March 8, 1955 O. WINKLER 2,703,673

VACUUM PUMP

Filed April 3, 1951 2 Sheets-Sheet 1

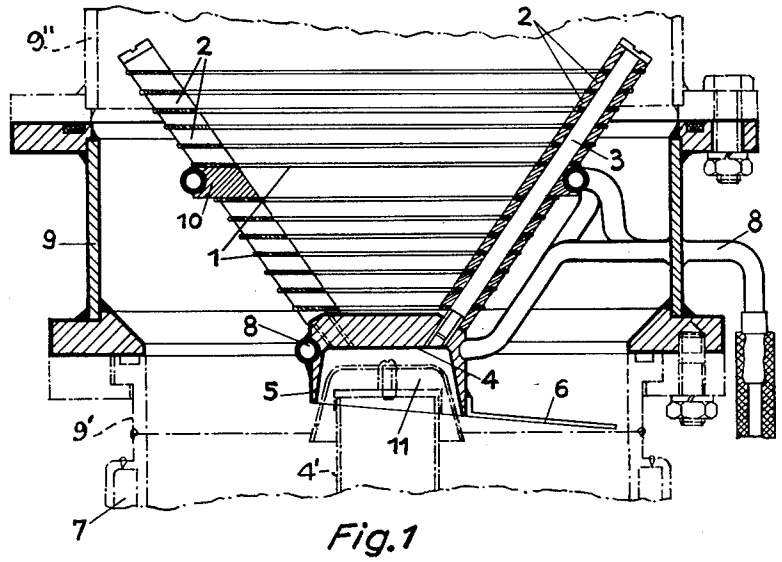


Fig. 1

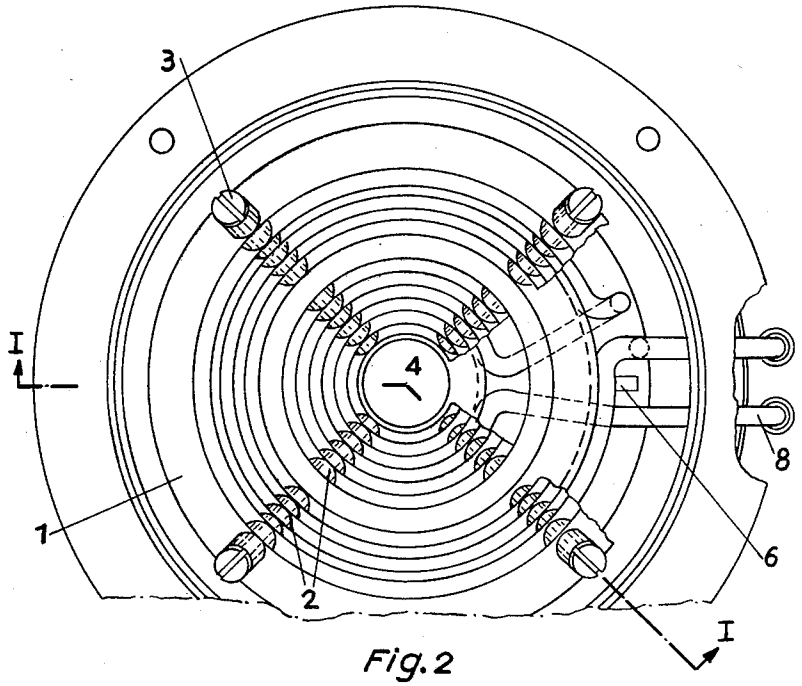


Fig. 2

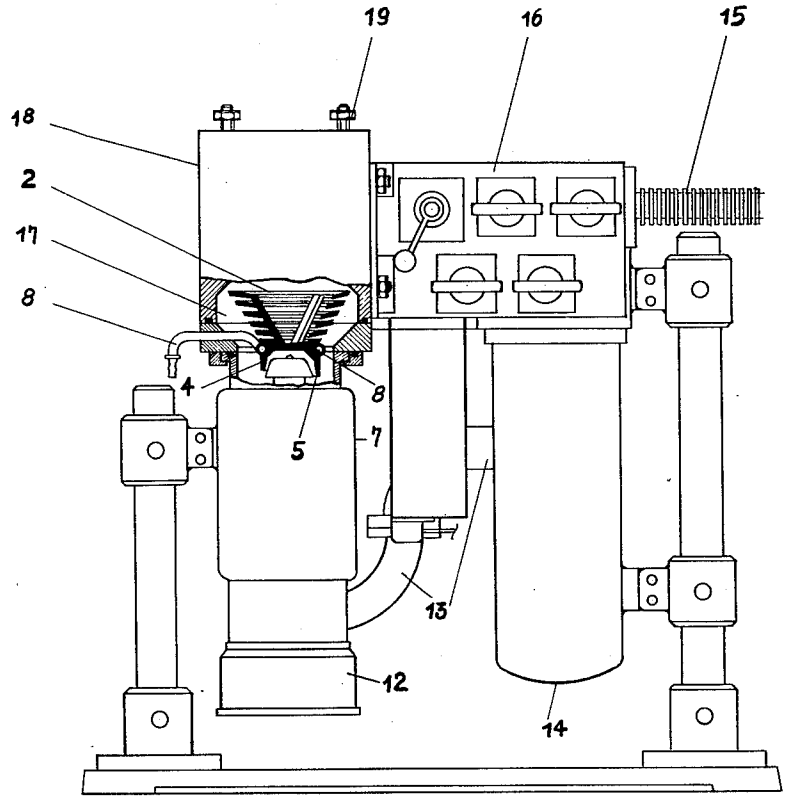
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Fig. 3



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VACUUM PUMP

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Claims priority, application Switzerland April 8, 1950

10 Claims. (Cl. 230—101)

The present invention relates to high vacuum pumps of the diffusion type, and preferably to high vacuum oil diffusion or oil vapor jet pumps. Such pumps have a higher suction capacity than pumps of the same dimensions, but using mercury as working medium. The oils serving as working medium, in contrast to mercury, have such a low vapor pressure at room temperature that highly cooled cooling traps or cooling pockets need not be inserted between pump and receptacle to be evacuated. Heretofore, such low temperature cooling traps or pockets had to be inserted to prevent vapor particles of the working medium from entering the high vacuum chamber.

It is accordingly one of the objects of this invention to prevent with certainty the diffusion of vapors of the working medium from the pump into the high vacuum chamber.

Heretofore, the use of baffle plates or of condensers has been suggested for this purpose. The cap of the nozzle provided for producing the oil vapor jet has also been covered by a shield which was fastened to the cooled wall of the housing. However, when using means of this type, it has not been possible to suppress sufficiently the diffusion of oil vapors into the high vacuum chamber.

It is consequently a further object of the invention to improve the cooling of such a shield, so that diffusion of oil vapors into the high vacuum chamber is practically eliminated.

