(No Model.)

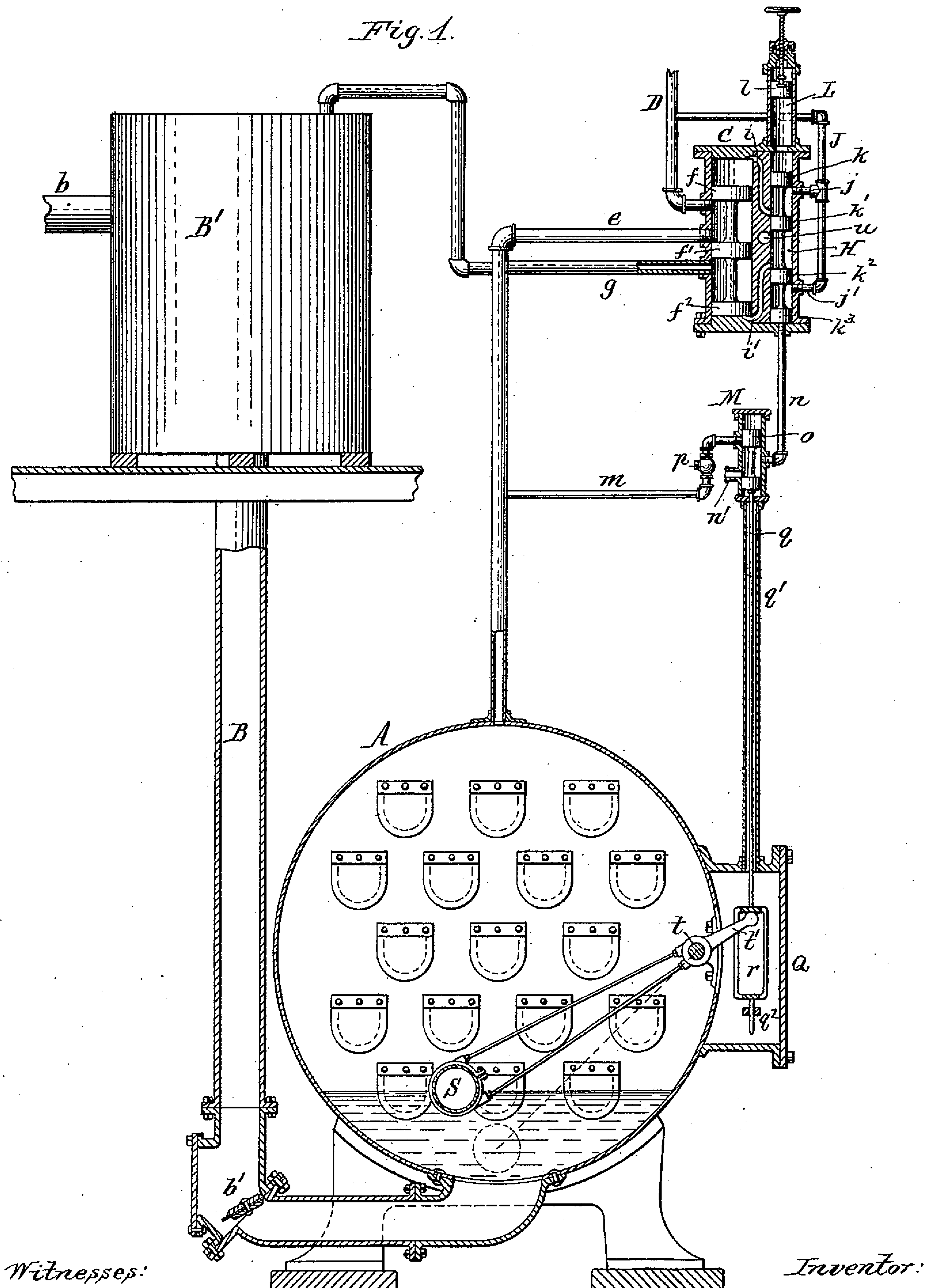
2 Sheets—Sheet 1.

U. CUMMINGS.

PNEUMATIC PUMP.

No. 464,651. Patented Dec. 8, 1891.

