No. 616,667. Patented Dec. 27, 1898.

A. H. HELANDER & C. O. LINDROTH.

COMPRESSOR OR BLOWING ENGINE.

(Application filed Aug. 21, 1896.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

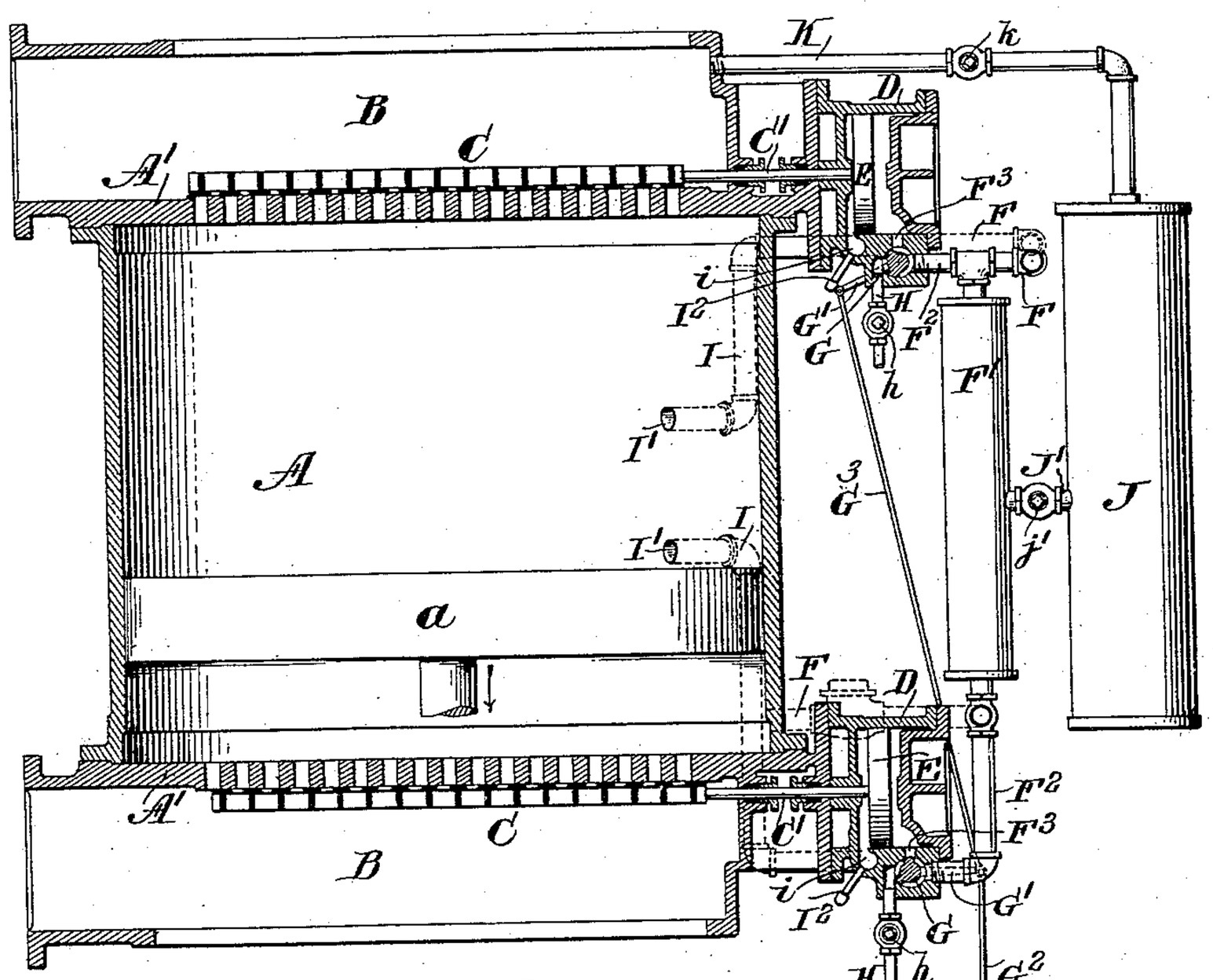


Fig. 6.

