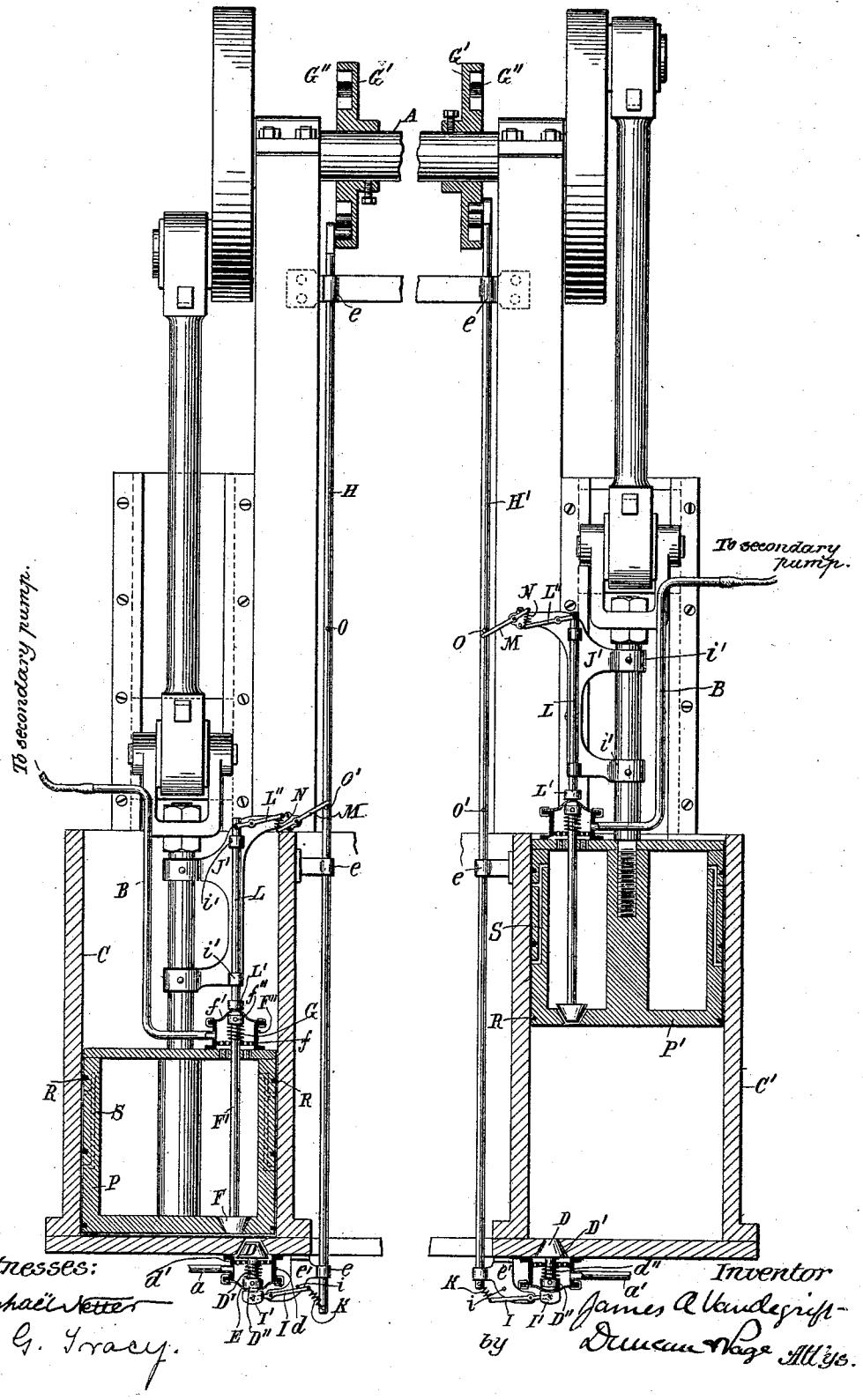
(No Model.)

# J. A. VANDEGRIFT.

## VACUUM PUMP.

No. 495,173. Patented Apr. 11, 1893.



# UNITED STATES PATENT OFFICE.

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## VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 495,173, dated April 11, 1893.

Application filed January 20, 1892. Serial No. 418,638. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES A. VANDEGRIFT, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Vacuum-Pumps, of which the following is a specification, reference being had to the drawing accompanying and forming a part of the same.

