June 17, 1941. W. W. DAVIDSON 2,246,273

ROTARY PUMP

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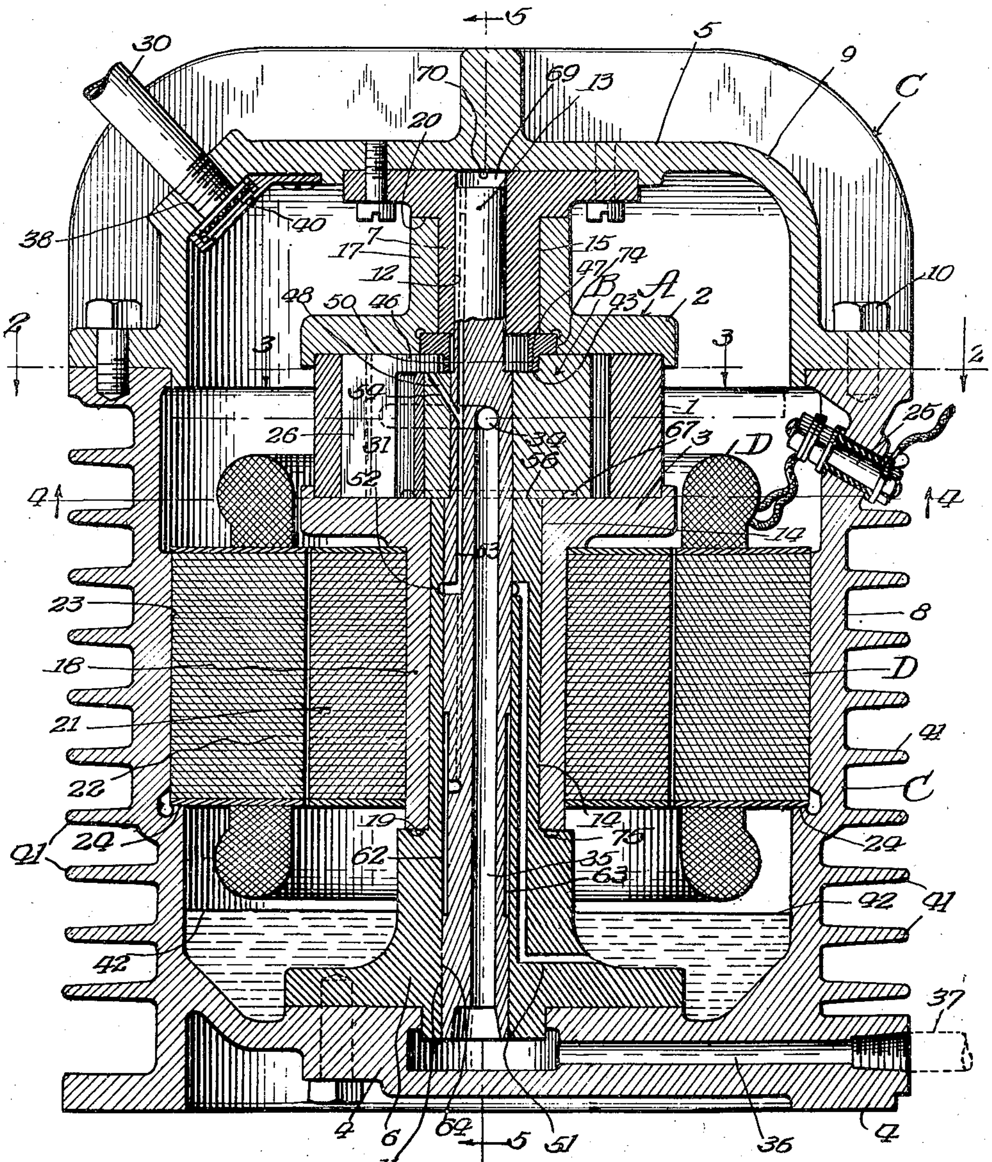
Fig. 1



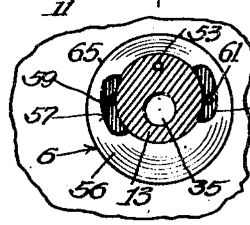


Fig. 7

Inventor
Wm. Ward Davidson
By Geo. E. Waldo, Atty.

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Fig. 2

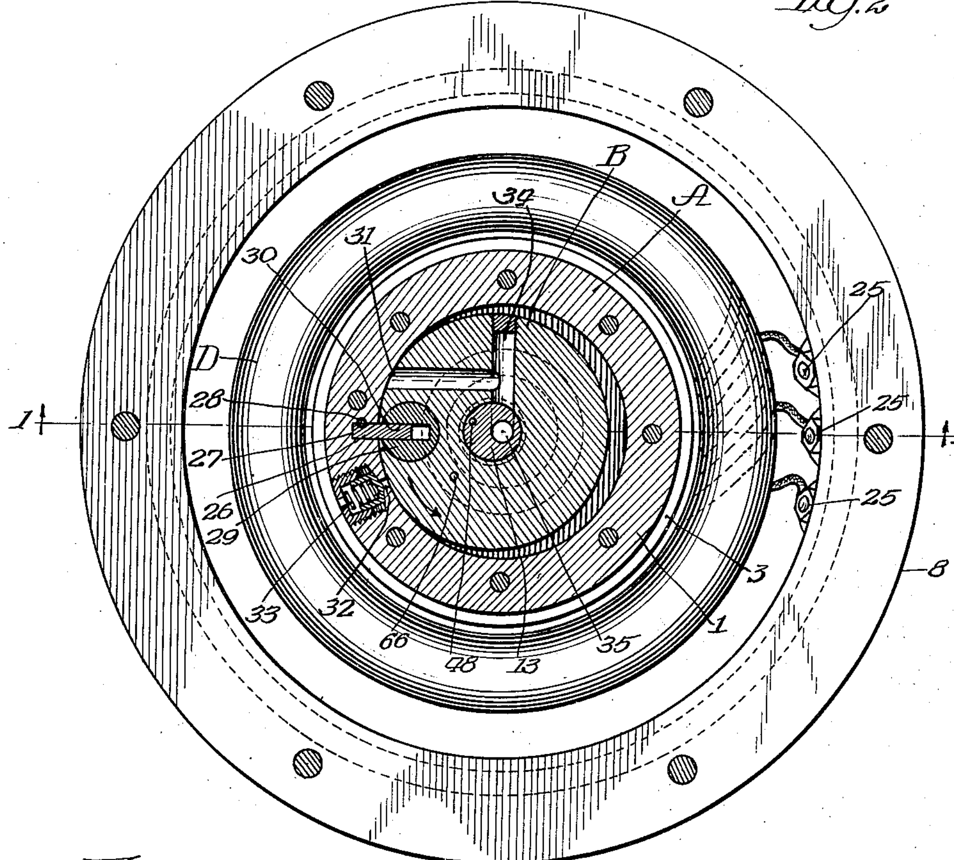


Fig. 3

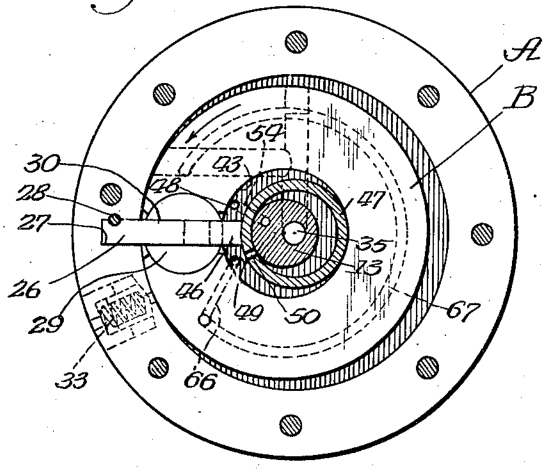
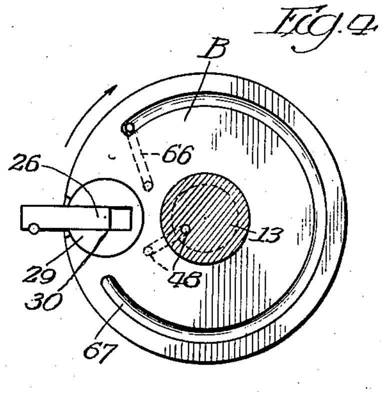


Fig. 4



Inventor
Wm. Ward Davidson
By Geo. E. Walder, Atty

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Fig. 5

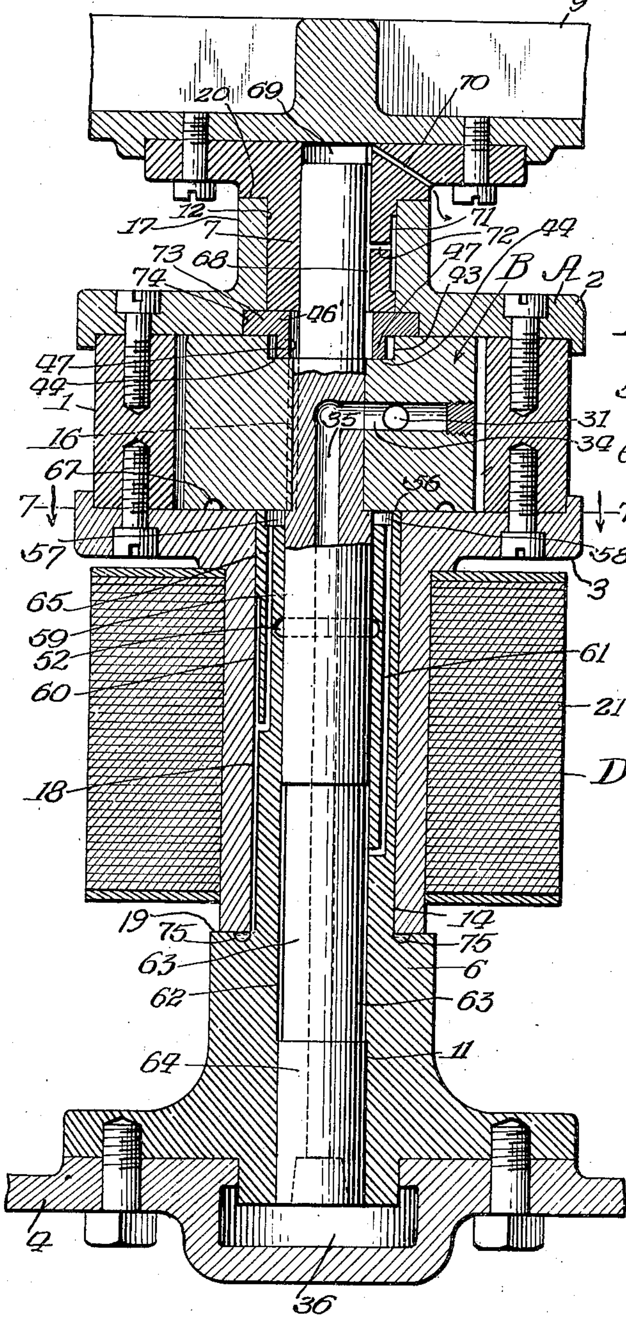
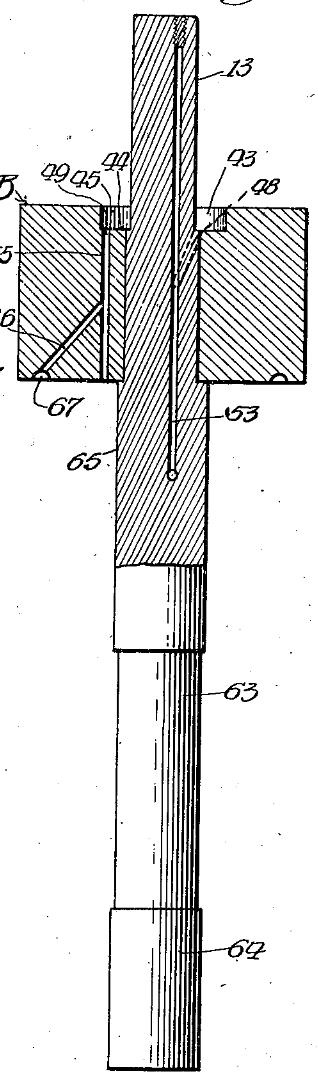


Fig. 6



Inventor
Wm. Ward Davidson
By [illegible]
Atty.

