

McCULLOCH

McCULLOCH CORPORATION
Los Angeles 45, California

MODEL	Bore	Stroke	Displacement	Drive Type
BP-1	1 3/4 in.	1 1/8 in.	2.7 cu. in.	Bevel Gear

The McCulloch BP-1 chain saw engine is a high speed two-stroke cycle, two piston engine using one piston for power and the second piston for balancing and as a sliding intake valve. See Fig. MC50 for schematic views of engine cycle. Maximum governed speed is 12000 RPM. Engine develops 4.2 horsepower at 10000 RPM. Saw has automatic chain oiler and sharpener.

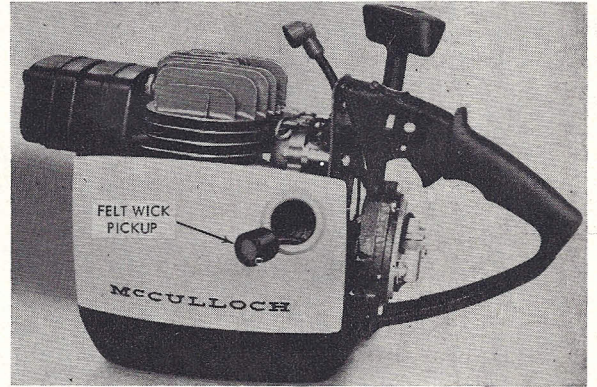
MAINTENANCE

SPARK PLUG. Recommended spark plug is AC type C45W low profile plug. Set electrode gap to 0.025.

CARBURETOR. A McCulloch diaphragm type carburetor with integral priming and fuel pumps is used. Exploded view of this carburetor is shown in Fig. MC52.

Initial carburetor adjustment is one full turn open on both high and low speed needles. Make final adjustments with engine warmed up and running. (CAUTION: Never run engine over one-half throttle unless actually sawing.) Adjust the idle speed stop screw (32—Fig. MC52) until engine idles at just below clutch engagement speed which is about 3000 RPM. Then adjust slow speed needle (22) for best engine performance at this speed. Readjust high speed needle (21) if engine four-cycles when warm, will not

Fig. MC51 — View of BP-1 powerhead with shrouds removed. Felt wick pickups can be fished out of fuel tank with hooked wire for cleaning or renewal.



run up to full speed while sawing, or emits a heavy blue exhaust. Turning both the low and high speed needles in a counter-clockwise direction richens the fuel mixture. Run a new or newly overhauled engine with a fairly rich fuel mixture to provide adequate lubrication until the engine is broken in.

MAGNETO AND TIMING. The flywheel type magneto has an external armature and coil with remote mounting of the breaker points and condenser in the rear handle

assembly with the recoil starter. For access to the breaker points and condenser, remove the domed cover inside the rear handle loop. Timing is fixed and non-adjustable at 27° BTDC. Breaker point gap is 0.018. Armature air gap is 0.008-0.010.

The breaker points can be adjusted by using a feeler gage; however, the timing light method is more accurate. Disconnect the coil lead from the breaker points and wire a light bulb and battery in a series

