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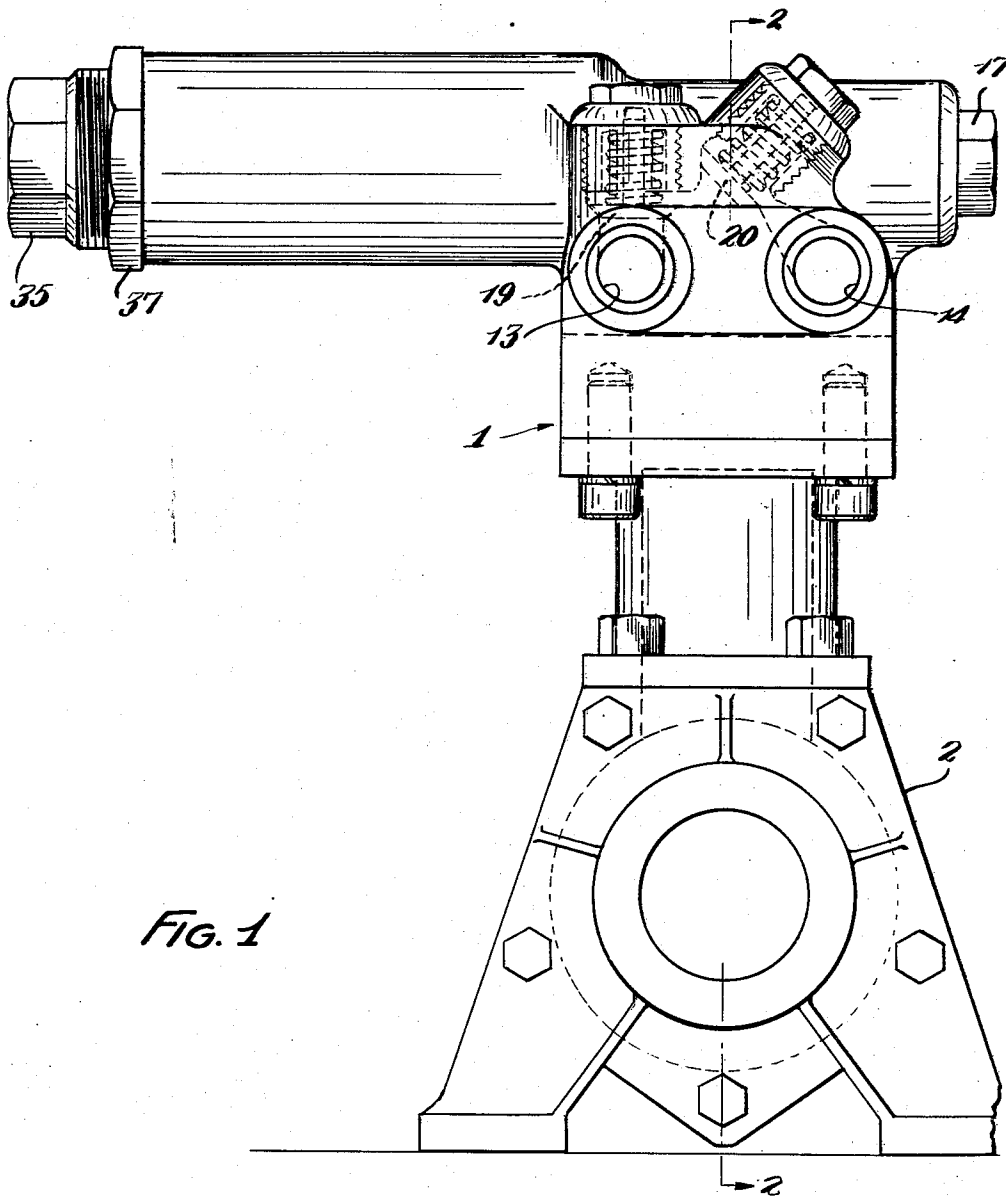
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2,683,417

