SERIES

1-40

McCULLOCH SHOP MANUA

1-50

1-60

CHAIN SAWS

McCULLOCH CORPORATION
6101 West Century Boulevard,
Los Angeles 45, California

SUGGESTED PRICE—FIVE DOLLARS

PART NO. 6027(

SHOP MANUAL

Covering McCulloch
Chain Saw Models:

1-40	1-52
1-41	1-53
1-42	1-60
1-43	1-61
1-45	1-62
1-46	1-63
1-50	1-62L
1-51	1-63L

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LITHO IN U.S.A.

Foreword

This shop manual is a compilation of material intended to provide information necessary or helpful to the disassembly, repair, overhaul, parts replacement, and reassembly of McCulloch chain saw engines for the following models: 1-40, 1-41, 1-42, 1-43, 1-45, 1-46, 1-50, 1-51, 1-52, 1-53, 1-60, 1-61, 1-62, 1-63, 1-62L, and 1-63L.

Model 1-62L and 1-63L are designations of chain saws made available for European operators. These models correspond to the Models 1-62 and 1-63 chain saws respectively, with only minor structural differences for more adaptability to cutting conditions prevalent in European countries.

Model 1-62L and 1-63L saws use the right-hand bar mounting option, and are further characterized by the starter mounting on the left-hand side of the saw similar to the 1-50 Series saws. Except for these differences, all information in this manual pertaining to the Model 1-62 and 1-63 saws, applies equally to the Model 1-62L and 1-63L saws.

While the general similarity of the sixteen chain saw engines covered in this manual makes it possible to include them all under one cover, it is important to know and remember that significant differences do exist and reasonable caution should be observed to avoid confusing service procedures. These differences are noted in the text where they affect the instructions given or the procedures described.

To make this manual most useful to the service man, it is divided into twelve main sections, each pertaining to a general subject or phase of service. Most of the main sections are further divided into sub-sections for more specific information pertaining to the general subject. In some cases, and wherever necessary, the sub-sections are still further divided for detailed information.

A page for notes will be found at the end of each main section. This page, titled "Service Bulletin Reference", is for the entry of information subsequently received through Service Bulletins. These bulletins, when properly filed, furnish a valuable and ready reference to service development, and manual holders are urged to keep their files up to date. The material presented in this shop manual can be used without reference to any other literature but it will be helpful to the service man to have an Illustrated Parts List for the engine being serviced, to which he can refer for part name or number.

In addition, this manual includes general information concerning service shop operation and practices which have been developed by qualified technicians.

Compiled by the Service Department
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U.S.A.

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General Information

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Warranty

Under terms of the McCulloch chain saw warranty, customers must direct all claims through a distributor or his authorized dealer. There is no direct contact between the customer and the factory. As the sole channel of communication therefore, it is important that the distributor and his dealer have a clear understanding of both the terms of warranty and the procedures which have been established for maintaining warranty policy.

Only by careful control and close attention to established procedures can the full benefits of the warranty program be obtained. Of these benefits, there are at least four of major importance; others may be realized on occasion.

First, there is the matter of protection. Under the terms of warranty, the company is afforded a necessary protection against claim or demand by the customer which may be unjustified or in extreme cases even fraudulent. This amounts to an insurance against profit loss through no fault of the product or its performance.

Second, there is the valuable time saved by close attention and adherence to instructions covering report of warranty material on proper forms, and the disposition of parts or units involved.

Third, the liberal provisions of warranty policy may be applied to building customer goodwill and improving public relations. These provisions thus permit warranty policy to be used as a sales tool and lend strength to promotional efforts.

Fourth, through well understood and closely followed warranty procedures, the factory is able to compile accurate and essential information from defective part reports or returned warranty materials. From this information, field needs and conditions may be analyzed and corrective action taken. This action leads to and supports the product improvement program, and eventually is returned to the dealer in more sales and greater profits.

Other benefits to be realized from the improvement program are new tools for better service and the development of new and better service techniques.

Factory Authorized Parts

The maintenance of product quality depends upon strict adherence to the standards of material, machining, heat treatment, dimensions, manufacturing tolerances, and assembly. If quality standards are to be maintained, there can be no deviation from specifications established for each part or assembly, or any substitution for a part by something "just as good".

Each part of a McCulloch chain saw or engine is designed for a specific use or purpose. Each part is also designed to complement each other part in the assembly and to form an integrated whole of consistently high quality. This is why so much emphasis is placed on the quality of the part and why service replacement is restricted to factory authorized parts. Use of these parts, available from factory stock, will contribute to the quality maintenance program and avoid many needless complaints of poor performance or service.

It should also be remembered that a close relationship exists between the use of only factory authorized parts in the repair of chain saws and the warranty policy of the company.

Ten Hour Check-Up

The first few hours of running of either a new engine or an overhauled and repaired engine is usually a very critical time of operation. During these first hours, any defects, flaws, or maladjustments will become evident and the service life of the engine can be seriously affected. If discovered in time, small operational faults can be prevented from becoming large, serious, and costly. A customer's satisfaction with the product or the service is also determined to a great extent by his early experience with the engine. Several important advantages may be obtained by the service man through a policy of offering a ten hour check-up on a new engine or one which has been in the shop for repair and overhaul. Such a policy will provide the opportunity to catch the small faults before they become large, and to discover other things which may have been overlooked when the repair work was performed. The customer too, will appreciate the interest of the service man and have more respect for the product and its proper maintenance.

The first step in a ten hour check-up is to find out from the customer how the saw and the engine are performing. Ask him about its performance, if he has any complaints, if he has noticed any faults, or has experienced any difficulty in starting or making adjustments. If any of these faults are mentioned, they provide clues for immediate check into the probable trouble spots and a quick correction. Even with no difficulties experienced however, a careful check should be made of the saw and engine to forestall later development of poor performance.

This check should show at least the following facts:

1. All nuts, bolts, and screws are tight.
2. Guards and covers are clean.
3. The starter ratchet engages smoothly and firmly.
4. The ignition switch works properly.
5. The engine starts quickly and easily.
6. The fuel adjustment needles are properly set to provide smooth, rapid acceleration and the correct full throttle mixture.
7. The bar and chain are installed properly.
8. The chain is at proper tension.
9. The clutch engages at proper speed.
10. The chain oiler works properly.

Check the condition of the filters, cylinder fins, sawdust guard, and muffler. Look for gray or white discoloration on the muffler, indicating too much heat from an over-lean carburetor setting with resultant damage to the engine. Examine the spark plug and check the spark for color and strength.

If all points checked are satisfactory, ask the customer if he has any questions on care, operation or adjustment. Make sure that he fully understands the importance of proper care and cleanliness.

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SECTION II
Your Shop

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THE CLEAN SERVICE SHOP

DIRT is one of the most harmful enemies an engine can have. It is very important therefore, that the engine, its parts, and the working area be kept as clean as possible when any work or repair is done on it.

Make sure that the work bench and surrounding area are clean before starting to work on any engine. Dirt from a scarred-up, grime-covered work bench can be transferred to parts being worked on and undo all efforts to do good work. Clean the work bench frequently or cover it with masonite or linoleum.

Have clean containers at hand to hold engine parts to keep them from becoming lost or mislaid. Plastic egg cups or biscuit tins do very nicely for screws, washers, nuts, and other small parts. Use bread tins or coffee cans for the larger parts.

The floor is another source of contamination that should not be overlooked. If masonite or linoleum is put down, it will be easier to keep the floor clean and will also help to prevent loss of small parts that may drop from the bench while working.

When an engine comes into the shop for repair or overhaul, clean the exterior thoroughly before starting to work. Scrape all the accumulated sawdust, dirt, and grease off the engine with a stiff bristle brush. Use commercial solvent to help remove the dirt. As the engine is taken apart clean all parts in solvent. Dry them with compressed air. Don't use rags or cloth because bits of cloth, threads and lint can be caught in the engine and sucked into the combustion chamber or crankcase and cause excessive wear on the engine interior before they can be destroyed. When finished with the repair work, clean the outside of the engine again, removing all dirt, grease, fingerprints, etc. Many dealers keep a spray can of McCulloch yellow paint on hand to touch up bare spots on the saw before returning it to its owner.

In cleaning an engine or any of its parts, do not use any kind of sand blasting in the shop. The sand is almost impossible to remove from small parts and especially from around the electrodes of spark plugs. Sand can cause extremely rapid wear on any engine. The same work with better results can be obtained with hand tools and solvent.

Be sure to use not only clean tools but correct tools. Never try to work with makeshift or something just as good. Use the proper size screwdriver, neither too large or too small for the screw, for if the slot is damaged, it will be almost impossible to remove later on. A worn and rounded screwdriver bit will ruin more screw heads than it can tighten properly. The wrong size wrench (or one even slightly larger) will round off the heads of hex head screws, bolts, and nuts. Broken screws sometimes result from using a wrench with a handle too long and applying too much torque. Hand tools kept in good condition indicate mechanical care and know-how. A clean, well conditioned saw after repair work is the mark of a good service man. Customers will recognize the mark and appreciate the effort.

Always keep replacement parts in their cartons or wrappers until ready to use them. If parts are unwrapped, they are very apt to get dirty, and there is always a risk of either losing them or getting them mixed up with others which are similar.

REMEMBER, a clean, well kept shop, customer satisfaction and more business go hand in hand.

GENERAL TOOLS AND EQUIPMENT

The usual hand tools used by an automobile mechanic are satisfactory to work on the chain saw engines covered in this shop manual. The following hand tools are considered to be the most useful or necessary.

Set of box and open end wrenches (combination) 1/4- to 1-inch size

Set of 1/4-inch and 3/8-inch drive socket wrenches from 3/16-inch thin wall to 1-inch size

Assorted Allen keys

Deep socket spark plug wrench, 13/16-inch

Assorted blade type screwdrivers up to 5/16-inch

Assorted drills, 1/16-inch to 1/2-inch size. (Letter drills, number drills, drill size chart.)

Rat-tail file, 1/8-inch

Fine cut flat file, 1/2-inch

Ignition point file or stone

Sharp pointed punch

Flat end punch, 5/16-inch

Drift punch, 1/8-inch

Chisel, 1/4-inch

Needle nosed pliers

Side cutters

Feeler gauges

Wire gauges

Flywheel puller

Seal protectors

Clutch puller

Wire brush

Small machinists hammer

Soft face plastic or rawhide hammer

Piston ring expander

Piston ring compressor

Speed indicator (Vibra-tak or equivalent)

Compression gauge

Timing light (continuity test type)

*Torque wrench, 3/8-inch drive, with 1/4-inch and blade screwdriver adapters, to 500 inch-pounds.

*The torque wrench is one of the most important tools in the service shop. The torque wrench is used to tighten all bolts and screws correctly and to the specified values listed in assembly or reassembly of the chain saw engine. Incorrectly tightened screws or bolts will reduce engine performance and life. When a screw or bolt is too loose or too tight, it can cause air leaks, blown gaskets, and warped or out-of-round parts. The screws and bolts in the chain saw engine should always be tightened to the torque value specified in the instructions for reassembly after repair or overhaul.

Your shop should have the following equipment to perform a satisfactory repair or overhaul on chain saw engines.

Work bench

Air compressor with hoses and nozzles

Drill press

Bench vise with soft face adapters

Arbor press

Heat lamp (375 watt) and/or heat oven

Coil, condenser, and continuity tester

Drill motor (1/4-inch chuck)

Cylinder hone (will require heavy duty drill motor)

McCulloch oil (for fuel mixture)

Container for fuel mixture

Oil (SAE 30 for general use)

Gear grease

Commercial or industrial solvent

Suitable containers for liquids

Carbon tetrachloride

Plio-bond cement (or equivalent)

Tank to wash parts

Emery cloth, fine to coarse grits

McCulloch yellow spray paint

An extremely useful addition to the shop tools and equipment listed, is a set of test parts which are used only for testing and trouble shooting. These parts, listed below should be plainly marked in a distinctive color or easily identified for test purposes only, and known to be of good quality.

Spark plug

Condenser

Coil

Flywheel

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

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SECTION III
Trouble Shooting and Testing

INDEX

Service shop work on chain saws and engines will usually fall into one or the other of two classifications: (a) Complete overhaul, and (b) Trouble shooting.

Complete overhaul means disassembly of all components and a thoroughness of examination, testing, repair or parts replacement that must necessarily require several hours of shop work. The owner of the equipment, realizing this fact, will ordinarily make allowance in his work schedule for the time loss involved. Trouble shooting, on the other hand, is a type of shop work arising from one or more operating faults which may be diagnosed and corrected in relatively short time.

Whether the saw is in the shop for a complete overhaul or for trouble shooting, efficient shop service demands that the work be completed in the shortest time consistent with good quality. There will always be more urgency however, in the trouble shooting job of the service man, and it is in this type of work that systematic methods of approach will be most valuable in saving time and reducing lost motion.

There are also two methods or approaches to trouble shooting. The first is an approach to solve the problem arising from a specific complaint and a known fault, such as the owner's remark that "the engine overheats", or that "it won't idle". Trouble shooting in this case could be termed "Trouble Shooting Specific Faults".

The second approach is concerned with the location of a trouble which is not identified and there is no clue to the actual fault. In a case of this kind the complaint may be only that, "the engine won't run good", and the service man must then proceed to solve the problem by process of elimination. This second approach might be termed "Trouble Shooting - General".

Both of these trouble shooting procedures are covered under separate headings on the pages that follow. They are treated in two sections with charts for easy reference to the most common troubles encountered in service shop work.

It should be noted that the complaints or faults charted on the following pages are those that are most commonly found in service work, and present most of the problems to be solved in the shop. There are others, perhaps, that could be included, and it is suggested that when such others are encountered, the information should be passed along for the benefit of others doing the same type of work.

TROUBLESHOOTING SPECIFIC FAULTS

FAULT	TROUBLE AREA	POSSIBLE CAUSE	SECTION	PAGE
Engine Won't Start, Hard to Start, Cuts Out, Misfires	Fuel System	No fuel	XI	118
		Wrong mixture		119
		Dirty or watered fuel		118
		Dirty or watersoaked filter	VIII	66
		Broken or plugged passages		77
		Plugged vents		68
		Cut or leaking fuel line		80
		Fuel Pump		
		Diaphragm damaged		75
		Filter plugged		77
		Pulse passage plugged		79
		Carburetor		
		Adjustment needles damaged or wrong adjustment		75
		Gaskets damaged		75
		Diaphragms damaged		78
		Inlet valve dirty		78
	Ignition System	Spark plug fouled, wrong gap, or insulation broken	VII	53
		Wiring connections loose or insulation frayed		54
		Incorrect spark plug		53
		Switch grounding out		49
		Switch in "OFF" position		49
		Breaker points burned, dirty, wrong gap, or poor ground		53
		Incorrectly timed		57
		Lamination - wrong air gap		59
		Condenser faulty or poor ground		54
		Coil damaged		54
		Magnet faulty		56
	Mechanical System	Cylinder cracked	X	100
		Cylinder head screws loose		112
		Cylinder head gasket damaged		112
		Rings worn		104
		Flywheel key sheared		104

TROUBLE SHOOTING SPECIFIC FAULTS (Cont)

FAULT	TROUBLE AREA	POSSIBLE CAUSE	SECTION	PAGE
Engine Won't Start, Hard to Start, Cuts Out, Misfires (Cont)	Mechanical System	Seals leaking	X	105
		Loose or missing welch plugs (cylinder)		100
		Damaged reed valve (and/ or seat)	VIII	72
		Loose fuel tank or airbox		67, 73
Engine Floods	Fuel System	Tank not venting	VIII	68
		Tank leaking		67
		Fuel Pump Diaphragm damaged		75
		Carburetor Diaphragm damaged		78
		Inlet valve damaged		78
		Adjustment needles damaged or wrong adjustment		75
		Choke stuck		72
		Needle seats damaged		75
		Welch plugs leaking		78
Engine Overheats	Fuel System	Wrong fuel mixture	XI	119
		Carburetor	VIII	78
		Diaphragm damaged Inlet valve damaged		78
		Adjustment needles damaged or wrong adjustment		75
		Air leaks		75
		Filters dirty		66, 77
	Ignition System	Wrong timing	VII	57
		Incorrect spark plug (heat range)		53
	Mechanical System	Sawdust guard dirty or plugged	VII	50
		Air leaks (seals & gaskets)	X	106
		Cylinder fins dirty	II	6
		Flywheel vanes broken	VII	51
		Muffler dirty or plugged or loose	V	33
		Fan housing loose	VII	50
		Crankcase cover damaged	X	110
		Spark plug cover missing	VII	56
Engine Lacks Power	Fuel System	Carburetor adjustment wrong	VIII	75
		Fuel Filter watersoaked or dirty		66

TROUBLE SHOOTING SPECIFIC FAULTS (Cont)

FAULT	TROUBLE AREA	POSSIBLE CAUSE	SECTION	PAGE
Engine Lacks Power (Cont)	Fuel System	Air filter dirty	VIII	72
	Ignition System	Wrong timing	VII	57
	Mechanical System	Rings worn	X	104
		Muffler dirty or plugged	V	33
		Exhaust ports plugged	X	101
		Cylinder scored		100
		Piston scored		101
		Piston rings worn, stuck, or broken		104
		Cylinder head gasket loose		112
		Oil seals damaged		105
		Air leaks		105
Engine Starves On Acceleration, Idles Too Fast	Fuel System	Filters plugged or dirty	VIII	66, 77
		Carburetor		
		Adjustment needles wrong adjustment		75
		Inlet valve damaged		76
		Inlet control lever bent		78
		Idle adjustment screw wrong setting		75
		Air leaks		75
Engine Starts, Runs Briefly, Stops	Fuel System	Fuel tank vent partly plugged	VIII	68
		Water in fuel mix	XI	118
		Air filter dirty or plugged	VIII	72
		Air leaks		75
		Carburetor		
		Inlet valve dirty or plugged		78
		Diaphragm defective		78
		Fuel passages dirty		77
Engine Won't Run Full Speed	Fuel System	Carburetor	VIII	
		Diaphragm defective		78
		Inlet valve dirty		78
		Filters dirty		72
		Vent partly plugged		77
		Butterfly not fully open		81
		Wrong needle adjustment		75
	Ignition System	Wrong timing	VII	57
		Plug breaking down high RPM		53

TROUBLE SHOOTING SPECIFIC FAULTS (Cont)

FAULT	TROUBLE AREA	POSSIBLE CAUSE	SECTION	PAGE
Engine Won't Run Full Speed (Cont)	Mechanical System	Muffler dirty	V	33
		Exhaust ports plugged	X	101
		Filters dirty	VIII	66, 77
		Rings worn	X	104
Chain Oiler Won't Work	Mechanical System	No oil	XI	119
		Oil too heavy or stiff		119
		Pump dirty	VIII	66
		Outlet plugged		67
		Seals leaking		67
		Valve assembly leaking		67
		Plunger bore worn		67
Clutch Slips	Mechanical System	Shoes worn or stuck	VI	38
		Incorrect retaining ring	IX	86
		Chain filed improperly or too tight on bar	III	17
Clutch Drags, Rattles	Mechanical System	Shoes stuck	VI	33
		Spring broken, too large or too weak	IX	86
		Drum out-of-round	VI	38
		Clutch drum bushing worn		40
		Incorrect retaining ring	IX	86
		Shoes excessively worn	VI	38
Starter Slips	Mechanical System	Pawls broken or worn	VII	47
		Pawl spring broken		51
		Ratchet worn		46
		Bushings worn		47
Starter Does Not Rewind	Mechanical System	Spring broken	VII	51
		Spring tension wrong		49
Transmission Noisy, Rough	Mechanical System	Gears broken or worn	IX	89
		Bearings broken or worn		90
		Lubricant wrong type (too heavy, too light, or none)		88
		Idler gear yoke loose or cracked		89

On the pages immediately preceding, we have listed a number of engine faults with a trouble area and possible cause for each. Starting with the complaint as a guide, the service man can go to the most probable spot and, with reasonable certainty, arrive at a quick solution to the problem. This approach to trouble shooting however, will not be possible if there are no definite clues to the trouble or as may be the case frequently, there are several faults to be located.

Most chain saw engine faults can be traced to one or more of three areas and may be divided into three related but individual types as follows:

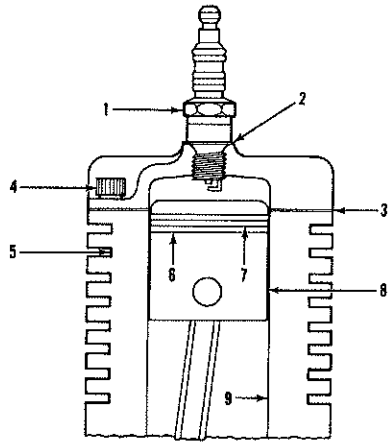
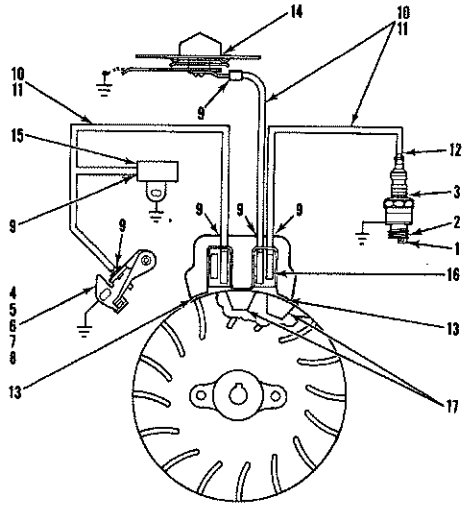
1. Those caused by mechanical malfunctions,
2. Those caused by one or more faulty elements in the ignition system,
3. Those found in the fuel system.

These three types of trouble may be further divided into groups of more specific faults for individual examination. In this method of trouble shooting, the service man checks the areas of possible trouble in sequence and solves the problem by process of elimination.

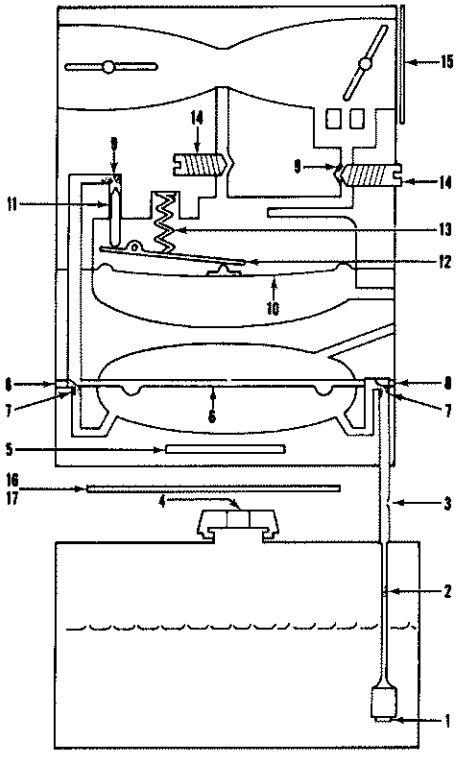
An outline of trouble spots and the areas in which they may be found, are shown in the pages which follow. An acceptable procedure for general trouble shooting is also included. Experience has shown this procedure to be effective in solving most of the problems encountered in trouble shooting. Some of the possible causes of trouble listed in this outline may be quite obvious from only a quick examination of the saw. Such things as a switch turned off, an empty fuel tank, or a disconnected spark plug can be spotted quickly. Always look the engine over carefully for any such obvious reason for malfunction.

Pull the starter rope through and try to start the engine if possible, then begin the check-out procedure. Also, don't forget to examine the chain. A dull or improperly sharpened chain can give the misleading impression of low power or other engine faults.

TROUBLE SHOOTING - GENERAL

FAULT	POSSIBLE CAUSE
Poor Compression  	Compression loss to the atmosphere 1-Loose spark plug 2-Defective or missing spark plug gasket 3-Defective or loose cylinder head gasket 4-Loose or missing cylinder head screws 5-Cracked cylinder crankcase Compression loss to the crankcase 6-Broken or worn piston rings 7-Broken or worn piston lands 8-Scored piston 9-Scored cylinder
Weak Or No Spark (Ignition System)  	Spark plug 1-Fouled 2-Wrong gap 3-Cracked or dirty insulation Breaker points 4-Dirty or greasy 5-Burned or pitted 6-Wrong gap 7-Poor alignment 8-Breaker block worn Wiring 9-Loose terminals 10-Broken wires 11-Frayed insulation 12-Connector pulled from lead Lamination 13-Wrong air gap Switch 14-Grounding out or in "OFF" position Condenser 15-Defective Coil 16-Defective Magnet 17-Weak

TROUBLE SHOOTING - GENERAL (Cont)

FAULT	POSSIBLE CAUSE
Insufficient Or No Fuel (Fuel System) 	Fuel Supply 1-Filter dirty 2-Passages plugged 3-Hose cut 4-Cap not venting Fuel Pump 5-Filter dirty 6-Diaphragm defective 7-Passages plugged 8-Gaskets installed improperly Carburetor 9-Passages dirty 10-Diaphragm defective 11-Inlet valve dirty or damaged 12-Inlet valve lever bent 13-Inlet valve spring deformed 14-Adjustment needles deformed or out of adjustment 15-Wrong mounting gaskets Reed Valve 16-Broken 17-Not seating

TROUBLE SHOOTING PROCEDURE

In the trouble shooting procedure described here, the service man should have at his disposal the following test units and equipment:

Spark Plug
Condenser
Coil
Flywheel and Magnet Assembly
Compression Gauge
Timing Light

The test units should be at full strength, in perfect condition, and known to be completely reliable when used in a substitution test.

Check Compression

Check compression of the engine by pulling on the starter rope and turning the crankshaft through several revolutions. There should be strong resistance on the compression stroke with a definite "bounce" as the piston comes up to top dead center. If the point of greatest resistance cannot be found, or there is a noticeable lack of "snap-back," the trouble is probably poor compression. This can be confirmed by measurement. If there is any doubt, a check should be made.

Remove the spark plug and install a compression gauge in the spark plug hole. Pull the starter rope for at least six pulls or until the gauge needle no longer rises. The compression gauge should read a minimum of 90 pounds per square inch. A reading below 90 P.S.I. can indicate any of the troubles listed in the preceding chart, broken ring lands, an out-of-round cylinder, or rings that have lost flexibility because of operation under conditions of extreme heat.

When tests and checks show poor compression, look first for the most common causes such as a missing or damaged spark plug gasket, missing or damaged cylinder head screws. Such faults can be quickly corrected and the engine rechecked for improvement. The more serious faults such as a damaged piston or cylinder will require a complete engine tear-down.

If compression is found to be satisfactory, proceed to the next step, a check of the ignition system.

Checking The Ignition System

When the spark plug removed from the engine is wet with unburned fuel, it is a good indication that the engine trouble is in the ignition system. To check this, ground the spark plug to the engine, pull the starter rope, and watch for the spark to jump the spark plug gap. If no spark occurs or if the spark is weak and has a yellow appearance, examine the electrodes. If they are burned away leaving the gap too wide, or they are bent and touching each other, or completely fouled, no arcing can occur. A heavy coating of dirt and grease on the outside of the porcelain will also ground the current and prevent an arc at the electrodes. Clean the plug thoroughly and set the gap to 0.025 inch (0.635 mm). If this does not cure the trouble, substitute the test spark plug and repeat the test. A strong blue spark with the test plug will show that the original plug is at fault. If there is still no spark, or it is very weak, continue the check of other components of the ignition system.

NOTE

Abrasive cleaning (sand-blast) of spark plugs is not recommended.

To see if the ignition switch is shorting out the coil, remove the fan housing which supports the switch, and check again for a spark. Examine the wiring for frayed insulation or a bare wire grounding out on the engine. Look for loose, broken, or disconnected wires. Check the lamination gap. It should be a minimum 0.008-inch (0.203 mm) and a maximum 0.012-inch (0.305 mm). Re-set if necessary and repeat the spark test. If there is still no spark, check the breaker points and the timing. The breaker point surfaces should be clean, bright, smooth; and in good alignment. The breaker point gap should be 0.018-inch (0.457 mm) when the points are in the fully open position. Clean the points and re-set the gap if necessary. This may be done most accurately with the use of a timing light.

Continue the check of the ignition system by testing the condenser and the coil. Both may be checked by substituting test units which are known to be good or on a coil tester. The condenser should be checked first, with a spark test after each part substitution. While it is very unlikely that the ignition will be faulty because of a defective magnet, it too can be checked by substitution of a test flywheel and magnet assembly in the same way that the other test units are employed. This completes the check of the ignition system with the result that any possible faulty component has been located and corrected either by repair, adjustment or replacement. With a strong blue spark and good compression as first established in the trouble shooting procedure, the third phase is a check of the fuel system.

Checking The Fuel System

It is entirely possible that a malfunction of the fuel system would be discovered when the spark plug was removed from the engine. The absence of wet fuel at the plug would indicate that no fuel was reaching the combustion chamber. This can also be checked by placing a thumb over the spark plug hole and pulling the starter rope several times, but be sure that the stop switch is in OFF position. If the fuel system is working properly, fuel will be discharged into the combustion chamber and your thumb will become wet with the fuel mixture in the chamber. If not, check to see if the fuel mixture is reaching the carburetor. Remove the air cleaner cover, air cleaner screen, and air cleaner attachment stud in the top of the carburetor. Removal of this stud will open the fuel passage between the fuel pump and the carburetor on Tillotson carburetors, used on all engines covered in this manual except the Model 1-45 and 1-46. Pull on the starter rope several times. If the fuel pump is working properly, fuel will be pumped out of the open passage and the stud hole.

Lack of fuel at this point can be caused by a defective fuel pump, damaged or obstructed pulsation passage, or by a plugged or cut fuel inlet hose, fuel tube, or fuel pickup filter. Check all elements between the fuel tank and the fuel pump. Loosen the fuel hose at the fuel pump connection and blow air through it. If the passages are open, air will be heard bubbling up through the fuel in the tank. If not, remove the hose and inspect it for cracks, swelling which would close the inside passage, or dirt plugging at any point. Drain the fuel from the tank, remove the cover and inspect the pick-up filter. Check for dirt and water soaking. Run a small diameter wire through the flexible hose and the fuel tube to make sure that the internal passages are clean and open. Replace all defective parts and wash or replace the filter.

If the pick-up filter, flexible hose, tube, and inlet hose are clean and open, remove the carburetor and fuel pump. Check the pulsation passage by smearing a small quantity of grease over the small hole in the carburetor mounting flange of the airbox, and pulling on the starter rope four or five times. If the passage is open the grease will be blown away. If the grease is not blown away, run a small diameter wire through the passage to clear it of the obstruction.

The pulsation passage could also be blocked by a shift in position of the reed valve. If the passage is blocked at the opening into the crankcase, remove the airbox from the engine and check the reed valve. Check the reed gasket, reed plate, reed valve, fuel deflector, and the alignment of these elements. Look for broken, chipped, or distorted reeds, and for dirt that prevents proper seating. Clean or replace parts as necessary and be sure that the central opening and mounting holes are correctly aligned.

Fuel system troubles will, at this point, be narrowed to malfunction of the carburetor or the fuel pump. The next step is to disassemble the fuel pump end of the carburetor and look for the cause of trouble in the supply of fuel between the fuel pump strainer and the discharge of fuel and air mixture into the crankcase. These troubles will most likely be found in dirty and clogged fuel strainers, dirt in the fuel transfer passages, or defective diaphragms. Diaphragm damage could consist of cuts, breaks, holes, or curled flapper valves that will not seat. Defective parts must be replaced. Fuel strainers may

be removed, washed in clean gasoline and blown dry. With the carburetor and fuel pump completely disassembled, fuel passages may be blown out to remove dirt and clogging material.

CAUTION

Never blow compressed air through carburetor or fuel pump passages while diaphragms are in place. The force of this air could rupture an otherwise good diaphragm.

Another possible source of carburetor trouble is in damage to the fuel adjustment needles. Remove both the idle and main adjustment needles and look for broken or bent points, or deformed taper of the points caused by jamming the points into their seats with such force that they can no longer meter the fuel and provide a correct mixture. If such damage is found, the carburetor body will probably be damaged beyond repair and must be replaced entirely.

Physical damage may also be found in the carburetor inlet valve. Examine the valve for possibility of a worn valve seat, a deformed valve or valve spring, or a bent valve lever. Replace any or all of these elements if examination shows damage or wear.

Sections which follow, are concerned with the service of engines requiring disassembly, parts replacement, overhaul, etc. For information of this nature which is needed as follow-up to trouble shooting, or which involves a more complete tear-down of the engine, look under the appropriate headings.

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SECTION IV
General Service

INDEX

GENERAL

The extent of disassembly of an engine will depend entirely on the purpose of the work undertaken. If the work is of a limited service nature, or if it is a follow-up of trouble shooting where the cause of trouble may be well established, only those parts or assemblies necessary should be removed from the engine and further disassembled. If however, a complete repair and overhaul is necessary, such as may be indicated by signs of long and hard usage of the engine, then the engine should be completely torn down.

Sections V to X inclusive of this shop manual deal with the repair and overhaul of engines and are arranged in a manner which will permit their use for either a complete teardown or for a particular or isolated repair job. These sections are also divided into sub-sections to assist the service man to quickly find and easily follow proper sequences for orderly removal of assemblies, sub-assemblies, and parts; to perform all necessary services and properly reassemble the engine.

These sequences may be followed for all engines included in this manual. Where variations from these sequences are necessary because of differences in the construction or parts locations of the engines, the variations are noted and separately treated under appropriate headings either in that section or with reference to another part of the manual.

Only the operating parts are listed in the various sequences of disassembly. Such parts as screws, washers, lockwashers, nuts and cotter pins have been purposely omitted to simplify the lists. Reference is made to nuts, bolts, and screws in the reassembly instructions however, when a specified torque is established for that part.

When servicing any chain saw engine including the work of disassembly, inspection, repair, parts replacement, overhaul, or reassembly, it will be helpful to have an Illustrated Parts List covering that engine for convenient references. Refer to the Parts List whenever there is any doubt about part name, part number, or sequence of assembly.

GUIDE TO DISASSEMBLY

TO WORK ON	MODELS	REMOVE
Fuel System		
Fuel Tank	1-40, 1-41, 1-42 1-43, 1-45, 1-46, 1-50, 1-51, 1-60	Vent System
	1-52, 1-53, 1-61, 1-62, 1-63	Fuel Tank Cap
	All	Fuel Tank Cover
Airbox & Air cleaner	All	Airbox Cover
Fuel pump	All	Airbox Cover & Carburetor
Carburetor	All	Airbox Cover & Carburetor
Reed Valves	All	Airbox
Ignition System		
Spark Plug	All	Spark Plug
Breaker Points	All	Fan Housing, Flywheel, Breaker Box Cover
Wiring	All	Fan Housing, Flywheel, Spark Plug
Lamination	All	Fan Housing
Condenser	All	Fan Housing, Flywheel,
Coil	All	Fan Housing
Switch	All	Fan Housing
Chain Oiler System	All	Airbox Cover
	1-41, 1-42, 1-43, 1-45, 1-46, 1-50, 1-51, 1-52, 1-53,	Oiler Tank Cover, Oiler Screen, Oiler Spring, Piston Cup, Piston, "O" Ring

GUIDE TO DISASSEMBLY (Cont)

TO WORK ON	MODELS	REMOVE
Chain Oiler System	1-60, 1-61, 1-62, 1-63	Oiler Tank Cap, Oiler Tank Plugs, Spring, Ball, Body, Spring, Piston, "O" Ring, Gearcase Cover, Weight Assembly
Starter	All	Starter Assembly
Clutch	1-40, 1-41, 1-42, 1-43, 1-45, 1-46, 1-50, 1-51, 1-52, 1-53	Clutch Guard
	1-60, 1-61, 1-62, 1-63	Starter Assembly
Muffler	All	Muffler Assembly
Transmission	1-60, 1-61, 1-62, 1-63	Gearcase Cover Starter Assembly Clutch Assembly
Crankcase & Powerhead Assembly	All	Fuel Tank, Carburetor, Airbox Assembly, Fan Housing Assembly, Flywheel Assembly, Muffler Assembly
	1-40, 1-41, 1-42, 1-45, 1-50, 1-51, 1-52, 1-53, 1-43, 1-46,	Clutch Guard, Clutch Assembly, Oiler Tank
	1-52, 1-53, 1-60, 1-61, 1-62, 1-63	Crankcase Bottom
	1-60, 1-61, 1-62, 1-63	Starter Assembly, Clutch Assembly, Transmission Assembly,
	All	Crankcase Cover Assembly

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SECTION V

Service of Assemblies — Group I

INDEX

CLUTCH GUARD

NOTE

Model 1-60, 1-61, 1-62, and 1-63 chain saws do not have a clutch guard as such. These are geared transmission models having a gearcase cover in the position corresponding to the clutch guard on direct drive models. For service information on the gearcase cover, refer to the Transmission Section of this manual. (Section IX)

Disassembly

Remove the two nuts and washers holding the clutch guard to the bar mounting studs, and pull the guard from the side of the chain saw. (Figure V-1)

Service

Check the condition of the bar adjusting screw and the threads of the screw hole. (Figure V-2)

The screws are not interchangeable between all saw models because of different thread sizes, and if the wrong screw is or has been

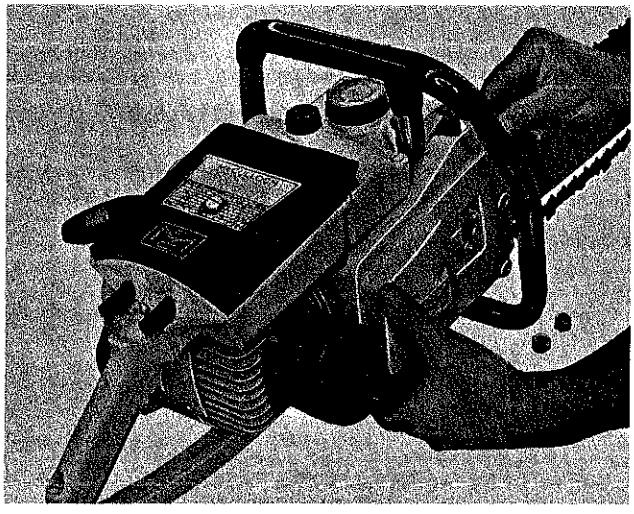

Figure V-1. Removing the clutch guard from the saw.

