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N. WARMOLTZ ET AL

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COOLER FOR USE IN VAPOR JET DIFFUSION PUMPS

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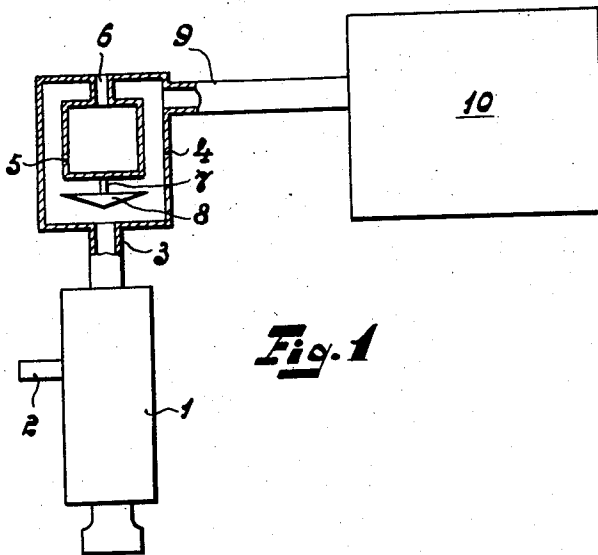


Fig. 1

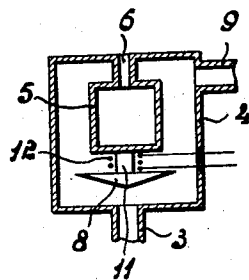


Fig. 2

INVENTOR
NICOLAAS WARMOLTZ
HENDRIK BRUGT GERHARD CASIMIR
BY *[Signature]*
AGENT

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COOLER FOR USE IN VAPOR JET DIFFUSION PUMPS

Nicolaas Warmoltz and Hendrik Brugt Gerhard Casimir, Eindhoven, Netherlands, assignors, by mesne assignments, to North American Philips Company, Inc., New York, N.Y., a corporation of Delaware

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4 Claims. (Cl. 230—102)

Mercury vapor diffusion pumps are often provided with a cooler arranged between the pump and the space to be evacuated. These coolers are intended to collect the mercury vapor and any other vapors, for example water vapor, contained in the duct between the pump and the space to be evacuated and thus to prevent the mercury from entering this space to be evacuated. Otherwise the vapor pressure of the mercury vapor would affect adversely the high vacuum in the space to be evacuated.

It is common practice to cool these coolers by means of liquid air or solid carbonic acid, so that the cooler assumes a temperature lower than -40°C . However, the use of these cooling agents is, in practice, attended with difficulties, since at this low temperature the mercury vapor sublimates on the cooler. If the pump has been in operation for some time, for example a few days, such a quantity of mercury vapor has sublimated on the cooler, that owing to lack of liquid mercury the pump can no longer operate satisfactorily. It is then necessary to stop the evacuation of the space and to heat the cooler, so that the mercury can again be supplied to the pump. Even with pumps operating by means of a different liquid, for example with certain oil diffusion pumps, the same effect is liable to occur under certain conditions.

The invention has for its object to construct the cooler in a manner such that the aforesaid adverse effect of sublimation cannot occur.

According to the invention the cooler is provided with a cooling plate, which is arranged in the path of the gas particles and provided with means, with the aid of which the temperature of the plate is maintained so high that the vapor of the pump liquid near this cooling plate can only condense thereon. It is desirable for the liquid produced on the cooling plate to have a viscosity such that, at the temperature of the plate, it drips readily off.

The means to maintain the desired temperature of the cooling plate, which temperature is about -30°C . for mercury, may be constructed in various ways.

In one embodiment of the invention the cooling plate is secured to the cooler by means of a heat conducting element, the thermal conductivity of which is such that the cooling plate is kept at the desired temperature. The thermal conductivity of the heat transferring element, which will frequently be shaped in the form of a rod, varies with the thermal conductivity coefficient of the material of the rod and with the dimensions thereof.

In a further embodiment of the invention the cooling plate is secured to the cooler by means of a heat transferring element and provided with a heating device in a manner such that it is kept at the desired temperature. The heating device will preferably be an electric heating element. This element is capable of supplying such a quantity of heat to the cooling plate that it assumes the desired temperature.

