April 17, 1945. G. A. WAHLMARK 2,373,723

FLUID PUMP OR MOTOR

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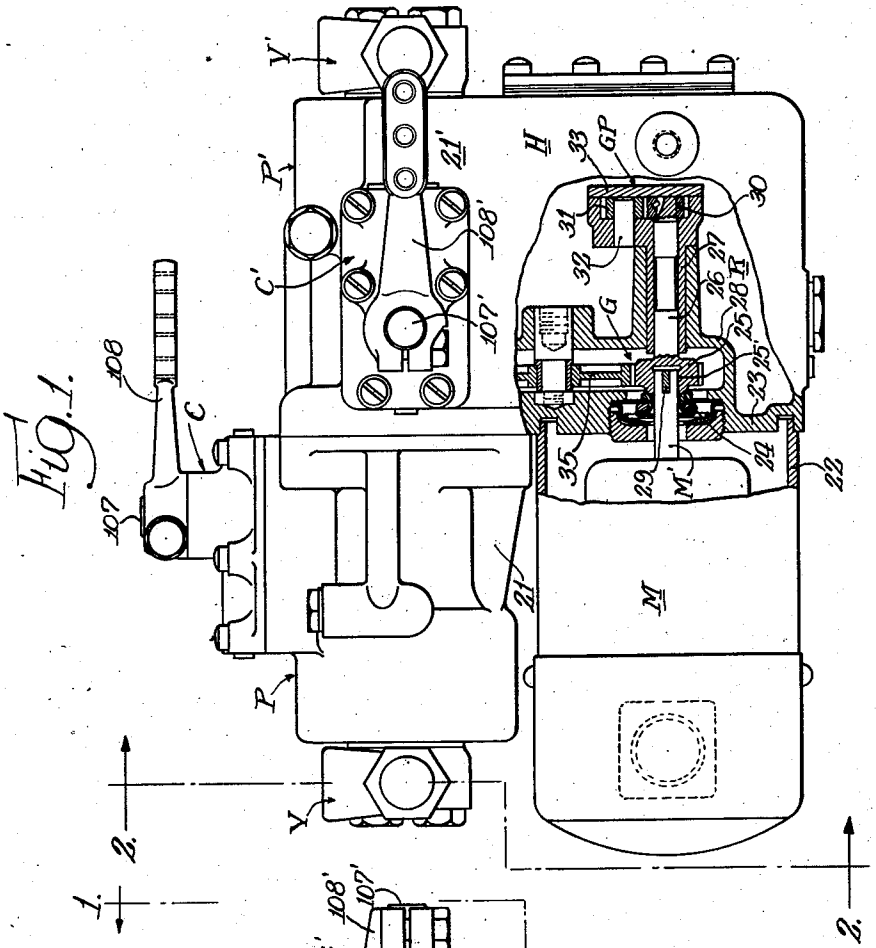


Fig. 1.

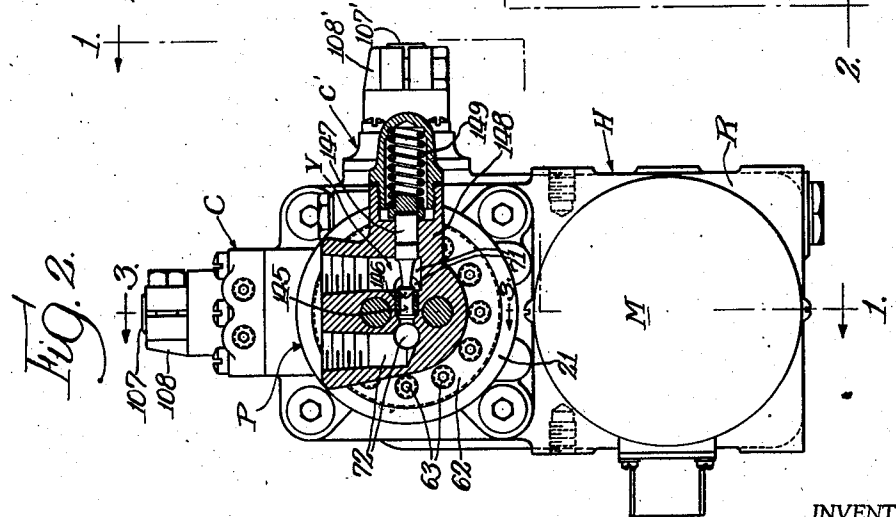


Fig. 2.

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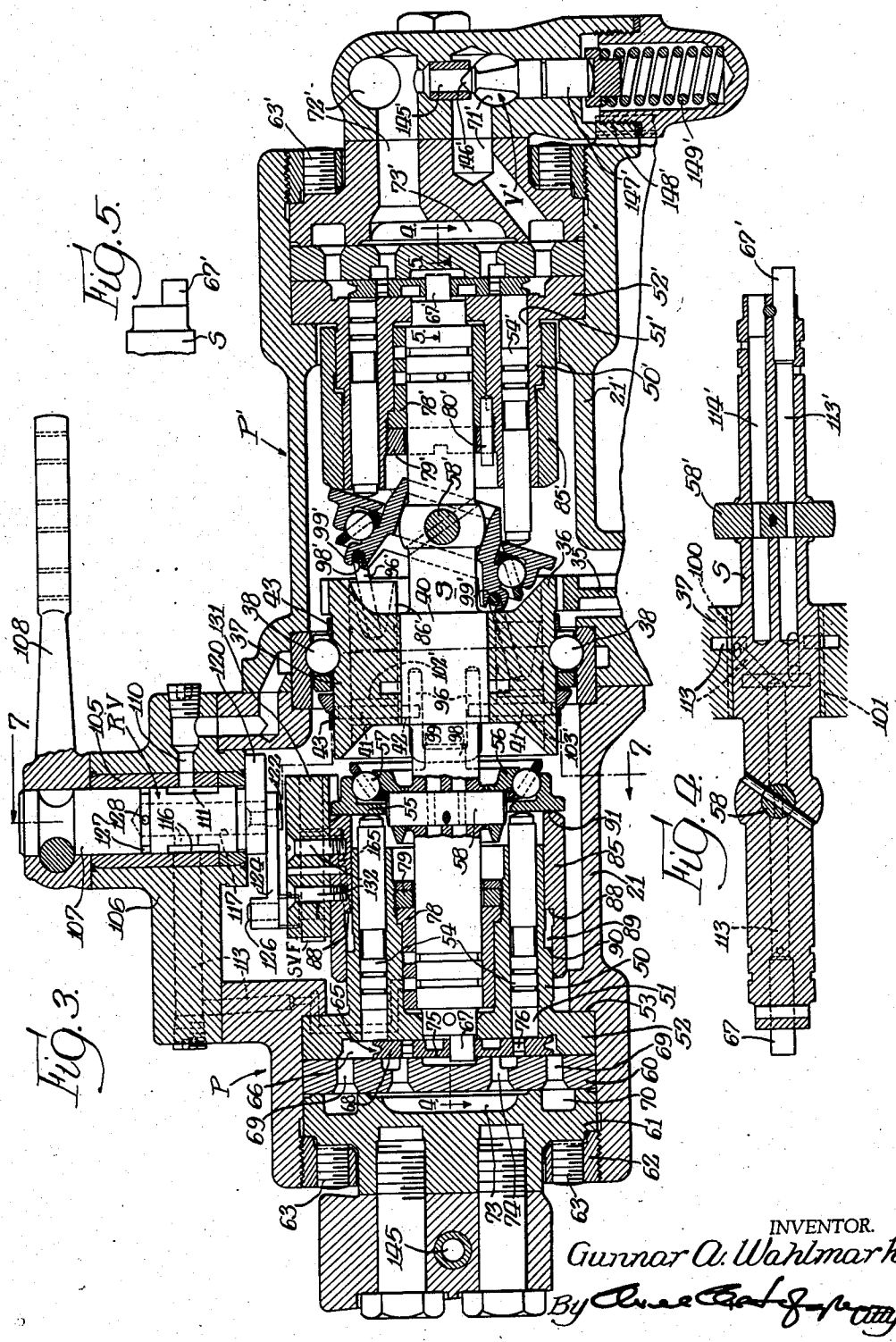


Fig. 5.

