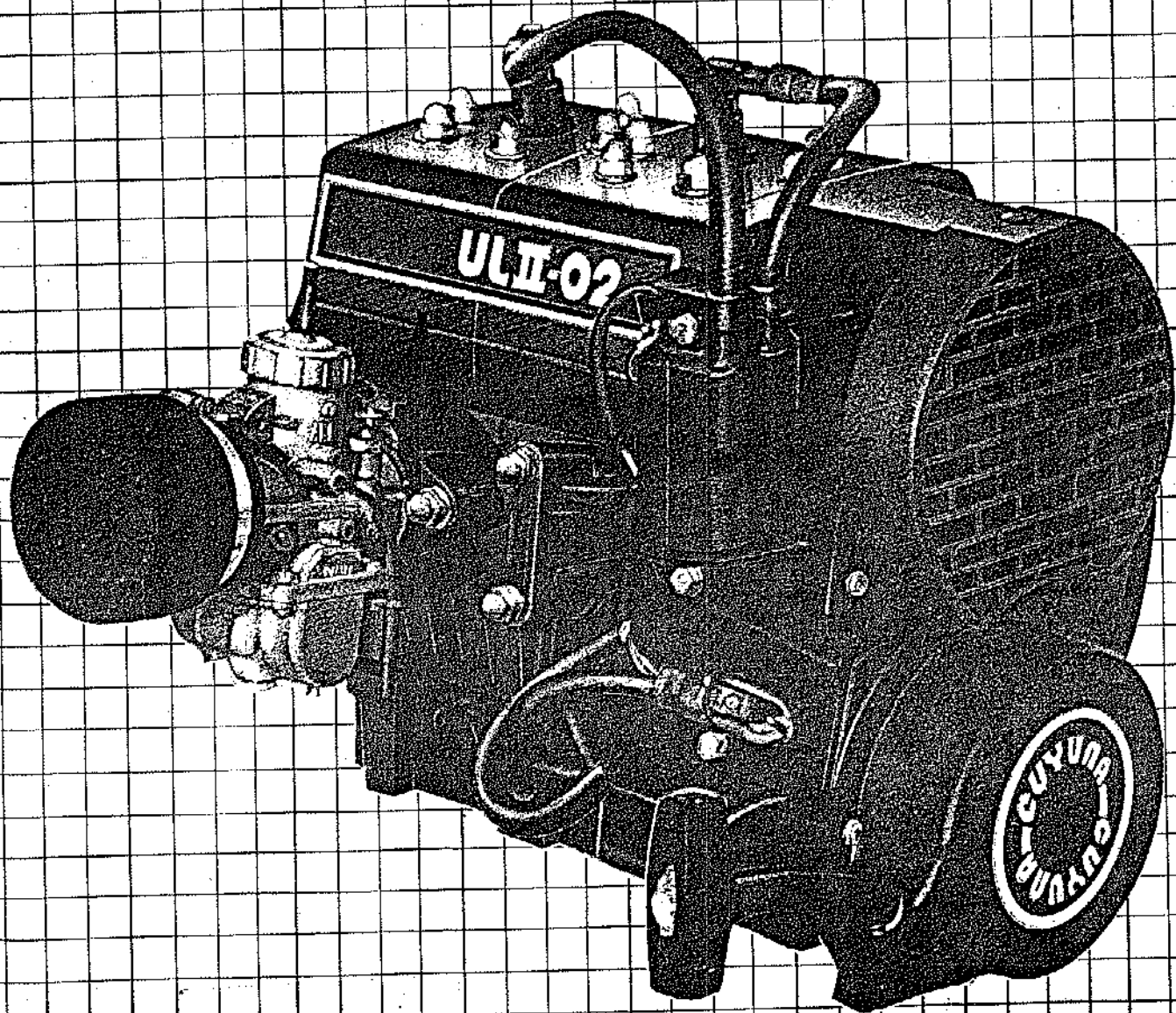


Cuyuna Engines



SERVICE MANUAL

APPENDIX

This Cuyuna Parts Manual has been prepared by Cuyuna Service Personnel to aid in ordering of service parts for all Cuyuna Engines manufactured since January 1, 1981.

When ordering certain parts, it may be necessary to specify the model designation of the engine. Crankcases will indicate the model by the letters stamped on the crankcase upper half, near the magneto end on the exhaust side.

CUYUNA ENGINE MODEL DESIGNATIONS For 215, 340, 430, and ULII-02

Engine Model

"RR"

Crankcase with PTO face machined and 4-10mm holes drilled and tapped to allow mounting of reduction assembly.

"RF"

Designates reverse flow of air through the engine. (Can be used with any model.)

When placing Parts Orders, phone 218/546-8313.

All shipments will be made freight collect unless prior arrangements are made.

Keep this manual in the shop area for reference and training.

CUYUNA ENGINE COMPANY
CUSTOMER SERVICES DEPARTMENT
P.O. BOX 116
CROSBY, MN 56441

FORWARD

This manual contains maintenance and troubleshooting information for the various Cuyuna engines. The manual is designed to aid service personnel in service - oriented application.

The manual is divided into sections. Each section of the manual covers a specific area of the engine in addition to the standard service procedures, which include disassembly, inspection and assembly procedures.

The service technician should familiarize himself with the different areas of the engine by first carefully studying the appropriate section of this manual. This manual will assist the service technician in becoming more aware of and efficient with service procedures. Such efficiency not only helps build consumer confidence, but also saves time and labor.

When servicing the Cuyuna engine, the technician should use discretion as to how much disassembly is needed to correct any given condition.

This manual uses the words: Warning, Caution and Note to emphasize certain information. The symbol ▲WARNING▲ identifies personal safety-related information. Therefore, be sure to read the directive because it deals with the possibility of personal injury. The symbol ●CAUTION● identifies engine related information. Be sure to read the directive because it deals with the possibility of damaging a part or parts of the engine. If the directive is violated, the engine will usually sustain major damage. The symbol ■NOTE: identifies supplementary information worthy of particular attention.

At the time of publication, all information, photographs and illustrations were technically correct. Because Cuyuna Engine Company constantly refines and improves its products, no retroactive obligation is incurred.

Keep this manual accessible in the shop area for reference.

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Break-in Procedure

1. For the first three (3) gallons of fuel used in a new or rebuilt Cuyuna engine, mix twice the amount of B.I.A. TC-W rated oil with a given amount of fuel (20:1 mix ratio), than is indicated in the section entitled, "Fuel Requirements".
2. Run the engine for one-half (½) hour under low load conditions at various engine speeds (RPM). Do not exceed one-half (½) throttle at this time, vary the throttle from idle to one-quarter (¼) to one-half (½) throttle settings for short periods (30 seconds) during this time. This will assist in seating the piston rings properly.
3. For the next ½ hour of engine operation, do not run the engine for sustained periods (more than 30 seconds) at throttle openings in excess of ¾ throttle. Continue to vary the throttle during this break-in period.
4. After the engine has been run for one hour, it is recommended that the cylinder heads be re-torqued while the engine is warm, but NOT HOT!
5. The engine should be run on the ground for the first hour of initial break-in or for the time required to consume 1 ½ gallons of the 20:1 fuel/oil mixture. When 1 ½ gallons of the 20:1 fuel/oil mixture has been used, top the fuel tank with 40:1 fuel/oil mixture.
6. For the first ten hours of flight it is suggested that the engine not be run for sustained periods at throttle opening in excess of ¾ throttle. Continue to vary the throttle during the first ten hours of flight.

Mixing Fuel

The two-cycle Cuyuna engine requires that oil be mixed with a good grade of gasoline for engine lubrication. Use clean, fresh leaded regular or unleaded premium. The gasoline should have a minimum pump octane rating of 88. Use genuine Cuyuna 40:1 oil or an oil that has been B.I.A. TC-W rated.

CAUTION Do not use aviation gasoline as it may upset carburetion.

NOTE: It is imperative to maintain the correct fuel/oil ratio (40:1). Too much oil will cause spark plug fouling, excessive smoke and carbon build-up. Too little oil will cause engine damage from inadequate lubrication.

WARNING Always mix fuel and oil in a well ventilated area. Do not smoke! Never mix or add fuel to the fuel tank near any open flame, with the engine running, or while the engine or exhaust system is hot.

1. Put 2½ gallons of gasoline in a five (5) gallon container (U.S. measure).
2. Add 16 Fl. oz. of B.I.A. TC-W, two-cycle engine oil.
3. Shake the container vigorously.

4. Add the remaining 2½ gallons of gasoline.
5. Agitate the container thoroughly again.
6. Use a clean funnel with a fine metal screen to pour the fuel mixture into the gas tank.

CAUTION Always keep your fuel system clean. Dirty or contaminated fuel can cause engine failure. Never attempt to mix gasoline and oil in your fuel tank. Improper mixing of the fuel/oil will result in engine damage.

Preparation for Storage

Prior to storing the Cuyuna engine during the off season months, it must be properly serviced to prevent rusting of internal components. To prepare the engine for storage, use the following procedure.

1. Drain all gas from the gas tank. Disconnect the fuel line from the fuel pump inlet fitting.
2. Remove the air cleaner from the carburetor.
3. Start the engine and allow it to idle. Rapidly inject a good two-cycle oil (petroleum base) into the carburetor for a period of 10-20 seconds until the engine stops. This procedure coats the crankshaft and internal parts of the engine with a protective film of oil.
4. Wash the foam air cleaner in parts washing solvent and wring dry. Install the air cleaner back onto the carburetor.
5. If the engine is being used in the upright position, remove the spark plugs. Pour 1 Fl. oz. of a good two-cycle oil (petroleum base) down each spark plug hole and slowly turn the engine over, just two revolutions.
6. Re-install the spark plug.
7. Plug the exhaust outlet to prevent anything from entering the exhaust system.

Preparation After Storage

Taking the engine out of storage and correctly preparing it for another season will assure many hours of trouble-free operation. To prepare the engine for use, follow this procedure:

1. Inspect all fuel lines and replace any that appear to be loose, swollen or cracked.
2. Inspect the in-line fuel filter and replace if necessary. Fill the tank with the correct fuel mixture. Inspect the fuel tank venting system and clean if needed.
3. Remove the spark plug and replace if they appear to be oil fouled, and adjust to recommended gap. Torque spark plug to 20 ft. lbs.
4. Inspect spark plug leads and caps for tightness and wear. Replace any caps that appear to be worn or loose.
5. Inspect the fan belt for tightness, cracks or fraying. Adjust or replace as required.
6. Inspect all wire connections for secure and clean connection.

GENUINE PARTS

When replacement of parts is necessary, use only genuine Cuyuna parts. They are precision made to ensure high quality and correct fit. Refer to the Cuyuna illustrated parts book for the correct part number, quantity and description.

Cuyuna Twin & Single Cylinder Engines Models 215 - 430 -ULII-02

SPARK PLUG DATA

Engine Model	Type Ignition	SPARK PLUG			
		Light Duty	Normal Duty	Heavy Duty	Plug Gap
215R/D	CDI	NGK BR7ES	NGK BR8ES	NGK BR9ES	.035-.040
430R/D	CDI	NGK BR7ES	NGK BR8ES	NGK BR9ES	.035-.040
ULII-02	CDI	NGK BR7ES	NGK BR8ES	NGK BR9ES	.035-.040
215R/D	CDI	Champion N4C	Champion N3C	Champion N2	.035-.040
430R/D	CDI	Champion N4C	Champion N3C	Champion N2	.035-.040
ULII-02	CDI	Champion N4C	Champion N3C	Champion N2	.035-.040
215	CDI	Bosch W5C	Bosch W4C1	Bosch W3C	.035-.040
430	CDI	Bosch W5C	Bosch W4C1	Bosch W3C	.035-.040
ULII-02	CDI	Bosch W5C	Bosch W4C1	Bosch W3C	.035-.040

■ **NOTE:** NGK spark plugs listed under the "Normal Duty" category are those which are installed at the Cuyuna factory. If spark plug brands other than NGK are to be used, be sure the spark plug heat range is equivalent to that of the original equipment spark plugs installed on your Cuyuna engine.

■ **NOTE:** The spark plug should be checked for appearance and gap after each ten (10) hours of use.

ENGINE SPECIFICATIONS

Model	UL-430	UL-215	ULI-02
Bore: in./mm	2.657/67.5	2.657/67.5	2.657/67.5
Stroke: in./mm	2.362/60	2.362/60	2.362/60
Displacement: cc	428 cc	215	428 cc
Compression Ratio:	6.5:1	6.5:1	6.5:1
Base Mounting Holes:	←————— 7/16-14 UNC —————→		
Cylinder:	Aluminum with Cast Iron Liner		
Upper Rod Bearing:	←————— Needle —————→		
Lower Rod Bearing:	←————— Needle —————→		
Connecting Rod Material:	←————— Forged Steel —————→		
Main Bearings:	←————— 4 or 5 Heavy Duty Ball Bearings —————→		
Ignition System:	←————— Nippon Denso C.D.I. or Bosch Magento —————→		
Lighting System:	←————— 35 Volts (AC) - 150 Watt —————→		
Contact Breaker Gap: in./mm	.012-.015/0.3-0.4		
* Timing/Full Advance: in./mm	.070-.078/1.8-2.0 mm		
Spark Plug Type:	N.G.K. BR8ES or Champion N-3C		
Gap: in./mm	←————— .016-.020 BOSCH/.035-.040 CDI —————→ .035-.040		
Rotation:	Counterclockwise Viewed From P.T.O. End		
Fuel-Oil Mixture:	40:1		
Lubrication:	Good Brand of Regular or Premium Gasoline and Cuyuna, or B.I.A.-TC-W 2 Cycle Oil		
Starter:	Rewind Type, Standard; Electric Start, Optional		
Approximate Weight: lbs./kg.	65 lbs.	42 lbs.	58 lbs.

* When checking timing on C.D.I. ignitions, refer to timing section of this manual.

CUYUNA ENGINE SPECIFICATIONS

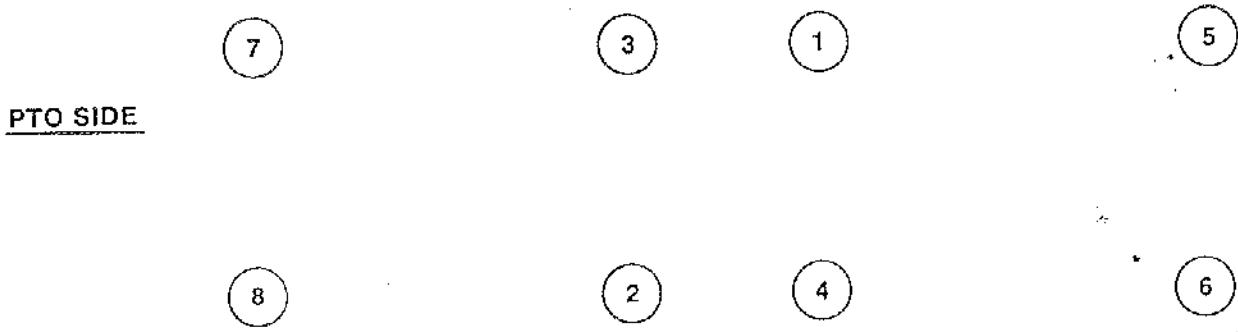
ENGINE			
Engine Model	215	339	430 & ULII-02
Displacement	214.7 cc (13.1 Cu. In.)	339.3 cc (20.7 Cu. In.)	429.4 cc 26.2 Cu. In.)
Bore x Stroke	67.5 x 60 mm (2.657 x 2.362 In.)	60 x 60 mm (2.362 x 2.362 In.)	67.5 x 60 mm (2.657 x 2.362 In.)
Piston-Ring End Gap Range	.18 - .43 mm (.007 - .031 In.)	.18 - .43 mm (.007 - .031 In.)	.18 - .43 mm (.007 - .031 In.)
Piston Skirt/Cylinder Clearance Range	.13 - .25 mm (.005 - .010 In.)	.13 - .25 mm (.005 - .010 In.)	.13 - .25 mm (.005 - .010 In.)
Piston-Pin Diameter Range	15.996 - 16.000 mm (.6298 - .6299 In.)	15.996 - 16.00 mm (.6298 - .6299 In.)	15.996 - 16.000 mm (.6298 - .6299 In.)
Piston-Pin Bore Diameter Range	16.004 - 16.030 mm (.6301 - .6311 In.)	16.004 - 16.030 mm (.6301 - .6311 In.)	16.004 - 16.030 mm (.6301 - .6311 In.)
Connecting-Rod Small End Diameter Range	22.000 - 22.013 mm (.8661 - .8667 In.)	22.000 - 22.013 mm (.8661 - .8667 In.)	22.000 - 22.013 mm (.8661 - .8667 In.)
Crankshaft End Play Range	.51 - .90 mm (.020 - .035 In.)	.51 - .90 mm (.020 - .035 In.)	.51 - .90 mm (.020 - .035 In.)
Crankshaft Runout (max.) (Total Indicator Reading)	.08 mm (.003 In.)	.08 mm (.003 In.)	.08 mm (.003 In.)
Max Out Of Round and Taper Not to exceed	.10 mm (.004 In.)	.10 mm (.004 In.)	.10 mm (.004 In.)
Timing Full Advance (CDI - See Note Below)	*CDI 18° or .078 1.8 - 2.0 mm (.070 - .078)	1.8 - 2.0 mm (.070 - .078)	*CDI 18° or .078 1.8 - 2.0 mm (.070 - .078)
Point Gap	0.3 - 0.4 mm (.012 - .016)	0.3 - 0.4 mm (.012 - .016)	0.3 - 0.4 mm (.012 - .016)
Spark Plug Gap (BOSCH)	0.4 - 0.5 mm (.016 - .020)	0.4 - 0.5 mm (.016 - .020)	
Spark Plug Gap (CDI)	.035 - .040	.035 - .040	.035 - .040

*All C.D.I. ignition must be checked with a timing light with the engine running at 6000 RPM - See instructions within manual. Engine timing can be checked at 1800 RPM if desired, use 28° or .174 B.T.D.C. at 1800 RPM.

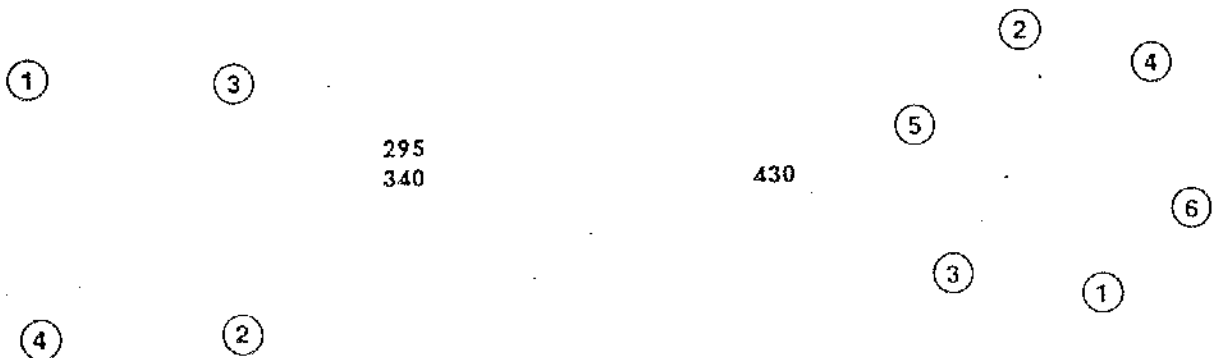
TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS	CUYUNA 295-340	CUYUNA ULII-02, 215 & 430
Cylinder Head Nuts:	28-32 Ft.-Lbs.	16-18 Ft.-Lbs.
Cylinder Base Nuts:	16-18 Ft.-lbs.	
Intake Manifold Nuts:	16-18 Ft.-Lbs.	
Spark Plugs 14 mm:	20-22 Ft.-Lbs.	
Fan Housing Screws:	16-18 Ft.-Lbs.	
Fan Shaft Nut:	20-22 Ft.-Lbs.	
Bearing Flange Bolts:	12-15 Ft.-Lbs.	
Impulse Fittings & Plugs:	50-60 In.-Lbs.	
Flywheel Nut:	46-50 Ft.-Lbs.	
All 6 mm Screws:	6-8 Ft.-Lbs.	
All 5 mm Screws:	40-50 In.-Lbs.	

Tightening Sequence for Cylinder Base Nuts
All Models



Tightening Sequence for
Cylinder Head Nuts



Cuyuna Service Manual

Cuyuna Engine Section

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*This section should be read prior to engine overhaul.

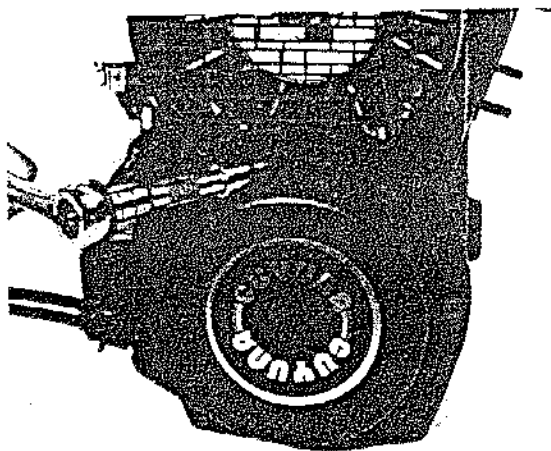
NOTE: Before starting the disassembly procedure, the engine should first be pressure tested to note any possible air leakage problems. This will alert the technician to problem areas which must be repaired. For pressure testing instructions, see page 28.

Another area to be checked before the disassembly starts, is ignition timing. Engines equipped with the point ignition should be checked prior to disassembly. In the event of engine overheating, you can either eliminate or point to one of the above as possible causes.

Once the engine has been disassembled, problem areas such as these cannot be detected. See "Engine Pressure Testing" section in this manual.

RECOIL STARTER AND FLYWHEEL NUT:

1-1 Remove the four (4) screws securing the recoil starter assembly, using a 5mm allen wrench. Remove the recoil. Be sure to mark the location of the recoil handle for reassembling purposes.



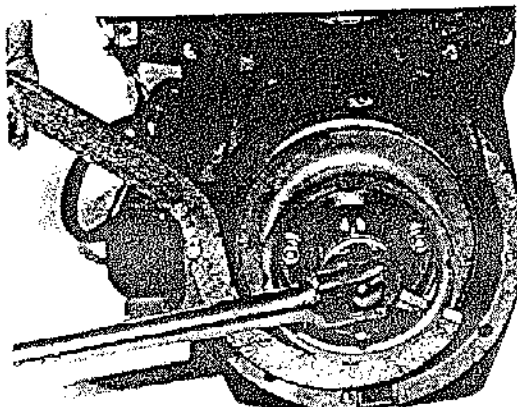
2-1 If the engine is equipped with the Eaton recoil starter, remove the number 2 cylinder spark plug and turn the engine over slowly until the piston closes the exhaust port.

3-1 Using 1/4 inch rope, insert 14-16 inches of rope down through the spark plug hole to secure the crankshaft while the flywheel nut is being removed.

CAUTION Be sure the rope is inserted into the number 2 cylinder (Mag side) spark plug hole. If the number 1 cylinder is used, the crankshaft could be damaged.

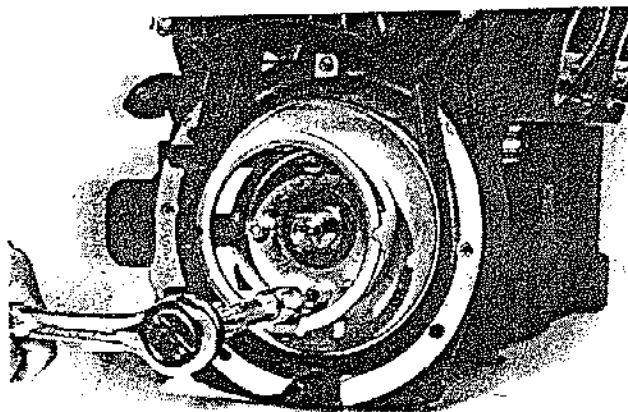
NOTE: On those engines equipped with the Mitsui recoil carrier, use spanner wrench (P/N 444-31-806-000) to secure the crankshaft.

4-1 Using a 30mm socket and breaker bar, loosen the flywheel nut.



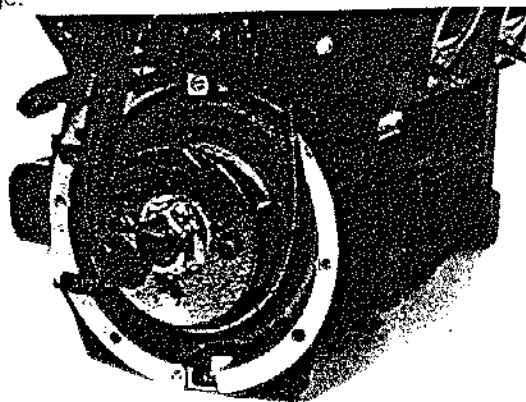
5-1 Remove the flywheel nut and lockwasher.

