

July 31, 1945.

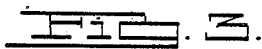
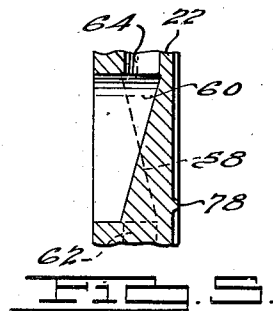
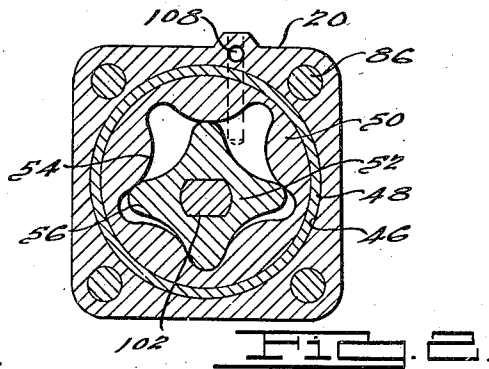
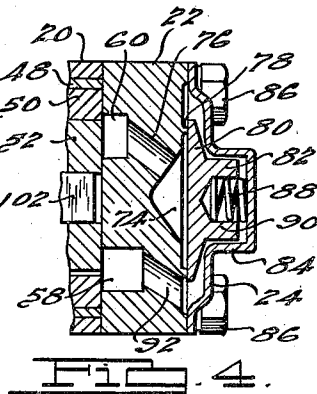
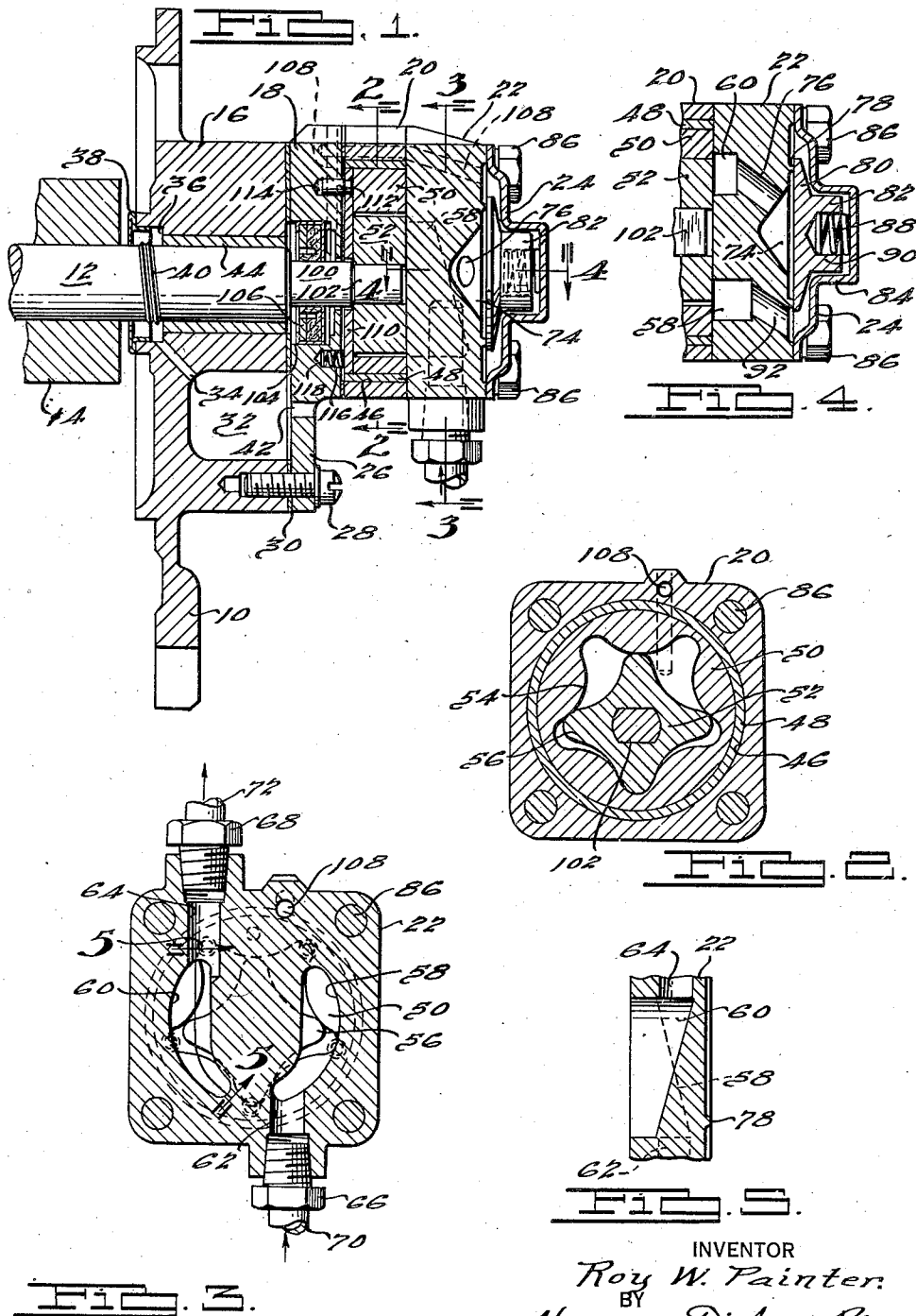
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2,380,783

