No. 886,379. PATENTED MAY 5, 1908.

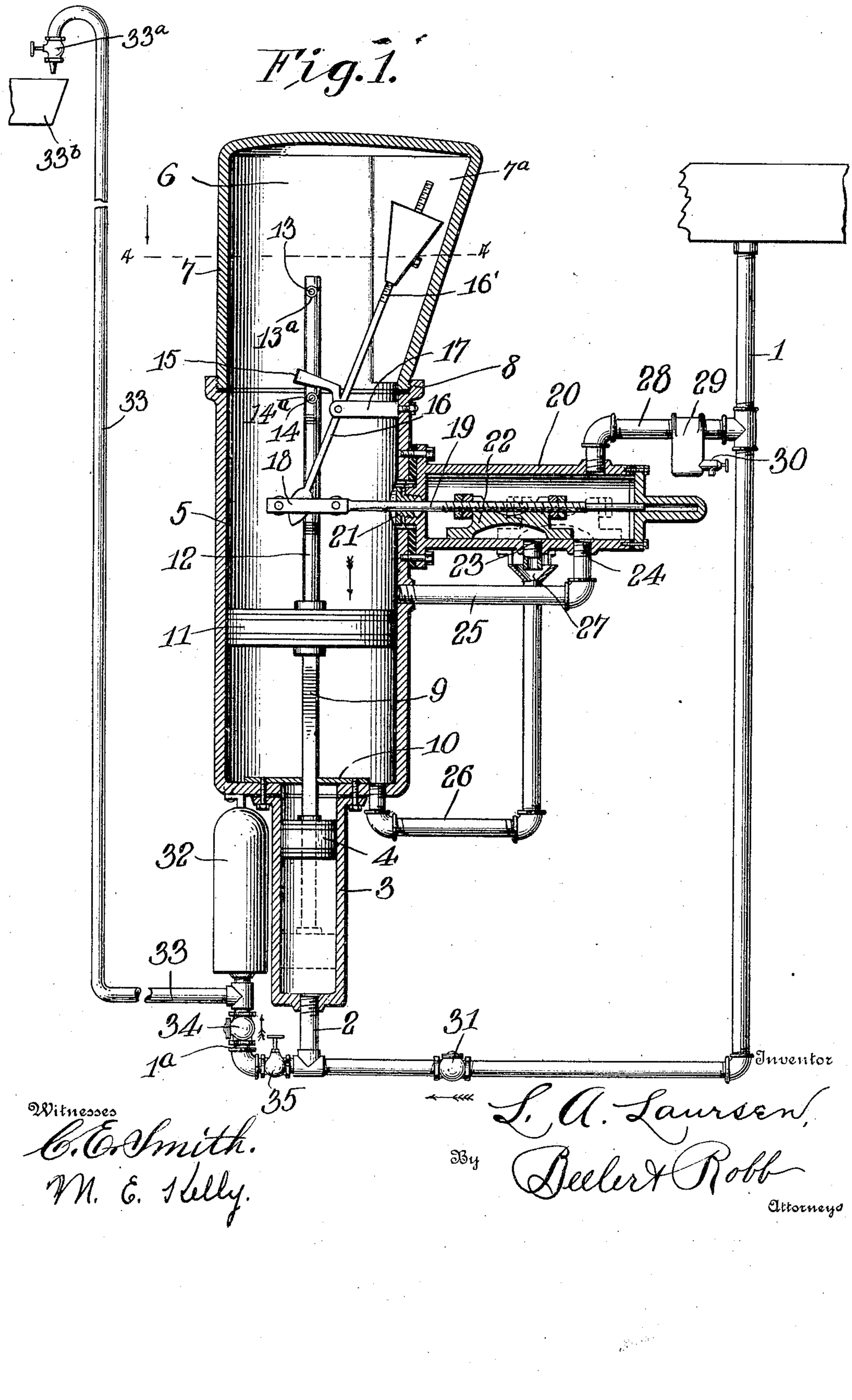
L. A. LAURSEN.

AUTOMATIC HYDRAULIC PUMP.

APPLICATION FILED OCT. 21, 1907.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses

C. E. Smith.

M. E. Kelly.

Inventor

L. A. Laursen,

By Beeler & Robb

Attorneys

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2 SHEETS—SHEET 2.

Fig. 2.

