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H. S. PARDEE

2,279,176

HYDRAULIC CONTROL

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FIG. 1.

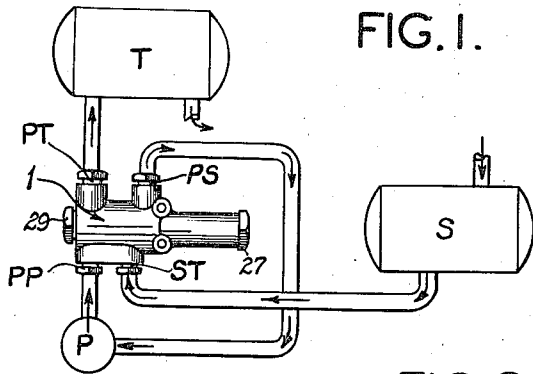


FIG. 2.

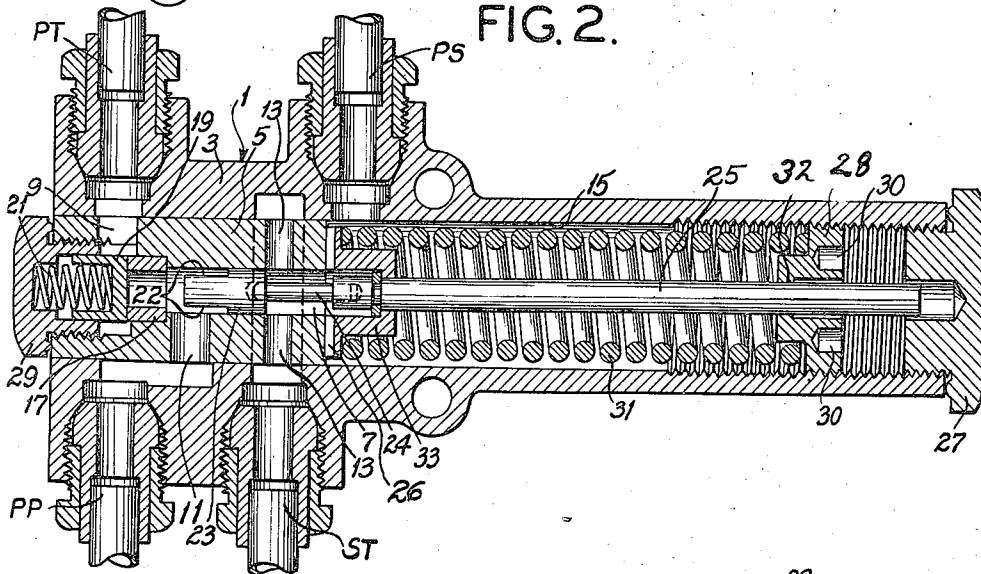


FIG. 3.

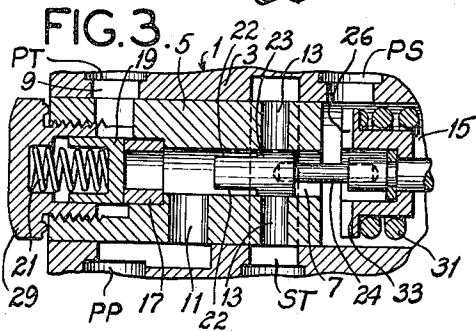
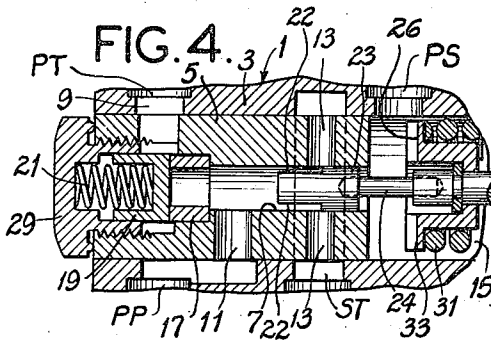


FIG. 4.



UNITED STATES PATENT OFFICE

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HYDRAULIC CONTROL

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4 Claims. (Cl. 103—42)

This invention relates to hydraulic system controls, and with regard to certain more specific features, to a control unit for a hydraulic pump circuit.

Among the several objects of the invention may be noted the provision of means for controlling pump pressure by simple and compact apparatus which also functions as a safety valve; and the provision of apparatus of the class described which is the equivalent in function to a variable-stroke pump, but without its intricacies. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing, in which is illustrated one of various possible embodiments of the invention:

Fig. 1 is a diagram showing the application of the device to a hydraulic circuit;

Fig. 2 is a longitudinal section of the control per se shown in a position at the start of pumping;

Fig. 3 is a view similar to Fig. 2 showing conditions after a normal pressure has been reached; and,

Fig. 4 is a view similar to Fig. 2 but showing the control in position to act as a safety valve at high pressures.

Similar reference characters indicate corresponding parts throughout the several views of the drawing.

