Sept. 12, 1944. J. B. FARR 2,357,942

OUTBOARD MOTOR

Filed Feb. 10, 1940 2 Sheets-Sheet 1

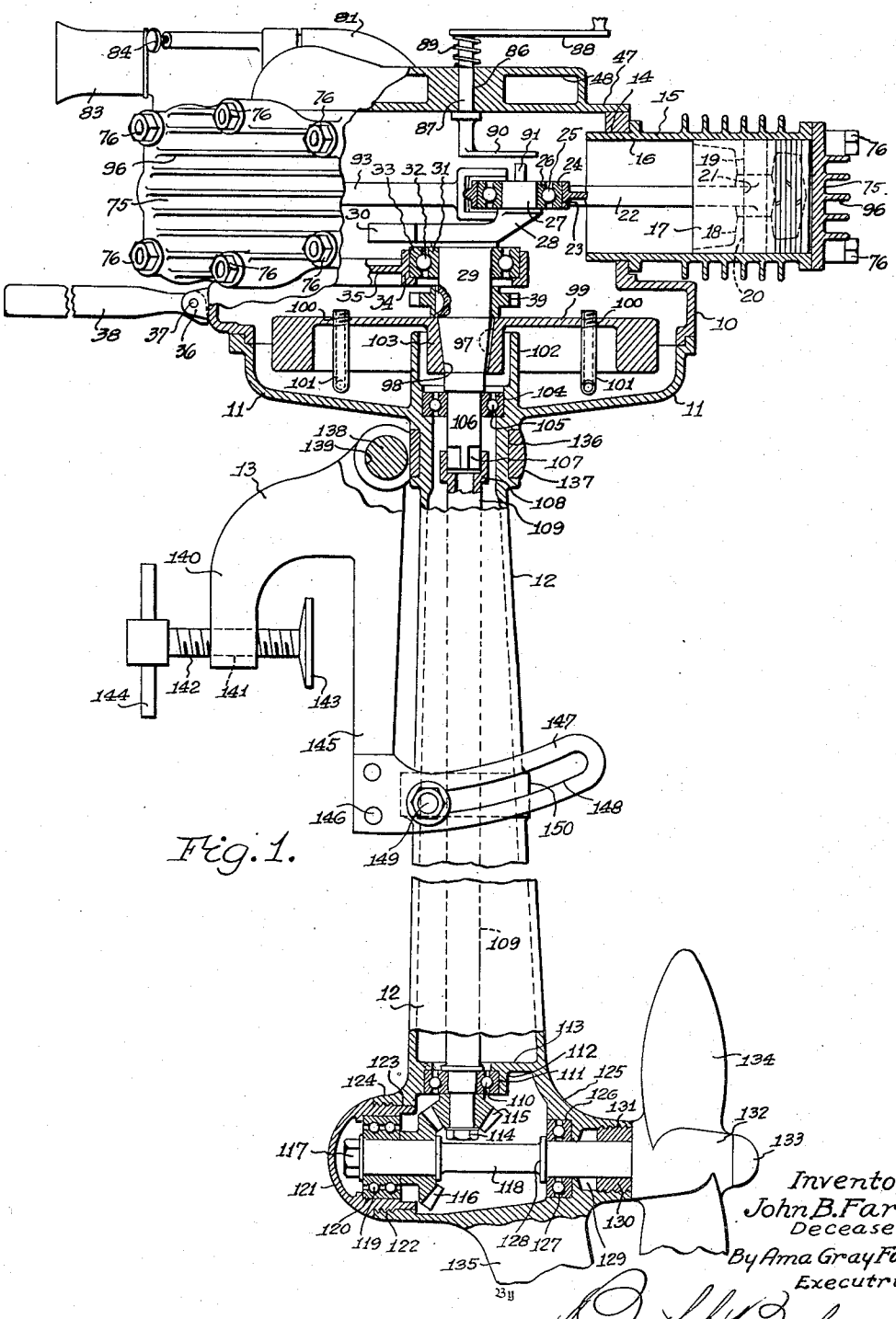


Fig. 1.

