(No Model.)

W. BOWERS.

GAS COMPRESSOR.

No. 350,862. Patented Oct. 12, 1886.

Fig. 1.

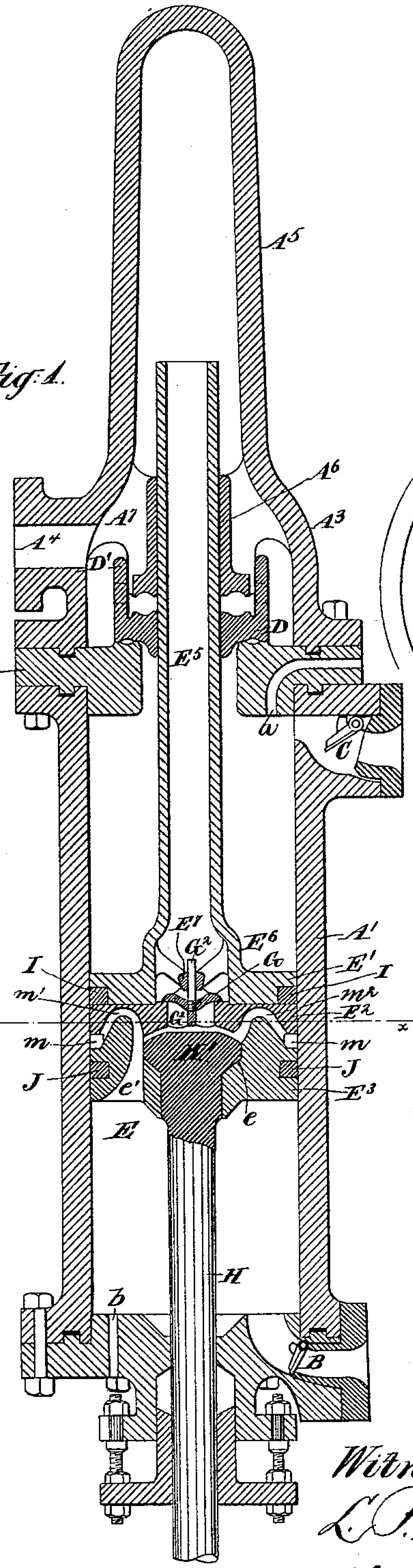


Fig. 3.

