Dec. 14, 1965 G. W. CONOVER ETAL 3,223,197

OIL PUMP AND COOLER ASSEMBLY FOR AN INTERNAL COMBUSTION ENGINE

Original Filed June 8, 1960 2 Sheets-Sheet 1

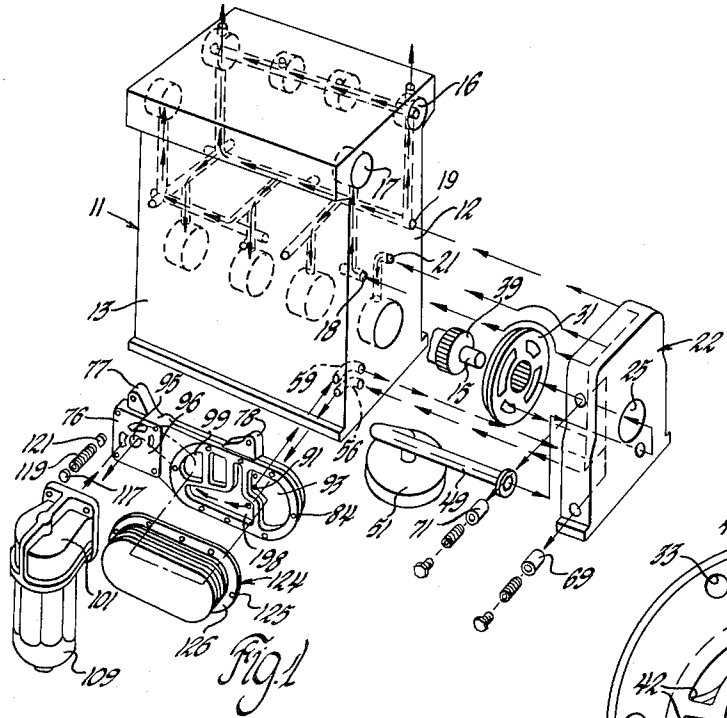


Fig. 1

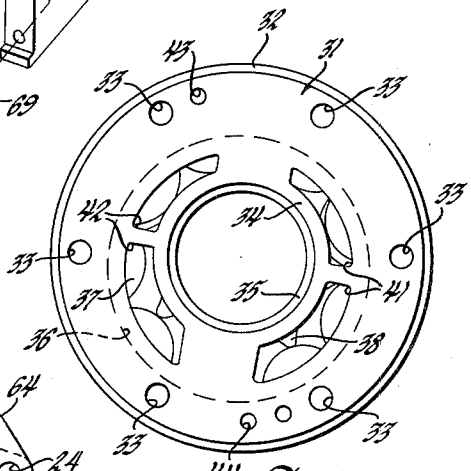


Fig. 3

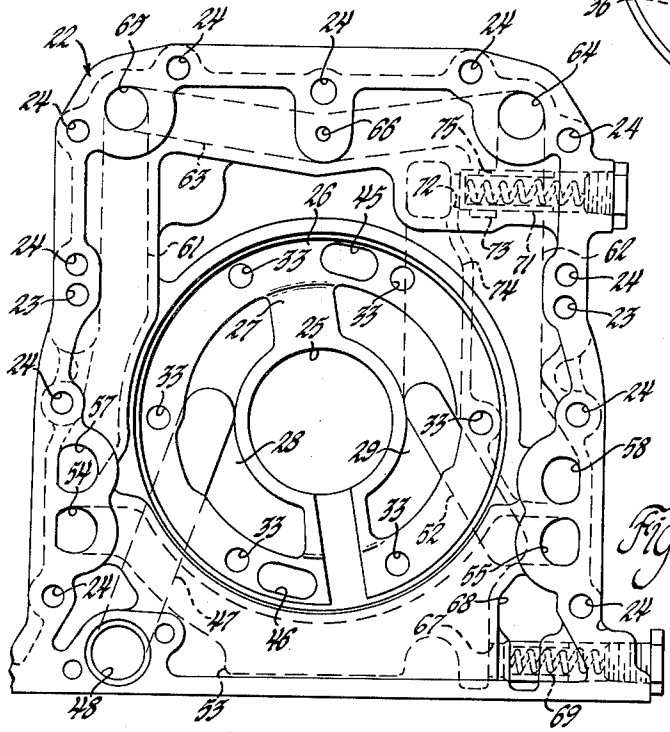


Fig. 2

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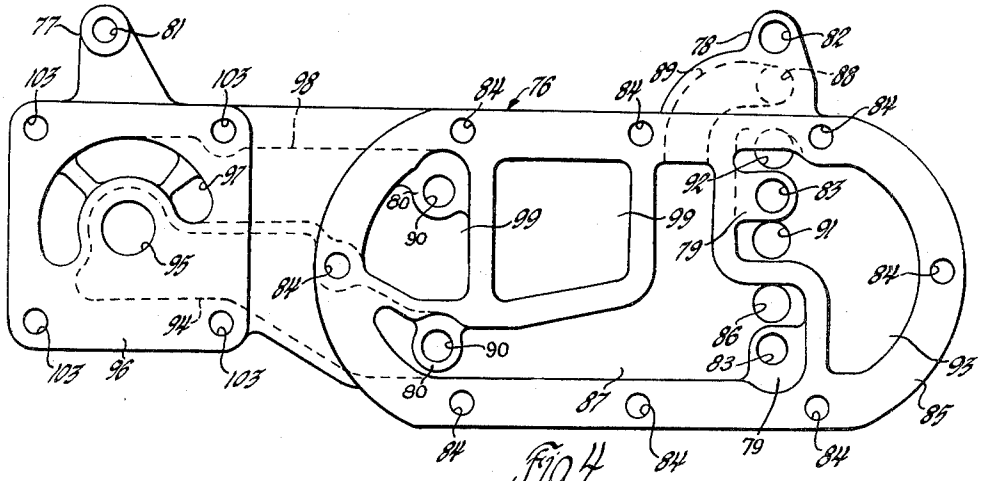
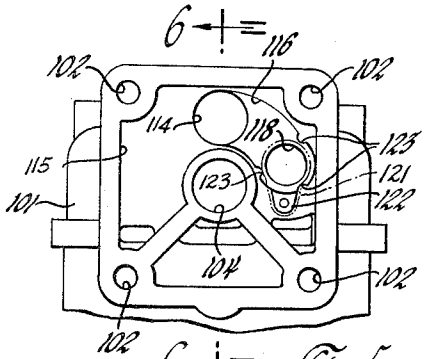


Fig. 4



6 Fig. 5

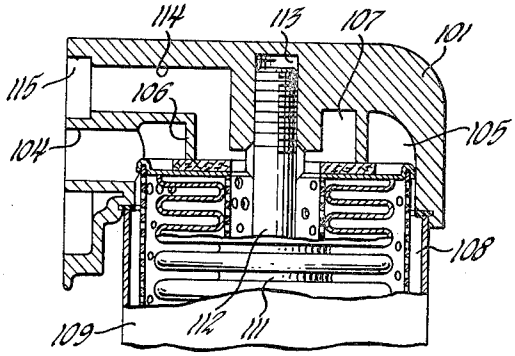


Fig. 6

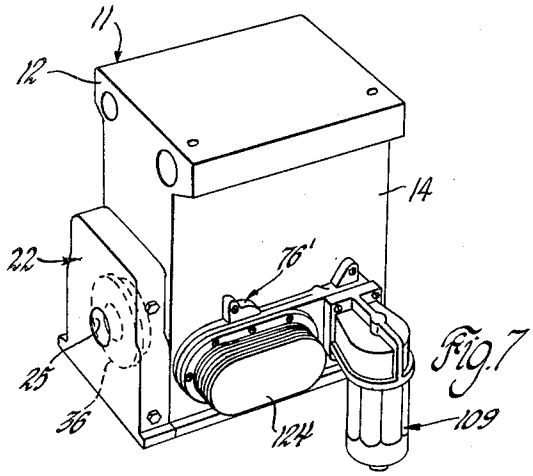


Fig. 7

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OIL PUMP AND COOLER ASSEMBLY FOR AN INTERNAL COMBUSTION ENGINE

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Original application June 8, 1960, Ser. No. 34,728, now Patent No. 3,094,190, dated June 18, 1963. Divided and this application June 17, 1963, Ser. No. 288,377

2 Claims. (Cl. 184—6)

This is a divisional application of the copending United States application, Serial No. 34,728, filed June 8, 1960, now U.S. Patent No. 3,094,190, in the names of George W. Conover, Kenneth L. Hulsing and Joseph Koehler, and entitled "Internal Combustion Engine."

