# ILLUSTRATED PARTS LIST

| PRO MAC 610 MODELS | SERIAL NUMBER PREFIX |
|---|---|
| 600041A | 11-, 12- |
| 600041B | 11-, 12- |
| 600041C | 11-, 12- |
| 600041D | 11-, 12- |
| 600041E | 11-, 12- |
| 600041F | 11-, 12- |
| 600041G | 11-, 12- |
| 600041H | 11-, 12- |
| 600041J | 11-,12- |
| 600041K | 11-, 12- |
| 600041L | 11-, 12- |
| 600041N | 11-, 12- |
| 600041O | 12- |
| 600041Q | 12- |
| 600041R | 11-, 12- |
| 600041S | 11-, 12- |
| 600041U | 11-, 12- |

| PRO MAC 650 MODELS | SERIAL NUMBER PREFIX |
|---|---|
| 600046A | 11- |
| 600046B | 11- |
| 600046C | 11- |
| 600046D | 11- |
| 600046E | 11- |
| 600046F | 11- |
| 600046H | 11- |
| 600046J | 11- |

McCulloch chain saws are identified by a model number (in this instance, 600041 ) followed by a suffix letter (A, B, C, etc.) stamped on the identification plate attached to the saw. Suffix letters denote variations in parts or assemblies in the manufacture of the saw.

Part numbers listed in this I.P.L. which have a suffix letter or letters following the description, indicate the part is used only on the model(s) identified by the letter or letters.

Part numbers and descriptions without suffix letter or letters apply to all versions of the chain saw model.

Part numbers which have one or more dots (.) preceding their descriptions may be ordered individually, but they are also included in the kit or assembly whose description begins directly above the dot(s).

Part numbers in this IPL which were not in the previous IPL covering these saws, are indicated by a dash (-) preceding the new part number.

The policy of McCulloch Corporation is one of continual improvement in design, manufacturing and engineering advancement wherever possible to assure still finer two-cycle power tools. Hence, specifications, equipment, colors, design and manufacturer's suggested list prices are subject to change without notice and McCulloch Corporation reserves the right to make such changes without prior notification or obligation to backfit or supply backfit components for units previously shipped from the factory.

# PRO MAC™ 610 and 650 Chain Saws


- CONTENTS -



(This IPL supercedes and replaces IPL, P/N 93716)

December 1984

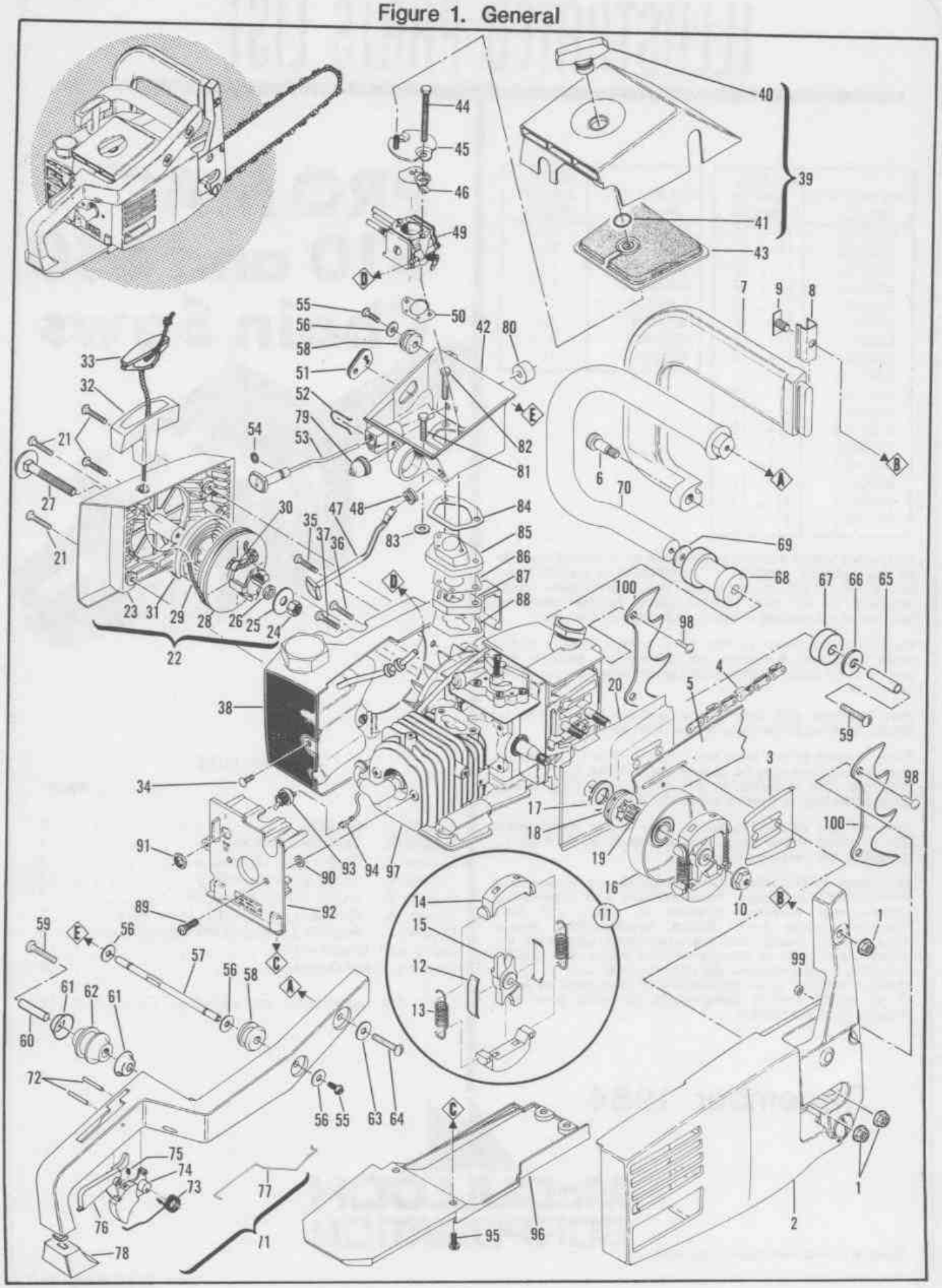
McCULLOCH CORPORATION



Printed in U.S.A.

215036-R3

## Figure 1. General

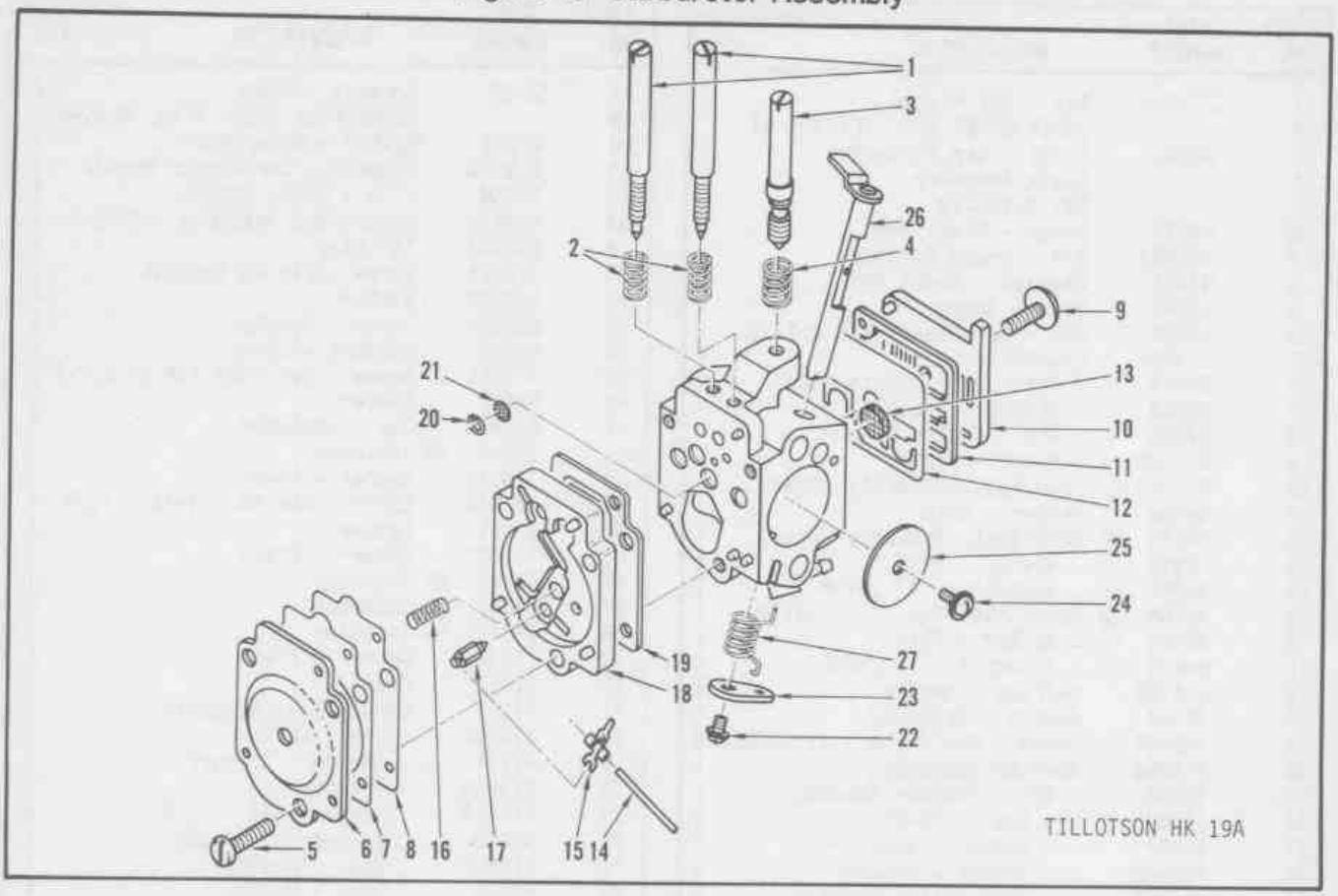


# Figure 1. General

| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| 1 | 213169 | Nut - HEX Flange | 3 |
| 2 | | CHAIN BRAKE ASY. (FIGURE 5) | |
| 3 | 64325 | Plate - Bar Protector | 1 |
| 4 | | Chain Assembly | |
| 5 | | Bar Assembly | |
| 6 | 95671 | Screw - Brake Arm | 1 |
| 7 | 91989B | Arm - Brake Actuator | 1 |
| 8 | 93721 | Channel - Brake Arm | 1 |
| 9 | 93746 | Stud - Brake | 1 |
| 10 | 92457 | Nut - Hex Flange M10 x 1.25 | 1 |
| 11 | 214301 | Clutch Assembly | 1 |
| 12 | 64583 | . Retainer - Clutch Shoe | 2 |
| 13 | 83223 | . Spring - Clutch | 2 |
| 14 | 67233 | . Kit - Clutch Shoe | 1 |
| 15 | 214300 | . Rotor - Clutch | 1 |
| 16 | 214979 ① | Drum/Spkt. Assembly (Spur) | 1 |
| 17 | 86958 | Washer - Shim | 1 |
| 16 | 95165 ② | Drum/Spkt. Assembly (Spur) | 1 |
| 17 | 86958 ② | . Washer - Shim | 1 |
| 18 | 86951 ② | . Sprocket - 7T .375P | 1 |
| 16 | 95166 ③ | Drum/Spkt. Asy. - 7T .375P | 1 |
| 17 | 86958 ③ | . Washer - Shim | 1 |
| 18 | 86145 ③ | . Sprocket - 7T .375P | 1 |
| 19 | 215720 | Bearing - Needle | 1 |
| 20 | 92354 | Jacket - Cylinder | 1 |
| 21 | 120081 | Screw - Pan Hd M4 x 16 (SEMS) | 4 |
| 22 | 216856 | Starter Assembly | 1 |
| 23 | 95353 | . Kit - Starter Housing | 1 |
| 24 | 111038 | . . Nut - 1/4-20 | 1 |
| 25 | 95401 | . . Washer - Starter | 1 |
| 26 | 216589 | . . Spacer - Starter | 1 |
| 27 | 215848 | . . Step Bolt - Starter | 1 |
| 28 | 216758 | . Drum Assembly - Starter | 1 |
| 29 | 87670 | . . Rope - Starter | 1 |
| 30 | 217730 | . . Bushing - Rope | 1 |
| 31 | 87680 | . Spring - Starter Rewind | 1 |
| 32 | 93137 | Starter Handle | 1 |
| 33 | 214699 | Insert Handle | 1 |
| 34 | 120002 | Screw - Pan Hd M5 x 14 | 1 |
| 35 | 93232 | Screw - Fan Housing (M5 x 40) | 1 |
| 36 | 93233 | Screw - Fan Housing (M5 x 35) | 1 |
| 37 | 93234 | Screw - Fan Housing (M5 x 30) | 1 |
| 38 | | Fan Housing & Fuel Tank Asy. (Figure 6) | |
| 39 | 216871 | Cover Asy. - Air Cleaner | 1 |
| 40 | 91991 | . Knob - Air Cleaner Cover | 1 |
| 41 | 110565 | . Ring - Retaining | 1 |
| 42 | 95215 | Kit - Air Box | 1 |
| 43 | 214226 | . Filter - Air | 1 |
| 44 | 120004 | Screw - Hx Hd M5 x 56 | 2 |
| 45 | 91938 | Bracket Asy. - Air Cleaner | 1 |
| | 94482 | Choke & Rod Kit | 1 |
| 46 | 94151 | . Choke Carburetor | 1 |
| 47 | 94171 | . Rod - Choke | 1 |
| 48 | 93261 | Grommet - Choke | 1 |
| 49 | | Carburetor Asys. (Fig. 2,3,4) | |
| 50 | 91924 | Gasket - Carburetor | 1 |
| 51 | 91995A | Grommet - Carburetor Needle | 1 |
| 52 | 93458 | Clip - Oiler Button | 1 |
| 53 | 92067A | Button/Rod Assembly - Oiler | 1 |
| 54 | 105614 | "O" Ring | 1 |
| 55 | 215266 | Screw - Pan M5 Special | 2 |
| 56 | 110990 | Washer | 4 |
| 57 | 93252A | Strut - Handle | 1 |
| 58 | 93253 | Grommet - Strut | 2 |
| 59 | 111015 | Screw - Pan Head 1/4-14 x 2.5 | 2 |
| 60 | 92071 | Spacer | 1 |
| 61 | 92066 | Cup - Isolator | 2 |
| 62 | 92065 ④ | Isolator | 1 |
| 63 | 102115 | Washer - Plain | 1 |
| 64 | 111014 | Screw - Pan Hd 1/4-14 x 1.75 | 1 |
| 65 | 92071 | Spacer | 1 |
| 66 | 111027 | Washer - Plain | 1 |
| 67 | 93913 ④ | Isolator | 1 |
| 67 | 94847 ⑤ | Isolator | 2 |
| 68 | 94140 ④ | Isolator | 1 |
| 69 | 111027 | Washer - Plain | 1 |
| 70 | 91951 | Frame | 1 |
| 71 | 94255 | Handle/Boot Assembly | 1 |
| 72 | 110994 | . Pin - Roll | 2 |
| 73 | 93771 | . Spring - Trigger | 1 |
| 74 | 91953A | . Trigger | 1 |
| 75 | 111013 | . Screw - Set | 1 |
| 76 | 91955 | . Release - Trigger | 1 |
| 77 | 214504 | . Rod - Throttle | 1 |
| 78 | 93459 | . Boot - Handle | 1 |
| 79 | 69597 | Boot - Control Rod | 1 |
| 80 | 92161 | Seal - Air Box | 1 |
| 81 | 120037 | Screw - Hx Hd M5 x 25 (SEMS) | 1 |
| 82 | 120039 | Screw - Hx Hd M5 x 30 (SEMS) | 2 |
| 83 | 93460 | Washer - Insulator | 1 |
| 84 | 94018 | Gasket - Air Box | 1 |
| 85 | 94017A | Insulator - Carburetor | 1 |
| 86 | 91933 | Gasket - Air Box | 1 |
| 87 | 91934 | Insulator - air Box | 1 |
| 88 | 92038 | Gasket - Insulator | 1 |
| 89 | 120037 | Screw - Hx Hd M5 x 25 (SEMS) | 2 |
| 90 | 93460 | Washer - Insulator | 1 |
| 91 | 104810 | Nut - Hx 15/32-32 | 1 |
| 92 | 92004 | Shroud - Cylinder | 1 |
| 93 | 93890 | Switch - Ignition | 1 |
| 94 | 92466 | Wire Assembly - Switch | 1 |
| 95 | 120002 | Screw - Pan Hd M5 x 14 | 4 |
| 96 | 214670 | Shroud - Bottom | 1 |
| 97 | | Powerhead & Oiler Asys. (Fig. 4) | |
| 98 | 120002 ⑥ | Screw - Pan Hd M5 x 14 | 4 |
| 99 | 120044 ⑥ | Nut - Hx M5 Lock | 2 |
| 100 | 93668 ⑥ | Spike | 2 |

① Used on PM 610 models with serial number prefix 12-.
② Used on all models with serial number prefix 11- except those with suffix letter A.
③ Used on models with serial number prefix 11- and suffix letter A.
④ PM 600 models with suffix letter J will use a second Isolator, P/N 94847, in place of Isolator, P/N 94140 (Item 68).
⑤ Used on PM 650 models with suffix letter J.
⑥ Optional equipment.

## Figure 2. Carburetor Assembly



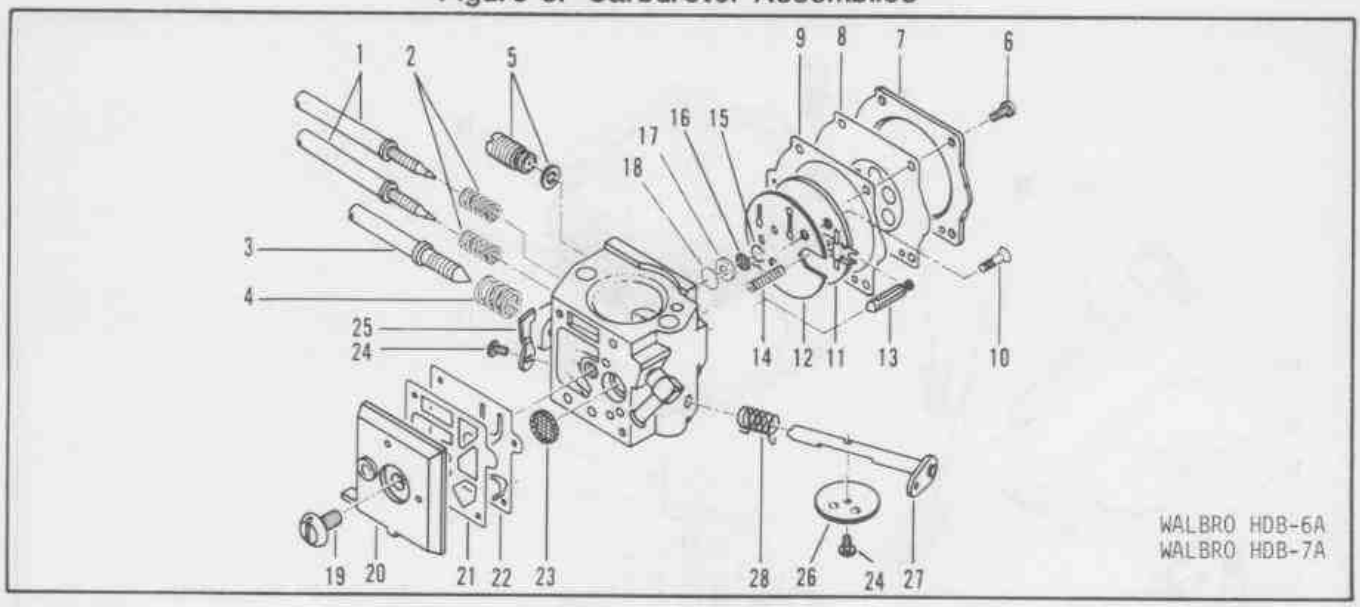

| ITEM NO. | PART NUMBER | | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|---|
| | 93739 * | | Carburetor - Tillotson HK 19A (PM 610) | |
| 1 | 94797 | | . Needle - Hi Speed + Idle | 2 |
| 2 | - - | ① | . Spring - Needle Adjustment | 2 |
| 3 | 94798 | ① | . Screw - Idle Speed | 1 |
| 4 | 94700 | ① | . Spring - Idle Speed Screw | 1 |
| 5 | 94789 | | . Screw - Diaphragm Cover | 3 |
| 6 | 94788 | | . Cover - Diaphragm | 1 |
| 7 | 94787 | ① | . Diaphragm | 1 |
| 8 | - - | ① | . Gasket - Diaphragm | 1 |
| 9 | 94793 | | . Screw - Pump Cover | 1 |
| 10 | 94792 | | . Cover - Fuel Pump | 1 |
| 11 | - - | ① | . Gasket - Fuel Pump | 1 |
| 12 | 94794 | ① | . Diaphragm - Fuel Pump | 1 |

| ITEM NO. | PART NUMBER | | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|---|
| 13 | 94796 | | . Screen - Fuel Strainer | 1 |
| 14 | - - | ① | . Pin - Inlet Lever | 1 |
| 15 | 94800 | ① | . Lever - Inlet | 1 |
| 16 | - - | | . Spring - Inlet | 1 |
| 17 | 94802 | | . Needle- Inlet | 1 |
| 18 | - - | | . Body - Module | 1 |
| 19 | - - | ① | Gasket - Module Metering | 1 |
| 20 | 94786 | | . Ring - Retaining | 1 |
| 21 | - - | | . Screen - Body Channel | 1 |
| 22 | 94807 | ① | . Screw - Throttle Lever Ret. | 1 |
| 23 | - - | | . Lever - Throttle | 1 |
| 24 | 94811 | | . Screw-Throttle Shutter Ret. | 1 |
| 25 | 94810 | | . Shutter - Throttle | 1 |
| 26 | 94808 | | . Shaft Assembly - Throttle | 1 |
| 27 | 94809 | ① | . Spring-Throttle Shaft Ret. | 1 |

* One of three carburetors used alternately on PM 610 Models. Identify carburetor before ordering service repair parts.

① Contained in Repair Kit, P/N 94813.

## Figure 3. Carburetor Assemblies




| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| | 95763A * | Carburetor - Walbro HDB -6A (PM 610) | |
| | 95631 | Carburetor - Walbro HDB-7A (PM 650) | |
| 1 | - - ① | . Needle - Hi Speed & Idle | 2 |
| 2 | - - ① | . Spring - Needle Adjustment | 2 |
| 3 | - - | . Screw - Idle | 1 |
| 4 | - - | . Spring - Idle Adjustment | 1 |
| 5 | - - | . Governor Asy. (HDB-7A Only) | 1 |
| 6 | - - | . Screw - Metering Cover | 4 |
| 7 | - - | . Cover - Metering Diaphragm | 1 |
| 8 | - - ① ② | . Diaphragm Asy. - Metering | 1 |
| 9 | - - ① ② | . Gasket - Metering Diaphragm | 1 |
| 10 | - - | . Screw - Circuit Plate | 1 |
| 11 | - - ① | . Plate Assembly - Circuit | 1 |
| 12 | - - ① ② | . Gasket - Circuit Plate | 1 |

| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| 13 | - - ① ② | . Valve - Inlet Needle | 1 |
| 14 | - - ① ② | . Spring - Metering Lever | 1 |
| 15 | - - ① ② | . Ring - Screen Retaining | 1 |
| 16 | - - ① ② | . Screen - Check Valve | 1 |
| 17 | - - ① | . Retainer - Check Valve | 1 |
| 18 | - - | . Valve - Check | 1 |
| 19 | - - | . Screw - Fuel Pump Cover | 1 |
| 20 | - - | . Cover - Fuel Pump | 1 |
| 21 | - - ① ② | . Gasket - Fuel Pump | 1 |
| 22 | - - ① ② | . Diaphragm - Fuel Pump | 1 |
| 23 | - - ① ② | . Screen - Inlet | 1 |
| 24 | - - | . Screw - Valve | 2 |
| 25 | - - | . Stop - Throttle | 1 |
| 26 | - - | . Valve - Throttle | 1 |
| 27 | - - | . Shaft Assembly - Throttle | 1 |
| 28 | - - ① | . Spring Throttle Return | 1 |

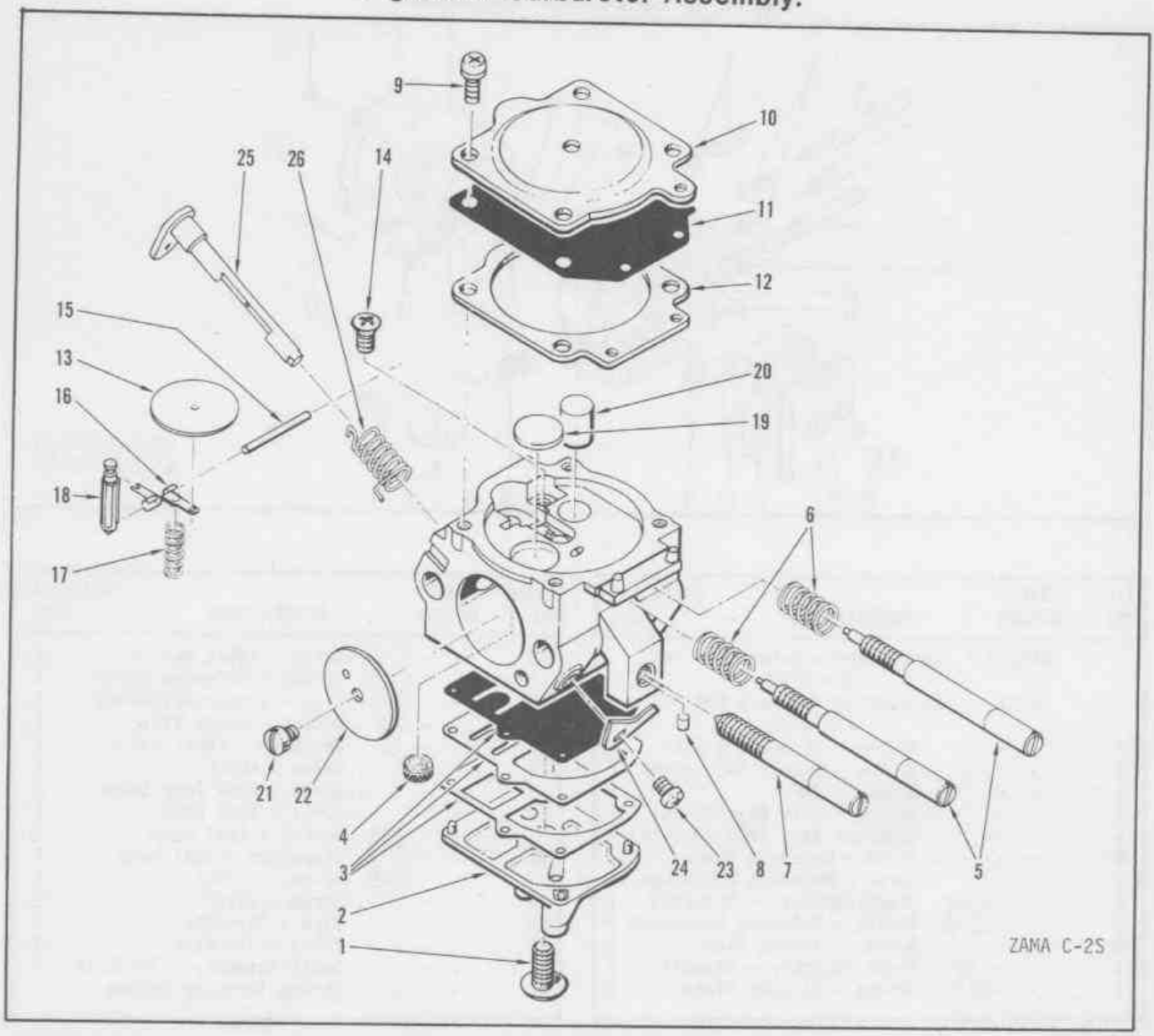
* One of three carburetors used alternately on PM 610 models. Identify carburetror before ordering service repair parts.

