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Dietch et al.

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[54] **CATHODE RAY TUBE RECLAMATION PROCESS**

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[52] **U.S. Cl.** **316/2**

[51] **Int. Cl.** **H01j 9/50**

[58] **Field of Search** 316/1, 2, 25

[56] **References Cited**

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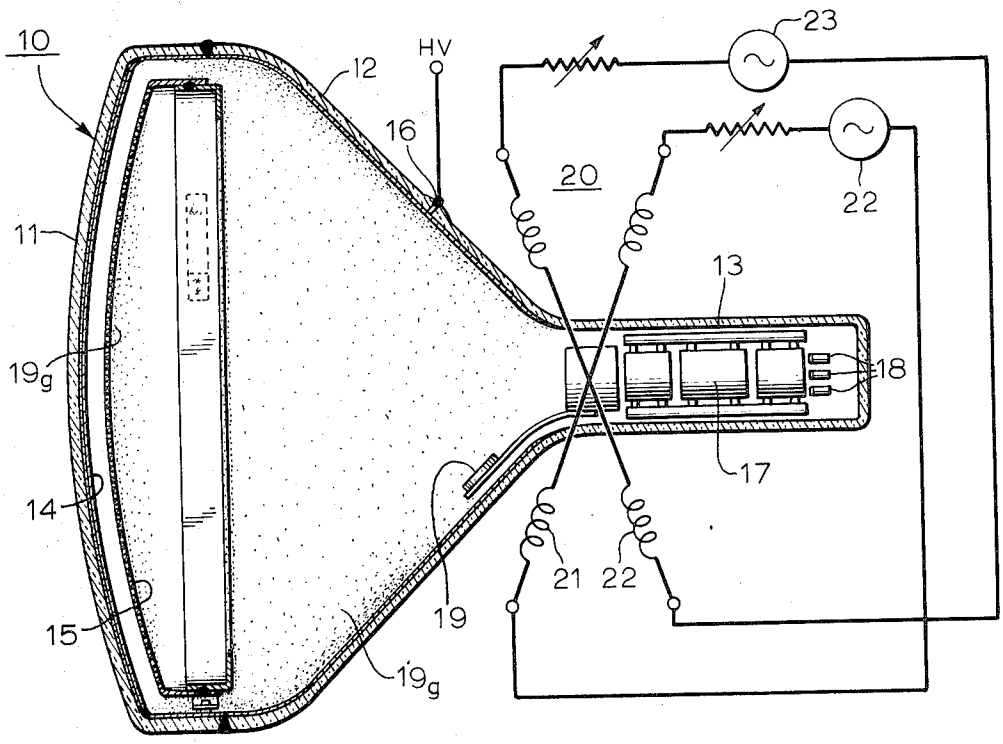
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[57] **ABSTRACT**

A method of neutralizing an undesired constituent trapped within a cathode ray tube which includes a gas absorber contemplates irradiating the constituent with a source of electromagnetic energy for a period of time sufficient to reduce the constituent to its gaseous reaction products and then effecting absorption of the gaseous products by pumping action of the gas absorber.

