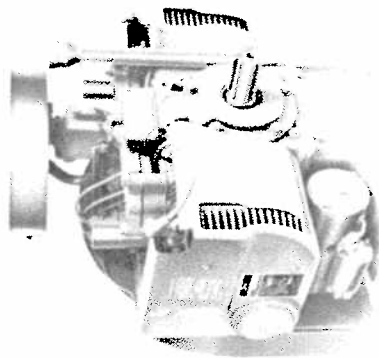
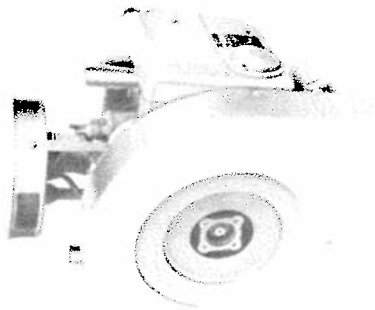
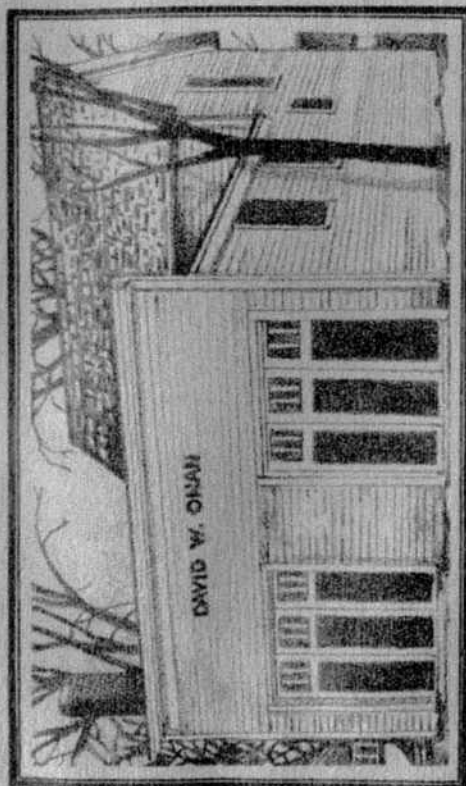


VACU-FLO AIR-COOLED  
NH SERIES  
ENGINES

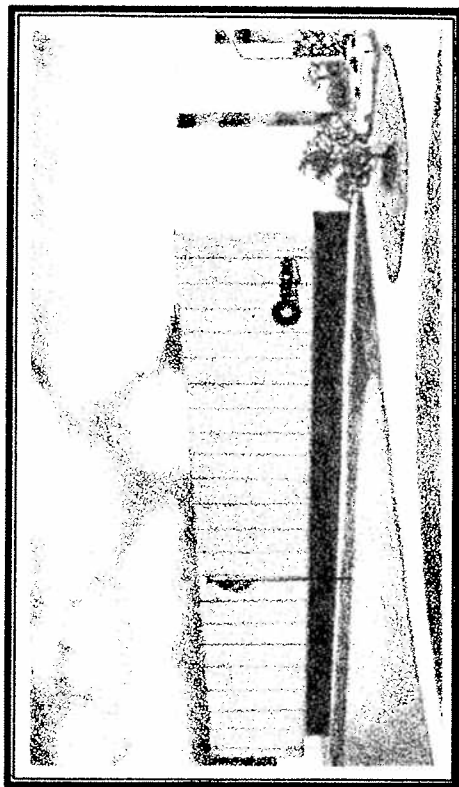




*Onan's tradition of using top quality materials and precision workmanship began in this converted garage back in 1920 . . .*

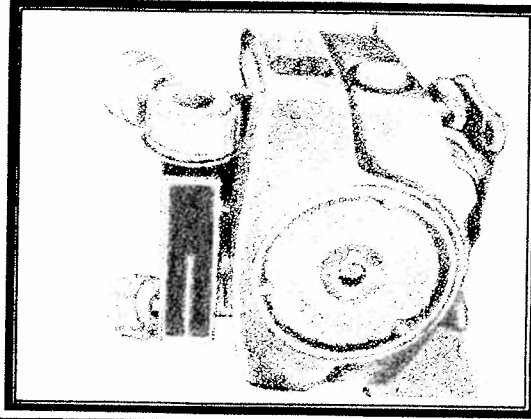
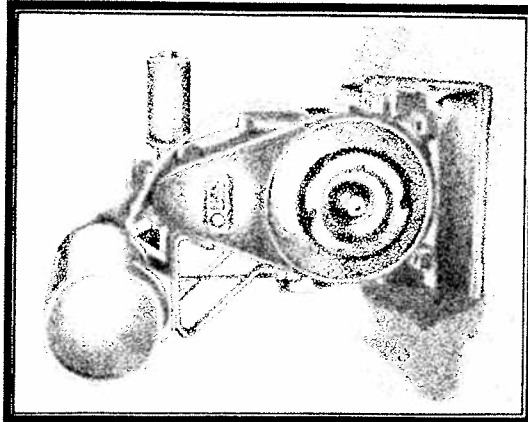
#### TABLE OF CONTENTS

General Description . . . . .	3
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... And continues at our new home in Fridley. We've come a long way.

In 1930, Onan designed and built its first two-cylinder, five-horsepower, air-cooled gasoline engine . . .



Today, Onan is still designing... and building . . . and always improving.

## General Description

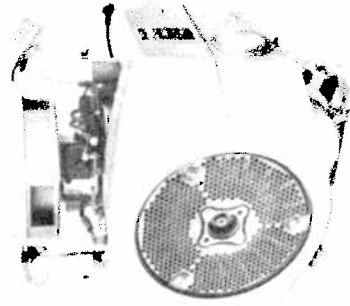
All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. Onan reserves the right to make changes at any time without notice.

### N Series Engines

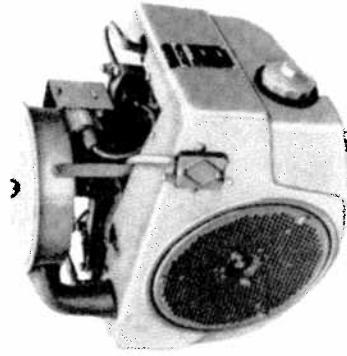
The industrial engines in the N Series provide optimum performance, reliable power and many years of trouble-free service with a minimum of maintenance.

Onan builds each N Series industrial engine

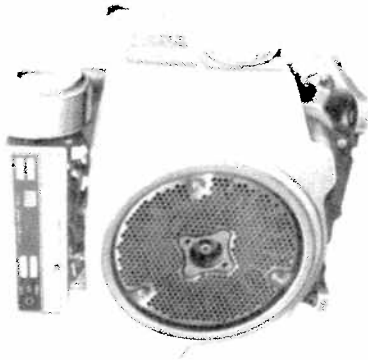
with quality materials and precision workmanship and subjects every unit to thorough performance testing. This ensures the customer of receiving the highest quality industrial engine available.



Basic NH Industrial Engine

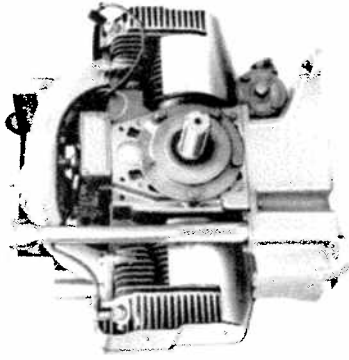


Basic N52M Industrial Engine



From the basic design of the NH industrial engine comes the NH Series that includes the NHA, NHB and NHC and the Vacu-Flo units NHA, NHBV and NHCV. All models are 4-cycle, 2 cylinders with horizontally opposed pistons, 3-9 1/16-inch bore, 3-inch stroke with a 60.0 cubic inch displacement.

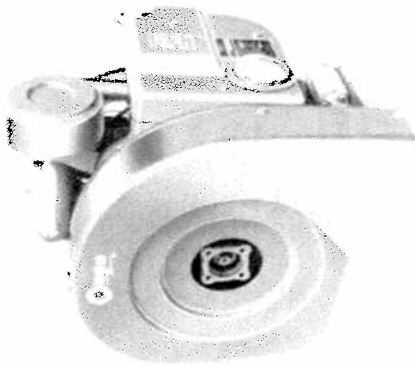
The N52M industrial engine has 3-9 1/16-inch bore, 2-5/8-inch stroke with a 52.0 cubic inch displacement.



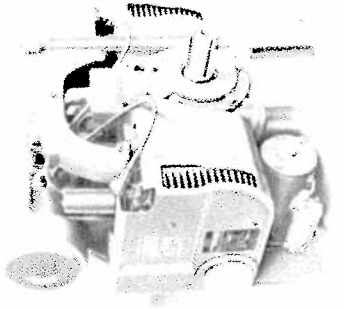
However, each model has distinguishing characteristics. For example, the NHA has a compression ratio of 6.5:1 and produces 18 horsepower at 3000 rpm. The NHB and NHC have a compression ratio of 7:1, the NHB produces 20 horsepower at 3300 rpm and the NHC produces 25 horsepower at 3600 rpm.

The N52M has a compression ratio of 7:1 and produces 19.9 horsepower at 3600 rpm.

Notes:



The NHAV, NHBV and NHCV are Vacu-Flo air cooled engines. These engines are designed for enclosed compartment installation and variable speed operation. A direct drive centrifugal blower wheel draws cooling air over the



engine and ventilates the installation enclosure. The specially designed reverse flow cooling system provides maximum engine cooling efficiency by pulling cool air into the compartment and controlling heated air out

Notes:

### STANDARD EQUIPMENT

- MECHANICAL FLYBALL GOVERNOR (CON- STANT SPEED)
- REPLACEABLE DRY ELEMENT AIR CLEANER
- SPIN-ON FULL FLOW OIL FILTER
- LUBE OIL PUMP
- OIL LEVEL INDICATOR
- MECHANICAL OR VACUUM PULSE FUEL PUMP
- MANUAL CHOKE
- TWIN MUFFLERS W/ EXHAUST CONNECTORS
- VALVE ROTATORS
- SOLID HARD CHROME COBALT VALVE SEAT INSERTS
- HARD CHROME COBALT ALLOY FACED EX- HAUST VALVES (NHA, NHB, INTAKE AND EX- HAUST (NHC))
- ROTATING BLOWER GUARD
- 12-VOLT BATTERY IGNITION (NHA, NHB, NHC MS)
- 12-VOLT SOLENOID SHIFT STARTER (NHA, NHB, NHC, MS)
- STARTING ROPE AND SHEAVE (NHC-S ONLY)

### Standard Equipment

This is a list of standard equipment that comes with the N Series industrial engines

### OPTIONAL EQUIPMENT

- CROSSOVER MANIFOLD WITH LEFT OR RIGHT OUTLET
- VARIABLE SPEED GOVERNOR
- REMOTE THROTTLE CONTROL
- FUEL TANK KIT
- OVERCENTER CLUTCH ASSEMBLY
- PT. MODIFICATIONS TAPERED CRANKSHAFT ADAPTATIONS GP, INTERNALLY SPLINED CRANKSHAFT AND ADAPTERS
- SNAP-ON HOOD (NHC ONLY)
- BATTERY CHARGING FLYWHEEL ALTERNATOR 12-VOLT 15 20 AMP DC W/ REGULATOR AND TERMINAL BLOCK
- CO-IGNITION (EARLY MODELS ONLY)
- VACU-EG COOLING
- LPG CARBURETOR
- STATIONARY BLOWER WHEEL GUARD
- LOW OIL PRESSURE SHUTDOWN
- CONTROL PANEL ADDERS (NHC-MS, NSM)

### Optional Equipment

This list includes all optional equipment that is available on the N Series. Most optional equip- ment must be factory installed



**ELECTRIC LIGHTS ANYWHERE**

**Complete Electric Lite Plant \$99**  
 for your Country Home, Camp, Cottage, Cabin, or Trailer. Complete with generator, engine, and wiring. **110 V. A.C. DIRECT CURRENT LIGHTING PLANTS** as low as \$99.00. Complete wiring for ten lights, including bulbs, \$12.00. Also other sizes. As easy to install as an outboard motor.

**ALTERNATING CURRENT and LARGER MODELS**  
 Complete, gasoline powered, electric generating equipment supplying the same current as far as lighting is concerned. Also, 220 V. A.C. for electric ranges, water heaters, and other household appliances. **Water Pump sets** and other water machinery to draw water from wells, ponds, and streams.

**WRITE FOR FOLDER**  
 If you will describe the place where you need electricity, we can send complete details and prices free.

**D. W. ONAN & SONS**  
 102 Roselawn Ave.  
 Minneapolis, Minn.



One cylinder, 500 to 1800 watts



Four cylinders, 2 to 10 K. W.

When this ad appeared in a 1932 issue of Fortune magazine, we were telling the people what we had to offer.



**Onan**  
for power on demand

We're still telling them.  
It's as simple as that.

## N SERIES ENGINE SPECIFICATIONS

**Engine Design:** Two cylinders, horizontally opposed, four-stroke cycle, 3.56-inch bore, 3-inch stroke; 60.0 cubic inch piston displacement; 6.5:1 (NHA) or 7.1:1 (NH, NHB, NHC) compression ratio. The N52M has 52.2 cubic inch displacement, 2.625-inch stroke and 6.5:1 compression ratio.

