(No Model.) 2 Sheets—Sheet 1.

G. DE LAVAL.

AIR COMPRESSOR.

No. 511,086. Patented Dec. 19, 1893.

Fig. 1.

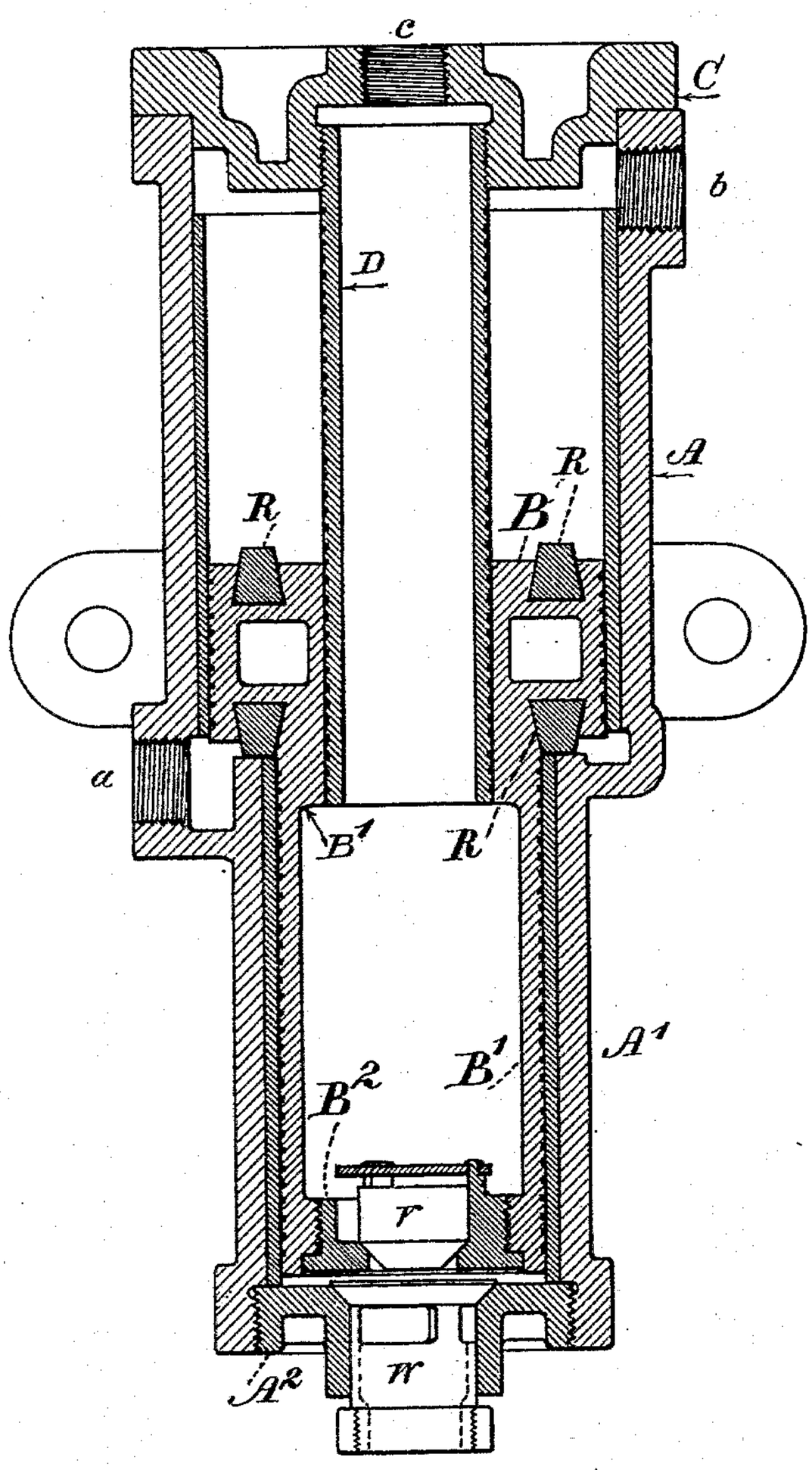
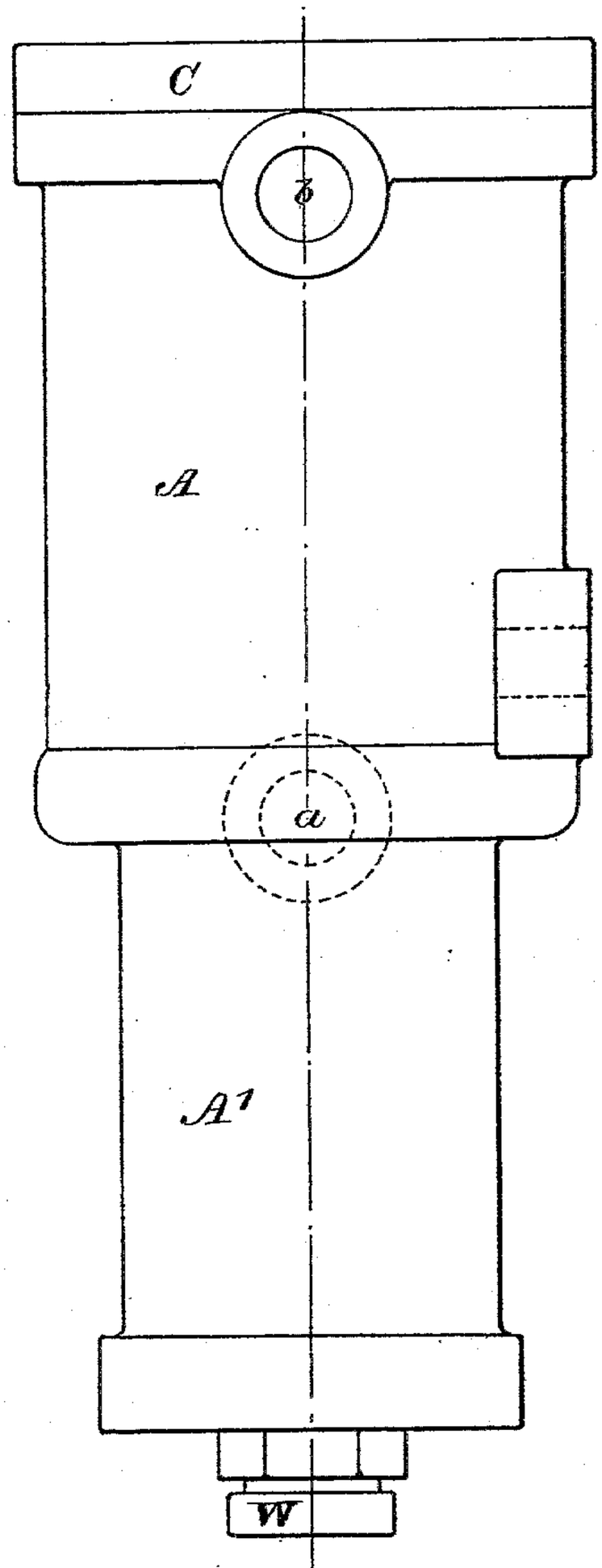


