(No Model.)

A. SIEBERT.

GAS COMPRESSOR.

No. 483,268. Patented Sept. 27, 1892.

Fig: 1

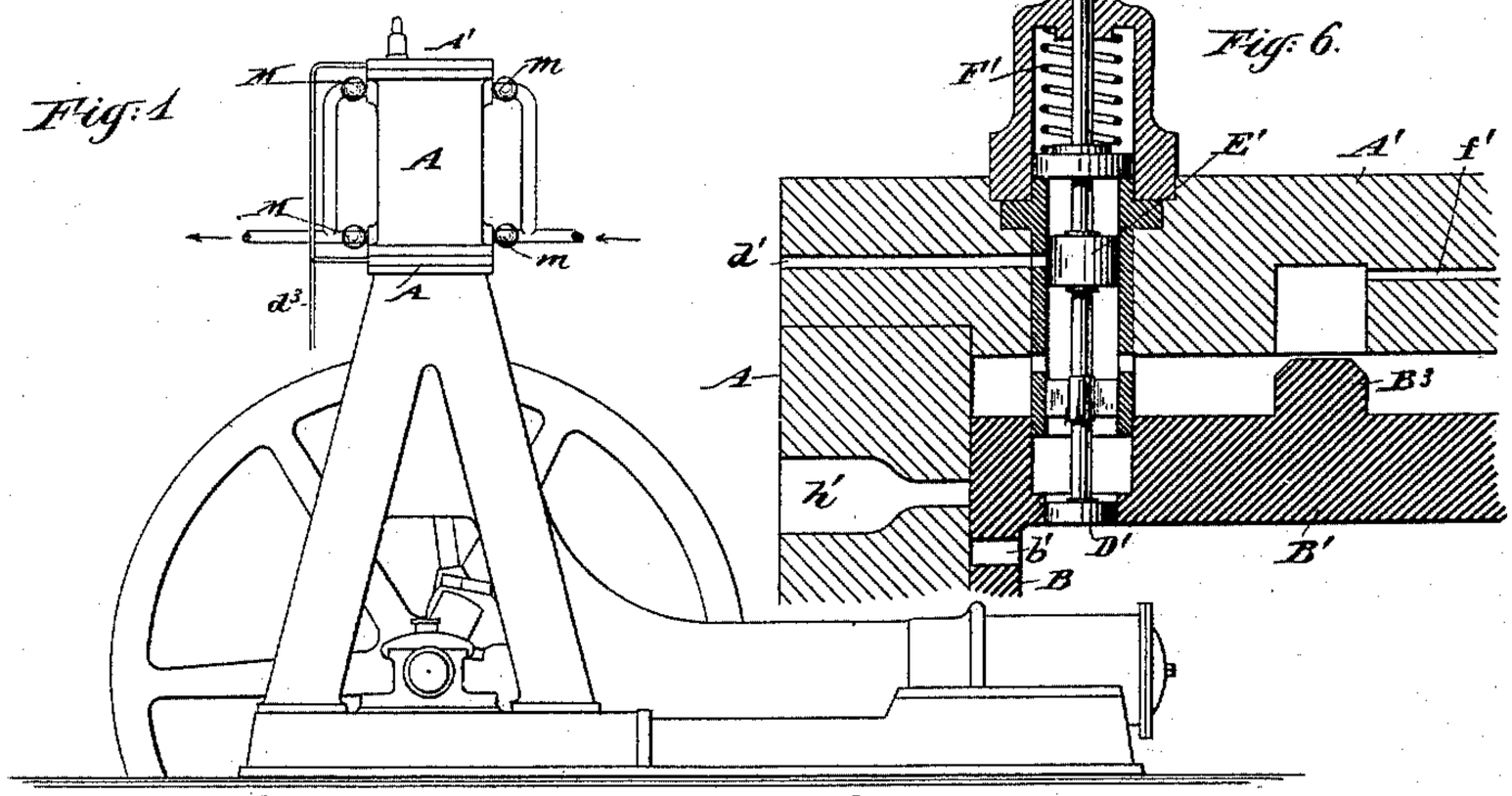

Fig: 6.

