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3,387,908

ELECTRON VACUUM TUBE GETTER AND METHOD OF USING THE SAME

Filed Aug. 17, 1966

FIG. 1

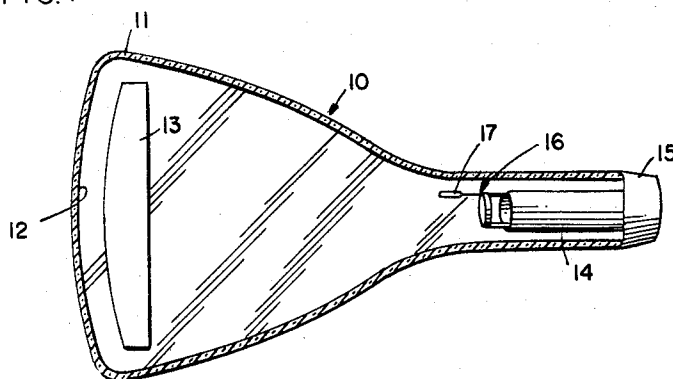


FIG. 2

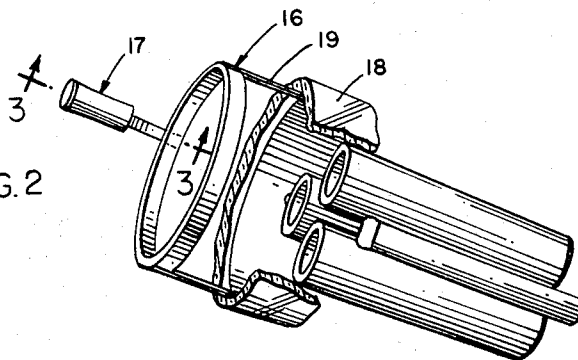


FIG. 3

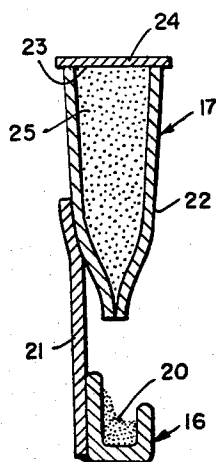


FIG. 4

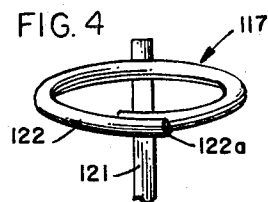
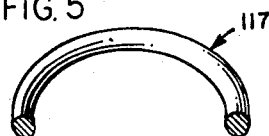


FIG. 5



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ELECTRON VACUUM TUBE GETTER AND
METHOD OF USING THE SAME
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ABSTRACT OF THE DISCLOSURE

The sequential use of barium and lithium during the manufacture of television picture tubes to remove residual gas after the tube has been sealed.

Summary of invention

This invention is based on the discovery that the alkali metals, particularly lithium, are effective as supplemental "getters" in the fabrication of electron vacuum tubes such as television picture tubes. Historically, barium alloys have been employed as residual gas getters and this invention makes use of the conventional barium alloy getter but in addition performs a supplemental and cooperative gettering function. The provision of such a getter and the method of using the same thus constitutes important objects of this invention.

Other objects and advantages of the invention may be seen in the details of construction and operation set down in this specification.

The invention is explained in conjunction with the accompanying drawing, in which:

FIG. 1 is a sectional view of a television picture tube, i.e., a species of electron vacuum tube, constructed according to teachings of this invention;

FIG. 2 is a fragmentary perspective view, partially broken away, of the electron gun portion of the tube of FIG. 1;

FIG. 3 is an enlarged sectional view of the supplemental getter taken along the line 3—3 of FIG. 2;

FIG. 4 is a fragmentary view of a modified supplemental getter assembly; and

FIG. 5 is an enlarged sectional view of the modified getter shown in FIG. 4.

In the illustration given and with particular reference to FIG. 1, the numeral 10 designates generally a television picture tube which is seen to have the usual face plate 11 which carries a screen of phosphors as at 12. In the case of a color television tube, the phosphors are made up of green, red and blue luminescence dots and are arranged in predetermined alignment with a shadow mask 13 suitably supported (by means not shown) within the interior of the tube 10.