It is a still further object of this invention to eliminate such diffusion of oil vapors to the limit of possibility, by arranging a condenser between the cooled shield and the suction connection of the pump. Thereby the cooling of the shield may also be employed for effectively cooling the condenser in such a manner that the temperature of all its condensing surfaces lies with certainty below the dew point of the vaporized working medium of said high vacuum diffusion pump, even when introducing a cooling agent of as high a temperature as room temperature. In this manner, although only cooling agents of room temperature are used, pressures as low as and even below 10^{-5} mm. Hg. are produced.

Another object of this invention consists in simplifying the construction of the condenser so that the shield and condenser can be readily inserted into and removed from the pump, even though a preferably liquid cooling agent is supplied to and discharged from the interior of the pump.

Still another object of this invention is to provide a step-by-step increased condensation of the vapor particles of the working medium in such a manner that the cooled walls of the pump are also utilized to complete or increase the preliminary condensation of oil vapor molecules at the condenser, at directly cooled parts of said condenser, or at the directly cooled shield of the uppermost nozzle cap, respectively.

It is still another object of this invention to protect the shield and condenser against loss of effectiveness caused by decomposition of the working medium at the surfaces of the shield and condenser by catalytic action.

The attached drawings illustrate, by way of example, a shield and a condenser constructed according to this invention, and show more particularly in what manner the above mentioned objects of this invention are achieved.

In said drawings,

Fig. 1 shows a vertical section through the condenser along line 1—1 in Fig. 2.

Fig. 2 shows a plan view of the condenser.

Fig. 3 shows a complete view of a diffusion pump installation.

The condenser has as shown a number of annular condensing plates or rings **1** which have different diameters and are so arranged that they together form a space of frusto-conical shape. In this the rings **1** are separated from one another and arranged by means of obliquely sectioned tubular pieces **2** which are mounted on bolts **3** extending in the direction of the surface of the frusto-cone.

