

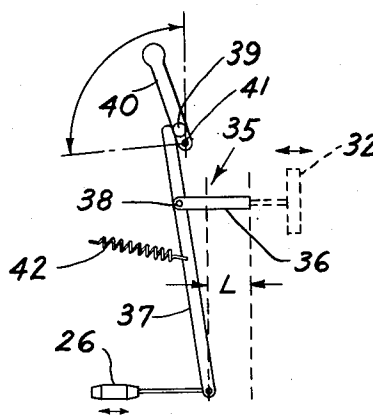
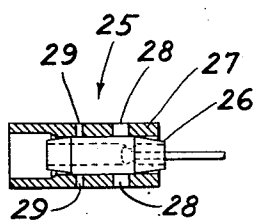
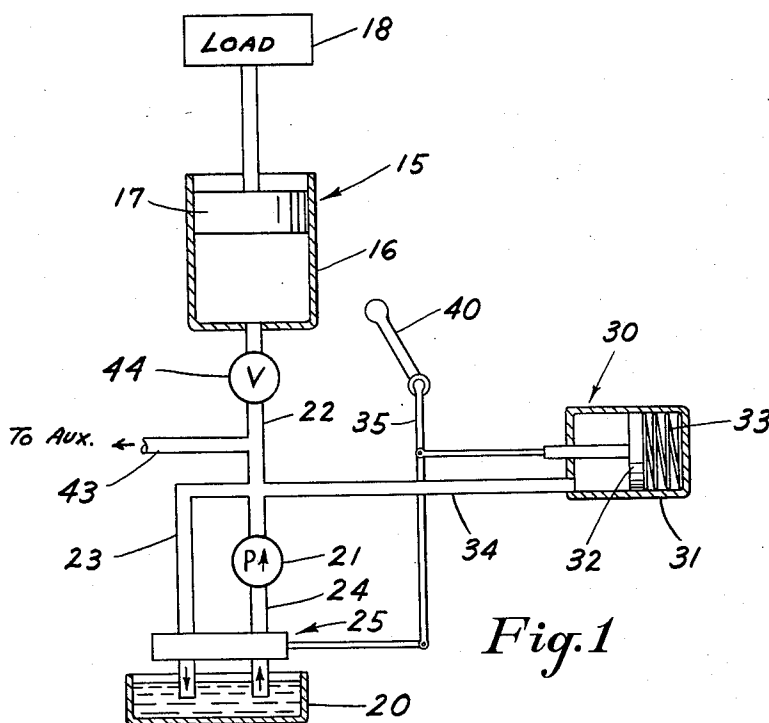
Feb. 10, 1953

E. V. BUNTING

2,627,815

CONSTANT PRESSURE HYDRAULIC POWER TRANSMITTING SYSTEM

Filed Jan. 2, 1948



UNITED STATES PATENT OFFICE

2,627,815

CONSTANT PRESSURE HYDRAULIC POWER TRANSMITTING SYSTEM

Ernest V. Bunting, Dearborn, Mich., assignor to Harry Ferguson, Inc., Detroit, Mich., a corporation of Delaware

Application January 2, 1948, Serial No. 227

7 Claims. (Cl. 103-40)

1

The present invention pertains to hydraulic power transmitting systems and more particularly to such systems of the constant pressure type.

One general object of the invention is to afford a hydraulic system in which fluid is pumped to build up a preselected fluid pressure and thereafter maintained automatically at such value with only such further pumping of fluid as is required for displacement of a load and to compensate for leakage, withdrawals to auxiliaries etc.

In a more specific aspect, it is an object to provide a system of such character in which the pumping is arrested simply by actuation of a valve mechanism and without entailing the constant spillage of fluid over a relief valve or the complications of stoppage of the pump itself or of varying the pump stroke. By avoiding spillage through a relief valve the heating and foaming of the pressure fluid normally incident to such operation is obviated. By avoiding the complications of stoppage of the pump or variation in its stroke, the cost of the system is reduced and its reliability of operation enhanced.

Moreover, it is an object to provide a system of the general character indicated in which the pressure automatically retained can be varied merely by appropriate positioning of some manual control device such as a hand lever or the like.

Further objects and advantages of the invention will become apparent as the following description proceeds, taken in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic layout of a constant pressure hydraulic system embodying the present invention.

Fig. 2 is an enlarged longitudinal sectional view of the control valve included in the system of Fig. 1.

Fig. 3 is a generally diagrammatic layout of a suitably adjustable mechanical linkage for interconnecting the pressure responsive means and manual control with the main control valve of the system.

Variants in individual components of the system will readily occur to skilled designers in this field. Accordingly, even though a particular embodiment of the invention has been indicated and described in some detail, there is no intention to thereby limit the invention to such specific form of employment. On the contrary, the intention is to cover all modifications and alternative arrangements falling within the spirit and scope of

2

the invention as expressed in the appended claims.

