(No Model.)

2 Sheets—Sheet 1.

A. HELLER.

AIR PUMP.

No. 530,106. Patented Dec. 4, 1894.

Fig. 5.

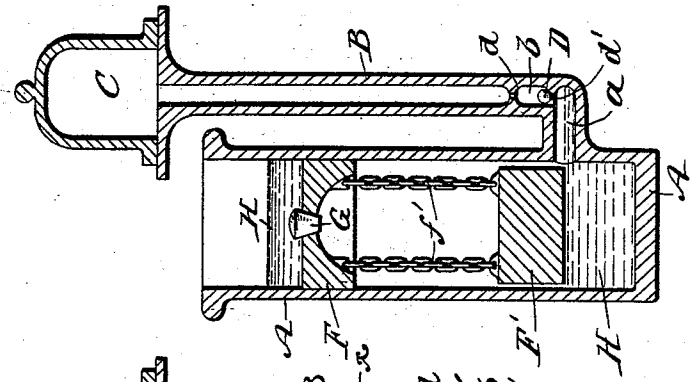


Fig. 2.

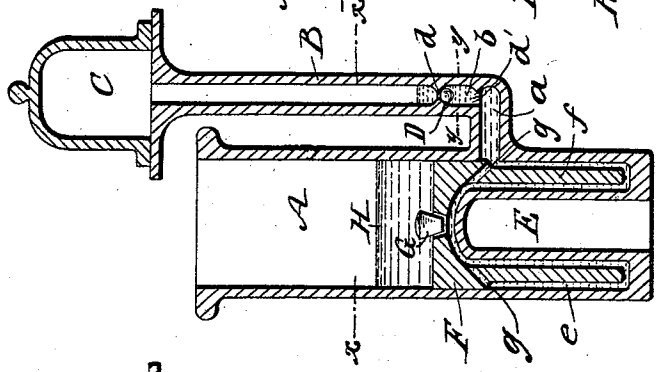


Fig. 1.

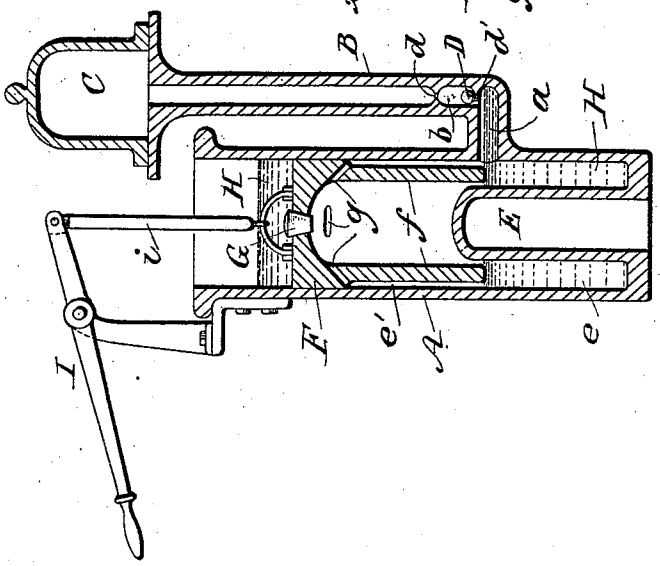
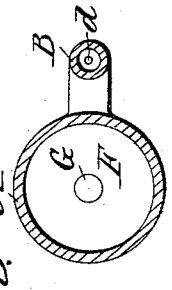


Fig. 4.

Fig. 3.



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(No Model.)

2 Sheets—Sheet 2.

A. HELLER.

AIR PUMP.

No. 530,106. Patented Dec. 4, 1894.

Fig. 8.

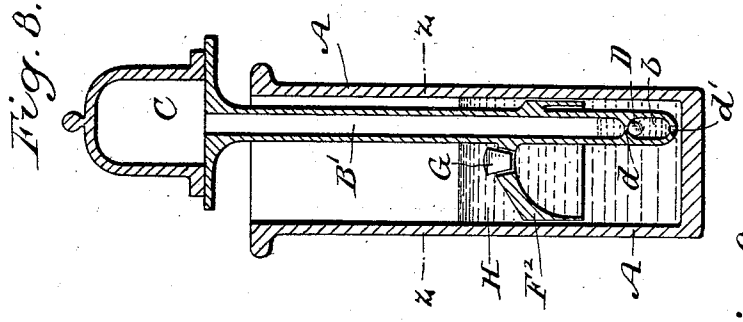


Fig. 9.

