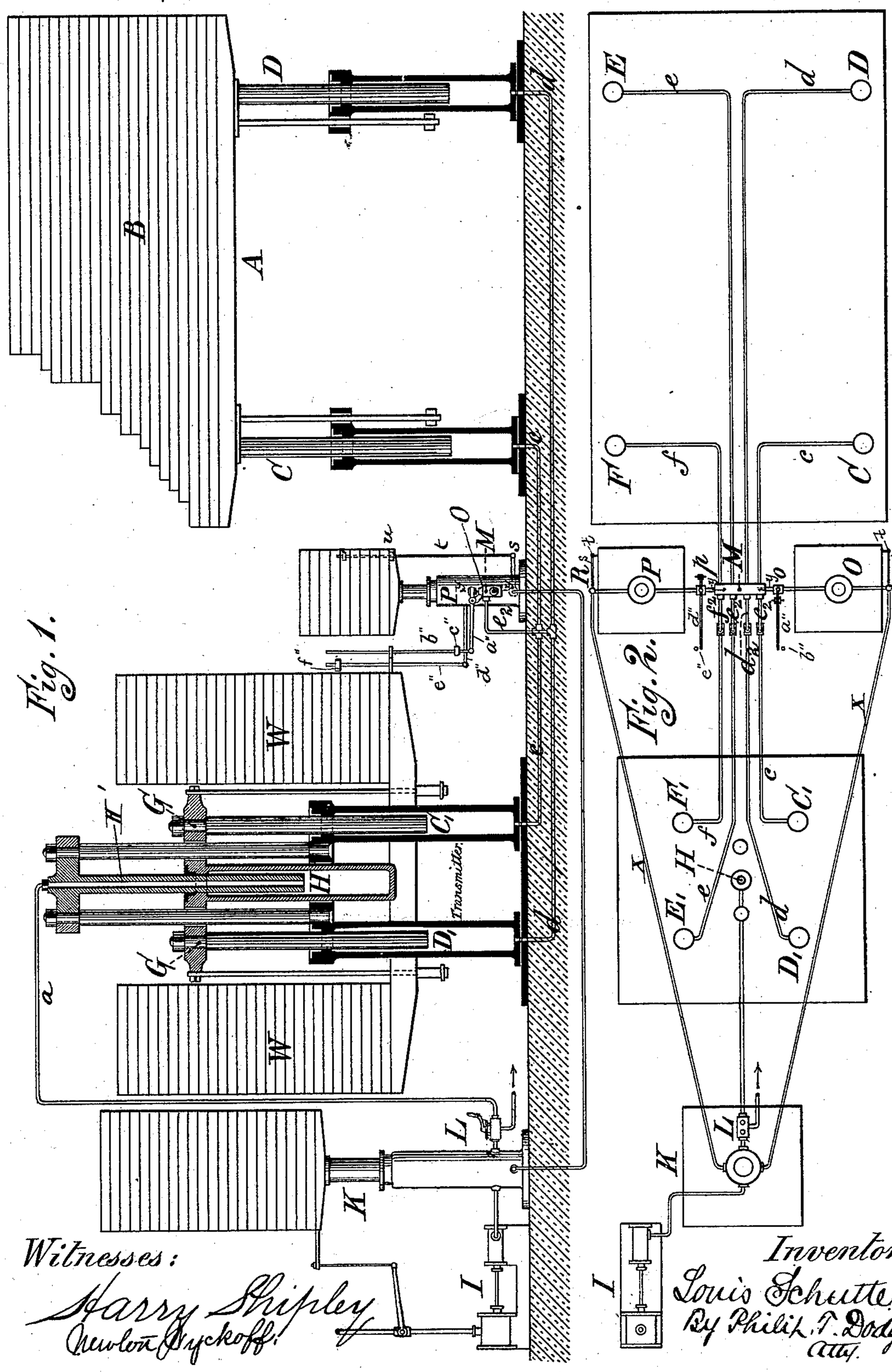
(No Model.) 3 Sheets—Sheet 1.

L. SCHUTTE.

HYDRAULIC RAMS ARRANGED IN SERIES.

