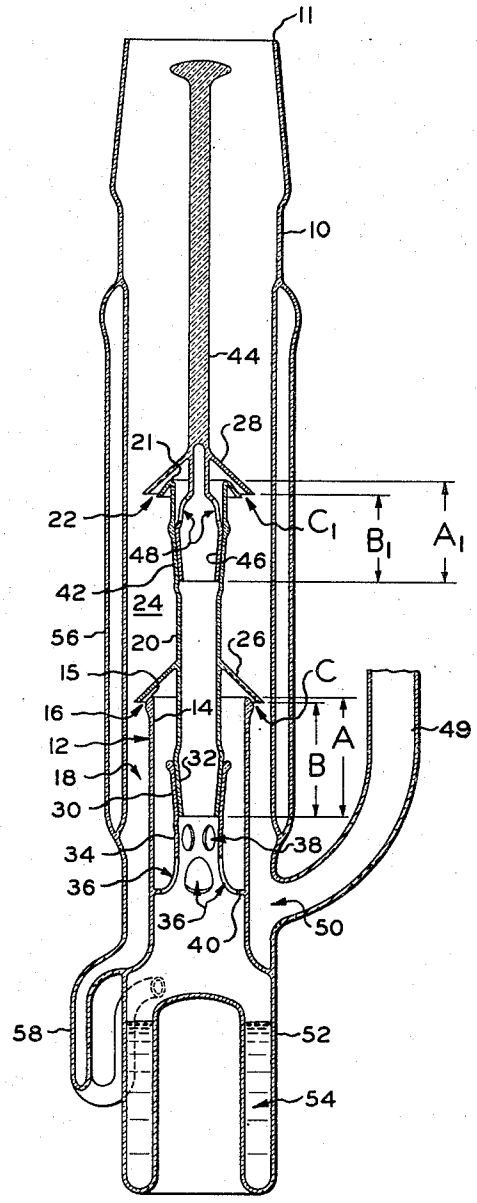
May 24, 1955 R. B. LAWRANCE ET AL 2,709,034

HIGH-VACUUM DEVICE

Filed March 2, 1953



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United States Patent Office 2,709,034 Patented May 24, 1955

2,709,034

HIGH-VACUUM DEVICE

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Application March 2, 1953, Serial No. 339,609

1 Claim. (Cl. 230—101)

This invention relates to vacuum pumps and more particularly to pumps which employ mercury as the pumping vapor.

A principal object of this invention is to produce a multi-stage glass mercury vapor pump wherein the various dimensions of the pump may be closely controlled and reproduced accurately during manufacture of a number of similar pumps.

Another object of the invention is to produce a multi-stage glass mercury vapor pump which may be easily assembled or disassembled.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claim.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing wherein there is shown a diagrammatic sectional view of a preferred embodiment of the present invention.

Heretofore glass mercury vapor pumps have been conventionally produced by fusing together the necessary glass pieces so as to form one glass unit. The assembly of such pumps required much time and the resultant pumps were very difficult to clean thoroughly due to the impossibility of disassembling the jet assembly.

In cases where any internal breakage occurred, such as in the jet assembly, the parts were difficult if not impossible to either repair or replace. However, the most important particular disadvantage of these pumps was in the formation of the jet throat spacing which could vary from pump to pump of similar size. Where the jet throat spacings depended upon the skilled hand of the glass blower it can be readily seen that it would be extremely difficult to duplicate the desired jet openings in the various pumps. Hence the performance of each pump could differ considerably and the results could not be entirely predicted.

The present invention provides for a multi-stage glass mercury vapor pump which may be easily assembled or disassembled, and in which the jet throat spacings may be closely controlled and duplicated so as to assist in giving the same desired performance in each pump. The glass mercury-vapor pump of the present invention comprises a substantially cylindrical pump body provided with a cooling chamber and a vapor jet assembly positioned within the pump body. This jet assembly has a smaller diameter than the pump body and defines several pumping chambers therewith. These pumping chambers are preferably surrounded by the cooling chamber for condensing mercury vapors. The jet assembly comprises a plurality of vapor jets, two being illustrated in the preferred embodiment of the invention. This assembly includes a lower vapor chimney and an upper vapor chimney, the lower chimney supplying vapors to the lower jet, and the upper chimney supplying vapors to the upper jet. The lower jet is defined by the top of the lower chimney and the underside of an umbrella which is carried by the upper chimney. In order to maintain a predetermined spacing for the lower jet, the upper chimney and its umbrella are predeterminedly spaced with respect to the lower chimney by a ground glass seat which is supported within the lower chimney. This arrangement provides for accurate positioning of the two elements which define the vapor jet to give a jet of optimum characteristics which fall within the design dimensions.