Comprised in the system of Fig. 1 is a main hydraulic actuator, which may take a variety of forms. Here it is shown as a one-way ram 15, including a cylinder 16 slidably receiving a piston 17. This ram may be arranged to move some desired "load" 18 applied to it. Pressure fluid, such as oil, is supplied to the ram 15 from a sump 20 by a pump 21, the latter being constantly driven by some suitable power source (not shown). The pump may be of a simple, constant displacement type. A conduit 22 connects the discharge side of the pump 21 with the ram cylinder 16. Also interconnected with the cylinder and pump discharge is a drain line 23.

By blocking both the drain line 23 and pump intake 24, fluid is trapped in the system and, even though the pump continues to operate, no further fluid is delivered by it into the system. Opening the pump intake 24 while retaining the drain 23 closed, permits the pump to deliver additional fluid to the system. Similarly, opening the drain 23 while retaining the pump intake 24 closed drains fluid from the system, relieving pressure in it. The control valve mechanism 25, one possible form of which is indicated in Fig. 2, serves to effect such blocking and opening of the drain 23 and pump intake 24.

As shown in Fig. 2, the valve mechanism 25 may include a slidable plunger 26 received in a bushing or housing 27 having spaced supply ports 28 and drain ports 29. With the plunger in its central or neutral position as shown, both the supply and the drain ports are blocked. Movement of the plunger in one direction, in this instance, to the left, progressively opens the ports 28 while retaining ports 29 closed. Movement of the plunger in the opposite direction effects a similar progressive opening of the ports 29 while retaining ports 28 closed. Return movement of the plunger to neutral position progressively closes the open port or set of ports. The tapers formed on the ends of the plunger accentuate the progressive character of its port opening and closing actions, and afford more accurate control with a minimum of overrun of the pressure adjustment in either direction. The ports 28 are of course connected to the pump intake 24 while the drain ports 29 are interposed in the drain or exhaust line 23. By making the ports 29 small, they constitute restricted orifices in the drain line thereby restraining the rate of descent of the ram piston.

It is with maintenance of preselected pressure

in the system that the present invention is primarily concerned. It is with such end in view that a pressure responsive means or unit 30 is connected to the line 22 between pump and cylinder. Such means is shown diagrammatically in Fig. 1 as comprising a cylinder 31 having in it a slidable piston 32 whose movement is resisted by a compression spring 33. Fluid led from the system into the cylinder 31 by a branch line 34 urges the piston 32 to compress the spring 33. Displacement of the piston 32 will therefore be substantially proportional to the pressure prevailing in the system.

Displacement of the piston 32 is utilized to shift the valve plunger 26. By providing between the pressure responsive means and valve a mechanical connection 35 which is of selectively variable length—rather than a direct connection of constant length—it is possible to vary at will the system pressure at which the valve mechanism 25 is centered in its cut-off or neutral position. That is to say, each point in the path of travel of the piston 32 corresponds to a different value of pressure in the system. And by making the connection between that piston and the valve of suitable length the plunger can be located in neutral for any given position (pressure setting) for the piston.

A suitable form of the linkage 35 for, in effect, varying the length of connection noted is shown more or less diagrammatically in Fig. 3. As there indicated a connecting link 36 from the piston 32 is pivotally connected at 38 to the upper intermediate portion of a floating lever 37. The lower end of this lever 37 is pivotally connected to the valve plunger 26, whereas the upper end of the lever bears against a revoluble eccentric pin 39 on a hand lever 40 which is pivoted at 41. A contractile spring 42 tends to rock the lever 37 clockwise about the pivot 38, retaining the lever in contact with the eccentric 39. The range of movement of the hand control lever 40 between zero and maximum pressure positions is indicated in Fig. 3. Swinging the hand control lever 40 downward (to the left) rocks the lever 37 counterclockwise about the pivot 38, shortening the effective length L of the linkage. Conversely, pulling the hand lever 40 upward increases such effective length.

Operation

Let it be assumed initially that the handle or hand control lever 40 is pushed downward to its zero pressure position. In such case the effective linkage length L is a minimum and the floating lever 37 is rocked counterclockwise, pulling the valve plunger 26 rightward so that the bleed ports 29 are uncovered, although supply ports 28 are blocked. In such condition fluid is bled from the system, relieving substantially all pressure.