① Contained in Major Repair Kit, P/N 217075.

② Contained in Minor Repair Kit, P/N 217077.

NOTE: Items are listed for identification and disassembly sequence purposes and ONLY those items included in the Major and Minor Repair Kits are available as service replacement parts.

## Figure 4. Carburetor Assembly.




| ITEM NO. | PART NUMBER | | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|---|
| | 95763 | * | Carburetor Asy. (Zama C-2S) | |
| 1 | 501311 | | . Screw - Pump Cover | 1 |
| 2 | 214954 | | . Cover - Pump | 1 |
| 3 | 214953 | ① | . Kit - Pump Diaphragm | 1 |
| 4 | 91820 | ① | . Screen - Filter | 1 |
| 5 | - - | ① | . Screw - Adjustment | 2 |
| 6 | - - | ① | . Spring - Adjustment Screw | 2 |
| 7 | - - | | . Screw - Throttle Adjustment | 1 |
| 8 | - - | | . Piece - Friction | 1 |
| 9 | 93945 | | . Screw - Diaphragm Cover | 4 |
| 10 | 214945 | | . Cap | 1 |
| 11 | - - | ① | . Diaphragm - Main | 1 |
| 12 | | ① | . Gasket - Main | 1 |
| 13 | - - | ① | . Disk | 1 |

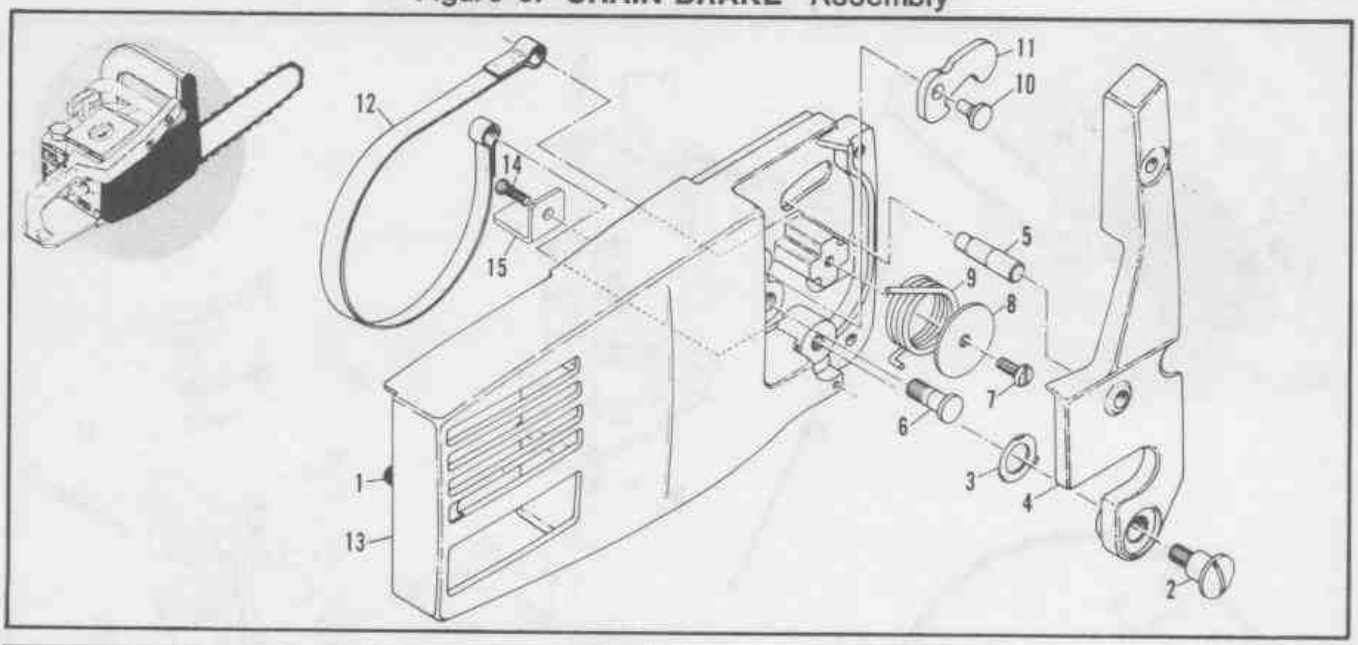
| ITEM NO. | PART NUMBER | | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|---|
| 14 | 91814 | ① | . Screw Pin Lever | 1 |
| 15 | 93942 | ① | . Pin - Arm | 1 |
| 16 | - - | ① | . Arm - Needle Valve | 1 |
| 17 | - - | ① | . Spring - Arm | 1 |
| 18 | - - | ① | . Valve - Needle | 1 |
| 19 | 93951 | | . Plug - Welsh | 1 |
| 20 | - - | ① | . Orifice - Main Fuel | 1 |
| 21 | - - | | . Screw - Plate | 1 |
| 22 | - - | | . Valve - Throttle | 1 |
| 23 | - - | | . Screw | 1 |
| 24 | - - | | . Lever - Throttle Adjustment | 1 |
| 25 | - - | | . Shaft Assembly - Throttle | 1 |
| 26 | - - | | . Spring - Throttle Return | 1 |

* One of three carburetors used alternately on PM 610 models. Identify carburetor before ordering service repair parts.

① Contained in Repair Kit, P/N 214959.

NOTE: Items are listed for identification and disassembly sequence purposes and only those items with part numbers or items contained included in the repair kit are available as service parts.

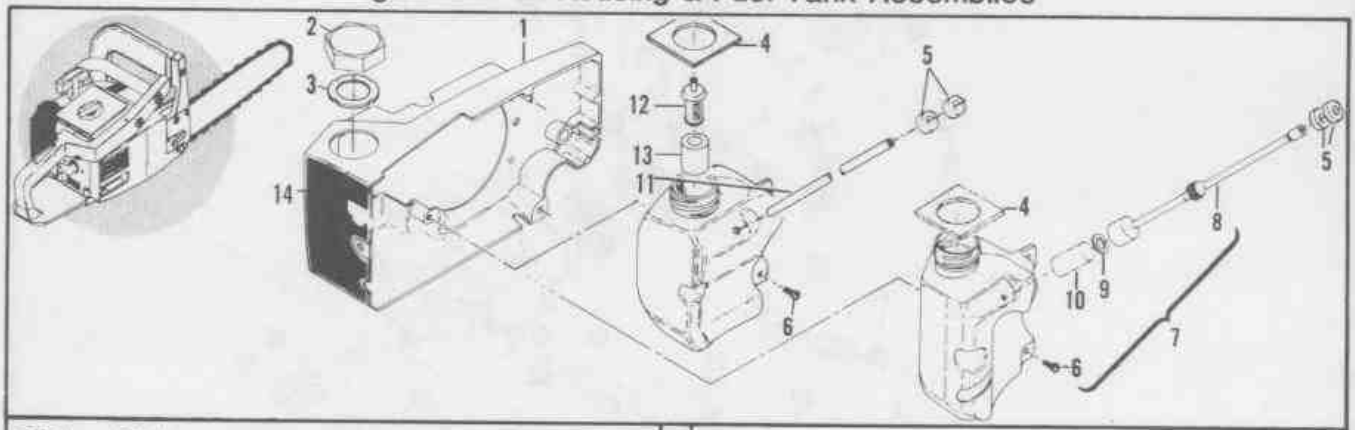
## Figure 5. CHAIN BRAKE Assembly




| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| | 217007 | CHAIN BRAKE Assembly | 1 |
| 1 | 92086 | . Snubber - Brake Housing | 1 |
| 2 | 216693 | . Screw - Pivot | 1 |
| 3 | 92216 | . Washer - Special | 1 |
| 4 | 217000 | . Lever - Brake Actuator | 1 |
| 5 | 214367 | . Pin - Assembly Roller | 1 |
| 6 | 93082 | . Pin - Band Anchor | 1 |
| 7 | 120019 | . Screw - Hx Hd M5 x 13 | 1 |

| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| 8 | 92134 | . Retainer - Spring | 1 |
| 9 | 92135 | . Spring - Actuating | 1 |
| 10 | 94144 | . Pivot - Latch | 1 |
| 11 | 94150 | . Latch Brake | 1 |
| 12 | 93081 | . Band - Brake | 1 |
| 13 | -216317 | . Housing - Brake | 1 |
| 14 | 120002 | Screw - Pan Hd M5 x 14 | 1 |
| 15 | 92178 | Stop - Chain | 1 |

## Figure 6. Fan Housing & Fuel Tank Assemblies

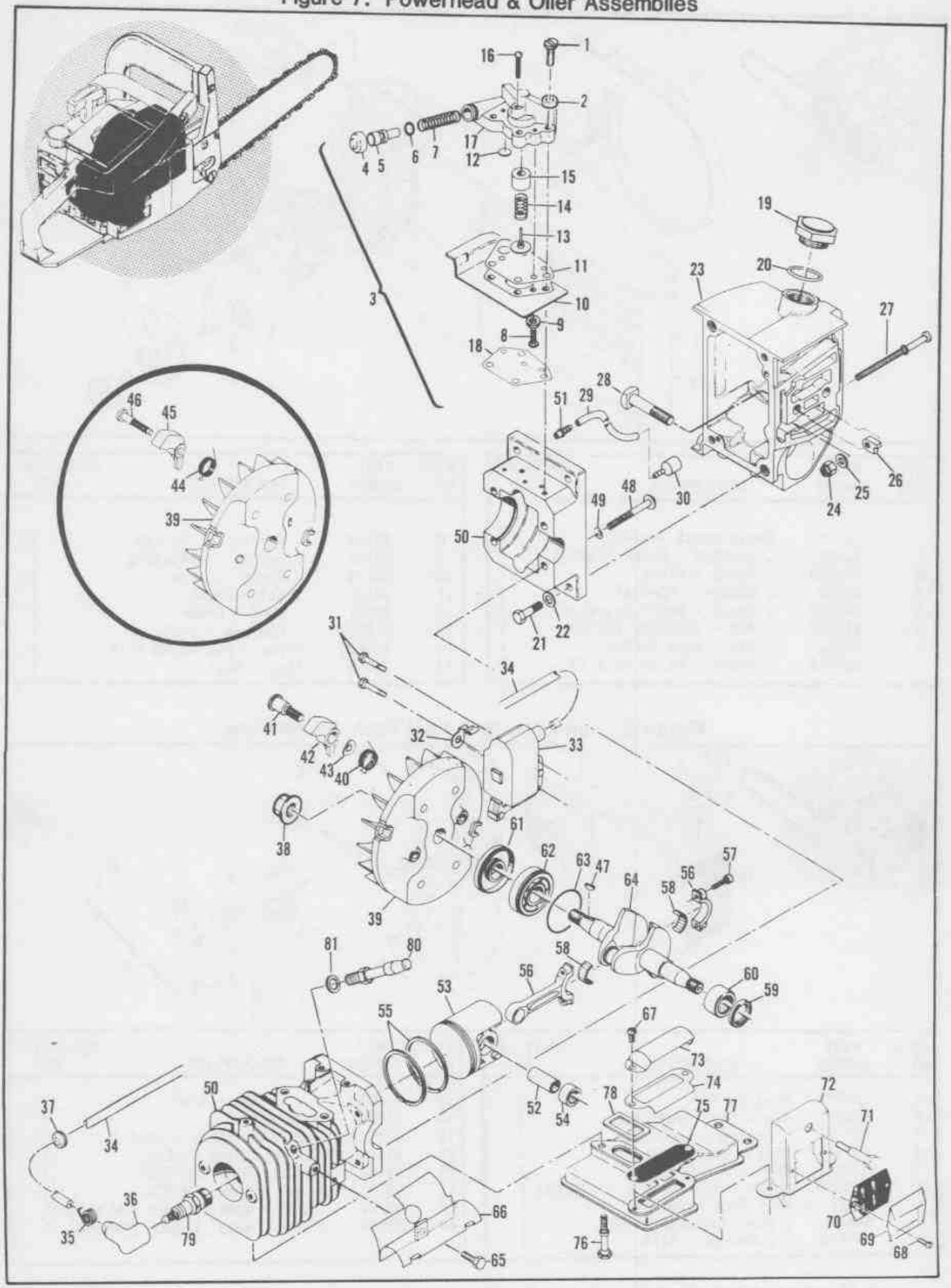



| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| 1 | 216154 | Housing Fan | 1 |
| 2 | 216157 | Cap - Fuel (vented) | 1 |
| 3 | 94707 | . Gasket - Fuel cap | 1 |
| 4 | 93251 | Seal - Fuel Vent | 1 |
| 5 | 92161 | Seal - Air Box | 2 |
| 6 | 120068 | Screw - Pan hd M4 x 12 (SEMS) | 2 |
| 7 | 94901 | ① Fuel Tank Assembly | 1 |
| 8 | 94899 | . Hose Assembly - Fuel | 1 |
| 9 | 100440 | . . Washer - 5/16 | 1 |

| ITEM NO | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| 10 | 63932 | . . Filter - Fuel | 1 |
| 11 | 91994 | ① Hose - Fuel | 1 |
| 12 | 215714 | ① Pickup Assembly - Fuel | 1 |
| 13 | 61159 | ① Filter - Fuel Pickup | 1 |
| 14 | 95184 | Plate - Name (PM 610) | 1 |
| 14 | 95185 | Plate - Name (PM 650) | 1 |
| 14 | 95196 | Plate - Name, French (PM 610) | 1 |
| 14 | 95194 | Plate - Name, French (PM 650) | 1 |

① If saw was originally equipped with Fuel Tank Assembly, P/N 93478, order individual parts as indicated. For complete replacement of Fuel Tank Assembly order P/N 94901.

Figure 7. Powerhead & Oiler Assemblies



## Figure 7. Powerhead & Oiler Assemblies.

| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| 1 | 120036 | Screw - Pan Hd M4 x 25 (SEMS) | 4 |
| 2 | 67177 | Washer - Insulating | 4 |
| 3 | 217208 | Pump Assembly - Pulse Oiler | 1 |
| 4 | -215151 | . Cap - Oil Pump | 1 |
| 5 | 93933 | . Plunger - Oil Pump | 1 |
| 6 | 105614 | . "O" Ring | 1 |
| 7 | 66687 | . Spring - Plunger | 1 |
| 8 | 110706 | . Screw - Pan Hd 8-18 x .50 | 3 |
| 9 | 216354 | . Gasket Washer | 1 |
| 10 | 217218 | . Cover - Diaphragm | 1 |
| 11 | 216992 | . Diaphragm - Oiler | 1 |
| 12 | 217217 | . Valve - Oiler | 1 |
| 13 | 91945 | . Piston Assembly - Pulse | 1 |
| 14 | 94322 | . Spring - Return | 1 |
| 15 | 91944 | . Sleeve - Oil Pump | 1 |
| 16 | 120092 | . Screw - Pan Hd M3.5 x 22 | 1 |
| 17 | 216991 | . Body Assembly - Oil Pump | 1 |
| 18 | 91950 | Gasket - Oil Pump | 1 |
| 19 | 216502 | Cap Assembly - Oil | 1 |
| 20 | 101148 | "O" Ring | 1 |
| 21 | 120006 | Screw - Hs Hd M6.3 x 24 | 4 |
| 22 | 100004 | Washer - Plain | 4 |
| 23 | 92077 | Tank Assembly - Oil | 1 |
| 24 | 110950 | . Nut - Lock | 1 |
| 25 | 102115 | . Washer - Plain | 1 |
| 26 | 91982 | . Nut - Bar ADjustment | 1 |
| 27 | 94362 | . Screw - Bar Adjustment | 1 |
| 28 | 92459 | . Bolt - Bar | 2 |
| 29 | 92616 | Hose - Oil Pickup | 1 |
| 30 | 92465 | Pickup - Oil | 1 |
| 31 | 120037 | Screw - Hx M5 x 25 (SEMS) | 2 |
| 32 | 84686A | Wire Assembly | 1 |
| 33 | 95553 | Ignition Assembly-Electronic | 1 |
| 34 | 95270 | . Wire Assembly - Spark Plug | 1 |
| 35 | 102556 | . . Connector - Spark Plug | 1 |
| 36 | 95266 | . . Boot - Spark Plug | 1 |
| 37 | 110995 | . Grommet - Spark Plug Wire | 1 |
| 38 | 94500 | Nut - Hx Flange M10 | 1 |
| 39 | 216739 ① | Flywheel/Pawl Assembly | 1 |
| 40 | 93144 | . Spring - Starter Pawl | 2 |
| 41 | 95362 | . Screw - Starter Pawl | 2 |
| 42 | 95361 | . Pawl - Starter | 2 |

| ITEM NO. | PART NUMBER | DESCRIPTION | UNITS PER ASY. |
|---|---|---|---|
| 43 | 213253 | . Washer - Spring | 2 |
| 44 | 93144 ① | Spring - Starter Pawl | 2 |
| 45 | 93145 ① | Pawl - Starter | 2 |
| 46 | 93146 ① | Pin - Starter Pawl | 2 |
| 47 | 100106 | Key - Woodruff | 1 |
| 48 | 62106 | Screw - Wsh Hd 12-24 x 1-3/4 | 4 |
| 49 | 111025 | Washer - Sealing | 4 |
| 50 | 94304 | Cyl/C'Case Assembly (PM 610) | 1 |
| 51 | 92096 | . Nipple - Oil Line | 1 |
| 50 | 94536 | Cyl/C'Case Assembly (PM 610) | 1 |
| 51 | 92096 | . Nipple - Oil Line | 1 |
| 52 | 87710 | Pin - Piston | 1 |
| 53 | 94130 | Piston Assembly | 1 |
| 54 | 111021 | . Bearing - Needle | 2 |
| 55 | 94132 | . Ring Set - Piston | 1 |
| 56 | 85352 | Rod Assembly Connecting | 1 |
| 57 | 61627A | . Screw - Connecting Rod | 1 |
| 58 | 63225 | Roller - Needle (Set of 20) | 1 |
| 59 | 110260 | Seal - Oil .625ID x .875 | 1 |
| 60 | 104357 | . Bearing - Needle | 1 |
| 61 | 67906 | Seal - Oil | 1 |
| 62 | 67905 | Bearing Ball | 1 |
| 63 | 63464 | Ring - Snap | 1 |
| 64 | 217041 | Crankshaft | 1 |
| 65 | 102762 ② | Screw - Hx Hd 10-24 x 1/2 | 1 |
| 66 | 95439 ② | Deflector Assembly - Exhaust | 1 |
| 67 | 120038 | Screw - Pan M4 x 8 | 2 |
| 68 | 216627 ③ | Screw - Pan 6-32 x .25 Tap | 2 |
| 69 | 93482 ③ | Cover - Muffler Chamber | 1 |
| 70 | 93605 ③ | Screen - Muffler | 1 |
| 71 | 93897 ③ | Screw - Muffler | 1 |
| 72 | -216524 ③ | Chamber Assembly - Muffler | 1 |
| 73 | 93604 ④ | Outlet - Muffler | 1 |
| 74 | 93481 ④ | Plate - Deflector | 1 |
| 75 | 214205 ②④ | Screen - Muffler | 1 |
| 76 | 92458 | Screw - Muffler | 1 |
| 77 | 93603 | Body/Cover Assembly - Muffler | 1 |
| 78 | 84007 | Gasket - Muffler | 1 |
| 79 | 93017 ⑤ | Spark Plug - CH - RDJ6H | 1 |
| 79 | 214223 ⑥ | Spark Plug - Ac CS 45 T | 1 |
| 80 | 214304 ⑦ | Valve - DSP | 1 |
| 81 | 214765 ⑦ | Washer - Valve | 1 |

① If saw was orignially equipped with Flywheel/Pawl Assembly, P/N 94183, order service replacement parts as indicated. For complete Flywheel/Pawl Assembly, order P/N 216739.

② Used on PM 610 models with suffix letters C, F, G, L, N, R and U. Also, PM 650 models with suffix letter D.

③ Used on PM 610 and PM 650 models with suffix letters A, B, E, H and J.

④ Used on PM 610 models with suffix letter K.

⑤ Used on PM 610 models with suffix letters A, C, F, G, H, J, K, L, N, R, and U. Also, PM 650 models with suffix letters A, D, H and J.

⑥ Used on PM 610 and PM 650 models with suffix letters B and E.

⑦ Used on PM 650 models only.

## Tools & Accessories.

| PART NUMBER | DESCRIPTION |
|---|---|
| 215432 | Pressure Test Tool |
| 63137 | Adaptor - Exhaust |
| 94415 | Adaptor - Intake |
| 110761 | Plug - D.S.P. |
| 501334 | Ignition Tester |
| 84223 | Kit - Piston Tools |
| 501222 | Piston Stop Tool |
| 95218 | Air Filter - Felt |
| 94962 | Scrench |
| 214195 | Gun - Lube (Disposable) |
| 214194 | Gun - Lube (Deluxe) |
| 85702 | Lubricant - Custom, 6 oz. Can |
| 85703 | Lubricant - Custom, 6 oz. Cans, 1 6-pak |
| 95159 | Allen Wrench - 5mm |
| 69794 | Locquic |
| 110083 | R.T.V. Sealant |
| 94121 | Kit - Carrying Case, 20" |
| 214203 | . Scabbard, 20" |
| 94367 | Kit - Carrying Case, 16" |
| 92896 | . Scabbard, 16" |
| 214208 | Kit - Spike |

## BAR and CHAIN COMBINATIONS

| PART NUMBER | DESCRIPTION |
|---|---|
| 214237 | Bar - 16" Sprocket Tip |
| 94074 | Bar - 16" Speed Mac |
| 89502 | Bar - 16" Mac 10 |
| 218061N | Chain - 16" PMR 370G |
| 89974N | Chain - 16" SPR 370G |
| 88167N | Chain - 16" PM 370G |
| 217025 | Bar - 18" Sprocket Tip |
| 218062N | Chain - 18' PMR 370G |
| 214238 | Bar - 20" Sprocket Tip |
| 93778 | Bar - 20" Speed Mac |
| 89503 | Bar - 20" Mac 10 |
| 89978N | Chain 20" SPR 370G |
| 89979N | Chain - 20" SPR 370G |

| PART NUMBER | DESCRIPTION |
|---|---|
| 88173N | Chain - 20" PM 370G |
| 86846 | Bar - 24" Speed Mac |
| 89504 | Bar - 24" Mac 10 |
| 88175N | Chain - 24" PM 370G |
| 89981N | Chain - 24" SPR 370G |
| 93551N | Chain - 24" PM 370G |
| 89982N | Chain - 24" SPR 370G |
| 86847 | Bar - 28" Speed Mac |
| 89505 | Bar - 28" Mac 10 |
| 89984N | Chain - 28" SPR 370G |
| 93552N | Chain - 28" PM 370G |
| 89985N | Chain - 28" SPR 370G |

## Service Specifications

| | |
|---|---|
| SPARK PLUG GAP. | .025 inch (.63mm) |
| LAMINATION GAP. | .011 to .015 inch (.28 to .38mm) |
| TIMING. | 26 BTDC |
| CLUTCH ENGAGEMENT SPEED | 2800 to 3000 RPM |
| IDLE SPEED. | 1800 to 2000 RPM |
| FUEL TYPE | Regular Grade Leaded |
| FUEL/OIL MIXTURE: | 40:1 w/McCulloch Oil |
| | 20:1 SAE Two Cycle |
| FUEL TANK CAPACITY. | 17.3 ounces (510 cc) |
| DISPLACEMENT. | 60 cc (3.7 cu. in.) |
| BORE and STROKE | 4.7mm x 35 mm (1.9 in. x 1.5 in.) |
| WEIGHT: PM 610. | 14.7 pounds (6.65kg) |
| PM 650. | 14.8 pounds (6.70kg) |

## Torque Values

| | |
|---|---|
| CONNECTING ROD SCREWS | 65 yo 70 pound x inches (7.3 to 7.9 N.m) |
| CLUTCH NUT. | 160 tO 170 pound x inches (18.1 to 19.2 N.m.) |
| FLYWHEEL NUT. | 265 to 325 pound x inches (29.9 to 36.7 N.m.) |

# GENERAL SERVICE INFORMATION

# McCULLOCH CORPORATION 600 SERIES SAWS

## Specifications

| | |
|---|---|
| Displacement | 60cc - 3.7 C.I.D. |
| Bore & Stroke | 47mm x 35mm (1.85in. x 1.378in.) |
| Cyl. Bore | Chrome Plated |
| Bearings: | |
| Main | Needle & Ball Bearings |
| Conn Rod | Needle |
| Piston Rings | 610 - Cast Iron |
| | 650 - Tool Steel |
| Intake System | 3rd Port Piston Timed |
| Fuel Tank Capacity | 510cc (17.2 Fluid Ounces) |
| Chain Oil Tank Capacity | 430cc (14.5 Fluid Ounces) |
| Chain Oiler Type | Manual & Auto Oiler |
| Clutch Engagement Speed | 2800 - 3000RPM |
| Idle Speed | 1800 - 2000RPM |
| Ignition | Capacitor Discharge (C.D.I.) |
| Spark Plug | A/C CS 45T (RDJ - 6 R.F.I.) |
| Weight P.U.O. (610) | 15.0 lbs. - 6.8 K.g. |
| Weight P.U.O. (650) | 15.0 lbs. - 6.8 K.g. |
| Cutter Bar:(610) | |
| Length | 16" - 20" |
| Type | Laminated Sprocket Nose |
| Chain Type (610) | PM 370G |
| Sprocket Type | Floating Rim - 7 Tooth .375 |
| Carburetor | Two Needle External Adj., Diaphragm |
| | 650 Internal Governor |
| | 10,500 - 11,500 RPM |

PRINTED IN U.S.A. 4/78

## 600 SERIES TORQUE SPECIFICATIONS

| FASTNER | TORQUE (PoundsxInches) |
|---|---|
| Conn. Rod | 65-75 |
| Crankcase to Cylinder | 70-75 |
| Spark Plug to Cylinder | 120 |
| D.S.P. Valve | 110-120 |
| Crankcase to Oil Tank | 75-80 |
| Air Box to Cylinder | 35-40 |
| Rear Shroud to Cylinder Head | 45-50 |
| Carburetor to Insulator | 35-40 |
| Fan Housing to Oil Tank | 45-50 |
| Fan Housing to Rear Shroud | 30-35 |
| Stop (Toggle) Switch Nut | 30-35 |
| Flywheel Nut | 265-325 |
| C.D.I. Lamination to Cylinder | 55-60 |
| Cover to Pulse Pump Assembly | 7-10 |
| Pulse Pump Assembly to Cylinder | 10-15 |
| Str. Drum to Str. Housing(8-18x .50)* | 25-30 |
| Str. Assembly to Fan Housing | 25-30 |
| Air Box to Rear Handle (1/4-14 S-T)* | 70-80 |
| Fuel Tank to Fan Housing | 15-20 |
| Air Box to Strut to Handle Assembly* | 25-30 |
| Handle Asy to Frame (1/4-14 S-T)* | 70-80 |
| Clutch Nut | 160-170 |
| Outlet Plate Screen to Muffler | 35-45 |
| Chamber Assembly to Muffler | 35-45 |
| Cover & Screen to Chamber | 25-35 |
| Chamber Assembly to Cylinder | 55-60 |
| Muffler to Cylinder | 65-75 |
| Lower Shroud to Muffler to Oil Tank | 45-50 |
| Lower Shroud to Rear Cylinder Shroud | 45-50 |

*Do not use Loctite on these fasteners

## REGULAR HAND TOOLS

| | METRIC SIZE - OR THE - STANDARD EQUIVALENT | |
|---|---|---|
| 1. | 8mm Wrench | 5/16" |
| 2. | 10mm Wrench | No Equivalent Size |
| 3. | 11mm Deep Wrench | 7/16" Deep |
| 4. | 13mm Wrench | 1/2" |
| 5. | 14mm Wrench | 9/16" |
| 6. | 17mm Wrench | 11/16" |
| 7. | Plastic or Rubber Mallet | |
| 8. | Small Drift Pin | |
| 9. | Ratchet 3/8" Drive | |
| 10. | Pliers (Needle Nose or Duck Bill) | |
| 11. | Small Phillips Screwdriver | |
| 12. | Small Standard Screwdriver | |
| 13. | Large Standard Screwdriver | |
| 14. | 3/8" to 1/4" Adaptor | |
| 15. | 6" - 1/4" Drive Extension | |
| 16. | Feel Gauges (.011-.015) | |
| 17. | Allen Wrench - 9/64 | |
| 18. | Allen Wrench - 3/16 | |

## SPECIAL TOOLS

| | | |
|---|---|---|
| 1. | Pressure Test Tool | P/N 90533 |
| 2. | Exhaust Adaptor | P/N 63137 |
| 3. | Intake Adaptor | P/N 94415 |
| 4. | Stopper - Pressure Test | P/N 85230 |
| 5. | Connector - Pressure Test | P/N 85231 |
| 6. | D.S.P. Plug | P/N 110761 |
| 7. | Kit - Piston Tools | P/N 84223 |
| 8. | Loctite | P/N 67537 |
| 9. | Locquic | P/N 69794 |
| 10. | R.T.V. | P/N 110083 |
| 11. | Piston Stop Tool | P/N 501222 |
| 12. | Wico Ignition Tester | P/N 501334 |

BEFORE WE GO INTO ANY OF THE 600 SERIES SERVICE PROCEDURES, LET'S TALK ABOUT YOUR SAFETY.* WE RECOMMEND YOU ALWAYS WEAR EYE PROTECTION WHEN WORKING ON OR OPERATING CHAIN SAWS. ALSO!!!

