March 24, 1942. W. P. SCHMITTER ET AL 2,277,270

GEAR PUMP

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FIG. 1.

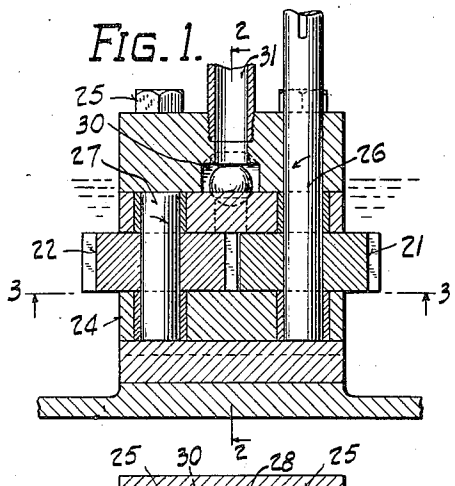


FIG. 2.

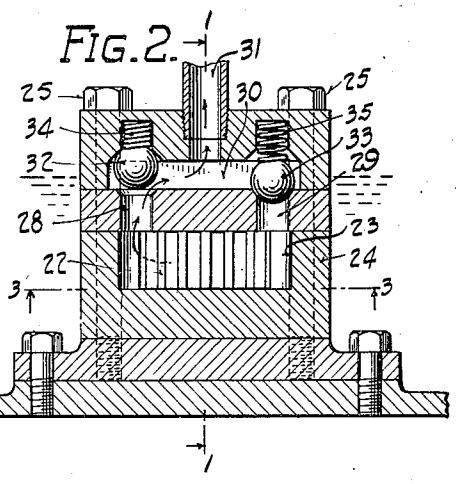


FIG. 3.

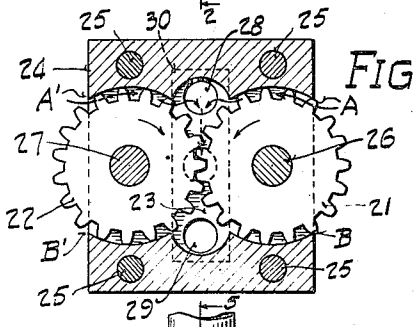


FIG. 4.

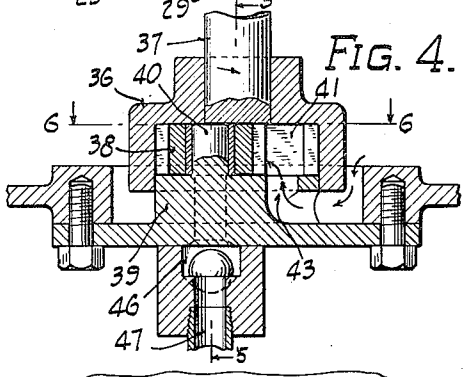


FIG. 5.

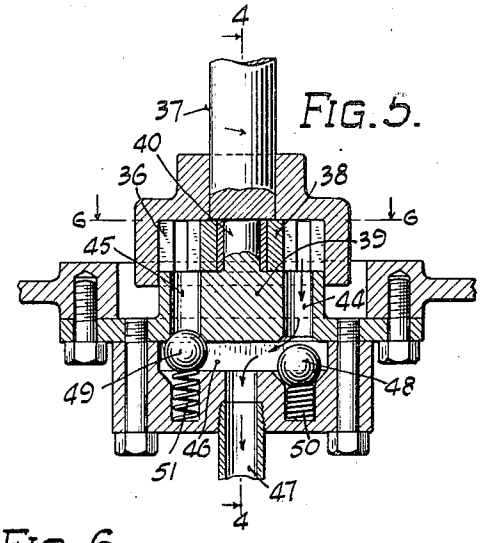
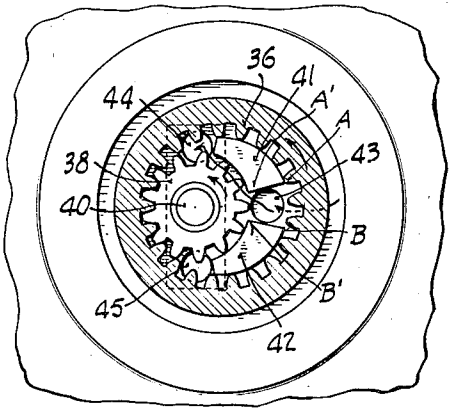


FIG. 6.



