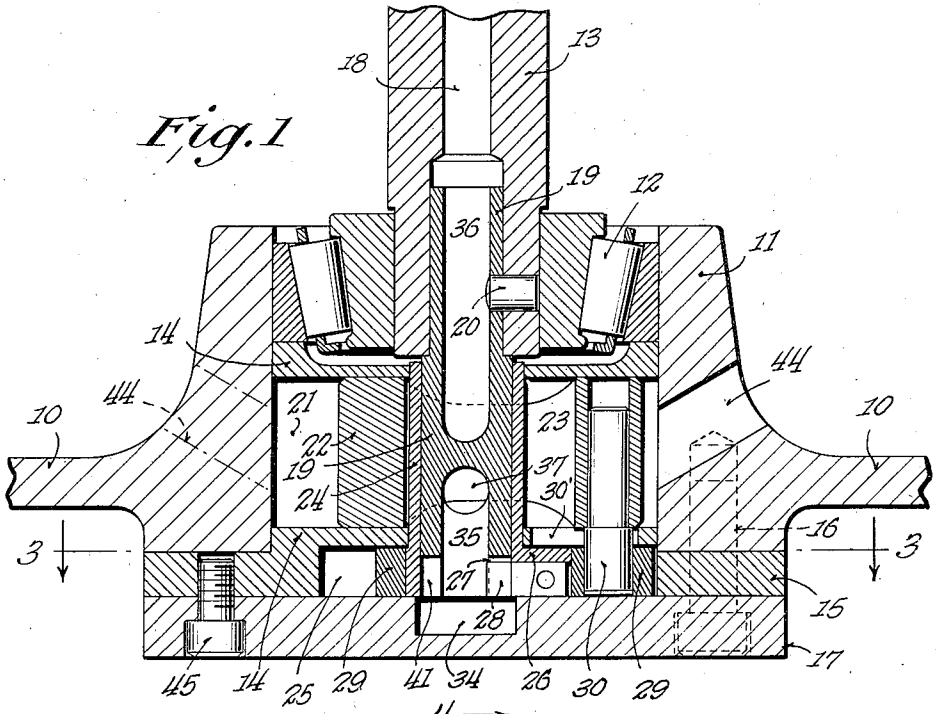
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Fig. 1



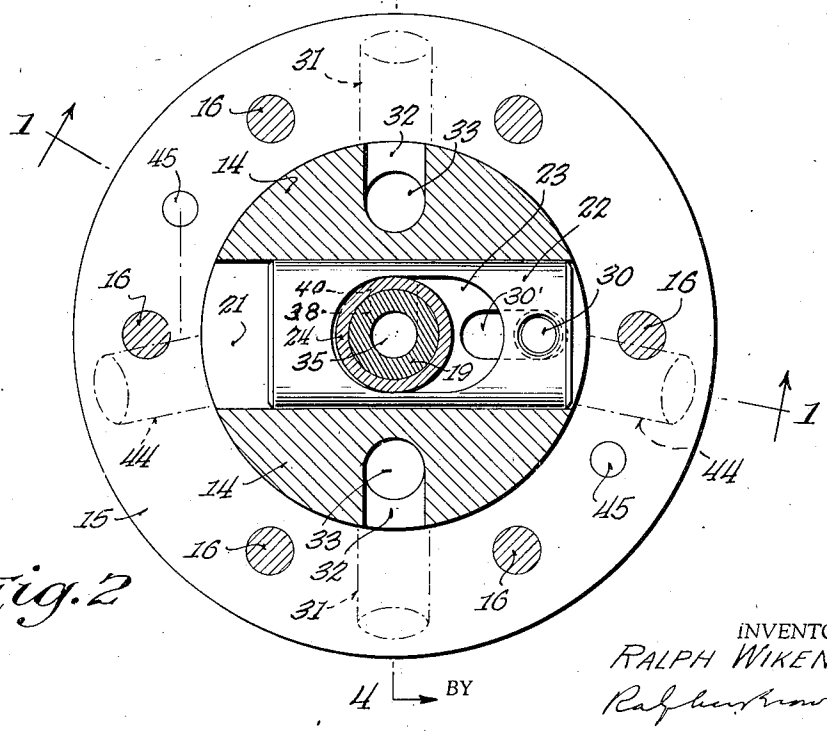


Fig. 2

INVENTOR.
RALPH WIKEN

ATTORNEY.

