March 9, 1965 C. G. NEEDHAM ETAL 3,172,745

SORPTION PUMP APPARATUS

Filed Dec. 19, 1961

FIG. 1

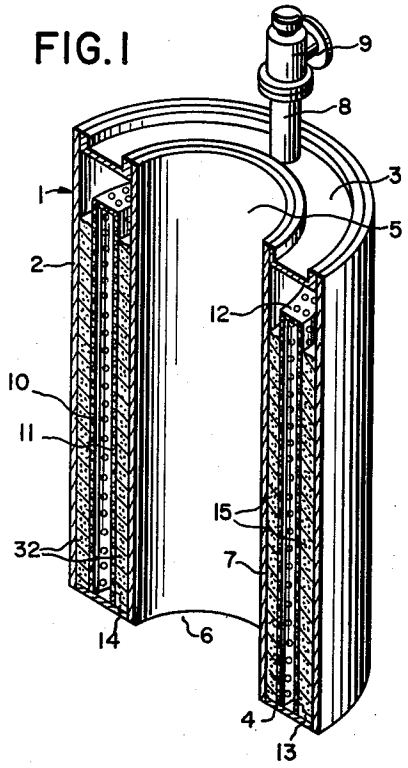


FIG. 2

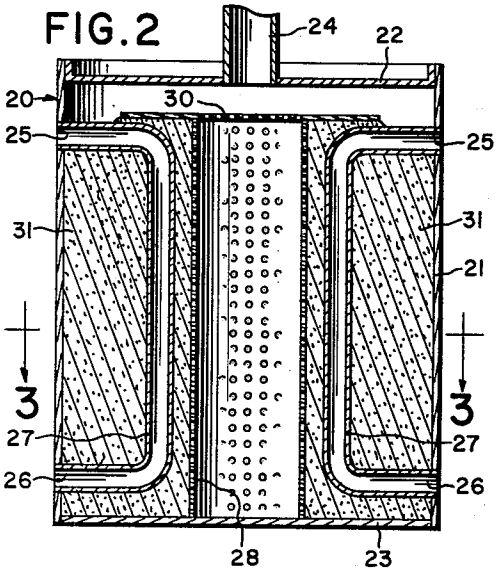
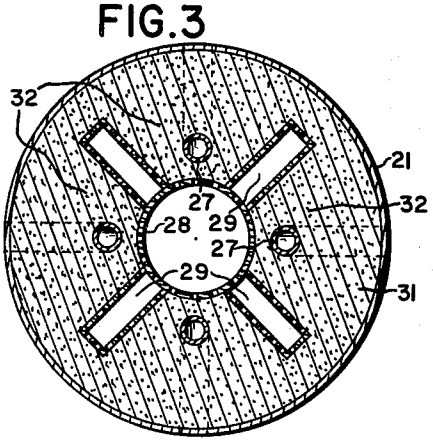


FIG. 3



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SORPTION PUMP APPARATUS

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1 Claim. (Cl. 55—269)

This invention relates to vacuum pumps.

More specifically the invention relates to vacuum pumps of the sorption kind, i.e. pumps which rely for their operation on the sorption properties of sorption materials, such as activated charcoal or molecular sieve, at very low temperatures.

Vacuum pumps of the sorption kind usually comprise a cylindrical container partially filled with sorption material, the container being closed apart from an inlet pipe which is connected through a suitable valve to the system to be evacuated. Before starting to evacuate the system the container must be placed in a liquid coolant, usually liquid air or liquid nitrogen, until the sorption material has been chilled to an extent determined by the initial speed of pumping required. This pre-chilling of the sorption material is essential for satisfactory operation of the pump and it is an object of the present invention to provide a vacuum pump of the sorption kind in which the time required to carry out the pre-chilling is considerably reduced.

According to the present invention a vacuum pump of the sorption kind includes a container for sorption material, wherein the container is closed apart from an inlet pipe, there is one or more walled passages extending into the container between two apertures in the surface thereof, which walled passage is disposed in such manner that when the container is placed in a liquid coolant, the coolant freely enters the passage without trapping any gas in the passage.

Said container may comprise a hollow cylinder, top and bottom closure members each having a central aperture, and a walled passage extending between the apertures, with an inlet pipe opening into the container through the top closure member.

The invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a sectional perspective view of one form of vacuum pump in accordance with the invention,

FIG. 2 is a sectional elevation of a further form of vacuum pump in accordance with the invention, and

FIG. 3 is a section along the line 3—3 in FIG. 2.

