

No. 720,162.

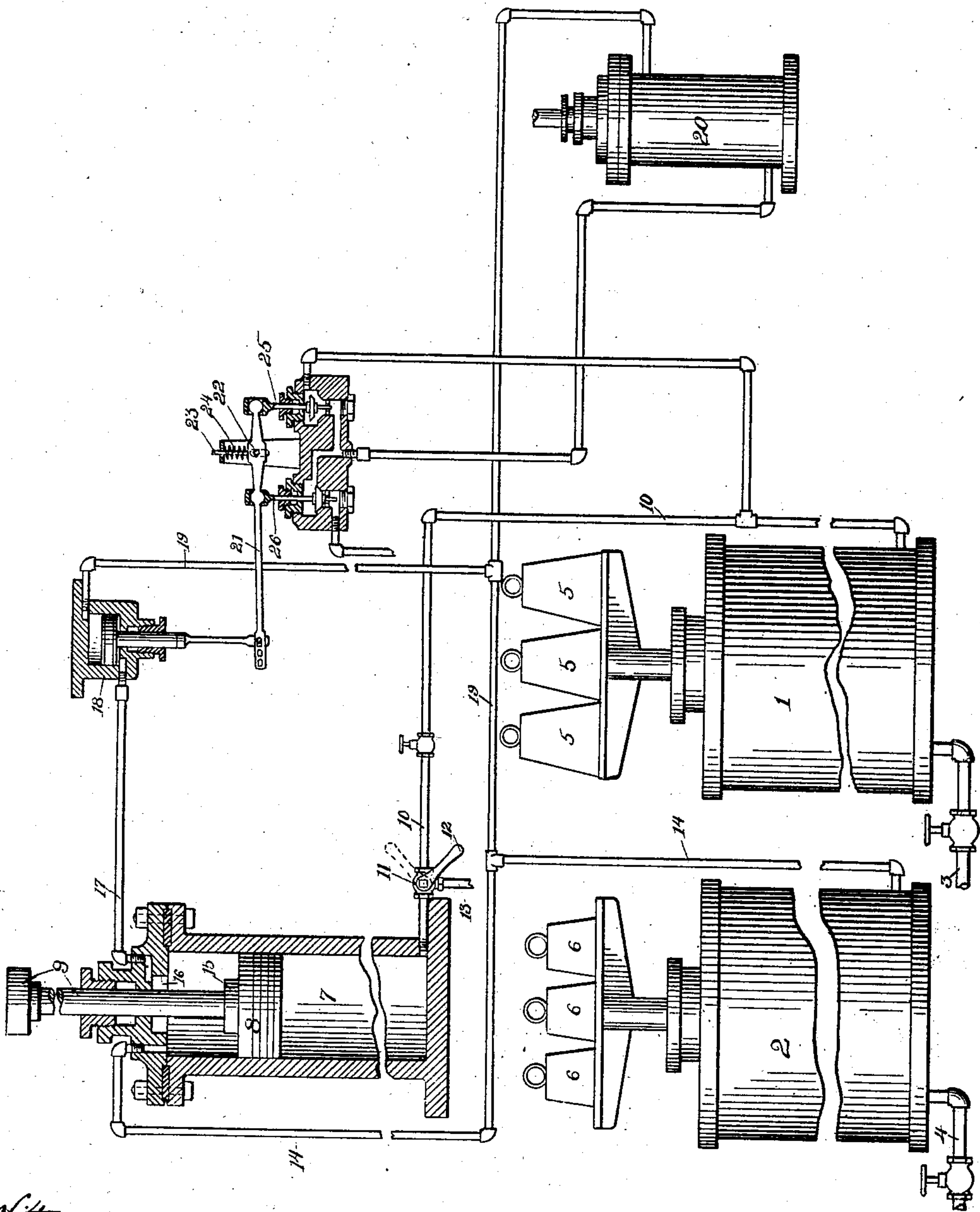
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# AUTOMATIC HYDRAULIC APPARATUS.

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NO MODEL.



Witnesses:

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# UNITED STATES PATENT OFFICE.

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## AUTOMATIC HYDRAULIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 720,162, dated February 10, 1903.

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*To all whom it may concern:*

Be it known that I, ALFRED B. LAWTHER, a citizen of the United States, residing in Syracuse, in the county of Onondaga and State of New York, have invented a new and useful Improvement in Automatic Hydraulic Apparatus, of which the following is a specification.

This invention relates to automatic hydraulic apparatus.

