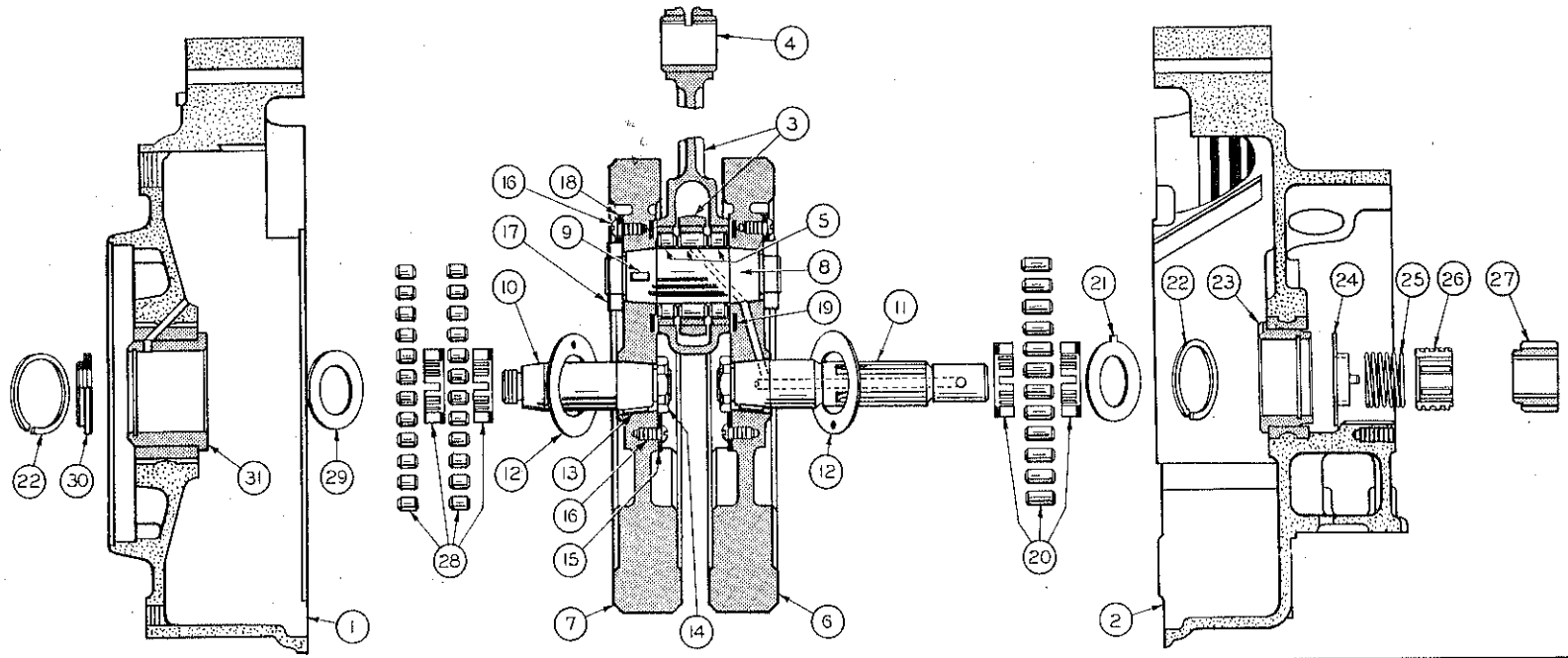
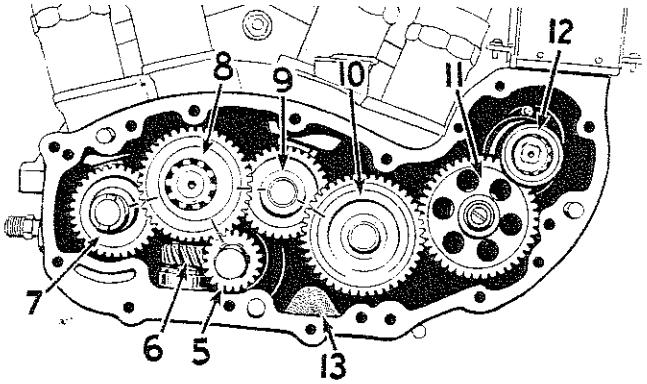


ITEM NUMBER	PART NUMBER	NUMBER USED	DESCRIPTION
1 2	403-37	1	SET OF CRANK CASES - NOTE: When only one-half case is damaged and needs to be replaced, return good half to the factory to be properly matched with a new half case.
3	289-32	1	SET CONNECTING RODS With Crank Pin & Roller Bearing Complete (includes Items 5 & 8). Forked Rod-Flywheel sideplay .006" to .010"
4	293-36	2	PISTON PIN BUSHING - Ream or hone to fit pin .001" loose.
5	309-29	1	CRANK PIN ROLLER BEARING COMPLETE - Fit this bearing .0007" to .001" loose. See "FOOTNOTE".
6	339-37	1	RIGHT FLYWHEEL When assembled, allow .012" to .014" endplay in
7	338-32	1	LEFT FLYWHEEL Crank Case. Adjust endplay with Thrust Collar "12"
8	348-29	1	CRANK PIN
9	1650-18	1	CRANK PIN KEY
10	352-29	1	SPROCKET SHAFT
11	355-37	1	GEAR SHAFT
12	357-26	2	FLYWHEEL THRUST COLLAR - .066" to .102" in steps of .004"
13	361-12	2	SHAFT KEY
14	364-29	2	SHAFT NUT
15	368-29	2	LOCKWASHER, SPROCKET & PINION SHAFT NUTS
16	030	4	LOCKWASHER SCREW
17	364-37	2	CRANK PIN NUT
18	368-12	2	LOCKWASHER, CRANK PIN NUTS
19	372-21	2	FLYWHEEL STEEL WASHER
20	414-37	1	GEAR SHAFT ROLLER BEARING COMPLETE - Fit this bearing .0008" to .0012" loose. See "FOOTNOTE".
21	414-39A	1	GEAR SHAFT BEARING WASHER
22	423-39	2	BEARING SPRING RING
23	413-39A	1	RIGHT CRANK CASE ROLLER BEARING BUSHING -- .0025" Press fit in Case
24	355-39	1	GEAR SHAFT BEARING OIL SEAL RING
25	355-37B	1	BEARING SEAL RING SPRING.
26	689-37B	1	BREATHER VALVE AND SCAVENGER PUMP DRIVE GEAR
27	604-37A	1	PINION GEAR
28	419-29	1	SPROCKET SHAFT ROLLER BEARING COMPLETE - Fit this bearing .0005" to .001" loose See "FOOTNOTE".
29	422-39	1	SPROCKET SHAFT BEARING WASHER
30	421-39	1	OIL RETAINING BUSHING ---------- Press fit in Bushing "31".
31	416-39	1	LEFT CRANK CASE ROLLER BEARING BUSHING - .0025" Press fit in Case.

"FOOTNOTE" - Referring to items Nos. 5, 20 & 28: Diameter of standard roller is .250". Complete bearings are available with rollers .001" undersize to .001" oversize in steps of .0002".

ILLUS. 28



ILLUS. 29

Valve and Ignition Timing Gears

(SHOWING GEAR MARKS IN CORRECT ALIGNMENT)

5. Pinion gear. Gear and shaft are spline-engaged and gear is a slip fit on shaft.
6. Crankcase breather sleeve gear; also drives scavenger pump.
7. Rear exhaust cam gear; also drives oil feed pump.
8. Rear intake cam gear; also drives ignition circuit breaker.
9. Front intake cam gear.
10. Front exhaust cam gear.
11. Intermediate or idler gear (not marked).
12. Generator drive gear with breather exhaust oil separator ring (not marked).
13. Oil screen.

Refer to paragraphs 4, 5 and 6 under "Disassembling Engine," Page 30, for information on removing timing gear case cover.

Installing Timing Gear Case Cover

Before installing cover, lay engine on its side and pour about ¼ pint of engine oil over timing gears.

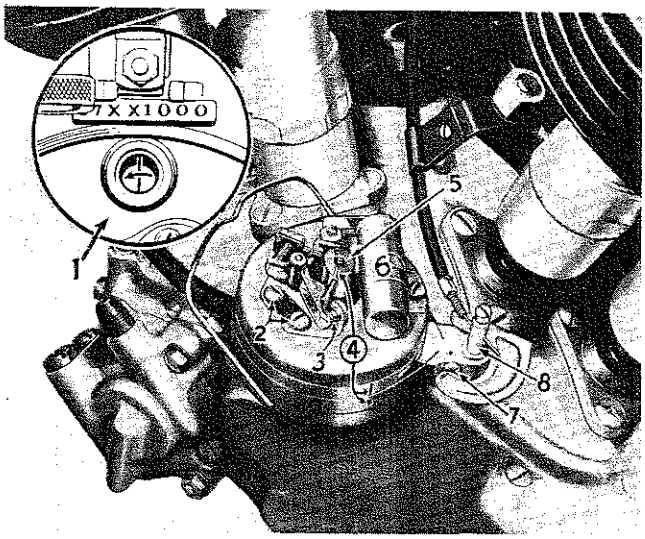
Unless old timing gear case cover gasket is in good condition, fit a new gasket. *Do not* use a "home made" gasket as this gasket has holes for oil passages, and if a hole is left out or put in wrong location, oiling system will not function normally.

After all gear cover screws, except hexagon-head bolt which also holds oil feed pump, are installed and pulled up tight (this includes generator screws), turn engine and note whether or not it turns freely. If considerable drag is felt, possibly too many steel shim washers have been fitted to one or more cam gear shafts. In this case make necessary correction. Cam gear endplay should be from free running to .005".

Installing Oil Feed Pump

If condition of oil feed pump gasket is in the least questionable, use a new "factory" gasket. *Never* use a "home made" gasket on oil feed pump as leaving out one hole or getting a hole in the wrong location may put oiling system completely out of commission.

Start pump onto its three mounting studs, turn engine slowly and press lightly against pump until driving dogs on cam gear shaft line up with and drop into driving slot in oil pump rotor. Insert hexagon-head bolt and lock washer and install the three lock washers and nuts on pump mounting studs. Pull all up tight. Note that two of these nuts are long extension nuts. These nuts should be put back on same studs from which they were originally removed.



ILLUS. 30
IGNITION CIRCUIT BREAKER AND TIMER

Ignition Circuit Breaker and Timer and Flywheel Timing Mark

1. Flywheel timing mark, in center of inspection hole in crankcase. Arrow shows direction in which engine runs.
2. Adjustable contact point lock screws. Loosen these screws to readjust point gap.
3. Contact point gap. Gap fully open (breaker lever fibre on highest point of cam) should be .022". Wrong gap affects time of ignition. See "Servicing Circuit Breaker and Ignition Timer," Page 24.
4. Mark on breaker cam (registers with breaker lever fibre), and marks on timer head, indicating original factory timing.
5. Breaker cam. Narrow cam times front cylinder; wide cam times rear cylinder. Cam should be lubricated occasionally with a *very light* application of grease.
6. Condenser.
7. Adjusting band screw. After loosening this screw and thus loosening adjusting band, timer head can be shifted to readjust timing.
8. Advance and retard lever; *inward* position is *advanced.*

Installing Circuit Breaker and Timing Ignition

(REFER TO ILLUSTRATIONS 20 AND 30)

Turn engine in direction in which it runs until tappets indicate *front* cylinder is on compression stroke (directly after front intake valve closes). Continue turning engine slowly until flywheel timing mark is in *center* of inspection hole in left crankcase.

Install gasket and timer head tension (ground) spring on timer shaft base assembly and insert shaft and shaft gear *all the way down* into place in timing gear case cover. Do not secure with timer base screws as yet.

Install timer head with control lever (8) within advance and retard quadrant as shown. Do not install cover retainer until later. *Fully advance* lever (8) (push inward) and observe how closely mark (4) on breaker cam lines up with breaker lever fibre. If it does not line up, lift timer base and turn shaft gear so its engagement with its driving gear is changed one tooth. Check again according to breaker cam mark. Repeat this procedure until gear engagement is attained which closely aligns mark (4) and breaker lever fibre. When this has been accomplished, note that base is turned so ignition coil wire is toward rear of engine and secure base with screws and lock washers.

Re-install head on base and secure with ground spring and cover retainer. Be sure ground spring is in its proper place so when cover retainer ends are fitted through holes in timer head, they also fit into spring locating notches. Otherwise, spring will have no tension and timer head will be loose on its base. Contact points and condenser are grounded through timer base and this spring holds the head in close contact with the base, thus insuring a good ground.

Provided mark on *side* of timer head and hole in adjusting band are still in alignment, also breaker point gap is correctly adjusted, engine is now timed according to original factory setting.

Recommended Recheck of Ignition Timing

Even though all marks are in perfect alignment, same as engine was originally timed, timing may change somewhat after engine has been in service for a time, due to normal wear and seating of the various moving parts that affect timing.

Since accurate ignition timing is the first essential to good engine performance, it is advisable, after ignition has been timed according to marks as explained above, to recheck as follows:

Refer to Illustration 30. See that circuit breaker points are properly adjusted with a gap of .022". Make sure breaker lever (8) is advanced all the way. Turn engine in direction in which it runs until *front* cylinder is on compression stroke and continue to turn it ahead slowly until narrow cam (the one with timing mark), *just starts to open* breaker points.

An accurate check as to when points just start to break can be made with a test lamp as follows:

If engine is not installed in chassis, connect a test battery in series with test lamp and circuit breaker. While points are closed, lamp will remain lit; as points start to open, lamp will go out.

If engine is installed in chassis, connect one wire of test lamp to coil rear terminal along with circuit breaker wire, connect other wire to ground and turn ignition switch "ON." As long as points are closed, lamp will remain out; as points start to open, lamp will light.

When exact position is found, where points just start to open, flywheel mark should be in *center* of inspection hole. If it is not, readjust timing as necessary by loosening screw (7), which loosens adjusting band, and shift timer head in band.

If flywheel timing mark shows forward of center in inspection hole, timing is slow. To correct, shift timer head *against rotation* of breaker cam. If flywheel mark is to rear of center of inspection hole, timing is fast and timer head must be shifted *with rotation* of breaker cam, to correct timing.

With ignition timing correct, front piston is $\frac{9}{32}$" before top center, on compression stroke, when points just start to open and cause spark to occur, firing front cylinder.

Ignition timing should be checked in this manner every 2000 miles.

Installing Pistons

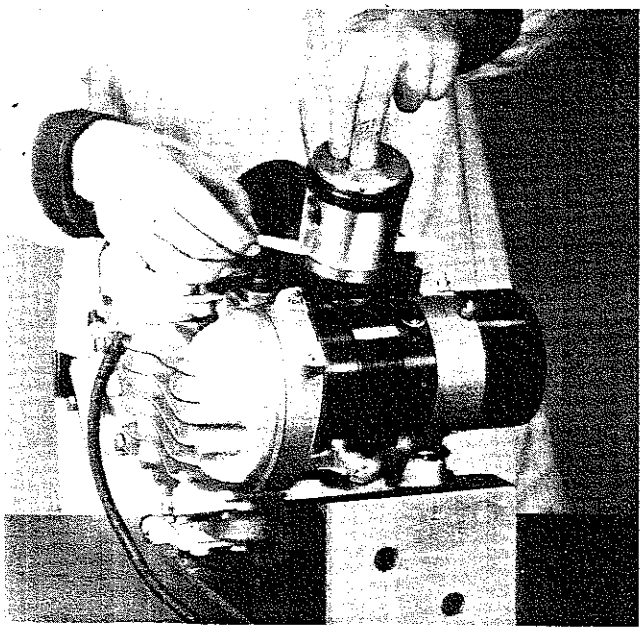
It is assumed that piston-cylinder fitting, also pin and ring fitting have already been given due attention as per information under "Refinishing Cylinders Oversize and Fitting New Pistons," Page 32, "Emergency Piston and Ring Service," Page 43 and "Piston Rings," Page 44. Whether new or used pistons are being installed, the rings should be new. It is not practical to reassemble an engine with used rings, even though rings may not be very badly worn.

Install pistons according to instructions under "Piston and Pin," Page 43. Handle pistons carefully so they will not be burred, cracked or otherwise damaged.

Aligning Rods

In refitting and reassembling connecting rods, and finally fitting pistons, rods may possibly be bent or twisted, throwing upper bearing and lower bearings out of alignment with each other to some extent. Therefore, after pistons have been fitted, rods must be checked and re-aligned as may be necessary. If a rod is left bent or twisted, piston has a cocked relation to cylinder bore and the result is excessive noise and rapid wear.

Check rod alignment by means of piston squaring plate (manufacturer's number 12655-26) as shown in Illustration 31. Be sure crankcase face is clean and



ILLUS. 31
PISTON CHECK FOR ROD ALIGNMENT

free from burrs so that squaring plate seats fully.

If a rod is in perfect alignment, piston bottom will rest squarely on plate with flywheels turned so that crank throw is in either forward or rear position. Bear in mind that this check, to be accurate, depends upon checking *with crank throw in both forward and rear positions,* as it is the change of rod angle, resulting from changing crank throw from one position to the other, that influences the seating of piston on squaring plate and thus indicates whether or not rod is in alignment.

Rather than depend entirely upon visual check, as to when piston seats squarely upon plate, insert narrow strips of paper of equal thickness underneath piston, one on each side, below piston pin, as shown in Illustration 31. Press piston down *lightly* with finger tips resting on *center* of piston head and pull first one paper, then the other, partially from underneath piston. If piston is perfectly square (rod in alignment), both will have the same amount of drag.

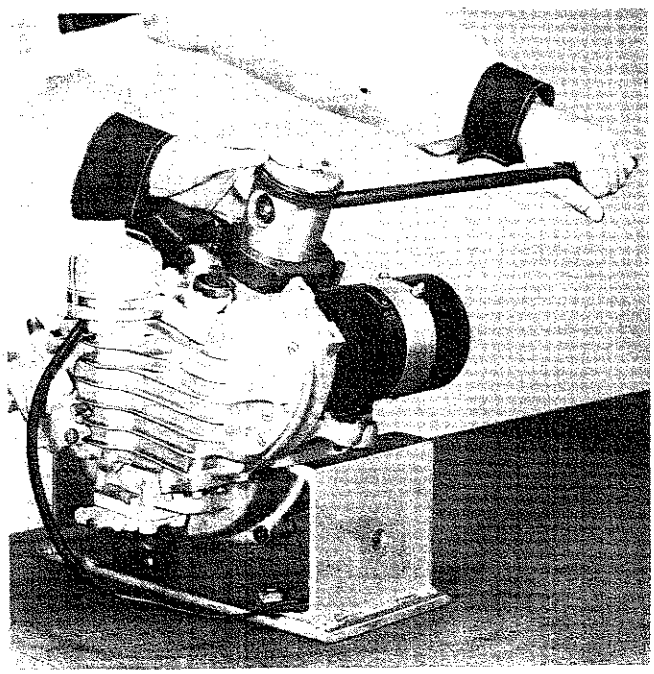
If rod proves to be out of alignment, it can be straightened by means of a bar inserted through piston pin, as shown in Illustration 32. Use bar of largest diameter that can be inserted through pin.

To straighten a *bend,* insert straightening bar through *low end* of piston pin and apply *upward* force.

To straighten a *twist,* insert straightening bar through *high end* of piston pin and pull *away* from crank throw.

The manner in which piston seats on squaring plate indicates as follows:

1. Piston high on *same* side, *both* crank throws; rod is bent.
2. Piston high on *opposite* sides as crank throw is changed; rod is *twisted.*
3. Piston square or nearly square with crank throw in one position and high on one side with crank throw in other position; rod is *bent* and *twisted.* In this case, remove bend first and then remove twist.



ILLUS. 32
SQUARING PISTON (STRAIGHTENING CONNECTING ROD)

After rods have been aligned, check to see that pistons center in crankcase cylinder opening, without side pressure on rod upper ends. If rod ends are offside enough to interfere with pistons centering, they must be corrected by one of the following methods: Further re-aligning; dressing off end of rod bearings with a file; fitting a different combination of thrust collars (Item 12, Illustration 28) to shift complete flywheel and rod assembly sideways.

Installing Cylinders

Lubricate cylinder walls, pistons, pins and rod upper bushings generously with engine oil. Also pour about ¼ pint of oil onto rod lower ends. This is an initial crankcase supply to take care of lubrication requirements while oiling system is building up normal pressure and circulation, directly after starting an overhauled engine the first time.

Space ring gaps about equidistant around piston but do not locate any gap near exhaust valve port, as in this position ring ends may be overheated and burned.

Turn engine until crank pin is at bottom center. See that crankcases are clean and fit cylinder base gaskets. Also note that valve cover gaskets on tappet guides are all in place and in good order. If any are damaged or broken, replace them. Cylinders with valves and valve covers assembled can now be installed over pistons and rings being careful not to change ring gap location. Work cylinders carefully down over rings to avoid any possibility of ring breakage. Install rear cylinder first and as cylinder seats, turn engine so tappets are at their lowest position. Turn on cylinder base nuts and pull them down jus snug, not tight. Follow same procedure with front cylinder. In connection with a top overhaul only which does not require removing muffler, insert exhaust pipes into cylinders as they are seated.

Check intake manifold packing bushings to see that they are in good condition. Assemble nuts and bushings to manifold after applying a light coat of oil or grease so bushings will freely adjust themselves to manifold and cylinder nipples as nuts are tightened. Turn nuts onto cylinder nipples and tighten securely with special wrench (manufacturer's number 12003-X). Unless manifold packing bushings are in good condition and manifold nuts securely tightened there are likely to be air leaks around manifold-cylinder joints. With this condition it will not be possible to get a satisfactory low speed carburetor adjustment.

After manifold is tight, loosen cylinder base nuts slightly to allow final shifting and lining up of cylinders and manifold, then tighten base nuts securely, using special wrench (manufacturer's number 12650-29).

Installing Cylinder Heads

It is recommended that new cylinder head gaskets be used each time heads are re-installed. This assures leak-free joints. Old gaskets should be re-used only in an emergency when new gaskets are not available, as in some cases a leak-free joint cannot be obtained with used gasket. Apply a light coat of engine oil or grease to both sides of gaskets. Make

sure tops of cylinders are clean and install gaskets.

Place heads on cylinders and install heavy washers and head bolts (See Illustration 19). Attach cylinder head-frame bracket with the two long bolts, spacers and flat washers. Spacers go between heads and frame bracket. A flat washer goes under the head of each long bolt above bracket and some engines have flat washers between spacers and bracket.

Head bolts must be tightened evenly to attain a tight joint. First turn bolts down just snug; then tighten each of them ⅛ to ¼ turn at a time until all are securely tightened. Use special head bolt wrench (manufacturer's number 12047-30A).

Adjusting Valve Tappets

Valve tappets must be checked and readjusted each time cylinders are removed and re-installed. See "Adjusting Valve Tappets," Page 23.

Installing Carburetor

After servicing carburetor as needed according to information under "Carburetor Service," Page 58, install it on manifold. Note that engine equipped with a ½" spacer between manifold and carburetor should be fitted with three heavy (asbestos) manifold gaskets. One gasket is placed between manifold and spacer, and two between spacer and carburetor.

Engine not equipped with spacer between manifold and carburetor may be fitted with either one heavy gasket or a paper gasket, between manifold and carburetor.

Install lock washers on carburetor-manifold screws and tighten screws securely. If these screws are not tight, an air leak will result, causing carburetion to be erratic. Attach carburetor support bracket to bowl nut extension. Tighten securely.

Disassemble gasoline strainer. Clean thoroughly before installing.

Installing Engine in Chassis

In connection with top overhaul only, engine is already in chassis and completing assembly is a matter of reversing the procedure followed in disassembly as outlined under "Disassembling Engine for Top Overhaul Only," Page 29.

In the case of a complete engine to be installed in chassis, reverse procedure followed in removing engine from chassis as outlined under "Removing Assembled Engine From Chassis for Complete Overhaul," Page 30.

In either case, pay close attention to the following: Install required number of shim washers to fill space between cylinder head bracket and frame lug and securely tighten the bolt through these fittings; bear in mind that clamp for front spark plug cable is also attached with this bolt. Be sure throttle and spark control clamps are tightened securely and check very closely to see that throttle opens and closes fully with grip movement and that spark advances fully with grip in inward position. Check clutch, gear shifter and brake controls for correct adjustment. Make close final inspection to be sure all nuts, bolts, screws, etc., are tight.