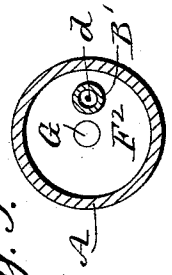


Fig. 7.

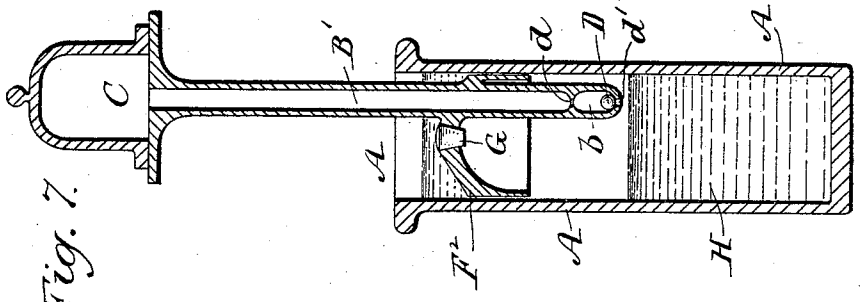


Fig. 6.

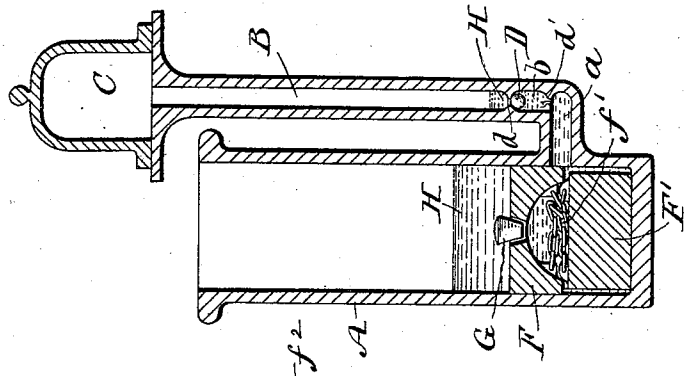
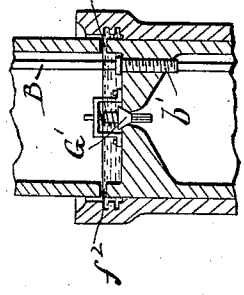


Fig. 10.



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UNITED STATES PATENT OFFICE.

ADOLF HELLER, OF BERLIN, GERMANY, ASSIGNOR TO SIEMENS & HALSKE, OF SAME PLACE.

AIR-PUMP.

SPECIFICATION forming part of Letters Patent No. 530,106, dated December 4, 1894.

Application filed January 25, 1893. Serial No. 459,745. (No model.)

To all whom it may concern:

Be it known that I, ADOLF HELLER, a subject of the King of Saxony, residing at the city of Berlin, Kingdom of Prussia, German Empire, have invented new and useful Improvements in Air-Pumps, of which the following is a specification.

My invention relates to an air-pump designed to combine the advantages of the mercury sealed pump and the ordinary piston or plunger pump.

The invention will first be described, and then will be particularly defined in claims hereinafter set forth.

Reference is to be had to the accompanying drawings, forming a part of this specification, and in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1, is a vertical central sectional view of an air-pump embodying my improvements, with the moving parts in positions they assume at the end of the upward or air exhausting stroke. Fig. 2, is a like sectional view, but with the parts in reverse positions taken at the completion of the downward or air discharging stroke. Fig. 3, is a detail horizontal sectional view, taken on the line x, x, in Fig. 2. Fig. 4, is a detail horizontal section taken on the line y, y, in Fig. 2. Figs. 5 and 6, are central vertical sectional views of a modified form of the pump, with moving parts in two extremes of position. Figs. 7 and 8, are central vertical sectional views of another modification. Fig. 9, is a detail horizontal section, taken on the line z, z, in Fig. 8, and Fig. 10, is a detail vertical sectional view showing modifications of the piston valve and the exhaust tube or pipe fitted therein.

Referring first to Figs. 1, 2, 3 and 4 of the drawings, it will be seen that the pump barrel or cylinder A, has communication by a lateral passage a, with a side suction pipe or tube B, of smaller area and which communicates with the interior of a receiver C, shown at the top of the tube. Substantially similar communication may be made with any vessel or vessels, such for instance as incandescent electric lamp bulbs, from which air is to be exhausted.

