3 Sheets--Sheet 1.

W. JOHNSTON.

Air-Compressing Apparatus.

No. 146,909. Patented Jan. 27, 1874.

Fig. 1.

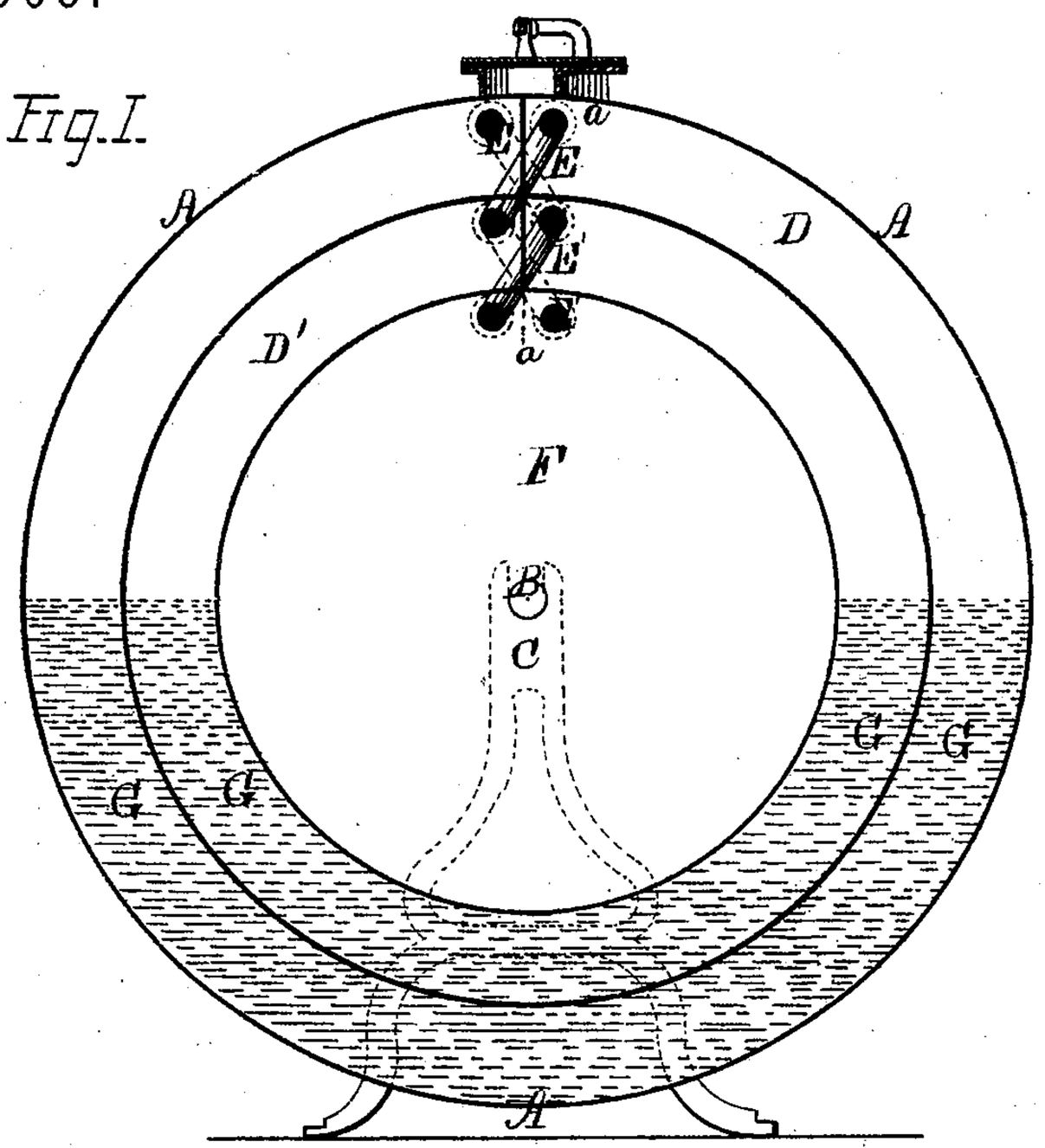
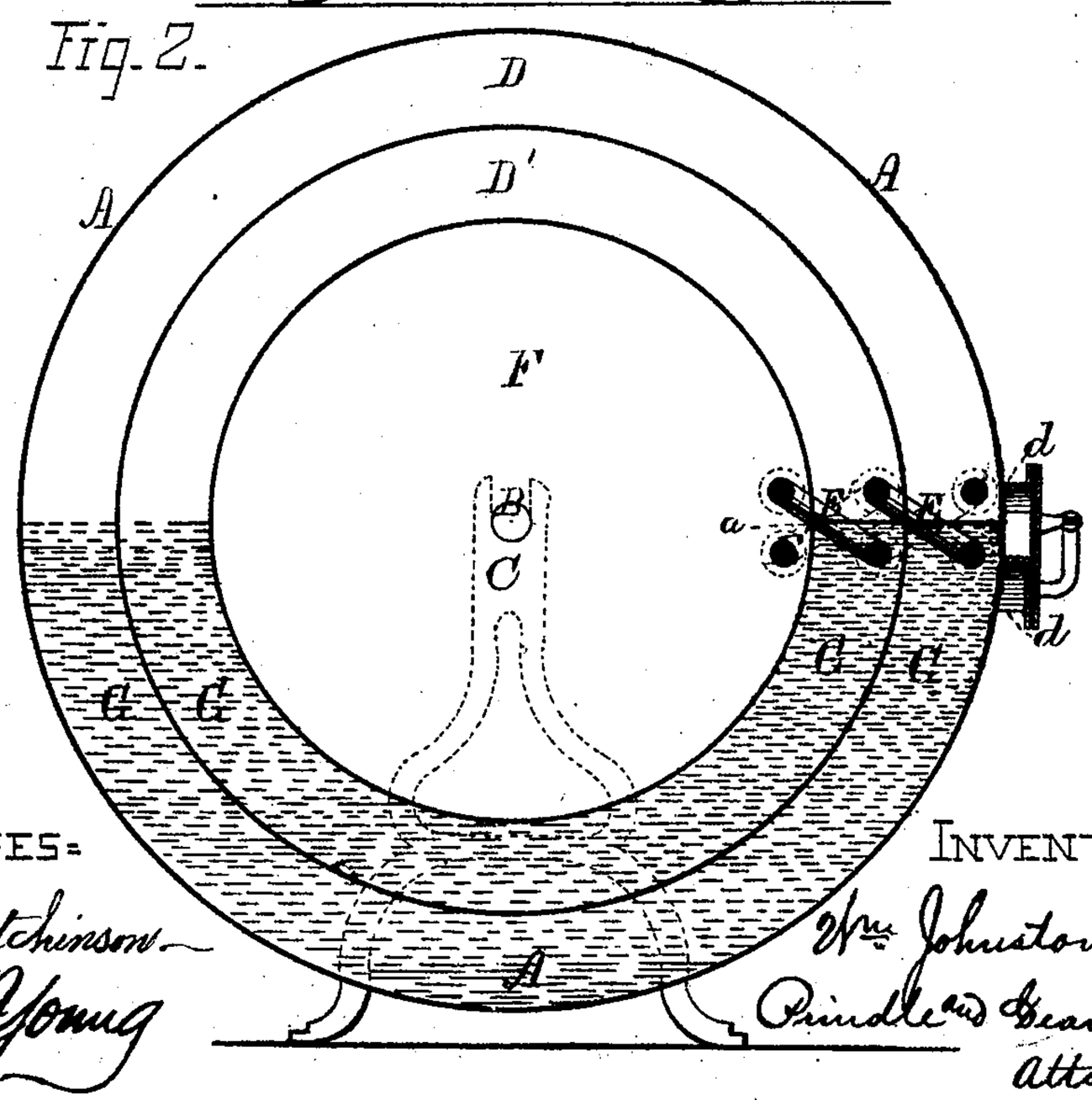


Fig. 2.