Emergency Piston and Ring Service

Need of replacement of rings, or possibly pistons and rings, is indicated by loss of normal compression, overheating, loss of power, abnormal oil consumption, excessive exhaust smoke and piston slap or knock.

As explained under "Refinishing Cylinders Oversize and Fitting New Pistons," Page 32, when pistons develop excessive clearance and slap due to wear or damage and cylinders are found worn more than .002", it is recommended regular practice to smooth and true up cylinder bore by honing, or boring and honing, to the next regular oversize piston step.

However, piston slap alone, due to wear and excessive cylinder-piston clearance, does not necessarily mean otherwise very poor and undependable performance. A good compression seal is the requirement of prime importance for good performance. Therefore, in rendering emergency or field service, when and where oversize pistons and facilities for refinishing cylinders oversize are not at hand, the main things to be considered are whether or not cylinders are deeply scored and piston ring grooves badly worn sideways.

Even though cylinders and pistons may be worn to the extent of very pronounced piston slap, if cylinders are in smooth condition so a new and reasonably good compression seal can be effected by fitting new rings, or new pistons and rings if ring grooves are badly worn, engine will be good for a further period of dependable performance.

See "Checking Connecting Rod Lower Bearing for Excessive Wear and Looseness," Page 29.

Piston and Pin

(REMOVING AND INSTALLING)

Piston pin, properly fitted, is a light hand press fit in piston and has .001" clearance in connecting rod upper bearing. The pin is secured in piston by means of a spring lock ring at each end of pin. Lock rings fit into grooves in pin and grip pin with considerable tension.

In removing piston pin, first remove lock ring from end of pin that is slotted. These slots permit getting a screwdriver underneath lock ring and forcing it off. Use end of special tool specified below as a rest for screwdriver. Pin can then be driven out of piston. Use a drift of proper size to avoid damaging end of pin and piston boss and strike *light* hammer blows to avoid bending connecting rod.

When reassembling piston to rod, after giving due attention to correct fit of pin in both, piston and rod upper bearing, clean lock ring groove and install lock ring on end of pin that is *not slotted*. Start slotted end of pin into piston boss and drive through in the same manner in which pin was removed.

If the piston (but not the pin) is heated about as hot as it can be handled before pin is started, pin will drive through easier than with piston at room temperature. After pin is in place, clean lock ring groove and install the other lock ring. It is important that manufacturer's special tool number 12052-32 be used for installing lock rings, as with this tool lock ring is expanded just enough to go over end of pin. Other means of installing may over-expand ring and

possibly crack it. Note that ring seats firmly in its groove; if it doesn't, discard it and install another new one. A lock ring loosely installed will rapidly loosen further in service and finally will come off pin, resulting in both piston and cylinder soon being damaged beyond repair. *Never* re-install a used lock ring; always use a *new* one.

Standard size pistons and those in the lower oversize steps have two horizontal slots, one front and one rear, in bottom ring groove. Oversize pistons in the larger steps are slotted horizontally and also have a vertical slot in one thrust face. Pistons with only the horizontal slots may be fitted with either thrust face to the front. Pistons with vertical slot in one thrust face must be *fitted with that thrust face to the front.*

Pistons obtained from the manufacturer, standard or oversize, are fitted with pin correctly fitted and piston rings installed. Piston pin lock rings are also supplied, one assembled on pin, the other one loose. Check ring gaps in cylinder being refitted.

Piston Rings

Piston rings are of two types; the two upper rings on each piston are plain compression rings. The bottom ring on each piston is an oil control ring, having a channel in its face.

Piston rings must have proper side clearance in ring grooves. In new assembly, this is .004". Check with thickness gauge. Maximum permissible side clearance is .008".

Gap between ends of rings, when inserted squarely in cylinder bore, must be .010" to .020". If gap is less than .010", ring ends may butt under expansion and rings may be scored or broken. Gap may be increased by filing with a fine-cut file.

Installing and Fitting Connecting Rod Upper Bushing

Connecting rod upper end bronze bushing may need to be renewed either due to wear and excessive pin clearance or due to becoming loose in rod. Inspect for both conditions.

When bushing is found tight in rod but is worn to excessive pin clearance (.002" or more) it is, of course, possible to service it by reaming oversize and fitting an oversize pin. However, it is better practice to install a new bushing and ream it to fit a standard pin, except when piston to be used has previously been fitted with oversize pin or pin is loose in bosses, necessitating fitting with larger pin. The principal objection to fitting upper end oversize is that, in the event of emergency field service requiring quick fitting of pistons, considerably more time is required for the job if upper end bearing is oversize. New pistons obtained from the manufacturer are supplied correctly fitted with standard pin, and installing one is a short job if the rod bushing is already reamed to standard size. If bushing has been reamed oversize, either new bushing must be installed and reamed to standard size or piston must be reamed oversize to fit an oversize pin, which involves extra time.

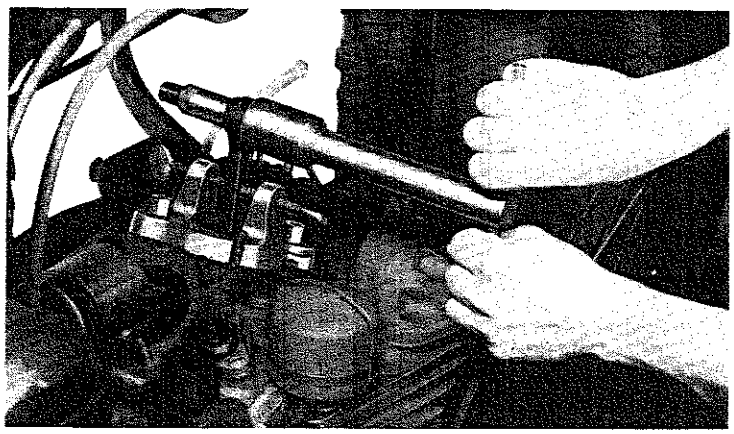
When installing new upper end bushings in rods disassembled from engine, an arbor press, if available, is usually used to press out old bushings and press in the new.

When renewing bushings in connection with only a *top* overhaul, use special manufacturer's tools shown in Illustration 33. Bushing tool is number 12057-X; rod holding fixture is number 12058-X. Be careful to start new bushings with oil slot in alignment with oil slot in rod.

Ream new bushing to size, or, preferably, ream nearly to size and finish to exact size with a hone (reamer number 11915-X; hone number 11844-X). A properly fitted pin should have .001" clearance; with this clearance, pin will have *just noticeable* shake in bushing. Fitting tighter is likely to result in a seized pin or bushing loosened in rod.

Oversize piston pins are available in the following oversizes: .002", .004", .006", .008", .010" and .012".

After installing new connecting rod upper end bushings in connection with only a top overhaul, connecting rod alignment must be checked the same as when an engine is completely overhauled. See "Aligning Rods," Page 41.



ILLUS. 33
INSTALLING NEW ROD BUSHING

SUMMARY OF ENGINE SPECIFICATIONS

(Fitting and Adjusting)

CYLINDER: Standard bore—2.7445″ to 2.7455″.

PISTON CLEARANCE IN CYLINDER: .001″ to .002″, measuring piston at bottom of skirt, front to rear.
Warning: This fitting clearance applies only to manufacturer's taper-cam ground piston, which is .0025″ smaller at top of skirt, underneath lower ring, than at bottom of skirt. This clearance (.001″ to .002″) is not sufficient for straight-cam ground piston obtained from some other source.

PISTON-CYLINDER HEAD CLEARANCE: $\frac{1}{16}$″ to $\frac{3}{32}$″ with piston at top center.

PISTON PIN IN PISTON: Light hand press fit.

PISTON PIN IN CONNECTING ROD UPPER BUSHING: .001″ clearance.

PISTON RING GAP: .010″ to .020″.

PISTON RING SIDE CLEARANCE IN GROOVES: .004″.

CONNECTING ROD LOWER END BEARING: .0007″ to .001″ loose.

CONNECTING ROD LOWER END SIDE PLAY: Forked rod must have .006″ to .010″ play between flywheels. Roller and retainer assembly must be narrower, but not more than .010″ narrower, than forked rod.

PINION GEAR SHAFT: .0008″ to .0012″ loose in roller bearing and .0005″ to .001″ loose in timing gear cover bushing. (Note: When new cover bushing is installed, oil transfer hole in bushing must be located 30° ahead of top center).

SPROCKET SHAFT: .0005″ to .001″ loose in roller bearing; .006″ to .007″ loose in oil retaining bushing.

FLYWHEEL ASSEMBLY: .012″ to .014″ endplay in crankcase.

CAM GEARS: .0005″ to .001″ clearance in crankcase and gear case cover bushings; free to .005″ endplay.

VALVE STEM-VALVE GUIDE CLEARANCE: .0035″ to .0055″.

TAPPET GUIDES: .0005″ to .001″ press fit in crankcase.

VALVE TAPPET-TAPPET GUIDE CLEARANCE: .0005″ to .001″.

TAPPET CLEARANCES: Engine cold. Intake .004″ to .005″; exhaust .006″ to .007″.

CIRCUIT BREAKER POINTS: .022″ gap with breaker lever fibre on highest point of cam.

SPARK TIMING: ¼″ to $\frac{9}{32}$″ before top center; time according to flywheel mark. (See Page 40.)

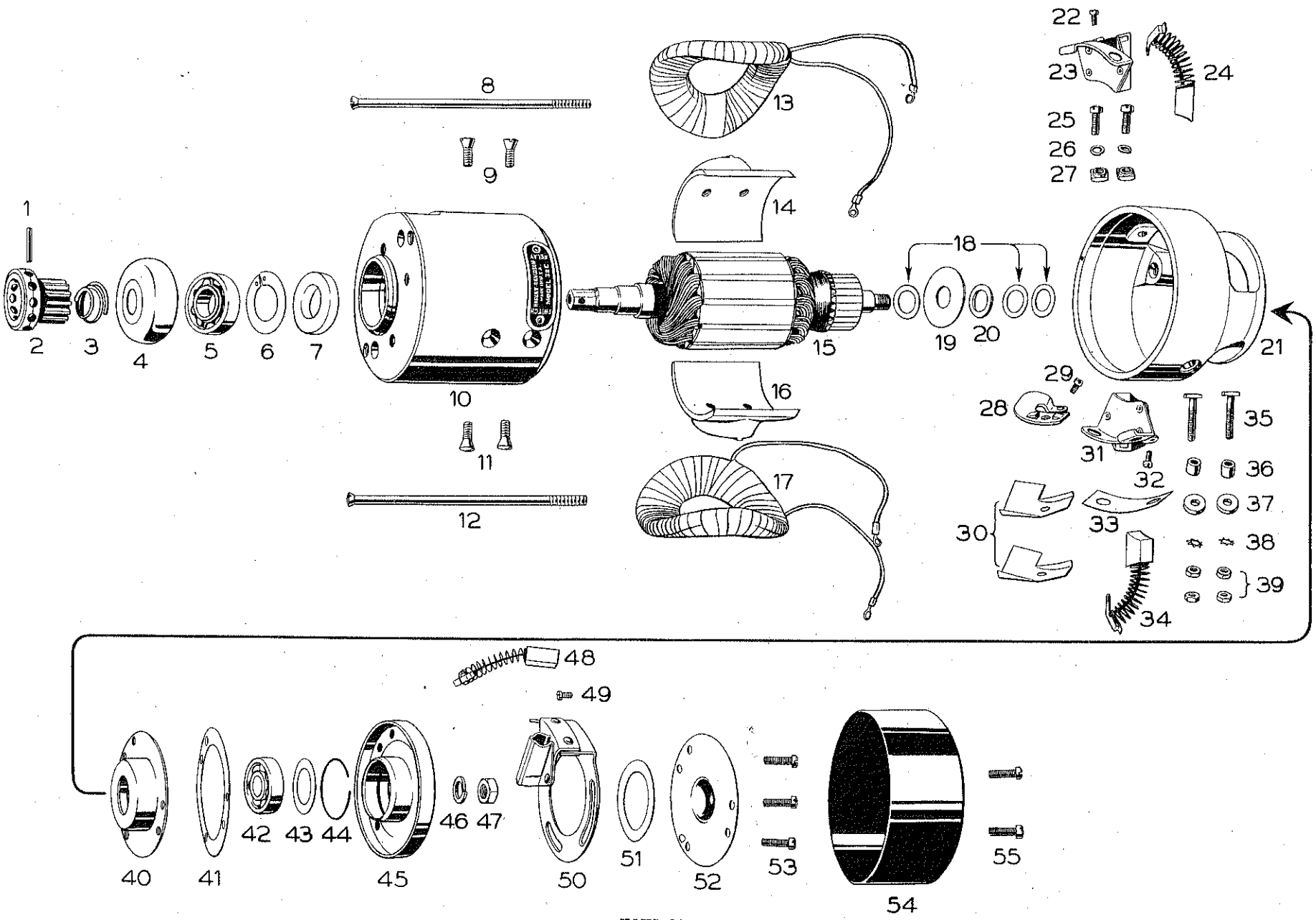
CRANKCASE BREATHER TIMING: See Page 37.

VALVE TIMING: Time according to gear marks (See Page 40). Tappets to be adjusted first. Intake opens $\frac{5}{32}$″ to $\frac{7}{32}$″ before top center; intake closes $\frac{37}{64}$″ to $\frac{45}{64}$″ after bottom center. Exhaust opens $\frac{37}{64}$″ to $\frac{45}{64}$″ before bottom center; exhaust closes $\frac{5}{32}$″ to $\frac{7}{32}$″ after top center.

OIL PUMP ADJUSTMENT: Normal setting—Head of pressure regulating valve adjusting screw ⅜″ from face of pump body.

FRONT CHAIN OILER ADJUSTMENT: Initial factory setting—Adjusted with the required washers under adjusting screw head to hold screw point 1⅛ turns off its seat. Make further adjustments as needed to meet actual service requirements (See Page 20).

REAR CHAIN OILER ADJUSTMENT: Initial factory setting—Adjusted with the required washers under adjusting screw head to hold screw point ½ turn off its seat (See Page 20).



ILLUS. 34

GENERATOR—SHOWING ALL PARTS IN CORRECT ORDER OF ASSEMBLY

GENERATOR ASSEMBLY

(ITEM NUMBERS REFER TO ILLUSTRATION 34)

ITEM	NUMBER USED	PART NUMBER	NAME
1	1	634-32	Drive Gear Pin
2	1	632-37	Drive Gear
3	1	1647-31B	Spring
4	1	1646-31	Oil Deflector
5	1	1644-30	Drive End Bearing (large)
6	1	1647-31D	Spring Ring
7	1	1647-31C	Felt Oil Retainer
8	2	1506-32	Frame End Screw (Same as Item 12)
9	4	1512-18	Pole Shoe Screw (Same as Item 11)
10	1	1504-32	Frame
11	(See Item 9)	-	—
12	(See Item 8)	-	—
13	1	1507-32	Shunt Field Coil (White identification mark)
14	2	1511-30	Pole Shoe (Same as Item 16)
15	1	1636-32	Armature
16	(See Item 14)	-	—
17	1	1508-32	Regulating Field Coil (Orange identification mark)
18	3	1643-29	Armature Steel Spacer (.025")
19	1	1642-29	Armature Bakelite Washer
20	1	1643-30	Armature Steel Spacer (.072")
21	1	1505-32	Frame End
22	4	010	Terminal Screw (Same as Items 29, 32 and 49)
23	2	1661-32	Brush Holder (Same as Item 31)
24	2	1669-32	Brush (Same as Item 34)
25	2	036	Brush Holder Bolt
26	2	0254	Lock Washer
27	2	1667-32	Nut
28	1	1663-32B	Shunt Field Coil Terminal
29	(See Item 22)	-	—
30	2	1663-32A	Shunt Field Coil Terminal Insulation
31	(See Item 23)	-	—
32	(See Item 22)	-	—
33	1	1663-32	Positive Brush Holder Insulation
34	(See Item 24)	-	—
35	2	1664-32	External Terminal Bolt
36	2	1665-32	Terminal Bolt Bushing
37	2	1666-32	Insulating Washer
38	2	0354	Lock Washer
39	4	0105	Nut
40	1	1641-30A	Grease Retainer, Inner
41	1	1697-30	Gasket
42	1	1644-18	Commutator End Bearing
43	1	1639-18	Spacing Shim (.020")
44	1	1647-29A	Spring Ring ($1\frac{5}{16}$" diameter)
45	1	1647-32	Bearing Housing
46	1	0261	Lock Washer
47	1	0129	Armature Shaft Nut
48	1	1671-26	Third (regulating) Brush (small)
49	(See Item 22)	-	—
50	1	1662-32	Third (regulating) Brush Holder
51	1	1642-30	Gasket
52	1	1641-33	Grease Retainer, Outer
53	5	037	Screw (Same as Item 55)
54	1	1696-32	End Cover
55	(See Item 53)	-	—

ELECTRICAL SYSTEM

Electrical system is a 6 volt, one wire, ground return system, with *negative ground*. Generator is third brush and "lamp load" regulating type. Lamp load regulation is accomplished by connecting "shunt" field winding in the lighting circuit. When lights are turned "ON," this field is energized and generator output is increased to carry load of lighting equipment.

When Generator Fails to Charge

When generator apparently quits charging (indicated by *green* signal light in switch panel staying lit or battery going dead), the trouble may be of such nature that repairs can be made without removing generator. Follow procedure outlined below, step by step, until the trouble is located.

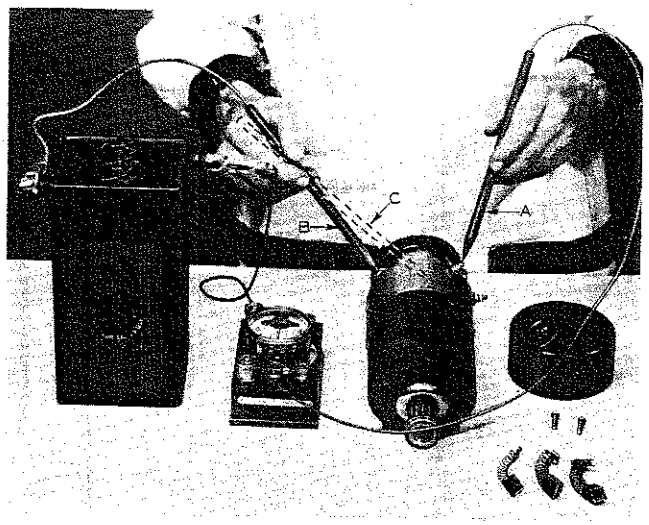
1. Test the battery and if its condition is questionable, replace with fully charged battery before making further tests.
2. Remove left footboard, footboard sidebar and clutch footpedal assembly.
3. Remove generator end cover and inspect brushes to make sure they are not worn out, broken, or gummy and sticking in brush holders.
4. See that commutator is not excessively oily, dirty or gummy.
5. Make sure brush holders are not bent and possibly striking shoulder on commutator.
6. If the fault is not found through above checks, it may be in the cut-out relay, or in wiring between generator and battery.

To check whether trouble is in generator, relay, or wiring between relay and battery:

1. Connect an ammeter between battery *negative* terminal and ground.
2. Disconnect wires from "relay" terminal of generator and battery *positive* terminal, and connect a jumper wire directly between these two terminals.
3. Start and speed up engine and check reading of ammeter. If generator shows *normal charge*, trouble is in cut-out relay (See "Cut-out Relay," Page 52) or in wiring between relay and battery (See "Wiring Details," Page 54). If generator shows *no charge*, it must be removed for further attention.

Removing Generator

1. Disconnect wires from generator "switch" and "relay" terminals.
2. Remove the two long screws, through timing gear case cover, that secure end of generator against gear case.
3. Remove nut, lock washer and curved washer from end of strap that clamps generator in its cradle on crankcase.
4. Lift strap high enough to permit raising generator so oil slinger (on end of generator gear) will clear adjacent gear and allow generator to be removed from engine.
5. Be sure to observe and count number of paper shims between generator and cradle. Lay these shims aside to be used again when generator is re-installed. Also, note location of hole in shims for oil drain. These shims were required in original assembly to adjust driving gears for proper mesh and, if left out, gears are still likely to mesh too deeply and howl, even though they have seen considerable service.
6. Unless a new generator gasket is available, to be used when generator is re-installed, be careful about damaging the old one.



ILLUS. 35
TESTING REGULATING FIELD COIL

Testing Field Coils and Brush Holders Without Disassembling Generator

Caution: Overloading ammeter, due to short circuit or otherwise, will damage it. Overload is indicated by needle going beyond range of calibrated scale; direct "short" is indicated by needle swinging violently to extreme limit of its travel. In either case, contact must be broken *instantaneously* to avoid damaging or burning out ammeter. Therefore, in making the following tests with ammeter, first make only a *momentary* contact to determine if a short exists. If ammeter needle does not go beyond calibrated scale, it is safe to make continuous contact and proceed with test as described.

As an added precaution, in making tests with ammeter, always work on a bench with an insulated top. This will prevent shorting through bench top.

Never touch test points together.

Connect a *fully charged* battery to suitable test ammeter and test points as shown in Illustration 35.

Remove the three brushes from their holders (See "Inspecting or Replacing Generator Brushes," Page 51). Removing main brushes requires removing screws connecting field coil terminal wires to brush holders. These *wires must be reconnected* before tests can be made.

Testing regulating field coil (see Illustration 35):

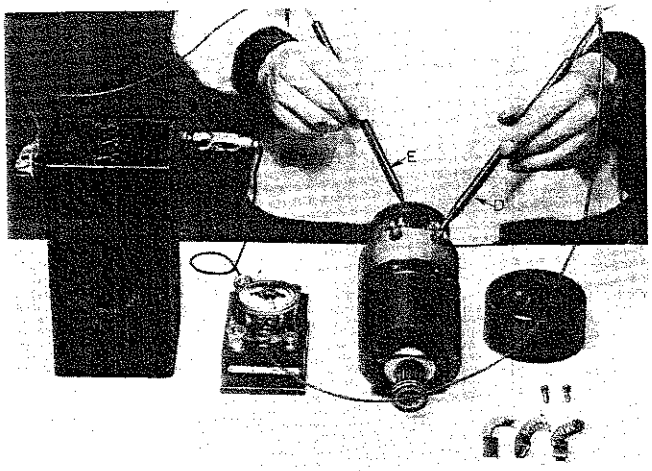
1. Touch test point "A" to "relay" terminal of generator and test point "B" to *third* (regulating) brush holder as shown in Illustration 35. The ammeter should read between 1.4 and 1.9 amperes. If ammeter shows *no reading*, field coil is *open* (See that terminal connections are tight and field coil wires are not broken at terminals). If reading is *appreciably higher* than 1.9 amperes, field coil is *shorted* internally.
2. With test point "A" still on "relay" terminal, ground other test point by moving it to generator frame, as indicated by dotted lines "C," Illustration

35. Ammeter should show *no reading* on this test. If ammeter registers a reading, field coil, "relay" terminal, positive brush holder or third brush holder is *grounded.*

If test shows ground, disconnect field coil wire from third brush holder. If trouble is eliminated, third brush holder is grounded. If ground still exists, disconnect field lead from positive brush holder. If trouble is now eliminated, ground is in field coil. If ground still exists, the positive brush holder or "relay" terminal is grounded.

Testing shunt field coil (See Illustration 36):

Touch test point "D" to "switch" terminal and test point "E" to negative brush holder (this brush holder is grounded) or on generator frame as shown in Illustration 36. Ammeter should read from .6 to 1.0 ampere. If ammeter shows *no reading,* coil is *open* (See that terminal connections are tight and field coil wires are not broken at terminals). If reading is *appreciably higher* than 1.0 ampere, coil is *shorted* internally or *grounded,* or "switch" terminal is *grounded.*



ILLUS. 36
TESTING SHUNT FIELD COIL

Disassembling Generator

(ITEM NUMBERS REFER TO ILLUSTRATION 34)

A. End cover and brushes have already been removed for previous checking and testing.

B. Disconnect field wires from brush holders. Closely observe how field coil wires are arranged to keep them in the clear so they will not be damaged by armature. Two are pulled between generator frame and frame end screws and one is brought over the outside of aluminum frame end. Also, excess slack is avoided by winding wires together, where they cross at brush holders. Note this arrangement and arrange wires in the same manner when reassembling.

