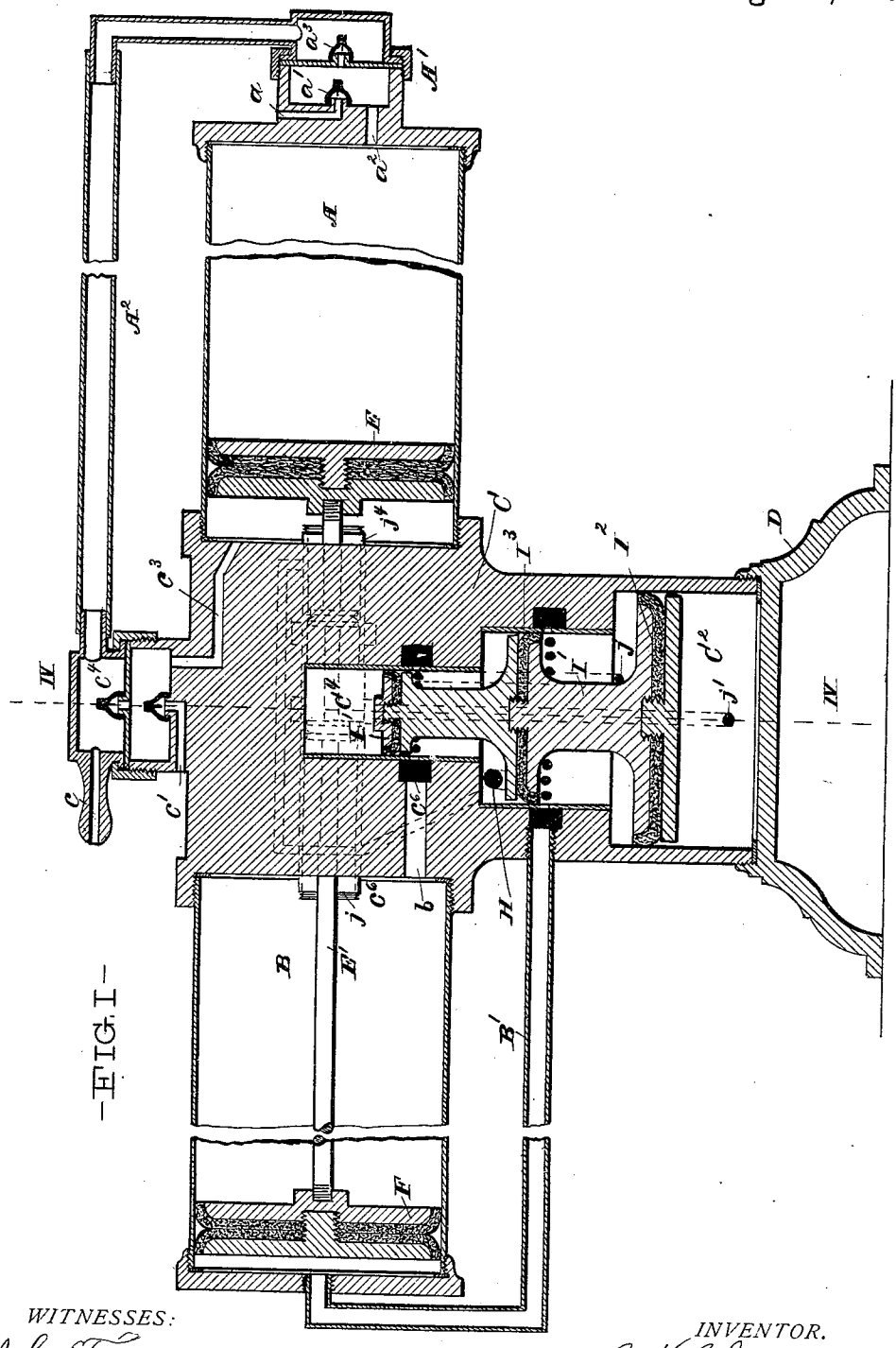
(No Model.)

4 Sheets—Sheet 1.

# J. H. CHAMP.

## HYDRAULIC AIR COMPRESSOR.

No. 544,456. Patented Aug. 13, 1895.



—FIG. I—

WITNESSES:

J. C. Turner

Wm Jeckus

INVENTOR.

J. H. Champ

By Hall & Fay

ATTORNEYS.