**Cooling System:** Pressure air cooled. Radial-flow blower.

**Governor:** Cam gear driven, adjustable mechanical flyball, pressure lubricated

**Exhaust System:** Twin mufflers, exhaust connections

**Ignition System:** Rainproof. Manual start—flywheel magneto ignition. Electric start—12-volt battery ignition.

**Lubrication System:** Gear lube oil pump provides full pressure lubrication to main and connecting rod bearings and governor at all speeds. Other moving parts are splash and jet spray lubricated. Spin on, full flow oil filter with by-pass.

**Fuel System:** Internally vented downdraft carburetor or side-draft carburetor. Dry element air cleaner. Mechanical fuel pump lift, 4 feet; vacuum pulse pump lift, 3 feet (N52M). Manual operated choke. Combustion air required at 3600 rpm, 80 cfm

**Starting System:** Electric start—12-volt solenoid shift starter (NH, NHA, NHB, NHC), 12-volt Bendix drive starter (N52M).

**Power Take-Off:** Rear mounted PTO pilot and keyed crankshaft extension. Counterclockwise rotation when facing the power take-off shaft. Front mount PTO pilot

**Bearings:** Mains—Steel backed aluminum with steel-back aluminum thrust washer. Bearing length, 1 inch; ID 2 inches. Replaceable precision inserts. Connecting rod bearings—Steel-backed Tri-metal (copper, tin, lead). Length 7/8 inch, ID 1-5/8 inches.

**Camshaft:** Cast alloy iron, two lead babbit bearings

**Connecting Rods:** Forged steel, heat treated, forged aluminum - N52M starting spec B

**Crankshaft:** Ductile iron (80-60-03) with induction hardened main bearing journals. Balanced

**Cylinders - Crankcase:** Alloy aluminum. Pearlitic iron cylinder liners, integrally cast into block. Machined-in oil lines. Removable oil base

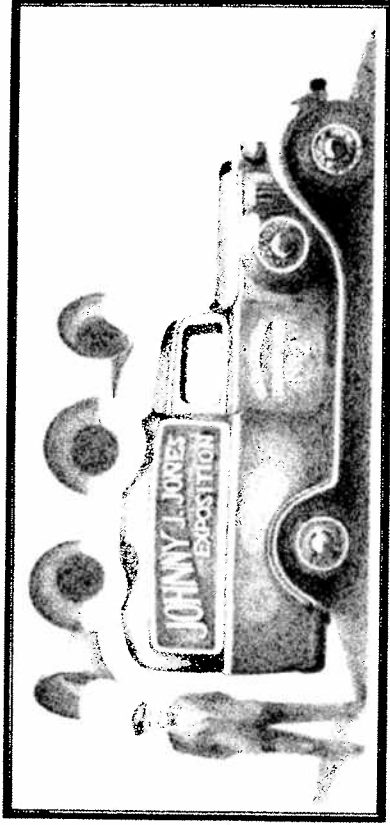
**Cylinder Heads:** Alloy aluminum. High turbulence combustion chambers

**Pistons:** Strut design aluminum alloy pistons, 3-ring (two compression, one oil control). Cooled and lubricated by jet oil spray

**Tappets:** Mechanical, barrel type, adjustable. Splash lubricated

**Valves:** Exhaust (NHA, NHB, N52M); Intake and Exhaust (NH, NHC) - One piece austenitic steel with hard chrome-cobalt alloy facing. Positive rotators (all valves)

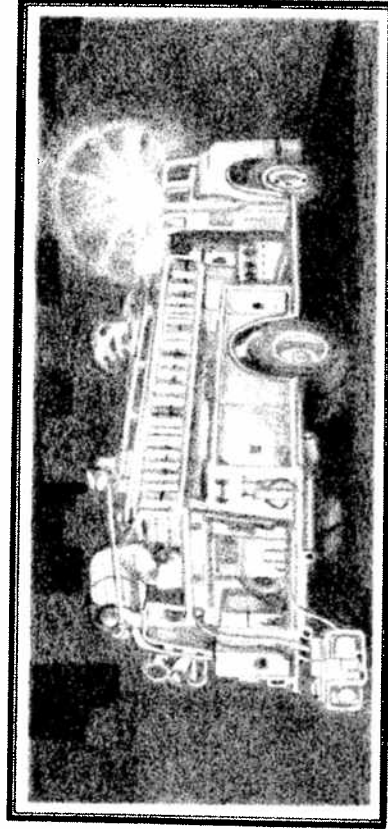
**Valve Seals:** Exhaust (NHA, NHB, N52M); Intake and Exhaust (NH, NHC) - Replaceable hard chrome-cobalt alloy



Our product applications have always been wide and varied:

... From helping Johnny J. Jones in his advertising business back in the '30s

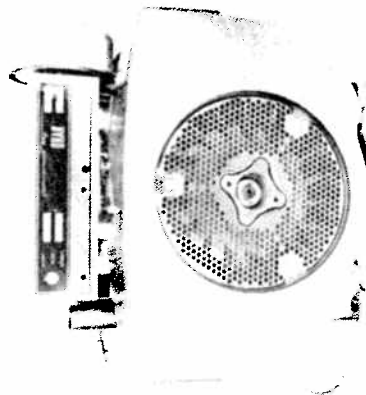
... To operating today's emergency vehicle equipment.



# Engine Rebuild

**WARNING** THIS SYMBOL IS USED THROUGHOUT THE TEXT TO WARN OF POSSIBLE INJURY OR DEATH.

**CAUTION** THIS SYMBOL IS USED THROUGHOUT THE TEXT TO WARN OF POSSIBLE EQUIPMENT DAMAGE.



## Disassembly

This section of the manual describes complete disassembly and assembly procedures for the NHC engine. Performing a major overhaul on an engine requires some common sense and judgment in determining the amount of work necessary and the items to replace. It also requires knowledge of tool use and the ability to measure bores, journals and other engine components.

## Reassembly

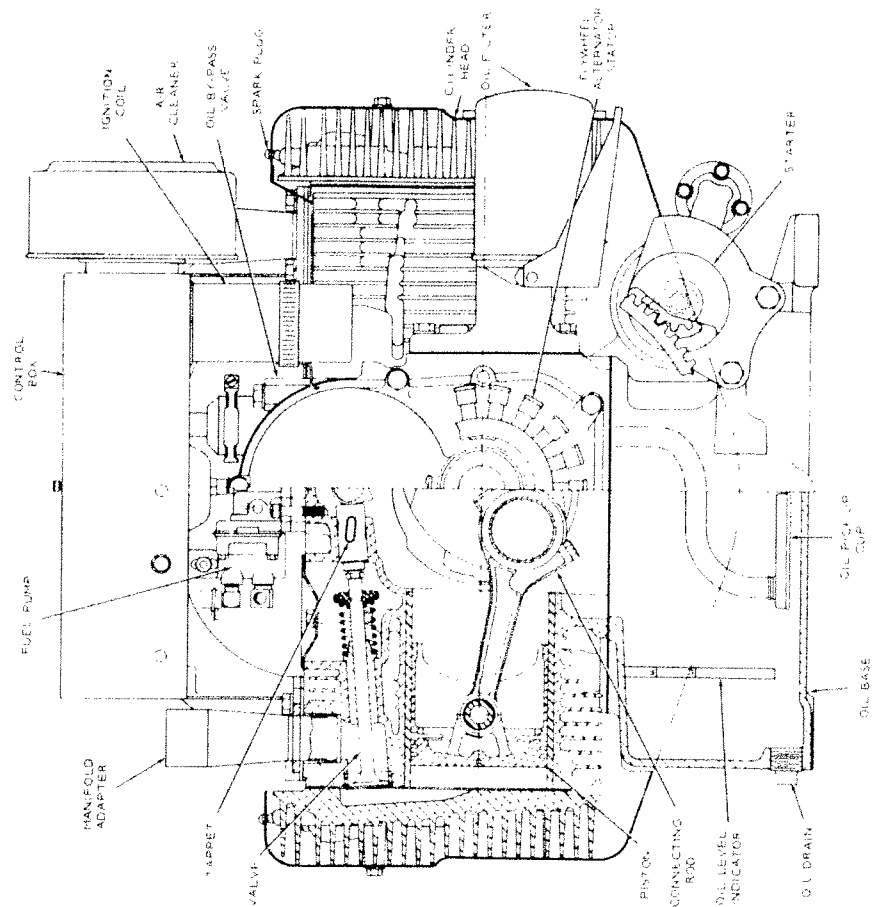
Reassembly is a simple procedure. Follow the disassembly sequence in reverse. By using the basic instructions recommended in this manual and selecting the right tools to do the work, the job is done right and quickly.

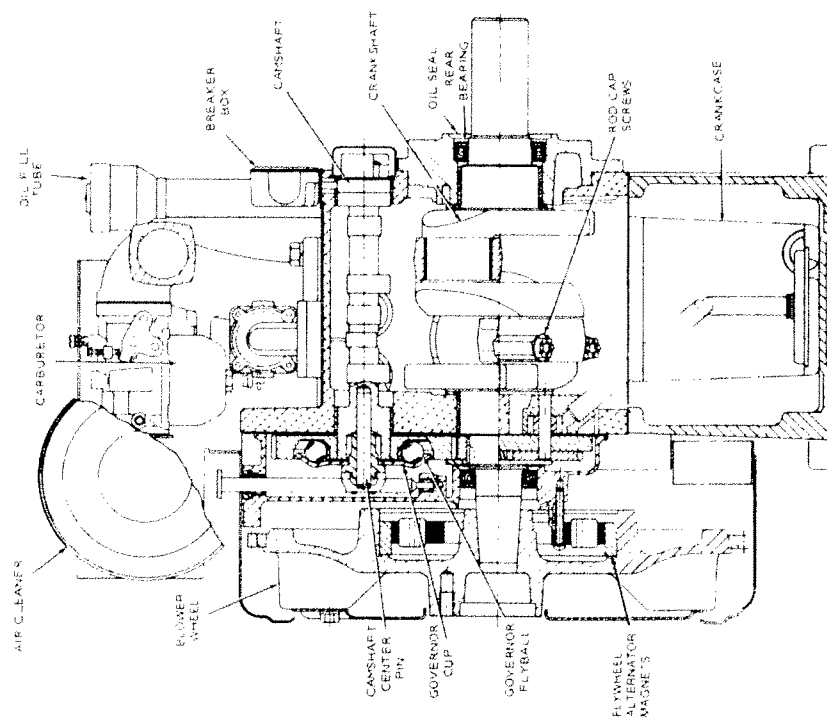
## Tools

Onan makes many special tools available for disassembling and reassembling the engine and installing various components such as bearings and oil seals. As this overhaul session progresses, many of these special tools and the jobs they do are demonstrated at the appropriate time. A complete listing is available from your Onan Distributor or the Onan Factory (see page 63).

## ENGINE REBUILD

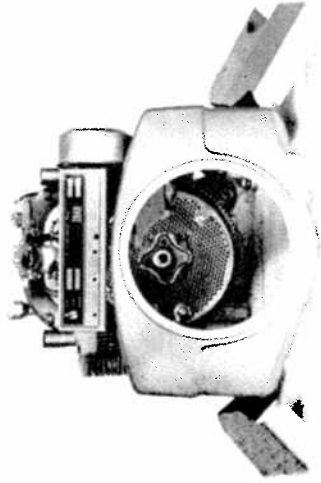
- FOLLOW SUGGESTED PROCEDURES
- USE COMMON SENSE
- USE PROPER HAND TOOLS
- USE SPECIAL ONAN TOOLS
- PRACTICE GOOD HOUSEKEEPING HABITS
- KEEP WORK AREA NEAT AND ORDERLY
- ANALYZE ANY PART FAILURE





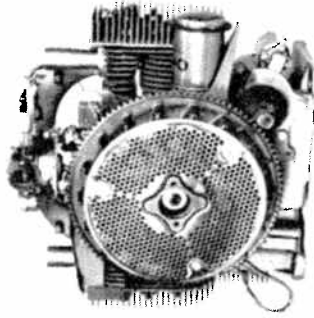
### Remove Shrouds

Remove the shrouds from the engine—first the cylinder shrouds, then the front shroud. On N52M engines it is necessary to remove the rotating blower screen first.



### Shrouds Removed

Removing the shrouds exposes the blower wheel, oil filter, cranking motor and other components. At this point, seal carburetor air intake and remove accumulated grease, oil and dirt from the engine with either a good solvent with air siphon or steam cleaning.



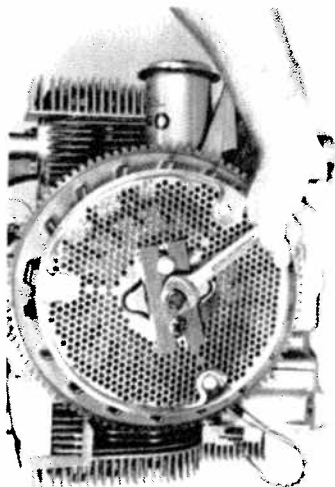
Notes:

### Remove Blower Wheel

After the engine has been thoroughly cleaned, remove the blower wheel with puller 420-0100 as follows:

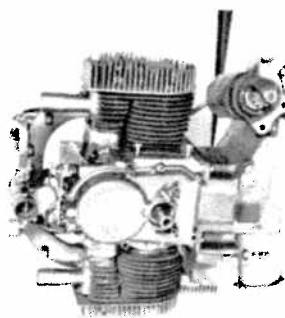
1. Remove the blower wheel through bolt.
2. Remove the thick washer on the through bolt.
3. Reinstall the through bolt (the center bolt of the puller will push against the through bolt and protect crankshaft threads).
4. Fasten the puller screws with sufficient thread in the blower wheel to prevent damage to the threads.
5. Secure the wheel in position by inserting a large screwdriver or wood block to prevent the wheel from turning.