No. 294,085. Patented Feb. 26, 1884.



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(No Model.) 3 Sheets—Sheet 2.

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HYDRAULIC RAMS ARRANGED IN SERIES.

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Fig. 3.

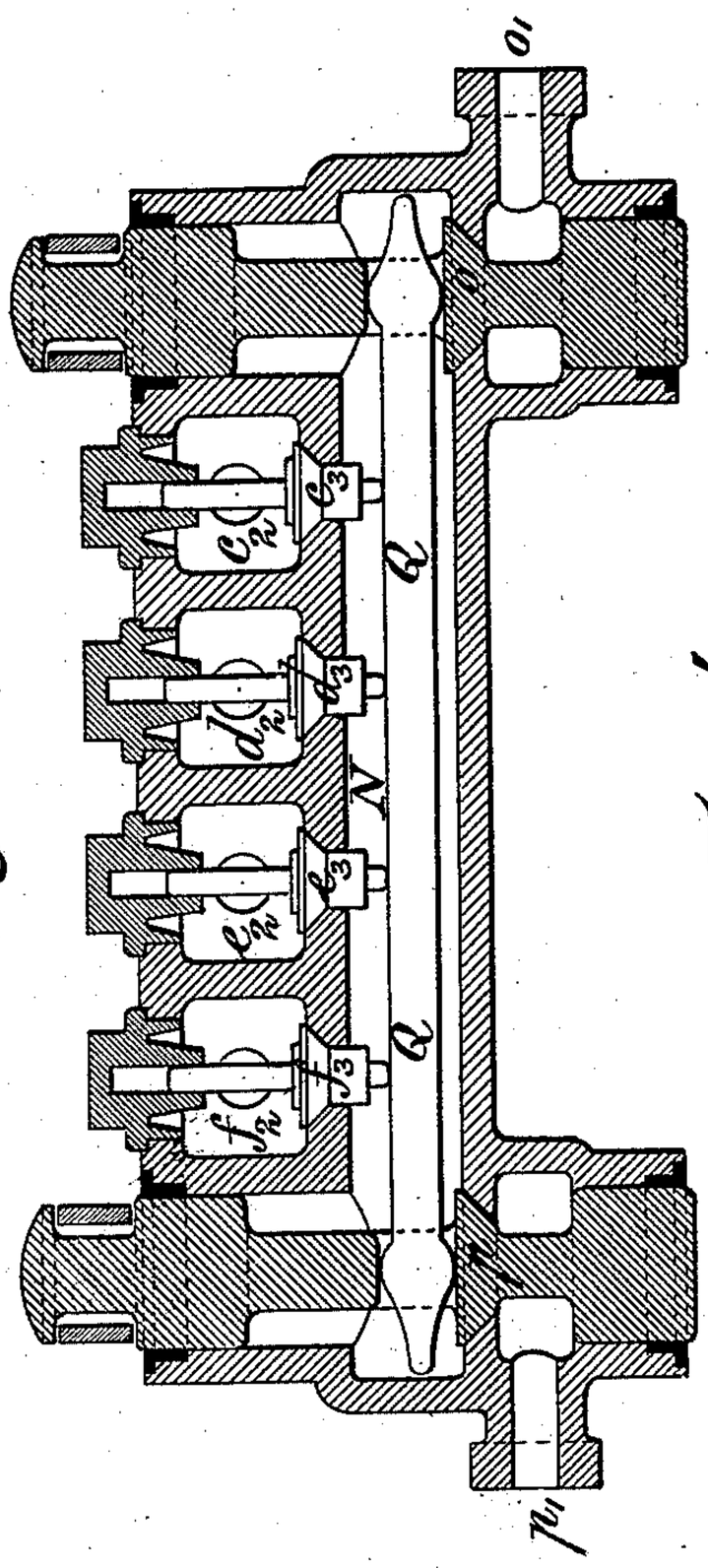


Fig. 4.

