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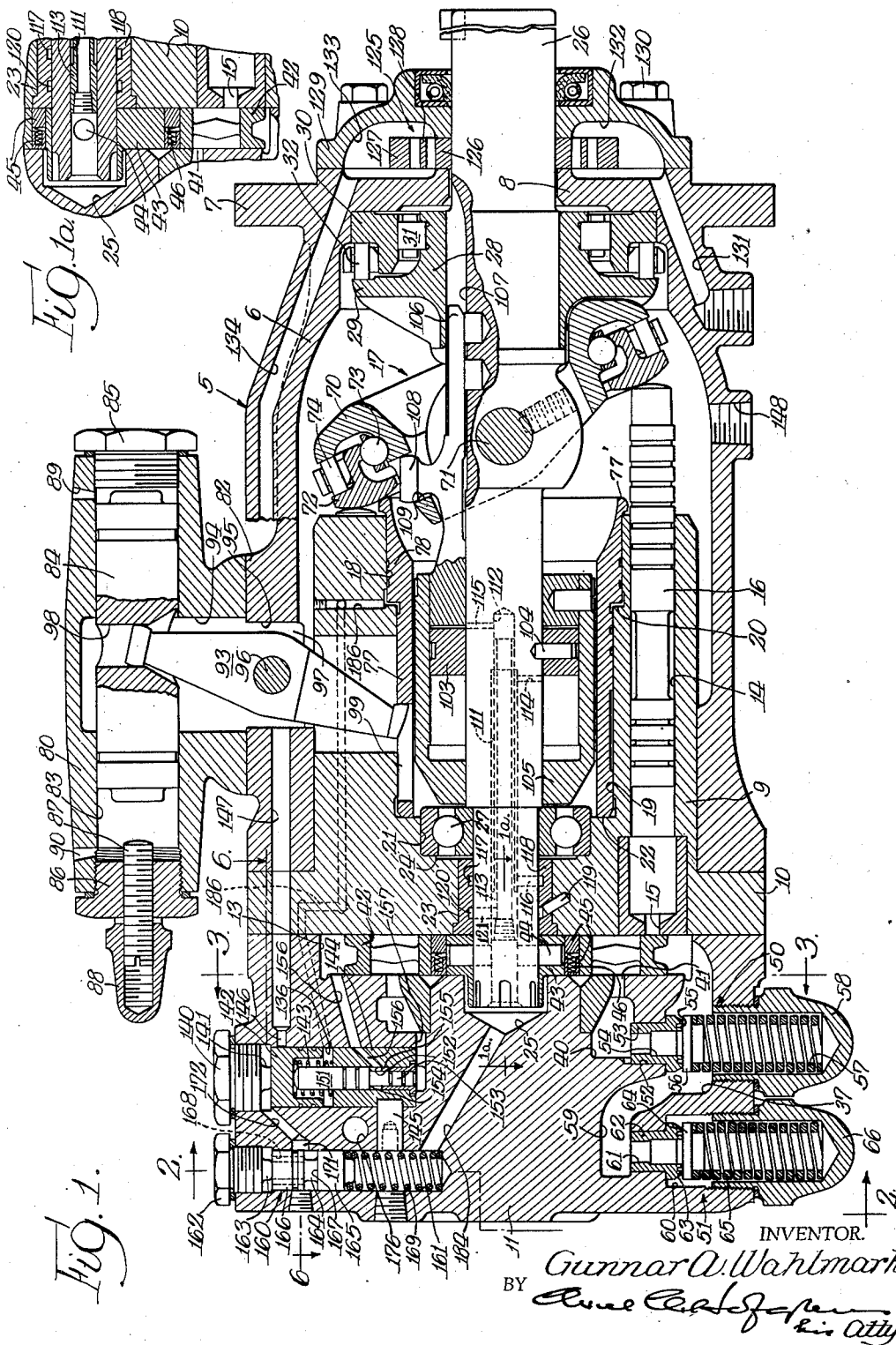
G. A. WAHLMARK

