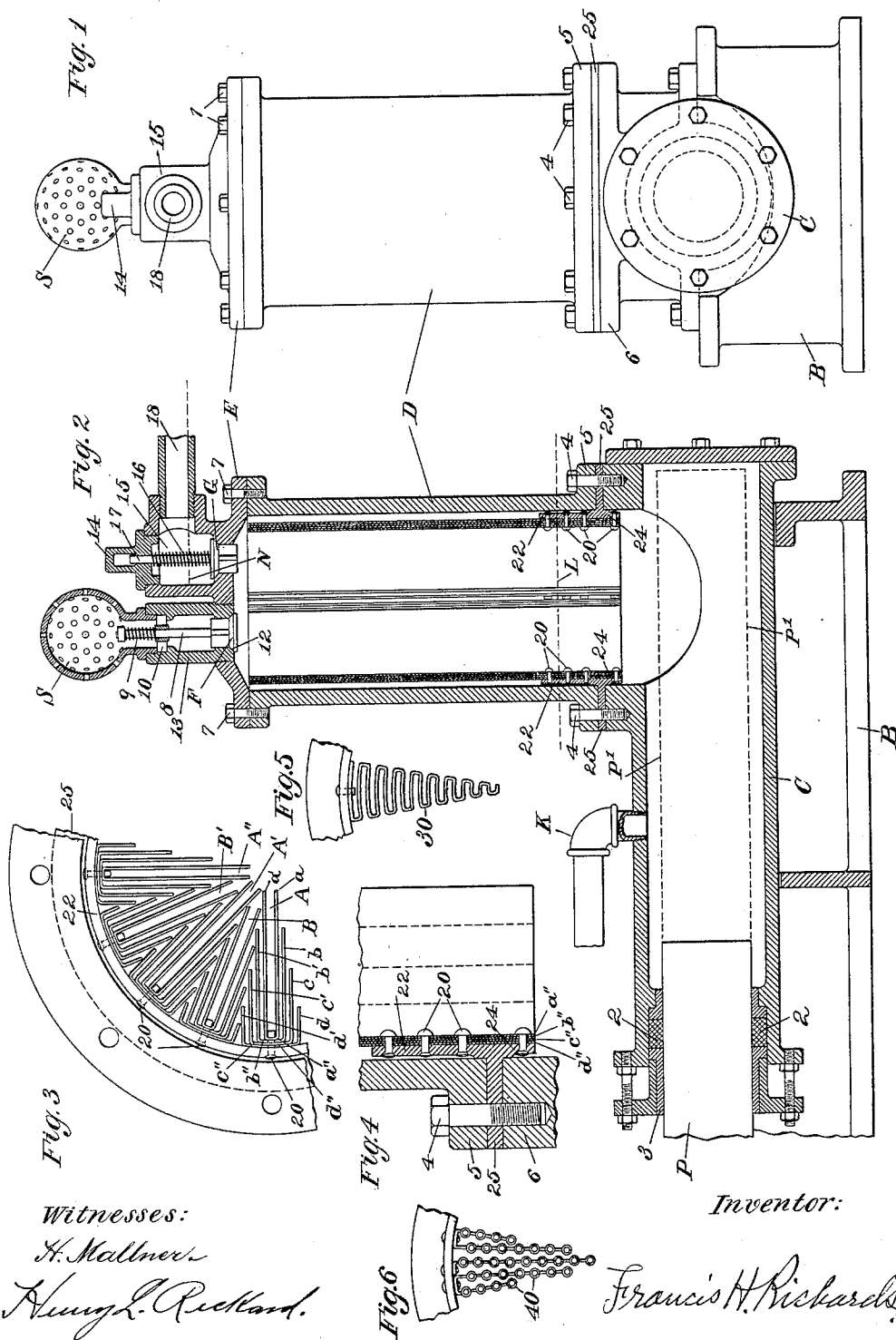


(No Model.)

F. H. RICHARDS.
AIR COMPRESSOR.

No. 462,776.

Patented Nov. 10, 1891.



Witnesses:

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AIR-COMPRESSOR.

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To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Air-Compressors, of which the following is a specification.

This invention relates to air-compressors of the class having the so-called "fluid-piston," the object of the invention being to furnish means for better economizing power by effectually cooling the air simultaneously with the compression thereof.

