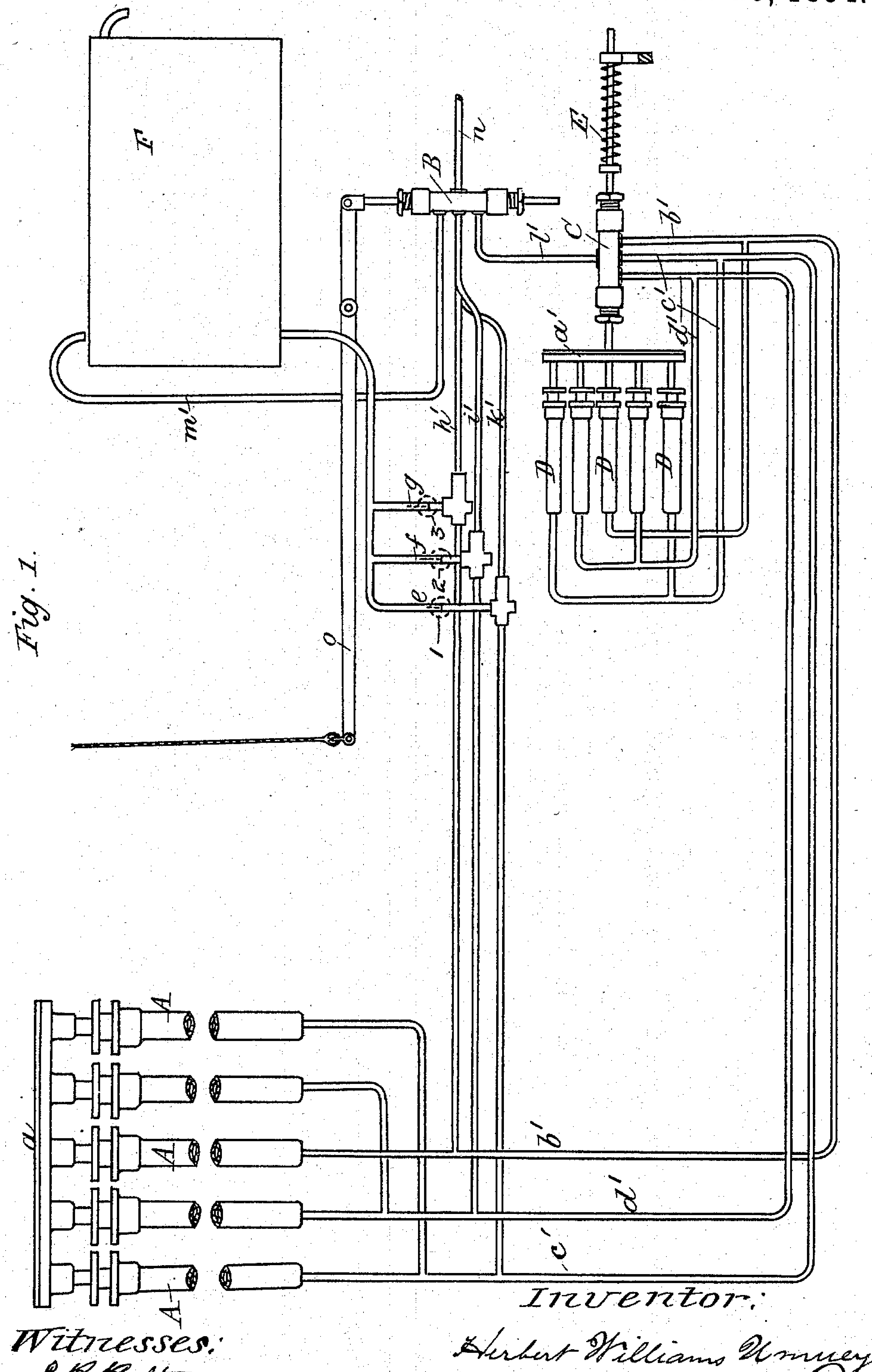
(No Model.)

4 Sheets—Sheet 1.

H. W. UMNEY.

HYDRAULIC HOISTING MACHINERY, &c.

No. 527,908. Patented Oct. 23, 1894.



Inventor:
Herbert Williams Umney
By Richards & Co
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Witnesses:
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(No Model.)

4 Sheets—Sheet 2.

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Fig. 2.

