Nov. 7, 1961 G. REICH 3,007,627

HIGH VACUUM DEVICE

Filed April 2, 1959 2 Sheets-Sheet 1

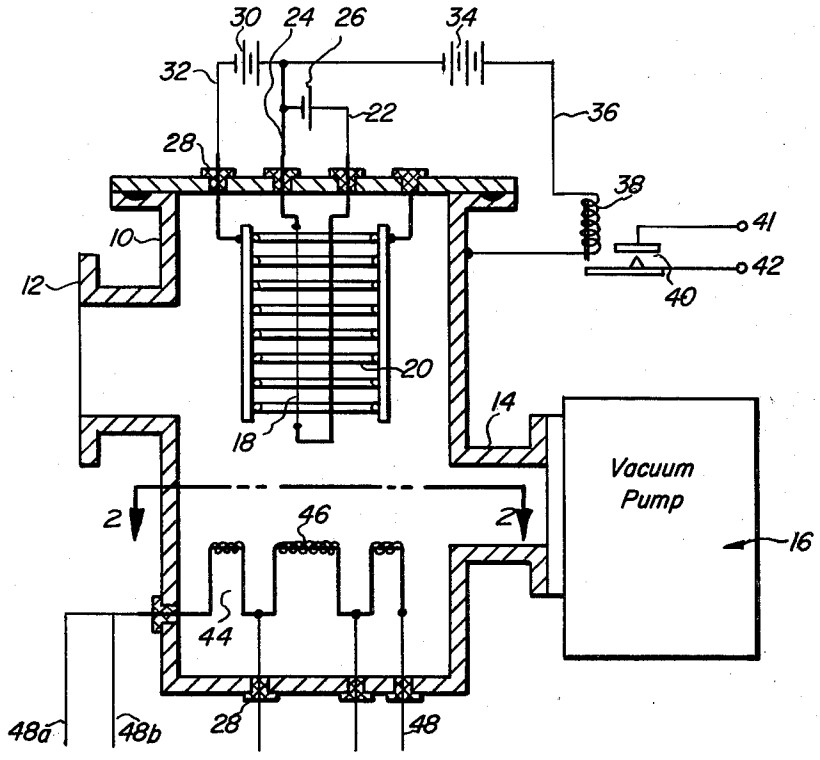


FIG. 1

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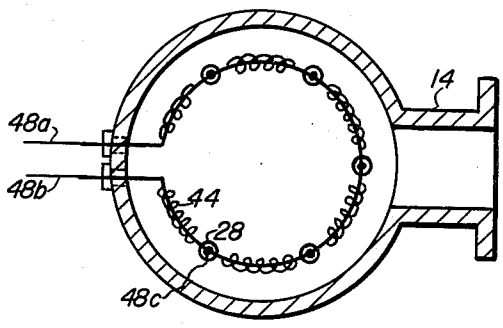


FIG. 2

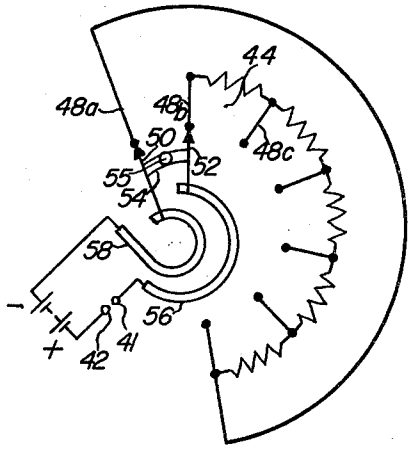


FIG. 3

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HIGH VACUUM DEVICE

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5 Claims. (Cl. 230—69)

This invention relates to vacuum pumps and particularly to ionization getter pumps useful for lengthening the continuous operating time of ion-getter pumps for vacuum production.

An object of the invention is to provide such a pump embodying novel principles of construction and operation which provide a longer continuous operating time than that obtainable with prior pumps.

Another object is to provide novel electric governing means for automatically controlling the operation of such pump.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the process involving the several steps and the relation and the order of one or more of such steps with respect to each of the others and the apparatus possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be defined in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with accompanying schematic drawings wherein:

FIG. 1 is a front view section of the ionization getter pump according to the invention;

FIG. 2 is a cross section of the ionization getter pump along the line 2—2 in FIG. 1; and

FIG. 3 is a wiring diagram of the heating elements in FIGS. 1 and 2.

A known way of vacuum production, in a vacuum chamber, is the evaporation of a suitable getter material which condenses on the walls of the chamber building a surface layer on which the gas molecules are absorbed. An ionizing means is often included in these types of "getter pumps."

Briefly stated, the invention comprises an arrangement of heating elements within an ionization getter pump. The elements have a getter material wrapped around them, and are connected to a source of electric current in such a manner that the resulting current produces a temperature which is below the evaporation temperature of the getter material. Such connection is preferably a series arrangement which provides for outgassing of the filaments and getter material during the fore-evacuation period This outgassing is essential for reaching ultimate high vacuums. After fore-evacuation is completed, the heating elements may be operated individually or in small groups on the same operating electric current. This type of arrangement is of particular advantage, since it does not have to take into consideration the regulation of available electric current. To accomplish this, the current will have to be, after consideration of the resistance value of the heating elements, chosen in such a manner that after all heating elements are connected in series, a temperature will result which shall be sufficient to effect the outgassing. Additionally, the same current, when connected to individual heating elements, will provide a temperature sufficiently high to cause evaporation of the getter material during the normal operation of the ionization getter pump. Therefore, the operating time of a getter

source can be held constant. Changes in the rate of getter material evaporated is accomplished, in a predetermined time period, by putting into operation or removing from operation other getter sources.

