G. H. REYNOLDS.

AIR-COMPRESSOR.

No. 187,906. Patented Feb. 27, 1877.

Fig. 1.

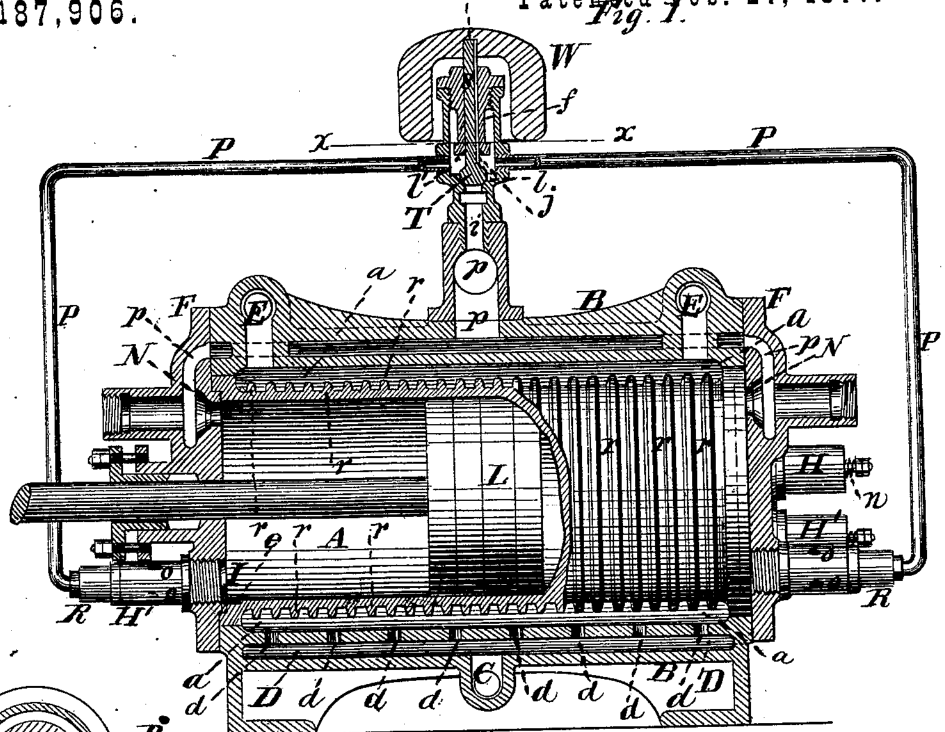


Fig. 3.

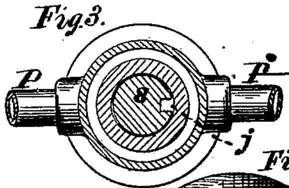


Fig. 4.

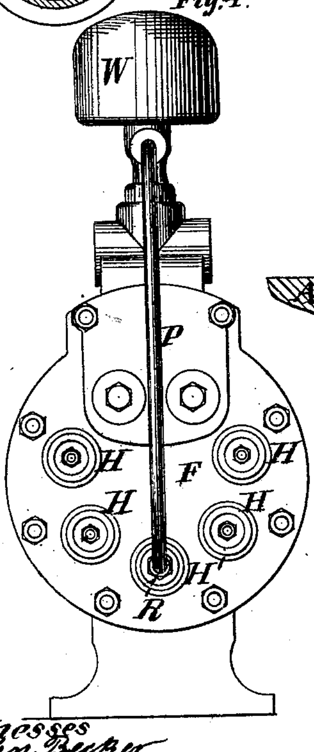


Fig. 2.

