No. 886,312. PATENTED APR. 28, 1908.

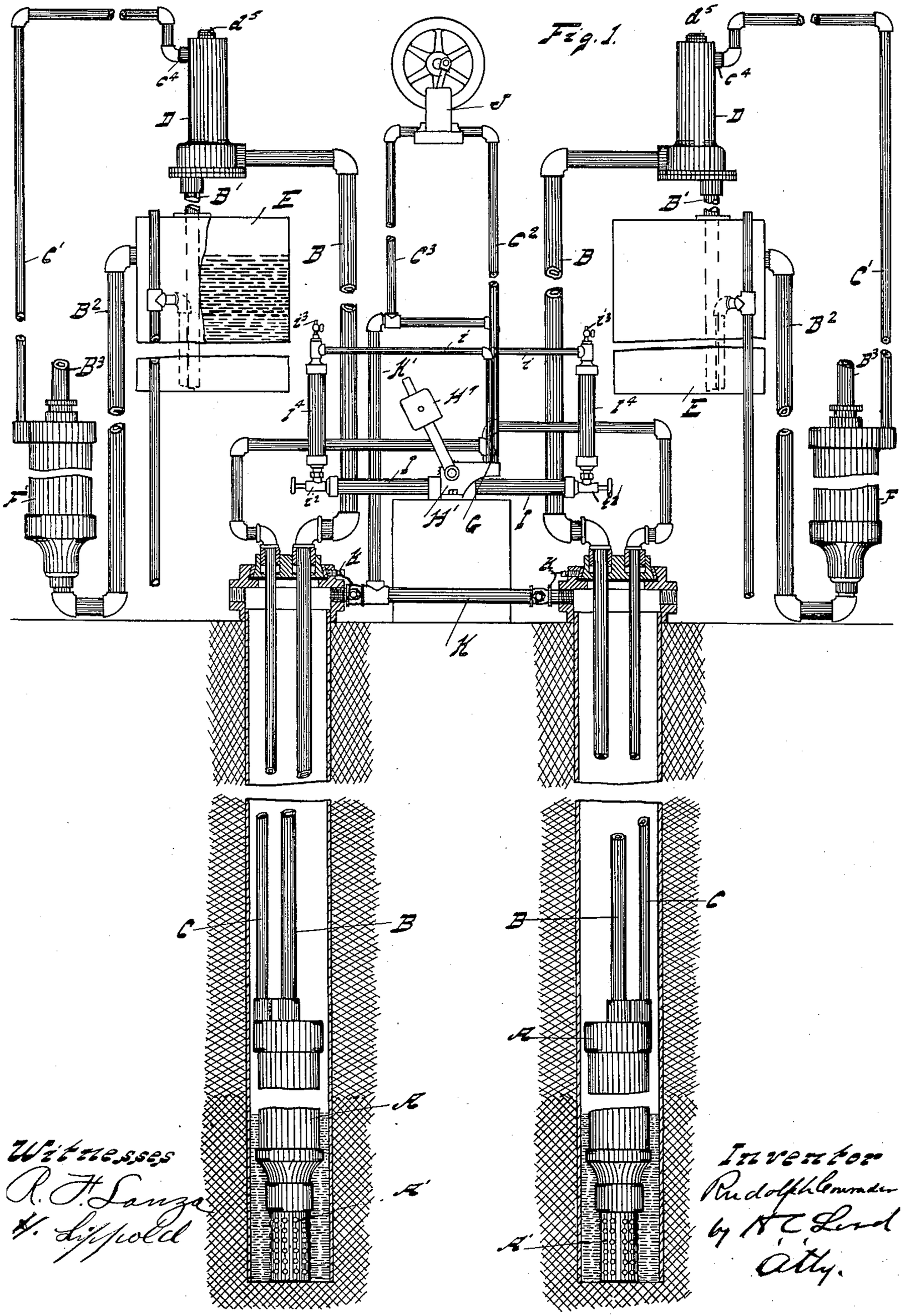
# R. CONRADER.

## APPARATUS FOR ACTUATING FLUIDS.

APPLICATION FILED JUNE 7, 1901.

4 SHEETS—SHEET 1.

Fig. 1.




Witnesses
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4 SHEETS—SHEET 2.

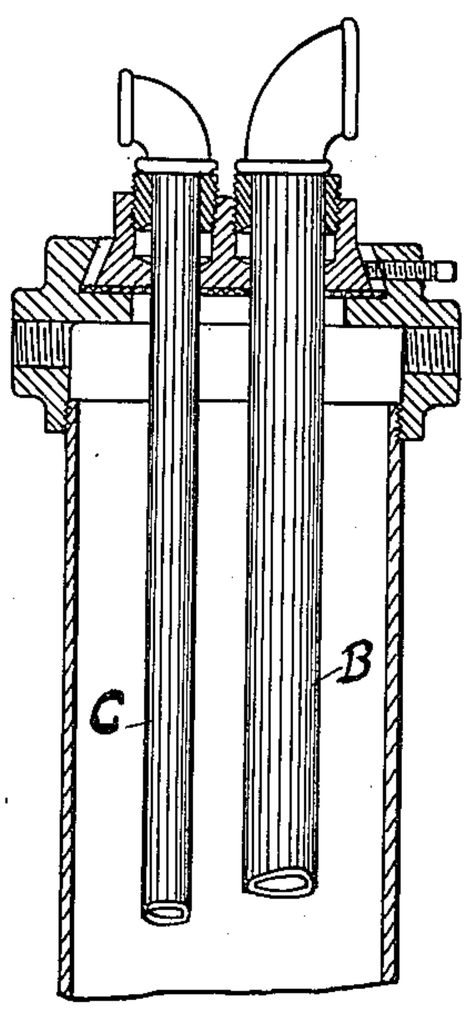



Fig. 2.

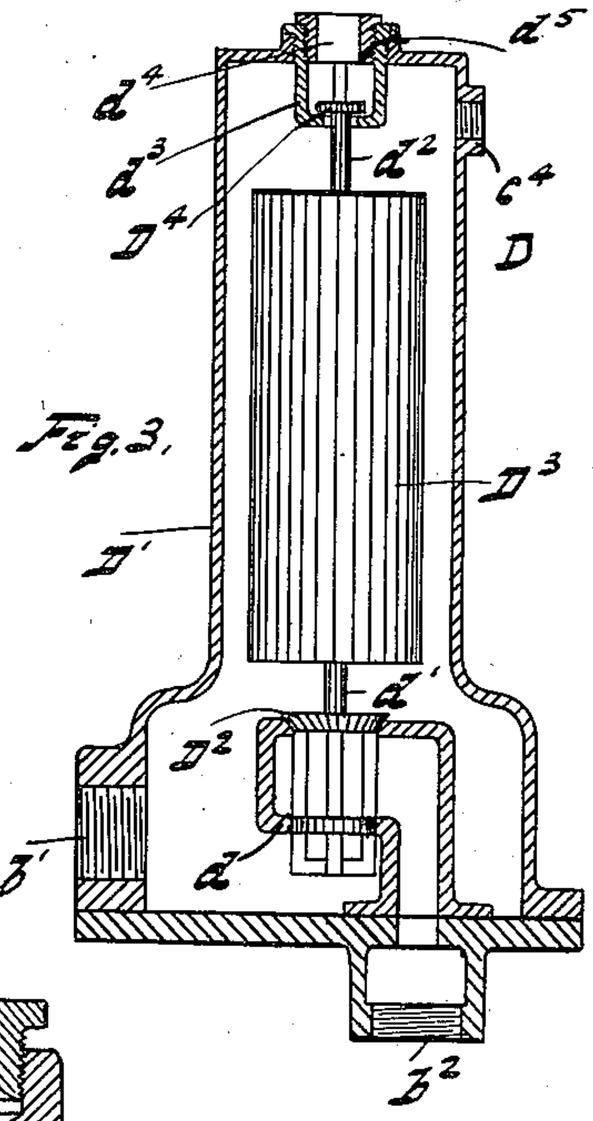
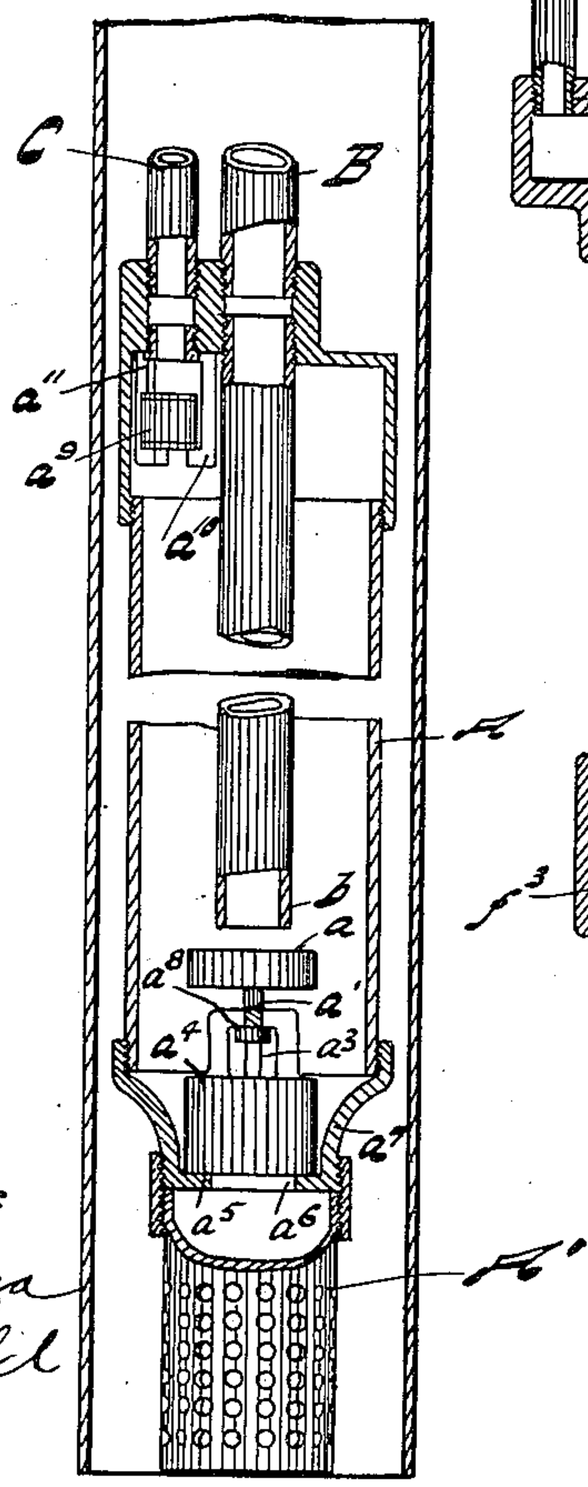