**WARNING** Once the blower wheel has been removed there is danger of this heavy weight being dropped on toes or fingers.



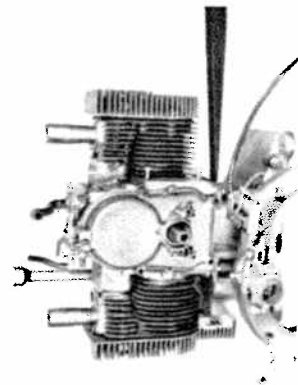
### Remove Starter and Filter

Remove the cranking motor and the oil filter. (Replace the oil filter on engine rebuild.) Examine the cranking motor for proper functioning and correct gear mesh.



Notes:





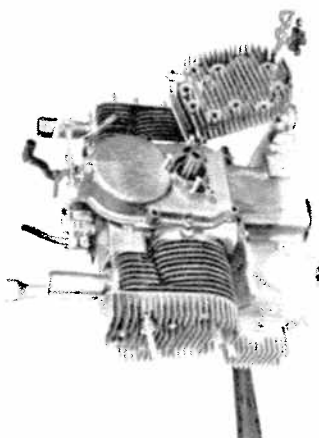
### Remove Manifold

Remove the intake manifold and accessories as a unit. Disassemble the carburetor and clean or overhaul as necessary.

### Use Speed Wrench

Use a speed wrench for running off all head nuts, manifold screws, shroud screws and others. Removing the head from a hot engine may damage the head gasket. The gasket surface on units with graphoil gaskets must be below 100° F before removal. Above 100° F, the gasket is gummy and difficult to remove.

**WARNING** Hot gasket material from graphoil gaskets may cause skin burns if contact is made.



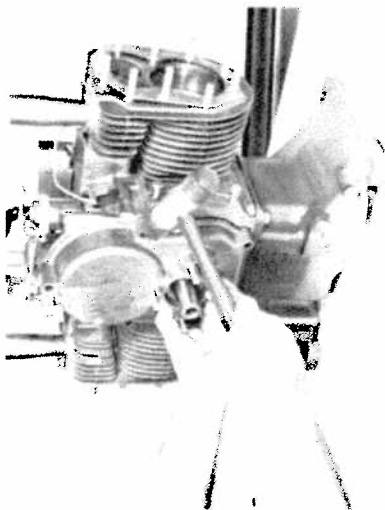
Notes:

### Remove Gear Cover

If engine has a flywheel alternator, remove three screws holding stator to the gear cover.

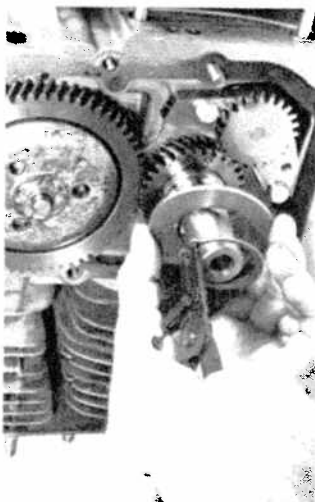
Remove crankshaft key first to prevent possibility of cutting seat. Remove the gear cover screws. Grasp the hub with one hand and tap the cover with a plastic or soft-faced hammer. This procedure eases removal of the gear cover.

**CAUTION** Do not pry on the cover to remove it.



### Use Snap Ring Pliers

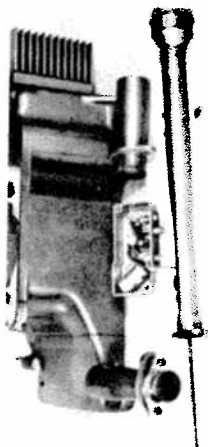
Remove valves and lifters. To enable camshaft and oil pump removal, use a pair of snap-ring pliers No. 420-0107 to remove the snap-ring and then the retainer ring.



Notes:

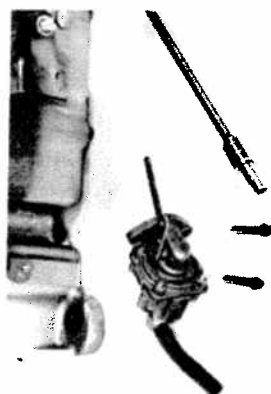
### Remove Top-Mounted Components

Remove the exhaust manifold adapters, breaker box and the oil fill tube. On later models, the oil fill tube is press-fit to oil base and should not be removed.



### Remove Fuel Pump

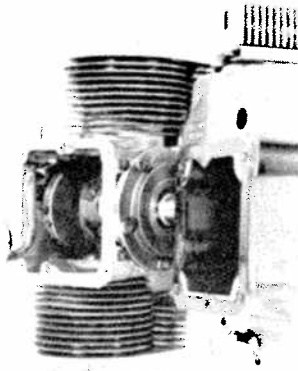
Use a 1/4-inch 12-point thin wall socket to remove the fuel pump.



Notes:

#### **Remove Oil Base**

Remove the oil base screws and free the oil base from the engine block. Wash the base in a cleaning tank.

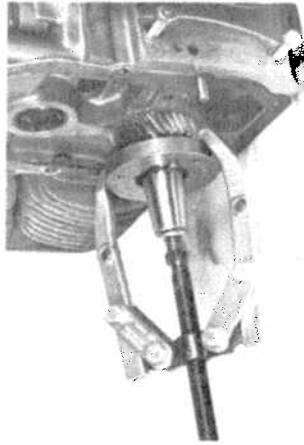


#### **Remove Oil Pick-Up Tube**

Remove the oil pick-up tube and cup by using a vise grip on the tube. Do not use the cup for removal.



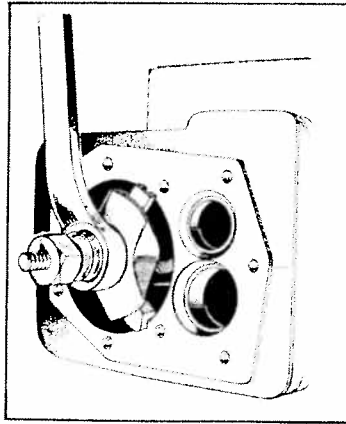
**Notes:**



### Remove Crank Gear

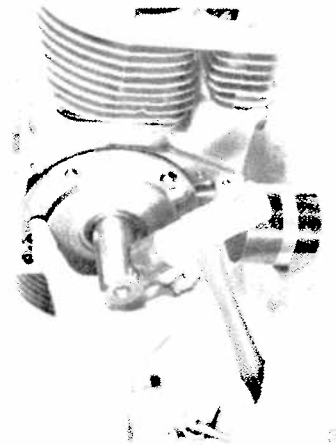
Use gear puller No. 420-0072 and gear puller ring No. 420-0248 to remove the crank gear. Remove the pistons and oil pump.

Mark each piston and rod assembly so they can be returned to their respective cylinders after overhaul. Keep connecting rod bearing caps and bearings with their respective rods.



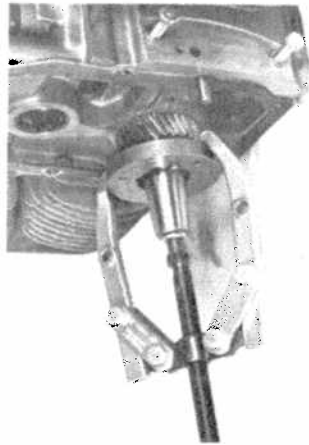
### Use Ridge Reamer

On an engine with many hours, be sure there is no carbon or wear ridge at the top of the cylinder before removing a piston from its cylinder. A ridge reamer will remove such ridges and prevent damage to the piston.



### Remove Bearing Plate

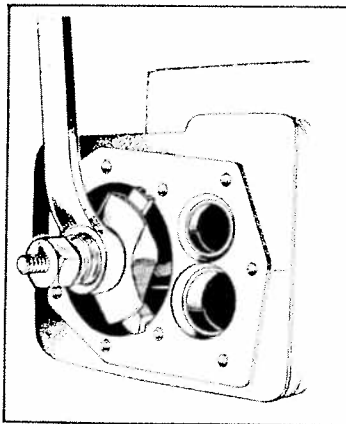
After all components have been removed except the crankshaft, remove the bearing plate screws. Grasp the hub of the bearing plate with one hand and tap the crankshaft stub with the plastic or soft-faced hammer. This action jars the bearing plate free from the block and makes for easy plate removal.



### Remove Crank Gear

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**Mark each piston and rod assembly so they can be returned to their respective cylinders after overhaul. Keep connecting rod bearing caps and bearings with their respective rods.**



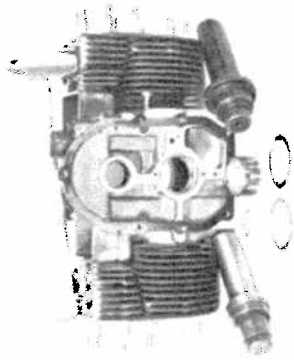
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### Remove Bearing Plate

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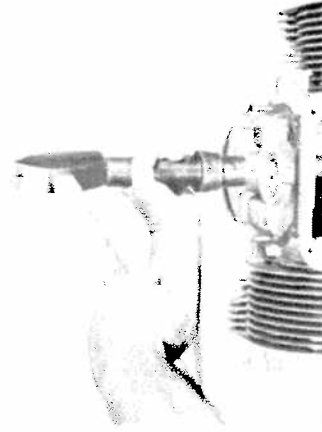


### Remove Main Bearing

Check the position of thrust washers and spacer washers when removing the crank. Wash the block in a steam cleaner or solvent tank to remove accumulations of oil and dirt. Remove the crank and cam bearings with the combination bearing remover No. 420-0325. Insert the driver into the bore of the main bearing and drive the bearing out with a machinist hammer.

### Remove Cam Bearing

Use the same driver to remove the cam bearings. With a long punch through the front cam bearing bore, remove the Welsh plug from the rear cam bearing.



Notes:

## DIMENSIONS AND CLEARANCES

All dimensions given in inches unless otherwise indicated.

	Minimum	Maximum
Valve Stem in Guide - Intake	0.001	0.0025
Valve Stem in Guide - Exhaust	0.0025	0.004
Valve Seat Interference Width	1.32	3.64
Valve Face Angle		44°
Valve Seat Angle		45°
Crankshaft Main Bearing	0.0025	0.0038
Crankshaft End Play	0.005	0.009
Camshaft Bearing	0.0015	0.003
Camshaft End Play	0.003	
Rod Bearing to Rod Journal Clearance	0.0005	0.0023
Connecting Rod End Play	0.002	0.016
Timing Gear Back Lash	0.002	0.003
Oil Pump Gear Back Lash	0.002	0.005
Piston to Cylinder Clearance - Strut Type (Measured below oil-control ring 90° from pin)	0.0015	0.0035
Light Weight (No Strut)	0.0065	0.0095
Piston Pin in Piston		Thumb Push Fit
Piston Pin in Rod	0.0001	0.0005
Piston Ring Gap in Cylinder	0.010	0.020
Crankshaft Main Bearing Journal - Standard Size	1.9992	2.0000
Crankshaft Rod Bearing Journal - Standard Size	1.6252	1.6260
Cylinder Bore - Standard Size	3.5625	3.5635

Notes:



### Table of Torques

This table gives the torque value for those nuts and screws that require the use of a torque wrench

N SERIES TORQUE SPECIFICATIONS	
	Ft. Lb.
*Cylinder Head Bolt (Standard)	17-19
W/Compression Washer	13-15
Starting Spec D - Top 6	12
- Bottom 4	15
Retorque second time before running	
Rear Bearing Plate -	
NH	25-27
NHA, NHB, NHC	20-23
Connecting Rod Bolt -	
Nodular Iron	27-29
Forged Aluminum	14-16
Flywheel Capscrew	35-40
Starter Mounting Bracket to	
Oil Base Screws	43-48
Gear Case Cover	8-10
Magneto Stator Screws (NH)	8-10
Oil Pump	7-9
Other 3/8 Cylinder Block Nuts	18-23
Intake Manifold (NHA, NHB, NHC)	18-20
Exhaust Manifold (NHA, NHB, NHC)	10-12
Manifold Screws (NH)	16-23
Fuel Pump Mounting Screws (NH)	5-6
Spark Plug (All except N52M)	15-20
(N52M)	7-9

\*Look for label's inside cylinder air strouds for torques on special engines

Notes:

### Align Main Bearing

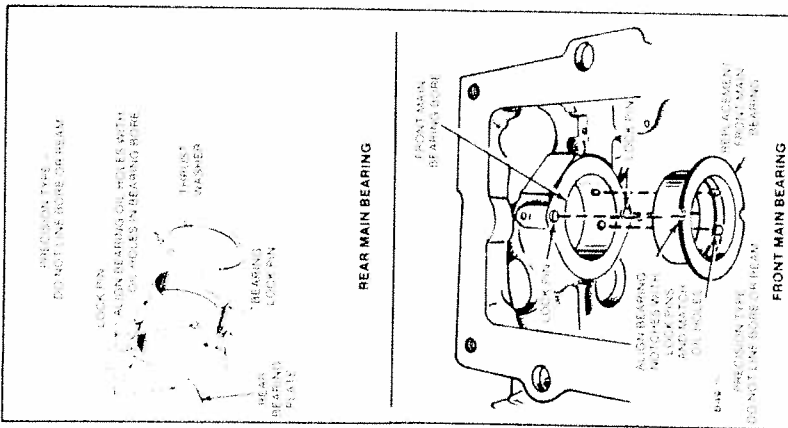
New main bearings come with new thrust washers. All necessary oil seals and gaskets will be in the overhaul gasket kit.