2 Claims, 3 Drawing Figures



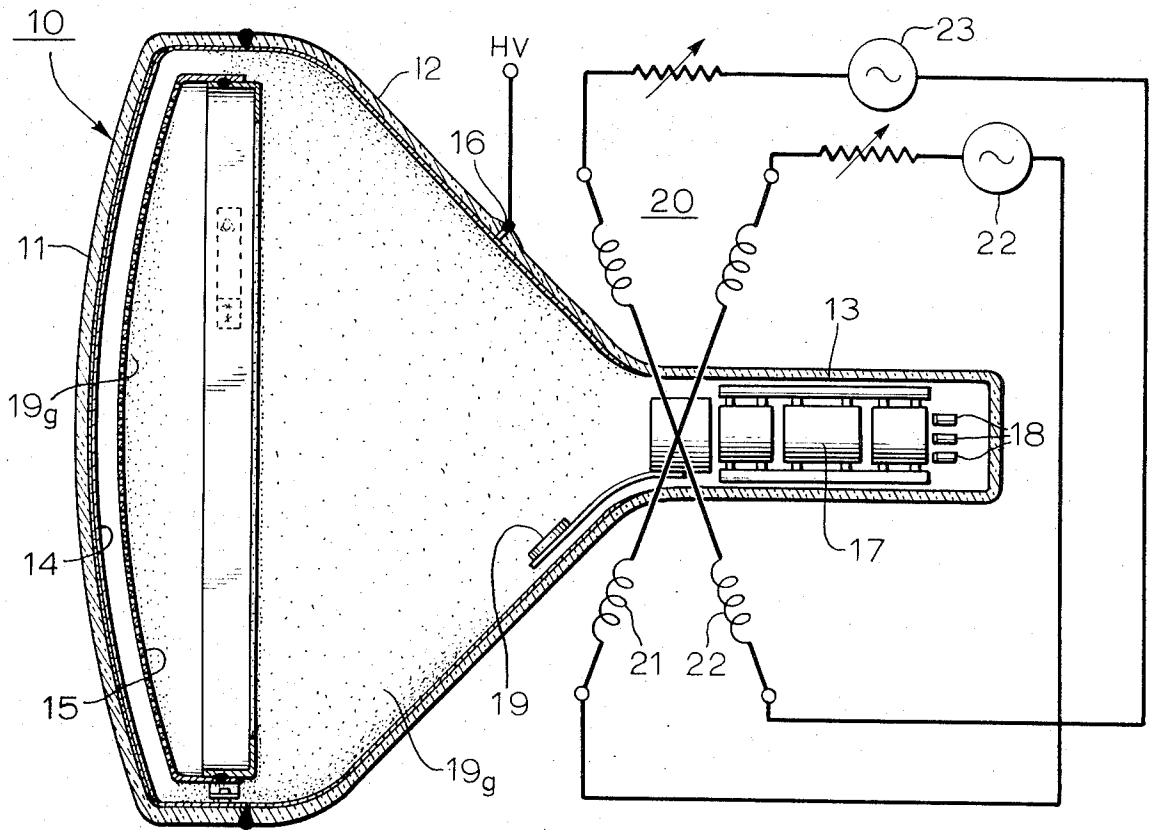


FIG. 1

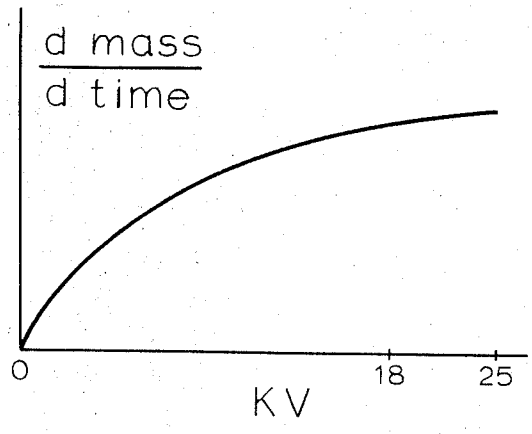


FIG. 3

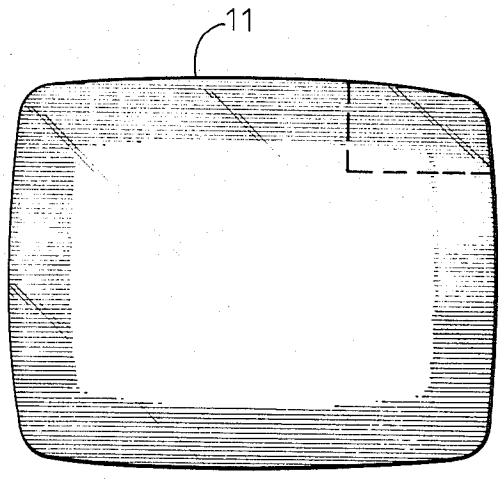


FIG. 2

CATHODE RAY TUBE RECLAMATION PROCESS

This invention relates in general to cathode ray tubes but more particularly to a method for reclaiming tubes containing a potential cathode contaminant.

BACKGROUND OF THE INVENTION

While the invention is useful for restoring substantially any type of evacuated electron discharge device containing a potential cathode contaminant, it finds particular application in the reclamation of the color reproducing cathode ray tubes, in view of the cost entailed in "re-gunning" a color tube to replace a contaminated cathode.