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Fig. 3

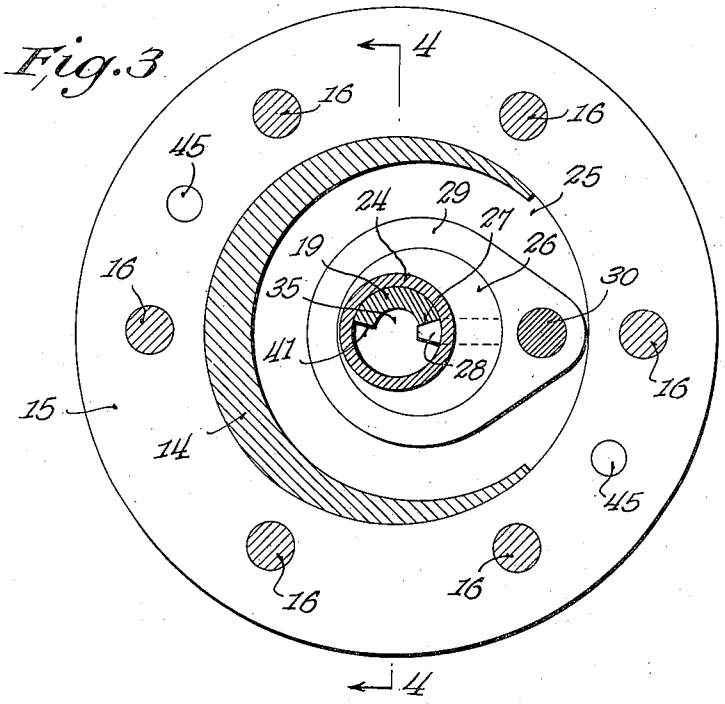
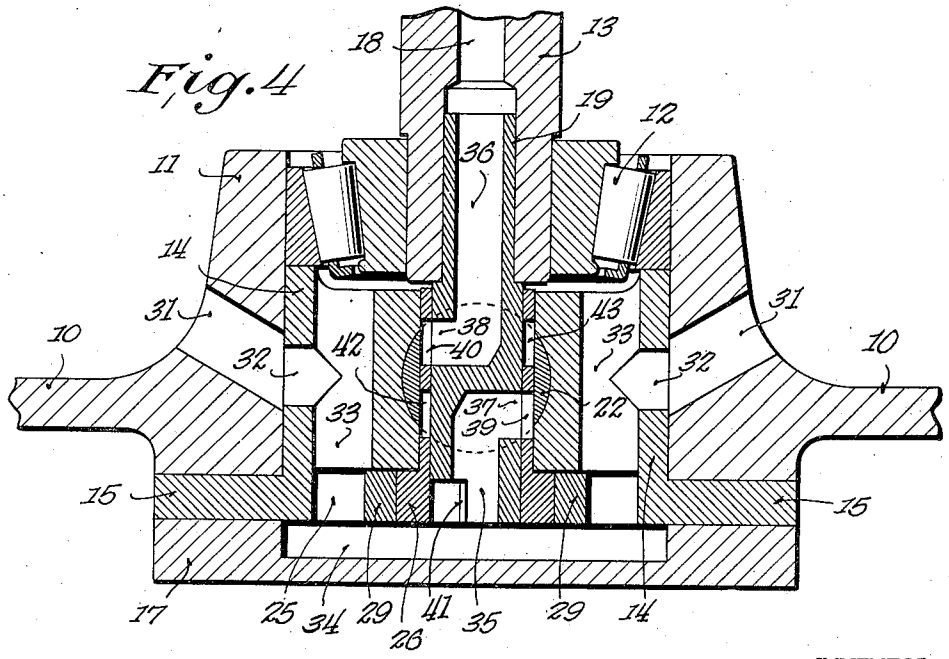


Fig. 4



INVENTOR.
RALPH WIKEN

BY

ATTORNEY.

