No. 684,955. Patented Oct. 22, 1901.

H. STRATER.

AIR COMPRESSOR.

Application filed July 20, 1901.)

(No Model.) 2 Sheets—Sheet 1.

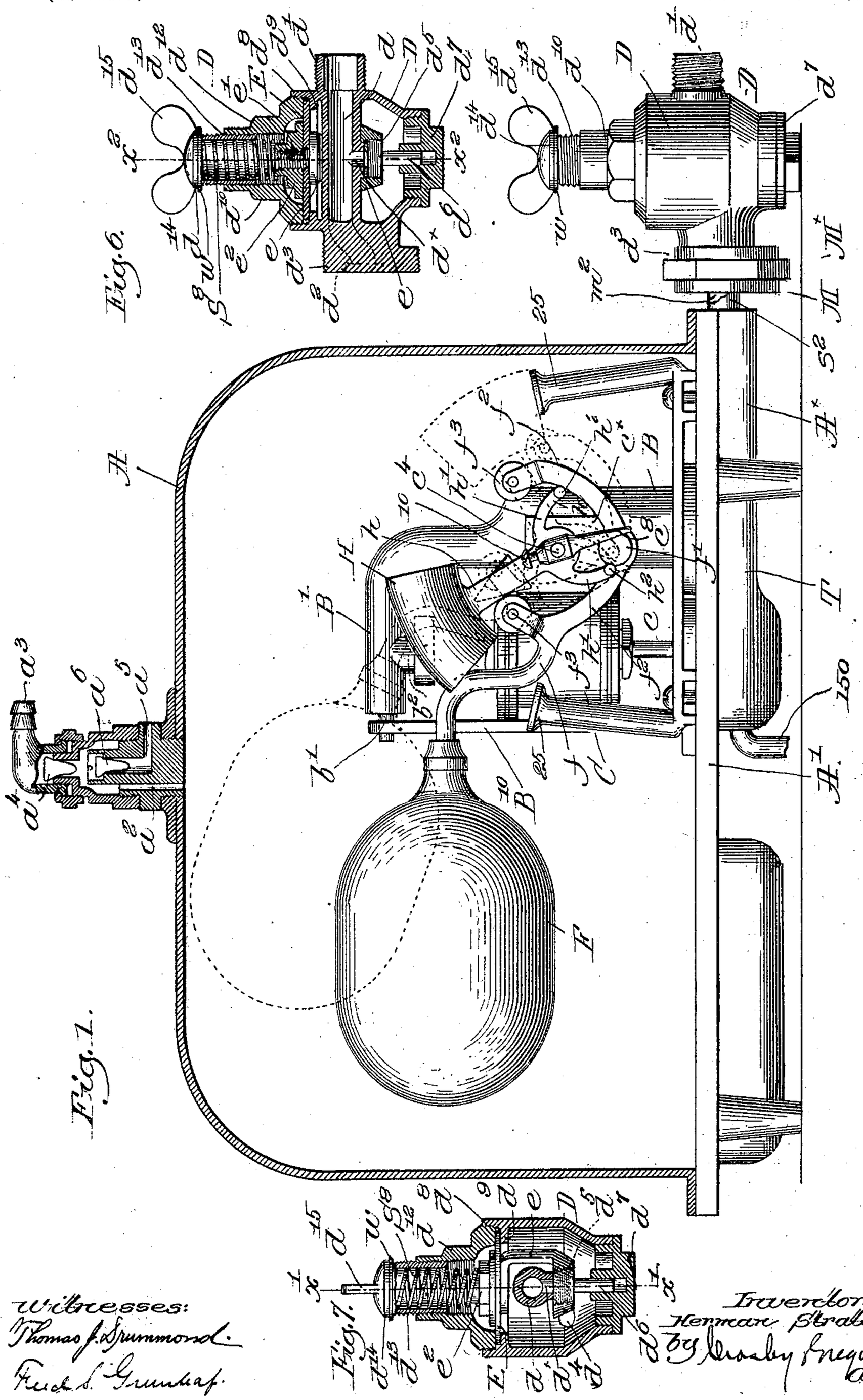

Fig. 6.

