July 9, 1963 A. CHAPLIN ETAL 3,096,849

GEAR PUMP FOR INTERNAL COMBUSTION ENGINE AND THE LIKE

Filed March 24, 1960 4 Sheets-Sheet 1

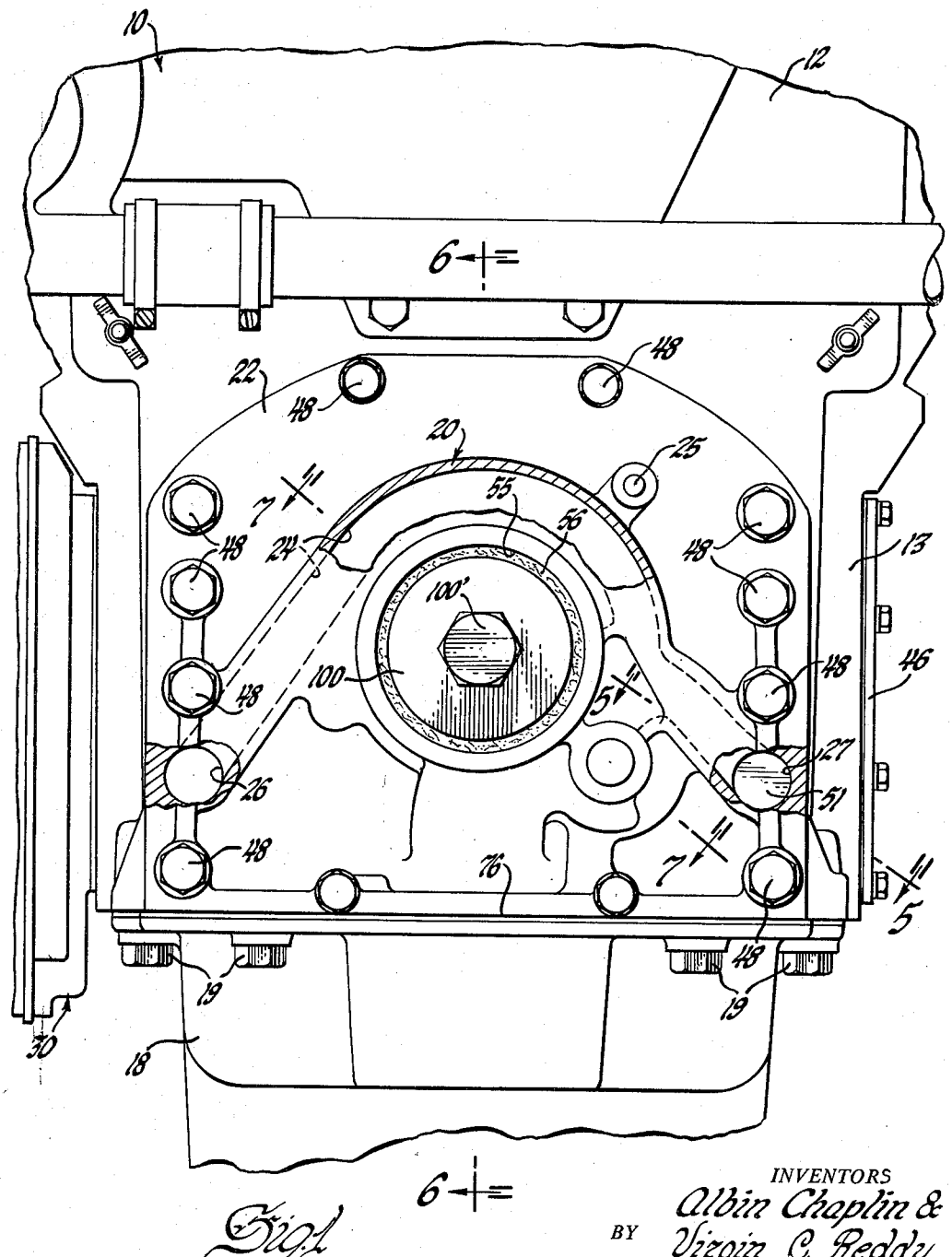


Fig. 1

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Filed March 24, 1960 4 Sheets-Sheet 2

