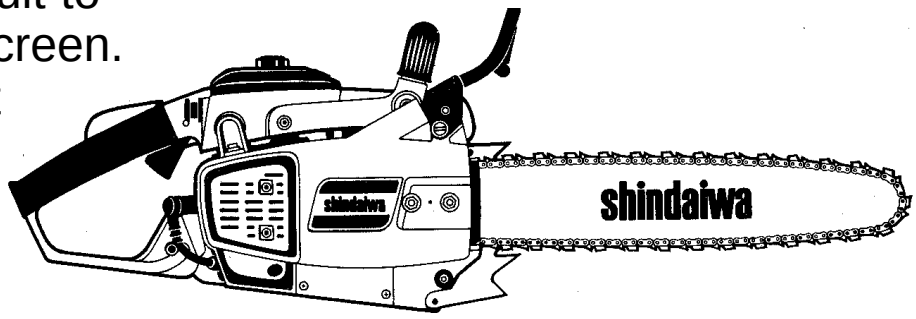
shindaiwa SERVICE MANUAL

CHAIN SAWS

Note: This is an older manual, not originally created in an electronic format, and may be difficult to read on your computer screen. For best results, print out the pages you wish to reference.



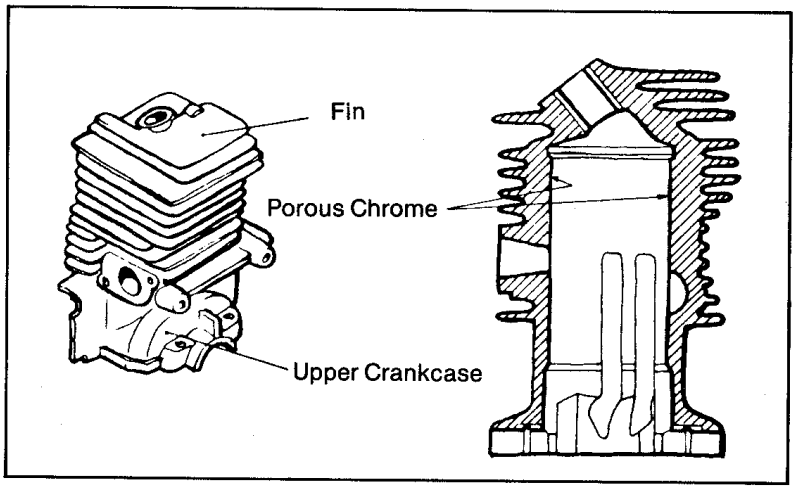
Section 1: Specifications

MODEL	350	415	450	500
Cycle/Type	2-Cycle Single Cylinder (ALL MODELS)			
Displacement cc(cu.in)	35.5(2.3)	39.4(2.4)	43.6(2.66)	47.9(2.9)
Bore/Stroke mm	37 x 33	39 x 33	41 x 33	43 x 33
Maximum HP @ RPM	2.2	2.6	2.8	3.1
Normal Operating RPM	6,000-10,000 (ALL MODELS)			
Maximum RPM	12,000 (ALL MODELS)			
Idle RPM	2,800-3,200 (ALL MODELS)			
Compression Ratio	6.8:1			6.9
Compression PSI	140-156 (ALL MODELS)			
Cooling System	Forced Air Cooling Hi Capacity Fan (ALL MODELS)			
Lubrication	Fuel/Oil Mix (ALL MODELS)			
Fuel Type	Unleaded/Regular (ALL MODELS)			
Ratio	25:1 (ALL MODELS)			
Fuel Capacity ℓ (oz)	.34(11.5)	.48(16.2)	.48(16.2)	.52(17.6)
Min. Fuel Consumption (G/HP/HR)	350 (ALL MODELS)			
Ignition System	Transistor Controlled Ignition (ALL MODELS)			
Coil/Flywheel Gap	.014'' (.35mm) (ALL MODELS)			
Spark Plug Type	Champion CJ-8Y (ALL MODELS)			
Spark Plug Gap	.024'' (.6mm) (ALL MODELS)			
Starting System	Multi-coil Recoil (Auto Rewind) (ALL MODELS)			
Stopping System	Toggle Switch (Ground) (ALL MODELS)			
Carburetor (Walbro)	WA115	WA101B		
Standard Opening Low	1¼ turns			
High	1¼ turns			
Air Cleaner	Flocked (Stainless Steel-Optional)			Stainless Steel-Standard (Flocked Optional)
Clutch	4-Shoe Automatic Centrifugal (ALL MODELS)			
Clutch Engagement RPM	3,500-4,000 (ALL MODELS)			
Chain Oiling	Adjustable Automatic - Clutch Driven (ALL MODELS)			
Chain Oil Capacity ℓ (oz)	.25(8.5)	.27(9.1)		.30 (10.1)
Chain Oil Consumption	7cc-Min @ 7200 RPM @ ½ Open Pump Setting			
Total Dry Weight w/o bar lb (kg)	10.1(4.6)	11.7(5.3)		
Sprocket	Spur			Rim System Standard
Bar Lengths	14-16''	16-18''	16-18-20''	16-18-20-24''
Chain Pitch	3/8''	.325''	.325''	.325''-(3/8'' optional)
Number of Drive Links	53, 57	66, 72	66, 72, 79	66, 72, 79, 92
Standard Chain Type	Oregon 91SG	Oregon 33LG		Oregon 33LG Standard Oregon 72DP Optional
Gauge - Drive Link	.050 (ALL MODELS)			
Chain Brake	Standard - Adjustable (ALL MODELS)			
Chain Brake	Rubber Coated (ALL MODELS)			
Muffler	USFS Spark Arrestor Type (ALL MODELS)			
Noise dB	97.2	105.0	101.8	99.0
Vibration (G)	1.1	1.0	.71	1.2
Dimensions in (mm)	15.7 x 9.5 x 9.8 (399 x 241 x 250)	15.7 x 10.6 x 9.8 (399 x 268 x 250)		15.7 x 10.6 x 9.8 (399 x 268 x 250)

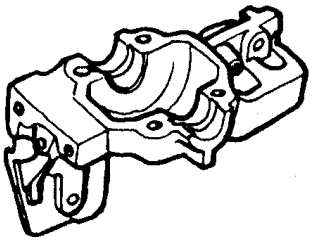
Section 2: Construction and Operation of Gas Chain Saws

A. Engine

1. **Cylinder.** The cylinder barrel and upper crank case assembly is a one piece magnesium design with the inside of the cylinder porous hard chrome-plated for rigidity, light weight and durability. A special fin shape is used for optimum cooling.

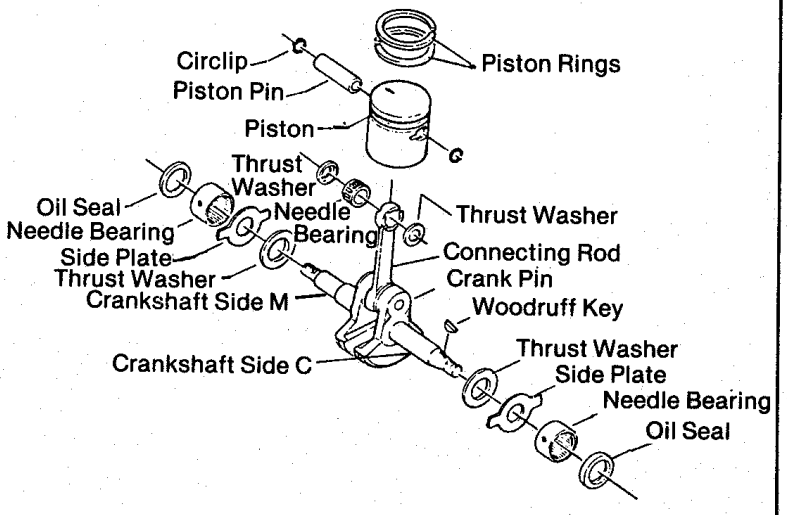


2. **Crankcase.** The lower half is a one piece magnesium design with bar mount attached directly to it for strong mounting and rigidity. Two thrust washers and two side plates are used on bearing surfaces to avoid wear to crankcase.

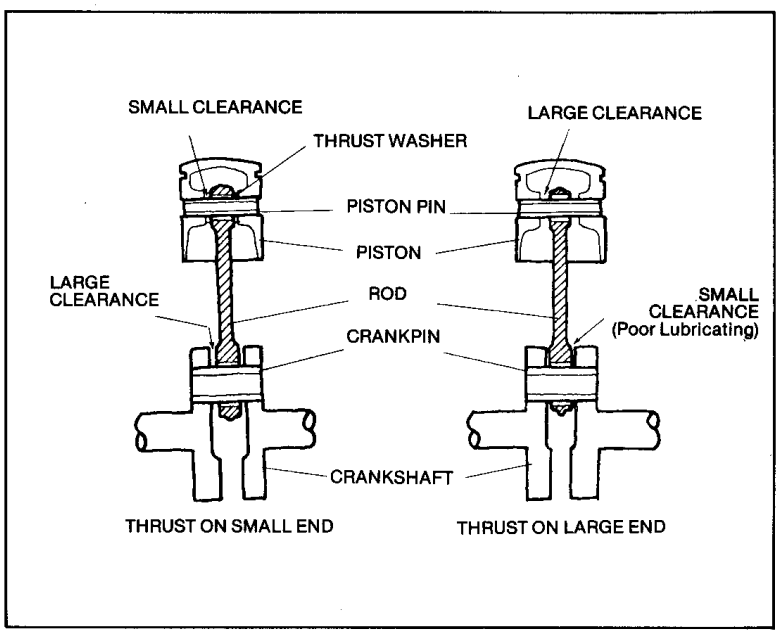


CRANKCASE — LOWER HALF

3. **Crankshaft.** The crankshaft is a three piece construction using high alloy carbon steel, surface hardened for increased longevity. The crankpin is pressed in and is non-replaceable. Premium custom-made, heavy-cased needle bearings are used at both ends of crankshaft for compactness of the unit. Needle bearings include an oil hole for improved lubrication. Non-metallic thrust washers are used at outer ends of crankshaft counterweight for quiet operation and long life.



4. **Connecting Rod.** Needle bearings are used on the small and large end of the connecting rod for increased durability and reliability. Most manufacturers use a thrust system on the large end of the crankshaft which decreases potential lubrication to the connecting rod large end bearing at high RPM and increases wear on the thrust washer. Shindaiwa puts its thrust system on the small end by adding thrust washers between the piston pin bosses, for increased lubrication at high RPM and long wear of thrust washers.

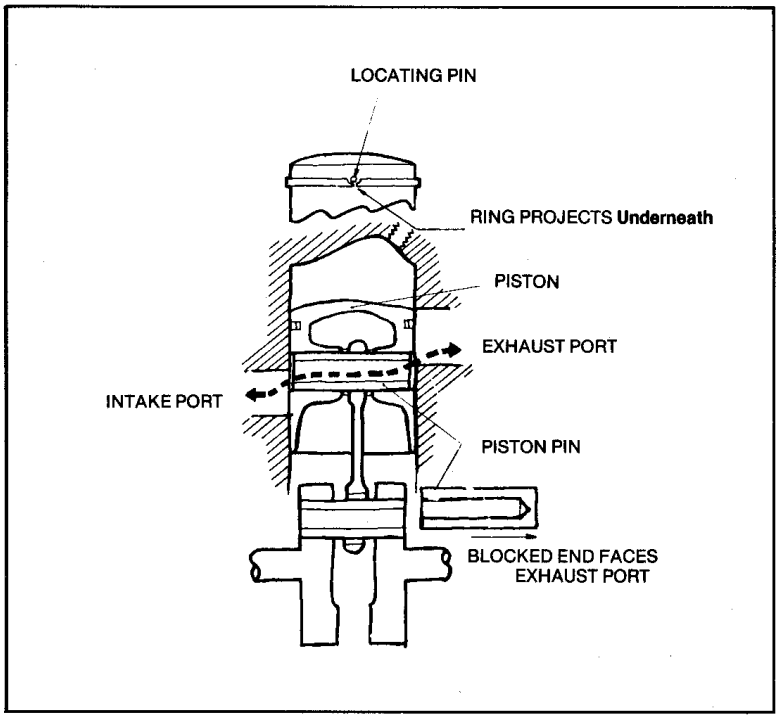


5. **Piston.** The piston is of a high alloy aluminum construction. Two piston rings are used for durability and stability at all RPM ranges. Piston and cylinder surfaces are carefully machined and proper tolerances maintained for superior trouble-free operation and long life.

NOTE: When installing the piston on connecting rod, arrow on piston top should point to exhaust side of engine. (To stepped side of crankshaft, not to tapered side of crankshaft.)

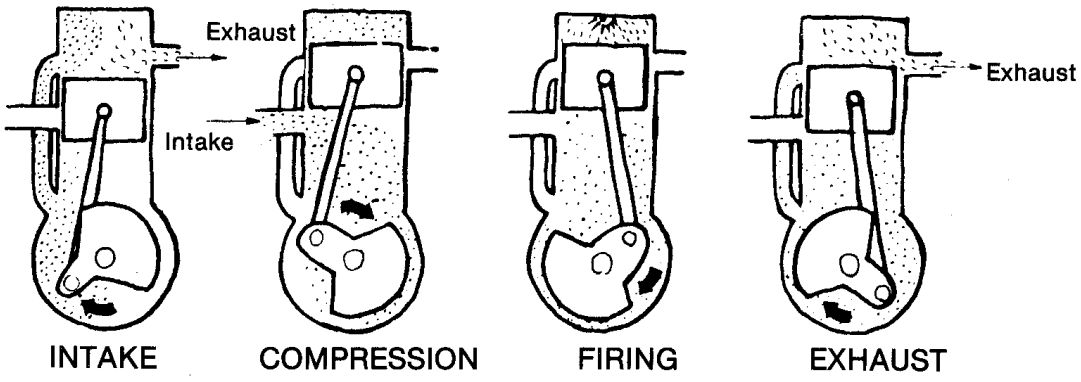
6. **Piston Pin.** The piston pin is constructed of high alloy steel; carefully machined, heat-treated and quenched. One end of the pin is closed to prevent loss of compression as intake and exhaust ports could connect.

NOTE: Blocked end must face exhaust!



B. Theory of Two-Cycle Operation

1. Intake — After firing, piston lowers, fuel air mixture comes in, and exhaust goes out.
2. Compression — As the crankshaft rotates, movement of the piston closes the intake and exhaust port, compression rises, and an intake of new fuel is sucked into the crankcase.
3. Ignition — Spark plug firing takes place at 31° before top dead center (BTDC), producing power, and the piston lowers.
4. Exhaust — The exhaust port is exposed as piston lowers. Exhaust gases go out the exhaust port as the intake mixture goes in.



C. Disassembly

1. Check compression before disassembly of engine.
2. Properly clean all external surfaces prior to disassembly for ease of disassembly, time savings, better diagnosis, etc.
3. Carefully place necessary screws, etc. near assemblies as removed. Place parts in order on bench for rapid assembly and to prevent loss of parts.
4. Disassembly steps: (Accessory Units)
   (a) Clean
   (b) Remove clutch cover
   (c) Remove front handle
   (d) Remove handle bracket (Note: Special screws)
   (e) Remove recoil case (gas and oil caps can remain in place)
   (f) Remove hoses, throttle linkage, air cleaner, carburetor, and choke assembly. (Note: Watch screws and washers of choke assembly carefully to prevent falling into carburetor.)
   (g) Push carburetor boot through hole, disconnect switch wire, and remove rear handle.
   (h) Remove clutch drum and clutch assembly using #22104-96100 puller and #22100-96410 flywheel wrench.
   (i) Remove oil pump gears and oil pump. (Note: The nylon pump gear can be removed by using a small straight blade screwdriver and counterclockwise rotation.)
   (j) Remove flywheel (rotor) using puller #22104-96100.

Disassembly (continued)

(k) Remove fuel and oil tanks (Note: First remove fuel tank nipple with needle nose pliers, then remove oil tank by pulling to the front of saw before removing.)

(l) Remove TCI unit.

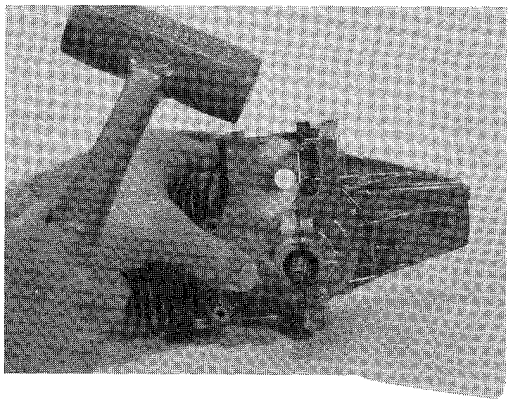
(m) Remove TCI coil (Note: Use oil in spark plug protector to slide it and covering off.)

(n) Remove muffler.

(o) Remove engine from engine cover by removal of 5 Allen screws.

C. Disassembly of Engine Unit

1. Remove woodruff key on flywheel (rotor) side of crankshaft (using nippers or side cutting pliers). Do not use screwdriver as it can damage crankshaft.