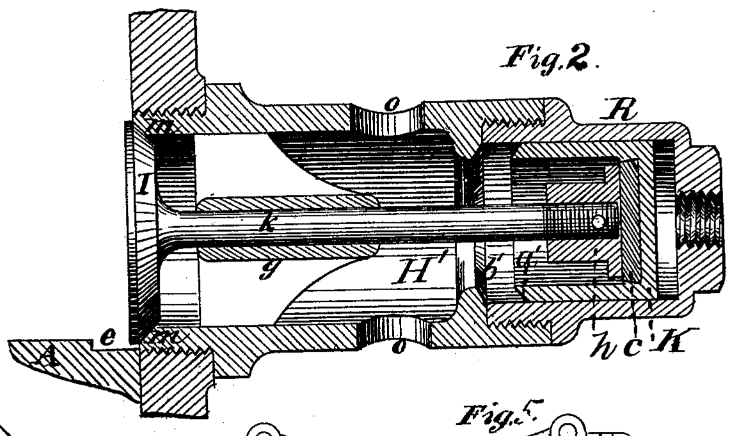
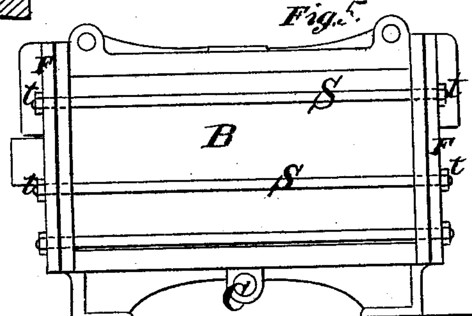


Fig. 5.



Witnesses
John Becker
Fred. Haynes

George H. Reynolds
by his Attorneys
Brown & Allen.

UNITED STATES PATENT OFFICE.

GEORGE H. REYNOLDS, OF NEW YORK, N. Y., ASSIGNOR OF PART OF HIS RIGHT TO CORNELIUS H. DELAMETER AND GEORGE H. ROBINSON, OF SAME PLACE.

IMPROVEMENT IN AIR-COMPRESSORS.

Specification forming part of Letters Patent No. **187,906**, dated February 27, 1877; application filed August 31, 1876.

To all whom it may concern:

Be it known that I, GEORGE H. REYNOLDS, of the city, county, and State of New York, have invented Improvements in Air-Compressors; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, which forms part of this specification.

My invention relates both to air-compressors driven by motors specially applied to air-compression, and to those driven by motors which perform work other than air-compression.

One of the objects of my invention is to more efficiently provide for the extraction of heat from the air while its volume is being reduced by the compression of the piston. Another object is to automatically and proportionally relieve the compressor-cylinder from air when the demand for the transmission of power through the medium of the compressed air from the compressor is lessened, and in such manner that when no work is required from the compressor the compressor-piston may run in unconfined air.

Another object accomplished by my invention is the prevention of the valves, through the breakage of the valve-stems, from dropping into the cylinder, and thus, by their obstruction of the piston, breaking said cylinder or the heads of the same.

My invention consists, partly, in the circumferential re-enforcement of the inner cylinder of the compressor by external rings formed on said cylinder at right angles with its longitudinal axis, which rings perform the functions of strengthening said cylinder, of increasing the radiating and conducting surface of the same, and directing the circulation of the water employed to cool said inner cylinder, which water is admitted to the space between the inner and outer cylinder of the compressor, and the channels between said rings on the inner cylinder at regular intervals along its entire length, as hereinafter set forth; the construction for the admission of the water at regular intervals, in combination with said cylinders, also forming part of my invention.

My invention consists, also, in relief-valves for the compressor-cylinder, which may, or may not, be also induction-valves, for admitting the air to be compressed, and which are acted upon positively by pistons working in cylinders, and actuated by compressed air from the compressed-air receiver, admitted thereto through an auxiliary valve placed in an air-passage leading from the receiver, or placed upon the receiver and controlling the admission of air through pipes or passages to said cylinders, said auxiliary valve being loaded and opened by the pressure of the air in said passage or receiver whenever the said pressure exceeds the prescribed limit of the load, and closing whenever the pressure falls below the limit of the load, as hereinafter described, said auxiliary valve also being applicable to the regulation of the motor which drives the compressor, as well as to admit air to pistons which actuate the relief-valves.

My invention further consists in the combination of recessed shoulders formed in the walls of the inner cylinder of an air-compressor, with the induction-valves of said cylinder, which stop the said valves and prevent their tipping over into said cylinder when their stems break, as hereinafter more fully set forth.