The bolts **3** are passed through apertures suitably provided in the rings **1** and their converging ends are screwed into a cup shaped body **4**. The edge of the cup with its hollow space opposed to the pump is cut off on a plane inclined to the axis of the frusto-cone. Further, the rings **1** are slightly curved so that the working medium condensing thereon flows along the bolts **3** or the distance pieces **2** to the cup **4** and thence over an inclined sheet **6** towards a cooled wall of the housing **9'** of the oil diffusion high vacuum pump **7**, such housing being shown in dot-and-dash lines at the lower part of Fig. 1. All parts of the condenser are made of a good heat conducting material, for example of copper, and the smooth parts are provided with a thin non-reactive galvanic coating, for example of nickel or chromium, to avoid the formation of decomposition products of the organic working medium of the pump owing to catalysis.

On the cup or shield **4** is disposed a fixed tube **8** fixed which surrounds it and which at one end is led out through the wall of the intermediate housing **9** receiving the condenser, and which at the other end surrounds an additional cooling element **10** arranged in the condenser at a higher level, and acting at the same time as a distance piece; the end of the tube **10** is similarly led out through the housing **9**. Inside the housing the tube **8** has no seams, joints or intersections which would require to be made tight against the vacuum by means of soldering or welding. The intermediate housing **9** may be provided with flanges for bolting the same to the suction connection **9''** which forms part of, or is connected to, the receptacle to be evacuated.

The cup shaped body **4, 5** forms a shield partly overlapping the nozzle device **4'** of the diffusion pump **7** and is directly cooled by means of a liquid stream flowing through the tube **8**. By this the radiant heat of the nozzle is kept for the most part from the condenser. The heat given off on the condensation surfaces or rings **1** themselves by the vapour molecules reaching them is conducted along bolts **3** to the shield **4, 5** and removed by the cooling medium. A part of the heat of condensation also passes from the bolts **3** into the additional cooling element **10** so that it is also conducted away by the cooling medium.

The additional cooling element is necessary or preferable only in the case of large condensers. In smaller condensers the dissipation of heat by means of the rings **1** and the bolts **3** to the cooled shield **4** is fully sufficient to keep the temperatures of the surfaces **1** low.

The direct cooling of the shield **4** and if necessary of the additional cooling element **10** can be effected by connecting the tube **8** to a fresh water pipe. In certain cases another cooling medium instead of cooling water is advantageous, such as for example strongly cooled alcohol, a salt solution or any other cooling brine.

Hollow spaces in the parts **4, 5,** and **10** may also take the place of the cooling tubes enclosing parts **4, 5** and **10,** to which the cooling medium is conducted directly or indirectly, i. e. via the copper bolts which take away the heat of condensation.

It is within the scope of the invention that in particular cases, e. g. with large pumps or with high vacua that are difficult to produce, in addition to the direct cooling of the shield further parts or all parts of the condenser may be cooled directly.

The cooling jacket of the diffusion pump **12** is seen at **7** on Fig. 3. The diffusion pump is constructed as an oil diffusion pump. It is connected by conduit **13** to a collecting vessel **14**. A conduit is to be seen at **15** which leads to a mechanically operating preliminary vacuum pump not shown. The connection between the conduit **15** and the collecting vessel **14** is made through valves

which have been united into a valve body 16. In this valve body are also located valves which connect the conduit 15 directly to the chamber 17 in which the high vacuum is produced. To the container 18 including the chamber 17 the receiver not shown is connected by screws 19.

What I claim is:

1. High vacuum pump of the oil-operated diffusion type comprising, in combination, a housing having a suction connection adapted to be connected to a receptacle to be evacuated, means for cooling the wall of the housing, means for forming operating oil vapors generated within the pump into at least one jet of oil vapor and for directing the oil jet against the cooled wall of the housing, a condenser in addition to the cooled housing wall and arranged between said means and the suction connection of the housing, means for cooling the condenser, said condenser being so disposed as to block the back diffusion of particles of the operating medium vapor into the said receptacle, a shield arranged between the vapor jet forming means and said condenser, means for directly cooling said shield with a cooling agent, and conduits for supplying cooling agent to said last mentioned means and for removing heated cooling agent therefrom.

2. High vacuum pump of the diffusion type according to claim 1, wherein said condenser is connected in good heat conducting relation with said shield.

3. High vacuum pump of the diffusion type according to claim 1, wherein elements for cooling said condenser by means of a cooling agent passing therethrough are provided within said housing.