1. USE HARD HATS WHEN CUTTING.
2. WEAR EAR PROTECTION.
3. OPERATE SAWS IN A WELL VENTILATED AREA.
4. WEAR TIGHT FITTING CLOTHES & SUBSTANTIAL SHOES, SUCH AS BOOTS.
5. USE WORK GLOVES AT ALL TIMES WHEN HANDLING CHAIN.
6. USE CAUTION WHEN RE-FUELING THE CHAIN SAW.
7. EMPTY FUEL TANK AND OIL TANKS BEFORE SERVICING THESE OR ASSOCIATED ITEMS.

FOLLOW THE MANUFACTURER'S INSTRUCTIONS WHEN USING ANY SOLVENTS OR ADHESIVES.

1. LOCTITE P/N 67537
2. LOCQUIC P/N 69794
3. R.T.V. P/N 110083

NOW LET'S LOOK AT THE SERVICE FEATURES OF THE 600 SERIES SAWS. FIRST,HERE ARE ALL THE REGULAR HAND TOOLS NEEDED TO SERVICE ALL THE 600 SERIES UNITS, AS YOU CAN SEE IT'S JUST A HANDFUL. ALTHOUGH MOST OF THE FASTENERS USED ON THE 600 SERIES ARE METRIC, STANDARD SIZE WRENCHES CAN BE SUBSTITUTED FOR USE ON ALL METRIC FASTENERS EXCEPT 10mm. Ⓑ Ⓐ

ACCESS CAN BE GAINED TO ALL OF THE MAJOR ASSEMBLIES ON THE 600 SERIES SAWS WITH THESE THREE TOOLS.Ⓚ

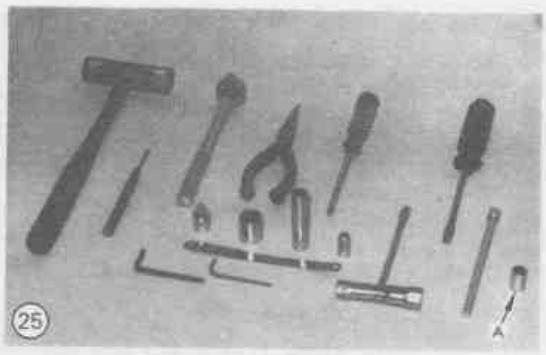
THE CHAIN BRAKE, AIR FILTER,AIR FILTER COVER, THE STARTER, AND THE WHOLE FAN HOUSING CAN BE REMOVED WITH THE TOOLS IN THE PREVIOUS PHOTO(THE ONLY NEED FOR THE PLIERS IS TO DISCONNECT THE FUEL HOSE).Ⓓ

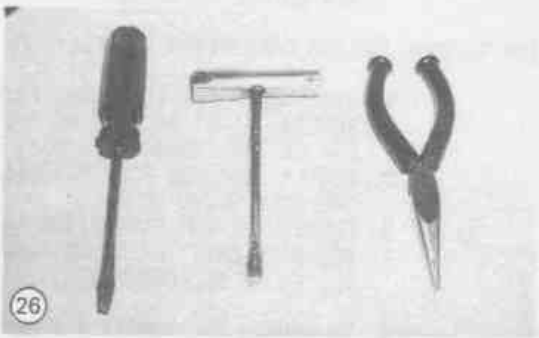
WITH THE AIR FILTER AND COVER REMOVED WE HAVE EXPOSED THE CARBURETOR, THE OILER ASSEMBLY, AND THE TOP SHOCK MOUNTS.Ⓜ

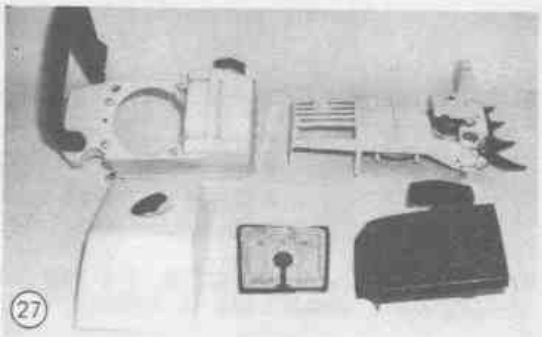
WITH THE STARTER AND FAN HOUSING ASSEMBLY REMOVED WE HAVE EXPOSED THE ELECTRONIC IGNITION SYSTEM, THE FLYWHEEL, AND THE STOP SWITCH ASSEMBLY.Ⓢ

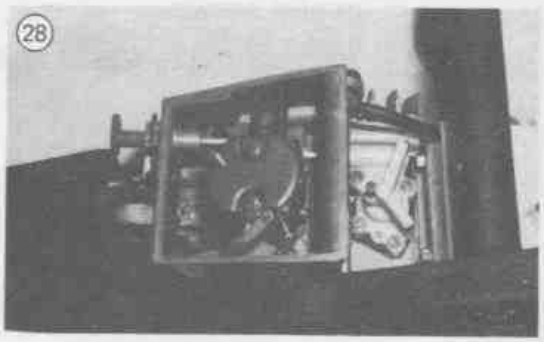
*REFER TO YOUR PM 610/650 OWNER'S MANUAL FOR ADDITIONAL SAFETY INSTRUCTIONS AS THEY MIGHT APPLY TO THE REPAIR OR OPERATION OF CHAIN SAWS.

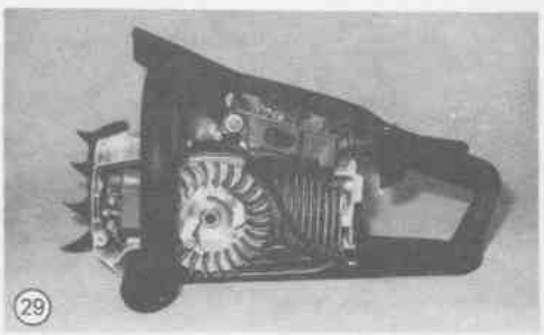
NOTE: THIS GENERAL SERVICE INFORMATION IS DERIVED FROM THE PRO MAC 610/650 SERVICE TRAINING SCRIPT/SLIDE PRESENTATION. THE INTRODUCTORY INFORMATION FROM THAT PROGRAM (INCLUDING PHOTOS 1-24) HAS BEEN LEFT OUT OF THIS MANUAL. THE PHOTO CALL-OUTS WILL BEGIN AT 25, AND WILL CORRESPOND TO PHOTOS 25-104 IN THE SLIDE PROGRAM.


(25)


(26)


(27)


(28)


(29)

WITH THE CHAIN BRAKE REMOVED WE HAVE GAINED ACCESS TO THE SPARK ARRESTOR SCREEN, THE D.S.P., THE CLUTCH AND UNDERLYING ASSEMBLY, AND THE BOTTOM SHOCK MOUNT. WE WILL COVER THE REMOVAL AND SERVICE PROCEDURE FOR EACH OF THE MAJOR ASSEMBLIES, BEGINNING WITH THE CARBURETOR OR THE TOP OF THE 600 SERIES SAWS. ⑳

THE FIRST OPERATION WILL BE TO REMOVE THE BAR AND CHAIN (WHICH IS NOT PICTURED), THEN REMOVE THE AIR FILTER COVER AND FILTER. ㉑

1. THE AIR FILTER COVER IS PART OF THE AIR INTAKE SYSTEM AND WAS DESIGNED TO REDUCE AIR INTAKE NOISE. Ⓐ

FOR REMOVAL OF THE CARBURETOR ASSEMBLY. ㉒

1. DISCONNECT THE FUEL HOSE FROM THE CARBURETOR FIRST BECAUSE OF THE VERY TIGHT FIT OF THE TYGON FUEL HOSE.
2. GENTLY SEAT THE FUEL MIXTURE NEEDLES, AND THE IDLE SPEED SCREW.
3. REMOVE THE TWO CARBURETOR HOLD DOWN SCREWS.
4. YOU CAN LEAVE THE CHOKE PLATE, COTTER PIN, AND CHOKE ROD CONNECTED.

5. TO UNHOOK THE THROTTLE ROD, AS YOU ARE LIFTING THE CARBURETOR OUT OF THE AIR BOX ROTATE THE CARBURETOR CLOCKWISE. THIS WILL DISCONNECT THE THROTTLE ROD.

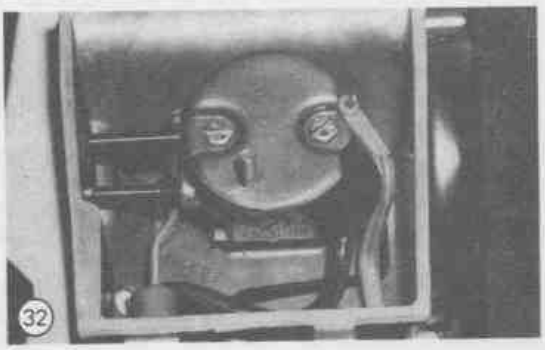
WITH THE ENTIRE ASSEMBLY REMOVED FROM THE AIR BOX. ㉓

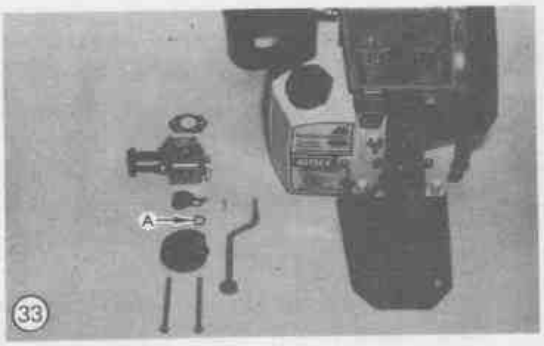
1. THIS WASHER/SPACER MUST BE IN PLACE TO PREVENT THE CHOKE PLATE FROM BINDING ON THE AIR CLEANER BRACKET WHEN THE CARBURETOR HOLD DOWN SCREWS ARE TIGHTENED. Ⓐ

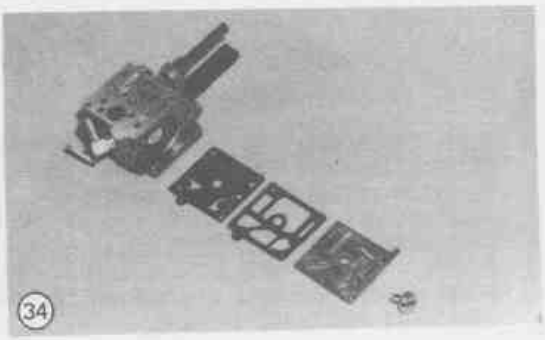
BY REMOVING THIS SINGLE SCREW, THE FUEL PUMP COVER, GASKET, AND DIAPHRAGM CAN BE REMOVED. ㉔

1. THE MAIN PROBLEMS TO LOOK FOR ARE TORN OR BENT GASKETS.
2. A HOLE IN THE DIAPHRAGM.
3. A BENT OR CURLED FLAPPER VALVE.



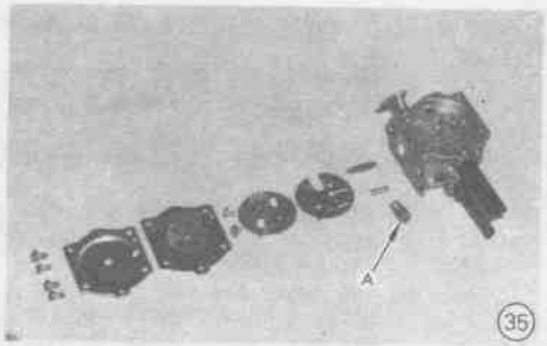


WITH THE METERING DIAPHRAGM COVER REMOVED WE CAN INSPECT THE METERING DIAPHRAGM AND GASKET FOR THE SAME PROBLEMS AS NOTED FOR THE FUEL PUMP. ALSO, Ⓗ

1. BY REMOVING TWO SCREWS WE CAN REMOVE THE CIRCUIT PLATE ASSEMBLY, GASKET, INLET NEEDLE, AND SPRING.
2. THE GOVERNOR ASSEMBLY CONTAINS A SPRING LOADED CHECK BALL THAT UNSEATS BETWEEN 10,500 and 11,500 R.P.M.ALLOWING UNMETERED FUEL TO ENTER THE HIGH SPEED SYSTEM, CREATING A RICHER CONDITION WHICH LIMITS THE ENGINE R.P.M.'S. YOU CAN ONLY CLEAN THE BALL; REPLACE THE SYSTEM IF CLEANING IS INEFFECTIVE. Ⓐ

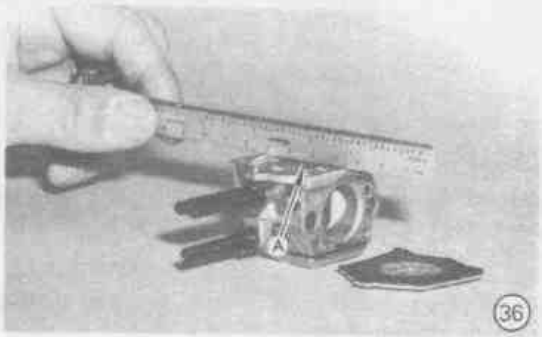


35

WE WILL GO INTO CARBURETOR PRESSURE CHECKING LATER IN THIS MANUAL.

TO CHECK THE INLET LEVER SETTING. Ⓗ

1. USE A STRAIGHT EDGE ACROSS THE CARBURETOR CASTING.
2. THE INLET LEVER SETTING SHOULD BE .005 BELOW CASTING OR .010 ABOVE CIRCUIT PLATE. Ⓐ



36

TO REASSEMBLE THE CARBURETOR FOLLOW THE REVERSE ORDER OF DISASSEMBLY.

TO REMOVE THE OILER ASSEMBLY. Ⓘ

1. DISCONNECT THE OILER ROD BY REMOVING THE RETAINING CLIP ON THE AIR BOX.
2. REMOVE THE FOUR OILER HOLD DOWN SCREWS AND LIFT THE ASSEMBLY OFF THE CYLINDER.


37

WITH THE OILER ASSEMBLY REMOVED, YOU CAN SEE THAT THE WHOLE ASSEMBLY CAN BE REMOVED BY FOLLOWING THE ABOVE STEPS WITHOUT REMOVING THE CARBURETOR. Ⓘ

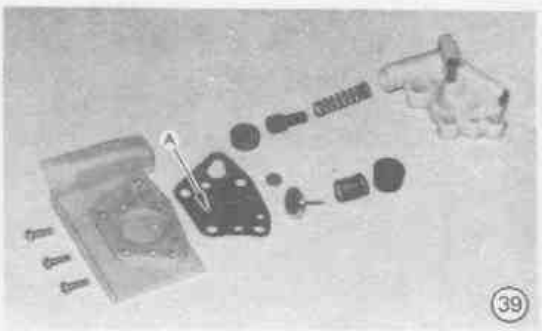
1. THIS GASKET GOES BETWEEN THE CYLINDER AND THE OILER ASSEMBLY. Ⓐ
2. THE AIR BOX SEAL FITS OVER THE MANUAL OILER CAP AND BETWEEN THE AIR BOX AND CAP WHICH SEALS THE AIR BOX AND OILER ROD HOLE.

TURN THE OILER ASSEMBLY OVER AND REMOVE THE THREE SCREWS SECURING THE DIAPHRAGM AND DIAPHRAGM COVER TO THE OILER BODY. Ⓗ

1. WITH THE COVER REMOVED WE HAVE ACCESS TO ALL OF THE INTERNAL COMPONENTS OF THE AUTOMATIC OILER. NOTE THE AIR VENT HOLE CENTERED IN THE DIAPHRAGM. Ⓐ
2. WITH THE MANUAL OILER CAP REMOVED WE ALSO HAVE ACCESS TO ALL OF THE MANUAL OILER COMPONENTS.
3. THESE ARE THE ONLY SERVICABLE PARTS OF THE OILER SYSTEM.

38

TO REASSEMBLE THE OILER FOLLOW THE REVERSE ORDER OF DISASSEMBLY. LATER IN THE PROGRAM WE WILL GO INTO THE CHECKING OF THE MANUAL SYSTEM AND THE PRESSURE CHECKING OF THE AUTOMATIC SYSTEM.



39

THE AIR BOX AND HANDLE ASSEMBLY CAN BE REMOVED IN ONE PIECE BY:㊵

1. REMOVING THE THREE AIR BOX HOLD SCREWS.
2. REMOVING THE TOP HANDLE SCREW.

WITH THE AIR BOX AND HANDLE ASSEMBLY REMOVED WE CAN SEE THAT:㊶

1. THE TWO LONGEST AIR BOX HOLD DOWN SCREWS ALSO SECURE THE INSULATORS AND GASKETS TO THE CYLINDER.
2. THE SHORT AIR BOX SCREW HAS A STAINLESS STEEL SPACER BETWEEN THE CYLINDER AND THE AIR BOX. THIS STAINLESS STEEL SPACER IS NECESSARY TO REDUCE HEAT TRANSFER FROM THE CYLINDER TO THE AIR BOX.Ⓐ
3. WITH THE AIR BOX REMOVED THE INSULATORS AND GASKETS CAN NOW BE SERVICED.

THE GASKETS AND INSULATORS ARE SHOWN IN THEIR ORDER OF DISASSEMBLY.㊷

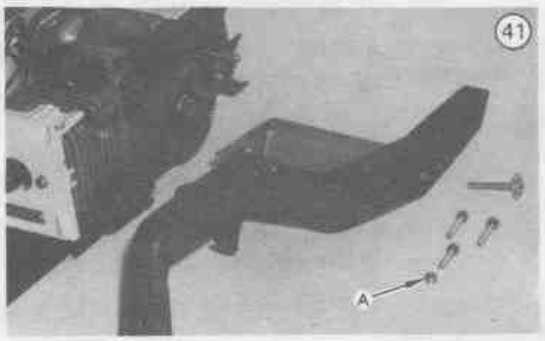
WE HAVE NOW COMPLETED THE DISASSEMBLY OF THE TOP OF THE 600 SERIES SAWS AND WE WILL NOW MOVE TO THE STARTER SIDE OF THIS UNIT.

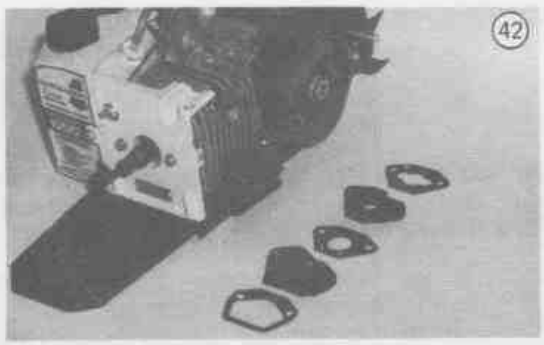
BY REMOVING THESE FOUR SCREWS WE HAVE REMOVED THE ENTIRE STARTER ASSEMBLY.㊸

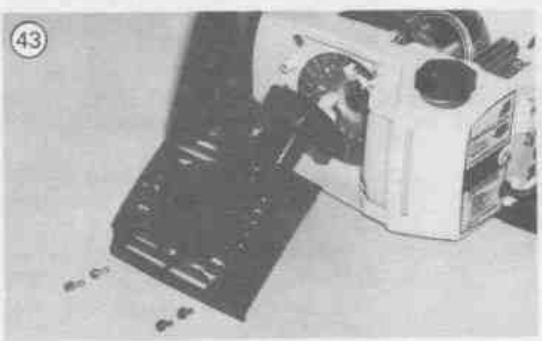
1. NOTE: THE DIFFERENT LENGTHS OF THE SCREWS.
2. THE TWO LONGEST SCREWS MOUNT UNDER HANDLE FRAME.
3. THE TWO SHORTER SCREWS MOUNT ON THE FUEL TANK SIDE OF THE STARTER.
4. ALSO NOTE HOW THE STARTER HANDLE STANDS UPRIGHT WITH THE PROPER SPRING TENSION.

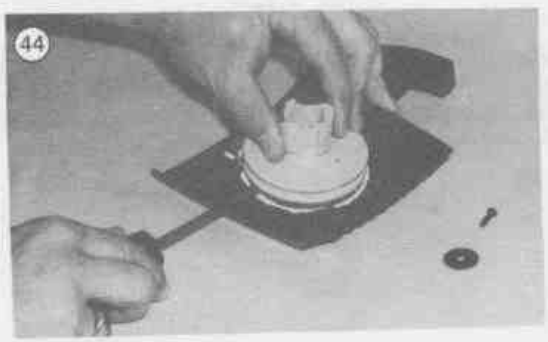
TO DISASSEMBLE THE STARTER ASSEMBLY.㊹

1. USE CARE WHEN WORKING ON THE STARTER BECAUSE OF THE TENSION OF THE STARTER SPRING.
2. UNWIND A COUPLE OF WRAPS OF ROPE TO RELIEVE MOST OF THE SPRING TENSION.
3. REMOVE THE PULLEY SCREW AND WASHER, CAREFULLY LIFT UP ON THE PULLEY WHILE HOLDING THE SPRING WITH A SCREWDRIVER UNTIL THE SPRING DISENGAGES FROM THE PULLEY. ROPE, SPRING, AND PULLEY CAN NOW BE REPLACED.

NOTICE HOW AND WHERE THE SPRING IS LOCATED IN THE STARTER HOUSING, AND HOW IT ENGAGES ON THE PULLEY. ⑮

TO RE-ASSEMBLE

1. SET THE SPRING IN POSITION IN THE HOUSING.
2. POSITION RAMP ON PULLEY SO THAT IT LINES UP WITH THE CURLED END OF THE SPRING. PUSH DOWN AND ROTATE THE PULLEY BACK AND FORTH UNTIL THE SPRING ENGAGES ON THE PULLEY. INSTALL SCREW AND WASHER (DO NOT USE LOCTITE ON THE SCREW) AND DO NOT OVER TORQUE (25 TO 30 INCH POUNDS).
3. TURN THE PULLEY COUNTER-CLOCKWISE UNTIL THE ROPE IS COMPLETELY WOUND ONTO THE PULLEY.
4. PULL OUT ENOUGH ROPE TO ENABLE YOU TO ROTATE THE ROPE AND PULLEY ONE TURN CLOCKWISE. THIS WILL SET THE PROPER SPRING TENSION, THE HANDLE SHOULD BE STANDING UPRIGHT. IF THE HANDLE DOES NOT STAND UPRIGHT OR SAGS, WIND ANOTHER TURN ON PULLEY.

THERE ARE FOUR SCREWS SECURING THE FAN HOUSING TO THE CYLINDER ASSEMBLY, REMOVE THE FOUR SCREWS. ⑯

1. YOU DO NOT HAVE TO REMOVE THE WRAP AROUND CHAIN BRAKE HANDLE TO REMOVE THE FAN HOUSING.
2. THE FUEL TANK IS PART OF THE FAN HOUSING AND WILL COME OFF WITH THE FAN HOUSING.

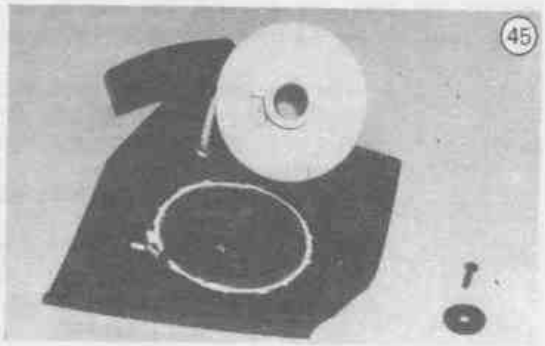
WITH THE FOUR SCREWS REMOVED. ⑰

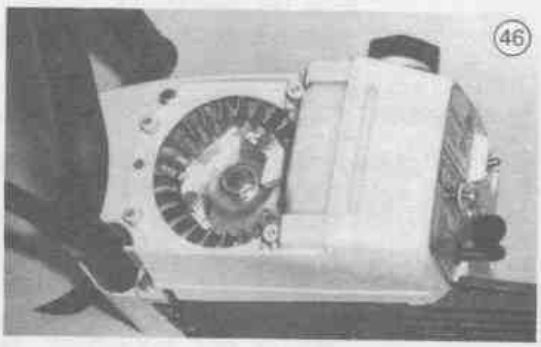
1. LIFT UP ON THE FAN HOUSING ASSEMBLY TO CLEAR IT FROM THE CYLINDER.