In the drawing, Figure 1 is a partial, vertical, and longitudinal section, and a partial side elevation, of an air-compressor cylinder comprising my improvement. Fig. 2 is an enlarged vertical section of one of the induction air-valves and relief-valves, with its attachments, and the piston and cylinder which actuates it for relieving the pressure. Fig. 3 is a horizontal cross-section on the line x x, Fig. 1. Fig. 4 is an end view of the compressor-cylinder. Fig. 5 is a side view of the same, illustrating my method of attaching the heads of the cylinder to the body thereof.

The compressor-cylinder is composed of an inner cylinder, A, and an outer cylinder, B, united as shown in Fig. 1, an annular space being formed between the two cylinders for the circulation of water. Water is passed into this space through the port C, Figs. 1 and 5. The port C opens into a passage, D, Fig. 1, formed in the wall of the outer cylinder B, which extends below the bottom of the water-space *a* the entire length of said water-space, and parallel therewith. The passage D, moreover, communicates with the said water-space *a* by short vertical passages *d*, formed at regular intervals in the wall of the outer cylinder B.

In order to secure sufficient strength with thinness and extensive radiating-surface, the exterior surface of the inner cylinder A has formed on it re-enforcing rings *r*, placed parallel to each other, and at right angles to the longitudinal axis of the cylinder A. The water, entering at C, is distributed to the several vertical passages *d*, through which it enters the annular space *a* at the lowest part of said space; thence it rises upward and around the cylinder A, through the channels between the rings *r*, to the upper part of said annular space, and, finally, passes out of the ports E, which lead from the upper part of the said annular space at the extremities thereof. In this water of uniform coolness is applied to all parts along the bottom of the inner cylinder, and by its upward circulation and action upon the thinner parts of the cylinder, as well as upon the re-enforcing rings, more effectually extracts the heat from the air in the cylinder A than has hitherto been done in such machines.

Attached to the heads F, Figs. 1, 4, and 5, are one or more induction-valve boxes, H H'. The valve-boxes H' each contain a valve, I, as shown in Fig. 2, such valve having a stem, *k*, which works in a guide, *g*. The said valves open to allow air to pass into the cylinder A, when the piston L, Fig. 1, moves away from the head in which said valves are placed, and close upon their seats *m*, Fig. 2, during the return stroke of said piston, and confine the air which has entered said cylinder, which air is then compressed by the piston L, and forced through a check valve or valves, N, Fig. 1, into the passage *p*, Fig. 1, which communicates with the interior of the compressed-air receiver. (Not shown in the drawing.)

At any convenient point in the passage *p*, or upon the receiver itself, I place a loaded regulating auxiliary valve, T, which controls the passage of compressed air through the pipes P, Figs. 1 and 4, the short passage *i* opening into said pipes, as shown in Fig. 1. The stem *s*, Figs. 1 and 3, of the valve T is loaded by a weight, W, Figs. 1 and 4, which limits the pressure at which said valve T will be raised from its seat *l*, Fig. 1; but, instead of a weight, a spring may be used to load said valve, or a lever may be used to multiply said load upon the said valve. A direct-acting weight, as shown in Figs. 1 and 4, is, however, preferred on account of its simplicity and freedom from friction.

When the pressure through decreased demand for compressed air from the compressed-air reservoir increases in said reservoir beyond the limit of the load W, the valve T rises from its seat, and allows compressed air to pass into the pipes P, and through said pipes to the cylinders R, which are attached to the induction-valve boxes H', Figs. 1, 2, and 4.

In each of the cylinders R is a piston, K, Fig. 2. The valve-stem *k* of the valve I is provided with a head, *h*, Fig. 2, and on the inner side of the piston K is attached a cushion, *c*, Fig. 2, preferably of rubber, which cushion takes up the shock when the said piston is forced against the said head *h*.

