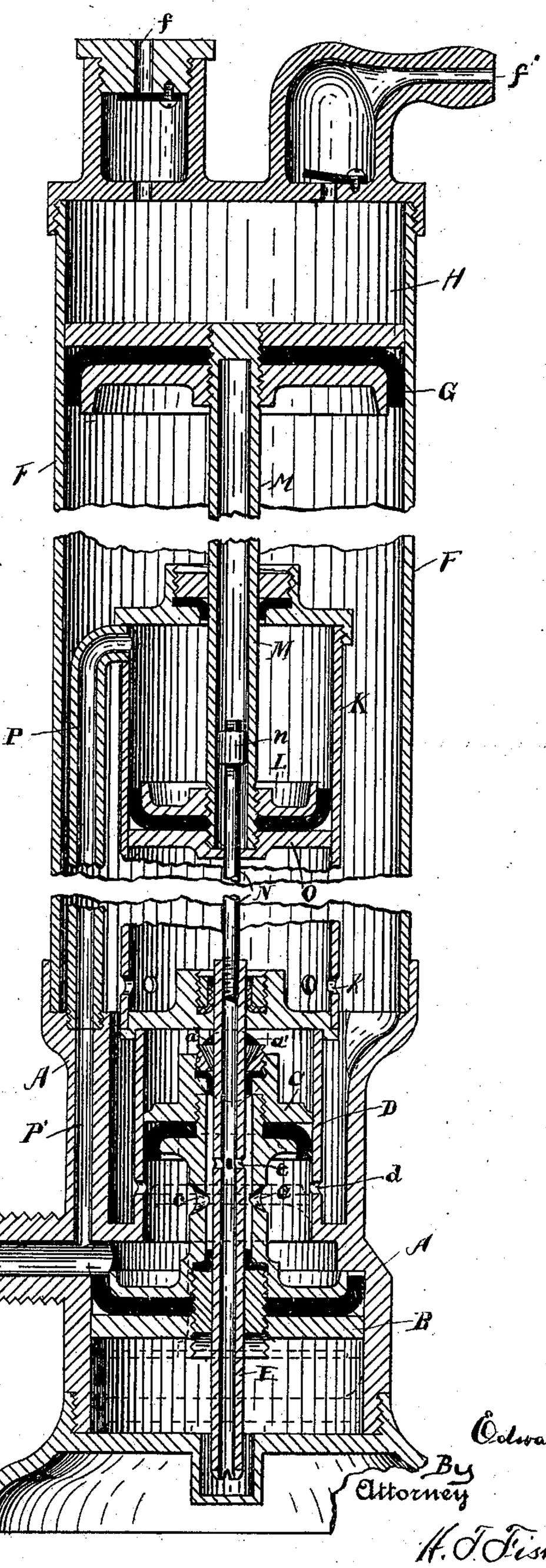
(No Model.)

E. H. WEATHERHEAD.

HYDRAULIC AIR PUMP.

No. 504,097. Patented Aug. 29, 1893.



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HYDRAULIC AIR-PUMP.

SPECIFICATION forming part of Letters Patent No. 504,097, dated August 29, 1893.

Application filed October 22, 1890. Serial No. 368,938. (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.

My invention relates to hydraulic air pumps of the variety in which hydraulic pressure is automatically controlled to compress air or to force the same under pressure into a receptacle or chamber, and to this end the invention consists in the construction shown and described and particularly pointed out in the claims.

In the accompanying drawing I show a central longitudinal sectional view of my new construction of pumps, the same being broken out transversely at two places to bring the drawing on a large scale within the limits of the sheet, and shortening the entire structure to about half its proper length.

This invention is an improvement on the patent to E. H. Weatherhead, No. 437,806, dated October 7, 1890, in which the valve mechanism herein shown is covered by claims, and I do not therefore lay claim here to said mechanism in itself. But in one of the forms of pump shown in said patent a plunger is employed in the compression cylinder, and it being desirable to avoid the use of this plunger by reason chiefly of its weight, I have made a construction in which the plunger is omitted and a piston under hydraulic pressure serves to perform the same function. This has necessitated a partial reorganization of the operating mechanism as hereinafter described and claimed.

