(No Model.) 3 Sheets—Sheet 1.

A. BERRENBERG.

VACUUM PUMP.

No. 449,066. Patented Mar. 24, 1891.

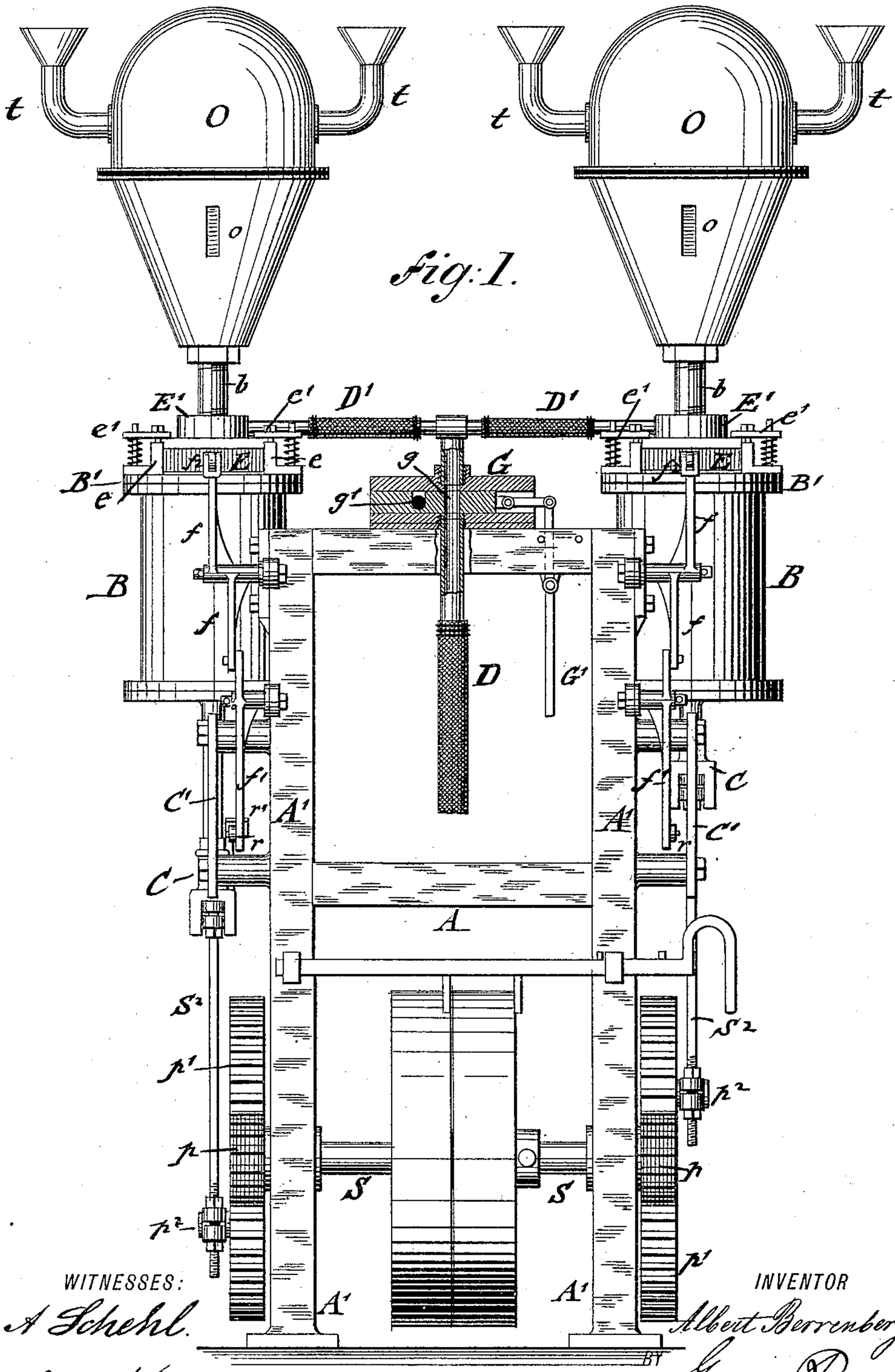

Fig: 1.