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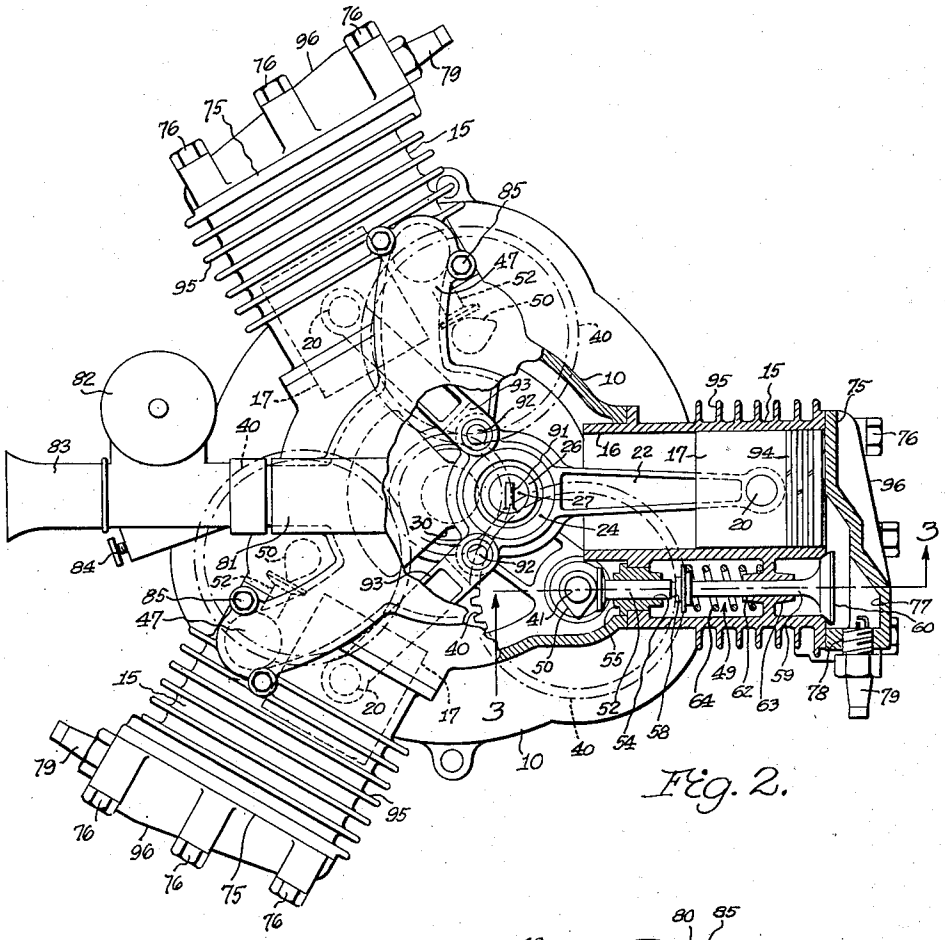


Fig. 2.

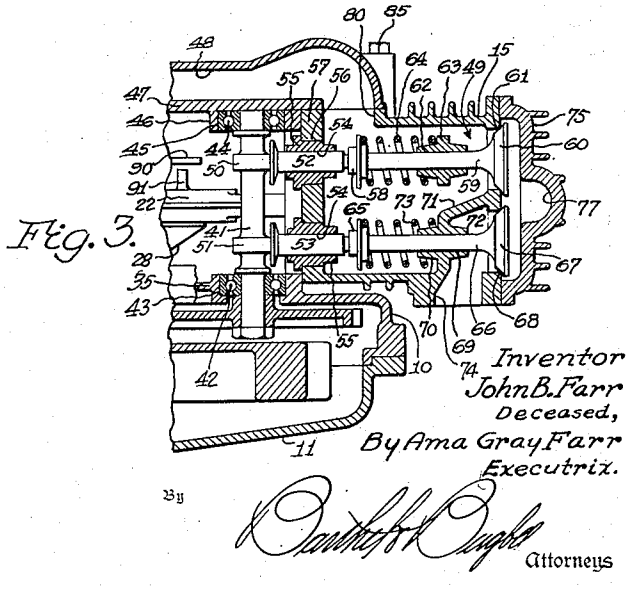


Fig. 3.