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FIG. 7.

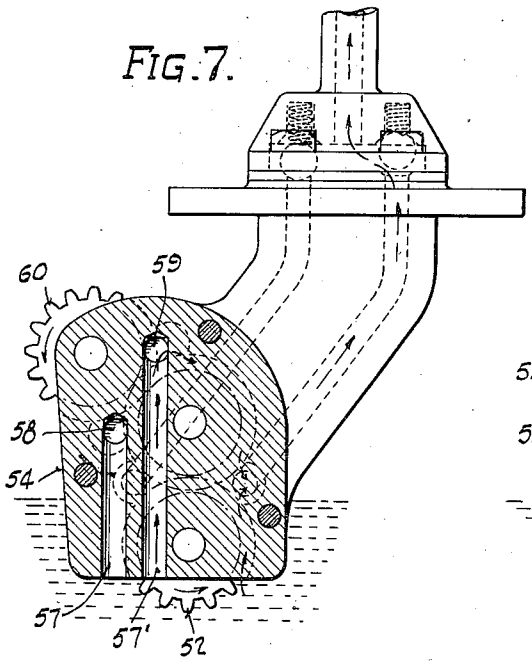


FIG. 8.

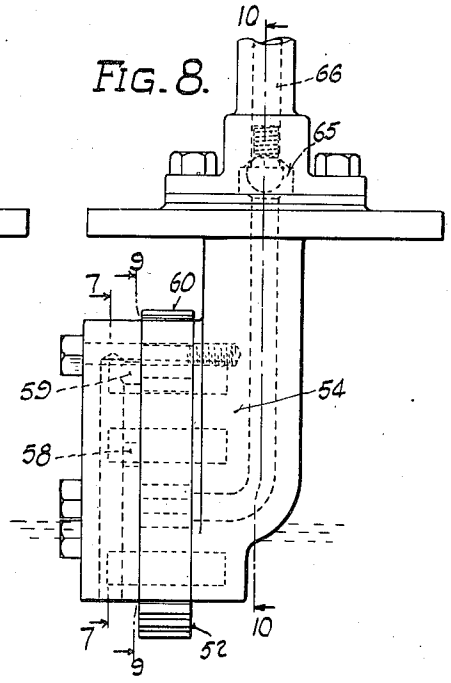


FIG. 9.

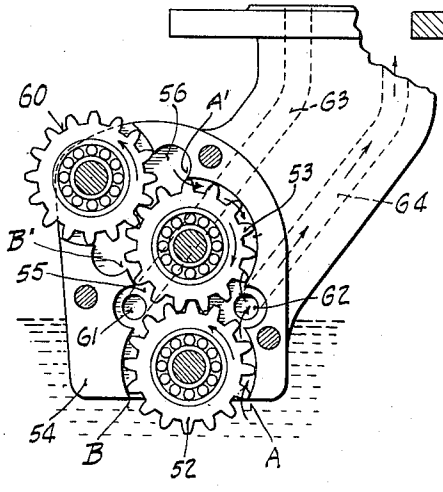
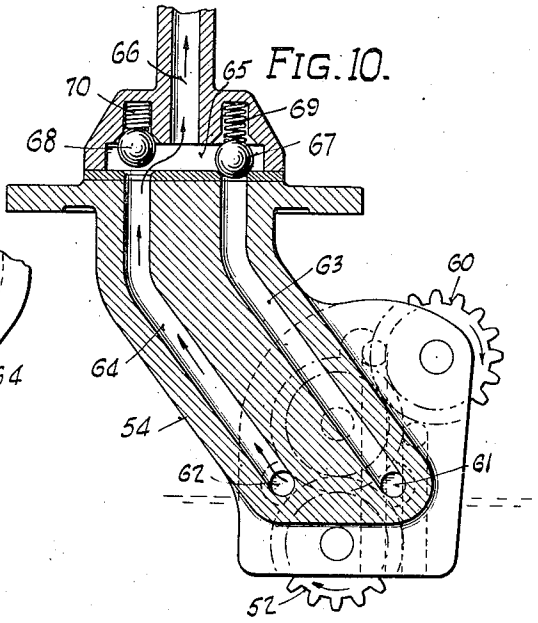


FIG. 10.