Fig. 3.



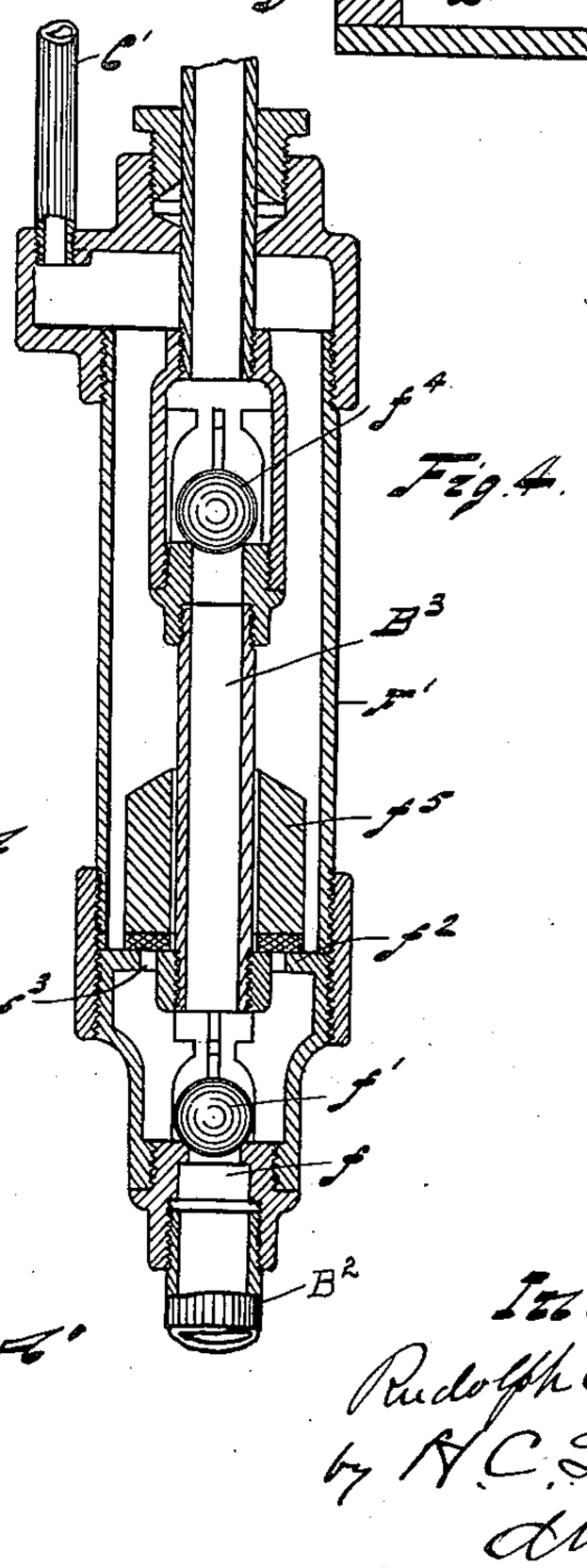




Fig. 4.

Witnesses
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4 SHEETS—SHEET 3.

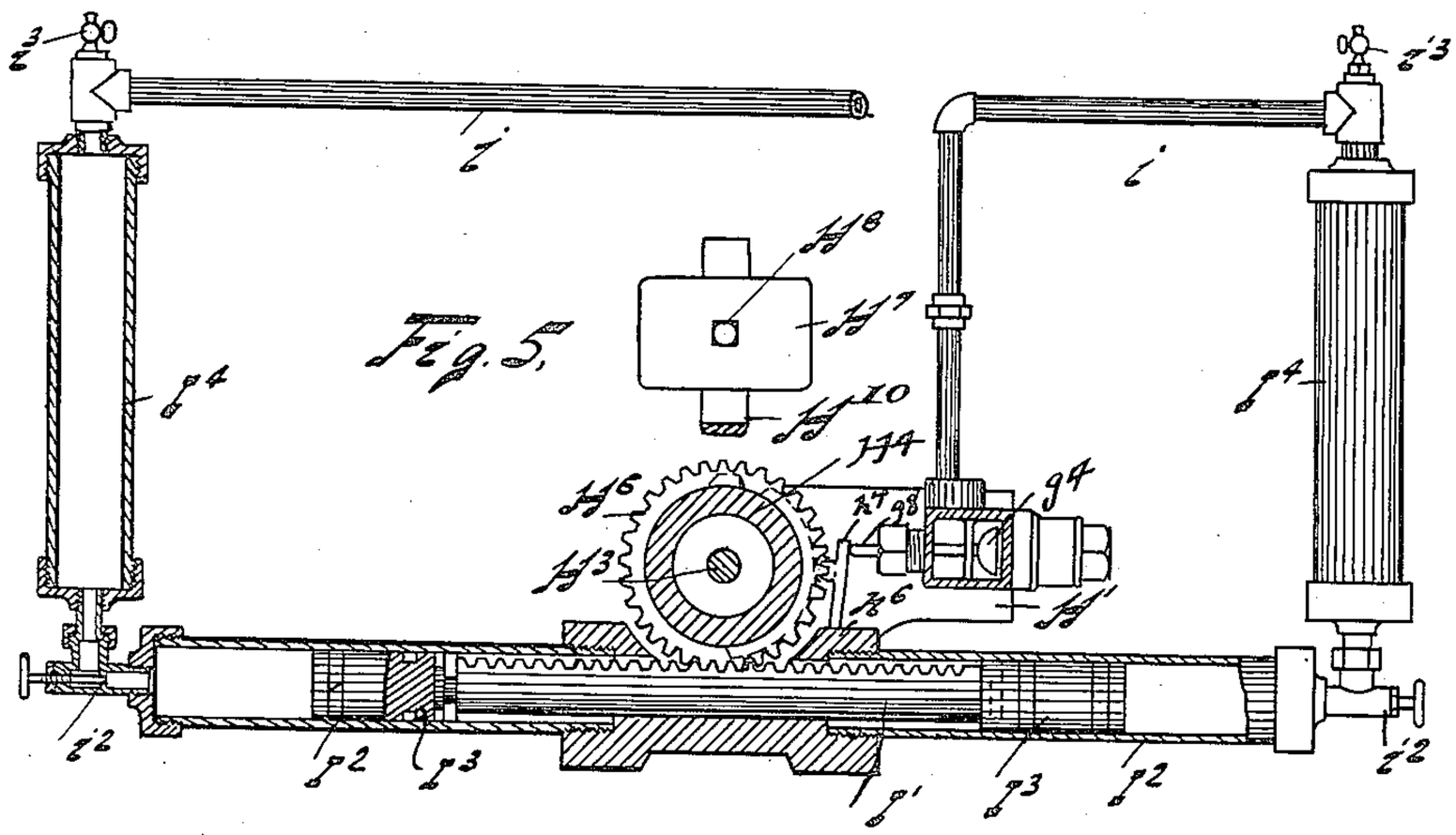

Fig. 5.