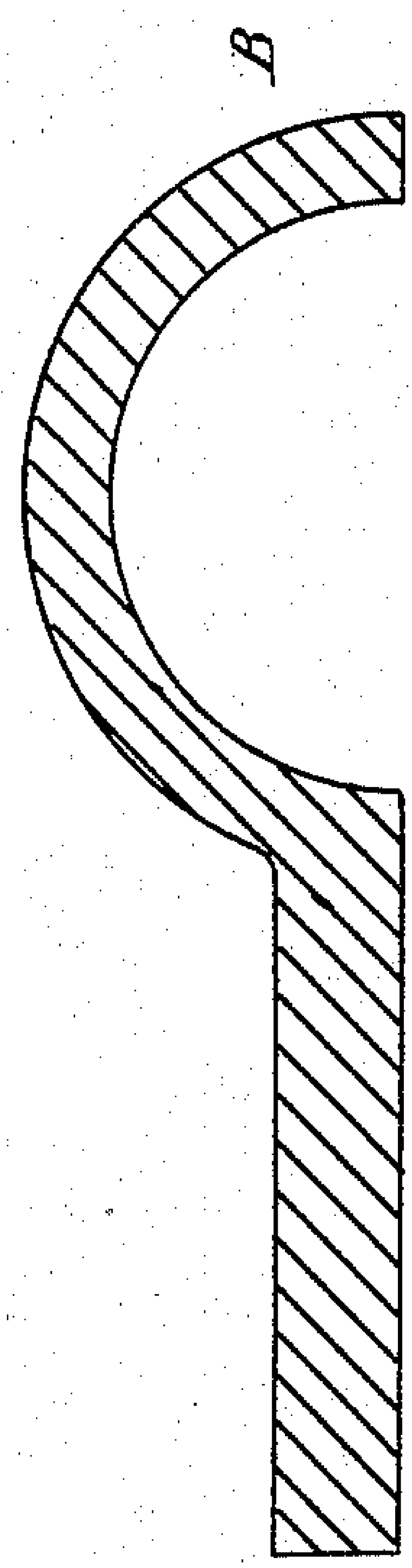


Fig. 3.

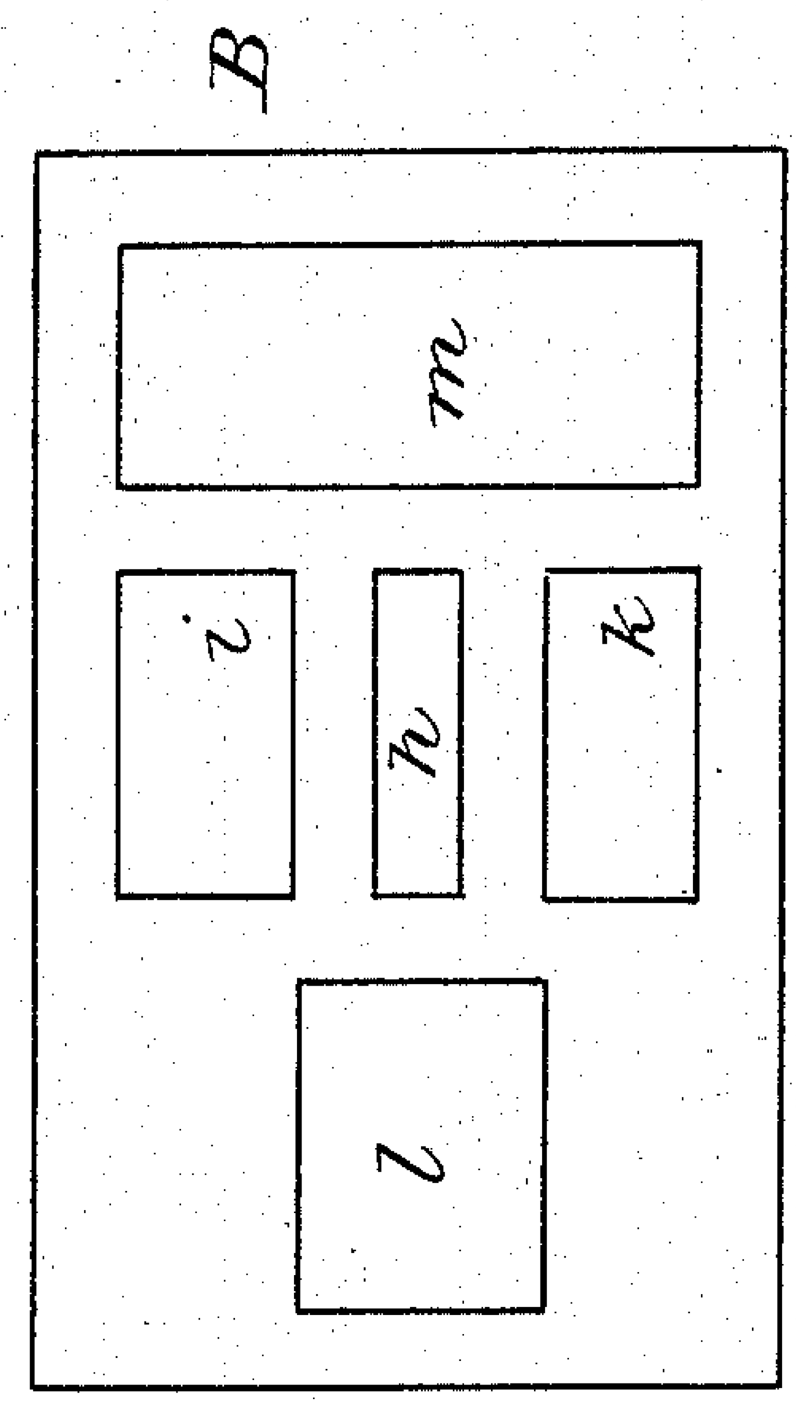


Fig. 4.

