(No Model.)

E. THOMSON.

PUMP FOR PRODUCING HIGH VACUA.

No. 358,131. Patented Feb. 22, 1887.

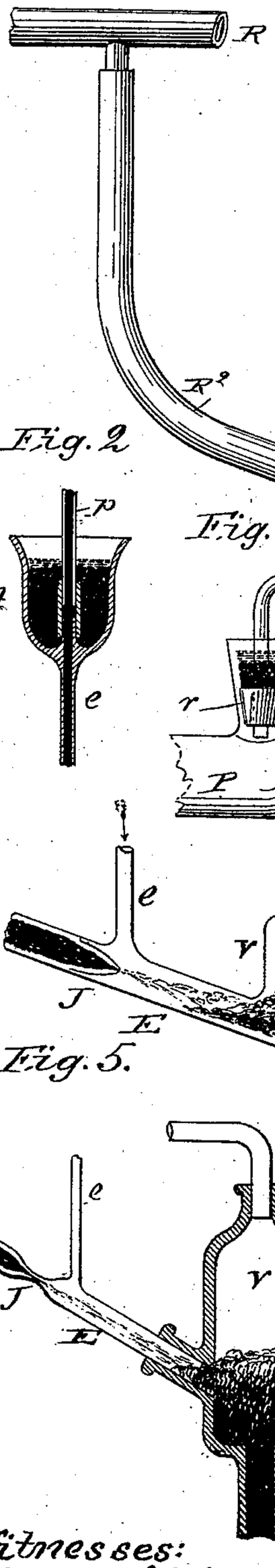

Fig. 1.

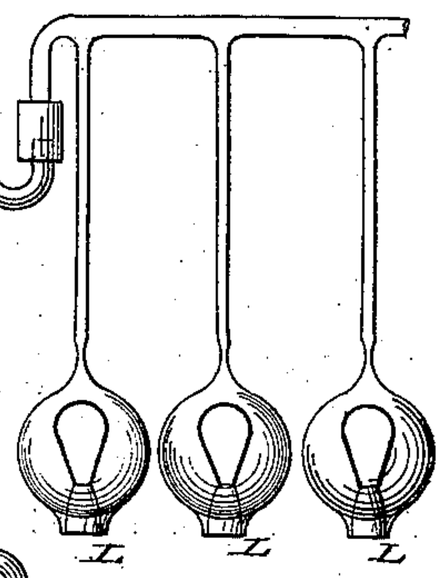

Fig. 2

Fig. 3.

Fig. 4.

Fig. 5.

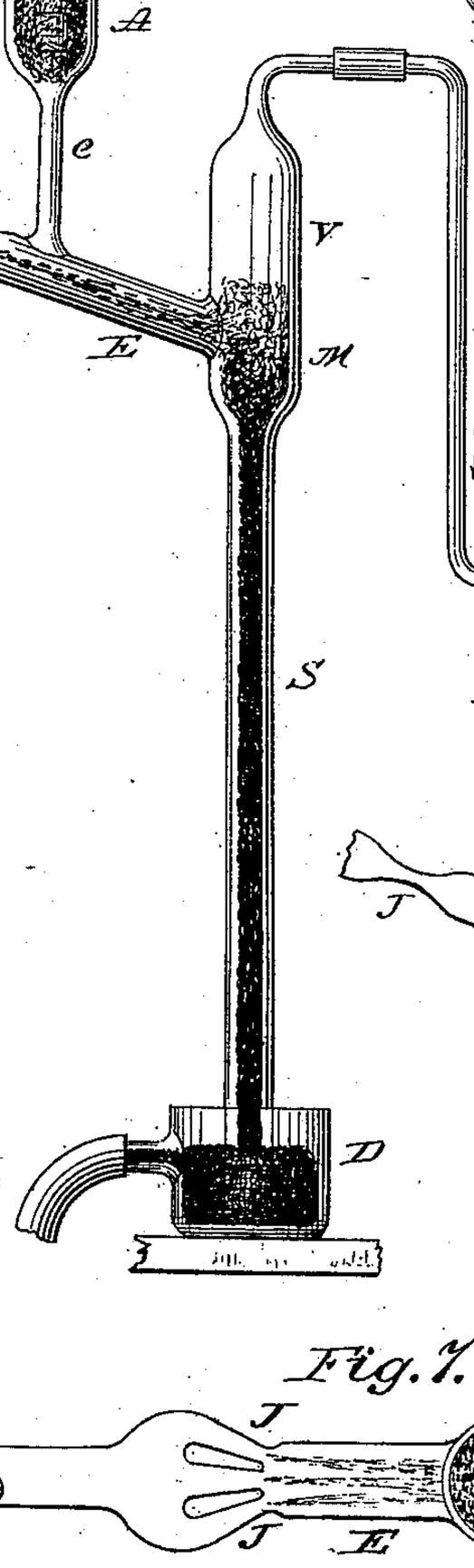

Fig. 6.