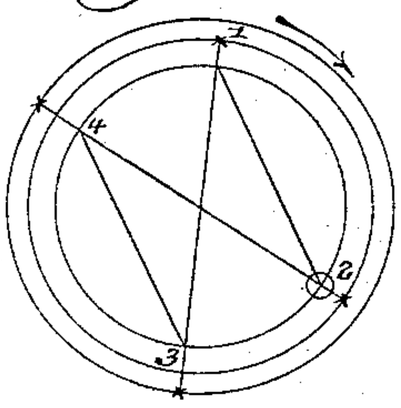
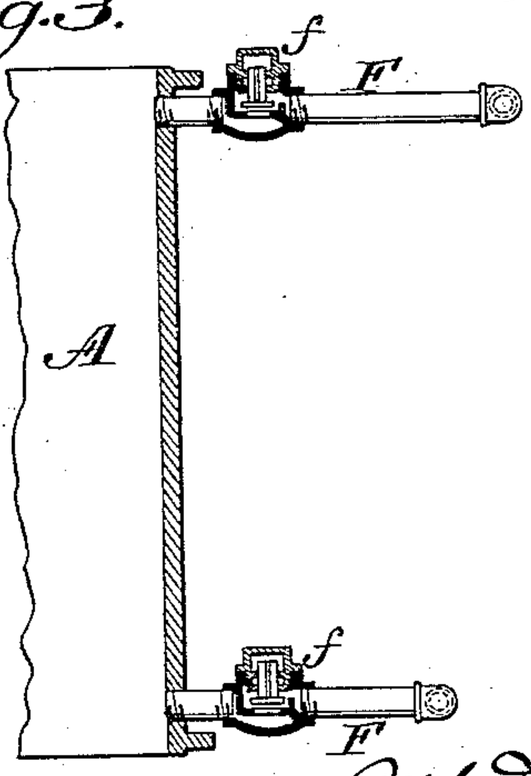


Fig. 3.



Witnesses.

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Fig. 2.

