ENGINE OVERHAUL MANUAL

250cc

This fine engine unit will give good performance and excellent reliability when these rebuilding instructions are followed.

Almost without exception, instructions also apply to the improved 1970 250cc model.

June, 1970

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ENGINE OVERHAUL MANUAL

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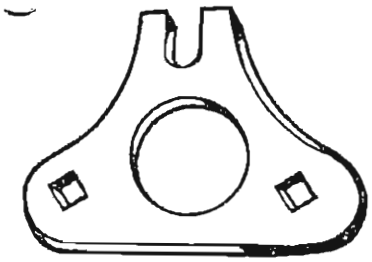
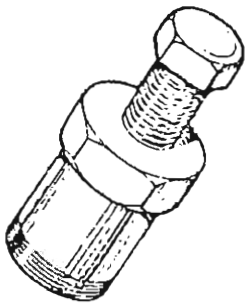
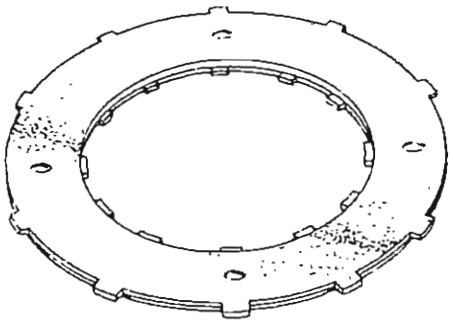
SPECIAL TOOLS REQUIRED



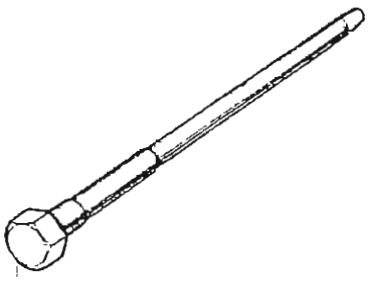
Clutch Nut Screwdriver
DA70



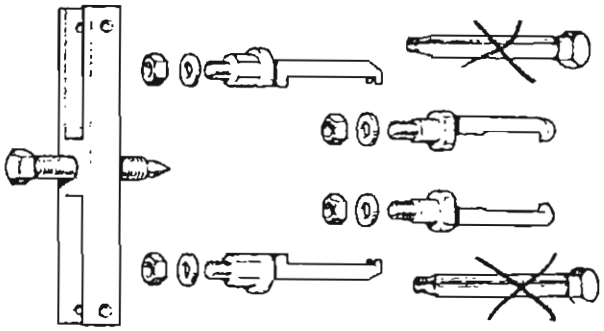
Clutch Hub Puller
x x x



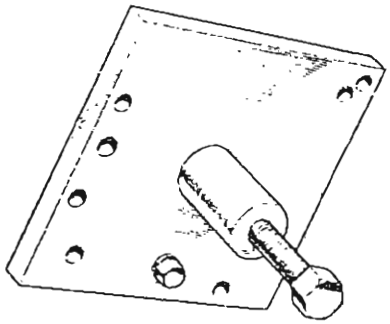
'Clutch Locking Tool
x x x



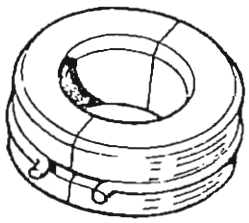
C/B Cam Puller



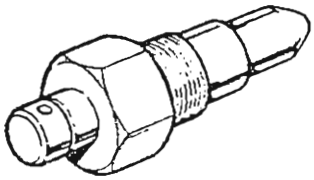
Gear Puller, Pinion and Oil Pump Drive



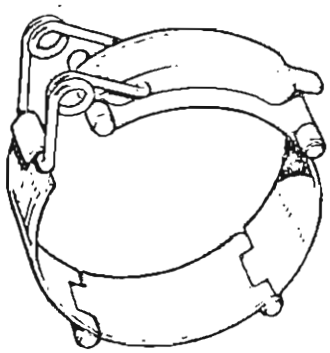
Crankcase Parting Tool



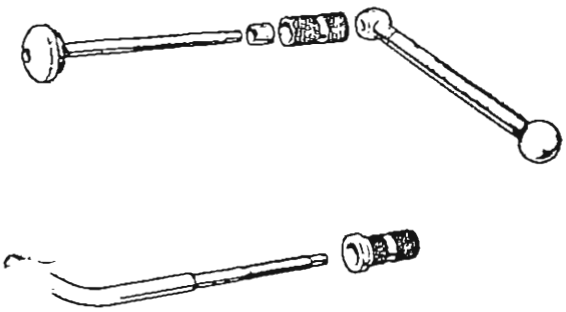
Balance Checkweight



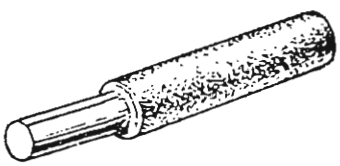
Timing Stop Tool



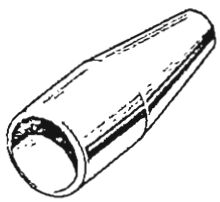
Piston Ring Compressor



Valve Guide



Piston Pin Drift



C/B Oil SealSpreader

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ENGINE REMOVAL

Remove fuse or disconnect battery Lo avoid short circuit damage when various wires are unplugged. Remove gas tank. Note that bottom tank cross strap should be positioned and formed so that it does not interfere with the top motor support brace. Cross strap should not, touch anything except gas tank or the possibility of vibrational tank fracture will be enccuntered.