2,383,093

FLUID PRESSURE GENERATING MEANS

Filed Sept. 15, 1941

3 Sheets-Sheet 1



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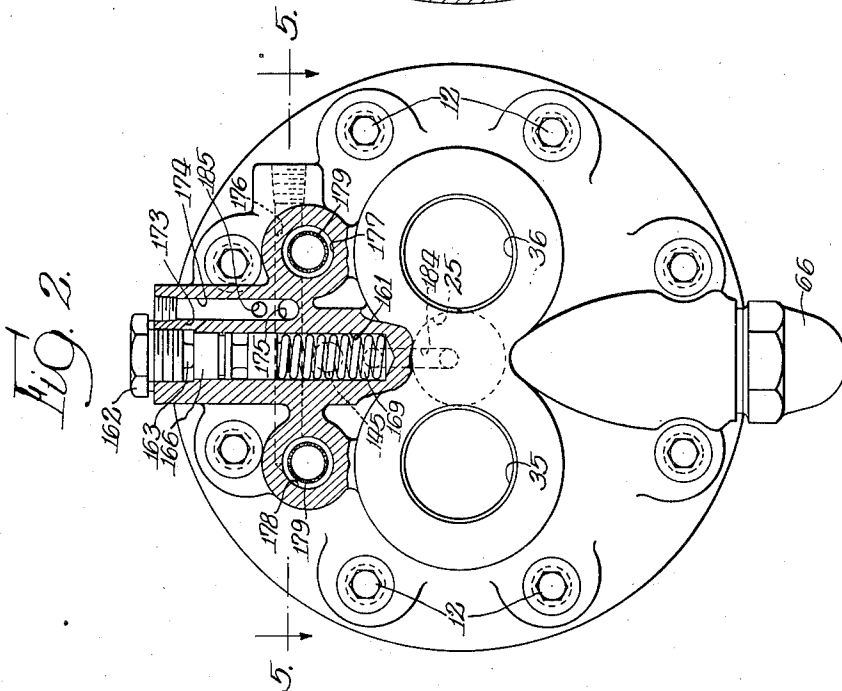
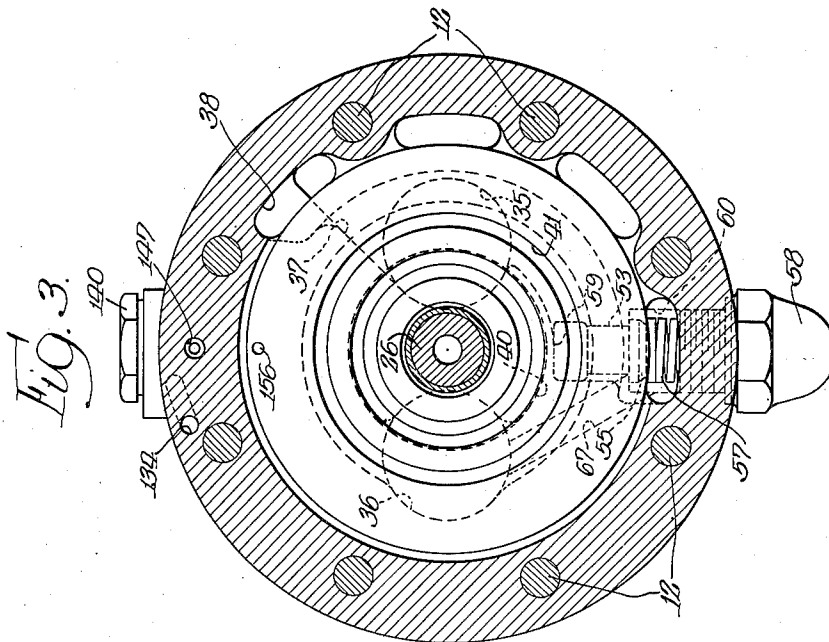
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FLUID PRESSURE GENERATING MEANS

Filed Sept. 15, 1941

3 Sheets-Sheet 2



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Aug. 21, 1945.