Fig. 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

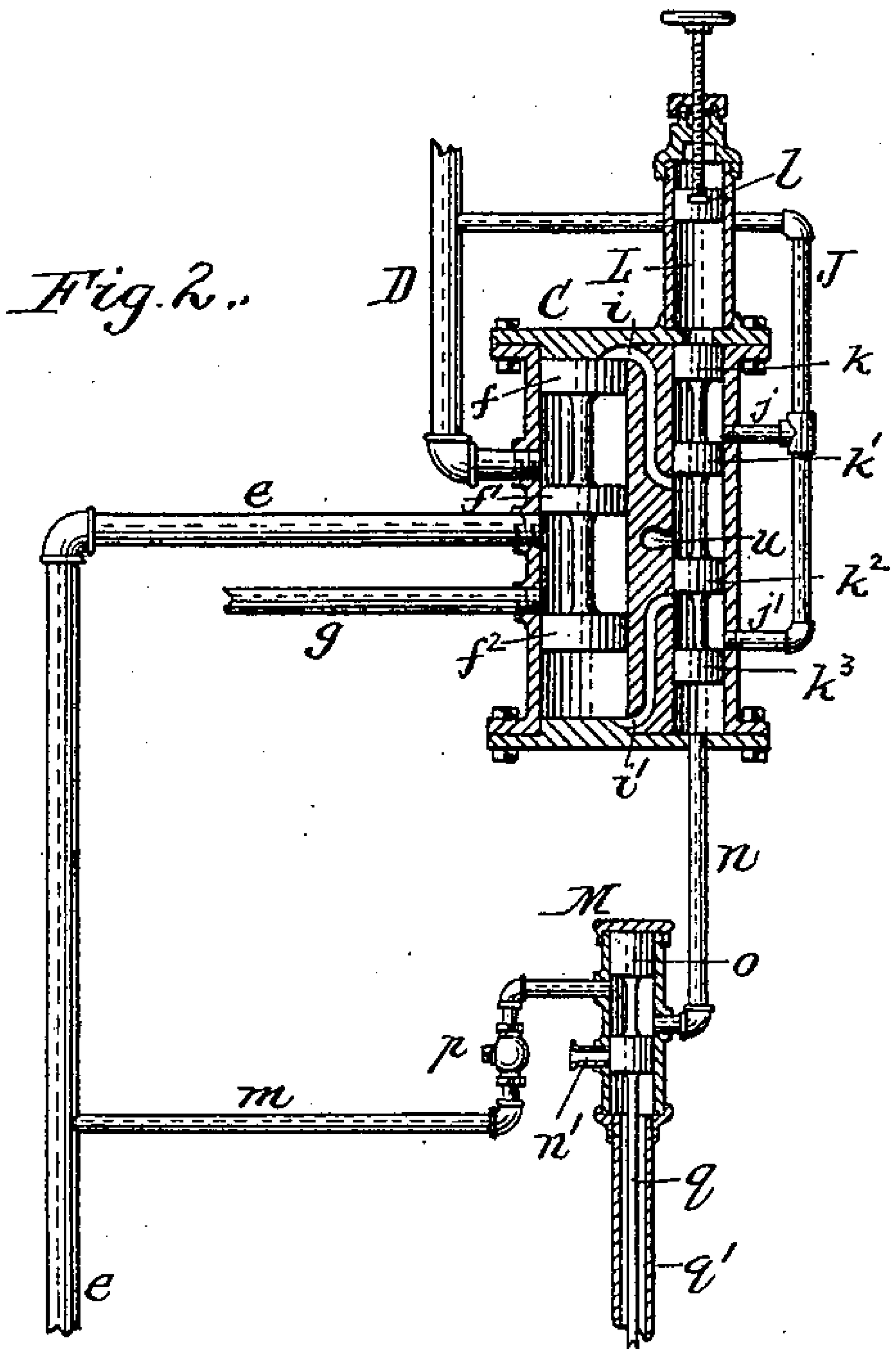
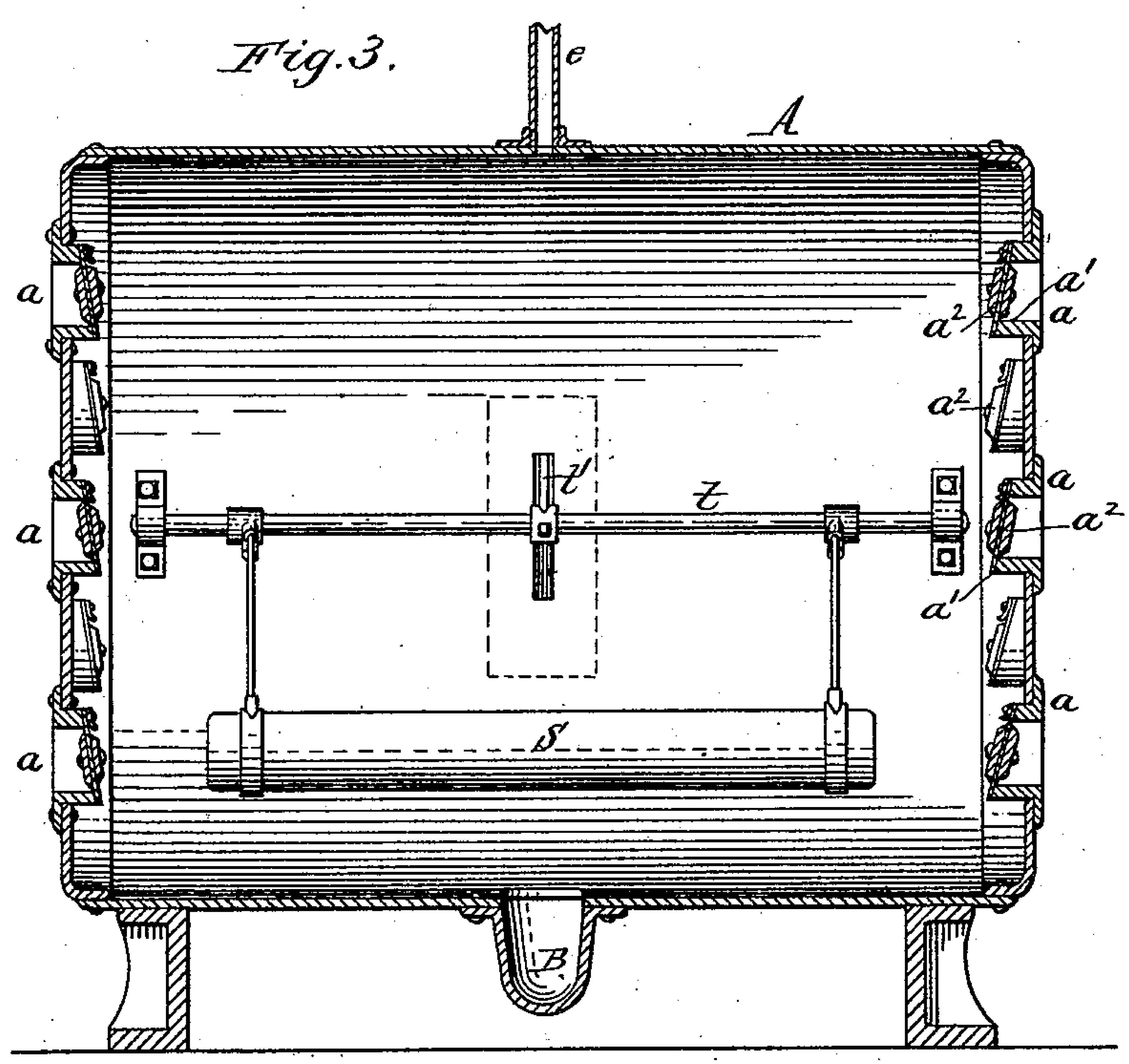