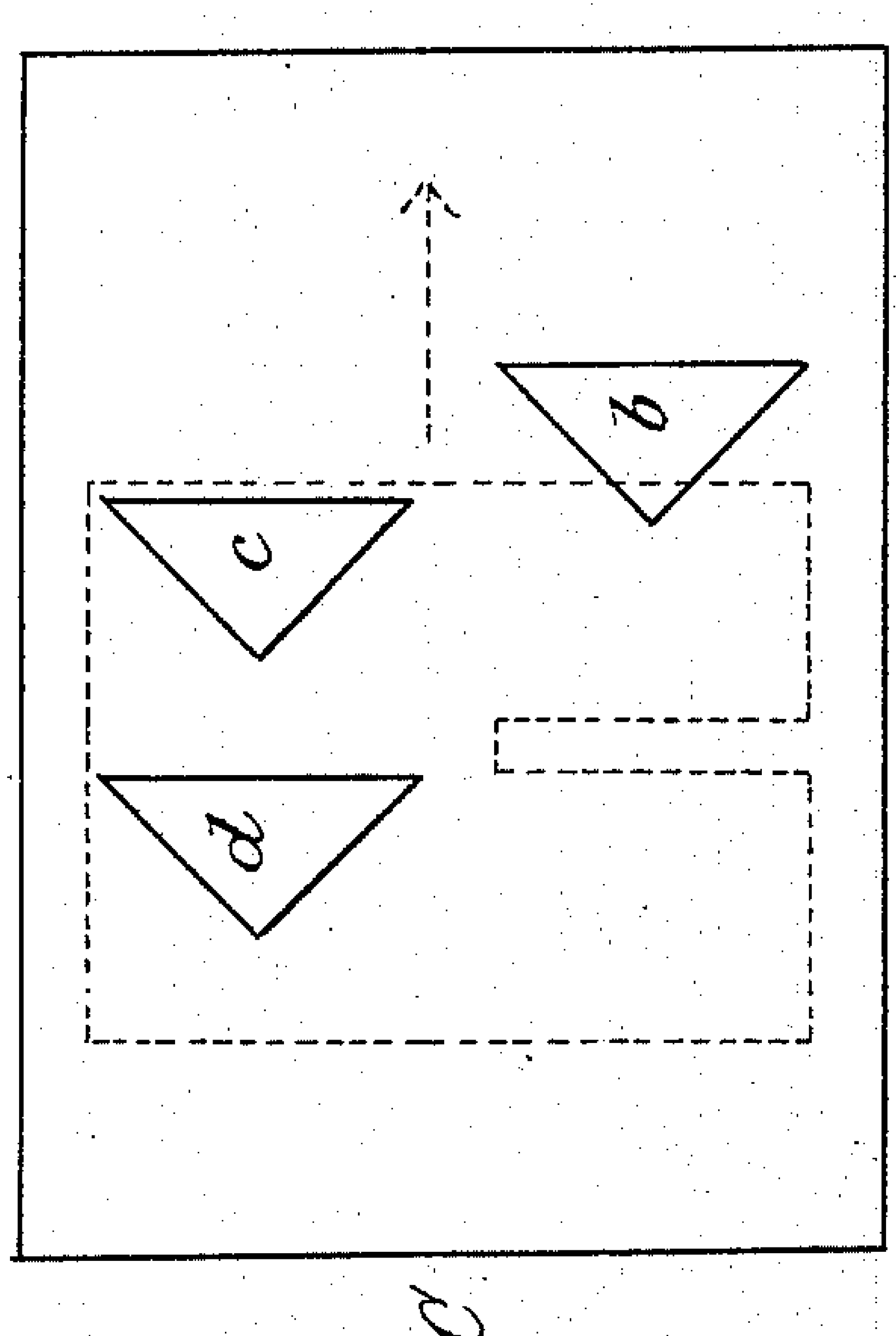
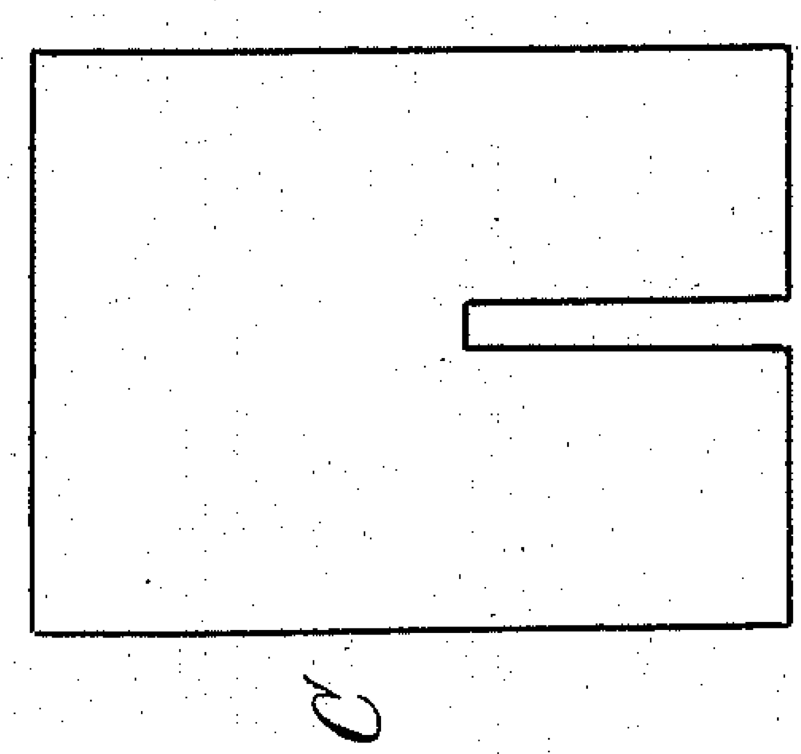


Fig. 5.



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(No Model.)

4 Sheets—Sheet 3.

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Fig. 6.