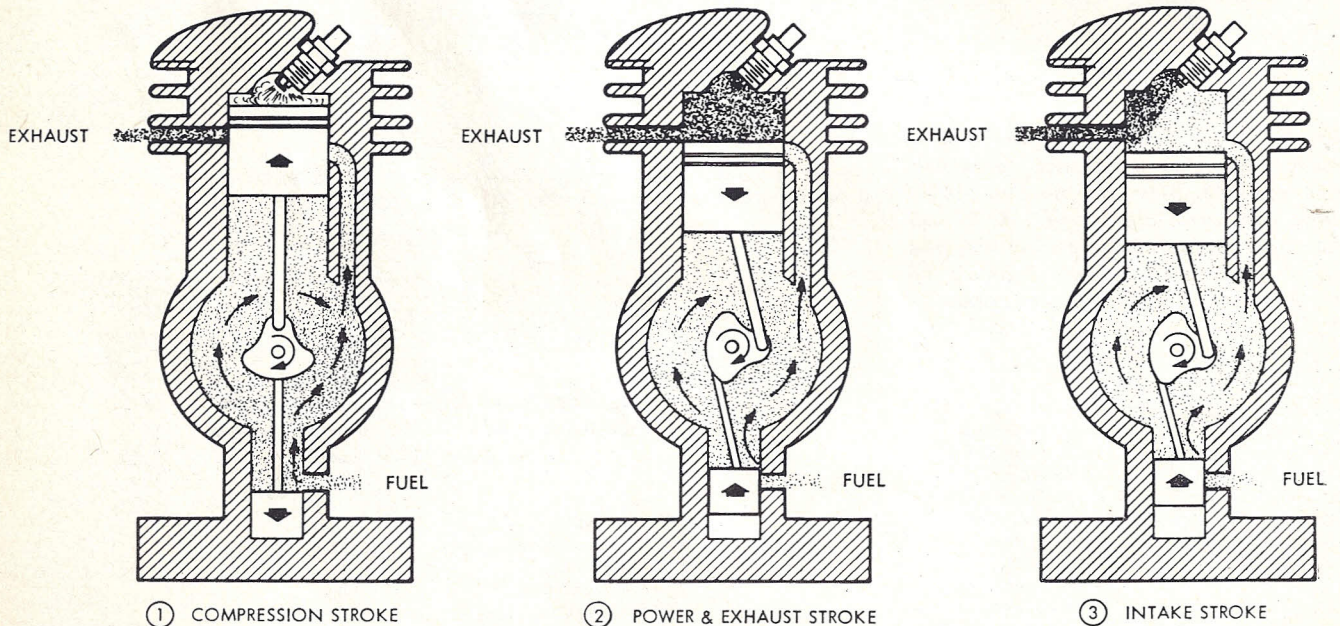


Fig. MC50 — Model BP-1 McCulloch chain saw engine operational diagram.

1. Compression Stroke — Ignition occurs at 27° BTDC. Both the intake and exhaust ports of power cylinder are closed and crankcase inlet port at balance cylinder is open.

2. Power and Exhaust Stroke — Power piston moves downward opening exhaust port at end of power stroke. At same time, balance piston is moving up compressing fuel-air mixture in crankcase.

3. Intake Stroke — Power piston, moving on down to bottom dead center, opens power cylinder intake port. Compressed fuel-air mixture enters power cylinder scavenging last of exhaust gas from power cylinder before power piston closes both ports on compression stroke.

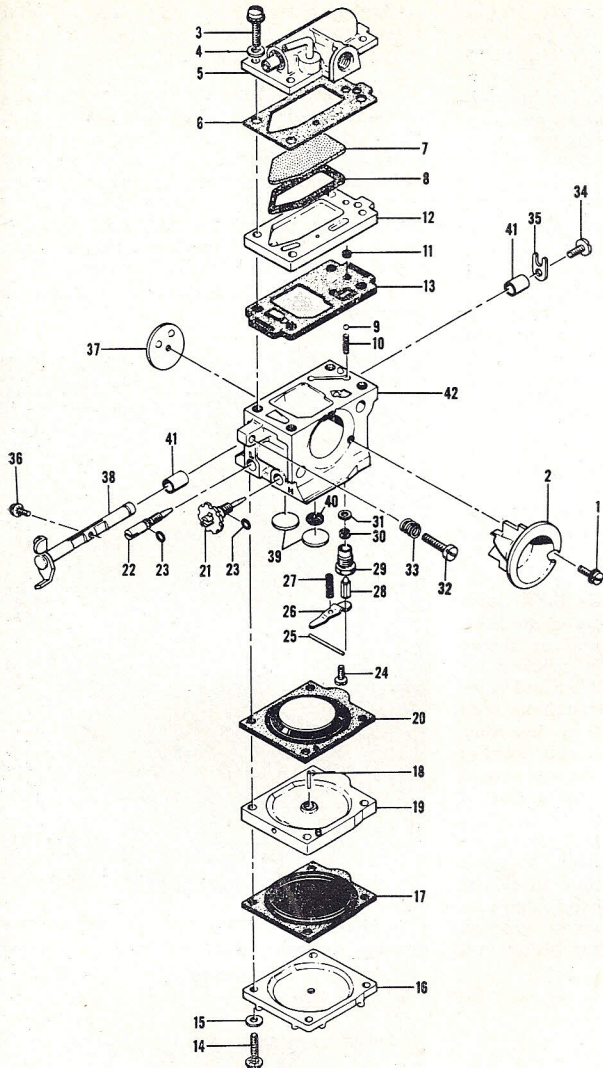


Fig. MC52 — Exploded view of McCulloch carburetor used on model BP-1 chain saw engine.