Fig: 2.

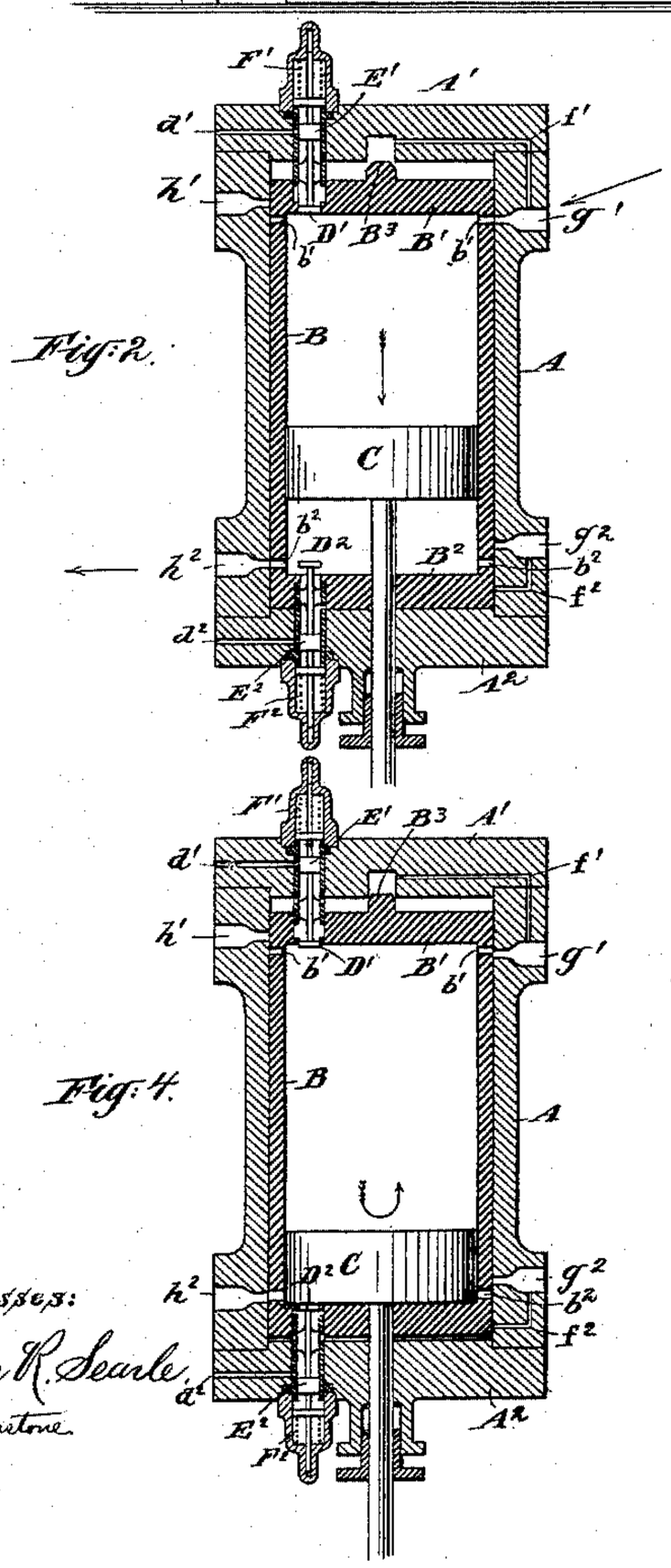

Fig: 3.