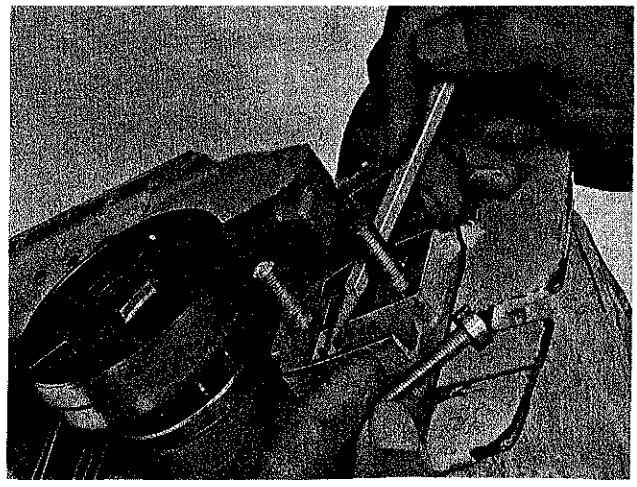

Figure V-2. Bar adjusting screw and the screw hole threads.

used, thread damage will result. When servicing the clutch guard or replacing the adjusting screw, refer to the appropriate Illustrated Parts List for the correct screw part number. Damage to the screw hole threads may be repaired with the use of a Heli-Coil or equivalent thread repair kit.

In checking the adjusting screw, look for damage to the threads, make sure that it is straight, and examine the screw head. A rounded edge on the screw head will make it difficult to adjust the bar and hold proper tension on the chain.

Check the bar mounting pad carefully. Nicks or worn spots around the edge of the bar pad face will permit chain oil to leak out of the pad and prevent oil from reaching the bar and chain. Not only will the leak be wasteful, but without oil the bar and chain will be quickly ruined.

Reassembly

When replacing the clutch guard on the saw with the bar and chain in place, be sure that the head of the bar adjusting screw fits in the small cut-out notch on the side of the bar. Tighten the nuts on the bar mounting studs enough to hold the bar straight and make the adjusting screw effective in the notch. Turn the adjusting screw counter-clockwise until

the chain is at proper tension, then tighten the nuts securely. They should be tightened to a torque value of 240 to 300 inch-pounds (20 to 25 foot-pounds) or (2.76 to 3.46 mkg).

BAR AND CHAIN ASSEMBLY

Disassembly

The bar and chain may be removed from the saw after removal of the clutch guard. Slide the bar toward the engine as far as the slot will allow. This will remove all tension on the chain and provide enough slack to pull the chain tangs out of the groove and slip the chain off the bar nose. (Figure V-3) If desired, the master pin may be removed to facilitate chain removal.

Remove the bar by pulling it straight out from the engine and off the studs. Lift the chain off the sprocket and over the clutch drum.

Service

Refer to the Chain Maintenance Manual for service on the chain.

Reassembly

The reassembly of bar and chain follows, in reverse order, the steps for their removal.

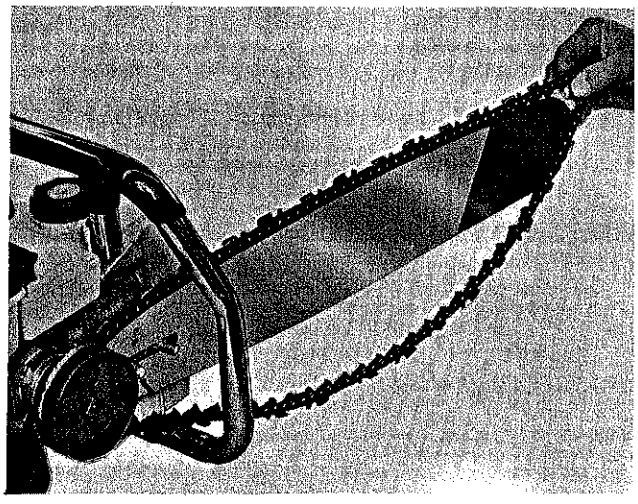

Figure V-3. Removing the chain from the bar.

FRAME ASSEMBLY

Disassembly

Remove all screws and insulators attaching the frame to the saw.

Reassembly

When re-attaching the frame to the saw, be sure that all of the insulators are replaced as they were originally. Install new screws for those that have thread damage and for those that are missing. Different sized screws are used on the various models of saws for attaching the frame. Each size has a recommended torque when they are turned up tight. These size and torques are as follows:

Screw 1/4-20	90 to 100 inch-pounds (7-1/2 to 8 foot-pounds) (1.04 to 1.12 mkg)
Screw 10-24	55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.69 mkg)

MUFFLER ASSEMBLY (EXHAUST PIPE)

Disassembly

Remove the muffler assembly and the gasket from the engine, then take the muffler apart, separating the top assembly, baffle, and the bottom assembly.

Service

NOTE

A dirty muffler causes loss of power because it slows down the discharge of burned gases from the combustion chamber and interferes with fresh fuel intake. Without a full charge of fresh fuel, full power cannot be developed.

Clean the dirt and carbon deposits from the three muffler elements both inside and out with a scraper and blow the scrapings away with compressed air. Be sure that the small

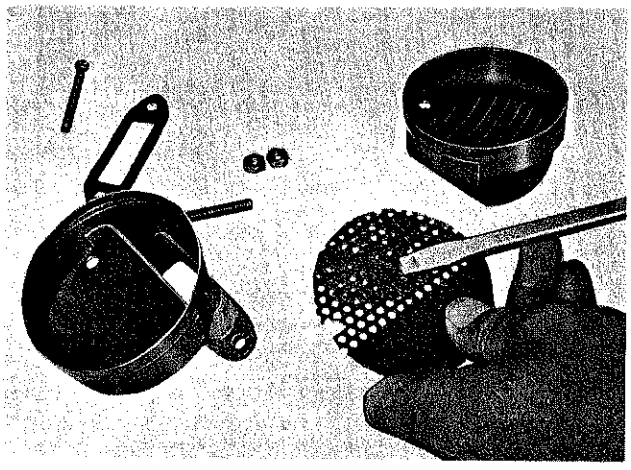

Figure V-4. Scraping the muffler baffle to clean and open all holes.

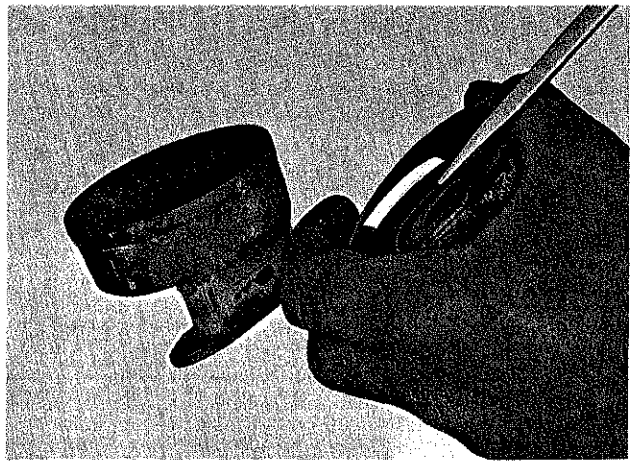

Figure V-5. Straightening the baffles in muffler top assembly.

holes in the baffle are all open and clean. (Figure V-4) Inspect the gasket and replace it with a new one if it is not in good condition. Straighten the deflectors with a screwdriver to make the openings uniform. (Figure V-5)

Reassembly

When the baffle is reinstalled correctly, the undrilled portion of the plate is over the exhaust port opening. Re-attach the muffler assembly, tightening the attaching screws to a torque value of 55 to 60 inch-pounds. (4-1/2 to 5 foot-pounds) (0.638 to 0.69 mkg)

NOTE

While the straight exhaust pipe used on some models cannot be disassembled as described above, the same care should be observed in cleaning and making sure that the holes are all open and clean. (Figure V-6)

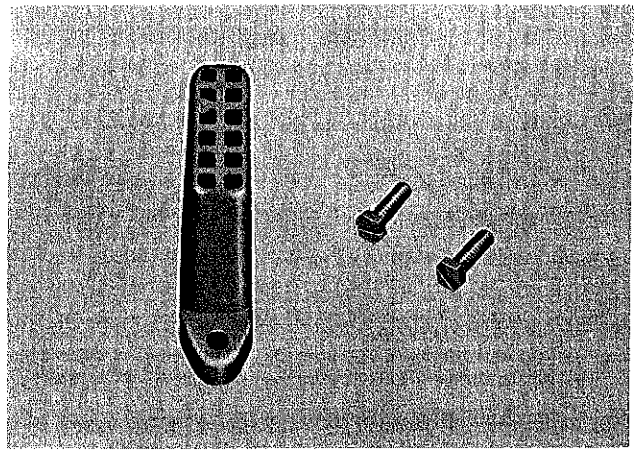

Figure V-6. Straight exhaust pipe (one-piece) type of muffler.

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SECTION VI
Service of Assemblies — Group II

INDEX

CLUTCH, SPROCKET, DRUM AND BEARING ASSEMBLY

NOTE

On the geared transmission models (Model 1-60, 1-61, 1-62, and 1-63) the clutch, sprocket, drum, and bearing assemblies have a different construction and are disassembled in a different sequence. For disassembly procedure on these models, refer to appropriate headings in the TRANSMISSION section of this manual. (Section IX) After disassembly, service of the parts is the same for all models.

CLUTCH ASSEMBLY

Disassembly

Remove the shoe spring, the four clutch shoes, and the clutch rotor assembly.

CAUTION

The clutch rotor fastens on the crankshaft with LEFT-HAND threads and is removed by turning in a CLOCKWISE direction. The word "OFF", with an arrow is stamped on the face of the rotor to show direction to be turned when removing the clutch assembly. (Figure VI-1)

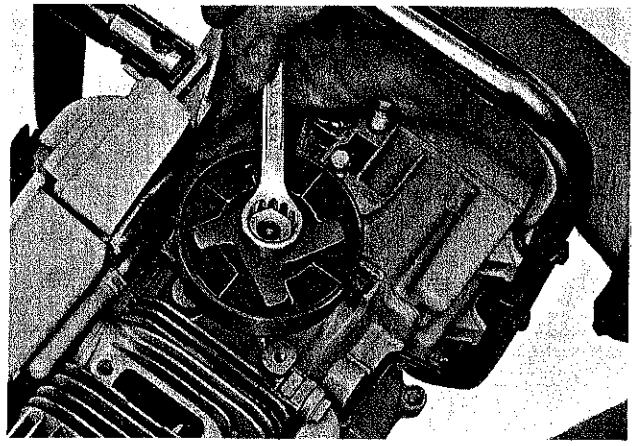

Figure VI-1. Removing the clutch rotor nut by turning in a clockwise direction. Note the locking pin for holding the flywheel

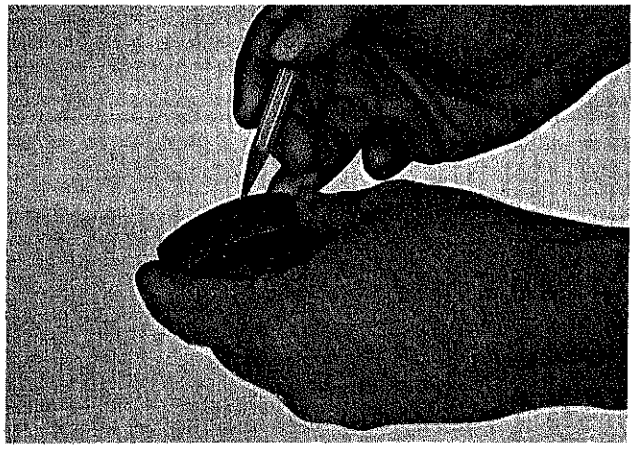

Figure VI-2. Checking the face or contact surface of a clutch shoe. Shoes should always be replaced in sets of four even if only one shoe shows wear.

Service

The four shoes should have the same wearing appearance on the drum contact surfaces, and should always be replaced in sets of four. (Figure VI-2) One new shoe working with three used ones will not work satisfactorily. The new shoe, having a larger radius, will make contact with the drum first and produce an unbalanced effect. If the clutch spring does not hold the clutch shoes tight against the hub, or if the spring appears as if it has been overheated, it must be replaced. A new spring MUST be installed if new clutch shoes are installed.

Examine the rotor plate for cracks and for a loose or hammered rotor. (Figure VI-3)

Check the drum for out-of-round condition and if necessary, replace it. See that it is free of grease which might cause the clutch to slip when operating.

Reassembly

Installation of clutch shoes and spring on the clutch rotor can be accomplished most easily by the following method:

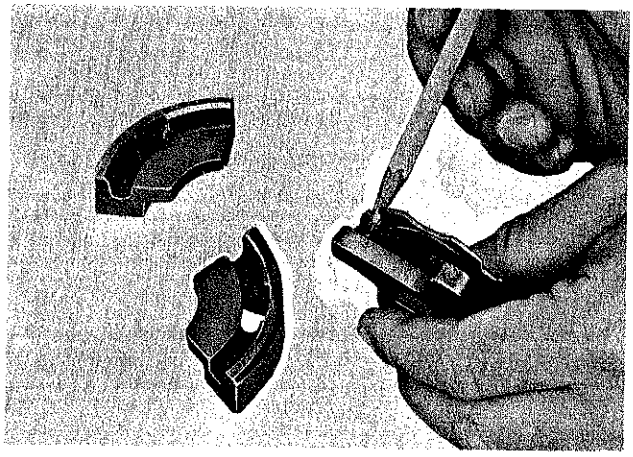

Figure VI-3. Wear on the clutch rotor is usually most severe on the outer corners where hammering takes place. The rotor plate should be checked for cracks and looseness at the center where it is attached to the hub.

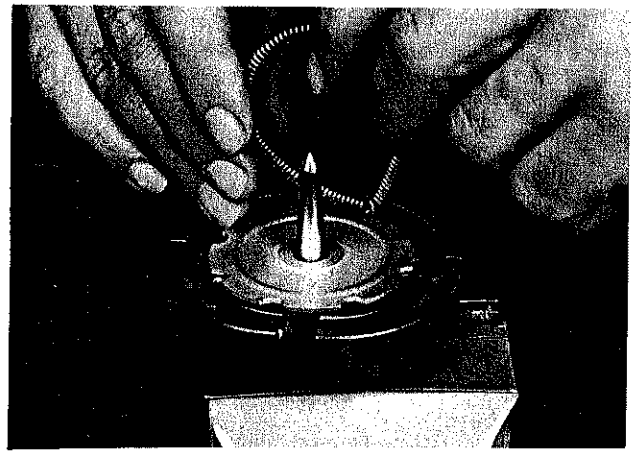

Figure VI-4. Starting assembly of the clutch, the hooked ends of the spring should be started into the clutch groove first.

1. Clamp a tapered shaft of about 1/2-inch (12.7 mm) base diameter in an upright position in a vise.

2. Place the clutch rotor spider assembly, with its notched plate facing up, over the smaller end of the shaft and slide it down to rest on the jaws of the vise.

3. Place the four clutch shoes in position around the spider assembly so that the spring grooves just clear the outer edge of the notched plate.

4. Hook the spring ends together and loop the spring over the shaft, placing the hooked ends in the groove of the closest shoe and starting the spring into the adjacent grooves. (Figure VI-4)

5. Hold the end thus started, then beginning at the opposite side, work the spring into the opposite groove.

6. Continue to press the remainder of the spring outward and over the edge of the notched plate and into the other shoe grooves. (Figure VI-5)

Figure VI-5. Continue to seat the spring by pressing it down into the groove from both sides of the rotor plate.

When reassembling and placing the rotor back on the crankshaft, remember that the threads are engaged by turning in a counter-clockwise direction. Tighten the rotor nut to a torque value of 300 to 360 inch-pounds (25 to 30 foot-pounds) (3.46 to 4.15 mkg).

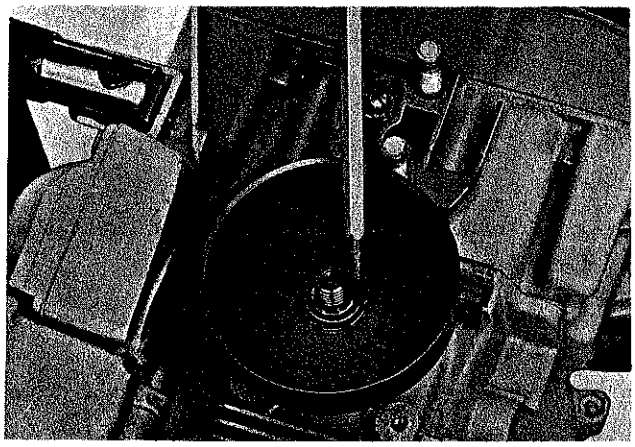

Figure VI-6. The drum and sprocket bushing should not be worn enough to allow wobble or appear loose on the shaft.

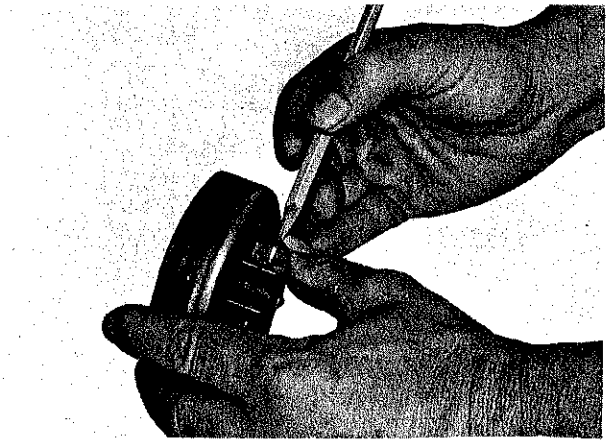

Figure VI-7. Checking the sprocket for wear caused by the tangs of the chain. This sprocket is approaching maximum allowable wear and should be replaced.

SPROCKET, DRUM, AND BEARING ASSEMBLY

(Removed with the Clutch Assembly as described above.)

Place the sprocket, drum and bushing on the crankshaft and spin them by hand to observe the fit. The assembly should spin freely without any sign of wobble. If there is any indication of looseness, replace the bushing. (Figure VI-6)

Examine the condition of the sprocket. If grooving in the teeth is 0.010-inch deep (0.254 mm) or more, or if there is evidence that the chain center link tang is bottoming in the sprocket, the sprocket and drum assembly should be replaced with a new one. It is even more advisable to use a new sprocket if a new chain is also being installed. It is much better to put on a new and relatively inexpensive sprocket, than to risk damage and avoidable wear on the new chain. When installing a new sprocket, be sure that is has the correct pitch. Check the part number in the Illustrated Parts List. (Figure VI-7)

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SECTION VII
Ignition System

INDEX

Service on the ignition system requires the removal of the fan housing, starter, and the sawdust guard. For this reason, and for convenience, service on the fan housing, starter, and the sawdust guard is included in the ignition system section of the manual.

FAN HOUSING ASSEMBLY

NOTE

On Model 1-40, 1-41, 1-42, 1-43, 1-45, 1-46, 1-50, 1-51, 1-52, 1-53, 1-62L, and 1-63L engines, the fan housing incorporates the starter assembly, sawdust guard, and the ignition switch assembly. This is also true of the Model 1-60, 1-61, 1-62, and 1-63 engines except for the starter assembly which is located outside the clutch on the gear case cover. The sequence of disassembly of the starter on the gear train engines differs slightly from the direct drive engines, and is treated therefore, in the transmission section of the manual. Except for this disassembly sequence, the starter and other elements of the fan housing assembly may be serviced in the same way and normally in one service operation.

STARTER ASSEMBLY

Disassembly

1. Remove the fan housing.

CAUTION

On Model 1-46, 1-53, and 1-63 engines, the ignition switch is attached to the coil with a short stop-switch wire assembly. Do not pull the fan housing away from engine until this wire assembly has been disconnected from the coil.

2. Remove the starter assembly from the fan housing.
3. Remove the starter cover.

NOTE

The starter rope may be removed and replaced with no more disassembly than the starter cover if only the rope requires service.

4. Unwind the starter rope from the starter drum and remove the rope.
5. Remove the ratchet from the starter drum shaft.

NOTE

On Model 1-40 and 1-50 engines, the starter ratchet has an integral shaft which extends through the starter assembly to the drum. The end of the shaft has a flat side to mate with a corresponding flat face in the drum hub, and is held by a pin. To remove the shaft, drive the pin out of the shaft and the shaft out of the drum.

Minor differences in construction of the starter on other and later engine models determine the method of locking the starter base and drum together for ratchet removal. Two methods are used for locking purposes:

(a) On starters having a notched drum, and
(b) On starters with drilled locking holes in both starter base and drum.

For the first of these types, proceed as follows: Place a locking pin through the starter spring recess in the base, and into the notch on the outer rim of the drum.

Put the starter in a bench vise, locking the drum in the vise jaws, and unscrew the ratchet with a small bar, turning the bar clockwise, as indicated by the arrow on the drum. (Figure VII-1)

CAUTION

Do not turn the bar counter-clockwise because the starter ratchet has left-hand threads and the threads will be stripped if the ratchet is turned in the wrong direction.

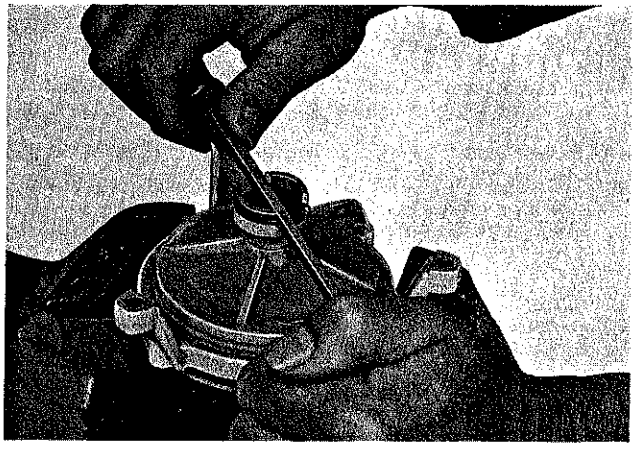


Figure VII-1. Removing the ratchet with a small bar between the ratchet jaws. The starter drum is held in the vise jaws and a locking pin holds starter base and drum together. The ratchet must be turned clockwise.

As an alternate method, the ratchet may be locked in the vise and the base unscrewed from it. If this method is used, be sure to turn the base clockwise to avoid stripping the threads on the ratchet. Be careful also, that too much strain is not put on the base mounting legs.

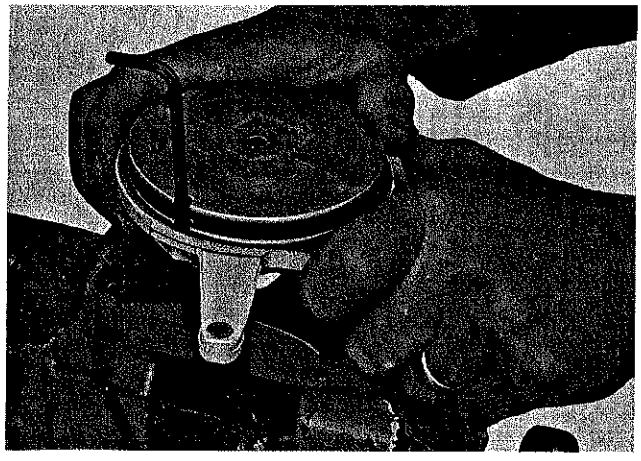


Figure VII-2. When the ratchet is held in a vise, it may be removed by turning the base in a clockwise direction. Note that base and drum are locked together by a pin through the notch on the drum and the starter spring loop on the outer edge of the base.

If the starter base and drum have locking holes drilled for holding these elements together, insert two 10-24 x 2-inch long screws into the holes and place the starter assembly in a vise with the two protruding screws held in the vise jaws. This locks base and drum together while holding both securely in the vise. The ratchet can then be removed with a small bar as described before.

NOTE

Some of the Model 1-41 or 1-51 engines may not have either a drilled base or a notched drum and the starter assembly will have to be altered by drilling for the insertion of the screws. If this is necessary, drill two 0.199-inch (5.05 mm) holes using a No. 8 drill, through the starter base, into and through the starter drum, 11/32-inch (8.73 mm) in from the outside of the base. Make the holes on opposite sides of the webbed face, and drill carefully to avoid damage to the rewind spring. Into these holes, insert the two screws for locking the assembly in the vise, then remove the ratchet. (Figure VII-3)

6. Remove the starter base bushing and take the starter assembly out of the vise.

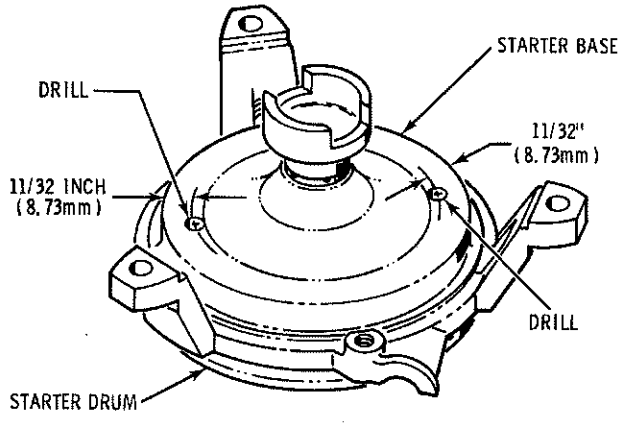


Figure VII-3

7. Carefully slip the end of the spring off the starter drum with the end of a screwdriver. Remove the drum from the base. Be careful when removing the drum to prevent the spring from jumping loose. (Figure VII-4) Remove the spring and the second starter base bushing from the base. The spring may be allowed to unwind in a container or it may be pulled from the base with a pair of pliers while holding the base flat side down, on the bench. (Figure VII-5)

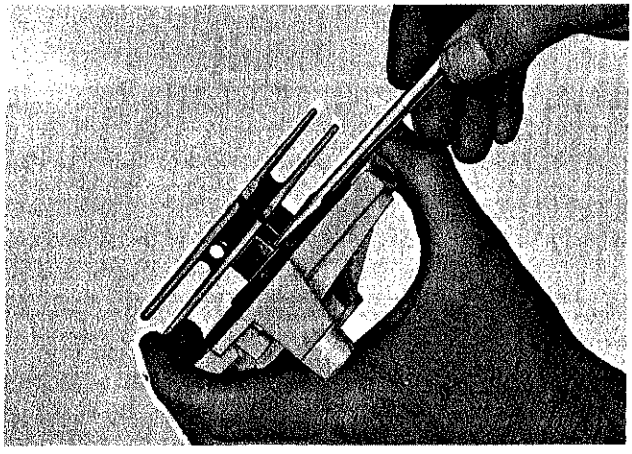


Figure VII-4. Be careful that the starter spring is not pulled out of the base when removing the starter drum. Hold the spring with a screwdriver to keep it from jumping out. Remove the drum slowly and carefully.

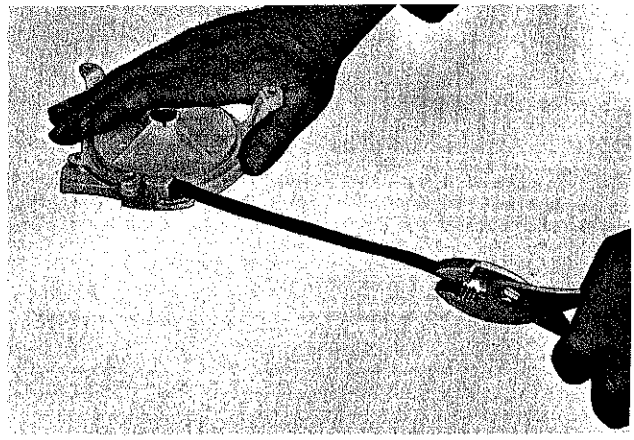


Figure VII-5. The starter spring may be removed from the base by pulling the spring out from the side of the base held on a flat surface.

NOTE

The new and stronger ratchets now being used for service replacement are designed for use with an improved drum and a slightly shorter shaft. (Figure VII-6) For this reason it is well to remember that when installing a new ratchet, particularly on Model 1-41 and 1-51 engines with the original drum, there is the possibility that the ratchet may bottom on the end of the crankshaft. (Figure VII-7) If this condition is encountered, it may be prevented by either of two ways:

Service

Examine the starter drum for cracks, rough edges, and damaged threads on the shaft. If there are rough spots on the rim of the drum, smooth out the roughness with a file. If there is other damage, replace with a new drum.

Look for cracks in the starter base, especially around the mounting legs. Check for damage to the threads of the screw holes. Check the ratchet for cracked or broken jaws and for damage to the threads. Replace the ratchet if any defects are found.

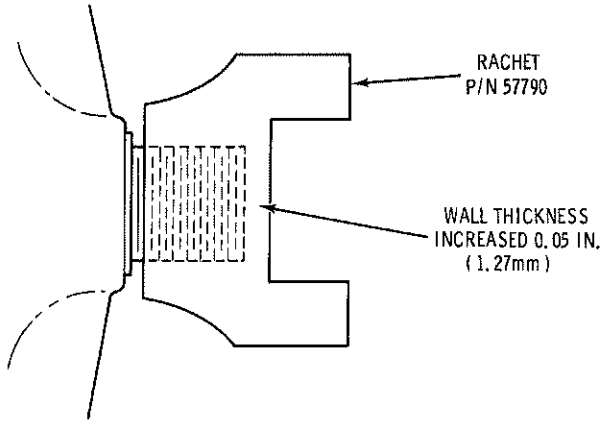


Figure VII-6

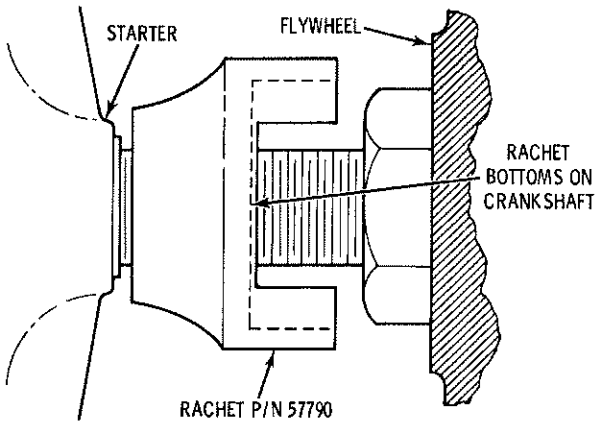


Figure VII-7

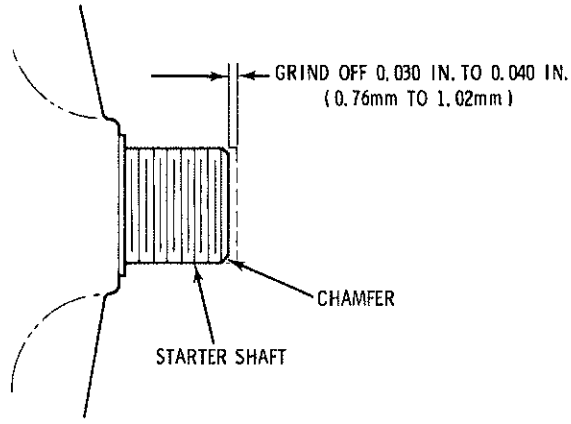


Figure VII-9

1. Install a washer between each starter mounting leg and the fan housing, to space the ratchet away from the crankshaft. (Figure VII-8)
2. File 0.030-inch to 0.040-inch (0.76 to 1.02 mm) off the end of the starter shaft and re-chamfer the shaft for smooth thread engagement. (Figure VII-9)

Examine the starter spring for kinks, sharp bends, wear, and breaks or cracks. Make sure that the loop at the anchor end assures a firm connection in the recess on the outer rim of the base, and that the other end of the spring has an adequate hook to hold securely in the drum slot.

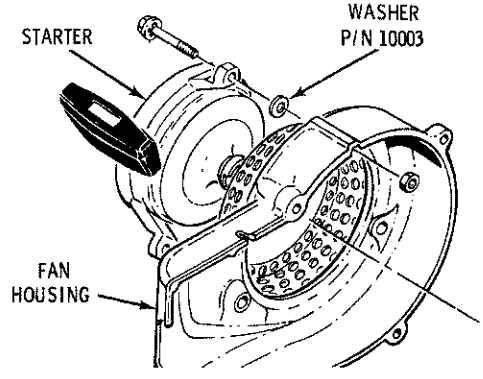


Figure VII-8

The loop on one end and the hook on the other end of the spring are formed in a short section which has been specially annealed for the purpose. These soft end sections of the spring are normal and necessary for shaping the end connections and should not be mistaken for defects.

Look for wear on the starter rope throughout its entire length. Discard and replace any rope showing signs of fraying or of weak (undersized) places caused by rubbing on the starter metal.

NOTE

- When replacing starter base bushings on Model 1-41 and 1-51 engines, the new non-metallic bushings have keys to keep them from turning in the bore of the base, and thus reduce wear. The old base may not have keyways to receive the bushing keys, so unless the base is also replaced, it will be necessary to make an alteration to either the bushings or the base. It is preferred that keyways be cut in the base and this can be done easily in this way: Using a hacksaw and a flat file, notch a keyway wide and deep enough to accept the bushing keys, one on each end of the starter bore. (Figure VII-10)

- If for any reason it is not desired to cut these keyways, the keys may simply be cut from the bushings with a sharp knife or razor blade and discarded. (Figure VII-11)

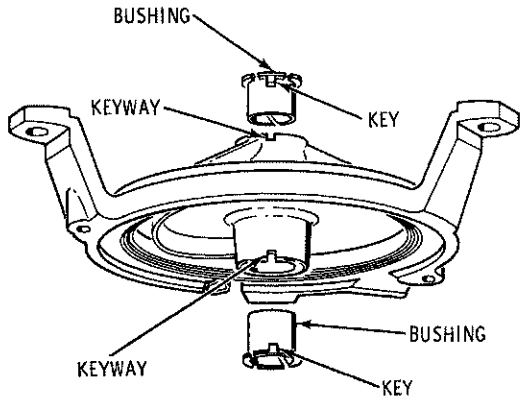


Figure VII-10

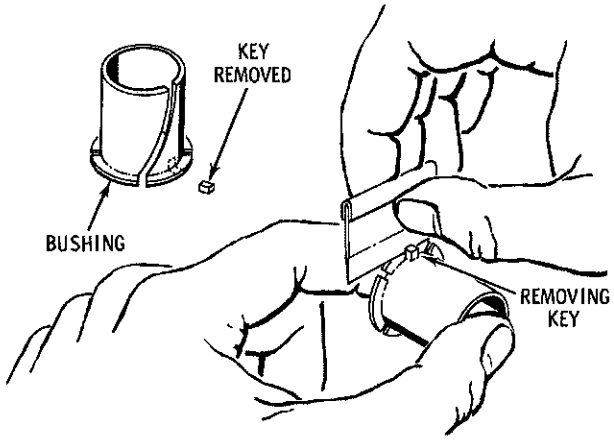


Figure VII-11

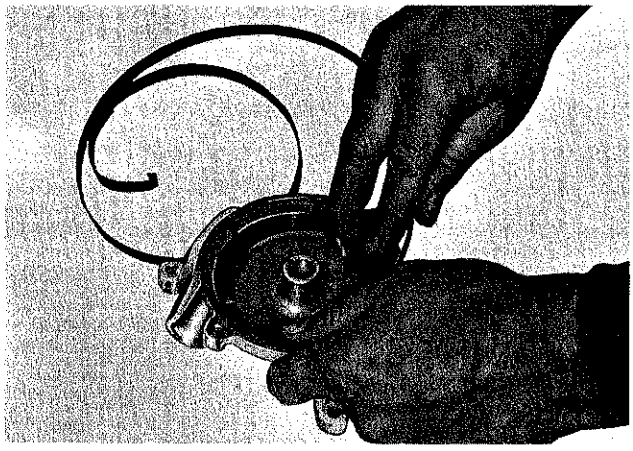


Figure VII-12. Wind the starter spring into the base in a counterclockwise direction. Spring ends are purposely annealed to assist in making spring conform to drum and base at the anchor ends.

Reassembly

Start the reassembly of the starter with the rewind spring. If a new rewind spring is being installed, unfasten the two clips which keep the spring tightly coiled. After removing the clips, release the spring carefully to avoid injury and allow to unwind. Cover the spring with a light coating of oil.

1. Put the loop end of the spring into the recess provided on the rim of the base.
2. Hand wind the spring in a counter-clockwise direction inside the starter base. (Figure VII-12)
3. Install one bushing, seating the bushing key into the keyway on the base.
4. Slide the starter drum shaft into the bore of the base with the hook on the free end of the spring fitting into the slot on the drum hub.
5. Install the second bushing on the drum shaft (ratchet side).
6. Install the ratchet on the drum shaft by turning it in a counter-clockwise direction. Tighten the ratchet to a torque value of 150 to 200 inch-pounds (12-1/2 to 16-1/2 foot-pounds) (1.7 to 2.3 mkg).
7. Insert the starter rope through the keeper at the center of the drum. (Figure VII-13)

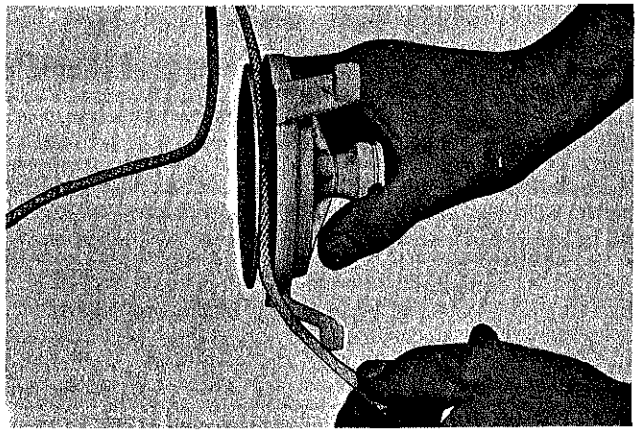


Figure VII-13. The anchor end of the starter rope is inserted through the keeper at the drum center.

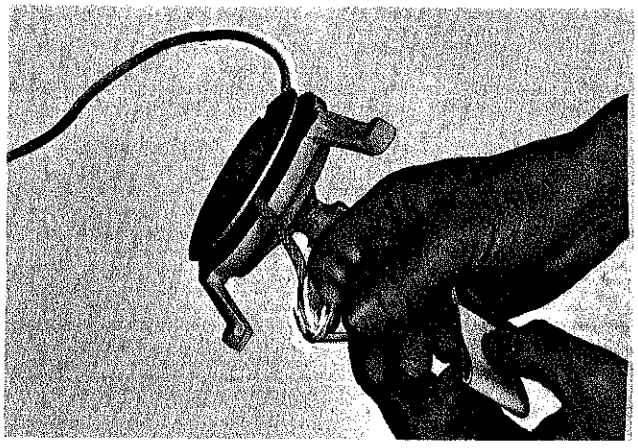


Figure VII-14. Burning the rope fibers at the end will prevent them from unraveling and will help to secure the anchor rivet.

