(No Model.) 4 Sheets—Sheet 1.

J. H. CHAMP.

DOUBLE ACTING HYDRAULIC AIR COMPRESSOR.

No. 523,830. Patented July 31, 1894.

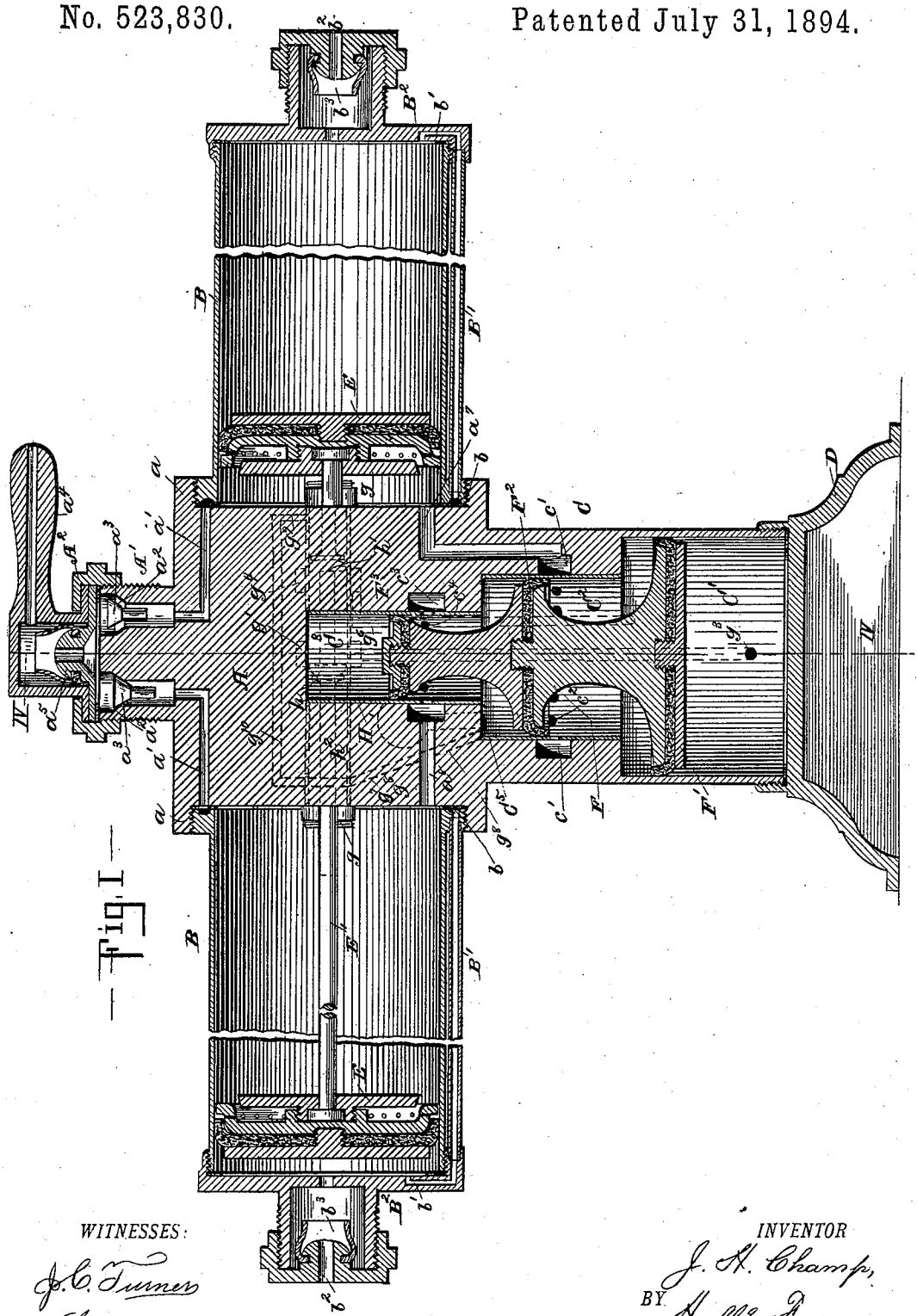

Fig. 1.

