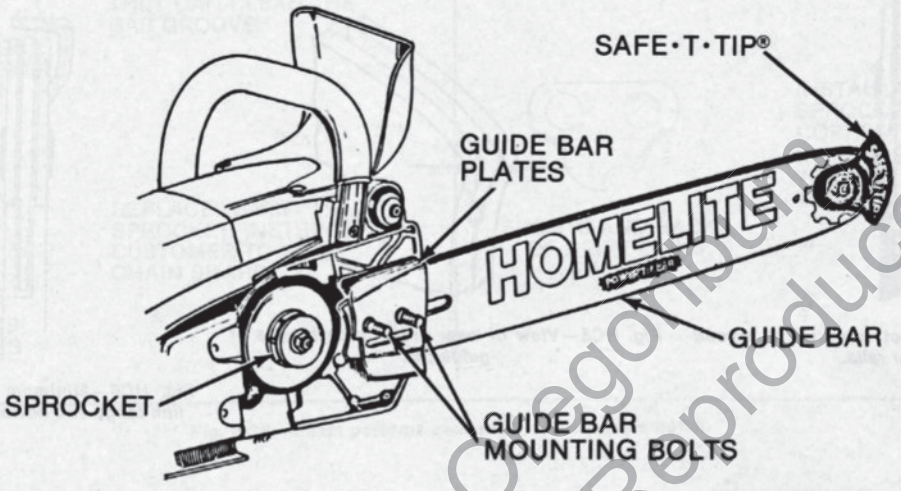
NOTES

HOMELITE

SAW CHAINS, BARS AND SPROCKETS



A CHAINLESS PICTURE OF A SAW CHAIN. TO EMPHASIZE THAT CHAIN UPKEEP SHOULD BEGIN WITH A THOROUGH EXAMINATION OF THE GUIDE BAR AND SPROCKET, THE CHAIN WAS LEFT OUT OF THE PICTURE.

TROUBLE DIAGNOSES

Question: HOW MUCH SPROCKET WEAR IS TOO MUCH?

Answer: It depends on the following circumstances:

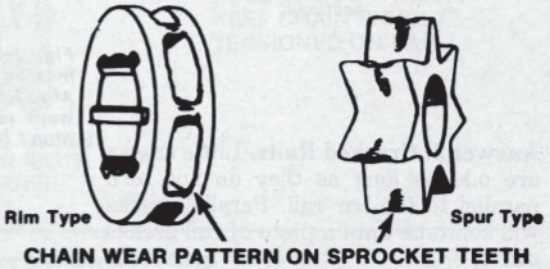
a) A sprocket is unserviceable when either the points of the chain drive link tangs become bent from "bottoming" against the sprocket, or when "slop" (too much space between the chain drive links and the sprocket teeth) allows the sprocket to pound the chain as illustrated in Fig. HC8.

b) Sprocket wear is difficult to measure, particularly when the sprocket is a rim type where the wear is inside the rims. (See Fig. HC1). Perhaps, sprocket tooth wear to a depth of two millimeters would produce the kinds of chain damage described above and illustrated in Fig. HC8. The normal service life of a sprocket is deemed to be twice that of a saw chain. Accordingly, a careful appraisal of the sprocket and old chain should be made when the first chain is being replaced. Note whether the sprocket damaged the chain. If you find no damage, examine the wear patterns on the sprocket teeth to see whether keeping the old sprocket in service is worthwhile. Remember this about the question of sprocket serviceability:

If in doubt, take it out.

c) When the clutch drum and sprocket are an integral assembly, the condition of the drum and the bearing as well as that of the sprocket must be taken into account.

Fig. HC1—View of wear areas on rim and spur type sprockets.



CHAIN WEAR PATTERN ON SPROCKET TEETH

Question: WHAT BAR TROUBLES SHOULD BE LOOKED FOR?

Answer 1: Bent bar. It will retard cutting, wear the chain drive links, and cause jumping out of the bar rails. If it can not be peened or bent back straight, discard the bar.

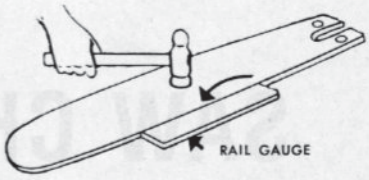


Fig. HC4—A screwdriver may be used to spread pinched guide bar rails. Insert a filler strip of drive link tang thickness and peen the guide bar rails to close rails which are spread.

Fig. HC2—Chain will not run true in spread guide bar rails.

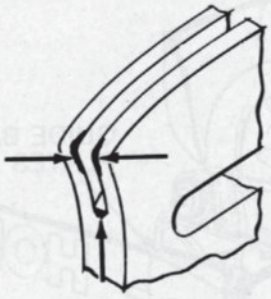


Fig. HC5—View of wear areas in entry area of guide bar.

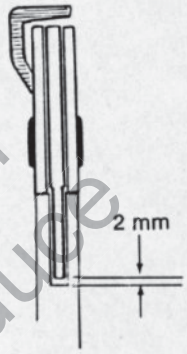


Fig. HC6—Minimum clearance between drive link tangs and bottom of bar groove is 2 mm.

Answer 2: Pinched or spread bar rails. Chain will run cocked to one side, or will not cut when the rails are too wide apart. Local peening of the rails after insertion of a filler strip of drive link tang thickness in the slot between the rails may restore pinched areas to normal clearance. Pinched rail areas can be spread to normal clearance with a screwdriver as shown in Fig. HC4.

Answer 4: Entry point of chain: The chain may not enter the bar groove smoothly if a bar with the wrong tail stock configuration was substituted for the original bar. Usually, however, peening of the chain against the bar, jumping off, and peening of the fronts of the chain tie-straps comes mostly from *too loose chain tension*. The *customer* should be warned about that, and shown how much tension is proper.

Answer 5: Shallow groove (Worn bar rails): Solid construction bars can often be ground (by bar shop) if the chain is not resting on top of sawdust packed in the groove. Clearance between drive link tangs and bottom of groove should be at least (2 mm) all around bar. NOTE: Bottoms of tangs will show wear from contact.

Answer 6: Unevenly worn bar rails: Owners manuals show these rail conditions, so there is no need to go into it in detail here. All these wear patterns can be due to improper chain tensioning or failure to maintain equal filing angles, cutter lengths or gauge depths. All you can do here is correct the damage, if possible, and tell the customer that a repeat of the damage can be avoided through proper chain filing and maintenance of proper tension.

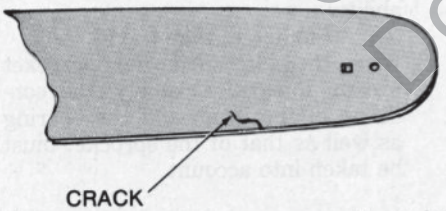


Fig. HC3—A cracked bar may be serviceable if parallel cracks do not result in broken off rail sections.

Answer 3: Cracked Rails. Little cracks are o.k. as long as they do not turn parallel to the bar rail. Parallel cracks will continue until a piece of rail breaks off.

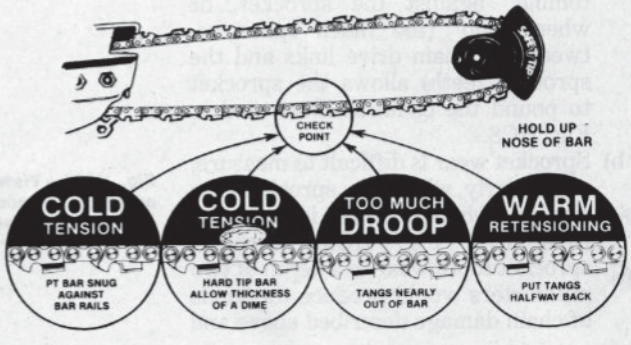


Fig. HC7—Chain tension may be checked as shown. After warm retensioning, always reset proper tension after chain has become "cold".

Condition	Procedure
 WORN, PEENED TIE-STRAP NOTCHES	EXAMINE FOR WORN SPROCKET
 DRIVE LINK TANGS BENT FORWARD FROM BOTTOMING IN SPROCKET	REPLACE SPROCKET FILE TANGS SO THEY CAN CLEAN THE BAR GROOVE.
 PEENED BACKS OF DRIVE LINKS	REPLACE WORN SPROCKET. INSTRUCT CUSTOMER TO KEEP CHAIN SHARP.

Condition	Procedure
 BACKS AND BOTTOMS OF DRIVE LINKS PEENED	REPLACE WORN SPROCKET. INSTRUCT CUSTOMER NOT TO RUN CHAIN "LOOSE."
 FRONTS AND BACKS OF DRIVE LINKS PEENED	INSTALL NEW SPROCKET OF CORRECT PITCH. KEEP THE CHAIN TENSION A BIT TIGHTER.

Fig. HC8—Chain patterns caused by sprocket mismatch.

Condition	Procedure
 BACKS NICKED SLIGHTLY	SHOW CUSTOMER HOW TO PROPERLY TENSION CHAIN
  FRONT OF DRIVE LINKS AND TIE-STRAPS PEENED	INCREASE TENSION. ALSO CHECK BAR RAILS FOR SMOOTHLY CHANNELED CHAIN ENTRY GROOVE.
 TANGS SCARRED FROM CHAIN JUMPING OFF BAR	TO PREVENT CHAIN FROM JUMPING OFF BAR REFILE CUTTERS TO UNIFORM ANGLES AND LENGTHS. MAKE SURE TOP PLATE ANGLE DOES NOT EXCEED 35°. TENSION CHAIN PROPERLY.

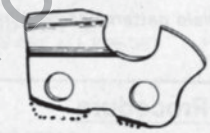
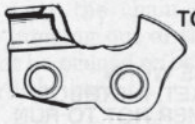
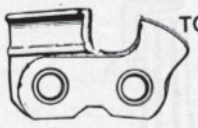
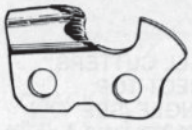
Condition	Procedure
 MOSTLY HEEL WEAR	SHARPEN CHAIN MORE OFTEN. TIGHTEN CHAIN TENSION. DO NOT KEEP DEPTH GAUGES SO LOW.
 CONCAVE BOTTOM WEAR	REDUCE CHAIN TENSION. KEEP CHAIN IN SHARPER CONDITION. AVOID HEAVY FEED PRESSURE TO CUT.
 DRIVE TANGS WORN, BOTH SIDES	REFILE ALL CUTTERS TO CORRECT TOP PLATE ANGLE (SEE FIG. HC28) TO REDUCE SIDE THRUST. KEEP CHAIN SNUGLY TENSIONED ON BAR.

Fig. HC9—Chain patterns caused by wrong tension or improper chain filing.

Condition	Procedure
BACKSLOPED AND BLUNT TOO LOW  EXCESSIVE HEEL WEAR	CORRECTIVELY FILE CUTTERS TO REDUCE GAUGE DEPTH. REMOVE BACK SLOPE AND INCREASE TOP PLATE ANGLE TO 35° AND CUTTING EDGE TO 60°. INCREASE CHAIN TENSION A BIT.
DULL OR BLUNT TOO HIGH  BOTTOM WEAR	REPLACE CHAIN. MAINTAIN PROPER (LOWER) DEPTH GAUGE SETTING OF NEW CHAIN. KEEP CHAIN SHARP AND FILED TO PROPER EDGE ANGLE.
 BOTTOMS PEENED AND BURRED	REFILE CHAIN TO ELIMINATE EXCESSIVE HOOK AND RESTORE PROPER TOOTH EDGE LEVEL OF 60°. FILE CHAIN MORE OFTEN TO MAINTAIN SHARPNESS.
HOOKED TOOTH THIN EDGE  REARS CRACKED	REPLACE CHAIN. FILE CHAIN TO ELIMINATE HOOK WHICH CAUSES CRACKS. KEEP CHAIN SHARP.

Condition	Procedure
TOO LITTLE DEPTH  FRONTS CRACKED	REPLACE CHAIN. KEEP GAUGES OF NEW CHAIN AT PROPER DEPTH SETTING.
 CRACKS UNDER FRONT AND REAR RIVETS	REPLACE CHAIN. KEEP NEW CHAIN SHARP AND PROPERLY TENSIONED (NOT TOO TIGHT ON BAR). LOWER DEPTH GAUGES TO PROPER HEIGHT.
 DRIVE LINKS WORN ONE SIDE	FILE LEFT AND RIGHT CUTTERS TO SAME ANGLES, CUTTER TOP PLATE LENGTHS AND UNIFORM GAUGE DEPTHS. ALSO CHECK THAT BAR RAILS ARE SAME HEIGHT

Fig. HC10—Chain patterns caused by wrong or irregular filing angles and gauge depths.

Condition	Procedure
 FRONTS OF RIVETS WORN, POLISHED	AVOID CUTTING INTO THE GROUND OR CUTTING DIRTY WOOD. USE SAFE·T·TIP® DEVICE TO PROTECT CHAIN
 SKID-NOSE WEAR CUTTING EDGES ABRADED	FILE TO REMOVE ENTIRE SKID-NOSE PORTION OF THE TEETH.
DULL CHAIN CUTTING EDGES BROKEN	CUT ONLY CLEAN WOOD, NO DIRT. NO NAILS, NO STONES.

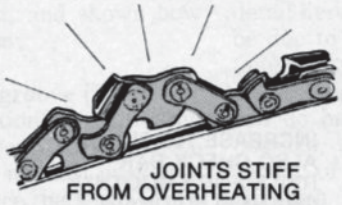
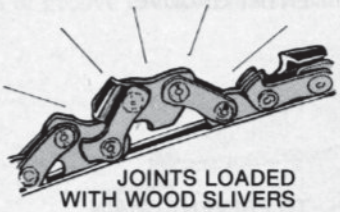
Condition	Procedure
 JOINTS STIFF FROM OVERHEATING	CHECK FOR PROPER FLOW OF OIL TO CHAIN. DO NOT CINCH CHAIN UP TIGHT ON BAR. WEAR IN NEW CHAIN WITH EXCESS OF OIL AND LIGHT FEED PRESSURE.
 JOINTS LOADED WITH WOOD SLIVERS	PENALTY FOR BORING OR RIP-CUTTING WITH THE GRAIN IN SOME TYPES OF WOOD. SOAK CHAIN IN LIGHT OIL. WORK JOINTS LOOSE.
 CHAIN STRETCHED. TOO LIMBER IN THE JOINTS	ABRASION, SPROCKET WEAR, BAR WEAR, ETC. TAKING THEIR TOLL ON THE CHAIN.

Fig. HC11—Chain conditions caused by abrasives or insufficient lubrication.

CHAIN CONSTRUCTION AND NOMENCLATURE

1. DRIVE LINK: THE LINK THAT IS DRIVEN BY THE DRIVE SPROCKET.

a) The back is slanted for contact against sprocket. Nicks and pounding marks indicate trouble such as pitch mismatch, too loose tension.

b) Tang portion is part that rides in bar groove. Side wear comes from loose chain, worn bar groove ("hour glass"), abrasive dirt.

c) Tang should be pointed. Not every tang has to be sharply pointed, but enough tangs should be sharp to keep sawdust from caking up in the bar groove. Tang points bent forward show chain is bottoming on worn sprocket. Peened, pounded, broken rear edges suggest sprocket is worn, or chain was too dull or run too loosely. See whether entry of bar is also scarred. Jumping off bar scars the sides of drive link tangs. Broken tangs occur from cinching chain up too tightly for a long time until the sprocket teeth are worn and the tangs break off against them.

d) Many types of chain have coined drive links. Coining is the process of pressing or stamping part of the metal to a narrower dimension than the original dimension. If the tang of a drive link has been coined, this thickness is the normal gauge of the saw chain. Your responsibility as a chain repairman is to be sure to use only the correct replacement parts.

e) Homelite® Raker III Saw Chain has two drive links, one with a coined depth gauge projection, and the other without it. The gaugeless drive links of 38ME50 Raker III chain also fit 38M series semi-chisel chain. The same interchangeability of tie-straps and drive links exists for type R37M50, R37ME50 Raker III and type R37C50 chains.

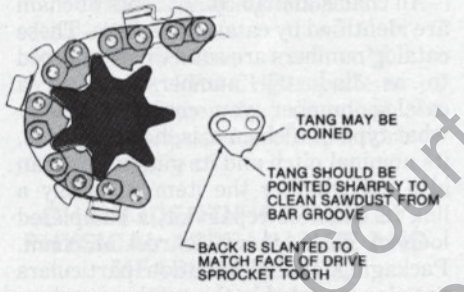
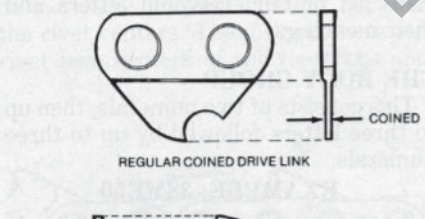


Fig. HC12— Note the areas shown above when inspecting drive links.



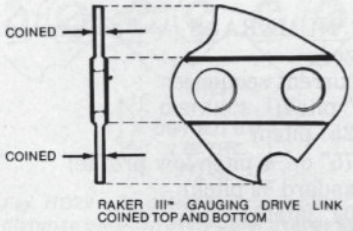


Fig. HC13— View of coined areas on drive links.

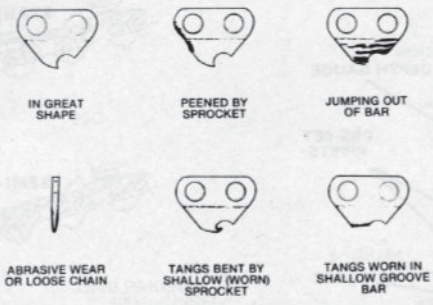
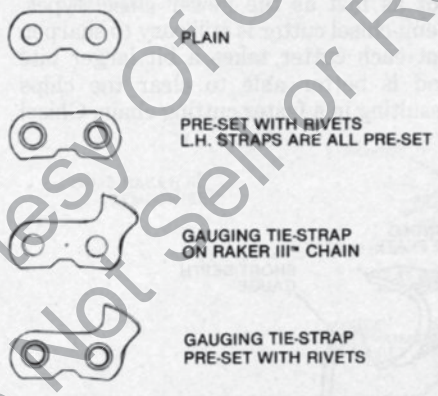


Fig. HC14— Some common problem areas on drive links are shown above.

2. TIE-STRAP: THE LINKS WHICH CONNECT THE DRIVE LINKS TOGETHER TO FORM THE LOOP OF CHAIN.



ON RAKER III™ CHAIN A GAUGING STRAP AND A CUTTER ARE PAIRED.

Fig. HC15— View of various types of tie-straps.

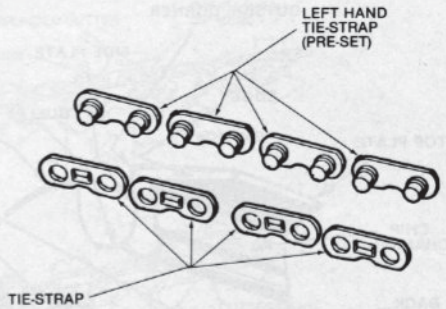


Fig. HC16— View showing right and left hand tie-straps. All left hand tie-straps have pre-set rivets.

a) Variations. Refer to Fig. HC15 for view of various types of tie-straps.

b) The construction order is that each end of one drive link is riveted between two tie-straps. Exception: When a cutter is put into the sequence then one L.H. (left-hand) cutter replaces one tie-strap on the left side, and a R.H. cutter replaces one tie-strap on the right side in the next sequence.

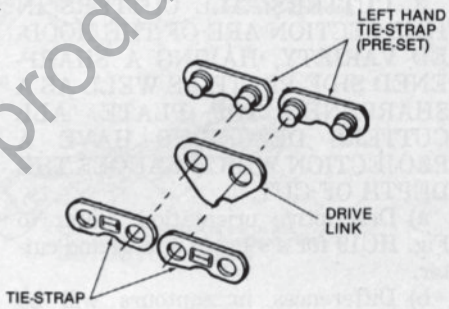


Fig. HC17— View showing right and left hand tie-straps with a drive link.

c) Tie-straps are subject to wear and breakage. Worn rivets display abrasion damage which may also be apparent on the tie-strap bottoms, cutter plates and edges, and drive link tangs. Cracks under the rivets come from combinations of wrong side plate angles, chronic cutter dullness or thin feathery cutting edges, and leaving depth gauges much too high.

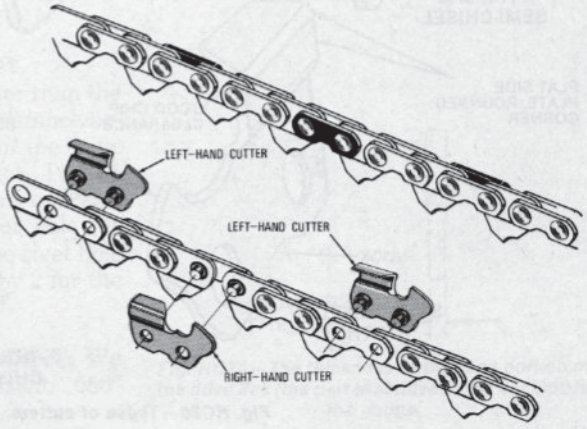


Fig. HC18— The top length of chain shown consists of tie straps and drive links. The bottom length of chain shows where cutters are installed in place of tie straps to form a cutting saw chain.

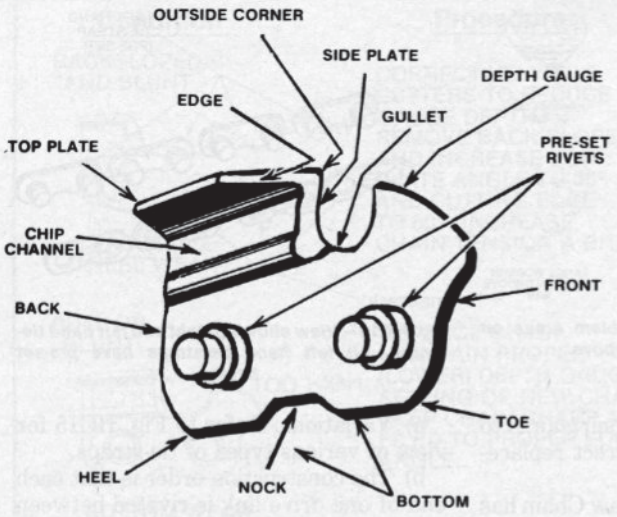


Fig. HC19— View of pre-set left-hand cutter.

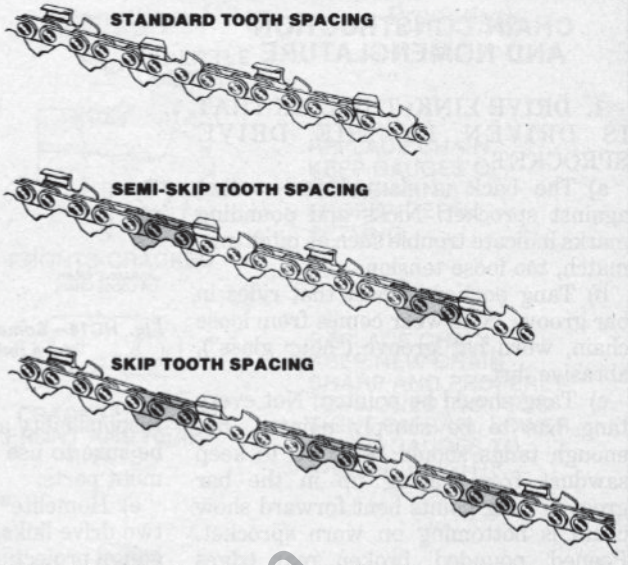


Fig. HC21— View showing various configurations of cutter spacing.

3. CUTTERS: ALL CUTTERS IN THIS SECTION ARE OF THE HOODED VARIETY, HAVING A SHARPENED SIDE PLATE AS WELL AS A SHARPENED TOP PLATE. ALL CUTTERS DESCRIBED HAVE A PROJECTION WHICH GAUGES THE DEPTH OF CUT.

a) Descriptive orientation. Refer to Fig. HC19 for a view of a left-hand cutter.

b) Differences in contours will be noticed from chain to chain. Some of these make a functional difference and others are purely evolvements of the engineers and designers who conceive them. Note types of cutters in Fig. HC20. Chipper cutter is easy to sharpen and edge holds up well, however, it is not as fast as the newer chisel types. Semi-chisel cutter is still easy to sharpen but each cutter takes a bit larger bite and is better able to clear the chips resulting in a faster cutting chain. Chisel cutter is fastest cutting type but will dull more rapidly. All Homelite branded saw chains are sharpened with a round file.

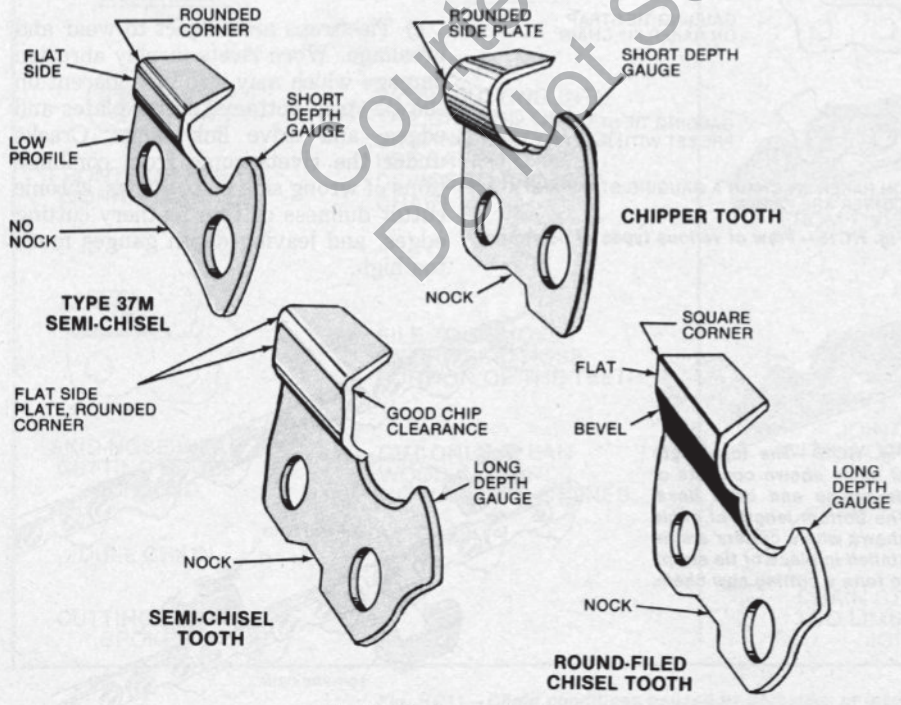


Fig. HC20— Types of cutters.

CHAIN IDENTIFICATION BY CATALOG NUMBERS

This is a typical catalog number describing one type of chain:

DR-37ME50-42

All chains and all components of chain are identified by catalog numbers. These catalog numbers are sometimes referred to as "industry numbers." From a catalog number you can tell exactly what type of a chain it is, how long it is, its nominal pitch and its gauge. You can also tell whether the item is merely a link of chain or repair kit, a completed loop of chain or whole reel of chain. Packaging and distribution particulars are also revealed in the catalog number. A prefix letter "D," for example, means "blister packed." Here is a more complete list of numerals and letters and their meanings:

THE BODY GROUP

This consists of two numerals, then up to three letters followed by up to three numerals.

EXAMPLE: 38ME50

FIRST NUMERALS = designated chain size.

This is current sequence:

25 (¼" pitch)
32 (.325" pitch)
37 (.375" or ⅜ pitch low profile)
38 (standard ⅜ pitch)
40 (.404" pitch)
50 (½" pitch)

MIDDLE LETTERS = design, style or type of chain. See Fig. HC20 and HC21. Letters currently in use include:

C (chipper)
E (3 depth gauges as in Raker III™ chain)
J (Skip-tooth construction sequence)
K (Semi-Skip tooth)
L (Chisel)
M (Semi-Chisel)

THE LAST NUMERALS = gauge of the drive links in thousandths of an inch. Homelite® chain gauges are as follows:

50 (.050" gauge)
63 (.063" gauge)

PREFIXES TO THE CATALOG NUMBER

D = blister packed
R = contoured for narrow nose bar.

SUFFIXES TO THE CATALOG NUMBER (coming after a dash)

-xx = any two or three numerals immediately following the dash gives the number of drive links in the loop of chain.
-7 = a repair kit.
-7E = a repair kit—"low profile" designation.
-7G = a repair kit—"low profile" PRO-CUT® Chain designation.
-8 = a joining kit.
-8 = a joining kit—"low profile" designation.
-8G = a joining kit—"low profile" PRO-CUT® chain designation.
-R25 = 25 foot reel
-R50 = 50 foot reel
-xxxCN = PRO-CUT® pattern of chain, otherwise described by main body and prefix portions of the number.

CHAIN IDENTIFICATION BY PHYSICAL APPEARANCE AND MEASUREMENTS

BY PITCH MEASUREMENT: Unlike bicycle chains, modern saw chains do not have uniform spacing between the rivet centers. The distance between rivet hole centers of the tie-straps and cutters of saw chains is greater than the true pitch of the chain. The distance between the rivet hole centers of the drive links is less than the true pitch. To find the true pitch of a saw chain, measure from the center of one rivet hole (or rivet head) to the center of the rivet hole two rivets away. Divide this by 2 for the pitch.

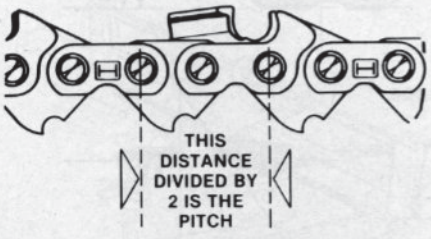


Fig. HC22—To determine chain pitch, measure distance between every other rivet as shown and divide by 2.

BY GAUGE MEASUREMENT: We have only two gauges at present: .050" and .063".

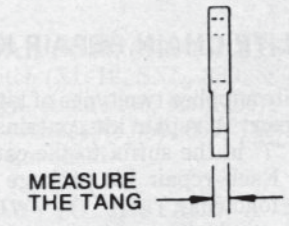


Fig. HC24—The thickness of the tang portion of the drive link (the part that rides in the bar slot) is the gauge.

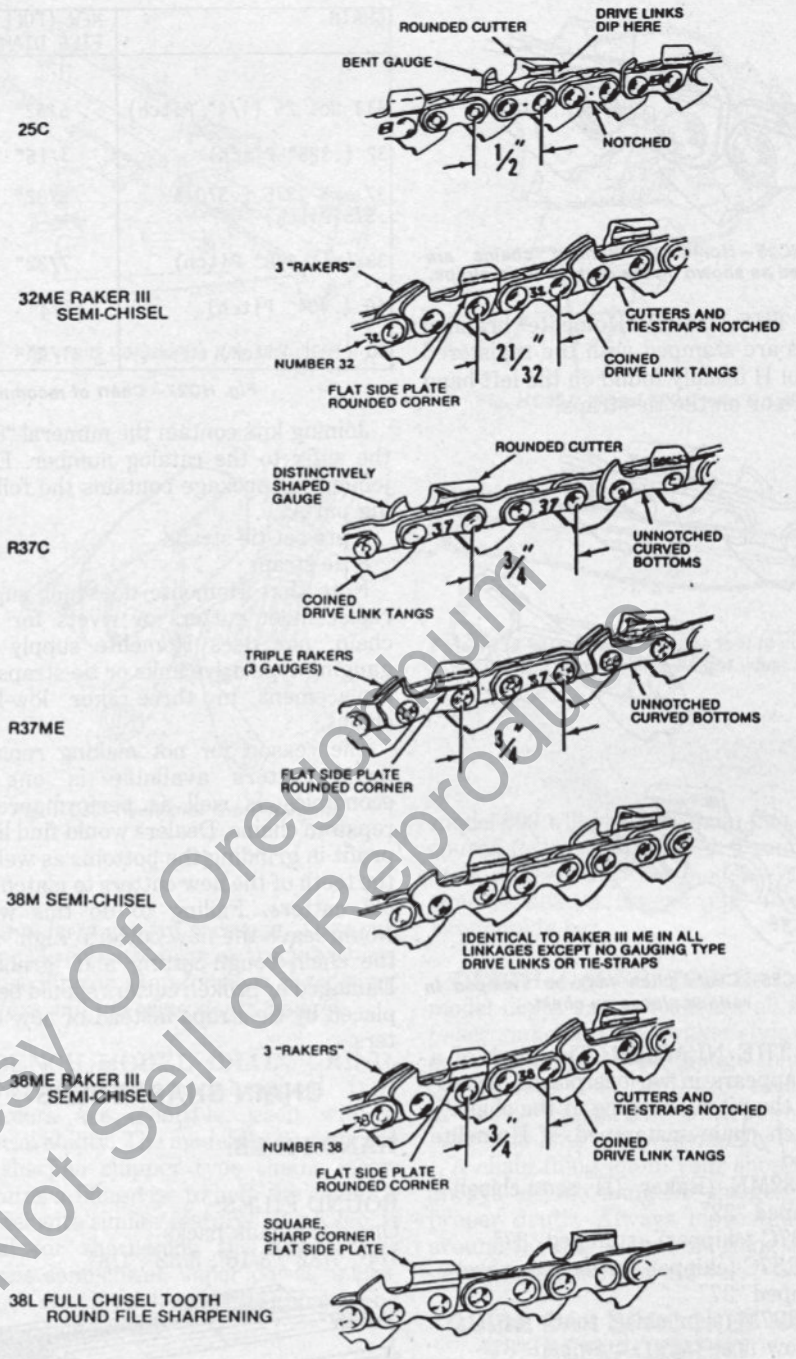


Fig. HC23—View showing various types of Homelite® chain and their identifying features.

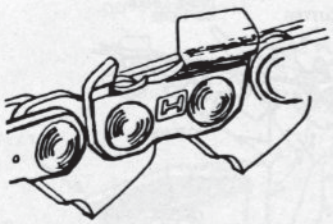


Fig. HC25—Homelite® branded chains are stamped as shown on the cutters or tie straps.

BY THE LABEL: Homelite® branded chains are stamped with the registered symbol H usually found on the left-hand cutters or on the tie-straps.

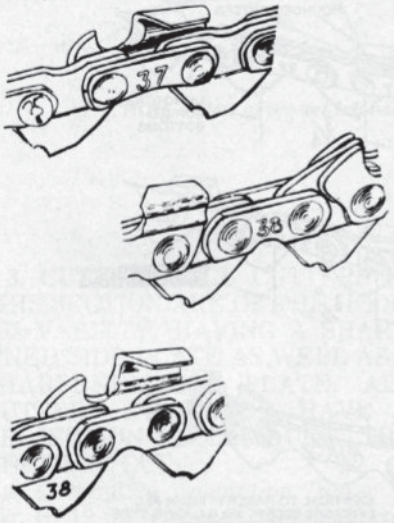


Fig. HC26—Chain pitch may be stamped in various places on chain.

BY THE NUMBER: The pitch of a chain appears in various places according to the pitch and type of the chain.
¼" pitch chain-unstamped, if Homelite brand.
Type 32ME (Raker III semi-chisel)—stamped "32"
Type 37C (chipper)—stamped "37"
Type R37C (chipper for narrow nose)—stamped "37"
Type R37M (semi-chisel tooth for narrow nose bars)—stamped "37"
Type R37ME50 (Raker III semi-chisel tooth for narrow nose bars)—stamped "37" on left drive links or tie-straps
Type 38C, 38M, 38L—stamped "38"
Type 40—stamped "40"
BY THE CONFIGURATION: See Fig. HC26.

HOMELITE CHAIN REPAIR KITS

Homelite supplies two types of kits for chain repair. A repair kit contains the numeral "7" in the suffix to the catalog number. Each repair kit package contains the following:
one drive link.
two preset tie-straps.
two plain tie-straps.

CHAIN	NEW (FULL LENGTH TOOTH) FILE DIAMETERS	DIAMETER WHEN LESS THAN HALF CHAIN LIFE REMAINS
All No. 25 (1/4" Pitch)	5/32" (4 mm)	1/8" (3.2 mm)
32 (.325" Pitch)	3/16" (4.8 mm)	5/32" (4 mm)
37 and .375 (.370 & .375 Pitch)	5/32" (4 mm)	1/8" (3.2 mm)
38 (all 3/8" Pitch)	7/32" (5.5 mm)	3/16" (4.8 mm)
40 (.404" Pitch)	1/4" (6.4 mm)	7/32" (5.5 mm)
50 (1/2" Pitch)	1/4" (6.4 mm)	7/32" (5.5 mm)

Fig. HC27—Chart of recommended file sizes when sharpening chain.

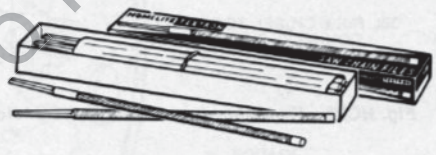
Joining kits contain the numeral "8" in the sufix to the catalog number. Each joining kit package contains the following parts:
8 pre-set tie-straps
8 tie-straps
Note that Homelite does not supply replacement cutters or rivets for any chain, nor does Homelite supply the gauging type drive links or tie-straps for replacement in three-raker low-kick chains.

The reason for not making replacement cutters available is one of economics as well as performance of repaired chains. Dealers would find little profit in grinding the bottoms as well as the teeth of the new cutters to match the old cutters. Failing to do this work would leave the new cutters "high" and the chain rough-cutting and "grabby." Damaged or broken cutters should be replaced by tie-straps instead of new cutters.

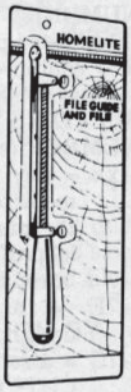
CHAIN SHARPENERS

HAND FILES:

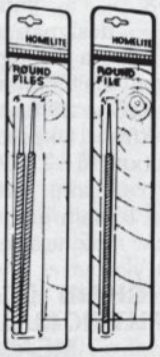
ROUND FILES:
One dozen bulk packs
1/4", 7/32", 3/16", 5/32", 1/8"



FILE AND GUIDES BLISTER PACKED IN THREE SIZES
5/32" dia.
7/32" dia.
1/4" dia.



ROUND FILES: BLISTER PACKED
5/32" dia. single pack
7/32" dia. single pack
5/32" double pack
7/32" double pack



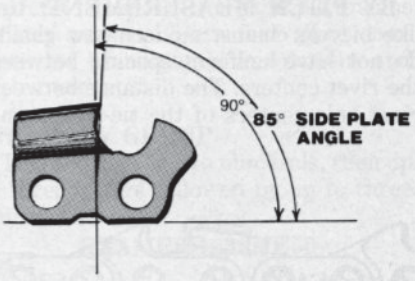
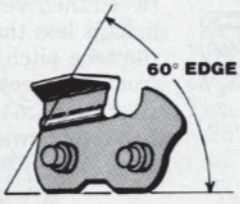
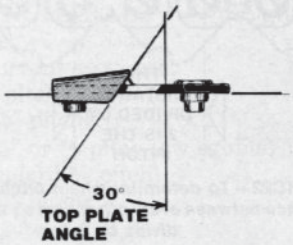


Fig. HC28—Recommended cutter sharpening angles. Top plate angle should be 30° for semi-chisel and chisel cutters, 35° for chipper cutters and 32° for Raker III® cutters.





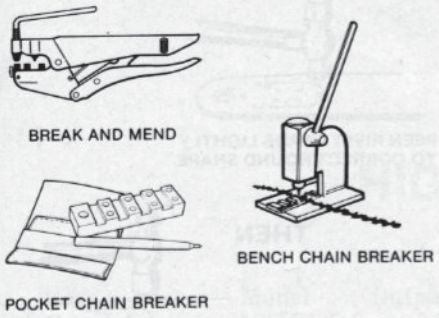


Fig. HC29—Types of chain breaker tools.

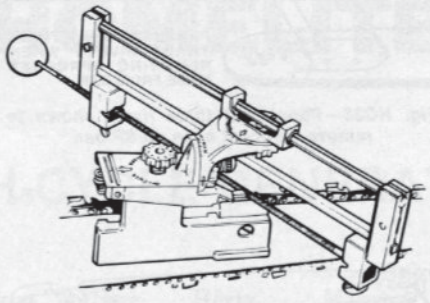


Fig. HC32—Homelite File-N-Guide®.

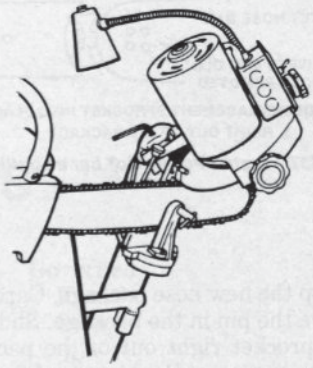


Fig. HC35—Model 600 Chain Grinder.

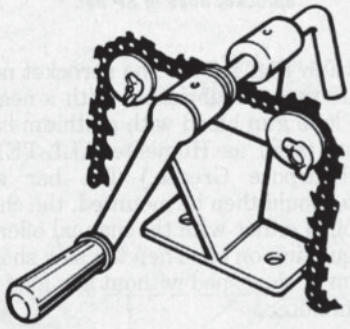


Fig. HC30—Homelite® Rivet Spinner.

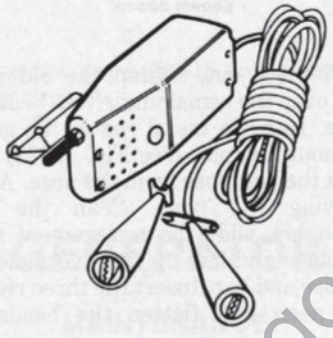


Fig. HC33—Homelite Grind-N-Joint®.

Fig. HC36—Use a depth gauge tool to accurately measure depth gauge height when filing.

FILE-N-JOINT® and FILE-N-GUIDE® FILE HOLDERS. These are file holders which clamp onto the guide bar. They are capable of being set for the exact filing angles, clearances and heights recommended for each chain.

They accommodate all 6" to 8" round chain saw files from 1/8" to 1/4" diameter. They also can be fitted with a 6-inch flat file for filing of the depth gauges.

GRIND-N-JOINT® CHAIN GRINDERS. These electric rotary files use replaceable grinding wheels available in the same diameters as our steel round files. The wheels are self-centering, screw into place, and can be tightened with only finger tip pressure. They can be powered with a car or truck battery, or used in the shop for both sharpening cutters and lowering depth gauges.

BENCH MODEL CHAIN GRINDERS. Various model wheel type grinders are available, each with a special ability. The model K-50, designed to sharpen chipper type chains incorporates a filing vise to hold the chain. A model with similar features, the K245, is ideal for sharpening the newer type chains semi-chisel, super chisel, micro-chisel, etc., as well as chipper chain. The model 600 will grind all chain that is contoured for sharpening with a round file. It is claimed that the model 600 saves time because it clamps onto the chain saw's guide bar.

DEPTH GAUGE TOOLS. Current model depth gauge tools are all slotted to accommodate three-raker style chains as well as single depth gauge chains.

Two sizes, .020" and .025" each come in blister backs. The other two sizes .030" and .035" are individually boxed.

A chain filing job in your shop should always include filing the gauges to the proper depth. Always move the chain around the bar so that the filing is done near the midpoint of the bar.

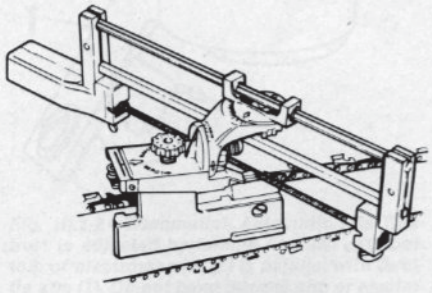


Fig. HC31—Homelite File-N-Joint®.

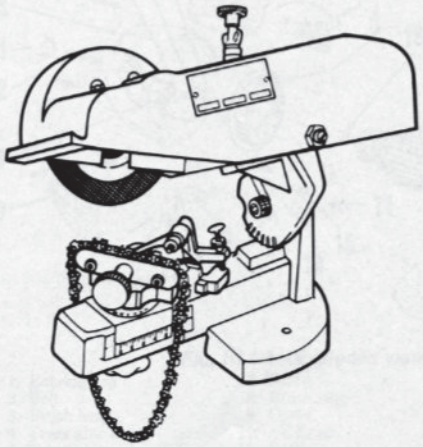


Fig. HC34—Model K245 Chain Grinder.

GUIDE BAR SPROCKET NOSE REPLACEMENT

POWER TIP® NOSE SPROCKETS
¼" pitch (early XL2)
.37" and .375" pitch (XEL, XL, XL2, Super 2 VI Super 2, 240 series)
⅜" pitch (150, SEZ, XL-12, SXL, 330, 360)

SP BAR NOSE SPROCKETS
⅜" pitch (XL-12, SXL, 330, 360, 410)
.050 ga. chain (450, 550, 750)
.404" pitch (450, 550, 650, 750)
.063" ga. chain

HOW TO INSTALL A POWER TIP® NOSE SPROCKET. Remove the retaining rivets and the old sprocket nose, thoroughly clean the bar nose.

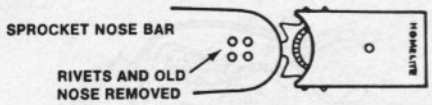


Fig. HC37—Install Power Tip® bar as outlined in text.

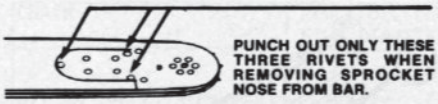
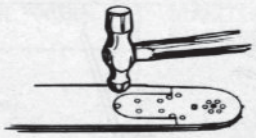


Fig. HC38—Punch out three rivets shown to remove sprocket nose on SP bar.



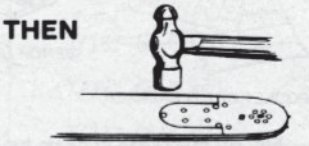


Fig. HC40—Peen and flatten rivets to fasten sprocket nose in SP bar.

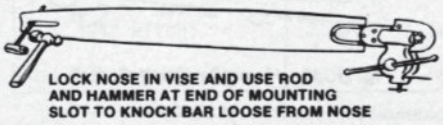


Fig. HC39—Separate sprocket nose from bar as shown above.

Pick up the new nose package. Carefully remove the pin in the package. Slide the new sprocket right out of the package into the bar nose. Be very careful not to let any of the bearings fall out of place during this maneuver. Put in the new rivets, peen lightly at first to a round shape, then flatten the heads against the bar. Grease sprocket.

HOW TO CHANGE AN SP BAR SPROCKET NOSE. The SP replacement nose comes with three aluminum rivets and is ready for use as soon as installed. Refer to Fig. HC38 for location of the three rivets to be removed from the old bar nose and bar. Drill through the centers of these three rivets and punch them out. Clamp the old nose right over the remaining rivets heads in a vise. Insert a metal rod in the guide bar mounting slot (see Fig. HC39) and knock the bar loose from the nose. After removing the nose, clean the bar thoroughly, slide the replacement nose into place and line up the rivet holes in the nose and bar. Insert the three rivets, then peen and flatten the heads as shown in Fig. HC40. The sprocket nose should then be lubricated with a needle nose lube gun lubed with a lithium base grease (such as Homelite ALL-TEMP Multi-purpose Grease.) The bar and chain should then be mounted, the chain pre-oiled either with the manual oiler or by squirting on oil. Then the saw should be run at slow sped without any load for one minute.

HOMELITE

HIGH-CYCLE GENERATORS

Model	Output-kw	Voltage	Hertz	Engine Make	Engine Model	Governed Rpm
185HY35-1	2.5	115vdc		B&S	243431	3600
	3.5	230vac	180			
190HY50-1	2.5	115vdc		B&S	243431	3600
	5.0	230vac	180			

The generators in this section produce 115 volt direct current and 3-phase, 180 Hertz, 230 volt alternating current.

GENERATOR

MAINTENANCE

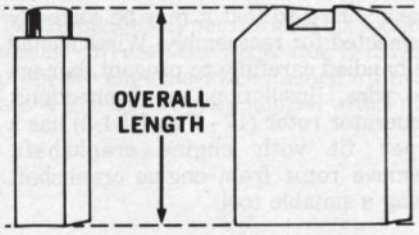


Fig. HL1-1—Measure brush length as shown.

BRUSHES. Twelve brushes are used in these generators; six are grouped around the DC commutator while two brushes contact each of the three AC collector rings. Brush assemblies may be inspected or removed by detaching brush head cover (9—Fig. HL1-3). Brushes should be marked if they are removed so they can be returned to their original positions. Check length of each brush as shown in Fig. HL1-1. Renew brush if length is 5/8 inch or shorter. Be sure to include length of projections for brush springs when measuring brush length.

If new brushes are required, use the following installation procedure: Wrap the commutator or collector ring with a medium grit (4/0 to 6/0) piece of garnet paper which will fit the commutator or collector ring. Install new brushes. Remove spark plug and use engine starter to rotate engine until brushes are seated. Remove brushes and install fine grit (8/0 to 9/0) garnet paper. Install

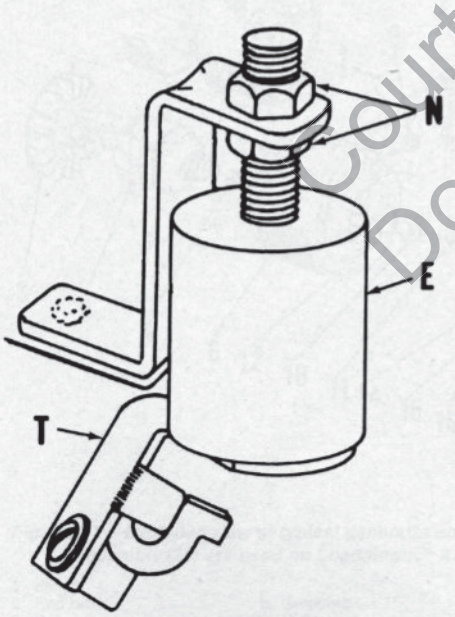


Fig. HL1-2—Loadmatic® Automatic Idle Control† is adjusted by turning nuts (N) until bottom of electromagnet (E) is parallel with throttle arm (T). Do not bend throttle arm or electromagnet bracket.

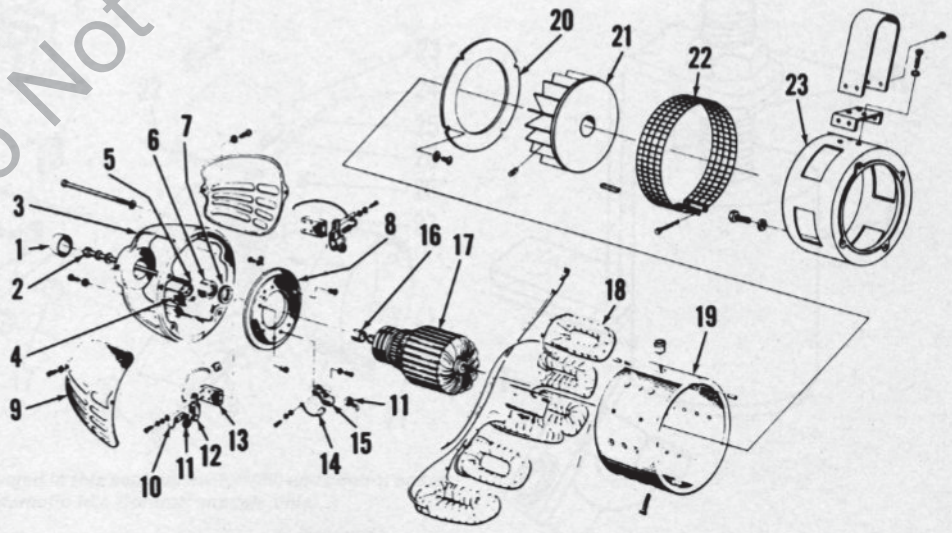


Fig. HL1-3—Exploded view of typical high-cycle generator.

1. Bearing cap
2. Bolt
3. Brush head
4. Transistor base
5. Transistor
6. Bearing
7. Seal
8. Brush ring
9. Cover
10. AC brush
11. Spring
12. AC brush holder
13. Brush holder block
14. DC brush
15. DC brush holder
16. Bearing race
17. Rotor
18. Field coil assy.
19. Housing
20. Baffle
21. Fan
22. Screen
23. Mounting ring

†Loadamatic® Automatic Idle Control system is covered by U.S. Patent No. 3,626,197.

brushes and repeat seating process. Remove brushes and garnet paper and install spark plug. Blow carbon and grit out of generator and install brushes.

LOADAMATIC®

Generator models 185HY35-1 and 190HY50-1 are equipped with a Loadamatic® Automatic Idle Control. An electromagnet is mounted adjacent to the engine's carburetor and acts on the carburetor throttle arm. When there is no load on the generator, the electromagnet is energized and the engine governor is overridden as the electromagnet pulls the carburetor throttle arm to idle position. The governor resumes control of engine speed when a load is imposed on the generator. The electromagnet is deenergized and the throttle arm is released to be controlled by the governor.

To adjust Loadamatic® Automatic Idle Control, proceed as follows: Refer to Fig. HL1-2 and adjust height of electromagnet parallel with throttle arm. Do not bend bracket or throttle arm to make this adjustment. Tighten electromagnet nuts. Position generator toggle switch to "START" to disengage idle control. Start engine and allow it to reach operating temperature. If necessary, adjust carburetor for proper mixture and speed. Flip toggle switch to "AUTO" position. Engine speed should reduce to idle speed. If idle speed is not steady, adjust carburetor idle mixture. Idle speed should be 2400-2600 rpm and is adjusted by loosening electromagnet nuts and altering position of electromagnet. Raising electromagnet will decrease engine speed while lowering electromagnet increases engine speed. Apply a light load to generator and then remove it. Engine speed should increase to governed speed and then return to idle after the load is removed.

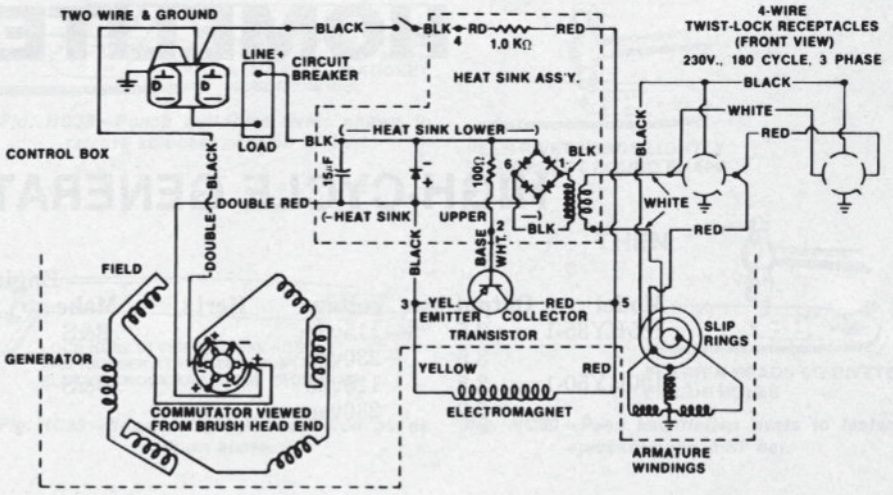


Fig. HL1-4—Schematic of high cycle generator.

OVERHAUL

DISASSEMBLY AND REASSEMBLY. Refer to Fig. HL1-3 for an exploded view of generator and to appropriate schematic in Fig. HL1-4. Be sure to mark wiring so that it may be correctly connected for reassembly. Wires should be handled carefully to prevent damage to wire, insulation or connections. Generator rotor (17—Fig. HL1-3) has a taper fit with engine crankshaft. Remove rotor from engine crankshaft using a suitable tool.

HOMELITE

VOLTAMATIC® AC GENERATORS*

Model	Output-kw	Voltage	Hertz	Engine Make	Engine Model	Governed Rpm
112A15-1	1.5	115	60	B&S	100232	3600
113A25-1	2.5	115	60	B&S	146432	3600
116A50-2	5.0	115/230	60	B&S	243431	3600
116A50-2L	5.0	115/230	60	B&S	243431	3600
118A35-1	3.5	115	60	Wisc.	S8D	3600
118A35-2	3.5	115/230	60	Wisc.	S8D	3600
119A35-1	3.5	115	60	B&S	200431	3600
119A35-1L	3.5	115	60	B&S	200431	3600
119A35-2	3.5	115/230	60	B&S	200431	3600
119A35-2L	3.5	115/230	60	B&S	200431	3600

The Homelite® Generators in this section are a rotating field type and produce alternating current. The generator is driven by the engine shown above. Refer to appropriate engine service manual for maintenance and overhaul of engine. All of the above generators are equipped with Voltamatic® control to regulate voltage.

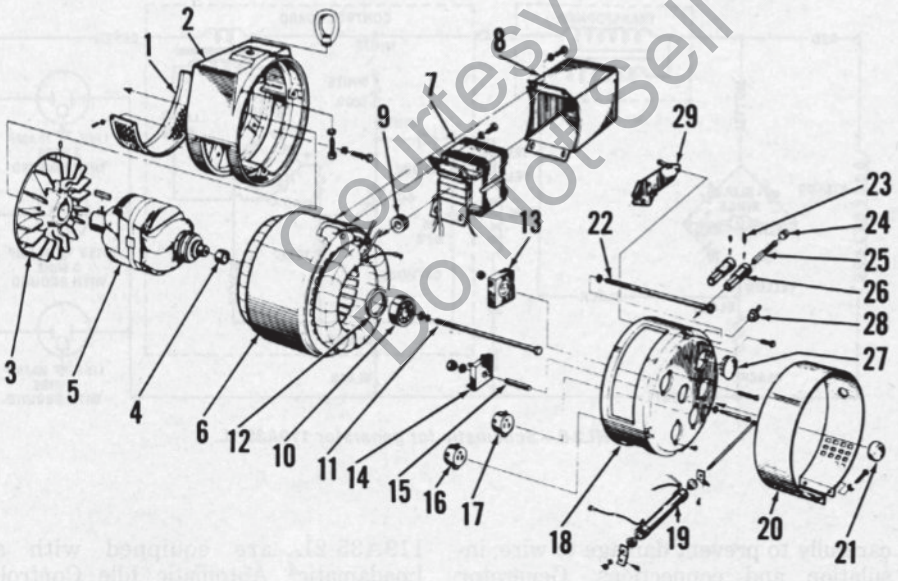


Fig. HL3-1 — Exploded view of typical generator covered in this section. Switch (28) and control board assembly (29) are used on Loadamatic® Automatic Idle Control† models only.

1. Shield
2. End bell
3. Fan
4. Inner race
5. Rotor
6. Stator
7. Transformer
8. Cover
9. Grommet
10. Ball bearing
11. Bolt
12. Seal
13. Receptacle
14. Rectifier
15. Roll pin
16. Receptacle
17. Receptacle
18. Brush head
19. Resistor
20. Cover
21. Bearing cap
22. Bolt
23. Set screw
24. Cap
25. Brush
26. Brush holder
27. Plug
28. Loadamatic switch
29. Loadamatic control board

*Voltamatic® Static Voltage Control system is covered by U.S. Patent No. 3,428,883.

†Loadamatic® Automatic Idle Control system is covered by U.S. Patent Nos. 3,612,892 and 3,626,197.

GENERATOR

MAINTENANCE

To remove brushes, unscrew clamp screws and slide brush cover (20 – Fig. HL3-1) off brush head (18). Unscrew set screws and remove brush caps (24) and brushes (25). Be sure to mark brushes so that they can be returned to their original positions. Check length of each brush as shown in Fig. HL3-2. Renew brush if length is 5/8-inch or shorter. Be sure to include length of projections for brush springs when measuring brush length.

If new brushes must be installed, use the following procedure: Wrap the commutator with a medium grit (4/0 to 6/0) piece of garnet paper which will fit the commutator. Install new brushes. Remove spark plug and use engine starter to rotate engine until brushes are seated. Remove brushes and install fine grit (8/0 to 9/0) garnet paper. Install brushes and repeat seating process. Remove brushes and garnet paper and install spark plug. Blow carbon and grit out of generator and install brushes.

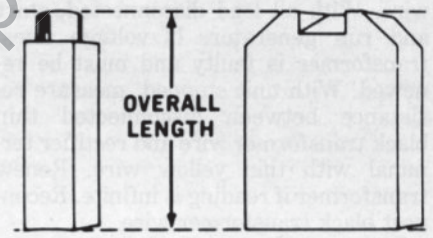


Fig. HL3-2 — Measure length of brushes as shown.

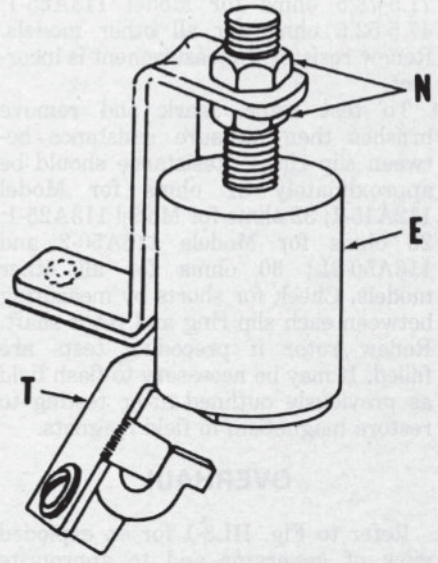


Fig. HL3-3 — Loadamatic® Automatic Idle Control is adjusted by turning nuts (N) until bottom of electromagnet (E) is parallel with throttle arm (T). Do not bend throttle arm or electromagnet bracket.

TROUBLESHOOTING

If little or no output is generated, check the following: The engine must be in good condition and maintain 3600 rpm under load or a no-load governed speed of 3750 rpm. Brushes, commutator and slip rings must be in good condition. All wiring connections must be clean and tight.

If loss of field magnetism is suspected cause of low generator output, flash the field as follows: Run unit without a load connected while using a 6-volt dry cell battery, momentarily connect the negative battery terminal to the negative (black) brush and the positive battery terminal to the positive (red) brush. Disconnect battery as soon as generator voltage rises.

To test rectifier, mark and remove brushes and disconnect rectifier leads. Using an ohmmeter measure resistance between each brush and each rectifier lead then reverse ohmmeter leads and again measure resistance. Resistance should be 4-100 ohms for one reading and infinite for other reading. Renew rectifier if resistance measurements are incorrect.

Disconnect thin black transformer wire. With all load disconnected, start and run generator. If voltage rises, transformer is faulty and must be renewed. With unit stopped, measure resistance between disconnected thin black transformer wire and rectifier terminal with thin yellow wire. Renew transformer if reading is infinite. Reconnect black transformer wire.

Disconnect resistor leads and measure resistance. Resistor resistance should be 95-105 ohms for Model 112A15-1; 71.5-78.5 ohms for Model 113A25-1; 47.5-52.5 ohms for all other models. Renew resistor if measurement is incorrect.

To test rotor, mark and remove brushes then measure resistance between slip rings. Resistance should be approximately 31 ohms for Model 112A15-1; 32 ohms for Model 113A25-1; 26 ohms for Models 116A50-2 and 116A50-2L; 30 ohms for all other models. Check for shorts by measuring between each slip ring and rotor shaft. Renew rotor if preceding tests are failed. It may be necessary to flash field as previously outlined after testing to restore magnetism in field magnets.

OVERHAUL

Refer to Fig. HL3-1 for an exploded view of generator and to approprite schematic in Fig. HL3-4, HL3-5, HL3-6 or HL3-7. Be sure to mark wiring so that it may be correctly connected for reassembly. Wires should be handled carefully to prevent damage to wire, insulation and connections. Generator rotor (5–Fig. HL3-1) has a taper fit with engine crankshaft and should be removed with a suitable tool.

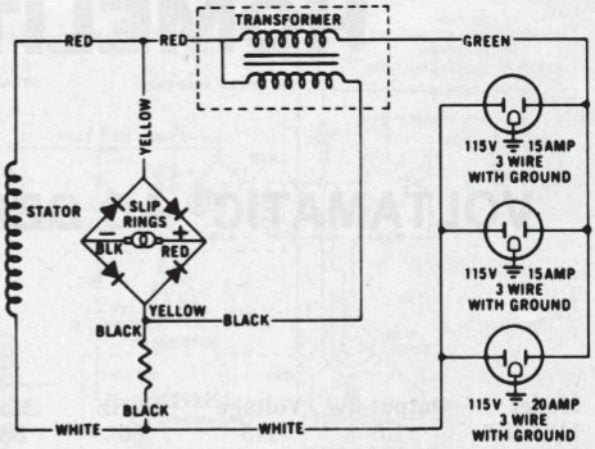


Fig. HL3-4—Schematic for generators 112A15-1, 113A25-1, 118A35-1 and 119A35-1.