PUMP STRUCTURE

Filed April 7, 1941

2 Sheets-Sheet 1



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UNITED STATES PATENT OFFICE

2,380,783

PUMP STRUCTURE

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Application April 7, 1941, Serial No. 387,188

4 Claims. (Cl. 103—126)

This invention relates to fluid pumps and particularly to pumps of the rotating positive displacement type, the principal object being the provision of a pump structure of this type that is simple in construction and efficient in operation.

Objects of the invention include the provision of a pump structure embodying a rotatable pumping element and including a movable end wall or member associated with the rotatable element and constantly urged towards contact therewith by yieldable means, whereby when the pump is dry and unprimed a zero clearance may be established between the rotatable element and walls at the opposite ends thereof, the movable wall being movable away from the pump element upon the presence of a desired fluid pressure in the pump chamber whereby to provide a running clearance during operation but not sufficient clearance to permit a sufficient amount of fluid to by-pass between the inlet and outlet sides of the pump between the pumping element and the movable wall to materially affect the operation of the pump in service; the provision of a pump as above described including a by-pass between the inlet and the outlet sides of the pump together with a spring-pressed pressure relief valve in the by-pass for limiting the maximum pressure capable of being built up by the pump; the provision of a pump structure as above described in which the rotating pumping means comprises a pair of rotating elements one surrounding the other and provided with interengageable tooth-like elements; and the provision of a pump structure as above described in which the drive shaft is projected through one side of the pump housing and a passage is connected with the space surrounding the shaft and with the suction side of the pump whereby to prevent undesirable escape of fluid along the shaft from the pump housing.

Other objects of the invention include the provision of a pump structure including a housing providing a chamber having an inlet and an outlet and pumping means in the chamber comprising a pair of rotatable pump elements one of which surrounds the other and both of which are provided with interengageable tooth-like projections, one end of each of the elements adapted to engage one end wall of the chamber and the plate member being arranged in overlying relationship with respect to the opposite ends of the pump elements, the plate member being rotatable and being drivingly connected to the outer of the pump elements and being movable axially of said chamber and constantly urged by yieldable means towards engagement with the pump elements, together

with means for driving the plate member and the provision of a construction as above described in which axial movement of the plate member is limited to an extent insufficient to permit an amount of leakage between the inlet and outlet sides of the pump chamber sufficient to materially interfere with the desired operation of the pump in service, together with a by-pass between the inlet and outlet sides of the pump chamber and a pressure relief valve controlling the flow of fluid through the by-pass.