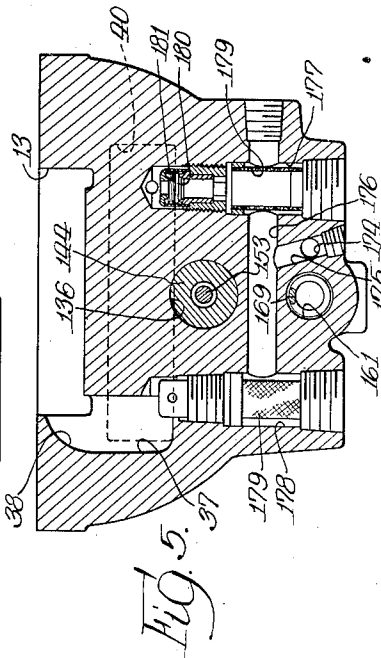
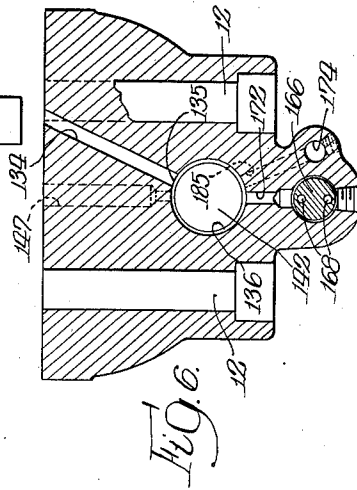
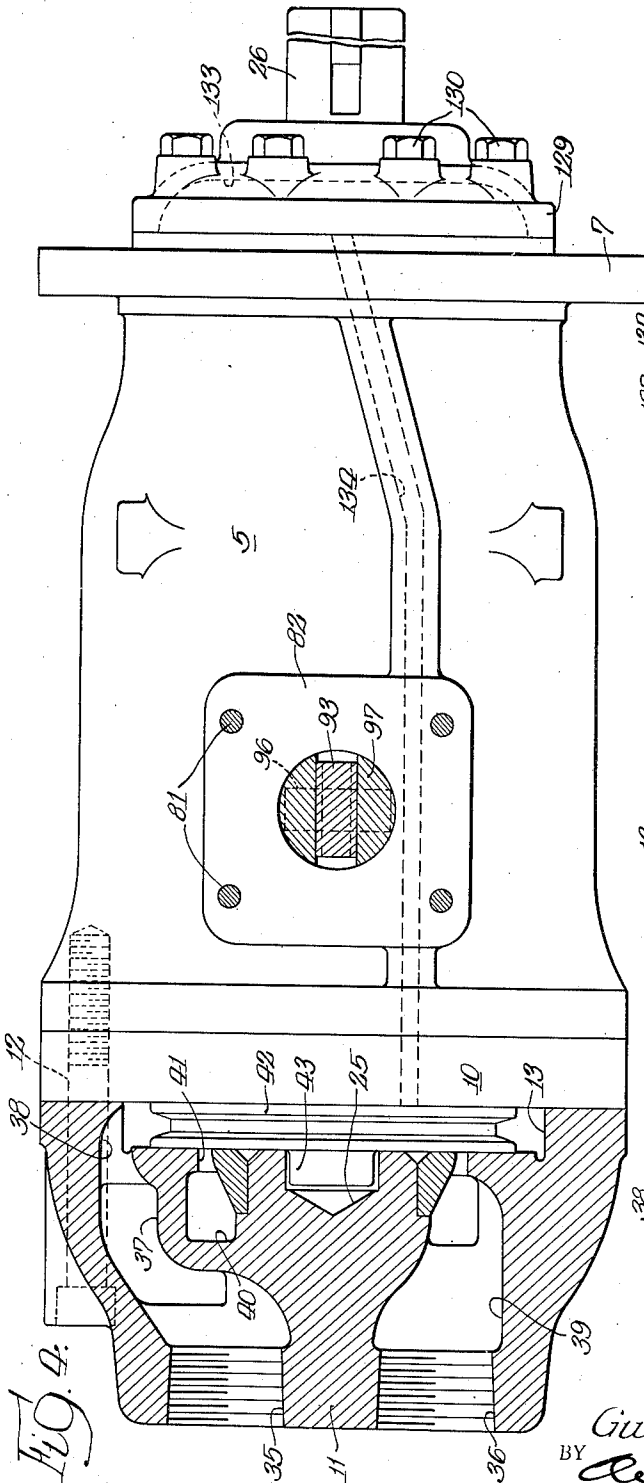
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FLUID PRESSURE GENERATING MEANS

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,383,093

## FLUID PRESSURE GENERATING MEANS

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Application September 15, 1941, Serial No. 410,861

10 Claims. (Cl. 103-173)

The invention relates generally to a fluid pressure generating means and more particularly to a pumping unit of the wobbler type.

One object of the invention is to provide a pumping unit of new and improved construction.

Another object is to provide a pumping unit of the wobbler type having new and improved means governing the wobbler to determine the displacement of the unit.

Another object is to provide a pumping unit of the wobbler type having a control means governing the position of the wobbler to determine the rate of fluid discharge and means for placing a constant pre-load on the control means.

Other objects and advantages will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a longitudinal central sectional view of a pumping unit embodying the features of this invention. A portion of the casing at the right end of the figure is illustrated projecting forwardly of the exact central section in order to illustrate a passage.

Fig. 1a is a detail view taken along line 1a-1a of Fig. 1.

Fig. 2 is a view partially in section and partially in elevation taken approximately along the line 2-2 of Fig. 1.

Fig. 3 is a transverse sectional view taken along the line 3-3 of Fig. 1 and looking in the direction of the arrows.

Fig. 4 is a fragmentary view partially in plan elevation and partially in horizontal diametrical section.

Fig. 5 is a fragmentary sectional view taken approximately along the lines 5-5 of Figs. 1 and 2.

Fig. 6 is a fragmentary sectional view taken approximately along the line 6-6 of Fig. 1.

While the invention is susceptible of various modifications and alternative constructions, it is shown in the drawings and will hereinafter be described in a preferred embodiment. It is not intended, however, that the invention is to be limited thereby to the specific construction disclosed, but it is intended to cover all modifications and alternative constructions falling within the spirit and scope of the invention as defined in the appended claims.

The pumping unit comprises a casing, generally designated 5, composed of a hollow housing member 6 having near one end a radially outwardly projecting annular flange 7 for attachment to a motor or other support (not shown) and a radially inwardly projecting annular flange 8. Non-rotat-

ably received in the housing member 6 at the end opposite the flange 8 is a cylinder block 9 provided with a radially outwardly extending annular flange 10. Mounted over the outer end of the cylinder block 9 is an end closure 11 secured to the housing member 6 through the medium of a plurality of bolts 12 projecting through the end closure, the flange 10 and into the housing member 6. The inner face of the end closure 11 is provided with a circular recess 13 which with the end face of the cylinder block 9 forms a valve chamber housing valve means more particularly described hereinafter.

