

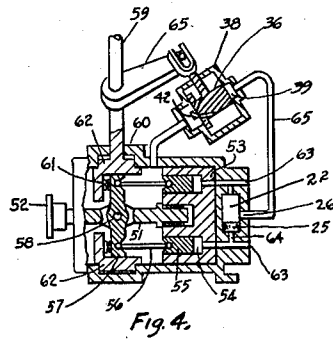
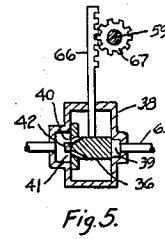
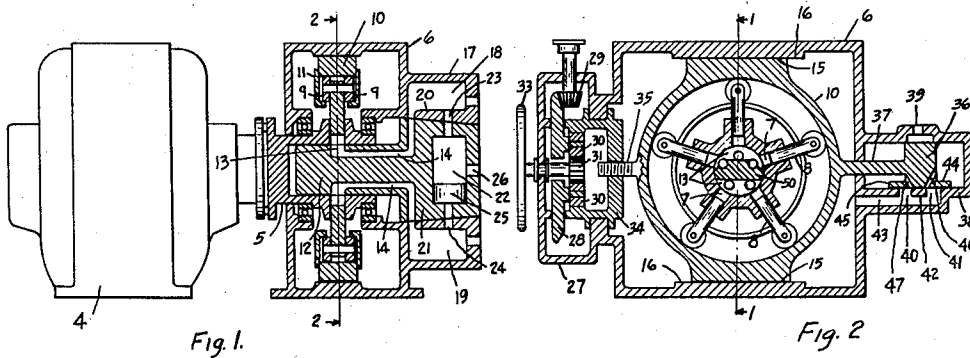
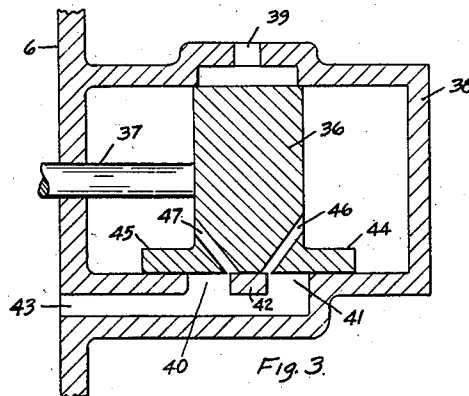
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CONTROL OF FLUID PRESSURE DEVICES

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CONTROL OF FLUID PRESSURE DEVICES

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This invention relates to means for and a method of controlling the working of fluid pressure devices.

The objects of this invention are:

5 To provide, in a fluid pressure device having movable mechanisms to control the effective working capacity thereof, means to assist the control mechanism by utilizing the pressure exerted in the device;

10 To provide, in a device of the kind and for the purpose set forth, means to aid in moving the controls thereof;

15 To provide, in a device of the kind and for the purpose specified, a compact assembly wherein the control actuating means and the pressure device itself are enclosed in a common housing structure.

In the drawing:

20 Fig. 1 is a longitudinal section of one such pressure device taken on the line 1—1, Fig. 2;

Fig. 2 is a section at right angles to Fig. 1 on the line 2—2, Fig. 1;

25 Fig. 3 is an enlarged detail of a piston used in applying pressure in the device to aid in moving the controls thereof;

Figs. 4 and 5 show two methods of applying my invention to pumps of the rotary control type.

I have shown, in the drawing, my invention specifically applied to a variable delivery pump with radial pistons, and to a variable delivery pump with axial pistons, but it is applicable in general to all fluid pressure devices having means to vary the effective working capacity thereof, which means must be operated against the pressure in the device acting on the parts thereof affected by the control mechanism.