Referring now to FIG. 1 of the drawings, the vacuum pump shown includes a container 1 comprising a hollow cylinder 2 of stainless steel and top and bottom closure members 3 and 4, also of stainless steel, each of which has a central aperture 5 and 6, respectively. A walled passage in the form of a hollow cylinder 7 of stainless steel coaxial with the cylinder 1 extends between the two apertures 5 and 6 and an inlet pipe 8, which is connected to the system to be exhausted through a suitable valve 9, opens into the enclosed annular space through the top closure member 3. Two coaxial cylinders 10 and 11 of perforated copper sheet bridged at their top end by an annular piece 12 of perforated copper sheet are disposed within the container 1 and are spaced from the cylinders 2 and 7 by lugs 13 and 14 secured to the cylinders 10 and 11 at their bottom ends. The annular spaces between the cylinders 2 and 10, and 7 and 11 are filled with molecular sieve 15, such as

dehydrated sodium alumino-silicate, to a level just below the tops of the cylinders 10 and 11.

In operation the inlet pipe 8 is connected to the system to be evacuated and the valve 9 is closed. The container 1 is then placed in liquid nitrogen to a level above the top surface of the molecular sieve 15. The liquid nitrogen enters the cylinder 7, and the molecular sieve in the annular space between the cylinders 7 and 11 is chilled as rapidly as that between the cylinders 2 and 10, thus considerably reducing the time necessary for chilling the molecular sieve. When the molecular sieve has been chilled to the required temperature the valve 9 is opened and the pump operates, the perforated copper sheet of the cylinders 10 and 11 ensuring that a large surface area of the molecular sieve 15 is exposed to the gas being evacuated.

After pumping is completed the system is sealed off and the pump removed, the valve 9 being left open to allow the escape of gas as the molecular sieve 15 returns to room temperature. The molecular sieve 15 is completely reactivated by heating.

FIGS. 2 and 3 of the drawings show a further form of pump in accordance with the invention in which the container 20 comprises a hollow cylinder 21 of stainless steel and top and bottom closure members 22 and 23, also of stainless steel, there being an inlet pipe 24 opening into the container through the top closure member 22. The cylinder 21 is provided with four equally-spaced apertures 25 near the top and a further four equally-spaced apertures 26 near the bottom. Four stainless steel tubes 27 are provided, each tube 27 being U-shaped and extending between one of the apertures 25 and one of the apertures 26 to form a walled passage within the container 20. The tubes 27 are welded to the cylinder 21 in a vacuum-tight manner.

Disposed within the container 20 there is a central cylinder 28 of perforated copper sheet from which extend four radial passages 29 defined by walls of perforated copper sheet, the passage 29 being symmetrically spaced between the tubes 27. The cylinder 28 and the passages 29 are covered at their top ends by a cover member 30, also of perforated copper sheet. The remaining space in the container 20 is filled with molecular sieve 31, such as sodium alumino-silicate, to a level below the tops of the cylinder 28 and the passages 29.

The perforated copper sheets 10, 11 in FIG. 1 and copper sheet 28 in FIG. 2 divide the molecular sieve materials 15 and 31 into a plurality of compartments 32 so as to provide for better gas access thereto.

In operation the pump is used in the same manner as that described above with reference to FIG. 1. When the container 20 is placed in liquid nitrogen the liquid enters the tubes 27 thus causing a more rapid chilling of the molecular sieve remote from the wall of the cylinder 21. The passages 29 and the cylinder 28 again ensure that a large surface area of the molecular sieve is exposed to the gas being evacuated.

In both of the examples described above, the stainless steel parts may be coated with copper to ensure a more even temperature over the surfaces as a whole. Also, copper gauze may replace the perforated copper sheet in both of the examples.

It will be noted that in each of the above examples the pump container provides a large exterior wall surface that is capable of contacting a liquid coolant. This large wall surface is obtained by utilizing a container of irregular shape such that at least one straight line passing through the container will pierce the wall surface at least four times.

The vacuum pumps described above may be varied

in many ways without departing from the scope of the invention. For example, the number of the walled passages within the container may be varied and the disposition of the passages may also be varied provided that the container may be placed in a liquid coolant so no gas is trapped in the passages.

What is claimed is:

A vacuum sorption pump apparatus comprising: a container made of heat conductive, impervious material and having a hollow, cylindrical side wall and top and bottom walls, said side, top and bottom walls adapted to be refrigerated by a liquid coolant; a vertical, heat conductive, impervious walled passage extending into said container, said container having a pair of apertures therein, one in the top wall and one in the bottom wall, between which said walled passage extends, said passage being cylindrical and concentrically disposed with respect to said cylindrical side wall; an annular heat conductive means having apertured, spaced-apart side walls and an apertured top wall and positioned in said container to

divide said container into a plurality of sorption compartments disposed on opposite sides of said annular heat conductive means; sorption material disposed within said sorption compartments and contacting said walls and said walled passage; and, valveable means for connecting said apparatus to a system to be evacuated.

References Cited by the Examiner

UNITED STATES PATENTS

2,151,053	3/39	Solberg	55—387
2,384,460	9/45	Kleen	55—387
2,404,468	7/46	Volkes et al.	55—387
2,557,557	6/51	Newcum	55—387 X
2,955,673	10/60	Kennedy et al.	55—53 X
2,970,669	2/61	Bergson	55—387 X
3,116,764	1/64	Jepson et al.	55—387

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