- 2. Diffuser
- 5. Primer assembly
- 6. Gasket
- 7. Fuel filter
- 8. Gasket
- 9. Ball
- 10. Spring
- 11. Primer valve seat
- 12. Fuel pump body
- 13. Pump diaphragm
- 16. Diaphragm cover
- 17. Actuator diaphragm
- 18. Actuator pin
- 19. Separator assembly
- 20. Regulator diaphragm
- 21. Main fuel needle
- 22. Idle fuel needle
- 23. "O" ring
- 25. Lever pin
- 26. Inlet control lever
- 27. Spring
- 28. Needle valve
- 33. Spring
- 35. Clip
- 37. Throttle plate
- 38. Throttle shaft
- 39. Plugs
- 40. Capillary seal
- 41. Bushing
- 42. Carburetor body

connection between the breaker point terminal and the engine ground. Then turn the engine until a pin can be inserted through the hole in the engine bottom cover into the timing hole in the flywheel. Adjust the breaker points so that the light bulb is burning; then open the points slowly until the light just goes out. Tighten breaker point mounting screws.

GOVERNOR. The model BP-1 saw engine is equipped with an air vane type governor. The vane is attached to the throttle actuator shaft and the governor spring is hooked over the primer rod. The governor spring should make one turn around the actuator shaft for correct tension. If engine does not run at full RPM, check governor and linkage for proper assembly.

LUBRICATION. Engine lubrication is provided by mixing oil with the fuel. Use one part SAE 40 non-detergent motor oil, SAE 40 outboard motor oil, or McCulloch chain saw oil with 20 parts of regular grade gasoline (½-pint of oil to 1¼ gallons of gas). Tilt saw about 45° to right side as viewed from the handle end to fill fuel tank to maximum capacity.

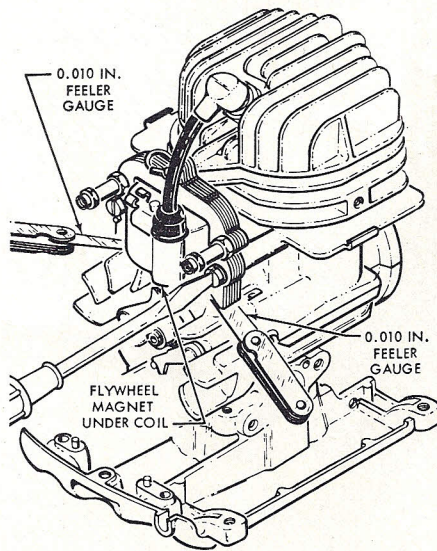


Fig. MC53 — Adjusting air gap on BP-1 chain saw engine magneto. Loosen mounting screws, turn flywheel magnet under coil, insert 0.010 feeler gage under each side of armature and tighten mounting screws.

For temperatures above 40° F., use SAE 140 gear oil in the transmission. For temperatures between 10° and 40° F., use SAE 90 gear oil; and for temperatures below 10° F., use a 50-50 mixture of SAE 90 gear oil and kerosene in the transmission. Fill the transmission with saw laying on its left side as viewed from handle end. Check the oil level with the saw upright.

Saw chain oiler tank is in the transmission gear case. Tilt the saw about 45° to right side and fill chain oiler tank with any new SAE 20 to SAE 50 oil. Chain is oiled automatically from a pump operated by the transmission sprocket shaft. An override button is provided on the pump adjustment to flood the chain with oil when this is considered necessary.

REPAIRS

The engine assembly can be removed from the BP-1 chain saw by removing shrouds, panels, fuel tank, carburetor and transmission. Transmission is detached after removal of other parts and assemblies by unhooking chain sharpener control rod and the bolts holding transmission attaching clamp. Special service tools for the BP-1 engine and transmission are available from the McCulloch Corporation as follows:

Tool Description	Part Number
Service Tool Kit, Complete	59556
Clutch wrench	59534
Transmission pinion puller	59541
Piston holding block	59545
Piston pin driver	59546
Piston pin bearing driver	59547
Oil pump bushing driver	59548
Muffler wrench	59549
Chain sprocket puller	59550
Sprocket wrench	59553

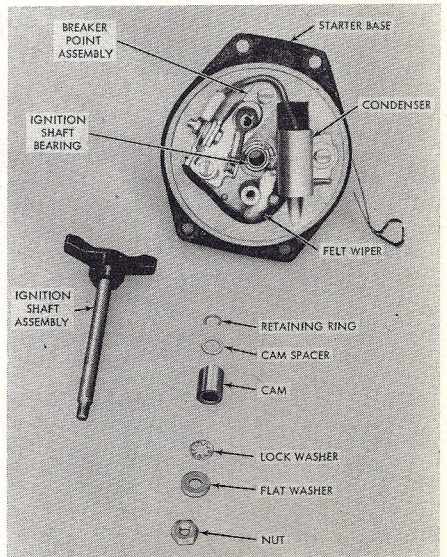


Fig. MC53A — Partly disassembled view of BP-1 ignition breaker assembly.