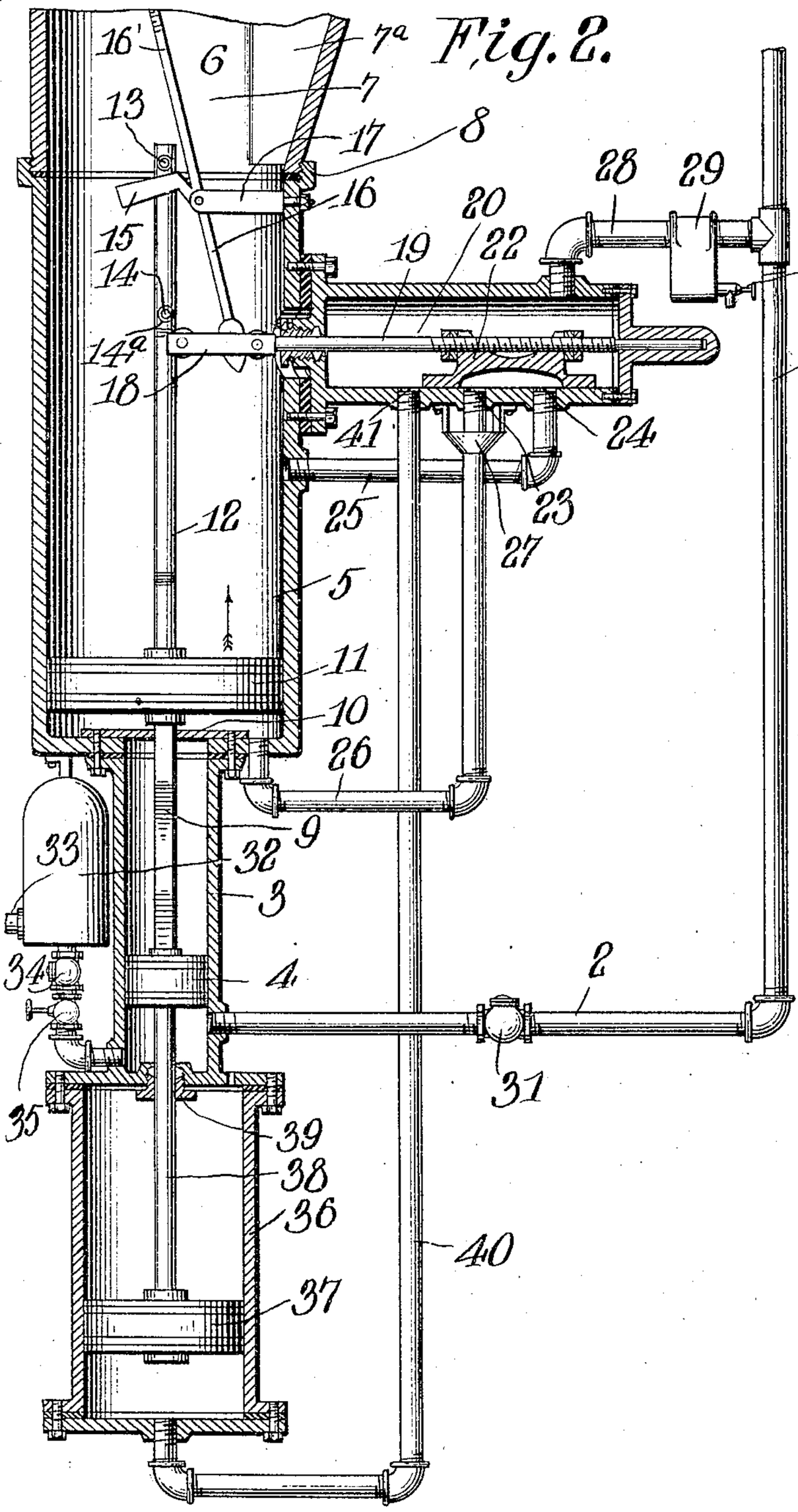


Fig. 4.