Fig. 3.



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UNITED STATES PATENT OFFICE.

URIAH CUMMINGS, OF NEW HAVEN, CONNECTICUT.

PNEUMATIC PUMP.

SPECIFICATION forming part of Letters Patent No. 464,651, dated December 8, 1891.

Application filed April 26, 1890. Serial No. 349,646. (No model.)

To all whom it may concern:

Be it known that I, URIAH CUMMINGS, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented new and useful Improvements in Pneumatic Pumps, of which the following is a specification.

This invention relates to pneumatic pumps or water-elevators which are operated by compressed air and in which the water is allowed to flow into a submerged chamber or receiver, from which it is expelled and elevated by the direct pressure of the compressed air upon the liquid in the receiver.

The objects of my invention are to provide a reliable automatic pumping apparatus of this character in which the valve mechanism is above water, where access is conveniently had thereto, and to utilize the waste air for cooling the elevated water.

In the accompanying drawings, Figure 1 is a sectional elevation of my improved pumping apparatus, showing the parts in the position in which compressed air is admitted to the water-chamber and the water expelled from the latter. Fig. 2 is a sectional elevation of the valve mechanism, showing the parts in a reversed position, in which the compressed air is cut off from the water-chamber and the water allowed to enter the same. Fig. 3 is a longitudinal section of the water-chamber.

Like letters of reference refer to like parts in the several figures.

A represents the submerged water-chamber, which consists of a cylindrical shell constructed of wrought-iron or steel and provided with heads which are riveted to the body of the shell.

a represents water-inlet openings formed in the heads of the chamber and provided at their inner ends with valve-seats *a'*, and a^2 are depending inlet-valves pivoted within the water-chamber and closing against the valve-seats *a'*. By this construction the inlet-valves are arranged at opposite ends of the water-chamber, and as the valves are hung vertically but a slight pressure is required to open the same and retain them in an open position.

B is the ascending discharge-pipe of the water-chamber, and B' is a tank or receiver which receives the elevated water and from which it is conducted to the place of consumption by a pipe *b*, connected with the upper part of the tank. The ascending pipe B is provided with the usual check-valve *b'* for preventing backward flow of the water.

C is a primary-valve chamber, and D the main air-supply pipe connected with the compressor, and which enters the primary-valve chamber near the center thereof.

e is an air-supply pipe connecting the water-chamber A with the central portion of the primary-valve chamber, the pipe *e* entering the valve-chamber below the main supply-pipe D.

f f' f^2 represent connected piston-valves sliding in the primary-valve chamber and constituting the primary valve.

g is an air-exhaust pipe connected with the primary-valve chamber below the air-supply pipe *e* and leading to the top of the tank B', so that the exhaust air is delivered upon the surface of the water in the tank. The valves *f f'* f^2 are so arranged in relation to the air-supply pipes D *e* and exhaust-pipe *g* that when the valves are in the depressed position represented in Fig. 1 communication is established between the main air-supply pipe D and the receiver supply-pipe *e* and cut off between said pipes and the exhaust-pipe *g*, while when the valves are in the reversed position illustrated in Fig. 2 the receiver supply-pipe is placed in communication with the exhaust-pipe *g* and cut off from the main supply-pipe D.

H represents a secondary-valve chamber arranged adjacent to and parallel with the primary-valve chamber C, and *i i'* are ports connecting the central portion of the secondary-valve chamber with opposite ends of the primary-valve chamber.

j j' represent air-induction pipes communicating with the secondary-valve chamber on opposite sides of the center thereof, and J is a branch pipe connecting said induction-pipes with the main air-supply pipe D.

k k' k^2 k^3 represent connected piston-valves sliding in the secondary-valve chamber H and constituting the secondary valve. These valves are so arranged with reference to the ports *i i'* and induction-pipes *j j'* that when the valves are in the depressed position represented in Fig. 1 the compressed air is cut off from the lower portion of the primary-valve chamber and admitted to the upper portion of the latter above the primary valve through the upper induction-pipe j and port i, while when the valve is reversed, as represented in Fig. 2, the compressed air is shut off from the upper port of the primary chamber and admitted to the lower part thereof below the primary valve through the lower induction-pipe j' and port i'

L represents a cylindrical air chamber or pocket communicating with the upper end of the secondary-valve chamber H. When the secondary valve is elevated or reversed, the air in the pocket L is compressed, forming an air cushion or spring which returns the valve to its depressed position when the air-pressure is removed from the lower end of the valve. An adjustable plunger or piston l is arranged in the pocket L for varying the capacity of the pocket and increasing or reducing the tension of the air-spring.