In a similar fashion the upper jet is defined by the top of the upper chimney and the under side of a top umbrella, this top umbrella being predeterminedly spaced with respect to the upper chimney by means of a second ground glass seat supported within the upper chimney. To permit the passage of the mercury vapors freely up the chimneys to the respective jets, openings are provided adjacent the means supporting the ground glass seats. The bottom of the jet assembly opens to a boiler for vaporizing mercury at the bottom of the pump. A foreline is connected to the pump body adjacent the bottom of the pumping chamber.

The use of tapered ground glass seats, particularly in the jet assembly, makes it very easy to assemble or disassemble the pump. It also provides the advantage of easily cleaning the pumps and of repairing or replacing damaged or broken parts. It also has the advantage of permitting the close control of jet throat spacings which can be easily duplicated. This additionally furnishes ease of manufacture, since jigs can be readily employed to replace, or augment, the skill of the glass blower.

Referring now to the drawing, the pump body is illustrated at 10 in the form of a cylindrical tube which is open at its upper end 11 to form a fluid inlet, and within which the jet assembly 12 is positioned. The open end of the pump body which leads to the chamber to be evacuated may be provided with a suitable tapered ground-glass seat. In the preferred form shown, the jet assembly comprises a lower cylindrical vapor chimney 14 which terminates at its top in a jet 16. This lower chimney 14 is preferably coaxially positioned with respect to the pump body 10 and defines a cylindrical lower pumping chamber 18 with the pump body. The jet assembly also includes a second vapor chimney 20 which terminates in a top jet 22. This upper chimney is preferably of smaller diameter than the first vapor chimney 14 and defines an upper pumping chamber 24 with the pump body. The lower chimney supplies mercury vapors to the lower jet 16 and the upper chimney supplies mercury vapors to the upper jet 22. The lower jet 16 is defined by the top 15 of the lower vapor chimney 14 and the underside of an umbrella 26 which is carried by the upper vapor chimney 20. The upper jet 22 is defined by the top 21 of the upper vapor chimney 20 and the underside of a top umbrella 28. The lower chimney 14 contains an upwardly extending concentrically positioned tapered ground glass seat 30 which joins with and supports a bottom tapered ground glass seat 32 on the upper chimney 20. The tapered ground glass seat 30 is joined by means of a glass support near the bottom part of the lower chimney wall 14. The glass seat support 34 is provided with two or three openings 36 around the base for the return of condensed mercury to the boiler. This support 34 is also provided with at least three holes 38 around the upper portion to insure a continuous passage of mercury vapors to the lower jet 16.

The glass seat support 34 is joined to the lower chimney wall 14 so that the portion immediately adjacent to the wall, as designated at 40, is preferably either perpendicular to the wall or slightly sloped downwardly. This con-

struction provides for the free drainage of condensed mercury and thus eliminates any mercury accumulation which might partially obstruct the openings in the base of the support so as to interfere with the flow of mercury vapors to the lower jet.

The upper chimney **20** in addition to the bottom ground glass seat **32** is also provided with a tapered ground glass seat **42** near the upper jet **22**. The umbrella **28** and ground glass seat **46** are carried by a hollow member. The umbrella **28** on the glass rod **44** is predeterminedly spaced with respect to the upper chimney by means of a ground glass seat **46** supported within the upper chimney by means of the seat **42**. To permit the passage of mercury vapors freely to the upper jet several openings **48** are provided above the ground glass seat **46**.