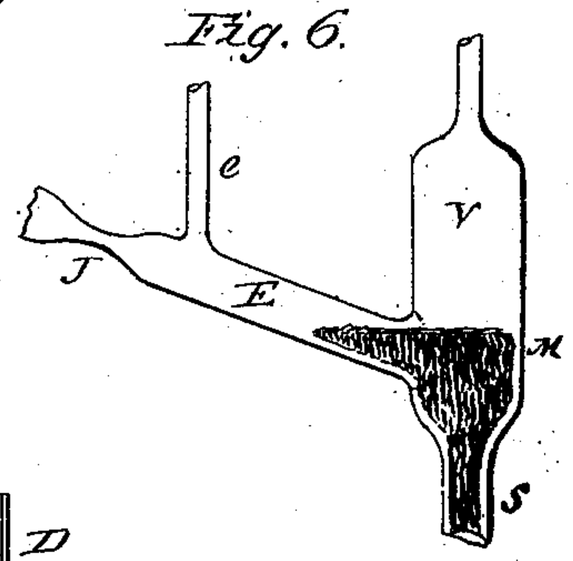

Fig. 7.

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UNITED STATES PATENT OFFICE.

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PUMP FOR PRODUCING HIGH VACUA.

SPECIFICATION forming part of Letters Patent No. 358,131, dated February 22, 1887.

Application filed September 10, 1884. Serial No. 142,702. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Pumps for Producing High Vacua, of which the following is a specification.

My invention relates to air-pumps employed for producing high vacua—such as required in incandescent electric lamps, Geissler tubes, or other apparatus—and is designed more particularly as an improvement on the mercury-pumps now in use for such purposes.

The object of my invention is to increase the rapidity with which exhaustion may be effected, to provide a pump easy of construction and manipulation, and especially to provide a pump free from the objections of pumps of the Geissler and Sprengel type. In pumps of the Sprengel type there is liability of breakage of the shafts or tubes, owing to the shock of the falling mercury when a nearly-perfect vacuum has been attained, while with the pumps of the Geissler type there is the necessity of manual attendance to avoid the violent shocks due to sudden stoppage in movement of a mass of mercury while the apparatus is in use. By my invention these objections are avoided, while at the same time all the advantages of the Sprengel pump for high exhaustion are preserved, my pump being virtually without valves. Unlike the Sprengel pump, it can be readily multiplied in number or size without inconvenience, while at the same time it is extremely simple in its working.

In the accompanying drawings, Figure 1 is an elevation of one form of apparatus embodying my invention. Figs. 2 and 3 illustrate a detail of construction. Fig. 4 illustrates a modification in the shape of the tubes. Fig. 5 illustrates a modification of the invention. Fig. 6 shows the position of the mercury in the vertical tube at the start. Fig. 7 shows another modified detail of the apparatus.

R indicates a pipe or conduit communicating with a reservoir or supply-source of mercury—such that a head or pressure may be maintained in a tube, R^2, connected to said pipe and leading to the exhausting device.

At J the tube R^2, or an attachment to the same, is reduced in size, so as to form a nozzle or jet by which a fine stream of mercury may be delivered into a tube, E, inclined, as shown. C is a stop-cock controlling the flow of mercury in the tube R^2. The mercury delivered into E flows to a vertical tube, S, in which the mercury stands in a column, like the mercury of a barometer-tube, or like that in the vertical tube of a Sprengel pump. At the bottom of the tube S is a drain-cup, D, of the ordinary kind, which cup is made vertically adjustable within the limits of barometric changes. At the top of the tube S is an enlargement, V, communicating by a proper pipe with a good air-pump or any means for exhausting air from the space at the top of the mercury column, so as to carry away the air brought down with the mercury jet in E into the mass of mercury at the top of the column, as well as to maintain the mercury column in S. A good piston air-pump suffices, or an ordinary Sprengel or rough Geissler may be used, since the vacuum to be maintained in V need not be very high. A vacuum whose pressure is a little less than one-eighth of an inch of a mercury-gage is good enough, representing a pressure of less than one ounce to the square inch. Whatever device be employed, it is to be kept in constant action while the apparatus is in use.

The tube E is arranged to deliver the mercury opposite a point, as M, just below the level at which the mercury column is maintained by the exhaust-pump connected with the space above it. Opening into E is the exhaust-pipe *e*, communicating with the articles to be exhausted—such, for instance, as incandescent electric-lamp bulbs, (indicated at L L L.) Between the bulbs or other articles and *e* is a drying-chamber containing phosphoric oxide or the like.

