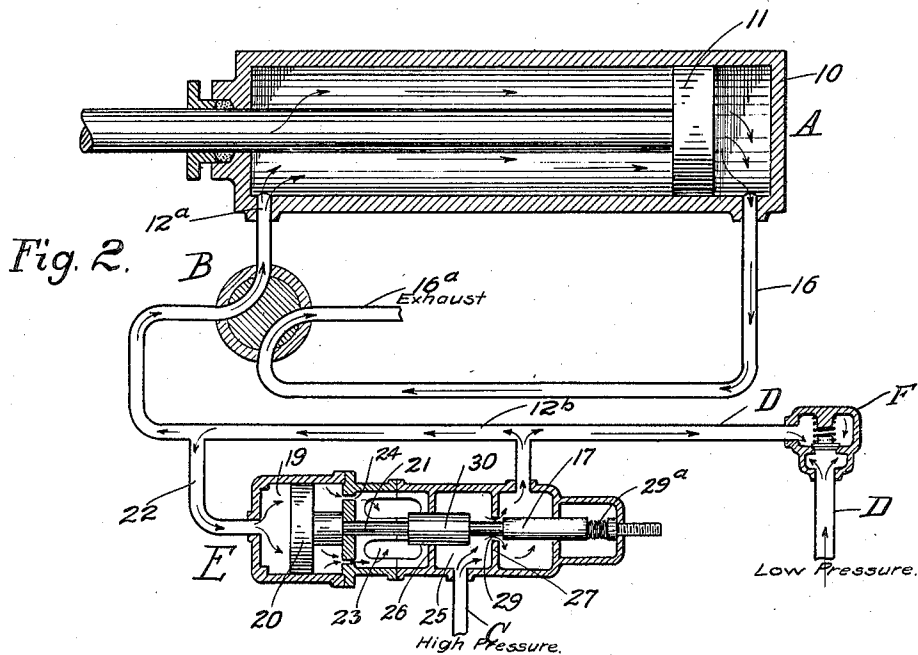


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Inventor:
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UNITED STATES PATENT OFFICE.

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CONTROLLING MECHANISM FOR HYDRAULIC PRESSES AND THE LIKE.

1,103,036.

Specification of Letters Patent.

Patented July 14, 1914.

Application filed June 7, 1912. Serial No. 702,274.

To all whom it may concern:

Be it known that I, WALTER R. CLARK, a citizen of the United States, residing in Bridgeport, county of Fairfield, and State of Connecticut, have invented certain new and useful Improvements in Controlling Mechanism for Hydraulic Presses and the like, of which the following is a full, clear, and exact description.

This invention relates to controlling mechanism for hydraulic presses, draw benches, and other machinery operated by fluid pressure, and it refers especially to controlling mechanism for machines in which a ram or other moving part is arranged for operation by fluid under high pressure or fluid from a source of low pressure, or fluid from both high and low pressure sources. Usually, the reciprocating ram or other member ordinarily employed for acting on the work is actuated by low pressure until the tool meets the work, and then water under high pressure is permitted to act on the ram in order to perform the working stroke, the return stroke being effected under low pressure. Ordinarily the low pressure water acts much more quickly than the high pressure water, so that considerable time is saved by having the low pressure water produce the return stroke of the ram or other member and the idle portion of the operative stroke *i. e.* that portion of the operative stroke which precedes the meeting of the tool with the work.

The object of the invention is to provide a simple, efficient system for automatically changing over from high to low pressure and vice versa in order to meet the above conditions. In a companion application, Serial Number 702,273 filed of even date herewith, I have described and broadly claimed a system of control in which the high and low pressure sources for operating the prime mover are automatically and oppositely controlled by means actuated by a change of velocity of the liquid flowing through the system, which change of velocity is due to the retarding or acceleration of the moving element of the prime mover as such prime mover encounters more or less resistance. In the apparatus described in said companion application the motor device for actuating the valve of one of the pressure mains is actuated by variations in the pressure drop between the opposite sides of one or more orifices past which the fluid

flows at one point in the system, which variations of pressure are directly due to the changes in the velocity of the fluid or liquid flowing through such orifice or orifices. According to the present invention, however, the pressure drop, of which the variations actuate the motor device controlling one or more of the pressure mains, is not produced by the use of a restricted orifice or orifices but, on the other hand, by the friction produced by the liquid upon itself and upon the walls of one or more of the conduits, as hereinafter described.