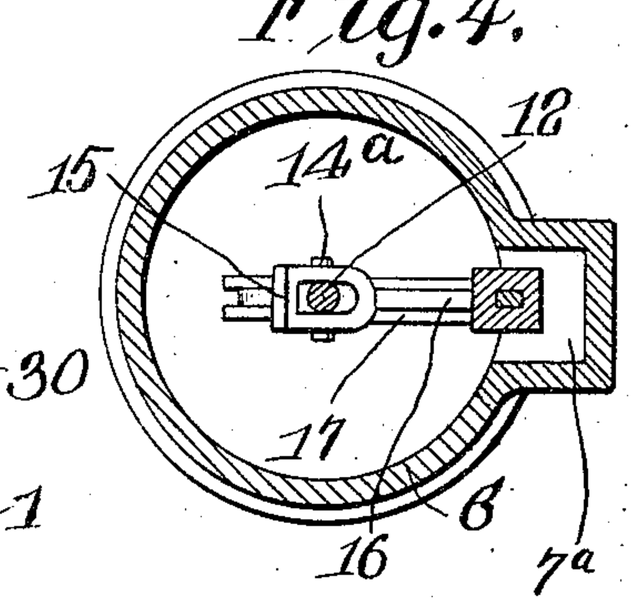
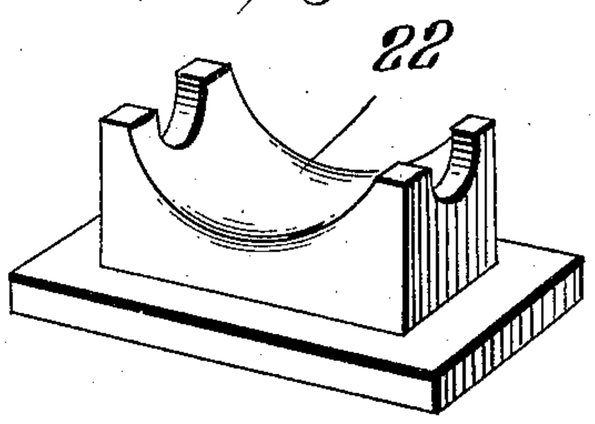


Fig. 3.



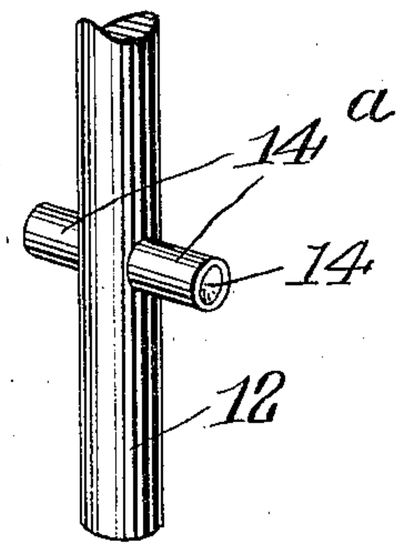


Fig. 5.

Witnesses
C. E. Smith.
M. E. Kelly.

Inventor
L. A. Laursen.
By Beeler & Robb
Attorneys

UNITED STATES PATENT OFFICE.

LAURITS AKSEL LAURSEN, OF CORNELL, WISCONSIN.

AUTOMATIC HYDRAULIC PUMP.

No. 886,379. Specification of Letters Patent. Patented May 5, 1908.

Application filed October 21, 1907. Serial No. 398,397.

To all whom it may concern:

Be it known that I, LAURITS AKSEL LAURSEN, a citizen of the United States, residing at Cornell, in the county of Chippewa and State of Wisconsin, have invented certain new and useful Improvements in Automatic Hydraulic Pumps, of which the following is a specification.

This invention relates to improvements in hydraulic pumps.

The object of the invention is to provide an automatic pump of the above type which may be placed at any point in a river or creek, and so connected with the water supply as to admit of operation of the pump by a comparatively small head of water, so as to elevate water a considerable distance dependent upon the head aforesaid.

In the practical operation of the invention the head of water sufficient to effect automatic operation of the pump comprising this invention may be secured in any of the various ways commonly employed in hydraulic engineering and the construction of the pump is of great advantage because of the power which is derived in its operation whereby water is elevated a considerable distance in the manner above premised. Of course it will be understood that the invention may be used for various purposes, as on a farm or in other places according to the necessities arising under actual conditions of service.