The above being among the objects of the present invention the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate suitable embodiments of the present invention and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a vertical sectional view taken axially through a pump structure embodying the present invention, illustrating the same as being mounted upon the end plate of an electric generator or the like;

Fig. 2 is a vertical sectional view taken transversely through the pump structure shown in Fig. 1 as on the line 2—2 thereof;

Fig. 3 is a vertical sectional view taken transversely through the pump structure shown in Fig. 1 as on the line 3—3 thereof;

Fig. 4 is a fragmentary sectional view taken axially through the structure shown in Fig. 1 as on the line 4—4 thereof;

Fig. 5 is a fragmentary horizontal sectional view taken on the line 5—5 of Fig. 3 and illustrating the shape of the inlet and outlet ports for the pump;

Fig. 6 is a view similar to Fig. 1 but illustrating a modified form of construction;

Fig. 7 is a vertical sectional view taken transversely through the pump structure shown in Fig. 6 on the line 7—7 thereof.

Fig. 8 is a view similar to Fig. 1 and illustrating a further modified form of construction; and,

Fig. 9 is a vertical sectional view taken on the line 9—9 of Fig. 8.

In the broader aspects the present invention is capable of use in connection with various types of rotatable pumps of the positive displacement type and where the language of the claims so permit they are to be interpreted in this broad sense. The invention is, however, particularly adapted or use in connection with those types of positive

displacement rotary pumps that include inner and outer members having interengageable tooth elements. One such type of pump is illustrated in United States Patent No. 1,682,563, issued August 28, 1928 to Myron F. Hill on Internal rotor, and accordingly such type of pump structure is illustrated in the drawings by way of explanation.

It will be appreciated that the pump of the present invention may be mounted in any suitable location and driven in any suitable manner, but for the purpose of description it is shown in the accompanying drawings as being mounted upon the end plate 10 of an electric generator having a shaft 12 and an armature 14, this providing a desirable mounting particularly where the pump is to be employed as a fuel or oil pump of an internal combustion engine employed in a motor vehicle, boat or the like. In such case the end plate 10 is provided with a boss 16 of substantial size projecting outwardly therefrom, the axially outer face of which is finished off in a single plane perpendicular to the axis of the drive shaft 12 for the purpose of receiving and supporting the pump structure thereon.

The housing for the pump structure is made up of four main parts, namely a supporting part 18, a pump housing part 20, a port part 22 and a cap or cover 24. The first three of all these parts have substantially plain end faces adapted for direct engagement with each other preferably with the inter-position of suitable gaskets or other sealing means between them. The supporting member 18 is provided with two or more ears or flanges 26 by means of which the pump is secured to the end plate 10 by means of screws such as 28, preferably with the inter-position of a gasket such as 30 between the member 18 and the end surface of the boss 16 of the plate 10.

As indicated in Fig. 1 the boss 16 is provided with a pocket 32 formed therein below the shaft 12 and connected by a passage 34 with a recess 36 surrounding the shaft 12 formed in the inner face of the plate 10 around the shaft 12. An oil guard 38 protects the inner end of this recess and an oil throw off ring 40 is formed on the shaft in the recess. Any oil trying to escape along the shaft 12 is thrown off by the ring 40 into the recess 36 and then flows through the passage 34 into the chamber or pocket 32 the outer face of which is closed by the member 18. An opening 42 in the cooperating ear 26 of the member 18 then permits escape of this oil to the outside.

The member 20 is provided with a cylindrical opening 46 therethrough and which opening is lined by a suitable cylindrical wear ring 48 within which the outer rotatable pump element 50 is rotatably received. The inner pump element 52 is received within the element 50 as illustrated in Fig. 2 and these elements are provided with interengaging tooth-like projections 54 and 56, respectively, the outer element having one more tooth or projection than the inner one and the arrangement being such that the teeth of the inner one are at all times in engagement with the outer element. It will be noted from an inspection of Fig. 2 that the inner element 52 is fixed against relative rotation concentrically to the shaft 12 while the outer element 50 is mounted to rotate in the ring 48 about an axis eccentric with the axis of rotation of the inner member. For complete details of the method of operation of these elements reference may be had to the Hill Patent No. 1,682,563 previously mentioned.

