Instructions for Assembly and Disassembly

of the

L-38 CLR OIL TEST ENGINE

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Revised November 1997

The following sheets are to be used as the recommended methods for the assembly and disassembly of your L-38 CLR Oil Test Engines.

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INTRODUCTION

The CLR Engine is a single cylinder balanced high speed four cycle engine designed primarily for oil test and research work. The major dimensions are:

Bore:	3.80 inch.	Stroke:	3.75 inch
Displacement:	42.5 cubic inch	Test Speed:	500 to 4000 rpm
Oil Sump Capacity:	2 pts. min. to 4 pts. max.		

The complete engine consists essentially of two sections, namely the Power Section, 120004-1, and Accessory Section, 120005-1. The power section is the engine proper. The Accessory Section is the mounting base for the Power Section and contains the balancing mechanism, the flywheel and the final drive shaft. Numerous power takeoffs for driving accessories are available on both Power Section and Accessory Section.

The convention in describing the Power Section and Accessory Section followed by the drawing reference number - item number combination. The drawing reference number is the last digit, i.e. Drawing Number 120004 and Part Number 120004-1 have drawing reference number 4. The item number is the ballooned number on the assembly drawing or the item number on the bill of material. Thus the barrel, item 4-18, is item 18 on drawing 120004 and on bill of material 120004-1.

SECTION I

New Engine Break-In

This engine has received a short break-in run at the factory with a full flow oil filter attached. All of the working parts have been inspected and adjusted. The engine is shipped dry. When received and before running under its own power it should be motored slowly 400-600 RPM with a full charge of oil for about 15 minutes. The oil should be completely drained and engine refilled with a new charge of oil before running under its own power.

For maximum engine life a full flow filter should be utilized during all break-in runs and whenever permitted during tests. When a full flow filter or oil heater is to be connected to the engine it is necessary to insert a 1/8 pipe plug, item 4-97, in the main oil passage of the side cover, from the pump to the gallery, in the crankcase cover plate, item 4-13. The location of this plug is shown on LABECO assembly drawing of the Engine, item 4-97, 120004-1, sheet 3 zone E-2.

Prior to utilizing the engine for test purposes, a new engine break-in run should be made after which the engine is disassembled and inspected.

Details of valve adjustment, nut and stud torque's and standard clearances are attached, item 4-116, item 4-87, 120004.1, sheet 1, zone G-5.

SECTION II

Disassembly of Engine - Power Section

The CLR engine has been designed to reduce the number of disassembly operations to a minimum. See LABECO assembly drawing 120004 and bill of material 120004-1 for proper location of the various parts by number.

The following tools are required for disassembly and assembly of the CLR engine:

1. Proto Torque Wrench, P/N 4966, or equivalent
2. Wrenches for Allen head cap screws
3. Lift Yoke Assembly, item P/N 2406
4. Roll over fixture, or equivalent

A. Removal of Power Section from the Accessory Section

Disconnect all ignition wires, instrument connections, water and exhaust connections and remove the carburetor intake manifold and spark plug. Drain the oil.

Push the flywheel support bars and rollers, items 5-21 and 5-22, in until the rollers snugly contact the flywheel rim.

Lock the rollers tightly in place with the .375-16 nuts, item 5-51. It is important that both the support rollers are locked tightly and that both are equally supporting the weight of the flywheel before the Power Section is removed.

Next remove the three (3) .375-24 Klincher lock nuts, item 5-54, that hold the Coupling Disc against the flywheel. Rotate the flywheel to top dead center marking on the rim of the flywheel before removing the Power Section.

Remove the four (4) .500-13 hex socket head shoulder bolts, item 5-81, that hold the Power Section to the Accessory Section. The Power Section is now free and can be removed from the Accessory Section. To do this, slide the Power Section straight forward on the base about .750" or until the coupling disc hub clears the flywheel. Be careful not to bend the coupling disc during these operations when slipping the disc free from the dowels in the flywheel. The Power Section can now be lifted free from the Accessory Section and put on a bench or on a "roll over" fixture.

B. Disassembly of the Power Section

The coupling disc, item 4-8, is detached first from the crankshaft hub by removing the three (3) .375-24 Klincher lock nuts, item 4-84. Be careful not to bend the coupling disc when slipping the disc free from the dowels in the crankshaft.

Remove the cylinder barrel cover plates, item 4-9, and gaskets, item 4-24, by removing the .313-18 x 2.750" long hex head cap screws, item 4-106.

Remove the crank case side cover, item 4-10, and gasket, item 4-25, removing the ten .250-20 x .500 long hex socket head cap screws, item 4-108.

Remove the crank case side cover, gallery plate, item 4-13, and gasket, item 4-26, by removing the eight .250-20 x .750 long hex socket head cap screws, item 4-110. The oil pump, item 4-44, is attached to the cover, gallery plate, item 4-13. To remove the cover, gallery plate, item 4-13, it is necessary to turn the crankshaft to approximately 30 degrees after TDC, so that the oil pump, which is attached to the side cover, gallery plate will clear the crankshaft as the assembly is pulled out.

The four (4) .500-13 Flexloc nuts, item 4-83, which retain the cylinder head can now be reached from either side through the holes uncovered by the cover plates. Before loosening the cylinder head nuts make sure the two .375-16 x .750" long hex head cap screws, item 4-107, which hold the seal ring, item 4-22, are in place and tightened to hold this ring and the cylinder sleeve in place when the cylinder head nuts are removed.

Remove the four (4) cylinder head nuts, item 4-83, and the cylinder head assembly can be lifted free from the Power Section. When the cylinder head assembly is removed the two valve push rods, item 4-52, can be lifted out of the tappets. The cylinder head bolts, item 4-4, may now be removed.

After removal of the cylinder head assembly, note the arrangement of the cylinder head gasket, item 4-28 and five (5) O-rings, items 4-89(2) 4-92 4-93 4-88, in the grooves of the top surface of the cylinder barrel, item 4-18.

Twelve (12) .500-13 Flexloc lock nuts, item 4-83, hold the cylinder barrel to the crankcase. Two (2) .500-13 x 2.00 long socket head set screws, item 4-114, are supplied and tapped holes for them are provided to assist in breaking the seal between the crankcase and cylinder barrel after the locking nuts are removed. The cylinder barrel can then be lifted clear of the crankcase and the piston assembly. Care is necessary to avoid injury of the piston and rings when performing this operation.

If it is preferred, the connecting rod lock nuts, Klincher .375-24 lock nuts, can be removed before the cylinder barrel is lifted and the piston and the rod assembly be

lifted free of the crankcase with the cylinder barrel. Otherwise the piston and rod assembly can be removed from the crankshaft after the cylinder barrel assembly has been removed by removing the .375-24 connecting rod lock nuts. The piston should be on top dead center before either operation is performed.

An alternate method to that described above for disassembling the cylinder head and barrel assemblies from the crankcase consists of first removing the head and barrel assemblies as a unit from the crankcase. The cylinder head assembly is then removed from the barrel assembly on a bench stand.

The timing gear cover, item 4-14, and gasket, item 4-34, should now be removed by removing the ten (10).250-20 x .750 hex socket head cap screws, item 4-110, holding the cover to the crankcase cover mounting plate. Two (2) .250-20 tapped holes are provided for removal of timing gear cover. The two (2) nuts, item 4-41, holding the crankshaft and crankshaft gears to their respective shafts can now be unlocked by flattening down the raised portion of the lock washer, item 4-69, and then removing the nuts. The two (2) gears can then be pulled off the shafts. A puller may be necessary to remove the crankshaft gear. Be careful not to damage the shafts or gears in this operation.

