

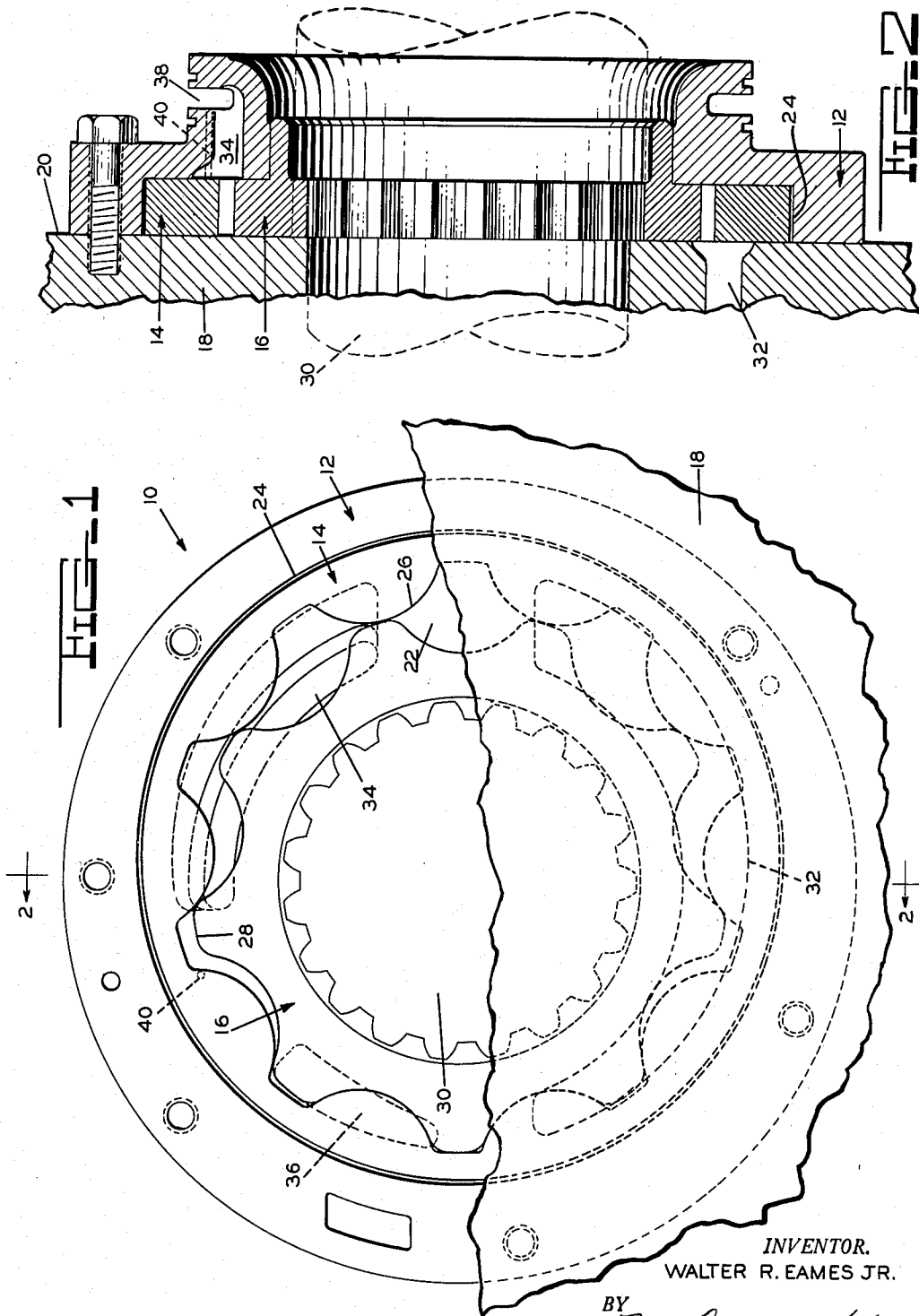
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INTERNAL GEAR PUMP