The rear main bearing is pressed into the rear bearing plate. The one-piece aluminum service bearing is installed only in the front main bearing bore as shown.

Align the new bearing so that the oil hole lines up with the oil hole in the bearing bore.

### Install Main Bearing

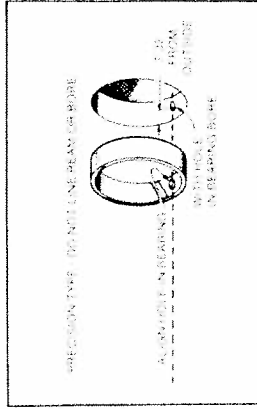
Use the combination bearing driver 420-0324 to drive the main cam bearings into position. A flange on the driver enables the bearings to be driven in just flush with the case.



Notes:

### Align Cam Bearings

Align the oil holes of the front cam bearing to assure lubrication of the front journal. Line up the elongated slot of the rear cam bearing with the hole in the top of the crankcase to assure the breaker point plunger having enough room to contact the cam on the camshaft.



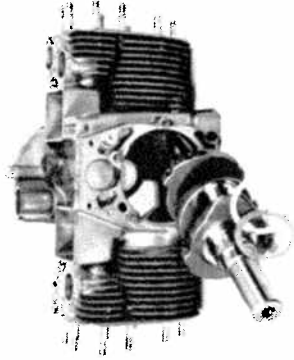
### Install Cam Bearings

Drive in the cam bearings with the same tool as was used for the main. Then close the hole in the back of the crankcase with a Welsh plug (on rear bearing only).

Notes:

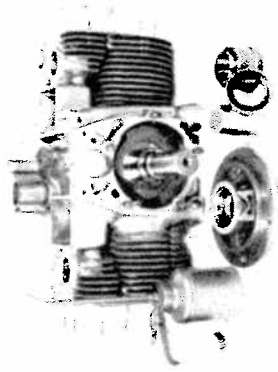
### Inspect Crankshaft

Examine the crankshaft. If it needs polishing or grinding, use a plunge polish or grind. This eliminates scratches on the journal that could auger out of the engine. When polishing the journal, check if a .002 undersize bearing will suffice. Undersize bearings are available in .002", .010", .020" and .030" undersize.

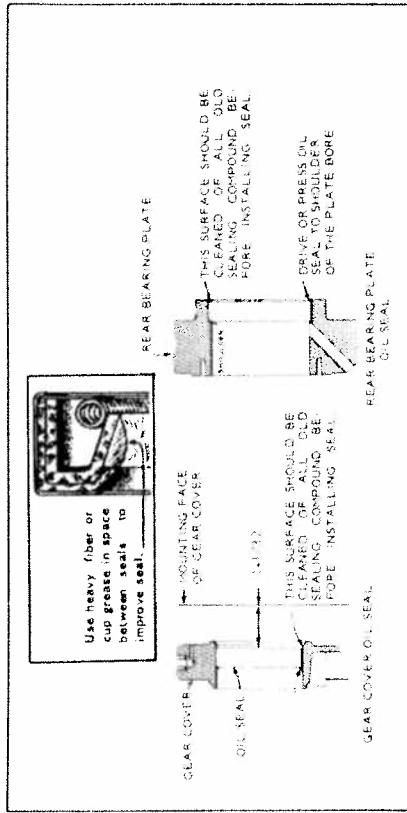


### Install Crankshaft

Lubricate the flat surface of the thrust washers with oil to hold them in position. Observe the shims that were in the engine when it was disassembled. Lubricate the crank journals with recommended engine oil or soluble grease. Insert the crankshaft into the block. Remove the new oil seal from the gasket kit and use oil seal guide and driver 420-0181.



Notes:

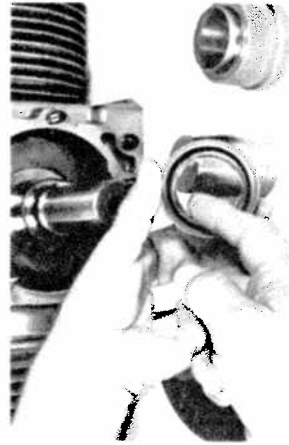


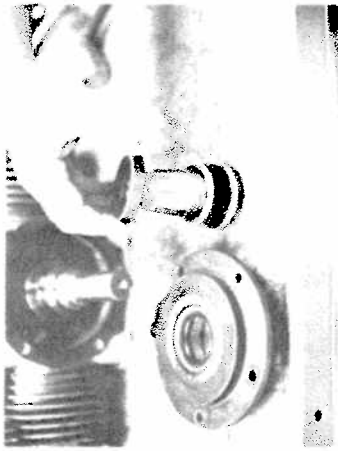
### Oil Seal Installation

This illustrates the installation dimensions for the seals and also specifies the precautions related to lubrication and installation

### Lubricate Oil Seal

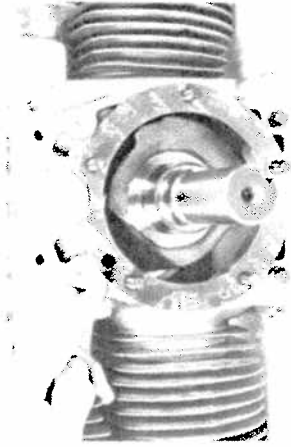
Before installing the oil seal on the guide and driver, lubricate the seal lips with a good grease. This provides initial lubrication until the engine oil reaches the seal. It prevents excessive friction, hardening of the oil seal and oil leakage





#### Install Oil Seal

Place the loader on the guide and driver and slip the seal down into position. Press the oil seal into the bearing plate with a suitable arbor press or drive it in with a hammer. Leave the guide and driver in position until the crankshaft end play has been established within allowable limits.



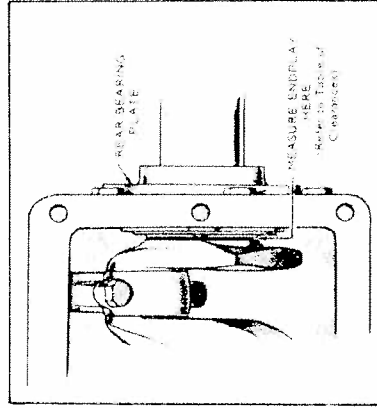
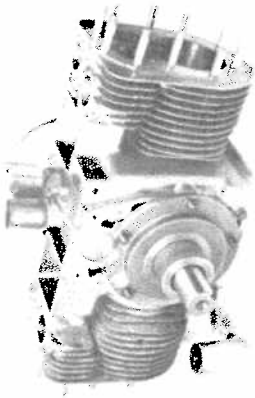
#### Install Gasket

Be sure the oil hole is exposed on the back of the block when the bearing plate gasket has been installed.

Notes:

### Seat Bearing Plate

Place the bearing plate in position and torque two nuts on opposite side of the crankshaft to assure full seating. Then check crankshaft end play.



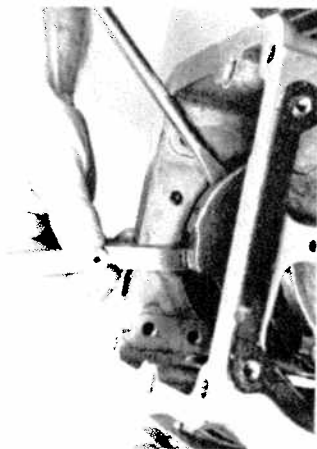
### Measure Crankshaft Endplay

With the bearing plate nuts torqued, apply pressure to the crankshaft. Then measure end play as shown here.

Notes:

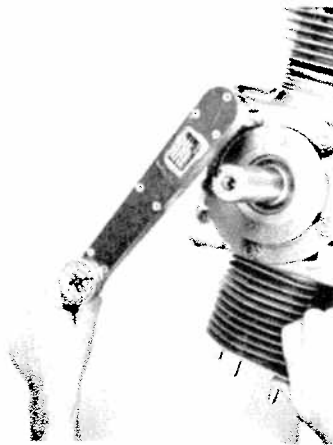
### Check Endplay

Crankshaft end play should measure between .005 inch and .009 inch. If crankshaft end play is excessive, insert one of the steel shims between the thrust washer and the bearing plate. If end play is insufficient, remove the bearing plate and remove one of the shims.



### Torque Bearing Plate Screws

When the crankshaft end play measures to the proper dimensions, torque the bearing plate screws to 20-23 lbs. ft.

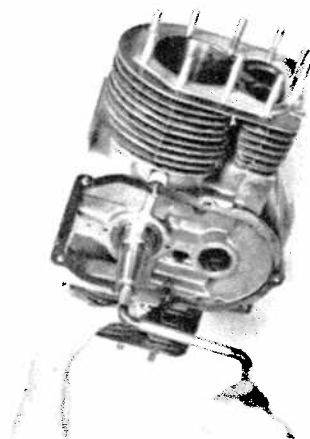


Notes:



### Check for Binding

Use the blower wheel lead screw as a crank for an appropriate bolt that will thread into the end of the crankshaft after each component is installed to check for binding. If binding should occur, remove the last component installed and correct the condition. This eliminates the need for extensive tear down should binding occur after reassembly. Use the cranking technique to check installation of pistons, valves, camshaft, and oil pump, and for setting the valves.



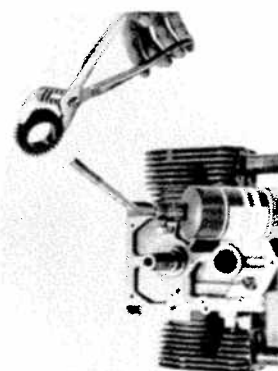
### Install Crank Gear

Turn the block over so the rear end of the crankshaft rests against a solid support. Place the key in the slot to hold the gear.

Crank gears are easier to install if heated a slight amount with a suitable torch or oven. Check for sufficient clearance so gear will slip onto crankshaft journal without damage to the shoulder on crankshaft or the snap ring groove.

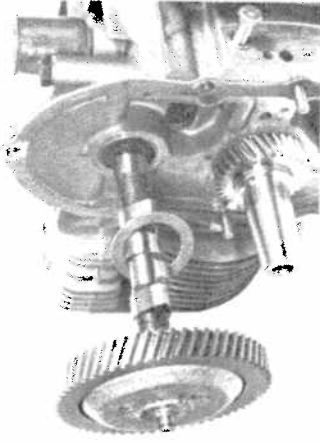
**CAUTION** DO NOT OVERHEAT CRANK GEAR OR THE TEMPER OF THE STEEL MAY BE LOST.

Make the driver from a piece of pipe with a cap welded on to one end. Drive the gear into position. Ensure gear timing marks face upwards and crankshaft is resting on a solid support before driving gear in place.



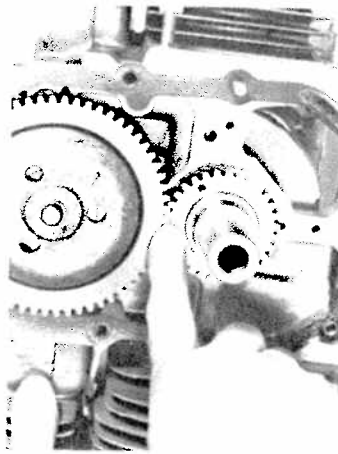
### Install Camshaft

Turn the crankshaft so the timing mark on the crank gear is up toward the camshaft. Apply engine oil to thrust washer. Position behind the gear and insert the camshaft. The camshaft will rotate slightly when the gears mesh with the crank gears.

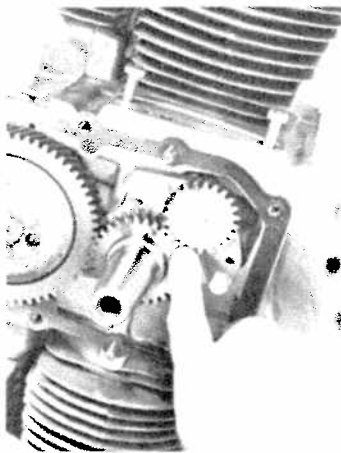


### Check Timing Marks

After camshaft installation, be sure the timing marks align.

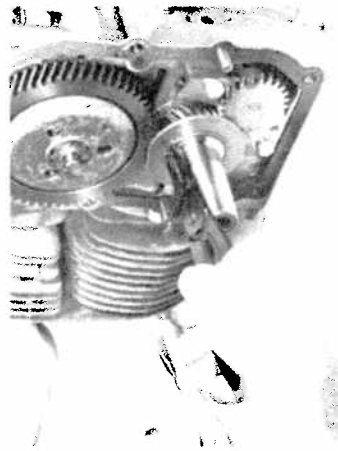


Notes:



### Install Oil Pump

Install the oil pump. Allow .005 inch backlash in the pump and crankshaft gears. The mounting bolt holes have enough room to obtain this clearance.