C. Remove pin from drive gear; remove gear, spring and oil deflector (Items 1, 2, 3 and 4).

D. Clamp armature shaft in copper-faced vise jaws, with generator in upright position.

E. Take out three end screws and remove outer grease retainer, gasket and third brush holder (Items 50, 51, 52 and 53).

F. Remove armature shaft nut and lock washer (Items 46 and 47); use $\frac{9}{16}$" socket wrench.

G. Remove bearing housing, gasket, bearing, and inner grease retainer (Items 40, 41, 42 and 45).

H. Remove steel and fibre washers from armature shaft (Items 18, 19 and 20).

I. Take generator out of vise and remove frame end screws (Items 8 and 12). If gasket is still on end of generator frame, it will have to be removed to uncover the heads of these screws. Before turning screws all the way out, tap them lightly to drive aluminum frame end (Item 21) off frame (Item 10).

J. Remove armature (Item 15) from frame by tapping drive end of shaft lightly with a soft hammer.

K. Drive end bearing can now be removed; also spring ring and felt oil retainer (Items 5, 6 and 7).

L. Do not remove pole shoes and field coils (Items 13, 14, 16 and 17) unless tests previously made proved one or both of the field coils in bad order. They should be removed only for good reason, as difficulty may be experienced in reassembling so they allow specified armature clearance. When a pole shoe and field coil must be removed, clamp generator frame *lightly* in vise and remove screws with a large screwdriver. These screws are very tight and difficulty will be experienced in removing them unless screwdriver bit is in good shape and seats fully in slot.

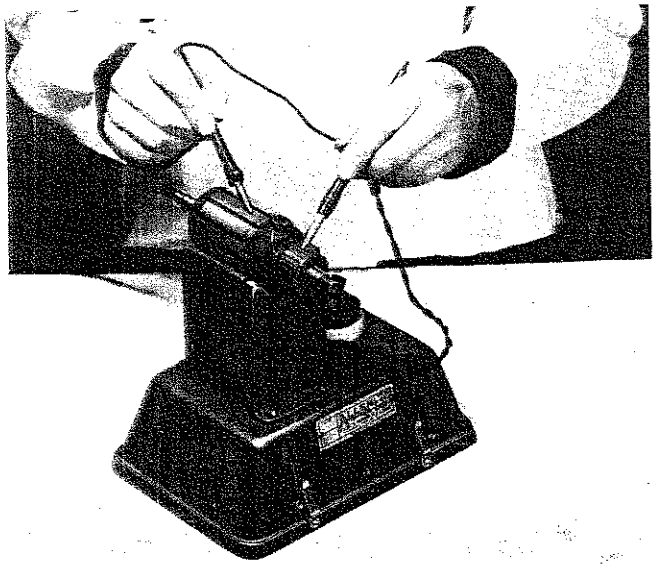
Testing Armature

(REFER TO ILLUSTRATIONS 37, 38 AND 39)

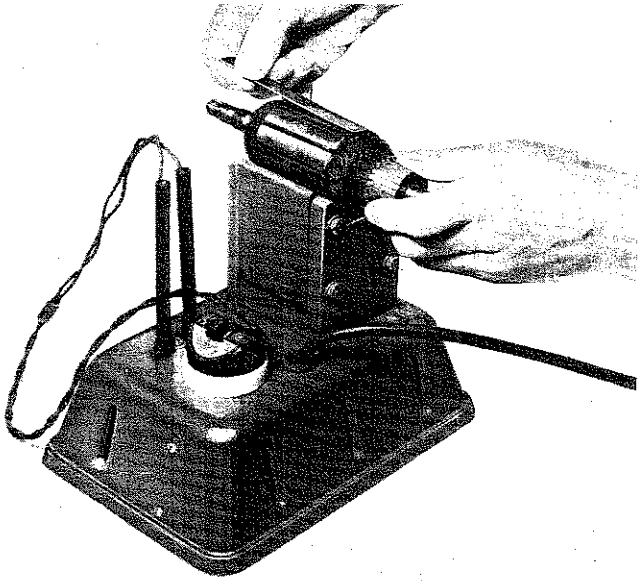
To test for "ground":

If growler with test points is available, test as shown in Illustration 37. If this means of testing is not available, test with battery and ammeter hook-up, same as used for testing field coils (shown in Illustrations 35 and 36). Contact commutator with one test point and armature core with the other. If circuit is completed, armature is grounded.

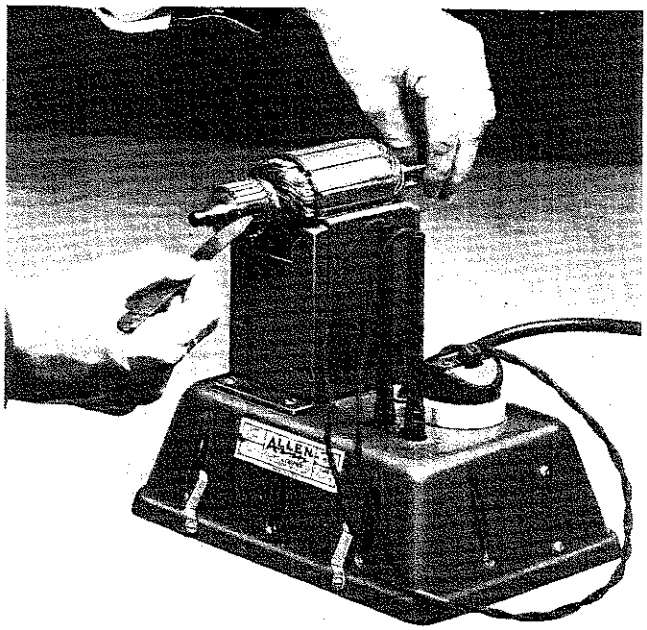
If armature is found to be grounded, make sure commutator is free from carbon and copper dust deposits. After cleaning thoroughly between segments and at ends of commutator and blowing off thoroughly with compresed air, repeat test. If ground still exists, armature must be replaced with a new one.



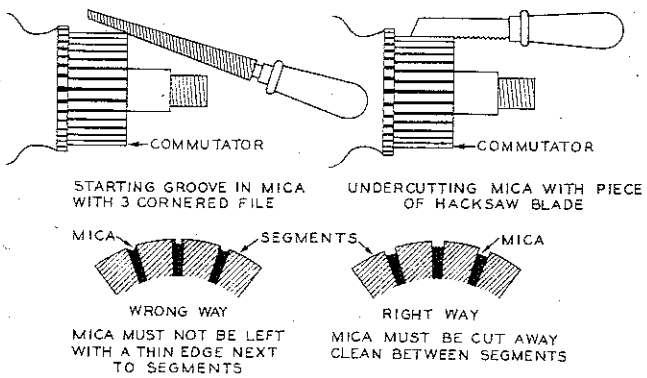
ILLUS. 37
TESTING ARMATURE FOR GROUND



ILLUS. 38
TESTING ARMATURE FOR "SHORT"



ILLUS. 39
TESTING ARMATURE FOR "OPEN"



ILLUS. 40
UNDERCUTTING COMMUTATOR MICA

"Growler" test for "short":

Place armature in "growler" and hold piece of hacksaw blade in loose contact with armature core as shown in Illustration 38. Turn "growler" "ON." Rotate armature slowly one or more full turns. If armature is shorted, hacksaw blade will be attracted to armature core and will vibrate violently at one or more points around armature.

If short is found, thoroughly clean commutator as described under "ground" test and test again. If short still exists, armature must be replaced with a new one.

"Growler" test for "open":

Place armature in "growler" as shown in Illustration 39 and turn "growler" "ON." Insert tip of hacksaw blade between segments that are closest in alignment with the point of contact of armature core and "growler" V. Make and break contact between segments with hacksaw blade.

A strong flash should be seen as contact is broken. *No flash* or a *very weak flash* indicates an *open circuit.*

Repeat this test between all segments, turning armature so that each test is made on the line of contact between armature core and "growler" V. If an open circuit is found, check for loose or broken wires at commutator connections. If none are found that can be repaired, armature must be replaced with a new one.

Turning Down Commutator

If commutator is found worn and irregular, it should be turned down in a lathe and smoothed with 00 sandpaper. When turning, mount armature shaft on its bearing seats; *do not* mount on shaft centers.

Undercutting Commutator

After commutator has been turned down, the mica insulation between segments must be undercut to a depth of approximately .025". Unless mica is properly undercut, brushes will not seat firmly against commutator segments and generator output will not be normal. Also, there will be excessive arcing at brushes.

Undercutting is usually done with a special undercutting machine. However, if such a machine is not available, it can be done as shown in Illustration 40.

After undercutting is completed, again smooth commutator with 00 sandpaper. It is also advisable to repeat "growler" check for "short" as there is a possibility of developing a "short" during the turning and undercutting operations. If so, it can very likely be corrected by more thorough cleaning between segments and at ends of commutator.

Reassembling Generator

(ITEM NUMBERS REFER TO ILLUSTRATION 34)

1. If one or both field coils have to be reassembled, do this first. Remember that *field coils are not alike* and must not be interchanged. If one has to be replaced, be sure it is replaced with one of same type (See Illustration 41).

Thoroughly clean generator frame where pole shoe seats and also clean face of pole shoe that seats against frame. Tighten pole shoe screws as tight as possible, with a large screwdriver that fits well into

screw slot. Unless screws are *very tight*, there will not be the required clearance (.007" or more) between armature and each pole shoe (this clearance is to be checked later when armature is assembled into frame).

2. Proceed with further assembly of generator, reversing order of disassembly as outlined under "Disassembling Generator," Page 49.

3. If felt oil retaining washer (Item 7) is worn, renew it.

4. Thoroughly wash and closely inspect both the drive end and commutator end bearings. If either is found worn to any extent, or pitted and rough, renew it. The commutator end bearing particularly should be replaced if it shows any appreciable wear, as a loose bearing allows commutator to run eccentric and chatter, even though commutator itself is perfectly true. Pack both bearings with General Purpose No. 2 Grease.

5. ***Gauging armature pole shoe clearance:***

(This operation is not required unless one or both pole shoes and field coils have been removed and replaced).

Select a sheet of paper .007" thick or use a double sheet totalling this thickness. Cut a piece as wide as length of armature core and long enough to wrap nearly, but not quite, around armature.

Assemble armature in frame with this paper around it, inserting shaft through drive end bearing. If pole shoe clearance is up to the required .007" or more on each side, armature can be inserted and will turn freely. If it binds, pole shoe or shoes removed and replaced must be pulled tighter to frame with pole shoe screws. Possibly parts were not well cleaned and there are particles of dirt between shoe and frame, preventing full seating.

Specified pole shoe clearance is necessary to allow for expansion of armature when hot and for play that normally develops due to bearing wear. Taking a chance on less than specified clearance may result in armature striking pole shoes and damaging both the armature and pole shoes. An armature damaged in this manner is usually grounded and must be renewed.

6. ***Installing frame end:*** Generator frame end fits over register in frame and is located by a dowel pin in frame and a corresponding hole in frame end. Frame end must be a snug fit on frame register or a new end must be fitted. If frame end is loose on frame, armature-pole shoe clearance is affected and the likely result is a damaged armature. Tighten screws securely.

7. Complete assembly of generator. Be sure drive gear pin is well riveted at both ends to prevent it from coming out in service and causing serious damage to timing gears and other parts. Measure the distance from face of oil slinger on generator drive gear to end of generator frame (gasket removed). This distance should be $1\frac{53}{64}$" to $1\frac{27}{32}$". Adjust if necessary by removing or adding an armature spacer (Item 18, Illustration 34).

Connect field coil wires according to Illustration 41 and paragraph "B" under "Disassembling Generator," Page 49.

Test generator on test stand if this equipment is available. If not, install on engine and test. Generator output can be adjusted by moving third brush (See "Generator Charging Rate").

Reassembling Generator to Engine

Reverse the operations followed in "Removing Generator," Page 48; also refer to "Installing Generator," Page 37.

Make sure same number of paper shims are used in reassembling as were found underneath generator when it was removed. After an engine has seen considerable service and gears have worn to some extent, they have possibly developed enough lash or play to permit safely removing one or more of the original shims and thus effecting closer meshing and quieter operation. However, this should not be done unless timing gear case cover is removed so gear mesh and lash can be carefully checked.

Make sure all external wire connections are correct and tight.

Generator Charging Rate

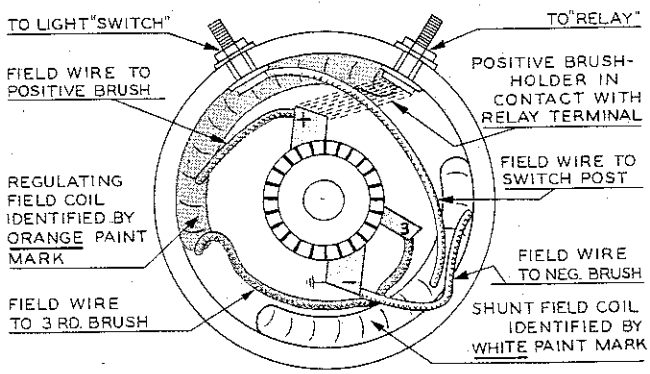
A maximum charging rate of about 4 amperes (with regular equipment lamps lighted) is the standard factory setting. This should be sufficient to keep battery in a good state of charge under normal service conditions. At average driving speeds, the charging rate is about the same with lights either "ON" or "OFF", because, when lighting switch is turned "ON", generator output is automatically boosted enough to take care of the standard lighting equipment. The charging rate can be readjusted higher or lower as desired to meet unusual service conditions, but bear in mind that a higher than normal charging rate is likely to overcharge, overheat, and damage battery.

When it is found necessary to readjust charging rate, proceed as follows: Remove generator end cover, and loosen screws that hold the regulating brush (small brush) plate assembly to generator frame end. Then, shift regulating brush *to the right*, to increase charging rate—*to the left*, to decrease charging rate. Shift brush only a little at a time, until desired maximum charging rate is obtained.

Inspecting or Replacing Generator Brushes

Remove the two screws in generator end cover and pull off cover, exposing the commutator and brushes. Brushes can be taken out after unfastening spring retainers. To unfasten small brush spring retainer, simply press it downward and outward. Remove fastening screw from each of large brush spring retainers.

Brushes are worn out and should be renewed when longest side of brush measures ⅜" or less.



ILLUS. 41
SCHEMATIC DIAGRAM, SHOWING GENERATOR INTERNAL WIRING CONNECTIONS AND LOCATION OF FIELD COILS AND BRUSHES IN RELATION TO EXTERNAL TERMINALS

Be sure to insert brushes into holders so that concave face of brush fits curve of commutator.

Lubricating Commutator End Armature Bearing

(ITEM NUMBERS REFER TO ILLUSTRATION 34)

To lubricate this bearing (Item 42) it is necessary to first remove end cover (Item 54). Then bearing can be oiled through hole in outer grease retainer (Item 52) or outer grease retainer can be shifted to expose bearing and permit greasing as follows:

Take out *two* of the three outer grease retainer screws (Item 53) and loosen the third screw *slightly* to permit shifting outer grease retainer to one side. Pack bearing with General Purpose No. 2 Grease. After greasing, replace outer grease retainer. *Caution:* If outer grease retainer is completely removed or two of the screws are removed and the third screw is made very loose, regulating brush (Item 50) is free to move and thus change charging rate. Therefore, before re-tightening outer grease retainer screws, be sure that regulating brush has remained in its original position.

If not convenient to grease bearing at specified interval, at least lubricate with a few drops of engine oil. Be careful that this bearing is not over-lubricated, as excess oil will very likely work out of bearing and some may get onto commutator and brushes.

Generator drive gear end bearing requires no attention as it is lubricated by the oil that circulates through engine.

Cut-out Relay

If relay fails to function normally, it should be referred to a qualified electrical service man or replaced with a new one. Checking and adjusting this unit requires not only a thorough knowledge of its functioning principles but also closely-calibrated instruments.

Specifications:

Armature-Core Air Gap (points closed)	.015"
Point Gap	.020"
Closing Voltage	6.3 to 6.8 Volts

Cut-out relay *must* be grounded; therefore, mounting screws *must* be tight.

Care of Storage Battery

It is the care given a battery, rather than time and miles in service, that has most to do with determining its life. Don't neglect it.

1. Inspect battery every week. Add pure distilled water as often as necessary to keep solution above the plates. (See "Adding Water to Battery").

2. Remove battery and have it given a charge from an outside source, when the hydrometer shows that this attention is needed. Allowing battery to remain in a discharged condition for any length of time shortens its life.

It is especially important that battery be kept well charged in below freezing weather as a low or discharged battery is very likely to be frozen and ruined.

3. Keep battery clean, and *terminal connections tight.* Oil the terminal felt washers frequently and replace immediately if deteriorated or lost.

Battery Constant Charge Rate 2 Amperes

When charging a battery from an outside source, the charging rate is constant and should not be allowed to go over 2 amperes. A higher rate will heat and damage the battery. *CAUTION—Therefore, don't allow battery to be charged in the same line with automobile batteries, at a high charge rate.*

Adding Water to Battery

Motorcycle should be standing straight up, not leaning on jiffy stand, when adding water to battery.

Turn off wing nuts, and remove battery cover and rubber mat. Take out the three screw-in filler plugs, and with a hydrometer or syringe add enough water to each cell to raise the level of the solution about $\frac{5}{16}$" above the plates and separators.

CAUTION: If battery is filled to a higher level, some of the solution will be forced out through vent holes when battery is charging. This not only weakens battery solution but also damages parts near battery.

Ignition Coil

When hard starting or missing indicates some fault in the ignition system, the first thing to do is check condition of battery. Coil will not function normally with battery in a nearly discharged condition. If it is found that lamps light with full brilliancy and horn blows, indicating that battery is in at least fair condition, try new spark plugs. If new plugs do not correct performance, inspect circuit breaker points and install new condenser. If the fault still exists, try a new coil without removing old coil. Simply attach new coil temporarily at any convenient point near old coil (coil will function without being securely grounded), transfer terminal wires to new coil, and after detaching old coil plug cables from spark plugs, attach new coil cables.

If new coil corrects performance, proving that the fault is in the old coil, inspect plug cables for cracked or damaged insulation, particularly at sealing nuts where cables enter coil. The insulation on cables sometimes becomes cracked or otherwise damaged, allowing high tension current to short to metal parts with which cables come in contact. Trouble due to this condition is most noticeable when operating in wet weather or just after motorcycle has been washed.

Replacing plug cables is the only repair that can be made to an ignition coil. If faulty performance is not corrected by installing new cables, coil is beyond repair and must be replaced with a new one.

When inspection indicates that coil trouble is very likely due to faulty condition of plug cables, they can be replaced as follows: Warm coil *slightly* to soften sealing compound so old cables can be pulled out easily, and without breakage. The usual way to warm a coil is to flow current through it by either turning "ON" ignition switch, or connecting a battery to coil terminals. This generates heat in coil winding. Have new cables ready to be inserted immediately when old cables are pulled out. New cable ends that insert into coil should be trimmed and rounded so they will follow through the holes left in sealing compound by old cable without catching and jamming. After coil is warm (not hot) turn off cable seal nuts and pull out cables one at a time. As each cable is pulled out, quickly transfer nut, steel washer and rubber packing washer to new cable. Insert a piece of stiff wire into coil and measure the distance from coil end to cable seat. Mark new cable accordingly. Dip end of cable in very light oil or gasoline and push into coil. Be sure it is pushed all the way into

its seat as per mark made on cable. After cables are inserted, turn seal nuts down against rubber packing washers to secure cables and to prevent water from getting inside coil.

When replacing plug cables do not heat coil to a higher degree than *just warm* as doing so will soften sealing compound to the extent that cable holes through compound will close up as the old cables are pulled out, blocking the insertion of new cables. In this case it is necessary to allow coil to cool and then form new cable holes by means of a piece of tubing with saw teeth filed in one end. Tubing should be of slightly larger diameter than cable. Holes through compound must be open so cables can be inserted all the way to their seats, where they contact high tension winding terminals; otherwise there is a gap in the high tension circuit and coil will not function.

Servicing Ignition-Light Switch

See "Wiring Details," Page 54 for information on switch operating positions.

1. After removing instrument panel cover, disconnecting wires and removing switch from panel, a faulty switch can be disassembled for inspection and repair as follows:

2. (All switch part positions mentioned below apply with switch *up-side-down* and *with lock-out button away from you.* Switch must be in "OFF" position and *unlocked).*

3. Remove cotter pin, plain washer, coil spring and spring support plate from end of center pin. (*Note:* Spring support plate will be found only on earlier switch with bakelite movable contact plate; later switch, with all-metal movable contact plate, as shown in Illustration 42, does not require this plate.)

Movable contact plate is now free to come off of center pin. Note that two contact buttons on this plate are toward *right* side of switch.

4. Grasp end of center pin with pliers and pull and move sideways to release contact bar from retaining notch in center pin. If switch has bakelite movable contact plate, note that end of contact bar with small extension is on left side of switch.

5. After contact bar has been released and removed, stationary contact plate with seven terminals attached can be removed. Note that side with four terminals is toward lockout button.

6. Contact bar holder assembly with spring and center pin can now be removed from switch housing by sliding either one of its fibre plate extensions out of retaining slot in switch housing and then sliding opposite extension out of other slot. Note that plain washer is assembled between head of center pin and end of spring.

7. Switch frame and lock plate can now be removed from switch housing. Note that narrow end of elongated hole in lock plate, and also lug on lock tumbler assembly which fits into hole in lock plate, are toward lockout button.

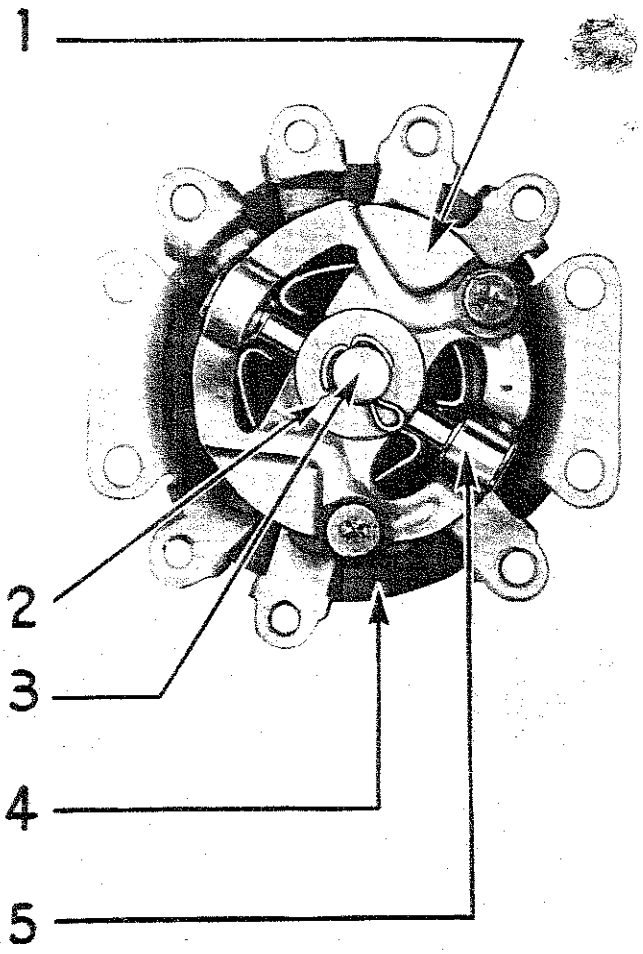
8. Lock assembly can now be lifted out of switch housing. Avoid separating lock tumbler assembly from its housing.

9. Inspect switch parts, particularly contact bar and contact plates, for excessive wear of contact bar and contact buttons or otherwise faulty condition. Contact bar and contact buttons may be found worn to the point where they no longer make positive contact. Extreme wear of these parts may allow head of center pin to "short" against switch lock plate. Loosened terminals on stationary contact plate may also develop a "short."