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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

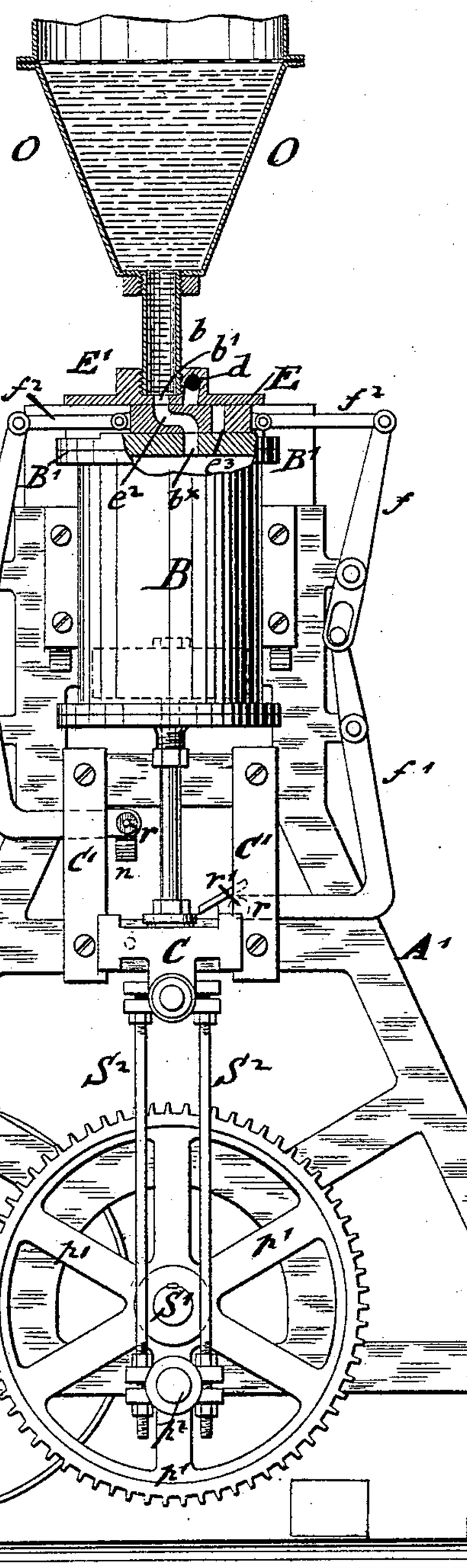
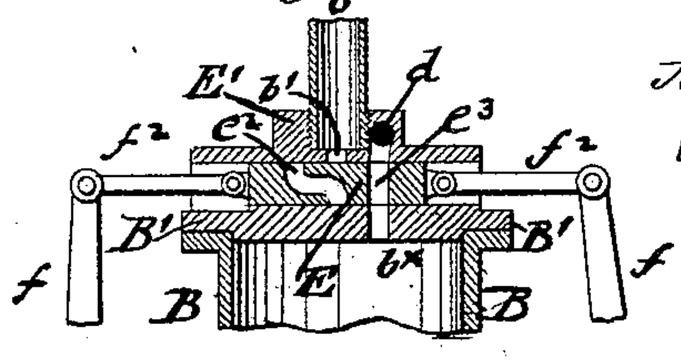


Fig. 2a.



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(No Model.) 3 Sheets—Sheet 3.

A. BERRENBERG.

VACUUM PUMP.

No. 449,066. Patented Mar. 24, 1891.

Fig. 3.