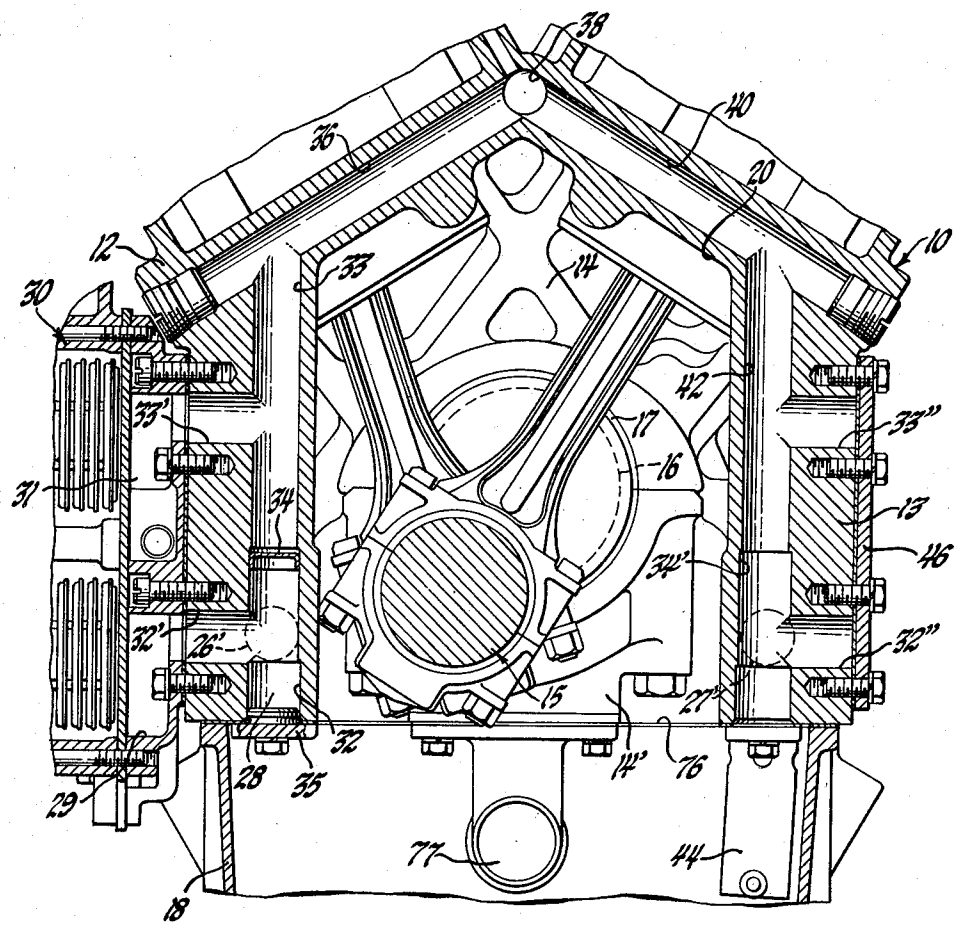


Fig. 2

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Filed March 24, 1960 4 Sheets-Sheet 3