This invention relates to internal combustion engines, and more particularly to a front mounted oil pump filter and cooler assembly which may be secured to an internal combustion engine cylinder block and which affords a great deal of flexibility in design.

In the design, manufacture and operation of internal combustion engines it is often necessary and desirable to provide various accessory mountings for the engine on either side of the engine cylinder block. This permits design and operation of the engine in accordance with space limitations and the like, and adapts the engine to a wide variety of uses. A particular example of the desirability of reversible mountings is in the oil pump, oil filter and oil cooler accessories which, for ease of maintenance and repair and for original flexibility, might be mounted on either side of the engine and might be mounted so as to adapt themselves to either direction of crankshaft rotation. For example, in marine use where a pair of engines might be placed side by side and the crankshafts rotated in opposite directions, it might be desirable to have these accessories mounted either centrally of the two engines or outboard of the two engines because of space requirements.

The engine in which this invention is embodied includes, generally, provisions for securing an oil pump and cover member at the front of the engine and on the engine crankshaft in such a manner as to provide for either direction of crankshaft rotation. The oil filter and oil cooler assembly may be mounted on the side wall of the cylinder block and may be mounted on either side wall of the cylinder block, depending on the desires of the operator. No structural changes are required in any of the components to change from one side or the other, the parts merely being reversed and remounted in their respective location.

It is apparent that with a construction of this nature considerable flexibility is permitted in the design, manufacture and operation of internal combustion engines.

These and other advantages will become more apparent from the following description and drawings, in which:

FIGURE 1 is an exploded, perspective view of a portion of a typical internal combustion engine, with the oil pump, filter and cooler assembly mounted thereon;

FIGURE 2 is an elevational view of the oil pump cover member, illustrating the position of the various chambers and passages therein;

FIGURE 3 is an elevational view of the pump member mountable in the cover member illustrated in FIGURE 2;

FIGURE 4 is an elevational view of an adapter plate which mounts on the side wall of the cylinder block to receive the filter member and the oil cooler assembly;

FIGURE 5 is an elevational view of a portion of the filter assembly, illustrating the position of the various ports and chambers;

FIGURE 6 is a cross-sectional view of the portion of the filter member illustrated in FIGURE 5, taken substantially along the line 6—6 of FIGURE 5 and looking in the direction of the arrows; and

FIGURE 7 is a perspective, diagrammatic view of the internal combustion engine cylinder block with the oil pump, oil pump cover, filter member and oil cooler mounted in an alternate position.

Referring more particularly to the drawings, FIGURE 1 best illustrates the oil pump, filter and cooling assembly mounting. A cylinder block, illustrated generally by the reference numeral **11**, is shown to include a front wall **12** and side walls **13** and **14**. The cylinder block supports the usual crankshaft **15** and further supports a camshaft **16** and a balance shaft **17**. These shafts are symmetrically disposed in the cylinder block **11** with respect to the longitudinal median plane of the block and either shaft may be mounted on either side of the median plane.

Formed in the cylinder block **11** are the usual oil distribution passages, illustrated in dotted lines in FIGURE 1, that lead to the usual shaft bearings and the like. These distribution passages are fed from the oil pump assembly, which will be hereinafter more fully described, and through the main inlets **18**, **19** and **21** located in the front face **12** of the cylinder block **11**.

FIGURES 1–3 best illustrate the combined front crankcase cover and oil pump assembly. A cover member, indicated generally by the numeral **22**, is located with respect to the lower front face **12** of the cylinder block **11** by two pins at **23** and sealingly secured thereto by a plurality of bolts which extend through bolt holes **24** and threadably engage suitably tapped holes in the block. A bore **25** extends through the cover member **22**. As seen in FIGURE 1, this bore spacedly embraces the forward end of the crankshaft **15** and a suitable seal is imposed therebetween. The crankcase side of the cover member has a boss or finished surface thereon defined in part by an annular portion **26**. This annular surface is in spaced concentric relation to the bore **25**, and thus to the rotative axis of the crankshaft **15**, and is intersected by a diametrically extending boss surface **27**. The cover member is recessed inwardly of these intersecting surface portions to define an inlet chamber **28** and an outlet chamber **29**.