In a preferred embodiment of the invention, the heating elements are preferably tungsten filaments having a suitable wire-like getter material wrapped around the elements. These elements, because of their small space consumption, can be installed in various ways inside the ionization getter pump. They are preferably arranged in concentric circles, each element being connected in series. The individual heating elements are provided with leads to the outside of the pump whereby the elements can be connected in series as well as individually to a current source. The individual elements can be provided with the same getter material or each one of them can be furnished with a different getter material. When one source of getter material is exhausted, a connection is made to the next source which is thereby set into operation.

The operation of the individual getter sources is preferably controlled by a pressure measuring means. A Bayard-Alpert ionization pressure gauge or other suitable gauge may be used for measurements of pressure. It is also possible to use the ionization apparatus in the getter pump as an additional pressure measuring system. For example, a self controlled relay utilizing electromagnetic, mechanical or electronic means would interrupt the operation of a getter source, should a pressure drop not take place in the vacuum chamber, after a predetermined period of time. Similarly, the getter source would be put into operation only if the pressure inside the vacuum chamber exceeds a predetermined value. In this manner, considerable conservation of getter material and thus prolonged, uninterrupted operating time of approximately one-half a year is achieved.

Referring now to FIG. 1 wherein a pumping chamber 10 is connected by a flange 12 to a high vacuum chamber (not shown), and by a flange 14 to a pumping system 16 which fore-evacuates the getter pump. A means for ionizing gases is shown having a heating filament 18 and a surrounding grid 20. The heating filament 20 is connected by leads 22, 24 to a current source 26. All leads are directed through the pump walls by power feed-throughs 28. The heating filament 18 and the surrounding grid 20 are connected on a circuit powered by a battery 30 whereby the grid 20 is connected by a lead 32. Another current, which directs the ionized gas molecules toward the walls of the chamber, is obtained from battery 34. Into the connection 36, leading from battery 34 to chamber 10, is an electromagnetic relay with a vibrator 38 which operates a set of contacts 40, thus connecting the junctions 41, 42 in the event the current in lead 36 should exceed a predetermined value corresponding to the pressure.

In the lower third of the pumping chamber is the gettering source consisting of individual heating elements 44 and around these is wrapped the wire-like getter material 46. The junctions 48 lead to the outside through power feed-throughs 28.

FIG. 2 shows the arrangement of the getter source in a concentric circle inside the pump and the position of the individual junctions 48.

FIG. 3 shows a schematic representation of the electric circuitry of the heating elements 44 wherein two riding contacts 50, 52 are coupled by a crossmember 54 with a handle 55 which enables movement of the contacts. The contacts 50, 52 are moved along contact guides 56, 58, during the fore-evacuation of the getter pump, into a position where they connect junctions 48*a*, 48*b*. Here, all the heating elements 44 are connected in series and are heated to a temperature below the oper-

ating temperature during the fore-evacuation. The contacts **41, 42** are short-circuited during the fore-evacuation to disengage the pressure dependent operations. After the outgassing has been accomplished, the fore-evacuating system **16** is closed and the ionization getter pump is put into operation. In order to start this operation, contacts **50, 52** are moved to the junctions **48***b*, **48***c* thereby connecting the first gettering source. By moving the contacts **50, 52**, other getter sources can be brought into operation until the entire supply of getter material is exhausted. In the contact guides **56, 58** there is installed a circuit breaker (FIG. 1), junctions **41, 42** in order to insure current flow only when the pressure inside the ionization getter pump exceeds a predetermined value.

Since certain changes may be made in the above process and apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description, or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In an ionization getter pump useful for providing high vacuum, the improvement which comprises a plurality of heating elements within said pump, getter material in thermal contact with said heating elements, electric circuit means connecting said heating elements in series, said circuit means having leads which connect said heating elements individually and which pass through power feed-throughs to the outside of said pump, electric means outside of said pump providing for individual and series connection of said heating elements to a current source, said heating elements having resistance values whereby the same quantity of current provides sufficient heat for outgassing when said heating elements are connected in series and sufficient heat to vaporize the getter material when said heating elements are connected individually thereby eliminating regulation of available electric current.

2. The apparatus of claim 1 wherein said heating elements comprise wire-like tungsten filaments arranged in a concentric circle within said pump.

3. In an ionization getter pump useful for providing high vacuum, the improvement which comprises, a plurality of heating elements within said pump, a getter material in thermal contact with said heating elements, electric circuit means connecting said heating elements in series, said circuit means having leads which connect said heating elements individually and which pass through power feed-throughs to the outside of said pump, electric means outside of said pump providing for individual and series connection of said heating elements to a current source, means for measuring the pressure within said pump, relay means connecting said pressure measuring means with said current source and providing for current flow to said heating elements when a pressure drop does not occur within said pump after a predetermined period of time.

4. The apparatus of claim 3 wherein pressure responsive means provides for interrupting the operation of a heating element when a pressure drop does not occur within said pump after a predetermined period of time.

5. The apparatus of claim 3 wherein said electric means outside of said pump comprise two riding contacts coupled by a crossmember and means providing for the movement of said contacts along contact guides whereby said heating elements are connected to said current source in series and individually.

No references cited.