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UNITED STATES PATENT OFFICE

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PUMP

Ralph Wiken, Milwaukee, Wis., assignor to The Falk Corporation, Milwaukee, Wis., a corporation of Wisconsin

Application September 12, 1938, Serial No. 229,438

12 Claims. (Cl. 103—158)

This invention relates to pumps for use primarily in lubrication systems for gear sets and other machines.

Gear sets of large power capacity present grave problems of lubrication, requiring a high degree of ingenuity for satisfactory solution. In the copending application of Walter P. Schmitter and Ralph Wiken, Serial No. 241,536, filed November 21, 1938, there is disclosed a gear reduction set having vertical gear shafts and having a novel lubrication system, including an upper reservoir receiving oil through a hollow channel in the center of one of the vertical shafts.

The novel pump of the present application has, as one of its advantages, the ability to deliver lubricant through the hollow shaft which drives the pump, in the manner required in the application above identified.

More broadly, the invention aims to provide a plunger pump in which a reciprocating pump chamber receives and delivers oil through a piston having a stationary location.

Another advantage lies in the ability of the pump to deliver lubricant in the same direction and through the same outlet during rotation of the driving shaft in either direction.

A further advantage lies in the provision of a pump which has no separate inlet or outlet valves, and which nevertheless will deliver lubricant when operated in either direction.

Other more specific objects and advantages will appear, expressed or implied, from the following description of an illustrative embodiment of the present invention.

In the drawings:

Figure 1 is a vertical sectional view taken substantially along the lines 1—1 of Fig. 2, showing a pump constructed in accordance with the present invention.

Fig. 2 is a horizontal section view of the pump removed from its support.

Fig. 3 is a horizontal sectional view in a lower plane indicated by the section line 3—3 of Fig. 1.

Fig. 4 is a vertical sectional view taken along the line 4—4 of Figs. 2 and 3.

The gear pump illustrated may be conveniently housed in a chamber formed in the bottom of a machine having a vertical shaft, such as the gear reduction set shown in the copending application identified above.

In Figs. 1 and 4 of the drawings, there is indicated at 10 the bottom of the housing of such a machine, the housing forming an oil reservoir and being constantly filled with oil to a level near the top of the present pump. Formed in the bottom plate of the housing is an upstanding circular flange or hub 11, extending above the level of the oil in the housing, and containing a cylindrical opening therethrough which extends downwardly through the bottom of the housing. The hub 11 not only serves as a mounting for the pump mechanism, but also as a support for the lower bearing 12 of vertical shaft 13 which may be one of the regular high speed shafts of the reduction gear system or other machine to which the pump is to be applied.

Within the hub 11 and below the bearing 12, there is seated a cylindrical block 14 having openings in which the various parts of the pump may operate, and also serving to position the bearing 12 above it. This block 14 has a lower peripheral base flange 15 through which pass screws 16 to secure the body to the housing 10. The screws 16 likewise pass through a cover plate 17 which forms the lower part of the pump assembly.

As illustrated in the copending application identified above, the vertical shaft 13 has a hollow interior 18, through which lubricant is fed to the lubricating system of the machine. At its lower end the shaft 13 is extended by means of a hollow extension shaft 19, secured thereto by a key 20 so as to rotate as a unit therewith. The shaft 19 extends downwardly through the pump mechanism, as shown in Figs. 1 and 4, to a point adjacent the cover plate 17 at the bottom of the pump.

Within the block 14 a transverse channel 21 extends directly across the center of the block to the flange 11 on either side, and forms a chamber for the reciprocating impulse element 22 of the pump. The channel 21 in the present case is conveniently made cylindrical in shape. The pump element 22 is slidably fitted in the channel 21 and has in its interior a hollow chamber 23 forming a vertical opening through which passes the vertical shaft 19 and a cylindrical bearing sleeve 24 which surrounds the shaft. The opening 23 is elongated in shape, so that the pump element 22 may reciprocate transversely of the shaft 19 from one end of the channel 21 to the other.

