aluminum	7.2	4 Cycle	B2500-1000	Long Life Cast Iron	25	4 Cycle
VS100-1000	Aluminum	7.2	4 Cycle	2790-1000	Long Life Cast Iron	25	4 Cycle
VS100-2000	Aluminum	7.2	4 Cycle	VS3000	Aluminum	7.2	4 Cycle
VS100-3000	Aluminum	7.2	4 Cycle	3100	Aluminum	8.3	4 Cycle
VS100-4000	Aluminum	7.2	4 Cycle	3100-1000	Aluminum	8.3	4 Cycle
200	Aluminum	4.5	2 Cycle	3100-2000	Aluminum	8.3	4 Cycle
A200	Aluminum	4.5	2 Cycle	3100-3000	Aluminum	8.3	4 Cycle
AVS200	Aluminum	4.5	2 Cycle	H3100-1000	Long Life Cast Iron	8.3	4 Cycle
AVS200-1000	Aluminum	4.5	2 Cycle	FV3100-1000	Long Life Cast Iron	8.3	4 Cycle
VS200	Aluminum	4.5	2 Cycle	AFV3100-1000	Long Life Cast Iron	8.3	4 Cycle
VS200-1000	Aluminum	4.5	2 Cycle	AV3100-1000	Long Life Cast Iron	8.3	4 Cycle
VS200-2000	Aluminum	4.5	2 Cycle	AV3100-2000	Long Life Cast Iron	8.3	4 Cycle
VS200-3000	Aluminum	4.5	2 Cycle	AVS3100	Aluminum	8.3	4 Cycle
VS200-4000	Aluminum	5.76	2 Cycle	AVS3100-1000	Aluminum	8.3	4 Cycle
300	Long Life Cast Iron	4.72	4 Cycle	AVS3100-2000	Aluminum	8.3	4 Cycle
A300	Long Life Cast Iron	4.72	4 Cycle	AVS3100-3000	Aluminum	8.3	4 Cycle
VS300	Long Life Cast Iron	4.72	4 Cycle	V3100-1000	Long Life Cast Iron	8.3	4 Cycle
350	Long Life Cast Iron	4.72	4 Cycle	V3100-2000	Long Life Cast Iron	8.3	4 Cycle
A400	Aluminum	5.76	2 Cycle	VS3100	Aluminum	8.3	4 Cycle
A400-1000	Aluminum	5.76	2 Cycle	VS3100-1000	Aluminum	8.3	4 Cycle
AVS400	Aluminum	5.76	2 Cycle	VS3100-2000	Aluminum	8.3	4 Cycle
AVS400-1000	Aluminum	5.76	2 Cycle	VS3100-3000	Aluminum	8.3	4 Cycle
BVS400	Aluminum	5.76	2 Cycle	4100	Aluminum	8.3	4 Cycle
CVS400-1000	Aluminum	5.76	2 Cycle	4100-1000	Aluminum	8.3	4 Cycle
VS400	Aluminum	5.76	2 Cycle	4100-2000	Aluminum	8.3	4 Cycle
VS400-1000	Aluminum	5.76	2 Cycle	AVS4100-1000	Aluminum	8.3	4 Cycle
VS400-2000	Aluminum	5.76	2 Cycle	AVS4100-2000	Aluminum	8.3	4 Cycle
VS400-3000	Aluminum	5.76	2 Cycle	VS4100-1000	Aluminum	8.3	4 Cycle
VS400-4000	Aluminum	5.76	2 Cycle	VS4100-2000	Aluminum	8.3	4 Cycle
500	Long Life Cast Iron	5.89	4 Cycle	400-0000-000	Aluminum	7.2	4 Cycle
GK590	Aluminum	5.76	2 Cycle	401-0000-000	Aluminum	7.2	4 Cycle
650	Long Life Cast Iron	5.89	4 Cycle	402-0000-000	Aluminum	7.2	4 Cycle
700-A	Long Life Cast Iron	5.89	4 Cycle	403-0000-000	Aluminum	7.2	4 Cycle
B700	Long Life Cast Iron	5.89	4 Cycle	404-0000-000	Aluminum	8.3	4 Cycle
C700	Long Life Cast Iron	5.89	4 Cycle	405-0000-000	Aluminum	8.3	4 Cycle
D700	Long Life Cast Iron	6.65	4 Cycle	406-0000-000	Long Life Cast Iron	8.3	4 Cycle
D700-1000	Long Life Cast Iron	6.65	4 Cycle	407-0000-000	Long Life Cast Iron	8.3	4 Cycle
D700-2000	Long Life Cast Iron	6.65	4 Cycle	407-0002-000	Long Life Cast Iron	8.3	4 Cycle
D700-3000	Long Life Cast Iron	6.65	4 Cycle	408-0000-000	Aluminum	8.3	4 Cycle
VS700	Long Life Cast Iron	5.89	4 Cycle	409-0000-000	Aluminum	8.3	4 Cycle
VS750	Long Life Cast Iron	5.89	4 Cycle	410-0105-000	Aluminum	9.2	4 Cycle
800	Long Life Cast Iron	8.3	4 Cycle	411-0000-000	Aluminum	7.2	4 Cycle
A800	Long Life Cast Iron	8.3	4 Cycle	411-0002-000	Aluminum	7.2	4 Cycle
VS800	Long Life Cast Iron	8.3	4 Cycle	412-0000-000	Long Life Cast Iron	15.5	4 Cycle
900	Long Life Cast Iron	8.3	4 Cycle	413-0000-000	Long Life Cast Iron	15.5	4 Cycle
900-1000	Long Life Cast Iron	8.3	4 Cycle	414-1300-000	Long Life Cast Iron	16.3	4 Cycle
900-2000	Long Life Cast Iron	8.3	4 Cycle	414-1301-000	Long Life Cast Iron	16.3	4 Cycle
900-3000	Long Life Cast Iron	8.3	4 Cycle	415-0000-000	Aluminum	8.3	4 Cycle
900-4000	Long Life Cast Iron	8.3	4 Cycle	415-0002-000	Aluminum	8.3	4 Cycle
VS900	Long Life Cast Iron	8.3	4 Cycle	416-1300-000	Long Life Cast Iron	16.3	4 Cycle
V1000-1000	Long Life Cast Iron	8.3	4 Cycle	417-0000-000	Long Life Cast Iron	8.3	4 Cycle
VS1000	Long Life Cast Iron	8.3	4 Cycle	418-1300-000	Long Life Cast Iron	18.6	4 Cycle
A & B 1100	Long Life Cast Iron	8.3	4 Cycle	418-1301-000	Long Life Cast Iron	18.6	4 Cycle
C1100	Long Life Cast Iron	8.3	4 Cycle	419-0005-000	Aluminum	9.2	4 Cycle
D1100	Long Life Cast Iron	8.3	4 Cycle	420-1300-000	Long Life Cast Iron	25	4 Cycle
V1100-1000	Long Life Cast Iron	9.5	4 Cycle	420-1301-000	Long Life Cast Iron	25	4 Cycle
VS1100	Long Life Cast Iron	9.5	4 Cycle	422-1300-000	Long Life Cast Iron	25	4 Cycle
VS1100-1000	Long Life Cast Iron	9.5	4 Cycle	422-1301-000	Long Life Cast Iron	25	4 Cycle
1200	Long Life Cast Iron	10.2	4 Cycle	424-0000-0000	Long Life Cast Iron	8.3	4 Cycle
1200-1000	Long Life Cast Iron	10.2	4 Cycle	426-0000-000	Aluminum	8.3	4 Cycle
1200-2000	Long Life Cast Iron	10.2	4 Cycle	429-0003-000	Long Life Cast Iron	9.2	4 Cycle
A1200	Long Life Cast Iron	10.2	4 Cycle	431-0003-000	Long Life Cast Iron	9.2	4 Cycle
B1290-1000	Long Life Cast Iron	10.2	4 Cycle	435-0003-000	Aluminum	8.3	4 Cycle
V1200-1000	Long Life Cast Iron	10.2	4 Cycle	492-0300-000	Long Life Cast Iron	8.3	4 Cycle
VS1200	Long Life Cast Iron	10.2	4 Cycle	494-0000-000	Long Life Cast Iron	8.3	4 Cycle
1600	Long Life Cast Iron	16.3	4 Cycle	494-0001-000	Long Life Cast Iron	8.3	4 Cycle
A1600-1000	Long Life Cast Iron	16.3	4 Cycle	497-0000-000	Long Life Cast Iron	10.2	4 Cycle
1800-1000	Long Life Cast Iron	18.6	4 Cycle	498-0300-000	Long Life Cast Iron	10.2	4 Cycle
2100	Aluminum	7.2	4 Cycle	498-0301-000	Long Life Cast Iron	10.2	4 Cycle
A2100	Aluminum	7.2	4 Cycle	499-0000-000	Long Life Cast Iron	10.2	4 Cycle
A2100-1000	Aluminum	7.2	4 Cycle	500-0000-000	Aluminum	5.76	2 Cycle
A2100-2000	Aluminum	7.2	4 Cycle	501-0000-000	Aluminum	5.76	2 Cycle
VS2100	Aluminum	7.2	4 Cycle	501-0001-000	Aluminum	5.76	2 Cycle

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HISTORY — CLINTON ENGINES CORPORATION

Clinton Engines Corporation was established in 1946 to manufacture small general purpose air-cooled gasoline engines. Today the Corporation is one of the largest suppliers of these engines which are used principally on power lawnmowers, and for other home, farm and industrial uses. A complete chainsaw line and air-cooled outboards from 3 to 9.9 horsepower are also manufactured at the Maquoketa, Iowa plant.

Clinton engines are sold and serviced by more than 12,000 dealers in the United States plus outlets in 88 foreign countries. Hundreds of original equipment manufacturers use Clinton engines on their power equipment. First operations of the Corporation were in Clinton where 150 employees started producing a 1.5 horsepower engine. Initial production was approximately 225 engines a week.

Within the first year the company employed approximately 1,000 persons. The following year, 1948, two additional models were added to the line, one a 2 horsepower engine and the other a 3 horsepower engine. In 1950 the Corporation purchased a 200,000 square foot manufacturing facility in Maquoketa built five years previous for a manufacturer of farm equipment. Since then the plant has been enlarged to 250,000 square feet. From the original 1.5 horsepower, 4-cycle engine Clinton now makes a total of 16 basic models ranging from 2 1/2 to 10.3 horsepower, of 2-cycle and 4-cycle design, horizontal and vertical crankshaft.

Largest outlet for Clinton engines is the power lawnmower market. It is estimated that about two-thirds of the Corporation's engines go into this field. Among the Corporation's contributions to the industry are— the first mass produced vertical-shaft engines for rotary lawnmowers; first to introduce an automotive-type oil pump in a 4-cycle engine and the "dry type" automotive air filter; first to use the shell-moulded engines; first to use a cast-iron liner, cast as an integral part of the cylinder block, in lightweight aluminum engines; and similar other developments which have made these engines more versatile, easier to start and give longer usable operating life.

In 1952 Clinton introduced its own line of chainsaws. The saws are used in agriculture, home construction and by utility companies for clearing land, landscaping, and cutting timber and pulpwood.

In 1957 Clinton introduced its own line of 5 horsepower air-cooled outboard motors, ideal for fishing, trolling and cruising. It can be used as stand-by auxiliary power for small and medium sized sailboats, as well as for a dinghy, canoe or any type of wood, fiberglass or aluminum craft. In 1966 a 9.9 horsepower air-cooled unit was added.

Clinton entered the export market in 1953. In recent years Clinton accounted for one-third of all air-cooled engines sold under 10 horsepower overseas. In May, 1966 Clinton received the coveted "E" Award for excellence in export from the President of the United States. Clinton is the first engine manufacturer to be so honored.

The versatile Clinton engine has thousands of applications. In addition to the previously mentioned uses, Clinton engines play a vital part in such products as garden tillers, paint sprayers, post-hole augers, tractors, well drilling equipment, rail spike hammers, sprayers, compactors, emergency generators and many other areas for home, industry and agriculture. Hardly a week goes by when applications such as powering underwater weed cutters, or Japanese farmers carrying a "popping" Clinton "lightweight" on their backs to power portable crop dusters, are not reported to Clinton headquarters. Throughout the world Clinton has built up a sales and service organization which has helped build customer satisfaction, both manufacturer and user.

MANUFACTURING PLANT, MAQUOKETA, IOWA

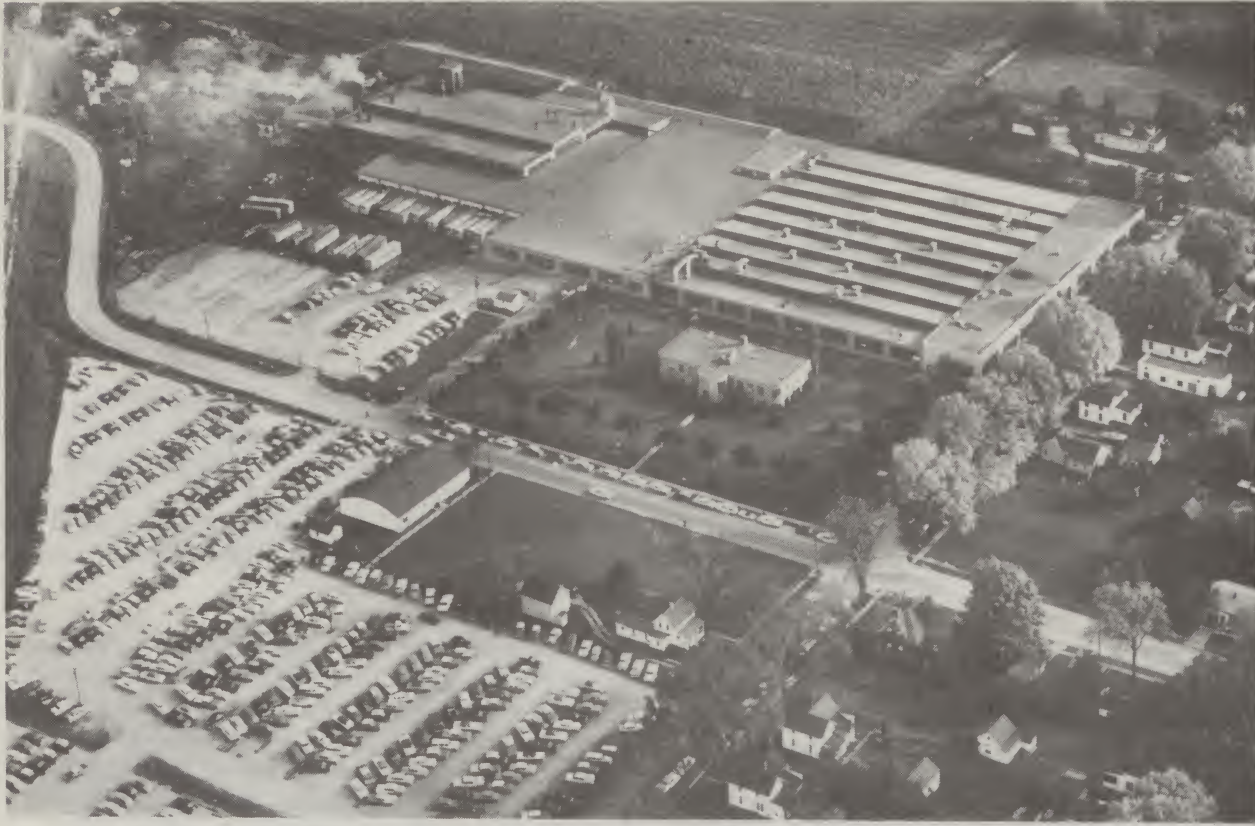


Figure 1

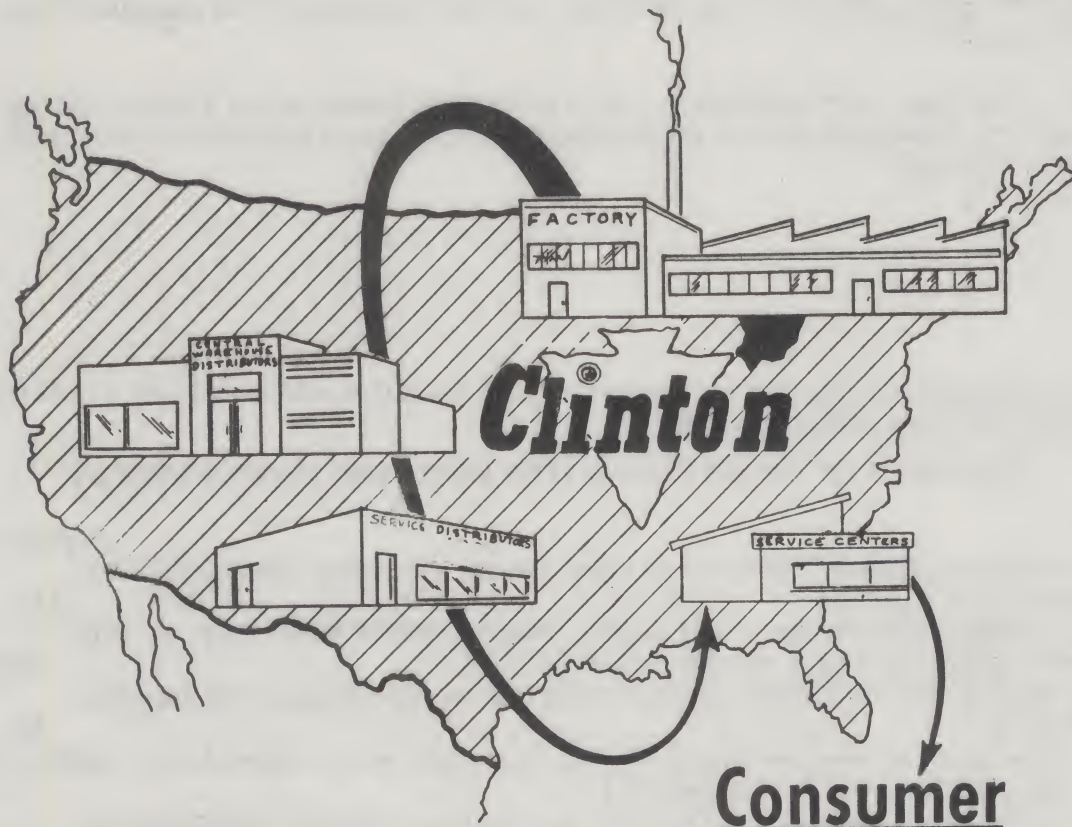
AFTER MARKET SALES AND SERVICE ORGANIZATION

Clinton has what is called a three step distribution on replacement parts and engines. Listed below are the steps of distribution Clinton uses.

1. The first step of distribution is from the factory where the parts are manufactured to the Central Warehouse Distributor who are located in key positions throughout the United States and Canada. The Central Warehouse Distributor's job is to see that parts and engines are available for the needs of the area they cover.

2. The second step of distribution is from the Central Warehouse Distributor to the Service Distributor who has been established within a general trade area. The Service Distributor's job is to see that replacement parts and engines are available for the needs of the area they cover.

3. The third step of distribution is from the Service Distributor to the Service Dealer who has been established within the general trade area. The Service Dealer's job is to have replacement parts and engines available so when the end user of a Clinton engine needs replacement parts or an engine they are available. Each step of distribution has a definite responsibility, this is, having replacement parts and engines available when they are needed. The Factory maintains a back-up stock of replacement parts and engines for the Central Warehouse Distributor, who in turn should back up the Service Distributor and the Service Distributor the Dealer. If the Service Dealer, Service Distributor, and Central Warehouse Distributor should not have parts needed by the customer, it might take well over a month to get the parts needed down through the steps of distribution. So, it is important that each step of distribution does their part in stocking parts and engines.



SALES - SERVICE MANUAL

The Sales - Service Manual is the key to servicing Clinton Engines. With this manual and knowledge of how to use it the following information is available to you:

- (A) Replacement part numbers.
- (B) Parts and engine prices.
- (C) Replacement engine stock numbers.
- (D) Service procedures, specifications and tolerances.

This manual consists of nine sections, these being the following:

- Sec. I Price list, on replacement engines and parts.
- Sec. II Complete engine parts break-down.
- Sec. III Accessories, items that are not normally standard parts.
- Sec. IV Specifications on individual crankshafts and bases.
- Sec. V Specifications on replacement engine.
- Sec. VI Manual of maintenance and complete overhaul instruction.
- Sec. VII Interchangeability from old model engines to current replacement.
- Sec. VIII Service bulletins covering warranty policy, short block usage, and service information.
- Sec. IX Service letters, covers advance service information.

Policy Governing Clinton Sales - Service Manual

All manuals are stocked at the factory and shipped from the factory. Orders for complete manuals should be routed through your source of supply on Clinton.

The Master Parts & Service Manual will only be shipped direct to the purchaser from the Factory, in order to assure complete mailing records for automatic upkeep. Orders must be complete with full information, giving name, address, and title of recipient. All manuals shipped F.O.B. Maquoketa, Iowa.

NOTE: At the time a new contract is signed a complete Master Parts & Service Manual is furnished each new authorized service account and is included as an item of the initial stock of parts at the cost of \$15.50

Any correspondence to the factory concerning your manual should include the serial number on the first page to insure proper handling.

SCHEDULE OF PRICES FOR MASTER PARTS AND SERVICE MANUAL

		All prices are net
One complete Master Parts and Service Manual with index pages and Clinton hard cover, 952-36		\$15.50 each
One complete Master Parts and Service Manual without hard cover, but with index pages (for use in catalog racks) 952-37		\$8.00 each
One hard cover for Clinton Master Parts and Service Manual without index, 952-35		\$7.50 each
The following extra sections of the Master Parts and Service Manual are available as listed.		
One Master Parts Price List, Section I		.40 each
One Maintenance Manual and Overhaul Instructions, Section VI of the Master Parts and Service Manual		\$2.00 each

HOW TO IDENTIFY CLINTON ENGINES

A very important element in servicing Clinton engines is being able to identify them.

A system of identification has been established as a key for obtaining this information. The basis of this system of identification begins with the Name Plate which was permanently attached to each Clinton engine at the factory. The reference for all Service and Repair on Clinton engines will be found on this Name Plate. It is very important that the plate remain with the engine. Should it ever become necessary to replace that part of an engine to which the Name Plate is attached, make certain to remove the plate and place it on the new part. Following on this page is additional information concerning the Name Plate as a key to service.

In 1961 Clinton altered the numbering system on engines making the numbering system acceptable to I.B.M. equipment. To properly identify engines it is now necessary to understand both numbering systems which will be covered separately.

There are three basic things that have to be taken from the engine name plate to be able to locate the parts needed in the sales - service manual.

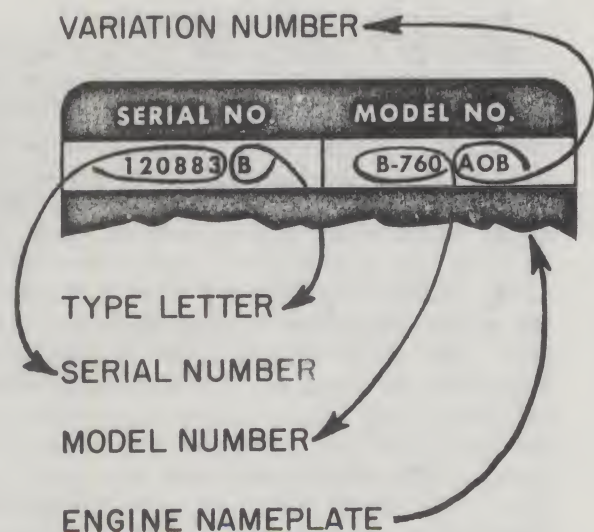


Figure 32

1. Model number.
2. Variation number.

3. Type letter.

Numbering system prior to 1961:

1. How to find Model (See Illus. No. 32)

The Model Number of your engine is found on the Name Plate, i.e., B-7xx is the Model Number in this case. . . then, by turning to Section II, Division B-700, you will find the illustrated Basic Parts List. For example, if the Model Number was D-1160, you would turn to Section II, Div. D-1100, etc. In some cases the model will be shown as D-700-2xxx which would be the D-700-1000 Series or D-700-2000 Series with model variations shown in the last three digits.

2. Variation numbers:

One thing to keep in mind when working with the Clinton manual, is that all models are set up in numerical and alphabetical sequence. The Model is further identified by the last TWO figures in the model designation number, i.e., B-760 in this example, and is sometimes followed by additional letters or numbers. All recent models and future production will have numbers only following the basic model number. The lettering system has been discontinued. Due to varied employment of many series, there may be a large number of models. A complete list of these models, referred to as MODEL VARIATIONS, will be found following each Basic Parts List. Under this system of assigning model variation numbers, the first variation from the standard engine will begin with "100." A typical model number might be 1200-107, for example. The model variation list following each Basic Parts List will tell what parts or assemblies are used on each variation. . . IN ADDITION TO or IN PLACE OF the standard parts found in the Basic Parts List. In the case of the name plate shown above, by looking in the Model Variation List following the Basic Parts List for the B-700 series, one finds that the B-760-AOB has a special crankshaft, a gear reduction assembly and that the gear reducer is mounted in the 12:00 position. If, for instance, a part is needed just for the gear reducer, then one must turn to Section III (Accessories) and look up the part under the appropriate assembly number; in this case 3800. It is advisable to always check thru the variations first to determine if other than standard parts were used.

3. How to determine type:

The type letter is very important as it designates when a part design change has taken place

and the original part set up for this model engine will not work. Whenever a part or assembly is not used on all types, this will be noted in the basic model parts list. If no note appears, this means that the part will be found on all types. The type in a Clinton engine is always shown as a suffix letter following the serial number 120883-B is an example.

New Numbering System Used Since 1961 (See Illus. No. 33).

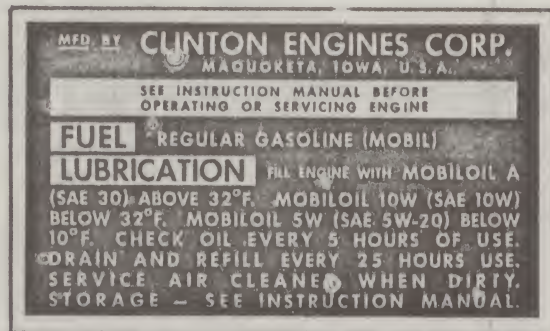


Figure 32 A

With the use of the Mylar name plate the engine model and serial number are stamped on the cylinder air deflector. These numbers are located next to the Mylar name plate.

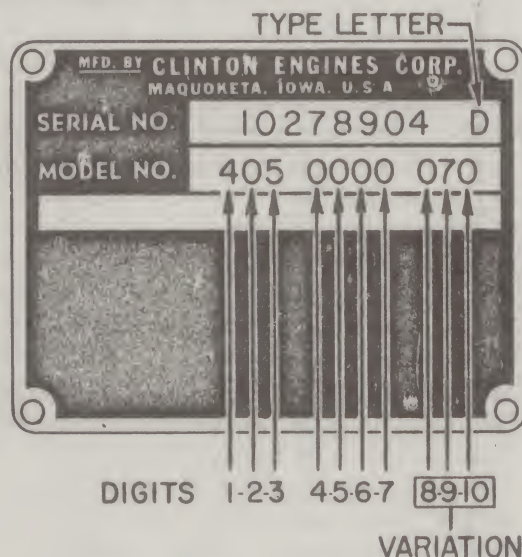


Figure 33

The first digit is used to identify the type engine, i.e., 4-4-cycle and 5-2-cycle.

The second and third digits complete identification of the basic series. Odd numbers will be used for vertical shaft engines and even numbers will be used for horizontal engines i.e., 405 will be a 4-cycle vertical shaft series and 406 horizontal.

The fourth digit identifies the starter as follows: 0 recoil starter, 1=rope starter, 2=impulse starter, 3=crank starter, 4=12 volt electric starter, 5=12 volt starter generator, 6=110 volt

electric starter, 7=12 volt generator, 8 is not assigned to date, and 9 short block.

The fifth digit identifies bearing usage, 0=standard bearing, 1 aluminum or bronze sleeve bearing with flange mounting surface and pilot diameter on engine mounting face for mounting equipment concentric to crankshaft center line, 2=ball or roller bearing, 3=ball or roller bearing with flange mounting surface and pilot diameter on engine mounting face for mounting equipment concentric to crankshaft center line, 4 thru 9 are not assigned to date.

The sixth digit identifies auxiliary power take-off and speed reducers, 0 without, 1=auxiliary PTO, 2=2:1 speed reducer, 3=not assigned to date, 4=4:1 speed reducer, 5=not assigned to date, 6=6:1 speed reducer, 7 thru 9 are not assigned to date.

The seventh digit will indicate a major design change. Model Variation numbers assigned after a 7th digit change will not correspond with variation numbers assigned before the change.

The eighth, ninth and tenth digits identify model variations.

The type letter will identify non-interchangeable part changes. (See Page 20 on How to Determine Type.)

Be sure to use all 10 digits and type letter to properly identify your engine.

4. How to Order Parts and Engines:

SECTION I - PRICE LIST contains descriptions of the various engine Series and up-to-date Supplements will furnish the current prices for replacement engines with or without accessories. DIVISION B of this section is a numerical Parts Price List. ALWAYS CHECK PART NUMBERS WITH THE PRICE LIST to make sure that this part is available on the current PRICE LIST. ALWAYS ORDER BY PART NUMBER. If the part number does not show up in the current price list, check Section I, Div. C which is the Parts History which will tell if the part has been depleted to another, or not available. When using the price list you will notice that some parts carry a suffix letter and others have prefix letters. The prefix letter denotes the discount structure to the various steps of distribution, and the suffix letters indicate the parts are assemblies.

IBM NUMBERING SYSTEM

Clinton is in the process of changing the replacement part numbering system making the numbering system acceptable to IBM equipment. This numbering system consists of three groups of numbers used in identifying the part classification, individual part identification, and

if the part is an assembly. To clarify the numbering system refer to the example to the right which is broken down into three groups. (See Illustration No. 34.)

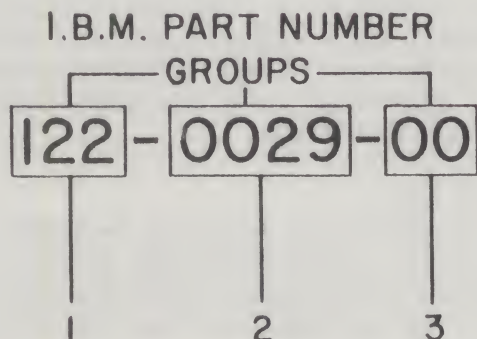


Figure 34

Group No. 1

Part Classification - Each group of like parts have a classification number assigned to them, for example, all heads will have a 122 for the first group of numbers.

Group No. 2

Individual part identification within the part classification.

Group No. 3

If a number 5 appears in the 3rd group of numbers this indicates the part is an assembly, and no number would indicate the part is not an assembly. In some cases you will find that a 99 will appear in the 3rd group of numbers, this 99 is for factory use and denotes that the part is supplied by several vendors.

The three groups of numbers used in this numbering system can consist of three digits for group #1, four digits for group #2, and two digits for group #3.

At the present time Clinton is using both numbering systems. Most all material being sent to the field at the present time carries both old and new part numbers. The new IBM number should only be used when there is no old number listed. The field will be informed when the new IBM numbering system will be completely changed in the field. Make sure when ordering parts by IBM numbers that the groups of numbers are separated by a dash.

Section II

The first few pages of Section II contain the engines that have the new IBM numbers assigned to. You will notice that some of the basic parts lists covers several model engines, these were set up this way as most of the parts that make up these models are alike. When parts are not interchangeable between the various models, the model they are used on will be listed. The first page of the basic parts list shows an exploded view of the parts that make up the engine. These parts have individual reference numbers and these reference numbers can be used to find the particular part number assigned, for example, using the 400-0100-000 basic model exploded view reference number 9, when referred to page 2 shows that the part is a part number 5735 breaker point assembly. All reference numbers listed on the exploded view of the engine are set up in numerical order on the following pages for cross-reference to part number. Once the correct terminology is known on the individual parts, the part numbers can be found without using the reference numbers, as the parts are all arranged in alphabetical sequence for example, the breaker points would be found under the (B)'s.

When working with the basic parts list you will notice that some parts or assemblies are not completely broken down, such as the recoil starters, electric starters, fuel pump, gear reducers, and carburetors, these parts or assemblies are completely broken down and illustrated in Accessory Section III. For individual parts that make up these accessories, refer to Section III of the manual.

Following the basic parts list for each model you will find the model variations which will tell you what changes have been made to the standard engine. These variations should be checked each time to make certain the correct parts or assemblies are used on the particular model engine involved. Anytime the variations do not show a parts change for a particular model the part or parts would be standard as illustrated or listed in the basic parts list.

Section III

This section is set up to cover the items that are not normally considered a standard part on engines; however, there are a few exceptions

which would be carburetors, and starters. When working with the manual you will find the basic parts list or variations will direct you to Section III for an illustrated parts breakdown on various assemblies.

Section IV

For dimensional information on bases, crankshafts, cam gears, and breaker cams, Section IV should be consulted.

Section V

When information is needed on service replacement stock number engines, as for exterior dimensions and horsepower, refer to Section V.

Section VI

For information regarding the proper method of servicing, and repairing Clinton engines refer to Section VI, and the correct division.

Section VII

When information is needed in finding the current stock number of a service replacement engine needed to replace an older model Clinton, refer to Section VII. This section is set up in numerical order listing all engines Clinton has manufactured in past years. Clinton also has set up an interchange from competitive brands to Clinton in this section.

Section VIII

For information regarding the Clinton warranty policy, short block, and special service information not listed in Section VI, use Section VIII. Warranty and short blocks will be covered separately.

Section IX

This section is set up to keep service accounts informed on advance service information before it is finalized for proper section of the manual.

OPERATION OF THE TWO CYCLE ENGINE

In a two cycle engine, intake, compression, power and exhaust are completed in two strokes of the piston. A power stroke results with every revolution of the crankshaft. On the upward stroke of the piston, a partial vacuum is created in the crankcase. (See Illustration No. 6.)

First, the vacuum and outside air pressure cause the reed valve between the crankcase and the carburetor to open. The air-fuel mixture from the carburetor flows into the engine crankcase. Then, the downward movement of the piston causes the reed valve to close while continued downward movement of the piston compresses the fuel charge in the crankcase. Near the bottom of its stroke the piston uncovers the intake by-pass port, which connects the combustion chamber and the crankcase. (See Illustration No. 7.)

As the piston moves upward on its stroke, it passes the intake port, closing the port opening. Its continued upward movement causes the fuel mixture in the cylinder to be compressed. At the same time a new fuel charge is drawn into the crankcase. As the piston nears the top of the compression stroke, the fuel mixture in the combustion chamber is ignited by the spark. The explosion and expansion of gases forces the piston down on its power stroke. Power is not delivered for the full length of the stroke. Some time is required to rid the cylinder of burned gases, so that it may receive a fresh fuel charge from the crankcase.

As the piston nears the bottom of its stroke, it uncovers the exhaust port opening slightly ahead of the intake port. This permits taking advantage of the pressure of the exhaust gases in the cylinder, which are still comparatively high, and allows them to start escaping. Further downward travel of the piston uncovers the intake by-pass port. The incoming charge assists in forcing the exhaust gases out of the cylinder, to complete the cycle. (See Illustration No. 8.)

The chief attributes of the two cycle engine are its lightweight, low cost and powerful but simple operation. With only three basic moving parts (crankshaft, piston and rod), maintenance costs are at a minimum while efficiency is at a maximum.

COMPRESSION



Figure 6

POWER

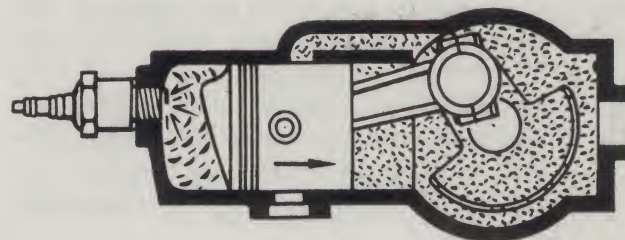


Figure 7

EXHAUST

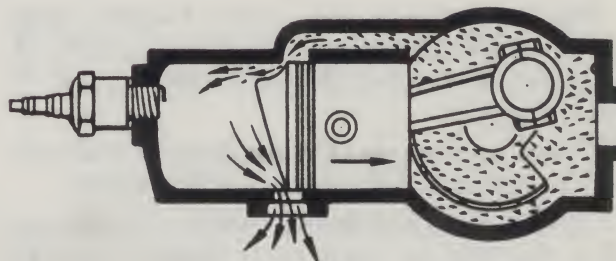


Figure 8

OPERATION OF 4-CYCLE ENGINE

4-CYCLE ENGINE PRINCIPLE - Operates more smoothly, more quietly - Mixing of gas and oil not necessary - Same type engine used in trucks, autos.

For an equivalent horsepower rating, the 4-cycle engine is a larger, heavier engine than the 2-cycle. Since power is delivered to the piston only on every other revolution of the crankshaft (instead of with every revolution as the 2-cycle), a larger cubic piston displacement is required, so that a greater amount of gas can be fired at each ignition period. Only one action is performed with each upstroke or downstroke of the piston. Starting with the piston at the top of the cylinder, let us see what goes on in the engine as the crankshaft is turned.

(1) The piston descends, opening the intake valve. Withdrawal of the piston creates a partial vacuum in the cylinder. Outside air pressure forces a mixture of vaporized gasoline and air into the cylinder. (See Illustration No. 9.)

(2) As the crankshaft turns over, the piston rises, compressing the gas in the cylinder. The intake valve closes as the piston reaches the bottom of its stroke. As the piston arrives at the top of the cylinder, the gas is fully compressed. The timing mechanism actuates the ignition system, which causes the spark plug to spark, igniting the gas in the cylinder. (See Illustration No. 10.)

(3) The piston is driven downward with great force, delivering power on the "power stroke" to the crankshaft. (See Illustration No. 11.)

(4) As the piston rises again, the exhaust valve opens and the burned gases are forced out through the exhaust. The exhaust valve closes as the piston reaches the top of its stroke. The intake valve opens as the piston starts down, and the cycle repeats itself. (See Illustration No. 12.)

The four-stroke cycle of the 4-cycle engine is, therefore as follows: (1) intake stroke, (2) compression stroke, (3) power stroke, and (4) exhaust stroke.

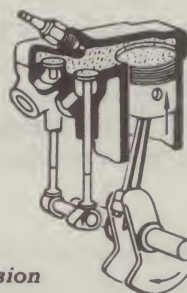
There is a single, clearly defined action for each upstroke and downstroke of the piston.

The 4-cycle engine is a cooler running engine than the 2-cycle, owing to its longer period between consecutive firing stages.



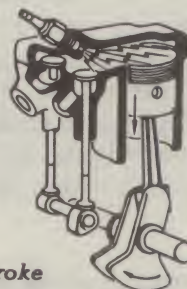
1. Intake Stroke

Figure 9



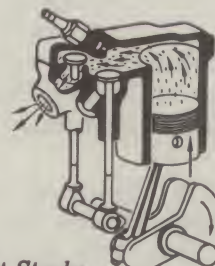
2. Compression

Figure 10



3. Power Stroke

Figure 11



4. Exhaust Stroke

Figure 12

CARBURETOR THEORY

Carburetor theory covered will be based on the Clinton float type carburetor which would generally apply to all air cooled engines using gasoline for fuel.

An engine will not operate unless a combustible fuel charge is supplied to the engine cylinder at the proper time. In a carburetor-type engine this fuel charge is formed by a mixture of air and vapor resulting from the vaporization of a volatile liquid fuel usually gasoline. The process of vaporizing or atomizing the liquid fuel and mixing it with the proper amount of air is called carburetion and the device for doing this is called a carburetor.

ATMOSPHERIC PRESSURE

To understand why air moves from one area into another we have to know something about pressure and pressure differential. Take a piece of a mailing tube, we call it a cylinder. The atmospheric pressure at all areas around and in this tube are equal so we have no air movement. See Illustration No. 13. Place a solid cylinder inside the mailing tube, then pull this solid cylinder out of the mailing tube. You will notice as the solid cylinder is being removed there is an air movement into the open end of the mailing tube. The air flow is caused by the low atmospheric pressure behind the solid cylinder, thus causing the outside atmospheric pressure to rush in to the end of the tube to balance out the low pressure. (See Illustration No. 14.)

To further illustrate this, place a piece of paper over the end of the mailing tube, and remove the solid cylinder again. You will note that the outside atmospheric pressure will force the paper inside of the tube if the paper is not too heavy. (See Illustration No. 15.)

In carburetion, the artificially created low atmospheric pressure caused by the piston downward travel in the cylinder of an engine is used in the movement of air and fuel into the combustion chamber.

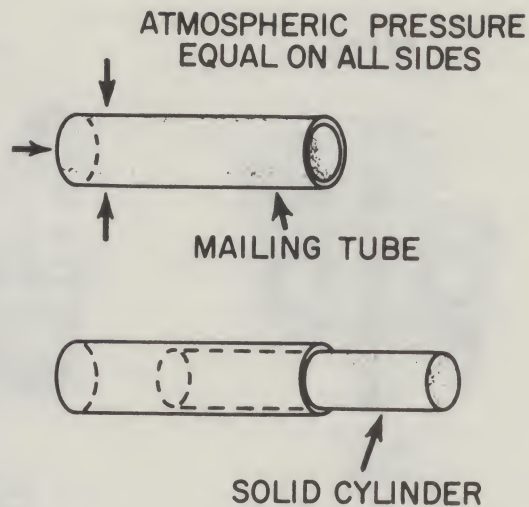


Figure 13

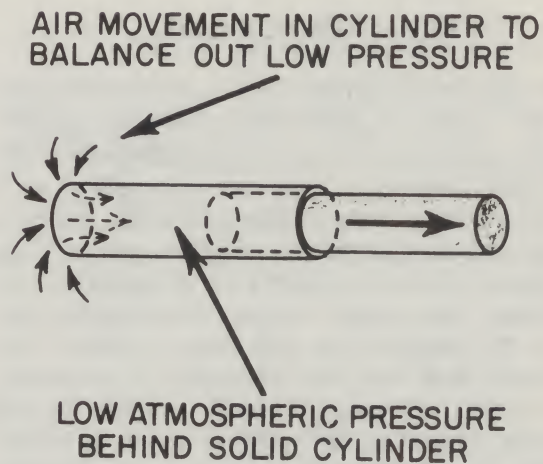


Figure 14

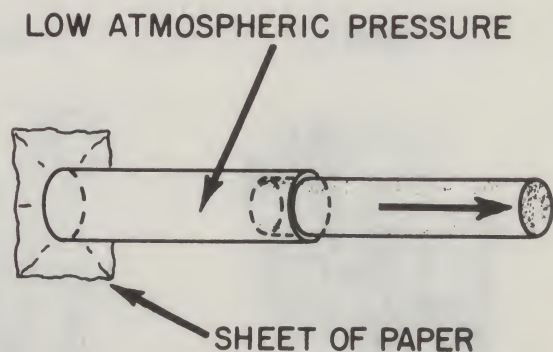


Figure 15

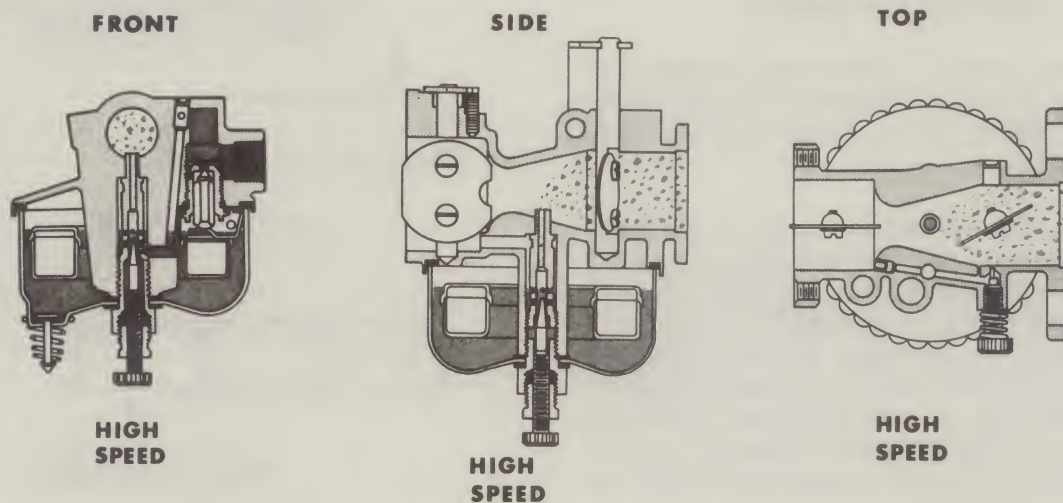


Figure 16

HIGH SPEED CIRCUIT

The high speed circuit in a carburetor is used when the engine is operated at working speeds. The high speed circuit is an important part of the carburetor, inasmuch as it has to supply a combustible mixture to the engine under full, partial, no load and also at various engine speeds. The high speed circuit consists of a metering jet, high speed adjustment screw, main nozzle and air jet. To explain the high speed circuit, let's first start with the low atmospheric pressure in the throat of the carburetor created by the downward travel of the piston in the cylinder with the throttle butterfly wide open, or almost wide open. With the low atmospheric pressure

now concentrated behind the venturi, fuel is being forced through the metering jet around the high speed adjusting screw into the main nozzle where air from the air jet blends with the fuel. From the nozzle the fuel air mixture moves up into the throat of the carburetor where additional air coming in from the front of carburetor helps to move the fuel air mixture into the combustion chamber. The amount of fuel being supplied to the main nozzle is controlled by the high speed adjustment screw, located below the main nozzle. The carburetor throttle assembly controls the engine speed by changing the pressure in the main nozzle area, when reduced will slow down the movement of fuel air mixture through the high speed circuit. (See Illustration No. 16.)

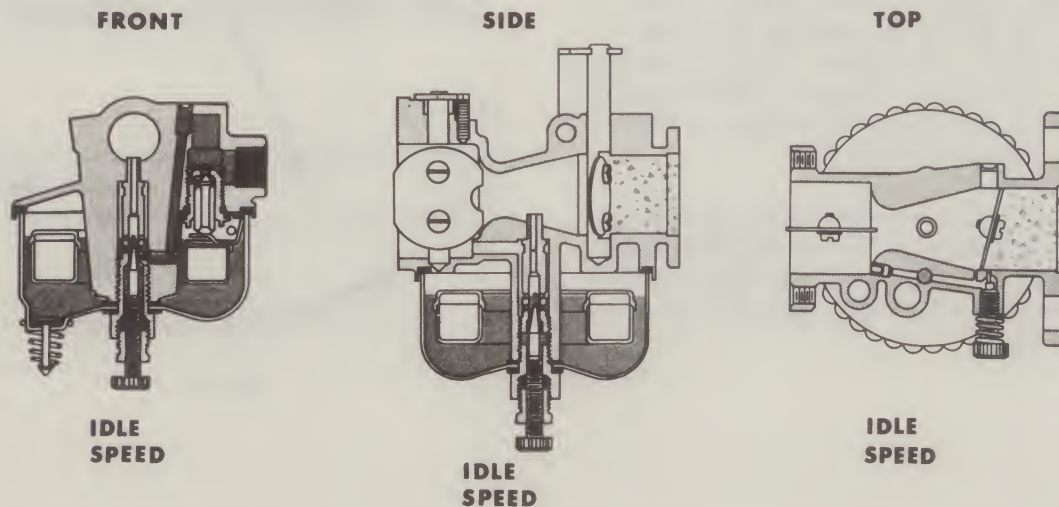


Figure 17

LOW SPEED CIRCUIT

The low speed circuit is used when the engine is being operated at a slow RPM (normally below 2900 RPM no load). The idle circuit is so calibrated that the proper mixture of air and fuel is supplied at speeds ranging from 1400 RPM through 2900 RPM. The idle circuit consists of a fuel metering jet, air jet, primary idle port, intermediate idle port and adjustment screw. The low speed circuit starts to function when the throttle butterfly is closed or almost closing the throat of the carburetor off. At this time the low atmospheric pressure is now concentrated in back of the throttle butterfly causing fuel to move through the fuel metering jet

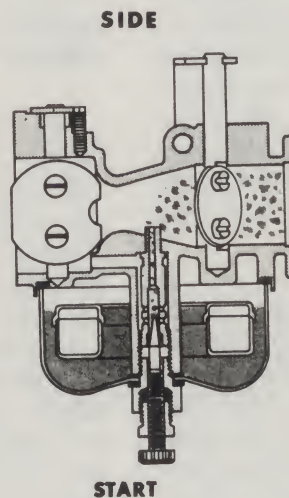
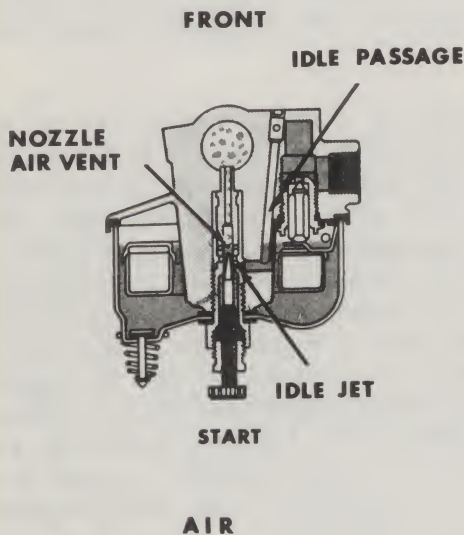
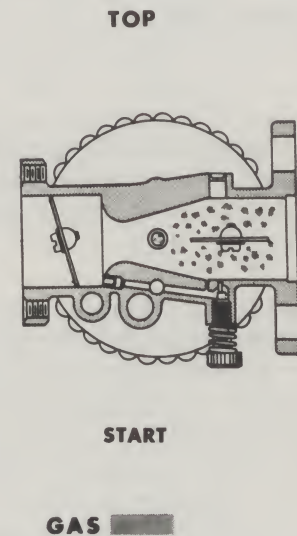


Figure 18

FLOAT CIRCUIT

The float circuit is to control the level of fuel in the carburetor bowl, so that a sufficient amount of fuel is available at all times for both idle and high speed operation. The float circuit consists of a metal float, inlet needle and seat. The float inlet needle and seat ass'y are calibrated to control the level and amount of fuel supplied to the carburetor bowl, with either a pump or a gravity feed fuel supply. The float level is very critical and should be set at the proper level. If the proper float level is not maintained the whole carburetor system will be out of balance, causing the engine to start hard, no idle, governor surging and not develop maximum horse power. (See Illustration No. 18.)



into the idle passage where air is mixed with the fuel. At this point, the fuel air mixture is ready to be moved into the primary or intermediate port area of the carburetor. The amount of fuel air mixture to be supplied to the carburetor throat is controlled by the idle adjustment screw located in the primary port area. The primary idle port operates independently from the intermediate port up to approximately 2200 RPM no load at which time the intermediate port starts to supply fuel mixture to the idle circuit. If the intermediate idle port was not functioning there would be a flat spot in the operation of engine above 2200 RPM to 2900 RPM where the high speed circuit blends in. (See Illustration No. 17.)

CHOKE CIRCUIT

The choke circuit is used in starting the engine in different temperatures and with different fuels. The device for choking the engine is located in the air intake side of the carburetor and consists of a shaft and butterfly. With this choke we can close or almost close off the throat of the carburetor and get a low pressure area in the venture area of the carburetor. When this is done a reduced amount of air is supplied to an increased amount of fuel which is moved into the venture area of the carburetor. Even with a low vaporization, this rich mixture will let the engine start easily. Prolonged choking is not recommended as the rich mixture will have a tendency to wash the oil film from the cylinder

walls and cause scoring or scuffing of the piston and dilute the crankcase oil. (See Illustration No. 18.)

Knowing that the piston on its downward travel in the cylinder creates a low atmospheric pressure, the preceding circuits of a carburetor are used to supply the fuel air mixture necessary to supply a combustible mixture to the engine.

MAGNETO THEORY

Out of all that is not known about electricity and magnetism, one thing at least is sure. They have a close relationship with each other. Every time an electric current flows, it sets up a magnetic field. Also, every time a magnetic field is increased, decreased, or changed in direction, an electric voltage is set up in any nearby conductor. Thus, if electricity flows through a coil around an iron core, it will make an electromagnet out of the iron core. Also, if the direction of magnetism passing through an iron core is reversed, a voltage will be generated in the windings of a coil of wire around this core. (See Illustration No. 19.)

A magneto is simply a specialized form of electric generator which uses this principle in order to generate electricity. Permanent magnets are used to produce the magnetic field. The magnets do not have to give up any magnetism in order to produce the electricity. All they have to do is to manage to produce a magnetic field in one direction through the iron core of a coil and then reverse this direction.

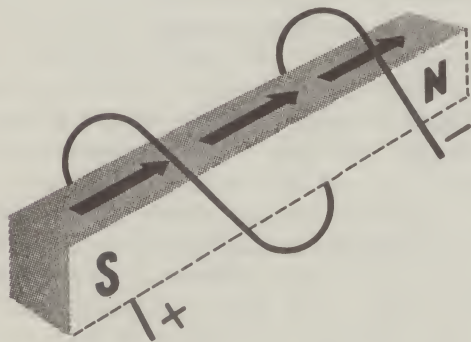


Figure 19

WHAT IS A MAGNET?

As explained in the last paragraph, anytime a current passes through a coil of wire around a piece of iron, it turns the iron into an electromagnet. If this is a piece of soft iron the magnetism will be lost as soon as the current stops flowing. Also if the direction of the current is reversed, the direction of the magnetic field in the iron will be reversed.

If, however, the piece of iron is hardened, it will retain a certain amount of magnetism after the current is shut off. In fact, the newer Alnico alloys retain a very large portion of the amount of magnetism that they had when the current was flowing in the coil; and, therefore are nearly as strong as permanent magnets as they were as electro-magnets when originally charged by the current.

A number of different metals can be magnetized to a certain extent, but by far the most common one and the one which is most easily magnetized, is iron in one of its forms or alloys. This is explained by some scientists by the fact that the iron atom has spinning electrons which act like a tiny magnet. The axes on which these electrons rotate in an ordinary piece of iron are pointed in all directions, so that the magnetic effect of them neutralizes one another. However, if a magnetic field is applied such as by a coil with current flowing through it, most of the elementary magnets have their axes all lined up in the same direction, and thus add all their magnetic forces together to make a magnet out of the piece of iron. In a soft piece of iron, these electrons return to their miscellaneous arrangement as soon as the electric current stops. In a hardened piece or in a special alloy, they remain lined up to a greater or lesser extent depending on the characteristics of the alloy, and the piece becomes a permanent magnet with established North and South poles. (See Illustration No. 20.)

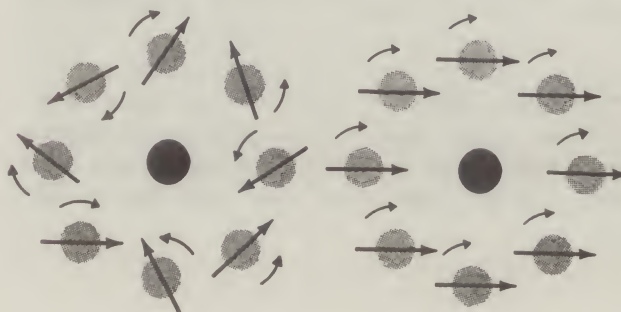


Figure 20

MAGNETIC FIELD

The field of a magnet is indicated by arrows pointing from the north end through the outside path to the south end. The field likes to concentrate itself as much as possible in the shortest possible distance between the two poles, but particularly it likes to concentrate itself within iron.

It will pull a piece of iron into place so as to reduce the length of the path through air. In fact, it is this preference of the magnetic field for iron that the coil core makes use of. The core leads the magnetic field through the path chosen by the magneto designer and concentrates it inside the coil. (See Illustration No. 21.)

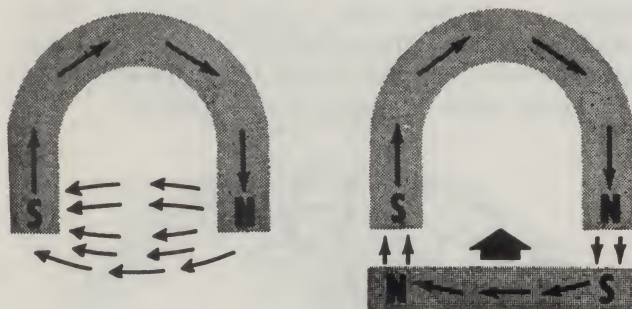


Figure 21

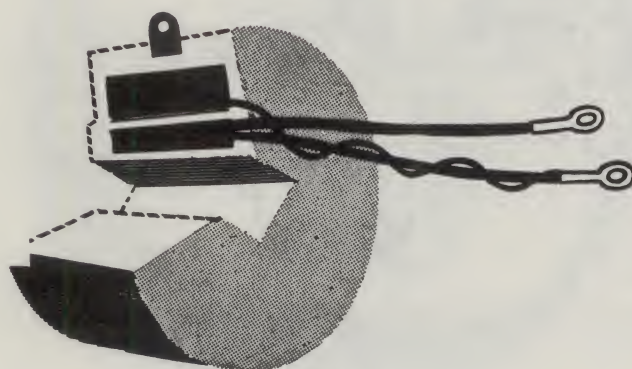


Figure 22

WHAT IS A MAGNETO COIL?

About 175 turns of heavy wire form the primary. One end of the primary is connected to the frame of the magneto as ground, and the other end is connected to the live insulated breaker point. The secondary usually has about 10,000

turns of very fine wire wound outside of the primary. The inside end of the secondary is grounded with the primary ground. The outside is connected to the spark plug wire. (See Illustration No. 22.)

WHAT IS A CONDENSER?

A condenser is a storage reservoir for electricity. It consists of two strips of foil with paper insulation between them—wound together so that one of the strips of foil can be grounded and the other strip of foil connected to the live breaker point. At the instant of breaker point opening, the insulating paper between the two strips of foil acts as a storage reservoir for electricity during an extremely small fraction of a second before the arc across the breaker points is extinguished. (See Illustration No. 23.)

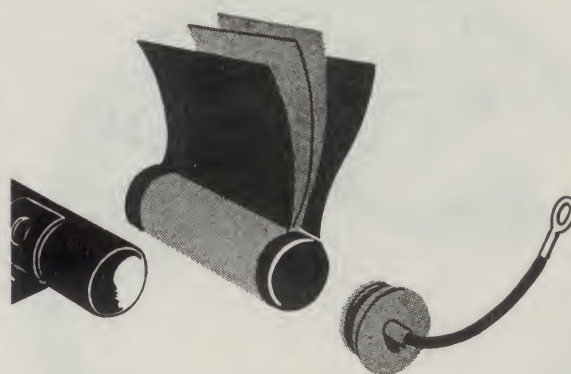


Figure 23

WHY IS THE CORE LAMINATED?

The core has magnetism concentrated in it first in one direction and then rapidly reversed. Because iron itself is an electrical conductor, large eddy currents would be set up in a solid piece of iron. These eddy currents would in themselves act as electro-magnets and oppose the change of direction of the magnetic field in the iron, thus slowing it down. By splitting the iron core up into a lot of thin laminations, the build-up of any one large electrical path for an eddy current is prevented. The slight amount of oxide between each lamination acts as enough insulation to prevent the eddy currents from traveling across between one lamination and the next.

THE MAGNETIC CIRCUIT

In the magneto design the Alnico magnets are charged in a radial direction and the iron flywheel rim forms a part of the magnetic circuit, connecting magnetically the two magnets. Thus, the right-hand pole can be considered as North. The left-hand pole can be considered as South. The magnetism is in a direction from the left-hand magnet pole and along the iron flywheel rim connecting the two magnets and then downward inwardly to the right-hand North pole. The poles are of soft cold-rolled steel, and allow the transfer of the magnetic field from end to end as needed to match the coil core.

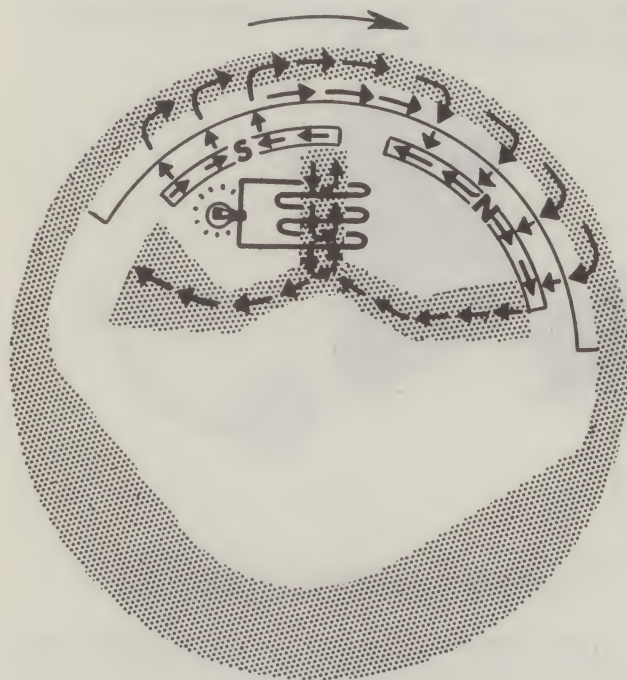


Figure 24-A

If an ordinary generating coil were put on the coil core in place of the ignition coil, and the flywheel rotated, the magneto would act as a generator. First, the North pole would be over the center leg of the core and the magnetism direction would be from the North pole down through the center leg to the left-hand leg of the core and to the South pole magnet—completing its circuit through the flywheel. A few degrees of revolution later, the North pole is over the right-hand leg of the coil core and the direction of magnetism is from the North pole through the right-hand end of the core and up through the center leg to the South left-hand magnet pole. The reversal of the magnetism generates electricity in the gen-

erator winding and would operate a light as indicated in the illustration. The intensity of the voltage generated in each turn of the coil depends on the amount of the magnetism and the speed with which it is reversed in direction. (See Illustration No. 24-A.)

IN A MAGNETO

We want to concentrate the electricity generated into one very high voltage discharge of short duration. The addition of primary, points and condenser accomplishes this.