In the drawings accompanying and forming a part of this specification, Figure 1 is an end elevation of so much of an air-compressor as embodies my present invention. Fig. 2 is a vertical longitudinal section of the machine. Fig. 3 is an enlarged top view of a portion of the compression-cylinder, showing a preferred arrangement of the air-cooling means. Fig. 4 is an enlarged vertical sectional view similar to a portion of Fig. 3, showing in detail the preferred mode of supporting the vertical cooling-plates shown in plan view in Fig. 3. Fig. 5 is a view similar to a portion of Fig. 3, showing one modified arrangement of the heat-abstracting plates. Fig. 6 is another similar view illustrating another modification of the heat-abstracters.

Similar characters designate like parts in all the figures.

It will be remembered that in the compressing of air heat is produced thereby, a portion of the latent heat of the air being converted into sensible heat by the change of volume due to the compression. This heating of the air, as is well known, results in practice in a considerable loss of power, since the heating of the air normally expands it to a larger volume. To overcome this difficulty the expedient has been resorted to of using water in the cylinders of the compressors, and also of using water-jacketed cylinders. These means, however, operate very inefficiently, since the air, being in a considerable volume and a slow conductor of heat, naturally retains its heat for a relatively long period, this being measured, of course, by the duration of the act of compression.

According to my present improvements, I use the so-called "fluid-piston," and in connection therewith employ means for abstracting the heat from the interior spaces of the volume of air under compression. These means consist of suitable heat-abstracters interspersed throughout the interior space of the compressor-chamber. The operation of these heat-abstracters is to receive heat of compression from the air during the act of compression and afterward to give off that heat to the water or other fluid constituting the fluid-piston. Said heat-abstracters, being interspersed as described and standing in close proximity to each other, act throughout the unsubmerged portion thereof to receive the heat of compression from the air instantly the heat is formed, thereby avoiding a further expenditure of power to overcome the afore-said normal increase in the volume of the air being compressed.

The compressor consists of the usual water-cylinder C, in which the plunger P (to be operated in the usual manner by some plunger-actuating mechanism not shown) is fitted to slide through the usual packing 2 and gland 3. The proper stroke of the plunger P is indicated in Fig. 2 by the dotted lines P'. The water-cylinder is or may be supported by a frame or bed-plate B, and is constructed for receiving on the upper side thereof the compression-chamber D, which may be held in place by the usual bolts 4, passing through the lower flange 5 of said chamber and into the upper flange 6 of said cylinder. On its upper end the compression-chamber carries the cap or plate E, which is or may be removably fixed to the compression-chamber by suitable bolts, as 7, in a well-known manner. The top plate or cap E carries the inlet and outlet valves F and G, respectively. The inlet-valve F is or may be carried on the lower end of the valve-stem 8, and is lifted by a spring 9 on said stem above the spider 10, that is removably fixed in place by means of the threaded hollow stem of the screen S. As shown in the drawings, the valve-seat 12 for said inlet-valve F is formed in a removable hollow plug 13. This arrangement permits the use of different materials for the respect-

ive parts, and also permits the convenient removal of the valve and its seat by unscrewing the plug 13. The outlet-valve G is shown fitted to a valve-seat formed in the plate E, and has its stem 17 guided at the upper end thereof in the removable nut or cap 14, which is screwed into the valve-chamber 15, formed on the aforesaid top plate E. A spring 16 on said stem 17 serves to return the valve to its seat when it has been lifted. The delivery-pipe 18 conducts the air away from the valve-chamber.

The heat-abstracters consist in their preferred form of metallic plates suitably supported in close proximity to each other and interspersed throughout the interior of the compression-chamber. The construction and arrangement of the plates which are deemed most effective and economical are shown in Fig. 3, the plates being arranged in sets, and each set consisting of a series of double plates joined at their outer edges by a connecting-plate, furnishing a means of properly holding the plates in position within the compression-chamber. In Fig. 3 the sets of plates A A' A'' are of the same proportions and construction, while the sets of plates B and B' are relatively narrower; but otherwise of the same construction. The object of said variation is to better subdivide the cross-sectional area of the compressor-chamber into narrow areas. The set of cooling-plates shown consists of the plates *a a' b b' c c' d d'*, of decreasing widths, substantially as shown. The plates *a a'* are connected at their outer edges by the plate *a''*, the plates *b b'* by the plate *b''*, the plates *c c'* by the plate *c''*, and the plates *d d'* by the plate *d''*. The several pairs of plates in the same set have these connecting-plates superimposed one upon the other, as indicated in the drawings, these being connected together by suitable rivets, as 20, which pass through said connecting-plates *a'' b'' c'' d''* and through the flanges 22 and 24 of the plate-carrier 25, as best shown in Figs. 3 and 4. As shown in Fig. 3, the two plates of each pair of plates are parallel with each other, the plates being in this form most easily constructed.

