

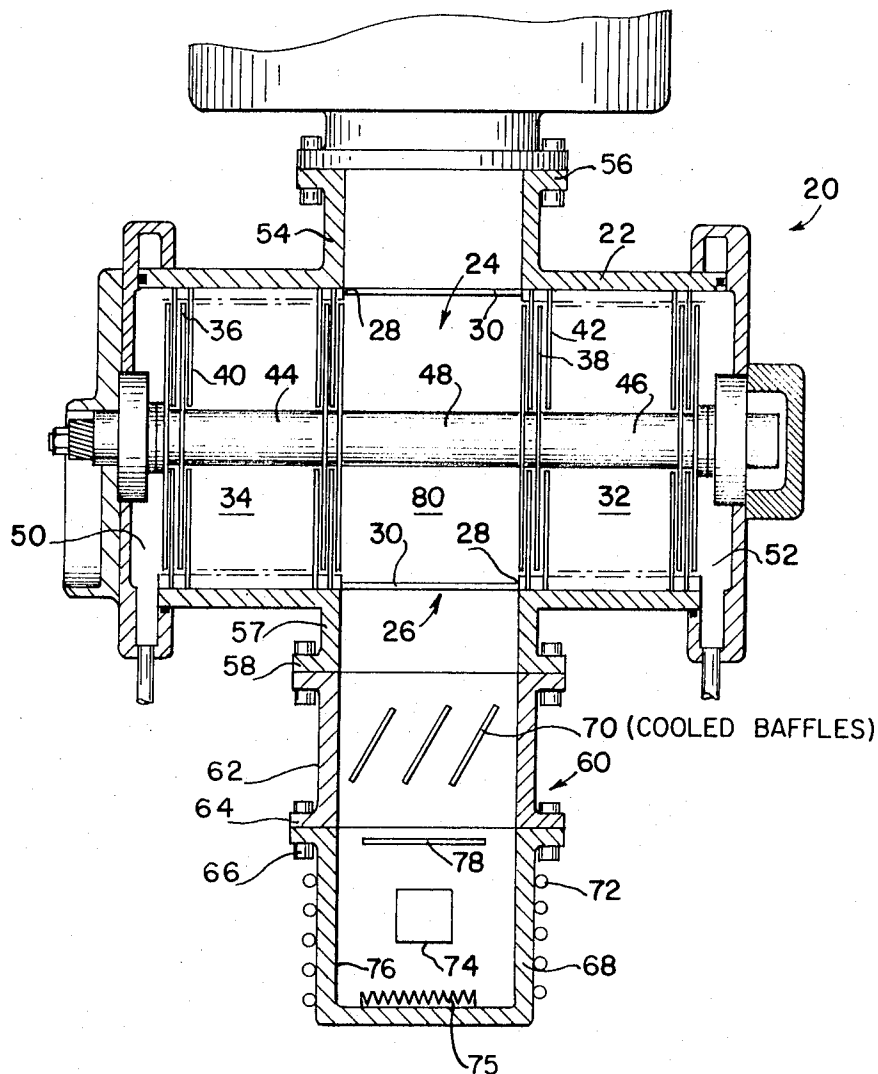
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VACUUM PUMP WITH DEMOUNTABLE COLD TRAP AND GETTER PUMP

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1

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## VACUUM PUMP WITH DEMOUNTABLE COLD TRAP AND GETTER PUMP

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9 Claims

### ABSTRACT OF THE DISCLOSURE

A turbo-molecular vacuum pump having a cylindrical casing with at least two large openings therein, one attached to or adapted for connection to a vessel to be evacuated and the other for providing access to a cold trap beneath which is disposed a getter pump, said cold trap and getter pump being arranged in the high vacuum portion of the pump, which consists of the compressor sections disposed oppositely in axial portions of said casing. The cold trap and getter pump are demountably attached, and may be advantageously used where contaminants of the type best removed by the getter pump or cold trap are present in the influent stream.

### BACKGROUND AND DESCRIPTION OF THE INVENTION

Recently, so called turbo-molecular pumps used for producing high vacuums have been improved to the point where they are, in many respects, superior to other forms of vacuum pumps. Some of the advantages of these pumps include high volume pumping capacity, the ability to attain very high vacuum levels, freedom from oil contamination, and the like.