Remove exhaust pipe and muffler. Remove carburetor and air cleaner assembly, To save time on reassembly it's a good idea to loosely assemble bolts and nuts back to the frame in their correct positions,

Disconnect clutch cable at the gearbox lever, Remove right hand footrest, Disconnect alternator leads and contact breaker lead at junction block near rear motor mount.

Remove rear chainguard,, disconnect and remove rear chain. Reassemble connecting link and clip in their original position so that you can eventually reassemble the chain the way it has been running.

Remove engine top support bra. :et from cylinder head and remove support bra. : et from frame. Disconnect rocker box feed line at the rocker box. Unplug oil pressure indicator wire.

Remove all three engine mounting bolts, then lift the engine up and tip it back to gain clearance at the oil line junction block.. Remove junction block nut and pull block and lines away from the engine. Allow oil to drain into a suitable receptacle

Now remove engine unit,. Clean the engine unit exterior thoroughly before disassembly,

ENGINE DISASSEMBLY

Engine unit can rest on workbench with top front mounting lug held steady by your vise and primary side toward you, Strip engine down keeping parts separated. The following order is recommended, Develop a box for each category. You will save time on reassembly by separating engine components., Note on a scratch pad as you work along, components which need replacement.

Cont'd..

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ENGINE DISASSEMBLY

1. ENGINE "TOP-END" - Remove rocker caps and rotate engine so that there is no strain on the rocker arms. (Both valves should be closed.) Remove all rocker box hold-down nuts and remove rocker box. It may be necessary to tap the rocker box with a rubber hammer to encourage it away from the cylinder head. Use an air or electric impact wrench or at least a speed handle to save time on nut, bolt, and screw removal, Remove push rods noting that inlet push rod is 1/16" longer than exhaust.

Remove spark plug. Remove the six cylinder head nuts and washers. Lift off cylinder head. If the cylinder head and cylinder block lift off at the same time, this is all right. Do not lever or tap against cooling fins because of the risk of breakage, Head and cylinder can be easily separated after removal by tapping on the inlet manifold or exhaust spigot with a rubber hammer.

Remove cylinder block, pry out one piston pin circlip using a scriber or tiny screwdriver. Using piston pin drift Part No. xxx, push or tap out piston pin, supporting the opposite side of piston to avoid possibility of damaging the connecting rod. On the inside of piston skirt, mark piston so that it can be re-assembled the same way if reused.

2. PRIMARY DRIVE - Use an impact wrench or speed handle to save time and remove the ten primary chaincase screws. After loosening the joint with a rubber hammer, remove chaincase using a suitable receptacle to catch the primary drive oil.

Remove the three stator nuts and stator. Check the stator for shorts and opens using a continuity light or ohmmeter, There must be no continuity between any stator lead and ground, There must be continuity between any combination of stator leads. If stator passes the short and open tests, it is very unlikely that stator need be replaced, Note that the stator lead grommet at front of crankcase should be replaced unless it is in perfect condition.

Cont'd..

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ENGINE DISASSEMBLY

2, PRIMARY DRIVE Cont'd

Before loosening rotor nut note whether or not rotor needs replacement due to a loose hub. If the rotor can be rotated or pushed back and forth even slightly with respect to the rotor hub, then it must be replaced., Bend back the rotor nut tab washer and remove rotor nut using an impact wrench, Alternatively an 11/16" diameter bar through the small end of the connecting rod will effectively lock engine for rotor nut removal, Remove the rotor woodruff key from drive side crankshaft.

Remove the chain tension adjuster assembly and look it over for mechanical damage with an eye to replacement needs. Remove the safety wire and four clutch spring adjusting nuts. Remove clutch pressure plate and all of the driving and driven plates and examine them for condition. When new, the thickness of driving plates measures .130/.135". Replace the plates if they are worn down as much as .020" or show evidence of serious overheating, Check the steel driven plates. They must be perfectly flat for the clutch to function as designed,

Remove the clutch release rod, bend back the clutch hub nut tab washer and remove nut using an impact wrench. Alternatively, use clutch locking tool, Part No.xxx (or two plates welded or bolted together to serve the purpose) and fitting the 11/16" diameter bar through the small end of the connecting rod, loosen and remove the clutch hub nut, Using clutch hub puller Part No. x x x carefully break the clutch hub loose from the mainshaft taper, Then remove clutch sprocket, engine aprocke t, and primary chain as a unit. It may be necessary to use a two jaw puller to remove the engine sprocket. If you will be using the same primary chain again make sure it goes back in its original position. Tie a wire tag on an outside chain plate for identification purposes,

Remove the mainshaft woodruff key and examine all of the primary parts to determine which need be renewed. It is a good idea to remove the six screws and the high gear sprocket, access plate so that the gasket can be renewed and seal replaced, On reassembl y loctite these six screws.

Cont'd..

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ENGINE DISASSEMBLY

3. OUTER TIMING COVER - Turn engine around and rest it on the bench with timing side toward you. Hold top front mounting lug in your vise jaws to steady the engine and remove the contact breaker cover, two pillar bolts and contact breaker plate, Then remove the contact breaker holding bolt, and using puller No. xxx, while positioning the connecting rod at bottom dead center, break the taper and remove the shaft and action plate assembly. (If you don't have this special puller thread a 5/16" - 24 cap screw into the contact breaker shaft and wiggle the head of the bolt slightly with a pair of pliers and withdraw the shaft and action plate assembly.) Check the points, point plate, shaft and action plate assembly (including wear on the auto-advance slot) for evidence of need for replacement.

Using an impact wrench or speed handle, remove the ten outer timing cover screws. Using a rubber hammer, tap and remove outer timing cover. Examine the clutch release lever and worm for condition. Also the kickstart spindle oil seal. There is a gasket you can order for the outer timing cover joint (Part No. x x x which saves time on reassembly.