MAGNETISM ESTABLISHED THROUGH COIL

Looking at the magneto with ignition coil, condenser and points in operation, the magnetism, as in the case of the generator, first establishes itself from the North right-hand pole downward through the center leg to the left-hand South pole. (See Illustration No. 24-B.)

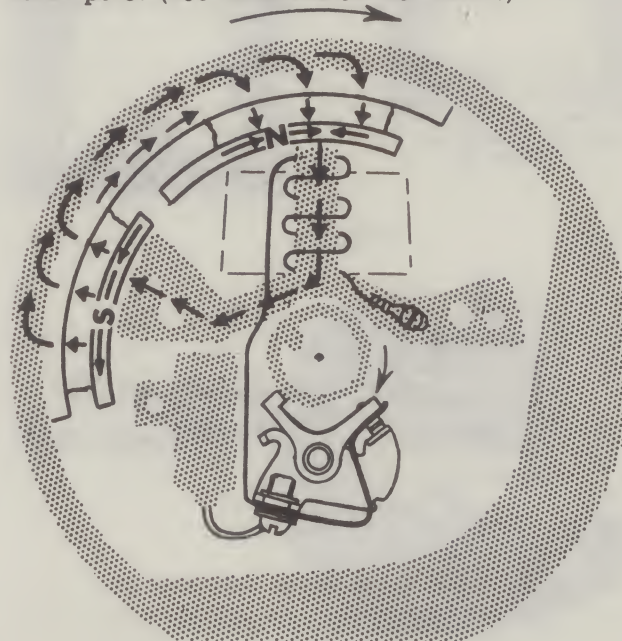


Figure 24-B

PRIMARY COIL RESISTS CHANGE OF DIRECTION

As the flywheel rotates and the North pole comes off from engagement with the center leg and the South pole comes in engagement with it, there is an attempt on the part of the magnetic circuit to reduce and reverse the direction of the magnetism in the center leg. However, as soon as there is even a slight reduction in the amount of magnetism in the center leg, a current passes through the primary coil. This, in turn, makes

the primary coil an electro-magnet, and the direction of the magnetism in this electro-magnet is such as to oppose a change in the direction of magnetism through the core. Thus there is a condition wherein the primary of the coil with the breaker points closed, is acting like a choke, throttling the efforts of the permanent magnets to reverse the friction of the magnetism through the center leg of the coil, virtually holding the magnetism through the center leg in a state of momentary suspense. (See Illustration No. 24-A.)

WHEN POINTS OPEN, REVERSING OF MAGNETIC FIELD CREATES LARGE VOLTAGE IN SECONDARY

A primary coil is only called upon to hold this choking effect for a very brief fraction of a second. Just as soon as the South magnet pole has sufficient coverage over the end of the center leg, the breaker points are opened by the cam. The opening of the points instantly stops the flow of the current in the primary circuit, releasing its choking effect. The built-up magnetic forces therefore surge through the center leg, instantaneously reversing the direction of the magnetic field from top to bottom to a direction from bottom to top. This sudden surge of magnetism through the center leg establishes an enormous voltage in the secondary coil, allowing it to break down the air resistance of the spark plug and to pass a spark across the spark plug gap. (See Illustration No. 25.)

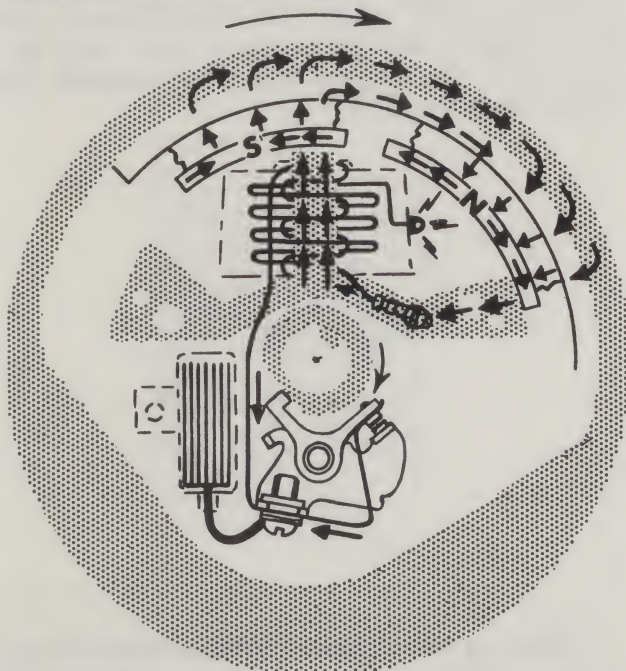


Figure 25

MOMENT POINTS OPEN

At the same instant the breaker points open, the condenser comes into play. Its function is to act as a momentary reservoir for the surge of current in the primary which, if it had nowhere to go, would continue to arc across the breaker points. With the condenser available the current surges into this reservoir momentarily, and then surges out again, which action further contributes to the change of magnetic field in the coil core and thus to the voltage of the secondary output. (See Illustration No. 25.)

How fast all this takes place can be figured from the fact that with an engine running at 3600 RPM the entire cycle is repeated sixty times a second.

MAGNETO EDGE-DISTANCE

Normally, this distance need not be checked as it is pre-set and will not give problems unless a worn or damaged part is in the magneto assembly. Of course, the magneto edge-distance is affected by point setting, and if the points are set too wide, the edge-gap becomes much less than it should be for the magneto to provide sufficient output to fire under compression. As points become too close and edge-gap becomes wider.

Quite often the reason an engine will start after points are reset is that the edge-distance, (i.e., the relationship between the rotating flywheel magneto and the stationary lamination) is re-established due to proper point setting.

Many things can throw edge-distance off; a worn breaker cam, a breaker cam with a worn key, breaker cam on upside down, split breaker cam, worn flywheel or crankshaft keyway, twisted crankshaft due to impact that affects or causes the flywheel to twist the crankshaft on the magneto side, wide crankshaft keyways, wide flywheel keyways, partially sheared key, no torque on flywheel, wide point settings, wrong points, wrong breaker cam, points not down in proper position, etc.

In the case of a magneto that has been carefully checked as to coil, condenser, points, point setting and cleanliness, flywheel magnet, and if a problem still occurs in the engine, the edge-distance can be checked readily. In the case of a "no fire" or a "Weak fire," and it is ques-

tionable that the relationship between the flywheel lamination is correct, the relationship can be checked by marking the position of the lamination on the bearing plate or block. (See Illustration No. 26.)

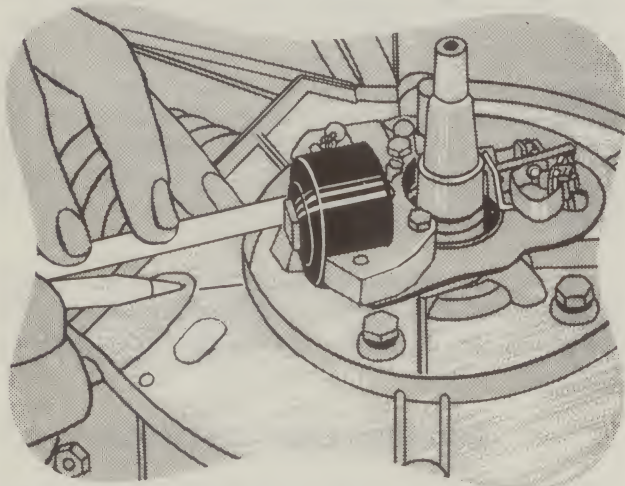


Figure 26

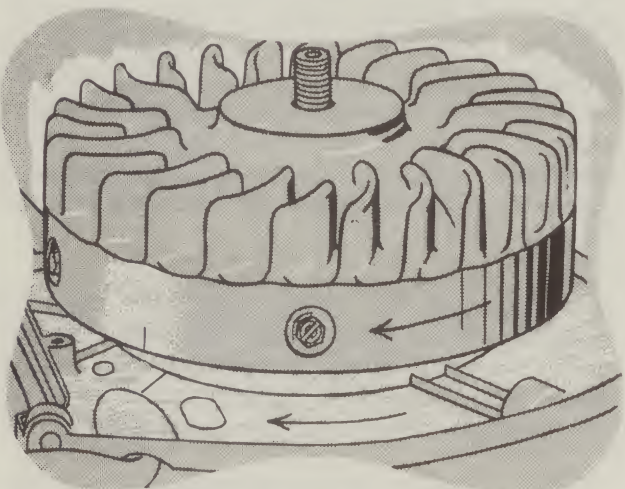


Figure 27

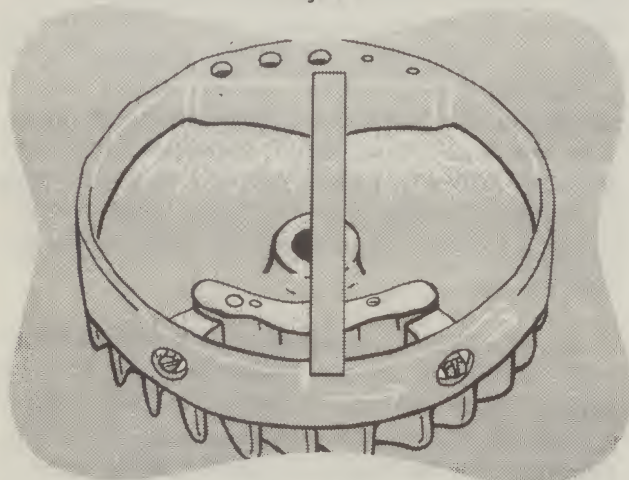


Figure 28

CAUTION: First show the direction of rotation of the flywheel with a small arrow as when the flywheel is turned over to mark out the trailing edge of the lamination it will appear correct, but will be backwards, and it will possibly be marked wrong. (See Illustration Nos. 27 and 28.)

CAUTION: As the lines are drawn farther and farther outward, they are farther apart so try to bring them out straight.

After the relationship has been marked between the core through the coil by the mark on the bearing plate and the lamination of the flywheel by the mark on the outside of the flywheel, the points should be set according to the service clearance. Then the crankshaft should be rotated in the direction of normal engine operation until the points just break or are open .001 of an inch with the original .020 point setting. The time at which the points break is where edge-distance is measured and this can be checked by using a magneto tester (which will indicate when the points first open) or by using something that is .001 of an inch thick, between the points to determine when it loosens.

After the crankshaft has been rotated so the points (that are pre-set at the proper setting) (for example .020) open .001, the flywheel key should be put into the crankshaft keyway and the flywheel carefully set down on the crankshaft taper and tapped lightly into place using caution not to move the crankshaft. Then by measuring the distance between the two lines, the edge-distance of the magneto can be determined. (See Illustration No. 29.)

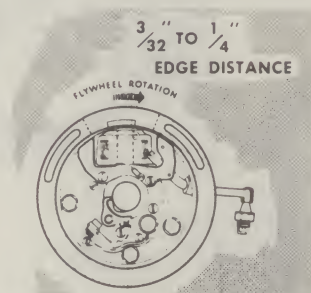


Figure 29

When the edge distance is off a great distance, it has either been marked wrong or else there is a wrong or damaged part in use on the engine.

Another way to check edge distance on an engine (which is being used by many service people) is to check fire at .020 (if that is the recommended point setting) and then move the point setting to .014 and recheck fire, then to .026 to recheck fire. In this way, they can determine at which point setting they secure the best magneto output. It is recommended (when edge-distance is a problem) that it be marked out carefully and the defective, worn, or wrong part be replaced.

In the event the engine has suffered impact, it may be the crankshaft. In the case of engines running with loose flywheels, it may be the flywheel, flywheel key, and possibly the crankshaft. The first thing to check on an engine with edge-distance off, would be the breaker cam. Replace it if necessary.

AIR GAP

Another thing that may affect the magneto's operation is improper air-gap. This is the distance between the stationary lamination and the rotating flywheel magnets. The proper clearance is .007 to .017 on engines under five horse power, and .012 to .020 on engines over five horse power.

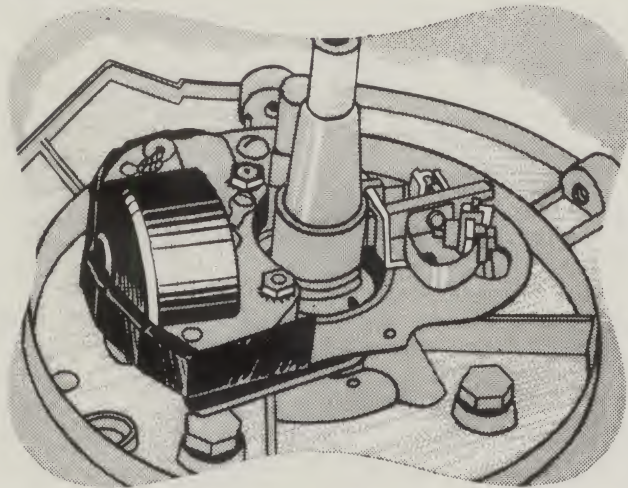


Figure 30

Checking the air-gap can be done by using plastic tape over the laminations. See Illustration No. 30. In other words, use one layer of plastic tape, checking it for its thickness, applying it to the laminations carefully, then replace the flywheel to the crankshaft (using care to have the relation between flywheel magnets to the station-

ary lamination separated by 1/2 turn), replace the flywheel and tighten the flywheel by using the flywheel nut. Then, turn the flywheel around about twice and return it to its original position.

If the flywheel magnets have cut through the tape, there is too little air-gap and the high spots on stationary laminations can be dressed down with a file. If this is done, care should be used because there is a requirement that each of the three legs of the lamination be equal distance to the rotating flywheel magnets.

In case the magneto is not operating properly and one strip of tape does not touch the flywheel, then apply another strip. It should contact or show contact by rubbing on the two thicknesses of tape as generally the tape when checked out will run .008 to .009 or larger per layer.

In case there is too much air-gap, replace flywheel or lamination assembly whichever might be the cause.

The closer the flywheel magnets without rubbing the stationary laminations the better the magneto output is. However, some distance must be allowed between the rotating and stationary laminations for possible bearing wear.

TIMING

From time to time, it may seem necessary to check the magneto timing to the piston. This can be done accurately if the top dead center of the piston travel is located. It is not easy to find exact top dead center. If a dial indicator is available (as the piston goes over top dead center) note that there is a definite spot where the piston seems stationary even though the flywheel moves. Top dead center can be found quite accurately by moving the flywheel back and forth—thus moving the piston over top dead center. With the dial indicator, it will show at which point the piston apparently stops. If a reference mark is put on the bearing plate or block in line with a mark on the flywheel as the piston starts to move as flywheel is turned counterclockwise and if the bearing plate and block are marked again as the piston starts to move, as the flywheel is turned clockwise, then half the difference between the two marks would be an exact top dead center of the crankshaft. (See Illustration No. 31.)

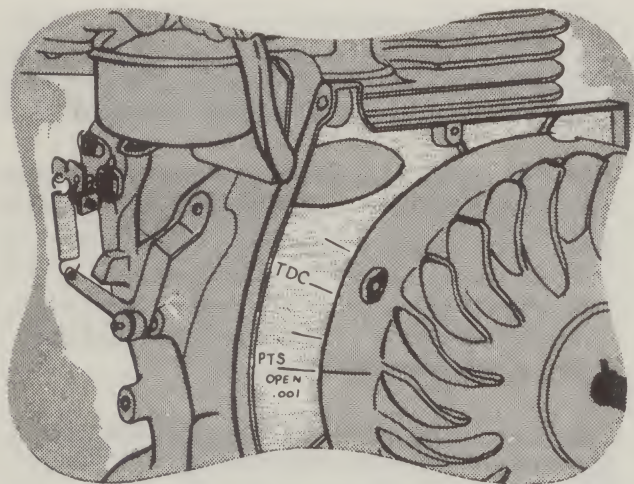


Figure 31

When exact top dead center is found, the flywheel should be removed. The points should then be set to the recommended Service Clearance. The crankshaft should then be rotated in the direction of engine rotation until the points break .001 of an inch (which can be checked the same as edge distance is checked). The flywheel key and flywheel then should be carefully replaced,

and the difference between where the reference mark was placed on the flywheel and the center mark was placed on the bearing plate or block would be the magneto timing position.

The number of degrees before top dead center can be figured by counting the number of flywheel fins and dividing them into 360 degrees. For instance: If there are 20 flywheel fins and that is divided into 360 degrees, the distance between each fin will be 18 degrees. And if the mark on the bearing plate or block is approximately one flywheel pin from the mark on the flywheel, the magneto timing to piston would then be approximately 18 degrees.

If it is more or less than this, the distance between two fins can be marked out into three degrees, six degrees, or whatever is desired by measuring the distance and dividing the distance into three parts which would give six degrees, six parts which would give three degrees, etc. With a different flywheel having a different number of fins the original division into 360 degrees will vary, but this gives a method of checking magneto timing accurately as to piston travel.

TROUBLE SHOOTING

To eliminate a lot of wasted time and dissatisfied customers, a suggested step by step guide has been set up to be used in analyzing engines brought into service accounts for repair. By following the steps outlined, the repairs necessary on an engine can be diagnosed, and repairs made to that portion of the engine. The result of having a set procedure to follow will be satisfied customers and more work turned out by a service account. Some service accounts spend hours replacing parts on engines, and after they are finished, the engine still will not perform satisfactorily. The four basic steps outlined will localize the problem; however, to further help to diagnose the trouble, a list of items that cause engines to malfunction and corrections that can be made, follow the four basic steps.

Please use this guide to your advantage.

We will proceed along this section as though you had a customer's engine in for repair. The extent of required service and adjustment depends on the condition and appearance of the engine, after we have completed a thorough visual and operational diagnosis.



Figure 35



Figure 36

4 STEP PROCEDURE

The following steps should be taken when trouble shooting to try and localize the trouble.

(A) Check magneto output with wide gap spark plug. (See Illustration No. 37.)

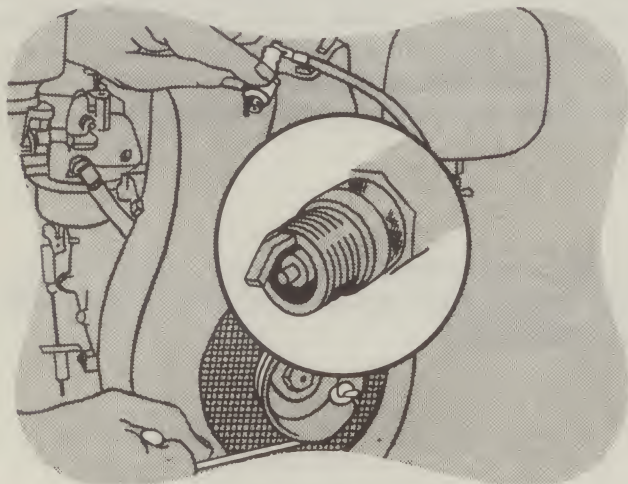


Figure 37

One of the first checks that should be made on a small gasoline is the magneto output. The check we recommend on the magneto output is done with an 18 M.M. spark plug with the gap set between the center electrode and ground electrode at (.156) $5/32$ to (.187) $3/16$. The high-tension lead should be fastened to the spark plug, and the plug grounded to the engine, then crank the engine over. To understand why we recommend the use of the wide gap plug, we first have to know the amount of magneto output that is required to fire a .028 gapped spark plug under compression, which is 7 kilo-volts. The 18 M.M. spark plug gapped at (.156) $5/32$ to (.187) $3/16$ requires approximately 10 kilo-volts to jump the gap, which is more than enough to fire the .028 gapped plug in the engine under compression. The magneto ass'y on Clinton engines are capable of putting out approximately 15 kilo-volts, providing the ass'y is in good condition. In the event the magneto output is not adequate to jump the wide gap plug, the component parts that made up the magneto should be checked, and replaced as required.

(B) Check compression with compression gauge. (See Illustration No. 38.)

The compression on a one-cylinder engine is very important and without the required amount the engine would be hard starting and/or not develop maximum horsepower.

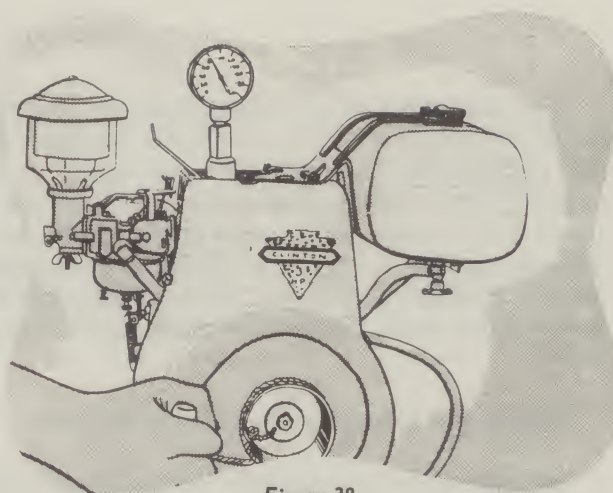


Figure 38

The recommended way to check the compression is to remove the spark plug from the cylinder head and hold or screw (depending on what type gauge is used) the gauge into the spark plug hole, crank engine over at normal cranking speed. The gauge reading should be above (60 P.S.I. 2-cycle) (65 to 70 P.S.I. 4-cycle through 4-1/2 H.P.) and (70 P.S.I. 4-cycle above 4-1/2 H.P.). In the event the compression reading was below what was required, the valves, seats, cylinder, piston or gaskets should be reworked or replaced as required.

(C) Check supply of fuel to carburetor. (See Illustration No. 39.) If the carburetor is equipped with a bowl drain, press this valve and let a small amount of fuel leak out onto the deck or in a flat container. If no fuel leaks out of the carburetor bowl this would indicate that there is an obstruction in the fuel supply tank or line. When fuel leaks out of the bowl drain, check the fuel for puddles of water or other foreign elements, if any are present consideration should be given to servicing the carburetor, fuel tank, and line.

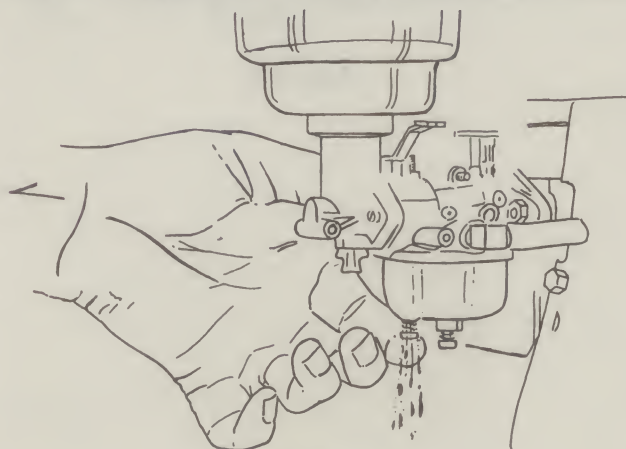


Figure 39

(D) Check spark plug condition.

During our inspection of the engine the spark plug should not be overlooked as this can cause an engine not to start or misfire when the engine is running. The only check that could be made on a spark plug would be a visual check. When checking the plug, look for carbon buildup, burned electrodes, the gap between electrodes, (should be (.028) to (.033) 2-cycle (.025) to (.028) 4-cycle engines) cracked insulation, and carbon between electrodes. If a spark plug has heavy carbon deposits, burned electrodes or cracked insulation, replace the plug with a new one.

A correct diagnosis of many types of troubles is possible for even an untrained mechanic by removing and examining used spark plugs. Following are pictures of some commonly encountered conditions.

NORMAL - Brown to greyish tan deposits and slight electrode wear indicate correct spark plug heat range and mixed periods of high and low speed. Spark plugs having this appearance may be cleaned, regapped and reinstalled. (See Illustration No. 40.)

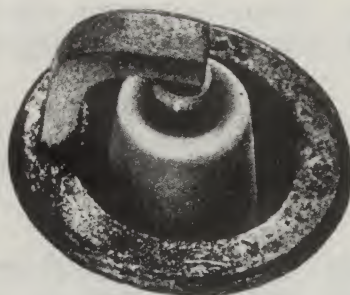


Figure 40

WORN-OUT - Eroded electrodes and a pitted insulator are indications of many hours of service. Spark plugs should be replaced when these conditions are observed for quicker starting and smoother engine performance. (See Illustration No. 41.)



Figure 41

CARBON-FOULED - Dry, fluffy black deposits may result from over-rich carburetion, excessive choking. Clogged air cleaner can restrict air flow to the carburetor causing rich mixtures. Poor ignition output (faulty breaker points, weak coil, or condenser, worn ignition cables) can reduce voltage and cause misfiring. Excessive idling, slow speeds under light load also can keep plug temperatures so low that normal combustion deposits are not burned off. In such a case a hotter type spark plug will better resist carbon deposits. (See Illustration No. 42.)



Figure 42

OIL-FOULED - Wet oily deposits, with a minor degree of electrode erosion may be caused by oil pumping past worn rings. "Break-in" of a new or overhauled engine before rings are fully seated may also result in this condition. Usually these plugs can be degreased, cleaned and reinstalled. Excessive valve stem guide clearances can also cause oil fouling. While hotter type spark plugs will reduce oil deposits, an engine overhaul may be necessary in severe cases to obtain satisfactory service. (See Illustration No. 43.)



Figure 43

BURNED ELECTRODES - Burned or blistered insulator nose and badly eroded electrodes are indications of spark plug overheating. Improper spark timing or low octane fuel can cause de-

tonation and overheating. Cooling system obstructions or sticking valves may also result in this condition. Lean air fuel mixtures are an additional cause. Sustained high-speed heavy-load service produce high temperatures which require use of colder spark plugs. (See Illustration No. 44.)

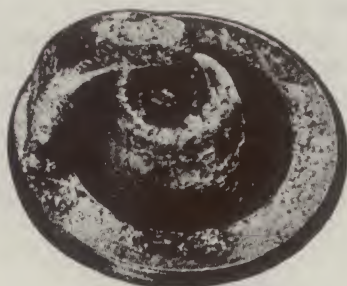


Figure 44

ENGINE FAILS TO START OR STARTS HARD

CAUSE

CORRECTION

- | | |
|---|--|
| 1. No fuel in tank. | Fill tank with clean, fresh fuel. |
| 2. Fuel shut off valve not open. | Open fuel shut off valve. |
| 3. Fuel line to carburetor blocked. | Clean fuel line or remove and replace with new. |
| 4. Water or foreign liquid in tank. | Drain tank. Clean carburetor and fuel lines. Dry spark plug points. Fill tank with clean, fresh fuel. |
| 5. Stale fuel in tank. | Drain tank. Clean carburetor and fuel lines. Dry spark plug points. Fill tank with clean, fresh fuel. |
| 6. No fire or insufficient fire to spark plug. | Check points, condenser, coil, high-tension lead, and flywheel keyway and magneto charge. Re-work or replace as necessary. |
| 7. Spark plug fouled or defective. | Replace spark plug with new. |
| 8. Stop device in the off position. | Move stop device to on position. |
| 9. Engine flooded. | Open choke. Remove air cleaner, clean and service. |
| 10. Choke valve not completely closing in carburetor. | Adjust control cable travel, and/or speed control lever. |
| 11. Carburetor idle needle or power needle not properly adjusted. | Reset idle and power needles to the recommended preliminary settings. |
| 12. Carburetor throttle lever not open far enough. | Move speed control lever to fast or run position; check for binding linkage, or unhooked governor spring. |

By making the four checks it can be determined what part of the engine needs repair or adjusting. Item (A) would indicate if the magneto is functioning. Item (B) would indicate if the valves or head gasket is in order. Item (C) would indicate if the fuel is being supplied to the carburetor. Item (D) would indicate if the carburetor is supplying fuel to the combustion chamber or if the plug is functioning properly.

If the steps outlined are followed, a lot of time can be saved by working only on the part of the engine that needs repair.

In addition to the four step procedure outlined we have set up check lists that can be used to diagnose the cause of malfunction or failure, and corrective steps to take.

ENGINE FAILS TO START OR STARTS HARD — Continued

CAUSE	CORRECTION
13. Low or no compression.	Check the following: (A) Blown head gasket. (B) Damaged or worn cylinder. (C) Valves stuck open, burned, not properly adjusted, or bad seats. Rework, or replace as necessary.
14. Not cranking engine over fast enough.	(A) Impulse starter spring broken or weak. (B) Too much drag on driven equipment. Replace broken or weak spring, and remove belts, chains, and/or release clutch.
15. Carbon blocking exhaust ports (2-cycle engine).	Remove muffler and clean carbon from ports.
16. Reed broken off (2-cycle engine).	Replace reed or reed assembly.
17. Oil seals leaking (2-cycle engine).	Replace oil seals with new.
18. Carburetor dirty.	Remove and clean carburetor in a recommended cleaning solvent.
19. Loose blade (vertical shaft engines).	Tighten blade.

ENGINE MISSING UNDER LOAD OR LACK OF POWER

1. Weak or irregular fire to sparkplug.	Check points, condenser, coil high-tension lead wire, flywheel, keyways, and flywheel charge.
2. Defective spark plug.	Remove and replace with new.
3. Choke not completely open.	Open lever to full choke position.
4. Carburetor idle or power needle not properly adjusted.	Reset idle and power needles to the recommended preliminary settings.
5. Restricted fuel supply to carburetor.	Clean tank, open gas tank cap vent, or clean and/or replace fuel lines.
6. Valves not functioning properly.	Reseat or reface valves, clean guides and stems of valves and reset valves to tappet clearance.
7. Stop device not in the positive on position.	Move stop device to the on position and/or adjust.
8. High-tension lead wire loose or not connected to spark plug.	Adjust high-tension lead wire terminal, and/or connect to spark plug.
9. Air cleaner dirty or plugged.	Clean and/or replace air cleaner element.
10. Not enough oil in crankcase (4-cycle engine).	Drain and refill with the proper type and quantity.
11. Improper fuel oil mix (2-cycle engine).	Drain tank and carburetor, and refill with the correct clean, fresh fuel mix.

ENGINE MISSING UNDER LOAD OR LACK OF POWER — Continued

CAUSE	CORRECTION
12. Engine needs major overhaul.	Overhaul engine.
13. Too much drag on driven equipment.	Adjust clutches, pulleys and/or sprockets on driven equipment.
14. Obstructed exhaust system or muffler not the type designed for engine.	Remove obstruction and/or replace muffler with correct one.
15. Weak valve springs (4-cycle engine).	Replace weak valve springs with new.
16. Reed valve assembly not functioning properly (2-cycle engine).	Replace and/or adjust reed assembly.
17. Crankcase gaskets or seals leaking (2-cycle engine).	Replace gaskets and/or seals in question.

ENGINE NOISY OR KNOCKS

1. Piston hitting carbon in combustion chamber.	Remove head and clean carbon from head and top of cylinder.
2. Loose flywheel.	Torque flywheel nut to recommended torque.
3. Loose or worn connecting rod.	Replace rod and/or crankshaft if tightening rod bolt won't correct.
4. Loose drive pulley blade, or clutch on power take-off end of crankshaft.	Replace, tighten or rework as necessary.
5. Rod lock or rod bolt hitting cam gear or block.	Crimp rod lock and/or tighten rod bolt.
6. Main bearings worn.	Replace worn bearings and/or crankshaft if necessary.
7. Rivet holding oil distributor to cam gear hitting counterweight of crankshaft.	Replace cam gear and/or grind head of rivet off.
8. Rotating screen hitting housing flywheel.	Center screen on flywheel.

ENGINE SURGES OR RUNS UNEVENLY

1. Fuel tank cap vent hole obstructed.	Remove obstruction and/or replace with new cap.
2. Carburetor float level set too low.	Reset float level.
3. Restricted fuel supply to carburetor.	Clean tank, fuel lines, and/or inlet needle and seat of carburetor.
4. Carburetor power and idle needles not properly adjusted.	Readjust carburetor power, and idle needles.

ENGINE SURGES OR RUNS UNEVENLY — Continued

CAUSE	CORRECTION
5. Governor parts sticking or binding.	Clean, and if necessary, repair or replace governor parts.
6. Engine vibrates excessively.	Check for bent crankshaft and/or out of balance condition on blades, adaptors, pulleys, sprockets and clutches. Replace or rework as necessary.
7. Carburetor throttle linkage or throttle shaft and/or butterfly binding or sticking.	Clean, lubricate or adjust linkage and deburr throttle shaft or butterfly.

OVERHEATING

1. Carburetor settings too lean.	Reset carburetor to proper setting.
2. Improper fuel.	Drain tank and refill with correct clean, fresh fuel.
3. Over speeding and/or running engine too slow.	Reset speed control and/or adjust governor to correct speed.
4. Overloading engine.	Review the possibility of using larger horsepower engine.
5. Not enough oil in crankcase (4-cycle).	Drain and refill with the proper type and quantity.
6. Improper fuel mix (2-cycle).	Drain tank and refill with correct clean, fresh mix.
7. Air flow to cooling fins and head and block obstructed.	Clean debris from rotating screen and/or head, cylinder cooling fins.
8. Engine dirty.	Clean grease and/or dirt from cylinder block, and head exterior.
9. Too much carbon in combustion chamber.	Remove head and clean carbon deposits from combustion chamber.
10. Obstructed exhaust system or muffler not the correct type designed for engine.	Remove obstruction and/or replace muffler with correct type.
11. Engine out of time (4-cycle engine).	Time the engine.

ENGINE VIBRATES EXCESSIVELY

1. Engine not mounted securely.	Tighten mounting bolts.
2. Bent crankshaft	Replace crankshaft with new.
3. Blades, adaptors, pulleys, and sprockets out of balance.	Rework or replace parts involved.

CAUSES OF ENGINE FAILURE

<u>FAILURE</u>	<u>CAUSE</u>
1. Broken or damaged connecting rods, and scored pistons.	Engine run low on oil (4-cycle engine). Rod bolt locks not crimped securely. Engine operated at speeds above the recommended RPM. Oil pump, line and passage obstructed with debris (4-cycle vertical shaft engines). Oil distributor broken off (4-cycle horizontal engine). Not enough oil in fuel mix (2-cycle engine). Oil in crankcase not changed often enough (4-cycle engine).
2. Excessive wear on parts. This covers valves, valve guides, cylinders, pistons, rings, rods, crankshafts and main bearings.	Air cleaner not serviced often enough. Oil not changed often enough in crankcase. Air cleaner element improperly installed in air cleaner body, or element needed replacing. Air cleaner body not making good seal to carburetor.
3. Main bearing failure.	Engine run low on oil. Excessive side loading of crankshaft. Oil in crankcase not changed often enough (4-cycle engine). Blades, adaptors, pulleys, and sprockets out of balance.

TUNE-UP SERVICE AND OVERHAUL

The majority of the engines brought into a service account for repair would involve what is called a minor engine tune-up. Listed are the items included in a minor tune-up.

MINOR ENGINE TUNE-UP

- (A) Clean, regap or replace spark plug.
- (B) Test compression.
- (C) Clean air cleaner
- (D) Adjust carburetor
- (E) Clean fuel tank, line, and filter.
- (F) Adjust governor speed.

When an engine needs work performed on the carburetor or magneto in addition to what is listed in a minor tune-up, this would be called a major tune-up. Listed are the items that are considered a major tune-up.

MAJOR TUNE-UP

- (A) Clean, regap or replace spark plug.
- (B) Test compression.
- (C) Clean oil filter.
- (D) Remove carburetor and overhaul.
- (E) Clean fuel tank, line, and filter.
- (F) Adjust governor speed.
- (G) Inspect reed valve 2-cycle engines.
- (H) Test condenser.
- (I) Test coil.
- (J) Install new breaker points.
- (K) Clean carbon from muffler, and exhaust ports—2-cycle engines.

If an engine is using oil and the compression is low, consideration should be given to overhauling it. A minor overhaul normally consists of the following:

MINOR OVERHAUL

- (A) Check rod and replace if necessary.
- (B) Check wrist pin, replace if necessary.
- (C) Replace rings.
- (D) Reseat valves.
- (E) Check cylinder and deglaze.
- (F) Also perform work outlined under major tune-up.

When an engine needs main bearings replaced in addition to what is listed under a minor overhaul, this would be called a major overhaul requiring the following:

MAJOR OVERHAUL

- (A) Check rod, replace if necessary.
- (B) Check wrist pin, replace if necessary.
- (C) Replace rings.
- (D) Reseat valves.
- (E) Check cylinder and deglaze.
- (F) Check crankshaft, replace if necessary.
- (G) Replace main bearings.
- (H) Also perform work listed under major tune-up.

The preceding echelon of repairs are for reference only, and change from one shop to another; however, they are normally what the customer would expect.

With the conclusion of this series of tests and inspection, we can determine if this repair will be a minor operation or it requires complete disassembly. If we remember the service requirements from our tests, we can also give the owner some idea as to when the service will be completed and the costs; let us try to eliminate this two and three tear down operations; it costs time and money.

CARBURETOR OVERHAUL

Before we actually get into carburetor overhaul we should fix a few important facts in our mind.

First, a carburetor has but one task to perform, it mixes fuel with air and feeds it into the combustion chamber. It must do this at all speeds.

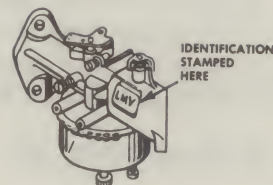
Second, there are only three areas of carburetor malfunction, it may be too lean, or it may be too rich or it may leak.

Third, the operational efficiency of a carburetor may be endangered by any foreign material, be it solid or liquid, if that material retards the flow of air or the movement of fuel.

Fourth, in overhauling a carburetor your task is to restore the unit to its original condition in order to get like-new performance.

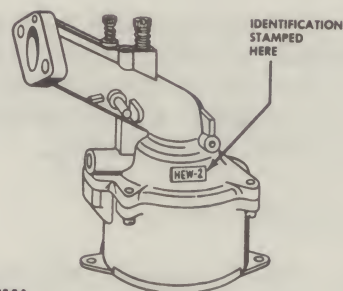
Fifth, more carburetors are rendered useless by neglect and abuse than all of the operational ills combined.

Sixth, in overhauling any carburetor it is advised that the engine be thoroughly tuned in order to handle the revised fuel distribution that is gained from correct metering.



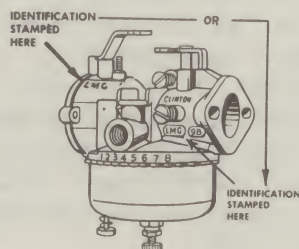
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Figure 47



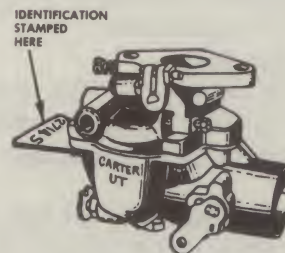
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Figure 48



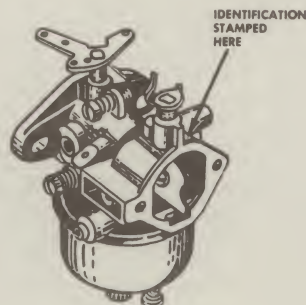
LMG

Figure 45



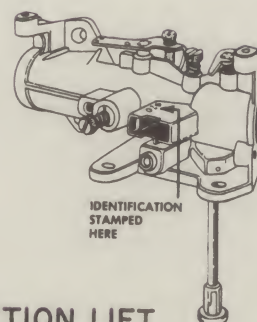
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Figure 49



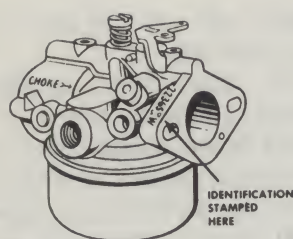
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Figure 46



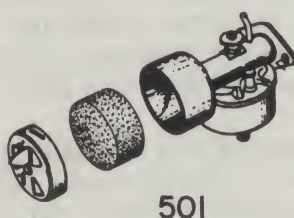
SUCTION LIFT

Figure 50



CARTER

Figure 51



501

Figure 52

CARBURETOR DIAGNOSIS

In this area of service, we try to determine if the carburetor will require minor readjustment or major service as a detached unit. With older carburetors, that have had considerable service, we suggest checking the correctness of the throttle shaft to main casting tolerance. This is one area of the carburetor in which we cannot make repair, the oversized hole is not repairable and any additional money spent on such carburetors is wasted. Illustration No. 53 points out this area.

If the carburetor is equipped with a bowl drain, press this valve and let a small amount of fuel leak out onto the deck or in a flat container; look for puddles of water in the fuel. If you do find water in the carburetor at this point we can assume it came through the fuel tank, fuel line and may have caused damage to the main casting of the carburetor.

You will have to run the engine to determine if the engine will respond to varying the low speed and high speed adjustment needles. Failure to get proper reaction will indicate that the fuel

mixture may be out of true setting or that an orifice in the carburetor is restricted by dirt or corrosion.

With some carburetors it will be difficult to determine the appearance of water in the bowl for lack of a drain valve. We will cover all Clinton carburetors separately with complete details on each series.

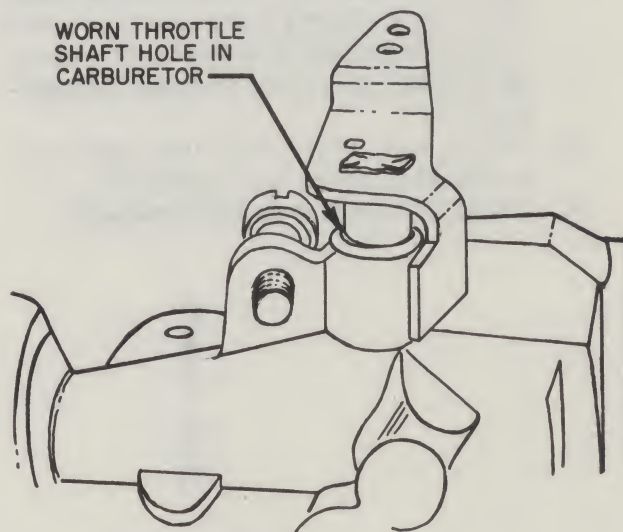


Figure 53

501 ENGINE CARBURETOR

Disassemble (See Illus. No. 54)

1. Remove carburetor from engine.
2. Remove choke assembly and air filter.
3. Remove adjusting screw and spring.
4. Remove bolt, lock nut, washer and upper body gasket.
5. Remove body assembly and lower cover gasket.
6. Remove bolt and jet assembly and bolt gasket.
7. Remove bowl (bowl drain) assembly.
8. Remove float pin, float ass'y and bowl ring gasket.
9. Remove pin, spring and gasoline intake needle. **CAUTION: Needle seat is not removable; when replacement is needed, install new bowl cover, needle pin, spring and seat assembly.**
10. Clean all parts in clean solvent. Blow off all parts with compressed air. Replace worn and damaged parts. Always use new gaskets.
11. Check to make sure atmospheric vent is open.

Re-Assemble

1. Install intake needle, spring and pin in needle seat of bowl cover assembly.
2. Install bowl ring gasket, float ass'y and float pin. Set float level. With bowl cover inverted, float resting lightly against intake needle pin, there should be $13/64''$ (plus or minus $1/32''$) clearance between outer edge of bowl cover and free end of float (side opposite needle seat); adjust by bending lip of float with small screwdriver.
3. Install bowl cover with drain ass'y opposite side of gas line connection.
4. Install bolt gasket on bolt assembly.

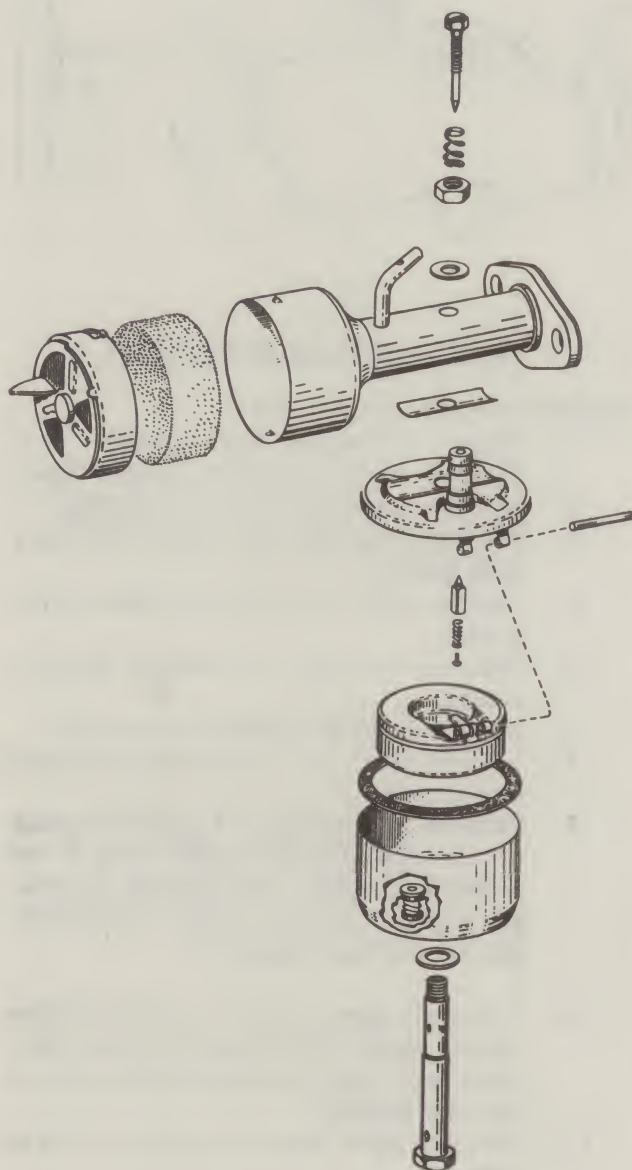


Figure 54

5. Install bolt and jet ass'y entering bowl and cover ass'y.
6. Install bowl cover gasket resting in groove of bowl cover.
7. Install body flange ass'y (with gas line connection facing toward you), choke and air intake on left hand side.
8. Install upper bolt gasket, washer and bolt lock nut. Tighten lock nut.
9. Install adjusting needle and spring, if tight. Set adjusting needle one turn open from seat to start engine.
10. Install air filter and choke ass'y (choke shutter opener at top of air intake).
11. This carburetor does not have an idle circuit and should only be operated between 3000 RPM and 3800 RPM.

After rebuilding and installation on engine is completed and adjusting needle set one (1) turn open from seat start engine. With the engine at normal operating temperature, check engine performance. If mixture is too rich, adjust needle clockwise, $1/16$ turn at a time to correct this condition.

NOTE: This carburetor does not have an idle system and will not operate at speeds below 3000 RPM no load.

LIFT CARBURETORS

(See Illustration Nos. 55-A and 55-B.)

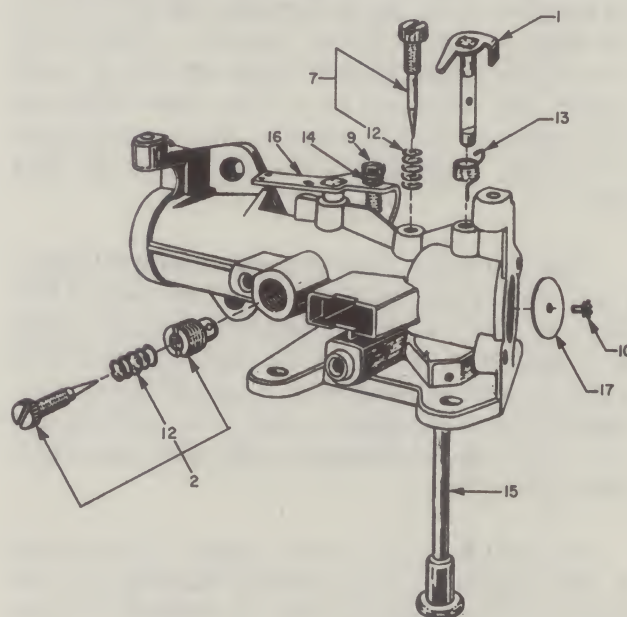


Figure 55-A

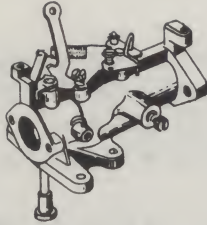


Figure 55-B

1. Throttle Shaft Disassembly

- a. Drill through the expansion plug at the rear of the carburetor body.
- b. Insert a drift punch into the drilled hole and force out the expansion plug.
- c. Remove the plastic plug.
- d. Remove the throttle valve screws.
- e. Remove the throttle valve and lift out the throttle shaft assembly.

NOTE: The horizontal suction lift does not have a plastic or expansion plug.

2. Throttle Shaft Re-Assembly

- a. Insert the throttle shaft assembly into the carburetor body.
- b. Insert the throttle valve into the carburetor body.
- c. Fasten the throttle valve to the shaft and torque the screw from 5 to 6-1/2 inch pounds.
- d. Throttle valve assembly should be completely free with no tendency to bind in any position.
- e. Insert the plastic plug from the rear.
- f. Insert a new metal expansion plug into its seat and strike the plug in the center until it expands and will not drop out.
- g. Seal the contact area between the plug and carburetor body with the following recommended sealer. Gasolia—made by the Federal Process Co., Cleveland, Ohio, or equivalent.

NOTE: The horizontal suction lift does not have a plastic or expansion plug.

3. Choke Shaft Assembly

- a. This is fastened like the throttle shaft assembly and may be assembled and disassembled at the front of the carburetor body by removing the air cleaner cover and filter element.
- b. Illustration No. 56 shows changes made on later production carburetor choke shaft lever, to eliminate breakage.

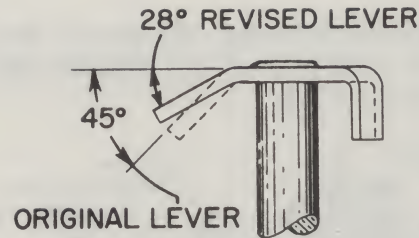


Figure 56

4. Stand Pipe Assembly

- a. This is a press fit into the carburetor body. It may be removed by clamping the stand pipe into a vise and pulling on the carburetor body. Check to see that metal has not been pushed into fuel passage above.
- b. The stand pipe may be re-assembled to the carburetor body by using a plastic hammer and tapping lightly on the bottom of the stand pipe. The stand pipe should be slowly tapped into the carburetor body until the end of the stand pipe is $1.94 \pm .045$ inches from the bottom of the carburetor body.
- c. Seal the contact area between the stand pipe and carburetor body with the recommended sealer.
- d. See Illustration No. 57-A for stand pipe changes.

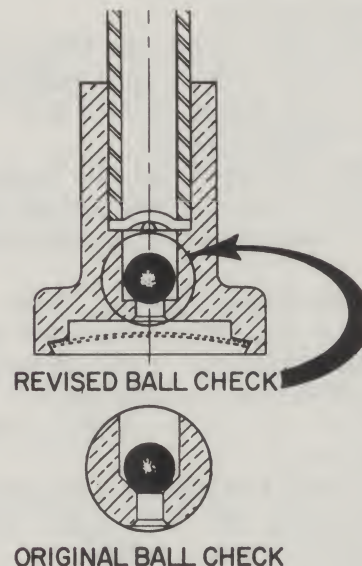


Figure 57-A

5. Idle Needle Bushing, Idle Screw, Idle Screw without Bushing, and Idle Setting. (See Illustration No. 57-B)

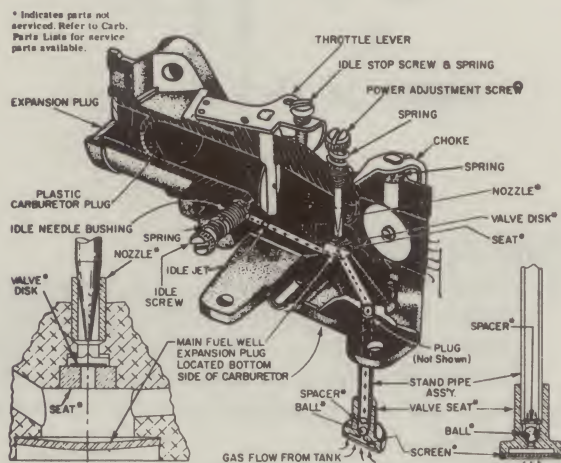


Figure 57-B

- Remove idle needle from bushing (turn idle needle in counter-clockwise direction). NOTE: Later model vertical-shaft-carburetor will not have this bushing.
- Use large screwdriver to remove bushing (turn in ccw direction).
- Before installing idle needle bushing into carburetor body, apply a light coating of the recommended sealer to the external threads of the bushing.
- Install idle bushing and torque from 40 to 50 inch pounds.
- Install idle screw into metal bushing or carburetor casting until screw seats and then open screw from 4 to 4-1/4 turns (fine thread screw).
NOTE: Where metal idle bushing is not used in carburetor casting open idle screw 1-1/2 turns (coarse thread screw).

6. Idle Jet (See Illustration No. 57-B)

- Remove expansion plug from bottom of carburetor body. (Same method as employed in Item 1-a and 1-b.)
- Remove idle needle bushing (Item 5), if applicable.
- The idle jet is located in the passage connecting the fuel well (under high speed nozzle) to the idle needle.
- To remove idle jet, push a piece of 1/16 diameter drill rod through the fuel well and up the idle passage until the jet is pushed out of the passage and into the idle fuel reservoir.

- To install new jet, scribe a mark on the 1/16 diameter drill rod exactly 1-1/4 inches from the end.
- Place the new jet on the end of the drill rod.
- Insert the rod through the main well and up into the passage until the mark on the rod is exactly in the center of the main fuel well.
- Remove the rod and install the idle needle bushing (Item 5), if applicable.
- Insert a new expansion plug and seal it with the same method used in Items 2-f and 2-g.

7. High Speed Screw and Main Nozzle

- Remove screw inspect for damage to taper; if screw taper is damaged replace.

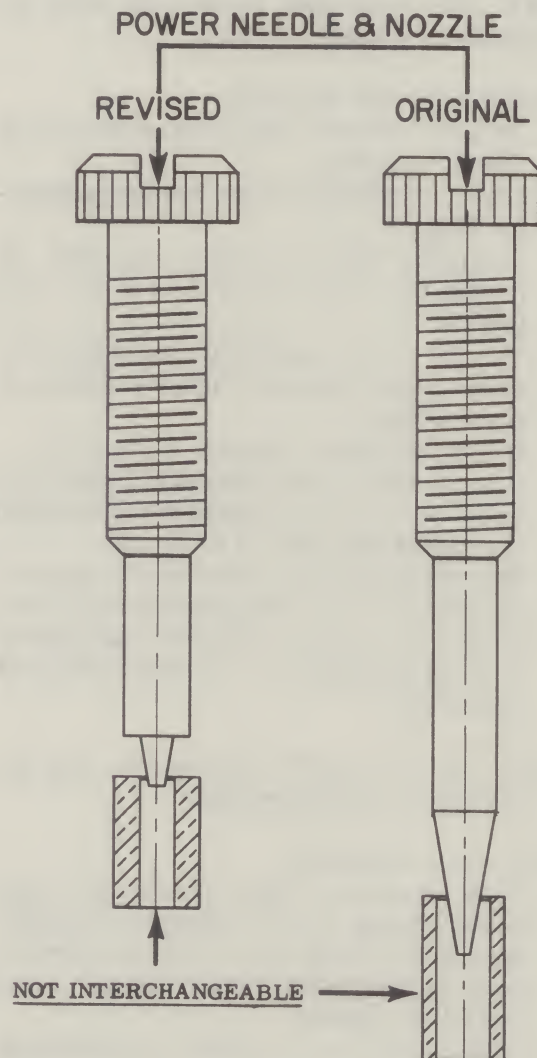


Figure 58

- b. Some changes have been incorporated in the later carburetors which changes the high speed screw and main nozzle from the first production, Illustration No. 58 illustrates the changes made.
- c. The main nozzle cannot be removed from the carburetor casting; however, it should be inspected to see if it has been tapered or split by forcing the high speed screw into the nozzle. If the main nozzle is split or tapered the complete carburetor should be replaced.
- d. The high speed power screw should be turned in clockwise until it seats. Do Not Force, then open $3/4$ to 1 turn, carburetor having screw with straight taper no shoulder and $1-1/4$ to $1-1/2$ turns open on screw having a shoulder or step above the taper.

NOTE: (A) Air leaking into the fuel system will cause the carburetor to malfunction and may be corrected by applying the recommended sealer to the following contact areas:

- (1) Standpipe to carburetor body.
- (2) External threads of idle needle bushing to carburetor body.
- (3) Expansion plug to carburetor body.

LMG, LMB AND LMV TYPE CARBURETORS

Disassemble (See Illus. No. 59-A)

1. As you remove the governor link from the throttle lever, tie a short wire in the hole to insure that you will reinstall the link correctly. This wire can remain hooked in the hole, even though you soak the unit in cleaner solution. Remove air cleaner.
2. Remove power adjustment needle ass'y, gasket and bowl.
3. Remove float shaft, float ass'y, float valve, float valve seat and gasket. Float should be examined for pin holes, leaks or wear in hinge pin holes on the float bracket.
4. Remove bowl ring gasket.
5. Remove idle adjusting needle and spring ass'y.
6. Remove throttle valve screws, valve, throttle shaft and lever ass'y if necessary.
7. Remove choke valve screws, valve, choke shaft and lever ass'y.

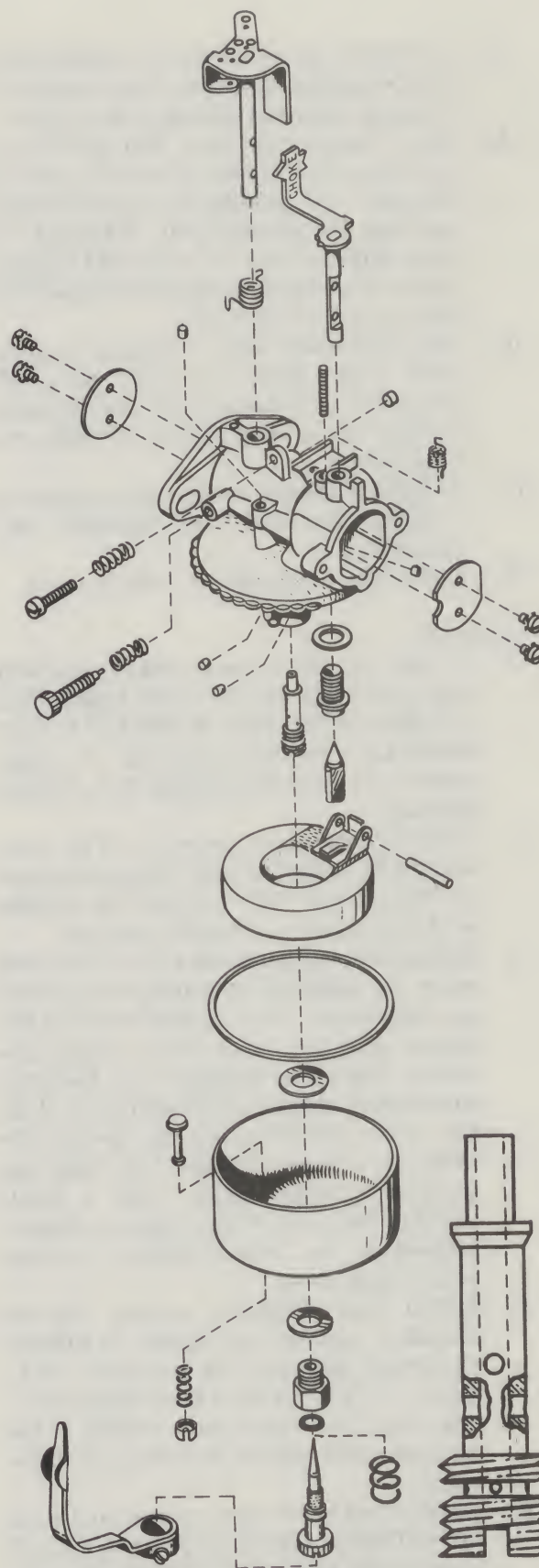


Figure 59-A

Figure 59-B

8. CAUTION: Do not adjust or remove main nozzle unless absolutely necessary for cleaning. Discard nozzle if removed.
9. Clean carburetor body and parts in a recommended cleaning solvent. Use as directed. All passages should be blown out with compressed air. Examine all parts for damage or wear and replace where necessary. New gaskets should be used on every overhaul.
10. Use "REPAIR KIT" overhaul assortment, a new float valve seat and needle ass'y for replacement of major parts. Always use a new gasket kit when re-assembling.
11. CAUTION: Never use compressed air on a carburetor with float and bowl ass'y assembled.
12. Make sure atmospheric vent is open.

Re-Assembly

1. If main nozzle was removed replace with service main nozzle. (See Illustration No. 59-B.) DO NOT REINSTALL OLD NOZZLE. Tighten securely. If torque wrench is available tighten 30 to 40 inch pounds.
2. Install choke shaft and valve. The valve should be installed with the part number or trademark "W" towards the outside with the valve in a closed position.
3. Install throttle shaft and valve. The valve must be installed with the part number or trademark "W" facing towards the flange with the valve in the closed position. The valve number must be on the idle needle side of carburetor bore. With the valve screws loose and the throttle lever stop screw backed out, seat the valve by tapping gently with a small screwdriver. With the valve properly located in the closed position tighten retaining screws.
4. Install idle adjusting needle. Needle should be seated very lightly by turning clockwise and back off (counter-clockwise) 1-1/4 turns as a preliminary setting. Replace with a new needle if the tapered point shows any wear or damage.
5. Install float valve seat, gasket and float valve. Tighten securely. If torque wrench is available, tighten 40 to 50 inch-pounds. This assembly is carefully matched and should any parts become separated, a

complete assembly should be re-installed. Any damage or signs of wear to any portion of the assembly should be replaced by a complete new Float Valve and seat (matched) set.