A foreline **49** is connected to the pump body adjacent an opening **50** in the pump body to provide a fluid outlet, this foreline, in operation, being preferably connected to a suitable mechanical pump. This foreline is preferably shaped for the easy drainage of any mercury that may be carried into the foreline and may also be provided with a suitably tapered ground glass seat for ease in assembling. At the bottom of the pump body there is provided a boiler housing **52** which is provided with a quantity of mercury **54**. The pump body **10** is provided with a cooling chamber **56**, this cooling chamber maintaining the pump body sufficiently cool so that the mercury vapors striking it are condensed thereon. The cooling means is connected to a suitable source of cooling water and extends for a substantial distance above the top jet and below the lower jet. The pump is also provided with a liquid return **58** for returning condensed mercury to the boiler **52**. The junction of this liquid return **58** with the bottom of the pumping chamber **18** is steeply sloped in order to prevent the condensed mercury from collecting in the bottom of the pumping chamber.

The jet assembly of the preferred embodiment is illustrated as having two cylindrical vapor chimneys and a removable umbrella which forms the upper portion of the top jet. In the event that more than two jets are desired, it can be seen that the construction of the lower cylindrical vapor chimney may be repeated in the upper cylindrical vapor chimneys. The top jet, however, can be formed like the combination of the upper cylindrical vapor chimney and removable top jet umbrella of the present invention.

The above described design of the components of the jet assembly permits the achievement of a predetermined spacing for the jets with greatly simplified manufacturing techniques. In a preferred method of manufacture the lower jet spacing may be accurately predetermined by means of jigging operations. In a first operation, for example, the ground glass seat **30** and support **34** are secured in a jig so that the top edge **15** of the lower chimney **14** is spaced from the bottom of the ground glass seat **30** by the distance "A." The support **34** is then fused to the wall of the lower chimney and the jig is removed. In a second operation, the upper chimney **20** and umbrella **26** are jigged so that the bottom edge of the umbrella **26** is spaced from the bottom of seat **32** by the distance "B." The umbrella **26** is then fused to the outer wall of the upper chimney and the jig is removed.

As a result of this method of manufacture when the upper chimney **20** and its umbrella **26** are supported within the lower chimney **14**, the predetermined jet spacing "C" is obtained.

An alternative method of manufacture is to fuse the parts as indicated above, but without using, at this stage of manufacture, the jigs for establishing final dimensions. After fusing the parts to roughly final dimensions, the exact final dimensions may be achieved with the aid of jigs or gauges, by means of heating and shrinking or by means of grinding, or both. As before, the final result is that the predetermined jet spacing "C" is obtained.

Similar jigging operations may be employed for obtaining the accurate spacings desired for the top jet. In this connection the dimensions "A_1" and "B_1" (which correspond to dimensions "A" and "B") are held to close tolerances to give a predetermined jet spacing "C_1."

Since certain changes may be made in the above apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description, or shown in the accompanying drawing, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

An all glass mercury-vapor pump comprising a substantially cylindrical pump body open at the upper end to form a fluid inlet and having a fluid outlet adjacent the lower end, a vapor jet assembly positioned within said pump body, said jet assembly having a smaller diameter than said pump body and defining a pumping chamber with said pump body, means forming a cooling chamber around said pump body, said jet assembly comprising a lower chimney for mercury vapors, a ground glass seat positioned in said lower chimney, the top of said lower chimney serving as one side of a vapor jet, an upper chimney having a ground glass seat near the bottom thereof for engagement with the ground glass seat of said lower chimney, an umbrella mounted on said upper chimney, the spacing between the underside of said umbrella and said ground glass seat near the bottom of said upper chimney being slightly greater than the spacing between the top of said lower chimney and said ground glass seat positioned therein to provide a predetermined clearance between the underside of said umbrella and the top of said lower chimney when said ground glass seats are in engagement, a second ground glass seat carried by the upper portion of said upper chimney, a hollow member having a second umbrella carried thereby and having a ground glass seat thereon for engagement with the second ground glass seat carried by the upper portion of said upper chimney, said second umbrella being arranged to form a jet with the top of said upper chimney, the spacing between the underside of said second umbrella and said ground glass seat on said hollow member being slightly greater than the spacing between the top of said upper chimney and said ground glass seat carried by the upper portion of said upper chimney to provide a predetermined clearance between the underside of said second umbrella and the top of said upper chimney when said last mentioned two ground glass seats are in engagement, and means defining vapor passages adjacent the ground glass seats to permit the passage of mercury vapors freely up the vapor chimneys to the jets, and a boiler for vaporizing mercury at the bottom of said pump body, the bottom of said jet assembly being open to mercury vapors generated in said boiler.

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