

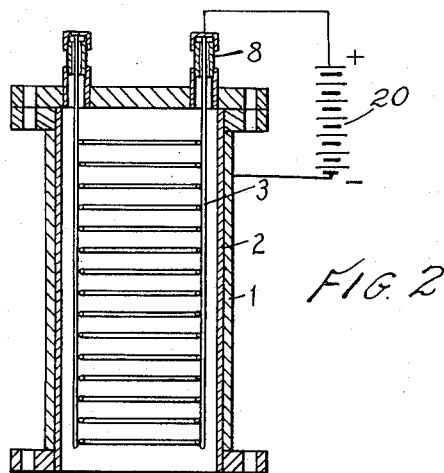
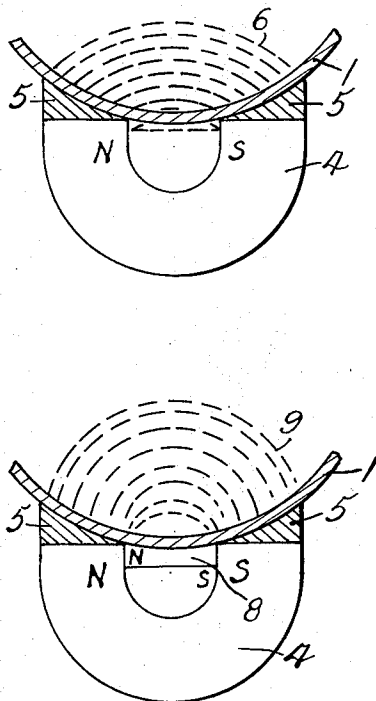
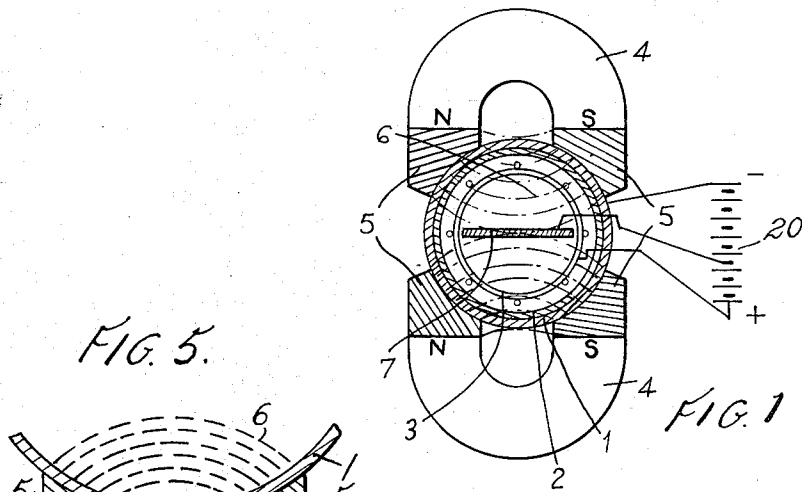
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M. MATRICON
VACUUM PUMPS

3,214,086

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2 Sheets-Sheet 1



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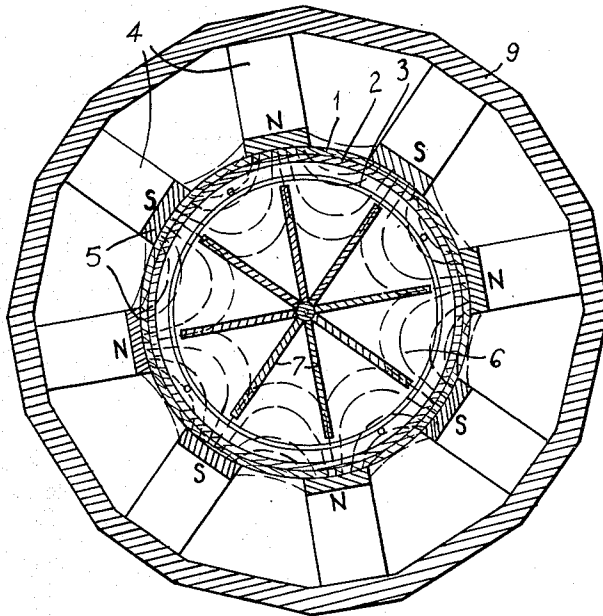


