

(No Model.)

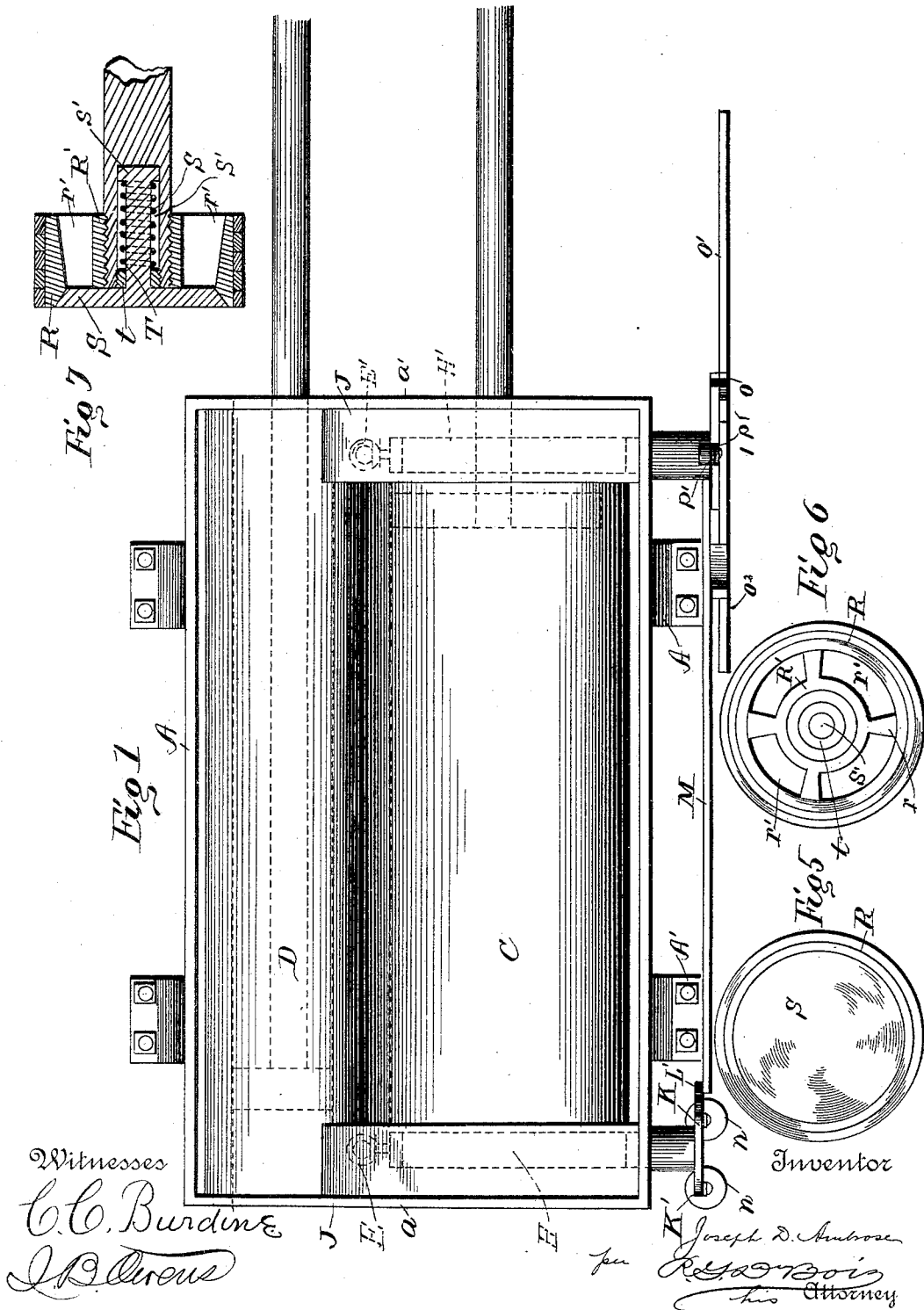
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J. D. AMBROSE.

