(No Model.) 3 Sheets—Sheet 1.

A. BERRENBERG.

VACUUM PUMP.

No. 421,346. Patented Feb. 11, 1890.

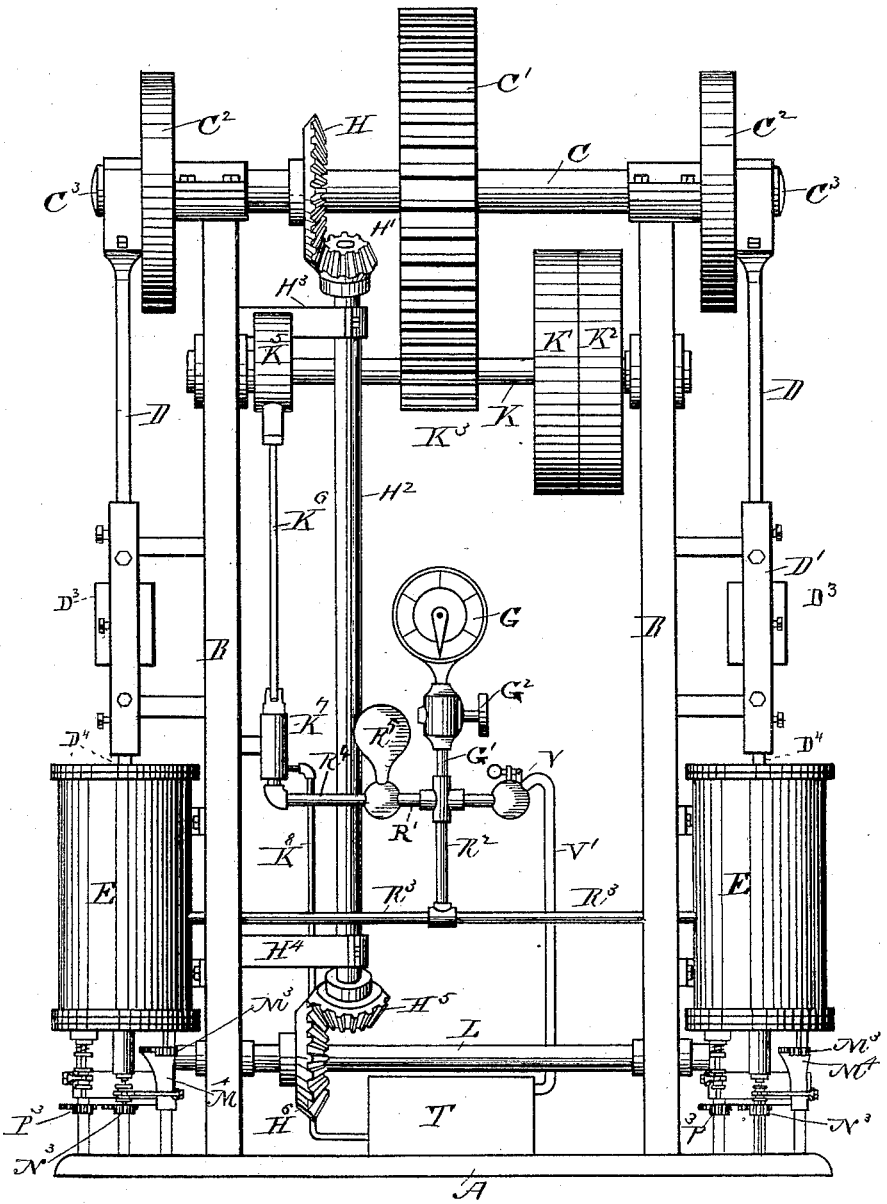

FIG. 1.