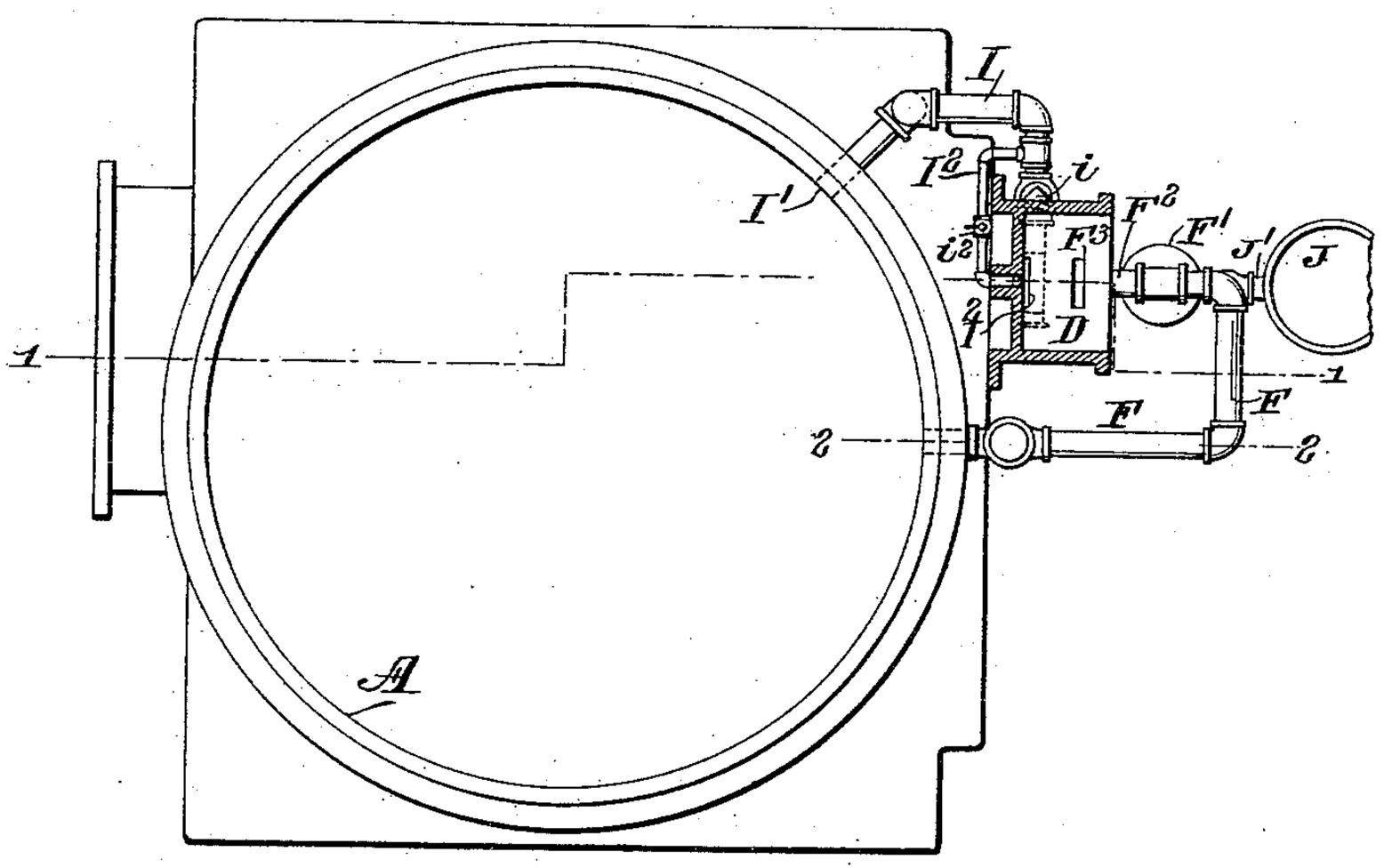


Fig. 5.