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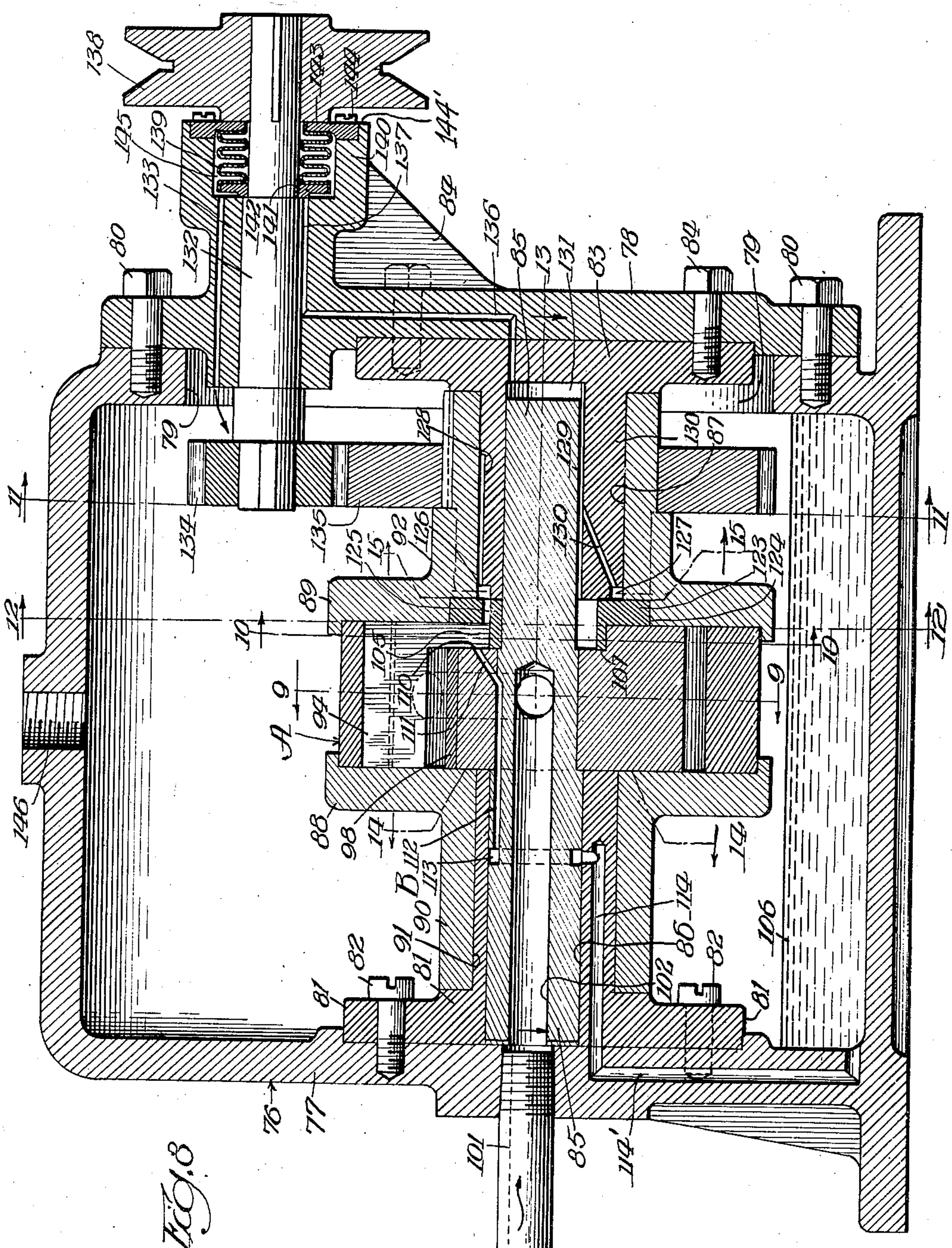

Fig. 8

Inventor
Wm. Ward Davidson
By Geo. E. Waldo, Atty

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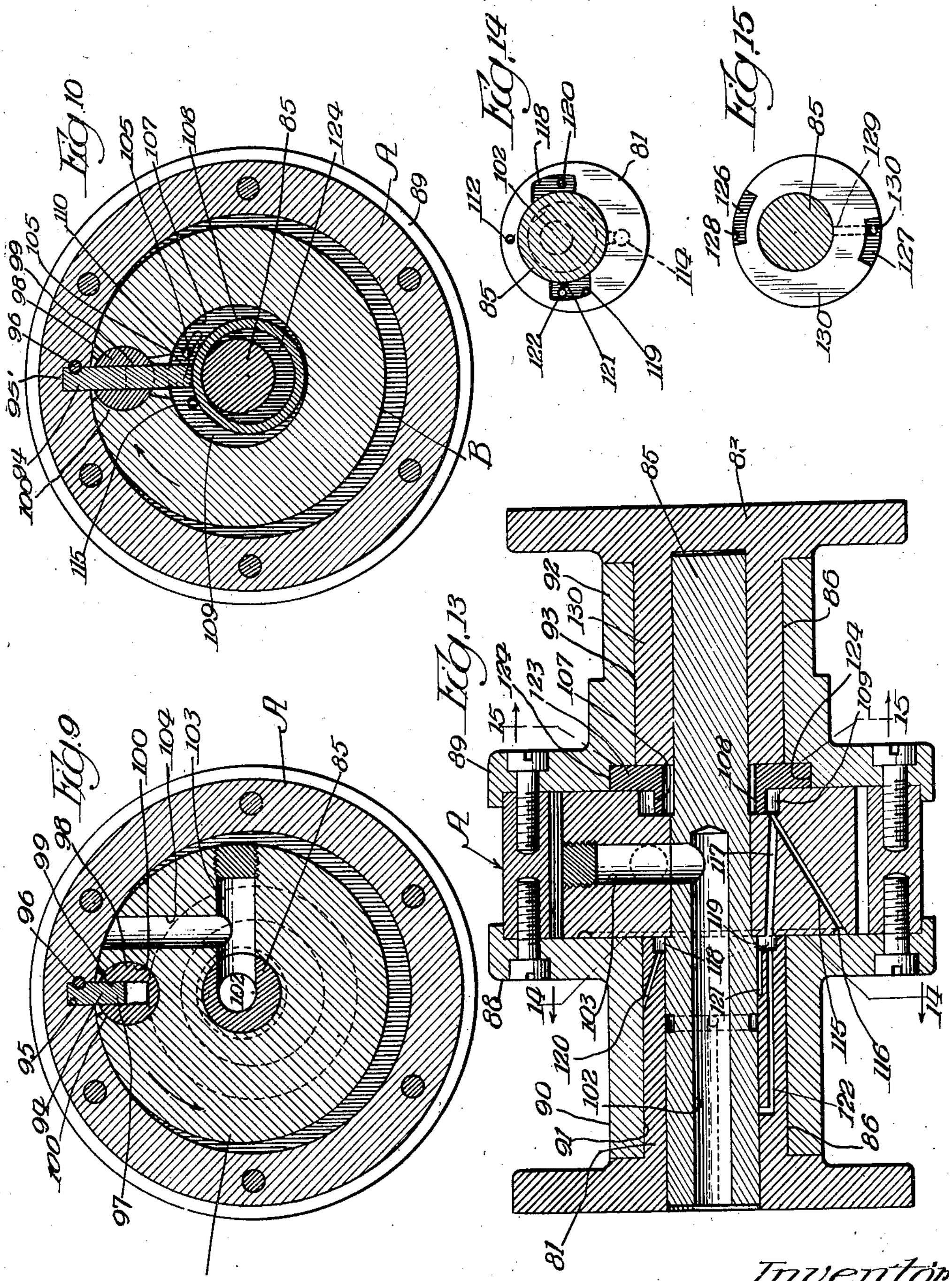

Inventor
Wm Ward Davidson
By Geo. E. Waldo, Atty.