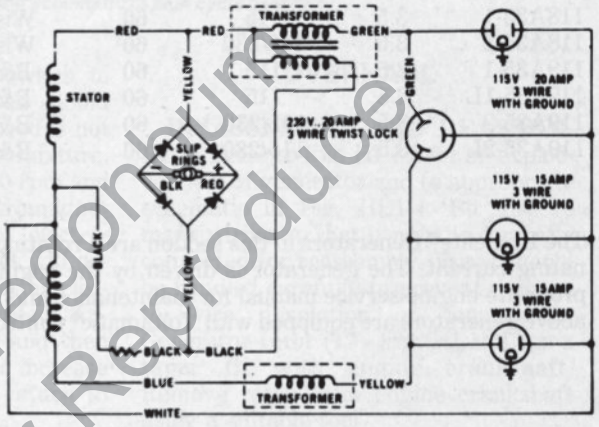


Fig. HL3-5—Schematic for generators 116A50-2, 118A35-2 and 119A35-2.

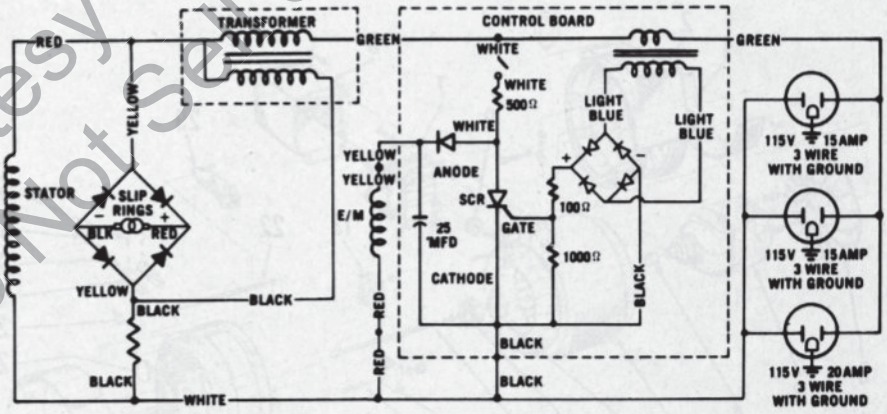


Fig. HL3-6—Schematic for generator 119A35-1L.

LOADAMATIC®

Models 116A50-2L, 119A35-1L and 119A35-2L are equipped with a Loadamatic® Automatic Idle Control. An electromagnet is mounted adjacent to the engine's carburetor and acts on the carburetor throttle arm. When there is no load on the generator, the electromagnet is energized and the engine governor is overridden as the electromagnet pulls the carburetor throttle arm to idle position. The governor

resumes control of engine speed when a load is imposed on the generator. The electromagnet is deenergized and the throttle arm is released to be controlled by the governor.

To adjust Loadamatic Automatic Idle Control, proceed as follows: Refer to Fig. HL3-3 and adjust height of electromagnet to place bottom of electromagnet parallel with throttle arm. Do not bend bracket or throttle arm to make this adjustment. Tighten electromagnet nuts. Position generator toggle switch to "START" to disengage idle control. Start engine and allow it to reach operating temperature. If necessary, adjust carburetor for proper mixture and speed. Flip toggle switch to "AUTO" position. Engine speed should slow to idle speed. If idle speed is not steady, adjust carburetor idle mixture. Idle speed should be 2400-2600 rpm and is adjusted by loosening electromagnet nuts and altering position of electromagnet. Raising electromagnet will decrease engine speed while lowering electromagnet will decrease engine speed. Apply a light load to generator and then remove it. Engine speed should increase to governed speed and then return to idle after the load is removed.

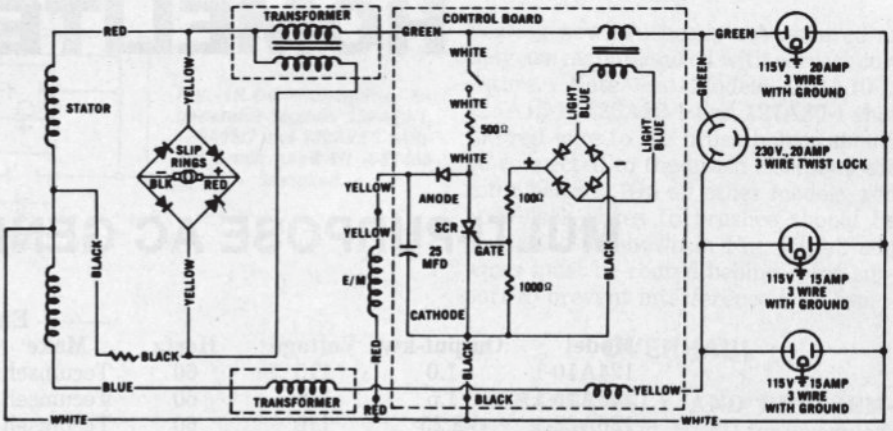


Fig. HL3-7—Schematic for generators 116A50-2L and 119A35-2L.

ENGINE

Engine make and model are listed at beginning of section. Refer to Briggs and Stratton or Wisconsin engine service manual for engine service.

HOMELITE

MULTI-PURPOSE AC GENERATORS

				Engine		Governed
Model	Output-kw	Voltage	Hertz	Make	Model	Rpm
124A10-1	1.0	115	60	Tecumseh	H30	3600
125A15-1	1.5	115	60	Tecumseh	H35	3600
126A22-1	2.25	115	60	Tecumseh	H50	3600
127A30-1	3.0	115	60	Tecumseh	H70	3600
128A10-1	1.0	120	60	Tecumseh	H30	3600
128A10-1B	1.0	120	60	Tecumseh	H30	3600
129A15-1	1.5	120	60	Tecumseh	H35	3600
129A15-1B	1.5	120	60	Tecumseh	H35	3600
130A22-1	2.25	120	60	Tecumseh	H50	3600
130A22-1B	2.25	120	60	Tecumseh	H50	3600
130A22-1C	2.25	120	60	Tecumseh	HS50	3600
131A30-1	3.0	120	60	Tecumseh	H70	3600
131A30-1B	3.0	120	60	Tecumseh	H70	3600
132A40-1	4.0	120	60	B&S	190412	3600
E1350-1	1.35	120	60	B&S	80212	3600
E1700-1	1.7	120	60	B&S	100212	3600
E2250-1	2.25	120	60	B&S	!130212	3600
E3000-1, E3000-1A	3.0	120	60	B&S	170412	3600
E4000-1, E4000-1A	4.0	120	60	B&S	190412	3600

GENERATOR

MAINTENANCE

BRUSHES. Brush length and condition should be checked after every 1000 hours of operation. Brushes can be inspected after removing brush head cover (1 – Fig. HL4-1), rotor bolt (2) and fan (3).

NOTE: Do not attempt to hold rotor with fan to remove rotor bolt.

Loosen screws retaining brush holder and slide out brush holder. Brushes must be renewed if brush length is shorter than ⅜ inch as shown in Fig. HL4-2. Be sure to reinstall a used brush so that brush curvature matches collector ring. During reassembly, fan must be mounted squarely on rotor shaft. Tighten rotor bolt to 120-140 in.-lbs.

Disassemble brush holder to install new brushes. Insert new brushes in brush holder so curvature of brush will match curvature of collector ring.

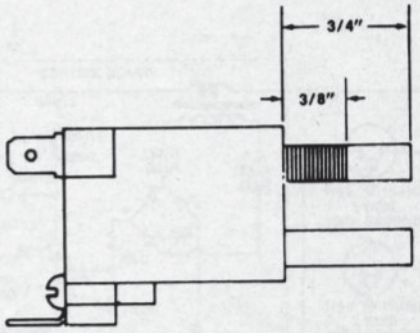


Fig. HL4-2 – Brush length should not be less than ⅜ inch when measured as shown above. Brush length of a new brush is ¾ inch.

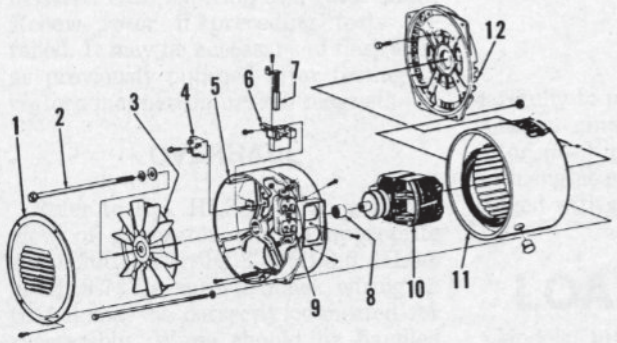


Fig. HL4-1 – Exploded view of generator.

1. Cover
2. Bolt
3. Fan
4. Rectifier
5. Brush head
6. Brush holder
7. Brush
8. Bearing
9. Receptacle
10. Rotor
11. Stator & housing
12. End bell

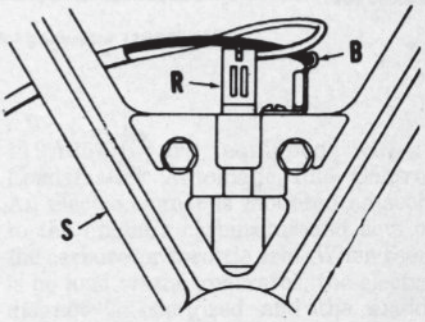


Fig. HL4-3 – On models indicated in text, red (R) and black (B) wires to brushes are connected and routed as shown.

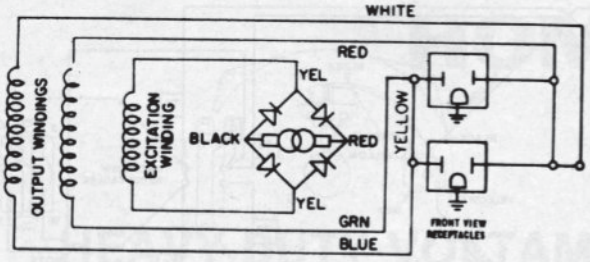


Fig. HL4-4—Schematic for generator Models 128A10-1, 129A15-1 and 130A22-1 without brush head kit A-51450 installed.

Seating new brushes is not required as they are manufactured with correct curvature. Note on Models 124A10-1, 125A15-1, 126A22-1 and 127A30-1 that the red wire to the brush holder should be connected to the brush closest to the rotor bearing. On all other models, red and black wires to brushes should be connected as shown in Fig. HL4-3 and wires must be routed behind rotor support to prevent interference with fan.

OVERHAUL

DISASSEMBLY AND REASSEMBLY. Refer to Fig. HL4-1 for an exploded view of generator and to appropriate schematic. Be sure to mark wiring so that it may be correctly connected for reassembly. Wire should be handled carefully to prevent damage to wire, insulation or connections. Generator rotor (10) has a taper fit with engine crankshaft and should be removed with a suitable tool.

BRUSH HEAD KIT. Brush head kit A-51450 is available as a direct replacement for the brush head assembly on Models 128A10-1B, 129A15-1B, 130A22-1B, 130A22-1C and 131A30-1B. Brush head kit A-51450 also supersedes brush head #53753-2 on Models 128A10-1,

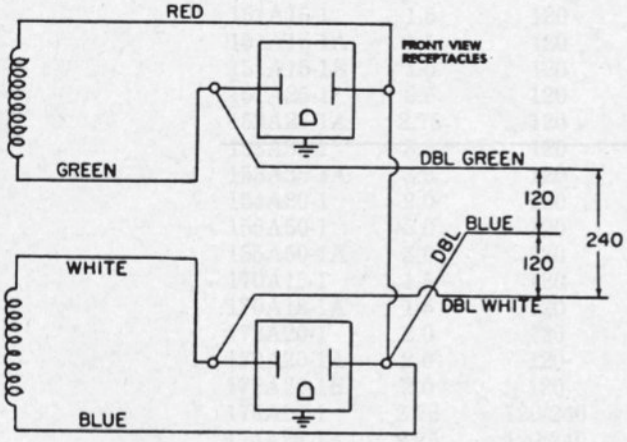


Fig. HL4-5—Schematic and practical diagram of Models E1350-1, E1700-1 and E2250-1 and Models 128A10-1, 128A10-1A, 128A10-1B, 129A15-1, 129A15-1A, 129A15-1B, 130A22-1, 130A22-1A, 130A22-1B and 130A22-1C with brush head kit A-51450 installed.

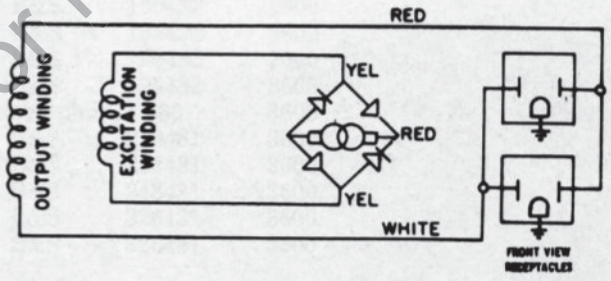


Fig. HL4-7—Schematic of Model 131A30-1 wired for 120 volts without brush head kit A-51450.

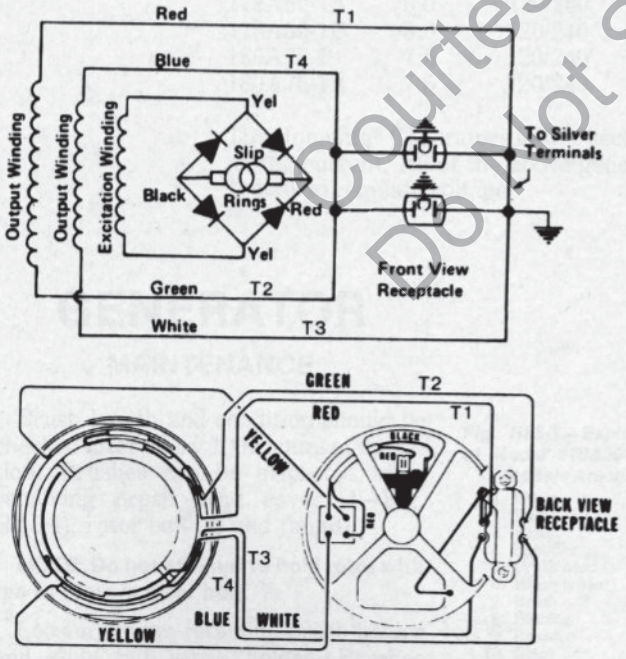


Fig. HL4-6—Schematic and practical diagram of Model E3000-1 and Models 131A30-1, 131A30-1A and 131A30-1B with brush head kit A-51450 installed.

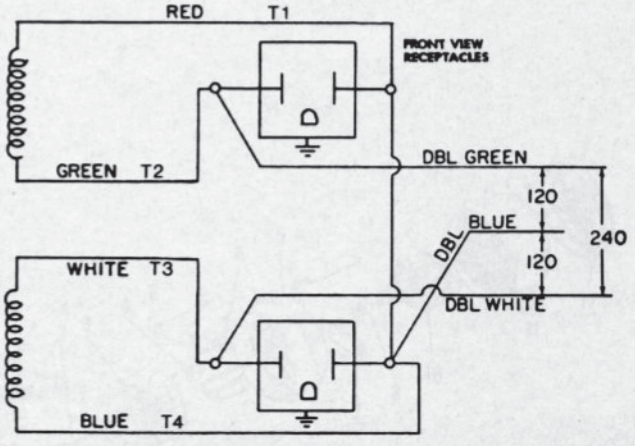


Fig. HL4-8—Schematic of Model 131A30-1 wired for 240 volts without brush head kit A-51450.

128A10-1A, 129A15-1, 129A15-1A, 130A22-1, 130A22-1A, 131A30-1 and 131A30-1A. Schematics for these models include installation of the brush head kit.

NOTE: Installation of brush head kit must include installation of Ground Terminal and Label Kit A-51202 if not previously installed. Alternator must be grounded with #8 ground wire to a suitable ground source.

ENGINE

Engine make and model are listed at beginning of section. Refer to Biggs and Stratton or Tecumseh engine service manual for engine service.

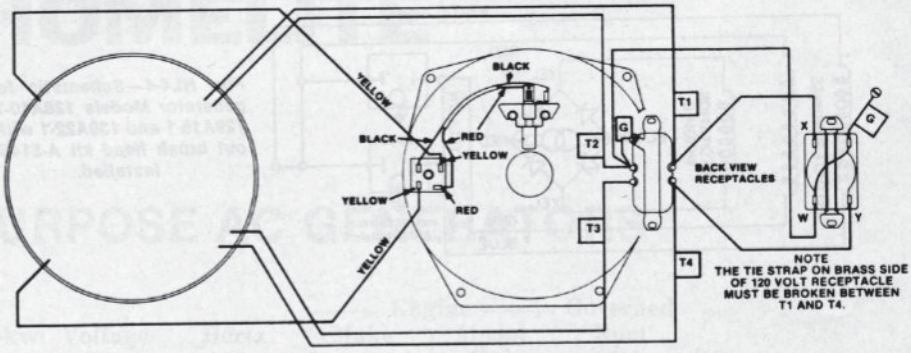


Fig. HL4-9—Wiring diagram for Models E3000-1A and E4000-1A.

HOMELITE

HEAVY-DUTY VOLTAMATIC® AC GENERATORS*

Model	Output-kw	Voltage	Hertz	Engine Make	Engine Model	Governed Rpm
151A15-1	1.5	120	60	B&S	100232	3600
151A15-1A	1.5	120	60	B&S	100232	3600
151A15-1B	1.5	120	60	B&S	100232	3600
151A25-1	2.5	120	60	B&S	170432	3600
152A27-1A	2.75	120	60	B&S	170432	3600
153A35-1	3.5	120	60	B&S	190432	3600
153A35-1A	3.5	120	60	B&S	190432	3600
154A20-1	2.0	120	60	B&S	130232	3600
155A50-1	5.0	120	60	B&S	243431	3600
155A50-1A	5.0	120	60	B&S	243431	3600
170A15-1	1.5	120	60	B&S	100232	3600
170A15-1A	1.5	120	60	B&S	100232	3600
172A20-1	2.0	120	60	B&S	130232	3600
172A20-1A	2.0	120	60	B&S	131232	3600
172A20-1B	2.0	120	60	B&S	131232	3600
174A27-1	2.75	120/240	60	B&S	170432	3600
174A27-1A	2.75	120/240	60	B&S	170432	3600
174A27-1B	2.75	120/240	60	B&S	170432	3600
175A42-1	4.2	115/230	50	B&S		3000
176A35-1	3.5	120/240	60	B&S	190432	3600
176A35-1A	3.5	120/240	60	B&S	195432	3600
176A35-1B	3.5	120/240	60	B&S	195432	3600
176A35-1C	3.5	120/240	60	B&S	195432	3600
177D38-1	3.8	120/240	60	Lombardini	530	3600
178A50-1	5.0	120/240	60	B&S	243431	3600
178A50-1A	5.0	120/240	60	B&S	243431	3600
178A50-1B	5.0	120/240	60	B&S	243431	3600
180A75-1	7.5	120/240	60	B&S	326431	3600
180A75-1A	7.5	120/240	60	B&S	326431	3600

The Homelite® Generators in this section are a rotating field type and produce alternating current. All of the above generators are equipped with Voltamatic® voltage control to regulate voltage.

GENERATOR

MAINTENANCE

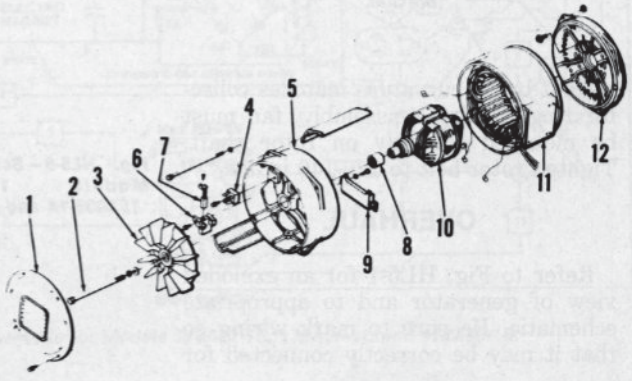
Brush length and condition should be checked after every 1000 hours of operation. Brushes can be inspected after removing brush head cover (1–Fig. HL5-1), rotor bolt (2) and fan (3).

NOTE: Do not attempt to hold rotor with fan to remove rotor bolt.

Loosen screws retaining brush holder and slide out brush holder. Brushes must be renewed if brush length is shorter than ⅜ inch as shown in Fig. HL5-2. Be sure to reinstall a used brush

Fig. HL5-1–Exploded view of Model 170A20-1A. Other models are similar.

1. Cover
2. Bolt
3. Fan
4. Rectifier
5. Brush head
6. Brush holder
7. Brush
8. Bearing
9. Resistor
10. Rotor
11. Stator & housing
12. End bell



*Voltamatic® Static Voltage Control system is covered by U.S. Patent No. 3,428,883.

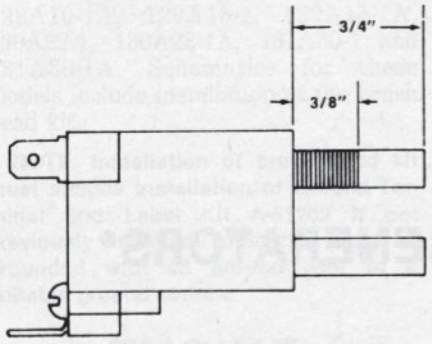


Fig. HL5-2—Brush length should not be less than ⅜ inch when measured as shown above. Brush length of a new brush is ¾ inch.

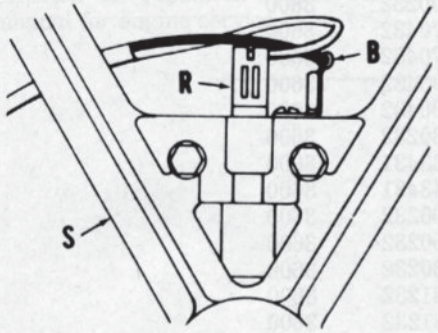


Fig. HL5-3—Red (R) and black (B) wires to brushes are connected and routed as shown.

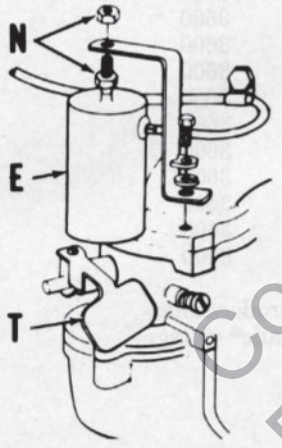


Fig. HL5-4—Loadamatic® Automatic Idle Control* is adjusted by turning nuts (N) until bottom of electromagnet (E) is parallel with throttle arm (T). Do not bend throttle arm or electromagnet bracket.

so that brush curvature matches collector ring. During reassembly, fan must be mounted squarely on rotor shaft. Tighten rotor bolt to 120-140 in.-lbs.

OVERHAUL

Refer to Fig. HL5-1 for an exploded view of generator and to appropriate schematic. Be sure to mark wiring so that it may be correctly connected for

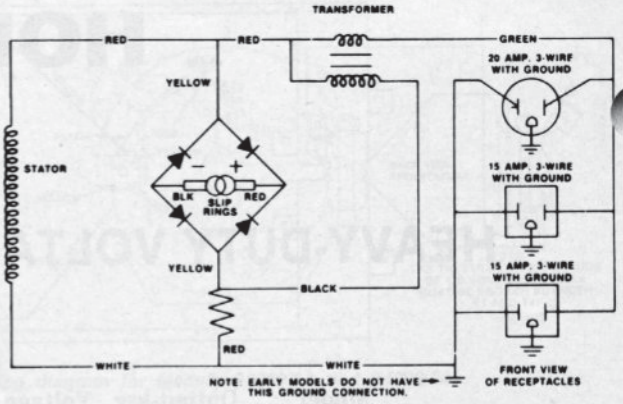


Fig. HL5-5—Schematic of Models 151A15-1 and 151A15-1A.

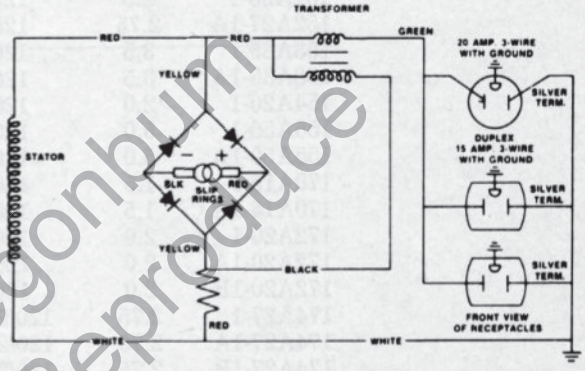


Fig. HL5-6—Schematic of Models 151A15-1B and 154A20-1. Models 172A20-1, 172A20-1A and 172A20-1B are similar but 20 amp outlet is not used.

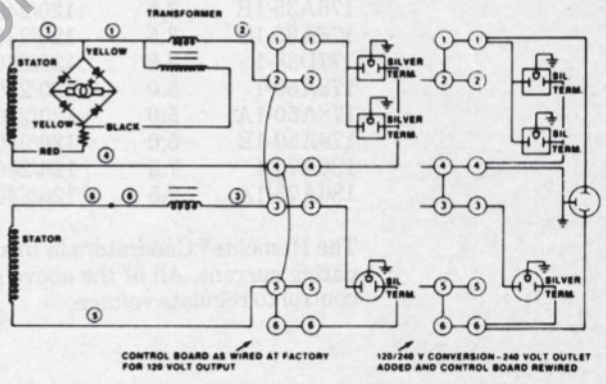


Fig. HL5-7—Schematic of Models 152A25-1, 153A35-1 and 155A50-1.

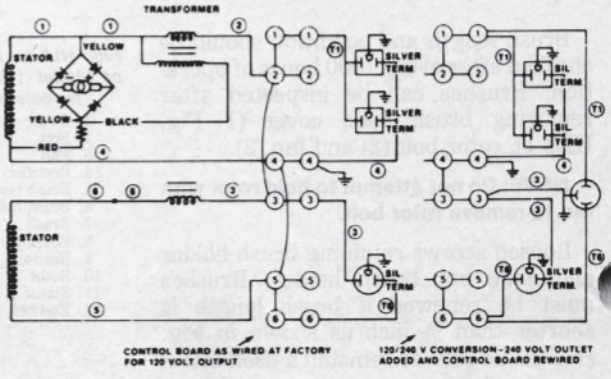


Fig. HL5-8—Schematic of Models 152A27-1A, 153A35-1A and 155A50-1A.

+Loadamatic® Automatic Idle Control system is covered by U.S. Patent Nos. 3,612,892 and 3,626,197.

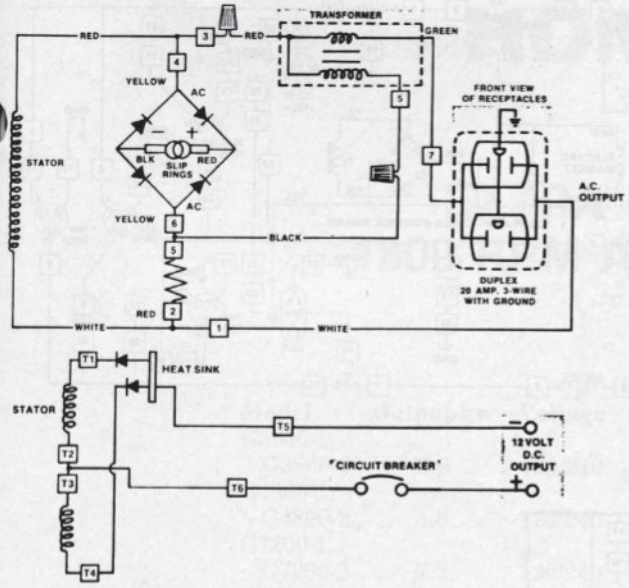


Fig. HL5-8A—Schematic of Model 170A15-1A.

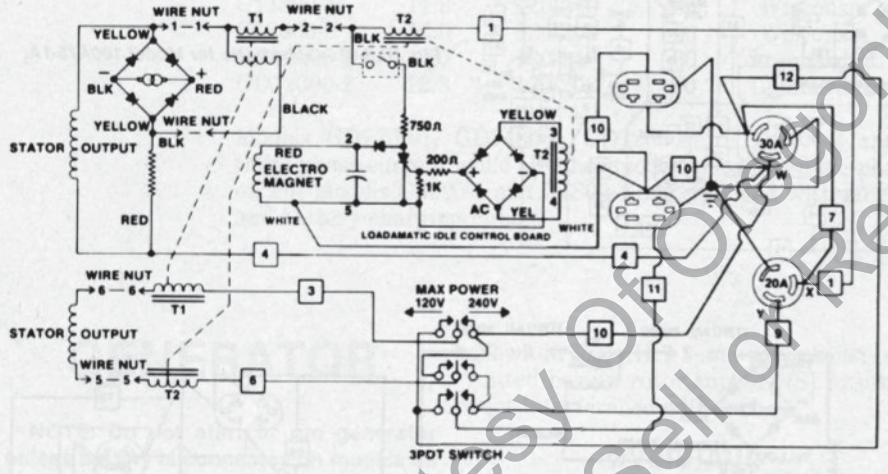


Fig. HL5-9—Schematic of Models 174A27-1A, 176A35-1A, 176A35-1B and 178A50-1A.

reassembly. Wires should be handled carefully to prevent damage to wire, insulation or connections. Generator rotor (10) has a taper fit with engine crankshaft and should be removed with a suitable tool.

Disassemble brush holder to install new brushes. Insert new brushes in brush holder so curvature of brush will match curvature of collector ring. Seating new brushes is not required as they are manufactured with correct curvature. Red and black wires to brushes should be connected as shown in Fig. HL5-3 and wires must be routed behind rotor support to prevent interference with fan.

LOADAMATIC®

Some models may be equipped with a Loadamatic® Automatic Idle Control.

An electromagnet is mounted adjacent to the engine's carburetor and acts on the carburetor throttle arm. When there is no load on the generator, the electromagnet is energized and the engine governor is overridden as the electromagnet pulls the carburetor throttle arm to idle position. The governor resumes control of engine speed when a load is imposed on the generator. The electromagnet is deenergized and the throttle arm is released to be controlled by the governor.

To adjust Loadamatic Automatic idle Control, proceed as follows: Refer to Fig. HL5-4 and adjust height of electromagnet (E) to place bottom of electromagnet parallel with throttle arm (T), by turning nuts (N). Do not bend bracket or throttle arm to make this adjustment. Tighten electromagnet nuts. Position generator toggle switch to "START" to disengage idle control. Start engine and allow it to reach operating temperature. If necessary, adjust carburetor for proper mixture and speed. Flip toggle switch to "AUTO" position. Engine speed should reduce to idle speed. If idle speed is not steady, adjust carburetor idle mixture. Idle speed should be 2400-2600 rpm and is adjusted by loosening electromagnet nuts and altering position of electromagnet. Raising electromagnet decreases engine speed while lowering electromagnet increases engine speed. Apply a light load to generator and then remove it. Engine speed should increase to governed speed and then return to idle after the load is removed.

ENGINE

Engine make and model are listed at beginning of section. Refer to Briggs and Stratton service manual or Lombardini service section for engine service.

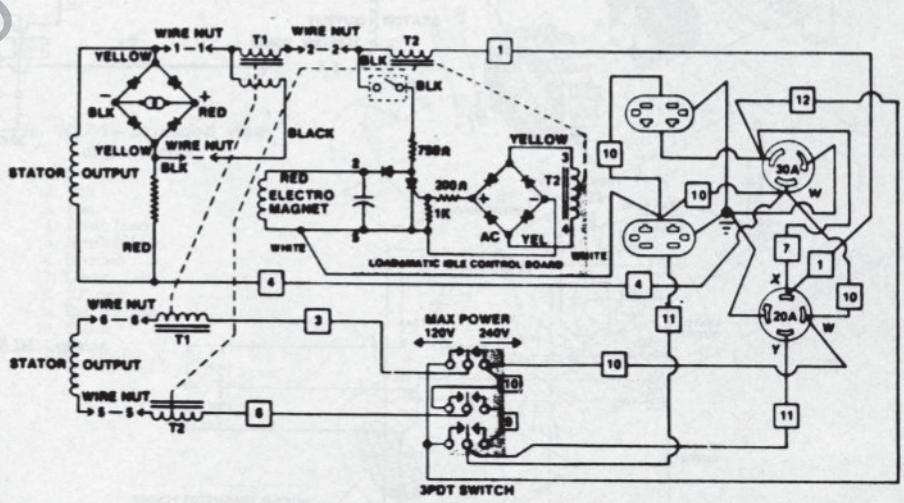


Fig. HL5-10—Schematic for Models 174A27-1B, 176A35-1C and 178A50-1B.

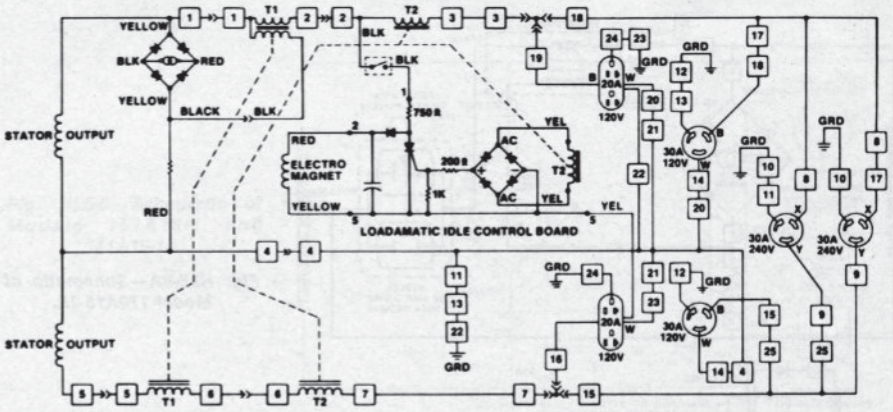


Fig. HL5-12—Schematic of Model 180A75-1.

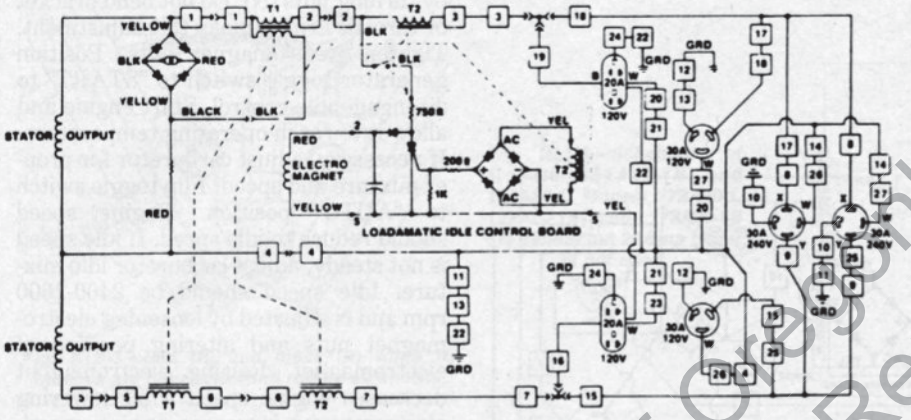


Fig. HL5-13—Schematic for Model 180A75-1A.

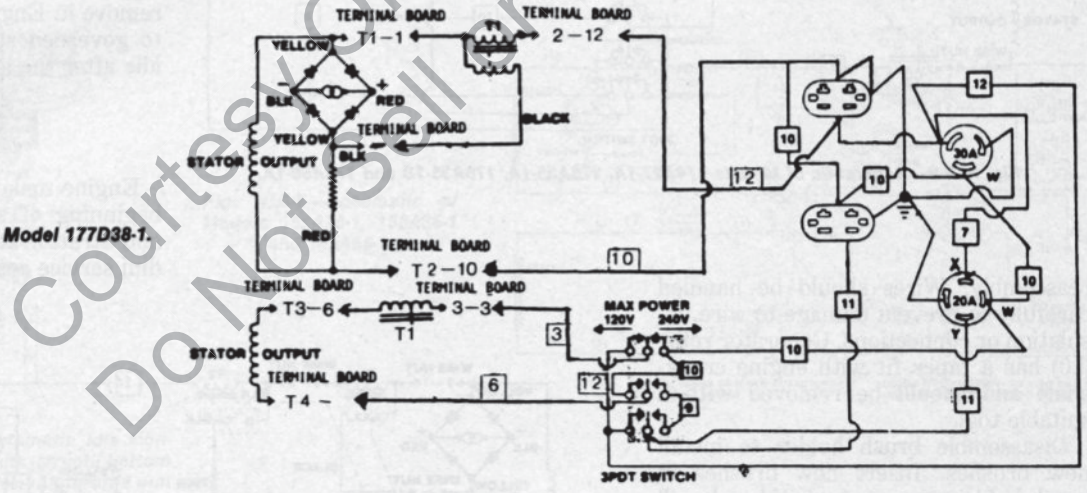


Fig. HL5-14—Schematic for Model 177D38-1.

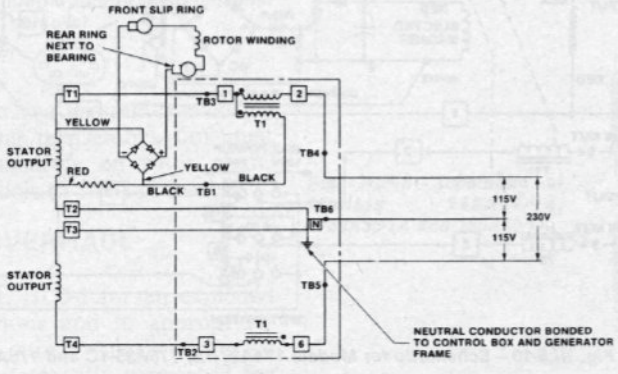


Fig. HL5-15—Schematic of Model 175A42-1.

HOMELITE

EXTRA HEAVY-DUTY 1800 RPM AC GENERATORS

Model	Output-kw	Voltage	Hertz	Engine Make	Engine Model	Governed Rpm
G3600-1, G3600-2	3.6	120/240	60	Kohler	K301	1800
G4800-1, G4800-2	4.8	120/240	60	Kohler	K341	1800
G7200-1, G7200-2	7.2	120/240	60	Kohler	K582	1800
GD7200-1	7.2	120/208	60	Lombardini	L20	1800
GD7400-2	7.4	120/208	60	Lombardini	L20	1800
G11800-1	11.8	120/240	60	Wisconsin	VH4D	1800
G12000-2	12.0	120/208	60	Wisconsin	VH4D	1800
GD12000-1	12.0	120/240	60	Lombardini	L27	1800
GD12300-2	12.3	120/208	60	Lombardini	L27	1800

Models GD7200-1, GD7400-2, GD12000-1, GD12000-2 and GD12300-2 produce three-phase current while all other models produce single-phase current. All models except Models G3600-1 and G4800-1 are equipped with an electric starter, battery and battery charging circuit.

GENERATOR

NOTE: Do not start or run generator unless battery is connected on models so equipped.

MAINTENANCE

Brush length and condition should be checked after every 1000 hours of operation. Brushes can be inspected after removing brush head cover (1–Fig. HL7-1), rotor bolt (2) and fan (3).

NOTE: Do not attempt to hold rotor with fan to remove rotor bolt.

Loosen screws retaining brush holder and slide out brush holder. Brushes must be renewed if brush length is shorter than ⅜ inch as shown in Fig. HL7-2. Be sure to reinstall a used brush so that brush curvature matches collector ring.

Disassemble brush holder to install new brushes. Insert new brushes in brush holder so curvature of brush will match curvature of collector ring. Seating new brushes is not required as they are manufactured with correct curvature. Red (No. 15) and black (No. 14) wires to brushes should be connected as shown in Fig. HL7-3 and wires must be routed behind rotor support (S) to prevent interference with fan.

OVERHAUL

Refer to Fig. HL7-1 for an exploded view of generator. Refer to Figs. HL7-4 through HL7-8 for wiring schematic. When installing brushes refer to MAINTENANCE section for proper brush installation.

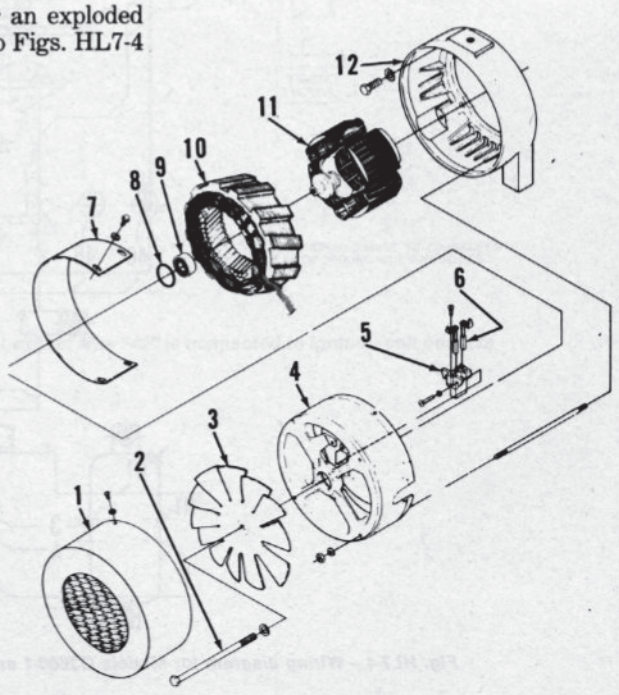


Fig. HL7-1—Exploded view of generator.

1. Cover
2. Bolt
3. Fan
4. Brush head
5. Brush holder
6. Brushes
7. Cover
8. "O" ring
9. Ball bearing
10. Stator
11. Rotor
12. End bell

ENGINE

Engine make and model are listed at beginning of section. Refer to Kohler or Wisconsin service manuals or Lombardini engine section for engine service.

NOTE: These generators are designed for operation at 1800 rpm. Adjust governor as outlined in engine section but adjust governed speed so engine runs at 1800 rpm under load.

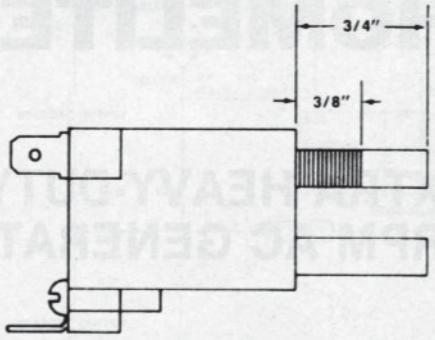


Fig. HL7-2—Brush length should not be less than ⅜ inch when measured as shown above. Brush length of a new brush is ¾ inch.

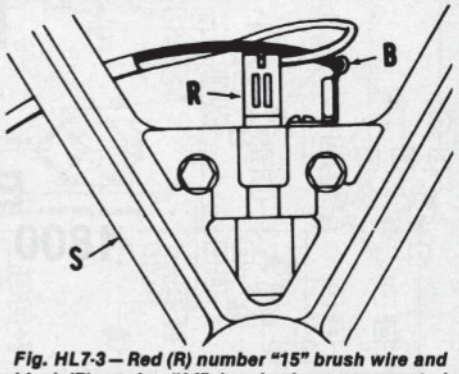


Fig. HL7-3—Red (R) number "15" brush wire and black (B) number "14" brush wire are connected and routed as shown.

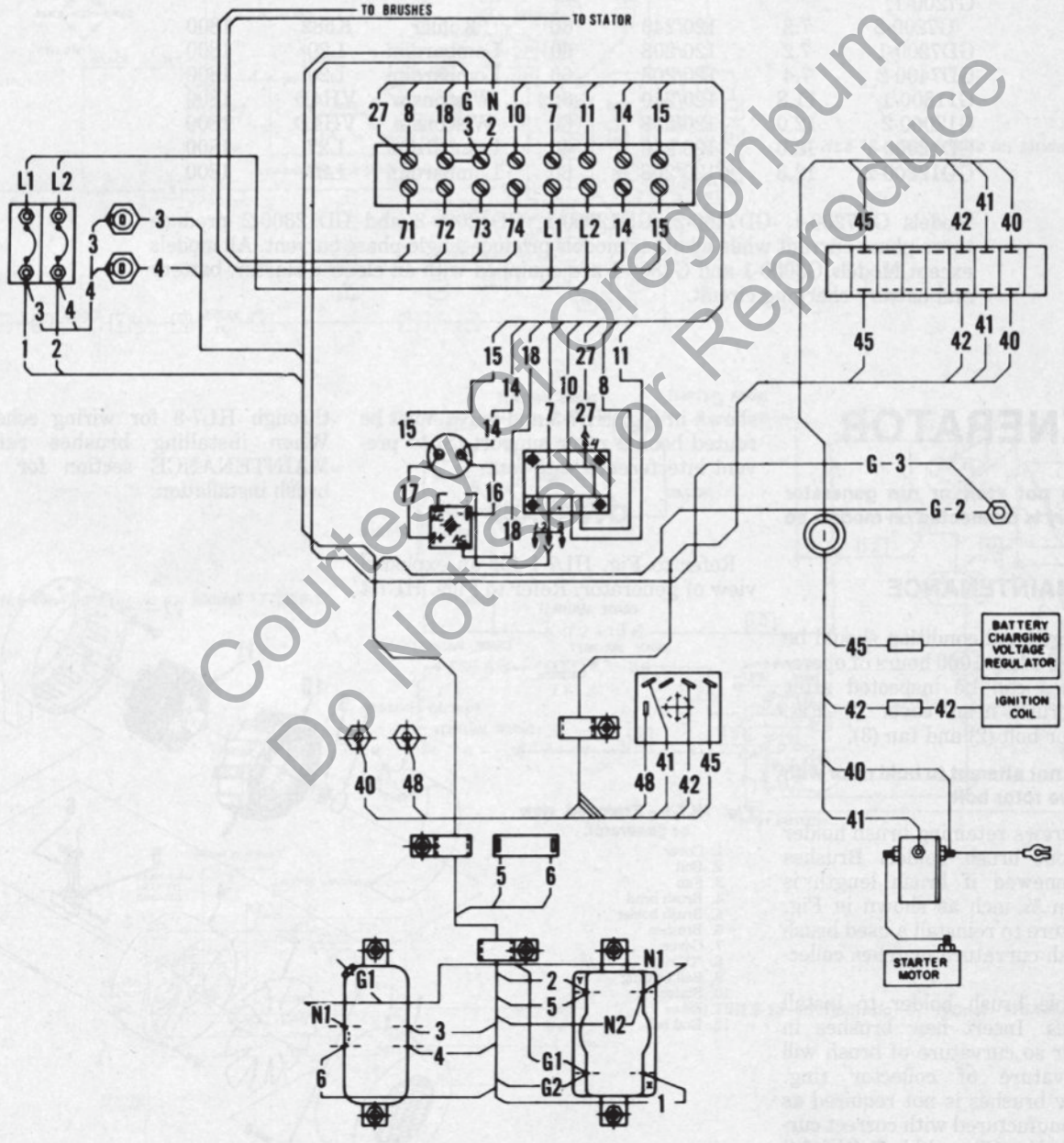


Fig. HL7-4—Wiring diagram for Models G3600-1 and G4800-1. Models G3600-2 and G4800-2 are similar except for engine circuit.

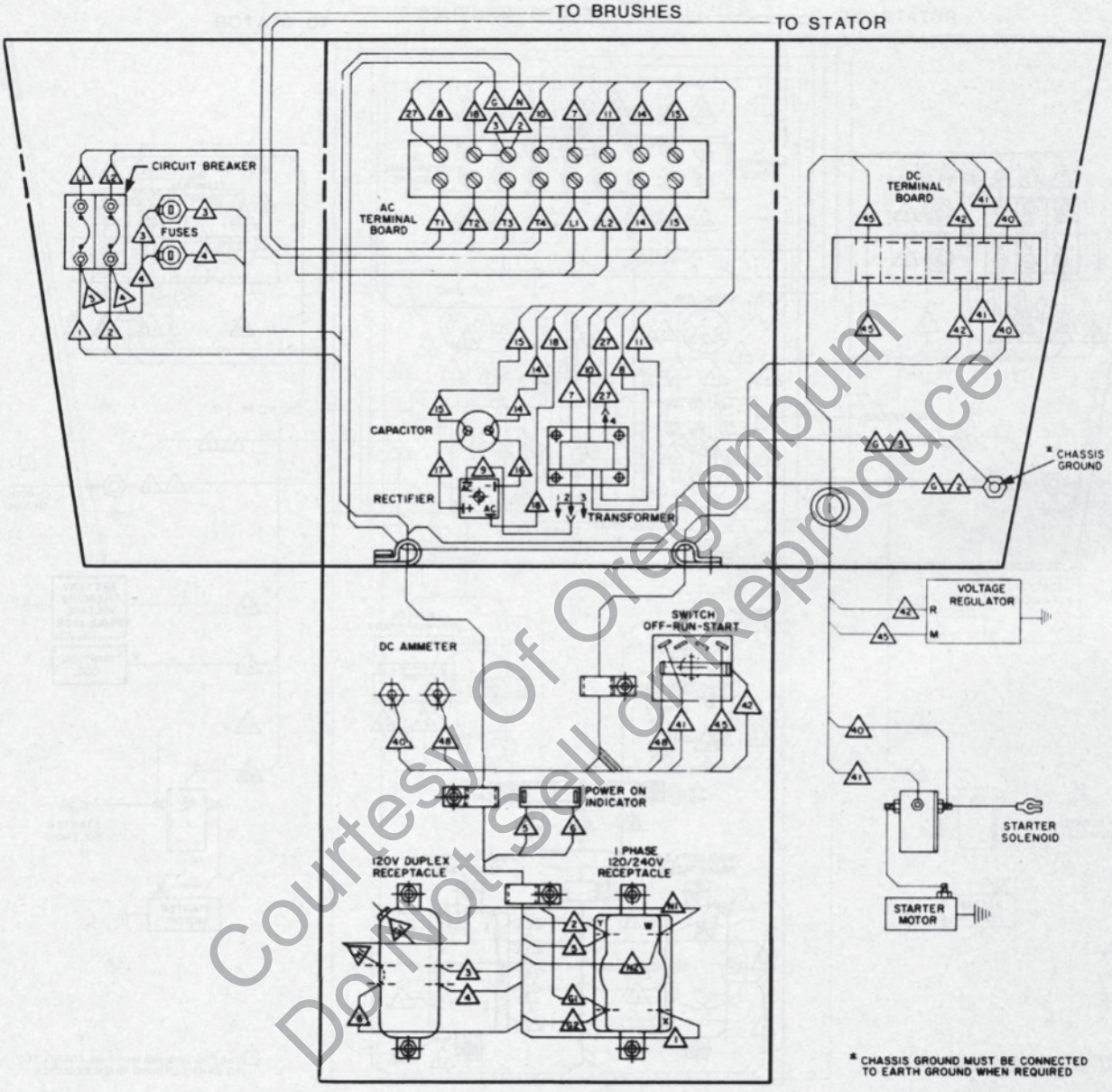


Fig. HL7-5 — Wiring diagram for Model GD7200-1. Model G7200-1 is similar except wire "42" is connected to ignition coil positive terminal.

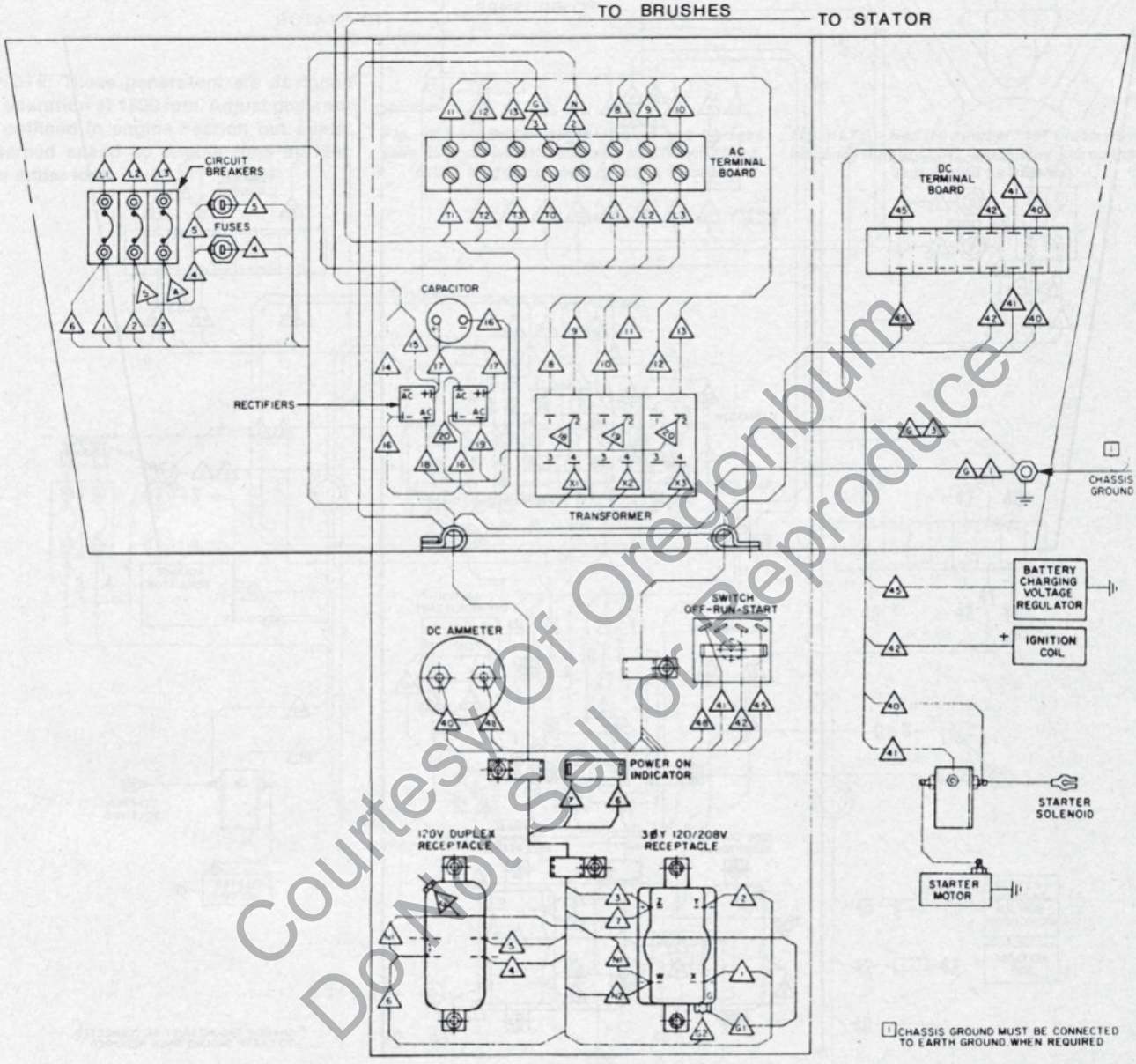


Fig. HL7-6—Wiring diagram for Model G7200-2.

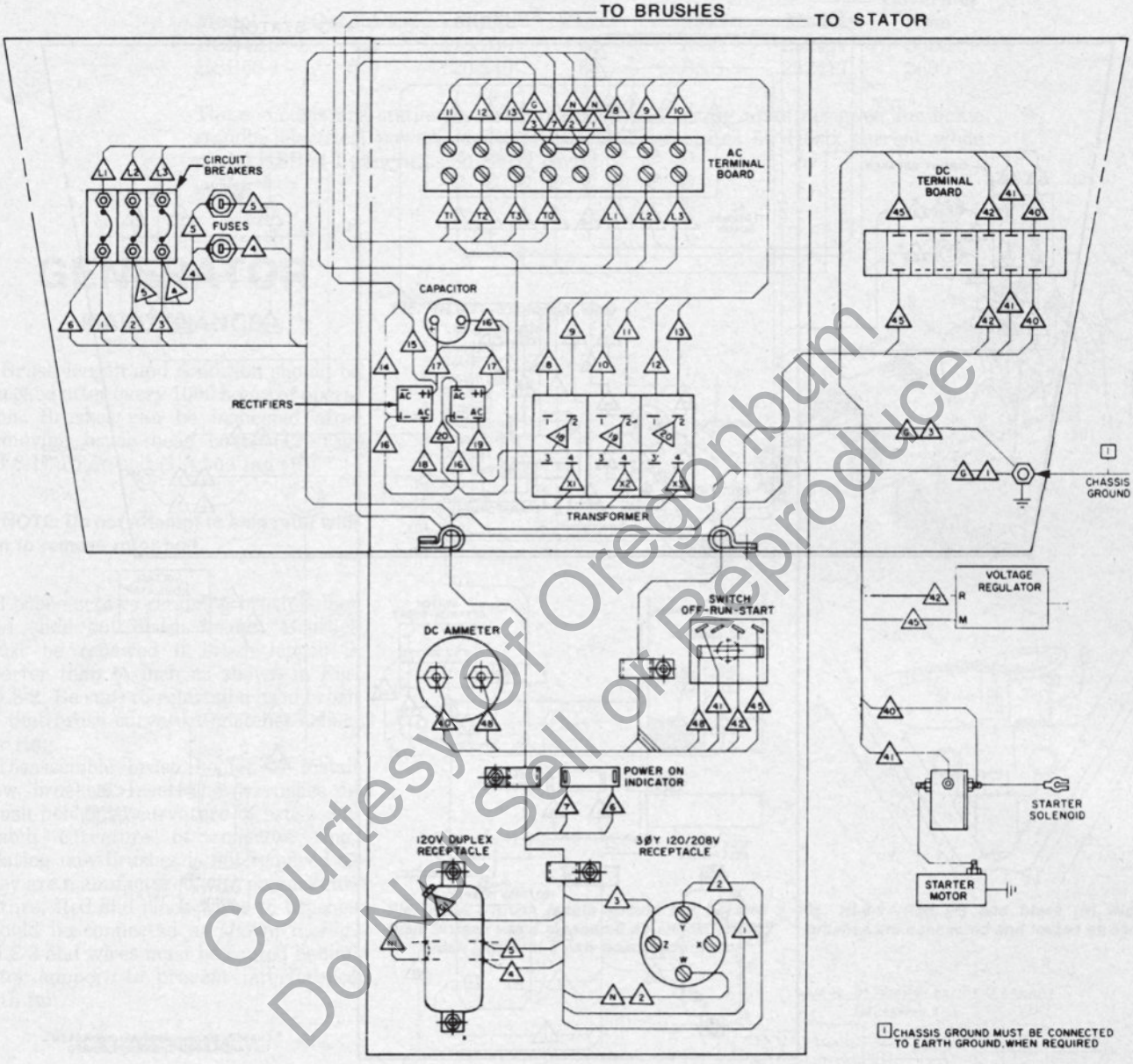


Fig. HL7-7—Wiring diagram for Models GD7400-2 and GD12300-2. Model G12000-2 is similar except wire "42" is connected to ignition coil positive terminal.

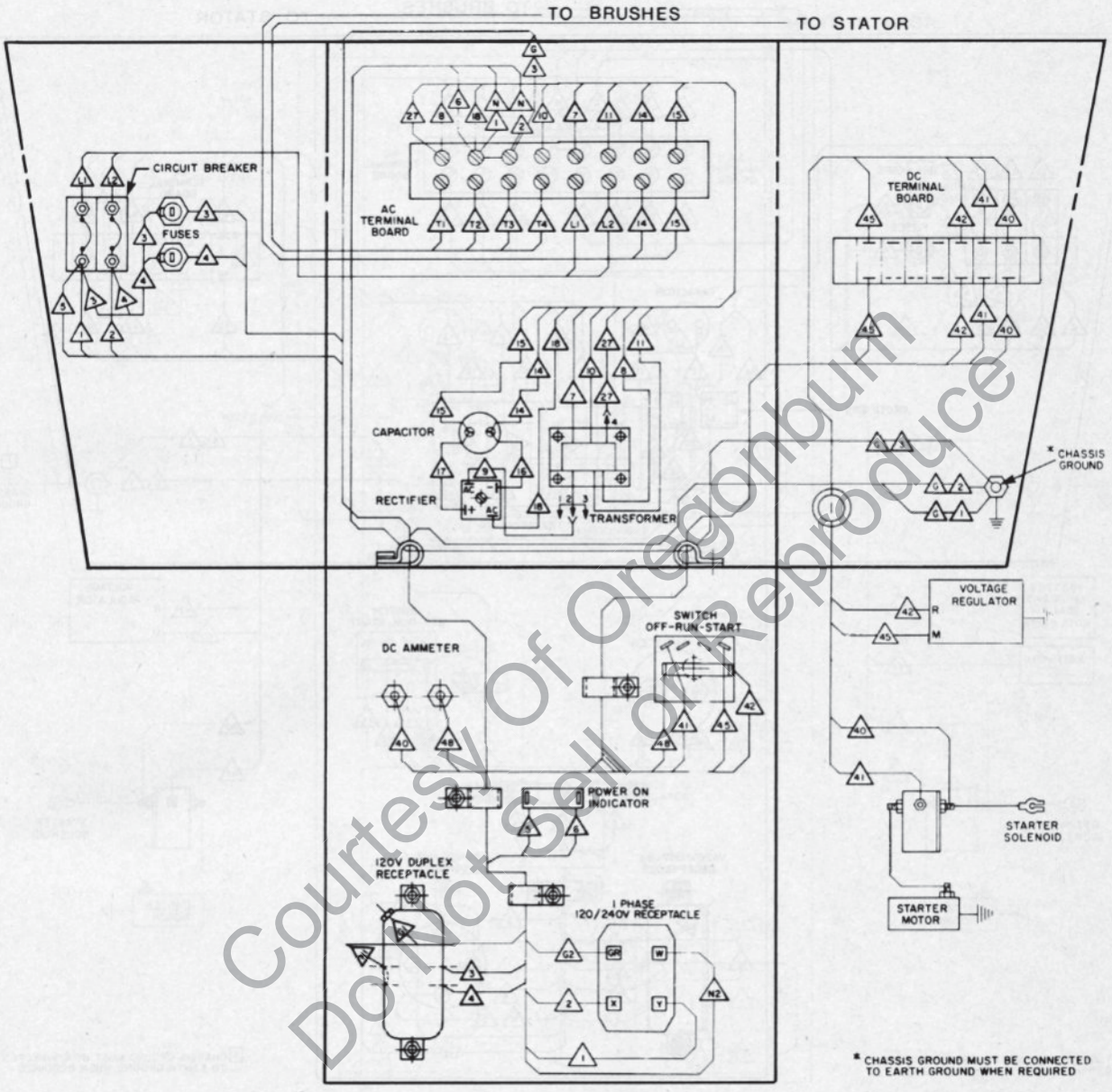


Fig. HL7-8—Wiring diagram for Model GD12000-1. Model G11800-1 is similar except wire "42" is connected to ignition coil positive terminal.

HOMELITE

STANDBY GENERATORS

Model	Output-kw	Voltage	Hertz	Engine Make	Engine Model	Governed Rpm
HSB42/50-1	4.2	115/230	60	B&S	252417	3600
HSB50-1	5.0	120/240	60	B&S	252417	3600

These models are stationary, self-contained generating units designed for home standby electrical power. Model HSB42/50-1 generates 50 Hertz current while model HSB50-1 generates 60 Hertz current.

GENERATOR

MAINTENANCE

Brush length and condition should be checked after every 1000 hours of operation. Brushes can be inspected after removing brush head cover (12–Fig. HL8-1), rotor bolt (13) and fan (10).

NOTE: Do not attempt to hold rotor with fan to remove rotor bolt.

Loosen screws retaining brush holder and slide out brush holder. Brushes must be renewed if brush length is shorter than ⅜ inch as shown in Fig. HL8-2. Be sure to reinstall a used brush so that brush curvature matches collector ring.

Disassemble brush holder to install new brushes. Insert new brushes in brush holder so curvature of brush will match curvature of collector ring. Seating new brushes is not required as they are manufactured with correct curvature. Red and black wires to brushes should be connected as shown in Fig. HL8-3 and wires must be routed behind rotor support to prevent interference with fan.

OVERHAUL

Refer to Fig. HL8-1 for an exploded view of generator. Refer to Fig. HL8-4 for wiring schematic. When installing brushes refer to MAINTENANCE section for proper brush installation.

