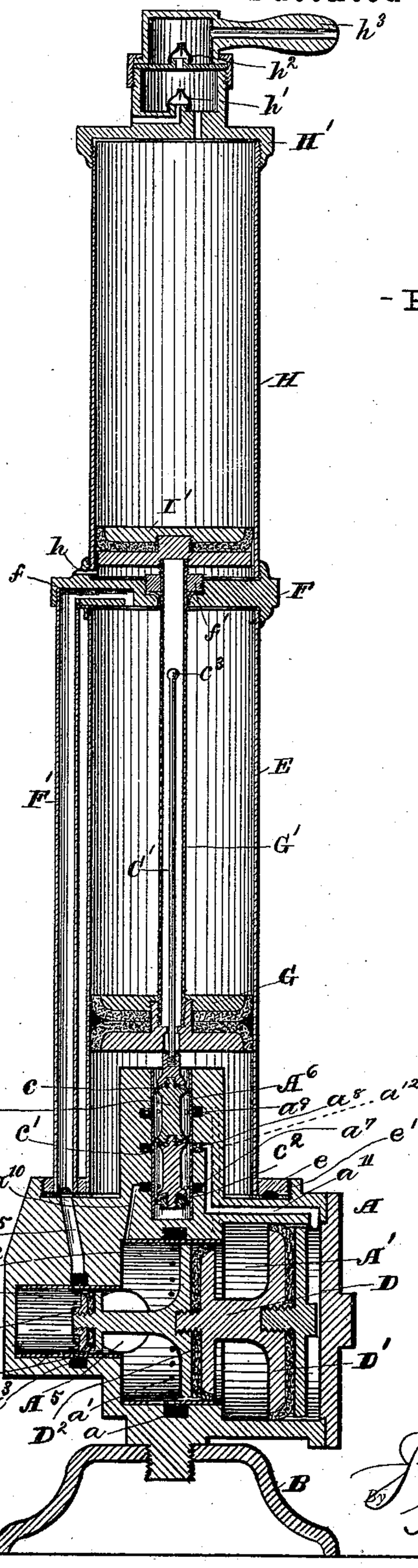
(No Model.) 3 Sheets—Sheet 1.

J. H. CHAMP.

HYDRAULIC AIR COMPRESSOR.

No. 547,768. Patented Oct. 15, 1895.