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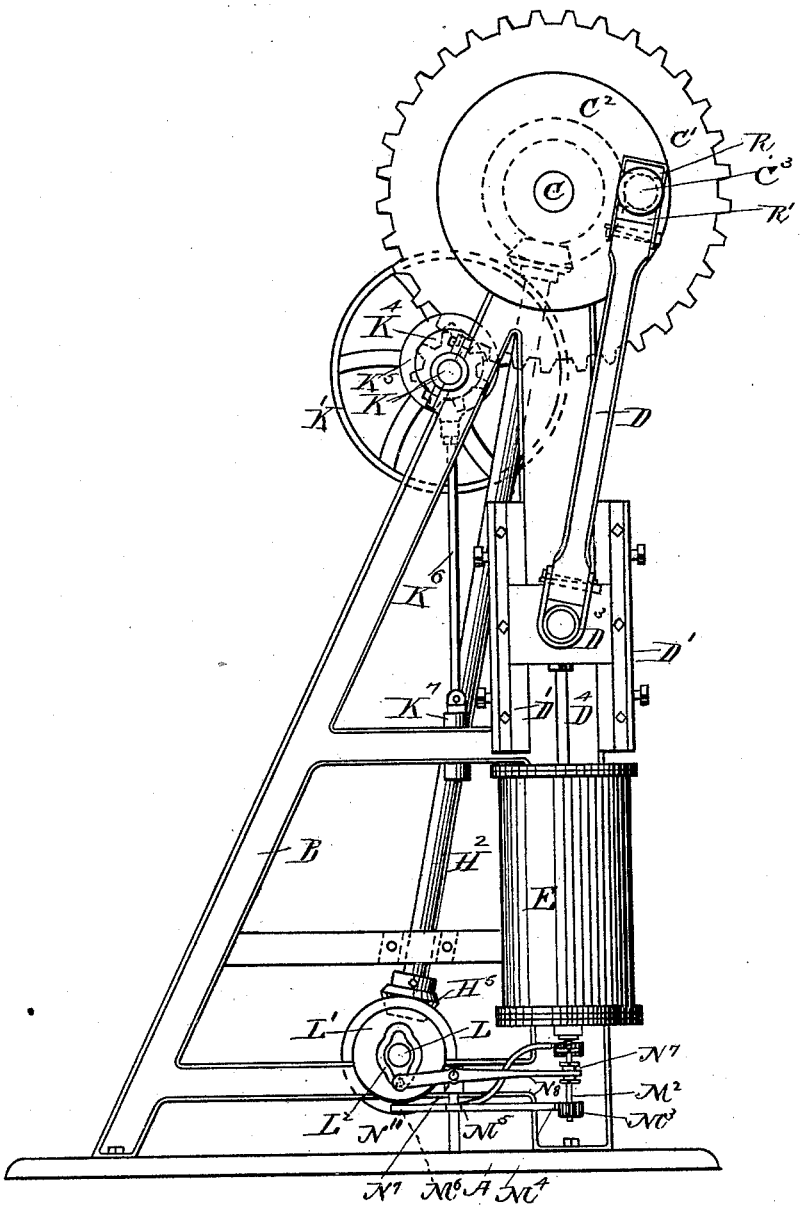

FIG. 2.

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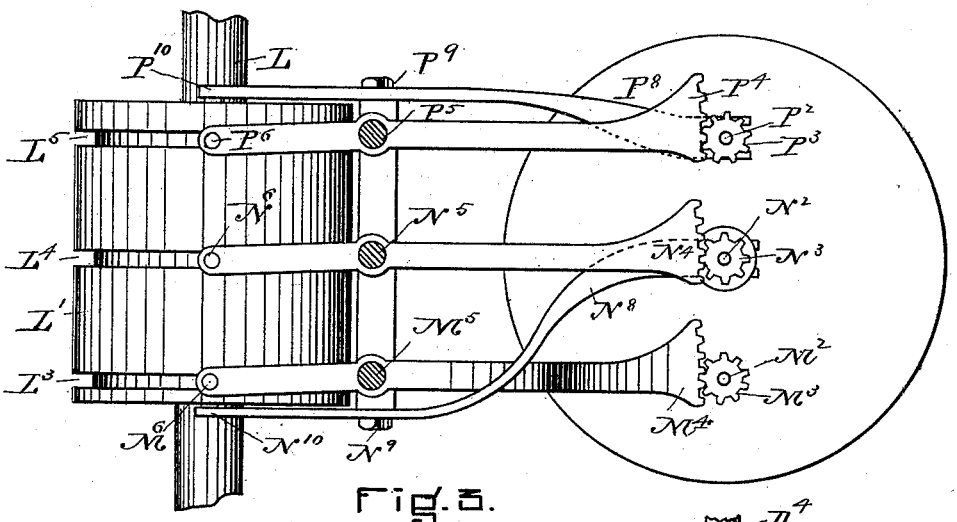

Fig. 3.