The present invention therefore consists in a specific mechanism for attaining the end in view under the general principles explained in my companion application, and the variations or improvements of the present application relate particularly to the form of the valve actuating motor device and its relation to the pressure conduits and the other parts of the system.

To these and other ends, the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the accompanying drawing, Figure 1 is a diagrammatic view of a controlling mechanism embodying the invention, showing the prime mover in one position, and Fig. 2 is a similar view showing the prime mover in another position.

Referring to the drawing, the prime mover A of the hydraulic press or other machine is shown as comprising a cylinder 10 and a piston 11 to reciprocate therein. At the respective ends of the cylinder 10 are ports 12^a and 13. The port 12^a is in communication by way of a pipe 15 with a four-way valve B communicating in turn with a common inlet pipe 12^b having connection with the high pressure conduit C and the low pressure conduit D. The port 13 is in communication with a conduit 16 leading to the four-way valve and adapted to be placed in communication with an exhaust pipe 16^a leading from said valve as shown. By turning the valve B the connections may be reversed in an obvious manner in order to drive the piston 11 in either direction.

The low pressure conduit D is provided with a control valve F which may be of any appropriate type although the valve shown is a spring actuated automatic valve normally held open by the pressure of the low

pressure water to permit the flow of such water into the common inlet pipe 12^b. The high pressure main or conduit C communicates directly with the casing of the motor device E which actuates a high pressure valve 17 controlling communication between the conduit C and a branch pipe 18 communicating with the junction of the low pressure conduit D and the common inlet conduit 12^b.

The motor device for actuating the high pressure valve 17 comprises a casing having a piston cylinder or chamber 19 at one end in which operates a piston 20 having a piston rod 21 passing through chambers at the opposite end of the casing and on which the piston valve 17 is directly mounted. The cylinder or chamber 19 containing the piston 20 is placed in communication at one side of the piston with a branch pipe 22 leading to the common inlet pipe 12^b at a point in advance of the branch 18. In this manner, the piston 20 is acted on at one side by liquid derived from the common inlet pipe leading to the prime mover. The space in the chamber 19 at the opposite side of the piston is, however, filled with air which has free access to said space by means of apertures 23 in the casing from which the air passes into said space by way of small openings 24 in one end wall of the chamber 19, as shown.

The high pressure conduit C communicates with a chamber 25 separated from the air space in the casing by means of a partition 26 and separated at the opposite end by means of a partition 27 from the chamber 28 with which the branch 18 is in direct communication. The valve 17 is in the form of an elongated piston coöperating with a valve seat 29 in the partition 27. With the valve 17 extended through the seat 29 in the manner shown in Fig. 1, communication between the chambers 25 and 28 will be cut off and high pressure water from the conduit C will therefore be prevented from passing into the branch 18 and common inlet pipe 12^b.

In the embodiment shown, the pressure water passing into the chamber 19 from the branch 22 acts on the piston 20 in such a direction as to urge said piston toward the right, and the high pressure water passing into the chamber or compartment 25 acts on the high pressure valve 17 in the same direction. Both of these pressures urge the high pressure valve toward its open position. In order to counterbalance the valve to a certain extent a spring 29^a is caused to act on the piston rod 21 to assist in normally holding the latter in the position shown in Fig. 1 when low pressure water is acting on the main piston 11. This action is also assisted by a balancing or compensating piston 30 of slightly larger diameter than the piston

valve 17, so arranged on the piston rod as to be acted on by the high pressure water in a direction opposite to that in which the valve 17 is acted on by high pressure water.