The essential thing to understand in connection with the type of pump structure shown is that

as the two elements 50 and 52 rotate in a counter-clockwise direction as viewed in Figs. 2 and 3, the rolling engagement between the two elements creates successive chambers in the direction of rotation of the two elements which chambers increase in volume from the lower portion of the pump to the top dead center position as illustrated in Fig. 2 and then decrease in volume toward the bottom dead center position, the fluid being drawn into these chambers during their expanding movements and being positively discharged therefrom during the contracting movement thereof. For the purpose of feeding fluid to these chambers and for the purpose of receiving the discharge therefrom the valve port member 22 has a pair of kidney-shaped ports formed in its inner face as illustrated in Figs. 3, 4 and 5, the port 58 being the inlet port and the port 60 being the outlet port. Transversely extending passages 62 and 64 connect the ports 58 and 60, respectively, with the exterior face of the member 22 at which point such passages are provided with suitable connections 66 and 68, respectively, connecting these passages with a suction line 70 and discharge line 72, respectively.

As illustrated best in Fig. 4 the axially outer face of the port member 22 is provided with a central pocket 74 therein connected by a passage 76 with the outlet port 60. An annular rib 78 formed on the axially outer face of the member 22 around the pocket 74 provides a seat for a pressure relief valve 80. The pressure relief valve 80 is provided with a short stem portion 82 which is slidably received for guiding movement within the cylindrical boss 84 formed centrally of the sheet metal cover member 24 which is sealed to the axially outer face of the port member 22. Bolts 86 which extend through the cap 24, port member 22 and chamber member 20 and thread into the supporting member 18 and suitable gaskets interposed between the mating surfaces of these parts when employed, serve to maintain the assembled relation of all of these parts. A coil spring 88 partially received within a central opening 90 in the stem portion 82 of the valve 80 is maintained under compression between the outer wall of the boss 84 and the inner end of the opening 90 and constantly urges the valve 80 toward contact with the seat 78. The space within the cover member 24 outwardly of the valve 80 is connected by a passage 92 with the suction port 58. Thus the discharge pressure of the pump is communicated from the port 60 through the passage 76 and pocket 74 to the face of the valve 80 and where the discharge pressure is sufficient to compress the spring 88 the valve 80 lifts from its seat and permits liquid to be by-passed from the inlet port 58 thereby and through the port 92 directly to the inlet port 58. The valve 80 thus provides a means for limiting the maximum pressure capable of being built up by the pump, and by employing a spring 88 of suitable weight the maximum discharge pressure may be suitably controlled as will be appreciated.

It will be appreciated from the fact that the axis of rotation of the inner pump element 52 is eccentric to the axis of rotation of the outer pump element 50, the various parts making up the pump housing must be secured to the plate 10 with the inner pump element 52 concentric with the shaft 12 and the pumping chamber formed within the sleeve 48 with its axis eccentric with the shaft 12. That portion of the shaft 12 projecting outwardly beyond the end of the boss 16 is preferably first reduced in diameter as indi-

cated at 100 up to approximately the face of the inner pumping element 52 and is then further reduced in diameter as indicated at 102 for reception of the inner element 52. For the purpose of providing a driving connection between the portion 102 and the inner element 52 opposite sides of the portion 102 are flattened off, as indicated in Fig. 2, and the inner element 52 is provided with a similarly shaped opening for reception thereof. While the fit between such opening and the portion 102 of the shaft 12 is necessarily a close fit in order to properly maintain the position of the element 52 with respect to the element 50, a slight amount of axial movement of the element 52 on the portion 102 is preferable for reasons which will hereinafter be more apparent.