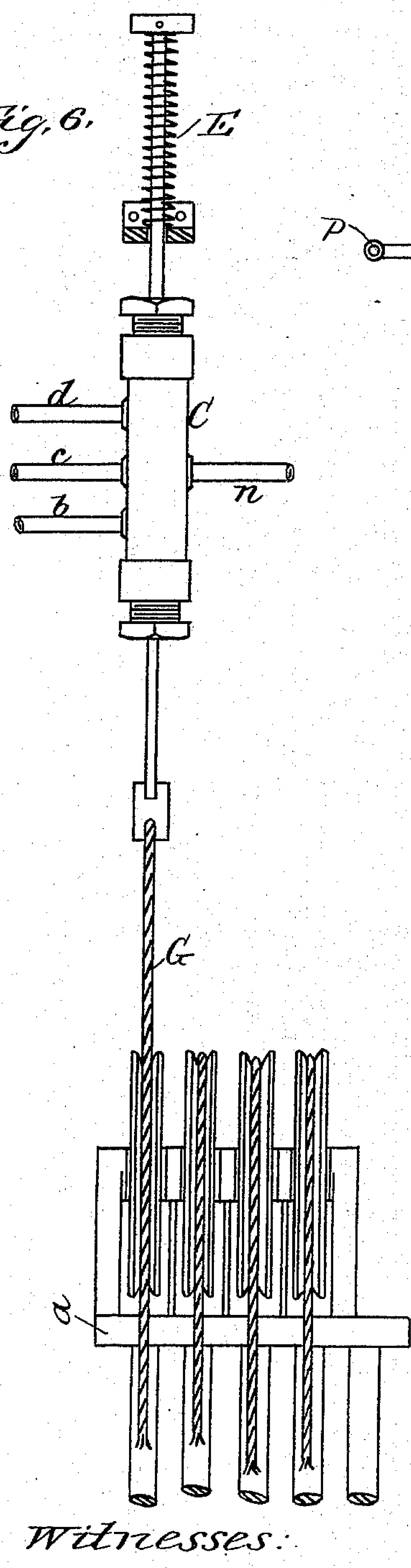

Fig. 7.