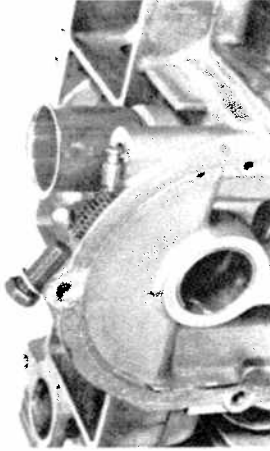
### Install Retainer and Snap Rings

Install the retainer ring and the snap ring.

Notes:

### Inspect Oil Bypass Valve

Inspect the fixed oil pressure bypass relief valve. This non-adjustable valve assures adequate oil pressure to the crank and rod journals. Ensure that only the calibrated length bolt is used.

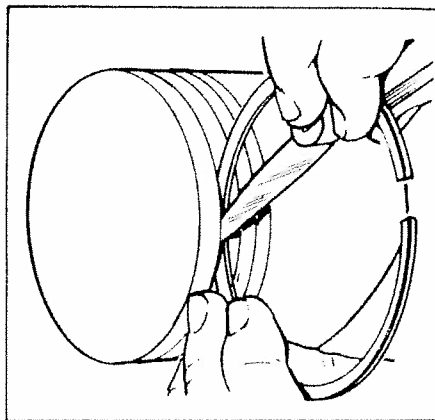
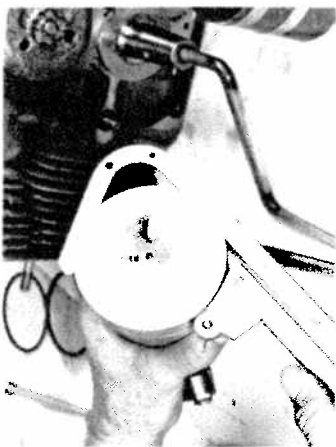


Notes:

### Clean Ring Grooves

Piston ring groove cleaner, No. 420-0332, scrapes carbon from the ring grooves to assure that the rings will fit freely in the grooves.

**CAUTION** DO NOT REMOVE METAL FROM GROOVES. DO NOT USE CAUSTIC SOLVENT. DO NOT USE WIRE BRUSH OR BUFFER.



### Measure Ring Lands

Before ring installation, check the ring side clearance for excessive wear of the ring grooves.

Notes:

### Install Rings

A ring spreader, No. 420-0146, eases installation of the rings into the proper grooves and eliminates breakage.



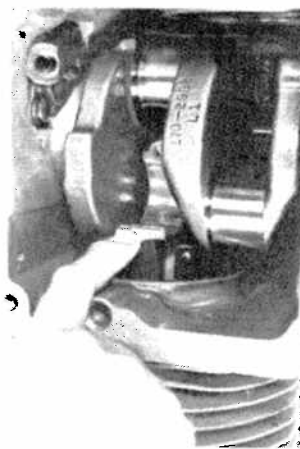
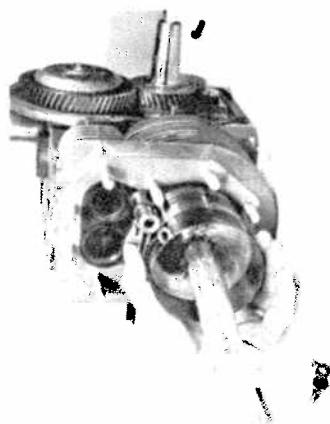
### Lubricate Rings

Lubricate the rings with recommended engine oil, turning the rings completely. Stagger the gaps and wipe the skirts of the piston with the excess oil.



### Install Piston

To insert the piston in the engine bore, seat the rings on the piston with a ring compressor. Position the piston so that protrusions of the compressor do not butt against the head bolt studs. Turn the crankshaft to place the rod throw as far as possible from the bore into which the piston is being inserted. This eliminates the connecting rod jamming into the rod journal and causing burning and consequent damage.



### Install Connecting Rods

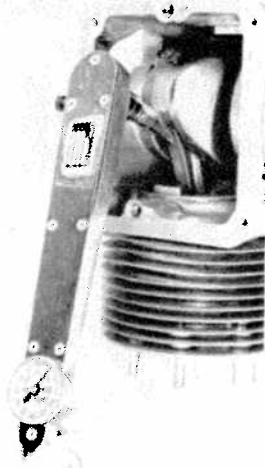
Lubricate the rod journals. Turn the crank into the rod and place the appropriate connecting rod cap in position. Insert cap screws.

Off-center cap screws on each rod assembly should be toward outside of case as shown.

Notes:

### Torque Rod Bolts

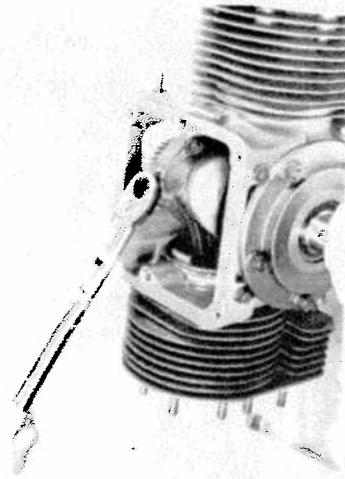
The cap screws used on the iron rods are called "place bolts." They do not need a lock to maintain tightness. Torque iron connecting rod bolts to 27-29 lb. ft., and aluminum connecting rod bolts to 14-16 lb. ft.



### Ratchet Torque Wrench

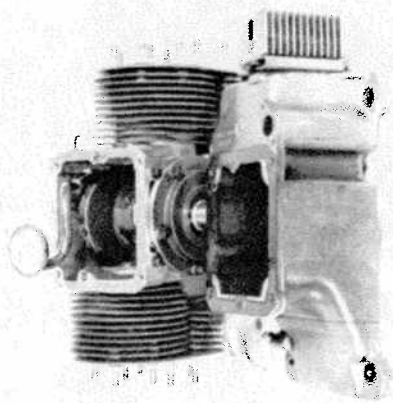
A torque wrench that releases when torque is reached may be used. It snaps only once so listen closely so over-torque does not develop.

Install the oil pickup tube and cup. Ensure the cup is parallel with the engine base.



Notes:





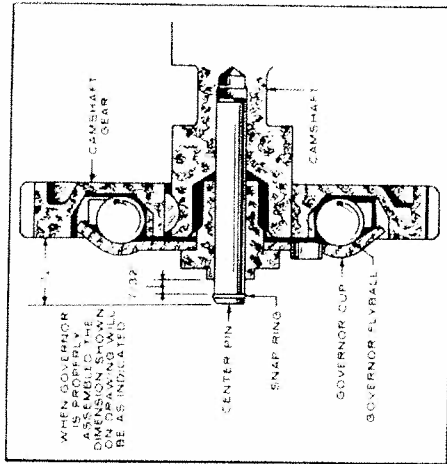
#### **Install Oil Base**

Install a new gasket and place the oil base in position. Fasten and torque to 18-23 lbs. ft.

**Notes:**

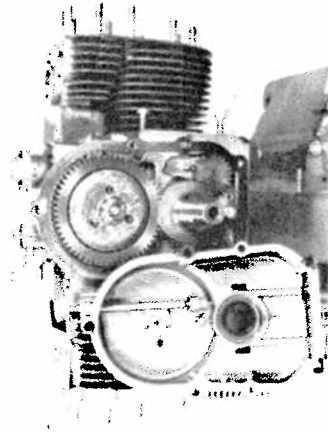
### Five-Ball Governor

The five-ball governor used on Qan industrial engines aids in maintaining the engine speed at a particular throttle setting. This drawing shows the correct dimensions of a governor properly assembled. If less than 10 balls are used, ensure that governor assembly is in balance.



### Install Gear Cover

Turn the engine to the normal up-right position. Place the governor cup bushed hole at the 3 o'clock position. Install a new oil seal in the cover and a new gear cover gasket on the engine block. Place the gear cover in position. The gear cover should go flush against the block indicating the roll pin in the gear cover has entered the bushed hole in the governor cup. Torque the gear cover screws to 8-10 lbs ft.

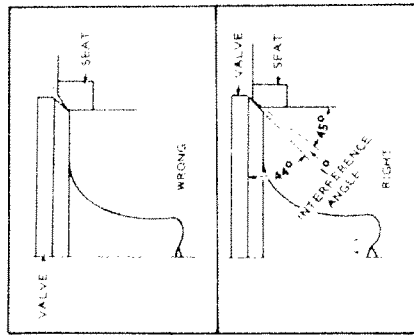


Notes:

## Valve System

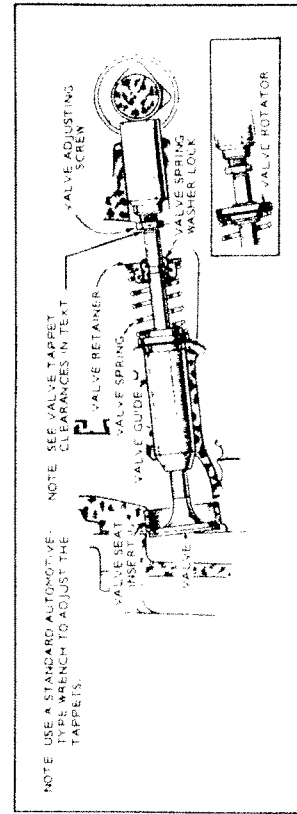
The valve system consists of

- Tappets
- Intake valves
- Exhaust valves
- Springs
- Retainers
- Retainer locks



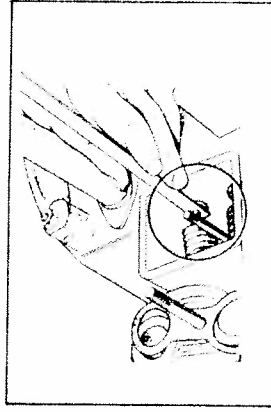
## Valve Grinding

Replace the valve seats and grind the valves. Replace any valve that shows warpage or excessive burning. The valve seat angles are 45° and the valve angles are 44° to provide a 1° interference angle for better seating. Onan does not recommend lapping valves after the grinding process.



### Replace Valves

Place the tappets in the appropriate holes and the valves into the guides. Put the springs and retainers into position and compress the springs with the valve spring compressor, 420-0119. Install the valve locks with replacer tool 420-0105.



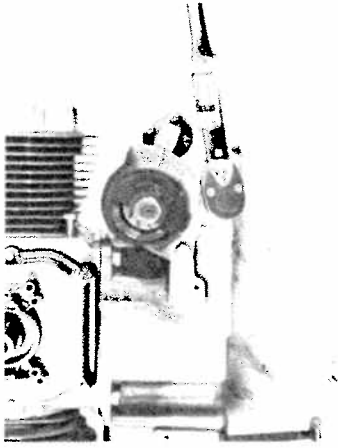
### Check Valve Clearance

Set valve clearance to .003" on intake and .012" on exhaust. Valve lash adjustment requires no reference point -- just place one cylinder on the compression stroke. Adjust those valves. Then turn the crankshaft one full turn placing the other cylinder on compression and adjust its valves.

Notes:

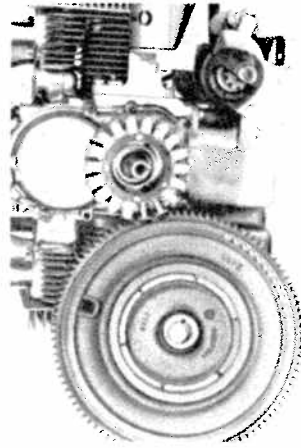
### Install Cranking Motor

Place the cranking motor in position. Insert the mounting screws and torque to 25-35 lbs. ft.

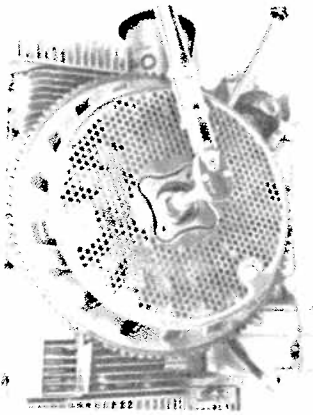


### Replace Stator

Install the flywheel alternator stator to the gearcase cover with the 3 screws.

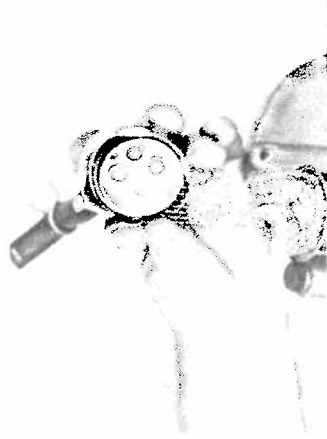


Notes:



### Torque Flywheel

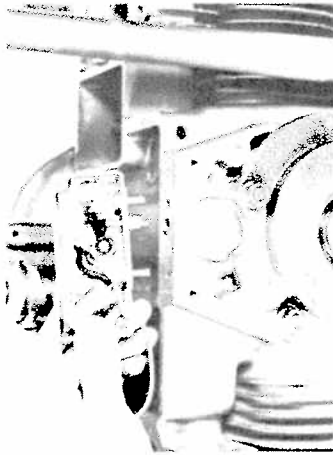
Insert crankshaft key and position the blower wheel. Tighten the cap screw and torque to 35-40 lb. ft.



### Install Breather Valve

Cummins equips the NH Series engines with the four-ball breather. A sticky breather valve can cause oil leaks, high oil consumption, rough idling, reduced engine power and a rapid formation of sludge and varnish within the engine. Clean the valve thoroughly, then reassemble the breather pack, place in position and fasten.