To establish pressure in the system the operator has only to swing the hand control lever 40 upward. Thereupon the floating lever 37 is rocked clockwise about the pivot 38, pushing the valve plunger 26 leftward to cover the bleed ports 29 and open the supply ports 28. Delivery of oil to the system by the pump 21 ensues. As such delivery continues the system pressure rises, gradually forcing the piston 32 of the pressure responsive means 30 inward against its spring 33. That results in a corresponding gradual rocking of the floating lever 37 in a counterclockwise direction, fulcruming in this instance about the eccentric 39 rather than about the pivot 38. The valve piston 26 is accordingly shifted rightward, progressively closing and finally blocking the in-

take ports 28. At such time the system is brought into equilibrium with further delivery of fluid cut-off.

The pressure prevailing in the system at cut-off will depend upon the position of the hand control lever 40. The higher that lever is in its arc of travel, the longer the effective linkage length L . The larger such length is, the farther must piston 32 be displaced to move the valve plunger 26 to neutral. And each additional movement of displacement for piston 32 requires an additional increment of fluid pressure on it.

Once cut-off or equilibrium condition is reached should the pressure inadvertently change for any reason, it is automatically restored to its pre-set value. Thus should the pressure go down, as because of leakage for example, the pressure responsive device's piston 32 will creep to the left, rocking the floating lever 37 clockwise to crack the supply ports 28. The additional fluid so supplied quickly restores the system to pressure and cut-off again takes place. Similarly should the pressure rise above the desired value, the resulting further displacement of the piston 32 rocks the floating lever counterclockwise to open bleed ports 29. As the pressure then falls cut-off occurs again when the pre-set pressure is reached.

To alter the pressure in the system at any time the operator has only to make a corresponding change in the position of the hand lever 40. As he shifts it the eccentric 39 is moved, displacing the lever 37 in a direction to bring about pumping or bleeding of fluid as the case may be and at the same time the effective linkage length L is changed to establish a new cut-off point at the desired pressure value.

In building up to, and in retaining, a desired pressure in the system so much fluid will be supplied as is required to meet the demands of the main ram 15 and of any auxiliaries which may be connected to the system, as for example, through a branch conduit 43 (Fig. 1). Additional fluid to move the ram piston 17 will, of course, be supplied only when its load 18 is low enough to be overcome by the pressure for which the system is set. Exit of fluid from the pump discharge line 22 into either the main ram 15 or into an auxiliary tends, of course, to diminish the pressure in the system. Consequently, the valve mechanism is shifted automatically as previously described to admit fluid to the pump for delivery into the system. Cut-off again occurs when the newly established volume of fluid in the system is brought up to pressure. Should the pump delivery rate be high enough, as compared to the rate fluid is taken up, the actuator or the like being moved, the pump may be cut-off and reopened intermittently as the actuator operation proceeds. In any event, the system pressure is retained substantially constant at the selected value.

If desired a cut-off valve 44 may be interposed in the line 22 leading to the ram 15. Closing that valve has the same effect as locking the ram piston against movement or imposing an immovable load on it. Pressure can thus be built up to any desired value for the auxiliary line 43 with the valve 44 closed and without regard to the actual load 18 on the piston 17.

From the foregoing it will be perceived that a constant pressure hydraulic system of rather remarkable structural simplicity and fidelity of operation has been provided. A simple plunger type valve can, if desired, be employed for the main valve mechanism 25, no spring loaded elements or the like being required. The pump 21

can be of simple form requiring no stroke adjustments or the like. The pressure responsive device 30 and adjustable connecting linkage 35 are also structurally simple. Close fits and fine tolerances are not imperative. Complete freedom of pressure adjustment is, however, attained, and the pressure fluid is fed by the pump when and only when pressure requirements demand it.

I claim as my invention.

1. In a constant pressure type hydraulic system, the combination of a pump having an intake and a discharge, a drain connection leading from the pump discharge, a valve mechanism including flow control means shiftable from a neutral position in which both said pump intake and drain connection are blocked into alternatively available exhaust and supply positions in which said drain connection and intake are respectively individually opened with the other remaining blocked, and means operable automatically in response to pump discharge pressure for retaining the flow control means of said valve mechanism in neutral position so long as the prevailing discharge pressure is of a predetermined value and for correctively shifting said flow control means to supply position or to exhaust position upon, respectively, a decrease or increase in discharge pressure from said predetermined value.

2. In a constant pressure type hydraulic system, the combination of a pump having an intake and a discharge, a drain connection leading from the pump discharge, a valve mechanism including flow control means shiftable from a neutral position in which both said pump intake and said drain connection are blocked into alternatively available exhaust and supply positions in which said drain connection and intake are respectively individually opened with the other remaining blocked, means operable automatically in response to pump discharge pressure for retaining the flow control means of said valve mechanism in neutral position so long as the prevailing discharge pressure is of a predetermined value and for correctively shifting said flow control means to supply position or to exhaust position upon, respectively, a decrease or increase in discharge pressure from said predetermined value, and manually operable means for varying said predetermined value of discharge pressure.

