2 Sheets--Sheet 1.

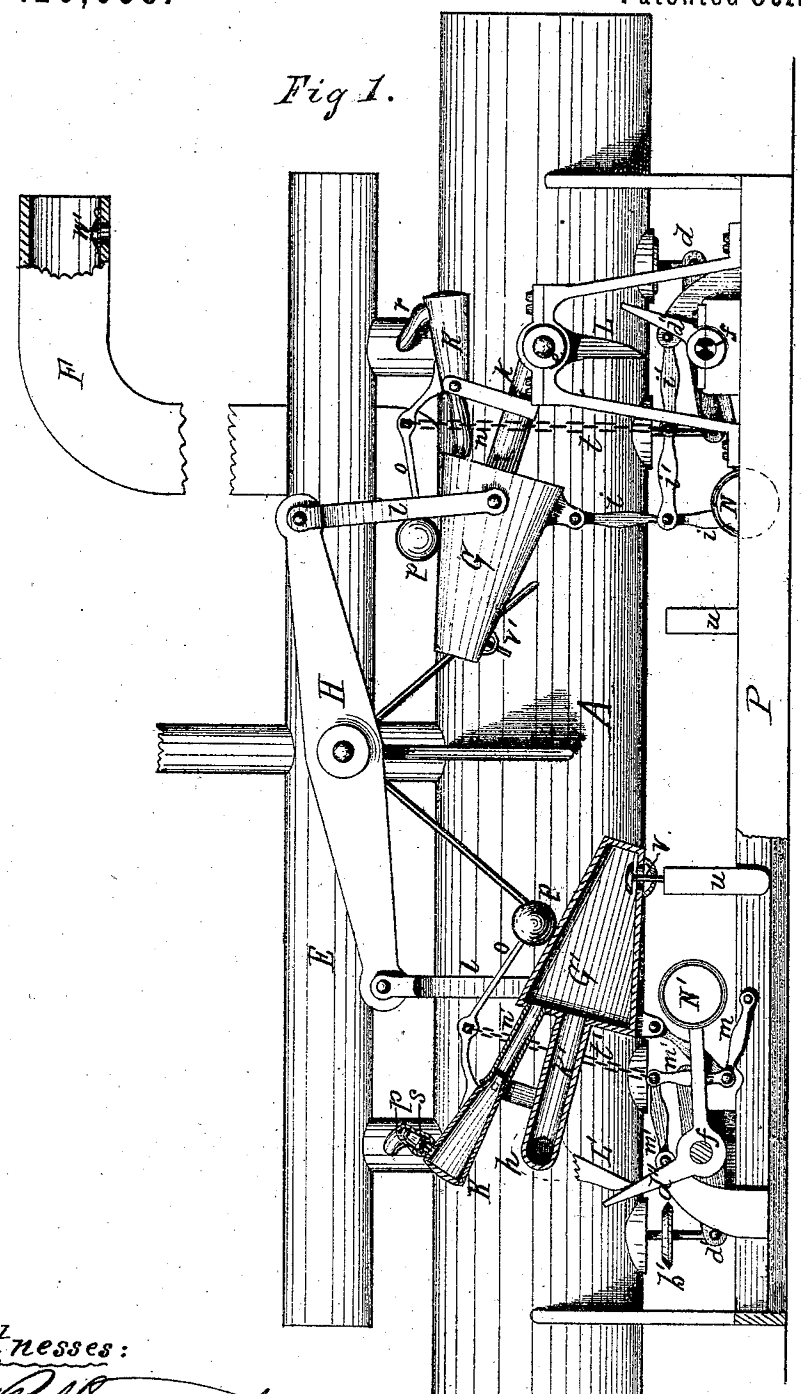
J. S. Patrie

Air-Compressor.

No. 120,095.

Patented Oct. 17, 1871.

Fig. 1.



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AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

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Fig 2.