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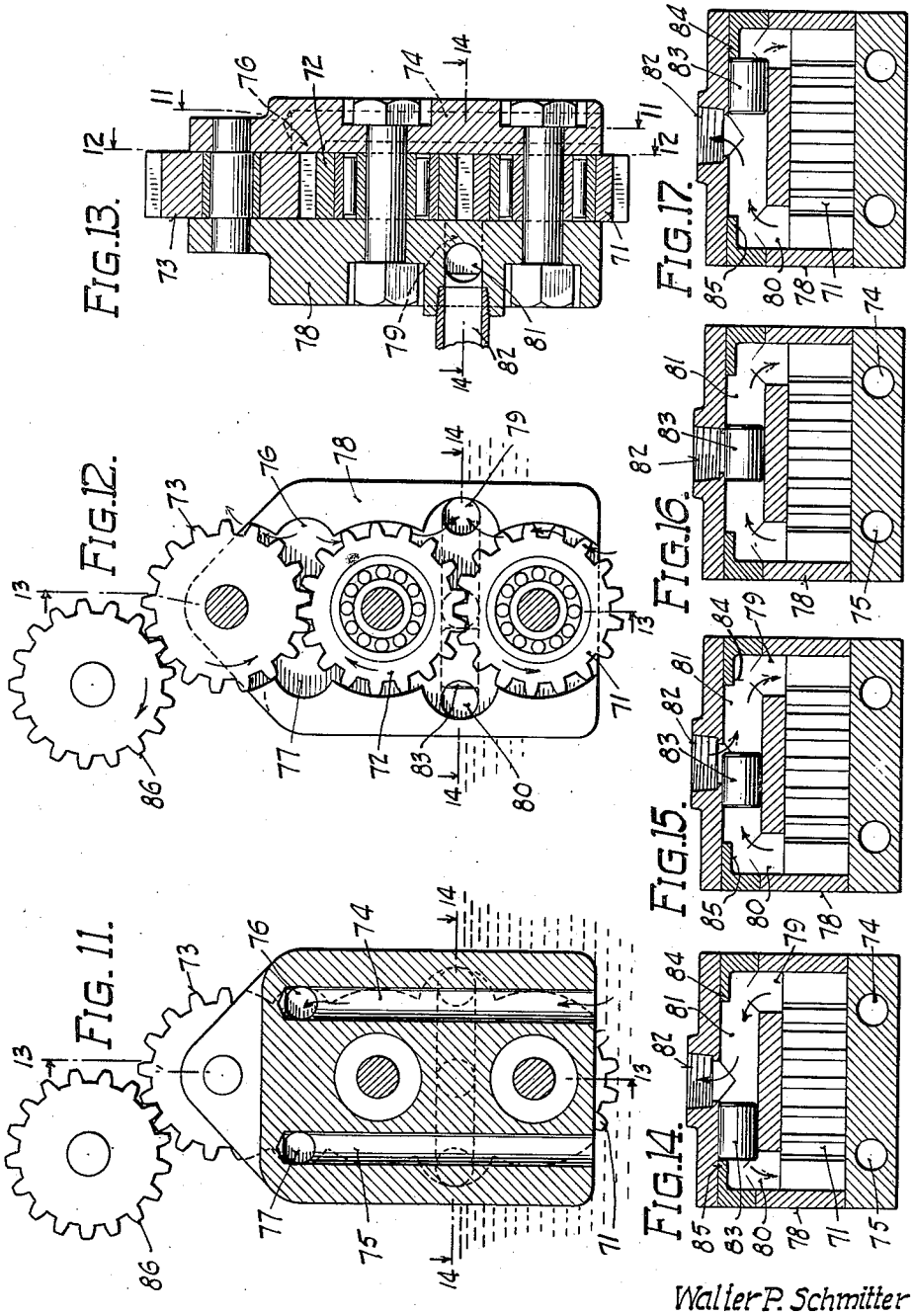
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GEAR PUMP

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UNITED STATES PATENT OFFICE

2,277,270

GEAR PUMP

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Application September 12, 1938, Serial No. 229,439

9 Claims. (Cl. 103—126)

This invention relates to gear pumps primarily for use in oil lubricating systems.