The lefthand face of the supporting member 18 as viewed in Fig. 1 is provided with a recess 104 surrounding the portion 100 of the shaft 12 and in this recess is received a suitable type of shaft seal element 106 which serves to prevent the escape of fluid to the left along the shaft 12 from the pump. Space is left between the bottom of the recess 104 and the seal 106 and this space is connected by a passage 108 which extends through all three members 18, 20 and 22 with the space between the member 22 and the cover 24 and, therefore, communicates through the cover 24 and passage 92 with the suction port 58 of the pump. By this means any leakage from the pump tending to travel to the left along the shaft 12, as viewed in Fig. 1, is returned to the suction side of the pump, and this feature in conjunction with the seal 106 prevents leakage along the shaft 12 to the left of the seal 106.

As brought out in Fig. 1 the pumping elements 50 and 52 are of equal axial dimensions and of less axial dimension than the axial dimension of the pumping chamber formed within the sleeve 48 between the opposed faces of the members 18 and 22. In this respect the outer face of the supporting member may be slightly recessed in concentric relation to the ring member 48 if desired to increase the effective length of the pumping chamber formed within the member 48. The pumping elements 50 and 52 are adapted to lie in substantial engagement with the cooperating face of the port member 22 thus leaving a space between the pumping elements and the opposed face of the supporting member 18. This space is partially filled with a disc-like plate member 110 which is of an external diameter to be closely but axially slidably received within the sleeve 48. It is centrally provided with an opening through which the portion 100 of the shaft 12 projects. The plate member 110 is held against rotation by one or more and preferably three pins 112 as shown fixed to the plate member 110 in equally angularly spaced relation about the center thereof and axially slidably received in cooperating openings 114 formed in the opposed face of the supporting member 18. Spring means are provided for constantly urging the plate member 110 to the right as viewed in Fig. 1 toward engagement with the opposed faces of the pumping elements 50 and 52. While any suitable and suitably arranged spring elements may be provided for this purpose, in the particular construction shown these comprise light coil springs 116 received in blind openings 118 equally angularly spaced about the righthand face of the supporting member 18 midway between the openings 114. The springs 116 are maintained under compression between the bottoms of the corresponding

openings 118 and the lefthand face of the plate member 110.

The springs 116 are relatively light in character so that when the pump is rotated and the discharge pressure of the pump is exerted on the righthand face of the plate member 110 the springs 116 will yield and will permit the plate member 110 to move to the left as viewed in Fig. 1 away from the cooperating face of the elements 50 and 52. It will be appreciated from this, however, that if the plate member 110 was permitted a sufficient amount of axial movement under such conditions the inlet port 58 would be connected to the discharge port 60 through the space thus provided between the plate member 110 and the pump elements 50 and 52 to such an extent as to seriously interfere with the proper operation of the pump and would limit the maximum pressure which could be built up by the pump to that required to overcome the springs 116 by the discharge pressure of the pump acting on the plate 110. However, in accordance with this phase of the present invention the space between the lefthand face of the plate member 110 and the righthand face of the supporting member 18, as recessed in the particular construction shown and the bottom of which recess constitutes the corresponding end wall of the pumping chamber in this case, is of a desired limited extent, the amount actually shown in the drawings being exaggerated simply for the purpose of illustration.

It will be appreciated that in operation it is not desirable that the ends of the pumping elements 50 and 52 actually lie in metal-to-metal contact with the plate member 110 and the inner face of the port member 22 as such condition would result in too rapid wear between these parts. It is preferable that a thin film of the fluid being pumped be present between such surfaces so as to obviate such wear. The amount of axial movement of the plate member 110 is preferably such that when the same is subjected to the discharge pressure of the pump it will move inwardly or to the left as viewed in Fig. 1 into contact with the cooperating face of the supporting member 18 under which circumstances the pumping elements 50 and 52 may shift axially of the shaft 12 to provide a desired amount of clearance between their opposite ends and the surfaces opposing the same to permit a desired thickness of film of the fluid being pumped to maintain the pumping elements out of metal-to-metal contact with these surfaces. The amount of such axial movement of the plate 110, however, while sufficient to provide such film of fluid on either side of the pumping elements 50 and 52 is preferably not sufficient to provide for a sufficient flow of fluid between the inlet and outlet sides of the pumping chamber to materially affect the pumping characteristics of the pump. Where the pump is designed to pump some thin liquid such as gasoline, for instance, under a maximum pressure of ten to fifteen pounds per square inch, the permissible movement of the plate member 110 away from the pumping elements should be limited to 0.002" to 0.005". The clearance will be desirably less when pumping gases and may be more when pumping heavy liquids, less when delivering fluid under a high pressure and more when delivering fluid under a low pressure. Thus while the plate member 110 may move axially to provide clearance between it and the pumping elements and permit the pumping elements to move axially to provide clearance between them and the inner face of the port member 22, this clearance is desirably