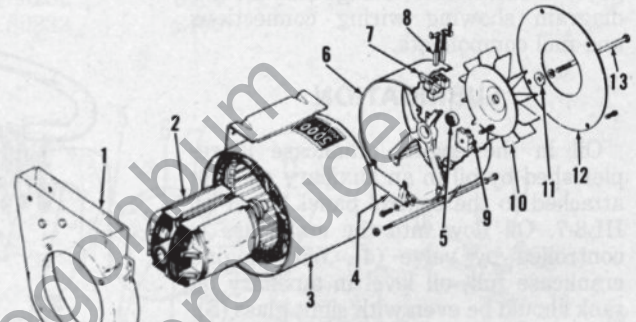


Fig. HL8-1—Exploded view of generator.
1. End bell
2. Rotor
3. Stator assy.
4. Resistor
5. Bearing
6. Brush head
7. Brush holder
8. Brushes
9. Rectifier
10. Fan
11. Washer
12. Cover
13. Bolt

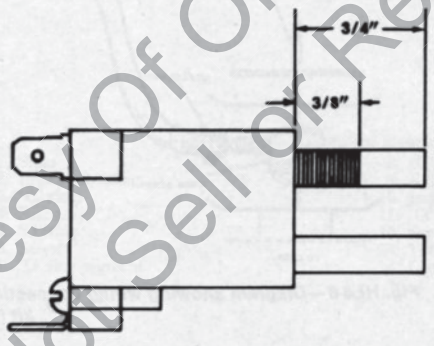


Fig. HL8-2—Brush length should not be less than ⅜ inch when measured as shown above. Brush length of a new brush is ¾ inch.

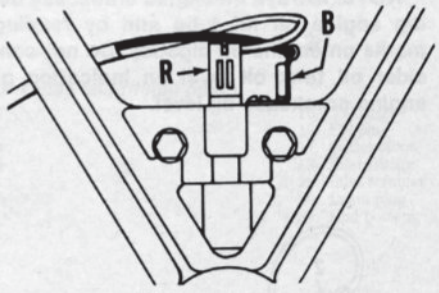


Fig. HL8-3—Red (R) and black (B) wires to brushes are connected and routed as shown.

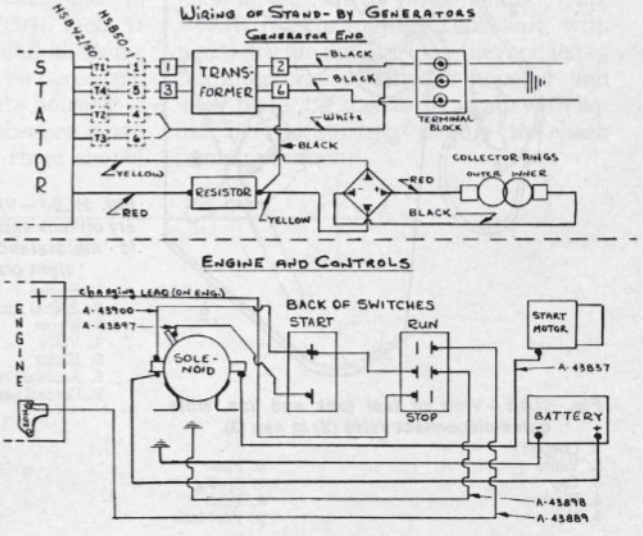


Fig. HL8-4—Wiring schematic for HSB42/50-2 and HSB50-1.

ENGINE

Engine make and model are listed at beginning of section. Refer to Briggs and Stratton service manual for engine service, however, note the following additional service areas.

FUEL SYSTEM

Fuel for gasoline-fueled engines is contained in the five gallon container shown in Fig. HL8-5. The engine fuel pump transfers fuel from the tank to the carburetor. Filters (6 and 8) must be clean and vents (2) in tank cap (3) must operate properly for adequate fuel movement. Vents (2) are one-way valves and must be installed in cap so one vent allows air in while other valve vents pressure in tank. Note quick-connect coupler (1) and valve (V) in tank cap which must also seal properly.

Conversion kit (#A-47499) may be installed to operate generator engine with gaseous fuel. Refer to Fig. HL8-6 for a diagram showing wiring connections and fuel components.

LUBRICATION

Oil in the engine crankcase is replenished by oil in an auxiliary oil tank attached to the control panel. See Fig. HL8-7. Oil flow into the crankcase is controlled by valve (4). With engine crankcase full, oil level in auxiliary oil tank should be even with sight glass (S). Oil amount necessary to fill oil tank from empty to sight glass is approximately one quart.

NOTE: Always fill engine crankcase using engine oil fill tube and by reading marks on engine oil dipstick. Do not consider oil tank oil level an indication of engine crankcase oil level.

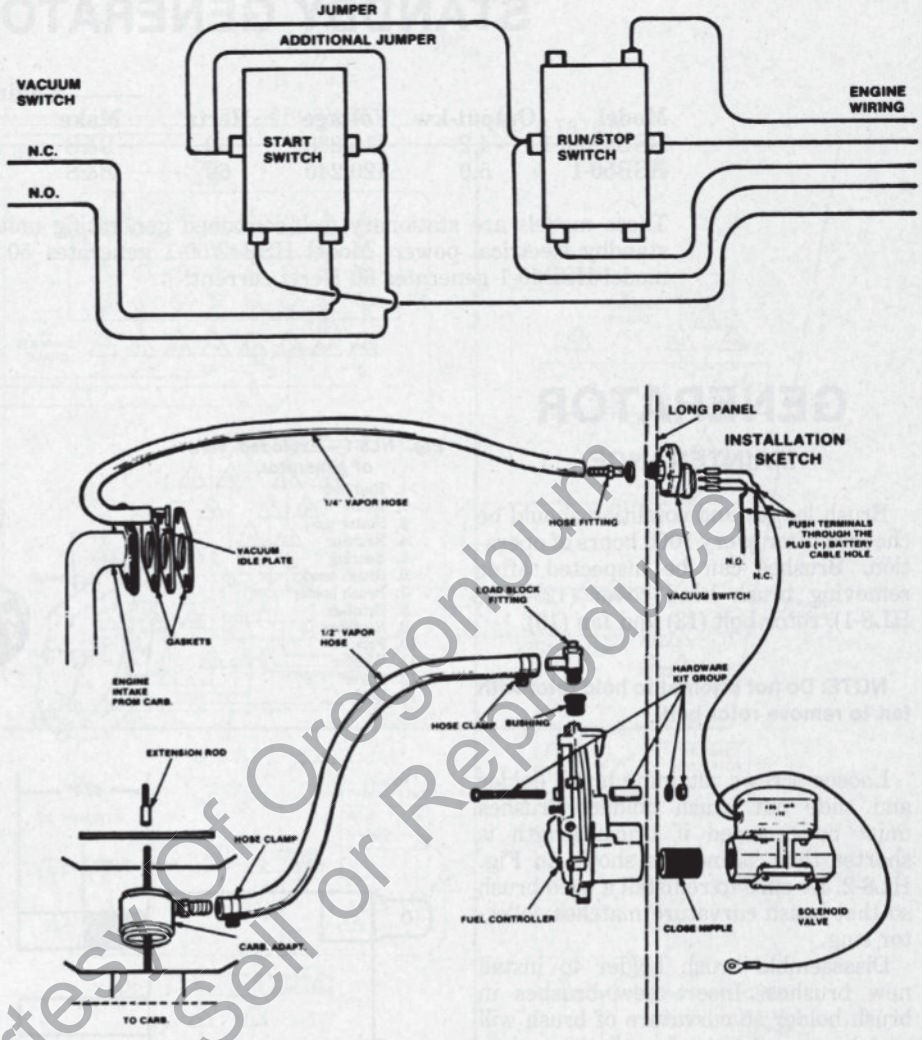


Fig. HL8-6 — Diagram showing wiring connections and fuel components of gaseous fuel conversion kit (#A-47499).

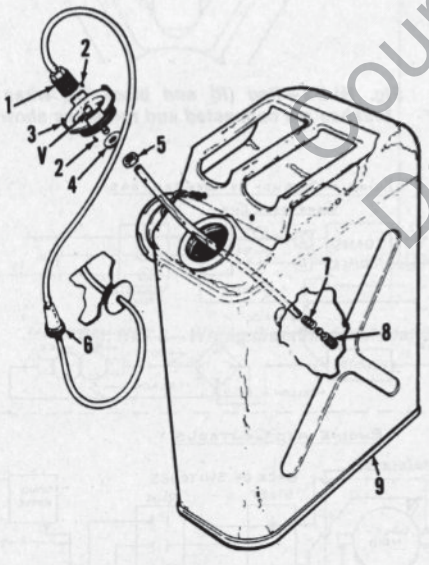


Fig. HL8-5 — View of fuel tank and line. Note quick-disconnect valve (V) in cap (3).

1. Coupler
2. Vents
3. Cap
4. Washer
5. Nut
6. Filter
7. Spring
8. Filter
9. Fuel tank

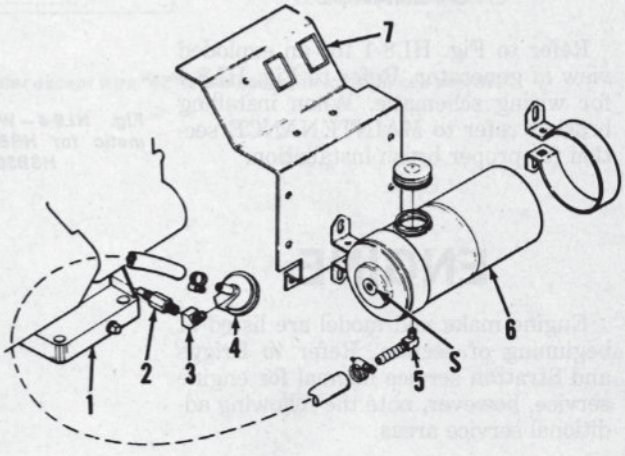


Fig. HL8-7 — View of auxiliary oil tank and line. Oil level is maintained even with sight glass (S).

1. Engine
2. Special fitting
3. Elbow
4. Valve
5. Elbow
6. Auxiliary oil tank
7. Control panel

HOMELITE

AP SERIES PUMPS

Pump Model	Engine Make	Engine Model	GPH
AP215-1	B&S	80232	6000
AP215-1A	B&S	80232	6000
AP220-1	B&S	80232	8400
AP220-1A	B&S	80232	8400
AP315-1	B&S	80232	6000
AP315-1A	B&S	80232	6000
AP320-1	B&S	80232	8400
AP320-1A	B&S	80232	8400

OPERATION

These centrifugal pumps are designed for pumping water and other non-flammable liquids. All pumps are self-priming but pump must be filled with liquid to prevent damage to pump shaft seal. Inlet connections must be air tight for efficient pump operation.

Pump seal, check valve and "O" rings are made of Buna N or EPDM elastomers and it may be necessary to install a different composition seal, check valve and "O" rings for compatibility with liquid. Consult Homelite publication ST-3048 when in doubt.

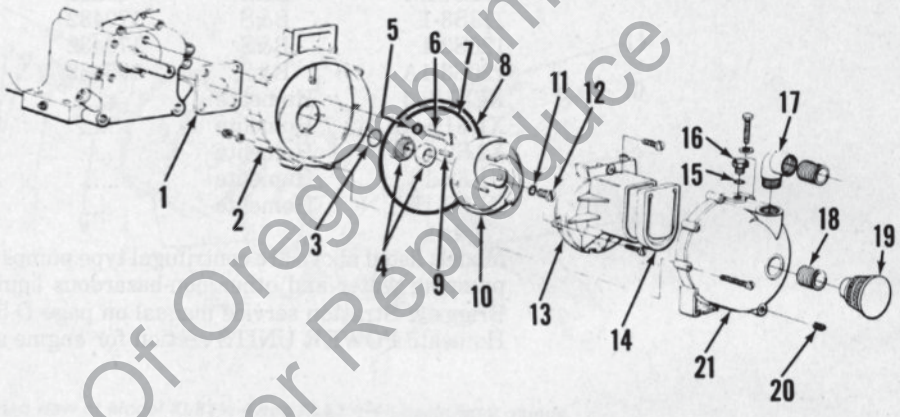


Fig. HL11-1—Exploded view of AP series centrifugal pump.

1. Shim
2. Impeller housing
3. "O" ring
4. Seal assy.
5. "O" ring
6. Screw
7. "O" ring segment
8. "O" ring
9. Key
10. Impeller
11. "O" ring
12. Screw
13. Volute housing
14. Check valve
15. "O" ring
16. Fill plug
17. Outlet elbow
18. Inlet fitting
19. Inlet strainer
20. Drain plug
21. End housing

REPAIRS

DISASSEMBLY AND REASSEMBLY. Disassembly and reassembly of pump is evident after inspection of unit and referral to exploded view in Fig. HL11-1. Impeller may be removed after unscrewing impeller retaining screw (12). Do not damage shims (1) when separating impeller housing (2) from engine. Inspect components and renew if excessively worn or damaged.

Before final assembly, make a trial assembly and check clearance between impeller and wear plate in volute housing (13). An approximate clearance of 0.015 inch between impeller and wear plate is desired. Install or remove shims (1) necessary to obtain desired impeller clearance. Shims (1) are available in thicknesses of 0.010 and 0.015 inch. If excessive clearance exists and all shims have been removed, it will be necessary to renew impeller and volute housing.

Reverse disassembly procedure when assembling pump. All "O" rings should be renewed. Do not overtighten volute housing retaining screws as "O" rings may be cut. After assembling pump, slowly rotate engine crankshaft with pump dry (do not start engine) and listen for interference between impeller and wear plate. Be sure to fill pump with liquid before starting engine to check pump operation.

HOMELITE

CENTRIFUGAL PUMPS

Pump Model	Engine Make	Engine Model	GPH
110S1½-1	B&S	80232	5500
110SU1½-1	B&S	60132	5000
110SU1½-1A	B&S	60132	5000
110SU1½-1B	B&S	60132	5000
110S1½-2	B&S	80232	5500
111S1½-1	B&S	80232	5500
111S1½-2	B&S	80232	5500
111S2-1	B&S	80232	9000
111S2-1A	B&S	81232	8700
111SU2-1	B&S	80231	8500
113S3-1	B&S	170432	18000
120S3-1	B&S	170432	18000
120S3-1A	B&S	195432	17200
XLS1½-4	Homelite	.....	4300
XLS1½-4A	Homelite	.....	4300
XLS2-1	Homelite	.....	8400
XLS2-1A	Homelite	.....	8400
XLS2-1B	Homelite	.....	8400

Models listed above are centrifugal type pumps designed for pumping water and other non-hazardous liquids. Refer to Briggs & Stratton service manual on page D-52 or D-56 of Homelite POWER UNITS section for engine service.

OPERATION

All pumps are self-priming type but pump must be filled with water during operation as seals are lubricated by fluid being pumped. Inlet connections must be air tight to prevent loss of vacuum and a reduction in pump efficiency.

REPAIRS

DISASSEMBLY AND REASSEMBLY. Disassembly and reassembly of pump is evident after inspection of unit and referral to exploded view in Fig. HL12-1, HL12-2, HL12-3 or HL12-4. Care should be taken not to damage gaskets during disassembly. Impeller must be turned counterclockwise for removal. Unscrew impeller by placing wrench on hex end of impeller and striking wrench sharply with a hammer. Take care not to damage or lose shims or seals. On Models XLS1½-4 and XLS1½-4A, impeller housing (1–Fig. HL12-3) must be removed from engine to inspect and renew seal (17) and bearing (16).

Install sufficient shims (4–Fig. HL12-1, HL12-2, HL12-3 and HL12-4) to obtain clearance between impeller (6) and wear plate (8) of 0.020-0.030 inch on Models 120S3-1 and 120S3-1A, and 0.015-0.025 inch on all other models. Some pumps are equipped with seal shims in place of spacer (5–Fig. HL12-1). Install original seal shims or add seal shims if impeller shims (4) are added–delete seal shims if impeller shims are removed. Before reassembling pump, hold wear plate (without gasket) against impeller housing and turn engine over by hand to be sure impeller does not rub against wear plate.

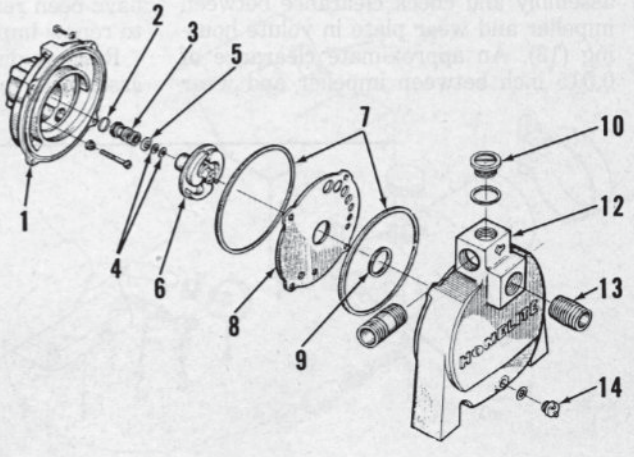


Fig. HL12-1–Exploded view of Model 111S2-1 centrifugal pump. Other models mounted on B&S engines are similar except Models 120S3-1 and 120S3-1A shown in Fig. HI12-2.

1. Impeller housing
2. Slinger
3. Seal assy.
4. Shims
5. Spacer
6. Impeller
7. Gasket
8. Wear plate
9. Gasket
10. Fill plug
11. Outlet fitting
12. End housing
13. Inlet fitting
14. Drain plug

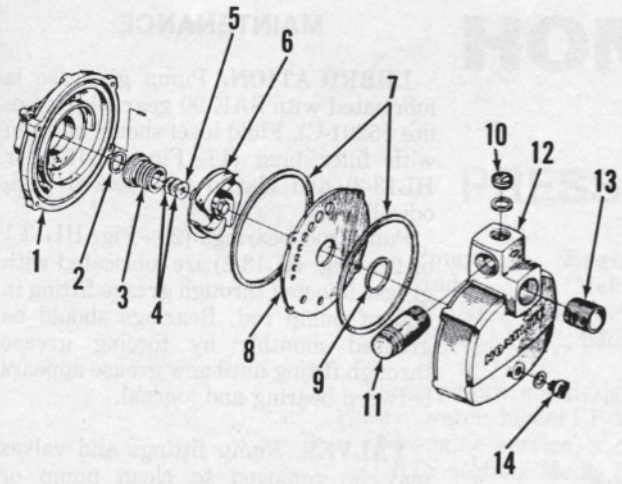


Fig. HL12-2—Exploded view of Model 120S3-1 and 120S3-1A centrifugal pumps. Refer to Fig. HL12-1 for parts identification.

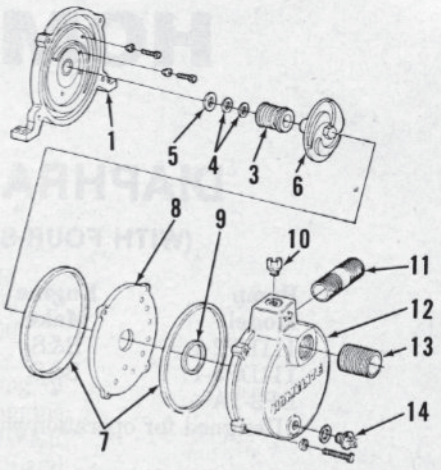


Fig. HL12-4—Exploded view of Model XLS2-1, XLS2-1A and XLS2-1B centrifugal pumps. Refer to Fig. HL12-1 for parts identification.

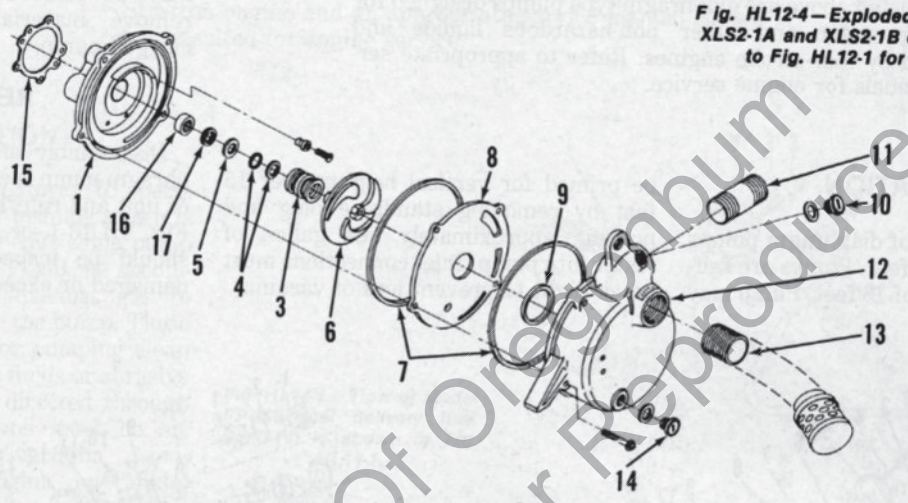


Fig. HL12-3—Exploded view of Model XLS1½-4 and XLS1½-4A centrifugal pumps.

1. Impeller housing
3. Seal assy.
4. Shims
5. Spacer
6. Impeller
7. Gasket
8. Wear plate
9. Gasket
10. Fill plug
11. Outlet fitting
12. End housing
13. Inlet fitting
14. Drain plug
15. Gasket
16. Bearing
17. Seal

HOMELITE

DIAPHRAGM PUMPS

(WITH FOUR-STROKE ENGINES)

Pump Model	Engine Make	Engine Model	GPH
111DP2-1	B&S	80232	1900
111DP3-1	B&S	80232	4800
DP3-1A	*	.....	3000

*Designed for operation with electric motor.

Models listed above are diaphragm type pumps designed for pumping water and other non-hazardous liquids and powered by four-stroke engines. Refer to appropriate service manuals for engine service.

OPERATION

Total suction lift of diaphragm pumps in this section is 25 feet. Pumps are self-priming up to a lift of 15 feet. Pump may be primed for vertical heights over 15 feet by removing standpipe plug and pouring approximately one gallon of water into pump. Inlet connections must be air tight to prevent loss of vacuum.

MAINTENANCE

LUBRICATION. Pump gearcase is lubricated with SAE 90 gear oil (Homelite 55291-C). Fluid level should be even with filler plug (17–Fig. HL13-1 or HL13-2) and should be checked periodically.

Pump rod bearings (29–Fig. HL13-1 or 22–Fig. HL13-2) are lubricated with grease injected through grease fitting in end of pump rod. Bearings should be greased monthly by forcing grease through fitting until new grease appears between bearing and journal.

VALVES. Pump fittings and valves may be removed to clean pump or remove material which may have clogged pump.

REPAIRS

Disassembly and reassembly of diaphragm pump is evident after inspection of unit and referral to exploded view in Fig. HL13-1 or HL13-2. Components should be inspected and renewed if damaged or excessively worn.

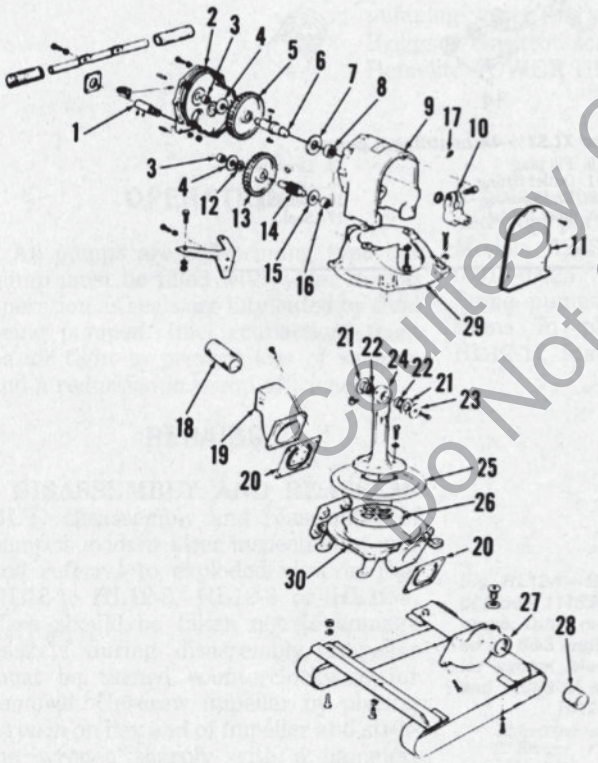


Fig. HL13-1—Exploded view of 111DP2-1 diaphragm pump.

1. Input shaft
2. Gearcase cover
3. Needle bearing
4. Thrust washer
5. Pump gear
6. Driveshaft
7. Thrust washer
8. Needle bearing
9. Gearcase
10. Crank
11. Shield
12. Spacer
13. Gear
14. Intermediate shaft
15. Thrust washer
16. Needle bearing
17. Fill plug
18. Outlet fitting
19. Outlet manifold
20. Valve
21. Thrust washer
22. Needle bearing
23. Washer
24. Rod
25. Diaphragm
26. Diaphragm cap
27. Inlet manifold
28. Inlet fitting
29. Pump body
30. Lower housing

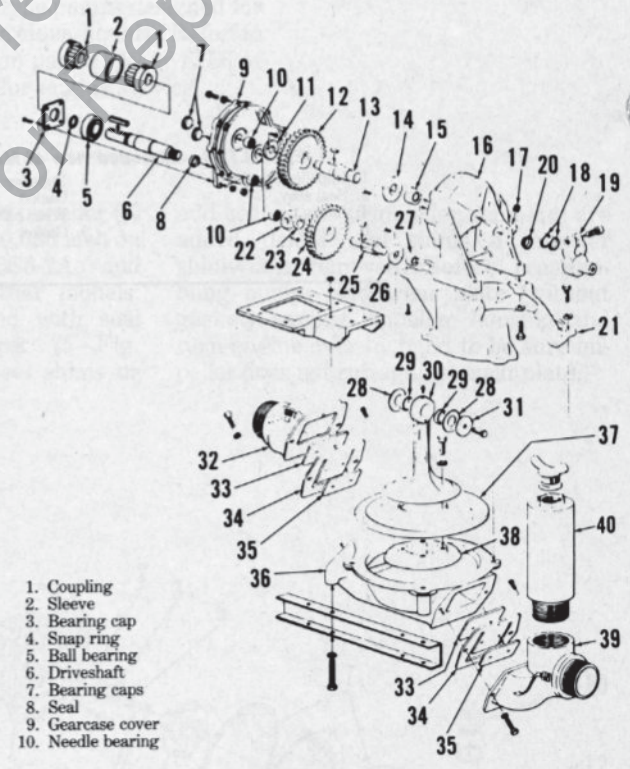


Fig. HL13-2—Exploded view of Model DP3-1A diaphragm pump. Model 111DP3-1 is similar.

1. Coupling
2. Sleeve
3. Bearing cap
4. Snap ring
5. Ball bearing
6. Driveshaft
7. Bearing caps
8. Seal
9. Gearcase cover
10. Needle bearing
11. Thrust washer
12. Pump gear
13. Driveshaft
14. Thrust washer
15. Needle bearing
16. Gearcase
17. Fill plug
18. Seal
19. Crank
20. Bearing cap
21. Pump housing
22. Thrust washer
23. Spacer
24. Gear
25. Intermediate shaft
26. Thrust washer
27. Needle bearing
28. Thrust washer
29. Needle bearing
30. Rod
31. Washer
32. Outlet manifold
33. Valve plate
34. Valve
35. Valve weight
36. Lower housing
37. Diaphragm
38. Diaphragm cap
39. Inlet manifold
40. Standpipe

HOMELITE

PRESSURE PUMPS

Pump Model	Engine Make	Engine Model	GPH
FP-150	Homelite	.....	3600
FP-250	B&S	221432	12500

These pumps are designed for high-pressure pumping of clean water. Model FP-150 is powered by a Homelite engine and engine service is covered on page D-49 in POWER UNITS section. Model FP-250 is powered by a Briggs and Stratton engine and an appropriate service manual should be consulted for engine service.

OPERATION

Pump must be primed prior to operation. A hand-operated priming pump is provided on Model FP-150 while pump priming on Model FP-250 is accomplished using engine exhaust gas to draw priming water to the pump. These pumps are designed for pumping clean water only. Hazardous fluids or abrasive material must not be directed through pump. Inlet connections must be air tight to prevent loss of vacuum.

Before starting engine on Model FP-150, connect fuel hose between fuel tank and engine, then open vent (V–Fig. HL14-1) by turning counterclockwise. Squeeze fuel hose primer bulb to transfer fuel from fuel tank to engine.

Model FP-150 pump is equipped with an automatic ignition system cut-off module (7–Fig. HL14-2) which stops engine in case of overspeeding at full throttle, such as when prime is lost. The engine's ignition system must cut-off before engine speed exceeds 10000 rpm. Ignition system cut-off resets after engine stops so engine can be immediately restarted.

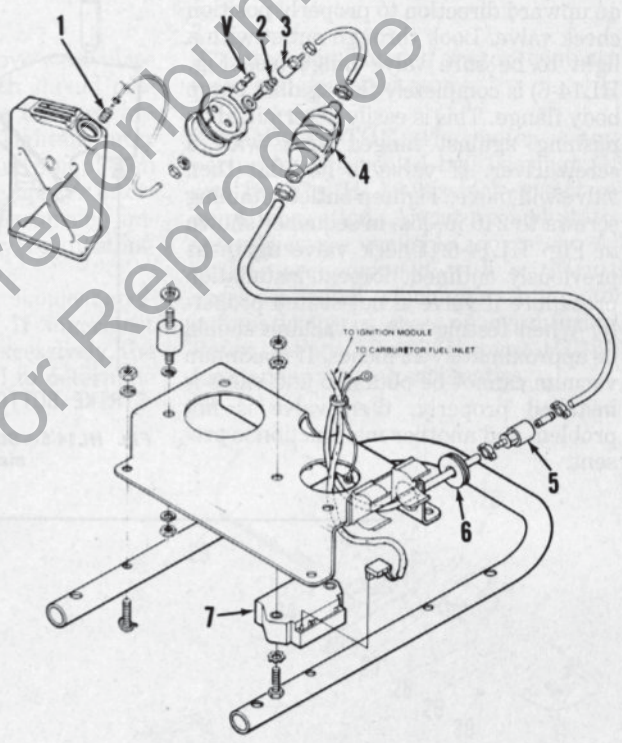


Fig. HL14-2–View of Model FP-150 fuel delivery line. Vent (V) is shown in Fig. HL14-1.

1. Filter
2. Bushing
3. Coupler
4. Primer bulb
5. Coupler
6. Grommet
7. Ignition cut-off module

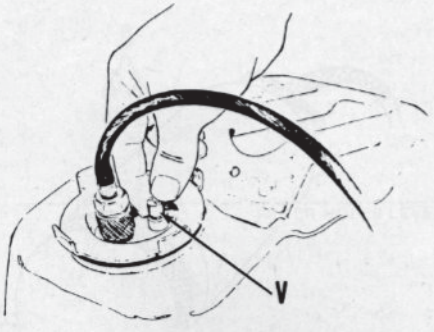


Fig. HL14-1–Turn vent (V) counterclockwise to open and vent Model FP-150 fuel tank.

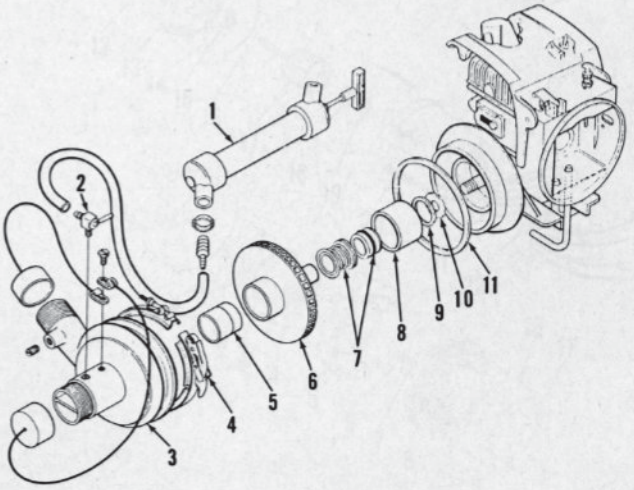


Fig. HL14-3–Exploded view of Model FP-150 pump.

1. Primer pump
2. Valve
3. End housing
4. Clamp
5. Wear ring
6. Impeller
7. Seal assy.
8. Wear ring
9. Thrust washer
10. Washer
11. Square ring

PUMP REPAIR

DISASSEMBLY AND REASSEMBLY. Refer to Fig. HL14-3 or HL14-4 for an exploded view of pump. Internal components are accessible after removing clamp (4–Fig. HL14-3) on FP-150 models or after removing end housing (4–Fig. HL14-4) on FP-250 models. Impeller is threaded on engine crankshaft. Inspect components and renew any components which are excessively worn or damaged.

Before installing check valve (3-Fig. HL14-4) on Model FP-250, apply Dow Corning no. 4 lubricant compound (Homelite part no. 22636-B) to faces of outlet and pump body. Install check valve and outlet on pump but tighten retaining screws until snug, do not tighten. Strike bottom of outlet, as shown in Fig. HL14-5, several times in an upward direction to properly position check valve. Look through outlet with a light to be sure valve hinge (see Fig. HL14-6) is completely flat against pump body flange. This is easily determined by pushing against hinged area with a screwdriver. If valve is not flat then valve will move. Tighten outlet retaining screws to 240 in.-lbs. in sequence shown in Fig. HL14-6. Check valve again as previously outlined. Repeat installation procedure if valve is not seated properly. When testing pump, vacuum should be approximately 22 inches. If maximum vacuum cannot be obtained and valve is installed properly, then valve is not problem and another malfunction is present.

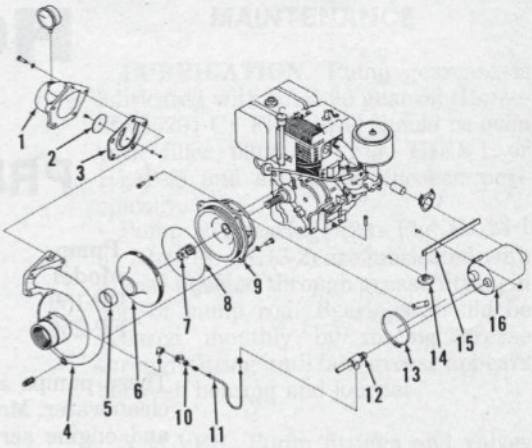


Fig. HL14-4–Exploded view of Model FP-250 pump.

1. Outlet
2. Weight
3. Check valve
4. End housing
5. Bushing
6. Impeller
7. Seal
8. "O" ring
9. Housing
10. Valve
11. Primer line
12. Primer venturi
13. Clamp
14. Diverter valve
15. Primer lever
16. Muffler

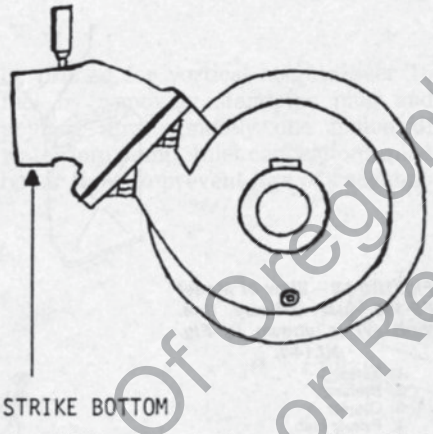


Fig. HL14-5–Strike bottom of outlet with a mallet to seat valve.

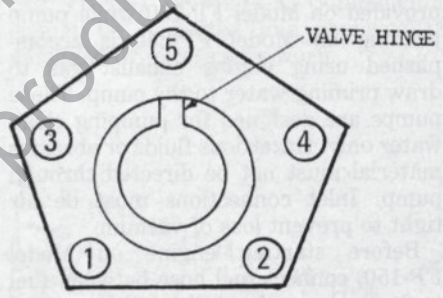


Fig. HL14-6–Tightening equence for outlet retaining screws.

HOMELITE

SUBMERSIBLE PUMPS

Pump Model	Volts	Amps	Hertz	Phase	GPH
SP150-1	*115	10.6	60	1	6500
SP150-1A	*115	10.6	60	1	6500
SP150-1B	*115	10.6	60	1	6500
SP200-1	230	21.0	60	1	13000
SP200-2	*115	21.0	60	1	13000
SP200-2A	*115	21.0	60	1	13000
SP200-2B	*115	21.0	60	1	13000
SP300-1	230	21.0	60	1	19000
SP300-1A	230	21.0	60	1	19000
SP300-1B	230	21.0	60	1	19000

*Models SP150 and SP200 may be converted to 230-volt operation using Homelite® Voltage Conversion Kit.

MAINTENANCE

The pump shaft is lubricated by oil contained in the back plate. Oil should be changed after every 500 hours or after one month of continuous operation. Remove oil plugs (9 – Fig. HL16-1) to drain oil. To refill pump, position pump on its side with oil plugs on top as shown in Fig. HL16-1, then fill cavity with SAE 30 non-detergent oil until oil level reaches bottom of plug holes. Inspect old oil for signs of contamination which may indicate faulty seals. Approximate oil capacity is 22 ounces.

REPAIRS

IMPELLER AND OIL SEALS. Pump impeller and wear plate should be renewed if excessively worn or damaged. The clearance between wear plate (2 – Fig. HL16-2) and impeller (4) should be 0.010-0.015 inch and is adjusted by turning stud nuts (N) as follows: While lightly pushing wear plate towards impeller, loosen inner nuts until wear plate contacts impeller evenly. Back off each inner nut ⅓ to ½ turn (move wear plate away from impeller) which should provide the desired clearance between impeller and wear plate. Tighten outer nuts against wear plate. Run pump, then stop pump and check for impeller interference with wear plate by turning impeller by hand. If necessary, readjust impeller clearance.

All seals and "O" rings should be renewed during overhaul. If innermost seal is damaged or worn excessively, the motor should be inspected to determine if water has entered motor compartment and damaged motor.

PUMP MOTOR. The motor is supported by two sealed ball bearings (15 and 18 – Fig. HL16-2) which do not require lubrication. Armature and stator assemblies are available separately. All models are equipped with a thermal overload switch which shuts off motor automatically in case of overheating. Refer to Figs. HL16-3 through HL16-8 for standard wiring schematics.

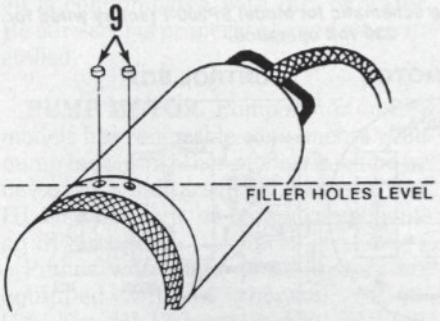


Fig. HL16-1 – Position pump as shown, remove plugs (9) and fill with oil until oil reaches bottom of plug holes.

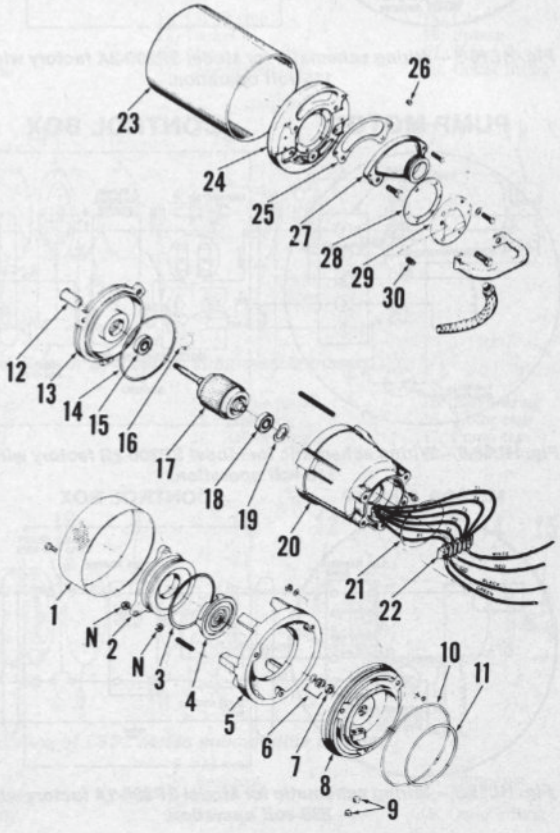


Fig. HL16-2 – Exploded view of Model SP300-1B pump. Other models are similar.

1. Strainer
2. Wear plate
3. "O" ring
4. Impeller
5. End plate
6. Shims
7. Spacer
8. Back plate
9. Plugs
10. "O" ring
11. "O" ring
12. Seal
13. Bearing housing
14. "O" ring
15. Bearing
16. Retaining ring
17. Armature
18. Bearing
19. Wave washer
20. Stator assy.
21. "O" ring
22. Terminal block
23. Shell
24. Top cap
25. Gasket
26. Threaded inserts
27. Outlet
28. Gasket
29. Cover
30. Plug

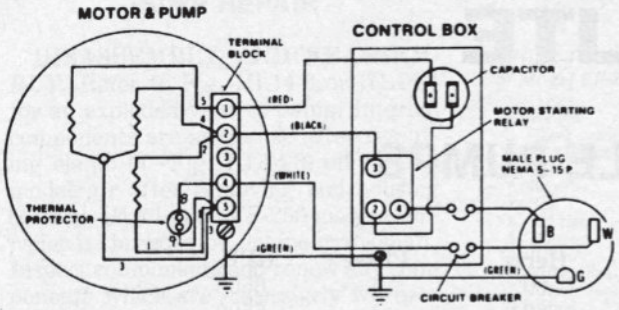


Fig. HL16-3— Wiring schematic for Model SP150-1 factory wired for 115 volt operation.

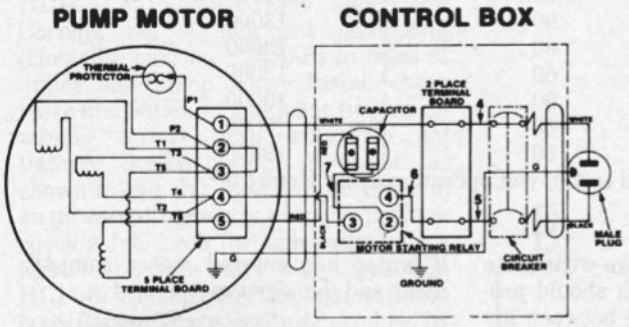


Fig. HL16-4— Wiring schematic for Model SP150-1B factory wired for 115-volt operation.

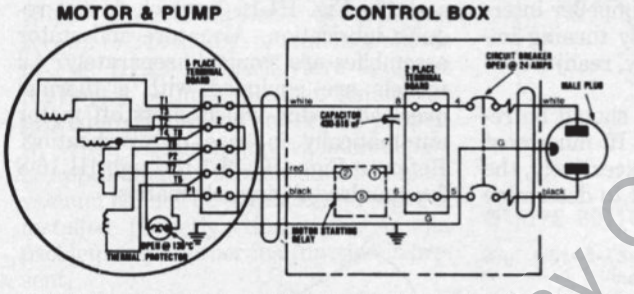


Fig. HL16-5— Wiring schematic for Model SP200-2A factory wired for 115-volt operation.

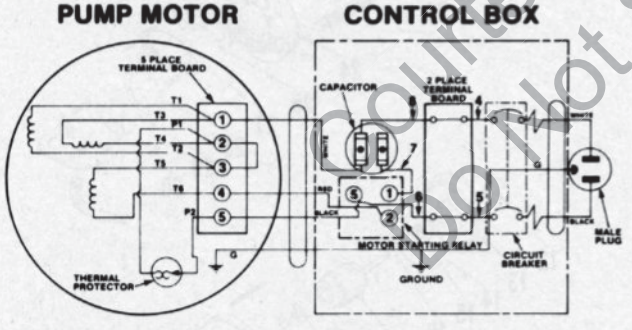


Fig. HL16-6— Wiring schematic for Model SP200-2B factory wired for 115-volt operation.

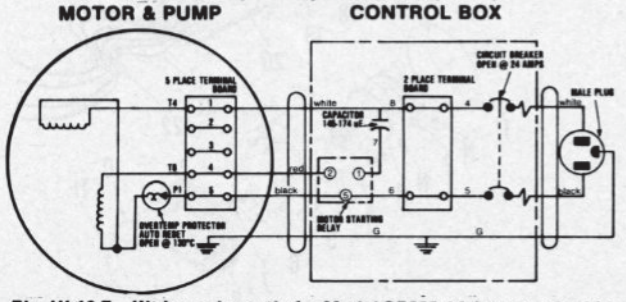


Fig. HL16-7— Wiring schematic for Model SP300-1A factory wired for 230 volt operation.

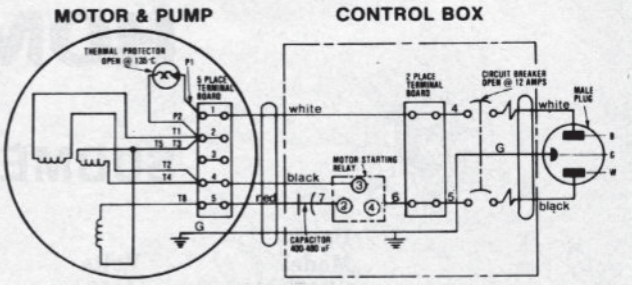


Fig. HL16-8— Wiring schematic for Model SP150-1A factory wired for 115-volt operation.

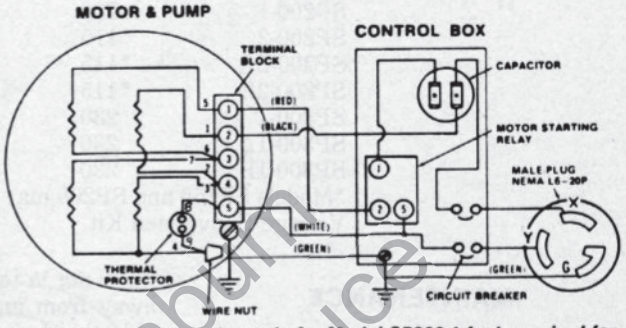


Fig. HL16-9— Wiring schematic for Model SP200-1 factory wired for 230 volt operation.

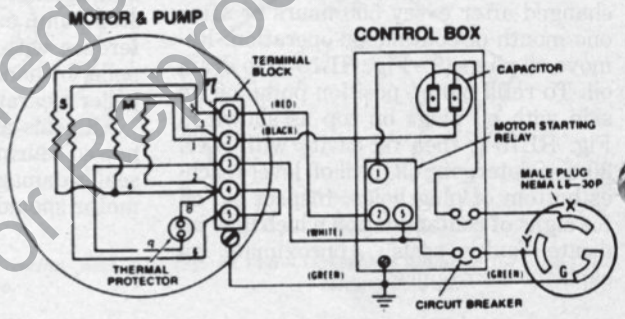


Fig. HL16-10— Wiring schematic for Model SP200-2 factory wired for 115 volt operation.

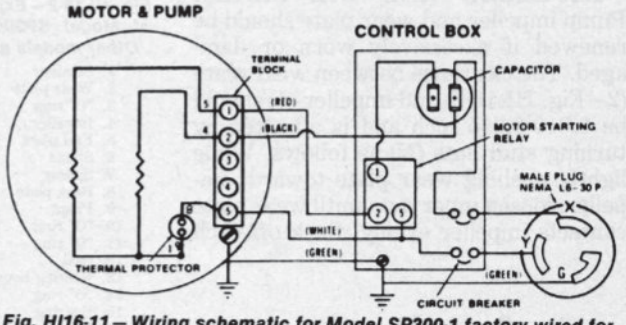


Fig. HI16-11— Wiring schematic for Model SP300-1 factory wired for 230 volt operation.

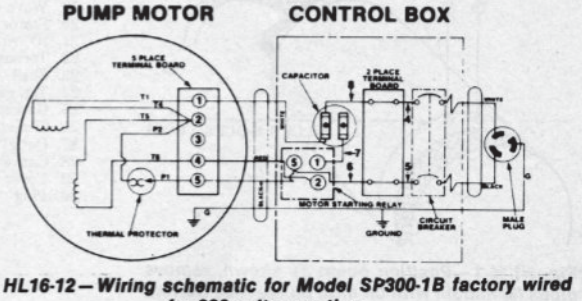


Fig. HL16-12— Wiring schematic for Model SP300-1B factory wired for 230 volt operation.

HOMELITE

SUBMERSIBLE PUMPS

Pump Model	Volts	Amps	Hertz	Phase	GPH
LSP2-115/1-1	115	16	60	1	7500
LSP2-220/1-1	230	8	60	1	7500
SP2-115/1-1&1A	115	18	60	1	9000
SP2-220/50/1-1&1A	220	12	50	1	7500
SP2-220/1-1&1A	230	9	60	1	9000
SP2-220/3-1&1A	230	6	60	3	9000
SP2-380/3/50-1&1A	380	5	50	3	7500
SP3-220/3-1, 1A&1B	230	15	60	3	18500
SP3-440/3-1, 1A&1B	440	8	60	3	18500

MAINTENANCE

LUBRICATION. All models are equipped with a transparent oil fill plug to indicate oil level. Oil should be changed after 200 hours of operation or after ten days of continuous usage. Recommended oil is clean SAE 30 oil or Texaco "Regal E" Turbine oil. Oil capacity of LSP2 models is approximately 8 oz. while oil capacity of SP2 and SP3 pumps is approximately 14 oz.

REPAIRS

IMPELLER & OIL SEALS. A new pump impeller should be installed if vanes are excessively worn or damaged. Install shims behind impeller to provide 0.015 inch clearance between impeller and wear plate (2–Fig. HL17-1), impeller housing (3–Fig. HL17-2) or strainer (2–Fig. HL17-3).

Oil seals shown in Figs. HL17-1, HL17-2 or HL17-3 should be renewed if oil is contaminated with dirt or water. Be sure seal is properly aligned when installed.

PUMP MOTOR. Pump motor on SP3 models has renewable components while pump motor on other models must be renewed as a unit assembly. Refer to Fig. HL17-2 for view of motor components on SP3 models.

Pumps with single phase motors are equipped with a thermal cut-out (14–Fig. HL17-1 or 12–Fig. HL17-3), which opens the circuit if an overload occurs. Pumps with three phase motors

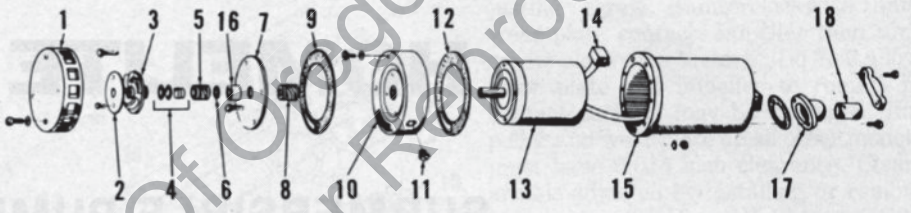


Fig. HL17-1—Exploded view of SP2 series submersible pumps.

1. Strainer
2. Wear plate
3. Impeller
4. Grit seal
5. Oil seal
6. Shim
7. Seal plate
8. Oil seal
9. Gasket
10. Frame plate
11. Oil fill plug
12. Gasket
13. Motor
14. Thermal cut-out
15. Case
16. Spacer
17. Outlet flange
18. Outlet fitting

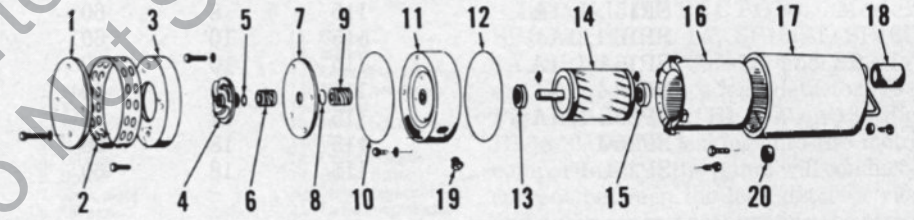


Fig. HL17-2—Exploded view of SP3 series submersible pumps.

1. Strainer plate
2. Strainer
3. Impeller housing
4. Impeller
5. Shim
6. Oil seal
7. Seal plate
8. Retainer
9. Oil seal
10. Quad ring
11. Frame plate
12. Quad ring
13. Ball bearing
14. Rotor
15. Ball bearing
16. Motor case
17. Pump case
18. Outlet fitting

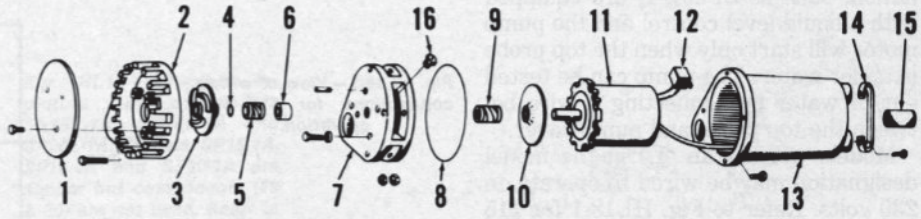
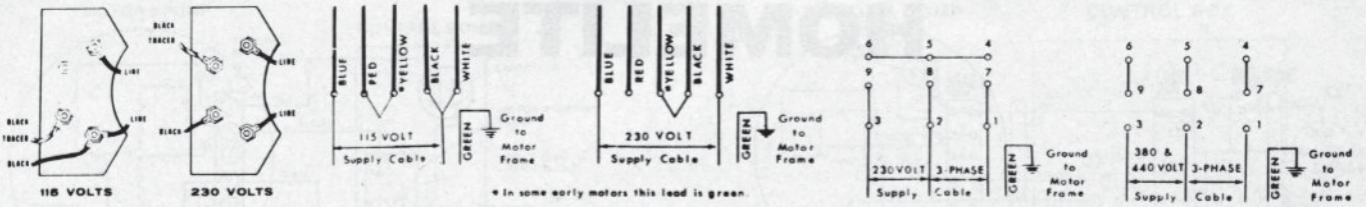


Fig. HL17-3—Exploded view of LSP2 series submersible pumps.

1. Strainer plate
2. Strainer
3. Impeller
4. Shim
5. Oil seal
6. Spacer
7. Frame plate
8. Quad ring
9. Oil seal
10. Seal seat
11. Motor
12. Thermal cut-out
13. Pump case
14. Handle
15. Outlet fitting



LSP-2 SP2-115 SP2-220/1 SP2-220/3 SP3-220 SP2-380 SP3-440

Fig. HL17-4—Use the above diagrams for checking pump wiring. If motor is not wired as shown, refer to diagram on cover plate of motor.

are equipped with fuses in the control box for circuit protection.

Three-phase motors will rotate in either direction and should be checked to insure proper wiring. Hold pump with strainer down and start motor briefly. Pump should twist sharply counterclockwise if wired correctly. If direction of rotation is wrong, disconnect and interchange any two live leads.

Refer to Fig. HL17-4 for wiring diagrams. If motor is not wired as shown, refer to diagram on cover plate of motor.

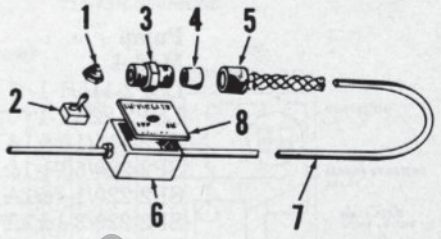


Fig. HL17-5—View of switch box used on all models.

1. Boot
2. Switch
3. Body & nut
4. Bushing
5. Collar
6. Switch box
7. Cable

HOMELITE

SUBMERSIBLE PUMPS

Pump Model	Volts	Amps	Hertz	Phase	GPH
SP15-1, 1A	115	8	60	Single	5000
SP15L-1, 1A	115	8	60	Single	3000
SP16-1, 1A	115	10	60	Single	4600
SP16A-1, 1A	115	10	60	Single	4600
SP20-1, 1A	115	14	60	Single	7400
SP20L-1, 1A	115	14	60	Single	7400
SP25-1	115	18	60	Single	9000
SP25L-1	115	18	60	Single	9000

OPERATION

Models with an "L" in the model designation, such as SP20L-1, are equipped with a liquid level control and the pump motor will start only when the top probe is under water. The pump can be tested out of water by connecting a wire between the top probe and pump cover.

Models without an "L" in the model designation may be wired to operate on 230 volts. Refer to Fig. HL18-1 for 115 volt wiring schematic. Pumps with an "L" model designation cannot be operated on 230 volts as level control is designed to operate on 115 volts only.

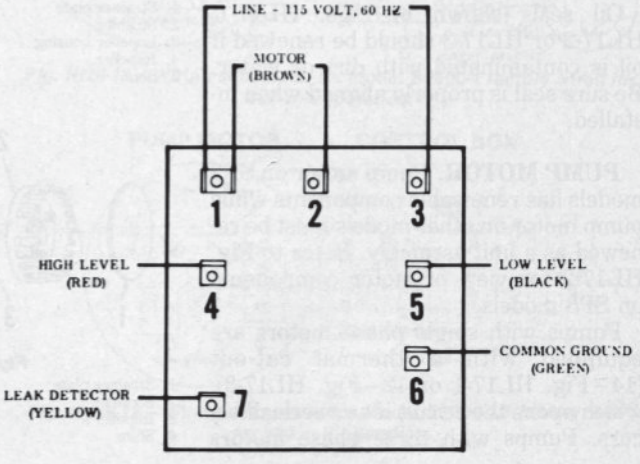


Fig. HL18-1—View of wiring connections for 115 volt operation.

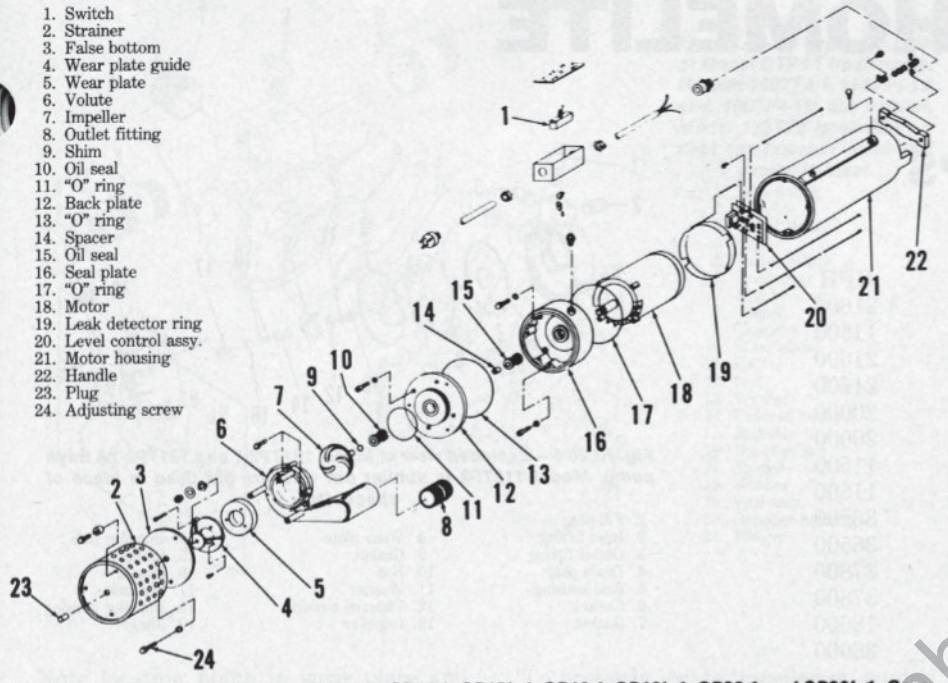


Fig. HL18-2—Exploded view of Models SP15-1, SP15L-1, SP16-1, SP16L-1, SP20-1 and SP20L-1. Components (19 & 20) are used only on models SP15L-1, SP16L-1 and SP20L-1.

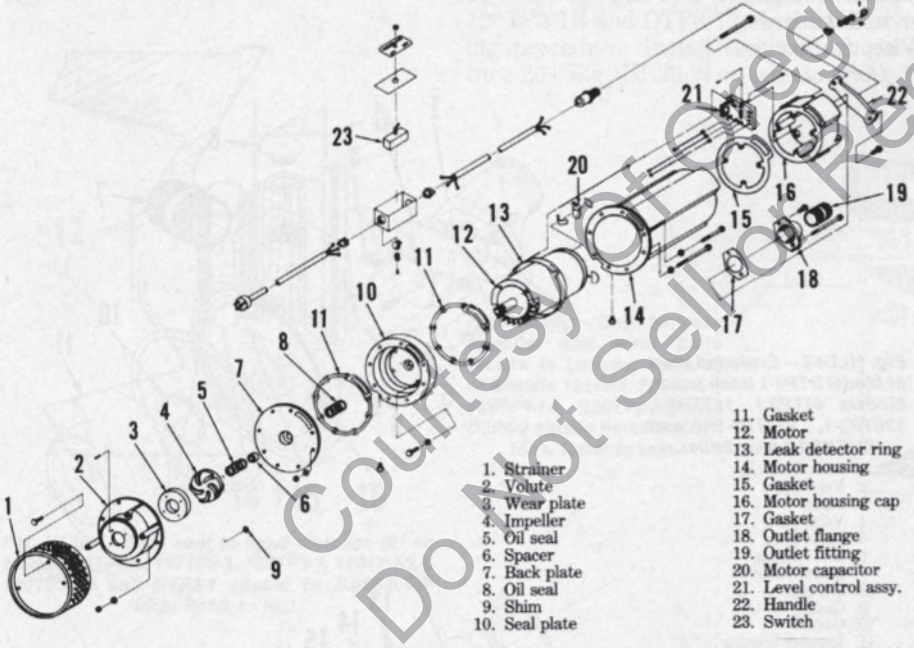


Fig. HL18-3—Exploded view of Model SP25L-1. Model SP25-1 is similar but components (13, 15, 16 and 21) are not used.

MAINTENANCE

LUBRICATION. All models are equipped with a transparent oil fill plug to indicate oil level. Oil should be changed after every 500 hours of operation or after one month of continuous operation. Recommended oil is clean SAE 30 non-detergent oil. Oil capacity is 20 ounces for models SP15-1, SP15L-1, SP16-1, SP16L-1, SP20-1 and SP20L-1; 23 ounces for models SP15-1A, SP15L-1A and SP16L-1A; and 48 ounces for models SP25-1 and SP25L-1.

REPAIRS

IMPELLER AND OIL SEALS. Pump impeller should be renewed if excessively worn or damaged. Desired clearance between impeller and wear plate (5–Fig. HL18-2, Fig. HL18-4 or 3–Fig. HL18-3) is 0.015 inch and is obtained by installing shims (9).

Oil seals should be renewed if oil is contaminated with dirt or water. Be sure seal is properly aligned when installed. If inner seal is worn excessively, motor should be inspected to determine if water has entered motor case and damaged motor.

PUMP MOTOR. Pump motor must be renewed as a unit assembly. Starter capacitor and thermal protector are renewable as separate components on some models.

Clearance between impeller and wear plate on models SP15-1, SP15L-1, SP16-1, SP16L-1, SP20-1, and SP20L-1 is adjusted by removing plug (23–Fig. HL18-2) and turning adjusting screw (24) with pump running. Slowly turn adjusting screw counterclockwise until wear plate contacts impeller then turn screw clockwise ¼ turn. Do not allow wear plate and impeller to remain in contact as both may be damaged. Impeller and wear plate on all other models must have 0.015 inch clearance. Clearance is adjusted by installing or removing shims (9–Fig. HL18-3 or Fig. HL18-4).

All models are equipped with a thermal overload detector to protect the pump motor from overheating.

LEAK DETECTOR. Models SP15L-1, SP15L-1A, SP16L-1, SP16L-1A, SP20L-1, SP20L-1A and SP25L-1 are equipped with a leak detector (19–Fig. HL18-2, Fig. HL18-4 or 13–Fig. HL18-3). Water leaking into the motor compartment of the pump will conduct a current between the leak detector ring and pump cover disconnecting the motor from the line. Pump must be disassembled and water removed before motor will operate.

