

Sept. 11, 1956

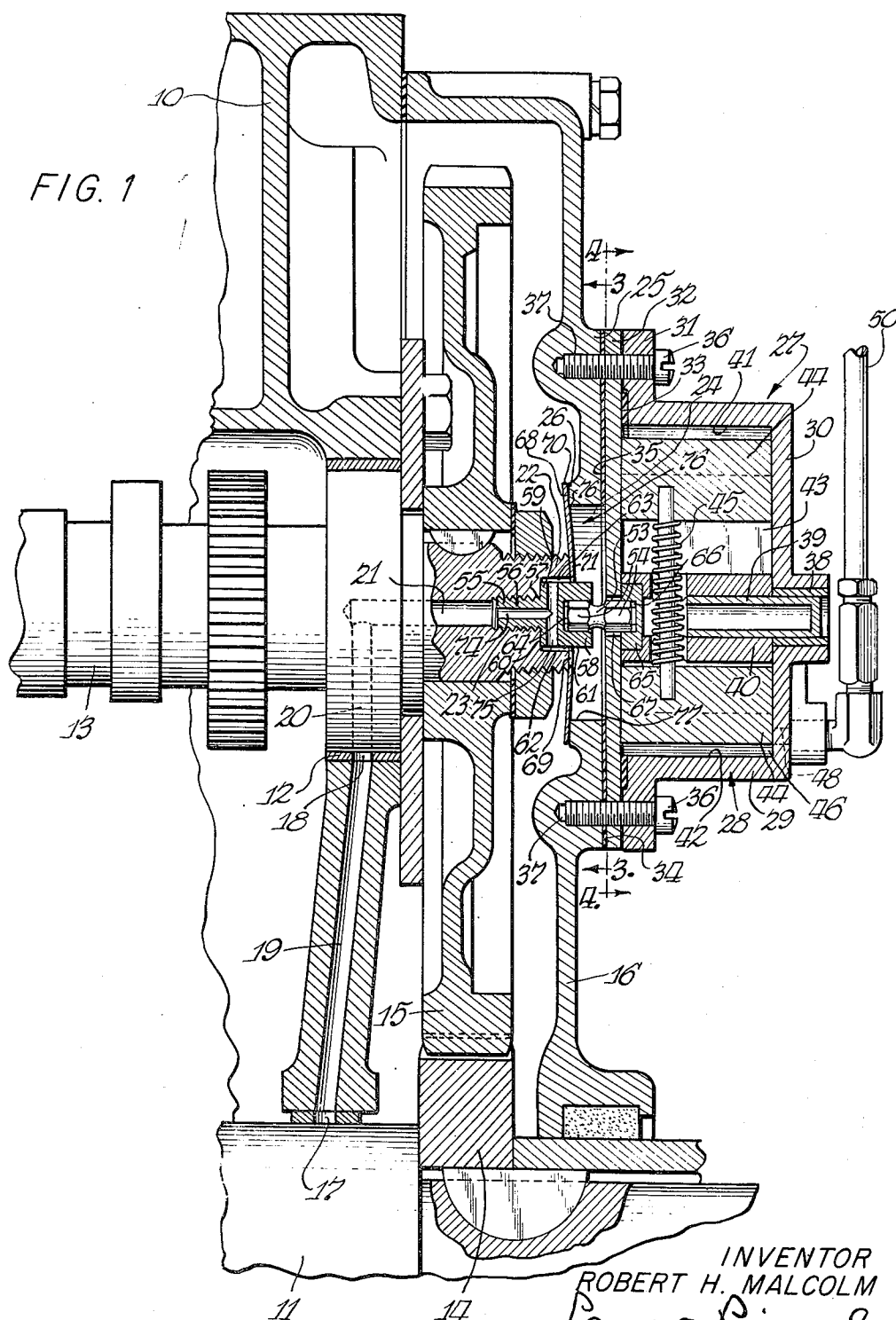
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2,762,349