6-1 Using a 5mm allen wrench, remove the (4) allen bolts securing the lower belt pulley halves and carrier to the flywheel.



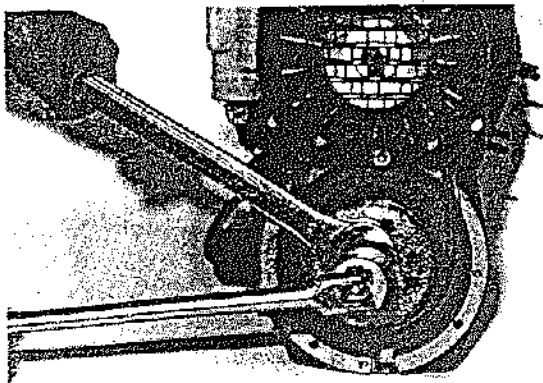
Flywheel

1-2 Attach flywheel puller (P/N 444-31-843-000) to flywheel, using the 4 bolts provided in the puller kit. Turn the four bolts evenly into the flywheel flange.

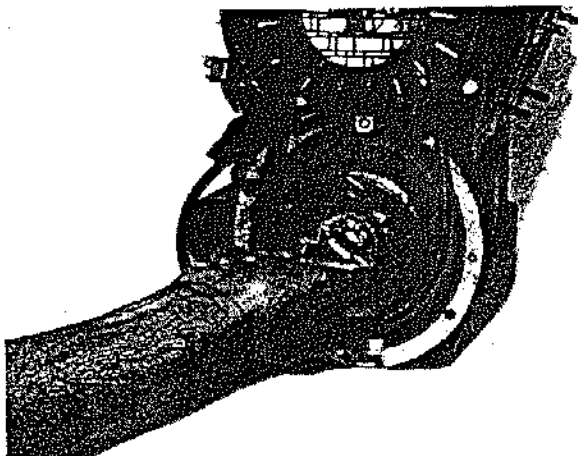


CAUTION Use care when installing the puller bolts. Bolts must not be screwed into the flywheel more than 1/2 inch. If care isn't used, the advance mechanism could be damaged, or if C.D.I. ignition, the inner coils will be damaged.

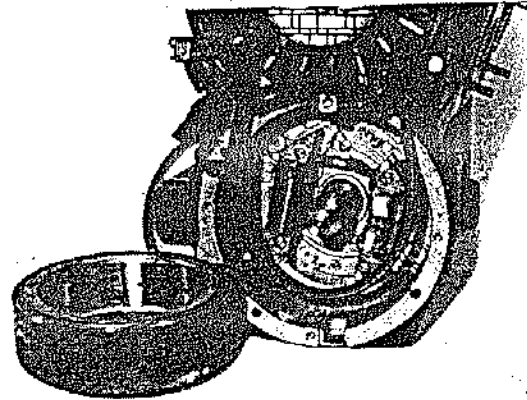
2-2 Using 1-1/8 end wrench to secure the flywheel puller, tighten the puller's center bolt against the crankshaft stub, using a 1-1/8 inch socket and breaker bar. Tighten the large puller bolt securely. If the flywheel doesn't loosen, apply a sharp blow to the puller bolt head with a large hammer, and tighten the bolt an additional 1/2 turn. Repeat this procedure until the flywheel is loosened.



3-2 After the flywheel is loose on the crankshaft, rotate the crankshaft until it's keyway is in the twelve o'clock position. Grasp the flywheel puller using it for a handle, and pull the flywheel from the crankshaft. Account for the flywheel key.



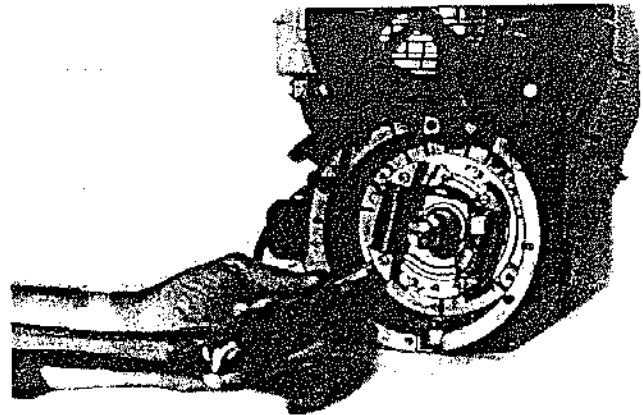
4-2 Remove the flywheel puller from the flywheel and place the flywheel on a clean bench with its magnets facing upwards. This practice will prevent the flywheel magnets from picking up any steel particles from the bench area.



FAN HOUSING & STATOR PLATE REMOVAL

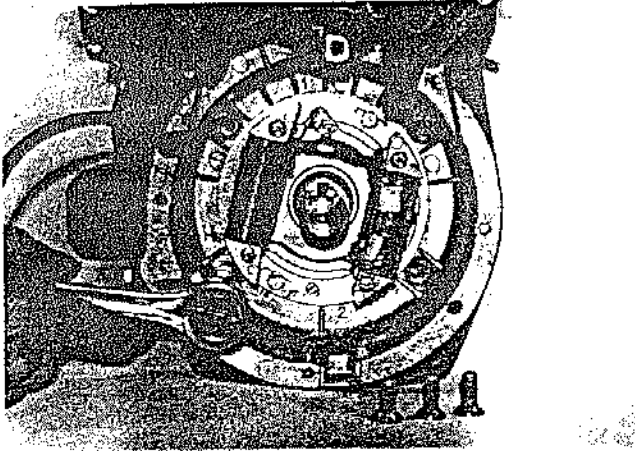
NOTE: Unless there are repairs to be made to the stator plate assembly, do not loosen the stator plate screws. Remove only the four (4) screws that secure the fan housing to the crankcase.

1-3 Using a large drift punch and hammer, apply a sharp blow to the head of each bolt, securing the fan housing to the crankcase.

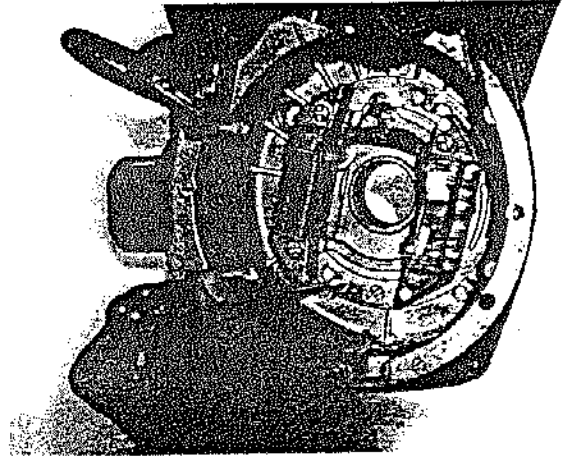


NOTE: If the above step isn't followed, removal of these four bolts is very difficult. A sharp blow will aid in loosening the bolts.

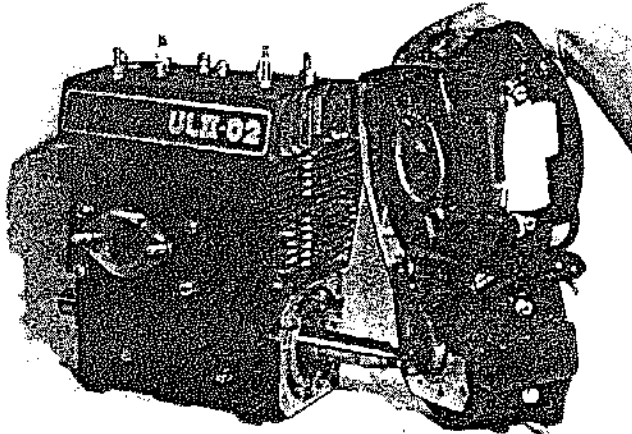
2-3 Using a 5mm hex-drive socket and 3/8 ratchet or impact gun, remove the four (4) bolts securing the fan housing to the crankcase. Disconnect the two (2) blue leads from the external coils. Remove screw holding the spark plug wire bracket to the fan housing. If the engine is equipped with C.D.I., all wires can remain in tact.



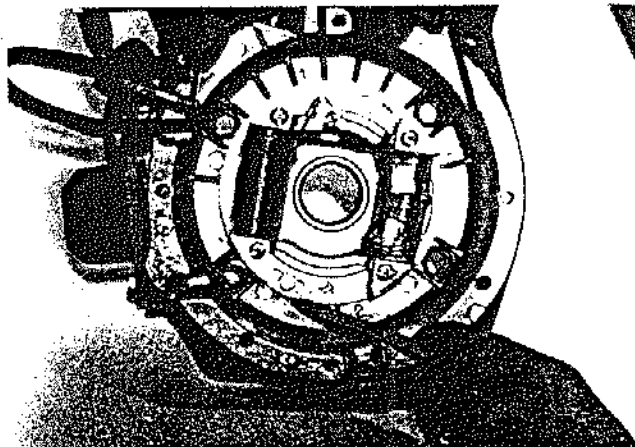
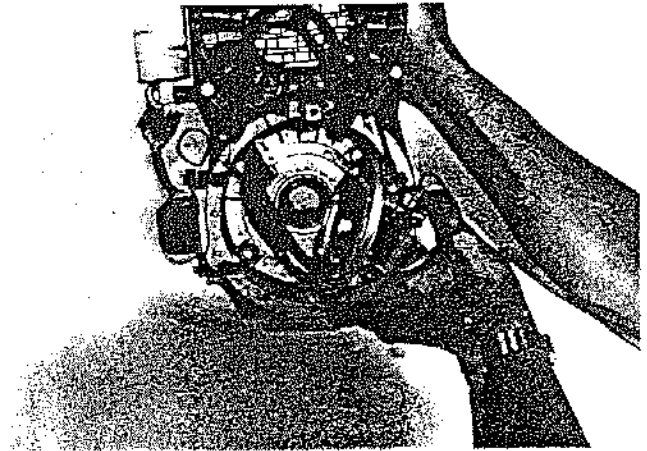
4-3 Before removing the stator plate from the fan housing, scribe a reference line on the stator plate and fan housing for assembly purposes. All C.D.I. ignition stator plates have a timing reference mark stamped on the lower radius.



3-3 Using a rubber or plastic hammer, tap the fan housing free of the crankcase.



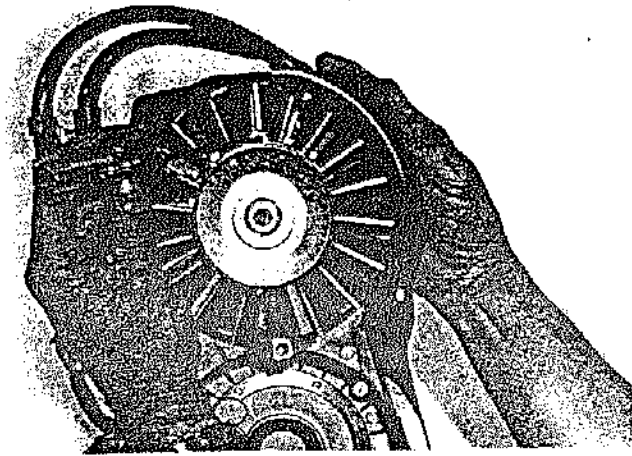
5-3 Remove the two screws that secure the stator plate to the fan housing. Remove the stator plate assembly from the fan housing.



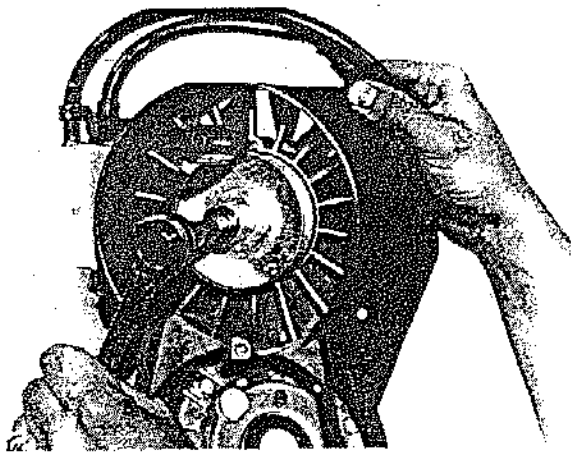
Upper Fan Belt Assembly

Fan and Bearing Removal

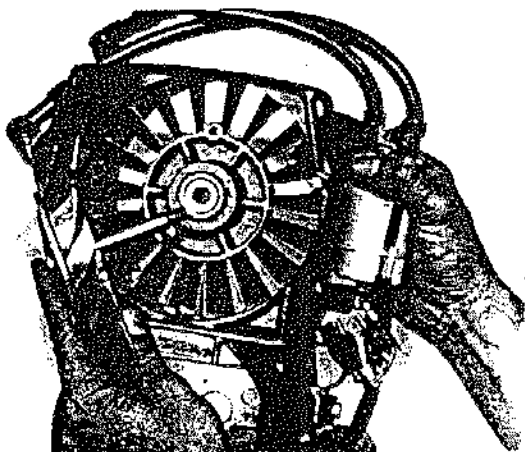
1-4 Insert a 3/16 drill or a suitable punch through the indexing hole located just above the upper pulley. Using light pressure, push against the drill or punch and slowly rotate the fanwheel. When its index hole aligns with the punch or drill, the tool used will lock the fan in place.



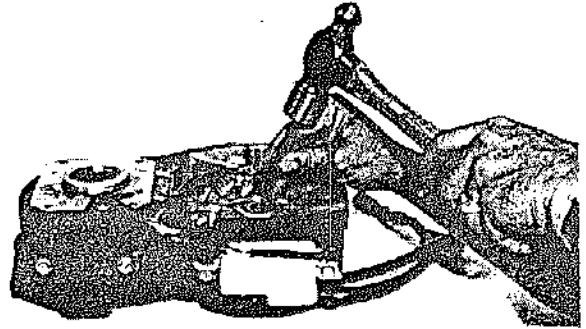
2-4 Using a 17mm socket wrench, remove the fan nut, lockwasher, shim washers, backing washer, pulley halves and spacers from the shaft.



3-4 Remove the fan from the housing by tapping on the end of the shaft with a plastic hammer.



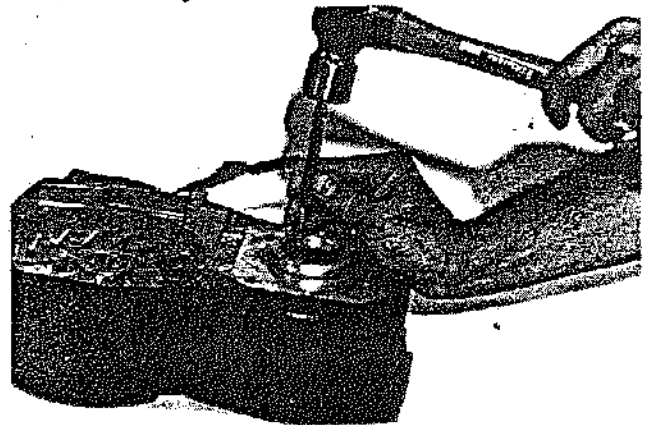
4-4 Using a long punch and hammer, tap against the inner race of the furthest bearing to drive it free of the housing. Turn the housing over and use the same procedure to remove the remaining bearing. Account for the spacer between the bearing.



Crankshaft End Seal

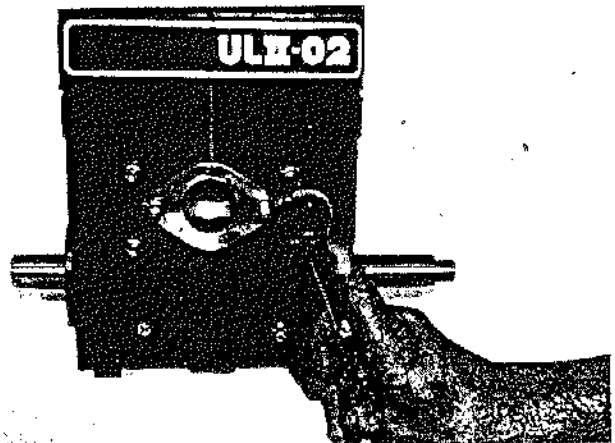
MAGNETO SIDE

1-5 Follow steps given in "Fan Housing and Stator Plate Removal". After the fan housing is removed, place it on the bench with the recoil side down. Using a flat punch, drive the seal free of the housing.

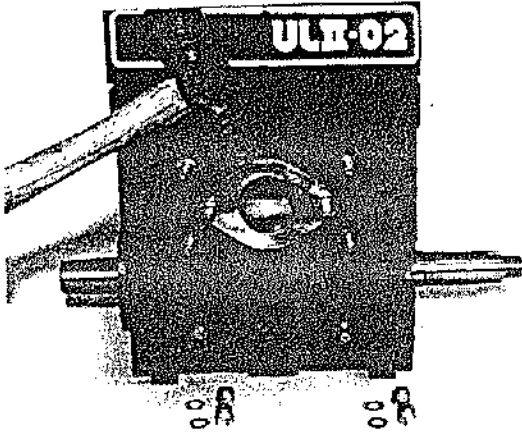


INTAKE MANIFOLD REMOVAL

1-6 Using a 13mm socket wrench, remove the four (4) nuts and wave washers, securing the intake manifold to the cylinders.



2-6 Lightly tap on the manifold with a plastic hammer to loosen it, then pull the manifold from the studs.

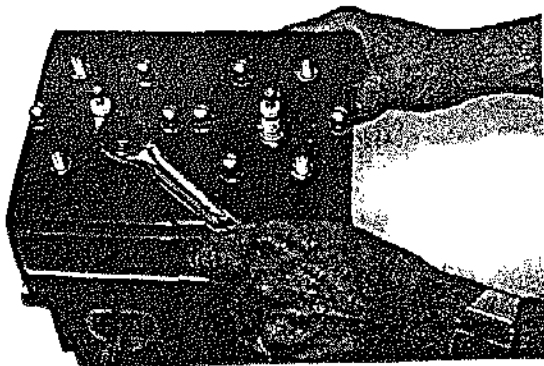


3-6 Remove the intake gasket, insulator block and intake gasket from each cylinder.

CYLINDER HEAD REMOVAL

NOTE: For proper assembly, keep all P.T.O. and Mag side components separated. Mark heads number 1 for P.T.O. side, and number 2 for Mag side.

1-7 Remove the cylinder head nuts evenly, using a 13mm socket wrench. Mark the cylinder heads before they are removed from the engine. Remove and discard the head gaskets.



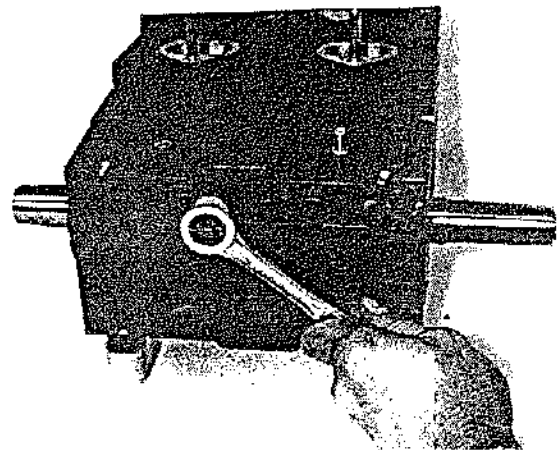
CAUTION Be sure to note the number of gaskets used under each head. The 430 engines may have either one (1) or two (2) head gaskets per cylinder and must be assembled the same way. One (1) head gasket must be used when the engine is equipped with a 28mm carb and two (2) head gaskets if a 32mm carb is used. The 215 single and ULI-02 must always have just one (1) head gasket.

CYLINDER REMOVAL

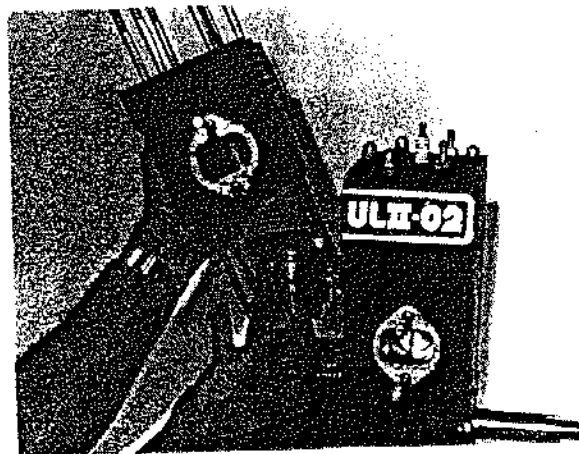
NOTE: If removal of cylinders only is required, care must be taken that the crankcase seal is not disturbed. The P.T.O. or number 1 cylinder should always be removed first. After it is removed, install two (2) long bolts, washers and nuts in the two cylinder stud holes next to the fan side cylinder and torque to 16 ft. lbs. The fan side cylinder can now be removed.

If the fan housing and number 2 cylinder is removed, the crankcase must be disassembled and resealed. Mark cylinders number one and number two for proper assembly.

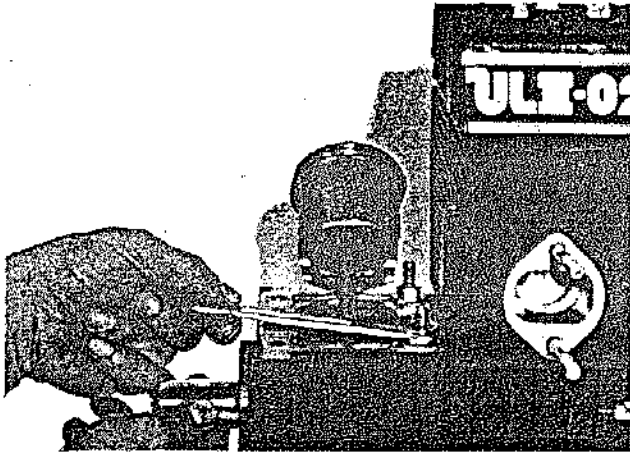
1-8 Lay the engine on its side. Loosen the four nuts securing the number one or P.T.O. cylinder. Remove the nuts and wave washers. Do not loosen the nuts securing the number two cylinder at this time.



2-8 Set the engine upright. Gently tap on the side of the cylinder using a rubber hammer to free it from the crankcase. Lift the cylinder straight up to clear the cylinder studs and piston. Remove and dispose of the cylinder base gasket.

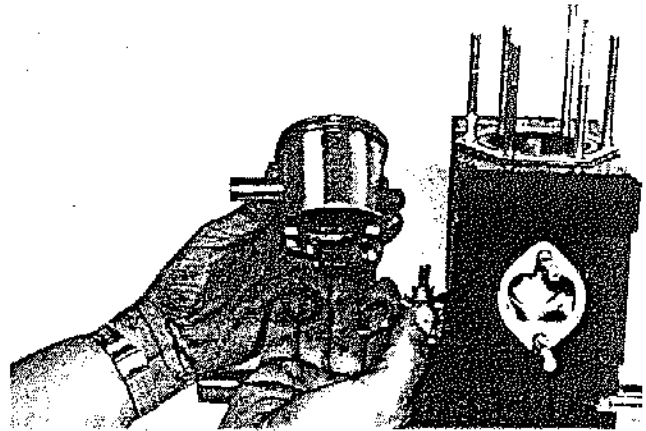


3-8 Install two long bolts, flat washers and nuts in the two stud holes next to the number two cylinder. Torque these to 16 ft. lbs. The number two (2) or fan side cylinder can now be removed.



CAUTION Do not drive the wrist pin free of the piston, damage to the connecting rod may result. Use a piston-pin puller, when removing the wrist pins.

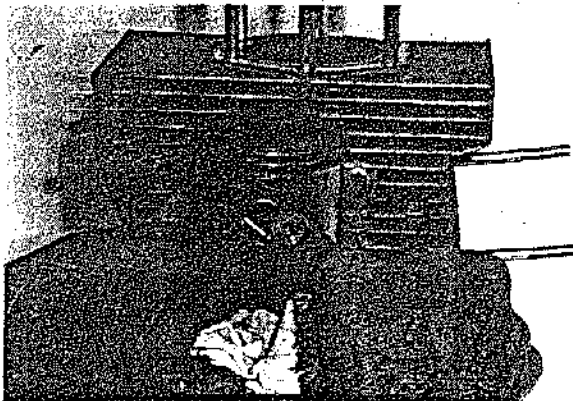
3-9 Lift the piston clear of the connecting rod. Remove the check plates and small end connecting-rod bearing. Remove the piston rings if new rings are to be installed.