Fig. 3

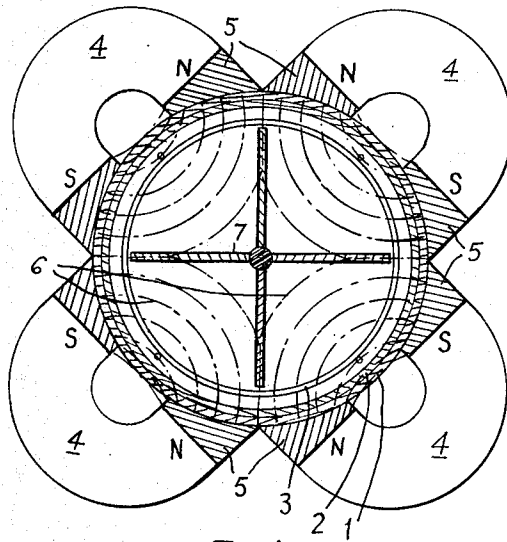


Fig. 4

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VACUUM PUMPS

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882,061, Patent 80,795

2 Claims. (Cl. 230-69)

The present invention relates to improvements to vacuum pumps of the evaporation and ionization type, and is a continuation-in-part application of my prior application Serial No. 155,656 entitled Vacuum Pumps, and filed Nov. 29, 1961.

It is known that electrical discharges in rarefied gases such as those which occur in the presence of a magnetic field and which are accompanied by an evaporation of the metal constituting the cathode, lead to the progressive disappearance of the residual gases. This phenomenon has been used as a method of perfecting the vacuum in sealed tubes and in vacuum pumps of the type known as evaporation and ionization pumps.

The present invention has for an object the construction of an improved pump implementing the above-mentioned phenomena.

Another object is to provide an arrangement whereby the distribution of the lines of force of the magnetic field excited in the pump according to my said prior application, is improved.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which show some embodiments thereof by way of example, and in which:

FIGURE 1 shows a cross-section of a first embodiment of a pump according to the invention,

FIGURE 2 shows an elevation thereof,

FIGURES 3 and 4 respectively show cross-sections of two further embodiments,

FIGURE 5 shows the distribution of the line of force around the poles of one of the magnets according to these embodiments, and

FIGURE 6 shows the distribution of the line of force with the improvement of the present application incorporated.

Referring to the drawings, the pump is constituted by a gas-tight cylindrical enclosure 1, made of non-magnetic material having an internal conductive coating 2 having good gas absorption properties. On the inside of this enclosure is a grid 3, arranged coaxial to the whole. Between members 2 and 3 a difference of electrical potential is established by a potential source indicated by the battery 20 so that the grid 3 becomes an anode and the cylinder 2 a cathode. Magnets 4 provided, for example, with polepieces 5, are arranged outside enclosure 1 in such a way that a magnetic field, the lines of force of which are shown in 6, are created on the inside of the device. When a suitable electrical voltage is applied between the cathode and the anode an electrical discharge results. The electrons abstracted from the cathode by the impact of the positive ions are accelerated by the electrical field which exists between the cathode 2 and the grid-formed anode 3 but they are guided by the magnetic field and can generally only attain the anode after having effected a large number of oscillations between the anode and the cathode. During this long trajectory they ionize the residual gases and the positive ions formed accelerate towards the cathode, causing the emission of new electrons.

The positive ions which strike the cathode can be absorbed into the metal constituting the cathode if this

metal is appropriately chosen. On the other hand, the shock of the positive ions tears away particles of cathodic metal which fix themselves onto the walls of the enclosure. During this process the gaseous molecules are imprisoned beneath the cathodic metal layer.

Such are the two phenomena which confer its gas absorption properties on the system. In order to render the second process more efficient, surfaces such as 7 (not shown on FIGURE 2) can be arranged in the system, to receive the evaporated cathodic metal. These surfaces should be placed in such a way that they do not hinder the electrical discharge, i.e. parallel to the magnetic field. For the same reason they can be carried to the potential of anode 3, or a somewhat less positive potential, in order that they do not absorb the distribution of the electrical field in the system.