4. INNER TIMING COVER AND GEARBOX - Remove the seven screws and one kickstart spring anchor bolt which retain the timing side inner cover. Note that these timing side inner and outer cover screws vary considerably from one another in length and it's wise to keep them separated with their respective cover to speed the reassembly process. It's not necessary to remove complete spindle or mainshaft nut, If the timing side inner cover is well stuck in place it is all right to tap on the left side of the transmission mainshaft with a rubber hammer to aid removal. Push the end of the camshaft inward with your finger as you remove the timing side inner cover so that the camshaft won't come out with the cover.

Note the thrust washers at transmission mainshaft and layshaft ends and don't lose them. Note a very important 'O' ring that is fitted in a circular groove between timing side inner cover and crankcase at the main oil feed passage from pump to crankshaft. If this 'O' ring seal is not fitted, oil pressure to the rods will be reduced with very possible subsequent rod bearing failure.

Cont'd.

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ENGINE DISASSEMBLY

5. CAMSHAFT, TAPPETS, TIMING GEARS, OIL PUMP - Remove camshaft and tappets. With a scriber or similar tool, identify the tappets so they can be reinstalled in the same position as original, Bend back the pinion gear tab washer. Use a 11/16" dia. bar through the small end of the rod to keep the crankshaft from turning while you loosen and remove the pinion gear nut, You may discard this tab washer as we favor the use of loctite on reassembly, Use puller No. x x x to remove pinion gear.

Remove the two nuts retaining oil pump and remove the pump. If the oil pump is tightly stuck, use an offset screwdriver between the lower pump plate and crankcase to pry pump loose,

Now use puller No, 61-3273 and the pair of jaws with teeth cut on an angle to remove the oil pump drive gear. (First remove pinion gear woodruff key,) A good way to remove woodruff keys is to use diagonal pliers (side cutters), grip the key firmly and then lift upward. When removing the spiral drive gear from the crankshaft, it will probably be necessary to hold the puller jaws tightly against the gear teeth with channel-lock or water-pump pliers to avoid puller jaws slipping off the spiral oil pump drive gear teeth,

Later models that employ a drive side roller bearing will have a large diameter spacer-washer behind the oil pump drive gear and this should now be removed. Note that the flat side goes toward the main bearing, Now is the time to determine which parts under headings 3, 4, and 5 need be replaced.

6. CRANKCASES - CRANKSHAFT - Use extreme caution to avoid damage to the timing side end of the crankshaft, Do not be tempted to tap on the end of this shaft. Remove the seven bolts, nuts and flat washers holding the crankcase halves together, Note and remove the hardened spacer washer interposed between engine sprocket and drive side bearing,

Cont'd..

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ENGINE DISASSEMBLY

6. CRANKCASES - CRANKSHAFT Cont'd

Unless crankshaft fits too tightly in the main bearings, the cases can now be separated by careful tapping with a rubber or plastic mallet. If this careful tapping operation is no% successful, then use crankcase parting tool Part No. x x x Thread puller adaptors onto crankcase stator studs, Select the appropriate puller plate holes and push crankshaft out of the drive side crankcase,

After drive side crankcase half is removed, grip the drive side crankshaft on the splined end by hand and carefully using a rubber or plastic mallet, tap the timing side crankcase half away from the crankshaft. If this careful tapping operation is unsuccessful, then heat the timing side crankcase half allowing the crankshaft to come out after the aluminum crankcase expands away from the timing side ball bearing,

Avoid a% all cost tapping on the timing side end of the crankshaft, An alternative methodfor pushing the crankshaft out of the timing side crankcase is to use crankcase parting tool part No, x x x Use three screws to bolt plate to crankcase, then push %he crankshaft out using the same method as for drive side,

CRANKSHAFT. CON ROD SERVICING

CRANKSHAFT - Remove con rod, noting relationship of punch marks on nuts, bolts, rod shank and cap, On reassembly, maintain same alignment. Later engines employ stronger connecting rods. Measure rod width (side to side) 1" down from piston pin bore, Early rods measure .490"/.495" at this point, Later rods measure .530"/.535". We recommend discarding early rods, Replace rod if big-end bore is out-of-round or shows signs of excessive "fretting" between bore and bearing shells. Check small-end bore using a new piston pin. If clearance between pin and bore exceeds .002", rebush or replace rod. Protect connecting rod shank from scratches and other handling damage. Surface damage can cause rod breakage,

Cont'd..

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CRANKSHAFT, CON ROD SERVICING

CRANKSHAFT Cont'd

Remove both flywheels. Measure rod journal in several places. If journal is out-of-round or undersize as much as .001", (under low limit) crank must be replaced or reground. Following are the correct dimensions:

Std.	1.4375"/1.438"
-.010"	1.4275"/1.428"
-.020"	1.4175"/1.418"
-.030"	1.4075"/1.408"

During crank grinding note radius at each side of journal. This .070"/.080" corner radius MUST be maintained to avoid crankshaft breakage. Also note oil pocket in journal surface at oil holes. This pocket is important and if it disappears when journal is ground undersize, it must be redeveloped by careful use of a small mounted grinding stone or chain saw file. Main bearings (drive-side and timing-side) should be a hand--press fit on crankshaft. Shafts may need to be polished down to allow this fit.

Thoroughly clean flywheels and crankshaft including oil passages, bolt holes and sludge trap. Fit drive-side flywheel using four new flywheel bolts. (Clean threads and use 2 drops of Loctite Stud Lock on each bolt.) Torque bolts to 32 lb/ft.