Notes:



### Install Breaker Box

Place the breaker box in position with its new condenser and set of points. Secure the breaker box to the engine block. Adjust the breaker point gap to 0.16 inch (.020 on N52M). Engine timing is 20° BTC (25° on N52M).

Some engines use a top adjust breaker box other than shown.

### Set Point Gap

To set the point gap, rotate the engine crankshaft clockwise (facing flywheel) until maximum breaker point gap is obtained. Turn the cam screw until proper point gap is measured with a feeler gauge. Wipe gauge before measuring to remove any accumulated oil or foreign material that could adhere to the breaker points and cause ignition failure.



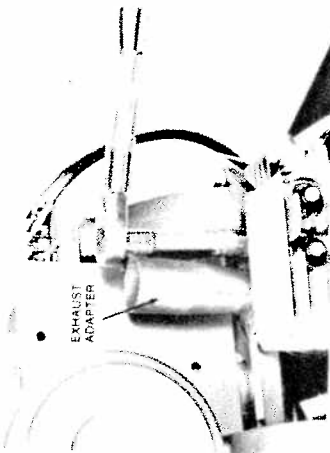
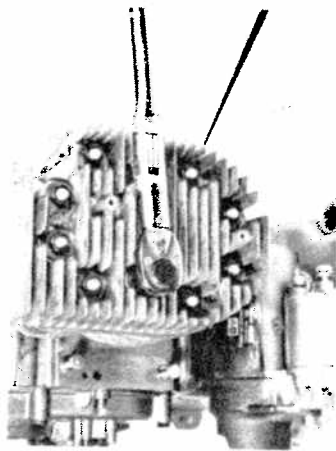
Notes:

### Torque Head Bolts

Install a new head gasket. Place the steel washers in position with the flat side against the head. Install the nuts and hand-tighten. Following the standard sequence of head bolt tightening, alternating back and forth across the head.

Use torque specs on page 23 unless label inside the cylinder head shroud is different.

Place the exhaust adapter in position and torque to 10-12 lbs. ft. Torque the intake manifold cap screws to 18-20 lbs. ft.



### Install Manifold

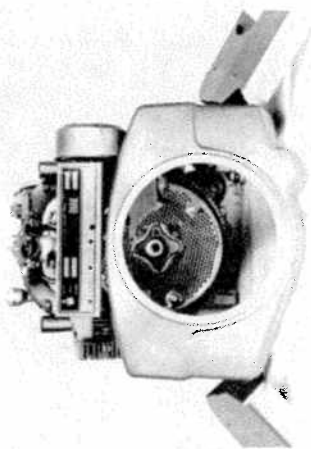
Install the manifold on the engine using new gaskets. This goes on as a completed assembly with the carburetor already installed. Torque the manifold stud nuts to the proper lb. ft.

Notes:



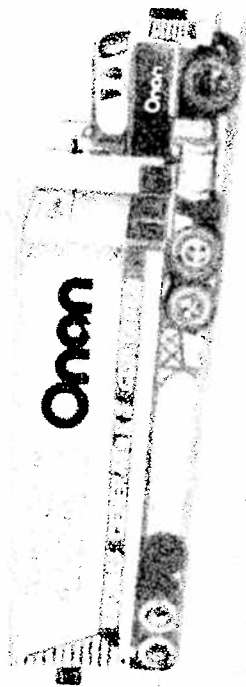
### **Replace Shrouds**

Install the shrouds beginning with the large engine shroud and then the cylinder head shrouds. If the engine needs painting, the Oran green is available in small spray cans No. 525-0305.

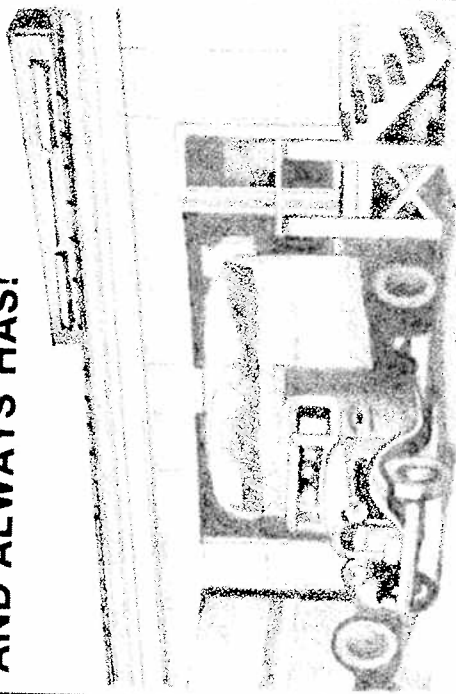


**Notes:**

ONAN DELIVERS . . .



AND ALWAYS HAS!



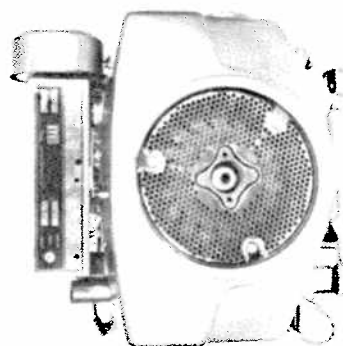
# Tune-Up

## Tune-Up

Now that the engine is reassembled, make the final adjustments to the following

- float
- spark plugs
- ignition timing
- carburetor
- governor

Prior to starting the engine, add new oil to the crankcase per recommendations on page 56



## TUNE-UP SPECIFICATIONS

- TAPPETS (IN TO FT)
  - INTAKE 0.003
  - EXHAUST INH 0.002
  - INHA NHB NHC NSM 0.012
- BREAKER POINT GAP
  - FULL SEPARATION NSM 0.020
  - INHA NHB NHC NHAV 0.016
  - NHBV NHCV 0.025
- SPARK PLUG GAP
  - IGASOL NEM 0.015
  - IGASOL NEM 0.015
  - NSM ALL FUEL 0.031
- IGNITION TIMING
  - BATTERY INH 22° B1C
  - BATTERY INHA NHB NHC 20° B1C
  - MAGNETO INH 22° B1C
  - BATTERY NSM 25° B1C

001

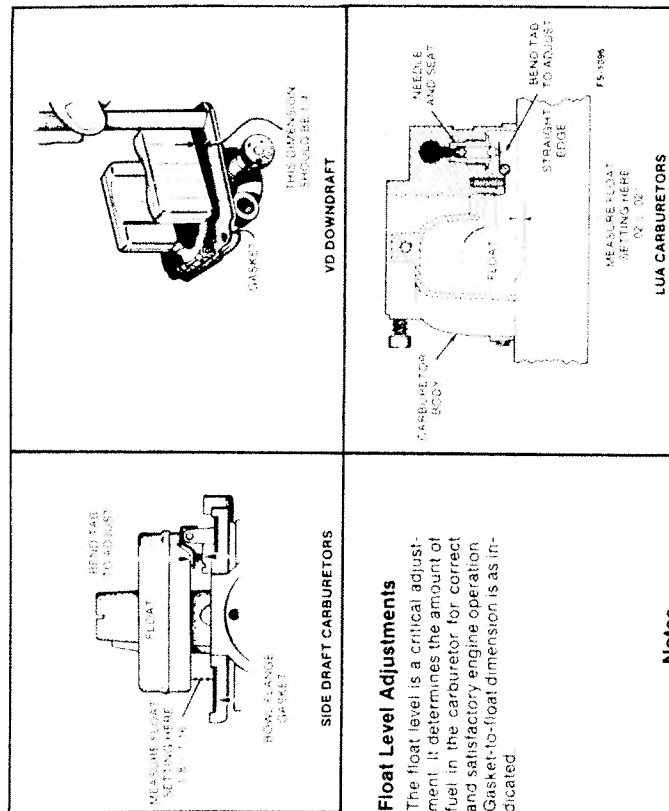
## Break-In Procedure

Controlled break-in is the ideal fitting of all internal moving metal parts. Using the proper oil and applying a conscientious maintenance program during this period helps assure satisfactory service from your Chan engine.

Maintain the proper cooling and lubrication during break-in. Run the engine at half load for the first three hours with intermittent periods of full load to control engine break-in.

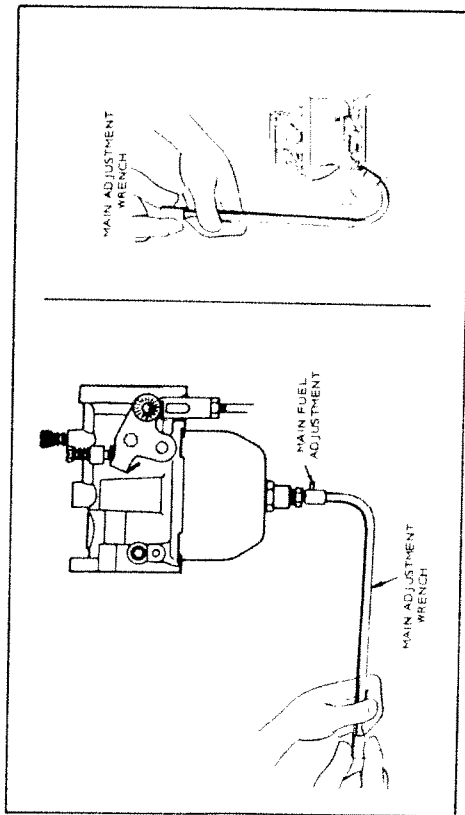
Check the oil level at least every five operating hours. Add oil to keep it at the proper level, but never overfill as overfilling may cause the oil to foam and enter the breather system.

**CAUTION** USING THE WRONG GRADE AND WEIGHT OF OIL CAN CAUSE HIGH ENGINE OPERATING TEMPERATURES DURING BREAK-IN CAUSING ENGINE DAMAGE.



## Notes

- Because of State and Federal Laws since August 1972, most highway vehicular engine applications have an Exhausted Emissions Control System that includes positive fuel shut-off that stops fuel evaporation when the engine(s) is not being used. Manual or electrically operated valves are especially important on any vehicular application where there is a possibility of engine stalling, the same fuel tank and lines if the larger engine is running and the smaller is not, the restricted fuel system may affect the smaller engine enough to cause flooding through its carburetor. This condition creates evaporative emissions of fuel fumes to the atmosphere and could become a fire or explosion hazard. For this reason, a positive shut-off valve must be installed between the fuel tank and the engine fuel pump inlet to stop fuel flow to the carburetor any time the engine is not running.
- Spark arrester mufflers are required by law in many States and by the Federal Park System in dry areas of the country which are vulnerable to grass and forest fires.



#### Carburetor Adjusting Wrenches

Use a carburetor adjusting wrench to simplify main jet adjustments. It helps prevent burns from a hot manifold or exhaust pipe. Select the wrench to fit the design and location of the carburetor. (Onan tool number 420-0294 or 420-0169)

#### Recommended Fuel

Use clean, fresh, unleaded or regular grade gasoline. Do not use highly leaded premium fuels. Using unleaded gasoline results in less maintenance and consistently longer valve life.

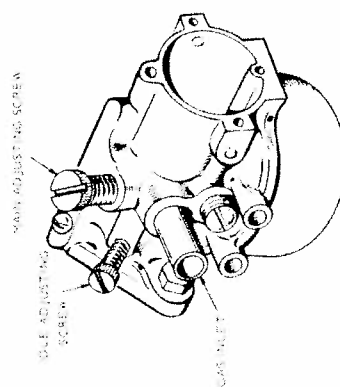
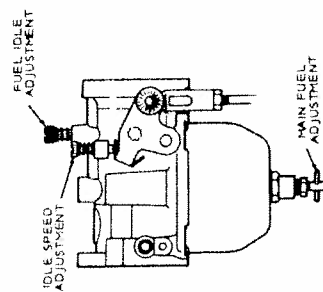
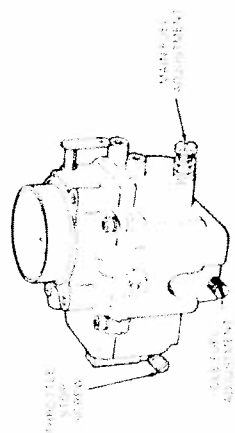
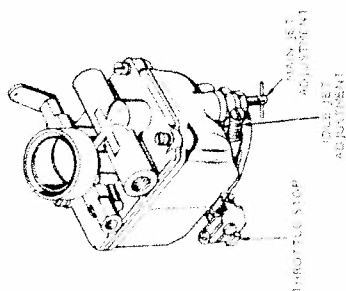
Use regular gasoline for the first 25 hours to allow the rings to seat well for best performance. Then use unleaded gasoline thereafter.

If regular gasoline is used continually, carbon and lead deposits must be removed from the cylinder heads as required because of engine power loss. Unleaded gasoline may be used safely after lead deposits have been removed.

**WARNING** NEVER FILL THE FUEL TANK WHEN ENGINE IS RUNNING! A SPARK OR THE HOT ENGINE MIGHT IGNITE THE GASOLINE FUMES.

Notes:

# CARBURETORS



## CARBURETOR ADJUSTMENTS

**CAUTION** Forcing the needle against its seat will damage it. The needle does not completely shut off fuel when turned fully in.

### Gasoline

Adjust the carburetor to obtain the correct air-to-fuel mixture for smooth, efficient operation. Before making adjustments, allow the engine to reach normal operating temperature.