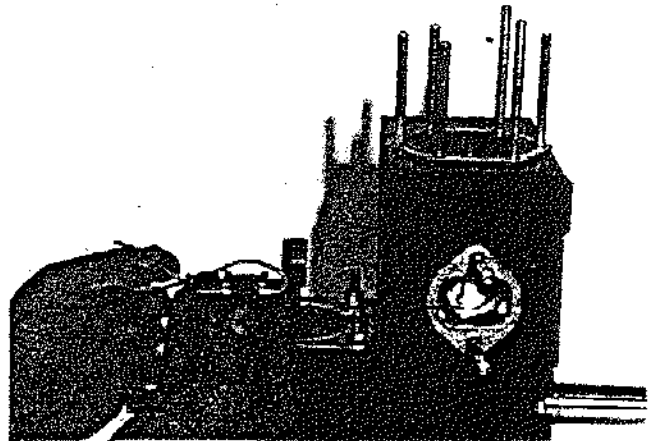
PISTON AND WRIST PIN REMOVAL

NOTE: Mark pistons number one and number two for proper assembly.

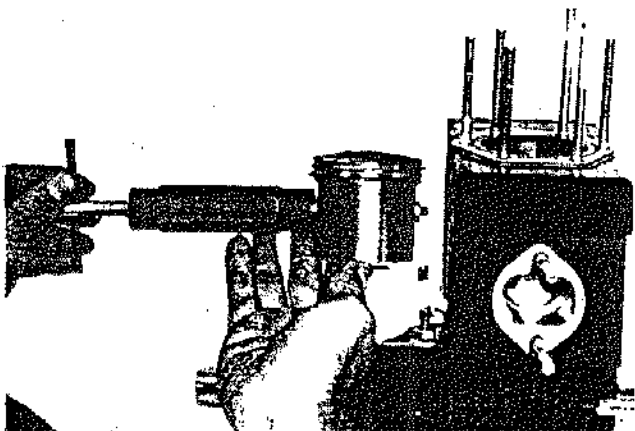
1-9 Using a small pick, screwdriver or needle nose pliers, remove the circlips from the piston. Place a shop rag around the base of the rod to prevent anything from dropping into the crankcase.



4-9 Keep the wrist pin, check plates and bearing together by running a soft piece of wire through the center of the pin and pin components, twisting its ends together. It is very important that these components stay together as a set and are not mixed with those from the other connecting rod. Repeat this same procedure for removal of the remaining piston.



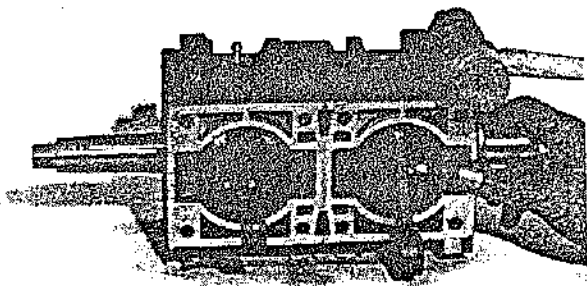
2-9 Using a wrist pin puller (P/N 444-31-805-000), remove the wrist pin from the number one (P.T.O.) piston.



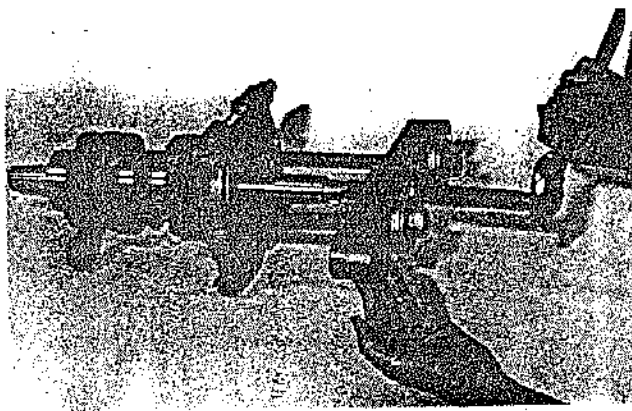
CRANKCASE DISASSEMBLY

CAUTION Do not drive any tool between halves to separate the crankcase. Damage to the crankcase sealing surfaces will result.

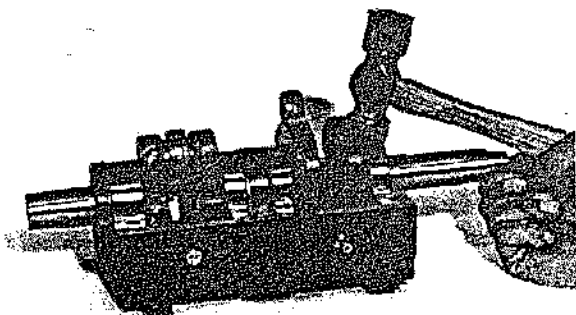
1-10 Lay the crankcase on its side. Using a plastic or rubber hammer, tap the case halves apart. Remove the top half of the crankcase.



2-11 Using a puller attachment, pull the bearing from the crankshaft.



2-10 Holding one end of the crankshaft up off the bench, tap down on the remaining crankcase half to free it from the crankshaft bearings. Lift the crankshaft free of the case half.



CAUTION To prevent damage to the crankshaft, always protect the end of the shaft by putting a protective piece of metal between the shaft and puller bolt.

MAIN BEARING REPLACEMENT

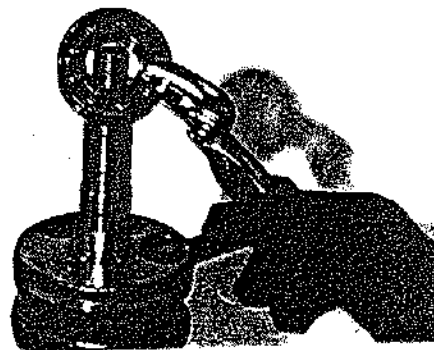
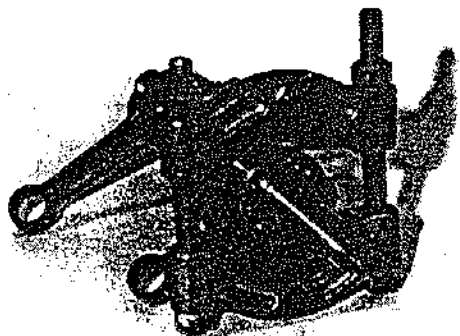
1-12 Place a small pan onto a hotplate. Pour $\frac{1}{2}$ inch of oil into the pan and place the new bearing into the oil. Heat the oil and bearing until the bearing is hot.

2-12 Position the crankshaft so the desired end is up. Using a clean pliers, pick up the hot bearing and position it on the crankshaft so that the open side of the bearing is facing "UP".

CRANKSHAFT BEARING REMOVAL

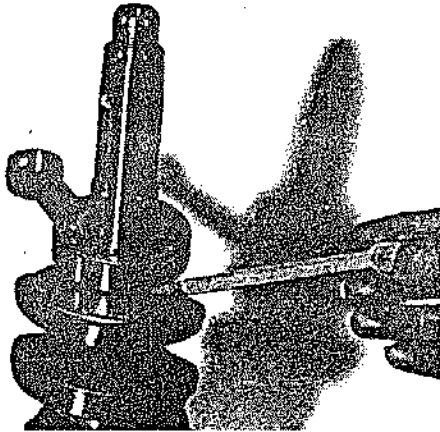
To remove the outer crankshaft bearings, use a standard bearing puller as shown. The bearings have a press fit and a puller will be needed.

1-11 Spread the puller jaws and install over the bearing to be removed. Tighten the nuts on either side of the puller evenly.



WARNING Always wear protective gloves when working with hot oil and bearing to prevent burns. Make sure no flammable material is near hotplate. Never leave the area while the bearing is being heated.

3-12 Release the bearing and make sure it drops down into position against the counterweight. If the bearing doesn't fall into position, use a piece of heavy pipe as a tool to press the bearing into position.



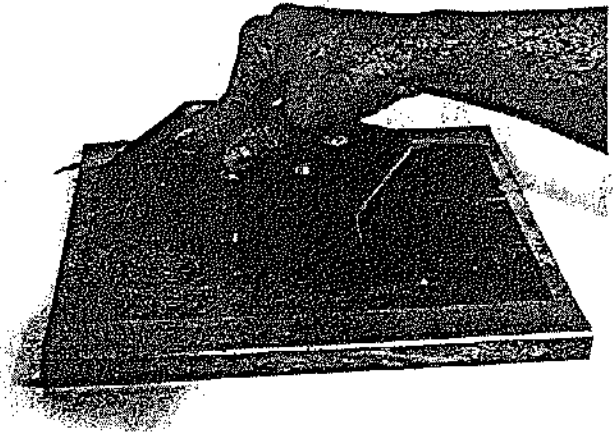
4-12 If the bearing must be pressed into position, the pipe must push against the inner bearing race. Support the crankshaft with a piece of heavy steel plate, placed between the counterweights.

2-13 Inspect the spark plug holes for damaged threads or carbon filled threads. If a wrong spark plug was used, the bottom threads will often fill with carbon. If these are not cleaned, the threads will be damaged when the proper reach spark plug is installed. To clean spark plug hole threads, turn a 14mm thread chaser into the hole until the effected threads are cleaned.

If the threads are stripped or cross-threaded, repair by using a "heli-coil" insert. Follow instructions provided with the heli-coil kit.

3-13 Closely examine the head for signs of cracks in the combustion and fin area. Examine the combustion area for signs of nicks caused by metal being caught between the piston dome and head. If either are found, replace the head.

4-13 Place each cylinder head on a surface plate covered with #400 wet-or-dry sandpaper. Using light pressure, move each cylinder head in a figure eight motion. Inspect the sealing surface for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots or damaged areas before assembly, by continuing to re-surface the part on the surface plate until a uniform bright metallic finish is noted on the entire sealing surface. Wash the cylinder heads in parts washing solvent and blow dry with compressed air.

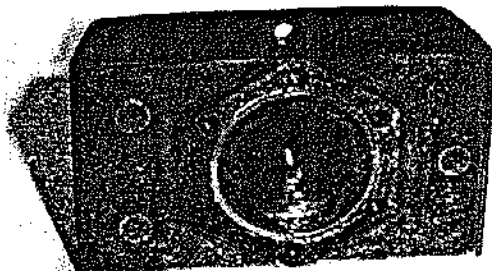


Cleaning and Inspecting Engine

■ **NOTE:** Every good technician should be extremely thorough when getting into this portion of engine overhaul. Cleanliness and a very close inspection of parts cannot be over emphasized. All procedures must be followed without any exceptions.

CYLINDER HEADS

1-13 Using a non-metallic carbon removal tool, remove any carbon build-up from the combustion chambers, being careful not to nick, scrape or damage the combustion chamber or sealing surface.



■ **NOTE:** When using wet-or-dry sandpaper, apply either water or solvent to the sandpaper surface to keep it from becoming clogged with aluminum. It will also cut much faster if its surface is kept wet using either of these liquids.

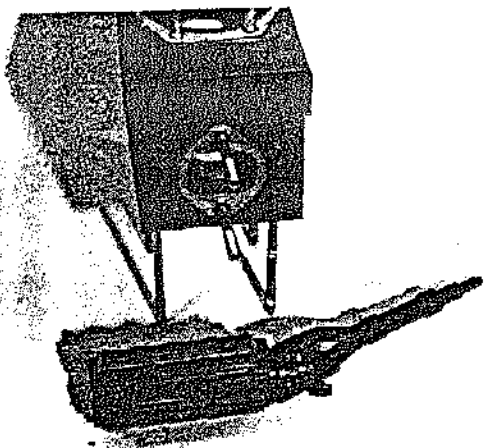
CYLINDERS

1-14 Using a non-metallic carbon removal tool, remove carbon found in the exhaust port.

2-14 Wash the cylinder in cleaning solvent and blow dry.

3-14 Inspect the cylinder bore for any signs of scoring or scuffing. If either are found, repair the bore surface using either a straight hone, flex hone or a ball hone.

4-14 The preferred hone is called a straight hone. It not only removes scoring or scuffing marks, but will also straighten any uneven bore surfaces. If using this hone, use 300 grit stones for best results. To produce the proper 60° cross-hatch pattern, use a low RPM drill (600 RPM) at the rate of 30 strokes per minute. If honing oil is not available, use clean parts washing solvent as a lubricant.



▲ WARNING ▲ When using a hone, never use gasoline or any combustible liquid as a lubricant. Personal injuries may result.

● CAUTION ● After the cylinder bore has been honed, all ports must be chamfered to remove sharp edges, using a small round file or emerypaper. Sharp edges will catch piston rings and cause extensive piston and cylinder damage.

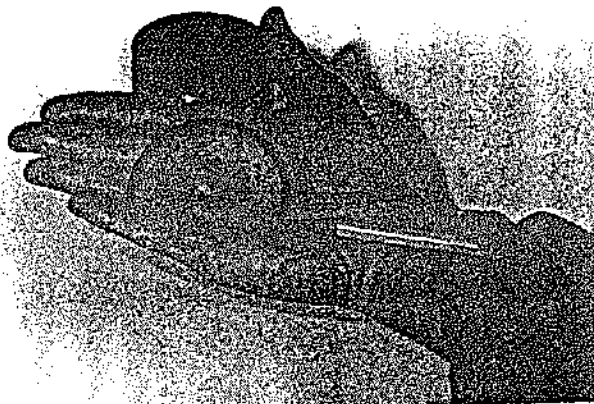
5-14 Thoroughly clean the cylinder bore after honing, using a detergent soap and hot water. Scrub the bore using a brush. Rinse in clean water and blow dry. Immediately apply oil to the cylinder bore.

PISTON CLEANING AND INSPECTION

1-15 Using one of the old rings as a tool, remove carbon build up from the dome of the piston.

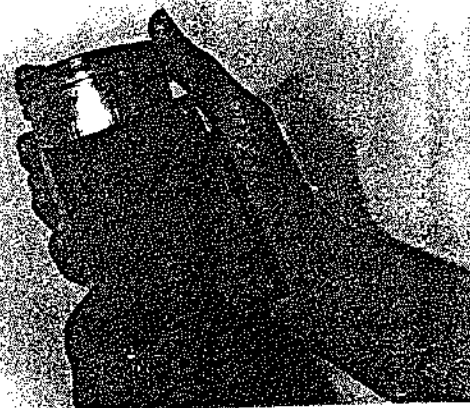


2-15 Break the ring in half. Grind one end at a 45° angle and use the ring to clean the carbon from the piston-ring groove. Make sure the top or inclined surface of the ring faces upward.



3-15 Inspect each piston for cracks in the piston pin and skirt area.

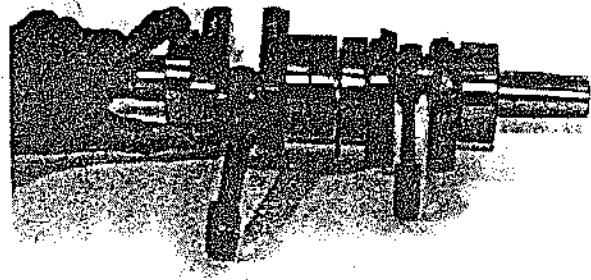
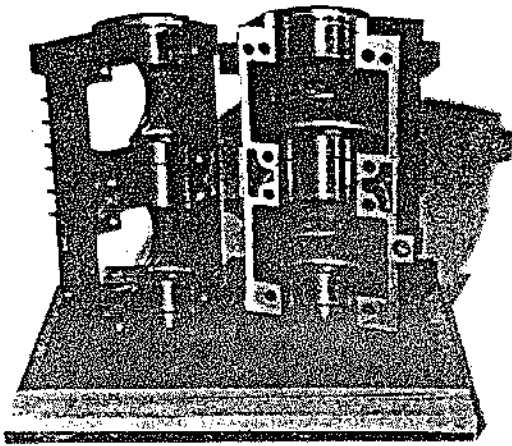
4-15 Inspect each piston for seizure marks or scuffing. Repair minor scuffing or seizure areas using #400 grit wet-or-dry sandpaper and part washing solvent. If scuffing or seizure marks are too deep to correct with light sanding, it may be necessary to replace the piston.



5-15 Inspect the perimeter of each piston for "blow-by". This will be indicated by heavy dark brown stains or carbon build-up just below the ring groove area. If found, remove by lightly sanding with #400 grit wet-or-dry sandpaper and parts washing solvent. After cleaning, wash in clean solvent and blow dry.

CRANKCASE

1-16 Clean the crankcase sealing surfaces free of all sealant. Wash both halves in clean parts washing solvent and blow dry with compressed air.

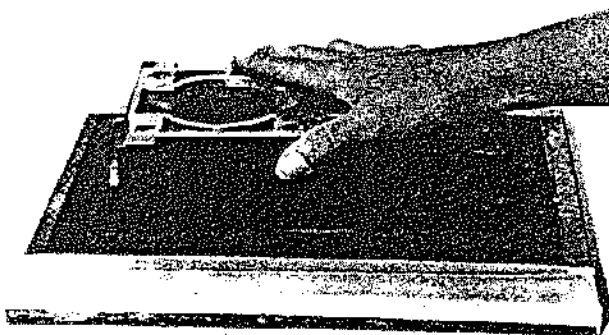


- 2-16 Inspect crankcase halves for scoring or cracks in the bearing areas. If either are found, replace the crankcase assembly.
- 3-16 Inspect all threaded areas for damaged or stripped threads. Repair by using heli-coil insert.
- 4-16 Inspect the crankcase sealing surface for trueness by placing each crankcase half on a surface plate covered with #400 wet-or-dry sandpaper. Using light pressure, move each half in a figure eight motion. Inspect the sealing areas for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots by continuing to move the half in a figure eight motion until a uniform bright metallic finish on the sealing area is attained. Use water or clean parts washing solvent on the sandpaper as a lubricant.

NOTE: The outer bearings can be replaced by following the procedure given in "Bearing Removal", found in the Disassembly Section of this manual. If the inner bearings are found to be rough, the crankshaft must be replaced as these are not replaceable.

- 2-17 Inspect the connecting rod bearings by rotating them. Bearings must rotate freely and must not bind or feel rough. If a connecting-rod bearing is found to be in poor condition, the crankshaft must be replaced.

NOTE: If either the connecting-rod bearings or main bearings are found to be rough, wash them in clean parts washing solvent, blow dry and re-oil. Again rotate them to see if they still feel rough. If they are still found to be rough, replacement of the bearing or the entire crankshaft is necessary.



Measuring Critical Components

CRANKSHAFT

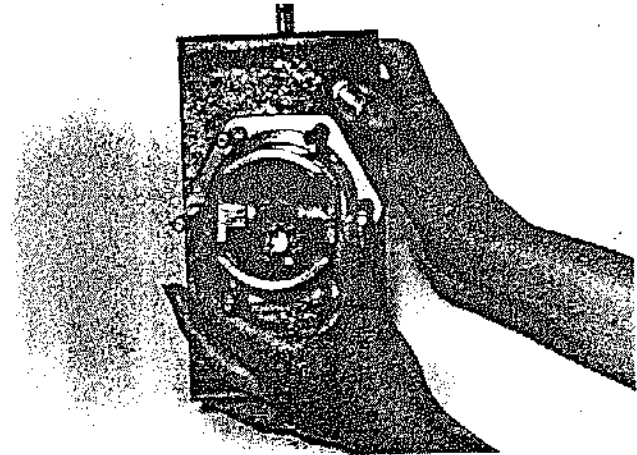
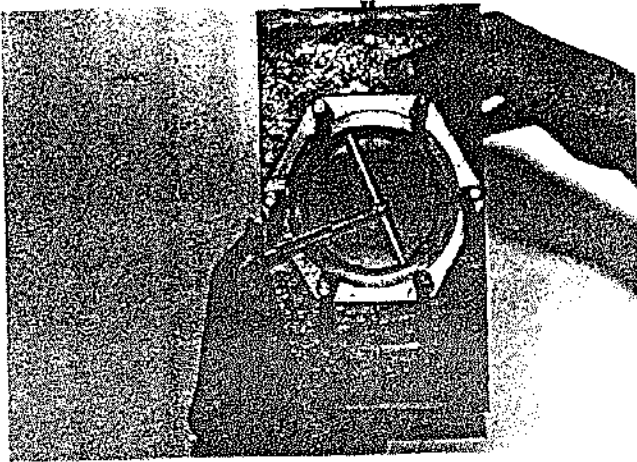
- 1-17 Inspect the outer and inner bearings by slowly rotating each bearing by hand. Bearings must rotate freely and must not bind or feel rough. If any abnormal condition is noted, replace the bearings.

CYLINDER TRUENESS

- 1-18 Measure each cylinder in three locations from front to back and side to side for a total of six readings. The trueness (out-of-roundness) is the difference between the highest and lowest reading. Maximum trueness (out-of-roundness) must not exceed specifications listed below.

PISTON RING END GAP

1-20 Place each piston ring in the wear portion above the exhaust port of its respective cylinder. Use the piston dome to position the ring squarely in the cylinder bore.



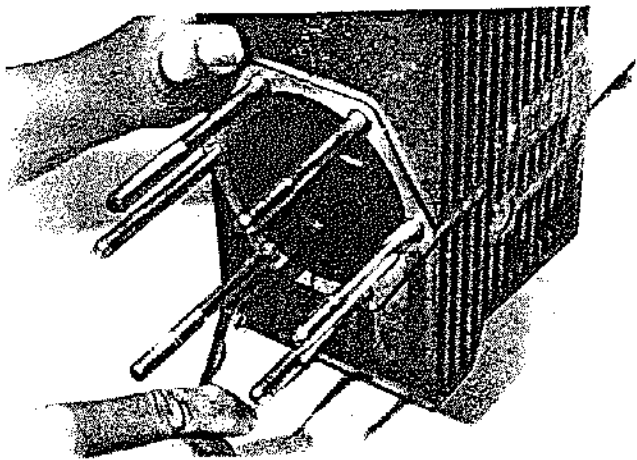
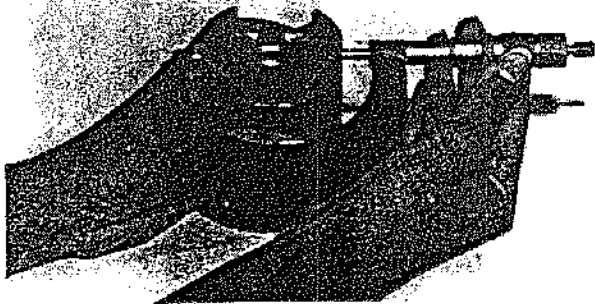
Cylinder Trueness Limit	
mm	in.
0.05	.002

PISTON SKIRT/CYLINDER CLEARANCE

1-19 Measure each cylinder front to rear about 2.5 cm (1 inch) from the bottom.

2-19 Measure the corresponding piston diameter at a point 1/4 inch above the bottom of the piston skirt at a right angle to the piston pin bore. Subtract this measurement from the measurement in step 1-19. The difference (clearance) must be within specifications.

2-20 Using a feeler gauge, measure piston-ring end gap. Acceptable ring end gap must fall within specifications below.



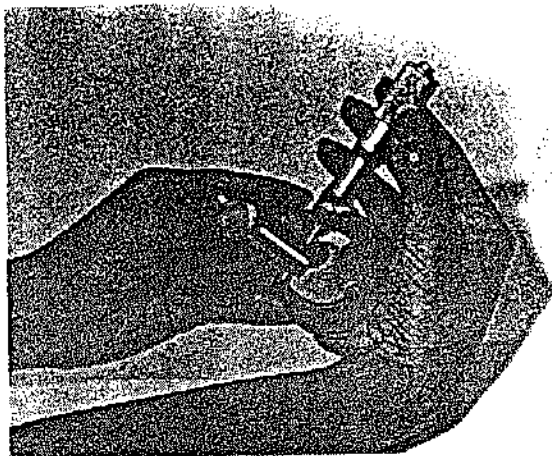
Piston-Ring End Gap Range	mm	in.
	215-430-ULII-02	.18 - .43

NOTE: If the cylinder bore is within tolerance, but the clearance exceeds the maximum value for the engine, the piston must be replaced. When replacing a piston, a new piston pin and needle bearing must also be installed.

PISTON PIN AND PISTON-PIN BORE

1-21 Measure the piston pin diameter in several places. If any measurement varies by more than 0.02 mm (0.001 in.) the piston pin and bearing must be replaced. Never replace one without replacing the other.

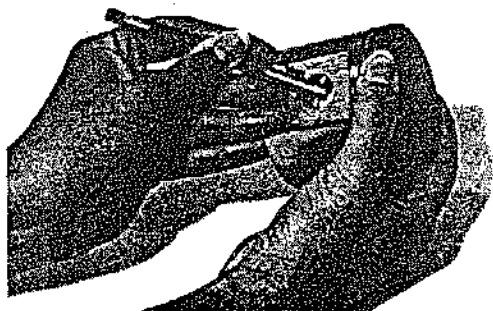
Piston Skirt Cylinder Clearance Range	mm	in.
	215-430-ULII-02	.13 - .25



Piston Pin Diameter Range	mm	in.
215 - 430 - ULII-02	15.996 - 16.000	.6298 - .6299

2-21 Insert a snap gauge into each piston-pin bore, then remove the gauge and measure it with a micrometer. Diameter must be within specifications. Take two measurements to ensure accuracy.