Fig. 4.

Fig. 3.

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Fig. 7.

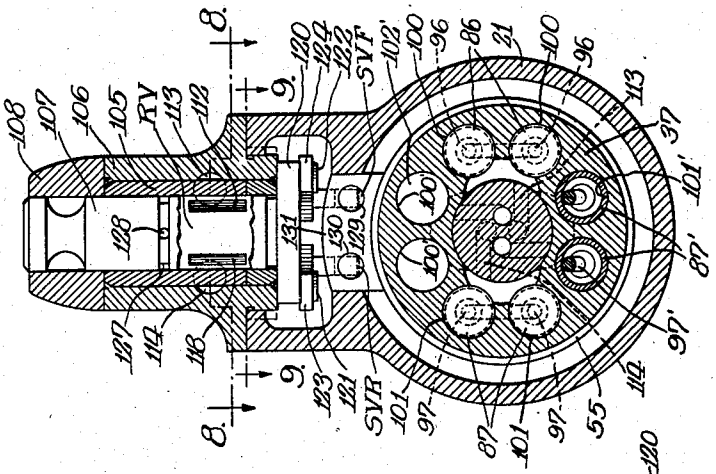


Fig. 6.

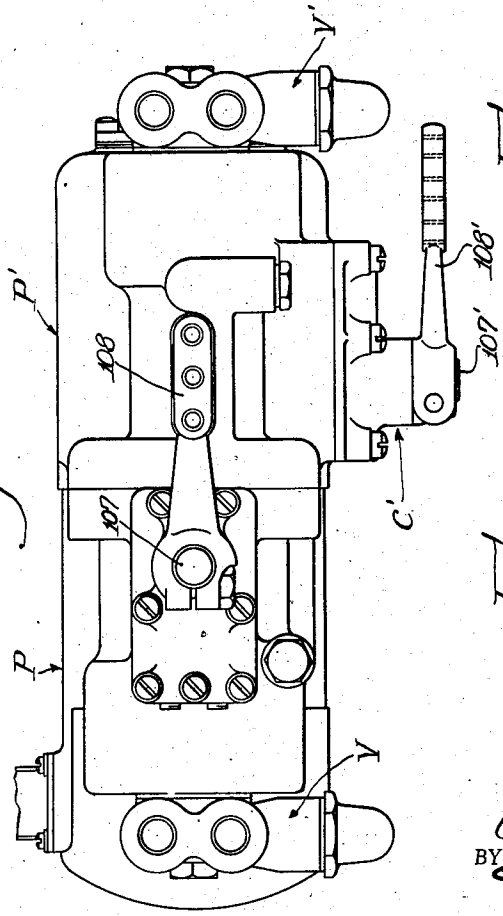


Fig. 9.

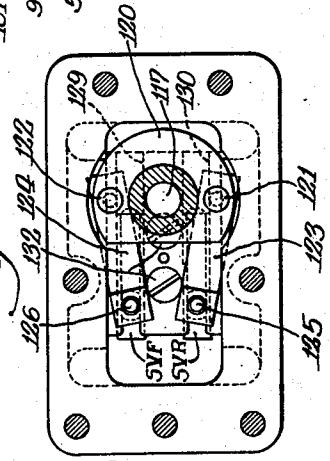
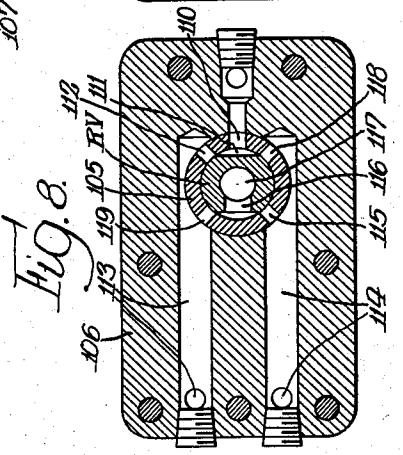


Fig. 8.



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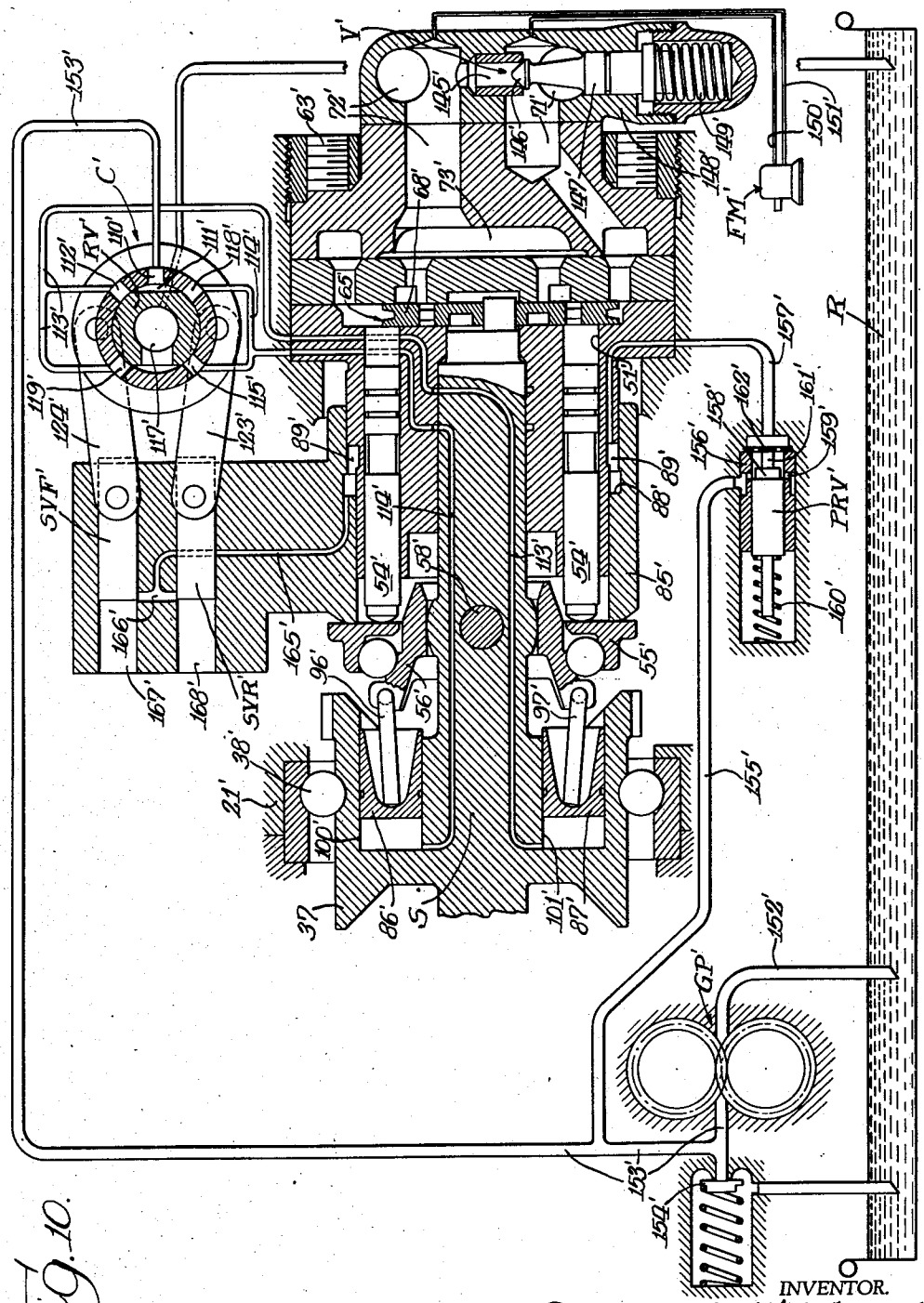


Fig. 10.

