(No Model.)

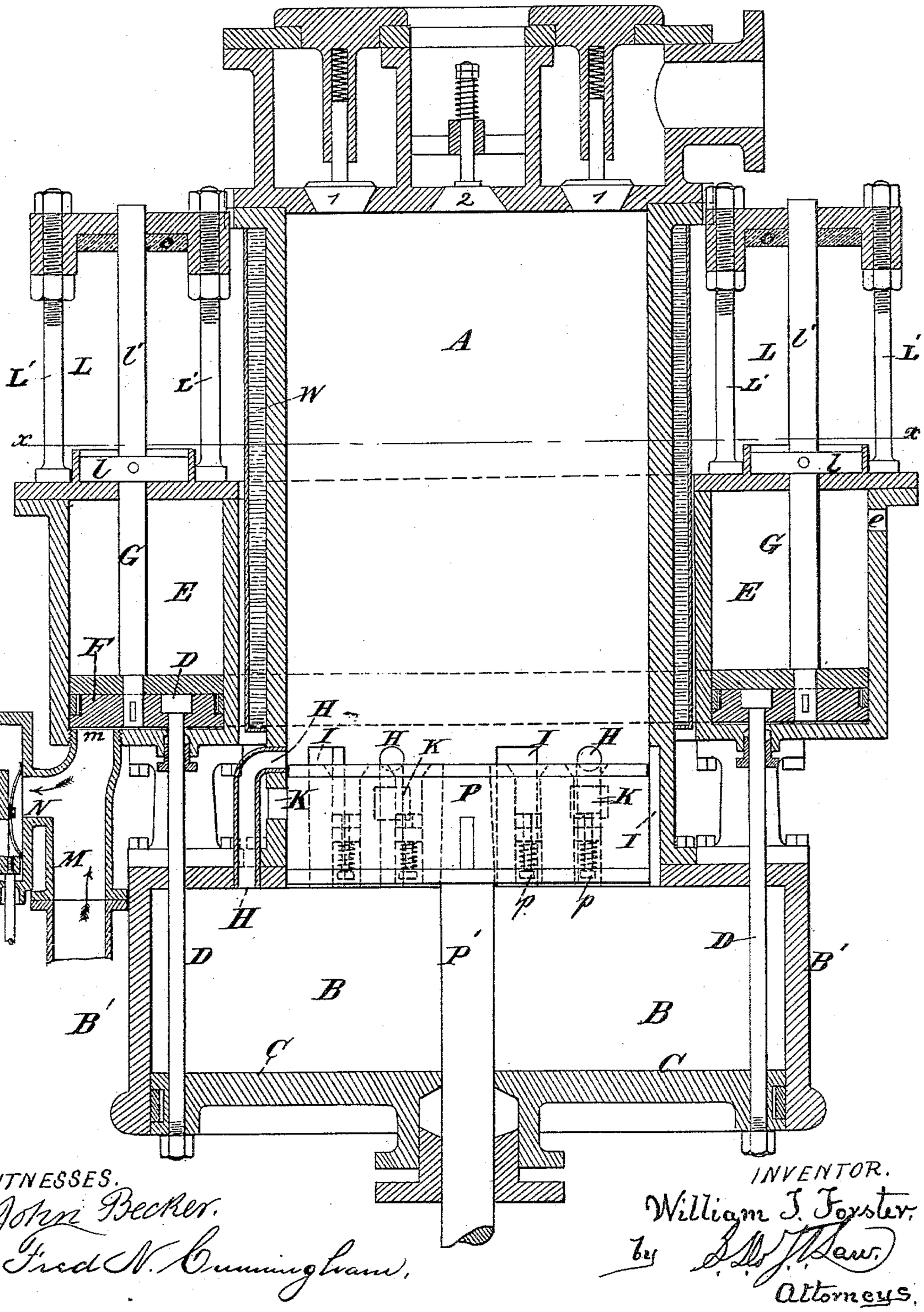
2 Sheets—Sheet 1.

W. T. FORSTER.

AIR COMPRESSOR.