Fig. 2.



Witnesses.
Chas. H. Smith
J. Stair

Inventor.
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(No Model.) 2 Sheets—Sheet 2.

G. DE LAVAL.

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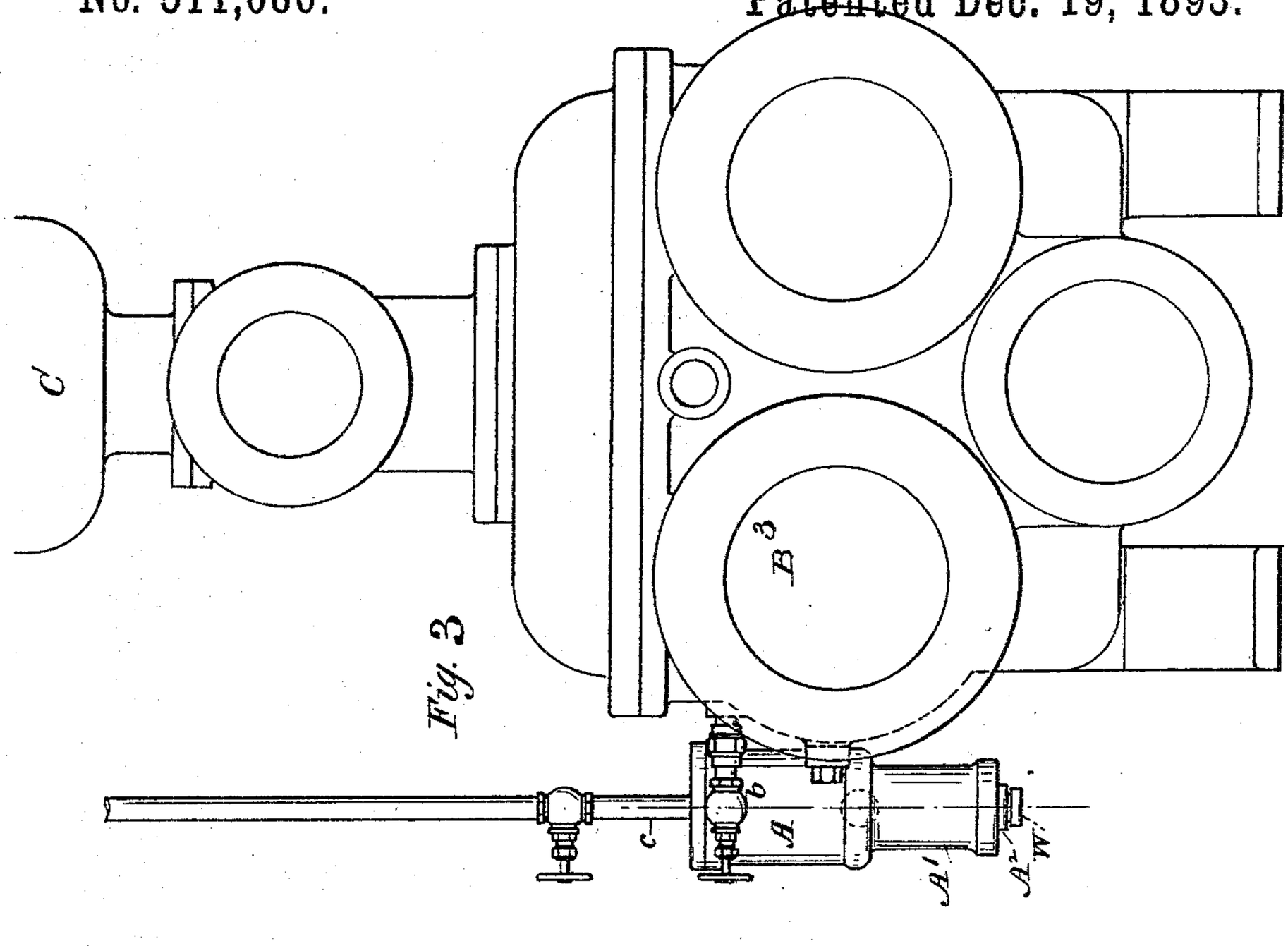