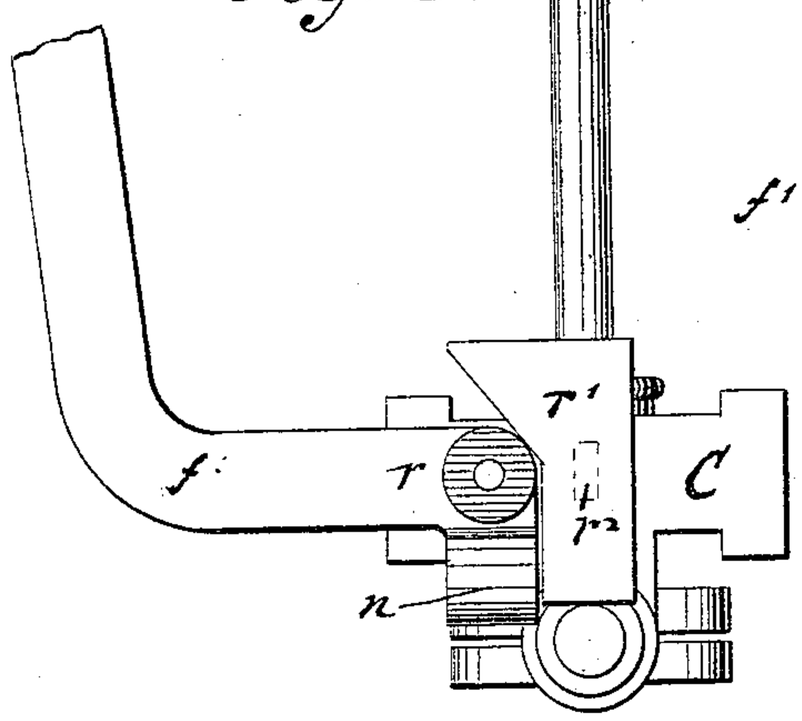


Fig. 4.

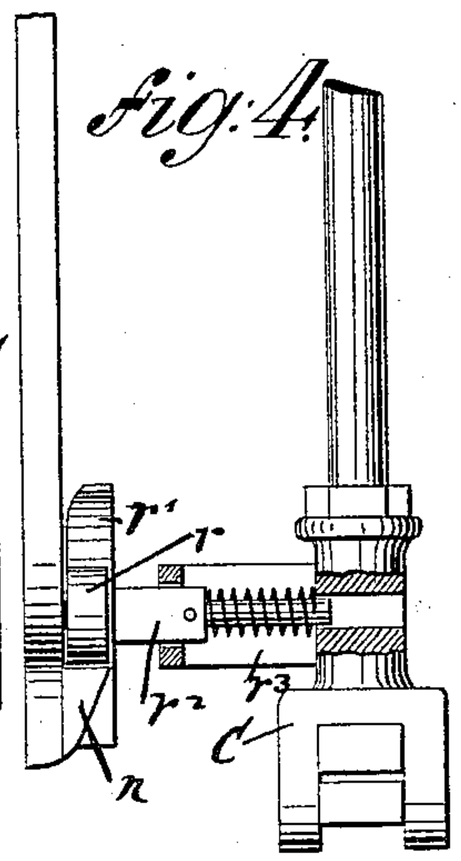


Fig. 5.

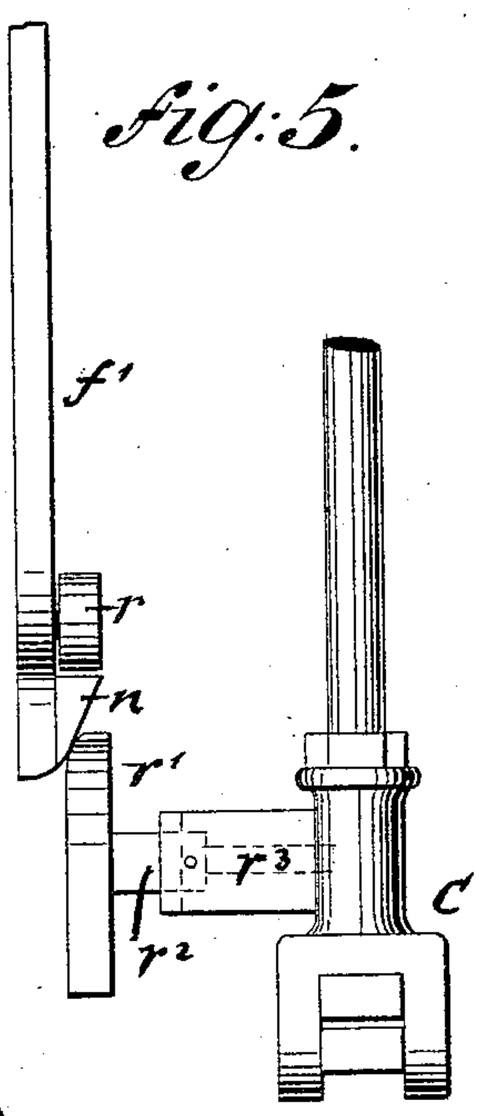


Fig. 6.