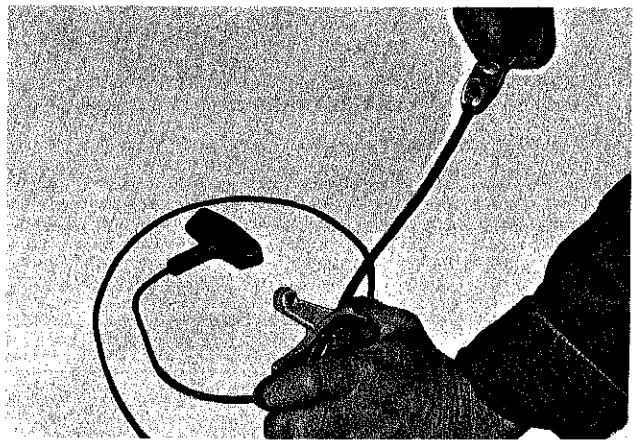


Figure VII-15. When the starter rope is pulled all the way out under spring tension and the drum is held firmly, it should be possible to pull from 8 to 14 inches of spring from the base. This will show that the spring is not wound so tightly that it is under strain at the anchor end.

8. Insert an anchor rivet in the rope about 1/2-inch from the end.
9. Hold a lighted match under the end of the new rope to heat-seal the rope fibers and prevent unraveling. (Figure VII-14)
10. Dip the rope and rivet into "Seal-All" or similar sealer and allow it to dry.
11. Pull back on the rope so that the rivet butts against the rope keeper. Make sure the rivet head faces toward the outer rim of the starter drum.
12. Rewind the rope on the drum. Wind all of the rope on the drum around so that it is under spring tension.
13. Check the tension of the spring by pulling the starter rope all the way out and holding the drum to prevent the rope from rewinding. Held in this position the spring is under full tension. While holding this tension, pull the anchor end of the spring out of the recess in the base with a pair of pliers. It should be possible to pull from 8 to 14 inches of spring out of the base without strain. (Figure VII-15) If this can be done, tension is not excessive and the spring can be fed back into the base and the loop end again secured in its recess.
14. Allow the rope to rewind slowly, and reinstall the starter cover.

IGNITION SWITCH

A slide type ignition switch is mounted on the fan housing. On all models except the 1-46, 1-53, and 1-63 engines, the switch button actuates a metal strip which grounds the current by contact with the coil primary connector when moved to the off position. If the switch fails to work, the metal strip is not making a ground contact. The fault may be corrected by bending the strip until proper contact is made. (Figure VII-16) If the strip is missing or broken, install a new part and check the contact for possible adjustment.

On Model 1-46, 1-53, and 1-63 engines, the current is grounded on the metal of the fan housing through a switch contact. (Figure VII-17) The on and off positions are determined by the position of the switch relative to the notches on the switch base. Failure of this switch to ground properly will usually be caused by a broken base or contact, or by a frayed or broken stop-switch wire assembly. Check for broken or missing parts and replace as required.

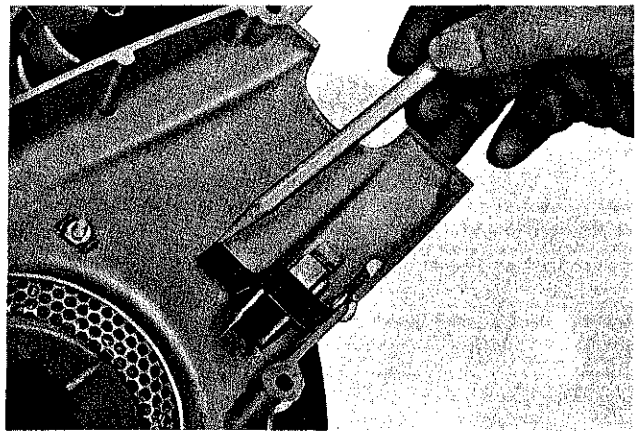


Figure VII-16. This metal strip may be bent to a position where it will contact the coil primary connector when moved to the "off" or grounding position.

SAWDUST GUARD

Clean the sawdust guard thoroughly inside and out by washing it in solvent. Make sure that all holes are open for free passage of cooling air when the engine is running. Install the guard with the cut-out over the loop on the rewind spring and the recess in the base.

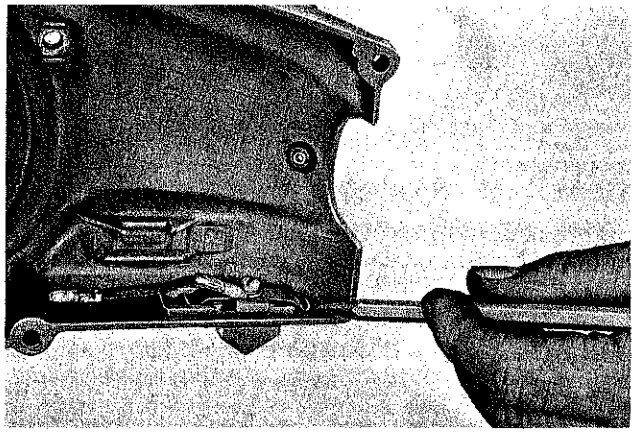


Figure VII-17. Make sure that the switch contact grounds on the fan housing metal when the switch is moved to the "off" position. Note the stop-switch wire assembly. The fan housing should not be pulled away from the engine while this wire is still connected to the coil.

Figure VII-18. When installing the fan housing, make sure that the screws are of the proper type. Much trouble is caused by using other than specified screws.

FAN HOUSING

When re-installing the fan housing, place it against the crankcase end cover and pull slowly on the starter rope until the starter ratchet engages the pawls on the flywheel. Pull the starter rope several times to see that it is working properly. Tighten the fan housing attaching screws to a torque value of 55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.69 mkg). (Figure VII-18)

FLYWHEEL AND PAWL ASSEMBLY

NOTE

On Model 1-60, 1-61, 1-62, and 1-63 engines, the pawl assembly is located on the clutch.

Disassembly

Lock the flywheel against rotation by inserting a 3/16-inch (4.76 mm) pin or bolt in the flywheel locking hole on the underside of the crankcase cover, and rotating the flywheel until the pin can be pushed into the cut-out on the rim of the flywheel or between the cogged teeth. Remove the nut and washer. (Figures VII-19 and VII-20)

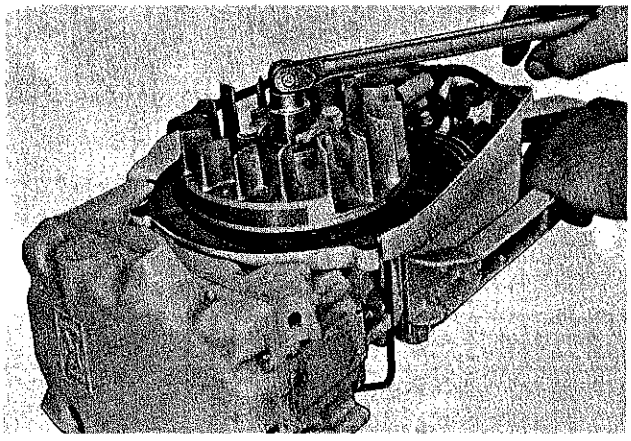


Figure VII-19. Removing the flywheel nut, with the flywheel locked against rotation. The locking pin fits into a cut-out on the flywheel rim.

CAUTION

When removing the flywheel, be careful that the coil and lamination assembly is not damaged.

Pull the flywheel from the crankshaft with a flywheel puller. (Figure VII-21)

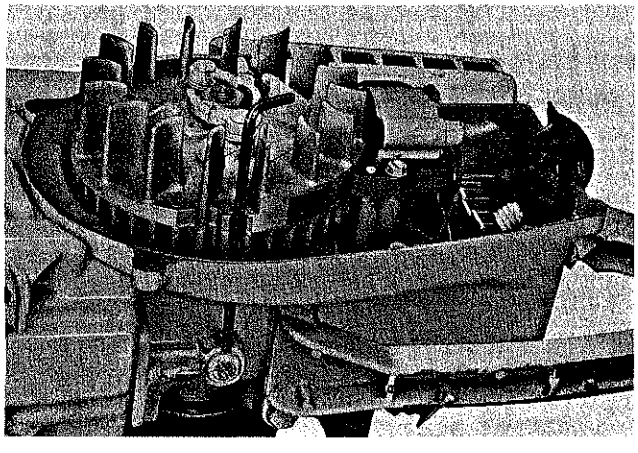


Figure VII-20. The flywheel of some early model engines has cogged teeth on the center rim. The locking pin fits between two of the longer teeth.

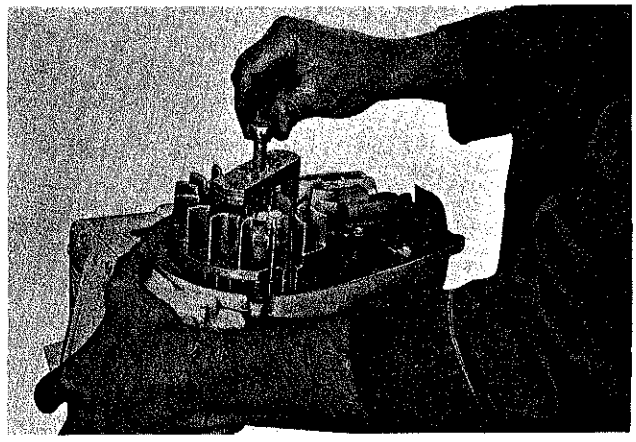


Figure VII-21. Removing the flywheel with a pulling tool. Be sure that the pulling screws are threaded at least 3/4-inch into the pulling holes to avoid stripping the threads. After a slight strain is made on the center screw, a light tap of a hammer on the center screw head will loosen the flywheel.

Service

Check for missing or broken pawl springs. Look for broken, cracked, or worn notches on the pawls where they are engaged by the starter ratchet. Replace any part that inspection shows to be doubtful, or with reduced service life remaining. Check the flywheel for broken vanes or cracks in the casting. Replace if necessary. (Figure VII-22)

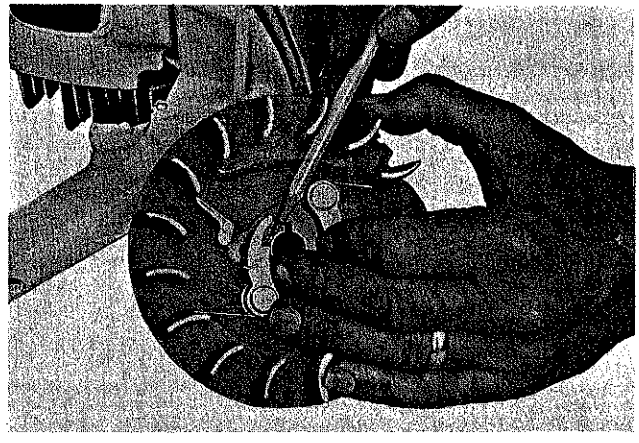


Figure VII-22. Checking the condition of the starter pawls, pawl springs, and the flywheel vanes.

Reassembly

Make sure that the Woodruff key is in the crankshaft. To reassemble the flywheel on the crankshaft, place it in position and push it down as far as it will go. Insert the flywheel locking pin. Install the flywheel washer and nut and tighten the nut to a torque value of 300 to 360 inch-pounds (25 to 30 foot-pounds) (3.46 to 4.15 mkg). Remove the locking pin. Adjust the position of the coil and lamination assembly with respect to the flywheel. Tighten the screws to hold the proper air gap.

NOTE

Procedure for setting the lamination-to-flywheel air gap is described in the Ignition System section of this manual immediately following.

IGNITION SYSTEM

All elements of the ignition system may be serviced by removing only the fan housing and the flywheel (which incorporates the magnet).

Disassembly

Remove ignition system components in the following order:

1. Spark plug and gasket
2. Flywheel and magnet
3. Breaker box cover retainer
4. Breaker box cover and cover gasket
5. Breaker point assembly
6. Condenser
7. Coil and lamination assembly with terminal, ground, and spark plug wire assemblies.

Service

Spark Plug

Check the spark plug first to determine if it is of the correct heat range. The appearance of the porcelain at the base of the center electrode will give a good indication of its efficiency. If the porcelain is chalky white the engine is running too hot. This is the result of a plug too hot or a fuel mixture too lean. If the porcelain is black or oil covered and wet, the plug is too cold or the fuel mixture is too rich. If the porcelain is brownish or the color of coffee with cream, the plug is of the correct heat range. (Figures VII-23 and VII-24)

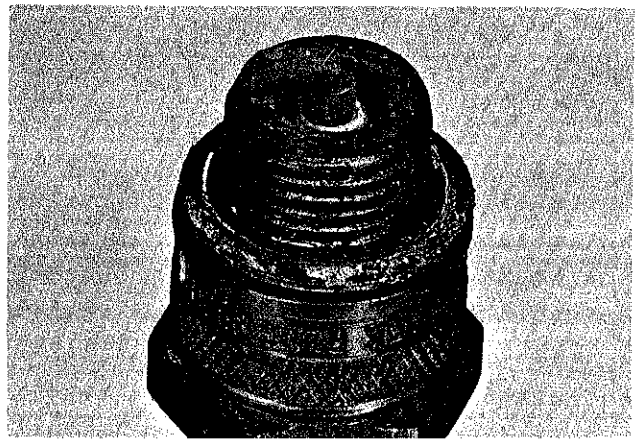


Figure VII-23. Example of a spark plug that is too hot. The porcelain at the base of the center electrode is chalky white.

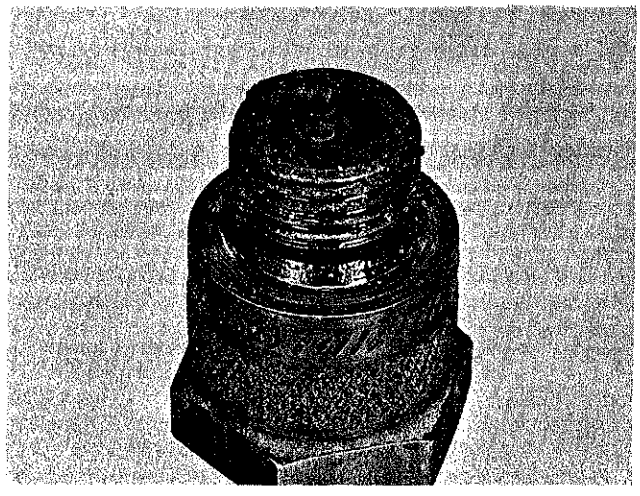


Figure VII-24. Example of a spark plug that is too cold. The electrodes are fouled and the porcelain is covered with a wet, black, oily residue.

NOTE

The above evidence is a good indicator of plug performance provided that other conditions of operation such as too rich or too lean mixtures are not being fed into the combustion chamber creating false evidence.

Under ordinary operating conditions the Champion J8J spark plug is recommended for McCulloch chain saw engines. Under special circumstances a hotter or colder plug may be used. The range of 14 mm Champion spark plugs, from hot to cold, is as follows: J11J, J8J, J7J, J6J, HO-3, and J4J. When changing to a different plug in the heat range, always try the closest in the range first, moving one step at a time. Plugs at the colder end of the scale are usually too cold running for McCulloch engines.

A good spark plug gasket is very important. Replace any gasket that is broken, crimped or encrusted with hard carbon deposits.

In almost every instance it is recommended that a new spark plug be installed rather than risk lowered efficiency from one that has been cleaned up after considerable use. If it is specifically not practical however, for reasons of availability or urgency, a used plug may be reinstalled for additional service after proper cleaning and attention to defects.

Look for chips, cracks and blisters on the insulation. Discard the plug if any of these defects are found. Do not try to re-use a plug with burned and pitted electrodes.

If the electrodes are in good condition, set the gap between the tips at 0.025-inch (0.635 mm). Adjust the outside (grounding) electrode only, to obtain the correct setting, and measure the gap with a wire gauge. Do not use a flat feeler gauge because it is not accurate enough for this purpose. (Figure VII-25)

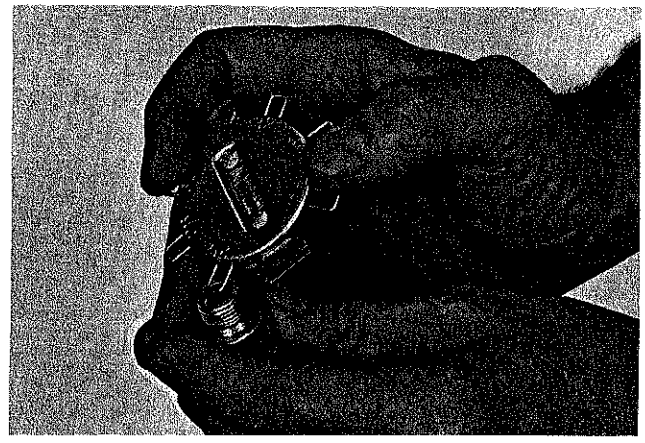


Figure VII-25. The air gap between spark plug electrodes should be checked and set with a wire gauge only.

Breaker Points

Faulty ignition caused by oil on and around the breaker points can result from a leaking crankcase oil seal. (Figure VII-26) For this reason, the breaker box should be examined carefully for oil and dirt. When inspecting the breaker point assembly in service, look for wear on the breaker block and looseness of the breaker block pivot pin. Check the condition of the insulator and be sure that it is properly installed when reassembling the breaker points.

When installing a new breaker point assembly, wash the assembly thoroughly in carbon

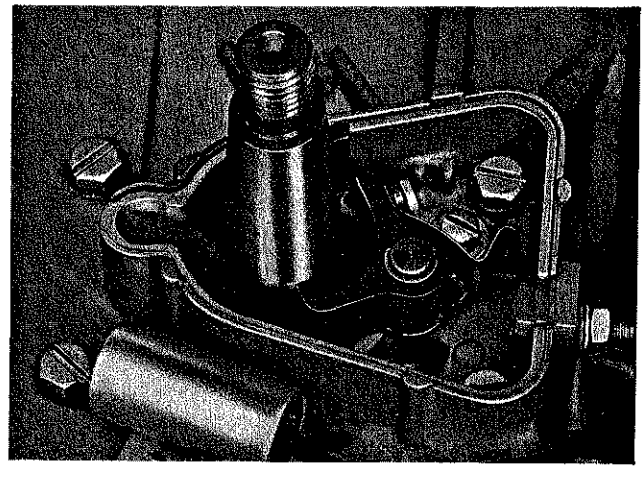


Figure VII-26. The presence of oil on the wiper felt, the breaker block, the points and the bottom of the breaker box indicates a leaking crankshaft oil seal.

tetrachloride to remove the wax. This can be done by saturating a card in the solution and drawing the card between the closed points or by sloshing the assembly around in a can of the solution.

WARNING

Carbon tetrachloride is toxic. Be sure that the room is well ventilated and avoid inhaling the fumes. Keep containers well capped when not in use.

The card method is also effective in cleaning oil from the point surfaces while installed in the breaker box.

As a general recommendation, a new breaker point assembly should be installed whenever the ignition system is serviced or the engine is given a general overhaul. While old points may be dressed for acceptable performance if burning and pitting is only mild, this service should be considered a temporary measure only. For such breaker point service, the contact surfaces should be dressed to a bright, mirror-like finish. (Figure VII-27)

If it is necessary to restore breaker point condition by dressing, use a point stone. The use of a file or emery cloth is not recommended.

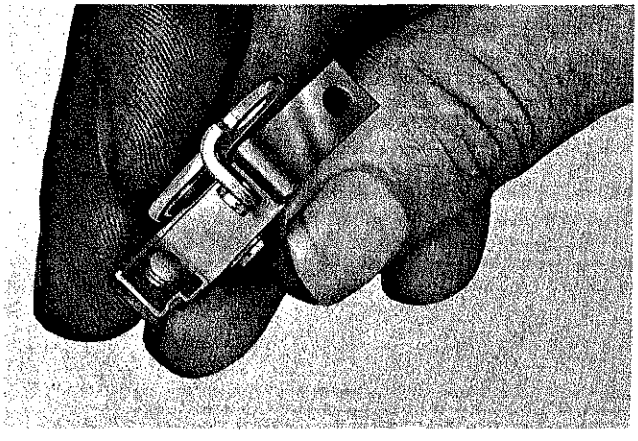


Figure VII-27. Properly dressed points have a bright, mirror-like finish.

The alignment of breaker points is extremely important to their service life so be sure to check alignment carefully and make any necessary corrections. Mis-alignment will usually be in a side-to-side direction. This can be corrected by forcing the spring-loaded arm gently in the proper direction.

CAUTION

Mis-alignment should not be mistaken for looseness caused by a worn pivot in the breaker block.

Be sure that the grounding area is scraped clean of all dirt, oil, paint, or other foreign material. Do not attach the breaker point assembly mounting screw until sure of a good ground.

Condenser

Under operating conditions the condenser will become mottled and discolored. This is a normal condition and is not an indication that the condenser is becoming weak or defective. A condenser should only be considered defective when it has been tested on a reliable condenser tester and has failed to pass a capacity and leakage test, or unless a condenser known to be good has been substituted for it and is found to correct a faulty operation. A condenser in good condition must have a resistance to leakage of at least one megohm and a capacity of 0.18 to 0.22 microfarad. Make sure that the condenser is adequately grounded, with the lead wire and case tightly secured. Replace or wrap frayed wire with insulating tape.

Coil and Lamination Assembly

The only service which can be performed on the coil and terminal assembly is to check the condition of the leads for worn or frayed insulation, tightness of the terminal connections, and replacement of the complete assembly if defective. There are two ways to check the coil itself. One is by putting the coil on an approved testing instrument and measuring it for adequate and

specified performance. The other is by substituting an assembly known to be good and proving by the substitution that the trouble is in the removed assembly.

Test specifications for various McCulloch Ignition Coils when tested on either a Graham, Model 51, or a Merc-O-Tronic, Model 88 Coil Tester are shown in the tables below. Values listed for one type of coil tester cannot be used for the other.

Following the specification tables for each type of coil tester are instructions in test procedures and a method for checking the accuracy of the coil tester being used.

GRAHAM, MODEL 51 COIL TESTER

Coil Identification *	Primary Continuity	(1000 ohms) Secondary Continuity	Coil Index	Coil Test	Gap Index
C-2 to I-7	0.025 to 0.50	3.5 to 5.0	60	13 min.	47 max.
J-7 to K-8	0.025 to 0.50	2.0 to 3.0	60	12 min.	67 max.
L-8 to F-1 **	1.1 to 1.5	3.0 to 4.0	60	24 min.	75 max.
F-1 on	0.7 to 1.2	5.5 to 7.2	60	22 min.	67 max.

MERC-O-TRONIC, MODEL 88, COIL TESTER

Coil Identification *	Operating Amperage	Primary Continuity	Secondary Continuity
C-2 to I-7	2.5	0.2 to 0.4	37 to 47
J-7 to K-8	2.5	0.2 to 0.4	20 to 30
K-8 to F-1 **	1.6	0.6 to 0.9	30 to 40
F-1 on	1.6	0.45 to 0.70	45 to 55

* Stamped on flywheel side of coil (bottom)

** Coils F-0 to F-1 with a red dot on the coil case near the primary ground terminal are Hi-Output coils and use the specifications for the F-1 on Hi-Output coils.

TESTING PROCEDURE

ALL TESTING MUST BE DONE WITH THE COIL AND LAMINATION ASSEMBLY REMOVED FROM THE ENGINE

If the coil and lamination assembly is tested on the engine, either the flywheel magnet or the flywheel counter-balance will be near enough to the coil to change the effective inductance of the coil and false readings will be obtained. Always remove the coil and lamination assembly from the engine and place on a dry non-metallic surface when making the test.

Follow the instructions given for the coil tester being used, connecting the positive of red lead (either model) to the primary connection on top of the coil. Connect the negative or black lead (either model) to the primary ground lead and to the lamination assembly. Use the specifications given in the coil tester table for the coil being tested.

CHECKING THE ACCURACY OF THE COIL TESTER

With the thorough check that every coil is given at the factory, it is unlikely that any sub-standard coil will reach the field. If, in making tests however, several such coils are found to be below specifications, there is reason to believe that the coil tester is defective rather than the coil itself.

Deterioration of any coil tester through long use will result in inaccurate readings. The Merc-O-Tronic, Model 88 is a battery type tester using a 7-1/2 volt dry cell battery which will gradually lose strength. With a weak battery or any other tester defect, coils being tested, even though they may be entirely satisfactory, will appear from the readings to be below standard. Knowing that good quality coils can appear to be sub-standard because of a defective tester, the service man should always be sure of the condition of the tester before accepting its readings.

Both types of testers may be checked quickly and easily with a coil which is known to be of good quality. Simply check the good coil on the tester. If the coil does not show the proper specifications the tester is at fault and steps should be taken to correct it. With a Merc-O-Tronic, the battery is probably at low strength and should be replaced.

A new coil and terminal assembly, part number 57643A, is available for service replacement on Model 1-41, 1-51, and 1-61 engines. This assembly includes a spark plug boot, P/N 55060. The boot is also sold separately as a replacement part. When installing the new coil and terminal assembly or the boot by itself, it will be necessary to also install a new spark plug cover assembly, P/N 57565. (Figure VII-28)

The cover too, may be installed by itself as a replacement part, but in any case the fan housing will have to be drilled to accept the riveted end of the cover. Drill a 0.340-inch (8.64 mm) diameter hole centered and 0.480-inch below the cut-out for the cover in the fan housing. (Figure VII-29)

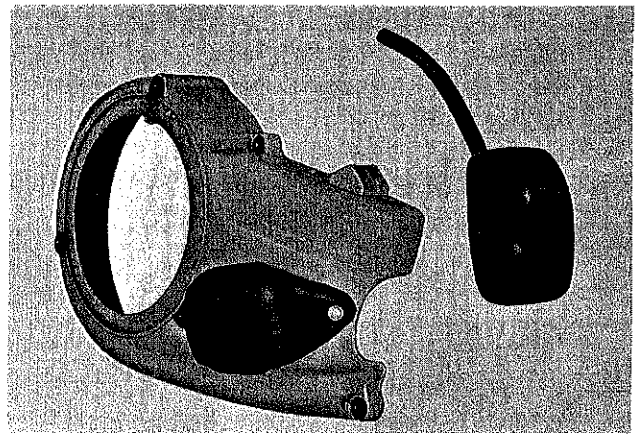


Figure VII-28. The spark plug cover riveted to the fan housing, replaces the former combination cover, boot and lead wire.

When replacing spark plug wire assemblies on Model 1-40, 1-50, and 1-60 engines, use P/N 50120. (Figure VII-30)

Magnet

Infrequently a flywheel magnet will lose part of its magnetism. This defect will result in a weak spark. The fault may be found by substituting a flywheel and magnet assembly known to be good and checking the spark strength by substitution. In service, replace any (flywheel) that fails to produce a good strong spark.

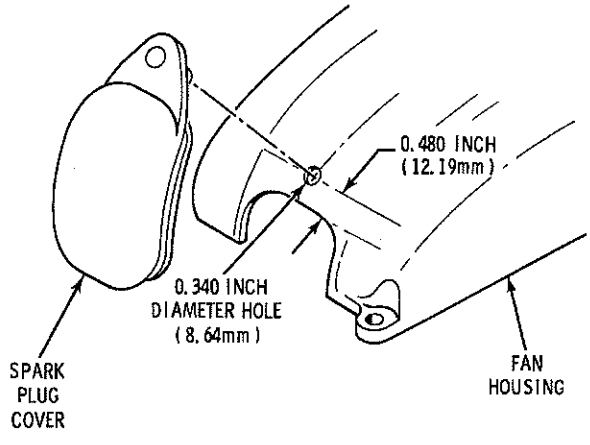


Figure VII-29

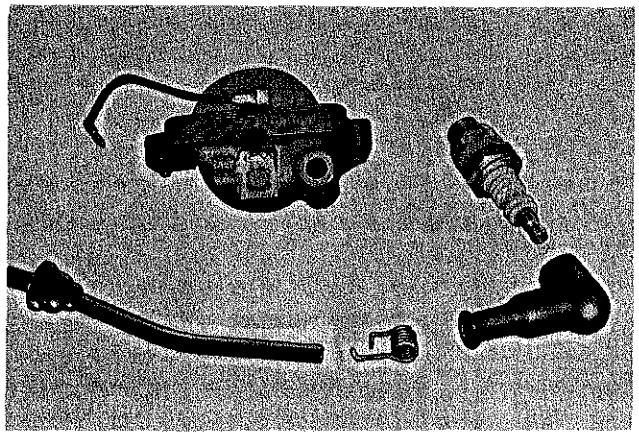


Figure VII-30. When the seal is broken at the coil, the lead wire may be unscrewed and removed from the coil assembly. The lead must be sealed again when it is attached to the coil. Other parts of the spark plug lead assembly consist of the nipple, connector and boot.

Ignition Switch Assembly

Check the switch to see that it grounds on the engine when in the off position. Tighten any loose connections and check the stop switch wire assembly for frayed insulation. (Refer to service of the fan housing assembly for further information on the ignition switch.)

Reassembly

Install the coil and lamination assembly. Clean and dry the condenser and breaker point mounting surfaces thoroughly so that when they are installed, there will be a good ground and resistance to oxidation. Install the condenser and tighten the mounting screw to a torque value of 30 to 35 inch-pounds (2-1/2 to 3 foot-pounds) (0.35 to 0.41 mkg).

Install the breaker point assembly and set the timing. The timing should be set with a timing indicator (P/N 57443A) and light. The timing indicator and light method is preferred because it is more accurate. Using this method, the timing may be accomplished as follows:

Place the indicator (using the 1-41, 1-51, 1-61 side up) on the crankshaft with the keyway slot fitting over the Woodruff key, with the curved edge of the indicator to the left, and with the tab on the end of the indicator between the left leg and the center leg of the lamination.

Disconnect the coil ground wire from the lamination mounting screw (if it has been connected) and fasten one lead of the timing light to the wire. Connect the other timing light lead to an unpainted surface of the engine. In this first position of the indicator, the breaker points are open and the timing light is out. (Figure VII-31)

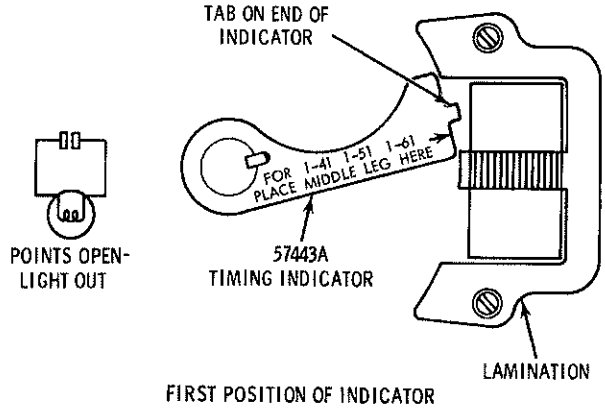


Figure VII-31

Turn the crankshaft clockwise until the tab on the end of the timing indicator comes up against the middle leg of the lamination. At this point (second position) the breaker points should be closed and the timing light should be on. (Figures VII-32 and VII-33)

Turn the crankshaft approximately 1/32-inch (0.894 mm) to the left (counterclockwise) to the third position. The timing light should be out. (Figures VII-34 and VII-35)

Adjust the breaker point gap until the timing light turns on in position 2, (tab against middle leg), and turns off in position 3 (tab moved about 1/32-inch) (0.894 mm) to the left.

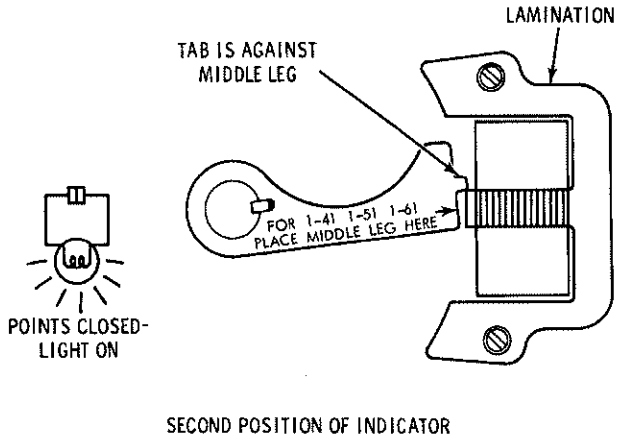


Figure VII-32

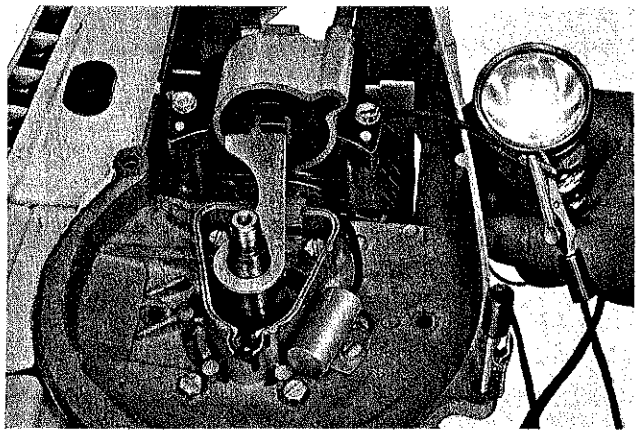


Figure VII-33. The timing light is on while the tab on the indicator just touches the center leg of the lamination.

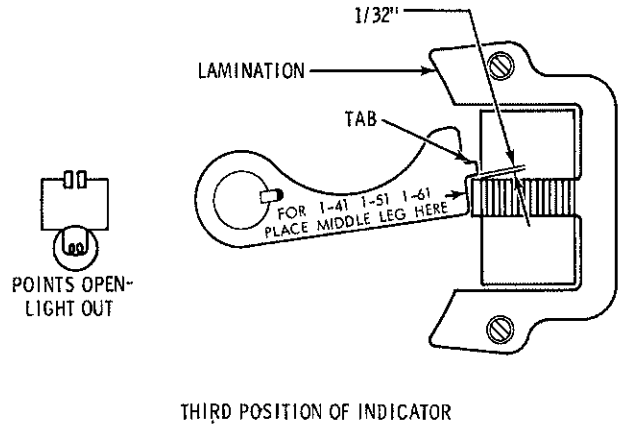


Figure VII-34

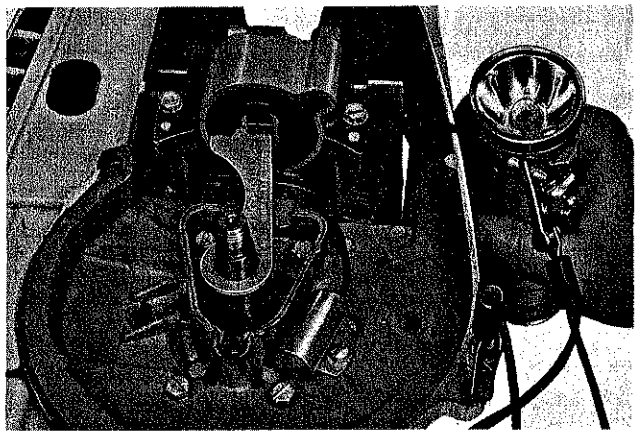


Figure VII-35. When the tab on the indicator is moved approximately 1/32-inch away from the center leg of the lamination, the timing light goes out.

After setting the breaker point gap, tighten the breaker point mounting screw and recheck the positions at which the timing light operates.

Remove the timing indicator and install the flywheel. Check the accuracy of the timing with reference to the timing marks on the flywheel. This will give assurance that there has been no slippage of the breaker point mounting screw and that the timing indicator has been properly used.

The center timing mark on the flywheel corresponds to the tab at the end of the indicator. If timing is correct, movement of the flywheel and its center timing mark, will cause the timing light to go on and off as the timing mark is centered on the middle leg of the lamination and is moved approximately 1/32-inch to the left. (Figures VII-36 and VII-37)

When the accuracy of the timing has been verified, remove the timing light, and reattach the coil grounding wire.

Although the engine should always be timed with a light and indicator when these tools are available, timing may in an emergency, be set with the use of a feeler gauge. This

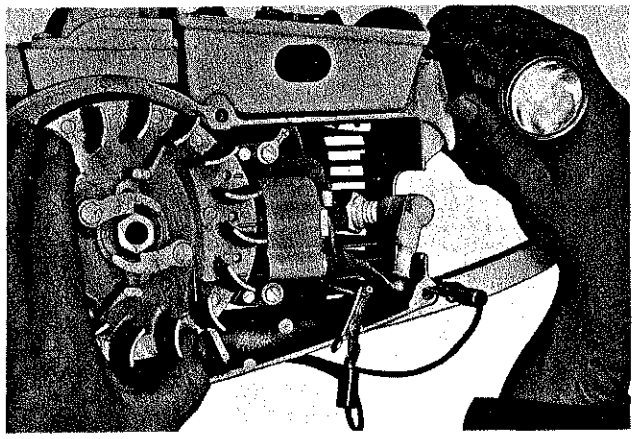


Figure VII-36. Note that the center timing mark on the flywheel is centered on the middle leg of the lamination and the timing light is on. One lead of the timing light is connected to the coil ground wire. The other lead is connected to the engine at a convenient grounding point.

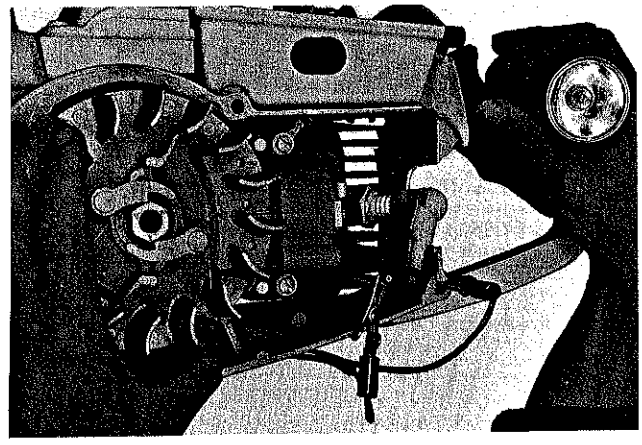


Figure VII-37. If the flywheel is turned approximately 1/32 inch to the left (counterclockwise) the timing light goes off. The engine is correctly timed.

method is much less accurate and should be used as a temporary measure or until a timing light can be obtained. If the feeler gauge method is used, proceed as follows:

Turn the crankshaft until the breaker points are open to their widest gap. Loosen the mounting screw and adjust the movable plate until the gap is 0.018-inch (0.457 mm). Turn the crankshaft until the points close. Make sure they meet squarely and over the entire contact surface. (Check to see that they are properly aligned.) Again turn the crankshaft until the points are open to the widest gap and adjust, if necessary to the proper distance. Tighten the mounting screw to a torque value of 30 to 35 inch-pounds (2-1/2 to 3 foot-pounds) (0.35 to 0.41 mm). Check the point gap at the widest position again. It is important to make the final gap measurement after the mounting screw is tight because of the possibility that the gap will be altered by the tightening.