For a full understanding of the invention, including its advantages and mode of operation, reference is to be had to the accompanying drawings, in which:—

Figure 1 is a view showing the main operating parts of the machine in vertical section, other parts being shown in elevation, and embodying the preferred form of the invention. Fig. 2 is a view similar to Fig. 1, a modification of the invention being illustrated, and certain parts of the invention shown in Fig. 1 being in reversed positions. Fig. 3 is a detail view of the slide valve. Fig. 4 is a horizontal sectional view taken on the line 4—4 of Fig. 1 looking downwardly. Fig. 5 is a detail view of the piston of the working cylinder.

Similar parts are referred to in all the views of the drawings, and indicated in the description by the same reference characters.

Specifically describing the invention and referring to the drawings, the numeral 1 designates a supply pipe which is connected with the water supply by which the pump is operated, in any suitable manner. The supply pipe 1 leads at its lower end by a vertical branch 2 into a discharge cylinder 3, in which operates a discharge piston 4. The upper end of the cylinder 3 is open and is connected by suitable fastenings with the lower end of a working cylinder 5 at the upper end of which is provided an air compartment or chamber 6 which comprises a head 7 detachably secured to the cylinder 5, as shown at 8. The piston rod 9 of the piston 4 is of many sided form, preferably square, in cross section, and passes through an opening of similar form provided in a guide member 10 which extends across the upper open end of the cylinder 3. The piston 4 is thus held from rotation by the coöperation of the member 10 with its piston rod. The piston rod 9 is connected at its upper end with a working piston 11 operating in the cylinder 5 and having the piston rod 12 extending upwardly therefrom in a central arrangement in said cylinder 5.

Mounted upon the upper end portion of the rod 12 are vertically spaced upper and lower engaging members 13 and 14 respectively, said members comprising transverse supports applied to the rod 12 and having antifriction rollers 13ª and 14ª mounted upon opposite ends and upon opposite sides of the rod. The rod 12 passes through a yoke 15 which constitutes the upper arm of a rocking lever 16, the latter being pivoted to a detachable supporting member 17 secured to the cylinder 5. The yoke 15 receives the rod 12 at that portion of the latter between the two engaging members 13 and 14, the said engaging members being adapted to engage the yoke in the up and down movement of the member 12 actuated by movement of the working piston 11. The piston 11 is also prevented from rotation by the coöperating guide member 10 and rod 9. The lower arm of the lever 16 has loose connection at 18 with a valve rod 19 which is arranged for horizontal movement in a casing or water chest 20. The valve casing 20 is attached at one end to a side of the cylinder 5 and the end portion of the rod 19 which is connected with the lever 16 preferably passes through a stuffing box 21. Connected with the valve rod 19 for operation thereby is a slide valve 22 which controls the opening and closing of waste and supply ports 23 and 24 respectively, the latter being provided in the lower portion of the casing 20. A supply pipe 25 leads from the supply port 24 into the cylin-

der 5 at an intermediate point in the length of said cylinder. A waste pipe 26 is connected at one end of the cylinder 5 at the bottom of the latter and leads upwardly to a point adjacent to the waste port 23, the upper end of said pipe 26 being flared to provide a funnel-like outlet 27. The waste port 23 is arranged just above the outlet 27 and is spaced therefrom as shown most clearly in the drawings. Leading off from the main supply pipe 1 is a branch supply pipe 28 which is connected at the upper portion of the casing 20, which casing as above mentioned virtually constitutes a water chest. In the length of the branch pipe 28 is interposed a sand trap 29 having a suitable cock 30 connected therewith whereby the trap may be flushed and cleansed as occasion may require.

At a suitable point in the length of the main supply pipe 1 is located a check valve 31 opening in the direction of the arrow. The pipe 1 extends some distance beyond the vertical branch 2 thereof and thence upwardly as shown at 1^a to its point of connection with an air and water dome or reservoir 32. The reservoir 32 may be situated some distance away from the parts of the mechanism before described but preferably said reservoir is located beneath the cylinder 5 and adjacent to the cylinder 3 at a side of the latter. The discharge pipe 33 extends laterally from the portion 1^a of the main supply pipe 1 and between the connection of the discharge pipe and the connection of the branch pipe 2 are located a check valve 34 and a globe valve 35, such valves being employed to control the passage of water through the several elements of the structure, as for instance when repairing or repacking the pistons, &c. The pipe 33 terminates adjacent to a sink 33^b or the like, and is provided with a cock or faucet 33^a by virtue of which the flow of water and the ordinary operation of the pump are controlled.

