(No Model.) 3 Sheets—Sheet 1.

E. H. WEATHERHEAD.

HYDRAULIC AIR PUMP.

No. 503,819. Patented Aug. 22, 1893.

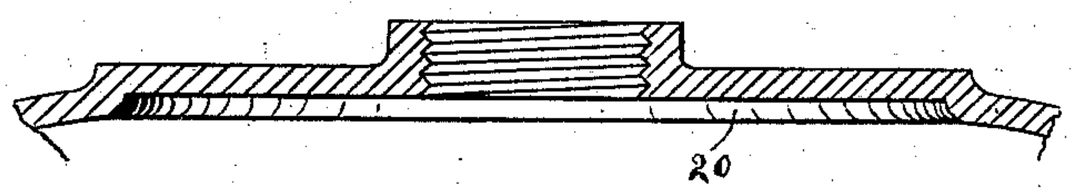
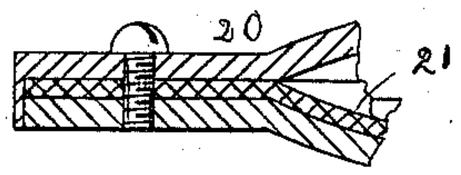
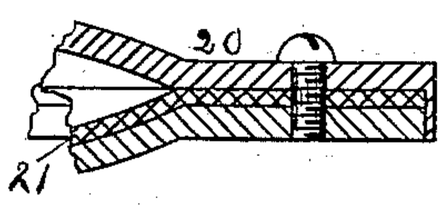
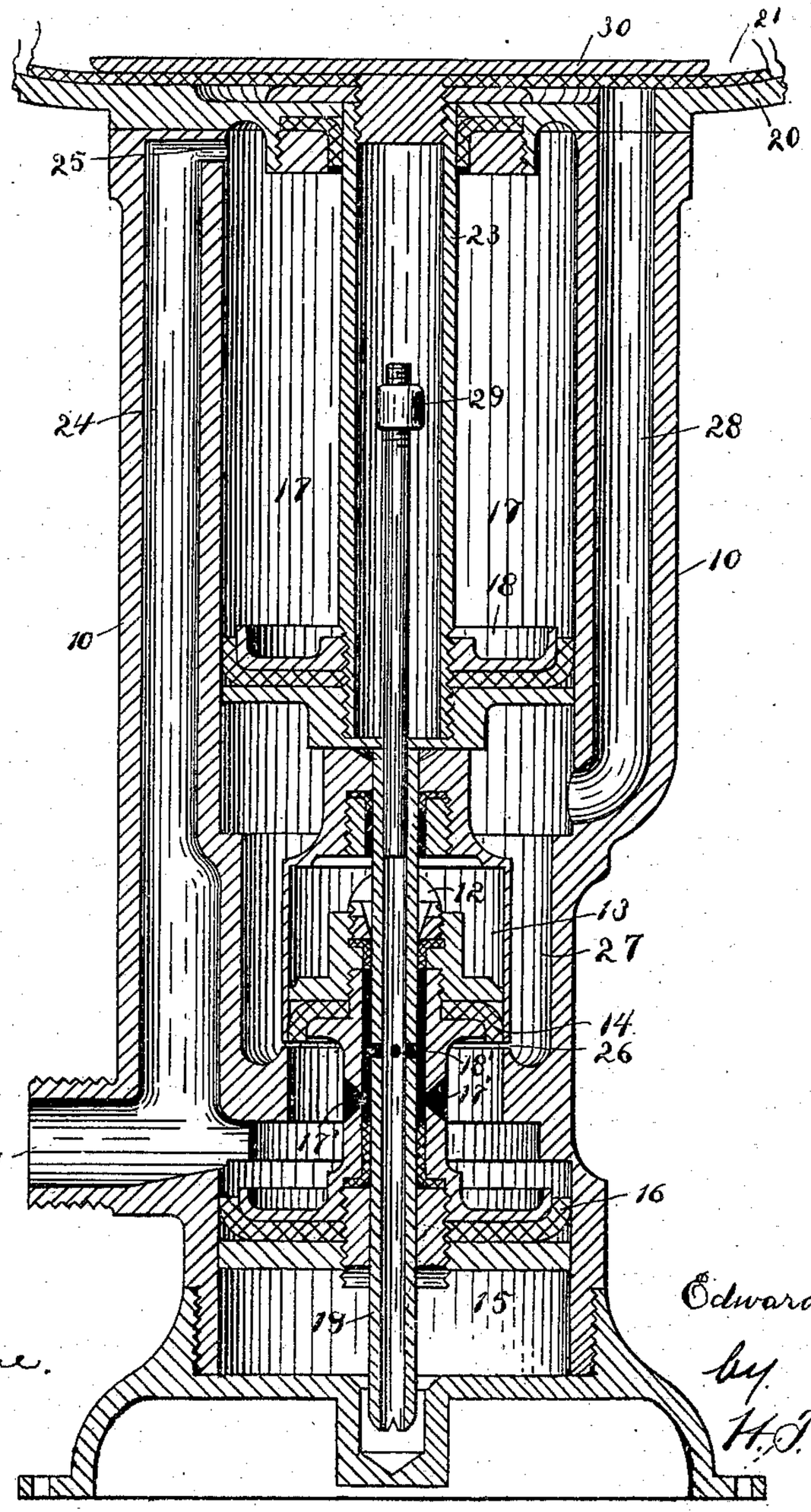