Fit timing-side flywheel. Use Permatex "Super 300" or Loctite Sealant between timing-side flywheel and crankshaft in the sludge trap pocket area to preclude oil pressure loss at this point. Fit new flywheel bolts as for drive-side.

Use Loctite Sealant or Stud Lock for threads of sludge trap plug to avoid possible oil pressure loss.

Check static balance of crankshaft assembly using parallel ways and xx61-3809 checkweight. If necessary, rebalance. Remove the same amount of metal from each flywheel (on the heavy side) using a 3/8" diameter drill bit.

Cont'd...

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CRANKSHAFT, CON ROD SERVICING

CRANKSHAFT Cont'd - Maximum hole depth limited to 1/2". Use masking tape to avoid any risk of drill chips entering oil passages at rod journal or timing-side shaft end.

Clean the connecting rod and new bearing inserts. Fit one bearing shell to rod shank and one to rod cap. Oil crank journal and rod bearing surfaces and assemble rod. Note punch marks and avoid reversing rod cap. Fit rod nuts to correspondingly marked bolts and tighten nuts until punch marks are in alignment.

If you cannot see punch marks, tighten rod nuts to 22 lb/ft. When rod cap is correctly assembled, locating segments on bearing shells will both be on the same side of journal.

After installation, connecting rod must be perfectly free to turn on journal but have no apparent "bearing clearance" by feel. Connecting rod side clearance should be .010"/.012". When crankshaft assembly is finished, wrap it in clean paper and set it aside until needed.

CRANKCASE SERVICING

Thoroughly clean drive-side and timing-side cases. Grip high gear sprocket teeth between copper vise jaws. Remove the high gear sprocket nut, sprocket, mainshaft high gear and then lever out the high gear oil seal. Carefully clean and check all ball bearings, needle bearings and bushings in the crankcase. When a ball bearing is correctly fitted, and all parts are at room temperature, the bearing will be perfectly free to spin but have little or no perceptible clearance. Working clearance between shafts and bronze bushings should be .0015"/.002". Same clearance applies to needle bearings used on the gearbox layshaft.

If in doubt as to the condition of any bearing or bushing, replace it. Always heat the crankcase for removal and replacement of bearings and check for proper fit after the parts have returned to room temperature. To remove the layshaft left side needle bearing, you must warm the crankcase and use a slide hammer puller or lever the old bearing out using an offset screw driver.

Cont'd..

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CRANKCASE SERVICING

There is a check ball in the scavenge pick up pipe which functions as a non-return valve. The diameter of this ball is .219" and must be free to move up and down inside the pick up pipe, If it is ever necessary to remove the pick up pipe, use a 1/4" - 20 tap to develop threads in the pick up pipe, then thread in a bolt and use a slide hammer to remove the pipe.

Now is the time to thoroughly clean the sump screen and examine it for condition, Be certain that the sump screen is properly made and undamaged, Any foreign particle that finds its way to the oil pump will cause the pump to jam up with subsequent engine failure. This screen has been improved for 1970 (Part No. x x x and can be fitted to earlier engines.

Remove the oil pressure release valve assembly. Thoroughly clean and check all oil drillways and passages. Compare the free length of the release valve spring with a new one to insure that normal oil pressures will be maintained, Make sure the oil pressure release valve assembly is correctly installed,

Be sure all bearings and bushings in the crankcases are fitted and in good condition, Fit the sump screen, mainshaft high gear, and tighten the high gear sprocket nut to 80 lb/ft. after renewing the oil seal, Thenwrap the crankcasesin clean paper and set them aside until needed.

OIL PUMP SERVICING

If the oil pump cannot be operated freely by hand or if there is some doubt as to the cleanliness of the pump, then completely dismantle and thoroughly clean all of the parts.

On reassembly, use Permatex Super 300 on the top and bottom cover joints. If the oil pump refuses to operate freely, then determine the cause and repair or replace the pump.

Cont'd..

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OIL PUMP SERVICING

Oil pump has been improved for 1970 (new Part No. xxx. This new pump can be fitted to earlier models. WARNING! Inner timing cover rib will interfere with latest pump and cause pump seizure. Check with modeling clay, then file or grind rib to provide needed clearance.

GEARBOX SERVICING

Thoroughly clean all gearbox parts and examine shafts, gears, camplate, shifter forks, and gear change quadrant for evidence of wear or deterioration.

The 250cc gearbox is very robust relative to engine size and normally shows very little evidence of wear and is completely trouble free.

1968 production 250 models used shifter forks which were identical (Part x x x These identical shifter forks were used in conjunction with shifter camplate identified by the stamped letter "T" (Part No, x x x Most of these models gave no gearbox trouble, but some would persist in "jumping out" of third gear.

To give more engagement of the gear dogs when the transmission is shifted to third, the camplate and the mainshaft shifter fork were altered for 1969 and given new part numbers, Mainshaft shifter fork became non-interchangeable under Part No. T3854. The new camplate number is x x x These two parts can be fitted to earlier models which fail to stay in third gear. The latest camplate x x x is identified by the digits, "69".

Shifter forks can be identified as follows:

x x x forks are "plain, or as forged" on Spindle bore O.D.
x x x forks have been machined (lathe-turned) on Spindle bore O.D.

Cont'd...

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ASSEMBLING ENGINE

1. CRANKCASE - Working on a perfectly clean bench, fit the crankshaft assembly to the drive side crankcase. Use a thin coat of Permatex Super 300 on each joint face and assemble the timing side crankcase. There is a felt washer, Part No. x x x which fits over the high gear bushing and is located between the high gear sprocket nut and sprocket access plate.