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Fig. 12

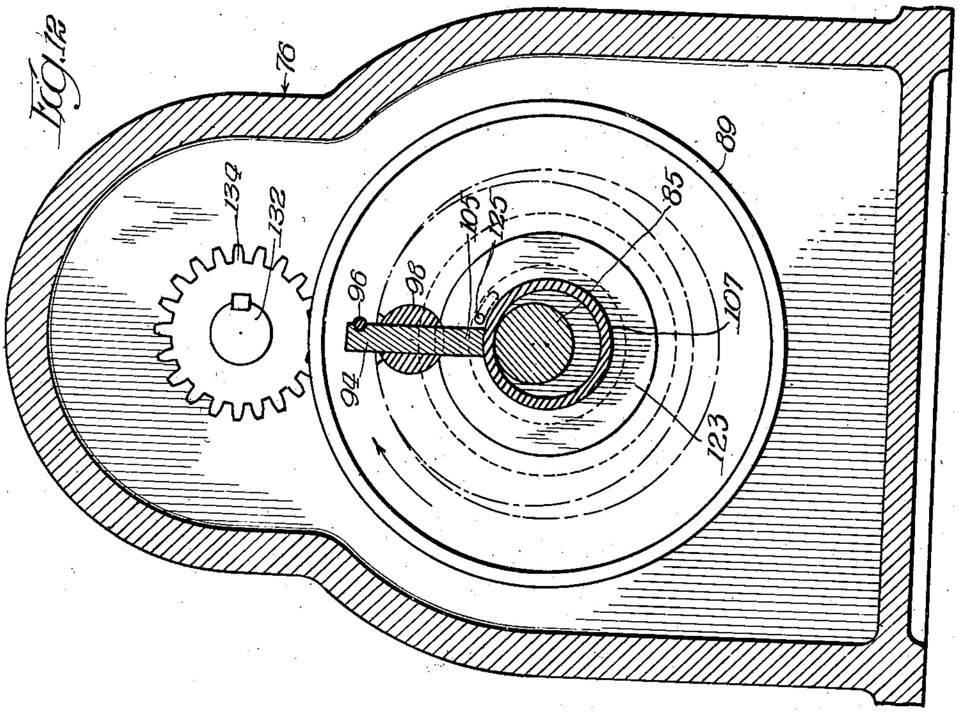
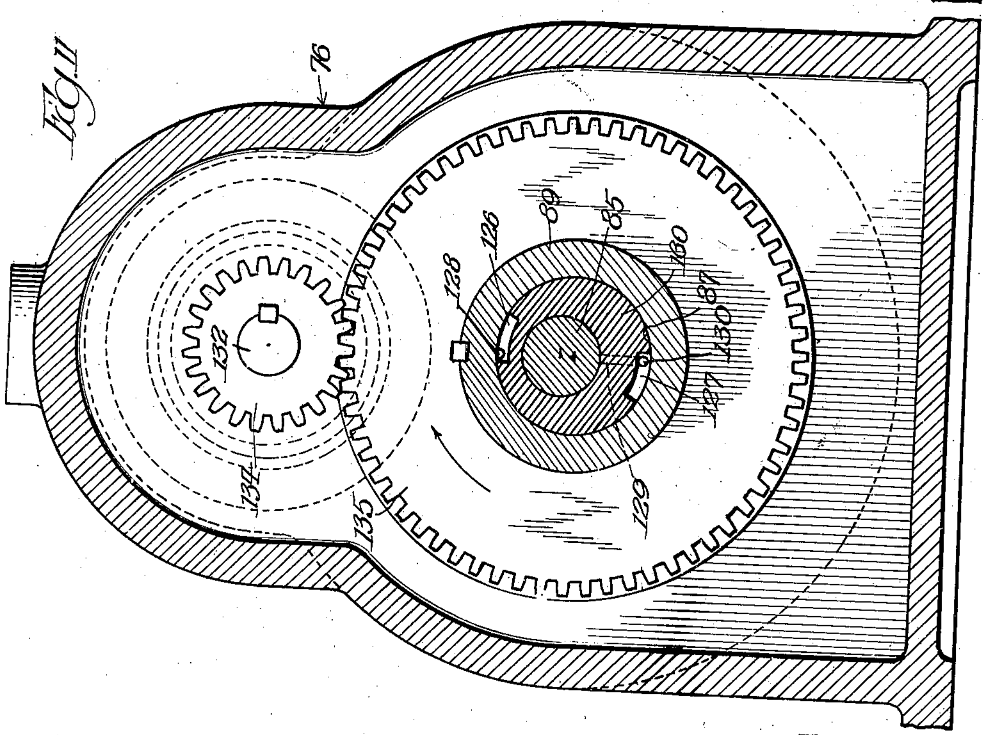


Fig. 11



Inventor:
Wm. Ward Davidson
By Geo. E. Waldo, Atty.

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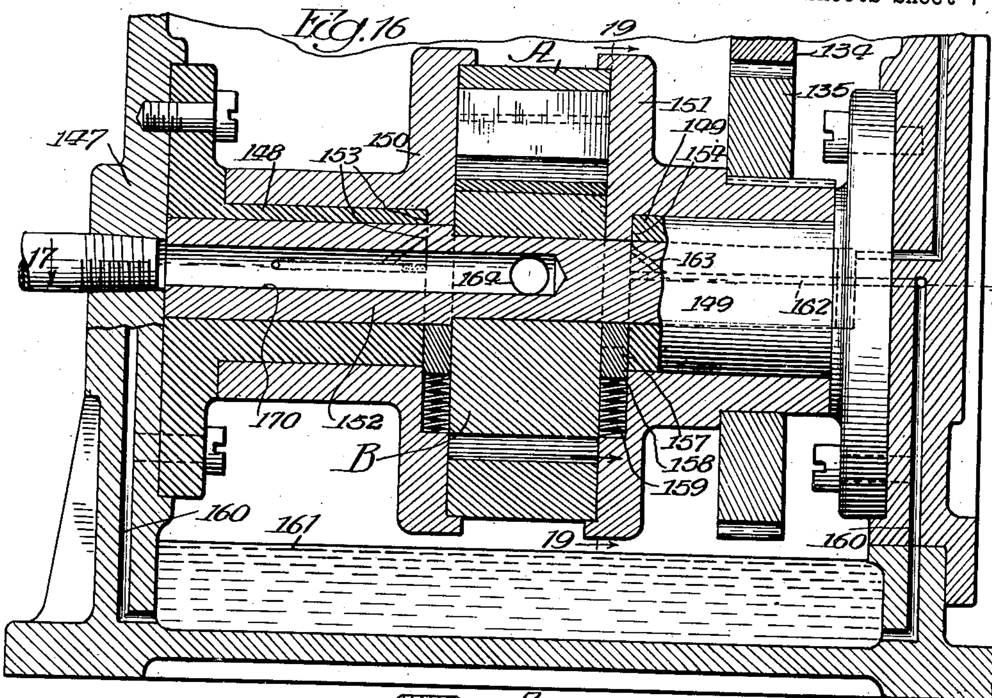

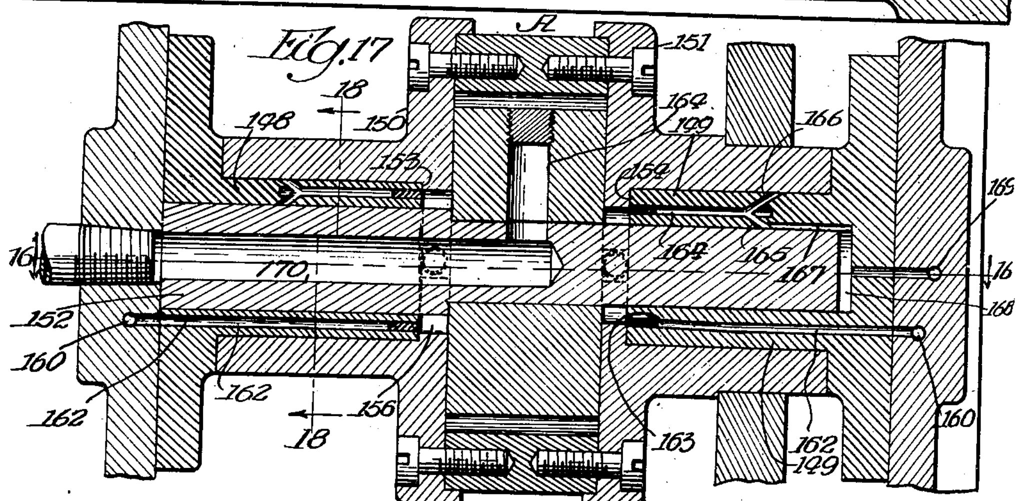

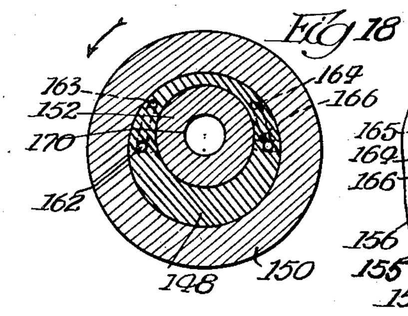

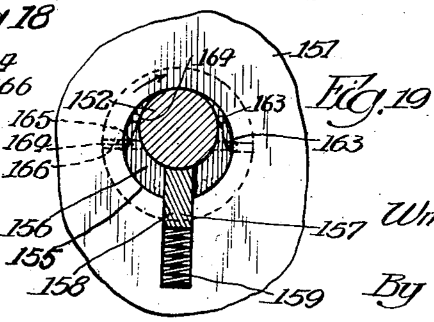

Inventor
Wm. Ward Davidson
By Geo. E. Waldo
Atty.

Patented June 17, 1941 2,246,273

UNITED STATES PATENT OFFICE

2,246,273

ROTARY PUMP

William Ward Davidson, Evanston, Ill.

Application August 19, 1935, Serial No. 36,877

34 Claims. (Cl. 230—140)

This application is a continuation in part of my earlier abandoned application, Serial No. 688,169, filed September 5, 1933, for Rotary pumps, which has been replaced by application Serial No. 62,874, filed February 6, 1936, for Rotary pumps.

This invention relates to improvements in rotary devices such as are commonly known as rotary pumps, compressors, motors, etc.

The objects of the invention are:

To provide an improved construction applicable to such rotary devices generally and particularly arranged and adapted for increased efficiency;

To provide a rotary pump which will subject air and other fluids to high pressure, which will be effective in operation, economical as to power consumption, which will retain substantially its maximum efficiency over a long period of use, which will be relatively free of vibration, and relatively inexpensive to manufacture;

To provide simple, improved and self-contained means for effectively lubricating the bearings of rotary pumps particularly when being used as air or gas compressors or as vacuum pumps, thereby greatly increasing their efficiency, particularly when driven at relatively high speed such as 1725 R. P. M., and for sealing with lubricant the clearance spaces between opposed pump surfaces, thereby adding to the efficiency of the pump, and accomplishing these objects with a minimum power consumption;

To provide a pump for the effective handling of liquids which will be simple in construction and adapted for high speed operation and which will apply pressure to the liquid in such a manner as to subject the liquid handled to pressure at substantially all stages of rotation, thereby tending to reduce vibration and noise incident to intermittent compression;

To provide a rotary pump having the aforementioned desirable features which can be used in large sizes without unduly increasing vibration or reducing efficiency;

To provide means for operating such pumps without a necessity of heavily packing any moving member, thereby obtaining a dry running pump, free from outside leakage, and at the same time reducing the power consumption of the pump;

To provide what may be designated a duplex rotary pump, comprising a primary pump which may be of a type adapted to usual pumping purposes, or which may be particularly designed and adapted for subjecting air and other gaseous fluids to relatively high pressures—as air or gas compressors which usually operate under fluid tight or sealed domes—and a secondary or auxiliary pump operatively arranged in co-operative association with the primary pump and which is preferably driven thereby, and which may be adapted either for lubricating the pump bearings subject to friction and wear in use, or for increasing the volumetric discharge from the pump unit;

To provide a pump unit comprising a primary and secondary pump, the secondary pump of which is combined and co-ordinated with the primary pump in a manner to equalize the volumetric discharge therefrom, thereby preventing vibration in operation, and minimizing pulsation and surging of the pump in operation;

To provide a rotary pump the pressure discharge of which shall be substantially uniform and steady during each revolution of the pump and substantially free of noticeable pulsations;

To attain the objects thereof, a pump unit embodying my invention and improvements, comprises the various features, combinations of features and details of construction hereinafter described and claimed.