The cylinder block 9 is formed with a plurality of parallel, longitudinally extending and annularly arranged cylinders 14 opening at their left end, as viewed in Fig. 1, to the valve chamber 13 through an annular series of ports 15, and at the other end opening without restriction to the interior of the housing member 6. Reciprocable in each cylinder 14 is a piston 16 adapted in all positions to extend partially from the cylinder block for engagement by an actuating means, generally designated 17. Extending axially of the cylinder block is a stepped bore having a first portion 18 opening outwardly through the right hand end of the cylinder block, as viewed in Fig. 1, a second portion 19 of slightly smaller diameter so as to form an annular shoulder 20, a third portion 21 of still smaller diameter so as to form an annular shoulder 22, and a portion 23 of still smaller diameter forming a shoulder 24. Extending longitudinally of the casing with its inner end projecting through the valve chamber 13 into a recess 25 in the end closure 11, and with its outer end projecting outwardly of the casing for connection with a motor, is a shaft 26. Near its inner end, the shaft is journaled in a roller bearing 27 seated in the portion 21 of the stepped bore, while near its outer end the shaft is surrounded by a sleeve 28 formed with a radially projecting flange 29. Mounted in the housing member 6 adjacent the flange 8 is an annular ring 30, generally L-shaped in cross section, and between the ring and the sleeve 28 there is interposed a roller bearing 31 while between the ring and the flange 29 there is interposed a roller bearing 32, respectively supporting the shaft radially and against end thrust.

The end closure 11 (see Figs. 2 and 4) has opening through the end thereof two large threaded ports 35 and 36. The port 35 opens to an arcuate recess 37, which in turn communicates with the outer portion of the chamber 13 through a plurality of oblong ports 38 (see Figs. 3 and 4). The port 36, through a passage 39, opens to

an annular chamber 40, which in turn communicates with the chamber 13 by a narrow annular port 41 concentric with the shaft 26 and disposed intermediate the center and the periphery of the chamber.

In order to control the flow of fluid between the ports 35 and 36, and the ports 15 of the cylinders 14, there is interposed in the chamber 13 a wheel-like or spoked valve 42 such as more particularly disclosed and claimed in my Patent No. 2,190,812, dated February 20, 1940. This valve is mounted eccentrically with respect to the shaft 26, and to that end such eccentric mounting is here obtained by the employment of an eccentric cam 43 (Fig. 1a) non-rotatably secured on the end of the shaft 26 by means such as a pin 44. To more effectively seal the inner periphery of the valve against leakage of fluid, there is interposed between the valve and the eccentric member 43 a pair of annular rings 45, and interposed between the rings are a plurality of small compression springs 46 urging the rings apart so as to cause them to complete an effective seal against the end faces of the end closure 11 and the cylinder block 9 to provide effective seals.

Incorporated in the end closure 11 are high pressure relief valve means, generally designated 50 and 51, one for each of the passages between the ports 35 and 36 and the valve chamber 13. The valves are so arranged that fluid which is relieved from a high pressure passage is returned to the other passage, which will then be at low pressure. To that end there is fitted into a bore 52 (see Fig. 1), extending between the annular chamber 40 and the arcuate recess 37, a nipple 53 having a central bore 54 and providing an annular valve seat 55 disposed in the recess 37. Co-operating with this annular valve seat is a disk valve 56 urged toward seated position by a strong compression spring 57. This compression spring bears at its other end in a cap screw 58 threaded into the end closure 11 so that the spring 57 may be adjusted to permit discharge from the annular recess 40 to the arcuate recess 37 only at certain desired high pressure. From the arcuate recess 37 there leads a passage 59 which is connected to a chamber 60 for the valve means 51 through the bore 61 of a nipple 62 similar to the nipple 53. This nipple provides an annular valve seat 63 disposed within the chamber 60, and cooperating with the valve seat is a disk valve 64 urged to seated position by a strong compression spring 65. This spring, like the spring 57, is seated in a cap screw 66 threaded into the end closure 11 so as to adjust the valve means to open only at certain desired high pressures in the recess 37. The chamber 60 is, as best seen in Fig. 3, connected by a passage 67 directly to the port 36.

