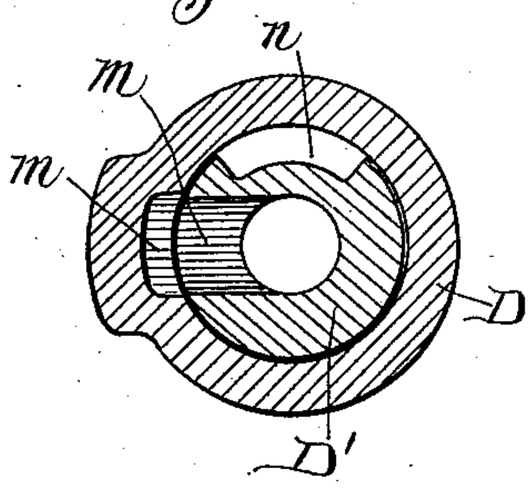
(No Model.) 2 Sheets—Sheet 1.

C. A. ANDERSON & E. A. ERICKSSON.

HOT AIR AIR COMPRESSOR.

No. 601,031. Patented Mar. 22, 1898.

Fig. 5.



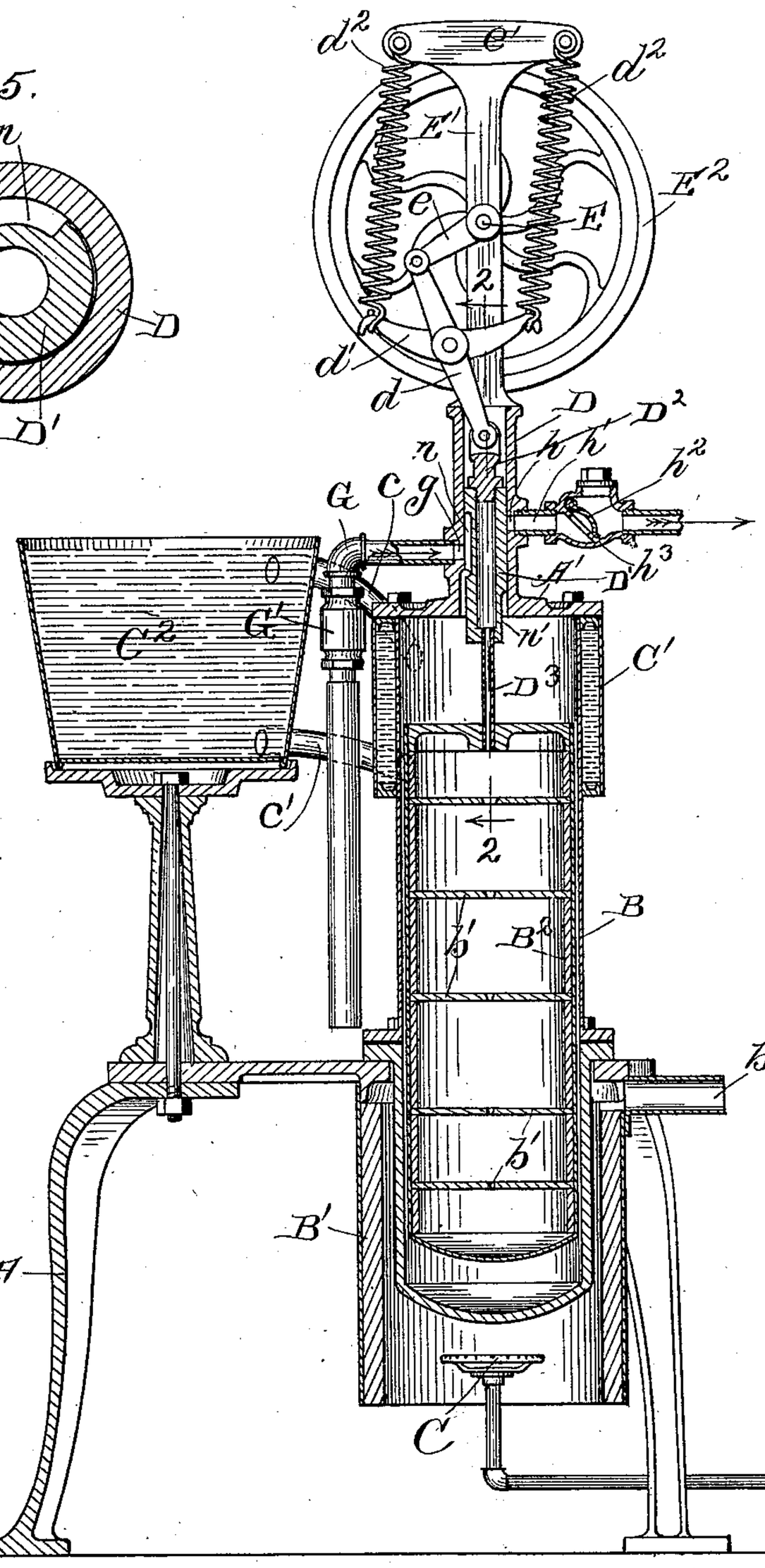


Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 7.