Install the breaker box cover, cover gasket, and retainer. Push the coil and lamination assembly away from the crankshaft as far as the screws will allow it to go. Install the flywheel. Insert 0.010-inch (0.254 mm) feeler gauges between the outer legs of the lamination and the flywheel rim. Rotate the flywheel until the magnet is under the legs of the lamination, and allow the magnet to pull the lamination down on the feeler gauges which have been inserted. At this spacing, the lamination-to-flywheel air gap determined by the inserted feeler gauges should be correct. (Figure VII-38)

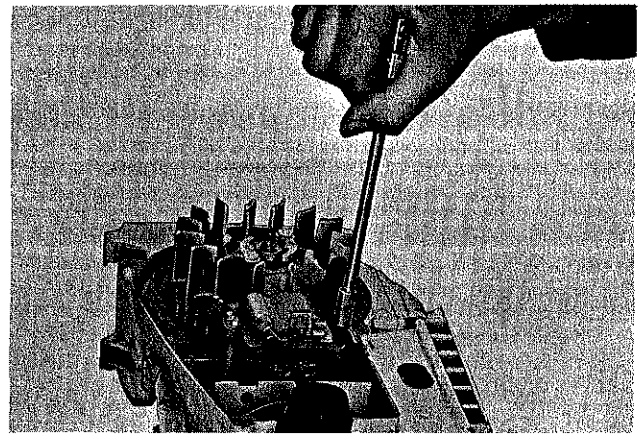


Figure VII-38. Feeler gauges between the outer legs of the lamination and the flywheel hold the proper air gap as the coil mounting screws are tightened.

Tighten the coil mounting screws by alternating between screws and tightening only a little bit at a time. Bring each screw up to the full tight position gradually so that there will be no tendency for torque on one screw to change the position of the lamination at the other screw. Unless the tightening is done gradually and carefully, it is very difficult to avoid moving the lamination and throwing the air gap setting out of adjustment. Torque the screws finally to 55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mm). Remove the feeler gauges. Rotate the flywheel to make sure it turns freely without interference with the lamination legs. Recheck the air gap to confirm that it is within the 0.008 (0.203 mm) to 0.0120-inch (0.305 mm) tolerance limits.

Check the spark plug lead wire, the connector, and the boot. Make sure that the connector has not been pulled away from the lead connection wire preventing current from passing to the spark plug.

Install the spark plug and tighten it to a torque value of 216 to 264 inch-pounds (18 to 22 foot-pounds) (2.48 to 3.02 mkg). Attach the spark plug wire.

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SECTION VIII
Fuel System

INDEX

FUEL TANK AND OILER TANK ASSEMBLIES

NOTE

There are several design differences between models covered in this section which affect sequence of disassembly and service on the tank assemblies discussed. Before beginning service on this group of engines, note some of the basic differences outlined below:

Model 1-40

The Model 1-40 was originally manufactured with a Lubri-Mac chain oiler system. Later production of this model incorporated a manual oiler system in addition to the Lubri-Mac.

Model 1-50

Both a Lubri-Mac oiler and a manual oiler in combination have been used on Model 1-50 chain saws. The Model 1-50 has the oiler tank mounted on the front of the fuel tank with a double gasket and plate. The oiler tank contains a flexible hose with screen and tube. The oiler piston on this model also incorporates an extra spring and spring seat.

The Lubri-Mac System

The Lubri-Mac System (Figure VIII-1) is based on the transfer of heavy oil and fuel condensate from the crankcase to the chain by pulse pressure. The transfer is made through a check valve and passages for the condensate. The check valve assembly consists of (a) valve seat, (b) valve disc, (c) valve spring, (d) gasket, and (e) valve body. These parts are assembled in the crankcase valve opening at "A". Crankcase pressure forces the oil through the check valve and into the passage opening at "B". This passage continues in the groove which runs along the fuel tank bottom from "C" to "D", and terminates at the opening "E" in the bar mounting pad.

Loss or damage to the valve disc will interfere with the chain oiler system on models also equipped with a manual oiler. This interference will be evident by heavy smoking and rough running whenever the oiler push rod is pushed to actuate the manual oiler. When the oiler rod is pushed, it backs up oil through the Lubri-Mac passages, through the defective check valve and into the crankcase. Back pressure plus crankcase suction thus loads the crankcase with chain oil which is then burned with the other fuel.

Since on engines having the manual chain oiler the Lubri-Mac system is not needed, it is common practice to plug the Lubri-Mac system when it gives trouble. There are two ways to do this:

1. Plug the opening at "B" with a steel ball driven into the passage.
2. Add a second valve seat above the disc so that the valve remains closed at all times and is not affected by either back pressure or crankcase suction.

Model 1-52, 1-53, 1-61, 1-62, and 1-63

The fuel tank is vented on these models through a vented fuel cap. Cap venting designated for these models however, should not be construed as a limitation to only these models. Others may, by design change or alteration in the field, be encountered in service work.

Model 1-60, 1-61, 1-62, and 1-63

Because of construction and assembly differences in these engines, fuel tank and oiler tank service is covered separately at the end of this sub-section.

Disassembly

Drain the fuel tank and the oiler tank, then remove in sequence the following parts: (Figures VIII-2 and VIII-3)

1. Fuel tank cover and gasket.
2. Fuel pickup filter.
3. Fuel pickup assembly.
4. Chain oiler discharge valve (from the bar mounting pad).
5. Fuel vent orifice assembly. (From the bar mounting pad.)

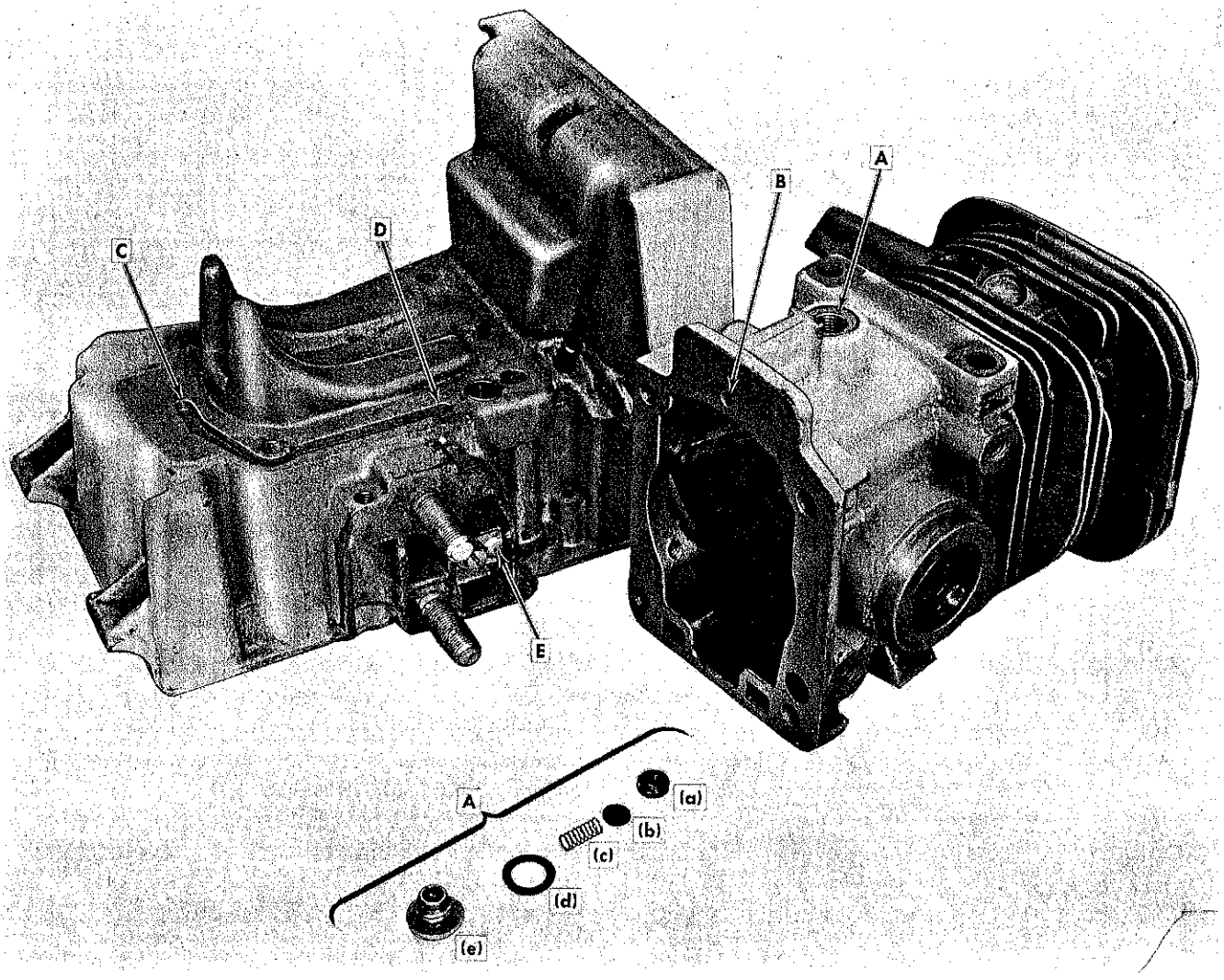


Figure VIII-1. Lubri-Mac System

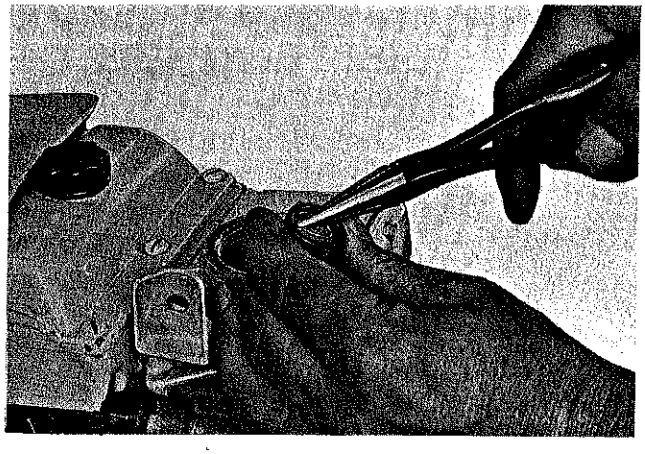


Figure VIII-2. Removing the filter from the fuel pickup assembly.

6. Fuel tank vent tube. (From the bar mounting pad.)
7. Oiler tank cover and gasket
8. Fuel tank.

NOTE

Be careful in separating the fuel tank from the crankcase, that the oiler piston, cup, and "O" ring do not jump out of the oiler rod opening in the fuel tank when the rod is pulled out. The fuel hose will be pulled off the fuel tube. (Figure VIII-4)

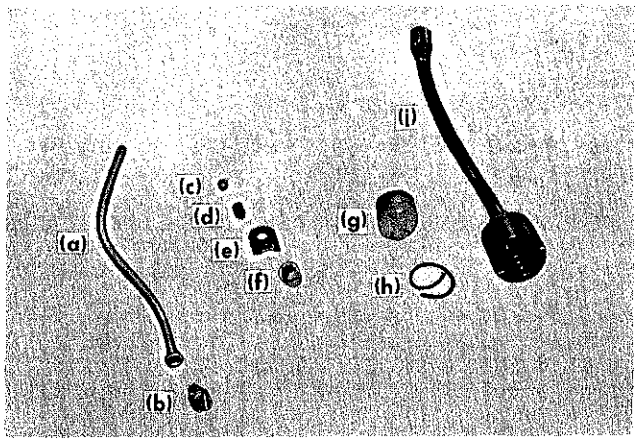


Figure VIII-3. Fuel tank and chain oiler discharge valve parts removed for service include (a) fuel tube, (b) orifice assembly, (c) ball, (d) spring, (e) retainer, (f) lockwasher and screw, (g) fuel filter, (h) filter retainer, (j) fuel pick-up assembly. Parts a, b, c, d, e, f are removed from bar mounting pad; parts g, h, and j from fuel tank.

Remove the oiler piston, cup, and "O" ring, then the oiler spring. From the bar mounting pad, remove the oiler ball, outlet spring, and ball. (Figure VIII-5)

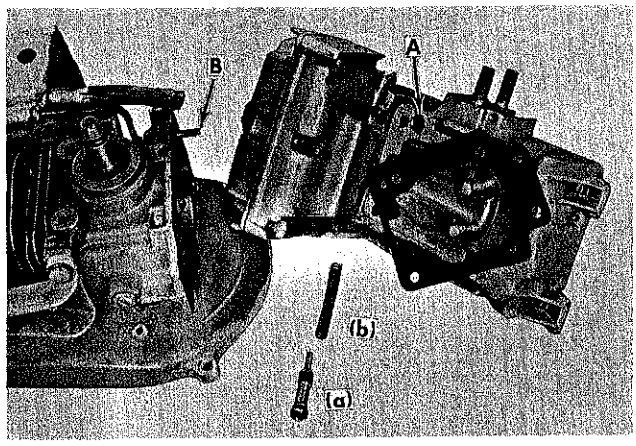


Figure VIII-5. The oiler cup, oiler piston, and "O" ring (a) and oiler spring (b) removed from the opening at "A" for service. The oiler piston is actuated by the oiler control rod "B"

9. Oiler tank screen. (Figure VIII-6)
10. Oiler tank and gasket. (From the fuel tank.)

Service

Blow low pressure air through the chain oiler passages in the fuel tank to clean them out. Wash the oiler tank screen in solvent and blow it dry. Wash the fuel pickup tube filter in clean unleaded gasoline, removing

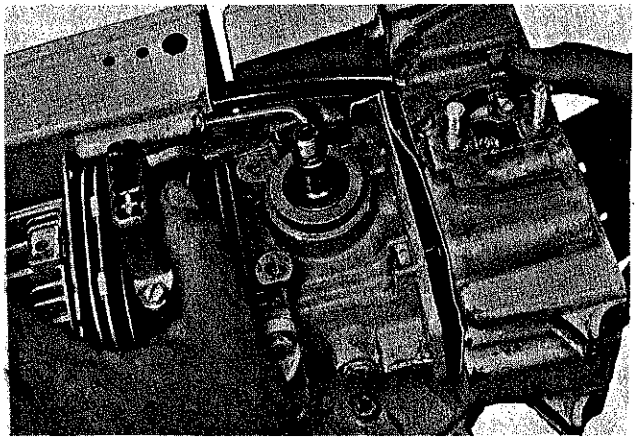


Figure VIII-4. Separating the fuel and oiler tank assembly from the crankcase. The fuel hose pulls off the fuel tank tube. The tube is not removed.

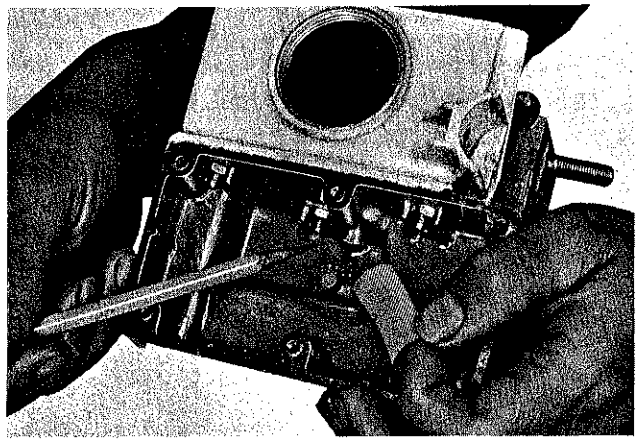


Figure VIII-6. Oiler screen removed from oiler tank for service. One end of the screen fits in the recess under the center screw and nut.

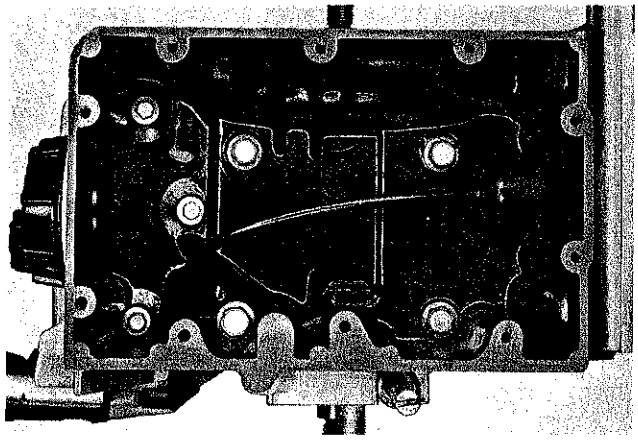


Figure VIII-7. Sealing screws are used to attach the fuel tank to the crankcase, and the oiler tank to the fuel tank.

all traces of dirt, and dry it in the open air. Clean filters are extremely important, and if there is any doubt about their condition they should always be replaced with new ones. Inspect the individual parts of the fuel vent orifice assembly and the oiler check valve parts. Clean them thoroughly and check for any parts missing. Replace those as well as any that appear to be in poor condition.

Reassembly

Reassemble the oiler tank and fuel tank assemblies in reverse order of disassembly. It is always advisable to use a new "O" ring. Tighten the attaching screws as follows:
Fuel tank to crankcase -- 90 to 100 inch-pounds (7-1/2 to 8-1/2 foot-pounds) (1.04 to 1.12 mkg) (Figure VIII-7)
Fuel tank cover to fuel tank -- 55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mkg)
Oiler tank cover to oiler tank -- 55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mkg)

FUEL TANK ASSEMBLY

Model 1-60, 1-61, 1-62, and 1-63 engines

Disassembly

Drain the fuel tank and the oiler tank.

Remove:
1. Fuel cap and "O" ring
2. Fuel tank cover
3. Fuel tank gasket
4. Fuel tank spring
5. Fuel wick cap
6. Fuel pickup wick
7. Bottom assembly (Figure VIII-8)

Service

Clean the fuel pickup wick by washing it in solvent or clean, unleaded gasoline, and dry it in the open air. Blow compressed air through the fuel passages to free them of any trapped dirt. Clean the fuel tube by removing it from the tank and running a wire through it if the compressed air does not clean the passage completely. Wash the inside of the bottom assembly and blow it dry. Check the condition of the individual parts and replace those showing damage.

Reassembly

NOTE

Originally, two different fuel tank assemblies were used on Model 1-60 and 1-61 engines. Now a single fuel tank assembly is available for service replacement for either of these models. The new tank assembly is P/N 57475, and requires a vented fuel cap assembly. If the new fuel tank assembly is being installed to replace one of the older assemblies having a drain tube from the fuel tank to the transmission assembly, the drain tube hole in the transmission will have to be plugged. Plug the hole by staking two 1/4-inch (6.35 mm) diameter lead balls into the hole. To be sure of a good seal, use a sealant on the lead balls before and after staking. (Figure VIII-9)

Reassemble the fuel tank elements using torque values as follows:
Fuel tank to crankcase -- 90 to 100 inch-pounds (7-1/2 to 8-1/2 foot-pounds) (1.04 to 1.12 mkg).

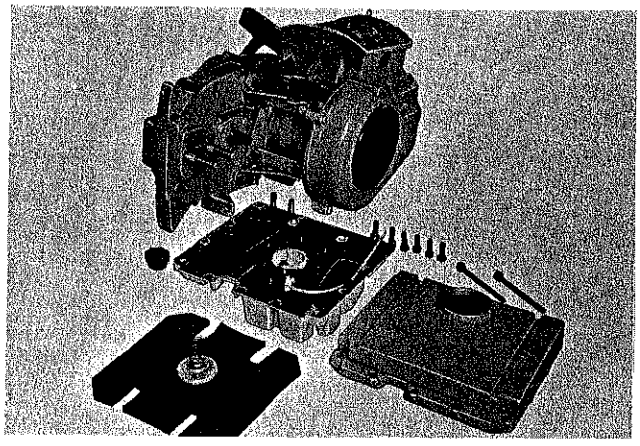


Figure VIII-8. The fuel tank assembly should be removed from the engine, separated into its several parts as illustrated, and thoroughly cleaned. The fuel tank wick, cap, and spring are shown in their working positions.

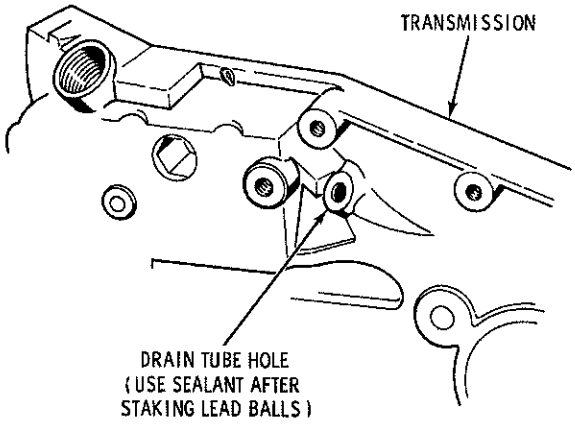


Figure VIII-9

Fuel tank cover to tank -- 55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mkg).

Fuel Cap Assembly (P/N 55934) (Figure VIII-10)

Disassembly

Remove the outlet fitting, rubber valve, phenolic disc, and spring.

Service

Wash all parts of the cap assembly to remove any dirt that may have accumulated and which may interfere with proper venting of the tank.

Reassembly

Reassemble the parts, taking care to get them back in the same order in which they were removed.

NOTE

Because of the many variations in the conditions under which a saw operates, such as area, temperature, humidity, and altitude, fuel tank venting may be adversely affected. For example, there may be constant venting and spilling of fuel through the fuel tank cap air vent because of a vent spring too weak, or engine flooding and accumulation of fuel in the airbox because of a vent spring that is too strong. If either of these conditions have been noted, check the spring to determine if a change in spring pressure is advisable. Measure the free spring length to see what type it is.

The low pressure spring (to relieve the flooding problem) has a free spring length of 0.350-inch (8.9 mm). The high pressure

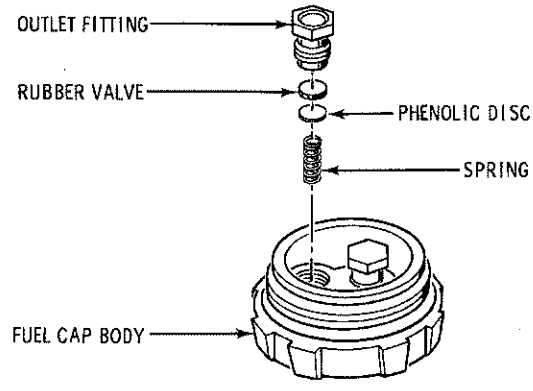


Figure VIII-10

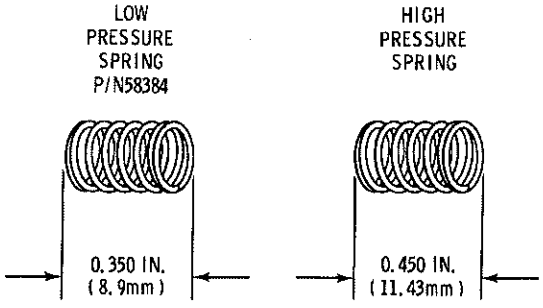


Figure VIII-11

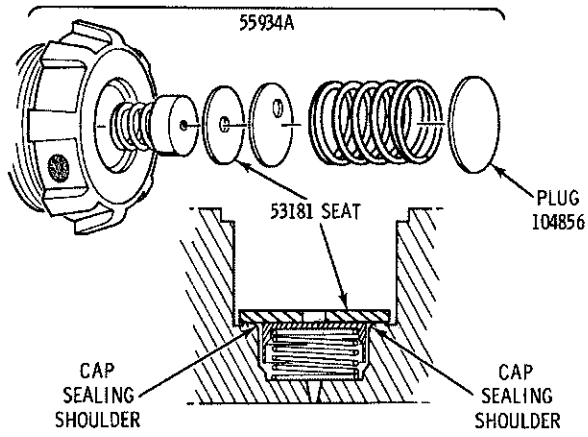


Figure VIII-12

spring (to relieve the spilling problem) has a free spring length of 0.450-inch (11.43 mm). (Figure VIII-11)

Fuel Cap Assembly (P/N 55934A) (Figure VIII-12)

Disassembly

Remove the expansion plug in the top of the cap with a small punch, prying it out of the seat. Remove the large spring, valve seat, cup, and the small spring.

Service

Clean all parts thoroughly (except the expansion plug). Wash and blow air through the sintered filter in the side of the fuel cap body. Remove all grease, dirt, and sawdust on or around the filter. Run a small diameter wire through the small hole in the bottom of the cap and wash or blow the cup and small spring cavity clean.

Reassembly

Seat the small spring in the cup and place both in the lower cavity of the cap, spring down. Install a new valve seat or turn the used one over so that it rests with the smooth side against the cap shoulder. Install the valve and large spring. Install a new expansion plug, seating it tightly in the top of the cap with a coating of Plio-bond or similar sealer around the edge to make an airtight seal.

AIRBOX AND REED VALVE ASSEMBLIES

Airbox Assembly

Disassembly

Remove the airbox cover and the air cleaner. Remove the throttle governor lever and detach the throttle rod. (Replace the lever and screw on the throttle shaft for safekeeping.) Work the fuel hose clip back on the hose, and pull the hose from the fuel pump. Loosen the carburetor mounting screws, remove the holding nuts, and push the screws back from the carburetor far enough to clear the carburetor mounting flange. Remove the carburetor from the airbox. (The choke rod will pull out of the choke button with the carburetor.) Replace the mounting screw nuts and leave them, with both gaskets and the adapter, in the airbox. Remove the oiler tank if it has not already been removed with the fuel tank, by removing its attaching screws from inside the fuel tank.

NOTE

Removal of the oiler tank in the above instructions does not apply to the Model 1-60, 1-61, 1-62, and 1-63 engines, where the oiler tank is integral with the transmission assembly.

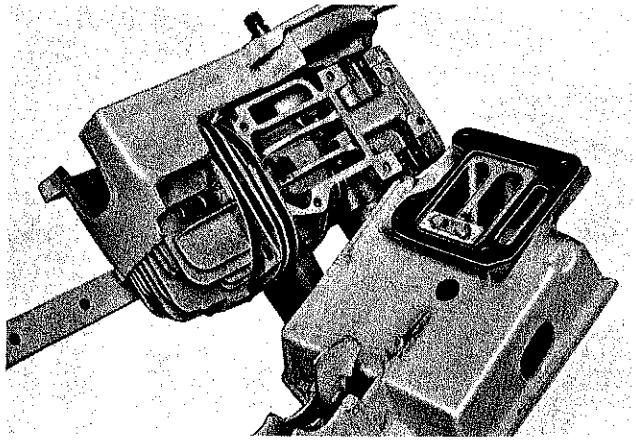


Figure VIII-13. Service on the reed valve assembly can be accomplished by removal of the air box. Note the pulsation passage between the two reeds close to the reed lock plate.

Work the fuel hose clip back on the hose at the tank end and pull the fuel hose from the fuel hose tube. Remove the handle screw from the handle brace (Model 1-42 and 1-43 engines excepted), and remove the screws holding the airbox to the crankcase. Lift the airbox from the crankcase, taking care that the oiler push rod is not bent in doing so. (Figure VIII-13)

Reed Valve Assembly

Disassembly

NOTE

Because of differences in the arrangement of the reed valve assembly on the various engines, sequences of disassembly listed below are grouped according to the engines of similar arrangement.

From the under side of the airbox, remove reed valve assembly parts as follows:

Model 1-40, 1-50, 1-60 (Figure VIII-14)
1. Reed plate insulator
2. Reed guard
3. Reed
4. Reed plate
5. Airbox gasket

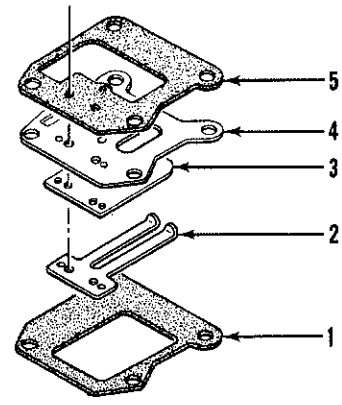


Figure VIII-14

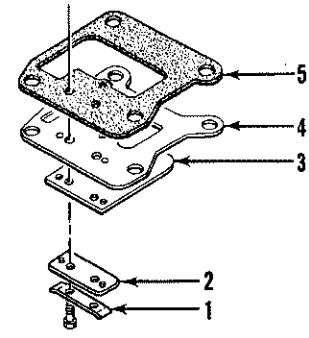


Figure VIII-15

Model 1-41, 1-51, 1-61 (Figure VIII-15)
1. Lock plate
2. Reed clamp
3. Reed
4. Reed plate
5. Airbox gasket

Model 1-42, 1-43, 1-45, 1-46 (Figure VIII-16)
1. Lock plate
2. Reed clamp
3. Fuel deflector
4. Reed
5. Reed plate
6. Airbox gasket

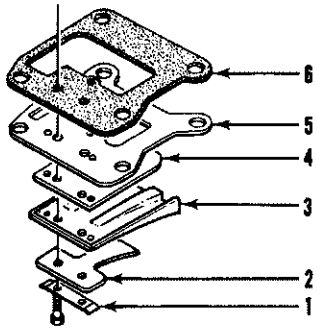


Figure VIII-16

Model 1-52, 1-53, 1-62, 1-63 (Figure VIII-17)
1. Lock plate
2. Reed clamp
3. Fuel defelctor
4. Reed
5. Reed plate
6. Airbox gasket

Service

The fuel deflector incorporated in the reed valve assemblies on Model 1-42, 1-43, 1-45, 1-46, 1-52, 1-53, 1-62, and 1-63 engines, is for the purpose of reducing fuel puddling. Fuel puddling can cause power loss and stalling.

NOTE

Fuel puddling was reduced on some early Model 1-41, 1-51, and 1-61 engines by installing a puddle wick in the third port cavity in the crankcase. If, during service on any of these engines, the puddle wick is found to be still installed, remove and discard it. Install in its place, a fuel deflector in the reed valve assembly, as used in the later model engines.

New reed valve assemblies including the fuel deflector may be installed as replacement parts on Model 1-41, 1-51, and 1-61 engines as a corrective measure for the puddling condition. The replacement should be made during service of these engines if the trouble is known to exist. For subsequent disassembly of parts which have previously been installed on these engines, they are removed in the following order: (Figure VIII-18)
1. Insulator
2. Lock plate
3. Reed clamp
4. Fuel deflector
5. Reed
6. Reed plate
7. Airbox gasket

The insulator is used as a spacer to prevent the end of the fuel deflector from hitting on the crankcase.

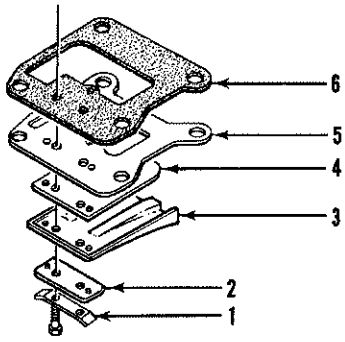


Figure VIII-17

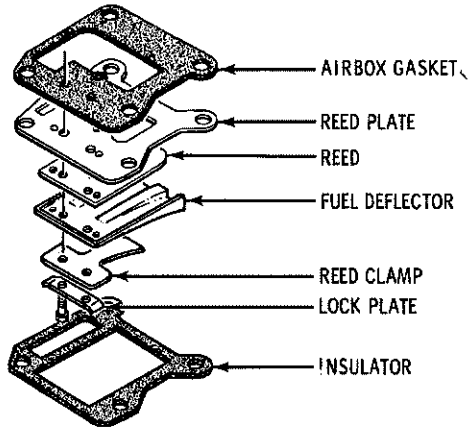


Figure VIII-18

Model 1-40, 1-50, and 1-60 engines employ a riveted reed valve assembly. It is very important that the reed valve be properly assembled and positioned. When positioning the reed on the reed plate, make sure that the burr edge of the reed faces away from the plate. If the burr edge is against the plate, the reed will not seat properly. Make sure also that flat head rivets are used to fasten the assembly, with the rivet heads against the reed plate and the peened ends against the reed guard. (Figure VIII-19) Note particularly the seating of the reed on the plate. There should not be more than 0.010-inch clearance between the tips of the reed and the plate. In the service of the reed valve assembly on any engine, check the condition of the reed for any distortion. Replace the reed if it is damaged or distorted in any way. Replace all gaskets showing signs of wear of any kind. These gaskets must provide an air tight seal.

The most important part of service on the airbox assembly is the care to be taken that it is perfectly clean and that possibility of air leakage is prevented. Examine the box for cracks and damage around the cover seal. The air cleaner should be washed in clean solvent and hung in the open air to dry. Look for damage to the oiler push rod seal and replace it if the rod hole is not completely sealed.

Early production of Model 1-50 and 1-60 engines did not include the push rod seal but parts for field installation were made available and service on these models which have not been altered should include the installation. This may be done in the following manner:

1. Remove the carburetor, airbox, and fuel hose.
2. Place the new oiler push rod seal and the retainer on the push rod, with the detent end of the retainer pointing toward the airbox. (Figure VIII-20)
3. Push the seal up tight against the oiler push rod hole in the airbox.
4. Insert the top of the retainer into and through the hole so that the detent is inside the airbox and the retainer is against the seal.
5. Reassemble the fuel hose, airbox, and the carburetor.

Before attaching the airbox to the crankcase, check the action of the choke button and the oiler button. See that they do not stick or bind because of swelling. If a slight sanding will not rid a button of a tendency to bind, replace it with a new button.

Check the action of the trigger assembly, making sure that the throttle rod moves freely through the grommet in both directions, that the grommet makes a good seal

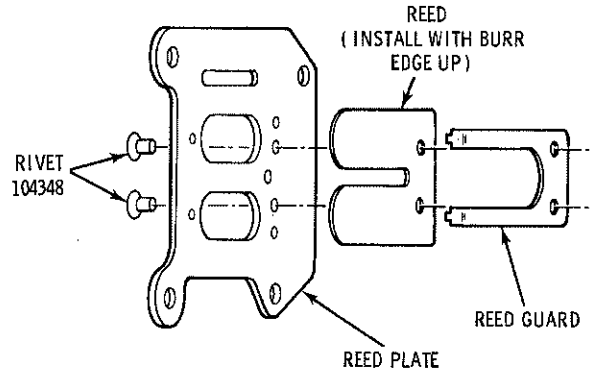


Figure VIII-19

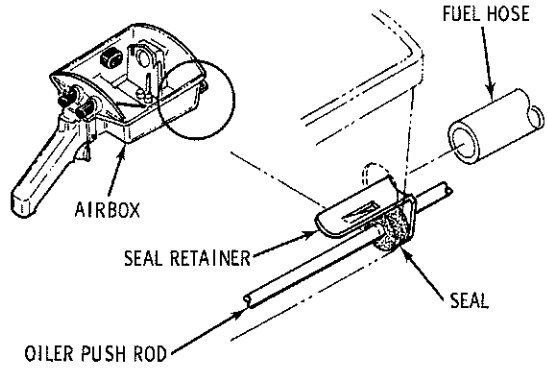


Figure VIII-20

between the rod and the airbox, and that the trigger spring is in place and not distorted. If replacement of any of these parts is indicated by trial or observation, the assembly may be removed from the airbox in the following sequence: (Figure VIII-21)

1. Trigger pin retainer
2. Trigger pin
3. Trigger spring
4. Trigger
5. Throttle rod and grommet

NOTE

A Throttle Lock Kit, P/N 57618, is available for installation of Model 1-41, 1-42, 1-51, 1-52, 1-61, and 1-62 engines, with instructions for installation. (Instruction Sheet P/N 57631A)

Reassembly

NOTE

If a new reed valve assembly including a fuel deflector is being installed for the first time on either a Model 1-41 or 1-51 engine, the airbox may require alteration. It is possible that the forward attaching holes in the airbox flange where it attaches to the crankcase, may not be recessed for the screw heads. If not, the installation of the new reed valve assembly may cause the screw heads to ride too high to allow the oiler tank to be put back in place. Under these conditions, the airbox flange holes must be counterbored. Use a 7/16-inch (11.11 mm) diameter drill and counterbore to a depth of 1/16-inch (1.58 mm). This will drop the screw heads far enough to allow the oiler tank to seat properly.

The reed valve and airbox assemblies are reinstalled on the crankcase in reverse order of their removal. If the fuel tank is in place, use caution in guiding the oiler push rod into the fuel tank passage as the airbox is worked into position. Be careful that the oiler piston is not damaged by jamming the oiler rod into its opening.

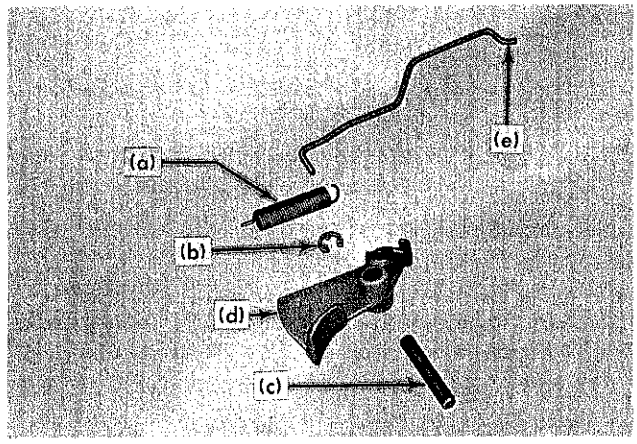


Figure VIII-21. The trigger assembly consists of the trigger spring (a) trigger pin retainer (b) trigger pin (c) trigger (d) and throttle actuator rod (e).

Tighten the airbox attaching screws to a torque value of 55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mkg).

CARBURETOR ASSEMBLY

NOTE

Model 1-45 and 1-46 engines are equipped with McCulloch carburetors. All other model engines covered in this manual are equipped with Tillotson carburetors except those which by special designation for test or other purpose, may also have McCulloch carburetors. The arbitrary separation of carburetor type by engine model is therefore not intended to be limiting in service procedures. Except for the sequence of disassembly, and in reverse order, reassembly, service procedures are the same for both types of carburetors. Instructions which apply to one type will also apply to the other except as specifically designated.