At the base of the tube 10, an electron gun 14 is suitably mounted on a base 15 integrated with the tube and the numeral 16 designates the usual barium alloy getter. In addition, a supplemental getter 17 is provided which can be seen in the remaining views.

More specifically, the numeral 18 in FIG. 2 denotes a convergence assembly which supports a pair of posts in forwardly-projecting relation, the posts being designated 19. Carried by the posts is a ring, heretofore identified as the barium getter 16 and which supports a barium alloy as at 20 (see FIG. 3). The alloys usually are barium-aluminum or barium-aluminum-nickel. Beyond that, I provide a supplemental post as at 21 which carries the supplemental getter and for this purpose I provide a tube constructed of non-magnetic material such as stainless steel as at 22 filled with alkali metal 25. It will be appreciated that the various elements are usually integrated by welding and the tube 22 has its open forwardly-

facing mouth 23 closed by a thin cover such as may be constructed of aluminum foil. The foil provides a barrier between the alkali metal and moist air when the getter is exposed to atmosphere.

In the practice of the invention, the getter material 25, which is advantageously elemental lithium, is vaporized in vacuum and in the course of this, the aluminum foil 24 is also evaporated. Inasmuch as the tube has an interior coating of aluminum, the cover 24 does not interfere with the operation of the tube 10.

For the purpose of determining the efficacy of the supplemental getter, I performed an experiment wherein two getters, one of barium alloy and one of lithium, were mounted within an evacuable glass envelope, along with a small quantity of copper sulfate crystals, i.e., of the order of 1% of the evacuated tube volume. The copper sulfate crystals when heated readily give off water to simulate a detrimental condition heretofore not remedied by use of the single barium alloy getter.

The procedure followed was first to evacuate the enclosure to a total pressure of the order of 10 microns. Thereafter, the glass envelope was heated gently to an interior temperature of the order of 100° C. to cause water evaporation from the copper sulfate crystals. At this point, the pressure increased to 600 microns and the gas was sampled using a mass spectrometer. The results of this test appear in the table below in column 1. Thereafter, the pressure was reduced by pumping to 400 microns and the composition of the gas was again measured with the mass spectrometer. The results of this test appear in column 2 in the table below. Following this, the lithium getter was heated to approximately 750° C. by RF eddy currents emanating from an encircling coil, causing the lithium to evaporate and deposit a mirror-like film on the glass wall of the envelope after which the pressure rose to about 1200 microns. It will be appreciated that other getter-heating methods may be used advantageously depending upon the manufacturing techniques and arrangements employed. At this time the gas was again sampled with the results thereof being set down in column 3 of the table. Lastly, the barium getter was flashed through the application of RF energy and at a pressure of 1500 microns whereupon the pressure dropped to about 9 microns following the flashing. The results of the sampling following barium getter flashing are set down in column 4 in the table immediately below.

TABLE

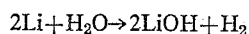
Gas Ion	Percent of Ion Current			
	(1)	(2)	(3)	(4)
H ₂	60.4	39.2	91.6	44.5
C.....	15.5	21.0	1.0	1.8
CH.....	.6	.3	.2	2.6
CH ₂ +N ₂	2.6	1.7	.7	5.2
CH ₃	3.9	3.6	3.0	21.3
CH ₄ +O.....	10.3	10.4	2.5	22
OH.....	1.2	1.5	.01	.8
HOH.....	3.2	4.5	.01	.....
C ₂ H ₂.....	.....	.....	.....	Trace
C ₂ H ₄.....	.....	.....	.....	.3
C ₂ H ₆ , N ₂ , CO.....	2.3	18	.4	1.2
C ₂ H ₈.....	.....	.....	.3	.3
C ₂ H ₁₀.....	.....	.....	.....	.2
A, C ₂ H ₄.....	.....	.....	.....	1.3

From the foregoing table, it will be noted that there was a remarkable decrease in the water content of the residual gas following the flashing of the lithium getter.

It will be noted that there was slight increase in the concentration of the hydroxyl ions, this being attributed to the fact that the mass spectrometer employed detected only the low-molecular weight hydrocarbon so that a portion of the hydroxyls associated with the higher-molecular weight hydrocarbons were detected as hydroxyls per

se rather than as a part of higher-molecular weight hydrocarbons.