Illustrations courtesy of McCulloch Corp.

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TIGHTENING TORQUES. Recommended tightening torques are as follows. (Values are in inch-pounds).

Connecting rod bolts	65-70
Crankcase bolts	140-150
Spark plug	240-264
Flywheel nut	300-360
Carburetor valve body	30-40
Carburetor valve lever screw	15-18
Carburetor diaphragm cover	20-25
Carburetor primer assembly	20-25
Ignition cam nut	12-15

CONNECTING RODS. Crankshaft with connecting rod and piston assemblies is removed after removing flywheel, clutch assembly and counterweight, and splitting crankcase as in Fig. MC54. To remove clutch assembly, place a pin through bottom engine cover into hole in flywheel and unscrew clutch assembly in a clockwise direction with wrench No. 59534. Slide counterweight from crankshaft taking care not to lose steel ball (See Fig. MC56) that retains the counterweight to the crankshaft. Remove flywheel nut, take pin from hole in engine bottom cover and flywheel, and pull flywheel from crankshaft.

Remove rod and piston assemblies from the crankshaft. Take care not to lose the 20 needle bearing rollers from each rod. Reinstall cap loosely in same position as it was removed as soon as each rod is removed from the crankshaft to prevent the caps from being mixed.

BALANCE PISTON CONNECTING ROD. To remove the connecting rod from balance piston, place piston in holding block, tool No. 59545, and press pin from piston and rod assembly with tool No. 59546. No snap

rings are used to retain piston pin as pin is a press fit in connecting rod. To reassemble, heat rod to 180° F. with heat lamp or in oven. (Do not use a torch as uneven heat would warp rod.) Place piston in holding block, insert rod and press pin into piston and rod. Allow rod to cool to room temperature.

POWER PISTON CONNECTING ROD. To remove the connecting rod from power piston, place piston in holding block, tool No. 59545, with closed end bearing down and press piston pin and closed end bearing out of piston and rod with driver No. 59546 inserted in pin through open end bearing. See cross-section view of power piston, connecting rod, bearings and spacers in Fig. MC57. To reassemble, heat connecting rod with heat lamp or in oven to 180° F. (Do not use a torch as uneven heat would warp rod.) Insert connecting rod and spacers in piston with bearings installed and push piston pin through open end bearing into piston, spacers and rod. Allow rod to cool to room temperature.

INSPECTION AND REASSEMBLY. Carefully inspect each connecting rod and renew if lower end I.D. is scored or shows signs of wear. Rods should be checked for alignment after installing in piston and prior to assembly to crankshaft. Straighten rods found to be twisted or bent by inserting bar in piston pin through open end bearing (no bearings are used in balance piston) and aligning assembly with lower end of rod attached to pin of alignment jig. See Fig. MC59. To assemble rod and piston assembly to crankshaft, use grease to stick 10 needle rollers in the rod and 10 rollers in the cap. Install balance piston and connecting rod on crankpin nearest tapered end of crankshaft. Install power piston and

connecting rod on remaining crankpin with closed end of bearing in piston towards stepped end of crankshaft.

Parting faces of rod and cap are fractured (not machined) to provide the dowel effect of the meshing of the consequent uneven surfaces. It is advisable to wiggle the rod cap back and forth while tightening to make sure the interstices (pips) of the fractured joint are in perfect mesh. When properly meshed, no "catch points" will be felt when finger nail is rubbed along the parting line of rod and cap. Torque cap screws to specified value.

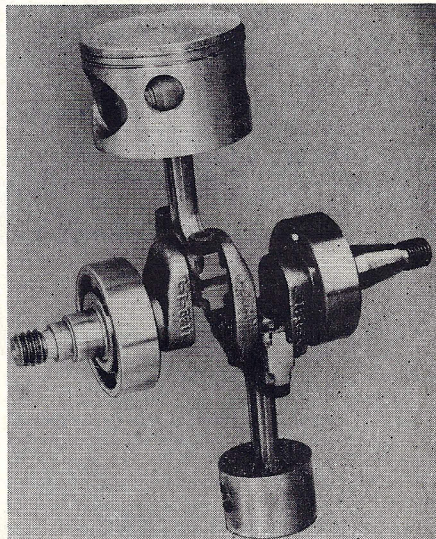


Fig. MC55 — Piston, rod, crankshaft and bearing assembly removed from BP-1 chain saw engine.