Heretofore in mechanical vacuum pumps, for exhausting incandescent lamp globes and analogous purposes, more or less difficulty has always been encountered with the means provided for operating the valves. In some instances valve rods reciprocated by some part of the mechanism and working through stuffing-boxes have been employed, and various kinds of packing materials have been relied upon to prevent leakage of air or gas, either from the outside atmosphere into the interior of the pump, or from the eduction to the induction sides of the piston. In other cases the pressure of the air or gas on the eduction side of the piston has been depended upon for opening the eduction valves, the closing of the valves being effected by the atmospheric pressure. Still another plan has been to cause the piston to strike at a given point in its course or stroke, the valve stem, and to gradually open the valve during the remaining portion of its stroke, and gradually close it in the same way during a certain portion of its return stroke, but necessarily in such manner that the complete closing and prevention of leakage depended upon the weight of the valves and atmospheric pressure. In other pumps slide valves have been employed which worked between plane surfaces in which ports or passages were cut for the induction or eduction of the air or gas. With all of the means previously devised, however, for mechanically operating the valves in pumps of this class, there is either a tendency to leakage through the stuffing-boxes, or between the slide valves and surfaces upon which they work, or that portion of the stroke of the piston which is most essential for the production of high vacua is rendered inoperative.

The object of my present invention is mainly to prevent entirely the leakage which the ordinary valves, stuffing-boxes and the like involve, and to utilize the full and complete stroke of the piston, particularly of that portion most essential for the production of high vacua. I furthermore prevent the leakage around or through the packing rings of the piston from affecting the induction side of the piston, and provide special means for reducing the usual wide difference of pressure between the induction and eduction portions of the pump, and for opening and closing the valves suddenly and positively. These several features I attain by means of a pump constructed and operated as illustrated in the accompanying drawing, which illustrates the pump in central vertical section.

The particular pump here shown is provided with two cylinders C, C′, and pistons reciprocated therein by connecting rods and eccentrics carried by a power-driven shaft A. The tubes or pipes *a*, *a*′, are the induction pipes leading from the cylinder to the lamps or other devices to be exhausted. The pistons P, P′, are hollow cylinders of any preferred construction but closed air-tight except through certain openings. These pistons form primary exhaust chambers and are constantly in communication with and exhausted by a secondary exhaust pump (not shown in the drawing) through the eduction pipes B, B, which enter the tops or covers of the pistons. A sufficient length of rubber tubing is used for these pipes to permit of the full and free movement of the pistons.

In the bottom of each cylinder C, C′, is located an induction valve. While the specific construction of these valves may be very considerably varied, I prefer to use a conical valve proper D, fitting into a correspondingly shaped seat and provided with a stem D′, which has an enlargement or head D″. Over the valve there is secured to the outside of the cylinder a small metal cylinder or valve chamber *d*, provided with a perforated partition *d*′, through which the valve stem passes. A spiral spring *d*″ surrounds the stem D′ and is compressed between the partition *d*′ and head D″, so as to exert a normal tendency to open the valve. The valve chamber is closed by a flexible head or diaphragm E, of india-rubber, corrugated copper or other impervious flexible material of sufficient strength. All the joints in and about the valve cham-

bers, being permanent, may be made perfectly air-tight. In the bottom of each piston is an eduction valve F, provided with a stem F′, that extends up through the hollow piston and through a perforation in the cover of the same into a chamber F″ secured to the outside of said cover over the projecting stem. This chamber contains a perforated partition *f*, and is closed by a flexible diaphragm *f′*, the construction in these respects being the same as the chambers over or containing the induction valves. The stem F′ is also provided with a head *f″* and is actuated by a spiral spring G that exerts a tendency to open the valve.

On the shaft A are carried two disks G′, with cam grooves G″ cut in their faces. With these cam grooves engage the pins or studs of two valve rods H, H′, supported in guides or brackets *e*, *e*, and which by the rotation of shaft A are reciprocated through a predetermined but short distance.