It has heretofore been common to employ gear pumps of the simple type comprising two intermeshing gears, in which the separation of the teeth creates a suction drawing up oil, which is carried around by the revolving teeth until displaced by intermeshing of the gear teeth, the oil thus being discharged under pressure into the lubricating system. Gear pumps of this simple type are non-reversible, and any attempt to operate them in the reverse direction results in a suction drawing air or oil from the lubricating system, and pumping it into the oil reservoir or supply pipe.

Attempts have heretofore been made to arrange the oil passages so that each of the single openings on either side of the meshing gears may function as intake or outlet, depending upon the direction of rotation. For this purpose, each of the two openings into the gear chamber has had two connecting passages communicating with the oil supply and oil delivery pipes respectively, with ball valves provided in each of the four passages to shut off one supply and one delivery passage during operation of the pump in each direction, so that the associated opening into the gear chamber may function either as inlet or outlet port. Such pumps have not proven satisfactory, however, because of the large number of valves necessary, and because the use of any valves whatever on the inlet side of a pump has serious disadvantages.

One object of the present invention is to provide a simple and practical gear pump which shall be operable in either direction.

Another object is to provide in such a gear pump separate paths for the carrying of oil therethrough, depending upon the direction of rotation.

Another object is to provide a gear pump having a number of openings serving as a plurality of both inlet and outlet ports.

Another object is to provide a reversible gear pump having no valves in the intake passages.

Another object is to provide a simplied form of reversible gear pump in which the number of valves has been reduced to a minimum.

Another object is to provide a novel, automatically operating slide valve for a reversible gear pump.

Another object is to provide a gear pump having an additional gear to form an auxiliary suction pump.

Another object is to provide a gear pump having a gear exposed through the casing for engagement with an externally mounted driving gear.

Another object is to simplify and improve the operation of a gear pump.

Other objects and advantages will appear, expressed or implied, from the following description of several embodiments of the present invention.

In the accompanying drawings:

Figure 1 is a vertical sectional view of one form of oil pump constructed in accordance with the present invention, taken along the line 1—1 of Fig. 2.

Fig. 2 is a vertical sectional view of the pump shown in Fig. 1, taken at right angles to the view in Fig. 1 along the line 2—2.

Fig. 3 is a horizontal sectional view of the pump shown in Figs. 1 and 2 taken along the line 3—3 thereof.

Fig. 4 is a vertical sectional view of a second form of pump embodying the present invention, taken along the line 4—4 of Fig. 5.

Fig. 5 is a vertical sectional view of the oil pump shown in Fig. 4, taken at right angles to the view in Fig. 4, along the line 5—5 thereof.

Fig. 6 is a horizontal sectional view of the oil pump shown in Figs. 4 and 5, taken along the line 6—6 thereof.

Fig. 7 is a vertical sectional view of a third form of oil pump embodying the present invention, and taken along the line 7—7 of Fig. 8.

Fig. 8 is a side view of the oil pump shown in Fig. 7.

Fig. 9 is a front view of the pump shown in Figs. 7 and 8, with the front cover removed, being a view substantially along the line 9—9 of Fig. 8.

Fig. 10 is a vertical sectional view of the pump shown in Fig. 8, taken along the line 10—10 of Fig. 8.

Fig. 11 is a vertical sectional view of a fourth form of gear pump embodying the present invention, taken along the line 11—11 of Fig. 13.

Fig. 12 is a front view of the gear pump shown in Fig. 11, with the front removed, being substantially a view along the line 12—12 of Fig. 13.

Fig. 13 is a vertical sectional view of the gear pump shown in Figs. 11 and 12, taken at right angles to the views 11 and 12 along the lines 13—13 thereof.

Figs. 14, 15, 16 and 17 are horizontal sectional views of the gear pump shown in Figs. 11, 12 and 13, taken along the lines 14—14 thereof, and

showing the valve mechanism in various stages of operation.

The form of oil pump illustrated in Figs. 1, 2 and 3 of the drawings includes a pair of gears 21 and 22 which intermesh and consequently rotate in opposite directions. These gears are mounted within a pump chamber 23 formed in a casing 24 which fits closely against the top and bottom of the gears, and which also fits closely to the periphery of the gears throughout portions of their circumferences. For ease of manufacture and assembly, the casing of the pump shown in the drawings is made in several sections, held together by vertical screws 25 passing therethrough. The gears 21 and 22 are mounted upon shafts 26 and 27, journalled at top and bottom in the casing 24, one of which may have a portion extending upwardly through the top of the casing by which the pump may be operated.