AUTOMATIC IDLING HYDRAULIC PUMP

Filed March 21, 1951

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

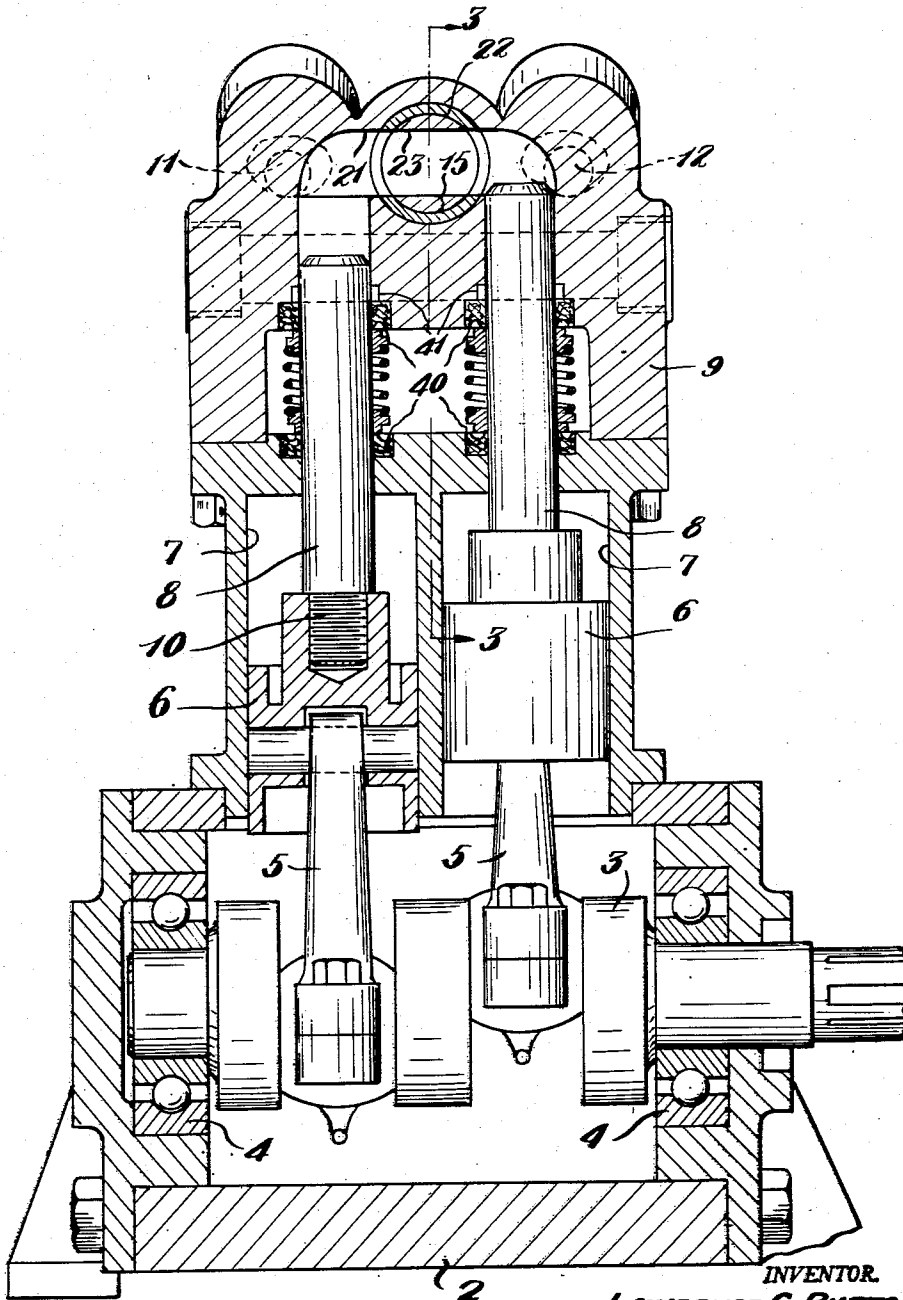


FIG. 2

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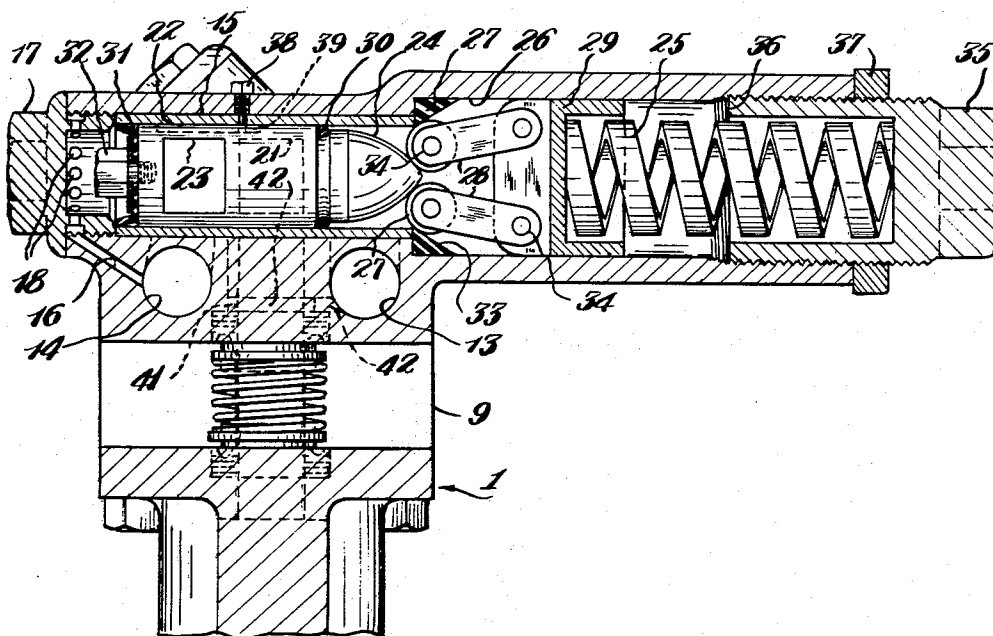


FIG. 3

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AUTOMATIC IDLING HYDRAULIC PUMP

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13 Claims. (Cl. 103—37)

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This invention relates to pumps, especially to a hydraulic pump that is adapted to change, automatically, its operating conditions from delivering output liquid over to an idling condition wherein liquid is recirculated through the pump when a predetermined output pressure is established.

Many, many types of pumps have been designed and manufactured heretofore but none of such pumps, to my knowledge, have provided an effective, efficient, low cost construction which would enable the pump to shut off its output function automatically when an idling condition is required in the pump to maintain a pressure in the pump circuit without delivering any appreciable amount of liquid from the pump. Furthermore, pumps of this type have not had an easily adjusted output pressure at which a predetermined change in operation of the pump would be established. Previous pumps of this general type may have been complicated in construction, or else they have been open to other disadvantages and objections.

The general object of the present invention is to provide an efficient idling fluid pump which is characterized by its ability to change its operation rapidly and smoothly from a pumping to an idling condition.

Another object of the invention is to provide a hydraulic pump with an automatic slide or release plunger for cutting off the pump output and causing a recirculation of liquid through the pump when a predetermined output pressure is reached in the pump circuit.

A further object of the invention is to provide an adjustable pressure control in a hydraulic pump whereby the output pressure of the pump can readily be varied from a point externally of the pump.

Another object of the invention is to provide a reciprocable slide plunger for changing a pump from a conventional output connection over to an idling or recirculation condition for liquid in the pump.

Another object of the invention is to provide a control for a slide plunger in a hydraulic pump whereby the plunger is maintained in one position until a desired output pressure is established after which the plunger will automatically and rapidly move to provide an idling circuit in the pump for passing liquids back and forth between a pair of pumping chambers or cylinders in the pump.

Still another object of the invention is to provide a hydraulic pump that has an operating

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cylinder or chamber physically separating the crankcase from the pressure chamber of the pump, and wherein a slide is provided in the operating cylinder for driving a piston which extends into the pressure chamber.