NOTE

Model 1-41, 1-42, and 1-43 engines employ a direct choke button air cut-off for choking action rather than a choke rod linkage and shutter as used on all other models. In the sequence of disassembly which follows therefore, the choke rod, shutter, choke lever, shaft, and choke return spring may be ignored for the Model 1-41, 1-42, and 1-43 engines, and for these models substitute the carburetor choke spring only.

Disassembly - Tillotson Carburetor

An approved sequence of disassembly, although not necessarily the only one, is as follows: (Figure VIII-22)

1. Fuel strainer cover retaining gasket
2. Fuel strainer cover
3. Fuel strainer cover gasket
4. Fuel strainer element
5. Fuel pump body
6. Fuel pump diaphragm
7. Fuel pump gasket
8. Diaphragm cover
9. Diaphragm
10. Diaphragm gasket
11. Idle fuel adjustment needle and "O" ring
12. Main fuel adjustment needle and "O" ring
13. Choke rod
14. Choke shutter
15. Choke shaft and lever
16. Choke return spring
17. Throttle shaft clip
18. Throttle shutter
19. Throttle governor lever
20. Throttle shaft and lever
21. Inlet control lever pinion screw
22. Inlet control lever
23. Inlet tension spring
24. Seat and needle
25. Inlet seat gasket
26. Throttle shaft bushings
27. Body channel cup plug
28. Body channel welsh plugs
29. Idle adjustment screw and spring
30. Air cleaner attachment stud and gasket

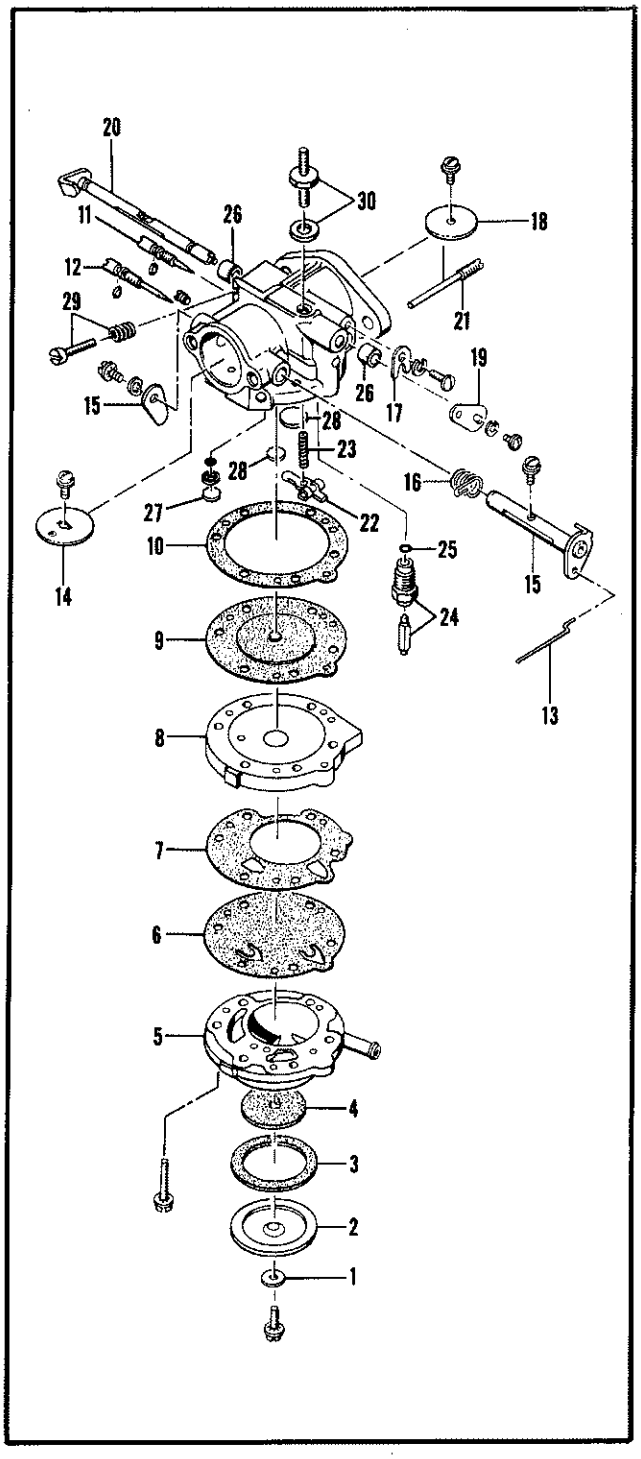


Figure VIII-22

Disassembly - McCulloch Carburetor (Figure VIII-23)

1. Fuel pump body
2. Fuel pump filter
3. Fuel pump diaphragm
4. Carburetor diaphragm plate

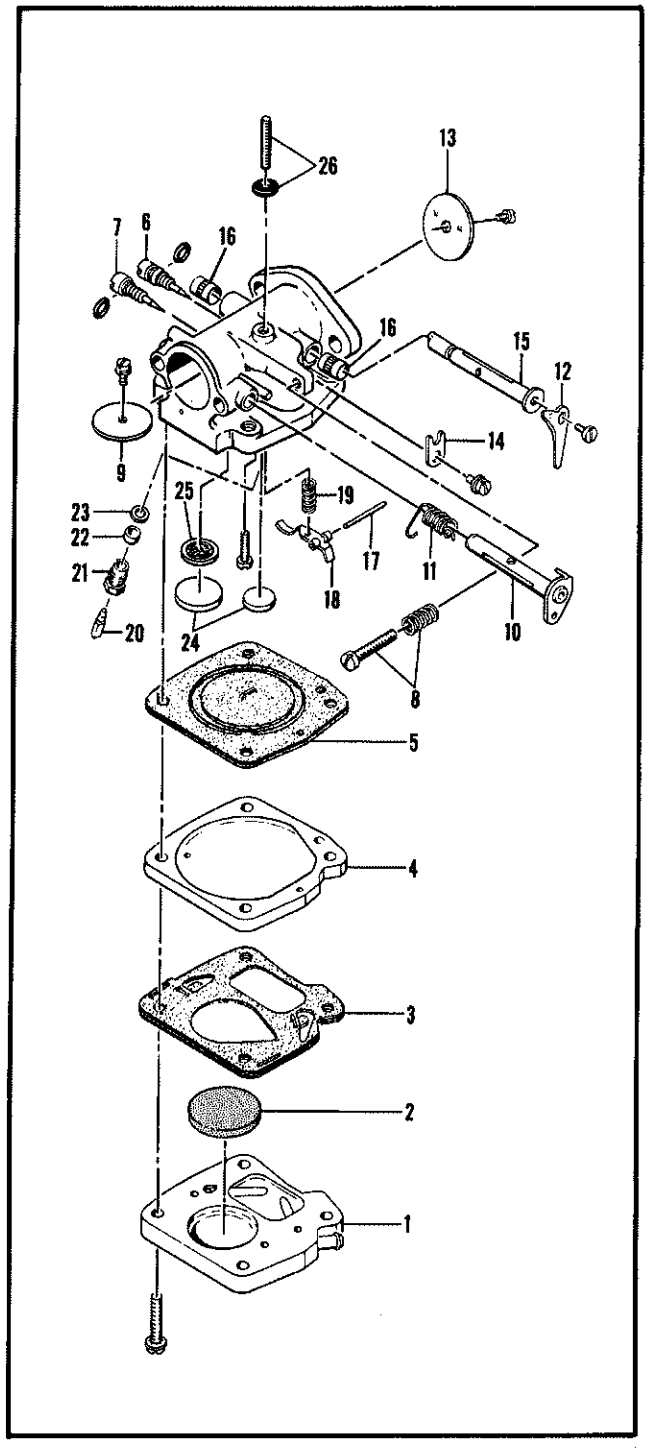


Figure VIII-23

5. Diaphragm
6. Idle fuel adjustment needle and "O" ring
7. Main fuel adjustment needle and "O" ring
8. Idle screw and spring
9. Choke plate
10. Choke shaft assembly
11. Choke return spring
12. Throttle shaft arm
13. Throttle plate
14. Throttle shaft clip
15. Throttle shaft assembly
16. Carburetor body bushings
17. Inlet lever pin
18. Inlet control lever
19. Inlet lever spring
20. Needle valve
21. Needle body
22. Needle seat
23. Valve washer
24. Expansion plugs
25. Capillary seal
26. Air cleaner attachment stud and grommet

Service

Since the carburetor's function is to supply fuel in the proper air-liquid proportion, the main service requirements will always be elimination of the troubles which upset this proportion. These troubles fall into three classes:
(a) Physical damage to one or more of the carburetor parts
(b) Dirt or other foreign agents which interfere with part function,
(c) Mal-adjustment.

The first of these trouble classes is eliminated by replacement of the damaged part, the second by cleaning and removal of the trouble agent, and the third by proper adjustment.

While some of the trouble shooting shortcuts may easily locate a point of trouble that may be eliminated by correction of the faulty element, it is always good practice to examine the whole system in general service. Look for trouble caused by physical damage in:
(a) Gaskets that leak air in the pulsation passage and restrict action of the fuel pump,
(b) Tears or holes in the fuel pump diaphragm that cause rich mixtures and flooding. (Figures VIII-24 and VIII-25)

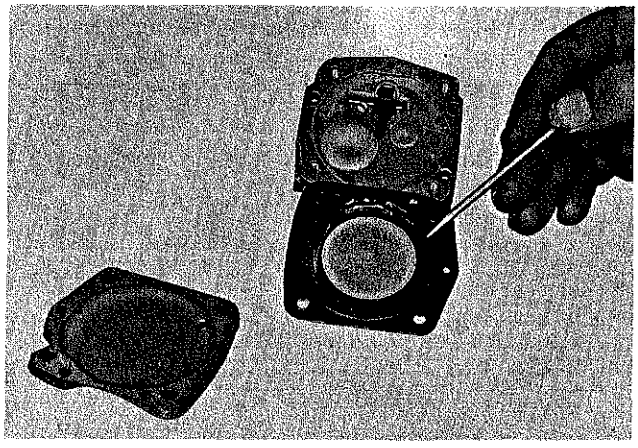


Figure VIII-24. Check the carburetor control diaphragm. Look for holes or cracks in the diaphragm, damage to the gasket, and evidence of the disc having interference from the expansion plugs.

(c) Stiff or curled flapper valves in the fuel pump diaphragm that result in little or no pumping of fuel to the carburetor,
(d) Worn or damaged inlet control valve and valve seat that cannot control fuel volume,
(e) Bent or broken control lever that cannot transmit diaphragm control action to the inlet valve,
(f) A compressed or stretched spring that may cause in the former case, flooding, and in the latter case, a lean mixture or starving,

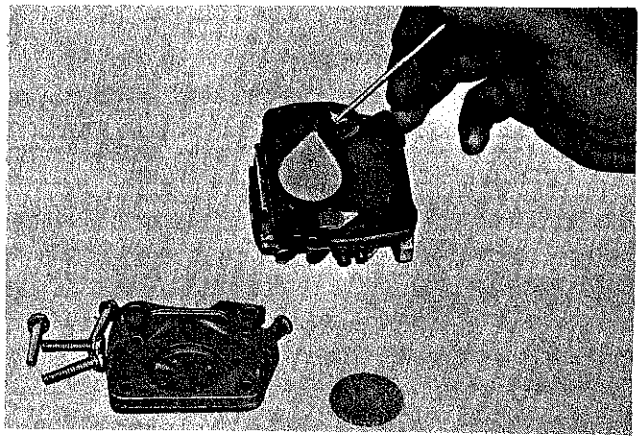


Figure VIII-25. When checking the fuel pump diaphragm on McCulloch carburetors, make sure the flapper valves are on the fuel side of the gasket.

(g) A torn or punctured diaphragm that will prevent regulation or adjustment of the carburetor,
(h) Worn, bent, or deformed adjustment needles that prevent proper metering of the fuel.

Look for carburetor troubles caused by dirt or other foreign matter in: (Figure VIII-26)
(a) Fuel passages
(b) Pulsation passages
(c) Fuel strainer element
(d) Inlet control valve
(e) Entries to passages caused by damaged or improperly positioned gaskets

In cleaning a carburetor, wash the parts including the body, diaphragm cover, and fuel pump body in clean gasoline and blow them dry. Do not try to dry any carburetor part with a cloth. Minute fibers can get into passages and block or interfere with fuel flow, making it impossible to adjust the carburetor. If any of the parts are found to be dirty with gummy deposits, soak the parts in alcohol or acetone to loosen the gum, then wash and blow them dry in the usual way.

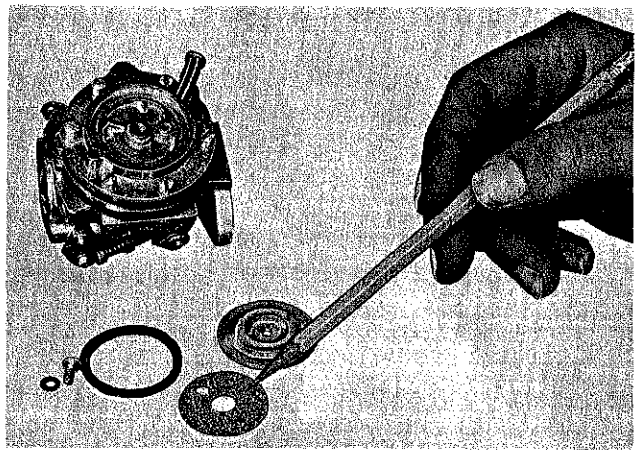


Figure VIII-26. The fuel strainer has a slightly finer grain on one side than it has on the other. The strainer should be washed and blown dry with compressed air. Small particles of dirt can be removed easier if the air is blown through the strainer from the fine grain side to and away from the coarse grain side.

CAUTION

Use extreme care in removal of the expansion plugs covering the fuel supply passages opening into the carburetor body. Any damage to the passage resulting from the plug removal will require a complete new body replacement. Never try to re-use a plug once removed.

On Tillotson carburetors, a cup plug, nozzle well ring, and nozzle well screen were adopted to relieve troubles of lean-out during idling due to air flow from the venturi through the high speed outlet hole to the diaphragm chamber. The mesh screen helps to prevent this flow of air and therefore prevents the lean-out action. The screen can load up with dirt however, if the fuel pump filter has been left out, is damaged, breaking down, or has been installed with the wrong side toward the carburetor. To clean or replace the mesh screen, proceed as follows:

1. Pry out the high speed cup plug with a sharp pointed punch. (Figure VIII-27)
2. Remove the screen.
3. Wash the screen thoroughly or replace it.
4. Clean the fuel passages and blow them dry. (Figures VIII-28 and VIII-29)
5. Reinstall the screen, ring, and a new cup plug.

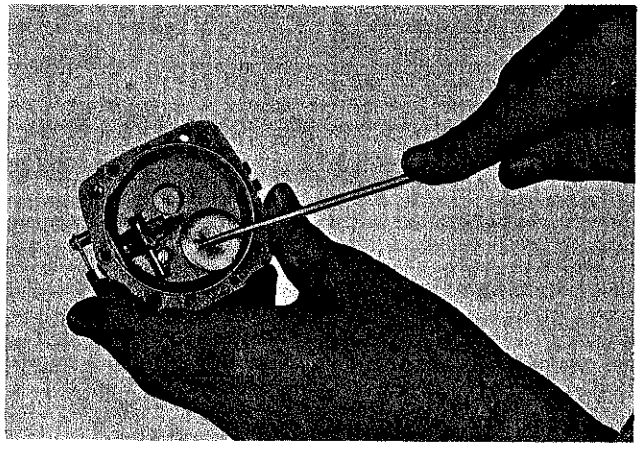


Figure VIII-27. To remove expansion plugs, punch a small hole just through the plug surface and pry it out of the body. Do not insert the punch so deep into the cavity under the plug that the screen is damaged.

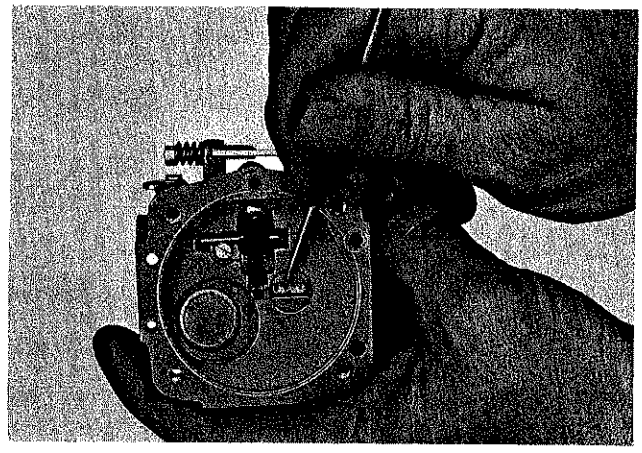


Figure VIII-28. Remove the fuel screen for cleaning and blow low pressure air through the adjustment needle openings to clean out the internal passages of the carburetor. Low speed passages are shown in this photo.

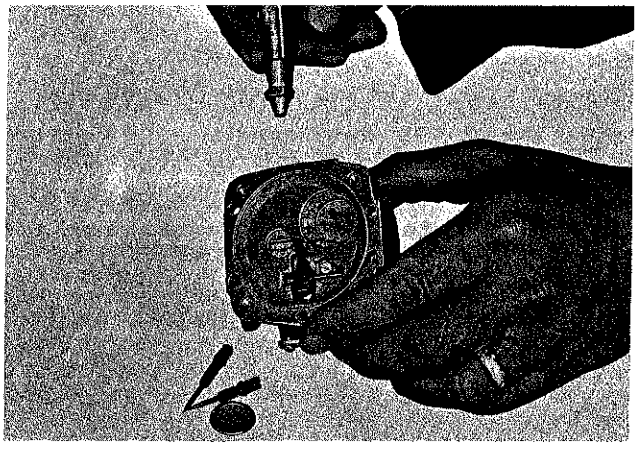


Figure VIII-29. Hold the end of the air hose an inch or two away from the adjustment needle openings when blowing air through the internal passages to clean and dry them. This will eliminate danger of blowing out plugs not being removed.

Inspect throttle and choke shafts and their bushings for wear. Press worn bushings from the body and replace them with new parts.

Reassembly

When all parts of the disassembled carburetor are thoroughly clean and dry, and all worn or damaged parts are discarded and replaced with new parts, the carburetor may be reassembled in the reverse order of disassembly. The following information should be noted:

(a) When replacing expansion plugs, coat the inside rim with plio-bond or equivalent sealer and place it in the opening with the high side of the curve up. Flatten the plug with a flat punch of the proper size and light taps with a hammer.

(b) Use new "O" rings and gaskets unless they are obviously in very good condition as shown after careful inspection.

(c) Oil any new "O" rings before installation.

(d) Make sure that the inlet control lever moves freely on the pinion screw, and that the dimple on the lever fits inside the spring. (Figure VIII-30) On Tillotson carburetors, the control lever should be flush to 0.010 inch (0.254 mm) below the body casting surface when installed. If above or below these limits, the lever should be corrected or replaced.

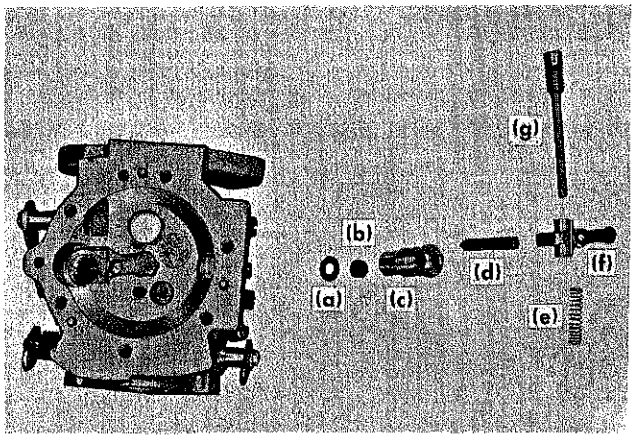


Figure VIII-30. Parts of the fuel inlet control consist of (a) inlet seat gasket, (b) seat, (c) needle valve body, (d) needle, (e) spring, (f) lever, (g) pinion screw.

In checking the position of the inlet control lever on McCulloch carburetors, measurements are made with reference to the diaphragm mounting face, instead of the fuel chamber surface as on Tillotson carburetors. (Figures VIII-31 and VIII-32) Although the correct operating position of the control lever on the McCulloch carburetor is the

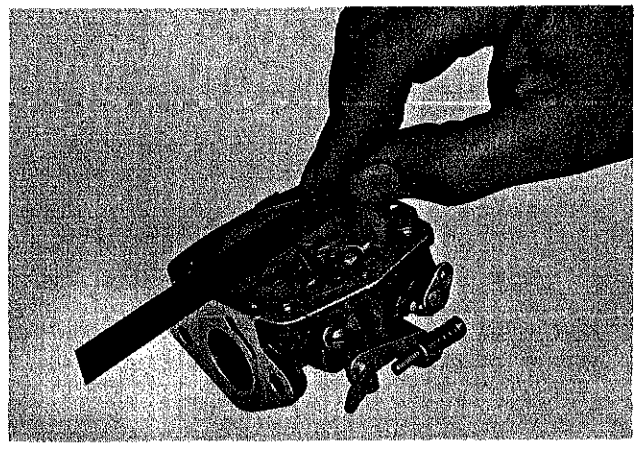


Figure VIII-31. The position of the inlet control lever on McCulloch carburetors is checked by a straight edge laid across the diaphragm mounting face.

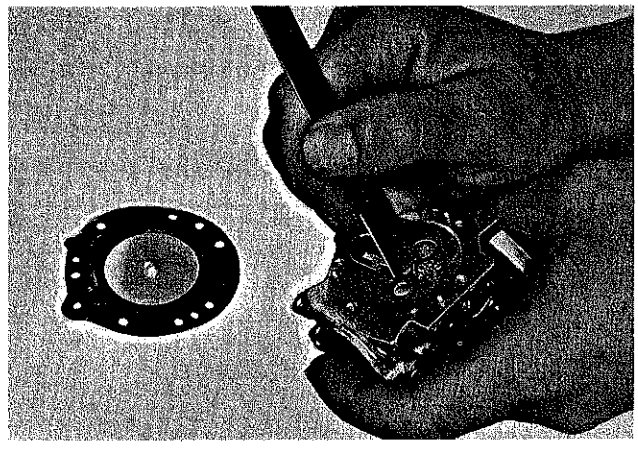


Figure VIII-32. The position of the inlet control lever on Tillotson carburetors is checked by a straight-edge on the face of the body casting close to the lever cavity. Check the diaphragm for cracks, holes, and tears.

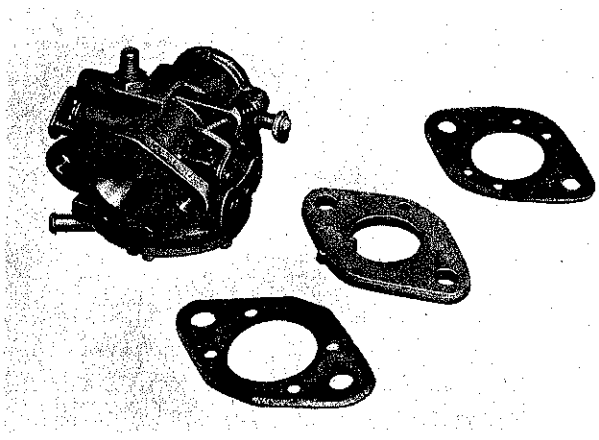


Figure VIII-33. When assembling the carburetor, carburetor adapter, and gaskets, make sure that the pulsation passage holes are open. The wrong position of either gasket or the adapter can block the passage and prevent operation of the engine.

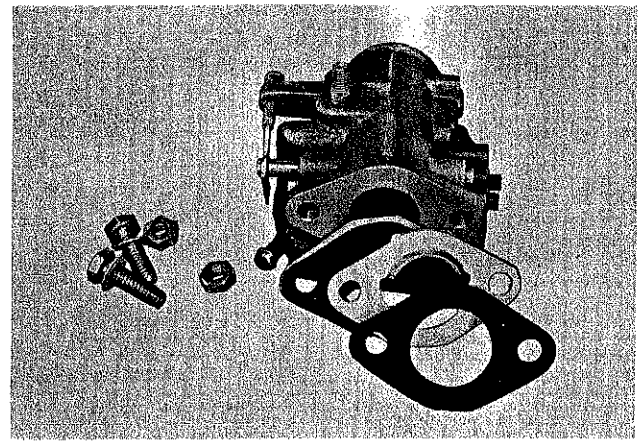


Figure VIII-34. Note that the McCulloch carburetor adapter plate has a flange on one side of the airbox opening. This flange must be on the upper side of the opening to prevent misalignment when the carburetor mounting screws are tightened.

same as for the Tillotson, the lever must be pre-set to a higher position when a new needle valve seat is installed.

The reason for this pre-set position on McCulloch carburetors is because of fuel action on the new needle seat. When fuel is first admitted through a new needle seat, the seat has a tendency to swell and slightly constrict the hole. This prevents the needle from opening as far as it normally does. The needle also pivots the hooked end of the control lever away from the control diaphragm. The result of these position changes of needle and control lever is less control from the diaphragm and a reduced flow of fuel through the needle seat. Lean-out and fuel starvation usually follow. Since the correct operating position of the lever is reached only after a short running period, the inlet lever must be pre-set to a higher than normal operating position. The lever position for a new seat should be from flush to 0.010 inch (0.254 mm) above the diaphragm mounting face.

(e) Be careful to reassemble the Tillotson carburetor parts in the proper order, and with the diaphragm gasket, diaphragm, and cover on the locating pins of the body. Then assemble the fuel pump gasket, fuel pump diaphragm, and pump body in the proper order on the locating pins of the diaphragm cover.

NOTE

A heavy duty fuel pump diaphragm, P/N 53164, is available for service replacement on Tillotson carburetors for Model 1-42, 1-43, 1-53, 1-62 and 1-63 engines. If a new fuel pump diaphragm is being installed, the heavier and longer wearing type is recommended.

(f) Install the fuel pump filter with the same side toward the fuel pump as it was originally installed. (Only when a new filter is not being used for replacement.)

(g) When assembling throttle and choke shafts in new shaft bushings, ream the bushings just enough to allow a light press fit of shaft to bushing.

(h) Be especially careful when mounting the carburetor flange gasket, adapter, and adapter gasket on Tillotson carburetors, that these elements are properly aligned and in the correct order. Make sure that the pulsation passages are open, because they can be blocked by getting the gaskets and the adapter (Figures VIII-33 and VIII-34) in the wrong position.

(j) Make sure that the tie-down screws are of the proper length so that they do not bottom on the carburetor body and prevent an air tight seal. (Figure VIII-35)

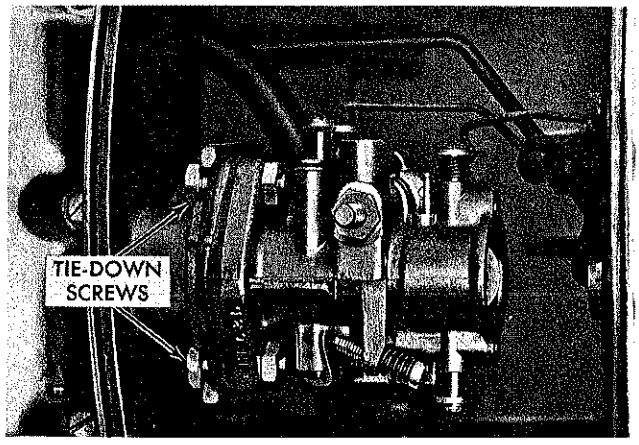


Figure VIII-35. It is important that the proper tie-down screws be used on the carburetor and airbox flanges. Screws too long will bottom on the carburetor body and permit air leaks.

When attaching screws are being installed on the carburetor, or in mounting the carburetor in the airbox, tighten screws to the following torque values:
Fuel pump to diaphragm cover and carburetor body -- 25 to 30 inch-pounds (2 to 2-1/2 foot-pounds) (0.288 to 0.350 mkg).
Fuel pump cover to pump body -- 25 to 30 inch-pounds (2 to 2-1/2 foot-pounds) (0.288 to 0.350 mkg).

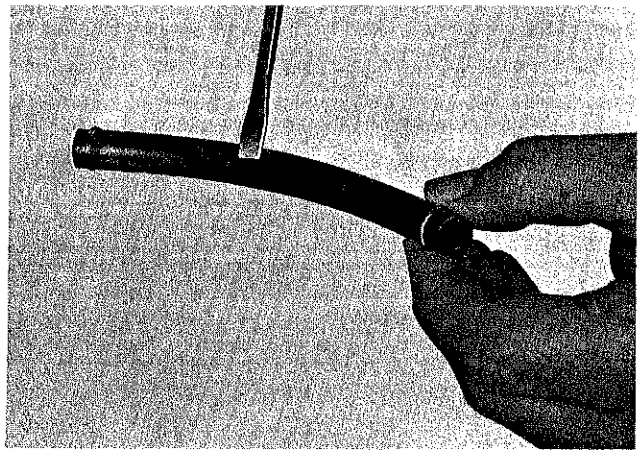


Figure VIII-36. Check the fuel hose carefully for small cuts or cracks. Make sure the retainer clips hold the hose securely when the hose is installed.

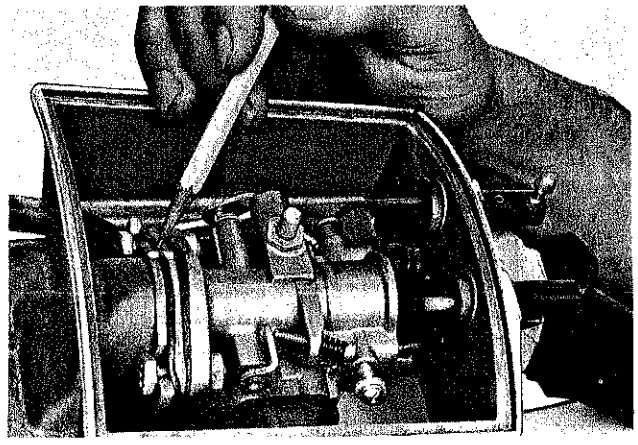


Figure VIII-37. Note that there are pips on the carburetor adapter and the airbox flange to assist in proper installation of the gaskets and adapter.

Carburetor flange and adpater to airbox flange -- 105 to 110 inch-pounds (8-1/2 to 9 foot-pounds) (1.178 to 1.235 mkg).

Fuel pump test for Tillotson carburetors

After the carburetor has been mounted in the airbox, a simple test can be made of fuel pump operation with the use of a pressure gauge, flexible hose, and a hose adapter for connecting it to the carburetor. This adapter can be made from an air cleaner attachment stud taken from stock or from

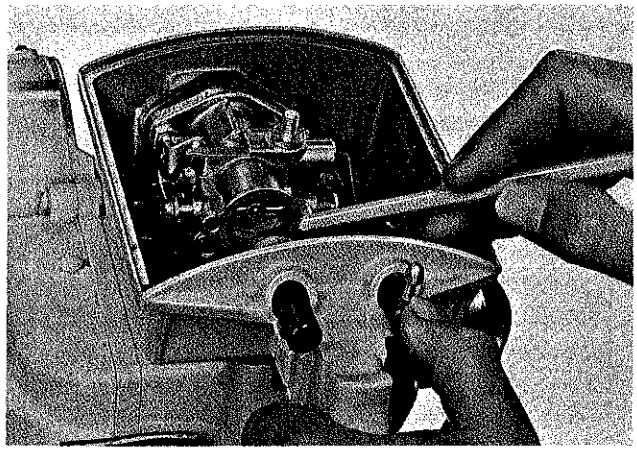


Figure VIII-38. Checking the choke butterfly to see that it closes the carburetor throat when the choke button is pressed all the way in.

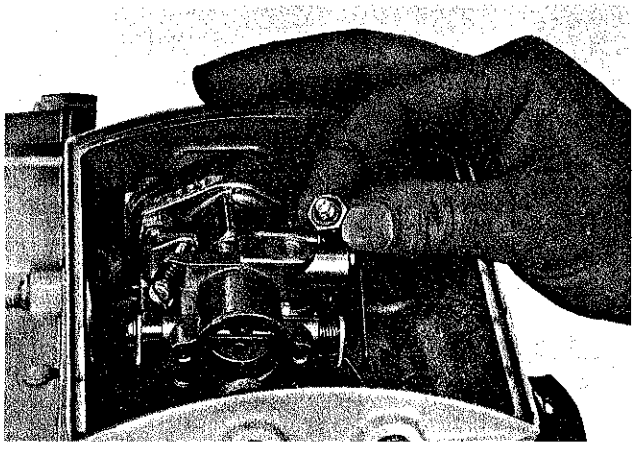


Figure VIII-39. The air filter cover attaches to a stud on the top of the carburetor. In Tillotson carburetors this stud is screwed into an opening into the fuel inlet passage. It must have a good gasket and the stud must be very tight to avoid air leak.

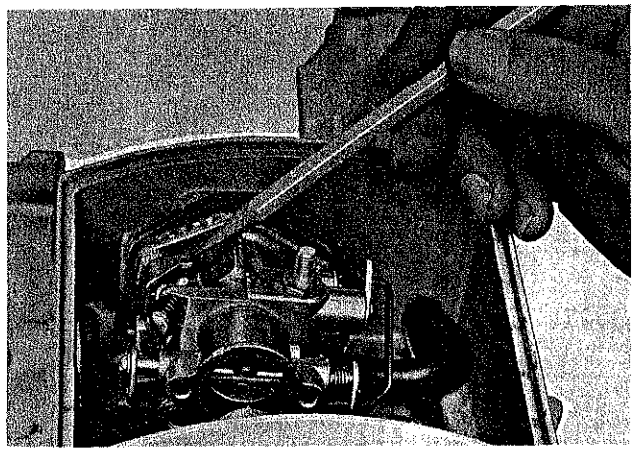


Figure VIII-40. Checking the throttle lever to see that it opens fully when the throttle trigger is pulled. Note the throttle linkage and be sure there is no interference between throttle and choke rod.

an old carburetor. To make the adapter, drill a 1/8-inch (3.175 mm) diameter hole lengthwise through the stud and file or grind the threads off the longer end, making this end a smooth nipple for attaching the hose. The other end of course, has the 1/4-28 threads which screw into the carburetor body in the usual way. The drilled hole through the stud now opens into the fuel passage between the fuel pump and the carburetor. Use a copper gasket and screw the adapter into the carburetor tight enough to make it leakproof. Slip the pressure gauge hose over the nipple end of the adapter, making sure that the fit is tight, and put fuel into the fuel tank. Pull the starter rope 8 or 10 times, watching the connected pressure gauge for pressure build-up. If the gauge indicates a pressure of 1/2 pound or more, the fuel pump is operating properly. If the gauge reads less than 1/2 pound the fuel pump is faulty.

Installation

After reassembly of the carburetor but before installation in the airbox, check the fuel inlet hose carefully for condition and damage (Figure VIII-36). Make sure that the pips on the carburetor and the carburetor mounting flange are together (Tillotson carburetors) (Figure VIII-37). If these pips are not lined up, the pulsation passage will be blocked.

When the carburetor is installed, make a final check to see that the choke butterfly (Figure VIII-38) and the throttle lever action (Figure VIII-40) is free, without interference, sticking, or restriction of travel.

Make sure also, that the airbox cover mounting stud (Figure VIII-39) has the gasket in place and that the stud is tight in the carburetor body.

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SECTION IX
Transmission Assembly

INDEX

TRANSMISSION ASSEMBLY

This section of the shop manual applies to the gear drive Model 1-60, 1-61, 1-62, and 1-63 engines only. Disassembly of the starter and clutch is also covered separately here because of their association with the transmission on these models. Service on the starter and the clutch, after disassembly is the same as that previously covered for the other models (Sections VI and VII).

Disassembly

STARTER ASSEMBLY

Remove the starter from the engine and then in sequence, the following parts: refer to Figures IX-1 and IX-2.

1. Starter cover
2. Rope pulley
3. Pulley bearing
4. Pin and washer
5. Starter handle and rope
6. Starter drum
7. Rewind spring
8. Starter shaft
9. Seal
10. Base bearing
11. Base and base gasket

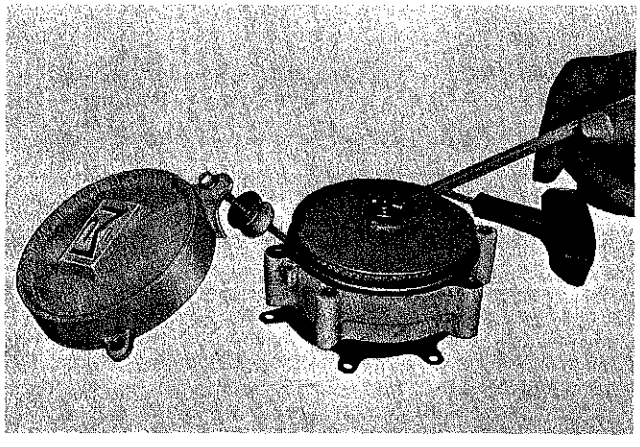


Figure IX-1. The starter drum is held on the shaft by a small pin. This pin must be removed before the shaft (and ratchet) can be removed. Note the rope pulley bushing and pulley on the starter cover screw. Check wear on this bushing when servicing the starter.

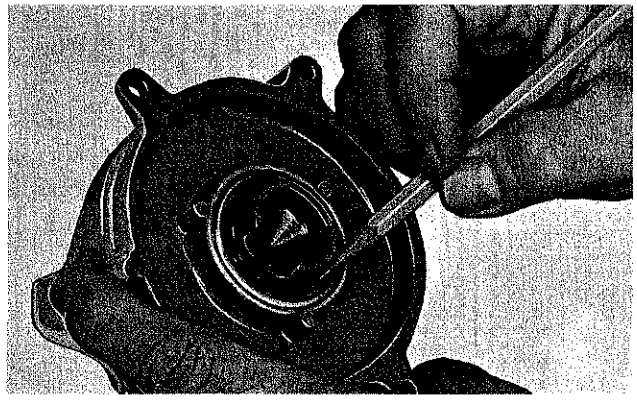


Figure IX-2. An oil seal is used to prevent oil from the transmission leaking around the starter shaft. Check the condition of the seal and replace it if there is damage or wear evident.