Fig 1.







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Nellie L. McLane.

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(No Model.) 3 Sheets—Sheet 2.

E. H. WEATHERHEAD.

HYDRAULIC AIR PUMP.

No. 503,819. Patented Aug. 22, 1893.

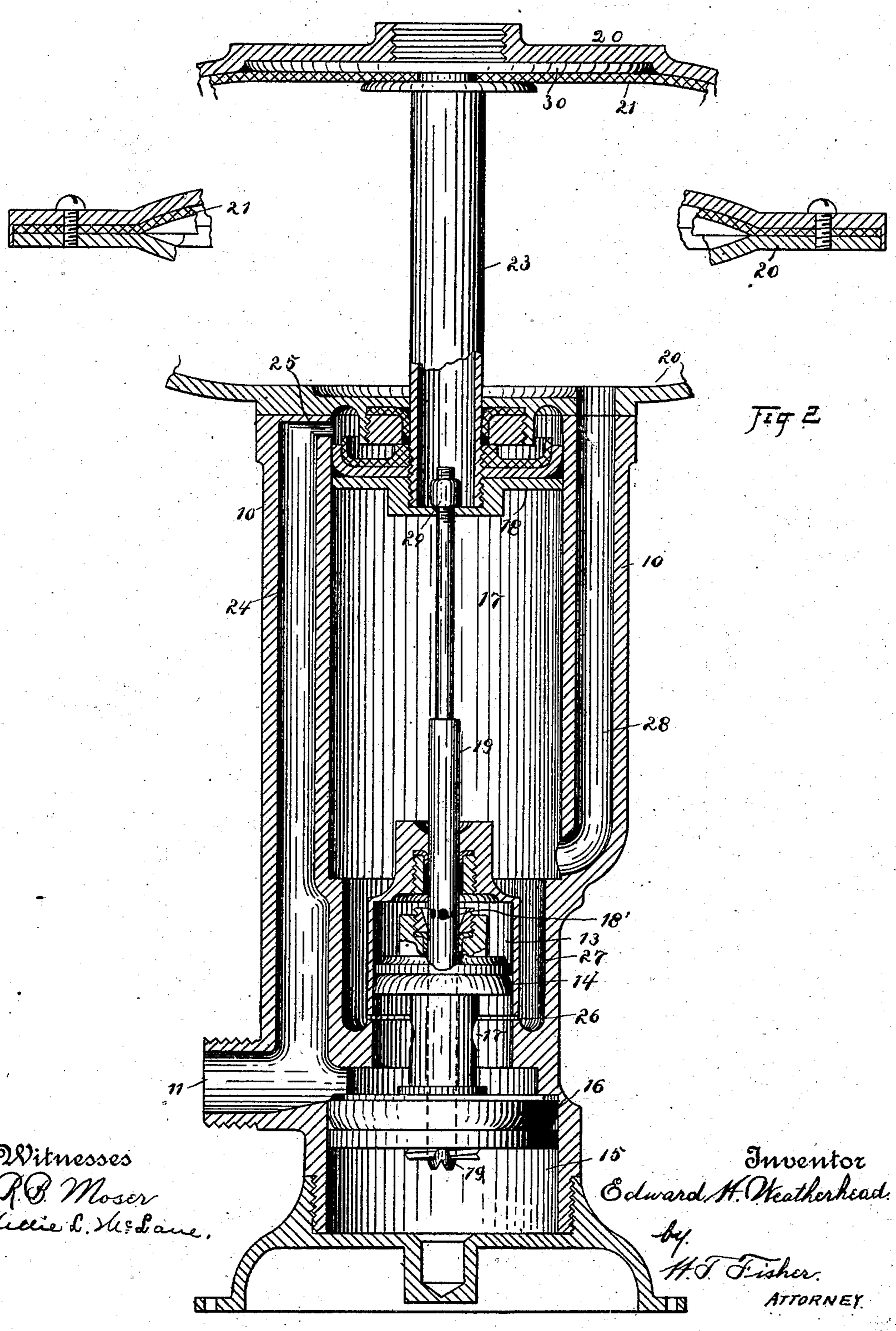

Fig 2.

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(No Model.) 3 Sheets—Sheet 3.

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HYDRAULIC AIR PUMP.

No. 503,819. Patented Aug. 22, 1893.