The mechanism for driving the reciprocating element 22 is novel. In a flat chamber 25 formed in the bottom of the block 14 below the channel 21, an eccentric ring 26 surrounds the lower end of the shaft 19. At the bottom of the shaft 19 a portion of the shaft is cut away, so that a shoulder 27 abuts against a key 28 fixed in the eccentric ring 26, by which means the eccentric 26 is caused to revolve with the shaft 19. Surrounding the eccentric ring 26 is a second, non-rotating ring

29, which carries a pin 30 extending up into the reciprocating pump element 22, through an elongated slot 30' communicating between the flat chamber 25 and the cylindrical cross channel 21. As may readily be seen, rotation of the eccentric ring 26 will be converted into reciprocating motion of the pin 30 and the pump element 22, the sidewise component of the eccentric 26 being accommodated by swinging of the ring 29 about the pin 30 as a fulcrum.

Oil is admitted to the pump from the reservoir in the housing 10 through a pair of ducts 31 piercing the upstanding flange 11 below the level of the oil in the reservoir. A pair of ports 32 give access through the block 14 to a pair of vertical ducts 33 formed in the block 14 and distributing oil through their lower ends into the lower flat chamber 25. A cross channel 34, formed in the upper side of the cover plate 17, conducts the lubricant beneath the rings 26 and 29, and communicates with the open lower end of the shaft 19.

The hollow interior of the shaft 19 in the vicinity of the pump element 22 is divided into two parts, each having a port communicating with the interior of the hollow chamber 23. These two parts form, respectively, a lower conduit 35 communicating with the cross channel 34 to serve as oil inlet, and an upper conduit 36 communicating with the lubrication system of the machine through the hollow interior 18 of the shaft 13, to form an oil outlet. Port 37 of the lower conduit 35 and port 38 of the upper conduit 36, are arranged upon opposite sides of the shaft 19, and since shaft 19 (with the surrounding sleeve 24) extends completely across the hollow chamber 23 from one side to the other, dividing it into two parts, it is apparent that the ports 37 and 38 will always be in communication with opposite parts of the chamber 23.

The sleeve 24, which surrounds the shaft 19 as it passes through the chamber 23, serves as a mounting means for the eccentric ring 26, being formed integrally therewith and being journalled at top and bottom in the block 14. The sleeve 24 has an opening 39 arranged to register with the port 37, whenever the shaft 19 is positioned with the shoulder 27 in driving engagement with the key 28, so that eccentric ring 26 and sleeve 24 are being rotated simultaneously with shaft 19. A similar opening 40 registers with port 38.

By reference to the drawings, we may see the manner in which this apparatus functions as an oil pump. Let us suppose that the shaft 19 is being rotated in a clockwise direction, when viewed as in Figs. 2 and 3, and that by engagement of the shoulder 27 with the key 28, the eccentric ring 26 has been carried to the position shown in Fig. 3, in which the pin 30 and consequently the pump element 22 have been carried to the extreme right of their reciprocating course. In such position, that part of the hollow chamber 23 to the right of the shaft 19 will be enlarged to its maximum size, and that part of the hollow 23 to the left of the shaft will have been reduced to a minimum, almost to zero. The ports 37 and 38 are so positioned in the shaft 19 with relation to the shoulder 27, that in the position described the ports will be facing the sides of the hollow chamber 23, with the outlet port 38 just entering the enlarged right hand part of the chamber 23, and the inlet port 37 just entering the reduced left hand part of the chamber, with the clockwise rotation of the shaft 19. As the rotation of the shaft continues, these ports will be carried further around into their respective parts of the hollow chamber, but at the same time, action of the eccentric 26 through the pin 30 will move the element 22 towards the left. The right hand part of the chamber 23 will thus be reduced, driving oil from the chamber through the port 38 and upper conduit 36 into the lubricating system. At the same time, the expanding left hand part of the chamber 23 will draw oil into the chamber from the inlet port 37, to which it is supplied by gravity from the outside oil reservoir through ducts 31, 32, 33 and channel 34.

This movement will continue for half a rotation of the shaft, until the pump element 22 is at the opposite end of its path, at which point continuing rotation of the ports 37 and 38 will switch them from one side of the hollow chamber 23 to the other, so that the same operation will be repeated as the pump element 22 moves toward the right in the second half of its cycle.

Reversal of the pump is made possible by a very simple expedient. When rotation of the shaft 19 is reversed, the shoulder 27 leaves the pin 28, and the pump elements remain stationary until, after exactly a half revolution of the shaft 18, a second shoulder 41 contacts the opposite side of key 28. By this maneuver the ports 37 and 38 will have exactly changed places before the pump begins its movement in the reverse direction, so that the portion of the chamber 23 which was previously expanding and drawing oil through the inlet conduit 35, will when reversed be contracting and expelling oil through the outlet duct 36, regardless of the point in the cycle at which the reverse took place.