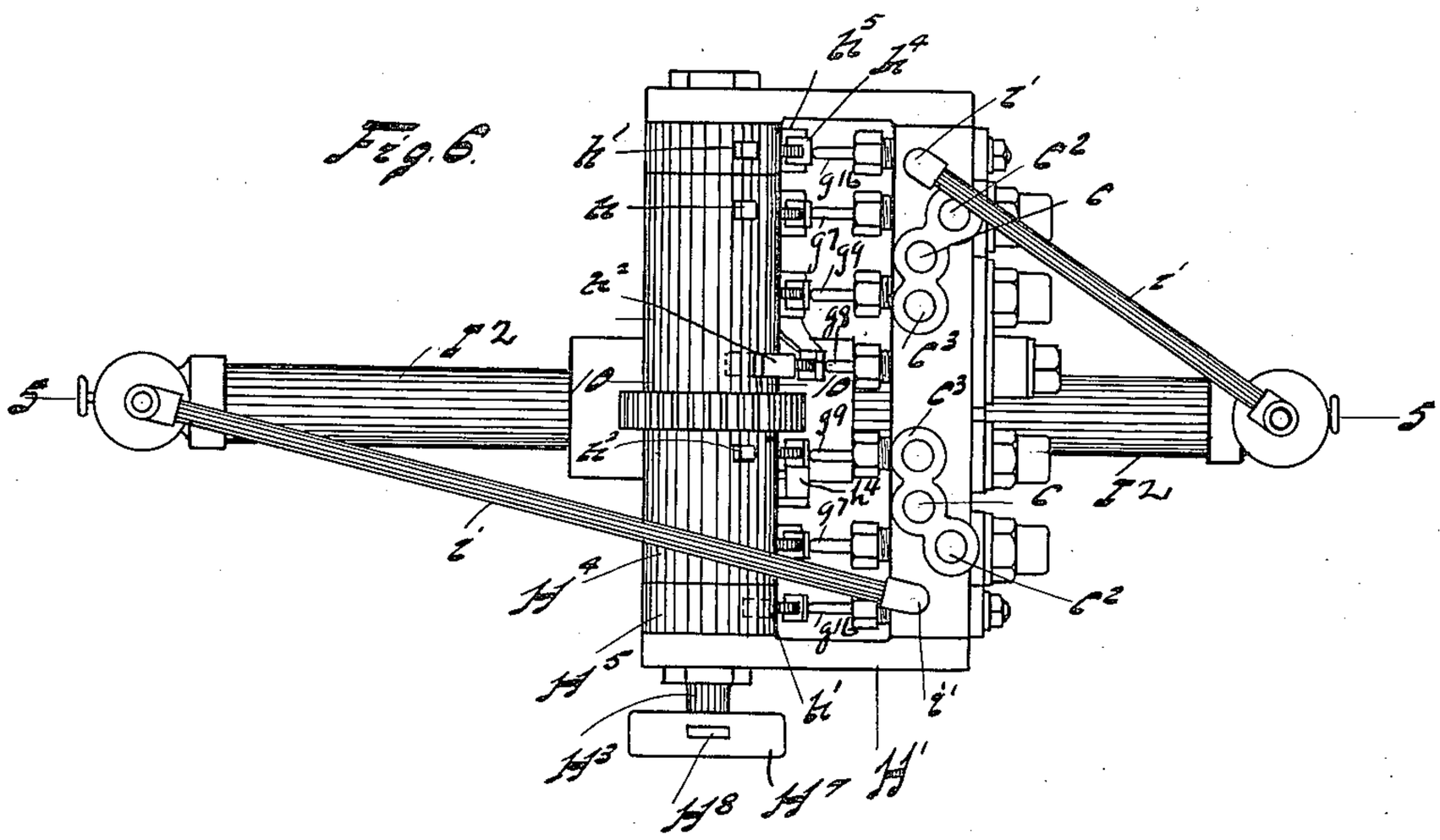

Fig. 6.

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4 SHEETS—SHEET 4.

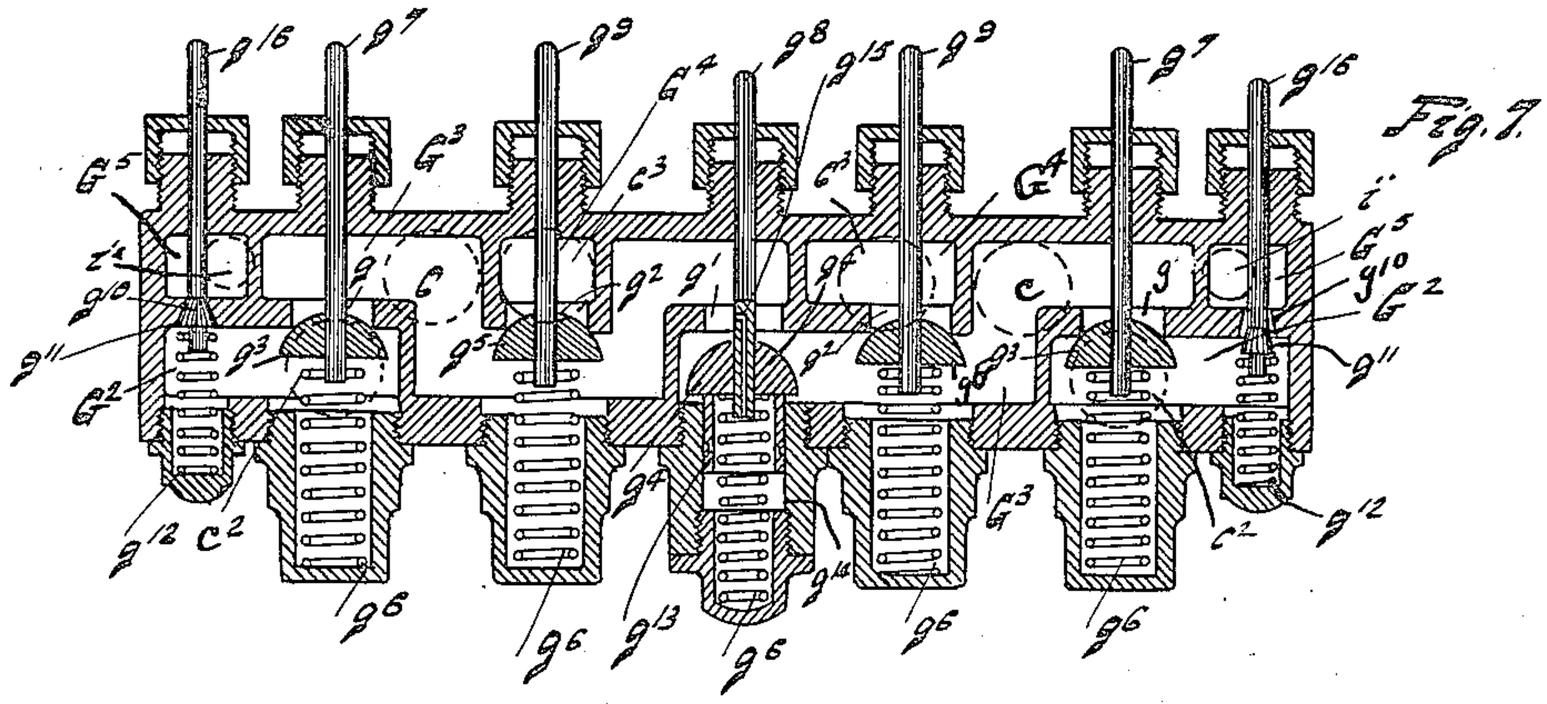

Fig. 7.

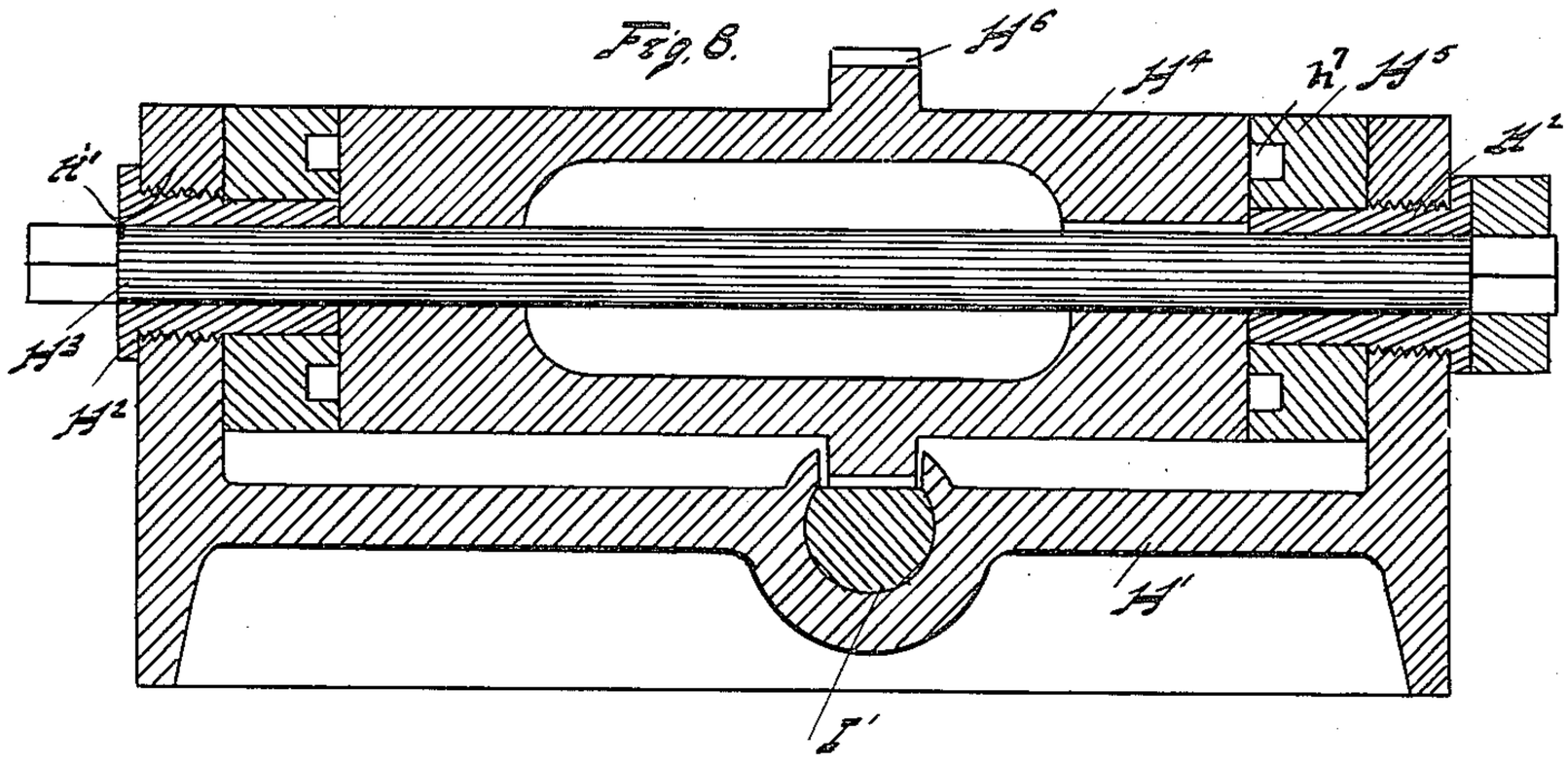

Fig. 8.