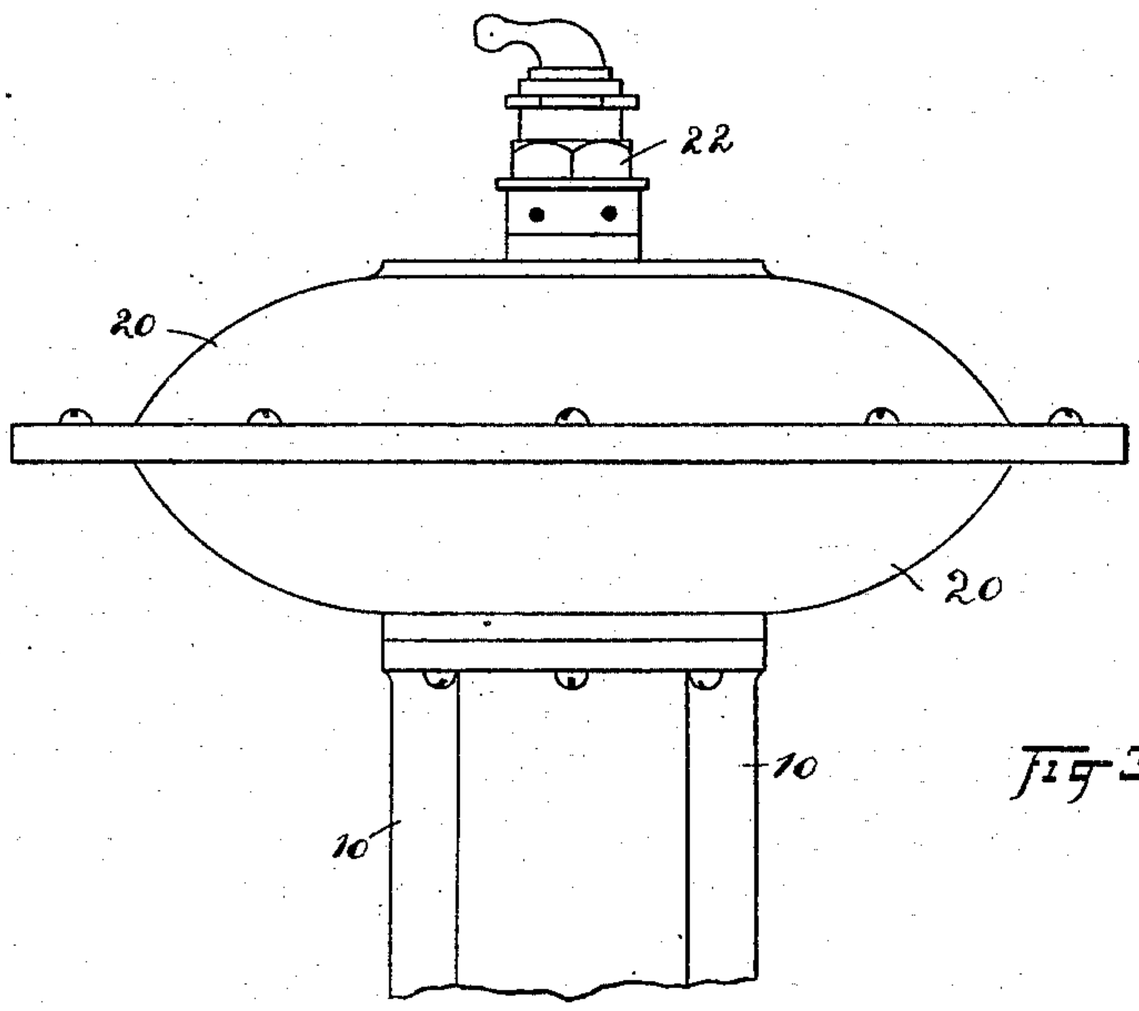