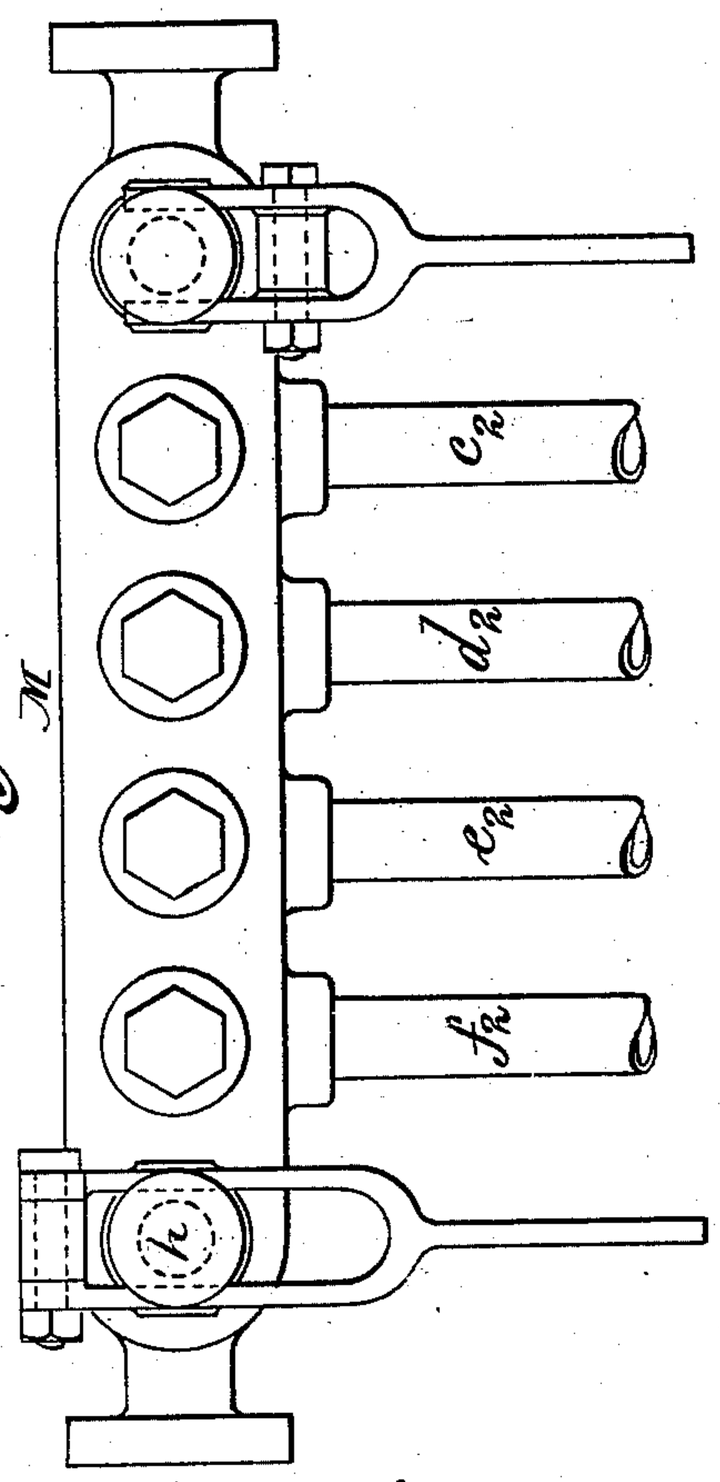
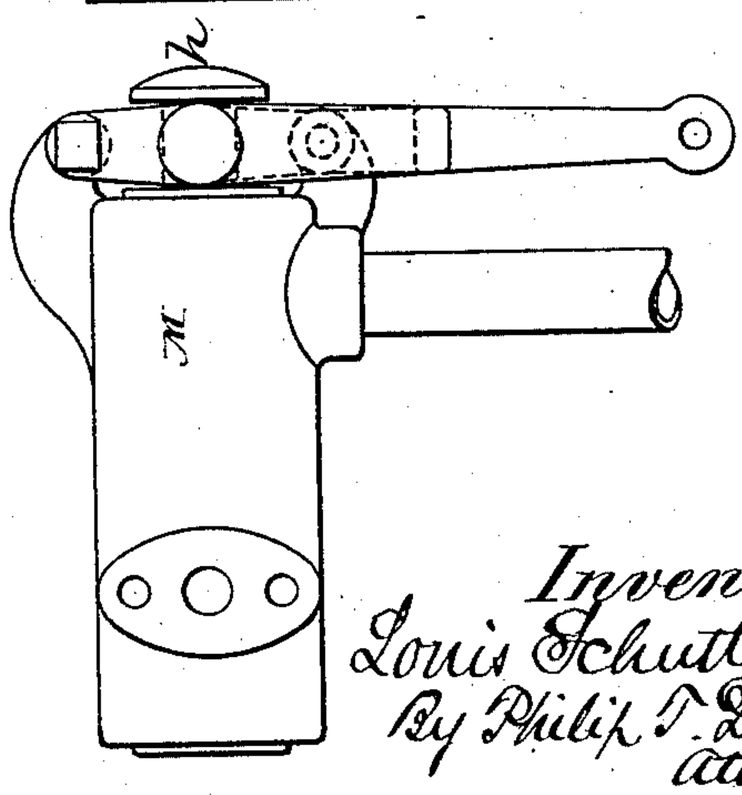