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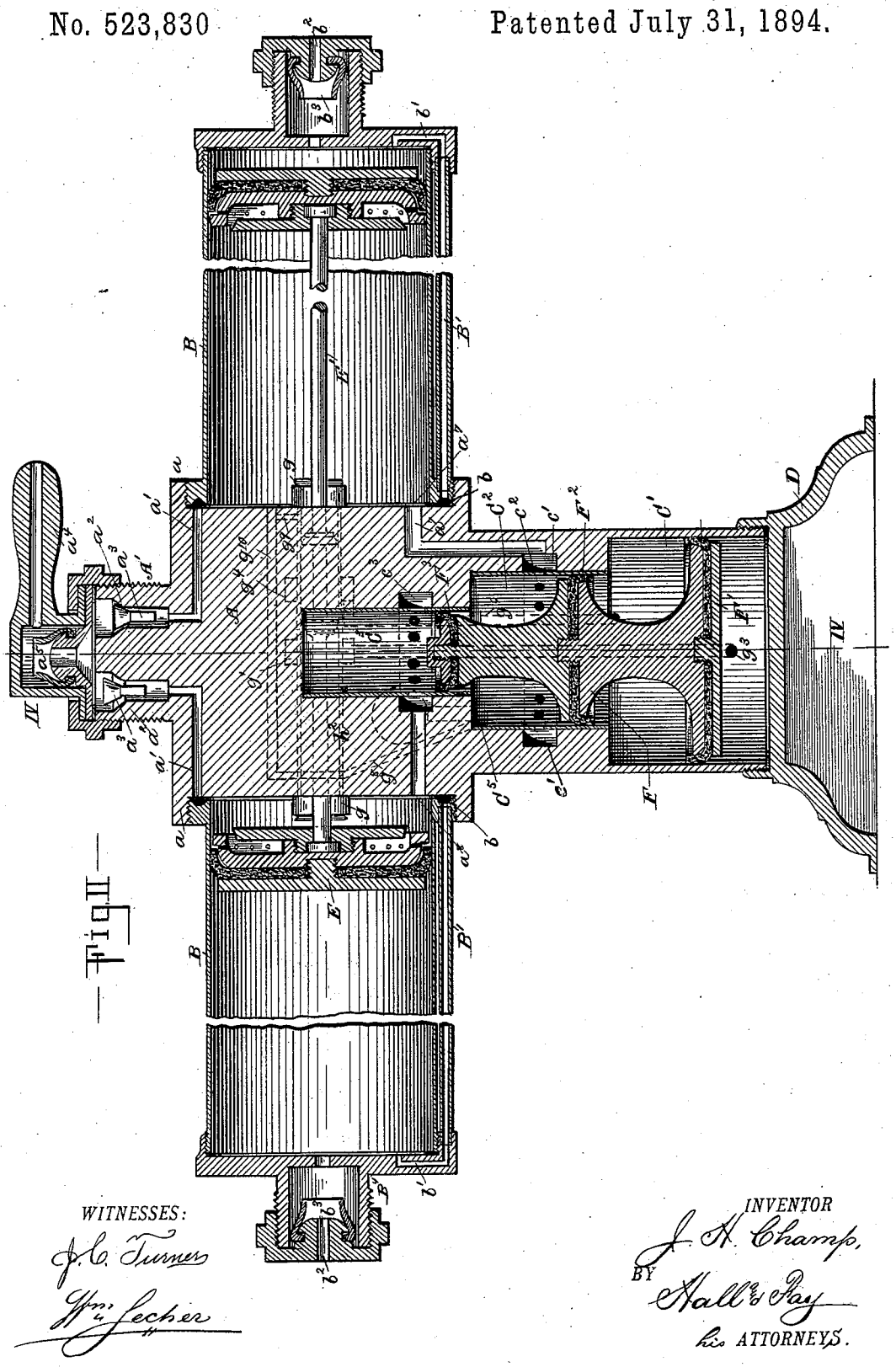

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DOUBLE ACTING HYDRAULIC AIR COMPRESSOR.