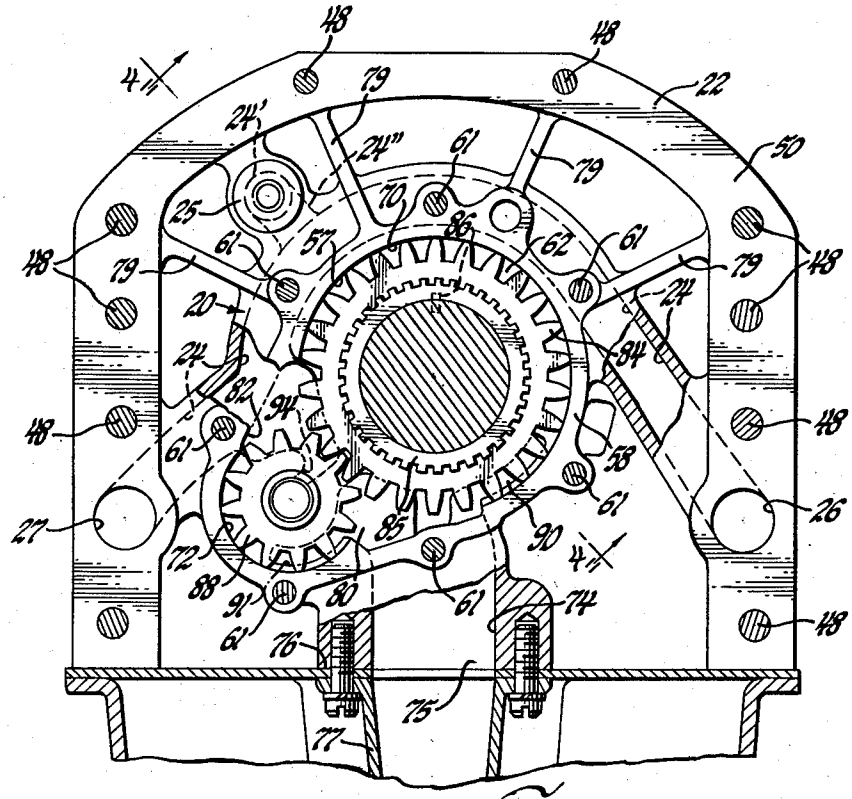


Fig. 3

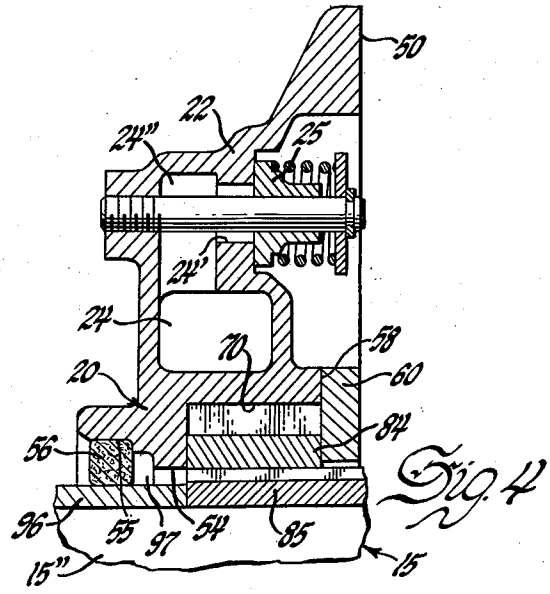


Fig. 4

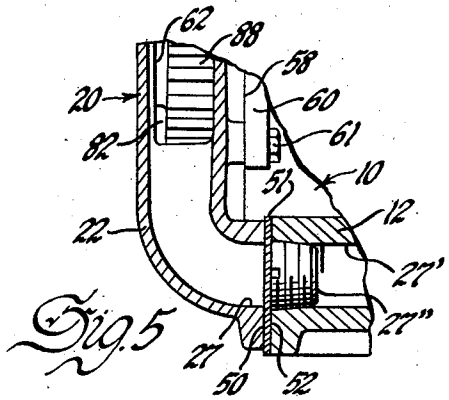


Fig. 5

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GEAR PUMP FOR INTERNAL COMBUSTION ENGINE AND THE LIKE

Filed March 24, 1960 4 Sheets-Sheet 4

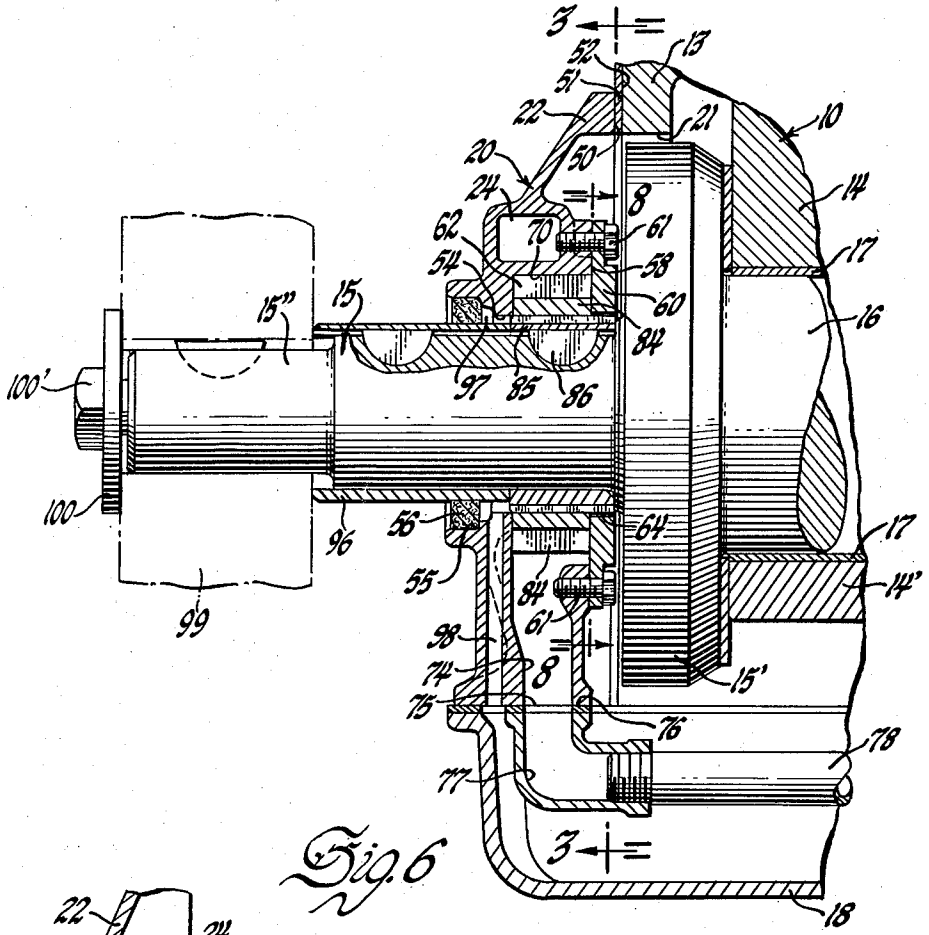


Fig. 6

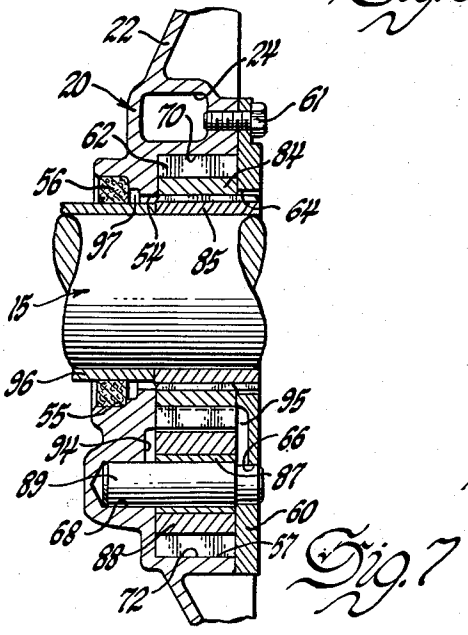


Fig. 7

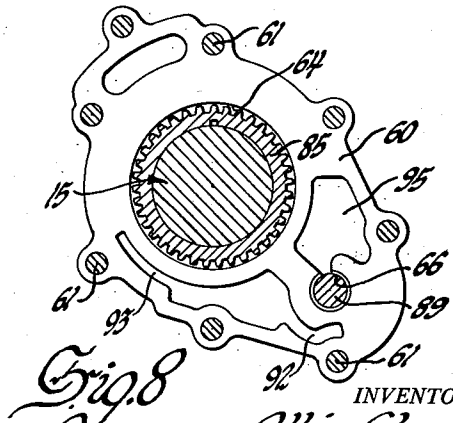


Fig. 8

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United States Patent Office

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3,096,849

GEAR PUMP FOR INTERNAL COMBUSTION ENGINE AND THE LIKE

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Filed Mar. 24, 1960, Ser. No. 17,402
12 Claims. (Cl. 184—6)

This invention relates to a pump; more particularly to a gear pump for hydraulic fluids; and with regard to certain more specific aspects thereof, to such a pump adapted to be directly driven off the crankshaft of the engine to supply pressurized oil through the lubricant distribution galleries of the associated engine.

The invention contemplates a gear pump having an improved inlet port arrangement increasing the pumping displacement and hence the volumetric efficiency of the pump unit; a gear pump having a relatively large diameter driving impeller gear meshing with a relatively small diameter driven impeller gear; and further a gear pump as indicated having a discharge passage defining an arch structurally reinforcing the pumping chamber portion of the pump housing relative to the supporting structure and providing alternative discharge outlet ports. In its more specific aspects, the invention further contemplates a gear pump particularly adapted to serve as a lubricant pressure supply pump for an internal combustion engine such as shown and described in copending United States Patent application Serial No. 1,488, filed January 11, 1960, in the names of Harold H. Albinson, George P. Hanley, Kenneth L. Hulsing, Harvey G. Humphries and John J. May, entitled "Two-Cycle Internal Combustion Engine." In such an engine installation, the invention contemplates such a pump having a relatively large primary impeller gear mounted directly on and driven by the crankshaft and meshing with a relatively small diameter valve impeller gear to provide pumping displacement between an inlet chamber and a discharge chamber intersecting the arch defining discharge passage which is connectable alternatively at opposite ends thereof with a port opening thereto and communicating with an arched oil distribution passage formed in the adjacent crankcase defining walls of the engine crankcase or frame.

The foregoing and other objects, advantages and features of the invention will become apparent from the following description of the preferred illustrative embodiment of the invention, reference being made therein to the several accompanying drawings, in which:

FIGURE 1 is a front elevational view showing a gear type crankshaft driven pump constructed in accordance with the invention with portions thereof broken away and shown in section, the pump being shown as mounted on the lower portion of an internal combustion engine which is preferably constructed as shown and described in the above-identified patent application;

FIGURE 2 is a transverse sectional view through the engine of FIGURE 1 and shows the symmetrical arched oil distribution passages formed in the front end thereof immediately adjacent to and mounting the pump of the invention;

FIGURE 3 is a view partially in section and partially in elevation showing the pump of the invention as taken

substantially in the direction of the arrows and in the plane of the line indicated at 3—3 of FIGURE 6;

FIGURE 4 is a sectional view taken substantially in the direction of the arrows and in the plane of the line indicated at 4—4 in FIGURE 3;

FIGURE 5 is a sectional view taken substantially in the direction of the arrows and in the plane of the line indicated at 5—5 in FIGURE 1;

FIGURE 6 is a sectional view taken substantially in the direction of the arrows and in the plane of the line indicated at 6—6 of FIGURE 1;

FIGURE 7 is a sectional view taken substantially in the direction of the arrows and in the plane of the line indicated at 7—7 in FIGURE 1; and

FIGURE 8 is a detail elevational view taken substantially in the direction of the arrows and in the plane of the line indicated at 8—8 in FIGURE 6.

Referring now in greater detail to the several drawings, an internal combustion engine is partially indicated at **10** and comprises a cylinder block or engine frame member **12** having a lower crankcase defining portion **13**. A crankshaft **15** having a plurality of spaced journal portions **16** thereon is rotatably supported within the crankcase by a plurality of spaced bearings **17** which are supported by webs **14** extending transversely of the crankcase and by bearing caps **14'** secured thereto. The crankshaft is provided with a radially extending flange **15'** forwardly of its front main journal and an end portion **15''** extending therefrom beyond the front end of the crankcase **13**. The flange **15'** has an engine and crankshaft balancing weight formed integrally and eccentrically thereof and provides a thrust bearing surface with the adjacent bearing arch and cap. The crankcase defining portion **13** of the cylinder block has a front opening **21** therein which is closed by a front cover member **22**. An oil pan **18** is secured to the coplanar bottom faces of the crankcase side walls and the cover member **22** by a plurality of bolts indicated at **19**.