TURN THE FAN HOUSING SO THAT YOU CAN THREAD THE WRAP AROUND CHAIN BRAKE HANDLE THROUGH THE FRONT FRAME. ⑱

WITH THE COMPLETE FAN HOUSING ASSEMBLY REMOVED. ⑲

1. ALL FOUR SCREWS ARE DIFFERENT LENGTHS; BE CERTAIN TO REASSEMBLE IN PROPER LOCATION
2. THESE ARE THE AIR BOX SEALS THAT SEAL THE AIR BOX FUEL HOSE HOLE. Ⓐ
3. TO DISASSEMBLE THE COMPONENTS, REMOVE THE WRAP AROUND HANDLE WITH AN ALLEN WRENCH AND TURN THE FAN HOUSING OVER.






REMOVE THE FUEL CAP AND THE TWO SCREWS SECURING THE FUEL TANK TO THE FAN HOUSING AND REMOVE THE FUEL TANK. (50)

1. YOU CAN SERVICE THE FUEL PICK-UP WITHOUT REMOVING THE FAN HOUSING, BUT TO REPLACE THE FUEL HOSE YOU MUST REMOVE THE FAN HOUSING.
2. THE CAP ON THE 600 SERIES HAS A VENT IN BOTH THE IN AND OUT VENT. THE FELT ON THE FUEL TANK IS A CUSHION BETWEEN THE TANK AND THE FAN HOUSING THAT ASSURES A TIGHT FIT AND WILL ABSORB A SMALL AMOUNT OF FUEL SPILLAGE.
3. WHEN REPLACING A FUEL HOSE THREAD IT IN FROM THE OUTSIDE OF THE TANK FIRST, LEAVING SLIGHTLY UNDER 4 3/4" TO THE OUTSIDE OF THE TANK.

TO RE-ASSEMBLE FOLLOW REVERSE ORDER OF DISASSEMBLY.

WITH THE FAN HOUSING ASSEMBLY REMOVED WE HAVE NOW EXPOSED THE ELECTRONIC IGNITION AND FLYWHEEL ASSEMBLIES, AS WELL AS THE STOP SWITCH AND HIGH TENSION LEAD WIRES. (51)

TO REMOVE THE FLYWHEEL:

1. REMOVE THE SPARK PLUG AND INSERT THE PISTON STOP TOOL P/N 501222. INSTALL THE PISTON STOP TOOL COMPLETELY INTO THE CYLINDER, FINGER TIGHT (DO NOT USE IMPACT WRENCH). (A)
2. ROTATE THE FLYWHEEL UNTIL THE PISTON MAKES CONTACT WITH THE PISTON STOP TOOL.

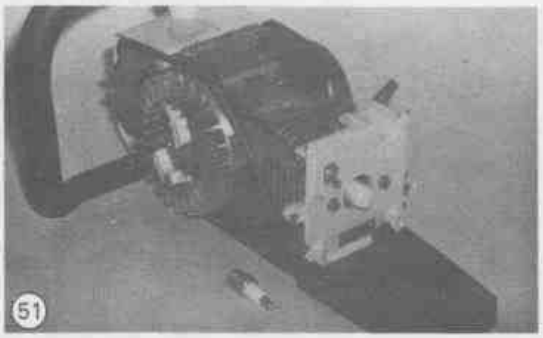
THE FLYWHEEL NUT AND FLYWHEEL CAN NOW BE REMOVED. DO NOT USE ANY IMPACT TOOL FOR FLYWHEEL NUT REMOVAL (TO PREVENT DRIVING THE PISTON AGAINST THE PISTON STOP TOOL, DAMAGING THE PISTON ASSEMBLY). (52)

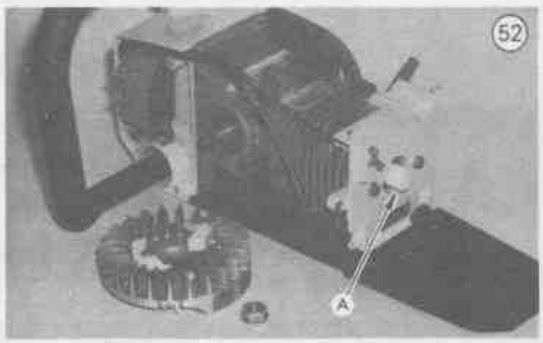
1. TAP THE FLYWHEEL GENTLY WITH A PLASTIC OR RUBBER MALLET ON THE COUNTERWEIGHT SIDE, NOT ON THE FINS, TO BREAK IT LOOSE FROM THE CARBURETOR.

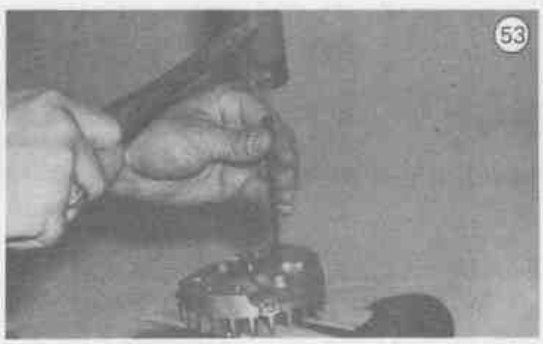
TO REMOVE AND REPLACE THE FLYWHEEL COMPONENTS, PAWL AND SPRING ASSEMBLIES, (53)

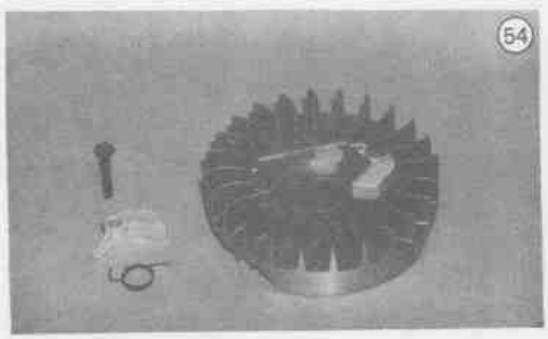
1. SUPPORT THE FLYWHEEL FINS ON A SOFT MATERIAL, SUCH AS WOOD (DO NOT SUPPORT DIRECTLY ON A VISE).
2. TAP OUT THE PAWL PIN FROM THE FLYWHEEL WITH A DRIFT PIN.

WITH THE COMPONENTS REMOVED ANY OR ALL CAN BE REPLACED. THEY ARE IN SEQUENCE OF DISASSEMBLY. (54)

TO REINSTALL THE SPRING, PAWL AND PAWL PIN, ⑭

1. CLEAN THE PIN AND PIN HOLES WITH LOCQUIC AND LOCTITE THE SCREW.
2. TAP THE PIN IN TO JUST BEFORE FLUSH WITH THE PAWL (IF THE PIN IS DRIVEN IN TOO FAR THE PAWL WILL BIND) CHECK TO SEE THAT THE PAWL IS FREE.

WITH THE FLYWHEEL COMPONENTS REPLACED, REINSTALL THE FLYWHEEL ONTO THE CRANKSHAFT. ⑮

1. THE PISTON STOP TOOL IS STILL IN THE PLUG HOLE.
2. THE SLOT IN THE FLYWHEEL IS ALIGNED WITH THE KEY IN THE CRANKSHAFT.
3. TURN THE FLYWHEEL UNTIL THE PISTON MAKES CONTACT WITH THE PISTON STOP TOOL.
4. INSTALL FLYWHEEL NUT AND TORQUE THE FLYWHEEL TO 265-325 INCH POUNDS (DO NOT USE IMPACT WRENCH).

TO REMOVE THE IGNITION ASSEMBLY, ⑯

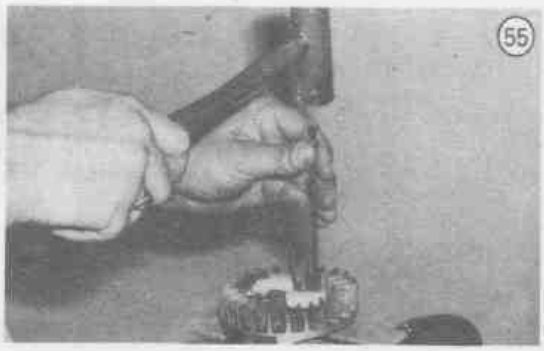
1. DISCONNECT THE SPARK PLUG WIRE AND THE STOP SWITCH WIRE.
2. REMOVE THE TWO SCREWS SECURING THE IGNITION ASSEMBLY TO THE CYLINDER.

WITH THE COMPLETE IGNITION REMOVED ANY OR ALL WIRES,OR THE ASSEMBLY ITSELF CAN BE REPLACED. ⑰

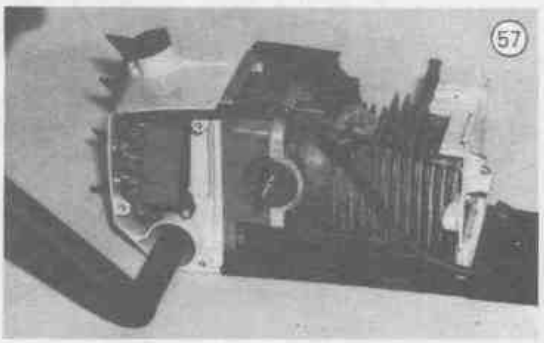
1. WE WILL COVER THE TESTING OF THE IGNITION ASSEMBLY LATER IN THE PROGRAM.
2. REINSTALL THE IGNITION ASSEMBLY WITH THE TWO SCREWS, BUT DO NOT TIGHTEN THEM.

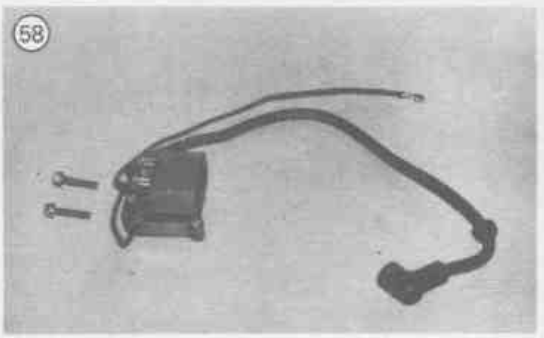
PLACE A .011-.015 FEELER GAUGE BETWEEN THE IGNITION ASSEMBLY LAMINATION LEGS AND THE MAGNETS ON THE FLYWHEEL. ⑱

1. PUSH THE IGNITION ASSEMBLY TOWARD THE FLY-WHEEL AND TIGHTEN THE TWO C.D.I. HOLD DOWN SCREWS.
2. THE PHOTO SHOWS A CHECK OF THE LAMINATIONS AT ONE LEG OF THE C.D.I.








WITH THE OILER ASSEMBLY, IGNITION ASSEMBLY, AND FLYWHEEL INSTALLED, ⑩

1. THIS PHOTO SHOWS THE CORRECT ROUTING OF THE SPARK PLUG AND STOP SWITCH WIRES, THEY SIT ON TOP OF THE OILER DIAPHRAGM PLATE TO ALLOW PROPER CLEARANCE FROM THE FLYWHEEL.

WE HAVE NOW COMPLETED THE STARTER SIDE OF THE 600 AND WE WILL MOVE TO THE CLUTCH SIDE.

TO REMOVE THE CLUTCH AND UNDERLYING COMPONENTS, ⑪

1. INSTALL THE PISTON STOP TOOL, OR YOU CAN USE THE 10-10 CLUTCH HOLDING TOOL.
2. REMOVE THE NUT (REMEMBER THE NUT ON THE CLUTCH SIDE IS A LEFT HAND THREAD).

BY REMOVING THE CLUTCH NUT ALL OF THE UNDERLYING COMPONENTS CAN BE REMOVED OR REPLACED. ⑫

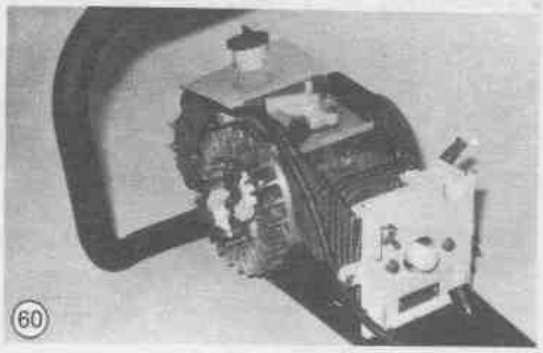
1. WITH THE CLUTCH ASSEMBLY REMOVED WE HAVE ACCESS TO THE BAR ADJUSTMENT COMPONENTS.

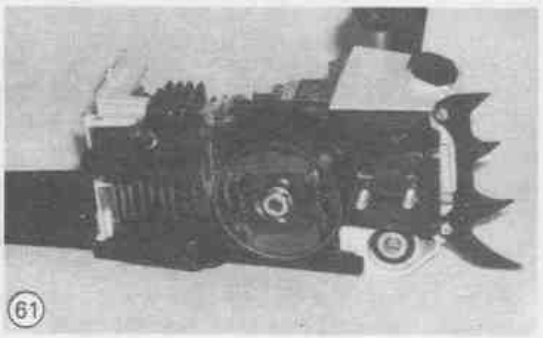
TO REPLACE OR REPAIR THE CLUTCH SHOES,ROTOR,RETAINERS,OR SPRINGS, ⑬

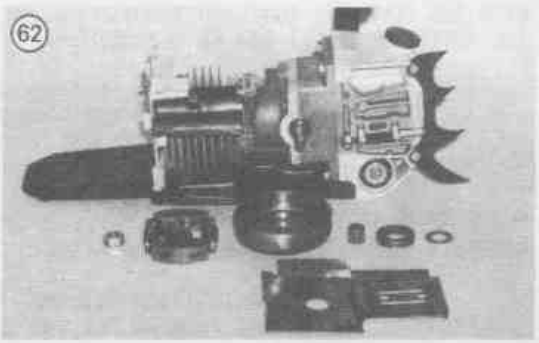
1. SECURE THE CLUTCH ASSEMBLY IN A VISE.
2. WITH A SMALL SCREWDRIVER,PRY THE SPRING OFF OF THE CLUTCH SHOE(BE VERY CAREFUL WHEN REMOVING OR REPLACING THE CLUTCH SPRING).

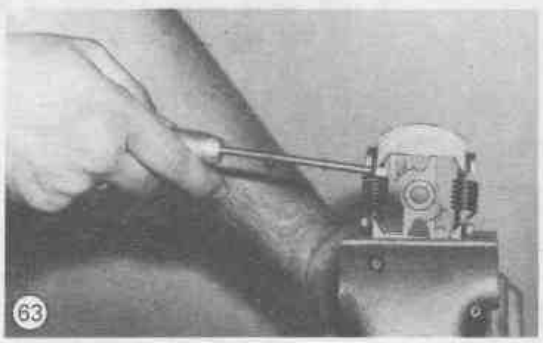
WITH THE SPRING AND RETAINER REMOVED FROM ONE SIDE THE TENSION HAS BEEN RELEASED AND THE OPPOSITE SIDE WILL BE EASIER TO REMOVE. ⑭

1. ANY OR ALL COMPONENTS CAN BE REPLACED.


60


61


62


63


64

TO RE-INSTALL THE CLUTCH SPRING AND RETAINER, ⑱

1. PUT THE RETAINER THROUGH THE SPRING, AND CONNECT THE BOTTOM HALF OF THE SPRING TO THE SHOE.
2. WITH THE RETAINER IN POSITION,CAREFULLY PRY THE TOP HALF OF THE SPRING ONTO THE CLUTCH SHOE.

REASSEMBLE THE REMAINDER OF THE COMPONENTS IN THE REVERSE ORDER OF DISASSEMBLY.

WITH ALL OF THE COMPONENTS REASSEMBLED AND WITH THE PISTON STOP TOOL IN POSITION, ⑱

1. TORQUE THE CLUTCH NUT TO 160-170 INCH POUNDS (DO NOT USE IMPACT WRENCH).

WE HAVE NOW COMPLETED THE CLUTCH SIDE OF THE 600 SERIES, AND WE WILL NOW MOVE TO THE BOTTOM COMPONENTS.

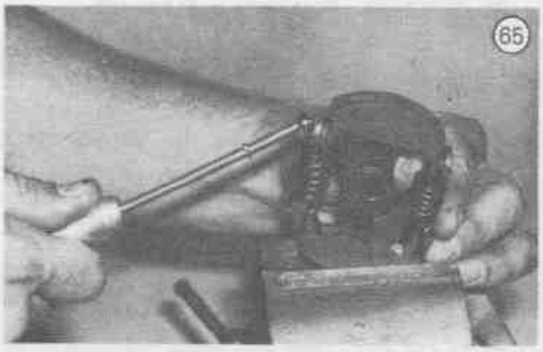
TO GAIN ACCESS TO THE MUFFLER WE MUST REMOVE THE BOTTOM SHROUD. ⑱

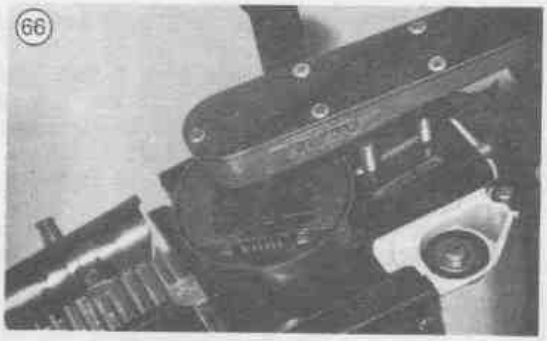
1. THE BOTTOM SHROUD IS SECURED BY FOUR SCREWS.
2. BY REMOVING THE FOUR SCREWS WE HAVE EXPOSED THE TWO MUFFLER HOLD DOWN SCREWS.Ⓐ

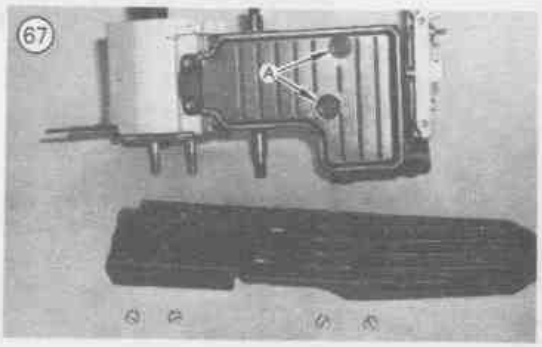
BY REMOVING THE TWO MUFFLER SCREWS, ⑱

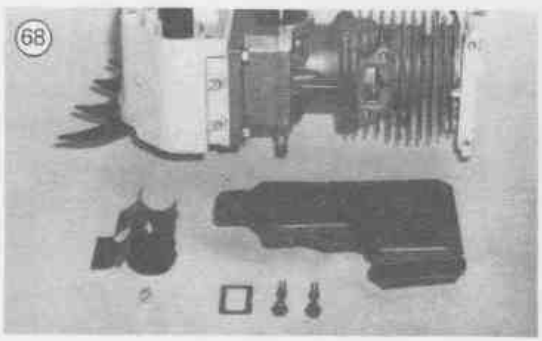
1. WE CAN NOW INSPECT THE MUFFLER AND GASKET.
2. WE ALSO CAN PERFORM AN INTERNAL INSPECTION OF THE CYLINDER ASSEMBLY.
3. NOTICE THE UNIQUE SHAPE OF THE EXHAUST PORT. IT IS CALLED THE "Q" PORT.

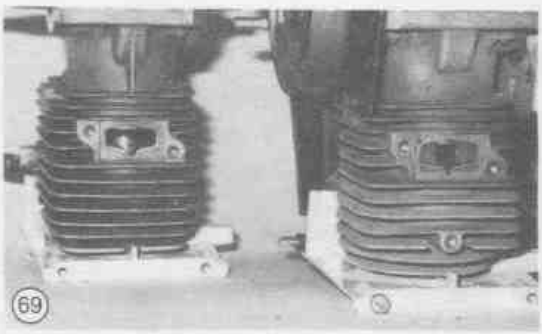
   A. THE "Q" PORT HAS BEEN DESIGNED TO ⑱ AID IN THE REDUCTION OF NOISE.
   B. IT ALSO ACTS AS A SLIGHT COMPRESSION RELEASE DURING STARTING.



BY REMOVING THESE TWO SCREWS, ⑱

1. YOU CAN REPLACE THE CYLINDER SHROUD.

THESE TWO STAINLESS STEEL SPACERS FIT BETWEEN THE CYLINDER AND SHROUD AND AID IN THE REDUCTION OF HEAT TRANSFER. ⑰ Ⓐ

THE OIL TANK ASSEMBLY AND HANDLE FRAME CAN BE REMOVED IN ONE PIECE BY, ⑯

1. REMOVING THESE FOUR OIL TANK SCREWS.

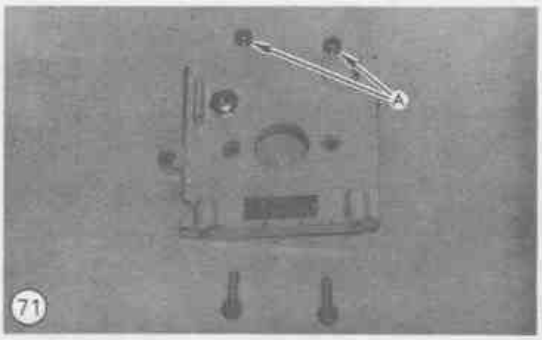
WITH THE OIL TANK AND HANDLE REMOVED, ⑮

1. WE HAVE ACCESS TO THE OILER PICK-UP HOSE.
2. R.T.V. IS USED AS SEALANT FOR OIL TANK TO CRANKCASE (THE PRODUCTION OIL TANKS ARE NOT PAINTED ON THE SEALING SURFACE).
3. BE CAREFUL NOT TO PLUG BAR PAD OIL OUTLET HOLE WITH R.T.V.
4. WE HAVE ACCESS TO FOUR C/C BOLTS.

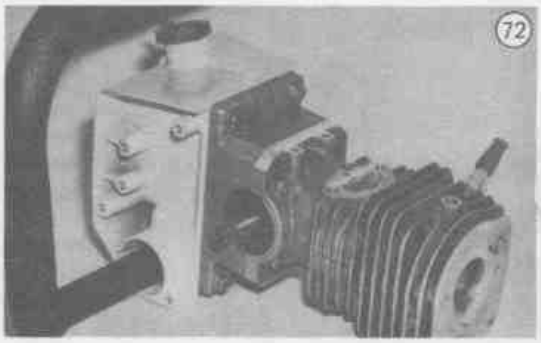
BY REMOVING THESE FOUR CRANKCASE BOLTS WE HAVE NOW GAINED ACCESS TO ALL OF THE INTERNAL COMPONENTS. ⑭

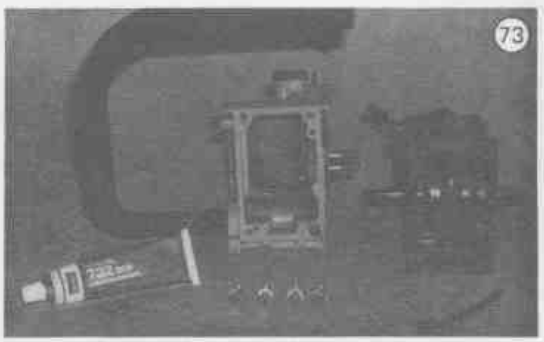
1. WHERE THE C/C BOLTS MOUNT TO THE CYLINDER (MAKE SURE THE SEALING WASHERS ARE IN GOOD CONDITION) APPLY R.T.V. TO THE C/C BOLTS.


70



71


72


73


74

THIS PHOTO SHOWS THE ENTIRE INTERNAL COMPONENTS Ⓡ DISASSEMBLED IN THE CORRECT SEQUENCE.

1. 20 NEEDLE BEARINGS (PISTON BEARINGS NOT REMOVED). Ⓐ
2. PINNED PISTON RINGS
   (650 HAS TOOL STEEL RINGS)
   (610 HAS CAST IRON RINGS) Ⓑ

TO REASSEMBLE THE POWERHEAD COMPONENTS REMEMBER Ⓣ

1. TO PRESS IN PISTON BEARING, HEAT THE PISTON WITH A HEAT LAMP (THIS EXPANDS THE METAL AND ENABLES THE BEARINGS TO PRESS IN EASIER). USE THE SPECIAL TOOLS FOR 10 SERIES TO SUPPORT AND PRESS IN THE BEARINGS, P/N 84223.
2. WHEN PRESSING IN THE WRIST PIN, HEAT THE CONNECTING ROD IN THE SAME MANNER AS ABOVE. NOTE THE "E" ON THE PISTON THAT MEANS THIS SKIRT GOES TO THE EXHAUST SIDE.
3. ASSEMBLE HALF OF THE NEEDLE BEARINGS IN EACH HALF OF THE ROD AND CAP. YOU CAN USE A LIGHT GREASE TO HOLD THEM IN POSITION.
4. THE DOTS ON THE CONNECTING ROD AND CAP MUST LINE UP WHEN THE CAP IS INSTALLED AROUND THE CRANKSHAFT BECAUSE THE TWO ROD SURFACES ARE A FRACTURED FIT. Ⓐ
5. INSTALL THE PINNED RINGS.
6. THE MAIN OR ROLLER BEARING IS ALSO PRESSED ONTO THE CRANKSHAFT. HEAT THE BEARING AND PRESS IT TO FLUSH WITH THE SHOULDER ON THE CRANKSHAFT.
7. INSTALL THE OTHER BEARING AND BOTH SEALS ON THE CRANKSHAFT, AND THE WHOLE ASSEMBLY IS READY TO BE INSTALLED IN THE CYLINDER.

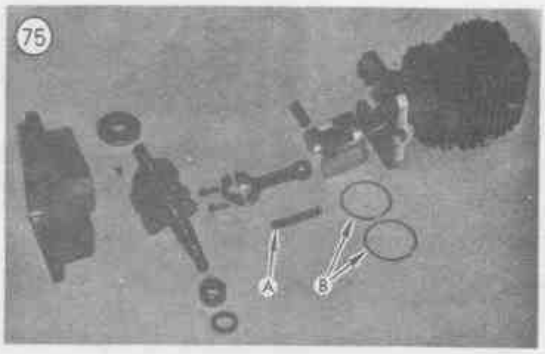
TO REASSEMBLE THE POWERHEAD INTO THE CYLINDER, Ⓜ

1. COAT THE PISTON AND RINGS WITH A FILM OF OIL.
2. APPLY R.T.V. TO THE SEALING EDGES OF THE CYLINDER HALVES (APPLY R.T.V. SPARINGLY).
3. SLIDE THE PISTON DOWN INTO THE CYLINDER. DO NOT USE HEAVY FORCE TO INSTALL THE PISTON INTO THE CYLINDER. IF A SHARP RESISTANCE IS FELT, PULL THE PISTON OUT TO MAKE SURE THE RINGS ARE LOCATED PROPERLY ON THE PISTON, AROUND THE PINS.
4. PLACE THE BEARING ON THE FLYWHEEL SIDE WITH THE SNAP RING, INTO THE GROOVE IN THE CYLINDER AND ALIGN THE SEAL SO THAT IT IS JUST INSIDE THE SEALING SURFACE.
5. PLACE THE CLUTCH SIDE BEARING AND SEAL JUST INSIDE THE SEALING AREA WITH THE BEARING BARELY TOUCHING THE SEAL.
6. TORQUE COVER BOLTS TO 70-75 INCH POUNDS.