When automatic devices are of moderate dimensions, there is ordinarily no great difficulty encountered in constructing a rigid framework to carry the usual cams, levers, shafts, gearing, and other mechanical parts and movements commonly employed in such devices; but in all those cases where these several parts of the automatic mechanism are necessarily arranged farther apart and are some of them very heavy—as, for instance, such mechanisms as oil-presses—the framing becomes a difficult problem and expensive, and there is a much increased difficulty in subsequent maintenance. For this reason I have thought that in such automatic machinery especially it would be desirable to have the movements produced by means of hydraulic engines, which may be connected by pipes from the source of power at whatever distance desired and controlled by valves, and thus the cost of heavy framing, extensive shafting, and ponderous moving mechanical parts and their cost of maintenance be largely overcome. In working out this general idea several problems of difficulty presented themselves: How to cause the piston of the hydraulic engine to be economically returned to its original position after its stroke, how to cause the stroke of one hydraulic engine to set in action automatically by hydraulic means a second hydraulic engine, and how to construct a suitable double-acting valve which shall possess the qualities of a slide-valve and yet in this relation be free from the disadvantages of the slide-valve; and the present invention consists in the novel parts and combination of parts and devices with the foregoing ends in view and which are more fully hereinafter described and claimed.

In the accompanying drawing, which forms a part of this specification, an apparatus involving my invention is diagrammatically shown.

In said drawing, 1 and 2 are sources of unequal hydraulic power of any kind or character and which may be, as illustrated in the present case, ordinary hydraulic accumulators. The hydraulic accumulator is a well-known device consisting, usually, of an upright hydraulic cylinder containing a piston the rod of which projects from the upper end of the cylinder and is loaded with weights. The liquid is pumped into this cylinder below the piston, which is thereby raised, lifting the weights, and the liquid for use is taken out below the piston, and consequently will stand in the pipes at a constant pressure determined by the amount of weight placed on the loaded piston. In the present case the piston of cylinder 1 is loaded much more heavily than the piston of cylinder 2, and the pressure in the pipes connected to cylinder 1 is therefore much greater than the pressure in the pipes connected to cylinder 2. For convenience I will call the pressure or power of cylinder 1 “P<sup>2</sup>” and the lesser pressure or power of cylinder 2 I will designate as “P’.” The amount of power in each of these accumulator-cylinders will be of course varied both directly and in relation to each other to suit the exigencies of any case.

3 4 are the supply-pipes leading, respectively, from accumulator 1 and accumulator 2 to the pump or pumps, driven by any suitable prime mover to supply the power to said accumulators.

5 6 indicate the weights, respectively placed upon the pistons of the accumulators 1 and 2, the weights 5 being heavier than weights 6.

7 is a hydraulic engine or cylinder containing a piston 8 to move a piston-rod 9. To the piston-rod 9 may be connected any desired mechanical device which can be operated by a to-and-fro movement. The lower part of this cylinder 7 through a pipe 10 receives liquid of the power P<sup>2</sup> from the accumulator 1, which lifts the piston 8 and forces the piston-rod 9 outwardly.

The admission of liquid through the pipe 10 to the cylinder 7 may be controlled by an ordinary three-way cock 11, provided with a hand-lever 12. When in the attitude shown in the drawing, the cock 11 is supposed to be in position to permit the liquid of the power P<sup>2</sup> to flow from accumulator 1 into the



cylinder. When the handle is in the position indicated in the dotted lines, this supply of liquid to cylinder 7 will be cut off and a waste-pipe 13 from the cylinder opened. For convenience in the present case I have described this cock 11 as being operated by hand. It may be, however, operated automatically, if desired, from some of the moving parts of the mechanism. By means of a pipe 14 liquid of the power  $P'$  is led from the accumulator 2 to the cylinder 7 above the piston 8, so that liquid of this power  $P'$  stands constantly in the cylinder above the piston to return the piston to its original position whenever the power  $P^2$  is cut off and the waste 13 opened. It will be seen that this power  $P'$  acts, therefore, in the nature of a spring—that is to say, the greater power  $P^2$  moves the piston against the power  $P'$  until the piston has reached the end of its stroke or to such point as the power  $P^2$  is cut off and the waste opened, when the power  $P'$  will assert itself and return the piston to its original position. When the piston is raised by the power  $P^2$ , the liquid above it of the power  $P'$  will simply be forced back into the accumulator 2.

