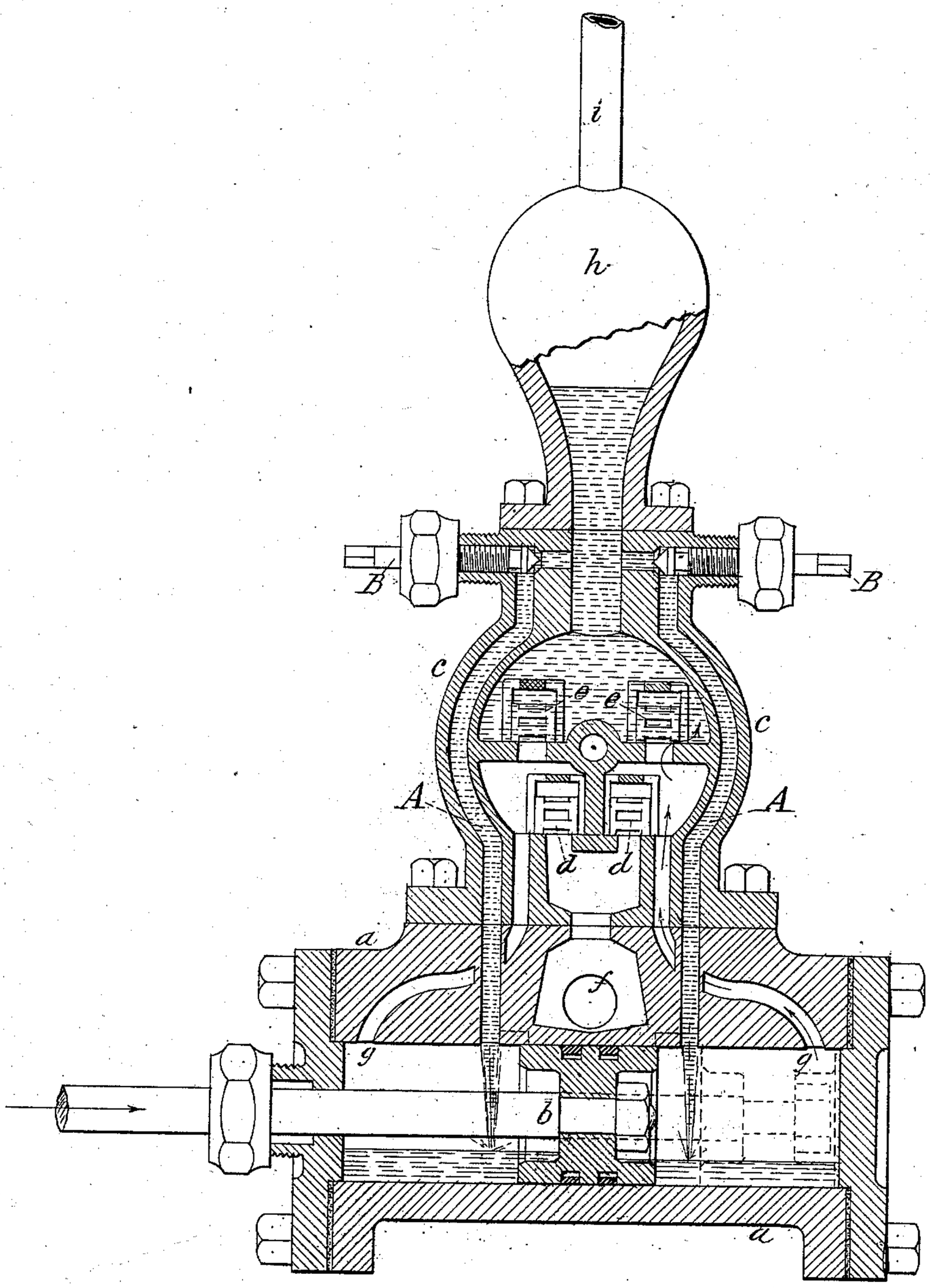
G. H. FELT.

Pump.

No. 224,668. Patented Feb. 17, 1880.



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UNITED STATES PATENT OFFICE.

GEORGE H. FELT, OF NEW YORK, N. Y.

PUMP.

SPECIFICATION forming part of Letters Patent No. 224,668, dated February 17, 1880.

Application filed July 23, 1879.

To all whom it may concern:

Be it known that I, GEORGE H. FELT, of New York city, State of New York, have invented certain new and useful Improvements in Pumps or Engines for Liquids and Gases, either for obtaining a vacuum or for compression purposes, of which the following is a specification.

It is well known that in pumping air, either for obtaining a vacuum or for compressing, it is necessary to avoid all air-clearance in the pump-cylinder, else its action becomes quite inefficient. Charging the ends of the air-cylinder with a quantity of water sufficient to fill the clearance-spaces, and thus insure the full discharge of air from the pump-cylinder at each stroke, has been tried. In this case, however, a small portion of the water works over into the air-reservoir at each stroke, thus causing an air-clearance to gradually form, which expands during the return stroke and prevents the free admission of more air, to avoid which it has been suggested to return this water from the reservoir to the ends of or heads of the cylinder; but it has not been successfully effected.

Now, my invention may be stated to consist in an improved arrangement of return tubes or ducts extending from the reservoir to the cylinder and opening into the sides of the cylinder at points behind the piston when near the end of its stroke, through which a quantity of the water is returned under pressure to the cylinder, thus avoiding all air-clearance, and at the same time rendering the back-pressure from the reservoir effective on the back or retreating side of the piston as an auxiliary to the steam-pressure in compressing or forcing out the charge in front of the piston, whereby air or gas may be compressed to a greater density or water pumped to a greater height than would be otherwise possible.