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FLUID PUMP OR MOTOR

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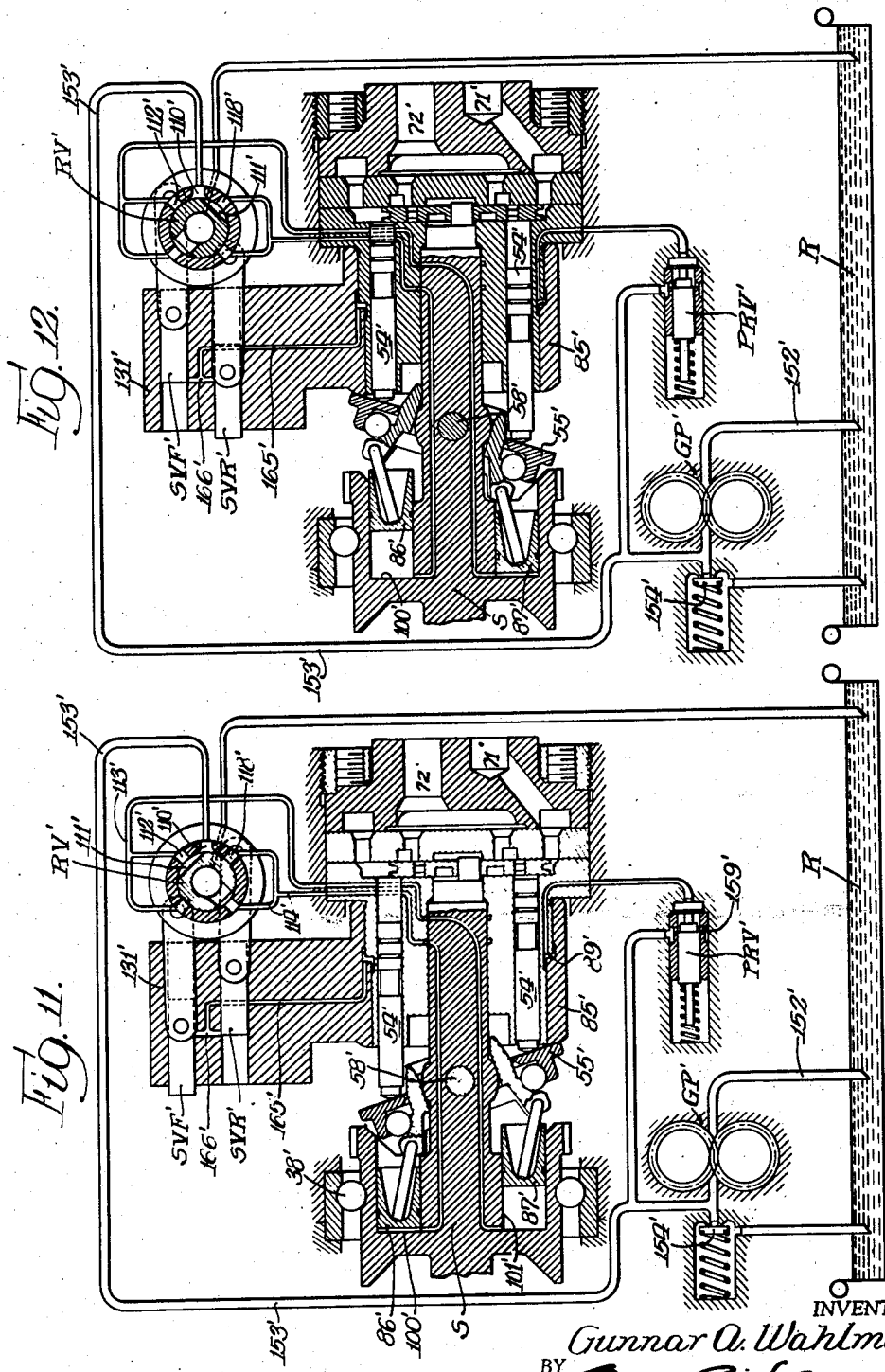


Fig. 12.

Fig. 11.

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Fig. 12.

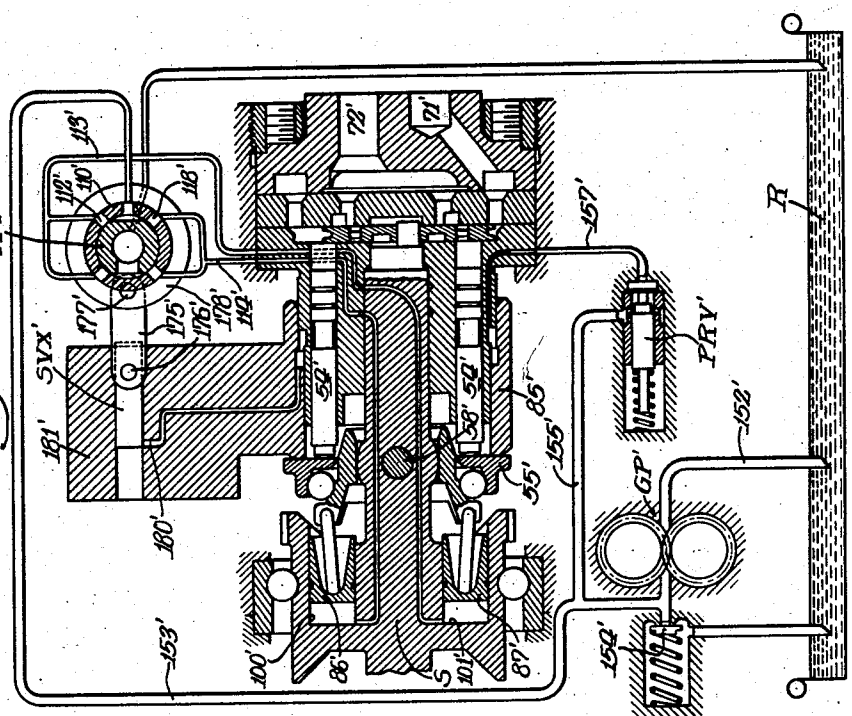
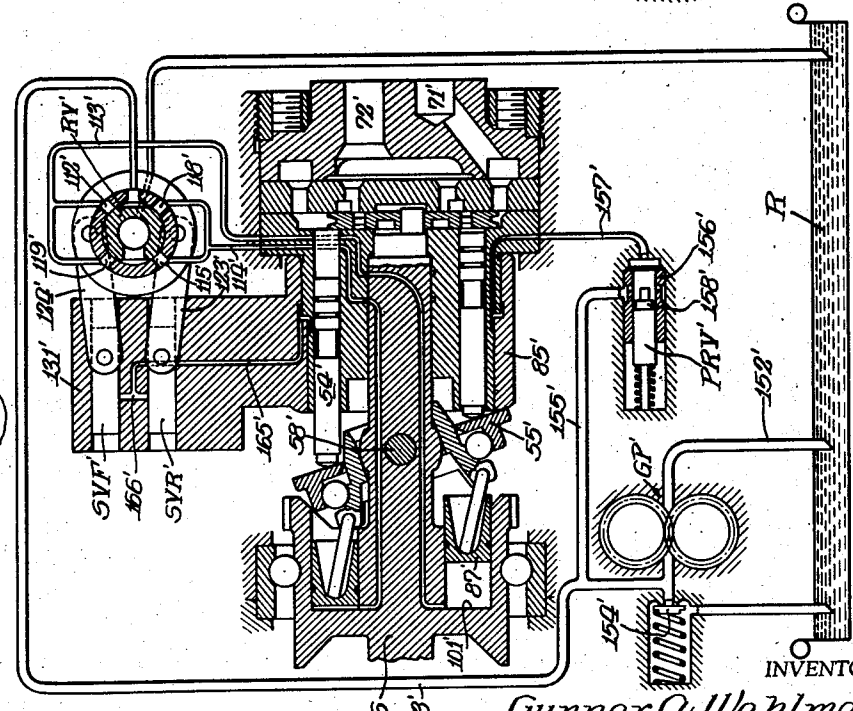


Fig. 13.



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Patented Apr. 17, 1945 2,373,723

UNITED STATES PATENT OFFICE

2,373,723

FLUID PUMP OR MOTOR

Gunnar A. Wahlmark, Rockford, Ill.

Application March 2, 1942, Serial No. 432,917

23 Claims. (Cl. 103—173)

It is the general object of the invention to provide a new and improved pump or motor. More particularly it is an object to provide a new and improved piston type pump or motor embodying servo control means for adjusting the stroke of the pistons.

Another object is to provide a reversible wobbler type mechanism with a new and improved control means for adjusting the stroke of the pistons, and the position of the wobbler on both sides of neutral as well as to its neutral or no-stroke position.