2,732,802

Filed March 10, 1950

2 Sheets-Sheet 1



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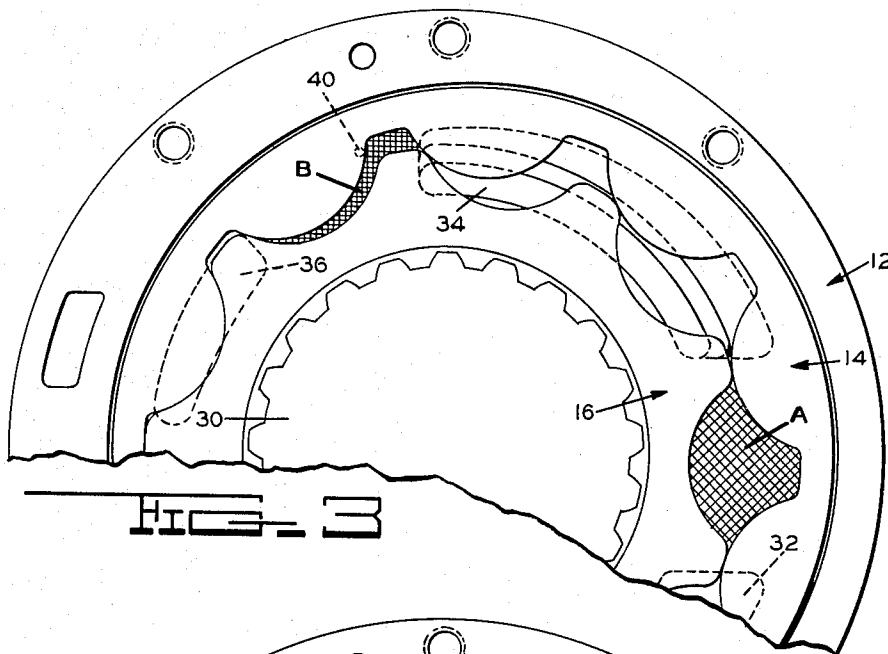


FIG. 3

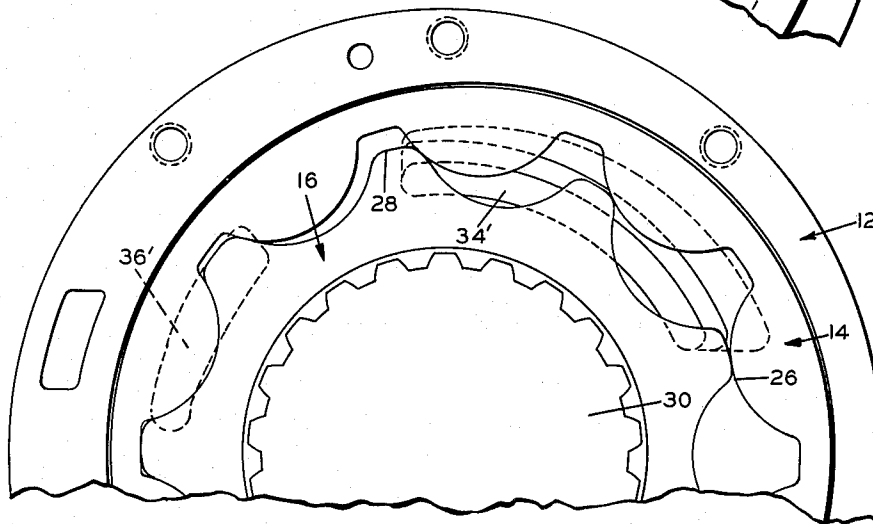


FIG. 4

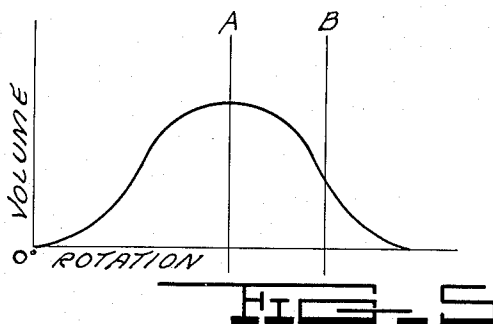


FIG. 5

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## INTERNAL GEAR PUMP

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9 Claims. (Cl. 103—2)

This invention relates to pumps and more particularly to novel structural details of internal gear pumps for specific applicational use.

Broadly the invention comprehends the provision of an internal gear type pump comprising inner and outer eccentrically related intermeshing rotors having split porting permitting of the effective utilization of the fluid discharged therefrom for the independent operation of two separate mediums requiring fluid delivery thereto.

Although pumps have been devised having two or more independent fluid discharge outlets for the operation of separate instrumentalities associated with each outlet the instant pump development provides novel structure incorporated in and related specifically to internal gear pumps such as the type commercially called Gerotor pumps permitting of the operation of said pumps without materially effecting the efficiency thereof. It is through the predetermined arrangements of the discharge porting of the pump with provision for the relief of pinch pressure between the discharge ports, because of the inherent structure and relation of the rotors of the pump, that permits of operation of the pump at high efficiency even with its plural fluid discharge arrangement.