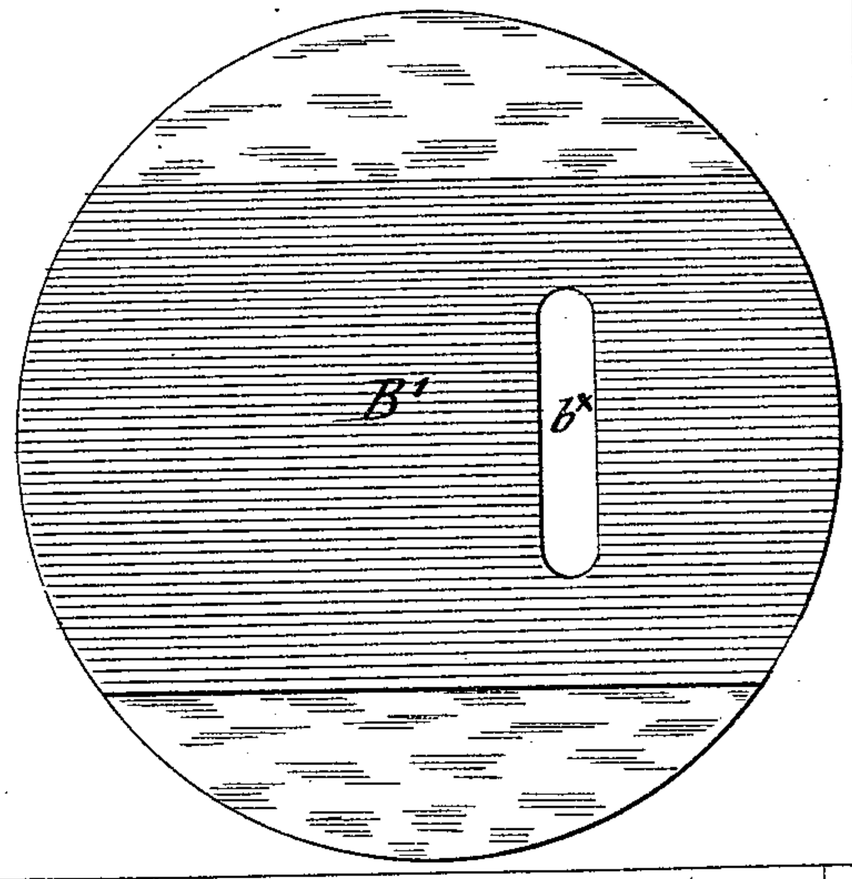
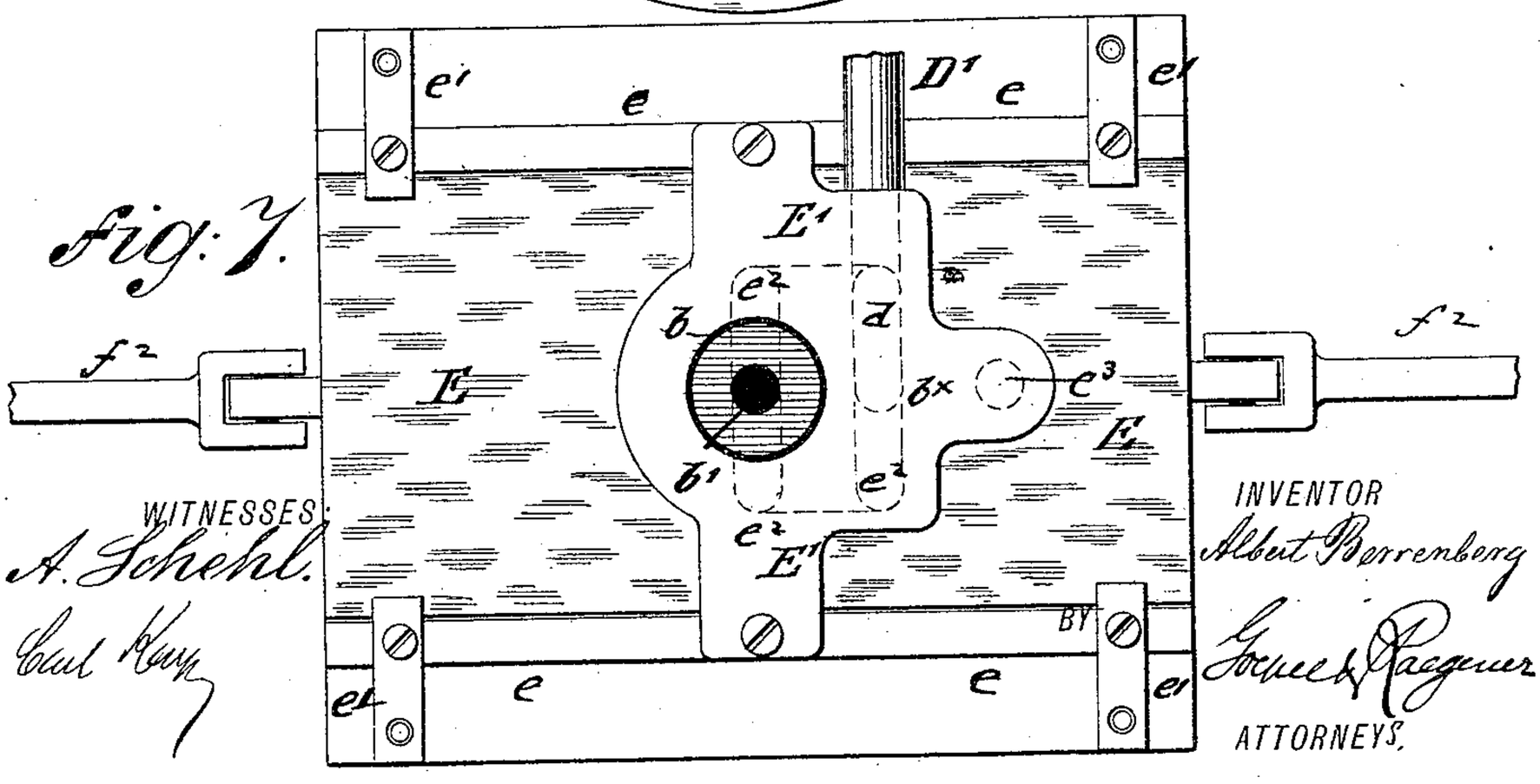