I have selected an embodiment of the invention, to be described to give a clear understanding of same, which is particularly designed for use as the compressor in a small automatic refrigeration system but I desire it to be clearly understood that such disclosure is merely for the sake of exemplifying the invention and also that the invention is not limited to this specific application or showing thereof.

In the accompanying drawings, in which the invention is fully illustrated—

Figure 1 is a central, vertical section of a rotary pump substantially on the line 1—1 of Fig. 2, and embodying the invention in a form especially adapted for use as a substantially, continuously, operable pump or compressor for use in small unit refrigerator systems; the compressor and co-operating motor being enclosed in a sealed housing;

Figure 2 is a horizontal section substantially on the line 2—2 of Fig. 1;

Figure 3 is a detail, horizontal section on the line 3—3 of Fig. 1, and showing a top plan view of the cylinder and rotor of the compressor;

Figure 4 is a detail, horizontal section on the line 4—4 of Fig. 1 and showing a bottom plan view of the rotor;

Figure 5 is a fragmentary, vertical, central section substantially on the line 5—5 of Fig. 1

and especially showing the means for lubricating the several bearings;

Figure 6 is a detail elevational view, partly in central longitudinal section of the rotor and its shaft and further disclosing the oiling system;

Figure 7 is a detail horizontal section on the line 7—7 of Fig. 5, showing a top plan view of the upper end of the lower fixed bearing member;

Figure 8 is a central, vertical section of a second form of the invention especially designed to enclose the pump in a sealed housing and arranged and adapted to be driven by a source of power arranged outside of the housing;

Figures 9, 10, 11 and 12 are detail, vertical sections on the lines 9—9, 10—10, 11—11, and 12—12, respectively, of Fig. 8;

Figure 13 is a detail, horizontal, central section on the line 13—13 of Fig. 8;

Figure 14 is a detail, vertical section on the line 14—14 of Figs. 8 and 13, and especially showing the inner end of one of the other fixed bearing members;

Figure 15 is a detail, vertical section on the line 15—15 of Figs. 8 and 13 and especially showing the inner end of the other fixed bearing member;

Figure 16 is a fragmentary, vertical, central section similar to Fig. 8, but taken on the line 16—16 of Fig. 17 and showing a second modified form of the invention;

Figure 17 is a fragmentary, horizontal, central section on the line 17—17 of Fig. 16;

Figure 18 is a detail, vertical section on the line 18—18 of Fig. 17; and

Figure 19 is a fragmentary, detail, vertical section on the line 19—19 of Fig. 16.

Each of the several embodiments of the invention shown in the drawings include a primary or main pump or compressor for use as an air or gas compressor and a secondary or auxiliary pump especially arranged and adapted to lubricate the bearings of the pump, to seal its opposed surfaces and, at the same time, to reduce vibration.

Referring now particularly to Figs. 1 to 7, inclusive of the drawings, the primary pump comprises a cylinder and a rotor respectively designated A and B.

The cylinder A consists of an annular ring 1, opposite ends of which are closed by heads 2 and 3 which, as shown, form separate parts and are detachably secured to opposite ends of said cylindrical ring by screws or other suitable means.

The rotor B is cylindrical, its diameter being less than the diameter of the bore of the cylinder A and its axial length being such that it fits between the opposed inner faces of the heads 2 and 3 with only operating clearance to permit the cylinder and rotor to turn freely, relative to each other, under contemplated operating conditions. Also the rotor B is mounted in eccentric, tangential relation to the bore of the cylinder A, in a usual relation to provide the usual crescent shaped pump space.

As assembled for use and as shown in said Figs. 1 to 7, inclusive, the cylinder A and rotor B are mounted for rotation in a housing C which includes a base 4 at its lower end and a top or cover 5 at its upper end. Centrally arranged on the base 4 is an upstanding fixed bearing member 6 and an axially aligned somewhat similar bearing member 7 is fixed to the top 5 and depends therefrom.

The housing C consists of a lower hollow part 8, the base 4 forming the bottom thereof and an upper part 9, the cover 5 forming the top thereof and the two parts 8 and 9 secured together to form a sealed housing by bolts 10 or other suitable means.

As explained, the fixed bearing members 6 and 7 are arranged in axial alignment and each is in the form of an elongated sleeve, the inner surfaces 11 of the member 6, and 12 of the member 7 forming aligned supports for a shaft 13 upon which the rotor B is mounted for rotation and the outer surfaces 14 of the member 6 and 15 of the member 7 forming aligned bearings for the cylinder A as will be more fully described.

As has been explained and as best shown in Fig. 2, the cylinder A and rotor B are mounted in tangential eccentric relation and the inner and outer cylindrical surfaces of the aligned bearing members 6 and 7 are in similar eccentric relation to properly mount the cylinder and rotor for free rotation.

The rotor B as shown is preferably secured to the shaft 13 to rotate therewith by any suitable means such as a key or spline 16 as shown in Fig. 5. Under some circumstances and for some purposes it is sufficient to provide the rotor B with a rotational support extending out at one side only and under such an arrangement one end of the shaft 13 may be described as a shank upon which the rotor is carried for rotation with the cylinder A.

For mounting the cylinder A on the aligned outer bearing surface 14 of the member 6 and the similar surface 15 of the member 7, the heads 2 and 3 are provided with outwardly extending hollow projections 17 on the head 2 and 18 on the head 3.

The bearing member 6 is provided with a horizontal bearing shoulder 19 upon which the lower end of the bearing sleeve 18 rests and by which the weight of the rotating parts is sustained. Likewise the upper bearing member 7 is provided with a horizontal bearing shoulder 20 and as shown the cylinder A with its heads 2 and 3 and the bearing projections 17 and 18 is confined endwise between the two shoulders 19 and 20 with just operating clearance provided.

As shown, the bearing projection 18 on the lower head 3 is considerably longer than the projection on the upper head 2. This is for the purpose of providing suitable space for arranging an electric motor D within the housing C and below the pump. The armature 21 of the motor D is secured to the bearing projection 18 of the lower head 3 of the cylinder and the field 22 of the motor D is mounted on the inner wall of the housing C as shown at 23, a supporting shoulder 24 being provided to properly align the field and armature of the motor.

The cylinder A is driven by the motor D by the described engagement of the armature 21, of the motor, with the bearing projection 18 on the lower head 3. Insulated connections 25 for the supply of electric current to the motor, project through the wall of the housing and are properly sealed therein.

The cylinder A is driven by the motor D and the rotor B is driven by the cylinder A as will now be described.

As best shown in Figs. 2 and 3 there is a radially arranged, longitudinally, extending vane or abutment 26 fixed in the wall of the cylinder A and projecting inwardly therefrom. This vane 26 fits snugly in a radial slot 27 formed in the wall of the cylinder A and is rigidly held therein by a pin or key 28.

The vane 26 projects into the rotor as best shown in Fig. 2 to drive the rotor and to form a radial abutment which will cause the pump to operate when rotated.

To allow for the necessary relative circumferential displacement of the cylinder and rotor during rotation and due to the eccentric arrangement of the two members, a flexible connection of the vane 26 with the rotor is provided. This flexible connection, as shown, consists of a cylindrical plug 29 arranged in the rotor B adjacent its periphery, the plug 29 being provided with a longitudinally extending slot 30 in which the inner edge portion of the vane 26 fits and slides out and in as the pump is revolved.

Suitable passages and ports are provided for the entrance and escape of the fluid to be acted on by the pump. These comprise first, an inlet port 31 through the rotor B leading to the crescent space between the rotor and the cylinder and arranged at one side of the vane 26 and an outlet port 32 extending through the wall of the cylinder A at the opposite side of the vane 26. The outlet port 32 is controlled by a spring pressed check valve 33 so that no compressed fluid can return to the pump through the delivery port 32.

To supply the fluid to be acted on by the pump to the inlet port 31 in the rotor a radial fluid passage 34 is provided in the rotor with which the port 31 connects, and this radial passage 34 connects at its inner end with a longitudinal passage 35 extending down through the shaft 13 and communicating at its lower end with a passage 36 in the base 4. The passage 36 extends through the wall of the housing and can be connected by a pipe, indicated at 37 with any suitable source of fluid to be acteed on by the pump. In case of using the pump as an air compressor the pipe 37 may be dispensed with.

The compressed fluid escapes from the pump past the check valve 33, as shown, into the interior of the sealed housing and an outlet from the housing is provided, as shown, consisting of an opening 38 extending through the wall of the housing and which may be connected by a pipe 39 with any suitable space or container for receiving the delivered fluid.

The outlet from the housing is protected by a simple filter 40 to hinder the escape of lubricant from the housing.

The housing is provided with heat radiating ribs 41 on its outer surface to assist in the dispersion of the heat generated in the housing during operation of the pump.

It is to be noted that both the rotor and the cylinder have ample bearing supports at both sides that the power is applied and absorbed at the most advantageous points, viz., on and between the opposed bearings and that all tortional displacements which would cause unwanted friction in operation are prevented or eliminated.

I make use of the lower portion of the sealed housing as a sump to hold the oil which I force to the several opposed surfaces including the bearings etc., of the pump. Preferably the quantity of contained lubricant is sufficient to fill the lower part of the housing to the level indicated approximately by the line 42 which preferably is entirely below the pump and the motor so that the oil will not be picked up and thrown by these moving parts. Another reason for keeping the level of oil below and out of contact with the rotating parts of the pump is to prevent the churning of the oil with its undesired effects of acting as a brake on the pump and the development of undesired heat. The oil may be introduced to the housing through any suitable opening, not shown, which opening, during operation, is closed by any suitable means such as a screw plug.

As explained, to make the unit complete and self-contained as well as attain other advantages, I provide what may be termed a secondary or auxiliary pump, especially in the forms shown, for lifting the oil from the bottom of the housing and forcing it to all of the bearings of the pump and to all other parts and surfaces subject to friction and wear, and between all opposed surfaces between which the fluid operated on by the pump might tend to pass, in other words, the lubricant tends not only to reduce wear but to seal the pump chamber against leakage of the fluids being operated upon.

In addition to the secondary pump which will presently be described, suitable passageways, ducts and channels are provided to conduct the lubricant from the bottom of the housing to the secondary pump and from the pump to the various places of application and back again to the lower part of the housing.