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3 Sheets--Sheet 2.

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Air-Compressing Apparatus.

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Fig. 3.

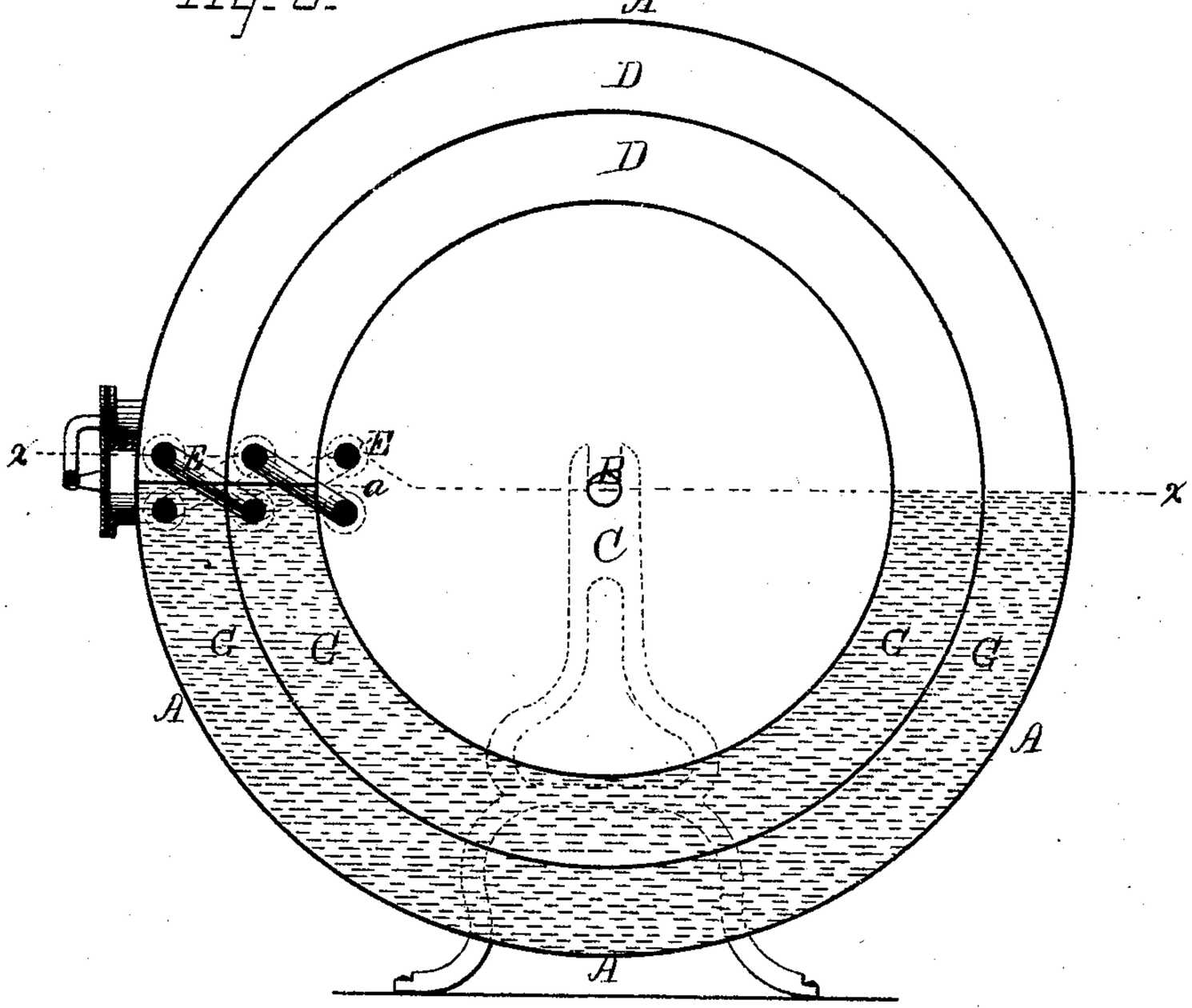
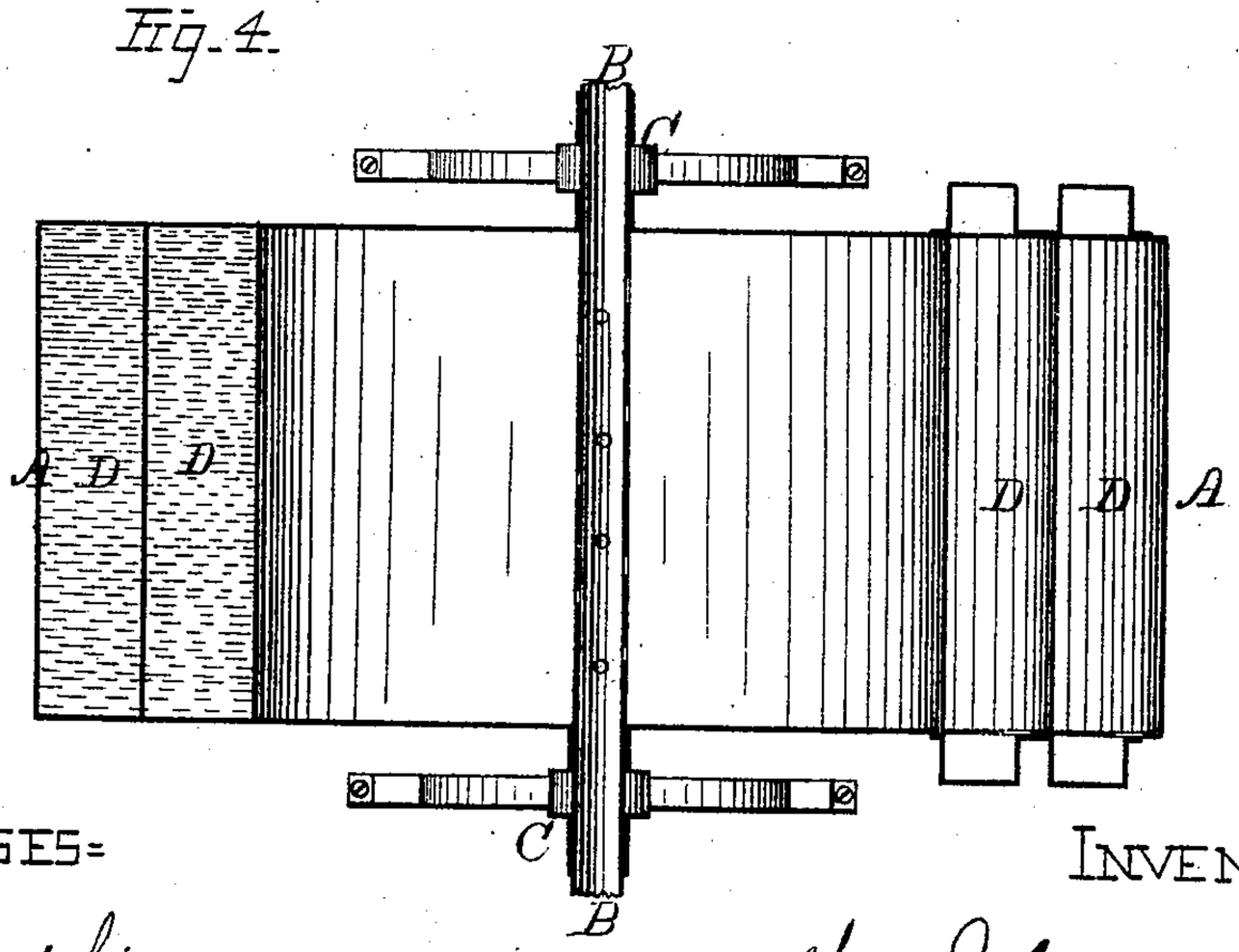


Fig. 4.