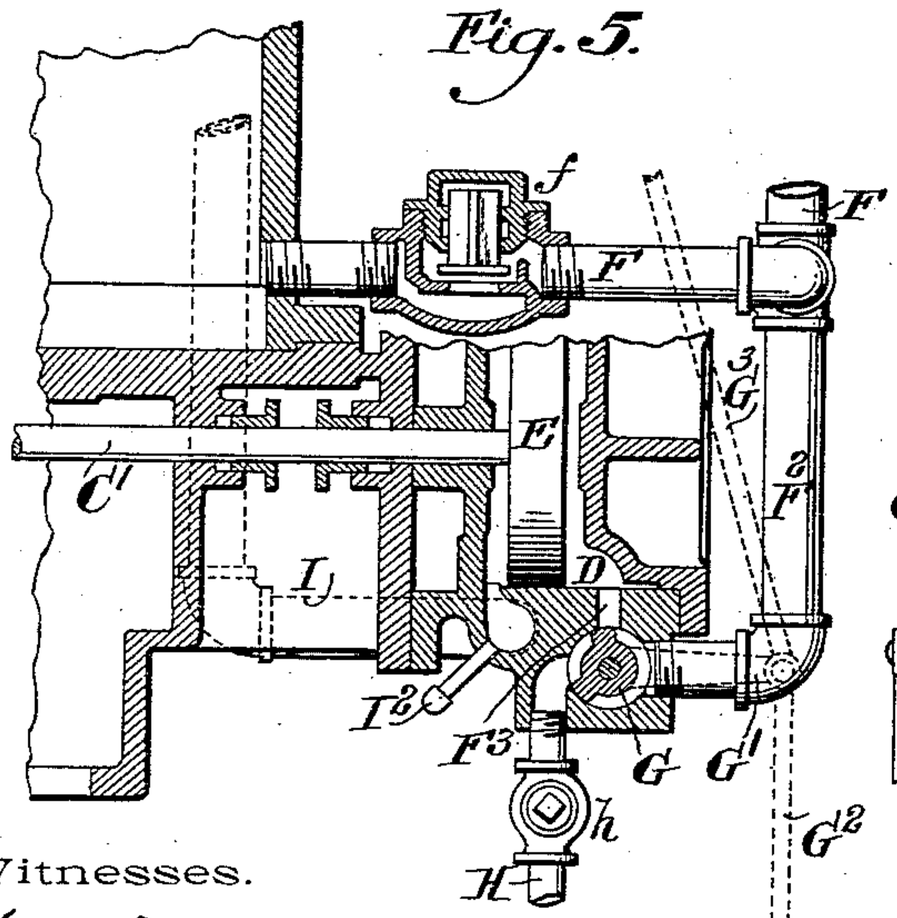
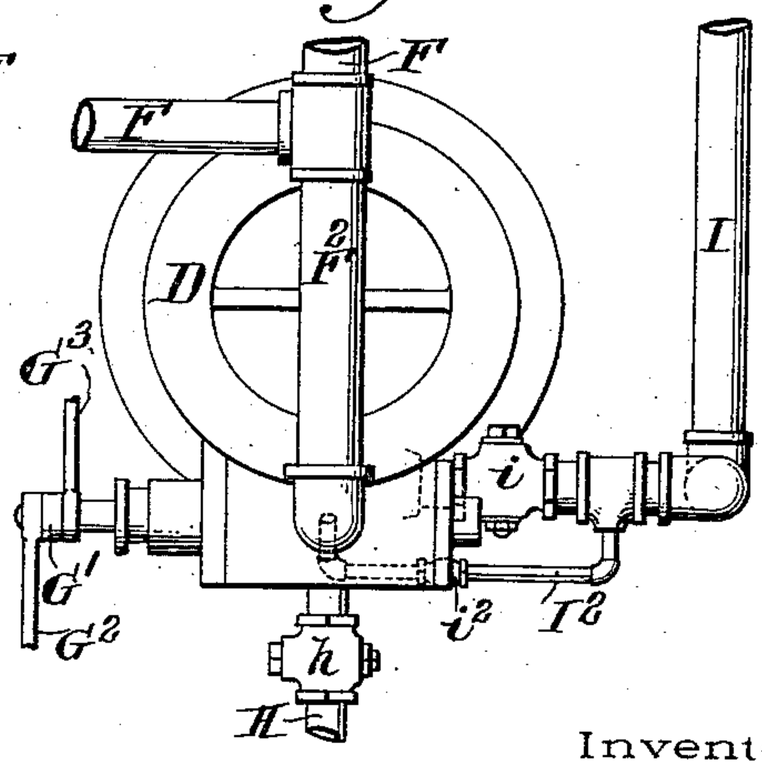


Fig. 4.



Witnesses.

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UNITED STATES PATENT OFFICE.

AXEL H. HELANDER AND CARL O. LINDROTH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS TO THE SOUTHWARK FOUNDRY AND MACHINE COMPANY, OF SAME PLACE.

COMPRESSOR OR BLOWING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 616,667, dated December 27, 1898.

Application filed August 21, 1896. Serial No. 603,443. (No model.)

To all whom it may concern:

Be it known that we, AXEL H. HELANDER and CARL O. LINDROTH, citizens of the United States, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Compressors or Blowing-Engines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

Our invention relates to the construction and operation of the delivery-valves of air-compressors, particularly of those compressors known as "blowing-engines."

Heretofore various plans have been devised and used for utilizing the pressure of the air compressed in the cylinder of the blowing-engines to actuate the delivery-valve of the engine, and while many such devices have proved practicable and of great value in use they are as a rule open to the objection that depending, as they do generally, upon the existence of pressure in the receivers of the blowing-engine they do not work or work properly when there is no pressure in the receiver, as is generally the case when the engine is being started.