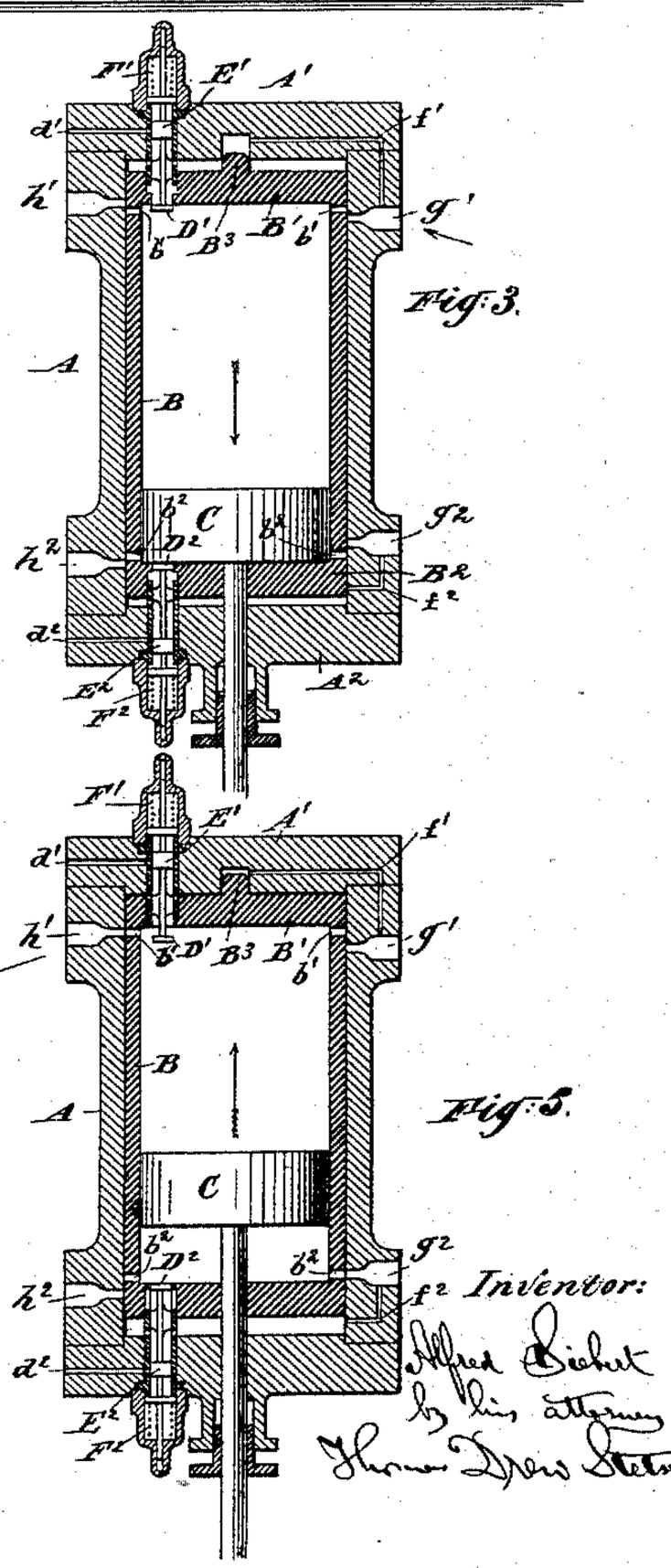

Fig: 4.

Fig: 5.

Witnesses:
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UNITED STATES PATENT OFFICE.

ALFRED SIEBERT, OF NEW YORK, N. Y.

GAS-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 483,268, dated September 27, 1892.

Application filed May 11, 1891. Serial No. 392,288. (No model.)

To all whom it may concern:

Be it known that I, ALFRED SIEBERT, a citizen of the United States, residing in the city and county of New York, and State of New York, have invented a certain new and useful Improvement in Gas-Compressors, of which the following is a specification.

My improvements apply to machines for compressing air or other gases or vapors for any purpose. It is more particularly intended for machines of considerable size employed in compressing ammonia-vapor for refrigerating apparatus.