Fig. 7.



UNITED STATES PATENT OFFICE.

ALBERT BERRENBERG, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE BERRENBERG MANUFACTURING COMPANY, OF NEW YORK.

VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 449,066, dated March 24, 1891.

Application filed February 26, 1889. Serial No. 301,184. (No model.)

To all whom it may concern:

Be it known that I, ALBERT BERRENBERG, of Boston, in the county of Suffolk and State of Massachusetts, a citizen of the United States, have invented certain new and useful Improvements in Vacuum-Pumps, of which the following is a specification.

This invention relates to an improved piston vacuum-pump of that class in which the up and down strokes of a hermetically-sealed piston operating in a vertical cylinder are employed to evacuate the air from the bulbs of incandescent electric lamps or other articles in which a high degree of vacuum has to be established; and the invention consists of a vacuum-pump the piston of which is lubricated and hermetically sealed by a suitable oil packing, which is supplied from an oil-receptacle above the pump-cylinder, in connection with a guided and spring-pressed slide-valve, the ports of which communicate with the supply-port of the oil-chamber and air-suction pipe and a port in the cylinder-head. The slide-valve is operated positively by the action of fulcrumed levers, which are actuated by the cross-head of the piston-rod. The pump can be thrown in or out of action by means of an auxiliary slide-valve operated by a hand-lever, which slide-valve is interposed between the air-suction pipe and the slide-valve of the cylinder-head, so as to produce either the suction action of the pump or the connection of the same with the atmosphere.