However, such turbo-pumps are not always ideal in every respect, and accordingly, are capable of further improvement. In particular, while it is desired to use a turbo-pump, if possible, because of its advantages there has been a need for insuring that such pump will be able to deliver the performance of which it is theoretically capable. For example, it is most efficient to use a turbo-pump to exhaust gases other than those easily trapped by cold traps or getter pumps. For example, a cold trap is effective to trap water vapors in large quantities without the need for using the turbo-pump for removing this component from air. Likewise, a getter pump is useful in removing certain gases.

Accordingly, there has been a need for pumps which will combine the advantages of gas removal by a number of different means, each operating best under certain conditions and for removal of certain gases.

Accordingly, an object of the present invention is to provide a turbo-molecular pump having means therein for receiving a getter pump and a cold trap adjacent the high vacuum portion thereof.

Another object is the provision of a demountable cold trap and getter pump assembly which may be advantageous with a turbo-pump.

Still another object is to provide a titanium getter pump disposed beneath cryogenic coiled baffles disposed above a titanium vapor baffle with the turbo-pump comprising a compressor section on either axial end of a rotatable shaft with outlets at either axial end and a common inlet between compressors and in communicating relation with the region to be evacuated and the cold trap and getter pump, whereby a substantial number of molecules may be removed from influent gases before they pass through various stages of the turbo-pump.

The above objects, and others, are accomplished by providing a single cylindrical casing with large open areas disposed centrally thereof, a compressor element in each

2

axial end of the casing, outlet means at each end of the casing, with at least one of said open areas communicating with the area to be evacuated and at least one other area communicating with a cold trap, a titanium vapor baffle disposed beneath the cold trap, and a titanium getter pump disposed beneath the vapor baffle.

The exact manner in which these objects are attained will become more clearly apparent when reference is made to the following detailed description of the preferred embodiment of the invention and to the drawings in which like reference numbers indicate corresponding parts throughout.

### BRIEF DESCRIPTION OF THE DRAWINGS

The figure is a vertical sectional view of the improved turbo-molecular vacuum pump of the invention, showing the compressor sections near the upper portion of the unit, with the cold trap disposed therebeneath and the getter pump in a lower portion of the apparatus.

Although it will be understood that the advantages of associating the cold trap and the getter pump with a turbo molecular pump may be realized in a number of differing configurations, the present invention will be described with reference to an embodiment wherein the turbo-pump itself comprise two compressor sections, one disposed in each axial end of a circular casing, with a single impeller assembly mounted for rotatable movement therein.

Referring now to the figure, a pump 20 according to the invention is shown to include a cylindrical casing 22 having a plurality of inlets 24, 26 defined by end portions of the side walls 28 of the casing 22 and braces 30 extending longitudinally of the casing. A pair of compressors 32, 34 are provided, each including a plurality of rotors 36, 38, a plurality of stators 40, 42 and hubs 44, 46, joined together by a center shaft 48.

An outlet 50 is provided on one axial end of the casing 22 for compressor 34 and an outlet 52 deposited on the opposite end for compressor 32, all in keeping with known prior practices. Disposed atop the casing 22 and in registry with one inlet 24 is a neck 54 having a flange 56 thereon for connection to a vessel to be evacuated.

A lower neck portion 57 having a mounting flange 58 thereon is disposed in registry with the bottom inlet 26, and is used to mount a pump assembly 60 in vacuum-tight relation to the casing 22.

Referring now to the construction of the pump unit 60, it may be seen to include an upper housing portion 62, connected by a flange 64 and fasteners 66 to a lower housing portion 68. A plurality of axially inclined baffles 70 are disposed in said housing 62 so as to present a large surface area to the inlet 26. These baffles 70 are of a construction which is well known in the art and are commonly in the form of cooled plates having means therein to allow passage of a liquid nitrogen or the like therethrough.

The lower pump housing 68 includes a continuously extending cooling coil 72 extending around the outer periphery thereof, and kept in intimate heat exchange relation thereto. A supply of material, such as titanium metal 74, which may be made to undergo sublimation or be sputtered from its surface, is disposed within the lower pump housing 68. In use, heating means such as cathodic filaments or other means adapted to produce a cloud of electrons, schematically shown and generally designated by the reference numeral 75, are used in a known manner to sublime or sputter the titanium from the supply thereof. At the pressures involved in the process, the mean free path of molecules is large, and the titanium will fall upon the walls on the interior surface 76, and will react, because of the high temperatures of sublimation, with all but the inert gas components of the gases within the pump unit. In addition, a significant amount of physical trapping of

ions and molecules will take place along the surface 76. These actions and reactions take place very rapidly, and assist in quickly lowering the pressure in the pump.