The cover member **22** houses a gear-type pump indicated generally by the reference numeral **20**. In accordance with certain aspects of the invention, a crescent or arch-shaped discharge passage **24** extends transversely of the cover member. The passage **24** partially embraces a pumping chamber defined therein and intersects the pressure outlet chamber of the pump unit. The discharge pressure of the pump is maintained at a relatively constant level by a pressure regulating valve **25** which is spring biased against the discharge pressure fluid to regulate fluid by-pass flow to the crankcase through a port **24'** and a branch passage **24''** intersecting the discharge passage **24** intermediate its ends. The discharge passage **24** terminates in alternative pressure outlet ports **26** and **27**. These outlet ports are alignable with ports **26'** and **27'** opening to passages **28** and **42** respectively, extending vertically in the crankcase side walls immediately adjacent the pump mounting ends thereof. The block defined port **27'** is sealed by a closure plug **27''** and the port **26** of the cover member is connected through the cylinder block port **26'** to the lower portion **32** of the vertical passage **28**. The lower passage portion **32** is separated from an upper portion **33** of the passage **28** by a plug shown at **34**. A plug **35** closes the lower end of the passage **28** otherwise opening to the crankcase and

oil pan compartment of the engine. From the lower passage portion 32, the pump supplied pressurized lubricant passes through a port 32' in the crankcase side wall into the inlet chamber 29 of a combined oil cooler and filter unit which is indicated generally by the reference number 30. After passing through the filter and cooler unit 30, the lubricant is returned to the upper passage portion 33 in the cylinder block through the outlet chamber 31 of the unit 30 and a mating port 33' in the block side wall.

At their upper ends, the vertical passages 28 and 42 are intersected by passages 36 and 40, respectively, which extend obliquely and upwardly to a main oil distribution gallery 38. The gallery 38 extends longitudinally of the cylinder block in the median vertical plane thereof. A pressure regulating valve mechanism 44 closes the lower end of the vertical passage 42 and serves to control the distribution gallery pressure at a pressure level substantially less than that supplied to the oil filter and cooler unit 30.

The vertical passage 42 may be intersected by parallel and spaced ports 32'' and 33'' which correspond to and are coaxial with the ports 32' and 33' intersecting the passage 28. The several passages 28, 36, 40 and 42 thus define an oil distribution manifold or gallery of arched configuration which is substantially symmetrical with respect to the vertical median plane of the engine and extends transversely of the pump mounting front end of the engine crankcase. In the illustrative embodiment, the ports 32'' and 33'' are sealed by a closure plate 46 and the side face of the crankcase wall to which the closure plate 46 is secured is machined to provide an alternative mounting location for the oil filter and cooler unit on the side of the engine opposite that shown to accommodate various engine installation requirements. For such an alternative oil filter and cooler mounting, the closure plate 46 may be installed to seal the ports 32' and 33', the closure plug 35 and the gallery pressure regulating valve 44 may be interchanged, the closure plug 34 may be installed at 34' in the passage 42 leaving the vertical passages 28 unrestricted intermediate the ends thereof, and the port 26' plugged to seal the pump discharge port 26.

The cover member 22 is secured to the front of the cylinder block by a plurality of bolts 48 and has a peripheral flange having a U-shaped end face 50 which is sealed by an interposed gasket 51 with the mating front face 52 of the block adjacent the crankcase opening 21. The gasket 51 is backed by the plug 27'' to seal the pump outlet port 27. A bore 54 extends through the cover 22 and spacedly embraces the forwardly projecting end 15'' of the crankshaft. The bore 54 is counterbored at 55 to mount a suitable crankshaft seal 56. As best seen in FIGURE 3, an oval shaped recess 57 is formed in the back side of the cover member by an upstanding wall or flange terminating in an end face 58. Bolts 61 secured a plate 60 to the cover member to define a pumping chamber with the recess 57, the plate having sealing engagement with the end face 58 formed on the cover member adjacent to the recess 57. The transverse web or wall portion of the cover member and the plate 60 thus cooperate to define opposite end walls of the pumping chamber. The end face 58 is recessed relative to the block engaging face 50 so that the closure plate 60 is substantially flush with the block engaging face after assembly of the pump on the engine and is spaced slightly from the crankshaft balance weight flange 15'. The plate 60 has a crankshaft embracing bore 64 and a second relatively much smaller bore 66 extending therethrough. The axis of the bore 66 is in parallel spaced relation to the axis of the crankshaft and is coaxial with a bore 68 in the cover member. The pumping chamber recess 57 is defined by two intersecting counterbores 70 and 72, the counterbore 70 being formed on a relatively large radius about the crankshaft axis and the counterbore 72 being formed on a relatively much smaller radius about the common axis of the bores 66 and 68.

The pump housing cover member is cored to provide an inlet passage 74 which interconnects a port 75 opening on the bottom face 76 of the cover member and an inlet chamber 80 opening on the pumping chamber 62 intermediate the counterbores 70 and 72. The inlet port 75 is connected through a fitting 77 and a pipe 78 to the sump defined by the oil pan 18. The crescent-shaped discharge passage 24 is formed by similar coring of the cover member and extends transversely of the cover member between the cover member portions defining the vertical legs of the U-shaped block engaging face 52. The arch defining the passage 24 thus partially embraces the pumping chamber on its upper pressure discharge side and supports the pump chamber relative to the sides of the cover member. A plurality of ribs 79 extend radially between the discharge passage arch and the bight portion of the pump mounting arch defining the mounting face 50. Intermediate its ends the passage 24 intersects a pressure outlet chamber 82 which opens on the pumping chamber 62 intermediate the counterbores 70 and 72 on the side of the pumping chamber opposite the inlet chamber 80.