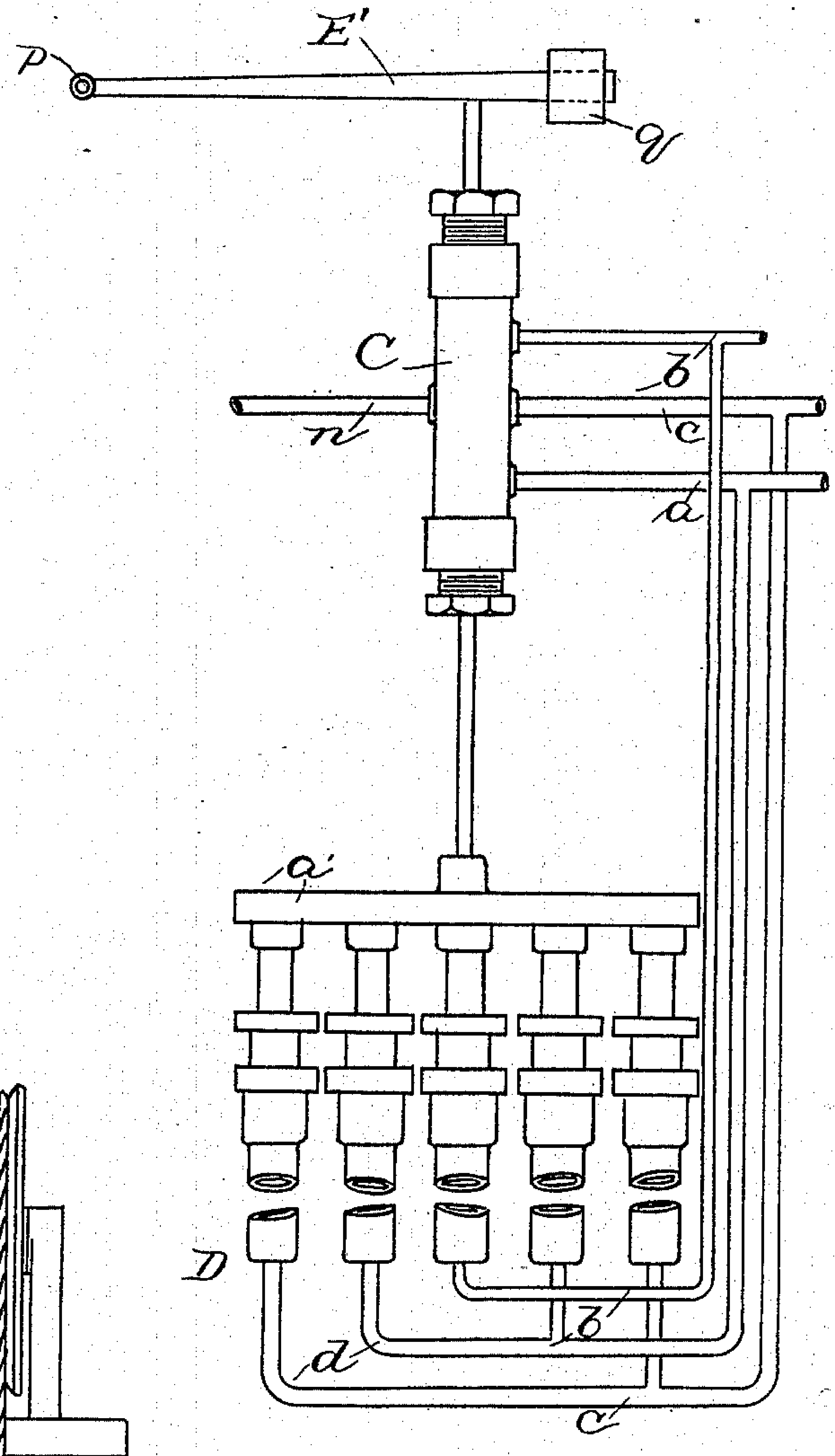

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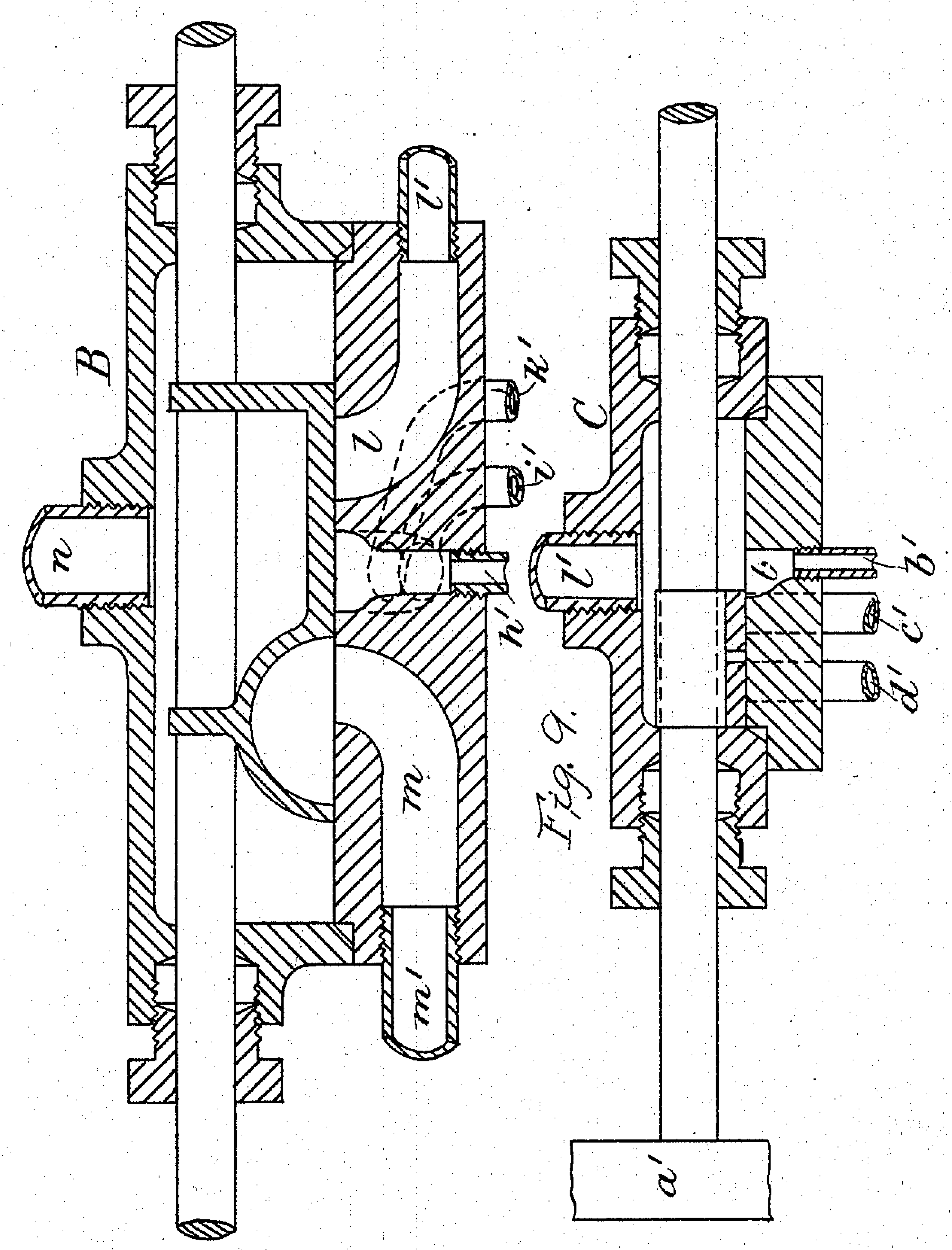
Fig. 8.

Fig. 9.



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J. L. Middleton.

Inventor
Herbert William Umney
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Attys

UNITED STATES PATENT OFFICE.

HERBERT WILLIAMS UMNEY, OF LONDON, ENGLAND.

HYDRAULIC HOISTING MACHINERY, &c.

SPECIFICATION forming part of Letters Patent No. 527,908, dated October 23, 1894.

Application filed June 6, 1893. Serial No. 476,783. (No model.)

To all whom it may concern:

Be it known that I, HERBERT WILLIAMS UMNEY, civil engineer, a subject of Her Majesty the Queen of Great Britain and Ireland, residing at Eardley House, Lawrie Park Road, London, in the county of Kent, England, have invented certain Improvements in or Relating to Hydraulic Lifting or Hoisting Machinery or Apparatus, applicable also to other hydraulic power apparatus, such as hydraulic presses and the like, of which the following is a specification.