6. Install float and float shaft. It is advisable on older carburetors to replace the float shaft.

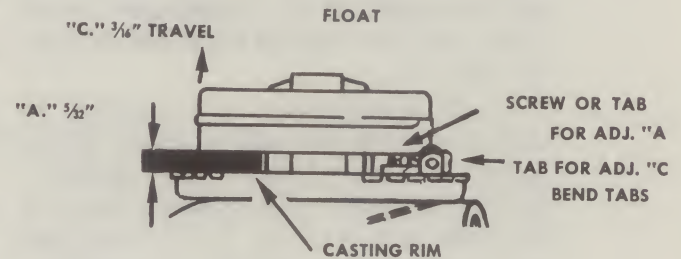


Figure 59-C

7. FLOAT SETTING: (See Illustration No. 59-C.) Invert the casting and float ass'y. There should be a clearance of 5/32 inch between the outer rim of the casting and the nearest part of the float at the opposite side from the hinge. If measurement is difficult, the float should be adjusted to rest lightly on the float valve and extend horizontally parallel with the casting rim.
The height adjustment can be made by bending the tab resting against the float valve. If a screw is provided in place of a tab this may be turned for proper height adjustment.
Reverse casting to normal position. The float would not drop more than 3/16 of an inch. A restricting tab is located in back of the hinge. This may be bent if necessary so that the float will not drop more than 3/16 of an inch in this position.
8. Install bowl ring gasket to nestle in the groove provided in the casting.
9. Install bowl using the fiber gaskets on the inner and outer side of the bowl, fitted to the bowl nut.
10. Install power adjusting needle ass'y with gaskets in place. Back out the needle before tightening securely. If torque wrench is available, tighten 50 to 60 inch pounds.
11. Seat power adjusting needle very lightly by turning clockwise and back off (counter-clockwise) 1-1/4 turns as a preliminary setting.

12. Using a new flange gasket install carburetor on the engine. Throttle control and governor linkage or any remote controls should be assembled exactly as in the original location. Service the air cleaner as directed in the Engine Manual and replace to carburetor.

H. E. W. CARBURETORS

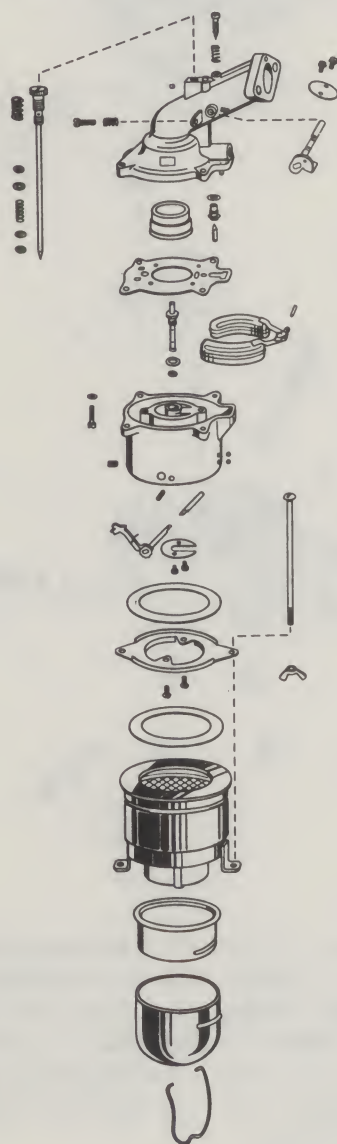


Figure 60-A

Disassembly (See Illus. No. 60-A)

1. Remove carburetor from engine, noting carefully all linkages and connections. Remove the air cleaner.
2. Remove high speed adjustment screw:

3. Remove (4) screws holding bowl on. Remove float shaft, float assembly, float valve, float valve seat, and gasket. Float should be examined for pin holes, leaks or wear in hinge shaft holes on the float bracket.
4. Remove bowl gasket.
5. Remove idle adjusting screw and spring.
6. Remove throttle valve screws, valve, throttle shaft and lever.
7. Remove choke valve screws, valve, choke shaft and lever.
8. Remove main nozzle.
9. Clean carburetor body and parts in a recommended cleaning solvent. Use as directed. All passages should be blown out with compressed air. Examine all parts for damage and wear and replace as necessary. New gaskets should be used on every overhaul.

Re-Assembly

1. Install main nozzle and tighten to 30 to 40 inch pounds.
2. Install choke shaft and valve. The valve should be installed with the part number or trademark "W" towards the outside with the valve in the closed position.
3. Install throttle shaft and valve. The valve must be installed with the part number or trademark "W" facing towards the mounting flange with the valve in the closed position. The valve number must be on the idle needle side of the carburetor bore. With the valve screws loose and the engine speed screw backed out, seat the valve by tapping gently with a small screwdriver. With the valve properly located in the closed position, tighten retaining screws.
4. Install idle adjusting screw. Screw should be seated very lightly by turning clockwise and back out counter-clockwise, 1-1/2 turns as a preliminary setting.
5. Install float valve seat, gasket and float valve. Tighten securely. If torque wrench is available tighten 40 to 50 inch pounds. If any part of the float valve assembly is defective, replace with a new matched set. Do not replace individual parts.
6. Install float and float shaft.
7. **FLOAT SETTING:** (See Illustration No. 60-B.) Invert the casting. Float assembly should be 3/16 of an inch from the

casting rim and outer tip of both sections of the float. The height adjustment can be set by bending the tab resting on the float valve. Reverse casting to normal position and set float travel down from seat to $\frac{3}{16}$ of an inch by bending the restricting tab located in back of the float hinge.

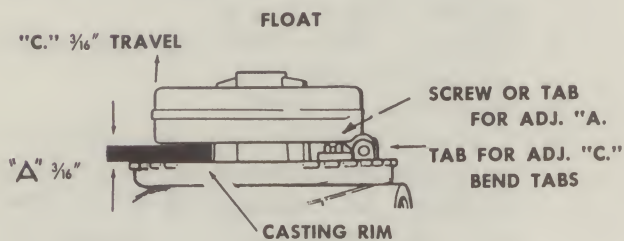


Figure 60-B

8. Install high speed adjusting screw in casting, do not tighten down. Use the end of the screw for locating the spring and gaskets that fit around the high speed adjusting screw.
9. Install bowl gasket.
10. Assemble bowl to carburetor casting, tighten hold down screws 50 to 60 inch pounds.
11. Seat high speed adjusting screw very lightly by turning clockwise, and back off counter-clockwise 1-1/2 turns as a preliminary setting.

U. T. CARBURETORS

Disassembly (See Illus. No. 61-A)

1. Remove carburetor from engine.
2. Remove bowl screws.
3. Remove float pin, float, needle and needle and seat. Check float for dents, leaks, and wear on float lip or in float pin holes.
4. Remove bowl gasket.
5. Remove idle and high speed adjusting screw assembly and springs.
6. Remove nozzle and idle jet tube.
7. Remove throttle valve screws, valve and shaft assembly.
8. Do not remove choke valve and shaft unless replacement of parts is necessary. A spring loaded pin retains choke in open position. Care should be taken if disassembled so that pin and spring are not lost.

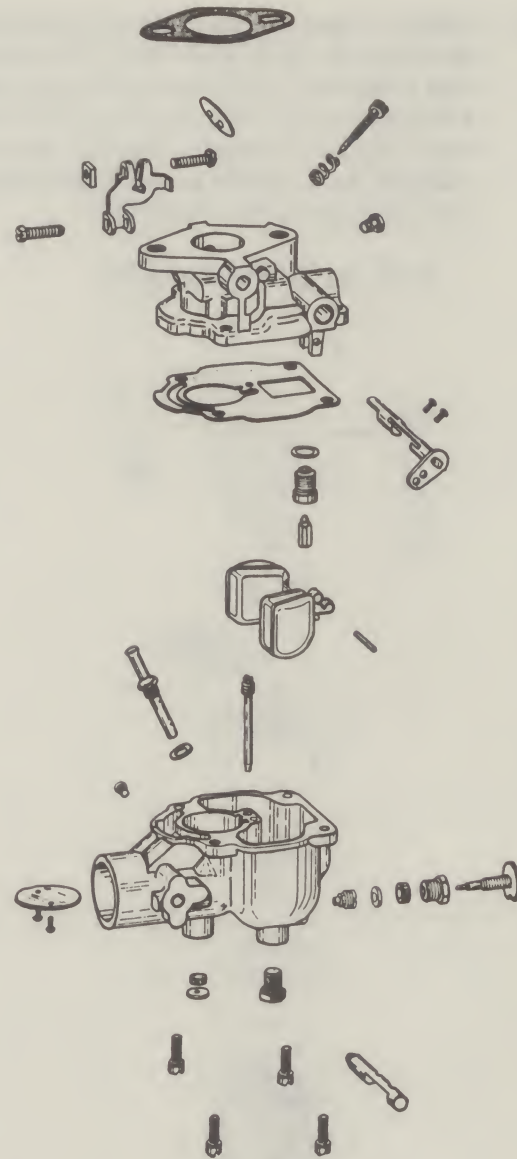


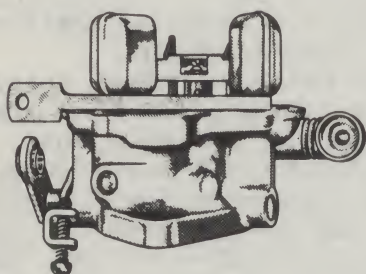
Figure 61-A

9. Clean all parts in a recommended cleaning solvent. Use as directed. All passages should be blown out with compressed air. Examine all parts for damage and wear, and replace as necessary. Always use new gaskets when re-assembling.

Re-Assembly

1. Install throttle shaft and valve assembly. Valve must be installed with trademark "C" on side toward idle part when viewing from mounting flange side. Always use new screws. With valve screws loose and throttle lever stop screw backed out seat valve by tapping lightly with a small screwdriver. Hold in place while tightening screws.

2. Install main nozzle, making sure it seats in casting.
3. Install needle seat, needle, float and float pin.
4. Set float level. (See Illustration No. 61-B.) With carburetor casting inserted, float resting lightly against needle in its seat, and bowl gasket removed, there should be the following clearance between float seam and throttle body. Adjust by bending lip of float with small screwdriver. Settings are as follows:



FLOAT ADJUSTMENT

Figure 61-B

Ident. No.	Part No.	Float Setting
2712-S	39-143-500	19/64
2713-S	39-144-500	19/64
2714-S	39-140-500	1/4
*2398-S	39-147-500	1/4
2336-S	39-146-500	1/4
2336-SA	39-146-500	1/4
2337-S	39-145-500	1/4
2337-SA	39-145-500	1/4
2230-S	39-343-500	17/64
2217-S	39-344-500	11/64

*When resilient seat is used, set float level at $.9/32 +$ or $- 1/64$.

5. Install bowl gasket making sure atmospheric vent and idle jet passage are not blocked off by the gasket.
6. Install idle jet tube.
7. Install high speed screw assembly. Turn in until it seats, then back out 1-1/4 turns.
8. Install idle adjusting screw finger tight, back out approximately 1-1/2 turns.
9. Assemble bowl to throttle shaft assembly casting.

CARTER CARBURETOR

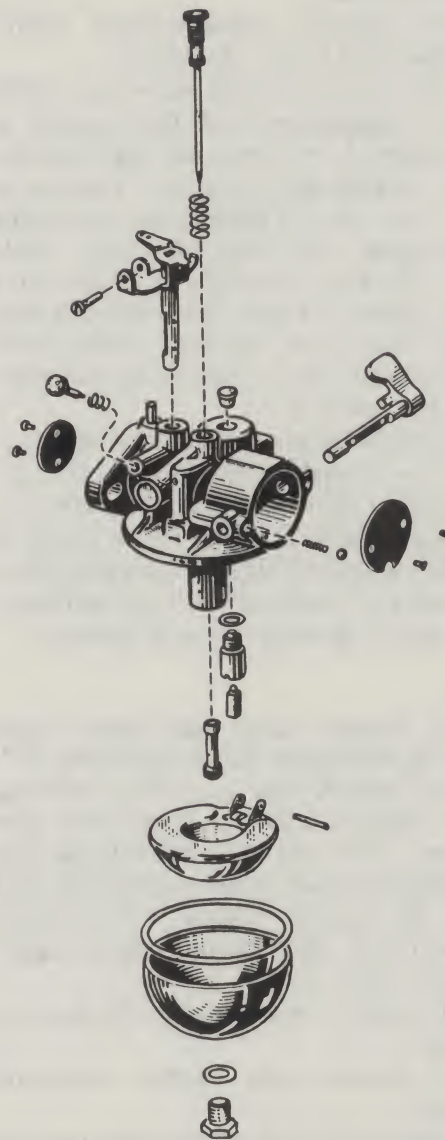


Figure 62

Disassembly (See Illus. No. 62)

1. Remove carburetor from engine.
2. Remove bowl nut, gasket and bowl.
3. Remove float pin, float, needle and needle seat. Check float for dents, leaks, and wear on float lip or in float pin holes.

4. Remove bowl ring gasket.
5. Remove low speed jet and high speed adjusting needle assembly and spring.
6. Remove idle adjustment screw and spring.
7. Remove nozzle.
8. Remove throttle valve screws, valve, and shaft and lever assembly.
9. Do not remove choke valve and shaft unless replacement of these parts is necessary. A spring loaded ball retains choke in wide open position. Be sure to use a new ball and spring when replacing choke shaft and lever assembly. CAUTION: Hold a screwdriver handle or a small piece of wood over threaded hole in air horn (side opposite choke lever) to prevent the ball from flying out when shaft is removed.
10. Clean all parts in a recommended cleaning solvent, making sure all carbon accumulation is removed from bore, especially where throttle valve seats in casting. Blow out all passages with compressed air. Replace all worn and damaged parts. Always use new gaskets.

Re-Assembly

1. Install throttle shaft and valve. Valve must be installed with trademark "C" on side toward idle port when viewing from flange side. Always use new screws. With valve screws loose and throttle lever set screw backed out, seat valve by tapping lightly with a small screwdriver. Hold in place while tightening screws.
2. Install nozzle, making sure it seats in casting.
3. Install needle seat, needle, float and float pin.
4. Set float level. With carburetor casting inverted, float resting lightly against needle in its seat, there should be 3/16" clearance between machine surface of casting and free end of float (side opposite needle seat). Adjust by bending lip of float with small screwdriver.
5. Install bowl ring gasket, bowl, bowl nut gasket and bowl nut. Tighten securely after making sure bowl is centered in gasket.

6. Install low speed jet and high speed needle assembly. Turn in until it seats in nozzle, then back out 2 turns.
7. Then install idle adjusting screw finger tight. Back out approximately 1-1/2 turns.

TOUCH 'N' START PRIMER CARBURETOR

Steps in operation of primer. (See Ill. No. 62 A)

1. Seal bowl vent with finger.
2. Depress bulb to pressurize bowl.
3. Pressure in carburetor bowl forces fuel into carburetor throat.
4. When engine is cranked, intake valve opens, letting gasoline into combustion chamber for one pull starting.
5. Gasoline forced from bowl during priming is replaced by flow of gasoline from fuel tank through gravity fuel inlet.

This primer is applicable to the LMG, LMB, and LMV carburetors. Servicing this carburetor would be the same as listed for the LMG, LMB, and LMV, except choke lever and choke valve are not used. NOTE: The bowl atmospheric vent is routed back through the primer tube and bulb.

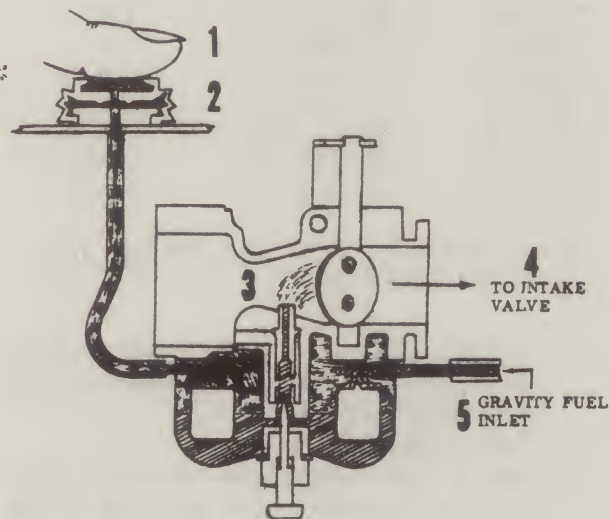


Figure 62A

FIXED SPEED CARBURETOR

Steps in operation. (See Illustration No. 62 B.)

1. Rotate control knob counter-clockwise to open throttle (4 cycle engines) (2 cycle not equipped with control knob)
2. To stop engine rotate control knob clockwise. (4 cycle engines) (2 cycle engines use shorting device)

NOTE: Governor spring is located on throttle shaft between lever and carburetor casting. Setting on high speed screw is $1 \frac{1}{4}$ to $1 \frac{1}{2}$ turns. Servicing this carburetor would be the same as listed for the LMG, LMB, or LMV except there is no main nozzle or idle circuit.

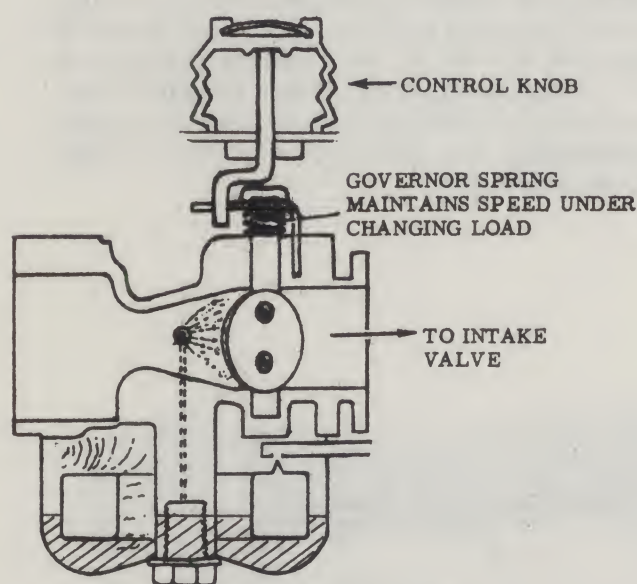


Figure 62 B

MAGNETO OVERHAUL

Illustration No. 63-A illustrates one of the magneto assemblies used on Clinton Engines. Regardless of variation in design all magnetos convert magnetic energy to electrical energy, and in this instance, the induced electricity is of the high voltage type and reaches as much as 18,000 volts. The overall efficiency of a magneto is related to the correctness of circuit conditions and adequate magnetic energy.

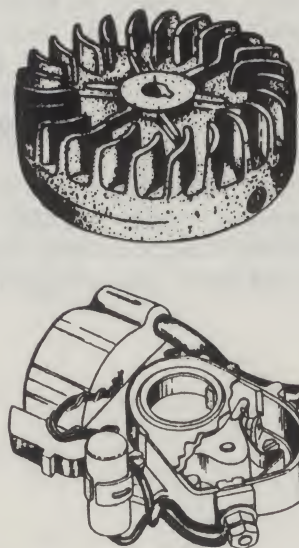


Figure 63-A

Before we get into the actual disassembly of the magneto let us understand one with reference to an engine "miss." The energy required to fire a spark plug under compression depends on the compression, the spark plug gap and the circuit conditions. If everything is in good order, the available voltage from the magneto will be maximum. If everything in the spark plug circuit is in good condition, it will require minimum voltage. When the required voltage is higher than the available voltage, electrical malfunction will result. The maintenance to the electrical circuit is to maintain high available voltage and to require minimum required voltage.

FLYWHEEL

After the flywheel has been removed check the condition of the flywheel key and the key slot in the flywheel. (See Illustration No. 63-B.) Check the taper in the flywheel and on the crankshaft for full surface contact. Usually, if the tapers are incorrect, you will note bright marks and dull surfaces. The ideal condition would be to have completely dull surfaces, bright surfaces indicate movement of some part. Check the magnetic pull of the flywheel magnets, by comparing it to a new part.

The comparison can be done either with a magnetometer or a steel screw driver. When a screw driver is used it should be placed on the magnet of the flywheel in question then on a new flywheel from stock noting the amount effort required to remove from each. If a flywheel magnet is low on charge, it is very noticeable when comparing the two parts.

Please do not overlook the flywheel magnet charge if you question, replace with a new. Do not recharge flywheel magnets as they will not stay charged or lose their charge again.

STATOR

Normally the stator (laminations and breaker box) do not fail or require any service. If the flywheel has rubbed and damaged the stator lamination, the stator assembly should be renewed.

BREAKER POINTS

Remove the bail, the magneto box cover and cover gasket. Check for evidence of excessive oil or lubrication within the box. If it appears that oil has been getting into the box, you may have a leaking oil seal, or an improperly installed seal. Too, you may have a defective breather assembly that is forcing oil past the seal. Oil is an insulator to electrical energy and when it settles on a contact surface a high resistance situation develops resulting in no spark.

Spread the contacts apart and check for pitting, blackened contacts and spring tension. Refer to Illustration No. 64. If the contacts are grey in color, properly adjusted insofar as gap is concerned, and the rubbing block or shuttle correct on cam contact, you have an ideal situation. (See Illustration No. 65.)

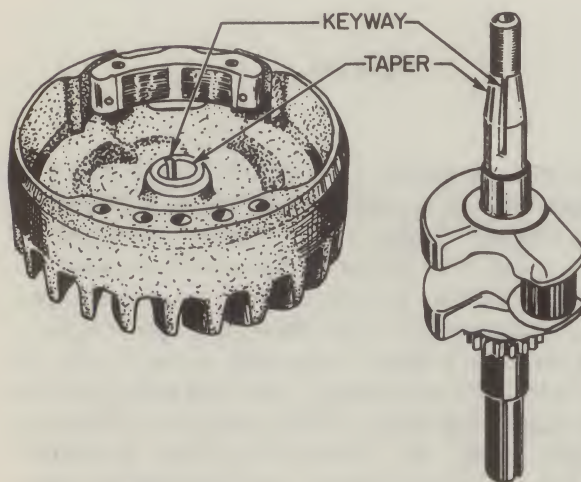


Figure 63-B

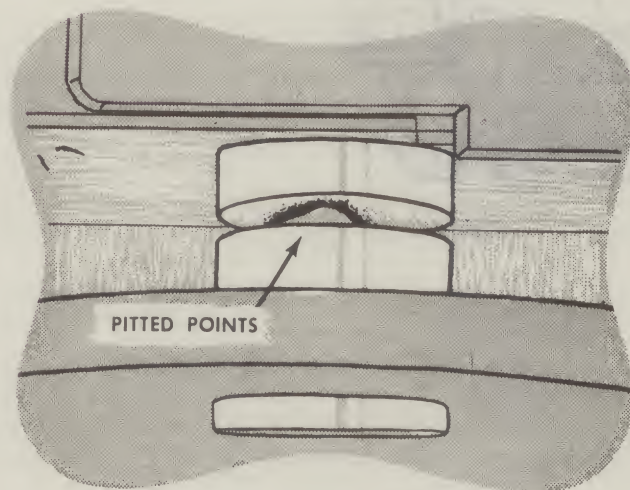


Figure 64

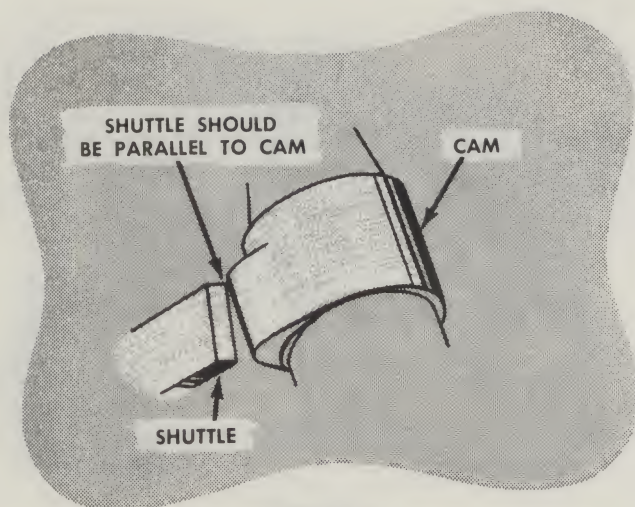


Figure 65

Refer to Illustration No. 66 for illustrations of contact alignment, "A" shows the correct setting, flat face to face contact, this will give you contact mating as in Illustration No. 67 "A," and will result in full flow of electrical energy. If the contacts are uneven, as in Illustration No. 66 "B" or in 67 "B," you lose more than half of the available contact surface.

If the rubbing block or shuttle is not properly aligned to the cam surface the points will have a short service life. The spring tension, in an improperly aligned rubbing block, will exert all pressure on a small portion of the available surface, resulting in rapid wear, change of point opening and early malfunction of the system. Check this alignment on every installation of contacts (See Illustration No. 65.)

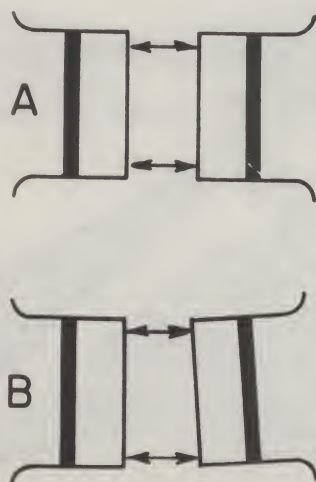


Figure 66

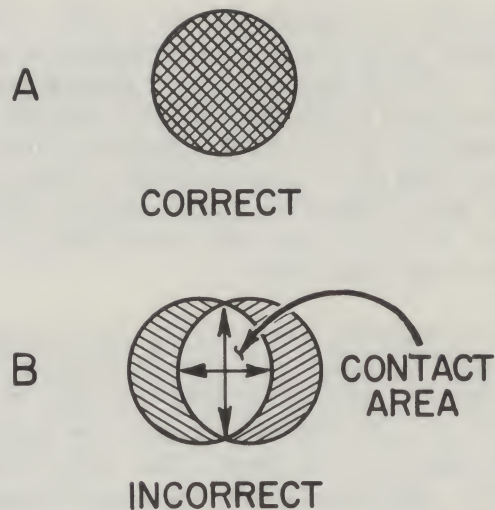
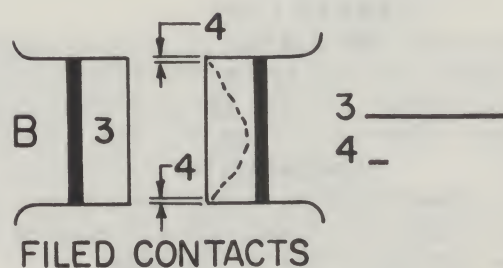
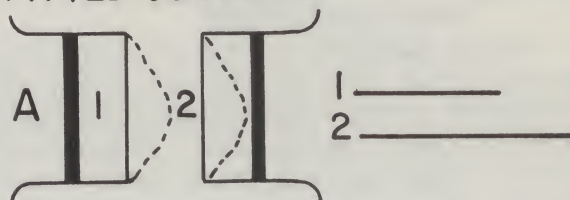


Figure 67

PITTED CONTACTS



FILED CONTACTS

Figure 68

If you find it necessary to do some bending to adjust contact alignment, bend only the solid point frame, do not try to bend the moveable arm. After alignment is obtained, set the gap in accordance with specifications.

Some mechanics still insist on filing contacts. This should be explained. The pits and corresponding hole in a contact surface are from circuit conditions, called metal transfer. The balance, electrically speaking, between the condenser and the coil actually control the point build-up or pitting. If the coil and condenser are completely compatible, the points will last for many years. Refer to Illustration No. 68 "A"; you

see a set of contacts that are pitted, with the opposite point showing a depression or hole. In "A," note the diameter of the point wafer, it is shown below in (1) stretched out. Note the length of the line (A-2), it too is stretched out and is longer than (A-1). In this instance if the contacts were grey colored we could assume that the pit would fall into the hole every time and give better than new contact.

Now suppose we file off the pit, our point is length (A-1) again, and it is shown under "B" as (3) but we did nothing with the hole, it's still there. So our contact surface of the right point is (4-plus-4), or about 1/6th of the available contact. Unless someone comes up with some way to fill holes in tungsten you may as well throw the points away. Too, there is the problem of finding a metal file that will file tungsten and still give a smooth, flat and clean surface.

COIL CONDENSER

Remove the condenser and check with an approved tester, (see Illustration No. 69), follow the testing machine manufacturer's instructions during the test. Illustration No. 70 shows the ignition coil being tested. There are several tests in this series. Make all as outlined by the manufacturer of the equipment.

BREAKER CAM

Check the cam that fits over the crankshaft, it should be smooth and should fit into the slot of the crankshaft solidly. Be sure it is properly installed, (See Illustration No. 71). Check the chart Illustration No. 73 to make certain that the engine is using the correct cam, there are 12 total. Model 412, 413 engines have breaker cam machined on crankshaft

SHORTING WIRE

If the engine is equipped with remote shorting of the magneto primary, check the lead and all other hardware in this area. In engines with the breaker box located on the outside of the engine, check the lead between the breaker points and the coil for evidence of grounding.

HIGH TENSION LEAD

In any engine, check the high-tension lead. The terminal for connecting the lead to the spark plug should be tight and the wire inside the cable should actually contact the terminal. Look for evidence of the insulation chafing where the lead is running close to the various housings and shields.

MAGNETO REASSEMBLY

If new contacts are to be installed, proceed with the installation making sure all connections are good and tight. Check the cam to rubbing block alignment. Set the contacts to the specific

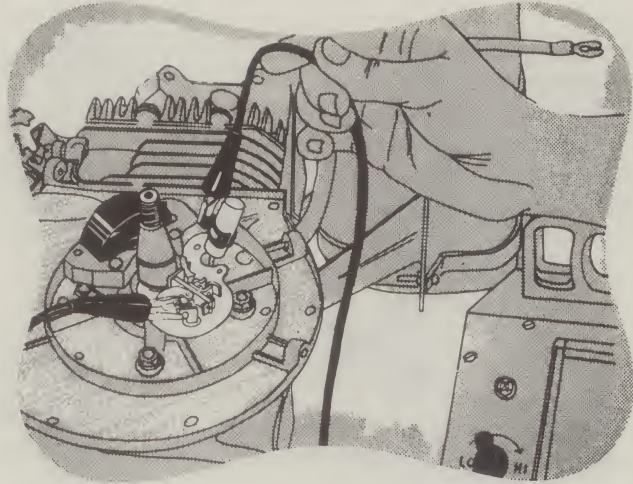


Figure 69

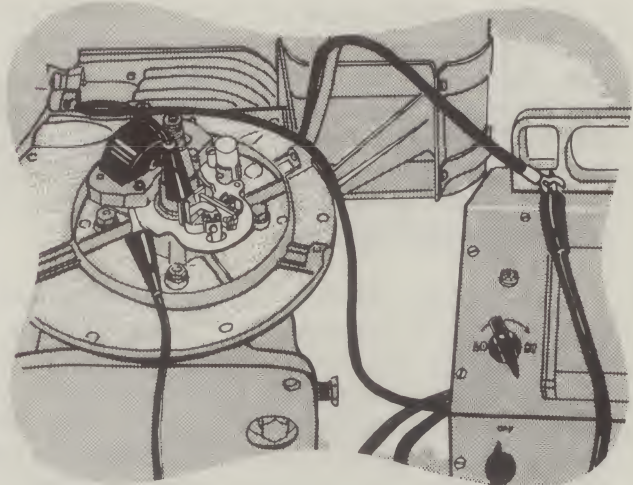


Figure 70

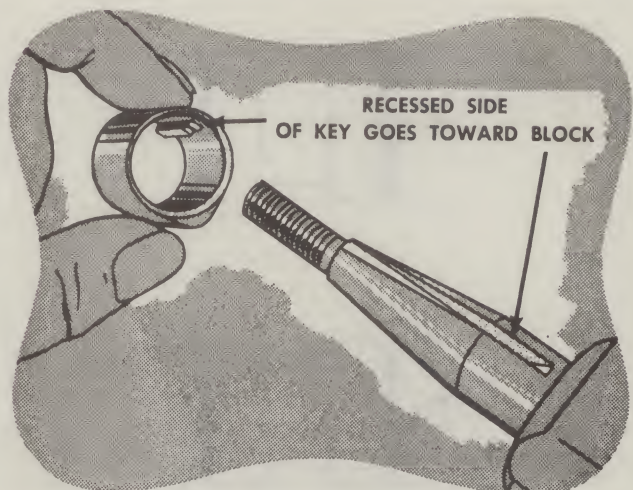


Figure 71

gap required. Clean the contact surfaces with carbontetrachloride or any good cleaner that will evaporate quickly without leaving a residue of its own. Dry the contacts with lintless tape or use strips of bond paper. Be sure all lint is removed from the contact surfaces. (See Illustration No. 72.)

Place a little cam grease on the cam and rotate the crankshaft to distribute it evenly. Remove excess grease.

Check the cover gasket, replace if it is torn or oil soaked. Install cover and snap bail into position.

Be sure to torque flywheel nut to specifications to insure against drift and chucking.

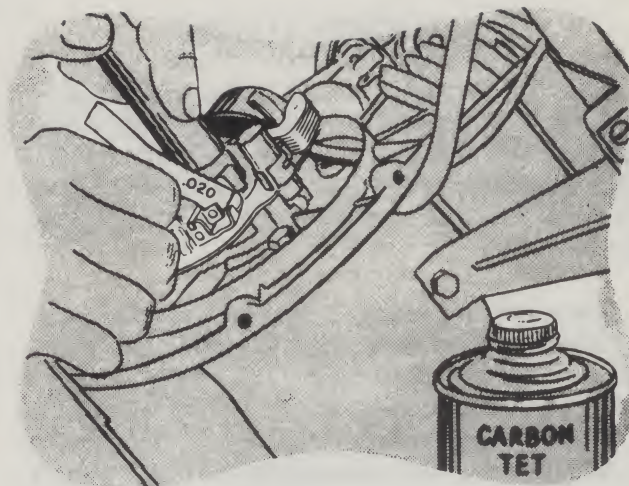


Figure 72

BREAKER CAM IDENTIFICATION

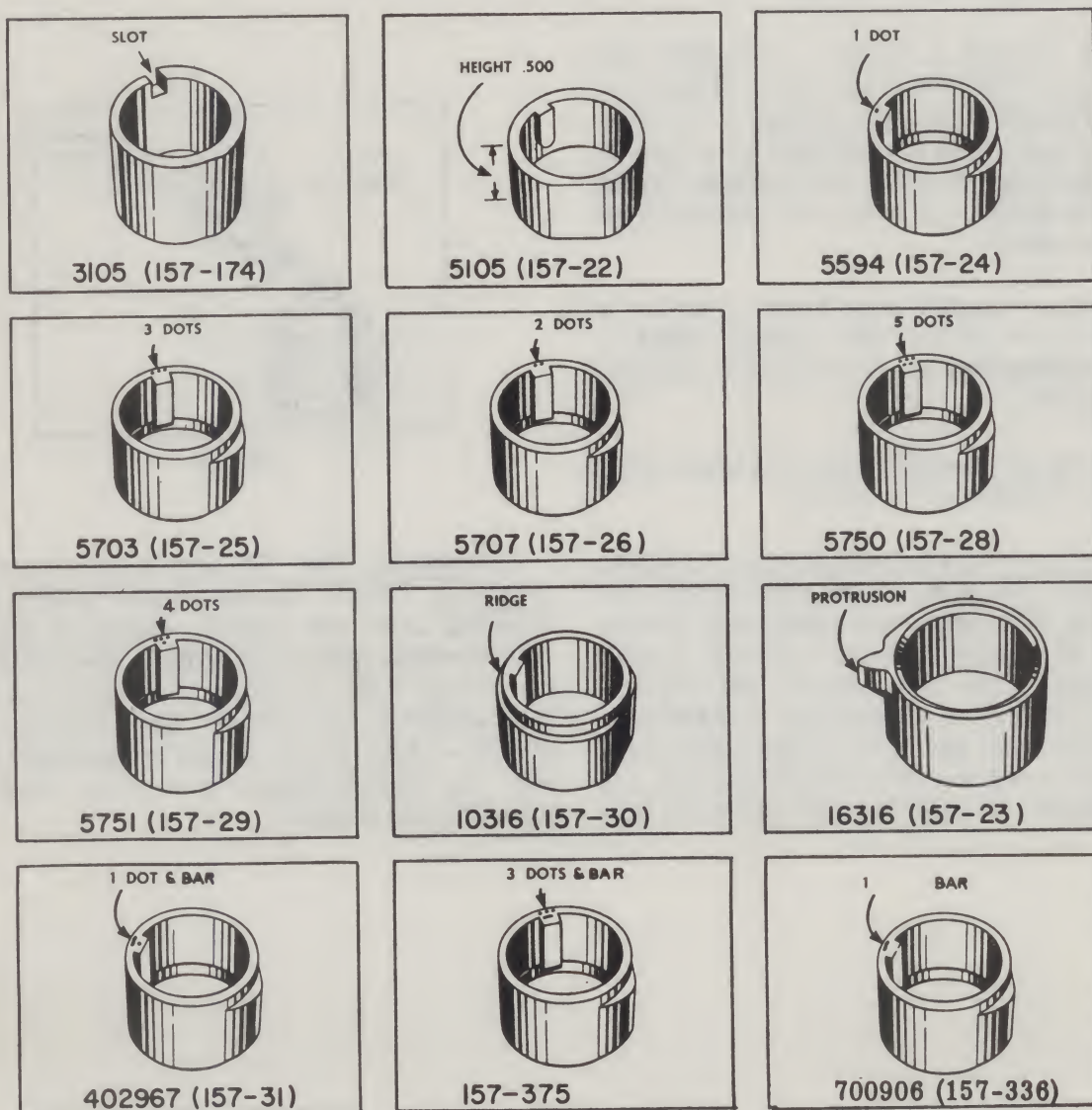


Figure 73

AIR CLEANER SYSTEMS

The air cleaner system, used on air cooled engines must provide complete filtration of dust and dirt for maximum engine protection. The cleaner must also deliver a full volume of clean air to insure correct carburetion at all engine speeds.

Since the air cleaner merely stops the passage of dust from entering the engine, this residue must be removed from the cleaner at service-required intervals. The frequency with which a cleaner must be serviced solely depends on the engine operating conditions. Extremely dusty conditions, such as garden tiller operation, may require daily cleaner service. On the other hand, the cleaner on a reel type mower engine, operating on a good established lawn would not require service for several weeks.

In your service procedure we suggest that immediately after removing the air cleaner, or cleaner element from the engine or housing, check for dust inside the carburetor or cleaner body. If dust is present it had to come through the element itself or it leaked by a sealing gasket in the system.

Correct and complete air cleaner service is a definite must. Do not use gaskets, seals or elements unless they are under factory specified part numbers.

Following are suggested methods of servicing the various Clinton air cleaners.

Illustration No. 74 Metallic Mesh Air Cleaner. The air filter should be cleaned regularly. All of the air for the carburetor must pass through this filter to remove dust and moisture. Loosen air cleaner screw and remove the cleaner. Place air cleaner in a container of solvent (do NOT use gasoline) and agitate vigorously to remove all dirt and dust from metallic mesh. Dip the air cleaner into oil, then place the filter back

on the engine and tighten. Obtain a new air filter element if the old one is damaged or becomes lost.

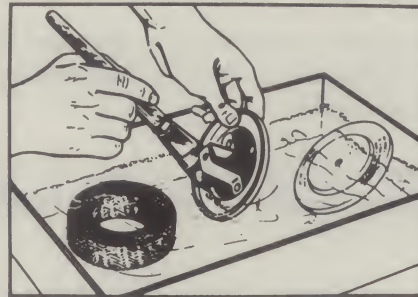


Figure 74

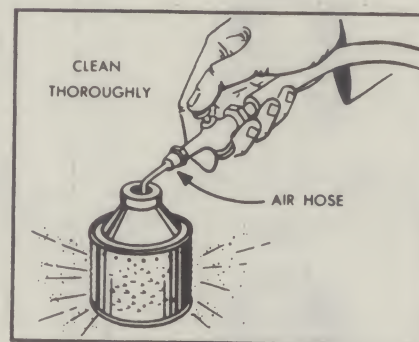


Figure 75

Illustration No. 75 Dry-Type Paper Air Cleaners. ("Can" series.) This cleaner, after removal from the engine, should be brushed with a bristle brush (not WIRE); after brushing, use an air hose to blow dirt from the inside of the cleaner to the outside. Do not wet or soak this type cleaner in a solvent or gasoline. Make sure the sealing gasket is in place when re-installing the cleaner.

Illustration No. 76 Oil Bath Air Cleaners.

After removal from engine the cleaner should be disassembled and washed thoroughly in a cleaning solvent. If the bowl is made of plastic, make certain that there are no cracks, especially around the sealing areas. Use compressed air to remove solvent from the mesh filler in the cover. Fill to correct level with S.A.E. 30 engine oil. Remind the owner that this cleaner will require regular service; the recommendations in the owner's guide, and the frequency of service is controlled by the operating conditions.

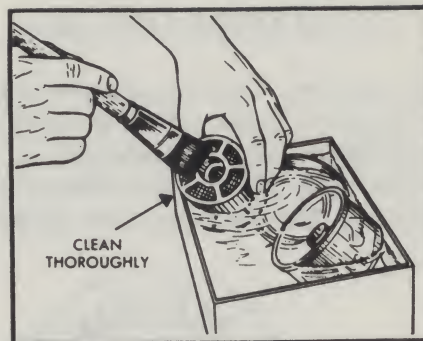


Figure 76

Illustration No. 77 Polyurethane Air Cleaners.

The air cleaners that use this type cleaning element require regular cleaning and re-oil service. After removing the element from the container, wash it in hot water, using soap to remove dust, dirt and original oil. Make sure element is dry then use S.A.E. 30 engine oil to re-lubricate; use enough oil to cover the face of the element, this would be about one tablespoon, depending on the size of the element. We suggest cleaning with hot water and soap as the owner is more likely to use this method of cleaning as compared to his buying a supply of solvent just for cleaning the element. In addition to doing an excellent cleaning job, warm water will expand the element, which will give a better seal around the edges when it is re-installed in the container.

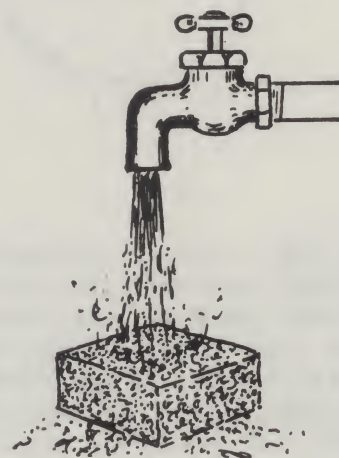


Figure 77

4 CYCLE LUBRICATING OILS

There has been much discussion on detergent and non-detergent oils. In the present Owner's Guide and Instruction Manuals the oil recommendations read MM or MS. Please assist in informing the customer as to the proper use of

lubricating oils. In order to help clarify the proper oils for use in Clinton 4-cycle engines listed below is a brief comment on what each particular rating means. All oil containers have a rating marked on the container, such as ML-MM.

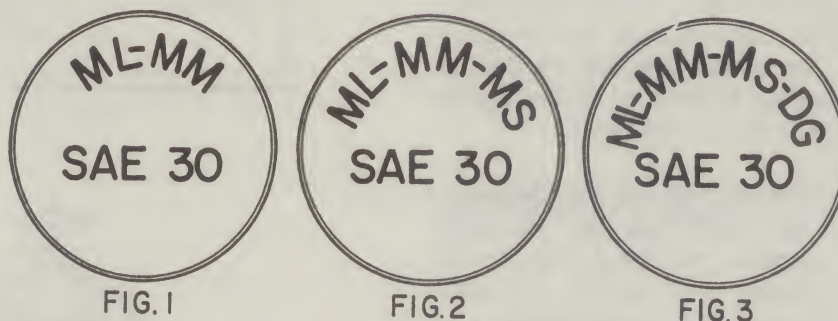


Figure 78

SERVICE ML - This is a service typical of gasoline engines used under light and favorable operating conditions. It includes moderate speed or moderate load operation most of the time with no severe low or high engine temperature operations. **NOTE:** NOT acceptable in a Clinton 4-cycle engine and use of ML rated oil voids engine warranty.

SERVICE MM - Oil usage is for service typical of gasoline engines used under moderate to severe operating conditions. It does not include extensive operation under the severe type of low engine temperature service such as prolonged idling or much starting and stopping of the engine. **NOTE:** This rating is acceptable for use in Clinton 4-cycle engines, but is the minimum rating to be used.

SERVICE MS - This service is typical of gasoline engines used under unfavorable or severe types of operating conditions. Service MS represents the most severe service encountered in the operation of gasoline engines and includes two different types (the severe or adverse) of operating condition. Start and stop operation would be an adverse condition. The second adverse condition would be operation at high temperature, high load or overload or extreme or maximum speed. **NOTE:** This rating of oil should be adequate under most any possible application of a Clinton 4-cycle engine.

The above listed oils would be what many people consider as non-detergent, however, the oils do have additives. The MS oil is excellent oil for 4-cycle air-cooled engines on all types of usage; MS is a high additive oil and may or may not have some detergent additive.

The following oils are commonly considered as detergent to high detergent oil:

SERVICE DG - This service is typical of diesel engines in any operation where there are no severe requirements. This oil is also commonly used in automobiles and especially automobiles with hydraulic valve lifters. **NOTE:** This is the highest rating to be used in Clinton engines but is not especially recommended. An MS oil is preferable.

SERVICE DM - This service is typical of diesel engines operating under severe conditions. Again this oil is commonly used in automobiles and especially where hydraulic lifters are used. **NOTE:** Oil of this rating is NOT RECOMMENDED and warranty is VOIDED by use of oil of this rating.

Owner's Guide calls for MM or MS, past Owner's Guides called for non-detergent, so customer has been informed. Figure 1 illustrates how a can would be marked for MM rated oil. Please note that it would carry both the

ML and the MM marking. Figure 2 illustrates the container that would be marked for MS rated oil and this is marked ML-MM-MS. Figure 3 illustrates a can marked for DG rated oil and again it carries the marking ML-MM-MS-DG.

It is recommended that an oil of a rating no lower than MM be used and warranty will not be allowed on engines operating on an ML rated oil. The maximum rating to be used would be DG and this is not especially recommended. Either MM rated oil or preferably MS rated oil should be adequate for normal usage and from review of the comments on the ratings, MS oil would be adequate for most any operating conditions at most any engine speed and most any engine load.

Following are listed the S.A.E. weights of oil based on temperature and when an oil is specified for customer summer use the statement can be made to the customer that S.A.E. 30 oil should be used of a rating ML-MM or ML-MM-MS. Please review the following temperature-weight recommendations.

Above 32°F. use S.A.E. 30 of MM or MS Rating.

Below 32°F. to -10°F. use S.A.E. 10W of MM or MS Rating.

Below -10°F. use S.A.E. 5W of MM or MS Rating.

In conclusion, any legitimate manufacturer's oil should be adequate for the Clinton 4-cycle engine if the above is considered as to weight, temperature and rating.

NOTE: ML oil has been tested in new engine. In a few hours of partial load operation, the oil had changed to the color and viscosity of dark brown molasses or very heavy transmission lubricant. The engine during operation had a very heavy vapor expelled from the breather assemblies due to the ML oil. The change in the oil (ML) from S.A.E. 30 to a heavy consistency results in engine failure to "improper oil" which equals "no warranty."

2 CYCLE LUBRICATING OILS

Use a SAE 30 high quality outboard motor oil, or it's equivalent in a SAE 30 or 40 viscosity with a minimum MM rating. Do not use DM or DS rated oils.

2 CYCLE FUEL MIX

Sleeve bearing engines 3/4 pint oil to each gallon of gasoline.

Needle bearing engines 1/2 pint oil to each gallon of gasoline.

NOTE: Outboard motors require 1/2 pint oil to each gallon of gasoline during break-in period (first 5 hours of operation). After break-in period 1/4 pint of oil to each gallon of gasoline.

INDIVIDUAL ENGINE OIL LEVELS

With the engine setting level, check the amount of oil in the crankcase. On some tillers with vertical shaft engines, you may have to block up the rear wheels to off-set the height of the tines in order to obtain a level engine. Note that in the following illustrations there are several different procedures used to check oil level so refer to the model that you are working with.

Models V-100, VS-100, A-300, 650, VS-2100 VS-3100, and VS-4100. Models 401, 403, 405, 407, 408, 409, 411, 415, 417, 429, 431 and 435,

All of the above-listed models require one (1) pint of oil to properly fill the crankcase. (See Illustration No. 79.) Except 429, 431, and 435 which requires 1 3/4 pints.

Models 100, 2100, 3100, H-3100, and 4100. Models 400, 402, 404, 406, 424, and 426.

All of the above-listed models require one and one quarter pints (1-1/4) to properly fill the crankcase. (See Illustration No. 80.)

Models 700-A, C and D-700, 800, A-800, 900, A and B-1100, C and D-1100, 1200, A-1200, B-1290, 492, 494, and 498.

All of the above-listed models require one and one quarter pints (1-1/4) to properly fill the crankcase. (See Illustration No. 81.)

Models VS-700, VS-750, VS-800, VS-900, V-1000, VS-1000, V-1100, VS-1100, V-1200, and VS-1200. Model 499.

All of the above listed models require one and one quarter pints (1-1/4) of oil to properly fill the crankcase. The correct oil level is when the oil is even with the top of the filler plug threads away from the engine. (See Illustration No. 82.)

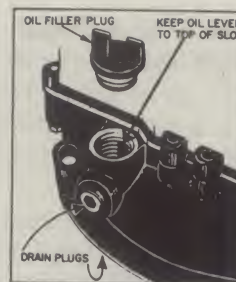


Figure 79

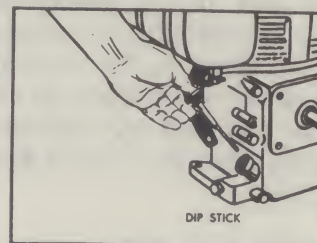


Figure 80



Figure 81

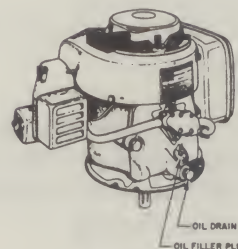


Figure 82

Model 413, this new model engine requires two pints (2) of oil to properly fill the crankcase. There is a dipstick on the bottom of the filler plug and in checking oil level, do not screw the plug into the threads, just place it on top of the casting and read indicated level. (See Illustration No. 83.)

Model 412, this new model engine requires two and one-half pints (2-1/2) to properly fill the crankcase. There is a dipstick on the bottom of the filler plug. Do not screw the plug into the threads to check oil, just place it on the casting above the filler hole, remove it and read the oil level on the dipstick. (See Illustration No. 84.)

Models 1600, 1800, Models 414, 418, have a combination filler plug-dipstick, and these models require three pints (3) to properly fill the crankcase. In checking oil level, do not screw the dipstick into the threads, just place it over the filler hole, remove it and read the indicated level. (See Illustration No. 85.)

Models 2500, 2790, Models 420, 422, have a similar filler-plug and dipstick. These engines require four and one-half pints (4-1/2) to properly fill the crankcase. Follow above instructions in checking level. (See Illustration No. 85.)

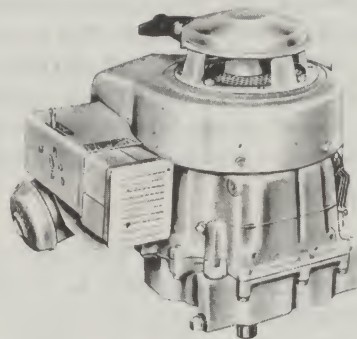


Figure 83

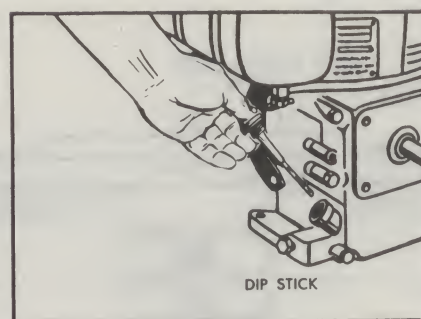


Figure 84

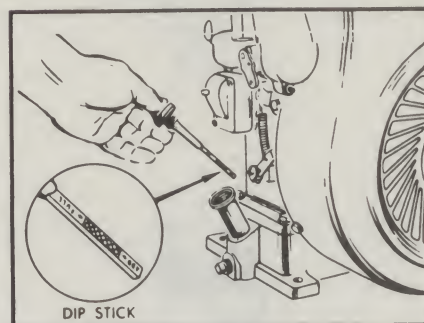


Figure 85

FUEL SYSTEMS

Our inspection in this area may as well start with the beginning, the fuel tank and the fuel tank cap. The fuel tank cap must perform three basic functions. It must seal out dust and other foreign materials, it must keep fuel from splashing out of the tank and it must allow the entrance of outside air to force the fuel from the tank during engine operation.

Your service to the fuel tank cap is limited to making sure that the gasket seals the cap to the tank and that the baffles are properly installed to insure correct breathing. Illustration No. 86 shows a cross-section of a six piece cap and in this instance, correct assembly of the baffles is very important.

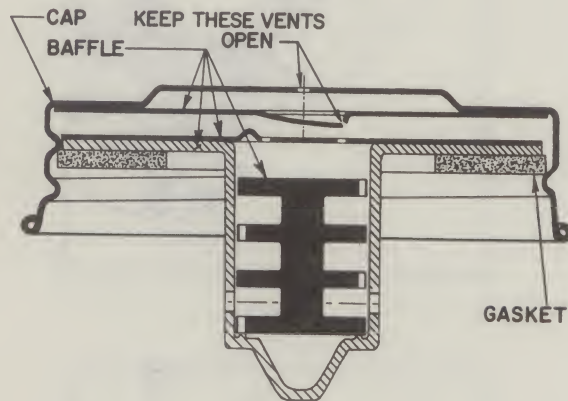


Figure 86



Figure 87-A

In Clinton Engines with float carburetion, we employ a fuel filter in the tank to fuel line adaptor. This adaptor may, or may not, have a shut-off valve included in the assembly. Filtration is

handled by a 120 mesh, bronze wire screen. Cleaning is simple, remove the adaptor from the tank, soak it in cleaning solvent and blow dry with compressed air. Illustration No. 87-A shows fuel line adaptors with shut-off valves as an assembly.

On the larger horizontal shaft engines, the standard fuel filter is mounted below the tank and utilizes a filter screen and a sediment bowl, plus a shut-off valve, (see Illustration No. 87-B).

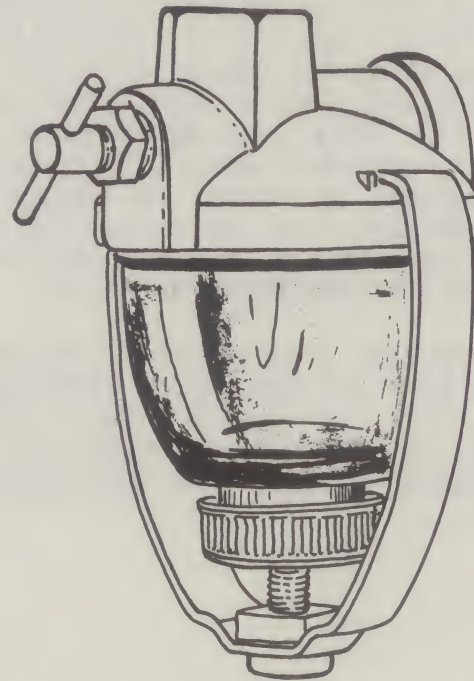


Figure 87-B

To service this assembly, the valve is closed, then the filter is disassembled for inspection and cleaning. Check for chipped edges on the glass bowl, warped sealing edges on the body and condition of the sealing gasket. You can obtain replacement parts for this filter through your regular source of supply.

The engines with the lift type carburetor have a fuel filter "built-in" on the bottom of the pick-up pipe or standpipe assembly. This bronze screen is 100 mesh or 200 mesh or a combination of both screens. To service and clean this filter, the standpipe is removed from the carburetor, soaked in cleaning solvent and blown dry with compressed air. Make sure all foreign material is removed from the entire pipe, so the operation of the check-ball will be correct. (See Illustration No. 88.)

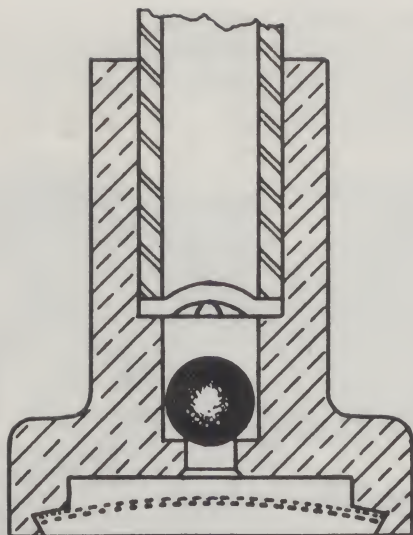


Figure 88

FUEL LINES

In our design and manufacturing divisions, we have three basic materials for making standard fuel lines; they are neoprene, steel and nylon. Neoprene is the most popular choice as it has all of the desirable characteristics necessary to insure adequate fuel flow under various conditions.

On the heavier cast iron engines the rigid steel or nylon line will retain its original configuration and it is capable of delivering maximum fuel to the engine regardless of load. These lines are longer than those used on the lighter engines.

To attach steel or nylon lines to the fuel tank adaptor or to the carburetor adaptor, a series of brass fittings are used. The original steel line has flared fittings and the nylon uses compression fittings.

If in your inspection, you detect any hardness of the neoprene line in the area of the engine muffler, replace the line. Flexible line hardness is usually followed by fracture. In replacing the neoprene line cut the line to correct length, avoid

all sharp bends and allow adequate clearance around the muffler or exhaust pipes.

Service to the fuel line system is limited to eliminating any leaks, to make certain that the line is in reusable condition and free of any foreign material that could cause engine malfunction.

With the exception of one part number, all Clinton fuel tanks are fabricated from pressed steel. All joints are soldered and where supporting brackets are employed they are spot welded into place and then surrounded by solder. Upon completion of manufacturing and assembly process, the steel tanks are sprayed internally, with a rust retarding solution.

Water that enters the tank, and remains for prolonged periods of time, will cause internal rusting. The resulting sediment will be trapped by the tank's filter for some time. After continued operation, the large pieces of sediment are reduced to a fine powder-like dust and could pass thru the filter. Should you have cases of chronic carburetor flooding do not dismiss the possibility of rust causing the malfunction. Our steel tanks can be soldered if necessary.

The plastic fuel tank will not allow rust to form and by this very action, will give many hours of trouble-free service. Should service be necessary, the plastic tank, a standard epoxy cement could make the repair. Throughout the middle of the plastic tank, we have placed strengthening members to reduce the possibility of operational failure. The plastic tank employs a non-removeable 120 mesh filter so service to this filter would be along the line of a back-flush operation with air pressure.

In finding an engine with a bent crankshaft, be sure to check the stability of the fuel tank on that engine. Out-of-balance operation tends to shake the engine to a point that everything seems to come loose, including a normally stable fuel tank.

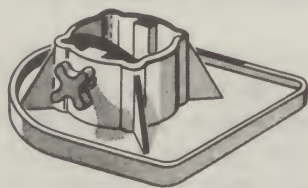
COMPLETE ENGINE DISASSEMBLY

Before we start disassembly let's check to make sure the following is available and in order.

- A. Clean work bench.
- B. Trays to put small parts in (nuts and bolts).
- C. Special tools needed for disassembly.
NOTE: From experience, Clinton has found that sockets with a 3/8 drive work the best and speed up the disassembly of a small air cooled gasoline engine.
- D. When disassembling an engine, try and lay the parts on the bench in the sequence that they have been removed.

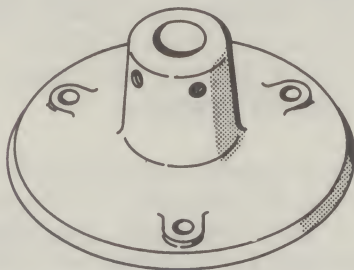
- 1. Remove engine from powered equipment, and then remove adaptors, pulleys, etc.
- 2. Clean exterior of engine with steam, air, or solvent,
- 3. Drain oil from crankcase, measure and examine (4-cycle engine).
NOTE: Clinton has (2) engine fixtures part number 951-24 and 951-65 that can be used to hold the engines for disassembly. (See Illustration No. 89.)

FIXTURE ENGINE REPAIR



***No. 951-24 FIXTURE - ENGINE REPAIR**

Used for VS200 and VS400 Repair, Testing and Display.



***No. TL-967 ENGINE STAND**

Used for display and repair of vertical shaft engines, either 7/8" or 1" Crankshaft Extension.

Figure 89

- 4. Remove tank and blower housing assembly.
- 5. Remove carburetor and governor linkage assembly. Mark all governor link and spring holes so that the links and springs will be installed in the proper holes when reassembled.

- 6. Remove muffler assembly.
- 7. Remove flywheel nut using 951-42 flywheel holder to hold flywheel from turning. (See Illustration No. 90.)

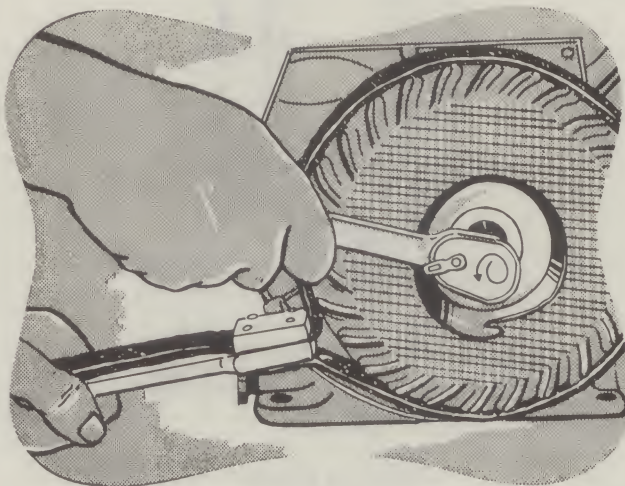


Figure 90

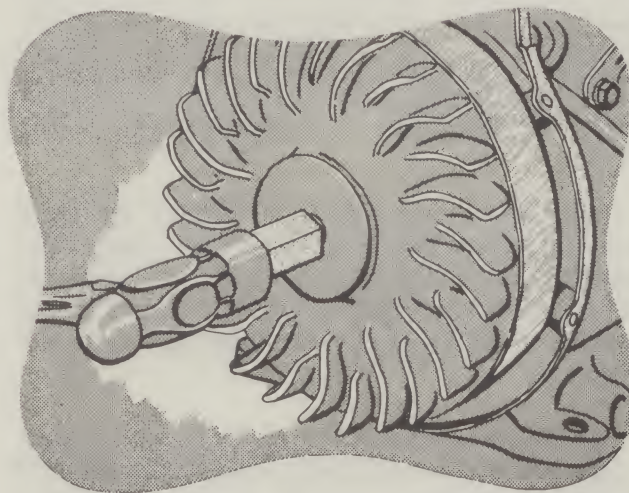


Figure 91

- 8. Using impact nuts 951-23, 951-36 or 951-66 (Illustration No. 91), turn nut on crankshaft within 1/8-inch of flywheel. Lifting up on flywheel with fingers, hit flywheel nut with steel hammer. This should break the flywheel loose from the crankshaft taper. In addition to the above impact nuts, Clinton has a flywheel puller 951-133 (Illustration No. 92), that can be used to loosen flywheel from crankshaft taper. The 951-133 should be installed over the rim of the flywheel and center screw tightened to 100 inch-pounds, and then the center screw hit with a steel hammer.