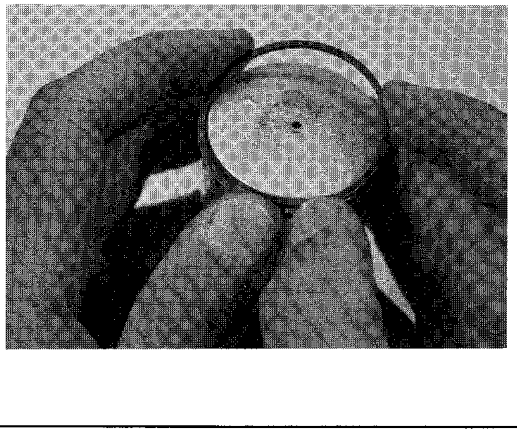


2. Remove four screws securing cylinder to crankcase. Tap crankshaft gently with a soft hammer to loosen sealing surfaces.

NOTE:

1. **Do not pry apart with screw driver as it may damage cylinder to crankcase sealing surfaces.**

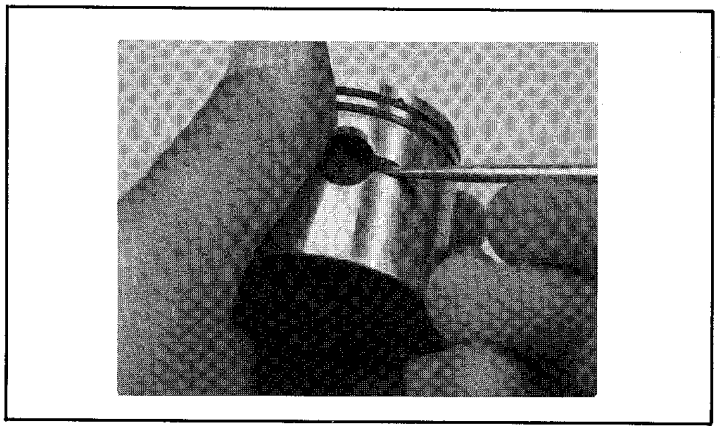
2. **Do not tap on crank as bending or misalignment may occur.**



3. To disassemble cylinder and crankshaft, carefully pull piston/crankshaft ass'y straight out.

4. Remove piston rings. NOTE: Piston rings are made of premium cast iron but can break if opened too far. Open slowly and carefully using index fingers to steady piston and thumbs to spread rings, or use a ring removing tool.

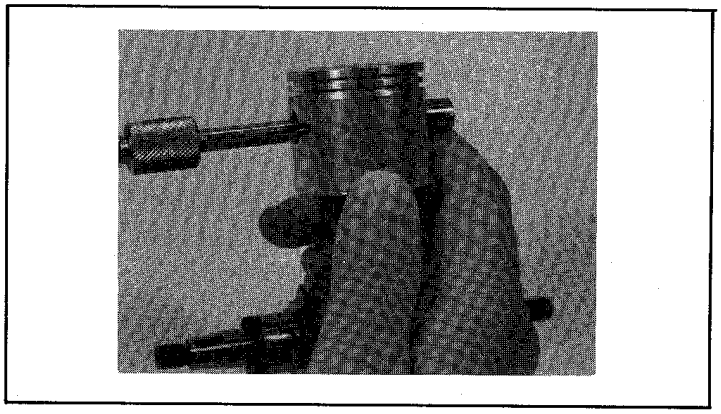
5. Remove wrist pin circlips. NOTE: Use small pointed tool to lift circlips. To avoid injury and loss, use thumb as shown in illustration to retain clip upon removal.



6. Remove piston pin using special tool #22102-96530. NOTE: When removing pin, place piston-crankshaft assembly in hand to avoid damage. DO NOT place against bench, vise, etc!

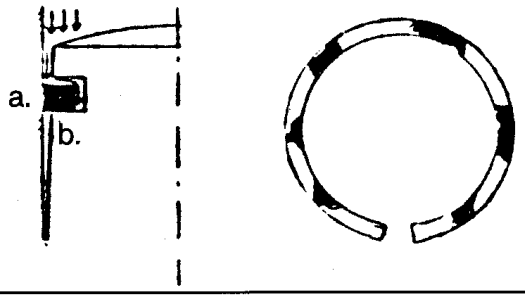
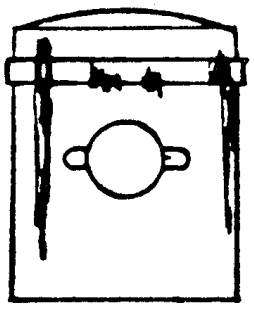
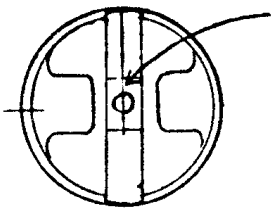
7. After removing piston from crankshaft assembly, remove needle bearing and thrust washers.

8. Remove oil seal, needle bearing, side plate, and thrust washer from both sides of crankshaft. NOTE: Squeeze oil seal away from woodruff key slot when removing to prevent damage by cutting and subsequent loss of crankcase pressure.



D. Inspection

		MAINTENANCE
1.	Cylinder surface and dimensions	Measure using tolerances shown on page 37. Replace if damaged or excessive wear is evident.
2.	Carbon on cylinder head	Scrape or clean to remove carbon using a soft scraper.
3.	Carbon on ring	Scrape clean to remove carbon.
4.	Carbon in ring groove	Remove using broken ring or ring groove scraper.
5.	Connecting rod or wrist pin wobbling	Replace crankshaft assembly and wrist pin. Also inspect piston pin bosses.
6.	Oil seal for signs of cracks, wear, brittleness	Replace
7.	Worn connecting rod bearing on large end of crankshaft; rod wobbling on crankshaft	Replace crankshaft-rod assembly.
8.	Burning of sideplate or roughness showing sign of lack of lubrication	Replace sideplate.
9.	Burning or damage to thrust washer	Replace thrust washer.

10. Wobbling of crankshaft in crankcase	Measure crankshaft and crankcase assembly tolerances, replace needle bearings, or crankshaft assembly as necessary.
11. Burning of large end of connecting rod bearing or stiff movement.	Replace crankshaft assembly.
12. Piston or wrist pin wobbling	Measure tolerances and replace pin or piston or both as necessary.
13. Low compression	Test compression, inspect, replace.
(a) Poor piston sealing. Check end gap and inspect rings (See illustration). Shiny spots around top and bottom of rings, worn rings, or warped cylinder are due to poor cooling or clogged cylinder fins.	
(b) Scuffed piston due to internal damage from: (1) Dislocation of snap rings (2) Burning or breakage of large end needle bearings (3) Burning wear or seizure of small end bearing (4) Damaged sideplate (5) Foreign material	Replace piston, inspect cylinder carefully. 
(c) Scuffed or burned piston due to: (1) Deformation from usage a. full throttle operation when cold. b. too lean of carburetor setting. c. clogged cylinder fins causing overheating. d. gas/oil ratio is too lean or the saw is being run on gasoline only. e. use of old fuel mix.	Replace piston and/or cylinder
(2) Excessive load a. To determine cause of burned piston: When color of inside of piston head is the same as aluminum casting, saw is properly loaded. When color is brown or black inside of piston, saw has been highly overloaded.	Replace piston as necessary 

GENERAL NOTE:

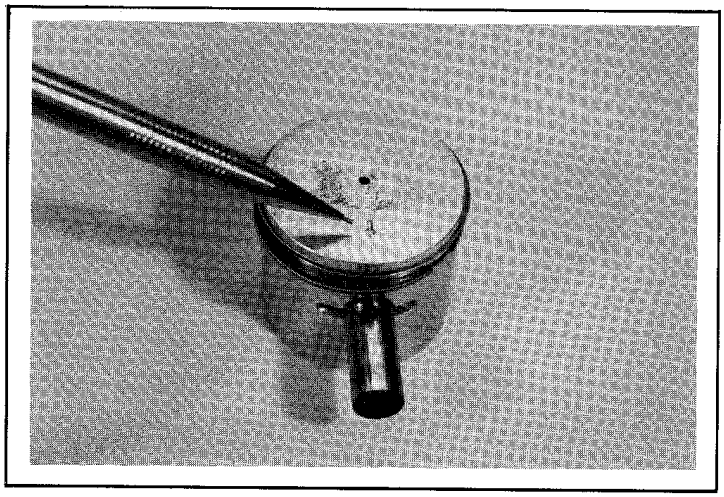
1. It is impossible to disassemble crankshaft without damage.

2. For more troubleshooting information, see Page 40.

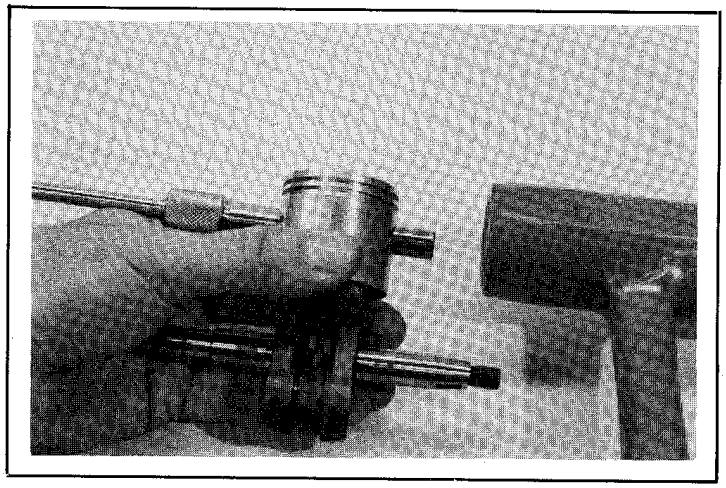
E. Engine Assembly

1. Piston Assembly

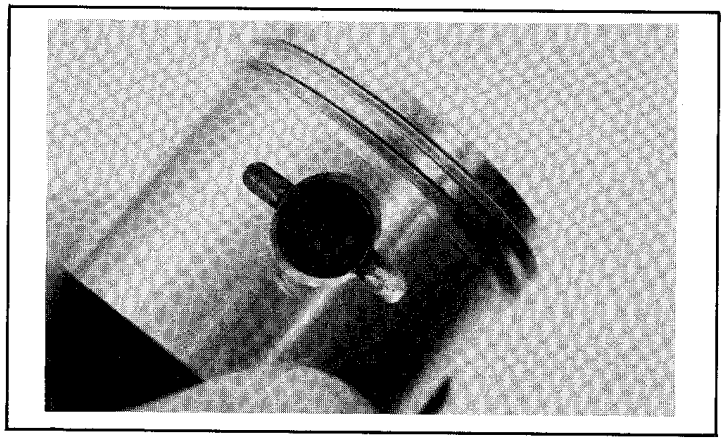
(a) Attach piston to connecting rod. Point arrow to clutch side (exhaust or output end) of crankshaft. Closed end of piston pin faces clutch or exhaust side.



(b) To install piston pin use special tool. Place pin in piston pin boss. Oil small end needle bearing and thrust washers before assembly. Insert guide pin on opposite side. Lightly tap closed end of wrist pin to install. (Use soft hammer).

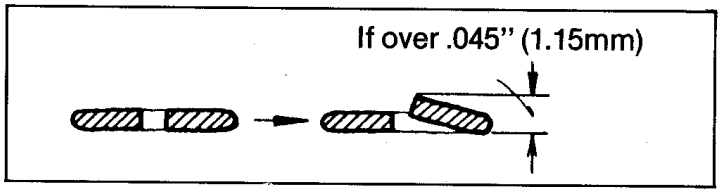


(c) Reinstall snap ring into correct position checking to keep snap ring 90° from horizontal slots in pin hole.

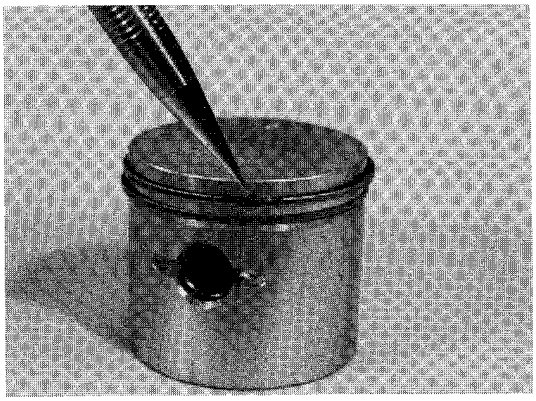


(d) Tap in slightly to allow first snap ring installed to move smoothly in groove. Do not put excessive pin pressure on snap ring as it is apt to pop out later, causing serious cylinder and piston damage.

NOTE: When disassembling, snap ring should be replaced if bent past specification shown in illustration below. (Snap ring can be bent to within specifications.)

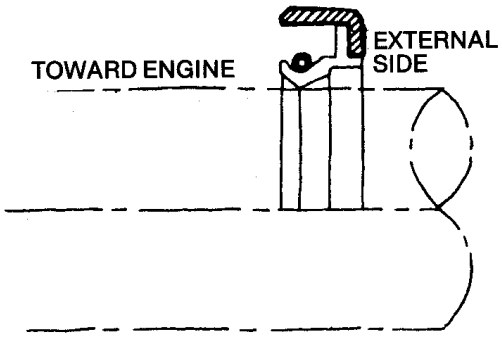


(e) Install piston ring in groove. Align ring with locating pin as shown in illustration.

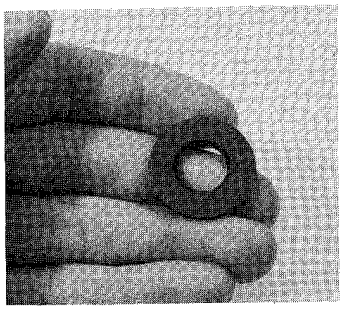


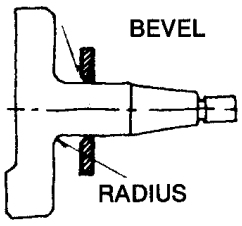
2. Assembly of Crankshaft

(a) To assemble, add: thrust washer, side plate, needle bearing, and oil seal. Oil seal must face as shown.

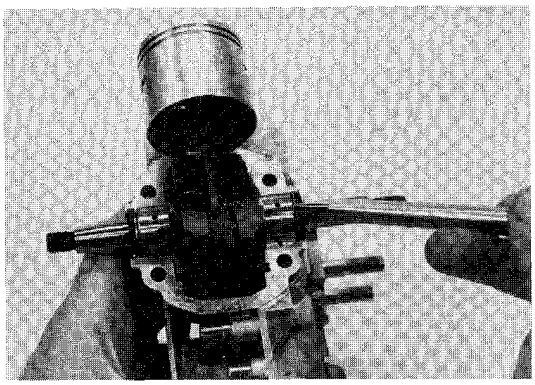


NOTE: Thrust washer must face direction shown in illustration, with bevel going toward crankshaft couterweight. If installed with bevel facing opposite direction, thrust washer will not seat flush with crankshaft.





NOTE: Needle bearing oil hole must point toward cylinder assembly, not toward lower crankcase. Also, put grease in lip of oil seal before installing.



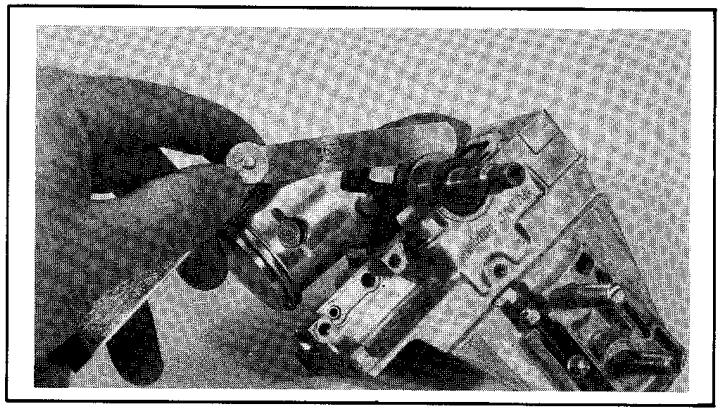
(b) Lightly tap in woodruff key with soft hammer.

(c) Assembly of cylinder and crankcase

(1) Place crankshaft and piston assembly in cylinder and check crankcase to side plate clearance with feeler gauge (.13- .24mm/.005-.009″). If incorrect clearance, replace sideplate or thrust washer as necessary.

(2) When gap is excessive, (.024″+) replace sideplate with "B" part number 22100-43150.

(3) If measurement is less than (.005″) .13mm, replace with "A" sideplate part number 22100-43140, and thrust washer part number 22102-43110.



Clean the surface of the crankcase and cylinder thoroughly with lacquer thinner or equivalent, then coat both surfaces with a thin even coating of crankcase adhesive. Spread evenly and thinly for best results.

NOTE: When excessive amounts of adhesive have been used, surplus may flow to crankcase, needle bearing, oil seal, oil passage or connecting rod bearing and cause damage, so use sparingly.

Install piston into cylinder. Before assembly, oil small and big end connecting rod bearings, cylinder wall, piston, and ring.