By removing the eight (8) .250-20 x .625 long hex socket head cap screws, item 4-109, the timing gear cover mounting plate, item 4-49, and gasket, item 4-35, may be removed. Note O-ring, item 4-88, in crankcase side of this plate at the oil supply passage should also be removed.

Lifting out the valve tappets permits the removal of the camshaft through the front camshaft bearing. Note the aluminum thrust washer, item 4-70, on the front end of the camshaft. This washer determines the axial running position of the camshaft and affect the end play of the camshaft.

To remove the camshaft rear thrust flange, item 4-64, and gasket, item 4-30, remove the four .250-20 x .500" long hex socket head screws, item 4-108.

Turn the crankcase bottom side up and remove the oil pan, item 4-42, and gasket, item 4-32, by removing the sixteen (16) .250-20 x .750" long hex socket head cap screws, items 4-110. Each main bearing cap is held in the crankcase by two (2) .500-20 Klincher lock nuts and two (2) .375-16 x 2.500" long socket head cap screws. Removing these four (4) lock nuts and four (4) cap screws permits removal of the two

(2) main bearing caps and the lower main bearings. Note: Be careful not to let the main bearings, item 4-3, fall out of the main bearing caps when removing the caps. Removing the four tubular (4) rubber oil seals, item 4-56, between the crankcase and bearing caps with long nose pliers will facilitate removal of the bearing caps.

Carefully lift crankshaft, item 4-15, from crankcase.

Remove the sludge trap, item 4-17, and its O-ring, item 4-87, from the crankshaft. The trap is held in the shaft by a cotter pin, item 4-94

C. Disassembly of the Cylinder Head

Unscrew the two (2) acorn nuts, item 4-82, on the rocker arm cover and remove the cover, item 4-11, and gasket, item 4-33. The studs through the rocker arm cover are sealed by sealing washers, item 4-123.

To remove the exhaust and intake valves the valve rocker arm shaft, item 4-57, and rocker arms, items 4-53 and 4-54, must first be removed. The rocker arm supports, item 4-62, are attached to the cylinder head by two (2) .313-18 x 2.500 hex head cap screws, item 4-105, and two (2) .313-18 nuts, item 4-79, on the studs. Remove these two (2) screws and two(2) nuts and the rocker arm assembly can be lifted from the cylinder head. The rocker arm oil line, item 4-43, and O-ring, item 4-86, at the lower end of the rocker arm oil line will also be removed.

Conventional split valve spring retainer keys are used to lock the valve springs in place. Do not lose the valve stem cap, item 4-72, which fits between the exhaust valve stem and rocker. This is part of the free valve retainer system on the exhaust valve which permits the valve to rotate when the engine is running. This cap and the valve springs retainer sleeve, item 4-102, and lock, item 4-77, are used to retain the exhaust valve. Valve spring retainer sleeve, item 4-101, and key, item 4-75, are used on the intake valve to retain the exhaust valve. Compressing the valve springs releases the valve locks and retainers so the intake valve, item 4-67, and exhaust valve, item 4-66, can be removed from the cylinder head. Remove the valve stem seals, item 4-122, from both valve guides.

D. Disassembly of the Barrel Assembly

The cylinder barrel assembly includes the cylinder barrel, item 4-18, the cylinder sleeve, item 4-58, fret ring, item 4-23, sleeve seal flange, item 4-22, sleeve O-ring, item 4-91 barrel to cylinder head inside O-ring, item 4-92, barrel to cylinder head outside O-ring, item 4-93, push rod O-ring, item 4-89, rocker arm oil O-ring, item 4-88, and the cylinder head gasket, item 4-28, as shown in Bulletin TD-269, attached.

To remove the cylinder sleeve take out two (2) .375-16 x .750 "long cap screws, item 4-107 which were installed previously to temporarily hold the seal flange, item 4-22 , to the cylinder barrel, item 4-18. Remove the seal flange and O-ring, item 4-91. Then the cylinder sleeve can be pushed upward clear of the cylinder barrel bore as shown in Technical Bulletin TD-269.

Removal of the cylinder sleeve exposes the fret ring, item 4-23, seated in the cylinder barrel. This can now be removed from the cylinder barrel bore.

E. Disassembly of the Oil Pump

Take out the four (4) oil pump cover socket head .250-20 x .375 long flat head screws, item 7-10, and the oil pump cover plate, item 7-1, can be removed for inspection of the oil pump gears.

To remove the oil pump, item 4-44, from the crankcase slide cover, gallery plate, item 4-13, knock out the .125 diameter x .750 long roll pin, item 7-8, locking the pump drive gear, item 7-2, to the drive pump shaft, item 7-6. Remove gear, item 7-2, from shaft, item 7-6, and pull the pump drive shaft and pump gear, item 7-3, out through the bottom of the oil pump.

Remove the four .250-20 x .750 long hex socket head cap screws, item 4-110, holding the pump casing, item 7-5, to the cover plate, item 4-13, and detach the casing from the plate. Note the O-ring, item 4-88, surrounding the pump outlet, and the two (2) .250 x .500 long dowels which position the pump on the cover plate.

F. Disassembly of the Oil Pressure Regulator

The pressure regulator assembly includes the housing, item 4-38, the pilot screw, item 4-46; with O-ring, item 4-86; lock nut, item 4-81; the spring, item 4-120; the valve, item 4-68.

Unscrewing the housing, item 4-38, from the side cover gallery plate, item 4-13, permits removal of the pilot screw, item 4-46, and O-ring, item 4-86, from the housing. The pilot screw must be screwed out of the bottom of the housing to expose the O-ring after removing the lock nut, item 4-81. A pair of long nose pliers is required to remove the valve, item 4-68 from the cover, item 4-13.

SECTION III

Assembly of CLR Power Section

A. Crankcase Assembly

Camshaft bearings, item 4-1 (2), are pushed into place in the crankcase, item 4-15, as shown in Bulletin TD-248.

With the crankcase bottom side up, install the upper half of the main bearings, item 4-3, in their proper bores. The bores and the back of the bearings should be completely clean and dry when they are installed. Do not use oil between the bearing and the bore. Make sure that the bearing lock lug is free in the lug groove in the crankcase. Refer to bearing charts to obtain proper bearing clearance.

Install the sludge cup, item 4-17, and its O-ring, item 4-87, in the sludge cup hole in the crankshaft after making sure there is no dirt in the oil passages or sludge cup hole. Lock the sludge cup in place with cotter pin, item 4-94.

Place the two (2) crankshaft thrust washers, item 4-71, in place. Coat the crankshaft seal surface with EF 411 and slip the rear crankshaft oil seal, item 4-117, in place on the crankshaft flange. With a light film of a good grade EF 411 oil on both the crankshaft and bearing surfaces of the upper half of the main bearings and the thrust washers, insert the crankshaft into place in the bearings.