The pump of the present invention, as embodied in this form, is characterized by the fact that pump chamber 23 is open at both ends, so that a segment of the gears 21 and 22 is exposed to the bath of oil, in which the pump is submerged.

Between the gears 21 and 22, adjacent the point of engagement and on either side thereof, are situated outlet ports 28 and 29 leading upward to a cross channel 30 from which an outlet duct 31 leads to the lubricating system. Both of the ports 28 and 29 will, when the pump is at rest, be kept out of communication with the cross channel 30 by the ball valves 32 and 33 within the cross channel 30, each valve being maintained seated in the outlet ports 28 and 29, respectively, by coil springs 34 and 35.

As the pump is operated so that the gears rotate, for example, in the direction indicated by the arrows in Fig. 3, oil from the reservoir will be picked up by the revolving gear teeth at the points A and A', and carried into the pump chamber 23. As the gear teeth come together, however, at the point of engagement, the oil will be forced out through the outlet port 28, lifting the ball valve 32 to flow out through the cross channel and the duct 31 into the lubricating system.

Upon reversal of the gear pump, the valve 32 will of course immediately close. The gears 21 and 22 then rotating in the opposite direction will pick up lubricant at points B and B', which will be carried into the pump chamber, and forced out through the port 29, lifting the valve 33, and thence flowing out through the duct 31 into the lubricating system as before.

The usual type of gear pump has two ports, corresponding in position to the ports 28 and 29 of the pump described, one of which must always be an inlet and one an outlet port. It will be noted that in the present invention the open ends of the pump chamber 23, exposing the outer segments of the gears 21 and 22, are the equivalent of a second pair of inlet ports for the pump chamber, so that the ports 28 and 29 may both be outlet ports alone, used alternately depending upon the direction of rotation, and when not in use cut off from the lubricating system by the ball valves 32 and 33, respectively.

The modified form of pump shown in Figs. 4, 5 and 6 of the drawings is quite different in structure from the form previously described, but is very similar thereto in principle and mode of operation.

This second form of pump includes a large internally toothed gear 36 mounted upon the lower end of the drive shaft 37 and meshing with an externally toothed pinion 38 disposed within it. In this case the gear 36 itself forms the top and outer wall of the pump chamber. The bottom wall of the pump chamber is formed by the base or casing 39 which has an upwardly projecting pintle 40 upon which the pinion 38 is mounted. The base 39 also has two lugs 41 and 42 projecting upwardly and each completely filling the space between the inner periphery of the teeth of the gear 36 and the outer periphery of the teeth of the pinion 38, throughout a portion of the circumference of each gear. Between the lugs 41 and 42, however, is an open space into the floor of which opens an inlet port 43 dipping under the rim of the gear 36, and constantly supplied with oil by gravity, either through a duct from an overhead reservoir, or by submergence beneath the surface of the oil in the reservoir.

Each of the lugs 41 and 42 stops short near the point of contact between the meshing gears 36 and 38, leaving on either side a space from the floor of which open the outlet ports 44 and 45, respectively. These ports lead downward to a cross channel 46 from which an outlet duct 47 leads to the lubricating system.

As in the form of pump first described, both of the ports 44 and 45 will, when the pump is at rest, be kept out of communication with the cross channel 46 by the ball valves 48 and 49 within the cross channel 46, each valve being maintained seated against the outlet ports 44 and 45, respectively, by coil springs 50 and 51.

The operation of this pump is almost exactly the same as that of the form previously described. As the pump is operated to rotate the gear, for example in the direction shown by the arrows in Fig. 6, oil from the inlet port 43 will be picked up by the revolving gear teeth at the points A and A', and carried along towards the point of engagement of the gears 36 and 38, where it will be forced out through the outlet port 44. As the pump is operated in the opposite direction, oil from the inlet port 43 will be picked up at the points B and B', and carried along until forced out through the outlet port 45. In either case, as in the form of pump described previously, return of lubricant from the system to the pump will be prevented by the closure of that outlet port not in use by the ball valve 48 or 49.

A third form of pump, shown in Figs. 7, 8, 9 and 10, also differs somewhat in structure from the form shown in Figs. 1 to 3, but exhibits the same principle and mode of operation. In this third form of pump, the intermeshing gears 52 and 53 are mounted vertically upon horizontal shafts journalled in the casing 54. As in the first form, the casing 54 is hollowed out to form a pump chamber 55, fitting closely around the peripheries of the teeth of the gears 52 and 53 throughout portions of the circumferences of each.