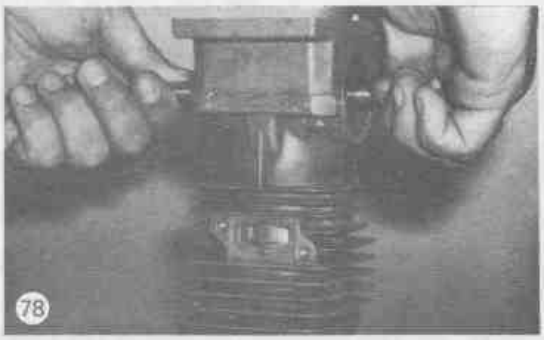
WITH THE WHOLE ASSEMBLY REASSEMBLED, Ⓝ

1. ROTATE THE CRANKSHAFT SEVERAL TIMES, IT MUST TURN FREELY. IF IT BINDS OR CATCHES, DISASSEMBLE THE UNIT TO LOCATE THE PROBLEM.

REASSEMBLE ALL OF THE COMPONENTS IN THE REVERSE ORDER OF DISASSEMBLY.





NOW THAT WE HAVE GONE THRU A COMPLETE DISASSEMBLY, WE WILL NOW COVER SPECIAL TEST PROCEDURES WHICH CAN BE DONE AT VARIOUS STAGES OF DISASSEMBLY. THE FIRST TEST IS PRESSURE TESTING OF THE FUEL TANK AND FUEL CAP.(79)

1. DISCONNECT FUEL HOSE FROM CARBURETOR AND CONNECT PRESSURE TEST TOOL DIRECTLY TO THE FUEL HOSE (DRAIN ALL OF THE FUEL IN TANK BEFORE PRESSURE TESTING).
2. PUMP THE PRESSURE TEST TOOL TO ONE POUND (REMEMBER THE CAP IS VENTED, BUT IT SHOULD HOLD BETWEEN ONE AND FOUR POUNDS AND IT SHOULD RELIEVE AT FOUR POUNDS.


IN THE EVENT THAT THE CAP WILL NOT HOLD ONE POUND.(80)

1. REMOVE THE CAP.
2. COVER THE FUEL TANK FILL HOLE AND PRESSURIZE TO ONE POUND. THERE SHOULD BE NO LEAKS. IF THE TANK LEAKS, REMOVE THE TANK AND SUBMERGE IN LIQUID (NOT WATER) TO LOCATE THE LEAK. IF IT LEAKS AROUND THE FUEL HOSE, REPLACE THE HOSE. IF THE TANK LEAKS IT MUST BE REPLACED.


TO PRESSURE TEST THE CYLINDER ASSEMBLY ON THE 600 SERIES,(81)

1. REMOVE THE MUFFLER AND CARBURETOR (ON 650 REMOVE THE D.S.P.).
2. INSTALL EXHAUST PORT ADAPTER, P/N 63137.
3. INSTALL INTAKE PORT ADAPTER, P/N 94415.
4. ON MODEL 650 INSTALL D.S.P. PLUG, P/N 110761.
5. ATTACH PRESSURE TEST TOOL TO INTAKE ADAPTOR AND PRESSURIZE TO 6 P.S.I. A LEAK RATE OF 1 POUND PER MINUTE IS ALLOWABLE. IF THE LEAK RATE IS HIGHER THAN 1 POUND PER MINUTE, IT MUST BE LOCATED. FIRST CHECK THE MOST LIKELY SOURCE OF LEAKS.

    A. YOUR PRESSURE TEST ADAPTORS AND GASKETS.
    B. THE INSULATORS AND GASKET ASSEMBLIES.
    C. THE D.S.P.PLUG ON THE 650.


ANOTHER WAY TO CHECK THE CRANKCASE ASSEMBLY IS,(82)

1. TO USE ALL OF THE SAME ADAPTORS AS ABOVE, EXCEPT THE INTAKE ADAPTOR.
2. CONNECT THE MINI MAC FUEL TANK ADAPTOR TO THE PRESSURE TEST TOOL, AND INSTALL THE PLUG INTO THE CARBURETOR INSULATOR (MINI MAC ADAPTOR, P/N 85229).
3. HOLD YOUR FINGER OVER THE PULSE HOLE AND PRESSURIZE TO 6 P.S.I.


THERE ARE TWO PRESSURE TESTS FOR THE CARBURETOR,(83)

1. ATTACH PRESSURE TEST TOOL TO THE FUEL HOSE FITTING. WITH THIS TEST WE ARE PRESSURIZING THE FUEL SIDE OF THE INLET NEEDLE.

PRESSURIZE TO 5 P.S.I. THERE SHOULD BE NO LOSS OF PRESSURE.IF THERE IS A LOSS OF PRESSURE, SUBMERGE THE CARBURETOR IN LIQUID (NOT WATER) TO LOCATE THE LEAK.

TO CHECK THE FUEL CONTROL DIAPHRAGM AND THE CIRCUIT PLATE GASKET SEAL, ⓗ

1. REMOVE THE DIAPHRAGM COVER, DIAPHRAGM, A CIRCUIT PLATE AND INLET NEEDLE, AND SPRING.
2. REASSEMBLE THE CIRCUIT PLATE GASKET, CIRCUIT PLATE, DIAPHRAGM, AND DIAPHRAGM COVER.
3. GENTLY SEAT BOTH THE HI AND LOW SPEED FUEL MIXTURE NEEDLES.
4. REMOVE THE GOVERNOR AND INSTALL A TEST GOVERNOR (TO MAKE A TEST GOVERNOR, SOLDER THE AIR RELEASE HOLES LOCATED NEXT TO THE GOVERNOR THREADS. BE CERTAIN NOT TO SOLDER THE THREADS). LIGHTLY GREASE THE GOVERNOR THREADS TO PREVENT LEAKAGE. NOTE: MARK THE TEST GOVERNOR TO DISTINGUISH IT FROM OTHER, FUNCTIONAL GOVERNORS.
5. PRESSURIZE TO 1 P.S.I. IF THERE IS A LEAK, SUBMERGE IT IN LIQUID AND LOCATE THE LEAK. A SLIGHT LEAK AROUND THE THREADS IS ALLOWABLE.

NOTE: REMOVE THE TEST GOVERNOR UPON COMPLETION OF THIS TEST. INSTALL A FUNCTIONAL GOVERNOR AND SEAL THE SURROUNDING AREA WITH GLYPTOL.

TO PRESSURE CHECK THE AUTOMATIC OILER, ⓘ

1. REMOVE THE OILER ASSEMBLY,
2. DISASSEMBLE THE AUTOMATIC OILER ASSEMBLY.
3. CONNECT THE PRESSURE HOSE COMPLETELY OVER THE CYLINDER, AND PLACE YOUR THUMB OVER THE OIL INTAKE HOLE.Ⓐ

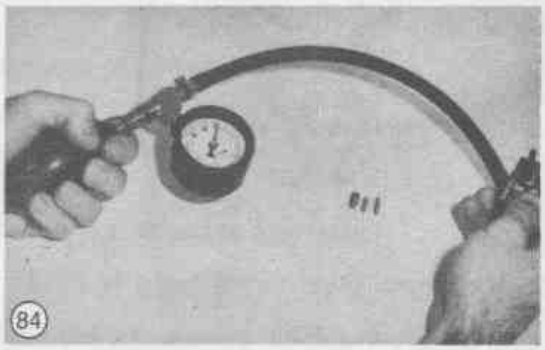
PRESSURIZE TO 6 P.S.I., IT SHOULD HOLD THIS PRESSURE. IF IT DOES, PRESSURIZE TO 12 P.S.I. THE PRESSURE SHOULD BE RELEASED BETWEEN 6 AND 12 P.S.I.

REPEAT THIS TEST. THE SYSTEM SHOULD HOLD PRESSURE 3 OUT OF 5 TIMES THE TEST IS PERFORMED. IF THE PUMP WILL NOT HOLD PRESSURE, FLUSH IT OUT BY FORCING OIL THROUGH THE OIL INTAKE, AND REPEAT THE TEST. IF THE PUMP STILL WILL NOT HOLD PRESSURE IT WILL HAVE TO BE REPLACED.

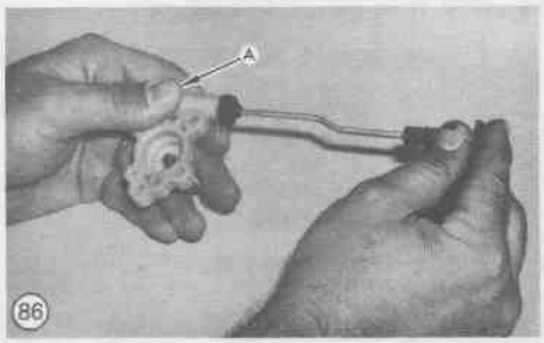
IF THE PRESSURE WILL NOT RELEASE BETWEEN 6 AND 12 P.S.I., PUSH A THIN WIRE DOWN THE CYLINDER TO BE CERTAIN THE BALL IS NOT STUCK. IF THE BALL IS NOT STUCK AND IT STILL WILL NOT RELEASE PRESSURE AT 12 P.S.I., THE ASSEMBLY WILL HAVE TO BE REPLACED.

TO CHECK THE MANUAL OILER, ⓙ

1. PUT YOUR THUMB OVER THE INLET HOLE.Ⓐ
2. WITH THE OILER ROD IN POSTITION, PUMP THE OILER.
3. IF THE OIL PUMPS UP THROUGH THE CYLINDER, THE MANUAL PUMP IS FUNCTIONING.


84

85



86

TESTING THE IGNITION ASSEMBLY IS DONE BY USING ⓟ
P/N 501334, SPECIAL TEST PLUG.

1. REMOVE THE SPARK PLUG LEAD AND THEN REMOVE THE SPARK PLUG.
2. CONNECT THE LEAD TO THE TEST PLUG, THEN CONNECT THE PLUG TO A GOOD GROUND.Ⓐ
3. STOP SWITCH SHOULD BE IN THE ON POSITION, AND PULL THE STARTER ROPE RAPIDLY. A CRISP BLUE SPARK SHOULD JUMP THE 1/4" GAP.

IF THERE IS NO SPARK OR THE SPARK IS FAINT,

1. CHECK THE STOP SWITCH AND WIRE.
2. CHECK THE FLYWHEEL TO LAMINATION AIR GAP.
3. CHECK THE GROUND WIRE FROM THE IGNITION ASSEMBLY TO THE LAMINATION.
4. CHECK ALL WIRING CONNECTIONS, AND MAKE SURE THE TEST PLUG IS ON A GOOD GROUND.

IF THERE IS STILL NO SPARK, THE IGNITION ASSEMBLY WILL HAVE TO BE REPLACED.

FOR DISASSEMBLY OF THE CHAIN BRAKE, ⓝ

1. PUT THE CHAIN BRAKE LEVER IN THE ENGAGED POSITION (TO RELEASE THE SPRING TENSION).
2. REMOVE THE SINGLE SCREW SECURING THE LEVER TO THE HOUSING.

THE LEVER THEN CAN BE REMOVED, ⓞ

1. NOTICE THE WASHER THAT SETS UNDER THE LEVER. IT HAS THREE TABS THAT LOCATE IT ON THE LEVER. Ⓐ
2. THE LATCH AND BRAKE BAND CAN BE REPLACED BY DRIVING OUT THE PINS.
3. THE SPRING CAN BE REPLACED BY REMOVING ONE SCREW (NOTE THE POSITION OF THE SPRING IN THE LATCH).

TO RE-INSTALL THE LEVER, ⓟ

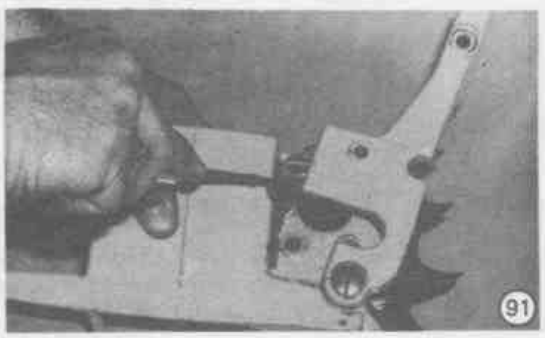
1. DISCONNECT THE SPRING FROM THE LATCH.
2. WITH ONE HAND, HOLD THE LEVER, WITH THE OTHER HAND REACH BEHIND AND PUSH THE BRAKE BANK FORWARD.
3. LOCATE THE PIN IN THE BRAKE BAND, REPLACE THE LEVER WASHER, AND RE -INSTALL THE HOLD DOWN SCREW.

WITH THE LEVER AND SCREW IN POSITION, ⓝ

1. REACH IN WITH A SCREWDRIVER AND PRY THE SPRING UP INTO THE LATCH.







TO REMOVE AND REPLACE THE SAFETY TRIGGER, TRIGGER ASSEMBLY, AND THROTTLE ROD, ⑫

1. REMOVE THE CARBURETOR.
2. TAP THE PIN INTO THE HANDLE ASSEMBLY.

DISCONNECT THE THROTTLE ROD FROM THE TRIGGER AND THE TRIGGER AND SPRING CAN BE REMOVED. ⑬

THIS SHOWS THE POSITION OF THE SPRING ON THE TRIGGER.⑭

1. THE SAFETY TRIGGER CAN NOW BE REMOVED, BUT IT IS NOT NECESSARY TO REMOVE THE SAFETY TRIGGER TO REMOVE THE TRIGGER ASSEMBLY.

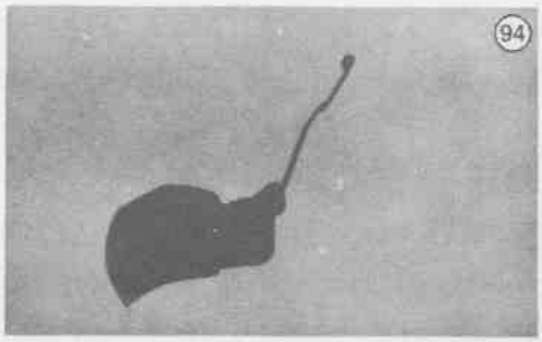
WITH THE TRIGGER AND SPRING REMOVED THE THROTTLE ROD CAN BE REPLACED.⑮

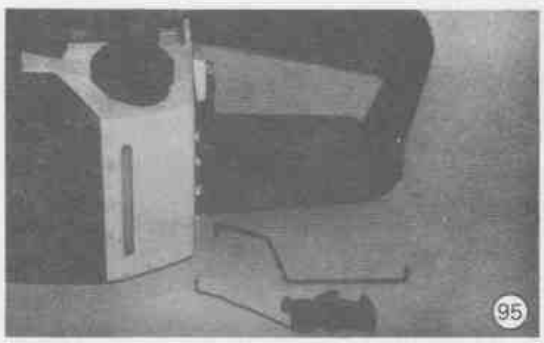
1. RE-INSTALL THE THROTTLE ROD.
2. RE-ASSEMBLE THE TRIGGER.

AS YOU ARE SLIDING THE TRIGGER BACK UP INTO POSITION, ⑯

1. CONNECT THE THROTTLE ROD.
2. TAP THE PIN BACK INTO THE TRIGGER, SECURING IT INTO POSITION.






TO REPLACE THE RUBBER SHOCK MOUNTS, WE WILL REPLACE THE BOTTOM MOUNT FIRST. (97) (A)

1. REMOVE THE CHAIN BRAKE.
2. THEN REMOVE THESE TWO HANDLE SCREWS.

WITH THE TWO SCREWS REMOVED BOTH BOTTOM MOUNTS CAN BE REPLACED. (98)

1. THE COMPONENTS ARE IN SEQUENCE OF DISASSEMBLY.

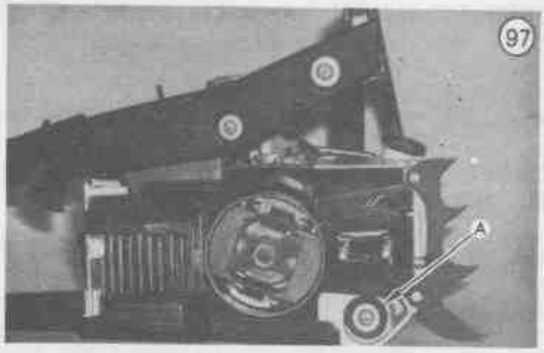
TO REMOVE THE REAR MOUNT NEAR THE TRIGGER, THIS SINGLE SCREW HAS TO BE REMOVED. (99)

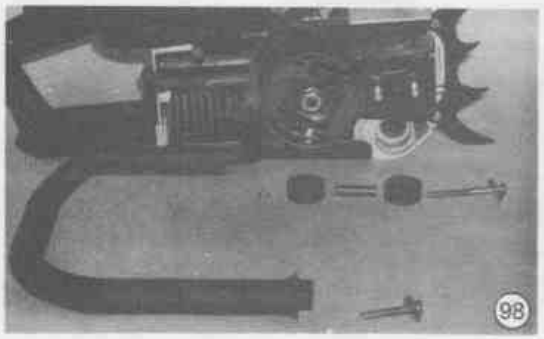
BY REMOVING ONE SINGLE SCREW, THE MOUNT CAN BE REPLACED. (100)

1. THIS SHOWS PROPER SEQUENCE OF DISASSEMBLY.

TO REMOVE THE STRUT MOUNTS, (101)

1. YOU MUST HOLD THE FLAT AREA OF THE STRUT HANDLE WITH A PAIR OF PLIERS.
2. THERE ARE TWO SCREWS TO BE REMOVED, AND THE TOP HANDLE SCREW MUST BE REMOVED TO ALLOW THE STRUT HANDLE TO BE REMOVED FROM THE HANDLE.





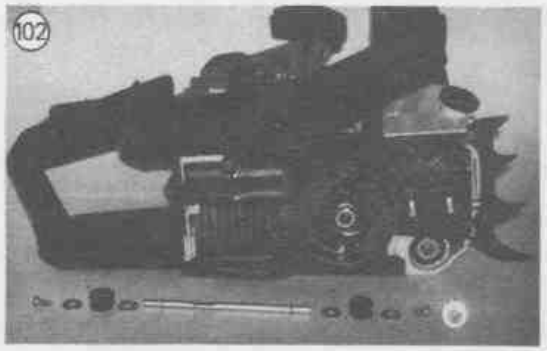

THIS IS THE STRUT MOUNT IN SEQUENCE OF DISASSEMBLY. (102)

TO REPLACE OR REASSEMBLE THE MOUNT SYSTEMS FOLLOW THE REVERSE ORDER OF DISASSEMBLY.

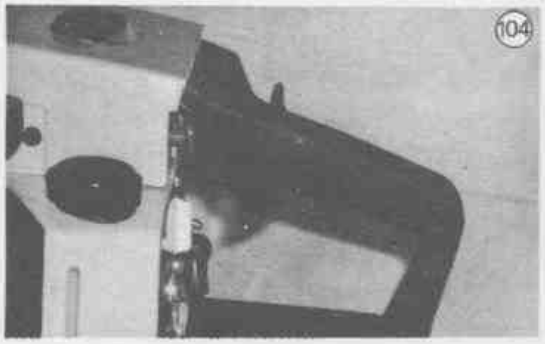
TO SET THE THROTTLE ADVANCE FOR EASIER STARTING, (103)

1. DEPRESS THE SAFETY LATCH AND ENGAGE THE THROTTLE TRIGGER TO WIDE OPEN THROTTLE.
2. LIFT BACK ON THE THROTTLE ADVANCE AND GENTLY LET UP ON THE THROTTLE TRIGGER.

THIS IS THE PROPER POSITION OF THE THROTTLE ADVANCE LEVER, AFTER IT HAS BEEN SET FOR STARTING. (104)







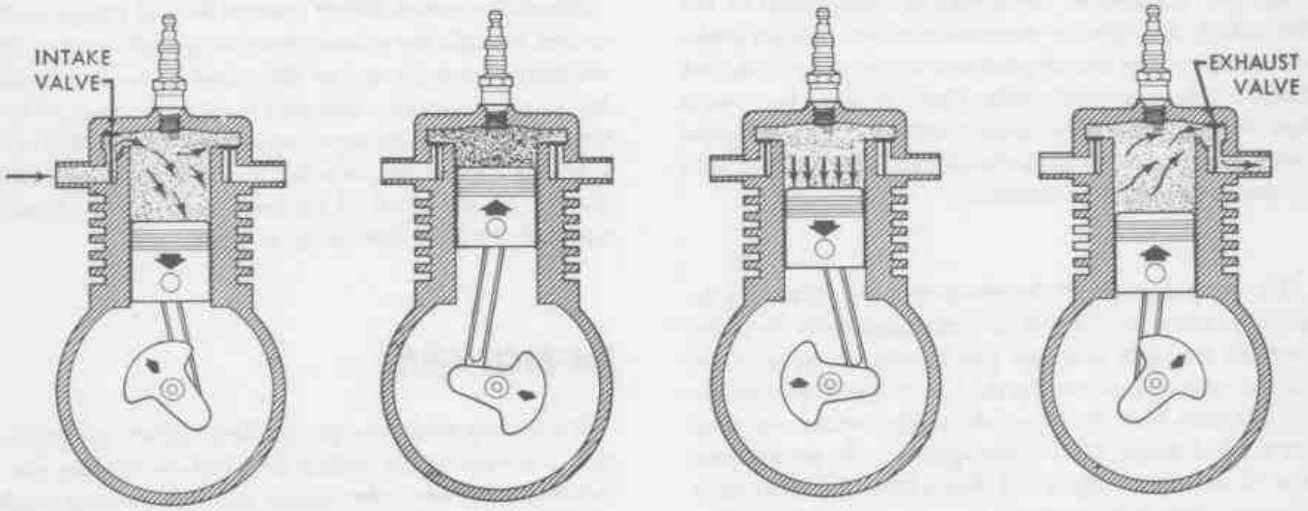
# HOW THE TWO-CYCLE ENGINE OPERATES

Although the two-cycle gasoline engine was first developed in 1878, its primary use before World War II was as an outboard engine for sportsmen, fishermen and small boat racing. A number of two-cycle gasoline engines were used on farms and ranches to generate electric power and to pump water, but it wasn't until after World War II that the small two-cycle gasoline engine really came into its own as a power source.

Nowadays, two-cycle gasoline engines are used to power target planes flying in the upper atmosphere and to power stand-by equipment in the basements of hospitals and other public buildings. Two-cycle gasoline engines are used to cut timber, brush and grass. They are used in digging holes for fence posts, telephone poles, and for plants, trees and shrubs. They power concrete handling carts and racing carts, drain septic tanks and pump water to fight fires. Their use is limited only by the imagination of man for the small two-cycle gasoline engine is the ideal, portable source of power for use all over the world.

The small two-cycle gasoline engine differs in many ways from the four-cycle engine. The four-cycle engine takes four strokes of the piston to go through one cycle from power stroke to power stroke. It has valves, valve lifters, valve springs, a camshaft and camshaft drive gears in addition to the flywheel, piston, crankshaft and connecting rods. The two-cycle engine takes two strokes of the piston to go through one cycle from power stroke to power stroke. It has no camshaft, valve springs or valve lifters and, in most cases, its piston acts as a slide valve. While the four-cycle engine uses its crankcase as a lubricating oil storage sump, the two-cycle engine uses its crankcase as a fuel mixture transfer pump and lubrication is taken care of by mixing oil with the gasoline.

The easiest way to understand how a two-cycle engine operates is by comparing its cycle of strokes with the strokes of a four-cycle engine. Originally both engines were known as two-stroke-and four-stroke-cycle engines. But time and the human inclination to shorten names, have dropped the word "stroke" and now we have two- and four-cycle engines. But the word "stroke" is the key to the way both engines operate.

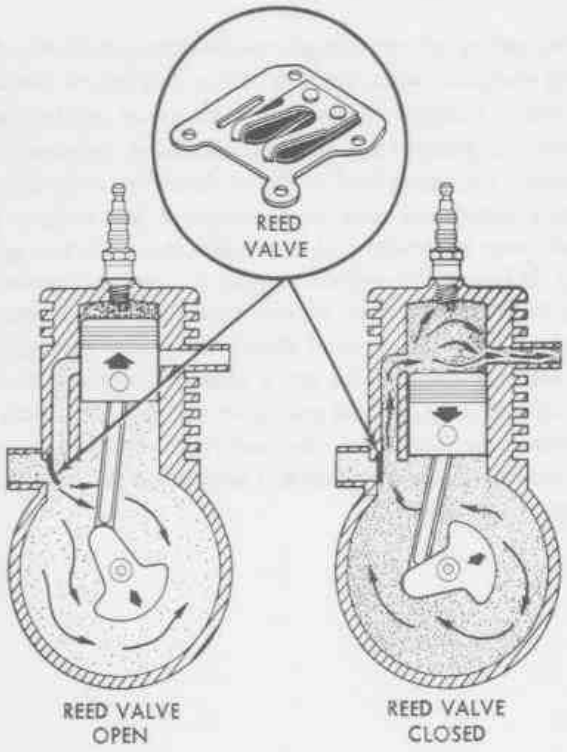


# FOREWORD

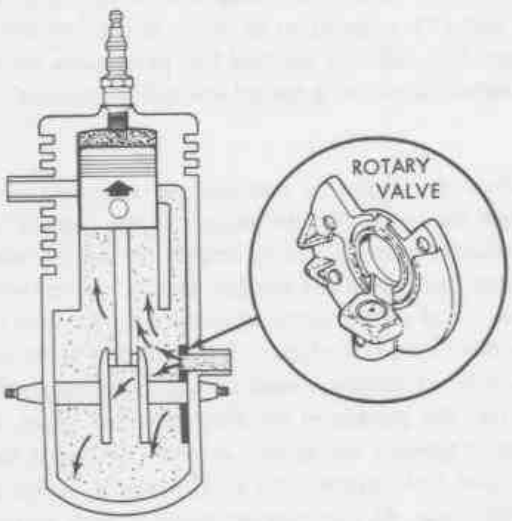
While this booklet discusses the two-cycle chain saw engines manufactured by the McCulloch Corporation, the information it contains applies to most two-cycle gasoline engines powering lawn mowers, outboards, carts, garden tractors and tillers, water pumps, brush cutters and post hole diggers.

This booklet is not intended as a shop manual, but is simply an explanation of how a two-cycle engine and its carburetion and ignition systems operate and of where and how to look for the more common causes of trouble when the engine no longer runs correctly.