A further object of the invention is to provide special idling means for a pump which can be used with a conventional pump, or with a pump having substantially tandem piston means as disclosed herein.

The foregoing and other objects and advantages of the invention will be made more apparent as the specification proceeds.

For a better understanding of the present invention, attention is directed to the accompanying drawings wherein one presently best known embodiment of my invention is illustrated and wherein:

Fig. 1 is an elevation of a pump of the invention;

Fig. 2 is a vertical section taken on line 2—2 of Fig. 1; and

Fig. 3 is a fragmentary vertical section taken on line 3—3 of Fig. 2.

In the following specification and the accompanying drawings, corresponding reference numerals are used to refer to corresponding parts to facilitate reference between the drawings and the specification to identify such parts.

In order to understand the invention more thoroughly, reference should be had to the details of the structure shown in the drawings, and a hydraulic pump is indicated in general by the numeral 1. This pump 1 has associated therewith a crankcase 2 in which a crankshaft 3 is journaled by means of bearings 4. The crankshaft 3 protrudes from the crankcase 2 and is engaged with a driving unit by suitable means (not shown). Connecting rods 5 are suitably engaged with a crankshaft 3 and extend therefrom to engage pivotally with individual slides 6 one of which connects to each of the connecting rods. These slides 6 are reciprocally positioned in individual cylinders 7.

As one important feature of the present invention, each of the slides 6 has an elongate plunger or piston 8 suitably secured thereto and protruding an appreciable distance axially therefrom. The plungers, or pistons 8 extend into a pump head, housing, or casing 9 which casing or head normally is separate from and, in all events, is spaced from the cylinder 7 and not connected thereto whereby a physical separation between the pump head and the remainder of the pump is provided. Usually the ends of the plungers 8 are

threaded as indicated at 10 and engage with tapped sockets provided in the slides 6. The pump head normally has a pair of pump cylinders, or pressure chambers 11 and 12 formed therein. The pump head 9 may be provided with an inlet bore 13 that extends therethrough and with a parallel outlet bore 14 likewise extending therethrough. The pressure chambers 11 and 12 connect to the inlet and outlet bores or ports through suitable valve means to be described hereinafter in more detail. Any desired means (not shown) may connect to the inlet and outlet bores 13 and 14 for providing for flow of liquid to and from the pump 1. Usually one end of each of the inlets and outlets is closed by suitable plug means.

As one feature of the pump of the invention, a slide bore 15 is provided in the upper portion of the head 9, Fig. 3, and one or more ports 16 connect the outlet bore 14 to one end of the slide bore 15. This end of the slide bore, having a port 16 connected thereto, may be provided with a closure plug 17 that engages with a tapped end of the slide bore 15 with the plug 17 being provided with a hollow end portion which has apertures 18 therein. One or more apertures 18 is always engaged with the port or ports 16 whereby any liquid in the outlet bore 14 will always be in direct connection with the end of the slide bore 15 having the plug 17 therein.

The pump 1 usually is provided with suitable inlet and outlet valves of conventional type and such means are shown more in detail in my co-pending application, Serial No. 177,709, of August 4, 1950 now abandoned, upon a somewhat similar pump to that disclosed herein.

Such control valve means may include an inlet valve 19 positioned intermediate each of the pressure chambers 11 and 12 and the inlet 13, and an outlet valve 20 positioned intermediate each of the pressure chambers 11 and 12 and the outlet bore 14 with such valves having conventional means associated therewith urging them into desired sealing relationship with the valve seats provided theretofore. The valves are of course automatically moved from and into engagement with their associated valve seats with movement of the pistons 8 provided in the pump.

Fig. 2 of the drawing best shows that a relief port, or by-pass bore 21 is provided in the housing 9 and connects between the pressure chambers 11 and 12 with such relief port 21 connecting to the slide bore 15 substantially normally with relation thereto. A slide plunger 22 is slidably received in the bore 15 and is movable longitudinally thereof to bring a by-pass port 23 provided therein and extending transversely thereof into and out of register with the relief port 21 provided in the housing 9. Preferably the slide plunger 22 is provided with an end piece 24 that is usually threadedly engaged therewith and which may be formed from hardened steel and which has a generally conical shaped portion protruding from the slide plunger.