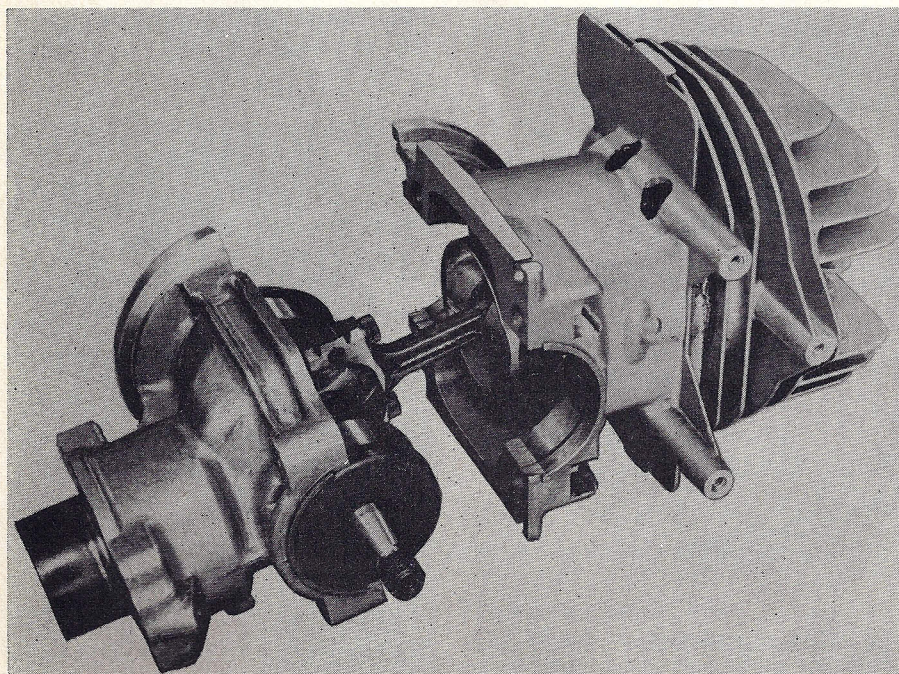


Fig. MC54 — Crankcase is split to remove crankshaft, pistons, connecting rods and bearings as an assembly.

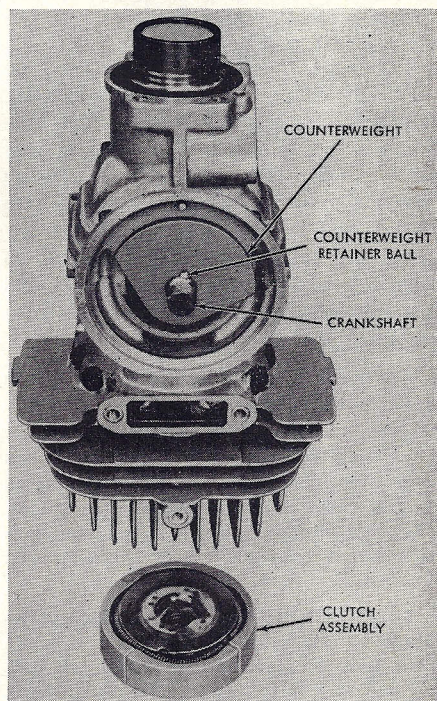


Fig. MC56—Clutch assembly removed from BP-1 engine showing position of counterweight and counterweight retaining ball on engine crankshaft.

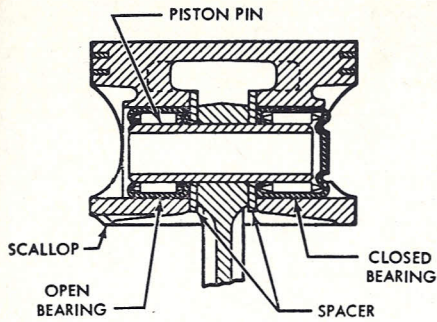


Fig. MC57 — Cross-section view of power piston showing position of needle bearings and connecting rod spacers.