It is another object to provide such a mechanism with a unitary wobbler reversing and stroke adjusting control of the servo type, and more particularly to provide a unitary control of this kind of extremely small size, light weight and high sensitivity.

Another object is to provide a piston type fluid pump or motor with an improved gyratory valve mechanism for controlling the flow of fluid to and from the cylinders.

Another object is to provide a compact and light weight motor driven unit embodying two pumps having stroke adjusting and fluid reversing control incorporated therein, and capable of producing large quantities of fluid at high pressures.

Another object is to provide a wobbler type pump with improved means for holding the parts thereof together so as to withstand high fluid pressures without leakage. A more particular object is to provide a motor driven pumping unit with two independently controllable pumps driven from a single motor, each pump being capable of absorbing the full output of the motor, and having built-in and manually adjustable servo controls, and a reservoir for containing the necessary fluid to operate two fluid motors.

Another object is to provide a pumping device of the wobbler type with fluid actuated stroke control means including mechanism for obtaining quick changes in the stroke adjustment.

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

Fig. 1 is a front elevational view, partly in section along the line 1—1 of Fig. 2, of a preferred form of my invention.

Fig. 2 is an end view, partly in section, along the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary central longitudinal section along the line 3—3 of Fig. 2, with certain parts at the right hand end turned 90° about the shaft axis.

Fig. 4 is a fragmentary section along the line 4—4 of Fig. 3.

Fig. 5 is a fragmentary view along the line 5—5 of Fig. 3.

Fig. 6 is a top plan view of the preferred form of the invention.

Fig. 7 is a vertical section along the line 7—7 of Fig. 3.

Fig. 8 is a horizontal section along the line 8—8 of Fig. 7.

Fig. 9 is a horizontal section along the line 9—9 of Fig. 7.

Fig. 10 is a diagrammatic representation of the hydraulic circuit for one piston pump device with its servo control valves and the wobbler adjusted to their neutral or no-stroke position.

Fig. 11 is a similar circuit diagram with the servo control valves and wobbler adjusted to their maximum stroke positions for fluid discharge from the pump in one direction.

Fig. 12 is a similar circuit diagram with the servo control valves and wobbler adjusted to their maximum stroke positions for fluid discharge from the pump in the opposite direction.

Fig. 13 is a similar circuit diagram with the servo control valves moved to their neutral position, the wobbler still remaining in the maximum stroke position of Fig. 11.

Fig. 14 is a similar circuit diagram, with the pump wobbler in its no-stroke position and a modified form of servo control adjusted to its neutral or no-stroke position.

There is illustrated in the drawings and hereinafter described in detail, a preferred form of the invention, together with a modification thereof, with the understanding that the disclosure is intended as an exemplification of the principles of the invention and is not intended to limit the invention to the forms shown. The scope of the invention will be pointed out in the appended claims.

In the form selected for purposes of disclosure and as illustrated in Figs. 1 to 13, the invention comprises generally a three-quarter horsepower 6000 R. P. M. direct current motor M, two twelve cylinder wobbler type piston pumps P and P' with self-contained servo controls C and C', respectively, a gear type pump GP for furnishing a fluid (such as oil) for control and make-up purposes, reduction gearing G connecting the motor shaft M' to a pump shaft S (which is common to both of the pumps P and P'), high pressure safety valves V and V' for the pumps P and P', respectively, and a casing or housing H which encloses and connects certain of the parts to pro-

vide a unitary structure. It is contemplated that the inlet and outlet ports for each pump will be connected by means of suitable conduits to a fluid motor (indicated at FM' in Fig. 10) which may be a rotary motor, a single piston and cylinder device or of any other desirable form.

More particularly, as illustrated in Figs. 1 to 9, the housing H has a lower portion forming a reservoir R for oil or other suitable fluid, and an upper portion 21' forming a casing for the pump P'. A casing 22, for the motor M, is suitably secured to the left hand end (Fig. 1) of the lower portion of the housing H. The motor shaft M' extends through an opening in the adjacent housing wall 23, through a mechanical seal 24 (which is shown as of the type disclosed and claimed in my Patent No. 2,216,218, dated October 1, 1940) and into a bore 25' in a pinion 25. This pinion is formed integrally with a shaft 26 which is supported in a bushing 27 carried in a bracket-like extension 28 on the housing wall 23. The fit of the motor shaft M' in the bore 25' is such that the end of the motor shaft is supported in the pinion. A driving connection is provided by a cross key 29 which extends through a diametrical slot in the shaft M' and into registering longitudinal slots (not shown) in the pinion 25.

The gear pump GP (Fig. 1) comprises a pinion 30 pinned on the end of shaft 26 and a meshing pinion 31, rotatably mounted on a pin 32. A chamber for the gears is formed by a recess in an extension 34 on the bushing 27, and a suitable cover plate 33.

The gearing G (Figs. 1 and 3) for driving the pumps P and P' includes the drive pinion 25, an idler gear 35, and a gear 36 (Fig. 3) formed integrally with a cylindrical pump drive member 37 which is rotatably mounted in the upper portion of the housing H by means of a ball bearing 38.

As illustrated herein the pumps P and P' (and their associated servo controls C and C') are substantially alike in construction and operation, so that a detailed description of pump P will suffice. The corresponding parts of pump P' will be given the same numerals with a "prime" added thereto.

The shaft S for the pumps extends in opposite directions from the drive member 37 (Fig. 3) and has a central enlarged portion 40 which is fitted into a central bore in the member 37. A plurality of pins 41 extend radially inward through bores in the drive member 37 and into registering sockets 42 in the shaft S to form a driving connection therebetween, a pair of bands 43 being provided to hold the pins 41 in their bores and sockets.

The pumps, as mentioned hereinbefore, are of the wobbler type and have twelve cylinders each. Preferably they are of the type disclosed and claimed in my prior application Serial No. 305,690, filed November 22, 1939, now issued as Patent No. 2,280,875, dated April 28, 1942. As illustrated, the pump P comprises a casing 21, generally cylindrical in form as shown best in Fig. 7, and secured at one end to the casing 21' of the pump P'. A cylinder block 50 has twelve cylinder bores 51 therein, and has an external flange 52 positioned against an annular shoulder 53 within the casing 21. Pistons 54 are reciprocably mounted in the cylinders 51 and extend therefrom and into engagement with an outer member 55 of a wobbler device. An inner annular member 56 is connected to the outer member 55 by a ball bearing 57, and is pivotally mounted on the drive shaft S by means of a pin 58. The wobble plate is thus adjustable angularly about the pin 58 from the neutral or no-stroke position shown in Figs. 3 and 10 toward the full stroke positions shown in Figs. 11 and 12 for wobble plate 55'.

A disk-like member or valve plate 60 is positioned in the pump casing against the flanged end of the cylinder block, and a cap member 61 is positioned against the outer surface of the valve plate 60. The cylinder block, valve plate and cap member are effectively clamped in place in the casing by a ring 62 which has external screw threads engaging corresponding threads on the casing 21, and a plurality of screw devices 63, herein twelve in number, which are threaded through the ring 62 and against the cap member 61 to tighten the parts in place. This type of clamping means for the ports has the advantage of the full tensile strength of the casing as distinguished from prior constructions wherein bolts under tension were used, the screws 63 herein being under compression.

The flow of fluid to and from the pump cylinders 51 is controlled by means of a wheel-like valve 65, which is positioned in a cylindrical valve chamber 66 formed in the cylinder block 50, and is driven by the shaft S through an eccentric pin 67 thereon so as to have a gyratory motion. This type of valve is disclosed and claimed in my Patent No. 2,190,812, dated February 20, 1940. Briefly, it includes a rim 68 which covers and uncovers the adjacent ends of the cylinders 51 and alternately connects them to the valve chamber 66 outwardly of the rim 68 and inwardly of the rim. The outer portion of the valve chamber connects through an annular series of ports 69 (in the valve plate 60) with an annular port 70 in the cap member 61, this annular port communicating in turn with a first pump port 71 (Fig. 2). A second pump port 72 connects with a recess 73 (Fig. 3) in the cap member 61, and through a plurality of ports 74 in the valve plate communicates with the gyratory valve 65 inwardly of the rim 68. Since the rim of the valve is connected to its hub 75 by spokes 76 communication is established periodically between the ports 74 and the cylinders 51.

