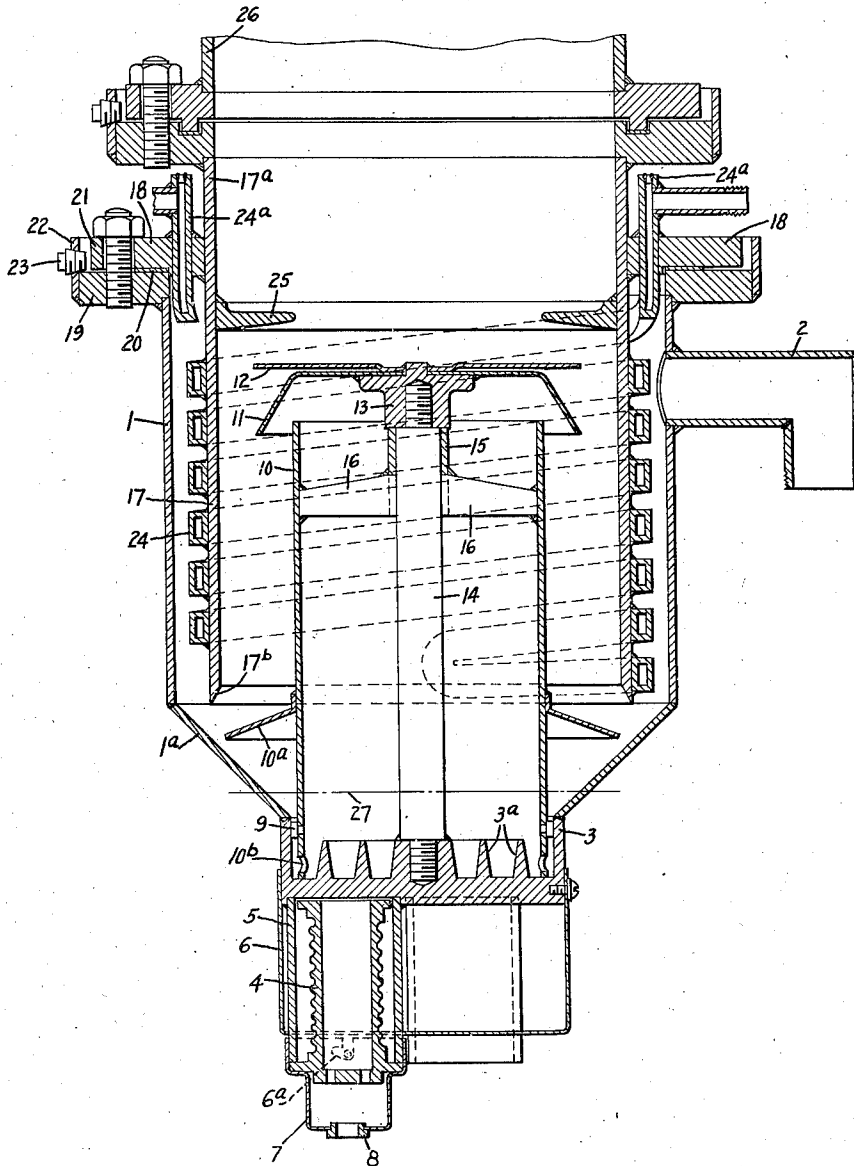


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DIFFUSION VACUUM PUMP
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DIFFUSION VACUUM PUMP

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This invention relates to improvements in diffusion vacuum pumps of the condensation or diffusion type. It is particularly applicable to pumps of the type described in British Patent No. 346,293 which are intended for use with a low vapor pressure oil as a working fluid.

One object of the present invention is to provide a high speed high vacuum single jet diffusion pump which is efficient, reliable and of simple and relatively cheap construction and capable of giving pressures less than 10^{-4} mm. for use in the continuous evacuation of large demountable apparatus such as thermionic valves and X-ray tubes. Other contemplated applications include use with induction furnaces, stills and the like.

To enable the invention to be clearly understood one convenient arrangement thereof by way of example is illustrated in the accompanying drawing and described with reference thereto, the single figure being a sectional side elevation of the vacuum pump.

While my improved pump is by no means limited to use with a particular working fluid, it has been found to possess unusually favorable characteristics for use with the low vapor pressure oil commercially available under the registered trade-mark name, "Apiezon". This comprises a highly refined oil possessing the quality of being able to be heated in vacuum sufficiently to raise its vapor pressure to about 1 or 2 mm. without cracking. Since its vapor pressure becomes extremely low at temperatures not much below room temperature, it is possible to employ it to obtain a very positive jet action without resorting to excessive cooling for condensation purposes.

Referring to the drawing, 1 is the outer shell of the pump, this shell comprising a tubular portion of cylindrical section and, at its lower end, a conical portion 1a, the cylindrical portion 1 having the lateral forevacuum connection pipe 2 near its upper end. The smaller diameter of the conical portion 1a of the shell is approximately half the diameter of the cylindrical portion 1 of the shell. Secured to the lower end of the conical portion 1a is the boiler 3 beneath which is disposed the heater which may be a hot plate applied to the flat underside of the boiler. In the arrangement illustrated said heater comprises a plurality, conveniently three, of heater elements, of which one is illustrated at 4, this element being of a known form and comprising a hollow core of insulating material carrying an external wire winding. Each such heating ele-

ment 4 is adapted to be located in a tube 5 welded beneath the boiler 3 and to be retained in the tube 5 by means of a bayonet fastening indicated by dotted lines at 6a, the slot of the fastening being provided in a detachable cap 7, having a bushed perforation 8 through which the electrical leads for the heater 4 pass. The three (or more) tubes 5 may be enclosed in a detachable shell 6 which may be chromium-plated for the purpose of retaining the heat.