What I now consider as a preferable form of secondary pump is as follows:

The top of the rotor B is provided with a counterbore 43 which extends down into the body of the rotor and has a flat bottom 44. The depth of the counterbore is but a fraction of the longitudinal depth of the rotor and the space defined by the outer wall 45 and bottom 44 of the counterbore and the opposed or under surface of the top cylinder head 2 constitutes, in a manner, the cylinder of the secondary pump. The diameter of this space, as shown, is such that it lies just within the inner side of the plug 29 and the main pump vane 26 is provided at one end with a projection 46 at its inner edge arranged and adapted to project into said secondary space and serve as the pump vane therefor.

The outer wall 45 of the auxiliary pump space is, of course, concentric with the rotor B and the inner end of the projection 46 rotates in a circle concentric with the cylinder A. To provide a crescent shaped space in which the projection 46 will operate as an abutment in a rotary pump I provide an eccentric ring 47 carried by the upper head 2 and projecting into said counterbore 43. This projecting ring is, of course, as shown, eccentric to the shaft 13 upon which the rotor is mounted, but is concentric with the cylinder A. The outer surface of the ring 47 forms the inner wall of the crescent shaped space of the secondary pump and it is eccentric and tangential to the outer wall 45 of the counter-bore 43. The inner end of the vane projection 46 contacts with the outer surface of the ring 47 and serves as the abutment of the secondary pump.

As plainly shown in Fig. 3, the crescent shaped space of the auxiliary or secondary pump is diametrically opposed to the crescent shaped space of the primary pump and consequently to the extent that pressures are produced in the two pumps, they tend to oppose or balance each other radially so far as bearing pressures or vibrations are concerned.

To supply oil to the secondary pump and to convey oil away from same, an inlet port 48 is provided at one side of the vane projection 46 and outlet ports 49 and 50 are provided at the opposite side.

To direct oil from the supply of oil in the bottom part of the housing to the secondary pump, I provide a passageway 51 which extends through the bearing member 6 entering the base below the normal level of the oil and extending through the wall of said bearing member to a point somewhat below the upper end thereof, where it connects with a circumferential groove 52 formed in the internal bearing surface of said member 6. As described before the shaft 13 is rotatably mounted within this bearing member and it is provided with a longitudinal oil passageway 53 extending up from the groove 52 and connected by an inclined passageway 54 with the inlet port 48 of the secondary pump. The inclined passageway 54 is formed partly in the shaft 13 and partly in the rotor B.

The outlet 49 is for delivering the oil to all of the surfaces below the secondary pump and the outlet 50 is for delivering the oil to all of the surfaces above the secondary pump.

The outlet 49 connects with a downwardly extending passageway 55, see Fig. 6, which extends vertically through the rotor B and discharges oil at its lower surface. The opposed top end 56 of the lower bearing member 6, is provided with two chambers or pockets 57 and 58 (Figs. 5 and 7) formed therein and open at their tops. As the pump rotates the delivery passageway 55 passes over these pockets and discharges oil into each of same once for each revolution of the pump cylinder.

The pocket or chamber 57 is connected by a longitudinal passageway 59 extending down through the bearing member 6 and which communicates at its lower end with a longitudinal oil groove 60 in the outer surface of said member 6 and supplies oil to the bearing surface of the bearing projection 18 extending down from the lower cylinder head 3.

The pocket 58 is connected by a longitudinal passageway 61 extending down through the bearing member 6 and which provides communication at its lower end between a space 62 within the bearing member 6 and said pocket 58 and through which the oil is delivered to the bearing surfaces of the lower part of shaft 13.

The lower end of the shaft 13 is reduced in diameter between its end portions as shown at 63 to provide the space 62, and which forms the lower part of said shaft with bearings 64 at the bottom portion and 65 at the portion adjacent to the cylinder A.

As best shown in Fig. 5, the circumferential groove 52 through which the oil passes on its way to the secondary pump lies wholly inside of the two longitudinal passageways 60 and 61 and does not communicate therewith.

For directing oil to the lower end of the rotor the delivery passageway 55 branches off within the rotor as shown at 66, Fig. 6, and communicates with a circumferential oil groove 67, in the bottom face of the rotor.

The oil delivery port 50 extends through the eccentric ring 47 and delivers oil to the space within the same and at the outer surface of the shaft 13.

The upper bearing member 7 is provided with a longitudinal oil groove 68 on its inner surface by which the bearing of the shaft is oiled and this groove 68 communicates at its upper end with a space 69 above the upper end of the shaft which space is provided with an outlet or overflow 70 to permit any surplus oil to escape into the housing and avoid the production of any end pressure on the shaft 13.

The groove 68 also communicates with a similar groove 71 in the outer surface of the bearing member 7 through a radial hole 72 and by means of which the cylinder bearing on the upper bearing member is supplied with oil.

The eccentric ring 46 is preferably formed with an enlarged base ring 73 for mounting the eccentric ring in the top cylinder head 2 which is provided with a concentric counterbore 74 for receiving same. The engagement of the base 73 in the counterbore 74 is preferably a drive fit.

The eccentric ring 47 is preferably made of a harder and tougher metal than the cyinder head, such as steel, while the cylinder head 2 is preferably made of cast iron or some similar metal.

To make sure of oil reaching the horizontal bearing 19 at the lower end of the bearing projection 18 on the lower cylinder head 3, an oil groove 75 is provided in said shoulder 19 which is fed by the oil groove 60 in the outer surface of the lower bearing member 6.

It is obvious that with oil under pressure in the pump chamber of the secondary pump, besides oil being forced through the oil delivery passages as has been described it will also be forced from said pump chamber into the clearance spaces at the ends of the rotor B, into the bearing for the plug 29, and into the slot 30 in the plug 29 in which the vane 26 slides back and forth, thereby not only lubricating the pump surfaces but also providing an effective seal between opposed pump surfaces which will prevent leakage between the chambers or recesses of the same or different pumps.

It should be understood, however, that I do not desire to limit the invention or the protection of any patent granted on this application, to the arrangement of oil distribution passageways shown and described, nor to any particular arrangement of lubicating passageways and ducts, but desire to extend the protection of the patent to any arrangement of oil distributory passageways, when distribution is effected by a secondary pump mounted in co-operative association with the primary pump in accordance with this invention, as defined by the appended claims.

It is to be noted that, with the relation of primary and secondary pumps described, the axis of rotation of the rotor B of the primary pump is eccentric to the axis of the cylinder A, and the axis of rotation of the rotor of the secondary pump (the ring 47) is concentric with the axis of rotation of the cylinder A of the primary pump, and that the cylinder of the secondary pump defined by the outer wall 45 of the auxiliary pump space is eccentric to the axis of rotation of the cylinder A, of the primary pump. Also, the axis of rotation of both the rotor B of the primary pump and the cylinder of the secondary pump defined by the wall 45, are off-set from the axis of rotation of the cylinder A of the primary pump.

With this relation it is obvious that the point of tangency of the primary rotor B to the bore of the cylinder A of the primary pump will be diametrically opposite to the point of tangency of the rotor 47 of the secondary pump with the cylinder wall 45. In other words the two pump recesses are diametrically opposed. Thus, while the primary pump vane is passing the point of tangency of the cylinder and rotor of the primary pump, corresponding to minimum discharge of the primary pump, the vane of the secondary pump will be in a position 180 degrees from the point of tangency of the cylinder and rotor thereof, corresponding to maximum discharge of the secondary pump.

It is obvious that a duplex rotary pump comprising primary and secondary rotary pumps combined and co-ordinated in accordance with this invention, substantially in the manner hereinbefore described for pumping different fluids, may readily be adapted for pumping one fluid only, so that each will supplement the other, and thereby increase and equalize the volumetric discharge of the pump, thus reducing vibration and minimizing pulsation, by changing the arrangement of and also the relative sizes of the pump cylinders and passageways, so that each pump will execute the initial one-half of its pumping cycle, during which the quantity of fluid handled—either supply or discharge—is increasing, concurrently with the execution of the other pump of the final one-half of its pumping cycle, during which the quantity of fluid handled thereby is decreasing, whereby the fluid supply to one pump will increase as that to the other pump decreases and vice versa, and the fluid discharge from one will increase as that of the other decreases, and vice versa.

In Figs. 8 to 15, inclusive, there is illustrated a pump quite similar to that already described except that power is applied from outside the housing to operate the pump. Another difference between the two forms is that in this second form the axes of the rotation parts are horizontal instead of vertical.

Furthermore as the bearing members are arranged horizontally, the means for distributing the oil thereto is somewhat different but to all practical purposes the same.

As in the former instance the pump is enclosed in a sealed housing comprising a hollow box-like member 76 which has an integral end wall 77 at one end and a removable end wall or cover 78 at the opposite end adapted to close a relatively large end opening 79. The removable end wall 78 is secured to the housing 76 by bolts 80 and serves to seal the housing.

As stated the cylinder A and rotor B, in this form rotate on horizontal axes and the fixed bearing members which support the rotating parts are secured to and project horizontally from the end walls 77 and 78. As shown, a sleeve-like bearing member 81 somewhat similar to the bearing member 6 in the other form is secured to the integral end wall 77 by screws 82 and a somewhat similar bearing member 83 is secured to the removable end wall 78 by screws 84 and is in axial alignment with the member 81 and the two bearing members 81 and 83 rotatably carry the rotor B and cylinder A on parallel axes.

As hereinbefore described the rotor B is mounted on and rotatably secured to a central shaft 85, the bearing members 81 and 83 being provided with bores 86 and 87 respectively, in which the end portions of the shaft are received.

The cylinder A as before described is closed at its ends by removably attached heads 88 and 89. The head 88 is provided with a bearing projection 90 provided with a central bore 91 in which the bearing member 87 fits and the opposite head 89 is provided with a bearing projection 92 which has a central bore 93 in which the bearing member 83 fits.

As in the first form described it is now seen that both the rotor and the cylinder have bearings on both sides. This tends to avoid all twisting or other unwanted forces which might increase the friction of the rotating members.

As before described the rotor B and cylinder A are arranged in eccentric tangential relation and the cylinder, as in the former instance carries a radially arranged vane or abutment 94 which is fixed in a longitudinal slot 95, provided in the wall of the cylinder, by a pin 96. The free inner end 97 of the vane 94 projects into the rotor B and as in the former instance there is provided a similar flexible connection between the vane and the rotor comprising a cylindrical plug 98 provided with a radial slot 99 to receive the vane 94 and fitted in a cylindrical opening 100 provided in the rotor near its outer periphery. The vane operates as an abutment to cause the pump action as the two members are rotated. When the cylinder A is rotated it serves, through the vane 94, to rotate the rotor.

In this form the inlet for the fluid to be acted on is preferably through the integral head as shown at 101 and the shaft 85 is provided with a longitudinal passageway 102 to conduct the fluid to a point within the rotor and which connects at its inner end with a radial passage 103 formed in the body of the rotor. This radial passage connects with a second passage 104 in the rotor which emerges at the rear side of the vane to direct the fluid into the pump compression space.