A constant speed prime mover, represented by the motor 4, is connected to drive a member 5 rotatably mounted in a main housing 6 that constitutes a portion of the enclosing structure for the mechanism. A plurality of radially extending cylinders 7 are formed in member 5 with their axes lying in a common plane at right angles to the axis of member 5 and in each cylinder a piston 8 is slidably disposed. A pair of rollers 9 is rotatably mounted on each piston at the outer end thereof, which rollers bear against the face of a track 10 and are constrained to follow a race defined by members 11 that lie against the rollers 9 on their radially inner sides. Disposed within the member 5 and coaxial therewith is a fixed member 12 having cut away portions 13 forming ports that are separated by a wall 50, each of which is in communication with a duct 14. The track member 10 has plane surfaces 15 formed thereon to slide upon plane surfaces 16 in housing 6 to guide the member 10 when shifted parallel to the axial plane of pistons 8. As is well known, when the member 10 is concentric with member 5 rotation of the last-named member produces no

effect upon the pistons, but when the member 10 is moved to a position that is eccentric with respect to member 5 the pistons 8 are caused to move inwardly during one half a rotation and outwardly during the other half thereof, fluid being taken into the cylinders from the port 13 that is in communication with the outwardly moving pistons and then discharged under pressure into the port that communicates with the inwardly moving pistons.

It is apparent that when the member 10 is in the concentric, or neutral, position very little effort is required to shift it, but as soon as it is notably displaced from such neutral position the inwardly moving pistons apply pressure to the fluid and react against the member 10 in a direction opposite the displacing movement. One phase of my invention relates to applying the pressure within the pump to aid in moving the member 10 against this reaction, which is accomplished by the mechanism now to be described. Fixed to main housing 6, either integrally or by suitable fastenings, is an auxiliary housing 17 having in its spaces 18 and 19 in communication with ducts 14 and 14', respectively, and having also an inturned portion 20 fitted upon an enlarged extension 21 of the fixed member 12, within which enlarged extension is a cylinder 22 communicating with the spaces 18 and 19 by ports 23 and 24, respectively. A shuttle valve 25 slidable in cylinder 22 is moved by the pressure of fluid entering the cylinder through either of the ports 23 or 24 in such direction that the fluid always passes out through port 26.

In an auxiliary housing 27, likewise carried by main housing 6, is disposed a bevel gear 28 having teeth engageable with a pinion 29 that is part of a follow-up system such as is well known in the art in the control of steering gear, gun turrets, hydraulic presses, etc. Two pinions 30 are rotatably mounted upon gear 28 adjacent the center thereof in diametrically opposite positions to engage a gear 31 on shaft 32 that carries hand wheel 33 and also in mesh with internal gear teeth of a rotatable member 34, which has in one portion an aperture provided with threads to engage the threaded shank 35 fixed to member 10, the aforesaid several gears constituting a differential gear mechanism. It is apparent that rotation of wheel 33 will be transmitted, through the intervening gears, through member 34 to slide member 10 in housing 6 when pinion 29 is held stationary and that when pinion 29 is rotated by the follow-up system the rotation of member 34 will be the algebraic sum of the movements of hand wheel 33 and pinion 39.

As soon as member 10 has been shifted off center by means of hand wheel 33 and the co-operating gear, stroke is put on the pistons 8 and further movement of member 10 must be

effected against the reaction of pistons 8 on member 10. To avoid placing the entire effort of thus moving the member 10 upon hand wheel 33, I have provided the piston 36 connected to member 10 by a connecting rod 37 and operably mounted in cylinder 38 carried by housing 6. In the wall of cylinder 38 is provided a port 39 that is connected, by means of a suitable pipe, to port 26, the inner mouth of port 39 being slightly less than the length of piston 36 and so disposed that when member 10 is concentric with member 5 the mouth of port 39 is closed by piston 36. To outlet ports 40 and 41, separated by a cylinder wall element 42, are provided in another part of the wall of cylinder 38 and are in communication with the interior of housing 6 by a duct 43. The lateral face of piston 36, adjacent ports 40 and 41, is provided with elongations 44 and 45, and ducts 46 and 47 are formed from the end faces of piston 36 to that part of the lateral face of the piston adjacent ports 40 and 41, the distance between the respective outermost walls of these ducts where they open on the side of the piston being somewhat greater than the width of element 42, whereby, when the piston 36 is in the neutral position, each end of the cylinder 38 is in communication with duct 43, but as soon as displaced from such neutral, or mid-position, the duct communicating with that end of cylinder 38 from which the piston is moving is closed by element 42, while the duct on the other side of the piston remains open into its respective port 40 or 41. It is easily seen that when the member 10 is in neutral position and there is no stroke on the pump, the port 39 will be closed by piston 36 and both ends of the cylinder 38 are in communication with duct 43, but when the member 10 is displaced from such neutral position and stroke is put on the pump, the piston 36 will be moved to open port 39 to admit fluid under pressure from the pump to cylinder 38 to act upon piston 36 in a direction that will aid in moving the member 10 against the reaction of the pump, regardless of the direction of such displacement and that at the time of opening of valve 39 the duct on that side of the piston 36 to which pressure will be applied is closed by element 42. The piston 36 need not be connected directly to the member 10 as shown but may be connected to act through the member 34, either including or excluding the rest of the differential gear mechanism.