Resting upon the floor of the boiler 3, and engaged with the latter by means of friction studs 9, is the vapor uptake tube 10 having a diameter only slightly smaller than that of the lower end of the conical portion 1a of the outer shell. The vapor uptake tube 10 is surmounted by the cowl 11, and above the latter the molecule baffle 12, these members being secured to a boss 13 which in turn is secured to the centre rod 14, which at its lower end is secured to the centre of the boiler 3. The vapor uptake tube 10 and the supporting rod 14 are centred with respect to each other by means of a tube 15 carried by a spider, two of the radial spokes of which are indicated at 16.

The condenser tube 17 depends into and divides the annular space between the main outer shell 1 and the vapor uptake tube 10. Said condenser tube 17 is attached to or more conveniently, as in the arrangement illustrated, is integral with the pump intake 17a. The tube 17a is provided with an external flange 18 which is adapted to be demountably vacuum-sealed to the flange 19 provided at the top of the main outer shell 1. The vacuum seal is preferably completed by means of a gasket 20 of appropriate material and an external flood of oil in a channel 21 provided above the flange 19 by the cylindrical flange 22 which may be provided with a drain tap or with the illustrated drain plug 23.

The condenser tube 17 has a water jacket, which in the illustrated arrangement comprises a tube 24 arranged in double or re-entrant helical form around the outer surface of the tube 17, and connected thereto such as by welding or soldering in a manner to provide good thermal contact. It will be obvious that the water jacket might be alternatively provided by means of an additional shell secured coaxially to the tube 17. The ends of the tube 24, which is preferably of flattened section as shown, are carried through perforations in the flange 18, as indicated at 24a. Within the condenser tube 17 is fixed the molecule baffle 25 in the form of an internal flange, this baffle in conjunction with the baffle 12 serv-

ing to prevent molecules of working fluid vapor passing into the evacuating system, as described for example in British Patent No. 346,293.

The lower edge of the condenser tube 17 is bevelled, as indicated at 17b, to facilitate the dripping of the condensed working fluid therefrom clear of the conical baffle 10a which is secured towards the lower end of the vapor uptake tube 10 within the conical portion 1a of the outer shell, said baffle 10a having a diameter slightly less than that of the condenser tube 17. The tube 10 is formed at its lower end with holes 10b to permit the condensed working fluid to flow into the boiler.

It will be seen that the pump inlet of the condenser and its securing means comprises a unit which can readily be connected with the apparatus to be evacuated either direct or by means of a pipe 26 which may be secured in a dismountably vacuum-tight manner, conveniently by an arrangement which may be generally similar to the seal already described comprising the items 18-23.

The floor of the boiler 3 has a ribbed upper surface, the ribs being arranged as two concentric circles, as indicated at 3a and radial channels (which are not visible in the drawing) are provided, namely, in order that a uniform fluid level may be maintained within the boiler in case the fluid level should become insufficient to flood the ribs 3a. Conveniently there are three such radial communicating channels arranged at an angle of 120° with respect to each other.

The pump above described and shown in the drawing is conveniently made of mild steel with the exception of the vapor uptake tube 10, its cowl 11, baffle 12, and centre supporting rod 14, which parts are preferably of copper or other metal having a relatively high thermal conductivity, for the purpose set forth in the aforesaid British Patent No. 346,293.

The pump as above described and shown in the drawing has actually been constructed and successfully operated, and the vertical height of the condenser tube 17, excluding the thickness of the illustrated flange at its upper end, was 11 inches, the accompanying drawing being otherwise substantially to scale. The normal working level of the oil in the boiler 3 is indicated at 27, and the capacity at this level is approximately 600 cc.

It will be understood that various minor modifications may be made in the arrangement illustrated, all within the scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A single jet diffusion pump comprising a substantially cylindrical outer casing having an

outlet for pumped gases adjacent the top thereof, said casing being inwardly tapered at the bottom to join with a circular heating member of substantially less diameter than said casing, a vapor uptake tube comprising a metal cylinder of substantially the same diameter as said member and projecting upwardly therefrom, a working fluid injection orifice adjacent the top of said tube, a cylindrical condenser unit projecting downwardly into the annular space between said outer casing and said uptake tube, an inlet at the top of said pump assembly for admitting pumped gases downwardly within said condenser unit, an external flange projecting laterally from said condenser unit for supporting the same, and demountable means hermetically sealing said flange to the upper portion of said casing.

2. A single jet diffusion pump comprising an outer casing having an outlet for pumped gases adjacent the top thereof, said casing being inwardly tapered at the bottom to join with a heating member of approximately one-half the diameter of the casing, a vapor uptake tube of approximately the same diameter as said member and joined thereto, a working fluid injection orifice adjacent the top of said tube, a condenser including a metal shell projecting downwardly into the space between said outer casing and said uptake tube, said condenser shell being outwardly beveled at its lower edge, a conical baffle of less diameter than the condenser shell secured to the vapor uptake beneath the lower edge of the condenser shell and an inlet at the top of said pump for admitting pumped gases downwardly within said condenser shell.

3. A diffusion pump comprising an outer casing having an outlet for pumped gases adjacent the top thereof and being inwardly tapered at the bottom to join with a heating member of substantially less diameter than the casing, said heating member being provided with ribbed heat-exchanging surfaces, a vapor uptake tube of substantially the same diameter as said member and projecting upwardly therefrom, a working fluid injection orifice adjacent the top of said tube, a condenser unit projecting downwardly into the space between said outer casing and said uptake tube, an inlet at the top of said pump for admitting pumped gases downwardly within said condenser unit, an external flange projecting laterally from said condenser unit for supporting the same, demountable means for hermetically sealing said flange to the upper portion of said casing, and conduits passing through said flange for supplying cooling fluid to said condenser unit.

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