The actuating means 17 here takes the form of a wobbler composed of an inner annular member 70 pivotally mounted on the shaft 26 by means of a pin 71 and an outer annular ring member 72. This ring member 72 is rotatable relative to the inner member 70, and to that end there is interposed between the members 70 and 72 a ball bearing 73 to take the side thrust and a roller bearing 74 to take the end thrust. The member 72 is, of course, disposed to engage the projecting ends of the pistons 16, and to that end the ends of the pistons, as well as the surface of the member 72 contacted thereby, are rounded. Herein the curvature given to the ends of the pistons and to the surface of the member 72 is such that the moment arms of the forward (in Fig. 1 upper) half of the wobbler will have such propor-

tion with respect to the moment arms of the rearward (in Fig. 1 lower) half of the wobbler as to tend to cause the reaction of the pistons on the wobbler to restore the same to neutral or no-stroke position.

Unique control means are herein provided for governing the position of the wobbler. This control means permits of a pre-loading of the wobbler and enables slight increase in pump displacement to be automatic to compensate for increased working pressures. Moreover, this control means in conjunction with certain valve means, presently to be disclosed, but more particularly disclosed and claimed in my copending application Serial No. 410,860, filed of even date herewith, permits of adjustment of the wobbler by a force of constant value regardless of the pressure at which the pump may be working at any particular time. Comprising this control means is a cylindrical control member or cam 77 slidable longitudinally in the portion 19 of the stepped bore in the cylinder block 9 so as to be concentric of the shaft 26 and particularly of the wobbler 17. At its right hand end, as viewed in Fig. 1, the control cam 77 is enlarged to form a piston 78 slidable in the portion 18 of the stepped bore. At its extreme right hand end, the control cam 77 is provided with an end edge 77' disposed in a plane at right angles to the shaft 26 and adapted to bear against the outer member 72 of the wobbler to determine the angular adjustment of the wobbler. The piston portion 78 of the control cam 77 in cooperation with the annular shoulder 20 forms a hydraulic means which, as presently will become apparent, is utilized to place the wobbler under a pre-load of a predetermined constant pressure.

The control cam 77 may be shifted longitudinally to determine the angular position of the wobbler 17 by a variety of means. Herein this means is shown as hydraulic and comprises a casing member 80 secured to the housing member 6 by suitable means, such as bolts 81, to a base surface 82 formed on the top of the housing member 6 for that purpose. Extending longitudinally of the casing member 80 is a bore 83 forming a cylinder in which is reciprocable a piston 84. The ends of the bore 83 are closed by caps 85 and 86 threaded therewith with the cap 86 having threadedly projecting therethrough an adjusting screw 87 against which the piston is adapted to abut to determine the limit of its movement in that direction. A cap screw 88 is mounted over the outwardly projecting end of the screw 87. Fluid under pressure may be supplied to either end of the cylinder through ports 89 and 90 by and under the control of suitable means not herein shown.

Reciprocatory movement of the piston 84 is transmitted to the control cam 77 through a lever 93 extending through registering openings 94 and 95 formed in the members 80 and 6, respectively. The lever 93 is pivotally mounted intermediate its ends on a shaft 96 journaled in ears 97 depending from the casing member 80 and extending into the opening 95 in the housing member 6. At its upper end, the lever 93 is somewhat rounded and projects into an appropriate socket 98 formed in the piston 84 for that purpose. The lower end of the lever 93 is adapted to engage the control cam 77 which, however, instead of being formed with a socket, is formed with an elongated slot 99 into which the end of the lever projects. The slot is so disposed that the lever is capable of shifting the control cam

in a direction to adjust the wobbler toward no-stroke position, but permits movement of the control cam in that same direction independently of the lever 93. The extent of shift of the control cam 77 to the right, as viewed in Fig. 1, under the influence of the piston 84 is determined by the adjustment of the screw 87 or by the control cam itself when the control cam has shifted the wobbler to its absolute zero or no-stroke position, determined by full 360° engagement of the end of the control cam with the member 72. Maximum stroke position of the wobbler is determined by abutment of the control cam with the shoulder 22, the piston 84, as best seen in Fig. 1, being arranged to still have some clearance when the control cam is in this position so that this maximum stroke position is definitely determined by the control cam. Shift of the wobbler from one side to the other of its neutral position to obtain reversal of operation of the pump is obtained by means operating independently of the control cam 77. Herein this means also is hydraulic and comprises an annular piston 103 fixedly secured on the shaft 26 by means such as a pin 104. Cooperating with the piston is a cylinder 105 having a narrow extension 106 slidable in a groove 107 formed in the periphery of the shaft for that purpose. Extending radially from the extension 106 is an arm 108 received in a suitable socket 109 formed in the inner member 70 of the wobbler.