- FIG. I -

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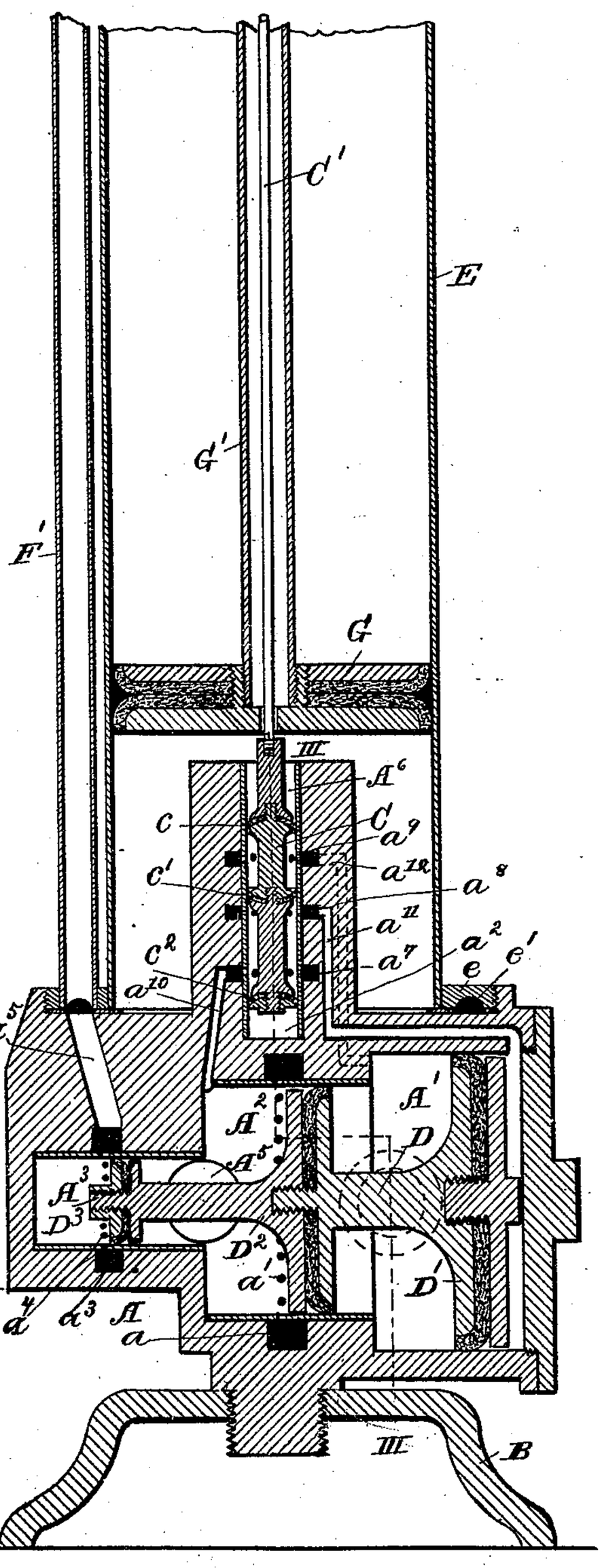
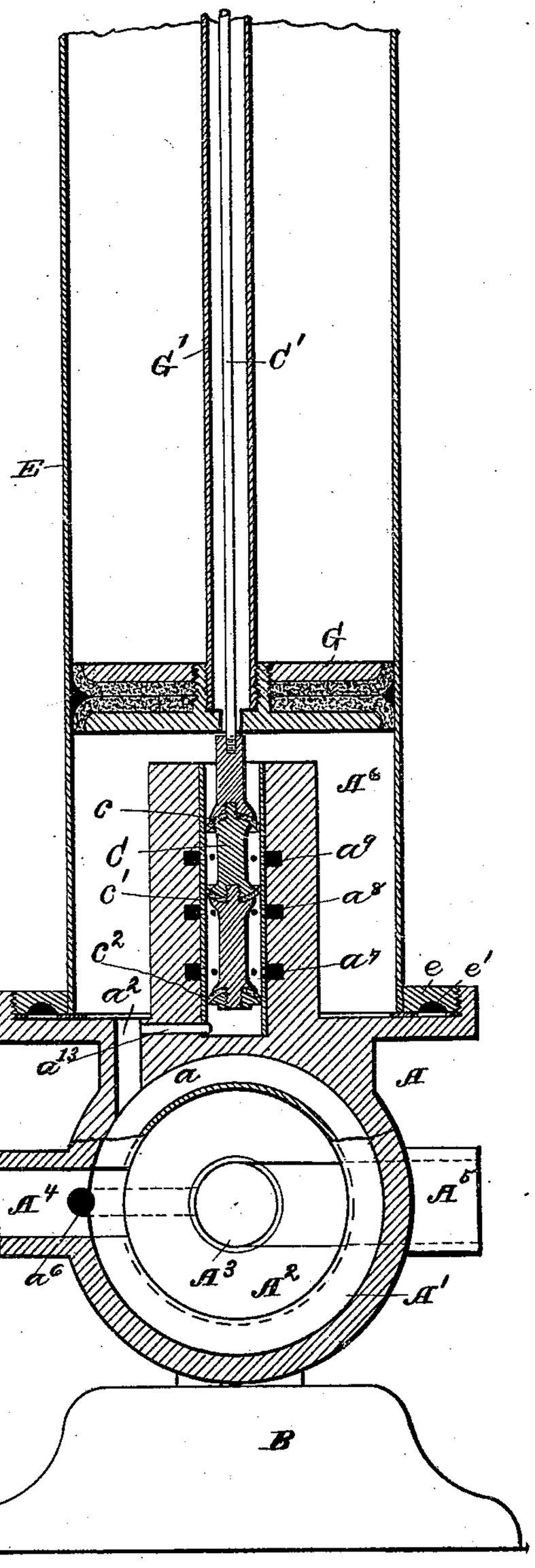
-FIG. II-