On the upper side of the piston 8 is a collar or plunger 15 of smaller diameter than the piston 8. A chamber 16 is formed in the cylinder-head of a diameter to receive the plunger-collar 15 with a liquid-tight fit, and when the piston rises to its extreme limit this plunger enters the chamber 16 and compresses the liquid of the power  $P'$  which stands in this chamber and gives to the liquid contained in said chamber a higher power by this compression, which higher power we will call for convenience " $P^x$ ." A pipe 17 connects the chamber 16 with a small hydraulic engine or cylinder 18 below the piston of such auxiliary cylinder. Above the piston this cylinder is connected by pipe 19 to the accumulator 2. Now it will be seen that normally the power  $P'$  will stand on both sides of the piston of the cylinder 18, and there being an equality of pressure except for the difference caused by the area of the piston-rod on the lower side said piston when down will be held down; but when the plunger-collar 15 enters the chamber 16 in cylinder 7 a greater power  $P^x$  will be produced on one side of the piston as opposed to said power  $P'$ , which will cause said piston to move through a stroke, and when the plunger-collar 15 is withdrawn from the chamber 16 by the downward movement of the piston 8 in the cylinder 7 the power  $P^x$  will be withdrawn from beneath the piston of cylinder 18 and power  $P'$  above that piston will now cause the said piston to make the reverse stroke and to resume its normal position, and after the collar is entirely withdrawn from the chamber 16 power  $P'$  will again stand on both sides of the piston of said cylinder 18, and there being equality of pressure said piston will now stand motionless. By this simple means I am enabled from one

hydraulic engine or cylinder to actuate by hydraulic means another hydraulic cylinder in succession, and thus successive action may be carried to a third cylinder, but with diminished power, by operating the chamber 16 and plunger 15, and so on until the resulting power  $P^x$  in each successive cylinder is so far reduced that it will no longer be able to overcome the power  $P'$ . However, in the instance actually illustrated in the drawing the small hydraulic engine or cylinder 18, as shown, is not employed for doing work with its piston similar to the work to be done by the piston-rod 9 of the first cylinder, but for the purpose of operating a valve to control a third cylinder 20, which may be of the same construction and mode of operation as cylinder 7, and this cylinder 20 may in the same manner, through a small auxiliary cylinder like cylinder 18, be made to control and bring into successive operation still another, and so on indefinitely, and in case of such an arrangement of a number of successively-operated cylinders controlled and started in succession the final cylinder so controlled may be made to operate an auxiliary, which can be connected to the valve 11, which controls the initial cylinder 7. In such case there would be an automatic cycle of operations, beginning with the initial cylinder, passing through the succession of cylinders back to the initial cylinder, and so on successively until the power is cut off.

Returning to the cylinder 18 and the valve which it operates, I will now describe briefly the construction of this valve, which is a double valve. A peculiarity of this double valve is that it is operated by what I term a "floating lever," which is marked in the drawing 21. To the long arm of this floating lever the piston-rod of the cylinder 18 is connected.

22 is a pin or pivot passing through the lever to the rod 23.

24 is a spring.

25 and 26 are valve-stems pivotally connected to the lever 21. Now when the long arm of the lever is depressed, as is shown in the drawing, the valve-stem 26 will descend and close its valve, as shown in said drawing. In doing this, however, if we suppose that the valve-stem 25 at the other side of the spring was already down and its valve closed, the lever will fulcrum on the valve-stem 25 in effecting the closure of 26. The valve-stem 26 being down, if the long arm of the lever be further depressed this valve-stem 26 becomes in turn the fulcrum and 25 is lifted and its valve opened, and this being the condition if the long arm of the lever be raised the effect will be to first close both valves and then by a further lift to open valve 26 and keep 25 closed. To assist in this operation and render it more possible, the pipes and valves should be so constructed and arranged, as shown in the drawing, that the pressure of the liquid in its flow shall be on



the top of the valve or on that side which tends to close them both.

It will be understood from the foregoing that either one of the valves may be opened at will by means of the lever, but that in so doing both valves are momentarily closed, and that consequently only one of the valves is at any time open—that is to say, to open either one of the valves the other one will be closed in performing the act of opening—and this is accomplished without expensive parts or complicated mechanism and by use of a form of valve that can be readily ground to a tight fit.