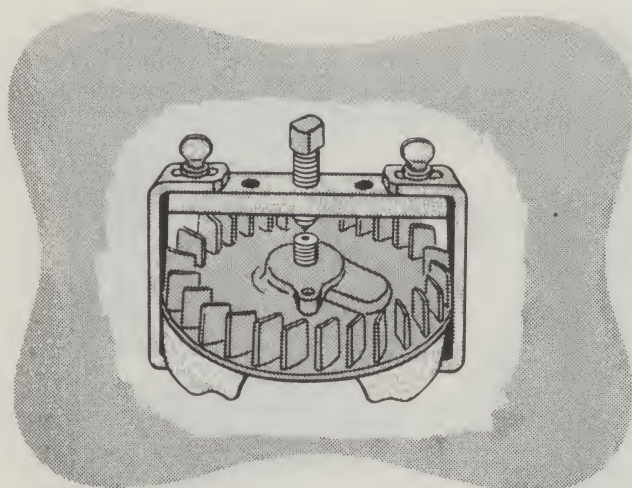


Figure 92

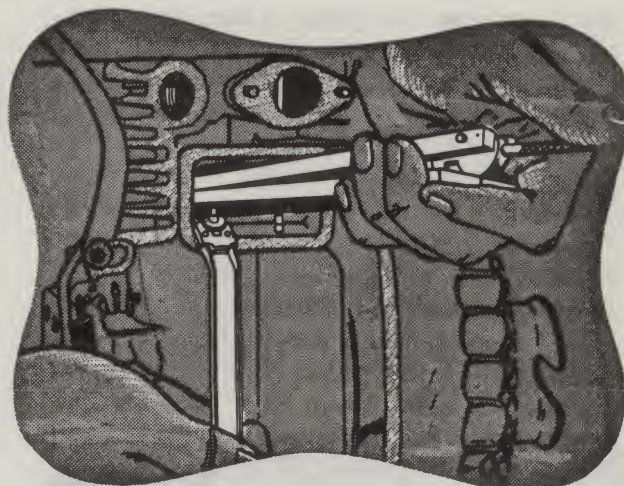


Figure 94

9. Remove flywheel and flywheel key.
10. Remove complete magneto assembly, this consisting of the coil, breaker points, condenser and lamination.
11. Remove cylinder head and gasket (4-cycle engine).
12. Remove valve chamber cover and breather ass'y (4-cycle engine).
13. Using valve spring compressor **951-67** or **951-32** remove valve spring keepers (4-cycle engine). (See Illustration Nos. 93 and 94.)

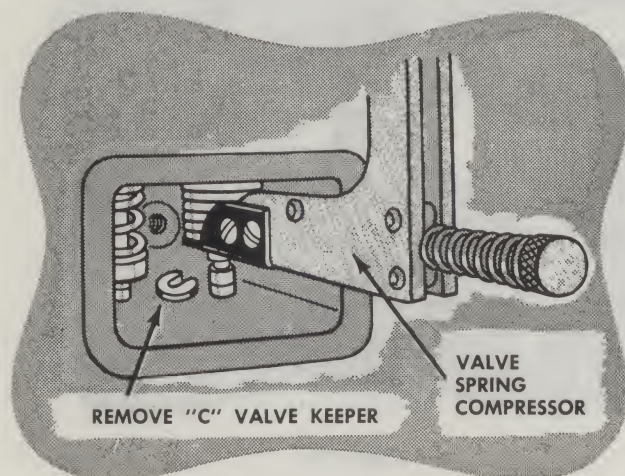


Figure 93

14. Remove valves and valve springs from block.
NOTE: In some cases it will be necessary to remove burrs from the valve stem lock groove before the valve can be removed from the guide hole. The burr can be removed from the valve stem by holding a flat file against the burred area and rotating the head of the valve. (4-cycle engine.) (See Illustration No. 95.)

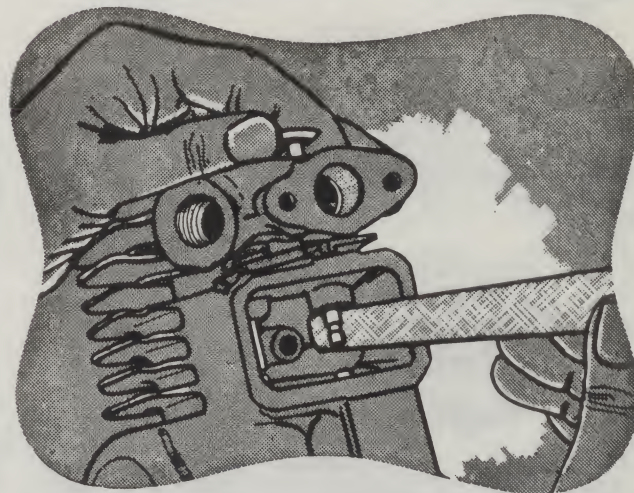


Figure 95

- 15A. Remove base plate or end cover assembly. This pertains to 4-cycle engine only. NOTE: On some engines the base is an integral part of the block and cannot be removed. If

this is so, the side plate on the power take-off side of the engine should be removed. Before removing the side plate or crankshaft make sure all paint, rust, and debris are cleaned from the area of the crankshaft the bearing is located, so the side plate can be removed easily. (See Illustration No. 96.) When removing the side plate of engines having ball bearings it will be necessary to remove the oil seal and the tru arc ring from the crankshaft before the plate can be taken completely off. (See Illustration Nos. 97 and 98.)

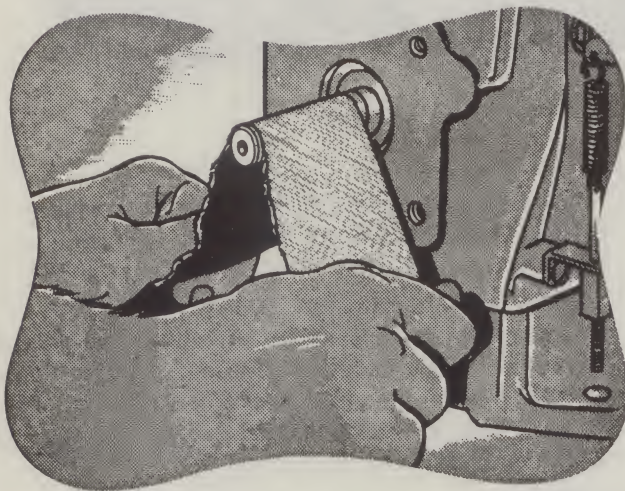


Figure 96

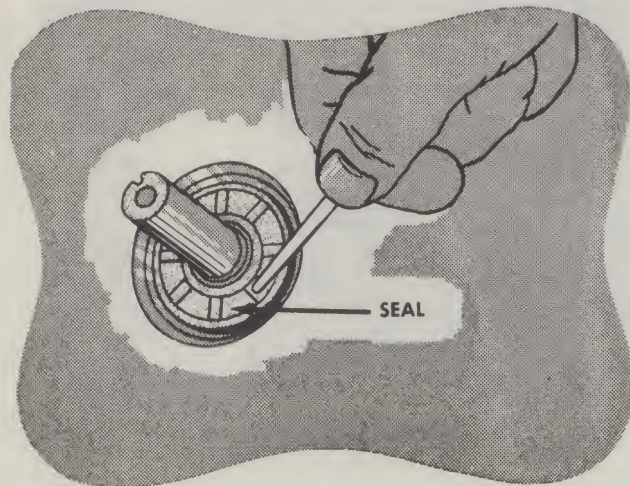


Figure 97

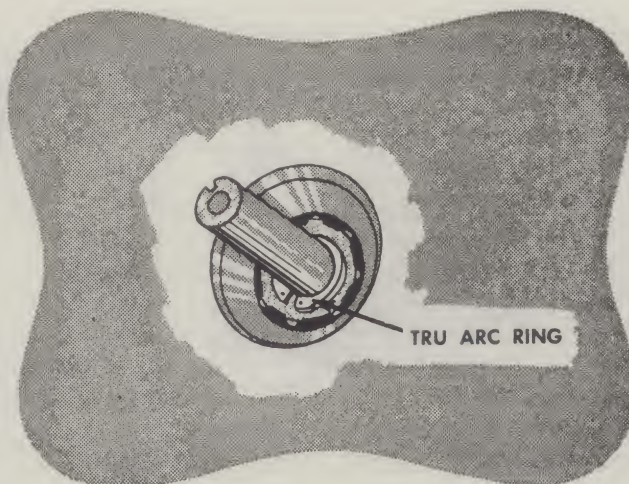


Figure 98

- 15B. Remove base mounting plate, and reed plate ass'y (2-cycle engine only).
- 16. Remove connecting rod screws and rod cap. The connecting rod cap and rod should be marked so that when they are reassembled they will be properly matched.
- 17A. Four-cycle engines should be checked for carbon or metal ridge in top of cylinder. If ridge is present remove with a ridge reamer or hone. (See Illustration No. 99.) The reason for this is to keep from damaging the piston when it is removed.

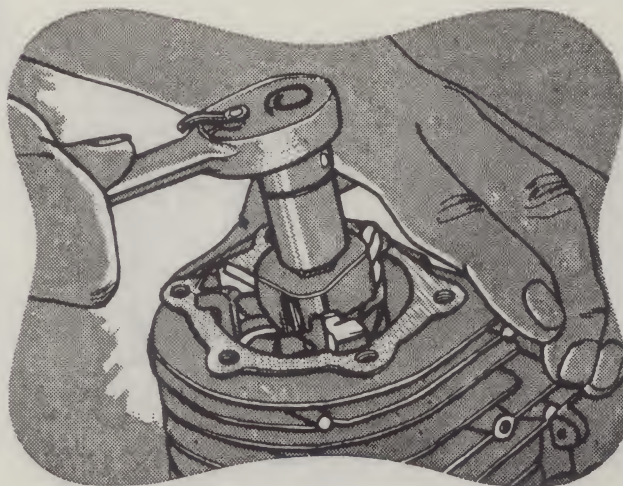


Figure 99

- 17B. Two cycle engines at this point should have the piston and rod assembly pushed as far as possible up into the cylinder, to keep the crankshaft from hitting the rod when it is removed.
18. Four cycle engines can now have the piston and rod assembly removed.
19. At this point if the engine being disassembled has a bearing plate on the flywheel side of the block, remove this plate.
20. Remove crankshaft. NOTE: On 4-cycle engines having a ball bearing on the power take-off side of the engine it will be necessary to remove (2) cap screws holding the bearing in place before the crankshaft can be removed. Also on some models with ball and tapered bearings it will be necessary

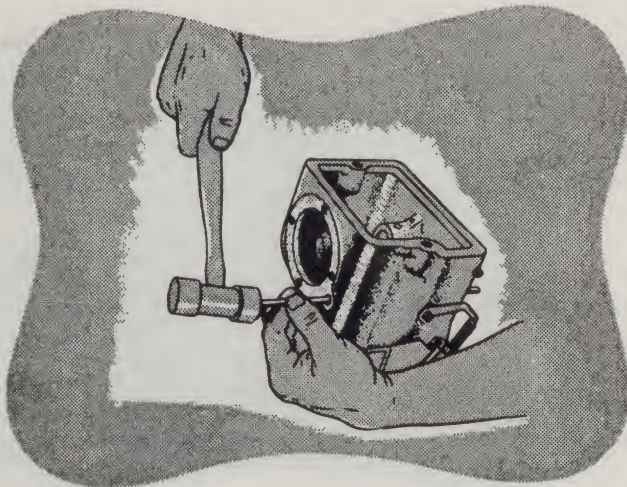


Figure 100

- to remove crankshaft oil seal, camshaft axle, and move the camshaft to one side before the crankshaft can be removed. Two-cycle engines having ball bearing on power take-off side of crankshaft will be necessary to remove the tru arc retainer holding the ball bearing in the pocket in the block.
21. Remove camshaft assembly. The camshaft axle on some Clinton Engines will have to be removed by use of a 951-46 cam axle driver and a steel hammer. (See Illustration No. 100.) When using the 951-46 drive, the cam axle should be removed by driving it out towards the power take-off side of the engine block; do not remove from flywheel side as the axle hole is smaller on that side.
22. Two-cycle engines can now have the piston ass'y removed.
23. After the camshaft is removed the tappets can be removed and marked as to whether they are exhaust or intake. The reason for marking these is if valve work is not required they will be installed in the proper place and the clearance between the tappet and valve will not have to be reworked.
24. The piston and rod assembly can be disassembled at this time.

When the disassembly is completed the individual parts can be reworked or replaced whichever is necessary to bring the parts back to the recommended operating tolerances. Before the parts are inspected or checked, it would be recommended that they be cleaned, by removing carbon or dirt and washing in a recommended cleaning solvent.

INTERNAL ENGINE INSPECTION AND REWORK

CYLINDERS

The block assembly should be given a visual inspection first to determine if it can be reworked. Check the following:

A. Cylinder bore for score marks; if cylinder score marks are too deep for oversizing a new block will have to be used.

B. Hole in block from rod failure, use new block.

C. Broken cylinder cooling fins can cause engine to overheat, replacement should be considered.

After making our visual check we can start checking the cylinder, valve guides and bearing bores of the block for size to determine the extent of work that will have to be done to bring these areas of the block back within the recommended service clearance.

GAUGING CYLINDER

Using a telescoping inside hole gauge with a dial indicator or a regular hole gauge and a micrometer check the cylinder in the ring travel, piston thrust side area. This check should be made at the top, and bottom of the ring travel area. This will tell you how much taper the cylinder has. Next; check the cylinder at 90 degrees of the previous reading. This will give you the out-of-roundness of the cylinder. (See Illustration Nos. 101, 102, and 103.)

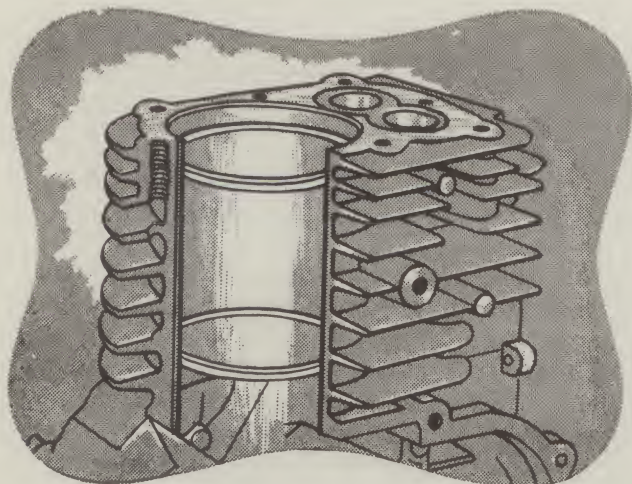


Figure 101

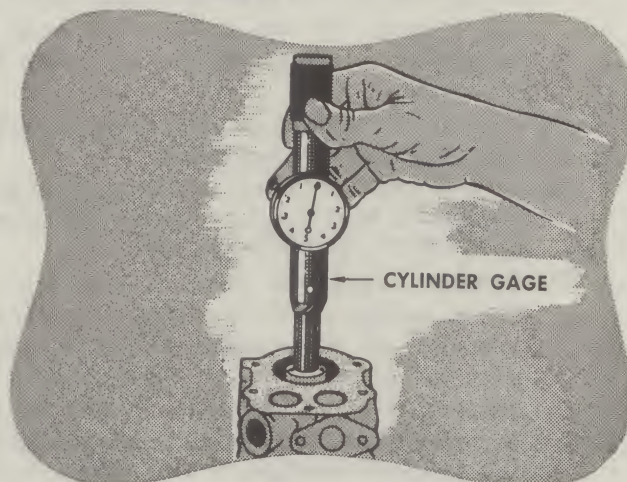


Figure 102

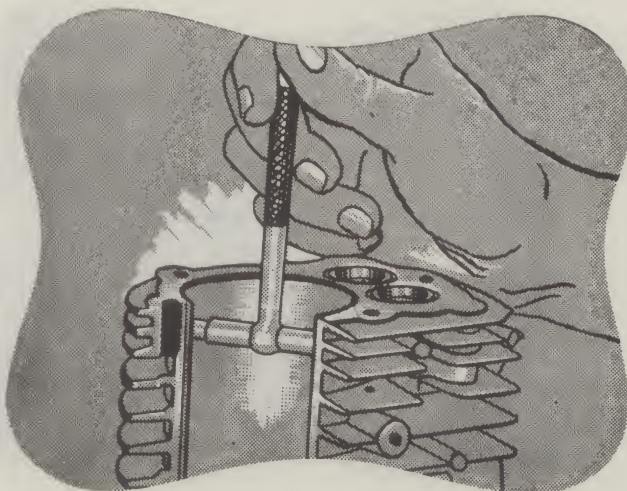


Figure 103

PREPARING CYLINDER FOR RINGS

If the cylinder checks out within the recommended service clearance, the high polish should be removed from cylinder by using a deglazer or finish hone with a stone grit number between 150 and 240. Follow the particular hone manufacturer's recommendation as whether or not to use honing oil. The deglazing operation should leave a cross hatch pattern with all vertical marks removed from the cylinder. (See Illustration Nos. 104 and 105.) The reason for the deglazing operation is so that the rings will seat in rapidly. If the glaze in the cylinder is not broken, there is a chance that the rings would not seat in at all resulting in excessive oil consump-

tion, loss of oil through breather and not develop maximum horsepower.

There are several methods that can be used to oversize or correct taper, out-of-round, or scored condition of a cylinder. The first step is to determine how much to oversize the cylinder to remove any score marks, taper or out-of-roundness. The cylinder can be reworked by using a hone, or boring-bar whichever is available. If the checks made on the cylinder are out of the recommended tolerance, the cylinder should be reworked to the nearest oversize.

Clinton has the following oversize pistons available: .010 and .020. This should be taken in consideration before oversizing the cylinder. The first step would be to take the cylinder bore out to .010 and if this does not remove the taper, out-of-roundness or score marks, the next step would be .020.

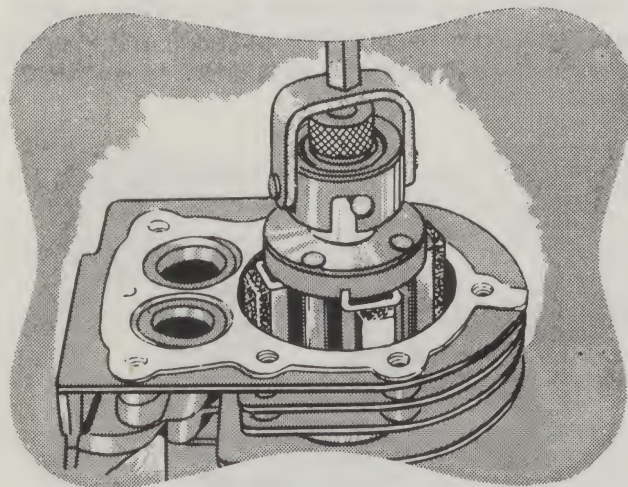


Figure 104

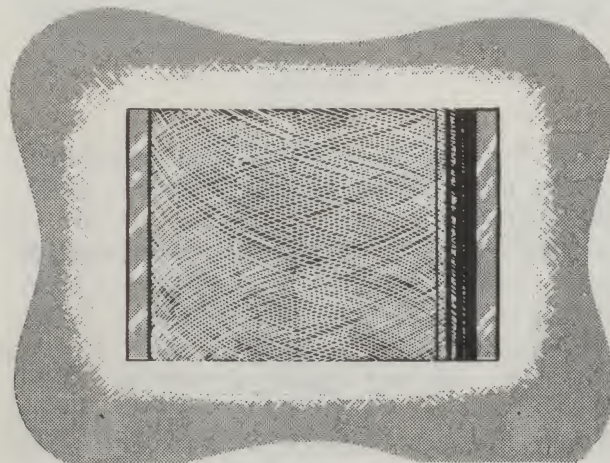


Figure 105

OVERSIZING WITH A CYLINDER HONE

If a standard cylinder is 2.375 inches and wear has changed it to a point requiring .010 oversize, it would be bored or honed out to a 2.375 plus .010 or 2.385. The .010 oversize piston will then fit with proper clearance. Oversize pistons are marked on the top with the indicated oversize. That is, 10, 20, etc. The following procedures should be followed in honing a cylinder oversize.

A. Clean a table of a conventional drill press to permit the cylinder block to rest on the table without rocking. If drill press is not available, a half-inch electric drill can be used as well.

B. Mount the cylinder hone in a chuck of the drill press, set the speed of the spindle to rotate 450-600 RPM.

C. Place the cylinder block on drill press table and center the spindle.

D. If oversizing, install a set of coarse stones in the cylinder hone and insert the hone in the cylinder.

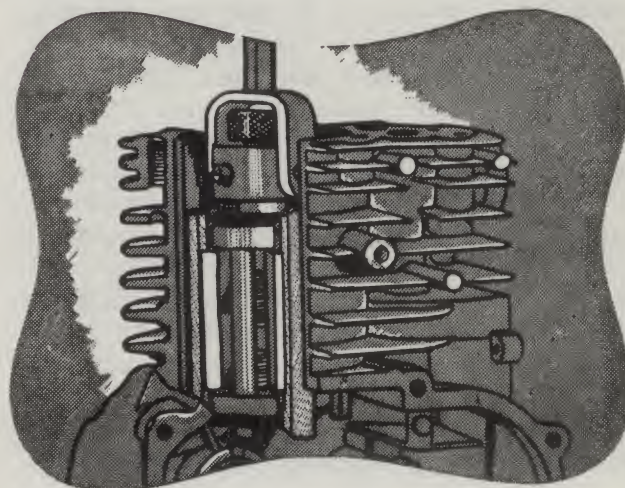


Figure 106-A

E. Lower the hone to the point where the lower ends protrude 1/2" to 1" past the bottom of the cylinder (see Illustration No. 106-A), then regulate travel upwards to the top of the cylinder so hone protrudes an equal distance at the top. After travel limits have been regulated, rotate adjusting nut until stone comes in contact with the cylinder wall at the narrowest point (normally crankcase end of cylinder). The amount of

tension applied is a matter of experience but apply tension and check by turning the hone by hand as tension is applied. If hone cannot be turned by hand, it is too tight in the cylinder. While honing, maintain a minimum stroke of about 40 cycles per minute of which each stroke should go to limit of travel from top to bottom and from bottom to top. Until one has experience in honing, the bore should be checked after approximately 40 cycles or one minute to see how fast the stones are cutting. An excellent indication of cylinder condition is the speed of the drill as a reduction of the drill speed during honing at either the top or the bottom of the cylinder indicates a smaller diameter and honing must be localized at such section until a drill speed is constant over 80 percent of the cylinder length, at which time the cylinder can be stroked fully from top to bottom to the limits of the regulated travel. The condition of the cylinder must be considered as it is possible to taper the cylinder, that is, to make it smaller at one end than the other by use of a hone if the varying sizes are not known prior to honing, or if the sound of the drill is not noted as an indication that the cylinder is not straight from top to bottom. In the use of hones, follow the hone manufacturer's recommendation as whether to use honing oil. If honing oil is not supposed to be used with a hone, on a cylinder, it is necessary that the oil be removed from the cylinder so that it does not affect the cutting action of the dry-type hone. If stones and/or buffers of the hone are collecting metal and stone debris, a wire brush can be used to clean them. If honing oil is recommended for a stone, and the stone and felt are building up with foreign material, it indicates that insufficient lubrication is being applied to the felts, and it will be necessary to remove hone from cylinder and clean both the stones and the felts with honing oil as the foreign material in the felts will feed on to the stones if only the stones are cleaned.

As the bore is straightened out during the honing process, continue honing with long full strokes carrying the hone through both ends of the cylinder approximately $1/2$ inch and not over 1 inch, and continue this honing until the cylinder is within .0015 to .002 inch of a desired finish size. *NOTE: Check cylinder with gauge to determine speed of cutting.* When cylinder is within the above range of size, remove the roughing stones and replace with finish stones with a grit between 150 to 280, and for rapid finish between about 150 and 240, and then finish cylinder bore to desired oversize. After using a hone in a cyl-

inder, the cylinder must be cleaned, and it is recommended that hot soapy water be used to remove the stone debris and the metal that has been removed. If this is not possible, it is necessary to at least clean cylinder carefully with a clean mop or clean rag soaked in SAE 10 engine oil to remove the metal and stone debris from the cylinder. (See Illustration No. 106-B.) After using either the mop or rag with the clean oil to remove foreign material, the cylinder can be wiped with a dry clean rag. When soap and water are used to clean the cylinder, the cylinder should then be dried and coated with clean oil to prevent rusting. In no case should a solvent, kerosene, gasoline, or other products of this nature be used to clean a cylinder, as it actually cuts the oil out of the cylinder and leaves the metal chip or stone debris embedded in the cylinder which can shorten ring life and cause damage to pistons. If the crankshaft, camshaft, and other moving parts are still in the engine while honing oversize, it will be necessary to carefully place oily rags over these parts prior to oversizing so that no stone or metal debris will be on these parts.

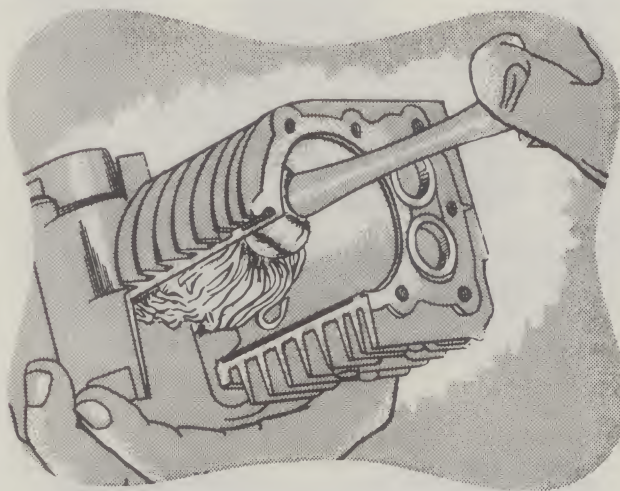


Figure 106-B

The 2-cycle engine or 2-stroke engine has a cylinder head integral with the block. When oversizing this block, it is preferable to "bore" it oversize for the most accurate oversizing job. Using a hone to oversize may result in a cylinder that is smaller at the head than at the crankcase end due to the inability of the hone to go through the cylinder equally in both directions. Also the stones may hit the top of the head and fill with die-cast material which would reduce their cutting. A hone can be used on the Panther block for deglazing and preparation for rings. It

is recommended prior to installation of new rings, that it be deglazed, and then cleaned as previously discussed.

OVERSIZING WITH BORING BAR

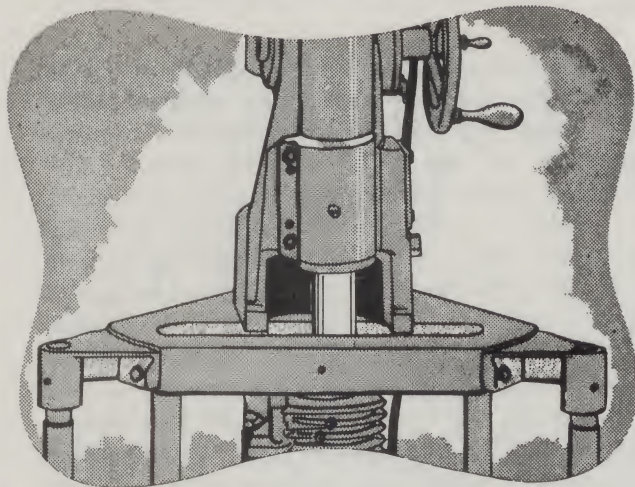


Figure 107

A boring bar is desirable for oversizing cylinders but care should be taken to maintain the cutting tool, as the tool and the rigidity with which the block is held in the fixture gives the finish on the cylinder. The boring bar tool can leave a thread from the top to the bottom of the cylinder consisting of many peaks and valleys such as a screw thread which will cut ring life, and actually in some cases, cause the ring to wheeze. An impurity in the cylinder bore may cause the tool to lose its cutting edge resulting in a rough cylinder. It is possible to bore a smooth enough finish for the use of rings to the cylinder wall but many engines are being bored oversize with a finish too rough for rings. (See Illustration No. 107.)

Check finish on each and every cylinder after boring to see that the finish compares to a hone finish, and that there is no tool chatter or that the tool has not been damaged by an impurity in the cylinder wall. *NOTE: For ease of ring installation, maintain 45 degree bevel between bore and top of block.* (See Illustration No. 108.)

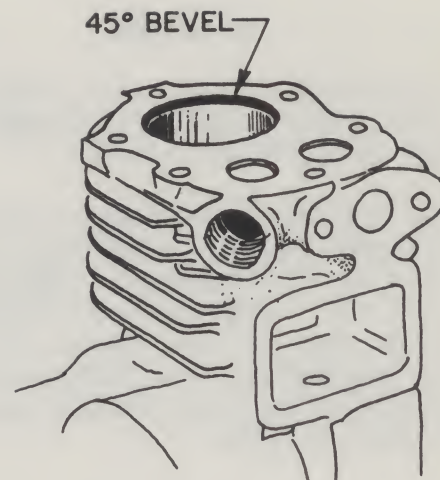


Figure 108

NOTE: See SECTION VI, DIV. H for cylinder bore, and piston dimensions.

BEARINGS

This section will also cover the bearing plate bearing as they normally would require the same service as the one in the block.

The first thing in servicing bearings would be to determine whether or not they are damaged or worn and need replacing. In the Clinton line you will find engines that have tapered roller bearings, ball bearings, needle bearings and sleeve bearings. The first we will cover will be the tapered roller, ball and needle bearings. (See Illustration No. 109.)

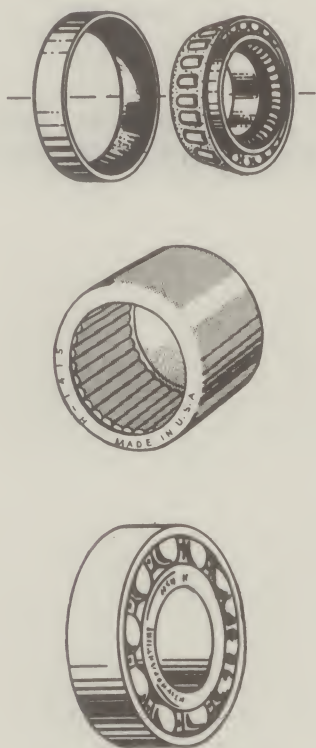


Figure 109

TAPERED ROLLER, BALL AND NEEDLE BEARINGS SERVICE

After the tapered roller or ball bearing equipped crankshaft has been removed from the block, the parts should be washed with a clean solvent to remove any dirt and should be visually inspected for condition of the roller or ball bearing. The bearing should be relubricated and rotated to check for damage to it. The tapered roller races mounted in the block, and the bearing plate should be washed, dried, and inspected for wear or roughness. If the race needs to be

replaced on either the bearing plate or block, the race can be impacted out using care not to damage the block or bearing plate and then a new race pressed back into the block or bearing plate.

If the roller or ball bearings do not pass visual inspection, or are rough after cleaning and lubrication, they can be removed from the crankshaft by use of a bearing splitter. The function of this splitter is to break the bearing free from the crankshaft by tightening down the two burrs which will start the bearing race to move, then the bearing can be pulled by use of a puller hooked to the splitter. (See Illustration No. 110.) The bearings should be replaced by pressing them on the crankshaft carefully so as not to damage the new bearing. Support the crankshaft so that the crankpin is not distorted due to the pressure needed to replace roller or ball bearings. (See Illustration No. 111.)

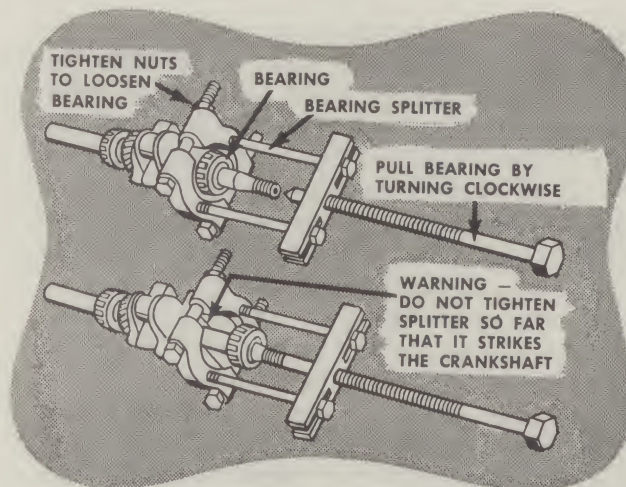


Figure 110

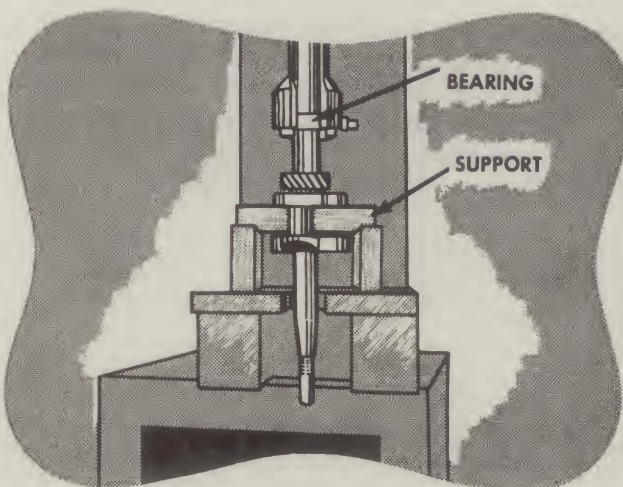


Figure 111

After the roller bearings are replaced on the crankshaft, and as the engine is reassembled, care should be taken to check end play on the roller bearing equipped crankshaft, these bearings should have at least .001 crankshaft end play and not over .006 end play. The end play can be checked by a dial indicator on end of crankshaft or by thickness gauges under fly-wheel. Use metal block on bearing plate to check with thickness gauge. End play can be controlled by different thicknesses of bearing plate gaskets. The different size bearing plate gaskets for the respective engines are listed in Section II, Basic Parts List of the Service Manual.

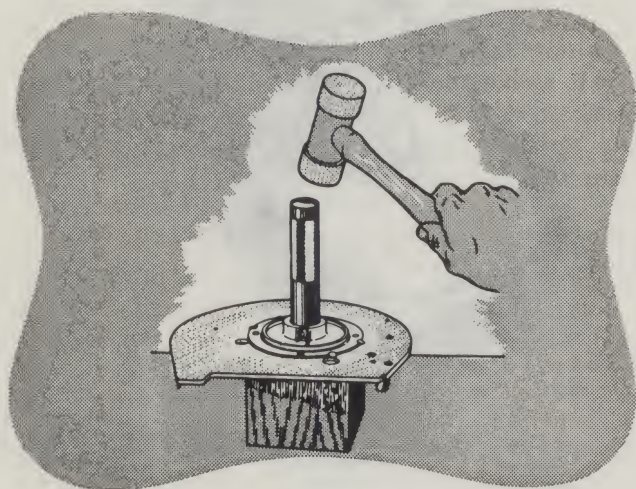


Figure 112

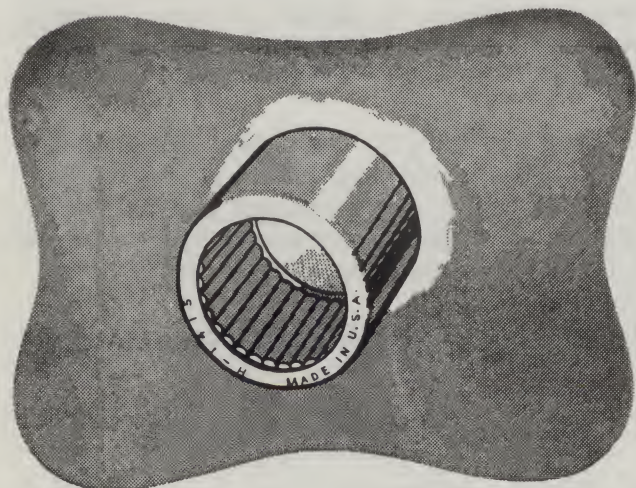


Figure 113

Many engines have used needle bearings, and these should be cleaned, lubricated, and checked for general wear. When these needle bearings are very loose in the cage, the caged bearings should

be removed by use of a driver with no particular care other than using care on the bearing plate or power take-off housing to prevent it from being damaged. (See Illustration No. 112.)

When a needle bearing is being replaced with a new caged bearing, care should be taken to drive only on the identification side. (See Illustration No. 113.) This is the side which should be used in applying pressure to move the bearing into position in the bearing plate or PTO housing. If the cage is damaged on replacement of needle bearings the bearings will damage the crankshaft readily. It is not recommended that needle bearings be used to replace sleeve bearings.

SLEEVE BEARINGS

When checking sleeve bearings in the block and/or bearing plate, the first check would be a visual to determine if the bearing surface is scored or damaged. Next the bearing diameter should be checked with a small hole gauge and micrometer for size, check in several spots. (See Illustration No. 114.) If the bearing surface is scored, damaged or worn oversize, the bearing area of the block or bearing plate should be reworked, to bring it back to the recommended service condition. In some of the die cast aluminum engines you will find that the bearing surface is the same material as the block, however these can be reamed out and sleeve bearings installed. We will proceed to cover the installing of sleeve bearings in the die cast aluminum block that originally did not have sleeve bearings installed at the factory. The first step would be to fasten the 951-48 alignment plate to the block or

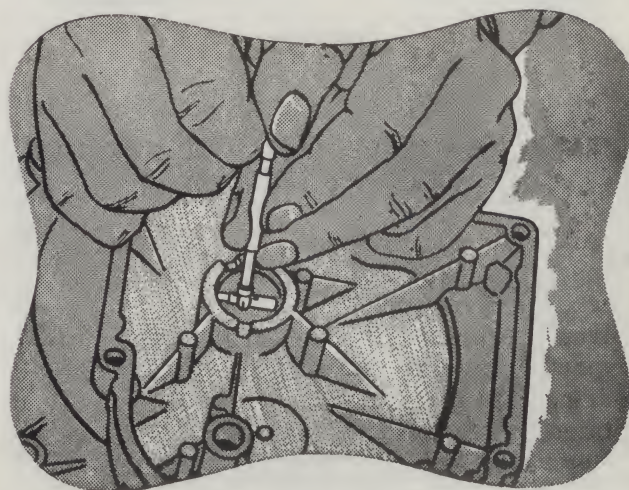


Figure 114

bearing plate; whichever might be the case, fasten the plate to the block or bearing plate with bolts using the dowel pins or dowel pinholes and pilots to align the 951-48 plate to the part being reworked. (See Illustration Nos. 115 and 116.)

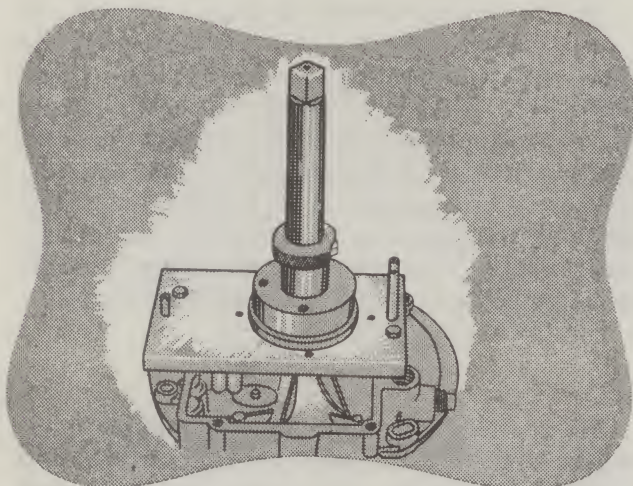


Figure 115

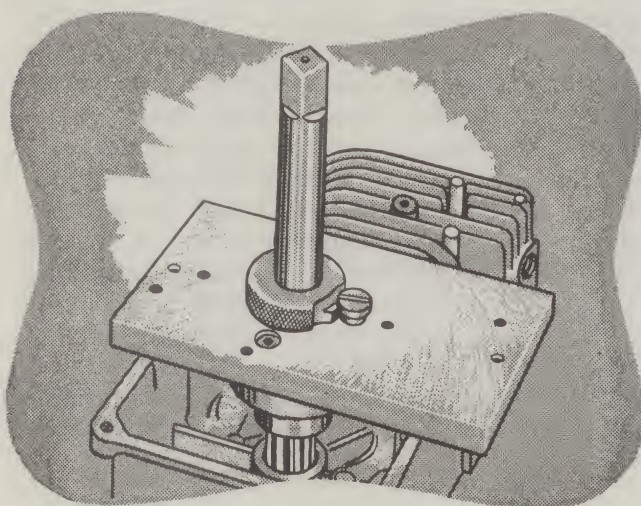


Figure 116

After the 951-48 alignment plate has been fastened to the block or bearing plate, (Refer to Service Bulletin #54 for proper reamer) use the proper bushing and rough reamer, turn reamer in a clockwise rotation until complete bearing surface has been reamed. After the rough reaming operation, use a finish reamer to straighten the bearing bore before the bearing installation. Using the proper bearing and bearing driver install bearing in block or bearing plate so that the bearing oil hole aligns with the oil passage or slot in block or bearing plate whichever might be the case. (See Illustration No. 117.) The bearing should be recessed approximately 1/32 of

an inch below the crankshaft thrust face of the block or bearing plate. **CAUTION:** The block or bearing plate should be supported in the bearing area when the bearing is being driven into place to keep from distorting the bearing alignment with the mounting face.

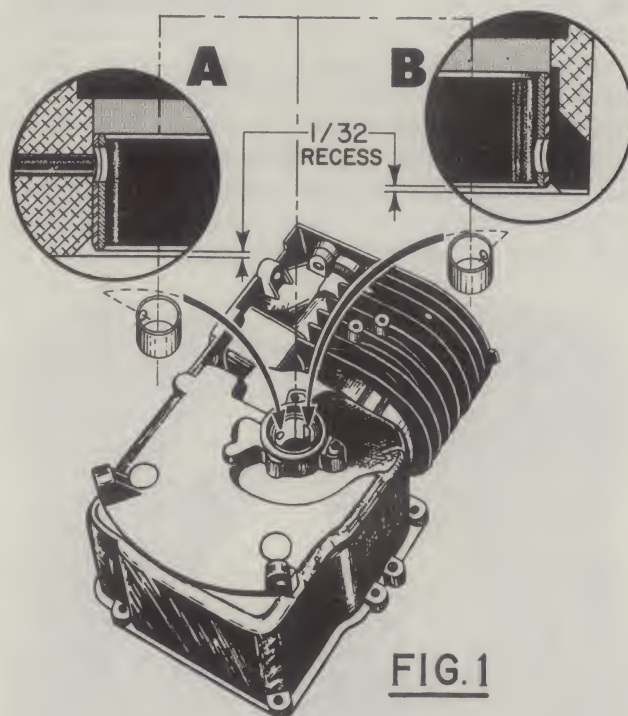


Figure 117

After the bearing is in place finish ream the bearing installed using the 951-48 alignment plate and proper bushing and reamer. The part reworked should be cleaned of cuttings and oil passages checked to make sure they are not obstructed.

When servicing blocks or bearing plates that need bearings replaced, and the part being serviced has had a sleeve bearing installed at the factory as original equipment, these can be serviced as follows: (See Service Bulletin #54 for proper reamer)

- A. Remove old bearing using proper driver and supporting the block and/or plate in the bearing area so that the part is not distorted. (See Illustration Nos. 118 and 119.)
- B. Install new bearing using care so the oil hole in bearing is aligned to the oil passage in block or bearing plate. Drive bearing into block or plate so that it is recessed approximately 1/32 of an inch from the crankshaft thrust face of the block or plate being serviced.

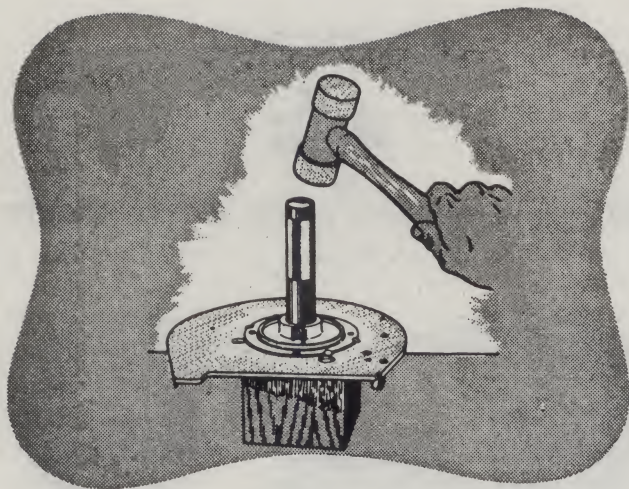


Figure 118

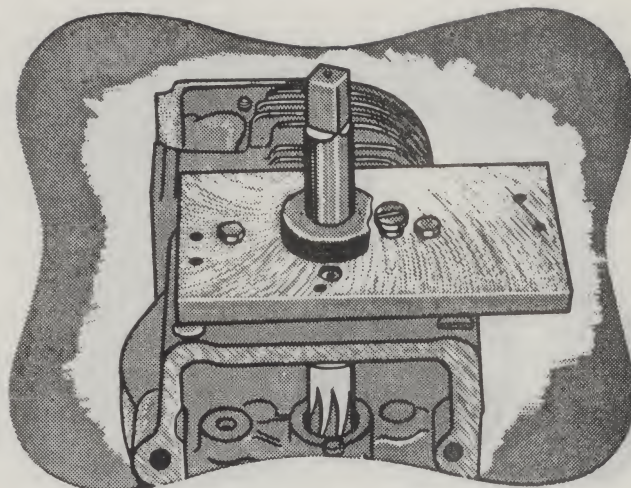


Figure 120

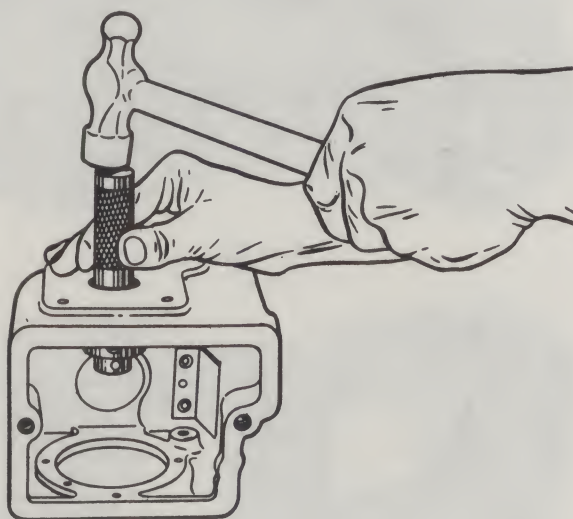


Figure 119

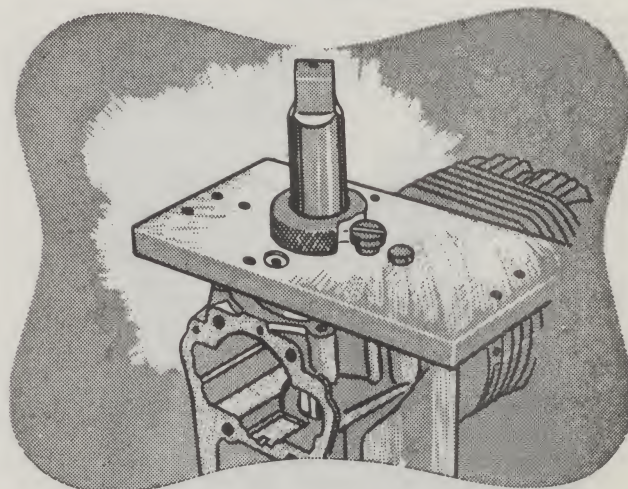


Figure 121

- C. Attach 951-48 alignment plate to the block or bearing plate that the new bearing has been installed in (See Illustration Nos. 120, 121, 122 and 123.) **NOTE:** Some bearing plates require the block to be used instead of the alignment plate, for reaming the bearing. (See Illustration No. 124.) (Refer to Service Bulletin #54 for proper reamer.)
- D. Using the proper finish reamer and bushing, ream the new bearing that was replaced. **CAUTION:** Always turn the reamer in a clockwise rotation even when removing, or the reamer will be damaged.
- E. After finish reaming the bearing, clean metal cuttings and debris from block or plate reworked, making sure the oil passages in the block and/or plate align with the bearing, and are open.

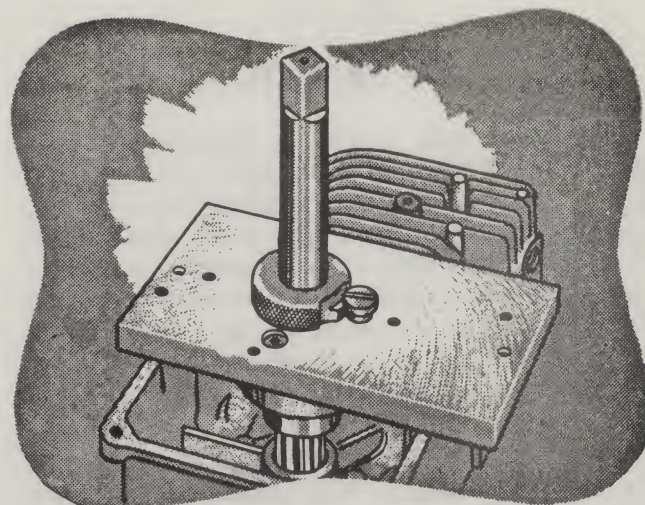


Figure 122

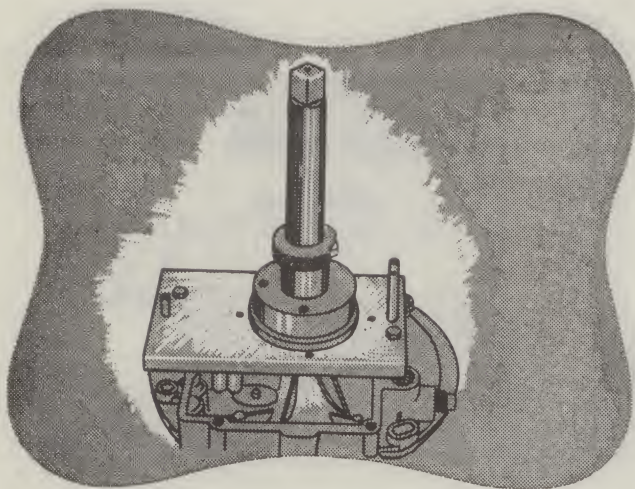


Figure 123

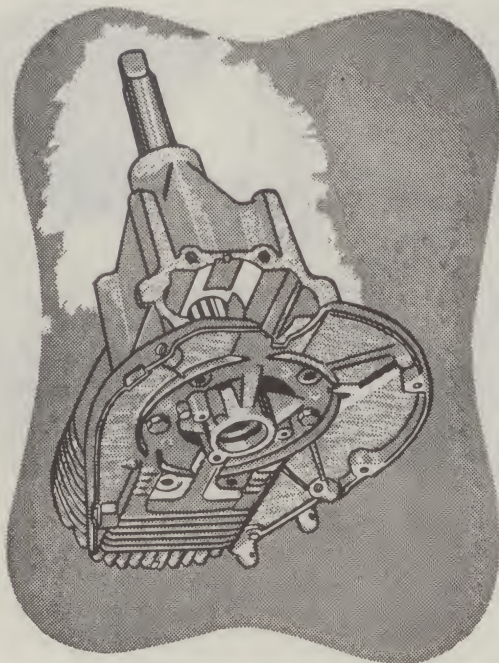
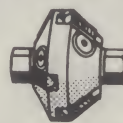


Figure 124

VALVE SEATS

The valve seat in a block must be reworked when a valve is refaced or replaced. Two tools are in common use for reworking valve seats, and either is acceptable. The cutter 951-37 (see Illustration No. 125), or a commercially available valve seat grinder may be used. Illustration No. 126 shows the use of 951-37, which is the cutter used to secure a 44 degree seat. Automotive type equipment can be adapted to air-cooled engines, if pilots of proper size are available. The hard seat grinders are being manufactured for use especially for air-cooled engines with guides and stones designed for this usage. (See Illustration No. 127.)

VALVE SEAT CUTTER



* No. 951-37 CUTTER - VALVE SEAT (44° & 30°)

Figure 125

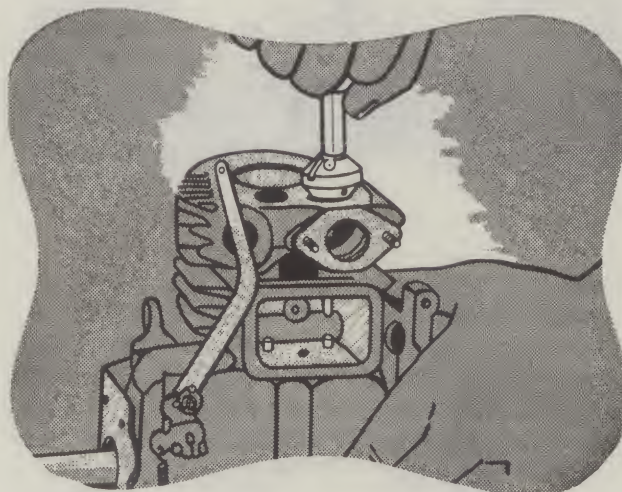


Figure 126

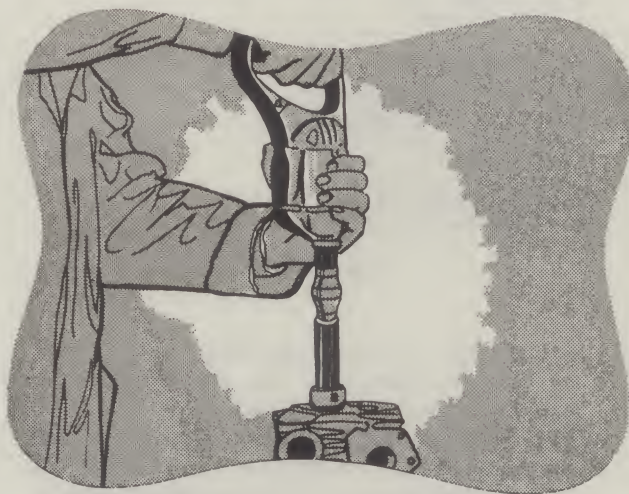


Figure 127

The pilot used in conjunction with the cutter or stone must be snug in the guide to secure a valve seat that will be true to the guide. The 951-58-500 pilot ass'y is used in conjunction with the 951-37 valve seat cutter. The 951-58-500 pilot ass'y consists of the following pilots: 951-137, 951-138. for standard 1/4 inch (.250), 951-139-3 .010 oversize (.260), 951-140 9/32 oversize (.282) for valve guides. The pilot used for guides having a .312 to .313 diameter is a 951-38-500

When reworking valve seats it is necessary to cut away all of the oxidized metal until new and solid metal is exposed. A good seat will normally have a brighter appearance than a surrounding metal. Using a cutter, apply steady pressure directly downward to minimize the possibilities of not having the seat true to the guide. In applying pressure, excess pressure can cause the cutter to chatter making the seat unsuitable for use, and it is difficult then to remove the irregularity caused by chatter and secure a seat suitable for sealing to the valve face.

The recommended valve seat angle is between $43\frac{1}{2}$ and $44\frac{1}{2}$ degrees as shown. Recommended valve seat width is between $\frac{1}{32}$ to $\frac{3}{64}$ (.030 to .045) of an inch. (See Illustration Nos. 128 and 129.) In reworking a seat it is common to secure a seat width wider than the maximum recommended and is then necessary in use of 951-137 to turn the cutter over to the opposite side and narrow the seat width with the 30 degree cutter. After narrowing the seat, reverse the cutter to the seat cutting angle and turn cutter lightly one or two revolutions to remove the burrs that may have been turned into the seat from the previous operation. Where cutters stop, there will be burrs across the seat, and the valve will not be able to close and seal tightly unless these burrs are removed.

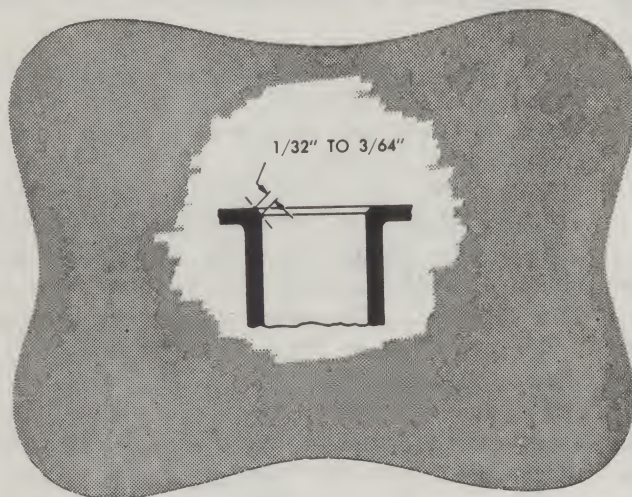


Figure 128

By using a fine grade of lapping compound these burrs can be removed assuring a more satisfactory seal between valve face and valve seat. The 951-136 lapping tool can be used in lapping operation. (See Illustration No. 130) When deburring a valve seat by applying lapping compound to it and rotating the valve

against the seat, move it around or rotate it a few times until the lapping compound produces a dull finish on the valve face which should indicate that the seat is satisfactory for usage. The valve seat width will be reflected by the scarring or dulling of finish on valve face.

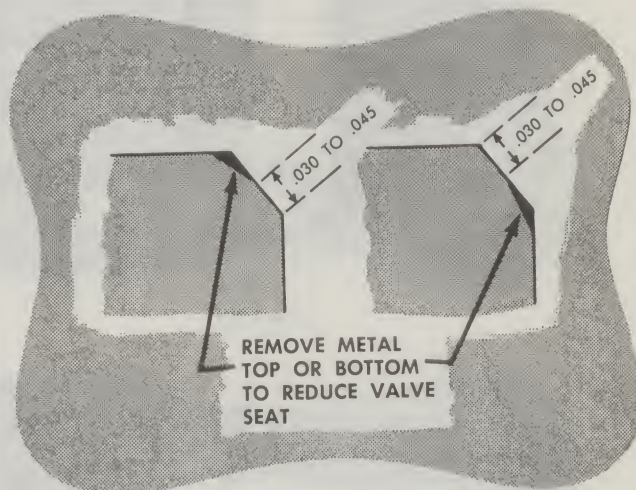


Figure 129

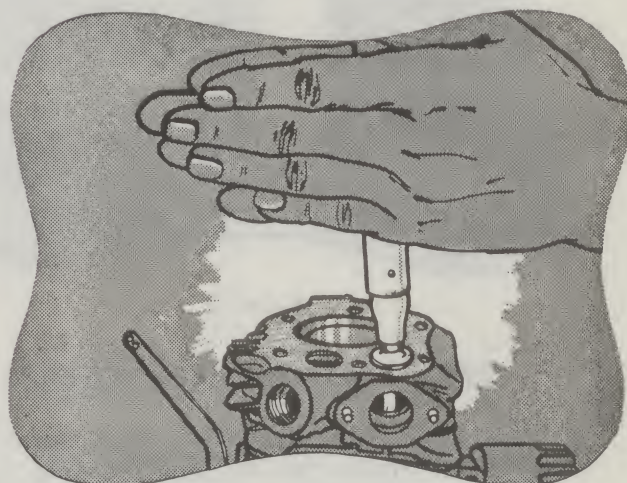


Figure 130

Due to the expansion of the block and valves when the engine is brought up to operating temperatures, heavy lapping is not recommended. Excessive lapping can result in a rounded seat and under heavy lapping conditions could groove the face of the valve. (See Illustration Nos. 131 and 132.)

After reworking valve seats, carefully clean with solvent all lapping compound, if used, and metal residue from seats, guides, cylinder block, and dry with compressed air.

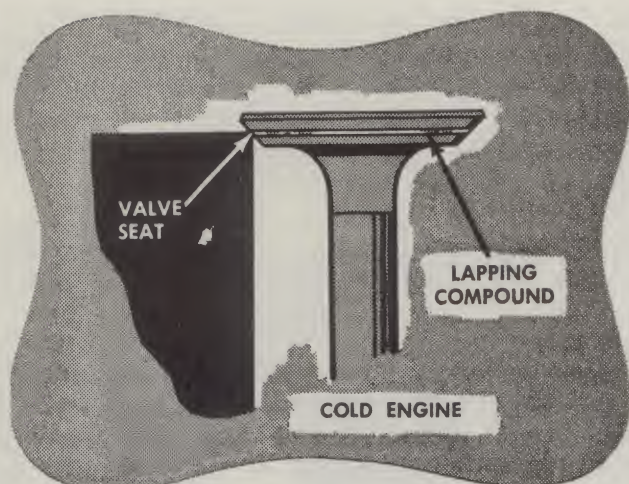


Figure 131

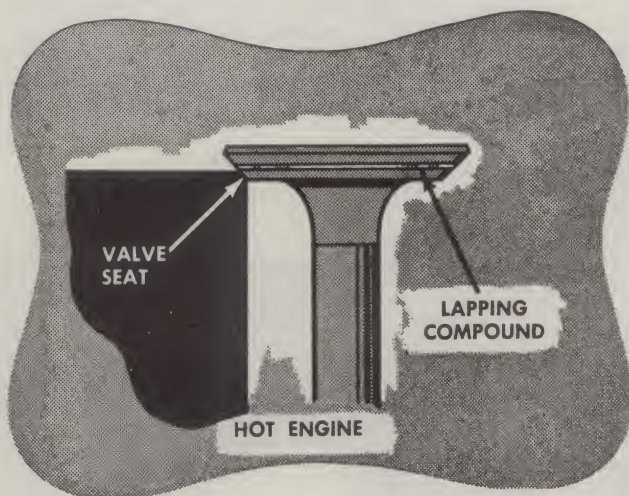


Figure 132

INSTALLING VALVE SEAT INSERTS

When the valve seats have been reworked a number of times they become too deep in the block, which requires that too much stock be removed from the valve stem to get the proper valve to tappet clearance, and also the valve spring tension is not adequate. A good gauge of when a valve seat has been cut too deep in the block would be to compare the end of the valve stem removed from the engine with a new one, if over half of the metal from the (C) lock groove (Illustration No. 133) to the end of the valve had to be removed to get the proper clearance between the tappet and valve, consideration should be given to installing a new valve seat insert in the block. In the Clinton line you will find aluminum die cast, and cast iron engine blocks. The aluminum die cast engines have valve insert seats installed at the factory which can be re-

moved and replaced. The cast iron engines normally do not have valve insert seats installed at the factory; however, service tools are available for installing valve inserts in the field.