-FIG. III-



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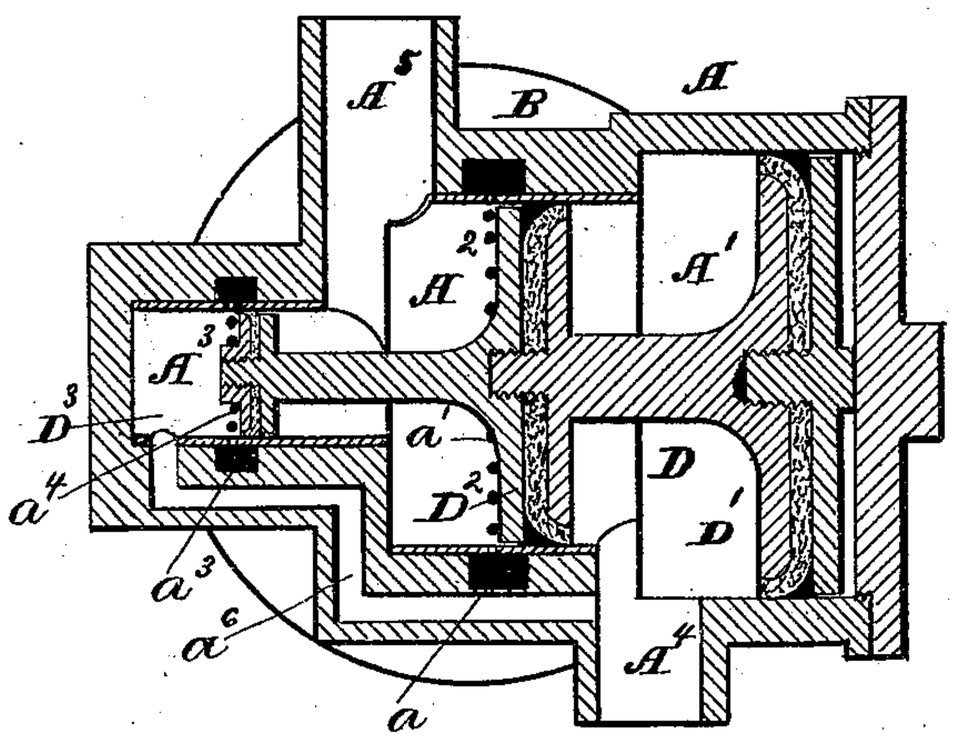