M is an auxiliary-valve casing, and m an air-inlet pipe connecting the upper portion of the casing with the receiver supply-pipe e.

n is a discharge-pipe leading from the central portion of the auxiliary-valve casing to the lower end of the secondary-valve chamber, and n' is an exhaust-pipe connected with said casing below the discharge-pipe n and opening into the atmosphere.

o represents an auxiliary or duplex piston-valve sliding in the auxiliary-valve casing M, whereby communication is alternately established and interrupted between the inlet and discharge pipes m n and between the discharge-pipe n and exhaust-pipe n', the inlet and discharge pipes being in communication and the exhaust-pipe closed when the valve is in the elevated position represented in Fig. 2 and the inlet-pipe being shut off from the valve-casing and the discharge-pipe placed in communication with the exhaust-pipe when the valve is in the reversed position represented in Fig. 1.

p represents a check-valve arranged in the inlet-pipe m, whereby the air confined in the discharge-pipe n and the lower portion of the secondary-valve chamber is prevented from escaping into the pipe e while the water is filling the chamber A.

q represents the stem of the auxiliary valve, which extends downwardly through a tube q', and is guided at its lower end in a bearing q^2, secured in a casing Q, arranged on one side of the water-chamber, and with which the lower end of the tube q' is connected. The valve-stem q is provided within the casing Q with a yoke r.

S is a float of any suitable construction, arranged within the water-chamber A and attached to a horizontal rock-shaft t, which is journaled at its ends in bearings secured to the interior of the water-chamber, as represented in Fig. 3.

t' is an actuating-arm mounted upon the rock-shaft t and engaging against opposite ends of the yoke r, so as to intermittently shift the same and the valve connected therewith in opposite directions as the float rises and falls. The actuating-arm t' projects into the casing Q through an opening formed in the adjacent side of the center thereof.

The operation of my improved pump is as follows: In the position of the parts illustrated in Fig. 1 the water is being forced out of the water-chamber, the primary valve being depressed and the compressed air passing from the main supply-pipe D into the primary-valve chamber between the valves f f', and thence to the water-chamber A through the supply-pipe e. The secondary valve is also in its depressed position, so that the compressed air from the supply-pipe J to the secondary chamber passes from the upper part of the secondary-valve chamber into the primary chamber above the primary valve, and thereby retains the latter in its depressed position. When the float S reaches the limit of its descent by the discharge of the water from the chamber A, which position of the float is shown by dotted lines in Fig. 1, the arm of the float shifts the yoke, thereby reversing the auxiliary valve, closing the exhaust-pipe of the auxiliary-valve casing and establishing communication between the receiver supply-pipe e and the secondary-valve chamber. Compressed air now enters the latter below the secondary valve and shifts the latter to the reversed position represented in Fig. 2, shutting off the compressed air from the upper part of the primary-valve chamber and admitting it to the lower part thereof below the primary valve and reversing the latter, as represented in Fig. 2. The main supply-pipe D is now shut off from the receiver supply-pipe e and the latter placed in communication with the exhaust-pipe g of the primary-valve chamber, allowing the air in the water-chamber to escape through said exhaust-pipe until the pressure is reduced to that of the external atmosphere and permitting the water to again fill the chamber. As the chamber A becomes filled the float rises, and as soon as the latter reaches the limit of its ascent the auxiliary valve is shifted to the position represented in Fig. 1, thereby breaking the communication between the inlet and discharge pipes m n of the auxiliary casing and establishing communication between the discharge-pipe n and the exhaust-pipe n' of the auxiliary casing. The air-pressure being now removed from the under side of the secondary valve, the spring air-cushion in the pocket L returns the secondary valve to the depressed position represented in Fig. 1, thereby allowing the compressed air in the branch supply-pipe J to enter the primary-valve chamber above the primary valve, reversing the latter and again admitting compressed air to the water-chamber A for expelling and elevating the contents thereof. The air underneath the secondary valve is exhausted through the discharge-pipe n and exhaust-pipe n', and the air between the piston of the secondary valve is exhausted through an exhaust-port u from between the ports i i' and opening into the atmosphere. The air-pressure is maintained in the discharge-pipe n by the check-valve p, so that the secondary valve cannot descend while the chamber A is filling with water.