PISTON, PIN AND RINGS (POWER PISTON). Piston is removed as in paragraphs on connecting rods. If necessary to remove open end needle bearing from the piston, place the piston in holding block with bearing down and press the bearing out with driver No. 59547. Check piston for score marks, excessive clearance between skirt and cylinder wall and for ring side clearance with new piston ring. Pistons are available in oversizes of 0.010, 0.020 and 0.030. The power piston uses one closed end needle bearing and one open end needle bearing. The open end needle bearing must be inserted in the scalloped side of piston. See Fig. MC57. Install bearings by placing piston in holding block and pressing bearings in with driver No. 59547.

The two piston rings are unpinned. Minimum end gap is 0.004 inch with wear limit to 0.020. McCulloch recommends renewing piston rings whenever engine is being overhauled. Install piston rings, bottom ring first, over head end of piston tak-

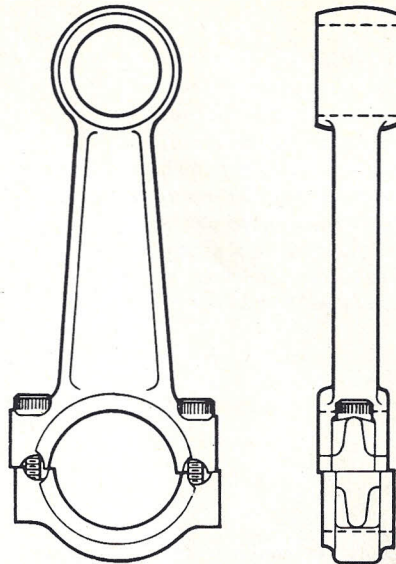


Fig. MC58 — Exaggerated view of cap improperly assembled to connecting rod. When cap is properly assembled to rod, no "catch points" can be felt when fingernail is rubbed against the parting line of rod and cap.

ing care not to scratch piston sidewalls. Place rings on piston so that end gaps are staggered. Reject piston pin if scored, pitted or shows any signs of wear. Reject piston pin and/or connecting rod if press fit cannot be obtained.

BALANCE PISTON. Balance piston is removed as in paragraphs on connecting rods. No rings or pin bearings are used in the

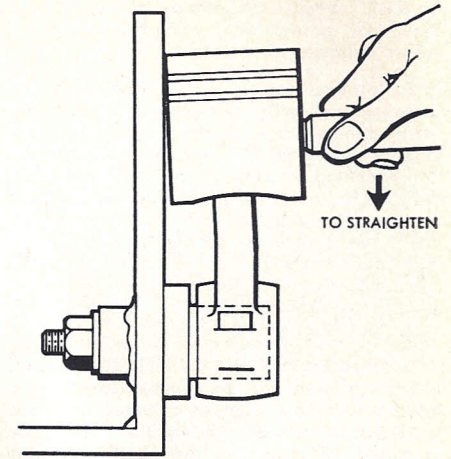


Fig. MC59 — To straighten bent or twisted connecting rod, mount rod and piston assembly on alignment jig, insert bar in piston pin through open end needle bearing and apply force in direction necessary to straighten rod. (Balance piston does not use needle bearings).

balance piston. Minimum piston to cylinder clearance for balance piston is 0.0015. Inspect balance piston for scoring or excessive piston to cylinder clearance, and for fit to piston pin. Renew balance piston and pin if any play of pin in piston is visible.

POWER PISTON CYLINDER. Inspect power piston cylinder for scoring, cracks or excessive piston skirt to cylinder clearance. Cylinder must be renewed or honed to oversize if any of these conditions are found. Nominal standard cylinder diameter is 1.750. Always hone to exact 0.010, 0.020,