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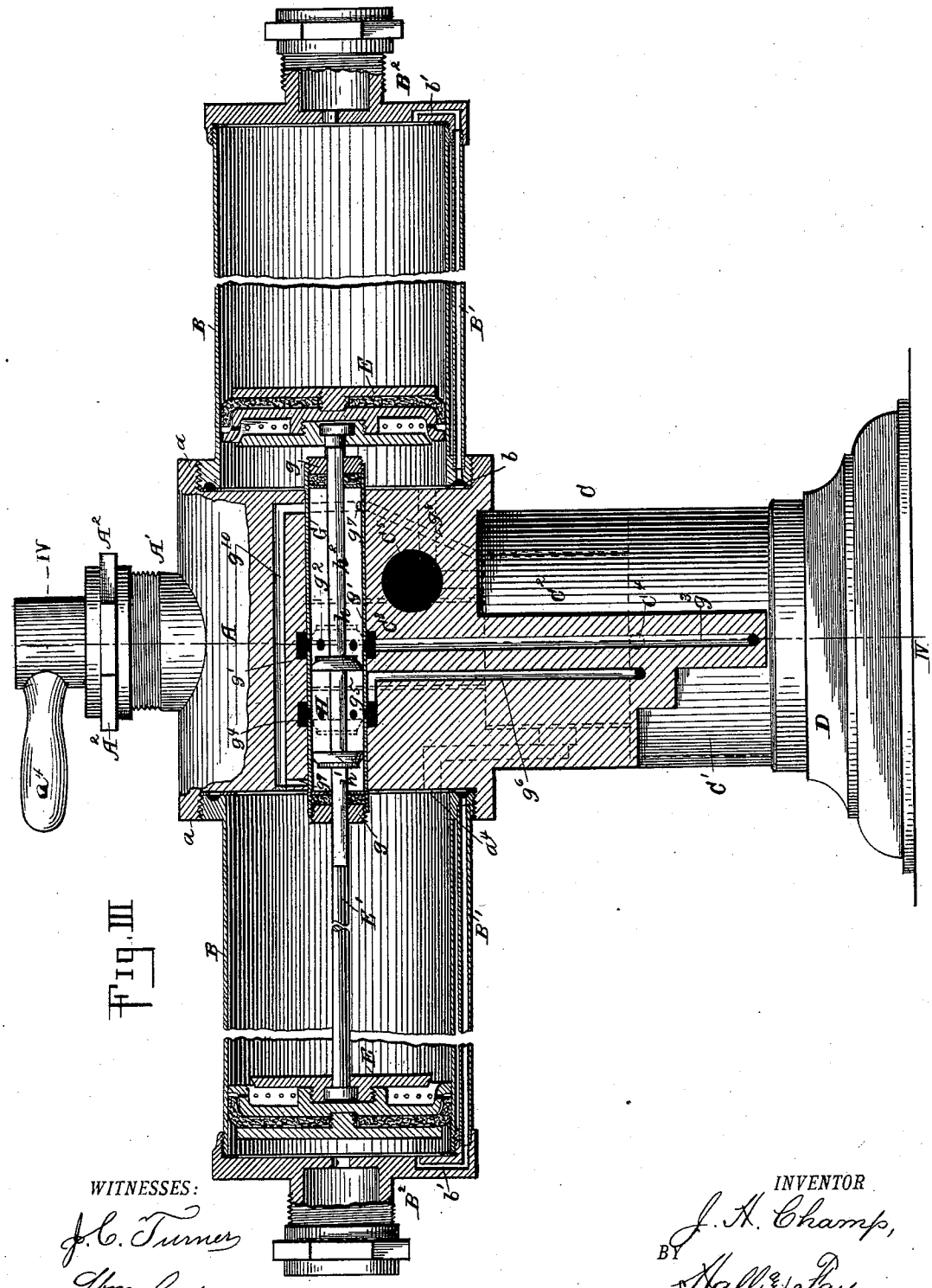

FIG. III.