This invention relates to improvements in that class or type of hydraulic lifting or hoisting machinery or apparatus wherein the maximum power may be subdivided into lesser graduated powers by the employment of a series or cluster of cylinders containing pistons or plungers for raising and lowering the lift or load, only sufficient cylinders of such series or cluster to raise any particular weight being put into communication with the pressure water supply by means of a regulating valve or valves automatically adjusted so that its position is determined by the varying weight elevated.

Now in hydraulic lifting or hoisting machinery of the above mentioned class or type as at present constructed, should a portion of the load be removed after the lift has started and before it has completed its ascent there is no provision for automatically causing the regulating valve or valves to lessen the power employed by automatically cutting off the supply of pressure water from such cylinder or cylinders as are not required, and consequently the power originally employed at the commencement to raise the heavier load will be continued with the lighter load thus causing considerable waste of water.

Now the chief object of my invention is to remove this defect, and to provide hydraulic lifting or hoisting machinery or apparatus of simple and economical construction, wherein a single regulating valve not only automatically increases the power as required by admitting pressure water to extra main power cylinders, but also automatically decreases the power if necessary by shutting off any main power cylinders not required from the pressure water supply the moment the load is lightened. I thus effect great economy in the amount of water consumed.

My invention may be equally well applied to other hydraulic power apparatus, wherein the maximum power is subdivided as above mentioned, such as to hydraulic presses and the like, for example.

According to my invention I employ a single regulating valve which controls the admission of pressure water to the whole series or cluster of lifting cylinders. The number of ports in this valve corresponds with the number of systems or groups having independent water supplies into which the whole series or cluster of main power cylinders is divided for producing the different powers, and the ports are so arranged that the forward movement of the regulating valve will successively bring the various powers into operation commencing at the lowest power. The devices employed for producing when required the automatic forward movement of the regulating valve (so that the position thereof is determined by the varying weight lifted or by the varying resistance to the stress of the main power cylinders) are so constructed and arranged that the forward stress they exert upon the regulating valve will always increase or diminish as the stress of the main power rams upon their crosshead increases or diminishes. The said forward movement of the regulating valve is always opposed by a resisting device, (such as a spring or weighted lever, for example) which is so arranged as to yield or give under a stress slightly less than the maximum forward stress exerted on the regulating valve when any power is operating, an amount sufficient to bring the next higher power into operation. In direct acting lifts I effect the said automatic forward movement of the regulating valve by means of a series or cluster of supplementary cylinders containing pistons or plungers, which are all connected with the spindle of the regulating valve and which correspond in number with the main power cylinders and are similarly connected together or grouped. The admission of pressure water to these supplementary cylinders is also controlled by the regulating valve, so that when pressure water is admitted to any main power cylinder or cylinders it is at the same time admitted to the corresponding supplementary cylinder or cylinders. The exhaust of both the main power cylinders and the supplementary cylinders takes place through independent exhaust pipes and is so controlled by a separate valve (preferably the main or starting valve) that when any main power cylinder or cylinders exhaust the corresponding supplementary cylinder or cylinders exhaust also. The low pressure water supply from the tank also admits low pressure water to corresponding main power cylinders and supplementary cylinders at the same time. From the above it will be seen that the stress exerted by the supplementary rams upon the regulating valve spindle will vary according as the stress of the main power rams upon their crosshead varies and that the position of the regulating valve will consequently be determined by the varying weight of the load or by the varying resistance to the stress of the main power rams. The areas of the supplementary rams must be proportionate to the amount of travel they are required to impart to the regulating valve for producing any power.

In those cases where the stress of the main power rams is exerted upon a hoisting rope as in suspended lifts or cranes for example I may dispense with the supplementary cylinders and effect the automatic forward movement of the regulating valve by the stress of the hoisting rope which I connect therewith. It is clear that in this as in the previously described arrangement the stress automatically exerted upon the regulating valve will increase or diminish as the stress of the main power rams upon the hoisting rope increases or diminishes and that the position of the regulating valve will be consequently determined by the varying weight of the load or by the varying resistance to the stress of the main power rams.

I will now proceed to more fully describe my invention and the manner of performing the same having reference to the accompanying drawings in which similar letters refer to corresponding parts in all the figures.

Figure 1 is a diagrammatic view representing in side elevation a five power direct acting lift of the class or type set forth constructed in accordance with my invention. Fig. 2 is a longitudinal vertical section of a main or starting slide valve constructed according to my invention. Fig. 3 is a plan of the valve face of the above mentioned valve showing the arrangement of the parts. Fig. 4 is a plan of the valve face of the regulating valve. Fig. 5 is a plan of the regulating slide valve. Fig. 6 illustrates the method of obtaining the automatic forward movement of the slide valve which I may employ in the case of suspended hydraulic lifts or cranes. Fig. 7 shows the application of a suspended weighted lever as the resisting device to the forward movement of the regulating valve. Fig. 8, is a detail sectional view of the starter valve with the various pipe connections, and Fig. 9, is a similar view of the regulating valve.

A A are the main power cylinders for raising and lowering the load. They are five in number, placed in a row, and their pistons or plungers are connected with the crosshead *a*.

B is the main or starting valve.

