

July 21, 1964

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3,141,605

MAGNETRON TYPE GETTER ION PUMP

Filed Aug. 18, 1961

2 Sheets-Sheet 1

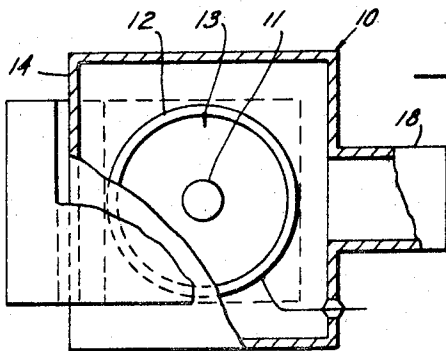


FIG. 1a.

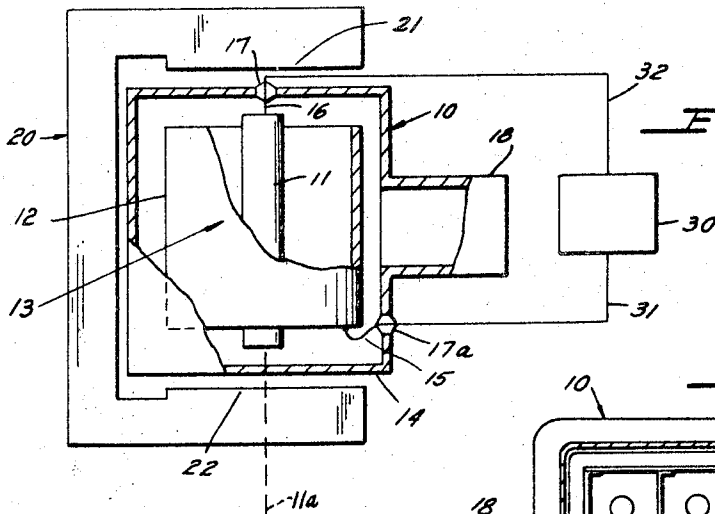


FIG. 1b.

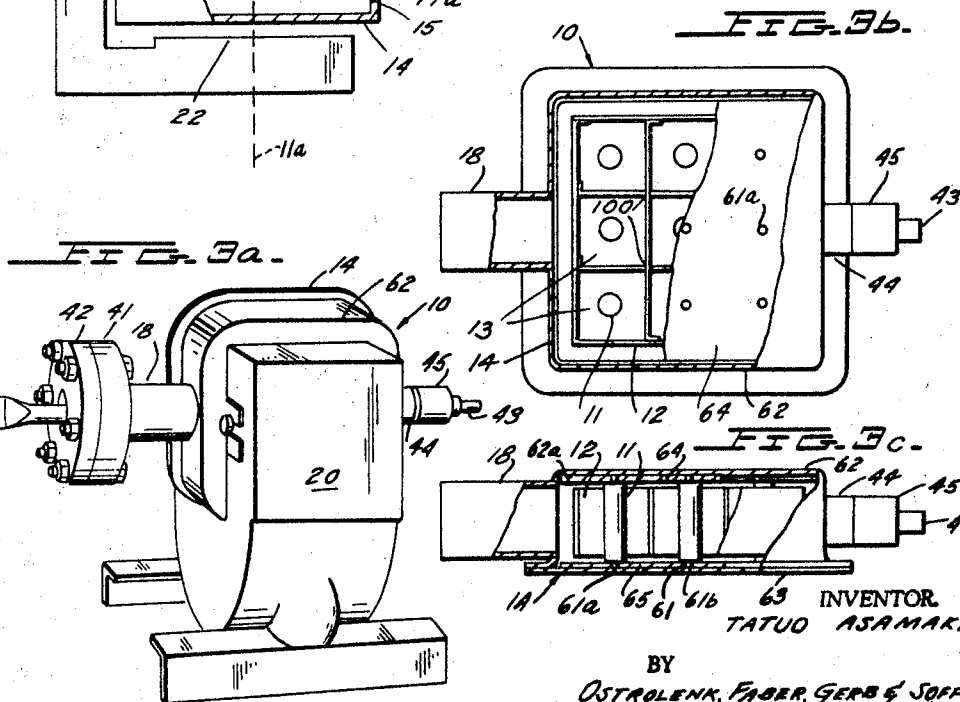


FIG. 2a.