### GAS COMPRESSOR.

No. 467,909.

Patented Feb. 2, 1892.



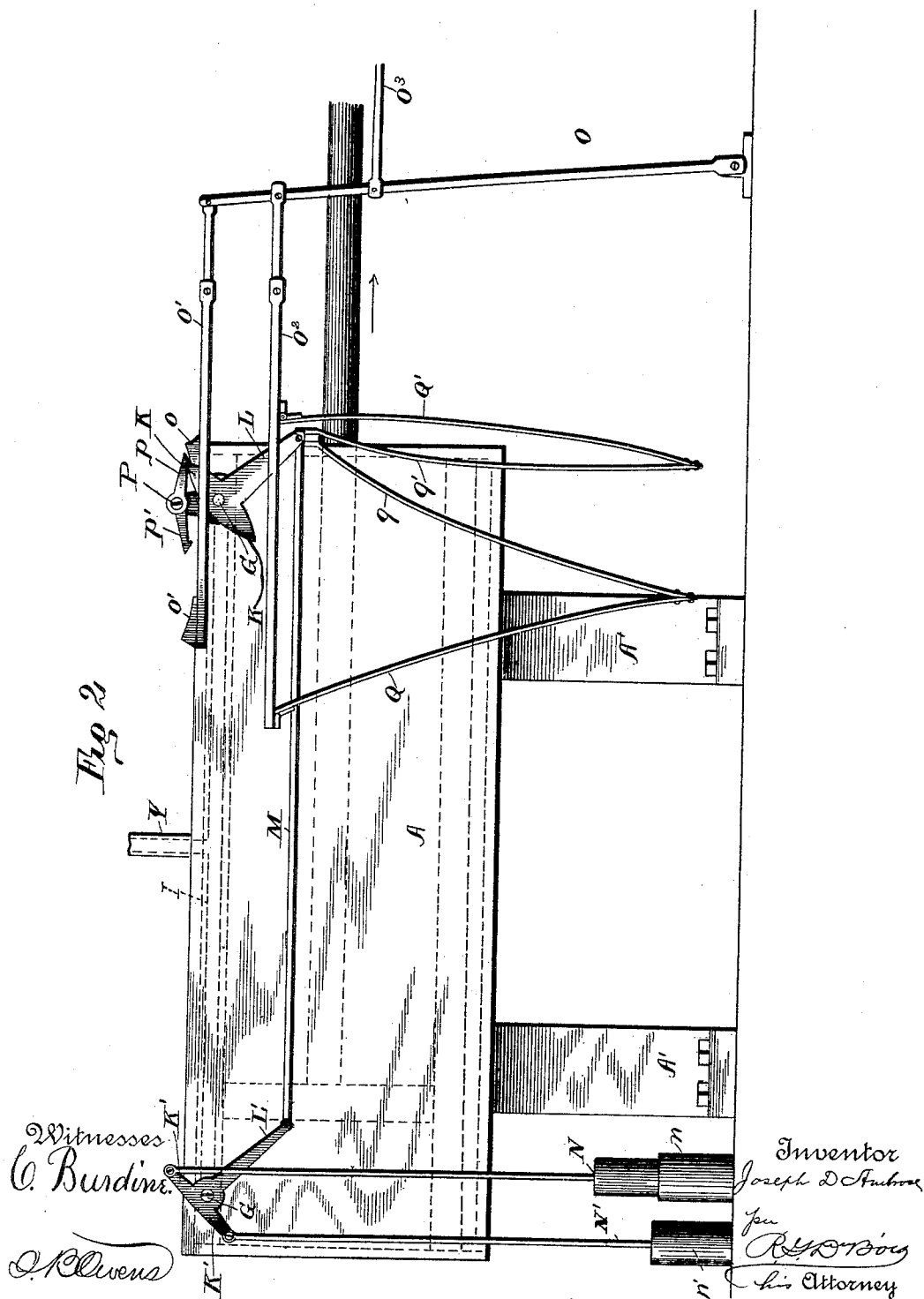
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