PUMP DRIVE AND LUBRICATION

Filed July 31, 1953

2 Sheets-Sheet 1



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FIG. 2

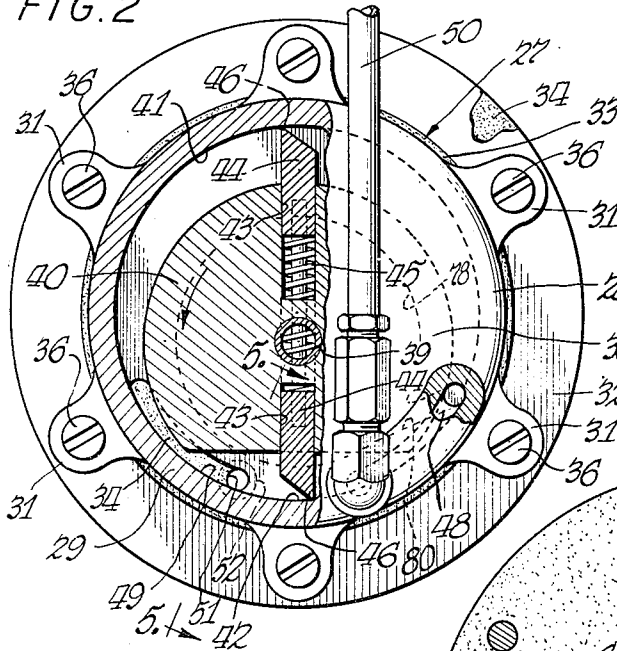


FIG. 5

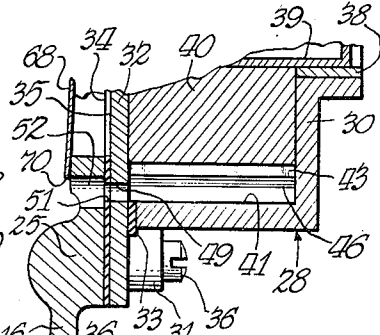


FIG. 3

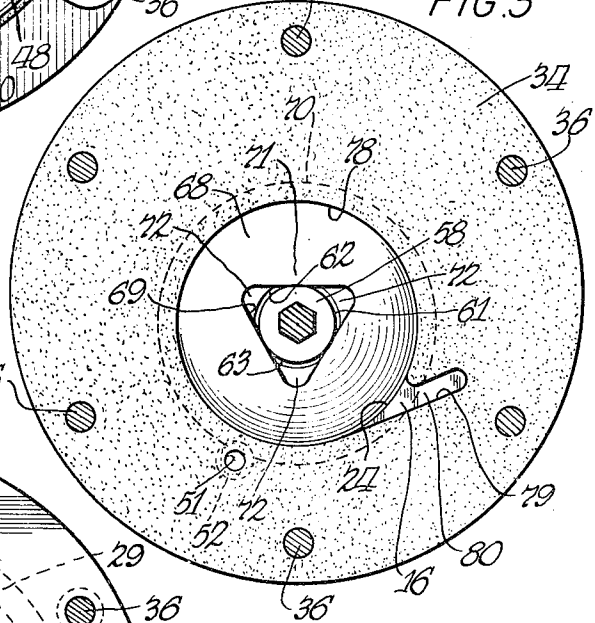
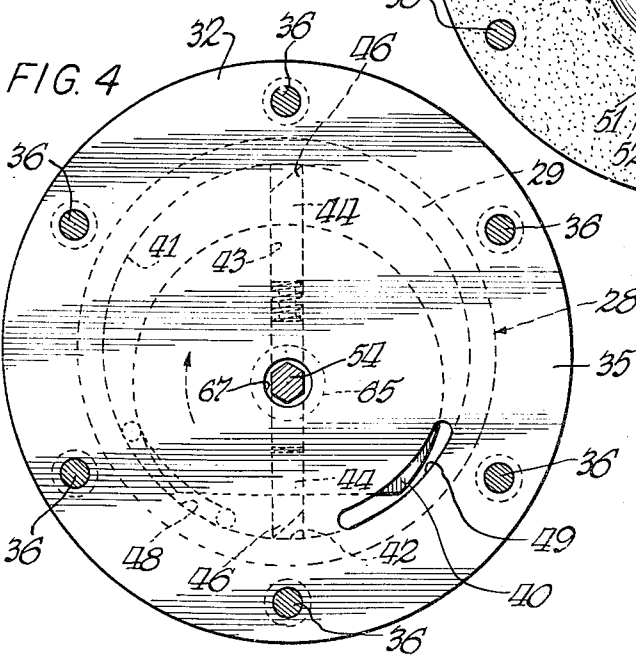


FIG. 4



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PUMP DRIVE AND LUBRICATION

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12 Claims. (Cl. 123—41.86)

This invention relates to air pumps used to operate various internal combustion engine accessories, and more particularly to the novel means for driving and lubricating the pump from the engine.