Fit the lower half of the main bearings, item 4-3, into the front and the rear, main bearing caps. Insert the bearing caps into place and tighten up the stud nuts, finger tight. Fit the crankshaft rear oil seal, item 4-117, into the counterbore in the rear bearing cap and crankcase. At each end of the main bearing cap there is a .313 hole reamed for tubular oil seals. It has been found that the rib type tubular seal (#8756) is more easily installed by inserting it in the crankcase (#8003) first. Make sure it is contacting the bottom of the blind hole, then slip the bearing caps (#8012 and #8021) into position, align the cap surface with the crankcase surface, using a straightedge, before tightening the bolts and locknuts. A little oil on the seal ribs makes this installation very easy. The rods should be about four (4) inches long. They should be pushed in to the bottom of the seal holes. The front face of the bearing cap should be flush with the front face of the crankcase to supply a smooth surface for gasket, item 4-35, when the bearing cap locking nuts are finally tightened.

Each bearing cap is held in place with two (2) studs and .500-20 Klincher lock nuts, and with two (2) .375-16 x 2.500" long hex socket head cap screws. The two (2) lock nuts should be torqued to 60 ft. lbs., before tightening the two (2) cap screws to 20 ft. lbs. After the stud nuts and cap screws are in place the crankshaft should turn freely. If it does not, investigate the fit of the bearings in the crankcase and bearing caps to make sure the bearing lock lugs are properly set in their grooves.

After the bearing caps are torqued in place, pull the steel rods out of the seal holes. Take four (4) tubular oil seals, item 4-56, put a thin film of EF 411 oil on them and push them in place, one on each side of each bearing cap. When the tubular seals have been pushed in so they bottom in the holes, they should extend not more than .063" above the surface of the cap. This puts these seals under compression when the oil pan is in place.

The oil pan, item 4-42, and gasket, item 4-32 can be installed either at this time or following the installation of the cylinder barrel. To apply the new gasket to the pan thoroughly clean the surface and use an approved liquid sealer or equivalent to cement the gasket to the pan.

Now turn the crankcase right side up and mount on a "roll over" fixture or equivalent. Be careful not to damage the surface of the four (4) mounting feet and bushings.

Assemble the camshaft, item 4-5, into the crankcase through the front camshaft bearing bore. Have a light film of EF 411 oil on both camshaft journals and lobes on the camshaft bearings when assembling.

Install rear thrust camshaft flange, item 4-64, and gasket, item 4-30, to the crankcase using four (4) .250-20 x .500 long hex socket head cap screws, item 4-108. Use an approved liquid sealer or equivalent on gasket. Lubricate the camshaft thrust washer, item 4-70, before assembly with EF 411 oil. Install the camshaft thrust washer on the front end of the camshaft.

Install O-ring, item 4-88, which surrounds the oil supply passage in the timing gear cover mounting plate, item 4-49. Install timing gear cover mounting plate, item 4-49 and gasket, item 4-35, on the front of the crankcase making sure that all the holes in both gasket and crankcase surface match.

The timing gear cover mounting plate, item 4-49, is held to the crankcase by eight (8) .250-20 x .625 hex socket head cap screws, item 4-109. The camshaft should turn freely and have end play within specification as listed the specification sheet after mounting plate cap screws are torqued to 70 lb. in.

The crankshaft timing gear, item 4-37, and the camshaft timing gear, item 4-36, can now be assembled to their respective shafts. To assemble the camshaft timing gear, item 4-36, to the camshaft gear flange, item 4-21, the "O" stamped on the flange should line up with the "O" on the camshaft gear. To assemble the camshaft timing gear to the camshaft in its proper relation with the crankshaft gear, item 4-37, in the engine, set the crankshaft at top dead center. Then match "O" on the camshaft gear teeth with the "O" on the crankshaft gear. These gears are locked in place on their respective shafts by woodruff keys, item 4-76, and large hex nuts, item 4-41. The hex nuts are locked in place by lock plates, item 4-69.

Cement a new gasket, item 4-34, in place on the timing gear cover and the cover is now ready for assembly to the crankcase. Attach the timing gear cover and gasket to the timing gear cover mounting plate using ten .250-20 x .750 hex socket head cap screws, item 4-110. The shaft extension covers, item 4-12 and O-rings, item 4-90 may now be pushed into place after lubricating the O-rings with EF 411 oil.

The two (2) valve tappets, item 4-63, can now be lubricated with EF 411 oil and placed into their proper holes. Make sure that the rocker arm oil control orifice is in place in the crankcase and is unobstructed. Also the oil grooves in the crankcase upper surface must be clear.

The crankcase is now ready for the cylinder barrel, cylinder head, and piston assemblies.

B. The Cylinder Barrel Assembly

The cylinder barrel assembly includes the cylinder barrel, item 4-18; the fret ring, item 4-23; the cylinder sleeve, item 4-58; the cylinder sleeve seal flange, item 4-22; and O-rings, item 4-92, 4-93, 4-89, 4-88. Bulletin TD-269 shows the assembly of the cylinder sleeve, item 4-58, in the cylinder barrel. The fret ring, item 4-23, is first dropped in place. Make sure the fret ring and supporting shoulder in the cylinder barrel are perfectly clean. The cylinder sleeve is then pushed into place, the top flange of the cylinder sleeve resting on the fret ring.

The cylinder barrel is then turned upside down and the O-ring, item 4-91, is fitted on the lower end of the cylinder sleeve and pushed up into place. The cylinder sleeve seal flange, item 4-22, is then fitted over the lower end of the sleeve and pushed up into place against O-ring, item 4-91, where it is held temporarily by two (2) .375-16 x .750 long hex heads cap screws, item 4-107, until the barrel is assembled to the cylinder head.

Cement the crankcase to barrel gasket, item 4-27, in place on the flange of the cylinder barrel making sure that all holes in both gasket and barrel flange match. The barrel assembly is now ready to receive the piston and connecting rod assembly and the cylinder head assembly.

C. Assembling the Piston and Connecting Rod

After assembly of the piston to the connecting rod make sure that the two (2) retainer rings are in place in their respective grooves in the piston.

The piston ring set, item 4-48, contains three (3) piston rings to be installed on the piston. These rings are: The top ring, a chrome faced compression ring; the second

ring, a conventional compression ring; the third ring, an oil control ring, backed by a spring in the bottom of the groove. Instructions for installation accompany the rings.

Connecting rod bearing, P/N 100034-1 are carefully fitted in the big end of the connecting rod. Note that as received the connecting rod bearing cap is bolted to the connecting rod. Also that there are dimples on the same side of both cap and rod. These dimples must match whenever the rod is assembled. A thin film of EF 411 oil should be spread on both bearing and crank pin before assembly. See appendix A for properly fitting the connecting rod bearings.

Take the bearing cap off the connecting rod and carefully wipe out the bore. Also carefully wipe off the backs of the connecting rod bearing. When fitting the bearing into the rod and cap bore make sure that there is no back interference between the locking lug on the bearing and the locking grooves in the connecting rod cap. It is well to assemble the connecting rod with bearing and cap together before final assembly to the crankshaft and carefully check the alignment of the two halves in relation to each other. If the connecting rod bolts are torqued to 45 ft. lbs. it will be possible to obtain a quite accurate measurement of the I.D. of the assembled bearing for clearance information.

After checking the connecting rod bearing, disassemble the cap and install the piston and rod assembly as described in the following paragraph.

Upon installation the connecting rod lock nuts are to be torqued to 45 ft. lbs. Remember the center line of the piston pin bore is .063" off center with the center line of the piston. When properly assembled the "F" mark on the piston should be toward the front of the engine. That is, the piston pin is offset in the piston away from the camshaft side of the engine.