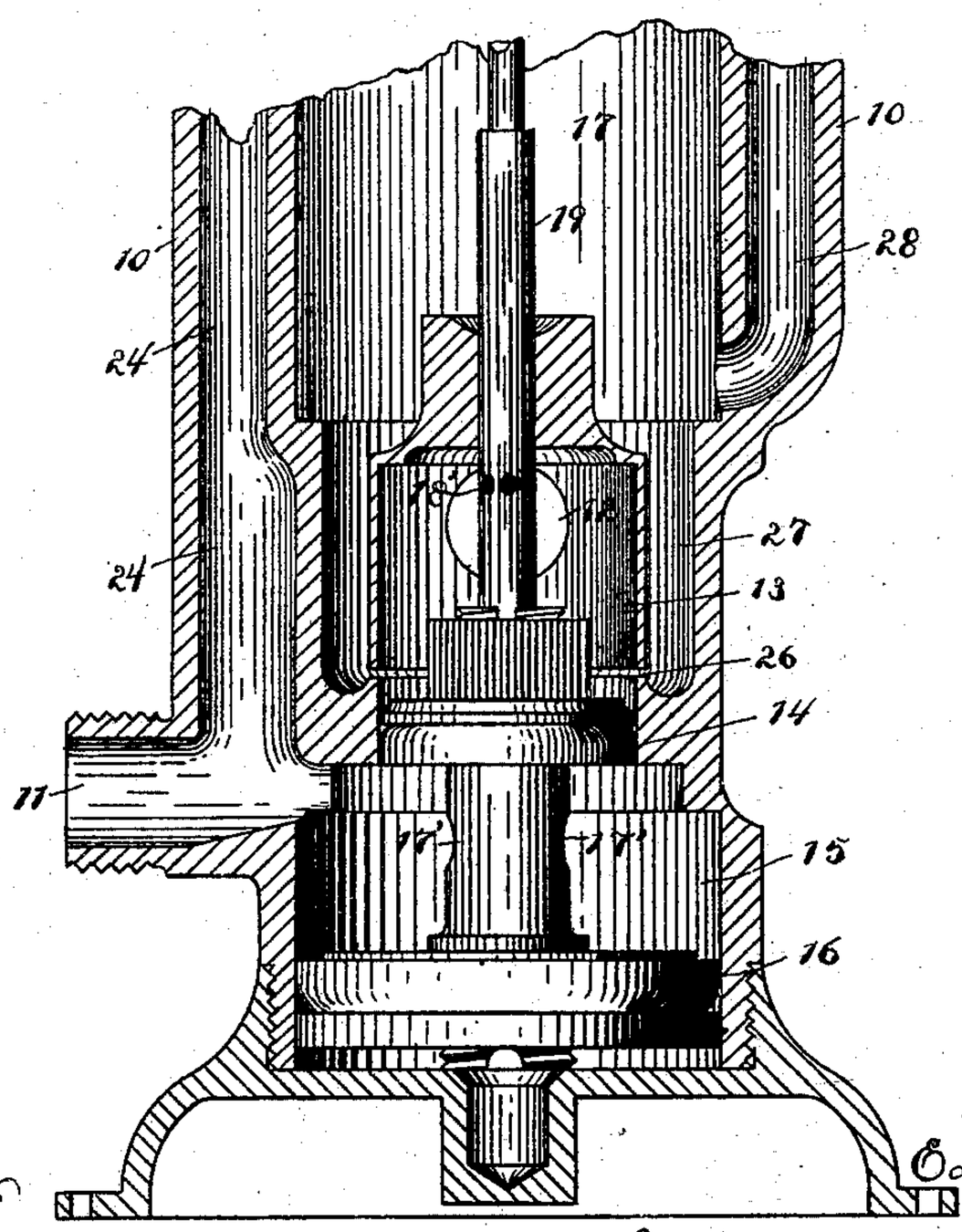