C is the regulating valve, and D represents the supplementary cylinders which correspond in number with the main power cylinders A. The center cylinder A is in no way connected as regards its pressure water supply with any of the remaining cylinders of the series or cluster which are connected by pipes in pairs, the two extreme outside cylinders and the cylinders adjacent to the center cylinder being respectively connected together by branch pipes as clearly shown in the drawings, thus making three systems or groups having each an independent pressure water supply for producing the various powers. The supplementary cylinders D are connected together or grouped similarly to the cylinders A as is also clearly shown in the drawings.

The admission of pressure water to all the main power cylinders A and to the supplementary cylinders D is controlled by and takes place through the regulating valve C which in this case would have three ports *b c d* (see Fig. 4) one port for each of the three systems or groups of cylinders, viz., the two pairs, and the single cylinder, to which pressure water may be admitted independently. The port *b* admits water to the center cylinder A and corresponding supplementary cylinder D only, through the pipe *b′*, the port *c* admits water to the outer pair of cylinders A and corresponding pair of supplementary cylinders D through the pipe *c′*, and the port *d* admits water to the inner pair of cylinders A and corresponding pair of cylinders D by the pipe *d′*. The slide valve and ports of the regulating valve C are so arranged as shown in the drawings as that when the valve is moved forward (in the direction indicated by the arrow, Fig. 4) by the ram or rams D from its normal position (*i. e.*, with the port *b* only open) it will first close port *b* and open port *d*, then without closing port *d* reopen port *b*, then close port *b* again and open port *c*, *d* and *c* being thus open simultaneously and finally reopen port *b*, all three ports being then open simultaneously. In every case as is well known one port must open just a moment before another closes. Five different powers will thus be produced, the first and lowest power admitting pressure water to the center cylinder A only, the second power admitting pressure water to the inner pair of cylinders A, the third power admitting pressure water to the center cylinder and inner pair of cylinders, the fourth power admitting pressure water to both pairs of cylinders A, and the fifth and highest power admitting pressure water to the whole series or cluster of cylinders, the corresponding ram or rams D being in every case operated at the same time.

The resisting device before referred to for opposing the forward movement of the regulating valve C is here shown in the form of a helical spring E, the strength of which must as before explained be such that it will be compressed under a stress slightly less than the maximum stress exerted by the ram or rams D on the regulating valve when any power is in operation, an amount sufficient to bring the next higher power into action.

Low pressure water is supplied to the cylinders A and cylinders D from the tank F by the pipes *e f g* which are fitted with the usual retaining or nonreturn valves as indicated at 1, 2, 3, in dotted lines Fig. 1. The tank F should be of such capacity as to hold always sufficient water to fill the four main power cylinders A and corresponding rams D when only one is working, and would be fitted with an overflow pipe to the meter which indicates the amount of water consumed.

As in apparatus constructed according to my invention the regulating valve ports are not in many cases all open when the lift or load descends. The exhaust water from the rams can not return by the supply pipes through the regulating valve. I therefore convey the exhaust water direct to the main or starting valve B by the independent exhaust pipes *h' i' k'* shown in the drawings as connected with the low pressure supply pipes *g*, *f*, *e*, and I will now proceed to describe the construction and arrangement of main or starting valve B employed.

The arrangement of the ports will be clearly seen in Fig. 3. *l* is the port through which the pressure water passes to the regulating valve C by the pipe *l'*. *h i k* are three ports, (one for each system or group into which the five cylinders are divided as before mentioned) through which the exhaust water passes to the tank F by the port *m* and pipe *m'*. One of these ports *h* admits the exhaust water from the center cylinder A and center cylinder D, and the other ports *i* and *k* admit the exhaust water from the inner and outer pairs of cylinders A and corresponding pairs of cylinders D respectively. The ports *i k* should be double the size of the port *h* and all three exhaust ports should be situated at equal distances from the exhaust port *m* so as to open simultaneously. *n* is the supply pipe from the main and *o* is the starting and stopping lever.

When the apparatus is not in action the exhaust ports *h i k* in valve B will be closed as also the port *l* which leads to the regulating valve C. When the valve B is moved in the direction to start the apparatus by means of the lever *o* the port *l* to the regulating valve will be opened and all the other exhaust ports closed. Pressure water then passes by the pipe *l'* to the valve C (which is in its normal position, viz., with port *b* only open as shown by the dotted lines in Fig. 4), and from thence through port *b* and pipes *b'* to the center cylinder A and center cylinder D only thus bringing the lowest power into operation. Should this power however be unequal to raise the load the said center supplementary ram D just before its stress on the valve C reaches its maximum will overcome the resistance of the spring E and compress the same sufficiently to bring the regulating valve into the proper position for causing the next higher power to act, that is to say in this case into such a position as to close port *b* and open port *d* thus admitting pressure water to the inner pairs of cylinders A and cylinders D by the pipes *d'*. Should this power be still insufficient to raise the load, the said pair of rams D just before their maximum stress on the valve C is reached will overcome the resistance of the spring E and compress the same still further a sufficient amount to move the regulating valve forward again into the proper position for bringing the next power into operation, that is to say into such a position as to reopen port *b* thus admitting pressure water to the central cylinder and adjacent pair of cylinders A and corresponding cylinders D, and so on, the same cycle of operations being repeated until a power just sufficient to raise the load, or until the maximum power is reached. Should however the weight of the load be decreased when partially elevated, then the spring E will automatically force back the valve C against the reduced pressure of the operating ram or rams D until the forward stress on the valve C is greater than the resistance of the spring E, thus automatically reducing the power to that required and avoiding waste of pressure water.