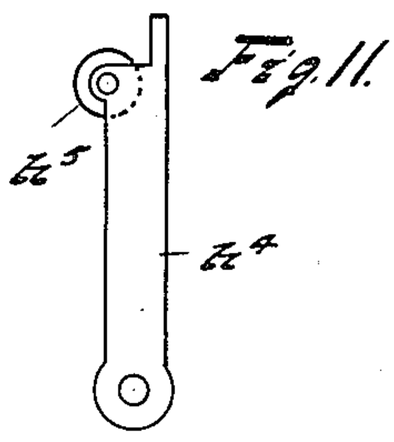

Fig. 11.

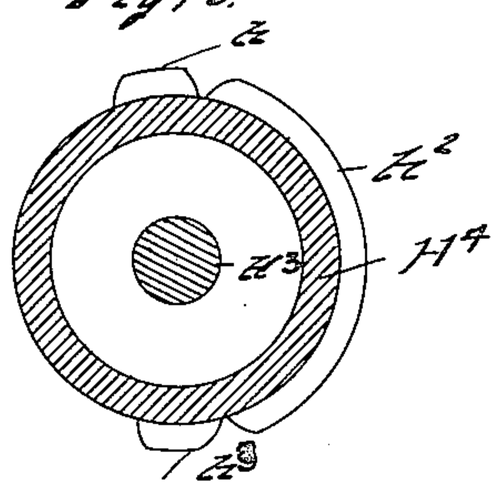

Fig. 10.

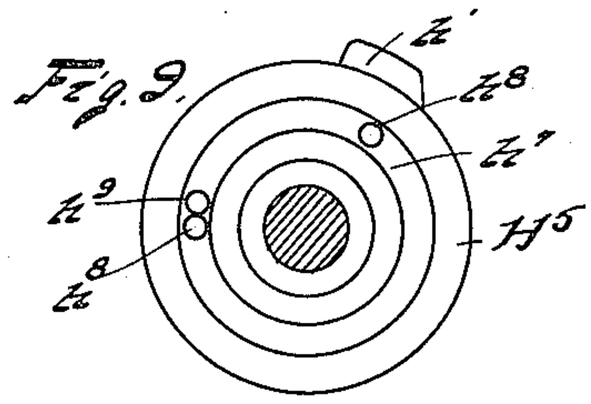

Fig. 9.

Witnesses
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# UNITED STATES PATENT OFFICE.

RUDOLPH CONRADER, OF ERIE, PENNSYLVANIA, ASSIGNOR TO JOHN W. WAITZ, OF OIL CITY, PENNSYLVANIA.

## APPARATUS FOR ACTUATING FLUIDS.

No. 886,312. Specification of Letters Patent. Patented April 28, 1908.

Application filed June 7, 1901. Serial No. 63,568.

*To all whom it may concern:*

Be it known that I, RUDOLPH CONRADER, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Actuating Fluids; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to apparatuses for actuating fluids under pressure and consists in certain improvements in the construction thereof as will be hereinafter fully described and pointed out in the claims.

More particularly, my invention relates to that class of fluid actuating devices wherein a motor fluid is used to actuate another fluid by the direct contact of the actuating and actuated fluids, the actuating and actuated fluids having different properties, especially as to specific gravity, so as to prevent the mixing of the fluids to any great extent.

In carrying out my invention, I admit the quantity of fluid to be actuated to a lift, that is, the pipe or passage through which the fluid is to be forced. I then subject it to the pressure of the actuating fluid and drive the column of fluid to be actuated to the desired point of admission. This, in a general way, has been accomplished heretofore but with my device, I have arranged means whereby the length of the column may be regulated in order that a uniform pressure will actuate it.

In carrying out my invention, I further utilize the expansive force of the actuating fluid to fill the clearance for a second operation, preferably in a second pumping apparatus.

In carrying out my invention, I have also arranged automatic means for controlling the actuating fluid so as to accomplish an intermittent action automatically.

I have also arranged mechanisms whereby the columns of fluid actuated may be by the same actuating fluid, positively acted upon to further convey the actuated fluid.

In carrying out my invention, where applied to oil wells, I have arranged a mechanism whereby the actuated fluid is gas, preferably from the well, from which the oil is being raised by the apparatus.

My invention also includes the devices hereinafter described in the claims.

The invention, as illustrated, is applied to an oil well and is shown in the accompanying drawings as follows: Figure 1, shows a general elevation of the apparatus and connections. Fig. 2, shows a detail of the pump chamber and mechanism in the well. Fig. 3, shows the trap for separating the actuating and actuated fluids. Fig. 4, shows a pump chamber for conveying the raised fluid. Fig. 5, is a central section, on the line 5—5, in Fig. 6, showing the valve actuating mechanism. Fig. 6, is a plan view of the valve actuating mechanism. Fig. 7, is a section of the valve. Fig. 8, is a section of the valve actuating cam mechanism. Fig. 9, is a side elevation of the cam mechanism for actuating the valve controlling the valve actuating motor. Fig. 10, is a cross section of the valve actuating cams. Fig. 11, is a side elevation of a cam actuated rock arm.

A, marks the pump chamber in which there is the usual perforated intake pipe. Extending from the pump chamber, A, is the pipe, B, which extends from said chamber, ordinarily, to the top of the well. The pipe, C, connects the chamber, A, with the actuating fluid supply. The pipe, B, extends down into the chamber, A, and is provided with a valve seat, $b$, on its lower end. A valve, $a$, is arranged to be seated on the seat, $b$. Extending from the valve, $a$, is a stem, $a'$, on which is a head, $a^8$. The head, $a^8$, is engaged by a cage, $a^3$, extending from a valve, $a^4$. The stem, $a'$, operating in the cage, $a^3$, gives to the valves, $a$, and $a^4$, a slight relative movement. The valve, $a^4$, is arranged to be seated on a seat, $a^5$, at the bottom of the chamber, A, and to close a passage, $a^6$, into the intake pipe, A'. The seat, $a^5$, is arranged on a curved bottom, $a^7$. The lower end of the pipe, C, is provided with a seating surface, $a^{11}$, so that the pipe, C, may be closed by a float valve, $a^9$. The float valve, $a^9$, is held in place by the cage, $a^{10}$. The valve, $a$, is preferably buoyant enough to just float the valves, $a$ and $a^4$. The device, however, would operate under ordinary pressures without such buoyancy. The operation of this part of the device is as follows: The oil enters the intake, A', passes through the passage, $a^6$, lifts the valve, $a^4$, and in lifting the valve, $a^4$, seats the valve, $a$. Oil continues to enter until it fills the chamber, A. The valve, $a^9$, prevents a movement of the oil into the supply pipe, C, and

the valve, *a*, prevents the entrance of the oil into the pipe, B. In this way, the amount of oil admitted each time is equal to just the capacity of the chamber, A. The actuating fluid supply is then turned on and through pressure, passes by the valve, $a^9$, and creates a back movement of the liquid from the chamber, A, through the passage, $a^6$. It will be noted that the bottom, $a^7$, is curved so that when the valve, *a*, is seated on the seat, *b*, and the valve, $a^4$, is in its uppermost position, there is quite an open space between the bottom, $a^7$, and the valve, $a^4$. As soon as the intake movement has ceased, the valve, $a^4$, drops back into the more contracted part of the bottom, $a^7$, so that as the pressure is turned onto the liquid, it creates an outward movement by the valve, $a^4$, and pressure is created on the valve, $a^4$, sufficiently to draw the valve, *a*, from its seat. The valve, $a^4$, is thus immediately seated and held on its seat by the pressure. The liquid from the chamber, A, is then forced through the pipe, B, until the end of the pipe, B, is exposed. The amount of liquid in the pipe, B, forms what is usually termed the slug and this is followed by the actuating fluid and raised in the form of this column or slug to the top of the well.