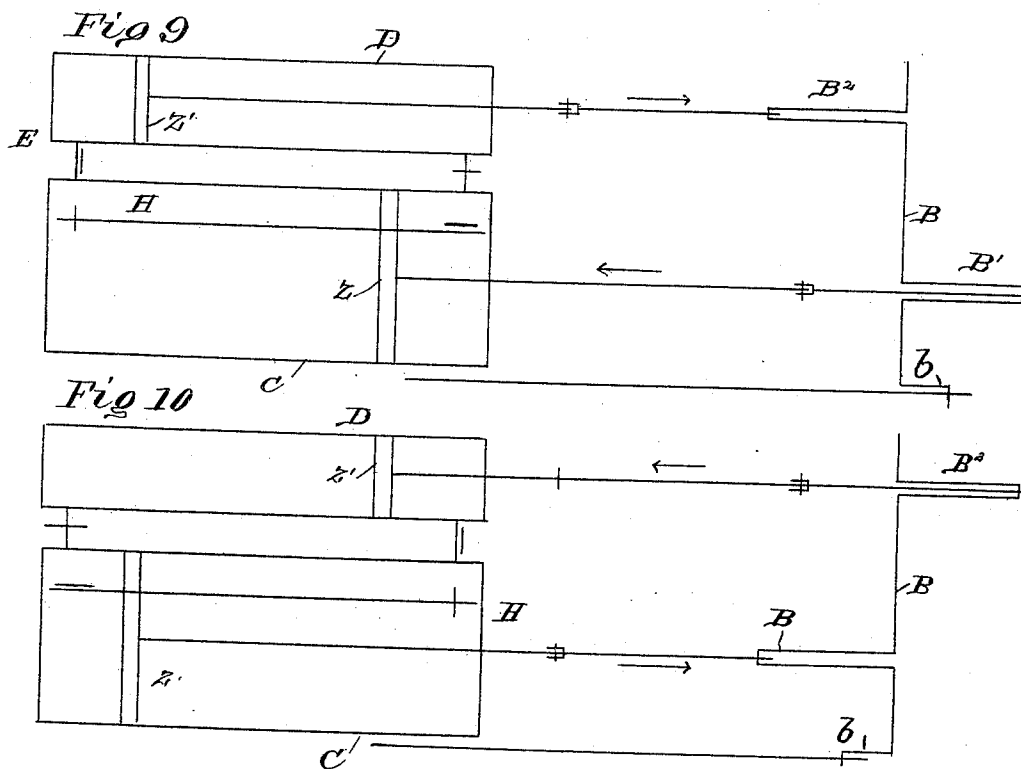
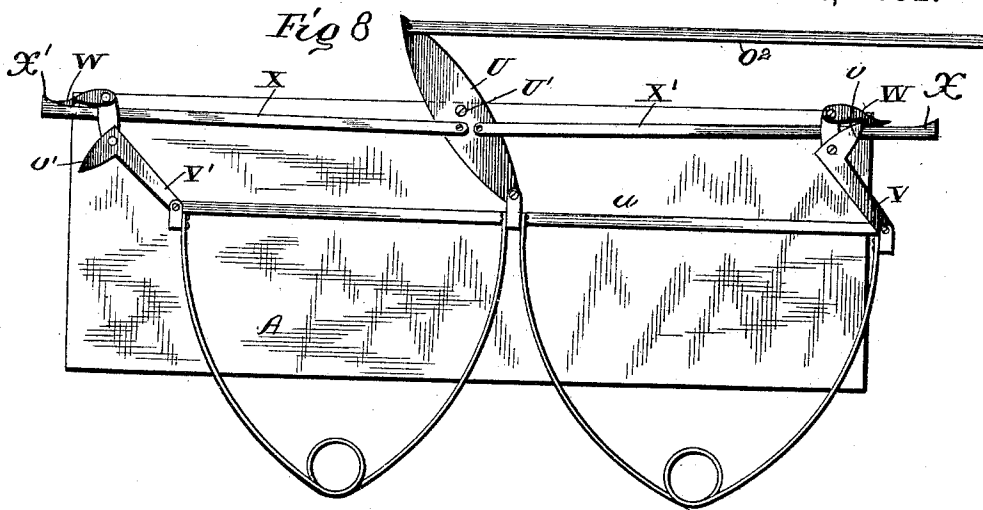
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GAS COMPRESSOR.