The purpose of this seal is to keep dirt and water from adversely affecting the access plate seal. Fit the seven crankcase bolts and nuts with a flat washer under each and tighten them gradually and uniformly to a final setting of 15 lb/ft. Check that the crankshaft is perfectly free to rotate. There should be .002" to .005" crankshaft end float.

Crankshaft is located in left crankcase by the drive side ball bearing (earlier models) after the engine sprocket nut is tightened,

Crankshaft is located in right crankcase by the timing side ball bearing (later models) after pinion gear nut is tightened. Subject later models are fitted with a two-piece roller bearing on drive side.

2. OIL PUMP-TIMINGGEARS - Rest engine on work bench with timing side toward you, Hold top front mounting lug in your vise jaws to steady engine. Fit oil pump drive gear and woodruff key. A large spacer washer is fitted before oil pump drive gear on later models to locate the crankshaft by timing side ball bearing.

Fit new oil pump gasket and oil pump assembly. Torque the nuts to 6 lb/ft.

Fit pinion gear and nut. Delete pinion gear nut tab washer. Use Loctite on threads and torque the nut to 50 lb/ft. Use an 11/16" dia. rod through the connecting rod small end to lock engine while tightening this nut. Check that crankshaft still rotates freely.

Cont'd....

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ASSEMBLING ENGINE

2. OIL PUMP-TIMING GEARS Cont'd

Fit exhaust and inlet tappets making sure that these tappets are perfectly free in the crankcase, They must be free enough to fall of their own weight, and if they won't, polish the tappet stems to provide a free fit. Note that the tappets are installed correctly, Thin end of each tappet foot faces front of engine. Oil tappet stems before assembly.

Oil camshaft lobes and bearing surfaces and fit camshaft, lining up the timing marks. Beginning with 1970 production, there are two marks for timing purposes on the camwheel. 1968 and 1969 models use the tooth marked with a straight line (directly opposite the camshaft key) for timing purposes. 1970 models use the tooth with a "V" mark which is two teeth to the right of original timing mark.

3. INNER TIMING COVER & GEARBOX - Clean up the inner timing cover and check the condition of outer camshaft bushing and oil seal. Check condition of crankshaft timing side oil seal in the inner cover and replace the seal unless it is in perfect condition, Note that the lip of this seal goes inside as the seal is pushed into inner timing cover.

If transmission mainshaft has been removed fit it to inner timing cover along with the K/S gears, mainshaft nut, and washer. Hold the mainshaft between copper vise jaws and tighten the mainshaft nut to 50 lb/ft. Bend up tab washer.

Assemble shifter forks, layshaft, and gears to inner cover. There is a very important 'O' ring that must be fitted before inner cover and gearbox is assembled. This 'O' ring is Part No. E8158T and goes between inner cover and crankcase at the main oil feed passage. There is a gasket available (Part No. x x x which can be fitted between inner cover and crankcase. Alternatively use a thin coat of "Permatex Super 300" on each surface,

Cont'd..

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ASSEMBLING ENGINE

3. INNER TIMING COVER & GEARBOX Cont'd

Use xxx oil seal spreader to avoid C/B seal damage, and fit the inner cover complete with gearbox, making sure that the camshaft timing marks are still in alignment. Fit and tighten the seven inner timing cover screws and K/S spring anchor pin. Fit K/S return spring.

4. OUTER TIMING COVER

Clean and check timing side outer cover. Check condition of K/S spindle oil seal. Check condition of clutch release lever and worn gear. Note that when the lever and gear are "timed" correctly lever arm points straight ahead in line with gasket surface and outer edge of worm gear is even with the top edge of the bore. Replace C/B wire and grommet if in doubtful condition.

Liberally grease clutch release lever gears, then fit cover. Use gasket x x x or "Permatex Super 300" at joint. Fit and tighten the ten outer timing cover screws. Test to confirm that starter crank mechanism works all right and that the gearbox shifts into all four gears and neutral satisfactorily.

5. PRIMARY DRIVE

Turn engine around and rest it on bench with primary side toward you. Steady engine by holding top front-mounting lug between vise jaws.

Replace seal in high gear sprocket access plate. Fit new felt washer x x x) and new plate gasket. Loctite and tighten the six screws.

There is provision for automatic rear chain oiling from the primary supply with these engines. To insure that primary is not run dry, this oiler should be plugged. Solder oil tube outlet hole, or replace oil tube assembly with a suitable bolt.

Cont'd.

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ASSEMBLING ENGINE

5. PRIMARY DRIVE Cont'd

Remove the four screws and plate from clutch shock absorber assembly. Replace rubbers if they have deteriorated. Clean screw threads and tapped holes. Loctite these four screws and tighten them with an Impac Driver.

Fit the (25) rollers to clutch hub using grease to hold them in place. Assemble hub, centre, and clutch sprocket.

Fit clutch hub key and spacer behind engine sprocket. Mainshaft and clutch hub tapers should be clean and dry.

Fit engine and clutch sprockets and primary chain as an assembly. Be sure engine sprocket is fitted correctly-longer hub goes outward. After sprockets are pushed on all the way, note that primary chain runs parallel with gasket surface.

Using locking tool x x x and 11/16" dia. bar through con rod small end. Fit clutch hub tab washer and torque nut to 60 lb/ft. Bend up tab washer. Insure that clutch centre turns freely by hand after tightening nut.

Fit rotor key and alternator rotor (strobe timing mark outward). Fit tab washer and torque nut to 60 lb/ft. Bend up tab washer.

Fit clutch release rod. Alternately fit the five "plain" and four "lined" clutch plates, noting that a "plain" plate goes in first. Fit clutch pressure plate, four cups, springs, and nuts. Tighten clutch spring nuts all the way.