Fig. 3

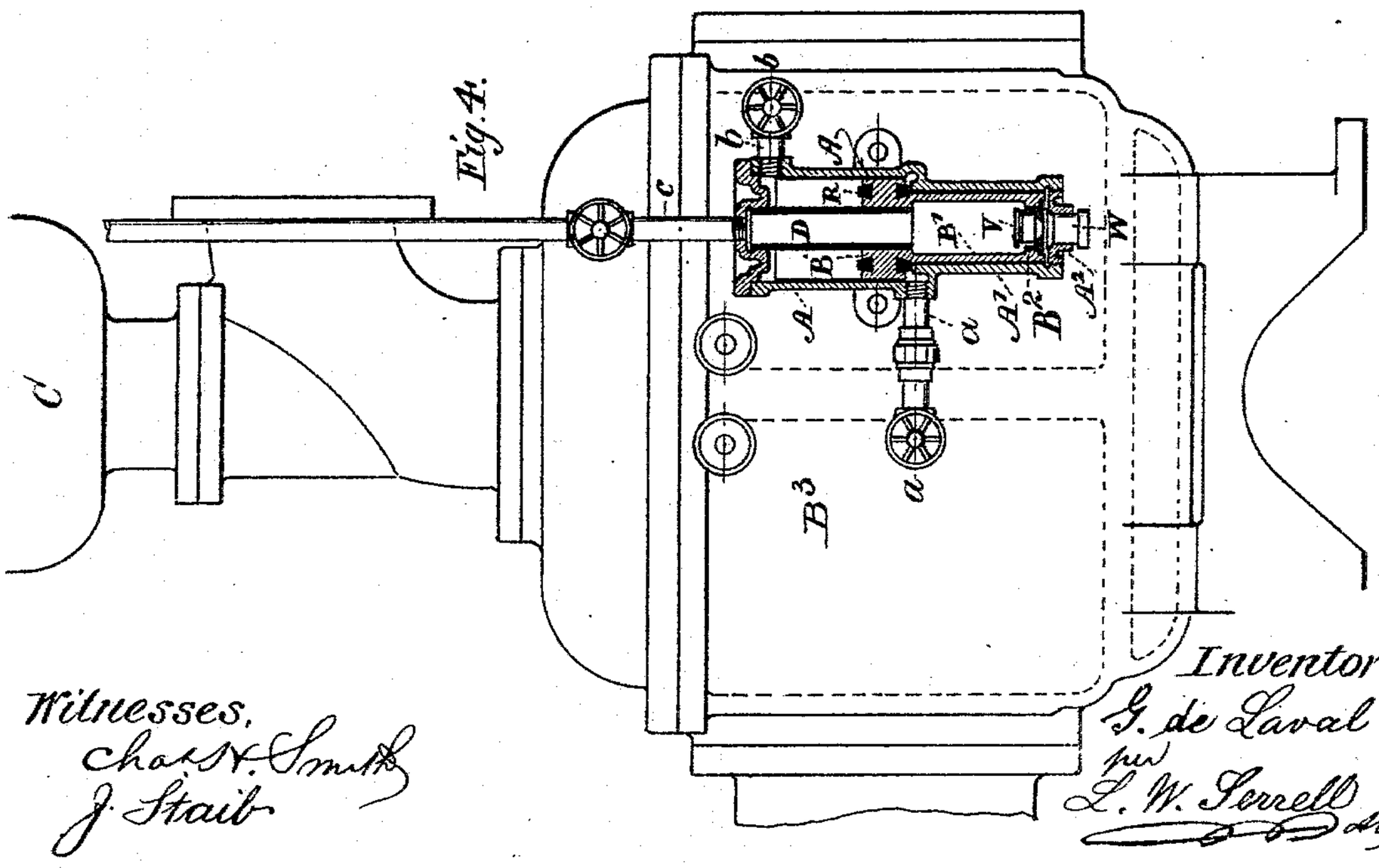

Fig. 4.

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GEORGE DE LAVAL, OF WARREN, MASSACHUSETTS, ASSIGNOR TO THE GEO. F. BLAKE MANUFACTURING COMPANY, OF NEW YORK, N. Y.

AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 511,086, dated December 19, 1893.

Application filed November 3, 1892. Serial No. 450,811. (No model.)

To all whom it may concern:

Be it known that I, GEORGE DE LAVAL, a citizen of the United States, residing at Warren, in the county of Worcester and State of Massachusetts, have invented an Improvement in Air-Compressors, of which the following is a specification.

This air compressor is adapted to be connected with a main pumping engine, so that the water under pressure from one side of the main pumping engine and then from the other, is employed to give motion to the piston in the air compressor, and such piston is adapted to exert greater power in one direction than in the other, so as to draw in the air when the power is the least and compress such air when the power is the greatest, and I make use of this air compressor specially in connection with the main water pump for forcing air into the air chamber of said water pump, thereby insuring a steady flow of water on the discharge main.

In the drawings, Figure 1 is a vertical section of the improved air compressor. Fig. 2 is an elevation of the same. Fig. 3 is an end view of the main pump with the air compressor affixed to the same, and Fig. 4 is a side view of said main pump with the air compressor in section.

The cylinders A A′ are advantageously cast together and the cylinder A is of larger diameter than the cylinder A′. At one end of the cylinder A′ is a head with an air inlet valve W, which valve is of any ordinary or desired construction; usually it is conical and resting upon a seat upon the inner face of the removable head A^2, and it is advantageous that the cylinders A and A′ should be lined with copper or brass cylinders as usual in this class of pumps.