4 Sheets—Sheet 4.

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Witnesses  
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# UNITED STATES PATENT OFFICE.

JOSEPH D. AMBROSE, OF DALLAS, TEXAS.

## GAS-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 467,909, dated February 2, 1892.

Application filed March 4, 1891. Serial No. 383,725. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH D. AMBROSE, a citizen of the United States, residing at Dallas, in the county of Dallas and State of Texas, have invented certain new and useful improvements in Gas-Compressors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to ice and refrigerating machines, and particularly to the gas-compressors employed therein.

My invention consists in a compound gas-compressor composed of two cylinders or pumps of different capacity, the larger being a receiving and the smaller a compression cylinder communicating therewith, and a peculiar arrangement of positively-actuated valves for permitting the entrance and discharge of gases respectively into the larger cylinder or double-acting pump and out of the same into the smaller one or single-acting pump, the former discharging twice its contents into the latter before the smaller one forces its compressed contents out into the coils.

These machines have heretofore been made both single and double acting—that is, the gas-pumps have been made to compress the gas at only one end, necessitating two pumps to perform the work of one, or they have been made to compress the gas at both ends. The necessary high pressure to which the gas must be subjected—175 pounds to the square inch—renders it impossible to make a perfect piston packing for the latter-named machine. Moreover the kind of valves usually employed in these machines prevents the pumps from being filled with gas at an equal pressure with that in the inlet-pipe, as the force of the springs which hold the valves in position, as well as the weight of the valve, must be overcome by the pressure of the inrushing gas, thus preventing the accomplishment of the full capacity of the machines. Another objection to these valves is the clattering and disagreeable noise they make in working, caused by the alternate vacuum and rapid expansion of gas in the pump.

In building these machines, especially those of larger capacity, it has been a source of

great trouble and expense to build pumps and pump-heads strong enough to resist the enormous pressure to which they are subjected over an unnecessarily large area. I propose by the use of my gas-compressor to overcome all these difficulties.

In order that my invention may be fully understood, I will now proceed to describe the same with reference to the accompanying drawings, in which—

Figure 1 is a plan view of my pump. Fig. 2 is a side view. Fig. 3 is an end view. Fig. 4 is a transverse sectional view. Fig. 5 is an end view of the piston-head of the smaller cylinder or pump. Fig. 6 is a similar view with the valve removed. Fig. 7 is a diametrical transverse section of Fig. 5. Fig. 8 is a modification of the valve-operating mechanism. Figs. 9 and 10 are diagrammatic views showing the relative positions of the valves during different strokes of the pistons.

The pumps are inclosed by the metallic boxing or jacket A for the circulation of water around them to keep them cool, as usual.

The jacket is supported on a suitable base A', beyond which is the crank-shaft B for working the pumps and valves. The crank-shaft is provided with cranks B' B<sup>2</sup>, with which the pistons of the large cylinder C and small cylinder D are respectively connected. These cylinders C and D are arranged in the jacket A, of which the ends a a' constitute the heads of the cylinders preferably cast therewith. The smaller cylinder D is one-half the capacity of the larger cylinder C, and they are arranged parallel with each other, their axes being in the same horizontal plane.