Since upon reversal the shaft 19 makes a half revolution independently of the sleeve 24, a second set of openings 42 and 43 are provided through the sleeve in the positions which the ports 37 and 38 will occupy when normal operation of the pump in the reverse direction is resumed.

By the novel arrangement of parts in the pump shown, spaces are provided within the channel 21 at the ends of the pump member 22 which, when filled with oil, act as cushions for the reciprocating pump element 22, thus insuring smoother and quieter operation than is ordinarily possible with a reciprocating pump. The spaces at the end of the channel 21 are connected with the outer oil reservoir by relief ducts 44, so that the spaces in the channel 21 are constantly kept full of oil. As the pump element 22 reciprocates within the channel, this oil will be alternately drawn into and expelled from the spaces at the end of the channel. However, since the ducts 44 are of smaller cross section than the channel 21, the oil is somewhat hindered in its entrance and escape, so that the effect is somewhat like that of a dashpot, cushioning the pump element 22 at each end of its stroke.

It will be noted that all of the moving parts at the bottom of the pump assembly, such as the eccentric 26, the ring 29, etc., are retained in place by the cover plate 17 at the bottom of the pump. The large screws 16, which pass through both cover plate and the flange 15 of the body block 14, serve not only to bind the pump assembly together, but also to secure the entire pump assembly to the bottom of the casing 10. In addition to the large screws 16 there are provided two short screws 45 which serve only to secure the cover plate 17 to the block 14. With such arrangement, the entire pump assembly may be removed as a unit from the casing 10 by

removal of the screws 16, sliding out of the cylindrical channel in flange 11 and off the extension shaft 19, without disturbing the main shaft 13 or the bearing 12 in which it is mounted. This arrangement also permits the entire pump mechanism to be separately assembled, and then applied as a unit to the machine in which it is to be used.

Various changes may be made in the embodiment of the invention hereinabove specifically described without departing from or sacrificing the advantages of the invention as defined in the appended claims.

I claim:

1. In a pump the combination of means forming an elongated chamber, a member rotatable about its own center within said chamber and dividing the same into segregated portions, said chamber being reciprocable in the direction of its length relative to said member, inlet and outlet ports in said member rotatable therewith into communication with said portions alternately, and means connecting said first named means and member to effect reciprocation of said chamber and rotation of said member in timed relation.

2. In a pump the combination of means forming an elongated chamber, a member rotatable about its own center within said chamber and dividing the same into segregated portions, said chamber being reciprocable in the direction of its length relative to said member, inlet and outlet ports in said member rotatable therewith into communication with said portions alternately, said ports being arranged so that each communicates with one of said portions while the other communicates with the other of said portions, and means to effect reciprocation of said chamber and rotation of said member in timed relation, said last named means including means for reversing the relation between said ports and portions upon reversing the direction of rotation of said member thereby to effect discharge through said outlet port in both directions of rotation of said member.

3. In a pump the combination of means forming an elongated chamber reciprocable in the direction of its length, a member having inlet and outlet ports, said member being fitted within said chamber to form a closure therefor and said member being fixed against movement in the direction of reciprocation of said chamber to thereby form a pump by coaction therebetween, said member being otherwise moveable to present said ports alternately to said chamber.

4. In a pump the combination of means forming an elongated chamber reciprocable in the direction of its length, a member fitted within said chamber and dividing said chamber into segregated portions, said member having inlet and outlet means therein, said member being fixed against movement in the direction of reciprocation of said chamber to thereby form a pump by coaction with said reciprocating chamber but being otherwise moveable to bring said inlet and outlet means into communication with said portions alternately in timed relation with said reciprocating chamber.

5. In a pump the combination of a reciprocable element having a chamber therein, a drive shaft having a fixed location, said shaft being fitted within said chamber across the path of reciprocation thereof and coacting with said chamber to form a pump, inlet and outlet ports in said shaft alternately presented to said chamber, shaft-engaging means operable to reciprocate said element in timed relation with the presentation of said ports, said shaft-engaging means being free from engagement with said shaft for one-half revolution upon reversal thereof but thereafter re-engaging said shaft to resume operation of said element in the same timed relation with respect to said ports.