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3 Sheets--Sheet 3.

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Air-Compressing Apparatus.

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Fig. 5.

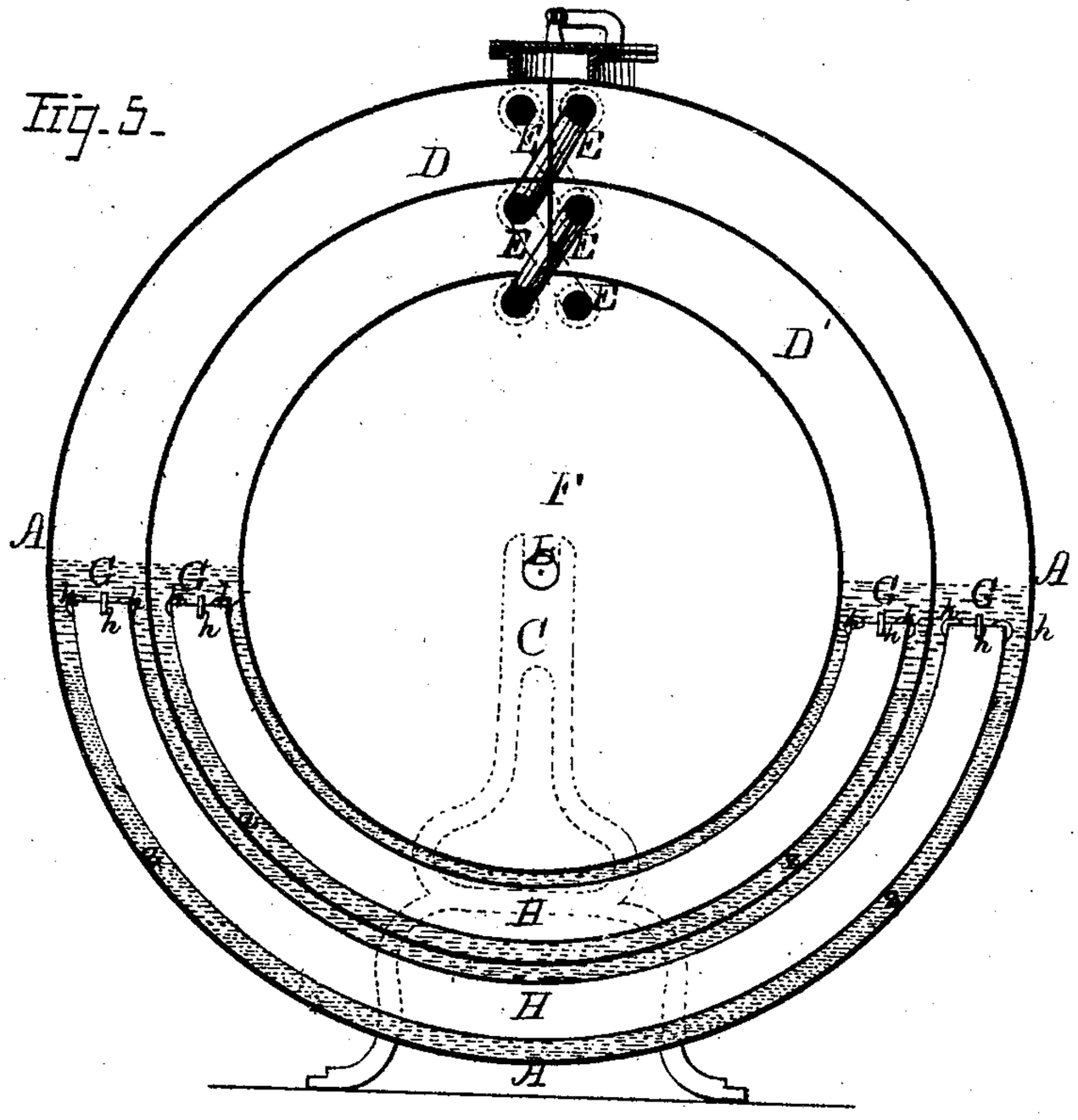
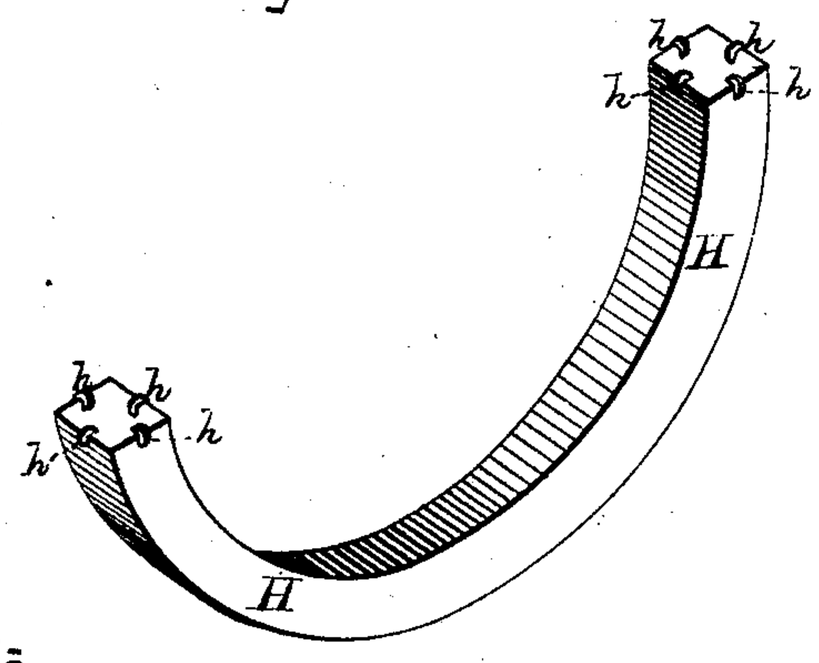


Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM JOHNSTON, OF LIMA, PERU.

IMPROVEMENT IN AIR-COMPRESSING APPARATUS.

Specification forming part of Letters Patent No. **146,969**, dated January 27, 1874; application filed January 6, 1874.

To all whom it may concern:

Be it known that I, WILLIAM JOHNSTON, of Lima, in the Republic of Peru, South America, have invented certain new and useful Improvements in Apparatus for Compressing Air; and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings making a part of this specification, in which—

Figure 1 is a vertical cross-section of my apparatus as arranged for use with water, said apparatus occupying its normal position. Figs. 2 and 3 are like views of the same when turned to the limit of its motion in opposite directions. Fig. 4 is a longitudinal section of said apparatus upon line *x x*, of Fig. 3. Fig. 5 is a cross-section of the same, showing the arrangement of parts employed for using mercury; and Fig. 6 is a perspective view of the plunger or float employed with the latter.

Letters of like name and kind refer to like parts in each of the figures.

The design of my invention is to lessen the power required in order to produce a given degree of compression of air; and it consists in the employment of a series of chambers formed upon circular lines, capable of oscillation around a common axis, having a regularly-decreasing capacity, and connected with each other and with the outer air by means of ducts and valves, so that when partially filled with a suitable fluid and caused to oscillate, said fluid, operating in each chamber as a piston, shall compress the air in advance and force it into the next smaller chamber of the series, substantially as and for the purpose hereinafter specified.