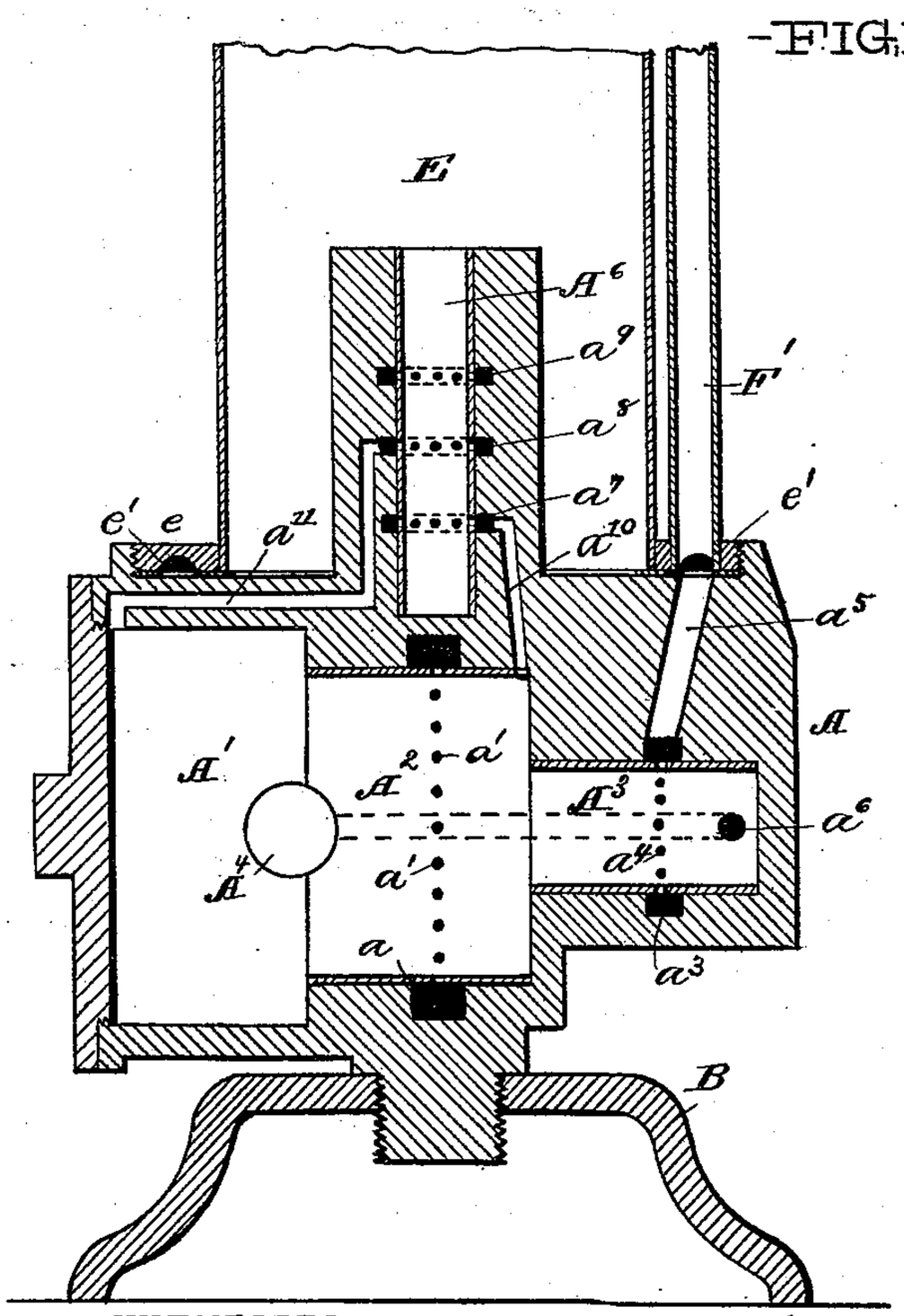
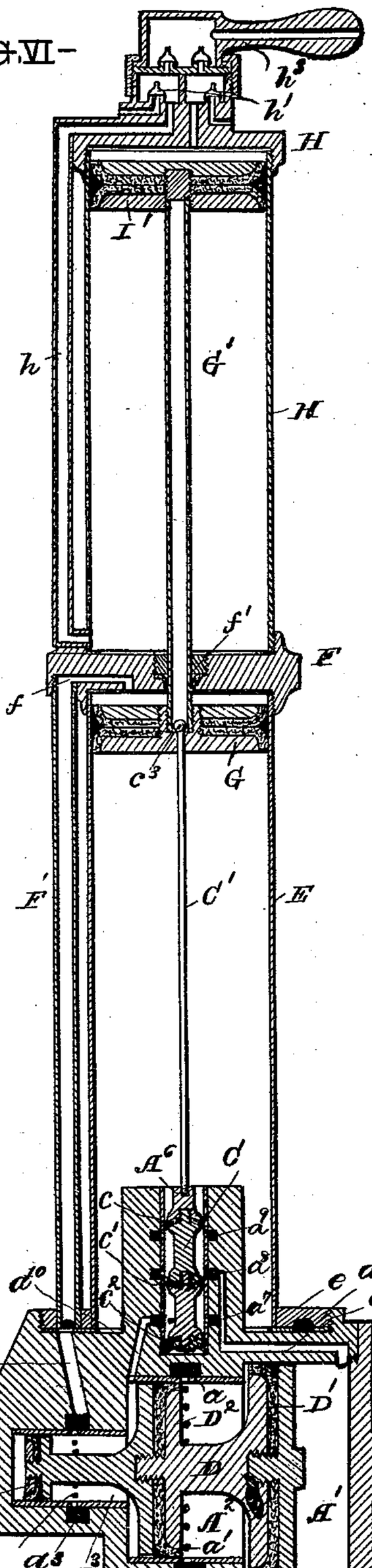
-FIG. V-