By reason of the presence of the titanium vapor baffle 78, molecules of titanium are largely retained in the lower housing 68. Removal of condensable components of the gases and vapors in question is facilitated by the provision of the baffles 70. In this manner, any water vapors are removed by freezing, and this serves the dual function of sparing the turbo pump from this task and protecting the interior of the pump, and particularly the getter pump, from contamination. Other vapors are also removed by this means, such as carbon dioxide vapors, and others.

The turbo-molecular pump itself is normally constructed so as to provide a flow volume of about 100 liters per second at pressures existing in the low pressure region 80 of the pump 20. Thus, it will normally include some 15 to 20 stages, and be capable of attaining vacuum levels of  $10^{-12}$  or more (torr), with an outlet pressure in discharge regions 50, 52 of about  $10^{-3}$  torr. Normally, a forepump of conventional construction is provided to produce this vacuum level and remove the gases exiting from the pump.

Another incidental feature of the invention, but one which is very useful because of the versatility it provides, is that the pump 60 is demountably mounted on the neck and flange 54, 56. With the pump 60 removed and a seal provided in place thereof, a turbo molecular pump of the type shown may be used in the conventional manner.

It will thus be seen that the present invention provides an improved turbo-molecular pump having a number of advantages and characteristics, including those pointed out herein and in the appended claims, and others which are inherent in the invention.

What is claimed is:

1. An improved turbo-pump for use in the free-molecule flow pressure range comprising, in combination, a cylindrical housing member, at least one axial flow compressor unit disposed therein, said compressor unit including a central, rotatable shaft, a plurality of rotors disposed on said shaft, a plurality of stators interleaved with said rotors and held in fixed relation thereto within said casing, at least one pump outlet adjacent an axial end of the casing with which the compressor is associated, inlet means associated with said casing, means associated with said inlet means for connection to a region to be evacuated, and, a pump unit associated with and disposed in substantially gas tight relation to said inlet means, said pump unit including at least one cold trap having a plurality of baffles with cooling means operatively associated therewith, and, disposed therebelow, a getter pump including exterior wall portions and cooling means associated therewith, holding means for a supply of metal adapted to be removed from said metal supply by sublimation, and a

baffle disposed within said pump unit for preventing flow of molecules of said metal from contacting said baffles and the operating portions of said turbo-pump.

2. An improved turbo-pump as defined in claim 1 in which said compressor unit includes oppositely disposed compressor elements operatively associated with each other.

3. An improved turbo-pump as defined in claim 1 in which said pump unit cold trap comprises a plurality of baffles adapted to be cooled by a liquified gas.

4. An improved turbo-pump as defined in claim 1 in which said pump unit is adapted to be detached from said pump casing, whereby said turbo-pump may be used without said pump unit attached thereto.

5. An improved turbo-pump as defined in claim 1 in which said getter pump comprises means for heating said supply of metal, in which said supply of metal comprises titanium and in which said getter pump includes inner wall portions adapted to receive condensed titanium vapors thereon with gas molecules from said region to be evacuated being trapped in said condensed vapors.

6. An improved turbo-pump for use in the free-molecule flow pressure range comprising, in combination, a cylindrical housing member, at least one axial flow compressor unit disposed therein, said compressor unit including a central, rotatable shaft, a plurality of rotors disposed on said shaft, a plurality of stators interleaved with said rotors and held in fixed relation thereto within said casing, at least one pump outlet adjacent an axial end of the casing in which the compressor is associated, inlet means associated with said casing, means associated with said inlet means for connection to a region to be evacuated, and, a pump unit associated with and disposed in substantially gas tight relation to said inlet means, said pump unit including at least one cold trap having at least one condensing surface with cooling means operatively associated therewith.

7. An improved turbo-pump as defined in claim 6 in which said compressor unit includes oppositely disposed compressor elements operatively associated with each other.

8. An improved turbo-pump as defined in claim 6 in which said pump unit cold trap comprises a plurality of baffles adapted to be cooled by a liquified gas.

9. An improved turbo-pump as defined in claim 6 in which said pump unit is adapted to be detached from said pump casing, whereby said turbo-pump may be used without said pump unit attached thereto.

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WILLIAM J. WYE, Primary Examiner

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,625,019 Dated December 7, 1971

Inventor(s) Gordon E. Osterstrom

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 63, "adapated" should read --adapted--

Column 3, line 12, after "contamination" insert a period

Column 4, line 51, "2,137,551" should read --3,137,551--

Signed and sealed this 10th day of October 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

ROBERT GOTTSCHALK  
Commissioner of Patents