# CONTENTS




The reed is a thin piece of spring steel located on the crankcase side of the carburetor inlet to the crankcase. One end of the reed is fastened to the machined area which acts as its seat. Spring tension of the metal holds the other end of the reed flat against the seat. Crankcase suction created by the piston as it moves upward in the cylinder, overcomes the spring tension of the reed, and pulls the free end of the reed from its seat so that the air-fuel mixture is sucked into the crankcase. As the piston nears the top of its stroke, it slows down and suction decreases allowing the reed to seat itself and thus prevent the flow of the air-fuel mixture from the crankcase to the carburetor as pressure is built up in the crankcase.




The rotary valve is a flat circular plate with a section of the plate cut away. The plate is mounted on the crankshaft and covers the carburetor inlet to the crankcase. While the piston is creating suction in the crankcase, the cutaway section of the plate rotates over the inlet and the air-fuel mixture can rush into the crankcase. As the crankshaft continues to turn and the piston starts downward, the solid part of the plate rotates over the inlet and the back flow of the air-fuel mixture is prevented as pressure is built up in the crankcase.

McCulloch has used all three types of valves in its chain saw engines. Several McCulloch models have used the slide valve piston and reed valve together. This is done because as the piston nears the top of its stroke, it slows down and crankcase suction falls off allowing the reed to close. The combination of the two valves permits the main quantity of air-fuel mixture to enter the crankcase through the reed valve and an additional quantity to enter through the "third port" of the slide valve after suction has fallen off enough so that the reed valve is closed. The additional quantity of air-fuel mixture produces a greater output of power when the fuel charge is fired in the combustion chamber.

## TWO-CYCLE LUBRICATION

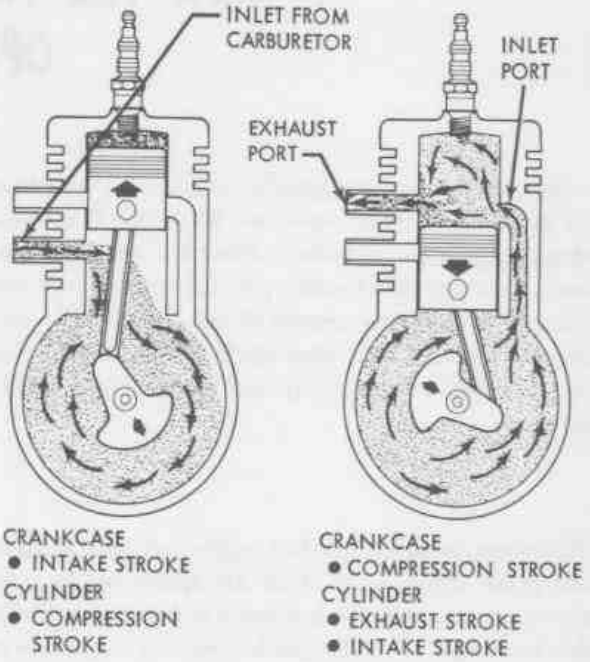
Because the crankcase of the two-cycle engine acts as a transfer pump for the air-fuel mixture, lubrication of the engine depends on the addition of oil to the gasoline. When the mixture passes through the carburetor, the gasoline becomes highly vaporized by the stream of air while the oil is broken into tiny droplets which lubricate all the surfaces with which they come in contact. Some oil remains in the crankcase but the greater quantity passes through the combustion chamber, where it is burned, and out the exhaust port.

The correct quantity, grade and type of oil as well as thorough mixing of gasoline and oil before using are very important. The quantity of oil to be mixed with gasoline will vary from engine manufacturer to engine manufacturer as will the grade of oil. But the manufacturer's recommendations should always be followed since he knows the lubrication requirements of his engines best. Most McCulloch

## FOUR-CYCLE OPERATION

The intake stroke of the four-cycle engine begins with the intake valve open and the piston at the top of the combustion chamber. As the piston moves toward the crankshaft on the downward stroke, the fuel charge is sucked into the combustion chamber. At the bottom of the first stroke, the intake valve closes, trapping the fuel charge in the combustion chamber. The second or upward stroke of the piston compresses the fuel charge. Just before the piston reaches the top of the stroke, the spark plug fires the fuel charge. The fuel charge *burns* rather than *explodes* and the burning spreads across the combustion chamber so that the increasing pressure of the hot burned gases is ready to drive the piston downward as the piston comes past top dead center. The third stroke of the piston is the power stroke. During this stroke the fuel continues to burn and the expanding heated gases shove the piston down. At the bottom of the third stroke, the exhaust valve opens and,as the piston comes up on its fourth stroke, the burned gases are pushed out of the combustion chamber. At the top of the fourth stroke, the exhaust valve closes, the inlet valve opens, and the piston is ready to begin a new four-stroke cycle.

FIGURE B




## TWO-CYCLE OPERATION

The two-cycle engine has to do in two strokes what is done by the four-cycle engine in four strokes. In addition, it has to charge the crankcase with the air-fuel mixture so that the mixture can be pumped into the combustion chamber. This means that charging of the crankcase, compression of the fuel charge, and ignition must occur on the upward stroke and exhaust of the burned gases and intake of the fresh fuel charge on the downward stroke. Figure B shows how this is possible through the use of three openings or ports: two ports opening into the combustion chamber and one opening into the crankcase from the carburetor.

The upward stroke of the piston creates a vacuum in the crankcase which sucks in the air-fuel mixture from the carburetor. At the same time, the piston seals off the inlet and exhaust ports and compresses the fuel charge in the combustion chamber. Near the top of the upward stroke, the spark fires the fuel charge. The burning spreads in the same manner as in the four-cycle engine and shoves the piston downward. The descending piston seals off the entrance to the crankcase from the carburetor and begins to build up pressure in the crankcase. As the piston continues downward, the exhaust port is uncovered and the burned gases are allowed to escape from the combustion chamber. Near the bottom of the downward stroke, the inlet port is uncovered by the piston and the compressed air-fuel mixture in the crankcase rushes into the combustion chamber. While some of the fuel charge usually escapes through the exhaust port, most small engine manufacturers shape the top of the piston to act as a barrier. McCulloch engines are designed to take advantage of swirl turbulence, that is, the imparting of a whirling motion to the inflowing fuel charge, to assist in clearing the combustion chamber of almost all of the burned gases while limiting escape of the fresh fuel charge to a minimum.

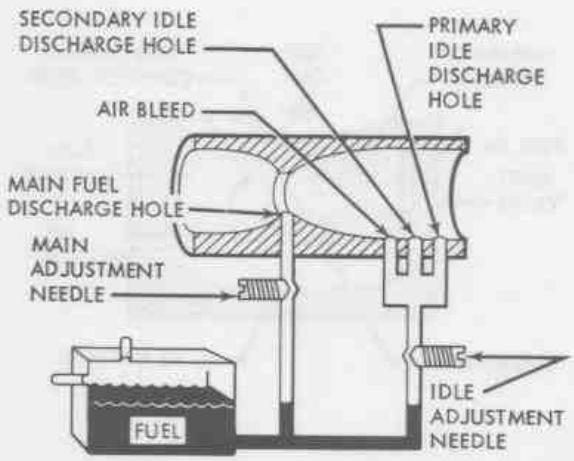
## TWO-CYCLE VALVES

While many small two-cycle gasoline engines use the piston as a slide valve in the manner described above, some manufacturers use several other simple devices,alone or in combination, to control the opening from the carburetor to the crankcase. Among these simple devices are the reed and the rotary valves.

The fuel can't be stretched because it's a liquid and liquids don't stretch. So at high engine speeds the weight of air decreases while the weight of fuel remains the same and this results in a richer and richer mixture as the engine speed increases.

Weight of air and fuel is important because proper burning of a pound of fuel requires fifteen pounds of air. If only thirteen pounds of air are mixed with one pound of fuel, the mixture will be "rich" and not all of the fuel will burn. If seventeen pounds of air are mixed with one pound of fuel, the mixture will be "lean" and will burn with more heat but produce less power. Weight of air and fuel should not be confused with quantity of air and fuel. In quantity, four thousand, seven hundred and seventy-one gallons of air are needed to burn one gallon of fuel properly.

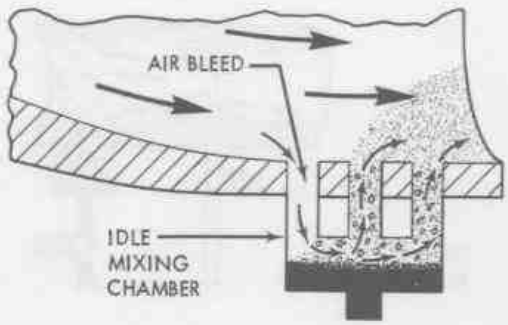
Under certain conditions, a slightly richer mixture is a good thing. For example, at idle speed a slightly richer mixture is necessary because suction is not very great and the fuel does not completely break down into a fine spray. This results in poor vaporization of the fuel or a lean mixture. The richer mixture overcomes this by providing more fuel. Again at full load, a slightly richer mixture provides more power. At intermediate speeds, a less rich or normal mixture gives the best and, in the long run, the most economical operation. To take care of this range of mixtures, several jets or fuel holes are used in the fuel passage.




The main or high speed fuel discharge hole is located in the venturi where the suction is greatest at high speeds. A needle valve replaces the orifice in the high speed fuel line.

Idle discharge holes—primary and secondary—are located downstream from the venturi with the secondary discharge hole just ahead of the throttle butterfly. The idle fuel line also has a needle valve. The two needle valves permit adjustment of the air-fuel ratio to provide for best operation at idle and at full power speeds.

Just ahead of the idle speed discharge holes in many carburetors is an air bleed which is used to make it easier to adjust the idle needle and assist in atomizing the fuel. The air bleed reduces the rate at which the fuel flow increases under suction by permitting air bubbles to pass through the idle mixing chamber and into the passage with the fuel. A number of carburetors don't use the air bleed because it's not a necessary part of the carburetor.




The flow of the air-fuel mixture into the engine and the resulting engine speed are controlled by the throttle. Because control of the air-fuel mixture is so very critical when the throttle is opened, the throttle is very carefully located in relation to the secondary fuel discharge hole.

## CARBURETOR OPERATION

When the engine is idling the throttle is almost completely closed and allows very little air to be sucked past it. This results in crankcase suction being applied at the primary idle discharge hole. The suction draws fuel from the fuel storage chamber of the carburetor and air from the passage through the secondary idle and air bleed holes into the idle mixing chamber. The mixture of air and fuel then passes into the passage through the primary idle discharge hole.

As the throttle is opened, it swings over the secondary idle discharge hole and changes it from an air inlet to an

chain saw engines use a mixture of sixteen parts gasoline to one part of any standard SAE 30, non-detergent motor oil or twenty parts gasoline to one part of McCulloch chain saw oil. The higher ratio of gasoline to McCulloch oil is possible because of McCulloch oil's greater ability to lubricate without burning in the high temperature portions of the engine, particularly in the piston ring area. Non-detergent oils should be used because the additives which detergent-type oils contain do not burn completely in the combustion chamber and the unburned detergent assists in the formation of heavy carbon deposits on the piston, spark plug and cylinder head and in the piston ring area.

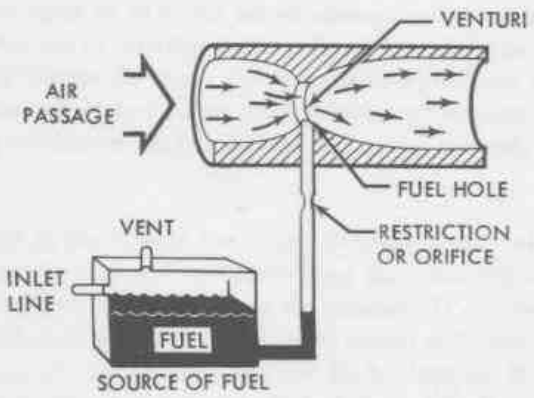
The quantity of oil is important because too much oil results in carbon formation, while too little oil doesn't provide proper lubrication. Unlike the four-cycle engine, the grade or weight of gasoline should not change from season to season.

### TWO-CYCLE GASOLINE

For many years, small engine manufacturers recommended using so-called "white gasoline" but as this type of fuel has become increasingly harder to buy, the use of regular grade automotive gasoline has been recommended. Premium-type gasolines containing lead tetraethyl should be avoided since these gasolines can cause the formation of lead balls on the spark plug electrodes and eventually short out the spark plug. When small two-cycle engines are used only occasionally, there may be trouble starting the engine. This is because most gasolines are adjusted during the year to compensate for seasonal temperatures and a gasoline purchased during the summer may not have enough of the lighter fractions to provide easy starting in the wintertime. For this reason, gasoline should be bought as it is needed and not stored over long periods of time.

# HOW THE CARBURETOR WORKS

Carburetion is the mixing of air and liquid fuel in the proper proportion to form a combustible mixture for burning in an engine. A carburetor is the device in which the mixing and proportioning take place.

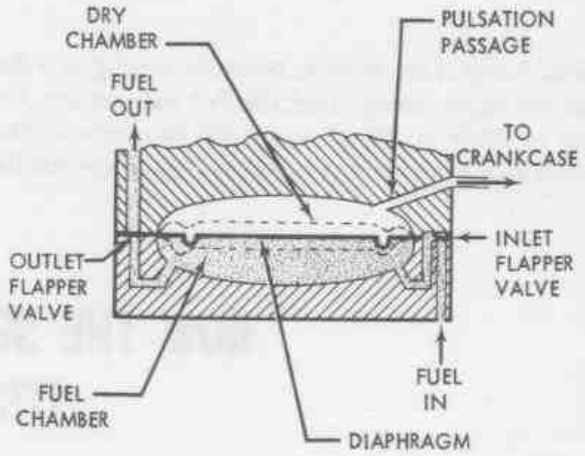



A carburetor consists essentially of four parts: (1) A passage through which air can flow on its way to the combustion chamber, (2) a fuel hole opening into the passage at a narrow section of the passage called a venturi, (3) a source of fuel with the fuel held at a constant level or pressure, and (4) a restriction or orifice in the fuel line to the passage. The orifice in the fuel line proportions the fuel to the amount of air being sucked through the passage.

When the engine is running, air is sucked into and through the passage by the engine. If the passage had the same diameter throughout its length, the suction would be the same throughout the passage. But the venturi section is narrower and suction increases in the narrower area causing a speedup in the flow of air through this part of the passage. The increased suction is used to pull fuel through the fuel hole into the passage in the form of a fine spray. As the engine is speeded up, suction increases and both the flow of air and fuel increase with it. This would be fine except for one thing: At high engine speed or high suction, air stretches out and becomes thinner and lighter in density.

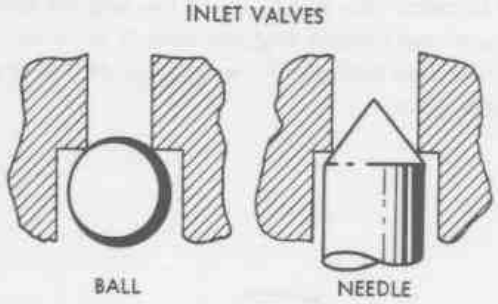
chamber is vented to the atmosphere. In some carburetors the inlet valve control lever is hooked onto the diaphragm. Other carburetors make use of the diaphragm spring to hold the lever against the diaphragm. The spring is an essential part of all diaphragm carburetors since it assists in controlling the flow of fuel into the carburetor and is essentially a balancing device.

When enough fuel has entered the carburetor, the diaphragm moves toward the dry or air chamber and the inlet valve is closed. As fuel is sucked from the chamber, the diaphragm moves toward the fuel chamber and the inlet valve opens and fuel is again allowed to enter the chamber from the fuel pump.




## INLET VALVE AND DIAPHRAGM SPRING

The inlet valve can be either a ball or needle type. Ball valves are simpler but needle valves permit greater manufacturing tolerances and are used most often. Diaphragm springs help control the position of the diaphragm when the carburetor is turned on its side or upended. Without spring pressure, the fuel by its own weight would dribble out of the main discharge hole.

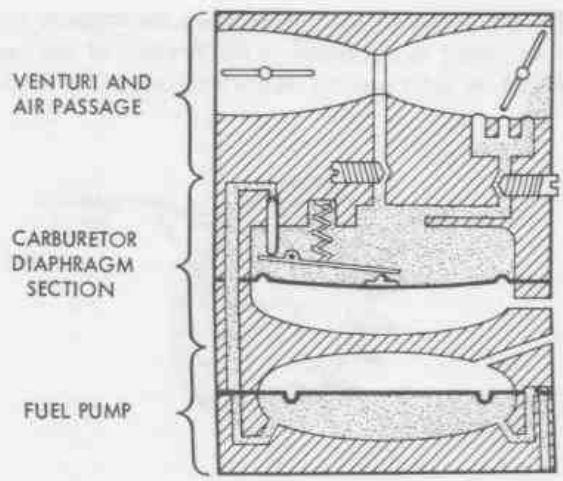


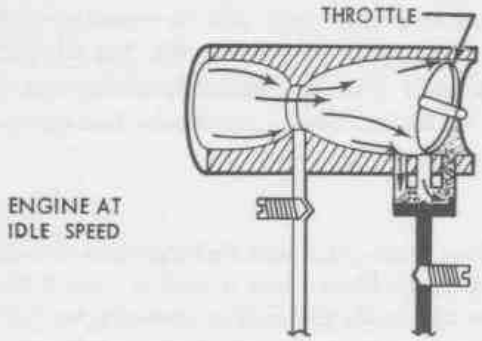

## FUEL PUMP

Chain saws make use of crankcase pulsation pressures to pump fuel into the carburetor. Most chain saws incorporate the pump as a part of the carburetor.

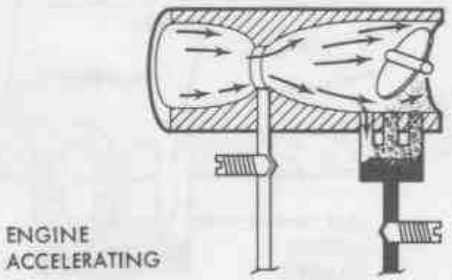
Like the carburetor diaphragm, the fuel pump diaphragm divides the fuel pump into a wet or fuel chamber and a dry or pulsation chamber. The pulsation chamber is connected by means of a passage to the crankcase so that when the piston goes up and down, the pulsations are transmitted to the diaphragm. The outer edge of the diaphragm contains two flapper-type valves which seat over passages in the pump body.

When the piston goes up in the cylinder, crankcase suction is transmitted to the dry side of the diaphragm and the diaphragm moves toward the dry chamber, drawing fuel past the inlet flapper valve into the fuel chamber. When the piston starts downward in the cylinder, the suction is turned to pressure. Pressure in the crankcase forces the diaphragm toward the fuel chamber. The inlet flapper valve is thrust against its seat while the outlet flapper valve is pushed open by the fuel as it moves toward the carburetor inlet valve. At the bottom of the piston stroke, pressure again turns to suction and a new charge of fuel is sucked past the inlet flapper valve into the wet chamber of the fuel pump.

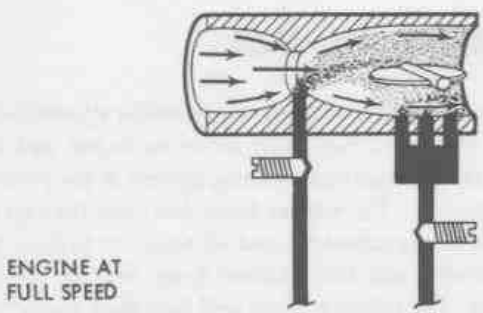





air and fuel outlet hole. The increased flow of air and fuel from the idle holes balances the increased flow of air past the throttle.

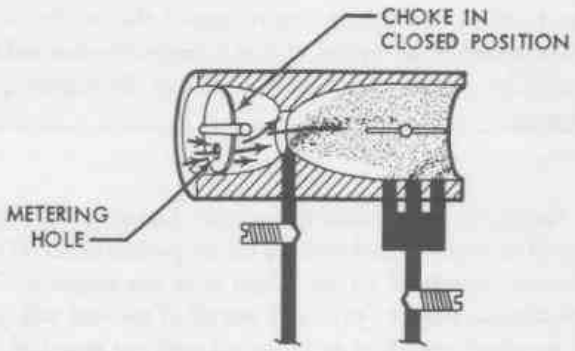



As the throttle continues to open, the suction in the venturi increases to the point where it begins to pull fuel from the main discharge hole. And finally, at wide open throttle, almost all of the fuel comes through the main fuel hole.




## THE CHOKE

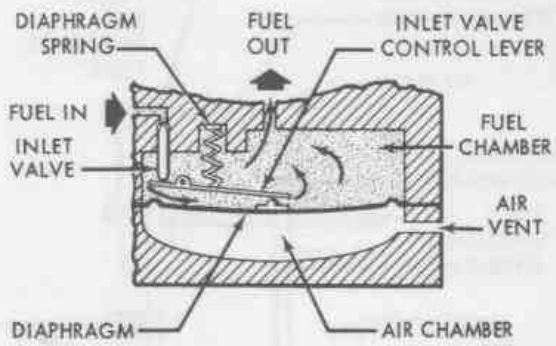
The choke provides an exceedingly rich mixture to make starting a cold engine easier. The choke is an elliptical plate




containing a small metering hole. When the choke is closed, only a small quantity of air can pass through the metering hole. Crankcase suction therefore draws larger quantities of fuel through the discharge holes and an exceedingly rich mixture results.

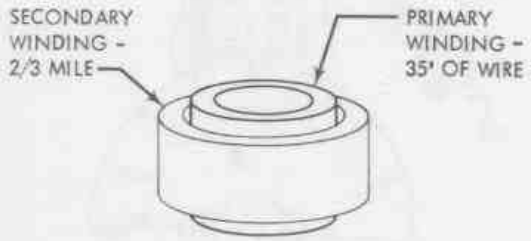
## FUEL SUPPLY CHAMBER

While float-type carburetors can be used on many small two-cycle gasoline engines, chain saw engines usually require the diaphragm-type carburetor. Float-type carburetors operate effectively as long as the carburetor is reasonably upright. But when the float-type carburetor is turned on its side, or upside down, the float loses all control over the amount of fuel that can enter the carburetor and the engine either starves or floods depending on the position of the float.




The diaphragm-type carburetor can be used in any position. The diaphragm is mounted between air and fuel chambers. An inlet valve controls the amount of fuel which can be pumped into the fuel chamber of the carburetor. The air

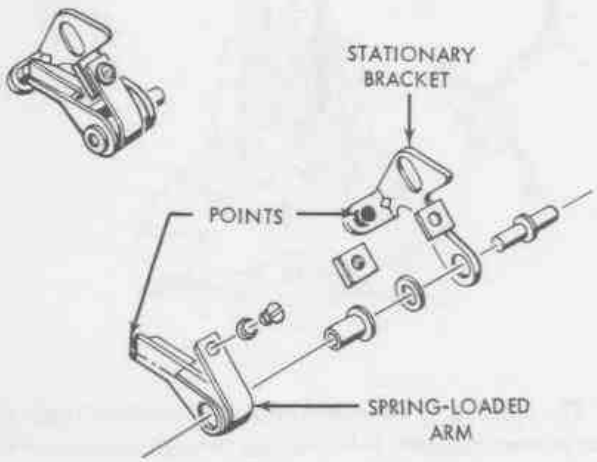
The coil consists of two windings of copper wire, one inside the other. The inner winding or primary winding contains about 35 feet of wire. The outer or secondary winding contains about two-thirds of a mile of very fine wire about the thickness of a human hair. The coil is a little like a transformer in that it makes use of the lower-voltage primary current to obtain a high-voltage secondary current. When we discuss the operation of the magneto system, you will see how this happens.



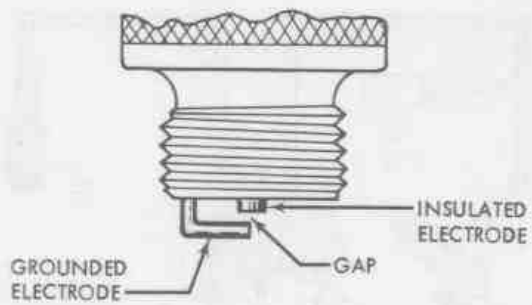

The condenser is used to absorb the electrical charge as the points open and prevent an arc or spark across the points as they move apart. The condenser is like a spring. A spring absorbs pressure when the ends of the spring are pushed together. When the ends of the spring are released, the spring returns to its former length. The condenser takes up or absorbs an electric charge and then releases the charge in a reverse surge of current.


CONDENSER

The breaker points are two small circular pads of tungsten. One is mounted on a stationary bracket whose position can be adjusted by means of an eccentric screw. The second tungsten pad is mounted on a spring-loaded arm. A cam or raised section on the crankshaft pushes the pad on the spring-loaded arm away from the pad on the fixed arm as the crankshaft turns. After the cam has moved past the spring-loaded arm, the pressure of the spring brings the pads or points together. In two-cycle one-cylinder engines, this occurs once for each revolution of the crankshaft. In a four-cycle one-cylinder engine, the cam would be mounted on a separate shaft which would make one revolution to each two revolutions of the crankshaft.




The spark plug provides an insulated and a grounded electrode with an air gap between the electrodes across which the spark jumps. The width of the gap is important for while narrow gaps mean easier starting of the engine, they are also more easily fouled. Wide gaps, on the other hand, require too much current. McCulloch chain saws operate best with a spark plug gap of 0.025 inch.




## HOW THE MAGNETO SYSTEM OPERATES

There are three rules of magnetism which affect operation of the magneto ignition system. The first is: "In a magnetic field about a permanent magnet, the lines of force move from the north pole of the magnet to the south pole." The lines of force (some people call them magnetic "flux") come out of the north pole of the magnet embedded in the flywheel, curve around and re-enter the south pole and return to the north pole through the magnet itself.

## FILTERS

Because one of the greatest enemies of any engine is dirt, chain saw engines are provided with fuel and air filters. Fuel filters are made of felt, plastic, screen or scintered metal. Current McCulloch chain saw engines make use of felt fuel filters because they last a long time and can be easily cleaned or replaced when necessary. Air filters are made of felt, cotton, plastic or screen. McCulloch uses screen with felt cemented to it because the screen provides a large area while the felt gives better filtration and greater service life. Without fuel and air filters, carburetor passages can be clogged with dirt and engines will quickly wear out.

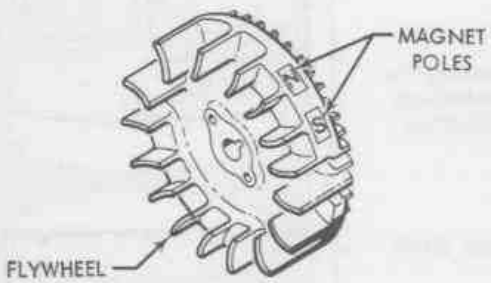
# HOW THE SPARK PLUG GETS ITS SPARK

Magneto ignition systems are used on most small two-cycle gasoline engines because of their simplicity and light weight. At one time, all automobiles used magneto ignition systems but, when the self starter was developed, the battery-powered ignition system became standard for automobiles because the self starter required an always-ready source of power to operate it.

The magneto and battery-powered ignition systems when used on one-cylinder engines differ only in that one requires a battery and a means of charging it, while the other makes use of a permanent magnet and laminated core to produce current. Both systems require a spark plug, breaker points, a condenser and a coil.