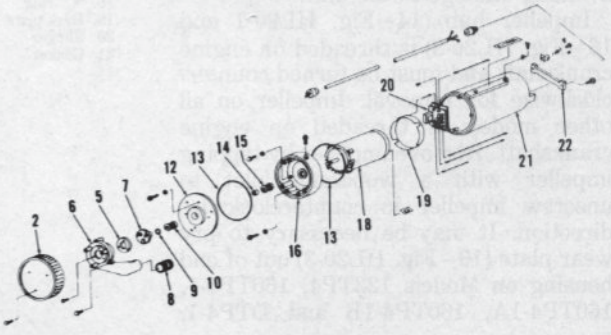


Fig. HL18-4—Typical exploded view of Models SP15L-1A, SP16L-1A and SP20L-1A. Models SP15-1A, SP16-1A and SP20-1A are similar but components (19 & 20) are not used. Refer to Fig. HL18-2 for parts identification.

HOMELITE

TRASH PUMPS

Pump Model	Engine Make	Engine Model	GPH
45TP3-1	B&S	170432	21600
112TP2	B&S	130232	11500
117TP3-1	Wisc.	S-7D	21600
120TP3-1	B&S	17432	21600
120TP3-1A	B&S	195432	20000
120TP3-1B	B&S	195432	20000
121TP2-1	B&S	130232	11500
121TP2-1A	B&S	131232	11500
123TP4	Wisc.	S-12D	36500
160TP4-1	B&S	326431	36500
160TP4-1A	B&S	326431	37800
160TP4-1B	B&S	326431	37800
DTP3-1	Lombardini	530	18600
DTP4-1	Lombardini	LDA510	36000

Models listed above are centrifugal type trash pumps designed for pumping water and other non-hazardous liquids and powered by four-stroke engines. Refer to Lombardini engine section or Briggs and Stratton or Wisconsin service manual for engine service.

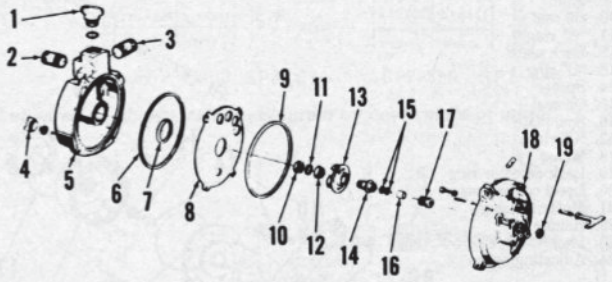


Fig. HL20-1—Exploded view of Model 121TP2-1 and 121TP2-1A trash pump. Model 112TP2 is similar but washers are used in place of spacer (16)

1. Fill plug
2. Inlet fitting
3. Outlet fitting
4. Drain plug
5. End housing
6. Gasket
7. Gasket
8. Wear plate
9. Gasket
10. Nut
11. Washer
12. Tapered bushing
13. Impeller
14. Impeller hub
15. Shims
16. Spacer
17. Seal assy.
18. Impeller housing
19. Slinger

OPERATION

All pumps are self-priming but pump must be filled with water during operation to prevent damage to seals as seals are lubricated by fluid being pumped. Inlet connections must be air tight for efficient pump operations.

REPAIRS

DISASSEMBLY AND REASSEMBLY. Disassembly of pump is evident after inspection of unit and referral to exploded view in Fig. HL20-1, HL20-2 or HL20-3. Impeller on Models 112TP2, 121TP2-1, 121TP2-1A and 123TP4 is resiliently mounted on a plastic bushing that allows the impeller to slip slightly when a solid object jams the impeller. This stalls the engine gradually, avoiding damage to the unit.

Impeller hub (14–Fig. HL20-1 and 16–Fig. HL20-3) is threaded on engine crankshaft and must be turned counterclockwise for removal. Impeller on all other models is threaded on engine crankshaft. Remove impeller by tapping impeller with a wooden mallet to unscrew impeller in counterclockwise direction. It may be necessary to pry wear plate (10–Fig. HL20-3) out of end housing on Models 123TP4, 160TP4-1, 160TP4-1A, 160TP4-1B and DTP4-1.

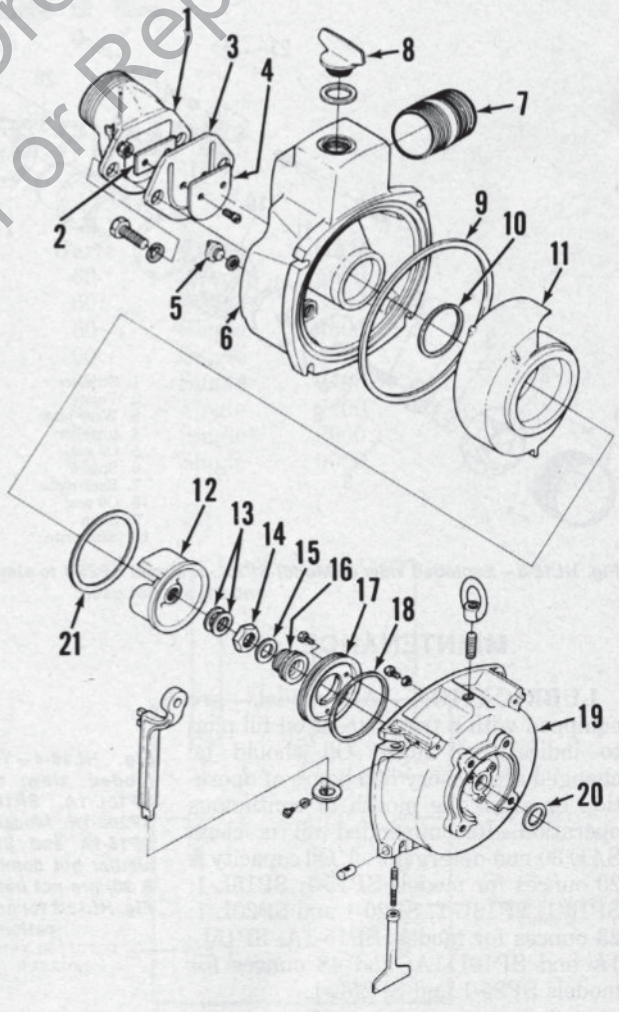


Fig. HL20-2—Exploded view of Model DTP3-1 trash pump. Models 45TP3-1, 117TP3-1, 120TP3-1, 120TP3-1A and 120TP3-1B are similar.

1. Inlet manifold
2. Valve plate
3. Valve
4. Valve plate
5. Drain plug
6. End housing
7. Outlet manifold
8. Fill plug
9. Gasket
10. Gasket
11. Impeller housing
12. Impeller
13. Shim
14. Nut
15. Shim
16. Seal assy.
17. Wear plate
18. "O" ring
19. Back plate
20. Slinger
21. Gasket

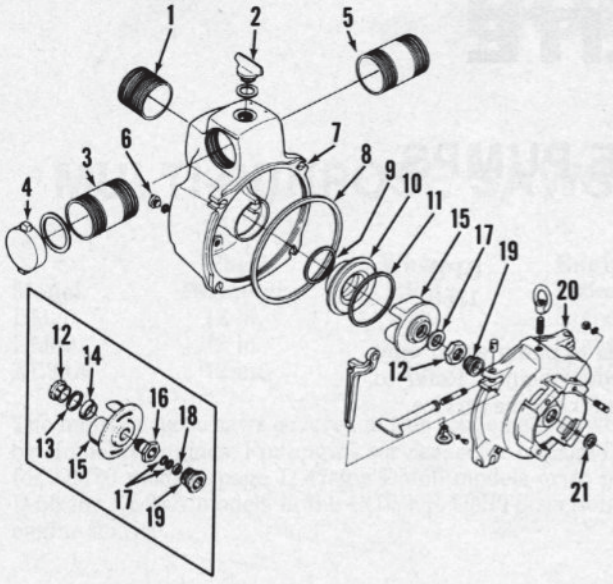


Fig. HL20-3—Exploded view of Model DTP4-1 trash pump. Models 160TP4-1, 160TP4-1A and 160TP4-1B are similar. Model 123TP4 is similar except for impeller assembly shown in inset.

1. Inlet fitting
2. Fill plug
3. Outlet fitting
4. Cap
5. Outlet fitting
6. Drain plug
7. End housing
8. Gasket
9. Gasket
10. Wear plate
11. Gasket
12. Nut
13. Washer
14. Tapered bushing
15. Impeller
16. Impeller hub
17. Shims
18. Washer
19. Seal assy.
20. Impeller housing
21. Slinger

Note locating notch in wear plate and corresponding locating boss in end housing.

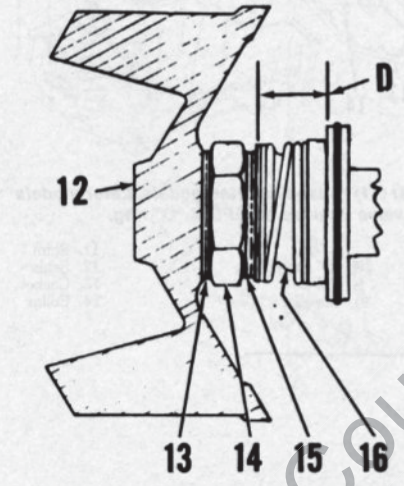


Fig. HL20-4—Seal seat to head distance (D) on Models 45TP3-1, 117TP3-1, 120TP3-1, 120TP3-1A, 120TP3-1B and DTP3-1 should be 0.865-0.885 inch. Refer to text.

To properly locate impeller on engine crankshaft of Models 45TP3-1, 117TP3-1, 120TP3-1, 120TP3-1A, 120TP3-1B and DTP3-1, use the following procedure: Install components (14 thru 20—Fig. HL20-2) on engine crankshaft, tighten nut (14) to 50 ft.-lbs., and measure distance between seal (16) seat and head as shown in Fig. HL20-4. Add or subtract shims (15) to obtain distance of 0.865-0.885 inch. Install impeller (12) and sufficient number or thickness of shims (13) so that impeller just touches impeller housing. Remove 0.015 inch from shim pack to obtain proper impeller clearance. Shims (13 & 15) are available in thicknesses of 0.010, 0.015 and 0.032 inch.

Proper impeller location on Models 123TP4, 160TP4-1, 160TP4-1A, 160TP4-1B and DTP4-1 is determined as follows: Install components (15 thru 21—Fig. HL20-3) on engine crankshaft and measure depth of impeller vane adjacent to wear plate recess of impeller housing (20) as shown in Fig. HL20-5. Install shims (17—Fig. HL20-3) to obtain a depth of 0.005-0.015 inch. Shims are available in thicknesses of 0.010-0.015 inch.

Proper location of impeller on Models 112TP2, 121TP2-1 and 121TP2-1A is determined by shims (15—Fig. HL20-1) which are available in thicknesses of 0.010 and 0.015 inch. There should be 0.020-0.030 inch clearance between impeller and wear plate (8).

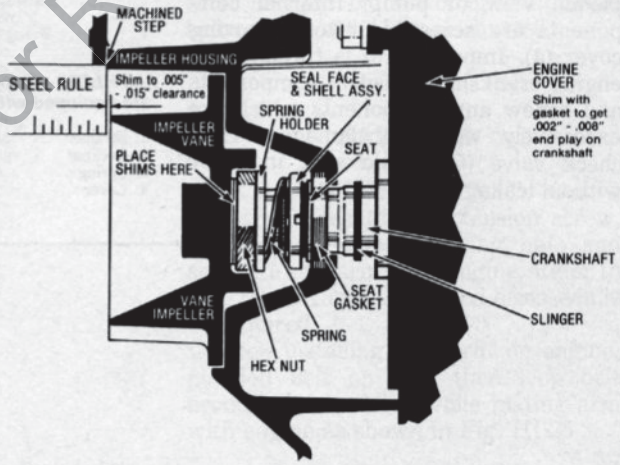


Fig. HL20-5—Gap between impeller and wear plate recess in impeller housing of Models 123TP4, 160TP4-1, 160TP4-1A, 160TP4-1B and DTP4-1 should be 0.005-0.015 inch. Refer to text.

HOMELITE

MULTI-PURPOSE PUMPS

Pump Model	Engine Make	GPH
P100-1	Homelite	1350

Model P100-1 (Waterbug™) is designed to pump water only and must not be used to pump hazardous liquids. Refer to page D-44 in POWER UNITS sections for engine service.

OPERATION

Model P100-1 is designed for pumping clean water only and hazardous fluids and abrasive material should not be directed through pump. The pump is self-priming, however, be sure pump is full of water before starting pump or seal may be damaged due to lack of lubrication. Inlet connections must be air tight to prevent vacuum loss.

PUMP REPAIR

DISASSEMBLY AND REASSEMBLY. Refer to Fig. HL22-1 for an exploded view of pump. Internal components are accessible after removing cover (4). Impeller (10) is threaded on engine crankshaft. Inspect components and renew any components which are excessively worn or damaged. Inlet check valve (5) should seat in cover without leakage.

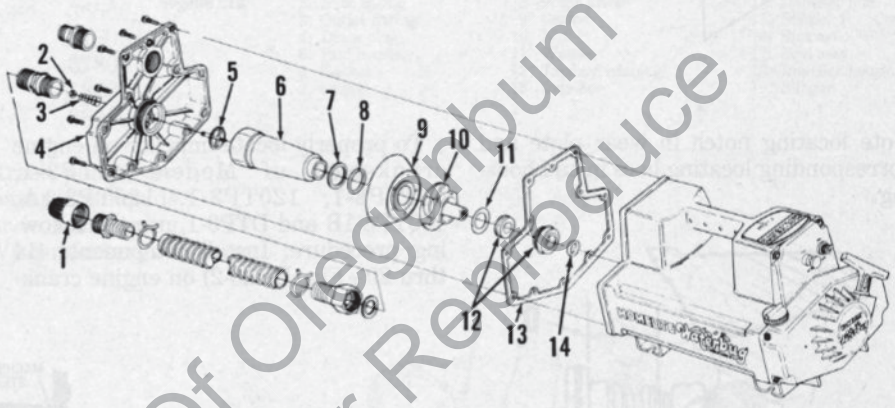


Fig. HL22-1 — Exploded view of Model P100-1 pump. Collar (11) is used on later models. Later models are equipped with EPDM seals and gaskets and check valve (5) uses an EPDM "O" ring.

1. Strainer
2. Locknut
3. Spring
4. Cover
5. Check valve
6. Inlet tube
7. Back-up ring
8. "O" ring
9. Volute
10. Impeller
11. Shim
12. Seals
13. Gasket
14. Collar

HOMELITE

MULTI-PURPOSE SAWS

Model	Wheel Diameter	Wheel RPM	Engine Make
DM20	12 in.	5500	Homelite
DM50	12 in.	5750	Homelite
XL98A	12 in.	5250	Homelite

The multi-purpose saws covered in this section are powered by Homelite engines. For engine service, refer to page D-52 for DM20 models, page D-47 for DM50 models or to page D-56 for XL98A models in the POWER UNITS section for engine service.

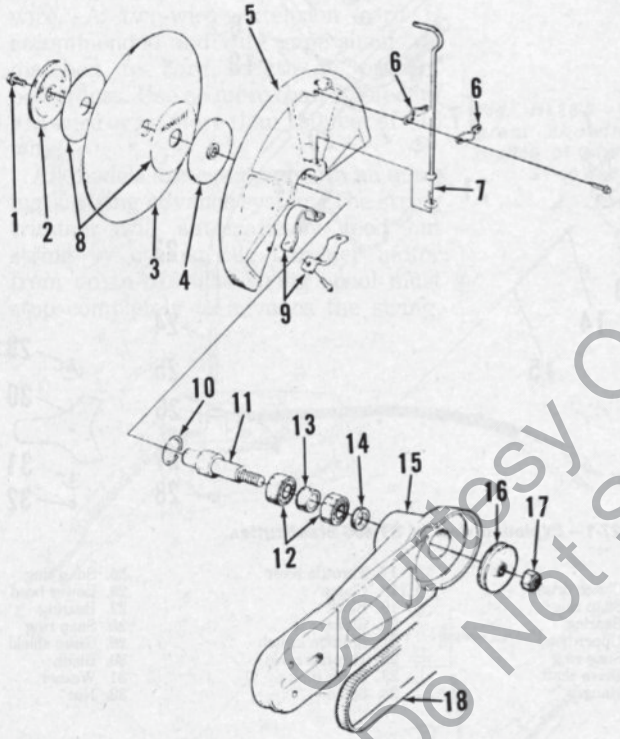


Fig. HL25-2—Exploded view of saw arm assembly used on Model XL98A.

1. Screw
2. Washer
3. Cutting wheel
4. Washer
5. Wheel guard
6. Clamps
7. Hook bolt
8. Spacer
9. Clamp
10. Snap ring
11. Spindle
12. Bearings
13. Spacer
14. Spacer
15. Arm
16. Pulley
17. Nut
18. Belt

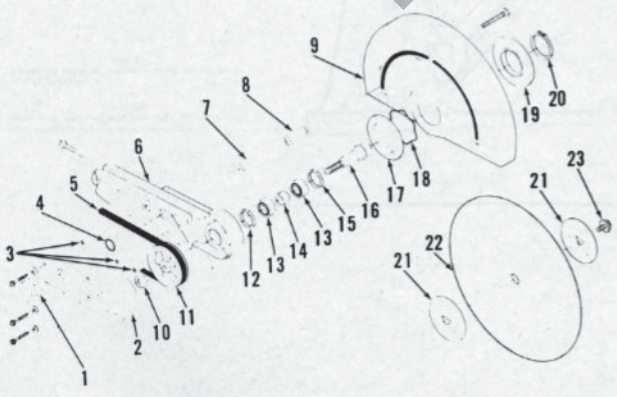


Fig. HL25-1—Exploded view of saw arm assembly used on Models DM20 and DM50.

1. Knob
2. Belt guard
3. "O" rings
4. Serrated washer
5. Belt
6. Arm
7. Spacer
8. Rubber tube
9. Wheel guard
10. Nut
11. Pulley
12. Snap ring
13. Bearings
14. Spacer
15. Snap ring
16. Spindle
17. Shim
18. Wave spring
19. Washer
20. Snap ring
21. Washers
22. Cutting wheel
23. Screw

OPERATION

The saw should be equipped with a cutting wheel rated for spindle speeds of 6000 rpm or higher. Maximum wheel diameter is 12 inches and maximum wheel thickness is 0.160 inch. Be sure wheel is not damaged and is otherwise safe for use.

The saw arm may be installed so the cutting wheel is inboard or outboard of the saw arm. After installing saw arm, install wheel guard so it is properly positioned, then adjust belt tension as outlined in following section.

BELT ADJUSTMENT

To adjust belt tension, loosen nuts securing saw arm then slide arm forward to remove belt slack. Turn tension adjusting screw until it contacts drive case cover or crankcase, then turn screw an additional 3 full turns. Tighten saw arm mounting nuts. Belt will stretch after an hour or two of operation and belt tension should be readjusted.

SAW ARM

R&R AND OVERHAUL. To remove saw arm, back off belt tension screw, remove saw arm mounting nuts and separate saw arm from engine. Refer to Fig. HL25-1 or HL25-2 and disassemble as required.

When installing saw arm on engine, position belt on arm then loop belt around clutch pulley while mating arm with engine as shown in Fig. HL25-3.

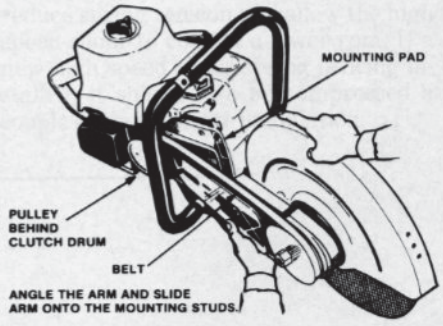


Fig. HL25-3—Hold saw arm as shown with belt in position, then loop belt around drive pulley while mating arm with engine.

HOMELITE

BRUSHCUTTER

Model	Blade Diameter	Engine Make
ST-400	10 in.	Homelite

Model ST-400 brushcutter is powered by a Homelite engine which is similar to XL-12 engine. Refer to page D-52 in POWER UNITS section for engine service.

SAW BLADE

The saw blade may be removed after unscrewing retaining nut. Prevent shaft rotation by inserting a suitable pin through the grass shield. Note when installing a toothed saw blade that shaft rotation is clockwise as viewed from underside.

DRIVE SHAFT

The flexible drive shaft should be removed, inspected and lubricated after every 25 hours of operation. To remove drive shaft, loosen clamp screw and remove screw in front side of lower head (26–Fig. HL27-1). Slide head off drive tube (23) and pull flexible shaft (15) from tube. Clean and inspect shaft, then lubricate shaft with a lithium grease. Insert shaft into drive tube (shaft ends are identical and shaft ends may be reversed to extend shaft life). With 3-5 inches of shaft extending from drive tube, engage shaft in lower head. Then while turning lower head so upper end of shaft engages clutch drum, install lower head on drive tube. Align holes in front side of lower head and drive tube and install screw. Tighten clamp screw so lower head will not turn.

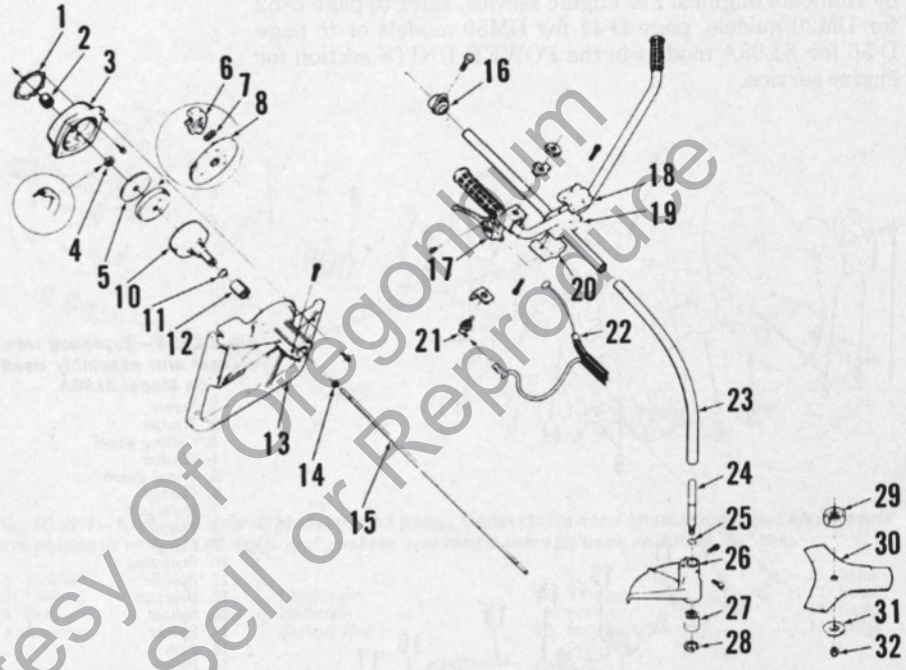


Fig. HL27-1–Exploded view of ST-400 brushcutter.

1. Gasket
2. Bearing
3. Drivecase
4. Seal
5. Cover
6. Clutch shoe
7. Spring
8. Clutch hub
10. Clutch drum
11. Snap ring
12. Bearing
13. Upper head
14. Snap ring
15. Drive shaft
16. Hanger
17. Throttle lever
18. Clamp
19. Block
20. Clamp
21. Ignition switch
22. Throttle cable
23. Drive tube
24. Spindle
25. Snap ring
26. Lower head
27. Bearing
28. Snap ring
29. Grass shield
30. Blade
31. Washer
32. Nut

HOMELITE

ELECTRIC STRING TRIMMERS

Model	Volts	Amps	Cutting Swath	Line Diameter
ST-20	120	2.2	10 in.	0.065 in.
ST-40	120	3.3	14 in.	0.065 in.
ST-60	120	4.0	16 in.	0.065 in.

ELECTRICAL REQUIREMENTS

Model ST-20, ST-40 and ST-60 string trimmers are designed to be used on electrical circuits with 120-volt alternating current. All models are double-insulated and do not require a ground wire. A two-wire extension cord is recommended and wire gage should be matched to cord length to prevent power loss. Use no more than 100 feet of #18 wire or no more than 150 feet of #16 wire.

All models are equipped with an automatic string advance system. The string trimmer will automatically feed out string by cycling the trimmer motor from on to off. The string spool must stop completely to advance the string, and if sufficiently short, it may be necessary to cycle the trimmer on and off several times. Operation is similar to that described in GASOLINE STRING TRIMMERS section.

If string will not advance on ST-40 or ST-60 models, it may be necessary to remove the high speed slider spring (the larger of the two springs) and compress the spring several times. This will reduce spring tension and allow the high speed slider to cock at a lower rpm. If a new high speed slider spring is being installed, it should also be compressed a couple of times before installation.

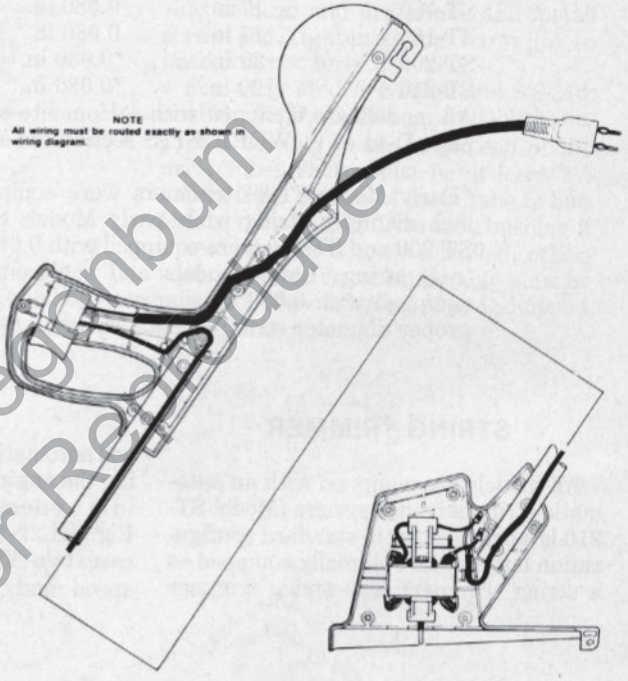


Fig. HL28-2—Wiring diagram showing correct routing of wire on Models ST-40 and ST-60.

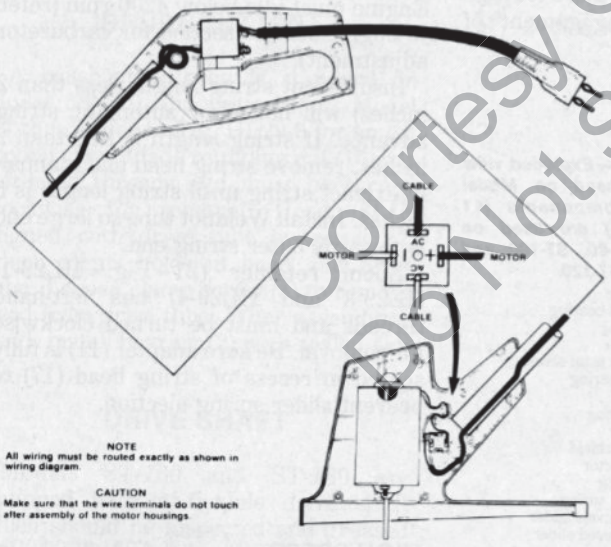


Fig. HL28-1—Wiring diagram showing correct routing of wire on Model ST-20.

HOMELITE

GASOLINE STRING TRIMMERS

Model	Cutting Swath	Line Diameter	Engine Make
ST-80	15 in.	*0.080 in.	Homelite
ST-100	20 in.	*0.080 in.	Homelite
ST-120	20 in.	*0.080 in.	Homelite
ST-160	17 in.	0.080 in.	Homelite
ST-180	17 in.	0.080 in.	Homelite
ST-200	20 in.	*0.080 in.	Homelite
ST-210	20 in.	*0.080 in.	Homelite

All models are equipped with a Homelite engine. Refer to page D-44 of POWER UNITS section for engine service.

*Early Model ST-80 trimmers were equipped with 0.065 inch diameter string while early Models ST-100, ST-120, ST-200 and ST-210 were equipped with 0.095 inch diameter (red) string. Later models and replacement spools are equipped with 0.080 in. diameter (yellow) string. Be sure proper diameter string is installed when restringing spool.

STRING TRIMMER

All models are equipped with an automatic string advance system (Model ST-210 is a brushcutter in standard configuration but may be optionally equipped as a string trimmer). The string trimmer will automatically feed out string by cycling the engine throttle from full speed to idle speed. String head (17 – Fig. HL29-1, HL29-3 and HL29-4) encases two slider and spring pairs for high speed and low speed engagement of string spool (18). Heavy spring (13) is used with high speed slider (14) and light spring (16) is used with low speed slider (15). Note position of lugs in Fig. HL29-2 to identify sliders. When string length is at desired cutting length engine speed is approximately 6500 rpm and high speed slider lug drives the string spool. As the string is shortened, engine speed will increase so that centrifugal force disengages the high speed slider lug from the string spool lug. The low speed slider lug picks up a string spool lug which allows the high speed slider to cock behind a string spool lug. When the engine is slowed to idle speed, the low speed slider will disengage and the high speed slider will engage the next string spool lug thereby allowing the string spool to rotate 1/6 turn and feed out string.

If automatic string advance malfunctions, be sure proper string is used, string advance components move freely and engine is properly tuned and will run at full speed of at least 7500 rpm. Engine must idle below 4200 rpm (refer to engine service section for carburetor adjustment).

Insufficient string length (less than 2 inches) will not allow automatic string advance. If string length is less than 2 inches, remove string head and manually extract string until string length is 5 inches. Install Weldnot tube so large end is towards outer string end.

Spool retainer (21 – Fig. HL29-1, HL29-3 and HL29-4) has left-hand threads and must be turned clockwise for removal. Be sure adapter (11) is fully seated in recess of string head (17) to prevent slider spring ejection.

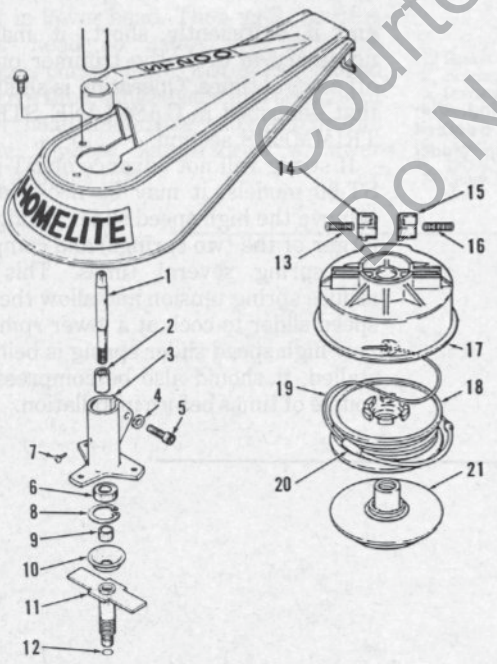


Fig. HL29-1 – Exploded view of lower head on Model ST-200. Components (11 through 21) are used on Models ST-80, ST-100 and ST-120.

1. Spindle
2. Needle bearing
3. Housing
4. Washer
5. Socket head screw
6. Ball bearing
7. Screw
8. Snap ring
9. Spacer
10. Grass shield
11. Connector
12. "O" ring
13. Heavy spring
14. High speed slider
15. Low speed slider
16. Light spring
17. String head
18. String spool
19. String
20. Weldnot tube
21. Retainer

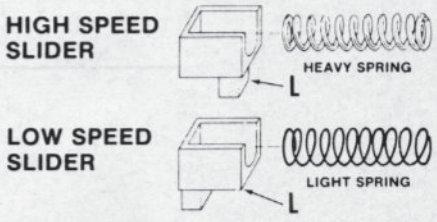


Fig. HL29-2 – Note position of lug (L) when identifying high and low speed sliders. Be sure correct spring is installed in slider.

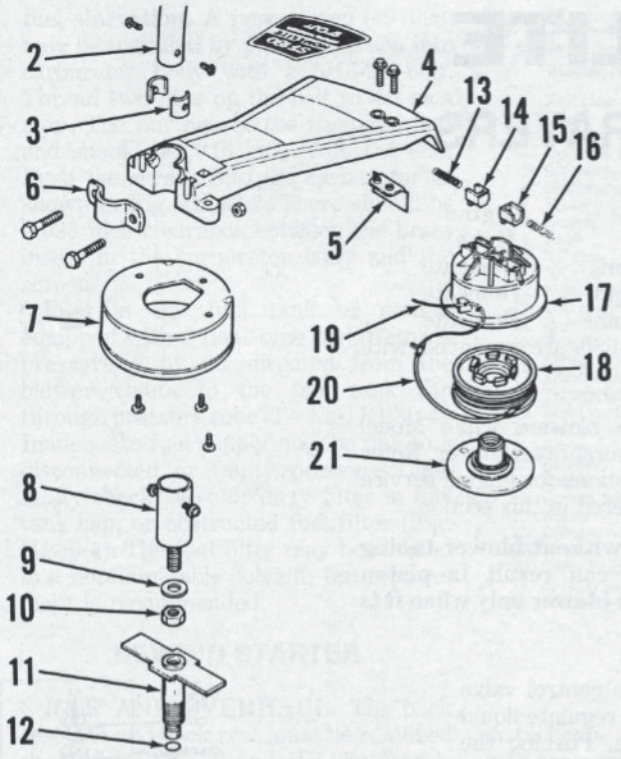


Fig. HL29-3—Exploded view of lower head on Models ST-160 and ST-180.

2. Drive tube
3. Inner clamp
4. Deflector
5. Cut-off blade
6. Clamp
7. Grass shield
8. Housing
9. Washer
10. Nut
11. Connector
12. "O" ring
13. Heavy spring
14. High speed slider
15. Low speed slider
16. Light spring
17. String head
18. String spool
19. String
20. Weldnot tube
21. Retainer

Models ST-200 and ST-210 are equipped with a flexible drive shaft between the engine and drive head. The flexible drive shaft should be removed, inspected and lubricated after every 25 hours of operation. To remove drive shaft, remove screw (7—Fig. HL29-1 or HL-29-5) and loosen clamp screw (5). Slide head off drive tube and pull flexible shaft from tube. Clean and inspect shaft, then lubricate shaft with lithium grease. Insert shaft into drive tube (shaft ends are identical and shaft ends may be reversed to extend shaft life). Install head while turning head to engage shaft ends in engine and head. Align holes in front side of head and drive tube and install screw (7). Tighten clamp screw (5) so head will not turn.

For early Models ST-200 and ST-210, bushing kit #A-96064 is available to install a bushing in the lower end of the drive tube. There must be at least 1¼ inches from bottom of drive tube to bottom of the existing drive tube bushing if a new bushing is to be installed, otherwise, a new drive tube assembly must be installed. New drive tubes are equipped with bushings.

BRUSHCUTTER

A brushcutter head is standard on Model ST-210 and optional on Model ST-200. Refer to Fig. HL29-5 for an exploded view. Blade retaining nut (15) has left-hand threads and must be turned clockwise for removal. Head (8) is aligned with drive tube by screw (7) which aligns holes in head and drive tube. Loosen clamp screw (5) to remove head from drive tube. When assembling head, install bearing (2) with sealed side up.

DRIVE SHAFT

Models ST-160 and ST-180 are equipped with a flexible drive shaft which should be inspected and greased annually. Detach drive tube from engine housing and pull drive shaft from drive tube. Clean drive shaft. Swap drive shaft end-to-end before inserting in drive tube to prolong shaft service life. While inserting drive shaft into drive tube, apply molybdenum disulfide grease to shaft; do not apply excess grease. Reconnect drive tube to engine housing while being sure drive shaft is properly connected.

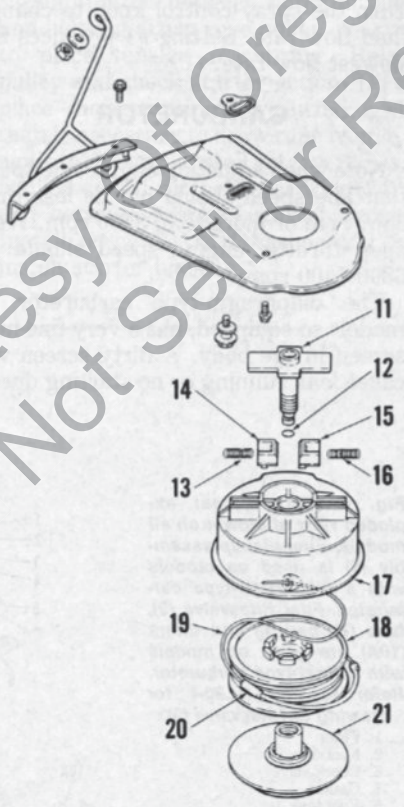


Fig. HL29-4—Exploded view of lower head on Model ST-80. Models ST-100 and ST-120 are similar.

11. Connector
12. "O" ring
13. Heavy spring
14. High speed slider
15. Low speed slider
16. Light spring
17. String head
18. String spool
19. String
20. Weldnot tube
21. Retainer

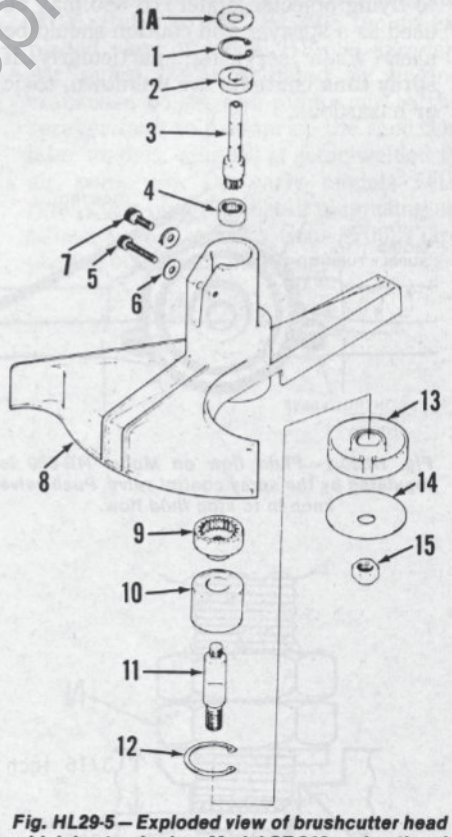


Fig. HL29-5—Exploded view of brushcutter head which is standard on Model ST-210 and optional on Model ST-200.

1A. Felt washer
2. Ball bearing
3. Pinion shaft
4. Needle bearing
5. Socket head screw
6. Washer
7. Socket head screw
8. Head
9. Ring gear
10. Ball bearing
11. Spindle
12. Snap ring
13. Shield
14. Cup washer
15. Nut

HOMELITE

BLOWER/SPRAYERS

Model	Maximum Air Volume	Engine Make
HB-280	245 cfm @ 7500 rpm	Homelite
HB-480	245 cfm @ 7500 rpm	Homelite
HB-680	245 cfm @ 7500 rpm	Homelite

* Early Models HB-480 and HB-680 are equipped with Homelite® XL engines.

Models HB-280 and HB-480 are blowers while Model HB-680 may be used as a blower or as sprayer/mister. Refer to page D-44 of POWER UNIT sections for engine service except rewind starter which is covered in this section.

CAUTION: Operation of blower without blower tubing allows engine to overheat and can result in piston seizure or worse damage. Operate blower only when it is fully assembled.

OPERATION

All models function as blowers and care must be exercised when operating blower to prevent injury or damage due to flying objects. Model HB-680 may be used as a sprayer and caution should be used when servicing, particularly if spray tank contents are unknown, toxic or hazardous.

Model HB-680 uses the control valve shown in Fig. HL30-1 to regulate liquid flow to the spray nozzle. Pushing the spray control knob in will shut off flow while pulling out knob opens the valve. Turn the spray control knob to change fluid flow rate. Setting #1 produces the slowest flow rate.

CARBURETOR

Note when adjusting engine idle speed that idle speed should not be less than 3350 rpm or more than 3500 rpm. Wide open throttle engine speed should be 6800-7400 rpm.

The diaphragm-type carburetor on models so equipped, has a very fine inlet screen in the body. A dirty screen will cause lean running or no starting due to

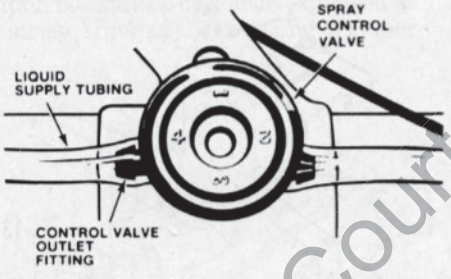


Fig. HL30-1—Fluid flow on Model HB-680 is regulated by the spray control valve. Push valve knob in to stop fluid flow.

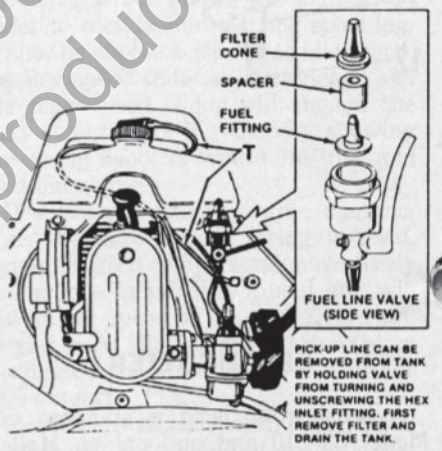


Fig. HL30-4—Drawing showing location of air pressure tube (T) to fuel tank. Fuel filter may be removed and cleaned.

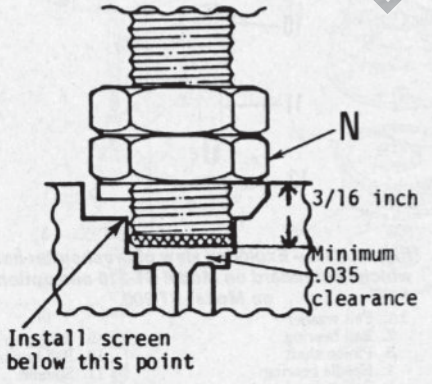


Fig. HL30-2—Install fuel inlet screen (S) as outlined in text. Face of nut (N) should be 3/16 inch from end of screw.

Fig. HL30-3—Typical exploded view of blower on all models. Fuel pickup assembly (6) is used on models with a diaphragm-type carburetor. Fuel filter/valve (9), tube (7), pad (8) and filters (10A) are used on models with a float-type carburetor. Refer to Fig. HL30-4 for drawing of filter/valve (9).

1. Filter
2. Fuel cap
3. Check valve
4. Gasket
5. Fuel tank
6. Fuel pickup assy.
7. Pressure tube
8. Pad
9. Filter/valve assy.
10. Shroud

10A. Filter

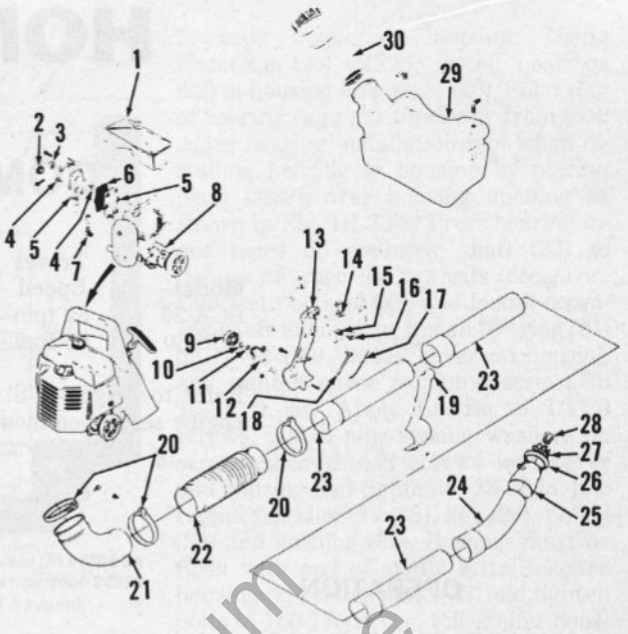
11. Engine
12. Backplate
13. Volute housing
14. Magneto rotor
15. Washer
16. Lockwasher
17. Nut
18. Fan
19. Volute housing
20. Rope handle
21. Screw
22. Washer
23. Ratchet
24. Ratchet lever wir
25. Rope pulley
26. Rewind spring
27. Starter housing

fuel starvation. A new screen (#97098) may be installed by pushing screen into carburetor body with a 5/16-24 bolt. Thread two nuts on the bolt to act as a stop. The nut nearer the threaded bolt end should be 3/16 inch from the end. Push the screen into the carburetor as shown in Fig. HL30-2. There should be 0.035 inch clearance between the brass insert in the carburetor body and the screen.

Fuel in the fuel tank of models equipped with a float-type carburetor is pressurized by air directed from the blower volute to the fuel tank cap through pressure tube (T – Fig. HL30-4). Inadequate fuel supply may be due to a disconnected or faulty pressure tube, faulty check valve or dirty filter in fuel tank cap, or obstructed fuel filter (Fig. HL30-4). The fuel filter may be cleaned in a nonflammable solvent, but replacement is recommended.

Fig. HL30-5 – Exploded view of sprayer components on Model HB-680.

1. Fuel tank
2. Plug
3. Filter
4. Umbrella valve
5. Air pump
6. Diaphragm
7. Elbow
8. Engine
9. Knob
10. "O" ring
11. "O" ring
12. Fluid control valve
13. Left control handle
14. Ignition switch
15. Trigger
16. Spring
17. Throttle cable
18. Trigger latch
19. Right control handle
20. Clamp
21. Elbow
22. Bellow
23. Tubing
24. Curved tubing
25. Nozzle
26. Diffuser
27. Vane
28. Spray head
29. Sprayer tank
30. Strainer



REWIND STARTER

R&R AND OVERHAUL. The back rest pad and back rest must be removed on Models HB-480 and HB-680 for access to starter. On all models, unscrew mounting screws and remove starter. Remove rope handle and allow rope to wind into starter. Unscrew retaining screw (21 – Fig. HL30-3) and remove ratchet (23) and pully while being careful not to dislodge rewind spring in housing.

When assembling starter, wind rope around rope pulley in a clockwise direction as viewed with pulley in housing. To place tension on rewind spring, pass rope through rope outlet in housing and install rope handle. Pull rope out and hold rope pulley so notch on pulley is adjacent to rope outlet. Pull rope back through outlet between notch in pulley and housing. Turn rope pulley clockwise to place tension on spring. Release pulley and check starter action. Do not place more tension on rewind spring than is necessary to draw rope handle up against housing. Install ratchet (23) with hooked end of ratchet lever wire (24) up and between posts of starter housing. Install screw (21) and washer (22) then install starter housing.

SPRAYER

DISASSEMBLY AND REASSEMBLY. Refer to Fig. HL30-5 for an exploded view of Model HL-680 sprayer. Air pump (5) is actuated by engine crankcase pulses and pumps air to the sprayer tank to pressurize the fluid. On later models, plug (2) is sonic-welded to air pump (5). On early models with removable plug (2), install plug using an adhesive such as Zip Grip #70627 applied around plug periphery.

HOMELITE

COMPACTORS

Model	Travel Speed	Compaction Force	Engine Make	Engine Model
PCA-20	52 fpm	2000 lbs.	B&S	100232
PCS-30	63 fpm	3000 lbs.	Kohler	K91T

Refer to Briggs & Stratton or Kohler service manual for engine service on models listed above.

OPERATION

Model PCA-20 is designed for asphalt compaction while Model PCS-30 is designed for soil compaction but may be converted to asphalt compaction with the addition of a water kit.

Do not operate compactors on a hard, unyielding surface. If necessary, the compactor may be placed across an old tire for testing.

Asphalt compactors are equipped with a water system to distribute water to the bottom plate thereby preventing asphalt from sticking to plate. Drain holes must be clear and clean water should be used for proper operation.

MAINTENANCE

LUBRICATION. The exciter is lubricated by oil contained in the housing. Exciter oil level should be checked after every 25 hours of operation. With engine stopped unscrew dipstick (26 – Fig. HL33-1) and note oil level (dipstick must be fully screwed into housing for an accurate reading). Recommended oil is SAE 30 with API rating SE. Exciter oil should be changed after 200 hours of operation or after one year, whichever comes first. Eight ounces of oil is required to fill an empty exciter housing to desired oil level.

BELT ADJUSTMENT. Drive belt (32 – Fig. HL33-1) tension is correct if belt will deflect ⅜ inch to ½ inch when depressed at center. If upper deck (15) moves downward while depressing belt, then belt is too tight. If upper deck doesn't move and belt is depressed more than ½ inch, then belt is too loose. If belt adjustment is required, loosen engine mounting bolts and reposition engine. Retighten engine mounting bolts to 12-14 ft.-lbs. after adjustment.

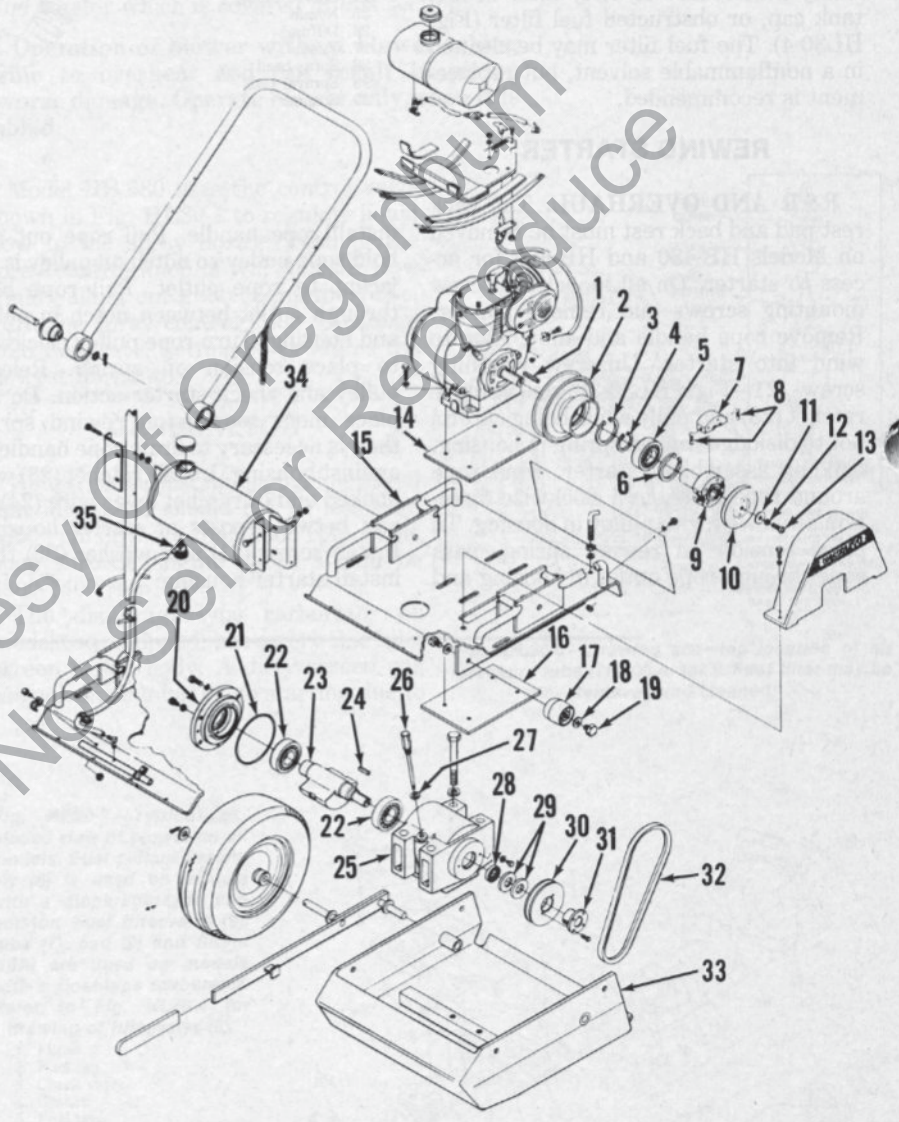


Fig. HL33-1 – Exploded view of Model PCS-30 soil compactor. Model PCA-20 asphalt compactor is similar.

1. Key
2. Clutch drum
3. Snap ring
4. Snap ring
5. Ball bearing
6. Snap ring
7. Clutch shoe
8. Clutch springs
9. Clutch assy.
10. Clutch cover
11. Washer
12. Lockwasher
13. Screw
14. Plate
15. Upper deck
16. Plate
17. Isolator
18. Lockwasher
19. Capscrew
20. Cover
21. "O" ring
22. Roller bearing
23. Eccentric
24. Key
25. Housing
26. Dipstick
27. Washer
28. Oil seal
29. Felt slingers
30. Pulley
31. Bushing
32. Drive belt
33. Bottom plate
34. Water tank
35. Valve

EXCITER REPAIR

R&R AND OVERHAUL. To disassemble exciter, disconnect spark plug cable and remove belt guard. Loosen engine mounting bolts, slide engine forward and remove drive belt. Support upper deck (15) then remove four isolators (17). Lift off engine and upper deck as a unit. Remove four bolts securing exciter housing (25) and remove exciter housing. Clean housing then remove dipstick (26) and drain oil from housing. Unscrew bushing (31) screws, then thread screws into tapped holes of bushing and tighten screws to force bushing off shaft. Remove pulley (30), felt slingers (29) and key (24). Remove six 5/16-18 capscrews and two 1/4-20 capscrews from cover (20). Thread screws into the two tapped holes in the cover and tighten screws to force cover (20) off housing. Remove eccentric shaft (23) and using a suitable puller remove inner bearing races from shaft. Bearings (22) may be forced from housing cavities by threading jack screws into tapped holes in housing. Use Homelite tool 24893 and remove oil seal (28).

Inspect components and renew any parts which are damaged or excessively worn. New seal washers, felt slingers, "O" ring and oil seal should be installed.

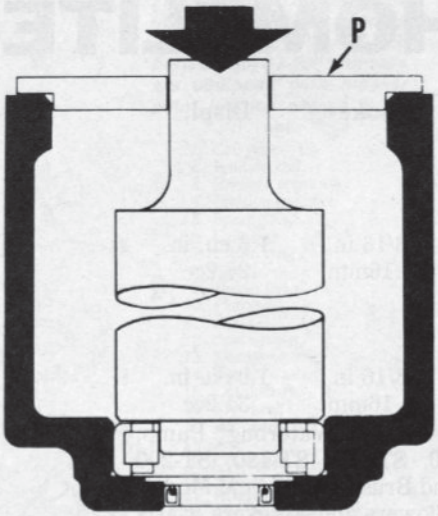


Fig. HL33-2 — Position aligning plate (P) 24895 as shown to center bearing installation tool 24893 when installing bearing in housing.

To reassemble exciter, proceed as follows: Using Homelite tool 24894, install oil seal (28) with open seal side towards inside of housing. Using Homelite tool 24893, install bearings (22) in housing and cover (20). Solid ring of bearing cage must be away from tool. Align bearing installation tool when installing bearing in housing by placing plate 24895 over housing opening as shown in Fig. HL33-2. Press bearing inner races on eccentric shaft (23) so flange of race is towards eccentric. Lubricate oil seal (28) and install eccentric shaft in housing. Install "O" ring (21) on cover (20), install cover on housing and tighten cover retaining screws to 12-14 ft.-lbs. Apply Loctite to 1/4-20 screws, install new sealing washers on screws then thread screws into cover and housing and tighten to 33-38 in.-lbs. Install felt slingers (29), key (24), pulley (30) and bushing (31). Bushing must be flush with end of shaft. Install exciter housing on bottom plate (33) and tighten bolts to 150-175 ft.-lbs. Fill exciter housing with oil as outlined in LUBRICATION section. Install engine and upper deck (15). Install four isolators (17) and tighten bolts to 56-65 ft.-lbs. Install drive belt and adjust belt tension as outlined in BELT ADJUSTMENT section. Install belt guard and tighten bolts to 12-14 ft.-lbs.

HOMELITE

CONCRETE VIBRATORS

Model	Volts	Amps	Hertz	Phase
VCH-178	230	3	180	3
VCH-250	230	6	180	3

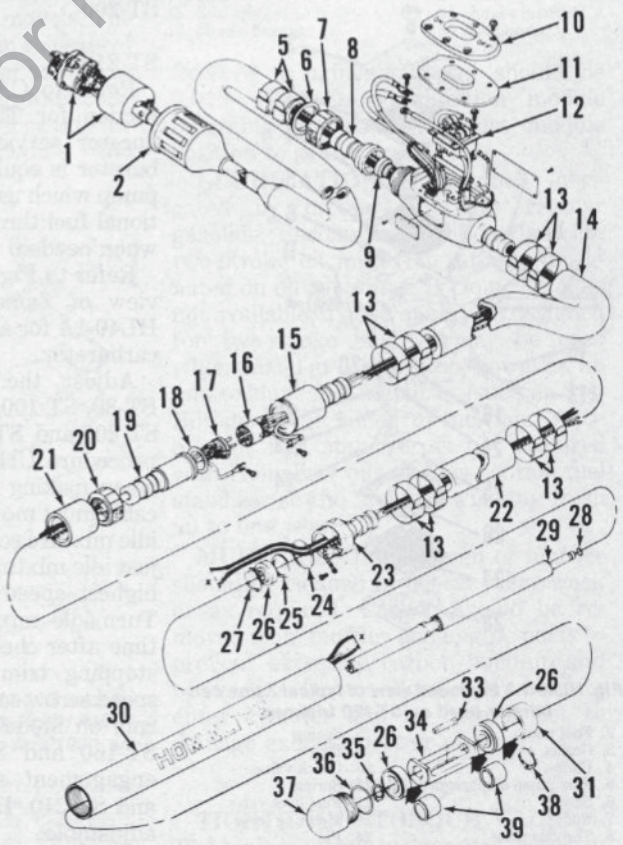


Fig. HL32-1 — Exploded view of concrete vibrator. Rotor (29) and eccentric (34) are a one-piece assembly on Model VCH-250. Snap ring (38) and spacers (39) are only used on Model VCH-250.

1. Plug
2. Cover
3. Grommet
4. Hose
5. Clamp
6. Sleeve
7. Nut
8. Connector
9. Seal
10. Cover
11. Gasket
12. Switch
13. Clamp
14. Hose
15. Housing
16. Female plug
17. Male plug
18. "O" ring
19. Housing
20. Nut
21. Spacer
22. Hose
23. Connector
24. "O" ring
25. Retaining ring
26. Ball bearing
27. Retaining ring
28. "O" ring
29. Rotor
30. Housing & stator
31. Bearing stop
33. Key
34. Eccentric
35. Snap ring
36. "O" ring
37. Nose
38. Snap ring
39. Spacer

OPERATION

Model VCH-178 and VCH-250 concrete vibrators operate on 3-phase, 180-Hertz, 230-volt current. Rotating frequency of both models is 9000-10000 rpm. Refer to Fig. HL32-1 for an exploded view of vibrator.

To check operation of vibrator, start vibrator then allow vibrator nose to touch the ground and hold in this position. Vibrator should walk in a clockwise circle around operator. If vibrator walks in a counterclockwise circle, immediately stop vibrator. Interchange any two current carrying leads and again check vibrator operation.

HOMELITE

Model	Bore	Stroke	Displ.
HB-280, P100-1, ST-80, ST-100, ST-120, ST-160, ST-180	1-5/16 in. 33.34mm	1-3/16 in. 30.16mm	1.6 cu. in. 26.2cc
HB-480, HB-680, ST-200, ST-210	1-7/16 in. 36.51mm	1-3/16 in. 30.16mm	1.9 cu. in. 31.2cc

These engines are used on Model P100-1 Waterbug™ Pump, Models ST-80, ST-100, ST-120, ST-160, ST-180, ST-200 and ST-210 String Trimmers and Brushcutters, and Models HB-280, HB-480 and HB-680 Blowers and Sprayers. Early Models HB-480 and HB-680 are equipped with 1.6 cu. in. (26.2 cc) displacement engine.

MAINTENANCE

SPARK PLUG. Recommended spark plug is a Champion DJ7Y for Models HB-280 (UT 08005), HB-480 (UT 08004), HB-680 (UT 08003), ST-160 and ST-180. Champion DJ7J is recommended for all other models. Spark plug electrode gap should be 0.025 inch.

CARBURETOR. Refer to the following table for carburetor applications:

Model	Carburetor
HB-280, HB-480, HB-680	Walbro WA-95
	Keihin
P100-1	Walbro HDC-68
ST-80	Walbro WA-83
ST-100	Zama C-1S-46
	Walbro WA-130
ST-120	Walbro WA-43A
	Zama C1S-H2A
ST-160, ST-180	Walbro HDC-70
ST-200	Walbro HDC-59
	Walbro HDC-69
ST-210	Walbro HDC-69

Refer to CARBURETOR SERVICE section for Tillotson and Walbro carburetor service. Walbro HDC-70 carburetor is equipped with an accelerator pump which uses a bladder to eject additional fuel through the main fuel orifice when needed.

Refer to Fig. HL40-1 for an exploded view of Zama carburetor or to Fig. HL40-1A for an exploded view of Keihin carburetor.

Adjust the carburetor on Models ST-80, ST-100, ST-120, ST-160, ST-180, ST-200 and ST-210 using the following procedure. UNIT MUST BE SHUT OFF when making adjustments and throttle cable must move freely. Initial setting of idle mixture screw is 1¼ turns open. Adjust idle mixture screw so engine idles at highest speed and accelerates cleanly. Turn idle mixture screw ⅛ turn each time after checking unit operation then stopping trimmer engine. Adjust idle speed screw so engine idles at 2800-3200 rpm on Models ST-80, ST-100, ST120, ST-160 and ST-180, or below clutch engagement speed on Models ST-200 and ST-210. High speed mixture is not adjustable.

There is no idle mixture or idle speed adjustment on P100-1 Waterbug™ models as pump engine runs at wide open throttle during operation. To adjust high speed mixture screw, run pump while pumping water so engine is loaded. Turn high speed mixture screw in until engine speed drops, then back out screw approximately ¼ turn or until maximum engine speed is obtained. Backing screw out too far will cause engine speed to drop and adjustment must be repeated.

Before adjusting carburetor on HB-280, HB-480 and HB-680 blowers, first be sure throttle cable is adjusted properly. With throttle trigger fully depressed, the carburetor throttle plate should be completely open; if not, adjust throttle cable. On models equipped with a Walbro carburetor, initial adjustment of idle and high speed mixture screws is one turn open. Adjust idle mixture screw so engine will accelerate cleanly, and adjust high speed mixture screw so maximum engine rpm is 7200-7800 for HB-280, 7800-8600 for HB-480 and 7600-8400 for HB-680. Idle mixture is not adjustable for Keihin carburetor and high speed mixture is controlled by main jet (14–Fig. HL40-1A) which

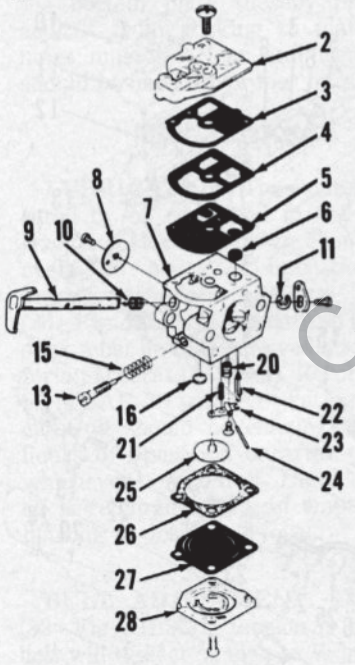
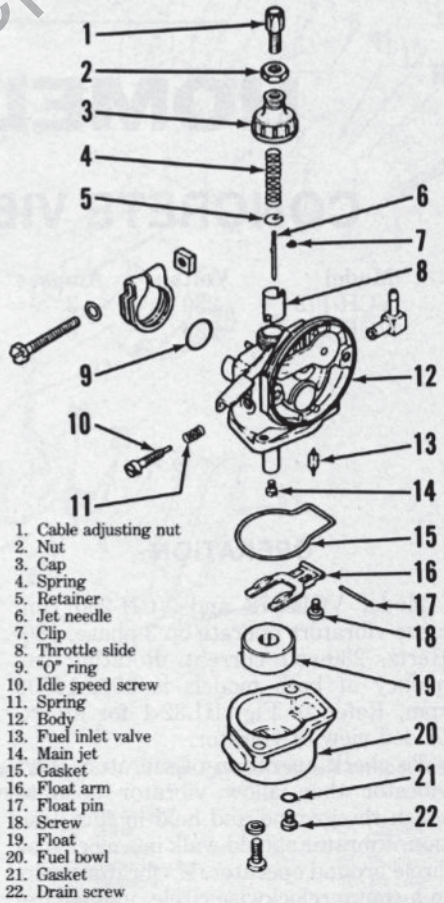


Fig. HL40-1 – Exploded view of typical Zama carburetor used on ST-120 trimmer.