insufficient to have any material effect upon the pressure produced by and volume of fluid discharged by the pump during normal operation.

It will, of course, be appreciated that the axial dimension of the pumping chamber could be fixed and sufficient to provide the desired amount of clearance on opposite sides of the pumping elements 50 and 52 as above described without the necessity of providing the axially movable plate member 110. Under such conditions, however, when the pump was dry or unprimed and, therefore, filled with air, the leakage of air through such clearance between the inlet and outlet sides of the pump might seriously interfere with the ability of the pump to pick up liquid having a level materially below the pump and thus adversely affect the ability of the pump to prime itself. With the axially movable plate 110 whenever liquid being operated upon by the pump is drained from the pump and the pump is filled with air, then the springs 116 force the plate 110 into actual contact with the elements 50 and 52 and force the elements 50 and 52 into actual contact with the inner face of the port member 22 and thereby positively eliminating all clearance at the ends of the pumping elements and any possibility of leakage of air between the inlet and outlet sides of the pump chamber past the end faces of the pumping elements. It is this feature of the elements that is especially valuable in helping the pump to quickly and readily prime itself when in a dry or substantially dry condition, and at the same time the structure provides the necessary clearance between the ends of the pumping elements and their cooperating surfaces to eliminate metal-to-metal frictional contact between them during normal operation, thereby providing a pump having long life in service.

In Figs. 6 and 7 a modified form of construction is shown which includes all of the features of the construction previously described with the exception that instead of driving the inner element of the pumping means the outer element thereof is driven. Accordingly, all of the parts in Figs. 6 and 7 which are identical to those illustrated in the previous views are identified by the same numerals and such parts thereof as are modified are identified by the same numerals bearing a prime mark. Accordingly, it will only be necessary to describe those parts of the construction in which any changes have been made.

In the construction shown in Figs. 6 and 7 the drive being through the outer pump element 50', the inner pump element 52' is mounted for rotation upon a stub shaft 120 projecting to the left, as viewed in Fig. 6, from the port member 22 and having its right end suitably fixed in the port member 22. The interior of the sleeve 48, instead of being arranged eccentrically with respect to the axis of the shaft 12' as necessitated in the first construction, is in this case arranged concentrically with such shaft in order to bring the outer pump element 50' into concentric relation with respect thereto. In this case the plate member 110' has fixed thereto one or more outwardly projecting pins 122 fixed with respect thereto and axially slidably received in openings 124 formed in the inner face of the pumping element 50' in parallel relation to the axis thereof. This construction provides a driving engagement between the plate 110' and the outer pump element 50' and yet provides for axial movement between the plate member 110' and the pumping elements for the same reasons and preferably

to the same extent as in the first described construction.