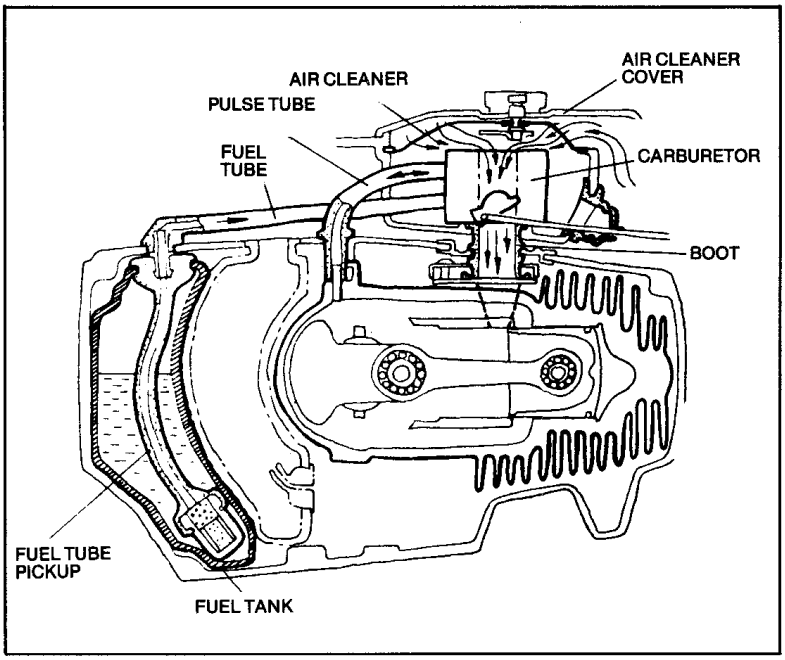
NOTE: Be sure ring gap is properly lined up with locating pin.

Use liquid screwlock for 4 cylinder screws, thread in lightly, then sequentially tighten in steps, tapping both side of crankshaft lightly to equalize gap between case halves. Torque to 70-80 kg/cm (61-70 in/lb). Check rotation of piston and crankshaft assembly by manually turning. If excessive roughness or tension is found, disassemble, inspect, and reassemble. Install gasket, insulator, boot and bracket to intake port of cylinder; tightening with two screws using a liquid screwlock.

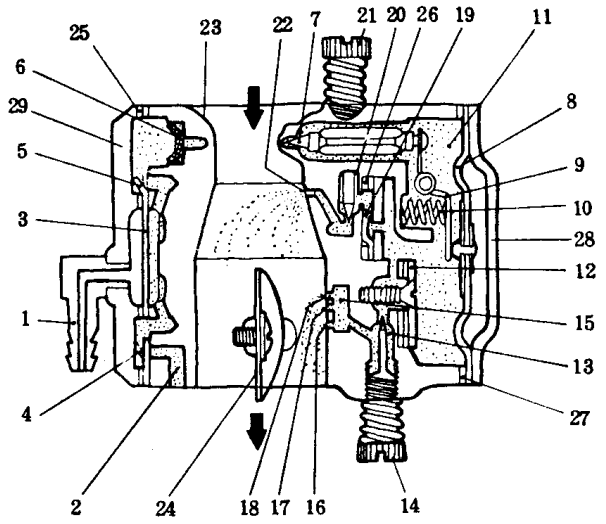
Section 3: Fuel System

A. Components: Fuel tank, fuel tube, pulse tube, carburetor, air cleaner, boot, air box.

Explanation of Vapor Lock Prevention System. The fuel tank is isolated from the cylinder to avoid vapor lock. The oil tank is located between the cylinder and fuel tank to aid in insulation. The fuel tube is externally mounted for cooler operation. The carburetor is isolated by a rubber boot for low maintenance, long life, and to avoid heat and vibration transfer from the engine. Air cleaners are available in stainless steel or flocked for easy cleaning and low maintenance.

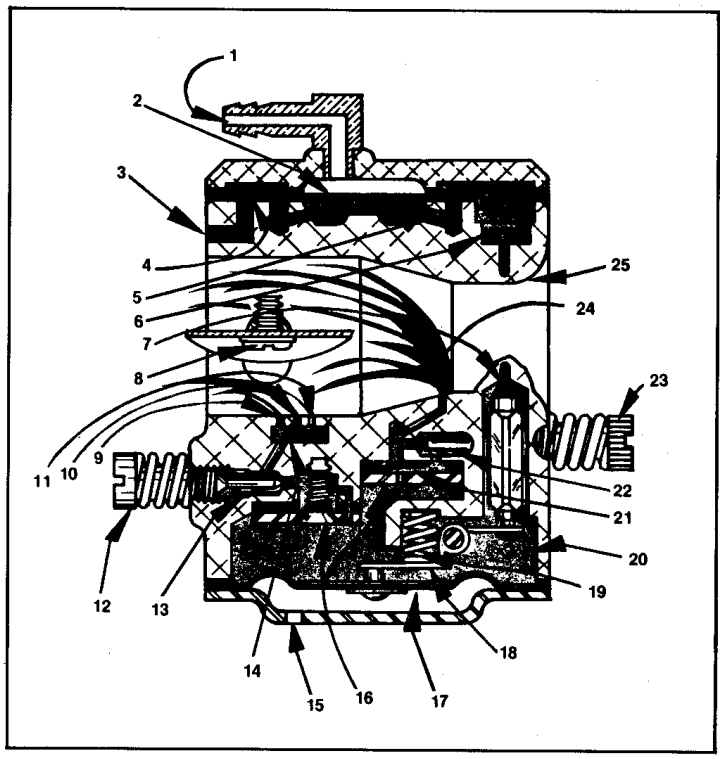


B. Construction of Carburetor. The carburetor is a diaphragm type so it can be used in any position without starving. To avoid vapor lock and add to carburetor life, the carburetor is isolated by a flexible boot. The carburetor adjustments are external. Carburetors used on Shindaiwa saws are as follows: Model 350 uses Walbro WA115; Models 415, 450 and 500 uses Walbro WA101B.



1. Pulse Joint
2. Fuel Inlet
3. Pump Diaphragm
4. Inlet Valve
5. Outlet Valve
6. Inlet Screen
7. Needle Valve
8. Diaphragm Assembly
9. Metering Level
10. Metering Spring.
11. Metering Chamber
12. Circuit Plate
13. Idle Take-off
14. Low Speed Needle
15. Idle Port
16. First Idle Hole
17. Second Idle Hole
18. Third Idle Hole
19. Diaphragm Circuit
20. Nozzle Chamber
21. High Speed Needle
22. High Speed Nozzle
23. Venturi
24. Throttle Valve
25. Pump Gasket
26. Circuit Plate Gasket
27. Diaphragm Gasket
28. Diaphragm Cover
29. Pump Cover

C. Operating Functions of Walbro Model WA Carburetor



1. Engine Impulse: Actuates Fuel Pump Diaphragm with alternating pressure-vacuum pulses.
2. Fuel Pump Diaphragm: Fluctuates in response to engine impulse. Transfers fuel through Fuel Pump Valves.
3. Fuel Inlet: Fuel drawn from tank.
4. Inlet Valve: Responds to Fuel Pump Diaphragm. Opens during vacuum pulse. Closes during pressure pulse.
5. Outlet Valve: Closes during vacuum pulse. Opens during pressure pulse.
6. Filter Screen: Filters fuel on route to Metering Chamber.
7. Inlet Needle Valve: Lifts off seat to allow fuel entry into Metering Chamber.
8. Throttle Valve: Regulates engine speed as it exposes Primary, Second, and Third Idle holes, then Nozzle for fuel delivery.
9. Primary Idle Hole: Only fuel source to engine at Idle position.
10. Second Idle Hole: Only fuel source to engine at Idle position.
11. Third Idle Hole: Increases fuel flow at Part Throttle.
12. Idle Needle: Adjust for fuel richness to 3 Idle holes.
13. Idle Take-Off: Fuel entry for Idle holes.
14. Idle Port: Fuel reservoir for Idle holes.
15. Atmospheric Vent: Allows air pressure against Metering Diaphragm.
16. Circuit Plate: Meters fuel from Metering Chamber to Low Speed and High Speed Circuits.
17. Metering Diaphragm: Drawn up by vacuum to activate Metering Lever.
18. Metering Lever: Lifts Inlet Needle off seat.
19. Metering Lever Spring: Transmits force to Metering Lever. Closes Needle Valve as Metering Chamber fills.
20. Metering Chamber: Fuel reservoir, feeds to Idle and Nozzle circuits.
21. Nozzle Check Valve: Engine vacuum draws Valve open.
22. Nozzle Well: Fuel is drawn in from Metering Chamber at high speed.
23. Hi Speed Needle: Adjusts for fuel richness at high speeds.
24. Nozzle: Increases fuel discharge for high speeds.
25. Venturi: Increases air velocity at Nozzle, creating a suction to draw fuel into Throttle Bore.

D. Disassembly

1. Remove air cleaner cover and air cleaner.

CAUTION: When disassembling the carburetor, and the inside of the cylinder is exposed through the intake port, use caution to keep foreign material out of the cylinder. Close choke plate of the carburetor during disassembly.

2. Remove the fastening bolts on the carburetor.
3. Remove the choke plate from the choke rod.
4. Remove the pulse and fuel tubes.
5. Remove carburetor by twisting (turning to the right) to remove throttle rod.
6. Remove fuel pump cover screw and pump cover.
7. Remove fuel pump diaphragm and fuel pump gasket.
8. Inspect diaphragm for flatness and continuity. Diaphragm should have no holes. The flapper valves should be flat and free from curling.
9. Blow through external fuel hole on body casting to insure that there are no obstructions.
10. Blow through internal fuel hole on body casting to insure that there are no obstructions.
11. Remove and discard filter screen.
12. Remove four screws and metering diaphragm plate.
13. Remove metering diaphragm and gasket.
14. Inspect metering diaphragm for holes, dirt, and foreign matter.
15. Remove metering lever screw and metering lever components including lever, pin, needle valve, and spring.
16. Remove circuit plate screw with diaphragm and gasket.
17. Remove high and low speed adjustment needles. Check for damage.
18. Thoroughly inspect and clean the carburetor, especially all small orifices and openings, using a solvent wash and an air gun.
19. Dry the carburetor with air and inspect the operation of the throttle valve and lever.

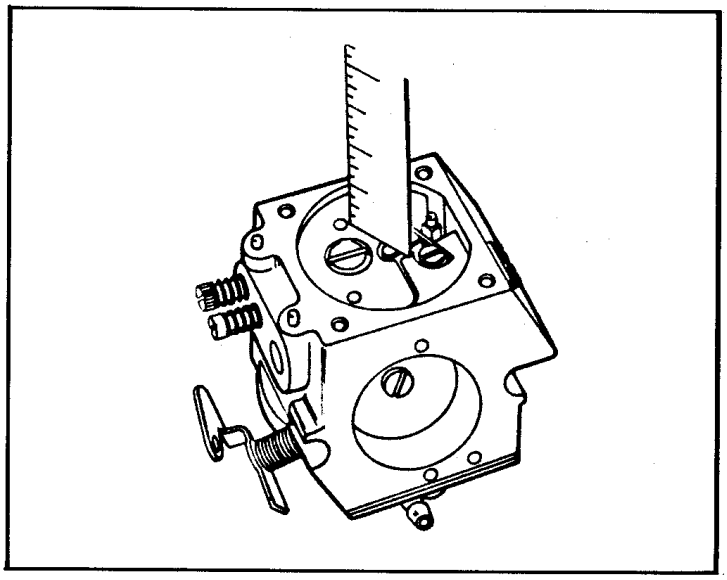
NOTE: Different models of WA Series Walbro carburetors use slightly different parts. Do not assume repair kits are identical.

E. Reassembly

1. Install the filter screen with any appropriate hollow tube or tool of approximately .300 inch diameter.
2. Inspect circuit plate for flatness and correct if necessary.
3. Inspect the new circuit plate diaphragm and gasket for flatness. Install the circuit plate, circuit diaphragm and circuit plate gasket with **diaphragm in contact with plate and gasket in contact with body casting.** Use only moderate pressure on the circuit plate screw so as not to warp the circuit plate.

4. Install metering lever components and adjust metering lever to be flush with surface of circuit plate.

NOTE: ADJUSTING THE METERING LEVER. The Metering Diaphragm gives movement to the Metering Lever which opens and closes the Needle Valve to regulate fuel flow according to engine demands. The Metering Lever of the Walbro Model WA carburetor is correctly adjusted when its upper surface is aligned with that of the circuit plate as shown in the adjoining picture. Correction is made by gently bending the lever as necessary.



5. Install high and low speed needles and set at approximately 1¼ turns open. The high and low speed letters are indicated on the side of the carburetor casting. The high speed needle is the long needle and the low speed needle is the short needle.
6. Install the metering diaphragm and related components as follows: Install the gasket over the locator pins of the casting. Next, install the metering diaphragm over the locator pins on the casting. (The metering plate pin must be in contact with the metering lever.) Next, install the metering diaphragm cover with four screws. The vent hole in the cover should be located opposite the throttle valve.
7. With the large single screw, install the fuel pump cover with **fuel pump diaphragm in contact with the body casting** and with the **fuel pump gasket in contact with the fuel pump cover.** The extension on the cover should be located on the same side as the throttle lever.
8. Visually inspect the carburetor and tighten all screws.

F. Adjustment

With both needles set at 1¼ turns open, proceed as follows:

IDLE ADJUSTMENT

1. Start engine and adjust idle throttle screw so that engine idles at a moderate speed slightly slower than clutch engagement.
2. Turn low speed needle **clockwise** (lean) until engine runs smoothly.
3. Readjust idle screw to correct engine speed.
4. Continue turning low speed screw slowly clockwise until a slight decrease is noted in engine speed. **Stop.**
5. Turn low speed needle **counterclockwise** for optimum smooth engine speed.

HIGH SPEED ADJUSTMENT

1. With high speed needle 1¼ turns open the machine should run rich at wide open throttle. Listen for the four-cycling sound.
2. With throttle wide open and no load on the chain, turn high speed needle clockwise until engine becomes smooth (two-cycling).
3. Optimum adjustment is achieved when a very slight four-cycling sound is heard.

G. Troubleshooting

1. Service Procedures for Flooded Carburetors.

CAUSE	SOLUTION
(1) Metering Lever set too high.	See Page 14
(2) Dirt under Inlet Needle Valve.	Remove and clean
(3) Circuit Plate and Gasket leaking.	Tighten screws or replace gasket
(4) Metering Lever Spring not seated on dimple in Metering Lever.	Remove lever and reinstall spring
(5) Fuel Pump Diaphragm leaking.	Remove and replace with new diaphragm

2. Service Procedure for Lean Carburetors

CAUSE	SOLUTION
(1) Dirt in Idle Main Channels	Disassemble carburetor & clean
(2) Metering Lever set too low	See Page 14
(3) Hole in Metering Diaphragm	Replace Diaphragm
(4) Pulse line from Crankcase to carburetor plugged	Remove obstruction
(5) Leaky Manifold Gaskets	Replace gaskets
(6) Leaky Nozzle Check Valve	Replace Check Valve with kit
(7) Fuel Pump Diaphragm check valves worn	Replace Fuel Pump Diaphragm
(8) Dirty Fuel Inlet Screen	Remove Fuel Pump Cover and clean
(9) Faulty Fuel Delivery System to carburetor.	Check complete Fuel Delivery System from Pickup in Fuel Tank to carburetor Fuel Inlet for cracks, dirt, etc. Replace fuel line or Pickup Filter when necessary.

Tighten All Screws

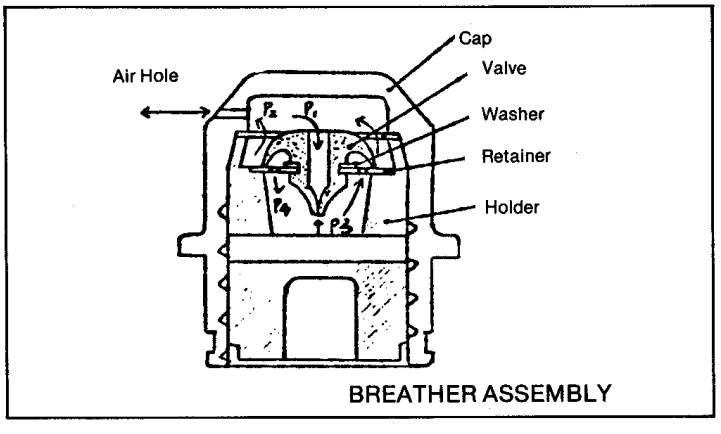
3. Trouble Shooting Guide

(1) Fuel Source — In-tank filters, lines, fittings — check for leaks or obstructions, venting and air filter.
(2) Choke and Throttle — Check mechanical linkage and cables — Look for kinks, ice, etc.
(3) Adjustments — Idle and Main needles, 1¼ turns off seat — Tune from rich side by 1/8 turn, gradually. Fixed jet models may require flushing in fuel to clean.
(4) Ignition — Spark plugs — Change if back-fires or pre-ignition — When times correctly, white plugs mean fuel is too lean; black - too rich; chocolate brown - normal.
(5) Fuel Mixture — Use 25:1 as recommended by Shindaiwa.
(6) Tighten all screws on the carburetor — tighten all mounting bolts — check for cracks or leaks at flanges and manifolds.