A pump housing comprising a port plate member **31** and a body member **32** is sealingly secured to the annular surface **26**. This mounting of the pump housing is preferably accomplished by a plurality of bolts which extend through equiangularly spaced bolt holes **33** in the body and plate members and threadably engage corresponding suitably tapped holes in the cover member **22**. The plate and body members **31** and **32** have crankshaft embracing bores **34** and **35**, respectively, extending therethrough. The body member is provided with an eccentric counterbore **36**. This counterbore cooperates with plate member **31** to define a pump chamber and rotatably journals an impeller gear member **37**. This outer gear is provided with internal teeth or lobes and is rotatably driven by the teeth of an inner impeller gear **38**. As seen in FIGURE 1, the inner impeller gear **38** is drivingly connected to the crankshaft by a splined hub **39** keyed to the crankshaft. The eccentricity of the driving and driven gears **38** and **37** and their coacting interengagement define a plurality of expansible pumping compartments therebetween.

Two arcuate ports **41** and **42** extend through the port plate **31** in spaced relation to the crankshaft embracing bore **34**. These ports connect the gear defined pumping chambers with the cover defined inlet and outlet chambers **28** and **29** and preferably diverge as shown toward the offset side of the pump chamber defining bore **36**. Two pins **43** and **44** reference the plate **31** and thus the ports **41** and **42** with respect to the pump body member

32. To insure proper assembly, these pins are unequally spaced intermediate the adjacent bolt holes 33. In mounting the pump unit on the cover member, the pins 43 and 44 alternatively engage grooves or slots 45 and 46 which open on the pump mounting annular face 26 of the cover member 22. The grooves 45 and 46 insure proper alignment of the plate ports 41 and 42 with either the inlet or outlet chambers of the cover member. To provide pumping displacement between the pump inlet and outlet chambers with right-hand or clockwise rotation of the engine crankshaft as viewed from the front of the engine, the pump unit is secured to the cover member 22 with the projecting ends of the pins 43 and 44 being loosely embraced by the grooves 45 and 46, respectively. To accommodate left-hand or counterclockwise rotation of the crankshaft, the pump body and plate members are rotated through 180° and secured to the cover member 22 with the pin 44 engaging the groove 45 and the pin 43 engaging the groove 46. This locates the eccentricity of the gear mounting bore 36 above the crankshaft axis with the plate ports 42 and 41 in mating relation with the inlet and outlet chambers 28 and 29 thus providing pumping displacement between the inlet and outlet chambers with this hand of crankshaft rotation.

The inlet chamber 28 is connected through a passage 47 to an inlet 48 opening toward the crankcase chamber in the lower corner portion of the cover member 22. The port 48 sealingly embraces the forward end of an oil intake tube 49. The opposite end of the tube 49 is connected to an oil intake screen assembly 51 located in the usual oil pan defined sump. The discharge chamber 29 is connected through a downwardly extending passage 52 to a gallery or manifold chamber 53 which extends transversely of the lower portion of the cover member 22. Two outlet ports 54 and 55 open from the laterally opposite ends of the manifold 53 to the block engaging face of the cover member 22 and mate with alternative elbow oil passages 56 formed in the adjacent crankcase side walls. One of the two block defined passages 56 is plugged, thus effectively sealing the mating cover port 54 or 55. The pumped oil is thus supplied through the other outlet port and the adjacent block defined passage to the oil filter and cooler assembly to be more fully hereinafter described.