Two (2) optional procedures are presented for installing the piston and connecting rod assembly. (1) The recommended procedure is to insert the piston and connecting rod assembly into the barrel assembly, install the cylinder head and then drop the combined assembly into place, or (2) the alternate procedure of attaching the connecting rod and piston assembly to the crank pin, then compressing the piston rings with a ring tool and slipping the combined barrel and head assembly down over the piston into place on the crankcase. The piston should be on top dead center when the barrel and head assembly is lowered into place.

Prior to installing the piston in the barrel assembly, a light film of EF 411 oil should be spread on the cylinder sleeve and piston.

If the oil pan is installed at this time, make sure that the tubular seals, item 4-56, are in place.

D. Cylinder Head Assembly

The intake and exhaust valves and springs are assembled to the cylinder head in a more or less conventional manner although there are two (2) types of valve spring retainers used. Valve stem oil seal, item 4-122, must be installed on the valve stem guides before the springs and retainer. The valve springs, item 4-59, are to be assembled with the closest wound coils at stationary end of spring.

The exhaust valve, item 4-66, has a free routing retainer assembly made up of valve spring lock, item 4-77, valve stem cap, item 4-72, and exhaust valve spring retainer, item 4-102.

The intake valve, item 4-67, is held in place by intake valve spring retainer, item 4-101; valve retainer sleeve, item 4-118, and intake valve spring locks, item 4-75.

Install the four (4) cylinder head to barrel bolts, item 4-4, in the cylinder head and screw into the head until they bottom. The bolts should be screwed in by hand or just light wrench tight to prevent cylinder head cracking. The cylinder head is now ready for assembly to the cylinder barrel.

Carefully place cylinder head gasket, item 4-28, on top of the cylinder sleeve as shown in Bulletin TD-269. Make sure it is exactly centered on the top of the sleeve. Make sure all O-rings are in place on top of the cylinder barrel before putting the cylinder head in place.

The cylinder head, item 4-19, with its assembled parts can now be placed on the cylinder barrel and the cylinder head bolt lock nuts, item 4-83, screwed up and tightened. These nuts should be torqued to 70 ft. lbs.

The two (2) .375-16 x .750 long hex head cap screws, item 4-107, temporarily holding the cylinder sleeve seal flange to the under side of the cylinder barrel should now be removed.

The combined cylinder and barrel assembly can now be lowered onto the crankcase and tightened down with the twelve lock nuts, item 4-83. Torque these nuts to 50 lb.-ft.. Install valve push rods, item 4-52, in place.

The valve rocker arm assembly is mounted on the cylinder head and held in place with two (2) studs and two (2) .313-18 x 2.500 long hex head cap screws, item 4-62; the rocker arm shaft, item 4-57; intake rocker arm, item 4-54; exhaust rocker arm, item 4-53; with valve adjusting screws, item 4-116; and lock nuts, item 4-85; locking spring, item 4-121; rocker arm oil line assembly, item 4-43; and O-ring, item 4-86.

The rocker arms assembly is installed on the cylinder head as shown in Bulletin TD-289 attached. The end of the oil tube acts as a pilot to hold the rocker arm shaft, item 4-57, in position. The rocker arm shaft should be in position as shown and the oil line

in place before the stud nuts and cap screws are tightened down. Make sure that the O-ring, item 4-86, is in place on the lower end of the oil line before it is pushed in place. Also make sure that the .250 pipe plugs, item 4-98, are in place in both ends of the rocker shaft.

It is well to have all parts of this assembly well lubricated with EF 411 oil before assembly to the cylinder head.

E. Assembly and Installation of the Oil Pump

The driver gear, item 7-3, in the pump is keyed to the oil pump drive shaft, item 7-6, which is driven by the camshaft through driver gear, item 7-2, pinned to the other end of the shaft, after assembly of the pump to the side cover gallery plate, item 4-13. Driven gear, item 7-4, meshes with the driver gear, item 7-3, when assembled in the pump body, item 7-5. The driven gear, item 7-4, is mounted on a hardened shaft which is a pressed into the pump body.

The gears are held in place and vertical clearances maintained by cover plate, item 7-1, which is attached using four .250-20 x .375 long hex socket flat head cap screws, item 7-10.

To assemble the oil pump to the crankcase cover side gallery plate, item 4-13, the oil pump body, item 7-5, is attached to the cover with four (4) .250-20 x .750 long hex socket head cap screws, item 4-110, and positioned by two (2) .250 x .500 dowels which are a part of the cover. Make sure that O-ring, item 4-88, is in position surrounding the oil passage from pump to gallery plate. The driver gear and shaft are then pushed up from the bottom of the housing and gear, item 7-2, is then slipped into place on the upper end of the shaft and locked into place with drive lock pin, item 7-4. The oil pump screen, item 4-55, is then slipped on the lower end of the pump and clamped into place using hose clamp, item 4-73.

The pressure regulator is assembled onto the oil gallery plate.

Gasket, item 4-26, is centered on surface of cover, item 4-13, and the cover and oil pump are ready for assembly to the power section.

Set crankshaft at 30 degrees past TDC before the oil pump and cover can be installed on the side of the crankcase. Position oil pump and cover assembly on side of crankcase with two (2) bottom cap screws in place, but loose. This allows the top of the cover to be held away from the case so that the pump and camshaft gears are not in mesh. Insert distributor and turn distributor shaft until the tang drops into oil pump shaft slot. With the engine on TDC of the ignition stroke and the distributor points open, move the cover into place and mesh the gears. The cover is located and held to the crankcase by two (2) dowels, which are part of the crankcase, and six (6) .250-20 x .750" long hex socket head cap screws, item 4-110.

Crankcase cover gasket, item 4-25, is cemented in place on crankcase cover plate, item 4-10, and this plate is put into place on the left side of the crankcase with ten .250-20 x .500" long socket head cap screws, item 4-108. Torque screws to 70 lb in.

Barrel cover gaskets, item 4-24, are cemented in place on the two (2) barrel cover plates, item 4-9, and they are fastened in place with two .313-18 x 2.750" long hex head cap screws, item 4-106. One (1) sealing washer, item 4-123, is fitted under the head of each of these cap screws. Torque the screws to 20 lb. in.

Rocker arm cover gasket, item 4-33, is cemented into the groove in rocker arm cover, item 4-11.

The valve lash is adjusted in accord with the recommended clearances, see specification sheet. The rocker arm cover is fitted in place and held down by two (2) acorn nuts, item 4-82, and two (2) sealing washers, item 4-123.

The coupling disc, item 4-8, is attached to the crankshaft flange studs with three (3) .375-24 Klincher lock nuts, item 4-84, and positioned by the three (3) .375 crankshaft flange dowels. The disc can go on only one way because of non-symmetrical hole drilling. Do not try to force the disc on. Torque the nuts to 40 lb ft.

The Power Section is now ready for installation on the Accessory Section, reference drawing 120003. First set the crankshaft at top dead center. Then set the flywheel with the top dead center mark up. Let the Power Section down so it rests lightly on the four (4) mounting bosses. Line up the dowel and stud holes in the coupling disc with studs and dowels in the flywheel. Push the Power Section back until the studs and the dowels engage their respective holes in the coupling plate. Set the flywheel stud Klincher lock nuts, item 5-54, finger tight.