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# J. H. CHAMP.

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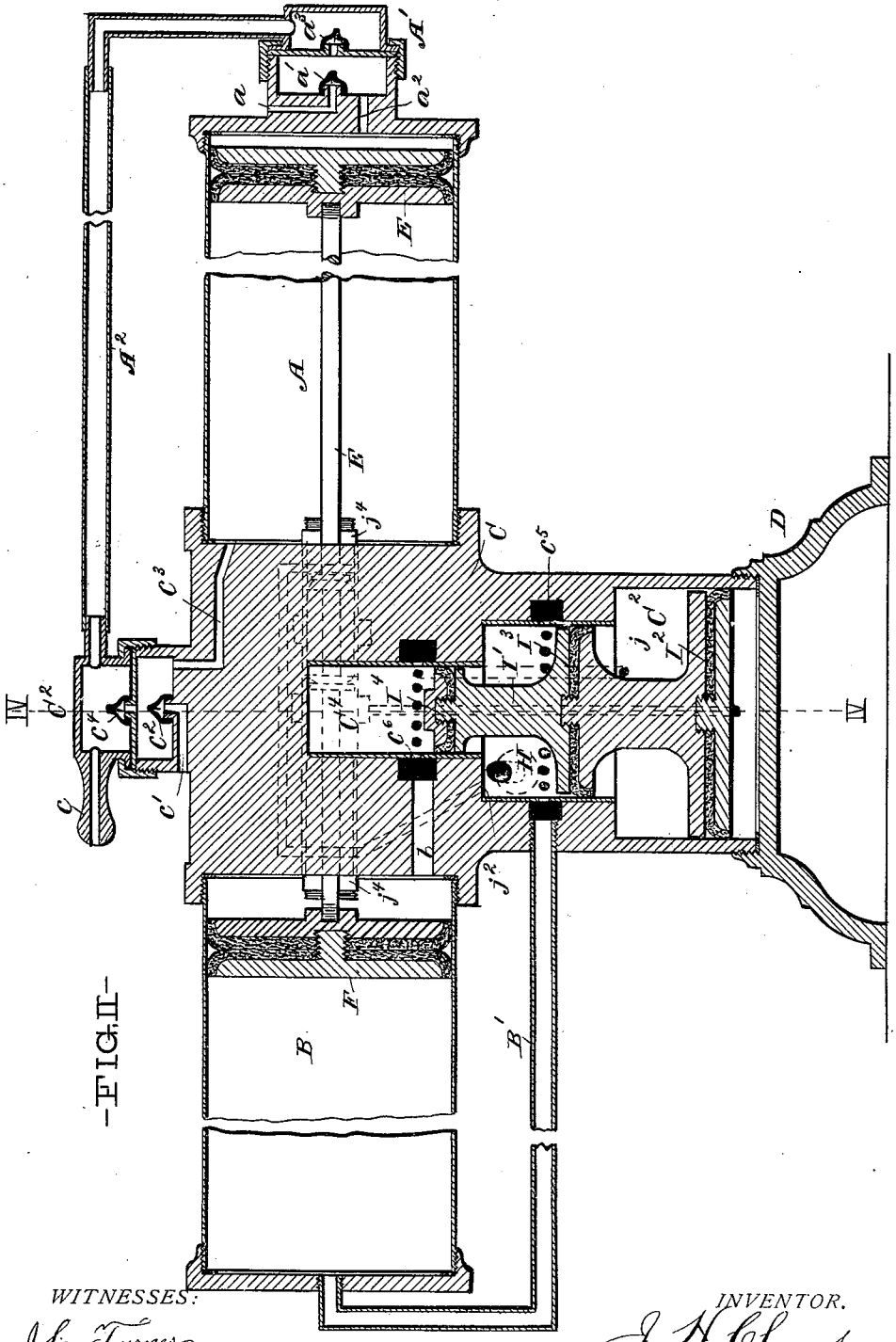


FIG. II.

WITNESSES:

J. C. Turner

Wm. Leclue

INVENTOR.

J. H. Champ

By Hall & Fay

ATTORNEYS.