In the manufacture of the screen for the panel portion of a color tube the red, green and blue phosphors, which form the screen, are individually applied to the panel in the form of slurries each comprising a polyvinyl alcohol (pva) carrier, an appropriate phosphor and a dichromate sensitizer. In known fasion each slurry mixture is sequentially exposed (with, of course, intervening washes) to actinic energy through an apertured shadow mask to form a dot pattern to the end that upon completion of three exposures, a screen comprising a plurality of phosphor dot triads is laid down upon the face panel. Thereafter, a thin film of lacquer is deposited over the phosphor dot pattern to provide a smooth base for a light reflecting backing layer of aluminum.

The panel is now ready for the bake-out process, a manufacturing step which consists of transporting the panel through an oven that subjects the panel to a temperature approximately 400° Centigrade in order to, inter alia, remove undesired or unnecessary constituents such as the pva and the lacquer. Since pva and the filming lacquer have thermal decomposition temperatures well below 400° Centigrade, they are readily vaporized and therefore, for the most part, removed during the bake-out process.

The panel is then joined to a funnel and frit sealed thereto after which an electron gun structure and a getter device are inserted in the neck portion of the funnel. Finally, the completed tube is evacuated to remove as much gaseous residue as possible and then the envelope is sealed off. However, since it is impossible to remove all the gas residue by evacuation, the remainder is removed by "gettering", a gas pumping process which entails firing the getter, a device formed of metal such as barium, magnesium or sodium. When the getter is fired vaporized metal condenses upon the inner surfaces of the funnel portion envelope wall as well as upon the rear face of the shadow mask where it serves to absorb substantially all the residual gas remaining in the envelope. In fact, this vaporized metal continues to pump, or absorb, gas for the life of the tube.

Insofar as undesired constituents remaining or trapped within the evacuated tube are concerned it has been found that polytetrafluoroethylene, more known by its tradename, Teflon, has a very deleterious effect upon cathode emission should it be introduced, even in minute quantities, into the envelope during the manufacturing process. This obtains because Teflon has a thermal decomposition temperature much higher than any temperature encountered by the face panel or the envelope during bake-out or frit sealing. In fact, Teflon is thermally stable up to about 530° Centigrade. The problem, however, arises when the Teflon particles are subjected to electron impingement during normal operation of the tube. This impingement reduces the Teflon

to its reaction products, one of which, fluorine gas, is highly detrimental in that it contaminates the cathode. Specifically, the fluorine combines with barium (the electron emitting agent of the cathode) to form barium fluoride, a substance that does not emit electrons at normal cathode operating temperatures. As a result the cathode may be contaminated to such an extent that the tube neck must be opened and the electron gun replaced. It must be recognized, of course, that re-gunning does not solve the contamination problems since the Teflon is still present.

While direct introduction of Teflon particles can be controlled by avoiding Teflon coated apparatus for handling or transporting the face panel, the funnel or the mask, total elimination of Teflon from the manufacturing facility is not possible since this material is commonly used in the valves and packing rings which convey slurries, filming lacquers, and also corrosive fluids, such as the etchants employed in manufacturing the shadow mask. Even though possible contamination from these sources is substantially avoided by vigilant monitoring, occasionally Teflon does find its way into a tube to create the above-described problem.

It is therefore a principal object of the invention to provide a method for neutralizing undesired constituents trapped within an evacuated electron discharge device.

It is a further object of the invention to provide a method of neutralizing an undesired constituent within an evacuated electron discharge device by reducing it to its gaseous reaction products and then effecting absorption of such gases.

It is a specific object of the invention to provide a method of neutralizing cathode contaminants in a cathode ray tube.

SUMMARY OF THE INVENTION

In accordance with the invention there is disclosed a method of neutralizing an undesired constituent trapped within an evacuated electron discharge device which includes a cathode and a gas absorber. The constituent is characterized by a thermal decomposition temperature which is higher than any processing temperature to which the electron discharge device is subjected to during manufacture. However, the constituent is reducible by high energy particle impingement during normal operation of the electron discharge device into reaction products, at least one of which consists of a contaminant that tends to reduce the emission of the cathode. The inventive method itself comprises the steps of presenting the electron discharge device to a source of electro-magnetic energy, then directing this source of energy upon that region within the electron discharge device suspected of containing the undesired constituent in order to irradiate the constituent for a period of time sufficient to reduce the constituent to its gaseous reaction products including the cathode contaminating product. Finally, absorption of the contaminating product is effected by the pumping action of the gas absorber enclosed in the electron discharge device.