Piston-Pin Bore Diameter Range	mm	in.
215 - 430 - ULII-02	16.004 - 16.030	.6301 - .6311



CONNECTING-ROD SMALL END BORE DIAMETER

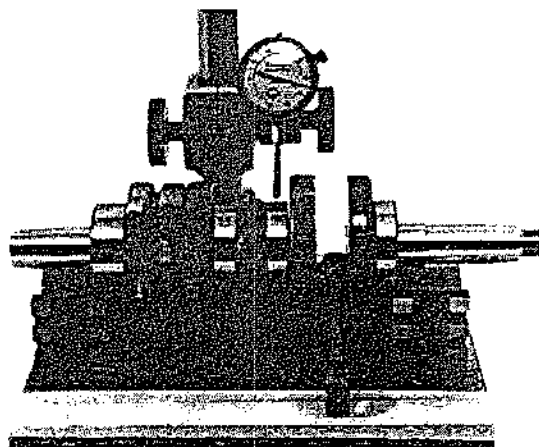
1-22 Insert a snap gauge into each connecting-rod small end bore, then remove the gauge and measure it with a micrometer. Diameter must be within specifications.

Connecting-Rod Small End Diameter Range	mm	in.
215 - 430 - ULII-02	22.000 - 22.013	.8661 - .8667

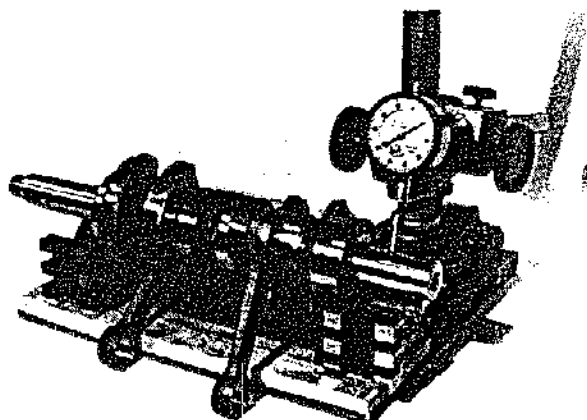


CRANKSHAFT RUNOUT

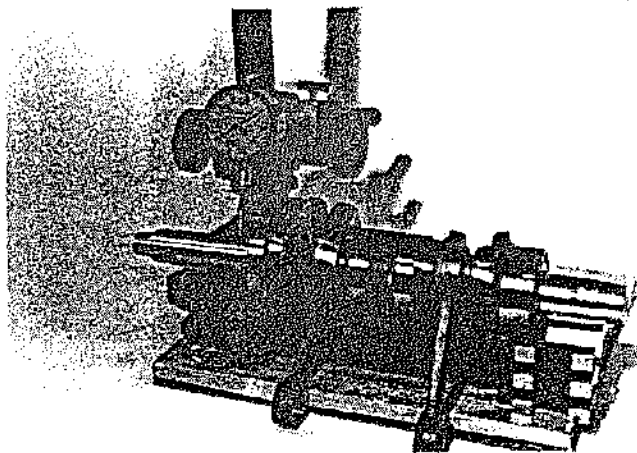
1-23 Using a set of V-blocks and a flat metal plate, position a V-block under each outer bearing on either end of the crankshaft. Place the crankshaft and V-blocks on the metal plate or surface.



2-23 Position a dial indicator having a magnetic base, next to the crankshaft. Position the indicator contact point against the crankshaft distance "A" (PTO End) from the crankshaft outer bearing. Pre-load the indicator needle .015 and zero the indicator. Rotate the crankshaft slowly. Note the amount of crankshaft runout (total indicator reading). See Fig. 1



3-23 Position the indicator contact point against the crankshaft distance "B" (Mag End) from the crankshaft outer bearing. Pre-load the indicator needle and zero the indicator. Slowly rotate the crankshaft and note the amount of crankshaft runout (total indicator reading). See Fig. 2



4-23 If the runout exceeds the specifications at either end, the crankshaft must be replaced.

Fig. 1

215 - 430 - ULII-02	mm	in.
A - Position	25.4	1
B - Position	17.78	.700

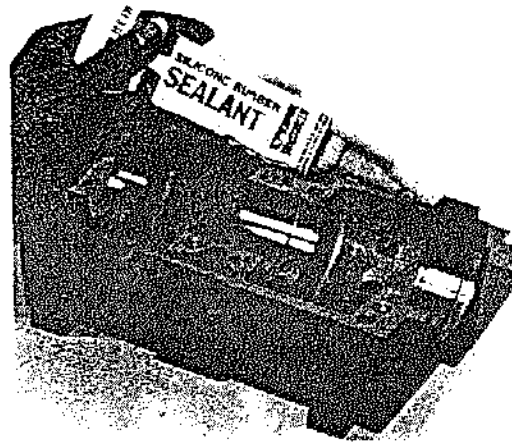
Fig. 2

Crankshaft Runout (Total Indicator Reading)	mm	in.
Maximum	.08	.003

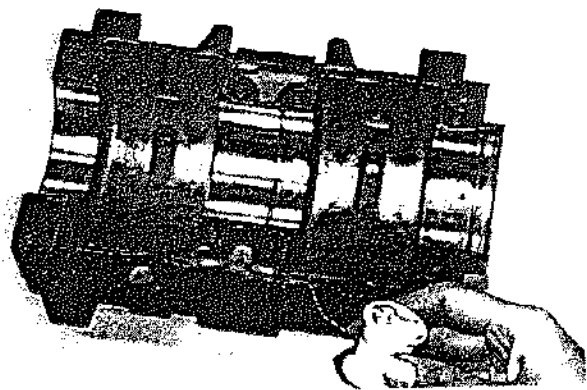
Assembling Engine

NOTE: At this time, all engine components should have been thoroughly cleaned and inspected. Any necessary repairs to individual components should have been made and the components layed out on a clean work area ready for assembly. All tools to be used during assembly should also be cleaned to prevent clean parts from becoming contaminated with dirt or grease, so many times found inside sockets and box-end wrenches. Wash all nuts and bolts in cleaning solvent and dry.

1-24 Apply a light coat of R.T.V. silicone sealant to the sealing surface of the lower crankcase.

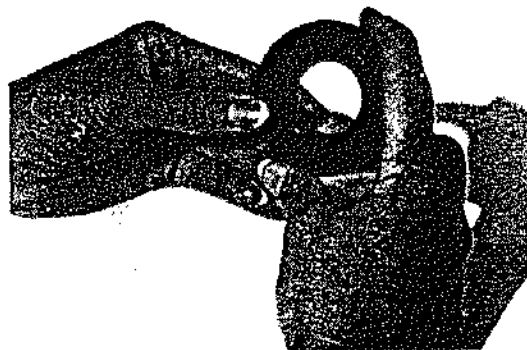


2-24 Lay a length of #50 cotton thread next to the inner edge of and along the full length of the lower crankcase half sealing surface. Be sure to position the thread to the inside of all the stud holes as shown.

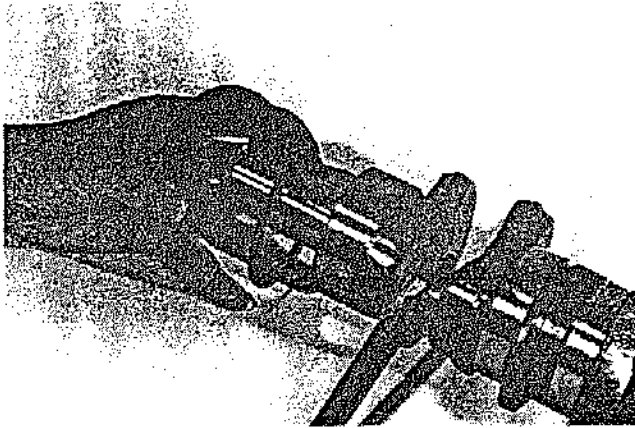


NOTE: Use cotton thread only. Polyester thread will not mushroom, resulting in an indentation in the crankcase sealing area.

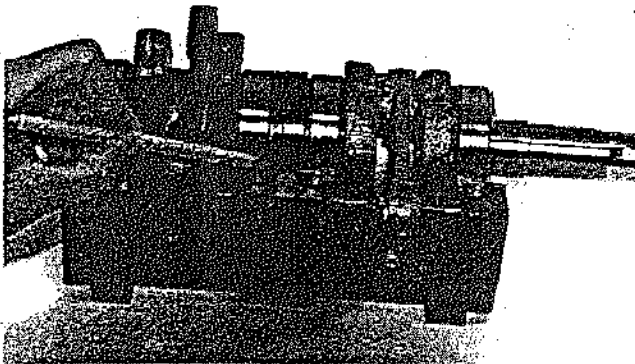
3-24 Lubricate the inner lips of the crankshaft oil seals with a good grease, then slide the crankshaft retaining ring and seal onto the P.T.O. end of the crankshaft. Make sure the spring side of the seal is positioned toward the crankshaft bearing.



4-24 Apply a good two-cycle oil to all the crankshaft bearings and rotate them several revolutions. Install the crankshaft into the lower crankcase half and position the thrust washer into its groove.

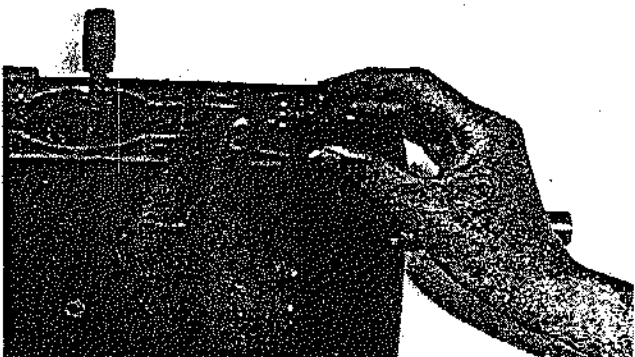


5-24 Rotate the rubber center seal until the pinch line found on its outer surface is aligned with the crankcase parting surface. Press the crankshaft firmly down into position. Using a rubber hammer, tap on the magneto end of the crankshaft, positioning the crankshaft firmly against the thrust washer on the opposite end.

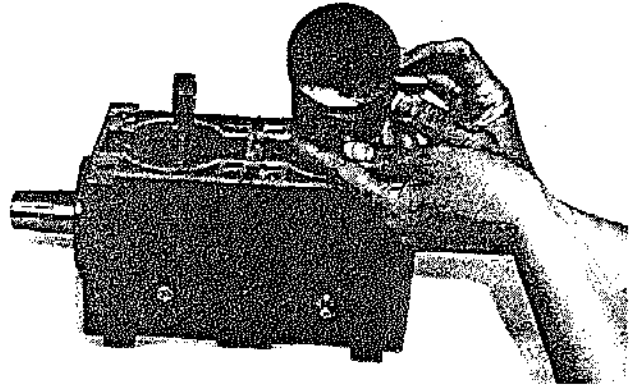


6-24 Assemble the upper crankcase half to the lower case. Press it down firmly into position.

7-24 Apply a light coat of two-cycle oil to the upper wrist pin bearing. Insert the bearing into the connecting rod and place a check plate on either side of the bearing.



8-24 Position the pistons over the connecting-rods so the arrows found on each piston dome points toward the exhaust side of the engine. Secure each piston to its connecting-rod with a well lubricated wrist pin.

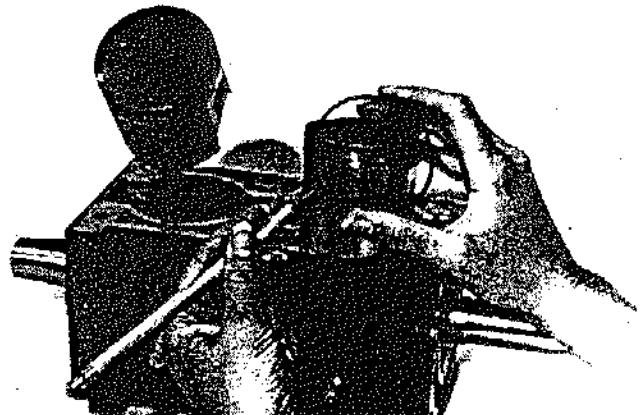


9-24 Install the piston circlips in the wrist pin bore, on either side of the piston. Make sure they snap into the groove. The open ends of the circlip must be positioned up or down.

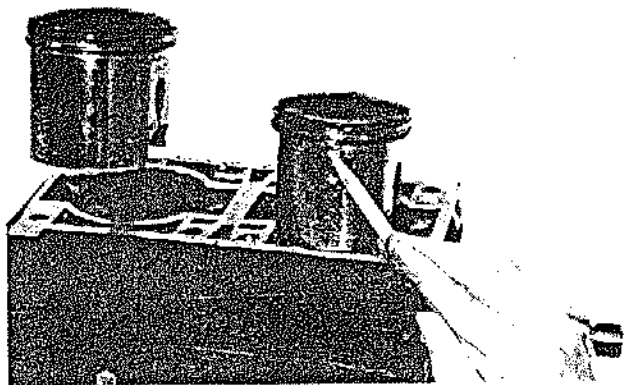


CAUTION Make sure both circlips are firmly seated in the circlip groove and that the open ends are either up or down before continuing with assembly. Never allow the open ends of the circlips to be located in the 3 or 9 o'clock position.

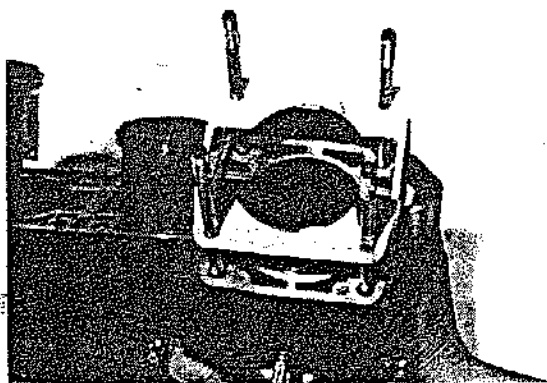
10-24 Install the piston rings on each piston, so the letter or inclined surface of the ring faces the dome of the piston. Apply a light coat of oil to the rings.



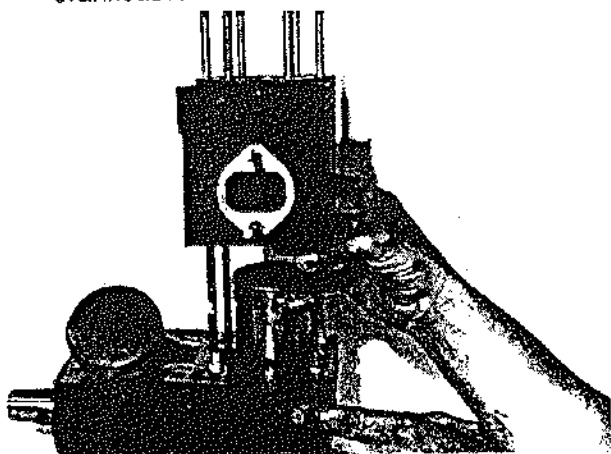
11-24 Rotate each piston ring until the ring ends are properly positioned on either side of the keeper pin.



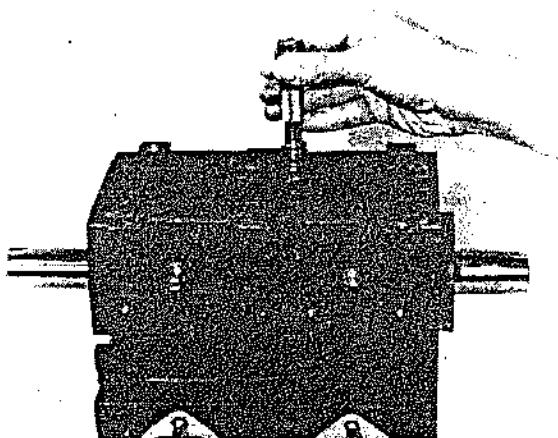
12-24 Apply a small spot of grease to the cylinder base gasket and slide the gasket onto the cylinder studs. Use only enough grease to hold the gasket in position. Do not use any sealer on the base gasket.



13-24 Before installing cylinders, place a piston holder (or suitable substitute) beneath the piston skirt and square the piston in respect to the crankcase, then using a large hose clamp, compress the rings and slide the cylinder over the piston. Remove the hose clamp and piston holder and seat the cylinder firmly onto the crankcase.



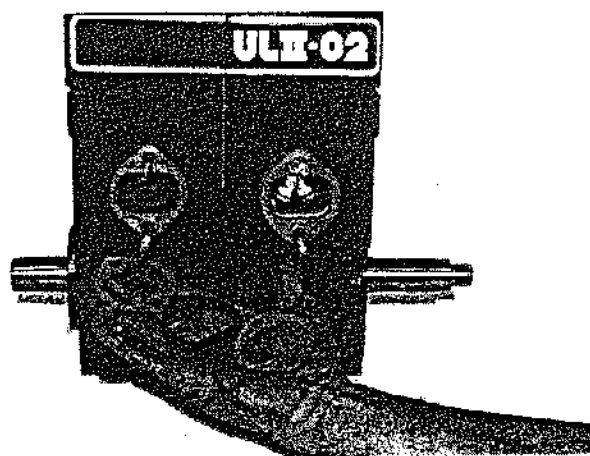
14-24 With both cylinders installed, firmly grasp the engine cylinders and crankcase bottom and turn the engine over, setting the engine upside down on the bench. Install wave washers and cylinder stud nuts finger tight only at this time.



NOTE: When installing the intake manifold on the standard UL430 engine, the word "Top" must be positioned towards the cylinder heads only.

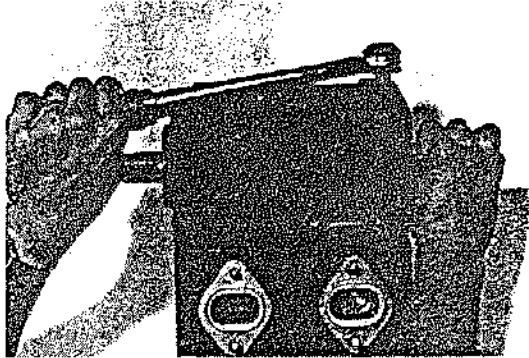
When installing the intake manifold on the ULII-02 engine, the word "Top" must always face upwards, even if the engine is mounted in the inverted position.

15-24 Position the engine upright on the bench. Install new intake gaskets, insulator blocks and intake gaskets on each cylinder. Install the intake manifold and torque the four nuts securing the manifold to 16 ft. lbs. using a crisscross torque pattern.

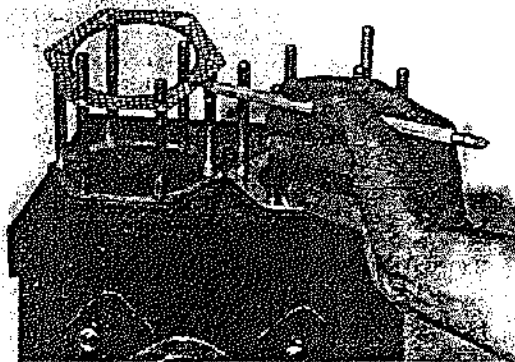


CAUTION The intake manifold must be torqued before the cylinder base nuts are tightened. The intake manifold will align the cylinders and prevent any chance of air leaks in this area.

16-24 With the intake manifold nuts torqued to 16 ft. lbs., go back and torque the crankcase nuts following the torque pattern shown on page 5. Tighten in three steps, finishing at 16 ft. lbs. the last time around. The first time around, torque each nut to 5 ft. lbs., then 10 ft. lbs. and finish with 16 ft. lbs.

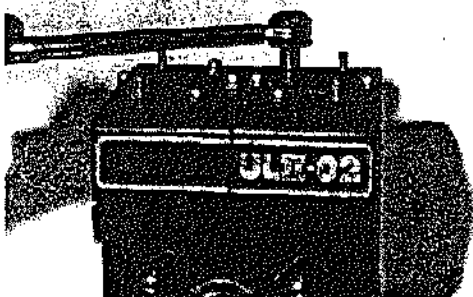


17-24 Install new cylinder head gaskets with the wide side of the fire ring up. Be sure to install the same amount of head gaskets that were previously found during disassembly.



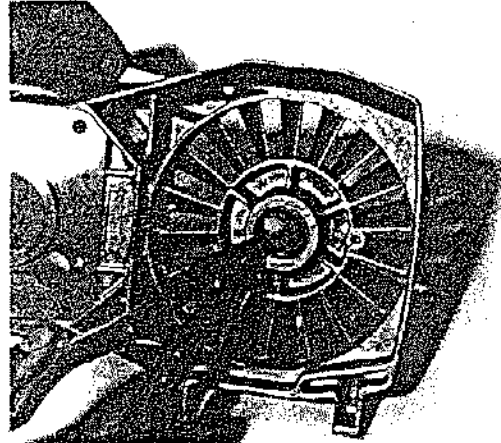
CAUTION All 215 single models use one head gasket. The 430 models use one head gasket per cylinder with the 28mm Mikuni carburetor and two head gaskets per cylinder using the 32mm carburetor. All ULII-02 models use one head gasket per cylinder in either case.

18-24 Install the cylinder heads, flat washers and nuts. Torque the nuts to 16 ft. lbs. in three even steps following the torque pattern shown on page 5. If a flo-thru head is used, be sure it is installed on the number 2 cylinder.

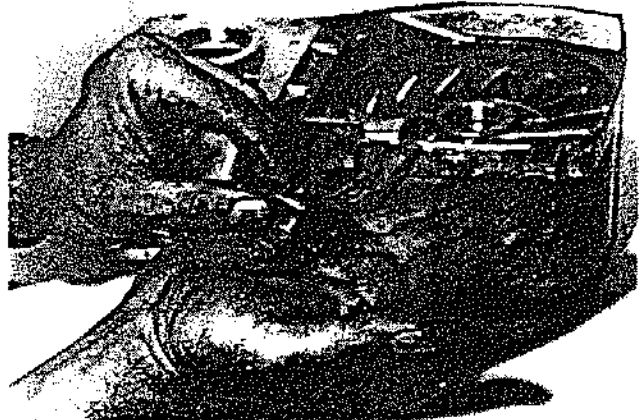


Fan Housing and Impeller Bearing Assembly

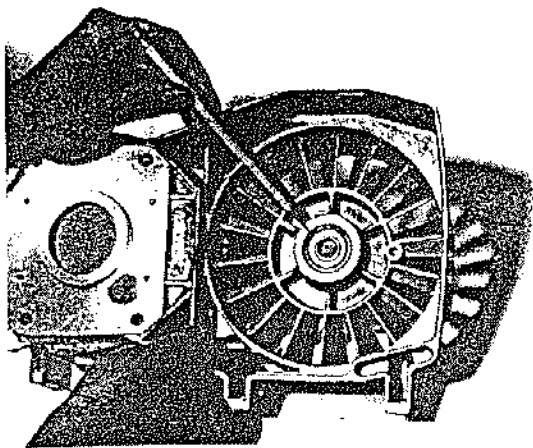
1-25 If locking rings were removed from bearing hub, re-install each ring into either side of the bearing hub. Be sure each ring is firmly seated into the hub groove.



2-25 Pack grease into each bearing, using a good medium weight bearing grease. Bearings should be packed by hand. Place a small amount of grease in the palm of your hand and press the bearing into the grease, at the same time pulling the bearing towards the back of your hand. This action will force grease in and around the ball bearings. Inspect the bearing making sure it is completely packed.



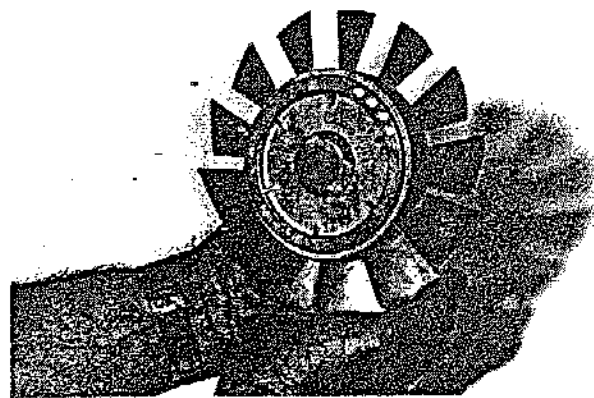
3-25 Press in the fan side bearing with the open side of the bearing facing the center of the bearing housing. Turn the housing over, install the spacer holding it in position with grease, and install the remaining bearing. The sealed side of each bearing must face outward.