When the invention is used for pumping fluid at relatively high pressures, the valve 65 is preferably made relatively thin, as shown. The peripheral portion of the valve plate 60, and the portion just inwardly of the ports 69 are backed up rigidly by the cap member 61 as is evident from Fig. 3. To reinforce the center of the valve plate when the ports 74 are pressure or outlet ports, the chamber 73 is arranged so that the fluid under high pressure can act against the adjacent central portion of the valve plate and keep it in efficient sealing contact with the valve 65.

As illustrated herein, the shaft S is supported at its ends by bushings 78 and 78' which are mounted in the cylinder blocks 50 and 50' and have outwardly extending flanges which are clamped against shoulders in the cylinder blocks by means of threaded rings 79 and 79'. Preferably the bushings and rings are then secured against rotation in the cylinder blocks by pins as indicated at 80'.

With the exemplary form of the invention it is contemplated that the pump shaft S will be driven continuously by the motor M and that the output of the pumps P and P' and the direction of flow of the fluid therefrom, will be controlled by adjustment of the wobble plates of the pumps

from neutral to forward and reverse positions. The means for adjusting the wobble plates will now be described.

As illustrated in the drawings the adjusting means for each pump comprises a control sleeve 85 (Fig. 3) control pistons 86 and 87 (Figs. 3 and 7) and means including the servo control C for controlling the fluid acting on the control sleeve and control pistons. The control sleeve 85 is slidably supported on the cylinder block 50 and is provided with an internal annular shoulder 88 which functions as a piston. An annular chamber 89 surrounds the cylinder block between the shoulder piston 88 and an opposed shoulder 90 on the block 50. As more fully described hereinafter, the chamber 89 is supplied with fluid from the gear pump GP to move the control sleeve towards the wobbler of the associated pump and thereby determine the angular position of the wobbler. In Fig. 3, the control sleeve has moved the wobbler 55, 56 to a neutral or no-stroke position wherein the right hand end 91 of the control sleeve engages the outer member 55 of the wobbler throughout its periphery and holds it in exact neutral.

The control pistons 86 and 87 (Fig. 7) are herein arranged in pairs, the pistons 86 operating through piston rods 96 (Figs. 3 and 7) to move the wobbler in one direction from its neutral position (against the action of fluid on the control sleeve piston 88), and the pistons 87 operating through piston rods 97 to move the wobbler in an opposite direction from neutral. Each pair of piston rods 96 is formed as the legs of a U-shaped member, the bight 98 of which is pivoted in a lug 99 formed integrally with the inner wobbler member 56. Cylinders 100 for the pistons 86 and cylinders 101 for the pistons 87 are bored through the drive member 37 and are then closed at one end by means of plugs 102 and 103, respectively, the plugs being held in place by the pins 41. The control pistons 86 and 87 may properly be referred to as "forward" and "reverse" pistons since their function, primarily, is to reverse the direction of fluid flow through the pump P. It is believed readily apparent that the control sleeve 85 acts to determine the stroke of the pump pistons regardless of the direction of fluid flow through the pump. This characteristic of the control sleeve is utilized in a unique manner in connection with the servo control C, the construction and operation of which will now be described.

The servo control designated generally by the letter C is associated with the pump P and includes a cylindrical reversing valve RV and a pair of servo valves SVF and SVR (Figs. 3, 7 and 9). The reversing valve RV is rotatably mounted in a bushing or casing 105 supported in a vertical position in a plate 106 secured to the top of the pump casing 21. This valve is herein provided with a stem 107 for the attachment of an operating arm 108 and is adapted to be rotated out of the neutral position of Figs. 1 to 3 and 6 to 10 to the forward and reverse positions of Figs. 11 and 12, respectively. As shown most clearly in Figs. 3, 7 and 8, control fluid under pressure supplied through a port 110 in the casing 105 enters a chamber 111 in the casing formed by a cutaway portion on the valve RV. By rotating the valve counterclockwise (Fig. 8) this fluid can be directed out through a valve port 112 to a passage 113 which leads ultimately to the control cylinders 100. When in this position, fluid from the control cylinders 101 is exhausted through a passage or port 114, through a port 115 in the casing 105, a port 116 in the valve RV and an axial passage 117 in the valve which discharges at its lower end into the casing 21 of the pump P. Rotation of the valve RV in a clockwise direction from the position of Fig. 8 directs control fluid through a port 118 in casing 105 into port 114 and on to control cylinders 101 while at the same time fluid from the control cylinders 100 exhausts through a passage 113, a port 119 in casing 105, valve port 116 and passage 117. A leakage groove 127 surrounds the valve RV and is connected to the return passage 117 by a port 128.

The servo valves SVF and SVR are connected to the reversing valve RV so as to be operated simultaneously therewith, the valve SVF functioning when the reversing valve is moved in one direction from neutral to a "forward" position (Fig. 11) and valve SVR functioning when the valve RV has been moved to its "reverse" position as in Fig. 12. As shown in Figs. 3, 7 and 9, the valve RV is formed with a flange 120 on its lower end and carries diametrically opposite, downwardly extending pins 121 and 122 to which links 123 and 124 are anchored. The other ends of these links are connected by pins 125 and 126, to the valves SVR and SVF respectively. The servo valves are cylindrical in form and slide in parallel bores 129 and 130 in a block or casing 131 which is mounted fixedly on the control sleeve 85 and is secured thereto by screw devices 132 so that the casing for the servo valves moves with the control sleeve 85 whose movement the servo valves control.

Although a more complete disclosure of the fluid circuits for the pumps and controls will be found in the circuit diagrams of Figs. 10 to 13, some of the passages are illustrated in Figs. 3, 4, 7 and 8. In these figures the passage 113 includes (Fig. 3) connecting bores in the plate 106, connecting bores in the casing 21, connecting bores in the cylinder block 50, a port through bushing 78, an annular groove in the shaft S, a short radial port, a longitudinal bore (Fig. 4) and an oblique bore in the shaft, and a recess (Fig. 7) in the member 37 which connects the outer end of the oblique bore with the two control cylinders 100. A corresponding series of bores, ports and recesses form the passage 114.

The high pressure relief valves V and V' are alike so a description of valve V in connection with Fig. 2 will suffice. The pump ports 71 and 72 are connected by a by-pass port 145. A valve 146 is arranged to control the by-passing of fluid through this port and is operable in this capacity when port 71 is the outlet port of the pump and also when the port 72 is alternatively the outlet port. Valve 146 has a cylindrical portion 147 which is slidably mounted in a bore in the valve casing 148 and is engaged by a coiled spring 149 which serves to urge the valve 146 constantly towards its closed position as shown. The cylindrical portion 147 is made to have a cross sectional area approximately twice the cross sectional area of the port 145 where it forms a seat for the valve 146. When the port 72 is the pump outlet port the fluid discharged by the pump acts against the left hand end of valve 146, and when the pressure rises above the value for which the spring 149 is adjusted, valve 146 opens and by-passes fluid back to the port 71 which is then the inlet port for the pump. When the wobbler is reversed so that port 71 is the pump outlet port the fluid acts on the exposed surfaces of the valve 146 which are within the port 71. These sur-

faces include the exposed end of the cylindrical portion 147 and part of both sides of the valve 146. The parts are so proportioned that the areas acted upon by the fluid to urge the valve 146 to its open position exceed the area acted upon by the fluid to seat the valve by an amount equal to the cross sectional area of port 145.

Thus the valve 146 opens to by-pass fluid at the same pre-adjusted pressure for both directions of pump discharge.