The object of our invention is to provide means for actuating the delivery-valves by the action of the air compressed in the main cylinder, which will come at once into properly operative condition on the starting of the engine; and the main feature of our new construction consists in the provision of a storage-reservoir for compressed air from which the actuating-cylinders of the delivery-valves can draw the power necessary to put them into operation. This storage-reservoir may be one which will receive a supply of compressed air when the engine is in full operation and store it ready for use after the engine has ceased to work or one which is adapted to receive a charge of compressed air from a source extraneous to the engine itself; but preferably and whether fit to be used as above noted or not the storage-reservoir is connected both with the top and bottom of the main cylinder of the blowing-engines by passages fitted with non-return valves and so that the first movements of the air-compressing piston will result in forcing air under pressure into the reservoir, from which it is drawn at proper times to actuate the delivery-valves of the engine.

The nature of our improvements, both general and specific, will be best understood as described in connection with the drawings, in which they are illustrated, and in which—

Figure 1 is a vertical section through the main cylinder of a blowing-engine, the section passing through the delivery-valves and through the actuating-cylinders by which such valves are operated, being taken, for instance, on the line 1 1 of Fig. 2. Fig. 2 is a plan view of the main cylinder with the head and receiver removed, showing the upper valve-actuating cylinder in section. Fig. 3 is a cross-sectional view on the line 2 2 of Fig. 2. Fig. 4 is an end view of one of the valve-actuating cylinders and connected parts. Fig. 5 is a central longitudinal vertical section through the lower valve-actuating cylinder and some of its connected parts, and Fig. 6 is a diagram illustrating the action of the valves which control the movement of the pistons in the valve-actuating cylinder.

A is the main or compressing cylinder of the engine, A′ A′ indicating the heads of the cylinder, in which, as shown, are formed the delivery-ports by which the air issues from the cylinder.

B B indicate the receivers for the compressed air; C C, the delivery-valves, the valve-rods of which are indicated at C′ C′, D D indicating the valve-actuating cylinders, each provided with a piston E, connected with the respective valve-stems C′ C′.

F F are passages or pipes leading from the ends of the cylinder A to an air-storage receptacle F′, a non-return valve *f* being situated in each pipe F. From the reservoir F′ lead pipes F^2 F^2, each connecting through a port F^3 with that side of the cylinder D the admission of air to which will cause the delivery-valve C to close.

H H indicate exhaust-pipes connecting with the ports F^3 and preferably each provided

with a cock or regulable valve, as indicated at *h*, by which the resistance to the exhaust can be regulated.

G G indicate valves controlling at the same time the connection of the ports F^3 with pipes F^2 and with the exhaust-pipes H. The spindles of these valves G have connected with them levers G', the said levers being connected, as shown, by a rod G^3, so that the valves are enabled to move upward in opposite directions, G^2 indicating a valve-actuating rod leading to a cam crank or eccentric actuated by a constantly-moving part of the engine and by which the valves G G are operated. From the opposite sides of the cylinders D lead pipes I I, which open into the compressing-cylinder A, as indicated at I' I'. The position of these openings should be as shown, that they will each be open for about two-thirds of the stroke of the piston as it moves toward the end of the cylinder with which they are connected, then closed by the piston moving across them, and then opened again shortly before the main piston (which is indicated at *a*, Fig. 1) reaches the end of its stroke. Thus in Fig. 1 the piston *a* is shown as just clearing the lower opening I' as it moves downward. The pipes I I are preferably provided with non-return or check valves, as indicated at *i*, and in this case they are also provided with a by-pass I^2, leading around the check-valves *i* and preferably provided with a regulable stop-cock, as indicated at i^2.

J indicates a supplemental storage-reservoir connected with the reservoir F' as by a pipe J', which should have a cock, as *j'*, and connected also, as shown, with the reservoir B of the engine by means of a pipe K, provided with a stop-cock *k*.