Fig. 5.



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(No Model.) 3 Sheets—Sheet 3.

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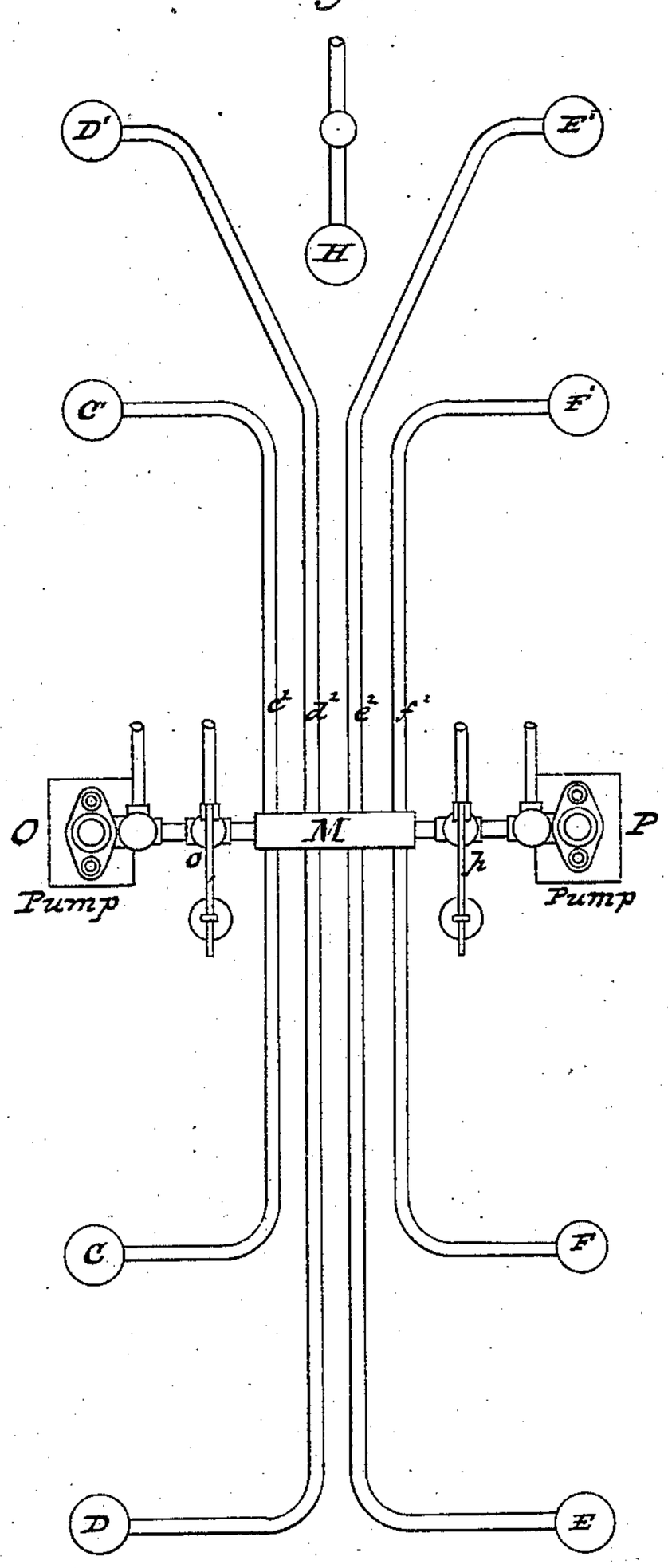
Fig. 6.