Reference is now made more particularly to Figs. 10 to 13. In these figures there is illustrated the hydraulic circuit for the pump P' and since the circuits for the two pumps are identical a description of one will suffice. In Fig. 10, the control C' and the pump P' are adjusted to their neutral or no-stroke position. The pump ports 71' and 72' are shown connected to a suitable fluid motor FM' by means of conduits 150' and 151'. Fluid from the reservoir R is conducted to the gear pump GP' by a conduit 152' and is conducted away from the gear pump by a conduit 153' which leads to the port 110' of the reversing valve RV'. A by-pass valve 154' is provided to maintain constant pressure in the conduit 153' and to permit excess fluid to pass back to the reservoir. A conduit 155' leads from the conduit 153' to the casing 156' of a pressure reducing valve PRV'. Fluid which passes the valve PRV' is conducted by a conduit 157' to the chamber 89' wherein it acts on the piston 88' formed on the control sleeve 85'. The valve PRV' has a reduced cylindrical portion 158', which normally lies opposite valve ports 159' in the casing 156' so as to restrict the passage of fluid over the valve. The valve is urged into this position by a spring 160', a stem 161' on the valve engaging a perforated disk 162' to limit the movement of the valve by the spring. The fluid in chamber 89' moves the control sleeve 85' towards the left (Fig. 10) to the no-stroke position shown since the pistons 86' and 87' are then inactive.

The pressure of the fluid in chamber 89' is herein controlled by the servo valves SVF' and SVR' by regulating the exhaust of fluid from said chamber through an exhaust passage 165'. This passage leads to a port 166' which communicates with bores 167' and 168' in which the valves SVF' and SVR' are slidable. Preferably the port 166' is so positioned that when the servo valves are in the positions shown in Fig. 10, there is a slight discharge of fluid into the bores 167' and 168', this fluid then returning to the reservoir R by gravity. The discharge under these conditions is so small that it does not affect materially the pressure in the chamber 89' but it does mean that the exhaust passage 165' is slightly open and that upon any movement of the valves SVF' and SVR' the exhaust of fluid from passage 165' increases instantaneously.

Movement of the reversing valve RV' in either direction from the position shown in Fig. 10 opens the ports 112', 115' or 118', 119'. Assuming the reversing valve is shifted to the "reverse" position of Fig. 11, fluid passes from the supply conduit 153', through port 110', port 112' and passage 113' to cylinders 101' to act on pistons 87'. Simultaneously the servo valve SVR' is pulled towards the right from the position shown in Fig. 10 so as to at first uncover the lower end of exhaust port 166' and thereby reduce the pressure in the annular control sleeve chamber 89', the exhaust of fluid through passage 165' then being greater than the fluid supplied through the ports 159' of the reducing valve PRV' due to the restriction caused by the port 158' of that valve. The pistons 87' then exert a force on the wobbler which overcomes the effect of the control sleeve piston 88' and the control sleeve is moved towards the right from the position of Fig. 10 towards the position of Fig. 11. Since the casing 131' for the servo valves is carried on and moves with the control sleeve 85', the casing 131' "follows" the servo valve SVR' to its right hand position (as in Fig. 11) and until the port 166' is again just slightly uncovered by the end of the servo valve and the exhaust of fluid through passage 165' is reduced to a slight discharge. The pressure in chamber 89' is then built up to the full value required to counter balance the effect of the pistons 87'. Since the servo valve SVR' is mechanically coupled to the flange 120 of the valve RV' the position of the valve member SVR' is determined by the angle through which the valve RV' is shifted, and this position of the member SVR' will determine the extent of the movement of the casing 131' as it "follows" the servo valve SVR' just far enough to cause the port 166' to be covered by the end of the valve member SVR'. The control sleeve 85', being rigidly connected to the casing 131', is thus arrested at any selected position corresponding to the angle through which the valve RV' is shifted. The wobbler is thus adjusted to whatever position is selected for the servo valve SVR', which may be anywhere between neutral and maximum stroke. Thus the direction of movement of the valve RV' from neutral determines the direction of flow of the fluid from the pump GP' and the distance the valve RV' is moved from neutral determines the volumetric output of the pump.

In Fig. 12 the reversing valve RV' is shown in its "forward" position, the servo valve SVF' then functioning to determine the volumetric output of the pump and the pistons 86' acting to move the wobbler clockwise from its "no-stroke" position to the position shown.

In Fig. 13 there is illustrated the positions of the parts and the condition of the circuit when the reversing valve RV' and the servo valves SVF' and SVR' are moved quickly from their "reverse" positions of Fig. 11 to their "neutral" or "no-stroke" positions of Fig. 10 and before the control sleeve 85' has had time to move to "neutral" in response thereto. The exhaust port 166' is, therefore, entirely closed, preventing even the slight leakage which normally passes therethrough when the parts have reached equilibrium. This condition causes an increase in the pressure of the control fluid in chamber 89' and also in the right hand end of the casing 156' of the pressure reducing valve PRV' with the result that this valve is shifted to the left as shown in Fig. 13 and permits increased flow of fluid through the ports 159'. This causes a fast movement of the wobbler to its neutral position and provides for a rapid deceleration of the associated motor FM'.

Fig. 14 illustrates a form of the invention embodying a modification of the servo control. In this form, a single servo valve SVX' is used. This valve is connected by a link 175' and pivot pins 176' and 177' to a flange 178' on the reversing valve RV'. The parts are arranged as shown so that with the wobbler and the reversing valve in their neutral positions, the link 175' is in a "dead center" position. Thus regardless of the direction of movement of the reversing valve from neutral, the servo valve SVX' moves towards the right and opens the exhaust or relief port 180'.

If the reversing valve is moved in a clockwise direction from the position shown in Fig. 14, control fluid passes from the port 110' through port 118' and passage 114' to cylinders 100' and actuates the pistons 86' so that the wobble plate turns in a clockwise direction from the position of Fig. 14. Movement of the control sleeve 85' then causes the valve casing 181' of the servo valve SVX' also to move towards the right, following the servo valve to the new position thereof. Correspondingly, if the reversing valve RV' is moved in a counterclockwise direction from the position of Fig. 14, control fluid from the port 110' passes through port 112' and passage 113' to the cylinders 101' and actuates the pistons 87' towards the right, thus swinging the wobbler in a counterclockwise direction from the position shown. This also causes the control sleeve 85' to move towards the right and to "follow" the servo valve to its new position.

Preferably the plate 106 which supports the reversing valve RV and the associated servo valves SVF and SVR, is mounted so that it may be adjusted on the casing 21 longitudinally of the axis of the casing so as to permit of slight adjustment of the servo valves with respect to the exhaust port 166. Although no particular means for this adjustment is shown, in practice the adjustment is obtained by enlarging or elongating the holes in 106 through which the clamping screws pass so that by loosening the screws the plate can be shifted to a slight extent.

I claim:

1. In a fluid pump or motor, in combination, a plurality of piston and cylinder devices, a shaft, a wobbler device pivoted with respect to the shaft and engaging the pistons, and means for controlling the angularity of the wobbler device comprising an annular member, one end of which forms a runway for a part of the wobbler device, movable from a neutral position, wherein the wobbler is held perpendicular to the shaft, to stroke positions wherein the wobbler is at another angle to the shaft, reversible means for moving the wobbler device out of its neutral position, means supporting said annular member for movement parallel to said shaft, means forming a control piston operable to move said member toward its neutral position, means for supplying fluid under pressure continuously to said piston to move said member toward its neuutral position, a servo control mechanism for controlling the pressure of the fluid acting on the control piston comprising a pair of servo valves and a casing for the servo valves carried on said member and movable therewith as a unit, a reversing valve for controlling said reversible means, and means connecting the servo valves to the reversing valve so that one servo valve operates in each direction of fluid output.

2. In a fluid pump or motor, in combination, a plurality of piston and cylinder devices, a shaft, a wobbler device pivoted with respect to the shaft and engaging the pistons, and means for controlling the angularity of the wobbler device comprising an annular member, one end of which forms a runway for a part of the wobbler device, movable from a neutral position, wherein the wobbler is held perpendicular to the shaft, to stroke positions wherein the wobbler is at another angle to the shaft, reversible means for moving the wobbler device out of its neutral position, means supporting said annular member for movement parallel to said shaft, means forming a control piston operable to move said member toward its neutral position, means for supplying fluid under pressure continuously to said piston to move said member toward its neutral position, and a servo control mechanism for controlling the pressure of the fluid acting on the control piston comprising a servo valve, a casing for said servo valve carried on said member and movable therewith as a unit, a reversing valve for controlling said reversible means, and means connecting the servo valve to the reversing valve so that the servo valve operates in each direction of fluid output.