A relatively large impeller gear 84 is drivingly secured to the crankshaft within the larger counterbored portion of the pumping chamber 62 by an externally splined hub or sleeve member 85 which is in turn keyed to the crankshaft at 86. This drive mounting of the large impeller gear 84 permits assembly of the pump unit prior to its mounting on the front crankcase face of the assembled engine. The impeller gear 84 drivingly engages a substantially smaller impeller gear 88 which is journaled by a bearing 87 pressed therein on a pin shaft member 89 mounted in and extending between the aligned bores 66 and 68 in the cover member and closure plate, respectively. Outwardly, the teeth of the gears 84 and 88 are provided with fluid sealing running clearances with the pumping chamber surfaces defined by the recess counterbores 70 and 72, respectively, and the closure plate 60. The mating engagement of the gear teeth serves as a seal intermediate the inlet and outlet chambers. Variations in required pumping capacity may be provided by machining the blanks for the impeller gears 84 and 88 to provide a different number of teeth per gear and thus in the capacity and number of the individual pumping compartments between the several gear teeth.

Right-hand or counterclockwise rotation of the crankshaft, as viewed in FIGURE 3, causes the impeller gears to carry oil between the several gear teeth from the inlet chamber 80 to the outlet chamber 82. To insure maximum filling of the several pumping compartments defined between the several gear teeth against the centrifugal, cavitation-inducing forces acting on the oil, both the cover member 22 and the closure plate 60 are relieved arcuately at 90, 91 and 92, 93, respectively. These arcuate recesses or grooves provide extensions of the inlet chamber which open on opposite ends of the several tooth defined pumping compartments radially inwardly of the cylindrical surfaces defining the pumping chamber and adjacent the root lands of the impeller gears. This arcuate lengthening of the inlet chamber 80 not only increases the time interval during which the several gear teeth compartments are permitted to fill, but also change the direction of compartment fill from radial in the main inlet compartment to longitudinally thereof through the inlet grooves 90—93.

To provide lubrication for the bearing 87 journaling the small gear 88 on the pin shaft 89, the gear adjacent ends of the shaft mounting bores 66 and 68 are connected to the pressure outlet chamber 82 by grooved passages or extensions of recesses 94 and 95 formed in the cover member and closure plate, respectively. These recesses and their lubrication supplying extensions extend laterally of the gear tooth interengagement and terminate in a

plane extending diametrically and common to both gears. After the pump has been mounted in place on the engine, a spacer sleeve 96 is slidably mounted on the crankshaft portion 15'' and sealably abuts the impeller driving hub 85. The seal 56 is then inserted at the counterbore 55 and sealingly embraces the spacer sleeve 96. The spacer sleeves is maintained axially by a pulley or fan member indicated in broken lines at 99. The member is drivingly keyed and maintained on the crankshaft by a clamping washer 100 and bolt 100' secured to the crankshaft end. The annular chamber 97 defined between the seal 56 and the gear 84 and its drive hub 85 is connected to the crankcase through a vent passage 98 in the cover member. This is also vented to the crankcase through the spline clearances intermediate the gear 84 and its driving hub 85. These vent passages prevent the accumulation of lubricant pressure in the chamber 97 which would otherwise tend to force oil leakage past the seal 56.

From the foregoing description of a preferred illustrative embodiment, it will be seen that the invention accomplishes its several advantages and objectives in that it provides a crankcase cover member housing a relatively high capacity lubricant pump with alternate outlet porting for maximum engine accessory versatility within dimensional limits precluding the use of a conventional crankshaft driven gear pump of the type having internal and external gear rotors.

While the foregoing description of the invention has been limited to one illustrative embodiment thereof, it will be apparent to those skilled in the art that various changes and modifications might be made therein without departing from the spirit and scope of the invention, as defined in the following claims.

We claim:

1. In an internal combustion engine, a crankcase defining member having an opening at one end of said engine, said crankcase member having an oil distribution passage extending transversely between alternative fluid pressure inlet ports opening to said one end on opposite sides thereof, a crankshaft journaled by spaced bearing means carried by said crankcase defining member, a gear pump assembly secured to said crankcase member and closing said opening, said assembly comprising a combined closure and pump housing member having a peripheral flange mating with the end of said crankcase member, an end wall extending transversely intermediate said flange and a wall upstanding from said end wall in spaced relation inwardly of said peripheral flange, said upstanding wall having two intersecting cylindrical surfaces of substantial difference in radial dimension and partially defining an ovate periphery of a pumping chamber, a plate member secured to said upstanding wall and forming a second end wall cooperating with the walls of said housing member to define the ovate pumping chamber, said pump housing and cover plate member having a first pair of aligned bores therein spacedly embracing said crankshaft adjacent said one end and having a second pair of aligned bores therein extending in spaced parallel relation to the rotative axis of said crankshaft, a first impeller gear drivingly secured to said crankshaft within said pumping chamber, a journal pin suitably mounted in and extending between said second bores, a second impeller gear journaled on said pin within the pumping chamber, said impeller gears having fluid pumping gear tooth interengagement with each other and rotative sealing clearances with the pump chamber defining surfaces and cooperating with the pumping chamber intermediate said cylindrical surfaces to define inlet and discharge chambers on opposite sides of said gear engagement, said inlet chamber being connected to an oil sump of the engine and providing radial fill of the several gear tooth defined pumping compartments upon rotation of the gear teeth therethrough, and passage means defined by and extending transversely of said housing member between said discharge chamber and ports opening on opposite sides of said peripheral flange in mating relation to the pressure inlet ports of said engine crankcase defining member.