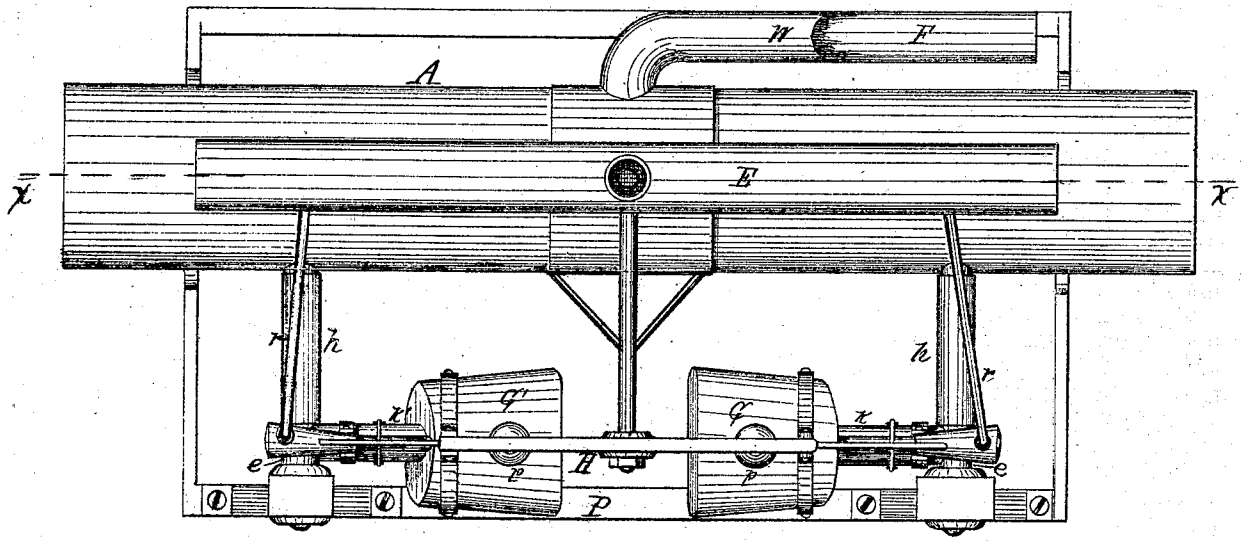


Fig 3.

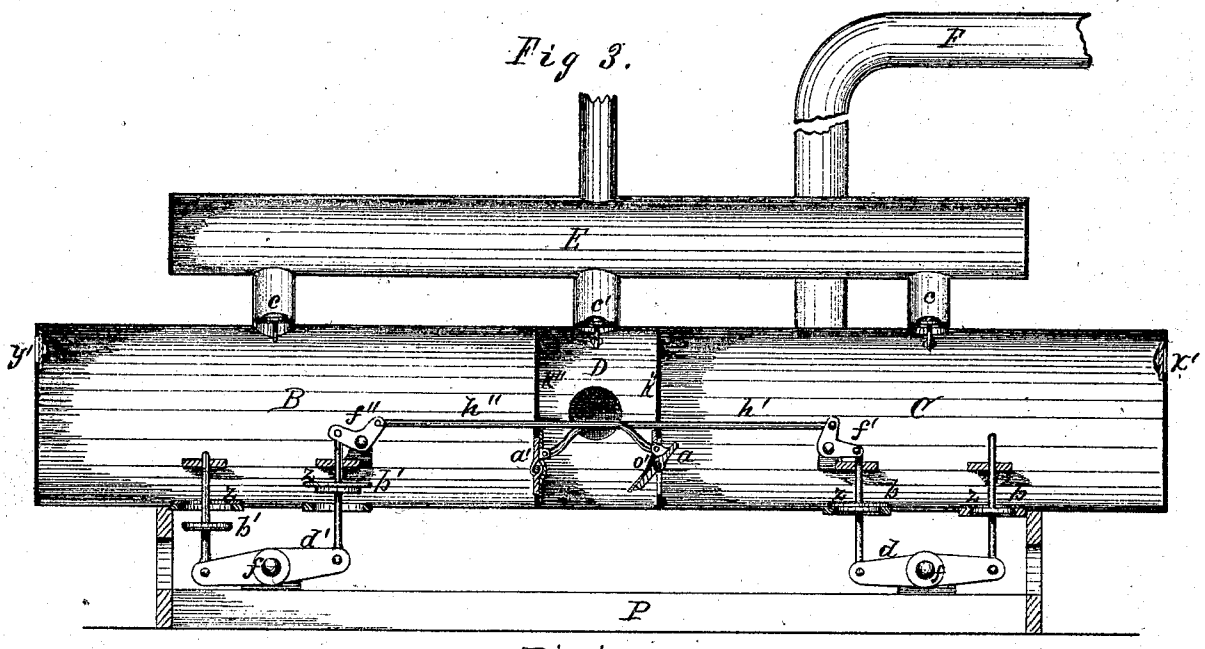
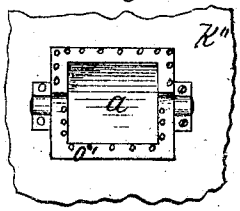