Among the objects of the invention are the provisions of an internal gear pump of the Gerotor type having two separate fluid discharge openings for the delivery of discharge fluid to independent mechanisms to be actuated thereby, and of pinch pressure relief means between the discharge openings of the pump, said discharge openings providing different flow capacities as required within predetermined limits and said pinch pressure relief reduces the shock losses in the pump which would otherwise be present if no relief was provided.

Other objects and advantages of the invention will appear from the following description taken in connection with the drawings, forming a part of the specification; and in which,

Fig. 1 is a front elevation partially cut away view of a Gerotor type internal gear pump incorporating the invention;

Fig. 2 is a vertical cross-sectional view taken substantially along lines 2—2 of Fig. 1;

Fig. 3 is a front elevation view of the pump of Fig. 1 illustrating the relation of the pumping volumes to be discharged therefrom;

Fig. 4 is a fragmentary front elevation view of a modified form of the pump of Fig. 1; and

Fig. 5 is a tooth displacement curve representative of the pump's operation.

This pump was devised for the purpose of providing a Gerotor type internal gear pump comprising a pair of inner and outer intermediary gear rotors arranged for eccentric motion relative to one another within a pump housing, having two fluid discharge openings for the delivery of fluid to independent mechanisms requiring same, without appreciably diminishing the inherent high efficiency normally present in a pump of this general construction. It is essentially necessary in the provision

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of such a pump to reduce shock losses which would normally occur therein through the build-up of pressure of the fluid trapped between the primary and secondary discharge ports by the relieving of the pinch pressure occurring through allowance that the ports are open at the same time to the fluid entrapment zone between the ports. This can be accomplished by the extension of the range of the ports beyond their normal limits, which leads to inefficiency of the pump dependent on the accuracy with which such extension can be controlled, especially wherein the ports are to be cast as is normally the case, or through the provision of an accurately positioned drilled hole having bleed back communication with either of the discharge ports. Whereas the control of extension of the ports presents a problem the drilled hole can be so located and of a size as to effectively relieve pressure of the fluid to be entrapped between the ports at the proper time and in the proper degree.

The pressure relief of fluid which will predeterminedly be entrapped between the primary and secondary ports is essentially necessary because of the rapid volume change occurring at this time as compared to the volume change occurring between the pump inlet opening and primary discharge port wherein the volume change is reasonably gradual and offers no problem of pressure build-up sufficient to cause shock losses in the operation of the pump. It is the shock losses which would otherwise occur in the pump tending to interfere with smooth and efficient operation that the provision is made to relieve any possible condition of fluid entrapment and excessive pressure build-up therein at any phase in its cycle of operation.

Referring to Figs. 1 and 2 of the drawings for more specific details of the invention, 10 represents generally an internal gear pump comprising a pump housing 12, and a pair of intermeshing gear rotors 14 and 16 respectively rotatable in the housing with the housing fixedly mounted upon mechanism 18 to which it is applied wherein a wall portion 20 thereof constitutes an end cover member for the pump per se.

The rotor 14 is mounted for rotation in a chamber 22 of the pump housing 12 upon a circumferential wall 24 thereof and is provided with a plurality of internal lobes or gear teeth 26 on its inner periphery adapted to mesh with external lobes or gear teeth 28 of rotor 16, said rotor 16 being suitably splined for rotation eccentric to rotor 14 upon a shaft 30. In view of the application of the pump in supported relation upon mechanism 18, the shaft 30 preferably forms a part of said mechanism.

Whereas intake porting 32 for the pump is provided in mechanism 18 communicating with chamber 22 of the pump, two discharge ports 34 and 36 respectively are provided in housing 12 communicating with chamber 22.

The discharge ports 34 and 36 are adapted to be individually associated with appropriate mechanism requiring the fluid discharged therefrom for the proper operation thereof such, for example, as the utilization of the discharged fluid from port 34 to provide cooling liquid for a main clutch of a transmission and the fluid discharged from port 36 for use to provide power assisted engagement of the same clutch. As such, the pump efficiently and economically provides for the simultaneous and independent operation of separate mediums.

Although, not shown, the discharge ports in the housing can be suitably communicated with the mechanism to be actuated by the fluid discharged therefrom, port 34 as shown having communication with a cored passage 38, the purpose of which will hereinafter further appear.