At the lower end of the suction tube B, and between two seats d, d', is formed a chamber b, in which is placed loosely, a suitable ball valve D, which in moving upward closes the tube at the opening formed at the seat d, and when moved downward rests on the seat d', which being formed of lateral prongs or projections, allows downward escape of a fluid from the valve chamber b, past the valve and to or toward the main barrel A, of the pump.

At the bottom of the barrel A, rises an interior projection or core E, which provides an annular space e, around it within the barrel, and a piston F, which is fitted to the wall of the barrel has a pendent ring or collar portion f, which has less diameter than the bore of the pump barrel, and is adapted to enter the barrel space e, but it is too small to fill said space from which it dislodges mercury or other fluid through the passage a, and into the valve chamber b, and tube B, on the downward stroke of the piston. At the junction of the collar f, with the main body of the piston F, a number of lateral passages g, are formed, and at the top of the piston is fitted a suitable valve G, which opens upward thereby establishing communication through the passages g, and past the open valve G, for both air exhausted from the receiver C, and a portion of the mercury H, which is charged into the barrel A, below and above the piston.

Any suitable means may be used to reciprocate the piston or plunger within the pump, such as a rod connecting the piston with a lever fulcrumed to the pump barrel. I show a chain connection i, between the piston and a lever I, having a grooved segmental head which guides the chain as the piston is raised by the lever and falls by gravity. This lever connection to the piston is shown only in Fig. 1, of the drawings.

The quantity of mercury or other suitable fluid H, charged into the pump is such that after allowing for so much of it as may pass or leak through at the joint of the piston with the pump barrel, the level of the mercury below the piston will not, on the full upstroke of the latter, entirely fill or close the passage a, between the barrel A, and suction tube B, of the pump.

The operation is as follows:—On the up-

stroke of the piston F, *f*, and while the mercury H, above it prevents admission of atmospheric air through or at the joint between the piston and the barrel A, some of the air will be drawn from the receiver C, downward through the tube B, and the opening of the seat *d*, from which the valve D, falls to the other seat *d'*, which latter retains the valve, but allows the air to pass through into the upper part of the passage *a*, not closed or sealed by the mercury. Thence the air enters the space *e'*, which is left between the pendent portion *f*, of the raised piston and the larger interior wall of the pump barrel, ready to be forced out upwardly during the downward stroke of the piston. See Fig. 1, of the drawings. As the piston begins its return or downward stroke, the entrance of its part *f*, into the mercury H, below it will at once raise the level of the mercury, and thus lift the valve D, to its seat *d*, in the tube B, and a little of the mercury, during the entire downward stroke of the piston, will or may force itself past the closed valve D, as shown in Fig. 2, of the drawings. At or immediately after the commencement of the downward stroke of the piston, the side passage *a*, is fluid-sealed by the rising mercury, and all the air, which, on the last upward stroke of the piston, had drawn from the receiver C, and pipe B, through the passage *a*, into the space *e'*, between the piston and barrel, will, as the piston descends in the mercury, be forced upward and outward by the continually rising mercury through the piston orifices *g*, and thence past the valve G, which opens upward to allow escape of the air past it and through the mercury H, above the piston to the atmosphere. At the completion of the downward stroke of the piston F, *f*, its pendent part *f*, in conjunction with the mercury H, will entirely fill the lower annular portion *e*, of the pump barrel, and the mercury will also fill, and force the air from the piston passages *g*, and from the space between the open valve G, and its seat. In fact the entire body of mercury in the pump barrel A, passage *a*, and valve chamber *b*, will be confluent or in communication, as shown in Fig. 2, of the drawings. Hence every particle of the air which had been exhausted into the pump barrel on or by the prior up-stroke of the piston is forced upward and outward through the mercury H, to the atmosphere on or by the following down-stroke of the piston. This important feature of operation thus entirely avoids waste room or "clearance" space in the pump barrel or piston for what may be termed residual air, and no part of the air which has already been exhausted from the receiver on the up-stroke of the piston can lurk or conceal itself in the barrel and afterward re-enter the side tube B, and the receiver C, in the interval between the complete upward and downward strokes of the piston. During the upward stroke, the piston valve G, will close and the suction valve D, will open, and by subsidence of the mercury communication will again be established through the passage *a*, between the receiver C, and tube B, to allow exhaust of air from the receiver to the pump barrel; the parts then being in the first described positions shown in Fig. 1, of the drawings, and ready for the next downward stroke of the piston to expel such exhausted air from the pump. Repeated reciprocations of the piston will produce any required vacuum in the receiver C, or other vessel or bulb opening to the exhaust tube B. Any mercury H, which may leak downward from above the piston F, at its periphery at the closed valve G, during the upward stroke of the piston will be returned above the piston on its downward stroke.