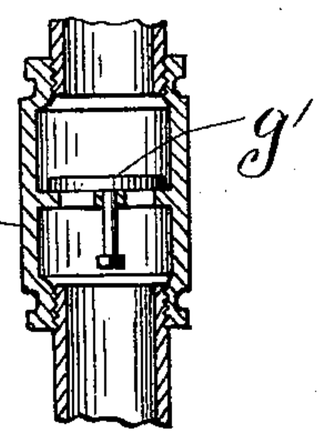


Fig. 2.

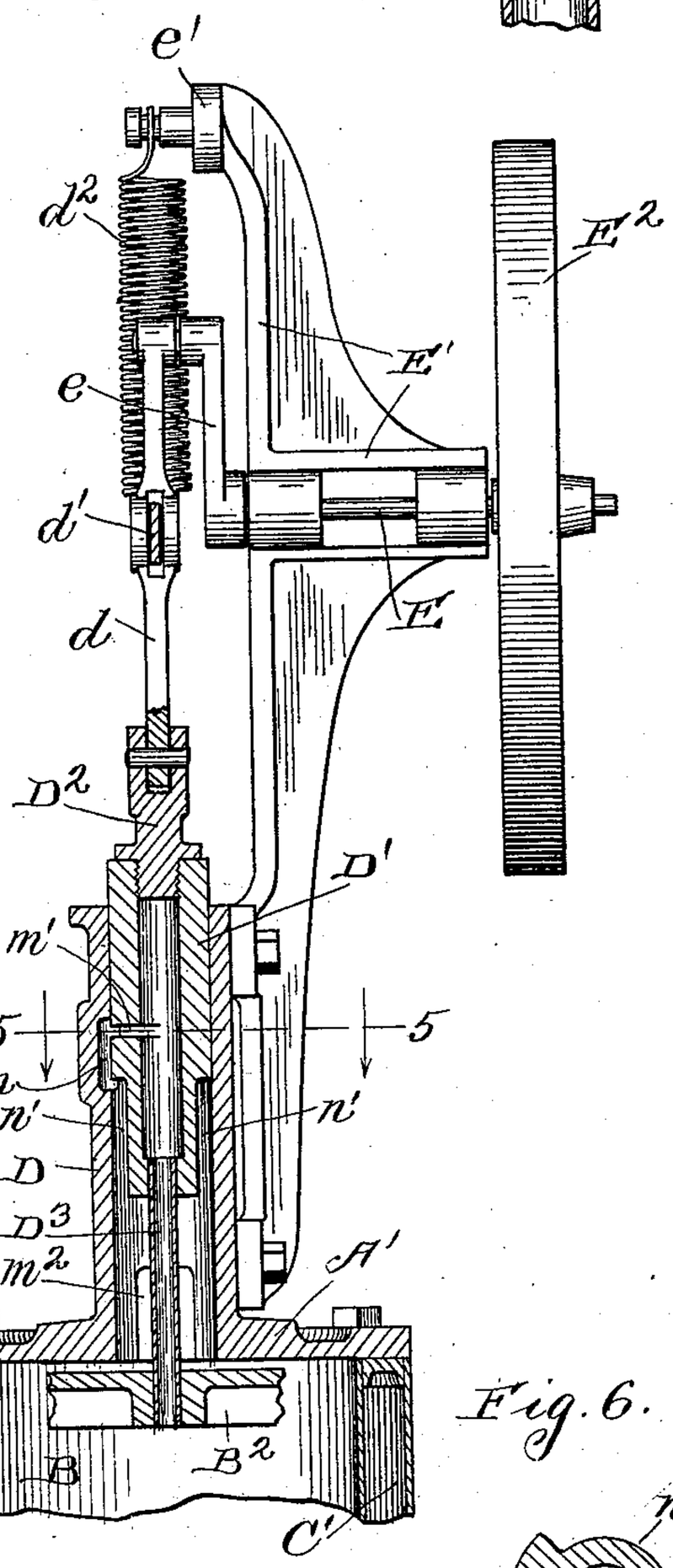


Fig. 3.