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UNITED STATES PATENT OFFICE

2,357,942

OUTBOARD MOTOR

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Application February 10, 1940, Serial No. 318,245

3 Claims. (Cl. 123—195)

This invention relates to internal combustion motors and in particular to outboard motors for propelling boats.

One object of this invention is to provide a multiple radial cylinder outboard motor with at least three cylinders wherein the various pistons are secured to a common crank through their connecting rods, this crank being mounted upon a crank shaft which drives the propeller.

Another object is to provide a four cycle radial multiple cylinder outboard motor with at least three cylinders wherein each cylinder is provided with a cam shaft for actuating the intake and exhaust valves, each cam shaft being preferably driven from a common gear on the crank shaft.

Another object is to provide a multiple radial cylinder outboard motor wherein the various piston connecting rods are connected to a half crank mounted on the crank shaft.

Another object is to provide a multiple radial cylinder outboard motor with at least three cylinders having a crank shaft with a half crank carrying an anti-friction bearing to which the various piston connecting rods are connected, so that the bearing, such as a ball bearing, may be mounted on the half crank without being split or otherwise divided.

Another object is to provide a multiple radial cylinder outboard motor with at least three cylinders having the multiple connecting rods connected to a half crank on the crank shaft, the end of this half crank projecting so as to be engaged by a hand operated crank for starting purposes.

Another object is to provide a multiple radial cylinder outboard motor having a vertical crank shaft driven by connecting rods from the multiple cylinders, the crank shaft carrying a fly-wheel beneath the cylinders, this fly-wheel rotating in a horizontal plane and carrying scoop devices which scoop up the oil and throw it upward to various parts of the motor.

Another object is to provide a multiple radial cylinder outboard motor with at least three cylinders having a cover plate on top of the housing, this cover plate having intake manifolds therein for equally distributing the explosive gas mixture to the various intake valves.

Another object is to provide a multiple radial cylinder outboard motor having the intake valve chamber immediately adjacent the exhaust valve chamber and separated therefrom by a thin wall so that the cold incoming gases tend to cool the walls heated by the outgoing exhaust gases.

Another object is to provide a multiple radial cylinder outboard motor having a one piece tubular propeller shaft housing having bearing seats at its opposite ends so that these bearing seats may be machined in accurate alignment without the danger of subsequent misalignment in assembly.

In the drawings:

Fig. 1 is a side elevation, partly broken away in central vertical section, showing a preferred embodiment of the multiple radial cylinder outboard motor according to the invention;

Fig. 2 is a top plan view, partly broken away, of the outboard motor shown in Fig. 1; and

Fig. 3 is a vertical section through the valve structure of a cylinder, taken along the line 3—3 in Fig. 2.

General arrangement

In general, the outboard motor of this invention consists of an approximately circular crank case carrying three or more radial cylinders having pistons connected to an anti-friction bearing mounted upon a half crank, which, in turn, is a part of the vertical crank shaft. This crank shaft, beneath the cylinders, carries a horizontal fly-wheel having scoop elements arranged to scoop up the oil from the crank case or sump and throw it to various parts of the invention. The crank shaft also carries a timing gear which meshes with individual timing gears mounted on an individual cam shaft for each of the several cylinders, this cam shaft operating the intake and exhaust valves of each cylinder. The half crank shaft projects upward so that it is engageable by a hand crank mechanism for starting purposes.

The upper part of the motor above the cylinders is occupied by a cover plate having intake manifolds therein running to the intake valves of the various cylinders. By this means the explosive gas is equally distributed to the various cylinders from the carburetor. Each intake manifold runs to an intake valve chamber which is separated by a thin wall from the exhaust valve chamber so that the cold incoming gases will cool the exhaust valve chamber.

The crank shaft is coupled to a propeller shaft mounted in anti-friction bearings in a one piece tubular housing, the bearing seats of which are machined in accurate alignment. Since the housing is not divisible in manufacture or assembly, this construction insures accurate alignment of the bearings.

The drive housing is mounted in a suitable bracket mechanism attached to the boat by which

the motor may be turned bodily through a complete revolution so that the boat may be reversed or the rudder, attached to the lower portion of the housing, turned through a wide angle.