Fig 3



Witnesses
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Nellie L. McLane.

Inventor
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H. T. Fisher.

UNITED STATES PATENT OFFICE.

EDWARD H. WEATHERHEAD, OF CLEVELAND, OHIO.

HYDRAULIC AIR-PUMP.

SPECIFICATION forming part of Letters Patent No. 503,819, dated August 22, 1893.

Application filed July 23, 1890. Serial No. 359,667. (No model.)

To all whom it may concern:

Be it known that I, EDWARD H. WEATHERHEAD, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Hydraulic Air-Pumps; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to hydraulic air pumps of the variety in which hydraulic pressure is employed to compress air or to force air under pressure into a chamber or receptacle and in which the action of the apparatus is automatic and continuous as long as the hydraulic pressure is maintained and excessive back pressure of air is not encountered.

In the accompanying drawings Figure 1 is a vertical central section of the apparatus with the parts in position to begin the expulsion of the air from the air chamber in the top of the apparatus. Fig. 2 is a similar sectional view with the pump pistons, valve and diaphragm at the upper limit of their stroke after the air has been expelled from the said air chamber. In these views the diaphragm chamber is broken at the sides to bring it within the sheet. Fig. 3 is a central vertical section showing the position of the valve and lower piston when the fluid is discharging from the space below the upper piston and beneath the diaphragm.

The diaphragm chamber and a broken section of the piston chamber are reduced to get said parts in the drawings.

In the several views 10 represents the main casing, which is advantageously cast in a single piece with all the parts and chambers therein, but it may be made sectional if preferred. This casing is provided with an inlet port 11, for the fluid under pressure, such for example, as is ordinarily obtained from city mains, and an outlet or exhaust port 12, in this instance at right angles to port 11, though it may sustain any other relation thereto. Inside the casing are what may be, for convenience of description, termed three different chambers for the two different pistons and the main valve. Thus there is a chamber 13 for the valve 14, a chamber 15 for the piston 16, and a chamber 17 for the piston 18.

The chambers 13 and 15 are of different diameter, and the valve 14 and piston 16 of correspondingly different area so that the pump may act automatically as it is designed to do. Thus it will be seen that the valve 14 and piston 16 are rigidly connected, the connection in this instance being a tubular neck having side openings 17′, but any other rigid open work connection may be used. The opposed faces of valve and piston are exposed to the full head of water pressure at all times, and of course as the area of the piston is greater than the area of the valve, the parts will move downward if unaffected by other conditions. Other conditions are however provided for. It will be noticed that the chamber 15 for piston 16 is closed at its bottom and sides, but fluid is enabled to enter said chamber through the openings 17′ into the connection between valve and piston, and thence through openings 18′ in auxiliary valve tube 19 down beneath the said piston 16. The tube 19 is open at its lower end, and is packed in the piston 16 so as to be fluid tight about its sides. Whatever the positions of this piston and tube the tube never is withdrawn from the piston. It will be noticed that the free space within the connection between valve 14 and piston 16 is of such length that when the tube is down, as in Fig. 1, so that its openings 18′ are beneath the valve, it may remain there and continue to supply pressure fluid beneath piston 16 until said piston has moved up to the limit of its upward stroke. For this purpose the valve may be formed as shown and thus extend said open space into the body of the valve.