The head C of the cylinder A is bolted on as usual and to it is connected the discharge air pipe *c*, and the standing cylinder D is fastened to the interior of the head C and extends down into the cylinder A′. The piston B fits within the cylinder A and around the standing cylinder D and it has a tubular extension B′ within the cylinder A′, and the lower end of this tubular extension B′ is provided with an escape air valve V of any suitable character. Preferably such air valve V is conical and within a removable head B^2, that is fastened into the tubular extension B′ of the piston B. The exterior surface of the tubular extension B′ fits closely within the cylinder A′ and its surface is preferably grooved with numerous peripheral grooves to lessen or prevent the passage of air between the interior of the cylinder A′ and the exterior of the tubular extension B′, and the exterior surface of the piston B is similarly grooved with peripheral grooves and so also is the exterior surface of the standing cylinder D. From the main water pump B^3 the pipes *b* and *a* connect from the opposite sides of the piston of said main pump B^3, one to the upper end of the cylinder A and the other to the lower end of such cylinder A, and it is advantageous to provide cocks in the inner pipes *a* and *b* as represented in Figs. 3 and 4. It will now be understood that as the piston in the main pump B^3 is reciprocated, the water pressure acts below the piston B as the piston of the main pump B^3 is moving in one direction, and then it acts through the pipe *b* above the piston B when the piston of the main pump B^3 is moving in the other direction, and there will be more or less pressure or suction action above and below the piston B as the piston of the main pump B^3 reciprocates. Hence the piston B of the air compressor is moved up and down by the water pressure from the main pump B^3, and in moving the piston B and its tubular extension B′ upwardly, the pressure is exerted on a less area of the piston B than it is when said piston B is moving downwardly, and as the piston B is moving upwardly the air is drawn in by the valve W and it is forced out through the standing cylinder D and pipe *c*, the valve V being closed, and when the piston B is moved downwardly the valve W closes and the air is compressed with a powerful pressure by the action of the water upon the top end of the piston B.