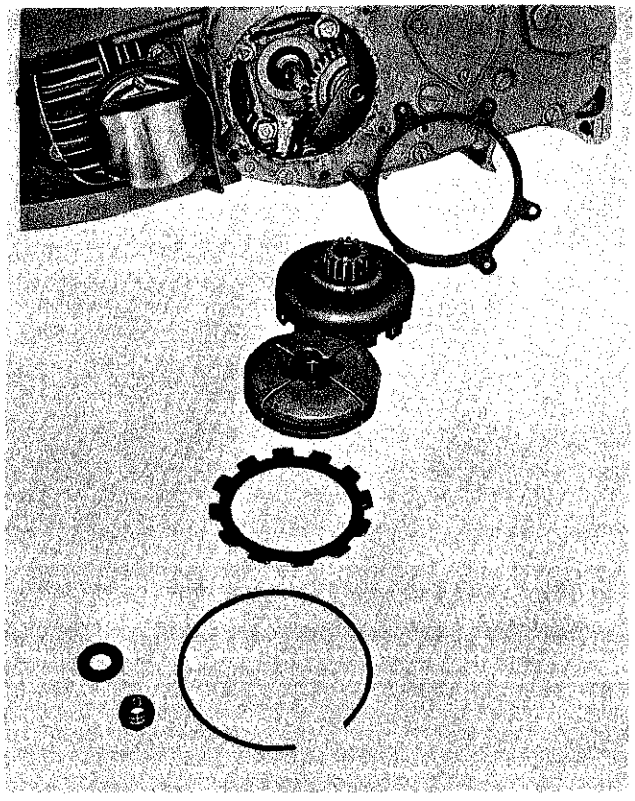


Figure IX-3. The clutch is removed from the engine by locking the flywheel against rotation, removing the clutch nut, and then pulling the clutch from the crankshaft with a pulling tool. After removal of the parts as illustrated, the clutch may be further disassembled for inspection and parts replacement.

CLUTCH ASSEMBLY

Lock the clutch against rotation by inserting a pin in the locking hole on the underside of the crankcase cover and rotating the clutch until the pin engages the cut-out in the flywheel. Then remove in order: refer to Figures IX-3, IX-4, IX-5, IX-6, IX-7.

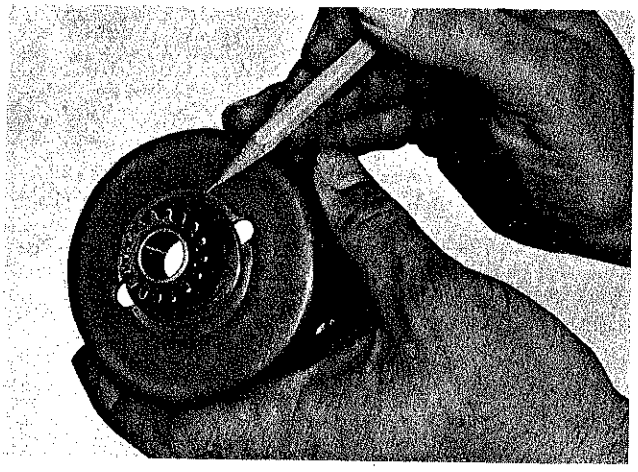


Figure IX-4. Inspection of the clutch drum assembly includes the pinion gear, bushing, and the friction surface of the drum. This surface is opposite to the pinion, on the inside.

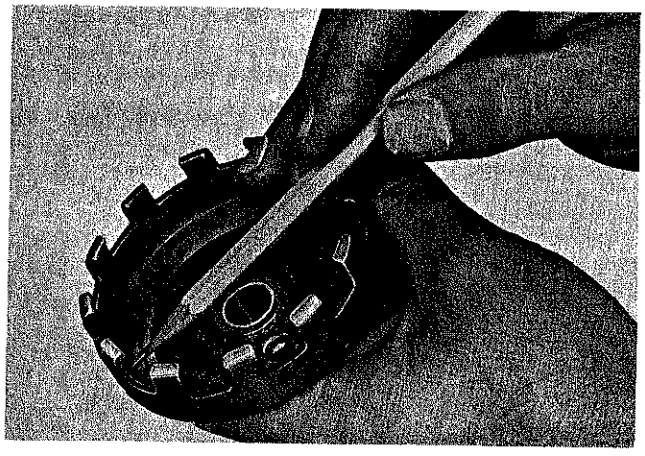


Figure IX-5. Wearing areas on the clutch drum include the sloping friction surface, and the inside of the retaining ring prongs.

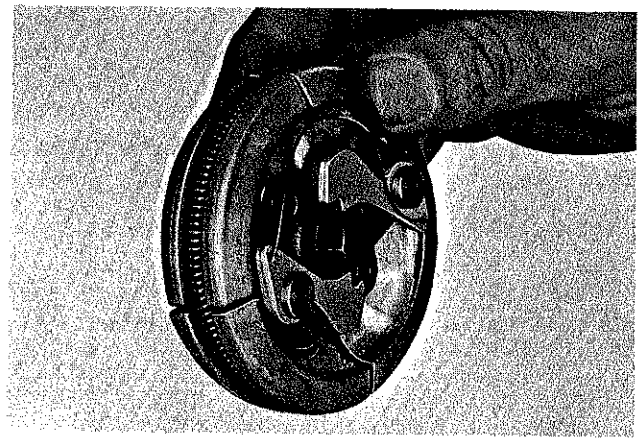


Figure IX-6. Contact surfaces, spring, pawls, and pawl springs on the clutch assembly may be checked for replacement need without disassembly. Replace clutch shoes in sets of four shoes only.

1. Nut and washer*
2. Retaining ring
3. Clutch friction disc
4. Clutch assembly (Use a pulling tool to remove the clutch)
   (a) Shoe retaining spring
   (b) Shoes
   (c) Pawl spring
   (d) Rotor and pawl assembly
5. Woodruff key
6. Drum assembly (including the pinion gear)
7. Bearing

*When reassembling the clutch, make sure that the correct washer is used. This is a special hard metal washer. Also be sure that the nut is turned tightly (torqued to 300 to 360 inch-pounds (3.46 to 4.15 mkg)). Unless care is taken to get the clutch secure on the shaft, the key can work loose and do severe damage to the crankshaft.

TRANSMISSION

Drain the oil from the oiler tank, remove the drain plug and drain the oil from the transmission gearcase, then remove the parts of the transmission and parts mounted on it.

Disassembly

When the starter and clutch are removed from the gearcase cover, three mounting

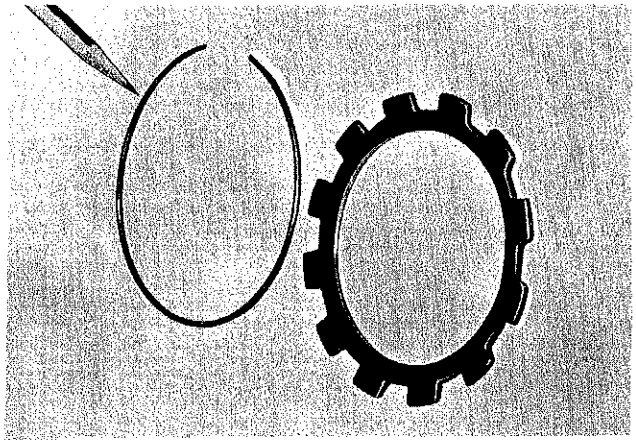


Figure IX-7. Wear on the clutch friction disc and the retaining ring must be checked carefully. The diameter of the retaining ring is important to operation because a loose ring could result in clutch slippage.

screws are exposed. With the removal of these three screws and two screws and a nut on the opposite side of the transmission (see Figures IX-8 and IX-9) the entire transmission may be removed from the engine as a complete unit. Note that there are washers

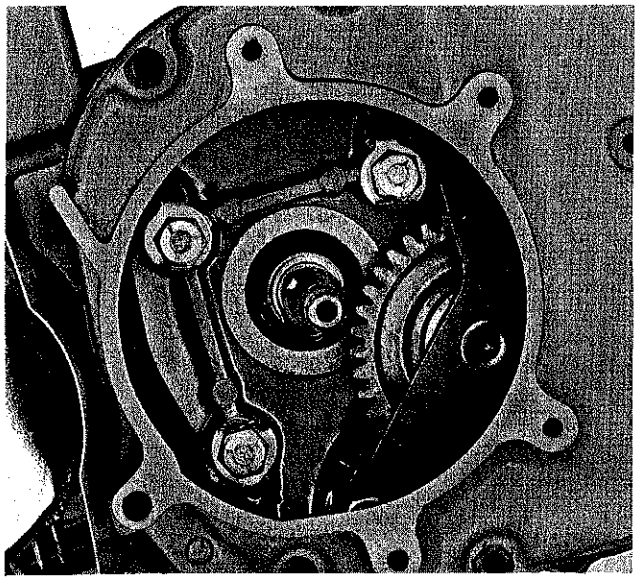


Figure IX-8. Note that the crankshaft oil seal on geared transmission engines is installed with the lips of the seal toward the gearcase. This is the reverse position of the oil seal when installed on direct drive engines.

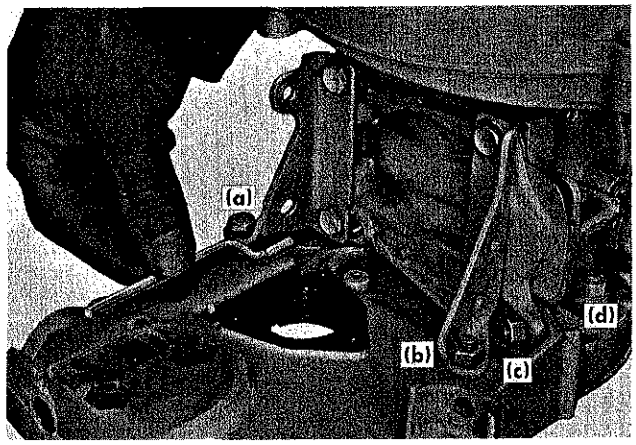


Figure IX-9. Screws (a) and (d), and nuts (b) and (c) must be removed allowing the transmission to be detached from the engine as a complete unit. Note that the nut (c) is on the gearcase brace side of the stuffer. Note also that the oiler push rod has a sleeve on one end to permit removal from the bar mounting pad.

under the lock plates which are not visible. Be very careful that these washers are removed in disassembly and that they are replaced when the screws and lockplates are inserted during reassembly.

Remove:

1. Spike*
2. Bar mounting nuts and washers*
3. Adjusting lockplate*
4. Gearcase protectors (Protector plates)*
5. Chain guard*
6. Bar mounting bolts*
   The bolts may be tapped out of gearcase with a light hammer, but be careful that the threads are not damaged.
7. Sprocket nut and washer *
8. Chain guide plate*
9. Sprocket *
10. Woodruff key*
11. Sprocket shroud*
12. Sprocket spacer* (Figure IX-10)
13. Bearing retainer*
14. Shaft cover gasket*
15. Sprocket shaft cover* (Figure IX-11)
16. Shaft cover gasket*
17. Gearcase cover
18. Sprocket shaft assembly (complete unit) including:*

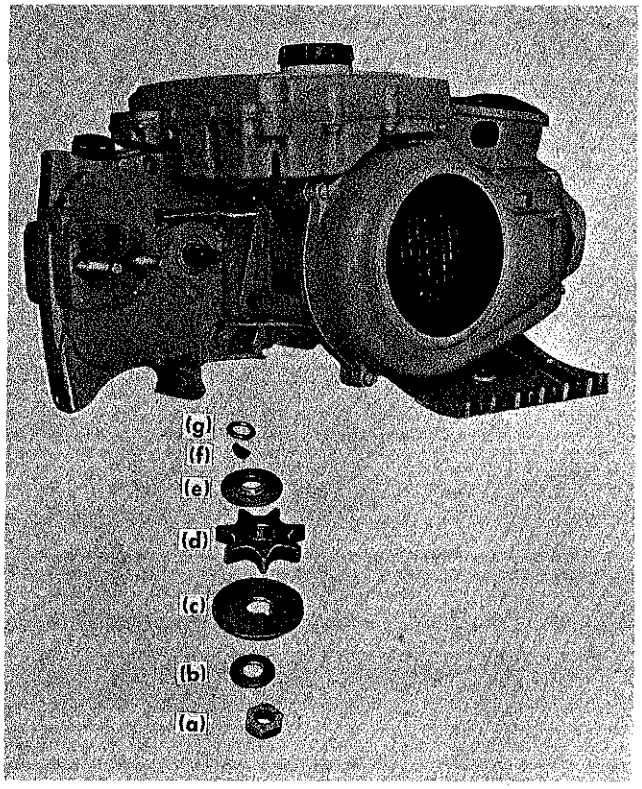


Figure IX-10. The sprocket is removed from the saw (and in reverse order re-installed) in the following order (a) nut, (b) washer, (c) chain guide plate, (d) sprocket, (e) sprocket shroud, (f) key, (g) spacer.

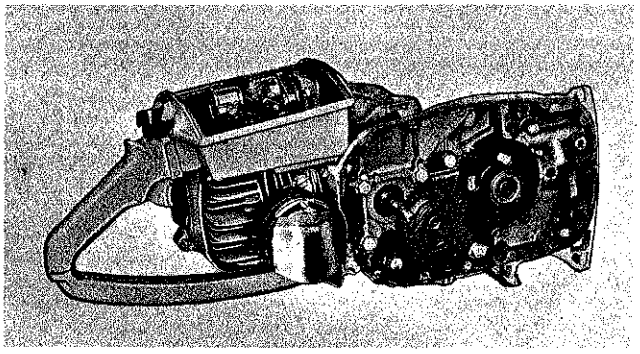


Figure IX-11. When the gearcase cover is removed, all elements of the transmission are exposed for inspection and service. Before removal of the cover, tap the bar mounting bolts out of the gearcase and remove the sprocket and sprocket shaft key.

*These parts are reversible on the saw so that the position of the bar may be changed from left to right on the gearcase. (Figure IX-12)

(a) Bearing
(b) Snap ring
(c) Gear spacer
(d) Sprocket shaft key
(e) Sprocket shaft
(f) Sprocket drive gear
(g) Gear spacer
(h) Oil seal
(j) Bearing
(Figure IX-13)

19. Idler gear
20. "O" ring or gasket**
21. Oiler assembly including:
    (a) Plugs
    (b) Ball spring
    (c) Ball
    (d) Body
    (e) Oiler spring
    (f) Piston and "O" ring
    (Figure IX-14)
22. Weight assembly including:
    (a) Screen
    (b) Weight
    (c) Hose
    (d) Check valve
    (See Figure IX-13)

**Gasket on Model 1-60 and 1-61. "O" ring on Model 1-62 and 1-63.

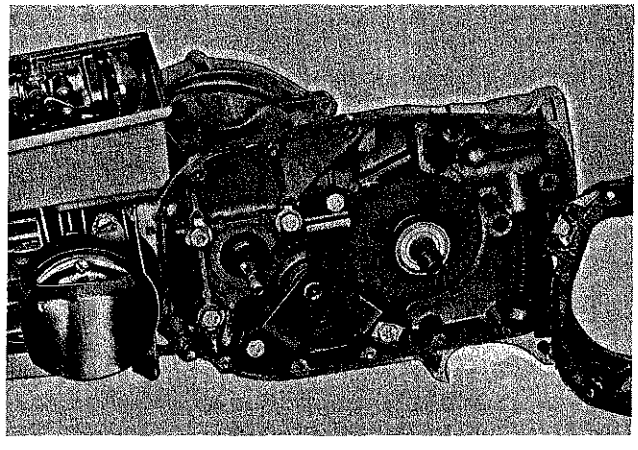


Figure IX-12. Illustrating the reverse installation of the sprocket shaft assembly for mounting the bar and chain on the right-hand side of the gearcase.

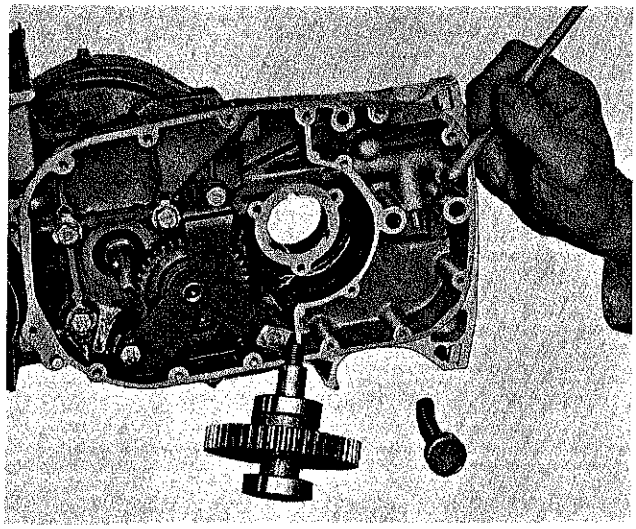


Figure IX-13. The sprocket shaft assembly may be removed from the gearcase by tapping the end of the shaft with a soft-face hammer. Note the weight assembly removed from the check valve for cleaning. Be sure the check valve is open before reassembly.

NOTE

When tapping or pressing the sprocket shaft assembly out of the gearcase, either one or both of the ball bearings may remain in the gearcase and/or the gearcase cover. The bearing or bearings will then have to be removed separately.

NOTE

A very effective gearcase cover puller may be made by adapting an old deep-pocket sprocket shaft cover, P/N 51622, to such use. To make this puller, drill the cover to make a hole slightly over 3/8-inch (9.525 mm) in the top. Weld a 3/8-inch (9.525 mm) nut to the underside of the pocket. A 3/8-inch (9.525 mm) bolt or cap screw, when screwed into the nut and against the end of the sprocket shaft, will pull the cover off the gearcase without damage to cover or shaft.

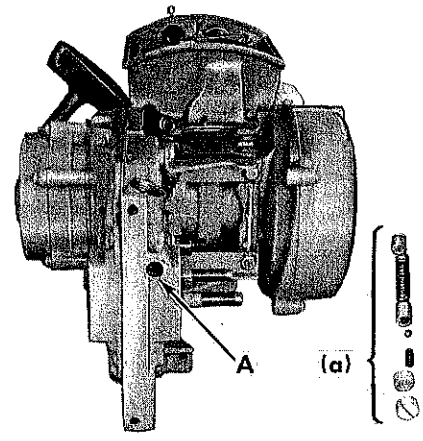


Figure IX-14. The oiler assembly includes two plugs, a ball spring, ball, oiler body, spring, and a piston with "O" ring. These parts are removed from the opening at the end of the gearcase at "A".

Service

Transmission

Transmission troubles fall into two classes: Trouble caused by too much or too little oil, and mechanical failure resulting from wear or improper reassembly after overhaul.

The importance of keeping the correct quantity of oil in the transmission cannot be overemphasized. If too much oil is in the transmission there will be a loss of power because the lubricant will act as a drag on the gears. The turning of the gears will gradually work the oil into a froth or a condition called cavitation, that will prevent proper lubrication and cause galling of the gears. As the gears continue to spin, heat and pressure will develop until the oil is forced past the oil seals, either into the crankcase or on to the exterior of the engine. As the heat continues to increase the gearbox will become hot enough to blister the paint. The heat will cause an expansion in the metal parts of the gearbox that will also affect wear of the gear teeth and bearings. Even if the excess oil is removed from the transmission, the damage already caused will materially shorten the service life of the rotating parts.

If the saw is operated with too little oil in the transmission, there will be inadequate lubrication and the gears will be galled. In addition, the bearings or the bushings will be scored and friction and heat accompanied with loss of power will result. In extreme cases, bearings may seize and cause the gear teeth to break.

The use of too heavy a lubricant will generally result in loss of power and possible overheating. Too light a lubricant will generally provide poor lubrication and other troubles ranging from cavitation to galling .

Wear and improper handling of the saw are primary causes of mechanical troubles in the transmission. Allowing a saw to "bang itself" into a cut rather than starting the cut with the spike against the tree, places a great strain on the gear teeth and may break them. The broken or missing teeth will affect all the other teeth with which they come into contact. The transmission will run noisy and the gears will have to be replaced.

Mechanical troubles can arise from improper reassembly of the transmission. If the shaft support plates, idler yoke, or idler gear shaft are not properly installed, they can vibrate loose and cause damage to gear teeth. The same is true of the gearcase cover. Make sure that screws are torqued properly and that lock plates are installed where specified. Normal wear will cause an increase in noise over a long period of time as the teeth gradually wear down. Always replace gears in matched sets. The combination of one new gear and one old gear will result in the rapid wear of the new gear until its wear pattern matches that of the old gear.

In transmissions employing a straight-line gear train, no provision is made for compensating wear. When the gears become worn they must be replaced.

Manufacturing specifications provide a tolerance of from 0.004 (0.102 mm) to 0.008-inch (0.203 mm) backlash between the drive pinion and the mating standard gear (idler gear) at standard center distance. A backlash

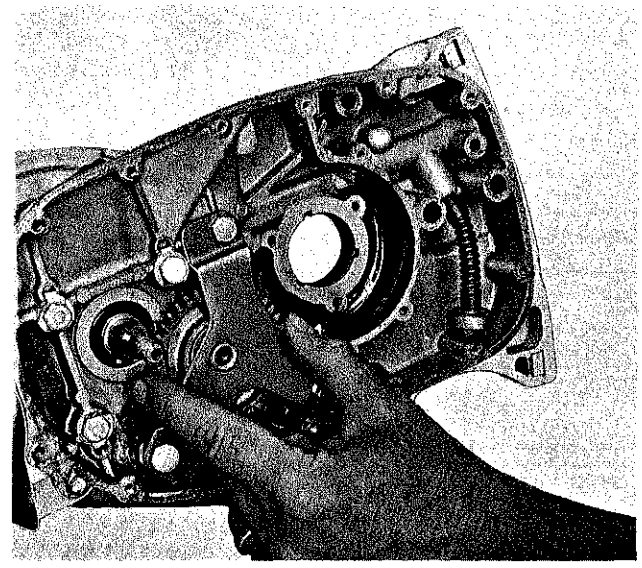


Figure IX-15. Checking the condition of the idler gear and yoke assembly. This assembly must be replaced as a complete unit if any part requires replacement. Check the teeth on the gear for wear or breaks, and look for looseness of the yoke shaft.

tolerance of from 0.004 (0.102 mm) to 0.008-inch (0.203 mm) is also specified for the sprocket drive gear and the mating standard gear (idler gear), at standard center distance. Although the average will be somewhat less, it is possible to have a cumulative backlash through the gear train of 0.016-inch (0.406 mm). This means that units at or near the upper limit of permissible backlash when new, will be subject to gear replacement at an earlier stage than units produced closer to the lower or average backlash specified. This is a consideration of only minor importance, however, because other factors have a much greater significance in the life of the transmission. Among these are proper lubrication in both quantity and grade, and the degree of abuse suffered in sawing operations.

The drive pinion, being the smallest gear in the train, and actuated by the clutch, is subject to more shock loading and more tooth contact than the idler gear or the sprocket drive gear. Its wear will be at a faster rate therefore, and replacement will be required at more frequent intervals.

Service of the transmission required because of noisy gears caused by excessive backlash, will usually be confined to the drive pinion and eliminated by replacing the clutch drum and gear. This will not of course eliminate troubles caused by broken teeth on the other gears, excessive wear, or damage caused by improper lubrication. The entire train should be carefully inspected for any evidence of such trouble.

Check the condition of bearings, gaskets, and oil seals. Replace any that show signs of wear, even slight. If the oil seal has been removed from the shaft, put a new one on as replacement. The oil seal is apt to receive some damage while being removed however careful the removal has been, and even a tiny cut can quickly lead to other troubles.

Weight Assembly

Wash the screen and see that the flexible hose is clean and fully open. A new, improved Check Valve Assembly, P/N 51982A is available for service replacement. The new valve assembly has the inside bore finished on the inside at the oiler housing end with a seat for the steel ball check valve. This is in contrast to the older check valve which had a separate valve seat pressed into the bore of the tube and staked to hold it in place. If the tube is not being replaced, be sure that the tube is open and the ball moves freely on and off its seat.

Oiler Assembly

Blow low pressure air through the oiler passages to check clearance and remove any dirt that may have accumulated in it.

Look for possible missing parts of this assembly as they are small and easily lost. Examine the "O" ring carefully. If it requires replacement, oil the new ring before placing it on the piston.

Reassembly

Reassemble the transmission with necessary new parts or assemblies, in reverse order of disassembly. If any new parts are being used, it is extremely important that the following service information be understood:

1. Three different transmission assemblies have been installed on Model 1-61 engines. Parts of these assemblies are not interchangeable and can cause serious damage to the transmission if any attempt is made to so use them.

Listed below are the part numbers of each of these assemblies, together with those parts and their part numbers which must be used in replacement.

Transmission Assembly	P/N 55437A (Figure IX-16)	P/N 55705A (Figure IX-17)	P/N 55927A (Figure IX-18)
1. Gearcase Cover	55428	55709A	55914
2. Cover Gasket	51609A	51609A	55913
3. Oil Seal	102939	104298	104298
4. Ball Bearing	103482	101039	101039
5. Gear Spacer	51625	55715	55715
6. Sprocket Shaft Key	51619	55744	55953
7. Sprocket Drive Gear	51690	55712A	55925
8. Sprocket Shaft	50811	55711	57849
9. Idler Gear & Yoke Assy	51895	55928	55928
10. Gearcase Assy	55434A	55525A	55879A
11. Snap Ring			104451

When servicing the transmission of Model 1-61 engines, note the improvements in the assembly since first manufactured, which can easily be applied to older engines to give them better performance when returned to service.

These improvements are:

1. The addition of a bottom gearcase brace to reduce possibility of transmission breakage. The brace is P/N 55537 and can be mounted on the idler yoke screw on the gearcase and connected to the crankcase bottom cover.
2. The addition of three flat washers under each lockplate on the three gearcase mounting bosses. These washers will prevent the gearcase mounting screws from crushing the bosses.
3. A change in the thickness of the gearcase gasket to prevent loosening of the transmission assembly because of gasket shrinkage. When servicing transmissions of Model 1-60 engines, replace the gasket with the new and thinner gasket P/N 51635A.

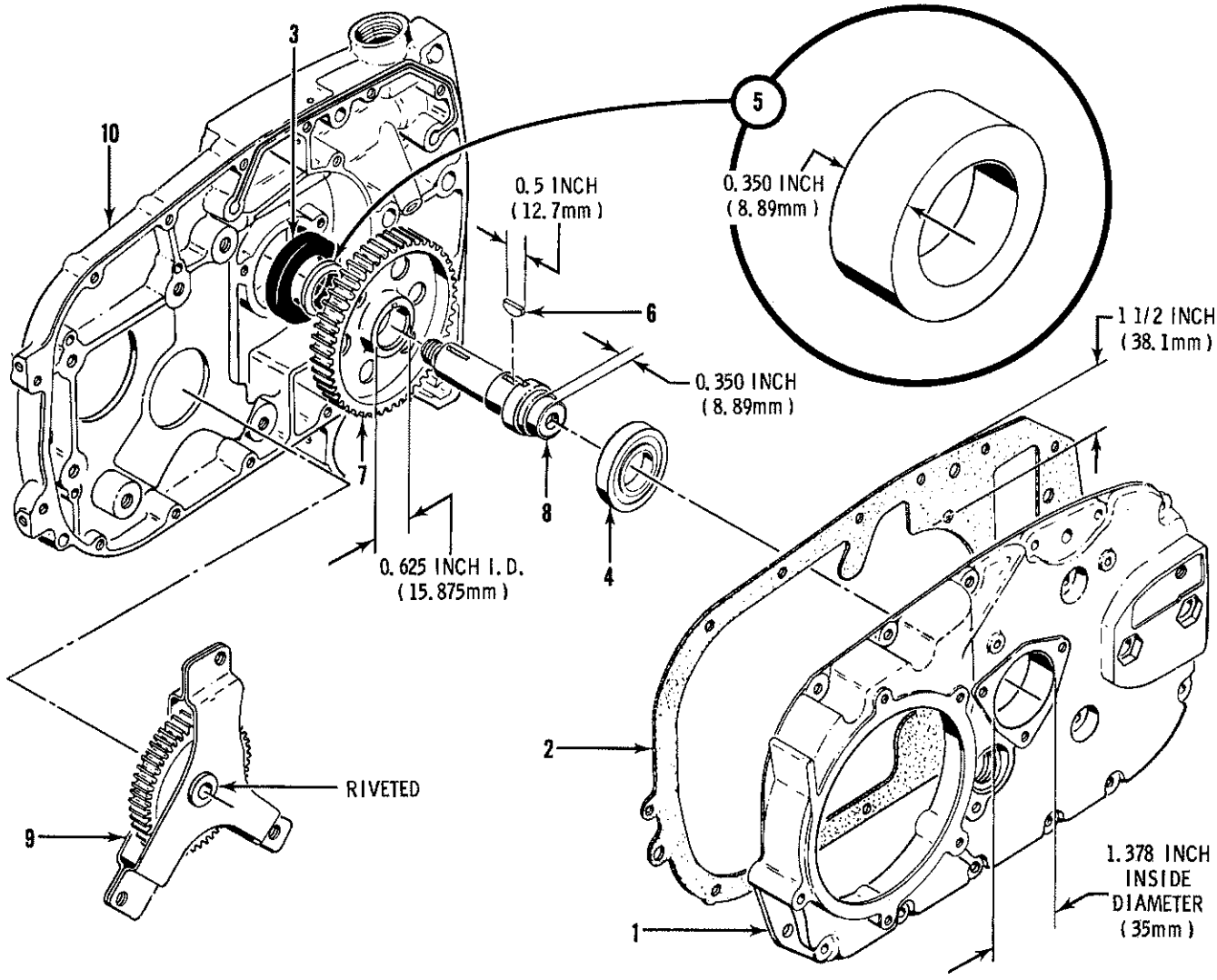


Figure IX-16

When reassembling transmissions, tighten the attaching screws to torque values as follows:

Gearcase to crankcase
100 to 110 inch-pounds . . (8 to 9 foot-pounds) (1.120 to 1.235 mkg)

Idler gear and yoke assembly to gearcase
90 to 100 inch-pounds . . . . . (7-1/2 to 8 foot-pounds) (1.04 to 1.12 mkg)

Gearcase cover to gearcase
55 to 60 inch-pounds . . . . . (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mkg)

Gearcase shield to gearcase . . . (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mkg)

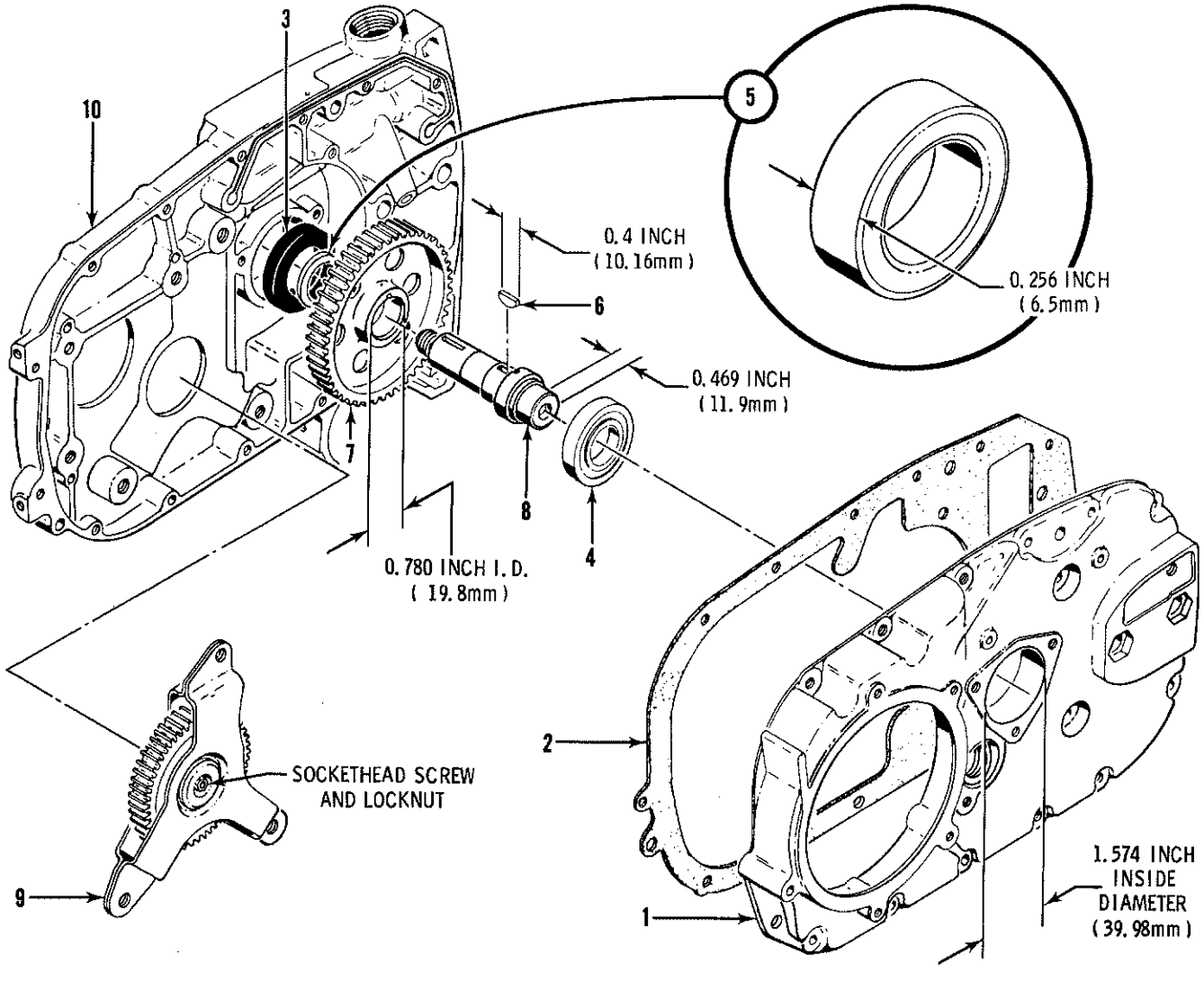


Figure IX-17

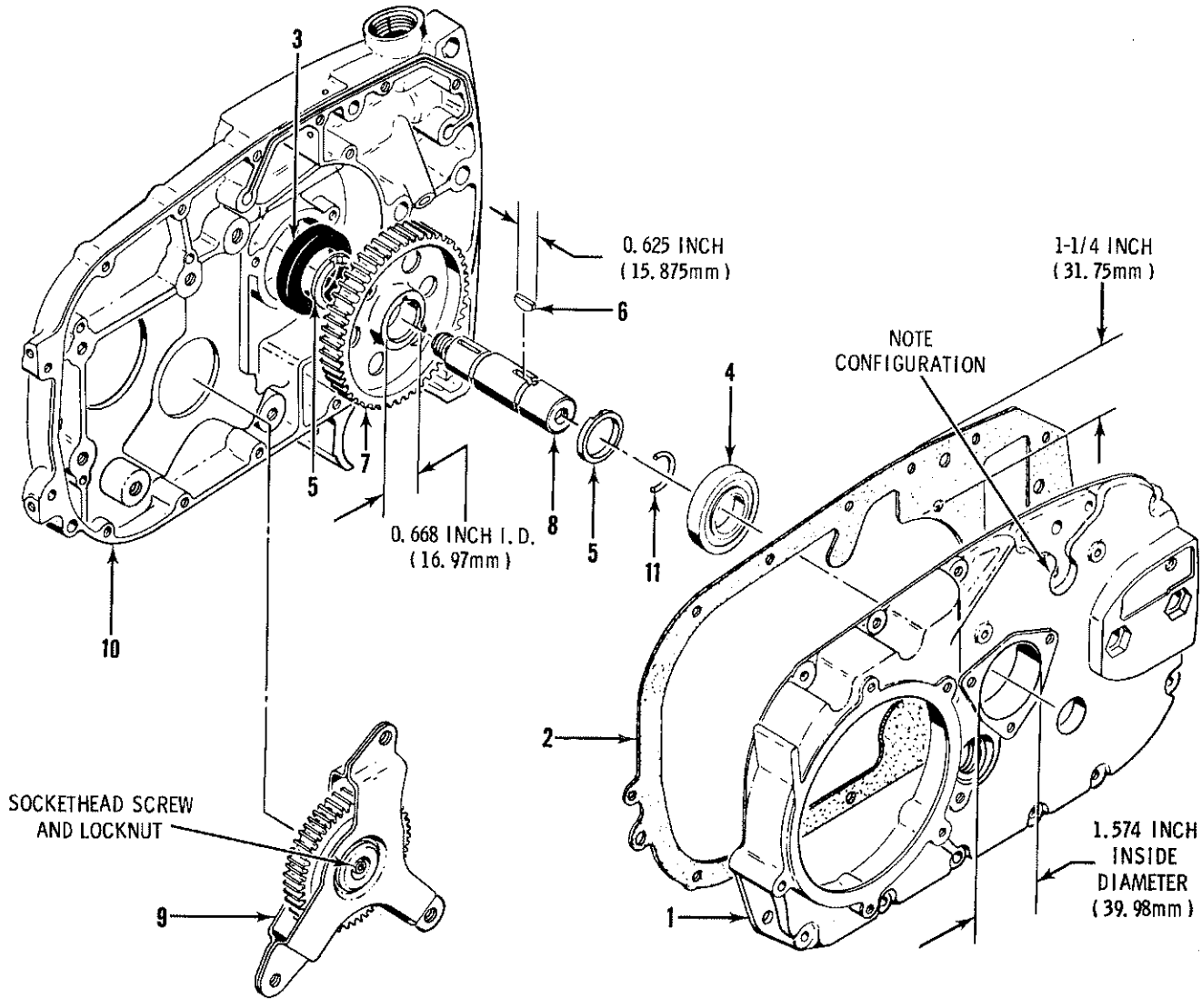

3
0.625 INCH
(15.875mm)
6
1-1/4 INCH
(31.75mm)
NOTE
CONFIGURATION
4
5
7
0.668 INCH I.D.
(16.97mm)
8
5
11
10
2
SOCKETHEAD SCREW
AND LOCKNUT
9
1
1.574 INCH
INSIDE
DIAMETER
(39.98mm)

Figure IX-18

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SECTION X
Powerhead Assembly

POWERHEAD ASSEMBLY

NOTE

Disassembly procedures for service on the powerhead assembly are somewhat different because of differences in cylinder crankcase construction. These procedures may be divided into two groups, (a) Those with crankcases having separate cylinder head and gaskets, and (b) Those with integral cylinder heads (one-piece cylinder crankcases).