Two oil return ports 57 and 58 are provided in the cover member 22 immediately above the outlet ports 54 and 55. These oil return ports mate with alternative oil return elbow passages 59 formed in the adjacent crankcase side walls. One of the oil return passages is plugged to effectively seal the adjacent oil return port 57 or 58 of the cover member and the other return passage is connected to an oil return chamber in the oil filter cooler assembly. The alternate oil return ports 57 and 58 open to opposite legs 61 and 62 of a U-shaped distribution passage or gallery 63 extending upwardly and transversely of the upper portion of the cover member 22. The upper bight portion of this distribution passage is intersected by three outlet ports 64, 65 and 66. These ports open to the block engaging face of the cover member and mate with ports 18, 19 and 21 opening to the lower block end face 12. The ports 18 and 19 lead to oil distribution galleries extending longitudinally of the crankcase. The intermediate port 66 is of small dimension relative to the ports 64 and 65 and mates with the block defined port 21. The port 21 is connected by a passage to supply oil to lubricate the front main bearing and crankshaft journal.

Referring to the lower ring hand corner of FIGURE 2, the cover member wall defining the pump discharge manifold 53 is provided with a port 67. This port opens to a recess 68 in the cover member and opening to the engine crankcase chamber. The port 67 is controlled by a pressure relief valve 69. This valve is of a cup-shaped plunger type and is spring biased to regulate the oil pressure supplied to the filter and cooler assembly. A second cup-shaped plunger valve 71 is reciprocably mounted within the upper portion of the cover member. As seen in the upper right-hand corner of FIGURE 2, this second valve controls a port 72 connecting a lateral bypass branch 73 off the U-shaped distribution passage 63 with the pump discharge chamber 29 through a passage 74 extending upwardly therefrom. The valve 71 is spring biased toward seating engagement with the port 72. This spring biasing is augmented by oil pressure from the gallery 63 which is supplied to the spring chamber behind the valve through a radial port 75. The valve 71 thus bypasses the oil filter and cooler assembly to insure adequate engine lubrication and cooling when the pressure differential between the pump discharge and the gallery exceeds a predetermined level. Such an excessive pressure differential may result from a restriction or blocking of oil flow through the oil filter and cooler assembly, or due to cool oil and lack of gallery pressure under engine starting conditions.

As indicated above, the pressurized oil normally passes from the pump through one of the block defined elbow passages 56. Referring now to FIGURES 1 and 4, an adapter plate, illustrated generally by the numeral 76, is mounted on the side wall 13 of the block 11 and about port 56. The adapter 76 has several bosses 77, 78, 79 and 80 provided with suitable bolt holes 81, 82, 83 and 90, respectively, to secure the plate 76 by means of standard bolts on the crankcase side wall 13 of the block 11. The oil cooler housing to be later described is secured to the adapter 76 by a plurality of bolts which extend therethrough and engage tapped holes 84 provided in a mounting flange or boss 85 on the adapter plate 76. The adapter has a first inlet port 86 opening directly to an inlet chamber 87 and a second alternative inlet port 88 which is connected to the inlet chamber through a passage 89. Two alternative oil return ports 91 and 92 open to a return chamber 93 in the plate 76.

This alternative inlet and outlet port arrangement permits the same adapter plate to be used on either side wall of the engine. When the adapter plate shown in FIGURE 4 is used on the left crankcase side wall as shown in FIGURE 1, the inlet and return ports 86 and 91 respectively mate with the oil supply and return elbow passages 56 and 59. The alternative inlet and return ports 88 and 92 are sealingly closed by the side wall 13 of the block 11. In using the same adapter plate on the right-hand crankcase side wall, the plate position is rotated 180° so that bosses 77 and 78 are at the lower edge thereof and the alternative inlet and outlet ports 88 and 92 mate with the elbow passages 56 and 59 in the adjacent side wall 14 with the ports 87 and 91 being closed by the side wall 14. The relationship of the adapter ports and bolt hole pattern provides a somewhat higher mounting of the oil cooler when the adapter shown in FIGURE 4 is installed on the right-hand side of the engine rather than on the left hand side thereof. To provide further versatility in the mounting of the oil cooler, an alternative adapter may be provided having a reverse image to that shown in FIGURES 1 and 4. The provision of such an alternative adapter 76′ as mounted on the engine right crankcase side wall 14 is shown in FIGURE 7. This alternative adapter 76′ could, of course, also be installed in rotated position on the left crankcase side wall 13 in the same manner as adapter 76 is used on the right crankcase side wall.