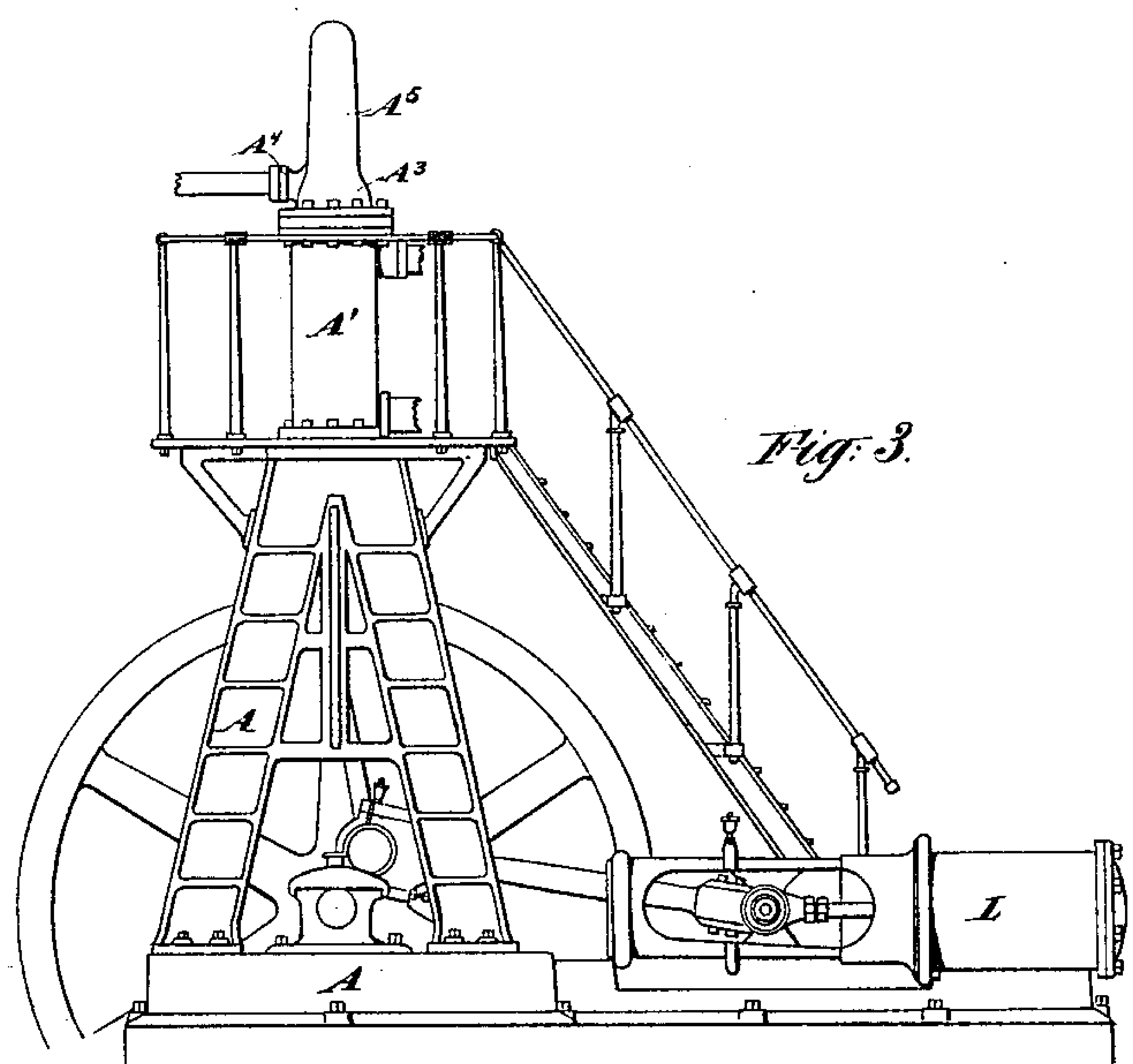
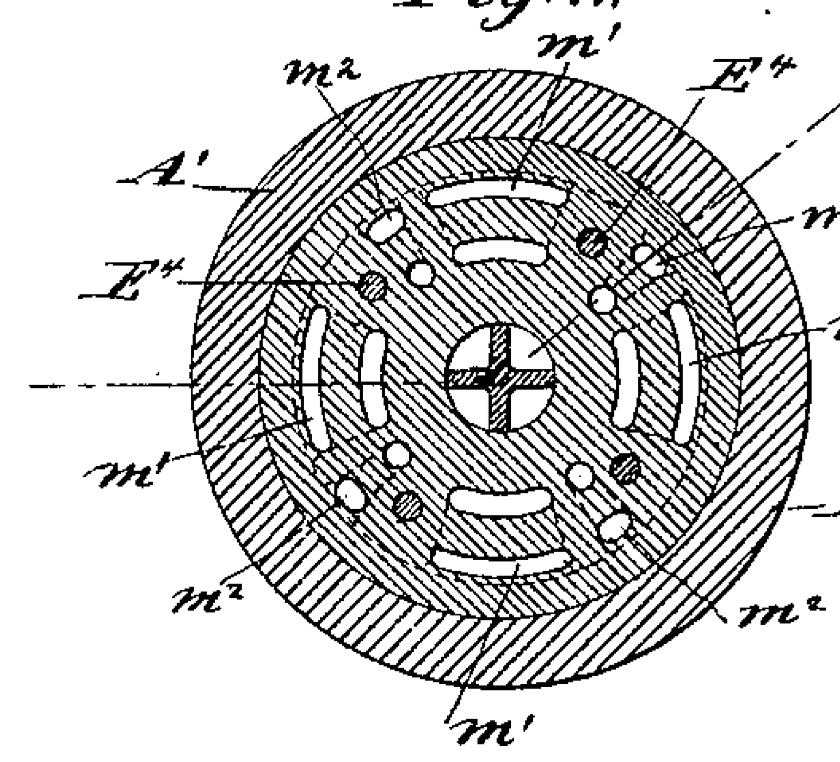


Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM BOWERS, OF NEW YORK, N. Y., ASSIGNOR TO SARAH E. BOWERS, OF SAME PLACE.

GAS-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 350,862, dated October 12, 1886.

Application filed November 20, 1885. Serial No. 183,386. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM BOWERS, of New York city, in the county and State of New York, have invented a certain new and useful Improvement in Gas-Compressors, of which the following is a specification.

I will describe the invention as applied to compress ammonia, in connection with refrigerating apparatus, and operating on a large scale, as in cooling a meat-packing establishment or a brewery.