FIG. 2b.

FIG. 2c.

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FIG. 2.

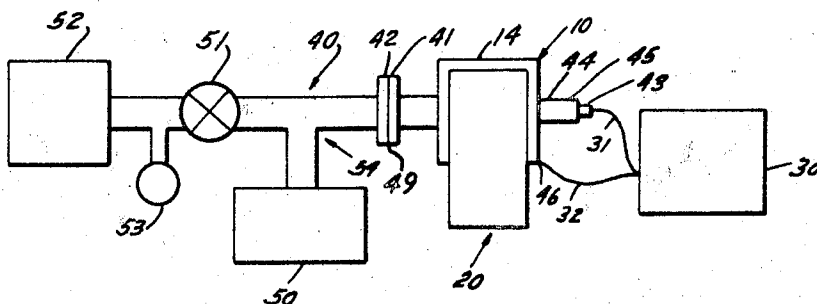


FIG. 4.

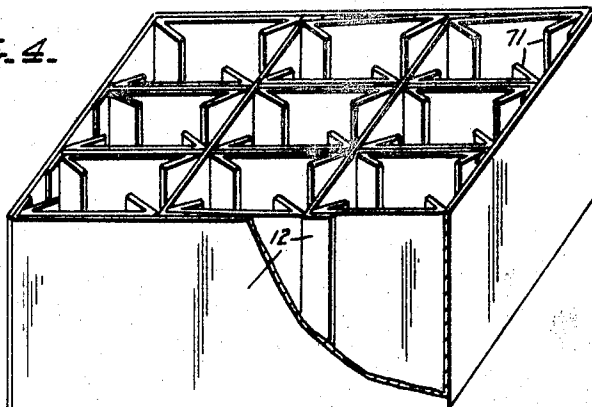
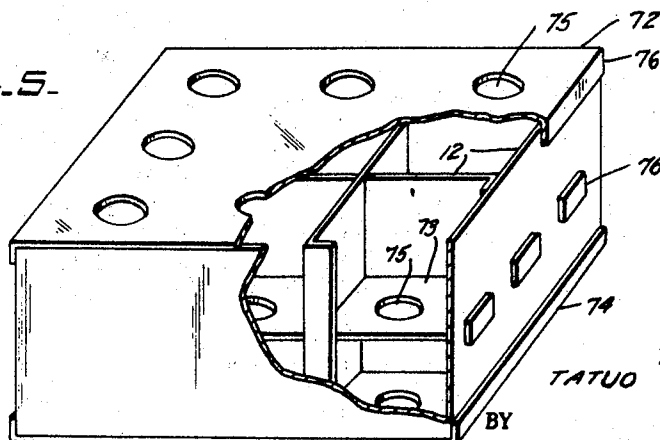


FIG. 5.



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MAGNETRON TYPE GETTER ION PUMP

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6 Claims. (Cl. 230-69)

This invention relates to a magnetron type getter-ion pump or a vacuum pump employing a magnetron type vacuum gauge. Some of the prior art methods for obtaining a high vacuum are: the employment of an oil diffusion pump; or the utilization of a gas adsorption action of charcoal at an extreme low temperature as of liquid air; or the utilization of a gas adsorption action of getter.

Any of these devices which are employed to produce a high vacuum may be considered as a vacuum pump. Further, another method of obtaining a high vacuum is set forth in the report by Mr. R. L. Jespen (page 80, No. 80, French Magazine Le Vide, 1958). This method employs a getter-ion pump or a cold cathode ionization vacuum gauge type vacuum pump. This type of getter-ion pump, aside from being small in size, is capable of obtaining a high vacuum of the order of 10^{-10} mm. Hg. Pumping speeds of approximately 5 liters/sec. are obtainable even with a small-size pump, and large size pumps have a pumping speed of tens of thousands of liters per second, and these pumping speeds are almost constant in the degree of vacuum which is maintained within the range of 10^{-4} mm. Hg to 10^{-9} mm. Hg.