We will first cover the removal and replacement of the inserts in the aluminum die cast engines, and then the installation of inserts in the cast iron engines.

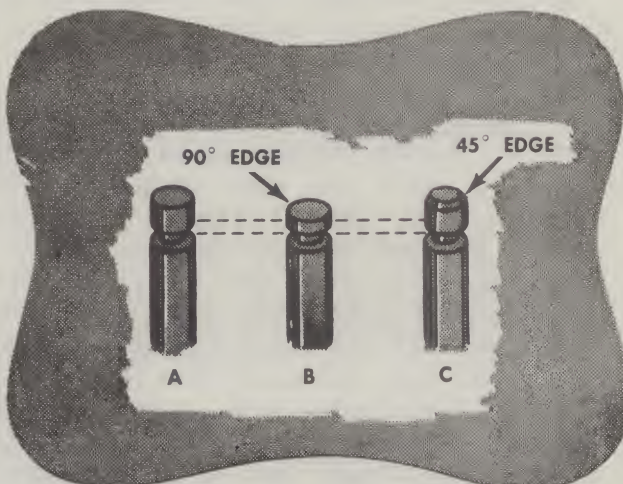


Figure 133

REMOVING AND INSTALLING VALVE SEAT INSERTS IN ALUMINUM DIE CAST ENGINES

When the standard valve seat is to be removed and replaced, the first step is to remove the metal that has been rolled over the upper, outer circumference of the insert by using a 951-41 cutter and 951-58-500 pilot ass'y. If the seat is loose, obviously this is not necessary. The actual dimension of the Gem series insert is .040 oversize. The oversize insert number is 136-22. The cutter used is approximately .038 oversize so there is a definite press fit when installing this insert. After the metal lip has been removed from over the insert, the insert can be removed by using a long punch to drive the insert out. The intake seat, and the exhaust seat can be removed in a similar manner if a curved tool is used. Care should be exercised to keep from damaging the cylinder block. (See Illustration No. 134.) After the seat has been removed, or if the seat was loose, then use the cutter 951-41 and cut the block to the proper depth of 3/16 inch to 7/32 of an inch. (See Illustration Nos. 135 and 136.) This is the depth of the insert plus 1/32 of an inch which is used to hold the inserts in place. The pilot must be tight in the valve

guide or the cutter will cut oversize. Take periodic measurements so that cutter does not go too deep. In using 951-41, operate it by use of a hand tool and do not press down with much pressure as the single edge cutter will gouge and damage the pilot.

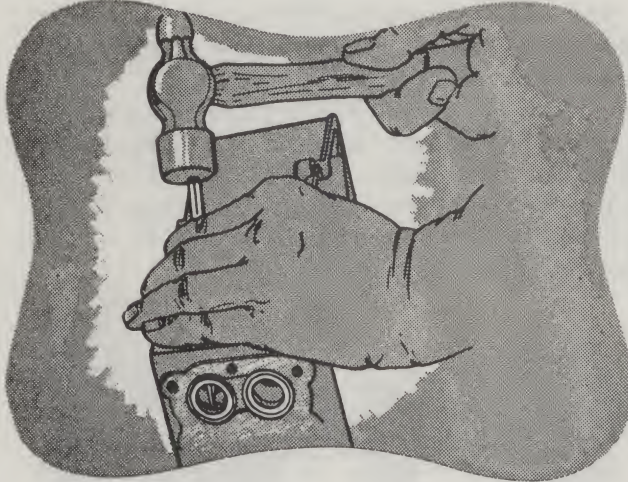


Figure 134

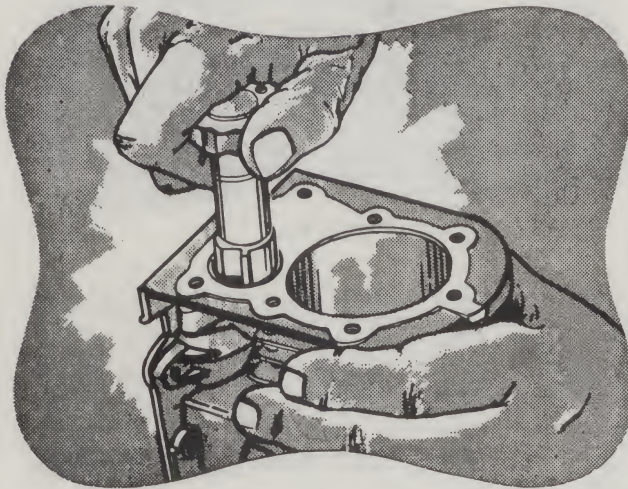


Figure 135

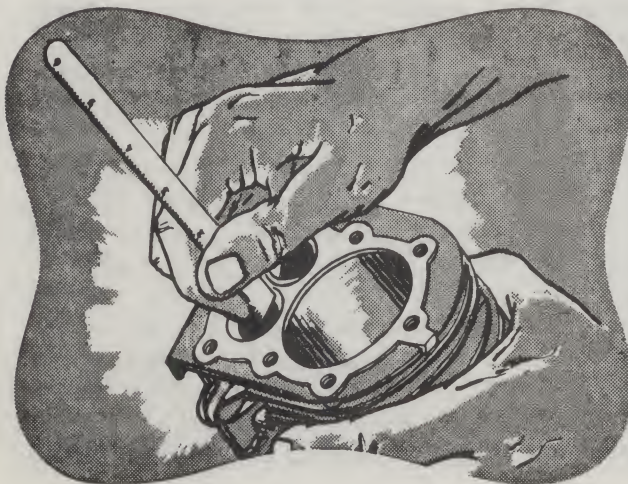


Figure 136

After the block has been prepared for the insert by the use of the respective cutter, clean up the bore by use of compressed air so that there are no metal chips. Clean the chips out of the engine carefully. If cleaning is done before the pilot is removed, the chips would not be in the valve guide or valve chamber. In installation of an insert, it is recommended that the insert be chilled to aid in the insertion. The insert can be placed in the block by the use of the driver 951-52.. (See Illustration No. 137.) Install the insert so that the 45 degree bevel is up toward the driver as this will aid in moving metal over the insert for holding it in place. (See Illustration No. 138.) Do not drive on a solid object when driving the insert in place as it will tend to distort the block. The insert can be installed by holding the block against the body which will minimize block distortion.

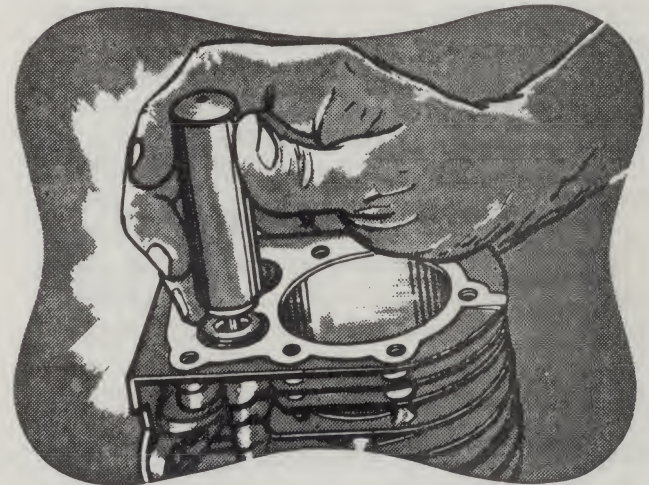


Figure 137

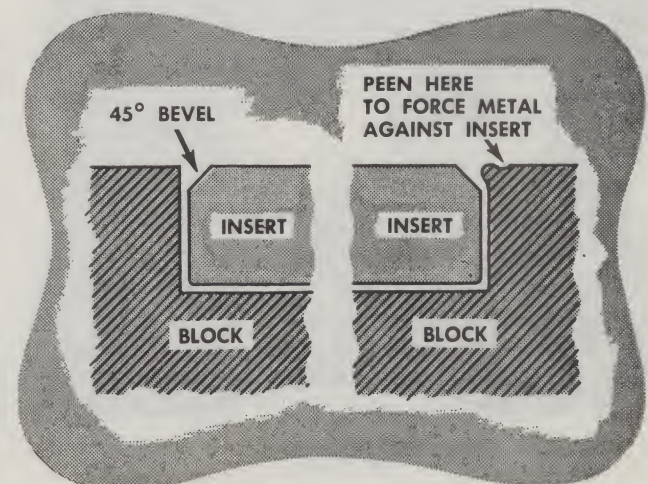


Figure 138

CAUTION: Be sure the driver does not contact the tappet as damage can result to cam and/or cam axle.

After the insert is in place, the metal should be peened over the top edge of the insert using the tool 951-53. (See Illustration No. 139.) The peening is very necessary on die cast material. Tip the tool to aid in moving metal toward insert. Be sure the insert is staked firmly in place all the way around the insert. Criss-cross to start the staking operation or insert may be moved or driven off center to the guide resulting in a variation of seat width. If the cylinder is to be deglazed or oversized on the Gem series engines, this deglazing or cylinder rework should be done prior to installation and staking in of the insert as installation of the insert can temporarily distort the cylinder bore at the top. After inserts have been installed, be careful in installation of piston and rings. It is recommended that engine be operated at no load or less than 50 per cent load for at least two hours after installation of the insert in the die cast engine block. The heat from the engine operation will minimize any distortion to the block. Heating block at not over 425 degrees F. for 2-1/2 hours or more and then cooling it out would minimize distortion and allow the cylinder to be deglazed or oversized after insert installation in die cast blocks. **NOTE:** This distortion to the cylinder block will vary from serviceman to serviceman due to the difference in severity of impact used to stake inserts, and also will vary due to the angle that the tool is held in relation to the insert. The straighter the tool is held, the more possible distortion to the cylinder itself.

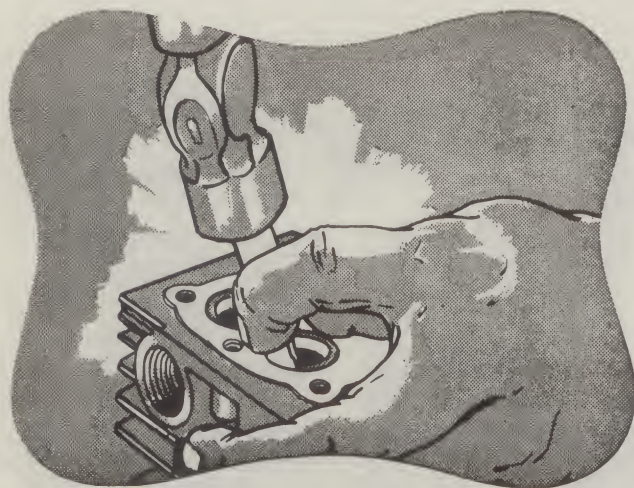


Figure 139

After the valve inserts have been installed the valve seats can be reworked as previously outlined.

INSTALLING VALVE INSERTS IN CAST IRON BLOCKS

The cast iron engine blocks normally do not have valve inserts in them, so a pocket has to be cut in the block with a cutter 951-61, and using the 951-58-500 pilot ass'y. The standard insert for the cast iron block engine is a part number 136-16. The pilot must be tight in the valve guide or the cutter will cut the pocket oversize. There is a depth gauge on the 951-61 cutter to control the depth of the insert bore being cut.

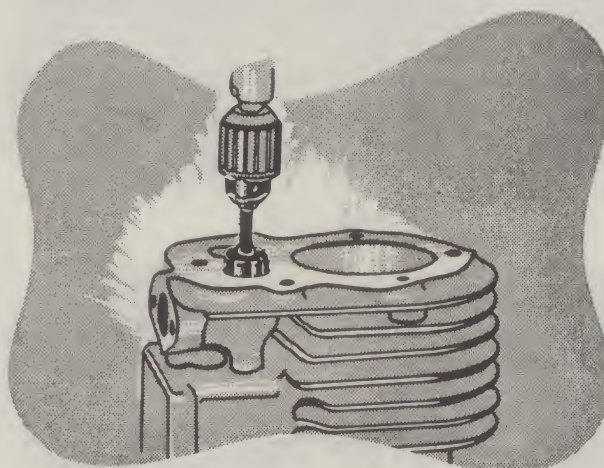


Figure 140

When using the 951-61, it can be used in conjunction with a half inch electric drill and pressure should be applied to keep the speed of the drill low and to maintain steady feed and a steady cut. (See Illustration No. 140.) A drill press can be used, but it must be in a very good condition as any tendency for the spindle or cutter to wobble in the spindle of the press would result in oversizing of the bore and the insert would be loose. The drill press should be operated as slow as possible, and if possible at 300 RPM for proper cutting. It is very essential that the pilot used in conjunction with the 951-61 be very tight in the guide and that the top of the pilot be lubricated so that the cutter will not overheat the pilot and pick it up which would cause oversizing. Check cutter to pilot prior to insertion of pilot to assure that they operate freely. It is recommended that the 951-61 be used on a scrap block first to learn the usage of the tool. After the block has been prepared for the insert by the use of the respective cutter, clean up this bore by use of compressed air so

that there are no metal chips. Clean the chips out of the engine carefully. If cleaning is done before the pilot is removed, the chips would not be in the valve guide or valve chamber. In installation of an insert, it is recommended that insert be chilled to aid in the insertion. The insert can be placed in the block by the use of the driver 951-52. (See Illustration No. 137.) Install the insert so that the 45 degree bevel is up toward the driver as this will aid in moving metal over the insert for holding it in place. (See Illustration No. 138.) Do not drive on a solid object when driving the insert in place as it will tend to distort the block. The insert can be installed by holding the block against the body which will minimize block distortion.

CAUTION: Be sure the driver does not contact the tappet as damage can result to cam and/or cam axle.

After the insert is in place, the metal should be peened over the top edge of the insert using the tool 951-53. (See Illustration No. 139.) Tip the tool to aid in moving metal toward insert. Be sure the insert is staked firmly in place all the way around the insert. Criss-cross to start the staking operation or insert may be moved or driven off center to the guide resulting in a variation to seat width.

After the valve inserts have been installed the valve seats can be reworked as previously outlined.

Listed below is a cross reference for valve insert seat usage.

	.040		
	Standard	Oversize	Stellite
4-Cycle Aluminum Die Cast Block	None	136-22	136-33-990
Cast Iron Block Engines under 5 Horsepower	136-16	None	136-17
Cast Iron Block Engines over 5 Horsepower	136-24	None	136-90-99C

At the present time Clinton does not have a tool for cutting the valve insert seat pocket in the engines over 5 H.P., however an automotive type valve insert seat cutter can be used.

VALVE GUIDES

Clean carbon from valve guide seats, ports, and block prior to checking and rework. A small hole gauge and micrometer can be used to check valve guide size. (See Illustration 141.) In using a small hole gauge, care should be used not to force it as it will misread as to the guide size. The guide should be checked at top and bottom, and also rechecked 90 degrees, to first checks made to determine an out of round condition. **CAUTION:** In using small hole gauges, certain gauges contact on edges and do not give a true reading.

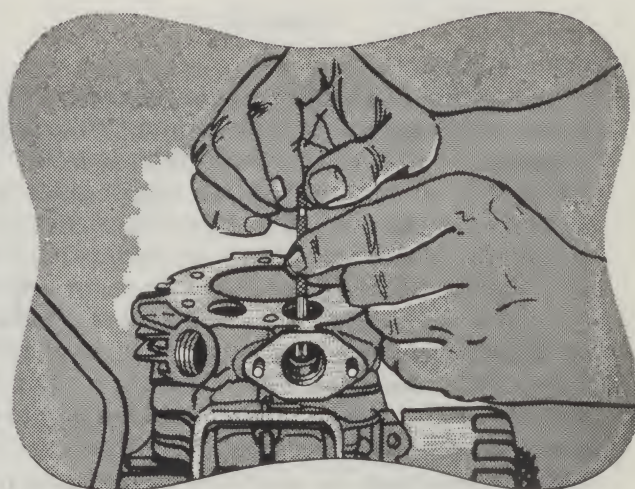


Figure 141

Standard guide size 4-cycle engines under 5 H.P. .2495 to .2510.

Standard guide size 4-cycle engines above 5 H.P. .312 to .313.

When the valve stem to valve guide clearance is over the maximum service clearance and cannot be corrected by the use of a new valve, the valve guide should be reworked by oversizing, knurling, or replacing the guide. (See Section VI, Div. H for valve to guide clearances.)

The 1600, 1800, 2500, 2790, 414-0000-000, 418-0000-000, 420-0000-000 and 422-0000-000 have replaceable valve guides and can be reworked by installing a new valve guide, if they are worn or damaged. (See Illustration No. 142.)

REPLACING VALVE GUIDE

The guides can be removed by using a press to press them from the base side to the cylinder head side.

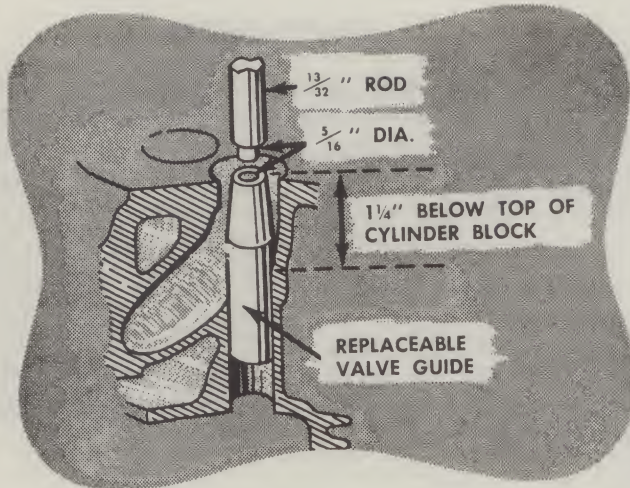


Figure 142

A tool for removal can be made from a 13/32 round stock by grinding a step to fit the inside diameter of the valve guide which is 5/16. The 13/32 rod will fit through the tappet guide with sufficient clearance. The position of the valve guide should be noted prior to removal and the new guides pressed into place by reversing the previous procedure. The new guides should be at least 1-1/4 inches below the top of the cylinder block. (See Illustration No. 142.) After replacing valve guides, it may be necessary to remove burrs caused by insertion, these burrs can be removed by use of a 5/16 (.312) inch reamer. Rework valve seats after guides have been replaced. If press is not available, it is possible to remove guides by using a driving tool as mentioned previously.

VALVE GUIDE REWORK

When it is necessary to oversize valve guide, extreme care should be taken as it is possible to ruin a block in this oversizing operation due to oversized guide being larger than desired or due to the guide not being true to the valve seat resulting in a wider seat on one side than on the other. In doing any service operation that has not been previously done, it is wise to practice on a scrap block. There are three different size reamers used in oversizing guides in Clinton engines.

Valve guide reamers for 4-cycle engines under 5 H.P.

- 951-69 Standard, 1/4 inch (.250)
- 951-43 (.010) Oversize (.260)
- 951-22 (9/32) Oversize (.2812)

A. When reaming the valve guide holes in blocks of engines listed in Group #XIII, XIV, and XV on Page 4 of Service Bulletin #54 a (T) handle must be used as the valve guide holes are not parallel to the cylinder. (See Illustration No. 143.) The guides on these engines could be damaged if a drill press was used, as the alignment would be difficult to maintain during the reaming operation.

B. When reaming valve guides in blocks of engines listed in Group #V, VI, VII, VIII, IX, and X on Page 4 of Service Bulletin #54 the following procedure should be followed:

1. Clean the table of a drill press so that the bottom surface of the cylinder block will be flat against the metal table.
2. Install the valve guide reamer in the chuck of the drill press and check for wobble in the spindle and/or reamer. (See Illustration No.

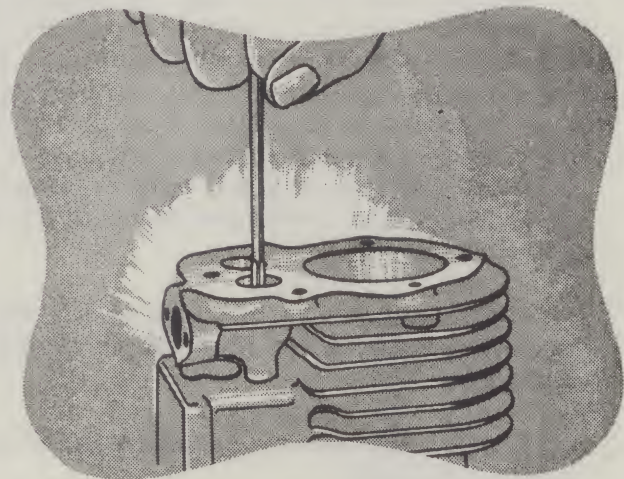


Figure 143

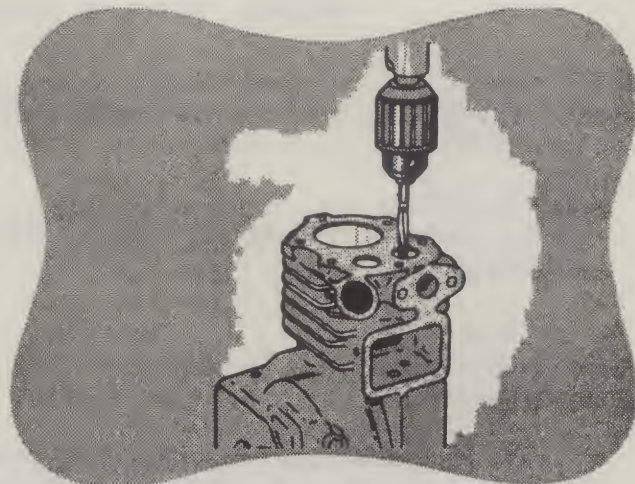


Figure 144

144.) Any tendency of the spindle and reamer to not run true will cause the guide to be above tolerance. Also check reamer to the top of the block as it must be at a right angle. Operate the spindle approximately 600 revolutions per minute and feed the reamer aggressively through the valve guide. Make only one pass through the guide with the reamer.

3. Ream other guide in the same manner.

4. If block is not to be used immediately, oil the guide to prevent rusting. CAUTION: Rework seats after the guides are oversized so that the seat is true to the valve guide.

KNURLING VALVE GUIDES

In addition to replacing or oversizing valve guides a knurling tool is now available for knurling both valve guide and tappet guide to bring guides back to a smaller size than the original and then can be reamed to standard size. If this tool is used, the valve seats should be reworked after knurling of the guides to be sure that the seat is true to the guide.

VALVES

Valve Rework: Valves should be inspected visually first for the following defects.

- A. Burned valve face.
- B. Warped stem or head.
- C. Scored or damaged stem.
- D. Keeper groove in stem for wear.
- E. Head margin less than $1/64$ of an inch.

If any of the above defects are found on the Valve being inspected it should be discarded and a new Valve used.

After the visual check on the Valve, the Stem should be checked to determine the condition of the Valve Stem, in the area which it operated in the Guide. (See Illustration No. 147.) Then compare this reading to that of a new Valve Stem.

Common Standard Valve Diameters

	Min.	Max.
Four Cycle Engines under 5 H.P.	.2465 to	.2475
Four Cycle Engines over 5 H.P.	.309 to	.310

Any time the clearance of Valve Stem to Valve Guide can be reduced by more than .001 by replacing the Valve, it is recommended that a new

Valve be used. If the previous check of the Valve Stem has indicated it is worn, it would indicate similar wear as well in the Valve Guide.

Any time the clearance between the Valve Stem and Valve Guide is over .0045 rework should be considered to bring the clearance below the .0045 and not less than .002. (See Illustration Nos. 145 and 146 for valve part names and margin dimensions.)

VALVE PART NAMES

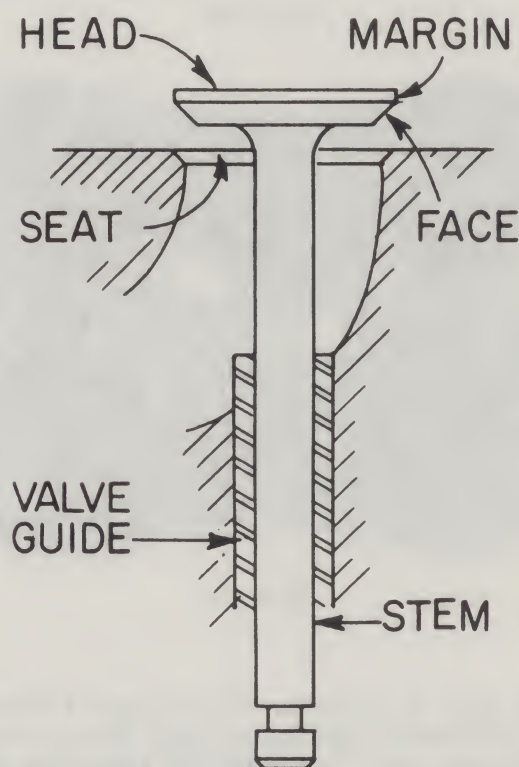


Figure 145

MARGIN DIMENSIONS

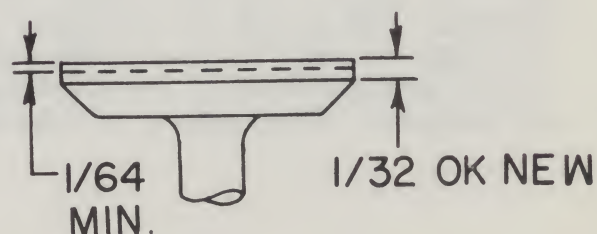


Figure 146

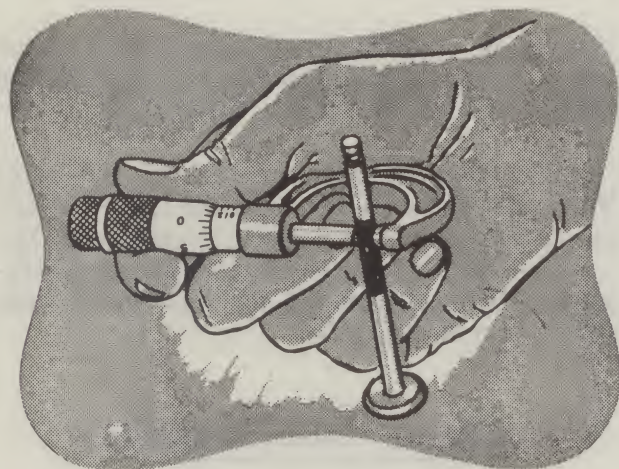


Figure 147

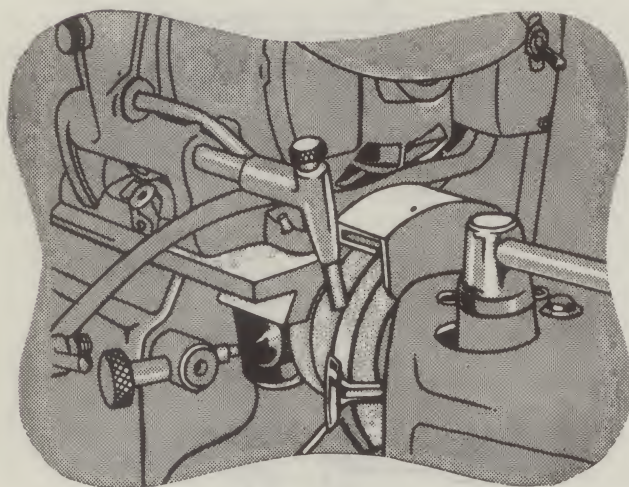


Figure 148

If after checking the valve to guide clearance it is determined that the old valve can be reused, then reface the valve by using an automotive type valve refacer to secure a 45 degree face. (See Illustration No. 148.) If this type equipment is not available, replace with a new valve as it is not recommended that a valve be refaced other than with stones. In refacing a valve, it may be necessary to grind off too much metal in securing a smooth surface on the valve face, which will result in the margin of the valve being too thin. A minimum width of $\frac{1}{64}$ is recommended. (See Illustration No. 149.) Valves narrower than this after refacing should not be used. If this width is not maintained, the strength of the valve is re-

duced and can give short life. Also a refaced valve that had a warped stem which is indicated by the variation in the width from valve head to face. This valve is not suitable for reuse due to sharp edge. The valve seat must be reworked when the valve is refaced or replaced.

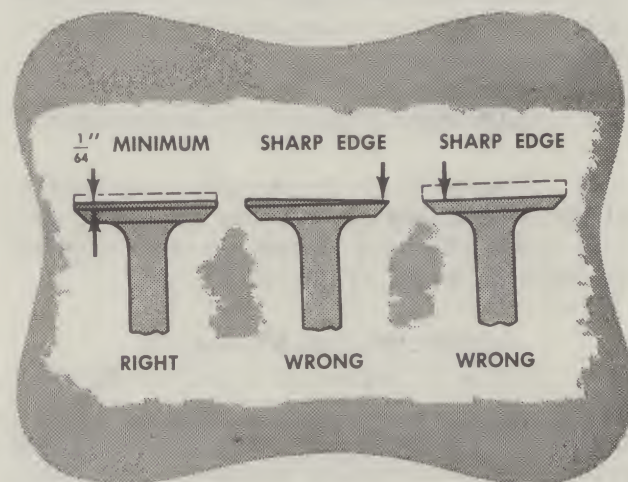


Figure 149

In the event the valve guide in the block was worn to a point where it was necessary to oversize, there are valves available with oversize valve stems to be used in conjunction with the oversize guide hole.

There are some options on valves for the various engines such as stellite valves and roto caps. In the usage of stellite valves especially, it is normal to use the exhaust valve in the intake side with the stellite valve and stellite seat in the exhaust side. This also could be followed when roto caps are used, but the special valving is normally applied to the exhaust side due to the heat applied to this valve in an open position. Engines operated on LPG normally are engines with a stellite valve and the stellite seat on the exhaust side. It is not recommended that these engines be operated otherwise.

The function of the roto cap is to keep the valve rotating slowly, and if the valve has carefully been replaced and the seat is true to the guide, this will give additional life to a valve service job. For heavy loads and long continuous operation, the roto cap is recommended.

Listed is the standard valve and the oversize that it would be replaced with, also listed is the stellite valve usage.

EXHAUST VALVE USAGE

Standard	291-1-990	291-4	291-8-990	291-10-990	291-27-990	
.010 Oversize	292-9-990		292-20-990	None	292-27	
9/32 Oversize	292-1	292-4	None	None	None	
Stellite	291-2-990	None	291-13-990	291-11-990	291-41-990	
Stellite .010 O. S.	292-14-990	None	292-15	None	292-22	
* Stellite Rotator	291-18-990	None	291-16	291-11-990	291-41-990	
** Stellite Rotator .010 O. S.	292-10-990	None	292-16-990	None	292-22	

INTAKE VALVE USAGE

Standard	291-3-990	291-5	291-9-990	291-12-990	291-26-990	291-48
.010 Oversize	292-13-990	None	292-7	None	None	292-48
9/32 Oversize	292-3	292-5	None	None	None	None

* Engines using rotor valve 291-18-990 or 292-10-990, spring 263-30, roto cap 291-19-500, and pin 203-58 will have to be used.

** Engines using rotor valve 291-16 or 292-16, spring 263-30, roto cap 291-19-500, and pin 203-58 will have to be used.

When engines over 5 horsepower require rotor for valve use rotor cap 291-20-500 and remove valve spring washer.

2-CYCLE REED VALVES

The reed valves are among the most important parts of a two cycle engine, and if not in proper order, can cause the engine to malfunction. The following items should be checked on the reed valve assembly, and put into order, to insure good performance. (See Illustration No. 150.)

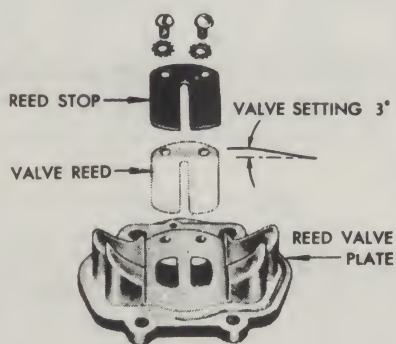


Figure 150

- Bent or distorted reed valves.
- Broken reed valve.
- Reed valve seat damaged or distorted.
- Reed valve stop bent, or broken.

If any of the defects listed are found on the reed assembly, the defective part or assembly should be replaced.

VALVE SPRINGS

If there is any question concerning the condition of the valve spring, compare it to a new spring. If the old spring is weaker, it will be shorter and will usually lean to one side. If definitely shorter or not straight, replace with a new spring. Some of the cast iron engines were built with a stronger spring on the exhaust side. Be sure that spring goes in the exhaust side, or when springs are replaced, two exhaust springs can be used in the engine. As previously mentioned in some cases where valve seats are very low and the valve face has been ground away as much as allowable, the spring tension will be reduced

due to the valve stem extending further into the valve chamber. This can be noted by the amount that has to be ground from the end of the valve stem. This reduction of spring tension may cause valve problems at high speed. A valve seat insert and/or new valve will minimize this condition. Also a thin washer may be placed in top of valve chamber around the metal extrusion to compensate for the additional distance between the (C) lock groove on valve stem and top of valve chamber. If any changes are made, rotate camshaft to check spring compression. This will restore the spring tension comparable to original tension.

CAUTION: Never substitute valve spring or double springs as damage can occur to camshaft, camshaft axle, tappets, and possibly to tappet guides.

VALVE SPRING RETAINERS

The valve spring retainers should be inspected for wear and burrs, if either are present the retainer should be replaced. In the Clinton line three types of retainers are used, these being a 232-3 split two piece, 304-90 one piece and a 203-58 pin retainer. (See Illustration No. 151.) Care should be taken when installing to make sure the retainers are properly installed and in place.

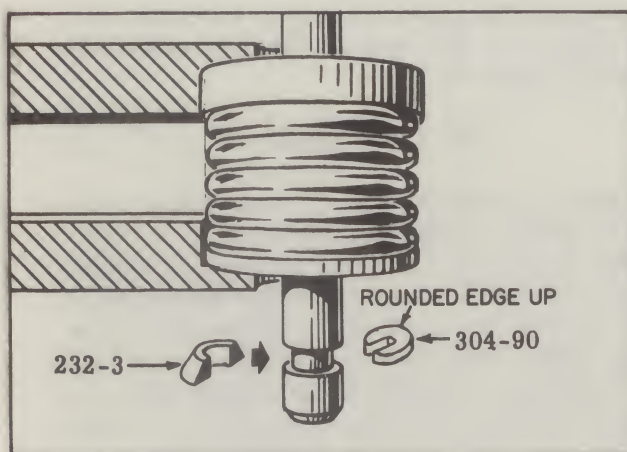


Figure 151

VALVE TAPPETS

The valve tappets should be inspected visually for the following:

- A. Score marks, and burrs on the stem.
- B. Wear on the head of the tappet.

If any of the above defects are present replace the tappet with a new one.

After the visual check, the tappet should be checked with a micrometer for size and length. (See Illustration No. 152.) Refer to Section VI, Div. H for dimensions.

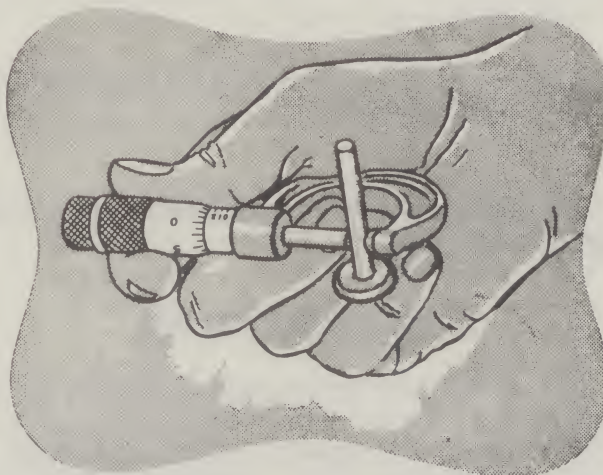


Figure 152

Clinton does not have tappets with oversize stems available. In the event the clearance between the tappet stem and tappet guide in the block is excessive the tappet guide hole can be reworked by using a knurling tool to reduce the size of the hole, then reaming it back to standard size.

When an engine is disassembled and valve work is not to be performed, the tappets should be marked so they will be installed in the same hole they were removed from. The reason for this is that the clearance between the valve and tappet might change, causing the engine to have too much or not enough clearance between the tappet and valve.

PISTONS

The piston should be given a visual inspection first to determine if it can be reused. Check for the following:

- A. Scored piston wall.
- B. Cracked or broken skirt.
- C. Damaged ring lands.
- D. Worn or damaged wrist pin lock ring grooves. (See Illustration No. 153 for piston part names.)

Any of these defects would require complete replacement. If the piston passes the above visual inspection we can proceed to check the following diameters with a micrometer and a small hole gauge.

- A. Skirt diameter: The reading should be checked 90 degrees of the wrist-pin bore on the lower part of the piston skirt. (See Illustration No. 154.)
- B. Land diameter: The reading should be checked 90 degrees of the wrist pin bore. When checking 4-cycle engine piston you will find that they are tapered and the reading at the ring land will be .00125 smaller per inch of piston length. (See Illustration No. 155.) The 2-cycle pistons are straight.
- C. Wrist pin bore: Using a small hole gauge and micrometer, take several readings on the bore size of the wrist pin hole. Refer to Section VI, Div. H for dimensions.

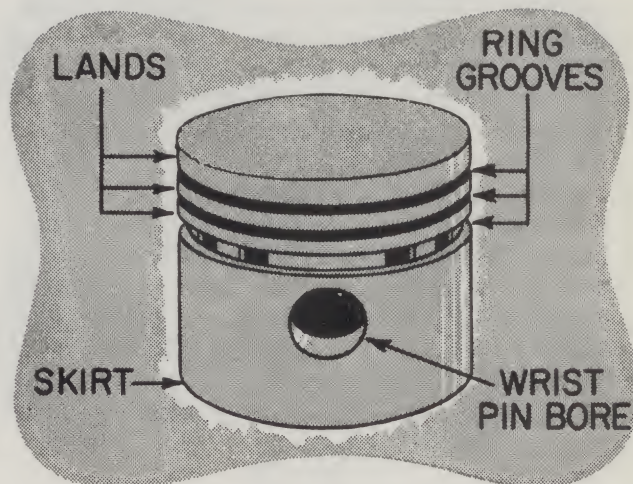


Figure 153

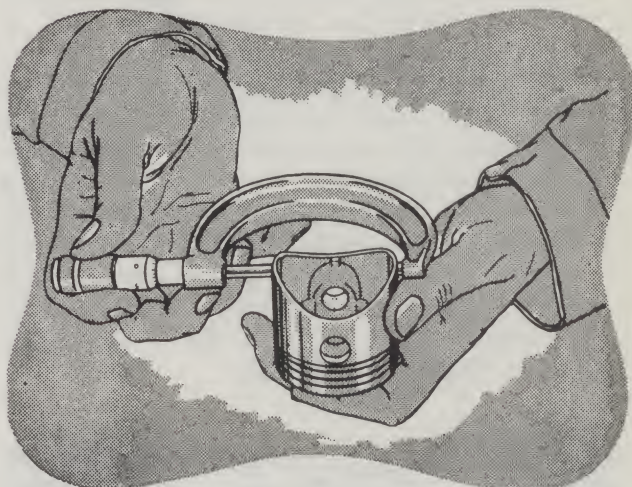


Figure 154

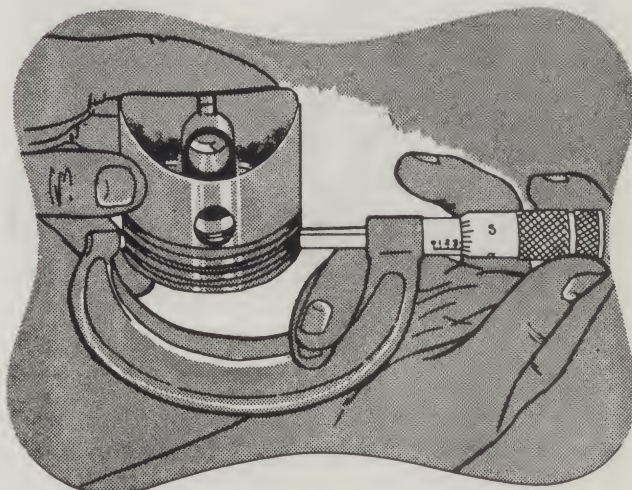


Figure 155

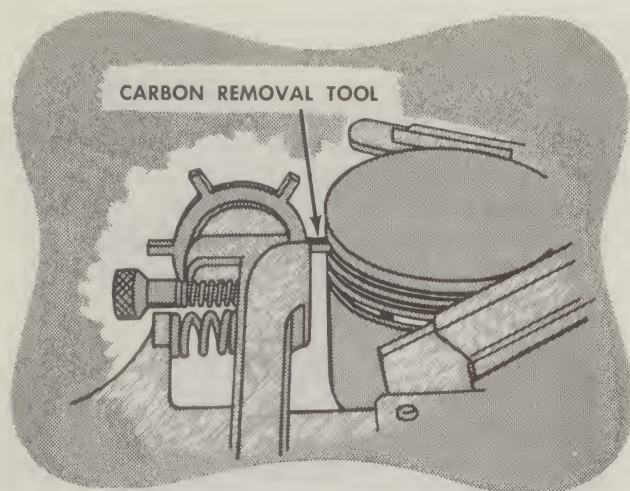


Figure 156

- D. Ring grooves: The ring grooves should be cleaned to remove all carbon deposits. The grooves can be cleaned by using a carbon removal tool (see Illustration No. 156), or breaking an old ring removed from the piston and using as a tool. Care should be taken during the cleaning operation to keep from damaging the ring grooves or ring lands. After the ring grooves are cleaned the ring to groove clearance can be checked by installing a new set of rings on the piston, and using a feeler gauge; check the clearance between the ring and groove. Listed are the recommended ring to groove clearances. (See Illustration No. 157.)

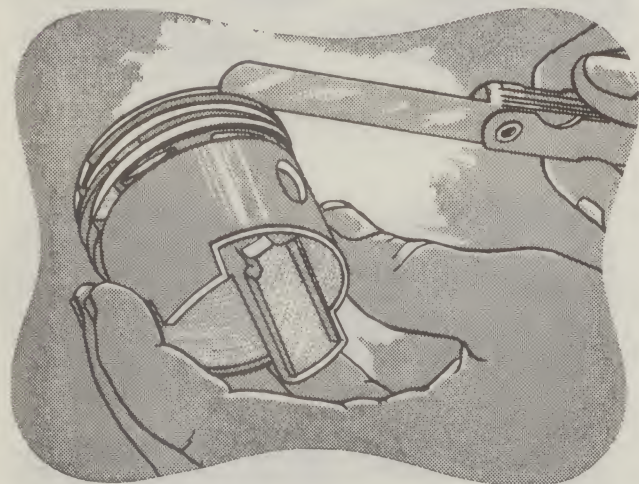


Figure 157

Two-cycle engines Minimum .0015, Maximum .004.

Four-cycle engines under 5 horsepower: Minimum .002, Maximum .005.

Four-cycle engines over 5 horsepower: Minimum .0025, Maximum .005.

The clearances listed applies to the oil, scraper, and compression where applicable!

Any time a piston does not fall between the minimum and maximum service clearances listed, the piston should be replaced with a new one.

Clinton has the following oversize pistons available, .010, .020, and .030. The amount of oversize will be stamped on the dome or top of the piston. (See Illustration No. 158.) The oversize pistons are used when a cylinder bore has been oversized due to wear, or a scored cylinder.

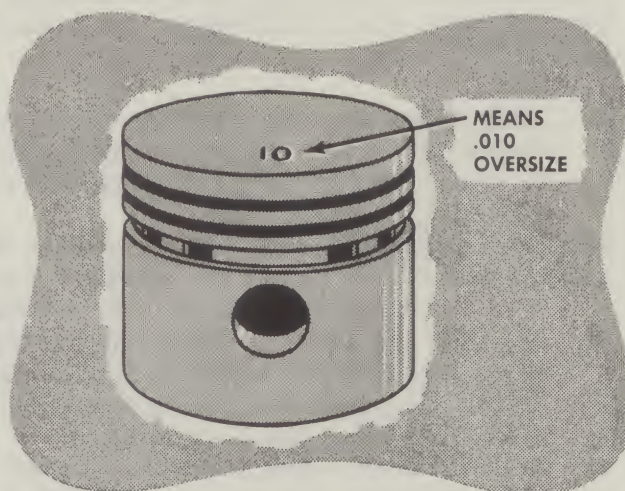


Figure 158

PISTON RINGS

After the removal of the piston from the cylinder, the rings can be checked. Normally when an engine has been operated a length of time the rings should be replaced; however, if the engine has only operated a short period of time, and the rough marks on the face of the rings have not been worn off they can be reused. (See Illustration No. 159.)

RING END GAP

To check the ring end gap it is necessary to slide the rings into the cylinder bore and push into position by use of the piston, so the ring is true with the cylinder. (See Illustration No. 160.)

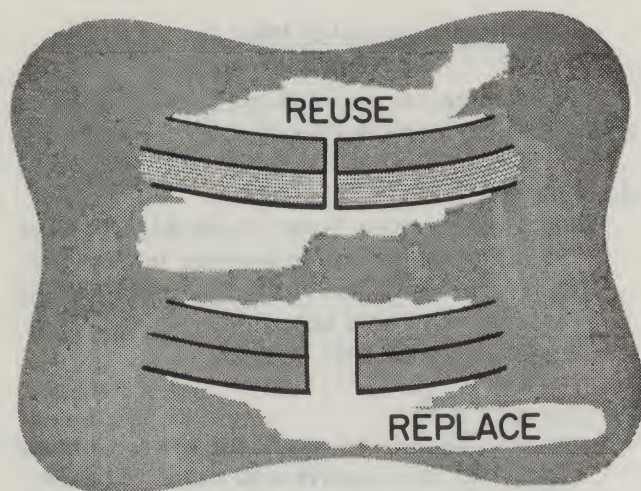


Figure 159

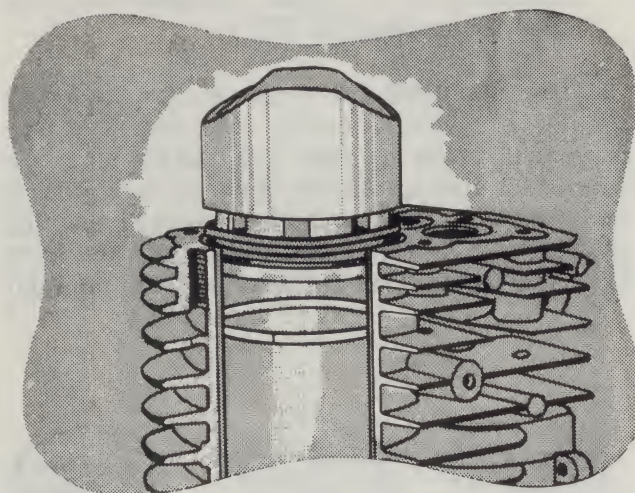


Figure 160

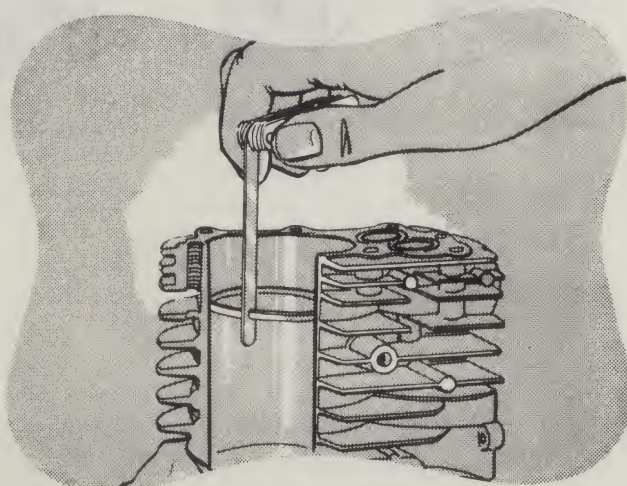


Figure 161

The ring end gap should be .007 to .017 on all rings, except the rings used in the 1-7/8 cylinder bore 2-cycle engine which require .005 to .013 ring end gap. In the case of a cylinder that has a little wear on it and is not to be oversized, it may be necessary to go to the next oversize ring and fit the ring to the cylinder by filing or stoning the gap. Care should be taken on fitting a ring in this way as a false gap measurement may be secured. (See Illustration Nos. 161 and 162.)

Clinton has .010, .020, and .030 oversize rings available for pistons where the cylinder bores have been oversized from wear or scoring.

In addition to the standard oversize rings, Clinton now has chrome "re-ring" sets in both standard and .020 oversize for most all model engines. Refer to Service Bulletin #4 for chrome ring usage. The chrome re-ring sets are designed for use in cylinders that are not suitable for standard rings, that is cylinders that have up to .010 out-of-roundness and taper.

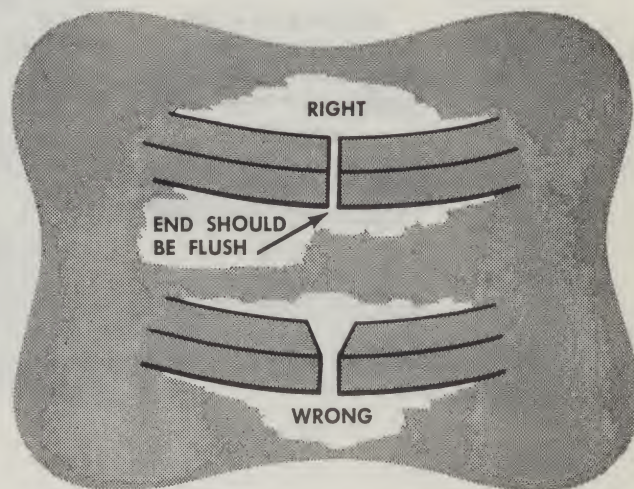


Figure 162

INSTALLATION OF RINGS ON PISTON

Before installation of the rings on the piston make sure the ring grooves have been cleaned to remove all carbon. The Clinton 4-cycle engines have (3) rings which are the oil, scraper, and compression, and should be installed on the piston as in Illustration No. 163. The compression ring should be installed with the 45 degree bevel on the upper inner circumference toward the top of the piston, the scraper ring should be in-

stalled with the step on the lower outer circumference toward the bottom or skirt, and the oil ring can be installed either way as there is no special machining. Stagger rings on piston before installing into cylinder. On Clinton 2-cycle engines you will find that some pistons use (3) compression rings and others that only use (2) compression rings. All 2-cycle engines using the (3) rings you will find they have a small wire ring retainer located in the ring groove to keep the ring from moving, which could result in a broken ring if the retainer was not in place. Some 2-cycle engines using (2) rings you will find have a pin in the ring groove to keep the rings from moving, this applies to older 2-cycle engines, the current production engines will not have the pin. When installing rings on 2-cycle piston make sure the ring ends do not line up, and match the retaining ring or pin when the piston is so designed. (See Illustration No. 164.)

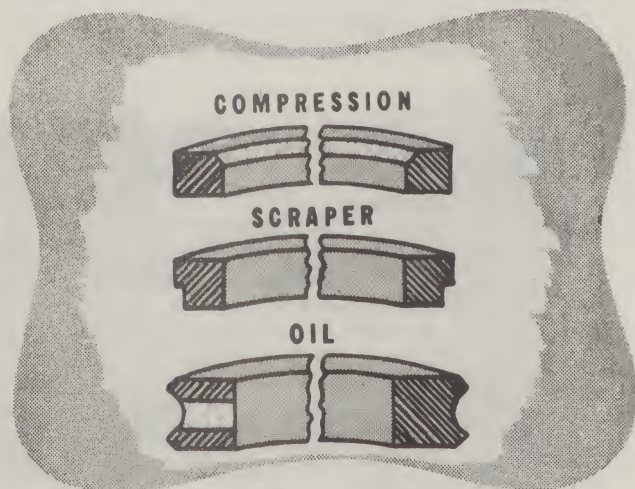


Figure 163

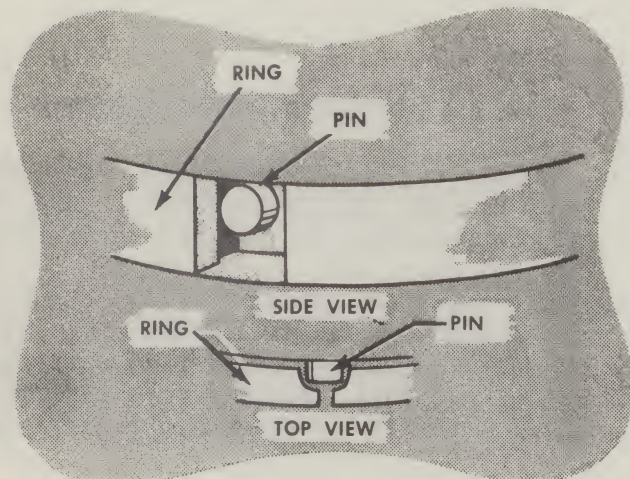


Figure 164

CHROME RE-RING INSTALLATION

The chrome re-ring set consists of (8) parts and should be assembled to the piston as follows:

- A. **Oil Ring**
Install Expander first. Then spiral lower Chrome Steel rail into groove. Install cast-iron spacer above rail and spiral second Chrome Steel rail into groove above spacer. (See Illustration No. 165.)
- B. **Scraper Ring**
Install Expander first. Then spiral Chrome Steel rail into groove and install cast-iron ring above rail with scraper groove down. (See Illustration No. 166.)
- C. **Compression Ring**
Install Bevel on inside circumference up. (See Illustration No. 167.)

After installing the rings on the piston they should be checked to make sure they have free movement in the grooves, and that the ring ends do not all line up on one side of the piston. If the rings were not free in the grooves or the ring ends all lined up, the engine would probably have low compression and excessive oil consumption!



Figure 165

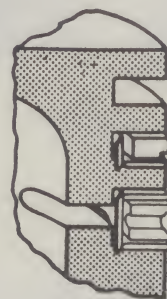


Figure 166

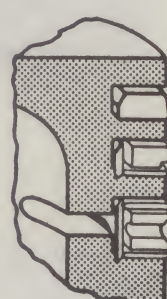


Figure 167

CONNECTING ROD

Our detailed inspection of the connecting rod is for one purpose, to determine if the old part is suitable for re-use. Naturally, any evidence of scuffing or discoloration on or around the bearing surfaces would automatically reject the part. Check the entire rod for cracks. Inspect the rod for stripped threads. If threads have been stripped, they will cling to the threads of the cap screws.

Assuming that the rod does not have any of the aforementioned faults, we must determine if the rod to crankshaft and the rod to piston or wrist-pin is within the recommended tolerances.

In all Clinton Engines, the recommended tolerance between the wrist pin and the rod is .0004" to .0011". Rework or replace when this tolerance reaches .002". Clinton does not supply oversized wrist pins.

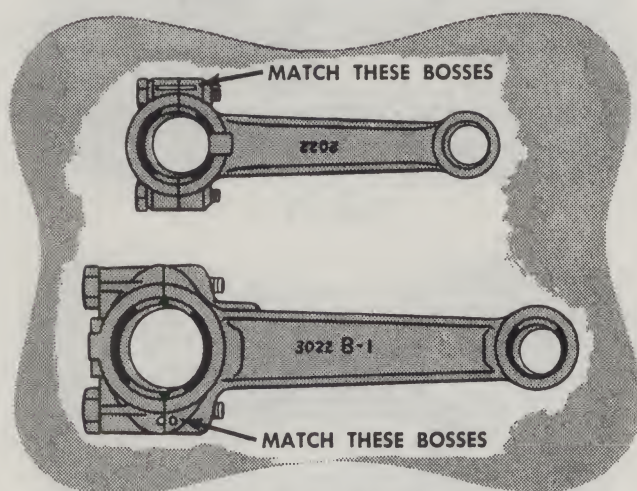


Figure 168

The rod to crankshaft clearance can be checked by several methods, these being a micrometer and inside hole gauge or plastic gauge.

Illustration Nos. 169 and 170 show the piston and rod assembly installed in the engine and plastic gauge on the crank pin for checking rod to crank pin clearance. The next step in the use of plastic gauge is to replace the rod cap and torque to the proper torque. Care should be taken in replacement of the rod cap as there is an extrusion on the rod cap and rod which must match. (See Illustration No. 168.) The reason for lining the cap to rod is that the rod and cap are made separately, then matched and machined. The reason torque is important on checking rod to crank pin clearance is that the torque brings the cap and rod back to the same relationship as when the part was machined.

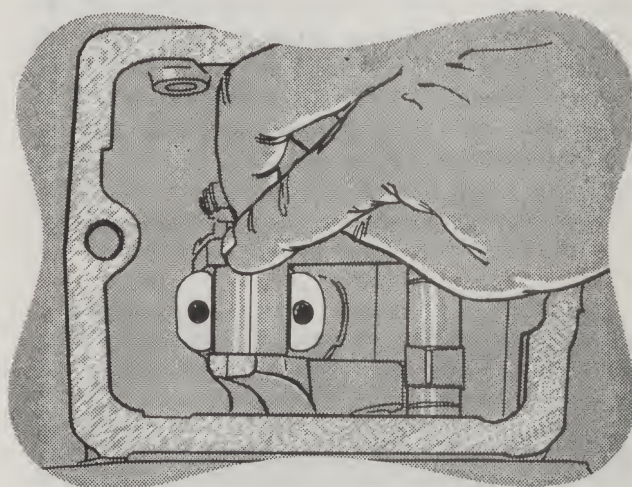


Figure 169

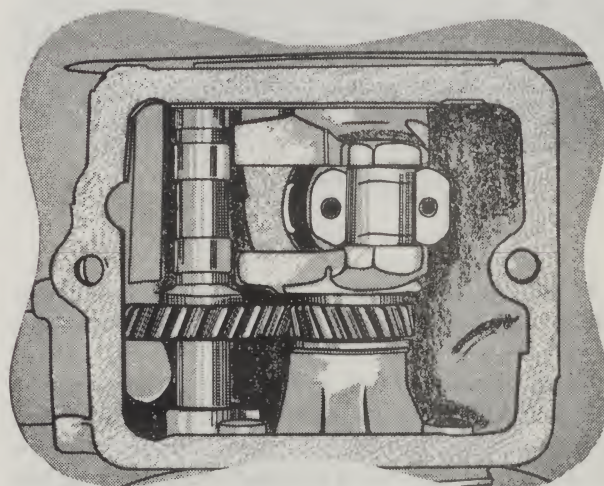


Figure 170

Torque is not intended to be used as holding power as the rod locks are used to hold the cap screws in place. If insufficient torque is used, the rod will be out-of-round in one direction. If excess torque is used, the rod will be squashed or egg-shaped due to over torque. For example, 50 percent to 100 percent over torque can readily reduce the clearance between rod to crank pin as much as .001, and this, if the parts are to size, could cause the lubricating film between rod and crank pin to be sheared and metal picked up from the rod and transferred to the crank pin resulting in the rod failure.

After the cap has been torqued to the proper torque, it should be removed immediately, and care should be taken during installation of the cap over the plastic gauge, torquing of the rod and cap together, and also in removal, that the crankshaft is not moved as the plastic gauge will be spread out and give a false reading. Use the container for the plastic gauge to check the operating clearance as in Illustration No. 171. If the crank pin has been carefully checked for size and for roundness, the plastic gauge can be applied at right angles to this previous check, and the rod be checked for out-of-round condition.

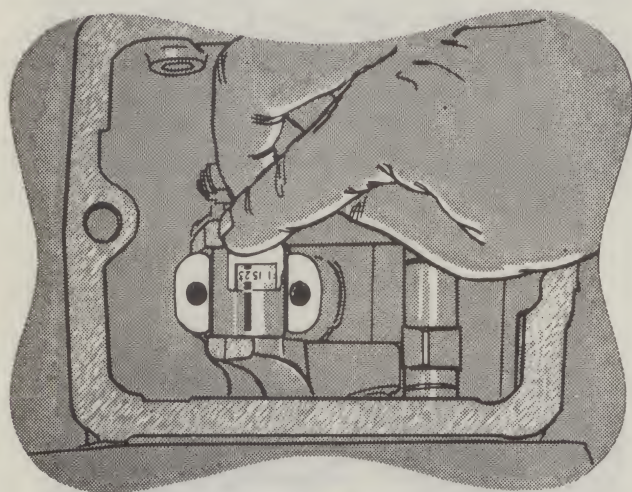


Figure 171

If clearance is within the operating clearance, remove plastic gauge from rod and/or crank pin.

When checking rod to crankshaft clearance with an inside hole gauge and micrometer, care should be taken to make sure the cap and rod are properly matched, and aligned. Readings of the bearing area of the rod should be taken from

both sides of the rod bearing and 90 degrees of these to pick up the out-of-roundness and taper of the bearing. Refer to Section VI, Div. H for dimensions.

CONNECTING ROD INSTALLATION

4-Cycle Engines:

On the four-cycle engines the piston may go in either way, but the rod has an oil hole in it that faces toward the flywheel side of the engine (see Illustration No. 172), with the exception of those engines that use a clearance rod (see Illustration No. 173). In the case of clearance rods, the clearance side pointed out in Illustration No. 173 goes towards the camshaft of the engine.