Fig. 1.

Fig. 7.

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Fig. 2.

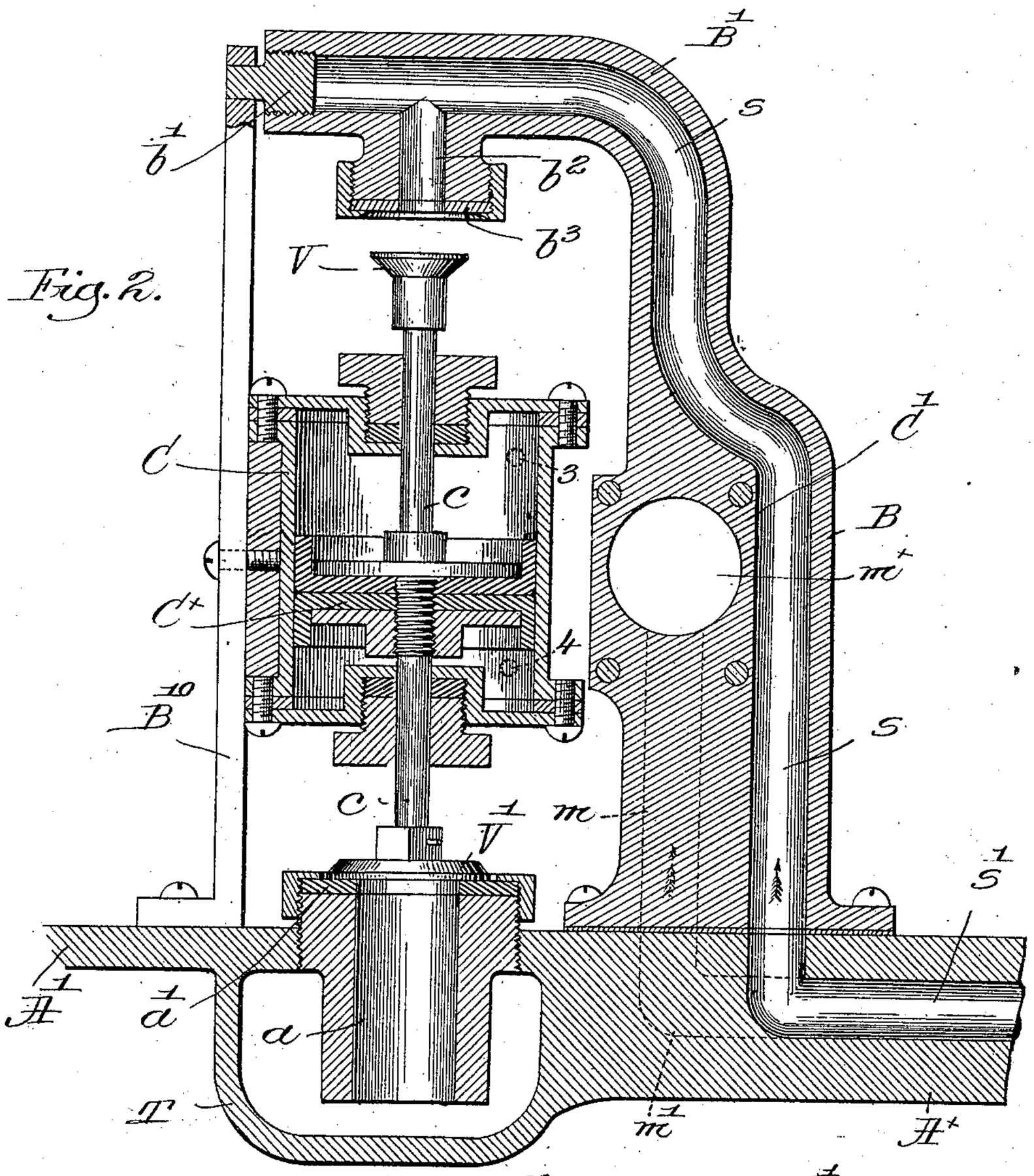


Fig. 4.