2. Fuel pump
3. Gasket
4. Plate
5. Fuel pump diaphragm
6. Screen
7. Body
8. Throttle plate
9. Throttle shaft
10. Spring
11. "E" ring
13. Idle mixture screw
15. Spring
16. Plug
20. Check valve
21. Spring
22. Fuel inlet valve
23. Metering lever
24. Pin
25. Metering disc
26. Gasket
27. Metering diaphragm
28. Cover



1. Cable adjusting nut
2. Nut
3. Cap
4. Spring
5. Retainer
6. Jet needle
7. Clip
8. Throttle slide
9. "O" ring
10. Idle speed screw
11. Spring
12. Body
13. Fuel inlet valve
14. Main jet
15. Gasket
16. Float arm
17. Float pin
18. Screw
19. Float
20. Fuel bowl
21. Gasket
22. Drain screw

Fig. HL40-1A – Exploded view of Keihin float-type carburetor used on later Models HB-280, HB-480 and HB-680.

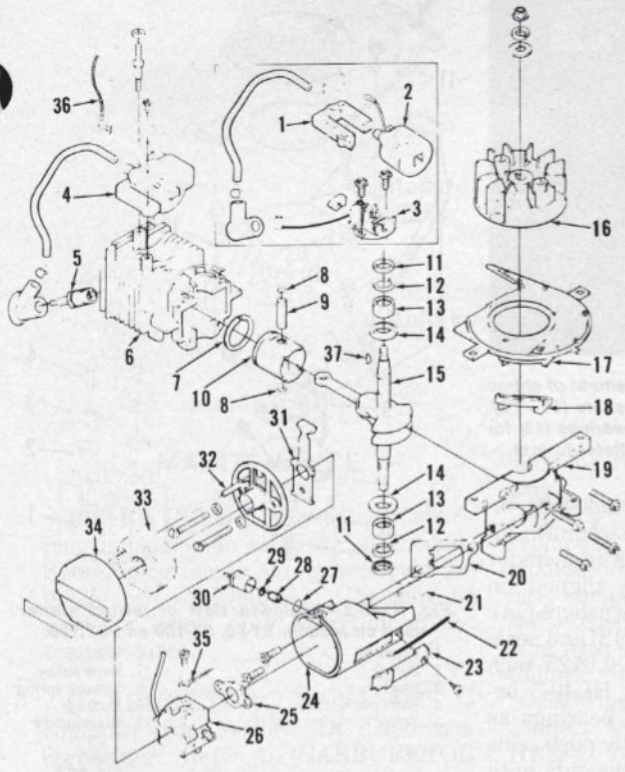


Fig. HL40-2 — Exploded view of engine used on Models ST-80, ST-100 and ST-120. Early Model ST-100 trimmers are equipped with breaker point ignition shown in inset.

1. Coil core
2. Ignition coil
3. Breaker point assy.
4. Ignition module
5. Spark plug
6. Cylinder
7. Piston ring
8. Circlip
9. Piston pin
10. Piston
11. Seal
12. Seal spacer
13. Needle bearing
14. Thrust washer
15. Crankshaft
16. Flywheel
17. Air cover
18. Seal
19. Crankcase
20. Gasket
21. Reed valve petal
22. Throttle cable
23. Cable clamp
24. Carburetor housing
25. Gasket
26. Carburetor
27. "O" ring
28. Filter
29. Gasket
30. Fuel inlet
31. Choke
32. Filter support
33. Air filter
34. Cover
35. Ground wire (early ST-100)
36. Ground wire (solid-state ign.)
37. Key

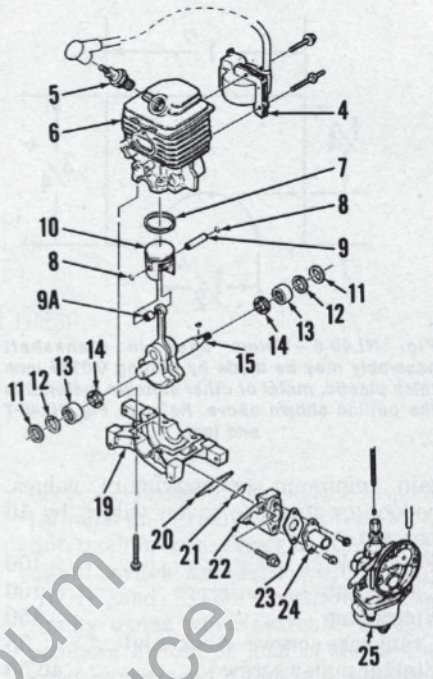


Fig. HL40-4 — Typical exploded view of engine used on Model HB-280, HB-480 and HB-680 Blowers and Sprayers. Bearing (9A) is only used on later models HB-480 and HB-680.

4. Ignition module
5. Spark plug
6. Cylinder
7. Piston ring
8. Circlip
9. Piston pin
10. Piston
11. Seal
12. Seal spacer
13. Needle bearing
14. Thrust washer
15. Crankshaft
17. Key
19. Crankcase
20. Gasket
21. Reed valve petal
22. Carburetor spacer
23. Gasket
24. Intake manifold
25. Carburetor

should not require adjustment. Adjust idle speed screw of HB series models so idle speed is not less than 3350 rpm or more than 3500 rpm.

MAGNETO AND TIMING. Early Model ST-100 is equipped with a conventional breaker-point, flywheel magneto. Breaker point gap should be 0.015 inch. Ignition timing is not adjustable, however, an incorrect breaker point gap setting will affect ignition timing.

A solid-state ignition is used on all models except early ST-100 models. The ignition module is attached to the side of the engine cylinder. Ignition service is accomplished by replacing ignition components until faulty part is located. Air gap between ignition module and flywheel is adjustable and should be 0.015 inch. Loosen ignition module mounting screws and adjust module position to set air gap.

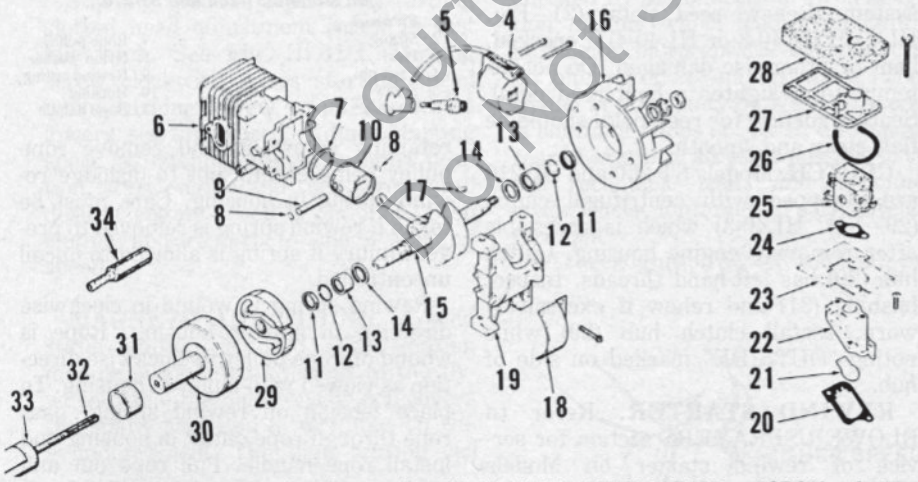


Fig. HL40-3 — Exploded view of engine used on Models ST-160, ST-180, ST-200 and ST-210; adapter (34) is used in place of clutch components (29, 30 and 31) on Models ST-160 and ST-180. Model P100-1 Waterbug is similar but clutch components are not used. Thrust washers (14) on Model P100-1 are equipped with tangs which must index in crankcase (19).

4. Ignition module
5. Spark plug
6. Cylinder
7. Piston ring
8. Circlip
9. Piston pin
10. Piston
11. Seal
12. Seal spacer
13. Needle bearing
14. Thrust washer
15. Crankshaft
16. Flywheel
17. Key
18. Shroud
19. Crankcase
20. Gasket
21. Reed valve petal
22. Carburetor spacer
23. Air baffle
24. Gasket
25. Carburetor
26. Tubing
27. Filter support
28. Air filter
29. Clutch hub
30. Clutch drum
31. Bushing
32. Drive shaft
33. Drive tube
34. Adapter

LUBRICATION. The engine is lubricated by mixing oil with regular gasoline. Recommended oil is Homelite two-stroke oil mixed at ratio as designated on oil container. If Homelite oil is not available, a good quality oil designed for two-stroke engines may be used when mixed at a 16:1 ratio, however, an anti-oxidant fuel stabilizer (such as Sta-Bil) should be added to fuel mix. Anti-oxidant fuel stabilizer is not required with Homelite® oils as they contain fuel stabilizer so the fuel mix will stay fresh up to one year.

MUFFLER. Outer screen of muffler should be cleaned of debris every week or as required. Carbon should be removed from muffler and engine ports to prevent excessive carbon build-up and power loss. Do not allow loose carbon to enter cylinder and be careful not to damage exhaust port or piston.

REPAIRS

TIGHTENING TORQUE VALUES. Tightening torque values are listed in following table. Note: Values given are average figures in inch-pounds. To ob-

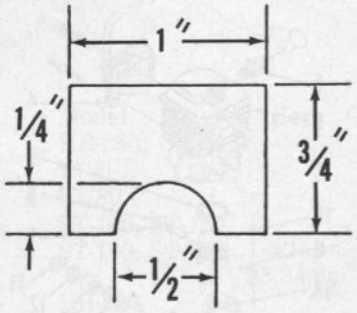


Fig. HL40-6—Shims used in crankshaft assembly may be made by cutting 0.0125 inch thick plastic, metal or other suitable material in the outline shown above. Refer to Fig. HL40-7 and text.

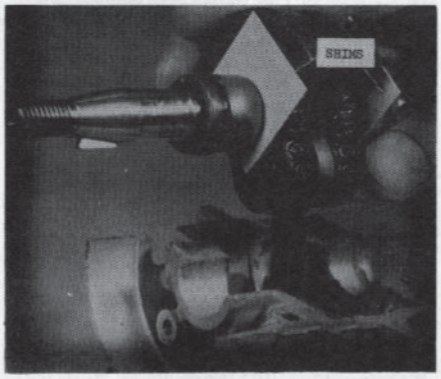


Fig. HL40-7—View showing placement of shims (Fig. HL40-6) between thrust washers (14—Fig. HL40-2, HL40-3 or HL40-4) and bearings (13) for correct crankshaft assembly. Refer to text.

tain minimum or maximum values, reduce or increase given values by 10 percent.

Flywheel	100
Clutch hub	100
Spark plug	150
Crankcase screws—socket hd	35
Starter pulley screw	40-50

COMPRESSION PRESSURE. For optimum performance of all models, cylinder compression pressure should be 115-145 psi with engine at normal operating temperature. Engine should be inspected and repaired when compression pressure is 90 psi or below.

CYLINDER, PISTON, PIN AND RINGS. Cylinder may be removed after unscrewing four screws in bottom of crankcase (19—Fig. HL40-2, HL40-3 or HL40-4). Be careful when removing cylinder as crankshaft assembly will be loose in crankcase. Care should be taken not to damage mating surfaces of cylinder and crankcase.

Inspect crankshaft bearings and renew if scored or worn. Thrust washers (14) should be installed with shoulder to outside. On P100-1 Waterbug™ models, note tangs on thrust washers (14) which must index in crankcase (19). Crankshaft seals are installed with seal lip to inside. Cylinder and crankcase mating surfaces should be flat and free of nicks and scratches. Mating surfaces should be cleaned then coated with room temperature vulcanizing (RTV) silicone sealer before assembly.

Early model cylinders are equipped with an open exhaust port while a bridged exhaust port is used on late model cylinders. Early model piston is equipped with a piston ring locating pin in the piston ring groove. Piston ring installed on early model piston must be positioned so end gap indexes with locating pin in ring groove. Late model piston does not have piston ring locating pin and piston ring should be installed so end gap is opposite exhaust port.

Bearings, seals and thrust washers must be positioned correctly on crankshaft before final assembly. Use the following procedure for crankshaft installation: With piston assembly installed on rod, insert piston in cylinder being sure piston ring is aligned on locating pin. Install thrust washers (14), bearings (13), seal spacers (12) and seals (11) on crankshaft. Place 0.0125 inch thick shims shown in Fig. HL40-5 between thrust washers and bearings as shown in Fig. HL40-6. Gently push seals toward crankshaft counterweights until assemblies are snug. Remove shims and complete assembly being careful not to disturb position of thrust washers, bearings and seals. On P100-1 Waterbug™ models, be sure tangs on thrust washers index in recesses of crankcase. Before final tightening of crankcase screws, lightly tap both ends of crankshaft to obtain proper crankshaft end play, then tighten crankcase screws.

REED VALVE. All models are equipped with a reed valve induction system. Renew reed petal (21—Fig. HL40-2, HL40-3 or HL40-4) if cracked, bent or otherwise damaged. Do not attempt to straighten a bent reed petal. Seating surface for reed petal should be flat, clean and smooth.

CLUTCH. Models ST-200 and ST-210 are equipped with centrifugal clutch (29—Fig. HL40-3) which is accessible after removing engine housing. Clutch hub (29) has left-hand threads. Inspect bushing (31) and renew if excessively worn. Install clutch hub (29) while noting "OUTSIDE" marked on side of hub.

REWIND STARTER. Refer to BLOWER/SPRAYERS section for service of rewind starter on Models HB-280, HB-480 and HB-680. To service the rewind starter on other models, proceed as follows: Remove starter housing (10—Fig. HL40-8 or HL40-9). Pull starter rope and hold rope pulley with notch in pulley adjacent to rope outlet. Pull rope back through outlet so that it engages notch in pulley and allow pulley to completely unwind. Unscrew pulley

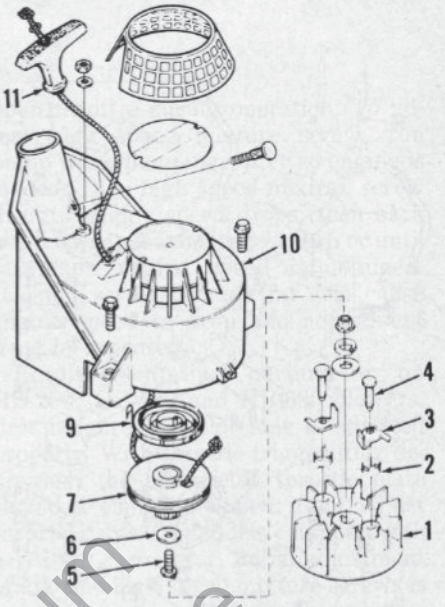
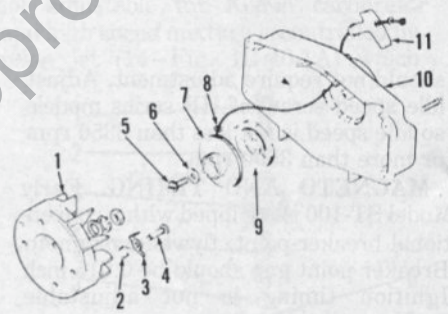


Fig. HL40-8—Exploded view of rewind starter used on Models ST-80, ST-100 and ST-120.

1. Flywheel
2. Spring
3. Pawl
4. Pawl pin
5. Screw
6. Washer
7. Rope pulley
9. Rewind spring
10. Housing
11. Rope handle



HL40-9—Exploded view of rewind starter used on Models ST-200 and ST-210.

1. Flywheel
2. Spring
3. Pawl
4. Pawl pin
5. Screw
6. Washer
7. Rope pulley
8. Nylon washer
9. Rewind spring
10. Housing
11. Rope handle

retaining screw (5) and remove rope pulley being careful not to dislodge rewind spring in housing. Care must be taken if rewind spring is removed to prevent injury if spring is allowed to uncoil uncontrolled.

Rewind spring is wound in clockwise direction in starter housing. Rope is wound on rope pulley in clockwise direction as viewed with pulley in housing. To place tension on rewind spring, pass rope through rope outlet in housing and install rope handle. Pull rope out and hold rope pulley so notch on pulley is adjacent to rope outlet. Pull rope back through outlet between notch in pulley and housing. Turn rope pulley clockwise to place tension on spring. Release pulley and check starter action. Do not place more tension on rewind spring than is necessary to draw rope handle up against housing.

HOMELITE

Model	Bore	Stroke	Displ.
DM50	1.875 in.	1.625 in.	4.5 cu. in.
	47.6 mm	41.3 mm	74 cc

This engine is used as the power unit on the Model DM50 Multi-Purpose Saw.

MAINTENANCE

SPARK PLUG. Recommended spark plug is Champion DJ6J for all models. Spark plug electrode gap should be 0.025 inch. A Champion CJ4 may be used for heavy duty operation in hot temperatures.

CARBURETOR. Model 450 is equipped with a Walbro SDC diaphragm carburetor. Refer to CARBURETOR SERVICE section for carburetor service.

Initial adjustment of idle speed mixture screw is one turn open. High speed mixture is not adjustable. Adjust idle speed screw (S – Fig. HL41-1) so engine idles at approximately 2400-2600 rpm. Adjust idle mixture screw (I) so engine will accelerate cleanly without bogging. If necessary, readjust idle speed screw to obtain engine idle speed of approximately 2400-2600 rpm.

Starting speed is adjusted by turning slotted head adjustment screw in fast idle latch. See Fig. HL41-1. Turning screw clockwise raises starting speed while turning screw counterclockwise lowers starting speed. Adjust starting speed by latching trigger in start position, start engine and turn screw until desired engine speed is obtained. Stop engine and restart to check starting speed.

MAGNETO AND TIMING. A solid state ignition is used. The ignition module is mounted adjacent to the flywheel while the high tension coil covers the spark plug and is mounted on the cylinder shield. The high tension coil must be removed for access to spark plug.

The ignition system is serviced by replacing the spark plug, ignition module, high tension coil or wires with new components. The ignition system can be checked using a test plug or spark plug with the side electrode removed as follows: Remove the high tension transformer and install the test plug and connect test wires as shown in Fig. HL284. Test wire should be inserted behind receptacle tab (T). Push ignition switch to run position and briskly operate starter. If test plug sparks then ignition system is operating satisfactorily and the spark plug should be checked. If no spark is seen at test plug then another transformer should be checked. If no spark is seen when another transformer is checked, then suspect a faulty ignition module, faulty ignition switch or loose connections.

High tension coil and leads may be checked by disconnecting wires at ignition module which lead from ignition module to coil receptacle and connecting an ohmmeter to end of wires. There should be continuity between wire ends. If continuity does not exist, disassemble rear of saw until access is possible to two coil receptacle leads and disconnect leads. Check continuity of each wire and terminal.

To check ignition switch and lead, connect one probe of ohmmeter to switch terminal and ground other probe to ignition module core. Check continuity of ignition switch and lead with switch in "RUN" and "STOP" positions. If continuity exists when switch is in "RUN" position, switch or lead is shorted and must be replaced. Continuity should exist with switch in "STOP" position. If continuity is not present in "STOP" position, check connection of switch lead and replace lead and switch if necessary.

Air gap between ignition module and flywheel is adjustable. Adjust air gap by loosening module retaining screws and place 0.020 inch (yellow) shim stock between flywheel and module. Load crankshaft bearings during adjustment by applying pressure to flywheel in direction of ignition module.

LUBRICATION. The engine is lubricated by mixing oil with unleaded gasoline. Rcommended oil is Homelite two-stroke oil mixed at ratio as designated on oil container. If Homelite oil is not available, a good quality oil designed for two-stroke engines may be used when mixed at a 16:1 ratio. Anti-oxidant fuel stabilizer is not required with Homelite® oils as they contain fuel stabilizer so the fuel mix will stay fresh up to one year.

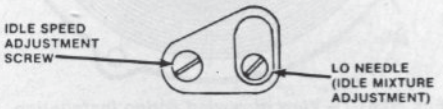


Fig. HL41-1 – View showing location of idle mixture screw (I) and idle speed screw (S).

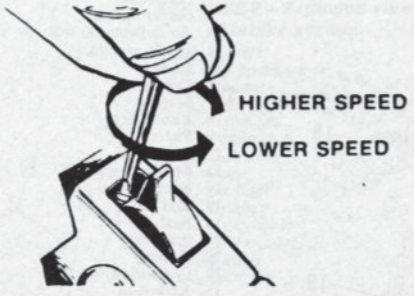


Fig. HL41-2 – View showing location of fast idle screw.

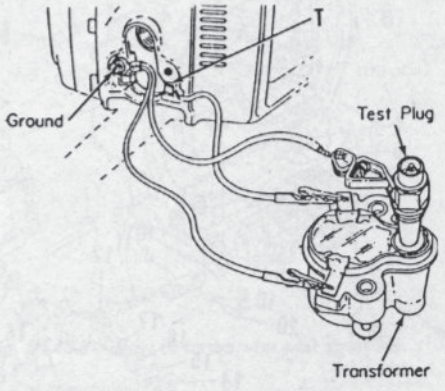
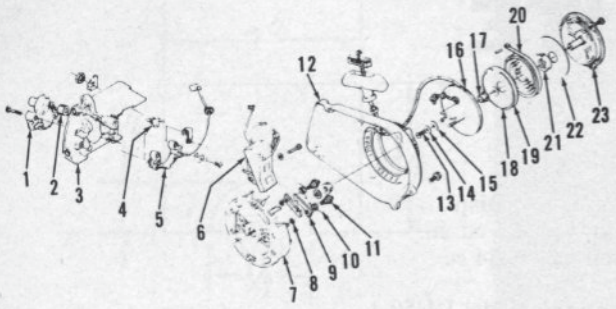


Fig. HL41-3 – A test plug may be used to determine if ignition system is operating correctly. See text.



1. Transformer
2. Grommet
3. Shield
4. Ignition switch
5. Transformer receptacle
6. Ignition module
7. Flywheel
8. Lockwasher
9. Starter pawl
10. Spring
11. Stud
12. Starter housing
13. Screw
14. Washer
15. Washer
16. Rope pulley
17. Bushing
18. Snap ring
19. Outer spring shield
20. Rewind spring
21. Spring lock
22. Inner spring shield
23. Cover

Fig. HL41-4—Exploded view of ignition system and rewind starter.

REPAIRS

COMPRESSION PRESSURE. For optimum performance of all models, cylinder compression pressure should be 160-190 psi with engine at normal operating temperature. Engine should be inspected and repaired when compression pressure is 90 psi or below.

CYLINDER, PISTON, PIN AND RINGS. The cylinder may be separated from crankcase after removing nuts securing cylinder to crankcase. Care should be used when separating cylinder and crankcase as crankshaft may be dislodged from crankcase. Inspect cylinder bore and discard cylinder if excessively worn or damaged. Cylinder may not be bored for oversize pistons and oversize cylinders are not available. Refer to CONNECTING ROD, CRANKSHAFT AND CRANKCASE section when installing cylinder.

The piston is equipped with two piston rings. Oversize pistons and rings are not available. The piston pin rides in non-renewable needle bearings in piston. Piston and bearings are available only as a unit assembly.

CONNECTING ROD, CRANKSHAFT AND CRANKCASE. Refer to preceding section and remove cylinder. Separate crankshaft assembly from crankcase and disassemble as required. Inspect components and renew any which are damaged.

Connecting rod (11—Fig. HL41-4) rides on twelve caged bearing rollers (12). The crankshaft is supported by roller bearings (16) which are installed so lettered end is towards snap rings (15).

Tighten connecting rod screws to 65-75 in.-lbs. When assembling crankcase and cylinder, use a suitable sealant on mating surfaces. Be sure components are properly assembled and snap rings (15) engage grooves in cylinder and crankcase. Tighten retaining screws to 60-70 in.-lbs.

CLUTCH. Model DM50 is equipped with clutch shown in Fig. HL41-5. Clutch hub on all models has left-hand threads. Clutch shoes should be renewed only as a set. Inspect bearing and lubricate with Homelite ALL-TEMP Multi-Purpose Grease (#24551) or a lithium base grease.

RECOIL STARTER. Refer to Fig. HL41-3 for an exploded view of starter assembly.

To disassemble starter, hold cover (23) and unscrew retaining screws. Allow cover to turn until spring tension is relieved and remove cover. Note: If outer hook of spring catches on starter housing, pull cover away from housing until cover is allowed to turn. Unscrew screw (13) to separate rope pulley (16) from cover. Remove snap ring (18) for access to rewind spring. If starter pawl assemblies must be removed, unscrew housing screws and remove starter housing (12). Threaded inserts are available if stud holes are damaged in flywheel.

Clean and inspect components. Lubricate sides of rewind spring with a small amount of Homelite® ALL-TEMP Multi-Purpose grease or a lithium base grease. Do not oil spring. Install inner spring shield (22), rewind spring (20) and spring lock (21) in cover with spring wound as shown in Fig. HL41-6. Install outer spring shield (19—Fig. HL41-3) and snap ring (18). Install inner washer (15). Insert bushing (17) in rope pulley (16) being sure knobs on bushings align with notches in pulley. Slide pulley onto post in cover and check to be sure splines on pulley engage splines in spring lock. Install and tighten capscrew (13) to 45 in.-lbs. Wind rope around pulley in clockwise direction as viewed from screw end of pulley. Set cover in housing. Pull rope handle and then allow rope to rewind so that starter pawls will be forced open and pulley hub can slide between them into place. Turn cover clockwise 2 or 3 turns to preload rewind spring, snap plastic screen into place and install cover screws. Check starter operation.

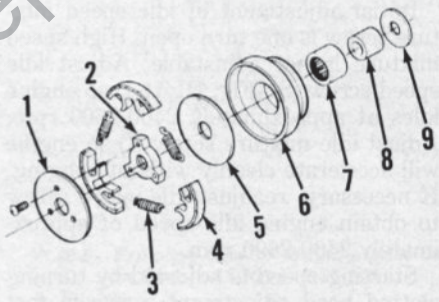


Fig. HL41-6—Exploded view of clutch used on DM-50 Multi-Purpose Saw.

1. Cover plate
2. Hub
3. Spring
4. Shoe
5. Washer
6. Clutch drum
7. Bearing
8. Inner race
9. Thrust washer

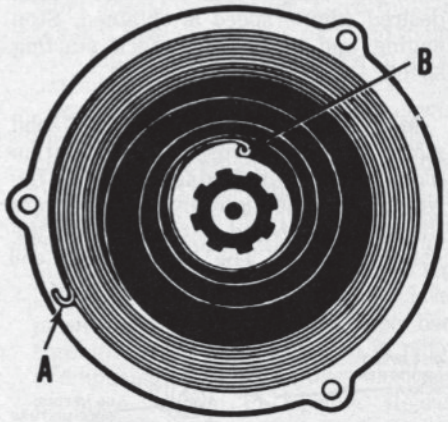
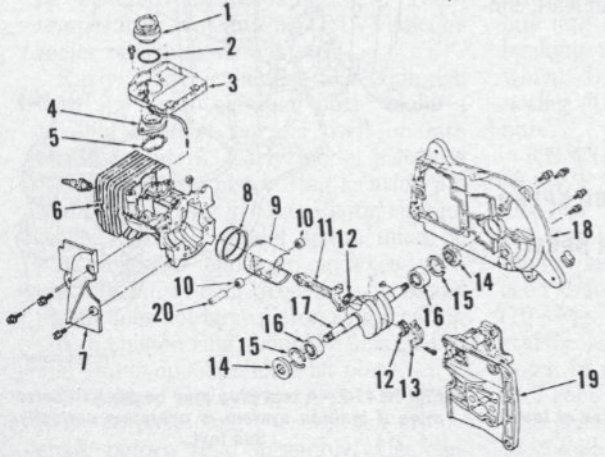


Fig. HL41-7—View of rewind spring installation in starter cover. Hook outer loop (A) of spring in notch as shown. Inner loop (B) of spring must be curved inward to engage notch of spring lock.



1. Connector
2. Garter spring
3. Air deflector & seal
4. Intake manifold
5. Gasket
6. Cylinder
7. Shield
8. Piston rings
9. Piston
10. Piston pin
11. Connecting rod
12. Bearing
13. Rod cap
14. Seal
15. Snap ring
16. Bearing
17. Crankshaft
18. Backplate
19. Crankcase

Fig. HL41-5—Exploded view of engine.

HOMELITE

Model	Bore	Stroke	Displ.
FP-150	2.250 in.	1.720 in.	6.8 cu. in.
	57.2 mm	43.7 mm	112 cc

This engine is used as the power unit on the Model FP-150 Pressure Pump.

MAINTENANCE

SPARK PLUG. Recommended spark plug is Champion CJ3. Spark plug electrode gap should be 0.025 inch.

CARBURETOR. Model FP-150 pump is equipped with a Walbro WB-12 diaphragm carburetor. Refer to CARBURETOR SERVICE section for carburetor service.

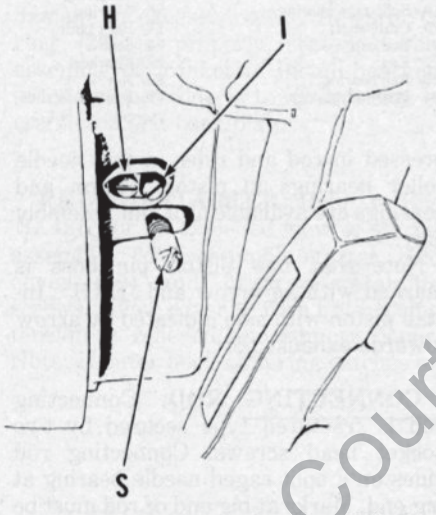


Fig. HL42-1 — View showing location of idle mixture screw (I), high speed mixture screw (H) and idle speed screw (S).

Before attempting carburetor adjustments, be sure pump is primed. Initial adjustment of idle and high speed mixture screws is one turn open. Adjust idle speed screw (S – Fig. HL42-1) so engine idles at 2600-3400 rpm. Adjust idle mixture screw (I) to obtain maximum idle speed, then readjust idle speed screw so engine idles as 2600-3400 rpm.

To adjust high speed mixture screw, close discharge valve until engine speed is 7000-7500 rpm or pump discharge pressure is 150-160 psi. Adjust high speed mixture screw so best lean power is obtained.

MAGNETO AND TIMING. A solid state ignition is used on Model FP-150 engine. The ignition module is mounted adjacent to the flywheel while the high tension coil covers the spark plug and is mounted on the cylinder shield. The high tension coil must be removed for access to spark plug.

The ignition system is serviced by replacing the spark plug, ignition module, high tension coil or wires with new components. The ignition system can be checked using a test plug or spark plug with the side electrode removed as follows: Remove the high tension transformer and install the test plug and connect test wires as shown in Fig. HL42-5. Test wire should be inserted behind receptacle tab (T). Push ignition switch to run position and briskly operate starter. If test plug sparks then ignition system is operating satisfactorily and the spark plug should be checked. If no spark is seen at test plug then another transformer should be checked. If no spark is seen when another transformer is checked, then suspect a faulty ignition module, faulty ignition switch or loose connections.

High tension coil and leads may be checked by disconnecting wires at ignition module which lead from ignition module to coil receptacle and connecting an ohmmeter to end of wires. There should be continuity between wire ends. If continuity does not exist, disassemble engine until access is possible to two coil receptacle leads and disconnect leads. Check continuity of each wire and terminal.

To check ignition switch and lead, connect one probe of ohmmeter to switch

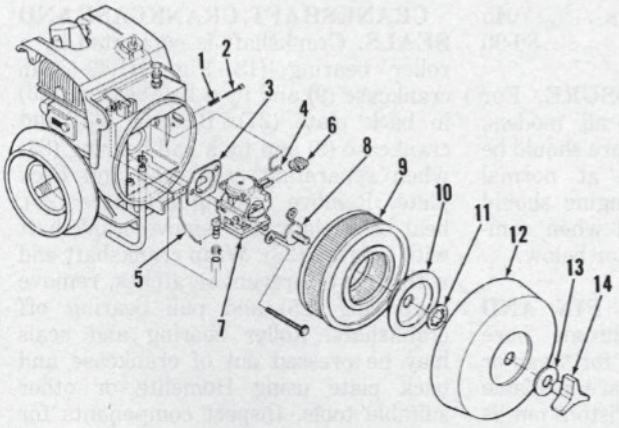


Fig. HL42-2 — Exploded view of intake system.

1. Spring
2. Idle speed screw
3. Spacer
4. Throttle link
5. Choke link
6. Grommet
7. Carburetor
8. Stud
9. Air filter
10. Retainer
11. Lockwasher
12. Cover
13. Washer
14. Knob

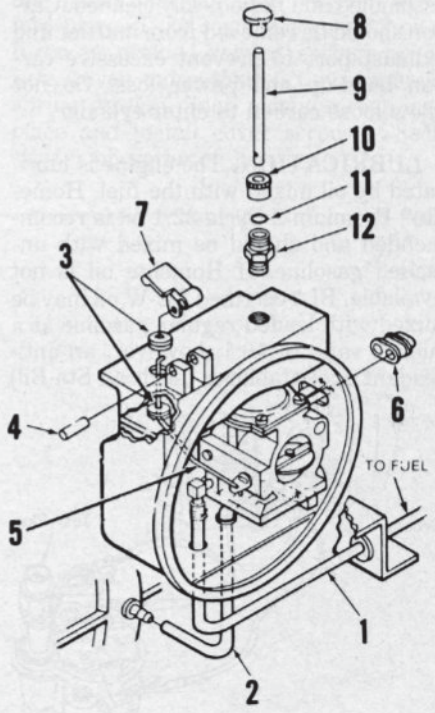


Fig. HL42-3 — View of carburetor and chamber.

1. Fuel line
2. Crankcase pulse line
3. Grommets
4. Pin
5. Choke link
6. Grommet
7. Choke lever
8. Throttle knob
9. Rod
10. Nut
11. "O" ring
12. Bushing

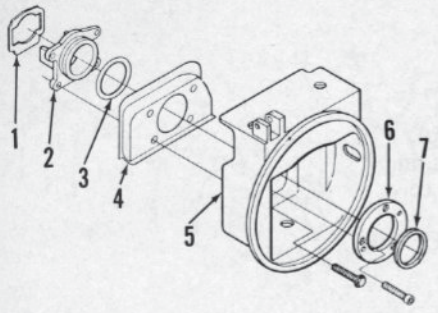


Fig. HL42-4—Exploded view of carburetor chamber assembly.

1. Gasket
2. Intake adapter
3. "O" ring
4. Air deflector
5. Carburetor chamber
6. Plate
7. Square ring

terminal and ground other probe to ignition module core. Check continuity of ignition switch and lead with switch in "RUN" and "STOP" positions. If continuity exists when switch is in "RUN" position, switch or lead is shorted and must be replaced. Continuity should exist with switch in "STOP" position. If continuity is not present in "STOP" position, check connection of switch lead and replace lead and switch if necessary.

Air gap between ignition module and flywheel is adjustable. Adjust air gap by loosening module retaining screws and place 0.015 inch (pink) shim stock between flywheel and module.

MUFFLER. Muffler should be disassembled and periodically cleaned. Carbon should be removed from muffler and exhaust port to prevent excessive carbon build-up and power loss. Do not allow loose carbon to enter cylinder.

LUBRICATION. The engine is lubricated by oil mixed with the fuel. Homelite® Premium 2-Cycle 32:1 oil is recommended and should be mixed with unleaded gasoline. If Homelite oil is not available, BIA certified TC-W oil may be mixed with leaded regular gasoline at a fuel:oil ratio of 16:1, however, an anti-oxidant fuel stabilizer (such as Sta-Bil) should be added to fuel mix. Anti-oxidant fuel stabilizer is not required with Homelite® oils as they contain fuel stabilizer so the fuel mix will stay fresh up to one year.

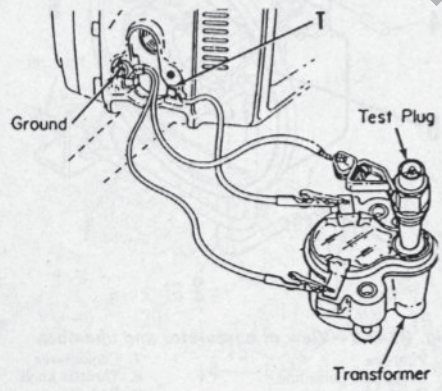


Fig. HL42-5—A test plug may be used to determine if ignition system is operating correctly. See text.

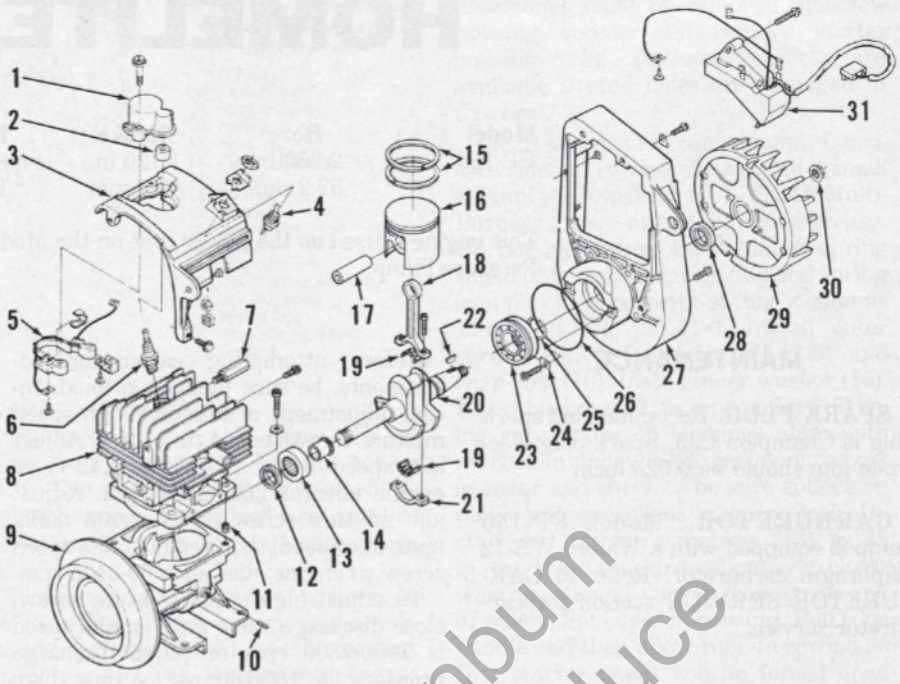


Fig. HL42-6—Exploded view of engine used on Model FP-150 pump.

1. High tension coil
2. Grommet
3. Shield
4. Ignition switch
5. Coil receptacle
6. Spark plug
7. Stud
8. Cylinder
9. Crankcase
10. Nipple
11. Helicoil insert
12. Seal
13. Roller bearing
14. Sleeve
15. Piston rings
16. Piston
17. Piston pin
18. Connecting rod
19. Split cage bearing
20. Crankshaft
21. Rod cap
22. Key
23. Ball bearing
24. Bearing retainer
25. Snap ring
26. "O" ring
27. Back plate
28. Seal
29. Flywheel
30. Nut
31. Ignition module

ENGINE REPAIRS

TIGHTENING TORQUES. Tightening torque values in inch-pounds are as follows:

Spark plug	150
Flywheel nut	250-300
Cylinder screws	80
Connecting rod screws	70-80
Starter housing screws	35
Ignition module screws	35
Transformer coil screws	27
Airbox to tank	45
Carburetor mounting screws	45
Starter pawl studs	80-90

COMPRESSION PRESSURE. For optimum performance of all models, cylinder compression pressure should be 135-165 psi with engine at normal operating temperature. Engine should be inspected and repaired when compression pressure is 90 psi or below.

CYLINDER, PISTON, PIN AND RINGS. Cylinder has chrome bore which should be inspected for wear or damage. Piston and rings are available in standard sizes only. Piston pin is pressed in rod and rides in two needle roller bearings in piston. Piston and bearings are available as a unit assembly only.

Note that one piston pin boss is marked with an arrow and "EXH". Install piston with side indicated by arrow towards exhaust port.

CONNECTING ROD. Connecting rod is fractured type secured by two socket head screws. Connecting rod rides on a split caged needle bearing at big end. Marks at big end of rod must be aligned and cap and rod properly mated during assembly. Needle bearings may be held around crankpin with a suitable grease to aid in assembly.

CRANKSHAFT, CRANKCASE AND SEALS. Crankshaft is supported by a roller bearing (13—Fig. HL42-6) in crankcase (9) and by a ball bearing (23) in back plate (27). Bearing (23) and crankcase (9) and by a ball bearing (23) when separating crankcase and back plate. Remove bearing retainers (24), heat back plate and remove crankshaft with bearing (23). Wrap crankshaft end with tape to prevent scratches, remove snap ring (25) and pull bearing off crankshaft. Roller bearing and seals may be pressed out of crankcase and back plate using Homelite or other suitable tools. Inspect components for

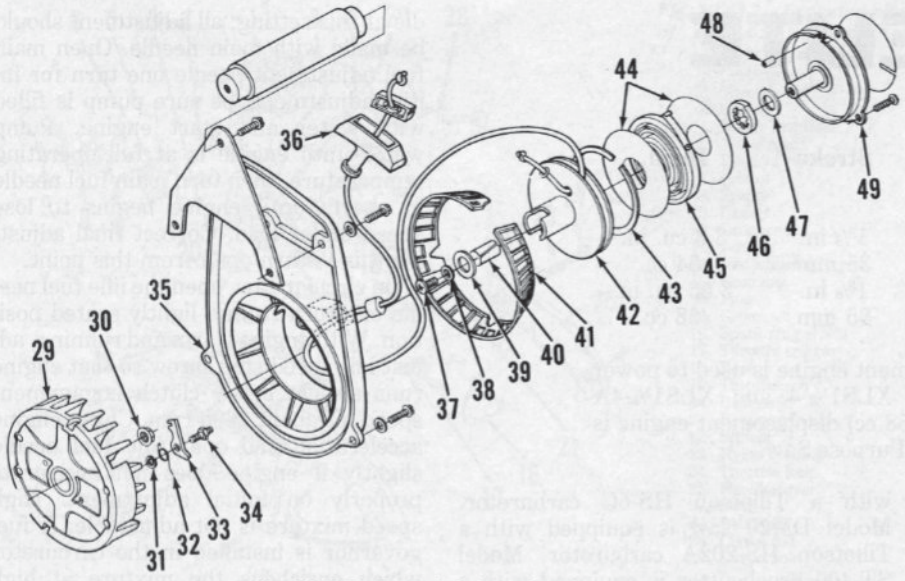


Fig. HL42-7—Exploded view of rewind starter.

29. Flywheel
30. Nut
31. Lockwasher
32. Spring
33. Pawl
34. Stud
35. Starter housing
36. Rope handle
37. Screw
38. Lockwasher
39. Washer
40. Bushing
41. Screen
42. Rope pulley
43. Snap ring
44. Spring shields
45. Rewind spring
46. Spring lock
47. Washer
48. Pin
49. Cover

Fig. HL42-8—View of rewind spring installation in starter cover. Hook outer loop (A) of spring in notch as shown. Inner loop (B) of spring must be curved inward to engage notch of spring lock.

damage or excessive wear. Be sure "O" ring (26) is properly seated during assembly of crankcase. Install bearings so unstamped side is towards inside of crankcase and back plate.

REWIND STARTER. Refer to Fig. HL42-7 for an exploded view of starter assembly. To disassemble starter, hold cover (49) and unscrew retaining screws. Allow cover to turn until spring tension is relieved and remove cover. Note: If outer hook of spring catches on starter housing, pull cover away from housing until cover is allowed to turn. Unscrew screw (37) to separate rope pulley (42) from cover. Remove snap ring (43) for access to rewind spring. If starter pawl assemblies must be removed, unscrew housing screws and remove starter housing (35). Threaded inserts are available if stud holes are damaged in flywheel.

Clean and inspect components. Lubricate sides of rewind spring with a small amount of Homelite® ALL-TEMP Multi-Purpose grease or a lithium base grease. Do not oil spring. Install washer (47), inner spring shield (44), rewind spring (45) and spring lock (46) in cover with spring wound as shown in Fig. HL42-8. Install outer spring shield (44–Fig. HL42-7) and snap ring (43). Insert bushing (40) in rope pulley (42). Slide pulley onto post in cover and check to be sure splines on pulley engage splines in spring lock. Install and tighten screw (37) to 45 in.-lbs. Wind rope around pulley in clockwise direction as viewed from screw end of pulley. Set cover in housing. Pull rope handle and then allow rope to rewind so that starter pawls will be forced open and pulley hub can slide between them into place. Turn cover clockwise 3 or 4 turns to preload rewind spring; never turn cover more than 5 turns against spring tension. Snap plastic screen into place and install cover screws. Check starter operation.

HOMELITE

Model	Bore	Stroke	Displ.
ST-400, XLS1½-4, XLS½-4A	1¾ in.	1⅜ in.	3.3 cu. in.
	44 mm	35 mm	54 cc
DM20	1-13/16 in.	1⅜ in.	3.55 cu. in.
	46 mm	35 mm	58 cc

The 3.3 cu. in. (54 cc) displacement engine is used to power the ST-400 brushcutter and XLS1½-4 and XLS1½-4A pumps while the 3.55 cu. in. (58 cc) displacement engine is used to power the DM20 Multi-Purpose Saw.

MAINTENANCE

SPARK PLUG. Recommended spark plug is a Champion CJ6. Spark plug electrode gap should be 0.035 inch on pump engine and 0.025 inch on brushcutter and saw engines.

CARBURETOR. Model XLS1½-4 and XLS1½-4A pumps are equipped with a Tillotson HS-5C carburetor. Model DM20 saw is equipped with a Tillotson HS-202A carburetor. Model ST-400 brushcutter is equipped with a Tillotson HS-207A carburetor. Refer to CARBURETOR SERVICE section for carburetor service.

On pump engine, set idle stop screw so that it does not interfere with full travel of throttle stop lever. Open idle fuel adjustment needle one turn and leave needle at this setting; all adjustment should be made with main needle. Open main fuel adjustment needle one turn for initial adjustment, be sure pump is filled with water and start engine. Pump water until engine is at full operating temperature, then turn main fuel needle in slowly until engine begins to lose speed under load. Correct final adjustment is ⅛-turn open from this point.

On circular saw, open the idle fuel needle one turn from a lightly seated position. With engine warm and running, adjust idle speed stop screw so that engine runs at just below clutch engagement speed, or about 2600 rpm. Check engine acceleration and open idle fuel needle slightly if engine does not accelerate properly on initial adjustment. High speed mixture is not adjustable. A fuel governor is installed in the carburetor which enrichens the mixture at high speed to prevent overspeeding.

On brushcutter, turn idle speed stop screw in until it just contacts throttle lever tab, then turn screw in ½-turn further. Turn idle and main fuel adjustment needles in gently until they just contact seats, then back each needle out one turn. With engine warm and running, adjust idle fuel needle so that engine runs smoothly, then adjust idle stop screw so that engine runs at 2600 rpm, or just below clutch engagement speed. Check engine acceleration and open idle fuel needle slightly if engine will not accelerate properly. Adjust main fuel needle under load so engine will neither slow down or smoke excessively.

PUMP GOVERNOR. On pump applications, engine is equipped with air-vane type governor as shown in Fig. HL43-1.

With engine running under no load (CAUTION: Be sure pump housing is

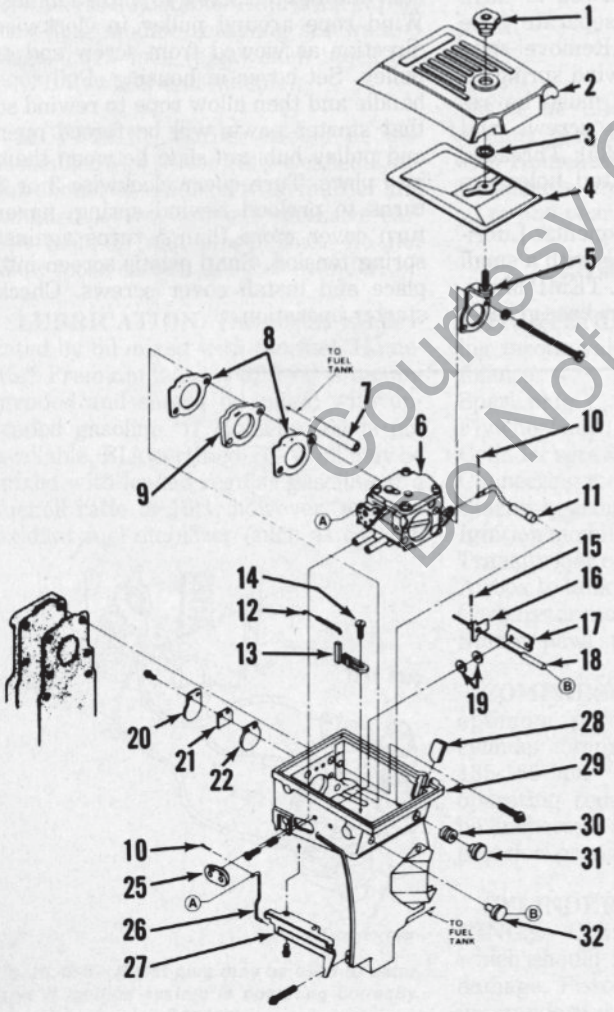


Fig. HL43-1 — Exploded view of air box assembly on Model XL-12 engine.

1. Nut
2. Air filter cover
3. Retaining ring
4. Air filter element
5. Mounting bracket
6. Carburetor
7. Fuel line
8. Gasket
9. Spacer
10. Cotter pin
11. Choke rod
12. Governor spring
13. Adjusting plate
14. Screw
15. Cotter pin
16. Collar
17. Clamp
18. Throttle cable
19. Washers
20. Reed stop
21. Reed backup
22. Reed valve
23. Throttle rod friction adjustment screws
24. Springs
25. Grommet
26. Governor link
27. Governor air vane
28. Felt plug
29. Air box
30. Grommet
31. Choke button
32. Throttle button

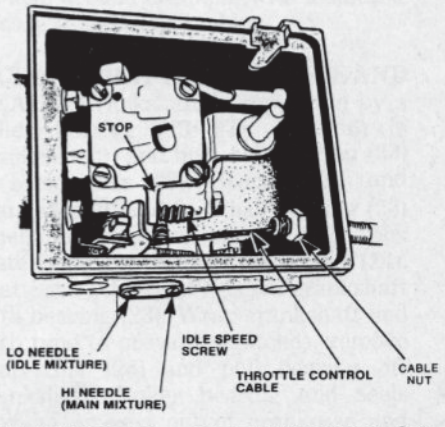


Fig. HL43-1A — View of brushcutter air box. Outside throttle cable nut is not shown.

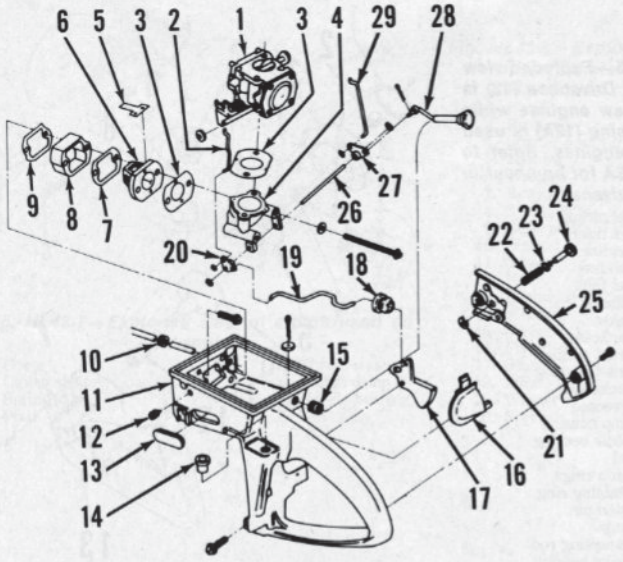


Fig. HL43-2—Exploded view of air box assembly on Super XL engine.

1. Carburetor
2. Throttle rod
3. Gasket
4. Intake manifold
5. Valve reeds
6. Reed valve seat
7. Gasket
8. Spacer
9. Gasket
10. Grommet
11. Air box
12. Idle adjusting screw
13. Grommet
14. Plug
15. Grommet
16. Spark plug shield
17. Throttle trigger
18. Boot
19. Throttle rod
20. Bellcrank
21. Retaining ring
22. Spring
23. Nylon bushing
24. Throttle lock
25. Handle cover
26. Shaft
27. Bellcrank
28. Choke rod
29. Choke link

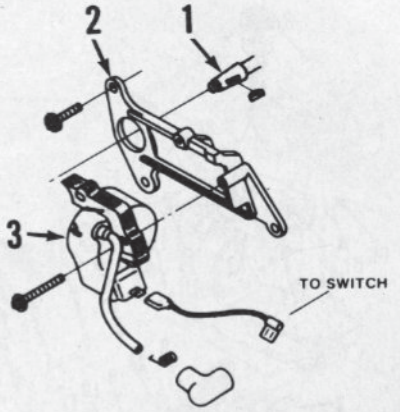


Fig. HL43-4—Exploded view of solid-state ignition.

1. Crankshaft
2. Stator plate
3. Ignition module

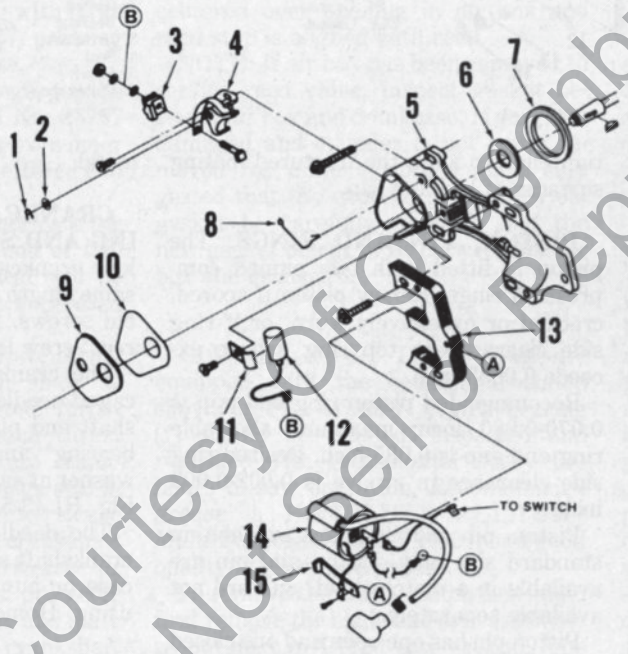


Fig. HL43-3—Exploded view of breaker-point type ignition used on early pump engines.

1. Pivot post clip
2. Washer
3. Terminal block
4. Breaker point set
5. Stator plate
6. Felt seal
7. Gasket
8. Clip
9. Cover
10. Gasket
11. Clamp
12. Condenser
13. Coil core
14. Coil
15. Coil retaining clip

filled with water), engine speed should be 6400 to 6600 rpm. If not, loosen screw (14) and move speed adjusting plate (13) as necessary so that engine governed speed is 6500 rpm.

If carburetor has been removed or linkage has been disconnected, be sure that governor link (26) is reconnected in hole "A" in carburetor throttle shaft lever. Be sure idle speed screw on carburetor is backed out so it will not interfere with full movements of throttle shaft lever and governor linkage moves smoothly throughout range of travel.

BRUSHCUTTER GOVERNOR. The engine used in brushcutter application is equipped with an air-vane type governor; refer to Fig. HL43-1.

To adjust governor using vibrating reed or electronic tachometer, proceed as follows: With engine warm and running and throttle trigger released, adjust position of cable nuts (see Fig. HL43-1A) on remote control cable so that engine slow idle speed is 2500 rpm, or just below clutch engagement speed. Then when throttle trigger is fully depressed, engine no-load speed should be 6300 rpm. To adjust maximum governed no-load speed, loosen screw (14 – Fig. HL43-1) and move speed adjusting plate (13) as required to obtain no-load speed of 6300 rpm. When adjusting maximum no-load speed, be sure that governor link (26) is reconnected at hole "A" in carburetor throttle shaft lever. Governor spring (12) is connected to third hole away from hole "A" (two open holes between link and spring). Be sure that governor linkage moves smoothly throughout range of travel.

MAGNETO AND TIMING. Early pump engines are equipped with a conventional breaker-point, flywheel magneto (Fig. HL43-3). Breaker point gap should be 0.015 inch. Ignition timing is not adjustable.

Later pump engines and all brushcutter and saw engines are equipped with a solid-state ignition (Fig. HL43-4). Ignition service is accomplished by replacing ignition components until faulty part is located. Air gap between ignition module (3) and flywheel is adjustable and should be 0.015 inch. Loosen ignition module mounting screws and adjust module position to set air gap.

LUBRICATION. The engine is lubricated by mixing oil with regular gasoline. Recommended oil is Homelite two-stroke oil mixed at ratio as designated on oil container. If Homelite oil is not available, a good quality oil designed for two-stroke engines may be used when mixed at a 16:1 ratio, however, an anti-oxidant fuel stabilizer (such as Sta-Bil) should be added to fuel mix. Anti-oxidant fuel stabilizer is not required with Homelite® oils as they contain fuel stabilizer so the fuel mix will stay fresh up to one year.

CARBON. Muffler, manifold and cylinder exhaust ports should be cleaned periodically to prevent loss of power through carbon build up. Remove muffler and scrape free of carbon; a bent wire can be inserted through hole in housing pump and generator mufflers to clean outer shell. With muffler or manifold removed, turn engine so that piston is at top dead center and carefully

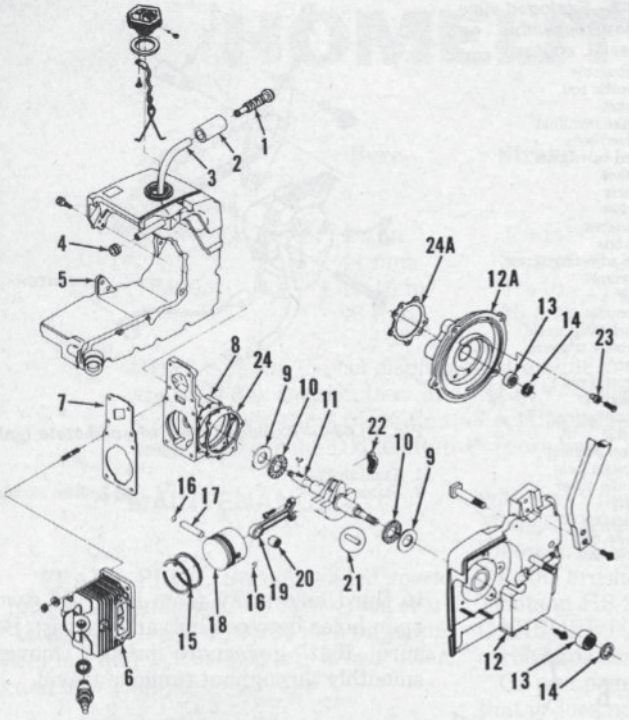


Fig. HL43-5—Exploded view of engine. Drivecase (12) is used on saw engines while pump housing (12A) is used on pump engines. Refer to Fig. HL43-5A for brushcutter drivecase.

1. Fuel pickup
2. Fuel filter
3. Fuel line
4. Grommet
5. Fuel tank
6. Cylinder
7. Gasket
8. Crankcase
9. Thrust washer
10. Thrust bearing
11. Crankshaft
12. Drivecase
12A. Pump housing
13. Needle bearing
14. Seal
15. Piston rings
16. Retaining ring
17. Piston pin
18. Piston
19. Connecting rod
20. Needle bearing
21. Crankpin rollers (31)
22. Rod cap
23. Sealing washer
24. Gasket
24A. Gasket

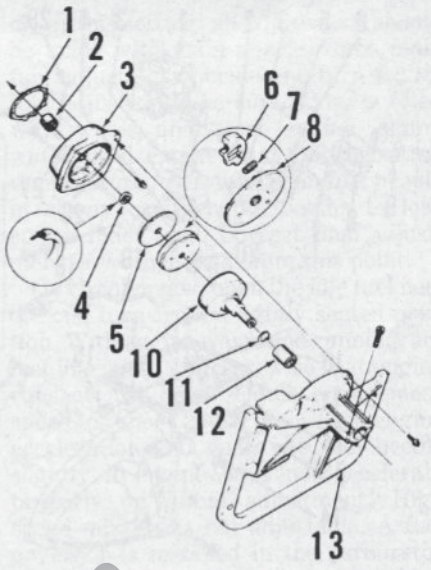


Fig. HL43-5A—Exploded view of ST-400 clutch assembly.

1. Gasket
2. Bearing
3. Drivecase
4. Seal
5. Cover
6. Clutch shoe
7. Spring
8. Clutch hub
10. Clutch drum
11. Snap ring
12. Bearing
13. Frame

remove carbon from exhaust ports with a wooden scraper. Be careful not to damage chamfered edges of exhaust ports or to scratch piston. Do not run engine with muffler removed.

REPAIRS

COMPRESSION PRESSURE. For optimum performance of all models, cylinder compression pressure should be 130-155 psi with engine at normal operating temperature. Engine should be inspected and repaired when compression pressure is 90 psi or below.

CONNECTING ROD. Connecting rod and piston assembly can be removed after removing cylinder from crankcase. Refer to Fig. HL43-5. Be careful not to lose any of the 31 needle rollers when detaching rod from crankpin.

Renew connecting rod if bent or twisted, or if crankpin bearing surface is scored, burned or excessively worn. The caged needle roller piston pin bearing can be renewed by pressing old bearing out and pressing new bearing in with Homelite tool No. 23756. Press on lettered end of bearing cage only.

It is recommended that the crankpin needle rollers be renewed as a set whenever engine is disassembled for service. When assembling connecting rod on crankshaft, stick 16 rollers in rod and 15 rollers in rod cap. Assemble rod to cap with match marks aligned, and with open end of piston pin towards flywheel side of engine. Wiggle the rod as cap retaining screws are being tightened to align the fractured mating surfaces of rod and cap.

PISTON, PIN AND RINGS. The piston is fitted with two pinned compression rings. Renew piston if scored, cracked or excessively worn, or if ring side clearance in top ring groove exceeds 0.0035 inch.

Recommended piston ring end gap is 0.070-0.080 inch; maximum allowable ring end gap is 0.085 inch. Desired ring side clearance in groove is 0.002-0.003 inch.

Piston, pin and rings are available in standard size only. Piston and pin are available in a matched set, and are not available separately.

Piston pin has one open and one closed end and may be retained in piston with snap rings or a Spirol pin. A wire retaining ring is used on exhaust side of piston on some models and should not be removed.

To remove piston pin on all models, remove the snap ring at intake side of piston. On piston with Spirol pin at exhaust side, drive pin from piston and rod with slotted driver (Homelite tool No. A-23949). On all other models, insert a 3/16-inch pin through snap ring at exhaust side and drive piston pin out.

When reassembling, be sure closed end of piston pin is to exhaust side of piston (away from piston ring locating pin). Install Truarc snap ring with sharp edge out.

The cylinder bore is chrome plated. Renew the cylinder if chrome plating is worn away exposing the softer base metal.

CRANKCASE, BEARING HOUSING AND SEALS. CAUTION: Do not lose crankcase screws. New screws of same length must be installed in place of old screws. Refer to parts book if correct screw length is unknown.

The crankshaft is supported in two caged needle roller bearings and crankshaft end play is controlled by a roller bearing and hardened steel thrust washer at each end of the shaft. Refer to Fig. HL43-5.

The needle roller main bearings and crankshaft seals in crankcase and drivecase or pump housing can be renewed using Homelite tool Nos. 23757 and

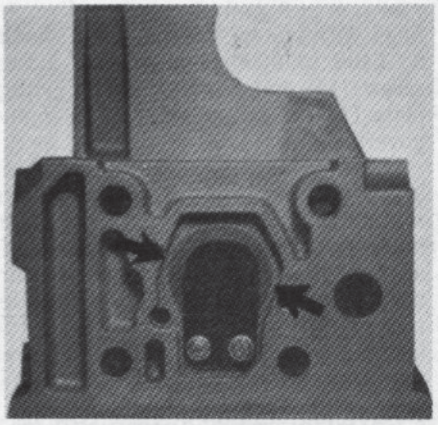


Fig. HL43-6—When installing flat reed valve, reed backup and reed stop, be sure reed is centered between two points indicated by black arrows.