The four (4) shoulder bolt holes in the engine feet can now be lined up and the shoulder bolts, item 5-81, started. Make sure that the Power Section fits freely in place. Torque the shoulder bolts, item 5-81, to 51 to 60 lb in. The three (3) Klincher lock nuts, item 5-54 holding the coupling disc to the flywheel can now be torqued to 40 lb ft. Loosen the nuts holding the flywheel supports, move the flywheel supports to their fully clear position and retighten the nuts. The engine is now ready for its accessories, the carburetor, distributor, etc. Reference drawings 120002.

Make sure that the crankshaft is free to move back and forth in the bearings and does not bear heavily against either crankshaft thrust bearing.

SECTION IV

Disassembly of the Accessory Section

The power Section must be removed from the Accessory Section before disassembling the latter. Follow instruction given in Section II-A for this operation.

A. Removal of Coupling, Drive Shaft and Flywheel

To remove the sheave or coupling, first flatten out the nut lock washer, item 5-36, and unscrew lock nut, item 5-37. The coupling should be removed with a puller. Driving off the coupling may injure the self-aligning bearing, item 5-40.

Slack off the counterbalance timing chain by loosening the hex jam nut, item 5-53, and turning out the chain adjusting screw, item 5-23, until it stops.

Take out the four (4) .375-16 x .875 long hex head cap screws, item 5-74, that hold the auxiliary cover, item 5-9, to the accessory case cover. The auxiliary cover, item 9, can be removed. Be careful not to damage the oil seal, item 5-82, or seal surface on the drive shaft, item 5-3, in this position.

Bend the locking tab outward on the lock washer to unlock the tapered sleeve lock nut. Back the lock nut off and remove the lock washer. Next remove the six (6) .375-16 x .875" long hex head cap screws, item 5-74, holding the accessory case cover to the accessory case. There are three (3) equally spaced tapped holes in the accessory case cover to be used for jacking screws. Screw three (3) of the .375-16 x .875 long hex head cap screws into these holes and use these to jack the accessory case cover free from the accessory case. A light tap with a plastic hammer on drive shaft, item 5-3, will release the split tapered sleeve in the self aligning bearing, item 5-40. Tap lightly, the ends of the idler shafts, item 5-7 and counter balance shafts, item 5-4 and 5-5, as the cover is being jacked to push them out of the cover. All five (5) shafts, drive, two (2) idlers and two (2) counter balance shafts, should remain in the accessory case., Be careful not to damage oil seals or oil seal surfaces on the shafts.

When the accessory case cover is removed, the timing chain, item 5-44, can be removed from the sprockets. The idler sprocket shafts, item 5-7, with their assembled sprockets, item 5-19, woodruff keys, item 5-48, and bearing, item 5-41, can be removed from the accessory case.

A special puller is required to remove the drive shaft sprocket, item 5-16, from the drive shaft, item 5-3. This sprocket must be removed before the drive shaft, item 5-3, can be removed from the accessory case.

After the drive shaft sprocket, item 5-15, is removed from the drive shaft, take out the six (6) .500-20x 1.500 long hex head cap screws, item 5-77, holding the flange end of the drive shaft, item 5-3, to the flywheel, item 5-2. The drive shaft can be driven forward out of the flywheel by light tapping on the end of the drive shaft with a plastic hammer. Care must be taken to avoid injury of either the front oil seal, item 5-83, or the seal surfaces on the drive shaft.

Now remove the counter balance shaft cover plate, item 5-27 and its gasket, item 5-28, from the accessory case removing eight .250-20 x .375 long hex socket flat head cap screws, item 5-72. This exposes the left hand and right hand counter balance shafts, items 5-4 and 5-5. Remove the trim counter balance weights, item 5-6 by removing the four (4) .375-24 x 1.000" long hex socket head cap screws, item 5-78.

We are now ready to remove the two (2) counter balance shafts, items 5-4 and 5-5. Remove the bearings, item 5-41, from each counter balance shaft. Remove the sleeve, item 5-14, and slinger, item 5-20 from the left hand counter balance shaft. Remove the sleeve, item 5-13, from the right hand counter balance shaft. Pull the right hand counter balance shaft sprocket, item 5-16 from the counter balance shaft. Pull the left hand counter balance shaft sprocket, item 5-17, from the counter balance shaft. Remove the woodruff keys, items 5-48 and 5-49 from the counter balance shafts. Remove the two (2) counter balance front bearing retainers, item 5-10, from the accessory case housing by removing eight (8) .375-16 x .875 long hex head cap screws, item 5-75. Be careful not to damage the oil seals, item 5-84, or the seal surfaces on the shafts during this operation. Push the counter balance shafts forward about .125 inch. Then with a Truarc lock ring tool, compress the lock ring, item 5-70, out of its groove and push it forward against the bearing. The counter balance shafts, item 5-4 and item 5-5, can now be pushed forward out of the case. The retaining rings, item 5-70, must be pushed through at the same time.

Note: For engines not using the standard water pump there are two (2) counter balance shaft front bearing retainers, item 5-10, and gasket, item 5-29.

Push the self-aligning bearing housing, item 5-8, out of the accessory case cover taking care not to lose the dowel, item 5-57. The self-aligning bearing, item 5-40 can then be removed from the housing after removing the retaining ring, item 5-71, from the housing, item 5-8.

Bearing, item 5-41 are pressed on to the front end of the idler shaft, item 5-7, and should be removed the same way.

Bearings, item 5-41 are pressed on to the counter balance shafts, item 5-4 and item 5-5 at the rear of the counter balance shafts and should be removed the same way. Sprockets, item 5-19 are pressed on the idler shafts, item 5-7, and should be removed the same way.

When pressing in or driving out oil seals, use a driver that fits the bore into which the seal is pressed. This will keep the seal from cocking and injuring the bore. When removing woodruff keys make sure that the key slot and shaft are adjacent so the key slot is not damaged.

SECTION V

Assembling the Accessory Case Unit

Make sure the accessory case housing and all component parts are clean before assembly operation begins.

Assembly is started with the counter balance shafts, items 5-4 and 5-5. These shafts are not interchangeable but are marked on the ends "R" and "L" for right and left. Right and left is based on looking forward from the chain case, the view on sheet 4 of drawing 120005.

The center support bearing, item 5-42 is pressed on each shaft back of the balance weights. The bearings should be snug against the weights. A thin film of anti-seize compound on the shaft will facilitate this operation.

The two (2) chain sprockets, item 5-17, and item 5-16, also are not interchangeable. Sprocket, item 5-17, fits the left hand shaft and sprocket, item 5-16, the right hand shaft. Sprocket, item 5-17, can be identified by the large key slot and the slot for the tongue in the oil slinger, item 5-20.

After pressing on the center bearings, insert the sprocket woodruff keys 5-49, and 5-48, on the rear end of each shaft. The 8- 5/32 x 3/4 woodruff key, item 5-49, in the left hand shaft and the 7-1/8 x 3/4 woodruff key, item 5-49, in the right hand shaft. Now press chain sprocket, item 5-17, with the 5/32" key slot on the left hand shaft and item, 5-16, on the right hand shaft. These sprockets should be pressed snug against the shaft shoulder. A thin film of castor or equivalent will ease this operation.

Make sure the counter balance shaft center bearing bores in the accessory case are clean and free from burs and nicks. Spread a thin film of anti-seize compound in the bores and push each shaft into its respective bore. Next insert bearing retainer ring, item 5-70, into its groove in the front bearing bores making sure the ring lock holes are on top and the bevel surface faces to the front.

The front counter balance shaft bearings, item 5-42, can now be pushed into place snug against the retainer ring, item 5-70.