Fig 4.



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UNITED STATES PATENT OFFICE.

JOHN S. PATRIC, OF ROCHESTER, NEW YORK.

IMPROVEMENT IN APPARATUS FOR CONDENSING AIR.

Specification forming part of Letters Patent No. 120,095, dated October 17, 1871; antedated October 7, 1871.

To all whom it may concern:

Be it known that I, JOHN S. PATRIC, of Rochester, in the county of Monroe and State of New York, have invented certain Improvements in Apparatus for Compressing Air, of which the following is a specification:

My invention relates to certain improvements upon a compressor patented by me April 18, 1865; and consists chiefly in a construction and arrangement of the parts by which the mechanism for working the valves is mainly located outside of the compression-chambers.

In the drawing, Figure 1 represents a sectional side elevation of my invention. Fig. 2 is a plan view. Fig. 3 is a vertical section at the dotted line *x*, Fig. 2.

The cylindrical vessel A is divided internally into the compression chambers B and C, Fig. 3, and water-box D, all of which communicate with the air-vessel E by means of valves *c c'*, which admit air into the latter, but prevent its return. Water from a dam or reservoir above the compresser descends through the pipe F into the water-box D, and from thence passes into either chamber B C through valves *a a'*. Other valves, *b b'*, operated from rocker-arms *d d'* upon shafts *f*, control the escape of water from these chambers, and air is admitted to the latter through puppets *x' y'*, Fig. 3. For the purpose of rendering the action of these valves automatic and regular I provide water-receivers G G', each communicating with a compressing-chamber by means of the hollow trunnions *e* and flexible pipes *h*, Fig. 2. The trunnions *e* have bearings in a suitable portion of the sole-plate P, upon which the other parts of the machine rest, and thus admit of an oscillation of the receivers G G', while the pipes *h*, being securely attached to necks upon the compression-chambers and to the trunnions, form strong water-tight passages, and, by their yielding to the movement of the receivers, dispense with the use of stuffing-boxes. The receivers G G' are connected together by the balancing-beam H and links *l*, Fig. 1, whereby the descent of one by the weight of the water in it causes the ascent of the other; and their shape is preferably such that, when elevated, their upper side shall be nearly or quite upon a level with the upper portion of the chambers B and C, and when depressed their lower sides shall be in the same position with relation to the lower part of said chambers, as indicated in Figs. 1 and 2. As each receiver rises to its upward position it is locked there by means of the double toggle levers *i i'* or *m m'*, which are thus drawn into a vertical and horizontal position, respectively, and retain the receivers till the levers are again drawn out of line. For the purpose of unlocking these toggles at the proper time I provide the tilting water-chambers K K' communicating with the receivers G G' very near their upper side by means of the flexible tubes *n n'*, and swinging vertically upon suitable pivots, which are supported either upon the receivers or upon their connecting-pipes *k k'*. Arms *o* are secured to the chambers K K', carrying counter-weights *p* at their outer extremities, as shown, to retain the chambers in their elevated position when empty, and chains or rods *t t'*, attached to the arms beyond the pivoting points of the chambers, connect said arms to the central joint of the horizontal toggles *i m'*. Flexible pipes *r*, provided with valves *s*, convey the air forced out of the chambers G G' and K K' by the entrance of the water to the air-vessel E, and puppet-valves *v v'* are provided in the lower parts of G G', which are lifted as the receivers descend by their stems coming in contact with stops *u* upon the sole-plate to allow the escape of the water. The toes L L', Fig. 1, are secured to the trunnions *e* and come in contact with arms *d''* upon the rock-shafts *f* as each receiver descends; but the arrangement and proportion of the parts are such that no motion is communicated to the rock-shafts till the downward movement of the receivers is partly completed. Counter-weights N N' return the rock-shafts and valves to their original position. The valves *b* and likewise *b'* are actuated from opposite extremities of the rocker-arm *d* or *d'*, one valve of each pair opening inward and one outward, as indicated in Fig. 3. By this means they are balanced against the pressure of the water or air within the chambers, and only a slight force is required to move them. If the area of the falling valve be somewhat in excess of the other the weight of the water will assist in opening them. A packing-ring, *z*, is attached to the face of the rising valve, and the pressure of water forces it down upon the seat, thus covering the crevice between the valve and seat. For the descending valve the gasket is secured to the seat and the valve is elevated against it,