Integral head cylinder crankcases were first introduced on Model 1-52 engines, followed by mid-year production of Model 1-42 engines, and made standard on all of the 1962-1963 models. With the adoption of the integral head crankcase, service replacements were made available for all models, and the two-piece types were dropped from manufacture.

The grouping of engines according to crankcase construction is made on a basis of original equipment only. It is quite possible therefore, that a replacement crankcase having an integral head will be found on models originally furnished with removable heads. The service man should be aware of this possibility and be guided by the appropriate procedure for disassembly, service, and reassembly.

Disassembly

(For powerhead assemblies having removable cylinder heads, including Model 1-40, 1-41, early production 1-42, 1-45, 1-50, 1-51, 1-60, 1-61, and 1-62 engines.) (Figure X-1)

NOTE

On Model 1-40, 1-41, 1-42, 1-45, 1-50, and 1-51 engines, the crankcase bottom or stuffer being integral with the fuel tank, is removed with the oiler tank and fuel tank assemblies, and leaves the bottom of the crankcase open.

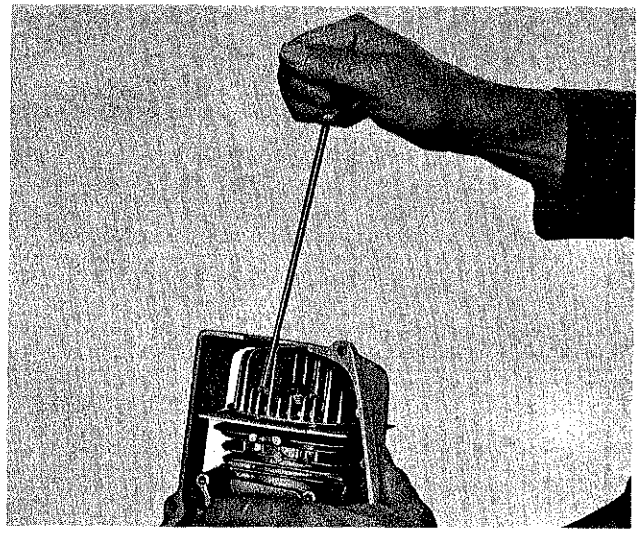


Figure X-1. Removing the cylinder head and cylinder head gasket.

NOTE

On Model 1-60, 1-61, and 1-62 engines, the crankcase bottom or stuffer must be removed to open the crankcase. (Figure X-2) Proceed with disassembly as follows:

1. Remove the cylinder head and gasket.
2. Turn the crankshaft until the throw is at the bottom of the stroke.

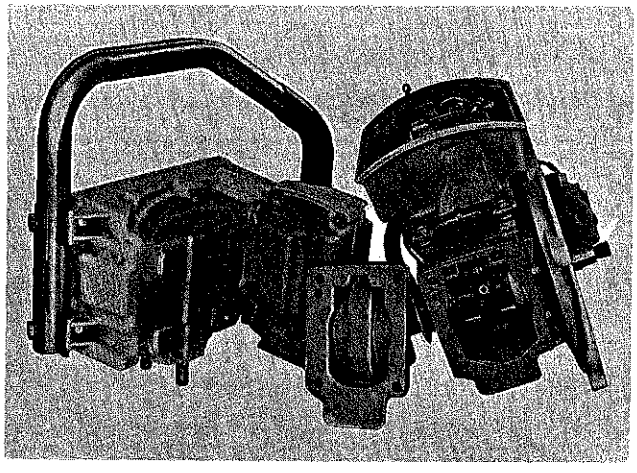


Figure X-2. Fuel tank and stuffer, removed to open the crankcase for removal of the connecting rod cap.

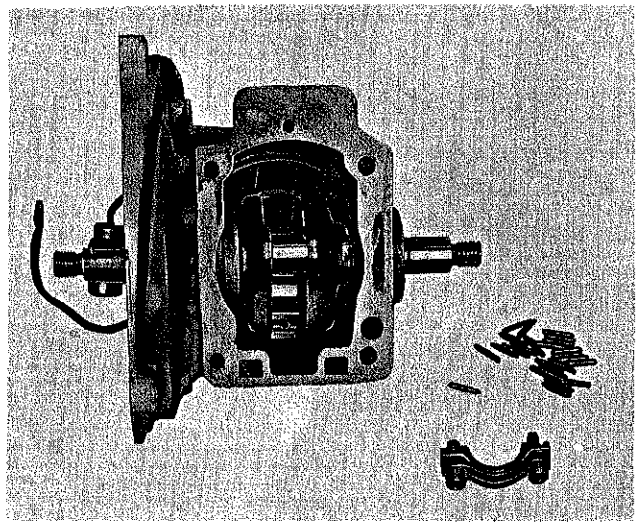


Figure X-3. The connecting rod cap and 24 needle bearings removed from the connecting rod and crankpin.

3. Remove the connecting rod cap and the 24 needle rollers, taking care to keep them all together and in a container where they will not become lost or scattered. (Figure X-3)
4. Push the piston assembly and the connecting rod out of the top end of the cylinder. (Figure X-4)
5. Remove the crankcase cover. (Figure X-5)

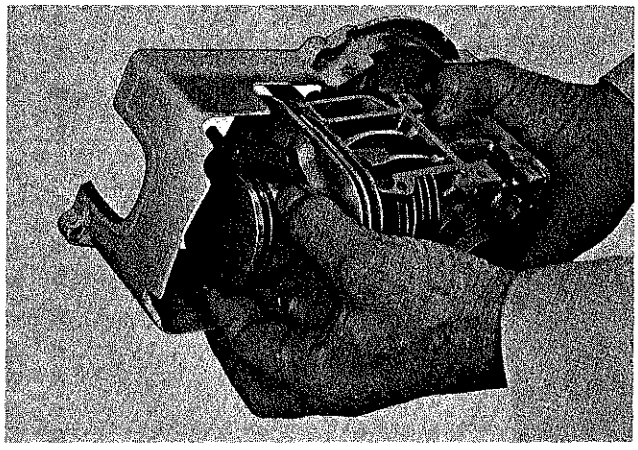


Figure X-4. Removing the piston and connecting rod assemblies from the cylinder.

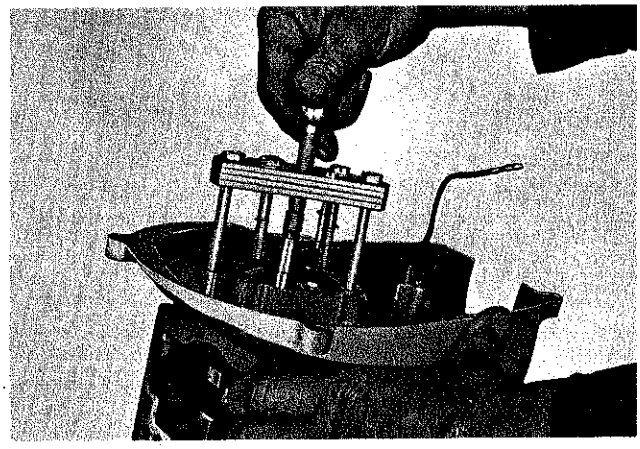


Figure X-5. Removing the crankcase cover with a pulling tool. The pulling tool is used when it is desired to remove only the crankcase cover. In almost all cases, the ball bearing will remain on the crankshaft.

NOTE

The crankcase cover may be removed by itself leaving the crankshaft in the crankcase, with the use of a pulling tool. This would be done if there was no requirement for removal of the shaft or bearings. For complete disassembly however, the crankshaft and cover are removed together by tapping on the clutch end of the crankshaft lightly with a soft-face hammer. The needle bearing and oil seal will remain in the crankcase.

6. Press the needle roller bearing and oil seal out of the crankcase from the inside, using a bearing driver.
7. Press the crankshaft from the crankcase cover.
8. Press the oil seal out of the crankcase cover.
9. Press the ball bearing from the crankshaft.

Disassembly

(For powerhead assemblies having integral head cylinder crankcases, including late production (after S/N 22604, December 2, 1961) Model 1-42 engines and Model 1-43, 1-46, 1-52, 1-53, and 1-63 engines.)

NOTE

On Model 1-52 and 1-53 engines, the crankcase bottom is removed with the fuel tank assembly when the fuel tank attaching screws are removed. Refer to Figure X-2.

NOTE

On Model 1-63 engines, remove the crankcase bottom or stuffer, and proceed with disassembly as follows: All models in this type group.

1. Turn the crankshaft until the throw is at the bottom of the stroke.
2. Remove the connecting rod cap and the 24 needle rollers, taking the usual precautions to prevent loss of the rollers.
3. Push the piston and connecting rod back up in the cylinder as far as possible. (Figure X-6)
4. Position the crankshaft counterweights for removal of the crankshaft and crankcase cover. Unless care is taken to get the counterweights in the proper position, they can hang up on the end of the connecting rod extending down toward them in the cylinder and break or severely damage the rod. Visual inspection will show the position at which maximum clearance will be obtained.
5. Tap lightly with a soft-face hammer on clutch end of the crankshaft to remove it and the crankcase cover from the crankcase.

NOTE

Using a pulling tool, the crankcase cover can be removed separately if it is not desired to remove the crankshaft.

NOTE

On Model 1-52 and 1-53 engines, having two ball bearings on the crankshaft, both bearings should come out when the crankshaft is removed. Other models in this type group will retain the needle roller bearing in the crankcase when the crankshaft and crankcase cover are removed. (Figure X-7)

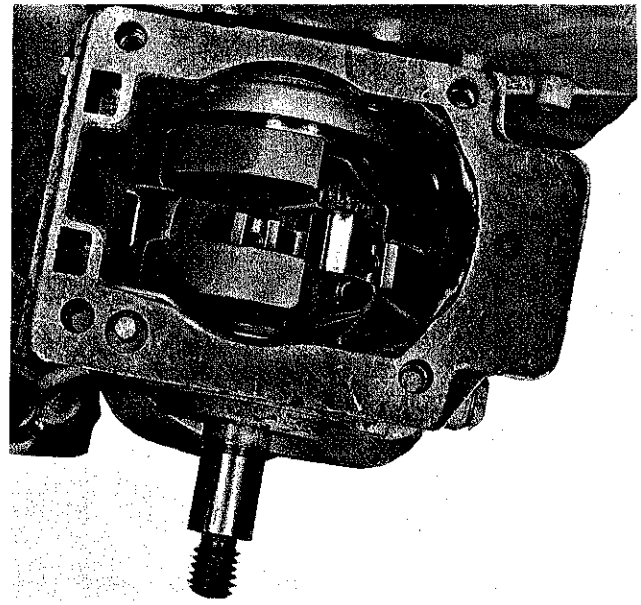


Figure X-6. The connecting rod and piston must be pushed up as far as it will go, with the end of the rod moved to one side of the cylinder. When the crankshaft counterweights are turned away from the end of the rod, the crankshaft can be removed from the crankcase without interference with the loose end of the rod.

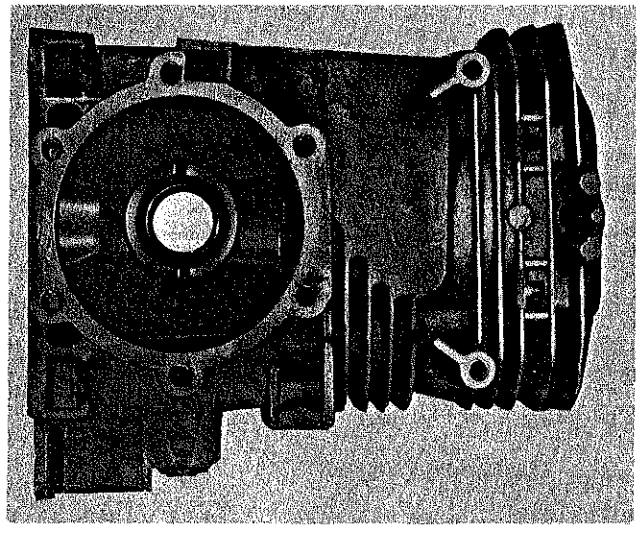


Figure X-7. After removal of the crankshaft, the needle bearing, bushing, and oil seal will remain in the crankcase.

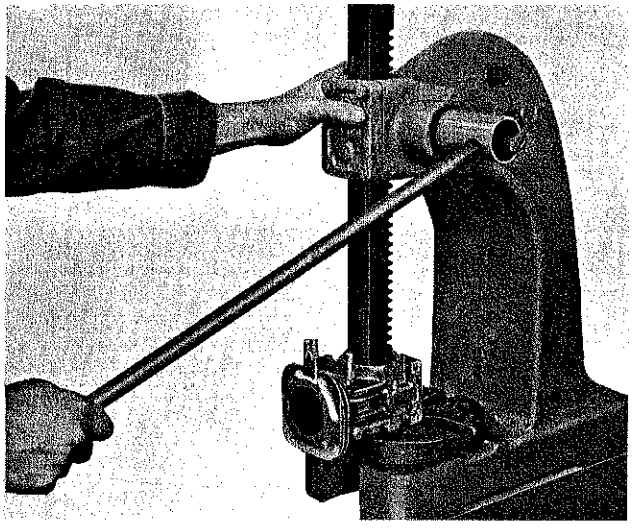


Figure X-8. Using an arbor press and a bearing driver to remove the crankcase needle bearing and oil seal.

6. Press the needle roller bearing and the oil seal out of the crankcase from the inside, using a bearing driver. (Figure X-8)
7. Press the crankshaft from the crankcase cover.
8. Press the oil seal out of the crankcase cover. (Figure X-9)

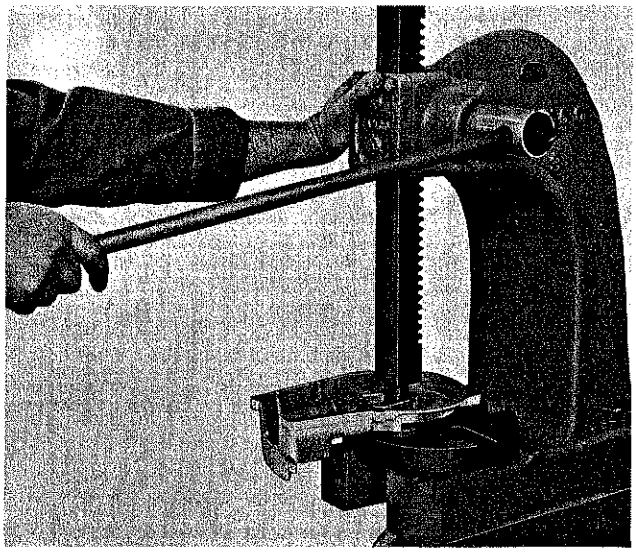


Figure X-9. Using an arbor press and a driver to press the oil seal from the crankcase cover.

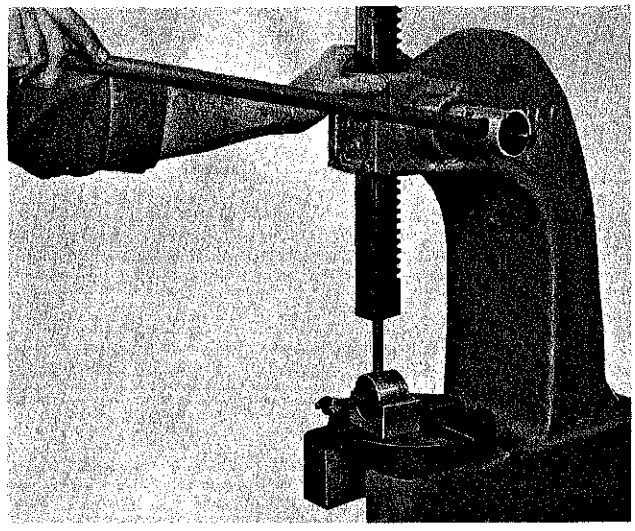


Figure X-10. Removing the piston pin and closed-end bearing from the piston using an arbor press, piston pin driver and piston holding block. The holding block has a large opening on the bottom to allow the bearing to come out. If the piston is properly heated before pin removal, the bearing will come out undamaged.

9. Press the ball bearing from the crankshaft, (two ball bearings on Model 1-52 and 1-53 engines).
10. Pull the piston and the connecting rod from the bottom of the crankcase.

Disassembly (all models)

1. Remove the piston rings from the piston.
2. Heat the piston and connecting rod under a heat lamp to about 300°F. (155°C.), concentrating the heat as much as possible on the closed-end bearing.
3. Press the piston pin out of the piston with a piston pin driver. (Figure X-10)

NOTE

All engines covered in this manual have needle roller upper rod bearings except the Model 1-40, 1-41, 1-42, and 1-43 engines, which have bronze bushings. The piston pin for these models is shielded (closed) on one end.

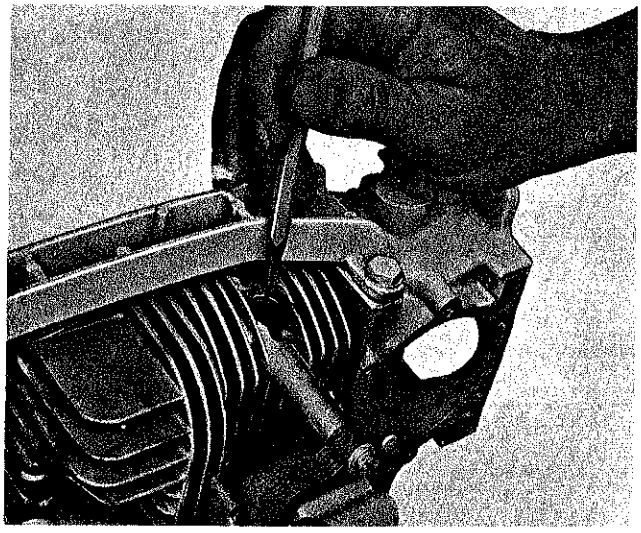


Figure X-11. Checking welch plugs for possible leaks.

NOTE

On the models with needle bearings, the closed-end bearing is pushed out with the pin. Heating the piston before pin removal will sometimes allow the closed-end bearing to come out without damage.

4. Press the open-end bearing from the piston (if required).

Service

Crankcase Cylinder

Examine the crankcase cylinder carefully for cracks and damaged surfaces over the entire area, both inside and outside. (Figure X-11)

Check the bearing bore, or bushing for the needle bearing, for scoring, gouging, wearing out-of-round. Replace any crankcase showing evidence of bearing seizure or galling in the bore.

Examine the cylinder bore for scoring. If either cracks or severe scoring is found, the crankcase cylinder must be replaced. This of course, will also require a new piston and rings. Always check the cylinder bore for an out-of-round condition. To determine the amount of cylinder wear, use a dial indicator or comparable gauge. Using the dial indicator, readings taken at different points around the cylinder bore will give variations indicating the degree of the out-of-round condition. Taper is found by setting the dial indicator, first at the top and then at the bottom of the ring travel area. The difference between the top reading and the bottom reading is the amount of taper in the cylinder.

Taper of the cylinder can also be measured with a new piston ring if a dial indicator is not available. To use a piston ring for this purpose, place the ring in the cylinder, using a piston to press it into position so that the ring will be square with the cylinder. Measure the ring end gap at the bottom of the cylinder and record the measurement. Now push the ring to the top of the cylinder, again using a piston to keep the ring square, and remeasure the end gap in the new position. The gap at the top of the cylinder will be greater because of the taper, and the difference between the reading at the top and the reading at the bottom of the cylinder is the amount of cylinder taper. (Figure X-12)

If the cylinder taper or the out-of-round measurement exceeds 0.005 inch (0.127 mm), the cylinder should be rebored and honed, and oversize pistons and rings installed. Reboring and honing may also clear up cases of scoring in the cylinder if the scoring is not too severe.

CAUTION

Always measure a rebored cylinder diameter and the diameter of the oversize piston to be installed. Measure the piston at the bottom of the skirt as the piston has a taper with the smaller diameter at the top. The correct sidewall clearance is 0.003-0.005 inch (0.076-0.127 mm).

Refer to the accompanying tables for standard and oversize pistons and rings available for the engines listed in this manual.

After a cylinder has been rebored, honed, checked for oversize, taper, symmetry, and surface finish, it must be thoroughly clean. Swab the inside of the cylinder with a rag soaked in SAE 10 oil, then wipe out with a

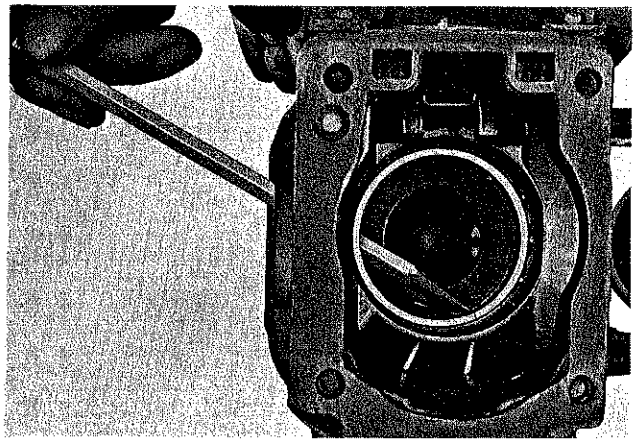


Figure X-12. Taper of the cylinder can be measured with a piston ring. End gap of the inserted ring as shown in the illustration can be measured with a feeler gauge. Measurements taken at both top and bottom of the cylinder will indicate taper by the difference between the two measurements. These measurements will also show proper end gap of the ring. It is important that the ring be square in the cylinder for accurate measurements. Use an inverted piston to push the ring into the cylinder and to keep it square with the cylinder wall.

clean dry cloth. Repeat the swabbing and wiping several times and until wiping with a clean white cloth shows no dirt or discoloration. Never use gasoline or solvent on the inside of a cylinder to clean it after honing. These materials cannot remove the small abrasives which are left on the cylinder wall after honing and which if allowed to remain, will very rapidly wear on the piston and rings and on the cylinder wall, causing extreme damage and always resulting in a much shortened engine life. Remember that proper cleaning of the cylinder wall is one of the most important points in servicing an engine. Use a wire brush or a wooden scraper to remove carbon deposits in and around the exhaust ports. Clean the ports with a cloth soaked in SAE 10 oil and wipe dry with a clean cloth. Clean the cylinder bore in the same way if it has not already been done after a reboring and honing operation.

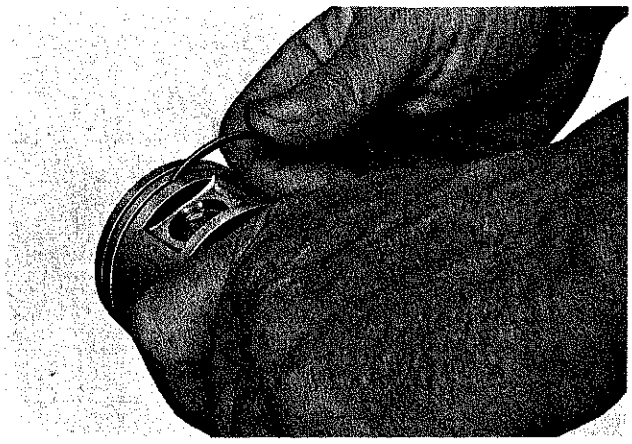


Figure X-13. The squared end of a broken piston ring makes a good scraper for cleaning the grooves in the piston.

Cylinder Head

NOTE

This section does not apply to Model 1-43, 1-46, 1-52, 1-53, 1-63, and late production 1-42 engines.

Remove carbon deposits and dirt with a wire brush or a wooden scraper. Be careful not to damage the gasket surface of the cylinder head. Examine the head for cracks and replace it if any cracks however small, are noted. Discard the head if it is warped. Remove small nicks and scratches in the gasket surface of the head with emery cloth or an oil stone.

Piston and Piston Pin

Examine the piston carefully for scuffed or scored skirts, and broken, cracked, or distorted ring lands. Discard the piston if any of these defects are found. If the piston shows no great wear and can be re-used, clean it thoroughly. Soak the piston in solvent to loosen the carbon in the ring grooves. Clean out the carbon with a groove cleaner. If a groove cleaner is not available, make a groove scraper by breaking an old ring and filing one end to a square edge. (Figure X-13)

TABLE OF STANDARD AND OVERSIZE PISTONS AND RINGS WITH DIMENSIONS IN INCHES

MODEL	SIZE AND OVERSIZE	PISTON ASSEMBLY NUMBER		PISTON TOP DIMENSION	PISTON SKIRT DIMENSION	CYLINDER ASSEMBLY NUMBER	CYLINDER INTERIOR DIMENSION	RING SET
		THRUST WASHERS USED	THRUST WASHERS NOT USED					
1-40	Standard 0.010 0.020 0.030	50206 50134		2.1190/2.1185 2.1390/2.1385	2.1220/2.1215 2.1420/2.1415	50737	2.1260/2.1250	55123 55125
1-41 1-42 1-43	Standard 0.010 0.020 0.030	50206 50134		2.1190/2.1185 2.1390/2.1385	2.1220/2.1215 2.1420/2.1415	58971	2.1260/2.1250	55123 55125
1-45 1-46	Standard 0.010 0.020 0.030	48695 48684 48685 48686	53927 53924 53925 53926	2.1190/2.1184 2.1290/2.1284 2.1390/2.1384 2.1490/2.1484	2.1220/2.1214 2.1320/2.1314 2.1420/2.1414 2.1520/2.1514	58971	2.1260/2.1250	48691 48692 48693 48694
1-50 1-60	Standard 0.010 0.020 0.030	55007A 55057A 55058A 55059A	53936 53937 53938 53939	2.1190/2.1184 2.1290/2.1284 2.1390/2.1384 2.1490/2.1484	2.1220/2.1213 2.1320/2.1313 2.1420/2.1413 2.1520/2.1513	50737	2.1260/2.1250	55123 55124 55125 55126
1-51 1-61 1-62 1-63	Standard 0.010 0.020 0.030	55007A 55057A 55058A 55059A	53936 53937 53938 53939	2.1190/2.1184 2.1290/2.1284 2.1390/2.1384 2.1490/2.1484	2.1220/2.1213 2.1320/2.1313 2.1420/2.1413 2.1520/2.1513	53528	2.1260/2.1250	55123 55124 55125 55126
1-52 1-53	Standard 0.010 0.020 0.030	55310A 55322A 55323A 55324A	53941 53942 53943 53944	2.1190/2.1184 2.1290/2.1284 2.1390/2.1384 2.1490/2.1484	2.1220/2.1213 2.1320/2.1313 2.1420/2.1413 2.1520/2.1513	57965 53563	2.1260/2.1250	55123 55124 55125 55126

TABLE OF STANDARD AND OVERSIZE PISTONS AND RINGS WITH DIMENSIONS IN MILLIMETERS

MODEL	SIZE AND OVERSIZE	PISTON ASSEMBLY NUMBER		PISTON TOP DIMENSION	PISTON SKIRT DIMENSION	CYLINDER ASSEMBLY NUMBER	CYLINDER INTERIOR DIMENSION	RING SET
		THRUST WASHERS USED	THRUST WASHERS NOT USED					
1-40	Standard 0.254 0.508 0.762	50206 50134		53.8226/53.8099 54.3306/54.3179	53.8988/53.8861 54.4068/54.3941	50737	54.0004/53.9750	55123 55125
1-41 1-42 1-43	Standard 0.254 0.508 0.762	50206 50134		53.8226/53.8099 54.3306/54.3179	53.8988/53.8861 54.4068/54.3941	58971	54.0004/53.9750	55123 55125
1-45 1-46	Standard 0.254 0.508 0.762	48695 48684 48685 48686	53927 53924 53925 53926	53.8226/53.8074 54.0766/54.0614 54.3306/54.3154 54.5846/54.5694	53.8988/53.8836 54.1528/54.1376 54.4068/54.3916 54.6608/54.6456	58971	54.0004/53.9750	48691 48692 48693 48694
1-50 1-60	Standard 0.254 0.508 0.762	55007A 55057A 55058A 55059A	53936 53937 53938 53939	53.8226/53.8074 54.0766/54.0614 54.3306/54.3154 54.5846/54.5694	53.8988/53.8810 54.1528/54.1350 54.4068/54.3890 54.6608/54.6430	50737	54.0004/53.9750	55123 55124 55125 55126
1-51 1-61 1-62 1-63	Standard 0.254 0.508 0.762	55007A 55057A 55058A 55059A	53936 53937 53938 53939	53.8226/53.8074 54.0766/54.0614 54.3306/54.3154 54.5846/54.5694	53.8988/53.8810 54.1528/54.1350 54.4068/54.3890 54.6608/54.6430	53528	54.0004/53.9750	55123 55124 55125 55126
1-52 1-53	Standard 0.254 0.508 0.762	55310A 55322A 55323A 55324A	53941 53942 53943 53944	53.8226/53.8074 54.0766/54.0614 54.3306/54.3154 54.5846/54.5694	53.8988/53.8810 54.1528/54.1350 54.4068/54.3890 54.6608/54.6430	57965 53563	54.0004/53.9750	55123 55124 55125 55126

CAUTION

Be careful when cleaning out the carbon not to cut or mar the grooves, or scratch the piston. NEVER CLEAN THE PISTON WITH A WIRE BRUSH.

Rinse the piston in solvent and wipe clean with a dry cloth.

Examine the piston pin for wear and replace it if any wear is noted. Always replace the pin if a new piston is installed. If the piston pin is serviceable, and the piston is not replaced, clean the pin with solvent and wipe it dry.

NOTE

Model 1-41, 1-42, and 1-43 engines have a shielded-end piston pin. If the shield is cracked or distorted, replace the piston pin.

Piston Rings

It is a recommended practice to replace piston rings whenever the engine is disassembled for service and repair. After disassembly the rings will often appear to be in good condition and suitable for reinstallation. However, the rings are subjected to heat, pressure, and constant tension, and it is likely that they have taken sufficient "set" to lower their efficiency. Ordinarily then, piston rings are not serviced in the usual sense, but discarded.

Connecting Rod

Examine the connecting rod for damage and wear. Look for scoring of the bearing surfaces, and twisting or bending of the rod. If either of these defects are found, discard the rod. If it is free of defects, wash the rod in solvent and wipe it dry with a clean cloth.

Crankshaft

Examine the crankshaft for bearing surface scoring, galling, and dirt. Look for worn keyways, keys sheared off, and stripped threads. Any burrs should be dressed down carefully with a fine file and polished with crocus cloth. If the crankshaft is unevenly worn or damaged, it should be replaced. (Figure X-14)

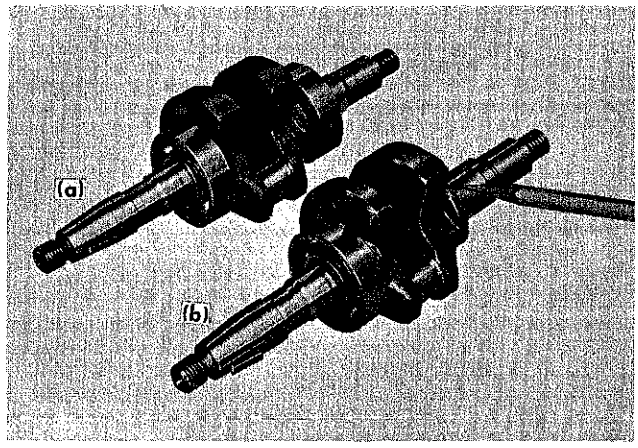


Figure X-14. Crankshaft (a) with two ball bearings, is used with Model 1-52 and 1-53 engines. Crankshaft (b) is used with other engine models, having one ball bearing and one needle roller bearing. Bearing surfaces should be checked carefully for roughness and uneven wear.

It is always more economical to replace a crankshaft that is in a questionable condition, than it is to attempt a repair that may result in damage to other parts of the engine. This usually results in greater expense than a new crankshaft.

Bearings and Oil Seals

Inspect ball bearings for abnormal wear and flat spots on any of the balls. Wash the bearing in gasoline or solvent and spin it by hand to test for binding or roughness. After washing, always lubricate bearing with clean oil before putting it into use. Replace the bearing if any of the above conditions are found. Inspect needle bearings for wear, and for burned or extruded rollers. Discard the bearing if any rollers are defective. The 24 connecting rod needle rollers should be replaced as a set if any of them are damaged, worn, or burned.

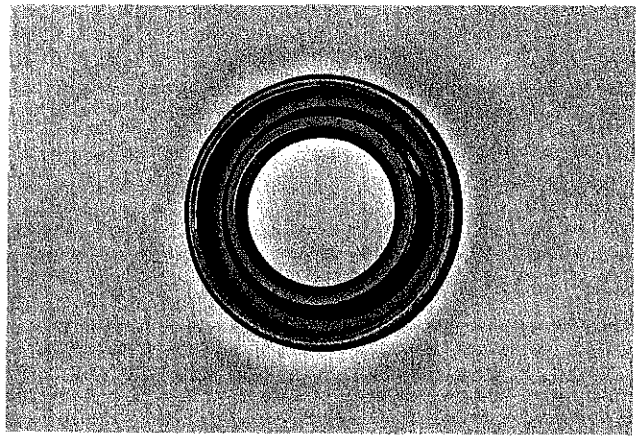


Figure X-15. It is important that the lips of the oil seal be entirely free of nicks or cuts. Any damage to this sealing edge will permit oil leaks from the crankcase.

Examine the oil seals for cuts and wear. Always replace a cut or worn seal even if the damage is only slight because of the possibility of crankcase pressure loss and air leaks. (Figure X-15)

Clean bearings and oil seals with gasoline or solvent and dry them thoroughly with a clean, lint-free cloth.

Crankcase Cover

Clean the crankcase cover thoroughly with solvent, removing all dirt, sawdust, and other foreign material.

Clean and smooth the crankcase cover gasket surface. Examine the screw hole threads. If the threads are stripped, repair them with a Heli-Coil or equivalent thread repair set. Carefully follow the manufacturer's repair instructions found in the repair kit.

Reassembly

Piston Rings

New piston rings should always be checked for cylinder bore fit (end gap) and for piston groove fit, before installation on the piston. To fit a piston ring correctly, proceed as follows:

1. Push the new ring down into the bore of the cylinder with an inverted piston (to make sure that the ring sets square in the cylinder). Press the ring to a position in the cylinder where it rests just above the exhaust ports.
2. Using a thickness gauge, measure the ring end-gap. End-gap should be between 0.004 (0.1016 mm) and 0.012 inch (0.3048 mm) tolerance.
3. If the ring end-gap is less than 0.004 inch (0.1016 mm) remove the ring and carefully dress down both ends, using a fine file, until the correct gap is obtained.
4. Install the second ring and repeat the measurement.

CAUTION

Make sure that the end-gap is within specified minimum tolerances. If the gap is less, expansion of the ring when heated will cause the ends to butt together, causing cylinder wall scuffing and possible seizure.

When the proper fit of rings to cylinder bore is established, check fit of the rings to the piston grooves. Make this check in the following way:

1. Place the new ring in the lower groove of the piston.
2. Rotate the ring completely around the groove, making certain that the ring is free in the groove.
3. Place the second ring in the top groove of the piston and check the free action of the ring.
4. Using a thickness gauge, check the side clearance between the rings and their respective grooves. (Figure X-16)

Clearance must be not greater than 0.004 inch (0.102 mm) nor less than 0.0015 inch (0.038 mm). If clearance is greater or less than these limits, replace the piston.

Another point to remember when installing new rings is to use only rings designed for 2-cycle operation. A 2-cycle ring is designed to have low outward pressure at the

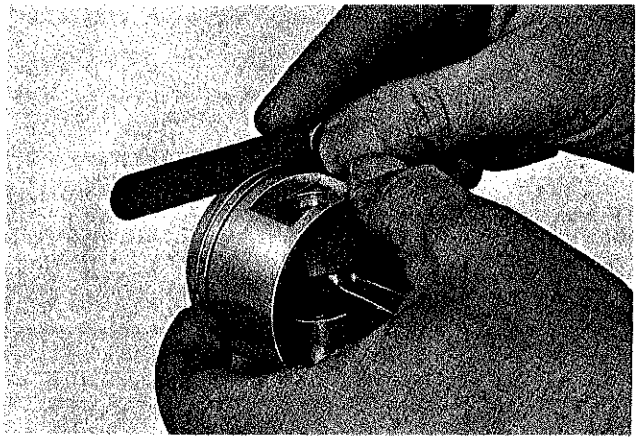


Figure X-16. Piston ring side clearance is measured by a feeler gauge inserted between the ring and the ring land.

ring ends so that there will be no tendency for the ends to hang up or snag in the cylinder ports. In contrast, the use of 4-cycle type rings will result in ring breakage and probably cylinder damage. (Figure X-17)

Connecting Rod

Assembly procedure for Model 1-40, 1-41, 1-42, and 1-43 engines having piston pin bushings.

1. Heat the connecting rod under a heat lamp or oven to approximately 300°F. (150°C.). (Figure X-18)

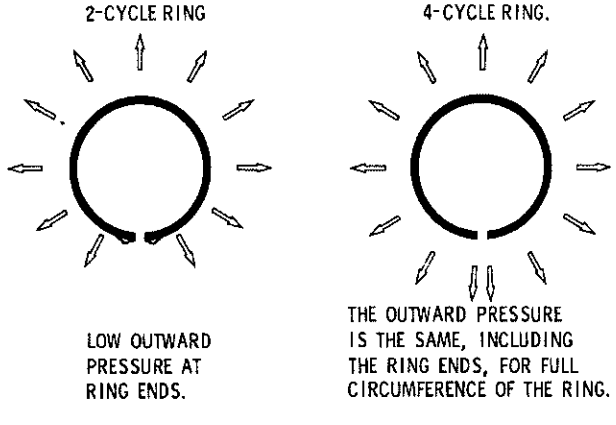


Figure X-17

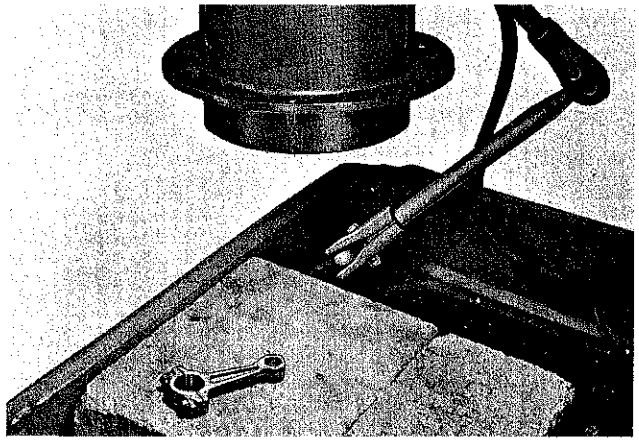


Figure X-18. Heating the connecting rod eye prior to installing rod in the piston.