4-25 Position the shaft through the fanwheel as shown.



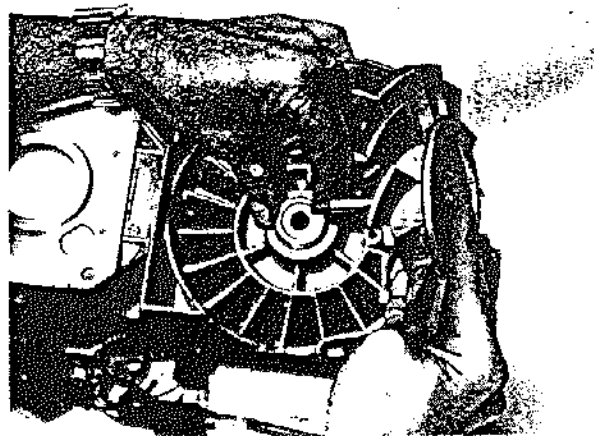
NOTE: Install the same amount of spacers between the pulley halves as found during disassembly. Affirm proper fan-belt tension and adjust if necessary. See Adjusting Axial Fan-Belt section.



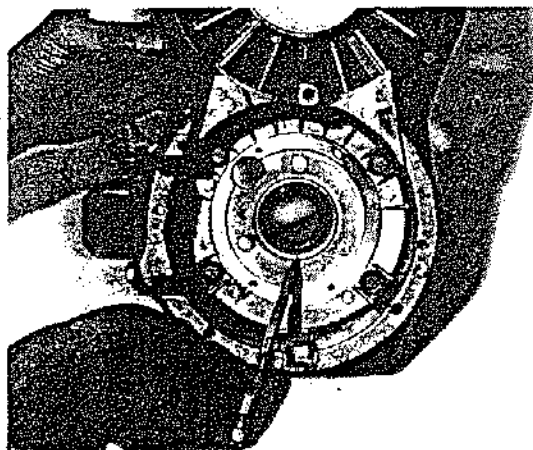
7-25 If the original crankshaft oil seal hasn't been removed from the housing, press it out towards the mag side at this time. Wipe the seal mounting area clean.

8-25 Press in the new seal, positioning the spring side of the seal towards the crankshaft bearing. Press the seal into the housing so its flat side is flush with the stator plate mounting area. Fill the inner groove between the sealing lips of the seal, with a good wheel bearing grease.

5-25 Position the nilos washer next to the bearing and slide the shaft and fanwheel into position.

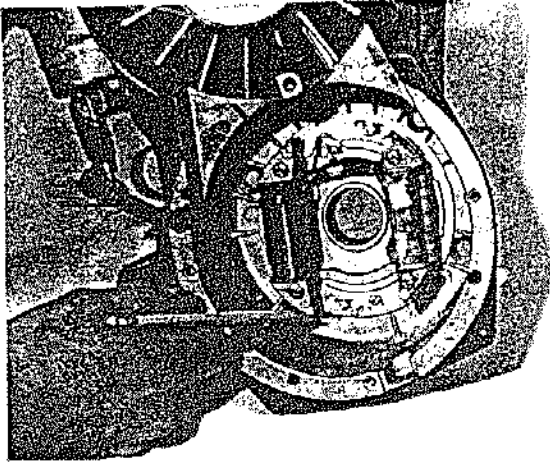


6-25 In order, install a nilos washer, a heavy backing washer, pulley half, spacers and remaining pulley half. Position any remaining spacers next to the outside pulley half, followed by the remaining heavy backing washer, lockwasher and nut. Torque to 20 to 22 ft. lbs.

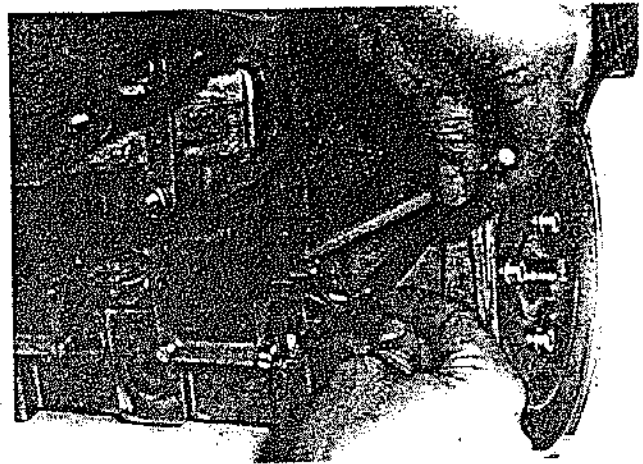


9-25 Position the stator plate in the fan housing and secure with screws and washers. On those engines using the point ignition, turn the stator plate full clockwise before locking in place.

10-25 If the engine has a C.D.I. ignition, align the mark found on the bottom of the stator plate with the mark in the fan housing. Secure with two screws, lockwashers and flat washers.



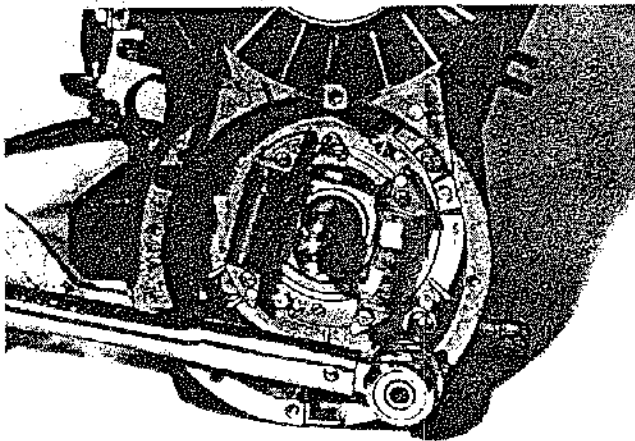
■ NOTE: Coat the stator plate screw threads with "blue" locktite.



■ NOTE: Check each external coil ground lead for being securely grounded to a clean surface.

11-25 Install a new o-ring on the backside of the fan housing flange. Apply a light coat of silicone sealant over the top of the o-ring.

12-25 Place fan housing assembly over the crankshaft and into position. Install the four allen head screws with lockwashers and tighten evenly, until the fan housing is against the crankcase assembly. Torque these four bolts 16-18 ft. lbs. using a crisscross torque pattern.



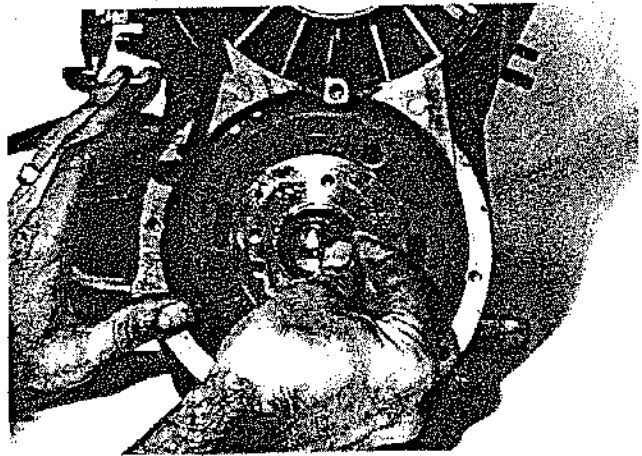
■ NOTE: There are no lockwashers used when securing the fan housing on C.D. ignition models.

■ NOTE: Before tightening the four fan housing bolts, be sure to position the wiring grommet in slot of crankcase assembly.

13-25 On point ignition models, attach the blue/red wire to the inside spade connector of the ignition coil nearest the fan housing. Attach the solid blue wire to the outside spade connector of the number one cylinder ignition coil.

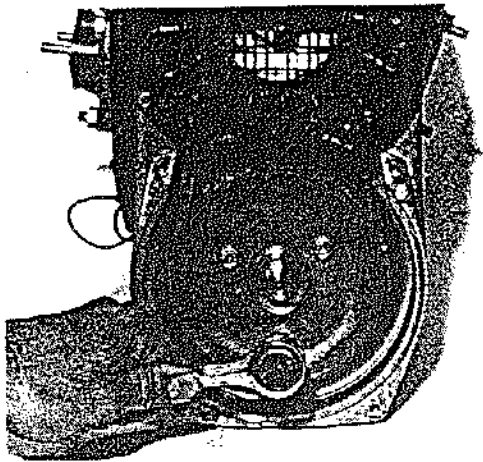
● CAUTION ● Your next step is to install the flywheel. Double check the magnet area within the flywheel to make sure no metal objects have been accidentally picked up by its magnets, while the flywheel was on the work bench.

14-25 Position the flywheel over the crankshaft and slide into position. Align the keyways and install the flywheel key.



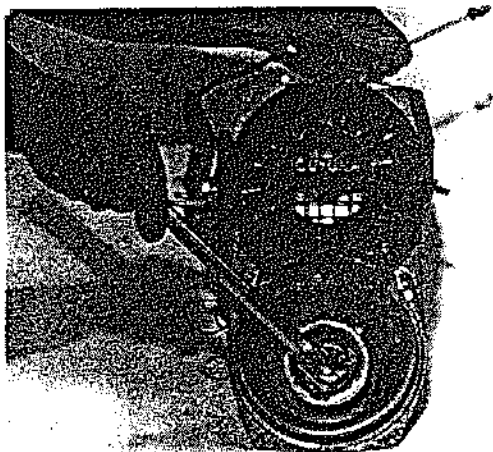
■ NOTE: On point ignition models, adjust engine timing before proceeding to the next step. For timing procedures, refer to the Electrical section of this manual.

15-25 On engines equipped with the Eaton starter, install the lower belt pulley halves, with the fan belt positioned between them. Attach the pulley halves to the flywheel using three allen bolts and lockwashers. Rotate the crankshaft as the three bolts are evenly tightened. Torque the three bolts 6-8 ft. lbs.



● CAUTION ● The crankshaft must be rotated as you tighten the three belt pulley attaching bolts. This will allow the belt to work its way out to the outer diameter of the pulley halves. If this procedure isn't followed, the outer pulley half will be damaged.

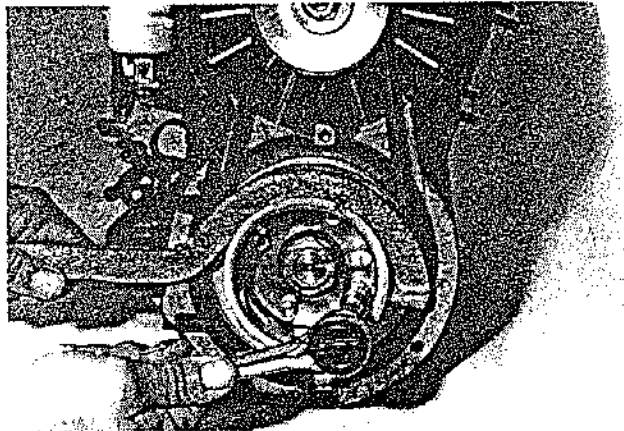
16-25 Install the starter carrier, lockwasher and flywheel nut. Apply a light coat of "red" loctite to the threads of the crankshaft. Torque the flywheel nut 46-50 ft. lbs.



■ NOTE: To hold the crankshaft while torquing the flywheel nut, insert 14-16 inches of 1/4 inch rope down through the spark plug hole of the number 2 (mag. side) cylinder. Be sure to check the piston position before inserting the rope. The piston dome should just close off the exhaust port. This will prevent the rope from entering one of the transfer ports as it is inserted down through the spark plug hole.

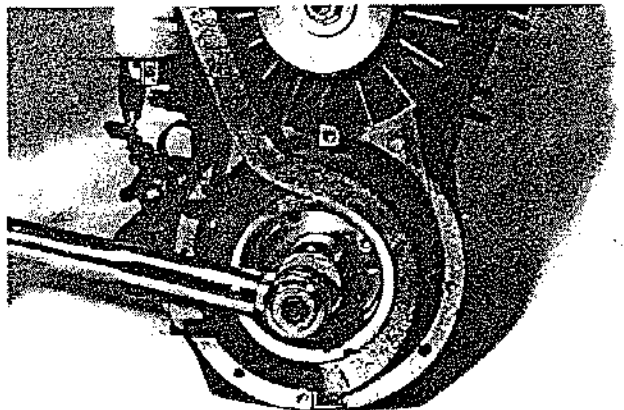
17-25 On engines equipped with the Mitsui recoil, after installing the flywheel and key, install the lockwasher and nut. Finger tighten the nut at this time.

18-25 Install the lower belt pulley halves and starter carrier, with the fan belt in position between the pulley halves. Attach the pulley halves and carrier with either four or three capscrews. Torque these attaching capscrews 6-8 ft. lbs. Rotate the crankshaft as you tighten the capscrews to allow the fan belt to work its way out to the outer diameter of the lower pulley. Tighten all bolts evenly.

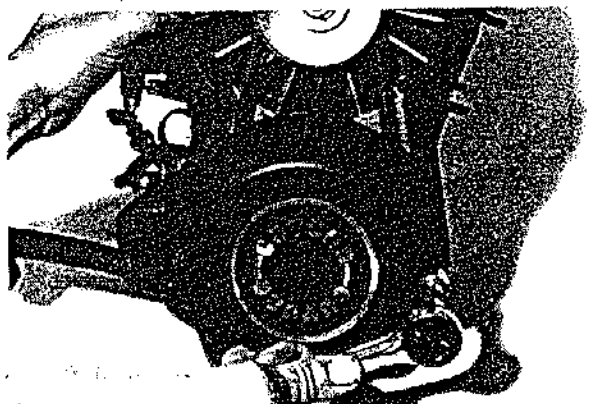


● CAUTION ● Failure to rotate the crankshaft as the lower belt pulley capscrews are tightened will result in damage to the outside pulley half.

19-25 Secure the crankshaft with a spanner wrench and torque the flywheel nut 46-50 ft. lbs.

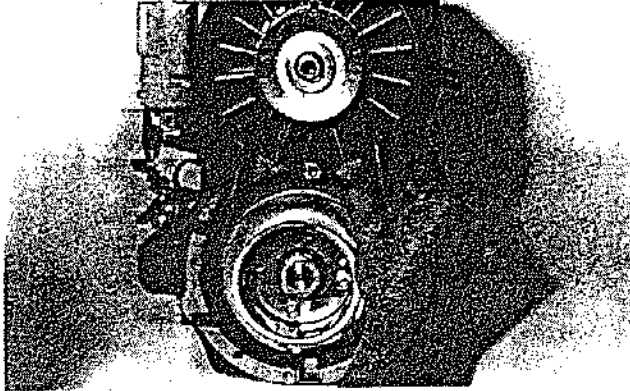


20-25 Position the recoil starter assembly on the fan housing and secure with four capscrews, lockwashers and clamps. Torque the four capscrews 6-8 ft. lbs.



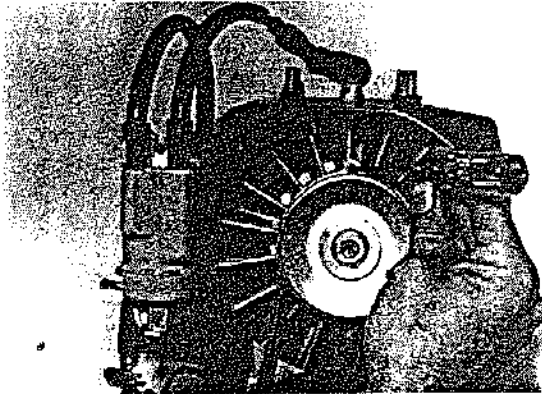
Adjust Axial Fan Belt Tension

- 1-26 Proper belt tension is 1/8 inch belt deflection, between the upper and lower pulleys.



- 2-26 Remove the fan cover.

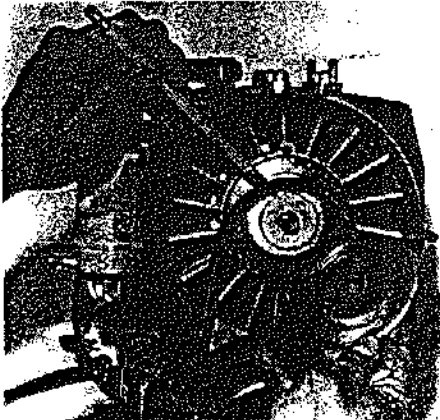
- 3-26 Insert a 3/16 inch drill or a suitable punch through the indexing hole, located just above the upper pulley. Hold light pressure against the punch and rotate the impeller until the punch slides into the impeller body hole.



- 4-26 Remove the fan shaft nut, using a 17 mm socket.

- 5-26 Remove the lockwasher, heavy backing washer, shim washers and pulley half.

- 6-26 Remove or add shim washers from between the pulley halves. Add washers to loosen belt, remove washers to tighten it.



- 7-26 Remove the punch from the fan housing. Reinstall the outside pulley half, shim washers, backing washer, lockwasher and nut. Slowly tighten the nut. As you tighten the nut, rotate the engine crankshaft. This will allow the belt to work its way out to the diameter of the pulley.

- 8-26 With the belt located at the outer diameter of the pulley, re-install the punch to secure the shaft. Torque the nut 20-22 ft. lbs.

Engine Overhaul Procedure Summary

In the following pages, added instruction is given in carrying out many of the overhaul procedures covered in the Service Manual. This portion of the manual is aimed at the technician who may be performing his first engine overhaul. Special areas of importance are covered in detail to save time and assure the repairs made are carried out in accordance with recommended overhaul practices. Areas covered are:

- A. Engine Sealers
- B. Engine Pressure Testing
- C. Surface Plate Usage
- D. Crankshaft Checking Procedures
- E. End Seal Lubrication
- F. Cylinder Reconditioning

ENGINE SEALERS

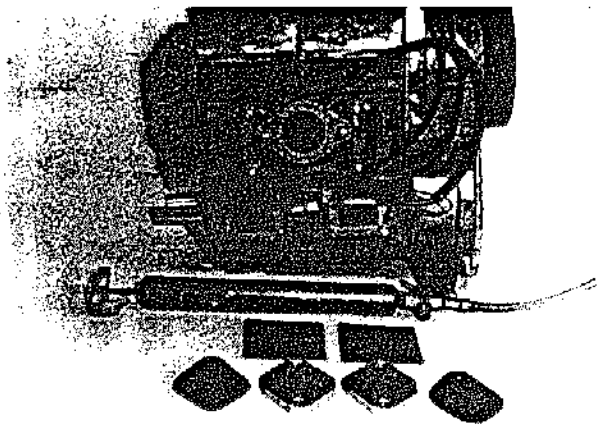
Non-hardening sealers must always be used, whenever sealing metal-to-metal surfaces. R.T.V. silicone sealant is recommended by Cuyuna. Do not use a hardening type sealer, as it may crack resulting in an air leak. Air leaks in two-cycle engines, which cause overheating, are one of the primary causes of two-cycle engine failure.

ENGINE PRESSURE TESTING

Whenever an engine is brought in for service because of an overheating problem, the engine should first be pressure checked before any major repair is performed. If the engine is disassembled without being pressure tested, the real reason for the overheating problem may go undetected.

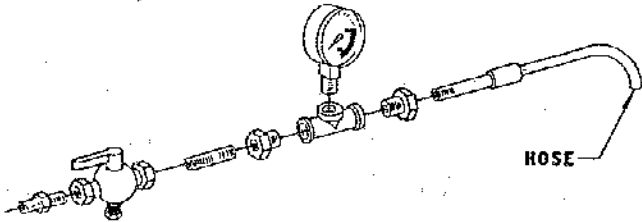
To pressure check the engine you will need to block off both the intake and exhaust ports. This is done by making intake and exhaust port covers out of a heavy rubber gasket material or 1/8 inch belting.

NOTE: Use the exhaust and intake manifold flanges as a template to mark the cover outline and hole pattern.



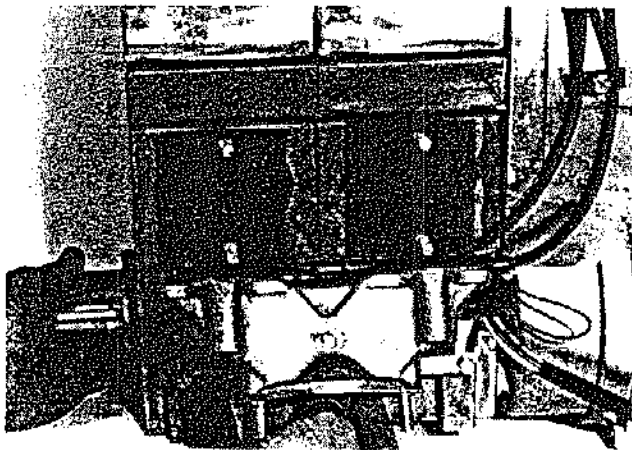
Below is an illustration of the items needed to make up the pressure checking equipment. All these items can be purchased at your local hardware store. They are as follows:

- A. Metal valve core (1)
- B. Pressure shut-off valve (1)
- C. 1/4 inch nipple (1)
- D. 3/8 - 1/4 reducer (2)
- E. 3/8 inch tee (1)
- F. 0 - 15 lb. pressure gauge (1)
- G. Hose nipple (1)

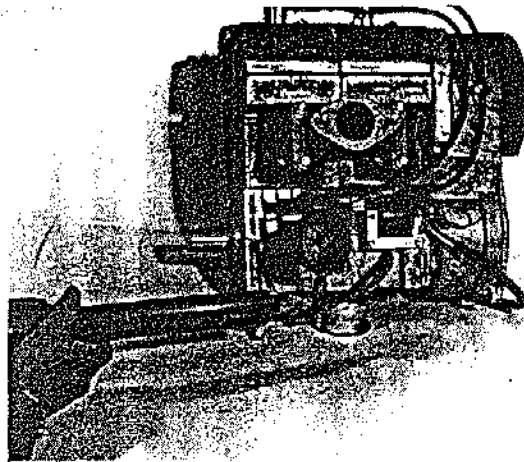


To pressure check the engine, follow this procedure.

1. Remove the intake and exhaust manifolds. Install the intake and exhaust port covers. Re-install both manifolds, torque to 16 ft. lbs.



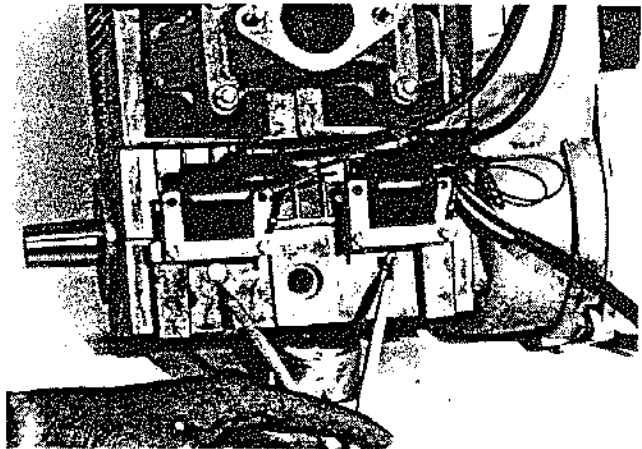
2. Check to make sure both spark plugs are tight.
3. Attach the hose from the pressure tester to the impulse nipple of the engine.



4. Open the pressure valve and pressurize the crankcase using a hand pump, to 3 lbs. Close the valve. Engine must maintain pressure for 3 minutes.
5. If a pressure drop is noted, check for leaks by applying soapy water to all gaskets and crankcase sealing surfaces. Note any leaks and repair.
6. If no leak is noted after 3 minutes, increase the pressure from 3 lbs. to 10 lbs. for an additional 3 minutes.

CAUTION Never exceed 12 lbs. pressure or possible seal damage may occur.

7. If no leaks are detected after 3 minutes at 10 lbs., the magneto side of the crankcase can be considered good. You must now check the P.T.O. half of the engine.
8. Remove the brass plug from the P.T.O. side of the crankcase. Install the impulse nipple from the magneto side of the crankcase and repeat steps 3-7.



SURFACE PLATE USAGE

Air leaks are normally caused by a nicked or scratched sealing surface, a damaged gasket or seal, or a warped sealing surface. To repair a nicked, scratched

or warped sealing surface, use a surface plate and a sheet of wet-or-dry sandpaper. If a surface plate isn't available, a flat piece of heavy plate glass may be substituted. Position the sandpaper on top of either flat surface and tape into position.

The grit size of wet-or-dry sandpaper to be used should be determined by the amount of finishing required. A coarse grit (200 or 220) wet-or-dry sandpaper should be used to repair large nicks and scratches or sealing surfaces that are warped excessively. A fine grit wet-or-dry sandpaper (400-600) should be used to repair minor nicks or warpage.

Always use a figure eight motion and light, equal pressure when re-surfacing a component. Continue the figure eight motion until a uniform bright metallic finish on the entire sealing surface is attained. Water or cleaning solvent must be used in conjunction with the wet-or-dry sandpaper, to prevent the sandpaper from becoming clogged with aluminum.