Figs. 4 and 5 show two methods of applying the principle of my invention to a variable delivery pump of the axial piston type. In the former figure the shaft 51 is connectible at 52 to a prime mover and has fixed to its other end to rotate therewith a member 53 wherein are formed cylinders 54, the pistons 55 in cylinders 54 being connected by piston rods 56 to a member 57 that is pivoted at 58 to shaft 51. The control spindle 59, which is connected to manual control means and follow-up mechanism in a manner common in this art, extends through pump housing 60 and is connected inside the housing to a member 61 that rotates with spindle 59 about the axis of the spindle, being held in operative position by gudgeons 62. When spindle 59 is rotated the member 61 is caused to assume a position at an angle to shaft 51 which constrains the pistons 55 to move into cylinders 54 during one half of each revolution and to move outwardly during the other half thereof. The fluid, usually oil, that is utilized to transmit the pressure developed in the

pump passes into the pump and out therefrom through ducts 63.

In communication with ducts 63 by ports 64 is a cylinder 22 in which is a shuttle valve 25 to cause the fluid always to flow from cylinder 22 through port 26 to which is connected a pipe 65 that transmits pressure to a cylinder 38 to act upon a piston 36, the parts of this piston and cylinder being in all respects the same as in the case of the like numbered elements in Figs. 1 and 2 and having the same mode of operation. The piston 38 in Fig. 4 is connected to actuate a lever 65 connected to control spindle 59 and thereby aid in displacing member 61 to vary the stroke of pistons 55.

Fig. 5 illustrates the connection of assistor piston 36 to control spindle 59 by means of a rack 66 connected to piston 36 and meshed with a pinion 67 on the spindle. It appears that the operation of this modification is obvious from the foregoing explanation.

It is thus apparent that I have provided a means for utilizing the pressure exerted in the fluid pressure device to aid in varying the effective working capacity thereof and that by building all the mechanism into a single enclosing structure I have greatly simplified the construction, eliminated a number of mechanical connections, and effected considerable economy of space necessary to accommodate the mechanism.

It is to be understood that the drawings forming a part of this specification are illustrative only and not limiting, since the principle herein disclosed may be applied to other types of mechanisms than the variable delivery pumps specifically shown.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. The combination with a fluid pressure device having a cylinder, a piston therein, and movable means acting on said piston to vary the stroke thereof in said cylinder, of manually actuatable means for operating said movable means, and mechanism actuatable by fluid subjected to the pressure exerted in said cylinder connected to operate said movable means, said mechanism including an element having a neutral position wherein it prevents access of fluid under pressure to said mechanism, said element being mechanically connected to said manually actuatable means to be moved by operation of said manually actuatable means to admit fluid to said mechanism in a direction to aid in the operation of said movable means.

2. The combination with a fluid pressure device having a cylinder, a piston therein, and movable means acting on said piston to vary the stroke thereof in said cylinder, of control means for operating said movable means, and mechanism operatively associated with said movable means having parts acted upon by fluid subjected to the pressure exerted in said cylinder, one of said parts being settable to prevent the passage of fluid into said mechanism and having a mechanical connection to said control means whereby actuation of the control moves said one part to a position to admit fluid to exert on said movable means a force in opposition to that exerted by said piston upon said movable means.

3. The combination with a fluid pressure device having a rotatable member wherein are formed a plurality of cylinders, pistons operable

in said cylinders, and movable means adjustable with respect to said cylinders to effect movement of said pistons in said cylinders during rotation of said member and to vary the stroke of said pistons, of manually actuatable means for operating said movable means, and mechanism actuatable by fluid subjected to the pressure exerted in said cylinders connected to operate said movable means, said mechanism including an element having a position at which it prevents passage of fluid into said mechanism, said element being mechanically connected to the manually actuatable means to be moved by operation of the manually actuatable means to a position to admit fluid into said mechanism to exert a force to aid said manual means to operate said movable means.