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The cooler and the cooling plate are preferably arranged in a manner such that, in accordance with a further aspect of the invention, mercury vapor condensed on the cooling plate is immediately resupplied to the pump, although, of course, it is also possible to collect the condensed mercury vapor for a comparatively long time and to conduct it away periodically to the pump.

The invention will be explained more fully with reference to two embodiments.

Fig. 1 shows diagrammatically a system comprising a cooler, in which between the cooling plate and the cooler provision is made of an element having the desired heat conductivity, and

Fig. 2 shows a cooler, in which the cooling plate is kept at the desired temperature by means of an electric heating helix.

In the system shown in Fig. 1 a vapor-jet diffusion pump, for example, a mercury vapor diffusion pump is designated by 1'. This pump may be constructed in known manner. The pump co-operates with a pre-vacuum pump, which is not shown in the figure and which communicates with the pump through the duct 2; this prevacuum pump may for example be an oil diffusion pump or a rotating pump.

The mercury vapor diffusion pump communicates through a duct 3 with a receptacle 4, which surrounds a cooler 5. This cooler is filled through a filling aperture 6 with liquid air of 1 atmosphere and therefore has a temperature of about -195°C . To the cooler 5 is secured through a heat transferring element 7 a cooling plate 8. The element 7, as well as the cooling plate 8, may be made for example of corrosion-free steel and has a size such that the temperature of the cooling plate may be for example -30°C . The surroundings and the condensing vapor transfer heat to the cooling plate 8; this heat is conducted away to the cooler 5. The space 4 communicates through a duct 9 with a space 10, to be evacuated. If in the duct 3 and in the space 4 below the cooling plate 8, located in the path of the gas particles, mercury vapor would be present, this mercury vapor will condense on the cooling plate 8 and it will not sublime. The condensate produced will flow back into the pump 1, so that the active quantity of mercury of the pump remains constant as much as possible and it will not be necessary at all or be required only a few times to stop the evacuation of the space in order to remove the sublimated mercury.

In the construction shown in Fig. 2 parts corresponding to those shown in Fig. 1 are designated by corresponding reference numerals. In this construction a heat transferring element 11 is provided between the cooling plate 8 and the cooler 5. The heat transferring element is surrounded by an electric heating helix 12, so that heat can be supplied to the cooling plate. However, if no additional measures are taken the temperature of the cooling plate would be for example -190°C ., if the cooler is filled with liquid air, owing to the high thermal conductivity of this element. Owing to the supply of heat by means of the heating helix, the cooling plate can assume the desired temperature. The cooler according to the invention may frequently be used, if the vapor jet diffusion pump is driven by means of a different pump liquid.

What is claimed is:

1. In a vapor-jet diffusion pump for evacuating a container, a cooler, a cooling member positioned between said pump and said container to be evacuated and adapted to transfer the heat in said container to said cooler and located in the path of the vapor molecules, and a heat transferring element connecting said cooling member and said cooler, the thermal conductivity of said heat trans-

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ferring element being of a value whereby the temperature of said cooling member is maintained at a predetermined level higher than said cooler and such that the vapor of the pump liquid contacting said member condenses thereon.

2. In a vapor-jet diffusion pump for evacuating a container, a cooler positioned between said pump and said container to be evacuated, a cooling member located in the path of the vapor molecules and arranged so as to shield said cooler from initial contact with the vapor issuing from said pump, and a heat transferring element connecting said cooling member to the cooler, the thermal conductivity of said element being such that the cooling member is kept at a predetermined temperature level which is higher than the cooler and the vapor of the pump liquid contacting said cooling member condenses thereon.

3. A vapor diffusion pump as claimed in claim 2 further comprising a receptacle containing said cooler, heat transferring element and cooling member, a duct connecting said pump and receptacle, said cooling member having a cone shaped surface with its apex directed toward said duct.

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4. In a vapor-jet diffusion pump for evacuating a container, a cooler, a cooling member positioned between said pump and said container to be evacuated and adapted to transfer the heat in said container to said cooler and located in the path of the vapor molecules, and a heat transferring element connecting said cooling member and said cooler, the thermal conductivity of said heat transferring element being of a value such that said cooling member is maintained at a predetermined temperature level higher than said cooler and such that the vapor of the pump liquid contacting said cooling member condenses thereon, and a heating device being provided adjacent to said cooling member to maintain said cooling member at the predetermined temperature higher than said cooler temperature.

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