The oil supplied to the adapter inlet chamber 87 passes longitudinally through a passage 94 to a port 95 which opens centrally of a filter mounting face 96 provided on the adapter 76 in spaced relation to the cooler mounting flange 85. An arcuate second port 97 opens on the filter mounting face in concentric spaced relation to the port 95. The port 97 is connected through a passage 98 to an oil cooler inlet chamber 99 in the adapter plate.

Referring now to FIGURE 5, a filter supporting base 101 is shown and which is sealingly secured to the adapter mounting face 96 of the adapter plate 76 by four bolts. These bolts extend through equiangularly spaced bolt holes 102 and threadably engage tapped holes 103 provided in the filter mounting portion of the adapter mem-

ber 76. An oil inlet port 104 opens centrally of the base 101 and mates with the adapter port 95. As best seen in FIGURE 6, the port 104 communicates inwardly of the filter base with an annular recess 105 which is partially defined by a partition wall 106. This partition wall further defines a central outlet chamber or recess 107 The oil inlet recess 105 is in open communication with a cylindrical chamber 108 formed between a housing can 109 and a cylindrical filter cartridge 111. The filter cartridge is of a conventional design having a corrugated filter paper element extending intermediate two concentrically spaced perforated sleeves. The housing can and filter unit are sealingly secured to the mounting base 101 by a bolt 112 extending therethrough. This bolt threadably engages a tapped hole 113 located centrally of the inlet and outlet recesses 105 and 107 in the mounting base.

The central outlet chamber 107 is in open communication with the interior sleeve of the filter unit and is connected through a passage 114 to an outlet port defined by a recess 115 formed in the base 101. The outlet port defining recess 115 subtends an angle of approximately 270° about the central inlet port 104. This permits the filter base to be rotated in its mounting on the adapter to orient the filter housing can and cartridge to extend vertically upwardly or downwardly or horizontally toward the rear of the engine. By use of an appropriate spacer member, the filter unit may also be located outwardly of the oil cooler unit, extending forwardly from its mounting location. In each of these filter mounting positions, the outlet port recess 115 of the filter base is connected to the arcuate port 97 of the adapter plate.

As shown in FIGURE 5, a groove 116 opening to the mounting flange defined recess 115 extends arcuately from the outlet passage 114 in spaced concentric relation to the oil inlet port 104. This groove serves to mount a filter bypass valve at its end opposite the passage 114. This bypass valve comprises a valve plate 117 which controls a port 118 opening to the oil filter inlet recess 105. The valve plate is thus subjected to the differential in oil pressures in the filter inlet and outlet chambers. A spring 119 is compressively interposed between the valve plate and a fixed spring seat plate 121 and biases the valve plate against the oil inlet pressure applied thereto. The plate 121 is retained within the valve mounting groove 116 by a single screw at 122 and by three equiangularly spaced bosses 123 which define plate seating shoulders. The filter bypass valve thus serves to interconnect the filter inlet and outlet chambers when the differential oil pressures therebetween exceeds a predetermined amount, e.g., 10–15 p.s.i.

Referring next to FIGURE 1, the oil returning from the filter unit passes through an oil cooler, indicated generally by the numeral 124. A water cooled core is disposed between the adapter defined inlet and outlet chambers 99 and 93. Cooler 124 is secured to the adapter plate 79 by suitable bolts passing through bolt holes 125 in the flange 126 and into suitably tapped holes 84 in the plate 76. The cooled oil then passes through the adjacent block defined oil return passage 59 to the U-shaped distribution gallery 63 of the crankcase cover member 22. The oil then passes to the longitudinally extending distribution galleries 18 and 19 of the block with a minor portion being supplied to the front main bearing and crankshaft journal through the passage 21. Lubrication for the remaining bearings and crankshaft journals are supplied through the various branch passages extending transversely of the block 11.