No. 384,356. Patented June 12, 1888.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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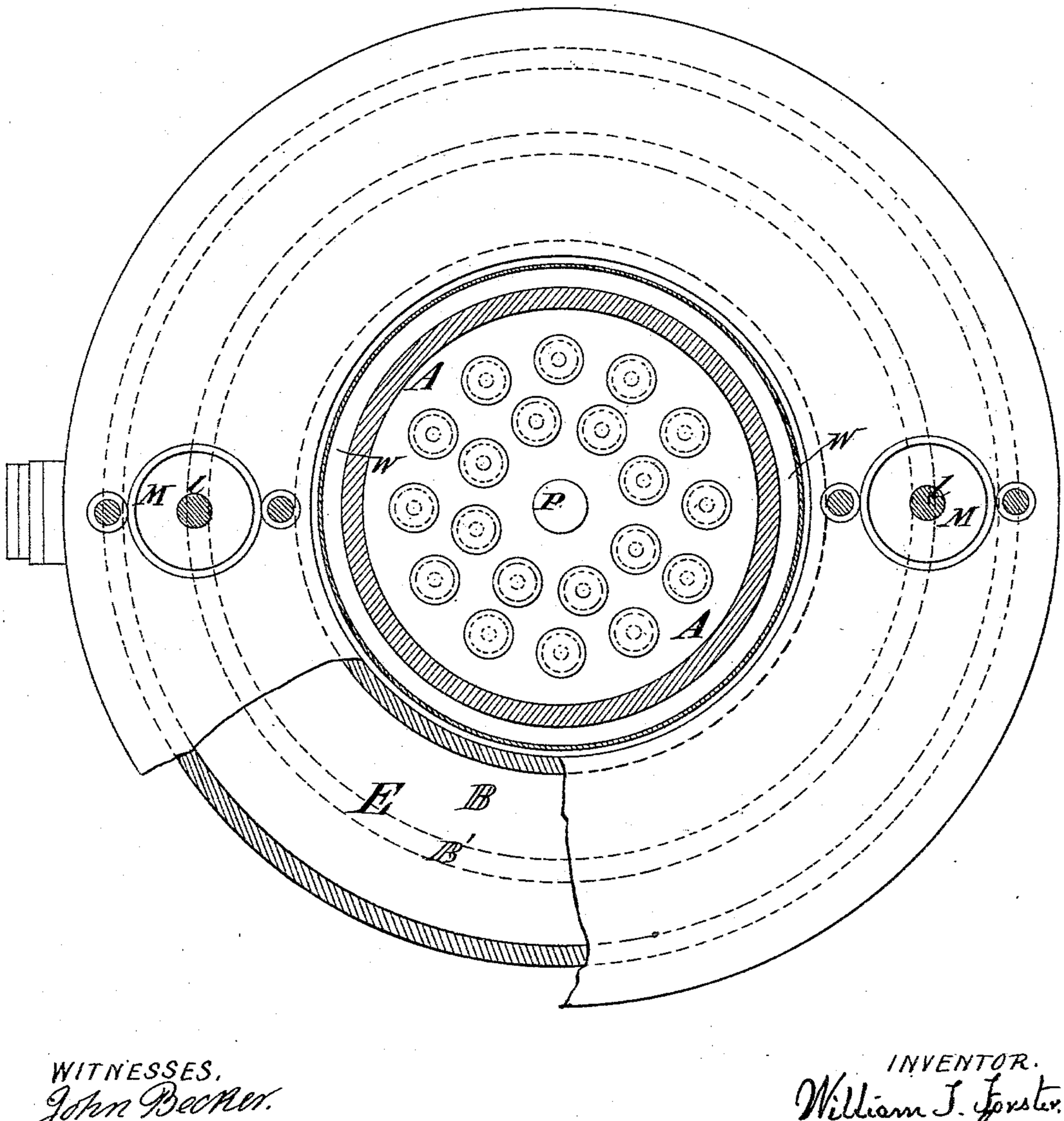
Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM T. FORSTER, OF ERIE, PENNSYLVANIA.

AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 384,356, dated June 12, 1888.

Application filed June 3, 1887. Serial No. 240,123. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM T. FORSTER, a citizen of the United States, and a resident of Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Air-Compressors, of which the following is a specification.

My invention refers to compressors for compressing air or other gases, and is intended to produce a compressor in which a greater quantity or volume of compressed air can be obtained by the application of a slight increase of power; and it consists in an improved construction of the compressor by which the exhaust-steam from the driving-engine is used to increase the quantity of air to be compressed in the cylinder.

In the accompanying drawings, illustrating my improvement, in which like letters indicate like parts, Figure 1 is a sectional elevation of my improved compressor. Fig. 2 is a plane view of the compressor shown in Fig. 1, through the line *x x*, looking down from the top.