I have in a patent to me dated September 3, 1889, No. 410,458, described a pump in which there is an internal cylinder with liberty for a limited amount of end movement within an inclosing cylinder, which latter is fixed. The sliding of the internal cylinder within the other brings the narrow apertures (ports,) in the inside cylinder into and out of coincidence at the right periods with ports formed in the fixed external cylinder, so that the changing relations of these parts causes these ports to serve as valves controlling the induction and eduction of the fluid pumped. The present improvement is based thereon. I have applied to such a pump provisions for introducing a dense liquid, which I will designate "oil," to partially fill the spaces at the ends alternately. I will describe the pump as "upright" and will refer to the spaces as the "top space" and "bottom space," respectfully. I will also assume that oil is injected, in order to simplify the description, while any other liquid, liquefied vapor, vapor, or gas might be used to advantage for moving the cylinder and to obtain other valuable economies during compression. At each movement of the internal cylinder upward a portion of the oil previously received in the top space is transferred into the internal cylinder. A like operation occurs at the bottom with the movement of the internal cylinder downward. In each case the oil is admitted to the space at high pressure, controlled by a valve, and serves usefully in causing the internal cylinder to commence its movement. This movement continues until the oil-supply is cut off, which happens when the oil-port is closed, and the gas liberated and expanded by further movement of the cylinder after the oil-supply at the other end had been shut off has again been compressed and forced into the oil and the pressure at both ends of the compressor been equalized. As soon as the piston in its onward movement has compressed the gas or vapor somewhat the cylinder moves farther, since the pressure exerted against the inside of the opposite end, in combination with the pressure exerted by the oil just entered, is greater than the pressure exerted by the oil and gas previously injected at the other end of the cylinder, and at the same time part of the previously-injected oil enters the internal cylinder, relieving the pressure, tending to retard the motion of the cylinder, and finally equalizing the pressure in the compressor and the opposite end of the cylinder. The piston moves farther forward, and also the cylinder, until the gas is compressed to the proper tension, when the discharge-port is brought opposite the discharge-opening and the gas discharged.

I have in carrying out the invention made the valves which admit the oil from the high-pressure part of the apparatus to the top and bottom spaces in the form of piston-valves, each working in a smoothly-bored hole in a head of the outer and stationary cylinder, and have connected rigidly to each another piston-valve, fitting in a smoothly-bored hole of the same size in the adjacent head or end of the internal cylinder. This latter valve controls the admission of the oil from some reservoir outside, under pressure, into the space, and the former valve controls the discharge of the oil from the space into the interior of the internal cylinder. I have made the valves of equal size and caused them to balance each other in certain important respects and have caused the pair of valves at each end to be worked in the outward direction or from the center by the direct contact of the main piston and have caused both to be worked in the inward direction or toward the center by the force of a coiled spring. The main piston, which I shall hereinafter term "the piston," always using the term "valve" with it when I mean the smaller pistons, is connected, as in ordinary pumps and compressors, so as to make exactly-determined reciprocations; but, as in all machines of this class, the exact points at which it comes to rest are subject to varia-

tions in position by the wear and adjustments of the brasses. My internal cylinder, which I will refer to simply as "the cylinder," may accommodate itself to any terminal position of the piston and make full contact therewith at each end of the stroke. The construction allows the forcing out of all the gas and oil by an absolute contact between the piston and the internal-cylinder end. The sliding of the several ports in the cylinder into and out of coincidence with the differently-spaced ports in the outer cylinder determines the conditions at each end as to induction and eduction of the gas. The space offered by the valve-passage is very small.

My improved compressor can operate successfully with but little oil. I designate the chambers and ports through which the gas is received as the "low-pressure" portion and the chambers and ports through which the gas and oil are expelled as the "high-pressure" portion of the apparatus.