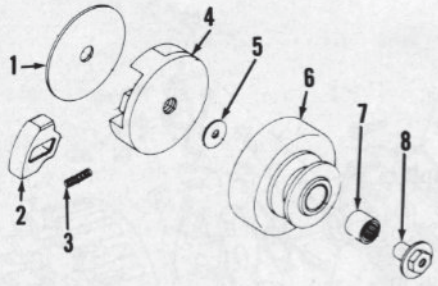
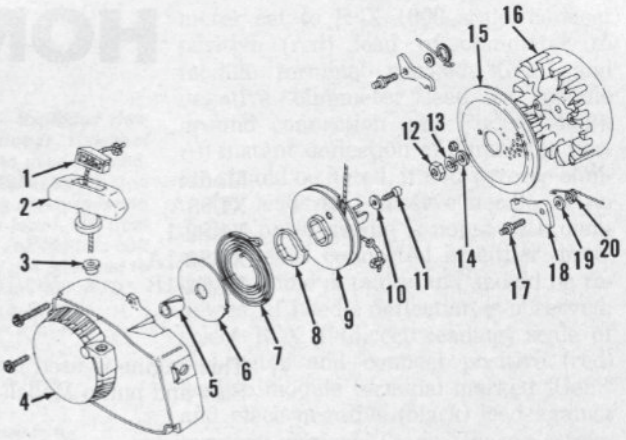


Fig. HL43-7—Exploded view of clutch used on saw engines.

1. Cover
2. Clutch shoe
3. Spring
4. Plate
5. Thrust washer
6. Clutch drum
7. Needle bearing
8. Nut

Fig. HL43-8—Exploded view of rewind starter.

1. Rope retainer
2. Handle
3. Bushing
4. Starter housing
5. Bushing
6. Washer
7. Rewind spring
8. Spring lock
9. Rope pulley
10. Washer
11. Screw
12. Nut
13. Lockwasher
14. Washer
15. Screen
16. Flywheel
17. Stud
18. Pawl
19. Washer
20. Spring



23758. Press bearings and seals from crankcase or bearing housing with large stepped end of tool No. 23757, pressing towards outside of either case.

To install new needle bearings, use the shouldered short end of tool No. 23757 and press bearings into bores from inner side of either case. Press on lettered end of bearing cage only.

To install new seals, first lubricate the seal and place seal on long end of tool No. 23758 so that lip of seal will be towards needle bearing as it is pressed into place.

To install crankshaft, lubricate thrust bearings (10) and place on shaft as shown. Place a hardened steel thrust washer to the outside of each thrust bearing. Insert crankshaft into crankcase being careful not to damage seal in crankcase. Place a seal protector sleeve (Homelite tool No. 23759) on crankshaft and gasket on shoulder of drivecase or pump housing. Lubricate seal protector sleeve, seal and needle bearing and mate drivecase or pump housing to crankshaft and crankcase. Use **NEW** retaining screws. Clean the screw threads and apply Loctite to threads before installing screws. Be sure the screws are correct length; screw length is critical. Tighten the screws alternately and remove seal protector sleeve from crankshaft.

FLAT REED INTAKE VALVE. A flat reed intake valve is used on pump engines. The reed valve is attached to the carburetor air box as shown in Fig. HL43-6 and is accessible after removing air box from crankcase.

Check the reed seating surface on air box to be sure it is free of nicks, chips or burrs. Renew valve reed if rusted, pitted or cracked, or if it does not seat flatly against its seat.

The reed stop is curved so that measurement of reed lift distance is not practical. However, be sure reed is centered over opening in air box and reed stop is aligned with reed.

NOTE: If air box has been removed to service reed valve, inspect gasket between air box and crankcase. If gasket is damaged and cylinder is not being removed for other purposes, it is suggested that the exposed part of the old gasket be carefully removed and the new gasket be cut to fit between the air box and crankcase.

CLUTCH. Model DM20 saws are equipped with the centrifugal clutch shown in Fig. HL43-7. Clutch bearing (7) should be cleaned, inspected and repacked with grease after every 100 hours of saw operation. Recommended grease is HOMELITE® ALL-TEMP Multi-Purpose Grease (#24551) or a good quality lithium base grease.

To remove the DM20 clutch assembly, first remove the blade and arm assembly as outlined in DM20 saw section. The clutch bearing inner race (8—Fig. HL43-7) unscrews clockwise (left-hand threads). Remove inner race with impact wrench, or if impact wrench is not available, use a ¾-inch socket wrench and strike wrench handle a sharp blow to loosen threads. Remove clutch drum, pulley and bearing assembly and remove thrust washer (5). Then, unscrew clutch plate (4) using a spanner wrench (Homelite tool No. A-23934 or equivalent) in clockwise direction. Remove clutch cover (1). Inspect clutch drum and pulley for excessive wear or scoring. Inspect all needle bearing rollers for scoring, excessive wear or flat spots, and renew bearing if such defect is noted. Bearing is excessively worn if rollers can be separated more than the width of one roller.

To service clutch on ST-400 models, unscrew capscrews securing frame (13—Fig. HL72) to bearing housing (3) and separate brushcutting unit from engine. Remove snap ring (11) and clutch drum (10). Rotate clutch hub in counter-clockwise direction to remove clutch assembly. Inspect clutch components and renew any which are damaged or excessively worn.

REWIND STARTER. To disassemble starter, refer to exploded view in Fig. HL43-8 and proceed as follows: Pull starter rope out fully, hold pulley (9) and place rope in notch of pulley. Let pulley rewind slowly. Hold pulley while removing screw (11) and washer (10). Turn pulley counterclockwise until disengaged from spring, then carefully lift pulley off starter post. Turn open side of housing down and rap housing sharply against top of work bench to remove spring. CAUTION: Be careful not to dislodge spring when removing pulley as spring could cause injury if it should recoil rapidly.

Install new spring with loop in outer end over pin in blower housing and be sure spring is coiled in direction shown in Fig. HL43-8. Install pulley (9), turning pulley clockwise until it engages spring and secure with washer and screw. Insert new rope through handle and hole in blower housing. Knot both ends of the rope and harden the knots with cement. Turn pulley clockwise eight turns and slide knot in rope into slot and keyhole in pulley. Let starter pulley rewind slowly.

Starter pawl spring outer ends are hooked behind air vanes on flywheel in line with starter pawls when pawls are resting against flywheel nut. Pull starter rope slowly when installing blower housing so that starter cup will engage pawls.

HOMELITE

Model	Bore	Stroke	Displ.
XL98A, XLS2-1, XLS2-1A, XLS2-1B	2-1/16 in. 52.4 mm	1½ in. 38.1 mm	5.0 cu. in. 82 cc

This engine is used to power Model XL98A Multi-Purpose Saw and pump Models XLS2-1, XLS2-1A and XLS2-1B.

MAINTENANCE

SPARK PLUG. Recommended spark plug is a Champion CJ6. Spark plug electrode gap should be 0.025 inch.

CARBURETOR. A Tillotson Model HS diaphragm carburetor is used. Refer to CARBURETOR SERVICE section for carburetor service. The carburetor used on Model XL98A saw has a fixed main jet and a governor valve which is designed to maintain a governed speed of about 5000 rpm. Neither main jet or governor valve is adjustable. The carburetor on Models XLS2-1A and XLS2-1B does not have adjustable idle or high speed mixture screws.

Initial carburetor adjustment on saw models is one turn open for idle mixture and high speed mixture screw, if so equipped. Adjust idle mixture screw and idle speed screw to obtain smooth idle with engine warm and running at 2400-2600 rpm which should be just below clutch engagement speed. Adjust high speed mixture screw, on models so equipped, to obtain optimum engine performance at cutting speed with saw under normal load. Do not adjust mixture screws too lean as engine damage may result.

To adjust carburetor on XLS2-1 pump models, turn idle and high speed mixture screws until they are 1½ turns open. Start engine and allow to run until warm. Adjust high speed mixture screw for highest pumping speed obtainable then turn high speed mixture screw ⅛ turn counterclockwise. Note: Governor is designed to limit maximum no-load speed to 6400 rpm. Adjust idle mixture screw by pulling throttle button all the way out and turn idle mixture screw to obtain highest and smoothest idle speed. Turn idle speed screw to obtain idle speed of approximately 3000 rpm. Adjustment of one mixture screw will require checking adjustment of remaining mixture screw as operation of mixture needles is related.

MAGNETO. Models XL-98A, XLS2-1B. Saw Model XL-98A and pump Model XLS2-1B are equipped with the capacitor discharge ignition system shown in Fig. HL44-1. Refer to CAPACITOR DISCHARGE IGNITION SYSTEM section of this manual for explanation of ignition system operation.

The capacitor discharge magneto is operating satisfactorily if spark will jump a ⅜-inch gap when engine is turned at cranking speed. If magneto fails to produce spark, service consists of locating and renewing inoperative unit; no maintenance is necessary.

To check magneto with volt-ohmmeter, proceed as follows: Remove starter housing and disconnect wire from ignition switch. Check to be sure there is no continuity through switch when in "ON" position to be sure a grounded switch is not cause of trouble and inspect wiring to be sure it is not shorted. CAUTION: Be sure that

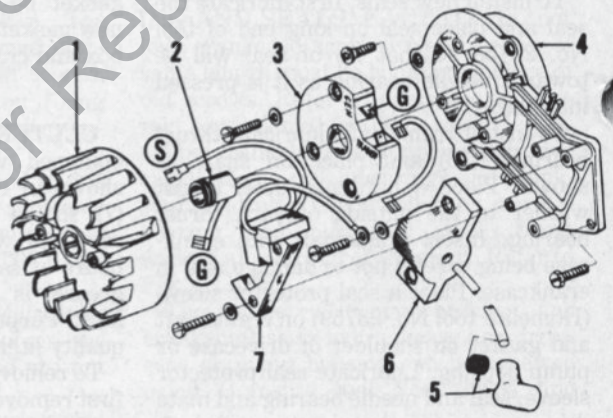


Fig. HL44-1—Exploded view of Phelon capacitor discharge type magneto used on Models XL-98A and XLS2-1B.

G. Connector to "Gen." terminal
S. Connector to "ON-OFF"
1. Magneto rotor (flywheel)
2. Dust cap
3. Ignition module
4. Back plate
5. High tension wire & terminal
6. Transformer coil
7. Generator coil & armature

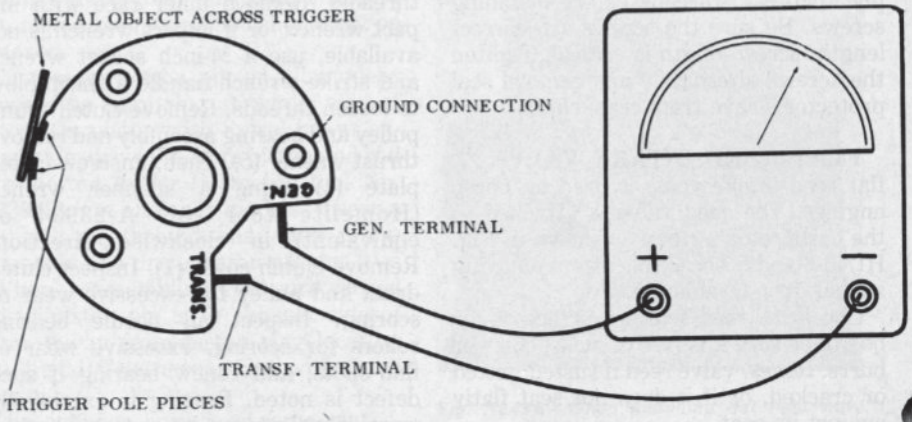


Fig. HL44-2—Drawing showing volt-ohmmeter connections to ignition module (3—Fig. HL44-1) for checking module. It should be noted that this is not a conclusive test and module should be renewed in event of spark failure when other magneto components test OK.

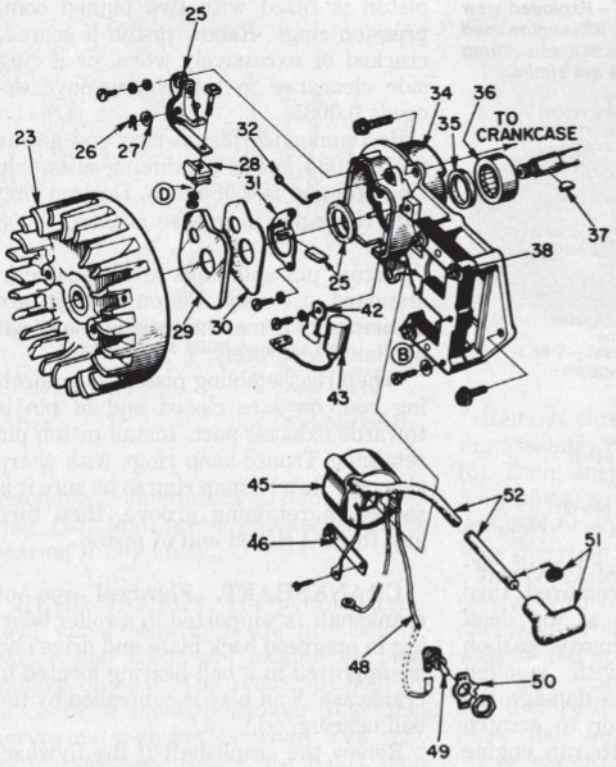


Fig. HL44-3—Exploded view of conventional flywheel type magneto used on models XLS2-1 and XLS2-1A. Coil clip retaining screw location is shown by letter "B". Condenser lead and ignition coil primary lead are attached to terminal block (28) at "D".

23. Rotor (flywheel)
25. Breaker point set
26. Clip
27. Washer
28. Terminal block
29. Breaker box cover
30. Gasket
31. Felt retainer
32. Cover spring clip
34. Back plate
35. Crankshaft seal
36. Roller bearing
37. Rotor key
38. Coil core (armature)
42. Clamp
43. Condenser
45. Ignition coil
46. Coil retaining clip
48. Ground lead
49. Ignition switch
50. "ON-OFF" plate
51. Spark plug terminal
52. Spark-plug wire

storage capacitor is discharged before touching connections; flip ignition switch to "OFF" position or ground switch lead (S).

Resistance through secondary (high tension) winding of transformer coil should be 2400 to 2900 ohms and resistance through primary winding should be 0.2-0.4 ohms. Connect ohmmeter leads between high tension (spark plug) wire and ground, then between input terminal and ground. If transformer coil does not test within specifications, renew coil and recheck for spark at cranking speed. If magneto still does not produce spark, check generator as follows:

Remove rotor (flywheel) and disconnect lead from generator to generator (G) terminal on module (3) and switch lead (S) at ignition switch. Connect negative lead of ohmmeter to ground wire from generator and the positive lead of ohmmeter to generator (G) wire. The ohmmeter should register showing continuity through generator. Reverse leads from ohmmeter; ohmmeter should then show no continuity (infinite resistance) through generator. Renew generator if continuity is noted with ohmmeter leads connected in both directions. A further check can be made using voltmeter if continuity checked correctly. Remove spark plug and reinstall rotor leaving wire (G) from generator disconnected. Connect positive (red) lead from voltmeter to wire (G) from generator and negative (black) lead of voltmeter to magneto back plate; wires must be routed so that starter can be reinstalled. A firm pull on starter rope should spin engine at about 500 rpm and voltmeter should show minimum reading of 4 volts. If both generator and transformer coil tested OK, a faulty ignition module (3) should be suspected.

A partial check of ignition module can be made using ohmmeter. With ohmmeter set to R X 1000 scale, connect positive (red) lead of ohmmeter to module terminal marked "Gen." and negative ohmmeter lead to module ground connection (see Fig. HL44-2). An instant deflection of ohmmeter needle should be noted; if not, reverse ohmmeter leads and observe needle. If no deflection of needle is noted with ohmmeter leads connected in either direction, module is faulty and should be renewed. If needle deflection is observed, select R X 1 (direct reading) scale of ohmmeter and connect positive (red) lead to module terminal marked "Gen." and place negative (black) lead against terminal marked "Trans." Place a screwdriver across the two trigger poles (see Fig. HL44-2); the ohmmeter needle should deflect and remain deflected until the ohmmeter lead is released from the module terminal. If the desired results are obtained with ohmmeter checks, the module is probably OK; however, as this is not a complete check and other magneto components and wiring check OK, renew module if no ignition spark can yet be obtained.

Models XLS2-1, XLS2-1A. Models XLS2-1 and XLS2-1A are equipped with a conventional flywheel magneto ignition system as shown in Fig. HL44-3. Breaker points and condenser are accessible after removal of starter housing, flywheel and breaker box cover. Adjust breaker point gap to 0.015 inch. Condenser capacity should test

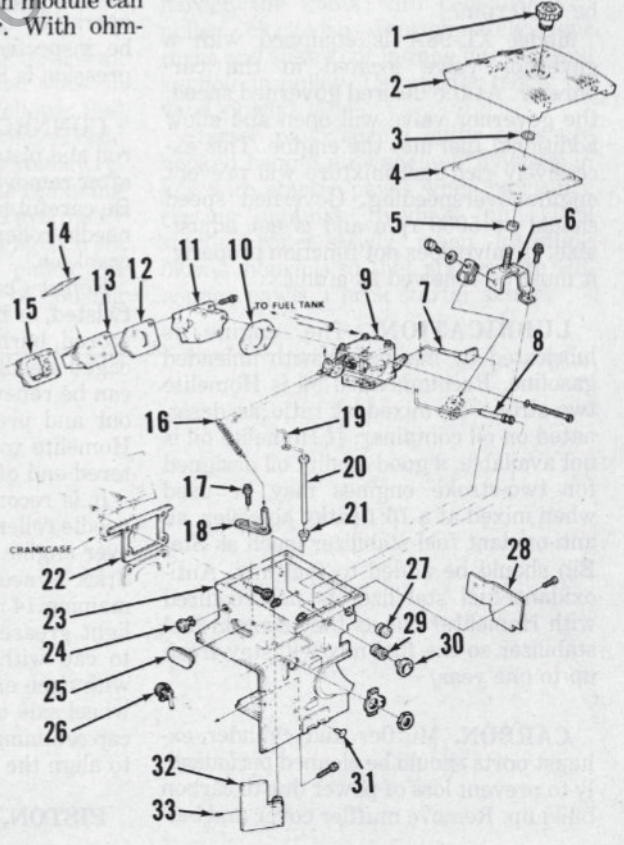


Fig. HL44-4—Exploded view of air box assembly used on Model XLS2-1B.

1. Nut
2. Air filter cover
3. Retaining ring
4. Air filter element
5. Gasket
6. Bracket
7. Choke rod
8. Throttle rod
9. Carburetor
10. Gasket
11. Intake manifold
12. Gasket
13. Reed valve seat
14. Valve reeds
15. Reed valve retainer
16. Governor spring
17. Adjusting plate screw
18. Adjusting plate
19. Link
20. Vane shaft
21. Bushing
22. Gasket
23. Air box
24. Plug
25. Grommet
26. Ignition switch
27. Grommet
28. Air deflector
29. Grommet
30. Choke knob
31. Rivet
32. Set screw
33. Air vane

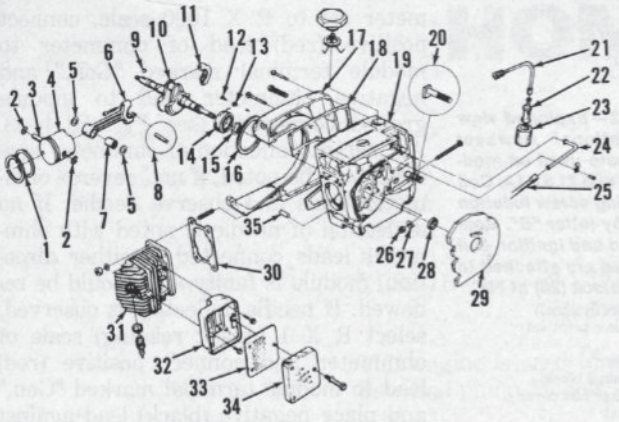


Fig. HL44-5 – Exploded view of Model XL-925 engine used on Model XL98A saw. Pump engines are similar.

1. Piston rings
2. Pin retaining rings
3. Piston pin
4. Piston
5. Thrust washer
6. Connecting rod
7. Needle bearing
8. Needle rollers (28)
9. Key
10. Crankshaft
11. Rod cap
12. Retaining screw
13. Bearing retainer washers
14. Ball bearing
15. Snap ring
16. Gasket
17. Fuel tank cover
18. Gasket
19. Crankcase & tank
20. Guide bar bolt
21. Fuel line
22. Fuel pickup
23. Fuel filter
24. Fuel connector
25. Fuel line
26. Locknut
27. Adjusting pin
28. Seal
29. Shield
30. Gasket
31. Cylinder
32. Muffler body
33. Baffle
34. Cap
35. Dowel pins (2)

0.18-0.22 mfd. Ignition timing is fixed at 30° BTDC. After reinstalling flywheel, check armature air gap which should be 0.005-0.007 inch. To adjust air gap, turn flywheel so that magnets are below legs of armature core and place plastic shim (Homelite part No. 23987) between armature and magnets. Loosen then tighten armature retaining screws and remove shim.

GOVERNOR. An air vane type governor is used on Models XLS2-1, XLS2-1A and XLS2-1B as shown in Fig. HL44-4. Governed speed is adjusted by loosening screws (17) and moving plate (18). Maximum governed speed should be 6400 rpm.

Model XL-98A is equipped with a governor valve located in the carburetor. At the desired governed speed, the governor valve will open and allow additional fuel into the engine. This excessively rich fuel mixture will prevent engine overspeeding. Governed speed should be 5000 rpm and is not adjustable. If valve does not function properly, it must be renewed as a unit.

LUBRICATION. The engine is lubricated by mixing oil with unleaded gasoline. Recommended oil is Homelite two-stroke oil mixed at ratio as designated on oil container. If Homelite oil is not available, a good quality oil designed for two-stroke engines may be used when mixed at a 16:1 ratio, however, an anti-oxidant fuel stabilizer (such as Sta-Bil) should be added to fuel mix. Anti-oxidant fuel stabilizer is not required with Homelite® oils as they contain fuel stabilizer so the fuel mix will stay fresh up to one year.

CARBON. Muffler and cylinder exhaust ports should be cleaned periodically to prevent loss of power due to carbon build up. Remove muffler cover and baffle plate and scrape muffler free of carbon. With muffler cover removed, turn engine so that piston is at top dead center and carefully remove carbon from exhaust ports with wooden scraper. Be careful not to damage the edges of exhaust ports or to scratch piston. Do not attempt to run engine with muffler baffle plate or cover removed.

REPAIRS

COMPRESSION PRESSURE. For optimum performance of all models, cylinder compression pressure should be 155-185 psi with engine at normal operating temperature. Engine should be inspected and repaired when compression is 90 psi or below.

CONNECTING ROD. Connecting rod and piston assembly can be removed after removing cylinder from crankcase. Be careful to remove all of the 28 loose needle rollers when detaching rod from crankpin.

Renew connecting rod if bent or twisted, or if crankpin bearing surface is scored, burned or excessively worn. The caged needle roller piston pin bearing can be renewed by pressing old bearing out and pressing new bearing in with Homelite tool No. 23955. Press on lettered end of bearing cage only.

It is recommended that the crankpin needle rollers be renewed as a set whenever engine is disassembled for service. Stick 14 needle rollers in rod and the remaining 14 needle rollers in rod cap with light grease or beeswax. Assemble rod to cap with match marks aligned and with open end of piston pin towards flywheel side of engine. Wiggle the rod as cap retaining screws are being tightened to align the fractured surfaces.

PISTON, PIN AND RINGS. The piston is fitted with two pinned compression rings. Renew piston if scored, cracked or excessively worn, or if ring side clearance in top ring groove exceeds 0.0035.

Recommended piston ring end gap is 0.070-0.080 inch, maximum allowable ring end gap is 0.085 inch. Desired ring side clearance in groove is 0.002-0.003 inch.

Piston, pin and rings are available in standard size only. Piston and pin are available as a matched set and are not available separately.

When reassembling piston to connecting rod, be sure closed end of pin is towards exhaust port. Install piston pin retaining Truarc snap rings with sharp side out. Rotate snap ring to be sure it is secure in retaining groove, then turn gap toward closed end of piston.

CRANKSHAFT. Flywheel end of crankshaft is supported in a roller bearing in magneto back plate and drive end is supported in a ball bearing located in crankcase. End play is controlled by the ball bearing.

Renew the crankshaft if the flywheel end main bearing or crankpin bearing surface or sealing surfaces are scored, burned or excessively worn. Renew the ball bearing if excessively loose or rough. Also, reject crankshaft if flywheel keyway is beat out or if threads are badly damaged.

CYLINDER. The cylinder bore is chrome plated. Renew cylinder if chrome plating is worn away exposing the softer base metal.

To remove cylinder, first remove the blower (fan) housing, carburetor and air box (handle) assemblies and remove the screw retaining magneto back plate to flywheel side of cylinder. The cylinder can then be unbolted from crankcase and removed from the piston.

CRANKCASE, MAGNETO BACK PLATE AND SEALS. To remove the magneto back plate, first remove the blower (fan) housing and flywheel. Loosen the cylinder retaining stud nuts on flywheel side of engine to reduce clamping effect on back plate boss, then unbolt and remove the back plate assembly from crankcase.

To remove crankshaft from crankcase, first remove the cylinder, connecting rod and piston assembly and the magneto backplate as previously outlined. Remove drive clutch assembly and dust shield (29 – Fig. HL44-5) on saws and pump assembly on Models XLS2-1, XLS2-1A and XLS2-1B. Then, remove the two ball bearing retaining screws (12) from inside of crankcase and remove crankshaft and ball bearing

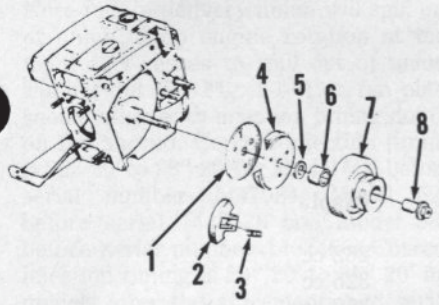


Fig. HL44-6—Exploded view of clutch used on Model XL98A Multi-Purpose Saw.

1. Cover
2. Clutch shoe
3. Spring
4. Plate
5. Thrust washer
6. Needle bearing
7. Clutch drum
8. Clutch bearing race

assembly from crankcase. Remove snap ring (15) and press crankshaft from bearing if necessary.

REED VALVES. The pyramid type reed valve seat is made of "Delrin" plastic and reeds are located by pins molded on seat. The reeds are held in place by a molded retainer that also serves as a gasket between reed seat and crankcase. Reeds are 0.004 inch thick.

When installing reed valve assembly, it is important that reed retainer be installed in crankcase first, then install reed seat with reeds in place. Oil can be used to stick reeds to seat. Also, special type shoulder retaining screws must be used.

CLUTCH. Model XL98A is equipped with a centrifugal clutch. To remove the clutch assembly, first remove the blade and arm assembly as noted in XL98A saw section. The clutch bearing inner race (8—Fig. HL44-6) unscrews counterclockwise (left-hand threads). Remove inner race with impact wrench, or if impact wrench is not available, use a ¾-inch socket wrench and strike wrench handle a sharp blow to loosen threads.

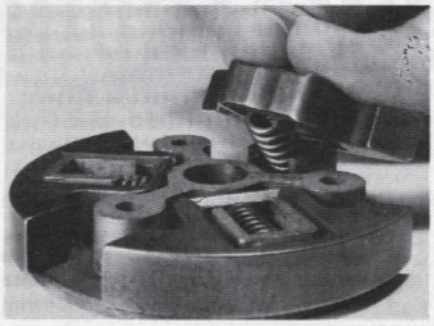


Fig. HL44-7—Installing shoes and springs on clutch spider plate.

Remove clutch drum, pulley and bearing assembly and remove thrust washer (5). Then, unscrew clutch plate (4) using a spanner wrench (Homelite tool No. A-23934 or equivalent) in counterclockwise direction. Remove clutch cover (1).

Inspect clutch drum and pulley for excessive wear or scoring. Inspect all needle bearing rollers for scoring, excessive wear or flat spots, and renew bearing if such defect is noted. Bearing is excessively worn if rollers can be separated more than the width of one roller.

Pry clutch shoes from spider plate with screwdriver. To install new shoes and/or springs, refer to Fig. HL44-7. Reinstall clutch by reversing removal procedure. Lubricate needle roller bearing in clutch drum with a small amount of Homelite® ALL-TEMP Multi-Purpose Grease (#24551). Note: The bearing should be cleaned and repacked after each 45 to 50 hours of operation.

REWIND STARTER. To disassemble starter, refer to exploded view in Fig. HL44-8 and proceed as follows: Pull starter rope out fully, hold pulley (7) and pry rope knot from pulley. Let pulley rewind slowly. Hold pulley while removing screw (11) and washer (10). Turn pulley counterclockwise until disengaged from spring, then carefully lift pulley off starter post. Turn open side of housing

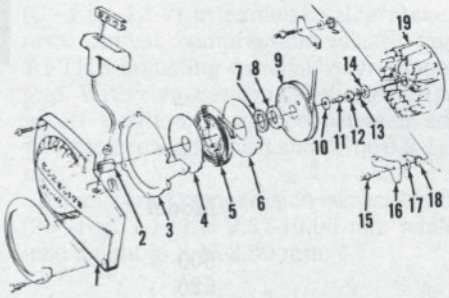


Fig. HL44-8—Exploded view of rewind starter.

1. Starter housing
2. Bushing
3. Air flow ring
4. Shield
5. Rewind spring
6. Shield
7. Bushing
8. Spring lock
9. Rope pulley
10. Washer
11. Screw
12. Locknut
13. Lockwasher
14. Washer
15. Stud
16. Pawl
17. Washer
18. Spring
19. Flywheel

down and rap housing sharply against top of work bench to remove spring. CAUTION: Be careful not to dislodge spring when removing pulley as spring could cause injury if it should recoil rapidly.

Install ring (3) and shield (4) in starter housing (1). Install new spring with loop in outer end over pin in blower housing and be sure spring is coiled in direction shown in Fig. HL44-8. Install shield (6) and pulley (9), turning pulley clockwise until it engages spring and secure with washer and screw. Insert new rope through handle and hole in blower housing. Knot both ends of the rope and harden the knots with cement. Turn pulley clockwise approximately four turns and slide knot in rope into slot and keyhole in pulley. Let starter pulley rewind slowly.

Starter pawl spring outer ends are hooked behind air vanes on flywheel in line with starter pawls when pawls are resting against flywheel nut. Pull starter rope slowly when installing blower housing so that starter cup will engage pawls. Check starter action.

LOMBARDINI

LOMBARDINI ENGINE, INC.
3402 Oakcliff Road, B-2
Doraville, Georgia 30340

Model	No. Cyls.	Bore	Stroke	Displ.
500	1	70 mm	68 mm	262 cc
520	1	78 mm	68 mm	325 cc
530	1	82 mm	68 mm	359 cc

Lombardini Model 530 engine is used on Homelite® DTP3-1 Pump.

Lombardini Model 500, 520 and 530 engines are four-stroke, air-cooled diesel engines. The cylinder head and cylinder block are aluminum. Crankshaft rotation is counter-clockwise at pto end.

Metric fasteners are used throughout engine.

MAINTENANCE

LUBRICATION

Recommended engine oil is SAE 10W for temperatures below 0° C (32° F), SAE20W for temperatures between 0° C (32° F) and 20° C (68° F), and SAE 40 for temperatures above 20° C (68° F). API classification for oil should be CD. Oil sump capacity is one liter.

A renewable oil filter is located in side of engine block. Manufacturer recommends removing filter (22–Fig. L1-1) and installing a new filter after every 300 hours of operation.

ENGINE SPEED ADJUSTMENT

Idle speed is adjusted by turning idle speed screw (I–Fig. L1-2). Idle speed should be 1000-1050 rpm. Maximum governed speed is adjusted by turning high speed screw (H). Maximum governed speed under load should be 3600 rpm.

FUEL SYSTEM

FUEL FILTER. The fuel filter may be located inside the fuel tank as shown in Fig. L1-3 or a cartridge type filter as shown in Fig. L1-4 may be used. Renew fuel filter after every 300 hours of operation or sooner if required.

BLEED FUEL SYSTEM. If equipped with cartridge filter (F–Fig. L1-4), unscrew bleed screw and allow fuel to flow until air-free, then retighten screw.

On gravity flow fuel systems (Fig. L1-3), loosen fuel line fitting on injection pump and allow fuel to flow until air-free, then retighten fitting.

On models equipped with a fuel pump (L–Fig. L1-4), loosen fuel line fitting on injection pump and operate fuel pump primer lever until air-free fuel flows from fitting, then retighten fitting.

On all models, loosen high pressure injection line at injector. Rotate engine crankshaft to operate injection pump until air-free fuel flows from injection line. Retighten injection line.

INJECTION PUMP TIMING

Injection pump timing is adjusted using shim gaskets (G–Fig. L1-3 and L1-4) between pump body and mounting surface on crankcase. To check injection pump timing, unscrew delivery line (D) fitting from delivery union (1–Fig. L1-5). Unscrew delivery union and remove spring (3), washer (4) and valve (5), then screw delivery union (1) into pump body. Move throttle control lever to full speed position. Rotate engine in normal direction (clockwise at flywheel end) so piston is on compression stroke.

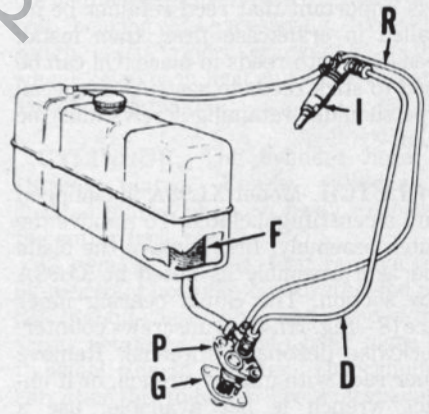


Fig. L1-3—Diagram of fuel system.

D. Delivery line
F. Fuel filter
G. Shim gasket
I. Injector
P. Injection pump
R. Return line

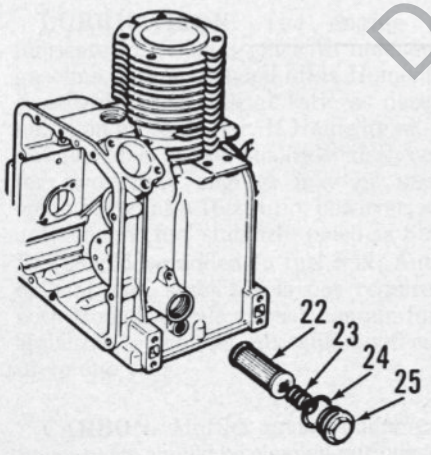


Fig. L1-1—Exploded view of oil filter.

22. Oil filter
23. Spring
24. "O" ring
25. Plug

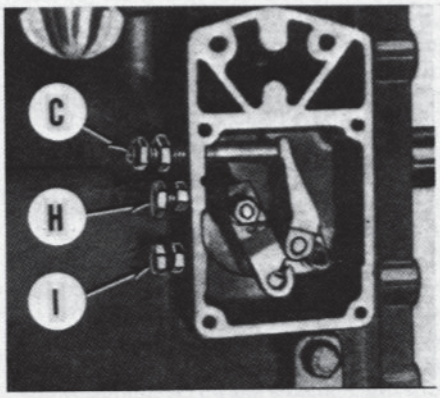


Fig. L1-2—Turn screw (I) to adjust low idle speed and screw (H) to adjust high idle speed. Torque control screw (C) must be adjusted as outlined in text.

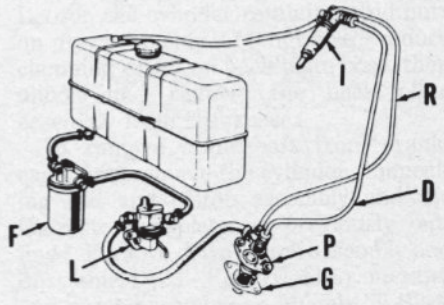


Fig. L1-4—Diagram of fuel system used on some models.

D. Delivery line
F. Fuel filter
G. Shim gasket
I. Injector
L. Fuel pump
P. Injection pump
R. Return line

Note fuel in delivery union will spill out of union. Stop engine rotation at moment fuel ceases to spill out of union. Timing dot (R – Fig. L1-6) on fan plate should align with injection timing dot (I) on fan shroud. Correct injection timing is 26° 20' to 28° 20' for Model 500 before serial number 1447084, Model 520 before serial 1448128 and Model 530 before serial number 1457466. Correct injection timing is 29° 20' to 31° 20' for models after the aforementioned serial numbers. To advance injection timing, remove shim gaskets (G – Fig. L1-3 and L1-4); install shim gaskets to retard injection timing. Shim gaskets are available in thicknesses of 0.1, 0.3 and 0.5 mm. Reinstall removed pump components after checking injection timing. Tighten injection pump retaining screws to 29 N·m.

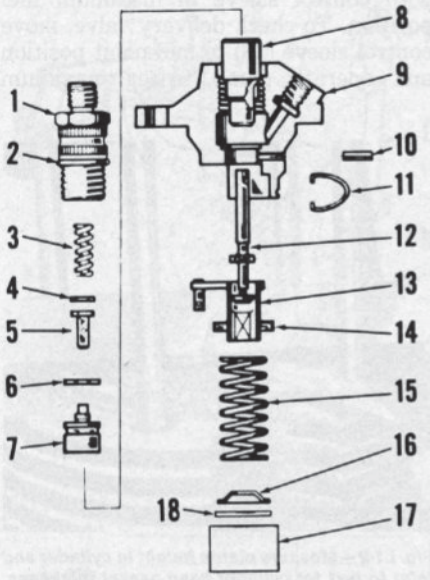


Fig. L1-5 – View of injection pump.

1. Delivery union
2. "O" ring
3. Spring
4. Washer
5. Delivery valve
6. Gasket
7. Delivery valve seat
8. Barrel
9. Pump body
10. Pin
11. Clip
12. Plunger
13. Control sleeve
14. Spring seat
15. Spring
16. Spring retainer
17. Tappet
18. Spacer

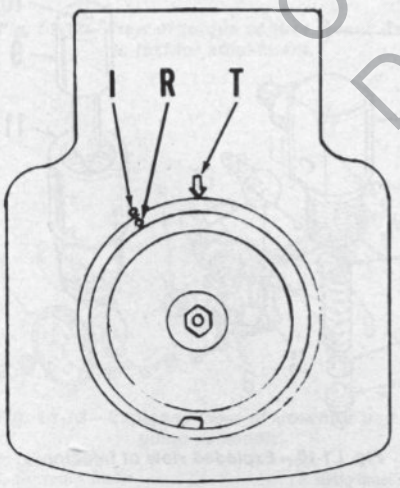


Fig. L1-6 – Injection should occur when timing dot (R) of fan plate is aligned with injection timing dot (I) on fan shroud. Piston is at TDC when timing dot (R) and arrow (T) are aligned.

REPAIRS

TIGHTENING TORQUES

Refer to following table for tightening torques. All values are in newton meters.

Connecting rod	33.3
Crankcase cover	29
Cylinder head	39.2
Flywheel	147
Injection pump	29
Injector nozzle nut	60-90
Injector retainer plate	12
Oil pump	11.8

VALVE TAPPET GAP

Valve tappet gap may be adjusted after removing rocker arm cover. Valve tappet gap should be 0.15 mm for both valves with engine cold. Note that there are two adjusting screws (Fig. L1-7) in exhaust rocker arm on some models. Adjusting screw (V) nearer rocker arm shaft is used to adjust valve clearance while outer screw (C) adjusts compression release gap on models so equipped.

COMPRESSION RELEASE

Some models are equipped with a manual compression release so the exhaust valve may be held open to aid starting. Compression release components (24 through 29 – Fig. L1-8) are mounted in the cylinder head. Rotating shaft (26) will force the exhaust rocker arm (10) to slightly open the exhaust valve.

The compression release is adjusted by turning outer adjusting screw (C – Fig. L1-7) in exhaust valve rocker arm. Adjust compression release gap AFTER adjusting exhaust valve tappet gap. With compression release lever (L) in off position, clearance between adjusting screw and shaft should be 0.9-1.1 mm.

Diameter of compression release shaft (26 – Fig. L1-8) is 9.37-10.00 mm while lobe height is 8.45-8.50 mm.

CYLINDER HEAD AND VALVE SYSTEM

Manufacturer does not recommend removing a hot cylinder head as deformation may result.

Valve face angle is 45 degrees and minimum valve head margin is 0.5 mm. Valve seat angle is 45 degrees with a seat width of 1.4-1.6 mm. Valve seats are renewable and must be installed with head heated to 160°-180° C (320°-356° F). Valve seals are used on intake valves. Valve stem diameter is 6.98-7.00 mm while valve guide diameter is 7.03-7.05 mm. Desired valve stem clearance is 0.03-0.07 mm. Valve guides are renewable and oversize valve guides are available. Exhaust valve guide is bronze. Note locating ring (15 – Fig. L1-8) around top of each guide. The cylinder head should be heated to 160°-180° C (320°-356° F) when installing valve guides.

Valve spring free length should be 42 mm. Valve spring pressure should be 225.4 newtons at 32 mm.

The rocker arms are supported by rocker arm shaft (6). Desired clearance between shaft and rocker arms is 0.03-0.06 mm. Renew shaft and rocker arms if clearance exceeds 0.1 mm.

The cylinder head gasket is available in varying thicknesses. Gasket thickness is determined by measuring piston height at top dead center (TDC) as shown in Fig. L1-9. Measure from piston crown to gasket seating surface of cylinder. Subtract measurement from 0.6-0.7 mm to obtain required gasket

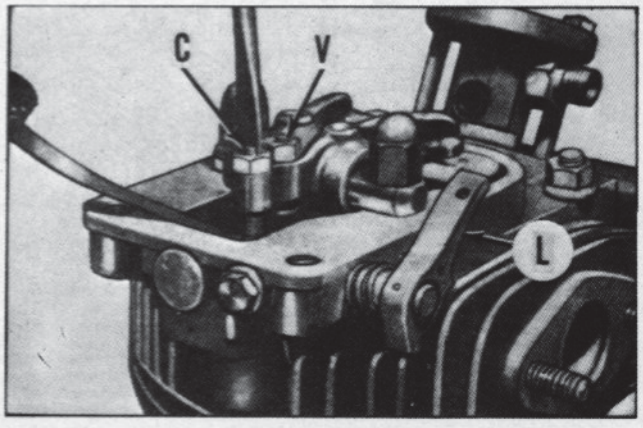


Fig. L1-7 – With compression lever (L) in off position, turn adjusting screw (C) so clearance is 0.9-1.1 mm (0.035-0.043 in.) between screw and shaft. Adjusting screw (V) determines valve clearance.

thickness. Cylinder head gaskets are available in thicknesses of 0.5 mm, 0.6 mm, 0.7 mm and 0.8 mm.

Tighten cylinder head nuts in a crossing pattern to 39.2 N·m.

INJECTOR

REMOVE AND REINSTALL. To remove injector, first clean dirt from injector, injection line, return line and cylinder head. Disconnect return line and injection line and immediately cap or plug all openings. Unscrew retainer plate nuts and lift off retainer plate (1–Fig. L1-10) being careful not to lose dowel pin (2). Injector may now be carefully removed from cylinder head. Do not lose shims between injector and cylinder head.

Tighten injector retaining plate nuts to 12 N·m. If accessible, measure protrusion of nozzle into combustion chamber. Nozzle tip should extend 2.5-3.0 mm above adjacent combustion chamber surface. Adjust position of nozzle by installing shims between injector and cylinder head. Shims are available in thicknesses of 0.5 mm and 1.0 mm.

TESTING. WARNING: Fuel leaves the injection nozzle with sufficient force to penetrate the skin. When testing, keep yourself clear of nozzle spray.

If a suitable test stand is available, injector operation may be checked. Only clean, approved testing oil should be used to test injector. When operating properly during test, injector nozzle will emit a buzzing sound and cut off quickly with no fluid leakage at seat.

Opening pressure with a new spring (4–Fig. L1-10) should be 20.5-22.5 MPa while opening pressure with a used spring should be 19.6-21.5 MPa. Opening pressure is adjusted by varying number and thickness of shims (5). Valve should not show leakage at orifice spray holes for 10 seconds at 17.6 MPa.

OVERHAUL. Clamp nozzle body (3–Fig. L1-10) in a vise with nozzle tip pointing upward. Remove nozzle holder nut (11). Remove nozzle tip (9) with valve (10) and spacer (8). Invert nozzle body (3) and remove spring seat (6), shim (5) and spring (4). Thoroughly clean all parts in a suitable solvent. Clean inside orifice end of nozzle tip with a wooden cleaning stick. The 0.20 mm diameter orifice spray holes may be cleaned by inserting a cleaning wire slightly smaller than spray hole. When reassembling injector, make certain all components are clean and wet with clean diesel fuel oil. Tighten nozzle holder nut (11) to 60-90 N·m.

INJECTION PUMP

Refer to Fig. L1-5 for view of injection pump. Disassembly and reassembly is evident after inspection of pump and referral to Fig. L1-5. Note that slot in barrel (8) must align with pin (10) and helix in plunger (12) must face pin (10).

The following tests may be used to check injection pump if necessary test equipment is available. With a suitable pressure gage connected to delivery union (1), operate pump. With control sleeve (13) at mid-point, pump pressure should be at least 29.4 MPa. Pump pressure should be at least 39.2 MPa with control sleeve in maximum fuel position. To check delivery valve, move control sleeve (13) to mid-point position and operate pump. After maximum

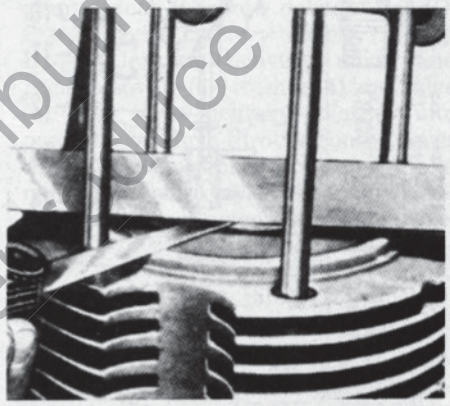


Fig. L1-9—Measure piston height in cylinder and refer to text for cylinder head gasket thickness.

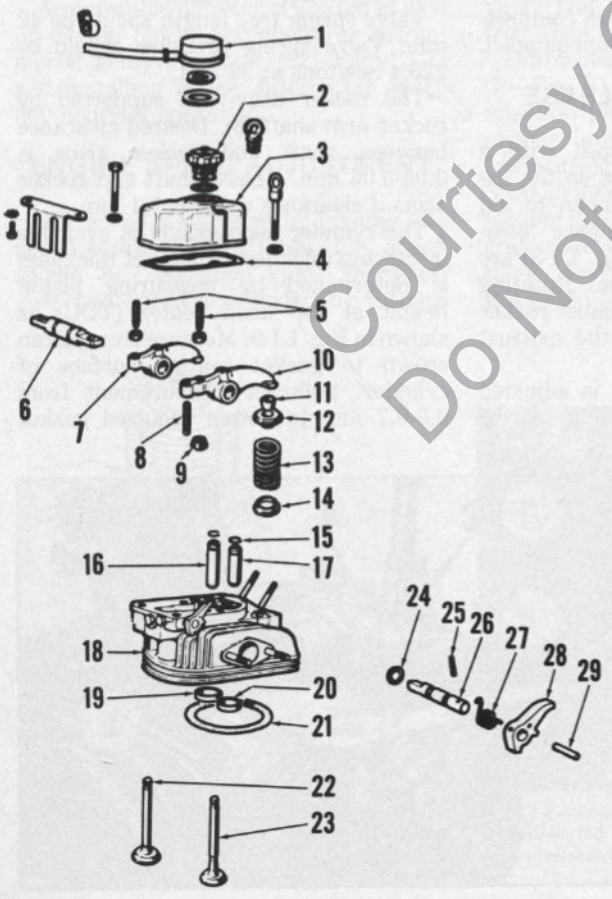


Fig. L1-8—Exploded view of cylinder head assembly.

1. Breather
2. Fill cap
3. Rocker cover
4. Gasket
5. Valve adjusting screws
6. Rocker arm shaft
7. Intake rocker arm
8. Compression release adjusting screw
9. Valve seal
10. Exhaust rocker arm
11. Valve keepers
12. Spring retainer
13. Spring
14. Spring seat
15. Locating rings
16. Intake valve guide
17. Exhaust valve guide
18. Cylinder head
19. Intake valve seat
20. Exhaust valve seat
21. Head gasket
22. Intake valve
23. Exhaust valve
24. "O" ring
25. Pin
26. Compression release shaft
27. Spring
28. Compression release lever
29. Pin

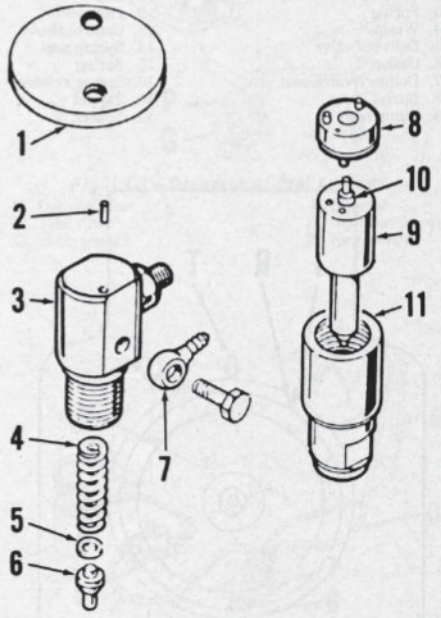


Fig. L1-10—Exploded view of injector.

1. Clamp plate
2. Dowel pin
3. Nozzle body
4. Spring
5. Shim
6. Spring seat
7. Return line fitting
8. Spacer
9. Nozzle tip
10. Valve
11. Nozzle holder nut

pressure is reached, pressure should drop sharply to a pressure 2940-4900 kPa less than maximum pressure if delivery valve is operating properly. Maximum delivery rate of pump is 44-46 cc at 1800 rpm for 1000 pump strokes.

Outside diameter of tappet (17) is 27.96-27.98 mm while maximum allowable clearance in tappet guide bore is 0.10 mm. Thickness of spacer (18) should be 3.45-3.55 mm.

When installing injection pump, place shim gaskets (G–Fig. L1-3 or L1-4) under pump then engage control sleeve (13–Fig. L1-5) pin with governor arm (F–Fig. L1-11). Tighten pump retaining screws to 29 N·m. Loosen clamp nut (N) then move throttle lever (T) to full throttle. Push governor lever (L) in until it stops thus moving injection pump control sleeve to maximum delivery. Tighten clamp nut (N).

Torque control screw (C–Fig. L1-2 and L1-12) allows additional fuel usage under high torque load. The tip (T–Fig. L1-12) is backed by spring (S). Tip (T) must travel 0.2-0.3 mm when 400-430 grams is forced against tip. To adjust torque control screw, run engine at high idle with no load and turn screw so there is 2.1-2.3 mm gap (G) between tip (T) and lever (L). Tighten locknut.

Refer to INJECTION PUMP TIMING section to time injection pump.

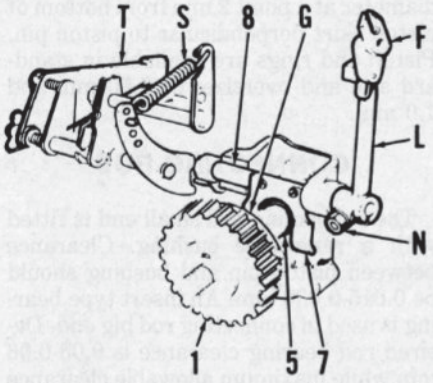


Fig. L1-11–View of governor mechanism. Refer to text for operation.

GOVERNOR

All models are equipped with a flyweight centrifugal type governor which is attached to the back of oil pump drive gear as shown in Fig. L1-11. The oil pump drive gear (1) is driven by the crankshaft and rotates governor flyweight assembly (G). The flyweights are interlocked with sleeve (5) to move fork (7) and rotate attached shaft. As the fork shaft rotates, governor lever (L) forces arm (F) against a pin in the fuel injection pump control sleeve thereby changing fuel flow to cylinder. Throttle lever (T) operates through governor spring (S) to control engine speed.

Governor components must move freely for proper governor operation. Governor spring (S–Fig. L1-11) free length should be 56.9-57.0 mm. At a spring length of 71.9-72.0 mm, spring tension should be 13.7-15.7 newtons.

Spindle (8–Fig. L1-13) diameter is 7.95 mm. Desired clearance between spindle and bores in oil pump body (13) is 0.06-0.10 mm with a maximum allowable clearance of 0.15 mm.

On most 3600 rpm models, hook governor spring end in second hole from governor lever end.

OIL PUMP

Refer to Fig. L1-13 for an exploded view of oil pump. The oil pump is accessible after removing crankcase cover (3–Fig. L1-14). Clearance between gears and pump body walls must not exceed 0.15 mm. Renew oil pump if components are excessively worn or damaged. Tighten pump mounting screws evenly to 11.8 N·m.

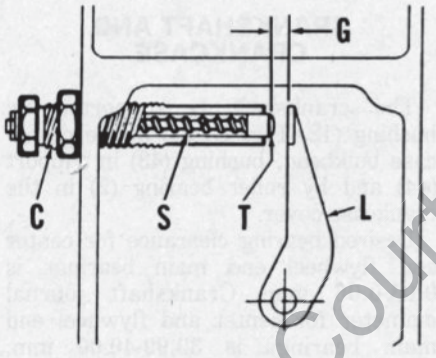


Fig. L1-12–View of torque control screw. Refer to text for adjustment.

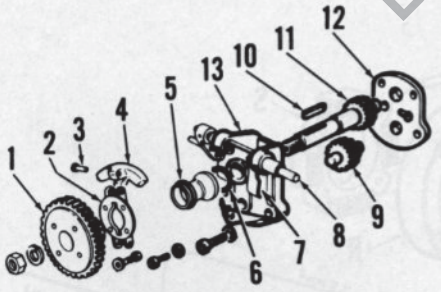


Fig. L1-13–Exploded view of governor and oil pump assembly.

1. Drive gear
2. Governor frame
3. Pins
4. Weights
5. Sleeve
6. Stop
7. Fork
8. Spindle
9. Gear
10. Key
11. Gear & shaft
12. Cover
13. Oil pump body

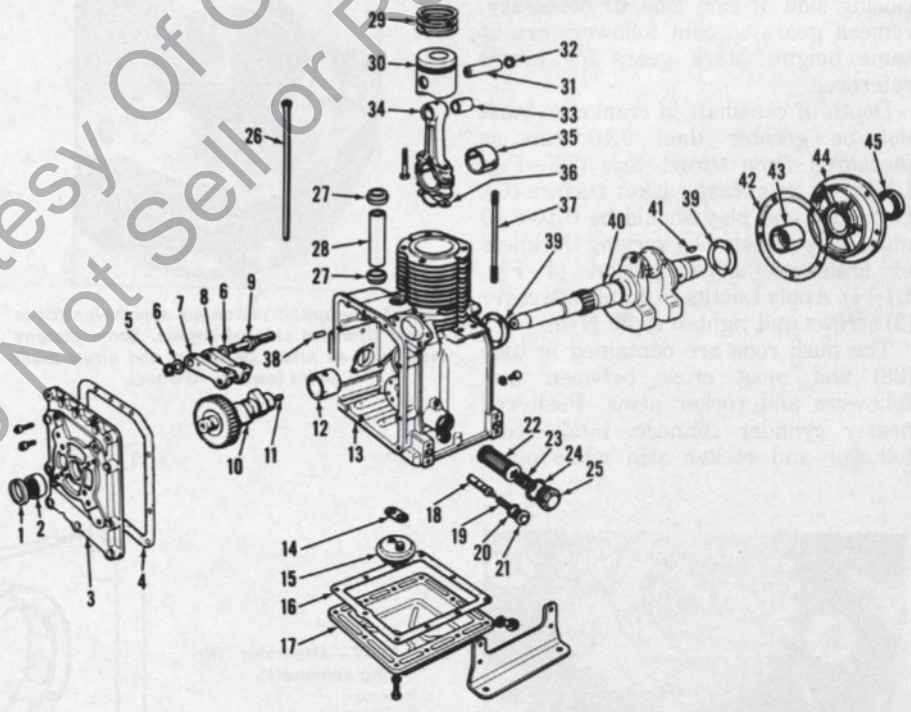


Fig. L1-14–Exploded view of engine.

1. Seal
2. Roller bearing
3. Crankcase cover
4. Gasket
5. Snap ring
6. Washer
7. Exhaust cam follower
8. Intake cam follower
9. Stud
10. Camshaft
11. Plug
12. Bushing
13. Engine block
14. Gasket
15. Oil pickup
16. Gasket
17. Oil pan
18. Oil pressure relief valve
19. Spring
20. Gasket
21. Plug
22. Oil filter
23. Spring
24. "O" ring
25. Plug
26. Push rods
27. Seal
28. Push rod tube
29. Piston rings
30. Piston
31. Piston pin
32. Snap ring
33. Bushing
34. Connecting rod
35. Rod bearing
36. Lock plate
37. Studs
38. Dowel pins
39. Thrust washers
40. Crankshaft
41. Key
42. Gasket
43. Bushing
44. Support
45. Seal

CAMSHAFT, CAM FOLLOWERS AND PUSH RODS

The camshaft rides directly in crankcase cover and crankcase bulkhead and is accessible after removing crankcase cover (3–Fig. L1-14). Cam followers (7 and 8) pivot on stud (9) and transfer motion to push rods (26) which pass through tube (28) to rocker arms. In addition to valve actuating lobes, a lobe is ground on the camshaft to operate the fuel injection pump.

Oil passages in the camshaft may be cleaned after removing plug (11). Be sure plug is securely reinstalled. Lobe height for intake and exhaust valves should be 33.14-33.15 mm while lobe height for injection pump should be 33.99-34.00 mm. Camshaft bearing journal diameters are 19.937-19.950 mm and 25.937-25.950 mm.

Desired clearance between cam followers and pivot stud (9) is 0.03-0.06 mm with a maximum clearance of 0.1 mm.

Install camshaft so timing marks (M–Fig. L1-15) are aligned. If timing marks are absent from gears, proceed as follows: Position piston at top dead center (TDC) then install camshaft so intake cam follower is on opening side of cam lobe and exhaust cam follower is on closing side of cam lobe. If necessary, remesh gears so cam followers are at same height. Mark gears for future reference.

Depth of camshaft in crankcase must not be greater than 0.10 mm as measured from thrust face (TF–Fig. L1-15) to crankcase gasket surface (G). Camshaft end play should be 0.10-0.30 mm and is adjusted by varying thickness of crankcase cover gasket (4–Fig. L1-14). Apply Loctite to crankcase cover (3) screws and tighten to 29 N·m.

The push rods are contained in tube (28) and must cross between cam followers and rocker arms. Push rod nearer cylinder connects intake cam follower and rocker arm while outer push rod connects exhaust cam follower and rocker arm.

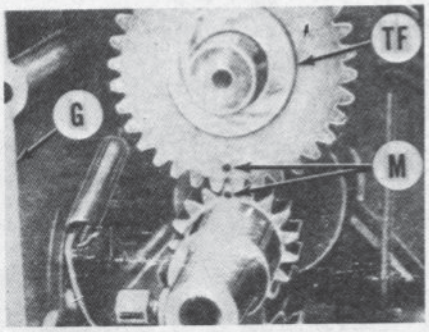


Fig. L1-15–View of camshaft and crankshaft timing marks (M). Measure depth of camshaft thrust face (TF) from crankcase gasket surface (G) as outlined in text.

PISTON AND ROD UNIT

REMOVE AND REINSTALL. Piston and connecting rod may be removed after removing cylinder head and oil pan.

When installing piston and rod, note that depression (D–Fig. L1-16) in piston crown is closer to one side of piston. Install piston so depression side of piston is nearer flywheel. Some pistons also have an arrow embossed in piston crown as shown in Fig. L1-16. Properly installed, arrow on piston crown will point towards flywheel.

The connecting rod and cap have machined serrations which must mate during assembly. Match marks on rod and cap must be on same side. Tighten connecting rod screws to 33.3 N·m.

PISTON, PIN AND RINGS

The piston may be equipped with two or three compression rings and an oil control ring. Piston ring end gap is 0.25-0.40 mm for all compression rings and 0.20-0.35 mm for the oil ring. Maximum side clearance is 0.22 mm for top compression ring, 0.17 mm for second, and if used, third compression ring and 0.12 mm for oil control ring.

Clearance between piston pin and bushing should be 0.015-0.030 mm. Renew pin if excessively worn or damaged.

Piston to cylinder wall clearance should be 0.11-0.14 mm with a maximum allowable clearance of 0.28 mm. When determining clearance, measure piston diameter at a point 2 mm from bottom of piston skirt perpendicular to piston pin. Piston and rings are available in standard size and oversizes of 0.50 mm and 1.0 mm.

Fig. L1-16–Install piston so depression (D) is nearer flywheel side of engine. Some pistons may have an arrow on crown and arrow must point towards flywheel.

CONNECTING ROD

The connecting rod small end is fitted with a renewable bushing. Clearance between piston pin and bushing should be 0.015-0.030 mm. An insert type bearing is used in connecting rod big end. Desired rod bearing clearance is 0.03-0.06 mm while maximum allowable clearance is 0.10 mm. Big end bearings are available in undersizes of 0.25 mm and 0.50 mm.

CRANKSHAFT AND CRANKCASE

The crankshaft is supported by bushing (12–Fig. L1-14) in the crankcase bulkhead, bushing (43) in support (44) and by roller bearing (2) in the crankcase cover.

Desired bearing clearance for center and flywheel end main bearings is 0.03-0.06 mm. Crankshaft journal diameter for center and flywheel end main bearings is 39.99-40.00 mm.

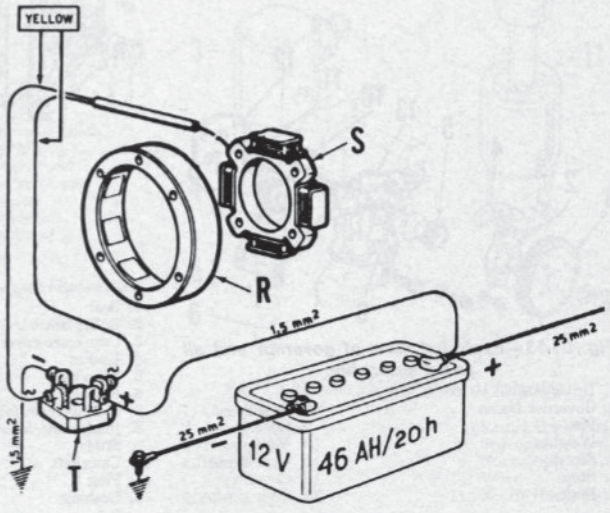


Fig. L1-17–Alternator wiring schematic.
R. Rotor
S. Stator
T. Rectifier

Center and flywheel end main bearings are available in standard size and undersizes of 0.5 mm and 1.0 mm. Crankshaft journal diameter at pto end is 27.94-28.00 mm. Crankshaft must be renewed if pto end journal is worn more than 0.10 mm.

The crankshaft has drilled oil passages to circulate oil. Expansion plugs located adjacent to crankpin may be removed to clean oil passages, however, new plugs must be installed securely.

ELECTRIC STARTER

Early models are equipped with a Prestolite MGL-4002A electric starter while later models are equipped with Bosch starter B.001.214.002.

The Prestolite starter is secured by clamps to the cylinder block and a rubber spacer ring between starter pinion housing and steel stamped backplate is used to properly locate starter. Rubber spacer ring thickness should be 14.5-15.5 mm. The Bosch starter is bolted to a cast aluminum backplate.

ALTERNATOR

An alternator is mounted on the flywheel end of engine to recharge the battery. The stator is secured to the engine crankcase while a ring of magnets is carried by the flywheel. Note wiring schematic in Fig. L1-17. The magnet ring may be removed from the flywheel if faulty. Stator and rotor are available only as an assembly.