My improved compressor is a double acting pump, standing upright, having a pump-rod below reciprocated by a steam-engine or other suitable power. It will be understood that I take into the pump at each movement of the piston up or down, first, the proper volume of uncompressed gas, and, second, a small quantity of a dense inelastic fluid, which I will call "oil," and which performs important functions. First, it packs the piston and valves; second, it fills the space remaining at the end of the stroke, which would otherwise contain elastic gas and involve loss; third, it absorbs the heat of compression, and, fourth, it lubricates the rubbing surfaces. This oil is forced out with the compressed gas. It is subsequently separated therefrom and cooled and returned. The oil may be introduced in the proper measure by any ordinary or suitable means, in accordance with the best practice.

I make the pump-piston of considerable thickness or depth, and provide it with two separate packings, with a considerable space between them. In this space I provide a reservoir extending around and bathing the interior of the cylinder on both the up and down strokes. On the upstroke this is not important, because the piston is then packed by a stratum of oil above the piston; but on the downstroke this reservoir performs the important function of insuring that oil, and not gas, shall be leaked, if, as usual, some leakage exists between the piston-packing and the cylinder. The gas received and compressed on the upper side of the piston is delivered through an annular self-acting valve. The gas which is received and compressed below the piston is delivered up through a self-acting valve in the piston, and through a vertical tube which is practically an upward extension of the piston and reciprocates therewith. This tube plays through the annular valve at the upper end of the pump. A sufficiently high casing or dome is mounted over the cylinder to allow the play of the reciprocating tube. The oil in traversing through the piston supplies the annular reservoir. The arrangement insures that this is filled with oil at each downward stroke, the surplus being delivered upward through the piston and its tubular extension. I provide for reducing the shock due to the movement of the annular valve. I arrange the passage to allow the oil to be received at each downstroke and to flow liberally into the annular reservoir carried in the piston, while the air or gas which it displaces is provided with a way of escape unresisted by the incoming oil.

The accompanying drawings form a part of this specification, and represent what I consider the best means of carrying out the invention.

Figure 1 is a central vertical section on the angular line *w w* in Fig. 2. Fig. 2 is a transverse section on the line *x x* in Fig. 1. These figures show the novel parts. Fig. 3 is a side elevation on a small scale, showing the connections for operating the compressor.

Similar letters of reference indicate corresponding parts in all the figures where they occur.

A is the fixed portion of the apparatus, additional marks, as $A' A^2$, being used, when necessary, to distinguish specific portions thereof.

A' is the upright cylinder; A^2, a top plate or upper head, having a liberal central opening.

A^3 is a top casing; A^4, a lateral nozzle thereof; A^5, a tall dome, and A^6 a hollow boss held in the central position by vertical webs A^7.

B is the lower induction-valve, and C the upper induction-valve, performing their ordinary functions of admitting the gas alternately at the top and bottom of the cylinder as the piston reciprocates.

D is an annular valve serving to deliver the gas which is compressed on the upper side of the piston. A deep rim, D', extending up from its periphery applies against the corresponding surfaces on the webs A^7, serving to guide it. A flange at the bottom of the boss A^6 serves as a stop to limit its lift.