2. In the combination set forth in claim 1, said passage means defining an arch partially embracing and reinforcing the pressure discharge side of said pumping chamber and said housing member having a plurality of ribs extending radially of the crankshaft rotative axis between the peripheral flange and upstanding wall and housing defined passage.

3. In the combination set forth in claim 1, said pumping chamber end walls having a plurality of grooves opening on the pump chamber and extending arcuately from said inlet chamber through limited sectors and communicating radially inwardly with opposite ends of the gear teeth defined compartments of the impeller gears, said grooves providing arcuate extensions of said inlet chamber and being of a size to provide complementary fluid fill radially inwardly and longitudinally of the several gear tooth defined compartments passing through the sectors of said inlet chamber extensions.

4. In an internal combustion engine having a crankcase defining member rotatably supporting a chankshaft therein and having an opening at one end of said engine and an oil distribution passage extending transversely between alternative fluid pressure inlet ports opening to said one end on opposite sides thereof: a gear pump assembly secured to said crankcase member and closing said opening, said assembly comprising a combined closure and pump housing member having a peripheral flange mating with the open end of said crankcase member, a transversely extending end wall bounded by said flange, and a wall upstanding from said end wall in spaced relation inwardly of said peripheral flange, a second pump housing member secured to the open end of said upstanding wall and forming a second end wall cooperating with the walls of said first housing member to define an ovate pumping chamber, said upstanding wall having two spaced cylindrical surfaces of substantially different radial dimension forming opposite ends of the ovate pumping chamber, said pump housing members having a first pair of aligned bores therein concentric with the larger of said cylindrical surfaces and spacedly embracing said crankshaft adjacent said one end and having a second pair of aligned bores therein in spaced parallel relation to the rotative axis of said crankshaft and concentric with the smaller of said cylindrical surfaces, a first impeller gear drivingly secured to said crankshaft within said pumping chamber, a journal pin suitably mounted in and extending between said second bores, a second impeller gear journaled on said pin within the pumping chamber, said impeller gears having fluid pumping gear tooth interengagement with each other and rotative sealing clearances with the pump chamber defining surfaces and cooperating with the pumping chamber intermediate said cylindrical surfaces to define inlet and discharge chambers on opposite sides of said gear engagement, said inlet chamber being connected to the oil sump of the engine and providing radial fill of the several gear tooth defined pumping compartments upon rotation of the gear teeth therethrough, and passage means defined by and extending transversely of said first housing member between said discharge chamber and ports opening on opposite sides of said peripheral flange and mating with the pressure inlet ports of said crankcase defining member, said passage means defining an arch partially embracing and reinforcing the pressure discharge side of said pumping chamber and said first housing member having a plurality of ribs extending radially of the crankshaft rotative axis between said peripheral flange and said upstanding wall and housing defined passage.

5. In the combination set forth in claim 4, said end walls having a plurality of grooves opening on their pump chamber defining surfaces and extending arcuately from said inlet chamber through limited sectors and communicating radially inwardly with opposite ends of the gear

teeth defined compartments of the impeller gears, said grooves providing arcuate extensions of said inlet chamber and being of a size to provide complementary fluid fill radially inwardly and longitudinally of the several gear tooth defined compartments passing through the sector of said inlet chamber extensions.

6. In the combination set forth in claim 5, said pump chamber defining end walls having recesses opening on the discharge chamber and extending therefrom laterally of said gear tooth engagement to supply lubricant to said journal pin and terminating in a diametrical plane common to both impeller gears.

7. In a gear pump, a housing defining a pumping chamber, two impeller gears rotatably supported within said housing and having rotative sealing clearances with spaced housing end wall surfaces and a peripheral wall surface defining said pumping chamber, said impeller gears having fluid pumping gear tooth engagement with each other and dividing said pumping chamber into an inlet chamber and a discharge chamber opening on opposite sides of said gear engagement and extending through limited sectors of said gears immediately adjacent thereto, said inlet chamber providing primary radial fill of the several gear tooth defined pumping compartments upon rotation therethrough, said housing having a plurality of grooves opening on said end wall surfaces and extending arcuately through limited sectors from said inlet chamber at opposite ends of the gear teeth defined compartments of the impeller gears, said grooves each being radially dimensioned to open on the inner root portion of said compartments between an inner groove defining wall immediately adjacent and coextensive with the inner root lands of the adjacent impeller gears and an outer groove defining wall radially spaced inwardly of the peripheral wall of the pumping chamber, said grooves providing arcuate extensions of said inlet chamber of a depth to provide complementary fluid fill radially inwardly and longitudinally of the several gear tooth defined compartments upon passing through the sectors of said inlet chamber extensions.