I am well aware that slide-valves have already been used for covering two ports, either one of which can be opened or closed and which operate to close one port before the other one can be opened, and I could use such a valve in this place; but I prefer the form of valve described, because it has no flat surfaces and can be easily maintained, and, moreover is specially fitted to the liquid-pressures required in this connection. It will be seen that the valve, as shown in the drawing, is in position to admit the liquid-pressure  $P^2$  to the cylinder 20. If the position of the valve be reversed by the action of the cylinder 18, the pressure  $P^2$  will waste and the pressure  $P'$  will go into action in cylinder 20 and cause the reverse stroke of the piston therein.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a hydraulic cylinder and its piston of means for supplying a greater liquid-pressure upon one side of the piston and a lesser liquid-pressure upon the other side of the piston and means actuated by the movement of the piston under the influence of the greater pressure, for creating a hydraulic pressure less than the greater pressure, but greater than the lesser pressure, substantially as specified.

2. The combination of a hydraulic cylinder and its piston provided with a greater liquid-pressure on the one side of the piston and a lesser liquid-pressure on the other side of the piston and a second hydraulic cylinder supplied with a lesser liquid-pressure on both sides of the piston and means for increasing the pressure in the second cylinder on one side of its piston which means is actuated by the movement of the piston in the first cylinder under the influence of the greater pressure of said first cylinder, substantially as specified.

3. The combination with a hydraulic cylinder and its piston of means for producing a greater liquid-pressure upon one side of the piston and a lesser liquid-pressure upon the other side of the piston, a chamber in the cylinder on the lesser-pressure side, a plunger actuated by the movement of the piston to enter said chamber, a second cylinder and its piston connected at one side of its piston to

said chamber and at the other side of its piston to said means for producing the lesser pressure, whereby a stroke of the piston of the first cylinder due to the greater pressure may cause a movement or stroke of the piston of the second cylinder and the pistons of both cylinders be returned by the action of the lesser pressure when the greater pressure is released from the first cylinder, substantially as specified.

4. As a means for controlling a subsequent action or mechanism from a hydraulic cylinder, a compression-chamber in the head of the hydraulic cylinder combined with a plunger for compressing the liquid contents of said chamber, said plunger being actuated by the piston of the hydraulic cylinder at the termination of its stroke, and an auxiliary hydraulic cylinder connected to said compression-chamber, whereby at the termination of the stroke of the piston of the hydraulic cylinder the piston of the auxiliary hydraulic cylinder will be actuated by the compressed liquid, substantially as specified.

5. The combination with a hydraulic cylinder the piston of which is advanced by a liquid under a higher pressure against a liquid under a lower pressure and returned by said liquid under said lower pressure when the liquid under the higher pressure is exhausted by a waste-valve, of a compression-chamber in the head of a cylinder on the low-pressure side, a plunger for said compression-chamber, and an auxiliary cylinder the piston of which is operated by the liquid from the compression-chamber, substantially as specified.

6. The combination with a hydraulic cylinder the piston of which is advanced by a liquid under a higher pressure against a liquid under a lower pressure and returned by said liquid under said lower pressure when the liquid under the higher pressure is exhausted by a waste-valve, of the compression-chamber in the head of the cylinder on the low-pressure side, a plunger for said compression-chamber, and an auxiliary cylinder the piston of which is operated by the liquid from the compression-chamber, said auxiliary cylinder having its piston returned by the lower pressure, substantially as specified.

7. The combination with two sources of liquid-pressure of unequal power of a cylinder and its piston the greater power being connected to the cylinder at one side of the piston and the lesser power at the other side of its piston, a compression-chamber on the lesser-power side of the piston, an auxiliary cylinder and its piston connected on one side of its piston to the lesser source of power and on the other side of its piston to said compression-chamber, a third cylinder and its piston connected to the greater source of power on one side of its piston and to the lesser source of power on the other side of its piston and a valve, for controlling the admission to and waste from said third cylinder of the liquid of greater power, said valve being oper-



ated by the movement of the piston in said auxiliary cylinder, substantially as specified.

8. The combination with two sources of liquid-pressure of unequal power of a cylinder  
5 and its piston the greater power being connected to the cylinder at one side of the piston and the lesser power at the other side of its piston, a compression-chamber on the lesser-power side of the piston, an auxiliary  
10 cylinder and its piston connected on one side of its piston to the lesser source of power and on the other side of its piston to said compression-chamber, a third cylinder and its piston connected to the greater source of power  
15 on one side of its piston and to the lesser source of power on the other side of its pis-

ton, and a valve, for controlling the admission to, and waste from said third cylinder of the liquid of greater power, said valve being operated by the movement of the piston in  
said auxiliary cylinder, said valve consisting of an inlet and an outlet port, two valves, two valve-stems and a floating lever connected to both valve-stems so that when the floating lever is actuated, it will first close both  
25 valves and its further movement open one of the valves, substantially as specified.

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Witnesses:

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