The principal object of the present invention is the provision of simple, efficient, and economical means for driving and lubricating an air pump by an internal combustion engine without the need of unduly modifying the engine structure.

A further object is to provide a rotary type air pump supported on the exterior of the engine housing and novel means for drivingly interconnecting the pump rotor and the engine camshaft.

A still further object is to provide means for supplying lubricating oil to an engine-driven air pump from the pressure lubricating system of the engine whereby the quantity of oil received by the pump for lubricating the moving parts thereof and for sealing the pressure side of the pump from the suction side is accurately controlled.

An important object is to direct and control the lubricating oil supply to an engine-driven air pump whereby a controlled quantity of lubricating oil is introduced at the periphery of the pump rotor and the amount is sufficient to maintain the desired seal between the pump housing and the pump rotor without materially decreasing the air displacement capacity of the pump.

Still another object is the provision of improved simple and efficient means for effectively sealing one end of a relatively rotatable shaft and a spaced wall to preclude the egress of lubricant from an oil reservoir partially defined by the shaft and wall which includes a relatively thin flexible and resilient annular disk bridging the space between the shaft end and the wall.

Another important object is the provision of a rotary-type pump supported on the exterior of an internal combustion engine housing and shaft means for detachably drivingly interconnecting the pump and the engine camshaft.

The foregoing and other important objects and desirable features inherent in and encompassed by the invention, together with many of the purposes and uses thereof will become readily apparent from a reading of the ensuing description in conjunction with the annexed drawings, in which:

Figure 1 is a fragmentary vertical sectional view taken longitudinally of an internal combustion engine;

Figure 2 is an end view of the pump, partially broken away and in section to better illustrate the invention;

Figure 3 is a sectional view taken substantially along line 3—3 of Figure 1;

Figure 4 is a sectional view taken substantially along line 4—4 of Figure 1; and

Figure 5 is an enlarged sectional view taken substantially along line 5—5 of Figure 2.

Referring to the drawings in detail, wherein like reference characters designate like elements throughout the various views, there is shown a fragment of an internal combustion engine block having an end wall 10 in which

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a bearing (not fully shown) is secured for journaling one end of a crankshaft 11. The wall 10 also carries a bearing 12 in which is journaled one end of a camshaft 13, as shown in Figure 1. Keyed to the crankshaft 11 exteriorly of the wall 10 is a gear 14 which meshes with a relatively larger gear 15 keyed to the camshaft 13. The gears 14 and 15 constitute the engine timing gears. A detachable cover 16 encloses the timing gears 14 and 15.

The crankshaft bearing has an annular groove 17 (partially shown) formed therein which, in any appropriate manner, is supplied with lubricating oil from the engine crankcase under pressure, by means of the usual oil pump mechanism (not shown) provided for that purpose. A similar annular groove 18 is provided in the camshaft 13 and the grooves 17 and 18 are in fluid communication by means of a passageway 19. A radial passage 20, formed in the camshaft 13, leads from the bearing groove 18 to an axially extending duct 21. From the foregoing, it will be appreciated that oil under pressure is fed to the axial duct 21 from the crankshaft bearing groove 17 by way of the passageway 19, groove 18, and the radial passage 20. The extreme end of the camshaft 13 is counterbored, as shown in Figure 1, and the axial duct 21 adjacent to the counterbored portion 22 has screw threads 23 cut therein for a purpose which will be explained hereinafter.

The cover 16 enclosing the timing gears 14 and 15 is provided with an opening 24 coaxial with the camshaft 13. Encircling the opening 24 on the exterior of the cover 16 is a raised, annular boss 25, which serves as an accessory attachment pad. Similarly, an annular lip 26 is provided on the inner side of the cover 16. It will be noted that the diameter of the camshaft 13 is smaller than the diameter of the opening 24.