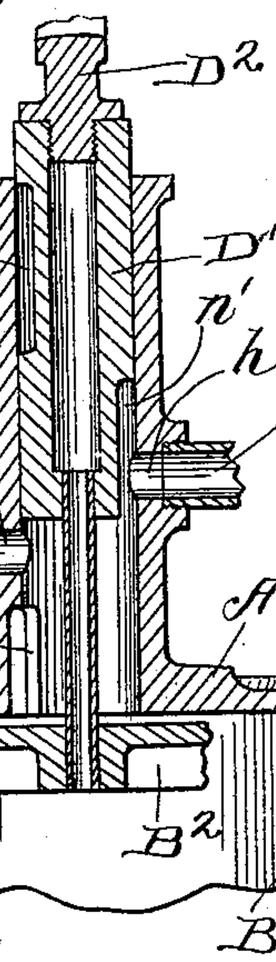


Fig. 4.

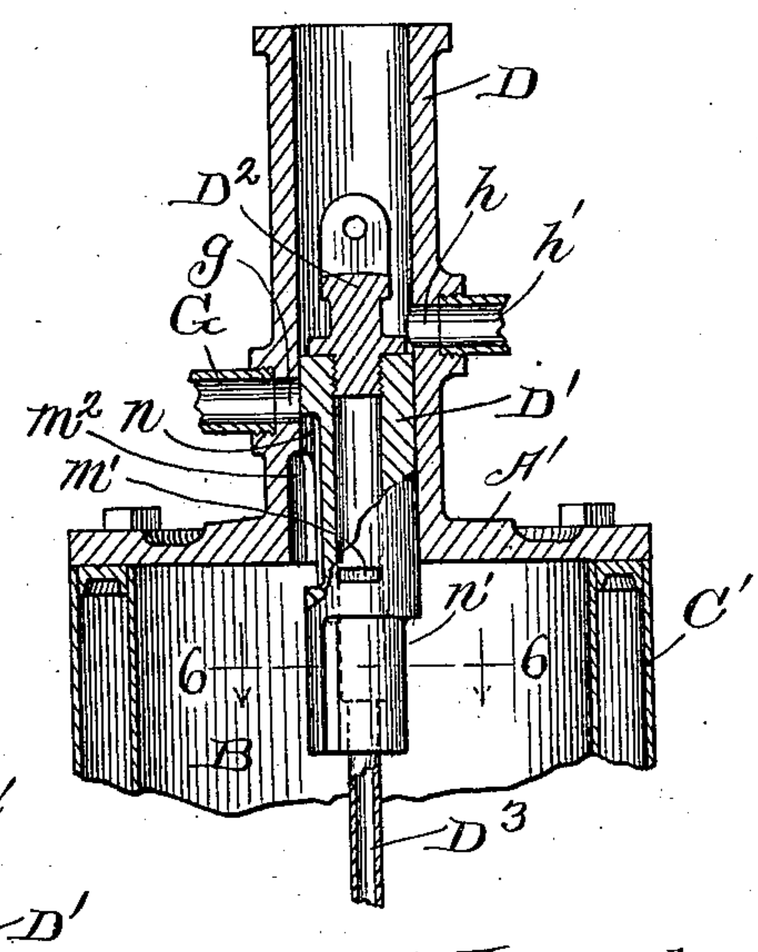
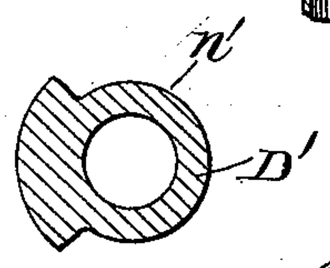


Fig. 6.



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UNITED STATES PATENT OFFICE.

CHARLES A. ANDERSON AND ERICK A. ERICKSSON, OF CHICAGO, ILLINOIS.

HOT-AIR AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 601,031, dated March 22, 1898.

Application filed November 27, 1896. Serial No. 613,560. (No model.)

To all whom it may concern:

Be it known that we, CHARLES A. ANDERSON and ERICK A. ERICKSSON, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Hot-Air Air-Compressors, of which the following is a specification.