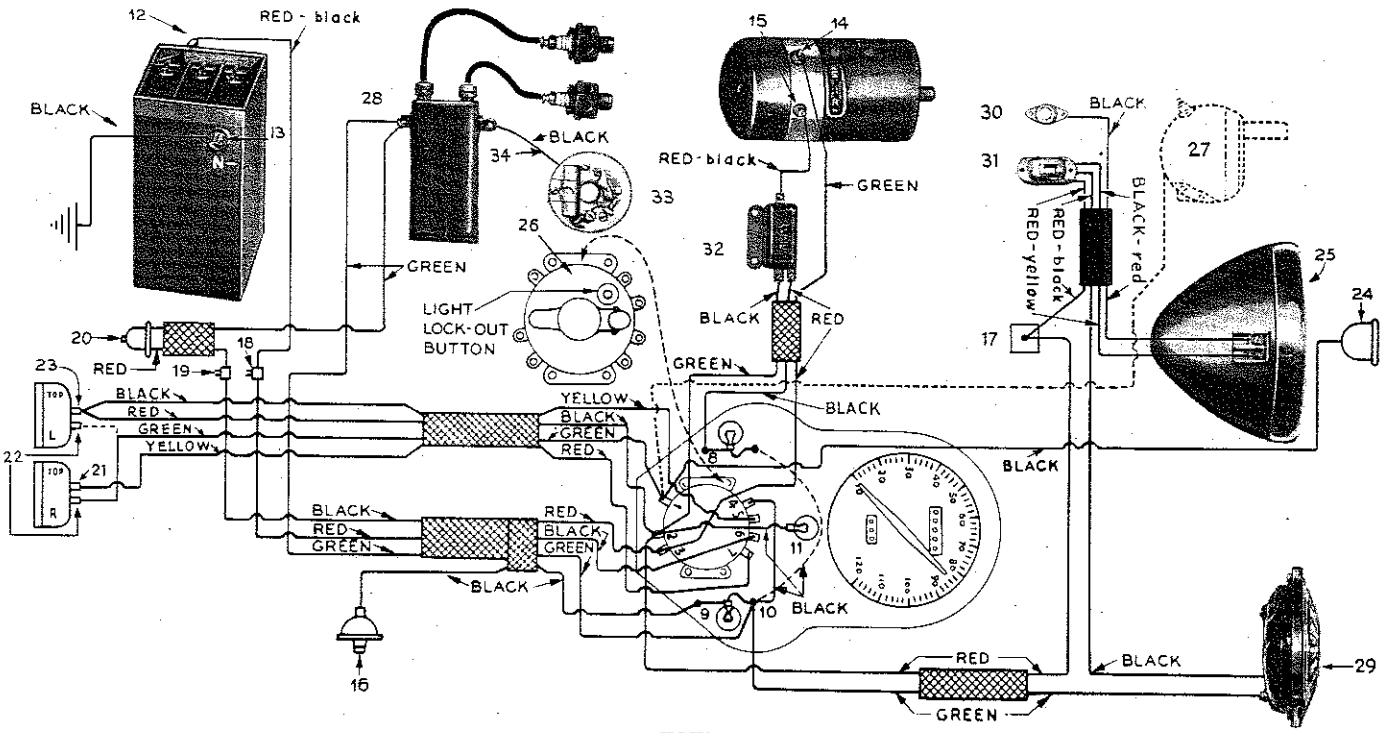
10. Obtain new parts for any found worn or damaged. In servicing early type switch originally fitted with bakelite movable contact plate, it is recommended that bakelite plate be replaced with improved all-metal contact plate. In this case, original contact plate, spring support plate, contact bar, coil spring and plain washer should be discarded and replaced with corresponding new type parts. These are included in replacement part set number 4539-41M.

Scrape off any rust that may be found on head of center pin, apply a light coat of oil or grease to head of pin and lock plate, contact bar and contact buttons and proceed with reassembly, reversing order of disassembly.

11. Bear in mind that if lock tumbler assembly has been taken out of its housing, it must be reinstalled in correct position in relation to housing. Otherwise, it will be found, after switch is completely reassembled, that switch cannot be locked. To reassemble correctly, insert lock tumbler assembly into its housing with tumblers in any one of the four registers. While pressing tumbler assembly into its housing with finger tip, insert key and turn *as far to right as possible.* Remove key.



ILLUS. 42
BOTTOM VIEW OF IGNITION-LIGHT SWITCH
1. Movable contact plate.
2. Plain washer.
3. Center pin.
4. Stationary contact plate.
5. Contact bar.



ILLUS. 43

WIRING DIAGRAM FOR WLA MODEL MOTORCYCLES WITH U. S. A. REGISTRATION NUMBERS BELOW 618,025. NOTE THAT THIS WIRING HARNESS HAS TWO-WIRE CABLE FROM SWITCH TO SERVICE HEADLAMP AND HORN. DOTTED LINE INDICATES WIRING FOR BLACKOUT HEADLAMP.

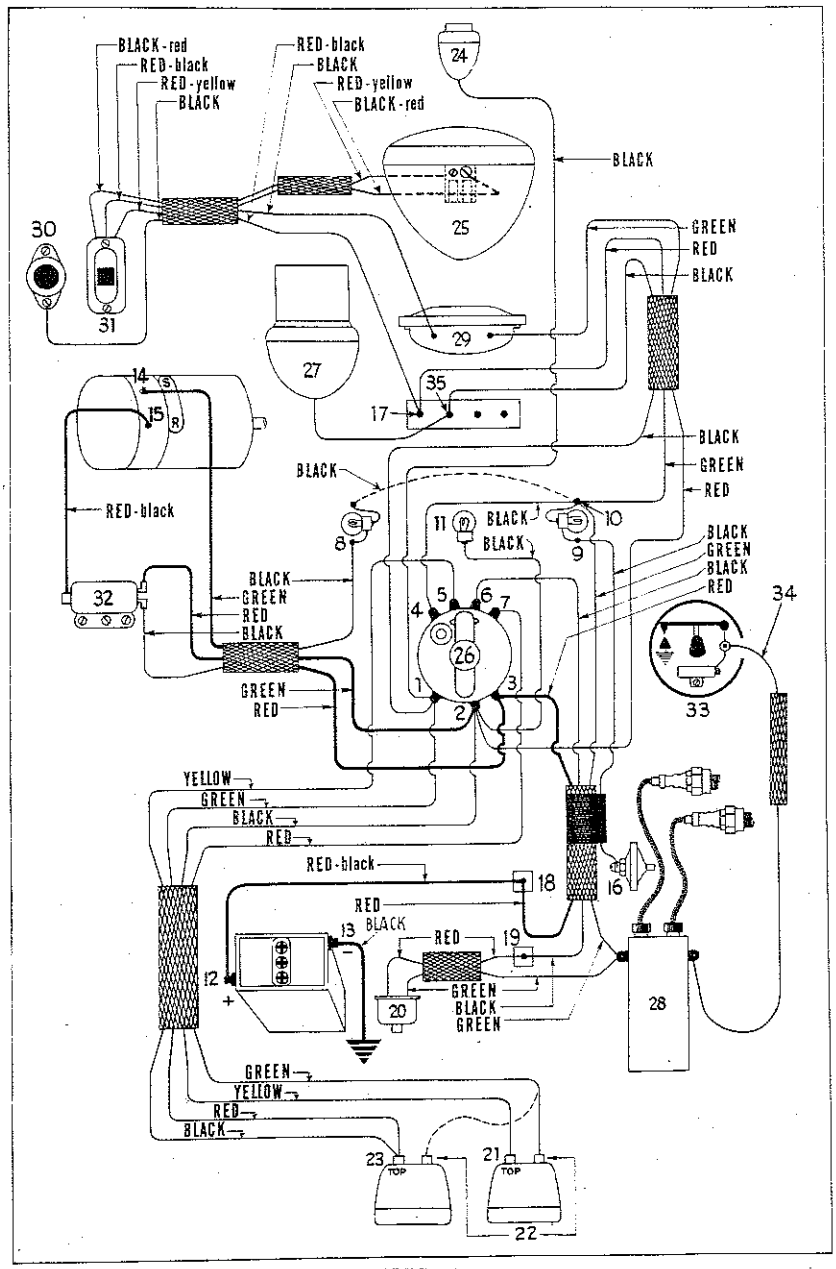
Wiring Details

1. SWITCH TERMINAL (Three wires connected)—*Black* wire from blackout marker lamp 24; tail lamp cable *green* wire from blackout tail lamp 22; single wire direct from blackout headlamp as shown by dotted line in Illustration 43, or horn and headlamp cable *black* wire from junction terminal 35 as shown in Illustration 44.
2. SWITCH TERMINAL (Four wires connected)—Generator and relay cable *green* wire from *"switch"* terminal (14) of generator; tail lamp cable *black* wire from service stop and tail lamp (23); horn and headlamp cable *red* wire from junction terminal 17; *black* wire from speedometer lamp (11).
3. SWITCH TERMINAL (Two wires connected)—Generator and relay cable *red* wire from terminal marked "BAT" on relay; coil and battery cable *red* wire from junction terminal 18.
4. SWITCH TERMINAL (One wire connected)—*Black* wire from oil signal lamp terminal (10).
5. SWITCH TERMINAL (One wire connected)—Tail lamp cable *yellow* wire from blackout stop lamp (21).
6. SWITCH TERMINAL (One wire connected)—Battery and coil cable *black* wire from junction terminal 19.
7. SWITCH TERMINAL (One wire connected)—Tail lamp cable *red* wire from service stop and tail lamp (23).
8. GENERATOR SIGNAL LAMP TERMINAL (One wire connected)—Generator and relay cable *black* wire from relay right front terminal.
9. OIL PRESSURE SIGNAL LAMP TERMINAL (One wire connected)—*Black* wire from oil pressure switch (16).
10. SIGNAL LAMP TERMINAL (Four wires connected)—*Black* wire (under switch panel) from generator signal lamp terminal (8); *black* wire from switch terminal (4); battery and coil cable *green* wire from coil front terminal; horn and headlamp cable *green* wire from horn.
11. SPEEDOMETER LAMP—*Black* wire from switch terminal 2.
12. BATTERY POSITIVE TERMINAL (LEFT SIDE)—*Red* wire with *black tracer* from junction terminal 18.
13. BATTERY NEGATIVE TERMINAL (RIGHT SIDE)—*Black* wire from ground clamp on frame.
14. "SWITCH" TERMINAL OF GENERATOR—Generator and relay cable *green* wire from switch terminal 2.
15. "RELAY" TERMINAL OF GENERATOR—*Red* wire with *black tracer* from relay rear terminal.
16. OIL PRESSURE SIGNAL SWITCH—*Black wire* from signal lamp terminal 9.
17. JUNCTION TERMINAL (BAKELITE TERMINAL PLATE ON HORN MOUNTING)—Horn and headlamp cable *red* wire from switch terminal 2; *red* wire with *black tracer* from handlebar toggle switch (31).
18. FRONT JUNCTION TERMINAL (in motorcycle frame, under saddle)—Coil and battery cable *red* wire from switch terminal 3; *red* wire with *black tracer* from battery positive terminal (12).
19. REAR JUNCTION TERMINAL (in motorcycle frame, under saddle)—Coil and battery cable *black* wire from switch terminal 6; *red* wire from stop lamp switch (20).
20. STOP LAMP SWITCH—*Red* wire from junction terminal 19; *green* wire from coil front terminal.
21. BLACKOUT STOP LAMP (Top socket in right tail lamp)—Tail lamp cable *yellow* wire from switch terminal 5.
22. BLACKOUT TAIL LAMPS—Tail lamp cable *green* wire from switch terminal 1. (As new motorcycle is assembled by manufacturer, plug is in bottom

socket of right lamp. Left, bottom lamp is spare blackout tail lamp. Plug can be inserted in bottom socket of either lamp for blackout tail lamp).

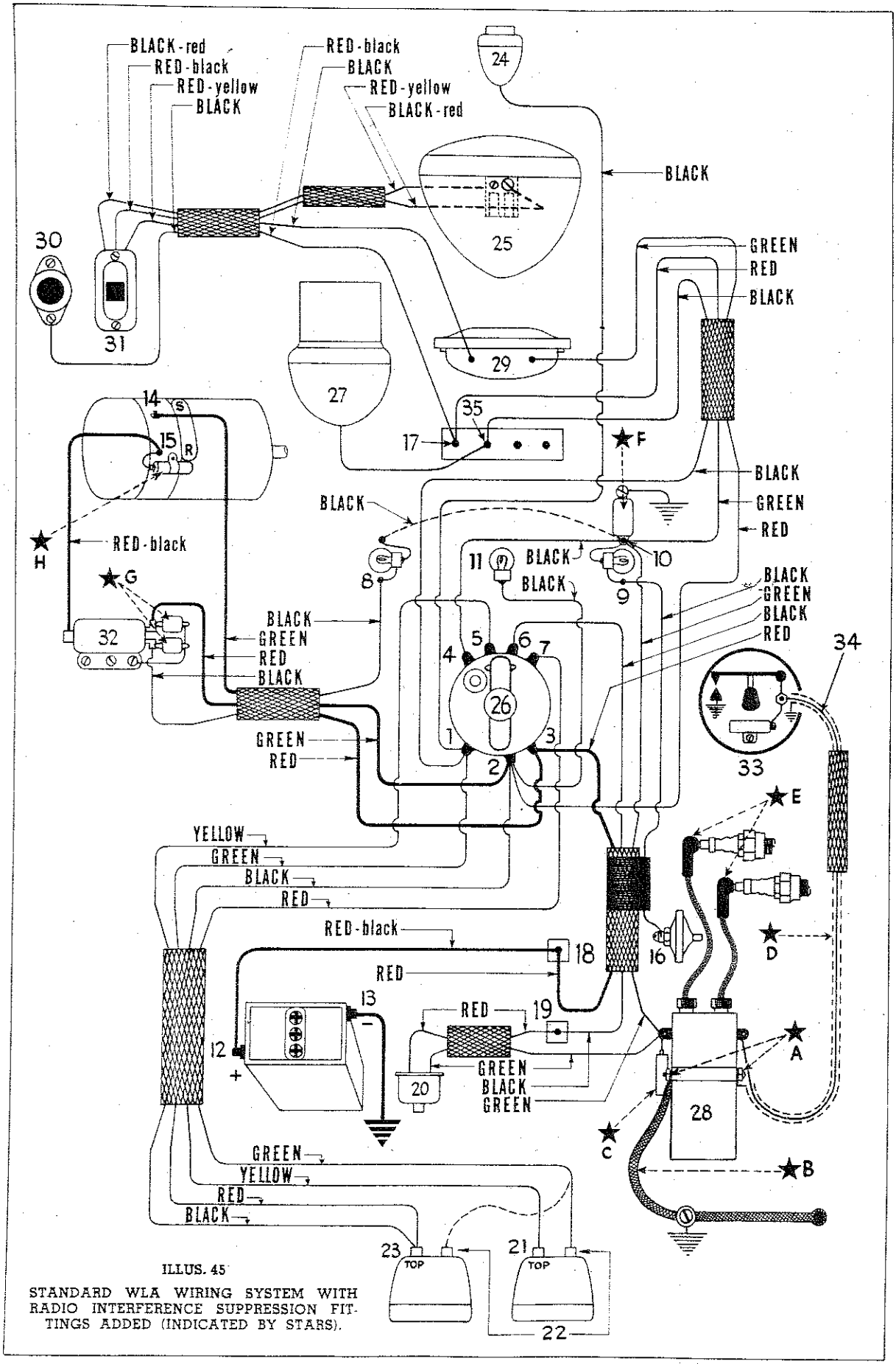
23. SERVICE TAIL AND STOP LAMP (Top socket in left tail lamp—two wires in one plug)—Tail lamp cable *black* wire from switch terminal 2 is for service tail light, and tail lamp cable *red* wire from switch terminal 7 is for service stop light. Stop light does not operate in daytime when *ignition only* is turned "ON."
24. BLACKOUT MARKER LAMP (ON FRONT MUDGUARD)—*Black* wire from switch terminal 1.
25. SERVICE HEADLAMP—*Black* wire with *red tracer* from handlebar toggle switch (31) to large terminal screw; *red* wire with *yellow tracer* from handlebar toggle switch to small terminal screw.
26. IGNITION-LIGHT SWITCH (TOP VIEW)—Switch "OFF" in straight-ahead position. Turn to *first right* position for ignition only; *second right* position is for ignition and blackout lights. After pressing down *lockout button*, switch can be turned to *third right* position for ignition and service lights. Bear in mind that turning lights "ON" when engine is not running also turns ignition "ON." Switch is provided with lock and key to permit locking, if desired, when motorcycle is not in use. It can be locked only in "OFF" position. When switch is unlocked and motorcycle is in use key should be removed from lock.
27. BLACKOUT HEADLAMP—Furnished as original equipment with WLA motorcycles having U.S.A. registration numbers 621,317 and higher. When adding this equipment to WLA motorcycles with U.S.A. registration numbers below 621,317 install lamp and connect wires according to instructions under "Blackout Headlamp Installation," Page 57.

    Switch terminal 1 becomes "live" when ignition-light switch is turned to second right position. However, blackout headlamp is fitted with independent switch in lamp body to permit turning it "OFF" while other blackout lamps are in use.
28. SPARK COIL—Coil and battery cable *green* wire from terminal 10 to coil front terminal; *green* wire from stop lamp switch (20) to coil front terminal; low tension wire (34) from circuit breaker (33) to coil rear terminal.
29. HORN—Horn and headlamp cable *green* wire from terminal 10; *black* wire from horn switch (30).
30. HORN SWITCH—*Black* wire from horn.
31. HANDLEBAR TOGGLE SWITCH—*Black* wire with *red tracer* from service headlamp terminal with large terminal screw; *red* wire with *yellow tracer* to service headlamp terminal with small terminal screw; *red* wire with *black tracer* from junction terminal 17.
32. CUT-OUT RELAY—*Red* wire with *black tracer* from *"relay"* terminal of generator to relay rear terminal; generator and relay cable *red* wire from switch terminal 3 to relay terminal marked "BAT"; generator and relay cable *black* wire from terminal 8, to relay right front terminal.
33. IGNITION CIRCUIT BREAKER AND TIMER—Low tension wire (34) from coil rear terminal.
34. CIRCUIT BREAKER-TO-COIL LOW TENSION WIRE—See Description 33.
35. JUNCTION TERMINAL ON BAKELITE TERMINAL PLATE (Illustration 44 only)—Horn and headlamp cable *black* wire from switch terminal 1; wire from blackout headlamp (27).



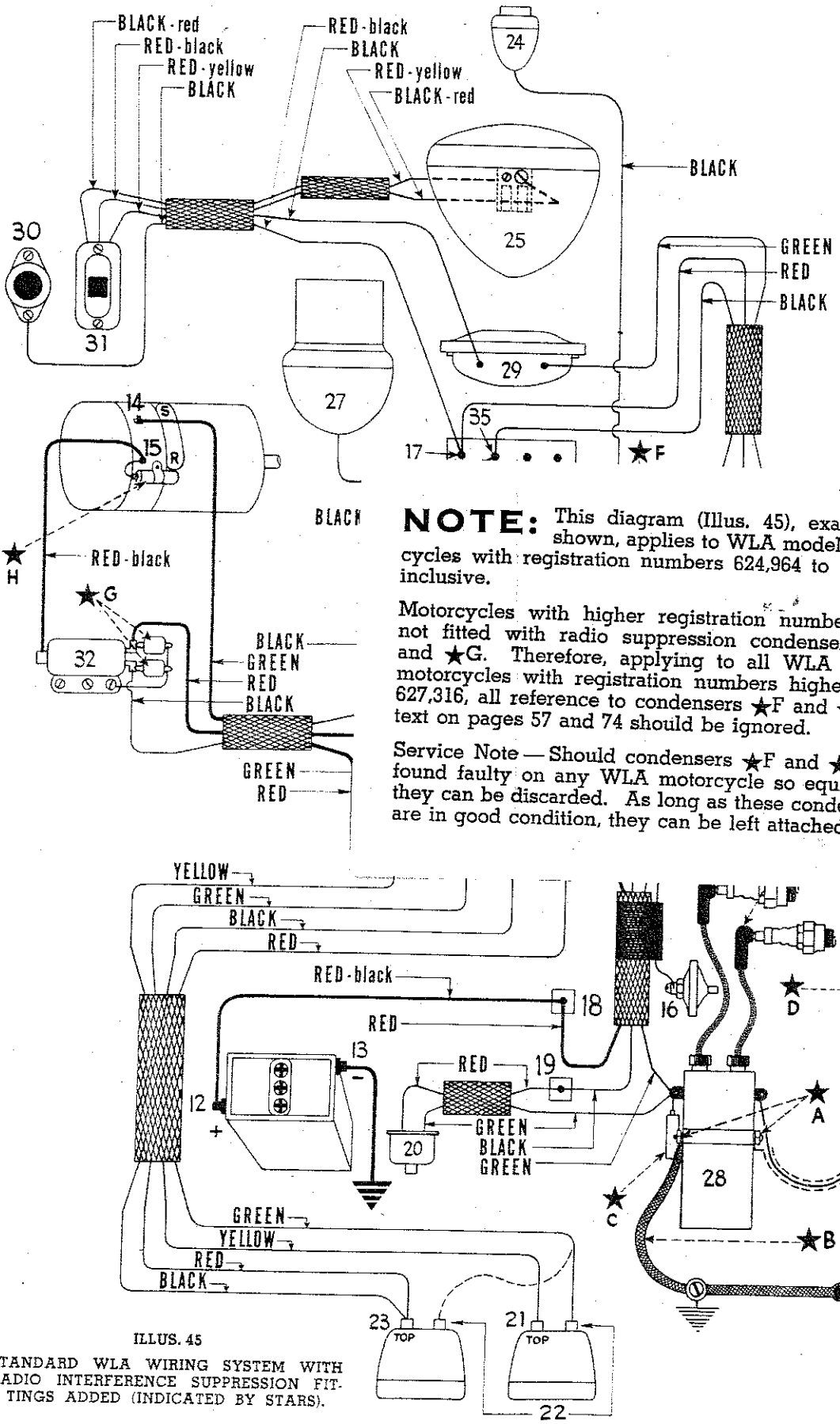
ILLUS. 44

WIRING DIAGRAM FOR WLA MODEL MOTORCYCLES WITH U. S. A. REGISTRATION NUMBERS 618,025 AND HIGHER. NOTE THAT THIS WIRING HARNESS HAS THREE-WIRE CABLE FROM SWITCH TO SERVICE HEADLAMP, BLACKOUT HEADLAMP AND HORN.



ILLUS. 45

STANDARD WLA WIRING SYSTEM WITH RADIO INTERFERENCE SUPPRESSION FITTINGS ADDED (INDICATED BY STARS).



ILLUS. 45

STANDARD WLA WIRING SYSTEM WITH RADIO INTERFERENCE SUPPRESSION FITTINGS ADDED (INDICATED BY STARS).

NOTE: This diagram (Illus. 45), exactly as shown, applies to WLA model motorcycles with registration numbers 624,964 to 627,316 inclusive.

Motorcycles with higher registration numbers are not fitted with radio suppression condensers ★F and ★G. Therefore, applying to all WLA model motorcycles with registration numbers higher than 627,316, all reference to condensers ★F and ★G in text on pages 57 and 74 should be ignored.

Service Note — Should condensers ★F and ★G be found faulty on any WLA motorcycle so equipped, they can be discarded. As long as these condensers are in good condition, they can be left attached.

Radio Interference Suppression System

Radio interference supression can be applied to the electrical system of any WLA motorcycle by the addition of suppression-devices indicated by stars in Illustration 45 and described below.

All WLA model motorcycles originally equipped with radio interference suppression-devices, or to which suppression-devices have been added, can be identified by a large letter S stenciled on left and right sides of instrument panel cover.

★A—GROUND TERMINALS ON COIL HOUSING (Harley-Davidson part number 1730-42M)—Terminal posts are attached to metal strip which is soldered to coil housing. Terminals are grounded through flexible braid conductor (★B).

★B—FLEXIBLE BRAID CONDUCTOR (Harley-Davidson part number 1743-42M)—Connected to front ground terminal (★A) on coil housing and grounded to saddle post frame tube at clutch control mounting bracket and to crankcase at rear, upper crankcase bolt.

★C—CONDENSER (Harley-Davidson part number 1629-30)—Mounting bracket grounded to front ground terminal (★A) on coil housing. End terminal connected to coil low tension wire front terminal by short metal strip.

★D—SHIELDED CIRCUIT BREAKER-TO-COIL LOW TENSION WIRE (Harley-Davidson part number 1613-42M)—Upper end of shielding grounded to rear ground terminal on coil housing. Lower end of shielding grounded to one of circuit breaker base mounting screws.