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 general side elevation showing all the principal parts which are visible on the exterior. Figs. 2, 3, 4, and 5 are all central longitudinal sections in outline showing the relations of the parts at different periods. In some of these figures much of the detail is omitted. Fig. 2 shows the compressor with the piston in the act of descending and expelling the gas and oil at the required high pressure through the eduction-port at the bottom and drawing in gas at small pressure through the induction-port at the top. Fig. 3 shows the piston near the bottom center, the movable internal cylinder having risen a little to meet it and forming an absolute contact therewith. Fig. 4 shows the parts at a little later period, the piston having completed its descent and commenced to rise, the cylinder rising with it. Fig. 5 shows the condition at a still later period, the cylinder having risen to its highest position and stopped and the piston rising to perform its upstroke and discharging the gas or vapor. Fig. 6 is a central vertical section of a portion on a larger scale with the cylinder in its lowest position.

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

A is the external cylinder or fixed body of the compressor, certain parts being designated, when necessary, by supernumerals, A′ indicating the upper head and A^2 the lower head.

B is the movable internal cylinder or cylinder proper, certain parts being also designated, when necessary, by supernumerals, B′ the upper head, and B^2 the lower head.

Ports b' b^2 in the cylindrical body serve both for the induction and the delivery of gas.

C is the piston, having a rod which is connected to a suitable cross-head and operated by a crank revolved at the proper speed by a steam-engine or other suitable power. The gas is received at low pressure at the proper times through a port g' at the top and a port g^2 at the bottom. The gas is delivered after it is compressed to the required high tension through a port h' at the top and a port h^2 at the bottom.

D′ D^2 are valves mounted in the ends of the cylinder, and E′ E^2 are piston-valves, each connected to its corresponding valve D′ or D^2 and mounted in the corresponding end of the external cylinder. One valve D′ and one valve E′ are actuated together, being forced outward at the proper times by the contact of the piston and being urged inward at all times by a spring F′. The valves E′ E^2 perform the important functions of admitting the oil to the exterior of the cylinder at the two ends alternately by each covering and uncovering a passage d' or d^2, which is in communication with a pipe d^3, leading from a vessel in which the oil is stored under pressure. The oil thus admitted at high pressure at each end alternately forces the cylinder toward the opposite end. The tendency of the exuding gas to accumulate in the upper part of the space in which the mixture lies, while the oil by its gravity tends to the lower portion of such space, requires a different arrangement of the vent-passages at the upper end from that at the lower end. A passage f^2 communicates from a high point in the bottom space, controlled by the sliding across it of the lower edge of the cylinder B. This passage when open makes a free escape for the gas which emanates from the oil on its being relieved from the pressure in the bottom space, such gas flowing freely through the passage f^2 into the low-pressure part of the apparatus. A passage f' performs a similar duty for the top space. The provision for controlling this latter is a projection B^3 on the upper end of the cylinder B. When the cylinder is at or near its lowest position, this passage f' is open and allows the gas emanating from the oil in the top space to flow freely away and form a contribution to the gas in the low-pressure part of the apparatus; but when the cylinder rises the projection B^3 enters a recess in the top head A′ of the outer cylinder A and stops the passage f'. These equalizing-ports, however, will not be referred to in the description of the operation of the compressor. When the piston C has risen nearly to its highest point, it strikes the upper valve D′. This valve is pushed upward into its seat, the spring F′ yielding to allow it, until it is flush with the head B′. This closes the valve and by moving the connected valve E′ also upward opens the passage d' and oil enters the top space, and finally the piston is moved upward until all the oil and gas are expelled through the ports b' h'. When the piston C is descending and has nearly reached its lowest point, the top space has been previously