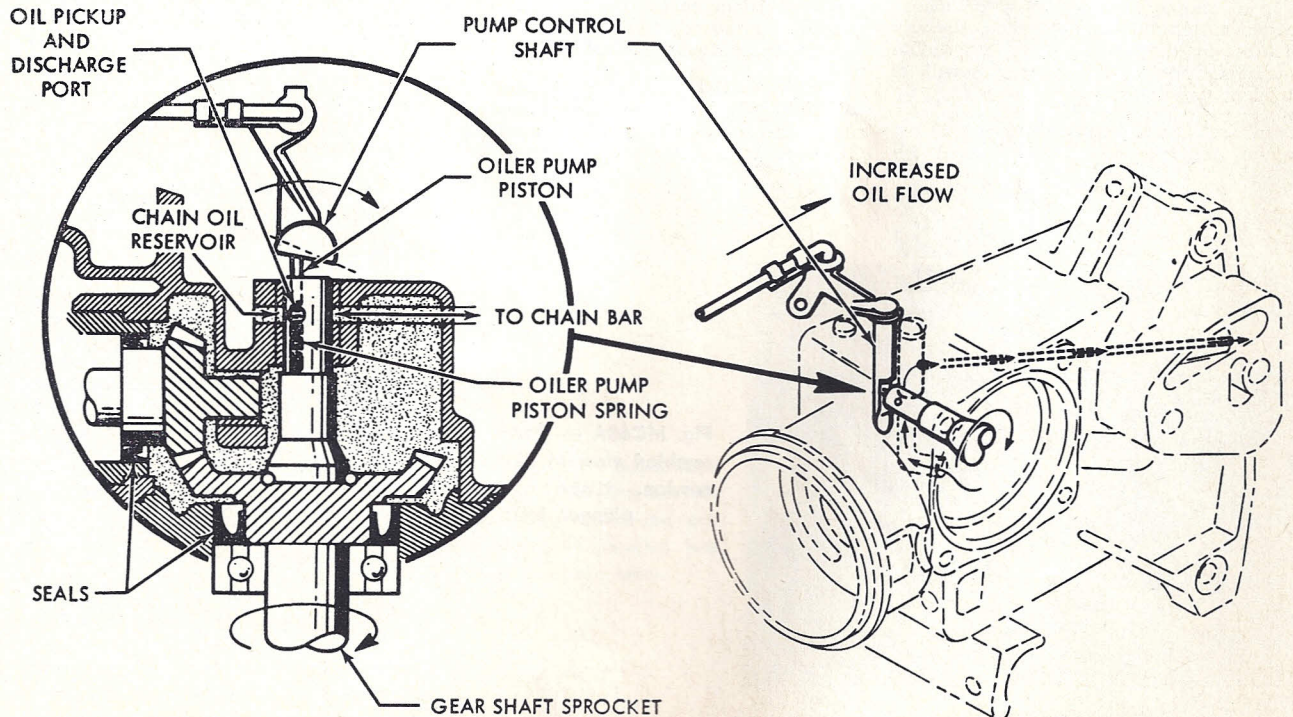


Fig. MC60 — Schematic view of automatic chain oiler pump operation.

Illustrations courtesy of McCulloch Corp.

or 0.030 oversize as service piston will be sized for proper skirt clearance at these exact cylinder diameters.

To protect honing stones from chipping from contact with port holes in cylinder, wrap one-half of each stone with one layer of fine emery cloth. After honing operation is completed, clean the cylinder and ports with SAE 10 engine oil. Never use gasoline or other solvents as they will only imbed the honed particles deeper into the pores and hone marks in the cylinder walls. After cleaning cylinder, insert new piston in cylinder to be sure piston to cylinder clearance is sufficient.

BALANCE PISTON CYLINDER. Balance piston cylinder can be pressed from crankcase lower half. Renew cylinder if scored or if excessive piston to cylinder clearance is noted. Clearance of new balance piston to new cylinder should be 0.0015-0.0025.

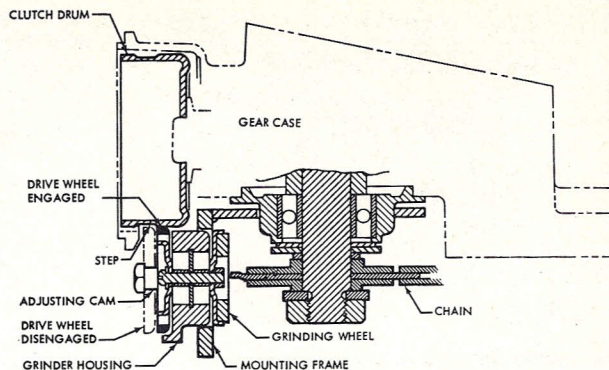
CRANKSHAFT, BEARINGS AND SEALS. Crankshaft rides in two ball bearing mains. Seals on crankshaft are held just outside each main bearing by tight fit in bearing bore when crankcase halves are joined. See Fig. MC54. Retaining ring for ball bearings fit in grooves in bearing bores.

Do not wash ball bearings in solvent. Rotate the bearings on crankshaft to check for noisy or "lumpy" condition which would indicate flat or chipped balls. Renew bearing if either of these conditions are noted or if excessive radial play of bearing is found. Remove bearings from crankshaft by supporting outer race of bearing and pressing shaft out of bearing. Support web of crankshaft to press new bearing into place. Do not put pressure on entire length of the crankshaft as this may warp shaft and cause excessive runout. Care should be taken not to damage area of crankshaft where seals ride or crankshaft ends while renewing the main bearings.