Witnesses.
Newton Wyckoff.
Harry Shipley

Inventor.
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By his Attorney.
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UNITED STATES PATENT OFFICE.

LOUIS SCHUTTE, OF PHILADELPHIA, PENNSYLVANIA.

HYDRAULIC RAMS ARRANGED IN SERIES.

SPECIFICATION forming part of Letters Patent No. 294,085, dated February 26, 1884.

Application filed January 24, 1883. (No model.)

To all whom it may concern:

Be it known that I, LOUIS SCHUTTE, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain Improvements in Hydraulic Rams Arranged in Series, of which the following is a specification.

The aim of my invention is to effect the simultaneous operation of a number of hydraulic rams or plungers; to maintain the same when in action at the same or at different levels, as circumstances may require; to secure the positive control of their movements in relation to one another, and to compensate automatically for leakages which may occur in such manner as to maintain the required action of the individual rams.

To this end the invention consists in the combination, with said rams, of secondary rams or cylinders, accumulators, and other appliances and devices, constructed and combined as hereinafter more fully explained.

The accompanying drawings illustrate my invention as embodied in that form which will be most generally found of service; but, as will hereinafter appear, the details of the apparatus may be modified in various respects and the invention embodied in different forms without departing from the limits of the invention.

Referring to the accompanying drawings, Figure 1 represents a sectional elevation of a system wherein four lifting rams or pistons are employed. Fig. 2 is a diagram illustrating in top plan the relative positions of the various parts. Fig. 3 is a transverse vertical section on the line *y y*, Figs. 1 and 2. Fig. 4 is a top plan view of the devices illustrated in the preceding figure. Fig. 5 is an end view of the same. Fig. 6 illustrates a modified form of the apparatus with pumps substituted in place of the accumulators as sources of high and low pressure fluid-supply.

Referring particularly to Fig. 1, A represents a platform carrying a load, B, to be sustained or elevated.

C, D, E, and F represent four hydraulic rams, of essentially ordinary construction, located beneath the respective corners of the platform, each ram embracing a cylinder and a piston entering the same through a stuffing-box at the end. The four rams are independent of each other, and are connected, respectively, by independent pipes with corresponding rams, C′, D′, E′, and F′, of an apparatus which I term, for convenience of description, the "transmitter." The rams of this transmitter consist each of a cylinder and a piston or plunger sliding therein, the four pistons being connected, as shown, rigidly to a common plate, by which they are caused to rise and fall in unison. This plate G bears at the center a cylinder, H, closed at its lower end, and receiving at its upper end a tubular piston, H′, fixed rigidly in position, and connected by a feed-pipe, *a*, with a force-pump, or preferably with an accumulating-cylinder, K, between said pipe and the force pump or engine I. Fluid, being passed through the pipe *a*, causes the descent of the head G and its four pistons, thereby driving the fluid from the respective rams of the transmitter through the intermediate pipes to the corresponding rams, C, D, E, and F, which elevate the load. It will be perceived that under this arrangement motion is communicated to each of the lifting-rams independently, and that as the rams of the transmitter descend the lifting-rams ascend, and vice versa. The position of each transmitter-ram is necessarily accompanied by a corresponding position of the lifting-ram with its connections. If a simultaneous and equal movement of the lifting-rams is required, the corresponding transmitter-rams will be made of equal size or area; but if an unequal movement of the lifting-rams is required they will be made of different sizes in relation to the transmitter-rams with which they are respectively connected.

In order to insure the simultaneous and equal movement of the pistons of the transmitter-rams C′ D′, &c., the top plate, G, may be arranged to work upon guides of any suitable character, so as to maintain the proper movement of the pistons, notwithstanding variations which may occur in the pressure beneath them.