Describing the general operation of the invention, all parts being assembled and in normal position, water passes from the supply pipe 1 to the cylinder 3, opening the check valve 31. The pressure of the water against the under side of the piston 4 forces the said piston and the piston 11 upwardly. As the piston 11 approaches the limit of its upward movement, the engaging member 14 of its rod 12 strikes the yoke 15 and tilts the lever 16 swinging the weighted arm 16′ beyond the dead center whereupon the weight will quickly and forcibly move the valve 22 into the position in which it is shown in Fig. 1 of the drawings, wherein the simple form of the invention is illustrated. In other words when the pistons 4 and 11 are at the upper limits of their movements the valve 22 will be in such a position as to open the supply port 24 to the water chest 20. The water from the branch supply pipe 28 will then pass from the chest 20 through the supply port 24 into pipe 25 and into the cylinder 5 above the piston 11. The area of the piston 11 being so much larger than that of the piston 4, it will be apparent that the excessive pressure upon the top of the piston 11 will cause the latter to move downwardly. When the water is admitted from the source of supply through the pipe 25 into the cylinder 5, the cylinder will fill with water above piston 11 causing the air confined therein to be compressed. The air thus compressed will have an expansive force substantially equal to the force of the water acting upon the upper side of the piston 11, and such force of the confined air will be maintained substantially uniform during the admission of water through the pipe 25.

As the piston 11 approaches the limit of its downward movement the member 13 on the rod 12 strikes the yoke 15 and the tilting of the lever 16 will cause the valve 22 to resume the position in which it is shown in Fig. 2, whereby the supply port 24 is closed permitting the pressure of the water from the main supply pipe 1 upon the bottom of the piston 4 to force the pistons upwardly again, said pressure exceeding the pressure exerted by the weight of the water upon the top of the piston 11. When the port 24 is closed of course the supply of water exerting a pressure upon a top of the piston has been cut off. In the gradual movement of the valve 22 closing the port 24, on the down stroke of the piston 11 it will be apparent that at a certain point the water passing into the supply pipe 25 will be so reduced in volume that the difference between the areas of the pistons 11 and 4 will not be sufficient to cause continued downward movement of the pistons, by reason of the resistance offered by the water entering the lower end of the cylinder 3 and exerting an upward pressure against the bottom of the piston 4. Under such conditions the pistons 4 and 11 would stop in their downward movement at the point whereat the downward pressure of the water upon the piston 11 is equal to the upward pressure of the water against the piston 4, but here the expansive force of the air in the air chamber 6 is sufficient to cause the small final movement of the pistons 11 and 4 sufficient to draw the valve 22 clear over the port 24 and permit waste from the port 23, whether or not the weighted arm 16′ is used for the purpose of shifting the valve 22 over port 24.

The upward and downward strokes of the pistons 4 and 11 have been described above from the starting of the mechanism. Now on the next upward stroke of the pistons, the water above the piston 11 will be forced from the supply pipe 25 through the port 24 and out of the casing 20 through the waste port 23. This water will pass into the pipe 26

and from thence into the cylinder 5 below the piston 11 and will by virtue of the buoyant force of the column of water in the vertical portion of pipe 26 augmented by the jet of water through the port 23 due to the expansive force of the air previously compressed within the chamber 6 assist in the lifting of the pistons caused by the pressure of the water from the main supply pipe 1 against the underside of the piston 4. When the piston 11 has reached the upper limit of its movement the valve 22 will have been moved so as to open the supply port 24 permitting water to again enter the cylinder 5 above the piston 11 and the stroke of the piston will be reversed. As the piston 11 moves down the water in the cylinder 5 below said piston will be forced into the waste pipe 26 and will pass from the outlet 27 before described, this happening at each downward stroke of the piston 11.

On the down stroke of the pistons 11 and 4, the piston 4 will force the water below the same in the cylinder 3 downwardly into the pipe 1, closing the check valve 31. Said water will then be discharged from the cylinder 3 into the reservoir 32 and when the air in the reservoir 32 is compressed to a certain degree, the water will of course be discharged through the discharge pipe 33, the latter leading off to an elevated point which is to be supplied by the water forced upwardly by means of the hydraulic pump.

Fig. 2 of the drawings illustrates a modified form of the invention which is particularly designed for elevating water to great heights when only a small head of water is supplied to the pumping mechanism. The modification of the invention is secured advantageously by employing an attachment which may be readily applied to the more simple form of the invention illustrated in Fig. 1.