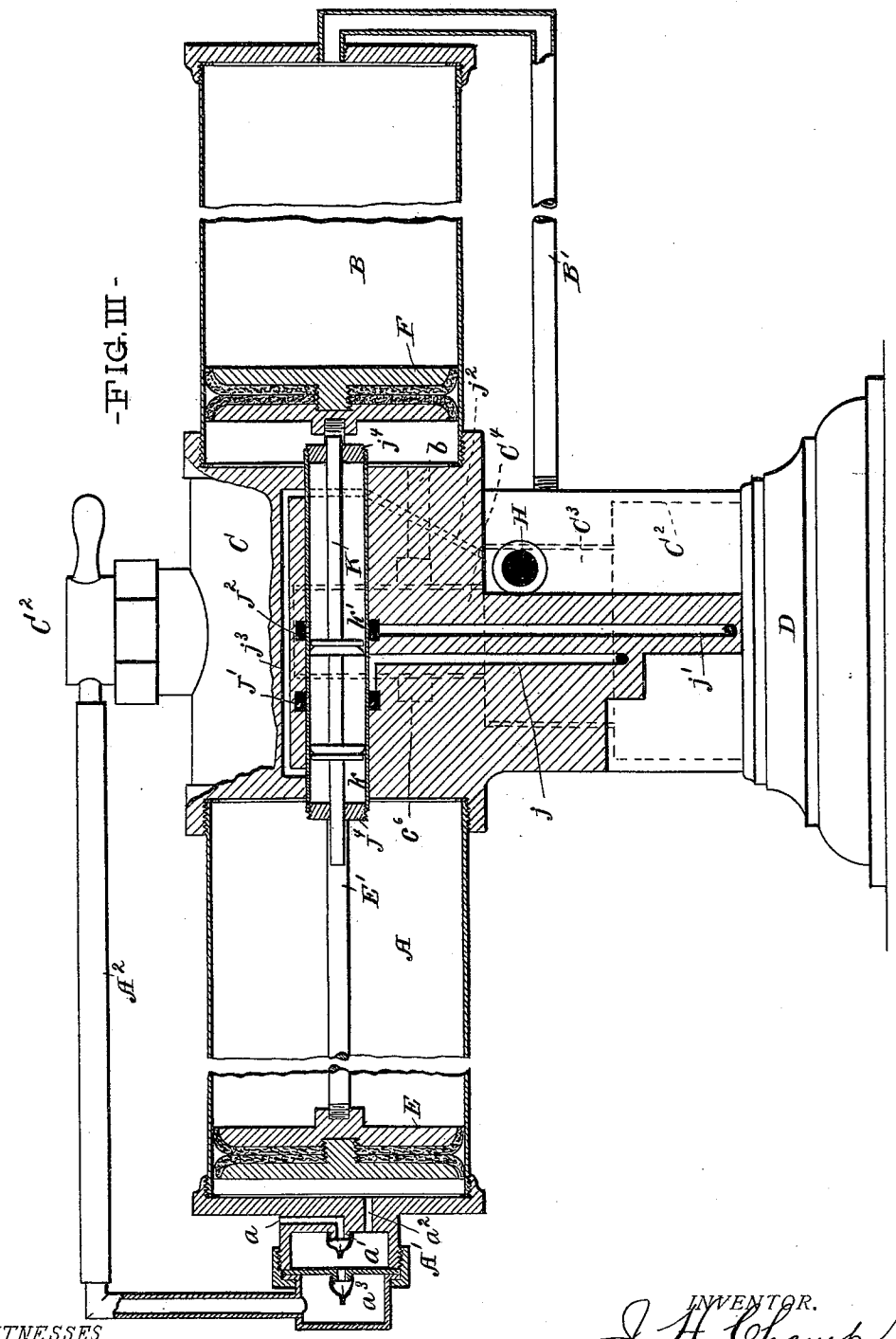
(No Model.) 4 Sheets—Sheet 3.

# J. H. CHAMP.

## HYDRAULIC AIR COMPRESSOR.

No. 544,456. Patented Aug. 13, 1895.

-FIG. III-




WITNESSES.

J. C. Turner

Jm Lecher

INVENTOR.

J. H. Champ

By Hall & Fay

ATTORNEYS.