Now adjust pressure plate center screw. Loosen lock nut, run screw in until all clearance is taken up - - then back screw off 1 to 1-1/2 turns. Tighten locknut.

Cont'd.

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ASSEMBLING ENGINE

5. PRIMARY DRIVE Con.t'd

Use a 6" length of pipe (or suitable alternative) to actuate clutch release lever. Pressure plate must move outward evenly when released. Loosen appropriate clutch spring nuts until pressure plate releases evenly.

When spring nuts are correctly adjusted and lever actuated, pressure plate can be easily rotated by hand. If Paternal run-out of pressure plate exceeds .010", clutch will not release cleanly.

Once you are satisfied clutch releases correctly, wire all four nuts together to maintain adjustment.

Now fit chain tensioner assembly and adjust primary chain to 1/2" slack.

Fit alternator stator (cable inward and to front) and torque stator nuts to 20 lb/ft. Use a .010" feeler strip to gauge clearance between rotor and stator. If less than .010", remove stator and grind steel laminations where needed to provide correct clearance.

Use a thin film of grease to locate new primary cover gasket correctly against crankcase. Fit primary cover and the ten screws. Note that an aluminum washer is fitted under the heads of drain and level screws.

6. CYLINDER BLOCK AND PISTON

Clean cylinder block thoroughly including top and bottom gasket surfaces. Use a telescope gauge and micrometer to determine bore wear. If cylinder bore is .003" or more tapered or out-of-round, cylinder must be rebored oversize.

The greatest wear takes place at (or near) the top of Piston Ring travel. The cylinder bore does not wear below lower limit of ring travel. Measure the bore at the top, and at the bottom. If difference in diameters is .003" or more, rebore cylinder oversize.

Cont'd.

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6. CYLINDER BLOCK AND PISTON Cont'd

If not necessary to rebore oversize, deglaze original bore to allow new piston rings to seat quickly.

After cylinder block has been rebored, honed, or deglaxed, scrub bore with hot soapy water to remove all traces of abrasive material.

TR25W CYLINDER BORE SIZES

STD. 67mm = 2.638"

O/S + .010" = 2.648"

o/s + .020" = 2.658"

O/S + .030" = 2.668"

o/s + .040" = 2.678"

Pistons are cam-ground and tapered. Correct clearance is .0035" at room temperature. Measure piston front-to-back at bottom of skirt to determine clearance between piston and cylinder bore.

If clearance is less than .003", cylinder bore should be increased as required. If clearance is more than .005", select another piston.

Check piston ring land wear. Correct clearance between a new ring and top of land is .0015". Replace piston if land clearance exceeds .003".

Usually only the top compression ring land suffers wear. Excessive wear leads to ring "flutter" and subsequent ring breakage.

Piston pin should be a hand-press fit in piston at room temperature. It is wise to examine pin ends. If ends are not smooth, polish ends to avoid possible wear on piston pin circlips.

Cont'd...

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6. CYLINDER AND PISTON Cont'd

Fit new piston rings to cylinder bore one at a time and check end gaps--should be .007" to .017".

Oil con rod small end, piston pin and pin bores in piston. Fit piston and pin. Fit both circlips making certain they locate accurately in grooves provided.

Fit a new cylinder base gasket and then install rings on piston. Oil control ring can go either way but note that compression rings are marked "T" or "TOP".

Oil cylinder bore, piston skirts and rings. "Stagger" ring end gaps at approximately 120 ^{o}, and fit cylinder block.

A rod (5/16"-3/8" dia.) through piston pin and resting against crankcase cylinder base surface will support piston while you slide cylinder block over piston rings.

Rings can quite easily be entered one at a time into cylinder block (use fingers only to depress rings) or the use of ring compressor (Part No. ST027) is recommended.

7. CAMSHAFT TIMING CHECK

It is now convenient and wise to confirm that camshaft is correctly timed. With piston on top center overlap stroke, inlet (outside) tappet should be lifted .128"/.130" and exhaust (inside) tappet should be lifted .106"/.108".

With piston on TDC Overlap, inlet tappet is starting upward, exhaust tappet is going downward. Use a dial test indicator to determine actual tappet lift with piston on TDC Overlap.

Cont'd...

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7. CAMSHAFT TIMING CHECK Cont'd

TAPPET LIFT FIGURES

	At TDC (Overlap)	Total Lift
Exxx (Std. '68-'69)	In .128"/.130", Ex .106"/.108"	.345"
E11276 (Std. '70)	In .128"/.130", Ex .106"/.108"	.345"
CDxx (M-X)	In .148"/.150", Ex .116"/.118"	.350"

8. CONTACT BREAKER AND IGNITION TIMING

Clean and check shaft and action plate, ignition cam and springs. Replace worn parts and assemble using Lubriplate or equivalent between shaft and contact breaker cam.

Wipe taper in camshaft bore and taper on shaft clean and dry. Fit C/B cam assembly, retaining bolt and washer but do not yet tighten bolt.

Clean point plate assembly. Replace points if in doubt as to condition. Connect C/B wire at point plate and fit plate, pillar bolts and washers. Locate point plate in the middle of radial adjustment range and tighten pillar bolts.

Loosen screws that hold contact point sub-plate to main plate. Actuate eccentric screw from limit to limit noting that sub-plate can be moved radially for timing purposes. Position sub-plate in the mid-position and tighten screws.

Rotate C/B cam counter-clockwise until points open (line up point rubbing block with mark on face of C/B cam). Gap points at .014" - .016".

Note when piston is coming upwards on the compression stroke. (Both tappets should be down since inlet and exhaust valves must be closed on compression stroke.)