The grid-formed anode 3 can be supported by members 8 (FIGURE 2) which form both the electrical connection and the insulating support. This arrangement is convenient if it is intended to heat the anode by the Joule effect in order to degasify it and to provoke evaporation of the fixing body of the gas. For this last purpose the anode can be wholly or partly made of the body it is wished to evaporate. The anode can also be positioned by insulating supports which are suitably placed and arranged independent of the electrical connection.

FIGURES 3 and 4 show arrangements according to the invention wherein the reference numerals similar to those of FIGURES 1 and 2 designate like parts.

In the structure shown in FIGURE 3, the magnetic masses 4 are prismatic and the magnetic field is closed by a yoke 9.

Surfaces 7 can be held at negative voltage in relation to anode 3 in such a way that these surfaces 7 function as ion collectors, thus favoring the fixing of the gases. The voltage to which these surfaces 7 is carried should be such that the ion collection be efficient but that the speed of these ions be too low to cause the atomization of the metal constituting these surfaces 7 or which is deposited on them. This method of operation can be accompanied by Joule heating of anode 3 and by its evaporation if said anode has been made of a metal able to fix the gases.

Referring now to FIGURE 5, this shows the distribution of the lines of force around one of the magnets of a magnet system used in the embodiments above referred to. In accordance with well known physical principles the lines of force, indicated at 6, follow the line of least resistance and therefore as shown in this figure they flatten out inside the insulating enclosure 1 and a small part of the flux actually passes directly between the poles N and S and outside the enclosure 1 as shown at 6a. This leakage flux reduces the operational efficiency of the pump. It will be appreciated that in order to keep the drawing simple, so as the more efficiently to show the lines of force, the conductive coating 2 and all the other parts of the pump, have been omitted.

To explain the improvement to which the present continuation-in-part application relates, reference is made to FIGURE 6 which shows an arrangement which is adapted to increase the penetration of the magnetic field in the enclosure 1. For this purpose an additional magnetic bar 8 is arranged between the adjacent dissimilar poles 5 of the magnet system of any one of the embodiments referred to above. For example only, the drawing shows a single magnet 4 of a system as used in FIGURE 1, 2 or 4, but it can also be used between the dissimilar poles of a system as shown in FIGURE 3. As will be seen from FIGURE 6, the pole N of the magnet 8 is arranged in the vicinity of a pole N and likewise therefore the pole S of the magnet 8 is close to the next

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adjacent S pole of the main magnet system. The result of the arrangement of the additional magnet 8 is that the lines of force now given reference numeral 9, penetrate more deeply into the enclosure 1 because they cross at or near to a perpendicular from a tangent of the walls of the enclosure 1 at each point and this redistribution of the field brings about an increased efficiency in operation of the whole arrangement.

It will be appreciated that FIGURES 5 and 6 show only two adjacent poles of a magnet system, exemplified as a single magnet only, but it will be apparent that an additional magnet 8 may be arranged between any or all or the co-adjacent dissimilar poles of the magnet system S referred to in the preceding embodiments of FIGURES 1 to 4.

It will also be clear that the embodiment described in FIGURE 6 has been given by way of example and that other variants may be designed within the scope of the invention.

I claim:

1. In a vacuum pump of the evaporation and ionisation type comprising a hermetically sealed enclosure defined by a wall of non-magnetic material, a gas-absorbing coating on the inner face of said wall, a grid-form electrode located axially within said enclosure, means for connecting said enclosure and said grid-form electrode to a voltage source whereby the inner face of said wall and said gas-absorbing coating can act as a cathode, the grid-form electrode then having a potential which is highly positive with respect to said cathode,

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and at least one permanent magnet mounted on the outside of said wall, with the poles of said magnet next adjacent said wall, the improvement which consists in an additional permanent magnet located wholly between the poles of said at least one permanent magnet and outside said wall, like poles of said two magnets being located adjacent each other.

2. A sealed enclosure for a vacuum pump, said enclosure including a cylindrical wall, a first permanent magnet located on the outside of said wall, the poles of said first magnet being located next adjacent said wall, and a second permanent magnet located on the outside of said wall and wholly between the poles of said first magnet, the like of said two magnets being co-adjacently arranged.

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