This invention relates to an apparatus for compressing air by the expansion thereof effected by the application of heat in which the air-cylinder is arranged to be heated at one of its ends while, its other end is by suitable means kept cool or at a comparatively low temperature, the air being transferred by the action of a transfer or displacer piston from one end of said cylinder to the other alternately, and being heated and expanded during its passage in one direction, and being cooled and contracted during its transference in the other direction and discharged in a compressed state through ports uncovered by the proper movement of a working piston into a suitable storage-reservoir or other receptacle.

The objects of our invention are to provide a simple, inexpensive, satisfactory, and accurately-operating mechanism for effecting the changes of positions of the transfer or displacer piston, to furnish a means for storing the compressed air in excess of that which is discharged within the displacer-piston, and other objects and advantages will appear in the description hereinafter set forth.

In order to enable others skilled in the art to which our invention pertains to make and use the same, we will now proceed to describe it, referring to the accompanying drawings, in which—

Figure 1 is a vertical central sectional view, partly in elevation, of our compressor as it appears when ready for use. Fig. 2 is an enlarged sectional view, partly in elevation, of the upper portion of the compressor, taken on line 2 2 of Fig. 1, showing the working piston raised to its utmost limit and in the position to admit a portion of the compressed air through said piston and its tubular connection into the displacer-piston. Fig. 3 is a vertical sectional view showing the upper part of the air-cylinder, water-jacket, and the working piston in its raised position, the line of section being at a right angle to that shown in Fig. 2. Fig. 4 is a like view, partly in elevation, showing the working piston in its lowered position. Fig. 5 is an enlarged cross-sectional view, taken on line 5 5 of Fig. 2, showing the ports in the working piston. Fig. 6 is a cross-sectional view of the lower part of the working piston, taken on line 6 6 of Fig. 4; and Fig. 7 is a sectional view of a portion of the supply-pipe, showing a valve therein.

Similar letters refer to like parts throughout the different views of the drawings.

A represents the main or supporting frame, upon which is mounted the air-cylinder B, the lower portion of which is surrounded by a fire-box B′ of the ordinary or any preferred construction. The upper portion of the box B′ is provided with a flue *b*, through which the smoke and gases from the fuel used for heating the air in the cylinder B may escape and which may be of any suitable kind, but usually gas properly supplied or furnished in the lower portion of the fire-box by means of a burner C or other device if other fuel than gas is employed.

Surrounding the upper part of the cylinder B is a water-jacket C′, which communicates through suitable pipes *c* and *c′* with a tank C^2, mounted near the cylinder and usually on the main frame, as shown, for supplying water to the jacket and causing a circulation thereof in the same.

The upper end of the cylinder B is covered by means of a head-plate A′, from which extends vertically a cylinder D for the reception and operation of the working piston D′, to the upper end of which is pivotally secured at one of its ends a pitman *d*, the other end of which is similarly connected to a crank *e* on the axle E, which is journaled in a suitable bracket E′, secured to the cylinder D and extending thereabove. On the shaft or axle E is mounted a fly-wheel E^2, which is used for giving momentum to the operating mechanism. Pivotally secured to the pitman *d* and about its middle is a transverse piece *d′*, to each end of which is connected a compensating spring d^2, the other ends of which springs are secured to a cross-piece *e′* on the upper part of the bracket E′ or hanger for the shaft of the fly-wheel.

As is clearly shown in Figs. 1, 3, and 4 of the drawings, the cylinder D is provided on one side with an opening g, in which fits a supply-pipe G, which is bent downward, as shown in Fig. 1, and provided in its vertical portion with a gravity-valve g', which has its seat in an enlarged portion G′ of said pipe and on the other side with an opening h, into which is fitted a discharge pipe or tube h', leading to a storage-reservoir or other receptacle. (Not shown.) The pipe h' is provided with a valve h^2, which is pivotally secured within an enlargement h^3 in said pipe, so that the valve h^2 will be raised by the outward pressure of the compressed air, thus allowing it to pass the valve, after which the valve will drop into the position shown in Fig. 1, thereby checking or preventing the return flow of air. The working piston D′ is hollow and has secured in its upper end a block or head D^2 and in its lower end a tube or pipe D^3, which connects with the transfer or displacer piston B^2, which is located in the air-cylinder and is somewhat smaller in order to permit the air to pass between their walls. The displacer-piston is provided with a number of perforated partitions b' to strengthen the piston and yet allow the air to pass from one compartment to another.