Inspect crankpin journals of crankshaft and renew shaft if either journal is pitted, scored or shows any sign of wear. Check threaded crankshaft ends, flywheel keyway and taper for damage or wear that should be corrected or would make renewal of crankshaft necessary.

Crankshaft seals may be reused if the lips are not damaged and the seal fits

Fig. MC61 — Schematic view of automatic chain sharpener operation. Sharpener operates only when control is actuated. Adjustable stop on grinding wheel is turned clockwise to move grinding wheel closer to chain in steps of 0.002 inch.



snugly to the crankshaft. However, as maintaining compression in the crankcase of two-cycle engines is very important, it would be best to renew the crankshaft seals in most cases.

INTAKE VALVING. Intake valving of engine utilizes the balance piston for a sliding valve. Refer to the paragraphs on balance piston and cylinder.

CLUTCH ASSEMBLY. Clutch rotor and shoe assembly are removed from engine crankshaft as discussed in paragraphs on connecting rods. Clutch shoes are retained in welded rotor assembly by a coil tension spring with ends hooked together. (See Fig. MC56). Disassemble by prying shoes apart to expose spring and lift spring from assembly with pointed tool. Free length of spring should be 4 3/4 inches and 6 to 7 pounds of pull should be required to stretch the spring to 5 1/4 to 5 3/4 inches. Check clutch shoes for burrs, wear or scoring that would damage drum and renew full set of four shoes if one or more shoes cannot be reused. Clutch drum is a part of the transmission assembly.

TRANSMISSION, CHAIN OILER AND SHARPENER. To disassemble transmission, first remove the bar and chain assembly. Then hold the chain sprocket with tool

No. 59553 and unscrew clutch drum in a clockwise direction with tool No. 59534. Renew clutch drum if scored or worn excessively. Clutch drum I. D. should be 2.248-2.253.

While holding chain sprocket with wrench No. 59553, remove sprocket nut, split spacer and sprocket key. Then pull sprocket with puller No. 59550. Remove second split washer and sprocket aligning shims. Keep shims together for reassembly of transmission. Shims are used to align groove in sprocket with groove in chain bar. Check alignment after reassembly and add or remove shims as necessary.

Drain oil from chain oiler tank and remove tank cover taking care not to allow the oiler pump piston spring from ejecting the piston from end of sprocket shaft. Remove piston and spring from end of shaft.

Drain oil from transmission and remove transmission cover by removing the four bolts with slotted nuts. Sprocket shaft with bevel gear can be removed from the cover by pressing on sprocket end of shaft. Pinion can be removed from transmission gear case with puller No. 59541. Take care not to lose the steel shims from the pinion bearing bore.

Further disassembly of transmission, chain oiler and chain sharpener is self-evident. Do not wash transmission bearings in solvent.

Oil pump piston spring free length should be 0.402-0.422. Renew pump piston (P—Fig. MC60A) if worn. Schematic view of chain oiler pump and related parts is shown in Fig. MC60. Bushing at inner end of sprocket shaft can be removed and a new bushing installed with driver No. 59548.

Pinion and bevel gear with sprocket shaft are renewable in matched sets only. Correct thickness of shims to use in pinion bearing bore when installing new gear sets is etched on the inner face of the new bevel gear. Heat gear case and cover to 180° F. to install pinion and sprocket shaft gear. Backlash of sprocket shaft gear should be 0.004-0.008 measured at sprocket tooth when pinion is held stationary after reassembly of transmission.

Cross-sectional schematic of chain sharpener is shown in Fig. MC61.

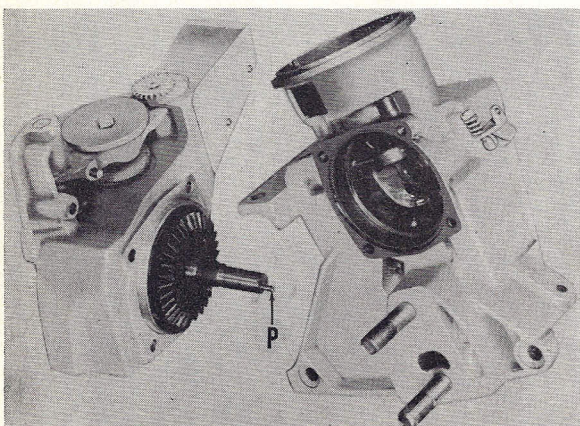


Fig. MC60A — Partly disassembled view of BP-1 transmission. Note oil pump plunger (P).