Operating fluid is supplied to opposite ends of the cylinder 105 through passages formed in the shaft 26. To that end, the shaft is formed with an axial bore 111 terminating at one end in a portion 112 of slightly reduced diameter. Inserted into the bore is a tube 113 fitting snugly into the bore 111 at its left hand end, but reduced throughout the major portion of its length to the diameter of the reduced portion 112 of the bore and projecting into the reduced portion 112 so as to define with the bore 111 an annular passage. This annular passage is by a radial passage 114 connected to the left hand end of the cylinder at a point immediately adjacent the piston 103. A similar radial passage 115 opens to the right hand end of the cylinder 105 immediately adjacent the piston 103 and communicates at its inner end with the interior of the tube 113. At its left hand end the annular passage formed by the bore 111 and the tube 113 is connected by a radial passage 116 to an annular groove 117 formed internally of a sleeve or bushing 118 fixedly retained by a pin 119 in the reduced portion 23 of the stepped bore in the cylinder block. Spaced from the groove 117 is a similar groove 120 connected by a passage 121 to the interior of the tube 113. Control fluid is supplied to the grooves 117 and 120 by and under the control of suitable means not completely shown herein, but which is fully disclosed and claimed in my copending application Serial No. 410,860, filed of even date herewith. Reference is made to that application for more complete disclosure. The extreme left hand end of the bore 111 is, of course, suitably plugged to close the passage formed by the interior of the tube.

Make-up fluid for the pump and control fluid are supplied by a make-up pump, generally designated 125. This pump is of the rotary gear element type disclosed and claimed in my Patent No. 2,132,813, dated October 11, 1938, and comprises generally an inner gear element 126 fixed on the shaft 26 to be driven thereby, an outer gear 127 mounted eccentrically with respect to

the inner element, and a crescent shaped dividing member 128. The elements operate in a chamber formed by the outer end face of the housing member 6 and an end closure 129 secured by bolts 130 to the housing member 6. Fluid is drawn into the pump through an intake passage 131 formed in the housing member 6 which leads to an enlarged recess 132 forming the intake port for the pump. A similar enlarged recess 133 forms the discharge port for the pump and leading from this recess is a make-up and control fluid supply passage 134. This passage, as best seen in Figs. 1 and 4, is formed as a bore extending longitudinally of the housing member 6 to one side of the opening 95 formed therein, thence through the flange 10 of the cylinder block and the end closure 11 (see Fig. 6) where it discharges through a port 135 to the extreme upper end of a bore 136 formed in the end closure 11.

Closing the upper end of the bore is a cap 140 formed with a raised boss 141 to provide an annular space to which the port 135 opens. Mounted in the bore 136 are valve means acting to govern the pressure of the control fluid supplied by the pump 125. These valve means include a piston valve 142 reciprocable in the bore 136. A light compression spring 143 bears at one end against the valve 142 and at the other end bears against a sleeve 144 disposed in the lower end of the bore 136. The valve is designed to maintain approximately 110 lbs. per square inch under normal operating conditions. The sleeve may be retained in position by a pin 145. The valve 142 is in the nature of a by-pass relief valve and governs a port 146 opening to the bore at a point spaced inwardly from the port 135 and communicates by means including a passage 147 with a tank or reservoir (not shown). The passage 147 opens to the opening 95 in the housing member 6, whence the fluid discharged from the passage 147 flows to the interior of the casing and thence back to the tank through a port 148 formed in the bottom of the housing member 6.

In addition to the spring 143 the valve 142 is urged toward its normal closed position, that is, in abutment with the raised boss 141 and with the port 146 covered, by a plunger 151 which is subjected to the working pressure of the pumping unit. This plunger is reciprocably mounted in a bore 152 in the sleeve 144 and projects out of the end of the sleeve into abutment with the inner face of the end of the valve 142. In order that this plunger may act on the valve 142 regardless of the direction of discharge of the pumping unit, it is formed at its inner end with a reduced portion 153 so as to provide an annular shoulder 154 constituting a first area on which pressure fluid may act to urge the plunger outwardly of the sleeve. The reduced portion of the plunger 153 reciprocates in a smaller sleeve 155 mounted in the bore 152. The end of this reduced portion 153 constitutes a second area upon which pressure fluid may act to shift the plunger outwardly. These pressure areas are made equal so that fluid under the same pressure will have the same effect on either. Opening to the space between the shoulder 154 and the end of the sleeve 155 is a passage 156 which communicates at the other end with the outer periphery of the valve chamber 13, while the end of the reduced portion 153 is subjected to the pressure of the fluid in the annular recess through the medium of a passage 157. Thus it will be seen that as the working pressure at which the pump unit is operating increases the valve 142 will

open the port 146 only at increased pressure, and thus will raise the pressure of the control fluid supplied by the pump 125.

Valve means, generally designated 160 is provided to maintain the supply of make-up fluid and fluid for pre-loading the control cam 77 at a constant pressure regardless of variation produced by the valve 142. Accordingly, there is formed in the end closure 11 parallel with the bore 136 a bore 161 which again is closed at its outer end by a cap 162 having on its inner face a raised boss 163. Reciprocable in the bore is a valve 164 of the cylinder type having lands 165 and 166 separated by a groove 167. The land 166 also has opening longitudinally therethrough a plurality of passages 168. The valve is urged toward abutment with the boss 163 by means of a compression spring 169 operable to maintain a certain desired pressure, herein approximately one hundred pounds per square inch.