My improvement consists, essentially, in combining with the air-cylinder in which the air is compressed a second or auxiliary cylinder communicating with the air-cylinder and provided with a piston so constructed and arranged as to be operated upon or moved by the application of the exhaust-steam as the latter comes from the steam-cylinder, by means of which the air in the auxiliary cylinder is thrown into the air-cylinder and added to the air already in the latter, and thus the volume or quantity of air to be compressed in the air-cylinder is increased and a greater quantity or volume of compressed air obtained at each stroke of the compressing-piston.

The drawings show my improvement applied to a single-acting compressor where the air is compressed by the movement of the piston in one direction only; but it may be used equally well on a double-acting compressor in which the air is compressed by each stroke of the piston.

In the construction and arrangement of my improved compressor shown in the drawings, A is a vertical single-acting air-cylinder in which the air is compressed by the piston P. At the top or upper end of the cylinder are the usual inlet and outlet or delivery valves, 2 and 1. At the bottom or opposite end of the cylinder, and below the piston P when on its lower center or at the end of its stroke, is a second or auxiliary cylinder, B, of the same capacity as the cylinder A, and opening directly into the latter. This cylinder B is inclosed on the sides and open at the top, where it communicates with the cylinder A, and at the bottom or lower end, which is closed by a piston, C. This piston is moved by the rods D, so as to slide toward the opening into the cylinder A and force the air contained in B into the air-cylinder A. In the walls of the cylinder A, near the lower end, are a series of grooves or channels, I, whose lower ends open directly into the cylinder B, and which extend upward for a distance greater than the thickness of the piston-head P, and between these channels I are openings K, by which air enters the cylinder, and which are covered by the piston-head P when the latter is at the end of its stroke, and are thus closed, so that the air in the cylinder cannot escape through the same.

In the piston P are a number of valves, *p*, arranged so as to open upward and allow the air to pass into the cylinder through the piston. Besides the channels I and valves *p* are a series of tubes, H, arranged outside of the cylinder A, having their lower ends opening into the cylinder B and their upper ends into the cylinder A above the piston P.

On account of the several openings I, H, and *p* the air in the cylinder B, when forced by the piston C, can pass freely and quickly into the air-cylinder A.

Surrounding the air-cylinder A and supported on posts, as shown in Fig. 1, is a circular cylinder, E, containing a piston, F, arranged to slide back and forth in the cylinder. To this piston F are secured the upper ends of the rods D, which extend into the cylinder E, the lower ends of which are connected with the piston C in the auxiliary cylinder B. As will be understood from the drawings, as the piston F slides upward in the cylinder E it draws the rods D with it, and thus moves the piston C in the auxiliary cylinder B toward the opening in the air-cylinder A.

The cylinder E is inclosed on all sides and

constructed so as to be steam-tight. At the bottom or lower end of this cylinder is the inlet *m*, and at or near the top is the outlet *e*, by means of which the air in the cylinder escapes as the piston F advances toward the top. The inlet *m* communicates by the pipe M with the steam-cylinder of the driving-engine, by which the exhaust-steam from the steam-cylinder passes into the cylinder E under the piston F, and, filling the cylinder with steam, forces the piston upward, and the latter as it moves draws up the rods D and moves the piston C in the cylinder B. The steam remains in the cylinder E until the engine opens the slide-valve *n* in the pipe N, when the steam at once escapes through the opening *m* and passes from the cylinder.

On top of the cylinder E are two buffer-cylinders or dash-pots, L, (shown also in Fig. 2,) provided with the pistons *l* and rods *l'*. The pistons *l* are connected by means of the rods G with the piston F, and thus move with the latter. The rods *l'* serve to guide the pistons L in their ascent and cause them to strike the buffers *o* evenly. The cylinders L serve to check the force of the piston F, and as the buffer *o* may be moved toward or away from the cylinder E by means of the screw-rods L' the length of stroke of the piston F can be regulated as desired.

As the steam fills the cylinder E with great rapidity, it moves the piston F, and consequently the piston C, very quickly, and thus throws the air in the cylinder B into the cylinder A while the piston is on its center, and on account of the several openings into the air-cylinder, the channels I, tubes H, and valves P the air can pass immediately into the latter cylinder. Moreover, as the pistons F and C move with so much rapidity, it is not necessary to pack them so carefully or take so much care to make the various joints tight.

Several rods D connect the piston C with the piston F, and thus the former piston is made to slide evenly and smoothly in the cylinder B.