As in the first form of pump, the peripherally enclosing portion of the pump chamber is discontinued throughout a portion of the periphery of each gear, so that a segment of the gear is exposed therethrough. The lower portion of the gear 52, extending through such opening, may be seen submerged in the oil in which the pump is submerged, and the upper portion of gear 53 exposed to a chamber 56.

Because of the vertical arrangement of the gears, however, it is possible that a pump of this

type may not be totally submerged beneath the surface of the oil bath. For that reason, oil ducts 57 and 57' have been provided, to conduct oil from the reservoir through inlet ports 58 and 59 to the chamber 56 into which the exposed peripheral segment of the upper gear 53 projects. In order to provide a suction for drawing oil up through the ducts 57 or 57', there has been provided a third gear 60, journalled in the casing 54, and having portions of its periphery enclosed by the casing. This third gear 60 meshes with the second gear 53, and forms therewith an auxiliary suction pump.

As in the form of pump first described, outlet ports 61 and 62 are situated between the gears 52 and 53 adjacent their point of engagement and on either side thereof. These outlet ports lead upward through passages 63 and 64, respectively, to a cross channel 65, from which an outlet duct 66 leads to the lubricating system. Ball valves 67 and 68, with their associated coil springs 69 and 70, serve to shut off the passages 63 and 64 from the outlet means, when not in use.

When the pump is operated so that the gears rotate, for example, in the direction indicated by the arrows in Figs. 7 and 9, oil from the reservoir will be picked up by the teeth of the revolving gear 52 at the point A and delivered to the outlet port 62. At the same time, separation of the teeth of the gears 53 and 60 will create a suction at the inlet port 59, drawing oil up from the reservoir, which will then be taken up by the teeth of the gear 53 at the point A', and carried thereby to the outlet port 62. From the outlet port, oil will be forced through the passage 64, lifting the ball valve 68 and flowing out therethrough into the lubricating system. Upon reversal of the pump, gear 52 will receive its oil at the point B, and gears 53 and 60 will create a suction, drawing oil through the inlet port 58, delivering it to the gear 53 at the point B'. The gears 52 and 53 will then of course deliver this oil to the outlet port 61, forcing it through the passage 63 past the ball valve 67 into the lubricating system.

A fourth form of gear pump, very similar to the third form described above, is shown in Figs. 11 to 17, inclusive. Like the third form described, the pump shown in this modification has two primary pumping gears 71 and 72, and a third gear 73 meshing with the second gear 72 to draw oil by suction from the reservoir through the passage 74 or 75 and to deliver it to the gear 72 through the inlet port 76 or 77. As in the other forms of pump described, the casing 78 has portions fitting closely around the peripheries of the gears 71, 72 and 73 throughout portions of their circumferences.

This modification differs from the others described primarily in the outlet port and valve structure. The outlet ports 79 and 80 are situated adjacent the point of engagement of the gears 71 and 72 and on either side thereof. As in the form of pump first described, the outlet ports lead directly to a cross channel 81 from which a duct 82 leads to the lubricating system. In place of the spring and ball valve arrangements of the previous forms, however, the pump in this modification has a single pressure-operated reciprocating valve. It comprises a member 83 designed to fit closely within the channel 81, and freely slidable from end to end therein, its movement in either direction being limited by shoulders 84 and 85 within the channel 81. As shown in Fig. 14, when the member 83 is positioned adjacent one end of channel 81, it fills the channel and completely closes off the outlet port 80 from the outlet 82 to the lubricating system. This is the position in which the member 83 will remain while the pump is being operated in the direction indicated by the arrows in Fig. 12, so that oil is being forced out through the outlet port 79 and the channel 81 and duct 82 into the lubricating system.

If, however, the pump be reversed, oil will be forced through the outlet port 80 against the member 83, as indicated by the arrows in Fig. 15. This pressure of oil will cause the member 83 to slide across the channel 81, past the center position shown in Fig. 16, in which position it completely bridges the outlet duct 82, so that at no time can oil escape through the channel 81 from one outlet port 80 or 79 to the other. At this central position there will be added to the pressure of oil through the port 80 a suction through the port 79, both forces operating to induce continued movement of the member 83 to the position at the opposite end of the channel 81, as shown in Fig. 17, in which position free communication will have been established from the outlet port 80 through the duct 82 to the lubricating system.