In the annexed drawings, A represents a hollow cylinder, provided at its ends with suitable journals B, which rest within corresponding bearings C, and enable said cylinder to be semi-rotated upon its axial center. The interior of the cylinder A is divided into a series of concentric chambers, D and D′, which are divided at one point by means of a radial longitudinal partition, *a*, from each side of which partition a duct, E, extends inward from the end of each chamber and connects with the opposite end of the next inner chamber, each of said ducts being closed at one of its ends by means of a valve, *e*, which opens toward the axial center of the apparatus. At each of its ends the outer chamber D communicates with the external air by means of an opening, *d*, which is closed by an inward-opening valve, while the inner chamber D′ communicates at each end through the valved ducts E′ with the central portion F of the cylinder A. The apparatus is now ready for use, as follows: Each chamber, D and D′, is filled with water to a point upon a line horizontally with its axis, and the cylinder A caused to have a semi-rotation in opposite directions until the partition *a* reaches a line horizontally with the center of motion. The water G, maintaining its level, will force the air contained between one end of its column and the downward-moving partition through the duct E into the opposite end of the next inner chamber, D′, while upon the opposite side of said partition a partial vacuum will be created by the recession of said water, and air to supply the same will be drawn through the valved opening *d*. Upon reversing the motion of the cylinder a reversal of the currents of air will be effected, the air just drawn into one end of said chamber being forced into the next inner chamber, and the exhausted end of said outer chamber again filled from without. The operation of the inner chambers is precisely the same as that described, except that each receives the air in a compressed state, and, after further compression, forces said air into the next chamber of the series, or, of the inner chamber, into the central reservoir. The size of each chamber of the series should be such as to enable it to just contain the air compressed by the preceding chamber, and, as said air is still further compressed by its passage through each chamber, it follows that said chambers should decrease in capacity exactly in proportion to the degree of such compression. If desired, the chambers D and D′ may be arranged side by side, instead of concentrically, in which event the length of the column of water would be the same in each, while their capacity would be determined by their transverse area. Where great pressure is required, and but small space is available for operating the apparatus, it may be expedient to employ some denser liquid in place

of water, but as most available liquids, except mercury, possess practical objections, and the expense of the latter offers a serious obstacle to its use, I employ the following-described mechanism for the purpose of rendering available, in part, the great specific gravity of the same. A curved iron shell, H, having a size transversely somewhat less than that of a chamber, is filled with lead and its ends sealed, and upon its sides, at or near said ends, is provided with projecting rollers *h h*, that form rolling bearings for said shell. The length of the loaded shell or plunger is somewhat less than the length of one-half of its chamber, so that when in place the ends of the former shall be beneath the level of the fluid. The space between the side of the plunger H and the walls of its chamber is now filled with mercury, *z*, which is permitted to extend upward nearly to the ends of said plunger, and over the latter and with said mercury is placed a sufficient quantity of water, G, to prevent air from coming into contact with and causing oxidization of the latter. As thus arranged, the mercury will pack the weighted plunger and cause the operation to be the same as though the chamber were filled with a fluid having a density equal to that of lead.

It will be seen that, while the pressure of air is constantly increasing as it passes from one chamber into another, the weight of the column of fluid within the inner chamber operates to precisely the same advantage as in the outer or first chamber, the pressure in rear of said column equalizing an equal amount of pressure at its front, so as to leave said column free to increase by its weight the pressure at said latter point in precisely the same proportion as though the initial pressure was but that of the external air. It will also be seen that the pressure thrown upon each valve is only equal to the difference between the air-pressure within the chambers to which it controls communication, so that the wear of one of the inner valves will be fully equal to that of the outer valves of the series.

The apparatus described is simple in construction, efficient in operation, and works with so little friction as to render the percentage of loss of power from such source so small as to be practically of no consequence.

Having thus fully set forth the nature and merits of my invention, what I claim as new is—

In an apparatus for compressing air, a series of chambers formed upon circular lines, capable of oscillation around a common axis, having a regularly-decreasing capacity, and connected with each other and with the outer air by means of ducts and valves, so that, when partially filled with a suitable fluid and caused to oscillate, said fluid, operating in each chamber as a piston, shall compress the air in advance and force the same into the next smaller chamber of the series, substantially as and for for the purpose specified.

In testimony that I claim the foregoing I have hereunto set my hand this 6th day of January, 1874.

WILLIAM JOHNSTON.

Witnesses:
GEO. S. PRINDLE,
THOMAS C. CONNOLLY.