While it is preferred to operate the transmitter-rams by hydraulic pressure, as illustrated, they may be operated by means of screws, gears, steam-cylinders, or other suitable motive apparatus, the invention in this regard not being restricted to the construction presented.

When a permanent load is included in the amount to be raised—such, for example, as the weight of the platform, rams, &c.—the transmitter may be made to act as a counter-balance therefor by loading the transmitter correspondingly. A second mode of doing this is represented in Fig. 1, in which the transmitter is provided with a platform and weights, W, placed thereon.

In the construction represented in the drawings a controlling and reversing valve, L, which may be an ordinary three-way valve, is placed between the transmitter and the pump or other source of fluid-supply, so that by turning said valve the operating-fluid may be directed into the transmitter or permitted to escape therefrom, according as it is desired to raise or lower the elevator-ram. When the fluid is directed into the transmitter, its rams will descend and the elevator-rams will ascend in the manner before explained; but on reversing the valve and permitting the fluid to escape from the transmitter the elevator-rams will descend and the transmitter-rams will be elevated, owing to the preponderance of weight upon the former.

In the foregoing description I have described the action which occurs, supposing that no leakage takes place in either of the rams and connections. In the event, however, of a leakage occurring in either of the pair of rams, the uniformity of level of the lifting-rams will be destroyed and the desired object defeated. To provide for this contingency, means must be provided to replace the liquid lost by leakage. This is effected in the following manner: Between each ram of the transmitter and the lifting-ram with which it is in connection I place a check-valve opening toward the lifting-rams, so that when these valves close each circuit will be independently closed, provided no outside influence is brought to bear. These check-valves are not placed directly in the connecting-pipes between the rams, but are placed, preferably, in a single body, M, to which branch pipes are extended, one from each of the conducting-pipes *d*. These branch pipes are isolated, and each terminates in a small independent chamber above the corresponding check-valves. These four check-valves open from a common passage or chamber, N, in the lower part of the body M, this passage communicating by separate pipes on one side with the accumulator O through a valve, *o*, and on the other side with an accumulator, P, through a valve, *p*. These accumulators consist each of a cylinder containing a piston loaded with a suitable weight, as represented. The valves *o* and *p* are connected with the transmitter by rods and levers, as shown, or by other suitable devices, arranged in such manner that as the transmitter approaches its upward limit of movement the valve *p* is opened, and that as the transmitter completes its downward movement the valve *o* is opened, thereby admitting the fluid from the accumulators O and P, respectively, into the chamber N below the check-valves. The details of these connections are as follows: The lever *a''* of valve *o* is pivoted to the valve at its end, and has its fulcrum at an intermediate point in its length, so that when its free end is depressed the valve will be opened. A rod, *b''*, rising from the free end of the lever passes through an ear or guide on the accummulator W, and carries at its lower end a collar, *c''*, upon which the guide on the accumulator acts to depress the latter and upon the valve *o*. The lever *d''* of valve *p* has its fulcrum at an intermediate point in its length, and has one end pivoted to the valve, so that the opening of the valve is effected by lifting the free end of the lever. This free end carries a rod, *e''*, passing upward through a guide or eye on the accumulator, and provided with a shoulder at its upper end, so that the elevation of the accumulator will serve to lift the rod and lever *d''*, thereby opening the valve *p*. Except when opened by the action of the transmitter the valves *o* and *p* remain closed, preventing communication between the accumulators O and P and the chamber N. The accumulator O is loaded to a pressure greater than that required to operate the lifting-rams and the load thereon, but less than that required to raise the transmitter when the latter is subjected to the pressure of the operating-fluid. The accumulator P is loaded to a pressure greater than that required to raise the transmitter-rams while they are relieved from the pressure of the operating-fluid, but too low to raise the platform and load B.