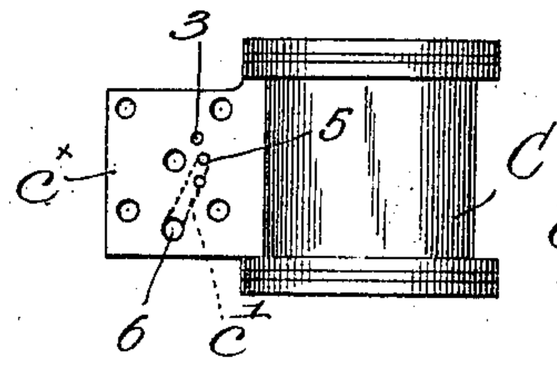


Fig. 3.

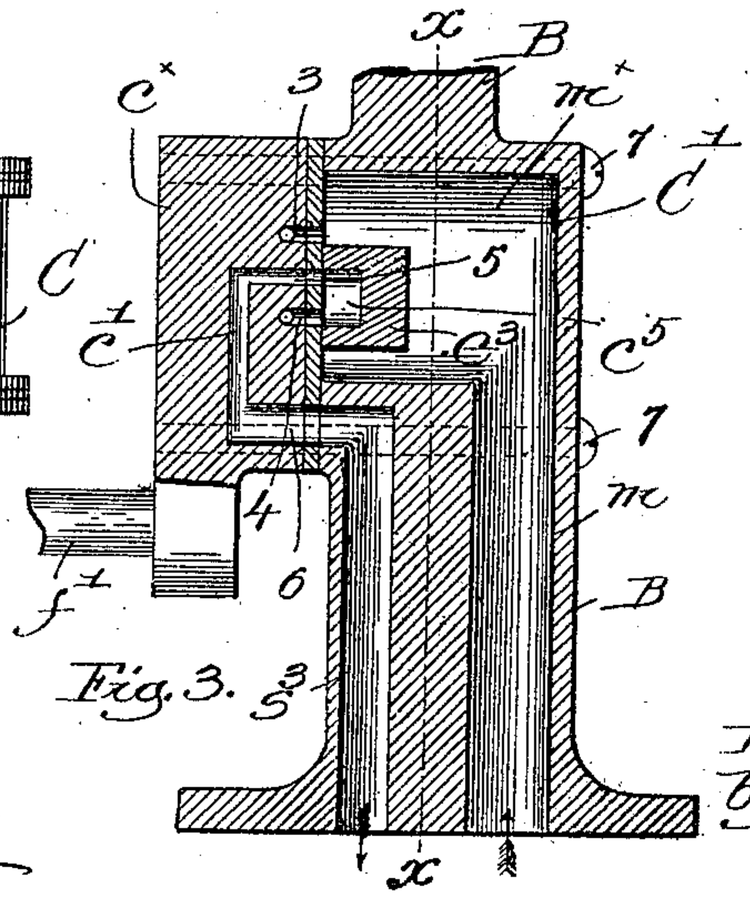
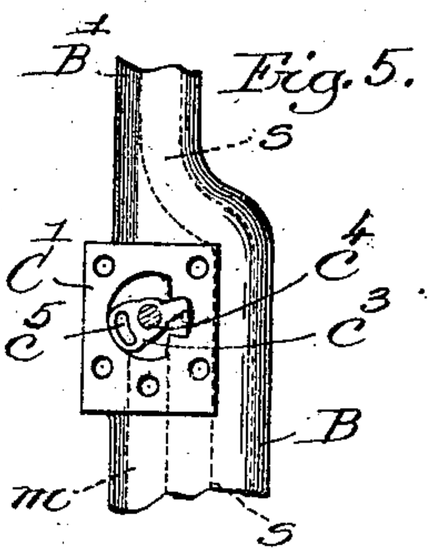


Fig. 5.



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UNITED STATES PATENT OFFICE.

HERMAN STRATER, OF BOSTON, MASSACHUSETTS.

AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 684,955, dated October 22, 1901.

Application filed July 20, 1901. Serial No. 69,049. (No model.)