Detailed construction

Referring to the drawings in detail, Fig. 1 shows a preferred embodiment of the outboard motor of this invention as consisting of a crank case 10 mounted upon the sump portion 11 of the drive housing 12, which, in turn, is pivotally supported upon the bracket 13 by means subsequently to be described.

The crank case 10 is provided with a plurality of radially disposed apertures 14 within which are mounted cylinders 15 having cylinder bores 16 containing pistons 17. The pistons 17 are provided with internal bosses 18 having aligned bores 19 carrying the wrist pins 20.

The wrist pins 20 are engaged by the bores 21 in the end of the connecting rod 22, the opposite end of which is provided with a bore 23 surrounding and containing the outer element 24 of an anti-friction bearing 25. The inner element 26 of the latter is mounted upon the portion 27 of the half crank 28 forming a part of the crank shaft 29. The half crank 28 is provided with an oppositely projecting counterweight portion 30 for counterbalancing the thrust of the crank.

The crank shaft 29 carries the inner element 31 of an anti-friction bearing 32, the outer element 33 of which is supported in a recess 34 within the spider 35 forming a part of the crank case 10. The latter is provided with an integral yoke portion 36 carrying a pivot pin 37 upon which is mounted a pivot handle 38 by which the motor may be swung to and fro by the operator around a vertical axis, for steering or reversing purposes.

Keyed to the crank shaft 29 is a timing gear 39 which meshes with gears 40 (Figs. 2 and 3) mounted on the cam shafts 41. Each cylinder 15 is provided with its own individual cam shaft, the lower end of which is mounted in the anti-friction bearings 42 supported in recesses 43 in the spider 35 of the crank case 10 (Fig. 3). The upper end of each cam shaft is mounted in anti-friction bearings 44 supported in the recess 45 formed in the boss 46. The bosses 46 project downwardly from the cover plate 47, the latter also containing intake manifold passageways 48 leading to the intake valve chambers 49 in each cylinder 15. The cam shafts 41 are provided with intake and exhaust valve cams 50 and 51, respectively, serving to actuate the valve tappets 52 and 53, respectively, mounted in the bores 54 of the collars 55. The latter, in turn, are mounted in the bores 56 within the partition portions 57 forming a part of the cylinder 15 (Fig. 3). The valve tappets 52, actuated by the cams 50, engage the enlargements 58 upon the ends of the intake valves 59 having valve heads 60 engaging valve seats 61 in the cylinders 15. The intake valve 59 is reciprocably mounted in a bore 62 within the spider 63 extending across the intake chamber 49. A coil spring 64 urges the intake valve 59 toward its closed position.

The valve tappet 53 engages an enlargement 65 upon the end of the exhaust valve 66 having a head 67 engaging exhaust valve seat 68. The exhaust valve 66 is reciprocably mounted in a bore 69 within a boss 70 forming a part of the partition wall 71 between the intake chamber 49 and the exhaust chamber 72 (Fig. 3). The exhaust chamber 66 is simply provided with a coil spring 73 urging it into a closed position. The exhaust valve chamber 72 is provided with an exhaust port 74 to which an exhaust manifold (not shown) may be connected in any conventional way, and leading either to a conventional muffler or to an underwater exhaust. These elements are omitted to simplify the disclosure.

The cylinder bores 16 of the cylinders 15, at their outer ends, are closed by the cylinder heads 75 bolted thereto as at 76 and containing the ignition chambers 77 having threaded bores 78 containing the spark plug 79. The energization of the spark plugs 79 is effected by electricity supplied from a conventional spark coil or magneto (not shown) through a conventional timer and distributor (not shown) mounted on the upper end of one of the cam shafts 41. This timing and distributing mechanism is likewise omitted for purposes of simplifying the showing.

Each of the intake chambers 49 is provided with an intake port 80 from which the intake manifold passageways 48 lead to the carbureter connecting portion 81 to which is attached the carbureter 82. The latter is provided as usual with an air intake portion 83 and an adjusting screw 84 for adjusting the needle valve.