In the accompanying drawings, Figure 1 represents a side elevation, partly in section, of my improved vacuum-pump, showing two pump-cylinders arranged on the same frame and operated by the same driving-gear. Fig. 2 is an end elevation, also partly in section, showing the slide-valve of one of the pump-cylinders and its actuating mechanism. Fig. 2^a is a detail vertical section of the slide-valve, showing the same in communication with the suction-pipe. Figs. 3, 4, and 5 are details of the mechanism by which positive motion is imparted from the cross-head to the slide-valve of the pump-cylinder. Fig. 6 is a detail top view of the head of the pump-cylinder, showing the port in the same; and Fig. 7 is a top view of the slide-valve of the pump-cylinder and of the base of the oil-chamber, showing the different ports of the same.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the supporting-frame of my improved vacuum-pump, which frame is constructed of transversely-braced standards A′ in such a manner that a pump-cylinder B is mounted on each standard. The pistons of both cylinders B are driven by the same driving-gear. At the lower part of the frame A are arranged suitable bearings for the driving-shaft S, which is provided with a loose and a fast pulley and a suitable belt-shifting device by which the motion-transmitting belt is shifted from one pulley to the other, according as the pump is to be stopped or set into motion. At both ends of the driving-shaft S are arranged pinions p p, which mesh with gear-wheels p' p' at the ends of a crank-shaft S′, to the crank-pins p^2 of which the connecting-rods S^2 of the cross-heads C C are pivoted. The cross-heads C C are guided in guides C′ of the standard A′ and connected to the piston-rods of the pump-pistons in the usual manner. The driving-gear of the pump-pistons, the cross-heads, and cross-head guides are made of any approved construction and do not form any part of my invention.

Vertically above each pump-cylinder B is arranged an oil-chamber O, the bottom of which is connected by a pipe b with an oil-port b' of a top plate or valve-cap E′, that is attached to guideways e of a laterally-reciprocating slide-valve E. The slide-valve E is arranged on the top of the cylinder-head B′, and tightly retained thereon by means of fulcrumed and spring-actuated lugs e', which project over the slide-valve E and serve to retain the same in a tight yet yielding connection with the cylinder-head and top plate E, so that the slide-valve can yield to some extent, and prevent thereby the pounding of the piston without interfering with the easy motion of the slide-valve E. The head B′ of

the pump-cylinder B is also provided with a port $b^{\times}$, which communicates with the ports e^2 e^3 of the slide-valve E. The top plate E′ is connected sidewise of the oil-port b' with an air-suction pipe D, which terminates in a port d vertically above the port $b^{\times}$ of the cylinder-head. The motion of the slide-valve E is governed by two sets of fulcrumed levers f f', which are mounted on the upper parts of the supporting-standards A′, the upper levers f being connected by pivot-rods f^2 with the opposite ends of the slide-valve E, while the lower ends of said levers are applied by yielding pivot connections to the upper ends of the lower levers f', which are provided at their lower ends with bent inwardly-extending arms that carry anti-friction rollers r r, which are located in the paths of two inclined projections or cams r' of the cross-head C, said cams engaging the anti-friction rollers r r, and operating thereby the actuating-levers f f' and the slide-valve E in connection with the up and down strokes of the pump-piston.

The port e^2 of the slide-valve E′ is made of **S** shape, so as to produce the connection of the oil-port b' in the top plate E′ with the port $b^{\times}$ in the head of the pump-cylinder, while the second port e^3 of the slide-valve is straight and serves to establish connection between the port $b^{\times}$ in the cylinder-head and the port d of the air-suction pipe D, as will appear by reference to Figs. 2 and 2ª, in which the two positions of the slide-valve E are clearly shown. The oil-chamber O is provided with a glass-covered gage-opening o in its side, by which the level of the oil in the oil-chamber can be readily observed. The upper part of the oil-chamber is provided with an outlet-tube t at each side, through which the air that is evacuated by the pump is conducted to the atmosphere.