Although a specific illustration of a form of pump to be attached to the engine is to be described hereinafter, it is to be understood that any rotary-type pump capable of operating in a like manner for delivering air or liquid under pressure could be used in lieu thereof without departing from the spirit and scope of the invention. Likewise, the fact that the particular pump shown and to be described is used to deliver air under pressure to the engine crankcase to ventilate the same, such use is not to be construed as limiting the application of the invention solely to that use. The pump, designated generally by numeral 27, includes a casing or housing 28, which, in turn, comprises a cylindrical section 29 and an integrally formed end wall 30. The end of the section 29 opposite the wall 30 is provided with a plurality of circumferentially spaced tabs 31 against which the peripheral edge of an end plate 32 is adapted to bear. A ring-like gasket 33 of cork and rubber or like material is interposed between the mating surfaces to seal the joint between the plate 32 and the section 29. As best shown in Figure 1, a relatively thin gasket 34 engages the outer surface of the boss 25 and the inwardly facing surface 35 of the end plate 32. A plurality of bolts 36 extending through the tabs 31, plate 32, and gasket 34 into engagement with threaded recesses 37 formed in the cover 16, are used to attach the pump 27 to the engine and to assemble the parts of the pump casing 28 together.

A bearing 38 is carried by the end wall 30 in which one end of a tubular shaft 39 is journaled. A pump rotor 40 is secured to the shaft 39 for rotation therewith and is positioned eccentrically with respect to the interior of the casing 28, as shown in Figures 1, 2, and 4, whereby it bears against the inner surface 41 of the section 29 at one point such as 42. The rotor 40 is provided with a pair of diametrically disposed, radial slots 43 in which a pair of pumping elements 44 are slidably mounted. The pumping elements 44 are constantly urged radially, outwardly of the rotor 40 by a coil spring 45 held under

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compression between them. It will be appreciated from the foregoing that the extreme outer edges 46 of the pumping elements 44 slidably engage the inner surface 41 of the cylindrical section 29. The wall 30 of the casing 28 is provided with circumferentially extending slot 48 disposed on one side of a plane containing point 42 and the rotational axis of the rotor 40. A similar slot 49 is formed in the plate 32 on the opposite side of the plane. The slot 48, being on the suction side of the pump, serves as an air inlet and is in fluid communication with a pipe 50 leading from an air source (not shown). One end of the slot 49 is in registration with aligned apertures 51 and 52 provided in the gasket 34 and the cover 16, respectively. It will be appreciated from the foregoing, that as the rotor 40 is rotated air is drawn into the casing 28 through the pipe 50 and slot 48 and delivered under pressure to the interior of the engine through slot 49 and apertures 51 and 52.

A novel coupling structure for driving the pump 27 from the camshaft 13 is provided which includes a connecting member 53 having its end portions 54 hexagonal in shape. It is to be understood that the end portions could be square or rectangular in shape rather than hexagonal without departing from the spirit and scope of the invention. The shank portion 55 of an adapter element 56 is provided with external threads 57 which are engageable with the threads 23 formed in the axial duct 21 to secure the adapter element 56 to the end of the camshaft 13. Integrally formed with the shank portion 55 is an enlarged portion 58 having a radially extending surface 59 adapted to abut the shoulder surface 60 of the camshaft counterbored portion 22. The outer peripheral surface 61 of the enlarged portion 58, which is cylindrical in shape, is radially spaced from the surface 62 of the counterbored portion 22 to provide an annular space 63, the purpose of which will be explained hereinafter. As best shown in Figures 1 and 3, a hexagonally-shaped, axially opening recess 64 is provided in the enlarged portion 58 for receiving one end portion 54 of the connecting member 53. A socket member 65 suitably secured to the pump rotor 40 is provided with a like recess 66 for receiving the opposite end 54 of the connecting member 53 which bridges the axial space between the socket member and the adapter element 56 and extends through a central opening 67 in the plate 32. It will be appreciated that the coupling structure described above affords a simple, efficient means for drivingly interconnecting the engine camshaft 13 and the pump 27.