### Idle Jet Adjustment

Make this adjustment with no load applied to the engine. Move the engine speed control on the NHA NHB to the SLOW position. Turn the idle jet needle out until the engine begins to lose speed. Then, turn the idle jet needle in until the engine runs smooth.

### Throttle Stop Adjustment

Adjust the throttle stop screw so that the throttle maintains a distance of 1/32 inch from the manifold.

### Main Jet Adjustment

Apply a full load to the engine. Grasp the governor mechanism, bringing it to minimum speed position. Release the governor and allow the engine to accelerate. If acceleration is even and without hesitation, the main adjust-

ment is correct. If acceleration is uneven, turn the main adjustment out about 1/4 turn and again bring the engine to minimum speed. Release the governor and observe acceleration. Adjust until the engine accelerates evenly and without hesitation. Do not open the needle more than 1/2 turn beyond the maximum point of power.

### Gas

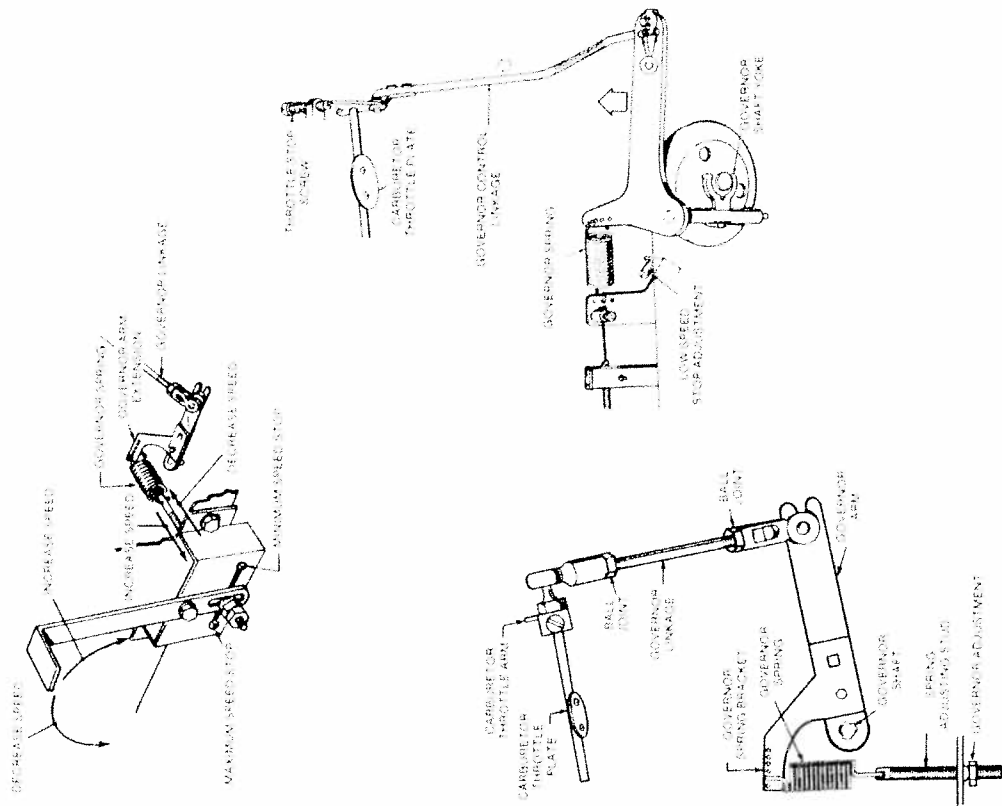
1. Adjust the main gas adjusting screw according to the gas used.

#### Preliminary Adjustment

Gas	Turns
800 BTU	6
1100 BTU	3-1/2
Propane	3

2. Open the idle adjusting screw two turns.
3. Start the engine and allow it to reach normal operating temperature. Apply a full load and turn the carburetor main gas screw in until the engine begins to lose speed. Then, turn the screw out until the engine will carry a full load smoothly.
4. Remove the load and adjust the idle screw in the same manner.

## GOVERNORS





### Governor Adjustments

Make governor adjustments concurrent with carburetor adjustments

#### Linkage Adjustment

Adjust the length of the linkage so that with the engine stopped and tension on the governor spring, the stop on the carburetor throttle lever is 1.32 inch from the carburetor stop boss. Check for binding.

#### Speed Adjustment

Check speed with a tachometer. If the engine needs a speed adjustment, turn the speed adjusting nut IN to increase the speed or OUT

to decrease the speed.

#### Sensitivity Adjustment

The sensitivity of the governor depends on the position of the arm end of the governor spring. To increase sensitivity, move the spring toward the governor shaft. To decrease sensitivity, move the spring toward the linkage end of the governor arm.

#### Low Speed Stop Adjustment

Set this adjustment screw for approximately 50 to 100 rpm above the throttle stop screw setting on the carburetor (Preferred speed is 1000 rpm.)

Notes:

### Spark Plug Gap

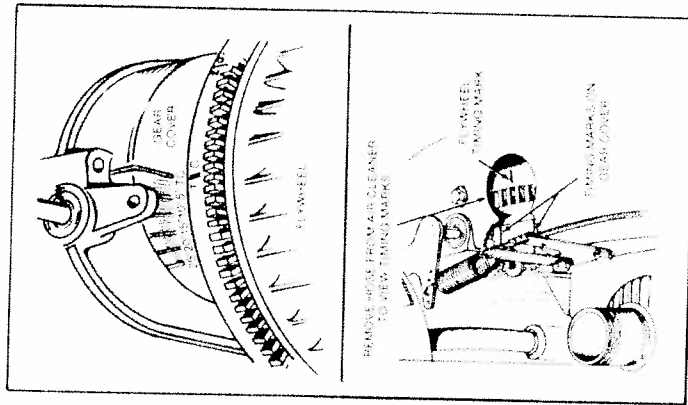
Gap the spark plugs at .025" for gasoline-fuel engines, .018" for gaseous fuel engines and .030" for N52M engines—all fuels. Always replace spark plugs after each 100 hours of operation.



### Ignition Timing

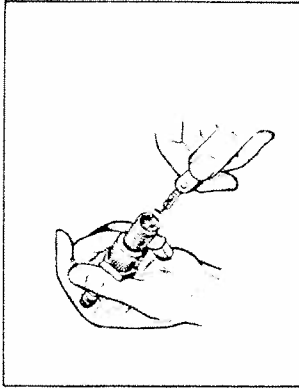
Onan stamps the correct timing on the cylinder block near the breaker box. To accurately check the time at which the spark occurs, use an automotive timing light when the engine is running. When the engine is stopped, use a continuity test lamp to determine when the points open. If timing marks do not align, readjust the point gap.

- Slightly open point gap to advance the timing
- Slightly close the gap to retard the timing



### Spark Plug Gap

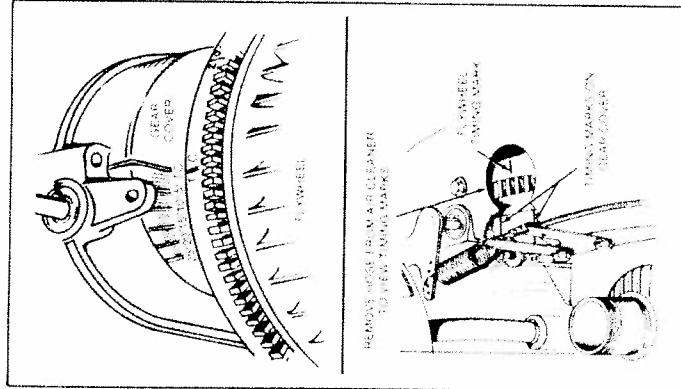
Gap the spark plugs at .025" for gasoline fuel engines, .018" for gasoline fuel engines and .030" for N52M engines—all fuels. Always replace spark plugs after each 100 hours of operation.



### Ignition Timing

Onan stamps the correct timing on the cylinder block near the breaker box. To accurately check the time at which the spark occurs, use an automotive timing light when the engine is running. When the engine is stopped, use a continuity test lamp to determine when the points open. If timing marks do not align, readjust the point gap.

- Slightly open point gap to advance the timing.
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### Periodic Maintenance

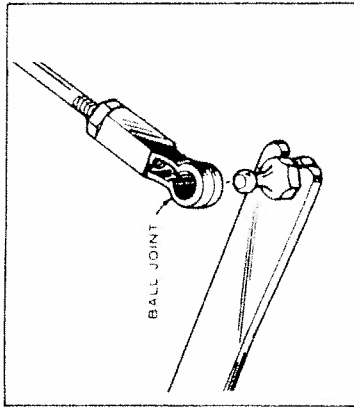
Periodically, inspect the engine and its components and clean or replace as is necessary. Use this factory recommended maintenance schedule as a guide in achieving long and efficient engine life. Neglecting routine maintenance can result in engine failure or permanent engine damage.

### PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS					
	8	25	50	100	200	
Inspect Engine Generally	x					
Check Oil Level	x					
*Service Air Cleaner		x1	x			
*Change Crankcase Oil		x1	x			
Check Battery Electrolyte Level			x			
Clean Cooling Fins			x			
*Replace Oil Filter (if used)			x1		x	
Replace Spark Plugs				x		
Check Breaker Points				x1	x	
*Clean Breather Valve					x	
*Replace Air Cleaner Element					x	
Clean Fuel System						x
*Clean Governor Linkage			x			x

\* Perform more often in extremely dusty conditions. x1 - Normal service interval.

Notes:



### Governor Linkage

The linkage must be able to move freely through its entire travel. Every 50 hours, clean the metal joints. Inspect the linkage for binding, excessive slack and wear.

### Change Oil

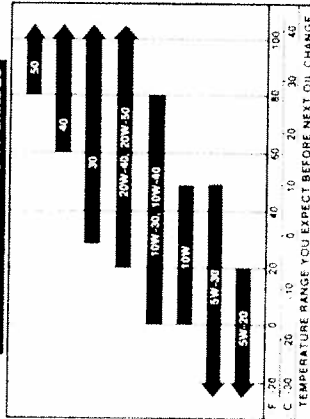
Change oil at the recommended interval, more often when the engine is operating in extremely dusty or dirty conditions. Use oil with the API (American Petroleum Institute) designation SE or SF.

Use low ash content oils (3-85 percent by weight) with natural gas or propane fueled engines.

### WARNING

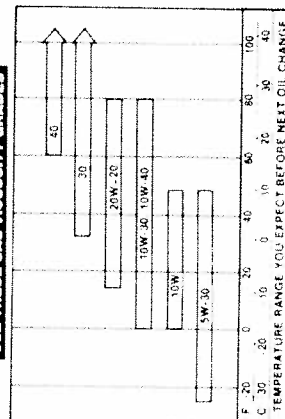
DO NOT REMOVE THE DIPSTICK WHILE THE ENGINE IS RUNNING. OIL MAY BLOW OUT THE OIL FILL TUBE CAUSING INJURY.

### USE THESE SAE VISCOSITY GRADES

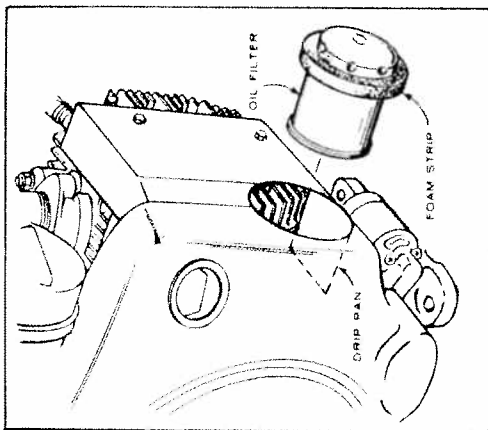


### GASOLINE ENGINES ONLY

### USE THESE SAE VISCOSITY GRADES

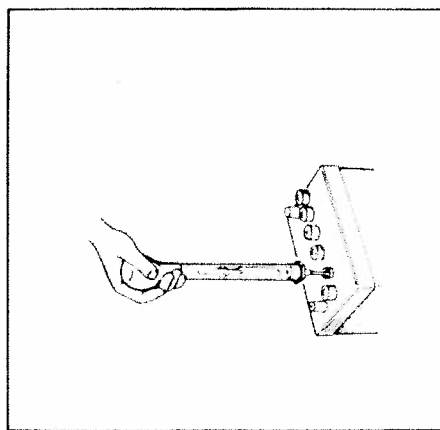


### GASEOUS-FUELED ENGINES ONLY



### Change Oil Filter

Change the oil filter at the recommended interval, or at every other oil change. Coat the filter gasket with a film of oil and install filter finger tight plus 1/4 to 1/2 turn.

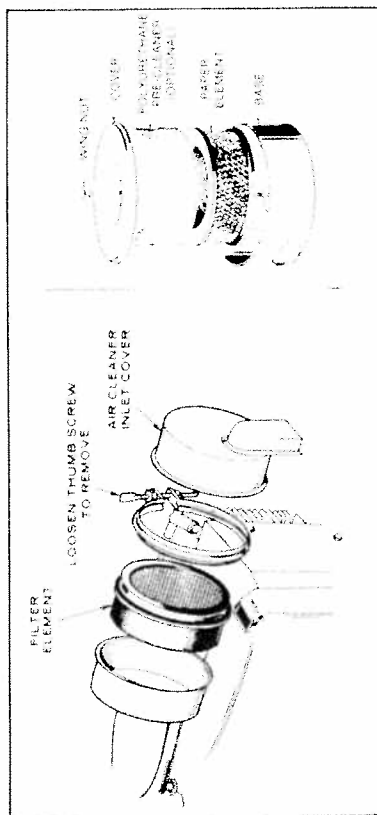


### Battery Check

Periodically check the specific gravity of the battery to be sure the charging system is functioning correctly. A fully charged battery provides a reading of 1.260 at 77°F. Use a good hydrometer to obtain an accurate reading.