The slide-valve E receives by the fulcrumed levers f f' and the inclined cams r r' of the cross-head C an intermittent reciprocating motion. During the upward motion of the cross-head C the inclined cam r' at the right-hand side of the cross-head C is pressed sidewise by a beveled nose n of the lever f' below the anti-friction roller r, which motion is assisted by the slightly-curved upper edge of the cam r'.

The cam r' is guided by a spring-cushioned shank r^2 in a socket of the cross-head C, as shown in Figs. 4 and 5, so as to "give" sufficiently and pass over the anti-friction roller r without engaging the same. By the downstroke of the cross-head the inclined cam r' engages the anti-friction roller r, as shown in Fig. 3, and presses thereby the lower lever f' sidewise, so as to actuate the upper lever f and shift the slide-valve from the right toward the left into the position shown in Fig. 2ª. When the cross-head C arrives nearly at the lower end of its downstroke, the inclined cam r' on the opposite side of the cross-head C engages the anti-friction roller r at the inner end of the lower lever f' at the right side of the pump-cylinder, so as to press the same sidewise and produce by the action of the upper lever f the shifting of the slide-valve from the left toward the right into the position shown in Fig. 2. The pump-cylinder communicates, therefore, at the commencement of the upstroke of the piston by the **S**-shaped port e^2 of the slide-valve E with the port b' of the oil-chamber, so as to force out first the air evacuated by the downstroke of the piston from the upper part of the pump-cylinder and then the packing of oil at the top of the piston, which oil is thereby returned into the oil-chamber, while the air is forced through the body of oil in the oil-chamber and passed through the air-outlet tubes to the atmosphere. During the upstroke of the piston the inclined cam r' at the left of the cross-head passes clear of the anti-friction roller r of the lower left-hand lever f' without moving the latter, so that the slide-valve remains in the position shown in Fig. 2, while immediately after the commencement of the downstroke of the cross-head the inclined cam r' operates the left-hand set of levers and causes the shifting of the slide-valve into the position shown in Fig. 2ª. Before the shifting of the slide-valve takes place a layer of oil is drawn in by the piston, which produces the air-tight packing for the same. When the slide-valve E is shifted toward the left, the connection of the cylinder with the oil-chamber is interrupted and the connection with the suction-port established. During the downstroke of the piston air is sucked from the bulbs or other spaces to be evacuated, which is continued until the piston arrives nearly at the lowermost end of its downstroke, at which point the right-hand cam r' of the cross-head C engages the anti-friction roller r of the right-hand set of levers, so as to shift by their instrumentality the slide-valve toward the right into the position shown in Fig. 2. The connection of the **S**-shaped port e^2 of the slide-valve with the oil-port b' and the port d of the cylinder-head is thereby re-established, so that during the upstroke of the piston the air in the pump-cylinder is forced through the oil-chamber to the outside, and then the oil-packing is forced up into the oil-chamber, and so on.

When the left-hand set of levers is operated by the inclined cam of the cross-head, the right-hand set of levers follows freely the motion of the slide-valve, while when the right-hand set of levers is operated by the second inclined cam of the cross-head the left-hand set of levers follows the motion of the slide-valve, neither set of levers interfering with the motion of the other, as the action of the cams on the same takes place at different times and in different relative positions of the cross-head, so that no interference of one set of levers with the other nor the blocking of

the shifting motion of the slide-valve can take place.

The suction-ports *d d* of the top plates E′ of both pump-cylinders B B are connected by branch pipes D′ with the main suction-pipe D, which latter is connected by a rubber or other flexible hose with the bulbs or other articles to be evacuated. In the air-suction pipe D is arranged below the branch pipe D′ an auxiliary slide-valve G, which is set by a fulcrumed hand-lever G′, said slide-valve being provided with a straight port *g*, which passes through the body of the slide-valve and connects the suction-pipe D with the branch pipe D′ as long as the evacuating action of the pumps is to be kept up. Whenever the required degree of vacuum in the bulbs is produced, the auxiliary slide-valve G is shifted and a second transverse port *g′* placed in connection with the branch pipes D′, said port communicating with the atmosphere and permitting the easy running of the pumps without stopping the same until the air-suction pipe is again connected to another set of bulbs or spaces to be evacuated. In this manner the air-pumps can be thrown in or out of work in a very easy and convenient manner without stopping the same, the auxiliary slide-valve producing either the working of the pump for establishing a vacuum in the spaces to be evacuated or the running of the pump. The connecting-rods of the pump-pistons are applied at diametrically-opposite sides of the motion-transmitting crank-shaft, so that the alternating action of the pumps is produced. Each piston makes about ten strokes per minute, and produces by the perfect sealing of its oil-packing quickly vacua of high pressure, so as to be specially applicable for all purposes where high vacua have to be established.