H. Construction of Fuel Tank

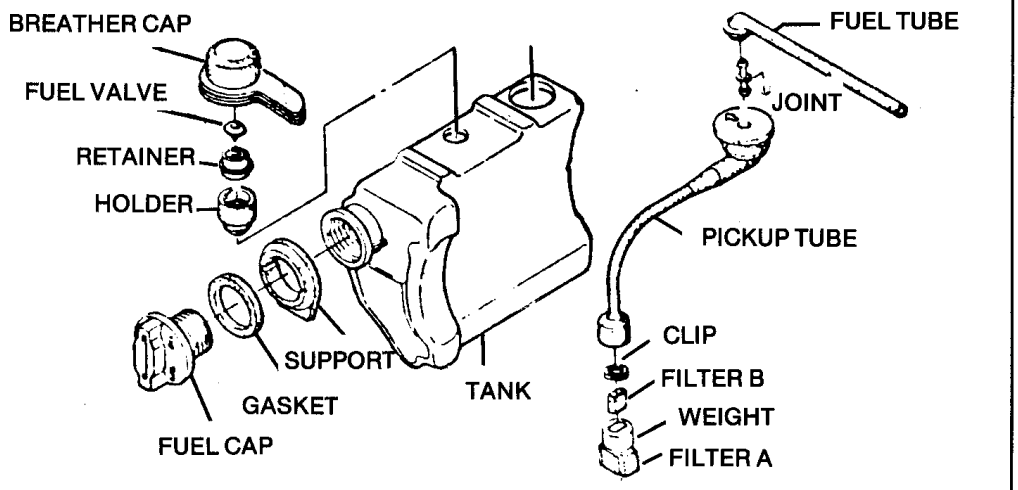
1. The fuel tank is constructed of oil-proof type 6/6 nylon material and is installed between the engine cover and recoil case for insulation and to absorb engine vibration.

2. A fuel breather is installed separate from the fuel tank filler cap to prevent carburetor problems from excessive fuel pressure variation and to insure a leak-proof system.

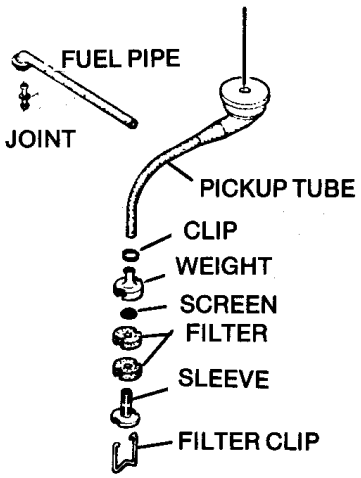


BREATHER ASSEMBLY

3. The fuel filter is two staged and weighted to insure proper pickup and positioning.



(TYPICAL FOR 350)

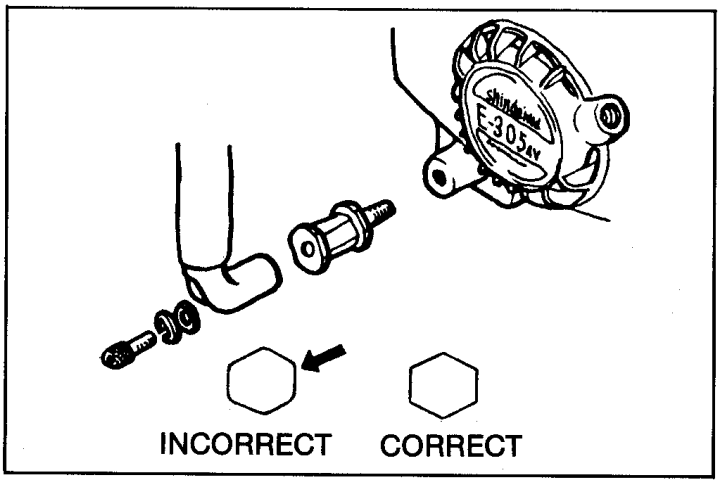


(TYPICAL FOR 450-500)

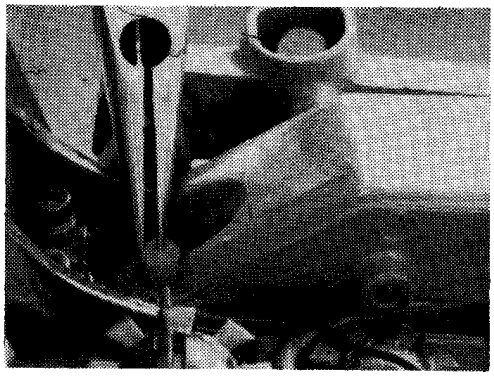
I. Disassembly of Fuel Tank

1. Remove Allen screws from front handle.
2. Remove recoil case.

CAUTION: Screws attaching the recoil case are mounted using a liquid screwlock. Use an Allen wrench of proper metric size and good condition when disassembling. Use a liquid screwlock on all four screws to reassemble.



3. Remove fuel tube from top of fuel tank. Remove nylon tube joint from top of fuel tank with needle nose pliers as shown in illustration.
4. Remove fuel tank and support from engine cover.
5. Remove fuel tube pickup assembly from top of tank.



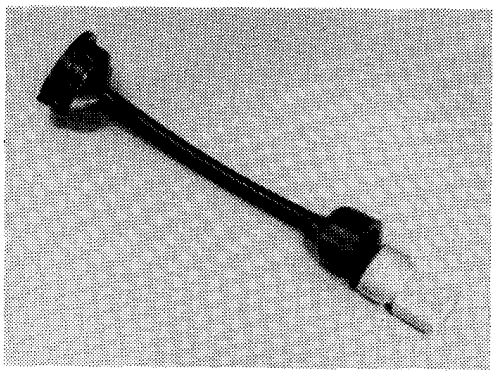
CAUTION:

1. **Do not scratch suction tube with pliers.**
2. **Check for pin hole leaks or damage to tube.**

6. Remove retaining spring and fuel filter assembly.

7. Clean fuel tank.

NOTE: It is not necessary to remove fuel vent internal parts, but check passages for blockage.



J. To Reassemble

Use reverse procedure of order shown.

CAUTION:

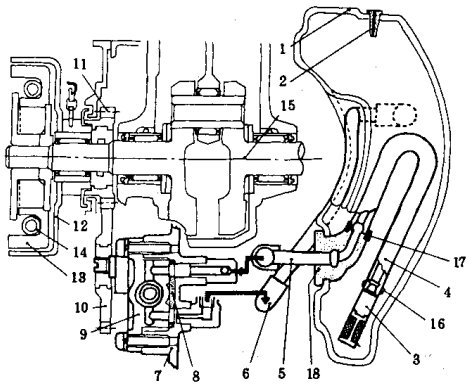
1. **Be sure pickup tube is securely installed in fuel tank to prevent possible air leakage.**
2. **Check to be sure that suction tube has all alignment points upward on the side of the fuel tank in the position of normal operation.**
3. **Insert fuel pickup tube joint securely into top of fuel tank.**
4. **Insert fuel tube to carburetor firmly, checking for potential air leakage.**

Section 3: Oil System

A. Mechanism of Oiling System

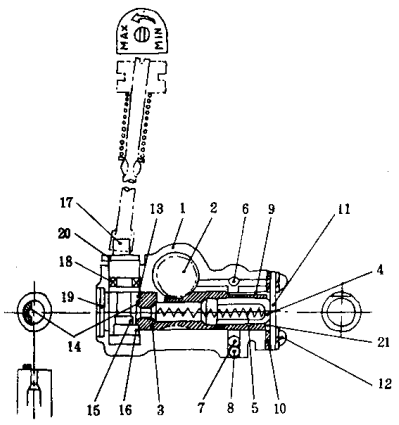
A mechanical pump which is used in motorcycles has been adapted for saw chain and guide bar oiling. Volume is variable during RPM changes. The oiling system drives off of the clutch, oiling only during chain movement and saving oil.

1. Oil Tank
2. Vent
3. Oil Filter
4. Oil Tube
5. Crankcase Elbow
6. Tube
7. Crankcase
8. Oil Pump Gasket
9. Oil Pump
10. Gear
11. Pinion
12. Clutch Drum
13. Clutch Shoe
14. Clutch Spring
15. Crankshaft
16. Oil Filter Clip
17. Oil Tube Clip
18. Oil Tube Elbow



B. Mechanism of Oil Pump

DIAGRAM OF OIL PUMP



1. Body
2. Worm Shaft
3. Plunger
4. Differential Plunger
5. Spring
6. Inlet
7. Outlet
8. Ball plug
9. Pumping Chamber
10. Gasket
11. Cap Plate
12. Screw
13. Plunger Guide
14. Lead
15. Guide Control
16. Cam
17. Control Shaft
18. X-Ring
19. Cam Side Plate
20. Stopper
21. Pump chamber

C. How to Operate

1. To transmit power once engine RPM is increased, the clutch drum is engaged, which turns the pinion gear. The pump gear then rotates, and the pump plunger works by a worm shaft (the worm shaft rotates in the opposite direction of the engine). The worm shaft is engaged to the worm gear with the plunger at 90°. Gear ratio of the pump gear is 16:23. The gear ratio of the plunger is 1:11.
2. Oscillation of Plunger — One end of plunger (3) cams to lead (14), control shaft (17) cams to guide (15) and cam plunger (3) is pressed by spring (5) toward control shaft (17). When it rotates, lead (14) of plunger (3) oscillates guide (15) of control shaft (17). Consequently, plunger (3) rotates one turn. Plunger oscillates according to lift amount of cam.
3. Opening and closing inlet and outlet holes — The plunger (3) has a pumping chamber (9) and rotates with inlet holes. Plunger (3) sucks oil to pump chamber.
4. Adjustment of oil volume — By operation of the control shaft, the direction of the cam is changed and the amount of movement toward the shaft is controlled, therefore controlling the amount of oil being pumped. The control shaft is easily adjustable when the pump is operating or the saw is stopped.

D. Specification of Oil Pump

1. Outlet volume: (Based on 7200 RPM)

Control shaft position:	Amount in cc's at minimum:
Minimum opening position	3cc
Medium position 90°	7cc
Maximum position 180°	15cc

To increase oil flow, rotate control shaft counterclockwise. To decrease flow, turn clockwise.

2. Blocked pressure:
   Inlet side (Suction side)
   9 psi (.6kg/cm²)
   Outlet side (Pressure side)
   26 psi (1.8kg/cm²)
   125 psi (9kg/cm²) for Model 500

CAUTION: In cold areas, thick oil may be difficult to pump. Thin with a 1:1 ratio with kerosene.

E. Features of Oil Pump

1. Economical operation. The oil pump is joined with the clutch drum so oil will not pump when the chain is not rotating.
2. Automatic variable oil system. As this is a plunger type oil pump, the volume of oil obtained can be increased as the RPM is increased.
3. Ease of adjustment. Oiling volume adjustments can be done externally making it possible to easily change in any working condition.
4. Superior durability. The oil pump is completely sealed, preventing entrance of dirt and debris. There is no need for disassembly and repair.

F. Inspection and Adjustment

In case oil flow is too low or completely stopped, inspect as follows:

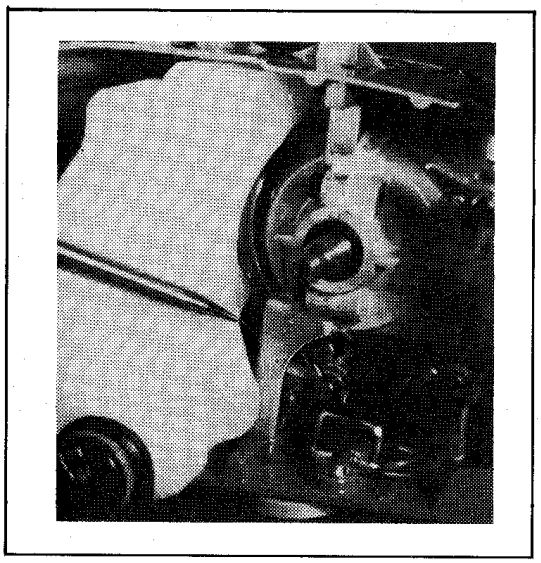
Where and How to Inspect	Items to Inspect	Repair of Adjustment Necessary
1. Check oil flow (turn control shaft to fully opened position)	If oil does not flow at maximum, check oil amount and type	If volume of oil is low, fill tank with oil (Refill with properly designated oil)
2. Check guide bar	Remove clutch cover, saw chain & guide bar If oil comes out with bar off, guide bar is clogged.	Clean guide bar groove
3. Check oil tank	Valve is clogged Oil filter is clogged	Clean or replace valve Clean oil filter
	Air leak in elbow, oil pickup tube, filter or tip of oil tube	Take out, clean and reassemble
	Air comes through due to elbow and oil tube not being firmly joined	Reassemble properly
	Air comes through pin hole in oil tube	Replace oil tube
	Air leak due to cracked or stretched oil pickup tube	Replace or repair using adhesives
	Oil filter does not stay at bottom of tank or tube is bent (not in proper location)	Reassemble properly
4. Check oil pump	Pump screw is loose	Put liquid screwlock on threads and replace. Tightening properly
	Oil pump gasket does not fit into groove properly	Replace gasket
	Burr or flashing is present on pump or cylinder causing air leaks	Remove flashing burrs, etc., clean and reassemble
	Worm shaft is scratched	Replace pump
	Oil leak from tank cap gasket	Inspect gasket and repair or replace
	Differential plunger is inoperative	Fix or replace pump
	Spring is broken	Replace spring
	Oil seal of pump is damaged, allowing air to enter	Replace pump
5. Miscellaneous	Insufficient oil supply burns worm gear in pump	Replace pump

G. Mechanism of an Oil Tank

1. The oil tank is made of a special type 6/6 nylon which is oil-proof. It is a cassette type; installed between the gas tank and cylinder for insulation and vapor lock prevention.
2. The oil tank is designed with sufficient capacity so it will not run out of oil faster than fuel with the oil pump volume setting at one-half or less.
3. The oil filter is installed with the weight at the end for proper location in the oil tank.
4. A spring has been installed inside the oil pickup tube in order to prevent collapsing under heavy pumping conditions.

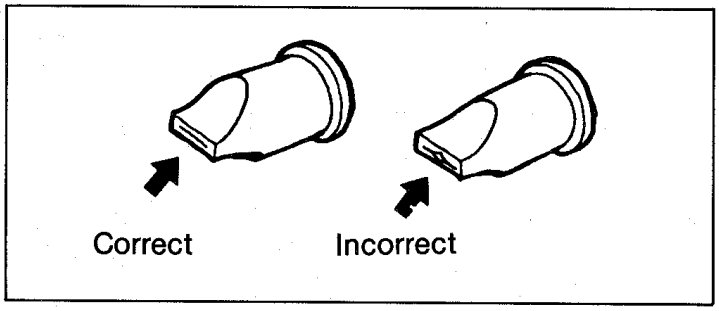
H. Disassembly of Oil Tank

1. Remove front handle
2. Remove recoil case
3. Remove rotor (nut is right-hand-thread)
4. Hold fuel tube connector with needle nose pliers and pull out from fuel tank.
5. Remove fuel tank.
6. Push oil tank toward front of engine cover and remove.
7. Do not scratch oil tube elbow. Carefully take out by using a screwdriver.
8. Remove valve from upper portion of oil tank.



I. Inspection and Maintenance of Oil Tank

1. Clean oil tank and check for cuts and signs of wear.
2. Replace vent if slit is open as shown in illustration.
3. Clean oil filter.
4. Check oil tube for blockage.



J. Assembly of Oil Tank

1. Install oil tube assembly through oil tank hole located under oil tank.
2. Check to be sure oil tube and filter are properly positioned. (See arrow, page 17)
3. Install vent in hole in upper part of tank.

CAUTION: If connections are not properly installed, air leakage may result, and no oil will flow.

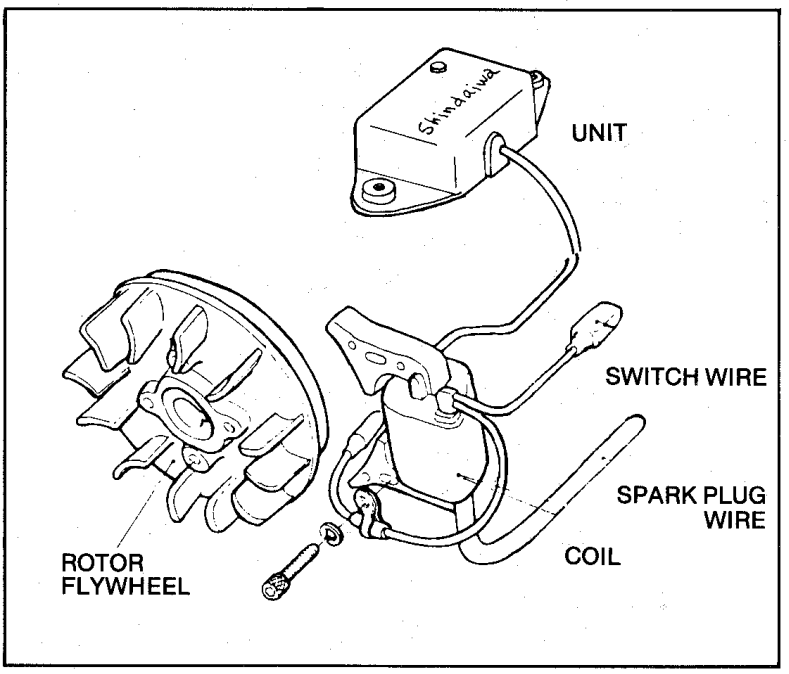
4. Install fuel tank.
5. Install fuel pickup tube and joint.
6. Install rotor. Torque to 104-122in/lb (120-140 kg/cm)
7. Install recoil case. Torque to 26-43in/lb (30-50 kg/cm)
8. Install front handle. Torque to 26-43in/lb (30-50 kg⁶cm)

CAUTION: Check to be sure screws are properly installed as previously indicated or antivibration cushion may be damaged or cut away.