The action of the compressor thus constructed is as follows: As the piston compresses the air in the air-cylinder A, air enters the cylinders A and B behind the piston through the openings K and fills the cylinder with atmospheric air. When on its return-stroke the piston P has almost reached its lowest position, it covers these openings K, thus closing them, and slides past the upper ends of the channels I and tubes H. Hence, when the piston P has reached its lowest position or is on its lower center, the two cylinders A and B, filled with ordinary or atmospheric air, communicate with each other through the tubes H and channels I. While the piston P is in this position or is on its lower center, the exhaust valve or port of the driving-engine is open, admitting the steam to the pipe M and inlet *m* into the cylinder E under the piston F, where it at once drives the piston up in the cylinder, and hence by means of the rods D slides the piston C in the cylinder B toward the air-cylinder A. As this latter piston advances, it forces the air in the cylinder B through the various channels and tubes I and H and through the valves *p* in the piston into the air-cylinder A, and adds to the air already in the latter cylinder that which was in the cylinder B, and hence increases the volume of air in the air-cylinder. The piston C is held in the upper end of the cylinder B by the steam in the cylinder E as the piston P starts on its upward stroke. The latter sliding past the openings of the channels I and tubes H closes the same, and thus confines the air in the air cylinder. As the piston commences its upward movement, the slide-valve *n* is opened by the engine and the steam in the cylinder E allowed to escape, when the pistons F and C fall by gravity and the cylinder B is again filled with air. As will thus be seen, while the compressing-piston P is on its lower center, and before it moves on its upward stroke, the air in the auxiliary cylinder is thrown into the air-cylinder and increases the quantity or volume of air in the air-cylinder by the amount of the air in the auxiliary cylinder. If, as in the drawings, the auxiliary cylinder is of the same capacity as the air-cylinder, then when the piston commences to compress the air there will be two volumes or double the quantity of air in the air-cylinder, and consequently double the amount of compressed air when the piston has compressed the air to the required degree.

By my improved compressor, therefore, at every stroke of the piston I obtain a greater volume or quantity of compressed air, depending on the capacity of the auxiliary chamber, and, furthermore, I obtain this increase by use of the exhaust-steam, which before was allowed to escape.

Surrounding the cylinder A is a water-jacket, W, to prevent the heating of the air-cylinder.

What I claim is—

1. In a compressor for compressing air, an air-cylinder having at one end of the compression-chamber in which the air is compressed, and substantially opposite to the exhaust-valves, an auxiliary chamber capable of being filled with atmospheric air and situated below and opening into the compression-chamber above the piston in the latter when in its lowest position, and provided with a piston actuated by exhaust-steam from the engine, adapted and arranged to force the atmospheric air in the auxiliary chamber into the compression-chamber in front of the compression-piston in the latter, substantially as and for the purpose set forth.

2. In a compressor for compressing air, the combination, with the air-cylinder A, having the piston P, in which the air is compressed, of the auxiliary cylinder B, capable of being filled with atmospheric air, situated at the end of the air-cylinder substantially opposite to the exhaust-valves and opening into the air-cylinder in front of the piston P when at its lowest position, and provided with the piston

C, adapted to be moved by the rods D, for the purpose of forcing the atmospheric air in the cylinder into the air-cylinder A in front of the piston P, and of the cylinder E, capable of being filled with exhaust-steam from the engine and having the piston F, connected with the rods D and so arranged as to be acted upon by the exhaust-steam to move the piston C, substantially as described, and for the purpose set forth.

3. In a compressor for compressing air, the combination, with the air-cylinder A, in which the air is compressed, provided with the openings K and tubes H, and having the piston P, containing the valves *p*, of the auxiliary cylinder B, capable of being filled with atmospheric air and opening into the cylinder A, through the tubes H and valves *p*, in front of the piston P, when in its lowest position, and provided with the piston C, arranged to be moved by the rods D, for the purpose of forcing the atmospheric air in the cylinder B into the air-cylinder A in front of the piston P, and of the cylinder E, capable of being filled with exhaust-steam from the engine and having the piston F, connected with the rods D, and so arranged as to be acted upon by the exhaust-steam to move the piston C in the cylinder B, and of the buffers L, having the screw-rods L′ and the pads *o*, and containing the pistons *l*, having the rods *l′*, and connected with the piston F by the rods G, so as to move with the latter, substantially as described, and for the purpose set forth.

Signed at New York, in the county of New York and State of New York, this 23d day of May, A. D. 1887.

WILLIAM T. FORSTER.

Witnesses:
BENJ. E. SMYTH,
JAMES T. LAW.