To all whom it may concern:

Be it known that I, HERMAN STRATER, a citizen of the United States, and a resident of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Air-Compressors, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to air-compressing apparatus of the "hydraulic" type, wherein a suitable liquid, usually water, is employed as the compressing agent, the air being compressed thereby in a suitable chamber provided with admission and discharge ports for the liquid, automatically operated by mechanism which through suitable valves opens and closes the ports at the proper time.

In another application filed by me March 16, 1901, Serial No. 51,563, I have shown and described novel air-compressing apparatus of the type above referred to, the valve-actuating mechanism including a hydraulic motor, and in order to provide for the quick and effective operation thereof I devised means for effecting the admission of the compressing agent to the motor at substantially the pressure of the source of supply, while such compressing agent is admitted at a lower pressure to the compressing-chamber. By such construction and arrangement a regulation of the pressure of the agent in the chamber does not alter the pressure of such agent supplied to the motor, so that the latter can work under full pressure. In my said application the means for effecting such difference of pressure is located wholly within the compressing-chamber, so that it is necessary to open the latter when a change in the pressure of the compressing agent entering such chamber is desired. As for some purposes it is quite desirable or even necessary to vary such pressure from time to time, the apparatus forming the subject-matter of my said application is somewhat inconvenient, and my present invention has for its object the production of an air-compressor of the type hereinbefore referred to, but provided with pressure-regulating means of novel construction and at all times under the instant control of the operator. The motor is operated under a constant pressure, substantially that of the source of supply of the compressing agent, while the pressure of such agent employed in compressing the air can be instantly varied, according to circumstances, without any disturbance whatever of the rest of the apparatus.

The various novel features of my invention will be hereinafter fully described, and particularly pointed out in the following claims.

Figure 1 is a vertical sectional view of the air-compressing chamber of an apparatus embodying my invention, the automatic hydraulic mechanism for controlling the inlet and outlet of the compressing agent being shown in elevation, as is also the means external to the chamber for varying the pressure of such agent as admitted to the chamber. Fig. 2 is an enlarged vertical section taken through the cylinder of the hydraulic mechanism to more clearly illustrate the operation of such mechanism, the section being taken on the line $x\ x$, Fig. 3. Fig. 3 is an enlarged sectional view showing the main inlet-passage for the compressing liquid and the outlet passage for the motor-exhaust. Fig. 4 is a detail in elevation, on a smaller scale, of the cylinder of the hydraulic motor with the valve-ports thereof. Fig. 5 is a detached detail, in elevation, of the valve and valve-chest. Fig. 6 is a vertical longitudinal section, on the line $x'\ x'$, Fig. 7, of the pressure-regulating connection between the liquid-supply and the compressing-chamber and motor; and Fig. 7 is a transverse sectional view thereof on the line $x^2\ x^2$, Fig. 6, looking toward the left.

Inasmuch as the hydraulic motor and the mechanism operated thereby for controlling the inlet and outlet of the compressing liquid to and from the compressing-chamber is substantially the same as shown in my said application it will be somewhat briefly described herein.

Referring to Fig. 1, the dome-like compressing-chamber A contains the hydraulic mechanism for regulating admission and discharge of the compressing liquid, and said chamber is secured to a base A', provided with a discharge-conduit a, forming at its upper end a discharge-port a' for the chamber, (see Fig.

2,) the conduit opening into a trap T, which communicates with the main waste-pipe (not shown) by an outlet 150.