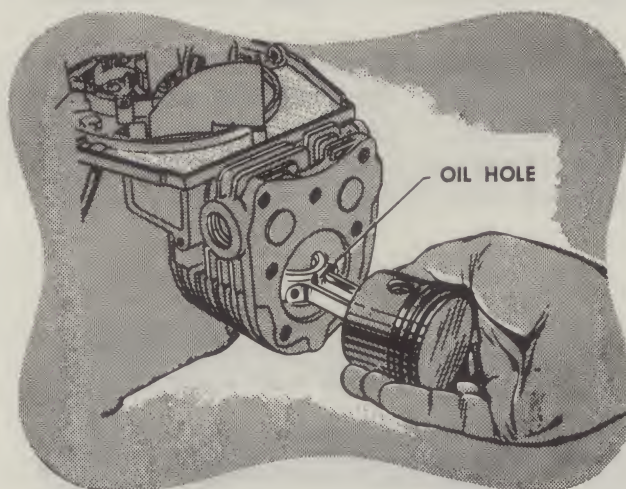


Figure 172

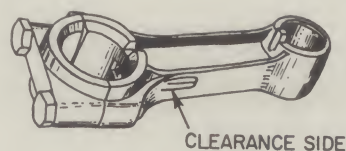
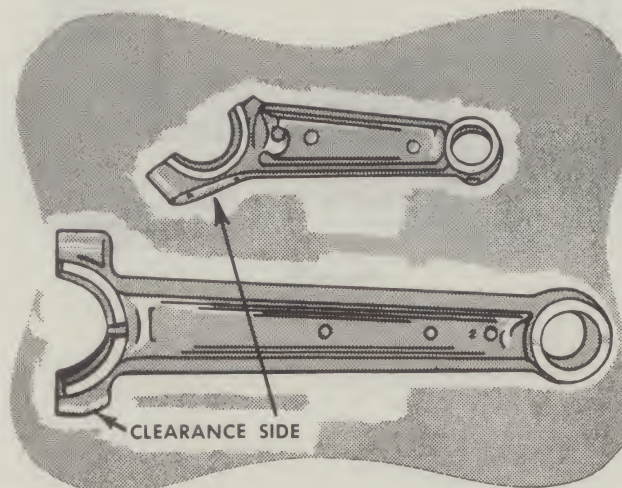


Figure 173

2-Cycle Engines:

On two-cycle engines, the piston is the determining factor to the proper installation of the connecting rod.

As the piston is installed, the abrupt side of the piston top must be toward the intake side of the block for the direction of the incoming fuel and air mixture. (Refer to Illustration No. 174.)

There is no special marking or way the rod should be installed other than the above.

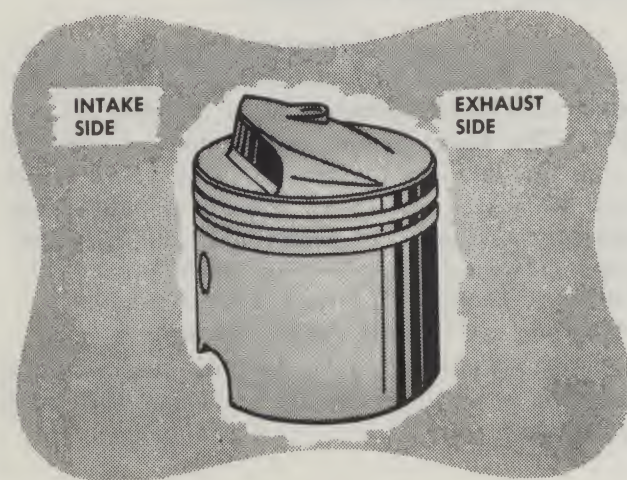


Figure 174

WRIST PINS

All Clinton wrist pins are a "hand press fit" into the piston. Care should be taken when removing or installing wrist pin into rod or piston. It is easy to distort or damage piston or rod when installing wrist pin. Never lay piston on a solid object when removing or installing wrist pin. The piston can be supported in the palm of your hand when servicing to keep from damaging. There is no special way to install the wrist pin into the piston or rod, except on the 2 cycle engines which in some cases have a hollow wrist pin closed on one end on this type. Make sure the closed end is towards exhaust side.

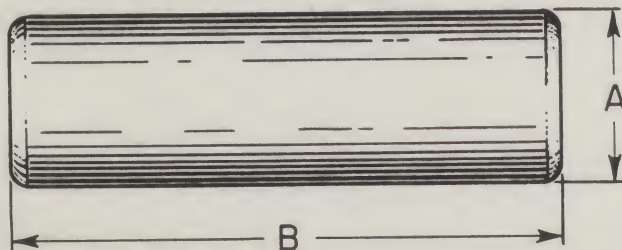


Figure 175

CRANKSHAFT INSPECTION

At this point we believe that the crankshaft should be the object of quite a check. This is especially true with regard to the engine on vertical shaft rotary lawnmowers that have the cutting blade attached directly to the shaft with some type of clutch. Remove the spark plug from the cylinder head. Turn the engine on its side and rotate the engine with the starter. Note any visual wobble of the crankshaft. (See Illustration No. 176.) A more detailed inspection could be obtained with a dial indicator, or by using the Clinton Engines run-out indicator, 951-64. This tool attaches to the engine base and a moveable arm shows shaft deflection. Clinton provided a threaded hole in the vertical shaft engine bases, in the Alumalloy and 3.5 H.P. Clintalloy series, to accept this tool. After the post of the tool is screwed into the threaded hole, the arm is placed adjacent to the outer end of the crankshaft, and the engine is rotated slowly. This tool gives you a stationary gauge at the area of inspection, and when used with feeler gauges, will show you amount of runout.

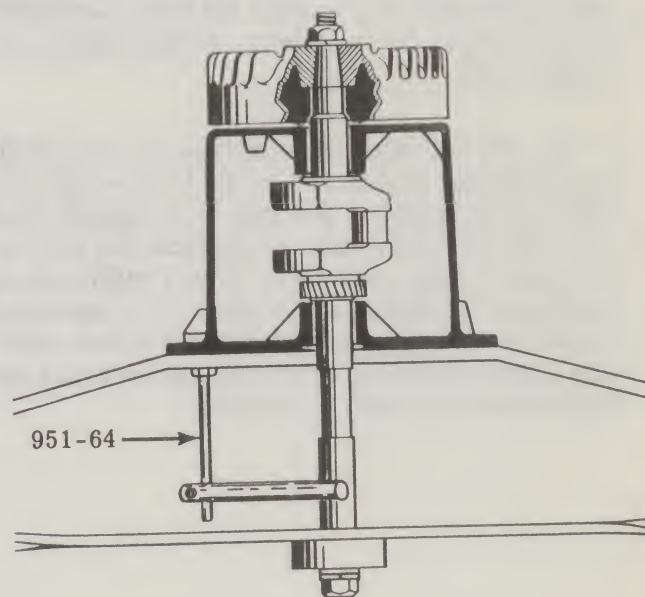


Figure 176

If you do detect a bent crankshaft, you had better give the engine base a close inspection for cracks or a broken casting. Damaged base castings would allow the oil to leak from the crankcase and result in total engine failure. In engines with Zinc or Cast Iron flywheels, bent crankshafts could split or shear the flywheel key and also split the key slot in the flywheel. Do not overlook any of these secondary damages if a bent crank is discovered.

On new crankshafts, the parallelism between the two main bearing surfaces is held to a maximum of .001", therefore when you note readings of crankshaft deflection or bend in excess of this you can realize that bearing life will be shortened with the degree of bend. Vibration from bent crankshafts can literally shake an engine apart.

In addition to checking for bent crankshafts, note the amount of end play in the shaft. On this entire series of vertical lawnmower engines, the end play tolerance is from .008" to .018", with instructions to rework this area of the engine if the end play exceeds .025".

Please understand that Clinton Engines does not accept warranty claims for bent crankshafts nor do we pay for repairs to secondary damages in this area.

We do not approve any type of crankshaft straightening device nor do we believe that you can re-establish the original .001" parallelism with any such tool that is available for service operation usage. Severe or even a mild case of bending a crankshaft could fracture the metal and result in a progressively serious crack, rust, and engine vibration would enlarge the crack and could cause the shaft to separate.

CRANKSHAFTS: The Crankshaft should be first given a visual inspection after being removed from the engine for the following defects:

- A. Scored or damaged bearing surfaces.
- B. Bent, cracked or broken crankshaft.
- C. Damaged keyways (caused from loose flywheel, adapter or pulley).
- D. Damaged flywheel taper.
- E. Damaged or stripped threads, flywheel, and customer end.

If any of the above defects are found the crankshaft should be replaced.

After the crankshaft passes the visual inspection, the bearing surfaces should be checked for size with a micrometer. (See Illustration No. 177.) The bearing surfaces should be checked from one side to the other to pick up the taper and 90 degrees of these checks to pick up the out-of-roundness. The maximum out-of-roundness allowed on a bearing surface is .0015. (Refer to Section VI, Div. H for dimensions.)

This will not include the diameter of a crankshaft surface that a ball or tapered roller bearing is used on, as they are a press fit to the crankshaft.

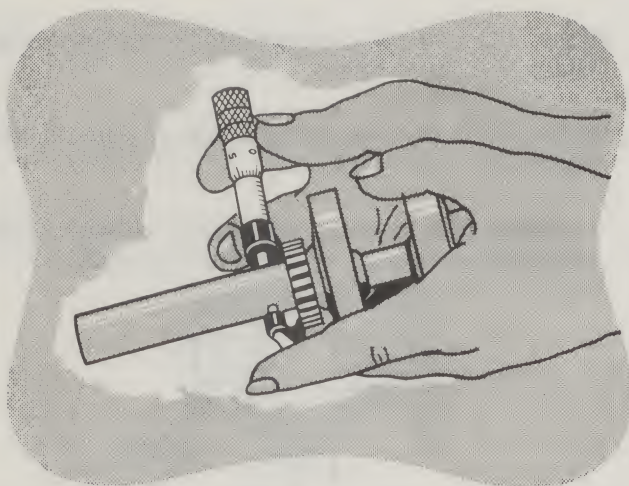


Figure 177

BEARING PLATES AND BASES

The bearing plates or bases should be given a visual inspection first, to determine if they can be reused. Listed below are items that should be checked. If any of the defects listed are found on the parts being inspected, consideration should be given to replacing it with a new part.

- A. Broken or cracked, (housing mounting flange bearing plate) (mounting ears or flange base).
- B. Cracked or distorted bearing bases.
- C. Warped or distorted gasket or mounting surface.
- D. Oil seal or bearing pocket oversize.
- E. Stripped threads (lamination hold-down screw holes bearing plate) (drain and filler plug holes bases).
- F. Worn crankshaft thrust face surfaces on base or bearing plate.

NOTE: For reworking or replacing bearings in bases or bearing plates, refer to division covering bearings.

CAMSHAFT ASSEMBLIES

Service on the camshaft assembly is very important as any malfunction in this area will affect engine efficiency in starting and at all speeds. (Refer to Section VI, Div. H for dimensions on camshafts.)

Your preliminary inspection should center around checking for extreme lobe wear and for broken gear teeth. Oil pump drive models have a pin located in the camshaft, below the gear; this pin must have a squared end and should be secure in the shaft. Several other camshaft assemblies have oil scoops riveted to the bottom of the gear, with an oil spray hole located above the scoop. Make certain the rivet is tight and that the scoop has not slipped out of position.

On those camshafts that incorporate a centrifugal spark advance, make sure the weights are free on the mounting rivet and that the control springs are not distorted or broken. Early models of this type camshaft used one advance weight controlled by one spring, the recent revisions have two weights and two control springs. (See Illustration No. 178.)

Remember, correct valve timing and full valve lift will insure full-volume intake fuel and rapid expelling of exhaust gases, not to mention full compression attainment.

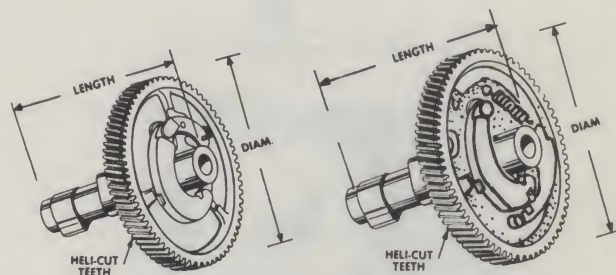


Figure 178

AUXILIARY POWER TAKE OFF ENGINE CAMSHAFT SERVICE

In vertical or horizontal shaft engines models that have a camshaft driven auxiliary PTO, extended from the engine base or the side plate, the camshaft and the cam axle are integral. The speed of this PTO shaft is half of the running crankshaft speed and due to shaft size and drive, the load on this PTO shaft should be limited to 1/2 H.P. Clinton does not list or supply the key for this shaft, but for your information the key slot is for a No. 2 Woodruff Key. (See Illustration No. 179.)

Dimensions of the camshaft assembly are listed below, these show bearing surfaces on the shaft itself plus the bore diameters in the engine block and the engine base. (See Illustration No. 180.)

Dim. "A" Top bearing O.D. shaft .4990 .4995

Dim. "B" Bottom bearing O.D. shaft .592 .593

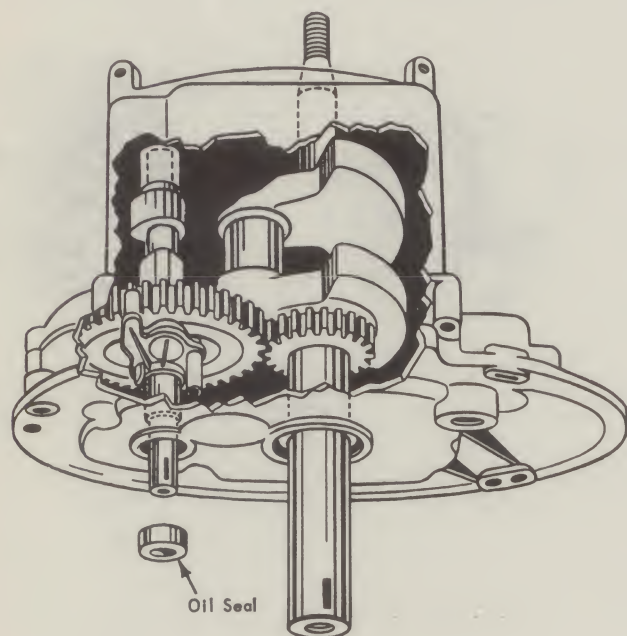


Figure 179

Dim. "C" Bore in engine block for upper shaft bearing .500 .501

Dim. "D" Bore in engine base for lower shaft bearing .594 .595

When the service clearance between these parts exceeds .006, rework is required.

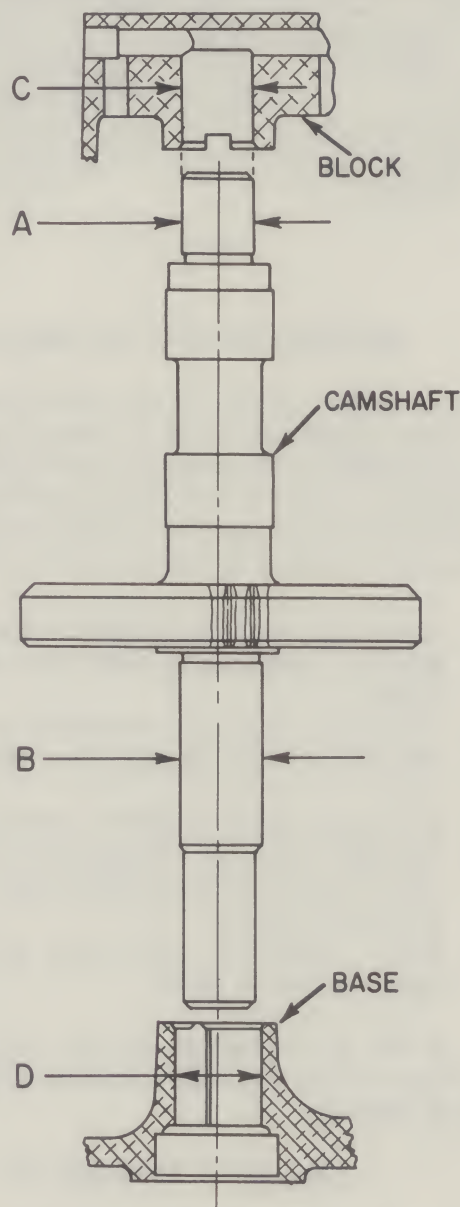


Figure 180

CAMSHAFT AXLES

Part numbers and dimension identification (see Illustration No. 181).

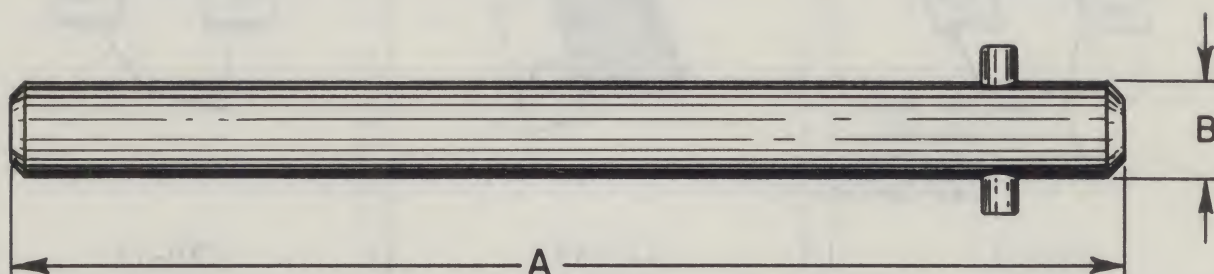


Figure 181

Axle No.	Dim. "A"	Dim. "B"		Pin Used
6-130	5.218	.3740	.3744	No
203-81	**	.4055	.4065	***
6-3	4.32	.3740	.3744	Yes
6-4	4.875	.4977	.4980	No
6-5	3.69	.3740	.3744	Yes

* All dimensions in inches.

** This pin, used on the VS-300 engine, was pressed in the bearing plate and not normally replaced in service.

*** The cam gears, on the VS-300, were secured to the ends of the shafts with a snap ring.

Where the camshaft assembly rotates on a separate axle, the tolerance between the bore of the shaft and the outside diameter of the axle itself, do not try to feel this tolerance, it must be measured, and be guided by your findings. Listings in inches.

Axle No.	Min.	Max.	Rework at -
6-130	.001	.003	.005
203-81	.001	.003	.005
6-3	.001	.003	.005
6-4	.0015	.0035	.0055
6-5	.001	.003	.005

LUBRICATION SYSTEMS

Lubrication of Clinton's horizontal shaft engines is accomplished by an oil distributor, fastened to the bottom of the connecting rod cap, passing through the crankcase oil. The design of the oil distributor is such that, when the engine is being operated within the limits of recommended speed, there is adequate oil distribution to all bearing surfaces. Illustration No. 182 shows the various oil distributors in this series of engines.

There are oil access holes or slots to pass oil in and out of the bearing surfaces, whether the replaceable sleeve type bushing is used or the alloy casting is the actual bearing surface. In service, all oil holes and slots are to be clean of foreign material and should have a coating of light oil, prior to assembly. The proper location of oil seals should be checked, the lip of the seal should not touch the edge of the bearing, yet, the lip should not block the oil return passage.

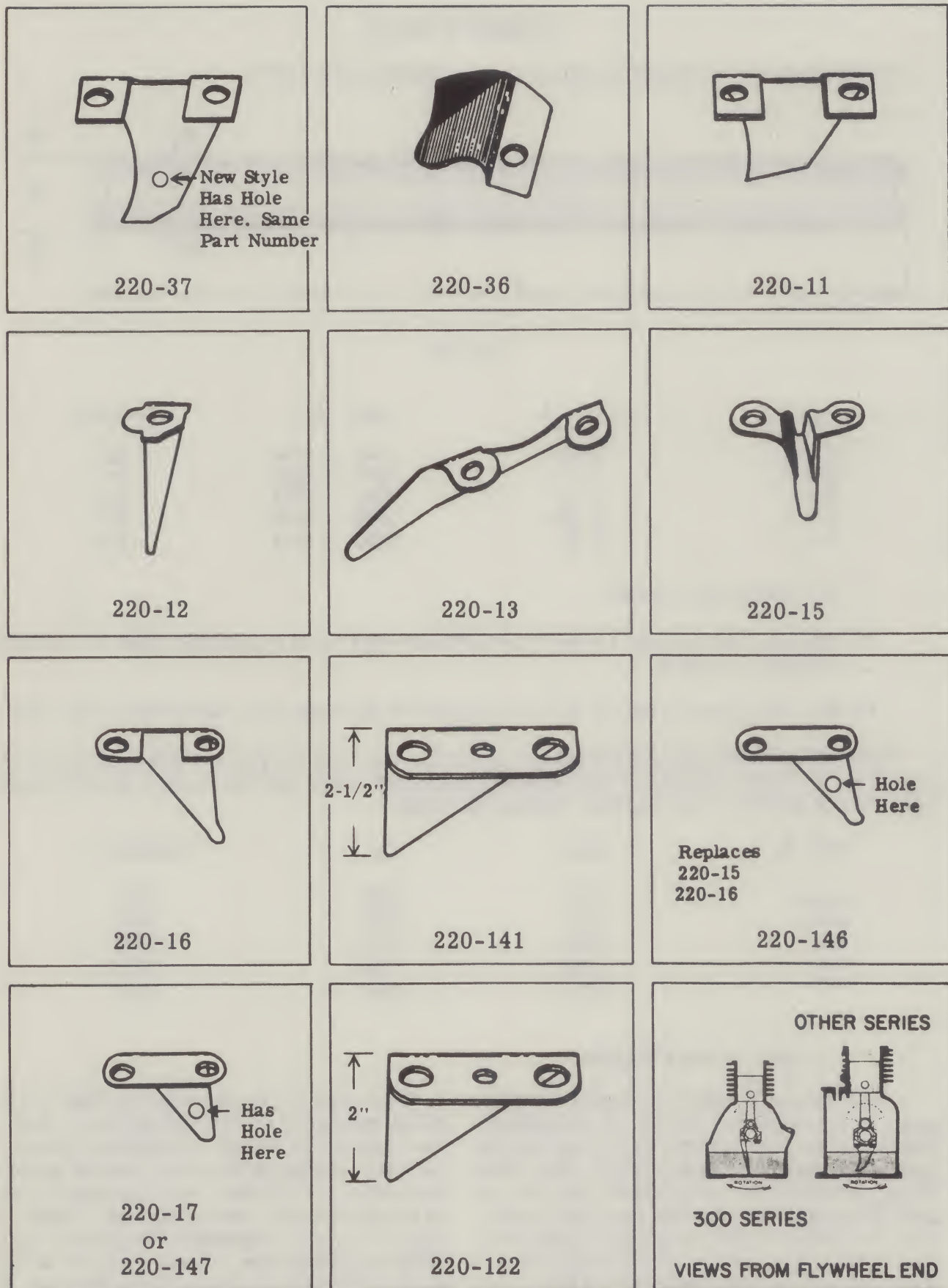


Figure 182

Vertical shaft engines use one of two available oiling systems, a rotary dual-gear pump or an oil scoop. The pump is driven by the camshaft by means of a drive pin located in the hub of the camshaft. From the pump outlet, oil is forced through a line to the top of the engine block, to connect with drilled passages toward the top main bearing. Illustration No. 183 shows the complete system. To insure complete lubrication the engine must not be operated at speeds slower than established minimum RPM or speeds faster than maximum RPM. We made a rough test of this rotary pump and find that it will pump one

into the rod mounted cup. (See Illustration No. 184-A.) This was the design of the rod in that system.

The positioning of the oil line was attained by using a special plastic pump to line adaptor. The adaptor was fixed in position by a rib on the pump. The adaptor had a molded offset at the bottom of the line opening. (See Illustration No. 184-B.) The special oil line, in addition to having the oil squirt hole, was squared off on the bottom, so that by fitting the squared end of the line into the offset in the adaptor, the oil spray was aimed

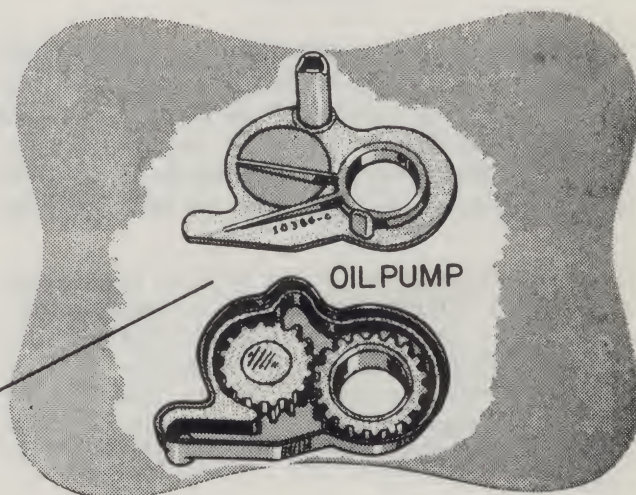
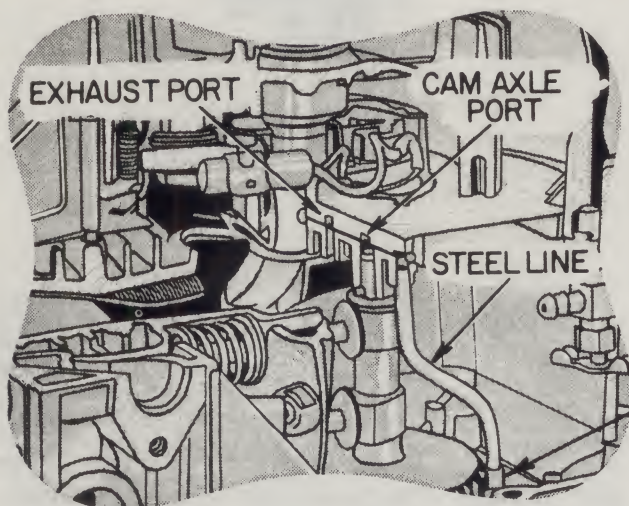


Figure 183

pint of oil in one minute, which extended out, means that pump has a capacity of 7-1/2 gallons per hour, and while making this test the lift and speed factors were considered. The oil used was of S.A.E. 30 viscosity with a temperature of 80 degrees. In servicing this type of oiling system make certain that all passages are free from all foreign material, the line should fit correctly into the pump adaptor and the block port. Check the drive lug on the camshaft, it should be secure in the hub. If the drive lug is worn round, the camshaft assembly will require replacement, as this hub is not replaceable.

directly at the oil cup on the rod. Illustration No. 184-B shows you the special line, Part No. 158-54

In the cast iron vertical shaft engines of the "Long Life" Series, there was some variation with regard to the pump oiling system. This difference centered around the design of the connecting rod used at that time, as there was a cup molded into the connecting rod cap. The oil line, from the pump to the upper block area, was positioned in the pump outlet adaptor, and sprayed oil through a hole in the line, directly

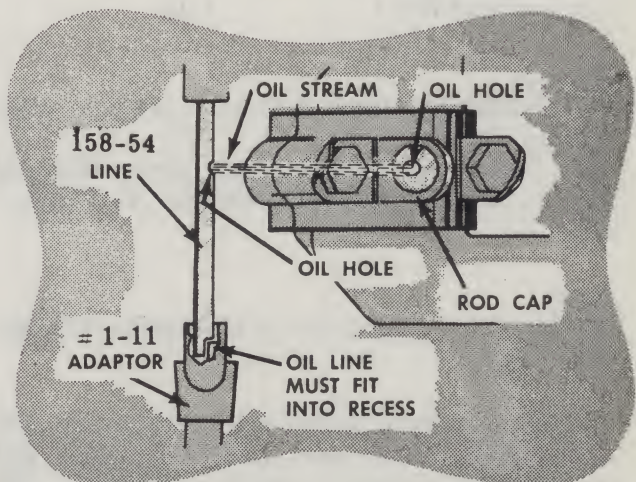


Figure 184-A

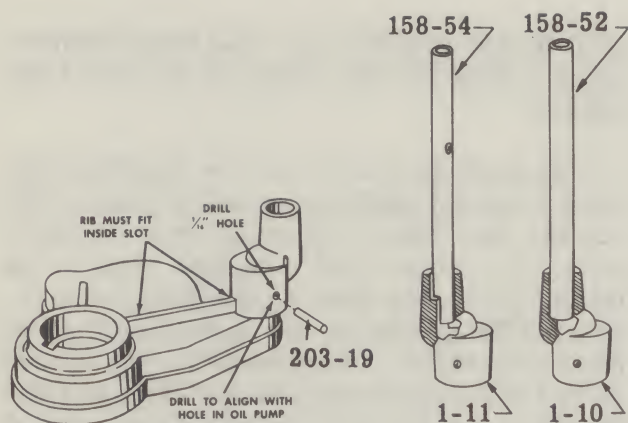


Figure 184-B

Changes in the connecting rod design have eliminated the need for this positioned oil line, as the cup was removed from the rod cap. The chamfer and access holes in the rod were revised so that adequate lubrication is obtained from the oil sprayed into the top main bearing.

If you have replaced the original connecting rod with a current design rod, we suggest that you change the oil line and the oil line adaptor. The oil spray, through hole in the line serves no useful purpose and using the line without the hole will give additional oil into the top main bearing area where it will be properly distributed.

Listed below are the part numbers of the line and adaptors that work together; do not mix them in service to this series engine.

Oil Line	Adaptor	Oil Pump
----------	---------	----------

Part No. 158-22 (Line without hole)	1-10	
--	------	--

Oil Line

Part No. 158-52 oil line without spray hole. (Use with No. 1-10 adaptor)

Part No. 158-54, oil line with spray hole and squared bottom end. (Use with No. 1-11 adaptor.)

Pump

Part No. 220-3-500 currently assembled with No. 1-10 adaptor.

The oil scoop, shown in Illustration No. 185 is riveted to the bottom of the camshaft gear, and in operation, sprays oil in a circular path throughout the top of the engine. About 80% of

this scoop runs in oil, so there is some margin for oil level variation. Considering that the camshaft assembly turns at one-half crankshaft speed, the maximum speed of the camshaft and attached oil scoop would not go over 1800 RPM, with the engine turning at 3600 RPM.

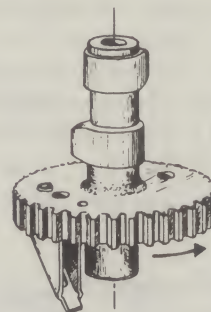


Figure 185

In engines that use the oil scoop, the top main bearing has an oil access slot milled into the top bearing area. Again, this slot is used to service the alloy bushing surface or the sleeve bearing, whichever is used in assembly. A wide acceptance chamfer is cut into the outer end of the slot in order that maximum oiling is received. Illustration No. 186-A shows the chamfer area, the slot and the oil return passage. Illustration No. 186-B, taken from Service Bulletin No. 8, shows the correct installation of the top oil seal when used on vertical shaft engines, with or without the sleeve bearing. Review this bulletin.

The base bearing of the vertical shaft engines is lubricated by agitation of the crankcase oil by the moving internal parts. The oil is fed into the access slot and provides lubrication for the full length of the bearing. As before, the access slot is used in the engines with the alloy bearing or the sleeve bushing. Due to the natural force of gravity, residue may collect in the slot, therefore, in service, the slot and the bearing should be free from foreign material and the bearing surface should be lightly oiled prior to engine reassembly.

All connecting rods have oil access holes or chamfers to insure adequate lubrication; the chamfer must accept oil from the bottom scoop spray as well as from the oil exhaust port in the top of the vertical shaft engines. When in-

stalling the connecting rod, make sure that the oil acceptance hole is toward the top main bearing. Illustration No. 187-A shows the oil

port drilled in the rod and the degree of chamfer on both sides, plus the relief at the rod and cap mating surface.

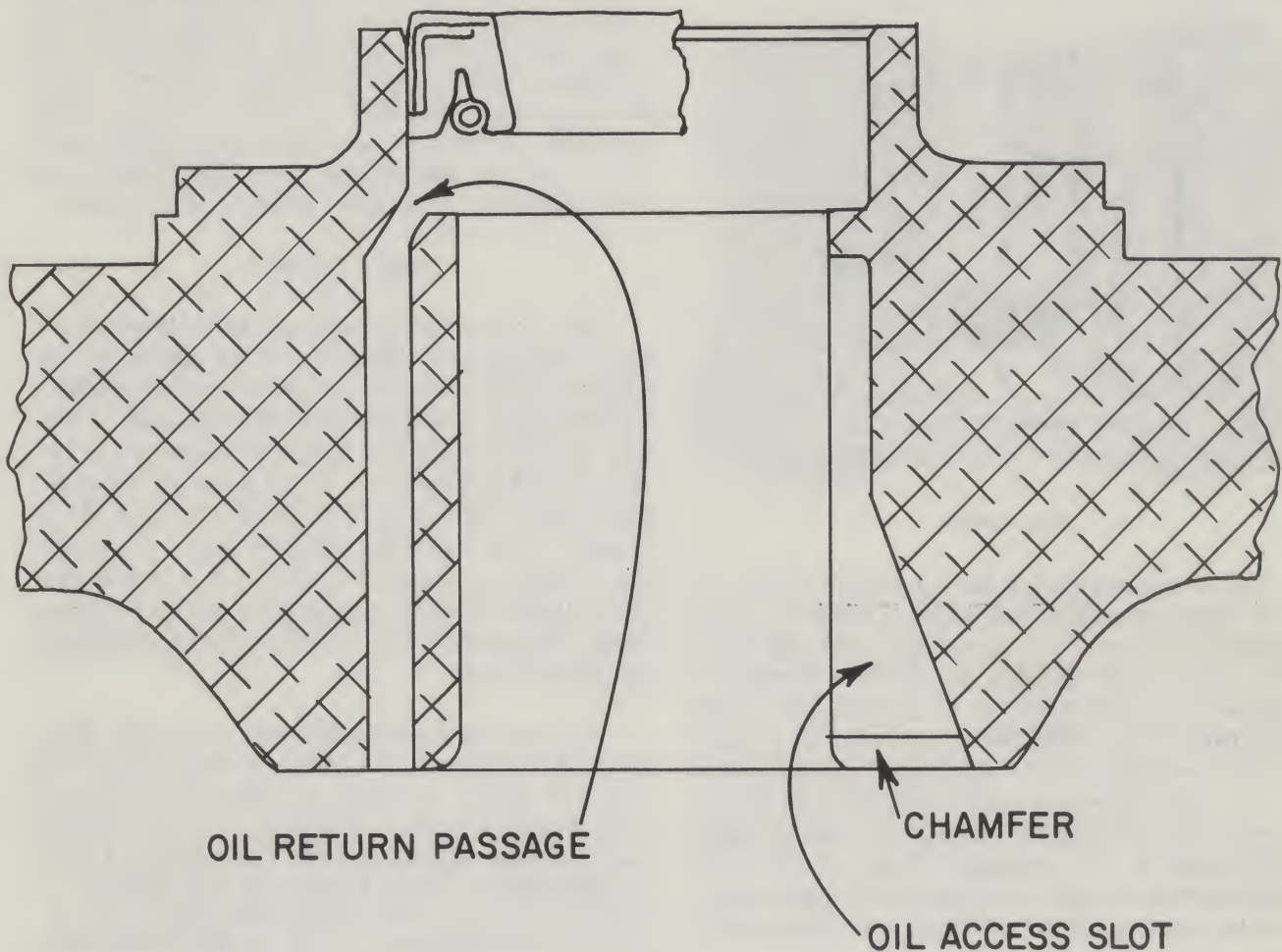


Figure 186-A

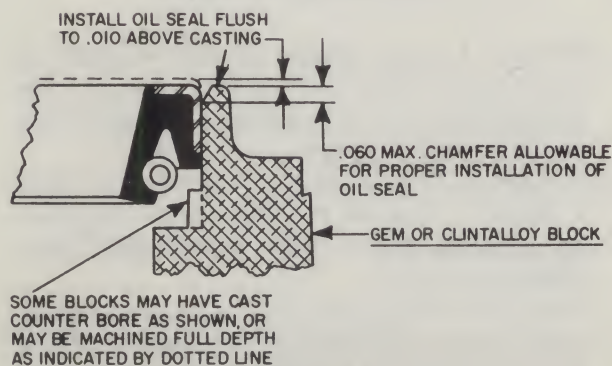


Figure 186-B

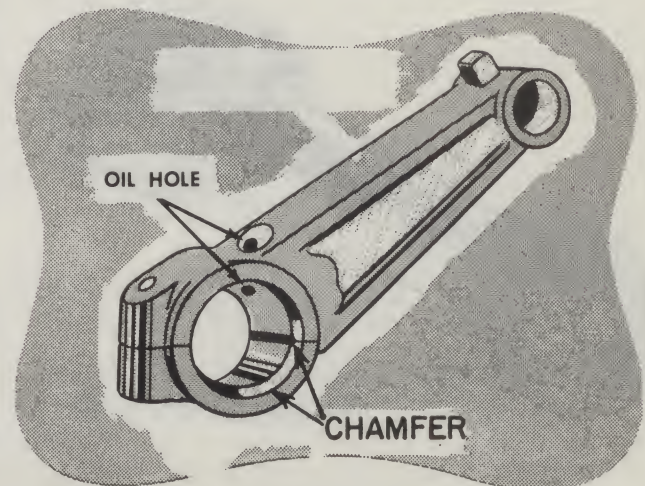


Figure 187-A

Check the condition of the oil passages into and out of the valve spring chamber (see Illustration No. 187-B); they should be clean, free of any accumulation of dirt and carbon.

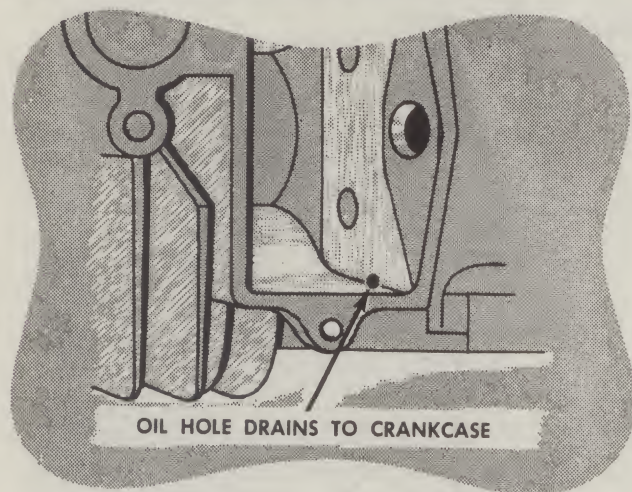


Figure 187-B

The 2-cycle engines have a series of oil access holes to admit the fuel-oil mixture to all bearing surfaces. The connecting rod cap has a wide acceptance opening to allow a volume of mixture to reach the rod to journal area. (See Illustration No. 188.) With attention to proper oil-fuel mixture ratio, this type of lubrication is very effective and contributes to long engine service life. It is this same mixture that provides lubrication to the cylinder wall, so the first evidence that the fuel-oil mixture is not correct will be scoring of the cylinder and piston skirt area.

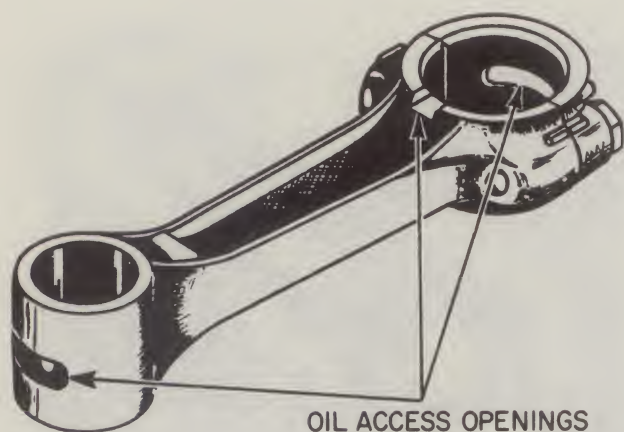


Figure 188

Be sure to impress on the engine owner, the importance of selecting the right grade and type of oil, not to mention checking oil level and changing oil at regular intervals. The local conditions under which a 4-cycle engine must operate should determine the frequency of oil changing. Under some conditions, the owner may have to change oil daily, or once a week or once a month. A regular schedule of oil replacement will certainly extend the life of the engine, and this is known to the local service technicians.

BREATHERS

The purpose of the breather is to allow crankcase pressure to escape from the engine and to admit outside air back into the crankcase without bringing dust and dirt in with the fresh air. Failure of the breather to exhaust crankcase pressure could result in blown oil seals or gaskets, this "blow-out" would be to the outside of the engine. If the breather failed to admit fresh air, the negative pressure within the crankcase would tend to draw the gaskets into the crankcase. Illustration No. 189 shows several types of breather valves.

The breather assembly can cause oil carry over. A breather valve jammed in open position can add to the problem or cause the problem. Dirt in the breather assembly can also affect the breather operation and can cause oil loss. **IMPORTANT:** When trouble is encountered a breather change should be performed due to possible mal-function. It is recommended that breather number 29-32-5 or 29-35-5 should be used to replace the 29-36, 260-13, and 29-7-500 where applicable. The 29-32-5 and 29-35-5 breather assemblies are new and completely redesigned to control the crankcase pressures, where the old style would be marginal.

CYLINDER HEAD SERVICE

1. When a 4-cycle engine is disassembled in accordance with instructions, inspect the cylinder head for dirt accumulations, carbon deposits and warpage.
2. Scrape the foreign matter from the head with a suitable tool and remove carbon deposits by cleaning with a wire brush. (See Illustration No. 190.)
3. If the head is warped, place a piece of emery cloth, rough side up, on a flat surface. Move the cylinder head (gasket surface downward)

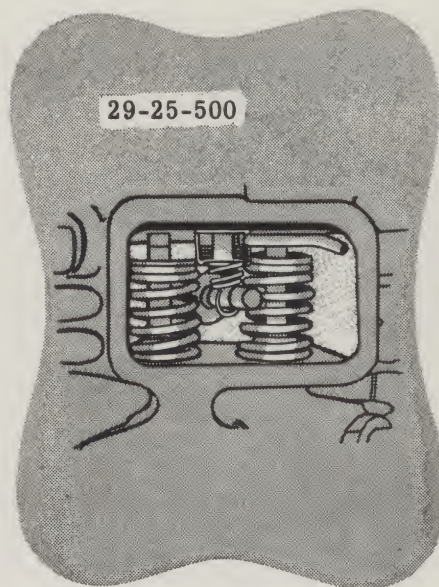
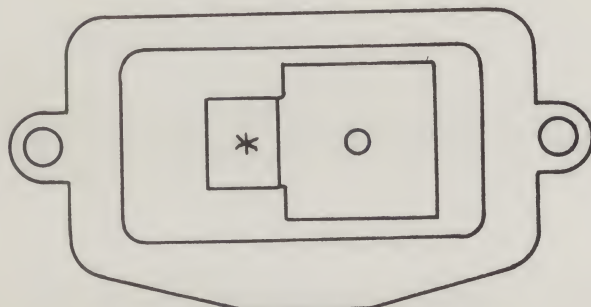
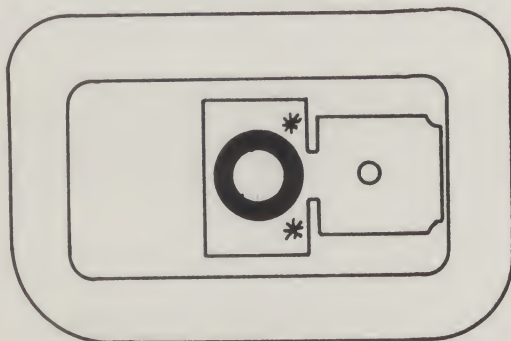
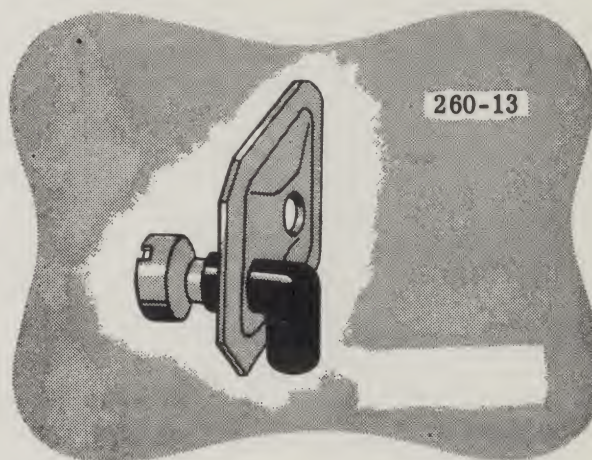
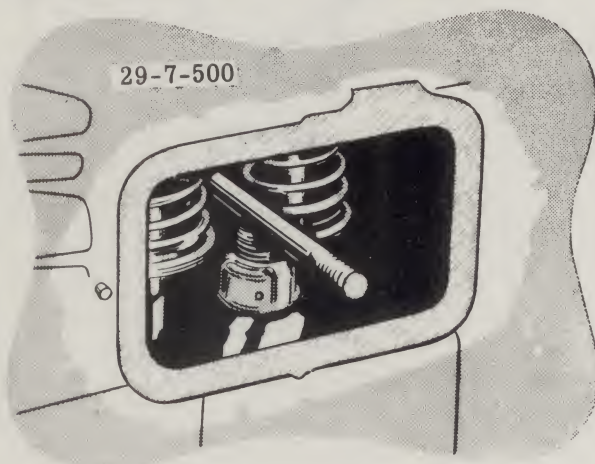
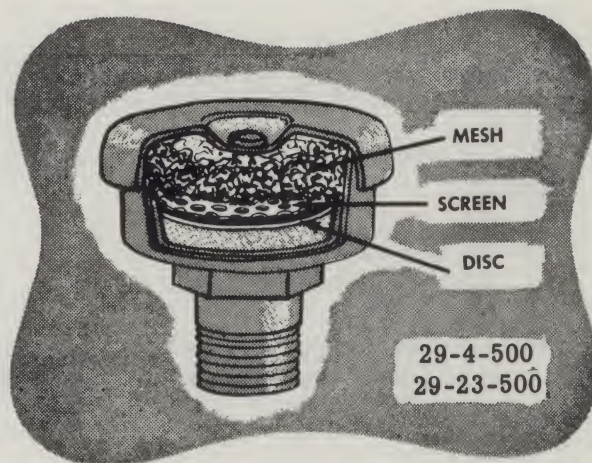
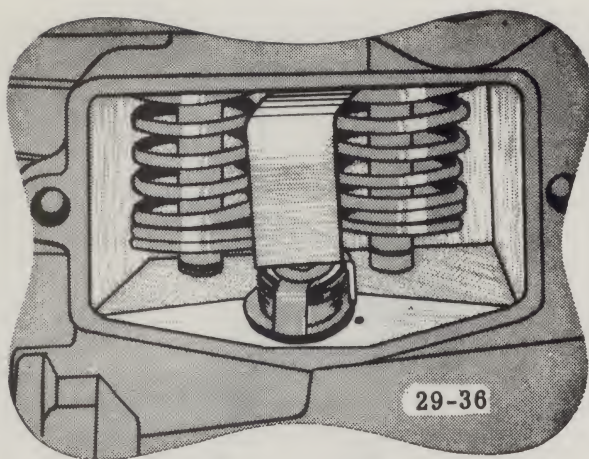


Figure 189

in a figure 8 design across the paper until roughness is removed and the surface is flat.

4. After the head is cleaned check for the following:
 - a. Broken cooling fins.
 - b. Stripped threads in spark plug hole.

Broken cooling fins or stripped threads in the spark plug hole would require head replacement.

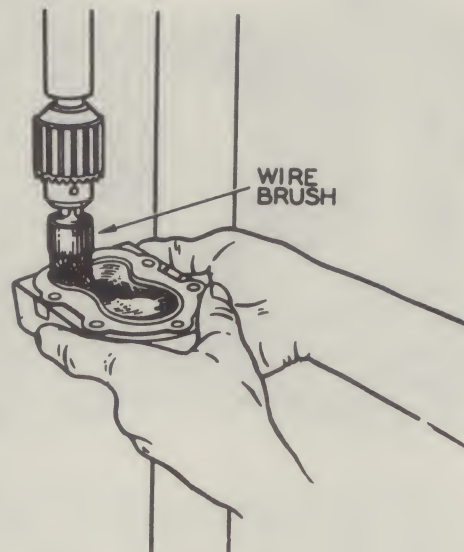


Figure 190

2- AND 4-CYCLE ENGINE RE-ASSEMBLY

This is a general re-assembly procedure, for the 2- and 4-cycle Clinton engines, and variations from this will be necessary on some models.

First make sure all parts have been cleaned, and the worn or damaged parts replaced. All bearing surfaces and cylinders should be coated with S.A.E. No. 30 motor oil. Replace all oil seals and gaskets.

NOTE: All nuts, bolts, and screws should be tightened to the proper torque, with a torque wrench. Due to the number of different model engines covered not all torques will be listed in the re-assembly procedure, however, Section VI, Div. H, Page 6 covers complete torque data.

4-CYCLE ENGINE RE-ASSEMBLY

1. Install tappets into the block.
2. Assemble oil pump to cam gear, if oil pump is used on engine being assembled.
3. Engine equipped with mechanical governor, should have the governor shaft installed in the block.
4. Install crankshaft and cam gear into block making sure crankshaft thrust washer is in place if engine is so equipped.
5. The timing marks on the crankshaft should be aligned at this time. (See Illustration No. 191.)

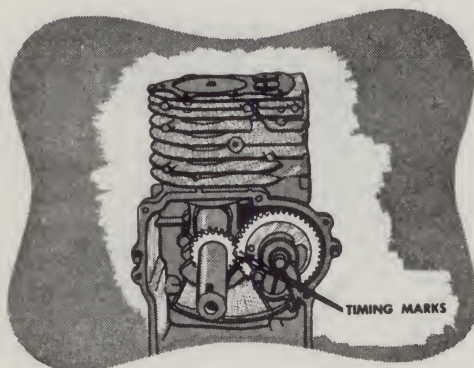


Figure 191

6. Install oil line from oil pump to upper main bearing if engine is so equipped. (See Illustration No. 192 and 193.)

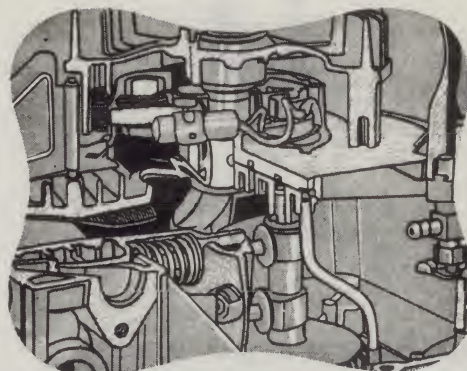


Figure 192

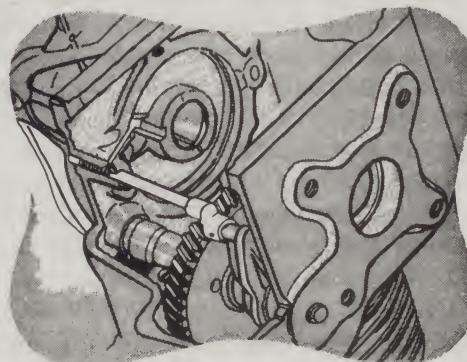


Figure 193

7. The piston and rod ass'y can be installed at this time into the block, by using a 951-34 piston ring loader. (See Illustration No. 194.) **NOTE:** Care should be taken when tapping or pushing the piston into the cylinder as it is possible to break rings or damage pistons.

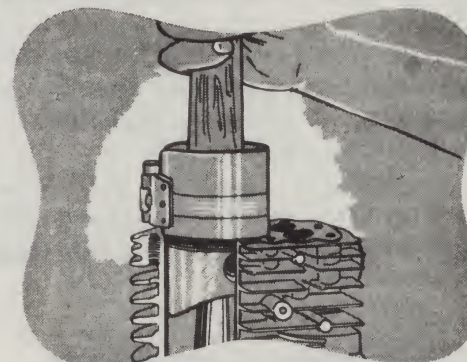


Figure 194

8. Install the rod cap (oil distributor if so equipped, see Illustration No. 195), rod screw lock, and rod cap screws. **NOTE:** Torque the rod bolts to the proper torque. (Refer to Section VI, Div. H for torque data.)

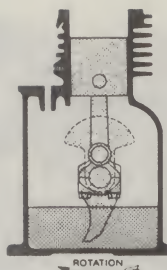


Figure 195

9. Crimp rod screw locks securely.
10. Assemble the bearing plate, base plate, or end cover to the block. *NOTE: Make sure the crankshaft end thrust is to specification.* Engines having sleeve bearings require .005 to .020 crankshaft end thrust. Engines using taper roller bearings require .001 to .006 crankshaft end thrust. Engines using ball bearings have no specifications on crankshaft end thrust, however, care should be taken to make sure the crankshaft is not tight after assembly. The proper crankshaft end thrust can be obtained by using various thickness gaskets between plate and block.
11. Install the crankshaft oil seals into the flywheel and power take off side of the engine using the proper oil seal loader and oil seal driver, so seals will not be damaged. The oil seals are normally installed flush to slightly recessed, below surrounding base.
12. Assemble valves in block making sure the clearance between the valves and tappets is correct. When setting the clearance between the valves and tappets, make sure the lobes of the cam gear are pointing away from the tappets. Normally the valve clearance is obtained by grinding or filing the end of the valve stem off. The valve to tappet clearance should be between .009 to .012 on all 4-cycle engines. (See Illustration Nos. 196-A and 196-B.)

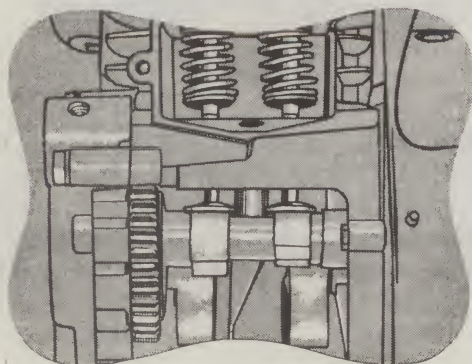


Figure 196-A

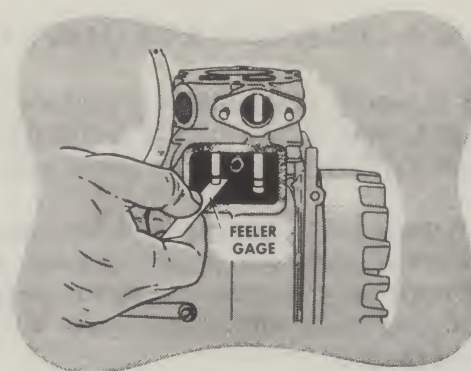


Figure 196-B

13. Assemble valve springs, to valve stems, using spring compressor 951-32 or 951-67. (See Illustration No. 197.)

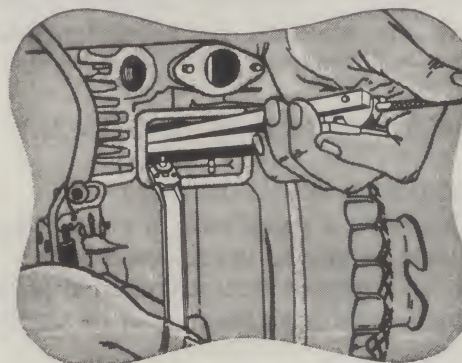


Figure 197

14. Assemble breather, and valve chamber cover to block.
15. Assemble cylinder deflector to engine block.
16. Assemble magneto assembly to block, or bearing plate, making sure the points are correctly set and clean. (See Illustration No. 198.)

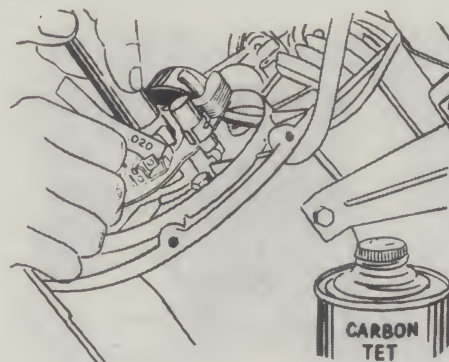


Figure 198

17. Assemble flywheel, flywheel screen and starter cup to crankshaft. *NOTE: Using a torque wrench and flywheel holder 951-42, torque the flywheel nut to the proper torque.*

(See Illustration No. 199.) (Refer to Section VI, Div. H, Page 6 for Torque Data.)

18. Assemble carburetor and governor ass'y to block. *NOTE: Make sure the governor links and springs are hooked in the proper holes.*

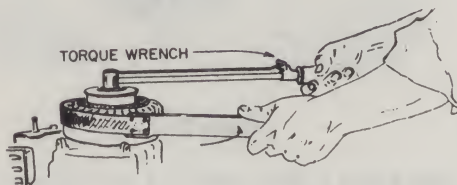


Figure 199

19. Assemble head to cylinder block. *NOTE: Make sure the head gasket matches the contour of the head, before assembly.* Head bolts should be torqued in the sequence illustrated (see Illustration No. 200), the torque should not be applied all at once. Apply torque in at least three stages.
20. Assemble blower housing and/or tank to engine block.
21. Assemble muffler, spark plug and air cleaner.

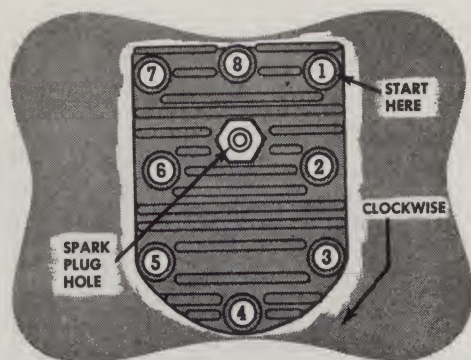


Figure 200

2-CYCLE ENGINE RE-ASSEMBLY

1. Assemble the piston and rod ass'y into the block, using a 951-153 or 951-150 piston ring mounting sleeve. *NOTE: Care should be taken when tapping or pushing the piston into the cylinder as it is possible to break rings or damage piston. (See Illustration No. 201.)*

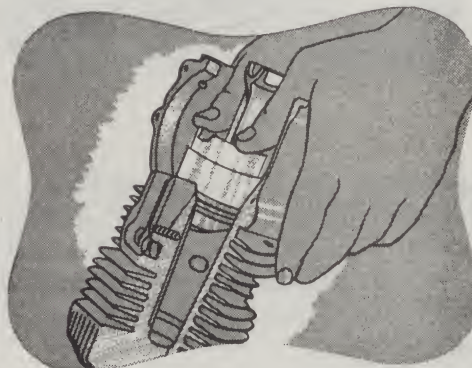


Figure 201

2. Assemble crankshaft into block, making sure crankshaft thrust washer is in place, if engine is so equipped.
3. Assemble connecting rod cap, screw lock and cap screws to rod and crankshaft. Torque rod cap screws to proper torque (Refer to Section VI, Div. H, Page 6.)
4. Assemble reed plate to block.
5. Assemble bearing plate to block. *NOTE: Make sure crankshaft end thrust is to specifications.* Engines using sleeve bearings require .005 to .020 crankshaft end thrust. Engines with ball bearings have no specifications on crankshaft end thrust, however, care should be taken to make sure the engine is not tight after assembly. The proper crankshaft end thrust can be obtained by using various thickness gaskets between bearing plate and block.
6. Install the oil seals into the flywheel and power take off side of the engine, using the proper oil seal loader and driver so the oil seal will not be damaged. (See Illustration No. 202.) The oil seals are normally installed flush to slightly recessed below surrounding bosses.
7. Assemble the magneto to the bearing plate making sure the points are correctly set, and clean.

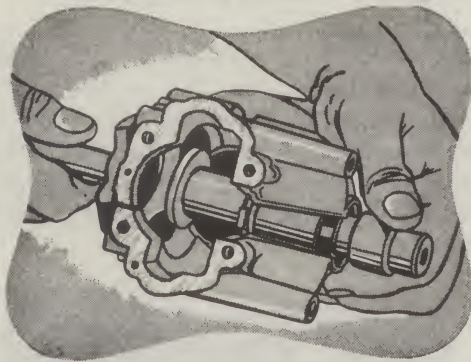


Figure 202

8. Assemble the flywheel, flywheel screen and starter cup to crankshaft. *NOTE: Using a torque wrench, and 951-42 flywheel holder torque the flywheel nut to the proper torque. (Refer to Section VI, Div. H, Page 6, for Torque Data.)*
9. Assemble carburetor, governor links, springs and air vane to engine.
10. Assemble cylinder deflector to engine.
11. Assemble housing and/or tank to engine.
12. Assemble muffler, spark plug and air cleaner to engine.

GOVERNORS

The governor used on engines serves two purposes, these being, No. 1 to keep engine from overspeeding and No. 2 to control the engine speed from no load to full load. In the Clinton line you will find two types of governors, these being the pneumatic air vane, and mechanical flyball type. Due to the difference in the design of the two types governors, they will be covered separately.

CAUTION: Never remove the governor spring or links from the throttle or governor lever without marking the proper hole. Failure to replace the spring or link properly can cause serious damage.

MECHANICAL FLYBALL GOVERNORS

To best illustrate the operation of the flyball governor (see Illustration No. 203), a practical example is necessary.

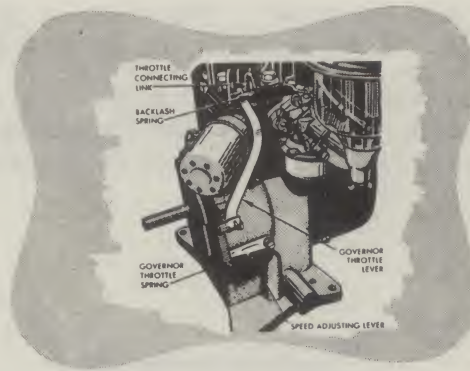


Figure 203

1. Start the engine and set the speed adjusting lever (or remote control throttle), to a point where the engine is operating at approximately 3600 RPM.
2. Place a load on the power take-off shaft of the engine. The engine will appear to slow down momentarily, but will quickly regain its former speed because of the governor action.
3. As the engine begins to slow down, the sets of centrifugal governor weights which are mounted on pivot pins on the side of the cam-shaft or governor gear will allow the governor yoke to move toward the cam or governor gear. (See Illustration No. 204.)