3. In a fluid pump or motor, in combination, a plurality of piston and cylinder devices, a shaft, a pivoted wobbler device pivoted with respect to the shaft and engaging the pistons, and means for controlling the angularity of the wobbler device comprising a member, one end of which has portions engageable with the wobbler device on opposite sides of its pivot axis, movable from a neutral position, wherein the wobbler is held perpendicular to the shaft, to stroke positions wherein the wobbler is at another angle to the shaft, reversible means for moving the wobbler device out of its neutral position, means supporting said member for movement parallel to said shaft, means forming a piston operable to move said member toward its neutral position, means for supplying limited quantities of fluid under pressure continuously to said piston to move said member toward its neutral position, a servo control mechanism for controlling the exhaust of the fluid acting on the control piston comprising a pair of servo valves and a casing for the servo valves carried on said member and movable therewith as a unit, and a reversing valve for controlling said reversible means.

4. In a fluid pump or motor, in combination, a plurality of piston and cylinder devices, a shaft, a wobbler device pivoted with respect to the shaft and engaging the pistons, and means for controlling the angularity of the wobbler device comprising an annular member, one end of which forms a runway for a part of the wobbler device, movable from a neutral position, wherein the wobbler is held perpendicular to the shaft, to stroke positions wherein the wobbler is at another angle to the shaft, reversible means for moving the wobbler device out of its neutral position, means supporting said annular member for movement parallel to said shaft, means forming a control piston operable to move said member toward its neutral position, means for supplying fluid under pressure continuously to said piston to move said member toward its neutral position, a servo control mechanism for controlling the pressure of the fluid acting on the control piston comprising a pair of servo valves and a casing for the servo valves carried on said member and movable therewith as a unit, a rotary reversing valve, and means connecting the servo valves to opposite sides of the reversing valve.

5. In a fluid pump or motor, in combination, a plurality of piston and cylinder devices, a shaft, a wobbler device pivoted with respect to the shaft and engaging the pistons, and means for controlling the angularity of the wobbler device comprising an annular member, one end of which forms a runway for a part of the wobbler device, movable from a neutral position, wherein the wobbler is held perpendicular to the shaft, to stroke positions wherein the wobbler is at another angle to the shaft, reversible means for moving the wobbler device out of its neutral position,

means supporting said annular member for movement parallel to said shaft, means forming a control piston operable to move said member toward its neutral position, means for supplying fluid under pressure continuously to said piston to move said member toward its neutral position, and a servo control mechanism for controlling the pressure of the fluid acting on the control piston comprising a servo valve, a casing for said servo valve carried on said member and movable therewith as a unit, a rotary reversing valve, and means connecting the servo valve to a dead center position on the reversing valve.

6. In a wobbler type pump or motor, a fluid operated means for moving the wobbler out of its no-stroke position to forward and reverse stroke positions, a fluid operated device opposing the movement of the wobbler from its no-stroke position and movable from a no-stroke position wherein the device engages the wobbler on both sides of its pivot axis to stroke positions wherein it engages the wobbler on one side of its pivot or the other, and effective to determine the wobbler position for both forward and reverse stroke adjustment, means for supplying fluid under pressure to said fluid operated means and said device, a reversing valve movable in opposite directions from a neutral position for controlling the fluid supplied to said fluid operated means, a servo control valve for controlling the pressure of the fluid operating on said device and having a casing carried on said device, and a link connecting said servo valve to the reversing valve and in a dead center position when the reversing valve is in neutral.

7. In a wobbler type pump or motor, a fluid operated means for moving the wobbler out of its no-stroke position to forward and reverse stroke positions, a fluid operated device opposing the movement of the wobbler from its no-stroke position and movable from a no-stroke position wherein the device engages the wobbler on both sides of its pivot axis to stroke positions wherein it engages the wobbler on one side of its pivot or the other, and effective to determine the wobbler position for both forward and reverse stroke adjustment, means for supplying fluid under pressure to said fluid operated means and said device, a reversing valve movable in opposite directions from a neutral position for controlling the fluid supplied to said fluid operated means, and means for controlling the fluid acting on said device comprising a pair of servo valves, a casing for said valves movable with said device, a fluid supply passage to said device, and a relief passage for fluid acting on said device controlled by said servo valves and a pressure operable valve normally restricting the flow of fluid through said supply passage, and operable when the relief passage is closed to increase the pressure of fluid on said device.

8. In a wobbler type pump or motor, a fluid operated means for moving the wobbler out of its no-stroke position to forward and reverse stroke positions, a fluid operated device opposing the movement of the wobbler from its no-stroke position and movable from a no-stroke position, wherein the device engages the wobbler on both sides of its pivot axis, to stroke positions wherein it engages the wobbler on one side of its pivot or the other, and effective to determine the wobbler position for both forward and reverse stroke adjustment, means for supplying fluid under pressure to said fluid operated means and said device, a rotary reversing valve movable in opposite directions from a neutral position for controlling the fluid supplied to said fluid operated means, a servo control valve for controlling the pressure of the fluid operating on said device and having a casing carried on said device, and a link connecting said servo valve to the reversing valve and in a dead center position when the reversing valve is in neutral.

9. In a wobbler type pump or motor, a fluid operated means for moving the wobbler out of its no-stroke position to forward and reverse stroke positions, a fluid operated device opposing the movement of the wobbler from its no-stroke position and movable from a no-stroke position, wherein the device engages the wobbler on both sides of its pivot axis, to stroke positions wherein it engages the wobbler on one side of its pivot or the other, and effective to determine the wobbler position for both forward and reverse stroke adjustment, means for supplying fluid under pressure to said fluid operated means and said device, a rotary reversing valve movable in opposite directions from a neutral position for controlling the fluid supplied to said fluid operated means, and means for controlling the fluid acting on said device comprising a servo valve, a casing for said valve movable with said device, a supply fluid passage to said device, and a relief passage for fluid acting on said device controlled by said servo valve, and a pressure operable valve normally restricting the flow of fluid through said supply passage and operable when said relief passage is closed to increase the pressure of fluid on said device.

10. In a piston type pump or motor having an element with a neutral position and movable varying amounts to either side of neutral to determine the operation of the pump or motor, a fluid operated means for moving said element out of its neutral position to positions on either side of neutral, a fluid operated device opposing the movement of said element from its neutral position, means for supplying fluid under pressure to said fluid operated means and said device, a reversing valve movable from and to a neutral position for controlling the fluid supplied to said fluid operated means, a pair of servo control valves for controlling the pressure of the fluid operating on said device and having a casing carried on said device, and means connecting said servo valves to the reversing valve at points on opposite sides thereof when the reversing valve is in neutral.

11. In a piston type pump or motor having an element with a neutral position and movable varying amounts to either side of neutral to determine the operation of the pump or motor, a fluid operated means for moving said element out of its neutral position to positions on either side of neutral, a fluid operated device opposing the movement of said element from its neutral position, means for supplying fluid under pressure to said fluid operated means and said device, a reversing valve movable from and to a neutral position for controlling the fluid supplied to said fluid operated means, and means for controlling the fluid acting on said device comprising a pair of servo valves, a casing for said valves movable with said device, a supply fluid passage to said device, and a relief passage for fluid acting on said device controlled by said servo valves, and a pressure operable valve normally restricting the flow of fluid through said supply passage, and

operable when the relief passage is closed to increase the pressure of fluid on said device.

12. A motor driven multiple pump device comprising a first pump having a casing and a pump shaft extending outwardly from one end thereof, a driving member for the shaft rotatably supported at the end of the casing from which the shaft projects and having gear teeth on its periphery, a second pump associated with and driven by the extending portion of said shaft and having a casing secured to the casing of the first pump, said first pump casing having a downwardly extending portion forming a fluid reservoir, a motor positioned under said second pump and mounted on said downwardly extending casing portion and having a motor shaft extending thereinto, a pinion on said motor shaft meshing with an idler gear which also engages the gear teeth on said drive member, means in the downwardly extending portion of said casing forming a housing for said gearing and supporting a control fluid pump, a shaft extending from said pinion to drive said control fluid pump and a unitary fluid direction and volume control device for said first and second pumps mounted within the pump casings and embodying servo control means for determining pump displacement.