Pivoted to a bracket or arm *e′*, attached to the bottom of each cylinder, is a lever I that carries a socket or block I′, bearing upon the diaphragm opposite to the head D″. This lever has a certain play, limited by a stud *i*. A spring K is connected to the free end of this lever by one end and to the valve-controlling rod H by the other. Each piston carries a bracket J′ provided with guides *i′* in which works a rod L, on the end of which and bearing upon the diaphragm *f′* opposite to the head *f″* is a head or block L′. A lever L″ is pivoted to the bracket J′, one end being pivotally connected to the rod L. A second lever M is pivoted to the said bracket, one end being connected to the free end of lever I″ by a spring N, and the other being prolonged so as to intercept in its movement two studs O, O′, set in the controlling rods H or H′.

The operation of the device thus far described is as follows: The piston P at the left is shown in the position in which it has just completed its downward stroke, and the eduction valve F has just been closed. As the piston descends the levers L″ and M are in the relative positions occupied by the corresponding levers attached to the piston P′, but after a given movement the lever M encounters the stud O′. The effect of this, inasmuch as the piston P is moving at a much greater rate of speed than the rod H, is to raise the outer or free end of lever M and compress the spring N. This continues until the end of the lever M has moved past the end of lever L″, and this permits the spring N to suddenly expand, and by a positive and sudden reaction to turn the lever L″ on its fulcrum, depress the rod L and close the valve F against the force of the valve spring. After the eduction valve F as been closed, the induction valve D is opened in the following manner. The rod H in descending carries the end of the spring K attached thereto across the line of the point or fulcrum of the lever I. The first part of such movement merely stores up energy by compressing the spring K, but the instant that the point of connection of the spring K with the rod H moves past the end of lever I, the spring expands, and raises the end of lever I. This withdraws the block or head I′ from the diaphragm E and permits the spring *d″* to open the valve D. The valves remain in this condition until the piston has completed its upward stroke. The secondary pump during this time is exhausting the air or gas contained in the hollow piston. At the completion of the upward stroke of the piston, the above described operations are reversed and the parts brought into the positions shown in the other side or part of the pump. That is to say, the induction valve or cylinder C′ is closed and the eduction valve of piston P′ is then opened by the engagement of the lever M with the stud O.

In order to prevent, during the operation of the pump, any leakage of air or gas, past the packing rings R, R, of the pistons, passages S are formed through the side walls of the pistons between the packing rings and into the interior of the pistons, from whence any air leaking in is abstracted by the secondary pump.

In operating the pump it is desirable to use a small quantity of oil in the pistons, as this facilitates the action of the valves.

Having now described my invention and the manner in which it is or may be carried into effect, what I now claim is—

1. In an apparatus of the kind described, the combination with a valve of a pivoted lever for operating the same and capable of a limited movement or play, a reciprocating valve-controlling rod and a spring, the ends of which are connected to the valve lever and to a point on the controlling rod movable past the limits of movement of the point on the valve lever to which the opposite end of the spring is connected, as set forth.

2. In a vacuum pump, the combination of a cylinder provided with an induction valve, a hollow piston having an eduction valve and a passage of communication from the interior of the piston for connection with a secondary exhaust pump, as set forth.

3. The combination in a vacuum pump, of a cylinder provided with an induction valve, a hollow piston provided with an eduction valve, and having air passages through its side walls between the packing rings thereon, and a pipe or passage from the interior of the piston forming a connection for a secondary exhaust pump, as set forth.

4. In a vacuum pump, the combination with the cylinder, of a piston working therein and an eduction valve in the piston, a pivoted valve-operating lever moving with the piston, a supplemental lever also moving with the piston, a spring connecting the two levers and adapted to be shifted across the dead point or line of fulcrums of the two, by the engage-

ment of the supplemental lever with stops independent of the piston, as set forth.

5. In a vacuum pump, the combination with a cylinder, an induction valve in the same, a lever for operating the valve, a reciprocating rod and a spring connecting the valve lever and rod movable by the latter across the dead point of the lever, of a piston working in the cylinder, an eduction valve therein, a lever for operating the valve, a supplemental or trip lever, both levers being carried by a part moving with the piston, a spring connecting the two levers, and stops in the path of the trip lever by engaging with which the spring is shifted by the movement of the trip lever across the dead point of the valve lever, as set forth.

6. In a vacuum pump, the combination with a cylinder provided with a mechanically operated or controlled induction valve, a hollow piston provided with a mechanically operated eduction valve and adapted to contain a small quantity of oil and a secondary exhaust pump connected with the hollow piston, as described.

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Witnesses:
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