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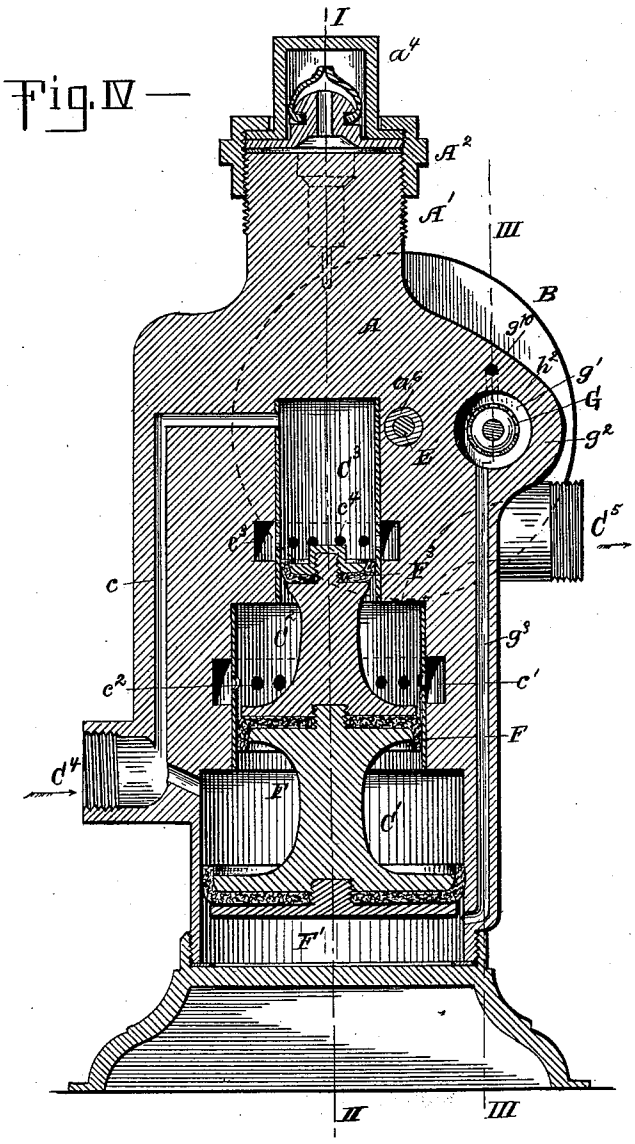
DOUBLE ACTING HYDRAULIC AIR COMPRESSOR.

No. 523,830. Patented July 31, 1894.

— Fig. IV —



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UNITED STATES PATENT OFFICE.

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

DOUBLE-ACTING HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 523,830, dated July 31, 1894.

Application filed March 21, 1891. Serial No. 385,892. (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 Double-Acting 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 longitudinal vertical section of my improved double-acting air compressor, such section being taken on the line I—II, in Fig. IV, and illustrating the right-hand piston at the beginning of its outward stroke; Fig. II, a longitudinal vertical section of the air compressor, such section being taken on the line I—II in Fig. IV, and illustrating the right-hand piston at the end of its outward stroke; Fig. III, a longitudinal vertical section taken on the line III—III in Fig. IV, and Fig. IV, a transverse vertical section on the line IV—IV in Figs. I, II and III.