In the annexed drawing the figure presents a vertical section of a pump of the ordinary kind embodying my invention.

As illustrated, *a* indicates the pump-cylinder, and *b* its piston, which is impelled in the usual manner by the piston of a steam-cylinder or equivalent motor arranged in line therewith at the opposite end of the piston-rod. *c* is the valve-chest of the pump; *d d*, the suction-valves; *e e*, the discharge-valves; *f*, the suction-port, and *g g* the discharge-ports, which are all of about the usual form; and *h* is the usual air vessel or reservoir, which may be connected by the pipe *i* with tanks or other suitable vessels.

Now, the novel feature lies in the return ducts or ports A A′ opening from the reservoir above the discharge-valves and extending into the sides of the cylinder between the discharge-ports thereof. These ducts extend to the cylinder, preferably through the walls of the valve-chest, as shown, and open into the side of the cylinder across the stroke of the piston at points between the discharge-ports, and respectively toward each end of the cylinder, and in such position relatively to the stroke of the piston that when the piston approaches the end of its stroke in either direction both of the return-ducts A A′ open behind it.

Valves B B′ control the opening of these passages from the reservoir, by which the amount of water admitted through them may be regulated as required, or by which the passages may be entirely closed. Now, when the supplementary valves B B′ are opened it will be seen that small streams of water will enter the cylinder under the full pressure in the reservoir. These entering streams of water will not only serve to keep the clearance fully charged, as will be readily understood, but in being admitted across the stroke of the piston, as shown, the back-pressure of this entering water not only does not resist the movement of the piston, but becomes a positive auxiliary to the pressure of the steam-piston. Thus, considering the piston at the middle of its stroke between the two ports A A′, it will be seen that the back-pressure from the reservoir on each side of the piston will be equalized, while the pressure of the steam-piston forms an additional force, pressing the piston forward to compress or force out the charge in front, and when the piston reaches the end of its stroke both ports A A′ open behind it, thus giving the piston a strong forward impulse in terminating its stroke.

Now, the first part of the return stroke of the pump, which would appear somewhat paradoxical, is performed as follows: The lead of the steam-valve on the steam-cylinder is such

that the steam is admitted in advance of its piston at about the time the pump-piston is passing over the last return-port toward the end of its stroke, and as the pump-piston is then being pressed forward by the back-pressure from the reservoir through the return-duct, which pressure is, of course, much higher than the steam-pressure, the steam thus admitted in front of the steam-piston becomes cushioned to about the same pressure as that impelling the pump-piston. As the pump-piston reaches the end of its stroke, however, so that both return-ducts open behind it, it receives a sudden powerful impulse, which drives it a little farther forward and cushions the steam to a somewhat higher pressure than that on the pump-piston. This impulse quickly ceasing, the pressure of the highly-compressed steam-cushion now reacts and forces the pump-piston back on its return stroke with a positive pressure till it passes over the first return-duct, during which time a fresh charge is drawn into the pump-cylinder through the suction-passages, after which the remainder of the stroke of the pump is performed by the pressure from the reservoir admitted through the return-duct, together with the steam-pressure on the steam-piston, against which a fresh charge of steam is admitted, to continue the motion as soon as the steam-cushion expands below the pressure on the steam-valves.

By this means the pump will discharge air or water under a much higher pressure than that of the steam which impels the pump, for the reason that the back-pressure is either equalized on the pump-piston or applied behind it, so that the steam-pressure thus forms always an effective working margin over and above the pressure in the reservoir into which the pump discharges. The pump will thus continue to accumulate pressure, pumping higher and higher if the pressure is continued in the reservoir, for it will be seen that no matter how high the pressure in the reservoir may be the steam always forms an overbalancing addition against it. In this way a pressure theoretically unlimited may be obtained with a small steam-pressure and with a steam-piston having the same diameter and stroke as that of the pump-piston.

It is not, of course, to be understood that in pumping the high pressures stated the pump draws in or discharges a fresh charge equaling its full capacity at each stroke, for the pump draws a fresh charge during only a fractional part of its stroke, as already indicated, the remainder of the stroke being effected by the rush of the water from the reservoir behind the piston. Thus a portion is drawn into the cylinder through the suction-ports at each stroke, while the remainder comes from the reservoir through the return-ducts, thus producing a differential action and utilizing the pressure of a volume of water from the reservoir as an auxiliary to the steam-pressure to discharge a small additional volume under a somewhat greater pressure at each stroke.

The pump is adapted for either liquids or gases, for compressing air or gases to a great density in tanks or reservoirs, or for raising water to great heights.

In the drawing the pump is shown as adapted for compressing air or gases; but precisely the same pump may be used for water or other liquids. For this purpose, however, I prefer to have the discharge-ports somewhat larger, and to have the mouth of the return-ports where they open into the cylinder prolonged by a groove in the side of the cylinder, as indicated by dotted lines; but this is not essential.

What I claim as my invention is—

A pump constructed with the return-ducts A A′ extending from the reservoir of the pump to the sides of the pump-cylinder and opening into the latter at points behind the piston when at the end of its stroke, substantially as and for the purpose herein set forth.

GEO. H. FELT.

Witnesses:
CHAS. M. HIGGINS,
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