Section 4: Electronic Ignition System

A. Components of Electronic System

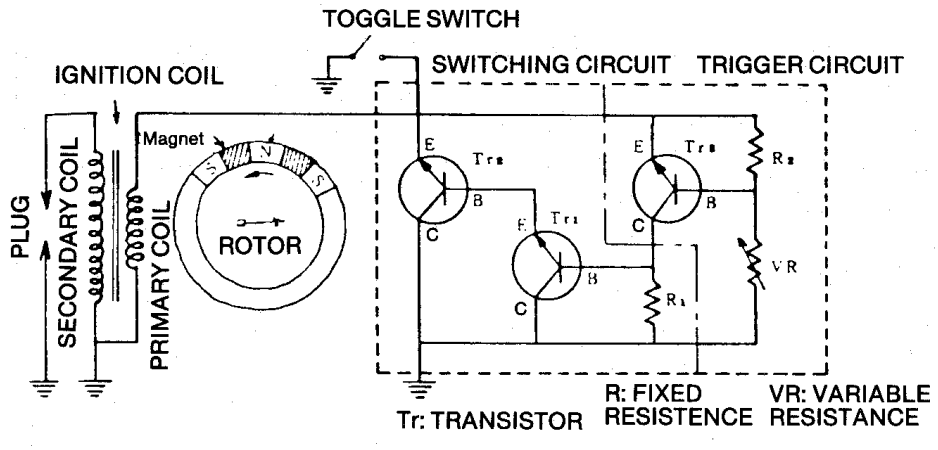
1. **Rotor.** The combination rotor and cooling fan is a one piece aluminum die casting with cast in magnets and steel boss for crankshaft attachments.
2. **Ignition Coil.** The ignition coil produces high voltage and is wrapped with a double layer of insulation paper which is temperature resistant. Furthermore, a heat resistant plastic is molded to the outside.
3. **Transistor Ignition Unit.** The unit, working as the points, contains the following items in the molded metal case: Semi-conductors (transistors), circuits and resistors contained in an epoxy resin. The molded construction insures proper insulation and waterproofing.



B. Standard Circuit

1. **Transistor.** The transistor has two functions. One is switching. In the normal conditions, C through E is nonconductive. By adding voltage between B through E, the voltage level comes to .6 volts and C through E become conductive and allow the flow of current. To make it nonconductive, the voltage B through E must be 0 or drop to less than .6 volts. The other function is amplification. The current Ic is equivalent to that of Ib and Ic is 30 tp 200 times stronger than that of Ib, which is amplification. By by using these characteristics, the transistor works as the cam to decide timing, allowing electrical current flow from the ignition coil to the spark plug.
2. **Resistance.** Resistance functions to cut electrical current, to regulate and protect operation of the transistor, and to adjust the electric current and voltage. There are two different types of resistors: one is fixed and the other is adjustable or variable.
3. **Mechanism of Unit Circuit.** The unit is constructed with the switching circuit functioning as the points and the trigger circuit functioning as the cam.

CIRCUIT CHART



C. Features

1. As there are no mechanical points, failures due to worn, burned or damaged points are eliminated. Moisture is also not as great a problem.
2. The inspection and adjustment of the point system is not required and the engine can produce more reliable power.
3. Because the system does not use points, there is no point bounce at high engine RPM.
4. The electric current produced is used only to provide spark and therefore provides a much greater amount of spark.
5. Compared to other methods such as a point system or a CDI system, the TCI system requires fewer parts, improving reliability and maintenance.

D. Inspection and Maintenance

Defects in the electrical system can come from the spark plug, switch, ignition coil, TCI unit, and wiring. The procedure for inspection is to check external parts, then check internal components.

1. **Test Spark Plug.** Remove the spark plug. Replace plug wire on plug and hold against the cylinder while pulling the recoil starter.NOTE: Be sure that the switch is in the "on" position. It is normal to see a thick blue spark.
2. **If no spark, or very weak spark is present, remove the spark plug and examine.**
   (a) check for sufficient clearance of electrode (.6mm).
   (b) Check for short circuit of electrode due to carbon. Clean as necessary.
   (c) Check for broken insulator. Replace as necessary.
   (d) Check for carbon buildup or fouled plug. Clean as necessary.
   (e) Replace with a new spark plug.

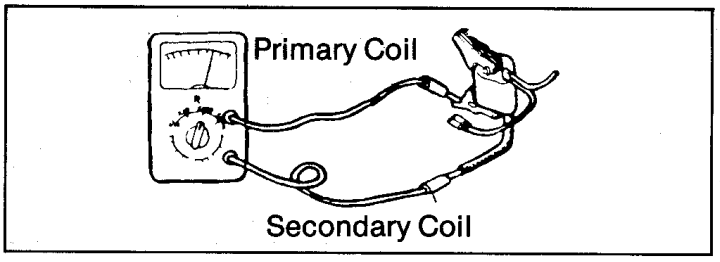
   If no spark is present after the above, check the switch.

CAUTION: Be sure to pull the recoil starter strongly as the engine is a transistor type ignition; otherwise no spark is produced.

3. **Inspection of switch.** A faulty-appearing switch can come from either poor contact of the wiring system or poor contact of the on-off switch.
   (a) Pull out the switch connector; connect the switch wire and switch body with a continuity tester; and turn the switch to the "on" position and check indication. Repeat in the "off" position.
   (b) Connect the switch connector and engine body. Push the switch to the "on" and "off" positions repeatedly and check the test indication. If the meter swings with an unstable reading, the defect can be found either in a partially cut lead wire to the switch, or poor contact, or breakage of the ground.
   (c) Disassemble and check ground connections. Check for defective conditions at the lead wire connector of ground. If damage appears to be repairable, solder in place and wrap with vinyl tape. If it does not appear to be repairable, replace.

CAUTION: Do not pull the wire from the switch as damage may be done to the wire internally. Take the connector on or off using pliers.

4. **Inspection of Ignition Coil**
   (a) Check for proper function of the primary and secondary coils as well as the resistance using an ohm meter.



The resistance of the primary coil should be 0.75 ohms ± 5%. The resistance of the secondary coil should be 5600 ohms ± 10%.

(b) If a small variation of the above is found, use an automotive type coil tester with a six volt range and check the coil itself. The spark should jump a gap greater than 6mm.

CAUTION: When using the automotive coil tester, always use the six volt range and for less than one minute. (The coil will overheat if run for longer periods.)

5. The TCI unit is very reliable. If it appears to be out of order, replace with a new unit and check for proper function with the new unit installed.

E. Caution

1. Never take off the plug cap to stop the engine. Do not attempt to pull recoil starter without the plug cap installed. This can cause damage to the ignition coil.
2. Use care not to apply voltage to the rotor, as this can cause a decrease in magnetic power and spark performance.
3. If the plug cap is aggresively pulled, the inside spring can be stretched.

NOTE: For easy removal of plug cap, put oil inside before disassembly.

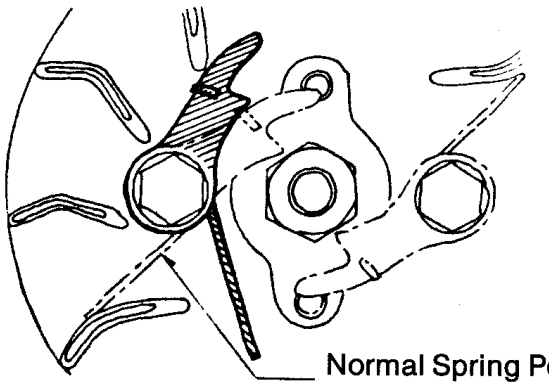
4. Inspection of spark timing. By means of electrical signals from the ignition coil, the triggering circuit of the unit is activated and the electro-magnets of the rotor control the spark timing by their position. Therefore, it is not possible to check the spark timing easily at point of ignition.

NOTE: Ignition timing is -31° before top dead center at 6000 RPM.

F. Disassembly

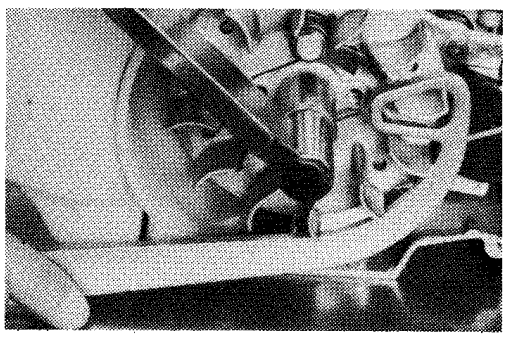
1. **Rotor**

(a) Remove recoil case and take out springs in center of rotor.


Normal Spring Position

(b) Secure rotor with special tool attached to rotor to prevent turning.

(c) Remove 14mm nut from rotor.

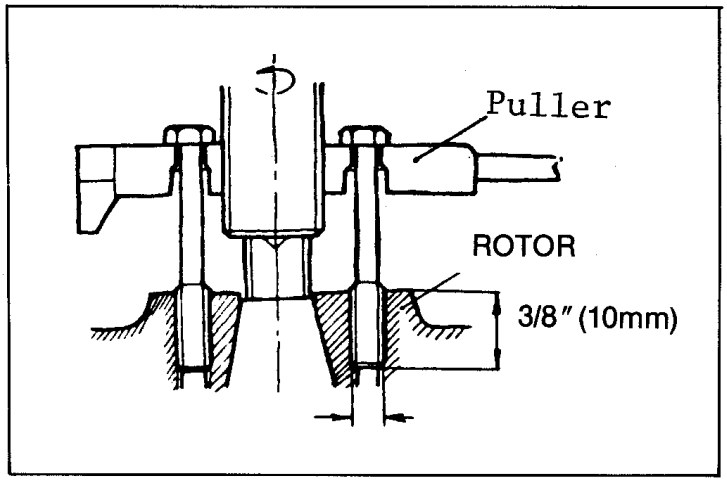


(d) Install special pulling tool and remove rotor from crankshaft. Note the following when using the special puller:

(1) When installing puller, bolt threads should go in a minimum of 10mm. (If less than this, rotor threads may be damaged.)

(2) When installing the puller, both bolts should be fastened at the same level. Check for 90° puller to crankshaft angle.

(3) When disassembling rotor, use the special puller. **Never** use a hammer. (A shock to the rotor from hammering can bend or crack fins, causing vibration.



2. **Unit**

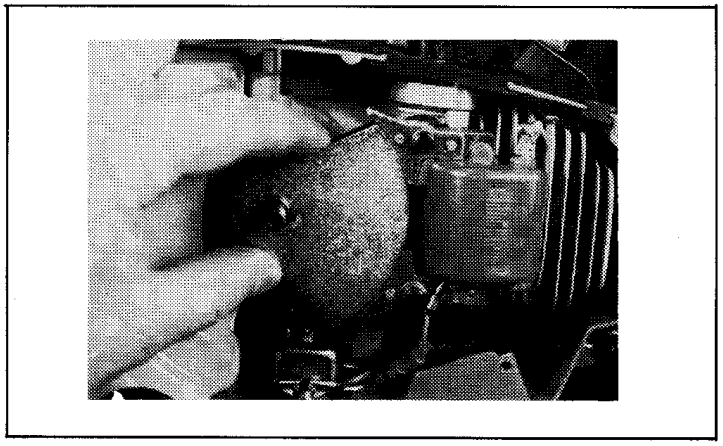
(a) The unit is fastened to the engine cover by two bolts. Remove the two 4mm bolts.

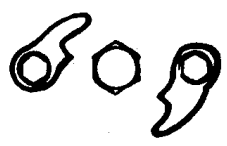
(b) Remove the connector of the lead wire (red wire). **Never** pull the cord. Pull connector body only.

3. **Ignition Coil.** Remove two bolts that separate the coil from the crankcase. (When replacing a coil, remove the plug cap and connector of red lead wire.)

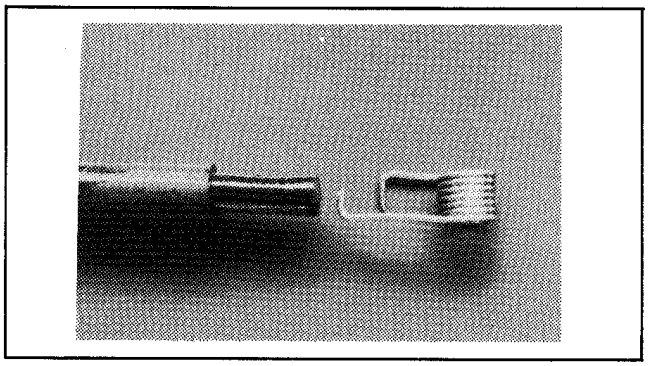
G. Assembly

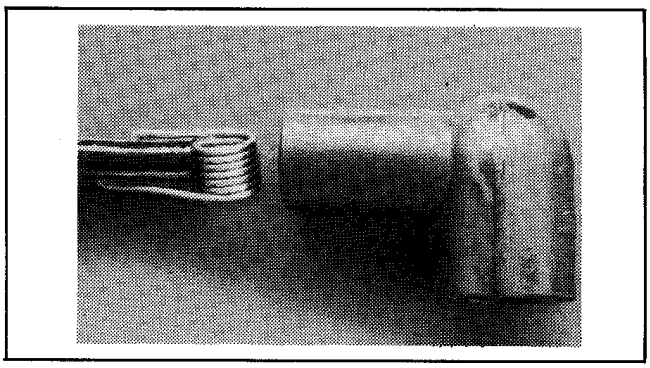
1. Ignition Coil. Install ignition coil and connect wire but do not tighten ignition coil bolts.
2. Attach special gapping tool to flywheel and turn in direction of coil.
3. Push coil against special tool and hold in place with fingers. Torque both coil attaching screws to proper specifications using a liquid screwlock. (35-44 in/lb or 40-50 kg/cm)
4. Install TCI unit as previously disassembled.
5. Connect unit wire to coil.
6. Install rotor and torque to proper specifications. (104-122 in/lb or 120-140 kg/cm)
7. Install starter pawls properly as shown in illustration.



		
CORRECT	INCORRECT	INCORRECT

8. Install plug wire assembly spring and boot as shown.





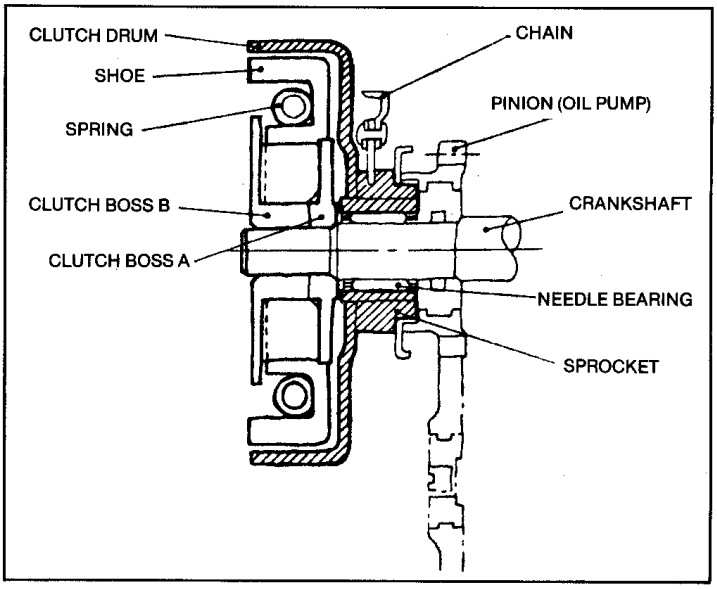
9. Install recoil starter case assembly.

10. Install front handle assembly.

Section 5: Centrifugal Clutch System

A. Construction of Clutch

The centrifugal clutch system uses four powdered metal shoes held in place with a tension spring. By operation of the throttle lever, and subsequent increasing RPM, the clutch is activated. The clutch and sprocket turns the oil pump drive system so that oil is not pumped unless the chain is turning. A needle bearing is used between clutch drum and crankshaft. The crankshaft is cross-drilled for external lubrication of the needle bearing.