A cylindrical central body, A, is formed at its ends with interiorly screwthreaded flanges, *a*, into which the ends of the air and water cylinders B B are secured,—said ends being formed with annular grooves, *b*, which form annular channels when the cylinders are secured into seat within the flanges *a*. The central body is formed in one piece with the vertical valve casing C, which is suitably mounted upon a base, D. Small air conducting pipes, B′, are secured upon the sides of the cylinders,—connected at their inner ends to the annular channels formed between the grooves *b* and the ends of the central body, and connected at their outer ends to the outlet openings b', in the outer heads B^2, of the air and water cylinders. The annular channels formed by the grooves *b* communicate with air outlet channels, a', in the central body, and said outlet channels extend upward through a neck, A′, formed upon the central body. The outer ends of said air outlet channels a' are formed with valve seats, a^2, in which outwardly-opening outlet valves, a^3, have play. A cap, A^2, is secured over the neck A′ and the valve seats therein, and has an outlet nozzle, a^4, and a common outlet valve, a^5, which controls the outlet of air from both outlet valves a^2, into the nozzle.

Air inlet openings, b^2, are provided at the outer ends of the air and water cylinders, and said air inlet openings are provided with air inlet valves, b^3.

Two air and water pistons, E E, reciprocate in the air and water cylinders,—separating the air in the outer portions of the cylinders from the actuating water in the inner portions of the cylinders; and said pistons are connected by means of a piston rod, E′, which slides in an axial bearing, a^6, in the central body. The piston rod is of such length, that one piston will be at the inner extreme of its stroke when the other piston is at the outer extreme of its stroke.

The vertical main controlling valve casing C is formed with a large cylindrical chamber, C′,—which I shall term the valve actuating piston chamber; with another cylindrical chamber, C^2, above said actuating chamber and of smaller diameter than the latter, and with another cylindrical valve chamber, C^3, above, and of smaller diameter than said former valve chamber C^2. The two smaller cylindrical chambers I shall term valve chambers, in contradistinction to the lower, larger chamber which I term the valve actuating piston chamber. The three chambers communicate with each other at their adjoining ends. The lower valve chamber C^2 has an annular channel, c', surrounding it, which is formed with a series of small perforations, c^2, or an annular slot, by means of which said annular channel communicates with the valve chamber. The annular channel communicates with the inner end of one of the air and water cylinders by means of a channel, a^7. The upper and smaller valve chamber C^3 is surrounded by an annular channel, c^3, communicating with the interior of the valve chamber through an annular series of perforations, c^4, or an an-

nular slot. Said annular channel c^3 communicates with the inner end of the other air and water cylinder by means of a channel, a^8. The annular series of holes in the two valve chambers form substantially each an annular port, and said two series of perforations may be referred to as annular ports.

A main controlling valve, F, slides in the main valve casing, C, and has an actuating piston, F′, reciprocating within the valve actuating piston chamber C′; a valve piston F^2, reciprocating within the lower and larger valve chamber, C^2; and a valve piston, F^3, reciprocating within the upper and smaller valve chamber C^3. Each of said valve pistons F^2 and F^3 has play from below the annular port in its valve chamber to above said port. The water inlet C^4 enters the upper end of the valve actuating piston chamber C′,—thus communicating with the latter and with the lower end of the lower valve chamber C^2,—and the waste or outlet opening C^5 extends from the upper end of the lower valve chamber C^2,—thus communicating with the latter and the lower end of the upper valve chamber C^3. A vertical channel, *c*, provides communication between the water inlet and the upper end of the upper and smaller valve chamber C^3.

A horizontal valve chamber, G, is formed in the central body, parallel and at about a level with the piston rod bearing. Said valve chamber,—which I shall term the primary valve chamber,—has stuffing boxes, *g*, at its ends. An annular channel, *g′*, surrounds the middle of the primary valve chamber, and communicates with the same through ports or holes, g^2, and communicates with the lower end of the valve actuating piston chamber through a vertical channel, g^3. A similar annular channel, g^4,—which I term the lateral channel,—surrounds the primary valve chamber, to one side of the middle of the same, and communicates with said chamber through ports or holes, g^5. Said lateral annular channel g^4 further communicates with the upper end of the valve actuating piston chamber C′, through a channel, g^6. A port, g^7, is formed in the primary valve chamber, at the side opposite to the lateral annular channel g^4, and said port communicates with the upper end of the lower main controlling valve chamber C^2 by means of the channel g^8. A channel, g^{10}, forms communication between the port g^7 and the opposite end of the primary valve chamber, where it has a port, g^9.