4. The combination with a fluid pressure device having a rotatable member wherein are formed a plurality of cylinders, pistons operable in said cylinders, and movable means adjustable with respect to said cylinders to effect movement of said pistons in said cylinders during rotation of said member and to vary the stroke of said pistons, of control means to actuate said movable means, and mechanism operatively associated with said movable means having parts acted upon by fluid subjected to pressure exerted in said cylinders, one of said parts having in it a passage to admit fluid under pressure thereto and a second part within the first part movable to close said passage, said second part being connected to said movable means and also mechanically connected to the control means whereby actuation of the control means moves said second part to the passage closing position or away therefrom to apply to said movable means a force in opposition to that exerted by said pistons upon said movable means.

5. The combination with a piston pump having movable means to vary the piston stroke, and manually operable means to actuate said movable means, of a piston operatively connected to said movable means, and means controlled by actuation of said manually operated means to admit fluid under pressure to act on said piston, said piston being mechanically connected to the manually operable means to be moved by actuation of said manually operable means to admit fluid as aforesaid, or to prevent admission of said fluid, the admission of fluid being always in a direction to aid in moving said movable means to increase the piston stroke.

6. The combination with a piston pump having movable means to vary the piston stroke, and control means to actuate said movable means, of a piston connected to said movable means to move therewith, and a cylinder in which said piston is slidable, said cylinder having an intake port and outlet ports connectible to said pump to subject said piston to the pressure produced by said pump, said ports being so disposed that the intake port is closed by said piston when said piston is in mid-position in said cylinder but is open when said piston is somewhat displaced from said mid-position through moving with said movable means in response to manipulation of said control means, the outlet ports being partially open when said piston is in said mid-position but otherwise respectively covered to close the outlet from the pressure end of said cylinder and uncovered to open the outlet from the other end of said cylinder, such opening of the ports effecting appli-

cation of the pump pressure to said piston in a sense to aid manipulation of said control means.

7. The combination with a piston pump having movable means to vary the piston stroke, and manually operable means to actuate said movable means, of a piston operatively connected to said movable means, a portion of the lateral face of said piston being longitudinally extended, and there being a duct extending from each end face of said piston through the aforesaid portion of the lateral face, a cylinder in which said piston is slidable, said cylinder having a port with its inner mouth of somewhat less width than the length of said piston and a pair of ports disposed to be covered by the piston and said extended portion, the ports of said pair being separated by a cylinder wall element of somewhat less width than the distance between the outermost walls of said ducts at their outer ends, the said wall element being opposite the first mentioned port.

8. The combination with a piston pump having movable means to vary the piston stroke, and manually operable means to actuate said movable means, of a piston operatively connected to said movable means, a portion of the lateral face of said piston being longitudinally extended, said piston having ducts to permit leakage from both ends of the cylinder when the piston is in mid-position in the cylinder and from that end of the cylinder nearest the piston when the piston is not in the mid-position, said cylinder having a port with its inner mouth of somewhat less width than the length of said piston and a pair of ports disposed to be coverable by the piston and said extended portion, the ports of said pair being separated by a cylinder wall element somewhat less in width than the distance between the outermost walls of said ducts at their outer ends, the said wall element being opposite the first said port and disposed to cover the outer end of the duct opening into the end of said cylinder from which the piston is more remote when the piston is not in said mid-position.

9. In combination, an enclosing structure, within said structure a variable delivery pump having movable means to vary the power output of said pump, control means in said structure to actuate said movable means, and means responsive to the operation of said control means to apply the pressure in said pump to shift said movable means in the same sense as said control means acts thereon, said responsive means including an element mechanically connected to the control means and movable thereby to prevent the action of the pressure upon said responsive means.

10. In a fluid pressure device, a piston having a portion of its lateral face longitudinally extended, and a duct extending from each end face thereof through the aforesaid portion of the lateral face, a cylinder in which said piston is slidable, said cylinder having a port with its inner mouth of somewhat less width than the length of said piston and a pair of ports disposed to be covered by the piston and said extended portion, the ports of said pair being separated by a cylinder wall element of somewhat less width than the distance between the outermost portion of the walls of said ducts at their outer ends, the said wall element being opposite the first mentioned port.

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