as indicated. The stem of one of each of the sets of valves *b b'* is linked or otherwise suitably connected to bell-cranks *f' f''*, having bearings within the compression-chambers, and the swinging or "butterfly"-valves *a a'* are operated by rods *h' h''* proceeding from the other arm of the bell-cranks. The inlet *a* to the chamber C is thus moved simultaneously with the outlets *b'* in the chamber B, and *a'* and *b* likewise fulfill the same condition. It will be observed that the swinging valves *a a'* are turned into such a position when opened that the water entering B or C from D is divided and scattered into spray, whereby the air therein is thoroughly cooled while it is being compressed. These valves are constructed to fit into an aperture in the partitions *k'' k''*, and when shut one of their faces is flush with the face of such partitions. Gaskets *o'*, Figs. 3 and 4, are formed to lap over the joint or crevice around the valve, and one portion of it is secured to the partition or seat, while the other part passes over the trunnions and is made fast to the face of the valve. Thus the oscillation of the valve does not interfere with the packing, and the pressure of the water in the chamber D upon it retains it in close contact with the valve and seat, covering the joint around the edge. It will be seen that the packing *o'* upon the valves *a a'* thus operates in the same manner and is similarly applied to that upon *b b'*; and by its use the necessity of fitting the valves accurately to their seats, as well as the consequent liability of their being "cut out" and destroyed by sand and other impurities in the water, are entirely avoided. The inlet-pipe F is provided with a valve, *w'*, Fig. 1, near the point where it leaves the reservoir, through which the air is drawn into the pipe by the rapid passage of the water down it. At the lower part of this pipe I introduce a short horizontal section, *w*, Fig. 2, near where it enters the water-box D, and the air which is carried down the pipe rises to the upper part of this section and passes from thence to the chamber D, and through the valve *c'* to the vessel E. Thus a large volume of air, which is unavoidably drawn in by the vacuum in F, is collected and conveyed to the compressed-air pipes or reservoirs.

