(No Model.)

R. P. ASHWELL & J. A. VANDEGRIFT.

VACUUM APPARATUS.

No. 512,789. Patented Jan. 16, 1894.

Fig. 1

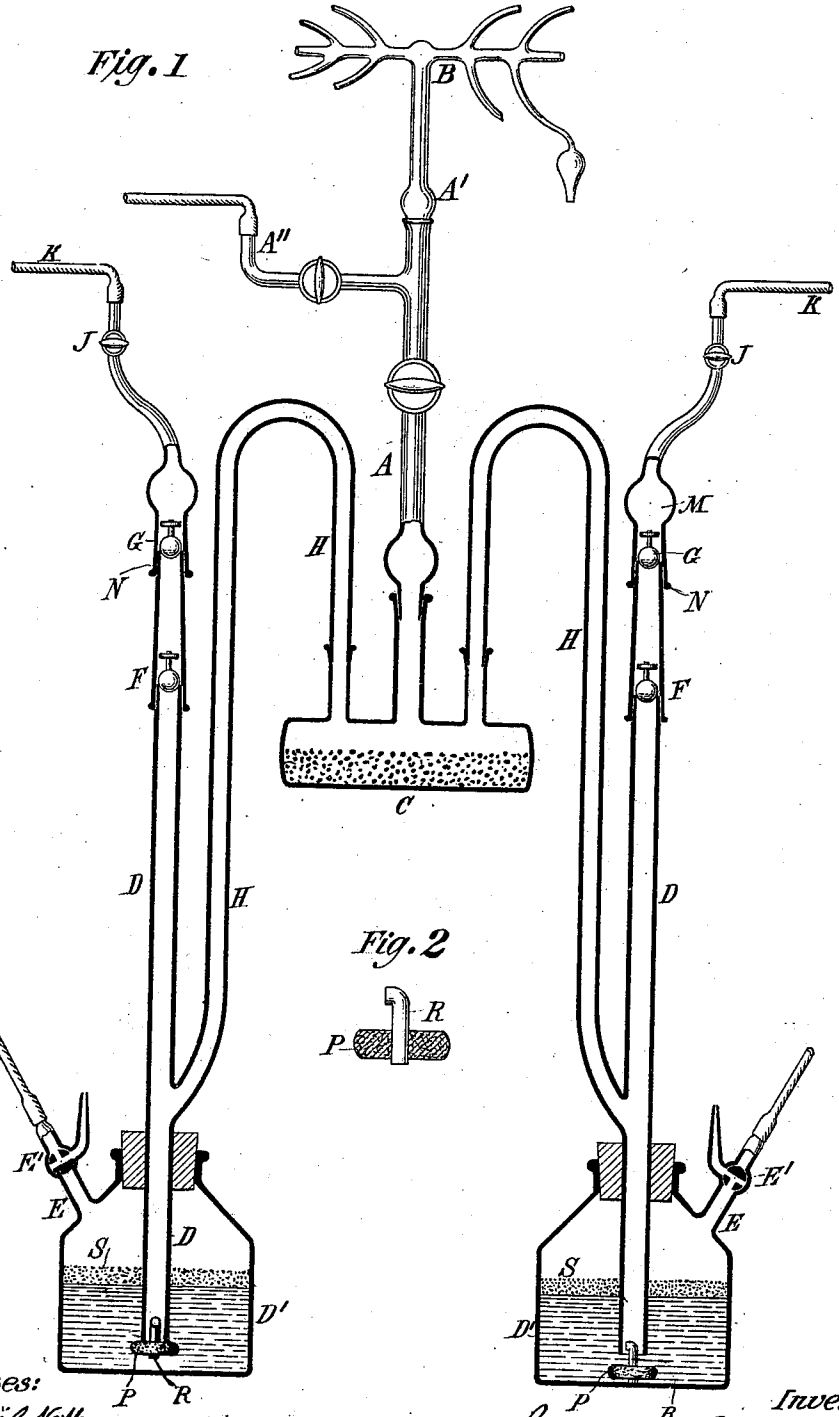

Fig. 2

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VACUUM APPARATUS.