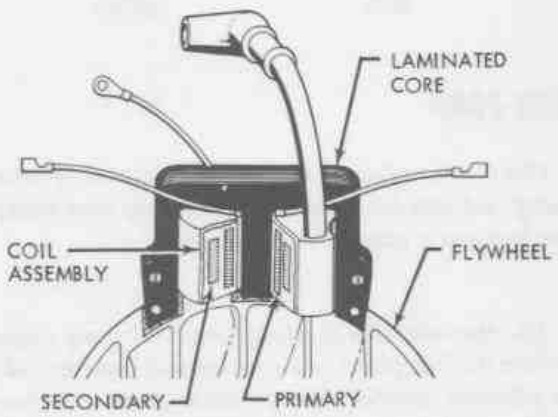
## PARTS OF THE MAGNETO SYSTEM

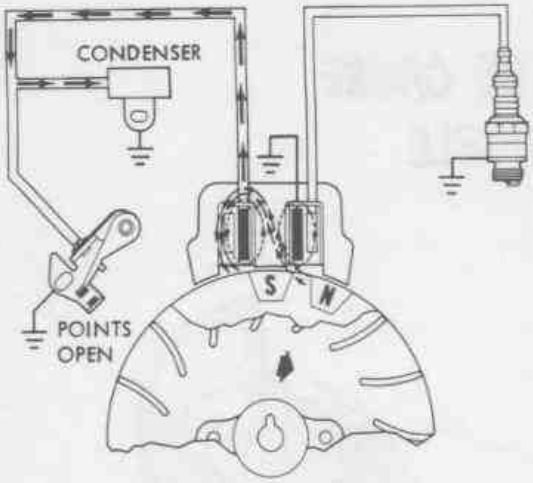
The permanent magnet (from which the magneto system gets its name) is embedded in the flywheel of the engine with both its poles exposed on the outer rim of the flywheel.

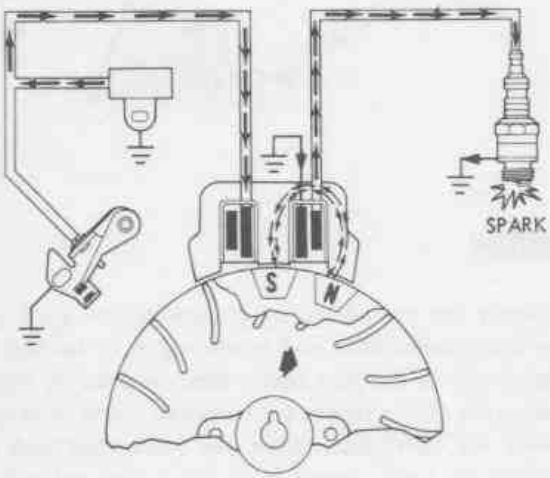



The magnet is made from a special alloy of aluminum, nickel, cobalt, copper and iron called "Alnico." "Alnico" is used because it holds its magnetic properties better than almost any other material.

The laminated core consists of a number of very thin soft iron plates fastened together. The core is shaped like the letter "E." The center leg of the "E" projects through the middle of the coil and the laminated core or "lamination" is mounted with its legs almost touching the flywheel. Soft iron is used because magnetic lines of force can move through soft iron more easily than through any other material including air.



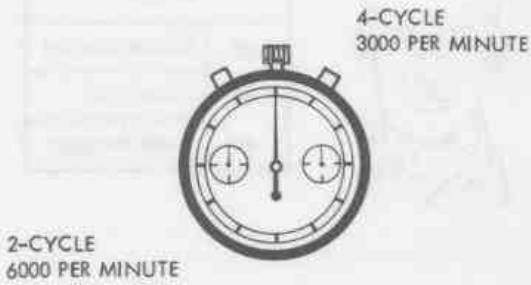


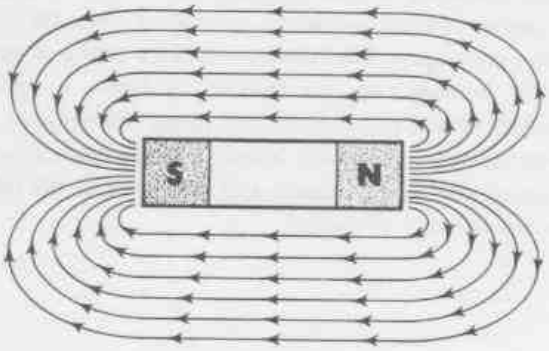




of the primary current as instantaneous as possible by absorbing the surge of primary current and preventing arcing across the points.

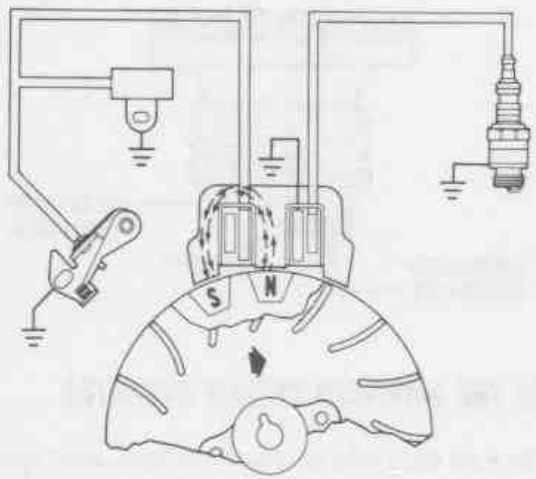
As the magnetic field collapses through the secondary winding, a high voltage current is induced in the secondary winding. At the same instant, the charge stored in the condenser surges back into the primary winding and reverses the direction of the current in the primary winding. This change of direction sets up a reversal in direction of the magnetic field cutting through the secondary and helps increase the voltage in the secondary circuit. The pressure of this high voltage forces the secondary current to arc across the spark gap and we have our spark.

In McCulloch chain saws, this sequence of events occurs approximately six thousand times a minute when the engine is running at high speed. In a four-cycle engine, the number of sparks would be only one-half or three thousand sparks a minute. Thus,a spark plug in a four-cycle engine might be said to have double the life of a spark plug in a two-cycle engine. But in actual practice this is not quite true.

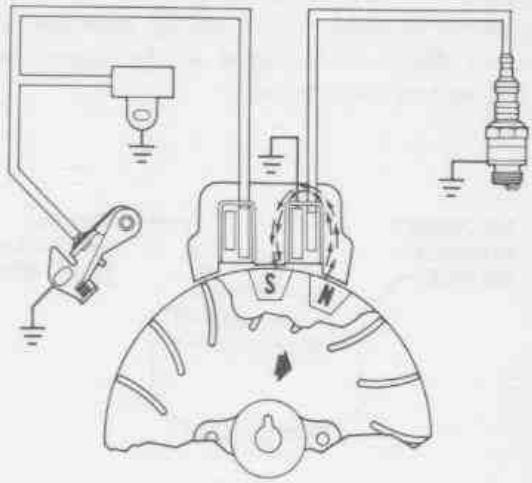




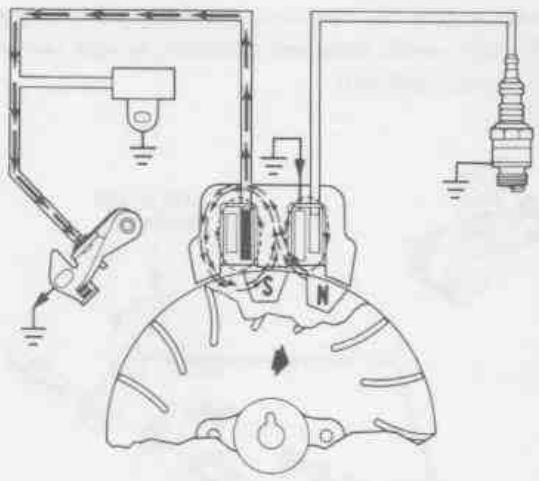

When the flywheel is turned the magnet passes under the legs of the lamination. When the north pole of the magnet is under the center leg of the lamination, the lines of force move up the center leg through the coil, across the top of the lamination and down the side leg to the south pole. The lines of force travel this longer distance rather than through the air, because the lamination is made from soft iron, a material through which lines of force flow most easily. As the flywheel continues to turn, the north pole of the magnet comes under the side leg and the south pole comes under the center leg of the lamination. Now the lines of force move from the north pole up through the side leg and down through the center leg and coil to the south pole. At this point, the lines of force passing through the coil have reversed their direction. Now we are ready for our second rule.




"When there is variation of magnetic lines of force in a conductor, a voltage will be induced in the conductor." Variation of magnetic lines of force can be caused by an increase, a decrease, or a change of direction of the lines of force. And the faster the variation occurs, the greater will be the induced voltage. So the change in direction of the lines of force through the center leg of the lamination and coil creates a low-voltage current in the primary winding of the coil.



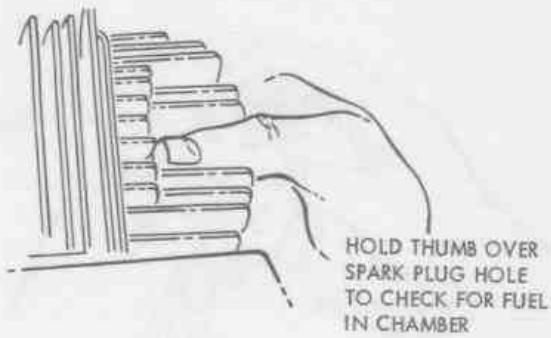

The third rule is: "A magnetic field of force lines exists about any flow of current." So, the current induced in the primary winding of the coil has now created a primary magnetic field which reinforces and helps maintain the direction of the lines of force in the center leg of the lamination. It does this until the magnet's poles move into a position where they can force the force lines to change direction in the center leg of the lamination. Just before this happens the breaker points are opened by the cam.




The opening of the points breaks the primary circuit and the primary magnetic field collapses through the turns of the secondary winding. The condenser helps make the breaking

## CARBURETION

Most carburetor troubles are caused by improper adjustment of the main and idle adjustment needles. Flow of the air-fuel mixture into the combustion chamber can be checked by holding your thumb over the spark plug hole in the cylinder head and pulling the starter rope several times. If your thumb does not become moist with oil and gasoline, the trouble may be caused by as simple a thing as an empty tank or it may be caused by a defective reed valve, or pump or by a clogged fuel filter.




# CHECKING THE IGNITION SYSTEM

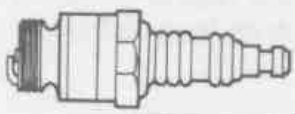
There are three places in the ignition system where most troubles arise: the spark plug, the breaker points and loose and shorted wiring. After these come the flywheel-to-lamination air gap, the condenser, the coil, the ignition switch and the magnet.

When checking out the ignition system, repeat the spark test after working on each part of the system.

| CHECKING THE IGNITION SYSTEM |
|---|
| 1 SPARK PLUG |
| 2 BREAKER POINT |
| 3 LOOSE AND SHORTED WIRING |
| 4 FLYWHEEL - TO - LAMINATION AIR GAP |
| 5 CONDENSER |
| 6 COIL |
| 7 IGNITION SWITCH |
| 8 MAGNET |

## SPARK PLUG

Spark plugs cause trouble by being dirty, having too large an electrode gap, by having cracked or broken insulation or by being in the wrong heat range. In normal usage carbon gradually builds up on the spark plug insulator base and around the electrodes. At the same time, the electrode tips become pitted and worn from sparking so that the electrode gap gradually becomes wider. After a while the gap can be so large that not enough current is produced by the ignition system for a spark to jump the gap.

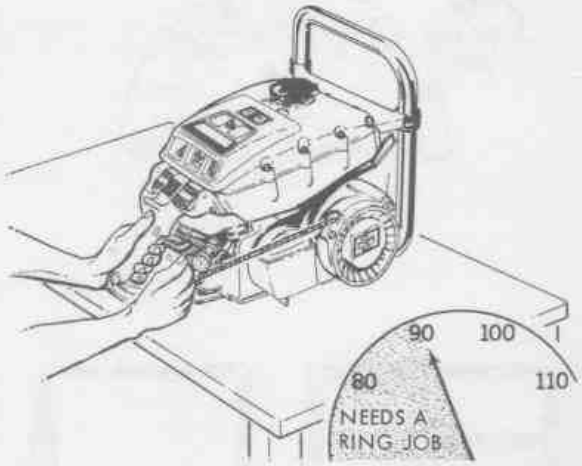


| SPARK PLUG | |
|---|---|
| • | DIRTY |
| • | LARGE ELECTRODE GAP |
| • | CRACKED OR BROKEN INSULATION |
| • | WRONG HEAT RANGE |

The spark plug electrodes can be cleaned with emery cloth and the gap can be adjusted by bending the side electrode. The gap width should be checked with a wire gauge. McCulloch chain saw spark plugs are gapped to 0.025 inch for best operation. If the porcelain is cracked or broken, discard the spark plug.

# HOW TO LOCATE THE CAUSE OF ENGINE TROUBLE

The small two-cycle gasoline engine must have three things in order to run: The correct air-fuel mixture must be able to enter the combustion chamber: the piston must be able to compress the fuel charge: the ignition system must be able to ignite the compressed fuel charge. Lack of one of these will prevent operation of an engine. Minor failures will prevent correct operation of an engine. Therefore, when the engine doesn't run or doesn't put out full power the things to check are (1) compression, (2) ignition and (3) carburetion or a combination of all three since trouble can strike in two or three places at once.




| CHECK | |
|---|---|
| ● | COMPRESSION |
| ● | IGNITION |
| ● | CARBURETION |

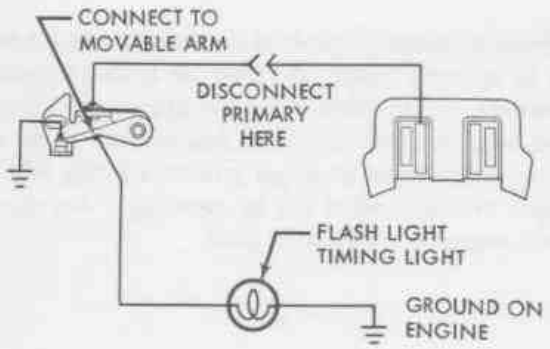
## COMPRESSION

Compression can be checked by pulling the starter rope gently until the greatest engine resistance is felt, slackening the starter rope, and noting the amount of engine snap-back. Or the starter rope can be pulled and slackened to determine the "bounce" off the high end of the compression. If the point of greatest resistance can't be found or if there is little snap-back or the "bounce" is below that of the average normal engine, the cause of the trouble can be traced to poor compression. Compression can also be checked by installing a compression gauge in the spark plug hole in the cylinder head and pulling the starter rope until the gauge needle no longer rises or for at least six pulls. The gauge should read above 90 pounds pressure for compression to be sufficient for the engine to operate.

## IGNITION

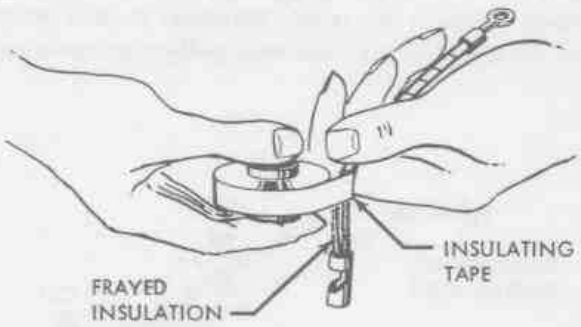
Ignition can be checked by unscrewing the spark plug from the cylinder head and grounding it by holding the threaded part of the plug against bare metal on the engine. If, when the starter rope is pulled briskly, there is no spark between the electrodes, replace the spark plug with one known to be good, ground it on the engine and pull the starter rope again. If there is still no spark, the ignition system is at fault.

The breaker points control the timing of magneto ignition systems by the number of degrees which they open before the piston reaches top dead center. Timing on some McCulloch engines can be adjusted by turning the crankshaft until the points are at their greatest distance apart, then loosening the eccentric screw on the fixed arm and turning it to provide a gap of 0.018 to 0.020 inch. The lock nut on the eccentric screw should be tightened without moving the eccentric screw. Other McCulloch chain saw engines can be adjusted by means of a timing pin and timing light. One lead of the timing light is connected to the movable arm of the breaker assembly and the other lead is grounded on the engine. The lead from the coil to the breaker points is disconnected. The timing pin is inserted through the timing hole in the bottom of the engine and the flywheel is rotated until the timing pin slips into the timing hole in the flywheel. The eccentric screw on the fixed arm is turned until the timing light just goes out and is locked in this position by the lock nut. Proper adjustment of breaker point gap is important because, if the gap is too wide, the points will open too soon and the timing will be advanced. If the gap is not wide enough, the points open after they should and timing is retarded. Either condition prevents proper operation of the engine.



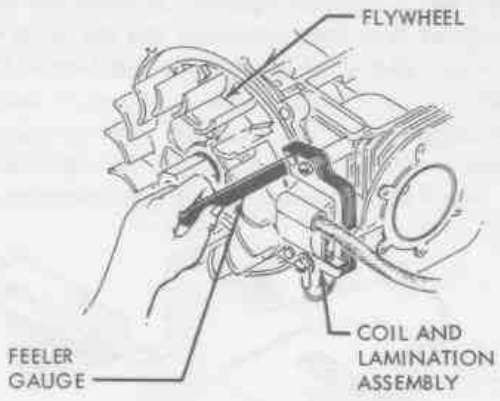

## LOOSE AND SHORTED WIRING

Check all electrical connections to make sure they are tight and examine the wires running from the coil to the breaker points, from the coil to the ignition switch, and from the coil to the spark plug. If any part of these three wires is bare or if the insulation is frayed or worn, shorts can result and the engine will either not run or will run irregularly. Tighten loose connections and either replace defective wiring or tape the bare, frayed or worn section with rubber or plastic insulating tape.

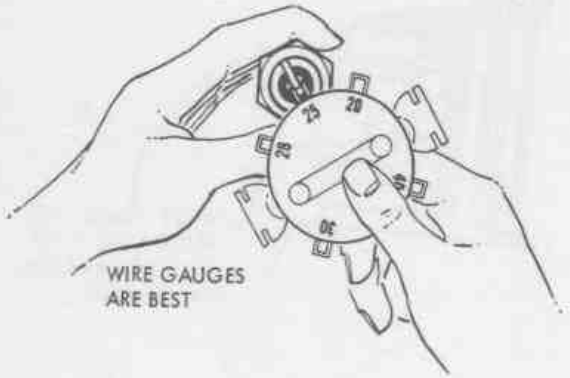



## FLYWHEEL-TO-LAMINATION GAP

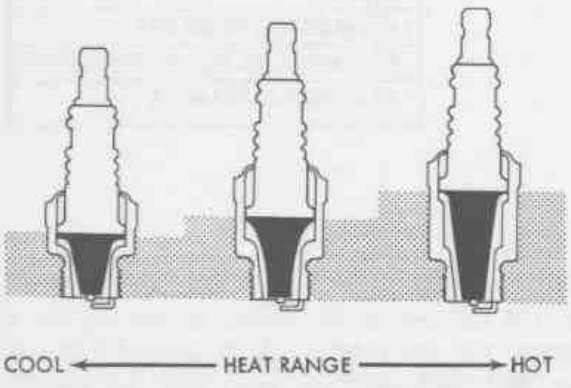
The flywheel-to-lamination gap is measured with the magnet under the lamination legs. McCulloch engines should have an air gap of from 0.008 to 0.012 inch. If the gap is greater than this the magnetic force lines will be so weak in the lamination that the necessary primary current will not be induced. If less than 0.008 inch, the legs may interfere with the rotation of the flywheel. The gap can be checked by inserting feeler gauges between the flywheel and the two side legs of the lamination.




Adjustment of the gap is made by loosening the lamination mounting nuts and placing 0.010-inch thick feeler gauges between the flywheel and legs. Then when the magnet is rotated beneath the legs, the lamination will be pulled tight against the feeler gauges and they will maintain the proper air gap while the mounting nuts are tightened.

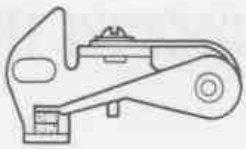



Heat range of spark plugs is important. Heat range depends on the distance the combustion heat has to travel through the insulation to the spark plug shell and cylinder head. If the distance is short, the heat passes quickly and the plug is a "cool" plug. If the distance between the tip of the insulator and the shell is long, heat has to travel further, the insulator stays hot and the plug is a "hot" plug. A hot plug can cause pre-ignition and detonation which will not only result in loss of power but will make the engine run hot and shorten its service life. A cold plug will make the engine hard to start and the engine will not run properly. A spark plug of the right heat range will show brown to grayish tan deposits around the electrodes. Wet, black, and sludgy deposits indicate the plug is too cool. If the deposits are whitish, the electrodes are badly worn, and the insulator nose appears blistered, the plug is too hot. In cold weather, plugs of a warmer heat range operate best; in summertime, cooler plugs provide the best performance.



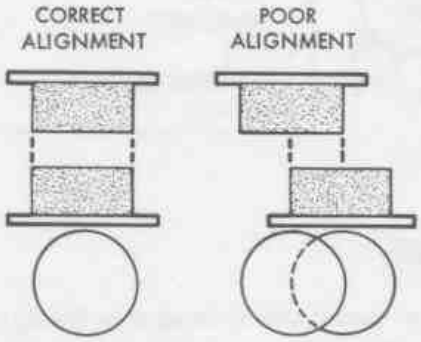

## BREAKER POINTS

The breaker points can prevent operation of the engine by being dirty, pitted or worn, oily or having too wide a point gap. Oily points can be cleaned with a drop of solvent followed by drawing a white card (like a business card) between them. When the card comes away clean, the points will be clean. Badly pitted and worn-away points should be replaced with a new breaker point assembly and the condenser should be checked to see that it operates correctly, for the purpose of the condenser is to prevent excessive pitting. If the points are not badly worn away, they can be levelled and polished or "dressed" by drawing a piece of emery paper between them or by using a point dresser.



| BREAKER POINTS |
| --- |
| • DIRTY |
| • PITTED OR WORN |
| • OILY |
| • TOO-WIDE A GAP |

Points should line up. The points can be adjusted by bending the movable arm so that the points contact each other over as wide an area as possible. This is important for,when the contact area is small, all of the primary current is forced to flow through the small area and the points pit and wear away rapidly. When the contact area is large, the primary current has a change to spread out and there is less pitting and wearing away. To provide for longest point life, the points should always be lined up.

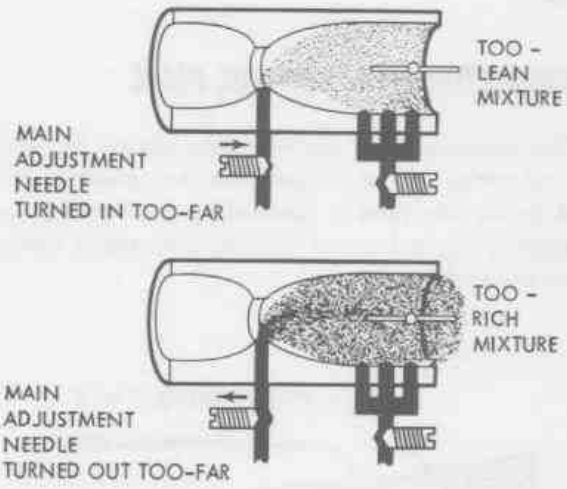


# CHECKING THE CARBURETOR AND FUEL SYSTEM

Carburetion problems range from too-rich and too-lean air-fuel mixtures to lack of fuel and failure to run at full speed. Many of these problems can be traced to the fuel adjustment needles. Because not all McCulloch chain saws use the same model carburetor, reference should be made to the Operator's Manual which came with the chain saw, for the correct positioning of the adjustment needles.

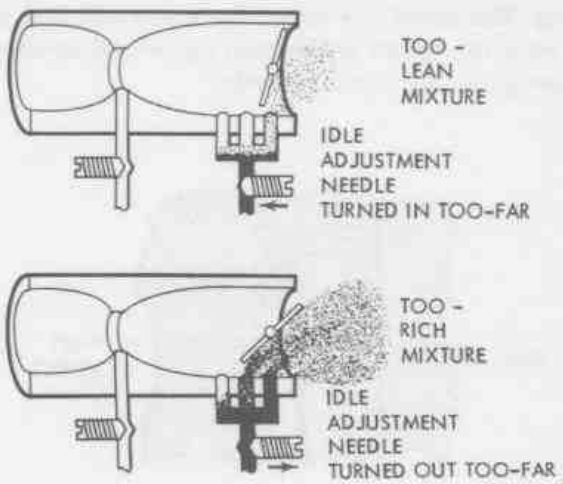

## MAIN ADJUSTMENT NEEDLE

When adjusted correctly, the main needle maintains an air-fuel ratio which provides the greatest available power at full throttle. When the needle is turned in too far, the sound of the exhaust becomes sharp and barking. This sounds powerful and fools many people. For, unfortunately, it also results in a lean mixture which prevents development of full power, and causes operating temperatures which can damage the piston and cylinder and eventually result in engine seizure. When the main needle is turned out too far, a rich mixture results; that is, too much fuel is sprayed into the air as it passes through the venturi. Such a mixture is not only uneconomical, but causes the formation of carbon on the piston and cylinder walls, fouls the spark plug, clogs the muffler and prevents the engine from operating as it should. If the main needle has been jammed onto its seat by being turned in too far, the needle and seat may be seriously damaged and no adjustment of the main needle will provide correct air-fuel mixture at full throttle.



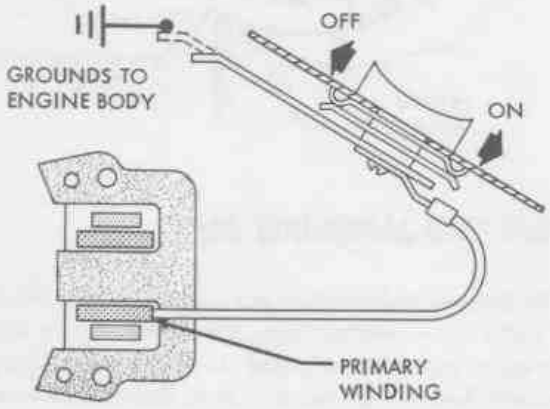

## IDLE ADJUSTMENT NEEDLE

When the engine is running at idle speed, the fuel mixture is not broken down into as fine a spray as when the engine runs faster. For this reason, a slightly richer mixture is provided at idle speed. The idle adjustment needle controls this air-fuel mixture. When set correctly, the slightly richer mixture causes no trouble in the engine. But if the



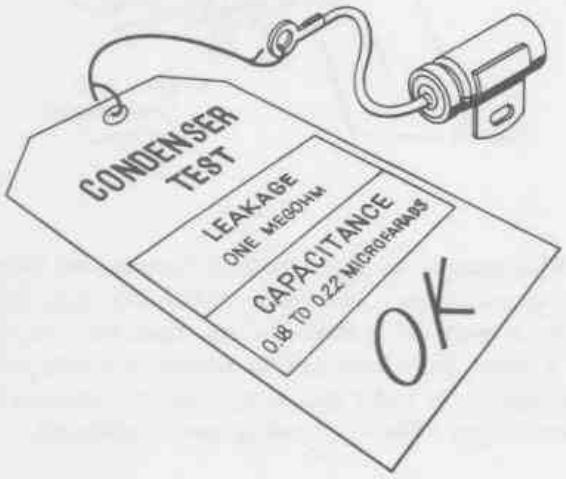
## IGNITION SWITCH

Almost all ignition switches, when a part of the magneto system, act by grounding the primary coil winding. If the switch is defective, it may do this even when in an ON position. To check the switch, disconnect it from the primary coil and check the spark while pulling the starter rope.