BRIEF DESCRIPTION OF THE DRAWING

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in

conjunction with the accompanying drawing and in the several figures of which like reference numerals indicate identical elements and in which:

FIG. 1 is a side view of a cathode-ray tube, partly in section, of a type amenable to practicing the invention;

FIG. 2 is a front view of the cathode ray tube shown in FIG. 1, illustrating a variety of scansions employable in practicing the invention;

FIG. 3 is a graph illustrative of the range of potential employed in practicing the invention.

The presence of Teflon in a manufactured cathode ray tube can be determined in a number of ways. A particularly effective method is to employ an analyzer, such as a mass spectrograph. In this approach, a tube, selected from a production batch suspected of having Teflon particles trapped therein is connected to the spectrograph and the contents of the atmosphere within the tube is qualitatively analyzed. The masses present in the tube are then identified by known techniques to determine if any of the reaction products of Teflon, for example, fluorine gas, are present.

Prior to discussing the cleanup process, that is the process employed to neutralize the Teflon, attention is directed to the cathode ray tube **10** depicted in FIG. **1.** Tube **10** comprises a face panel **11,** a funnel section **12,** which is frit sealed to panel **11** and which terminates in a neck portion **13.** A phosphor dot screen **14** is deposited upon the inside surface of panel **11** and a shadow mask **15** is suspended within the panel adjacent screen **14** in conventional fashion. A high voltage anode button **16,** fitted upon one surface of funnel **12,** is connected to a source of accelerating potential, HV. An electron gun structure **17,** comprising a plurality of cathode **18,** is mounted within tube neck section **13.** A getter device **19,** which is supported by gun structure **17,** extends into the funnel portion of the tube. Device **19,** which is activated after the tube has been evacuated and sealed off, serves to deposit a thin layer of getter material upon the inner wall of the funnel **12,** as well as upon that surface of the shadow mask **15** which confronts the electron gun structure of the tube. This layer of getter material then functions to absorb or pump gaseous residue remaining within the evacuated envelope. Finally, a controllable deflection apparatus **20** is associated with tube **10.** This apparatus, which comprises a pair of deflection windings **21, 22,** differs from the conventional deflection yoke in that a pair of adjustable sweep generators **22, 23,** respectively are individually associated with an assigned one of the deflection windings so that any desired raster configuration can be generated.

During normal operation of the tube **10,** the impingement of high energy electrons upon any Teflon particles trapped in the tube serves to break these particles down into a number of reaction products. Specifically, when Teflon is bombarded, it decomposes into CF_4, carbontetrafluoride, a gas, which, in turn, under bombardment is reduced to F_2, fluroine gas. The cathodes employed in picture tubes are mainly formed of barium oxide and it is the barium that is principally the emitter of the electrons. However, in the presence of fluorine the barium combines with that gas to form barium fluoride, a substance that does not emit electrons at normal cathode operating temperatures. Thus in a cathode ray tube containing even traces of Teflon, the periodic bombardment of the Teflon by the electron beams eventually breaks the Teflon down into the contaminating fluorine gas.

The specific manner in which the subject invention reclaims a picture tube known or suspected of having Teflon particles therein is to present the tube to a source of electromagnetic energy, the most readily available source being the electron beams of the tube itself. The filaments of the cathodes are heated to a higher than normal operating temperature by raising the heater voltage to about seven volts, this in contrast to normal heater voltage of 6.3 volts. The accelerating anode is then raised to a potential higher than that normally employed for the tube being reclaimed. For most applications final anode voltages between 18 KV and 25 KV have proven successful in practicing the invention. As indicated in FIG. 3 the decomposition rate of Teflon, with respect to time, tends to level off at approximately 25 KV. In any event utilizing higher than normal potentials for the cathode and anode achieves two objectives; first a concentrated stream of very high energy particles is created and secondly, a relatively dense cloud of electrons, or space charges, is formed about the cathode to create, in effect, a protective shield around the cathode surface. Then the sweep generators **22, 23** for the deflection coils are suitably adjusted so that the stream of electrons can be directed to any desired region within the tube. For example, and with reference to FIG. **2,** if traces of Teflon are believed to have adhered to the rim of the shadow mask or to the periphery of the screen panel then generators **22** and **23** are adjusted to develop the peripheral scanning raster indicated in FIG. **2** by the shaded area. However, if Teflon particles are suspected in only one sector of the tube, generators **22** and **23** are adjusted to scan only the suspect area, for example, the upper right hand corner of the tube, shown enclosed by the broken lines. On the other hand, which may be the more common case, the location of the Teflon is probably unknown so that a full raster is developed even to the extend of producing a pronounced oversweep to spray the entire inner surfaces of the envelope and mask with a beam of high energy electrons.