A represents the main casing, inclosing the lower piston B, and the main valve C, and having an induction port *a*, and an eduction port *a*. It will be understood that a constant and equal pressure of water is maintained through the port *a'*, which is connected with the water main of the city, or some other source of supply under the necessary head or pressure. The valve C works in a chamber D, which communicates at its top directly with the exhaust port *a'*, and has fluid inlet and outlet passages *d*, about its lower portion. That is, these passages serve to let the fluid into the cylinder above when the valve C is in the position seen in full lines, and to exhaust it therefrom when the valve is down below the same, as seen in dotted lines, the way being then clear for the fluid behind the said valve in said cylinder to escape through the exhaust port *a'*. The piston B and valve C are rigidly connected, and in the connections are openings *c*, through which, and the tube E and the openings *e* therein, a fluid passage is provided to the chamber beneath the piston B to raise the said piston. Normally the piston B, having equal pressure on both sides, will be balanced, and then the pressure upward on the valve C will overcome the balance and the two parts will rise together. This will open the passages *d*, as shown in the drawing, when the pressure fluid is free to enter the air compression cylinder F beneath the piston G therein.

It will be understood here that the purpose of the mechanism hereinbefore described is to utilize the same through hydraulic pressure for the purpose of automatically compressing and forcing air, and the air chamber H in which this occurs is in the cylinder above the piston G. This chamber has an air inlet *f* and an outlet *f'*, and when the piston G descends, the said chamber fills with air through port *f*, and when it ascends the air is forced out through port *f'*. The piston G is packed fluid tight so that no water can pass into the air chamber H upon its opposite side.

K represents an inner fluid pressure cylinder, shown here as supported on the head of the valve chamber D, and of such diameter as to leave a free fluid space between it and the outer cylinder F. A piston L, in the cylinder K is connected by a tube M with the upper piston G, and the tube M and cylinder K are about equal in length, so that the piston G, will have sufficient movement to do the work for which it is designed. The tube M is closed at its upper end, and passes through a fluid packing in the head of cylinder K, while at its lower end it has an opening for the rod N which connects with the valve tube E, and serves to operate the same. The rod N has a head *n*, in the tube M adapted to be

engaged by the disk O, connected with piston L, so that when the said piston rises, the said disk will engage head *n*, and raise the valve tube E until its ports *e*, will come above the valve C and thus form an open passage way between the exhaust port *a'*, and the fluid chamber beneath piston B, whereby said chamber can be discharged and the piston B with its valve C descend. This descent will continue until the valve C drops below ports *d*, when the fluid in chamber or cylinder F will exhaust through said ports *d* and the exhaust opening *a'*. When this part of the operation is completed the piston G will have come down far enough to bear the rod N and its tube E so far downward that the ports *e*, in tube E will come into communication with the normal fluid pressure through ports *c*, and thus the pressure upon piston B and valve C will be reversed and these parts will rise so as to open ports *d* again for the inflow of water as before, and as seen in full lines in the drawing.

In the foregoing operation the piston L performs an important office. Thus at the left of the figure is shown a tube P extending between an opening in the top side of cylinder K and the channel P', which opens into the fluid inlet passage *a*, while about the bottom of cylinder K, beneath piston L, are a series of openings *k*. A constant fluid pressure is thus maintained through tube P above piston L, while the pressure beneath said piston is intermittent according to the position of valve C with respect to ports *d*. Hence when the fluid exhausts beneath pistons G and L, the pressure behind piston L through tube P will force the said piston and the connected piston G downward. Then when the downward limits of these parts and the tube E have been reached, the action will be reversed and an equilibrium of pressure on piston L established by pressure from below through holes *k*. Meantime the full volume of pressure will be exerted against piston G and the air in chamber H forcibly expelled.