An upright standard B, secured to the base and extending up into chamber A, has two conduits or passages therein, *s* and *m*, the lower end of the former (shown in full lines, Fig. 2) registering with a short passage *s'* in an enlargement $A^{\times}$ of the base, the upper tubular end B' of the standard B, which forms a continuation of the conduit *s*, being bent over in the upper part of chamber A and closed at its end by a suitable plug *b'*. An admission-port b^2, having an annular valve-seat b^3, is made in the under side of the overhang B', directly above the discharge-port *a'*. A strong bracket B^{10} is secured at its foot to the base and at its upper end is secured to the plug *b'*, as shown in Fig. 2, the bracket serving to support the cylinder of the hydraulic motor, to be described. The conduit *m* (shown in dotted lines, Fig. 2) opens at its upper end into a chamber $m^{\times}$ in the standard B and at its lower end registers with a passage *m'* (see dotted lines, Fig. 2) in the part $A^{\times}$ of the base, the passages *s'* and *m'* being arranged side by side and connected at their outer ends by short pipes s^2 m^2 with a head M. (See Fig. 1.) The compressing liquid (usually water) is admitted to the chamber A through the admission-port b^2, the inlet-conduit *s* being connected by passage *s'*, through pressure-regulating means, to be described, with a water-supply, such as the city mains, the gradual accumulation of the water in the chamber compressing the air contained therein, the compressed air passing through an outlet a^2 and nozzle a^3 to a storage-receptacle or to the apparatus which is to utilize the compressed air, a check-valve a^4 preventing return of the latter to the chamber. After compression of the air to the desired extent the admission-port is closed and the outlet-port *a'* opened for discharging the liquid in the chamber, and a fresh charge of air enters the chamber through an inlet a^5, Fig. 1, controlled by a check-valve a^6. Valves V V' coöperate with the admission and discharge ports, respectively, and said valves are secured to the end of a piston-rod *c*, which passes through stuffing-boxes in the heads of the motor-cylinder C, the latter having ports 3 4 at opposite ends thereof, communicating at their other ends with a valve-chest C', shown as containing or forming the chamber $m^{\times}$ in the standard B, Fig. 3. In Fig. 4 the extension $c^{\times}$ of the cylinder-casting shows the ports or passages 3 and 4, and an exhaust-passage *c'* is shown having one end or port at 5 and the other at 6. (See also Fig. 3.) The extension $c^{\times}$ is secured to the valve-chest C' by bolts 7, and the chamber $m^{\times}$ contains the valve c^3, (best shown in Fig. 5,) rigidly secured to an oscillating spindle c^4, and having a recess c^5 therein to effect communication between the exhaust-port 5 and either cylinder-port 3 or 4, the valve-spindle c^4 being extended through the extension $c^{\times}$ and having a finger c^8 adjustably secured to its outer end by a set-screw 10, Fig. 1. The valve-actuator herein shown comprises a swinging arm *h*, loosely fulcrumed on the spindle c^4 and having a weight H at its upper end, its forked lower end providing two branches *h'*, having each a tappet h^2, located on opposite sides of and alternately coöperating with the finger c^8. The operation of this part of the apparatus is well known, the weight H throwing the actuator, as soon as it passes dead-center, so that one of the tappets h^2 will hit the finger c^8 a quick blow, to thereby turn the spindle c^4 in one direction or the other, to thereby change the position of the motor-valve c^3.

A float F, Fig. 1, in the chamber A imparts initial movement to the actuator *h* in well-known manner, the rise of liquid in the chamber acting through the float to swing the actuator from left to right, and the fall of the liquid-level effects the swing of the actuator from right to left. The float is secured to an arm *f*, fulcrumed on a stud *f'*, secured to a part of the cylinder extension $c^{\times}$, the arm having upturned branches f^2, diverging from its fulcrum and shown in Fig. 1 as having rolls f^3 in the path of movement of and at opposite sides of the actuator *h*, and, as shown, the arm *f* forms a bent continuation of one of the branches f^2. Fixed stops 25, secured to the base A', serve to limit the throw of the actuator-weight H.

In the drawings the admission-port b^2 is open and the valve V' is seated, closing discharge-port *a'*, and at such time the port 4 of the cylinder will effect exhaust of the latter below the piston $C^{\times}$ by the recess c^5 in valve c^3 to exhaust-passage *c'*, and port 3 will be admitting liquid to the cylinder above the piston. Shifting of valve c^3 by the actuator *h*, when the latter moves into dotted-line position, Fig. 1, connects the port 3 with the exhaust-port *c'* and establishes direct communication between the port 4 and the supply of liquid, causing a quick and powerful upward movement of the piston $C^{\times}$, simultaneously opening discharge-port *a'* and closing the admission-port b^2.