In order to provide a resilient and adjustable pressure bearing on the end piece 24 for urging the plunger 22 toward a position in the slide bore 15 at which the relief port 21 is shut off by means of the body portion of the slide plunger 22, a coil spring 25, or equivalent member, is positioned in a counterbored portion 26 of the slide bore 15. The coil spring 25 has suitable means associated with the inner end thereof for transmitting the pressure setup thereby to the end piece 24 and such means normally comprise a pair of hardened

steel rollers 27 which have links 28 suitably and pivotally engaged therewith, and the other ends of the links 28 pivotally engage a slide block 29 that engages the inner end of the coil spring 25. The slide block 29 has a tubular section in which the end of the spring 25 is received, and the block 29 is slidably and snugly positioned in the counterbored portion 26 of the slide bore 15. The plunger 22 is provided with a groove which receives an O ring 30 and will function as a gasket or sealing member for one end of the slide plunger 22 in the bore in which it is positioned. The opposite end of the slide plunger is sealed in the bore 15 by means of a cup gasket or ring 31 suitably engaged therewith as by a cap screw 32 or similar device whereby the center portion of the slide plunger is sealed with relation to the end portions thereof and flow of liquid past the ends of the slide plunger is prevented, as is entrance of liquid into the counterbore 26 of the slide bore 15.

Fig. 3 of the drawings shows the slide plunger 22 when it is positioned in its sealing relationship to the relief port 21 and wherein the links 28 extend substantially longitudinally of the slide plunger 22. Thus the rollers 27 are, in effect, almost at their dead center positions with relation to the tapered surface of the end piece 24 so that the rollers 27 and the support links 28 provided therefore define a line that extends substantially normally from the surface of the end piece that the rollers contact. A cup ring 33, or similar means which is triangularly shaped in section smoothly connects the counterbored portion 26 to the remainder of the slide bore 15 to facilitate smooth rolling motion of the rollers 27 with axial movement of the coil springs 25 on compression or expansion thereof. The action of the slide plunger 22 is such that when pressure exerted upon the end of the slide plunger 22 carrying the gasket 31 by the outlet pressure of the pump 1 is sufficiently great to overcome the pressure exerted on the opposite end of the slide plunger 22 by the coil spring 25 and associated means, then the slide plunger will be forced or moved very rapidly from the position shown in solid lines in Fig. 3 over to a position with the spring 25 compressed, and the by-pass port 23 in register with the by-pass bore 21. That is, as soon as axial movement of the slide plunger is started, the relationship of the rollers 27 and links 28 to the surface of the end piece 24 is changed so that the resistance provided to continued axial movement of the slide plunger is appreciably reduced due to the outward movement of the rollers 27 permitted by compression of the coil spring 25 and the resultant changing of angular relation of the links 28 to the surface of the end piece 24 contacted by the rollers 27. Use of the rollers and the construction shown provides a low friction control means for the slide plunger 22. Usually a pair of links 28 is provided to position each of the rollers 27 by engaging with opposite sides thereof by support pins 34.

In order to permit ready adjustment or control of the output pressure of the pump 1, a control plug 35 is shown engaged with a tapped zone 36 provided in the counterbored portion 26 of the slide bore so that this control plug can be adjusted axially of the slide bore 15 and control the force set up by the coil spring 25 when the slide plunger 22 is in its sealing position, as indicated in Fig. 3. A lock nut 37 may also be engaged with the control plug 35 and bear on the

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end of housing 9 for retaining the control plug in a given position.

Any conventional means, such as a set screw 38 may engage the housing 9 and protrude into the bore 15 to engage a longitudinally extending recess 39 in the plunger 22 to prevent rotary movement of the plunger 22.