SPECIFICATION forming part of Letters Patent No. 512,789, dated January 16, 1894.

Application filed May 4, 1893. Serial No. 472,964. (No model.)

To all whom it may concern:

Be it known that we, RICHARD P. ASHWELL, residing at Newark, in the county of Essex and State of New Jersey, and JAMES A. VANDEGRIFT, residing at New York, in the county and State of New York, citizens of the United States, have invented certain new and useful Improvements in Vacuum Apparatus, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

Our invention is an improvement in high vacuum pumps, such as are commonly employed for exhausting the globes of incandescent electric lamps, and has for its object to provide an apparatus that will effect the proper degree of exhaustion at less expense and in a shorter time than is required with the pumps now in use, and also to simplify and improve in certain particulars the construction of the pump.

Our invention involves improvements in apparatus constructed and operated on the principle of the Geissler pump, and in practice we prefer to combine two of these pumps for exhausting the same lamp or cluster of lamps or other devices, by connecting them both to the said lamp and working them in alternation, in a manner well understood, but our improvements are applicable to the single pumps, and will be explained in detail by reference to the accompanying drawings, in which—

Figure 1 is a side elevation of two of our improved pumps combined in the manner above described. Fig. 2 is an enlarged view of one of the parts of the pump detached.

It will be understood that the various parts, composed almost entirely of glass, are to be secured to a vertical support in the usual manner.

A is a vertical tube or chamber with a ground orifice A′ into which the stem of a cluster of lamps B, which are to be exhausted, is to be fitted. The tube A has a branch A″ through which the preliminary or rough exhaustion of the lamps and the interior of the pump is effected by a mechanical or power pump. The high vacuum or mercury pumps are connected with the tube A through the usual receptacle C for an anhydrous absorbent. As both of the aforesaid mercury pumps are of the same construction, a description of one will suffice.

D is a vertical tube the lower end of which extends down into a mercury reservoir D′ through an air-tight seal. From the upper part of the reservoir D′ runs a tube E divided into two branches one connected with the mechanical exhaust pump, the other open to the air. These branches are controlled by a suitable three-way cock E′.

Any means or devices, it may be here stated, may be employed for admitting or withdrawing the air to or from the upper part of the reservoir D′ alternately for causing the mercury to rise or fall in the tube D. The interior of the tube D is of as nearly as possible uniform diameter to its upper end, which is contracted and connected by a suitable pipe or tube K with a mechanical exhaust pump. A cock J is placed in the contracted portion of the pipe D at a point somewhat more than thirty inches above the lowest level of the mercury in the reservoir D′, and below said cock and in the uncontracted portion of the tube D are two automatic valves F G. At a point slightly above the reservoir D′ the tube D is branched, and connected by an inverted U-shaped tube H with the receptacle C. The highest point or the bend in tube H is somewhat over thirty inches above the line of lowest normal level of the mercury in the reservoir D′, or a little above the highest level to which the mercury rises in the tube D.

By the mechanical or power pump the air is partially exhausted from the interior of the apparatus through the tubes A″ and K. Air is then admitted into the reservoir D′ above the mercury which causes the latter to rise in tube D. When its level reaches the branch to tube H, a certain portion of the residual air is intercepted in the upper part of tube D and is forced by the rising column of mercury up through the valves F and G into the exhausted chamber to which the pipe K is connected. The mercury flows up around the valves F and G, rising until the air bubble is

properly expelled, and at the same time flows up in tube H to a point sufficiently below the bend to prevent its passing over into the receptacle C. While this operation is taking place in one of the pumps the reverse occurs in the other. That is to say, the air is exhausted from the reservoir D′ by the mechanical pump so that under the more nearly equal pressures the mercury descends from the pump and flows back into the reservoir D′.

The valves F G are loaded so that they seat themselves when only sufficient mercury is left above them to partially cover them. These actions go on alternately until the desired degree of exhaustion is attained.