It will be noted that as the column or slug is lifted to the surface, the entire pipe, B, as well as the supply pipe, which in the ordinary practice, may reach several thousand feet, are filled with actuating fluid at the supply pressure. It must be apparent of course, that if this is immediately exhausted, that great waste of power takes place. In order to overcome this largely, I have arranged a plurality of pumping apparatuses, as shown, two apparatuses, each in a different well. I have also arranged a mechanism so that after the column or slug has been raised and discharged, the actuating fluid is trapped to prevent it from escaping and is then conveyed to the supply pipe of the second well, so that the clearance in the supply pipe of the second well is filled in this manner. After filling this clearance, I preferably convey the remainder of the actuating fluid remaining in the first well to the intake of the compressor. I have heretofore utilized the compounding of actuating fluid in apparatuses for actuating fluids as shown in my patent dated September 18th, 1900, No. 657,917, and also utilized in such apparatuses the increase of pressure after the movement of the actuating fluid for reversing the valve, as indicated in said patent.

I trap the actuating fluid after the discharge of the oil in the following manner: (See Figs. 1 and 3.) The oil is carried by the pipe, B, through the passage, $b'$, to the trap chamber, D′. A passage, $b^2$, is arranged to allow the outflow of the liquid. Controlling this passage is a balance valve, $D^2$. This valve is arranged in a double diaphragm, *d*, with the method ordinarily used in throttling governors. Extending from the valve $D^2$, is a stem, $d'$, and extending from this stem is a float, $D^3$. A passage, $d^4$, is arranged at the upper end of the trap and extending into the trap from this passage is a cage, $d^3$. A valve, $D^4$, is arranged in the cage and adapted to be seated on the seat, $d^5$, over the passage, $d^4$. The stem, $d^2$, of the valve, $D^4$, just contacts the float, $D^3$, when in its lower position, and the valve, $D^2$, closed. As soon as the liquid reaches the trap through the passage, $b'$, from the pipe, B, it carries up with it the float, $D^3$, and opens the valve, $D^2$. With the in rush of the liquid, the float, $D^3$, is carried up a sufficient distance to seat the valve, $D^4$, and the liquid then passes out through the passage, $b^2$. There is however, a sufficient pressure maintained in the trap chamber, D′, increasing of course, as the length of the column or slug decreases in the pipe, D. This pressure maintains the valve, $D^4$, on its seat, $d^5$. The float is maintained in its upper position and the liquid passes out so long as the liquid is delivered to the trap. After the entire column or slug has been delivered to the trap, so that the actuating fluid enters, the float, $D^3$, drops carrying with it the valve, $D^2$, and thus closes this outlet and prevents any outflow of actuating fluid so that where no further mechanism for trapping the air is provided as for instance when the pump F is not used and the connection $c^4$ closed the valves $D^2$ and $D^4$ will remain closed until the air pressure is so reduced as to permit them to act, the closure allowing the increase in pressure necessary to actuate the valve mechanism as hereinafter described.

It is desirable in oil wells to separate the water from the oil. This is done in the separator, E, which is of the usual construction. If it is desired to convey the oil or actuated fluid a greater distance, the actuating fluid, which has raised the column or slug and deposited it in the separator, E, may be utilized for this purpose. I show a mechanism for accomplishing this purpose, as follows: (See Figs. 1 and 4.) Extending from the separator, E, is a pipe, $B^2$. This enters a chamber, F′, through an intake passage, *f*. The intake passage is controlled by a check valve, $f'$, and is separated from the main pump chamber, F′, by a diaphragm, $f^2$. A passage, $f^3$, extends through the diaphragm, $f^2$. The eduction pipe, $B^3$, extends from below the diaphragm, $f^2$, out of the chamber. Arranged in the eduction pipe is a check valve, $f^4$, and arranged over the passage, $f^3$, is a float and check valve, $f^5$. A passage, $c^4$, is arranged in the end of the trap chamber, D′, and connects with a pipe, C′, which passes into the upper end of the chamber, F′. After the outflow of the liquid from the trap, D, the actuating fluid under pressure, passes

through the passage, $c^4$, and pipe, C′, into the chamber, F′, the chamber, F′, having been filled by gravity from the separator, E. The chamber, F′, is preferably of sufficient size to accommodate the oil raised in one slug. The supply pressure on the upper surface of the oil forces it down through the passage, $f^3$, up through the eduction pipe, $B^3$, past the check valve, $f^4$. As soon as the oil reaches the bottom of the chamber, F′, the actuating fluid is trapped and further action is prevented by the seating of the float valve, $f^5$. During the outflow of the fluid from the chamber, F′, a back movement from the chamber to the pipe, $B^2$, is prevented by the check valve, $f'$, and after the completion of the operation and the reduction of pressure in the chamber, F′, a return movement from the eduction pipe, $B^3$, is prevented by the check valve, $f^4$. It is desirable that these movements should be accomplished automatically. I carry this out by providing a valve mechanism which will reverse only when the maximum supply pressure is brought into action in the pipe, C. It will be noted that after forcing up the slug and conveying the oil from the chamber, F′, the actuating fluid is trapped both by the trap, D, and the pump, F, so that the pressure of this fluid rises to the full supply pressure. This rise in pressure due to the trapping of the actuating fluid just described, is arranged in my device to actuate the valve mechanism. When the pump F is not used the opening $c^4$ is closed and the trap D then effects in itself the trapping of the air.

The valve mechanism is as follows: A valve body, G, has the supply chambers, $G^2$—$G^2$. These chambers are in communication with the chambers, $G^3$—$G^3$, through the passages $g$ $g$. The chambers, $G^3$, $G^3$, I term, for convenience, the equalizing chambers. They are connected by a passage, $g'$. Adjacent to the equalizing chambers are the exhaust chambers, $G^4$, $G^4$. These are connected with the equalizing chambers by passages, $g^2$, $g^2$. A supply pipe, $C^2$, is connected with the passages, $c^2$—$c^2$, entering the supply chambers, $G^2$—$G^2$. The pipes, C, one in each well, are connected with the passages, $c$—$c$, entering the equalizing chambers, $G^3$—$G^3$. The exhaust passages, $c^3$—$c^3$, lead from the exhaust chambers, $G^4$—$G^4$, preferably through a pipe, $C^3$, to the intake of the compressor, J, so that the compressor produces suction on the chamber exhausted. The supply valves, $g^3$, $g^3$, which are preferably of the check valve type, cover the passages, $g$—$g$. The equalizing valve, $g^4$, covers a passage, $g'$, the exhaust valves, $g^5$, $g^5$, cover the passages, $g^2$, $g^2$. All of these valves are similar in shape and are normally crowded to their seats by the springs $g^6$. Adjacent to the supply chambers, $G^2$, $G^2$, are the motor valve chambers, $G^5$, $G^5$. From these chambers extend the passages, $i'$, $i'$ which lead through the pipes, $i$, $i$, to the motor operating the various valves. The chambers, $G^5$, are connected with the supply chambers by the passages, $g^{10}$. The valves, $g^{11}$, close these passages and the springs, $g^{12}$, tend to normally seat these valves.

The operation of the valve mechanism in relation to the pumping apparatus is as follows: Starting with the main valves closed, the expansive force of the actuating fluid on the valve motor opens one of the valves, $g^3$, and one of the valves, $g^{11}$. It also opens the exhaust valve, $g^5$, operating on the opposite well. The motor is so arranged that it will not operate in a reverse direction except when a maximum pressure is brought to bear upon it, and as there is a ready outflow for the supply in the chamber, $G^2$, through the passage, $g$, and one of the pipes, C, the pressure in the supply chamber, $G^2$, is kept below this maximum pressure until the slug is raised and the fluid is conveyed from the pump chamber, F. After the conclusion of the operation of the trap, D, and pump, F, and the trapping of the actuating fluid therein, the supply pressure of course reaches its maximum, and this acting through the passage, $g^{10}$, operates upon the motor to permit the closing of the valve, $g^3$, and the exhaust valve, $g^5$, that is open. A slight advance movement of the motor opens the equalizing valve, $g^4$. The equalizing valve is maintained in an open position a sufficient length of time to permit the actuating fluid to pass from the first well, where it in under pressure, into the supply pipes of the second well, so that the pressure in the two wells may be equalized. A further movement of the motor permits the closing of the equalizing valve and then as a last movement of the motor in that direction, permits the closing of the open valve, $g^{11}$. The expansive force of the actuating fluid on the motor, as well as a weight device hereinafter described, carries the motor forward so as to open the supply valve, $g^3$, motor valve, $g^{11}$, and exhaust valve, $g^5$, for the opposite well from the one first opened. This completes the cycle of operation and it will be noted that there are two pumping systems and that the valve connects the first of said systems with the supply, cuts off said supply, connects the systems, exhausts the supply from the first system and turns on the supply in the second system to supplement the pressure admitted to the second system through the compounding operation.

I preferably make the equalizing valve balanced. This, I do by placing the valve plunger, $g^{13}$, back of the valve, and this operates in a cylinder, $g^{14}$, in the valve body. A small opening, $g^{15}$, passing through the stem connects the cylinder, $g^{14}$, with the chamber, $G^3$, opposite the one occupied by the valve. The plunger $g^{13}$, is approximately the size of

the passage, $g'$, so that when pressure is in the chamber opposite the one occupied by the valve, the pressure on both sides of the valve is practically the same and when the pressure is in the side occupied by the valve, the plunger, $g^{13}$, prevents a top pressure on the valve, so that the valve is practically balanced with pressure in either chamber.