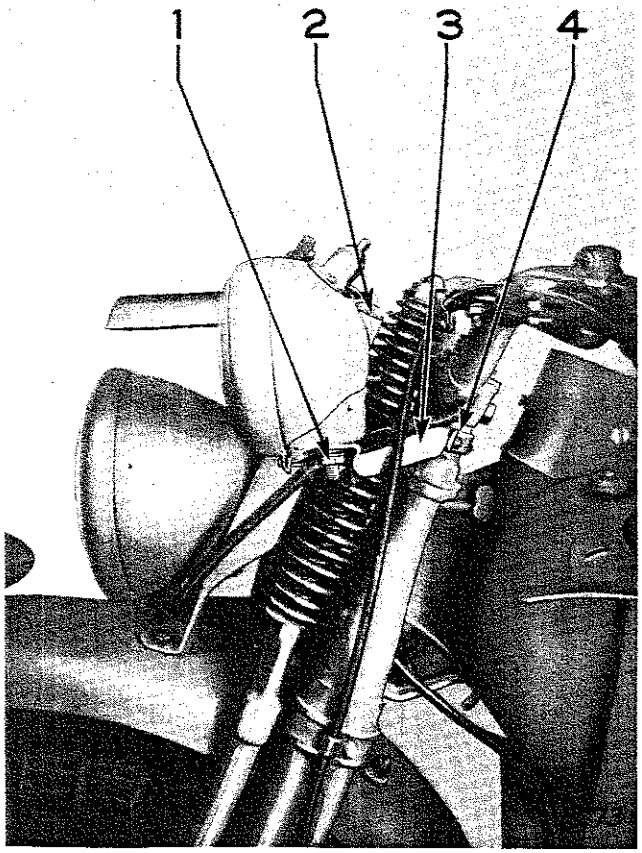
★E—SPARK PLUG SUPPRESSORS (Harley-Davidson part number 1600-42M)—Attached to ends of spark coil high tension leads and secured to spark plug terminals by snap connections.

★F—CONDENSER (Harley-Davidson part number 4788-42M)—One terminal of condenser connected to signal lamp terminal 10. Other terminal grounded to switch panel base (Pinched under speedometer bracket).

★G—CONDENSERS (Harley-Davidson part number 4788-42M)—One condenser connected to each relay front terminal. Both condensers grounded to relay base through condenser mounting bracket.

★H—CONDENSER (Harley-Davidson part number 1629-30)—Mounting bracket grounded to generator frame end. End terminal connected to "RELAY" terminal of generator by short wire.

If suppression-equipped WLA motorcycle causes radio interference, check electrical system as described under "Servicing Radio Interference Suppression System," Page 74.



ILLUS. 46

Blackout Headlamp Installation

1. MOUNTING STUD NUT (Curved washer and lock washer mounted between bracket and stud nut).
2. BAKELITE TERMINAL PLATE—Applying to WLA model motorcycles with U.S.A. registration numbers 618,025 and higher, connect lamp wire to second terminal from left. See Detail 35, Illustration 44.

   Applying to WLA model motorcycles with U.S.A. registration numbers below 618,025, connect lamp wires directly to ignition-light switch terminal I. See Detail 27, Illustration 43.
3. MOUNTING BRACKET—Before installing blackout headlamp on motorcycle, clean paint from left upper fork end, just below handlebar, to insure a good ground connection for mounting bracket.
4. MOUNTING BRACKET FORK SIDE CLAMP.

Horn

Horn operating (ground) button is on left handlebar. Tone adjusting screw is in back side of horn.

If a horn fails to operate and moving adjusting screw does not remedy the trouble, it will probably be necessary to disassemble horn and clean contact points. When reassembling, tighten all bolts securely and then readjust tone by means of adjusting screw. *Do not* change position of adjusting screw *in diaphragm.*

Adjusting Service Headlamp

To get the greatest efficiency from headlamp and to meet the requirements of law, adjust as follows: Adjustment should be made in a darkened room or at night. Have motorcycle standing on a level surface about 25 feet away from, and headed toward a wall or screen upon which a horizontal line has been drawn at exactly the same height as lamp center. Motorcycle must be resting on both wheels and front wheel must be in straight-ahead alignment.

Turn light switch "ON," set handlebar thumb switch in "bright" position, and check light beam for height and direction. The top of main beam of light should register on wall or screen even with, but no higher than the horizontal line mentioned. After loosening the clamp nut underneath lamp bracket, lamp can be tilted up or down to properly aim it in relation to horizontal line, and at the same time can be turned right or left to direct beam of light straight ahead.

Lamp Bulbs

	Contact	C.P.	Mazda Number	Harley-Davidson Part Number
1940 and later				
Service headlamp—Pre-focused	D.C.	32-21	2320L	4925-35
Blackout marker lamp	S.C.	3	63	4927-15
Speedometer lamp	S.C.	3	63	4927-15
Generator signal lamp	S.C.	3	63	4927-15
Oil pressure signal lamp	S.C.	3	63	4927-15
1941—				
Service stop and tail lamp	D.C.	21-3	1158	5058-34
Blackout stop lamp	S.C.	3	63	4927-15
Blackout tail lamp	S.C.	3	63	4927-15
1942 and later (bulb units)			Guide Number	
Service stop and tail lamp	D.C.	21-3	5933104	5077-42MB
Blackout stop lamp	S.C.	3	5933121	5077-42MA
Blackout tail lamp (2)	S.C.	3	5933078	5077-42M
Blackout headlamp			5934473	4909-42

CARBURETOR SERVICE

The following Model "M" Linkert carburetors are used on Military motorcycles: M-64, M-65, M-84, M-88, M-90, M-97 and M-641. Model numbers are stamped on top of carburetor.

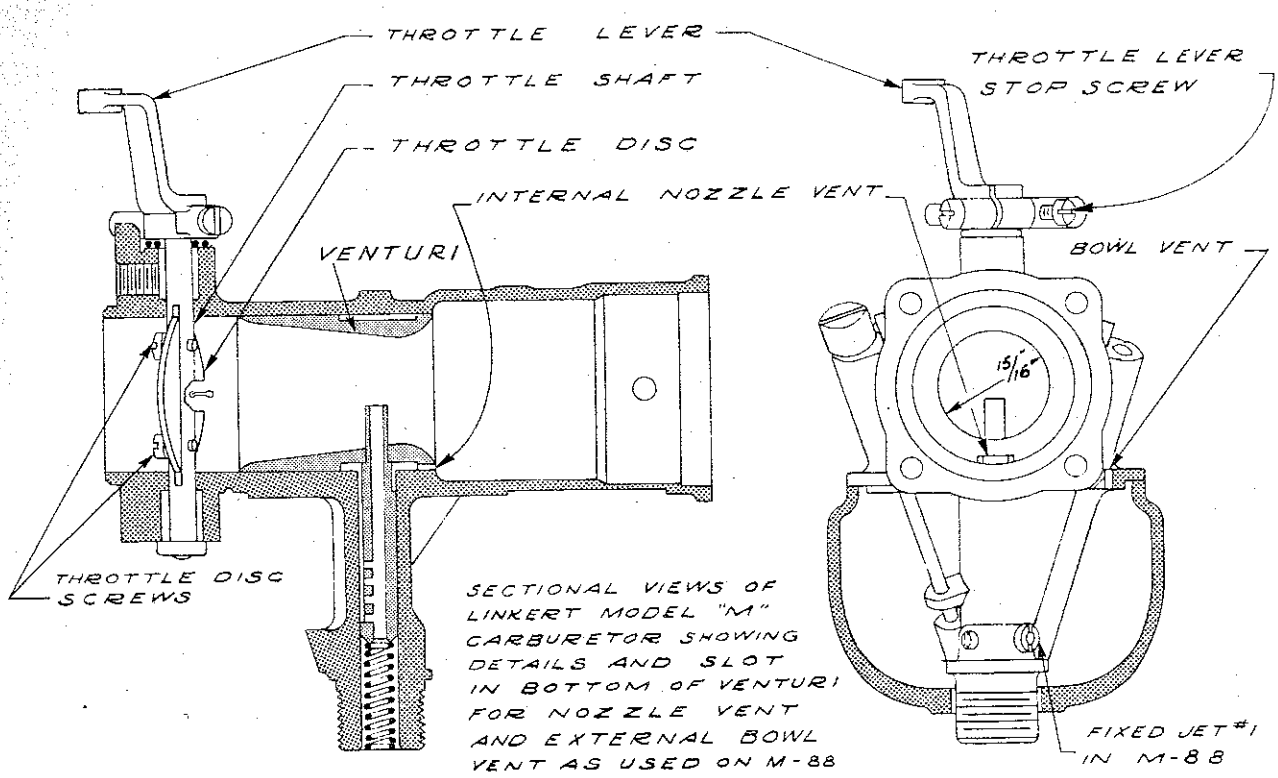
M-64 and M-65 models have external or outside nozzle and bowl vents; air bleed to nozzle and bowl are from external holes drilled in body casting. These two models are exactly alike except that one has a different size fixed high speed jet than the other. (See "Carburetor Specifications," Page 61). These two models are used with a standard (not oil bath) air cleaner.

M-84 model has internal vent in the form of a tube extending back of venturi and pointing into air stream. This vent supplies the air bleed to nozzle. Bowl is vented through hole drilled in body and opening externally. This model is used with oil bath air cleaner and is equipped with fixed high speed jet (See "Carburetor Specifications," Page 61).

M-88 model has internal vent to nozzle in the form of a slot cut in lower side of venturi on air intake end. Bowl vent is external and same as in M-64, M-65 and M-84. This model is equipped with fixed high speed jet (See "Carburetor Specifications," Page 61) and is used with oil bath air cleaner.

M-90 model has internal vent to nozzle in the form of a slot cut in lower side of venturi on air intake end. Bowl vent is external and same as in M-64, M-65, M-84 and M-88. This model is equipped with fixed high speed jet (See "Carburetor Specifications," Page 61) and is used with oil bath air cleaner. Bowl on M-90 model is different than on M-64, M-65, M-84 and M-88 in that this bowl uses a special gasket between upper edge of bowl and lower face of body. This gasket must always be located in its proper place to seal bowl to the body. Use a new gasket if old one is the least damaged or defective. If gasket is not properly located, gasoline leakage at bowl will result.

M-97 model has internal vent in the form of a tube extending into air stream and back of venturi. This vent supplies both the air bleed for the nozzle and the vent for the bowl. There are no external vents on this model. Special bowl gasket between the upper edge of bowl and lower face of the body must always be properly located and in place to seal bowl to the body. Use a new gasket if the old one is the least damaged or defective. If this gasket is not



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correctly assembled, leakage of air will take place at bowl edge and will cause internal nozzle and bowl vent to be inoperative. This model is used with oil bath air cleaner and is equipped with fixed high speed jet (See "Carburetor Specifications," Page 61). *Use M-90 model when replacement carburetor is needed.*

M-641 model has the same arrangement of vents as M-88 and is used with an oil bath air cleaner. M-641 carburetor is not equipped with a fixed high speed jet. It has a standard high speed needle adjustment (adjusting needle near air intake end of carburetor and to left, looking at air intake end). This adjustment should be set to 1¼ turns open for initial adjustment and then set in operation to best setting for power, being sure not to adjust it too lean, thus causing excessive engine heating.

M-64, M-65, M-84, M-88, M-90, and M-97 carburetors with fixed high speed jet are equipped with a special short needle valve to shut off the opening provided for variable high speed adjusting needle which is standard instead of fixed jet for all commercial motorcycle carburetors and also applies to M-641 Army carburetor. A locking plug screwed in above it locks it in place. This needle valve and its locking plug are located in same place as just described for high speed adjustment in M-641 model. This needle valve in M-64, M-65, M-84, M-88, M-90 and M-97 carburetors must always be fully seated or screwed down to a tight seat and the locking plug must be screwed down firmly to hold this needle valve in place. All high speed fuel in these models is delivered through high speed fixed jet and there is no other adjustment for the high speed mixture.

All models have exactly the same bowl, both in casting shape and in the complete float mechanism, except the M-90 and M-97 which both use the same special bowl. However, this special bowl contains the same parts as for all of the other carburetors.

Effect of Crust Formation

These notes apply to carburetors which have been in service for some time and have become dirty, full of "crust" in the throttle barrel, and are found to be difficult to get adjusted properly. Usually the effect of excessive dirt or "crust" formation in the carburetor throttle barrel, around the throttle disc and in the fuel mixture passageways, is to cause the carburetor to have a lean spot off idle. This "crust" should be removed, particularly when a lean spot comes in at speeds off idle up to 30 M.P.H. with the low speed (idle) adjustment set properly for idling. Idle adjustment should not be set to the very lean side when checking this point, but to a point about five to ten notches rich from the setting where the engine dies from leanness.

How to Remove Crust

1. Back off throttle lever stop screw so throttle disc closes tightly. With a sharp pointed tool like a sharp pen knife or scriber, scratch a line deeply on closed throttle disc and also on throttle barrel so lines on disc and on barrel meet. These lines should "jibe up" again when disc is replaced. Remove throttle lever, throttle disc and shaft, idle hole body plug next to idle holes in throttle barrel, body plugs in carburetor flange and carburetor body idle channels, and low speed (idle) lift lever and needle valve assembly. Also remove venturi and nozzle.

2. Scrape out caking or "crust" in throttle barrel with a scraper or knife, being sure not to cut into the metal.

3. Clean up throttle disc by rubbing both sides on emery cloth on a flat plate and clean edge of the disc all around, being careful not to round the corners or cut into the metal.

4. Clean out idle holes in throttle barrel next to the disc with proper size drills of clean-up tool set described on Page 61. Proper sizes for both holes are listed in "Carburetor Specifications," Page 61.

5. Clean out the slot of all models by inserting tool with .009" blade through slot between the two idle holes.

6. Clean out idle channels with #42 drill. *When cleaning vertical idle channel do not completely bottom drill as doing so may damage low speed needle seat.*

7. Clean out low speed (idle) needle valve seat hole with correct size drill. The M-64, M-65, M-84, M-88, M-90, and M-97 carburetors are cleaned with #53L drill. The M-641 is cleaned with #53L#2 drill which has a smaller handle. (This tool has two rings around its handle).

8. Blow out all channels and holes with compressed air and wash all parts in gasoline.

9. Reassemble parts, *being sure* lift lever spring seat (washer) is between the spring and carburetor body when assembling the low speed lift lever and needle valve assembly back into place. This spring seat or washer limits the air bleed to the idle system and must be in place; otherwise carburetor cannot be adjusted for satisfactory engine idling.

Be sure throttle disc is properly assembled in barrel and closes off tight. Have correct side of disc up or toward flange and with the lines previously scratched lining up with each other exactly. Push up shaft collar (on throttle shaft) firmly against body before tightening throttle disc screws. Throttle lever should be clamped to shaft with disc wide open, with throttle lever "wide-open" stop against body lug and with wear take-up spring between throttle lever and bearing.

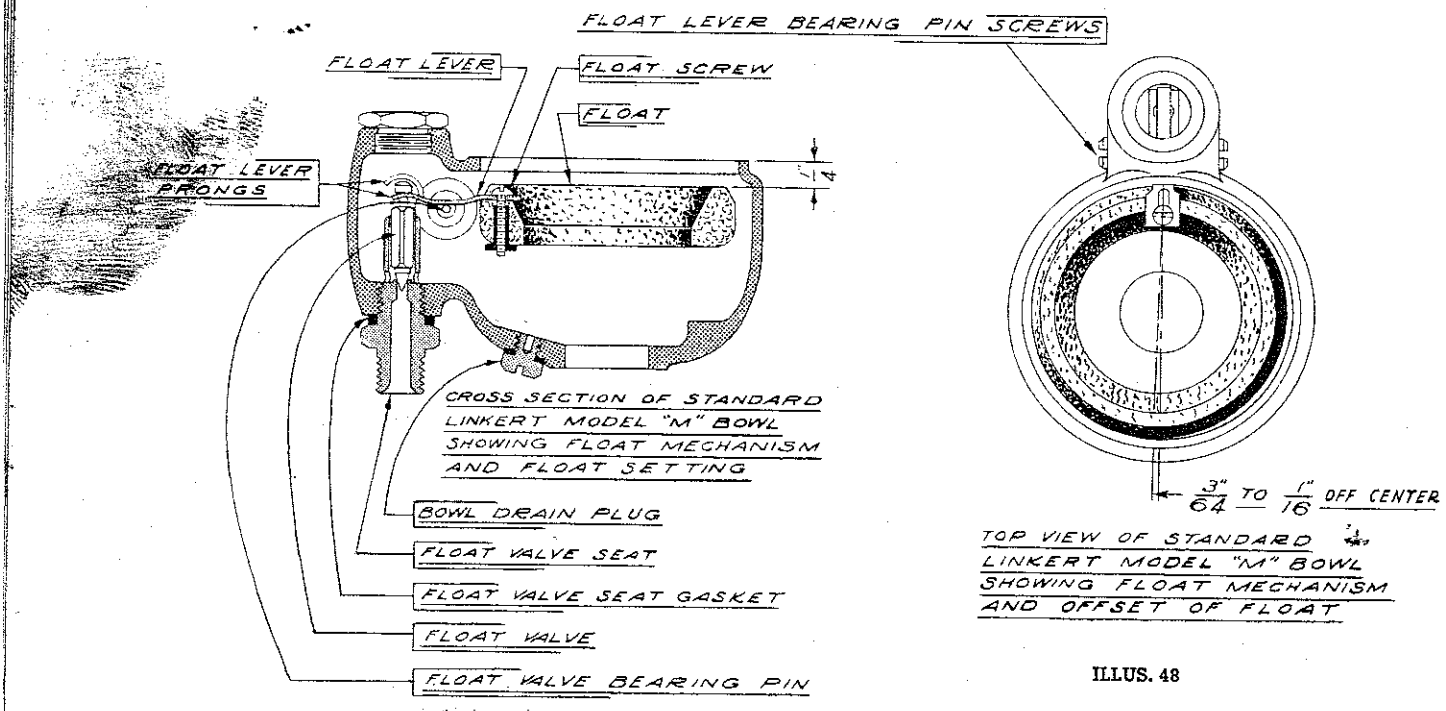
Attention to Carburetor Bowl

10. If carburetor bowl continually leaks or runs over, remove it from carburetor body and first remove all dirt by cleaning it out with gasoline and compressed air. Hold bowl up-side-down so that float valve closes and suck on bottom of float valve seat. Valve and seat should hold this suction. If valve and seat leak after repeated testing, replace with new float valve and float valve seat.

11. If float is damaged or "logged" replace with a new one. Remove old float by cutting seal around float screw which fastens float to float lever. This seal can be cut with a pocket knife. Remove float screw and assemble new float to lever. This should be done with float valve, float valve lever, float hinge pin and screws, float valve seat and gasket assembled in bowl. Before tightening float screw securely, adjust as follows: Looking down on bowl with gasoline inlet side away from you, pull float toward you to the limit of slot in float lever and about $\frac{1}{16}$" to left of center line. This provides necessary body clearance. Tighten float screw and cement top of float screw to float with Dupont Household Cement, with a mixture of celluloid dissolved in acetone, or with thick shellac. When cement has dried thoroughly, check float height and adjust as explained in 12.

12. Check float level and, if necessary, reset to ¼". Measure directly opposite float lever with bowl held up-side-down (top of float to top of bowl). When readjusting carburetor float, do not attempt to do so by simply bending float lever upward in some manner, without disassembling from bowl. Readjusting in this manner bends and spreads fingers between which head of float needle fits, and thus develops lost motion between float and needle. Float and lever assembly should be removed from bowl, and lever then bent as required.

Before reassembling, see that needle head is a good free fit between lever fingers with not more than approximately .003" play. This clearance can



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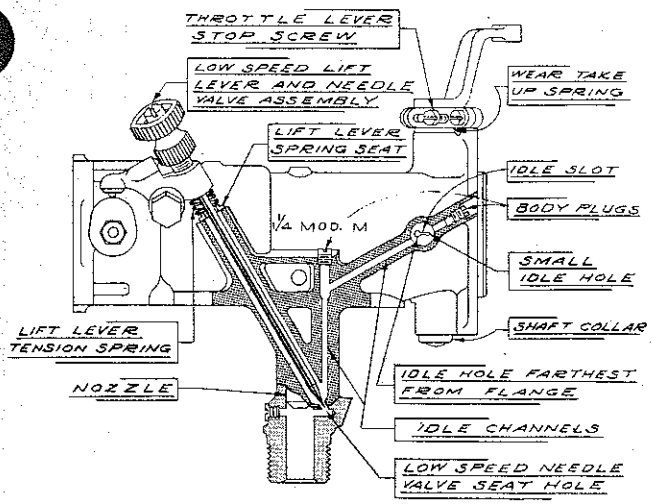
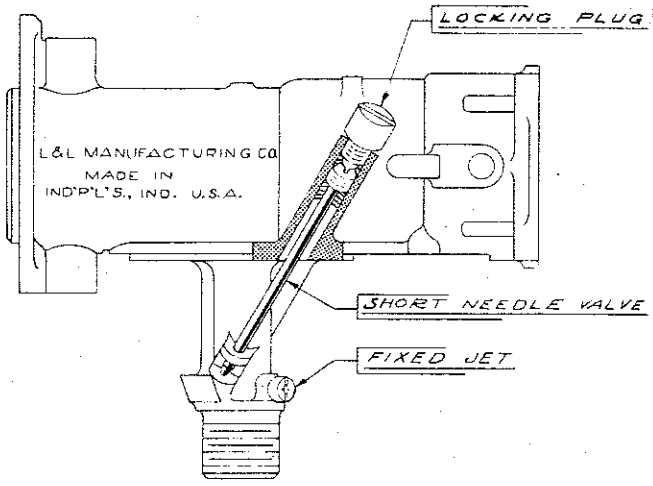


VIEW OF LINKERT MODEL "M" CARBURETOR SHOWING LOW SPEED NEEDLE VALVE, LIFT LEVER SPRING SEAT, LOW SPEED NEEDLE VALVE SEAT HOLE, IDLE HOLES AND SLOT, BODY PLUGS, AND IDLE CHANNELS

ILLUS. 49



VIEW OF LINKERT MODEL "M" ARMY CARBURETOR SHOWING FIXED JET, SHORT NEEDLE AND LOCKING PLUG

ILLUS. 50

also be checked after lever is assembled in bowl, by carefully placing a small screw driver or a small rod against the valve head in such a position that it will hold the valve firmly against the seat and yet not bind the lever. Moving the lever up and down will then show the amount of actual clearance between the valve head and fingers. If this clearance is excessive, the float mechanism will not feed properly. After assembling note that float is approximately square with top of bowl.

13. Bowl drain plug now being used in Model "M" carburetors can be removed for quick flushing of bowl. Before removing this plug, turn off gasoline at tanks. Be sure to pull this screw up tight when replacing.

Carburetor Adjustments Provided

A needle is provided to right of carburetor air intake end for variable low speed adjustment. Most military model carburetors have fixed high speed jet as listed in the specifications below. This applies to Models M-64, M-65, M-84, M-88, M-90 and M-97. Fixed high speed mixture in these carburetors is effected by replacing one of the small drill hole plugs, near lower end of carburetor body, with special jet plug. Size of hole in jet plug varies with carburetors of different models. Bear in mind, however, that this special jet plug cannot be duplicated by simply drilling a hole with a drill of certain size through one of the regular drill hole plugs; several plugs drilled with same drill will vary considerably in the amount of fuel they flow. Therefore, each jet made at carburetor factory must be tested individually on a flow meter to be sure of uniform flow or in other words, uniform carburetor adjustment. In no case should jets be manufactured or re-drilled to different size. If a new jet is needed, order by number from manufacturer.

All fixed jets are numbered on the face next to the screw slot. Be very careful in handling. Particularly do not mar screw driver slot. Use a screw driver blade that fits slot and pull up jet so that the taper end of jet seats lightly in carburetor body. Always place fixed jet in carburetor body hole pointing to rear of motorcycle.

After a carburetor has been apart for clean-up service, readjust it according to instructions applying to carburetor that is badly out of adjustment (see "Adjusting Carburetor," Page 23).