13. A motor driven multiple pump device comprising a first pump having a casing and a pump shaft extending outwardly from one end thereof, a driving member for the shaft rotatably supported at the end of the casing from which the shaft projects, a second pump associated with and driven by the extending portion of said shaft and having a casing secured to the casing of the first pump, said first pump casing having a downwardly extending portion forming a fluid reservoir, a motor positioned under said second pump and mounted on said downwardly extending casing portion and having a motor shaft extending thereinto, means connecting said motor shaft drivingly to said drive member, a control fluid pump in the downwardly extending portion of said casing, means connecting said motor shaft drivingly to said control fluid pump and a fluid direction and volume control means for said first and second pumps mounted within the pump casings and utilizing fluid from said control fluid pump.

14. A motor driven multiple pump device comprising a first piston type pump having a casing, a second piston type pump having a casing secured to the casing of the first pump, said first pump casing having a downwardly extending portion forming a fluid reservoir, a motor mounted on said downwardly extending casing portion and having a shaft extending thereinto, means for driving said pumps from said motor shaft, and a unitary fluid direction and volume control device for each pump mounted within the pump casing and embodying servo control means for determining pump displacement.

15. In combination with a reversible flow pump having a pair of pump ports, a by-pass port connecting said pump ports, a valve closing one end of said by-pass port and extending through the adjacent pump port, a spring urging said valve to seated position, and a differential piston means on the portion of said valve in said pump port having a net effective area subject to the fluid passing out of said pump port equal substantially to the area of said valve subjected to the fluid in said by-pass port and faced in the same direction as said area and against the action of said spring.

16. In combination with a reversible flow pump having a pair of pump ports, a by-pass port connecting said pump ports, a valve closing one end of said by-pass port and extending through the adjacent pump port, a spring urging said valve to seated position, and a differential piston means on the portion of said valve in said pump port having a net effective area subject to the fluid passing out of said pump port equal substantially to the area of said valve subjected to the fluid in said by-pass port.

17. In a wobbler type pump or motor, in combination, a tubular casing formed with an internal shoulder, a cylinder block having a flange around one end positioned against said shoulder, a valve plate positioned against the flanged end of the cylinder block and cooperating therewith to form a cylindrical valve chamber, a gyratory wheel-like valve operable in said chamber, a cap member positioned within the casing and against said valve plate, a ring member screw threaded into the casing and overlying an annular portion along the outer edge of said cap member, and a plurality of screw devices spaced annularly around and extending in threaded engagement through said ring member and into engagement with said cap member to clamp the cap member, valve plate and cylinder block together and the cylinder block against said shoulder.

18. In a wobbler type pump or motor, in combination, a tubular casing formed with an internal shoulder, a cylinder block having a flange around one end positioned against said shoulder, a valve plate positioned against the flanged end of the cylinder block and cooperating therewith to form a valve chamber, a valve operable in said chamber, a cap member positioned within the casing and against said valve plate, a ring member screw threaded into the casing and overlying an annular portion along the outer edge of said cap member, and a plurality of screw devices spaced annularly around and extending in threaded engagement through said ring member and into engagement with said cap member to clamp the cap member, valve plate and cylinder block together and the cylinder block against said shoulder.

19. In a device of the character described, a casing comprising a cylinder block having a plurality of annularly arranged parallel cylinders formed therein and a port opening through one face of the block to each of the cylinders, said ports being annularly arranged, a plate having fluid supply and exhaust passages formed therein, an annular flange on said cylinder block cooperating with the face of the block and said plate to form a cylindrical valve chamber, one of said passages communicating with said valve chamber inwardly of said ports and radially outwardly of the center of the chamber, and the other of said passages communicating with said chamber adjacent the periphery of the chamber, a wheel-like valve comprising a rim, a hub and connecting spokes, said rim and hub each having a fluid-tight sliding fit in said valve chamber with both said cylinder block and said plate, said hub and rim providing said valve with a fluid tight seal at its inner periphery as well as at its outer periphery, means for imparting to said valve an eccentric motion whereby the valve successively connects the ports alternately to the supply and exhaust passages, means for clamping said plate and cylinder block flange together and means forming a chamber adjacent said plate on the side opposite said valve chamber and in

communication with the passage leading from the valve chamber inwardly of said ports, thus subjecting the outer face of said plate to the pressure of the fluid in said chamber and maintaining the plate in efficient sealing contact with the valve.

20. In a device of the character described, a casing comprising a cylinder block having a plurality of annularly arranged parallel cylinders formed therein and a port opening through one face of the block to each of the cylinders, said ports being annularly arranged, a plate having fluid supply and exhaust passages formed therein and means forming an annular spacer interposed between said plate and the face of the block cooperating therewith to form a cylindrical valve chamber, one of said passages communicating with said valve chamber inwardly of said ports and radially outwardly of the center of the chamber, and the other of said passages communicating with said chamber adjacent the periphery of the chamber, a wheel-like valve in said valve chamber, means for imparting to said valve an eccentric motion whereby the valve successively connects the ports alternately to the supply and exhaust passages, and means forming a chamber adjacent said plate on the side, opposite said valve chamber and in communication with the passage from the inner portion of the valve chamber so as to subject the outer face of said plate to the pressure of the fluid in said chamber and maintain the plate in efficient sealing contact with the valve.

21. In a piston type fluid device operable as a pump or as a motor and having an element determinative by its position of the direction and rate of discharge of fluid when the device is operating as a pump and the direction and rate of operation when operating as a motor, a first fluid pressure actuated means for moving said element in opposite directions from a neutral position, a member movable in one direction from a neutral position and operable to control the position of said element on both sides of its neutral position, a second fluid pressure actuated means operable to move said member toward its neutral position, means for supplying fluid under pressure to said first fluid pressure actuated means and continuously supplying fluid to said second fluid pressure actuated means to urge said member toward its neutral position including means forming a port movable with said member, mechanism for controlling the pressure of the fluid acting on said second fluid pressure actuated means including a servo valve positioned to control said port, a reversing valve for controlling the supply of fluid to said first fluid pressure actuated means, and means connecting said servo valve to operate with said reversing valve.

22. In a piston type fluid device, operable as a pump or as a motor, and having an element determinative by its position of the direction and rate of discharge of fluid when the device is operating as a pump and the direction and rate of operation when operating as a motor, a first fluid pressure actuated means for moving said element in opposite directions from a neutral position, a member movable in one direction from a neutral position and operable to control the position of said element on both sides of its neutral position, a second fluid pressure actuated means operable to move said member toward its neutral position, means for supplying fluid under pressure to said first fluid pressure actuated means and continuously supplying fluid to said second fluid pressure actuated means to urge said member toward its neutral position, a rotary reversing valve movable from and to a neutral position for controlling the fluid supplied to said first fluid pressure actuated means, a pair of servo control valves for controlling the pressure of the fluid operating on said second fluid pressure actuated means and having a casing movable with said member, and means connecting said servo valves to the reversing valve at points on opposite sides thereof when the reversing valve is in neutral so as to move in opposite directions as said reversing valve is moved in either direction from neutral.

23. In a piston type fluid device operable as a pump or as a motor and having an element determinative by its position of the direction and rate of discharge of fluid when the device is operating as a pump and the direction and rate of operation when operating as a motor, a first fluid pressure actuated means for moving said element in opposite directions from a neutral position, a member movable in one direction from a neutral position and operable to control the position of said element on both sides of its neutral position, a second fluid pressure actuated means operable to move said member toward its neutral position, means for supplying fluid under pressure to said first fluid pressure actuated means and continuously supplying fluid to said second fluid pressure actuated means to urge said member toward its neutral position including means forming a fluid supply passage and a discharge port, the latter being movable with said member, a reversing valve for controlling the supply of fluid to said first fluid pressure actuated means, and mechanism for controlling the pressure of the fluid acting on said second fluid pressure actuated means including a valve positioned to control said port and connected to operate with said reversing valve to determine the extent of movement of said element in the direction determined by said reversing valve, and a pressure operable valve normally restricting the flow of fluid through said supply passage and operable when said port is closed to increase the pressure of the fluid supplied to said second fluid pressure actuated means.

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