It is also possible to measure the degree of vacuum while performing an exhaust operation. On the other hand, a magnetron type vacuum gauge, as described in the report by Mr. P. A. Redhead (American publication Fifth National Symposium on Vacuum Technology Transaction, 1958, pages 148-152, especially pages 151-152), employs a cold cathode discharge principle which continues discharge of negative particles even at such an ultra high vacuum as 10^{-13} mm. Hg.

Generally, in a cold cathode ionization vacuum gauge, although this kind of vacuum gauge is not a vacuum pump, the difference between the degree of vacuum of the region to be measured and the degree of vacuum of the region occupied by the vacuum gauge, that is, the region where the measurement of vacuum is taking place, must be considered. Thus the pumping speed is a major factor which must be taken into account. According to the report by Mr. Redhead, set forth above, the pumping speed in a magnetron type vacuum gauge is in the range of 0.15 l./sec. for helium, which is a reasonably large value.

The instant invention is designed to provide a new magnetron type getter-ion pump arrangement in order to obtain a higher pumping speed at an ultra high vacuum which has not been attained by the conventional getter-ion pump of the prior art as well as improving the effective attainable degree of vacuum for the getter-ion pump as described above.

The ultra high vacuum pump of this invention is comprised of an anode and a cooperating cathode which are immersed in an air-tight container. At least the surface of the cathode of the magnetron type vacuum gauge should be made from a material exhibiting a substantial amount of gettering action such as titanium, zirconium,

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magnesium, molybdenum or hafnium, for example. One or a multiple of pump elements (the pump element being the combination of the anode of a magnetron type vacuum gauge and the cathode which is treated as set forth above), are housed in a vacuum vessel. Further, in some cases, fin-shaped portions made from the same material, preferably as the pump electrodes, are secured to the electrode, especially to the anode electrode, in such a way that said fin portions face project toward the opposing electrode.

The vacuum vessel of a magnetron type getter ion pump which is constructed as described above is placed in a magnetic field and is positioned to communicate with both a vacuum system to be evacuated, as in the case of exhaust by charcoal or by ordinary getter-ion pump, and the high vacuum system. That is, the magnetron type getter-ion pump and the vacuum system is evacuated to a low vacuum of about 10^{-2} mm. Hg. by means of an auxiliary pump which then initiates the magnetron type getter-ion pump into operation by applying an energizing voltage when the vacuum at 10^{-2} mm. Hg. is attained. Soon after the start of this pumping action, the connection between the high vacuum system and the auxiliary vacuum pump is cut off, allowing only the magnetron type getter ion pump to continue its pumping operation. The vacuum system reaches a high vacuum quickly through the gettering action of the constituent material of the surface of the anode, which sputters out of the cathode surface.

It is therefore one object of this invention to provide a vacuum pump designed to produce an ultra high vacuum condition and to maintain said condition.

Another object of this invention is to provide a relatively small vacuum pump capable of producing an ultra high vacuum wherein said pump is designed to pump substantially large quantities of gases.

Another object of this invention is to provide a pump structure which employs materials having substantially large gettering characteristics.

Still another object of this invention is to provide a vacuum pump having a novel electrode arrangement for obtaining large pumping capabilities.

Another object of this invention is to provide a vacuum pump having a novel arrangement which includes a plurality of anode-cathode pump elements.

These and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being made to the accompanying drawings, wherein:

FIGS. 1a and 1b are top and side elevational views respectively of one vacuum pump in accordance with the instant invention.

FIG. 2 is a diagrammatic view of an entire vacuum pump system.

FIG. 3a is a perspective view of another embodiment of this invention.

FIGS. 3b and 3c are side and end views respectively of a portion of the vacuum pump of FIG. 3a with portions of the pump cover removed.

FIG. 4 is another preferred embodiment of the electrode portion of the ultra high vacuum pump.

FIG. 5 is still another preferred embodiment of the electrode arrangement.

Prior art operations and devices with which the present application is concerned, are described, for instance, in the prior art publications listed below:

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"The Production and Measurement of Ultra-High Vacuum (10^{-8} - 10^{-13} mm. Hg)," by P.A. Redhead, published in Fifth National Symposium on Vacuum Technology Transactions, 1958, pp. 148-152.