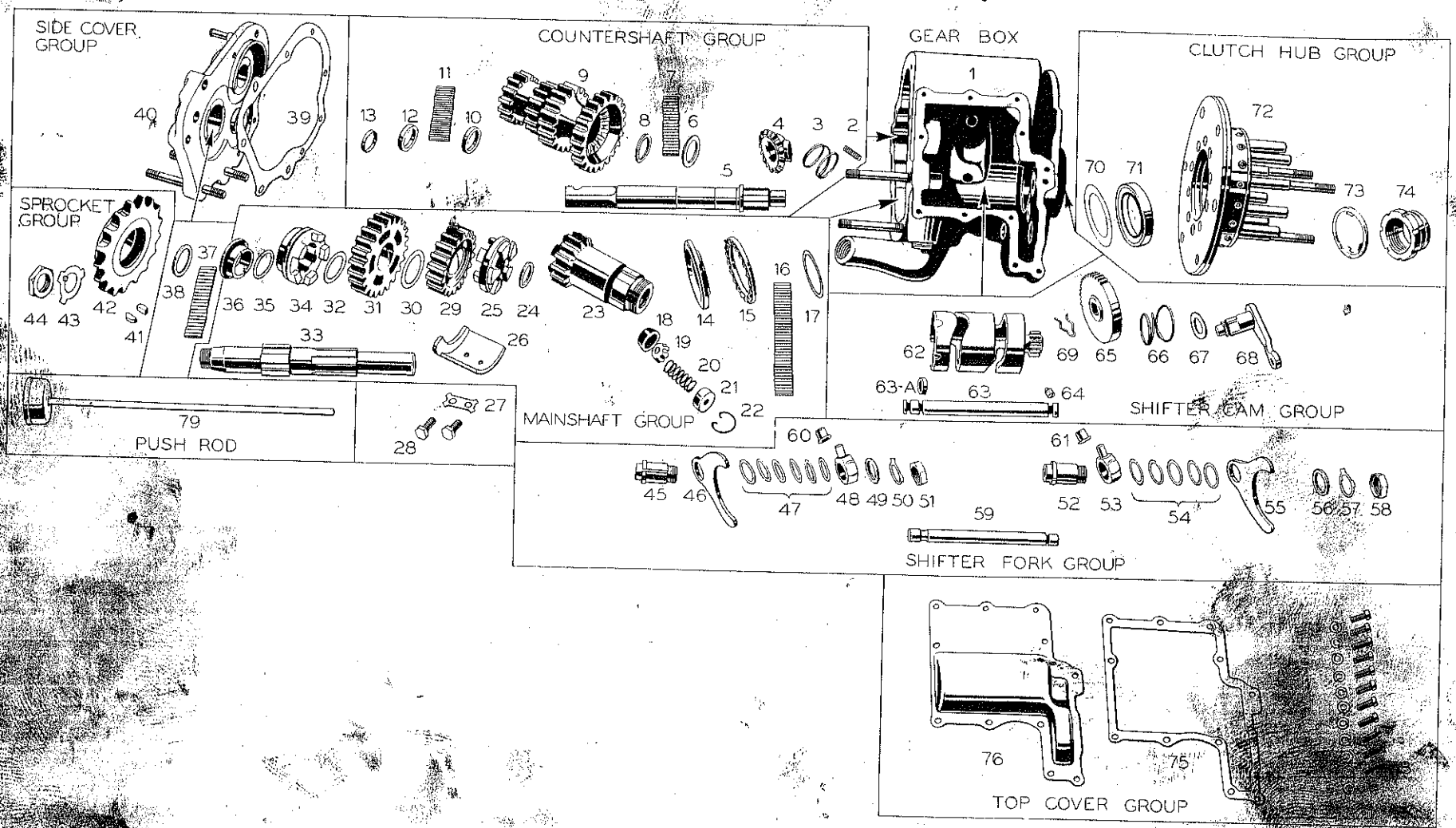
To set the high speed adjustment on the M-641 model, see the instructions given in the note about this model on Page 59.

Carburetor Clean-up Tools

A complete kit of carburetor clean-up tools, including all drills and slot cleaners, required for Army motorcycle carburetors, is available (manufacturer's number 12012-38). This kit does not include tools for disassembling and assembling carburetors.

Carburetor Specifications

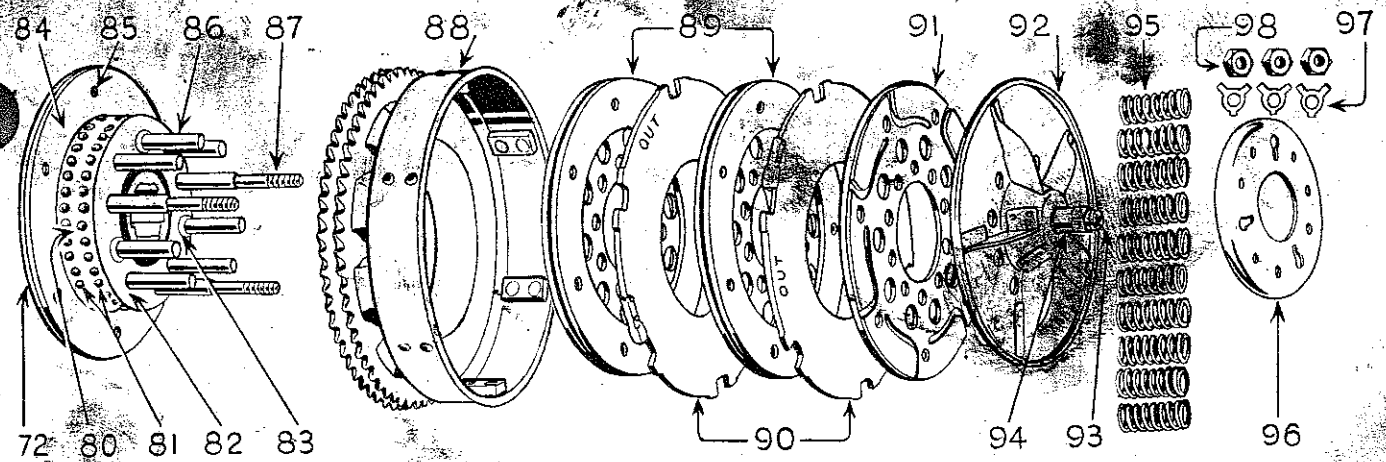
Model (Stamped in Top of Carb. Body)	Venturi Size	Small Idle Hole Nearest Manifold Flange (Drill Size)	Idle Hole Farthest From Manifold Flange (Drill Size)	Slot Width	Fixed Jet Number
M-64	$1\frac{1}{16}$"	#70	#55	.009"	#4
M-65	$1\frac{1}{16}$"	#70	#55	.009"	#5
M-84	$1\frac{1}{16}$"	#70	#55	.009"	#5
M-88	$\frac{15}{16}$"	#70	#55	.009"	#1
M-90	$\frac{15}{16}$"	#70	#55	.009"	#1
M-97	$1\frac{1}{16}$"	#72	#55	.009"	#5
M-641	$\frac{15}{16}$"	#70	#55	.009"	—



ILLUS. 51

TRANSMISSION—SHOWING ALL PARTS IN CORRECT ORDER OF ASSEMBLY

Illustrations 51 and 52 are of the 1941 and later transmission and clutch. 1940 transmission and clutch are almost identical in general construction and assembly. The few differences in parts and adjusting specifications are fully explained in the following parts list and overhauling instructions.



ILLUS. 52
CLUTCH—SHOWING ALL PARTS IN CORRECT ORDER OF ASSEMBLY

TRANSMISSION ASSEMBLY

ITEM	NUMBER USED 1940	NUMBER USED 1941 AND LATER	PART NUMBER 1940	PART NUMBER 1941 AND LATER	NAME
1	1	1	2258-40	2258-41	Transmission Case, as shown, includes the following seven items assembled in case:
	1	1	2518-33	2518-41	Mainshaft Bearing Outer Roller Race
	1	1	2312-26	2312-26	Countershaft Bushing
	1	1	2251-36	2251-36	Shifter Cam Plunger Ball
	1	1	2251-36A	2251-36A	Shifter Cam Plunger Ball Spring
	1	1	2251-36B	2251-36B	Shifter Cam Plunger Cap Screw
	2	2	2172-26	2172-26	Tripper Bolt
	2	2	2173-26	2173-41	Tripper Bolt Nut
2	1	1	2168-26	2168-26	Countershaft End Spring
3	1	1	2166-26	2166-26	Starter Clutch Spring
4	1	1	2165-32	2165-32	Starter Clutch
5	1	1	2300-33	2300-41	Countershaft
6	1	1	2308-33	2308-33	Countershaft Gear End Washer Inside Diameter—$\frac{13}{16}$″ Outside Diameter—$1\frac{3}{16}$″ Thickness—.080″
7	19	19	2306-32	2306-32	Left Bearing Roller Standard Size—.152″x ⅝″; available from .001″ undersize to .001″ oversize in steps of .0002″.
8	1	1	2305-33	2305-33	Roller Bearing End Washer Inside Diameter—$\frac{13}{16}$″ Outside Diameter—$1\frac{5}{64}$″ Thickness—.092″
9	1	1	2303-33	2303-41	Countershaft Gear
10	2	2	2305-39	2305-39	Roller Bearing End Washer (Same as Item 12) Inside Diameter—$\frac{13}{16}$″ Outside Diameter—1″ Thickness—.180″
11	24	24	2289-39	2289-39	Right Bearing Roller Standard Size—.114″x ¾″; available in .0004″ and .0008″ oversizes only.
12	See Item 10	—	—	—	—
13	1	1	2262-39	2262-39	Cover Rubber Oil Seal
14	1	1	2522-33	2522-41	Thrust Bearing Race
15	1	1	2521-33	2521-41	Retainer and Balls
16	31	40	2306-32	2289-36	Clutch Gear Bearing Roller 1940—(Same roller as Item 7) 1941—Standard Size .125″x .615″; available in .0004″ and .0008″ oversizes only.

ITEM	NUMBER USED		PART NUMBER		NAME
	1940	1941 AND LATER	1940	1941 AND LATER	
17	1	1	2520-33	2520-41	Roller Bearing End Washer
18	2	1	2552-29	(Complete Oil Seal Set— 2461-41D)	Seal
19	1	1	0208		Metal Cup or Disc
20	1	1	2461-36B		Spring
21	1	1	2551-29		Push Rod Guide
22	0	1	—	2461-41B	Push Rod Guide Spring Ring
23	1	1	2513-33	2513-41	Clutch Gear
24	1	1	2516-26	2516-41	Mainshaft Endplay Adjusting Spacer. 1940—Inside Diameter—$\frac{11}{16}$″ Outside Diameter—⅞″ Thickness—.090″ to .140″ in steps of .005″ 1941—Inside Diameter—¾″ Outside Diameter—$\frac{15}{16}$″ Thickness—.078″ to .113″ in steps of .005″
25	1	1	2298-39A	2298-41	Shifter Clutch for Second and High Gears
26	1	1	2299-39	2299-41	Second Gear Retaining Bracket
27	1	1	2299-33A	2299-33A	Bracket Bolt Lock Washer
28	2	2	1123-29	1123-29	Bracket Bolt
29	1	1	2295-39	2295-41	Second Gear
30	1	1	2294-39A	2294-41A	Low and Second Gear Endplay Adjusting Washer 1940—Inside Diameter—$1\frac{1}{64}$″ Outside Diameter—1⅜″ Thickness—.029″ to .041″ in steps of .003″ 1941—Inside Diameter—$1\frac{5}{64}$″ Outside Diameter—$1\frac{7}{16}$″ Thickness—.040″ to .075″ in steps of .005″
31	1	1	2294-39	2294-41	Low Gear
32	1	1	2292-33	2294-41B	Low Gear End Thrust Washer 1940—Inside Diameter—⅞″ Outside Diameter—$1\frac{7}{64}$″ Thickness—.052″ 1941—Inside Diameter—$\frac{15}{16}$″ Outside Diameter—$1\frac{7}{32}$″ Thickness—.052″
33	1	1	2272-33	2272-41	Mainshaft
34	1	1	2298-36	2298-41B	Shifter Clutch for Low Gear
35	1	1	2292-33	2292-33	Thrust Washer Inside Diameter—⅞″ Outside Diameter—$1\frac{7}{64}$″ Thickness—.052″
36	1	1	2296-33A	2296-33A	Spacing Collar
37	21	21	2306-32	2306-32	Mainshaft Bearing Roller Standard Size .152″x ⅝″; available from .001″ undersize to .001″ oversize in steps of .0002″.
38	1	1	2291-33	2291-33	Roller Bearing End Washer Inside Diameter—$\frac{29}{32}$″ Outside Diameter—$1\frac{3}{16}$″ Thickness—.063″
39	1	1	2262-33	2262-41	Side Cover Gasket
40	1	1	2260-39	2260-41	Side Cover
41	2	2	2279-26	2279-26	Sprocket Key
42	1	1	2035-33	2035-41	Sprocket
43	1	1	2278-26	2278-26	Lock Washer
44	1	1	364-12	364-37	Sprocket Nut
45	2	2	2249-36	2249-41	Shifter Fork Bushing (Same as Item 52)
46	1	1	2247-33	2247-41	Shifter Fork for Low Gear
47	Varies	Varies	2253-33A 2253-33B	2253-33A 2253-33B	Spacing Shim—.014″ Spacing Shim—.007″ (Same as Item 54)

ITEM	NUMBER USED 1940	NUMBER USED 1941 AND LATER	PART NUMBER 1940	PART NUMBER 1941 AND LATER	NAME
48	2	2	2248-36	2248-36	Shifter Finger (Same as Item 53)
49	2	2	2253-33	2253-33	Spacing Shim—$\frac{5}{64}$" thick (Same as Item 56)
50	2	2	2251-33	2251-33	Bushing Lock Washer (Same as Item 57)
51	2	2	2250-33	2250-33	Bushing Nut (Same as Item 58)
52	See Item 45	—	—	—	—
53	See Item 48	—	—	—	—
54	See Item 47	—	—	—	—
55	1	1	2246-33	2247-41	Shifter Fork for Second and High Gear
56	See Item 49	—	—	—	—
57	See Item 50	—	—	—	—
58	See Item 51	—	—	—	—
59	1	1	2245-38	2245-41	Shifter Fork Shaft
60	2	2	2248-39	2248-39	Shifter Finger Roller (Same as Item 61)
61	See Item 60	—	—	—	—
62	1	1	2243-40	2243-41	Shifter Cam
63	1	1	2244-38	2244-41	Shifter Cam Shaft
63A	1	1	2245-36A	2245-36A	Cam Shaft Rubber Oil Seal
64	1	1	2244-38A	2244-38A	Cam Shaft Lock Screw
65	1	1	2241-38	2241-41	Shifter Gear
66	1	1	2166-26	2166-26	Shifter Shaft Spring
67	1	1	2245-26	2245-26	Shifter Shaft Leather Washer
68	1	1	2242-40	2242-40	Shifter Lever and Shaft
69	1	1	2242-38A	2242-38A	Shifter Gear Retaining Spring
70	0	1	—	2520-41A	Left Bearing Retaining Washer
71	1	1	2524-36	2512-41	Oil Seal 1940—Pressed in clutch hub 1941—Pressed in transmission case
72	1	1	2528-33	2472-41A	Clutch Hub Complete as shown in Illustration 52
73	1	1	2530-33	2515-41A	Clutch Hub Nut Lock Washer
74	1	1	2531-33	2515-41	Clutch Hub Nut
75	1	1	2271-38	2271-41	Inspection Cover Gasket
76	1	1	2270-38	2270-41	Inspection Cover
77	9	11	0253	0253	Lock Washer
78	9	11	032	032	Inspection Cover Screw
79	*	1	—	2446-41	Push Rod Bearing Complete

*Concerning Item 79: Push Rod and Bearing for 1940 model are separate items. Push Rod—2446-33; Bearing—2448-36; one of each used.

Concerning Bearing Rollers (2306-32): When ordering replacement rollers, note that this roller is used in three bearings in the 1940 transmission (Items 7, 16 and 37) and in two bearings in the 1941 transmission (Items 7 and 37). In the 1940 transmission there is a total of 71 2306-32 rollers; in the 1941 transmission there is a total of 40.

Caution Regarding Fitting of Oversize Rollers: Fitting oversize rollers to take up radial clearance also takes up circumferential clearance. Therefore, care must be taken to avoid crowding of rollers. Assemble specified number of rollers and observe whether last roller goes into place freely without any effort to force it; if it doesn't go into place freely, leave it out.

CLUTCH ASSEMBLY

ITEM	NUMBER USED 1940	NUMBER USED 1941 AND LATER	PART NUMBER 1940	PART NUMBER 1941 AND LATER	NAME
72	1	1	2528-33	2472-41A	Clutch Hub Complete, with sprockets, bearing, studs, etc., as illustrated.
80	*	1	*	2473-41A	Ball Bearing Retainer
81	*	60	*	2472-41B	Ball—$\frac{7}{32}$"
82	*	1	*	2475-41A	Bearing Retaining Plate
83	0	3	—	2458-38	Retaining Plate Lock Ring
84	0	1	—	2482-41A	Hub Disc Lining
85	0	6	—	2485-41	Lining Rivet
86	0	7	—	2478-41A	Pin
87	4	3	2549-34	2477-41A	Stud
88	1	1	2039-40M	2039-41A	Sprocket Complete with Disc Spline Ring

ITEM	NUMBER USED 1940	NUMBER USED 1941 AND LATER	PART NUMBER 1940	PART NUMBER 1941 AND LATER	NAME
89	*	2	*	2481-41A	Lined Disc
90	*	2	*	2487-41A	Plain Steel Disc
91	0	1	—	2481-41C	Sprung Steel Disc with Lining
92	1	1	2544-34	2479-41A	Releasing Disc
93	1	1	2463-34	2463-41A	Push Rod Adjusting Screw
94	1	1	2465-26	2465-41	Adjusting Screw Lock Nut
95	12	10	2511-30	2511-41	Clutch Spring
96	1	1	2547-34	2505-41A	Spring Compression Collar
97	4	3	0259	2512-41A	Stud Nut Lock Washer
98	4	3	0117	0117	Stud Nut

Additional Parts Required for 1940 Clutch

NUMBER USED	PART NUMBER	NAME
1	2548-40	Spring Tension Adjusting Nut
1	2550-34	Push Rod Thrust Cap

Corresponding 1940 Clutch Parts

	NUMBER USED	PART NUMBER	NAME
*Corresponding with 1941 sprocket bearing— (Items 80, 81 and 82):	1	2536-33	Bearing Race (in sprocket)
	1	2537-33	Bearing Race (in clutch hub)
	1	2538-33	Bearing Washer
	1	2539-33	Bearing Spacer
	96	2540-33	Ball—$\frac{5}{32}$"
*Corresponding with 1941 clutch discs and linings— (Items 89 and 90):	1	2533-26	Sprocket Lining
	6	2485-29	Lining Rivet
	2	2535-29	Plain Steel Disc
	3	2534-29	Splined Fibre Disc

OVERHAULING TRANSMISSION AND CLUTCH

Removing Transmission From Chassis

A. Lower rear end of bottom skid plate. In some cases it will be found necessary to remove only the two rear mounting bolts; in other cases a U-clamp holding skid plate to front frame tube will have to be removed.

B. Remove left footboard, sidebar and clutch pedal assembly in one unit. Release cable must first be disconnected from clutch footpedal by removing cotter pin and washer.

C. Remove oil bath air cleaner and mounting plate; this requires loosening hose clamp at carburetor hose connection fitting and removing the three bolts attaching mounting plate to frame.

D. Remove outer front chain guard.

E. Remove engine sprocket, using manufacturer's wrench number 12731-29. It will be necessary to strike wrench with a hammer to loosen nut. Remove sprocket from taper by giving flat surface near outer edge a light but sharp rap with a hammer, being careful not to strike teeth.

F. Free inner front chain guard by removing the two mounting screws.

G. Remove tool box from mounting bracket by removing the two mounting bolts from inside of box; then remove mounting bracket from frame.

H. Remove brake rear rod.

I. Remove rear chain.

J. Remove rear chain guard.

K. Remove battery box as follows: Disconnect battery terminal wires and remove battery. Loosen two nuts securing rear safety guard center connection to mounting studs. Unscrew mounting studs to free plate clamping battery box bracket to frame. Remove battery box front bolt and two rear bottom bolts. Remove battery box from left side of frame.

L. Remove clutch release cable and tube.

M. Remove shifter rod.

N. Remove three bottom mounting stud nuts and lift transmission to permit removal of front chain adjusting screw.

O. Loosen U-bolts on ignition coil and swing coil as far as possible toward the front.

P. Remove transmission and clutch assembly as follows: Lift unit to free mounting studs from frame slots, rotate top of transmission backward about a quarter turn and remove from *left* side of frame.

Disassembling Transmission

A. Disassemble and remove clutch as described under "Disassembling Clutch," Page 22, and "Removing Clutch Hub," Page 67.

B. Remove starter crank.

C. Remove sprocket cover.

D. Remove top inspection cover (Item 76).

E. Remove shifter cam (Item 62) by unscrewing lock screw (Item 64) and pulling out shifter cam shaft (Item 63).

F. Remove shifter fork assemblies by drifting shaft (Item 59) out through hole in transmission side cover.

Caution: Bear in mind that shifter fork assemblies are *not interchangeable;* note exact arrangement of

parts before disassembling. This precaution can save needless gauging and adjusting when reassembling.

G. Remove sprocket (Item 42) using manufacturer's wrench number 12731-29. It will be necessary to strike wrench with a hammer to loosen nut (Item 44). Remove sprocket from taper by giving it a light but sharp rap with a hammer, near outer edge, being careful not to strike teeth.

H. Remove transmission side cover (Item 40); all gears, shafts, etc., are now free to be removed from open side of case.

Note: Do not remove clutch gear oil seal and bearing retaining washer (Items 70 and 71—1941 and later only) unless inspection shows them damaged or worn.

Removing Clutch Hub

Remove clutch hub nut (Item 74). On 1940 models use manufacturer's wrench number 12745-26 with adapter number 12745-26A; on 1941 and later models use wrench number 12745-41.

1940 model: Clutch hub can be removed from taper by giving it a light but sharp rap with a hammer and soft punch, striking close to center but being careful not to strike bearing.

1941 and later models: Clutch hub is a press fit on splined end of clutch gear. Puller number 12022-41 is needed to remove it.

Inspection of Parts

Inspect all parts and determine which must be renewed. Check all gears for extent of tooth wear; also inspect all bushings and bearing races.

Give especially close attention to possibly battered or rounded condition of engaging dogs on shifter clutches and clutch gear and engaging slots in other gears. This condition results from shifting abuses or possibly from poorly adjusted clutch that does not release fully.

Damaged engaging dogs and slots try to creep out of engagement under steady driving load. This creeping action develops tremendous side pressure that finally results in serious damage to shifting mechanism and all thrust points along the mainshaft assembly. Therefore, in doing a thorough and dependable transmission overhaul, it is of prime importance that all gears and shifter clutches with badly rounded engaging dogs and slots be replaced with new.

Installing Clutch Gear

A. Assuming that oil seal (Item 71) and bearing retaining washer (Item 70) are already assembled in case, install roller bearing end washer (Item 17) in roller race next. Assemble rollers (Item 16) in roller race after applying sufficient grease to race to hold rollers in place.

B. Insert oil seal tool (manufacturer's tool number 12747-41) through oil seal from the outside so that it will be in place to meet clutch gear when it is inserted through bearing from the inside. It is necessary that this oil seal tool be used to facilitate assembly and avoid damaging oil seal. Assemble thrust bearing race (Item 14) and retainer and balls (Item 15) on clutch gear. Now insert clutch gear through bearing from inside of case. Be sure end of gear is engaged with oil seal tool before pushing it through seal.

Adjusting Mainshaft Endplay

A. Install mainshaft in case with mainshaft spacer (Item 24), thrust washer (Item 35) and spacing collar (Item 36) in place.

B. Install roller bearings (Item 37) in side cover bearing race, holding them in place by means of light coat of grease.

C. Install side cover and gasket on transmission case. In checking endplay, it is important to tighten cover screws and stud nuts just as tight as in final assembly; otherwise endplay in final assembly will not be the same as this check shows. Check endplay as indicated in Illustration 53; it should be .003" to .005". Increase or decrease endplay as necessary by fitting mainshaft spacer (Item 24) of required thickness.

D. After correct mainshaft endplay has been established, remove mainshaft from case and set aside spacer washer selected, to be sure it goes into final assembly.

Adjusting Endplay of Low and Second Gears Between Retaining Bracket and Transmission Side Cover

A. Assemble only the following parts on mainshaft: *From left (clutch) end*—low gear end thrust washer (Item 32), low gear (Item 31), endplay adjusting washer (Item 30), second gear (Item 29), mainshaft spacer (Item 24); *from right (sprocket) end*—thrust washer (Item 35) and spacing collar (Item 36).

B. Install roller bearings in side cover and install gasket and cover on case. Tighten cover just as tight as in final assembly.

C. Check endplay of low and second gears between sidecover (Item 40) and second gear retaining bracket (Item 26), as indicated in Illustration 53. Measure by means of thickness gauge inserted between second gear retaining bracket and second gear. Endplay should be .005" to .007". Adjust as necessary by fitting endplay adjusting washer (Item 30) of required thickness.