The operation of the apparatus is substantially as follows: The various parts of the device E for actuating the high pressure valve 17 are so designed that when the low pressure water enters the common inlet pipe 12^b and the cylinder 10 during the idle stroke of the main piston 11 or during the inactive portion of its working stroke, the pressure in the branch pipe 22 will not be sufficient to act on the piston 20 with enough force to open the valve 17 in opposition to the pressures of the spring 29, the high pressure water on the balancing piston 30 and the air pressure on the right hand side of the piston 20. The high pressure valve 17 will therefore be held in its closed position. Assuming the piston 11 of the prime mover to be moving toward the right on the working stroke of the plunger or other part of the hydraulic machine, said piston will be driven by low pressure water derived from the conduit D as long as the velocity of the water passing into the prime mover through the inlet pipe 12^b does not fall below a certain limit. However, when the tool of the machine meets the work the piston 11 of the prime mover will be retarded thereby decreasing the velocity of the water flowing into the cylinder 10. As the pipe friction in the inlet conduit 12^b varies as the square of the velocity of the liquid passing through said conduit, it will be evident that as the velocity of the liquid is decreased the pipe friction will be decreased in a still greater proportion whereby the drop of pressure between the junction of the branch 22 with the inlet pipe 12^b, on the one hand, and the low pressure source on the other hand, will be considerably decreased, tending to make the pressure in the pipe 22 more nearly equal to that of the low pressure source. As the pressure in the pipe 22 increases, the pressure at the left hand side of the piston 20 will increase correspondingly until it reaches a point where it is sufficient to move the piston 20 to the right in opposition to the forces acting in the opposite direction. This movement of the piston will obviously open the high pressure valve 17, permitting water to pass from the high pressure conduit C into the common inlet pipe 12^b by way of the branch 18. Some of this high pressure water will pass to the low pressure valve F and close said valve, while the remainder of such high pressure water will rush through the inlet pipe 12^b and into the main cylinder 10 to commence and complete the working portion of the operative stroke of the piston 11.

When the valve B is reversed the same operations will take place if the return

stroke of the piston 11 is a working stroke, but if it is simply an idle stroke the piston will be moved back by low pressure water throughout its entire movement, the speed of said piston determining directly the position assumed by the piston 20 of the high pressure valve. Of course, it will be entirely feasible to so actuate the high pressure valve during certain phases of the operation that the pressure water flowing into the main cylinder through the inlet pipe 12^b is derived in part from both high pressure and low pressure sources. As previously stated, the low pressure liquid should act much more quickly than the high pressure liquid in order to save time in making the idle portions of the strokes.

Obviously, I do not limit myself in all aspects of the invention to the use of any particular form of prime mover or any specific form of valve actuating device, or specific arrangement of such valve actuating device with respect to the inlet and outlet conduits. The valve actuating device may in practice be used to control either the high or low pressure valve or both, and it may be located in the system in many different ways so long as the general principle of its operation by pressure variations due to pipe friction is retained. Of course, I have used the term "pipe friction" herein and in the claims in its broad sense, intending to cover the friction arising from contact of the water or other fluid with the walls of any passage which carries or conducts the fluid through any appreciable distance as compared to the unappreciable distance between the opposite sides of a port or orifice such as the restricted orifice of a Venturi tube. In some cases it is not necessary to operate the valve actuating motor device by pressure variations due to changing pipe friction in the inlet passage to the prime mover, as it may be feasible to utilize the pipe friction in the exhaust or other conduits or passages. I prefer, however, to control the motor device by the variations of friction in a comparatively long supply or inlet pipe, as in the example shown.

I do not claim herein the general combination, as set forth in my companion application, Serial No. 702,273, of a prime mover, a source of motive fluid under high pressure, a source of motive fluid under low pressure, means connecting said sources with said prime mover, and means actuated by a decrease in the velocity of the fluid flowing through the system, due to an increase in the resistance encountered by the prime mover, to cut off the low pressure source from said prime mover and cut in the high pressure source. Neither do I claim such a combination in which the last named means includes a motor controlled by a Venturi tube, as set forth in my application, Serial No. 702,275.

What I claim is:

1. In controlling mechanism for hydraulic presses and the like, the combination with a prime mover, of a source of high pressure fluid to operate said prime mover, a second source of pressure fluid, of less degree than the first but likewise capable of operating said prime mover, means connecting said sources with said prime mover, and means actuated by variations in the pipe friction at one or more points in the system to cut off the low pressure source from said prime mover and cut in the high pressure source; substantially as described.

2. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a conduit connected with said prime mover to supply the same with high pressure motive fluid, a second conduit connected with said prime mover to supply the same with motive fluid under lower pressure but which is likewise capable of operating said prime mover, said low pressure conduit being in communication with the prime mover under ordinary conditions for operating the same, and automatic means actuated by variations of pipe friction in the system for cutting out the low pressure conduit and cutting in the high pressure conduit when the prime mover encounters a predetermined amount of resistance; substantially as described.

3. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a high pressure conduit, a low pressure conduit, a common supply conduit connecting both of said first named conduits with said prime mover, and means actuated by variations of pipe friction in said common supply conduit to cut off communication of said low pressure conduit with said prime mover and establish communication of the prime mover with the high pressure conduit; substantially as described.

4. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a comparatively long supply conduit of substantially uniform cross-section connected therewith to convey motive fluid to said prime mover, a valve to control the passage of fluid to said prime mover through said conduit, and a motor device for said valve having a branch connection with said conduit and operated by variations of pipe friction therein; substantially as described.

5. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a high pressure conduit, a low pressure conduit, a common supply conduit connecting said first named conduits with said prime mover, a valve to control one of said first named conduits, and a motor device for said valve having a movable element acted upon by portions of fluid derived from

said last named conduit and from said common supply conduit respectively; substantially as described.

6. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a high pressure conduit, a low pressure conduit, a common supply conduit connecting both of said last named conduits with said prime mover, a valve to control the passage of fluid through the high pressure conduit, and a motor device for said valve comprising a movable element acted upon at one side by fluid derived from said common supply conduit and acted upon at the opposite side by fluid derived from said high pressure conduit; substantially as described.

7. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a high pressure conduit, a low pressure conduit, a long supply conduit of substantially uniform cross-section connecting said first named conduits with said prime mover, a valve in the high pressure conduit, and a motor device for operating said valve comprising a piston, and a casing therefor connected at opposite sides of the piston with the high pressure conduit and the common supply conduit respectively; substantially as described.

8. The combination of a prime mover, a high pressure conduit, a low pressure conduit, a common inlet pipe connecting said conduits with said prime mover, a valve for controlling one of said conduits, and a motor device for operating said valve, comprising a casing connected with said common inlet pipe and a movable valve actuating member in said casing subjected to oppositely acting liquid pressures and operated by variations of pipe friction in the piping; substantially as described.

9. The combination of a prime mover, a high pressure conduit, a low pressure conduit, means to connect said conduits with said prime mover, a valve to control one of said conduits, and a motor device to operate said valve, including a member subjected to the pressures of oppositely acting portions of fluid in the system and operated by variations of pipe friction in the piping to open said valve, as such pipe friction de-

creases below a certain limit; substantially as described.

10. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a high pressure conduit, a low pressure conduit, a common supply conduit connecting said first named conduits with said prime mover, a valve to control one of said first named conduits, and a motor device for said valve having a movable element acted on in one direction by fluid derived from one of said first named conduits, and acted on in the opposite direction by fluid derived from said common supply conduit; substantially as described.

11. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a high pressure conduit, a low pressure conduit, a common supply conduit connecting both of said conduits with said prime mover, and means actuated by variations of pipe friction in said common supply conduit to cut off communication of said low pressure conduit with said prime mover and establish communication of the prime mover with the high pressure conduit, said means comprising a motor device having a casing connected with the common supply conduit, and with one of said first named pressure conduits and a valve actuating element in said casing; substantially as described.

12. In controlling mechanism for hydraulic presses and the like, the combination of a prime mover, a high pressure conduit, a low pressure conduit, a common supply conduit connecting said first named conduits with said prime mover, a valve for controlling said high pressure conduit, and a motor device for operating said valve, comprising a casing and a movable valve operating element in said casing subjected to the pressures of the high pressure conduit and the common supply conduit respectively; substantially as described.

In witness whereof, I have hereunto set my hand on the 5 day of June, 1912.

WALTER R. CLARK.

Witnesses:

JOSEPH B. HARRIS,
RONALD C. HANDS.