As stated hereinbefore, the present invention contemplates the provision of means for supplying lubricating oil to the pump 40 from the pressure lubricating system of the engine in such a manner that the quantity received by the pump for lubricating the relative parts thereof and for sealing the pressure side of the pump from the suction side is accurately controlled. The quantity of oil flowing to the pump 40 is limited to an amount necessary to provide an adequate seal between the pressure and discharge sides of the pump and to provide proper lubrication of the moving parts. By limiting the quantity of oil flowing to the pump 40, overlubrication of the pump and its resulting adverse effect on the pumping capacity and efficiency of the pump is avoided. The means for supplying the pump 40 with lubricating oil and for controlling the supply includes a relatively thin, flexible disk 68 having a triangular opening 69 in the center thereof. The disk 68 is of the type of spring which is normally flat when not in use but is capable of being deformed, which deformation it yieldably resists, into the shape of a disk when the outer periphery 70 thereof is moved relatively to the center portion thereof. As best shown in Figures 1 and 3, the enlarged portion 58 of the adapter element 56 extends through the triangular opening 69 and the surface 71 of the disk 68 encircling the opening 69 is adapted to bear against the end of the camshaft 13. Referring to Figure 3, it will be noted that the diameter

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of the enlarged portion 58 is such that it completely fills the area of the opening 69 except for the three circumferentially spaced areas 72. The outer peripheral edge 70 of the disk 68 firmly abuts the annular lip 26 and the disk is caused to assume a disk shape. It will be appreciated that although the camshaft 13 rotates relatively to the cover 16 and is radially spaced therefrom the disk 68 continually bridges the radial space.

The shank portion 55 is provided with a central axial passage 74 which establishes lubricant communication between the axial duct 21 and a radial duct 75 formed in the enlarged portion 58 of the adapter element 56. Oil received in the radial duct 75, which oil is under pressure, flows to the annular space 63, through the areas 72, to a lubricant reservoir, designated generally by numeral 76. One wall of the lubricant reservoir 76 is formed by the disk 68 and by virtue of the construction and arrangement of the disk 68, described hereinbefore, egress of lubricant from the reservoir 76 between the disk and the cover 16 and between the disk and the end of the camshaft 13 is precluded. The lubricant reservoir 76 is further defined by annular surface 77 of the cover 16 outlining the opening 24 and the pump plate 32.

The gasket 34 is provided with a central circular opening 78 having a diameter substantially equal to the diameter of opening 24 formed in the cover 16. As best shown in Figure 4, an elongated slot 79, formed in the gasket 34, extends from the opening 78 to the inner surface 41 of the cylindrical section 29. It will also be noted that the outer terminal end of the slot 79 is in axial alignment with one end of the slot 48, which, as pointed out hereinbefore, is on the suction side of the pump 40. It will be appreciated, therefore, that the slot 79 serves as a restricted passage 80 for establishing lubricant communication between the lubricant reservoir 76 and a point on the inner surface 47, which point is disposed on the suction side of the pump 40.

In operation, lubricating oil delivered to the axial duct 21 in the camshaft 13 from the engine pressure lubricating system flows under pressure through axial passage 74 in the shank portion 55 of the adapter element 56. The oil then flows to the annular space 63 by way of the radial duct 75 formed in the enlarged portion 58. The oil received in the annular space 63 is discharged into the lubricant reservoir 76 through the areas 72 with a consequent drop in pressure. Inasmuch as the lubricant reservoir 76 is in communication with the low pressure or suction side of the pump 40, oil is drawn through the elongated slot 79 for sealing the pressure side from the suction side and for lubricating the sliding engagement surfaces of the pump. It will be appreciated that since the thickness of the gasket 34 is relatively small and the width of the slot 79 when compared to its length is also small, the cross sectional area of the passage 80 is consequently small and tends to restrict the flow of lubricant therethrough regardless of the pressure differential between the subatmospheric pressure developed by the pump and the pressure existing in the reservoir 76. The oil received within the pump 40 is discharged with the air delivered to the interior of the engine through slot 49 and apertures 51 and 52.

The embodiment of the invention chosen for the purposes of illustration and description herein is that preferred for achieving the objects of the invention and developing the utility thereof in the most desirable manner, due regard being had to existing factors of economy, simplicity of design and construction, and the improvements sought to be effected. It will be appreciated, therefore, that the particular structural and functional aspects emphasized herein are not intended to exclude, but rather to suggest, such other adaptations and modifications of the invention as fall within the spirit and scope of the invention is defined in the appended claims.