FIGURE 7 illustrates an alternative mounting of the oil pump, filter and cooler assembly on the opposite side of the cylinder block 11 from that illustrated in FIGURE 1. As shown, alternative adapter plate 76' is secured to the left side wall 14 in a manner similar to the mounting of adapter plate 76 as illustrated in FIGURE 1. The oil filter 109 is secured to the adapter plate 76' in the same manner as in FIGURE 1 and the oil cooler assembly 124 is also secured to the adapter plate. Cylinder block passages 56 and 59, connecting end wall 12 with side wall 13 of the block 11, are plugged, closing ports 55 and 58 of front cover member 22 and the alternative cylinder block passages 56 and 59, connecting end wall 12 and side wall 14 of block 11, are open and communicate with ports 54 and 57 of front cover member 22. Furthermore, assuming that the direction of crankshaft rotation is opposite that of the FIGURE 1 arrangement, the pump assembly is in its rotated position with the eccentric chamber 36 rotated 180°, as earlier described.

From the foregoing it is apparent that an oil pump, filter and cooler assembly is provided which permits reversibility of mounting on an engine cylinder block. This permits a great deal of flexibility in mounting these accessories to provide for space limitations and operator desirability. The construction of the cover member 22 and the adapter plate 76 to properly align the various communicating passages permits the reversibility and flexibility of the engine construction. The reversibility of the pump member 31 within the front cover 22 allows for opposite hands of crankshaft rotation and the proper placement and alignment of the pumping chambers.

What is claimed:

1. An internal combustion engine having a cylinder block and a crankshaft adapted for rotation in either direction;

said cylinder block having an end wall and a pair of side walls extending from said end wall;

oil distribution passages in said cylinder block and opening through said end wall;

first oil passage means in said cylinder block opening through said end wall and one of said side walls, said cylinder block having corresponding second oil passage means opening through said end wall and the other of said side walls;

a cover secured to said end wall and having passages formed therein, each of said passages including ports opening to said end wall and symmetrically disposed with respect to the median plane of said cover, certain of said ports on one side of said plane communicating with said first oil passage means and the corresponding ports on the other side of said plane communicating with said second oil passage means, said second oil passage means being plugged to prevent oil flow through said corresponding ports, the others of said ports communicating with said oil distribution passages;

a pump received in said cover and driven by said crankshaft, said pump being rotatable with respect to said cover for mounting thereon in one of two alternative positions corresponding to the direction of crankshaft rotation;

an adapter plate secured to said one side wall and having passage means formed therein and communicating with said cylinder block first oil passage means;

an oil filter mounted on said adapter plate and having inlet and outlet passages formed therein communicating with said adapter plate passage means, said oil filter being alternatively mountable on said adapter plate in any one of a plurality of positions;

and an oil cooler mounted on said adapter plate, said oil cooler having inlet and outlet passages formed therein and in communication with said adapter plate passage means;

whereby said oil cooler and said oil filter communicate with said pump and said oil distribution passages through said first oil passage means;

said adapter plate being alternatively mountable on said other side wall whereby to communicate said adapter plate passage means with said cylinder block second oil passage means while said first and second oil passage means are alternatively adapted to be plugged and opened respectively, whereby to com-

municate said oil cooler and said oil filter with said pump and said oil distribution passages through said second oil passage means rather than through said first oil passage means.

2. An oil pump, filter and cooler assembly for an internal combustion engine and comprising;

a cylinder block having an end wall and a pair of side walls, said cylinder block having oil distribution passages therein;

separate oil passage means in said cylinder block and extending from each of said side walls through said end wall;

a cover, carrying an engine driven pump and having passages formed therein, each of said passages including ports opening to said end wall, certain of said ports communicating with said oil passage means and others of said ports communicating with said oil distribution passages;

an adapter plate secured to one of said side walls, said adapter plate having passage means formed therein and communicating with certain of said cylinder block oil passage means;

an oil filter mounted on said adapter plate having inlet and outlet passages formed therein communicating with said adapter plate passage means said oil filter being alternatively mountable on said adapter plate in any one of a plurality of positions;

and an oil cooler mounted on said adapter plate, said oil cooler having inlet and outlet passages formed therein and in communication with said adapter plate passage means;

whereby said oil cooler and said oil filter communicate with said pump and said oil distribution through said certain oil passage means;

said adapter plate being alternatively mountable on said other side wall whereby to communicate said adapter plate passage means with other of said oil passage means and to communicate said oil cooler and said oil filter with said pump and said oil distribution passages through said other oil passage means rather than through said certain oil passage means.

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