With reference to Fig. 3, A represents the full trapped volume of the interengaging rotors, which volume in the case of the pump disclosed is normally discharged nine times into port 34, the number of times this volume is

trapped between the end arcuate extremity of intake port 32 and the beginning arcuate extremity of discharge port 34, viewing Fig. 1 in a counter-clockwise rotation of the rotors. As shown by Fig. 3, it is desirable to maintain a seal at each arcuate extremity between ports 32 and 34, such that the ports are at no time both in communication with the entrapped volume of fluid therebetween, wherein the crests of the respective teeth on the inner and outer rotors are in sealing engagement. It will be apparent that as the rotors are rotated from the position of Fig. 3 that as the entrapped volume is being discharged to port 34 from between the engaging rotor teeth a succeeding volume of fluid is being entrapped between the next adjacent teeth as supplied from the intake port until again as rotation progresses another full volume is entrapped between the teeth and intake and discharge ports 32 and 34 respectively.

Simultaneously with the entrapment of volume A between the rotor teeth and intake port 32 and discharge port 34, a volume B of fluid of less quantity than A is entrapped between the rotor teeth at a counter-clockwise advanced point from volume A between the end arcuate extremity of discharge port 34 and the beginning arcuate extremity of discharge port 36, said volume B as volume A to be discharged in equal relation to the number of teeth on the inner rotor, nine, for each complete rotation thereof. The volume B is discharged from port 36 for the proper utilization thereof as is the discharge from port 34.

Normally for the most efficient operation of the pump and the maximum volume discharge from port 36, it will be most desirable to have an effective seal at the end extremities between the entrapped volume B but such is not possible inasmuch as a build-up of pressure of the fluid occurs with consequent shock losses in the pump.

Reference is had to the rotor tooth displacement curve shown by Fig. 5 for the purpose of more clearly explaining the comparative operating conditions prevalent between attainment of volume A for discharge from port 34 and volume B for discharge from port 36. It is to be noted at point A in the curve representing the location of volume A that the curve is reasonably flat, thus denoting a relatively little volume change in the tooth form, whereas at point B representative of the location of volume B a rapid change in tooth form is noted, designating a decided rapid change in volume entrapment at this point. While the seal between ports 32 and 34 is feasible because of the slight or little change in volume that occurs as volume A is attained, the converse is the case between ports 34 and 36 because the volume change is so rapid. For this reason high pressures are not built up in the trapped volume A with very slight or no shock losses, whereas the pressure build-up and shock losses would be great in trapped volume B if relief for the pinch pressure were not provided.

It has been found most advisable for the purpose of relieving the build-up of excessive pressures in volume B especially in view of the normally cast character of the ports 34 and 36 in the pump housing to drill a hole 40 of accurate predetermined size at a precise location in housing 12 communicating with chamber 20 of the pump at the most desirable point in the zone of volume B so that the pressure relief will occur at the proper time and bleed off a desirable amount of fluid and thereby not appreciably diminish the efficiency of the pump. The bleed hole 40 as shown by Fig. 2 is provided with the cored passage 38 back to port 34 for discharge therewith. The hole 40, if desired, could equally as well be communicated to port 36 without varying the function thereof.

As a variation from the employment of the drilled hole 40, the end extremities of the ports 34 and 36 can each be extended arcuately toward one another so that an overlapping of the ports will occur within the zone of volume B, such that both ports will have communication with volume B at the same time. This provision of structure

will suffice equally as well as the drilled hole without diminishing the efficiency of the pump to any greater degree if in the casting of the parts desired tolerances can be maintained, otherwise the drilled hole 40 arrangement is more desirable to assure minimum loss of efficiency.

While this invention has been described in connection with certain specific embodiments, the principle involved is susceptible of numerous other applications that will readily occur to persons skilled in the art. The invention, therefore, is limited only as indicated by the scope of the appended claims.

What I claim is:

1. A rotor pump comprising a housing having a pumping chamber, an intake port communicating with the chamber and two independent discharge ports communicating with the chamber, said ports extending arcuately and being spaced a predetermined angular distance from one another about the axis of the pump, and pumping means in said chamber comprising inner and outer eccentrically related rotors having interengaging teeth, one of said discharge ports having one end extremity thereof arcuately spaced an equal distance from one end extremity of the intake port as the one end extremity of the other discharge port is arcuately spaced from the other end extremity of said one discharge port, such that a volumetric pocket of fluid entrapment, for discharge from said one discharge port, is had between two adjacent teeth on one rotor and two corresponding adjacent teeth of the other rotor and another volumetric pocket of fluid entrapment, for discharge from the other discharge port, is had between two adjacent teeth on one rotor and two corresponding adjacent teeth of the other rotor.