CRANKSHAFT RUNOUT AND STRAIGHTENING

During engine overhaul, special attention must be given to the crankshaft. It is the heart of the engine. Inspect the crankshaft for trueness and if necessary, straighten or replace it. To inspect crankshaft trueness, use a set of V-blocks, a dial indicator and the procedure in the Service manual. If runout (total indicator reading) exceeds .003 or .07mm at either end, the crankshaft must be straightened or replaced. The procedure for straightening the crankshaft is to first use a dial indicator to locate high point. When found, mark it with a magic marker on the counterweight. Using a heavy brass hammer, sharply strike the counterweight where the mark is located. Recheck the crankshaft runout. Follow this procedure until the trueness is within specifications. Do not use a steel hammer for straightening a crankshaft as the counterweights will be damaged.

END SEAL LUBRICATION

When installing the crankshaft, always use new end seals. Before the end seals are placed into position, clean the sealing areas of the crankshaft with crocus cloth, then apply a generous amount of grease to the inner lips of the seals. If seals are installed dry, they will fail in a short period of time.

CYLINDER RECONDITIONING

Whenever an engine is overhauled, the cylinder bore must be inspected for the following conditions:

1. Wear beyond the cylinder wear limit.
2. Uneven wear, scoring, pitting and corrosion.
3. Wear beyond the cylinder trueness (taper) limit.

Minor scoring, pitting and corrosion can be repaired using a flex hone. On cast iron sleeved cylinders, use



300 grit stones. Light honing should be performed on cylinders to deglaze the cylinder bore before installing new rings. This will aid in the break-in of the new piston rings and will provide the bore area with more lubricant for proper break-in. To produce the proper 60 degree "crosshatch" pattern, use a low RPM drill (or variable-speed drill) at a speed of 600 RPM at the rate of 30 strokes per minute. Use honing oil or parts washing solvent to lubricate the hone stones. Always keep the hone moving from top to bottom of the bore in even strokes.

Never allow the hone to rotate in just one area of the cylinder without moving it up and down in the bore. Clean the bore with detergent soap and hot water, then dry with compressed air. After drying, apply a light coat of oil to the cast-iron bore.

To repair a cylinder which is tapered beyond the trueness (taper) limit, use a rigid-type hone and the following procedure:

1. Thoroughly clean the cylinder bore with parts cleaning solvent and dry.
2. Coat the entire cylinder bore with Prussian Blue.
3. Using a rigid hone, hone the bore approximately 12 complete strokes, then check the bore surface for high and low areas highlighted by the Prussian Blue. All Prussian Blue must be honed off the bore surface as blueing indicates a low, hollow or uneven area, which will cause blowby and a decrease in engine power.
4. Clean the cylinder bore with detergent soap and hot water, then dry with compressed air.
5. After honing the cylinder, check the bore size to be sure it is within specifications.
6. Apply a light coat of oil to the cylinder bore.

As stated before, when using a hone of either type (Flex or rigid), honing oil must be used as a cutting fluid or lubricant.

 **WARNING**  Never use gasoline as a lubricant. It may ignite and cause personal injury. If honing oil isn't available, parts washing solvent may be used.

Torquing Engine Hardware

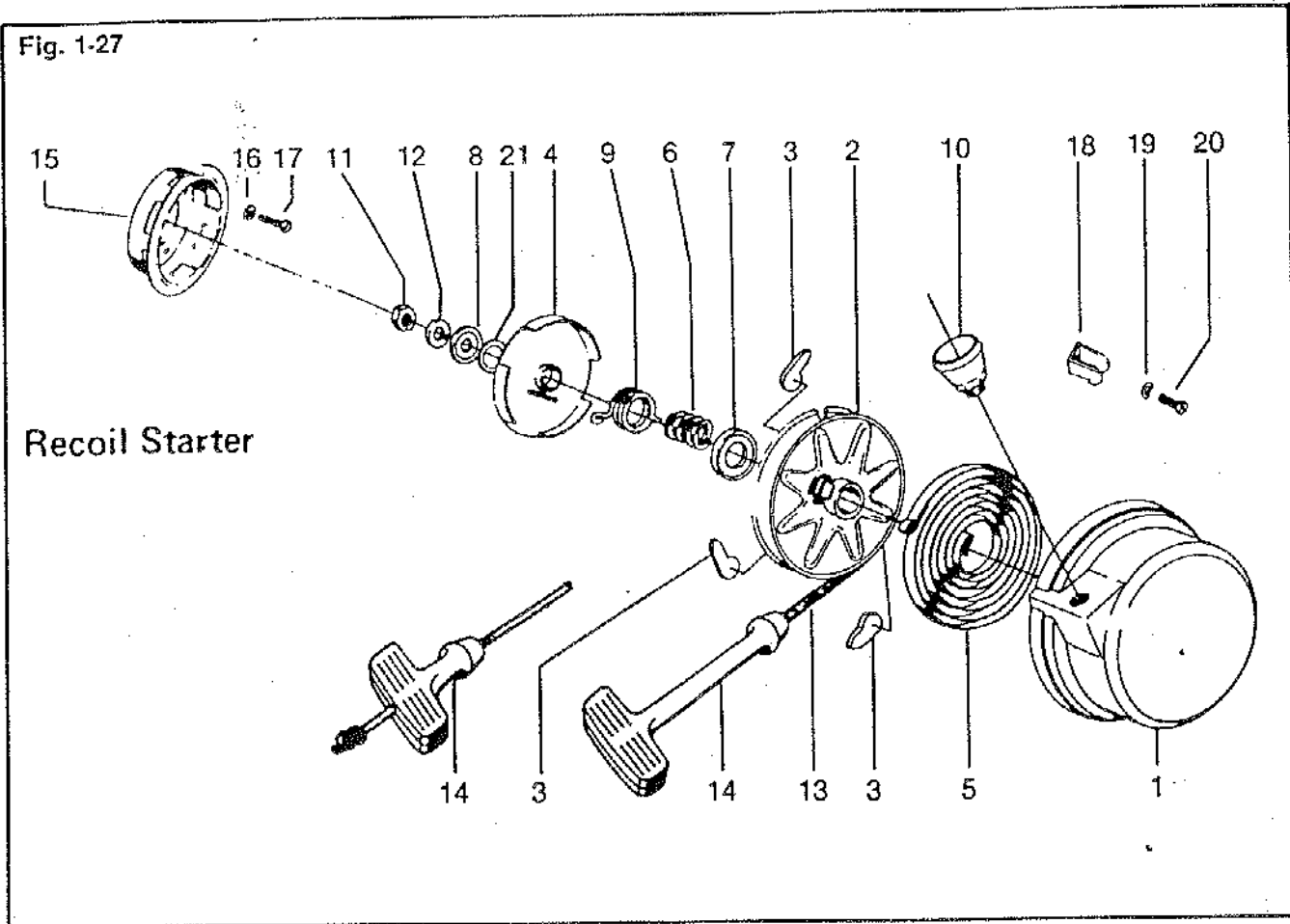
When torquing engine hardware, always follow the torque patterns given in the Service manual. It is important that all nuts and bolts are torqued in a criss-cross pattern and in 3 steps. For example, if the torque specification is 15 ft. lbs., divide this number by 3 and torque to 5 ft. lbs., then 10 and finish the third time around at 15 ft. lbs. This procedure will assure that the component is being torqued down evenly.

Recoil Starter (MITSUI)

DISASSEMBLY

(See Fig. 1-27 for recoil start breakdown, and Fig. 2-27 for Recoil Starter Assembly.)

Fig. 1-27



1. Remove retaining nut (11), spring washer (12) and thrust washer (8) from threaded shaft of reel hub (Fig. 3-27)

Fig. 2-27

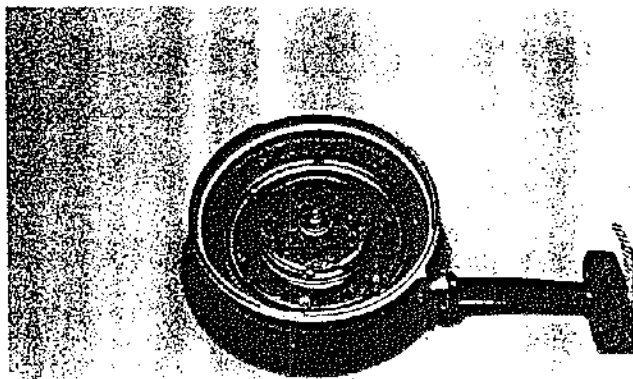
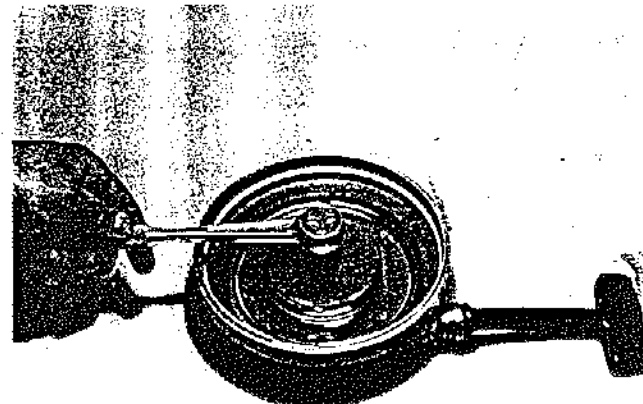


Fig. 3-27



2. Manipulate friction plate (4) on reel hub until eye end of return spring (9) aligns with retaining slot. Remove friction plate (Figs. 4-27 and 5-27).

Fig. 4-27



Fig. 5-27



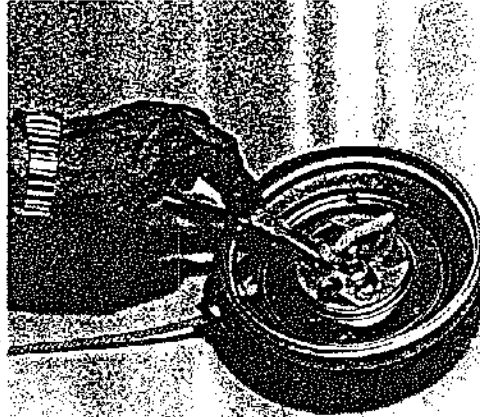
3. Remove the three pawls (3), (Fig. 6-27).
4. Remove return spring (9), spring (6) and cup washer (7), (Fig. 6-27). Note position of plain end of return spring in the spring retaining hole in reel hub.

Fig. 6-27



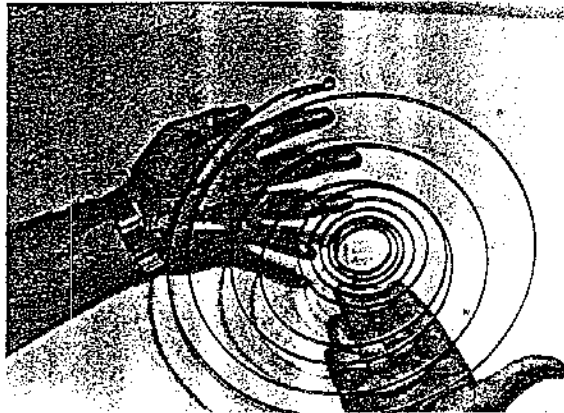
5. Unwind the rope; lift and untie the knotted end from center hub of reel, remove reel (2), (Fig. 6-27).

Fig. 7-27



6. Lift long rolled end of main springs (5) from the fixed spring retaining pin in the case and carefully remove the spring (Fig. 8-27).

Fig. 8-27

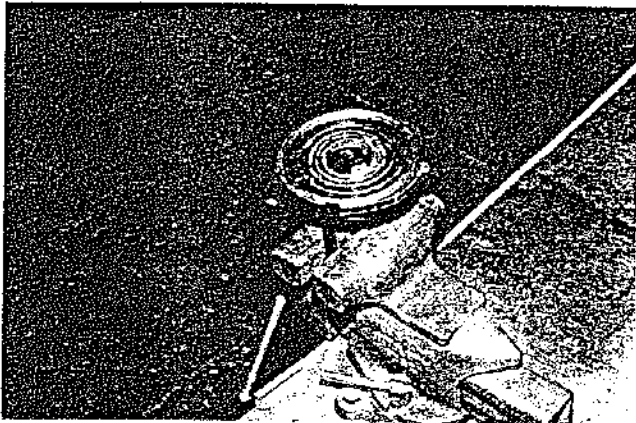


7. Clean all parts, except rope, using a suitable cleaning solvent. If rope requires cleaning, wash it in a solution of soap and water. Thoroughly dry all parts after cleaning.
8. Inspect all parts for obvious damage and wear.

ASSEMBLY

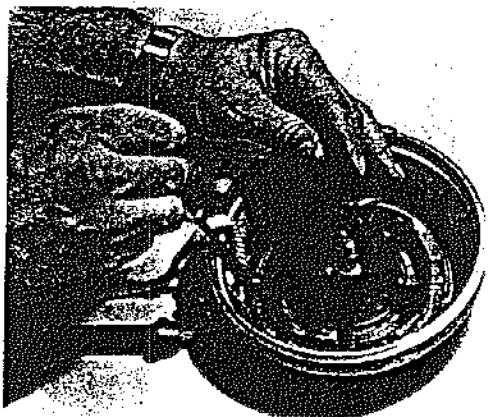
1. Replace defective parts.
2. Install main spring as follows:
 - a. Secure main spring winding tool, part number 43-0797-60, or equivalent tool, circular end up, in a suitable bench vise.
 - b. Start with the long rolled end of main spring (5) and wind spring into circular end of tool in a clockwise direction (Fig. 9-27).

Fig. 9-27



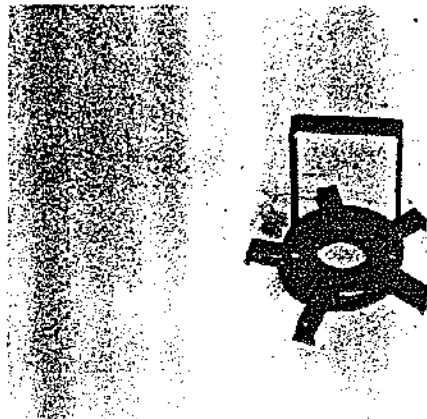
- c. Remove tool from vise. Grasp the tool by its handle and lower the tool, with spring installed into case (1), (Fig. 10-27).

Fig. 10-27



- d. Secure the long rolled end of spring over the fixed spring retaining pin. Remove winding tool (Fig. 11-27). Apply a light film of Lubriplate, or equivalent, to spring.

Fig. 11-27



3. Secure case, open side up, in bench vise.
4. Tie a knot at one end of the rope. Secure knotted end in the center of reel. Pull rope taut and wind entire rope around reel in an anticlockwise direction until the free end protrudes through the notched section of the reel.

5. Apply a light film of Lubriplate, or equivalent, to center hub of case and install the reel. Push down and rotate reel in an anti-clockwise direction until the hook engages with the free end of main spring. Tension will be felt when reel and spring are properly engaged (Figs. 12-27 and 13-27).

Fig. 12-27

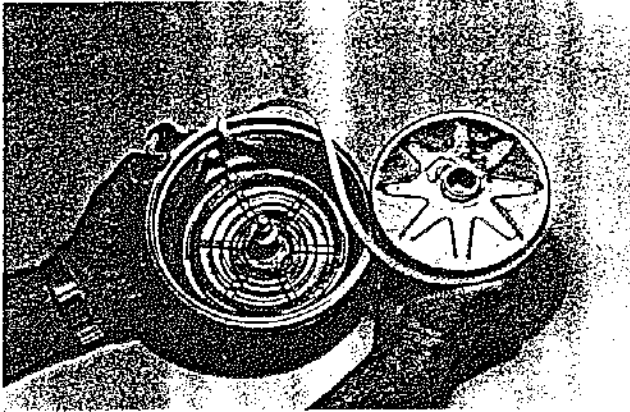
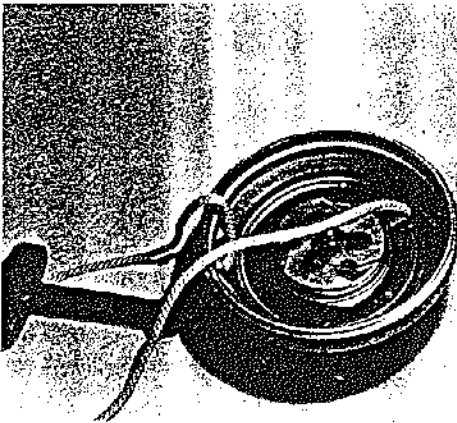
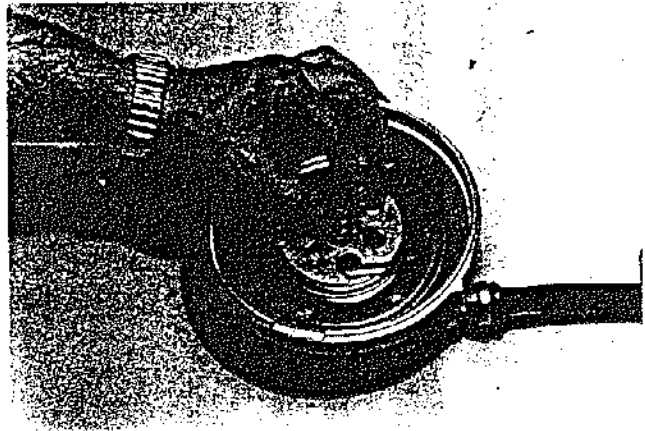


Fig. 13-27



6. Rotate reel a maximum of three complete turns in an anti-clockwise direction. Do not exceed three turns; hold reel in this position and feed free end of rope through case at the rope guide hole. Install rope guide. Loosely knot the rope to prevent recoil.
7. Apply a light film of Lubriplate or equivalent to pawls (6) and install them on the reel in the pawl retainers (Fig. 14-27). (See Fig. 1-27 for part identification numbers.)

Fig. 14-27



8. Install cup washer (7) flat side down, spring (6) and return spring. Ensure that plain end of return spring is properly engaged in the retaining hole in reel hub.
9. Install friction plate (5) over reel hub. Manipulate plate until eye end of return spring engages and locks crosswise in retaining slot.
10. Rotate friction plate until the three notches are aligned with pawls when pawls are at the recoil position.
11. Install flatwasher (8), lockwasher (12) and nut (11). Tighten nut securely.
12. Untie the temporary knot in free end of rope and install the rope handle. Tie a permanent knot and fit handle securely.
13. Check starter for proper operation. When handle is pulled outward, pawls should move outward.

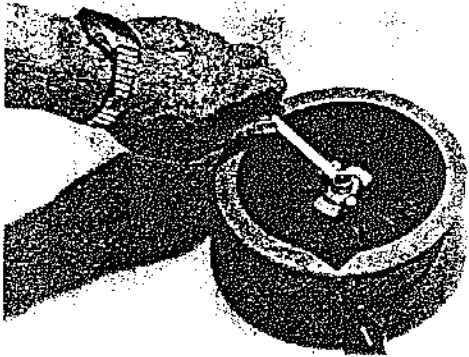
NOTE: If main spring is to be installed without the use of a spring winding tool, wind main spring into case in an anti-clockwise direction. Clockwise installation on the winding tool is necessary to ensure correct anti-clockwise installation of the spring when tool is placed upside down in the case.

Recoil Starter (Eaton)

DISASSEMBLY

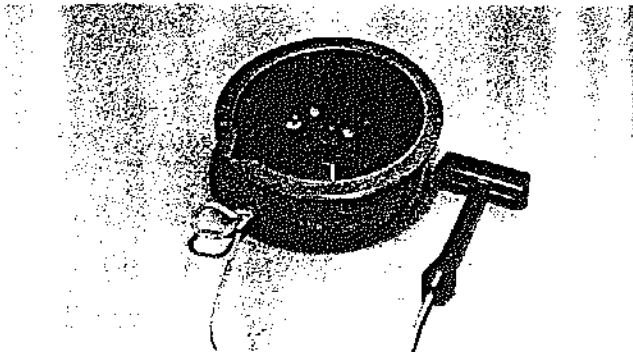
1. Remove screw, washer, dog cam, brake spring and steel washer from center hub (Fig. 1-28).

Fig. 1-28



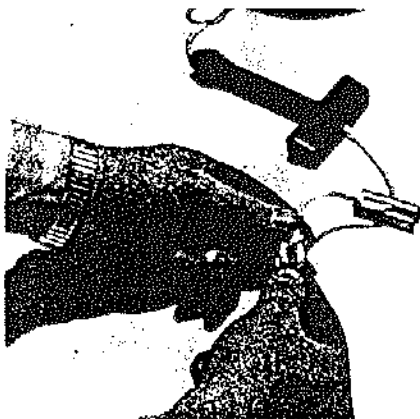
2. Pull rope out of rewind approximately 18 inches and tie a slip knot in rope at housing (Fig. 2-28).

Fig. 2-28



3. Remove reinforcement (7) from rope handle, untie rope and remove handle (6), (Fig. 3-28).

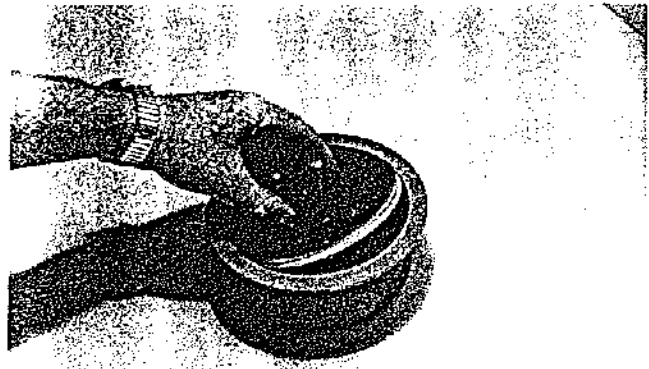
Fig. 3-28



4. Hold center pulley (4) and untie slip knot from rope. Let spring tension loose by allowing center pulley to turn slowly and the rope wind around pulley.

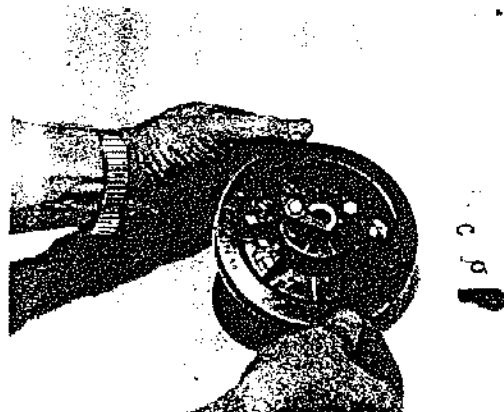
5. Remove center pulley by pulling upward (Fig. 4-28).

Fig. 4-28



6. Remove dog retainer, dog and spring (Fig. 5-28).

Fig. 5-28

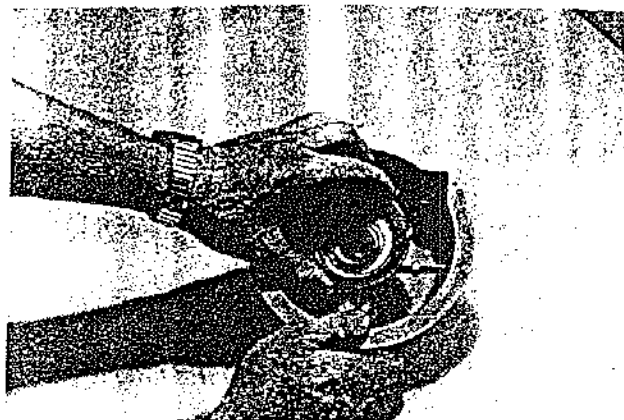


7. Remove center bearing by pressing from bottom to top.

8. Remove rope.

9. Remove spring and spring keeper by lifting up (Fig. 6-28).

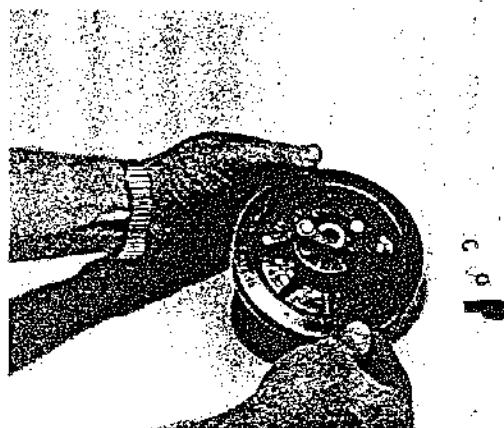
Fig. 6-28



3. Replace center bearing in pulley.

4. Replace dog spring, dog and retainer (Fig. 8-28).

Fig. 8-28

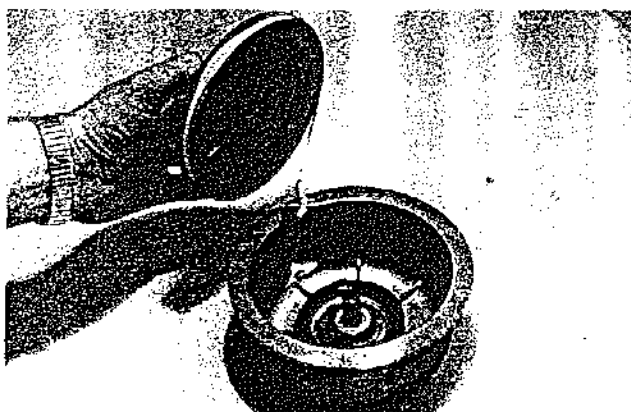


10. Clean all parts except rope in a suitable cleaning solvent. If rope requires cleaning, wash it in a solution of soap and water thoroughly. Dry all parts after cleaning.