3. In a constant pressure type hydraulic system, the combination of a pump having an intake and a discharge; a drain connection leading from the pump discharge; a valve mechanism including flow control means shiftable from a neutral position, in which both said pump intake and said drain connection are blocked, into alternatively available exhaust and supply positions in which said drain connection and intake are respectively individually opened with the other remaining blocked; a pressure responsive device subjected to the pressure prevailing in said pump discharge and including a shiftable element displaceable through a fixed path of travel proportionately with changes in such pressure; a mechanical operating connection from said element to the flow control means of said valve mechanism; and a manual adjusting means for selectively varying the effective length of said operating connection.

4. In a constant pressure type hydraulic system, the combination of a pump having an intake and a discharge, a valve mechanism includ-

ing flow control means having alternatively available supply and exhaust positions for effecting, respectively, the supply of pressure fluid from said pump and the exhaust of fluid through said discharge, a pressure responsive device subjected to the pressure prevailing in said pump discharge and including a shiftable element displaceable through a fixed path of travel proportionately with changes in such pressure, a floating lever, a connecting link pivotally connected at one end of an intermediate point on said floating lever and at the other to said shiftable element of said pressure responsive device, a connection from one end portion of said floating lever to the flow control means of said valve mechanism, and a manually positionable fulcrum for the other end portion of said lever for varying the effective lever ratio between said shiftable element and said valve mechanism.

5. In a constant pressure type hydraulic system, the combination of a pump having an intake and a discharge, a drain connection leading from the pump discharge, a valve mechanism having flow control means shiftable from a neutral position in which both said pump intake and said drain connection are blocked into alternatively available exhaust and supply positions in which said drain connection and intake are respectively individually opened with the other remaining blocked, a pressure responsive device including a cylinder having a slidable position therein subjected to the pressure prevailing at the discharge of said pump, a spring for yieldably resisting displacement of said piston under the influence of said pressure, a floating lever, a connecting means pivotally connected at one end to an intermediate point on said lever and connected at the other end to said piston, a connection from one end portion of said lever to the flow control means of said valve mechanism, a fulcrum arranged to coact with the opposite end portion of said lever, and manually operable means for shifting said fulcrum to vary the relative lengths of the arms of said lever.

6. In a constant pressure type hydraulic system, the combination of a pump having an intake and a discharge; a drain connection leading from the pump discharge; a valve mechanism including flow control means shiftable from a neutral position, in which both said pump intake and said drain connection are blocked, gradually into alternatively available exhaust and supply positions in which said drain connection and intake are respectively individually opened progressively with the other remaining blocked, said flow control means in its return to neutral position progressively closing the open one of said intake and said drain connection; a pressure responsive device subjected to the pressure prevailing in said pump discharge and including a shiftable element displaceable through a fixed path of travel proportionately with changes in such pressure; a mechanical operating connection from said element to the flow control means of said valve mechanism; and a manual adjusting means for selectively varying the effective length of said operating connection.

7. In a constant pressure type hydraulic system, the combination of a pump having an intake and a discharge, a drain connection leading from the pump discharge, a valve mechanism including a flow control plunger shiftable from a neutral position in which both said pump intake and said drain connection are blocked into alternatively available exhaust and supply posi-

tions in which said drain connection and intake are respectively individually and progressively opened with the other remaining blocked, said flow control plunger in its return to neutral position progressively closing the open one of said intake and said drain connection, and means operable automatically in response to pump discharge pressure for retaining the flow control plunger of said valve mechanism in neutral position so long as the prevailing discharge pressure is of a predetermined value and for correctively shifting said flow control plunger to supply position or to exhaust position upon, respectively, a decrease or increase in discharge pressure from said predetermined value.

ERNEST V. BUNTING.

REFERENCES CITED

The following references are of record in the file of this patent:

20

UNITED STATES PATENTS

Number	Name	Date
1,075,701	Drago -----	Oct. 14, 1913
1,470,701	Staude -----	Oct. 16, 1923
1,923,518	Thiberge -----	Aug. 22, 1933
1,952,690	Strom -----	Mar. 27, 1934
1,968,700	Milotta -----	July 31, 1934
1,974,775	Gorsuch et al. -----	Sept. 25, 1934
1,988,296	Blume -----	Jan. 15, 1935
2,256,144	Gifford -----	Sept. 16, 1941
2,338,379	Henke -----	Jan. 4, 1944
2,381,346	Gregg -----	Aug. 7, 1945
2,397,042	Pfost -----	Mar. 19, 1946
2,423,417	Stokes et al. -----	July 1, 1947
2,433,220	Huber -----	Dec. 23, 1947