"A Cylindrical Magnetron Ionisation Gauge," by A. H. Beck and A. D. Brisbane, published in Vacuum, vol. II, No. 2, April 1952, pp. 137-146.

"The Interplay of Electronics and Vacuum Technology," by J. M. Lafferty and T. A. Vanderslice, published in Proceedings of the IRE, July 1961, pp. 1136-1154.

To simplify the description of the present invention, it is assumed that all operations and operating elements of such known systems are to be considered part of the present disclosure, except for the modifications and features of the present invention as hereinafter described.

Referring now to the drawings, FIGS. 1a-1b show a magnetron type getter-ion pump 10 according to this invention which is comprised of a cylindrical cathode 11 made of titanium and a cylindrical anode 12 made of titanium plate, said cylindrical anode 12 being so arranged as to coaxially surround the cathode. The cathode 11 should employ, at least upon its surface, a material having strong getter properties, such as titanium, zirconium, magnesium, molybdenum or hafnium. As to the electrode shape, it is sufficient if the cathode has an elongated configuration and not necessarily a cylindrical shape. Also, it does not effect operating efficiency if the electrode surface is uneven. The anode 12 also may be made of a metal other than titanium plate, and it is not necessary that its shape be cylindrical. It can be a square or a hexagon as will be described later.

The pump assembly 13, that is, the combination of anode 12 and cathode 11, is put in a vacuum vessel 14 made of a stainless steel plate. This vacuum vessel 14 may be made of glass or porcelain, or any other metal provided that it is not a magnetic material having extremely high magnetic permeability such as an ordinary steel or a soft steel. Lead wires 15 and 16 which are connected to anode 12 and cathode 11, respectively, are inserted through apertures in vessel 14. Sealing means 17 and 17a are provided for maintaining the vessel 14 in an air-tight condition. The sealing means 17 and 17a which are made of porcelain or other suitable insulating materials further act to electrically insulate leads 15 and 16 from vessel 14.

The vacuum vessel 14 is provided with an exhaust extension 18 which acts to place the interior of the vacuum vessel 14 in communication with the vacuum system to be evacuated (not shown in FIGS. 1a and 1b). The dimensions of anode 12, cathode 11 and vacuum vessel 14, as well as the construction of pump 10 according to this invention will be more fully described in conjunction with the practical example shown in FIG. 3.

Pump 10 according to this invention is operated with a magnetic field in the direction of the longitudinal axis of cathode 11. In FIGS. 1a and 1b a horseshoe shaped permanent magnet 20 is so positioned with respect to pump 10 that it is substantially perpendicular to the axis of magnetic poles 21 and 22 and to the longitudinal axis 11a of pump element 13, and preferably magnet 20 and pump 10 should be firmly fixed relatively by means of suitable supporting metal fittings or screws (not shown in drawing) applied in any well known manner. An electromagnet may be used instead of the permanent magnet 20 shown in FIGS. 1a and 1b, or a magnetic field may be produced by applying D.C. or A.C. current to a coil which is positioned coaxial to the axis 11a of pump element 13. Also, the polarity of the magnetic field is not important; it can be in either the upward or downward vertical direction. A power source 30 shown in FIGS. 1a and 1b provides a potential difference between anode 12 and cathode 11. In the case when the power source 30 is to supply D.C. power, the positive terminal of this power device is connected to anode lead wire 15, and the negative terminal is connected to cathode lead

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wire 16, by means of electrical conductors 31 and 32, respectively. But, in the case where the power source 30 is to supply A.C. power, either of the terminals of the power device can be connected to either of the lead wires. Usually, electrical conductor 32 which is connected to cathode lead wire 16 is grounded. In this case, electrical conductor 31 which is connected to anode lead wire 15, will have a relatively high voltage and it should be sufficiently insulated. The reason why vacuum pump 10 according to this invention is operative even when A.C. voltage is applied to pump element 13 is that the cathode 11 and the anode 12 are non-symmetrical elements.