In the construction shown in Figs. 6 and 7 the supporting member 18', corresponding with the supporting member 18 first described, is required to be made of a greater axial length. In this case it is provided with a central bore 126 in the inner or lefthand portion of which a sealing element 106' is received against an abutment 128 formed in the bore 126 adjacent the lefthand end thereof as viewed in Fig. 6 so as to limit movement of the seal in that direction. The shaft 12' in this case is provided with an axial extension 130 centrally received by the seal 106' and the righthand end of the extension 130 terminates in the bore 126 and is provided with a diametrical slot 132 therein. The plate member 110' is provided with an axial stub shaft portion 134 projecting inwardly or to the left as viewed in Fig. 1 which extension terminates in a diametrically disposed tongue 136 closely but axially slidably received within the slot 132. The inter-engagement of the slot 132 and tongue 136 thus forms a driving engagement between the shaft 12' and the plate member 110' and yet provides for axial movement between them. In order to constantly press the plate member 110' towards the pumping elements 50' and 52', a coil spring 138 is provided in the bore 126 surrounding the shaft portions 130 and 134 and is maintained under compression generally between the plate member 110' and the seal 106'. Because of the relative rotation between the plate member 110' and the seal 106', a plurality of anti-friction thrust washers such as 140 are preferably provided between each end of the spring 138 and the cooperating surfaces of the seal 106' and plate member 110'. The effect of the spring 138 is, of course, intended to be exactly the same as that of the springs 116 in the first described construction.

It will be observed that the construction illustrated in Figs. 6 and 7 operates in substantially the identical manner as the construction illustrated in Figs. 1 to 5, inclusive, the main difference being that in driving through the plate member 110' to the outer pumping element 50', with the particular construction of the pumping element shown, that is an inner one having four tooth-like projections 56 and an outer one having five tooth-like projections 54, the construction shown in Figs. 6 and 7 will operate at a 20% higher speed and consequently will deliver 20% greater flow of fluid at the same rate of rotation of the driving shaft than the construction first described.

A still further modification is illustrated in Figs. 8 and 9. This modification is identical to the construction shown in Figs. 6 and 7 except that a port member 150 is employed to replace the port member 22, cover member 24 and associated elements, and except for the fact that in this case the plate member 110' is permitted to have a greater amount of axial movement thereby to serve as a pressure relief valve. In other words the righthand or outer end of the supporting member 18' is in this case provided with a recess 152 into which the plate member 110 may axially move under the influence of the discharge pressure of the pump to an extent sufficient to permit fluid to be by-passed from the outlet to the inlet sides of the pumping elements to limit the maximum pressure which may be built up by the pump. For this purpose the spring 138 will, of course, necessarily be a heavier spring than the spring 138 employed in the construction illustrated in Figs. 6 and 7, the spring

138' being of sufficient weight or strength to restrict the movement of the plate member 110' to that necessary to build up the desired discharge pressure in the pump but yielding when this pressure is exceeded to permit by-pass of the fluid across the inner ends of the pumping elements 50' and 52' to prevent the further building up of such pressure. Obviously with such construction it is unnecessary to provide the pressure relief valve structure provided in the first described constructions and consequently the port member 150 is provided in its inner face with inlet and discharge ports 58' and 60', corresponding with the ports 58 and 60 previously described, and these are connected to inlet passage 62' and outlet passage 64', respectively, leading to the outer end face of the member 150. The operation will, of course, be apparent.

Having thus described my invention, what I claim by Letters Patent is:

1. In a fluid pump, in combination, a housing having a chamber therein and inlet and outlet passages communicating with said chamber, a rotatable pumping means in said chamber, said pumping means being of a dimension axially thereof smaller than the axial dimension of said chamber, a plate member interposed between one end of said pumping means and the corresponding end of said chamber and having a limited amount of axial movement therein sufficient to provide axial running clearance for said pumping means in said chamber but insufficient to permit by-passing of fluid between the inlet and the outlet sides of said pumping means in sufficient quantities to materially detract from the normal volume and pressure characteristics of the pump in service, readily yieldable means urging said plate towards engagement with the corresponding face of said pumping means, said housing having a by-pass between said inlet and said outlet passages, a spring pressed relief valve associated with said by-pass passage subject to the discharge pressure of said pump for limiting the maximum pressure capable of being built up by said pump on the discharge side thereof, a shaft for driving said pumping means, said housing having a second chamber surrounding said shaft in axially offset relation with respect to the first mentioned chamber, sealing means arranged between the walls of said second chamber and said shaft in axially spaced relation with respect to said plate member, and said housing having a passageway communicating the space between said sealing means and said plate with said suction passage, said readily yieldable means yielding under the discharge pressure of said pump acting on said plate member at a materially lower pressure than that required to lift said relief valve from its seat.