It will be noticed that as the piston B is moved upwardly, the standing cylinder D acts as a displacer to the air within the tubular portion B′ of the piston, and only so much air will be driven out from this tubular portion B′ of the piston as may be displaced by the standing cylinder D; for this reason the

volume of air displaced each upstroke can be regulated according to the diameter of the standing cylinder D, and this displacing of the air occurs when the air is under a pressure, and by this arrangement I am enabled to obtain a greater pressure of air than there is in the water that gives motion to the piston B, and hence I am enabled to carry the air from the air compressor into the air chamber of the main pump, so as to supply into said air chamber air under the proper pressure for rendering the flow of water steady and uniform in the discharge main; but it is to be understood that the air compressor before described may be used for furnishing air for any other desired object.

By opening the cocks in the pipes *a* and *b* the air compressor will be set in motion whenever air is required either for supplying the air chamber of the main pump, or for performing any other duty, in which air under pressure can be employed.

It will be observed that the annular grooves in the exterior surfaces of the standing tube D, the piston B and the tubular extension B′ serve the purposes of packings, and that any water that may pass between the respective surfaces will not be injurious in the operation of the air pump, and such water will eventually be discharged with the air and it will serve to lubricate the respective surfaces and to seal the air valves tightly.

I find it advantageous to employ elastic bumpers R at the opposite surfaces of the piston B to lessen concussion of the piston at the ends of the stroke. These bumpers are preferably in the form of rubber blocks or rings introduced into recesses in the surface of the piston.

I claim as my invention—

1. The combination in an air compressor, of a cylinder, a piston within the cylinder, pipes connecting such cylinder at opposite sides of the piston for the admission of a fluid under pressure alternately to move the piston first in one direction and then in the other, a smaller cylinder connected with the aforesaid cylinder, a tubular extension from the piston filling the smaller cylinder, an inlet valve opening into the smaller cylinder and a valve opening into the tubular extension, a standing pipe or cylinder connected with the head of the larger cylinder and passing through the piston, whereby the air that is drawn into the smaller cylinder and confined by its inlet valve is passed into the tubular extension of the piston when the piston is moving in one direction and confined by its valve and then forced through the standing pipe when the piston is moving in the other direction, substantially as set forth.

2. The combination with a pump, of an air compressor cylinder having a moving piston, pipes and cocks connecting the cylinder of the air compressor with the cylinder of the pump at opposite sides of such pump so that the piston of the air compressor is moved first in one direction and then in the other by the action of the water of the pump, a tubular extension connected with the piston and valves substantially as set forth, whereby the air compressor is actuated by the movement of the pump, and a pipe for conveying the air under pressure to the air chamber of the pump, substantially as set forth.

3. The combination with a pump, of an air compressor cylinder having a moving piston, pipes connecting the cylinder of the air compressor with the cylinder of the pump at opposite sides of such pump so that the piston of the air compressor is moved first in one direction and then in the other by the action of the water of the pump, a tubular extension connected with the piston and valves substantially as set forth, whereby the air compressor is actuated by the movement of the pump, and a pipe for conveying the air under pressure to the air chamber of the pump, substantially as set forth.

4. The combination in an air compressor, of a cylinder, a piston within the cylinder having elastic bumpers at each side thereof, pipes connected with the cylinder near the respective ends for the admission of fluid under pressure first at one end and then at the other, whereby the air compressor is rendered direct acting, a smaller cylinder extending from and in line with the aforesaid cylinder, a tubular extension from the piston filling the said smaller cylinder, an air inlet valve at the end of the smaller cylinder, and an air inlet valve at the end of the tubular extension, a standing pipe or cylinder permanently connected at one end to one head of the main cylinder and passing through the piston thereof, whereby the direct air pump draws air into the smaller cylinder and then compresses the same into the tubular extension, when moving in one direction, and the discharge of the air from the tubular extension takes place when the piston is moving in the other direction, substantially as set forth.

Signed by me this 28th day of October, 1892.

GEORGE DE LAVAL.

Witnesses:
GEORGE P. ABORN,
C. F. STAPLES.