The operation of the engine is readily followed. Assuming that both valves C are closed and the piston A at the upper end of the cylinder, the arrangement of the mechanism actuating the valves G G will be such as to open the passage leading from the upper pipe F^2 through the port F^3 into the upper cylinder D, and on reaching the point marked 1 in the diagram Fig. 6 the passage from F^2 to the upper cylinder D still remains open, but the passage from the lower pipe F^2 to the lower cylinder D is closed, and the passage from said lower cylinder to the exhaust-pipe H is open. Then as the piston A continues to move downward air is at first forced from the cylinder A through both pipes I I to the front ends of the cylinders D and through the lower pipe F into the reservoir F', from which the air passes to the rear side of the upper cylinder D, but does not enter the lower cylinder D. Obviously as long as the upper cylinder D is receiving air through its pipe I on one side of the piston the pressure of this air is being exactly balanced by the compressed air admitted to the other side of the piston through the reservoir F', and after the piston *a* has passed the upper opening I' the air on the front side of the piston is permitted to escape back into the cylinder A through by-pass I^2 and upper pipe I. Secondly, the upper delivery-valve under the conditions named will not be opened, but will be held firm in a closed position. On the other hand, the air entering the lower opening I' in the cylinder A will act on the front face of the piston E in the lower cylinder D, and as the port F^3 in the rear of the said cylinder is open to the atmosphere the piston E will move backward and will open the lower delivery-valve C as soon as the accumulated pressure becomes sufficient to overcome the inertia and frictional resistance of said valves. When the piston *a* in passing downward reaches the point 2, (diagrammatically illustrated in Fig. 6,) the valve-actuating mechanism will move the lower valve G so as to throw the rear of the lower cylinder into communication through pipe F^2 with the storage-reservoir F', and the lower opening being then cleared by the piston *a*, as indicated in Fig. 1, the air is free to escape from the front of the lower cylinder D through by-pass I^2 of pipe I, whereupon the pressure on the rear of piston E will move it and close the valve, and the reason for supplying the pipes I with non-return valves and with the by-passes I^2 is to afford resistance to the escape of air through the pipe I, a resistance which can be easily regulated by means of the cocks i^2 and which serves the purpose of a dash-pot to prevent too sudden a movement of the valve, and we may here properly mention that the function of the cocks *h* in the exhaust-pipes H H is precisely the same—viz., to enable the resistance to the escape of air from the rear of cylinder D to be nicely regulated and preventing too sudden movements of the valves in the other direction. The adjustment of the valves should be such that the lower delivery-valve C will close just as the piston *a* comes to the bottom of its stroke. Then as it moves upward the operations described are again repeated, except that the positions of the upper and lower valves G are reversed. As the pressure in the reservoirs B B increases the pressure in the reservoir F' also increases and in the same proportion, and this is true also, though to a less degree, of the pressure in the pipes I I. The parallelism of pressure in the reservoir F' and the reservoirs B B is important, because the resistance which the delivery-valves oppose when being closed depends largely upon the pressure in the receiver, but as the power applied to the valve-operating cylinders from the reservoir F' increases in proportion to this resistance the valves will by our device be closed substantially at the same time under all conditions of use.

As described above, it will be seen that even from the first stroke of the piston *a* we secure power to close the delivery-valves. Obviously also in case of the stoppage of the en-

gine a certain amount of air under pressure will remain in the reservoir F′ in condition for use as soon as the engine is restarted, and it is from certain points of view desirable that the reservoir F′ should be supplemented by a reservoir such as J, in which a considerable volume of compressed air can be stored and kept for some time. Such a supplemental reservoir can be filled from the receiver of the engine, as shown, or, if convenient, may be filled from some other source of compressed air.