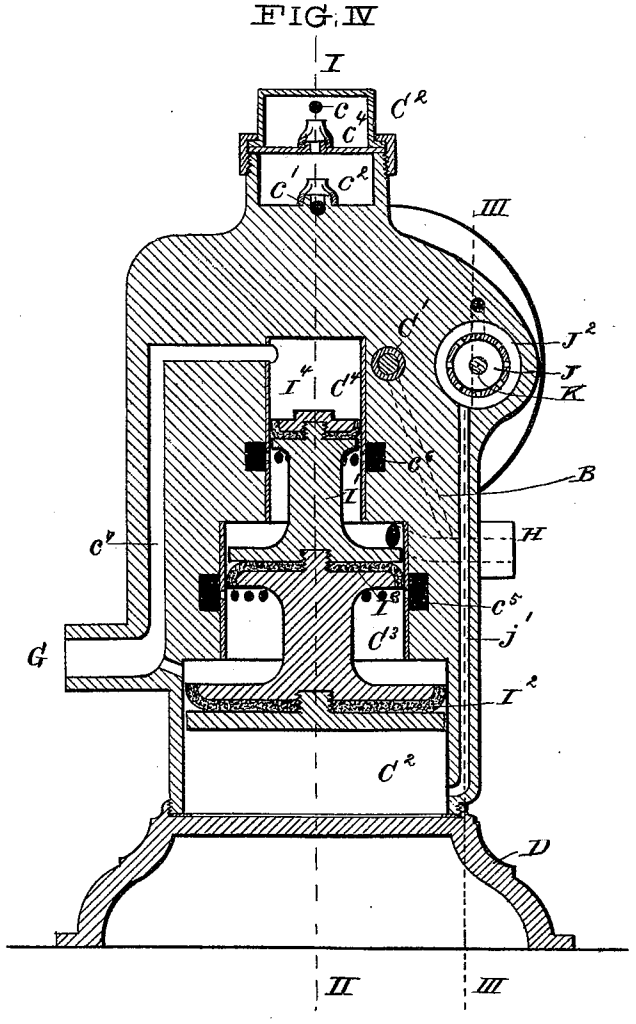
(No Model.) 4 Sheets—Sheet 4.

# J. H. CHAMP.

## HYDRAULIC AIR COMPRESSOR.

No. 544,456. Patented Aug. 13, 1895.

FIG. IV




WITNESSES:

J. C. Turner

Wm. Fecher

INVENTOR.

J. H. Champ

By Hall & Gay

ATTORNEYS.

# 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. 544,456, dated August 13, 1895.

Application filed February 20, 1893. Serial No. 463,006. (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 longitudinal vertical section of my improved double-acting hydraulic air-compressor, taken on the line I II, Fig. IV, and illustrating the pistons at the beginning of one stroke; Fig. II, a longitudinal vertical section of the compressor, taken on the line I II, Fig. IV, and illustrating the pistons at the beginning of the opposite stroke; Fig. III, a longitudinal vertical section of the compressor, taken through the primary-valve chamber and on the line III III, Fig. IV; and Fig. IV, a transverse vertical section taken on the line IV IV, Fig. I.

An air-compressing cylinder A and a water-motor cylinder B are secured at their inner ends in a main casing C, which latter is suitably supported upon a base D. Two pistons E and F, respectively an air-piston and a water-piston, reciprocate each in its respective cylinder, and are connected by means of a common piston-rod E′, sliding in a suitable water-tight packed bearing C′ in the main casing. The air-cylinder has a valve-casing A′ at its outer end provided with an air-inlet channel *a*, having an air-inlet valve *a′*, a channel $a^2$ leading into the end of the cylinder, and an air-outlet valve $a^3$. A pipe $A^2$ extends from the valve-casing to the top of the main casing, where it enters a casing $C^5$, having a nipple *c*, to which a pipe or tube may be connected for conveying compressed air away from the air-compressor, and provided with an air-inlet channel *c′* having an air-inlet valve $c^2$, a channel $c^3$ leading into the inner end of the air-cylinder, and an air-outlet valve $c^4$.