In FIG. 2, a flange 41 is provided at the end of the exhaust pipe 18 for securing the pump 10 to an exhaust system 40. In the case where the exhaust extension 18 in the exhaust system 10 is a metal pipe, a mating flange 42 for the flange 41 is fitted at one end of the exhaust pipe by soldering, argon arc welding, etc., while in the case of a glass exhaust pipe, an adaptor with a flange which is attached by means of vacuum sealing material, as is well known in the art of vacuum sealing of glass and metal, is fitted at one end of the exhaust pipe. Both flanges 41 and 42 should be tightened so that they form an air tight seal by means of suitable bolts and nuts (not shown) after inserting a gasket 49 between the flanges, said gasket being composed of oxide free copper, Teflon or silicon rubber. Further, in FIG. 2 the axis of pump element 13 (not shown) of pump 10 is made perpendicular to the surface of FIG. 2 which shows only the permanent magnet 20, power supply 30 and electrical conductors 31 and 32. As will be subsequently explained with reference to FIGS. 3a-3c, lead wire 43 to the anode of the pump 10 is fitted to the end portion of branch pipe 44 which forms an air tight seal for vacuum vessel 14 in cooperation with electrical insulator 45 which corresponds to electrical insulator 17 as shown in FIG. 1. The lead wire 32 is connected to the pump element cathode (not shown) by electrical connection with vacuum vessel 14 directly at point 46. The body 50 to be evacuated is connected to an auxiliary vacuum pump 52, such as an oil rotary pump, through a cock or a seal valve 51. Pump 10 according to this invention is placed between the body to be evacuated 50 and the cock 51 and communicates with the body 50 by means of the flanges 41 and 42 as described before. A vacuum gauge 53 capable of measuring vacuum up to 10^{-2} mm. Hg is positioned between the cock 51 and the auxiliary pump 52. In a case when a substance of high vapour pressure is present in the exhaust system due to the use of a vacuum gauge such as the Macleod vacuum gauge, insertion of a trap (not shown in the drawing) which is designed to cool by liquid air is necessary. The trap should be installed between the high vacuum system 54 and the cock 51, said high vacuum system consisting of the body to be evacuated 50 and the pump 10 according to this invention. In the case where vacuum pumping of a plurality of bodies of the type of body 50 is desired, it is advantageous to provide another cock (not shown in the figure) at the opposite side of the pump 10 with respect to the flange 42, thereby enabling maintenance of the interior of the pump 10 at high vacuum by dividing the high vacuum system 54 into two regions by the closing of said cock whenever the high vacuum system 54, that is the region between the body to be evacuated 50 and pump 10 according to this invention, is open to the atmosphere for changing the body 50 to be evacuated. The auxiliary vacuum pump 52 is operated by opening the cock 51, and, when the degree of vacuum in the exhaust system reaches 10^{-2} mm. Hg, impressing a voltage of 1 to 5 kv. to the pump 10 by means of the power supply 30. The power supply 30 has a maximum load current preferably of 200 ma. (which is employed for a 15 minute period). The intensity of a magnetic field should be approximately 700 gauss. When such a voltage is impressed upon the pump 10 according to this invention, a cold cathode discharge occurs in the interior of

the pump. At the start, the electric current is approximately 100 ma., but this gradually decreases and finally it becomes nearly 20 ma. This change in the electric current can be read by means of an ammeter which is fitted at the power supply 30. As an alternative an electric lamp which gradually becomes dim, and, finally goes out, may be installed as part of the power supply 30 which lamp may further act as a resistance element for limiting the discharge electric current. When the discharge current decreases to the above mentioned magnitude, the pump, according to this invention, is in perfect operating condition, enabling the cock 51 to be closed thereby isolating the high vacuum system 52 from the body 50. Instead of using cock 51, the same effect can be obtained by sealing that part of the exhaust pipe which corresponds to the cock 51.

In the interior of the pump 10 according to this invention, charged bodies, such as electrons, are produced by the cold cathode discharge. Of these charged bodies, electrons and other negative charged bodies will travel from cathode 11 to anode 12, along a very long path whose length is determined by the magnitudes of the electric field and the magnetic field which are in existence in the space between anode 12 and cathode 11. The accelerated negative particles moving towards the anode collide with the residual air molecules causing ionization to occur. The positive charged bodies formed by ionization reach cathode 11 which collision emits electrons again, while spattering titanium out of the surface of the cathode 11.