2. In a fluid pump, in combination, a housing having a chamber therein, a pair of rotatable pumping elements in said chamber, one of said elements enveloping the other thereof and having internal tooth-like elements operatively engaging external tooth-like elements of said enveloped element, said elements being of equal axial dimension and the axial dimension thereof being less than the axial dimension of said chamber, a plate non-rotatably but axially slidably received in said chamber between one end of said elements and the opposed end of said chamber, said plate being limited in its axial movement to that sufficient to provide axial running clearance for said pumping elements but less than

that required to materially affect the pumping action of said elements by permitting flow of fluid between it and said elements from the outlet to the inlet sides of said chamber, spring means constantly urging said plate toward contact with said elements, a by-pass between said inlet and said outlet passages, a spring pressed relief valve in said by-pass passage for limiting the maximum pressure capable of being built up by said pump, and means for driving said elements, said spring means yielding under a materially lower discharge pressure of said pump acting on said plate than that required to actuate said relief valve.

3. In a fluid pump, in combination, a housing having a chamber therein and inlet and outlet passages communicating with said chamber, a pair of rotatable pumping elements in said chamber, one of said elements enveloping the other thereof and having internal tooth-like elements operatively engaging external tooth-like elements of said enveloped element, said elements being of equal axial dimension and the axial dimension thereof being less than the axial dimension of said chamber, a plate rotatably and axially slidably received in said chamber between one end of said elements and the opposed end of said chamber, said plate being limited in its axial movement to that sufficient to provide axial running clearance for said pumping elements but less than that required to materially affect the pumping action of said elements by permitting flow of fluid between it and said elements from the outlet to the inlet sides of said chamber, spring means constantly urging said plate toward contact with said elements, a by-pass between said inlet and said outlet passages, a spring pressed relief valve in said by-pass passage for limiting the maximum pressure capable of being built up by said pump, means forming a driving connection between said plate and the outer element of said pumping means comprising pin means arranged in parallelism to an axis of rotation of said pumping means forming a driving connection between the outer element of said pumping means and said plate, a rotatable drive shaft, and a connection between said plate and said drive shaft permitting relative axial movement of said plate with respect to said drive shaft, said spring means yielding under a materially lower discharge pressure of said pump acting on said plate than that required to actuate said relief valve.

4. In a pump structure, in combination, a housing having a chamber therein and inlet and outlet passages communicating with said chamber, rotatable pumping means in said chamber of less axial dimension than the axial dimension of said chamber and comprising a pair of rotatable elements one surrounding the other and having interengageable tooth-like elements, a plate member in said chamber interposed between one end of said pumping means and the opposed end wall of said chamber and having a limited amount of axial movement therein, spring means constantly urging said plate member toward engagement with said pumping means, the possible axial movement of said plate member being sufficient to provide axial running clearance for said pumping means in said chamber but less than that required to permit a sufficient flow of fluid between the inlet and outlet sides of said pumping means to materially affect normal operating characteristics of said pump, means forming a driving connection between said plate member and the outer element of said pumping means

comprising pin means arranged in parallelism to an axis of rotation of said pumping means forming a driving connection between the outer element of said pumping means and said plate member, a rotatable drive shaft, a connection between said plate member and said drive shaft permitting relative axial movement of said plate member with respect to said drive shaft, said housing having a by-pass therein between said inlet and said outlet passages, and a spring pres-

5 sure controlled relief valve associated with said by-pass passage for controlling the maximum pressure capable of being built up by said pump structure, said spring means yielding under a materially lower pressure on the discharge side of said pump and acting against said plate member than that required to actuate said relief valve against the force of its spring.

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