Cont'd...

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ASSEMBLING ENGINE

8. CONTACT BREAKER AND IGNITION TIMING Cont'd

Timing mark on alternator rotor and pointer in chaincase, when aligned, indicate 38° Before Top Center. 38° B.T.C. corresponds to 11/32" (.343") before top linear piston travel.

Position crankshaft at 38° B.T.C. on compression stroke. 1969 and 1970 models have a. flywheel timing knotch. Use timing stop tool Part No. ST023 to quickly locate crankshaft for ignition timing purposes.

Now turn C/B cam counter clockwise until contacts just break (as indicated visually or with a continuity light). If you push in against C/B cam you can hold cam fully advanced (against auto-advance spring pressure) and rotate tapered shaft end in camshaft taper at the same time until points just separate.

Tighten C/B cam bolt to 8 lb/ft. Check point gap again (.014" - .016" with contact point rubbing block aligned with reference mark on face of C/B cam),

Again locate crankshaft at 38° B.T.C. on compression stroke. Rotate C/B cam counter-clockwise against spring tension. Contact points should just break when cam reaches the full advance stop limit. Ignition timing can be advanced or retarded by rotating contact point plate and/or main plate. Rotate plate clockwise to advance timing, counter clockwise to retard.

After engine is installed and running, it is wise to check fully advanced timing (38" B.T.C.) using a strobe light.

Wipe a thin film of lubriplate or equivalent on C/B cam and fit gasket, cover, and screws.

9. CYLINDER HEAD SERVICING

Remove valves, using Part No. X X compressor or equivalent, and thoroughly clean cylinder head. Check head gasket surface with a good straight-edge. If surface is not flat within .002"/.003" have the surface remachined.

Cont'd...

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9. CYLINDER HEAD SERVICING Cont'd

You can use a sheet of emory cloth (or coarse wet-or-dry paper) fixed to a flat surface such as a sheet of plate glass. Use kerosene as a lubricant, rub the head back and forth across the emory sheet until surface is reasonably flat.

Clean and check valves. If stems show evidence of wear, replace them. If stems are O.K., regrind valve faces at 45°. Regrind valve stem tips flat and square if tips are worn noticeably.

Check valve guides for wear. These guide bores if worn will be out-of-round. The quickest and best way to determine if a guide needs replacement is to push a new (or good) valve in place and move the tip from side-to-side and then from front-to-back,

Guide bore wear takes place front-to-back (due to rocker arm thrust) and if you can detect a difference in clearance when moving the valve tip first side-to-side, and then front-to-back, replace the guide.

Use valve guide removal and replacement tool (Part No. x x x' to pull old guide out. It is wise to heat the head to about 150° F. in an oven or on a 'hot plate. Oil guide portion which extends into port before removal.

New guide can be pulled into place with components at room temperature. Oil guide and cylinder head bore before installation. Oversize guides for this model are available and listed in your 1970 x x x parts manual.

Actual interference between guide O.D. and head bore should be .0015"/ .002". If guides don't fit tightly enough they will work loose and cause serious damage unless caught in time.

Regrind valve seats in cylinder head to 45° . Clean head, guide bores and valves.

Cont'd...

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9. CYLINDER HEAD SERVICING Cont'd

Apply a thin coat of "medium" oil-mix valve grinding paste to face of valves. Lightly lap in valves and then remove all traces of the abrasive.

Look at valve seats in cylinder head. If seat width (as indicated by the lapped surfaces) exceeds 3/32", valve seats should be narrowed from the outside. For best efficiency width of seats should be 1/16" to 3/32".

Seats can be narrowed from the outside by using a 15° stone. However for best results use blending cutter (Part No. x x and arbor (Part No. x x available from our Parts Department stock.

Check valve springs for free-length by comparison with new springs. If old springs are 1/8" or more shorter, replace them.

Some trouble was experienced with 1968 and 1969 x x models valve collars. The keepers tended to "Pull Through". Discard early collars and keepers, replace them with 1970 type, Part No. x x x collar, and xx keeper.

The difference between early and late collars/keepers is slight but important? Early collars use 15° taper - late collars use 20°.

Assemble valves, cups, springs, collars and keepers to cylinder head using a film of oil on valve faces, stems, valve keepers.

Actual length of outer spring with valve on seat should be 1-5/16". Shim washers (Part No. x x x can be used if needed under lower spring cups to provide correct spring height.

Cont'd...

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10. ROCKER BOX SERVICING

Check rocker arm end-float. Should be .003"/.004". A steel thrust washer is fitted at each end of each rocker arm and can be thinned down by filing or grinding if required.

Strip rocker boxes - clean and check all parts. Note two drill access holes in rocker box gasket surface (timing side). These two holes should be plugged to prevent possible oil leakage. Use a tight fitting aluminum plug preferably but lead will do. You may also use epoxy tank sealer.

Lighten rocker arm ends by grinding. Especially exhaust rocker arm which features a projection designed for use with a compression release.

Accelleration will be noticeably better and risk of valve float will be minumized by careful attention to these rocker box assembly steps.

11. PUSH RODS

There have been reports of "Push Rods too short". As a result valve clearance could not be adjusted correctly. Push Rods can be replaced - or - if a bit short, top push rod cup can be removed and a steel washer interposed between cup and rod to increase length. To remove top cup, hold push rod between plastic vise jaws. Using pliers, rotate cup and pull at the same time. If cup is unusually tight, heat cup to about 200°F., then turn and pull.

On reassembly of push rod cup, clean parts thoroughly, and use Loctite. Drive push rod all the way into cup.