The operation of the apparatus is as follows: The operating-fluid delivered under suitable pressure into the working-cylinder H of the transmitter, the pistons C', D', &c., of the latter will be forced down, displacing the fluid thereunder and forcing the same beneath the lifting-rams C D, &c., compelling them to rise until they reach their limit of upward movement, or until the motion of the transmitter is stopped. Before the transmitter reaches its downward limit of motion it causes the valve *o* to open, thereby establishing communication between the accumulator O and the chamber N, whereupon the fluid will pass from said accumulator O through the passage N and the communicating-pipe beneath such of the lifting-rams, if any, as have not reached their proper level. The elevation of these rams should be limited by means of rods applied thereto, as shown in the drawings, or other suitable stop devices.

It will be seen that when the load is elevated to its highest point, and the transmitter-pistons depressed to their lowest point, and a full pressure of the accumulator O turned on the communicating-pipes, the level of all the lifting pistons is necessarily maintained and leakage compensated for. If, now, the pressure be removed from the working-cylinder of the transmitter, the transmitter will rise, causing the valve *o* to close and allowing the platform and lead B to descend until they reach the end of their stroke. Before this point is

reached, however, the transmitter causes the valve *p* to open communication between the accumulator P and chamber N, thereby elevating said transmittter should it not have reached the limit of its movement before.

It will be observed that in this manner, while the load is at its lowest point, the transmitter at its highest point, and a full pressure from the accumulator P in communication with the rams, the level is maintained and all leakage compensated for.

To prevent the excessive filling of the respective rams and connecting-pipes, and to provide means of relief should the same have occurred, I apply mechanism to lift the check-valves positively in such manner that while either of the valves *o* or *p* is opened all the check-valves are open and prevented from closing, so that a free flow of the liquid may be had through the system in either direction. A simple means of effecting this operation of the check-valves is by the employment of a bar, Q, as shown in Fig. 3, seated at its ends in the valves *o* and *p*, and acting beneath the spindles of the check-valves. Upon opening either of the valves *o* and *p* the corresponding end of the arm Q is elevated and caused to open the entire series of check-valves. The accumulators O and P are supplied with fluid through pipes X, extending therefrom to the pump or reservoir or other primary source of supply. These pipes will be closed, respectively, by valves R and S, connected each by a rod or equivalent device with the piston or equivalent moving part in such manner that when the accumulator is entirely filled the valve will close the supply-pipe automatically. Fig. 1 represents a simple device for this purpose, the valve being provided with an operating-lever, *s*, connected to a rod, *t*, the upper end of which has a collar or enlargement to be acted upon and lifted by an ear, *u*, or other guide on the platform or piston of the apparatus. Various forms of automatically-operated valves which may be substituted for those shown are in common use and familiar to those skilled to the art.

In the arrangement represented in the drawings the main or primary accumulator K, located between the pump or other source of supply and the transmitter, as before mentioned, must of course be loaded to a pressure in excess of that required by either of the accumulators O and P. Good results may be obtained by dispensing with the accumulator O and connecting the primary accumulator P directly with the valve *o;* but the arrangement shown is, for various reasons, preferred. The employment of accumulators is, for various reasons, considered advisable; but either or all of the accumulators may be dispensed with, and each one replaced by a force-pump having an overflow or relief valve to secure the delivery of the fluid at the desired pressure, pumps of this character being common and well understood by every person familiar with the art. This modified arrangement is represented in Fig. 6, in which O and P represent the force-pumps substituted in place of the accumulators represented in Fig. 2, the system being in all other respects identical with that illustrated in the last-mentioned figure.

When employed in the connection heretofore represented, the accumulators are to be considered simply as a series of reservoirs of liquid of certain pressures, or, in other words, as sources of high and low pressure fluid-supply, and it is manifest that pumps communicating with suitably-loaded valves adapted to supply fluid at certain pressures only will be merely mechanical equivalents of the accumulators.

By the expression "high pressure," as herein employed, is meant any pressure sufficient to operate the lifting-rams and load; and by the expression "low pressure" is meant a pressure insufficient to accomplish the above-named object.

While in the accompanying drawings I have shown four lifting and transmitting rams connected with one another, it is manifest that the number employed may be increased or decreased as circumstances may require, a corresponding number of intermediate connections and check-valves being in such case employed.

While I have described the working-rams as lifting-rams, it will of course be understood that they may be arranged and applied to operate in any direction for any purpose required.