The cover plate 47 containing the exhaust passageways 48 is bolted as at 85 to the cylinders 15. The cover plate 47 is likewise provided with a vertical bore 86 containing the shaft 87 on one end of which is mounted the manually operated starting crank 88. A coil spring 89 urges the shaft 87 and crank 88 upward. The other end of the shaft 87 carries an arm 90 engageable with a projection 91 upon the crank portion 27. The projection 91 is wedge-shaped (Fig. 2) so as to permit the arm 90 to be thus disengaged automatically when the motor starts.

Connecting rod 22 is a master connecting rod which is provided with pivot pins 92 to which the connecting links or secondary connecting rods 93 are pivotally connected. Opposite ends of the secondary connecting rods 93 are pivotally connected to the wrist pins 20 of the pistons 17 in the manner previously described. The pistons 17 are provided with the usual piston rings 94 for the prevention of leakage between the pistons 17 and the cylinder bore 16. The cylinders 15 are provided with the usual cooling fins or flanges 95 with corresponding fins 96 upon the cylinder heads 75.

The crank shaft 29 is provided with a tapered portion 97 engaged by the correspondingly tapered bore 98 of the fly-wheel 99 keyed thereto. The fly-wheel 99 is provided with bores 100 within which are secured the downwardly extending scoop tubes 101. The latter project slightly above the top of the fly-wheel 99 and, in the rotation of the latter, serve to pick up oil from the sump portion 11 and throw it upward to the various moving parts of the motor.

The sump portion 11 is provided with an upwardly projecting annular flange 102 surrounding the fly-wheel hub 103 and serving to prevent the escape of lubricant. The sump portion 11 within the flanged portion 102 is provided with a recess 104 serving to receive the outer element of an anti-friction bearing 105, the inner element of which is mounted upon the reduced diameter portion 106 of the crank shaft 29.

The crank shaft portion 106 terminates in a

coupling portion 107 having cooperating ridges engaging a corresponding coupling socket 108 in the upper end of the drive shaft 109. The latter is preferably tubular and at its lower end carries the inner element of an anti-friction bearing 110, the outer element of which is supported in a recess 111 in the boss 112 forming a part of the partition 113 in the lower end of the drive housing 12 (Fig. 1).

Secured, as at 114, to the lower end of the drive shaft 109 is a bevel gear 115 meshing with a bevel gear 116 secured, as at 117, to the propeller shaft 118. One end of the propeller shaft 118 is mounted in double anti-friction bearings 119 supported in a recess 120 formed in the drive housing cap 121. The latter is threaded, as at 122, into the bore 123 in the projecting portion 124 at the lower end of the drive housing 12.

The drive housing 12 also is provided with a projecting portion 125 (Fig. 1) provided with a recess 126 containing an anti-friction thrust bearing 127 which is engaged by the enlargement 128 on the propeller shaft 118. The latter is provided with a packing 129 compressed by a gland 130 threaded into the bore 131. The outer end of the propeller shaft 118 is provided with a screw propeller 132 secured thereto, as at 133, and having propeller blades 134. Formed integrally with the drive housing 12 is a downwardly projecting fin or rudder 135.

The upper end of the drive housing 12 is provided with an annular recess 136 loosely receiving an annular member 137 carrying a pivot pin 138. Engaging the pivot pin 138 is the bore 139 formed in the upper end of the bracket 13 which has an outwardly extending arm structure 140 provided with threaded bores 141 carrying a pair of clamping screws 142, each being provided with a head 143 and handle 144 for clamping the motor to a boat (in Fig. 1 the two clamping screws 142 are in horizontal alignment and hence only one is visible.)

The bracket 13 is likewise provided with a downwardly extending arm structure 145 to which are secured, as at 146, spaced arms 147 containing arcuate slots 148 having their centers of curvature at the center of the pivot shaft 138. The slots 148 are engaged by adjusting bolts 149 seated in annular members 150 loosely mounted upon the casing 12 in a manner similar to the annular membr 137. In this manner the motor may be swung completely around by grasping the handle 38. The bolts 109 also permit an adjustment of the motor and a tilting relatively to the vertical plane.

The drive housing 12 is preferably of streamlined cross-section so as to offer the minimum resistance in its passage through the water. For this purpose, the leading edge is rounded and the trailing edge is thin and fin-shaped.