As the ports 3 and 4 open directly into the chamber $m^{\times}$, the full pressure of the liquid is utilized to act upon the piston and maintain the valves V V' in desired position irrespective of the pressure within the compression-chamber A. A third conduit or passage s^3 in the standard B communicates at its upper end with the end 6 of the exhaust-passage *c'*, and at its lower end it opens into the trap T, the motor-exhaust being thus independent of and separate from the discharge-passage of the compression-chamber.

While the pressure of the liquid which operates the motor is substantially constant, it will be manifest that it is very desirable to vary the pressure of the liquid in the chamber A, so that the air will be compressed to

the required density, and this density will usually vary, according to the work to be performed by the compressed air. So I have herein provided a very convenient, simple, and effective pressure-regulating device, operative at all times and instantly without any disturbance of the compressing apparatus or interference with its operation.

Referring to Figs. 1, 6, and 7, I have shown such pressure-controlling means as forming a part of the device for connecting the hydraulic mechanism and the admission-port b^2 with the common liquid-supply.

A coupling comprising a case or shell D has a through-passage d therein communicating at its inlet end with a nipple d', adapted to be connected with the liquid-supply, the other or outlet end communicating by a duct d^2 (see dotted lines, Fig. 6) with the outer face of a head d^3, (shown as externally screw-threaded.) A second duct d^4, Fig. 7, leads directly from the lower part of the case D to said head d^3, so that when the head is butted against the head M, Fig. 1, the outer ends of the ducts d^2 and d^4 will register, respectively, with the ends of the passages m^2 s^2, and the former will, by means of the through-passage d, communicate directly with the source of liquid-supply. A coupling member or ring $M^\times$ is screwed onto the head d^3 and connected rotatably with the head M in usual manner to tightly hold the faces of the heads close together without leakage. The through-passage d is shown as having a port $d^\times$, Figs. 6 and 7, which opens into the case D and is controlled by a puppet-valve d^5, its stem d^6 being guided in a recessed cap d^7, which closes the lower opening in the case, so that the valve d^5 can move toward or from the port $d^\times$. The top of the case is provided with an interiorly-threaded hub d^8, having an annular inturned flange d^9, on which is seated a flexible diaphragm E, of stout rubber, thin metal, or other suitable material. A C-shaped yoke e loosely embraces the through-passage d, (see Fig. 7,) and the valve d^5 is screwed into the lower end of the yoke, the upper end of the latter bearing against the lower face of the diaphragm and having an upturned threaded shank e' extended through it. A nut e^2, having a large base, is screwed upon the shank and tightly upon the top of the diaphragm, securely connecting the latter and the yoke and preventing leakage around the spindle, the nut being movable up and down in the recessed lower end of an upright nipple d^{10}, which is screwed into the hub d^8 and bears upon the diaphragm near its periphery, holding it liquid-tight upon the seat d^9. The nipple is interiorly threaded, as at d^{12}, to receive a tubular shank d^{13}, depending from an annular head d^{14}, provided for convenience with a thumb-nut d^{15}. A strong spiral spring S^8 is inserted in the tubular shank between the top of the nut e^2 and the under side of the head d^{14}, and by screwing the shank d^{13} into the nipple d^{10} the spring will be compressed to a greater or less extent. The liquid entering the coupling from the source of supply through the inlet d' passes along the through-passage d and thence, as has been described, to the motor to operate the valves V V' against the pressure in the chamber A, and I am enabled to use a comparatively small yet powerful motor to operate such valves, the motor being actuated by the compressing liquid at full pressure. At the same time the liquid in the through-passage tends to pass into the case D through the port $d^\times$, provided the valve d^5 is open, the spring S^8 acting upon the upper side of the diaphragm, tending to open such valve, while the pressure of the liquid in the case acts upon the under side of the diaphragm E, tending to seat the valve and close the port $d^\times$. Now by regulating the pressure of the spring in accordance with the full pressure of the liquid from the source of supply and according to the working pressure desired in the compressing-chamber it will be manifest that the liquid which passes through the case D and out through the outlet d^4 to the compressing-chamber will enter the latter at any desired pressure below the full pressure of the liquid as it is received from its source of supply. Should the diaphragm become ruptured, leakage through the nipple d^{10} can be prevented by simply screwing down the shank d^{13} until the head d^{14} is seated on the annular upper end of the nipple, and, if desired, a washer w of suitable material may be placed upon the tubular shank, immediately below the head.