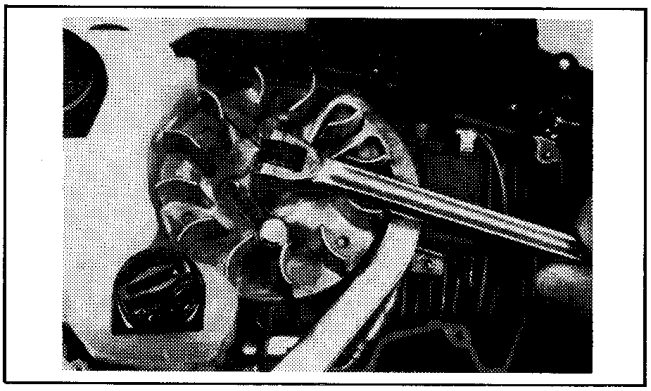
B. Actuation of the Clutch

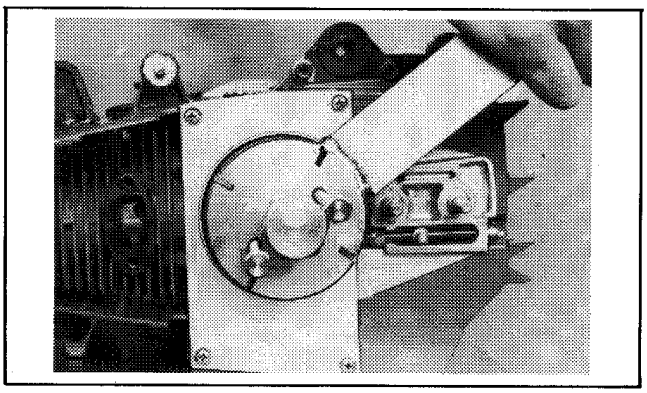
With the engine at idle, the clutch is disengaged. Engagement begins at about 3850 RPM.

CAUTION: If the saw is overloaded, the engine will continue to turn after the chain stops, and a burned clutch can result if this situation is continued for more than a few seconds. Lower RPM imediately upon stoppage of chain.

C. Disassembly of Clutch

1. Take off clutch cover and remove chain and guide bar.
2. Remove front handle.
3. Remove recoil case.
4. Attach stop wrench to rotor fin to stop rotation. Place puller on clutch shoe and turn in proper direction to remove clutch. (Left hand thread as indicated on arrow on clutch.)

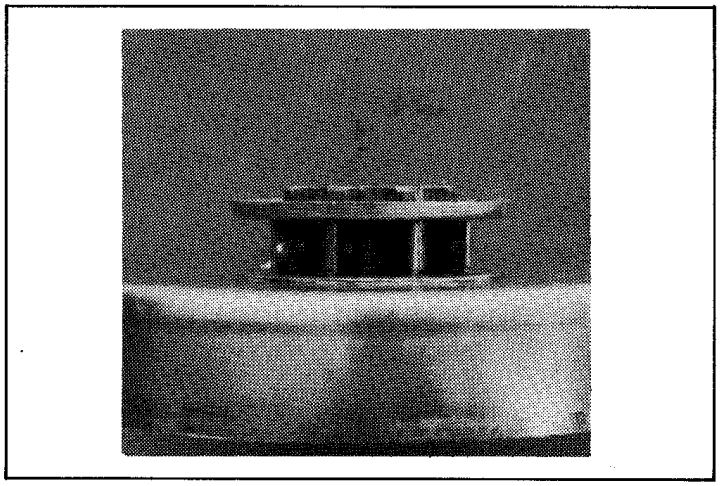




CAUTION: do not use hard impact when removing or installing clutch. Do not insert screwdriver into rotor fins with recoil case removed to hold flywheel. Damage to fins may result.

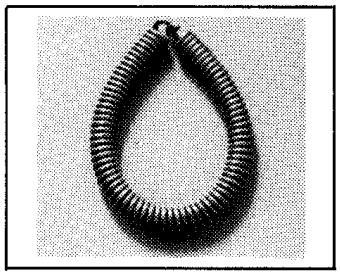
D. Maintenance of Clutch

1. Replace sprocket when wear exceeds 25mm (.010″)

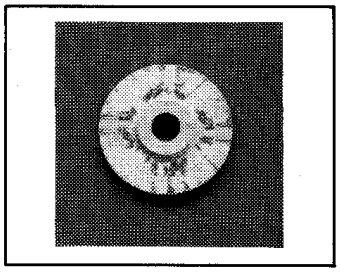


CAUTION: If a badly worn sprocket is used, rapid wear to the tie straps of the chain will result, even on a new chain.

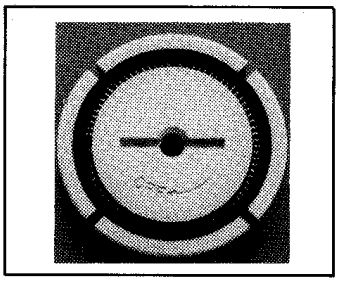
2. Check clutch spring for proper tension. Examine the hook area closely for scratches or signs of wear which can result in breakage. Replace if found.



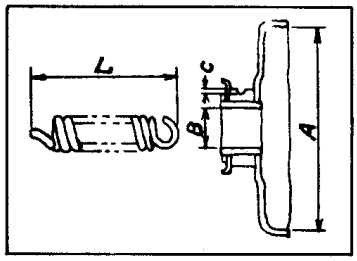
3. Check for wear on clutch shoes and boss B. If more than .024" (.6mm) of wear on steps or ridges is found, replace assembly.



4. Check for cracks in Boss A. If found, replace.
5. Replace needle bearing if any burning is evident.



Item	Standard Measurement	Allowance	Check Point
Inside Diameter of Drum	A - 68mm (2.677")	69mm (2.717")	
Diameter of Bearing	B - 13mm (.512")	13.03mm (.513")	
Step of Sprocket	C - O	.25mm (.010")	
Length of Spring w/o Tension	L - 133.5mm (5.256")	137mm (5.394")	



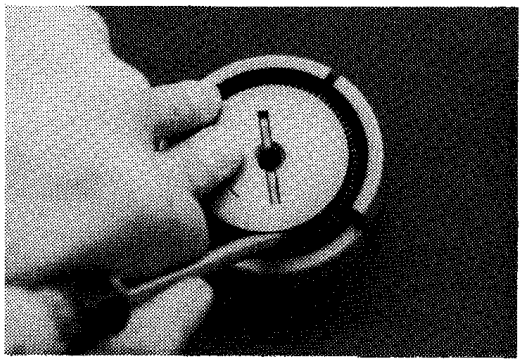
E. Clutch Assembly

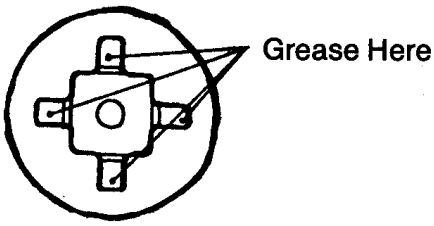
1. Place spring in a loop configuration and insert 3 clutch shoes.

   Hold clutch Boss B; fit in the last shoe using a screwdriver.

NOTE: Put grease on clutch shoes and boss to ease assembly.

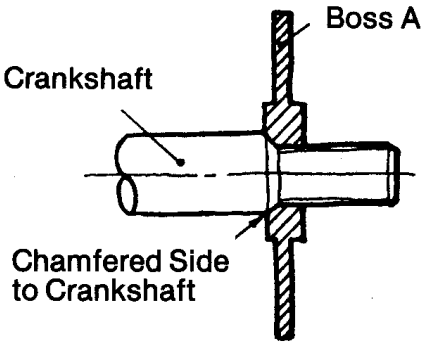
2. Coat grease to needle bearing, then insert bearing into assembled clutch drum. After greasing assembly on crankshaft, check for proper actuation of oil pump pinion gear.





3. Place Boss A on the crankshaft with the chamfered side to the inside as shown in the drawing.

4. Screw in clutch shoe, then tighten gently by using a clutch tool. Do not use impact or over torque.
   Fastening torque is 20-25 kg/cm (17-22 in/lb).



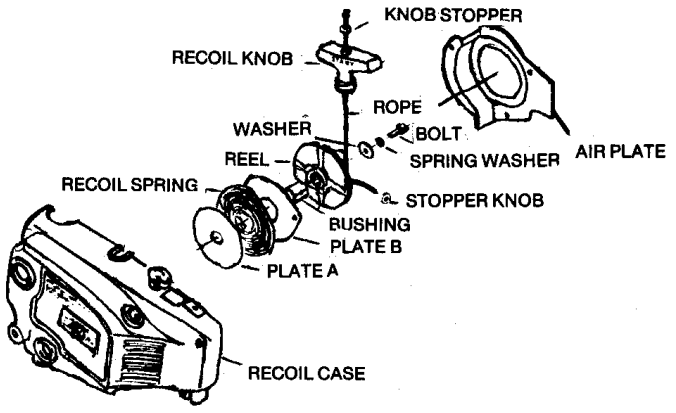
F. Clutch Recheck

1. Check to be sure the clutch drum turns smoothly. If not, the clutch drum is too tightly fastened or improperly assembled. Disassemble and recheck.
2. The gap between the ID of the drum and the OD of the shoe is normally 1.0mm ± .1mm (.039" ± .004").
3. Make sure the joining section comes to the center of the clutch shoe and does not gap.
4. If no abnormal condition is found, start engine and check for proper engagement at 3850 RPM (± 200 RPM).

Section 6: Starter Device

A. Construction of Recoil Starter

The recoil starter case is a magnesium diecasting, designed for efficient operation due to expanded inlets of cooling air. The reel is an aluminum diecasting with cast-in steel pawl. (Nylon with cast-in steel pawl on 350, 500). A slotted groove of the pawl fits the ratchet of the rotor when engaged. The rotor ratchet is designed to move outward by centrifugal force when rotated. The recoil starter spring is a cassette type for easy replacement.

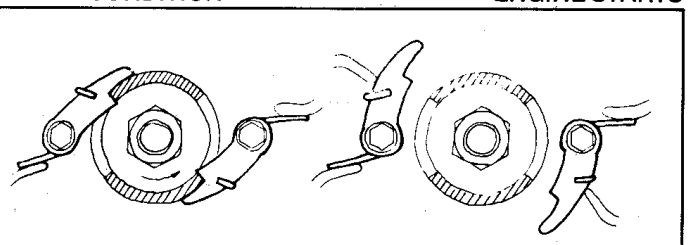


TYPICAL MODEL 450

Pressure of springs mesh ratchet and pawl to turn the crankshaft when stopped.

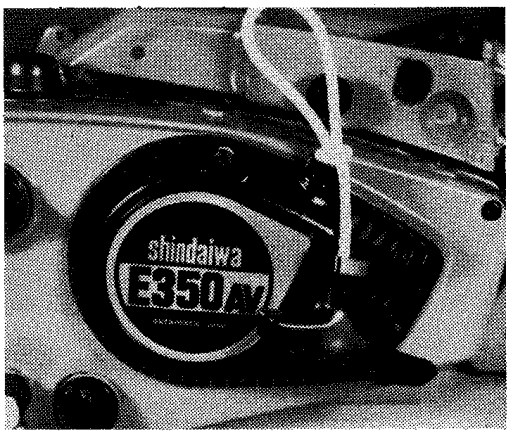
Pawls are pulled away automatically by centrifugal force when the saw starts.

STOPPED CONDITION ENGINE STARTS



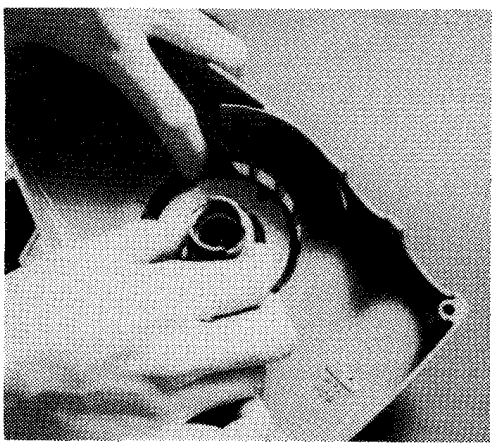
B. Disassembly of Recoil Starter

1. **Driving Side**
   (a) Pull starter rope out, and make a loop and form a knot.
   (b) Disassemble handle stopper and knob.
   (c) Untie knot and carefully allow the cord to pull back inside the reel, keeping some tension on the reel as it retracts.

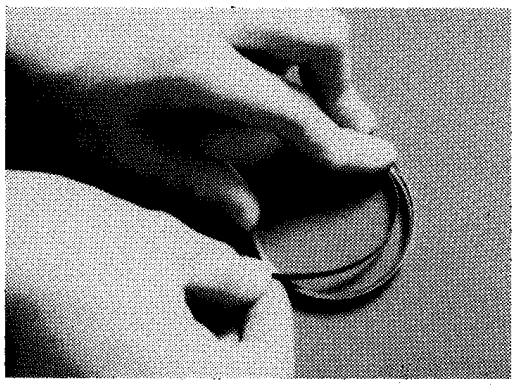


(d) Remove the Allen screw holding the reel in place. Remove the reel and plate B, then lift out the cassette type spring.

CAUTION: If plate B has no pressure placed upon it from the top side, the spring can jump out when removing reel.



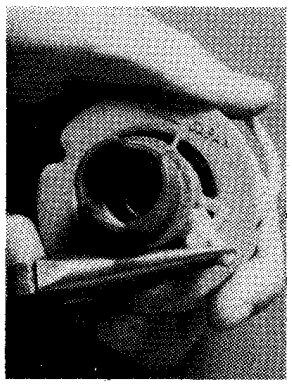
(e) Remove Plate B, spring, and Plate A. When taking out the spring, hold it with pliers. Should the spring unwind, put the spring end in the spring holder, place on a flat surface, and rewind from the outside to the inside.

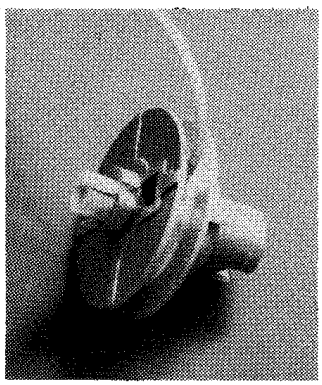


(f) Release knot in cord and pull rope out from reel. (Needle nose pliers may have to be used to remove knot.)

(g) Remove plastic bushing inserted in reel bore. (Model 415 & 450 only).

CAUTION: It is not necessary to disassemble the ratchet and spring system if there is no sign of damage or wear.



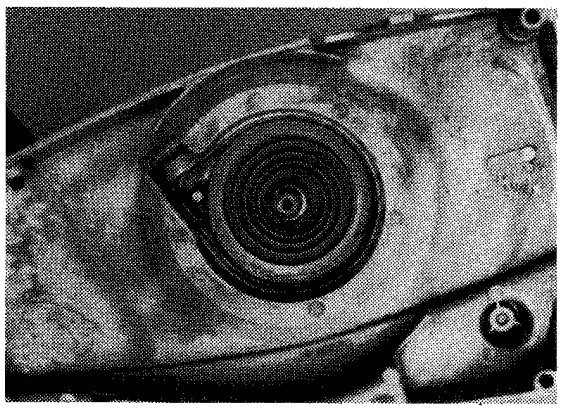


C. Maintenance and Inspection of Recoil Starter

1. Check rope carefully for fraying or wear. (Replace as necessary.)
2. Check for burrs or scratching on the reel surface. File or replace as necessary.
3. Inspect plates A and B. If damaged from spring movement or cracked, replace.
4. Check for signs of wear or cracking of spring. Replace as necessary.
5. Check for cracks at reel boss (guide). Replace if found.
6. Check for cracks at pawl inserted into reel. Replace as necessary.
7. Check for wear on ratchet bolt and ratchet spring. If worn, replace both bolts or both springs at the same time. (Ratchet bolt torque is 80-120 kg/cm 70-104 in/lb).

D. Assembly of Recoil Case

1. Driving portion
   (a) Assemble plate B.
   (b) Both sides of spring should be lightly lubricated. (Use all-weather grease).
   (c) Assemble spring assembly and plate A.

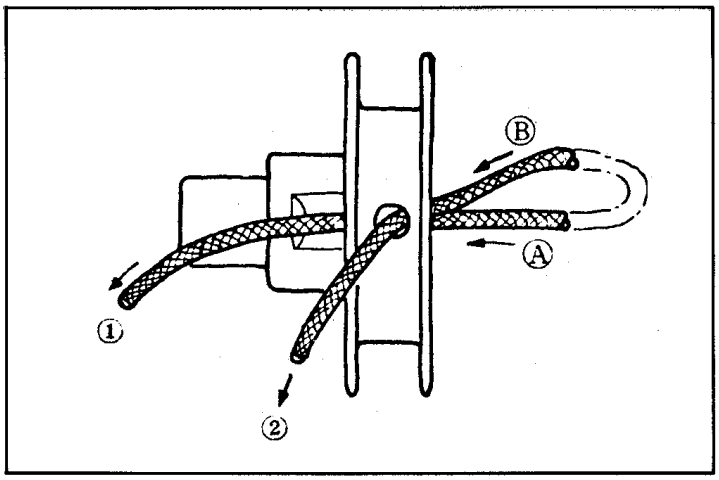


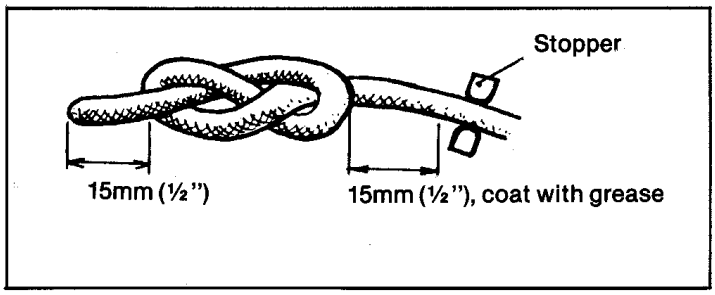
(d) Insert rope through reel as shown in illustration.