Push rods should be checked to make sure they are straight. Set up in your lathe (or other fixture) a tappet stem and a rocker arm ball pin.

Cont'd...

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11. PUSH RODS Cont'd

Locate push rod between socket and ball and check for run-out in the middle of push rod using a Dial Test Indicator. Run-out in the middle should not exceed .002". Push rods can be straightened by careful use of a plastic hammer.

12. FITTING CYLINDER HEAD

1970 models incorporate a cylinder block liner with increased O.D. top flange. This flange should project .004"/.005" above aluminum cylinder block head gasket surface so when the head bolts are tightened, head gasket holds liner in place.

Earlier models must have a steel ring fitted in addition to the head gasket to hold cylinder liner in place.

These steel rings are available in three different thicknesses and the correct thiclmess ring must be selected. Part No. x x x (.009" thick), x x x (.015" thick).

Fit new head gasket, steel ring and cylinder head. Push down on cylinder head by hand, and using a feeler strip, determine clearance between head gasket and cylinder head gasket surface. Qearance at this point should be .006" to .008" which represents the amount steel ring will "crush" after head bolts are tightened.

After selecting correct thickness steel ring by trial, use a thin coat of Permatex "Super 300" on each side of head gasket and assemble gasket, ring, and cylinder head. Fit the six flat washers and head nuts. Gradually tighten head nuts to a final setting of 20 lb/ft (two 5/16" nuts) and 25 lb/ft (four 3/8" nuts). Never torque these nuts unless engine is cold! Aluminum casting threads will be damaged!.

Cont'd...

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ASSEMBLING ENGINE

13. PUSH RODS, ROCKER BOX

Fit push rods using a bit of grease to hold them in tappet cups. Note exhaust (inner) push rod is 1/16" shorter than inlet (outer) push rod.

Rotate engine as required to position both push rods "down", and fit rocker box gasket and rocker box assembly. Be certain inner push rod goes to exhaust rocker arm and outer push rod goes to inlet rocker arm, To make this job easier, top end of exhaust push rod is identified by red paint.

Now fit the seven 1/4" I.D. flat washers and nuts and the two 5/16" I.D. flat washers and nuts which retain rocker box, Gradually tighten these nuts to a final setting of 6 lb/ft for the 1/4" nuts and 10 lb/ft for the 5/16" nuts. These nuts should never be tightened unless the engine is cold because of the risk of damage to aluminum casting threads,

14. ADJUSTING VALVE CLEARANCE

Crank the engine through several times and then position the piston at top dead center on the compression stroke (both valves closed). Using a feeler strip, adjust the inlet valve clearance to .008" and the exhaust valve clearance to .010". Adjustment is provided for by an excellent design feature employing eccentric rocker arm spindles. Loosen rocker arm spindle nut on the left side of rocker box and rotate rocker spindle using a large screwdriver to obtain needed clearance. IMPORTANT NOTE--Observe that you can obtain the actual required clearance with the rocker spindle in either Of two positions (180° apart). Only one of these positions is correct, however, and if the rocker spindles are improperly positioned, rapid wear of valve guides can result.

When either valve is exactly 1/2 open, rocker arm end should contact valve tip exactly in the center. In practice we find that the exhaust rocker arm needs to be positioned as far forward as possible, The inlet rocker arm needs to be positioned as far rearward as possible,

Cont'd,...

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14. ADJUSTING VALVE CLEARANCE Cont'd

After the valves are properly adjusted, fit the rocker inspection caps and gaskets. We recommend the use of Permatex Super 300 on rocker cap threads to prevent loosening.

Fit rocker inspection cover on the right side of the rocker box using a new gasket. To prevent oil leakage use 10-32 x 1/2" Allen cap screws to replace the original Phillips screws.

We recommend the use of Champion N-3 spark plugs, Be certain to oil spark plug threads any time a plug is fitted and torque the plug to 25 lb/ft.

15. FITTING AND TUNING ENGINE UNIT

While the engine is on your work bench, it is convenient to fill primary chain case and gearbox. Use 150cc SAE #20 for the primary and 285cc of Hypoy-90 for the gearbox.

Thoroughly clean the motorcycle chassis. Clean and oil the rear chain (or renew it) and make a special point of thoroughly cleaning the oil tank, filter, and lines. We recommend the use of gasoline to thoroughly clean the tank and this operation should, of course, be done outside because of the risk of fire.

Fit the rebuilt engine and referring to engine removal instructions on Page 2, be sure all lines, wires, and connections are correctly made. Be sure to properly tighten all bolts and nuts. Fill oil tank (2 quarts). We recommend SAE #30.

You should disassemble and thoroughly clean the carburetor, Confirm that the specifications are correct by comparing carburetor parts with the listing in the replacement parts manual applicable to this model.,

You should check ignition timing using a strobe light after the engine is running.

Before this rebuild job is released to its owner, you should road test the model for at least ten miles to insure that it runs perfectly and is free from any gasoline leaks or oil leaks.

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xx.% TORQUE CHART

APPLICATION	LB/FT TORQUE
Flywheel Bolts	32
Connecting Rod Nuts	22
High Gear Sprocket Nut	80
Crankcase Bolts	15
Oil Pump Nuts	6
Timing Pinion Nut	50
Kickstarter Ratchet Nut	50
Clutch Hub Nut	60
Alternator Rotor Nut	60
Alternator Stator Nuts	20
C/B Cam Bolt	8
5/16" Cylinder Head Nuts	15
3/8" Cylinder Head Nuts	20
1/4" Rocker Box Nuts	6
5/16" Rocker Box Nuts	10
Spark Plug	25
Carburetor Flange Nuts	10

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