As in the first form described the vane 94 is provided at one end with a projection 105 extending inwardly from its inner edge and which operates as the vane of a secondary pump for the purpose, in the form shown, of pumping oil to the various opposed and moving surfaces of the pump.

The lower part of the housing 76 constitutes an oil reservoir, the normal level of the oil therein being as shown approximately at the level indicated by the line 106 which is as shown below all rotating parts to avoid any possibility of churning or splashing the oil when the pump is operating.

Similar to the form first described, the rotor B is provided with a counterbore 107 at one end concentric with the periphery of the rotor and which provides a space in which the inner projection 105 on the vane 94 can operate. Also similar to the first form an eccentric ring 108 projects into said counterbore 107 and with which the inner end of the projection 105 tightly contacts. The eccentric ring 108, as best shown in Fig. 10, is tangential to the periphery of the counterbore 107 and provides the crescent shaped space 109 in which the vane projection 105 operates as a pump.

As in the former instance, passageways are provided for conducting oil from the supply in the base of the housing to the suction side of said space 109 and for delivering oil from the delivery side to the several opposed and moving surfaces of the pump.

The oil supply passages include an inlet port 110 for said space 109 at the suction side of the vane, a passageway 111 through the rotor leading to said port, a longitudinal passageway 112 in the shaft 85 connected at one end with the passageway 111 and at the other end with a circumferential groove 113 in the outer surface of the shaft. This groove 113 communicates with a longitudinal passageway 114 in the body of the fixed bearing member 81 and this communicates by a vertical passageway 114′ in the end wall with the oil space in the bottom of the housing below the normal oil level thereof. This is quite similar to the oil supply passages in the pump first described.

To direct oil from the secondary pump to the several surfaces to be oiled the passageways are quite similar to those described in connection with the description of the first form.

A delivery passage 115 is provided for said pump space 109 located on the opposite side of the vane from the inlet passage 110. This delivery passage extends through the rotor B and leads to a circumferential oil groove 116 formed in the opposite side face of the rotor. A second delivery passage 117 is provided for the pump space 109, which leads through the rotor B and delivers oil into pockets or chambers 118 and 119 provided in the adjacent inner end of the fixed bearing member 81. The pocket 118 delivers oil to the outer bearing surface of the bearing member 81 through a passageway 120 and the pocket 119 delivers oil to the inner bearing surface of said member 81 at two places, the first through an oil groove 121 formed in the inner surface of said bearing member and the second through a longitudinal passageway 122 extending longitudinally through the body of said bearing member.

As in the form first described the eccentric ring 108 is formed integral with a base ring portion 123 which is received and held in a counterbore 124 provided in the cylinder head 89 and the fixed bearing member 83 terminates at the rear face of this base ring as shown in Fig. 8.

For delivering oil from the secondary pump space 109 to the bearing surfaces at the same end of the pump with the secondary pump a delivery port 125 is provided extending through the base 123 of the eccentric ring 107 and the adjacent inner end of the fixed bearing member 83 is provided with two diametrically spaced pockets or chambers 126 at the upper side and 127 at the lower side and with both of which pockets the delivery port 125 registers once for each revolution of the pump.

The upper pocket 126 oils the outer bearing surface of the fixed bearing member 83 through a longitudinal oil groove 128 formed in the outer surface of said member.

The inner surface of said member is provided with a longitudinal oil groove 129 which extends through said member to its base end and is connected with said lower pocket 127 by a passageway 130. The surplus oil flows through to a space 131 at the outer end of the shaft 85 within said bearing member 87 and is utilized to lubricate the driving shaft which extends through the wall of the housing as will now be described.

Instead of the electric motor arranged within the housing for driving the pump as shown in the first form described it is often desirable to have the motor outside of or independent of the pump especially in larger or cheaper units particularly where used for compressing air for automobile tires and other purposes. In the form being described there is a countershaft 132 provided which extends through a suitable bearing 133 formed on the removable end plate or wall 78.

A toothed pinion 134 is secured rigidly on the inner end of said shaft 132 and a co-operating gear 135 is secured rigidly on the bearing projection 92 of the cylinder head 89 so that when the shaft 132 is rotated the pump will be driven.

For oiling the bearing of the shaft 132 a vertical oil passageway 136 is provided in the head 78 communicating at its lower end with said space 131 in the base of the fixed bearing member 83 and at its upper end with a longitudinal oil groove 137 formed in said bearing 133 and extending from its connection with the upper end of said passageway 136 to the outer end of said bearing 133.

A belt pulley 138 or other suitable means may be secured on the outer end of the shaft 132 as a medium for applying power thereto.

The surplus oil is delivered to the outer end of said bearing and to make said opening pressuretight and to prevent the escape of the oil from the housing and its consequent depletion, a suitable packing means is provided at the outer end of the bearing.

It is desirable that the packing be such as to add a minimum of friction and it has been found that what is known as a metal bellows packing 139 fulfills the requirements.

This packing 139, as shown in the drawings, is contained in an enlarged extension 140 of the bearing 133 which is formed to provide a space to receive the packing. The packing as shown consists of a metal ring 141 at the inner end which contacts with a shoulder 142 formed on the shaft 132, a ring 143 at the outer end which is secured tightly to the outer end of the bearing 133 by screws 144 and the two rings connected by and sealed to a sheet metal bellows connector 144′. This construction effectually seals this opening in the wall of the housing against the passage of any fluid either into or out of the housing and prevents the escape of the oil which can fill the space 145 outside of the packing. This space 145 is connected by a passageway through the bearing 133 to the interior of the housing so that any surplus oil can readily escape back into the housing and flow down into the base thereof.

As in the form first described the pump cylinder A is provided with a delivery opening controlled by a check valve arranged at the opposite side of the vane 95 from the supply opening 104 but it has not been thought necessary to illustrate this obvious detail, also the housing is provided with means such as the screw-threaded opening 146 for delivery of the fluid acted on by the pump to a point outside of the housing as is usual in such apparatus.

In Figs. 16 to 19, inclusive, there is illustrated a form of pump which embodies many of the features shown in connection with the gear driven form just described but varies therefrom as regards the application and development of the secondary pump idea.

In the form of pump as shown herein, with its central shaft, the fixed bearing members and the co-operating cylinder and rotor, the cylinder is eccentrically arranged about the central shaft and I make use of this idea in the form shown in the figures now being described to provide the secondary or oil pumps.

As the shaft is relatively small and the consequent amount of oil delivered by one pump would be relatively small, I provide what may be termed a double pump or one at each end of the rotor. This results in another important advantage, namely, the two secondary pumps being arranged one at each end of the rotor, the resultant pressures of the main and secondary pumps are more nearly balanced, resulting in less friction and less power absorption.

Another quite important advantage will be understood from the drawings and the description and relates to a simplification of the oil supply and distribution passageways, thus reducing costs and possibility of stoppage.

In this form as in the others described, the pump which includes the cylinder A and rotor B is arranged within a sealed housing 147, indicated by the end and base walls thereof. The pump is of the gear driven form just above described and the cylinder and rotor rotate on horizontal axes.

In the present form as shown in the drawings, a secondary pump is arranged at each end of the rotor B and these two together with their connecting oil passages are duplicates of each other except that one secondary pump is connected with a passageway leading to the pinion shaft (not shown) and also except that the diameter of the central shaft is smaller at one pump than at the other pump. Excepting as to the details mentioned, the two secondary pumps are substantial duplicates of each other and a description of one will suffice for both.

In this form the fixed sleeve-like bearing members 148 and 149 which are similar to the members 81 and 83 of the second form described likewise project inwardly from the end walls of the housing and both terminate somewhat short of the inner faces of the adjacent cylinder heads 150 and 151, respectively, and the heads each have inner circumferential flanges which project in toward the central shaft 152 as shown at 153 and 154 respectively. The cylinder A with its heads as already described and as best shown in Fig. 19 is mounted eccentrically to the central shaft 152 and consequently the inwardly projecting parts 153 and 154 of the heads which overlap the inner ends of the respective fixed bearing members have to be provided with central openings as indicated at 155, Fig. 19, large enough to allow for the eccentric movement of the cylinder and shaft. This opening 155 is made just large enough so that its periphery will be tangent to the eccentric shaft within and this construction forms a crescent shaped space 156 which I utilize as the pump space for the secondary pump.

In this form of the invention the cylinder is driven and it drives the rotor and the rotor is preferably secured to the shaft as before so that the shaft rotates with the cylinder as in the form hereinbefore described.

I provide a substantially square plunger 157 which is mounted in a radial opening 158 provided in the inner part of the cylinder head. This opening 158 is open towards the rotor and is equal in width, that is along the shaft, to the thickness of the inwardly projecting flange 150 on the cylinder head. As the vane or abutment 157 is wholly within the cylinder head and does not contact with any other part at its outer end to force it in, I provide a push spring 159 arranged in the outer end of the opening 158 which yieldingly holds the abutment 157 pushed inwardly with its inner end in contact with the shaft 152 at all times.

To supply oil to said pump spaces, vertical supply passageways 160 are provided in the end walls of the housing which communicate at their ends with a supply of oil 161 in the base of the housing and at their upper ends with longitudinal passageways 162 extending in through the fixed bearing members 148 and 149 respectively.

Confining ourselves for the present to the right hand secondary pump, the longitudinal passageway 162 extends through to the inner end of the fixed bearing member terminating in a port 163 through which the oil enters the pump space 156 at one side of the tangential point between the shaft 152 and the perimeter of the pump space.

For delivering the oil from said pump space to the several opposed surfaces of the main pump at the adjacent end of the pump, I provide a second passageway 164 in the wall of the fixed bearing member 149 which communicates at its inner end with the pump space 156 preferably close to said tangential point at its opposite side. This second passageway is arranged at the opposite side of the member 149 from the supply passage 162 and supplies oil to both the inner and outer bearing surfaces of the fixed bearing member 149 through delivery passageways 165 and 166 respectively with which the passageway 164 communicates.

The delivery passageway 165 communicates with a longitudinal oil groove 167 provided on the inner bearing surface of the fixed bearing member and which communicates at its outer end with a free space 168 at the outer end of the shaft 152. This space is connected with the bearing of the pinion shaft (not shown) by a passageway 169 made through the adjacent end wall of the housing.

The oil passageways at the other end of the main pump are the same as those already described except as to the pinion shaft oil passageway.

The oil pump at the opposite side of the rotor is similar to that already described except that it operates on the shaft 152 where it is of slightly larger diameter. It will be readily seen that as the openings 156 are each closed on one side by the adjacent ends of the rotor the oil will be carried out between the ends of the rotor and the cylinder heads and will reach all surfaces of the rotor B and cylinder A which need lubrication.

As in the geared form of pump hereinbefore described an inlet passageway 170 for the fluid to be acted on by the pump is provided in one end portion of the shaft 152 and a suitable passage (not shown) is provided for the discharge of the fluid from the housing.