E is the piston, certain portions of which will be designated, when necessary, by additional marks, as E′ E^2. The piston is made in three parts, E′ E^2 E^3, secured together by bolts and nuts E^4, to facilitate the production of smooth passages, for purposes which will presently appear. A tubular attachment, E^5, on the upper side, in line with the axis, plays through the valve D and through the boss A^6 as the piston reciprocates. An enlargement, E^6, at the connection of this tube with the piston serves as a chamber or cage for a self-acting valve, G, opening upward, and guided by wings G′ and stem G^2, in the obvious manner. There is a cross-bar, E^7, which is cast in or otherwise inserted in the enlargement E^6. It serves to guide and limit the rise of the valve G, so that the latter is certain to sink instantly to its seat on the termination of the downstroke of the piston. The pump-rod H plays through a stuffing-box in the bottom. It is actuated by a steam-engine or other suitable means, (not shown,) with a motion somewhat in excess of that required for the piston. It is connected loosely to the piston by a stout nicely-finished head, H′, inclosed within a corresponding chamber, *e*, in the piston, with liberty to play up and down therein to a limited extent. When this rod H moves upward, the head H′ fits tightly against the upper surface of the chamber *e*. The piston and rod move together during all the later portion of the upstroke, constituting a tight piston. During the later portion of the downstroke the piston will be retarded, and the piston-rod will move downward farther to the extent allowed by the head H′. In this condition the space above the head serves, in connection with other passages, to allow the gas and oil to move upward through the piston. The passages are peculiarly arranged. I provide a considerable deep channel, *m*, extending around the exterior of the piston near the mid-height. This, in connection with the adjacent surface of the cylinder A′, forms an annular reservoir, *m*, which it is desired to keep supplied with oil, so that when, by the descent of the piston and the compression of the gas below, there is a tendency of the gas to leak upward between the piston-packing and the cylinder, such leakage will be oil instead of gas. The replenishing of this hollow ring or annular reservoir *m* is effected at each descent of the piston into the oil in the bottom of the cylinder. Channels *e*′ extend from the bottom of the piston up to the periphery of the chamber *e*. There are corresponding channels, *m*′, which lead further upward and outward and downward, as shown in Fig. 1, and communicate with the hollow ring *m*, and form the means for supplying the oil at every stroke. I provide for the easy escape of the gas, which in the interim fills the ring *m* and its connected passages, by making passages m^2 adjacent to the passages *m*′, but not exposed to the force of the jets of oil from *e*′. At each descent of the piston into the oil which has been previously allowed to accumulate in the bottom of the cylinder the oil is, by the downward pressure of the piston, projected upward through the passages *e*′. The jets of oil move by their momentum past the chamber *e*, and are deflected outward through the passages *m*′. The oil is thus thrown in liberal quantities into the hollow ring *m* and fills it, while the gas which previously occupied the space flows inward through the passages m^2, and thus reaches the chamber *e* and escapes up through the valve G. There is a packing, I, fitted in the periphery around the upper portion, E, of the piston. There is a packing, J, fitted in the periphery of the lower portion, E^3. These packings perform their usual functions, aided by the oil. On the downstroke a portion of the oil supplied to the annular reservoir *m* bathes the interior of the cylinder and remains there, followed by the close-fitting packing I, which it aids to make effectual. The two constitute a complete stop to the leakage of gas upward past the piston during the downstroke, which is the only period when the gas tends to so leak. On the upstroke, besides the oil carried on the top of the piston, the oil in *m* bathes the cylinder, and a part remains and is followed by the lower packing, J, which it aids to make tight. Thus the oil in the space *m*, in combination with the two packings I and J, makes the piston tight in moving in both directions. Suitable pipes (not represented) admit thin gas through the valves B and C. The cool oil is injected by pumps or other means. (Not represented.) It is received through separate orifices. A suitable pipe is also provided to conduct away the gas and the hot oil from the nozzle A^4. Suitable connections are made to a steam-engine to reciprocate the pump-rod H. The movement of the piston-rod up and down within the piston performs an important function. Its descent provides the ample passage required for the movement of the gas and oil inward through the top of the chamber *e* during the descent of the piston. So soon as the piston has reached its lowest point and commences to ascend, there is no longer any requirement for this passage. On the contrary, it is desirable to make the piston as tight as possible. The valve G alone might attain this. The firm contact and tight fit of the upper face of H′ with the surface at the top of the chamber *e* serves as an additional safeguard. Either alone would make the piston tight. Both together give double surety on this point.

The action in the lower part of the compressor is as follows: When the rod H with its head H′ rises, the valve G shuts and the piston rises, drawing in the gas through the valve B. The oil is admitted at the proper time by any ordinary or suitable means. When the piston-rod H is drawn forcibly downward, the piston compresses the gas below it until it reaches the required tension, when it will lift the valve G and commence to be delivered. The gas will move upward through the channels e', inward through the space in the upper portion of the chamber e, provided by the sinking of the head H′, and upward past the valve G, to mingle with the previously-compressed gas in the tube E^5 and the connected dome A^5 and its attachments. This action will continue until near the termination of the downstroke. Then, all the gas having been delivered, the oil lying in the bottom of the cylinder A′ will be struck by the piston and thrown up through the same passages. In making this movement the oil will, by its momentum, be projected upward through the narrow passages e' into the passages m', and thence be led outward through the path represented into the reservoir m. So soon as the oil has filled these spaces, the remainder of the oil will, like the gas which has preceded it, move inward through the top of the chamber e, and upward past the valve G into the tube E^5, partially or entirely filling it. If there is a large excess of oil, some will flow over the top of the tube. The action on the upper side of the piston will more closely approximate that of the ordinary upright gas-compressor. On the descent of the piston the thin gas will enter through the valve C, followed by oil to form a stratum lying on the piston. On the rise of the piston the thin gas will be compressed until it attains the proper tension, when it will lift the annular valve D and be delivered past it to mingle with the previously-compressed gas in the chamber around and above this valve. During the last part of the upward motion the oil will be similarly delivered, contributing to pack the valve D. The rim D′ around the valve D should be nicely finished on its interior to match the corresponding inner edges of the webs A^7 and form a smooth guide. This rim should be of so moderate height that oil will flow inward over it at each stroke and lie in its interior to pack the tube E^5.