2. Lightly oil the piston pin and insert the pin (closed end first) half-way into the piston bushing, on the side opposite the exhaust port side of the piston.
3. Align the connecting rod eye between the two piston bushings.
4. Using a piston holding block and a piston pin driver, press the pin through the connecting rod eye and into the second bushing. Continue pressing until the ends of the piston pin are flush with or slightly below the two bushing faces. Be sure snap rings are in place to retain bushings.

Assembly procedure for Model 1-50, 1-51, 1-52, 1-53, 1-60, 1-61, 1-62, and 1-63 engines, having needle roller upper rod bearings.

1. Heat the piston under a heat lamp or in an oven to approximately 200°F. (95°C.). (Figure X-19)
2. Place the closed-end bearing (shield side out) in the bearing boss of the exhaust port side of the piston.
3. Press the bearing into the piston boss until the inside edge of the bearing is flush with the inside edge of the boss. (Figures X-20 and X-21)
4. Press the open end bearing into the other side of the piston until the inside edge of the bearing is flush with the inside edge of the boss. (Figures X-22 and X-23)
5. Heat the connecting rod under a heat lamp or in an oven to approximately 300°F. (150°C.).

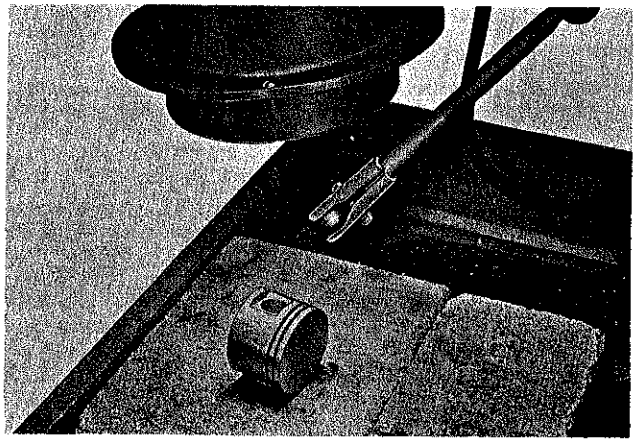


Figure X-19. Heating a piston under a heat lamp prior to installation of the piston pin bearings.

6. Put a light coating of oil on the piston pin and the bearing rollers.
7. Insert the piston pin through the open end bearing and place a thrust washer on the inner end of the pin.

   Insert the connecting rod eye between the thrust washer and the opposite boss. Place a second thrust washer between the connecting rod and the piston boss. (Figure X-24)

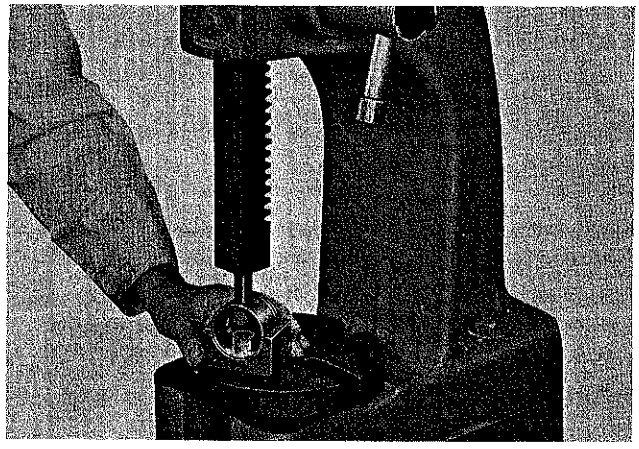


Figure X-20. Pressing the closed-end bearing into the piston. The inner edge of the bearing must not be pressed lower than the piston boss, or the connecting rod and thrust washers cannot be inserted.

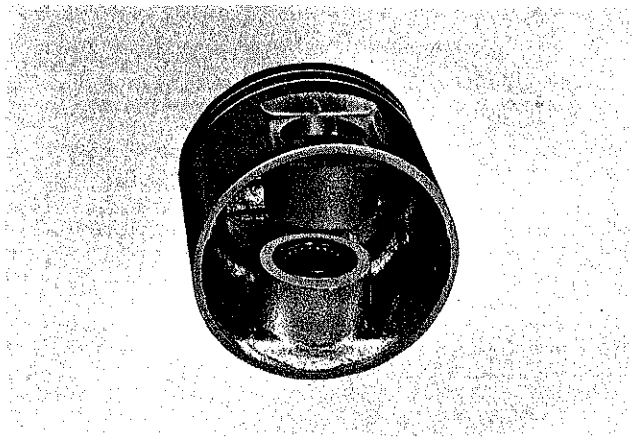


Figure X-21. The inside edge of the piston pin bearing must be flush with the inside edge of the piston boss.

Press the piston pin through the connecting rod eye and the second thrust washer. Continue pressing the pin in until the outer edge of the pin is flush with the outer edge of the open-end bearing. (Figures X-25 and X-26)

CAUTION

Do not press the piston pin below the surface of the open end bearing. If the pin touches the shield of the closed-end bearing, friction will destroy the bearing and cause serious damage when the engine is put in operation.

If the piston pin is pressed into the closed-end bearing too far, both the piston pin and closed-end bearing will have to be pressed out of the piston. Usually when this is done, the piston pin will be distorted or break the shield of the closed-end bearing, and one or the other or both will have to be replaced.

Connecting Rod and Piston Alignment

1. Install an adapter mandrel on an aligning fixture plate.
2. Mount the piston and connecting rod assembly (less needle rollers) on the mandrel. Make sure the index pips on the connecting rod are matched.

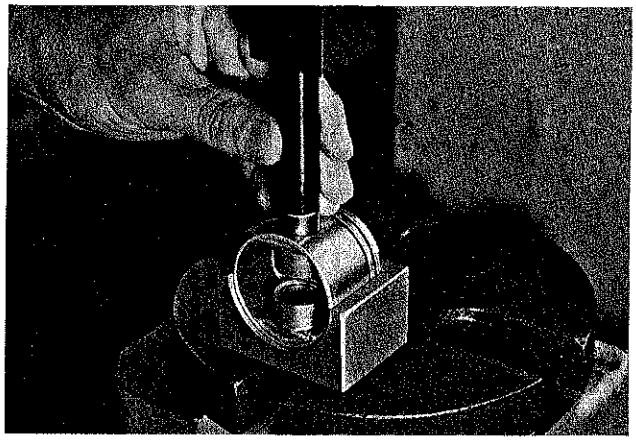


Figure X-22. Pressing the open-end bearing into the piston.

3. Move the piston and rod on the mandrel until the piston just touches the face of the aligning plate. If there is no visible light streak between the plate and the skirt section of the piston (the distance from the lower ring groove to the bottom of the piston) the assembly is properly aligned. However, as a precautionary measure, reverse the piston and rod assembly 180° on the mandrel and check the opposite side for alignment.
4. If a light is visible, it is an indication that the assembly is out of line and straightening is required. To straighten, insert a small diameter bar into the piston and apply leverage in the necessary direction.

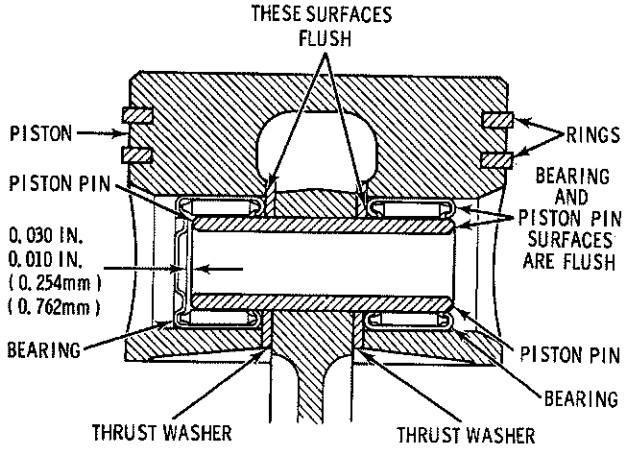


Figure X-23

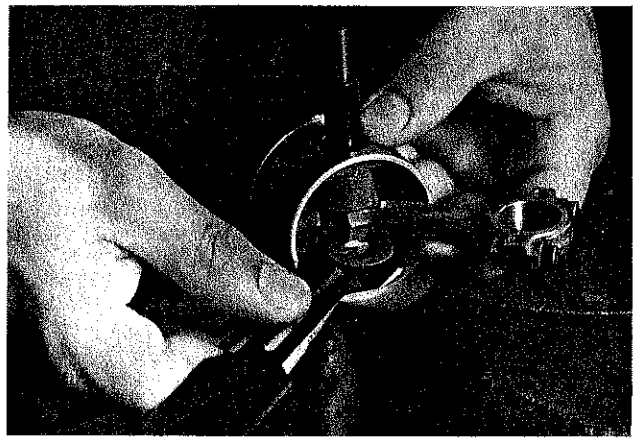


Figure X-24. Using an inserter tool to line up the thrust washers makes it easier to properly align connecting rod, washers, and piston and to press the piston pin into position.

CAUTION

Avoid using too much leverage or the rod will be twisted in the opposite direction. Always recheck the assembly to make sure that the connecting rod has been straightened.

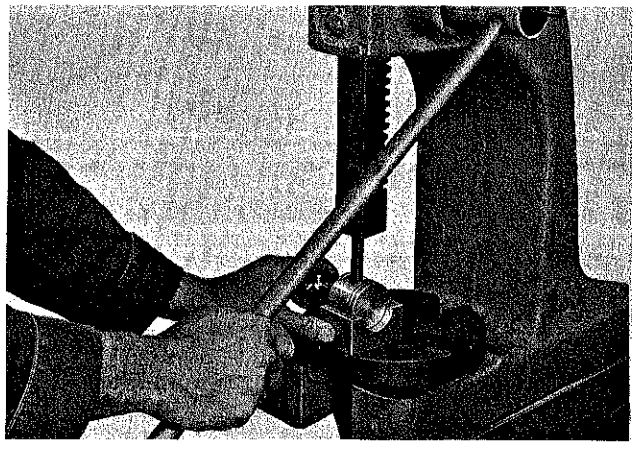


Figure X-25. Pressing the piston pin into the piston. The connecting rod eye and the thrust washers must first be properly aligned to permit pin installation. The pin must be pressed only far enough to make the end flush with the outer edge of the bearing.

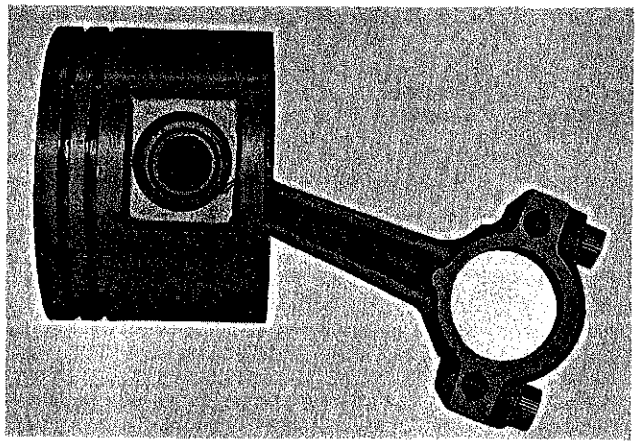


Figure X-26. A correctly installed piston pin. The end of the pin and the bearing are flush.

5. After straightening and rechecking, slowly rock the piston to the right and to the left. Check for light streaks between the piston and the face of the aligning plate. If a light streak is noticed at the piston skirt in one position, and at the lower ring groove when rocked to the opposite position, the rod is twisted.
6. To correct a twisted rod, determine in which direction pressure must be applied to the connecting rod eye to remove the twist. Insert a small diameter bar into the piston and apply leverage in the required direction. Avoid using too much force during this operation or a twist in the opposite direction will result.

Crankcase and Crankshaft

(For powerhead assemblies having removable cylinder heads, including Model 1-40, 1-41, early production 1-42, 1-45, 1-50, 1-51, 1-60, 1-61, and 1-62 engines.)

1. Heat the crankcase cylinder to approximately 180°F. (85°C.). Press the needle bearing into the bearing insert in the cylinder. Install the oil seal in the cylinder. Set the outside face of this oil seal flush with the face of the boss. Make sure that needle bearing and oil seal have adequate clearance. This should be approximately 1/8 inch.

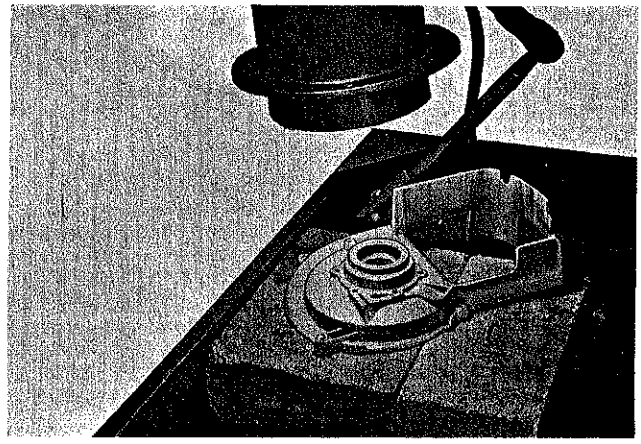


Figure X-27. Using a heat lamp to heat the crankcase cover prior to installing the crankshaft and ball bearing.

CAUTION

Be sure that the oil seal driver is the proper size. A driver too large can damage the cylinder, while a driver too small can cut or damage the rubber part of the seal.

2. Press the ball bearing on the crankshaft.
3. Heat the crankcase cover to 180° to 200°F. (85° to 95°C.) and press the crankcase cover onto the crankshaft ball bearing. (Figures X-27 and X-28)
4. Install the oil seal in the crankcase cover.

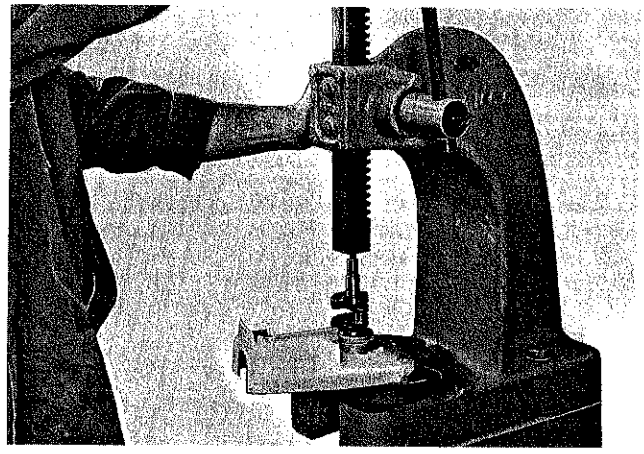


Figure X-28. Pressing the crankshaft (with ball bearing) into the crankcase cover.

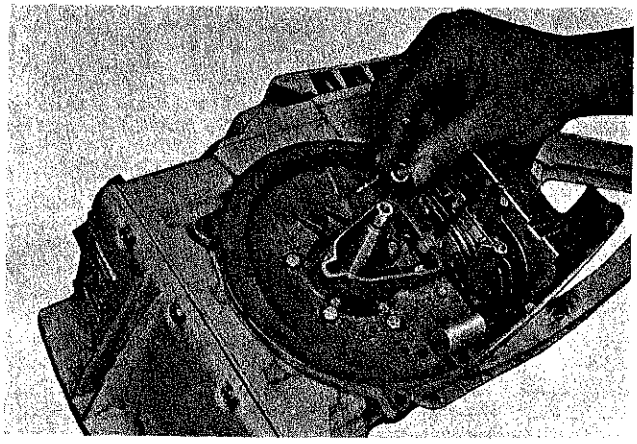


Figure X-29. The crankcase cover is attached to the crankcase with six screws. Two of these, which are inside the breaker point box, are sealing screws.

CAUTION

If a new crankcase cover is being installed on the engine, the oil seal is already in place in the cover. Be careful therefore, that when heating the crankcase cover assembly, not to overheat and cause damage to the oil seal.

5. Heat the crankcase cylinder to 180° to 200°F. (85° to 95°C.). Be sure that the gasket screw holes are correctly aligned with the crankcase cover screw holes.

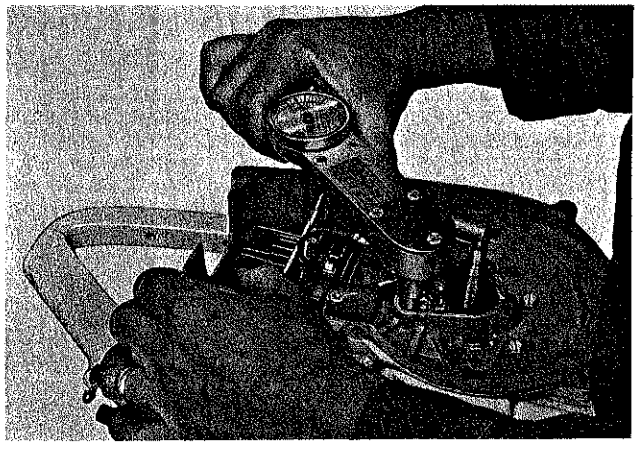


Figure X-30. Using a torque wrench to tighten the crankcase cover screws.

Figure X-31. If a piston ring expander is not available, the rings may be removed or installed on the piston as shown. When installing rings, the bottom ring must be installed first.

6. Place an oil seal protector sleeve on the drive sprocket end of the crankshaft.
7. Install the assembled crankshaft and crankcase cover assembly in the crankcase cylinder. Press the assembly into position by hand or by using an arbor press, and install five of the six crankcase cover attaching screws. (Figure X-29) Do not install the sixth screw (breaker box retaining screw) at this time. Using a torque wrench, tighten the five screws to a torque value of 60 to 65 inch-pounds (5 to 5-1/2 foot-pounds) (0.69 to 0.75 mkg). (Figure X-30) Turn the crankshaft several revolutions to make sure that it turns freely and smoothly without drag or binding. Remove the oil seal protector sleeve.
8. Remove the connecting rod cap (if installed for alignment of connecting rod and piston), and install the rings on the piston. Always install rings over the head of the piston because of the smaller diameter at the top. (Figure X-31)
9. Oil the piston, rings, (Figure X-32) and cylinder walls (Figure X-33) with a light coating of engine oil. This will make installation in the cylinder bore easier and provide initial starting lubrication.
10. Turn the crankshaft until the throw is down to the bottom of the stroke. Using a ring compressor, insert the connecting

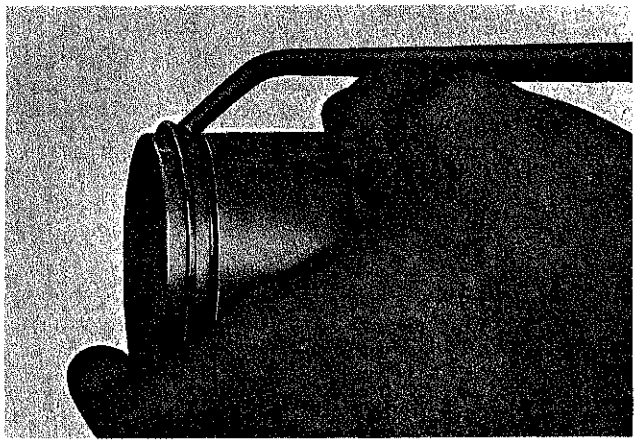


Figure X-32. Oiling the piston and rings before inserting them into the cylinder.

rod and piston assembly into the cylinder bore. Make sure that the closed end of the piston pin or the closed end bearing is installed on the exhaust port side of the crankcase cylinder. (Figure X-34)

11. Coat the connecting rod needle roller surfaces, both rod and cap, with a non-fiber grease (water pump lube or heavy petroleum jelly). Place 12 needle rollers in the grease on both rod and cap. (Figures X-35 and X-36)
12. Push the piston deep into the cylinder until the connecting rod is fitted against

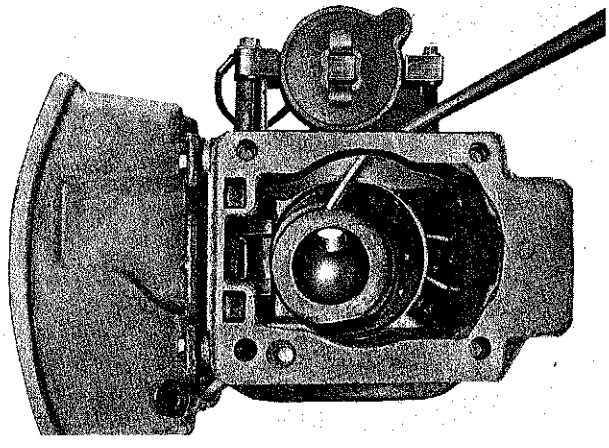


Figure X-33. Before inserting the piston, the cylinder walls should be oiled. Note the bevel edge on the bottom of the cylinder which acts as a ring compressor to guide the rings into the cylinder.

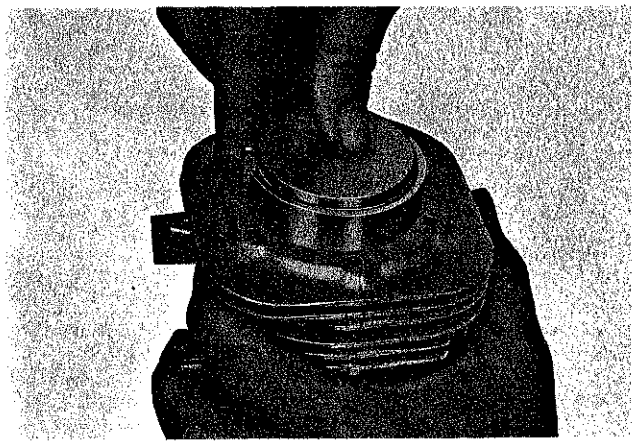


Figure X-34. A ring compressor makes installation of piston and rings much easier on engines which have removable cylinder heads.

the crankpin. Fit the connecting rod cap to the crankpin and connecting rod and install the connecting rod screws. Make sure that the screws are clean and oiled, and that the identifying pips on the rod and cap are matched. (Figure X-37) Tighten the screws to 70 to 75 inch-pounds (6 to 6-1/2 foot-pounds) torque (0.81 to 0.87 mkg). (Figure X-38) After the screws are properly tightened, turn the crankshaft through several times to be sure there is no binding.

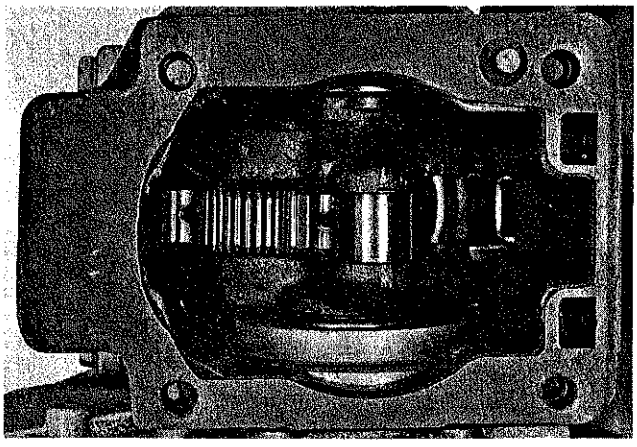


Figure X-35. The bearing surface of the connecting rod has been coated with grease and 12 of the needle bearings are placed in position. The grease will hold the needles while the rod is pushed down and under the crank journal, then raised to fit around it.

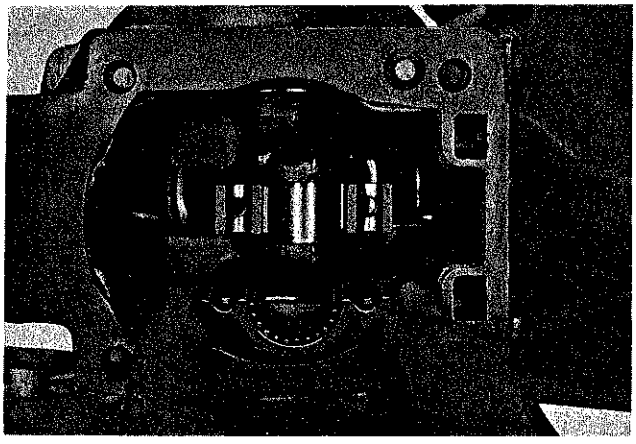


Figure X-36. The other 12 needle bearings in the connecting rod cap are held in position by the grease-coated cap bearing surface. The cap is now ready for attaching to the connecting rod in position around the crank journal.

CAUTION

Make sure all 24 needle rollers are in place in the connecting rod. A loose needle roller in the crankcase cylinder can quickly ruin the engine.

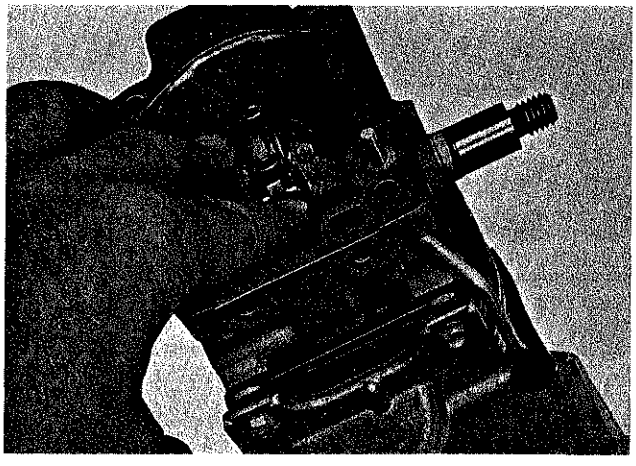


Figure X-37. Check the joint line between connecting rod and cap. This "finger nail" test will show whether the cap has been installed properly. It should not be possible to detect the joint line between connecting rod and cap when the screws are tight.

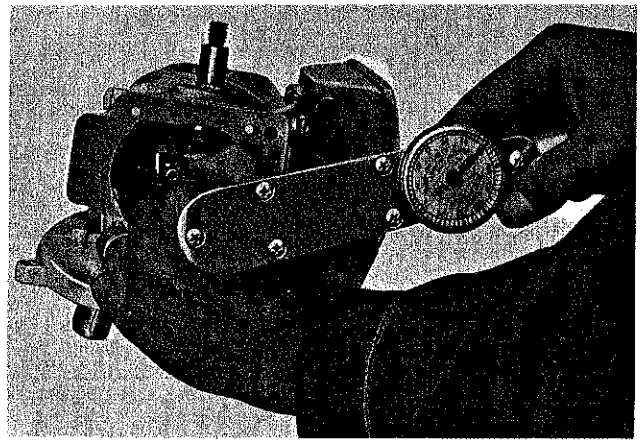


Figure X-38. Connecting rod cap screws should be torqued up tight. Using a torque wrench, they should be tightened to a torque value of 70 to 75 inch-pounds.

13. Align the cylinder head gasket and cylinder head on the crankcase cylinder.

NOTE

When reassembling the cylinder head gasket, cylinder head, and crankcase, it is extremely important to follow the correct procedure. There are very close tolerances for piston, cylinder head, and gasket, so that improper installation can result in piston failure. The proper way to install the cylinder head and gasket is as follows:

(a) Turn the crankshaft until the piston is at top dead center.
(b) Install the gasket, cylinder head and screws, but leave the screws loose enough to allow the cylinder head and gasket to be shifted slightly from side to side.
(c) Carefully, and by feel, shift the head and gasket until they fit over the piston without interference.
(d) Tighten the cylinder head screws to proper torque value, 55 to 60 inch-pounds (4-1/2 to 5 foot-pounds) (0.638 to 0.690 mkg). (Figure X-39)
(e) Turn the crankshaft through several revolutions, checking interference. Repeat the steps if necessary, and until there is no interference with the piston.

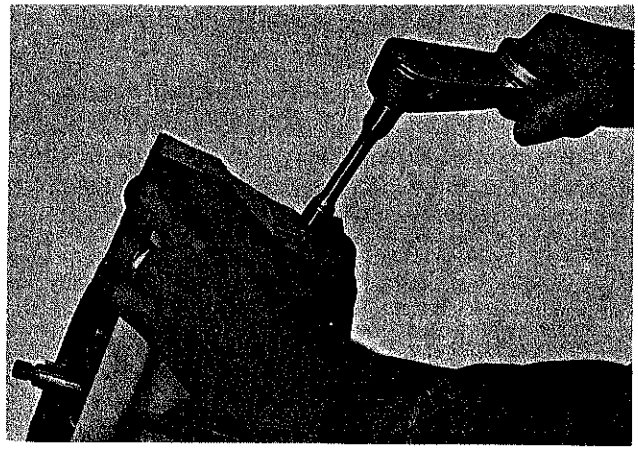


Figure X-39. Using a torque wrench to install cylinder head screws. Specified torque is very important in the assembly of the engine.

Crankcase and Crankshaft

(For powerhead assemblies having integral head cylinder crankcases including late production Model 1-42 engines, and Model 1-43, 1-46, 1-52, 1-53, and 1-63 engines.)

NOTE

Step No. 1 below, as it pertains to the installation of the crankshaft needle roller bearing, does not apply to Model 1-52 and 1-53 engines which have two ball bearings on the crankshaft.

1. Heat the crankcase cylinder to approximately 180°F. (85°C). Press the needle bearing into the bearing insert in the cylinder. Install the oil seal in the cylinder with the outside face of the oil seal flush with the face of the boss. Make sure that the oil seal and the needle bearing have adequate clearance. This should be approximately 1/8 inch (3.18 mm).
2. Press the ball bearing on the crankshaft.

NOTE

On Model 1-52 and 1-53 engines, having two ball bearings on the crankshaft, press both bearings on the shaft.

3. Heat the crankcase cover to 180° to 200°F. (85° to 95°C.) and press the crankcase cover onto the ball bearing. (Ball bearing on crankshaft into the crankcase cover.)
4. Install the oil seal in the crankcase cover.
5. Install the rings on the piston, seating the lower ring first, and both rings over the head of the piston.
6. Oil the piston and rings, and the inside of the cylinder with a light coating of engine oil.
7. Insert the piston assembly and connecting rod (with cap removed) into the cylinder, and push the assembly as far as possible into the top of the cylinder. Make sure the closed-end bearing in the piston is on the exhaust port side of the cylinder.

Correct Cylinder Head Gaskets

Model	P/N	Thickness	
1-40	55012B	0.064"	(1.63 mm)
1-41	55012B	0.064"	(1.63 mm)
1-42	48858		
1-43	None		
1-45	48742	0.016"	(0.4 mm)
1-46	None		
1-50	55012B	0.064"	(1.63 mm)
1-51	55012B	0.064"	(1.63 mm)
1-52	None		
1-53	None		
1-60	55012B	0.064"	(1.63 mm)
1-61	55012B	0.064"	(1.63 mm)
1-62	48742	0.016"	(0.4 mm)
1-63	None		

8. Heat the crankcase cylinder to 180° to 200°F. (85° to 95°C.). While the crankcase cylinder is heating, fasten the crankcase cover gasket to the cover with gasket cement. Be sure that the gasket screw holes are correctly aligned with the crankcase cover screw holes.
9. Place an oil seal protector sleeve on the drive sprocket end of the crankshaft.
10. Insert the crankshaft, with attached crankcase cover, into the crankcase.

CAUTION

Very carefully turn the crankshaft until the counterweights are in a position to slide past the connecting rod end that extends down toward the bottom of the cylinder, and not hang up or interfere with the rod.

11. Coat the connecting rod needle roller surfaces with a non-fiber grease (water pump lube or a heavy petroleum jelly).
12. Place the 12 needle rollers in both rod and cap, embedded and held in position by the grease, then work the connecting rod into position around the crankpin and attach the connecting rod cap. Make sure that the pips on the rod and cap are together and that the cap fits tightly around the crankpin.
13. Insert the connecting rod screws (cleaned and well oiled before insertion) and tighten them to a torque value of 70 to 75 inch-pounds (6 to 6-1/2 foot-pounds) (0.81 to 0.87 mkg).
14. Turn the crankshaft through several revolutions to make sure that it turns freely without binding at any place.
15. Replace the crankcase bottom (stuffer) on Model 1-60, 1-61, 1-62, and 1-63 engines.

Proceed with reassembly of the other components of the engine which were removed prior to disassembly and service on the powerhead assembly.

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SECTION XI
Fuel and Lubrication

FUEL AND LUBRICATION

It is good practice to prepare only the quantity of oil and gasoline fuel mixture that will be used in a day or so. Never prepare large quantities of the fuel mixture and store it for long periods. Temperature and humidity changes will cause condensation of moisture on the inside of the storage container and will add water to the fuel, making it difficult or impossible to start the engine. The fuel pickup filter may also become watersoaked and require cleaning or replacement.

Also, gasoline stored for long periods will lose its higher fractions to the atmosphere and change the oil-gasoline ratio. This too can result in a hard starting engine that will not develop full power.

It is important that the fuel mixture be prepared properly if the engine is to run efficiently. Certainly, the container must be absolutely clean and preferably have a flexible spout to avoid spilling when the fuel tank is filled. Also the fuel must be thoroughly mixed before it is put into the fuel tank. A recommended procedure is to pour half of the gasoline and all of the oil into the mixing container, cap it, and shake well. Then add the balance of the gasoline and shake the container again, long enough to be sure of complete mixing.

Keep fuel containers capped at all times when not adding or pouring the fuel. This will help to exclude dirt and reduce the danger of fire. Engines should never be fueled in the close vicinity of saw operation.

FUEL MIXTURE TABLE

OIL QUANTITY	* GASOLINE QUANTITY			
	Mixed With McCulloch Oil		Mixed With SAE 40 Motor Oil	
	Gallons	Liters	Gallons	Liters
1/2 pint (0.236 liters)	1 1/4	4.73	1	3.785
1 pint (0.472 liters)	2 1/2	9.46	2	7.57
1 quart (0.944 liters)	5	18.925	4	15.14
2 quarts (1.888 liters)	10	37.85	8	30.28
1 gallon (3.785 liters)	20	75.7	16	60.56

* Use only unleaded gasoline of about 70 octane, or with as low an octane rating above 70 as is available.

CHAIN OIL

Temperatures

Above 40°F. (4.4°C.)	SAE 30 Motor Oil
Below 40°F. (4.4°C.)	SAE 10 Motor Oil

TRANSMISSION LUBRICANT

Temperatures

Above 40°F (4.4°C.)	SAE 140 Gear Oil
Between 10°F. and 40°F. (-12°C. and 4.4°C.)	SAE 90 Gear Oil
Below 10°F. (-12°C.)	Half SAE 90 Gear Oil and Half Kerosene

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.

SECTION XII
Specifications

SPECIFICATIONS

McCulloch chain saw engines covered in this shop manual have the following specifications common to all.

Type	2 Cycle
Number of Cylinders	1
Cooling	Air
Fuel Supply	Pulse Pressure
Clutch	4-shoe Centrifugal
**Engine Speed Clutch Engagement	(See note)
Clutch Lining	None
Ignition	Flywheel Magneto
*Spark Plug	Champion J8J
Spark Plug Gap	0.025 inch (0.635 mm)
Breaker Point Setting	0.018 inch (0.457 mm)
Coil	McCulloch Waterproof
Starter	Rewind

**The engine speed at which the clutch engages on McCulloch chain saw engines, falls within a range of 2100 to 3400 R.P.M., depending primarily upon the engine model and the type and condition of the clutch. This speed is one at which the engine runs at sufficiently fast idle to avoid stalling, yet does not drive or cause the chain to creep.

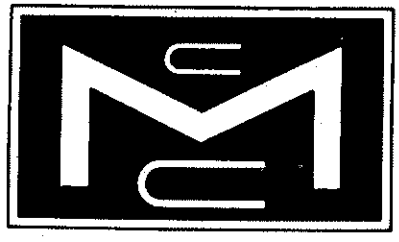
*Standard. Other heat ranges are permissible under special circumstances. Comparable spark plugs of other manufacture are also approved.

TABLE OF SPECIFICATIONS

Transmission	Direct Drive										Gear Train			
Model	1-40	1-41	1-42	1-43	1-45	1-46	1-50	1-51	1-52	1-53	1-60	1-61	1-62	1-63
Weight, pounds	18	18	18	19	18	21	18	18	20	21	21	21	21	24
Weight, kilograms	8.56	8.56	8.56	8.62	8.56	9.53	8.56	8.56	9.07	9.53	9.52	9.52	9.52	10.89
Bore, inches	2.125	2.125	2.125	2.125	2.125	2.125	2.125	2.125	2.125	2.125	2.125	2.125	2.125	2.125
Bore, millimeters	53.97	53.97	53.97	53.97	53.97	53.97	53.97	53.97	53.97	53.97	53.97	53.97	53.97	53.97
Stroke, inches	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.5	1.5	1.375	1.375	1.375	1.375
Stroke, millimeters	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	38.1	38.1	34.92	34.92	34.92	34.92
Displacement, cubic in.	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	5.3	5.3	4.9	4.9	4.9	4.9
Displacement, cubic cent.	80.3	80.3	80.3	80.3	80.3	80.3	80.3	80.3	86.86	86.86	80.3	80.3	80.3	80.3
Compression Ratio	5.5/1	5.5/1	6.3/1	6.3/1	6.0/1	6.0/1	5.5/1	6.0/1	6.25/1	6.25/1	5.5/1	5.5/1	5.5/1	5.5/1
Crankcase (type)	2 piece	2 piece	2 piece & Int. Hd.	Integral Head	2 piece	Integral Head	2 piece	2 piece	Integral Head	Integral Head	2 piece	2 piece	2 piece	Integral Head
Main Bearings	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball	2 ball	2 ball	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball	1 needle 1 ball
Connecting Rod Bearings	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle
Upper Rod Bearings	Needle	Bushing	Bushing	Bushing	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle	Needle
Fuel Tank Capacity, pints	2-1/2	2	2-1/2	2-1/2	2-1/2	2-1/2	2	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2
Fuel Tank Cap. liters	1.18	0.94	1.18	1.18	1.18	1.18	0.94	1.18	1.18	1.18	1.18	1.18	1.18	1.18
Chain Oiler Tank Capacity, pints		1	1	1	1	1	3/4	1	1	1	2/3	1	1	1
Chain Oiler Tank Capacity, Liters		0.473	0.473	0.473	0.473	0.473	0.35	0.473	0.473	0.473	0.315	0.473	0.473	0.473

SERVICE BULLETIN REFERENCE

Date	Subject	Bulletin No.



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