On the top of the casing 10 is secured a combined air and water chamber 20, suitable flanges on the respective parts, not shown, being provided for bolting them together. The chamber 20 is made of two horizontal sections between which is fastened a flexible, preferably rubber, diaphragm 21, adapted to play between the upper and lower interior surfaces of said chamber. The top of the said chamber is provided with suitable air inlet and outlet mechanism 22, so that the cham-

ber may be supplied with fresh air from the outside through one channel and discharge through the nozzle by hose, or otherwise.

Connected with the diaphragm 21 is a tube 23 which passes centrally through a packed opening in the bottom of chamber 20 and extends some distance into piston chamber 17 in the upper portion of the main casing. A piston 18 is attached to the lower end of this tube and is adapted to play up and down in its chamber according as the pressure fluid is directed to one side or the other through the operations of the main valve. Thus a channel or duct 24, open to the main inlet has a lateral opening 25, at its top into the chamber 17 behind piston 18, and the valve chamber 13, has a circumferential slot or opening 26 about its lower portion through which fluid is admitted from said chamber, (Fig. 1) into the open space 27 about said valve chamber and thence into the chamber 17 beneath piston 18. Another duct or channel 28, leads from the bottom and side of chamber 17 up into the diaphragm chamber 20, through which fluid pressure is introduced beneath the diaphragm at the same time that it bears on the bottom of piston 18.

The auxiliary valve tube 19 is packed in both the valves 14 and the piston 16, so as to have an independent sliding movement therein at the same time that it is fluid tight about its sides in said parts. In this instance the said tube is shown as having a stem at its upper portion which forms its continuation into tube 23, with a head 29 which prevents its being drawn out of piston 18, but the tube itself if closed at the top, might be so extended.

The operation is as follows: Assuming that the parts are down at all points, the pressure fluid enters between the main valve and lower piston through holes 17′ and 18′ and through tube 19 to the space beneath piston 16. This causes said piston and the valve 14 to rise, say to, the position seen in Fig. 1. At the start of this upward movement the tube 19 of course is down so that the holes 18′ are free for the passage of fluid from the open space in the neck connecting the main valve and lower piston, as seen in Fig. 1, and it remains down until raised by the piston 18 as hereinafter explained. The fluid entering through the channel indicated causes valve and piston, 14 and 16, to rise as seen in Fig. 1 till the valve passes inlet slot or opening 26, at the bottom of valve chamber, when fluid pressure is admitted beneath piston 18 and the diaphragm 21. Meanwhile fluid pressure is behind piston 18 through opening 25, but this is counterbalanced by the pressure from beneath the piston while a heavy upward pressure is introduced beneath the diaphragm through channel 28. The tube 23 is mounted upon the upper side of the diaphragm with a large disk 30, and between the joint pressures thus introduced and bearing against the piston 18 and the diaphragm, these parts are carried upward and the air in the chamber above the diaphragm is forcibly expelled through the channel provided for that purpose. As the piston and diaphragm rise, the head 29 on tube 19 is engaged and said tube is carried up with them until it reaches the upward limit of its movement and the openings 18′ are brought above valve 14, as seen in Figs. 2 and 3. This accomplished, the several parts are in position to begin the reverse movement. The fluid beneath lower piston 16 under the downward pressure on said piston is forced out through tube 19, the holes 18′ and the outlet or exexhaust port 12. The valve 14 and the piston 16 then further descend until the piston is seated at the bottom of its chamber and the valve is carried down past the slot or opening 26, Fig. 3. This opens the way for the discharge of the fluid beneath piston 18 and the diaphragm, and the fluid pressure again asserts itself through opening 25 behind piston 18 drawing the diaphragm down and expelling the fluid from the diaphragm chamber. In this downward movement the piston 18 carries the tube 19 down to starting position and the piston and diaphragm also reach their downward limit. It will be noticed that the exhaust is from the top side of the valve chamber, and that the pressure fluid which actuates the upper piston and the diaphragm first enters through slot 26 beneath the valve and then discharges back through said slot above the valve. Suitable webs, not shown, connect the valve chamber with the surrounding casing above slot 26, but are so located as not to interfere with the fluid space about said chamber. Because of its function with relation to valve 14 and also in order the more readily to identify the piston 16 in the claims, I designate it by the term "governing piston."