8. In a gear pump, a housing defining a pumping chamber of ovate cross-section, two impeller gears of corresponding difference in radial dimension rotatably supported within said housing and having rotative sealing clearances with spaced housing end wall surfaces and a peripheral wall surface defining said pumping chamber, said impeller gears having fluid pumping gear tooth engagement with each other and rotative sealing clearances outwardly with said pumping chamber surfaces and dividing said pumping chamber into fluid inlet and discharge chambers opening on opposite sides of said gear engagement and extending through limited sectors of said gears immediately adjacent thereto, said inlet chamber providing primary radial fill of the several gear tooth defined pumping compartments upon rotation therethrough, said housing having a plurality of grooves opening on said end wall surfaces and extending arcuately through limited sectors from said inlet chamber adjacent opposite ends and radially inwardly of the gear teeth defined compartments of the impeller gears, said grooves opening on said compartments radially inwardly of the peripheral wall of the pumping chamber and immediately adjacent the inner root lands of the impeller gears and providing arcuate extensions of said inlet chamber of a size to provide complementary fluid fill radially inwardly and longitudinally of the several gear tooth defined compartments upon passing through the sectors of said inlet chamber extensions, and said housing end walls having recesses opening to said discharge chamber and extending laterally of the gear tooth interengagemnt and terminating in a diametrical plane common to both of said impeller gears.

9. In a gear pump, a housing defining a pumping chamber of ovate cross-section extending between two spaced parallel end walls and a peripheral wall having two spaced cylindrical surface portions of different radial dimensions, two impeller gears rotatably supported within said housing and having rotative sealing clearances outwardly with the cylindrical surface portions and fluid pumping gear tooth interengagement dividing said pumping chamber into fluid inlet and discharge chambers opening on opposite sides of and extending through limited sectors of said gears adjacent said gear engagement, said inlet chamber providing radial fill of the several gear tooth defined pumping compartments upon rotation therethrough, and said end walls having recesses extending arcuately from said inlet chamber through limited sectors adjacent to and opening on the gear teeth defined compartments of said impeller gears, each of said recesses being radially dimensioned to open on the inner root portion of said compartments between an inner groove defining wall immediately adjacent and coextensive with the inner root lands of the adjacent impeller gears and an outer groove defining wall radially spaced inwardly of the cylindrical portion of the peripheral wall, said recesses providing arcuate extensions of said inlet chamber of a depth to provide substantially unrestricted fluid fill radially inwardly and longitudinally of the several gear tooth defined compartments upon passing through the sectors of said inlet chamber extensions.

10. In an internal combustion engine having a crankcase member rotatably supporting a crankshaft and defining an oil receiving sump chamber, said crankcase member being open at one end of said engine and having an oil distribution passage extending transversely between alternate inlet ports opening on opposite sides of said one end. an oil supply gear pump comprising a first housing member secured to and closing the open end of said crankcase member, a second housing member secured to and cooperating with said first housing member to define an ovate pumping chamber disposed obliquely to said crankcase opening and having two spaced and opposed cylindrical surfaces of substantially different radial dimensions, said pump housing members having aligned bores therein concentric with the larger of said cylindrical surfaces and embracing the adjacent end of said crankshaft, a first impeller gear drivingly secured to said crankshaft within said pumping chamber, a second impeller gear journaled within the pumping chamber in spaced parallel relation to the crankshaft rotative axis, the gear teeth of said impeller gears having fluid pumping interengagement and rotative sealing clearances with the pump chamber defining surfaces and cooperating with the pump chamber to define inlet and discharge chambers on opposite sides of said gear engagement, said inlet chamber being connected to the oil sump of the engine and passage means defined by one of said housing members and extending transversely between said discharge chamber and alternate pressure inlet ports of said crankcase member.

11. In an internal combustion engine as set forth in claim 10, the passage means of said gear pump defining an arch partially embracing and reinforcing the pressure discharge side of the pumping chamber and said one housing member having a plurality of ribs extending radially of the crankshaft rotative axis and reinforcing said housing defined passage and arch.

12. In an internal combustion engine having a crankcase member rotatably supporting a crankshaft and defining an opening at one end of said engine and having an oil distribution passage extending transversely between alternate inlet ports opening on opposite sides of said one end: a gear pump comprising a housing secured to and closing the open end of said crankcase member and defining an ovate pumping chamber disposed obliquely to said crankcase opening, said pumping chamber having two spaced and opposed cylindrical surfaces of substantially different radial dimension, the larger of said cylindrical surfaces being concentric with said crankshaft and said housing having aligned bores therethrough embracing the adjacent end of said crankshaft, a first impeller gear drivingly secured to said crankshaft within said pumping chamber, a second impeller gear journaled within the

pumping chamber in spaced parallel relation to the crankshaft rotative axis, said impeller gears having fluid pumping gear tooth engagement and rotative sealing clearances with the pump chamber defining surfaces and cooperating with the pump chamber to define inlet and discharge chambers on opposite sides of said gear engagement, said inlet chamber being connected to the oil sump of the engine, and passage means extending transversely of said housing between said discharge chamber and alternate pressure inlet ports of said crankcase member and defining an arch partially embracing and reinforcing the pressure discharge side of the pumping chamber.

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