2. A claim according to claim 1 wherein the discharge ports are of unlike capacity.

3. A pump comprising a housing having a pumping chamber, an intake port and independent discharge ports, each of said ports communicating with the chamber and extending in arcuate spaced relation to one another about the axis of the pump, and pumping means in said chamber comprising inner and outer eccentrically related rotors having interengaging teeth, the arcuate distance respectively between the end extremity of the intake port and the beginning extremity of the adjacent discharge port and the end extremity of one of the discharge ports and the beginning extremity of the other discharge port taken in the direction of rotation of the rotors, being equal to the end limits of sealing between the interengaging rotor teeth, that is the sealing contact between two adjacent teeth of the one rotor and the two corresponding adjacent teeth of the other rotor forming a fluid entrapment pocket therebetween and said housing having an outlet opening communicating with the chamber intermediate the respective end and beginning limits of said discharge ports.

4. A pump comprising a housing having a pumping chamber, an intake port, two independent discharge ports, said ports extending arcuately about the axis of the pump and being predeterminedly arcuately spaced apart from one another between the end extremities thereof, and an accurately sized substantially circular discharge opening intermediate the arcuate space between the discharge ports, having a capacity much less than either of the discharge ports, and effective to relieve excessive build up of pressure in the chamber between the discharge ports, each of said ports and opening communicating with the chamber, said accurate opening having communication with one of the discharge ports remote from its communication with the chamber and pumping means in said chamber comprising inner and outer eccentrically related rotors having interengaging teeth.

5. A pump comprising a housing having a pumping chamber, an intake port and two independent discharge ports, each of said ports communicating with the chamber and extending arcuately spaced apart from one another between the end extremities thereof, and pumping means

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in said chamber comprising inner and outer eccentrically related rotors having interengaging teeth, the teeth on the outer rotor being one more in number than the teeth on the inner rotor, and the arcuate distance respectively between the end extremity of the intake port and the adjacent discharge port and the end extremity of one of the discharge ports and the other discharge port, taken in the direction of rotation of the rotors, constituting the volumetric pocket or zone of fluid entrapment between the sealing contact of two adjacent teeth of one rotor and the corresponding adjacent teeth of the other rotor for the respective one and other mentioned discharge ports, said housing providing means in the volumetric zone of fluid entrapment for the other discharge for relieving excessive build-up of pressure therein, said ports being arranged arcuately spaced from one another, in the direction of rotation of the rotors, respectively in the order of intake port, discharge port and discharge port with the pressure build up relieving means arranged arcuately intermediate the discharge ports.

6. A claim according to claim 5 wherein the rotors are so arranged eccentrically to one another and the ports in the housing as to entrap a volume of fluid between the end and beginning extremities of the respective intake port and said one discharge port and said discharge ports proportionate to the capacities of the respective one and other discharge ports.

7. A claim according to claim 5 wherein the rotors are so arranged eccentrically relative to one another and the ports in the housing as to afford sealing of a maximum volume of fluid for discharge from said one discharge port by sealing contact of two adjacent teeth of one rotor and the two corresponding teeth of the other rotor between the intake port and said one port and the entrapment between said discharge ports, with leakage back to said one discharge port, of a volume of fluid less than that sealed between the intake port and said one discharge port for discharge to said one discharge port.

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8. A pump comprising a housing having a pumping chamber, an intake port and two independent discharge ports, each communicating with the chamber and extending arcuately in spaced relation to one another about the axis of the pump, and pumping means in said chamber comprising inner and outer eccentrically related rotors having interengaging teeth, the arcuate distance between one extremity of the intake port and one beginning extremity of one of the discharge ports, taken in the direction of rotation of the rotors, being equal to the distance between the sealing engagement points of the interengaging teeth and constituting the volumetric pocket or zone of fluid entrapment between two adjacent teeth of one rotor and the corresponding adjacent teeth of the other rotor having sealing contact with the aforesaid teeth of the said one rotor, and the arcuate distance between the other extremity of said one discharge port and one extremity of the other discharge port being predeterminedly less than that between the intake port and said one discharge port and constituting the volumetric pocket or zone of fluid entrapment between two adjacent teeth of one rotor and the corresponding adjacent teeth of the other rotor having sealing contact with the aforesaid teeth of the said one rotor.

9. A claim according to claim 8 wherein the discharge ports are of unlike capacity.

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