The mechanism for operating the several valves is as follows: Immediately at the side of the valve body is a frame, H′, to which the valve body is attached. Arranged in this frame are the journal bushings, $H^2$, and journaled in these bushings is the rod, $H^3$. Keyed on the rod or shaft, $H^3$, is the cam cylinder, $H^4$. Journaled on the exterior of the bushing, $H^2$, are the cam rings, $H^5$. The cam cylinder is provided with a gear, $H^6$, which meshes a rack, I′. The rack, I′, is connected with a motor, which as before described, operates only with a maximum pressure at the times mentioned. When the motor starts, it moves forward, turns the cam cylinder, and when reversed, it turns the cam cylinder in the opposite direction. Arranged on the cam cylinder are the cams, $h$, one at each side of the cam cylinder, and arranged in the paths of the stems, $g^7, g^7$, of the supply valves, $g^3$, $g^3$. These cams, $h$, are arranged so that they lift one of the valves, $g^3$, just as the cylinder reaches its extreme position. The cam cylinder is also provided with two cams, $h^3$, the paths of which pass the stems, $g^9$, $g^9$, of the exhaust valves, $g^5$, $g^5$. These are arranged in line with the cams, $h$, one of the cams, $h^3$, being arranged to open the exhaust valve opposite the supply valve opened by the cam, $h$, in line with which it is. Also arranged on the cylinder, $H^4$, is the equalizing cam $h^2$, its path being such as to operate upon the stem, $g^8$, of the equalizing valve, $g^4$. The equalizing cam, $h^2$, is of considerable length, the extreme ends being just inside of the cams $h$ and $h^3$, so that the supply and exhaust valves have dropped off the cams, $h$ and $h^3$, before the cam $h^2$, reaches the stem of the equalizing valve. In order that the motor may continue its operation without closing the motor valves, $g^{11}$, $g^{11}$, some mechanism must be provided which will permit this movement and still make the valve, $g^{11}$, subject to the action of the motor. I accomplish this by providing the rings, $H^5$. These rings are provided with the grooves, $h^7$, in which are arranged the shoulders or pins, $h^8$. A pin, $h^9$, is secured to the cylinder, $H^4$, and is free to move in the groove, $h^7$, except when in contact with a shoulder, $h^8$. The mechanism operates somewhat in the manner of the tumblers of a combination lock. The pin, $h^9$, contacts the shoulder, $h^8$, so as to bring the cam, $h'$, in line with the adjacent cam, $h$, just before the cam, $h$, reaches the stem of the supply valve. Of course, when the pin, $h^9$, reaches this shoulder, $h^8$, the ring, $H^5$, is locked with the cylinder, $H^4$, so that the cams, $h$ and $h'$, lift the supply valve and motor valve together. When the maximum pressure is reached and the motor is reversed, the cams $h$ and $h^3$, are of course, immediately actuated with the cam cylinder, as well as the equalizing cam, $h^2$. The cam, $h'$, however, being arranged on the ring, $H^5$, and the ring, $H^5$, being carried by separate bearings from that in which the cylinder, $H^4$, moves, remains stationary until the pin, $h^9$, in its backward movement reaches the rear shoulder, $h^8$. This takes place just as the end of the equalizing cam passes from under the stem of the equalizing valve and just before the cams, $h$ and $h'$, of the opposite side of the valve mechanism, pass under the stems of their respective valves so that the motor valve controlling the motor in the movement of its direction is closed just before the end of the stroke of the motor. In order that there may be no side strains on the valve stems, I provide the rock arms, $h^4$. These arms are pivoted on a plate, $h^6$, and are provided with a roller, $h^5$. These rollers operate upon the cams, $h$, $h'$, $h^2$ and $h^3$, and the rock arms communicate the motion to the valve stems.

The motor for actuating the valve is as follows: Screwed into the opposite sides of the frame, H′, are the cylinders, $I^2$. Arranged in these cylinders are the pistons, $I^3$, and connecting these pistons is the rack, I′. The passages, $i'$, $i'$, lead from the chambers, $G^5$, $G^5$, and pass by the pipes, $i$, into the oil reservoirs, $I^4$. The oil reservoirs are connected with the cylinder through the needle valves, $i^2$, $i^2$. A liquid, preferably oil, is arranged in the reservoirs, $I^4$. The purpose of utilizing oil is for convenience in that it is easier to form a tight joint between the cylinders, $I^2$ and the pistons, $I^3$. Arranged on the end of the shaft, $H^3$, is an arm, $H^{10}$. A weight, $H^7$, is fixed on this arm by means of a set screw, $H^8$. The weight may be adjusted by means of the set screw so as to lengthen or shorten the arm. The arm is in a horizontal position at the extreme ends of the stroke of the piston. The weight is adjusted on the arm so as to require the maximum pressure of the actuating fluid upon the ends of the piston arranged to raise the weight before any movement of the motor cam takes place. As soon as this maximum pressure is reached, as heretofore described, the air or gas operating upon the oil and indirectly upon the piston starts the motor and moves the cam cylinder, as heretofore described. In order that a sufficient time may elapse for the actuating fluid in one apparatus to pass from that apparatus to another so as to equalize the pressure in the two during the time that the equalizing cam is under the equalizing valve, or in other words, during a movement of the motor, I

provide the needle valves, $i^2$. By reducing the area of the passage by the needle valve, the speed in the motor may be decreased, or by enlarging this passage, the speed of the motor may be increased so as to adjust it for this purpose. In order to provide an exhaust for the actuating fluid after a movement of the motor, I provide the valves, $i^3$, $i^3$. These are arranged with very minute openings and the actuating fluid is exhausted through this minute opening. This taking place during the entire time of the movement of the actuating fluid into the apparatus, ordinarily precedes the time of the initial movement of the motor. The exhaust of course, may be completed after the motor starts in a reverse direction, but ordinarily the entire exhaust would have taken place before the reverse.

It has been found in practice that the contact of air with oil has a tendency to separate the paraffin from the oil, and this taking place in the well, operates to choke the well. In order to overcome this objection in apparatuses using gaseous actuating fluids, I prefer to utilize a gas for that purpose and preferably natural gas from the well. I therefore connect the well casing through the pipes, K, K′, with the intake, $C^3$, of the compressor. Where a group of wells are pumped by the apparatus, all of these may be connected with the intake of the compressor, and preferably each well is provided with a check valve, $k$. Where the exhaust from the well is directed to the intake of the compressor, as shown in the drawings, there is of coure, very little waste of the actuating fluid and it is utilized over and over again. When, however, the supply of actuating fluid falls below normal, a fresh supply may be had from the well through the check valves. Thus, the wells are not subjected at any time to an increased pressure which tends to check the flow of oil into the well and on the other hand, a ready supply is always at hand as an actuating fluid.

I have shown in my co-pending application filed Dec. 24, 1902, No. 136,431, a pressure device controlling the admission of actuating fluid to the pump chamber; with means actuated with the pressure in said chamber for controlling the pressure device and do not claim in this application the construction claimed therein.

What I claim as new is:

1. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; a suction device; a connection leading from one of said lifts to a source of motor fluid supply; a connection leading from said lifts to said suction device; a connection between said lifts; means for admitting fluid to be actuated to each of said lifts; and a valve mechanism for controlling the movement of motor fluid arranged to successively open the connection leading from the source of supply during a closure of the connection leading to the suction device and the connection between said lifts, then to open a connection between said lifts during a closure of the connection leading from the source of supply and the suction device, and then to open a connection leading to the suction device during a closure of the connection leading to the source of supply and the connection between the lifts.

2. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; connections leading from one of said lifts to a source of motor fluid supply; a motor fluid connection between said lifts; means for admitting a fluid to be actuated by said lifts; valve mechanisms controlling the movement of motor fluid arranged to open a connection to one of said lifts during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the connection to the source of motor fluid supply; and an automatic means for actuating said valve device.

3. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; connections leading from one of said lifts to a source of motor fluid supply; a motor fluid connection between said lifts; means for admitting a fluid to be actuated by said lifts; valve mechanism controlling the movement of motor fluid arranged to open a connection to one of said lifts during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the connection to the source of motor fluid supply; and an automatic means for actuating said valve device.

4. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; connections leading from one of said lifts to a source of motor fluid supply; a motor fluid connection between said lifts; means for admitting a fluid to be actuated by said lifts; valve mechanism controlling the movement of motor fluids arranged to open a connection to one of said lifts during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the con-

nection to the source of motor fluid supply, to open the connection between the second of said lifts and the source of supply during a closure of the connection between said lifts and to open the first lift to an exhaust during a connection of the second lift to the source of the supply; and an automatic means for actuating said valve device.

5. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; a suction device; a connection leading from one of said lifts to a source of motor fluid supply; a connection leading from said lifts to said suction device; a connection between said lifts; means for admitting fluid to be actuated to each of said lifts; a valve mechanism for controlling the movement of motor fluid arranged to successively open the connection leading from the source of supply during a closure of the connection leading to the suction device and the connection between said lifts, then to open a connection between said lifts during a closure of the connection leading from the source of supply and the suction device, and then to open a connection leading to the suction device during a closure of the connection leading to the source of supply and the connection between the lifts; and an automatic means for actuating said valve device.

6. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; a suction device; connections leading from both of said lifts to a source of motor fluid supply; connections leading from said lifts to said suction device; connections between said lifts; means for admitting fluid to be actuated to each of said lifts; a valve mechanism for controlling the movement of motor fluid arranged to successively open the connection between the first of said chambers and the source of motor fluid supply during a closure of the connection to the suction device with said lift and the connection between said lifts, then to open the connection between said lifts during a closure of the connection between said lifts and the source of motor fluid supply and the suction device, then to open the connnection between said lifts and between the first of said lifts and the source of supply.

7. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; a suction device; connections leading from both of said lifts to a source of motor fluid supply; connections leading from said lifts to said suction device; a connection between said lifts; means for admitting fluid to be actuated to each of said lifts; a valve mechanism for controlling the movement of motor fluid arranged to successively open the connection between the first of said chambers and the source of motor fluid supply during a closure of the connection to the suction device with said lift and the connection between said lifts, then to open the connection between said lifts during a closure of the connection between said lifts and the source of motor fluid supply and the suction device, then to open the connection between the first of said lifts and the suction device and the second of said lifts with the motor fluid supply during a closure of the connection between said lifts and between the first of said lifts and the source of supply; and an automatic means for actuating said valve device.

8. In combination with two Artesian wells or the like, an apparatus comprising two lifts, one in each well; means arranged to carry an actuated fluid through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; a connection with a motor fluid supply and the bottom of the lift in one of said wells; a connection between said lifts; a valve mechanism for controlling the movement of motor fluid arranged to open the connection to the motor fluid supply during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the connection to a source of motor fluid supply: and an automatic means for actuating said valve mechanism.

9. In combination with two Artesian wells or the like, an apparatus comprising two lifts, one in each well; means arranged to carry an actuated fluid through said lifts by a following action of an actuating fluid through the lifts in contact with the actuated fluid; a connection with a motor fluid supply and the bottom of the lift in one of said wells; a connection between said lifts; a valve mechanism for controlling the movement of motor fluid arranged to open the connection to the motor fluid supply during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the connection to a source of motor fluid supply, said valve mechanism being arranged without said wells; and an automatic means for actuating said valve mechanism.

10. In combination with two Artesian wells or the like, an apparatus comprising two lifts, one in each well; means arranged to carry liquids through said lifts by a following action of an actuating fluid through the lifts in con-

tact with said liquids; connections leading from the bottom of said lifts to a source of motor fluid supply; motor fluid connections between said lifts; a valve mechanism for controlling the movement of motor fluid arranged to open the connections between the motor fluid supply and the first of said lifts during a closure of the connection between said lifts, then to open the connection between said lifts during a closure of the connection between the first of said lifts and the motor fluid supply, then to open a connection between the second lift and the motor fluid supply during a closure of the connection between said lifts; and an automatic means for actuating said valve mechanism.

11. In an apparatus for actuating fluids under pressure, the combination of a lift; means arranged to carry the fluid through said lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; the trap, D, connected with the discharge of the lift, comprising the valve, $D^2$; a float, $D^3$, connected with the valve, $D^2$, said float and valve, $D^2$, being arranged to maintain the valve, $D^2$, in an open position during the discharge of the actuated fluid and to close the valve, $D^2$, at the completion of the discharge of the actuating fluid, the trap also comprising the valve, $D^4$, closing an opening to the atmosphere, said valve, $D^4$, being adapted to be closed by an entrance of an actuated fluid into the trap.

12. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through the first of said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; connections leading from the first of said lifts to a source of motor fluid supply; a motor fluid connection between said lifts; valve mechanisms controlling the movement of motor fluids arranged to open a connection to the first of said lifts during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the connection to the source of motor fluid supply; and a trap connected with the discharge to the first of said lifts, said trap being arranged to permit the discharge of the actuated fluid but to close against the discharge of the actuating fluid.

13. In an apparatus for actuating fluids under pressure, the combination of two lifts; means arranged to carry the actuated fluid through the first of said lifts by a following action of the actuating fluid through the lift in contact with the actuated fluid; connections leading from the first of said lifts to a source of motor fluid supply; a motor fluid connection between said lifts; valve mechanisms controlling the movements of motor fluids arranged to open a connection to the first of said lifts during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the connection to the source of motor fluid supply, then to open the said first lift to the exhaust; a trap connected with the discharge to the first of said lifts, said trap being arranged to permit the discharge of the actuated fluid but to close against the discharge of the actuating fluid, said trap having an opening to the atmosphere during the lift of the actuated fluid, the opening to the atmosphere being closed with the discharge against the actuating fluid; and means for opening said trap to the atmosphere with the exhaust of the actuating fluid from the first lift.

14. In an apparatus for actuating fluids under pressure, the combination of a lift passage; means arranged to carry the actuated fluid through said lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; an admission chamber at the lower end; a valve controlling the admission of fluid to said chamber; a valve operating upon the lower end of the lift, said valve being arranged to close the lower end of the lift with the admission movement of the actuated fluid to the chamber and to close the inlet to the chamber with an inflow of motor fluid to the chamber.

15. In an apparatus for actuating fluids under pressure, the combination of a lift passage; means arranged to carry the actuated fluid through said lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; an admission chamber at the lower end of the lift; a valve controlling the admission of fluid to said chamber; a valve operating upon the lower end of the lift, said valve being arranged to close the lower end of the lift with an inflow of fluid to be actuated in the chamber and to close the inlet to the chamber and open the end of the lift with an inflow of motor fluid.

16. In an apparatus for actuating fluids under pressure, the combination of a lift passage; means arranged to carry the fluid to be actuated through the lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; an admission chamber at the admission end of the lift, said chamber being provided with an inlet passage in the lower end thereof; a valve arranged to close the admission end of the lift; a float for actuating said valve; a valve for closing the admission passage to the chamber; a connection between said valve and the valve operating upon the admission end of the lift, said valve operating upon the admission passage to the chamber being arranged to close with an outward movement of fluid through said passage and in closing to open the valve on the end of the lift.

17. In an apparatus for actuating fluids

under pressure, the combination of a lift; means to carry a fluid to be actuated to the lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; an admission chamber at the admission end of the lift, said admission chamber having the inlet passage at its lower end, the chamber being contracted in a direction toward said passage; the valve, $a^4$, arranged to operate over said passage; the valve, $a$, arranged to operate at the end of the lift; a connection between said valves whereby the valve, $a$, is closed with an inflow of actuated fluid and the valve, $a^4$, closed with an outflow of actuated fluid, and the valve, $a$, opened.

18. In an apparatus for actuating fluids under pressure, the combination of a lift; means arranged to carry a fluid to be actuated through the lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; an admission chamber at the admission end of the lift, said admission chamber having the inlet passage at its lower end, the chamber being contracted in a direction toward said passage; the valve, $a^4$, arranged to operate over said passage; the valve, $a$, arranged to operate at the end of the lift; a connection between said valves whereby the valve, $a$, is closed with an inflow of actuated fluid and the valve, $a^4$, closed with an outflow of actuated fluid and the valve, $a$, opened; a connection between said chamber and the motor fluid supply; and the valve, $a^9$, arranged to close said connection.

19. In an apparatus for actuating fluids under pressure, the combination of a lift passage; means arranged to carry the actuated fluid through said lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; a pump chamber into which said actuated fluid is discharged from said lift; a motor fluid connection between said lift and said pump chamber; and means for trapping the motor fluid in said pump chamber after the discharge of actuated fluid therefrom.

20. In an apparatus for actuating fluids under pressure, the combination of a lift passage; means arranged to carry fluid to be actuated through said lift by a following action of the actuating fluid through the lift in contact with the actuated fluid; a trap at the discharge of said lift arranged to permit a discharge of the actuated fluid but to prevent the discharge of actuating fluid; a pump chamber into which said discharged liquid is conducted; a motor fluid connection between said trap and said pump chamber; and means for trapping the motor fluid in said pump chamber after the discharge of fluid therefrom.

21. In an apparatus for actuating fluids under pressure, the combination of two lift passages; means arranged to carry a fluid to be actuated through the first of said lifts by a following action of the actuating fluid through the lift in contact with the actuated fluid; a motor fluid connection between said lifts; a pump chamber to which the fluid discharged from the first of said lifts is conducted; a connection between the first of said lifts and the motor fluid supply; a motor fluid connection between said first lift and said pump chamber; means arranged to trap the motor fluid in said pump chamber after the discharge of actuated fluid therefrom; and valve mechanisms arranged to open a connection between the first lift and motor fluid supply during a closure of the connection between said lifts and to open a connection between said lifts during a closure of the connection between the first of said lifts and the motor fluid supply.

22. In an apparatus for actuating fluids, the combination of a lift; a connection between said lift and the motor fluid supply; means arranged to carry the actuated fluid through the lift by a following action of the motor fluid; a valve mechanism controlling the movement of motor fluid; means for checking the flow of motor fluid in the connection and a valve motor for controlling the valve arranged to operate only at a higher pressure than will carry the fluid through the lift and after checking of the flow of fluid in the connection.

23. In an apparatus for actuating fluids, the combination of a lift; a connection between said lift and the motor fluid supply; a valve mechanism controlling the movement of motor fluid; means for trapping the motor fluid after a lifting operation; and a valve motor for controlling the valve arranged to operate only at a higher pressure than will actuate the fluid in the lift and after the trapping of the motor fluid at the completion of a discharge of actuated fluid.

24. In an apparatus for actuating fluids, the combination of two pump chambers; a connection between the first of said chambers and the motor fluid supply; means for checking the flow of motor fluid in said connection; a motor fluid connection between said chambers; a valve mechanism controlling a movement of motor fluid; a motor for controlling said valve arranged to operate only at a higher pressure than is necessary to expel fluid from said first chamber and after the checking of the flow of fluid in the supply connection, said valve mechanism and motor being arranged to open a connection between the motor fluid supply and the first of said chambers during a closure of the connections between said chambers.