My improved mechanism is simple. The complexity in the construction of the piston involves merely additional labor in coring or otherwise producing and smoothly finishing the required passages. The working parts are very simple. The oil carried on the upper surface of the piston is efficient as a packing to keep the gas from moving down past the piston on the upstroke. The liberal supply of oil carried in my ring m affords an equally complete packing of oil to prevent the gas from moving upward past the piston when the latter is on the downstroke. This is an important end to be attained. It is important to renew the supply of oil at short intervals. My passages as arranged insure that this ring and its connected passages are filled at each descent of the piston to its lowest position. By my invention at each descent of the piston a quantity of oil always just sufficient to fill the passages is taken up from below and conditioned to fill the annular reservoir m, and it results from the arrangement that as the pressure below the piston increases during the descent of the piston, pressure is transmitted through the passages e' m', and is felt by the oil in the reservoir m, forcing it outward, so that whatever may be the pressure of the gas endeavoring to flow upward past the piston, it will be balanced by the pressure on the oil, forcing the oil outward. The oil is certain to stay there, and to act, in combination with the packing above, to make the piston absolutely tight during the descending motion. There is less pressure on the oil on the ascending motion; but my invention is of less consequence in that motion, because there will always be oil standing above the piston, which will pack the piston during that motion.

Modifications may be made in the forms and proportions within wide limits without departing from the principle or sacrificing the advantages of the invention. The parts of the piston may be secured together by bolts or other means, differently arranged. The piston may be made in a less number of parts. There may be a greater or less number of the passages m' e'. The bottom of the piston may be differently shaped. The bottom of the cylinder may be correspondingly shaped or not. It will be understood that the bottom space, whatever it may be, is of no effect on the action, because it is always filled with oil. The upper surface of the head H′ being spheroidal, and the adjacent surface of the chamber e being similarly shaped and both smoothly finished, the piston may rock slightly or the piston-rod be a little out of line without involving leakage. This feature may be varied. Simply plane or conical surfaces will serve, but not as well.

Parts of the invention may be used without the whole. The same construction and arrangement of the passages to supply oil to the annular reservoir m may be used with a single-acting compressor. Instead of separate passages m^2, I can attain substantially the same effect by making these passages in one with the passage m'. In such case the oil thrown up from the passages e' will move outward through the passages m', but will occupy only half or three-fourths of the width of the latter, leaving a portion of the passage m' to serve as a vent for the escape of the gas. I prefer the construction and proportions exactly as shown.

I do not claim, separately, a piston-rod having a head allowed to move in a piston, nor a tubular extension for delivering below the piston through the top of the cylinder; neither do I claim an oil-chamber between packings independent of the mode of supplying it, or the mode described of supplying an oil-chamber by taking up oil at each descent of the piston, irrespective of its application to a double-acting compressor.

I claim as my invention—

1. In a double-acting gas-compressor hav-

ing an upright cylinder, A′, and a piston, E, having two packings, I and J, and an annular oil-reservoir, m, between them, the passages e' m', arranged as shown, so as to take in oil from a reservoir below at each descent of the piston, and thereby supply the reservoir m, as herein specified.

2. In such gas-compressor, the piston E, having the passages e' m' m^2, arranged as shown relatively to each other and to the annular reservoir m and discharge-chamber e, so as to afford a clear space for the escape of gas through the passages m^2, while the oil is received through the passages e' m', all substantially as and for the purposes herein specified.

3. The double-acting gas-compressor described, having a piston, E, with the chamber e, as shown, in combination with the cylinder A′, and with the piston-rod H and its head H′, allowed to move to a limited extent in said chamber, and with the tubular extension E^5 and valves D and G, arranged for joint operation as herein specified.

In testimony whereof I have hereunto set my hand, at New York city, New York, this 16th day of November, 1885, in the presence of two subscribing witnesses.

WILLIAM BOWERS.

Witnesses:
CHARLES R. SEARLE,
MARRIENE ELLISON.