-FIG. IV-



-FIG. VI-



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UNITED STATES PATENT OFFICE.

JOSEPH H. CHAMP, OF CLEVELAND, OHIO, ASSIGNOR TO THE BISHOP & BABCOCK COMPANY, OF SAME PLACE.

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 547,768, dated October 15, 1895.

Application filed February 20, 1893. Serial No. 463,005. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH H. CHAMP, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented certain new and useful Improvements in Hydraulic Air-Compressors, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

The annexed drawings and the following description set forth in detail one mechanical form embodying the invention, such detail construction being but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings, Figure I represents a vertical section of my improved hydraulic air-compressor; Fig. II, an enlarged vertical section of the valve-casing and of the lower portion of the water-cylinder; Fig. III, a vertical section on the line III III in Fig. II; Fig. IV, a vertical section of the valve-casing, taken on the same plane as the section Fig. II, but looking in the opposite direction and having both valves removed; Fig. V, a horizontal section of the valve-casing, taken through the axis of the controlling-valve; and Fig. VI, a vertical section of the air-compressor, illustrating it as double acting.

A controlling-valve casing A is supported upon a suitable foot B, and said controlling-valve casing is formed with three axially-aligned cylindrical chambers, the first of which is of a greater diameter than the second, which again is of a greater diameter than the third chamber. The adjoining ends of said three chambers are open and communicate one with the other. The largest of the three chambers is lettered A′ in the drawings and will be termed the "valve-piston" chamber. The adjoining smaller chamber A^2 will be termed the "larger" valve-chamber, and the next and still smaller chamber A^3 will be termed the "smaller" valve-chamber, the three chambers serving as cylindrical seats for the actuating and distributing pistons of the controlling-valve. A water-inlet A^4 for the actuating-water opens into the casing at the juncture of the valve-piston chamber and the larger valve-chamber and a water-outlet A^5 opens through the casing at the juncture of the larger and the smaller valve-chamber. An annular channel a surrounds the middle of the larger valve-chamber and communicates with the same through an annular series of holes a' or an annular slot, forming an annular port. Said annular channel communicates with the lower end of the water-motor cylinder, which will hereinafter be described, by means of a vertical channel a^2. (Illustrated in Fig. III.) The smaller valve-chamber is surrounded by an annular channel a^3, which communicates with the chamber by an annular series of holes a^4 or an annular slot forming an annular port. Said annular channel has a channel a^5, which extends upward through the valve-casing, opening at the upper side of the same. A channel a^6 connects the outer end of the smaller valve-chamber with the water-inlet.

A cylindrical valve-chamber A^6 is formed in the upper end of the valve-casing and has three annular channels a^7, a^8, and a^9 surrounding it, each of said channels communicating with the interior of the valve-chamber through an annular series of holes or an annular slot forming an annular port. The lower annular channel communicates with the waste through a channel a^{10}, which opens into the larger valve chamber and through said chamber. The middle channel communicates with the outer end of the valve-piston chamber through a channel a^{11}. The upper channel communicates with the water-inlet through a channel a^{12}, which opens into the valve-piston chamber and through said piston-chamber. A channel a^{13} extends from the channel a^2, which conveys water into and out of the water-cylinder into the lower end of the cylindrical valve-chamber A^6.

A primary valve C reciprocates in the primary valve-chamber A^6, and said valve is formed with three pistons c, c', and c^2, the upper one c of which is permanently above the upper annular port of the valve-chamber, and the lower piston c^2 of which is permanently below the lower annular port of the valve-chamber, while the middle piston c'

shifts with the valve alternately above and below the middle port of the valve-chamber, so as to alternately connect said port with the lower and upper port.

A controlling-valve D reciprocates in the controlling-valve chamber, and said valve has a large actuating-piston D′, which reciprocates in the valve-piston chamber, a smaller piston D^2, which reciprocates in the larger valve-chamber, and a still smaller piston D^3, which reciprocates in the smaller valve-chamber.

A cylinder E is provided with a foot-flange *e*, which is screwed or otherwise secured in the upper side of the valve-casing. The under side of the foot-flange has a channel *e′*, which registers and communicates with the end of the channel a^5 from the annular port-channel of the smaller valve-chamber. A head F is screwed or otherwise secured to the upper end of the water-motor cylinder E and has a channel *f*, which opens into the upper end of the cylinder and is continued downward at the side of the cylinder by a pipe F′, which is inserted through the foot-flange and communicates with the annular channel in the foot-flange, thereby being connected to the channel a^5 and the controlling-valve chamber.

A piston G fits and slides in the water-cylinder and has a hollow piston-rod G′, which fits and slides in a stuffing-box *f′* in the head of the cylinder. A valve-rod C′ is secured to the primary valve C and projects into the hollow piston-rod, having a head c^3 at its upper end, which may be caught by a contraction at the lower end of the hollow piston-rod, so that the primary valve may be raised by the piston and rod when the piston is in its uppermost position in the water-cylinder. The water-piston G may strike and push down the primary valve when said piston reaches its lowermost position.

An air-cylinder H is screwed or otherwise secured at its lower end to the head F and has a free air-opening *h* at its lower end. A piston I′ fits and slides in the air-cylinder and is secured to the upper end of the piston-rod G′, which thus connects the water and air pistons to move together. A head H′ is secured upon the upper end of the air-cylinder, and has an air-inlet valve *h′* and an air-outlet valve h^2, and a nipple h^3, to which a hose or tube may be attached to convey the compressed air to its destination. As the upper and lower ends of the primary valve-chamber are open to water having the same pressure, the primary valve is perfectly balanced.