In its upper portion the cylinder D is provided in its inner surface with a port m, which communicates with a port or opening m', extending into the hollow of the working piston to allow the excess of compressed air to pass through the hollow of the working piston, the tube D^3, and into the displacer-piston when the working piston is raised to its highest limit, as shown in Fig. 2 of the drawings. The piston is provided in its side adjacent to the supply-pipe opening with a port n, through which air is admitted from the pipe G to the air-cylinder when the piston is in the act of assuming the position shown in Fig. 4. The lower portion of the working piston is provided with a port n' on its surface adjacent to the opening h, in which the exhaust or discharge pipe h' is located. In other words, the lower part of the working piston is formed in cross-section, as shown in Fig. 6—that is, with a reduced portion adjacent to the wall of the cylinder B, in which is located the discharge-pipe.

From the foregoing and by reference to the drawings it will be seen and clearly understood that by heating the lower part of the air-cylinder through the medium of fuel in the fire-box or beneath said cylinder the air in the lower portion thereof will be expanded, thus causing the working piston D′ to rise by reason of the pressure of the expanded air and at the same time raise with it the displacer-piston B^2 to its highest limit, as shown in Figs. 2 and 3 of the drawings, in which position the compressed air will be free to pass out through the discharge-pipe h' and through the ports n', m, and m' into the hollow of the working cylinder and from thence into the displacer-piston, which passage of the air will occur at the instant that the working piston has reached its uppermost limit. As the working piston is forced downward by reason of the partial vacuum produced in the air-cylinder by the sudden cooling and contraction of the air and the impetus given through the medium of the fly-wheel the displacer-piston will also be forced toward the bottom of the air-cylinder, thus transferring the remaining heated air therefrom to the upper part of said cylinder to be cooled by the action of the water in the water-jacket, in which operation or movement of the working piston fresh air will be drawn in through the supply-pipe G, port n of the piston, and m^2 in the lower part of the cylinder D by reason of the vacuum produced by the sudden cooling and contraction of the air in the upper part of the air-cylinder. It is apparent that as the air is drawn in through the supply-pipe G the valve g' therein will be lifted from its seat by the suction, thus allowing fresh air to pass through said pipe and into the air-cylinder, when, as soon as the working piston returns on its upward stroke and the port m^2 is thereby closed, suction in the supply-pipe will cease and the valve g' therein rest on its seat by reason of its gravity. When the working piston reaches its lowest limit, as shown in Fig. 4, the compressed air which has been stored in the displacer-piston by the previous upward stroke will escape through the port m' into the air-cylinder, thus adding pressure to the air before it is heated. It will be seen and understood that the cylinder D is of less capacity than the volume of expanded air produced by the application of heat and that the working piston communicates with and is directly and rigidly connected to the displacer-piston, so as to move therewith. Momentum may be imparted and maintained to and in the working and displacer pistons through the medium of the balance or fly wheel E^2, which is connected to the working piston, as before stated, by means of a pitman d and crank e on the shaft E, on which the said wheel is mounted, and the weight of said pistons be counterbalanced by means of the compensating springs d^2, which are employed for this purpose.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In an air-compressor, the combination of an air-cylinder, with a displacer-piston located therein, a cylinder on and communicating with the upper part of the air-cylinder and having ports for the supply and discharge of air, a hollow working piston located in the cylinder on the air-cylinder, and communicating with the displacer-piston, and having ports to admit of the passage of air from the air-cylinder to its hollow and through the discharge and supply ports, substantially as described.

2. In an air-compressor, the combination of

an air-cylinder, with a displacer-piston located therein, a cylinder on and communicating with the upper part of the air-cylinder and having ports for the supply and discharge of air, a hollow working piston located in the cylinder on the air-cylinder and communicating with the displacer-piston and having ports to admit of the passage of air from the air-cylinder to its hollow, and through the supply and discharge ports, and a mechanism to impart to and maintain momentum and equipoise in the pistons, substantially as described.

3. In an air-compressor, the combination of an air-cylinder, with a displacer-piston located therein, a cylinder D, of less capacity than the volume of expanded air in the air-cylinder, said cylinder D, located on and communicating with the upper part of the air-cylinder and having ports for the supply and discharge of air, a hollow working piston communicating with the displacer-piston and located in the cylinder D, and having ports to admit of the passage of air from the air-cylinder to its hollow and through the discharge and supply ports, substantially as described.

4. The combination of a hollow displacer-piston, with a hollow working piston directly connected to and communicating therewith, and having a port adapted to communicate with the air-cylinder, when said working piston is at its highest and lowest positions, the working-piston cylinder, and the air-cylinder substantially as described.

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