After correct endplay adjustment has been attained, remove mainshaft assembly from transmission. Be sure selected endplay washer remains with the assembly.

Assembling Transmission

After mainshaft spacer (Item 24) and endplay adjusting washer (Item 30) in their required thicknesses have been selected, complete assembly of transmission can proceed, reversing order of disassembly.

If new shifter clutches (Items 25 and 34) are required, see that they fit free on mainshaft and slide on shaft splines without binding. Shifting will be difficult unless these parts work freely.

When assembling shifter cam, two things must be watched very closely: First, shifter finger rollers must be in place on shifter fingers; second, shifter cam gear and shifter lever gear must be correctly timed. Small gear has one tooth chamfered at end. This tooth must engage with space marked "3" between teeth of large gear. See Illustration 54.

Adjusting Shifter Clutches

With shifter cam (Item 62) in *neutral* position and highest points on driving dogs overlapping about ⅛" (See Illustration 54), the following clearances should exist:

Shifter fork to low gear—

1940 ..... .248" to .253"
1941 and later ..... .283" to .288"

Shifter clutch to clutch gear—

1940 ..... .030" to .037"
1941 and later ..... .053" to .058"

Suitable strips of metal dressed down to the above thicknesses will serve as gauges for these adjustments.

Relative adjustment between shifter fingers (Items 48 and 53) and shifter forks (Items 46 and 55) is determined by spacing shims (Items 47 and 54). By increasing or reducing number of these shims between shifter forks and shifter fingers (Items 48 and 53) a corresponding change is effected in clearance of shifter clutches. These adjusting shims are .007" and .014" in thickness. Transfer shims as necessary to properly locate clutches. Reassemble shifter fork assemblies to transmission and recheck clearances.

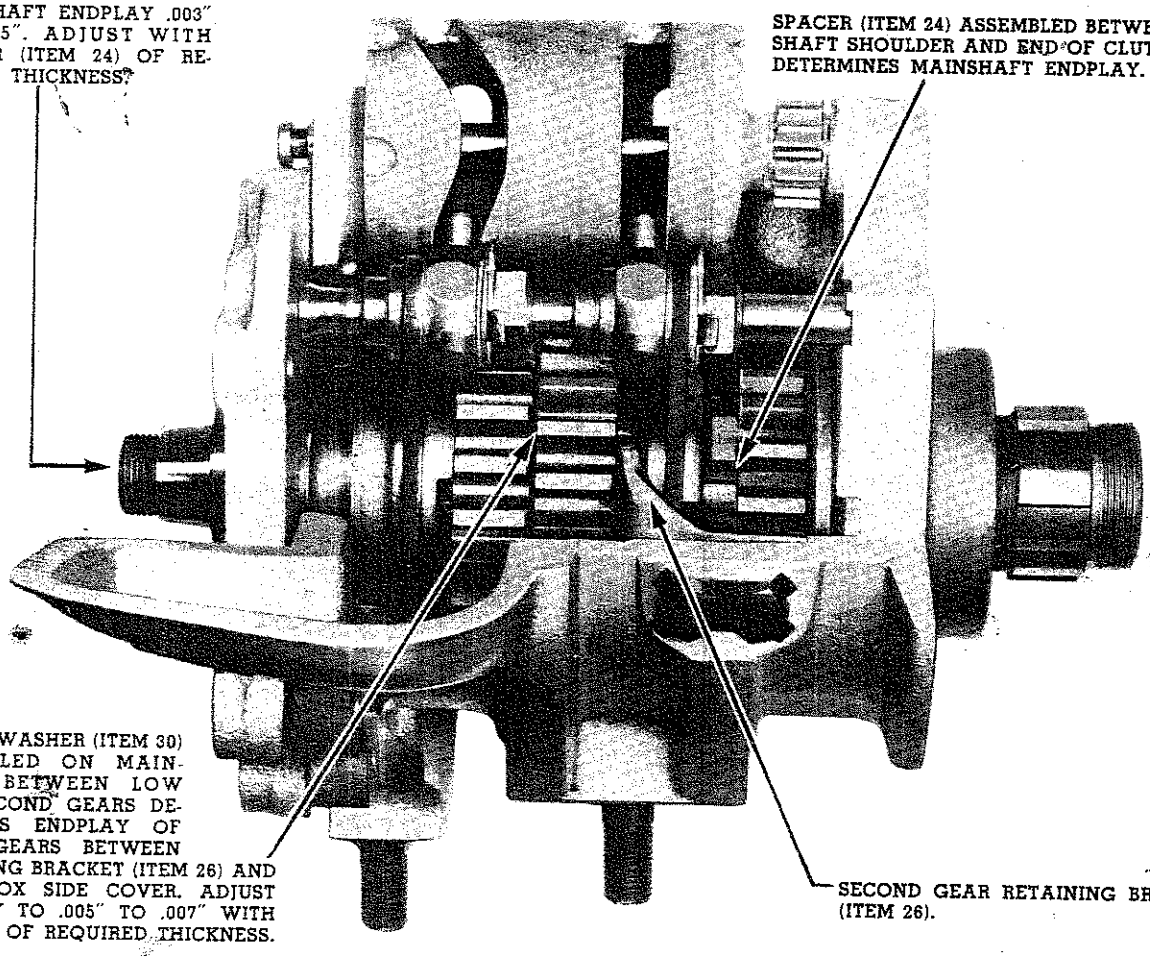
Before installing transmission inspection (top) cover, pour about ¾ pint of oil (same grade as used in engine) into case; 1940 and earlier holds ½ pint.

Installing Clutch Hub

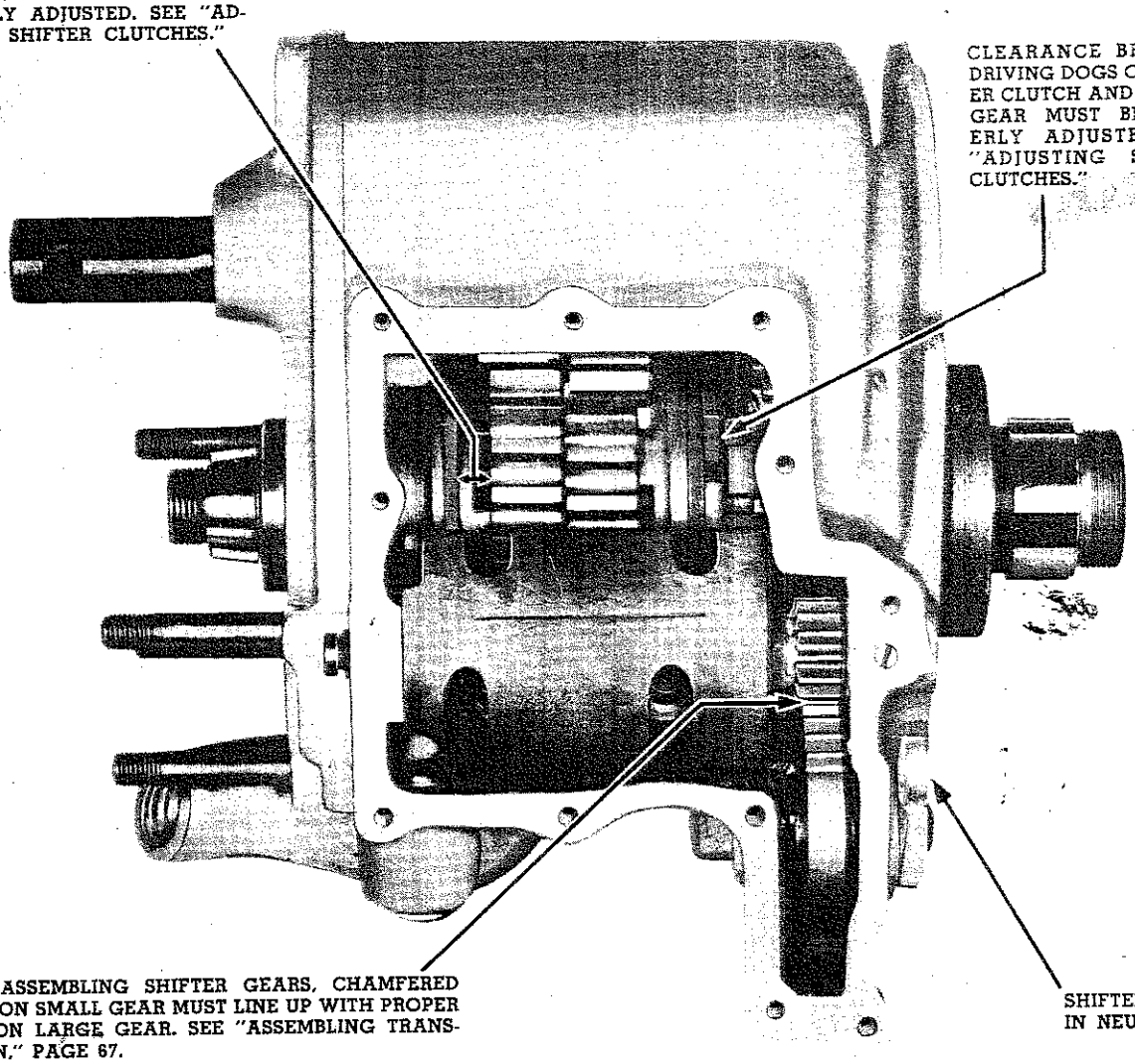
Clutch hub and clutch may be installed either before or after transmission is installed in frame.

1941 and later clutch hub is a light press fit on splined end of clutch gear. Drive hub onto splines with a hammer and a block of wood or piece of tubing of required diameter. Install lock washer (Item 73), tighten nut (Item 74) securely and lock by setting washer into one of the nut wrench slots with a punch.

If sprocket bearing (Items 80 and 81) and bearing retaining plate (Item 82) have been removed from hub, re-install them first. Bearing retaining plate is held in place against hub face by spring rings (Item 83) pushed onto three short studs and tight against



ILLUS. 53
TRANSMISSION ENDPLAY ADJUSTMENTS



ILLUS. 54
SHIFTER CLUTCH CLEARANCES AND SHIFTER GEAR TIMING

plate. Spring rings should be spaced as nearly equidistant as possible; do not install spring rings on long studs.

1940 clutch hub is mounted on tapered end of clutch gear. When installing, see that tapers are clean and key is in place. Install lock washer (Item 73) so inner ear engages hole in clutch hub. Tighten lock nut (Item 74) securely and lock by setting one of the lock washer outer ears into one of the lock nut wrench slots.

1940 clutch sprocket bearing is secured by peening hub shoulder over bearing race. It should be removed only when it requires replacement.

Installing Clutch

Before installing clutch shell and sprocket, apply a very small amount of grease to ball bearing.

Proceed with the assembly of clutch according to instructions under "Reassembling Clutch," Page 22, and Illustrations 12 and 52. Adjust clutch as per instructions under "Adjusting Clutch Spring Tension," Page 21.

Installing Transmission in Chassis

Installation is a reverse procedure of removal. See "Removing Transmission From Chassis," Page 66.

In replacing any parts attached by a number of bolts, such as the battery box, get all bolts in place before tightening any one. Draw all down evenly to preserve alignment.

Chains, rear brake, clutch controls and shifter controls must be carefully readjusted. Securely tighten transmission mounting stud nuts.

Caution: Be sure transmission is filled to level of filler opening with oil of the same grade used in engine.

SUMMARY OF TRANSMISSION SPECIFICATIONS

(Fitting and Adjusting)

ALL ROLLER BEARINGS: .0006" to .001" loose; .0008" preferred.

MAINSHAFT IN CLUTCH GEAR BRONZE BUSHING: .0015" to .0025" clearance; .002" preferred.

COUNTERSHAFT IN TRANSMISSION CASE BRONZE BUSHING: .0015" to .0025" clearance; .002" preferred.

COUNTERSHAFT IN TRANSMISSION CASE SIDE COVER: .0005" to .0015" clearance; .001" preferred.

MAINSHAFT ENDPLAY: .003" to .005".

LOW AND SECOND GEAR ENDPLAY BETWEEN SECOND GEAR RETAINING BRACKET AND TRANSMISSION CASE SIDE COVER: .005" to .007" (check between side of second gear and retaining bracket in transmission case).

SECOND AND HIGH GEAR SHIFTER CLUTCH SIDE CLEARANCE: Check with shifter cam in *neutral* position, and highest points on driving dogs overlapping about ⅛"—

1940 ..... .030" to .037"
1941 and later ..... .053" to .058"

LOW GEAR SHIFTER CLUTCH SIDE CLEARANCE: Check between sides of shifter fork and low gear, with shifter cam in *neutral* position.

1940 ..... .248" to .253"
1941 and later ..... .283" to .288"

SHIFTER CAM ENDPLAY: Free to .005". If, when fitting new shifter cam or new transmission case, cam is tight endways, file boss in case. If too much endplay, fit shim washer of required thickness.

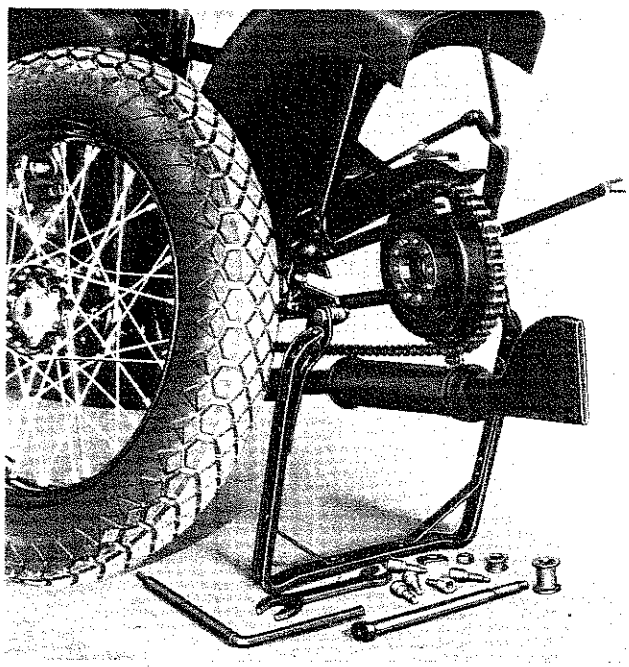
CLUTCH SPRING TENSION ADJUSTMENT:

1940 clutch—Distance from face of spring collar to shoulder on thrust plate mounting studs should be $\frac{3}{32}$".

1941 and later clutch—Distance from inner edge of spring collar to surface of outer disc should be $1\frac{1}{32}$".

WHEELS, HUBS AND TIRES

Wheels normally require little attention other than ample lubrication of hubs. See "Lubrication Chart," Page 15. Occasionally, set motorcycle on rear stand, block up front end of motorcycle to raise front wheel, and check adjustment of hubs. Adjustment is all right when only a small amount of side shake can be found at rim of wheel. Also check spokes and tighten any found loose.



ILLUS. 55
REAR WHEEL REMOVED

To Remove Front Wheel

Raise front end of motorcycle by blocking up under frame loop. Remove brake shackle bolt from rigid fork. Remove axle nut. Wheel is then free to come out by pulling out axle. After rolling wheel forward, brake assembly can be removed from drum, leaving brake assembly attached to control wire and housing.

Caution: Before removing axle, note how slot in brake stabilizer plate is fitted over extended end of left front rocker plate stud. In re-installing wheel, make sure this slot is again fitted properly.

To Remove Rear Wheel

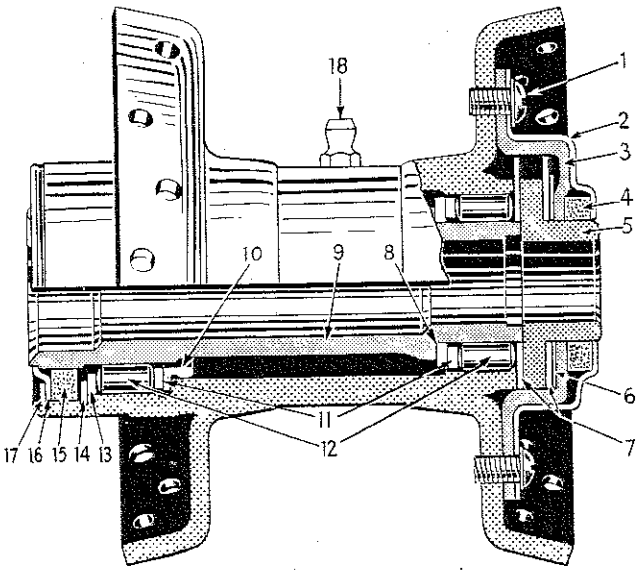
Set motorcycle on rear stand. Loosen and raise rear end of mudguard. Remove five wheel mounting socket screws that secure wheel to brake assembly. (Use manufacturer's wrench number 12025-35). Wrench can be inserted only directly to the rear of axle and wheel must be turned to bring each screw into position for removal.

To prevent brake shell and sprocket from coming off of brake assembly while wheel is being removed, apply rear brake and lock it by shifting brake rod lock *back* against some stationary part of motorcycle.

Remove axle nut, pull out axle, remove spacer from between wheel hub and left side of frame and wheel is then free to come out.

When replacing wheel, reverse operations of removal. Securely tighten wheel mounting socket screws *before* tightening axle nut. Double check socket screws; if they loosen in service due to careless tightening, considerable damage to hub may result.

Before riding motorcycle, be sure to secure brake rod lock in a position on brake rod where it will not catch on anything or interfere in any way with full, free movement of brake rod and brake footpedal.



ILLUS. 56

Rear Wheel Hub

1—Thrust bearing cover screws (five); 2—Thrust bearing outer cover; 3—Thrust bearing housing; 4—Cork grease retainer; 5—Thrust bearing sleeve; 6—Thrust bearing adjusting shims (each shim .002" thick; use as many as necessary to adjust so that sleeve (5) has .003" to .005" endplay); 7—Thrust washers; 8—Left roller retainer thrust washer; 9—Hub inner sleeve; 10—Right roller retainer thrust washer (pressed into hub shell); 11—Roller retainer; 12—Bearing rollers; 13—Roller bearing washer; 14—Roller bearing spring lock ring; 15—Cork grease retainer; 16—Cork retaining washer; 17—Spring lock ring; 18—Grease connector.

Adjusting Rear Wheel Hub

(SEE ILLUSTRATION 56)

To take up only excessive sideplay that may develop, it is not necessary to take hub completely apart. Simply take out screws (1) and complete thrust bearing assembly comes off end of hub and can be taken apart. One or more shims (6) as required can then be added, and the assembly reassembled on hub. Be careful about adding too many shims and thus binding thrust sleeve (5). It must still be free with cover screws (1) securely tightened. It is best to leave cork retainer (4) out of thrust assembly while determining correct adjustment of thrust sleeve, and put it back in when readjustment is completed. Cork retainer interferes to some extent with free movement of thrust sleeve and, therefore, makes it difficult to determine whether or not sleeve is altogether free between thrust washers (7).

Excessive radial (up and down) play in wheel hub bearings, due to wear, can be taken up by fitting oversize rollers (12). To take hub completely apart for attention to roller bearings, first remove thrust assembly as explained above. Next, remove spring lock ring (17), washer (16), cork retainer (15) and pull out inner sleeve (9). Rollers and retainers can then be taken out. It is necessary to remove spring lock ring (14) and washer (13) before brake side bearing can be removed.

In fitting oversize rollers, care must be exercised to avoid fitting too tight. With hub assembled, roller bearings must turn freely and have slight play or shake.

Adjusting Front Wheel Hub

Remove wheel from motorcycle, and then remove cone lock nut and washer from right side of hub. Cone can then be turned to obtain proper adjustment. Adjust so that just slight play or shake can be detected, and wheel turns freely. Check adjustment after cone lock nut has been replaced and securely tightened. To remove and inspect cones and balls, turn right side cone all the way off axle bushing. There are 26, $\frac{5}{16}$" balls in hub—13 on each side.

Removing and Installing Tires

Wheel rims are of the drop-center type, having a depression or well in center of rim. Rim-well, being smaller in circumference than rest of rim, allows one casing bead to fit loosely in it while other bead is being worked over edge of rim. Bear in mind the importance of keeping one bead in rim-well while other bead is being worked onto or off of rim.

To Remove Tire from Rim

1. Remove wheel from motorcycle and lay wheel on its side. (See "To Remove Front Wheel" and "To Remove Rear Wheel," Page 70.)
2. Remove valve cap and valve core to free all air from tube.
3. Press casing bead into rim-well to within a short distance of each side of valve.
4. Using tire tool (not a sharp instrument), start bead over edge of rim at valve. *Don't use force* when starting bead over edge of rim with tire iron, because bead wires may be broken or stretched and tire ruined. With first bead in rim-well, second bead can be started over edge of rim easily.
5. After a portion of second bead is started over rim edge, casing can be further removed from wheel without aid of tire iron.
6. It isn't always necessary to completely remove casing from rim. Removing one side only, allows inner tube to be removed and re-installed and also allows inside of casing to be inspected.

To Install Tire on Rim

1. Before applying casing to rim, see that rubber rim strip is in place in rim-well and that rim strip valve hole registers with valve hole in rim.
2. Start either bead of casing over rim edge, working around wheel until entire bead is on rim.
3. Place inner tube in casing. *Note:* Inner tube may be placed in casing before or after first bead of casing is on rim. Insert valve stem, through hole in rim and start valve stem lock nut.
4. While pressing first bead into rim-well, work remaining bead over edge of rim, starting directly *opposite* valve stem. Work both ways around wheel toward valve.

5. Inflate tire. See "Tire Inflation Pressures," Page 6.
6. Re-install wheel.

CAUTION: Tire casings are balanced and must be applied to rim with balance mark located at valve stem. On Firestone tires, the balance mark is a *red triangle* and on Goodyear tires a *red dot.*

Wheel Spokes and Nipples

Front Wheel: The 20 spokes used on the brake shell side for the front wheel are (manufacturer's part No. 3945-30N), $5\frac{5}{16}$" long. The 20 spokes used on the opposite side of the front wheel hub are (manufacturer's part No. 3943-30N) 8⅜" long. 40 spoke nipples (manufacturer's part No. 3947-16N) are used in the front wheel.

Rear Wheel: All 40 of the rear wheel spokes are of the same length and size. Rear wheel spokes (manufacturer's part No. 3943-36N) are .161" diameter, $8\frac{5}{32}$" long. 40 spoke nipples (manufacturer's part No. 3947-29N) are used for rear wheel spokes.

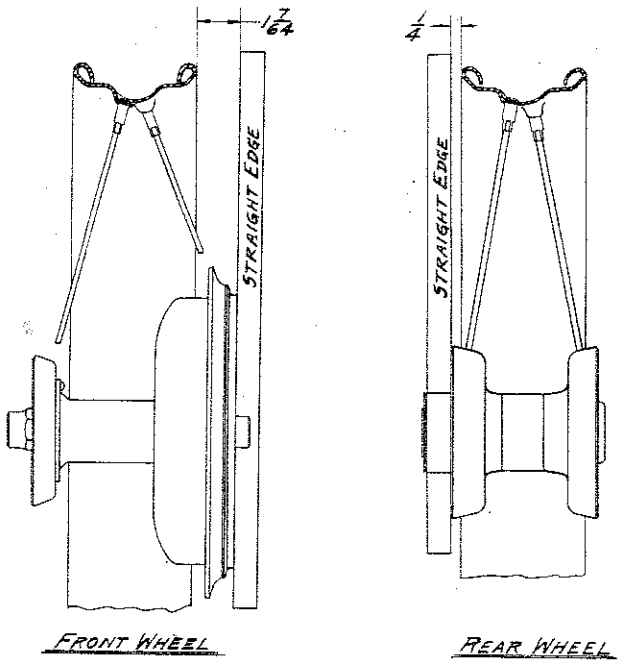
Centering Wheel Rims

When respoking and truing a wheel, the rim must be properly centered in relation to hub for correct alignment and "tracking" of front and rear wheels. Illustration 57 shows method of using a straight edge to determine correct centering of both front and rear wheel rims. Measurements shown in illustration apply to wheels with 4" tire rims.

Straight edge should be a perfectly straight metal bar.

Front Wheel (4" tire rim)—Lay straight edge across face of brake shell and measure distance of straight edge from rim. When rim is correctly centered, this distance will be $1\frac{7}{64}$".

Rear Wheel (4" tire rim)—Lay straight edge across brake side spoke flange of hub and measure distance from straight edge to rim. When rim is correctly centered, this distance will be ¼".