Press the oil seals, item 5-84 into place in the front counter balance shaft bearing retainer, item 5-10, and the bearing retainer for mounting the water pump, item 5-11, with lip facing to the rear, plate side out. The bearing retainer and bearing retainer for mounting the water pump are not symmetrical and are assembled to the accessory case housing with the narrow edges together. The bearing retainer, item 5-10 is sealed with a gasket, item 5-29. The bearing retainer, item 5-11 is sealed with an O-ring, item 5-55. The O-ring and cover should have a light coat of oil to ease assembly.

With the gasket and O-ring in place, assemble the bearing retainers to the case with eight (8) .375-16 x .875 long hex head cap screws, item 5-74. Torque the screws to 21 to 24 lb. ft.

Note: For engines not using the standard water pump, two (2) bearing retainers, item 5-10 and two (2) gaskets, item 5-29 are used. The same seal is used in both the water pump adapter and bearing retainer.

Through the inspection hole in the top of the accessory case, assemble the two counter weights, item 5-6, bevel side down to the counter balance shafts, item 5-4 and 5-5, with two each .375-24 x 1.000" long hex socket head cap screws, item 5-78. Torque the screws to 44 to 52 lb. ft. Then install cover plate gasket, item 5-28, and cover plate, item 5-27, in place on the inspection hole with eight (8) .250-20 x .375" hex socket flat head cap screws, item 5-72. Torque screws to 65 to 76 in. lb.

Now to the rear of the accessory case. Assemble the oil slinger, item 5-20, and short spacer, item 5-14, on the rear end of the left hand counter balance shaft, item 5-4, making sure the driver on the slinger slips into the keyway on the sprocket. Next, push the bearing, item 5-41, on the shaft and lock in place with retainer ring, item 5-68.

Install the long spacer, item 5-13 and bearing, item 5-41 retainer ring, item 5-68, on the right hand counter balance shaft, item 5-5.

Press the accessory drive shaft front seal, item 5-83, into position in the accessory case housing.

The two (2) idler accessory drive shafts, item 5-7 and their assemblies are identical. Insert a .125 x .750 woodruff key, item 5-48, in the key slot in the idler shafts, item 5-7. Press the idler sprockets, item 5-19 on shafts, item 5-7 fitting snug against the shoulder. A thin film of castor oil on the shafts will facilitate this operation. Slip long spacer, item 5-13, on the shafts and press bearings, item 5-41, on the front and rear end of the shafts, thus completing the idler sprocket assembly.

The chain tension adjusting assembly is comprised of the yoke, item 5-24, the adjusting screw, item 5-23, the adjusting screw nut, item 5-53, the retaining ring, item 5-67, the idler sprocket, item 5-18, the thrust washers, item 5-26, the idler sprocket spindle, item 5-25 and two (2) retaining rings, item 5-66.

The idler sprocket adjusting screw, item 5-23 is fastened in the idler sprocket yoke, item 5-24, with the retaining ring, item 5-67. The idler sprocket, item 5-18, is assembled into the yoke between thrust washers, item 5-26. The idler spindle, item 5-25, is then pushed through the yoke, thrust washers and idler sprocket and then locked on each end with retaining rings, item 5-66. The components of this assembly should have a film of oil on mating surfaces at assembly.

The adjusting screw assembly is then installed into the accessory case from the inside. The screw should be turned out as far as possible and lightly locked in place with idler screw lock nut, item 5-53.

Assemble the flywheel support bars, item 5-21, to the base shown on sheet 1 of assembly drawing 120005 section CC. First, set the .375-16 x 2.500" long studs, item 5-88 into the accessory case housing with 2.688" +/- .060 extending above the case. Install the flywheel support assembly so that the end opposite the roller extends 2.125" beyond the stud. This will position the flywheel center line almost in line with the crankshaft and accessory drive shaft center lines.

Now lift the flywheel, item 5-2, into position and rest it on the flywheel support rollers. The degree numbered edge should be facing forward. Drive three (3) .375 x 1.000 long dowels, item 5-59, into flywheel center flange leaving .375" extending from flywheel.

Insert a .188 x .750 woodruff key, item 5-50, into the key slot in the accessory drive shaft, item 5-3, taking care not to damage the shaft. From the front, push the drive shaft through the flywheel hub and accessory case until the flange on the drive shaft is engaged with the flywheel hub and properly located on the dowel in the flywheel. During this operation care is necessary not to damage the drive shaft seal in the accessory case. Coat pilot diameter dowel, item 5-61.

Using six (6) .500-20 x 1.500" long drilled hex head cap screws, item 5-77, pull the accessory drive shaft, item 5-3, into proper location on the web of the flywheel. Torque the cap screws to 60 lb. ft. Safety wire the cap screws, item 5-77, using lockwire, item 5-91, 188 x .750 woodruff key, item 5-50, never seize.

Press on accessory drive shaft sprocket, item 5-15, onto the accessory drive shaft. The sprocket should fit tight against the shoulder on the drive shaft. Slide the accessory drive shaft spacer, item 5-12 onto the accessory drive shaft.

Note: The flywheel must be at the top dead center (TDC), position and the counter balance shafts must have flat sides of the weight portion of the shafts horizontal and up before and after the counter balance chain is installed.

Drape the drive chain, item 5-44, over the drive shaft sprocket, item 5-15, under the right hand counter balance sprocket, item 5-16, and over the left hand counter balance sprocket, item 5-17. Install one (1) idler assembly on the right hand side with the front bearing in recess in the accessory case housing with the chain on the left hand side of the sprocket. Install the other left hand idler assembly on the left hand side of the accessory case housing in a similar manner with the chain on the left hand of the sprocket. The chain tensioner must be tightened sufficiently to prevent the chain from

slipping and changing the timing of the counter balance shafts but not so tight as to pull on the accessory drive shaft end.

It is now necessary to install the Power Section in place to line up the drive shaft and flywheel with the crankshaft. Follow instructions for installation of the Power Section in Section III of these instructions. Attach drive disc, item 4-8, to the flywheel. It may be necessary to readjust the flywheel supports during this operation so the flywheel center matches the crankshaft center. This should be done very carefully in order not to spring the driving disc.

Four (4) oil seals, item 5-84, are now pressed into the idler shaft and counter balance shaft holes in the accessory case cover. The seals should be installed plate side out. Thread the large O-ring, item 5-56, into the O-ring groove around the accessory case cover. A few drops of oil in the groove and on the O-ring will facilitate in this operation.

Set the flywheel and crank at the top dead center. Turn both counter balance shafts so that the small keyways are vertical. In this position the flat surfaces of the counter weights are up and in line. With flywheel and counter weights in this position, thread the drive chain, item 5-44 on the sprocket in the following sequence.

1. Chain over the drive shaft sprocket
2. In mesh with left side of the right hand sprocket.
3. Pull chain taut between drive shaft and right hand counter balance shaft sprocket and thread chain to the right around and under this sprocket, making sure the small keyway in the shaft is vertical.
4. Pull chain taut between the right and left hand counter balance shaft sprocket threading the chain over the top of the left hand sprocket making sure that both small keyways in the counter balance shaft are vertical.
5. Draw the chain taut over the left hand side of the left hand idler and screw in the idler adjusting screw until it contacts the chain. Do not tighten chain at this stage of the operation.