Opening to the bore so as to be controlled by the valve 164 is a port 171 which is by a passage 172 connected to the bore 136 at the annular space provided by the boss 141, so as at all times to be supplied with fluid by the pump 125. This port 171 is so positioned relative to the land 166 of the valve 164 that it is open when the valve abuts the boss 163, but is progressively closed to reduce the fluid supply to the bore 161 as the pressure of the fluid acting on the end of the piston 164 forces the piston downwardly (Fig. 1) against the action of the spring 169. Opening to the bore 161 opposite the boss 163, so as to be constantly open, is a passage 173 (see Fig. 2) leading to a bore 174 extending parallel with the bore 161.

From the bore 174 a diagonal passage 175 (Fig. 5) leads to a horizontal bore 176 intersecting a bore 177, and opening at one end to a bore 178 similar to and parallel with the bore 177. Interposed in each of the bores is a cylindrical screen or strainer 179. The bore 177 communicates with the annular recess 40, while the bore 178 communicates with the arcuate recess 37, all as best seen in Fig. 5. Disposed in each bore is a check valve 180 urged to seated position by a light compression spring 181, and so disposed as to permit flow of fluid from the bore 176 toward the recesses but to prevent reverse flow. A diagonal passage 184 leads from the inner end of the valve bore 161 to the recess 25 in the inner face of the end closure 11.

This constant pressure fluid provided by the reducing valve means 160 is also supplied to pre-load the control cam 77, and is additionally supplied to the valve bore 136 inwardly of the valve 142 so as to act on the valve in a manner to maintain the port 146 closed. The passages or conduits for supplying the fluid to these places include a diagonal bore 185 (Fig. 6) leading from the bore 174 to the bore 136 inwardly of the valve 142 and a passage 186 leading from the opposite side of the bore 136 first diagonally upwardly and rearwardly in the end closure 11 (see Fig. 1), thence downwardly, longitudinally, forwardly, and again downwardly through the cylinder block 9 to the space between the shoulder 20 and piston 78.

It is intended that the cylinder 105 will be supplied with control fluid generated by the pump 125 and at the pressure of such control fluid as determined by the valve 142. Such control fluid is to be constantly supplied to one end or the other of the cylinder 105 and thus will hold the wobbler against the control cam 77, the pres-

sure area of the piston and cylinder being such that the device will hold the wobbler against the end of the control cam in opposition to the action of the pistons on the wobbler tending to restore the same to neutral or no-stroke position. It will be seen that with this arrangement an increase in the working pressure of the pumping unit will, through the control pressure governing valve means, increase the pressure acting on the cylinder 105 to increase the angle of the wobbler and thus increase the displacement of the pumping unit. This increase in pressure acting on the cylinder 105 is sufficient to overcome the pre-load pressure and the reaction of the pistons on the wobbler and thus, merely by taking up the play inherent in the mechanism, increase the angular position of the wobbler just enough to compensate for the increased leakage which takes place at such higher working pressures. As the working pressure increases the metal parts which carry the thrust stretch or compress, as the case may be, and cause the pivot 71 of the wobbler to move slightly to the right (Fig. 1). This permits the control to increase the pump stroke and compensate for the increased leakage at higher pressures. It is to be borne in mind that the increase in stroke here mentioned is extremely small, in the order of a few thousandths of an inch. With the construction shown, the end edge 77' of the control cam is actually the fulcrum for the tilting of the wobbler, and since this edge is effective for both directions of pump discharge the increased stroke with increased working pressure is obtained for both directions of pump discharge. In practice pumps of this type with absolutely constant output are thus possible. In fact, pumps of this type can even compensate for leakage in a fluid motor connected thereto, as well, so as to obtain constant motor speed regardless of variations in working pressure. Moreover, with this arrangement the increase of the pressure of the control fluid compensates for the increased reaction of the pistons at the higher working pressures to tend to return the wobbler to neutral or no-stroke position, so that the pressure of the ring member 72 against the end edge 77' of the control cam is of constant value regardless of the working pressure. This makes possible adjustment of the wobbler by the application of a force of constant value regardless of the working pressure of the pumping unit. The arrangement further makes possible the employment of a low pressure control and make-up fluid for normal conditions of operation.

I claim as my invention:

1. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being adjustably mounted to vary the stroke of said pistons, and control means governing the adjustment of said wobbler including hydraulic means for placing a pre-load on said wobbler biasing the same toward no-stroke position including an annular piston member concentric with said shaft and movable longitudinally thereof, said member having an end edge disposed in a plane perpendicular to said shaft and adapted to engage said wobbler.

2. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylin-

ders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being adjustably mounted to vary the stroke of said pistons, and control means governing the adjustment of said wobbler including hydraulic means for placing a pre-load on said wobbler biasing the same toward no-stroke position comprising a stepped bore concentric with said shaft and providing an annular shoulder and an annular member slidable in said bore and having a piston portion disposed opposite said annular shoulder, said member having an end edge disposed in a plane perpendicular to said shaft and adapted to engage said wobbler.

3. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being adjustably mounted to vary the stroke of said pistons, and control means governing the adjustment of said wobbler including hydraulic means for placing a pre-load on said wobbler biasing the same toward no-stroke position including an annular piston member concentric with said shaft and movable longitudinally thereof, said member having an end edge disposed in a plane perpendicular to said shaft and adapted to engage said wobbler, and means operable to engage said piston member and shift the same to adjust said wobbler toward no-stroke position.

4. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being adjustably mounted to vary the stroke of said pistons, and control means governing the adjustment of said wobbler including hydraulic means for placing a pre-load on said wobbler biasing the same toward no-stroke position including an annular piston member concentric with said shaft and movable longitudinally thereof, said member having an end edge disposed in a plane perpendicular to said shaft and adapted to engage said wobbler, and means operable to engage said piston member and shift the same to adjust said wobbler toward no-stroke position, said last mentioned means having a one-way connection with said piston member.

5. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being adjustably mounted to vary the stroke the said pistons, and control means governing the adjustment of said wobbler including hydraulic means for placing a pre-load on said wobbler biasing the same toward no-stroke position including an annular piston member concentric with said shaft and movable longitudinally thereof, said member having an end edge disposed in a plane perpendicular to said shaft and adapted to engage said wobbler, and additional means including hydraulic means operable to engage said piston member

and shift the same to adjust said wobbler toward no-stroke position.

6. In a fluid device, a casing, a cylinder block having a plurality of cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a rotatable shaft, means on the shaft operatively engaging said pistons, said means being adjustable to vary the stroke of said pistons and the direction of operation of the device, and control means governing the adjustment of said piston engaging means comprising means for determining the stroke of said pistons urging said piston engaging means toward no-stroke position including means operable to place a bias of constant force on said piston engaging means urging it toward no-stroke position, and means governing the direction of operation of the device urging said piston engaging means toward increased stroke of said pistons in opposition to the first mentioned control means.

7. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being adjustably mounted to vary the stroke of said pistons and the direction of operation of the device, and control means for the wobbler comprising a first hydraulic means including an annular member concentric with said shaft and said wobbler and operatively engaging said wobbler to determine the length of stroke of said pistons, said piston and cylinder means when supplied with fluid being operable to provide a pre-load biasing the wobbler toward no-stroke position, a second hydraulic means operable to adjust said wobbler from one side of its neutral to the other side, said second hydraulic means when supplied with operating fluid urging said wobbler in a direction to increase the stroke of said pistons in opposition to the piston of said first hydraulic means, and a third hydraulic means having a member engaging said piston of said first hydraulic means and operable when supplied with fluid under pressure to determine the adjustment of said wobbler.

8. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being pivotally mounted on said shaft to vary the stroke of said pistons and the direction of operation of the device, and control means for the wobbler comprising hydraulic means operable to swing said wobbler about its pivot in either direction away from its neutral position, an annular member concentric with said shaft and said wobbler providing an end edge operatively engaging said wobbler radially outwardly of its pivot and on the same face as said pistons to determine the length of stroke of said pistons and means constantly urging said member in a direction to pre-load said wobbler; the end edge of said annular member constituting a fulcrum about which said entire wobbler pivots under yield of the parts with increases in the working pressure in said cylinders to increase slightly the stroke of said pistons to compensate for increased leakage.

9. In a fluid device, a casing, a cylinder block having a plurality of annularly arranged cylin-

ders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a shaft rotatably mounted concentrically of said cylinders, a wobbler on said shaft operatively engaging said pistons, said wobbler being adjustably mounted to vary the stroke of said pistons and the direction of operation of the device, and control means for the wobbler comprising means operable to urge said wobbler in either direction away from its neutral position to determine the direction of operation of the device, and means engaged by said wobbler on either side of neutral and constantly opposing shift of said wobbler from neutral determining the length of stroke of said pistons, said last mentioned means constituting a fulcrum about which said entire wobbler pivots under increases in the working pressure in said cylinders to increase slightly the stroke of said pistons to compensate for increased leakage.

10. In a fluid device, a casing, a cylinder block

having a plurality of cylinders therein, a piston reciprocable in each cylinder and projecting at one end therefrom, a rotatable shaft, means on the shaft operatively engaging said pistons, said means being adjustable to vary the stroke of said pistons and the direction of operation of the device, and control means governing the adjustment of said piston engaging means comprising means operable to adjust said first mentioned means to determine the direction of fluid discharge from the device, and means engaged by said first mentioned means in either direction of operation of the device and constantly opposing an increase in piston stroke gauging the length of stroke of said pistons for determining the displacement of the device, said first mentioned means and its mounting yielding under increases in the working pressure in said cylinders to increase slightly the stroke of said pistons.

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