A primary valve, H, slides in the primary valve chamber, and has two pistons, *h* and *h′* secured upon its stem, h^2. One, *h*, of said pistons is secured at about the middle of the valve stem, so as to have play at either side of the ports for the central annular channel *g′* of the primary valve chamber; and the other primary valve piston, *h′*, has play between the ports of the lateral annular channel g^4 and the port g^9, said piston thus being permanently to the outside of the ports g^5 of said lateral annular channel g^4. The ends of the valve stem project sufficiently beyond the stuffing boxes of the primary valve chamber to alternately be struck by the air and water pistons E, at the inner ends of the strokes of the same; so that the primary valve may be shifted by said pistons at each one of their strokes.

When the water inlet is connected to a suitable source of water under pressure,—such as to the ordinary water service pipe,—and the waste outlet is suitably connected to a sewer or other waste, the pump is ready for pumping action. The air outlet nozzle is connected by means of a pipe or hose to the barrel or keg of liquid upon which air pressure is required, or to whatever place air under pressure is to be furnished. We will now assume that the parts are in the positions illustrated in Fig. I; in which the right-hand air and water piston is at the beginning of its outward stroke. The water under pressure, or live water,—entering the valve actuating piston chamber,—will pass up through the vertical channel g^6, into the lateral annular channel g^4, from which it will pass into the primary valve chamber between the pistons of the primary valve. Said valve has been shifted so as to connect the central ports and lateral ports of the primary valve chamber, and the live water will consequently pass from the lateral annular channel g^4 to the central annular channel *g′*, from which it will pass through the vertical channel g^3, down beneath the valve actuating piston, raising the same by means of the upward pressure on piston F^2, the pressures on piston F′ being balanced. As the actuating piston raises the main controlling valve, the annular port of the lower valve chamber C^2 will be brought into communication with the live water inlet, so that live water may pass through such annular port into the inner end of the right-hand air and water cylinder, forcing the piston in the same outward, and forcing air under pressure out at the outer end of said cylinder. As the pistons are connected, the piston in the left-hand cylinder will be drawn inward, drawing air into the outer portion of the cylinder and expelling waste water at the inner end of the cylinder,—the annular port of the upper valve chamber C^3 being put into communication with the waste water outlet by the main valve being raised. When the pistons arrive at the extreme of this last mentioned stroke, the incoming left-hand piston will strike the left-hand end of the primary valve stem, shifting said valve to the right,—as illustrated in Fig. II, or to the left as shown in Fig. III, it being remembered that the pump is viewed from opposite sides in Figs. II and III. The central port of the primary valve chamber will thereby be placed in communication with the waste channel g^8, which opens into the upper end of the lower valve chamber C^2, and thereby connects with the waste water outlet. Waste water beneath the valve actuating piston of the main con-

trolling valve may thus be exhausted and the combined pressure of the live water upon the upper side of the valve actuating pistons F′ and F³ will force the main controlling valve downward, bringing the inner end of the left-hand cylinder,—in Fig. II through its channel a^8 and the annular channel c^3 and channel c,—into communication with the live water, while the right-hand cylinder will be brought into communication with the water waste, through its channel a^7, the annular channel c' and the lower valve chamber C^2. The pistons will then start upon their stroke to the left, at the end of which the primary valve will again be shifted to the position shown in Fig. I, and the movement of the pistons be reversed. The pistons will thus alternately draw air into one air and water cylinder, and expel air under pressure in the other air and water cylinder, and vice versa; so that a practically continuous current of air under pressure will be supplied.

All working parts of the entire air compressor are within the central part and the cylinders; so that no damage from external causes will happen to such working parts. The primary valve will be shifted at each stroke of the air and water pistons by one of the latter, and such primary valve will control the action of the main controlling valve, which distributes the actuating water to the air and water cylinders.