What is claimed is:

1. In an internal combustion engine having a pressure-

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type lubrication system and including a bearing adapted to receive lubricating oil under pressure from said lubricating system, and an end wall contiguous to said bearing provided with a circular opening in alignment with said bearing, said opening being encircled by an annular boss formed on the exterior surface of said end wall, the combination comprising: an engine-driven shaft having one end journaled in said bearing; a pump mounted on said annular boss including a cylindrical housing adapted to cover said opening and a rotor having peripherally spaced pumping elements in sliding engagement with a portion of the inner surface of said housing, said rotor being eccentrically journaled in said housing and having one end axially spaced from and aligned with said shaft end; means for drivingly interconnecting said rotor and shaft; and means for supplying lubrication oil to said pump from said bearing to lubricate the sliding engagement surfaces of said pumping elements and said housing including a lubricant reservoir axially spaced between said pump and bearing, oil passage means for conducting oil under pressure to said lubricant reservoir from said bearing, and a restricted passage means extending from said lubricant reservoir to said sliding engagement surface of said housing, said last mentioned means including a relatively thin gasket member disposed between said pump housing and said annular boss having an elongated slot formed therein, one end of said slot being in liquid communication with said lubricant reservoir and its opposite end being registered with an aperture formed through a wall of said housing adjacent said sliding engagement surface.

2. The combination as set forth in claim 1, in which said lubricant reservoir is partially defined by a relatively thin flexible and resilient disk having a central opening therethrough, the annular surface of said disk encircling said opening being adapted to frictionally engage said shaft end and the outer peripheral edge of said disk being adapted to frictionally engage said end wall.

3. In an internal combustion engine having a pressure-type lubricating system and including a bearing adapted to receive lubricating oil under pressure from said lubricating system, and an end wall contiguous to said bearing provided with a circular opening in alignment with said bearing, the combination comprising: an engine-driven shaft journaled in said bearing; a pump mounted on the exterior of said wall including a cylindrical housing adapted to cover said opening and a rotor having peripherally spaced pumping elements in sliding engagement with a cylindrical portion of the inner surface of said housing, one portion of the volume enclosed by said housing having a relatively low pressure and the remaining volume having a relatively high pressure when said rotor is driven, a wall portion of said housing adjacent said cylindrical portion being provided with an aperture therethrough having one end thereof opening into the portion of the volume enclosed by said housing having a relatively low pressure, said rotor being eccentrically journaled in said housing and having one end axially spaced from and aligned with one end of said shaft; means for drivingly interconnecting said rotor and shaft; and means for supplying lubricating oil to said pump from said bearing to lubricate the sliding engagement surfaces of said pumping elements and said housing including oil passage means extending between said bearing and one end of said aperture formed through said housing wall portion whereby lubricating oil is drawn into said housing through said aperture at a point adjacent said sliding engagement surface by virtue of the relatively low pressure developed when said rotor is driven.

4. The combination as set forth in claim 3, in which the axially spaced ends of said rotor and said shaft are each provided with an axially extending recess having a hexagonal cross section in a plane normal to the axis of rotation; and said means for drivingly interconnecting

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said rotor and said shaft includes a connecting member bridging the axial space between said ends of said rotor and shaft and having each end provided with hexagonally shaped portion insertable in a respective recess, said connecting member extending through a section of said oil passage means.

5. The combination as set forth in claim 4, in which said oil passage means includes a lubricant reservoir axially spaced between said pump and bearing through which said connecting member extends, an oil passage for conducting oil under pressure to said lubricant reservoir from said bearing, and a restricted passage leading from said lubricant reservoir to one end of said aperture formed in said housing wall portion adjacent said cylindrical portion of said housing.

6. In an internal combustion engine having a pressure lubricated bearing and a wall spaced from said bearing provided with a circular opening in alignment with said bearing, the combination comprising an engine-driven shaft journaled in said bearing; a pump mounted on the exterior of said wall having a low pressure, suction side and a high pressure, discharge side including a cylindrical casing having a cylindrical inner surface portion adapted to cover said opening and a rotor having peripheral elements in sliding engagement with said cylindrical inner surface portion of said casing, a wall portion of said casing adjacent said cylindrical inner surface portion being provided with an aperture therethrough having one end thereof opening into the low pressure, suction side of said pump; detachable means for drivingly interconnecting said shaft and said rotor; and means for supplying lubricant to the cylindrical sliding engagement surface of said casing from said bearing including lubricant passage means extending between said bearing and one end of said aperture whereby lubricant is drawn into said casing through said aperture by virtue of the low pressure developed on the suction side of the pump when said rotor is driven.