A represents a flexible joint, which I prefer to employ in the tube *e*, and which is applicable, in general, to such pumps. It is formed as follows: A cup-shaped extension from *e* at A, as seen in Fig. 2, has an internal nipple to receive a rubber connector, slipped at one end over said nipple and at the other over the tube *p* leading from the drying-vessel. The cup

A is filled with mercury, and a film of oil placed upon its surface. Absolute freedom from leakage is thus secured. In like manner the neck B, where connection is made from the drying-chamber with the article to be exhausted, is expanded to receive a rubber cork and tube, *r*, Fig. 3, above which is a space filled with mercury upon which latter is a layer of oil, to prevent leakage.

The operation of the pump is as follows: At the start the vessel D is adjusted so that when the space V is fully exhausted by the ordinary pump connected therewith the mercury shall stand as at M, Fig. 6, leaving open the passage from E and V, and equalizing the vacuum throughout, although this procedure is not essential. The jet J is now started, and the level adjusted to stand as at M, Fig. 1, just above the mouth of E. The tube S will therefore require to be of such length that the distance from M to the level in D is not far from barometric height. While the jet J is running it causes a vigorous transfer of air-bubbles from E to V, and they cannot return, because the level of the mercury in V at M covers the junction of E and V at all times. The passage of air under the influence of the jet J continues until a complete exhaustion is obtained in E and the other vessels communicating therewith. This is known by the sound of the mercury and the non-appearance of bubbles rising into V. The jet J acts to entangle air with the mercury, which settles out in V, and is carried off by the ordinary pump attached to V. Many pumps—such as shown in Fig. 1—may be connected to exhaust into a single ordinary or other air-pump.

In Fig. 4 I have shown a slight modification in the shape of the tube S and chamber V, the tube in this instance having a bend at its top, and V being connected therewith above the bend. The arrangement is obviously the same in principle, as has already been described.

My invention permits of many modifications, some of which are advantageous. Thus a number of jets and jet-tubes, E, may throw streams into a common receiver, as indicated in Fig. 5, or a number of jets may operate in a common tube, E, as shown in plan in Fig. 7.

In Fig. 5, V is composed of a cast-iron vessel with lateral inclined nipples, into which one or more tubes, E, enter. These are securely cemented in place and provided with jets J and eduction or exhaust tubes *e e*. The vessel V, which is made nearly or quite air-tight, communicates at top with an air-pump, as before, and at bottom with a vertical pipe, S, of proper length and having suitable means for draining off the mercury, which means may be modified to a large extent without affecting my invention.

The action of the device shown in Fig. 5 is the same as that of Fig. 1. Its great advantage in construction is that the tubes E E and parts subjected to high vacuum alone need be of glass, while iron is suitable for the other parts of the pump.

What I claim as my invention is—

1. The combination, in a mercury-pump, of a tube into which a mercury jet is delivered, an exhaust-pipe leading to said tube, a tube or receptacle connected to the jet-tube and containing a permanent barometric column, into which the combined mercury and air from the first-named tube is delivered, and a chamber at the top of said column in which a comparatively low vacuum is maintained.

2. The combination, in a mercury-vacuum pump, of a tube connected to the article to be exhausted, into which tube a mercury jet is delivered, a mercury column receiving the mercury from said tube and cut off from the tube by a mercury seal, and an air-pump connected with the space above said column, as and for the purpose described.

3. The combination, in a mercury-pump, of a tube or chamber, as E, a jet, J, for delivering a jet of mercury into the same, a tube, S, into which the mercury is delivered, and a chamber, V, at the top of the mercury column, sealed from E by the mercury and having an outlet through which the air may be exhausted.

4. In a mercury-pump, a sealing-cup, as A, having an opening through its bottom terminating in a nipple, a flexible connection between said nipple and the continuation of the air-duct, of which the nipple forms a part, in combination with a liquid seal contained in said cup and surrounding the joint, as and for the purpose described.

5. The cup A, having a nipple at its bottom, in combination with a flexible tube connecting said nipple with the tube leading to the drying-chamber, and a mercury seal covered with oil contained in the cup.

6. The combination of a vacuum space or chamber connected with the article to be exhausted, a second space or chamber having a lower vacuum and communicating with the first, a body of mercury by which communication between the two is normally sealed, and an independent jet of mercury flowing into the sealing-body, whereby a continuous transfer of the gas to be exhausted may be caused from the former chamber to the latter, as and for the purpose described.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 6th day of September, A. D. 1884.

ELIHU THOMSON.

Witnesses:
W. O. WAKEFIELD,
A. L. ROHRER.