Now fit the accessory case cover to the accessory case. A few drops of oil on the drive shaft, the two (2) idler shafts and the two (2) counter balance shafts will help slide them through the oil seals. Be careful not to damage the seals. The accessory case cover cannot be pushed into its seat because of the O-ring, item 5-56. The O-ring should be coated with oil before installing on the accessory case cover. Push the cover in as far as it will go and then pull it down into place with the six (6) .375-16 x .875 " long hex head cap screws, item 5-74. Torque the screws to 21-24 ft. lb.

The self aligning bearing and adapter kit, item 5-40, is an assembly comprised of a bearing, a split taper adapter fitted in the tapered inner raceway of the bearing and a lock nut and lock washer to pull the taper ring into the tapered raceway. The object of this construction is to permit locking the bearing to the drive shaft in the required position.

The self-aligning bearing and adapter kit is fitted into the self-aligning bearing housing, item 5-8, with the small end of the inner raceway toward the retainer ring groove in the housing. The bearing should be pushed snug against the shoulder in the housing and locked into place with the retaining ring, item 4-71.

Slip the taper adapter into its place in the inner raceway of the self-aligning bearing. Install the lock washer on the threaded end of the taper adapter with the tongue of the washer in the taper adapter groove and the outer fingers facing away from the bearing. Screw the adapter lock nut on the threaded portion of the adapter with the bevel surface of the nut in contact with the lock ring fingers. Turn up the nut only finger tight.

Install the self-aligning bearing housing, item 5-8, into the large bore in the accessory case cover, lining up the half hole for the .250 x .750 long dowel, item 5-57, with the half hole in the accessory case. Push the self-aligning bearing housing, item 5-8, in until the outer edge is flush with finished surface of the accessory case. Then insert the .250 x .750 long dowel, item 5-57 into its proper place.

Press oil seal, item 5-82, in place in auxiliary cover, item 5-9. Then without the auxiliary cover gasket, item 5-30, assemble the auxiliary cover, item 5-9, to the accessory case cover with four .375-16 x .875 long hex head cap screws, item 5-75. Pull screws down tight. This positions the bearing housing in relation to the drive shaft and flywheel assembly.

Remove the cover plate, item 4-10, from the right hand side of the Power Section with feeler gauges between both crankshaft cheeks and thrust washers, item 4-17, locate the crankshaft equal distant between the washers. This locks the crankshaft in proper position for final adjustment of the self-aligning bearing.

Next remove the auxiliary cover, item 5-9. With a light brass rod give the inner raceway of the bearing a sharp tap to push the adapter of the self-aligning bearing, item 5-40, against the drive shaft spacer, item 5-12, and lock the adapter to the shaft. Hand tighten the nut for the tapered adapter and then advance the nut one quarter turn tighter. Lock the nut by bending a finger on the lock washer into a notch in the lock nut. Caution, insufficient tightening of the nut will result in the bearing slipping on the shaft and likely causing damage to the bearing adapter, shaft and or the engine. Excessive tightening of the nut will result in insufficient internal bearing clearances which will result in excessive heat, high bearing loads and reduced bearing life. The gasket, item 5-30, can now be applied to auxiliary cover, item 5-9, and the cover installed in place on the accessory case cover. Torque the cover screws, item 5-74, to 21 to 24 ft. lb.

Note: For proper alignment the drive shaft with the crankshaft and power section without stressing the driving disc during assembly, it is necessary that the flywheel supports be adjusted to hold the flywheel center in perfect alignment with the driving disc center during operation.

The counter balance drive chain tension must now be adjusted. About one (1) inch below the auxiliary cover just to the right of center is a 1/4" pipe plug opening. The center line of this hole is along the center line of the chain. When properly adjusted it should be possible to move the chain sideways .125" each side of center. Screwing the idler sprocket adjusting screw in reduces the chain slack and backing the screw out increases the slack. It is important that the total slack should not exceed 1/4". The pipe plug hole is 7/16" in diameter.

Insert the sight oil gauge, item 5-85, on the left hand side of the accessory case. Straight plug, item 5-65 and gasket, item 5-46, close the oil hole on the top of the accessory case opposite the idler sprocket adjusting screw.

Charge the accessory case to the center of the sight gauge with an SAE 30 weight MS motor oil through the opening for plug, item 5-65.

SECTION VI

Directions for Mounting the CLR Engine on Dynamometer Stand

A single cylinder engine must be mounted on a dynamometer stand with greater care than is required for mounting a multi-cylinder engine because of the large amplitude torque variation inherent in this type of engine.

This is especially true when the CLR engine is connected to a large dynamometer such as has been used for mounting the L-4 Chevrolet engine.

1. First, check the driving disc, item 4-8, for flatness, concentricity of the dowel holes and trueness when mounted on the crankshaft.

2. Make sure that the self-aligning bearing is adjusted as per print TD-249 of the modifications. But follow this procedure- With the Power Section mounted on the Accessory Section and before the three (3) disc lock nuts, item 5-54, are tightened, take off the right hand cover plate, item 4-10, to gain access to the crankshaft. With feeler gauges space the crankshaft cheeks equal distant between the two thrust washers, item 4-71. With flywheel dowels, item 5-54, lined up with the dowel holes in the driving disc, item 4-8, tighten up the disc lock nuts, item 5-54. The flywheel can be lined up by adjusting the flywheel supports. Now follow the procedure on print TD-249 for adjusting the self-aligning bearing.

3. The flexible couplings and connecting shaft between the dynamometer shaft and engine drive should be in good static and dynamic balance. At relatively high speeds very slight unbalance especially in the front coupling (if two (2) spaced couplings are used) will tend to impress high loads on the rear main bearing of the engine as the self-aligning bearing will not resist this type of loading. Also make sure that the flexible couplings do not wobble as this may impart a longitudinal movement of the shaft and excessively load the crankshaft thrust bearings. Do not use large heavy flexible couplings. Keep the mass of the connecting assembly as light as possible.

The Morflex coupling 702-CC as shown in our bulletin print TD-268 has given excellent results. With this coupling, care should be taken to ensure as perfect alignment as possible between engine shaft and dynamometer shaft. If a drive shaft is required with this coupling, it is preferable to use the Drive Shaft Series "T" rather than the "S" or "ST" series that has a splined shaft.

The couplings on a single cylinder four cycle engine receive very rugged service. The torque in this engine varies widely during the cycle and may reverse in sign as many as eight (8) times per cycle depending on the engine speed. The torsion acceleration during these reversals sets up disturbing forces of varying frequencies.

Resonance in the drive line with any of these disturbing frequencies may set up forces of considerable magnitude in the main bearing and the crankshaft thrust bearings with destructive consequences.

