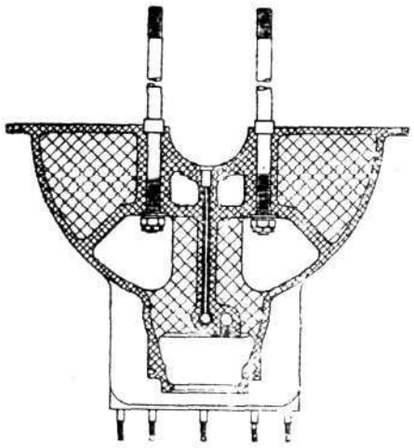
single row ball bearing at the upper end and a single row ball bearing just above the bevel gear at the lower end. The camshaft driving shafts are carried on two single row ball bearings at their lower end and in a bronze bushing at the upper end.

The drive is taken from this point to a bevel gear on the end of the camshaft which actuates the valves. The camshaft assembly consists of a camshaft with the cams integral, the cam-



Cross section through lower half of crank case of Liberty engine.

shaft bearing, camshaft driving gear, rocker levers, camshaft housing together with the covers, and also the camshaft driveshaft with the gear, bearings and camshaft driveshaft housing. The two camshaft assemblies for the left and right rows of cylinders are identical and are interchangeable, with the exception of the camshafts themselves and the camshaft housing covers. Each shaft is stamped with a serial number on the soft plug in the end of the camshaft opposite the flanged end. The right hand shafts are marked R and the left hand shafts are marked L. The housing covers are machined in place on the housing.

The valves are operated from the camshaft by means of roller cam followers which actuate the rocker shaft and in turn the valve rocker arms. The valve rocker arms bear directly on the valve stems by means of an adjusting bolt directly on the ends of the valve stems. The valves are set into the cylinders on an angle of 15 deg. to the centre line. The valves are the standard mushroom type with 45 deg. seat. The cylinder heads are bushed for the valves and the valve springs are of the double concentric type. The adjustment for the clearance between the end of the valve stem and the valve pushrod is made by turning the screw in the end of the rocker or pushrod and then locking it by means of the nut on the top of the rocker. This nut is locked by a cotter pin and is a castellated type. The clearance on the exhaust valve is ·019 to ·021 in. and on the inlet, ·014 to ·016 in.

Ignition System

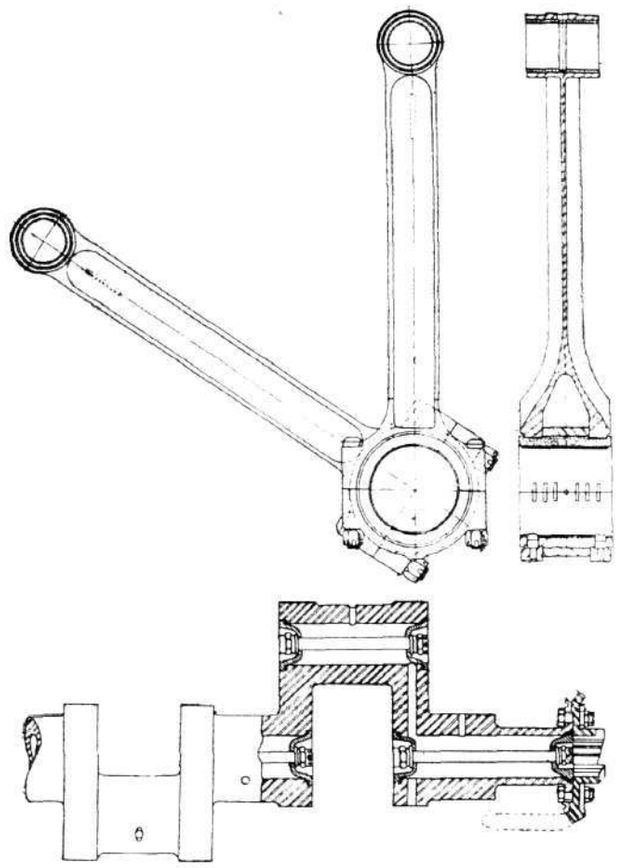
The distributor is mounted on the ends of the camshaft and arranged to fire 1L, 6R, 5L, 2R, 3L, 4R, 6L, 1R, 2L, 5R, 4L, 3R. The ignition system used on the Liberty 12 is the battery type with two independent breaker and distributor mechanisms, identical in every respect and each one firing all 12 cylinders. These distributors are supplied with electrical energy from two sources. For starting and idling speeds up to 650 r.p.m. current is drawn from the specially constructed four-cell storage battery which has sufficient capacity to ignite the engine at full speed for three hours and it is so constructed that it will function properly upside down. The generator builds up so that it takes up the load at 650 r.p.m.

Two main circuit breakers connected in parallel are located in each distributor box and the two circuit breakers are timed to operate simultaneously. Circuit breakers are provided in duplicate as a precautionary measure. There is also an additional circuit breaker to prevent the production of a spark when the engine is turned backward or rocked. The auxiliary breaker is connected in parallel with the other two through a resistance unit which reduces the amount of current flowing through it. The breaker is so timed that it opens slightly before the other two when the engine is turned in a forward direction. When the engine is turned in a backward direction, the main breakers open first and no spark is produced, because the auxiliary breaker permits the current to continue to flow through the coil, but in diminished quantity, owing to the resistance unit. The distributor shaft is carried on two ball bearings.

The generator is driven from the same vertical shaft which drives the two camshaft driving shafts, the drive being taken off the upper end of this shaft. The generator rests in a vertical position above this shaft on the centre line of the engine between the two rows of cylinders. By simply removing one flat head screw the entire generator driveshaft assembly can be lifted out. The mesh between the lower generator driveshaft gear and the crank gear is adjusted by pins between the bearing container at the top of the shaft and the crankcase.

The oil supply for the Liberty engine is carried in a reservoir which is cooled. This reservoir is mounted somewhere in the vicinity of the engine and from it oil is led to the connection on the right side of the oil pump body, which is marked in raised letters "Oil In." The oil is filtered at this point through a large-area, fine mesh screen. A delivery pump of the gear type takes the oil after it has passed through the screen, and delivers it under pressure to a distributor pipe running the entire length of the crankcase. There is a pressure-regulating valve between the pump and the distributing pipe which holds the pressure so that it does not exceed 50 lbs. per square inch.

From the distributor pipe there are pipes fitted in the crankcase leading to the main crankshaft bushings. The crankshaft is hollow, and in the centre of each main bearing there is a radial hole drilled through the shaft into the hollow



Liberty con. rod assembly in side view and section. Bottom: Detail of crankshaft, showing method of plugging bores.

centre. A passage leads from each hollow main bearing to the adjacent crank pin, which is also hollow. A radial hole is drilled through each crank pin, and carries the oil out on the surface of the pin. There are oil grooves and passages in the connecting rod bushings to ensure proper lubrication for both the forked and plain connecting rods.

Lubrication of Piston Pins

The oil spray thrown off by centrifugal force from the ends of the connecting rods lubricates the piston pins and cylinder walls. A part of the oil conducted to the crankshaft