CHARGING SYSTEM TESTS REQUIRE A FULLY CHARGED BATTERY.

**WARNING** DO NOT SMOKE WHILE SERVICING BATTERIES. EXPLOSIVE GASES ARE EMITTED FROM BATTERIES IN OPERATION. IGNITION OF THESE GASES CAN CAUSE SEVERE PERSONAL INJURY.



### Air Cleaner Maintenance

Check and clean filter element and optional polyurethane pre-cleaner at recommended interval. Clean element by gently tapping on a flat surface. Wash pre-cleaner in water and detergent and gently squeeze out excess moisture. Allow to dry, then coat evenly with three tablespoons of SAE 30 engine oil. Knead into and wring excess oil from pre-cleaner before installing over element.

Replace element every 200 hours, sooner in dusty operating conditions.

**CAUTION** DO NOT RUN ENGINE WITH THE AIR CLEANER REMOVED.

Notes:

### Cleaning Cooling Fins

1. Check clean cooling fins every 50 hours
2. Remove accumulated dust/dirt/oil.
3. Remove all chaff from rotating or stationary blower screen.
4. Steam clean or wash down engine regularly.

**CAUTION** PLUGGED OR CLOGGED COOLING FINS CAN CAUSE OVERHEATING AND ENGINE DAMAGE.

### "HOT" WEATHER OPERATION

When operating temperatures are above 75° F:

- Keep cooling fins clean free of obstructions
- Air flow to and from engine must be unrestricted
- Use proper grade and weight of oil
- Check oil level when refilling fuel tank
- Check battery level more frequently than the 50-hour battery check at normal temperatures
- High temperatures can cause vapor lock
- Use unleaded regular gasoline
- Vacu-Flo cooling is excellent for close area installation -- but provide a sufficient air intake opening
- Generally keep engine as clean as possible

### "COLD" WEATHER OPERATION

When operating temperatures are below 30° F:

- Use proper grade and weight of oil for the colder temperature conditions
- Change oil only when the engine is warm
- If engine is filled with summer oil -- before starting engine, move unit to a warmer location until oil flows freely
- Use fresh gasoline -- keep tank full to prevent condensation in tank and lines.
- Keep battery in fully charged condition. booster charge if in low condition



#### Out-Of-Service Protection

If the engine is out of service for more than 30 days, corrosion damage could occur. To keep the engine in good condition over extended periods of time, perform these steps:

#### OUT-OF-SERVICE PROTECTION

If the engine is to be out of service for more than 30 days, perform the following:

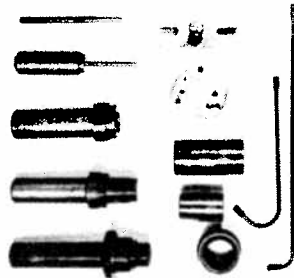
- Run the engine until it reaches normal operating temperature
- Turn off fuel supply and run the engine until it stops
- Drain oil from warm engine
- Refill crankcase with fresh oil — attach tag indicating viscosity used
- Remove spark plugs — Place rust inhibitor oil in cylinders — Rotate crankshaft a few times — Reinstall spark plugs
- Service air cleaner
- Clean governor linkage
- Plug exhaust outlet and fuel inlet fittings.
- Wipe off entire unit — coat rustable parts with light film of oil/grease.
- Remove battery — store separately following standard battery storage procedures
- Provide entire unit with a porous cover such as canvas. Do not use plastic — it causes moisture condensation.

# Tools



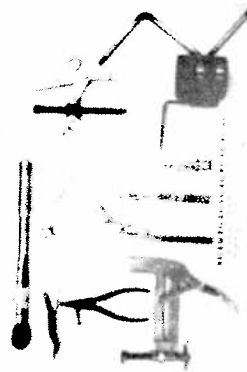
Mechanic's Normal Hand Tools

- 3/8" DRIVE RATCHET
- 3/8" SPEED HANDLE, 3" EXTENSION
- SOCKETS — 12 PT. 3/8", 7/16", 1/2", 9/16", 5/8", AND SPARK PLUG SOCKET 13/16"
- WISE GRIP PLIERS
- PHILLIPS SCREWDRIVER, BLADE SCREWDRIVER
- 7/16 x 9/16" OPEN END TAPPET WRENCHES
- STANDARD SET FEELER GAUGES



Special Tools

- 420-0071 VALVE SEAT DRIVER
- 420-0100 FLYWHEEL PULLER PLATE
- 420-0181 OIL SEAL GUIDE AND DRIVER, REAR BEARING PLATE
- 420-0248 INCLUDES OIL SEAL LOADER
- 420-0300 CRANK GEAR PULLER RING
- 420-0313 VALVE GUIDE DRIVER
- 420-0324 OIL SEAL GUIDE AND DRIVER, GEAR COVER
- 420-0325 COMBINATION MAIN AND CAM BEARING DRIVER
- 420-0325 COMBINATION MAIN AND CAM BEARING REMOVER
- 420-0169 CARBURETOR ADJUSTMENT WRENCH
- 420-0294 CARBURETOR ADJUSTMENT WRENCH
- 420-0296 TIMING ADVANCE MECHANISM COVER DRIVER



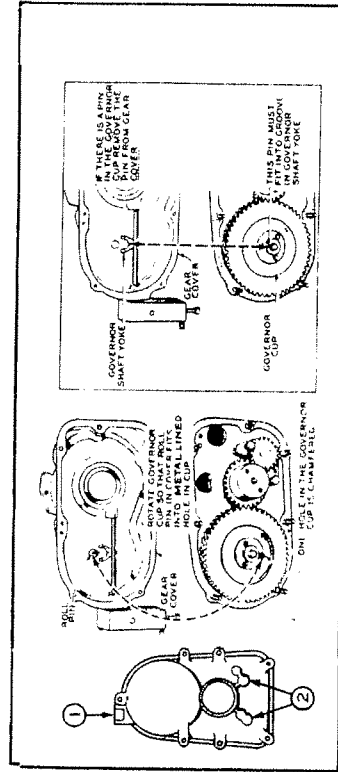
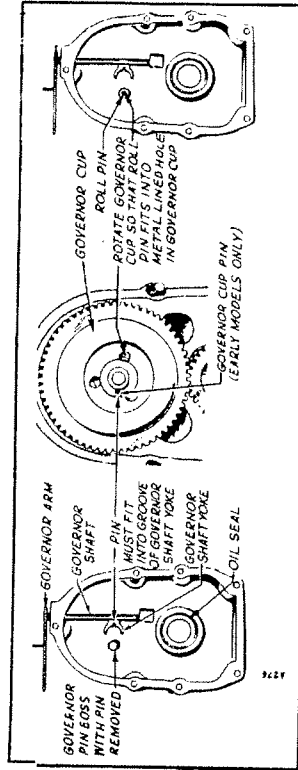
Optional Tools

- 420-0119 VALVE SPRING COMPRESSOR
- 420-0105 VALVE LOCK REPLACER
- 420-0139 VALVE TAPPET ADJUSTING WRENCH
- 420-0214 RING COMPRESSOR, EXPANSION
- 420-0146 PISTON RING SPREADER
- 420-0332 PISTON GROOVE CLEANER
- 420-0256 PLASTI-GAGE .002 - .006
- 420-0072 GEAR PULLER
- 420-0107 SNAP RING PLIER
- 420-0106 TORQUE WRENCH

# INSTALLING GEAR COVER

This gear cover, with pin installed, is to be used with a governor cup that does not have a pin in the cup. If the governor cup has a pin in it, remove the pin in this gear cover.

1. For units with no pin in the cup, install cover with its pin fitting into the metal lined (smoothest) hole in the cup.
2. For units having a pin in the governor cup, remove the pin in the cover. It can be twisted out with pliers.
3. Use the self tapping screws provided for mounting the blower housing (1), and the magneto stator (2).



#### INSTALLING BENDIX FUEL PUMPS FOR SELF PRIME

These instructions are void for replacement pumps installed in systems with solenoid valves after the pump outlet.

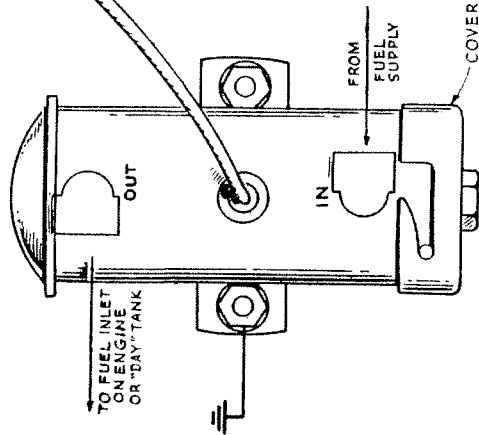
This pump is recommended for use with a float tank switch, but it may be used alone by continuously pumping against a fuel head.

Mount the pump as close as possible to the main fuel tank to prevent vapor lock and to attain maximum pump capacity. No solenoid is needed to sustain a prime because of the mounting position of the pump.

A suitable ground must be connected to the pump body. The hot lead must be connected to an appropriate dc source. If a float switch is used, connect the hot lead to the switch.

Fuel lines must be at least 5/16" inside diameter for maximum pumping capacity. If a float tank is used, the engine return line must run to the float tank to take some of the load off the pump. If a float tank is not used, the engine return line must run to the main fuel tank.

Only on engines equipped with a diaphragm type mechanical fuel pump, avoid the hazard of fuel entering the crankcase through a worn-out or damaged pump diaphragm. To do this, bypass the engine's pump so that it is not used and plug its openings.



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Onan has been a proud, bold name  
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and bolder  
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#### End Of Session

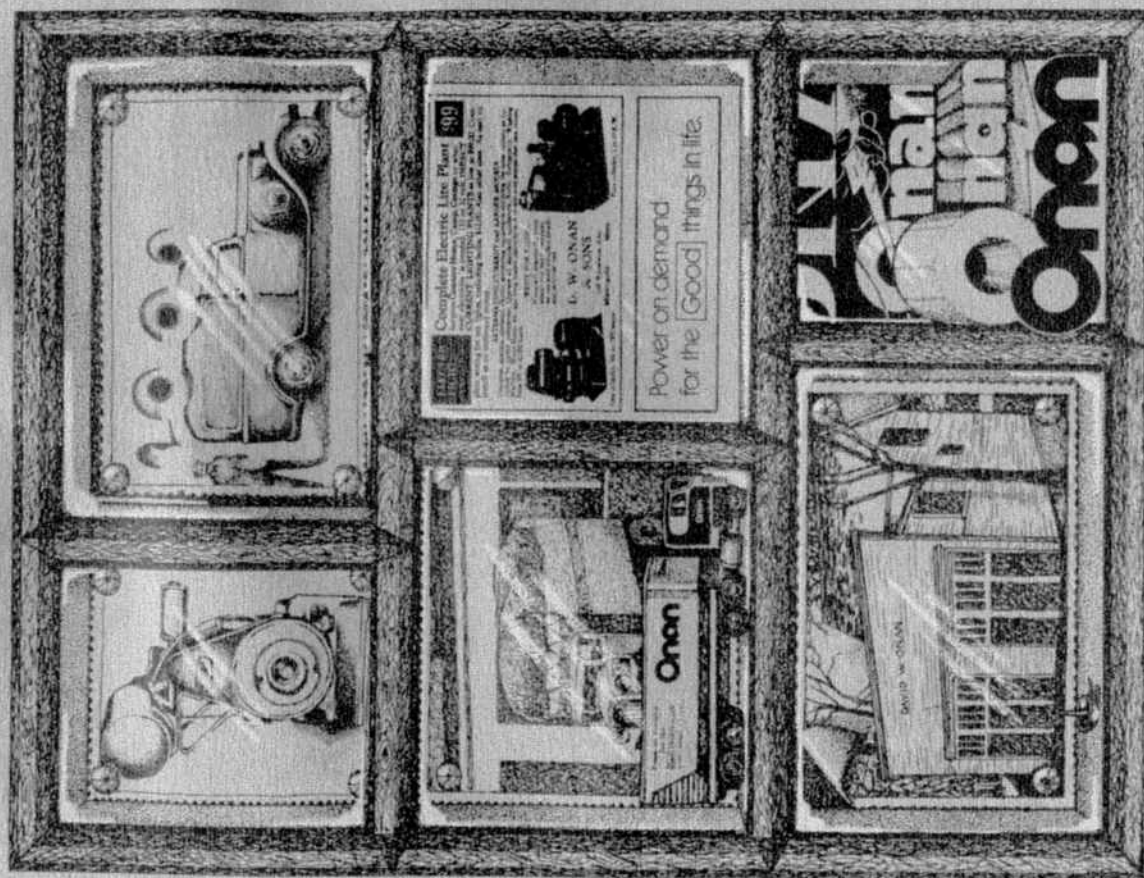
Return the engine to the customer so that it looks and runs like a completely new engine—in first class condition ready to do its designated job.

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