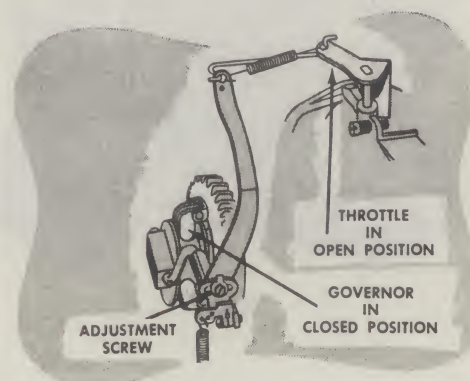


Figure 204

4. This lateral movement of the yoke activates the governor shaft ass'y which transmits the action through connecting linkage to open the throttle. Movement of the governor shaft and the amount the throttle is opened will be proportionate to the loss of engine speed. The throttle will open just enough to restore lost speed.
5. When the load is removed from the engine drive shaft, the governor will reverse the operation to prevent the engine's running away. (See Illustration No. 205.)
6. When the engine is stopped, the governor weights fall dead toward the center of the camshaft or governor gear allowing the governor yoke to move all the way over against the cam or governor gear. This causes the governor shaft to open the throttle wide by means of the governor spring and connecting linkage.

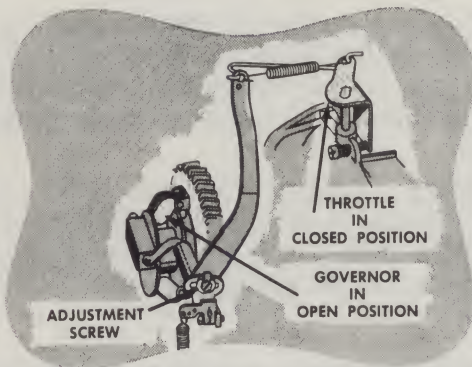


Figure 205

7. The governor throttle spring is the control or balance acting against the centrifugal force produced by the governor weights. The speed of the engine depends upon the initial tension applied to this spring, either by the speed adjusting lever or by the remote control throttle lever. The spring has been carefully selected and is calibrated to permit speeds up to 3600 RPM. Do not substitute a heavier or lighter spring, as this would seriously affect operation of the governor. Maximum engine speed should not be above 3600 RPM.

INSPECTION AND ASSEMBLY

It is best, when reassembling an engine equipped with the centrifugal weight governor, to inspect the governor shaft bearing in the block and the governor arm ass'y that goes through the bearing, for wear and replace it if necessary. After inspection, insert the arm through the bearing and fasten the arm and weight ass'y into the bearing.

Care should be taken on installation of this arm and weight assembly as they may be locked to the outside linkage 180 degrees from the correct position which would tear out the centrifugal weights and damage the arm and weight ass'y upon operation of the engine. (See Illustration No. 204 or 205.) The weight and arm or yoke should be as close to the cam axle or governor gear as it can be to be properly installed. In this position, it will operate against the governor collar or thimble ass'y and will move in conjunction with the governor spring tension and the centrifugal force of the weights which are attached to the camshaft or governor gear.

The collar should be inspected for wear and possible damage, and the weight ass'y itself should be inspected for wear and possible damage or bending of the weights or the weight supports.

When servicing a centrifugal governor, check to be certain that the collar or thimble operates freely on the camshaft or governor gear and that the governor shaft moves freely in the bushing. When the bushing in block is replaced, check carefully the freedom of shaft as the bushing may be distorted in installation.

Also the governor shaft can be bent easily on disassembly, reassembly and can be bent in usage. Also check range of movement of collar or thimble after assembly of camshaft or governor gear to determine that these parts do not lock against block.

On Illustration Nos. 206 and 207 are shown an adjustment screw. This is an important part of the governor. By loosening this screw the governor weight's travel can be set to the throttle travel. With the engine in a stopped position and with tension on the governor spring, Illustration Nos. 208 and 209 illustrates the position of the throttle and the governor arm, and the throttle lever should be locked together in this position.

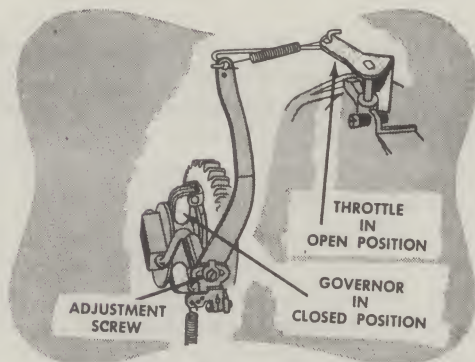


Figure 206

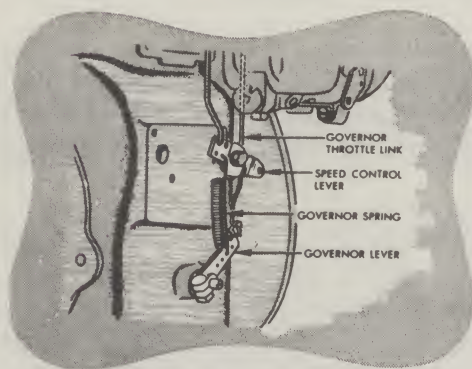


Figure 207

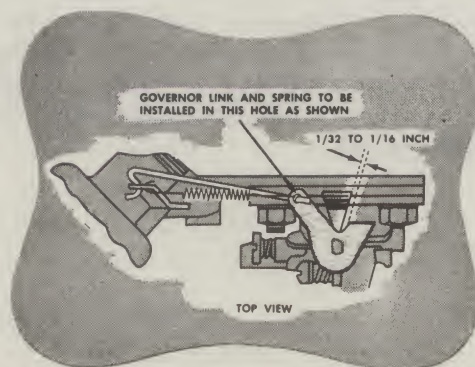


Figure 208

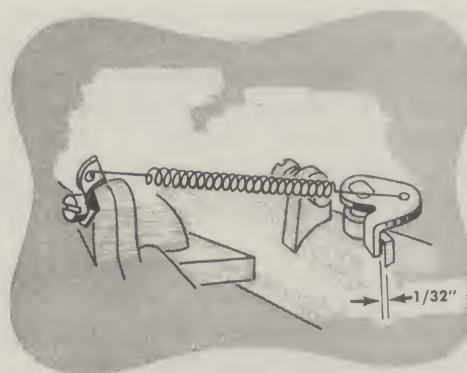


Figure 209

On older production engines, that didn't have this screw for balancing the throttle valve to the governor travel, the loop in the governor link can be opened or closed to secure the same results.

NOTE: The 1/32" to 1/16" distance between the throttle plate and the carburetor casting is critical. If this adjustment is ignored, it is possible to tear the governor weights out or damage them.

On most of the horizontal cast iron engines a governor back lash spring is used in conjunction with the governor link between the throttle and the governor arm. The hook-up of this spring is very important and its function is to move the throttle open as the engine speed drops. The link is to close the throttle as the engine goes overspeed. If the spring is hooked over the link in any way, it will give a "sloppy" linkage in the governor arm or throttle plate which will bring surge into the engine operation due to the extra travel of the governor arm prior to any response from the throttle; Illustration No. 209 illustrates this hook-up.

AIR VANE GOVERNOR

1. The air blast created by the finned flywheel operates the air vane governor. The air vane is located inside the blower housing and linked directly to the throttle lever. The air vane governor is positioned in respect to the air blast by a light coil spring attached to the throttle lever or in some instances to the governor link. (See Illustration Nos. 210 and 211.)

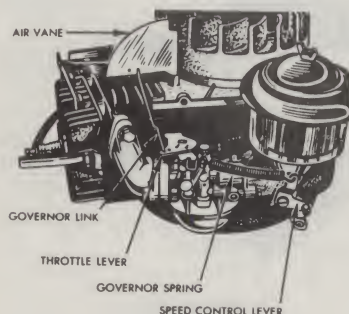


Figure 210

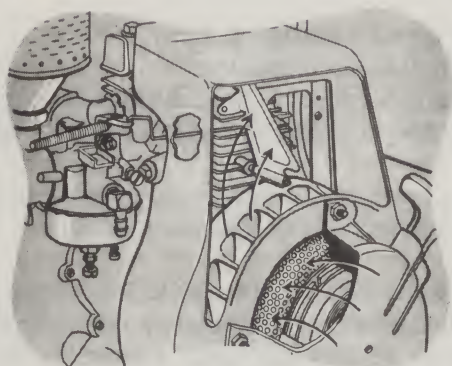


Figure 211

2. When a load is applied to an engine drive shaft, the flywheel begins to slow down, causing a reduced air blast. The governor spring will move the linkage (and the air vane) in proportion to the engine speed reduction. The air vane, in turn, opens the throttle enough to restore the lost engine speed.

3. When the load is removed, this action is reversed and the governor operates to prevent the engine from running away.
4. The governor spring is the balancing force of the governor. The engine can be set to run at any desired speed within the operating range by adjusting the initial tension of the governor spring.

NOTE: Do not substitute a heavier or lighter spring, since this would seriously affect governor action. Maximum engine speed should not be above 3600 RPM.

INSPECTION AND ASSEMBLY

On reassembly of an engine the air vane governor should be replaced hooking the linkage between the carburetor and air vane so the linkage can be reassembled without bending. Any time a governor link is bent it will save time and trouble if it is replaced with a new link.

The air vane should be inspected visually when reassembling and replaced if bent or damaged. The linkage should be replaced if it has been bent or if it is questionable and care should be used in the hook-up of air vane link and throttle plate so that they move freely and do not drag at connection or on bearing plate or blower housing. Many of the air vane governors have a spring inside of the vane at the pivot. The spring gives a dampening affect on the vane movement. This spring can be replaced if the engine has been out for a period of time, and if it is not replaced, possibly it can be stretched slightly so that it retains the pressure on the bushing or vane for the dampening effect of movement that it was put in there to supply.

When servicing an air vane governor, the condition of the blower housing is important. Dents and bends should be removed from it so that the air stream moves as it should to the air vane. The air vane must be in the same condition as "produced" and replaced when bent because the governor spring tension and the vane are balanced. If the vane does not set in the air blast properly, the spring will be too strong for the air vane to stretch.

As the engine is reassembled in the air vane governor area, apply tension to the governor spring and close the throttle manually and see that it moves open freely, that it does not bind at the governor linkage, air vane, pivot post, bushings, bearing plate, blower housing, etc. It should move freely from closed to open position by governor spring tension.

It is always advisable to caution the customer to keep the air intake open and not allow grass, weeds, or other debris to pile up on the intake. If the air is blocked from going into the flywheel through the opening in the blower housing or recoil starter, there is less available air in the air stream from the flywheel is reduced. As when the air blast from the flywheel is reduced, due to plugging of the air intake, the engine speed will increase and can cause damage to engine due to excessive RPM. Obviously any reduction of air intake would affect cooling as well, but the engine speed is also very important.

Remember, when working with governors, that a wide variation in speed (surge) can be caused by improper carburetor adjustment as well as due to binding linkage, improperly installed linkage, governor spring, etc. Refer to the carburetor service section for basic carburetor settings. A slight opening of the idle adjustment needle can often minimize surge. In the case of governor surge after an engine is repainted, it can be caused by paint on the links. It is recommended that a new engine or rebuilt engine be operated for a period of time at "no load" to wear off any paint on the throttle shaft governor linkage, etc.

OIL SEALS

Oil seals serve two purposes, these being, No. 1 to keep the oil from leaking out of the crankcase 4-cycle engines, and No. 2 sealing the crankcase on 2-cycle engines, to keep the vacuum and pressure from being affected by the outside atmospheric pressures.

Any time an engine is being disassembled and the oil seals are not going to be replaced with new, it is a must that oil seal loaders be installed over the crankshaft or cam gear axle to keep from damaging the seal lips when the base, bearing plate, crankshaft or cam gear is removed. (See Illustration No. 212-A.) Clinton has oil seal loaders, that will fit any diameter shaft used in the Clinton line of engines.

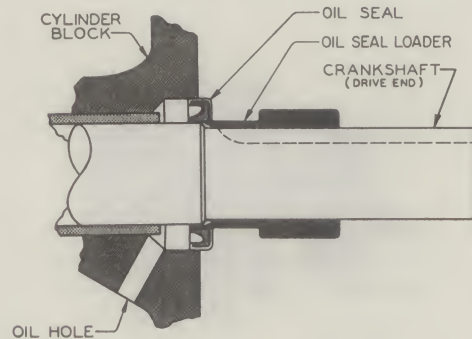


Figure 212-A

Whenever an engine is disassembled or the oil seal removed from it, the oil seal should be given a visual inspection for the following, to determine if it can be reused.

- A. Cut or damaged seal lips.
- B. Distorted or bent seal.
- C. Condition of seal lip to make sure it still is flexible, and has not taken a permanent set.

Any of the above defects, would require replacement of the seal with a new one.

To insure that an oil seal will function properly it is recommended, that any time an oil seal area of an engine has been worked on that new seals be used.

No comment has been made on seal removal thus far, but oil seals should be removed prior to removal and replacement of bearings and reaming of bearings. The oil seals may be removed by prying out or by any means at hand with some care being used not to damage the bearing plate, block, or base to which a new seal must be replaced.

Illustration No. 212-B illustrates the 951-50 which is used to pull the magneto side seal on some engines with the crankshaft in place. Oil seals may be replaced after the parts are cleaned up, or they may be replaced after the crankshaft is in the engine and the engine is partially re-assembled.

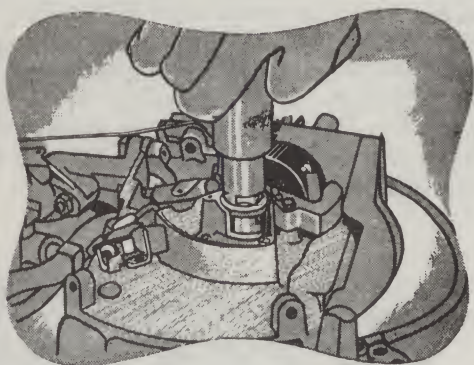


Figure 212-B

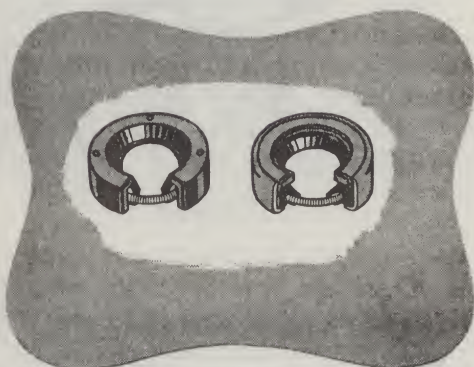


Figure 213

When replacing oil seals after the engine is reassembled, it is necessary to have drivers long enough to slip over the end of the crankshaft to drive the seal in place. On the installation of an oil seal to a bearing plate, block or base, it is necessary to note that the seal has a heavy lip that goes in towards the crankcase. (See Illustration No. 213.) In some cases there may be a second lip. The second one is smaller, and care should be taken when installing the seal with the heavy lip towards the crankcase. It is possible upon removal of an oil seal to distort the bore, the bore, that the new seal will be replaced in causing it to be slightly out of round. On steel bound seals it is possible, if there is any "out of round," that the seal might leak around the outer circumference. It is a common practice when

servicing engines (replacing the oil seal) to use a gasket sealer around the outer circumference of the seal being replaced (See Illustration No. 214.) As the seal is driven in with the gasket sealer around the outer circumference, the sealer is wiped "up" and seals off any out of round condition on the bore of the bearing plate, base, or block in relation to the oil seal.



Figure 214

Many seals have an outer neoprene coating which is approximately .020. This type of seal will take care of any out of round without the use of a sealer.

CAUTION: Place gasket sealer on outer circumference of oil seal only. If the sealer is placed in the bore and the seal then driven in, the sealer may roll back on the lip of the seal causing a leak or possibly block off oil relief hole which could cause seal leakage.

Clinton has oil seal drivers available to be used to insure that the seal will be installed straight to the proper depth, and not distort or damage.

As previously stated, the positioning of the oil seal to the bearing is very important as a definite space is needed between the lip of the seal and the bearing for the lubrication to drain back to the crankcase.

In replacement of oil seals on the D-1100, 1200, 1200-2000, A-1200, B1290 and 498 engines it is necessary to replace the bearing plate oil seal from the crankcase side of the bearing plate and it must be removed from the crankcase side. Illustration No. 215 illustrates this seal on this type bearing plate.

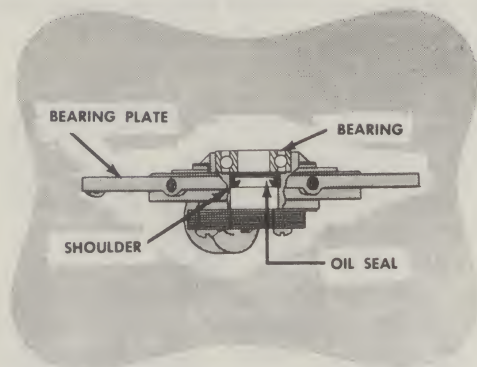


Figure 215

Care must be used when the crankshaft is installed or if the seal is to be slid over the crankshaft, as any burrs, sharp keyways, or roughness can damage the lip of the seal which will allow lubrication to move through the new seal. The crankshaft should have been inspected previously, and if any roughness, rust, paint or any other damage to the seal area were apparent, the crankshaft should have been polished with crocus cloth in a circular motion in the seal contact area (See Illustration No. 216.) It is definitely recommended that oil seal loaders be used when a crankshaft is to be slid through an oil seal or when the seal is to be slid over the crankshaft.

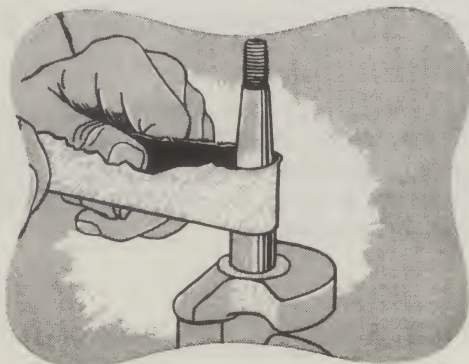


Figure 216

Illustration Nos. 217 and 218 illustrate loading oil seals. Obviously the loader must be free of burrs and clean and undamaged, or the loader can damage the oil seal. Lubricate loader, seal and crankshaft to minimize seal stress or damage. Illustration Nos. 217 and 218 illustrate seal loaders in place and the seal with a lip expanded to miss the crankshaft. After oil seals are replaced on vertical shaft engines, a protector is available for the crankshaft PTO side of the engine. Under certain application and operating conditions the protector can give added seal life. Illustration No. 219 illustrates type of protector for the two standard size PTO extensions. (No. 218-13 for 7/8" dia. and No. 218-4 for 1" dia. crankshaft.)

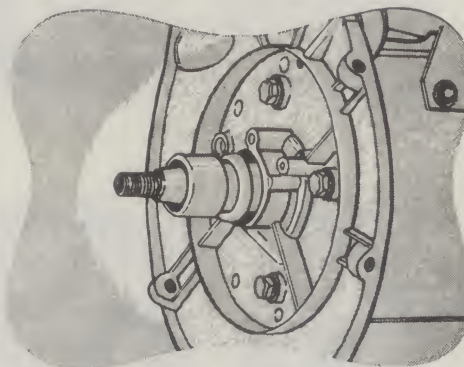


Figure 217

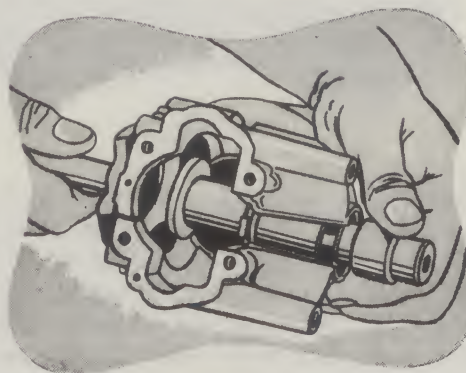


Figure 218

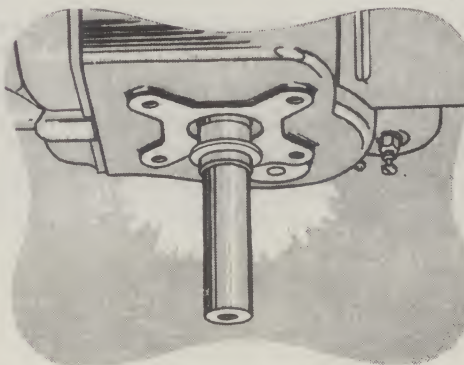


Figure 219

ACCESSORIES

RECOIL STARTER SERVICE

Disassembly (See Illustration Nos. 220 and 221.)

1. Remove recoil assembly from engine.
2. Release spring tension slowly.
3. Remove rope pulley assembly.
4. Remove rope from pulley.
5. Remove recoil spring.

After disassembly the parts should be cleaned in a recommended parts cleaner. After the cleaning operation, the recoil parts should be given a visual inspection for the following:

- a. Bent, damaged, or broken recoil spring.
- b. Worn bearing in rope pulley.
- c. Bent, cracked, or damaged housing.
- d. Bent, worn, or broken pawls or pawl plate.
- e. Broken, worn or defrayed rope or cable.

Any of the above listed defects would require replacement of part or assembly involved.

Reassembly (See Illustration Nos. 220 and 221.)

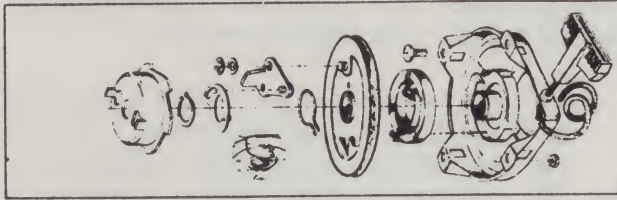


Figure 220

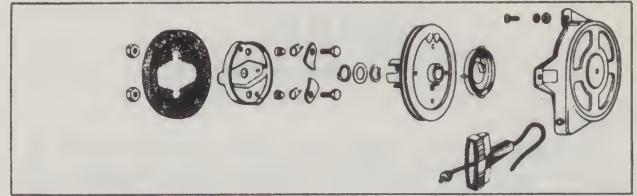


Figure 221

1. Coat with luber plate grease, recoil spring, inside dome of housing and rope pulley shaft.
2. Install recoil spring, making sure that it is installed correctly, that is so it will be wound the right direction.
3. Install rope pulley, making sure the spring hooks into the pulley. NOTE: Some recoils require the rope or cable to be installed before the pulley is put into place.
4. Assemble the pawls or washers to recoil housing shaft or rope pulley.
5. Wind the recoil spring by turning the rope pulley; The spring can be wound completely tight, and then backed off (1) one turn. Holding the pulley to keep it from unwinding, install the starter rope and handle.

NOTE: If the recoil spring is wound the wrong direction, or the spring not backed off (1) one turn, the spring will fail on the first pull of the rope.

The attached sheets show the correct disassembled sequence of the parts on current recoil starters.

RECOIL TROUBLE SHOOTING CHART

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Rope does not recoil	Spring bent Broken spring Spring disengaged Not enough end play Starter housing damaged Binding starter pulley Broken rope	Replace with new spring Replace with new spring Replace with new spring Remove shims Replace with new housing Replace with new housing Replace with bulk rope cut to length
	Insufficient tension on spring	Rewind spring
2. Noisy when running	Hub rubbing on cup Too much end play	Use additional washer or shim stock to get clearance. Replace pulley assembly.
3. Starter frozen up Will not pull	Starter spring broken and jammed on hub	Replace spring with new check hub for damage and replace if necessary for new.
	Improper lubrication or dirty	Disassemble and clean, lubricate with Lubriplate

DIE CAST IMPULSE STARTER

Identification

The heavy duty 265-196-500 starter has a waffled top and is 2-3/4 inches from bottom of legs to top of housing. (See Illustration No. 222.)

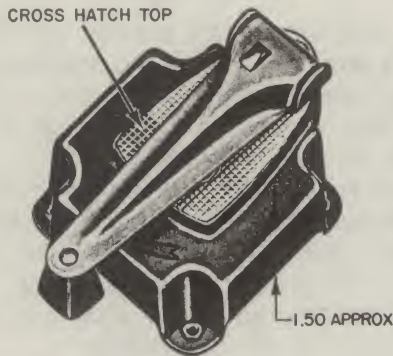


Figure 222

The standard 265-135-500 starter is 2-3/4 inches from bottom of legs to top of housing and has a smooth top. (See Illustration No. 223.)

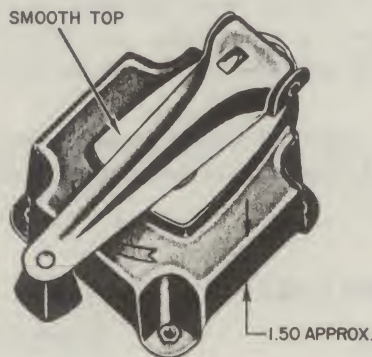


Figure 223

The compact and/or low profile 265-206-500 starter is 2-1/4 inches from bottom of legs to top of starter housing, and has the waffled top. The only way to tell the difference between the standard 265-196-500 and the compact 265-206-500 starter is the overall height. (See Illustration No. 224.)

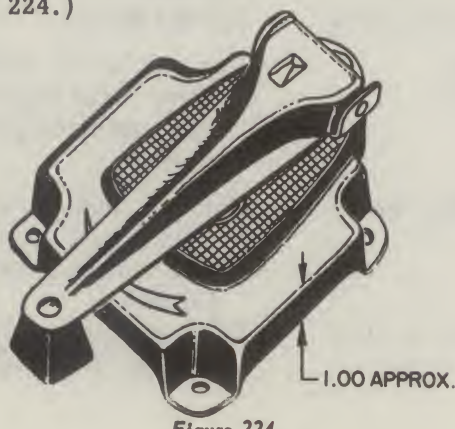


Figure 224

Below is listed the suggested application of impulse starters. Please review this since Engineering has revised somewhat on this application.

1. HEAVY DUTY STARTER

Use for all engines up to and including 4-1/2 B.H.P. and all installations which use these engines.

2. STANDARD IMPULSE STARTER

Use on vertical shaft engines under 3-1/2 B.H.P. Not to be used on installations that impose a heavy starting load on the engine.

3. LOW PROFILE COMPACT IMPULSE STARTER

Used on horizontal and vertical engines under 3-1/2 B.H.P. Not to be used on installations that impose a heavy starting load on the engine.

Below is listed a "Starting Procedure" in case problems are experienced in starting engines equipped with impulse starters.

1. Choke Procedure—The throttle lever must be in the full choke position prior to starter release and kept there until the engine starts.
2. To Activate Starter—Rotate handle in a clockwise direction until the spring is wound tight. (Approximately 6-1/4 turns) (See Illustration No. 225.)

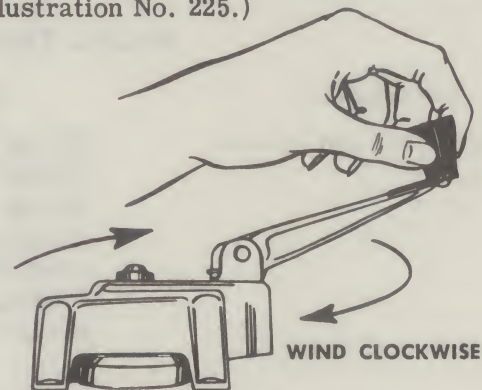


Figure 225

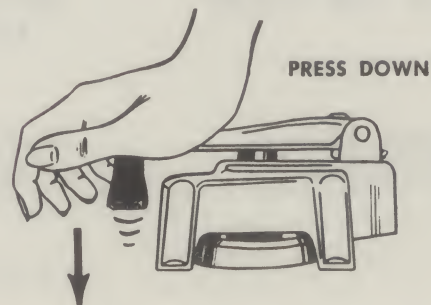


Figure 226

3. To Release Starter—Push down on the starter handle and hold firmly against the stop until the starter releases. Occasionally there will be a hesitation or time lag of several seconds between the time you push in on the handle and the time the starter releases. (See Illustration No. 226.)
4. Failure of Engine to Start—Make the following checks if the engine has failed to start after 5 releases:
 - a. Remove air cleaner and check the choke plate to see if it is fully closed when the throttle lever is in full choke position. (Adjust touch and go bracket if choke is not fully closed.)
 - b. Check the idle and Main Jet Needle position.
5. Repeat item Nos. 1, 2, and 3.

NOTE: The occasional hesitation prior to release of the starter is caused by the piston traveling thru its compression stroke. The hesitation will not occur if the piston is traveling on any other stroke at the time of release.

This note has been released so that Sales and Service may forewarn the customer of the starting procedure of the low profile impulse starter and the customer will not be alarmed when the hesitation occurs.

The above has been listed for your review. In certain starting problems, correction of problems has been accomplished by use of heavy duty starter; however, the starting problem could have been corrected if the belt tension is corrected, if the engine would have gone to full choke and/or if the carburetor had been properly adjusted. Under normal conditions, replacement with the heavy duty starter would not be allowed under warranty.

DIE CAST IMPULSE STARTER SERVICE

Disassembly (See Illus. No. 227.)

1. Prior to disassembly, make certain starter spring is released. Turn handle a few turns and press handle on release button.
2. Remove ratchet with 3/8" Allen Wrench. Turn in counterclockwise direction (facing bottom of starter ass'y). If ratchet is broken or will not unscrew skip this operation and do Step 3.
3. Remove Phillips Screws (4) holding bottom cover ass'y to starter housing.

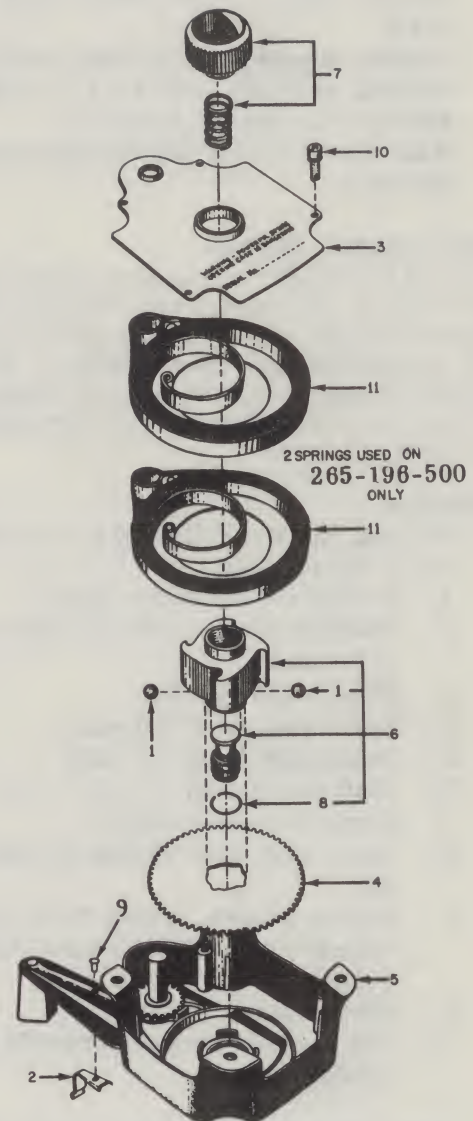


Figure 227

4. Grasp starter housing top and lightly tap starter ass'y (legs down) on clean work bench holding starter at arms length with fingers on main housing ass'y only. Starter is safe to disassemble if the previous comment is followed.

Tapping will remove bottom cover ass'y, spring and cup ass'y(s), plunger ass'y and large gear.

NOTE: Do not remove power spring from power spring cup. These are serviced as power spring and cup ass'y only. Mark position of each spring and cup ass'y on double spring starter and replace in same relationship.

5. Main housing ass'y will be serviced as a complete assembly and includes handle ass'y and shaft, small gear, pawl and spring, etc.

6. Remove bottom cover ass'y from internal ass'y.
7. Remove plunger ass'y from power spring and cup ass'y(s). Use care so that power spring is not forced from cup.
8. Wash parts in cleaning solvent prior to inspection.

Identification - Internal

The 265-196-500 heavy duty starter has two power spring and cup ass'y(s). The 265-135-500 standard starter has one power spring cup ass'y plus an additional cup used as spacer. The 265-206-500 compact starter has one power spring and cup ass'y and due to lower silhouette does not require spacer.

Inspection

1. Housing Ass'y - Following requires housing ass'y replacement.
 - A. Broken or cracked housing.
 - B. Rounded corners where handle engages to ratchet.
 - C. Broken pawl spring.
 - D. Small gear tooth damage.
 - E. Small gear loose on shaft.
 - F. Shaft grooved by bottom cover.
 - G. Screw threads stripped.
 - H. Large gear teeth cutting into main housing.
 - I. Handle groove spread to the point that plunger cannot be depressed sufficiently for starter release.
 - J. Knob broken.
 - K. Housing bore for plunger ass'y worn excessively.
2. Gear - Following requires gear replacement.
 - A. Broken or damaged teeth.
 - B. Peening, grooving or heavy burring of center plunger hole of gear. Check closely where balls lock into gear.
3. Plunger Ass'y - Following requires replacement of individual parts and/or plunger ass'y.
 - A. Damaged or broken ratchet.
 - B. Ratchet loose on bushing.
 - C. Damaged plunger.
 - D. Plunger frozen to bushing-ratchet ass'y.
 - E. Balls missing. Replace individual parts.
 - F. Balls out of round or peened. Replace individual parts.
 - G. Retainer missing, damaged, or broken. Replace individual parts.
 - H. Bushing-Pockets for balls elongated.
4. Power Spring Ass'y - Following requires replacement.
 - A. Lack of tension on internal formed hook of spring. Spring hook tension should push plunger ass'y to one side and good spring will require side pressure on spring to install spring over plunger.
 - B. Broken spring.
 - C. Spring damage to spring cup (Case); this can be noted by uneven sides of cup or bulged cup.
 - D. Elongation of handle shaft hole of power spring cup.
5. Cover Ass'y - Following requires replacement ass'y.
 - A. Bent or distorted cover ass'y.
 - B. Elongated handle shaft hole.
 - C. Damaged or worn plunger ass'y bushing.
6. Ratchet and Spring Kit - Following requires a replacement.
 - A. Damaged teeth on ratchet.
7. Cup Ass'y - Following requires replacement of Ass'y.
 - A. Pawls lazy.
 - B. Pawl spring broken.
 - C. Pawls bent.
 - D. Cup damage.

Reassembly

1. Coat with lubriplate grease (Melting point 500° F. plus or equivalent) all internal working parts including both sides of large gear, cup on side which springs slides, inside of bottom cover, etc.
2. To reassemble plunger ass'y, slide plunger into bushing and sprocket ass'y, install a ball from each side and slide retainer into place to complete ass'y.
3. Install large gear in housing with beveled side of gear teeth facing housing opening. Hook pawl with gear teeth and apply side pressure to allow gear to move into place as shown in Illustration No. 228.

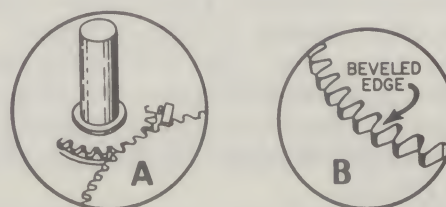


Figure 228

4. Hold large gear in place centered to housing with handle shaft gear and large gear teeth meshed, then install plunger ass'y through large gear and housing so that release end of plunger ass'y protrudes through starter housing top.
5. Install power spring and cup ass'y so that open side of spring cup is toward housing opening with small hole in spring cup (outer end of spring) to be installed over handle shaft. On double spring starters, reinstall springs in same position as originally assembled.
6. Use screw driver and position the center end of spring over plunger ass'y. NOTE: Care should be taken so that spring is not pushed out of spring cup.
7. After spring is hooked over plunger ass'y push power spring and spring cup ass'y against the large drive gear.
8. If starter has (2) springs the second can be installed the same as outlined previously (Steps 5, 6 and 7). If standard 265-135-500 starter, there will be one empty spring cup and open side of empty cup is to be installed toward housing opening after power spring and cup ass'y is installed.
9. Starter cover plate ass'y can now be installed making certain that bushing in cover plate ass'y has the thrust side of the bushing toward the inside.
10. Install the four (4) Phillips screws in place, tighten securely (20 inch pounds).
11. Install plunger spring into plunger ass'y. This spring pushes plunger up and failure to install causes starter to be inoperative.
12. Install drive ratchet gear securely by hand. It is not necessary to tighten with Allen Wrench as it will automatically tighten up when used. Turn in a clockwise rotation.

STAMPED METAL IMPULSE STARTER

The suggested application of the 265-250-500 stamped metal impulse starter (See Illustration No. 228-A) is all vertical shaft engines up to and including the 4-1/2 H. P.

This starter is not adaptable to the horizontal engines, as the handle will not ratchet.

Below is listed a "Starting Procedure" in case problems are experienced in starting an engine equipped with impulse starters.

1. Choke Procedure - The throttle must be in the run position, and the choke fully closed prior to starter release and kept there until the engine starts.

2. To operate impulse starter, push release lever in until release lug engages with starter cup. Fold out handle and turn clockwise until fully wound. When starter is fully wound fold handle back in place. To start engine, move release lever away from starter.



Figure 228-A)

IMPULSE STARTER SERVICE

Disassembly

The service on the 265-250-500 stamped metal impulse starter is limited to only the handle. The main power spring and drive gear are not serviceable, if trouble is encountered in this area it would require complete starter replacement. (See Illustration No. 228-B)

To disassemble handle, remove center screw holding handle to starter body. When the screw is removed the handle can be lifted from starter body, this will expose the starter locking pawls and springs. The starter handle, pawls or pawl springs can be serviced as necessary.

Reassembly

Coat with lubriplate grease (melting point 500° F. plus or equivalent) pawls and handle gear. To assemble handle to starter, starter pawls have to be held out away from center, so handle gear will fit into place. After handle is in place center screw can be installed.

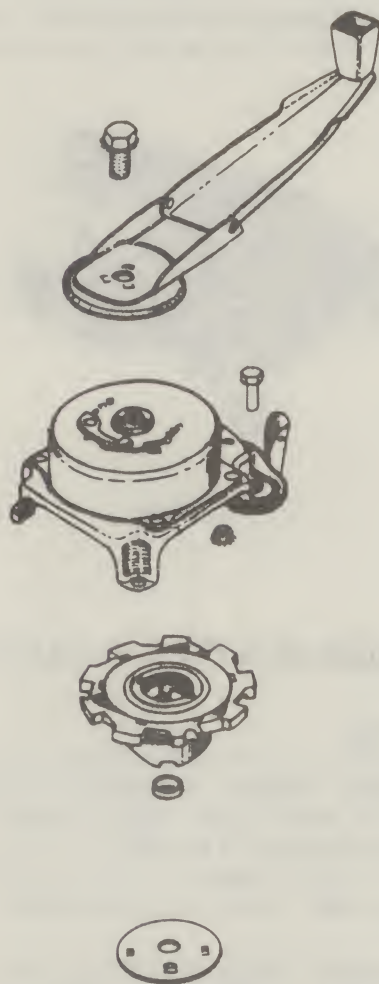


Figure 228-B)

LP GAS

LPG or Liquefied Petroleum Gas is either Butane or Propane or any mixture of the two and as far as the operation of a small gasoline engine is concerned the operating characteristics are the same. Illustration No. 229 illustrates a typical hook-up for LP Gas on a Clinton engine. These hook-ups are either factory installed or available in kit form for adaption by service accounts.

There are two types of LP Gas hook-ups as used on small engine.

1. Liquid operating and
2. Vapor operating. Clinton engines use the vapor operating.



Figure 229

NATURAL GAS

Natural Gas operation is basically the same as LPG except the primary regulator is not required. Natural gas flows through the meter and is released from the meter at 6 oz. pressure. The secondary regulator, carburetor, and engine are the same and adjustments should be made the same as on LPG.

THERE ARE FIVE COMPONENTS TO THE CLINTON LP GAS FUEL SYSTEM*

1. Tank
2. Primary Regulator
3. Secondary Regulator
4. Carburetor
5. Engine

The LP Gas vapor flows from the tank under high pressure to the primary regulator where this pressure is reduced from approximately 186 pounds per square inch down to 6 ounces above atmospheric pressure. The vapor then flows to the secondary regulator where this pressure is reduced to just less than atmospheric or so that no vapor will be released unless there is a vacuum and allows the vapor to be taken through the carburetor and into the combustion chamber of the engine. (See Illustration No. 230.)

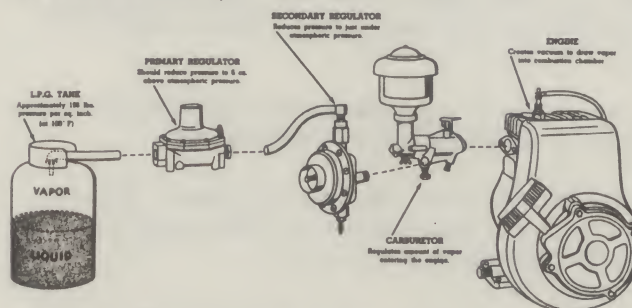


Figure 230

TANK

Only a VAPOR withdrawal tank should be used. Care should be used that the connection for removal is at the TOP so that only vapor is withdrawn and not liquid. *NOTE: When the tank valve is opened it should be opened slowly.* If opened too fast the safety valve inside the tank may close and not allow the vapor to be released from the tank. If this happens, close the valve and open SLOWLY. The line from the tank to the primary regulator should be at least 1/4" in diameter and 250 pound test. If the line is too small it may refrigerate and restrict the flow of vapor. (See Illustration No. 231.)

NOTE: Some equipment manufacturers place a safety shut-off in the line between the tank and the primary regulator that is operated either by crankcase pressure or electrical device.

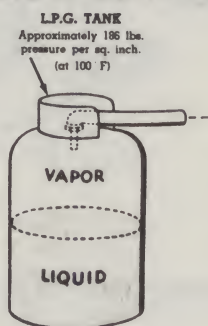


Figure 231

PRIMARY REGULATOR

The purpose of the primary regulator is to reduce the pressure of the gas to six ounces above atmospheric pressure. Care should be taken that the air vent on the side of the regulator be kept open and not plugged with dirt. Also leaks may be detected, caused by a punctured diaphragm or from dirt under the plunger. (See Illustration No. 232.)

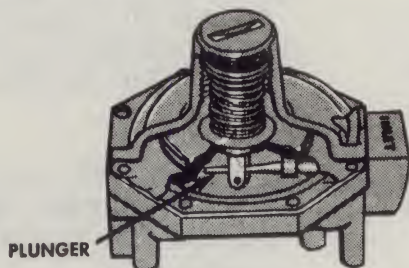


Figure 232

NOTE: Some units use a special Primary Regulator set to 5 lbs. pressure instead of 6 oz. The same Secondary is used but it requires a different setting.

SECONDARY REGULATOR

The secondary regulator reduces the pressure (6 ounces) to just below atmospheric pressure. The adjustment screw is on the end of the regulator and has been preset and if over one full turn is required to shut off flow of the fuel the regulator should be disassembled and checked. The air vent then must be kept clean and diaphragm free of holes. Dirt can get under the plunger lever causing a leak of fuel. The fuel should be shut off and the adjustment screw turned 1/8 to 1/4 turn more. Use soap bubbles on outlet to check shut off. (See Illustration No. 233.)

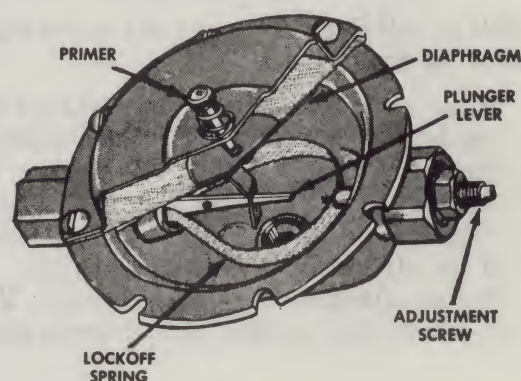


Figure 233

CARBURETOR

The carburetor should be opened one turn on the high speed and 1/4 to 3/8 turn on the idle screw. After engine is started and warmed up, the carburetor should be adjusted the same as any other carburetor. (See Illustration No. 234.)

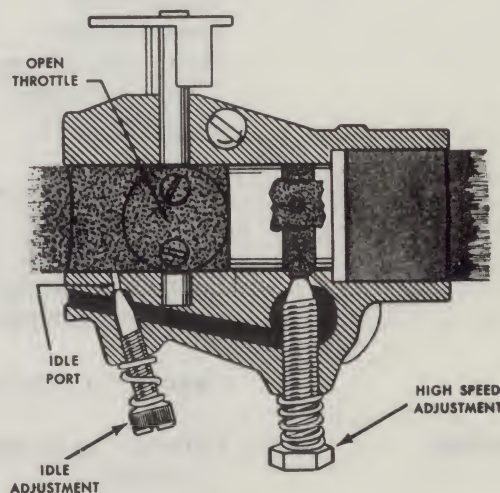


Figure 234

ENGINE

An engine equipped for LP Gas should have a stellite valve and seat in the exhaust and a standard exhaust valve in the intake. Also, the shorting clip should be removed as an LP unit should only be shut off at the tank. Sparkplug gap should be set at .018 for better starting. Engine should be equipped with the new style breather assembly in the valve chamber cover. It is also recommended that a closed breather system be used. (See Illustration No. 235.)

STARTING PROCEDURE

NOTE: All Regulators are preset on engines built at the factory.

1. Turn on valve at fuel tank SLOWLY. (If opened too quickly, safety valve in tank may shut off fuel supply.)
2. Completely depress primer on secondary regulator and bleed line until gas is smelled at the air cleaner (15 to 20 seconds).
3. Engine started in normal manner. If unit does not start on first pull, depress plunger

for three or four seconds on every other attempt to start to keep from flooding.

4. After engine is started, allow engine to warm up and then adjust carburetor in normal manner.

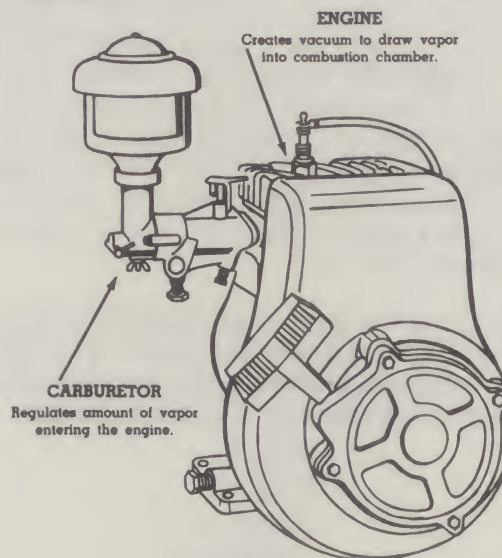


Figure 235

TROUBLE SHOOTING CHART

NOTE: Check local and state regulations regarding LPG servicing prior to proceeding with repairs.

TROUBLE	POSSIBLE CAUSE	CORRECTION
No Fuel at Engine	Fuel shut off at tank	Turn on fuel
	Safety valve in tank tripped	Shut off valve at tank and re-open slowly
	Line refrigerated	Replace with larger diameter line; also check for proper tank
	Line broken	Replace line
	Line crimped	Straighten or replace if cracked
	Oil in primary regulator from transportation truck pump	Remove and take to propane distributor for checking
	Primary dirty	Remove and take to propane distributor for checking
	Air vent in primary or secondary plugged	Clean
	Leak in lines or at connector	Replace line and seal connection
	Improper type tank used (Use only vapor withdrawal)	Replace with vapor withdrawal type (Be sure tank is with outlet on top)
Flooding	Carburetor cracked or broken	Replace carburetor
	Primary or secondary regulator leaking	Readjust if possible, check for foreign matter under plunger or damaged plunger or seat
	Air cleaner plugged	Clean or replace air cleaner
	Carburetor not adjusted properly	Adjust

ELECTRIC STARTER 12-VOLT DC STARTER GENERATOR

Used on D-700, 900, A-1200, B-1290, 1600, 1800, 2500, 2790, 414, 418, 420, 422, 494 and 498 Series engines. (See Illustration No. 236.) Refer to Section III, Div. N of Master Parts Manual for exploded view and parts list.

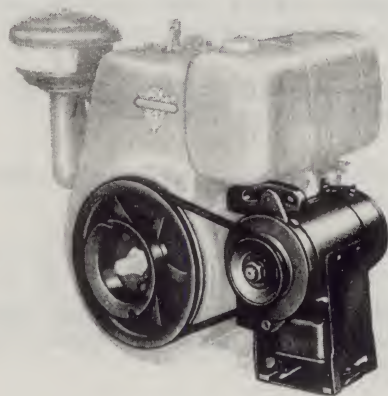


Figure 236

Clinton does not supply replacement parts for the starter generator, or regulator. Service, replacement parts, and warranty can be secured through an authorized Delco-Remy Warranty Station of United Motor Service.

NOTE: For correct wiring hook-up see Illustration No. 237.

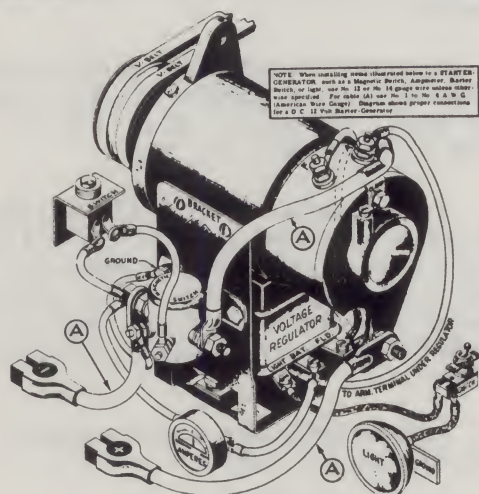


Figure 237

12-VOLT STARTER AND DC BATTERY CHARGING

Used on 412, 413, 498, and 499 Series Engines. Clinton does not supply replacement parts for these starters; however, service, replacement

parts and warranty can be secured through an authorized American Bosch Arma Corp. warranty station. (See Illustration Nos. 238 and 239.) Refer to Section III, Div. N of Master Parts Manual for exploded view and parts list.

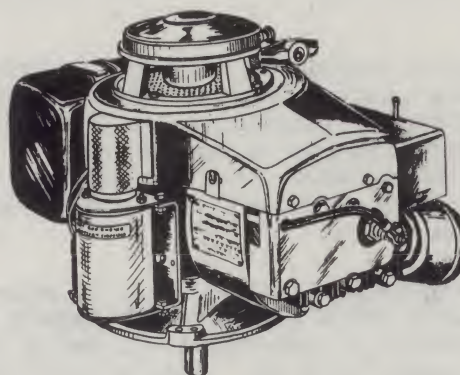


Figure 238

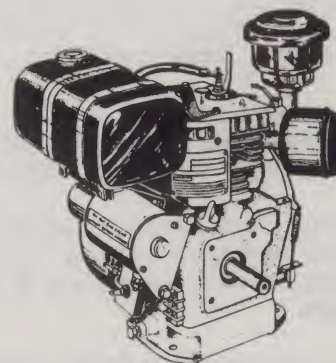


Figure 239

See wiring diagram for installing optional items, and correct wiring hook-up. (Illustration No. 240)

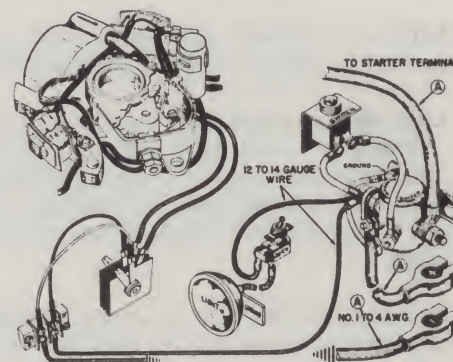


Figure 240

GENERAL INFORMATION

Starter consists of an alternator-magneto, rectifier and panel also 12 Volt D. C. Series wound motor actuating a Bendix type drive engaging an external tooth ring gear which is an integral part of the flywheel. Power source is a 12 Volt automotive type battery usually 20 ampere hour.

When the Electric Starting Motor is energized (by pushing a button or turning a switch or key as provided by mower manufacturer) the Bendix drive gear engages ring gear on flywheel, cranking engine. Releasing button or key de-energizes electric motor and Bendix drive gear automatically disengages.

If temperature is above 32° F. fill engine to proper level with a good grade #30 regular oil. If temperature is below 32° F. fill engine with #10 W regular grade oil. This is particularly important for cold weather starting.

If specific gravity is below 1.265 to 1.285 have battery slow charged at a rate of 2 amp. maximum rate until battery is fully charged.

Due to size requirements, this starter has certain cold weather limitations under 0° it may be necessary to use recoil starter to start engine.

The following cranking time must be observed to prevent over heating or burning out electric motor. Low battery causes armature to heat and burn out of same.

- (a) Never run starter over 10 seconds continuously.
- (b) Allow one full minute between each 10 second cranking period.
- (c) Do not repeat step more than 5 times. If engine does not start during intervals outlined above, there is a mechanical reason - check and correct.
- (d) Allow 15 minutes before beginning cycle outlined in steps A, B, and C.

Failure to observe time limits will over heat starter causing permanent and expensive damage.

Alternator-magneto, consists of the usual coil, condenser, and point set for firing engines also incorporated are two extra generating coils and flywheel, to generate current for recharging battery. Charging rate at 3600 is approximately 2-4 amps.

The flywheel has 10 magnets, 2 of which are used for ignition and all 10 used for generating current.

The generating coils are series wound with two extending leads of which is attached to the

rectifier terminals. Do not apply battery current to coil leads. Current from battery to coil leads will de-magnetize flywheel magnets, and cause coils to burn out. Connect battery to rectifier as shown in Illustration No. 240.

Polarity of this unit is negative ground. To test coils, remove coil leads from the rectifier. Use a test light made from a flash light bulb, using a (PR 12 bulb,) connect test light to coil leads. Remove spark plug to relieve compression, using recoil starter with a quick pull the bulb should glow. If bulb does not glow replace coils.

Generating coils are supplied in pairs and can only be replaced in pairs.

Rectifiers are of selenium type and are directional.

In most cases when damaged or shorted the rectifier has a fowl odor. If test of coil is used as of above and current to rectifier is correct by using ampmeter to check will show if rectifier is good or not.

If battery becomes over charged or fuming, disconnect one coil lead from rectifier. Make sure pulled lead does not touch ground.

LIGHTING COILS

Consists of the usual coil condenser and point set for firing engines also incorporated are two extra generating coils and flywheel, for generating current for lights.

The flywheel has 10 magnets 2 of which are used for ignition and all 10 used for generating current.

The generating coils are parallel wound with extending leads of which is attached to the terminal strip. See wiring diagram for correct hook-up. (Illustration No. 241)

To test coils remove coil leads from terminal strip. Use a test light made from a flash light Bulb, using a (PR 12 bulb) connect test light to coil leads. Remove spark plug to relieve compression. Using recoil starter, with a quick pull the bulb should glow. If bulb does not glow replace coils.

Lighting coils are supplied in pairs and can only be replaced in pairs.

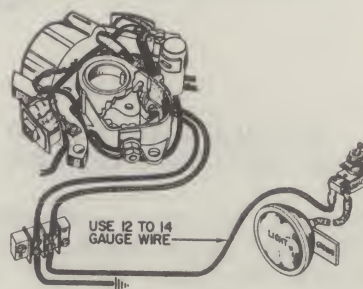


Figure 241

FUEL PUMPS

Fuel pumps are used on engines that use a remote fuel tank or have a tank mounted to the engine in such a way that a gravity fuel system will not work. Clinton uses two types of fuel pumps, which are the mechanical and diaphragm types.

MECHANICAL FUEL PUMPS

The mechanical fuel pumps are activated by an eccentric on the engine crankshaft. This type fuel pump will lift fuel approximately 48 inches. (See Illustration No. 242.)

If the pump does not supply fuel to the carburetor or leaks, it can be repaired. Refer to Section III Div. O of the Master Parts Manual for exploded view and parts list.

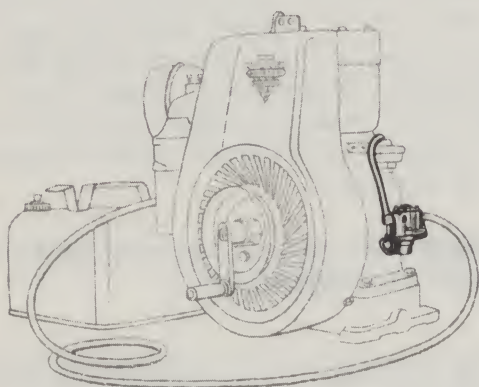


Figure 242

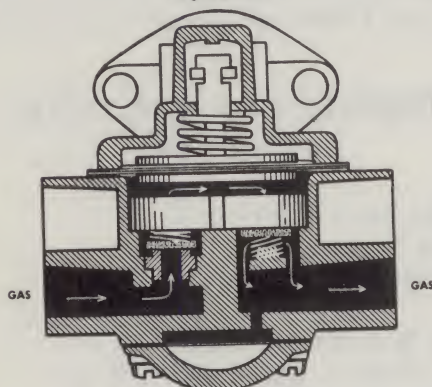


Figure 243

DIAPHRAGM FUEL PUMPS

Part number 220-122-500 fuel pumps were first used on the 2 cycle engines with float carburetors. The fuel pump screwed into the inlet side of the carburetor and was activated by use of an impulse tube connected to the crankcase. This fuel pump is designed to lift fuel 6 inches. (See Illustration No. 244.)

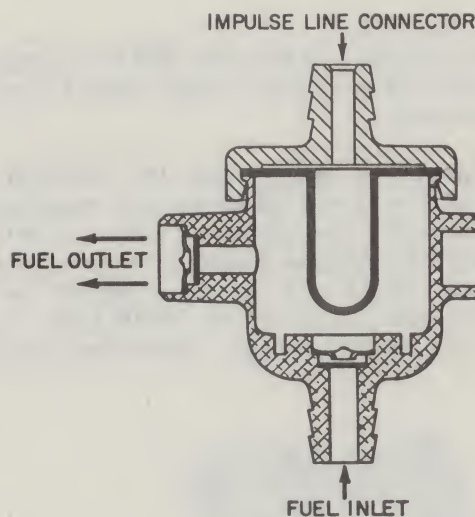


Figure 244

Part number 220-145-500 fuel pumps were used on 4 cycle engines. This pump screws into the inlet side of the carburetor, and is activated by an impulse tube connected to the intake manifold. This pump is designed to lift fuel 6 inches. (See Illustration No. 245.)

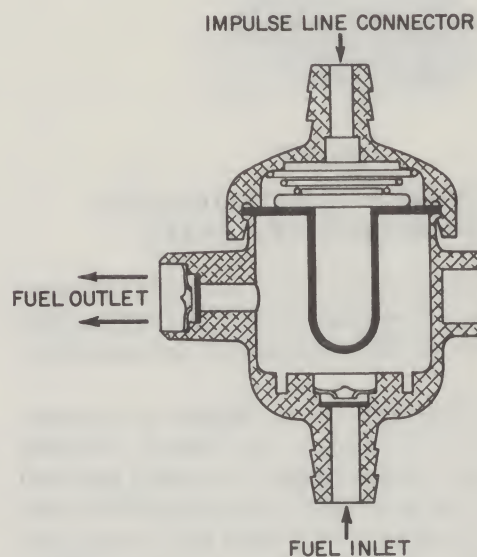


Figure 245

The 220-122-500 and 220-145-500 fuel pumps cannot be repaired; if defective they require complete replacement.

Diaphragm fuel pump used on VS-1200, V-1200, and 499 series engines are not supplied as a complete ass'y; the individual parts have to be used. This fuel pump is attached to the engine crankcase end cover and is activated by the crankcase vacuum and pressure. This pump is designed to lift fuel 12 inches. (See Illustration No. 246.)

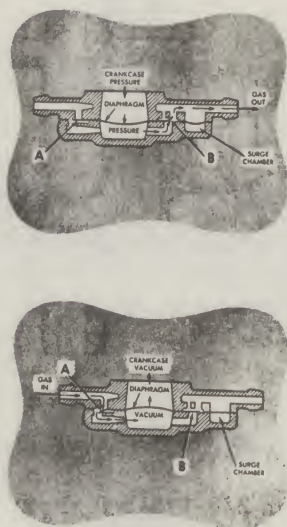


Figure 246

DIRECT MOUNTED CLUTCH WITH POWER TAKE-OFF SHAFT

As an accessory item, this manually operated neutral and power engagement clutch with power take-off shaft provides dependable performance.

Mounting directly to the engine crankcase, this dry plate over-center type clutch provides complete safety in operation. The power take-off shaft is carried in a double thrust ball-bearing with no lubrication required other than occasional greasing of the bronze throw-out bearing which is accessible through a grease port. (See Illustration No. 247.)

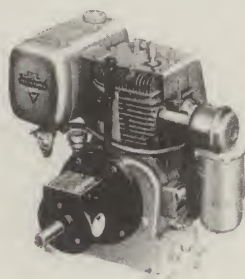


Figure 247

CLUTCH USAGE

Clutch assembly 44-7-500 was used on the 1600, 2500, and A-2500 Series engines.

Clutch assembly 44-4-990 is used on the B-2500-1000, 2790-1000, 420 and 422 Series engines.

Clutch assembly 44-5-990 is used on the A-1600-1000, 1800-1000, 414 and 418 Series engines.

NOTE: The 44-7-500 clutch is no longer available and is replaced with the 44-4-990 or 44-5-990 depending on the engine series involved.

CLUTCH ADJUSTMENT

When clutch adjustments are deemed necessary, loosen the set screw in the adjustment spider and turn the spider clockwise approximately one quarter turn. Proper clutch adjustment requires approximately twenty pounds at the end of the handle to engage the clutch correctly. Tighten or loosen the clutch adjustment spider as necessary.

WARNING: Be sure to securely tighten set screw after each adjustment.

These clutches are manufactured by Rockford Clutch Division, Borg Warner Corp., Rockford, Illinois. Parts and warranty will have to be secured through their authorized dealers and distributors listed.