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

1. In a blowing-engine or compressor having discharge-valves as C C the combination with said valves of cylinders D D having pistons connected with the valves, passages as I I leading from the compression-cylinder of the engine to the cylinder by which compressed air is admitted to open the valves, a storage-reservoir for compressed air separate from and independent of the main compressed-air receiver of the engine but connected with and receiving its air from the engine, passages leading from said reservoir to cylinders D D, non-return valves situated in said passages exhaust-ports leading from said cylinders, valves as G G adapted to connect cylinders D D with the reservoir and with the exhaust-ports and positively-actuated mechanism for moving said valves, all substantially as and for the purpose specified.

2. In a blowing-engine or compressor having discharge-valves as C C, the combination with said valves of cylinders D D having pistons connected with the valves, passages as I I leading from the compression-cylinder of the engine at distances from its ends greater than the breadth of the compressor-piston to the cylinders by which compressed air is admitted to open the valves, non-return valves as *i* situated in passages I I, a restricted passage or by-pass connecting the pipe-sections around said valve a storage-reservoir for compressed air separate from and independent of the main compressed-air receiver of the engine but connected with and receiving its air from the engine, passages leading from said reservoir to cylinders D D, exhaust-ports leading from said cylinders, valves as G G adapted to connect cylinders D D alternately with the reservoir and with the exhaust-ports and positively-actuated mechanism for moving said valves all substantially as and for the purpose specified.

3. In a blowing-engine or compressor having discharge-valves as C C, the combination with said valves of cylinders D D having pistons connected with the valves, passages as I I leading from the compression-cylinder of the engine at distances from its ends greater than the breadth of the compressing-piston to the cylinders by which compressed air is admitted to open the valves, a storage-reservoir for compressed air, separate from and independent of the main receiver of the engine passages as F F leading from the compressing-cylinder to said reservoir and having non-return valves as *f f*, passages as F^2 F^2 leading from the reservoir to the cylinders D D, exhaust-passages as H H leading from said cylinders and valves as G G actuated by the engine and adapted to control the communication of the cylinders D D with passages F^2 and H.

4. In a blowing-engine or compressor having discharge-valves as C C, the combination with said valves of cylinders D D having pistons connected with the valves, passages as I I leading from the compression-cylinder of the engine at distances from its ends greater than the breadth of the compressing-piston to the cylinders by which compressed air is admitted to open the valves, non-return valves as *i* situated in passages I I, a restricted passage or by-pass connecting the pipe-sections around said valve, a storage-reservoir for compressed air separate from and independent of the main receiver of the engine, passages as F F leading from the compressing-cylinder to said reservoir and having non-return valves as *f f*, passages as F^2 F^2 leading from the reservoir to the cylinders D D, exhaust-passages as H H leading from said cylinders and valves as G G actuated by the engine and adapted to control the communication of the cylinders D D with passages F^2 and H.

5. In a blowing-engine or compressor having discharge-valves as C C the combination with said valves of cylinders D D having pistons connected with the valves, passages as I I leading from the compressing-cylinder at distances from the ends greater than the breadth of the compressing-piston and by which passages air is admitted to cylinders D to open the valves, non-return valves as *i* situated in passages I, a restricted passage or by-pass connecting the pipe-sections around said valve-passages as F F^2 F F^2 leading from the ends of the compressing-cylinders to the closing side of the cylinders D said passages having non-return valves as *f*, and provision for the storage of compressed air on the delivery side of said valves and valves as G G actuated by the engine and arranged to control the opening of cylinders D to passages F F^2 and to an exhaust.

6. In a blowing-engine or compressor having discharge-valves as C C the combination with said valves of cylinders D D having pistons connected with the valves, passages as I I leading from the compressing-cylinder at distances from its ends greater than the breadth of the compressing-piston and by which passages air is admitted to the cylinder D to open the valve, non-return valves as *i* situated in passages I, a restricted passage or by-pass connecting the pipe-sections around said valve-passages as F F^2 F F^2 leading from

the ends of the compressing-cylinders to the closing side of the cylinders D, said passages having non-return valves as *f*, and provision for the storage of compressed air on the delivery side of said valves, a connection F′ between said passages and valves as G G actuated by the engine and arranged to control the opening of cylinders D to passages F F² and to an exhaust.

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