Any water which may have leaked past the side piston h' of the primary valve will be forced through the port g^9 and the channel g^{10} into the opposite end of the primary valve chamber, when the primary valve is moved toward that side upon which said side piston is, so that there will be no counter pressure or water cushion to obstruct the free movement of the valve; as the end of said channel g^{10} will at that time be connected with the water exhaust through the port g^7 and channel g^8.

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 disclosed, 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 an air compressor, the combination of a central body, two air and water cylinders on opposite sides of said body and provided with air inlets and outlets at their outer ends and with water inlets and outlets at their inner ends, pistons within said cylinders, a main controlling valve within the central body controlling the inflow and outflow of water through the water inlets and outlets and provided with an actuating piston, and a primary valve provided with a stem projecting to be engaged by the pistons in the cylinders to shift the valve and control the actuating water for the actuating piston of the main controlling valve, substantially as set forth.

2. In an air compressor, the combination of a central body formed with a live water inlet and with a waste water outlet and with a main controlling valve chamber and a primary valve chamber,—both of said chambers being connected to each other and to the live water inlet and waste outlet, two air and water cylinders provided with air inlets and outlets at their outer ends and with water inlets and outlets at their inner ends communicating with the main controlling valve chamber, connected pistons sliding in said cylinders, a main controlling valve in the main valve chamber constructed to control the inlet and outlet of water into the air and water cylinders, and provided with an actuating piston, and a primary valve in the primary valve chamber having its stem projecting to be engaged and shifted by the air and water pistons and constructed to control the inflow and outflow from the actuating piston of the main controlling valve, substantially as set forth.

3. In an air compressor, the combination of two opposite air and water cylinders having air inlets and outlets at their outer ends, connected pistons in said cylinders, a main controlling valve casing formed with a valve actuating piston chamber and two valve chambers,—said valve actuating piston chamber having the live water inlet opening into it, and one of said valve chambers having the inlet and outlet of one cylinder and the waste water outlet opening into it, and the other of said valve chambers having the inlet and outlet of the other cylinder and the live water inlet opening into it,—a main controlling valve having pistons in said three chambers, a primary valve chamber formed with a port communicating with the valve actuating piston chamber beneath the piston therein, a water inlet port and a water outlet port, and a primary valve in said chamber provided with a stem projecting at the ends of the chamber to be engaged and shifted by the connected pistons in the air and water cylinders, substantially as set forth.

4. In a hydraulic air compressor, the combination with a primary valve chamber having closed ends, a central port, a water inlet at one side of said central port and a water outlet at the other side of said central port, and formed with a channel connecting said outlet with the opposite end of the valve chamber, of a primary valve in said chamber having a central piston and a piston permanently located to the outer side of the inlet, substantially as set forth.

5. In an air compressor, the combination of two cylinders having air inlets and outlets and water inlets and outlets at opposite ends, pistons in said cylinders, a main controlling valve casing having a valve actuating piston chamber and two valve chambers,—each of said valve chambers being connected to said cylinders and having the water inlet and outlet opening into them, a main controlling

valve having pistons in said three chambers, and a primary valve controlling the water inflow and outflow into the valve actuating piston chamber and constructed to be actuated by the pistons in the cylinders, substantially as set forth.

6. The combination of a central body, two cylinders on opposite sides of said body and provided with water inlets and outlets, pistons within said cylinders, a main controlling valve within the central body controlling the inflow and outflow of water through the water inlets and outlets and provided with an actuating piston, and a primary valve constructed to be shifted by the pistons in the cylinders and controlling the actuating water for the actuating piston of the main controlling valve, substantially as set forth.

In testimony that I claim the foregoing to be my invention I have hereunto set my hand this 11th day of March, A. D. 1891.

JOS. H. CHAMP.

Witnesses:
THOS. B. HALL,
WM. SECTUR.