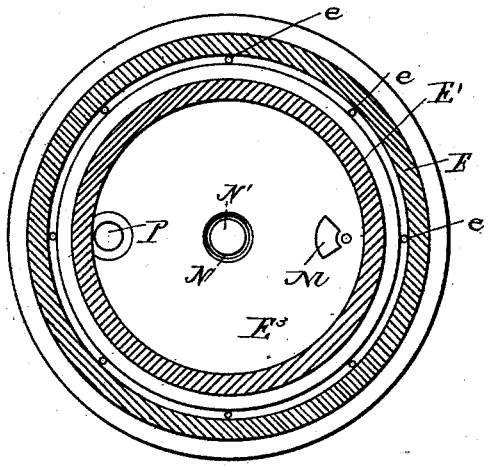

Fig. 5.

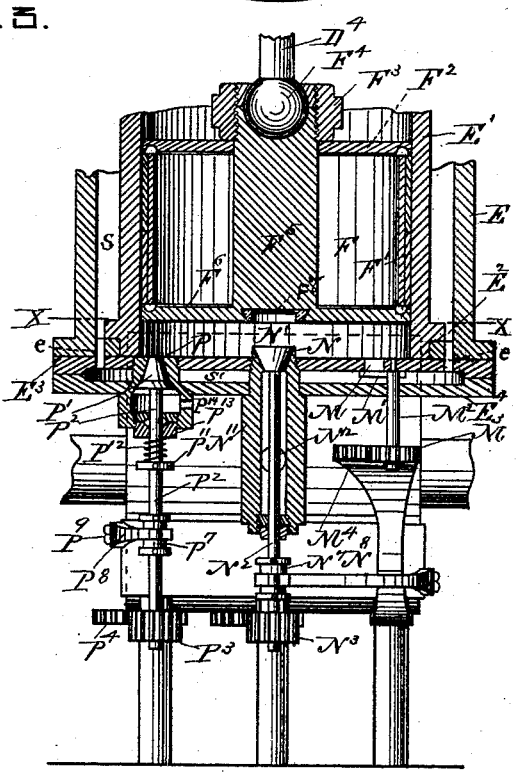

Fig. 4.

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UNITED STATES PATENT OFFICE.

ADOLPH BERRENBERG, OF SOMERVILLE, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO JACOB HEILBORN, TRUSTEE, OF BOSTON, AND ANNA M. BERRENBERG, OF SOMERVILLE, MASSACHUSETTS.

VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 421,346, dated February 11, 1890.

Application filed May 2, 1888. Serial No. 272,582. (No model.)

To all whom it may concern:

Be it known that I, ADOLPH BERRENBERG, of Somerville, in the county of Middlesex and State of Massachusetts, have invented a new and useful Improvement in Vacuum-Pumps, of which the following, taken in connection with the accompanying drawings, is a specification.

The object of my invention is to so construct and treat the parts of an air-pump that no air shall enter the cylinder by infiltration, leakage, or openings of valves. This object I attain by the mechanism shown in the accompanying drawings, in which—

Figure 1 is a front elevation. Fig. 2 is a side elevation. Fig. 3 is a plan looking from underneath, showing the mechanism for operating the valves. Fig. 4 is a cross vertical section through the lower part of the cylinder and piston, showing in elevation a part of the mechanism for operating the valves; and Fig. 5 is a horizontal section taken on line $x\ x$ of Fig. 4.

In the drawings, Figs. 1 and 2, A represents the base of the machine, and B B the standards or frame-work to which the operating parts are attached.

The main shaft C is mounted at the top of the frame-work, as shown in Figs. 1 and 2. To this main shaft C, I attach at each end a crank-disk C^2, and in the center a large gear-wheel C′. I also have on this shaft a beveled gear H. Each of the crank-disks C^2 C^2 has a crank-pin C^3, which gives motion to the pitman D. These pitmen D, acting through the cross-heads D^3, in turn give motion to the piston-rods D^4, and thence to the pistons, one of said pistons being shown in section enlarged in Fig. 4.

E and E are cylinders made exactly alike. Therefore I will describe but one of them. I may also add that the valves and their connected parts and the valve-actuating gears are the same for both cylinders.