Between the two cylinders C and D there are at each end vertical rotary valves E E', semi-cylindrical in shape and working within casings e, the upper ends being packed by means of perforated disks F' F<sup>2</sup> and intermediate packing f to prevent the escape of gas. The upper ends of the valve-spindles F are provided with bevel gear-wheels f', and these intermesh with the bevel gear-wheels g at the inner ends of spindles G of the horizontal rotary valves H H', arranged one at each end of the top of the cylinder C within valve-casings h, which communicate with the interior of the cylinder C and with a hollow receptacle I, cast at the top of the latter. These

valves are similar in form and position to those employed in the Corliss engine. Caps J cover the gearing  $f'g$  and further assist in preventing the escape of gas around the valve-spindles.

At the outer ends of the valve-spindles G are pairs of oppositely-extending arms K K and K' K' for valves H H', respectively.

Between the arms K K and K' K', respectively, and projecting from the valve-spindles in the same plane as the arms are valve-cranks LL'. Connecting the ends of the valve-cranks L L' is a rod M to cause simultaneous movement of all the valves for the purpose hereinafter described. The movements of the valves are eased by pistons N N', depending from the ends of the arms K' and working in dash-pots  $n n'$ .

The instrumentalities for working the valves are as follows: O is a vertical rock-arm connected with horizontal pivoted reciprocating rods O' O<sup>2</sup>, moving in suitable guides, the former of which is provided on its upperside with cams  $o o'$ , adapted to act in opposite directions. The ends of the arms K of valve H are adapted to be alternately engaged by oppositely-extending catches  $p p'$ , pivoted at their inner ends upon a pin P above the valve-spindle, said catches being released from the arms by the cams  $o o'$ . A W-shaped spring, consisting of spring-bars Q Q'  $q q'$ , is arranged to throw the valve H at the proper time through the medium of the rod O<sup>2</sup>, the upper ends of the spring-bars Q Q' being connected to the rod O<sup>2</sup> and the upper ends of the intermediate spring-bars  $q q'$  being connected to the end of the valve-crank L. The crank-shaft is provided with a crank  $b$ , with which the reciprocating rod O<sup>2</sup> is connected. The piston-head working in the small cylinder D is composed of an outer ring R, which is connected to its piston-rod by means of connections  $r$  and a screw-threaded sleeve R'. Between connections  $r$  spaces  $r'$  are left for the passage of gas. The valve in the piston-head consists of an inward-seating disk S, provided with an axial stem  $s$ , having at its end a head  $s'$ . The stem is received by an axial opening S' in the end of the piston-rod, within which and surrounding the stem is confined, between the head  $s'$  and a collar  $t$ , screwed into the outer end of the opening, a spiral spring T.

A different construction of the valve-operating mechanism may be used, if preferred, and this consists, as shown in Fig. 8, of rocking lever U, connected at its upper end to the rod O<sup>2</sup> and at its lower end to the intermediate bars of a W-spring, the outer ends of which latter are connected with the ends of a rod  $u$ , that connect the ends of valve-cranks V V'. These valve-cranks V V' are respectively provided with arms  $v v'$ , extending laterally in opposite directions and alternately engaged by pivoted gravitating catches W W'. Below the pivot U' of the rocking lever U the inner ends of suitably-guided aligned

reciprocating rods X X' are pivoted, the outer ends of said rods having cams  $x x'$  for releasing the catches W W' from the arms of the valve-cranks.