ILLUS. 57
WHEEL RIMS CORRECTLY CENTERED (4" TIRE RIMS)

Should there be occasion to service wheel with rim for 5" tire, following method of measuring and measurements given will apply:

Front Wheel (5" tire rim)—Lay straight edge across brake shell and measure distance of straight edge from rim. When rim is correctly centered, this distance will be $1\frac{1}{16}$".

Rear Wheel (5" tire rim)—Lay straight edge across rim on brake side and measure the distance to brake-side spoke flange of hub. When rim is correctly centered, this distance will be $1\frac{1}{64}$".

Rough Check for Fork Alignment

The rigid fork may be rough checked for alignment as follows: Referring to Illustration 58, use a perfectly straight $\frac{7}{16}$" diameter round bar, about 30" long passed through the hole in fork center stem to determine if fork sides are parallel with center stem. As shown in illustration the fork side tips should be $3\frac{23}{32}$" from the sides of test bar.

Upper end fork sides and fork stem must be spaced to fit handlebar mounting holes.

Fork sides can be checked for relative alignment by using two perfectly straight $\frac{5}{16}$" diameter round bars at least 18" long. Referring to Illustration 59, note that fork is to be supported in horizontal position on level blocks or by clamping center stem in a vise. Insert one rod through holes in lower fork tips and lay the other squarely across upper end of forks. Sight across two rods and note their relative alignment. If they are not in close alignment, either one or both of the fork sides are not straight, or possibly the fork sides are straight enough, but they are out of alignment with each other, or across the fork, due to a twist in the fork crown.

This method of checking fork alignment is recommended only in connection with emergency repair. Except in emergency, fork straightening and aligning should be referred to a base shop where any needed straightening equipment and more accurate aligning gauges are available.

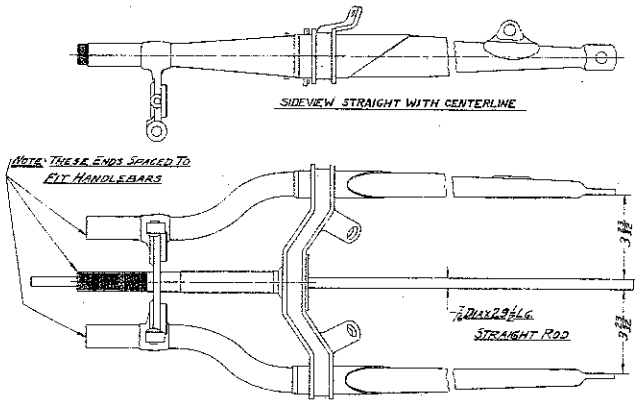
Rough Check for Frame Alignment

Sketch (Illustration 60) shows a satisfactory method of rough checking a frame that is not visibly badly damaged but there is doubt as to its possible alignment. This check will determine whether or not frame is far enough out of alignment to require either a major re-aligning job or replacement. Straightening a badly bent frame requires special tools and fixtures for holding, bending and gauging.

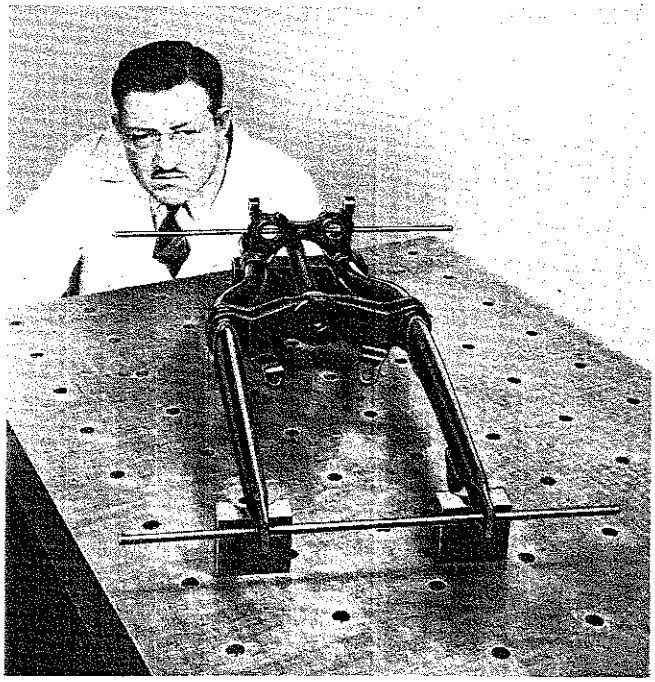
The straight edge may be any convenient size of square, rectangular or round bar stock, just so it is perfectly straight and of sufficent cross section so that it is rigid. Its length should be 5 ft. or more. The shim to be inserted between straight edge and frame seat post tube must be $\frac{1}{16}$" thick.

The round bar for head must be $\frac{31}{32}$" in diameter and at least 26" long. A shoulder or pin may be provided at top end of bar to prevent it from passing all the way through frame head. Bearing cups are left in frame head when using test bar.

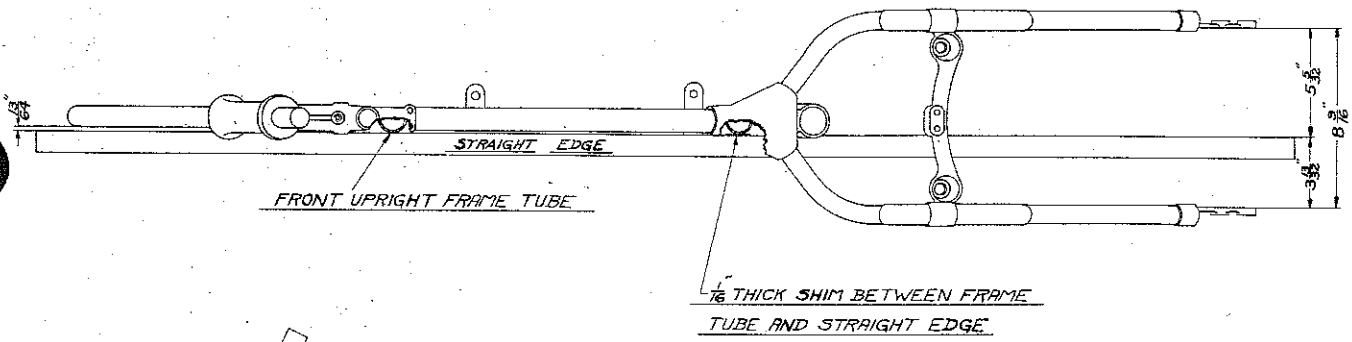
Sketch includes measurements for checking alignment.

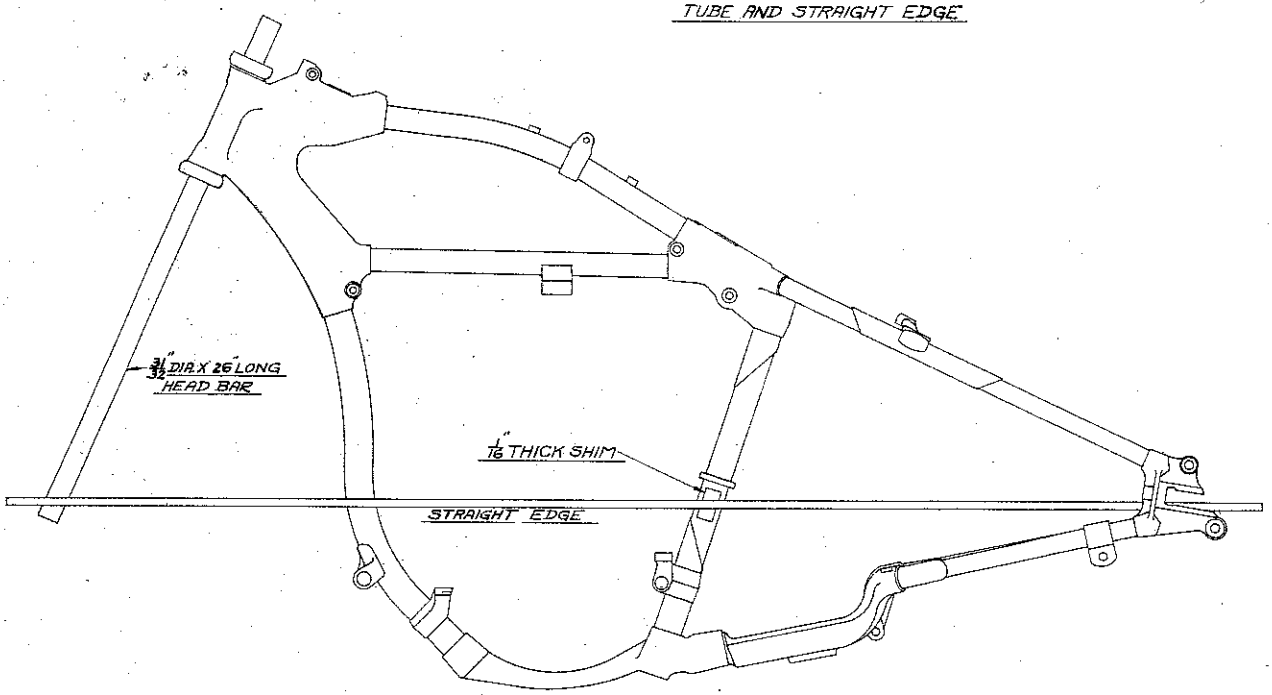


ILLUS. 58 (ABOVE)—CORRECT ALIGNMENT OF FORK SIDES WITH FORK STEM.



ILLUS. 59 (RIGHT)—VISUAL CHECK OF FORK SIDE RELATIVE ALIGNMENT.





ILLUS. 60
USE OF STRAIGHT EDGE IN ROUGH-CHECKING FRAME FOR ALIGNMENT

SERVICING RADIO INTERFERENCE SUPPRESSION SYSTEM

(Refer to Radio "Interference Suppression System," Page 57)

Should it be found that electrical system on radio suppression equipped motorcycle produces radio interference noise it does not necessarily mean that suppression-devices are at fault. Before checking and replacing suppression-devices, check entire electrical system for loose, corroded or poor connections. See that battery connections are clean and tight and that battery solution level is above plates. Excessively worn generator brushes and commutator, dirty commutator and poor circuit breaker or relay contacts may be the cause of radio interference.

Radio interference may also be caused simply by loose fittings, bolts, nuts and screws on any part of the motorcycle.

Suppression-devices on the WLA model come under three classifications for trouble-shooting purposes:

1. Bonding and shielding (★A, ★B and ★D)
2. Condensers (★C, ★F, ★G and ★H)
3. Resistors (★E)

If it has been determined that the motorcycle electrical system is responsible for radio noise then check each of the three above listed groups, outlined as follows: Replace suspected faulty parts with new ones, one at a time, and test for radio noise after each change.

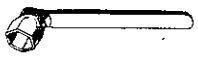
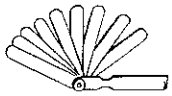
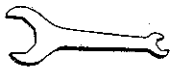
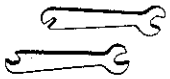
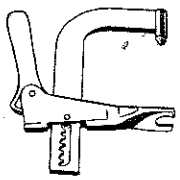
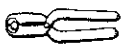
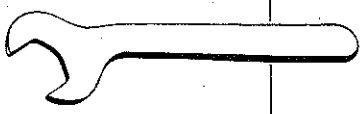
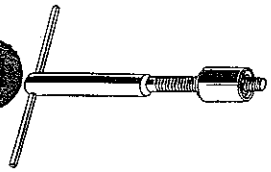
1. Check bonding and shielding. See that flexible braid conductor (★B) used to ground spark coil housing, air cleaner bracket and engine base to frame, is tight at all connections (shake-proof washers used). Circuit breaker-to-coil wire (★D) is enclosed in metal shielding. See that ends of shielding are securely grounded to coil housing and inside of timer housing.

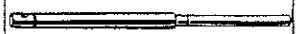
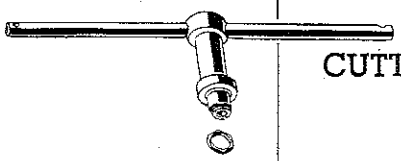
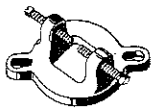
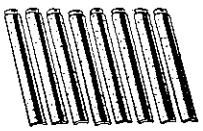
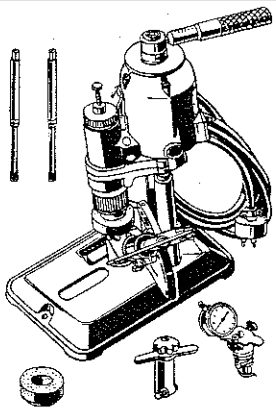
2. Metal encased suppression-condensers are used on generator (★H) and spark coil (★C). The surface of the terminal post which supports condenser on spark coil housing and also end of flexible braid conductor, should be kept clean to insure good contact. Mica suppression condensers are used on cut-out relay (★G) and in instrument panel (★F). All suppression condensers are readily accessible and are easily replaced. Should a condenser be suspected of being faulty, it should be replaced by a new one, the motorcycle being checked again for radio noise.

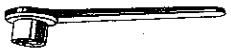
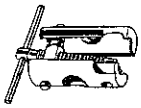
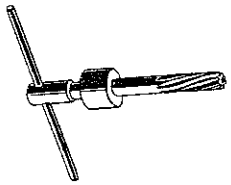
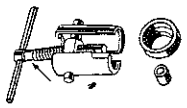
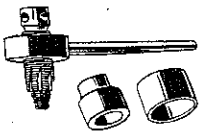
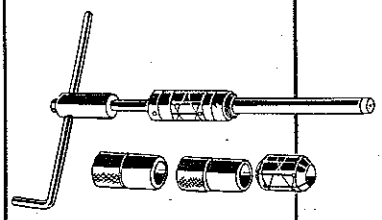
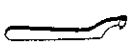
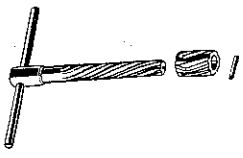
3. Resistor-suppressors (★E) are screwed onto ends of spark plug cables. Keep these suppressors clean and tight. Examine for cracks or scorched condition. Faulty suppressors must be replaced with new ones.

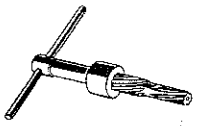
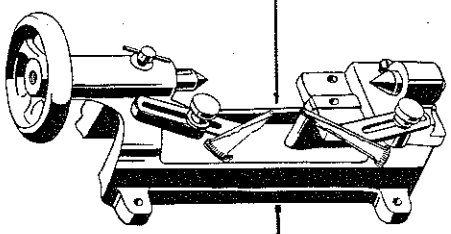
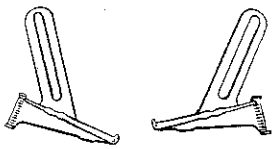
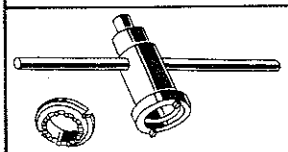
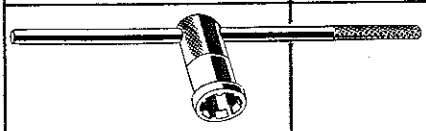
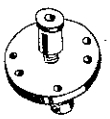
SPECIAL TOOLS FOR SERVICING WLA (SOLO) MODEL HARLEY-DAVIDSON MILITARY MOTORCYCLE

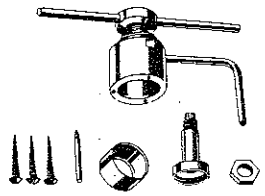
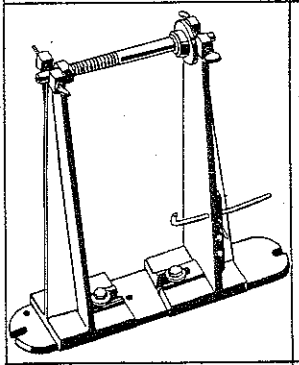
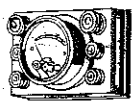
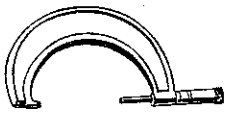
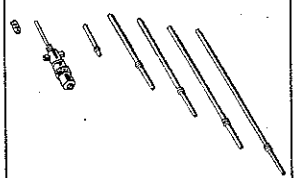
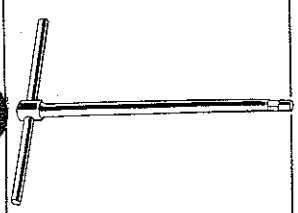
THIS LIST COVERS REQUIRED HARLEY-DAVIDSON SPECIAL TOOLS. IT DOES NOT INCLUDE STANDARD SHOP TOOLS NEEDED SUCH AS STANDARD OPEN END AND SOCKET WRENCHES AND OTHER MISCELLANEOUS TOOLS.

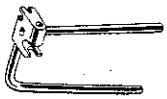
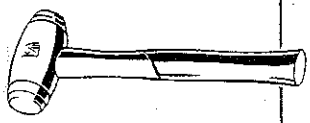
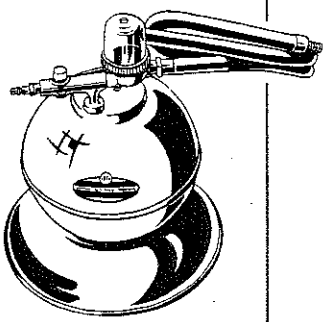
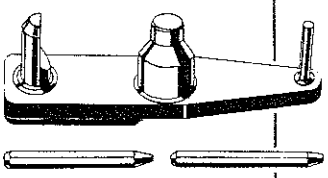
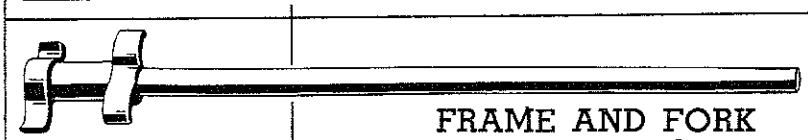
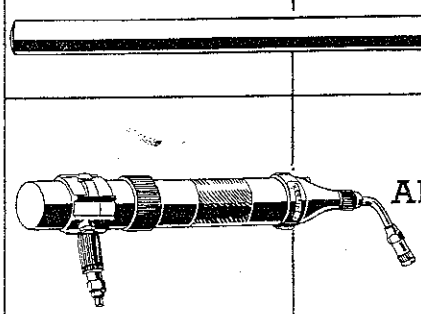
TOOL ILLUSTRATION	NAME OF TOOL	FEDERAL STOCK NO.	HARLEY-DAVIDSON NO.
	SPARK PLUG WRENCH	41-W-3334	11929-40
	TUNGSTEN POINT FILE	41-D-1410	11840-X
	THICKNESS GAUGE	41-G-407	11974-X
	VALVE COVER WRENCH		11806-31
	SET OF VALVE TAPPET ADJUSTING WRENCHES	41-W-3573	11904-X
	HEAD BOLT WRENCH	41-W-1525	12047-30A
	VALVE SPRING COMPRESSOR	41-L-1410	12053-30
	VALVE KEY TOOL	41-R-2403	12054-30
	MANIFOLD WRENCH	41-W-1570-10	12003-X
	CYLINDER BASE NUT WRENCH	41-W-872-10	12650-29
	PISTON PIN BUSHING TOOL	41-T-3305	12057-X

TOOL ILLUSTRATION	NAME OF TOOL	FEDERAL STOCK NO.	HARLEY-DAVIDSON NO.
	LOCK RING TOOL	41-T-3260	12052-32
	VALVE GUIDE REAMER	41-R-2309-65	12623-26
	STANDARD SIZE VALVE GUIDE PILOT FOR USE WITH CLEARANCE CUTTER (11890-29)	41-P-412	12621-26
	OVERSIZE VALVE GUIDE PILOT FOR USE WITH CLEARANCE CUTTER (11890-29)	41-P-410	12622-26
	CUTTER HOLDER WITH HANDLE AND NUT FOR 11890-29	41-H-2270	11898-X
	VALVE SEAT CLEARANCE CUTTER FOR USE WITH HOLDER 11898-X	41-C-2822-30	11890-29
	SPIRAL EXPANSION REAMER FOR PISTON PIN BUSHINGS		11915-X
	CONNECTING ROD CLAMPING FIXTURE FOR USE WITH 12057-X AND 11915-X	41-T-3091	12058-X
	PISTON PIN BUSHING HONE (WITH FINE ABRASIVES)	41-H-2382	11844-X
	EXTRA SETS OF FINE ABRASIVES FOR 11844-X (4 SETS PER BOX)	41-A-10	11845-X
	ECCENTRIC VALVE SEAT GRINDER (WITH DIAL GAUGE)	40-V-530	
	PISTON SQUARING PLATE	41-P-1550-25	12655-26

TOOL ILLUSTRATION	NAME OF TOOL	FEDERAL STOCK NO.	HARLEY-DAVIDSON NO.
	SET OF CARBURETOR CLEAN-UP TOOLS	41-T-3081-45	12012-38
	SPROCKET NUT WRENCH (ALSO FITS 45 CRANK PIN NUTS)		12731-29
	GEAR AND BEARING PULLER	41-P-2903	11849-X
	FLYWHEEL SHAFT NUT WRENCH	41-W-1410	12645-29
	PINION SHAFT BUSHING REAMER	41-R-2304	12135-37
	CONNECTING ROD LAPPING ARBOR	41-A-337-10	11944-X
	TAPPET GUIDE PULLER	41-P-2956	11960-38
	CAM GEAR BUSHING REMOVER	41-R-2372-20	11952-36
	CRANKCASE MAIN BEARING LAP	41-L-203	11954-40
	LAPPING ARBOR WRENCH FOR 11944-X AND 11954-40	41-W-475	11950-X
	CAM GEAR SHAFT AND TIMER DRIVE SHAFT BUSHING REAMER	41-R-2265	12133-37

TOOL ILLUSTRATION	NAME OF TOOL	FEDERAL STOCK NO.	HARLEY-DAVIDSON NO.
	OILER DRIVE SHAFT AND PINION SHAFT BUSHING REAMER	41-R-2303	12132-36
	FLYWHEEL TRUING DEVICE	41-S-4970	11962-X
	EXTRA STATIONARY CENTER FOR 11962-X	41-C-468-60	11963-X
	EXTRA MOVABLE CENTER FOR 11962-X	41-C-468-50	11964-X
	EXTRA SET OF INDICATORS FOR 11962-X	41-I-125	11969-X
	ENDPLAY GAUGE	41-G-198	11967-38
	CLUTCH WRENCH (1940 AND EARLIER)		12745-26
	INNER CLUTCH DISC NUT WRENCH (1941 AND LATER)		12745-41
	INNER CLUTCH DISC PULLER	41-P-2905-90	12022-41
	CLUTCH GEAR BUSHING REAMER (1940 AND EARLIER MODELS)	41-R-2268	12660-26B
	CLUTCH GEAR BUSHING REAMER (1941 AND LATER MODELS)		12132-42
	CLUTCH GEAR OIL SEAL TOOL	41-G-1255	12747-41

TOOL ILLUSTRATION	NAME OF TOOL	FEDERAL STOCK NO.	HARLEY-DAVIDSON NO.
	CLUTCH GEAR OIL SEAL REPLACEMENT TOOL		12735-42
	WHEEL TRUING STAND (INCLUDES WHEEL ARBORS)	41-S-4995	12028-X
	REAR WHEEL SPOKE NIPPLE WRENCH	41-W-3340	12033-39
	FRONT WHEEL SPOKE NIPPLE WRENCH		12032-X
	BATTERY HYDROMETER	18-H-1242	11831-X
	COMBINATION VOLT-AMMETER		11828-X
	2" TO 3" OUTSIDE MICROMETER	41-C-233-50	12063-X
	0" TO 1" OUTSIDE MICROMETER	41-C-225	12062-X
	2" TO 8" INSIDE MICROMETERS	41-C-304	12065-X
	WHEEL MOUNTING SOCKET SCREW WRENCH	41-W-3832	12025-35

TOOL ILLUSTRATION	NAME OF TOOL	FEDERAL STOCK NO.	HARLEY-DAVIDSON NO.
	CHAIN TOOL	41-T-3320	12039-X
	SET OF COPPER JAWS FOR VISE	41-J-325	11973-X
	HANDLEBAR END TAP	41-T-1026	12043-36
	RAWHIDE MALLET	41-M-486	12034-X
	COPPER HAMMER	41-H-265	11970-X
	OIL SIPHON AND TANK FLUSHER		12059-X
	REAR SPROCKET RIVETING SET	41-J-373	12067-42
	FRAME AND FORK STRAIGHTENING BAR	41-T-3205	12082-X
	EXTENSION HANDLE FOR 12082-X		12082-XA
	AIR OPERATED GREASE GUN	40-G-498-25	

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