Generally, there are two ways of producing the exhaust action of the getter, i.e., the dispersal gettering and the contact gettering, as is explained on page 13 in a Japanese book "Sinkukan no Getta nikansuru kenkyo (Studies on vacuum tube getter)," by Dr. Osamu Harashima, published February 1950 by Maruzen Book store. In the dispersal gettering, the getter molecules and the gas molecules are combined and adhere to the wall of a vessel when the getters fly, thus exhibiting a high adsorption power although for a very short time. In the contact gettering, a gettering film which has been formed on a vessel wall adsorbs the residual gas molecules for a long time, although it does not show a high adsorption power. The pump 10 according to this invention is designed to perform the contact gettering by adhering titanium to anode 12. The reason why the magnetron type getter ion pump of this design has an effective attainable high vacuum, is as described before, that in the magnetron type vacuum gauge a cold cathode discharge is continued at an ultra high vacuum. By this fact and together with a gettering action, especially by the dispersal gettering, the pumping speed at high vacuum becomes larger and it is possible to measure the pumping speed at ultra high vacuums. Further, in the magnetron type getter ion pump of this invention, the cathode 11 will normally be consumed, but when operated in a vacuum of 10^{-6} mm. Hg it is possible to continue use of the cathode without trying to improve its performance even when it has been operating for more than 40,000 hours, which means it has more than 40,000 hours of successful operating life.

In FIGS. 3a-3c, the pump 10 according to this invention consists of nine individual pump elements 13. The cathode 11 of each pump element 13 is a titanium rod (about 6 mm. dia. and 30 mm. length). Both ends of each of the rods 11 are provided with projections 61 (about 3 mm. dia. and 15 mm. length) which are integral with and coaxial with the main cathode portion 11. The anode 12 is made of titanium plate (about 0.4 mm. thick, and 25 mm. height) and is so constructed, by means of spot welding, as to form a regular square electrode with each side being 13 mm. It should be understood that the dimensions given are merely exemplary and play no novel part in the instant invention. A notched anode arrangement 100 is employed where the titanium plates intersect. The vacuum vessel 14 is comprised of a dish shaped body 62 and a planar cover 63 each made of

stainless steel of about 1.5 mm. thick. The dish shaped body 62 may be formed by pressing a stainless steel plate and is designed to form substantially a regular square pole interior space having about 60 mm. side length and 33 mm. height. To this dish shaped body 62 is connected the stainless steel extension pipe 18 of 32 mm. in diameter which serves as a suction pipe and the stainless steel pipe 44 of 20 mm. in diameter which serves as a branch pipe in such a way that the spaces within these pipes are in communication with the aforementioned interior space bounded by said bodies 62 and 63. An air tight seal is provided at the communicating edges of members 62 and 63 by argon arc welding.