25. In an apparatus for actuating fluids, the combination of two pump chambers; a

connection between said chambers and the motor fluid supply; means for checking the flow of fluid through said supply connection; a motor fluid connection between said chambers; a valve mechanism controlling the movement of motor fluid through said connections; a motor for controlling said valve arranged to operate only at a higher pressure than is necessary to expel fluid from said chambers and after the checking of the flow of fluid in said supply connection, said valve mechanism and motor being arranged to open a connection between the motor fluid supply and the first of said chambers during a closure of the connection between said chambers, then to open a connection between said chambers during a closure of the connection between the first of said chambers and the motor fluid supply, then to open a connection to the second of said chambers during a closure of the connection between said chambers.

26. In an apparatus for actuating fluids, the combination of a lift; a connection between said lift and motor fluid supply; means acting independently of the fluid in the lift for checking the flow of actuating fluid through said supply connection; a valve mechanism controlling the movement of motor fluid; a valve motor for controlling the valve; a counter pressure mechanism arranged in said valve motor; means for adjusting the force of said counter pressure to prevent the operation of said valve motor except at a higher pressure than will effect a lift and after the checking of the flow of fluid in said supply connection.

27. In an apparatus for actuating fluids, the combination of a lift; a connection between said lift and the motor fluid supply; a valve mechanism controlling the movement of motor fluid; means for trapping the motor fluid after a lifting operation; a valve motor for controlling the valve; a counter pressure device arranged to exert force against the action of the valve motor; means for adjusting said counter pressure device to exert sufficient force to prevent the action of the valve motor except after the lifting operation and trapping of the actuating fluid.

28. In an apparatus for actuating fluids, the combination of two lifts; means for carrying a fluid to be actuated through said lifts by a following action of the actuating fluid through the lifts in contact with the actuated fluid; a motor fluid connection between said lifts; a motor fluid connection between the first of said lifts and the motor fluid supply; means for checking the flow of fluid through said supply connection; a valve mechanism controlling the movement of motor fluid; a motor for controlling said valve arranged to operate only at a higher pressure than will expel fluid from said lift and after the checking and flowing of fluid through said supply connection, said valve mechanism and motor being arranged to open a connection between the motor fluid supply and the first of said chambers during a closure of the connection between said chambers and to open a connection between said chambers during a closure of the connection between the supply and the first of said chambers.

29. In an apparatus for actuating fluids, the combination of a lift; means acting independently of the fluid in the lift for checking the flow of actuating fluid through said supply connection; a motor fluid supply connected with said lift; a valve arranged to control said motor fluid; a motor for actuating said valve, said motor being operated by the motor fluid; a shaft operated by said motor; an arm on said shaft; an adjustable weight on said arm, the weight on said arm being arranged to prevent the movement of motor except at a higher pressure than will actuate the fluid in the lift and after the checking of the flow of supply fluid.

30. A valve device for apparatuses for actuating fluids under pressure comprising two supply chambers, two exhaust chambers, an equalizing chamber between each supply chamber and its corresponding exhaust chamber, valves of the check valve variety for controlling the passages connecting said chambers, said passages leading from the supply chambers to the equalizing chambers, from the equalizing chambers to the exhaust chambers, and from one equalizing chamber to the other, means arranged to open one of the supply valves and one of the exhaust valves, then to close said supply valve and exhaust valve and to open the equalizing valve, then to close the equalizing valve, then to open the second supply valve and the second exhaust valve, and mechanism for automatically actuating said means.

31. A valve device for apparatuses for actuating fluids under pressure, comprising two supply chambers, two exhaust chambers having an equalizing passage between said exhaust chambers; passages leading from said exhaust chambers; valves of the check valve variety for controlling the passages from the supply chambers and from the exhaust chambers and the equalizing passage; a cam arranged to open one of the supply valves and one of the exhaust valves, then to close said supply valve and exhaust valve and to open the equalizing valve, then to close the equalizing valve, then to open the second supply and second exhaust valves; and means for actuating the cam.

32. In a valve device for controlling an apparatus for actuating fluids under pressure, the combination of a series of valves of the check valve type for controlling the motor

fluid; means for actuating said valves in proper succession; a motor for controlling said means; a valve of the check valve type for controlling the fluid for actuating said motor; and means actuated by said motor for actuating said motor valve.

33. In a valve device for controlling an apparatus for actuating fluids under pressure, the combination of a series of valves of the check valve type for controlling the motor fluids; a cam for actuating said valves; a motor for controlling said cam; a valve of the check valve variety for controlling the fluid for actuating said motor; and a cam actuated by said motor for actuating said motor valve.

34. In a valve device for controlling an apparatus for actuating fluids under pressure, the combination of a series of valves of the check valve variety for controlling motor fluids; a cam for actuating said valves; a motor for controlling said cam; a valve of the check valve variety for controlling the fluid for actuating said motor; a cam for actuating said motor valve, said cam actuating the motor valve being operated by said motor but in varying relation to the other cams.

35. In a valve device for controlling motor fluids for apparatuses for actuating fluids under pressure, the combination of a valve for controlling the flow of motor fluids to the actuating apparatus; a cam for controlling said valve; an oscillating means on which said cam is mounted; a motor for oscillating said means; a valve for controlling the motor fluid actuating said motor valve; a cam for actuating said valve; an oscillating means carrying said cam; and means carried by the oscillating means carrying the apparatus valve cam for conveying movement to the motor valve cam, said means allowing relative movement between said oscillating means.

36. In a valve device for apparatus for actuating fluids under pressure, the combination of a valve for controlling the motor fluid for the actuating apparatus; a cam, $h$, for actuating said valve; an oscillating means carrying said cam, said oscillating means being provided with a shoulder, $h^9$; a motor for actuating said oscillating means; a motor valve for controlling the motor fluid actuating said motor; a cam, $h'$, for actuating said valve; an oscillating means carrying said cam and having a part in the path of the shoulder, $h^9$, for giving to the oscillating means carrying the motor valve cam movement but differing in extent from the movement of the cam, $h$.

37. In a valve device for actuating fluids under pressure, the combination of a valve for controlling the actuating fluid; the cylinder, $H^4$, having the shoulder, $h^9$, thereon; the cam, $h$, thereon arranged to operate the said actuating valve; a pinion on said cylinder; a rack engaging said pinion; a motor arranged to actuate said rack; a valve for controlling the fluids passing to the motor; the cam, $h'$, for actuating said valve; a ring, $H^5$, carrying said cam journaled with the axis of the cylinder, $H^4$, as a center and having the groove, $h^7$, therein and shoulder, $h^8$, arranged in the groove in the path of the shoulder, $h^9$.

38. In a valve device for controlling actuating motor fluids in apparatuses for actuating fluids under pressure, the combination of a valve body having the supply chambers, exhaust chambers and equalizing chambers therein; passages connecting said chambers; the valves, $g^3$, $g^3$, controlling passages from the supply chambers to the equalizing chamber; the valves, $g^5$, $g^5$, controlling the passages from the equalizing chambers to the exhaust chambers; and the valve, $g^4$, controlling a passage between the equalizing chambers; stems extending from said valves to without the valve body; the valves, $g^{11}$, $g^{11}$, controlling passages to a motor; stems extending from said valves to without the valve body, the cylinder, $H^4$, having the cams, $h$, $h^2$ and $h^3$, thereon, arranged in the relation described; cylinders, $H^5$, having cams, $h'$, thereon; locking means between said cylinders whereby the rings, $H^5$, are driven from the cylinder, $H^4$, but with a movement differing in extent from the movement of the cylinders, $H^4$; the pinion on the cylinder, $H^4$; a rack engaging said cylinder; motor cylinders, $I^2$, at each side of the rack; pistons in said cylinders for actuating said rack; and connections between said motor cylinders and the motor valve passage in the body of the valve chamber.

39. In a valve device for controlling actuating motor fluids in apparatuses for actuating fluids under pressure, the combination of a valve body having the supply chambers, exhaust chambers and equalizing chambers therein; passages connecting said chambers; the valves, $g^3$, $g^3$, controlling passages from the supply chambers to the equalizing chamber; the valves, $g^5$, $g^5$, controlling the passages from the equalizing chambers to the exhaust chambers and the valve, $g^4$, controlling a passage between the equalizing chambers; stems extending from said valves to without the valve body; the valves, $g^{11}$, $g^{11}$, controlling the passages to a motor; stems extending from said valves to without the valve body; the cylinder, $H^4$, having the cams, $h$, $h^2$, and $h^3$, thereon, arranged in the relation described; rings, $H^5$, having cams, $h'$, thereon; locking means between said cylinders whereby the rings, $H^5$, are driven from the cylinder, $H^4$, but with a movement differing in extent from the movement of the cylinder, $H^4$; the pinion on the cylinder, $H^4$; a rack engaging said pinion; motor cylinders,

$I^2$, at each side around the rack; pistons in said cylinders for actuating said rack; connections between said motor cylinders and the motor valve passages in the body of the valve chamber; the arm, $H^6$, fixed with the cylinder, $H^4$; and an adjustable weight on said arm.

In testimony whereof I affix my signature, in presence of two witnesses.

RUDOLPH CONRADER.

Witnesses:
R. F. LANZA,
H. LIPPOLD.