Referring to Fig. 4, I will describe one of the cylinders. E represents an outside casing made of some strong metal, like iron. This casing E has an inwardly-projecting flange E^2 at the bottom. (See Fig. 4.) The upper and inner edge of this flange E^2 is turned perfectly true and smooth and receives the lower end of the inner cylinder E′, which makes with it an air-tight joint. Both cylinders E and E′ fit air-tight onto the valve-plate E^3. The valve-plate E^3 has a series of perforations *e e e e*, which coincide with corresponding perforations in the inner flange E^2 of the outer cylinder E. These perforations *e e e e* connect the space S between the cylinders E and E′ with the space S′ between the valve-plate E^3 and the lower plate E^4. The lower plate E^4 is made to fit air-tight onto the under side of the valve-plate E^3, but leaving a space S′ between. The space S′ between the valve-plate E^3 and the lower plate E^4, being connected with the space S between the inner and outer cylinders, is always full of fluid under pressure, which will prevent air from leaking into the cylinder through the pores of the valve-plates. The fluid also in passing in small quantities through the valve M occupies all of the space that may exist between the bottom of the piston when down and the valve-plate E^3, and thus exclude any air that might otherwise exist between the piston and the valve-plate.

As these pumps are single-acting, the upper ends are left open; but the space S, forming the chamber between the inner and outer cylinders, is made air-tight at the top, so that a fluid under pressure may be confined in the space S S′. The piston F is made as shown in Fig. 4, F^5 being a central portion, to which the lower disk F^6 is attached or made a part of. F^2 is a disk that serves to form the top of the piston and is held in place by a screw-nut F^3. F^4 is a ball-and-socket joint which serves to connect the piston-rod D^4 to the piston, and is made in this manner to allow the piston to adapt itself to work in exact collimation with the cylinder E′. F′, Fig. 4, represents packing-rings made double and arranged to break joints.

The above-described piston is fully described in the specification of Patent No. 369,093, granted to me August 30, 1887, entitled "piston-packing."

For the purpose of allowing the piston to

rest for a short time on the bottom of the cylinder—*i. e.*, on the valve-disk—I make the pitman D longer than is required to take the piston down to the full end of its stroke, and to compensate for this extra length I have rubber packing-boxes R and R′, Fig. 2, so that although the piston has actually come to the bottom of the cylinder before the crank-pin C^3 has reached its lowest point the crank-disk may continue to revolve, simply compressing the rubber packing R′, and as the crank-pin C^3 passes its center then the piston will not begin to ascend, as the expansion of the rubber R′ will still keep it down onto the valve-disk E^3. By this arrangement I am enabled to have the valve-working mechanism in operation while the piston is still down on the valve-disk.

The fluid-valve M M′ (see Figs. 4 and 5) is operated as follows: It is hung on a semi-rotating stem M^2, upon which I have a gear M^3, which is operated by a segment-gear on the end of the lever M^4. (See Fig. 3.) This lever M^4 is pivoted at M^5 and has a pin M^6, which is worked by the cam-groove L^3. The above valve M moves in one plane only—that is, horizontally about its axis—and serves to allow a small portion of the fluid in the space S′ to pass up into the cylinder, so as to exclude any air that might otherwise occupy the space and impair the vacuum.

The valve M opens when the piston is down and lets the fluid from the space S pass in and occupy any space between the piston and valve-plate, and thus exclude air that might otherwise enter.

The valve-opening at P, Figs. 4 and 5, serves as an outlet, and its valve P has two motions—viz., an up-and-down or close-and-open motion and a rotary motion on its seat. This rotary motion is given to it for the purpose of keeping it always in good order. In fact, it is ground onto its seat at each motion. The spring P^{12}, Fig. 4, is connected to the disk P^{11} and to a part of the box P^{13}, and, being a tension-spring, serves to keep the valve P′ up to its seat. The exhaust through the valve-opening at P passes into the box P^{13}, Fig. 4, and out through an opening P^{14}. A rotary motion is given to the valve P′ by means of a gear P^3 on its stem P^2, said gear being turned by the segment-gear on the end of the lever P^4, said lever P^4 (see Fig. 3) being pivoted at P^5 and operated by a pin P^6, working in the cam-groove L^5. The up-and-down motion is given to the valve P by means of a forked lever P^8, which works in a collar P^7, Fig. 4, on the stem P^2, and is pivoted at P^9 (see Fig. 3) and worked by pin P^{10}, which is operated by a face cam-groove L^2, Fig. 2.