A material advantage is obtained in the use of a diaphragm by which to force the air, over a piston or plunger, by reason of the absence of weight or friction in the diaphragm. If a plunger or piston were used instead of a diaphragm the friction upon the cylinder and the weight would have to be overcome by the fluid pressure by which the pump is operated before pressure would be exerted to compress or force the air, and several pounds of such pressure to the square inch would be required. In places where the pressure is low, either by reason of the normal pressure being low or by reason of the elevated location in which the pump may be used, it is of the highest importance that as little weight or friction be encountered as possible, as otherwise the pump might refuse entirely to act. The range of pressure in different places is very great, say from ten to a hundred pounds to the square inch, and it is necessary that the pump should be adapted to work in either case. Of course if the pump be so constructed that the lowest pressure named be required to operate it, the pump

would be useless in many places, but by the use of a diaphragm which has no perceptible weight and no friction whatever, the only resistance to be overcome is found in the necessary valve and pistons, and this leaves a measurable pressure to be taken off to compress the air even when the pressure is unusually low, and makes the pump available in places and under conditions where it would not be available if not so constructed.

The diaphragm 21, in the relation and operation as herein shown and described, performs the function of an ordinary piston of which it is the mechanical equivalent.

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

1. In a pump to compress or force air by water pressure, the main casing having a valve chamber and a valve therein and a piston to operate the valve, a piston chamber and a piston above said valve chamber, and water passages from one chamber to the other, in combination with an air and water chamber provided with an air opening in its upper portion, and a water passage in its lower portion communicating with the aforesaid valve and piston chambers, and a diaphragm separating the air and water in said chamber, substantially as described.

2. The main casing having a piston chamber in its upper portion, a chamber with a centrally attached flexible diaphragm on said casing, and a piston attached to said diaphragm working in said piston chamber, said casing having passages for the pressure fluid to enter upon both sides of said piston and on the lower side of the diaphragm, and a valve to control the flow of the pressure fluid and a governing piston, substantially as described.

3. The main casing having a valve chamber and valve, a piston chamber and piston above said valve chamber and passages for the pressure fluid leading into said valve chamber and into the piston chamber behind the piston therein, in combination with an air and water chamber having a diaphragm connected with said piston and a water passage between the lower side of the said piston and the lower side of the said diaphragm, substantially as described.

4. In a hydraulic pump, the main casing provided with a water valve and a piston of different area rigidly connected, in combination with a combined water and air chamber having a flexible diaphragm at its center, a piston in the main casing connected with the center of the diaphragm, an auxiliary water valve tube operated by said piston and extending through the aforesaid valve and piston, and fluid passages, substantially as described.

5. The main casing having a piston chamber in its upper portion and a pressure fluid duct leading to the upper portion of said chamber from the main fluid inlet and entering above the piston therein, and a valve chamber beneath said piston chamber having an opening for the passage of pressure fluid to and from the lower portion of said piston chamber and beneath the piston, a piston and a valve in said chambers, respectively, and the diaphragm and the governing piston substantially as described.

6. The main casing having a valve chamber with a lateral opening, a piston chamber, and a combined air and water chamber above the piston chamber, and fluid ducts leading into both of said chambers supplied through the lateral opening in the valve chamber, in combination with a central diaphragm in the air and water chamber, and a valve and piston in the valve and piston chambers respectively, and the governing piston substantially as described.

Witness my hand to the foregoing specification this 16th day of July, 1890.

EDWARD H. WEATHERHEAD.

Witnesses:

H. T. FISHER,

NELLIE L. MCLANE.