With the object of expelling by each rise of the mercury a larger proportion of the residual air, it has always been customary to enlarge the tube D at a point above the branch, or to introduce at such point a reservoir or chamber. We find that better results are secured by dispensing with all such devices, and we make this portion of the tube D of uniform diameter. We find that the increased rapidity with which the pump may be worked under such conditions more than compensates for the smaller capacity of the interior of that portion of the pump from which the air is expelled by the rise of the mercury.

In pumps of this character it has heretofore been usual to employ a valve between the exhaust chamber proper of the pump and the tube D, although it has been proposed to carry up the tube corresponding to our tube H over thirty inches above the level which the mercury attains or may attain in the upper chamber, but this was only in pumps in which an enlarged mercury chamber was used in place of our tube D and open to the air and not connected with a secondary pump.

We find a special advantage, and one which contributes very materially to the rapid operation of the pump in combining with the tube D of uniform diameter, the tube H also of uniform diameter and free from valves of all kinds.

In order to secure the best and most rapid operation of the pump we have found it necessary to carry out the feature of uniform diameter of tube D to the extent of so constructing the valves F and G that there will be a practically unobstructed passage for the mercury through them, and for this purpose, instead of seating said valves in contracted portions of the tube we make the valve chamber M, or that portion of the tube containing the valve, with a ground opening which fits over the ground end N of the section of tube below it and seat the valve directly upon the open end N. The tubes are not contracted at all, or at least to any material extent.

Inasmuch as the tube D affords a free and unobstructed passage to the mercury, the too sudden or accidental admission of air to the reservoir D′ would cause the mercury to rush up the tube D and through the valves F G with considerable violence. It is therefore necessary to check the flow of mercury from the reservoir into the tube D. But it is desirable that the return of the mercury should be free and unobstructed; hence we provide between the reservoir and the tube any suitable valve which will accomplish the result. We prefer to use for this purpose a body of rubber P through which extends a contracted glass tube R, the upper end of which is bent over to prevent the mercury from squirting up into the tube. This prevents too rapid a flow of mercury into the tube but allows it to return freely back into the reservoir by lifting the valve bodily away from the end of tube D which forms its seat.

In these pumps it has been usual to pass the air admitted to the mercury reservoir through some material that would absorb the moisture contained therein, but this has not proved altogether effective. We find that we can secure very much better results by placing on the mercury within the chamber any suitable absorbent S, that will float on the mercury. In this way the mercury is fully protected from direct contact with the inflowing air, and as the mercury flows back from tube D it surges up through the absorbent and is thoroughly dried.

Except in the special particulars herein indicated, the invention is not limited to any particular construction of pump, and the details of the particular pump to which the invention is herein shown as applied may be considerably varied without departure from the invention.

What we claim is—

1. In a vacuum pump of the kind described, the vertical tube D connected with the mercury reservoir and from which the air is expelled by displacement, and having a uniform diameter or bore throughout the portion traversed by the mercury in the operation of the pump, as set forth.

2. In a Geissler pump the combination with the vertical tube D connected with the mercury reservoir and from which the air is expelled by displacement and having a uniform diameter or bore throughout the portion traversed by the mercury in the operation of the pump, of one or more valves at the upper end of the said tube, contained in chambers formed by one section of glass tubing fitting over the end of another below, and seated on the uncontracted end of the lower or inner section as set forth.

3. In a vacuum apparatus the combination with the tube D and a mercury reservoir with which said tube communicates, of an intermediate valve adapted to partially oppose the passage of mercury from the reservoir into the tube but to permit its free return, as set forth.

4. The combination with the vertical tube

D of uniform diameter, the mercury reservoir into which its lower end extends, and means for varying the atmospheric pressure acting on the mercury within the reservoir, of a perforated valve at the orifice of the tube D that retards the flow of mercury into the tube but permits its free return, as set forth.

5. In a vacuum apparatus the combination with a tube, as D, through which mercury is caused to rise and fall, of a mercury reservoir with which said tube communicates, means for varying the atmospheric pressure within said reservoir and an anhydrous absorbent in said reservoir and floating on the mercury, as set forth.

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