In operating the compressor the cylinder C is filled with water or other suitable fluid, (oil being sometimes employed for this purpose,) the water reaching, when the plunger is withdrawn, to its outermost position (shown by solid lines in Fig. 2) to about the height of the line L, and when the plunger is at the opposite end of its stroke (shown by the dotted lines P') rising to the height of the line N within the valve-chamber 15. As the fluid rises within the compressor-chamber, the air is compressed and heat generated, which is immediately absorbed by the submerged portions of the abstracters or plates. At the same time these plates, being good conductors of heat and being partially immersed in the rising fluid, rapidly conduct the heat downward into and impart the same to the fluid. By this means heat is instantly and rapidly

abstracted from the air and transmitted to the fluid-piston, which in practice should be oversupplied at each stroke by the usual supply-pump, (not shown,) which is suitably connected with the cylinder C by means of the pipe K. The oversupply of fluid is discharged at the termination of each stroke by the plunger P through the outlet-valve G and the discharge-pipe 18. By means of this constant replenishing of the fluid of the fluid-piston the mass of fluid within the compressor is kept relatively cool. At each stroke the heat-abstracting plates are entirely immersed in the fluid, and thereby thoroughly cooled, ready for effective operation at the next stroke of the compressor. The plates, being continuous solid metal to a point below the water-line, act during the compression to receive the heat and rapidly conduct the same downward and discharge it into the fluid-piston, thereby materially reducing the heating of the upper portions of the plates, and thus maintaining those portions in the most effective condition. During the compression the plates are being continuously submerged (throughout their entire cross-sectional periphery) from the lower end upwardly.

The plates or other forms of heat-abstracters, whereby the compression-chamber is subdivided into narrow spaces, being immersed at each stroke of the plunger in the fluid-piston are on the descent of the piston covered with a thin coating or layer of water, (or other like fluid used,) which promotes the action of the plates for cooling the air being compressed.

The particular construction and arrangement of the heat-abstracters are not limited to the particular construction and arrangement of the heat-abstracting plates, nor to the use of the heat-abstracters in the form of plates. In Fig. 5 the said abstractor-plate is shown in plan view in a serpentine form, (designated by 30, and occupying the space of one of the sets of plates, as A or B, Fig. 3.) In Fig. 6 the heat-abstractor consists of a series of wires or tubes, as 40, set vertically and in close proximity to each other.

Having thus described my invention, I claim—

1. In an air-compressor, the combination, with a compression-chamber having an inlet-valve and an outlet-valve, of fixed heat-abstracters, substantially as described, supported within the compression-chamber and interspersed through the interior thereof, a fluid-piston submerging said abstracters on the upward stroke of the piston, and means operating said piston to raise and lower the same, substantially as described.

2. In an air-compressor, the combination, with the compression-chamber, of a series of fixed plates, substantially as described, located within said chamber and dividing the interior thereof into narrow spaces, and the rising and falling fluid-piston partially submerging said plates when in its lowest position.

tion and fully submerging the same when in its uppermost position, substantially as described.

3. In an air-compressor, the combination, 5 with a compression-chamber, substantially as described, of a set of heat-abstracting plates, consisting of pairs of connected plates superimposed one upon the other and projecting into the interior of said chamber, substantially 10 as described.

4. In an air-compressor, the combination, with the water-cylinder and with the compression-chamber located above the water-cylinder, of the plate-carrier supported at the 15 lower end of said chamber and carrying heat-abstracting plates extending upwardly into the interior of said chamber, substantially as described.

5. In an air-compressor, the combination, 20 with the pump-cylinder C, constructed to support the compression-chamber, of the vertical compression-chamber supported on the pump-cylinder, the plate-carrier having a flange intermediate to the pump-cylinder and com-

pression-chamber, and a series of plates fixed 25 to the inner side of said carrier and extending inwardly and upwardly therefrom into the interior of the compression-chamber, substantially as described.

6. In an air-compressor, the combination, 30 with the cylindrical compression-chamber thereof, of a removable plate-carrier, substantially as described, and a series of heat-abstracting plates fixed within said carrier and having the plates of each set of success- 35 ively decreasing widths from the middle of the set outward, substantially as described.

7. In an air-compressor having a compression-chamber, substantially as described, the combination, with the plate-carrier having a 40 flange in said chamber, of the series of superimposed plates rigidly attached to said flange, substantially as set forth.

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Witnesses:

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