LOMBARDINI

Model	No. Cyls.	Bore	Stroke	Displ.
832	2	100 mm	105 mm	1648 cc
833	3	100 mm	105 mm	2472 cc
834	4	100 mm	105 mm	3296 cc
L27	2	100 mm	105 mm	1648 cc
L40	3	100 mm	105 mm	2472 cc
L54	4	100 mm	105 mm	3296 cc

Lombardini Model L27 engine is used on Homelite® GD12000-1 and GD12300-2 Generators.

Engines covered in this section are four-stroke, air-cooled diesel engines. Crankcase, cylinders and cylinder head are cast iron. Crankshaft rotation is counterclockwise at pto end. Number 1 cylinder is cylinder nearest flywheel. Firing order is 1-3-2 on Models 833 and L40, and 1-3-4-2 on Models 834 and L54.

Metric fasteners are used throughout engine.

MAINTENANCE

LUBRICATION

Recommended engine oil is SAE 10W for temperatures below 0° C (32° F), SAE 20W for temperatures between 0° C (32° F) and 20° C (68° F), and SAE 40 for temperatures above 20° C (68° F). API classification for oil should be CD. Oil sump capacity is 3.5 liters on Models 832 and L27, 5.5 liters on Models 833 and L40, and 8 liters on Models 834 and L54. Manufacturer recommends renewing oil after every 100 hours of operation.

A renewable oil filter is mounted on side of crankcase. Manufacturer recommends renewing filter after every 400 hours of operation.

All models are equipped with a pressurized oil system. Refer to Fig. L3-1 for a diagram of the oil circuit.

ENGINE SPEED ADJUSTMENT

Models 834 and L54

Engine application will determine engine speed settings. Manufacturer recommends that personnel experienced with Bosch fuel injection pumps should adjust engine speed settings.

All Other Models

Idle speed is adjusted by turning idle speed screw (I–Fig. L3-3). Idle speed should be 900-950 rpm. Maximum governed speed is adjusted by turning high speed screw (H). Maximum governed speed under load is 2200 rpm for Models L27 and L40, and 2600 rpm for Models 832 and 833.

FUEL SYSTEM

FUEL FILTER. Models 834 and L54 are equipped with two renewable fuel filters while all other models are equipped with a single renewable fuel filter. Renew the fuel filter after every 300 hours of operation or sooner if required.

BLEED FUEL SYSTEM. To bleed the fuel system on Models 834 and L54, open the bleed screw on fuel filter housing then operate primer (M–Fig. L3-4) on fuel transfer pump until air-free fuel flows. Retighten bleed screw. Open the fuel injection pump bleed screw (B), then operate primer (M) until air-free fuel flows and retighten bleed screw. Loosen high pressure line fittings at injectors. Rotate engine to operate fuel injection pump until air-free fuel flows from fittings, then retighten fittings.

To bleed fuel system on all other models, loosen bleed screw on fuel filter housing then operate primer (M–Fig. L3-5) on fuel transfer pump until air-free fuel flows. Retighten bleed screw. Open injection pump bleed screw, on models so equipped, or loosen inlet fuel line fitting at injection pump. Operate primer (M) until air-free fuel flows, then tighten bleed screw or fuel fitting. Loosen high pressure line fittings at injectors. Rotate engine to operate fuel injection pump until air-free fuel flows then retighten fittings.

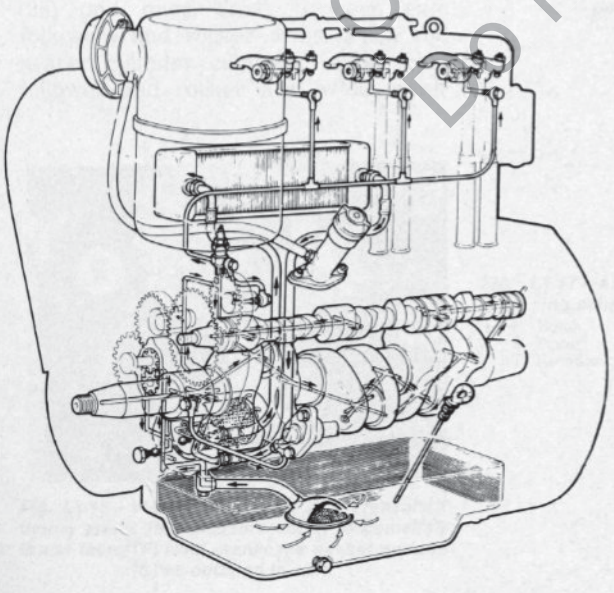


Fig. L3-1—Drawing of lubrication system.

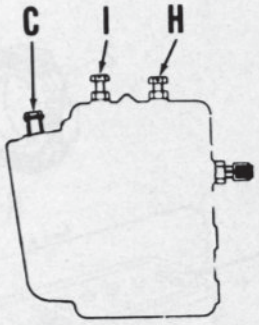


Fig. L3-3—Drawing showing location of low idle speed screw (I), high idle speed screw (H) and torque control screw (C) on all models except 834 and L54.

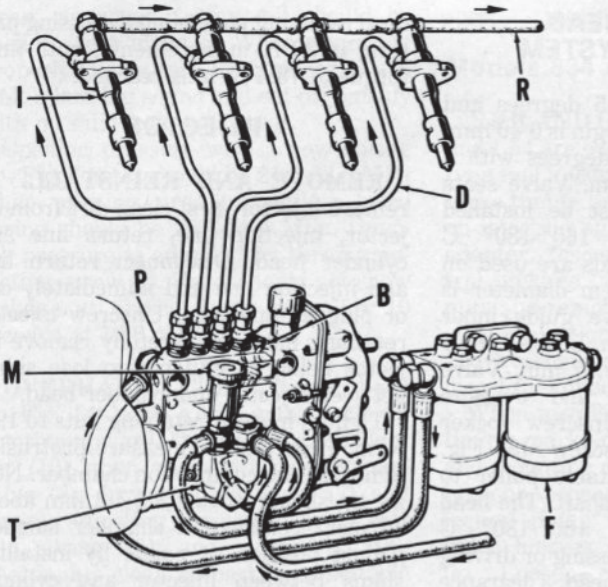


Fig. L3-4 – Fuel circuit diagram for Models 834 and L54.

B. Pump bleed screw
D. High pressure delivery line
F. Fuel filters
I. Injector
M. Primer
R. Fuel return line
T. Fuel transfer pump

INJECTION PUMP TIMING

Models 834 and L54

Injection occurs between 28°30' and 30°. To check injection pump timing on Models 834 and L54, rotate crankshaft so injection timing mark (I – Fig. L3-6 or L3-7) is aligned with reference mark (M). Disconnect number 1 injection line from fuel injection pump. Loosen clamp (C – Fig. L3-8) and remove delivery valve holder (H). Remove spring (S) and delivery valve (D) then reinstall delivery valve holder (H). If available, attach a spill pipe to holder. Loosen injection pump retaining nuts. Operate primer pump (M – Fig. L3-4) and rotate injection pump so fuel flows from delivery valve holder or spill pipe. Rotate injection pump until fuel just stops flowing and tighten injection pump retaining nuts to 29.4 N·m. Reinstall delivery valve and spring and connect injection line.

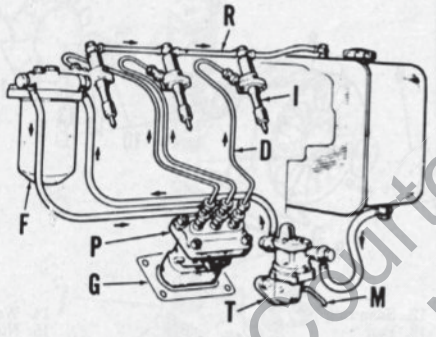


Fig. L3-5 – Fuel circuit diagram for Models 833 and L40. Models 832 and L27 are similar.

D. High pressure delivery line
F. Fuel filter
G. Shim gasket
I. Injector
M. Primer lever
P. Fuel injection pump
R. Fuel return line
T. Fuel pump

All Other Models

Fuel injection occurs between 25° and 26° 5'. Injection timing is adjusted using shim gaskets (G – Fig. L3-5) between pump body and mounting surface on crankcase. To check injection timing, unscrew number 1 cylinder delivery injection line (D) fitting from delivery valve holder (25 – Fig. L3-9). Unscrew delivery valve holder (25) and remove spring (23) and delivery valve (22) and then screw delivery valve holder (25) into pump. Move throttle to full speed position. Rotate engine in normal direction (counter-clockwise at pto) so number 1 piston is on compression stroke. Note fuel in delivery valve holder will spill out of holder. Stop rotation at moment fuel ceases to flow out of holder. Timing marks (I and M – Fig. L3-6 and L3-7) should be aligned. To advance injection timing, remove shim

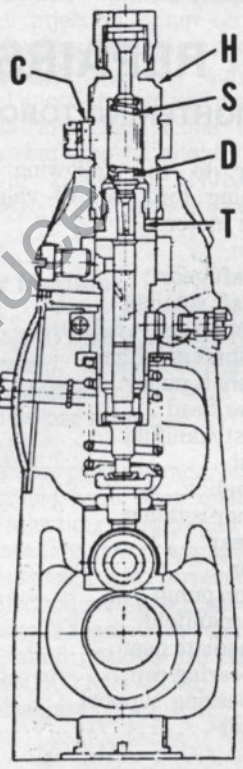


Fig. L3-8 – Cross-sectional view of Bosch PES fuel injection pump.

C. Clamp
D. Delivery valve
H. Delivery valve holder
S. Spring
T. Delivery valve seat

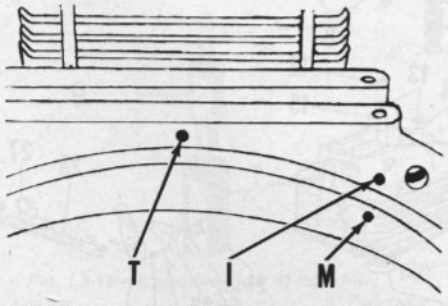


Fig. L3-6 – View of timing marks located on flywheel of some models.

I. Injection
M. Reference mark
T. Top dead center

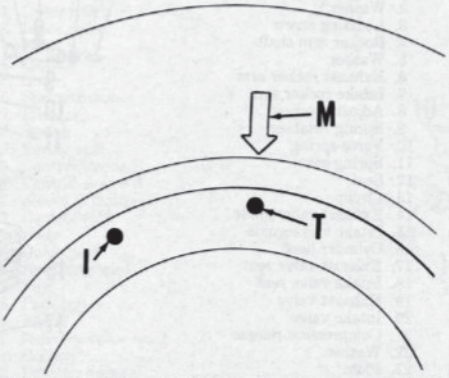


Fig. L3-7 – View of timing marks on crankshaft pulley used on some models.

I. Injection
M. Reference mark
T. Top dead center

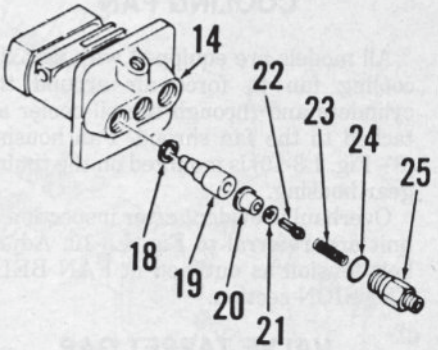


Fig. L3-9 – Partial exploded view of fuel injection pump used on all models except 834 and L54.

14. Pump body
18. Packing
19. Barrel
20. Delivery valve seat
21. Gasket
22. Delivery valve
23. Spring
24. "O" ring
25. Delivery valve holder

gaskets (G–Fig. L3-5); install shim gaskets to retard injection timing. Reinstall removed pump parts after checking timing. Tighten injection pump retaining screws to 29.4 N·m.

FAN BELT TENSION

All models are equipped with a belt-driven, cooling fan. Belt tension is adjusted by varying the number of shims between fan pulley halves. Belt tension is correct when thumb pressure applied midway between pulleys deflects belt approximately 1 cm.

REPAIRS

TIGHTENING TORQUES

Refer to the following table for tightening torques. All values are in newton meters.

Camshaft gear	196
Camshaft retainer	19.6
Connecting rod	49
Crankshaft drive gear	490
Crankshaft pulley	441
Cylinder head	78.4
Exhaust manifold	19.6
Fan nut	34.3
Flywheel	343
Governor retainer	19.6
Idler gear	137
Injector	19.6
Injection pump	29.4
Intake manifold	19.6
Intermediate gear	137.2
Main bearing cap	49
Main bearing support	
Center	49
End	39.2
Oil pan	29.4
Oil pump	34.3
Rocker arm shaft	12.7
Timing gear cover	19.6
Timing gear housing	19.6

COOLING FAN

All models are equipped with an axial cooling fan to force air around the cylinders and through the oil cooler attached to the fan shroud. Fan housing (8–Fig. L3-10) is mounted on the timing gear housing.

Overhaul is evident after inspection of unit and referral to Fig. L3-10. Adjust belt tension as outlined in FAN BELT TENSION section.

VALVE TAPPET GAP

Valve tappet gap may be adjusted after removing rocker arm cover. Valve tappet gap should be 0.3 mm for both valves with the engine cold.

CYLINDER HEAD AND VALVE SYSTEM

Valve face angle is 45 degrees and minimum valve head margin is 0.40 mm. Valve seat angle is 45 degrees with a seat width of 1.4-1.6 mm. Valve seats are renewable and must be installed with head heated to 160°-180° C (320°-356° F). Valve seals are used on intake valves. Valve stem diameter is 8.98-9.00 mm and valve guide inner diameter is 9.03-9.05 mm. Desired valve stem clearance is 0.03-0.07 mm. Valve guides are renewable and oversize guides are available. Unscrew rocker arm shaft locating screw (3–Fig. L3-11), then use a suitable puller to remove the rocker arm shaft. The head should be heated to 160°-180° C (320°-356° F) before pressing or driving rocker arm shaft into head. Clearance between rocker arms and shaft should be 0.03-0.06 mm with a maximum allowable clearance of 0.1 mm.

Valve spring free length should be 54.56 mm. Valve spring pressure should be 412.6-420.4 newtons at a length of 26.3-26.5 mm.

Before tightening cylinder head nuts, install manifolds so heads are properly mated with manifolds. Tighten cylinder head retaining nuts using a crossing pattern, in 20 N·m increments, until final torque of 78.4 N·m is reached.

INJECTOR

REMOVE AND REINSTALL. To remove injector, first clean dirt from injector, injection line, return line and cylinder head. Disconnect return line and injection line and immediately cap or plug all openings. Unscrew injector retaining nuts and carefully remove injector being careful not to lose shims between injector and cylinder head.

Tighten injector retaining nuts to 19.6 N·m. If accessible, measure protrusion of nozzle into combustion chamber. Nozzle tip should extend 3.5-4.2 mm above adjacent combustion chamber surface. Adjust position of nozzle by installing shims between injector and cylinder head. Shims are available in thicknesses of 0.5, 1.0 and 1.5 mm.

TESTING. WARNING: Fuel leaves the injection nozzle with sufficient force to penetrate the skin. When testing, keep yourself clear of nozzle spray.

If a suitable test stand is available, injector operation may be checked. Only

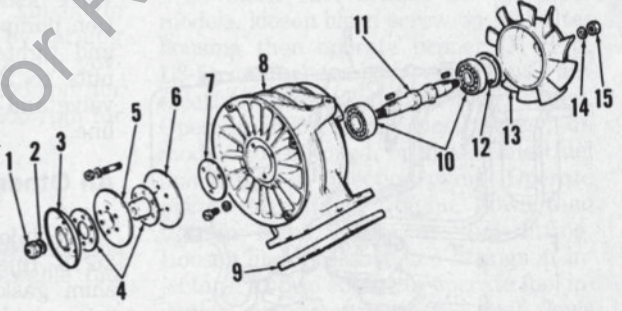


Fig. L3-10—Exploded view of cooling fan. Models 834 and L54 are equipped with two drive belts while one belt is used on all other models.

1. Nut
2. Washer
3. Pulley half
4. Shims
5. Center pulley half
6. Drive pulley half
7. Washer
8. Fan housing
9. Spacer
10. Bearings
11. Shaft
12. Snap ring
13. Fan
14. Washer
15. Nut

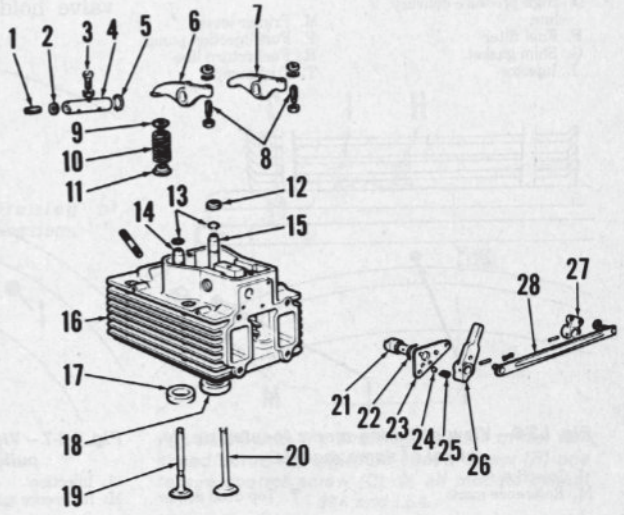


Fig. L3-11—Exploded view of cylinder head assembly.

1. Plug
2. Washer
3. Locating screw
4. Rocker arm shaft
5. Washer
6. Exhaust rocker arm
7. Intake rocker arm
8. Adjuster screw
9. Spring retainer
10. Valve spring
11. Spring seat
12. Seal
13. Circlip
14. Exhaust valve guide
15. Intake valve guide
16. Cylinder head
17. Exhaust valve seat
18. Intake valve seat
19. Exhaust valve
20. Intake valve
21. Compression release
22. Washer
23. Plate
24. Ball
25. Spring
26. Lever
27. Arm
28. Link

clean, approved testing oil should be used to test injector. When operating properly during test, injector nozzle will emit a buzzing sound and cut off quickly with no fluid leakage at seat.

Opening pressure with a new spring (5–Fig. L3-12) should be 21.6-22.5 MPa while opening pressure with a used spring should be 20.6-21.6 MPa. Opening pressure is adjusted by turning adjusting screw (2). Valve should not show leakage at orifice spray holes for 10 seconds at 17.6 MPa.

OVERHAUL. Clamp nozzle body (7–Fig. L3-12) in a vise with nozzle tip pointing upward. Unscrew nozzle holder nut (10), then remove nozzle (9) and valve (8). Invert nozzle body (7) and remove adjusting screw (2), spring seat (4), spring (5) and push rod (6). Thoroughly clean all parts in a suitable solvent. Clean inside orifice end of nozzle with a wooden cleaning stick. The orifice spray holes may be cleaned by inserting a 0.20 mm cleaning wire. When reassembling injector, make certain all components are clean and wet with clean diesel fuel oil. Tighten nozzle holder nut (10) to 49 N·m.

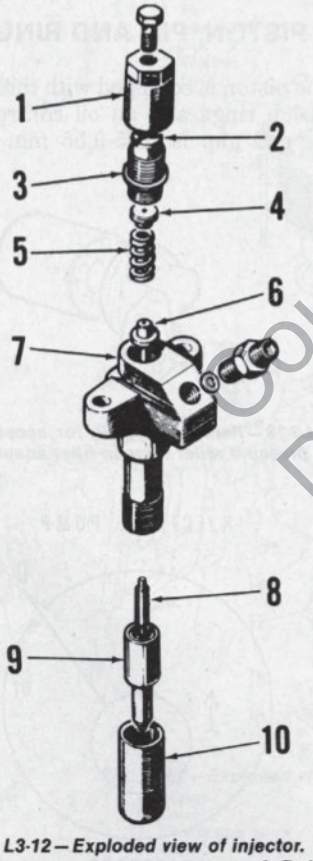


Fig. L3-12—Exploded view of injector.

1. Cap nut
2. Adjusting screw
3. Gasket
4. Spring seat
5. Spring
6. Push rod
7. Body
8. Valve
9. Nozzle
10. Nozzle nut

INJECTION PUMP

Models 834 And L54

R&R AND OVERHAUL. Models 834 and L54 are equipped with a Bosch PES type fuel injection pump. If not present, make timing marks for future reference on injection pump flange and mounting adapter. Disconnect fuel lines and control linkage, then unscrew retaining nuts and remove fuel injection pump.

The injection pump should be tested and overhauled by a shop qualified in diesel fuel injection pump repair.

When installing injection pump, align timing marks on injection pump flange and mounting adapter. If marks are not present, proceed as follows: Mount injection pump in a vise with delivery valve holders (H–Fig. L3-8) pointing up. Loosen clamp (C) and remove delivery valve holder (H) for number 1 cylinder (farthest from mounting flange). Remove spring (S) and delivery valve (D) then reinstall delivery valve holder (H). If available, attach a spill pipe to holder. Connect an external fuel supply to injection pump fuel inlet so pump is gravity fed with fuel. Turn injection pump shaft in a counter-clockwise direction, as viewed at shaft end. Then, stop shaft rotation at moment fuel stops flowing from delivery valve holder or spill pipe. Remove plug (P–Fig. L3-12A) and install a suitable screw that will bear lightly against pump shaft to prevent shaft rotation. If available, Mercedes tool number 700-589-86-73 may be used. Rotate engine crankshaft so injection timing mark (I–Fig. L3-6 or L3-7) is aligned with reference mark (M). Install injection pump on engine and tighten pump retaining nuts to 29.4 N·m. Reinstall delivery valve and spring, fuel injection lines and drain plug (P–Fig. L3-12A). If crankshaft or injection pump shaft moved slightly during installation, refer to INJECTION PUMP TIMING and recheck pump timing.

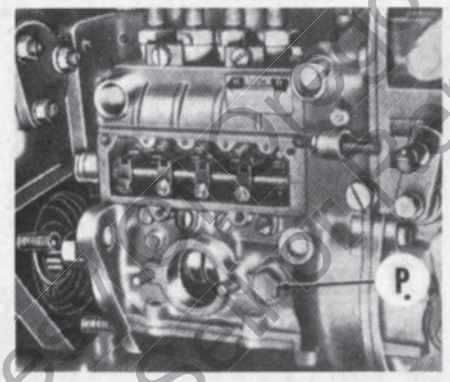


Fig. L3-12A—View of Bosch injection pump used on Models 834 and L54 showing location of drain plug (P).

All Other Models

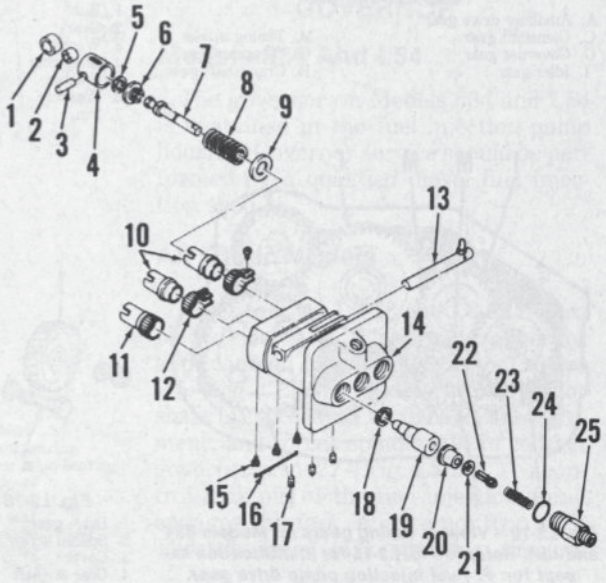
R&R AND OVERHAUL. To remove injection pump, disconnect fuel lines, unscrew retaining screws and remove pump. Do not lose shim gaskets (G–Fig. L3-5).

The injection pump should be tested and overhauled by a shop qualified in diesel fuel injection pump repair.

When installing pump, engage pin on pump control rack with governor fork. Tighten injection pump screws to 29.4 N·m. If pump is renewed or overhauled, or original shim gaskets are not used, refer to INJECTION PUMP TIMING section and adjust pump timing.

Fig. L3-13—Exploded view of fuel injection pump used on Models 833 and L40. Models 832 and L27 are similar.

1. Outer roller
2. Inner roller
3. Pin
4. Guide
5. Shim
6. Spring retainer
7. Plunger
8. Spring
9. Spring seat
10. Control sleeve B
11. Control sleeve A
12. Sleeve B pinion
13. Control rack
14. Body
15. Guide pins
16. Retaining wire
17. Pins
18. Packing
19. Barrel
20. Delivery valve seat
21. Gasket
22. Delivery valve
23. Spring
24. "O" ring
25. Delivery valve holder



TIMING GEARS

To remove timing gear cover, remove fan belt guard, fan belt and crankshaft pulley. Unscrew and remove timing gear cover. Gears may be removed after unscrewing retaining nut or screw and by using a suitable puller. Refer to Fig. L3-15 or L3-16 for view of timing gears.

To remove the fuel injection pump drive gear (2 – Fig. L3-17) on Models 834 and L54, the fuel injection pump must be removed as previously outlined. Detach snap ring (4) and remove gear and hub. Unscrew gear retaining screws and separate the gear from the hub. Bushings (10) in adapter (9) are renewable.

Timing marks on crankshaft, idler and camshaft gears must be aligned as shown in Fig. L3-15 and L3-16. If timing gears do not have marks, proceed as follows: If not previously removed, remove cylinder head and push rod tubes on number 1 cylinder. Install crankshaft and camshaft gears, but do not install idler gear. Rotate crankshaft so number 1 piston is at top dead center. Rotate camshaft so number 1 cylinder intake valve tappet is opening (rising) and exhaust valve tappet is closing (going down) then stop rotation when tappets are at same height above crankcase surface. Install idler gear and mark crankshaft, idler and camshaft gears for future reference.

Tighten timing gear cover screws to 19.6 N·m. Adjust fan belt tension as outlined in FAN BELT TENSION section.

OIL PUMP

R&R AND OVERHAUL. The oil pump is mounted on the front of the engine and is accessible after removing the timing gear cover. Unscrew pump gear retaining nut then using a suitable puller, remove pump gear (1 – Fig. L3-18). Remove pump cover (3) and gears. Pump housing (6) surrounds the crankshaft and the crankshaft gear must be removed before pump housing can be removed. Note that screw (2) is drilled to allow oil flow through screw.

Oil clearance between oil pump housing and crankshaft should be 0.04-0.08 mm. Renew pump housing if clearance exceeds 0.13 mm. Maximum allowable backlash between gears is 0.15 mm. Maximum allowable clearance between gears and pump housing bore is 0.15 mm.

Assembly is reverse of disassembly procedure.

Normal oil pressure with engine running at 3000 rpm and oil hot is 303.8-352.8 kPa. Oil pressure is adjusted by removing plug (P – Fig. L3-19) and turning adjusting screw.

PISTON AND ROD UNITS

REMOVE AND REINSTALL. Piston and connecting rod may be removed after removing cylinder head and oil pan.

When installing piston and rod, note that depression (D – Fig. L3-20) in piston crown is closer to one side of piston. Install piston so depression side of piston is nearer injectors. Some pistons also have an arrow embossed on piston. Properly installed, arrow on piston crown will point towards injection pump.

Tighten connecting rod screws to 49 N·m. Refer to CYLINDER section and measure piston height in cylinder.

PISTON, PIN AND RINGS

The piston is equipped with three compression rings and an oil control ring. Ring end gap is 0.35-0.55 mm for all

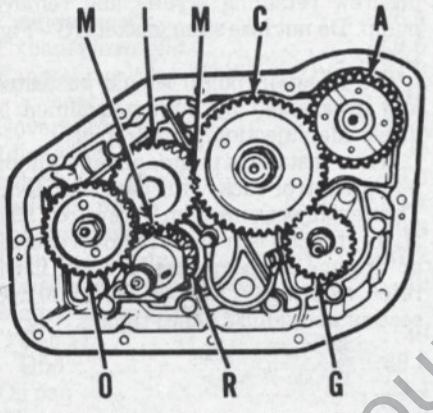


Fig. L3-15 – View of timing gears on Models 832, 833, L27 and L40.

A. Auxiliary drive gear
C. Camshaft gear
G. Governor gear
I. Idler gear
M. Timing marks
O. Oil pump gear
R. Crankshaft gear

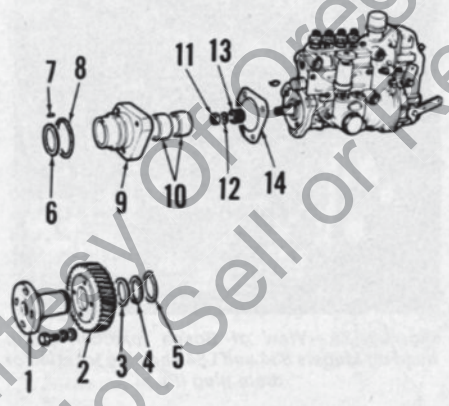


Fig. L3-17 – Exploded view of fuel injection pump drive assembly on Models 834 and L54.

1. Hub
2. Gear
3. Washer
4. Snap ring
5. Washer
6. Washer
7. Pin
8. "O" ring
9. Adapter
10. Bushings
11. Nut
12. Washer
13. Gear
14. Gasket

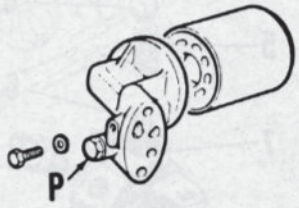


Fig. L3-19 – Remove plug (P) for access to oil pressure relief valve in filter adapter.

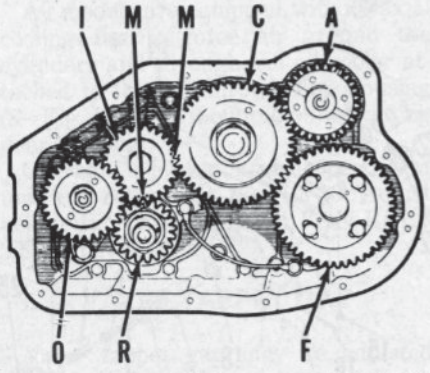


Fig. L3-16 – View of timing gears on Models 834 and L54. Refer to Fig. L3-15 for identification except for: F. Fuel injection pump drive gear.

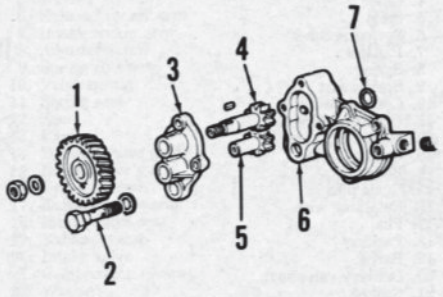


Fig. L3-18 – Exploded view of oil pump.

1. Drive gear
2. Special screw
3. Cover
4. Gear & shaft
5. Gear
6. Pump body
7. "O" ring

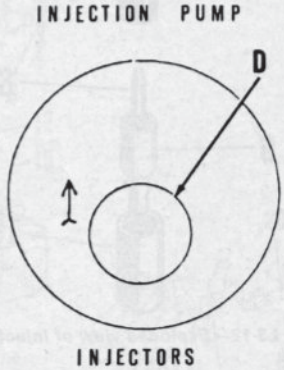


Fig. L3-20 – Arrow on piston crown should point towards injection pump and depression (D) should be near injectors.

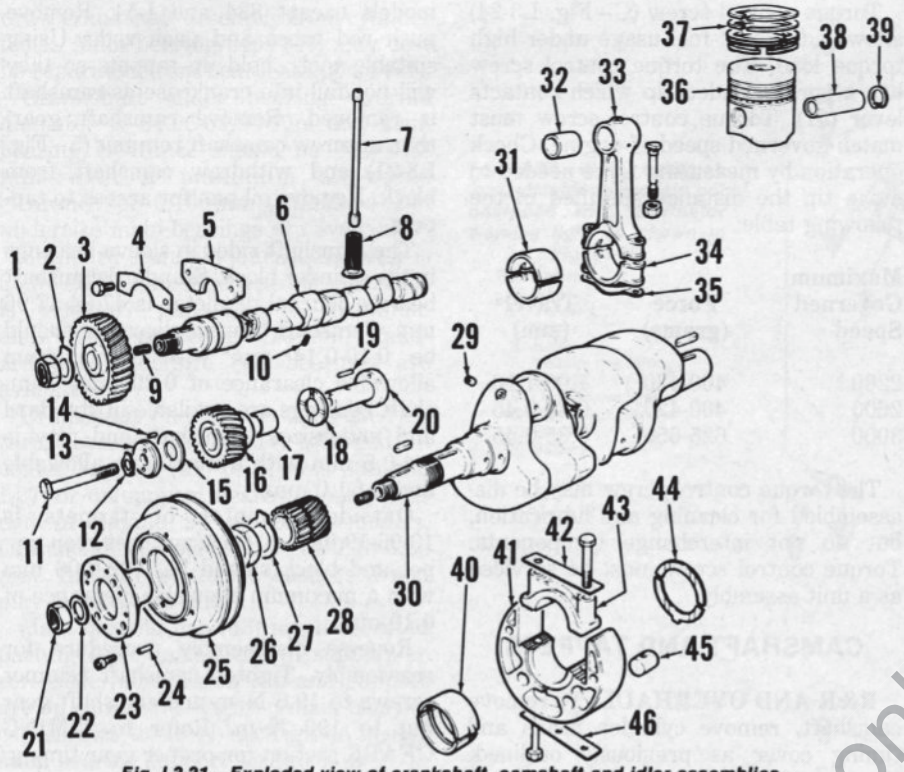


Fig. L3-21—Exploded view of crankshaft, camshaft and idler assemblies.

1. Nut
2. Tab washer
3. Camshaft gear
4. Lockplate
5. Retainer
6. Camshaft
7. Push rod
8. Tappet
9. Plug
10. Plug
11. Screw
12. Tab washer
13. Spacer
14. Pin
15. Washer
16. Idler gear
17. Bushing
18. Thrust washer
19. Pin
20. Idler shaft
21. Nut
22. Washer
23. Hub
24. Pin
25. Pulley
26. Nut
27. Tab washer
28. Gear
29. Plug
30. Crankshaft
31. Bearing
32. Bushing
33. Connecting rod
34. Rod cap
35. Lockplate
36. Piston
37. Piston rings
38. Piston pin
39. Snap ring
40. Bearing
41. Main bearing support
42. Lockplate
43. Main bearing cap
44. Thrust washer
45. Nut
46. Lockplate

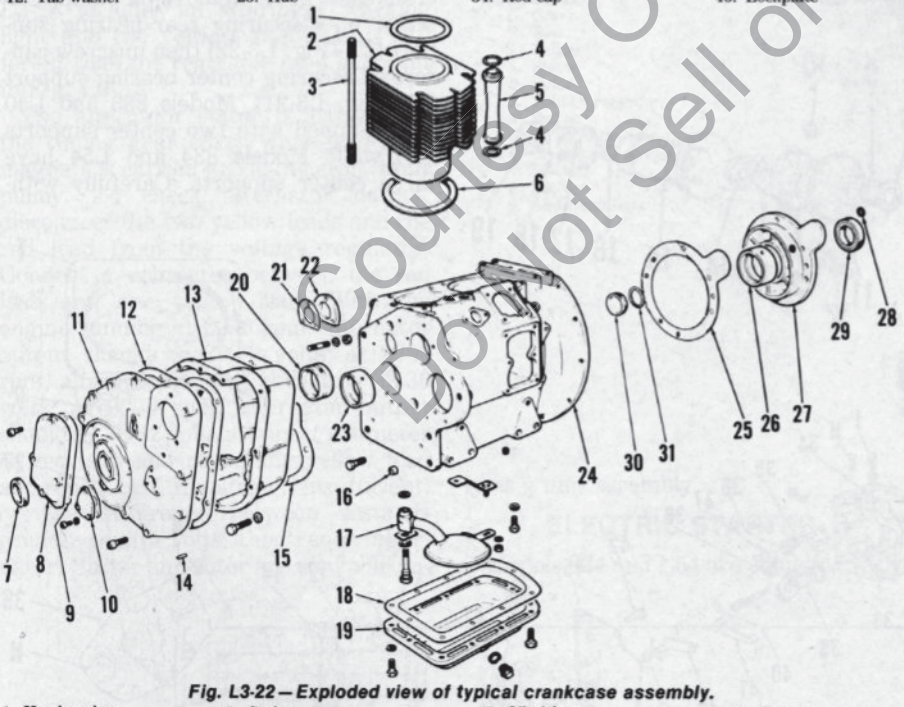


Fig. L3-22—Exploded view of typical crankcase assembly.

1. Head gasket
2. Cylinder
3. Stud
4. Seal
5. Push rod tube
6. Shim gasket
7. Seal
8. Cover
9. Gasket
10. Cover
11. Timing gear cover
12. Gasket
13. Gear housing
14. Pin
15. Gasket
16. Dowel
17. Oil pickup
18. Gasket
19. Oil pan
20. Camshaft bearing
21. Gasket
22. Cover
23. Main bearing
24. Crankcase
25. Gasket
26. Main bearing
27. Rear main bearing support
28. "O" ring
29. Oil seal
30. Camshaft cover
31. "O" ring

compression rings and 0.25-0.40 mm for the oil control ring. Piston ring side clearance should be 0.30 mm for top compression ring, 0.20 mm for second compression ring, 0.15 mm for third compression ring and 0.10 mm for oil control ring.

Standard piston diameter measured 2 mm from bottom of skirt, perpendicular to piston pin, is 99.800-99.810 mm. Piston to cylinder clearance should be 0.19-0.22 mm. Piston and rings are available in standard size and oversizes of 0.5 and 1.0 mm.

Clearance between piston pin and connecting rod should be 0.02-0.03 mm. Maximum allowable clearance is 0.07 mm.

CONNECTING ROD

The connecting rod small end is fitted with a renewable bushing. Clearance between piston pin and rod bushing should be 0.02-0.03 mm with a maximum allowable clearance of 0.07 mm.

An insert type bearing is used in connecting rod big end. Desired rod bearing clearance is 0.04-0.07 mm with a maximum allowable clearance of 0.10 mm. Big end bearings are available in standard and undersizes.

CYLINDERS

All models are equipped with removable cylinders. Standard cylinder diameter is 100.00-100.02 mm. Cylinders may be bored to accept oversize pistons. Maximum allowable taper or out-of-round is 0.1 mm.

Piston height in cylinder is adjusted using shim gaskets (6—Fig. L3-22). With piston at top dead center, piston crown should be 0.0-0.1 mm below top of cylinder. Install shims (6) to obtain desired piston height.

GOVERNOR

Models 834 And L54

The governor on Models 834 and L54 is contained in the fuel injection pump housing. Governor service should be performed by a qualified diesel fuel injection shop.

All Other Models

Refer to Figs. L3-23 and L3-24 for exploded views of flyball type governor and control linkage. Governor sleeve (15—Fig. L3-23) slides on governor shaft (4) according to flyball (10) movement, and forces spindle (19) to contact governor arm (27—Fig. L3-24). The control rack pin of the fuel injection pump engages the fork in governor arm (27). Throttle lever (47) operates through

governor spring (31) to control engine speed.

The governor shaft assembly (Fig. L3-23) may be removed after removing timing gear cover. Unscrew retainer (6) screws and withdraw governor shaft. Inspect components for excessive wear or damage. Components must move easily without binding. When installing governor shaft, tighten retainer (6) screws to 19.6 N·m.

To synchronize governor linkage with fuel injection pump, remove cover (45–Fig. L3-24) and loosen nuts (N–Fig. L3-25) securing eccentric (39). Fully rotate eccentric in counter-clockwise direction. With fuel injection pump removed, install tool (T) number 7276-2003-04 on Model 832 or number 7277-2003-05 on Model 833 so tool roller (R) engages fork on governor arm (27). Rotate eccentric (39) until all play is removed from governor but tool roller (R) is still free in fork. Tighten nuts (N), remove tool and install fuel injection pump.

Start spring (25–Fig. L3-24) allows maximum fuel delivery when starting engine. Spring free length should be 42 mm.

Torque control screw (C–Fig. L3-24) allows additional fuel usage under high torque load. The torque control screw has a spring loaded tip which contacts lever (41). Torque control screw must match governed speed of engine. Check operation by measuring force needed to move tip the distance specified in the following table:

Maximum Governed Speed	Force (grams)	Travel (mm)
2200	400-420	1.00-1.10
2600	400-420	0.35-0.45
3000	625-650	0.35-0.45

The torque control screw may be disassembled for cleaning and lubrication, but do not interchange components. Torque control screw must be serviced as a unit assembly.

CAMSHAFT AND TAPPETS

R&R AND OVERHAUL. To remove camshaft, remove cylinder heads and timing cover as previously outlined. Remove fuel injection pump on all models except 834 and L54. Remove push rod tubes and push rods. Using suitable tools, hold up tappets so they will not fall into crankcase as camshaft is removed. Remove camshaft gear, then unscrew camshaft retainer (5–Fig. L3-21) and withdraw camshaft from block. Remove oil pan for access to tappets.

The camshaft rides in sleeve bearings in the cylinder block. Standard camshaft bearing journal diameter is 47.94-47.96 mm. Camshaft bearing clearance should be 0.10-0.14 mm with a maximum allowable clearance of 0.20 mm. Camshaft bearings are available in standard and undersizes. Camshaft end play is 0.4-0.6 mm with a maximum allowable limit of 1.0 mm.

Outside diameter of tappets is 19.96-19.98 mm. Clearance between tappet and block should be 0.02-0.06 mm with a maximum allowable clearance of 0.10 mm.

Reverse disassembly procedure for reassembly. Tighten camshaft retainer screws to 19.6 N·m and camshaft gear nut to 196 N·m. Refer to TIMING GEARS section for proper gear timing.

CRANKSHAFT AND BEARINGS

R&R AND OVERHAUL. To remove crankshaft, remove pistons and timing gear cover as previously outlined. Remove idler gear, oil pump gear and crankshaft gear. Remove oil pump. Unscrew nuts securing rear bearing support (27–Fig. L3-22) then unscrew capscrews securing center bearing support (41–Fig. L3-21). Models 833 and L40 are equipped with two center supports (41) while Models 834 and L54 have three center supports. Carefully with-

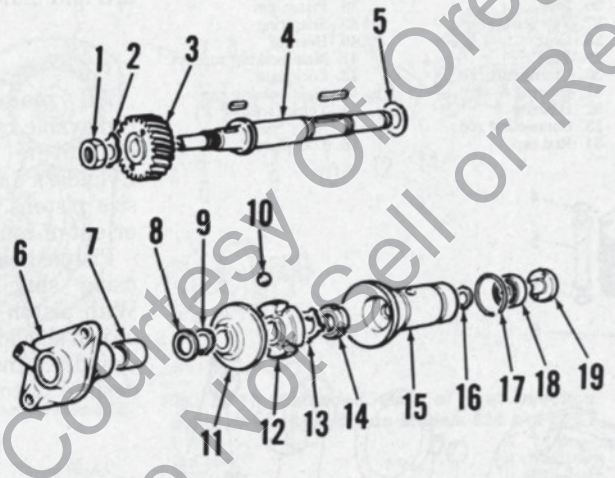


Fig. L3-23–Exploded view of governor shaft.

1. Nut
2. Tab washer
3. Governor gear
4. Shaft
5. Washer
6. Retainer
7. Bushing
8. Washer
9. Snap ring
10. Balls (4)
11. Ball retainer
12. Ball carrier
13. Tab washer
14. Nut
15. Governor sleeve
16. Snap ring
17. Circlip
18. Bearing
19. Spindle

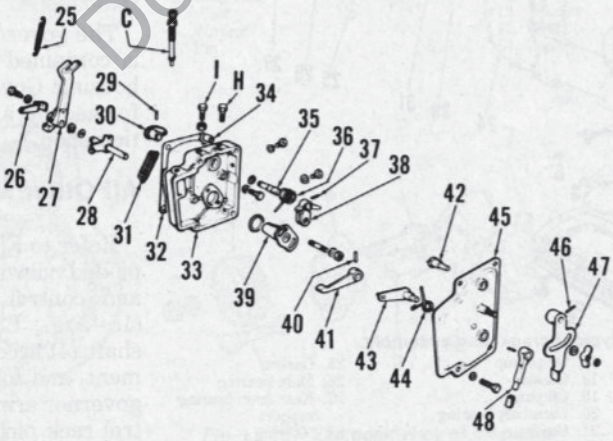


Fig. L3-24–Exploded view of governor and throttle linkage.

C. Torque control screw
H. High idle speed screw
I. Low idle speed screw
25. Start spring
26. Lever
27. Arm
28. Spindle
29. Pin
30. Lever
31. Governor spring
32. Gasket
33. Control housing
34. Dowel
35. Shaft
36. Spring
37. Pin
38. Arm
39. Eccentric
40. Pin
41. Lever
42. Shaft
43. Lever
44. Spring
45. Cover
46. Pin
47. Throttle lever
48. Stop lever

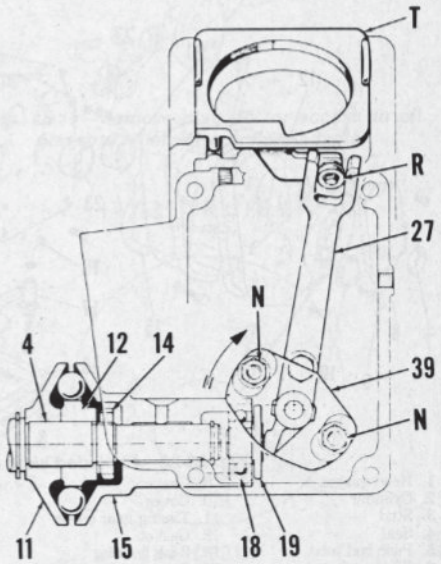


Fig. L3-25–View of governor linkage. Refer to text and Fig. L3-24.

draw crankshaft assembly from cylinder block. Main bearing caps (43) may now be separated from bearing support (41).

Crankshaft main bearing journal diameter is 64.96-64.98 mm and main bearing clearance should be 0.05-0.08 mm with a maximum allowable clearance of 0.10 mm. Standard and undersize main bearings are available.

Standard crankpin journal diameter is 55.34-55.35 mm. Rod bearing clearance is 0.04-0.07 mm with a maximum allowable clearance of 0.10 mm. Standard and undersize rod bearings are available.

Crankshaft end play is controlled by thrust washer halves (44) mounted on center support (41) of Models 832 and L27, or on support nearest timing gear end of engine on all other models. Crankshaft end play should be 0.15-0.25 mm. Install new thrust washers if end play exceeds 0.5 mm.

Main bearing cap (43) has a serrated parting face. Install cap in support so reference numbers on cap and support are on same side. Tighten main bearing cap screws to 49 N·m. Tighten center main bearing support screws to 49 N·m and nuts securing rear main bearing support (27–Fig. L3-22) to 39.2 N·m.

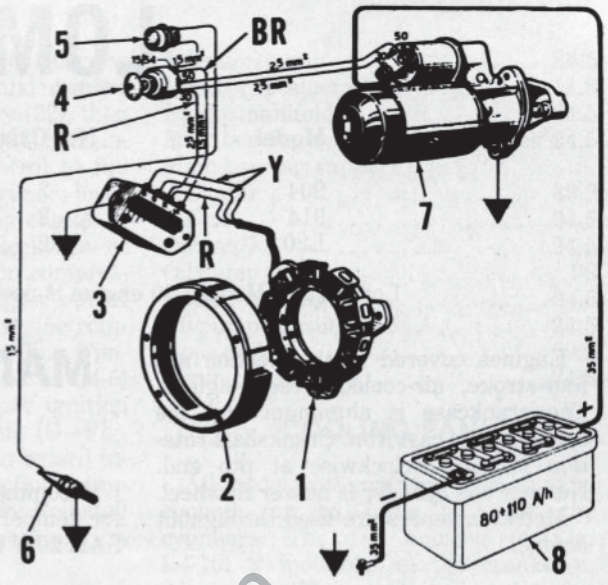


Fig. L3-27—Wiring schematic applicable to models not equipped with alternator warning light as shown in Fig. L3-28.

BR. Brown
R. Red
Y. Yellow
1. Stator
2. Rotor
3. Voltage regulator
4. Switch
5. Oil pressure light
6. Oil pressure sender
7. Starter
8. Battery

ALTERNATOR AND VOLTAGE REGULATOR

Refer to Fig. L3-27 or L3-28 for wiring schematic. Note that circuit in Fig. L3-28 includes an alternator warning light and the voltage regulator is different than the regulator used in circuit in Fig. L3-27.

The alternator stator is attached to the timing gear cover while a ring of magnets is carried inside the crankshaft pulley. To check alternator output, disconnect the two yellow leads and the red lead from the voltage regulator. Connect a voltmeter between the red lead and one yellow lead. With the engine running at 2200 rpm, alternator output should be 28-30 volts; at 2600 rpm, alternator output should be 32-36 volts; at 3000 rpm, alternator output should be 38-42 volts. Connect voltmeter to red lead and remaining yellow lead and repeat test. If voltage is insufficient, or the difference between tests is greater than 5 volts, then renew alternator. Stator and rotor are available only as a unit assembly.

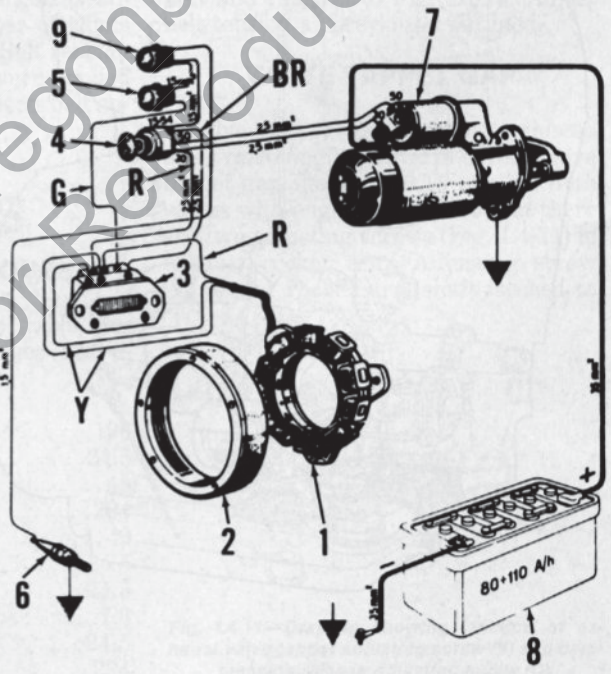


Fig. L3-28—Wiring schematic of models equipped with an alternator warning light.

BR. Brown
G. Green
R. Red
Y. Yellow
1. Stator
2. Rotor
3. Voltage regulator
4. Switch
5. Oil pressure light
6. Oil pressure sender
7. Starter
8. Battery
9. Alternator light

ELECTRIC STARTER

Models 834 and L54 are equipped with a Bosch JD 12V-4PS electric starter. All other models may be equipped with either a Bosch JD 12V-1.8PS or Femsa MTL 12-6 electric starter.

LOMBARDINI

Model	No. Cyls.	Bore	Stroke	Displ.
904	2	90 mm	94 mm	1196 cc
914	2	95 mm	94 mm	1332 cc
L20	2	95 mm	94 mm	1332 cc

Lombardini Model L20 engine is used on Homelite® Model GD7200-1 and GD7400-2 Generators.

Engines covered in this section are four-stroke, air-cooled diesel engines. The crankcase is aluminum and the cylinders are cast iron. Crankshaft rotation is counterclockwise at pto end. Number one cylinder is nearer flywheel.

Metric fasteners are used throughout engine.

MAINTENANCE

LUBRICATION

Recommended engine oil is SAE 10W for temperatures below 0° C (32° F), SAE 20W for temperatures between 0° C (32° F) and 20° C (68° F), and SAE 40 for temperatures above 20° C (68° F). API classification for oil should be CD. Oil sump capacity is 2.8 liters. Manufacturer recommends renewing oil after every 100 hours of operation.

A renewable oil filter is mounted on side of engine crankcase. Manufacturer recommends renewing filter after every 400 hours of operation.

All models are equipped with a pressurized oil system. Refer to Fig. L4-1 for a diagram of the oil circuit.

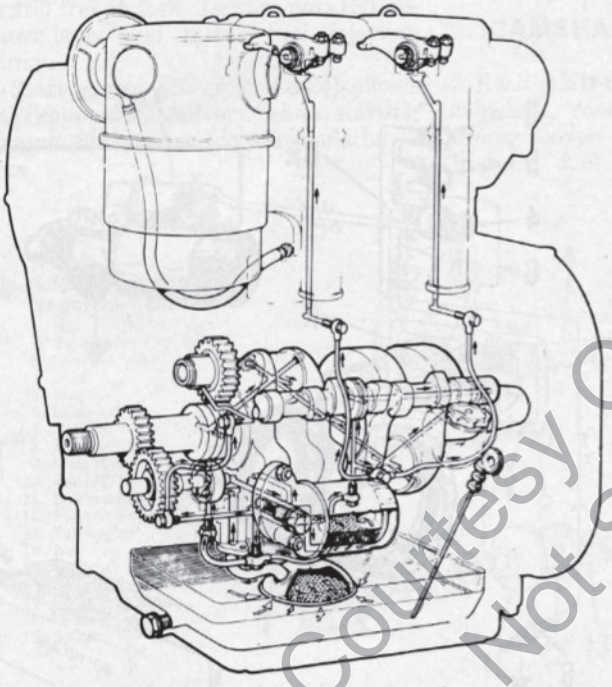


Fig. L4-1—Drawing of lubrication system.

ENGINE SPEED ADJUSTMENT

Idle speed is adjusted by turning idle speed screw (I—Fig. L4-2). Idle speed should be 900-950 rpm. Maximum governed speed is adjusted by turning high speed screw (H). Maximum governed speed under load is 3000 rpm for Models 904 and 914 and 2200 rpm for Model L20.

FUEL SYSTEM

FUEL FILTER. A renewable fuel filter is located in the fuel tank. Renew filter after every 300 hours of operation or sooner if required.

BLEED FUEL SYSTEM. To bleed fuel system, remove fuel injection pump bleed screw (B—Fig. L4-3), then operate fuel pump primer lever (P) until air-free

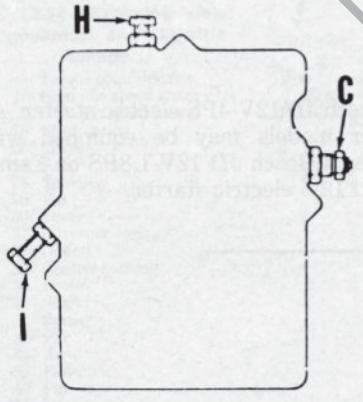


Fig. L4-2—Drawing showing location of low idle speed screw (I), high idle speed screw (H) and torque control screw (C).

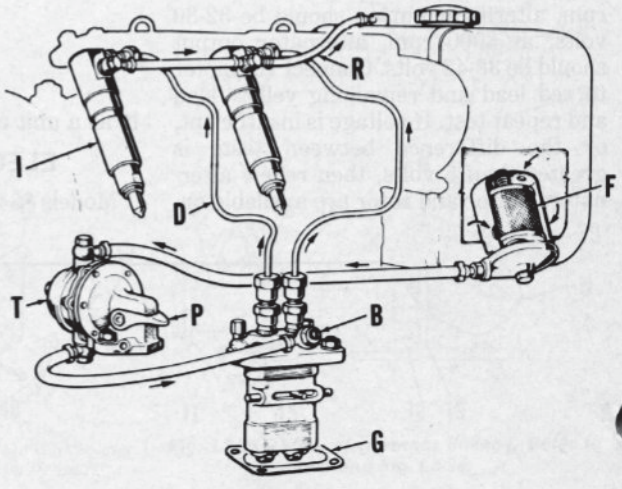


Fig. L4-3—Fuel circuit diagram.
B. Pump bleed screw
D. High pressure delivery line
F. Fuel filter
G. Shim gasket
I. Injector
P. Primer lever
R. Fuel return line
T. Fuel transfer pump

fuel flows from injection pump. Reinstall bleed screw (B). Loosen high pressure injection lines at injectors, then rotate engine crankshaft to operate fuel injection pump until air-free fuel flows from injection lines. Retighten injection lines.

INJECTION PUMP TIMING

Injection pump timing is adjusted using shim gaskets (G – Fig. L4-3) between pump body and mounting surface on crankcase. Injection should occur at 26° 45' – 28° 30' before top dead center. To check injection pump timing, unscrew high pressure injection line of number 1 cylinder from injection pump delivery valve holder (25 – Fig. L4-4). Unscrew delivery valve holder (25) and remove spring (23) and delivery valve (22), then screw delivery valve holder (25) back into pump. Move throttle control to full speed position. Operate primer lever (P – Fig. L4-3) while rotating engine in normal direction (counterclockwise at pto) so number 1 piston is on compression stroke. Note fuel will flow out of delivery valve holder. Stop engine rotation at moment fuel ceases to flow. Timing marks (I and M – Fig. L4-5 or L4-6) should be aligned. To advance ignition timing, remove shim gaskets (G – Fig. L4-3); install shim gaskets to retard injection timing. Tighten injection pump retaining screws to 24.5 N·m. Reinstall removed pump parts after checking timing.

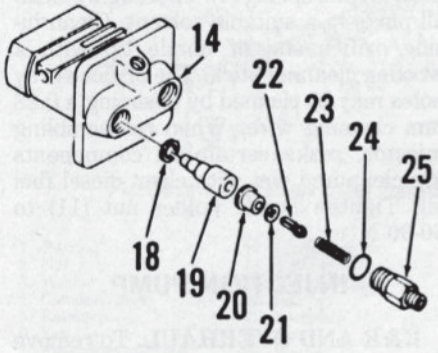


Fig. L4-4 – Partial exploded view of fuel injection pump.

14. Pump body
18. Packing
19. Barrel
20. Delivery valve seat
21. Gasket
22. Delivery valve
23. Spring
24. "O" ring
25. Delivery valve holder

Fig. L4-5 – Drawing of flywheel timing marks used on some models.

I. Injection
M. Reference mark
T. Top dead center

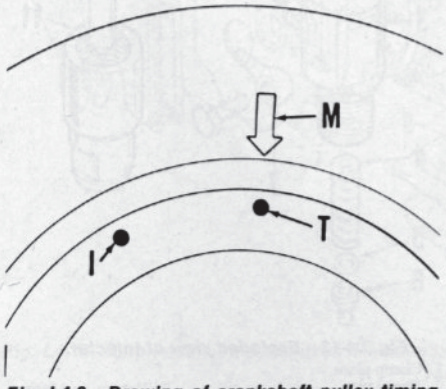


Fig. L4-6 – Drawing of crankshaft pulley timing marks used on some models.

I. Injection
M. Reference mark
T. Top dead center

FAN BELT TENSION

All models are equipped with a belt-driven cooling fan. Belt tension is adjusted by varying the number of shims between fan pulley halves. Belt tension is correct when thumb pressure applied midway between pulleys deflects belt approximately 1 cm.

REPAIRS

TIGHTENING TORQUES

Refer to the following table for tightening torques. All values are in newton meters.

Camshaft gear	196
Camshaft retainer	24.5
Connecting rod	49
Crankshaft pulley	294
Cylinder head	49
Exhaust manifold	24.5
Fan nut	24.5
Fan pulley	7.8
Fan pulley hub	24.5
Flywheel	294
Injection pump	24.5
Injector retainer plate	11.8
Intake manifold	24.5
Main bearing center support halves	24.5
Main bearing support	
Center	39.2
End	24.5
Oil pan	24.5
Oil pump gear	98
Rocker arm stand	24.5
Oil pump housing	24.5
Rope pulley	39.2
Timing gear cover	24.5

COOLING FAN

All models are equipped with an axial cooling fan to force air past the cylinders. The fan housing (4 – Fig. L4-10) is mounted on the crankcase. Alternator (7) is contained in the fan housing with the alternator rotor mounted on shaft (6).

Overhaul is evident after inspection of unit and referral to Fig. L4-10. Adjust belt tension as previously outlined.

VALVE TAPPET GAP

Valve tappet gap may be adjusted after removing rocker arm cover. Valve tappet gap should be 0.15 mm for both valves with engine cold. Note that there are two adjusting screws (Fig. L4-11) in exhaust rocker arm. Adjusting screw (V) nearer rocker arm shaft is used to

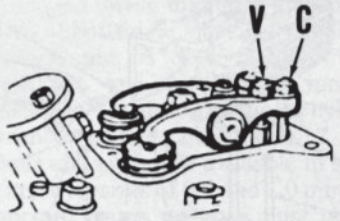


Fig. L4-11 – Drawing showing location of exhaust valve tappet adjusting screw (V) and compression release adjusting screw (C).

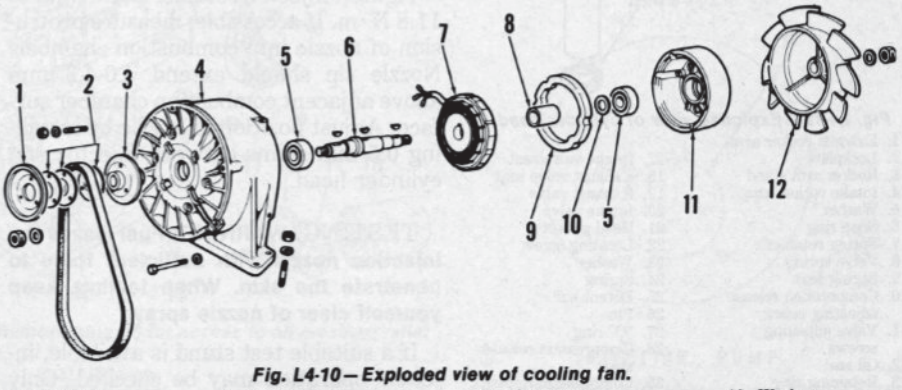


Fig. L4-10 – Exploded view of cooling fan.

1. Pulley half
2. Shims
3. Pulley hub
4. Fan housing
5. Bearing
6. Shaft
7. Alternator
8. Spacer
9. Spacer
10. Washer
11. Alternator housing
12. Fan

adjust valve clearance while outer screw (C) adjusts compression release gap.

COMPRESSION RELEASE

A manual compression release is located on each cylinder head so the exhaust valve can be held open to aid starting. Rotating shaft (28–Fig. L4-12) forces the exhaust rocker arm to slightly open the exhaust valve.

The compression release is adjusted by turning outer adjusting screw (C–Fig. L4-11) in exhaust valve rocker arm. Adjust compression release gap AFTER adjusting exhaust valve tappet gap. With compression release lever in off position, clearance between adjusting screw and shaft should be 0.9-1.1 mm.

Diameter of compression release shaft (28–Fig. L4-12) is 11.95-11.97 mm while lobe height is 10.4-10.5 mm.

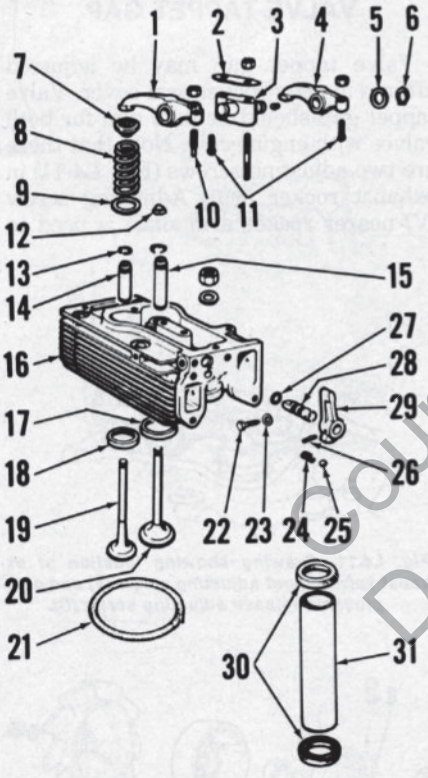


Fig. L4-12–Exploded view of cylinder head.

1. Exhaust rocker arm
2. Lockplate
3. Rocker arm stand
4. Intake rocker arm
5. Washer
6. Snap ring
7. Spring retainer
8. Valve spring
9. Spring seat
10. Compression release adjusting screw
11. Valve adjusting screws
12. Oil seal
13. Retaining ring
14. Exhaust valve guide
15. Intake valve guide
16. Cylinder head
17. Intake valve seat
18. Exhaust valve seat
19. Exhaust valve
20. Intake valve
21. Head gasket
22. Locating screw
23. Washer
24. Spring
25. Detent ball
26. Pin
27. "O" ring
28. Compression release shaft
29. Compression release lever
30. Seals
31. Push rod tube

CYLINDER HEAD AND VALVE SYSTEM

Do not remove cylinder head while hot as head may deform.