It will be noted in the three forms of pump shown in Figs. 1 to 3, 7 to 10, and 11 to 17, that one or more of the gears in the train constituting the pump has a portion exposed through the outside of the casing. Such exposed gear may of course be made to engage with any convenient gear of the machine to which the pump is attached, such as that indicated at 86 in Figs. 11 and 12, for the purpose of driving the pump. It may thus be possible to eliminate a special drive shaft or special driving gears for the gear pump.

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.

We claim:

1. In a gear pump the combination of three gears intermeshing to form a train, a pair of inlet ports disposed one on either side of said train adjacent the point of engagement of the center gear and one of the end gears, a pair of outlet ports disposed one on either side of said train adjacent the point of engagement of the center gear and the other end gear, a delivery duct communicating with either of said outlet ports alternatively, said gears forming a pump inducing flow of fluid from one of said inlets to one of said outlets and from such outlet to said delivery duct.

2. In a gear pump the combination of three gears intermeshing to form a train, a pair of inlet ports disposed one on either side of said train adjacent the point of engagement of the center gear and one of the end gears, a pair of outlet ports disposed one on either side of said train adjacent the point of engagement of the center gear and the other of end gear, a delivery duct alternatively connectable with each of said outlet ports, said gears during operation in one direction forming a pump inducing flow from one of said inlets to one of said outlets and from such outlet to said delivery duct, said gears when operating in the reverse direction inducing flow from the other of said inlets to the other of said

outlets and from such outlet to said delivery duct.

3. In a gear pump the combination of a pair of upper and lower intermeshing gears arranged in an upright sequence, inlet means permanently disposed to admit fluid by gravity to the lower part of the lower of said gears, additional inlet means disposed near the top of the upper of said gears and isolated from the lower gear, suction means inducing a supply of fluid through said last named inlet means, and outlet means intermediate said upper and lower inlet means near the point of engagement of said gears.

4. In a gear pump the combination of a pair of upper and lower intermeshing gears arranged in an upright sequence, inlet means permanently disposed to admit fluid by gravity to the lower part of the lower of said gears, additional inlet means disposed near the top of the upper of said gears, a third gear engaging the upper of said pair of gears and cooperating therewith to draw fluid by suction through said upper inlet means, and outlet means intermediate and isolated from said upper and lower inlet means.

5. In a gear pump the combination of three gears intermeshing to form a train, a port on each side of said train adjacent the point of engagement of the center gear and one of the end gears, a port on each side of said train adjacent the point of engagement of the center gear and the other end gear, the two ports on one side of said gear train functioning as inlet and outlet ports respectively when said pump is operated in one direction, and means rendering the two of said ports on the opposite side of said train ineffective during operation of the pump in such direction.

6. In a gear pump the combination of intermeshing gears each having fluid-carrying teeth, a casing closely fitting portions of the peripheries of said gears and completely enclosing the areas adjacent the point of interengagement of said gears to form separate chambers on each side thereof, and fluid inlet and outlet means for said casing including an opening at one end thereof, the teeth of one of said gears being exposed through said opening.

7. In a gear pump the combination of intermeshing gears each having fluid carrying teeth, a casing closely fitting portions of the peripheral surface of said gears and enclosing the areas adjacent the point of interengagement of said gears to form separate chambers on each side thereof, separate fluid outlets for said casing each communicating with one of said chambers, said outlets being alternately effective in reverse directions of rotation of said gears, fluid inlet means for said casing including an opening at one end thereof, a portion of one of said gears projecting through said opening.

8. In a gear pump the combination of intermeshing gears having fluid-carrying teeth, a casing closely fitting portions of the peripheries of said gears and forming a pump chamber completely enclosing the areas adjacent and at opposite sides of the point of engagement of said gears, and fluid inlet and outlet means for said casing including an opening at each end thereof, a toothed portion of each of said gears being exposed through said openings.

9. In a gear pump the combination of three intermeshing gears arranged in sequence, a casing forming a pump chamber enclosing said gears and having an opening at each end thereof, one of said openings forming an inlet admitting fluid to the gear at one end of said sequence, the gear at the other end of said sequence having a peripheral portion projecting from the other of said openings for engagement with an external driving member, and outlet means for said chamber.

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