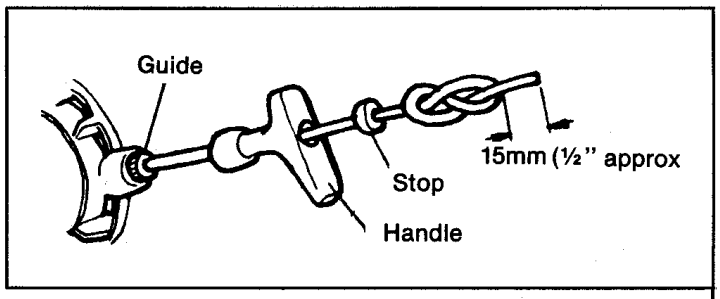
(e) Insert rope through stopper and tie rope in figure 8 knot as shown with 15mm (½") tail at end.

(f) Coat grease over 15mm area behind the knot (see picture). Assemble reel to recoil case and check spring and reel mesh. (Check by turning clockwise.) If return feels okay, it is assembled properly.

(g) Thread rope through guide and handle then place knot as shown in illustration.

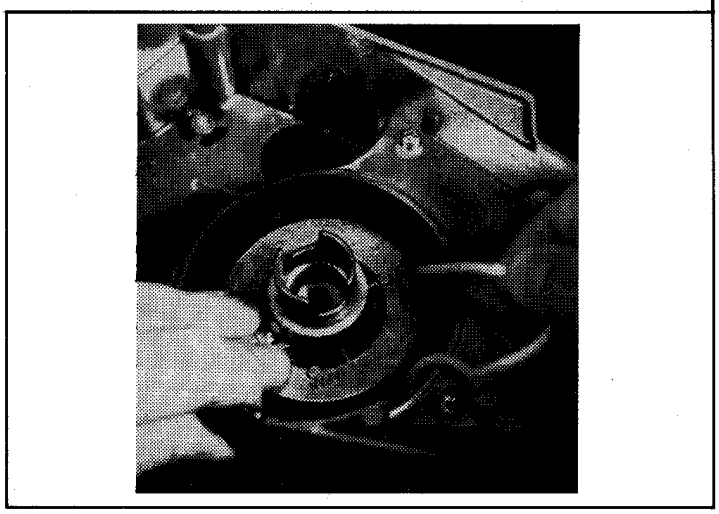






(h) Place rope in slot and turn reel counter-clockwise. To arrive at necessary tension, turn 7 to 8 turns. Hold reel and release rope, then turn knob to eliminate rope twisting. Pull out and rewind several times to check to proper tension.

(i) Pull out cord to its furtherest extension. Turn reel by hand and check for an additional ½ to 1½ turns past the length of the rope. If more than 1½ turns, give one additional turn of tension. If less than ½ turn, release one turn of tension.



2. Driven Portion (Rotor)
Sequence of Assembly: Spring, washer, ratchet, bolt.
Do not put liquid screwlock.
Standard torque for screws is 80-120 kg/cm (70-104 in./lb.)
Grease between ratchet and washer for smooth action.

CAUTION IN OPERATION: When starting engine, do not pull rope to end. Also, pull from point of highest resistance.

E. Recoil Starter Troubleshooting

Problem	Cause	Solution
1. Cord not returning completely	Lack of tension	Add 1 turn of tension
2. Reel does not turn lightly	Lack of grease or too much tension	Grease reel bushing. Drop 1 turn of tension

Section 7: Muffler

A. System and Maintenance

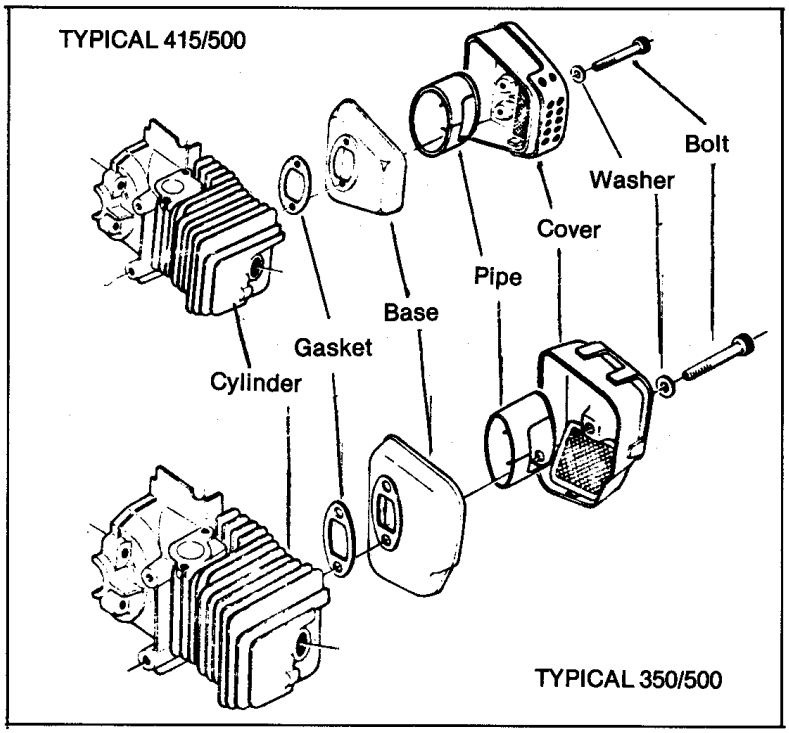
The muffler is in three parts: Base, Cover and Baffle. It is easy to clean and keep in good operating condition.

B. Disassembly of Muffler

1. Remove two attaching bolts.
2. Take out muffler cover, muffler baffle, muffler base, and gasket.

C. Inspection and Maintenance

1. Check to make sure base surface which attaches to cylinder is flat. If found to be burned or warped, replace.
2. Check for carbon buildup. If found, remove as necessary.



D. Assembly of Muffler

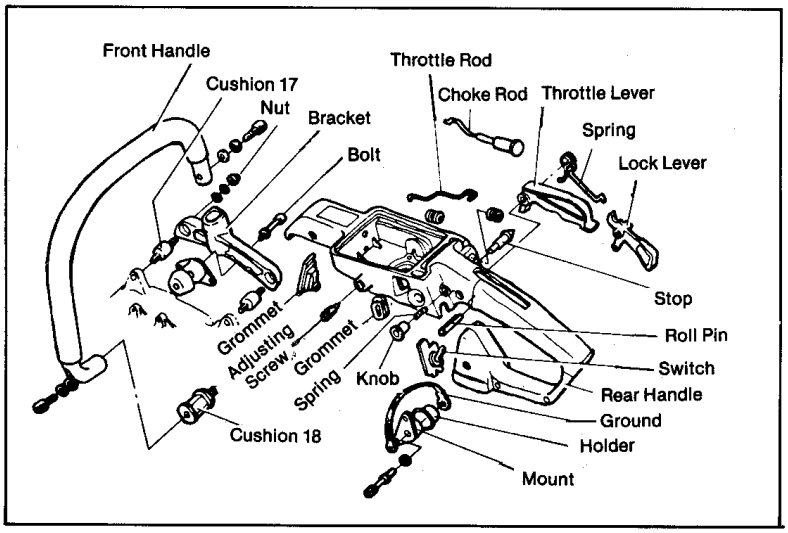
1. Always replace gasket. (Carbon buildup can cause gas leakage.)
2. Check direction of muffler baffle and install. Always install with window of baffle pointing **away** from outlet or muffler cover.
3. Fastening torque is 70-80 kg/cm (61-70 in/lb).

CAUTION: When fastening bolts, tighten in increments for even and proper tension to prevent leakage and warpage.

Section 8: Antivibration System

A. Handle Mechanism.

The front and rear handles are independently suspended. A special anti-vibration system reduces vibration. The front handle is wrapped with a special vibration resistant rubber and installed to the recoil case through a rubber cushion. The other end of the handle is installed to a bracket which is attached to two rubber cushions. The rear handle, a magnesium diecasting, is joined with the engine cover at two locations: one at the rear and lower portion of the handle, and one at the front central position of the engine cover. Both are mounted to rubber cushions. Rear handle movement is controlled by two side cushions. A part of the rear handle works as the carburetor box. The carburetor is joined to a rubber boot. The rear handle is designed for compactness with the choke throttle lock and switch positioned so they can be operated with one hand.



Starting Throttle Lock
For improved starting, a lock is installed on the throttle lever. When set, this position opens the throttle by one-third. After running the engine, release the throttle lever, otherwise engine RPM can increase to around 8600 RPM if left in the locked position.

Throttle Lever Interlock
For safe operation, an interlock mechanism is used and attached to the throttle lever. The interlocking lever is mounted to the upper part of the rear handle grip. If the interlocking lever is not depressed, the throttle lever will not move.

Grounding Cord
A grounding cord is installed between the handle and engine through the antivibration rubber cushion; keeping the operator safe from electrical shock.

NOTE: On Models 350 and 500, grounding is accomplished by a spring fastened between the rear handle and engine cover.

B. Disassembly of Bracket

1. Remove front handle.
2. Remove bracket.
3. Remove cushions No. 22 and 18A.

C. Rear Handle

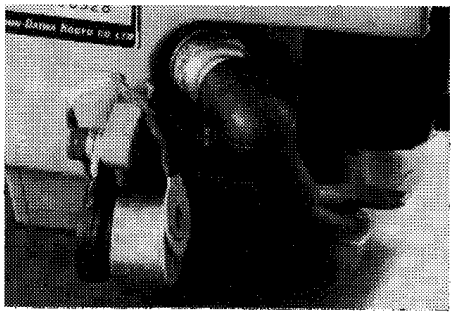
1. Remove air cleaner cover and air cleaner.
2. Remove fastening bolts of carburetor and remove carburetor from choke plate assembly. When doing this operation, twist carburetor slightly for ease of removal of throttle linkage.
3. Remove fuel and pulse tubes.
4. Remove side cushions from engine cover and recoil case.
5. Remove bolt from rear handle.
6. Disconnect starting switch.
7. Remove pulse and fuel tubes from connection on crankcase and fuel tank.
8. Remove rear handle by grabbing at rear and sliding carburetor boot through center hole.

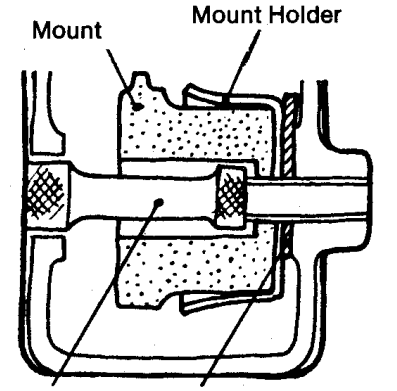
D. Inspection and Maintenance of Handle

1. Front Handle
   (a) Check for breakage or damage on cushions No. 17 and No. 18.
   (b) If a roughness or flashing is found on bracket facing cushion rubber No. 17, file or smooth surface properly.
2. Rear Handle
   (a) Check for breakage or damage in mount and replace as necessary.
   (b) Check for damage to ground cord. Replace as necessary.
   (c) Check for damage or breakage on rear handle and replace as necessary.
   (d) Check for wear and damage on tapered area of adjusting screw. If found, replace.
   (e) Check for damage to threads of carburetor mounting holes. Replace rear handle if necessary.

E. Assembly of Handle

1. **Rear Handle**
   (a) Install mounts to upper and lower section of engine cover. Assemble rear section with ground cord (use liquid screwlock).
   (b) Insert one end of pulse tube into crankcase connection and one end into rear handle with fuel tube. Fuel tube is to project so that it can clear antivibration mount.
   (c) Install mount holder with mounts and cover rear handle.
   (d) Before installing bolts, insert lead wire of "on/off" switch.
   (e) Assemble carburetor boot and rear handle. (NOTE: Take care so as not to damage boot.)
   (f) While assembling upper part of rear handle, insert bolt from right to left. The correct procedure is: Mount, Holder, then Handle.
   (g) When assembling **back** section of rear handle, install bolt from left side. It will go through: mount, mount holder, then ground wire. (Use liquid screwlock).
   (h) Assemble throttle lock with carburetor lever. Insert choke plate into choke rod plate bracket on carburetor and fasten. (Use liquid screwlock).

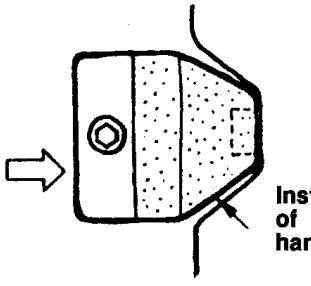




CAUTION: Be sure to place washer to allow free movement of choke plate. Check to make sure all 4 washers are properly installed. Fastening torque of carburetor should be 30-40 kg/cm (26-35 in/lb). If fastened too tightly, threads may be damaged.

CHECK:

1. **To be sure that choke rod and plate can operate freely. If not, washers are installed improperly.**
2. **If throttle lever moves smoothly.**
3. **If throttle lever returns when throttle lock is released.**
   (i) Install pulse tube and fuel tube to carburetor. Check for proper location.
   (j) Put air cleaner and cover in place and fasten.
2. **Install Side Cushions** (Fasten Evenly)



Install so that end, not sides of cushion, contacts rear handle housing.

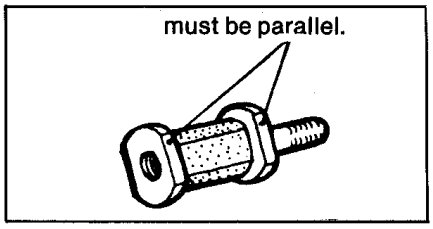
NOTE: To install side cushions properly, check to be sure that cushion rubber contacts correctly.

3. **Front Handle**
   (a) Assemble cushion No. 17 on engine cover. Secure metal portion of cushion 17A with pliers to prevent turning. (Use liquid screwlock).
   (b) Insert bracket through cushion No. 17, bolt and fasten. (Do not use liquid screwlock).

CAUTION: Overtightening may break cushion rubber. Fastening torque should be 30-40 kg/cm (26-35 in/lb).

   (c) Assemble cushion No. 18 to recoil case. (Use liquid screwlock).
   (d) Insert upper part of front handle into bracket and fasten bolt securely. (Use liquid screwlock).
   (e) Install lower portion of front handle with cushion No. 18. (Use liquid screwlock).

CAUTION: Use care not to twist cushion No. 18 when fastening. Hold cushion No. 18 so that it does not twist. Surfaces must remain parallel.



F. Tips for Saw Disassembly and Assembly

1. Disassembly

Disassembly should involve only necessary parts to be repaired. Use caution on the following points:
   (a) Take off saw chain for safety.
   (b) Be sure to check for deformity, breakage, damage, etc.
   (c) Check assembly procedure. If necessary, measure dimensions before disassembling, especially if needed for adjustment.

2. Assembly

Check the following before assembly:
   (a) Clean parts with solvent and place in assembly order. By doing this, damaged and missing parts can readily be seen. When cleaning parts, check which are important for reassembly order. If dirty, it may be necessary to clean twice.
   (b) When replacing parts and components, check clearance and tightness with matching parts.
   (c) When disassembling parts, be sure to check function before reassembly.
   (d) Put proper lubrication on rotating and oscillating areas.

   EXAMPLE: Needle bearing and side plate of crankshaft. Needle bearing of connecting rod at large and small end. Piston, cylinder and ring.
   (e) If oil seals, rings, etc. are not worn, note for next checkup.
   (f) When tapping cast parts, use wood or soft hammer with a cushion material between.
   (g) Evenly tighten screws on recoil case, gear case, cylinder, etc.
   (h) If oil seal on crankcase is damaged, it greatly decreases crankcase pressure, which causes oil leakage, a drop in horsepower and increased fuel consumption. Check oil seals carefully before assembly. If damage is found, replace.
   (i) The oil hole of the crankshaft needle bearings should point toward the cylinder for proper lubrication.
   (j) On both crankcase surfaces spread a thin even layer of adhesive. If too thick, excess can clog bearings or other internal parts.
   (k) Do not put high tension on crankshaft during disassembly or assembly.
   (l) Use caution when installing spark plug connector cap and wire assembly to assure proper connection.

Section 9: Cautions on Usage and Handling During Operation - Cutting

A. The operation of any saw should be done only after the operator has carefully read the operator's manual.

B. The best cutting RPM is full throttle between 8-9,000 RPM. Do not overload. Low speed operation between 4-5,000 RPM is not recommended because of clutch slippage.

C. When a saw stalls, lift out and recut. Do not run at full throttle with no load at 12,000 RPM. This can cause rapid wear.

D. A chain saw is safer with a sharp chain. File often and properly.

E. The oiling system is automatic but check oil level each time fuel is added. Check to be sure the oiler is functioning properly by spraying oil on some surface where it is visible during operation of the saw.