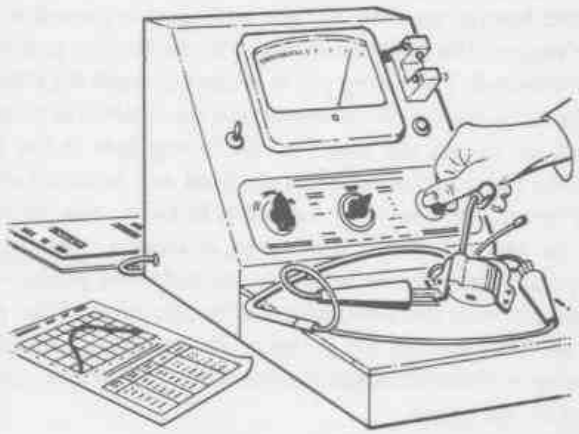

## CONDENSER

Under normal operating conditions, the condenser may become discolored or mottled. The discoloration does not affect the way a condenser operates. To determine whether the condenser is at fault, remove it and test it on a condenser tester. McCulloch condensers must have a leakage of more than one megohm and a capacitance of from 0.18 to 0.22 microfarad. If no condenser tester is available, a substitute condenser can be installed. The substitute condenser should be one known to be in good condition.



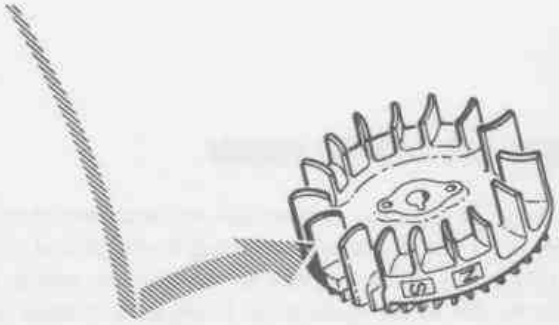

## COIL

Like the condenser, the coil can be removed from the engine and tested on a standard coil tester. Because coil tester specifications vary, always check the coil against the figures given by the manufacturer of the coil tester. Or a substitute coil and lamination assembly can be installed if no tester is available.



## MAGNET

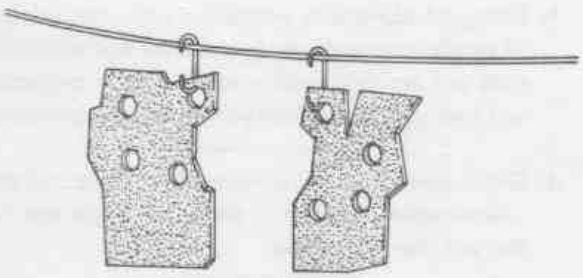
While the magnet is made of a material known for retaining its magnetic properties under all kinds of operating conditions, a sharp blow as from a hammer or a shock as from being dropped may cause loss of some of the magnetism so that it can no longer generate a strong field. The magnet can be checked out by installing a new flywheel whose magnet is known to be good.



not-so-common cause is a broken or leaking pulsation passage. Where there is little or no transfer of pulsation pressures from the crankcase to the dry chamber of the fuel pump, the diaphragm will not operate or the flow of fuel will be extremely small and the engine will not be able to run at much more than idle speed.

## FUEL FILTERS

Fuel filters are designed to catch dirt in the fuel and prevent it from entering the carburetor and engine. The dirt from the fuel builds up on the surface of the filter and eventually clogs the filter so that the fuel flow is cut down. When this happens the engine will not be able to run at full speed. Filters should be cleaned or replaced periodically. They can be cleaned by washing in solvent and rubbing the dirty surfaces together so as to break up the crust of dirt. It is cheaper to replace inexpensive filters with new ones than it is to clean them.

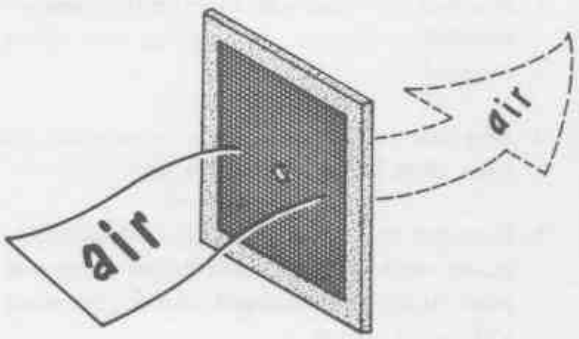


Water, which condenses in the fuel tank if the engine is not run for a period of time, can also clog fuel filters. Water soaked felt filters should be hung in the open air and sunlight to dry.

## AIR FILTERS

Like the fuel filters, the air filters become clogged with dirt during operation of the engine. The amount of air which can flow through the filter is gradually cut down and results in gradually changing the air-fuel mixture from the correct ratio to a too-rich mixture. Frequent cleaning or replacement of air filters is necessary.

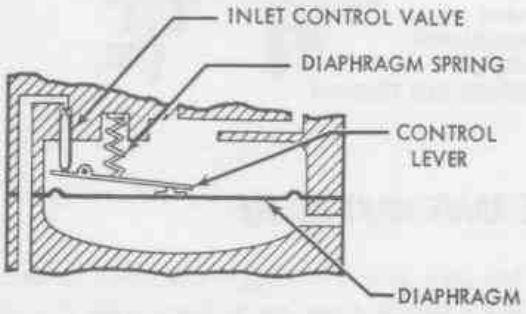
Operating a small two-cycle gasoline engine without an air filter or with a damaged filter will cause rapid wear of the moving parts of the engine. Even a hole the size of a lead pencil can pass enough dirt to ruin the piston, rings, cylinder and bearings. Never take chances with an air filter; if in doubt, replace it.



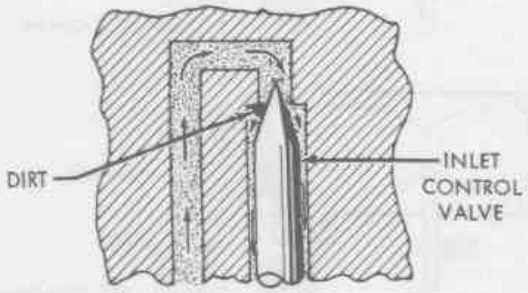
idle needle is turned out too far, the mixture becomes so rich that excessive carbon is formed, the spark plug is fouled and the engine will run roughly or may die. If the idle needle is turned in too far, the mixture will be lean and again the engine may die during idle or miss and falter during acceleration. If the idle needle is jammed onto its seat, the needle or the seat or both may be damaged and it will be impossible to adjust the idle fuel mixture for correct operation.

## CARBURETOR INLET CONTROL VALVE

The carburetor inlet control valve regulates the amount of fuel which can be pumped into the carburetor by the fuel pump. The valve is operated by the diaphragm, diaphragm spring and control lever so that each of these can affect the air-fuel ratio.



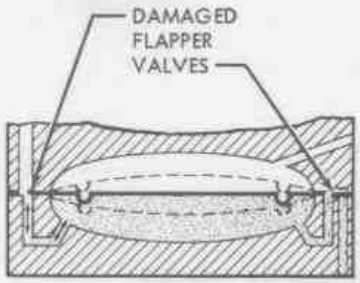

Dirt in the fuel is the principal cause of trouble for the inlet control valve. A piece of dirt can be caught between the inlet valve and its seat preventing the valve from fully closing. This results in a continuous flow of fuel from the fuel pump through the fuel chamber and into the carburetor air passage and the engine is flooded.



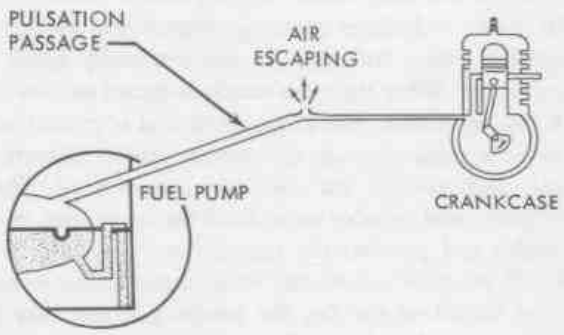

If the diaphragm spring is compressed, the inlet valve may not close all the way allowing the fuel pump to force fuel through the carburetor into the passage. This extra fuel will flood the engine. If the spring is stretched, it will prevent proper adjustment of the carburetor and the mixture will tend to be too lean.

## FUEL PUMP

The fuel pump diaphragm is the only moving part in the fuel pump and is usually the cause of any fuel pump troubles. If the center of the diaphragm is torn or has a small hole, fuel may be sucked through the diaphragm into the pulsation passage and from there to the crankcase. This will result in either a rich mixture or flooding, depending on the size of the tear or hole. If the flapper valves on the outer edge of the diaphragm are damaged or have become stiff or curled, they will not close off the pump inlet or outlet passages. Even though the diaphragm moves up and down, little or no fuel will be pumped from the fuel tank to the carburetor.




Another common cause of failure of the fuel pump to work is blocking of the pulsation passage by the improper positioning of gaskets between the pump and crankcase. A



## ENGINE WON'T IDLE

This classification covers engines that run too fast or engines that die during idle.

1. Engine won't idle because it runs at too high a speed—carburetor idle speed control screw turned in too far—readjust according to instructions in the Operator's Manual.

2. Engine dies at idle speed—idle adjustment needle turned in too far—readjust according to instructions in the Operator's Manual.

## ENGINE WON'T RUN AT FULL SPEED

An engine won't run at full speed because something is preventing the full air-fuel mixture from reaching the combustion chamber.

1. Dirty fuel filter—remove fuel filter, check condition and clean or replace if necessary.

2. Dirty air filter—remove air filter, check condition and clean or replace if necessary.

3. Damaged fuel pump diaghragm—disassemble fuel pump, check diaphragm and flapper valves and replace diaphragm if damaged.

## ENGINE FLOODS OUT

An engine can only flood out if too much fuel is pouring into the crankcase.

1. Damaged carburetor diaphragm—disassemble carburetor, check diaphragm and replace if ruptured or torn.

2. Dirt caught between carburetor inlet control valve and seat—disassemble carburetor, check valve for dirt and clean if required.

3. Damaged or missing carburetor inlet valve control spring—disassemble carburetor, check spring condition and replace if damaged or missing.

4. Torn or ruptured fuel pump diaphragm—disassemble fuel pump, check diaphragm for damage, check dry chamber for evidence of fuel and replace diaphragm if necessary.

# CARBURETOR AND FUEL SYSTEM TROUBLE SYMPTONS

## TOO-LEAN MIXTURES

Too-lean mixtures cause an engine to run hot, rob an engine of full power and cause rapid wear of the moving parts of the engine. Too-lean mixtures are caused by the following:

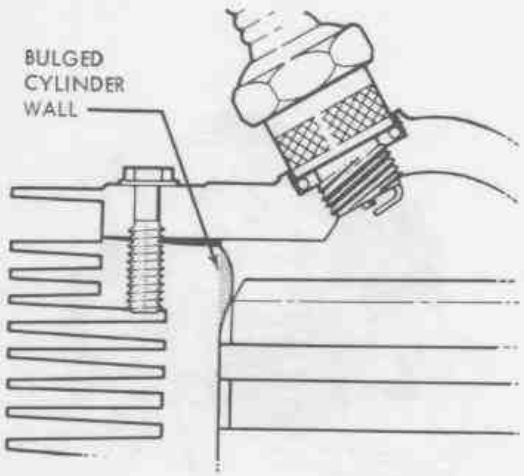
1. Main adjustment needle turned in too far—readjust according to instructions in the Operator's Manual.
2. Idle adjustment needle turned in too far—readjust according to the instructions in the Operator's Manual.
3. Stretched carburetor inlet valve control spring—disassemble carburetor, check spring and replace if stretched.
4. Bent inlet valve control lever—disassemble carburetor, check lever and replace if bent.
5. Damaged fuel pump diaphragm—disassemble fuel pump, check diaphragm and flapper valves and replace diaphragm if damaged, or if flapper valves are stiff, curled or bent.
6. Dirty or water-soaked fuel filter— check condition of filter, clean and dry or replace with new filter if necessary.
7. Air leaks—air leaks into the carburetion system can be caused by damaged or missing gaskets between the carburetor and combustion chamber, loose carburetor mounting screws, damaged crankcase oil seals or a crack in the crankcase.

## TOO-RICH MIXTURES

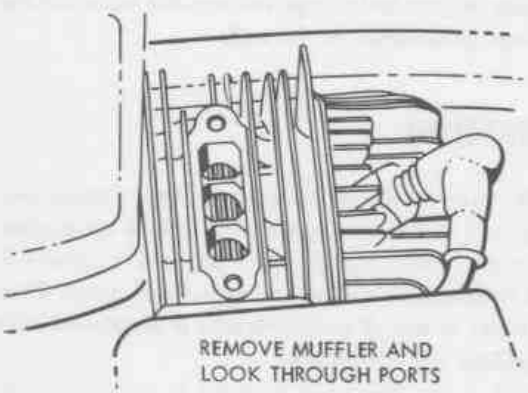
Too-rich mixtures cause the formation of carbon in the combustion chamber, foul the spark plug, carbon up the muffler and are uneconomical. Causes of too-rich mixtures are the following:

1. Main adjustment needle turned out too far—readjust according to the instructions in the Operator's Manual.
2. Idle adjustment needle turned out too far—readjust according to instructions in the Operator's Manual.
3. Damaged adjustment needles or seats—inspect tips of needles and seats, replace needles and seats or, if seats are not replaceable, install a new carburetor and warn operator against turning needles in too far.
4. Dirt caught between carburetor inlet valve and seat —disassemble carburetor, check valve and seat for dirt and clean if required.
5. Worn or damaged carburetor inlet valve and seat—disassemble carburetor, check condition of valve and seat; and replace if required.
6. Damaged carburetor diaphragm—disassemble carburetor, check condition of diaphragm, and replace if torn, broken or ruptured.
7. Bent inlet valve control lever—disassemble carburetor, check condition of lever and replace if bent.
8. Compressed carburetor inlet valve control spring—disassemble carburetor, check spring and replace if compressed.
9. Dirty air filter—check condition of air filter and clean or replace with new filter if necessary.

Tightening cylinder head screws to their correct torque value is especially important because if the screws are not tight enough, they can loosen under vibration and the alternate heating and cooling of intermittent operation. If the screws are tightened too much, the cylinder wall may be bulged and interfere with the operation of the piston. Such interference will lead to a hot spot or a spot where friction is so great that the engine can be damaged. The correct way to install cylinder head screws is to turn them in until they are just tight. Then torque them to the correct value, going from the screw on one side of the cylinder head to the screw on the other side. Cross from side to side as you do when tightening wheel nuts after changing a flat tire.

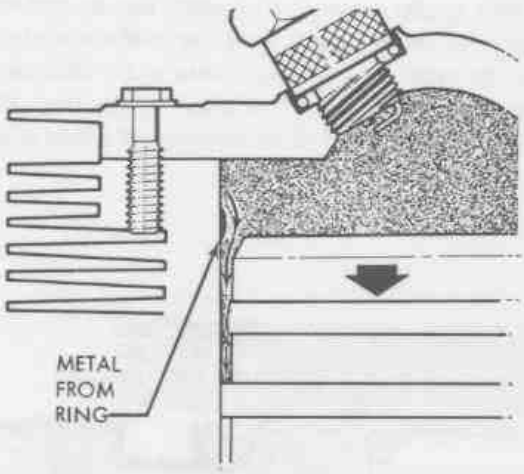



The most serious cause of lack of power and poor compression is worn rings, piston and cylinder because these involve an engine tear-down and possibly complete overhaul.

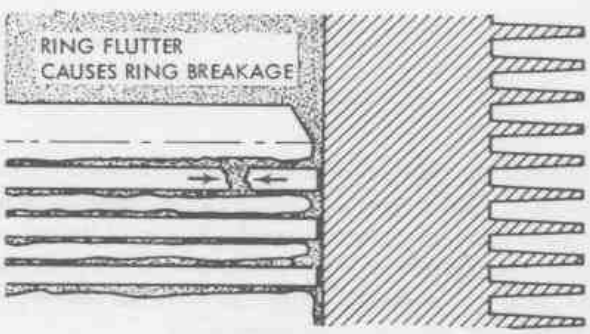



The condition of the rings and piston can be checked by removing the muffler and looking at them through the exhaust ports. If the rings or piston are scuffed or show signs of excessive wear, the cylinder head should be removed and the piston taken out for further examination.

Hot spots, caused by excessive friction, bulging metal or overheating, cause the ring and cylinder wall to weld together. Since the piston keeps moving, it pulls the ring free but some of the metal remains behind attached to the cylinder wall. The continued movement of the ring causes the area around the scuffed spot to become burnished and excessively worn and the damaged ring can be so weakened that compression and combustion pressures blow by.




Excessive piston ring wear can be seen through the exhaust ports as too-wide an end gap of the piston rings or as a



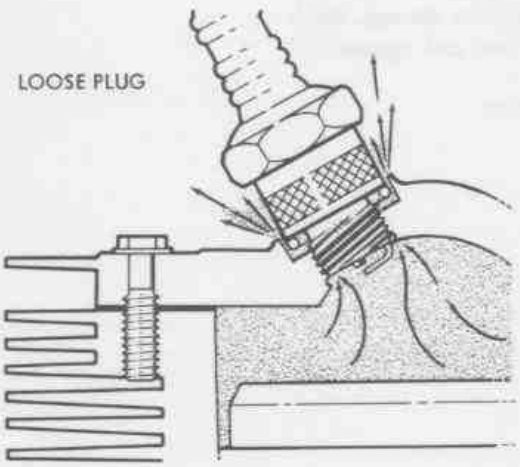
# CHECKING FOR LOSS OF POWER

Although the primary cause of loss of power is poor compression, loss of power can also be caused by overheating, a dirty muffler and a malfunctioning or incorrectly adjusted carburetor. Loss of power caused by the carburetor is discussed in the section headed "Checking the Carburetor and Fuel System." The other three causes are discussed in this section.

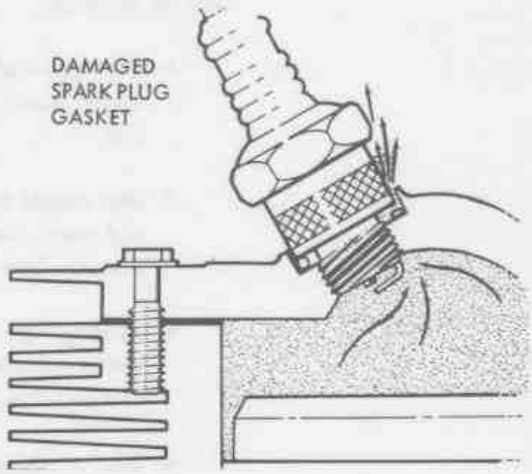
| COMPRESSION |
|---|
| • OVERHEATING |
| • DIRTY MUFFLER |
| • MALFUNCTIONING OR INCORRECTLY ADJUSTED CARBURETOR |

## POOR COMPRESSION

Poor compression can be caused by a loose spark plug, loose cylinder head screws, damaged or missing spark plug or cylinder head gaskets and by wear.

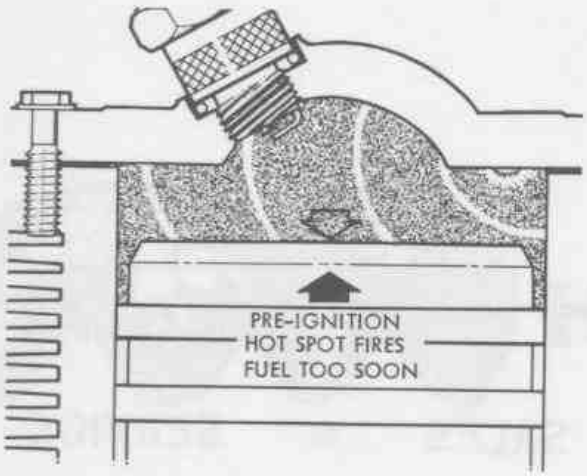



A loose spark plug allows part of the fuel charge to escape past the spark plug during compression so that when the spark is fired only part of the fuel charge is left in the combustion chamber. As soon as the fuel charge is ignited and begins to burn, combustion pressures drive some of the burned gases out of the chamber past the plug and less pressure remains to drive the piston downward. Loose cylinder head screws let the fuel charge escape between the cylinder head and the crankcase during compression just as the loose spark plug does. A loose spark plug will run hot because the heat of combustion cannot escape from the plug to the cylinder head very easily.

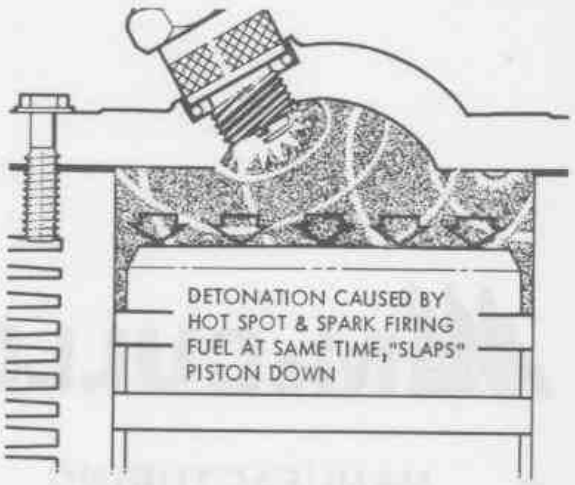



Damaged or missing spark plug or cylinder head gaskets leak during compression and may blow out under combustion pressures. The spark plug gasket is made of thin copper formed into a ring. If one side of the ring is pinched or compressed more than the other side, the ring cannot seal the fuel charge or combustion pressures in the combustion chamber. The metal gasket between the crankcase and cylinder head of McCulloch chain saws is not easily damaged, but it can take on the impression of the crankcase and cylinder head mating surfaces when the cylinder head screws are tightened. If the gasket is re-installed in a different position or even upside down, it may not seal properly. For these two reasons, new spark plug and cylinder head gaskets should always be used and the old ones discarded.

Pre-ignition is the term for combustion caused by a glowing carbon particle or by a hot spot, before the spark is timed to fire the fuel charge. It causes loss of power because the too-early combustion pressures try to drive the piston down while the crankshaft and flywheel are driving it up. So, pre-ignition only succeeds in slowing the piston down.




Detonation is the term for combustion caused by a glowing carbon particle or by a hot spot, at the same time as the spark fires the fuel charge. Instead of a smooth wave of burning which results in lots of power, detonation causes at least two waves and the fuel charge is burned too quickly, releasing all the power at once. The excessive heat and pressure tries to "slap" the piston down instead of shoving it. The slap is heard every time an engine "pings."




To prevent overheating due to lack of cooling, remove the dirt from all the cooling surfaces of the engine and especially from the cooling fins on the crankcase and cylinder head.

* * *

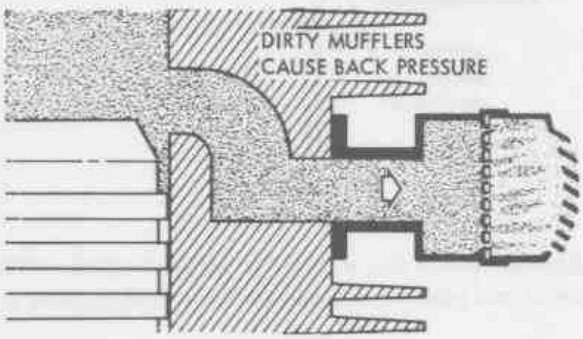
This booklet has had a great deal of information compressed into a very few pages. Knowledge of how an engine, its carburetor and its ignition system operate is almost essential if troubleshooting is to become simple and easy-to-do. It is our hope that through this booklet we have helped you to understand a little more about the two-cycle gasoline engine—the finest small power package in the world today!

rounded-over contact surface. Excessive end gap and rounded contact surfaces (rather than flat) permit blow-by also.

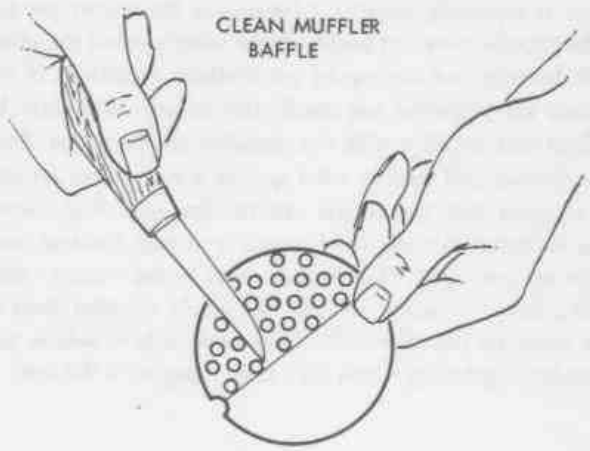
Sometimes new rings can't end poor compression. If the ring grooves on the piston are worn, pressure can move around behind the piston rings. If the ring grooves are badly worn, the new rings may begin to flutter and will eventually break. Part of the broken ring may jam between the piston and cylinder wall and gouge both of them. Thus a simple repair can become a major overhaul. When installing new rings, make sure a new piston isn't needed also.

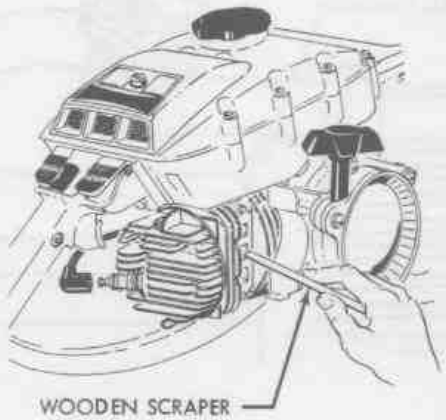
## LOSS OF POWER DUE TO DIRTY MUFFLER

A dirty muffler causes loss of power because it slows the discharge of exhaust gases from the combustion chamber. When the gases are forced to remain in the chamber, they occupy room which should be taken by the fresh charge. Without a full charge, full development of power is impossible.




The cure for a dirty muffler is to clean it. Remove it from the engine, take it apart and scrape all the openings clean. To clean carbon from around the exhaust ports of the engine, turn the crankshaft until the piston covers the ports and clean them with a wooden scraper. Blow all the carbon particles and dirt away with compressed air.




Running a chain saw without a muffler is dangerous. Not only can it cause fire in timberland, but it permits the piston to suck dirt and air back into the combustion chamber. The air leans out the fuel charge and the dirt wears out the piston rings, piston and cylinder wall.

## OVERHEATING

The main causes of overheating are a leaned-out fuel charge and dirt on the cooling surfaces of the engine. Improper oil or not enough oil in the fuel mixture can also cause friction which in turn leads to overheating. Overheating results in loss of power because it permits and leads to pre-ignition and detonation.