The tube is scanned for a predetermined period, usually 24 hours, with the aforementioned elevated final anode potential and above normal cathode operating temperature. In this regard it has been noted that operating the cathode at high temperature combats cathode poisoning since the cathode is activated faster than the contaminant can recombine with the cathode surface. The impact of the high energy electron breaks the Teflon down into its reaction products including fluorine gas. This gas is then absorbed by the pumping action of the getter material deposited upon the inside surface of the envelope and the shadow mask instead of combining with the cathode barium.

It may be that the tube being subjected to the above-described reclamation process was so highly contaminated that the cathode's electron emitting capability becomes substantially reduced, if not exhausted. In that event, the neck of the tube is opened and the tube is "re-gunned"; that is, a new cathode or electron gun is substituted for the original. However, even in the situation calling for "re-gunning", a substantial savings is effected since the screen and the mask, to say nothing of the glassware, are salvaged.

As noted above, it is convenient to use the electron beams themselves as the source of high energy parti-

cles. However, it is recognized that other sources of electromagnetic energy are suitable. For example, X-rays, a laser beam, or even a sourc of alpha particles can be employed with equal facility. The use of an external source of electromagnetic energy has the advantage that the cathodes of the picture tube need not be energized, therefore further reducing the chance of cathode poisoning since the barium in a cold cathode is substantially inert to fluorine gas molecules. However, as noted above, an elevated operating temperature for the cathode does provide protection for the cathode by forming a space charge in the vicinity of the cathode as well as combating recombination between the cathode barium and the fluorine gas.

While the inventive process has been described in relation to neutralizing the effects of Teflon reaction products, namely, fluorine gas, it is appreciated that the invention can be utilized to neutralize other contaminating materials which, characteristically, are stable at high temperatures. In summary, any material which does not thermally decompose at or under the bake-out or frit sealing temperatures employed in manufacturing a cathode ray tube and which is capable of producing a deleterious reaction product under normal electron beam bombardment can be neutralized by practicing the described invention.

While a particular embodiment of the invention has been shown and described, modifications may be made, and it is intended in the appended claims to cover all such modifications as may fall within the true spirit and scope of the invention.

We claim:

1. A method of neutralizing an undesired constituent trapped within an evacuated cathode ray tube which includes a cathode, an accelerating electrode and an activated gas absorbing getter device, said constituent having a thermal decomposition temperature higher than any processing temperature employed in the manufacture of said cathode ray tube but which is reducible by electron impingement during normal operation of said tube into reaction products including a contaminant that tends to reduce the emission of said cathode, said method comprising the following steps:

energzing said cathode to an operating temperature higher than its normal operating temperature to produce emission of electrons;

energizing said accelerating electrode for operation at an elevated potential to generate a beam of high energy electrons;

directing said beam of electrons upon that region within said cathode ray tube suspected of containing said undesired constituent to bombard said constituent for a period of time sufficient to reduce said constituent to its gaseous reaction products including said contaminant;

and effecting absorption of said contaminant by the pumping action of said activated getter.

2. The method as set forth in claim 1 for use with a cathode ray tube having a controllable deflection apparatus associated therewith for generating within said tube a scansion of the desired configuration;

wherein said method includes the step of energizing said deflection apparatus to develop a scansion raster with said generated beam of electrons;

and the further step of adjusting said deflection apparatus to concentrate said scansion raster upon that region of said tube suspected of containing said undesired constituent.

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