To understand the operation of the pump it should be remembered that there is a continuous fluid pressure through the induction opening *a* against the under surface of the valve C, the upper surface of the governing piston B and the upper surface of the piston L through the channel or passage P. When the valve C is in the position shown, fluid pressure enters into the chamber outside of said valve chamber through the openings *d*, whence it passes into the middle piston chamber below the piston L through the openings *k* and up to the under side of the piston G, and also through openings *c* and *c* and tube E into the chamber beneath piston B. This causes the pistons L and G to rise, the piston L being balanced by the equal pressure of the water upon both sides, and the upward pressure of the two pistons L and G being effected by the pressure of the water against the bottom of piston G. The said pistons having gone to their proper limit, they draw the rod N upward so as to bring the openings *e* above the valve packing and in position for the fluid to discharge above said packing through said openings *e* and out of the eduction port *a'*. This causes the water beneath the piston B to be discharged through the tube E and the said openings *e*, whereupon the piston B and the valve C connected therewith descend until the valve passes beneath the ports *d*. When this is done the inflow of the water is cut off and the exhaust from beneath the upper pistons is established through said openings *d* and the eduction port *a'*. As this exhaust continues pressure upon the lower piston L is exerted through passage P and promotes the descent of those pistons and the discharge of the water beneath them, and this continues until they have reached the lower limit of their stroke, when the rod N and the tube E connected therewith are carried down say to the position shown in the drawing, which cuts off discharge through the said tube E from beneath the piston B.

The operation of the pump is automatic, and the discharge and inlet of the fluids is controlled by the valve C and the tube E when they have moved to their proper positions as herein described.

The piston B is a governing piston for valve C, and having the pressure from the main constantly upon it, it discharges the water through the tube E and openings *e* under said pressure. The greater area of the piston B as compared with the area of valve C causes said piston and the valve through it to respond to the pressure on either side of the piston. If it stood alone this piston would be balanced, but in rising the area of the valve is added to overcome the balance, and in falling the bottom pressure is removed, except the resistance of the water to rise through tube E, but there is sufficient top area to the piston B to overcome this resistance and to draw the valve C down at the same time.

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

1. In a hydraulic air pump, the pump casing and the valve and piston to control the inlet and outlet of the motive fluid, in combination with two cylinders one within the other having each an open fluid connection with the pump casing, and connected pistons in said cylinders, substantially as described.

2. A main casing having fluid channels through the same and valve mechanism in the casing to control the inflow and the outflow of fluid, an outer cylinder open at its bottom into said casing and an inner cylinder open at its bottom into the water channel of said outer cylinder, and a pair of rigidly connected pistons working in said cylinders, one in each, substantially as described.

3. The main casing containing valve and piston chambers and inlet and outlet ports, an outer water and air cylinder open at its bottom for the passage of fluid from the main

casing and an inner water cylinder over the valve chamber, in combination with a connected valve and piston in the main casing, and connected pistons in the outer and inner cylinders, and a valve tube, substantially as described.

4. The main casing and a cylinder fixed thereon and open at its bottom into the casing, an inner cylinder having a water space between it and the outer cylinder, and a water channel extending from the main inlet to the upper portion of the inner cylinders, in combination with a valve and piston in the main casing, connected pistons in the inner and outer cylinders, and an auxiliary valve actuated by said pistons, substantially as described.

5. The main casing provided with valve and piston chambers and fluid inlet and outlet ports and passages, and a valve and piston in said casing, in combination with an outer cylinder having air inlet and outlet passages at its top and opening at its bottom into the main casing, an inner fluid cylinder and fluid openings at its lower end and a constant fluid pressure channel leading into its upper end, a pair of connected pistons in said cylinders and the valve stem connected with said pistons, substantially as described.

6. In a hydraulic air pump, the combination with a main cylinder provided with air and water inlets and outlets, and a piston reciprocating therein with air and water respectively on opposite sides thereof, of a hydraulic returning cylinder and piston within the main cylinder, the pistons being connected, all substantially as described.

7. In a hydraulic air pump, the combination of a main cylinder having air inlets and outlets in one end and water inlets and outlets in the other end, a main piston separating the air and water in said cylinder, a hydraulic returning cylinder within the main cylinder and having a piston connected to the main piston, and a valve mechanism controlling the inlet and outlet of water in the cylinder, substantially as described.

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

EDWARD H. WEATHERHEAD.

Witnesses:
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