This invention relates to the production of high vacua utilizing the cleaning-up action on residual gases of certain materials known as getters.

It is well known that a high vacuum can be produced in an enclosed space by the use of a getter following the removal of the greater part of the contained atmosphere by a pump. A getter is a chemically active material, usually a metal, which combines with gases impinging upon it. It thus removes them from the gas phase, and holds them in chemical combination. In one form of getter, the reaction which takes place on the getter surface is followed by diffusion of the getter material through the layer of reaction products to the outer surface, so that gettering continues until the whole bulk of the material is used up. An example of such a getter process is barium interacting with oxygen gas.

Titanium may also be used as a getter. In the case of titanium, if a new layer of titanium is formed on the getter material, the getter surface is restored. This process presents difficulties in the case of titanium, because, in the molten state, it is extremely reactive and it is difficult to find a suitable non-reactive crucible or hearth from which to evaporate it.

The object of the present invention is to provide a means of continuously presenting a clean metal surface for the getter reaction to proceed continuously.

According to the invention, the surface of the getter material is continuously subjected to erosion whereby the gas saturated outer layer is removed, thus rendering the gettering reaction continuous. The erosion is conveniently effected by subjecting the getter material to abrasion, scraping or the like.

In one application of the method using titanium as the getter, a boat-shaped sheet of titanium containing a small quantity of coarse carborundum grains is mounted in a glass bulb and incorporated into a vacuum system. When the bulb is shaken so that the abrasive grains slide back and forth along the titanium sheet from end to end, a continuous gettering action is obtained. When the shaking is stopped, the gettering action ceases after a short time interval.

To utilise the method in practice, an abrading action may be obtained by rubbing an abrading surface on a block or sheet of the getter material, which may be titanium or any other metal, metal alloy or mixture. Alternatively, grains of an abrasive may be placed inside a hollow drum of the getter material, and the drum rotated.

The invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 shows an apparatus for applying the invention to the evacuation of a cathode ray tube. Fig. 2 illustrates an alternative manner for effecting the abrasive action of the getter material.

Fig. 3 is an end view of the abrasive drum employed in the arrangement of Fig. 2.

Fig. 4 is a cross-section of the drum as shown in Fig. 2 to an enlarged scale.

Referring to the drawings, a cathode ray tube 1 to be evacuated is mounted in a suitable support 2 and is connected by way of its evacuating tubulation 3 and an intermediate connection 4 to a vacuum pump 5. The intermediate connection 4 and the evacuating tubulation 3 may be removably connected by means of a rubber sleeve 6. The removal of the major part of the gaseous molecules enclosed in the envelope of the cathode ray tube 1 is effected by the vacuum pump 5, and the residual portion thereof is removed by means of getter material 6', located in the intermediate connection 4, after the cathode ray tube envelope and the intermediate connection have been isolated from the pump by closure of valve 4'.

In order to maintain the effectiveness of the getter material 6', according to the invention, the surface of the getter material is continuously subjected to an abrasive action by means of a metal part 7 having an abrasive surface 8 in the nature of file teeth which rests on the surface of the getter 6' and is moved to and fro by means of a magnet 9 located outside the intermediate connection 4. By moving the magnet 9 back and forth, the surface particles of the getter material 6' which have chemically combined with the residual gases are continuously removed by the abrasive action of the metal part 7, thereby exposing a clean surface of the getter to the action of the residual gas.

The getter material may conveniently be in the form of a sheet of block of titanium or any other reactive metal alloy or mixture which is capable of exercising a gettering action on the residual gas in the enclosed space formed by the envelope of the cathode ray tube 1, and the Intermediate connection 4.

In order to avoid the necessity for movement of the magnet 9 back and forth, an arrangement such as that shown in Figs. 2, 3 and 4 may be adopted. In this arrangement the getter material and the abrasive device are located in a chamber 10 communicating with the intermediate connection 4. The abrading device is in the form of a conical drum 11 against which blocks 12 of the getter material are adapted to rest, being prevented from movement when the drum 11 is rotated by providing internal projections 13 on the wall of the chamber 10. The drum is mounted in a bearing 14 supported by the inner wall of the closed end of the casing 10 and is provided with diametrically extending arms 15 of magnetic material. A U-shaped magnet 16 is arranged with its limbs around the external periphery of the chamber 10 and is arranged to be rotated by a belt 17. As the magnet 16 is rotated, the magnetic field from the pole pieces thereof collies with the arms 15 of the rotation of the drum 11 and effects continual abrasion of the surface of the blocks 12 of getter material.

Portions 11' of the periphery of the drum are made of ferromagnetic material so as to expose the surface of the getter material to the action of the residual gas contained in the system.

It will be appreciated that, in the interests of economy and long life, the abrasive action should remove only the thin surface layer which has become saturated. Naturally, if more than this is removed, all the fresh surfaces so formed still contribute to the overall pumping action.
What we claim is:

1. In apparatus for exhausting residual gas from an enclosed space, means in the enclosed space for supporting a getter material capable of chemically combining with at least part of said residual gas, abrasive means in contact with and movable relative to the surface of getter material on said supporting means whereby continually to expose a fresh surface of such getter material to the action of said residual gas.

2. In apparatus for removing residual gas from an enclosed space including a getter material located in said space and exposed to the action of residual gas therein, said getter material being capable of chemical combination with said residual gas, an abrasive device in contact with said getter material, and means located outside said space for continually moving said device whereby to remove from the surface of said getter material particles thereof which have chemically combined with said residual gas, thereby exposing the clean surface of said getter material to the action of said gas.

3. Apparatus for evacuating an enclosed space comprising a vacuum pump, an intermediate connection connected between said pump and said enclosed space, a getter material located in said connection, an abrasive device movably supported in contact with said getter material, and means for causing relative movement between said getter material and said abrasive device.

4. Apparatus for evacuating an enclosed space comprising a vacuum pump, an intermediate connection connected between said pump and said enclosed space, a getter material located in said connection, an abrasive device in contact with and movable relative to said getter material, and means located outside said connection for continually moving said abrasive device.

5. Apparatus for evacuating an enclosed space comprising a vacuum pump, an intermediate connection between said pump and said enclosed space, a chamber communicating with said intermediate connection, a getter material located in said chamber, a rotatably mounted abrasive device located in said chamber in contact with and movable relative to said getter material, a magnetic armature carried by said abrasive device, a magnet located outside said chamber and having pole pieces cooperating with said armature, said magnet being rotatably mounted co-axially with said abrasive device, and means for rotating said magnet to cause rotation of said abrasive device by interaction between said pole pieces and said armature.

References Cited in the file of this patent

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