When the pressure in the compressed-air receiver is increased beyond the limit of the load W on the valve T, Fig. 1, the said valve is raised, and compressed air passes into the pipes P, and through said pipes to the cylinders R, attached to the heads F of the compressor-cylinder, and that one of the valves I in the valve-boxes H' away from which the compressor-piston L is moving will be instantly opened by its piston K, and held open till the pressure in the receiver again falls to the prescribed limit of the load W. When the said piston L makes its return stroke toward the valve I so held open, the air passes freely from the cylinder A, before the moving piston L, into the interior of the valve-box H', toward which the said piston L is moving, and thence, through openings *o*, Figs. 1 and 2, into the external atmosphere. Meanwhile the opposite relief-valve is similarly opened and held open, and thenceforward the piston L moves with equalized atmospheric pressure on its opposite sides until the pressure in the compressed-air receiver falls to the prescribed limit of the load W. In either the stem *s* of the loaded valve T or in the wall of the tubular guide *f*, in which said valve-stem plays, is formed a passage, *j*, Figs. 1 and 3, which, when the valve T is seated on its seat *l*, communicates with the interior of the pipes P; but the said valve T has an upper as well as a lower face, and, when said valve is lifted from its seat *l*, is pressed upward against another seat, *l'*, Fig. 1, and, thus seated, it cuts off the communication between the pipes P and the said passage *j*; and when the valves I in the valve-boxes H' have been opened, as hereinbefore specified, and the pressure of the air in the compressed-air reservoir has fallen to its prescribed limit, the falling of the valve T upon its lower seat *l* again opens communication between the passage *j* and the interior of the pipes P, and the escape of the compressed air in the pipes P through said passage *j* removes the resistance to the closure of the valves I. The said valves I then immediately close, and the compression of air in the cylinder A recommences.

To facilitate the closing of the valves I they are usually provided with springs, one of which is shown at *n* in the valve-box H, Fig. 1. The pistons K may, moreover, be directly attached to the valve-stems *k*, in which case the cushions *c* are dispensed with.

In order to avoid packing the said pistons K, I form them with valve-faces *a′*, Fig. 2, on their inner sides, which fit seats *b′*, attached to the valve-boxes H′, by which construction the leakage of air by said pistons is wholly stopped when the said pistons are forced forward sufficiently to seat the said valve-faces *a′*.

When the valves I, actuated by the pistons K, are used as induction-valves, it will be seen that they perform also the function of relief-valves; but separate relief-valves working in the same manner may be employed.

It will also be seen that an easy application of the lifting of the loaded valve T to the regulation of the speed of a steam-engine, water-wheel, or other prime mover employed to drive the air-compressor may be effected.

In order to prevent either of the valves I, in case its stem *k* should break, from tipping over into the interior of the cylinder A, which would be certain to cause further breakage, I form in the wall of the cylinder A recessed shoulders *e*, Figs. 1 and 2, and the relief-valves I are so placed that their edges project outward beyond the inner circumference of the cylinder A, as shown in Fig. 2, into the recesses of said shoulders, and, should the valve-stems *k* break, said recessed shoulders *e* form stops which prevent said valves from falling over into the said cylinder.

The two cylinder-heads F F are represented as secured by long bolts extending through both heads and through the flanges on the ends of the cylinder; but as this feature forms part of a separate invention, which I propose to include in another patent, no particular description of it is necessary here.

I claim—

1. The combination, with the inner and outer cylinders A B, of the longitudinal passage D, receiving the cooling-fluid at or near the middle of its length, and the short passages *d*, connecting the said passage D at intervals with the annular space between said cylinders and the outlet-passages E E near the ends of the cylinder, all substantially as and for the purpose specified.

2. The combination of the interior cylinder A, constructed with radiating and re-enforcing rings *r* on its exterior, forming channels in between them for the circulation and direction of cooling-fluid around said cylinder, the outer cylinder B, an inlet-passage, C, for the cooling-fluid to the space between the two cylinders, at a distance from the ends of them, and the outlet-end passages E E, substantially as described.

3. The combination of the relief-valve I, piston K, cylinder R, pipe or passage P, and loaded valve T, substantially as and for the purpose specified.

4. The piston K of the relief-valve, constructed with a valve-face, *a′*, in combination with a valve-seat, *b′*, provided between the relief-valve box H′ and the cylinder R, in which said piston works, all substantially as herein described.

5. The recessed shoulder *e* in the walls of the compressor-cylinder, in combination with the induction-valve I, extending beyond the circumference of the bore of said cylinder, substantially as and for the purpose herein set forth.

GEO. H. REYNOLDS.

Witnesses:

BENJAMIN W. HOFFMAN,
FRED. HAYNES.