Valve face angle is 45 degrees and minimum valve head margin is 0.4 mm. Valve seat angle is 45 degrees with a seat width of 1.4-1.6 mm. Valve seats are renewable and must be installed with head heated to 160°-180° C (320°-356° F). Valve seals are used on intake valves. Valve stem diameter is 7.98-8.00 mm while valve guide diameter is 8.03-8.05 mm. Desired valve stem clearance is 0.03-0.07 mm. Valve guides are renewable and oversize valve guides are available. Note locating ring (13–Fig. L4-12) around top of each valve guide. Outside of oversize valve guide must be machined so outer diameter is 0.05-0.06 mm greater than hole in head. The cylinder head should be heated to 160°-180° C (320°-356° F) when installing valve guide.

Desired clearance between rocker arms and shafts is 0.03-0.06 mm. Maximum clearance is 0.1 mm.

Before tightening cylinder head nuts, install exhaust manifold, then tighten cylinder head nuts to 49 N·m.

When installing cylinder head, be sure oil tubes to head are properly connected as shown in Fig. L4-1. Before tightening cylinder head nuts, install exhaust and intake manifolds to correctly position head, then tighten cylinder head nuts to 49 N·m.

INJECTOR

REMOVE AND REINSTALL. To remove injector, first clean dirt from injector, injection line, return line and cylinder head. Disconnect return line and injection line and immediately cap or plug all openings. Unscrew retainer plate (1–Fig. L4-13) being careful not to lose dowel pin (2). Injector may now be carefully removed from cylinder head. Do not lose shims between injector and cylinder head.

Tighten injector retainer plate nuts to 11.8 N·m. If accessible, measure protrusion of nozzle into combustion chamber. Nozzle tip should extend 4.0-4.5 mm above adjacent combustion chamber surface. Adjust position of nozzle by installing 0.5 mm shims between injector and cylinder head.

TESTING. WARNING: Fuel leaves the injection nozzle with sufficient force to penetrate the skin. When testing, keep yourself clear of nozzle spray.

If a suitable test stand is available, injector operation may be checked. Only clean, approved testing oil should be used to test injector. When operating properly during test, injector nozzle will emit a buzzing sound and cut off quickly with no fluid leakage at seat.

Opening pressure with a new spring (4–Fig. L4-13) should be 21.6-22.5 MPa while opening pressure with a used spring should be 20.6-21.6 MPa. Opening pressure is adjusted by varying number and thickness of shims (5). Valve should not show leakage at orifice spray holes for 10 seconds at 19.1 MPa.

OVERHAUL. Clamp nozzle body (3–Fig. L4-13) in a vise with nozzle tip pointing upward. Remove nozzle holder nut (11). Remove nozzle tip (9) with valve (10) and spacer (8). Invert nozzle body (3) and remove spring seat (6), shim (5) and spring (4). Thoroughly clean all parts in a suitable solvent. Clean inside orifice end of nozzle tip with a wooden cleaning stick. The orifice spray holes may be cleaned by inserting a 0.28 mm cleaning wire. When reassembling injector, make certain all components are clean and wet with clean diesel fuel oil. Tighten nozzle holder nut (11) to 60-90 N·m.

INJECTION PUMP

R&R AND OVERHAUL. To remove injection pump, disconnect fuel lines, unscrew retaining screws and remove pump. Do not lose shim gaskets (G–Fig. L4-3).

The injection pump should be tested and overhauled by a shop qualified in diesel fuel injection pump repair.

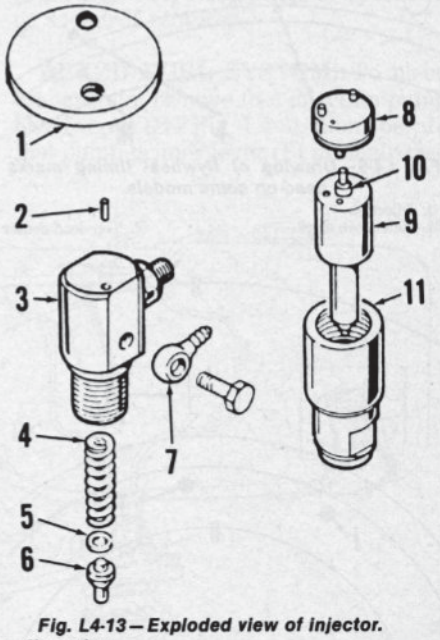


Fig. L4-13–Exploded view of injector.

1. Clamp plate
2. Dowel pin
3. Nozzle body
4. Spring
5. Shim
6. Pressure pin
7. Return line fitting
8. Spacer
9. Nozzle
10. Valve
11. Nozzle holder nut

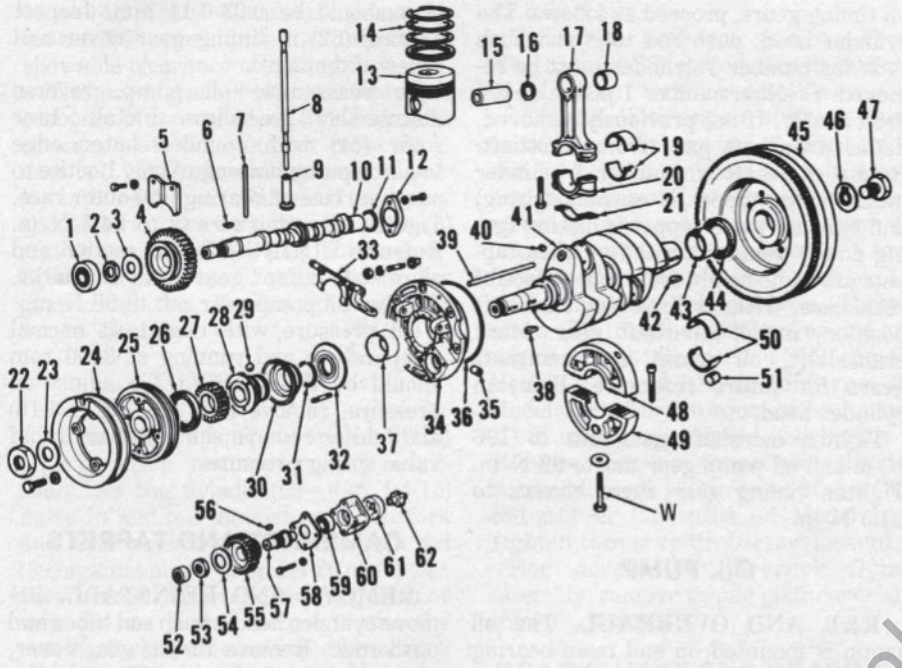


Fig. L4-15—Exploded view of crankshaft, camshaft and oil pump assemblies.

1. Bearing
2. Nut
3. Washer
4. Camshaft gear
5. Retainer
6. Key
7. Fuel pump push rod
8. Push rod
9. Tappet
10. Camshaft
11. "O" ring
12. Cover plate
13. Piston
14. Piston rings
15. Piston pin
16. Snap ring
17. Connecting rod
18. Bushing
19. Rod bearing
20. Rod cap
21. Lockplate
22. Nut
23. Washer
24. Rope pulley
25. Fan pulley
26. Seal
27. Gear
28. Governor hub
29. Balls
30. Governor cup
31. Snap ring
32. Seal
33. Governor arm & shaft
34. End bearing support
35. Bushing
36. "O" ring
37. Main bearing
38. Key
39. Governor rod
40. Plug
41. Crankshaft
42. Key
43. Main bearing
44. Seal
45. Flywheel
46. Lockwasher
47. Cap screw
48. Upper center bearing support
49. Lower center bearing support
50. Center main bearing
51. Round nut
52. Bearing
53. Nut
54. Washer
55. Gear
56. Key
57. Drive shaft
58. Bearing retainer
59. Bearing
60. Oil pump cover
61. Outer rotor
62. Inner rotor
W. Support screw

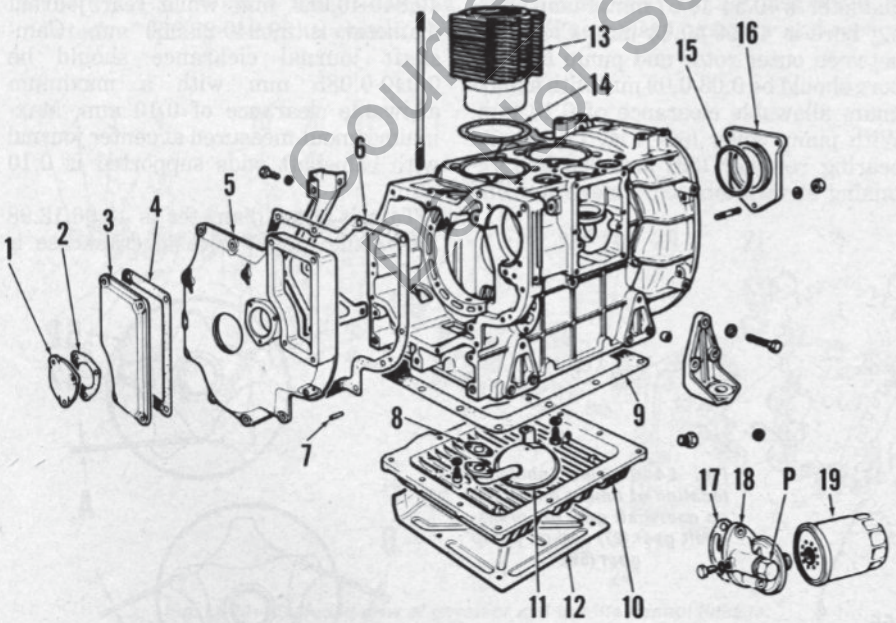


Fig. L4-16—Exploded view of crankcase assembly. Remove plug (P) for access to oil pressure relief valve.

1. Cover
2. Gasket
3. Cover
4. Gasket
5. Timing gear cover
6. Gasket
7. Pin
8. Gasket
9. Gasket
10. Oil pan
11. Oil pickup
12. Air shroud
13. Cylinder
14. Shim gasket
15. "O" ring
16. Cover
17. Gasket
18. Filter adapter
19. Oil filter

When installing pump, engage pin on pump control rack with governor fork. Tighten injection pump screws to 24.5 N·m. If pump is renewed or overhauled, or original shim gaskets are not used, refer to INJECTION PUMP TIMING section and adjust pump timing.

PISTON AND ROD UNITS

REMOVE AND REINSTALL. Piston and connecting rod may be removed after removing cylinder head, oil pan and oil pickup.

When installing piston and rod, note that depression (D – Fig. L4-17) in piston crown is closer to one side of piston. Install piston so depression side of piston is nearer injector. Some pistons also have an arrow embossed on piston. Properly installed, arrow on piston crown will point towards injection pump. Match alignment marks on rod and cap and tighten rod screws to 49 N·m.

Refer to CYLINDER section and measure piston height in cylinder.

PISTON, PIN AND RINGS

The piston is equipped with three compression rings and an oil control ring. Ring end gap is 0.35-0.55 mm for all compression rings and 0.25-0.40 mm for the oil control ring. Piston ring side clearance should be 0.15 mm for top compression ring and 0.10 mm for all other piston rings.

Standard piston diameter measured 2 mm from bottom of skirt, perpendicular to piston pin, is 89.85-89.86 mm for Model 904 and 94.85-94.86 mm for Models 914 and L20. Piston to cylinder clearance should be 0.14-0.17 mm. Pistons and rings are available in standard and oversizes of 0.5 and 1.0 mm. Difference in piston weights must not exceed 6 grams.

Piston pin diameter is 27.995-28.005 mm. Piston pin clearance in rod should

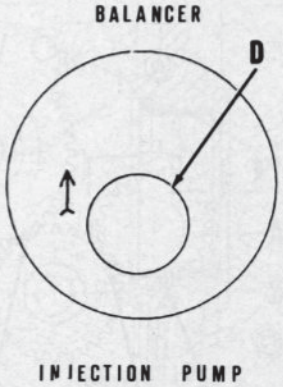


Fig. L4-17—Arrow on piston crown should point towards injection pump and depression (D) should be near injectors.

be 0.015-0.035 mm with a maximum allowable clearance of 0.05 mm.

CONNECTING ROD

The connecting rod small end is fitted with a renewable bushing. Clearance between piston pin and rod bushing should be 0.015-0.035 mm with a maximum allowable clearance of 0.05 mm. Bushing inner diameter is 28.020-28.030 mm.

An insert type bearing is used in connecting rod big end. Desired rod bearing clearance is 0.03-0.07 mm with a maximum allowable clearance of 0.10 mm. Big end bearings are available in standard and undersizes.

CYLINDERS

All models are equipped with removable cylinders. Standard cylinder diameter is 90.00-90.02 mm for Model 904 and 95.00-95.02 mm for Models 914 and L20. Maximum allowable taper or out-of-round is 0.1 mm.

With piston at top dead center, top of piston must be even with cylinder top edge. Cylinder height is adjusted using shim gaskets (14 – Fig. L4-16) which are available in thicknesses of 0.1 and 0.3 mm.

TIMING GEARS

REMOVE AND REINSTALL. Remove belt guard and fan belt. Unscrew nut, then using a suitable puller, pull pulley off crankshaft. Remove timing gear cover.

Use a suitable puller to remove gears. Note that retainer (5 – Fig. L4-15) must be removed before pulling off camshaft gear (4). When installing camshaft gear, place gear on shaft so retainer groove is out. Align timing marks (M – Fig. L4-18) on models so equipped, when installing gears. If timing marks are not present on timing gears, proceed as follows: The cylinder head, push rod tube and push rods for number 1 cylinder must be removed. Position number 1 piston at top dead center. If not previously removed, detach camshaft gear from camshaft. Rotate camshaft so number 1 cylinder intake valve tappet is opening (rising) and exhaust valve tappet is closing (going down) then stop rotation when tappets are same height from top surface of crankcase. Without disturbing camshaft position, install camshaft gear. Mark crankshaft, oil pump and camshaft gears for future reference. Reinstall cylinder head.

Tighten camshaft gear nut to 196 N·m and oil pump gear nut to 98 N·m. Tighten timing gear cover screws to 24.5 N·m.

OIL PUMP

R&R AND OVERHAUL. The oil pump is mounted on end main bearing support (34 – Fig. L4-15). To remove pump, remove timing gear cover and oil pump gear (55). Unscrew pump housing screws and disassemble pump.

Refer to Fig. L4-19 and measure clearance between inner and outer rotors (61 and 62). Clearance (A) should be 0.01-0.06 mm with a maximum allowable clearance of 0.10 mm, and clearance (B) should be 0.02-0.10 mm with a maximum allowable clearance of 0.20 mm. Width of inner and outer rotors should be 14.95-14.97 mm and difference in rotor widths must not be greater than 0.02 mm. Outer rotor outer diameter is 40.54-40.57 mm. Pump housing bore is 40.60-40.63 mm. Clearance between outer rotor and pump housing bore should be 0.03-0.09 mm with a maximum allowable clearance of 0.13 mm. With pump cover (60 – Fig. L4-15) and bearing retainer (58) installed and retaining screws torqued, inner rotor end play should be 0.03-0.11 mm. Inspect bearing (52) in timing gear cover and renew if damaged.

To reassemble oil pump, reverse disassembly procedure. Install outer rotor (61) with rounded outer edge towards pump housing. Apply Loctite to outer surface of bearing (59) outer race. Tighten oil pump screws to 24.5 N·m. Refer to TIMING GEARS section and align oil pump gear timing marks. Tighten oil pump gear nut to 98 N·m.

Oil pressure with engine at normal temperature and running at 3000 rpm should be 343-392 kPa. To adjust oil pressure, remove plug (P – Fig. L4-16) and add or remove shims to vary relief valve spring pressure.

CAMSHAFT AND TAPPETS

REMOVE AND REINSTALL. Remove cylinder heads, push rod tubes and push rods. Remove timing gear cover, gear retainer (5 – Fig. L4-15) and camshaft gear (4). Remove fuel injection pump. Using suitable tools, pull valve tappets away from camshaft and secure tappets so they will not fall into crankcase when camshaft is removed. If tappets fall into crankcase, then crankshaft must be removed so tappets can be reinstalled. Withdraw camshaft from crankcase. Remove oil pan for access to tappets.

Inspect bearing (1) in timing gear cover and renew if damaged. Inspect camshaft lobes and bearing journals. Center journal diameter is 40.940-40.960 mm while rear journal diameter is 29.940-29.960 mm. Camshaft journal clearance should be 0.040-0.085 mm with a maximum allowable clearance of 0.10 mm. Maximum runout measured at center journal with camshaft ends supported is 0.10 mm.

Tappet outer diameter is 13.96-13.98 mm while tappet bore in crankcase is

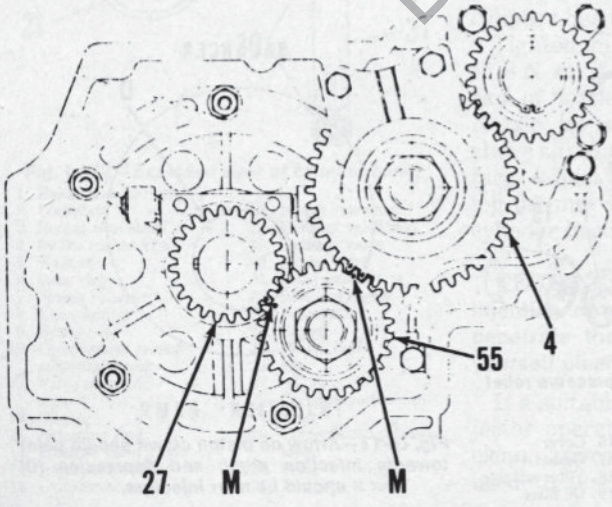


Fig. L4-18 – View showing location of timing marks (M) on camshaft gear (4), crankshaft gear (27) and oil pump gear (55).

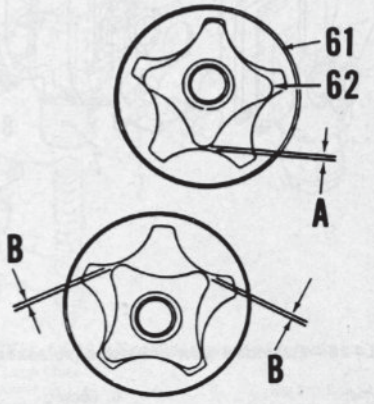


Fig. L4-19 – Refer to text for clearances (A&B) between oil pump outer rotor (61) and inner rotor (62).

14.00-14.02 mm. Clearance should be 0.02-0.06 mm with a maximum allowable clearance of 0.10 mm.

If removed, install tappets. Camshaft end play is controlled by camshaft gear retainer plate (5). Retainer plate thickness is 5.7-5.8 mm while groove in gear (4) is 6.0-6.1 mm. Camshaft end play should be 0.2-0.4 mm. Renew plate (5) and/or gear (4) if end play is incorrect. Refer to TIMING GEARS section for gear installation. Tighten camshaft gear nut to 196 N·m.

GOVERNOR

All models are equipped with a flyball type governor mounted on the crankshaft. As the flyballs (29–Fig. L4-15) move in and out against cup (30), fork and lever assembly (33) forces push rod (39) against pin (1–Fig. L4-20 or L4-21). Pivot flange (4), lever (16) and governor arm (5) are forced to rotate thereby moving fuel injection pump control rack pin (P). Throttle lever (25) operates through pivot arm (12) and governor spring (13) to control engine speed.

Torque control screw (C) on Models 904 and 914 allows additional fuel usage under high torque load. The tip is spring loaded. The tip should recede 0.5-0.6 mm when 470-500 grams force is applied to tip. Torque control screw is available only as an assembly.

Start spring (6) returns the fuel injection pump control rack to maximum fuel position to aid in starting. Spring free length is 29.5-30.5 mm.

Governor spring (13) free length is 69.5-70.5 mm. With a force of 56.84 newtons, spring length should be 82.5-83.5 mm.

To adjust governor, remove cover (24–Fig. L4-20) and on Models 904 and 914, back out torque control screw (C) 5 or 6 turns. With engine stopped, check to be sure start spring (6–Fig. L4-20 and L4-21) has removed slack in governor mechanism. Loosen governor arm screw (8) and move governor arm (5) towards torque control screw (C) until fuel injection pump control rack pin (P) is in maximum fuel position. Tighten screw (8). Install control cover and run engine at high idle speed of 3150 rpm for Models 904 and 914 or 2350 rpm for Model L20. Turn torque control screw (C) in until engine speed just begins to decrease, then turn torque control screw in an additional 1½ turns on Models 904 and 914 or 2.2 turns on Model L20. Tighten torque control screw locknut.

For access to governor flyball assembly, remove timing gear cover and crankshaft gear.

CRANKSHAFT AND BEARINGS

R&R AND OVERHAUL. The crankshaft rides in sleeve bearings in the crankcase bulkhead and end bearing support (34–Fig. L4-15), and in insert bearings in center support halves (48 and 49).

To remove the crankshaft, remove flywheel, pistons and rods, and governor as previously outlined. Unscrew center support retaining screw (W). Unscrew end support (34) retaining nuts and remove end support. Carefully extract crankshaft and center bearing support from crankcase. Do not lose round nut (51). If necessary, unscrew and separate center support halves (48 and 49).

Standard diameter of center main bearing journal is 55.34-55.35 mm. Standard diameter of outer main bearing journals is 54.94-54.95 mm. Bearing clearance should be 0.05-0.09 mm for center main bearing and 0.05-0.07 mm for outer main bearings with a maximum allowable clearance of 0.12 mm. End main bearings (37 and 43) must be reamed to size. Standard and undersize main bearings are available.

Standard crankpin journal diameter is 49.989-50.000 mm and rod bearing clearance should be 0.03-0.07 mm with a maximum allowable clearance of 0.10 mm. Standard and undersize rod bearings are available.

Serrated parting surfaces of center support halves (48 and 49) must be aligned during assembly. With support screws tightened to 24.5 N·m, center support outside diameter should be 154.980-154.990 mm and inside diameter should be 59.074-59.093 mm. Maximum out-of-round for either diameter is 0.01 mm.

When installing main bearing (37) in end support (34–Fig. L4-22), distance

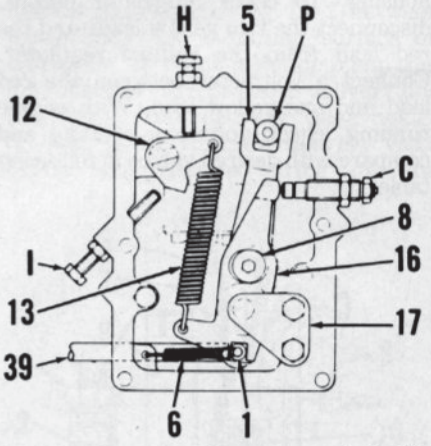


Fig. L4-21–Drawing of governor and throttle control linkage. Refer to Fig. L4-20 for parts identification.

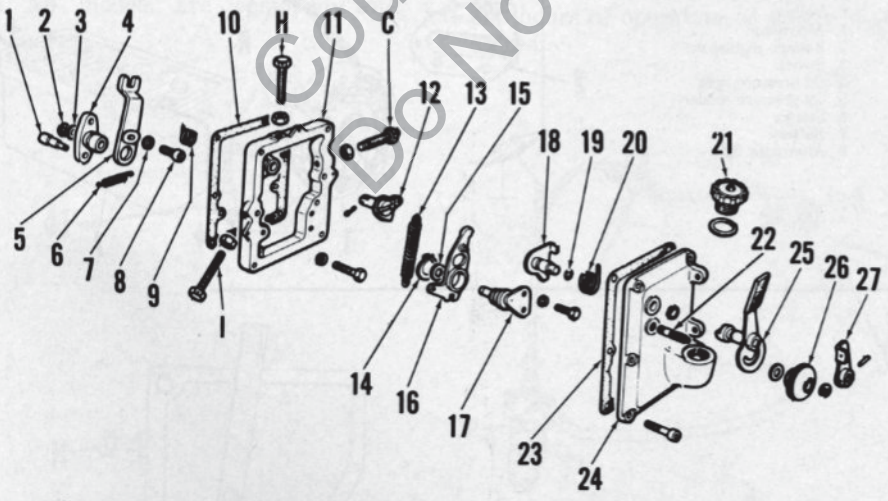


Fig. L4-20–Exploded view of governor and throttle control linkage.

1. Pin
2. Snap ring
3. Washer
4. Pivot flange
5. Governor arm
6. Start spring
7. Washer
8. Allen screw
9. Spring
10. Gasket
11. Plate
12. Pivot arm
13. Governor spring
14. Snap ring
15. Washer
16. Lever
17. Pivot
18. Arm
19. Washer
20. Spring
21. Oil fill cap
22. Stud
23. Gasket
24. Cover
25. Throttle lever
26. Knob
27. Stop lever
C. Torque control screw
H. High idle speed screw
I. Low idle speed screw

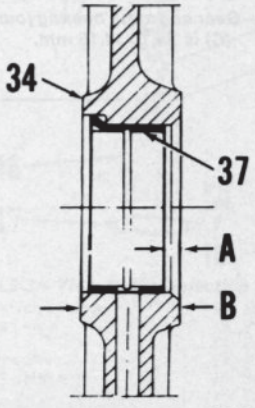


Fig. L4-22–Depth (A) of bearing (37) in end support (34) should be 5 mm. Support width measured at (B) is 33.90-33.95 mm.

(A) from bearing (37) to inside surface of support should be 5 mm.

Crankshaft end play should be 0.15-0.25 mm and is not adjustable. End support (34 – Fig. L4-15) width measured at (B) should be 33.90-33.95 mm. Width of gear end main bearing journal measured from shoulder to thrust face as shown at (C – Fig. L4-23) should be 34.10-34.15 mm. A worn end support or crankshaft will cause excessive end play.

Reassembly is reverse of disassembly. Tighten screws securing center support halves to 24.5 N·m. Tighten end support retaining nuts to 24.5 N·m. Tighten center support retaining screw to 39.2 N·m.

ALTERNATOR AND REGULATOR

Refer to Fig. L4-25 or L4-26 for wiring schematic. Note that circuit in Fig. L4-26 includes an alternator warning light and the voltage regulator is different than the regulator used in circuit in Fig. L4-25. Alternator output may be 14 or 21 amperes as noted on voltage regulator.

The alternator is contained in the fan housing. To check alternator output, disconnect the two yellow leads and the red lead from the voltage regulator. Connect a voltmeter between the red lead and one yellow lead. With engine running, check voltmeter reading and compare with desired values in following table:

Engine RPM	14 Amp Alternator	21 Amp Alternator
1500	18.5-20 Volts	30-32 Volts
2000	24-25 Volts	45-47 Volts
2500	31-32 Volts	57-58 Volts
3000	37-38 Volts	68-69 Volts

Connect voltmeter to red lead and remaining yellow lead and repeat test. If voltage is insufficient, or the difference between tests is greater than 5 volts, then renew alternator. Stator and rotor are available only as a unit assembly.

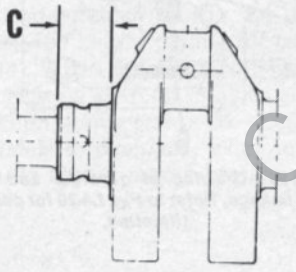


Fig. L4-23 – Gear end main bearing journal width (C) is 34.10-34.15 mm.

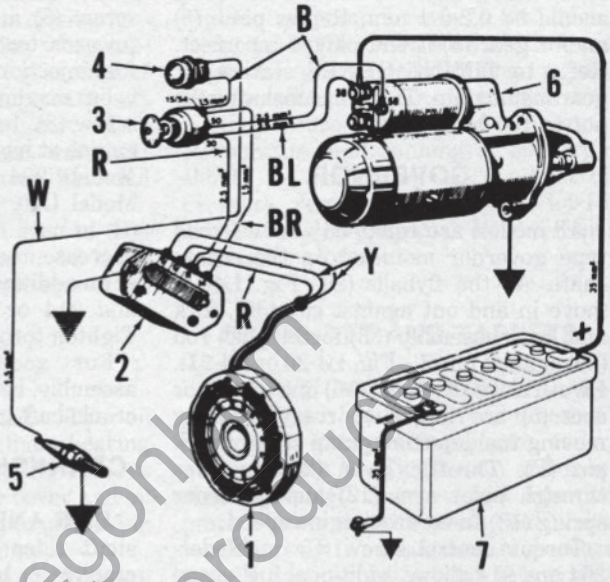


Fig. L4-25 – Wiring schematic of models not equipped with an alternator warning light.

B. Black
BL. Blue
BR. Brown
R. Red
W. White
Y. Yellow
1. Alternator
2. Voltage regulator
3. Switch
4. Oil pressure light
5. Oil pressure sender
6. Starter
7. Battery

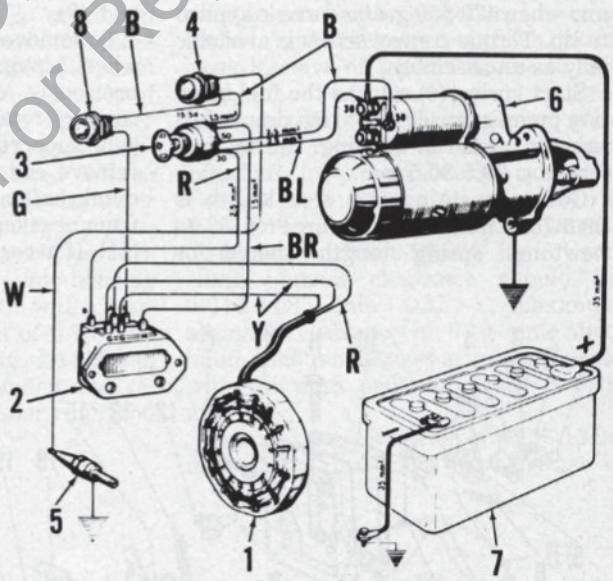


Fig. L4-26 – Wiring schematic of models equipped with an alternator warning light.

B. Black
BL. Blue
BR. Brown
G. Green
R. Red
W. White
Y. Yellow
1. Alternator
2. Voltage regulator
3. Switch
4. Oil pressure light
5. Oil pressure sender
6. Starter
7. Battery
8. Alternator light

LOMBARDINI

Model	No. Cyls.	Bore	Stroke	Displ.
L8	1	85 mm	90 mm	510 cc
L10	1	95 mm	90 mm	638 cc
L14	1	102 mm	100 mm	817 cc
LDA96	1	95 mm	90 mm	638 cc
LDA100	1	100 mm	90 mm	707 cc
LDA450	1	85 mm	80 mm	454 cc
LDA510	1	85 mm	90 mm	510 cc
LDA820	1	102 mm	100 mm	817 cc

Lombardini Model LDA510 Engine is used on Homelite® Model DPT4-1 Pump.

All models are four-stroke, single-cylinder, air-cooled diesel engines. Crankshaft rotation is counterclockwise at pto end.

Metric fasteners are used throughout engine.

MAINTENANCE

LUBRICATION

Recommended engine oil is SAE 10W for temperatures below 0° C (32° F), SAE 20W for temperatures between 0° C (32° F) and 20° C (68° F), and SAE 40 for temperatures above 20° C (68° F). API classification for oil should be CD. Oil sump capacity is 1.65 liters on Models L8, LDA450 and LDA510 or 2.6 liters on all other models. Manufacturer recommends renewing oil after every 100 hours of operation.

A renewable oil filter is mounted on side of engine crankcase. Manufacturer recommends renewing filter after every 300 hours of operation.

All models are equipped with a pressurized oil system. Refer to OIL PUMP section for service.

ENGINE SPEED ADJUSTMENT

Idle speed is adjusted by turning idle speed screw (I–Fig. L5-1). Idle speed should be 1000-1100 rpm. Maximum governed speed is adjusted by turning high speed screw (H). Maximum governed speed under load should be 2200 rpm for Models L8, L10 and L14, 2600 rpm for Models LDA100 and LDA820, and 3000 rpm for Models LDA96, LDA450 and LDA510.

Maximum fuel delivery is adjusted by loosening screws (S) and moving plate (41). Set plate so satisfactory engine pickup is obtained without excessive smoke. Moving plate to left increases fuel delivery.

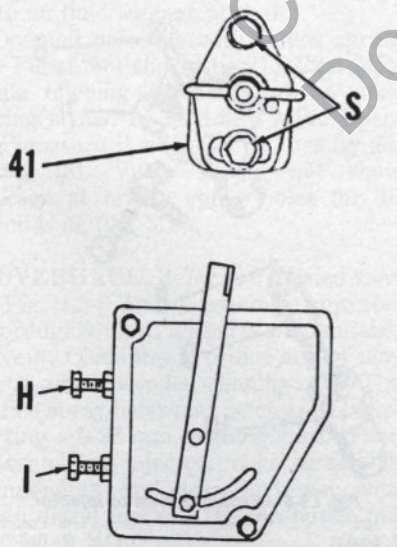


Fig. L5-1 – Refer to text for engine speed adjustment.

FUEL SYSTEM

FUEL FILTER. The fuel filter is located inside the fuel tank as shown in Fig. L5-2. Renew fuel filter after every 300 hours of operation or sooner if required.

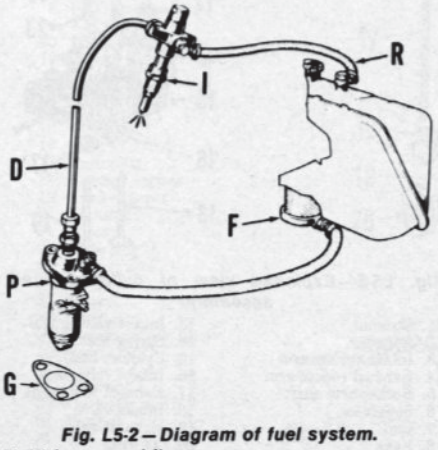


Fig. L5-2 – Diagram of fuel system.

D. High pressure delivery line
F. Fuel filter
G. Shim gasket
I. Injector
P. Injection pump
R. Return line

BLEED FUEL SYSTEM. To bleed fuel system, loosen fuel line fitting on fuel pump and allow fuel to flow until air-free, then retighten fitting. Loosen high pressure injection line at injector, then rotate engine crankshaft to operate injection pump until air-free fuel flows from injection line. Retighten injection line.

INJECTION PUMP TIMING

Injection pump timing is adjusted using shim gaskets (G–Fig. L5-2) between pump body and mounting surface on crankcase. To check injection pump timing, unscrew high pressure delivery line (D) fitting from delivery valve holder (1–Fig. L5-3). Unscrew delivery valve holder and remove spring (3) and

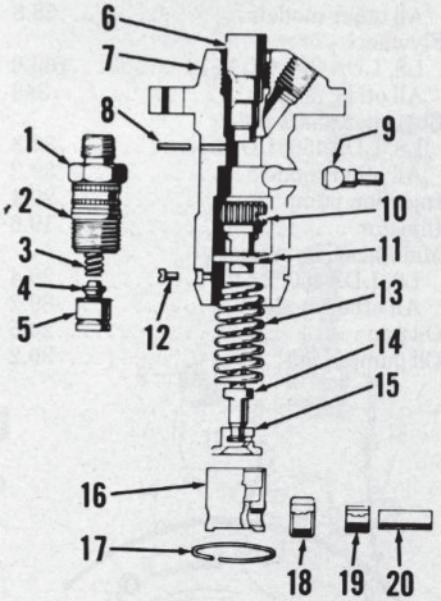


Fig. L5-3 – View of fuel injection pump.

1. Delivery valve holder
2. "O" ring
3. Spring
4. Delivery valve
5. Delivery valve seat
6. Barrel
7. Pump body
8. Pin
9. Control rack
10. Pinion
11. Spring seat
12. Pin
13. Spring
14. Plunger
15. Spring retainer
16. Tappet
17. Circlip
18. Outer roller
19. Inner roller
20. Pin

delivery valve (4) then screw delivery valve holder (1) into pump body. Move throttle control to full speed position. Rotate engine in normal direction (counterclockwise at pto) so piston is on compression stroke. Note fuel in delivery valve holder will spill out. Stop engine rotation at moment fuel ceases to flow out. Timing dot (R–Fig. L5-4) on fan plate should align with injection timing dot (I) on fan shroud. Ignition timing should occur at 22°-23° BTDC on Model L8, 23°45'-25°30' on Models LDA450 and LDA510, and 25°15'-26°45' on all other models.

To advance injection timing, remove shim gaskets (G–Fig. L5-2); install shim gaskets to retard injection timing. Reinstall removed pump components and tighten delivery valve holder to 34.3-39.2 N·m. Tighten injection pump retaining screws to 29.4 N·m.

REPAIRS

TIGHTENING TORQUES

Refer to following table for tightening torques. All values are in newton meters.

Balancer case	49
Balancer cover	49
Connecting rod	
L8, LDA450, LDA510	29.4
All other models	44.1
Cylinder head	
L8, LDA450, LDA510	49
All other models	58.8
Flywheel	
L8, LDA450, LDA510	166.6
All other models	343
Governor shaft nut	
L8, LDA450, LDA510	34.3
All other models	39.2
Injection pump	29.4
Injector	19.6
Main bearing support	
L8, LDA450, L510	29.4
All other models	39.2
Oil pan	24.5
Oil pump	39.2
Oil pump gear	19.6
Pto bearing support	
L8, LDA450, LDA510	24.5
All other models	39.2
Pto flange	225.4
Rope pulley	
L8, LDA450, LDA510	34.3
All other models	39.2

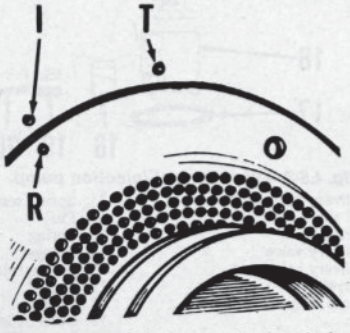


Fig. L5-4—View of timing marks located on air shroud. Refer to text for injection timing.

VALVE TAPPET GAP

Valve tappet gap may be adjusted after removing rocker arm cover. Valve tappet should be 0.20 mm for both valves with engine cold.

COMPRESSION RELEASE

A manual compression release is located in the rocker arm cover so the exhaust valve can be held open to aid starting. Exhaust valve should be lowered approximately 1 mm from valve seat when compression release is operated. Compression release may be adjusted by varying thickness of rocker arm cover.

CYLINDER HEAD AND VALVE SYSTEM

Do not remove a hot cylinder head as head may deform. To remove rocker arms, unscrew rocker shaft locating pin (21–Fig. L5-5) on Models L8, LDA450 and LDA510 or shaft locating screw (6) on all other models, then use a suitable puller and withdraw rocker shaft.

Valve face angle is 45 degrees and minimum valve head margin is 0.4 mm. Valve seat angle is 45 degrees with a seat width of 1.4-1.6 mm. Valve seats are renewable and must be installed with head heated to 160°-180° C (320°-356° F). A valve seal is used on the intake valve. Valve stem diameter is 6.98-7.00 mm on Models L8, LDA450 and LDA510 or 7.98-8.00 mm on all other models. Valve guide inside diameter is 7.03-7.05 mm on Models L8, LDA450 and LDA510 or 8.03-8.05 mm on all other models. Desired valve stem clearance for all models is 0.03-0.07 mm. Valve guides are renewable and oversize valve guides are available. Note locating ring (12) around top of each guide. Outside of oversize valve guide must be machined so outer diameter is 0.05-0.06 mm greater than hole in head. The cylinder head should be heated to 160°-180° C (320°-356° F) when installing valve guides.

Valve spring pressure should be 294 newtons at valve spring length of 25.2 mm on Models L8, LDA450 and LDA510 or 25.8 mm on all other models.

The rocker arm shaft on Models L8, L10 and L14 is drilled to allow passage of pressurized oil to rocker arms. Desired clearance on all models between rocker arms and rocker shaft is 0.03-0.06 mm with a maximum clearance of 0.1 mm.

No cylinder head gasket is used.

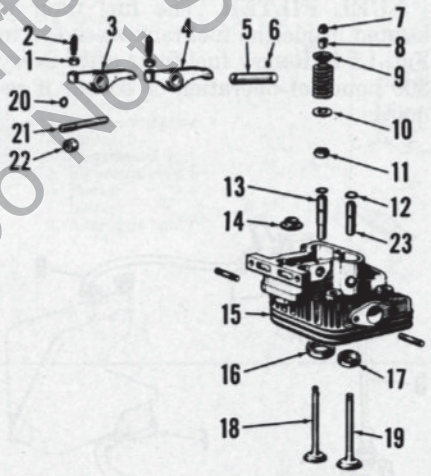


Fig. L5-5—Exploded view of cylinder head assembly.

1. Locknut
2. Adjuster
3. Intake rocker arm
4. Exhaust rocker arm
5. Rocker arm shaft
6. Set screw
7. Cap
8. Keys
9. Spring retainer
10. Washer
11. Oil seal
12. Circlip
13. Intake valve guide
14. Spring seat
15. Cylinder head
16. Intake valve seat
17. Exhaust valve seat
18. Intake valve
19. Exhaust valve
20. "O" ring
21. Rocker shaft locating pin
22. Locknut
23. Exhaust valve guide

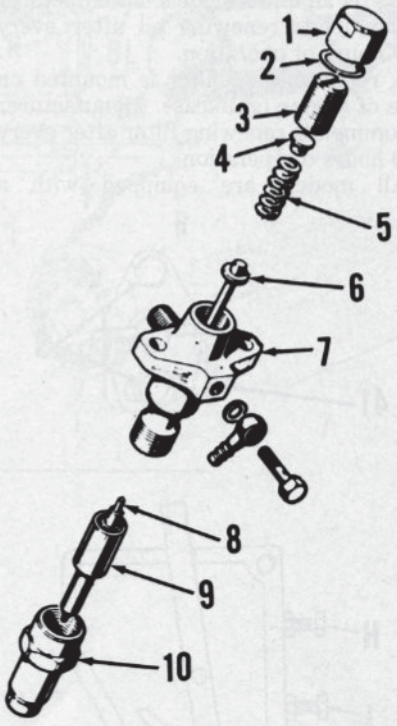


Fig. L5-6—Exploded view of injector.

1. Nut
2. Gasket
3. Adjuster
4. Spring seat
5. Spring
6. Push rod
7. Body
8. Valve
9. Nozzle
10. Nozzle nut

Cylinder head surface must not be deformed more than 0.30 mm. The cylinder head and cylinder may be lapped together to improve mating surface.

Push rod tube seals should be inspected and discarded if damaged. Push rod nearer cylinder connects to intake rocker arm while outer push rod connects to exhaust rocker arm.

Tighten cylinder head nuts to 49 N·m on Models L8, LDA450 and LDA510 or to 58.8 N·m on all other models.

INJECTOR

REMOVE AND REINSTALL. To remove injector, first clean dirt from injector, injection line, return line and cylinder head. Disconnect return and injection lines from injector and immediately cap or plug all openings. Unscrew injector retaining nuts and carefully remove injector from head being careful not to lose shims between injector and head.

Tighten injector retaining nuts to 19.6 N·m. If accessible, measure protrusion of nozzle into combustion chamber. Nozzle tip should extend 2.5-3.0 mm on Model LDA450, 3.0-3.5 mm on Models L8 and LDA510 or 3.5-4.0 mm on all other models. Adjust position of nozzle by installing 0.5 mm shims between injector and cylinder head.

TESTING. WARNING: Fuel leaves the injection nozzle with sufficient force to penetrate the skin. When testing, keep yourself clear of nozzle spray.

If a suitable test stand is available, injector operation may be checked. Only clean, approved testing oil should be used to test injector. When operating properly during test, injector nozzle will emit a buzzing sound and cut off quickly with no fluid leakage at seat.

Opening pressure with a new spring (5–Fig. L5-6) should be 21.6-22.5 MPa while opening pressure with a used spring should be 20.6-21.6 MPa. Opening pressure is adjusted by turning adjuster (3). Valve should not show leakage at orifice spray holes for 10 seconds at 19.1 MPa.

OVERHAUL. Refer to exploded view in Fig. L5-6 and disassemble injector. Thoroughly clean all parts in a suitable solvent. Clean inside orifice end of nozzle tip with a wooden cleaning stick. The orifice spray holes may be cleaned by inserting a 0.28 mm cleaning wire. When reassembling injector, make certain all components are clean and wet with clean diesel fuel oil. Tighten nozzle nut (10) to 49 N·m.

INJECTION PUMP

Refer to Fig. L5-3 for view of injection pump. Disassembly and reassembly is evident after inspection of pump and referral to Fig. L5-3. Note that slot in barrel (6) must align with pin (8). Align marks on pinion (10) and rack (9).

The following tests may be used to check injection pump if necessary test equipment is available. With a suitable pressure gage connected to delivery valve holder (1), operate pump. With control rack (18) at mid-point, pump pressure should be at least 29.4 MPa. Pump pressure should be at least 39.2 MPa with control rack in maximum fuel position. To check delivery valve, move control rack (9) to mid-point position and operate pump. After maximum pressure is reached, pressure should drop sharply to a pressure 2940-4900 kPa less than maximum pressure if delivery valve is operating properly. Maximum pump volume at a rate of 1000 pump strokes at 1500 rpm is 27 cc for Model LDA450, 31 cc for Models L8 and LDA510, 36-37 cc for Models L10 and LDA 96, and 51-53 cc for Models L14, LDA100 and LDA820.

Place shim gaskets (G–Fig. L5-2) on pump and engage control rack pin with governor arm during installation. Tighten pump retaining screws to 29.4 N·m. Refer to INJECTION PUMP TIMING section to time injection pump.

PISTON AND ROD UNIT

REMOVE AND REINSTALL. Piston and connecting rod may be removed after removing cylinder head and oil pan.

When installing piston and rod, note that depression in piston crown is closer to one side of piston. Install piston so depression side of piston is nearer exhaust. Some pistons also have an arrow embossed in piston. Install piston so arrow points toward injection pump.

Install cap on connecting rod so bearing tangs are on same side and tighten rod screws to 29.4 N·m on Models L8, LDA450 and LDA510 or 44.1 N·m on all other models.

PISTON, PIN AND RINGS

The piston is equipped with three compression rings and an oil control ring. The top compression ring is chrome plated. Compression ring end gap is 0.35-0.55 mm on Models L14, LDA100 and LDA820 or 0.30-0.45 mm for all other models. Oil control ring end gap is 0.25-0.40 mm for all models.

Refer to following table for standard piston diameter and desired piston clearance. Piston diameter is measured at bottom of skirt perpendicular to piston pin.

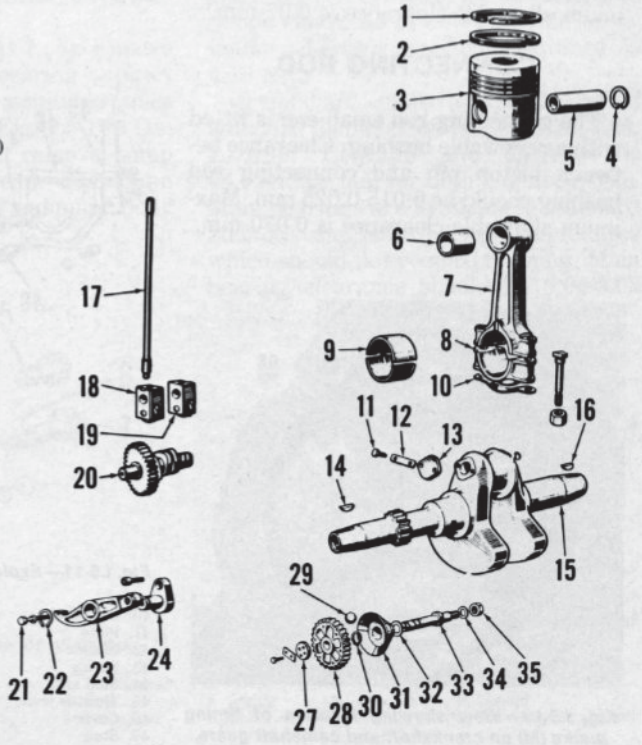


Fig. L5-7—Exploded view of crankshaft, governor and camshaft assemblies. Some models use flyweights instead of flyballs shown.

1. Compression piston rings (3)
2. Oil control ring
3. Piston
4. Snap rings
5. Piston pin
6. Bushing
7. Connecting rod
8. Rod cap
9. Rod bearing
10. Lockplate
11. Screw
12. Lockplate
13. Plate
14. Key
15. Crankshaft
16. Key
17. Push rods
18. Exhaust tappet
19. Intake tappet
20. Camshaft
21. Screw
22. Snap ring
23. Rocker arm
24. Stud
27. Plate
28. Gear
29. Governor balls (6)
30. Snap ring
31. Cup
32. Washer
33. Governor shaft
34. Washer
35. Nut

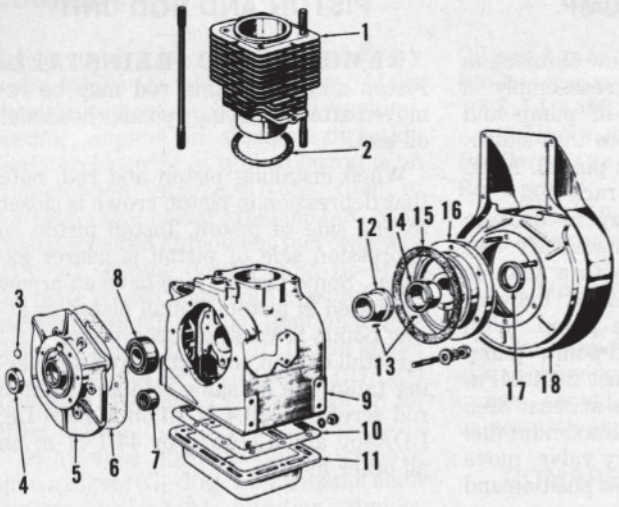


Fig. L5-8—Exploded view of crankcase.

1. Cylinder
2. Shim gasket
3. Plug
4. Seal
5. Pto bearing support
6. Gasket
7. Bearing
8. Bearing
9. Crankcase
10. Gasket
11. Oil pan
12. Main bearing
13. Dowel pins
14. Main bearing
15. Shim gasket
16. Main bearing support
17. Seal
18. Air shroud

Model	Standard Piston Dia. (mm)	Piston Clearance (mm)
L8	84.88-84.90	0.10-0.14
L10	94.85-94.87	0.13-0.17
L14	101.84-101.86	0.14-0.18
LDA96	94.85-94.87	0.13-0.17
LDA100	99.82-99.83	0.17-0.20
LDA450	84.88-84.90	0.10-0.14
LDA510	84.88-84.90	0.10-0.14
LDA820	101.84-101.86	0.14-0.18

Pistons and rings are available in standard size and oversizes of 0.5 mm and 1.0 mm.

Piston pin diameter is 22.995-23.000 mm on Models L8, LDA450 and LDA510 or 27.995-28.000 mm on all other models. Piston pin clearance in rod bushing should be 0.020-0.035 mm. Maximum allowable clearance is 0.07 mm.

CONNECTING ROD

The connecting rod small end is fitted with a renewable bushing. Clearance between piston pin and connecting rod bushing should be 0.015-0.025 mm. Maximum allowable clearance is 0.070 mm.

An insert type bearing is used in connecting rod big end. Desired rod bearing clearance is 0.03-0.06 mm for Models L8, LDA450 and LDA510 or 0.05-0.06 mm for all other models. Maximum allowable clearance for all models is 0.1 mm. Big end bearings are available in standard and undersizes.

CYLINDER

All models are equipped with a removable cylinder. Standard cylinder diameter is 85.00-85.02 mm for Models L8, LDA450 and LDA510, 95.00-95.02 mm for Models L10 and LDA96, 100.00-100.02 mm for Model LDA100, and 102.00-102.02 mm for Models L14 and LDA820. Maximum allowable taper or out-of-round is 0.1 mm.

With piston at top dead center, top of piston should be 0.9-1.0 mm below cylinder top edge. Cylinder height is adjusted by varying shim gaskets (2—Fig. L5-8).

TIMING GEARS

Gears are accessible after removing pto bearing support (5—Fig. L5-8). Crankshaft and camshaft gears are embossed with marks (M—Fig. L5-10) which should be aligned as shown. If crankshaft and camshaft gears are not marked, proceed as follows: If not previously removed, remove cylinder head, push rod tube and push rods. Position crankshaft so piston is at top dead center. Intake valve tappet (nearer cylinder) should be opening (rising) and exhaust valve tappet should be closing (going down). Valve tappets should be same height above crankcase when piston is at top dead center. If not, refer to CAMSHAFT section and remove camshaft, then install camshaft so it is correctly timed with crankshaft. Mark crankshaft and camshaft gears for future reference.

CAMSHAFT, TAPPETS AND PUSH RODS

REMOVE AND REINSTALL. To remove camshaft, remove cylinder head, push rod tube, push rods, valve tappets and fuel injection pump. Remove pto bearing support (5—Fig. L5-8) and withdraw camshaft.

Inspect camshaft for excessive wear

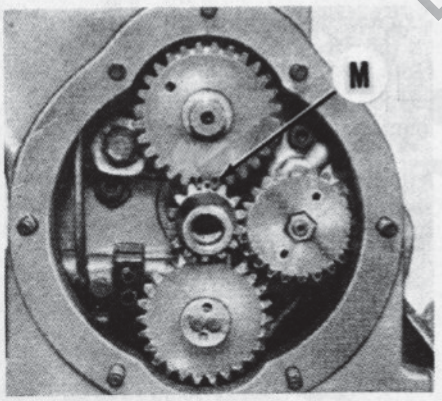


Fig. L5-10—View showing location of timing marks (M) on crankshaft and camshaft gears.

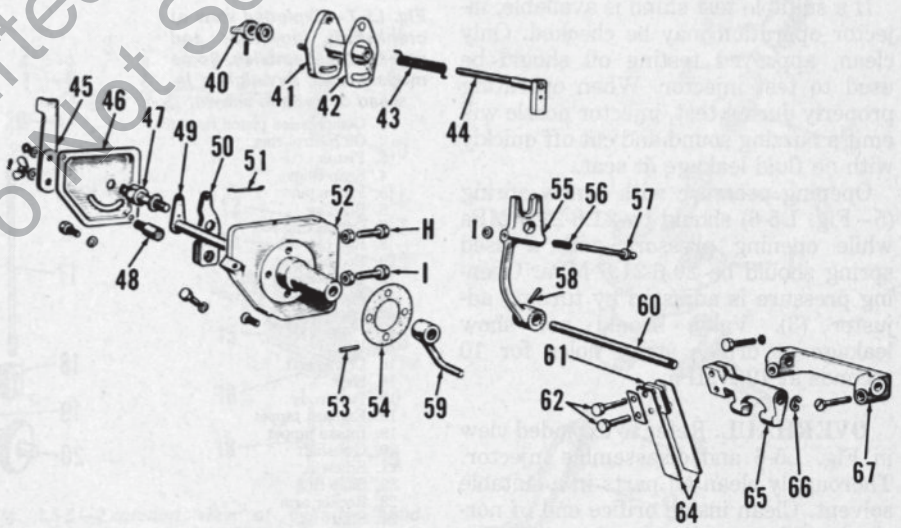


Fig. L5-11—Exploded view of governor and control linkage. Governor fork (65) contacts governor cup (31—Fig. L5-7).

40. Stop knob
41. Plate
42. Gasket
43. Spring
44. Stop arm
45. Throttle lever
46. Cover
47. Stud
48. Pivot screw
49. Arm
50. Lever
51. Link
52. Housing
53. Pin
54. Gasket
55. Arm
56. Spring
57. Torque control rod
58. Pin
59. Arm
60. Shaft
61. Spacer
62. Screws
64. Spring plates
65. Fork
66. "E" ring
67. Bracket
I. Low idle speed screw
H. High speed screw

and damage. Diameter of both camshaft bearing journals is 17.96-17.98 mm. Height of injection pump lobe (lobe nearest gear) should be 33.45-33.55 mm while lobe height for intake and exhaust should be 33.95-34.05 mm.

Reassembly is reverse of disassembly. Refer to TIMING GEARS section to time camshaft and crankshaft. Note that tappets have roller offset to one side and a notched sliding surface on the opposite side. Install tappets so sliding surfaces are together and rollers are on opposite sides. The push rods are contained in a tube and must cross between tappets and rocker arms. Push rod nearer cylinder connects intake tappet and rocker arm while outer push rod connects exhaust cam follower and rocker arm.

GOVERNOR

Most models are equipped with a flyball type governor while some models may be equipped with flyweights. The governor shaft is shown in Fig. L5-7 while governor linkage is shown in Fig. L5-11. The flyball assembly (G–Fig. L5-12) is rotated by the crankshaft. The crankshaft rotates flyball assembly (G–Fig. L5-12) which bears against fork (65–Fig. L5-11). As the flyballs move, the shaft attached to the fork is rotated thereby moving governor arm (55). Arm (55) mates with fuel injection control rack pin to regulate fuel flow. Throttle lever (45) operates through governor spring plates (64) to control engine speed. One spring plate is used on Models L8, L10 and L14, two spring plates are used on Models LDA96, LDA100 and LDA820, and three spring plates are used on Models LDA450 and LDA510.

To stop engine, stop knob (40) is turned counterclockwise which forces governor arm to move fuel injection pump control rack to no-fuel position. All models except L8, L10 and L14 are equipped with a torque control rod (57) and spring (56) which allows the governor arm (59) additional movement for additional fuel usage under high torque load. By pulling stop knob (40) away from engine, stop arm (44) will slide off tip of torque control rod (57) and allow governor arm to move forward so maximum fuel is delivered during starting.

Governor mechanism is accessible after removing pto bearing support (5–Fig. L5-8), however, the oil pan must be removed for access to nut (35–Fig. L5-7) so governor shaft can be withdrawn from crankcase. Inspect governor components and renew any which are damaged or excessively worn. Mechanism must move freely for proper governor operation.

To adjust governor, pto bearing support (5–Fig. L5-8) and gasket must be removed. Move throttle lever (45–Fig. L5-11) to full throttle position. Loosen spring plate screws (62) then move governor arm (55) towards crankcase opening and measure distance from pto bearing support mating surface of crankcase to upper part of governor arm. Distance between crankcase surface and governor arm should be 22 mm on Models L8, LDA450 and LDA510 or 28 mm on all other models. Retighten spring plate screws (62).

OIL PUMP AND RELIEF VALVE

R&R AND OVERHAUL. To remove oil pump, remove pto bearing support (5–Fig. L5-8) and using a suitable puller remove pump gear (3–Fig. L5-13). Unscrew pump screws and remove pump from crankcase bulkhead. Maximum clearance between gears and pump body should not exceed 0.15 mm. Maximum clearance between ends of gears and mounting surface of pump body is 0.15 mm.

Apply a thin coating of sealer to mounting surface of pump body. Install pump and tighten mounting screws to 39.2 N·m. Tighten oil pump gear nut to 19.6 N·m. Install timing gear cover.

The oil pressure relief valve is located on inner face of main bearing support (16–Fig. L5-14). To remove main bearing support, remove crankshaft pulley or crank starter, flywheel and shroud. Unscrew retaining nuts and remove main bearing support. Inspect pressure relief valve components and renew if damaged or excessively worn. Reinstall relief valve by reversing disassembly procedure.

Normal oil pressure with warm oil is 49-98 kPa at idle and 245-392 kPa at full throttle.

CRANKSHAFT AND BEARINGS

R&R AND OVERHAUL. Remove crankshaft pulley or crank starter then remove flywheel. Remove piston and connecting rod as previously outlined. Remove pto bearing support (5–Fig. L5-8) and air shroud (18). Remove main bearing support (16) and withdraw crankshaft from crankcase.

Crankshaft main bearing journal standard diameter on Models L8, LDA450 and LDA510 is 41.99-42.00 mm for pto end and 39.99-40.00 mm for flywheel end. Main bearings (12 and 14) on Models L8, LDA450 and LDA510 are available in standard and 1.0 mm undersizes. Main bearings must be reamed to obtain clearance of 0.04-0.06 mm. Maximum allowable bearing clearance is 0.10 mm.

Crankshaft main bearing journal standard diameter on Models L10, L14, LDA96, LDA100 and LDA820 is 44.99-45.00 mm for both main bearings. Main bearings are available in standard and 0.5 mm and 1.0 mm undersizes which should not require reaming. Main bearing clearance should be 0.06-0.08

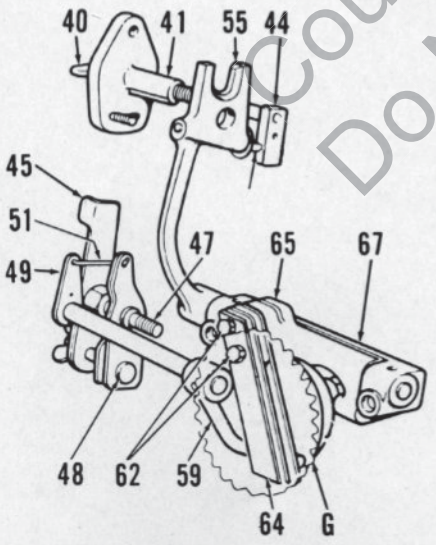


Fig. L5-12—Diagram of governor mechanism. Refer to text and Fig. L5-11 for parts identification.

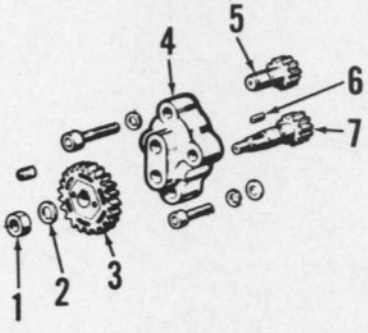


Fig. L5-13—Exploded view of oil pump.

1. Nut
2. Lockwasher
3. Gear
4. Pump body
5. Driven gear
6. Key
7. Drive gear

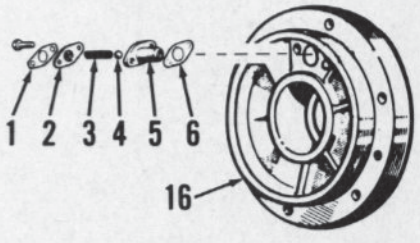


Fig. L5-14—Exploded view of oil pressure relief valve.

1. Lockplate
2. Cover
3. Spring
4. Ball
5. Body
6. Gasket
16. Main bearing support

mm with a maximum allowable clearance of 0.10 mm.

Reverse disassembly procedure to install crankshaft. Crankshaft end play should be 0.10-0.30 mm and is adjusted by varying thickness of gasket (15 – Fig. L5-8). Tighten main bearing support nuts to 29.4 N·m on Models L8, LDA450 and LDA510 or to 39.2 N·m on all other models.

MANUAL CRANK STARTER

Models L8, L10 and L14 are equipped with a crank type manual starter as shown in Fig. L5-15. Starter repair is evident after inspection of unit.

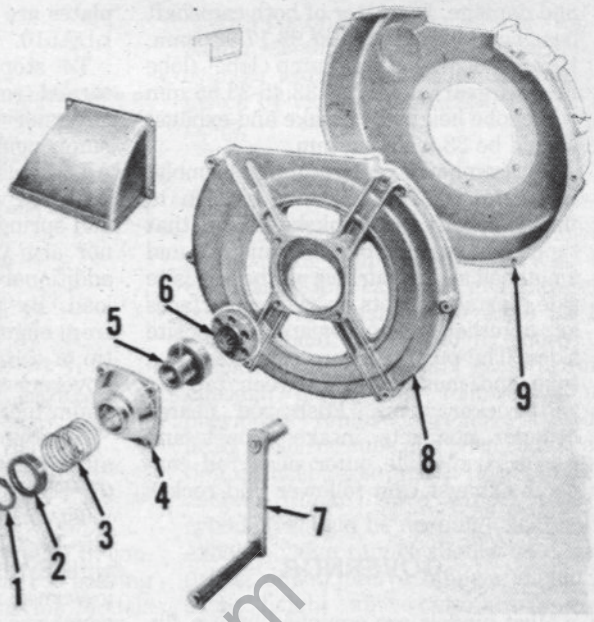


Fig. L5-15 – Exploded view of manual crank starter used on Models L8, L10 and L14.

1. Snap ring
2. Cap
3. Spring
4. Flange
5. Ring gear
6. Pinion
7. Crank
8. Cover
9. Case

HOMELITE TEXTRON

Homelite Division of Textron Inc.