The operation of my invention is as follows: Water under a head passes down the pipe F into the water-box D, and when, for example, the valve *a* is open and *b b'* shut, rushes into the chamber C, the stream being divided and scattered by the valve, and the air in the chamber forced out under pressure through the valve *c* into the vessel E and distributing-pipes. As the chamber C fills, the water-receiver G being in its upward position is also filled through the pipe *h*, and, on account of its peculiar formation, as before described, both it and the compression-chamber are completely filled at the same instant. Lastly, however, the tilting-chamber K also becomes partly or wholly filled from the receiver, and since its capacity is such that the weight of the water more than overbalances the counter-weight *p* it tilts downward, lifting the chain *t* and drawing the toggles *i i'* out of their locked position. The receiver G is thus liberated and falls by the weight of its contents, the movement operating the rock-shaft *f* by means of the toe L and arm *d''*, and opening the valves *b* and *v'* for the discharge of the water, while a new supply of air rushes into the chamber through the valve *x'*. Simultaneously with the descent of G, however, G', which is empty, ascends by means of the balancing-beam H and the outlets *b'* in the chamber B, and the inlet-valves in C, which were open, are closed during the first part of such movement by means of the counter-weight N', which causes the arm *d''* to follow the toe L' as the receiver rises till said valves are completely closed. Now, since the valves *a'* and *b* are opened by the toe L during the latter part of this compound movement of the receivers, it follows that the inlet *a* to C is closed before the outlets *b* are opened, and similarly the inlet *a'* to B is closed before *b'* are opened; these conditions being satisfied by the peculiar construction and arrangement of the receivers G and G', toes L and L', and valve connections. This is an important advantage, since no loss of water or compressed air can occur by the movement of the valves. After the descent of the receiver G the same operation takes place with regard to the compression-chamber B and receiver G', the compressed air being forced alternately into the vessel E to be distributed where wanted, the parts all acting as above described. The ascent of each receiver G G' draws the toggles *i' m' i m* into their locked position, and the former thus retained till again unlocked by the tilting of the chambers K K'.

Among the advantages obtained by my improved compressor may be enumerated the following: The action of the parts is automatic, requiring no extraneous aid whatever to accomplish its results beyond the action and reaction of the air and water. The working parts are nearly all exposed to view, and thus are not subject to injury or displacement by the force of the water. The valves are all balanced or nearly so, whereby the power to reverse them need be only sufficient to overcome the friction of the parts. The construction and arrangement of the valves and working parts are such as to attain the greatest economy in the operation of the machine, while there are no expensive fitting or nice adjustments, which are liable to get out of order, necessary.

The balanced valves *b b'* would operate fully as well in place of the butterflies *a a'*, or vice versa, as it is plain that they are equivalents of each other in operation and result, but differ in construction.

Various forms of a locking device may be contrived to take the place of the toggles *i i' m m'*; and, therefore, I do not wish to confine myself to the form shown, though its operation is satisfactory in all respects.

Another plan of operating the valves *a a' b b'* may consist in passing rock-shafts, to which the receivers G G' are attached, centrally through the tubes *h*, and securing the beams *d d'* or bell-cranks *f' f''* thereto within the compression-

chambers. In this case the valve connections are necessarily so made that the valves perform the functions hereinbefore described.

The balancing-beam H may be supported upon an axis attached either to the vessel A or the sole-plate P, or both, as deemed desirable. Instead of conducting the air from the horizontal part *w* of the pipe F through the water-box D, a pipe may convey it directly to the vessel E.

What I claim as my invention is—

1. The vessel A, provided with compressing-chambers B and C, centrally-located water-box D, and suitable inlet and outlet water and air-valves, for the purposes set forth.

2. The oscillating water-receivers G G′ arranged to operate the inlet and outlet water-valves *a a′ b b′* conjointly, substantially as and for the purposes set forth.

3. The oscillating water-receiver G in combination with the locking-links *i*, whereby the receiver is locked in its upward position to be automatically released when filled, for the purposes set forth.

4. In combination with the oscillating water-receiver G and its locking device, the tilting water-chamber K, operating substantially as described.

5. In combination with the oscillating water-receivers G G′, the balancing-beam H, connected and operating substantially in the manner set forth.

6. The oscillating receivers G G′, balancing-beam H, and toes L L′, in combination with the rock-shafts *f* and attachments, outlet-valves or valves *b b′*, and inlet-valves or valves *a a′*, when the parts are so arranged that said valves shall operate conjointly for the purposes set forth.

JOHN S. PATRIC.

Witnesses:
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(2)