In the modified form of pump shown in Figs. 5 and 6 of the drawings, the main body or head F, of the piston, instead of having a fixed pendent ring or plunger portion *f*, shown in the preceding views, has a plunger portion F', hung to it by flexible chains or connections *f'*. The plunger F', is somewhat smaller than the interior wall or bore of the pump barrel to give passage of air and of fluid H, between the side opening *a*, and the piston opening controlled by the valve G. The operation of this modified pump is substantially the same as that of the pump shown in Figs. 1 and 2, of the drawings, except that the chains allow the piston head F, to approach the fluid displacing plunger, as shown in Fig. 6, of the drawings, and thereby permit the pump to be made somewhat shorter for a given capacity than the pump first above described.

In the modification show in Figs. 7, 8, and 9, of the drawings, the suction tube or pipe B', which carries the receiver C, is fixed to and penetrates the piston F^2, which is fitted with an upwardly opening valve G; and the tube, which reciprocates with the piston, has at its lower end a valve chamber *b*, containing a ball valve D, and having seats *d*, *d'*, with which the valve operates in the same manner as hereinbefore described. With this construction the level of mercury or fluid H, in the barrel A, remains nearly the same during the reciprocations of the cup-shaped piston F^2, and attached exhaust pipe B', and the air exhausted from the receiver and pipe B', into the barrel A, when the up-stroke of the piston is completed, is discharged from the pump past the open valve G, and through the mercury above the piston on the downward stroke of the latter.

Fig. 10, of the drawings shows how a spring-closed valve G', may be used at the head of the piston, instead of the plug valve G, shown in Figs. 1, 2, 5, 6, 7, and 8, of the drawings. Fig. 10, also illustrates how the suction tube B, which carries a ball valve in a chamber at or near its lower end, may be fitted adjustably in the piston by a screw collar or bushing *b'*, which allows the lower valve carrying end of the tube to be nicely adjusted relatively to the level of the mercury, oil or other

fluid at the bottom of the cylinder. Apertures f^2, in the piston wall give confluence to mercury or fluid above the piston and that which may pass through at the joint of the cylinder and piston. The valves used may be made of iron, ivory or any other suitable material.

In all the constructions above described, the operation of the piston in the fluid-charged pump barrel prevents waste room or "clearance," and consequently all the air exhausted into the barrel on the upward stroke of the piston is discharged on its downward stroke, and return to the receiver of air once exhausted from it into the barrel is prevented. Hence the pump will always act effectively and economy of motive power used to operate it is assured.

I claim—

1. An air pump consisting of a barrel, a suction tube communicating therewith and provided with an inwardly opening valve; a liquid in said barrel; and a bell-shaped pump piston having an externally opening valve and provided with lateral passages and arranged to communicate to the said liquid a reciprocatory movement, substantially as described.

2. An air pump consisting of a barrel having a re-entrant base forming an annular passage; a suction tube; an inverted bell-shaped piston adapted to fit loosely over the re-entrant base, and having its upper portion arranged to fit the pump barrel snugly, and provided with an outwardly opening valve; and lateral passages in the sides of the piston and affording means of communication between the suction tube and the piston valve whereby, in the descent of the piston, the air included between the narrowed portions thereof and the pump barrel may be forced upwardly and outwardly through the piston valve, substantially as described.

3. An air pump consisting of a barrel having a partial filling of suitable liquid; and a reciprocating valved piston, provided with a suction tube having an apertured chamber therein, a float valve controlling the openings in said chamber and means for connection with the cavity to be exhausted, substantially as described.

4. An air pump consisting of a barrel having a partial filling of suitable liquid; and a reciprocating valved piston, provided with an adjustable suction tube having a suitable valve and means for connection with the cavity to be exhausted, substantially as described.

5. An air pump consisting of a barrel; a suction tube therefor having connections with a cavity to be exhausted; a liquid in said barrel; and a bell-shaped pump piston having an externally opening valve, and provided with lateral openings, whereby the level of the liquid may be mechanically shifted to exhaust the air from said cavity, substantially as described.

In testimony whereof I have affixed my signature in the presence of two witnesses.

ADOLF HELLER.

Witnesses:
GUSTAV STENZEL,
MAX WAGNER.