When the starting valve B is moved in the direction to permit the lift to descend, the port *l* therein will be closed and the exhaust ports *h i k* and *m* opened thus permitting the exhaust water from all the cylinders A and cylinders D to pass away to the tank F.

In Fig. 6 which as before mentioned illustrates the method of obtaining the automatic forward movement of the regulating valve I prefer to employ in the case of suspended hydraulic lifts or cranes, G is the hoisting chain or rope, one end of which is here shown as directly connected with one end of the regulating valve spindle, but it is obvious that in some cases it might be more convenient to connect the rope G and valve C through the intervention of levers, or levers and links, and the like. It is clear that in this as in the previously described arrangement the stress automatically exerted by the hoisting rope G upon the regulating valve will increase or diminish as the stress of the main power rams A upon the rope G increases or diminishes, and that the position of the valve C will consequently be determined by the varying weight of the load or by the varying resistance to the stress of the main power rams. The spring E acts in precisely the same manner as described with reference to Fig. 1 except that it is compressed by a pull instead of a thrust.

In Fig. 7 which shows the application of a suspended weighted lever as a resisting device to the forward movement of the valve C, E′ is the lever suspended from the pivot *p* and *q* is the weight. As before explained in describing the conditions of the resisting device the length and weight of lever E′ must be so arranged that it will swing back on its pivot under a stress slightly less than the maximum forward stress upon the valve C when any power is in operation sufficiently to allow the next higher power to be brought into action.

By obvious modifications my invention may be applied to all hydraulic power machines of the class or type set forth (*i. e.* wherein the maximum power is subdivided into lesser graduated powers). For example it may be applied to hydraulic presses and the like whether working vertically, horizontally or at an angle, and the apparatus illustrated in Fig. 1 may be considered to be a hydraulic press instead of a lift if desired. I do not therefore confine or limit myself to the precise details of construction and arrangement hereinbefore described and illustrated in the drawings, as the same might clearly be somewhat modified without in any way departing from the spirit of my invention as set forth.

In conclusion I would observe that I am aware that a single regulating valve for controlling the supply of pressure water to all the main power cylinders has been employed, but such regulating valve was however usually operated by a constant unvarying pressure and in those cases where a single regulating valve with varying pressure was employed the apparatus could only be used with two different powers. I am also aware that a series or group of supplementary cylinders, each ram of the series or group being connected with a separate independent regulating valve which it operated against the resistance of a separate independent spring has been proposed.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a hydraulic power apparatus and in combination, a main or starting valve, a single regulating valve, a pressure supply pipe leading direct from the starting valve to the regulating valve to cause all of the pressure water to pass through the said regulating valve, a series or cluster of main power cylinders, pipes extending from the single regulating valve to said cluster of cylinders the exhaust passage entirely independent of the regulating valve and constituting the only escape for the exhaust water, the series of exhaust pipes extending from the cluster of cylinders to the independent exhaust, the said single regulating valve and the single exhaust passage being common to all the cylinders of the cluster and being connected thereto by the said cluster or series of pipes and the means for regulating the position of the regulating valve to control the distribution to the various cylinders of the group, substantially as described.

2. In combination in a hydraulic power apparatus, a series of main power cylinders, a main or starting valve the single regulating valve C controlling the water pressure therein, the series or cluster of supplemental cylinders D, the supply pipes therefor also controlled by the said single valve, the connection between the supplemental pistons and the single regulating valve for controlling the same, the exhaust pipes in connection with both the main and supplemental cluster of cylinders and the exhaust passage with which said exhaust pipes connect said exhaust passage being entirely independent of the regulating valve substantially as described.

3. In a hydraulic power apparatus the combination of a cluster of main power cylinders A, a single regulating valve C controlling the supply of pressure water thereto, the cluster of supplemental cylinders D having their pistons connected with the stem of the single valve C the supply pipes for the supplemental cylinders communicating with the pressure supply between the regulating valve and the main cylinders and the resisting means acting on the stem of valve C in opposition to the pressure in the cylinder D, the said regulating valve also controlling the pressure water supply in the supplemental cylinders, substantially as described.

4. In combination in a hydraulic power apparatus, a series or cluster of main power cylinders A, the single regulating valve C controlling the water pressure therein, the cluster of supplemental cylinders D the supply pipes for the supplemental cylinders communicating with the pressure supply between the valve C and the main cylinders, said cluster of supplemental cylinders having their pistons connected with the stem of the regulating valve, the resisting means for placing the valve under tension in opposition to the pressure in the cluster of supplemental cylinders, the starting valve having connection with the regulating valve, and the exhaust pipes from the cluster of cylinders leading to exhaust ports in the starting valve independent of the regulating valve C, substantially as described.

5. In combination in a hydraulic power apparatus, the cluster of main power cylinders A comprising the central cylinder, the cylinders about the same connected together in pairs of which pairs one member is on one side of the central cylinder and the other member is on the opposite side the single regulating valve C for controlling the pressure in the cylinders, the means for placing a resistance on said valve the cluster of supplemental cylders comprising a central one and a series arranged on each side of the same and con-

nected up in pairs to correspond to the main power cylinders, said supplemental cylinders having their pistons connected with the single regulating valve, and the pipe connections between the regulating valve and the main and supplemental cylinders, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 25th day of May, A. D. 1893.

HERBERT WILLIAMS UMNEY.

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Clerk to above.