The air-cylinder in Fig. VI is illustrated as double acting, the air-opening *h* at its lower end, being extended to the head of the cylinder and having there air inlet and outlet valves similar to those for the upper end of the air-cylinder.

If we presume the air-compressor as having its parts in the positions illustrated in Fig. I and presume that the water-inlet is connected to a source of supply of water under a head and the water-outlet is connected to a sewer or other outlet, the water will enter at the inlet and press against the large valve-piston D′ and will pass through the channel a^6 to the outer end of the smaller valve-chamber, pressing against the small valve D^3, the joint pressure thus forcing and holding the main valve back. The live water will pass from the small valve-chamber through the uncovered annular port of the same and through the distributing-channel a^5 of the upper end of the water-cylinder, through the upright pipe F′ to the upper end of the water-cylinder, where it will force the pistons down, drawing air into the upper end of the air-cylinder and expelling it at the lower end of the same. Whatever water is back of the actuating-valve piston D′ is exhausted through the channel a^{11}, the middle port of the primary valve-chamber, between the lower and middle pistons of the primary valve, out through the lower port of the primary valve-chamber, into the large main valve-chamber A^2, and out through the outlet. The water in the water-cylinder below the water-piston is expelled by the latter and passes through the distributing-channel a^2 for the lower portion of the water-cylinder, into the annular channel *a*, and through its annular port into the large valve-chamber, which is open to the outlet. When the water-piston arrives at the end of its downstroke, it will strike the upper end of the primary valve and shift the latter to its lower position, as it appears in Fig. VI of the drawings. The upper and middle ports of the primary valve-chamber will now be connected, and live water will pass through channel a^{12}, through the primary valve-chamber, through the middle port of the latter and the channel a^{11} to the rear of the actuating-valve piston, which thus will be shifted forward, throwing the distributing-channel for the upper end of the water-cylinder open to the outlet and the distributing-channel for the lower end of the water-cylinder open to the water-inlet, thus reversing the stroke of the pistons and expelling air at the upper end of the air-cylinder and drawing air into the lower end of the same. When the water-piston arrives at the uppermost end of its upstroke, it will draw the primary valve-rod and valve upward, repeating the first-described operation.

Although the air-cylinder may be made double acting, as illustrated in Fig. VI, it may be preferable to make the lower end of the air-cylinder open to the atmospheric air, as it is difficult to prevent leakage of water through the stuffing-box between the cylinders, and such leakage may be obstructive to the air-pumping functions of the lower portion of the air-cylinder.

Other modes of applying the principle of my invention may be employed for the mode herein explained. Change may therefore be made as regards the mechanism thus dis-

closed, provided the principles of construction set forth, respectively, in the following claims are employed.

I therefore particularly point out and distinctly claim as my invention—

1. In a hydraulic air compressor, the combination of a valve casing provided with three axially aligned cylindrical chambers of decreasing sizes,—each of the two smaller chambers being provided with an annular port, and the largest and next largest chamber having respectively a water inlet and a water outlet,—and provided with a primary valve chamber having three annular ports respectively connected with the inner end of the largest chamber, the outer end of the largest chamber, and the next largest chamber; distributing channels communicating with the annular ports of the two smaller valve chambers; a controlling valve having a large actuating piston in the large chamber of the valve casing and two smaller pistons in the two smaller valve chambers of the casing, and a reciprocating primary valve in the cylindrical valve chamber, having a central piston and two end pistons, said end pistons being respectively permanently to the outside of the upper annular port and the lower annular port, substantially as set forth.

2. In a hydraulic air compressor, the combination with a valve casing formed with a channel, a cylinder secured to said valve casing and formed with an annular channel at its secured end,—said last named channel registering with the end of the channel in the valve casing,—and a pipe entering said annular channel, substantially as set forth.

3. In a hydraulic air compressor, the combination of a water cylinder, a primary valve chamber having its upper end open into said cylinder and its other end connected to the distributing channel for said cylinder, and a valve having pistons at its ends and reciprocating in said primary valve chamber, substantially as set forth.

In testimony that I claim the foregoing to be my invention I have hereunto set my hand this 13th day of February, A. D. 1893.

JOSEPH H. CHAMP.

Witnesses:
WM. SECHER,
J. C. TURNER.