7. In an internal combustion engine having a pressure lubricated bearing and a wall spaced from said bearing provided with a circular opening in alignment with said bearing, the combination comprising: an engine-driven shaft journaled in said bearing having one end thereof provided with a socket facing said wall; a pump mounted on the exterior of said wall having a low pressure, suction side and a high pressure, discharge side including a cylindrical casing adapted to cover said opening and a rotor having peripheral elements in sliding engagement with a cylindrical inner surface portion of said casing, said casing including a wall portion adjacent said cylindrical inner surface portion provided with an aperture therethrough having one end thereof opening into the low pressure, suction side of said pump, said rotor being provided with a socket in axial alignment with and facing said shaft socket; a connecting member having each of its ends inserted in a respective socket; and means for supplying lubricant to the sliding engagement surface of said casing from said bearing including lubricant passage means extending between said bearing and one end of said aperture whereby lubricant is drawn into said casing through said aperture by virtue of the low pressure developed on the suction side of said pump when said rotor is driven, said connecting member extending through a section of said lubricant passage means.

8. The combination as set forth in claim 7, in which said lubricant passage means includes a lubricant reservoir axially spaced between said pump and bearing, an oil passage for conducting oil under pressure to said lubricant reservoir from said bearing, and a restricted passage connecting said lubricant reservoir and one end of said aperture formed in said casing wall portion adjacent said cylindrical inner surface portion.

9. In an internal combustion engine having a rotatable shaft journaled in a pressure lubricated bearing, one end of said shaft being provided with a socket, and a pump

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mounted on a wall of said engine having a low pressure, suction side and a high pressure, discharge side, said pump including a rotor provided with a socket in axial alignment with and spaced from said socket provided in the end of said shaft, the combination comprising, means for supplying lubricant to said pump from said bearing including lubricant passage means extending between said bearing and the low pressure, suction side of said pump comprising a lubricant reservoir axially spaced between said pump and bearing having one wall thereof including a relatively thin flexible and resilient disk having a central opening therethrough, the annular surface of said disk encircling said opening being adapted to frictionally engage said shaft end adjacent the socket therein and the outer edge of said disk being adapted to frictionally engage said end wall, said lubricant passage means further including an oil passage for conducting oil under pressure to said lubricant reservoir from said bearing, and a restricted passage connecting the low pressure, suction side of said pump and said lubricant reservoir; and detachable means for drivingly interconnecting said shaft and pump including a connecting member extending through said lubricant reservoir having each of its ends inserted in a respective socket.

10. In an internal combustion engine having a rotatable shaft journaled in a pressure lubricated bearing, and a pump having a low pressure, suction side and a high pressure, discharge side mounted on a wall of said engine, the combination comprising, means for supplying lubricant to said pump at the low pressure, suction side thereof from said bearing including a lubricant reservoir axially spaced between said pump and bearing, oil passage means for conducting oil under pressure to said lubricant reservoir from said bearing, and a restricted

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passage connecting the low pressure, suction side of said pump and said lubricant reservoir, said lubricant reservoir being partially defined by a relatively thin flexible and resilient disk having a central portion thereof abutting one end of said shaft and its outer peripheral edge abutting said wall of said engine.

11. The combination substantially as set forth in claim 10, in which, detachable means for drivingly interconnecting said shaft and pump are provided, said means including a connecting member extending axially through said lubricant reservoir having its ends operatively connected respectively to said pump and said shaft.

12. In an internal combustion engine having a rotatable shaft journaled in a pressure lubricated bearing, and a pump mounted on a wall of said engine having a low pressure, suction side and a high pressure, discharge side, the combination comprising, means for supplying lubricant to said pump from said bearing including a lubricant passage means extending between said bearing and low pressure, suction side of said pump; and detachable means for drivingly interconnecting said shaft and pump including a connecting member coaxial with respect to said shaft and extending through a section of said lubricant passage means, said connecting member having its ends operatively connected respectively to said shaft and said pump.

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