The main casing has a large valve-actuating-piston chamber $C^2$, a valve-chamber $C^3$ above said piston-chamber, and a smaller valve-chamber $C^4$ above said other valve-chamber. The piston-chamber and valve-chambers are arranged in axial alignment, communicate with each other at their superposed ends, and each chamber has a smaller interior diameter than the chamber below it. The water-inlet G enters the upper end of the piston-chamber, and the water-outlet H extends from the upper end of the larger valve-chamber. The valve-chambers have annular channels $c^5$ and $c^6$, respectively, which channels communicate with the interiors of the valve-chambers by annular series of holes, annular slots, or similar annular ports. The annular channel of the smaller valve-chamber communicates with the inner end of the water-cylinder by a channel *b*, and the larger valve-chamber communicates with the outer end of the water-cylinder by a channel extending through a pipe B′ opening into the outer end of the water-cylinder. A channel $c^7$ extends from the water-inlet to the upper end of the smaller valve-chamber. A main controlling-valve I′ slides in the chambers of the main casing and has an actuating-piston $I^2$ in the actuating-piston chamber, and two valve-pistons $I^3$ and $I^4$, the former of greater diameter than the latter, sliding respectively in the larger and smaller valve-chambers.

A primary-valve chamber J is formed in the main casing and has two annular channels J′ and $J^2$ surrounding it, said channels communicating with the valve chamber by annular ports formed by annular series of holes or by annular slots. The port and channel J′ communicate with the water-inlet through a channel *j* in the main casing opening into the upper end of the actuating-piston chamber, and the port and channel $J^2$ communicate with the lower end of the actuating-piston chamber through a channel *j′* in the main casing. A channel $j^2$ extends from a port near one end of the primary-valve chamber to the upper end of the larger valve-chamber for the main controlling-valve, and thus communicates with the water-outlet. A channel

$j^3$ extends from one end of the primary-valve chamber to the other to produce balance of water-pressure at both ends of the chamber. A primary valve K slides in the primary-valve chamber, and has its stem passing through stuffing-boxes $j^4$ at each end of the valve-chamber, so as to admit of the ends of the valve-stem projecting into the inner ends of the two cylinders. The primary valve has two pistons $k$ and $k'$, which alternately connect the port connected to the lower end of the valve-actuating-piston chamber with the water inlet and outlet as the valve is reciprocated.

When the parts of the air-compressor are in the respective positions illustrated in Fig. I, the primary valve has been shifted by the air-piston so as to connect the under side of the valve-actuating piston with the inlet water, causing the main controlling-valve to be raised. This brings the outer end of the water-cylinder in connection with the water-inlet and the inner end of said cylinder in connection with the water-outlet, causing the water-piston to travel inward and the air-piston to compress air in the outer end of the air-cylinder and to draw air into the inner end of said cylinder. When the water-piston arrives at the inner end of its stroke, it will shift the primary valve so as to bring the under side of the valve-actuating piston in connection with the water-outlet, such as illustrated in Figs. II and III. This will admit of the main controlling-valve being depressed by the pressure of the inlet water upon the actuating-piston and small valve-piston, which movement will connect the outer end of the water-cylinder with the water-outlet and the inner end of said cylinder with the water-inlet, whereby the water-piston will be forced outward, causing the air-piston to compress air in the inner end of the air-cylinder and to draw air into the outer end of said cylinder. At the end of this stroke the valves are again reversed, reversing the stroke of the pistons, &c. Both the water and the air cylinder are double acting, and air will be compressed on both strokes of the pistons. The compressed air will be dry, as the air-cylinder is separate and distinct from the water-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 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 an air cylinder and a water cylinder, pistons respectively in said cylinders and connected together, a main controlling casing between the ends of said cylinders, a main valve in said casing operated by and controlling the piston actuating fluid, and primary valve mechanism constructed to be operated by the movement of the pistons and to control the actuating fluid for the main controlling valve, substantially as set forth.

2. In an air compressor the combination of a main casing provided with a base which supports the entire structure, an air cylinder secured to project from one side of the casing and having air channels from both ends connected to the main casing, a water cylinder secured to project from the opposite side of the casing and having water channels at both ends connected into the main casing, pistons respectively in said air cylinder and water cylinder and connected together, a main controlling valve controlling the water for the water cylinder and actuated by the inlet water, and a primary valve constructed to be actuated by the pistons and to control the water for actuating the main controlling valve, substantially as set forth.

3. In an air compressor, the combination of a main casing provided with a base at its lower end and at its upper end with an air valve chamber having a nipple, an air cylinder projecting from one side of said main casing and having both ends connected to the air valve chamber, a water cylinder projecting from the opposite side of the main casing and having water connections at both ends with said casing and pistons in said cylinders and connected together, 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.