The structure herein shown and described is very effective in its operation, is powerful and rapid, and at the same time it is absolutely controllable at any time from the exterior of the compressing-chamber, so that the working pressure in the latter can be varied from time to time, as desired.

My invention is not restricted to the precise construction and arrangement herein shown, as various changes or modifications may be made without departing from the spirit and scope of my invention.

The valve-actuating mechanism herein shown is not claimed, broadly, as the same is covered by claims in my pending application hereinbefore referred to.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an air-compressor, a compressing-chamber having admission and discharge ports for the compressing liquid, hydraulic mechanism, operated by such liquid, to automatically open and close said ports, and means to independently connect the hydraulic mechanism and the admission-port with a common liquid-supply, said means including a device operative from the exterior of the compressing-chamber to vary the pressure of the liquid entering the same irrespective of the liquid supplied to the hydraulic mechanism.

2. In an air-compressor, a compressing-

chamber having admission and discharge ports for the compressing liquid, hydraulic mechanism, operated by such liquid, to automatically open and close said ports, a coupling located outside the chamber to independently connect the hydraulic mechanism and the admission-port with a common liquid-supply, and means within the coupling to vary the pressure of the liquid entering the chamber irrespective of the liquid supplied to the said hydraulic mechanism.

3. In an air-compressor, a compressing-chamber having admission and discharge ports for the compressing liquid, hydraulic mechanism, operated by such liquid, to automatically open and close said ports, a coupling located outside of the chamber and having an inlet adapted to be connected with the liquid-supply, two outlets adapted to be operatively connected with the admission-port and the hydraulic mechanism, respectively, and pressure-regulating means interposed between the said coupling-inlet and the outlet thereof in connection with the admission-port of the chamber.

4. In an air-compressor, a compressing-chamber having admission and discharge ports for the compressing liquid, hydraulic mechanism, operated by such liquid, to automatically open and close said ports, a coupling located outside of the chamber and having a through-passage adapted to connect the liquid-supply and the hydraulic mechanism, said passage having a port opening into the case of the coupling, an outlet for the case, adapted to be connected with the admission-port of the chamber, a valve for the port in the through-passage, and means to exert a variable pressure on said valve, whereby the pressure of the liquid passing through said port to the chamber can be regulated at will.

5. In an air-compressor, a compressing-chamber having admission and discharge ports for the compressing liquid, coöperating valves, actuating mechanism therefor, including a hydraulic motor operated by the compressing liquid, means located between the liquid-supply and the chamber, to admit the liquid to the latter at a pressure variable at will and to the motor at the pressure of the supply, and controlling means for the motor, governed by the level of the liquid in the compressing-chamber.

6. In an air-compressor, a compressing-chamber having admission and discharge ports for the compressing liquid, coöperating valves, actuating mechanism therefor, including a hydraulic motor, separate supply-conduits communicating with the motor and the admission-port, a coupling exterior to the chamber, to connect said conduits with a common liquid-supply, and means carried by the coupling to at will vary the pressure of the liquid supplied to the admission-port conduit irrespective of the pressure in the motor-conduit.

7. In an air-compressor, a compressing-chamber having admission and discharge ports for the compressing liquid, coöperating valves, actuating mechanism therefor, including a hydraulic motor, separate supply-conduits communicating with the motor and the admission-port, a coupling exterior to the chamber, having a through-passage provided with a port opening into the coupling-case and adapted to be connected at its ends with the liquid-supply and the motor-supply conduit, an outlet-port for the case, to be connected with the admission-port supply-conduit, a flexible diaphragm in the coupling, a valve connected therewith for the port in the through-passage, pressure of the liquid in the case acting upon one side of the diaphragm to seat the valve and close the said port, and adjustable means acting upon the opposite side of the diaphragm to open the port, whereby the pressure of the liquid passing through the coupling to the compressing-chamber can be reduced at will below the pressure of the liquid-supply.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HERMAN STRATER.

Witnesses:
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AUGUSTA E. DEAN.