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

1. In a pump, the combination, with a cylinder provided with an inlet port or passage and a piston, of an intermittently-reciprocating slide-valve provided with ports to register with the said inlet-port, a valve-cap having ports, and an oil-reservoir communicating with one of said ports in the valve-cap.

2. In a pump, the combination, with a cylinder provided with an inlet port or passage and a piston, of a slide-valve provided with ports to register with the said inlet-port, a valve-cap having ports, an oil-reservoir communicating with one of said ports in the valve-cap, and a double set of levers connected with opposite sides of said valve to intermittently reciprocate it.

3. In a pump, the combination, with a cylinder provided with an inlet port or passage and a piston in said cylinder, of a valve fitted to its seat and provided with ports to register with the said inlet-port, a valve-cap having ports and fitted on said valve, a closed reservoir to contain atmospheric air and oil communicating with a port in said valve-cap, and valve-actuating mechanism for moving said valve to establish communication between said reservoir and cylinder and thereafter to cut off said communication.

4. In combination with a cylinder covered with a head having an inlet and a piston fitted in said cylinder, a valve apparatus having ports to register with the inlet of the said cylinder, and a reservoir to contain liquid and air, having a passage capable of being opened and closed through said valve, the said liquid being adapted to flow from said reservoir into and through said valve apparatus into said cylinder and upon said piston.

5. The combination, with a vertical pump cylinder and piston, of a cylinder-head having a single port, an oil-chamber above the cylinder, an air-suction pipe, a top plate having two ports connected, respectively, with the oil-chamber and air-suction pipe, and an intermittently-reciprocated slide-valve guided between the cylinder and top plate, said slide-valve having a straight port and an **S**-shaped port, substantially as set forth.

6. The combination of a vertical pump-cylinder having a head with a single port, of an oil-chamber above the pump-cylinder, an air-suction pipe, a top plate having two ports connected, respectively, with the oil-chamber and air-suction pipe, a slide-valve guided between the top plate and cylinder-head and provided with a straight port and an **S**-shaped port, and a double set of levers connected to opposite ends of the slide-valve and actuated by a cam-head of the piston-rod, so as to intermittently reciprocate the slide-valve, substantially as set forth.

7. The combination of a pump-cylinder, a cylinder-head having a port, guideways on said head, a reciprocating slide-valve having ports communicating with the port in the cylinder-head, and spring-cushioned retaining-lugs fulcrumed to said ways and projecting laterally over the slide-valve at opposite sides thereof, substantially as set forth.

8. The combination, with a pump-cylinder, of a slide-valve guided in ways of the cylinder-head, two sets of fulcrumed levers connected to opposite ends of the slide-valve, one of said levers having a nose at the lower end, and inclined cams attached to the cross-head of the piston-rod, said cams engaging the lower ends of the fulcrumed levers, one of said cams being spring-cushioned and guided in a socket of the cross-head, so as to pass over the lower end of one set of levers during the upstroke of the piston but engage it by the downstroke of the same, substantially as set forth.

9. In a pump, the combination, with a cylinder provided with an inlet port or passage and a piston, of an intermittently-reciprocating slide-valve provided with ports to register with said inlet-port, a valve-cap having ports, an oil-reservoir communicating with

one of said ports in the valve-cap, an air-suction pipe connected with the other port in said valve-cap, and an auxiliary slide-valve located in the suction-pipe and provided with two ports, one connecting with the suction-pipe and the other with the atmosphere, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

ALBERT BERRENBERG.

Witnesses:

CARL KARP,

JOHN ALONZO STRALEY.