Operation

The operation of the invention has been described, in part, in connection with the description of the construction thereof. The operator starts the engine by rotating the hand crank 88 after pushing it downward into engagement with the projection 91 on the half crank 28. Assuming that the carbureter 82 has been supplied with fuel and the timing apparatus and spark plugs 79 energized from a suitable source of electricity, the explosions take place in timed sequences within the cylinders 15.

While the explosions are taking place within the cylinders 15, the cam shafts 41 are being rotated so as to open and close the intake valves 80 and exhaust valves 67 in accordance with the predetermined cycle of operation, according to the four-cycle plan. Thus the piston 17 makes one complete stroke upon its explosion and exhaust half strokes and a successive complete stroke upon its intake and compression half strokes. This cycle of operations is repeated indefinitely according to the desires of the operator.

As the explosion stroke of each cylinder occurs, the thrust of each piston 17 is communicated to the half crank 28 of the crank shaft 29 by the engagement of the main connecting links 93 with the anti-friction bearing 25. This rotation is transmitted to the drive shaft 109 through the coupling members 107 and 108 and, thence, to the screw propeller 132 through the shaft 118 and bevel gearing 115 and 116.

Meanwhile, the rotation of the fly-wheel 99 causes the scoop tubes 101 to pick up oil from the sump portion 11 and throw this oil upward to lubricate the various bearings and the cylinder bores 16.

The exhaust valve chamber 72 is cooled by the incoming gas passing through the intake chamber 49. This occurs by reason of the contact of the cool incoming gas with the thin partition 71 between the two chambers.

The motor may be adjusted as to position by manipulating the bolts 149, thereby allowing for any tilt at which the bracket structure 13 must be set in the particular boat.

To steer the boat, the operator merely swings the handle 38, thereby swinging the motor and its connected parts, including the drive housing 12, screw propeller 132, and the rudder 135. To reverse the boat, the operator merely swings the handle 38 through a half revolution, so that the screw propeller 132 is directed forward instead of rearward, as shown in Fig. 1. The bearing ring members 137 and 150 permit this wide angle swinging of the motor assembly relatively to the bracket structure 13.

The term "outboard motor" used herein is defined as a small internal combustion engine with propeller attached, temporarily secured to the stern of a small boat.

While a specific embodiment of the invention has been described and illustrated, it will be understood that various modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. In an outboard motor, a crank case having a closure plate to provide an end wall therefor, a plurality of removable cylinders disposed radially about said crank case, pistons reciprocably mounted in said cylinders, a crank-shaft journaled in one wall of said case, a cantilever crank pin on the crank shaft having its end terminating within the confines of the cylinders and spaced from the end wall closure plate a sufficient distance to provide clearance therebetween, and a connecting rod assembly mounted said crank pin being drivingly connected to said piston, said clearance space being so proportioned as to admit the removal of the connecting rod assembly laterally from the crank pin after the cylinders have been removed from the crank case.

2. In an outboard motor, a crank case having an open end provided with a closure plate, a plurality of removable cylinders disposed about the

crank case and extending radially therefrom, pistons mounted in said cylinder, a crank shaft journaled in said crank case, a cantilever crank pin on said crank shaft having its end terminating within the confines of the cylinders and spaced from the closure plate a sufficient distance to provide a clearance space therebetween, and a connecting rod assembly mounted on said crank pin connecting said pistons with said crank pin, said clearance space being so proportioned as to permit removal of the connecting rod assembly laterally from the crank pin after the cylinders have been removed from the crank case.

3. In an outboard motor, a crank case having an end wall, a series of cylinders radially disposed about said crank case, pistons reciprocably mounted in said cylinders, a crank-shaft journaled in said crank case, a cantilever crank pin on said crank shaft within the confines of said cylinders with its end terminating a sufficient distance from the end wall to provide a clearance space, and a connecting rod assembly mounted on said crank pin comprising a main connecting rod connected to one of the pistons, and a plurality of secondary connecting rods connecting the remaining pistons to said main connecting rod, said clearance space being so proportioned to admit removal of the connecting rod assembly laterally from the crank pin after the cylinders have been removed from the crank case.

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