11. Inspect all parts for obvious damage and wear.

5. Place center pulley over the center shaft and spring. Be sure pulley is all the way down. Shaft should protrude slightly out of center bearing (Fig. 9-28).

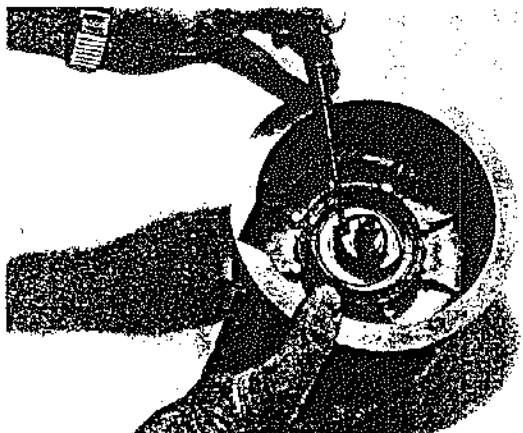
Fig. 9-28



ASSEMBLY

1. Replace defective parts.
2. Install main spring by placing spring and keeper over center shaft and aligning inside end of spring in notch on center hub (Fig. 7-28).

Fig. 7-28



6. Wind pulley counterclockwise six (6) turns, push rope through hole in the housing. Tie a slip knot about halfway down the rope to prevent it from winding back inside housing. (Figs. 10-28, 11-28).

Fig. 10-28

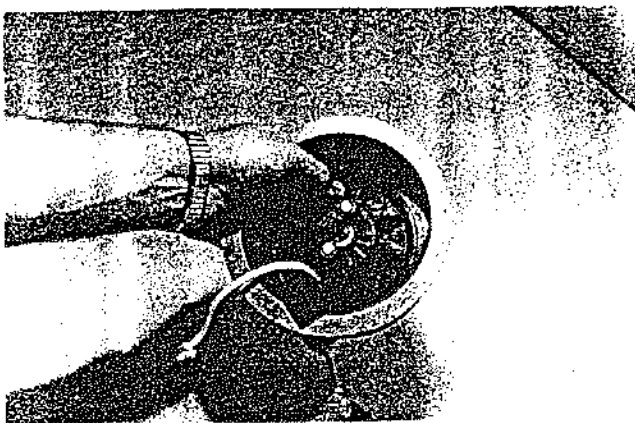
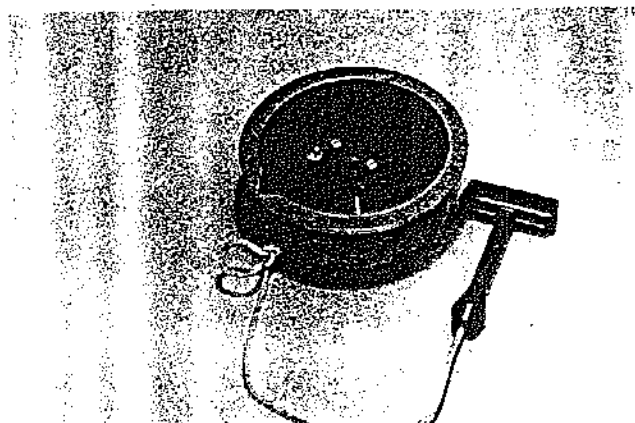
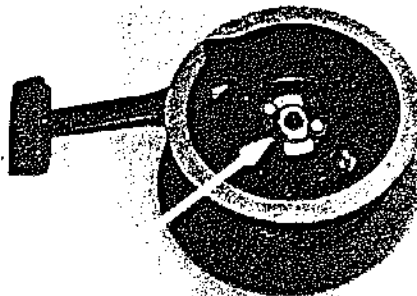


Fig. 11-28



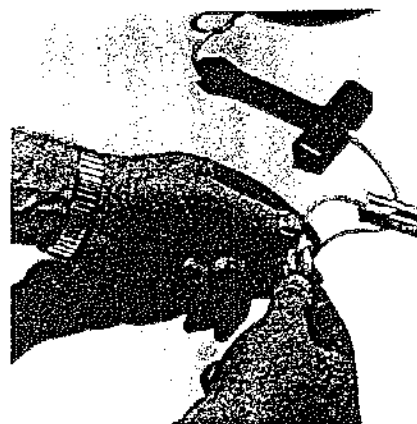
7. Replace retaining washer, spring, dog cam (bent portion down) and retaining screw. Be sure dogs are positioned so there is a slight preload on them before installing cam (Fig. 12-28).

Fig 12-28



8. Reinstall handle and reinforcement on the rope, tie a good knot in end of rope.

Fig. 13-28



9. Untie the slip knot and check spring tension by pulling on rope.

Two Cycle Engine Troubleshooting

NOTE: Not all conditions will be appropriate for all engine models.

PROBLEM: ENGINE DOES NOT START	CONDITION	REMEDY
<p>A. No spark at spark plugs</p>	<ol style="list-style-type: none"> 1. Ignition switch malfunctioning-switch not in RUN position 2. Wiring harness shorting-disconnected (NCI Models) 3. Spark plug(s) fouled-damaged 4. Spark-plug cap(s) damaged-leaking-shorting 5. High tension wire(s)-ignition coil loose-grounded-defective 6. CDI defective 7. Magneto coil(s) defective 8. Flywheel magnets weak 9. Magneto coil(s) air gap incorrect 10. Breaker points adjusted incorrectly-defective 11. Condenser defective 	<ol style="list-style-type: none"> 1. Replace ignition switch. Turn switch to RUN position. 2. Repair-replace-connect-wiring harness 3. Clean-replace spark plug(s) 4. Replace spark-plug cap(s) 5. Service-replace high tension wire(s)-ignition coil 6. Replace CDI unit 7. Replace magneto coil(s) 8. Replace flywheel 9. Adjust air gap 10. Adjust-replace break points 11. Replace condenser
<p>B. No fuel at cylinders</p>	<ol style="list-style-type: none"> 1. Fuel tank empty 2. Fuel hose broken-pinched 3. Fuel tank vent-cap obstructed 4. In-line fuel filter obstructed-damaged 5. Fuel pump malfunctioning-defective 6. Impulse hose cracked-broken-pinched-disconnected 	<ol style="list-style-type: none"> 1. Fill fuel tank 2. Replace-service fuel hose 3. Remove obstruction-replace vent hose-fuel tank cap 4. Remove obstruction-replace in-line fuel filter 5. Service-replace fuel pump-pump plates 6. Replace-connect impulse hose

B. No fuel at cylinders (con't)	<ul style="list-style-type: none"> 7. Carburetor(s) adjusted incorrectly-dirty-damaged 8. Primary compression absent 	<ul style="list-style-type: none"> 7. Troubleshooting carburetor(s) 8. Repair-replace damaged-worn engine components (end seals, rings, cylinder(s), cylinder gaskets, reseal crankcase halves)
C. Miscellany (Fuel does not ignite)	<ul style="list-style-type: none"> 1. Carburetor-to-cylinder air leak 2. Carburetor(s) adjusted incorrectly-dirty-damaged 3. Fuel contaminated 4. Engine flooded 5. Secondary compression 6. Ignition timing adjusted incorrectly 7. Spark plug fouled 	<ul style="list-style-type: none"> 1. Replace-service gasket(s) intake flange-manifold 2. Troubleshoot carburetor(s) 3. Clean fuel tank and entire fuel delivery system 4. Troubleshoot carburetor(s) clean-replace air-intake filter 5. Repair-replace damaged-worn engine components (piston, rings, cylinder(s) head, gasket)-tighten spark plug(s) 6. Timing ignition 7. Clean or replace
PROBLEM: ENGINE DOES NOT IDLE	CONDITION	REMEDY
	<ul style="list-style-type: none"> 1. Carburetor(s) adjusted incorrectly-dirty-damaged 2. Fuel pump malfunctioning-defective 3. Impulse hose cracked-broken 4. Air-intake filter obstructed-damaged. 5. Spark plug(s) fouled-damaged-adjusted incorrectly 6. Ignition timing adjusted incorrectly 7. Breaker points dirty-adjusted incorrectly defective 	<ul style="list-style-type: none"> 1. Troubleshoot-replace carburetor(s) 2. Service-replace fuel pump 3. Replace hose 4. Remove obstruction-clean air filter 5. Clean-replace-adjust spark plug(s) 6. Time ignition 7. Clean-adjust-replace breaker points

PROBLEM: ENGINE LOSES POWER-RUNS ON ONE CYLINDER	CONDITION	REMEDY
	<ol style="list-style-type: none"> 1. Fuel tank vent-cap obstructed 2. Fuel hose cracked-broken-pinchd 3. In-line fuel filter obstructed-damaged 4. Carburetor adjusted incorrectly-dirty-damaged-loose 5. Propeller is too large, causing the engine to run below the recommended RPM 6. Muffler obstructed-damaged 7. Air-intake filter obstructed-damaged 8. Exhaust port(s) carboned 9. Spark plug(s) fouled-damaged 10. High tension wire(s)-ignition coil loose-defective 11. Spark plug cap(s) leaking-shorting 12. Timing adjusted incorrectly 13. Primary compression-secondary compression low 14. Magneto coil(s) defective 15. Fuel pump malfunctioning-defective 16. CDI unit defective 	<ol style="list-style-type: none"> 1. Remove obstruction-replace vent 2. Replace-service fuel hose 3. Remove obstruction-replace in-line fuel filter 4. Remove carburetor and clean. Check jetting specifications. 5. Change to prop of less diameter 6. Remove obstruction-replace muffler 7. Remove obstruction. Clean or replace air-intake filter 8. Clean exhaust port(s) 9. Clean-replace spark plug(s) 10. Service-replace high tension wire(s)-ignition coil 11. Replace spark plug cap(s) 12. Time ignition 13. Repair-replace damaged-worn engine components (end seals, center seal, rings, cylinder(s), crankcase halves, piston(s), head(s), head gaskets(s)-tighten spark plug(s)-cylinder head nuts) 14. Replace magneto coil(s) 15. Service-replace fuel pump 16. Replace CDI unit

PROBLEM: ENGINE OVERHEATS	CONDITION	REMEDY
	<ol style="list-style-type: none"> 1. Cooling fins obstructed 2. Spark plug heat range too hot 3. Axial fan blades broken bent-fan belt broken-stretched-adjusted incorrectly 4. Carburetor(s) adjusted incorrectly-jetted incorrectly-dirty 5. Carburetor-to-cylinder air leak 6. Air leak in engine 7. Rings/grooves carboned 8. Exhaust port(s) obstructed 9. Muffler obstructed 10. Gas/oil mixture too lean 11. Primary compression low-absent 12. Timing adjusted incorrectly 13. Gasoline octane too low 	<ol style="list-style-type: none"> 1. Remove obstruction 2. Install lower heat range spark plug(s) 3. Repair-replace axial fan components-adjust fan belt tension 4. Troubleshoot-clean carburetor(s). Check jetting specifications 5. Replace-service gasket(s) intake flange-manifold-service intake port(s) 6. Pressure check engine and repair 7. Clean-replace rings-piston(s) 8. Remove obstruction 9. Remove obstruction 10. Check jetting - mix per instructions in manual 11. Repair-replace damaged-worn engine components 12. Time ignition 13. Use 88 minimum octane regular lead-ed gasoline-replace gasoline-gas/oil mixture
PROBLEM: ENGINE BACKFIRES	CONDITION	REMEDY
	<ol style="list-style-type: none"> 1. Ignition switch defective 2. Spark plug(s) fouled-damaged 3. Spark plug heat range too hot 	<ol style="list-style-type: none"> 1. Replace switch 2. Clean-replace spark plug(s) 3. Install lower heat range spark plug(s)

PROBLEM: ENGINE BACKFIRES (con't)	CONDITION	REMEDY
	<ol style="list-style-type: none"> 4. High tension wire(s) ignition coil shorting 5. Carburetor-to-cylinder air leak 6. Carburetor(s) adjusted incorrectly-dirty-damaged-loose 7. Gas/oil mixture incorrect-contaminated 8. Jetting too lean 	<ol style="list-style-type: none"> 4. Service-replace high tension wire(s)-ignition coil 5. Repair-replace gasket(s) 6. Remove carburetor and clean. Check for proper jetting. 7. Replace gas/oil mixture 8. Install larger jet
PROBLEM: ENGINE FOUR-CYCLES (Floods Excessively)	CONDITION	REMEDY
	<ol style="list-style-type: none"> 1. Carburetor(s) adjusted incorrectly-dirty-damaged 2. Gas/oil mixture contaminated 	<ol style="list-style-type: none"> 1. Troubleshoot-clean carburetor(s), check float adjustment and inlet needle seat-choke-choke adjustment 2. Replace gas/oil mixture
PROBLEM: ENGINE STOPS SUDDENLY	CONDITION	REMEDY
	<ol style="list-style-type: none"> 1. In-line fuel filter obstructed-damaged 2. Fuel hose obstructed-broken-pinch 3. CDI unit defective 4. Ignition coil defective 5. Magneto coil(s) defective 6. Spark plug(s) bridged 7. Fuel tank vent-cap obstructed-damaged 8. Engine seized 9. Ignition switch defective 10. Wiring harness shorting disconnected (NCI models) 11. Breaker points damaged-shorting 12. Prop too large 	<ol style="list-style-type: none"> 1. Remove obstruction-replace in-line fuel filter 2. Remove obstruction-repair-replace fuel hose 3. Replace CDI unit 4. Replace ignition coil 5. Replace magneto coil(s) 6. Replace spark plug(s) 7. Remove obstruction-replace vent hose-fuel tank cap 8. Overhaul engine 9. Replace switch 10. Repair-replace-connect wiring harness 11. Replace breaker points 12. Check engine for proper RPM. Switch to smaller prop (less diameter)

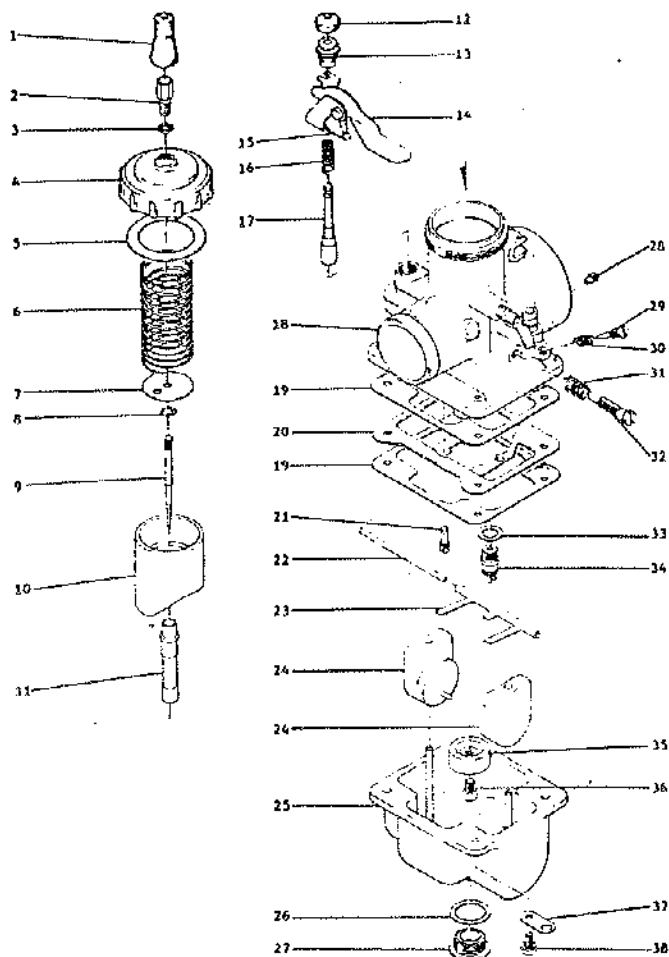
PROBLEM: ENGINE STOPS GRADUALLY	CONDITION	REMEDY
	<ol style="list-style-type: none"> 1. In-line fuel filter obstructed-damaged 2. Fuel hose obstructed broken-pinched 3. Head gasket(s) burning out 4. Cylinder head(s) loosening 5. Spark plug(s) loosening 6. Impulse hose cracked 7. High tension wire(s)-ignition coil defective 8. Propeller too large 	<ol style="list-style-type: none"> 1. Remove obstruction-replace in-line fuel filter 2. Remove obstruction-replace-repair fuel hose 3. Replace head gasket(s)-service cylinder(s)-head(s) 4. Tighten cylinder head nuts 5. Tighten spark plug(s) 6. Replace impulse hose 7. Replace high tension wire(s) 8. Use propeller which allows proper RPM

Cuyuna Service Manual

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EXPLODED VIEW OF VM TYPE CARBURETOR



1. Rubber Cap, Throttle Cable
2. Cable Adjuster
3. Locknut, Cable Adjuster
4. Top, Mixing Chamber
5. Gasket, Mixing Chamber Top
6. Spring, Throttle Valve
7. Plate, Needle Retainer
8. "E" Ring
9. Needle
10. Throttle Valve
11. Needle Jet
12. Rubber Cap, Starting System
13. Fitting, Starter System Plunger
14. Lever Assy, Starting System
15. Leaf Spring, Lever Positioning
16. Spring, Starter Plunger
17. Plunger, Starting System
18. Body, Mixing Chamber
19. Gasket, Float Chamber
20. Baffle Plate, Float Chamber
21. Pilot Jet
22. Pin, Float Arm Hinge
23. Float Arm
24. Float
25. Float Chamber
26. Gasket, Float Chamber Plug
27. Plug, Float Chamber
28. Air Correction Jet
29. Screw, Air Adjusting
30. Spring, Air Adjusting Screw
31. Spring, Idle Adjusting Screw
32. Screw, Idle Adjusting
33. Gasket, Needle & Seat Assy
34. Needle & Seat Assy
35. Cup, Fuel Retaining
36. Main Jet
37. Plate, Vent Tube Retaining
38. Screw, Float Chamber

Function of Carburetor

1-29 The function of a carburetor is to provide the engine with a combustible air/fuel mixture, by breaking fuel into tiny particles (in the form of vapor) and by mixing fuel with air in a proper ratio. A proper ratio means an ideal air/fuel mixture that can burn without leaving an excess of fuel or air.

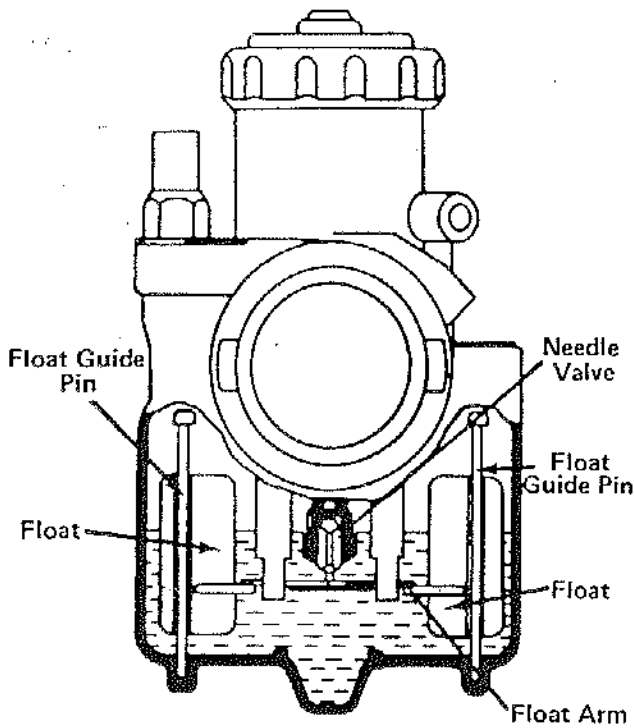
Functions and Construction of the VM Mikuni Carburetor

The two-cycle engine must operate under a wide range of conditions, from idle with the throttle valve almost closed to fullpower (maximum output) with the throttle valve opened. In order to meet the requirements for proper mixture ratio under these vary-

ing conditions, a low speed fuel system (pilot system) and a main fuel system are provided in the Mikuni VM-type carburetor. There are also three other systems built into the carburetor, they are the starting, mid-throttle and the float system.

1-30 Float System

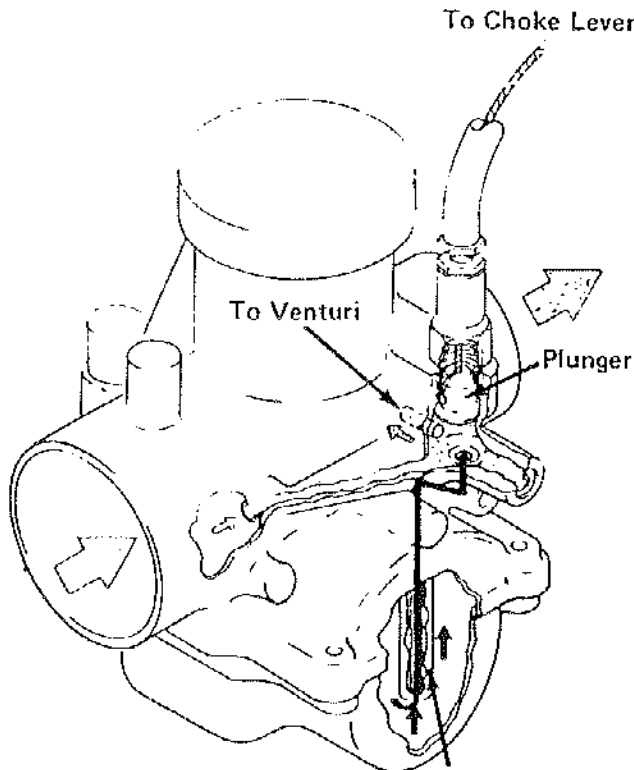
The float system is designed to maintain a constant fuel level in the float bowl during all phases of engine RPM. When the fuel flowing from the fuel pump into the float chamber reaches the constant fuel level, the floats rise. The buoyancy of the floats causes the float pins to contact the fuel inlet arm, which closes the needle valve and prevents further delivery of gasoline until the fuel level drops in the float chamber.



The fuel level in the float chamber controls the amount of fuel in the fuel mixture. Too high a level allows more fuel than necessary to leave the nozzle, enriching the mixture. Too low a level results in a leaner mixture, as not enough fuel leaves the nozzle. Therefore, the predetermined fuel level should not be changed arbitrarily.

2-30 Starter System

A starter system is provided in the Mikuni carburetor to provide the engine with a very rich mixture needed for starting a cold engine. Since the engine parts are cold and will not vaporize fuel droplets, the starter system must provide an even richer mixture to ensure ease in starting.

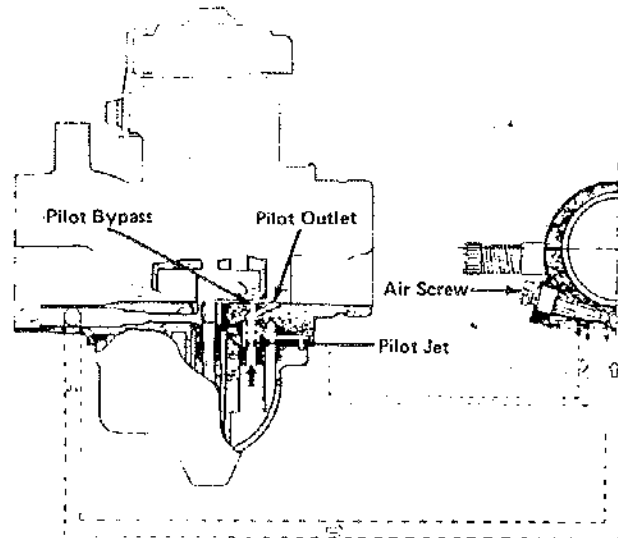


The starter system consists of a metering jet and a barrow shaped plunger, which opens an air passage from the front of the carburetor into the venturi, and a fuel passage from a well in the float bowl, see figure 9. The plunger is lifted by either a cable or lever. As the plunger is lifted off its seat, it first allows air to be drawn over the fuel passage from the float bowl, which in turn draws fuel through the starter jet and up through the starter emulsion tube. The fuel is mixed with air as it passes up through the emulsion tube and is again mixed with the air as it enters the venturi.