Heretofore double pneumatic pumps have been used, to which compressed air was alternately admitted by a valve controlling the flow of air to both water-chambers, which valve was operated by the air entering the water-chambers. The air-pressure is subject to frequent variation, and when it becomes so high as to expel the water from one chamber faster than the water enters the other chamber a premature reversal of the valve takes place, allowing compressed air to be admitted to the last-mentioned chamber before the same is completely filled with water and incurring a considerable loss of compressed air. The compressed air is also liable to follow the water through the discharge-pipe and escape therewith, reducing the pressure in the water-chamber to such an extent that the same is insufficient to shift the valve and causing the machine to come to a standstill. The height of the water is also subject to variation, which affects the operation of a double pump, the water entering the chamber more rapidly when the same is high than when it is low.

In my improved apparatus a single chamber is employed, to which the supply of compressed air is controlled by a valve mechanism which is not operated by the air entering the water-chamber, but by air coming directly from the main supply-pipe, so that any variation of the air-pressure will not affect the operation of the apparatus and no waste of air can take place, thus utilizing the full capacity of the apparatus.

It will be observed that the action of my improved apparatus is intermittent; but it is obvious that several independent apparatus may be arranged side by side and operated to elevate water alternately or successively to produce a constant flow by connecting all of the several discharges with a common discharge-conduit and supplying all of the pumps from one supply-pipe. In this manner each apparatus operates independently of the other and is controlled by its own valve mechanism, so that, although the several pumps together elevate water constantly, they are unaffected by variations in the air-pressure or in the height of the water.

In my improved apparatus the valve mechanism is arranged above water, where it is conveniently accessible for making repairs, &c., and this arrangement permits the valve mechanism to be located near the air-compressor or in the same room therewith. The exhaust-air from the pipe g, being reduced in temperature to nearly the freezing-point as soon as relieved from compression, serves to cool the water in the tank or receiver by being delivered upon the surface of the water in the tank, thereby considerably reducing the temperature of the water, which is especially desirable in warm weather. The exhaust-air which is ordinarily wasted is thus utilized and the elevated water is cooled without extra expense.

I do not wish to claim anything in this application which is claimed in another pending application filed by me November 19, 1890, Serial No. 371,915.

I claim as my invention—

1. The combination, with the submerged water-chamber having a water inlet and an outlet, of a main air-supply pipe, a primary-valve chamber communicating with the main supply-pipe and having an exhaust, an air-supply pipe connecting the primary-valve chamber with the water-chamber, a valve arranged in the primary-valve chamber, a secondary-valve chamber connected with the main supply-pipe and communicating with opposite ends of the primary-valve chamber, a valve arranged in the secondary-valve chamber, a branch pipe connecting the secondary-valve chamber with the supply-pipe of the water-chamber, and a valve arranged in said branch pipe, whereby the compressed air is alternately admitted to and shut off from the secondary-valve chamber, substantially as set forth.

2. The combination, with the submerged water-chamber having a water inlet and an outlet, of a main air-supply pipe, a primary-valve chamber communicating with the main supply-pipe and having an exhaust, an air-supply-pipe connecting the primary-valve chamber with the water-chamber, a valve arranged in the primary-valve chamber, a secondary-valve chamber connected with the main supply-pipe and communicating with opposite ends of the primary-valve chamber, a valve arranged in the secondary-valve chamber, a branch pipe connecting the secondary-valve chamber with the supply-pipe of the water-chamber, an auxiliary-valve chamber arranged in said pipe and having an exhaust, a valve arranged in said chamber, and a float arranged in the water-chamber and opening said auxiliary valve, substantially as set forth.

Witness my hand this 21st day of April, 1890.

URIAH CUMMINGS.

Witnesses:
F. C. GEYER,
ALICE G. CONNELLY.