The operation of my improved gas-compressor is as follows: At the outset it will be stated that the position of the mechanism shown in Fig. 2 is just at the instant that the cranks of the valves are to be thrown from right to left. The valves are so correlated that when valve H is open its opposite vertical valve E is shut, whereas valve H' is closed and its opposite vertical valve E' is open, as shown diagrammatically in Fig. 9. In Fig. 10 the relative open and closed positions of the valves are reversed. Gas is admitted through the pipe Y on top of the large cylinder C and enters the hollow receptacle at the top of the latter, which leads to the valves H H' at each end, whereby gas is admitted into the cylinder; but the gas is admitted through said valves alternately. Suppose that no gas has entered the compressor. The valves in that event should be in the relative open and closed positions shown in Fig. 9. The machine being now set in motion, the piston Z of the large cylinder will move outwardly and the piston Z' of the small cylinder inwardly, and the valve H being open gas will be admitted into cylinder C behind piston Z thereof, but none will enter the cylinder D, although valve E' is open. At the limit of these respective strokes of the pistons the cam  $o$  on reciprocating rod O' will release the catch  $p$  from the end of the arm K, which is engaged thereby, thus permitting the W-spring (which is moved to the left by the reciprocating rod O<sup>2</sup> to set it) to throw the valves in their other position or that position shown in Fig. 10. The motions of the pistons being now reversed, so that piston Z will move inwardly and piston Z' outwardly, the gas in cylinder C will be pressed through open valve E and behind the piston in cylinder D, thus being compressed in the latter into substantially half its former bulk, whereas more gas will be admitted into cylinder C through the open valve H'. As soon as the pistons reach the limit of these respective strokes, the relative open and closed positions of the valves will be again reversed to the positions shown in Fig. 9, and the pistons will then reverse their movements. The gas in front of piston Z will now be pressed through the open valve E' into the small cylinder D, and to permit the piston Z' to move inward the valve S in its head will be pressed open by the gas behind it and flow through the opening in front of the piston Z'. When the piston Z' reaches the limit of its inward stroke, the small cylinder will contain a volume of gas compressed to one-fourth or thereabout of its original volume, and when the piston Z' again moves outwardly the compressed gas will be forced into the cooling-coils, (not shown,) which connect with the head of the small cylinder at the left. An

ordinary spring stop-valve (not shown) is used in the head of the small cylinder to prevent the gas from flowing back into said cylinder at the return stroke of its piston. The motion of the compressor being continued, the small cylinder will have received each time the piston thereof takes its outward stroke twice the contents of the large cylinder.

In my gas-compressor the highest pressure on the packing ends of the cylinders will not be more than one-fourth in the larger one and one-half in the smaller one of the ultimate pressure in other compressors at these weak points.

I maintain that with this compressor I can handle double the amount of gas of other styles of compressors of equal size.

The mechanism will be comparatively noiseless, and the amount of material used in the construction of the compressor will be reduced to a minimum.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a gas-compressor, the combination, with a cylinder or pump of large capacity having a single inlet-pipe at its side leading into a receptacle therein located at one side and a cylinder or pump of smaller capacity, of a pair of positively-actuated alternately opening and closing horizontal valves arranged one at each end of said receptacle for admitting air or gas into the large cylinder or pump, a pair of positively-actuated alternately opening and closing vertical valves

arranged between and in the contiguous sides of the cylinders or pumps, one at each end, and suitable means connecting the valves, whereby the movement of one affects the others, substantially as and for the purpose set forth.

2. In a gas-compressor, the combination, with a double-acting pump provided with gas-inlet valves at each end, of a single-acting pump having valved communication there-with at each end, and the piston of the single-acting pump provided with a valved piston-head, substantially as and for the purpose set forth.

3. In a gas-compressor, the combination, with a pump and valves arranged one on each side thereof, of the herein-described valve-operating mechanism, comprising valve-cranks projecting from the valves, gravitating catches engaging said valve-cranks for holding the valves in one or the other of two positions, so that one valve will be closed and the other open, a reciprocating rod connected with the pump-actuating mechanism and provided with cams for disengaging said catches, and a spring for acting quickly on said valve-cranks to throw the valves to one or the other of their positions, substantially as and for the purpose substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH D. AMBROSE.

Witnesses:

JAS. T. FLEMING,  
JENNIE E. AMBROSE.