It will be appreciated that the pump of the invention may have any desired number of pressure chambers provided therein. However, normally such pressure chambers must be provided in pairs so that liquid in the pump can be circulated back and forth between adjacent pairs of pressure chambers when the pump is to have an idling operation after a predetermined outlet pressure has been established in the outlet line provided for the pump and no fluid is being used in the circuit connected to the pump. Of course, the spring 25 will force the slide plunger back to its sealing position as soon as the pressure in the output circuit connected to the pump drops below the effective spring pressure and the spring 25 can return the slide plunger 22 to its sealing position.

It may be desirable to use the pump of the invention for pumping gases in some instances. The ring 33 may be made from any suitable material.

Oil retainers or seals 40, Fig. 2, are provided and they engage the plungers 8 snugly to prevent oil or the liquid being pumped from leaking around the plungers. To relieve any pressure on the oil seals 40, a counterbore 41 is provided around the inner end of the seals 40 positioned in the casing head 9 for the accumulation of oil which may seep between the plungers 8 and the casing head 9. Port 42 connects the counterbore 41 to inlet bore 13 to pass liquid therebetween and create a vacuum rather than a pressure on the oil seals 40.

In view of the foregoing, it is submitted that a sturdy, low cost, efficient pump has been provided which takes the load off the motor driving the pump when the desired output pressure is established and no output is being taken from the pump. This pump has an effective automatic member therein for changing the pumping circuit from output to idling conditions when the desired output pressure is created in the circuit connected to the pump and no energy is being taken therefrom, so that it is submitted that the objects of the invention have been achieved.

While one complete embodiment of the invention has been disclosed herein, it will be appreciated that modification of this particular embodiment of the invention may be resorted to without departing from the scope of the invention as defined by the appended claims.

Having thus described my invention, what I claim is:

1. A hydraulic pump comprising a pump housing having a pair of pressure chambers provided therein, inlet and outlet means for said pressure chambers, valve means for controlling flow of liquid to and from said pressure chambers, said housing also having a slide bore provided therein, a slide plunger having a by-pass port provided therein, a by-pass bore formed in said housing and connecting said chambers through said slide bore, said slide plunger being movable longitudinally of said slide bore to register said by-pass bore with said by-pass port, said housing having a bore therein to connect the outlets of said pressure chambers to said slide bore to apply the output pressure to one end of

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said slide plunger, a spring positioned in said slide bore, said slide plunger having a substantially conical end remote from that end to which said output pressure is applied, and roller means bearing on said tapered end and engaging at its other end said spring for resiliently urging said slide plunger to a position with said by-pass port out of register with said by-pass bore.

2. A pump as in claim 1 wherein a member is adjustably engaged with said housing and supports the end of said spring remote from said roller means for varying the position of said spring to control the pressure set up thereby.

3. A pump as in claim 1 wherein said roller means include a pair of rollers, a block engaging the end of said spring, and links pivotally connecting said rollers to said block, said rollers being engaged with opposite sides of said tapered end piece and said links being substantially normal to the surface of said end piece contacted by said rollers when said by-pass port and bore are out of register.

4. A pump as in claim 1 wherein said spring is received in a counterbored portion of said slide bore and the counterbored portion of same connects to said bore by inclined portions, said roller means engaging said inclined portions and engaging said end piece adjacent the tip thereof when said by-pass port and bore are out of register.

5. A hydraulic pump comprising a pump housing having a pair of pressure chambers provided therein, inlet and outlet means for said pressure chambers, valve means for controlling flow of liquid to and from said pressure chambers, said housing also having a slide bore provided therein, a slide plunger having a by-pass port provided therein, a by-pass bore formed in said housing and connecting said chambers through said slide bore, means engaging said slide plunger to prevent rotation thereof, said slide plunger being movable longitudinally of said slide bore to register said by-pass bore with said by-pass port, said housing having a bore therein to connect the outlets of said pressure chambers to said slide bore to apply the output pressure to one end of said slide plunger, a spring positioned in said housing, a tapered end piece carried by the end of said slide plunger remote from that end to which said output pressure is applied, means carried by said plunger adjacent said end piece forming a seal for said plunger, and roller means bearing on said end piece and connected to one end of said spring for resiliently urging said slide plunger to a position with said by-pass port out of register with said by-pass bore.