F. When cutting, chips clog the air cleaner, etc., making a richer fuel mixture and lower power. Also, clogged fins can overheat the saw, again decreasing power. Keep these areas clean!

Section 10: Maintenance and Inspection

A. DAILY

1. Clean air cleaner.
2. Clean guide bar groove and oil hole.
3. Clean and sharpen chain.
4. Check chain for damage.
5. Check oil tank level.

B. PERIODICALLY

1. Disassemble muffler and remove carbon.
2. Clean and gap filter.
3. Replace fuel filter
4. Clean oil filter.
5. Clean recoil case, rotor and cylinder fins.
6. Check clutch drum for wear.
7. Check clutch shoes for wear and damage, also clutch spring.
8. Check guide bar for wear.

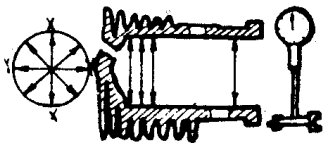
C. FOR STORAGE OVER A LONG PERIOD

1. Drain fuel, start, and run dry.
2. Remove bar and chain, clean and oil lightly.
3. Remove plug and add oil to cylinder. Crank over 2-3 times to circulate oil.
4. Pull choke on, crank piston to highest point, and replace plug.

Section 11: Tolerances and Wear Limits

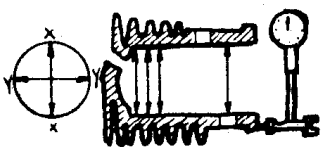
A. Cylinder

Roundness



Measure the cylinder dimensions at several locations (X-X, Y-Y, etc.). Roundness is the difference between these measurements.

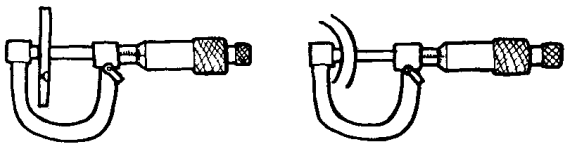
Taper



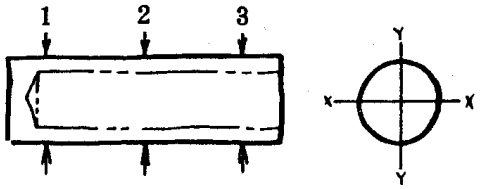
Measure at multiple locations down the cylinder wall (X-X). The difference between minimum and maximum is taper. (Y-Y dimensions should be measured as well.)

For Compression Readings:
Before disassembling a saw, remove spark plug and press a compression gauge firmly into spark plug hole. Pull the starter rope firmly and read the gauge. Repeat 1-2 times for maximum accuracy.

C. Piston Ring

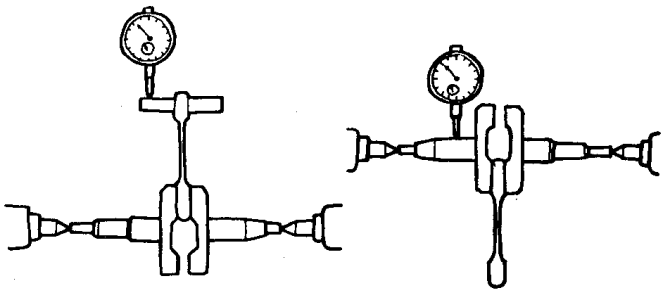


D. Piston Pin



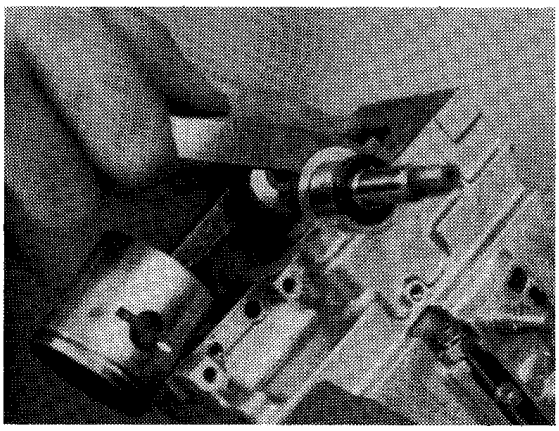
Measure 3 locations, 1 thru 3 at X-X and Y-Y. If exceeding dimensions shown, replace. Y-Y will show more wear, as it carries the load.

E. Crankshaft



1. Place the crank between centers and turn using the con-rod. Check for variation with a dial indicator.
2. With the crank between centers, install a 100mm test bar in the small end and use a dial gauge.

F. Crankcase



Adjust to standard dimensions with appropriate thrust washers, and/or change sideplate as necessary.

P/N 22102-43110 Thrust Washer .0591" (1.5mm)
P/N 22100-43140 Sideplate A .0571" (1.45mm)
P/N 22100-43150 Sideplate B .0591" (1.5mm)

Section 11: Tolerances and Wear Limits - in (mm)

MODEL	350	415	450	500
A. CYLINDER — Hard chrome plated and cannot be bored. Replace if deviation is found. (See diagram page 36)				
Inside Diameter				
Standard Dimension +.001-0 (+.02-0)	1.457(37)	1.535(39)	1.614(41)	1.693(43)
Limit - Maximum +.004(.10)	1.461(37.1)	1.539(39.1)	1.618(41.1)	1.697(43.1)
To Measure	Use telescoping/bore gauge at several locations			
Roundness				
Standard Dimension	.0002(.005)			
Limit - Maximum	.001(.03)			
To Measure	Use telescoping/bore gauge at several locations			
Cylinder-Wall Taper				
Standard Dimension	.0004(.01)			
Limit - Maximum	.002(.05)			
To Measure	Use telescoping/bore gauge at several locations			
Cylinder-Compression				
Standard Dimension	140-156 PSI (10-11kg/cm²)			
Limit - Maximum	90 PSI (6.5kg/cm²)			
Crankcase-Pressure				
Standard Dimension	5 PSI (.2kg/cm²)			
B. PISTON MEASUREMENT				
Outer Diameter				
Standard Dimension -.001-.0015(-.025-.040)	1.4551-1.4557 (36.960-36.975)	1.5338-1.5344 (38.960-38.975)	1.6125-1.6133 (40.960-40.975)	1.6913-1.6919 (42.960-42.975)
Limit - Minimum	1.4527(36.9)	1.5314(38.9)	1.6102(40.9)	1.6890(42.9)
To Measure	Use a 1-2'' or 25-50mm micrometer. (Preferably with a .0001'' or .001mm scale)			
Pin Boss Diameter				
Standard Dimension	.394(10) +0 - +.0003(.01)			
Limit - Maximum	.3976(10.1)			
To Measure	Use telescoping or hole gauge			
Ring Groove Width				
Standard Dimension	.0591(1.5) +.001 - +.002(.03-.06)			
Limit - Maximum	.0654(1.66)			
To Measure	Remove carbon before measuring with gauge			
Piston/Cylinder Clearance				
Standard Dimension	.001-.0024 (.025-.06)			
Limit - Maximum	.0071 (.18)			
To Measure	Subtract min. dia. of piston from max. dia. of cylinder			
Ring Groove Gap				
Standard Dimension	.0015-.0035 (.04-.09)			
Limit - Maximum	.0079 (.20)			
To Measure	Remove carbon, use a feeler gauge			

MODEL	350	415	450	500

C. PISTON RING (See diagram page 36)

Width

Standard Dimension	.059 (1.5)
Limit	.054 (1.37)
To Measure	Use a Micrometer

Thickness

Standard Dimension	.059 (1.5)
Limit	.051 (1.3)
To Measure	Use a spherical micrometer

Clearance

Standard Dimension	.012-.0039 (.1-.3)
Limit	.0276 (.7)

D. PISTON PIN

Diameter

Standard Dimension	.3937 (10)
Limit - Minimum	.3929 (9.98)
To Measure	Use micrometer

E. CRANKSHAFT (See diagram page 36)

Inside Diameter of Small End of Connecting Rod

Standard Dimension	.5512 (14)
Limit - Maximum	.5528 (14.04)
To Measure	Use Caliper

Offcenter of Crank

Standard Dimension	.0007 (.02)
Limit - Maximum	.0027 (.07)

Parallel of Piston Ring

Standard Dimension	.0020/3.937 (.05/100)
Limit - Maximum	.0059/3.937 (.15/100)

F. CRANKCASE (See diagram page 36)

Side gap of Crankshaft

Standard Dimension	.0027-.0094 (.07-.24)
To Measure	Measure gap between crankshaft and sideplate with a feeler gauge. See illustration.

Section 12: Torque Specifications - in/lb. (kg/cm)

A. STANDARD FASTENERS

SIZE	SOCKET SIZE	PHILLIPS SCREW	NUT
4mm	26-44 (30-50)	17-22 (20-25)	
5mm	44-70 (50-80)	26-35 (30-40)	26-35 (30-40)
6mm	70-104 (80-120)	44-61 (50-70)	
8mm			104-122 (120-140)

B. SPECIAL FASTENERS SPECIFIC LOCATIONS

LOCATION	BOLT/SCREW SIZE	FASTENING TORQUE
Ignition Coil	4mm*	35-44 (40-50)
Carburetor, Front & Rear Handle	5mm*	25-35 (30-40)
Muffler, Engine Cover	5mm*	61-70 (70-80)
Cylinder, Crankcase	5mm*	61-70 (70-80)
Rotor-Crankshaft	8mm	104-122 (120-140)
Oil Pump	4mm*	17-22 (20-25)
Spark Plug	14mm	148-165 (170-190)

*SCREW LOCKING AGENT RECOMMENDED

Section 13: Troubleshooting

PROBLEM	CAUSE	SOLUTION
I. When Engine Does Not Run		
A. ELECTRICAL — Remove plug, ground to case, pull starter to check for fire:		
1. No Fire:		
(a) Spark Plug	1) Wet electrode	1) Clean and dry
	2) Carbon on electrode	2) Clean and gap
	3) Cracked insulator	3) Replace
	4) Burned electrode	4) Replace
	5) Improper gap	5) Adjust gap to .024" (.6mm)
(b) TCI System	1) Poor adjustment of coil/rotor	1) Readjust using gauge .014" (.35mm) gap
	1) Faulty unit	2) Replace
	3) Short in coil	3) Replace
	4) Cut in wire	4) Repair or replace
	5) Improper ground	5) Repair (clean, etc.)
(c) Switch	1) Switch is off	1) Turn on
	2) Poor contact in switch	2) Repair or replace
	3) Short circuit of ground	3) Repair or replace
B. FUEL — Check for fuel in carburetor:		
1. With Fire:		
(a) Compression, fuel O.K.	1) Flooded	1) Remove plug, crank to clean
	2) Rich mixture	2) Check metering lever, adjust to needle
	3) Wrong mix	3) Mix to 25:1 ratio
	4) Wrong oil type	4) Use only 2 cycle oil
5) Clogged air cleaner	5) Clean and dry	
(b) No Fuel Flowing	1) Air vent plugged	1) Clean
	2) Needle valve stuck	2) Disassemble and clean
	3) Air leak in pulse tube	3) Reinstall or replace
	4) Idle port and hi nozzle clogged	4) Clean
	5) Fuel filter clogged	5) Clean
	6) Air leak in fuel tube	6) Replace
C. MECHANICAL — Check for Compression:		
1. Poor Compression	1) Scoring, wear on cylinder, piston, and rings	1) Replace assembly
	2) Spark plug loose	2) Tighten
II. Stops During Operation		
A. SUDDEN STOPPAGE OF ENGINE — Pull starter rope to check rotation:		
1. Turns easily (electrical problem):		
(a) Spark Plug	1) Plug cap off	1) Replace securely
	2) Shorted electrode	2) Clean or replace
	3) Insulator cracked	3) Replace plug
	4) Loose plug	4) Tighten properly
(b) Magneto	1) Unit failure	1) Replace unit
	2) Broken, loose leadwire	2) Replace
	3) Short-circuit of leadwire	3) Repair or replace
	4) Gap of rotor to coil excessive	4) Readjust gap .014" (.35mm)
(c) Switch	1) Turned off	1) Turn on
	2) Short circuit of switch	2) Repair or replace
2. Turns hard:		
(a) Piston	1) Burned piston	1) Replace piston, rings
	2) Snap ring off	2) Replace cylinder, piston, rings
(b) Crankshaft	1) Burning of conrod	1) Replace assembly
	2) Foreign material between rotor and coil	2) Remove obstruction, check for damage and regap
(c) Magneto	1) Loose bearing causing contact of coil and rotor	1) Replace bearing, readjust gap

B. GRADUAL STOPPAGE OF ENGINE — Check Fuel System		
1. Fuel Tank and Tube:	1) Insufficient fuel	1) Refill
	2) Air vent clogged	2) Clean
	3) Clogged filter, fuel pickup tube	3) Clean tube, replace filter
	4) Loose fuel pickup tube	4) Fasten securely
	5) Cracked, checked tube	5) Replace
	6) Water in fuel	6) Flush and refill with clean fuel
	7) Loose pulse tube	7) Replace properly
	8) Broken pulse tube	8) Replace
2. Carburetor:	1) Clogged filter	1) Replace
	2) Damaged, cracked diaphragm	2) Replace
	3) Clogged port	3) Clean
	4) Poor needle valve movement	4) Clean, adjust
C. STOPPAGE DURING ACCELERATION		
1. Electrical:	1) Hi voltage plug wire broken, or damaged	1) Replace plug wire
2. Fuel	1) Air leak in fuel or pulse tube	1) Replace tube

III. Saw is Difficult to Stop

A. OVERHEATING — Check for overheating:		
1. Carburetor:	1) Hi adjustment too lean	1) Readjust to 1¼ turns
	2) Oil mix ratio wrong	2) Replace with 25:1 mix
	3) Metering lever too low	3) Readjust
2. Recoil Case and Cylinder	1) Clogged cooling fan	1) Clean
	2) Dirt in recoil case and engine engine cover	2) Clean
	3) Dirt in cylinder fins	3) Clean
3. Spark Plug:	1) Improper gap	1) Regap to .024" (.6mm)
	2) Incorrect plug	2) Replace with CJ-8Y
B. SHORTING — Check Electrical System:		
1. Switch:	1) Poor/loose contact with rear handle	1) Fasten securely
	2) Loose ground	2) Install securely
	3) Cut/damaged ground wire	3) Replace

IV. Poor Performance

A. COMPRESSION — Check compression:		
1. Poor compression:		
(a) Cylinder	1) Loose plug	1) Tighten
	2) Worn rings	2) Replace rings, piston, cylinder as necessary
	3) Cracked cylinder	3) Replace cylinder
2. Compression Normal to High:		
(a) Cylinder	1) Burned piston	1) Replace piston, rings
	2) Leaking crankcase seal	2) Replace seal
	3) Carbon buildup in exhaust port	3) Remove carbon
(b) Muffler	1) Carbon buildup	1) Clean
(c) Air Cleaner	1) Clogged	1) Clean
(d) Clutch	1) Stuck	1) Replace/repair spring
B. OVERHEATING — Check Engine for Overheating:		
1. Carburetor:	1) Improper hi speed adjustment	1) Readjust
	2) Air leakage thru carburetor boot of flange	2) Repair or replace
2. Recoil Case & Cylinder:	1) Clogging of cooling fan	1) Clean
	2) Clogged cooling fins	2) Clean
	3) Debris in engine cover	3) Clean
	4) Carbon in exhaust port	4) Clean

3. Muffler has carbon buildup		1) Clean
V. Irratic Operation		
A. IMPROPER ROTATION — Unstable at low RPM:		
1. Electrical:		
(a) Spark Plug	1) Fouled plug	1) Clean or replace
	2) Improper gap	2) Adjust gap .024" (.6mm)
	3) Loose plug	3) Tighten
	4) Improper coil/rotor gap	4) Readjust
	5) Cracked insulator	5) Replace plug
(b) Switch	1) Poor switch contact (internal)	1) Replace
	2) Poor ground	2) Clean, reground securely
(c) Ignition Coil	1) Faulty coil	1) Replace
	2) Improper ground	2) Clean, reground
	3) Improper leadwire contact	3) Clean, fasten securely
	4) Coil/rotor gap too great	4) Regap to .014" (.35mm)
(d) Unit	1) Loose	1) Tighten securely
2. Fuel:		
(a) Fuel tank	1) Filter clogged	1) Replace
	2) Vent clogged	2) Clean
	3) Pinhole in pickup tube	3) Replace
	4) Pinhole in fuel tube	4) Replace
	5) Improper tube connector	5) Fasten securely
(b) Carburetor	1) Clogged filter	1) Clean
	2) Clogged lo speed port	2) Clean
	3) Poor lo speed adjustment	3) Readjust (std. opening 1¼ turns)
	4) Improper fuel level	4) Readjust metering lever
(c) Fuel	1) Improper ratio	1) Refill with 25:1 ratio
	2) Improper type of oil	1) Refill using 2 cycle oil
3. Internal:	1) Rotor contacting coil	1) Readjust to .014" (.35mm)
	2) Piston scored	2) Replace piston, rings, and cylinder as necessary
	3) Rings worn	3) Replace rings
	4) Oil seal leaking	4) Replace oil seal