A distinct benefit accrues from the use of an alkaline metal as a supplemental getter in that this substantially increases the hydrogen content of the gas according to the following equation.



I have found this to be extremely advantageous in avoiding electron emission slump from the oxide cathodes even where the "forming" or stabilizing of the electron emission of the cathode associated with the electron gun 14 is of a very short time. It is believed that this is due to the beneficial effect of hydrogen gas on the cathode.

When the inventive getter arrangement is employed, the "forming" can be as low as 10-12 minutes. This getter arrangement is utilized in a conventional television picture tube and the emission after 3 minutes of filament heating was of the order of 3.0 milliamps. After only 10 minutes of forming using first 11½ volts for two minutes on the filament and then 8 volts on the filament for approximately 8 minutes, the emission remained constant at 6.3 volts on the heater (nominal voltage) and retained this value after three days' standing without operation. In other words, there was no slumping when the tube was not in operation. The tube further had good stable emission after three thousand hours of continuous operation. It will be appreciated that normally a tube such as this requires, in addition to the heater voltage, voltages on the G-1 and G-2 grids and further, drawing current to these grids for at least an hour and one half and perhaps in excess of three hours in order to "form" or stabilize the cathode.

The alkali metal getter is believed to be effective in breaking down the heavier hydrocarbons by extracting hydroxyl radicals therefrom so that subsequently the barium alloy getter is more easily able to absorb the lower-molecular weight hydrocarbons to provide a felicitous atmosphere for the operation of the oxide cathode in the electron gun 14.

Reference is now made to FIG. 4 where a slightly different version of a getter assembly is pictured. In FIGS. 4 and 5 the getter assembly is generally designated by the numeral 117 and is seen to include a ring-like tubular member 122 which advantageously may be constructed of thin stainless steel tubing and in which the elemental lithium (not shown) may be contained. The ends of the split ring are crimped as at 122a so as to initially isolate gettering material from exposure to the atmosphere. The ring-like member 122 is advantageously supported on a standard 121. In operation, the application of heat causes the thin stainless steel portions to break through so as to permit exiting of the vaporized lithium, thereby serving a function analogous to the aluminum foil covering 24 described in conjunction with FIG. 3. In the ordinary gettering of an electron vacuum tube such as a television picture tube, I find it advantageous to use from about 25 to about 50 milligrams of elemental lithium. This is far in excess of the material

needed but it does represent a conveniently handleable amount.

A number of advantages accrue from the use of the supplemental getter—there is the activation of the oxide cathode by means of the hydrogen gas released by the alkali metal getter. There is prolonged tube life due to elimination of water vapor (which is detrimental to electron emission) by converting it to hydrogen by means of the alkali metal getter. Further, it is possible to use lower bake-out temperatures during pump down because the unbaked water can be absorbed by the alkali metal getter.

While in the foregoing specification a detailed description of an embodiment of the invention has been set down for the purpose of explanation, many variations in the details hereingiven may be made by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. In an electron vacuum tube, a sealed envelope supporting an electron gun, a barium alloy getter mounted within said envelope, and a supplemental getter mounted within said envelope, said supplemental getter including as an essential element one selected from Group I of the Periodic Table of Elements.

2. The structure of claim 1 in which said supplemental getter element is lithium.

3. The structure of claim 1 in which said lithium is supported within a non-magnetic enclosure within said tube, said enclosure being initially closed to prevent deterioration of the said supplemental getter element prior to evacuation of said envelope.

4. The structure of claim 3 in which said enclosure is equipped with a vaporizable foil covering.

5. The structure of claim 3 in which said enclosure is physically deformed to provide a closure openable by the vaporization of said supplemental getter element.

6. A method of manufacturing electron vacuum tubes comprising the steps of installing a supplemental getter within the tube in addition to a principal getter constructed of a barium alloy, evacuating the tube, heating the supplemental getter to a temperature below the vaporizing temperature of the barium alloy, and thereafter vaporizing the barium alloy.

7. The method of claim 6 in which said tube includes an oxide cathode, said cathode being activated by means of hydrogen gas released by co-action of said supplemental getter with water vapor.

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