AUTHORIZED ROCKFORD CLUTCH DISTRIBUTORS

Continental Sales & Service Co.
3817 Santa Fe Avenue
Los Angeles 58, California

Auto Gear & Parts Company
S. E. Cor. 16th St. & Hunting Park Ave.
Philadelphia 40, Pennsylvania

Lighbourn Equipment Company
511 South Industrial Boulevard
Dallas 2, Texas

Auto Clutch & Parts Service, Inc.
3125 Fullerton Avenue
Chicago, Illinois

Atlas Auto Parts & Grinding Company
1326-28-30 West Jefferson Street
Louisville, Kentucky

Genuine Motor Parts of Pa., Inc.
4925 Baum Boulevard at Morewood
Pittsburgh 13, Pennsylvania

General Machine Parts Co.
471 Walton Ave. at 146th Street
New York 51, New York

Blalock Machinery & Equipment Company
225 Forsyth Street
Atlanta, Georgia

Wepco Equipment Company
3421 Independence Road
Cleveland 5, Ohio

Highway & Industrial Equipment Co., Inc.
5213 Hillsboro Road
Raleigh, North Carolina

R. Angus (Alberta), Ltd.
8407 103rd Street
Edmonton, Alberta, Canada

Maase Equipment Company, Ltd.
6139 Cote-de-liesse Road
P. O. Box 904, Station "O"
Montreal 9, Canada

B-W-H Service Parts, Ltd.
Merritton, Ontario, Canada

National Supply Engine Corp.
237 S. E. Union Avenue
Portland, Oregon

National Supply Engine Corp.
Salmon Bay Terminal
Seattle 99, Washington

M. D. Moody & Sons, Inc.
4652 Phillips Highway
P. O. Box 5618
Jacksonville 7, Florida

GEAR REDUCERS

Clinton has 2:1, 4:1, and 6:1 reduction units available for the horizontal shafted engines. Facing the power take-off end of engine the 2:1 and 4:1 reduction units turn in a clockwise rotation and the 6:1 turns in a counterclockwise. These reduction units can be mounted in four positions on the engine, these being 3:00, 6:00, 9:00, and 12:00 o'clock positions in relation to the engine crankshaft. (See Illustration Nos. 248, 249, and 250.)

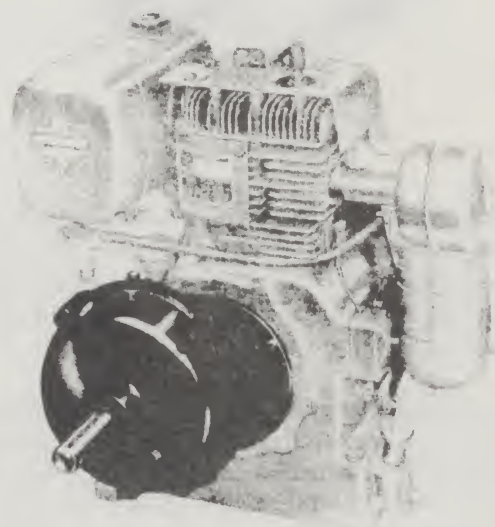


Figure 248

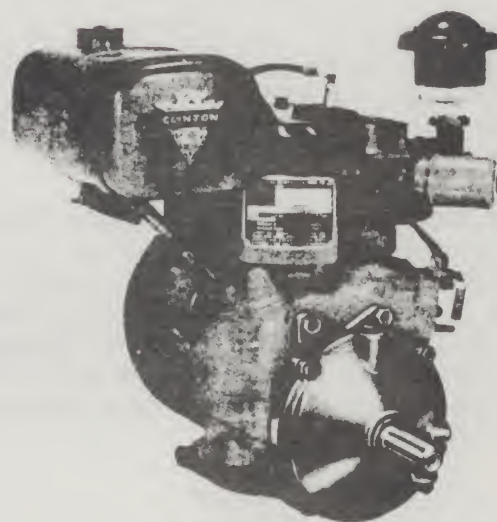


Figure 249

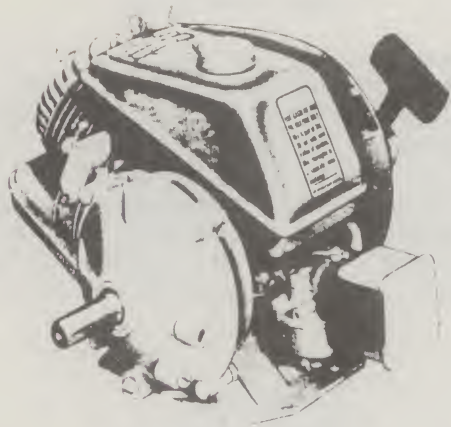


Figure 250

Gear reducers used on engines under five horsepower require filling with SAE-30 oil to the level plug. The oil should be checked every 10 hours of operation, and changed at least every 100 hours.

Gear reducers used on engines 5 horsepower or over, require filling when first new or after the reduction assembly has been drained with the same weight and rating oil as used in the engine crankcase. Change oil every 100 hours of operation. This reduction ass'y is designed to maintain an adequate level of lubrication without adding, providing the oil level of the crankcase is maintained. The operating oil level of this reduction ass'y is normally below the level plug after the engine has been operated. The inner housing of the reduction ass'y has a passage drilled through it, to let oil transfer from the engine crankcase to reduction unit.

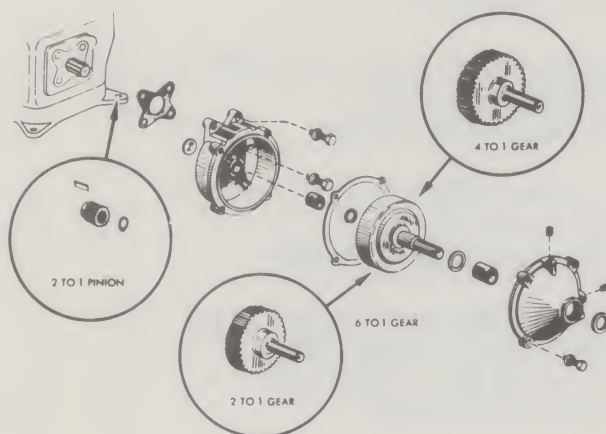
The reduction units used on engines 5 horsepower and over have been redesigned, to incorporate a tapered roller bearing instead of a bronze sleeve bearing, in the inner housing of the reduction ass'y. The only way to determine where the change was made is to refer to the engine models listed which will have the tapered roller bearing.

412 - All units manufactured
 414 - All units manufactured
 418 - All units manufactured
 420 - All units manufactured
 422 - All units manufactured
 A1620-1104 - and all later models manufactured
 A1640-1104 - and all later models manufactured

A1660-1108 - and all later models manufactured
 1820-1000 - All units manufactured
 1840-1000 - All units manufactured
 1860-1100 - and all later models manufactured
 B2520-1100 - and all later models manufactured
 B2540-1100 - and all later models manufactured
 B2560-1104 - and all later models manufactured
 2720-1000 - All units manufactured
 2740-1000 - All units manufactured
 2760-1100 - and all later models manufactured

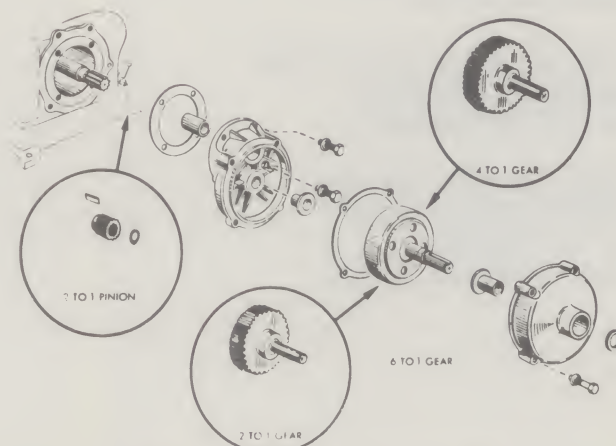
NOTE: Any Model Variation smaller than the one listed would have the sleeve bearing in the inner reduction housing.

NOTE: See Illustration Nos. 251 and 252 for exploded view of the various reduction units.



ENGINES UNDER 5 H.P.

Figure 251



ENGINES OVER 5 HORSEPOWER

Figure 252





SERVICE CLEARANCES TOLERANCES & SPECIFICATIONS TORQUE DATA

SECTION VI - DIV. H

Issued October, 1960

Revised February, 1966

INTRODUCTION

This division is to be used as a reference to necessary Tolerances, Specification, Service Clearances, and Torque Data when servicing Clinton engines.

Listed below in numerical order are all the various model Clinton engines manufactured. NOTE: Each model has a column number assigned to be used on pages 2, 3, 4 or 5 for reference to the necessary Tolerances, Specifications or Service Clearance for a specific model engine.

Under each column heading there are shown two (2) figures; the minimum clearance and the maximum clearance. When reworking is necessary, the final clearance should be between the minimum and maximum and favoring the minimum for best performance.

TOLERANCES AND SPECIFICATIONS ----- Pages 2 thru 5 TORQUE DATA ----- Page 6

MODEL NO.	COLUMN NO.	MODEL NO.	COLUMN NO.	MODEL NO.	COLUMN NO.
E-65	29	V1000-1000	10	VS4100-2000	4
100	1	VS1000	10	J-5	36
100-1000	1	A&B1100	9	J-6	36
100-2000	1	C1100	9	J-7	36
V100-1000	3	D1100	9	J-8	36
VS100	3	V1100-1000	11	J-9	36
VS100-1000	3	VS1100	11	E10-1000	33
VS100-2000	3	VS1100-1000	11	D15-1000	30
VS100-3000	3	1200	12	D25-1000	30
VS100-4000	3	1200-1000	12	D35-1000	31
200	24	1200-2000	13	D55-1000	32
A200	24	A1200	13	D65-1000	31
AVS200	24	B1290-1000	13	E75-1000	34
AVS200-1000	25	V1200-1000	14	E95-1000	35
VS200	24	VS1200	14	400-0000-000	1
VS200-1000	24	1600	17	401-0000-000	3
VS200-2000	25	A1600-1000	18	402-0000-000	1
VS200-3000	25	1800-1000	19	403-0000-000	3
VS200-4000	27	2100	1	404-0000-000	2
300	5	A2100	1	405-0000-000	4
A300	5	A2100-1000	1	406-0000-000	2
VS300	6	A2100-2000	1	407-0000-000	4
350	5	VS2100	3	407-0002-000	4
A400	28	VS2100-1000	3	408-0000-000	2
A400-1000	28	VS2100-2000	3	409-0000-000	4
AVS400	26	VS2100-3000	3	411-0000-000	3
AVS400-1000	27	2500	20	411-0002-000	3
BVS400	27	A2500	22	412-0000-000	16
CVS400-1000	27	B2500-1000	21	413-0000-000	16
VS400	26	2790-1000	23	414-1300-000	18
VS400-1000	26	VS3000	3	414-1301-000	18
VS400-2000	27	3100	2	415-0000-000	4
VS400-3000	27	3100-1000	2	415-0002-000	4
VS400-4000	27	3100-2000	2	416-1300-000	18
GK590	29	3100-3000	2	417-0000-000	4
650	7	H3100-1000	2	418-1300-000	19
700-A	7	FV3100-1000	4	418-1301-000	19
B700	7	AFV3100-1000	4	420-1300-000	21
C700	7	AV3100-1000	4	420-1301-000	21
D700	8	AV3100-2000	4	422-1300-000	23
D700-1000	8	AVS3100	4	422-1301-000	23
D700-2000	8	AVS3100-1000	4	424-0000-000	2
D700-3000	8	AVS3100-2000	4	426-0000-000	2
VS700	7	AVS3100-3000	4	429-0003-000	15
VS750	7	V3100-1000	4	431-0003-000	15
800	9	V3100-2000	4	435-0003-000	4
A800	9	VS3100	4	492-0300-000	9
VS800	9	VS3100-1000	4	494-0000-000	9
900	9	VS3100-2000	4	494-0001-000	9
900-1000	9	VS3100-3000	4	497-0000-000	14
900-2000	9	4100	2	498-0300-000	13
900-3000	9	4100-1000	2	498-0301-000	13
900-4000	9	4100-2000	2	499-0000-000	14
VS900	10	AVS4100-1000	4	500-0000-000	28
		AVS4100-2000	4	501-0000-000	27
		VS4100-1000	4	501-0001-000	27

		1	2	3	4	5	6	7	8	9	10
Cylinder Bore Dia.	Min.	2.3745	2.3745	2.3745	2.3745	2.000	2.000	2.000	2.125	2.375	2.375
	Max.	2.3755	2.3755	2.3755	2.3755	2.001	2.001	2.001	2.126	2.376	2.376
Piston Skirt Dia.	Min.	2.3690	2.3690	2.3690	2.3690	1.9935	1.9935	1.9935	2.119	2.3690	2.3690
	Max.	2.3700	2.3700	2.3700	2.3700	1.9945	1.9945	1.9945	2.120	2.3700	2.3700
Piston Skirt to Cylinder Clearance	Min.	.0045	.0045	.0045	.0045	.0045	.0045	.0045	.005	.0055	.0055
	Max.	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.007	.0075	.0075
Piston Ring to Groove Clearance	Min.	.002	.002	.002	.002	.002	.002	.002	.002	.002	.002
	Max.	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005
Ring End Gap in Cylinder	Min.	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
	Max.	.017	.017	.017	.017	.017	.017	.017	.017	.017	.017
Connecting Rod Bore Crankshaft End	Min.	.8140	.8770	.8140	.8770	.7515	.7515	.8770	.8770	.8770	.8770
	Max.	.8145	.8775	.8145	.8775	.7520	.7520	.8775	.8775	.8775	.8775
Connecting Rod to Crankshaft Clearance	Min.	.0015	.0015	.0015	.0015	.0018	.0018	.0018	.0018	.0018	.0018
	Max.	.0030	.0030	.0030	.0030	.0035	.0035	.0035	.0035	.0035	.0035
Connecting Rod to Wrist Pin Clearance	Min.	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004
	Max.	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011
Crankshaft Rod Pin Diameter	Min.	.8119	.8745	.8119	.8745	.7483	.7483	.8745	.8745	.8745	.8745
	Max.	.8125	.8752	.8125	.8752	.7490	.7490	.8752	.8752	.8752	.8752
Crankpin Out-of-Round	Max.	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001
Crankshaft Main Diameter P.T.O. End	Min.	.8733	.8733	.8733	Note #1	.7483	.8745	.8745	.8745	.8745	.9995
	Max.	.8740	.8740	.8740		.7490	.8752	.8752	.8752	.8752	1.0002
Crankshaft Main Diameter Flywheel End	Min.	.8120	.8120	.8120	.8120	.7483	.7483	.8745	.8745	.8745	.8745
	Max.	.8127	.8127	.8127	.8127	.7490	.7490	.8752	.8752	.8752	.8752
Crankshaft to Main Bearing Clearance	Min.	.0018	.0018	.0018	.0018	.0018	.0018	.0018	.0018	.0018	.0018
	Max.	.0035	.0035	.0035	.0035	.0035	.0035	.0035	.0035	.0035	.0035
Crankshaft End Play	Min.	.008	.008	.008	.008	.004	.004	.008	.008	.008	.008
	Max.	.018	.018	.018	.018	.012	.012	.018	.018	.018	.018
Block or Bearing Plate Main Bearing Bore P.T.O. End	Min.	.8758	.8758	.8758	Note #5	.7510	.877	.877	.877	.877	1.002
	Max.	.8768	.8768	.8768		.7520	.878	.878	.878	.878	1.003
Bearing Plate or Block Bearing Bore (Flywheel) End	Min.	.8145	.8145	.8145	.8145	.7510	.7510	.877	.877	.877	.877
	Max.	.8155	.8155	.8155	.8155	.7520	.7520	.878	.878	.878	.878
Valve or Tappet Guide Bore I.D.	Min.	.2495	.2495	.2495	.2495	.2495	.2495	.2495	.2495	.2495	.2495
	Max.	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2510
Valve Stem to Guide Clearance	Min.	.0015	.0015	.0015	.0015	.0020	.0020	.0020	.0020	.0020	.0020
	Max.	.0045	.0045	.0045	.0045	.0045	.0045	.0045	.0045	.0045	.0045
Valve Clearance, Intake & Exhaust	Min.	.009	.009	.009	.009	.007	.007	.009	.009	.009	.009
	Max.	.011	.011	.011	.011	.009	.009	.011	.011	.011	.011
Camshaft to Axle Clearance	Min.	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001
	Max.	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003
Camshaft Axle Clearance P.T.O.	Min.	.001	.001	.001	.001						
	Max.	.003	.003	.003	.003						
Camshaft Axle Clearance Flywheel End	Min.	.001	.001	.001	.001						
	Max.	.003	.003	.003	.003						
Point Setting	Min.	.018	.018	.018	.018	.018	.018	.018	.018	.018	.018
	Max.	.021	.021	.021	.021	.021	.021	.021	.021	.021	.021
Spark Plug Gap	Min.	.025	.025	.025	.025	.025	.025	.025	.025	.025	.025
	Max.	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028
Comp. at Cranking Speed, P. S. I.	Min.	65	65	65	65	65	65	65	65	65	65
Carburetor Float Setting (Clinton)	Min.	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32
	Max.	11/64	11/64	11/64	11/64	11/64	11/64	11/64	11/64	11/64	11/64
Carburetor Float Setting (Carter)	Min.	11/64	11/64	11/64	11/64	11/64	11/64	11/64	11/64	11/64	11/64
	Max.	13/64	13/64	13/64	13/64	13/64	13/64	13/64	13/64	13/64	13/64
Magnet Air Gap	Min.	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
	Max.	.017	.017	.017	.017	.017	.017	.017	.017	.017	.017
Magnet Edge Gap (Phelon)	Min.	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32	5/32
	Max.	9/32	9/32	9/32	9/32	9/32	9/32	9/32	9/32	9/32	9/32
Magnet Edge Gap (Clinton)	Min.	7/64	7/64	7/64	7/64			7/64	7/64	7/64	7/64
	Max.	1/4	1/4	1/4	1/4			1/4	1/4	1/4	1/4
Oil Recommended A.P.I. Rating	See Bulletin #9 for SAE	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS
Fuel Recommended		Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas

Note 1 Crankshaft diameter .8733 to .8740 or .9995 to 1.0002, except 435-0000-000 which is 1.220 to 1.221.

Note 2 Ball, needle or roller bearing used. Check component parts, if worn or defective, replace.

Note 3 Wrist pin clearance, .0004 minimum, .0011 maximum on units other than listed below. Needle bearing used in D65-1000 Type (C), J9-1000 Type (B), J6-1100 and J6-1101. Check component parts, if worn or defective, replace.

Note 4 412-0000-000, 413-0000-000 with sleeve bearings .002 to .006, 412-0300-000 with roller bearings .001 to .006.

Note 5 Bearing bore diameter .8758 to .8768 or 1.0002 to 1.0003, except 435-0000-000 which is 1.2228 to 1.2235.

Note 6 Valve guides .312 to .313 inside diameter and are replaceable. Tappet guide inside diameter .437 to .438.

Note 7 412-0000-000 .001 minimum, .004 maximum. 413-0000-000 .0005 minimum, .002 maximum.

		11	12	13	14	15	16	17	18	19	20
Cylinder Bore Dia.	Min.	2.375	2.4685	2.4685	2.4685	2.499	2.8125	2.8125	2.8125	2.9995	3.1245
	Max.	2.376	2.4695	2.4695	2.4695	2.500	2.8135	2.8135	2.8135	3.0005	3.1255
Piston Skirt Dia.	Min.	2.3690	2.4630	2.4630	2.4630	2.4935	2.8045	2.8045	2.8045	2.9915	3.117
	Max.	2.3700	2.4640	2.4640	2.4640	2.4945	2.8055	2.8055	2.8055	2.9925	3.118
Piston Skirt to Cylinder Clearance	Min.	.0055	.0055	.0055	.0055	.0045	.007	.007	.007	.007	.0065
	Max.	.0075	.0075	.0075	.0075	.0065	.009	.009	.009	.009	.0085
Piston Ring to Groove Clearance	Min.	.002	.002	.002	.002	.002	.0025	.0025	.0025	.0025	.0025
	Max.	.005	.005	.005	.005	.005	.0050	.0050	.0050	.0050	.0050
Ring End Gap in Cylinder	Min.	.007	.007	.007	.007	.007	.007	.007	.007	.007	.010
	Max.	.017	.017	.017	.017	.017	.017	.017	.017	.017	.020
Connecting Rod Bore Crankshaft End	Min.	.9140	.8770	.9140	.9140	.8770	1.2510	1.1265	1.1265	1.1265	1.2510
	Max.	.9145	.8775	.9145	.9145	.8775	1.2513	1.1268	1.1268	1.1268	1.2513
Connecting Rod to Crankshaft Clearance	Min.	.0018	.0018	.0018	.0018	.0015	.001	.0015	.0015	.0015	.0010
	Max.	.0035	.0035	.0035	.0035	.0035	.002	.0025	.0025	.0025	.0018
Connecting Rod to Wrist Pin Clearance	Min.	.0004	.0004	.0004	.0004	.0004	.0002	.0002	.0002	.0002	.0002
	Max.	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011
Crankshaft Rod Pin Diameter	Min.	.9114	.8745	.9114	.9114	.8745	1.2493	1.1243	1.1243	1.1243	1.2495
	Max.	.9120	.8752	.9120	.9120	.8752	1.2500	1.1250	1.1250	1.1250	1.2500
Crankpin Out-of-Round	Max.	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001
Crankshaft Main Diameter P.T.O. End	Min.	.9995	Note #2	Note #2	.9995	1.220	1.2510	Note #2	Note #2	Note #2	Note #2
	Max.	1.0002			1.0002	1.221	1.2515				
Crankshaft Main Diameter Flywheel End	Min.	.8745	Note #2	Note #2	.8745	.8120	1.2510	Note #2	Note #2	Note #2	Note #2
	Max.	.8752			.8752	.8127	1.2515				
Crankshaft to Main Bearing Clearance	Min.	.0018	Note #2	Note #2	.0018	.0018	.0010	Note #2	Note #2	Note #2	Note #2
	Max.	.0035			.0035	.0035	.0025				
Crankshaft End Play	Min.	.008	.001	.001	.008	.008	Note #4	.006	.001	.001	.006
	Max.	.018	.006	.006	.018	.018		.020	.006	.006	.020
Block or Bearing Plate Main Bearing Bore P.T.O. End	Min.	1.002	Note #2	Note #2	1.002	1.2228	1.2525	Note #2	Note #2	Note #2	Note #2
	Max.	1.003			1.003	1.2235	1.2535				
Bearing Plate or Block Bearing Bore (Flywheel) End	Min.	.877	Note #2	Note #2	.877	.8145	1.2525	Note #2	Note #2	Note #2	Note #2
	Max.	.878			.878	.8155	1.2535				
Valve or Tappet Guide Bore I.D.	Min.	.2495	.2495	.2495	.2495	.2495	.312	Note #6	Note #6	Note #6	Note #6
	Max.	.2510	.2510	.2510	.2510	.2510	.313				
Valve Stem to Guide Clearance	Min.	.0020	.0020	.0020	.0020	.0015	.002	.002	.002	.002	.002
	Max.	.0045	.0045	.0045	.0045	.0045	.004	.004	.004	.004	.004
Valve Clearance, Intake & Exhaust	Min.	.009	.009	.009	.009	.009	.011	.010	.010	.010	.010
	Max.	.010	.010	.010	.010	.011	.012	.012	.012	.012	.012
Camshaft to Axle Clearance	Min.	.001	.001	.001	.001			.0015	.0015	.0015	.0015
	Max.	.003	.003	.003	.003			.0035	.0035	.0035	.0035
Camshaft Axle Clearance P.T.O.	Min.					.001	Note #7				
	Max.					.003					
Camshaft Axle Clearance Flywheel End	Min.					.001	.001				
	Max.					.003	.003				
Point Setting	Min.	.018	.018	.018	.018	.018	.018	.028	.028	.028	.028
	Max.	.021	.021	.021	.021	.021	.021	.030	.030	.030	.030
Spark Plug Gap	Min.	.025	.025	.025	.025	.025	.025	.025	.025	.025	.025
	Max.	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028
Comp. at Cranking Speed, P.S.I.	Min.	65	65	65	65	65	65	70	70	70	70
Carburetor Float Setting (Clinton)	Min.	5/32	5/32	5/32	5/32	5/32	5/32		11/64	11/64	
	Max.	11/64	11/64	11/64	11/64	11/64	11/64		13/64	13/64	
Carburetor Float Setting (Carter)	Min.	11/64	11/64	11/64	11/64			15/64	15/64	15/64	15/64
	Max.	13/64	13/64	13/64	13/64			17/64	17/64	17/64	17/64
Magnetos Air Gap	Min.	.007	.007	.007	.007	.007	.007	.012	.012	.012	.012
	Max.	.017	.017	.017	.017	.017	.017	.020	.020	.020	.020
Magnetos Edge Gap (Phelon)	Min.	5/32	5/32	5/32	5/32						
	Max.	9/32	9/32	9/32	9/32						
Magnetos Edge Gap (Clinton)	Min.	7/64	7/64	7/64	7/64	7/64	7/64				
	Max.	1/4	1/4	1/4	1/4	1/4	1/4				
Oil Recommended A.P.I. Rating	See Bulletin #9 for SAE	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS	MM MS
Fuel Recommended		Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas

Note 1 Crankshaft diameter .8733 to .8740 or .9995 to 1.0002, except 435-0000-000 which is 1.220 to 1.221.

Note 2 Ball, needle or roller bearing used. Check component parts, if worn or defective, replace.

Note 3 Wrist pin clearance, .0004 minimum, .0011 maximum on units other than listed below. Needle bearing used in D65-1000 Type (C), J9-1000 Type (B), J6-1100 and J6-1101. Check component parts, if worn or defective replace.

Note 4 412-0000-000, 413-0000-000 with sleeve bearings .002 to .006, 412-0300-000 with roller bearings .001 to .006.

Note 5 Bearing bore diameter .8758 to .8768 or 1.0002 to 1.0003, except 435-0000-000 which is 1.2228 to 1.2235.

Note 6 Valve guides .312 to .313 inside diameter and are replaceable. Tappet guide inside diameter .437 to .438.

Note 7 412-0000-000 .001 minimum, .004 maximum. 413-0000-000 .0005 minimum, .002 maximum.

		21	22	23	24	25	26	27	28	29	
Cylinder Bore Dia.	Min.	3.1245	3.1245	3.1245	1.875	1.875	2.125	2.125	2.125	2.125	
	Max.	3.1255	3.1255	3.1255	1.876	1.876	2.126	2.126	2.126	2.126	
Piston Skirt Dia.	Min.	3.117	3.1185	3.1185	1.8695	1.8695	2.1195	2.1195	2.1195	2.1195	
	Max.	3.118	3.1195	3.1195	1.8705	1.8705	2.1205	2.1205	2.1205	2.1205	
Piston Skirt to Cylinder Clearance	Min.	.0065	.005	.005	.0045	.0045	.005	.005	.005	.005	
	Max.	.0085	.007	.007	.0065	.0065	.007	.007	.007	.007	
Piston Ring to Groove Clearance	Min.	.0025	.0025	.0025	.0015	.0015	.0015	.0015	.0015	.002	
	Max.	.0050	.0050	.0050	.0040	.0040	.0040	.0040	.0040	.004	
Ring End Gap in Cylinder	Min.	.010	.010	.010	.005	.005	.007	.007	.007	.010	
	Max.	.020	.020	.020	.013	.013	.017	.017	.017	.015	
Connecting Rod Bore Crankshaft End	Min.	1.2510	1.2510	1.2510	.7820	.7820	.7820	.7820	.7820	Note	
	Max.	1.2513	1.2513	1.2513	.7827	.7827	.7827	.7827	.7827	#2	
Connecting Rod to Crankshaft Clearance	Min.	.0010	.0010	.0010	.0026	.0026	.0026	.0026	.0026	Note	
	Max.	.0018	.0018	.0018	.0040	.0040	.0040	.0040	.0040	#2	
Connecting Rod to Wrist Pin Clearance	Min.	.0002	.0002	.0002	.0004	.0004	.0004	.0004	.0004	.0004	
	Max.	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011	
Crankshaft Rod Pin Diameter	Min.	1.2495	1.2495	1.2495	.7788	.7788	.7788	.7788	.7788	.6594	
	Max.	1.2500	1.2500	1.2500	.7795	.7795	.7795	.7795	.7795	.6599	
Crankpin Out-of-Round	Max.	.001	.001	.001	.001	.001	.001	.001	.001	.001	
Crankshaft Main Diameter P.T.O. End	Min.	Note	Note	Note	.8745	.8745	.8745	.9995	.8745	Note	
	Max.	#2	#2	#2	.8752	.8752	.8752	1.0002	.8752	#2	
Crankshaft Main Diameter Flywheel End	Min.	Note	Note	Note	.7495	.7495	.7495	.7495	.7495	.7495	
	Max.	#2	#2	#2	.7502	.7502	.7502	.7502	.7502	.7502	
Crankshaft to Main Bearing Clearance	Min.	Note	Note	Note	.0015	.0015	.0015	.0015	.0015	Note	
	Max.	#2	#2	#2	.0035	.0035	.0035	.0035	.0035	#2	
Crankshaft End Play	Min.	.001	.006	.001	.005	.005	.005	.005	.005	Note	
	Max.	.006	.020	.006	.020	.020	.020	.020	.020	#2	
Block or Bearing Plate Main Bearing Bore P.T.O. End	Min.	Note	Note	Note	.8770	.8770	.8770	1.002	.8770	Note	
	Max.	#2	#2	#2	.8780	.8780	.8780	1.003	.8778	#2	
Bearing Plate or Block Bearing Bore (Flywheel) End.	Min.	Note	Note	Note	.7517	.7517	.7517	.7517	.7517	Note	
	Max.	#2	#2	#2	.7525	.7525	.7525	.7525	.7525	#2	
Valve or Tappet Guide Bore I.D.	Min.	Note	Note	Note							
	Max.	#6	#6	#6							
Valve Stem to Guide Clearance	Min.	.002	.002	.002							
	Max.	.004	.004	.004							
Valve Clearance, Intake & Exhaust	Min.	.010	.010	.010							
	Max.	.012	.012	.012							
Camshaft to Axle Clearance	Min.	.0015	.0015	.0015							
	Max.	.0035	.0035	.0035							
Camshaft Axle Clearance P.T.O.	Min.										
	Max.										
Camshaft Axle Clearance Flywheel End	Min.										
	Max.										
Point Setting	Min.	.028	.028	.028	.018	.018	.018	.018	.018	.018	
	Max.	.030	.030	.030	.021	.021	.021	.021	.021	.021	
Spark Plug Gap	Min.	.025	.025	.025	.025	.025	.025	.025	.025	.025	
	Max.	.028	.028	.028	.028	.028	.028	.028	.028	.028	
Comp. at Cranking Speed, P.S.I.	Min.	70	70	70	60	60	60	60	60	60	
Carburetor Float Setting (Clinton)	Min.	11/64		11/64	5/32	5/32	5/32	5/32	5/32	5/32	
	Max.	13/64		13/64	11/64	11/64	11/64	11/64	11/64	11/64	
Carburetor Float Setting (Carter)	Min.	15/64	15/64	15/64	11/64	11/64	11/64	11/64	11/64	11/64	
	Max.	17/64	17/64	17/64	13/64	13/64	13/64	13/64	13/64	13/64	
Magneto Air Gap	Min.	.012	.012	.012	.007	.007	.007	.007	.007	.007	
	Max.	.020	.020	.020	.017	.017	.017	.017	.017	.017	
Magneto Edge Gap (Phelon)	Min.				5/32	5/32	5/32	5/32	5/32		
	Max.				9/32	9/32	9/32	9/32	9/32		
Magneto Edge Gap (Clinton)	Min.				7/64	7/64	7/64	7/64	7/64	7/64	
	Max.				1/4	1/4	1/4	1/4	1/4	1/4	
Oil Recommended A.P.I. Rating	See Bulletin #9 for SAE	MM MS	MM MS	MM MS	Outboard Motor Oil or SAE 30 Non Detergent						
Fuel Recommended		Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	

- Note 1 Crankshaft diameter .8733 to .8740 or .9995 to 1.0002, except 435-0000-000 which is 1.220 to 1.221.
Note 2 Ball, needle or roller bearing used. Check component parts, if worn or defective, replace.
Note 3 Wrist pin clearance, .0004 minimum, .0011 maximum on units other than listed below. Needle bearing used in D65-1000 Type (C), J9-1000 Type (B), J6-1100 and J6-1101. Check component parts, if worn or defective, replace.
Note 4 412-0000-000, 413-0000-000 with sleeve bearings .002 to .006, 412-0300-000 with roller bearings .001 to .006.
Note 5 Bearing bore diameter .8758 to .8768 or 1.0002 to 1.0003, except 435-0000-000 which is 1.2228 to 1.2235.
Note 6 Valve guides .312 to .313 inside diameter and are replaceable. Tappet guide inside diameter .437 to .438.
Note 7 412-0000-000 .001 minimum, .004 maximum. 413-0000-000 .0005 minimum, .002 maximum.

		30	31	32	33	34	35	36	
Cylinder Bore Dia.	Min.	1.8750	2.1255	1.8750	1.811	1.8750	2.1255	2.1255	
	Max.	1.8765	2.1270	1.8765	1.814	1.8765	2.1270	2.1270	
Piston Skirt Dia.	Min.	1.8695	2.120	1.871	1.807	1.871	2.120	2.120	
	Max.	1.8705	2.121	1.872	1.809	1.872	2.121	2.121	
Piston Skirt to Cylinder Clearance	Min.	.0045	.0045	.0045	.003	.0045	.0045	.0045	
	Max.	.0065	.0070	.0065	.007	.0065	.0070	.0070	
Piston Ring to Groove Clearance	Min.	.002	.002	.002	.002	.002	.002	.002	
	Max.	.004	.004	.004	.005	.004	.004	.004	
Ring End Gap in Cylinder	Min.	.010	.010	.010	.004	.010	.010	.010	
	Max.	.015	.015	.015	.020	.015	.015	.015	
Connecting Rod Bore Crankshaft End	Min.	.7816	Note	Note	Note	Note	Note	Note	
	Max.	.7825	#2	#2	#2	#2	#2	#2	
Connecting Rod to Crankshaft Clearance	Min.	.0021	Note	Note	Note	Note	Note	Note	
	Max.	.0037	#2	#2	#2	#2	#2	#2	
Connecting Rod to Wrist Pin Clearance	Min.	.0004	Note	.0004	Note	.0004	Note	Note	
	Max.	.0011	#3	.0011	#2	.0011	#3	#3	
Crankshaft Rod Pin Diameter	Min.	.7788	.6594	.6594	.4960	.6594	.6594	.6594	
	Max.	.7795	.6599	.6599	.4965	.6599	.6599	.6599	
Crankpin Out-of-Round	Max.	.001	.001	.001	.001	.001	.001	.001	
Crankshaft Main Diameter P.T.O. End	Min.	Note	Note	Note	Note	Note	Note	Note	
	Max.	#2	#2	#2	#2	#2	#2	#2	
Crankshaft Main Diameter Flywheel End	Min.	.7495	.7495	.7495	Note	.7495	.7495	.7495	
	Max.	.7502	.7502	.7502	#2	.7502	.7502	.7502	
Crankshaft to Main Bearing Clearance	Min.	.0015	Note	Note	Note	Note	Note	Note	
	Max.	.0035	#2	#2	#2	#2	#2	#2	
Crankshaft End Play	Min.	Note	Note	Note	.003	.003	.003	Note	
	Max.	#2	#2	#2	.020	.020	.020	#2	
Block or Bearing Plate Main Bearing Bore P.T.O. End	Min.	Note	Note	Note	Note	Note	Note	Note	
	Max.	#2	#2	#2	#2	#2	#2	#2	
Bearing Plate or Block Bearing Bore(Flywheel) End	Min.	Note	Note	Note	Note	Note	Note	Note	
	Max.	#2	#2	#2	#2	#2	#2	#2	
Valve or Tappet Guide Bore I.D.	Min.								
	Max.								
Valve Stem to Guide Clearance	Min.								
	Max.								
Valve Clearance, Intake & Exhaust	Min.								
	Max.								
Camshaft to Axle Clearance	Min.								
	Max.								
Camshaft Axle Clearance P.T.O.	Min.								
	Max.								
Camshaft Axle Clearance Flywheel End	Min.								
	Max.								
Point Setting	Min.	.018	.018	.018	.013	.014	.014	.018	
	Max.	.021	.021	.021	.017	.016	.016	.021	
Spark Plug Gap	Min.	.025	.025	.025	.025	.025	.025	.025	
	Max.	.028	.028	.028	.030	.028	.028	.028	
Comp. at Cranking Speed, P.S.I. Min.		60	60	60	80	60	60	60	
Carburetor Float Setting (Clinton)	Min.							1-25/64	
	Max.							1-27/64	
Carburetor Float Setting (Carter)	Min.								
	Max.								
Magneto Air Gap	Min.	.007	.007	.007	.007	.007	.007	.007	
	Max.	.017	.017	.017	.017	.017	.017	.017	
Magneto Edge Gap(Phelon)	Min.								
	Max.								
Magneto Edge Gap (Clinton)	Min.	7/64	7/64	7/64	3/32	3/32	3/32	7/64	
	Max.	1/4	1/4	1/4	5/16	5/16	5/16	1/4	
Oil Recommended A.P.I. Rating		Outboard Motor Oil or SAE 30 Non Deterger							
Fuel Recommended		Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	Reg. Gas	

- Note 1 Crankshaft diameter .8733 to .8740 or .9995 to 1.0002, except 435-0000-000 which is 1.220 to 1.221.
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CLINTON ENGINES

TORQUE DATA

		All 4 Cycle Aluminum Vertical & Horizontal Shaft V100, V3100, 406, H3100 407, 417 429 & 431 A300 300, VS300, 350, 500, 650, 700A, C700 D700, VS700, VS750, 800, A800, VS800 900, VS900, V1000, A-B-1100, C1100, D1100, V1100, VS1100, 1200, A1200, B1290, V1200, VS1200, 492, 494, 497, 498, 499 412 & 413 1600, 1800, 2500, 2790 414, 416, 418, 420, 422 200, A200, VS200, VS400, A400, 500, 501 E65 & GK590 E10 - Chainsaw D15 - Chainsaw D25 - Chainsaw D35, D55, D65 - Chainsaws E75, E95 - Chainsaws J5, J6, J7, J8, J9 - Outboards												
Connecting Rod Aluminum	Min. Max.	100 125	100 125	100 125	70 80	70 80	215 235	215 235	35 45	70 80	50 55	55 65	80 90	80 90
Connecting Rod Forged Steel	Min. Max.									90 100			90 100	90 100
Bearing Plate P.T.O. End	Min. Max.	75 85	75 85	75 85			75 85	160 180						
Bearing Plate Flywheel End	Min. Max.				120 150	140 160			75 95	75 95		80 90	80 90	75 95
Back Plate to Block	Min. Max							70 80						
Head Bolts	Min. Max.	125 150	225 250	225 250	200 220	200 220	200 220	200 220						
Base Bolts	Min. Max.	75 85	75 85	75 85	150 160	325 375	75 85	150 160	125 150	125 150				
End Cover or Gear Box	Min. Max.					120 150								
Speed Reducer Mounting	Min. Max.	110 150	110 150		110 150	110 150	110 150	110 150	110 150					
P.T.O. Housing or Mounting Flange	Min. Max.	75 85	75 85	75 85		120 150	75 85	160 180	125 150					
Carb. Reed Plate or Manifold to Blk.	Min. Max.	60 65	60 65	60 65	60 65	60 65	65 75	60 65	60 65	60 65	45 55	50 60	50 60	50 60
Carb. to Reed Plate or Manifold	Min. Max.	35 50	35 50	35 50	60 65	35 50	35 50	60 65	60 65	60 65		50 60	50 60	50 60
Blower Housing	Min. Max.	60 70	60 70	60 70	65 70	65 70	65 75	65 70	65 70	65 70	90 110	80 90	80 90	75 85
Muffler to Block	Min. Max.	110 120	110 120	110 120	140 150	140 150	170 180	170 180	40 60	40 60	90 110	60 70	60 70	
Flywheel	Min. Max.	375 400	375 400	375 400	375 400	400 450	400 500	*100 *120	375 400	250 300	150 180	375 425	**250 **300	250 300
Flywheel Touch & Stop for Brake	Min. Max.	650 700	650 700											
Spark Plug	Min. Max.	275 300	275 300	275 300	275 300	275 300	275 300	275 300	275 300	275 300	250 300	230 270	230 270	230 270
Stator Plate	Min. Max.	50 60	50 60	50 60	50 60	50 60	50 60	80 100	50 60	50 60	50 60	50 60	50 60	45 65

All torque in inch pounds except those marked with a single *.

* Foot Pounds

** D35 Requires Same as D25



SERVICE BULLETIN

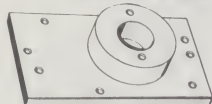
NO. 54

Sec. VIII, Div. A
Service Bulletin #54
Revised February, 1965
Supersedes August, 1959

This bulletin contains all of the Special Tools that may be required for servicing all Clinton Engines, Chainsaws and Outboards. These tools are specially designed by the Clinton Engines Corporation to make your Service work more efficient. Always order by Part Number...consult the current Parts Price List in your Clinton Master Parts & Service Manual for current prices.

BEARING TOOLS

REAMER GUIDE



951-48

Used to line ream bearing in blocks of group no. II, III, IV, V, VI, VII, VIII, IX, X, XIII, XIV, XV Engines. Used to ream bearings in bases of group no. VIII Engines.

Three Bushings Included
With the Following Inside
Diameters:

.878
1.0003
1.030

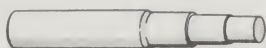
GUIDE



951-148

Bushing is used when reaming bases on group no. XV engines that have a 1.000 Dia. bore

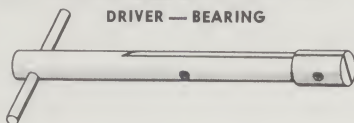
DRIVER — BEARING



951-18 and 951-39

Used to remove and install bearings in blocks, bases, and bearing plates of group no. I, II, III, IV, V, VI, VII, VIII, IX, X, XIII, XIV, XV Engines.

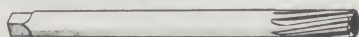
DRIVER — BEARING



951-31

Used to remove and install bearings in two bearing blocks or mounting flanges of group no. II and VIII Engines.

REAMER



951-29

Diameter .8773 to .8778

Used to ream bearings in blocks of group no. II, IV, VI, VII, & VIII and bearing plates of group no. VII and VIII, using block for guide. When reaming bearing plates in group no. X, it is necessary to use a sleeve bearing block of group no. VII or VIII.

951-30

Diameter .7518 to .7523

Used to ream bearing in bearing plates of group no. II, III, IV, V & VI, and blocks of group no. V.

951-44

Diameter 1.0003 to 1.0008

Used to enlarge bore of 7/8" bases so bronze bearing can be installed in group no. XV.

951-59

Diameter 1.0023 to 1.0028

Used to ream bearing in blocks of group no. III & X.

951-60

Diameter .8144 to .8155

Used to ream bearing in blocks of group no. XIII, XIV & XV.

951-63

Diameter .8758 to .8763

Used to ream bearings in bases of group no. XIV & XV.

951-143

Diameter 1.1218 to 1.1220

Used as second step to enlarge bore of 1" diameter bases of group no. XV so bronze bearing can be installed.

951-144

Diameter 1.1042 to 1.1062

Used as first step to enlarge bore of 1" diameter bases of group no. XV so bronze bearing can be installed.

951-146

Diameter .9338 to .9340

Used as second step to enlarge bore of blocks of aluminum engines in group no. XIV & XV so bronze bearing can be installed.

951-147

Diameter .9167 to .9187

Used as first step to enlarge bore of blocks of aluminum engines in group no. XIV & XV so bronze bearing can be installed.

OIL SEAL LOADERS

For Loading Oil Seals Over Shafts Having The Following Dia.:

951 - 12 for 3/4" Dia. Shaft
951 - 13 for 5/8" Dia. Shaft
951 - 40 for 1 3/8" Dia. Shaft
951 - 49 for 1 3/16" Dia. Shaft
951 - 55 for 7/8" Dia. Shaft
951 - 56 for 1" Dia. Shaft
951 - 57 for 3/4" Dia. Shaft
951 - 47 for 1/2" Dia. Shaft
951 - 14 for 5/8" Dia. Shaft
951 - 118 for 1 1/4" Dia. Shaft
951 - 145 for 3/4" Dia. Shaft

LOADER — OIL SEAL



OIL SEAL PULLER

951 - 50 for removing oil seal on flywheel side of group no. XIII, XIV & XV Engines.

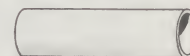
PULLER — OIL SEAL



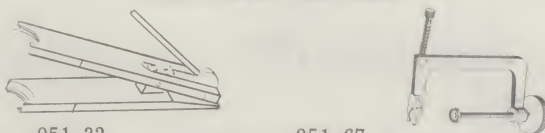
OIL SEAL DRIVERS.

951 - 16 1.010 Inside Dia. &
1.250 Outside Dia.
Length 4.00 Inches.
951 - 17 .885 Inside Dia. &
1.125 Outside Dia.
Length 4.00 Inches.
951 - 62 .760 Inside Dia. &
1.00 Outside Dia.
Length 3.00 Inches

DRIVER — OIL SEAL



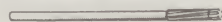
VALVE SPRING COMPRESSOR



951-32 Used to remove and install valve springs in group no. V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV & XV.

951 - 67 Used to remove and install valve springs in group no. V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV & XV. (Replacement Foot Part No. 951-134)

REAMER — VALVE GUIDE



951 - 22 (9/32 Oversize .281 Dia.)
Used to enlarge valve guide holes so oversize stemmed valve can be used in group no. VI, VII, VIII, IX & X.

951 - 43 (.010 Oversize .261 Dia.)
Used to enlarge valve guide holes so oversize stemmed valve can be used in group no. XIII, XIV & XV.

951 - 69 (Standard .250 Dia.)
Used to clean standard valve guides. Can be used on group no. V, VI, VII, VIII, IX, X, XIII, XIV & XV.

PILOT ASS'Y — VALVE GUIDE



951 - 58 - 500
This assembly contains one each of the following:

951 - 137 (.249 to .2505 Dia.)
951 - 138 (.2505 to .252 Dia.)
951 - 139 (.2605 to .262 Dia.)
951 - 140 (.2805 to .282 Dia.) Used in conjunction with 951 - 37 Valve Seat Cutter and, 951 - 41, 951 - 61 Cutter Valve Seat Counter Bore on group no. V, VI, VII, VIII, IX, X, XI, XIII, XIV & XV.

PILOT — VALVE SEATING



951 - 38 (.3115 to .313)
Used in conjunction with 951 - 37 Valve Seat Cutter on group no. XI & XII.

VALVE SEAT CUTTER



951 - 37
Used to cut valve seats on group no. V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV & XV Engines.
NOTE: Replacement cutters for tool 951 - 37, set of three (3), Part Number 951 - 131.



951 - 136
Used for lapping valves on group no. V, VI, VII, VIII, IX, X, XIII, XIV & XV Engines.

CUTTER



951 - 41
Used to oversize valve seat insert pocket .040 for installation of replacement insert in group no. XIV & XV Engines.

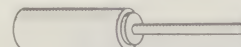
951 - 61
Used to cut counter-bore for valve seat insert on group no. V, VI, VII, VIII, IX & X Engines.



951-61

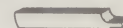
SEE PAGE 4 FOR USAGE

DRIVER — VALVE INSERT



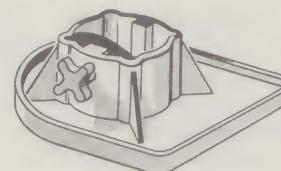
951 - 52
Used to drive valve seat inserts in place on group no. V, VI, VII, VIII, IX, X, XIII, XIV & XV Engines.

ROLLING TOOL



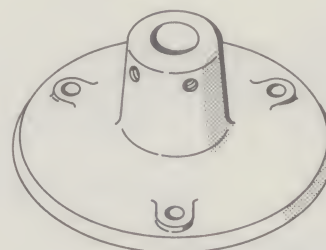
951 - 53
Used to peen or roll metal around outside diameter of valve seat insert after installation on group no. V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV & XV Engines.

FIXTURE ENGINE REPAIR



951 - 24
Used for holding for display or repair on group no. III & IV Engines

ENGINE STAND



951 - 65
Used for display or repair group no. III, VI, VIII, X, XI, XII, XIII and XV Engines.

SPANNER WRENCH



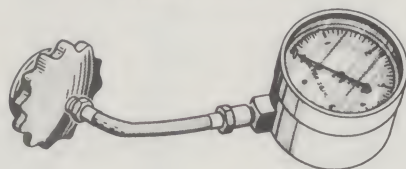
951 - 111
Used for removing gear from clutch drum on gear drive chainsaws.

SPANNER WRENCH



951 - 112
Used for removing drive gear from clutch drum on gear drive chainsaws.

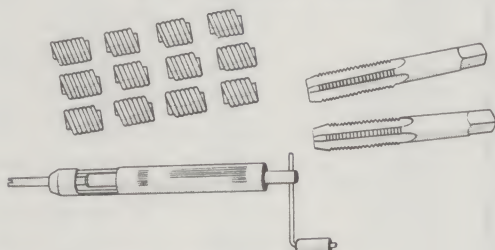
PRESSURE GAUGE



951 - 156

Used for indicating fuel tank pressure when making adjustments on check valves on chainsaws manufactured before 1960.

HELI-COIL THREAD REPAIR



951 - 236 Consists of the following:

- | | | | |
|------|---------|---------|--------------------|
| (1) | 951-154 | 1/4-20 | Inserting Tool |
| (1) | 951-155 | 5/16-18 | Inserting Tool |
| (1) | 951-157 | 1/4-20 | Tap Heli-Coil |
| (1) | 951-158 | 5/16-18 | Tap Heli-Coil |
| (20) | 136-75 | 1/4-20 | Heli-Coil |
| (40) | 136-76 | 5/16-18 | Heli-Coil |
| (2) | 952-47 | | Instruction Sheets |

Used for installing 1/4-20 and 5/16-18 Heli-Coils in Engine, Outboard or Chainsaw castings.

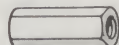
LOCTITE SEALANT



951 - 234 (50cc Bottle Loctite, 6oz. Spray Can Cleaner)

951 - 235 (Two 10cc Bottles Loctite, 4 Fl. Oz. Jar Cleaner)
Used to assist in securing proper holding properties of screws

IMPACT NUTS



For Removing Flywheel From Taper
951 - 23 (7/16 Threaded End Crankshaft)

951 - 36 (7/8 Threaded End Crankshaft)

951 - 66 (1/2 Threaded End Crankshaft)

PULLER FLYWHEEL



951 - 133

Used for removing flywheels from crankshaft taper on group no. I, II, III, IV, V, VI, VII, VIII, IX, X, XIII, XIV, XV Engines.

HOLDER — FLYWHEEL

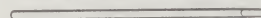


951 - 42

Used to hold flywheel when removing flywheel nut.

NOTE: Replacement Belt 951-151.

DRIVER — CAM AXLE



951 - 46

Used to drive cam axle from block of group no. VII, VIII, IX, X & XI.

HAND CRANK



951 - 45

Used for turning engine when setting points, checking timing (or) for operation of parts in group no. I, II, III, IV, V, VI, VII, VIII, IX, X, XIII, XIV & XV Engines.

PISTON RING COMPRESSOR



951 - 34

Used for compressing rings on pistons 1 3/4" to 3 1/8" Dia. in group no. V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV & XV Engines.

PISTON RING MOUNTING SLEEVE



951 - 150 (1-7/8" Bore)

951 - 153 (2-1/8" Bore)

Used for installing standard and .020 oversize piston assembly in block of group no. I, II, III & IV Engines.

TRU ARC PLIERS



951 - 68 (5-5/8" External)

951 - 100 (8-3/8" Internal)

951 - 132 - 500 (6-1/2" Internal)

Used for removing and installing tru-arc retainers on recoil starters, crankshafts, governor shafts, blocks, etc.

RUN OUT GAUGE — CRANKSHAFT



951 - 64

Used for checking engines for bent crankshafts. Shows crankshaft deflection quickly.

SEE PAGE 4 FOR USAGE

**ENGINE GROUP
NUMBER FOR TOOL USAGE**

GROUP I

E65, D25-1000, D35-1000, D55-1000, D65-1000, J5, J6, J7, J8 & J9.

GROUP II

AVS200, AVS200-1000, VS200, VS200-1000, AVS400, VS400, VS400-1000.

GROUP III

VS200-2000, VS200-3000, VS200-4000, AVS400-1000, BVS400, CVS400-1000, VS400-2000, VS400-3000, VS400-4000, 501-0000-000, and 501-0001-000.

GROUP IV

200, A200, A400, A400-1000, GK590, and 500-0000-000.

GROUP V

300, A300, 350.

GROUP VI

VS300

GROUP VII

650, 700A, B700, C700, D700, D700-1000, D700-2000, D700-3000, 800, A800, 900, 900-1000, 900-2000, 900-3000, 900-4000, A&B1100, C1100, 494-0000-000, 494-0001-000.

GROUP VIII

VS700, VS750, VS800.

GROUP IX

D1100, 1200, 1200-1000, 1200-2000, A1200, B1290-1000, 498-0300-000, 498-0301-000.

GROUP X

VS900, V1000-1000, VS1000, V1100-1000, VS1100, VS1100-1000, V1200-1000, VS1200, 497-0000-000, 499-0000-000.

GROUP XI

1600, A1600-1000, 1800-1000, 2500, A2500, B2500-1000, 2790-1000, 414-1300-000, 414-1301-000, 416-1300-000, 418-1301-000, 420-1300-000, 420-1301-000, 422-1300-000, 422-1301-000, 418-1300-000.

GROUP XII

412-0000-000, 413-0000-000.

GROUP XIII

429-0003-000, 431-0003-000.

GROUP XIV

100, 100-1000, 100-2000, 2100, A2100, A2100-1000, A2100-2000, 3100, 3100-1000, 3100-2000, 3100-3000, H3100-1000, 4100, 4100-1000, 4100-2000, 400-0000-000, 402-0000-000, 404-0000-000, 406-0000-000, 408-0000-000, 417-0000-000, 424-0000-000, 426-0000-000.

GROUP XV

V100-1000, VS100, VS100-1000, VS100-2000, VS100-3000, VS100-4000, VS2100, VS2100-1000, VS2100-2000, VS2100-3000, VS3000, FV3100-1000, AFV3100-1000, AV3100-1000, AV3100-2000, AVS3100, AVS3100-1000, AVS3100-2000, AVS3100-3000, V3100-1000, V3100-2000, VS3100, VS3100-1000, VS3100-2000, VS3100-3000, AVS4100-1000, AVS4100-2000, VS4100-1000, VS4100-2000, 401-0000-000, 403-0000-000, 405-0000-000, 407-0000-000, 407-0002-000, 409-0000-000, 411-0000-000, 411-0002-000, 415-0000-000, 415-0002-000, 417-0000-000, 435-0003-000.

**ENGINES
NUMERICAL FOR TOOL USAGE**

MODEL NO.	GROUP #	MODEL NO.	GROUP #
E-65	I	VS200-1000	II
100	XIV	VS200-2000	III
100-1000	XIV	VS200-3000	III
100-2000	XIV	VS200-4000	III
V100-1000	XV	300	V
VS100	XV	A300	V
VS100-1000	XV	VS300	VI
VS100-2000	XV	350	V
VS100-3000	XV	A400	IV
VS100-4000	XV	A400-1000	IV
200	IV	AVS400	II
A200	IV	AVS400-1000	III
AVS200	II	BVS400	III
AVS200-1000	II	CVS400-1000	III
VS200	II	VS400	II

MODEL NO.	GROUP #	MODEL #	GROUP #
VS400-1000	II	AVS4100-1000	XV
VS400-2000	III	AVS4100-2000	XV
VS400-3000	III	VS4100-1000	XV
VS400-4000	III	VS4100-2000	XV
GK590	IV	J-5	I
650	VII	J-6	I
700A	VII	J-7	I
B700	VII	J-8	I
C700	VII	J9	I
D700	VII	D25-1000	I
D700-1000	VII	D35-1000	I
D700-2000	VII	D55-1000	I
D700-3000	VII	D65-1000	I
VS700	VIII	400-0000-000	XIV
VS750	VIII	401-0000-000	XV
800	VII	402-0000-000	XIV
A800	VII	403-0000-000	XV
VS800	VIII	404-0000-000	XIV
900	VII	405-0000-000	XV
900-1000	VII	406-0000-000	XIV
900-2000	VII	407-0000-000	XV
900-3000	VII	407-0002-000	XV
900-4000	VII	408-0000-000	XIV
VS900	X	409-0000-000	XV
V1000-1000	X	411-0000-000	XV
VS1000	X	411-0002-000	XV
A&B1100	VII	412-0000-000	XII
C1100	VII	413-0000-000	XII
D1100	IX	414-1300-000	XI
V1100-1000	X	414-1301-000	XI
VS1100	X	415-0000-000	XV
VS1100-1000	X	415-0002-000	XV
1200	IX	416-1300-000	XI
1200-1000	IX	417-0000-000	XV
1200-2000	IX	418-1300-000	XI
A1200	IX	418-1301-000	XI
B1290-1000	IX	420-1300-000	XI
V1200-1000	X	420-1301-000	XI
VS1200	X	422-1300-000	XI
1600	XI	422-1301-000	XI
A1600-1000	XI	424-0000-000	XIV
1800-1000	XI	426-0000-000	XIV
2100	XIV	429-0003-000	XIII
A2100	XIV	431-0003-000	XIII
A2100-1000	XIV	435-0003-000	XV
A2100-2000	XIV	494-0000-000	VII
VS2100	XV	494-0001-000	VII
VS2100-1000	XV	497-0000-000	X
VS2100-2000	XV	498-0300-000	IX
VS2100-3000	XV	498-0301-000	IX
2500	XI	499-0000-000	X
A2500	XI	500-0000-000	IV
B2500-1000	XI	501-0000-000	III
2790-1000	XI	501-0001-000	III
VS3000	XV		
3100	XIV		
3100-1000	XIV		
3100-2000	XIV		
3100-3000	XIV		
H3100-1000	XIV		
FV3100-1000	XV		
AFV3100-1000	XV		
AV3100-1000	XV		
AV3100-2000	XV		
AVS3100	XV		
AVS3100-1000	XV		
AVS3100-2000	XV		
AVS3100-3000	XV		
V3100-1000	XV		
V3100-2000	XV		
VS3100	XV		
VS3100-1000	XV		
VS3100-2000	XV		
VS3100-3000	XV		
4100	XIV		
4100-1000	XIV		
4100-2000	XIV		

CLINTON ENGINES CORPORATION • MAQUOKETA, IOWA

WARRANTY

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE PRODUCT DESCRIPTION EXCEPTING ONLY THAT EACH PRODUCT SOLD HEREUNDER IS WARRANTED AS FOLLOWS

ONE YEAR LIMITED WARRANTY

FOR ONE YEAR FROM PURCHASE, CLINTON ENGINES CORPORATION, WILL REPLACE FOR THE ORIGINAL PURCHASERS, FREE OF CHARGE, ANY PART OR PARTS, FOUND UPON EXAMINATION BY ANY FACTORY AUTHORIZED SERVICE ACCOUNT, OR BY FACTORY AT MAQUOKETA, IOWA, TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP OR BOTH. ALL TRANSPORTATION CHARGES ON PARTS SUBMITTED FOR REPLACEMENT UNDER THIS WARRANTY MUST BE BORNE BY PURCHASER.

THERE IS NO OTHER EXPRESS WARRANTY.

IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO ONE YEAR FROM PURCHASE AND TO THE EXTENT PERMITTED BY LAW ANY AND ALL IMPLIED WARRANTIES ARE EXCLUDED. THIS IS THE EXCLUSIVE REMEDY AND LIABILITY FOR CONSEQUENTIAL DAMAGES UNDER ANY AND ALL WARRANTIES ARE EXCLUDED TO THE EXTENT EXCLUSION IS PERMITTED BY LAW.

Clinton

1. Engines Governed — — — — — One Year
2. Outboard — J-K Series — — — — — One Year
3. Engines — — — Used on Mini Bikes — — — 90 Days
4. Engines — Non-governed and Chainsaws — 45 Days
5. Engines — — — Used on Karts — — — No Warranty

Clinton Engines Corporation

CLINTON WARRANTY CONDITIONS

To avoid misunderstandings which may arise between engine owners and our Service Account, and to eliminate delays in repair where warranty is questioned, we list causes of engine failures where repair or replacement under warranty is not justified.

NORMAL WEAR — EXCLUDED FROM WARRANTY

Where normal wear has exhausted the life of a part or engine, warranty does not apply. Mechanical equipment of all types need periodic parts replacement and maintenance service to operate for the normal service life of the unit.

ABUSE OR NEGLECT — EXCLUDED FROM WARRANTY

1. Failure due to lack of lubrication, improper weight, type of oil or insufficient oil.
2. Improper fuel or fuel mixture. Stale fuel can cause gum deposits in the fuel system.
3. Bent crankshafts. This is the result of the cutter blade striking a solid object. Clinton assumes no responsibility or liability for bent crankshafts or engines where an attempt has been made to straighten crankshaft.
4. Operating the engine at speeds above factory specifications or overloading above factory rated horsepower.
5. Damage caused by overheating because cool-

ing fins are allowed to become plugged with dirt, grass or debris, or when an engine is operated in a confined area without sufficient ventilation.

6. Damage due to excessive tensions, loose or unbalanced blades and/or adaptors or improper assembly of accessories.
7. Broken parts due to excessive vibration caused by loose engine mounting.
8. In the event inspection by Clinton Authorized Service Agency reveals that the unit air cleaner has been improperly maintained and dirt allowed to get into the engine, repair of damage will not be covered under warranty.
9. Use of other than original Clinton parts.
10. Repairs by a non-authorized account or owner modification.
11. Minor carburetor readjustment due to difference in altitude or climate. (These minor adjustments are covered in the Owner's Operation and Maintenance Instructions Manual.)
12. Accident.

The Clinton Authorized Service Accounts are rated among the top service organizations in the nation and warranty is handled in a prompt and courteous manner as rapidly as it can be fitted into their work schedule.