The principal valve-opening N, Figs. 4 and 5, acts as an inlet for the pump, and is connected with the lamp or other article to be exhausted. Its valve N′ has also a twofold motion—one up and down to open and close, and another about its center to cause a grinding action on its seat to keep it always in order. The rotating motion is secured by the following means: N^3, Figs. 3 and 4, is a gear attached to the stem N^2 of the valve N′, and is made to rotate by means of the segment-gear on the lever N^4, Fig. 3, said lever N^4 being pivoted at N^5 and operated by a pin N^6, working in the cam-groove L^4. The up-and-down motion is given to the valve N′ by means of a forked lever N^8, which works in the collar N^7 on the stem N^2, and, being pivoted at N^9, Fig. 3, is operated by pin at N^{10}, working in a face cam-groove (not shown) made in the end of the cam-wheel L′. The valve N N′ opens from the chamber N^{12}, which is directly connected to the lamp-bulb or other vessel which is to be freed from air or exhausted.

Motion is given to the cams L′ by means of the beveled gear H on the shaft C. This gear H, acting through the gear H′, shaft H^2, and gears H^5 and H^6, drives the shaft L, upon which the cam-drum L′ is mounted. The shaft H^2 is mounted in housings at H^4 H^3, Fig. 1.

The shaft K has upon it fast and loose pulleys K′ K^2 and a pinion K^3, which engages with the large gear-wheel C′ on the shaft C. Motion is communicated to the machine by a belt, which, acting through the pulley K′ and shaft K, turns the pinion K^3, and through it the large gear-wheel C′.

My auxiliary or fluid pump is shown at K^7, Fig. 1. This pump is operated by a pitman K^6, which is attached to an eccentric-strap K^5, and is driven by the eccentric K^4 on the shaft K. The pump K^7 draws its supply from the tank T through the pipe K^8 and distributes it through the pipe R^4, R′, R^2, and R^3 to the chambers S S′ in the casing of the cylinders E E. R^5 is an air-chamber attached to the pipe R^4 to ease the flow of the fluid. G is a gage for indicating the pressure of the fluid as it passes from the pump. This is attached to the pipe R′ by the pipe G′. G^2 is a hand-valve for connecting or disconnecting the gage G to the pipes.

V is a safety-valve connected to the pipe R′, and serves to prevent a too great pressure from accumulating in the pipes or chambers S S′. Any overflow from the safety-valve V can pass through the pipe V′ back to the tank T.

When my pump is in use, the tank T, Fig. 1, has a supply of some liquid—for instance, oil, glycerine, or even water. This liquid is pumped by the pump K^7, so as to fill all of the pipes, and also the spaces S and S′, and is maintained under pressure, so as to fill any pores in the metal casing, as well as to fill all of the joints in or through which air might leak. In filling the pores of the metal and maintaining a pressure about the cylinder in the chambers S S′, I effectually prevent any infiltration of air, and thus am enabled to obtain and maintain almost a perfect vacuum. The piston F is also to be filled with a liquid, as has been fully disclosed in the specification of the patent above referred to.

F^7, Fig. 4, is a disk made of some yielding material, like rubber, and inserted in the under side of the piston F, it being made with a recess, as shown, so that as the piston comes down onto the valve-disk E^3 it—the rubber—will closely fit the projection in which the valve-seat N is formed.

I claim—

1. In an air-pump, the combination of the valve-disk E^3, outlet-valve P′, stem P^2, spring P^{12}, collar P^7, lever P^8, cam-wheel L′, and pinion P^3, with the segment-gear lever P^4 and cam-wheel L′, all operating together substantially as described, and for the purpose set forth.

2. In an air-pump, the combination of the valve-disk E^3, inlet-valve N′, stem N^2, collar P^7, lever P^8, cam-wheel L′, pinion N^3 with the segment-gear lever N^4 and the cam-wheel L^4, all operating together substantially as described, and for the purpose set forth.

3. In an air-pump, the combination of the piston F, cylinders E and E′, valve-disk E^3, and lower disk E^4, forming chambers S S′, adapted to receive a liquid under pressure, the said valve-disk E^3 having a valve N′ and raised valve-seat N, with the valve N′, valve-seat N, and valve M, adapted to admit at each stroke of the piston a quantity of fluid from the chamber S′, substantially as and for the purpose set forth.

4. In an air-pump having cylinders E and E′ and disks E^3 and E^4, said cylinders and disks forming chambers S and S′, adapted to receive a liquid under pressure, the combination of the inlet-valve N′ and its seat N in the disk E^3 with the outlet-valve P, having an opening through both disks E^3 and E^4 and the valve M, all operating together substantially as described, and for the purpose set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 26th day of April, A. D. 1888.

ADOLPH BERRENBERG.

Witnesses:
WILLIAM EDSON,
MATTHEW M. BLUNT.