Referring now more particularly to Fig. 1, there is shown a pressure tank T or accumulator, connected with an outlet port PT of the control, the latter being designated in general by the numeral 1. Connected with the inlet port PP of the control 1 is a pump P. The suction side of the pump P is connected with a suction port PS of said pump control 1 and a sump tank S is in communication with its suction port ST.

The purpose of the pump P is to withdraw fluid from the sump tank S (via ports ST and PS) and to deliver it to the pressure tank T (via ports PP and PT) for use in a circuit connected to the pressure tank T. The circuit is not shown, because it does not form a part of the present invention per se. It receives fluid from tank T and drains it back to S.

Referring to Figs. 2-4, numeral 3 indicates a body portion of the pump control, which forms

the ports PT, PP, PS and ST. A bushing 5, having a central passage or interconnection 7, serves to form a communication between the ports PT and PP via ports 9, 11 and the left end of passage 7. It also serves to form a connection between the ports PS and ST via passages 13 in connection with the right end of the passage 7. It will be seen that the passage 7 communicates with the interior of the body 3 and that therefore the space 15 also forms part of the last-specified connection.

Ports PP and ST may also be connected by the central part of passage 7, which may be referred to as an interconnection.

At the left end of the passage 7 is a valve seat insert 17 with which cooperates a valve 19. Valve 19 is normally pressed to its seat by a spring 21 held by a cap 23. Parts 17, 19 and 21 form a check valve between the pump port PP and the pressure tank port PT, which opens in response to pressure directed from PP to PT. It will not permit reverse flow, as when the pump is disconnected and the pressure tank T left connected.

It is to be understood that the check valve is optional, and that its primary function is to permit disconnection of the pump without relieving the pressure tank T of pressure, that is, without reflux from the tank T (acting as an accumulator) to the discharge connection of the pump. It also prevents flow between the pressure tank and the sump in the extreme right-hand or relief position of the plug 23. This plug will be described more fully hereinafter.

At 23 is shown a valve or control plug, having upper and lower flats 22, which slides in the passage 7 and, with 24, forms an extension of a control rod 25. The rod 25 is guided at 32 for true axial movement. The guide 32 is in an adjustable threaded bushing 28 forming a stationary reaction point for spring 31. The other end of the spring acts against a shouldered abutment 33 carried on the stem 25. A cap 27 encloses the spring chamber. A cross opening 26 is provided on the end of abutment 33.

Operation is as follows:

When the pump P starts and tank T is under no internal pressure, the parts are in the condition shown in Fig. 2, wherein the plug 23 is pushed to the left by the extended spring 31. The right end of the plug 23 thus uncovers the port 13, as shown, and places the sump tank in communication with the pump via connected ports ST, right end of 7, 26, 15 and PS.

Then as the discharge pressure from the pump is transmitted from the pressure pump port PP

to the pressure-tank port PT and into the tank T, this pressure increases and forces the plug 23 to the right, thus compressing spring 31 (Fig. 3).

Finally, when under a chosen value of moderate or normal pressure conditions the plug 23 covers the port 13, the suction side of the pump is cut off from the sump tank (ports ST and PS out of communication) and no more liquid is available for permitting the pump to increase pressure on the left side of the plug 23. The plug 23 then ceases to move further to the right and balanced conditions prevail between the pressure on its left side and the pressure in biased spring 31. The pressure at which the balanced condition occurs may be controlled from member 28.

If pressure is released from the tank T to its work circuit or elsewhere, pressure is accordingly reduced on the left side of the plug 23 which moves to the left under the resulting unbalance of spring 31. This reconnects the ports ST and PS so that when the pump again comes into operation liquid is available for building up pressure in the tank T and thus also for resetting the plug 23 to covering position with respect to the ports 13.

On the other hand, when the pressure builds up too high and above said chosen moderate or normal value, for some accidental reason, excess pressure on the left side of the plug 23 finally forces it to uncover the port 13 (Fig. 4), but since the plug itself at this time obstructs the right end of passage 7, it prevents a supply of liquid from entering the suction side of the pump, that is, the connections ST and PS are still out of communication. At the same time, this establishes a communication between the pressure port PP and the sump tank port ST, whereby fluid from the pump is released to the sump tank. The device thus functions as a safety valve, preventing the pump from building up pressure in the tank T to excessive values.

The extending portion to the left of the plug 23 acts as a guide extension for the plug, being ground flat on one or two sides, as at 22, up to a shoulder; the flat portions affording passage for escape of fluid when acting as a safety valve.

The area of the plug 23 exposed to pressure from the pressure port PP and acting as an abutment is calculated to balance the forces of spring 31 under the desired conditions of pressure in the tank T. The cylindric portion of the plug 23, which engages the cylindric passage 7, constitutes a slide valve mechanism. After the device is installed, should it be desired to make adjustments in the pressure to be maintained in the tank T, this may be done by adjusting the plug 23 by means of a suitable spanner wrench in openings 30. Adjusting the plug 23 to the left will result in increase of normal pressure in the tank T, and to the right, pressure decrease.