6. In a hydraulic pump, a pump housing having a pair of pressure chambers therein, a slide plunger reciprocably positioned in said housing, the output pressure of the pump being exerted on one end of said plunger, by-pass means for connecting said pressure chambers, spring means urging said plunger oppositely to the output pressure of the pump, the axial position of said plunger in said housing controlling said by-pass means to open or close same, and roller means for connecting said spring means to said plunger to set up maximum force thereon when said plunger has said by-pass means closed.

7. A pump as in claim 6 wherein said slide plunger has a substantially conical end adjacent said spring means, and said connecting means include roller means bearing on said conical end, links connecting said roller means to said spring means, and means for positioning said roller and

link means to engage said conical end substantially normally thereto and substantially parallel to the longitudinal axis of said plunger when same has said by-pass means closed and to engage said end at a relatively low angle when said plunger has said by-pass means open.

8. In a hydraulic pump, a pump housing having a pair of pressure chambers therein and a bore therein, a slide plunger having a conical end positioned in the bore in said housing, the output pressure of the pump being exerted on one end of said plunger, by-pass means for connecting said pressure chambers, spring means urging said plunger oppositely to the output pressure of the pump, the position of said plunger controlling said by-pass means to open or close same, and roller means connecting said spring means to the conical end of said slide plunger, said roller means engaging the walls of said bore and the conical end of said slide plunger.

9. A pump as in claim 8 wherein said housing has a counterbore connecting to said bore, said roller means appreciably reducing the resistance of said spring means to movement of said plunger after same has been started to move by the output pressure, said roller means engaging the walls of said counterbore when said plunger is positioned to open said by-pass means.

10. A pump as in claim 6 wherein said pump housing has a bore in which said slide plunger is received, said pump housing having a counterbore in which said spring means are received and which counterbore is aligned with said bore, said slide plunger has a by-pass port provided therein for register with a relief port in said pump housing to provide said by-pass means in one position of said slide plunger, and link and roller means connect between an end of said spring means and an adjacent end of said slide plunger to transmit compressive forces therebetween and change the relative angular relationship between the connected means with movement of said slide plunger from a position with said by-pass port in register with said relief port to one with such ports out of register, said link and roller means moving into said counterbore with movement of said slide plunger from a non-registering to a registering position for said by-pass port with said relief port.

11. A pump as in claim 6 wherein said pump housing has a bore in which said slide plunger is received, said pump housing having a counterbore in which said spring means are received and which counterbore is aligned with said bore, and link and roller means connect between an end of said spring means and an adjacent end of said slide plunger to transmit compressive forces

therebetween and change the relative angular relationship between the connected means with movement of said slide plunger from a position opening to one closing said by-pass means.

12. A pump as in claim 6 wherein said pump housing has a bore in which said slide plunger is received, said pump housing having a counterbore in which said spring means are received and which counterbore is aligned with said bore, said slide plunger has a by-pass port provided therein for register with a relief port in said pump housing to provide said by-pass means in one position of said slide plunger, and said roller means engage the wall of the member in which they are positioned and connect between an end of said spring means and an adjacent end of said slide plunger to transmit compressive forces therebetween and change the relative angular relationship between the connected means with movement of said slide plunger from a position opening to one closing said by-pass means.

13. In a hydraulic pump, a pump housing having a pair of pressure chambers therein, a slide plunger positioned in said housing, the output pressure of the pump being exerted on one end of said plunger, by-pass means for connecting said pressure chambers, spring means urging said plunger oppositely to the output pressure of the pump, the position of said plunger controlling said by-pass means to open or close same, roller means, and pivotally positioned arms connecting said spring means to said roller means to position same, said housing positioning said roller means and said arms to extend substantially normally from the portions of said plunger contacted thereby when said plunger has said by-pass means closed and to extend at an acute angle from the portions of the said plunger contacted thereby when said plunger has said by-pass means open.

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