As many modifications of the invention will readily suggest themselves to one skilled in the art, I do not limit or confine the invention to the details of construction or to the specific combinations of parts and devices herein shown and described except within the scope of the appended claims.

I claim:

1. In a rotary pump, the combination of support and housing means forming a frame and also forming a sealed housing, pump members therein comprising a cylinder and a rotor, heads which close the ends of the cylinder and are fixed thereto and one at least of which is detachable, one of said cylinder heads provided with an opening into which a portion of the pump frame extends, the construction being such that the inner face of said extended portion of the pump frame is opposed to and parallel with the inner face of the other cylinder head, means for rotatably mounting said cylinder and rotor on the pump frame in eccentric, tangential relation, comprising a shank rigidly fixed to the rotor, said shank extending through said opening in a cylinder

head, said shank being rotatably fitted to a bearing formed in the pump frame, a single vane rigidly secured to the cylinder and which flexibly connects the cylinder and the rotor and has rocking and sliding engagement with the rotor, and means for rotating said pump members applied to the cylinder, said pump being provided with fluid supply and discharge passageways which communicate with the pump chamber at opposite sides of the pump vane, one of which passageways comprises a section formed in the bearing shank of the rotor and both of which passageways communicate with other passageways formed through the frame and housing means.

2. In a rotary pump, the combination of a frame, primary pump members comprising a cylinder having two heads and a rotor within said cylinder, means for rotatably mounting said cylinder and rotor in bearings on the pump frame in eccentric tangential relation, an impelling vane sealed to both pump members, and which flexibly connects said pump members, means for rotating said pump members, said pump being provided with fluid supply and discharge passageways which communicate with the pump chamber at opposite sides of the pump vane, the supply passageway comprising a section formed in a rotatable pump member, and a secondary rotary pump the cylinder of which comprises a cylindrical recess formed in an end face of one primary rotatable pump member and concentric thereto, and the rotor of which secondary pump comprises a cylindrical boss formed on the proximate end face of the other primary rotatable pump member, concentric thereto, and tangentially engaging the inner cylindrical wall of said recess, a secondary pump vane having engagement with the rotor of the secondary pump, said secondary pump being provided with fluid supply and discharge passageways which communicate with the secondary pump chamber at opposite sides of the secondary pump vane, the supply passageway of the secondary pump comprising a section formed in a rotatable pump member, the construction being such that the section of the supply passageway of the primary pump formed in a rotatable pump member and the section of the supply passageway of the secondary pump formed in a rotatable pump member are independent and have no communication within the confines of the primary pump cylinder.

3. A duplex pump as specified in claim 2 in which the cylinder of the secondary rotary pump comprises a cylindrical recess formed in one end of the rotor of the primary pump and concentric thereto and the rotor of which secondary pump comprises a cylindrical boss formed on the proximate cylinder head of the primary pump and concentric thereto.

4. The duplex pump specified in claim 2, in which the relation is such that in operation said pumps traverse corresponding portions of their pumping cycles during equal alternate time intervals.

5. A duplex rotary pump as specified in claim 2, in which the primary pump vane is rigidly fixed to the cylinder of the primary pump, and has rocking and sliding engagement with the rotor of the primary pump and in which an extension of said vane constitutes the secondary pump vane and divides the crescent-shaped chamber of the secondary pump into vacuum and compression sections during rotation.

6. A duplex rotary pump as specified in claim 2, in which the inlet side of the secondary pump communicates with a lubricant oil supply and the discharge side of said secondary pump communicates with the clearances existing between the inside wall and heads of the primary cylinder and the surfaces of the primary rotor, and with various bearing points.

7. A duplex rotary pump as specified in claim 2, in which the fluid supply passageway of the secondary pump is formed through the rotor of the primary pump and communicates with a passageway formed through the pump frame, and in which the fluid discharge passageway of the secondary pump is, in part formed through the rotor of the primary pump.

8. A duplex rotary pump as specified in claim 2, in which the discharge passgeway of the secondary pump is formed in part through the rotor of the primary pump and communicates through several passgeways, respectively, with the clearances existing between the inner surfaces of the primary cylinder and its attached heads and the surfaces of the primary rotor, and with the various bearing points, including one bearing of the rotor, the construction being such that the said communication to the said bearing of the rotor is effective separately from the other said communications during the rotation of the pump.

9. A duplex rotary pump comprising primary and secondary pumps, the primary pump comprising a cylinder and rotor rotatably mounted in eccentric, tangential relation, a pump vane rigidly secured to the primary pump cylinder, a rock-member rotatable in an open-sided bearing formed in the rotor of the primary pump provided with a slot to which the vane of the primary pump is slidably fitted, and the secondary pump comprising a tangentially engaging cylindrical recess and boss formed respectively, in an end of the rotor and on the proximate cylinder head of the primary pump concentric, respectively, with the axes of rotation of the rotor and cylinder of the primary pump, and in tangential relation to each other, and a projection on the primary pump vane which extends through a cut-away portion of the bottom of the slot in the rock-member to which the primary pump vane is slidably fitted, the end of which contacts with the perimeter of the boss which forms the rotor of the secondary pump, and constitutes a vane which divides the secondary pump chamber into suction and discharge compartments, the construction being such that the suction compartments of said pumps are at all times separated within the confines of the cylinder of the primary pump, and means for rotating said pump members applied to the cylinder of the primary pump.

10. In a rotary pump, the combination of a frame, pump members comprising a cylinder and rotor, said cylinder having two heads rigidly attached thereto one of which is provided with an opening in which a part of the pump frame is exposed, means for rotatably mounting said cylinder and rotor on the pump frame in eccentric, tangential relation, comprising a bearing shank rigidly fixed to the rotor rotatably fitted to a bearing formed in the part of the pump frame exposed in the opening in said pump cylinder, a single vane rigidly secured to the cylinder, which flexibly connects the cylinder and rotor and has rocking engagement with the rotor, means for rotating said pump members applied

to the cylinder, said pump being provided with fluid supply and discharge passageways which communicate with the pump chamber at opposite sides of the pump vane comprising a supply passageway a portion of which is formed through the rotor shank and rotor, and a discharge passageway formed through the wall of the cylinder, and a fluid-tight housing which encloses the discharge opening from the pump cylinder in which fluid discharged from the pump may be accumulated, and a check-valve applied to said discharge opening arranged to prevent the passage of fluid from said housing into the pump cylinder, the construction being such that, in operation, the areas of opposed surfaces of the cylinder heads exposed to pressure within the pump cylinder will be equal.

11. The rotary pump specified in claim 10, and a secondary rotary pump comprising pumping members formed within the cylinder of said first mentioned pump, and means rendered operative by actuation of said first mentioned pump for driving said second pump, the construction being such that the suction sides of said pumps, respectively, will be separated within the confines of the cylinder of said first mentioned pump.

12. In a rotary pump, a sealed housing and frame, pump members therein comprising a closed cylinder and a rotor therein forming a primary pump chamber, means for rotatably mounting said cylinder and rotor on the pump frame in eccentric tangential relation, comprising bearing projections on the cylinder heads, axially a ligned bearings on the pump frame by which said projections are rotatably supported, means for eccentrically mounting the rotor comprising supports extending from each end of the rotor also supported by axially aligned bearings, a vane secured to one of said pump members against relative radial movement thereto, means for flexibly connecting said vane with the other pump member for rotation therewith, means for rotating said pump members applied to the one to which the vane is secured, the housing adapted to hold a body of lubricating oil in its lower part, means operable by said pump for raising oil from said body and delivering it to the opposed and relatively movable surfaces of the cylinder, rotor and frame, comprising a secondary pump within the confines of the primary pump and consisting of a cylindrical recess formed in an end face of one primary rotatable pump member and concentric therewith, a cylindrical boss formed on the proximate face of the other member, concentric thereto forming the rotor of the secondary pump, which boss tangentially engages the inner cylindrical wall of said recess, a secondary pump vane having engagement with the rotor of the secondary pump, said rotatable members provided with fluid inlet and discharge passageways which communicate with the pump chamber at opposite sides of said pump vane, means for directing fluid from outside said housing to said inlet passageway, means for directing fluid from said discharge passageway outside of said housing and inlet and discharge passageways for the secondary pump which are independent of the inlet and discharge passageways of the primary pump.

13. The invention as defined in claim 12, in which the inlet passageway for fluid to the primary pump chamber has a portion which extends through one of the rotor supports.

14. The invention as defined in claim 12, the means for applying power to the rotatable pump members comprising a source of power outside of the housing, a counter-shaft adapted to be driven by said source of power, the counter-shaft extending through a bearing on one wall of the housing, means within the housing for operatively connecting the counter-shaft with the rotatable pump member to which the vane is secured to rotate same, said secondary pump being connected to deliver oil to the counter-shaft bearing, and means for sealing said counter-shaft bearing against the passage of fluid either into or out of the housing.

15. A duplex rotary pump comprising primary and secondary pumps, the primary pump comprising a cylinder and rotor rotatably mounted in eccentric, tangential relation, a pump vane secured in rigidly fixed position to the cylinder of the primary pump, a rock-member rotatable in an open-sided bearing formed in the rotor of the primary pump provided with a slot to which the vane of the primary pump is slidably fitted, and the secondary pump comprising an engaging recess and boss formed, respectively, in an end of the rotor and on the proximate cylinder head of the primary pump concentric, respectively, with the axes of rotation of the rotor and cylinder of the primary pump, and in tangential relation to each other, and a projection on the primary pump vane which extends through a cutaway portion of the bottom of the slot in the rock-member to which the primary pump vane is slidably fitted, the end of which contacts with the perimeter of the boss which forms the rotor of the secondary pump, the construction being such that the vaccum chambers of said pumps will be separated within the confines of the primary pump cylinder, and means for rotating said pump members applied to the cylinder of the primary pump.

16. The invention as defined in claim 15, the cylinder and the rotor each having supports at each side thereof.

17. In a rotary pump, the combination of a frame, primary pump members comprising a closed cylinder and a rotor within said cylinder, means for rotatably mounting said cylinder and rotor on the pump frame in eccentric tangential relation, a single impelling vane secured to one pump member against radial sliding engagement therewith, and which flexibly connects said pump members, means for rotating said pump members applied to the member to which the vane is so secured, said pump being provided with fluid supply and discharge passageways which communicate with the pump chamber at opposite sides of the pump vane, the supply passageway comprising a section formed in a rotatable pump member, a secondary rotary pump the cylinder of which comprises a cylindrical recess formed in an end face of one primary rotatable pump and concentric thereto, and the rotor of which secondary pump comprises a cylindrical boss formed on the proximate end face of the other primary rotatable pump member, concentric thereto, and tangentially engaging the inner cylindrical wall of said recess, a secondary pump vane having engagement with the rotor of the secondary pump, said secondary pump being provided with fluid supply and discharge passageways which communicate with the secondary pump chamber at opposite sides of the secondary pump vane, the supply pasageway of the secondary pump comprising a section formed in a rotatable pump member, the construction being such that the section of the supply passageway

of the primary pump formed in a rotatable pump member and the section of the supply passageway of the secondary pump formed in a rotatable pump member are independent and have no communication within the confines of the primary pump cylinder.