Describing the modification it will be observed that an auxiliary working cylinder 36 is provided, the same being arranged below and attached in a substantial manner to the lower end of the discharge cylinder 3. Within the auxiliary cylinder 36 operates an auxiliary piston 37 having its piston rod 38 attached to the discharge piston 4, said rod 38 passing through a stuffing box 39 at the upper end of the cylinder 36, the two cylinders 3 and 36 being entirely separate and independent so far as the inclosed chambers or spaces thereof are concerned. Connected with the lower end of the cylinder 36 is an auxiliary supply pipe 40 which is also connected with the casing or water chest 20 at the lower portion of the latter, an auxiliary supply port 41 being located at the point of connection of the pipe 40 and casing 20.

The arrangement of the port 41 is such that in the operation of the pumping mechanism to which the attachment is applied, the valve 22 will control the opening and closing of the port 41 in a simple and advantageous manner. The provision in the auxiliary cylinder 36 of the auxiliary piston 37, of a considerable area will be effective in forcing the pistons 4 and 11 to the limit of their upward movement, when if the piston 37 were not used, the comparatively small head of water supplied to the pumping mechanism would not cause elevation of the water a sufficient distance. In other words by the addition of the attachment modifying the operation of the invention, the same head of water which elevates water a certain distance, in the operation of the invention shown in Fig. 1 will elevate water a far greater distance in the operation of the mechanism illustrated in Fig. 2 due to the working area of the piston 37 which acts auxiliary to the piston 4 in the lifting of the pistons to the limits of their upward movements. In the actual operation it will be apparent that upon the downward stroke of the pistons in the form of the invention shown in Fig. 2, the supply port 24 will be closed and the water below the piston 11 will waste through waste pipe 26 and outlet 27. After the pistons have reached the lower limits of their movement and the port 24 has been closed, the valve 22 will be so arranged that the auxiliary port 41 is open and the pistons will be forced upwardly not only by the pressure of the water from the main supply pipe 1 against the underside of the piston 4 but by the pressure of the water passing from the water chest 20 into the pipe 40 and against the lower side of the piston 37 in the cylinder 36. It will be obvious that by increasing or decreasing the size of the cylinder 36 and piston 37 used as an attachment for the more simple form of my mechanism, the proper capacity of the machine may be determined.

From the foregoing description it will be understood that for the elevation of water to a high elevation relative to the source, it is requisite that the working piston 11 must have a surface area proportionately greater than that of the discharge piston 4. If then it be required to elevate to an exceedingly high point and with only a low head, the working piston would have to be made so large in proportion to the piston 4 that the latter alone would be inadequate to restore said piston 11 to its upper limit of movement in a practical manner, hence in such a case the auxiliary mechanism of Fig. 2 is utilized to assist the piston 4 to lift an excessively large piston 11.

In order for the head 7 to have sufficient capacity to accommodate the weighted arm 16′ in its oscillations, I may provide an extension 7ª and attach the same to the main portion of the head in any suitable manner, or in some cases it may be preferred to so proportion the main parts as to not require

such extension. In this and many other specific details, it will be understood that such variations may be resorted to as may suggest themselves to any one skilled in the art without departing from the spirit of the invention.

As diagrammatically indicated in Fig. 1, the pump is well adapted for connection with a city water main, and from which at low pressure or head the water may be elevated to the top or the several apartments of a tall building or elsewhere to which the normal pressure of the source would be inadequate to supply. In general terms the height of the head or source (or main pressure) bears the same ratio to the elevation of the point supplied as the area of the discharge piston 4 bears to the area of the working piston 11. The machines will, therefore, be constructed to meet the necessities of the various requirements as to the work to be performed.