From the above, it will be seen that the device brings about a new fluid control circuit in which there is always a pressure connection between the pump P and pressure tank T. There is also a suction connection between the pump and the sump tank S which is normally open itself and blocked from the pressure connection by plug valve 23 in the interconnection 7 (Fig. 2). Under predetermined pressure the suction connection between pump P and sump S is blocked without unblocking the interconnection 7 (Fig. 3). Under excessive pressure the block in the suction connection is maintained while opening

the block in the interconnection. The latter connects the pressure side of the pump with the sump tank S.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A hydraulic system comprising in combination a liquid storage sump, an accumulator for storing liquid under pressure, a pressure-developing pump having an inlet connection normally in communication with the sump and a discharge connection normally in communication with the accumulator, a check valve arranged to prevent reflux from the accumulator to said discharge connection, and a combined unloader and relief valve mechanism comprising a movable abutment subject to the pressure in the discharge connection between the pump and the check valve, yielding means reacting upon said abutment in opposition to discharge pressure, and a valve mechanism arranged to be actuated by said abutment and controlling communication between the sump and the pump inlet connection and between the pump discharge connection and the sump, said valve mechanism assuming a normal position unless the pump discharge pressure exceeds a chosen value and in which the sump is connected with the pump inlet and isolated from the pump discharge, and assuming an unloading position when said pressure moderately exceeds said chosen value and in which said sump is disconnected from pump inlet and discharge, and which assumes a relief position when said pressure substantially exceeds said chosen value and in which the sump is disconnected from the pump inlet and connected with the pump discharge.

2. A hydraulic system comprising in combination a liquid storage sump, an accumulator for storing liquid under pressure, a pressure-developing pump having an inlet connection normally in communication with the sump and a discharge connection normally in communication with the accumulator, a check valve arranged to prevent reflux from the accumulator to said discharge connection, and a combined unloader and relief valve mechanism comprising a movable abutment subject to the pressure in the discharge connection between the pump and the check valve, yielding means reacting upon said abutment in opposition to discharge pressure, and a valve mechanism arranged to be actuated by said abutment and controlling communication between the sump and the pump inlet connection and between the pump discharge connection and the sump, said valve mechanism assuming a normal position unless the pump discharge pressure exceeds a chosen value and in which the sump is connected with the pump inlet and isolated from the pump discharge, and assuming an unloading position when said pressure moderately exceeds said chosen value and in which said sump is disconnected from pump inlet and discharge, and which assumes a relief position when said pressure substantially exceeds said chosen value and in which the sump is disconnected from the pump inlet and connected with the pump discharge, said valve mechanism comprising a cy-

lindrical valve chamber having a side port connected with the sump, and opposite end ports connected with the pump inlet and the pump discharge respectively, and said valve element comprising a cylindrical plunger subject on one end to pump discharge pressure and on the other end to pump inlet pressure whereby the valve itself serves as the movable abutment, said valve having a mid position in which it disconnects the side port from the two end ports and two opposite limiting positions in which respectively it connects the side port with one or the other of said end ports.

3. A hydraulic control system comprising in combination an accumulator pressure tank, a sump tank, a pump having a suction-pressure connection with the sump tank and a discharge-pressure connection with the pressure tank, a control device comprising a member having a cylinder in communication with said discharge-pressure connection, a piston valve in said cylinder responsive on one side to pressure in said discharge-pressure connection, a side inlet in said cylinder communicating with the sump tank and traversed by the valve, the cylinder having another opening on the suction-pressure side of the piston valve forming a permanent communication between the valve and the suction side of the pump whereby the valve is at all times subject to pressure difference between its pressure and suction sides, means biasing the valve to a normal position in response to normal pressure differences on its opposite ends wherein said side inlet is open and in communication with the sump, said valve in response to moderate increase in pressure differences on opposite ends moving

against said bias to a position covering said side inlet, and responding to greater differences in pressure on opposite ends to move beyond said side inlet to a point where the pump discharge connection is placed in communication with the sump.

4. In a pump circuit control, a control device forming a pressure passage connecting the pressure side of a pump with a pressure tank, said control device also forming part of a suction passage connecting the suction side of said pump with a sump tank, said control device having a cross passage connecting with the pressure passage and intersecting the suction passage, a piston valve movable in said cross passage, said valve having one face exposed to pressure in the pressure passage and the other face to suction in the suction passage, means biasing the valve away from said intersection and toward a point to separate the pressure passage from the suction passage, said valve being responsive to a predetermined pressure value in the pressure passage to move to the intersection to block the suction passage but initially without connecting said pressure and suction passages, said valve being movable in response to greater pressure in the pressure passage to move to the other side of the intersection whereby the pressure passage is connected to the sump tank without unblocking the suction passage, and a check valve in the pressure passage operable independently of said piston valve and arranged to close against back-flow from the pressure tank through said control device.

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