My apparatus may be employed for any and all purposes for which it may be required to operate a series of rams in unison—as, for example, in oil-presses, in draw-bridges which act with a rising-and-falling motion, and in car-elevators.

Having thus described my invention, what I claim is—

1. In combination with two or more hydraulic lifting-rams, a transmitter embracing a corresponding number of rams connected separately with the respective lifting-rams, accumulators or sources of fluid-supply, and means whereby communication may be established between said accumulators and the lifting-rams at or near the end of their movement, substantially as described.

2. In combination with a series of hydraulic lifting-rams, a corresponding number of transmitting-rams arranged to move in unison and connected separately with the respective lifting-rams, the accumulators or equivalent sources of fluid-pressure supply, substantially as described, and stop-valves located between the accumulators and lifting-rams and operated by the transmitter, substantially as described and shown.

3. The combination of a series of lifting-rams, a corresponding number of transmitter-rams moving in unison, and connected separately with the respective lifting-rams, accumulators or equivalent sources of supply, O P, automatic valves connecting the same al-

ternately with a common chamber, and check-valves, whereby communication may be established with the respective rams independently of each other.

4. In combination with the series of lifting-rams, the corresponding series of simultaneously-moving transmitter-rams, each connected separately with the corresponding lifter-rams, the accumulators O P, chamber N, automatic valves *o* and *p*, and check-valves *c d e f*.

5. In combination with the valves *o* and *p* and the series of check-valves, arranged to operate as described, the bar Q, whereby the opening of the check-valves is effected.

6. In a system of hydraulic rams, the combination of a series of lifting-rams, a corresponding series of transmitter-rams, each connected independently with the corresponding lifter-rams, and intermediate means, substantially as described, for automatically supplying to the rams fluid to replace that which may escape by leakage.

7. In combination with the series of lifter-rams, the series of simultaneously-operating transmitter-rams in individual connection therewith, the operating piston and cylinder H, the check-valves between the transmitter and lifting rams, and the automatic valves *o p*, connecting with sources of pressure fluid-supply, substantially as described.

8. The combination, with the lifting-rams, of the corresponding series of transmitter-rams, the individual fluid-conductors connecting the rams, substantially as described, the counterbalancing-weight W, applied to the transmitter, check-valves applied to the respective fluid-conductors, and automatic valves *o* and *p*, communicating, respectively, with sources of high and low pressure fluid-supply, substantially as described and shown.

9. In combination with a series of elevator-rams, each having an independent fluid-supply by which it is actuated, an independent fluid-supply at a pressure greater than that required to actuate the lifter-rams, and automatic means, substantially as described, whereby said independent supply is placed in communication with the rams as the latter complete their outward or lifting movement, whereby automatic compensation for the leakage of fluid is effected.

10. In combination with the lifting-rams, the simultaneously-operating transmitter-rams, conductors connecting the respective transmitting and lifting rams, the intermediate check-valves, accumulators and automatic valves, and the accumulator K in advance of the transmitter, and a pump or equivalent source of supply to said accumulator K.

11. In combination with the lifting-rams, the transmitter-rams connected therewith, substantially as described, the cylinder and piston H H′, for operating the transmitter, the high-pressure accumulator K, connected with said cylinder, and a reversible valve, L, located between the accumulator and transmitter, substantially as and for the purpose described.

12. In a hydraulic ram, the combination of a lifting or working ram, a transmitter-ram, a fluid-conducting pipe connecting the two, a branch pipe provided with a check-valve opening outward, and a high-pressure fluid-supply communicating with said check-valve on the opposite side, substantially as described, whereby the outward flow of fluid from the conductor-pipe is prevented, but the inward flow from the high-pressure supply permitted to replace loss from leakage.

13. In combination with a hydraulic ram, a conductor for supplying fluid thereto, a source of high-pressure supply to said conductor, a source of low-pressure supply to said conductor, and automatically-operating valves, substantially as described, connecting said sources of supply alternately with the conductor, whereby the admission of fluid to supply loss from leakage is permitted through the one valve or the escape of surplus fluid permitted through the other.

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