After the valve 33ª is closed the pump will continue to operate until the dome or reservoir 32 becomes charged with water and the air contained therein is compressed to the limit of the capacity of the pump. The force of the air thus confined will be exerted to immediately discharge water upwardly through the pipe 33 when the valve 33ª is again opened. The reservoir 32, therefore, serves not only in the sense of a storage chamber but also to render the flow of water practically steady during continuous operation of the pump. It will also be noted that if the pump be located at the foot of a dam or well, when the outlet valve 33ª is closed the water in said dam or well will rise to a higher level, so that the force or capacity of the pump will be correspondingly increased. By virtue of this arrangement a more economical machine may be employed, *i. e.*, one with a less differential between the discharge and working pistons.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent of the United States, is:—

1. In an automatic pump, the combination of the working cylinder 5 and its piston 11, the discharge cylinder 3 and its piston 4, a valve casing having a waste port 23, the waste pipe 26 connected with the working cylinder 5 and having the outlet 27 below said waste port and being spaced therefrom, the supply pipe 25 connecting the casing and cylinder 5, the valve 22, movable in the valve casing to connect pipes 25 and 26 on the upstroke of piston 11 so that the pressure medium will be forced from one side of said piston to the other side, and also movable into a position closing the port 23 and permitting the pressure medium to pass from the valve casing into the pipe 25 and cylinder 5, means for supplying the pressure medium to the valve casing and discharge cylinder, and means for automatically operating the valve 22.

2. In an automatic pump, the combination of the working cylinder 5 and its piston 11, the discharge cylinder 3 and its piston 4, a valve casing having a slide-valve therein and arranged at a right angle to the cylinders aforesaid, waste and supply pipes for controlling the supply of water passing to and from the working cylinder and in coöperation with the slide-valve, a valve rod leading from the slide valve through a side of the cylinder 5, a lever pivoted between its ends within the cylinder 5 and having one end operably connected with the valve rod, a piston rod extending from the piston 11, spaced members carried by the said piston rod and adapted to engage the other end of the above mentioned lever at intervals in the movement of piston 11, a weighted arm projecting from the lever aforesaid to carry it past the dead center when tilted by engagement of the members carried by the rod of piston 11, and means for supplying water under pressure to the valve casing and discharge cylinder.

3. In an automatic hydraulic pump, the combination of a working cylinder and a working piston therein, a discharge cylinder and a discharge piston therein of smaller diameter than the working piston, and connected therewith, a waste pipe leading from the working cylinder, means for supplying a pressure medium to the working cylinder at one side of the piston, means for supplying said pressure medium to the discharge cylinder at the opposite side of the discharge piston, means for cutting off the supply of the pressure medium at predetermined intervals to cause reverse movement of the pistons, an auxiliary working cylinder, and an auxiliary working piston therein connected with the discharge piston, and means for supplying the pressure medium to the auxiliary working cylinder controlled by the same means that controls the supply of pressure medium to the first mentioned working cylinder.

4. In an automatic hydraulic pump, the combination of a main working cylinder and a working piston therein, a discharge cylinder and a discharge piston therein of smaller diameter than the working piston and connected therewith, an auxiliary working cylinder having an auxiliary working piston therein for actuating the discharge piston and connected with the latter, a waste outlet for the main working cylinder, means for supplying a pressure medium to the auxiliary working cylinder and the discharge cylinder at the same sides of the pistons operating therein, means for supplying a pressure medium to the working cylinder at the opposite side of the piston operating therein, and valve mechanism operable automatically in

the movement of the working pistons to alternately cut off the supply of the pressure medium from the main and auxiliary working cylinders for reversing the stroke of the pistons operating in the various cylinders.

5. In an automatic pump, the combination of a discharge cylinder and its piston, a working cylinder having its piston connected with the discharge piston, main supply and discharge pipes, mechanism including an auxiliary working piston connected with the discharge piston and connected with pressure supply means, and automatic valved controlling mechanism for causing the pressure medium to act alternately upon one working piston in one direction and upon the other working piston and the discharge piston in the other direction.

6. In an automatic pump, the combination of a discharge cylinder and its piston, a working cylinder having its piston connected with the discharge piston, main supply and discharge pipes, an auxiliary working cylinder and piston secured to the discharge cylinder, a piston rod connecting the auxiliary working piston and the discharge piston, a valve casing, supply and waste pipes leading from said casing to the first mentioned working cylinder, a branch supply pipe leading from the main supply pipe to the valve casing, another pipe leading from the valve casing to the auxiliary working cylinder to supply the pressure medium to the latter, a valve movable in the valve casing and arranged to control the passage of the pressure medium to and from the two working cylinders, and automatic means operated by the pistons for reversing the position of the valve relative to the waste and supply pipes of the working cylinders.

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

LAURITS AKSEL LAURSEN

Witnesses:

A. J. EDMINSTER,

ROBT. L. ZIMMERMAN.