SPECIFICATION SHEETS

TECHNICAL BULLETINS

LABECO Bulletin Status	Document
LABECO Bulletin No. 13	Mark II Oil Heater
LABECO Bulletin No. 20	Shaft Extension Cover
LABECO Bulletin No. 22	Dip Stick Thermocouple Seal
LABECO Bulletin No. 24	Main Bearing Cap Tubular Seals and Main Bearing Oil Seal
LABECO Manufacturing Bulletin Status	Document
LABECO Manufacturing Bulletin No. 5	Rear Crankshaft Seal
LABECO Manufacturing Bulletin No. 8	Clearance Tolerance of Piston Skirt
LABECO Manufacturing Bulletin No. 9	Procedure for Timing CLR Engine
LABECO Product Information Letter Status	

LABECO BULLETIN STATUS

Bulletin	Dated	Subject	Ref. Note
1	03-28-57	Revised Orifice	A
2	03-28-57	Improved Oil Pump	A
3	03-28-57	Front Main Brg. Cap Rework	A
4	03-28-57	Timing Gear Cover Mnt. Plate Rework	A
5	03-28-57	Improved Oil Spray Nozzle	A
6	03-28-57	Improved Camshaft Thrust Flange	A
7	03-28-57	Revised Timing Gears	A
8	11-06-58	Crankcase & Side Cover Plate Rework	A
9	11-06-58	Crankcase & Timing Gear Cover Mnt. Rework	A
10	11-06-58	Camshaft Revision	A
11	11-06-58	Rework for Valve Seat Inserts	A
12	11-06-58	Aluminum Camshaft Thrust Washer	A
13	11-06-58	Mark II Oil Heater	B
14	01-30-59	Timing Information	C
15	10-27-59	Oil Pan Modification	A
16	10-27-59	Rework for Valve Stem Seals	A
17	03-15-60	Main Brg. Cap Tubular Seals	A
18	03-15-60	Cone Shape Oil Regulator	A
19	03-15-60	Add Distributor O-ring	A
20	06-09-60	Shaft Extension Cover Assy.	B
21	12-12-60	Sintered Conn. Rod Brgs.	A
22	12-12-60	Dip Stick Thermocouple Seal	B
23	04-24-62	Add Distributor Shaft Seal	A
24	01-08-62	Main Brg. Oil Seals	B

Notes: A - Have been incorporated in all known engines and is no longer applicable.

B - Furnished for information purposes.

C - Obsolete - Superseded by Manufacturing Bulletin #9 dated 3-21-62.

LABECO BULLETIN NO. 13

For Additional Reference See Drawings
No. 2430-A and TD-358

Date Approved

Nov. 6, 1958

Service Bulletin for
CLR Oil Test Engine
Laboratory Equipment Corp.

MARK II OIL HEATER

Purpose:

This newly designed oil heater is to provide relatively low, uniform surface temperatures in contrast to the high surface temperatures experienced with the former heater.

General Description:

The Mark II Oil Heater consists of a hollow inner steel core, containing the standard Chromalox heating element and the hollow core filled with a low melting lead-bismuth alloy. The outside surface of this core has a coarse thread machined on it to direct the oil flow. A thermocouple is inserted into the melted alloy to measure the heater temperature. This inner core fits into the outer steel casing, forming a helical oil passage around the heater.

Ordering Instructions:

To order a complete heater assembly, specify Mark II Oil Heater No. 2430-A. If you elect to use the heating element from your old heater and make up your own thermocouple, specify Mark II Oil Heater Sub-Assembly No. 2431.

Installation Instructions:

Follow outline as indicated on TD-358.

Remarks:

The use of this heater is mandatory for L-38 technique operation and is available as an accessory item.

CLR OIL TEST ENGINE
L-38 Test Procedure

TECHNICAL BULLETIN No. 20

Date Approved June 9, 1960

Subject: Part No. 2463, Shaft Extension Cover Assembly.

Purpose: To prevent air from being drawn into crankcase around the camshaft extension and front crankshaft extension. Supersedes Oil Seal, Part No. 4911, at above points.

General Description:

Shaft Extension Cover Assembly (Part No. 2463) includes aluminum cup shaped Cover (Part No. 9891) and synthetic O-ring (Part No. 3329).

Ordering Instructions:

The covers may be ordered as an assembly or by individual parts, as desired.

Installation Instructions:

For detailed installation instructions see TD-423, dated 6-23-60, attached.

Remarks: The use of these covers was recommended by C.R.C. - Motor Oil Oxidation Test Group at their June 9, 1960 meeting.

Use of these covers on camshaft and crankshaft extensions is now mandatory on L-38 tests.

May be used as an oil and dust seal on all shaft extensions of accessory case, in place of expendable oil seal, Part No. 4911, if desired. The covers enhance the appearance of the engine and serve as guards where covering of exposed shafting is a safety requirement.

CLR OIL TEST ENGINE
L-38 Test Procedure

TECHNICAL BULLETIN No. 22

Date Approved December 12, 1960

Subject: Dip Stick Thermocouple Seal.

Purpose: To provide an effective air and oil seal, thereby preventing air leakage into the crankcase.

General Description:

This Dip Stick Thermocouple Seal (Part No. 3411), is shaped like an elongated cap and is a tight fit over the top of the dipstick tube. It also has a displacing fit hole for the Dip Stick Thermocouple, thus preventing air leakage into the crankcase.

Ordering Instructions:

Order Part No. 3411 Dip Stick Thermocouple Seal.

Installation Instructions:

See Print No. TD-427 attached.

Remarks: These seals are being provided in all shipments made subsequent to November 7, 1960.

STANDARD CLEARANCES

Valve-tappet clearance, inlet, in.	0.010 hot
Valve-tappet clearance, exhaust, in.	0.020 hot
Valve-stem clearance in guide, inlet, in.	0.0022-0.0034
Valve-stem clearance in guide, exhaust, in.	0.0032-0.0044
Connecting-rod bearing clearance, in.	0.0024-0.0030
Main bearing clearance, in.	0.002-0.003
Crankshaft journal out-of-round, max., in.	0.001

TORQUE SPECIFICATIONS

Connecting-rod bearing cap	45 ft. - lb.
Main bearing block	60 ft. - lb.
Cylinder head hold down	70 ft. - lb.
Drive Plate	40 ft. - lb.
Cylinder-barrel hold down	50 ft. - lb.
Accessory cover cap screws	20 ft. - lb.
Auxiliary cover cap screws	10 ft. - lb.

MANUFACTURING TOLERANCES

Valve-guide press in cylinder head, inlet, in.	0.0005-0.0013	tight
Valve-guide press in cylinder head, exhaust, in.	0.0005-0.0013	tight
Valve-insert shrink fit in cyl. head, exhaust, in.	0.002-0.004	tight
Valve-insert shrink fit in cyl. head, intake, in.	0.002-0.004	tight
Valve-spring load at 1.80-inch height, lb.	64-70	
Valve-spring load at 1.47-inch height, lb.	133-147	

Valve-rocker, arm clearance on shaft, in.	0.0015-0.0035
Valve-lifter assembly clearance, in.	0.0013-0.0028
Piston top-land clearance in cylinder, in.	0.0242-0.0287
Piston-skirt and other land clearance in cyl., in.	0.0012-0.0015
Piston-ring gaps - all rings (as installed new), in.	0.015-0.020
Piston-pin clearance in piston, in.	0.0001-0.0003
Piston-pin clearance in conn.-rod bushing, in.	0.000-0.0006
Crankshaft end play, in.	0.007-0.018
Camshaft clearance in bearings, in.	0.0012-0.0052
Camshaft end play, in.	0.009-0.032
Camshaft bearing press in crankcase, in.	0.0025-0.0055 tight
Cylinder sleeve in cylinder barrel clearance, in.	0.001-0.003
Cylinder barrel in crankcase clearance, in.	0.002-0.007
Main bearing bore in the crankcase, with bearing cap torqued in place, 60 ft. - lb., in.	2.941-2.942
Main bearing journal, dia., in.	2.7485-2.749
Connecting-rod bore in the rod, with bearing cap torqued in place, 45 ft. - lb., in.	2.2765-2.277
Connecting-rod bearing journal, in.	2.1235-2.124