6. In a pump the combination of a longitudinally reciprocable element having a chamber therein, a rotating shaft of fixed location fitted within said chamber across the path of reciprocation thereof and dividing said chamber into segregated portions, said shaft having inlet and outlet ports alternately presented to said chamber portions, a cam rotatable with said shaft, a pin on said reciprocable element, a ring surrounding said cam and swingable on said pin to thereby accommodate lateral displacement of said cam, said ring and pin being moved by said cam toward and away from said shaft to thereby induce reciprocation of said reciprocable element in timed relation with presentation of said ports to said chamber portions.

7. In a pump the combination of a longitudinally reciprocable element having a chamber therein, a rotating shaft of fixed location fitted within said chamber across the path of reciprocation thereof and dividing said chamber into segregated portions, said shaft having inlet and outlet ports alternately presented to said chamber portions, a cam engaged with said shaft for rotation thereby in one direction, a pin on said reciprocable element, a ring surrounding said cam and swingable on said pin to thereby accommodate lateral displacement of said cam, said ring and pin being moved by said cam toward and away from said shaft to thereby induce reciprocation of said reciprocable element in timed relation with presentation of said ports to said chamber portions, said cam being free from engagement with said shaft for one-half revolution upon reversal thereof to permit reversal of said ports but thereafter re-engaging said shaft to resume operation of said element in the same timed relation with respect to said ports but in the reverse direction of movement.

8. In a pump the combination of a member rotatable about its own center, means forming a chamber reciprocable in the direction of its length toward and from said member, said member dividing said chamber into segregated portions to thereby form a pump, said member having inlet and outlet ports rotatable therewith each communicating with said portions alternately.

9. In a pump the combination of a stationary block having a channel formed therein, an element in said channel reciprocable lengthwise thereof, said element and the sides of the said channel forming sides and one end of a pump chamber, a member rotatable about its own center and having a fixed location relative to said block, said member forming a closure for the other end of said pump chamber, the increase and decrease in size of said chamber upon reciprocation of said element serving to effect a pumping action, inlet and outlet ports in said member alternately presented to said chamber in timed relation with reciprocation of said element, and means controlling the relation between said member and said element responsive to a change in direction of rotation of said rotary member for insuring presentation of said outlet port to said chamber during a compression stroke by said element.

10. In a pump the combination of a stationary block having a channel formed therein, an element in said channel reciprocable lengthwise thereof, said element and the sides of the said channel forming sides and one end of a pump chamber, a member rotatable about its own center and having a fixed location relative to said block, said member forming a closure for the other end of said pump chamber, the increase and decrease in size of said chamber upon reciprocation of said element serving to effect a pumping action, inlet and outlet ports in said member alternately presented to said chamber in timed relation with reciprocation of said element, a rotary driver for said member and element having a discharge duct in communication with said outlet port, and means controlled by the direction of rotation of said driver and controlling the relation between said member and said element for insuring presentation of said outlet port to said chamber during a compression stroke by said element.

11. In a pump the combination of a stationary element and an element reciprocable relative thereto, said elements forming sides and one end of a pump chamber alternately increasing and decreasing in size upon reciprocation of said element, a member rotatable about its own center and having a fixed location relative to said stationary element, said member forming a closure for the other end of said pump chamber, inlet and outlet means in said member alternately presented to said chamber by rotation of said member, and means connecting said reciprocable element and said rotary member to effect reciprocation of said element in timed relation with said member.

12. In a pump the combination of a stationary block having a channel formed therein, an element in said channel reciprocable lengthwise thereof, said element and the sides of the said channel forming sides and one end of a pump chamber, a member rotatable about its own center and having a fixed location relative to said block, said member forming a closure for the other end of said pump chamber, the increase and decrease in size of said chamber upon reciprocation of said element serving to effect a pumping action, inlet and outlet ports for said chamber in said rotatable member, and a rotary driver for said element and said member having a discharge duct in communication with said outlet port to conduct fluid discharged by said pump chamber.

RALPH WIKEN.