An electrical insulator 45, formed of an insulating material such as porcelain, is positioned to form an air tight seal by means of a vacuum seal body such as an iron-nickel-cobalt alloy known as "Kovar." A "Kovar" wire 43 of approximately 6.0 mm. dia. is sealed in electrical insulator 45 in an air tight arrangement. The wire which is a Monel wire extends slightly into the interior of the vacuum vessel 14 to serve as the anode lead wire 43. A cathode 11 is inserted at the bottom of the dish shaped body 62 (which corresponds to topmost portion in the elevation at view of FIG. 3b). A cathode supporting body 64, consisting of a titanium plate of about 1.6 mm. thickness, is provided with an aperture to receive the projection 61 of the cathode 11 when it is positioned therein. Said cathode supporting plate 64 is inserted in such a way that the upper surface of the plate touches the inner surface 62a of the dish shaped body 62. Thus the cathode 11 is maintained in a predetermined position by fitting one of the projected portions 61a into the aperture in the supporting body 64, and the anode 12 is positioned in the region enclosed by the dish shaped body 62 and cover plate 63. The anode is secured to the predetermined position shown in FIGS. 3b and 3c by spot welding an anode supporting element (not shown in the drawing) and the end of the Monel wire extension (not shown) of the anode lead wire 43. The anode supporting element consists of a fin shaped projection which is spot welded to the exterior of the anode. Next, the cathode 11 is secured to a desired position by fitting the other projection 61b of the cathode 11 into a cooperating aperture in the cathode supporting body 65 which is similar to the cathode supporting body 64. The cover plate 63 fits over the cathode supporting body 65 so that the surfaces of both members contact each other (members 63 and 65), sealing the circumference of the plate 63 and the flanged portion of the dish shaped body 62 by means of argon arc welding which creates an air tight seal. The electrical connection between the cathode 11 and the vacuum vessel 14 is effected merely by the pressure fitting of the elements and by engagement of the surfaces of the cathodes 11 and members 62 and 63, since the discharge current is approximately 200 ma. at the maximum. As previously described, a cathode of the type of cathode 11 is worn out by sputtering, the percentage of wearing-out being approximately 5% out of 100% in cases where the pump 10 has been operated for 40,000 hours at pressures 10^{-6} mm. Hg. Regarding materials and types for each element, only those restrictions as previously described are to be followed, while no other restrictions are present with respect to special materials, types and dimensions. The ways of welding and air tight sealing in the course of construction are not restricted to those described here. Especially in the case where the vacuum vessel 14 is of a large size, and is provided with multiple pump elements 13, it is necessary to use a metal plate of about 3 mm. thickness to increase mechanical strength of the vessel 14. FIG. 4 shows one preferred embodiment of anode 12 which is provided with fin shaped portions 71 which are arranged in such a manner that their planes are parallel to the longitudinal axis of the pump element 13 (see FIGS. 1b and 3b). The fins 71 are spot welded so as

to project inwardly towards the region bounded by the regular square pole between plates which constitute the beforementioned anode.

As shown in FIG. 5, anode 12 is provided with fin-shaped portions 72, 73 or 74 the planes of which are perpendicular to the aforementioned cathode longitudinal axis, but in this case it is necessary that these fin-shaped parts should be provided with apertures 75 having diameters which are greater than the outer diameter of the cathode (not shown) so that they do not come into engagement with each other. FIG. 5 also discloses lugs 76 which are employed for spot welding the fin shaped members 72, 73 and 74 to the main body of the anode 12.

In the pump according to this invention which employs the modified anodes as shown in FIG. 4, the mean free path of charged body is longer than the path of prior art devices, resulting in higher pumping speed, as described on page 60 in a Japanese book "Tyokoshuha Densikan (Ultra-high-frequency Electron Tube)," by Dr. Kenjiro Okabe and others (Shukyosha, 1953). In the pump according to this invention, which uses the modified anodes, as shown in FIG. 5, the pump electric current or pumping speed is much higher, by the same reason as in the case where the electric current of a vacuum gauge is made larger by making projections on the surface of the anode of a magnetron vacuum gauge as described in the report by A. H. Beck in English magazine "Vacuum," 1952, volume 2, starting on page 137.

The outline of the present invention, together with the several embodiments have been given. The features and principles underlying the invention described above in connection with specific exemplifications thereof will suggest to those skilled in the art many other modifications thereof. It is accordingly desired that the appended claims shall not be limited to any specific features or details described in connection with the exemplifications thereof.

I claim:

1. A magnetron type getter ion pump comprising a plurality of pump elements each of which consists of a cathode of predetermined length, said cathode being cylindrical in shape, at least the surface of said cathode being formed of material having high gettering action, a cylindrical shaped metallic anode arranged around the cathode and electrically insulated therefrom; the longitudinal axes of said anode and said cathode being arranged substantially in parallel; first means for generating a magnetic field in the region of said pump element, a vacuum vessel for housing said pump elements; said vessel having at least one cylindrical portion extending from the body of said vessel suitable for connection to a vacuum system to be evacuated; second means positioned outside of said vessel for applying a voltage across said anode and said cathode, the longitudinal axes of each of said pump elements being arranged in parallel relation with said magnetic field, a planar member arranged perpendicular to said longitudinal axes and having apertures for receiving said cathode, each of said apertures having a diameter greater than the diameter of said cathode; said planar member being secured to said anode at one end thereof.