4. High vacuum pump of the diffusion type according to claim 1, wherein said shield is constructed as the base of said condenser.

5. High vacuum pump of the diffusion type according to claim 1, wherein the condenser is of frusto-conical shape, and wherein said shield forms the smaller end of the condenser.

6. High vacuum pump of the diffusion type according to claim 5, wherein elements for cooling said condenser by means of a cooling agent passing therethrough are provided within said housing, said last-mentioned cooling elements being constructed as cooling tubes adjoining the condenser.

7. High vacuum pump of the diffusion type according to claim 1, in which said shield cooling means and said condenser are provided with a chemically inactive coating for preventing catalytic decomposition of the oil.

8. High vacuum pump of the oil-operated diffusion type comprising, in combination, a housing having a suction connection adapted to be connected to a receptacle to be evacuated, means for cooling the wall of the housing, means for forming operating oil vapors generated within the pump into at least one jet of oil vapor and for directing the oil jet against the cooled wall of the housing, a condenser in addition to the cooled housing wall and arranged between said means and the suction connection of the housing, means for cooling the condenser, said condenser being so disposed as to block the back diffusion of particles of the operating medium vapor into the said receptacle, a shield arranged between the vapor jet forming means and said condenser, and forming the base of the condenser, means for directly cooling said shield with a cooling agent, passing conduits for supplying cooling agent to said last mentioned means and for removing heated cooling agent therefrom, said shield cooling means being in the form of a cooling pipe adjoining said base, said condenser being comprised of rods mounted on said shield, said rods being uniformly distributed with their central longitudinal axes coinciding with surface elements of a hollow frustum of a cone, axially spaced flat rings mounted upon said rods and of increasing diameter as their distance from said shield increases, tubular distance pieces between the rings adapted to hold the same in spaced relation, the hollow interior of said condenser being directed toward the suction connection of the housing of the pump, and the planes of said rings being arranged approximately perpendicularly to the longitudinal axis of the housing.

9. High vacuum pump of the oil-operated diffusion type comprising, in combination, a housing having a suction connection adapted to be connected to a receptacle to be evacuated, means for cooling the wall of the housing, means for forming operating oil vapors generated within the pump into at least one jet of oil vapor and for directing the oil jet against the cooled wall of the housing, a condenser in addition to the cooled housing wall and arranged between said device and the suction connection of the housing, means for cooling the condenser, said condenser being so disposed as to block the back diffusion of particles of the operating medium vapor into the said receptacle, a shield arranged between the vapor jet forming means and said condenser, means for directly cooling said shield with a cooling agent, conduits for supplying cooling agent to said last mentioned means and for removing heated cooling agent therefrom, said shield being constructed as the base of said condenser, said shield cooling means being in the form of a cooling pipe adjoining said base, said condenser being formed of rods fixed to said shield, and flat annular condensing members mounted upon said rods, tubular distance pieces between said condensing members for spacing the same from each other, said annular condensing members being of increasing diameter as their distance from said shield increases, the central axes of said rods coinciding with uniformly distributed surface elements of a hollow frustum of a cone, the hollow space of said hollow cone being directed towards the suction connection of said housing, the planes of said flat annular condensing surfaces being arranged approximately perpendicularly to the longitudinal axis of the housing, the outer surfaces of the distance pieces lying along the surface of a frustum of a cone, the means for cooling the condenser being constructed as a cooling tube lying against at least one of said distance pieces, and means for supplying cooling agent to such cooling means and for removing heated cooling agent therefrom.

10. High vacuum pump of the oil-operated diffusion type comprising, in combination, a double-walled housing having a suction connection adapted to be connected to a receptacle to be evacuated, means for supplying a cooling agent to the space within said double wall and for removing the heated cooling agent therefrom, said housing defining an intermediate space, means for forming operating oil vapors generated within the pump into at least one jet of oil vapor and for directing the oil jet against the cooled wall of the housing, a condenser in addition to the cooled housing wall and arranged between said jet forming means and the suction connection of the housing, means for cooling the condenser, said condenser being so disposed as to block the back diffusion of particles of the operating medium vapor into the said receptacle, a shield arranged between the vapor jet forming means and said condenser, means for directly cooling said shield with a cooling agent, and means for conducting the working medium condensing at the shield away from said shield, said conducting means being of such length that the condensed working medium is conducted from the shield to the cooled wall of the housing.

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