18. A duplex pump as specified in claim 17, in which the cylinder of the secondary rotary pump comprises a cylindrical recess formed in one end of the rotor of the primary pump and concentric therewith, and the rotor of which secondary pump comprises a cylindrical boss formed on the proximate cylinder end face of the primary pump and concentric to the primary cylinder.

19. In a rotary pump of the kind described, having a primary pump comprising a pump cylinder and a rotor mounted in eccentric tangential relation, a pump frame, axially aligned bearing parts on the pump frame upon which the cylinder and rotor are rotatably carried, a secondary pump associated with the primary pump and comprising a cylindrical opening provided in a part which rotates with the cylinder, the outer cylindrical wall thereof being concentric with the axis of rotation of the cylinder and forming the outer wall of the secondary pump space, means within said opening having a continuously curved outer surface forming the inner wall of the secondary pump space, said inner and outer walls being in tangential contact at one point, a vane dividing said secondary pump space, means for retaining the inner end of said vane in contact with said inner wall of the secondary pump space, suitable ports for the secondary pump arranged at opposite sides of said tangential point and inlet and discharge passageways for the secondary pump which are independent of the inlet and discharge passageways of the primary pump.

20. The invention as defined in claim 19, the primary rotor having a bearing projection extending out therefrom, said projection extending through said secondary pump space and forming the rotor thereof.

21. In a rotary pump of the kind described, a pump frame, pump members comprising a cylinder and a co-operating rotor, heads closing the ends of the cylinder, means for rotatably mounting the cylinder and rotor in eccentric, tangential relation, comprising bearing projectious on said cylinder heads, axially aligned bearings on the frame by which said projections are rotatably supported, a shank upon which the rotor is supported for rotation, a vane secured to one pump member against radial movement relative thereto, means for fle.:.bly connecting the vane to the other pump member for causing the rotation thereof with the pump member to which the vane is secured, means for rotating said pump members, a secondary pump associated with the primary pump and of which the rotor shank constitutes the rotor, a vane for the secondary pump arranged to rotate with the primary cylinder, means for causing the secondary vane to be held in yielding contact with said shank and suitable inlet and outlet ports for the secondary pump.

22. The rotary pump as defined in claim 21, in which the secondary pump consists of two like units one at each end of the primary pump, and inlet and discharge passageways for each unit of the secondary pump which are independent of the inlet and discharge passageways of the primary pump.

23. In a rotary pump of the kind described a primary pump comprising a pump cylinder and a co-operating rotor, means for rotatably mounting said cylinder and rotor in eccentric, tangential relation, comprising rigid axially aligned bearing members, bearing projections on the cylinder and rotor rotatably supported on the rigid bearings, and two secondary pumps one at each end of the rotor, the rotor bearing projections constituting the inner walls of the secondary pump spaces, said secondary pumps each arranged and adapted to deliver lubricating oil to the opposed bearing surfaces of the cylinder, rotor and bearings.

24. In a rotary pump, in combination, a pump frame, primary pump members comprising a cylinder closed at its ends by heads and a rotor within the cylinder, means for rotatably mounting the cylinder and rotor on the pump frame in eccentric, tangential relation, an impelling vane rigidly secured to one pump member and projecting radially thereto, and which flexibly rotatably connects the two members, means for rotating the two members applied to the one to which the vane is secured, a secondary rotary pump including a cylinder and a tangential rotor formed within the confines of the primary pump, said impelling vane of the primary pump being provided with an extension at one end arranged and adapted to act as the vane of the secondary pump, the arrangement being such that the two cylinders are diametrically opposed, inlet and discharge passageways communicating with said cylinders at opposite sides of their respective vanes the construction being such that the inlet and discharge passageways for the secondary pump are independent of the inlet and discharge passageways of the primary pump.

25. A duplex rotary pump as defined in claim 24, in which the inlet passageways of the secondary pump communicate with an oil supply and the discharge passageways of which communicate with clearances existing between the inside walls and heads of the primary cylinder and the opposed surfaces of the primary rotor, and with the various bearing points.

26. A duplex pump as specified in claim 24, the primary cylinder and rotor each provided with bearing supports at each end of the pump.

27. A duplex pump as specified in claim 24, the primary cylinder and rotor each provided with bearing supports on the pump frame at each side, the pump frame comprising a sealed housing adapted to contain a supply of lubricating oil in its base, the inlet passageway of the secondary pump connecting with said supply of oil, and having a portion extending through a rotary part of the pump.

28. A duplex pump as specified in claim 24, the primary cylinder and rotor each having bearing supports on the pump frame at each side, the pump being mounted in a sealed housing adapted to contain lubricating oil in its base, the inlet passageway of the secondary pump connecting with the supply of oil and the discharge passageway of the secondary pump, having portions which extend through rotating parts of the pump.

29. A duplex pump as specified in claim 24, the pump being mounted in a sealed housing adapted to contain lubricating oil in its base, the inlet passageway of the secondary pump being connected with said supply of oil, said passageway having a portion extending through a stationary part of the pump and another portion extending through a rotating part of the pump and a circumferential groove in one of said parts connecting said two portions of said passageway.

30. The rotary pump as specified in claim 24,

and the pump being mounted in a sealed housing, bearing projections on each cylinder head, bearing members rigid with the frame supporting said bearing projections, the primary rotor having supports extending at each side and supported by said rigid bearing members, the housing adapted to contain a supply of lubricating oil in its base, the inlet passageway of the secondary pump being connected with said oil supply and the discharge passageways of the secondary pump being connected with the bearings of the primary cylinder and rotor, said latter passageway including an opening extending through the primary rotor, passageways extending through at least one of said rigid bearing members, and pockets at the inner end of the said rigid bearing member into which oil is intermittently discharged from the opening extending through the primary rotor.

31. In a pump a cylindrical pump member having two fixed heads, a pump member movably mounted therein on bearings in eccentric tangential relationship to the said cylindrical pump member, a single vane which extends between the cylindrical pump member and the said inner pump member, power means applied to one of said pump members, means for delivering oil to opposed surfaces of the cylindrical pump member, the inner pump member, and the bearings, comprising a secondary pump consisting of a cylindrical recess formed in an end face of one pump member and concentric therewith, a cylindrical boss formed on the proximate face of the other pump member, concentric thereto, which boss tangentially engages the inner cylindrical wall of said recess, a secondary pump vane having engagement with the said cylindrical boss, fluid inlet and discharge passageways which communicate with the primary pump chamber at opposite sides of the primary pump vane, and fluid inlet and discharge passageways which communicate with the secondary pump chamber at opposite sides of the secondary pump vane, the construction being such that the two inlet passageways are separate and independent.

32. In a rotary pump, the combination of frame and housing means forming a frame and also forming a sealed housing, pump members therein comprising a cylinder and a rotor, heads which close the ends of the cylinder and are fixed thereto and one at least of which is detachable, one of said cylinder heads provided with an opening into which a portion of the pump frame extends, the relationship being such that the inner face of said extended portion of the pump frame is opposed to and parallel with the inner face of the other cylinder head, means for rotatably mounting said cylinder and rotor on the pump frame in eccentric, tangential relation, comprising a shank rigidly fixed to the rotor, said shank extending through said opening in a cylinder head, said shank being rotatably fitted to a bearing formed in the pump frame, and a single vane rigidly secured to the cylinder and which flexibly connects the cylinder and the rotor and has rocking engagement with the rotor, said pump being provided with fluid supply and discharge passageways which communicate with the pump chamber at opposite sides of the pump vane, one of which passageways comprises a section formed in the bearing shank of the rotor and both of which passageways communicate with other passageways formed through the frame and housing means, and the means for mounting the cylinder consisting of an axial shank on one of the cylinder heads which is rotatably fitted to a bearing in the pump frame, and to which power for driving the pump is applied directly.

33. In a rotary pump, the combination of support and housing means forming a frame and also forming a sealed housing, pump members therein comprising a cylinder and a rotor, heads which close the ends of the cylinder and are fixed thereto and one at least of which is detachable, one of said cylinder heads being provided with an opening into which a portion of the pump frame extends, the construction being such that the inner face of said extended portion of the pump frame is opposed to and parallel with the inner face of the other cylinder head, means for rotatably mounting said cylinder and rotor on the pump frame in eccentric tangential relation, comprising a shank rigidly fixed to the rotor, said shank extending through said opening in a cylinder head, said shank being rotatably fitted to a bearing formed in the pump frame, a single vane rigidly secured to the cylinder and which flexibly connects the cylinder and the rotor and has rocking and sliding engagement with the rotor, means for rotating said pump members applied to the cylinder, said pump being provided with fluid supply and discharge passageways which communicate with the pump chamber at opposite sides of the pump vane, one of which passageways comprises a section formed in the bearing shank of the rotor and both of which passageways communicate with other passageways formed through the frame and housing means, said frame and housing means being adapted to hold a body of oil in the lower part thereof, and a secondary pump adapted to deliver oil from said body to the clearances between the rotor and the heads in sufficient pressure to effectively seal said clearances against leakage of gas

34. In a compressor, pump members including a headed cylinder comprising an outer ring and end walls and a piston within the cylinder in eccentric tangential relationship to the outer ring, to form a pump chamber, a blade dividing the chamber into intake and discharge stages, said blade being rigid with one of the members and having a pivotal sliding fit with the other and sealed with respect to both of the members, actuating means for producing a pumping action with relative movement between said members, and an auxiliary pump including as pump members a cylinder formed in a recess in one of said members, and a piston in eccentric tangential relationship thereto, and a blade for the auxiliary pump carried by one of the auxiliary pump members and engaging the other thereof, and dividing said recess into intake and discharge sections, said auxiliary pump being actuated with the main pump by said actuating means to produce a pumping action with relative movement between the piston and cylinder of the auxiliary pump, an intake for the auxiliary pump adapted to supply a lubricant thereto, discharge passage means for delivering the lubricant from the auxiliary pump to the clearances between the members of the main pump.

WM. WARD DAVIDSON.

CERTIFICATE OF CORRECTION.

Patent No. 2,246,273.

June 17, 1941.

WILLIAM WARD DAVIDSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 9, first column, line 34, claim 12, for "a ligned" read --aligned--; same page, second column, line 60, claim 17, after the word "pump" insert --member--; page 11, first column, line 10, claim 30, for "passageways" read --passageway--; line 20, claim 31, after "pump" first occurrence, insert --comprising--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of July, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.