2. A magnetron type getter ion pump comprising a plurality of pump elements each of which consists of a cathode of predetermined length, said cathode being cylindrical in shape, at least the surface of said cathode being formed of material having high gettering action, a cylindrical shaped metallic anode arranged around the cathode and electrically insulated therefrom; the longitudinal axes of said anode and said cathode being arranged substantially in parallel; first means for generating a magnetic field in the region of said pump element, a vacuum vessel for housing said pump elements; said vessel having at least one cylindrical portion extending from the body of said vessel suitable for connection to a vacuum system to be evacuated; second means positioned outside of said

vessel for applying a voltage across said anode and said cathode, the longitudinal axes of each of said pump elements being arranged in parallel relation with said magnetic field, first and second planar members arranged perpendicular to said longitudinal axes and having apertures for receiving said cathode, said planar members being electrically insulated from said cathode, each of said apertures having a diameter greater than the diameter of said cathodes; said planar members each being secured to said anodes at opposite ends thereof.

3. A magnetron type getter ion pump comprising a plurality of pump elements each of which consists of a cathode of predetermined length, said cathode being cylindrical in shape, at least the surface of said cathode being formed of material having high gettering action, a cylindrical metallic anode arranged around the cathode and electrically insulated therefrom; the longitudinal axes of said anode and said cathode being arranged substantially in parallel; first means for generating a magnetic field in the region of said pump element, a vacuum vessel for housing said pump elements; said vessel having at least one cylindrical portion extending from the body of said vessel suitable for connection to a vacuum system to be evacuated; second means positioned outside of said vessel for applying a voltage across said anode and said cathode, the longitudinal axes of each of said pump elements being arranged in parallel relation with said magnetic field, a planar member arranged perpendicular to said longitudinal axes and having apertures for receiving said cathode, said planar member being electrically insulated from said cathode and electrically connected to said anode, each of said apertures having a diameter greater than the diameter of said cathodes; said planar member being secured to said anode at one end thereof.

4. A magnetron type getter ion pump comprising a plurality of pump elements each of which consists of a cathode of predetermined length, said cathode being cylindrical in shape, at least the surface of said cathode being formed of material having high gettering action, a rectangular shaped metallic anode arranged around the cathode and electrically insulated therefrom; the longitudinal axes of said anode and said cathode being arranged substantially in parallel; first means for generating a magnetic field in the region of said pump element, a vacuum vessel for housing said pump elements; said vessel having at least one cylindrical portion extending from the body of said vessel suitable for connection to a vacuum system to be evacuated; second means positioned outside of said vessel for applying a voltage across said anode and said cathode, the longitudinal axes of each of said pump elements being arranged in parallel relation with said magnetic field, a planar member arranged perpendicular to said longitudinal axes and having apertures for receiving said cathode, each of said apertures having a diameter greater than the diameter of said cathode; said planar member being secured to said anode at a point intermediate the ends thereof, said planar member being adapted to divide said pump elements into an upper and a lower pump region.

5. The getter ion pump of claim 2 further comprising a third planar member parallel to said first and second planar members and being secured to said anode at a point intermediate the ends thereof; said third planar member having apertures for receiving said cathode; said third planar member being adapted to divide each of said pump elements into an upper and a lower pump region, each of said apertures having a diameter greater than the diameter of said cathode; said planar member being secured to said anode at one end thereof.

6. A magnetron type getter ion pump comprising a plurality of pump elements each of which consists of a cathode of predetermined length, said cathode being cylindrical in shape, at least the surface of said cathode being formed of material having high gettering action, a cylindrical shaped metallic anode arranged around the cathode and electrically insulated therefrom; the longitudinal axes

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of said anode and said cathode being arranged substantially in parallel; first means for generating a magnetic field in the region of said pump element, a vacuum vessel for housing said pump elements; said vessel having at least one cylindrical portion extending from the body of said vessel suitable for connection to a vacuum system to be evacuated; second means positioned outside of said vessel for applying a voltage across said anode and said cathode, the longitudinal axes of each of said pump elements being arranged in parallel relation with said magnetic field; each of said cylindrical shaped anodes having

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a plurality of fins projecting towards said cathode; each of said fins being secured to said anode at the corners thereof and being substantially parallel to the longitudinal axis of said cathode.

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