With the throttle slide in the start position (closed), almost all the air that goes to the engine must pass through the starter system passage. It is very important that the throttle slide be in the closed position when starting a cold engine. If the slide or throttle is opened during the starting procedure, the starting system will be bypassed and the engine will be very difficult to start.

3-30 Pilot System

The pilot system's main function is to meter fuel at idle and low engine RPM. Though it's main function is to supply fuel at low speed (idle to 1/4 throttle), it does supply fuel continuously, throughout the entire operating range.



Fuel for the pilot system is drawn from the float bowl up through the pilot jet. It is mixed with air regulated by the air screw and delivered to the engine through the pilot outlet. The mixture is regulated to some degree by adjusting the pilot air screw. When the air screw is closed, the fuel mixture becomes rich, as the amount of air is reduced. When the air screw is opened, the mixture is leaned as the amount of air is increased.

4-30 Pilot Jet

From idle to 1/4 throttle, the fuel supply is metered chiefly by the pilot jet. In the lower barrow of the pilot jet are several bleed holes. Air is bled through these openings to aid in breaking up the fuel into droplets and reducing the fuel to a mist for combustion. The number stamped on the jet is an indication of the amount of fuel in

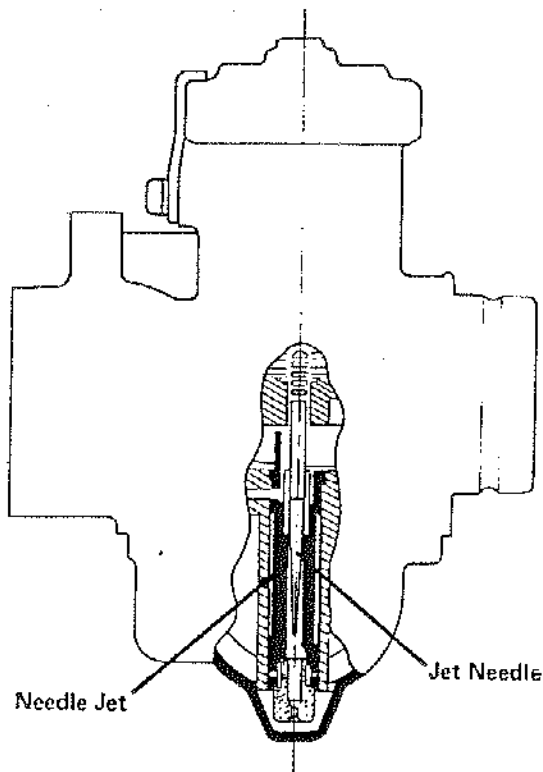
cc's which passes through the jet during a one minute interval under a given set of conditions.

5-30 Pilot Air Screw

The pilot air screw controls the mixture from idle to 1/4 throttle. The tapered tip of the air screw projects into the air passage leading to the pilot jet air bleeds. By turning the screw in or out, the cross-sectional area of the air passage is varied, in turn, varying the pilot jet air supply and changing the mixture ratio.

6-30 Jet Needle

The jet needle has five grooves located in its upper portion and is tapered from approximately the middle of the needle to the lower end. The top is fixed to the center of the throttle by the needle clip, and the tapered end extends into the needle jet. Fuel flows through the space between the needle jet and the needle. As the throttle valve is opened, the tapered needle is lifted upwards in the needle jet. The space between the needle and jet increases and allows more fuel to enter the venturi area. The jet needle along with the needle jet has the most effect on fuel mixture between 1/4 and 3/4 throttle. The top groove on the needle is the leanest mixture position with the bottom groove being the richest position.



7-30 Needle Jet

In addition to working together with the jet needle to meter the flow of fuel into the venturi during part (1/4 - 3/4) throttle, the needle jet has another important function. By causing the fuel to be broken into tiny droplets, which are easily vaporized when they come into contact with engine parts, the needle jet functions as a pre-

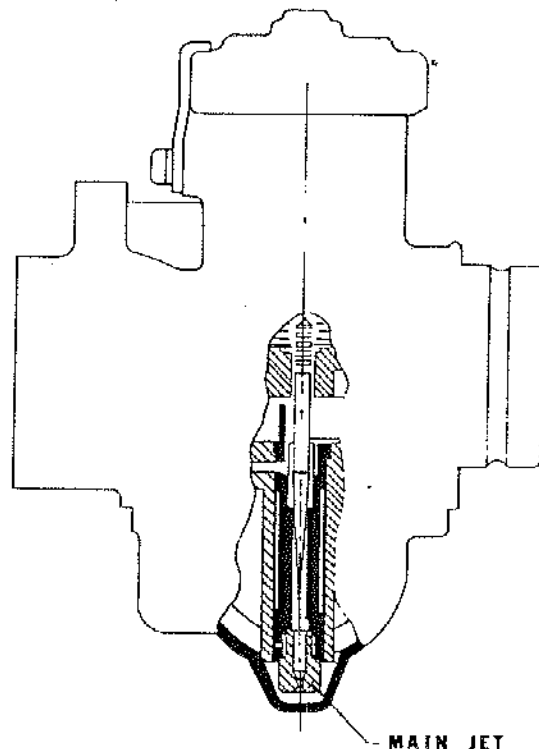
atomizer. Since fuel burns best when it is fully vaporized, this function of the needle jet actually helps improve the burning efficiency of the engine.

The needle jet commonly used with the two-cycle engines found in most ultralights is call the "primary type". The primary type jet, has a "reservoir" which surrounds the nozzle of the needle jet. This reservoir is connected by a passage-way in the carburetor body, located in the air intake barrow. Air passes into the passageway and enters the needle jet reservoir. It is here that the air arrives at a high velocity and aids in fuel atomization.

Surrounding two-thirds of the reservoir is a lip which extends up into the venturi. Facing towards the intake side of the carburetor, this lip, known as a primary choke, creates a turbulence behind itself where the reservoir and jet nozzle are located. At high RPM, this turbulence and the extra vacuum effect it creates, helps pull more fuel up from the float bowl.

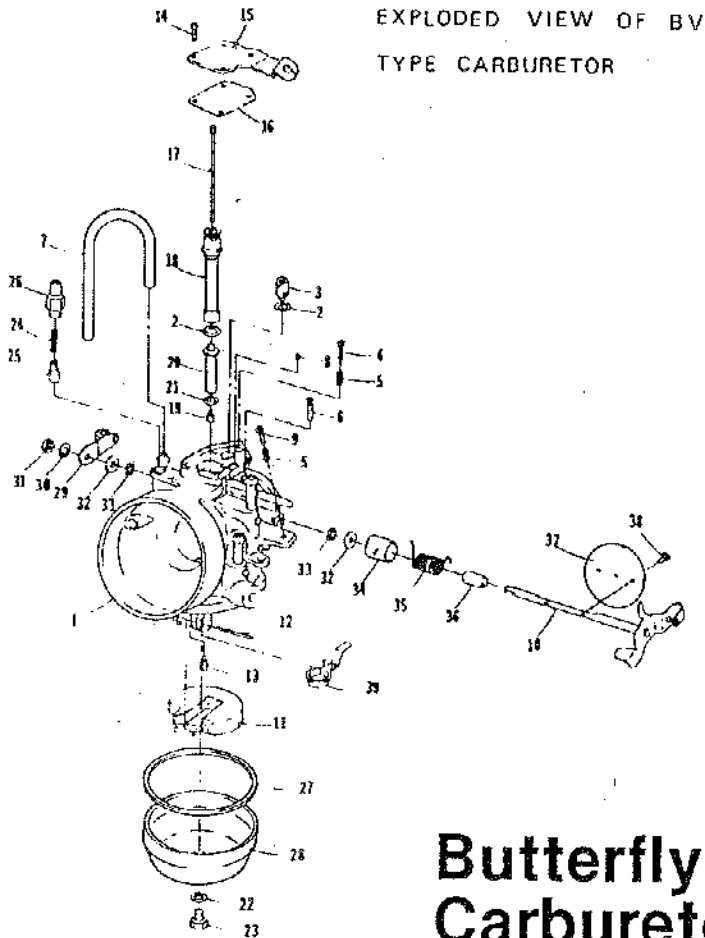
8-30 Main Jet

The last component of the main system is the main jet. Located at the bottom of the needle jet, the main jet controls the flow of fuel into the needle jet. As soon as the main system begins to meter fuel (at 1/4 throttle), the throttle slide cutaway, jet needle, needle jet and main jet all work together to deliver the correct amount of fuel to the engine for the amount of air entering it. This working relationship continues until about 3/4 throttle at which point the cross-sectional area of the main jet is the primary controlling factor determining how much fuel will be available. The main jet controls fuel flow from 3/4 to wide open throttle.



Mikuni BV-type Carburetors:

Key



EXPLODED VIEW OF BV TYPE CARBURETOR

- | | |
|------------------------|----------------------|
| 1. Carburetor Assembly | 21. O-Ring |
| 2. O-Ring | 22. Washer |
| 3. Jet Block | 23. Bolt |
| 4. Pilot Screw | 24. Spring |
| 5. Spring | 25. Plunger Assembly |
| 6. Pilot Jet | 26. Plunger Cap |
| 7. Hose | 27. Packing (O-Ring) |
| 8. Air Jet | 28. Float Chamber |
| 9. Screw | 29. Lever |
| 10. Throttle Shaft | 30. Lock Washer |
| 11. Float | 31. Nut |
| 12. Float Pin | 32. Packing |
| 13. Needle Assembly | 33. Seal |
| 14. Screw | 34. Hose |
| 15. Bracket | 35. Spring |
| 16. Gasket | 36. Ring |
| 17. Pipe | 37. Throttle Valve |
| 18. Nozzle | 38. Screw |
| 19. Main Jet | 39. Plate |
| 20. Jet Holder | |

Butterfly Mikuni Carburetor, Function and Construction

The Mikuni Butterfly Carburetor has four circuits: the starting circuit, idle circuit, part throttle circuit and full throttle circuit.

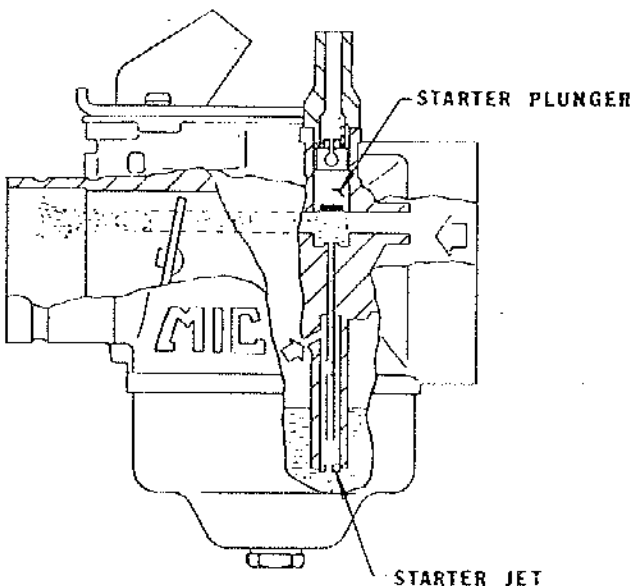
1-31 Starting Circuit

The Mikuni butterfly carburetor is equipped with an enrichment valve instead of a conventional choke plate for cold starting. The circuit consists of a starter jet, a starter plunger and a fuel passageway from the float bowl to the venturi.

The starter plunger is lifted by a choke lever to the side open position for cold starts. After the engine starts, it may be necessary to leave the choke lever in the open position several moments until the engine will remain running.

As the starter plunger is lifted off its seat, it allows fuel to be drawn up from the float bowl through the emulsion tube passageway. The starter jet meters the delivery of fuel into the emulsion tube.

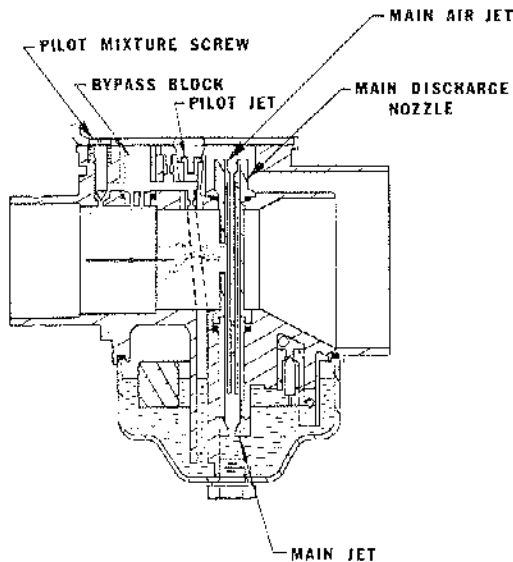
In order for this starting system to function, the throttle butterfly must be in the full idle position. If the throttle is opened or cracked even just a small amount, the starting circuit will not be effective.



2-31 Idle Circuit

The idle circuit is responsible for metering the fuel/air mixture from idle to 1/8 throttle. The circuit consists of a pilot jet, a pilot mixture screw, a pilot air jet and a system of passageways through the body of the carburetor.

HIGH SPEED

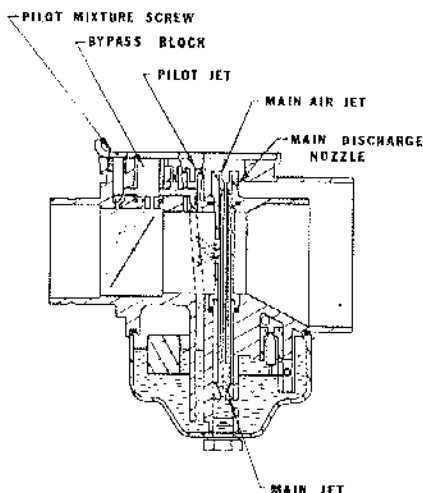


As the engine idles, the throttle valve is nearly closed creating a low pressure area behind the throttle butterfly. The pilot outlet is located in the low pressure area. The low pressure area at the pilot jet and through the passageways. As fuel leaves the pilot jet, it is mixed with air provided by the pilot air jet. This fuel/air mixture is metered by the pilot mixture screw as it passes past the screw tip.

3-31 Part Throttle Circuit

Fuel is delivered to the engine during part throttle through the pilot jet and then the bypass block.

PART THROTTLE

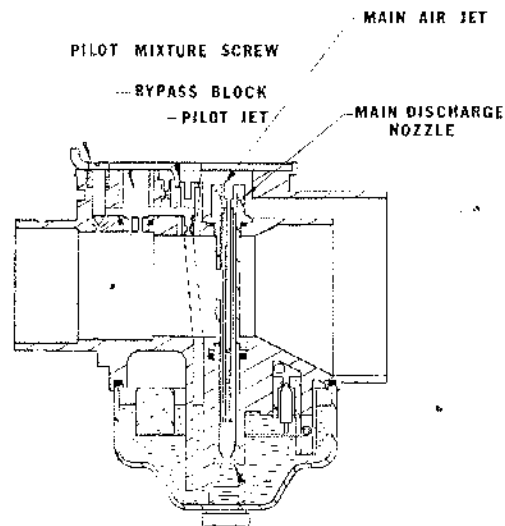


The part throttle circuit affects fuel discharge from 1/8 throttle to 3/8 throttle. As the throttle valve is opened, engine RPM increases, the additional fuel required from the carburetor is supplied from primary and secondary discharge ports of the bypass block. Air from the pilot air jet is pre-mixed with the fuel from the pilot jet enroute to the bypass block.

4-31 High Speed Circuit

The correct fuel/air mixture required by the engine during high speed operation (3/8 throttle to wide open throttle) is delivered by the high speed circuit and metered by the main jet. Other components which make up the high speed circuit are the main air jet and main discharge nozzle. All components work together to provide the engine with the correct fuel/air mixture during 3/8 to wide open throttle operation.

IDLE

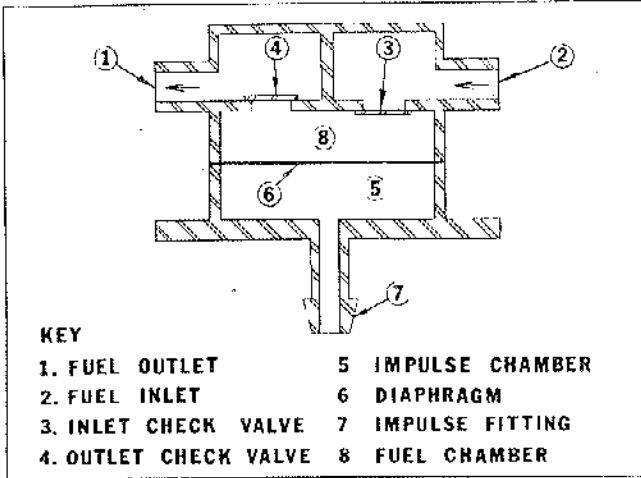


MAIN JET

As the throttle valve reaches 3/8 throttle, fuel is drawn up through the main discharge nozzle by the low pressure area in the venturi. The amount of fuel entering the main discharge nozzle is metered by the main jet located at the nozzle end in the float bowl. Air is drawn down through the top of the main discharge nozzle and is metered by an air jet located at the top of the nozzle. The fuel and air are pre-mixed in the main nozzle and discharged into the venturi.

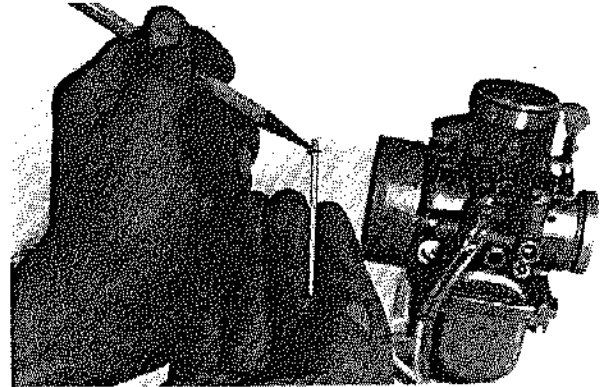
1-32 Fuel Pump Operation

The Mikuni fuel pump has proven itself to be very dependable, operating in temperatures as low as -65°F.



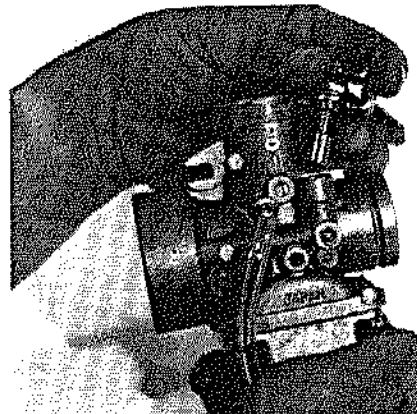
The fuel pump diaphragm is activated by crankcase impulses. As the piston moves upward in the cylinder, a vacuum is created in the crankcase, which is transmitted via the impulse hose to the impulse diaphragm (item 6). The impulse diaphragm is then flexed into the impulse chamber (item 5) and the inlet check valve (item 3) is forced open and fuel flows into the float chamber (item 8) through the fuel inlet. As the piston moves downward in the cylinder, it creates pressure (primary compression), which is again transmitted to the impulse diaphragm to flex into the fuel chamber (item 8), the outlet check valve (item 4) is forced open, and the inlet check valve is closed. The pressure increases within the fuel chamber which forces fuel out the outlet check valve.

2-33 Remove the jet needle from the throttle slide. Pull spring up out of the slide area. While holding the spring, push up on tip of the needle. Lift retaining plate and the needle from the slide. Note the E-clip position for assembly purposes.



3-33 Inspect the jet needle for wear in the E-clip groove area and down the tapered sides of the needle. If the groove in which the E-clip is installed, is worn and the E-clip doesn't fit tight, replace the needle. The needle should be replaced with the same numbered or size needle. The size of the needle is stamped on the needle towards the top.

4-33 Remove the choke plunger, check the condition of the neoprene seal at its bottom. Any nicks or cuts in this area will cause leakage and a rich mixture condition.

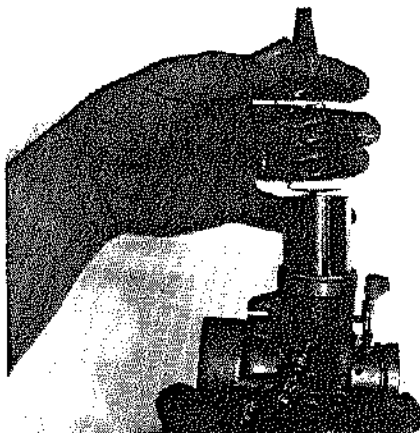


VM Mikuni

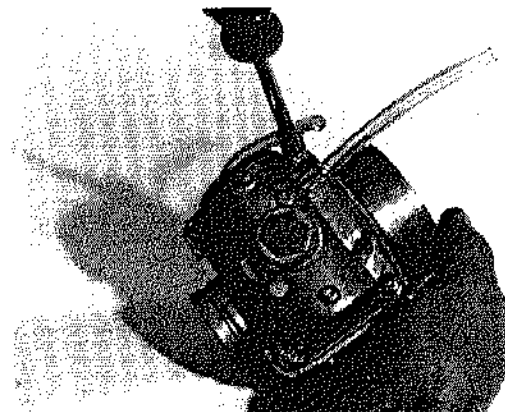
DISASSEMBLY & INSPECTION

NOTE: Before disassembling the carburetor, clean the outside of the carburetor thoroughly with parts washing solvent. Do not use any harsh carburetor cleaning fluids.

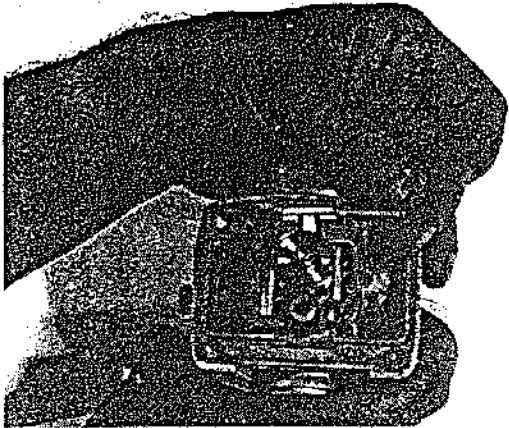
1-33 Remove the slide valve by first removing the cap from the top of the carburetor. Inspect the slide and slide bore for nicks or burrs which may cause sticking. Remove any rough areas using very fine (600 grit) wet or dry sandpaper or replace with new part.



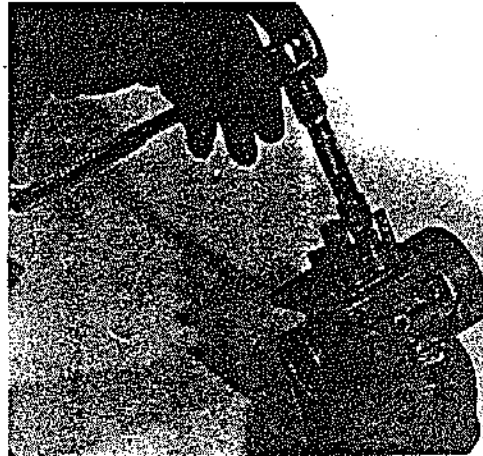
5-33 Remove the four screws that secure the float bowl to the main carburetor body. Lightly tap on the side of the float bowl to free it from the body of the carburetor.



6-33 Remove the float arm pin. Use a small pin punch and gently tap the pin out of the pin bore. Because of the large head, the pin can only be removed one way. Remove the float arm, being careful not to bend or damage it.



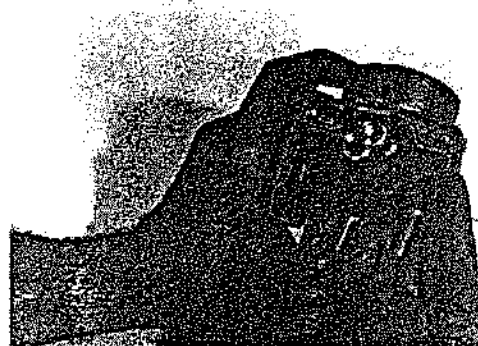
9-33 Remove the inlet needle and seat assembly using a 9mm socket. Inspect the inlet needle tip for wear.



7-33 Remove the main jet using a mainjet wrench or a 5mm socket. Lift the main jet cup from its mounting area.



10-33 After removing the inlet needle seat, account for a red hard paper gasket, splash plate and another gasket washer. Inspect each gasket washer to be sure neither are cracked. If they do not seal, a high float level and a rich condition will exist.



8-33 Using a small screwdriver, push the needle jet out through the top of the carburetor.



11-33 Using a small screwdriver, remove the pilot jet.