filled partly with oil, and through the further movement of the cylinder after the oil-inlet has been closed some of the gas contained in the oil has been liberated, and thereby the pressure exerted upon the oil and the cylinder-head reduced. As soon as the piston C has struck and has moved the valves D^2 E^2 down by the yielding of the spring F^2 the communication between the interior of the cylinder B and the bottom space is stopped. (See Fig. 3.) Now the bottom valve E^2 has moved down so far that it opens the oil-passage d^2 and oil is admitted under pressure into the bottom space. The force of the oil pressing upward against its lower face causes the cylinder B to promptly move upward, meeting the descending piston, and being thereby arrested. It remains in close contact with the piston until the latter has reached its lowest position and begins to ascend. (See Fig. 4.) As it rises, the cylinder B continues to press upward against it and the bottom valve D^2 is held up against the piston C by the force of the spring F^2. After the piston has risen so far that the bottom valve E^2, rising therewith, has closed the oil-passage d^2 this movement of the cylinder has closed the upper inlet-port and the pressure below and above the cylinder is equalized, since the gas liberated previously by the downward movement of the cylinder after the upper oil-inlet has been closed is again driven into the oil and the pressure exerted against the upper head of the cylinder is the same as the pressure of the oil in the oil-tank. While the cylinder moves upward during the first half of the rising motion of the piston several other conditions have been changed at the top: First, the port b' has passed the port g' and the gas, being compressed above the piston, cannot return the way it came; second, the valve D′ has stood still while the internal cylinder rose, and thus has ceased to close the opening in top head B′ and allowed the oil confined in the space between top heads B′ and A′ to flow into the interior of the cylinder B, and thus the oil is injected after the compressor has taken its full complement of gas and just at the beginning of the compression. The piston still rising and the valve D′ having opened the passage between the inside of the cylinder and the space above the cylinder the pressure above the top head of the cylinder is reduced, while the liberation of the gas from the oil just injected (the lower oil-passage being shut as the oil is admitted into the cylinder from above by valve D′) exerts a pressure against the lower head of the cylinder, driving the latter upward; but the increasing pressure in the cylinder above the piston is also communicated to the space above the top head of the cylinder, and, while the pressure exerted against the inside of the top head of the cylinder is partly equalized by the same pressure exerted above the head, yet the surface exposed to the pressure above the top head of the cylinder is greater, and therefore the upward motion of the cylinder is retarded, and only when the pressure above the piston has reached the tension desired the communication with the discharge-opening is to be made. I propose in some cases not to trust to such an adjustment, but to provide a check-valve M for each discharge-opening. With such check-valve it would not matter whether the discharge-port opened too soon or not. If no check-valve is provided and the discharge-opening communicates with the inside of the cylinder before the desirable tension is obtained, then the work of compressing the gas is increased. In some cases I esteem it advisable to also provide check-valves for the inlets, so as to prevent the gas from escaping into the suction; but, the check-valves being there or not, this gas would only mingle with the gas admitted and involve no loss to the efficiency of the compressor. A rod may be directly connected with a steam-piston moving in a steam-cylinder, transmitting the power without the use of the cross-head, crank, &c. Since the manner of operating the compressor with the use of an internal cylinder does not make it necessary to have an exact length of stroke, the stroke may be varied considerably without interfering with the efficiency of the compressor on account of the absence of clearances.

I claim as my invention—

1. In a compressor for gaseous fluids, a reciprocating piston, an internal cylinder and an external cylinder movable relatively to each other, and provisions for admitting fluid under pressure to the spaces between the two cylinders at the ends of the same alternately, so as to aid in moving the internal cylinder from one extreme position to the other at the required periods, as herein specified.

2. In a compressor for gaseous fluids, having a reciprocating piston and a movable internal cylinder, provisions for admitting oil or analogous fluid under pressure to the two ends of the external cylinder, so as to aid in throwing the internal cylinder from one extreme position toward the other, and ports f' f^2 in the external cylinder near the ends thereof, alternately opened by the reciprocations of the internal cylinder, in combination with each other and check-valves in the suction-pipe, said parts being adapted to allow gas to freely escape from such oil at the proper time, as herein specified.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

ALFRED SIEBERT.

Witnesses:
RAE HARRISON,
M. F. BOYLE.