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Fujimura

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[45] **Oct. 9, 1973**

[54] **THERMAL RECORDING TUBE**

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[51] **Int. Cl.** **H01j 31/58**

[58] **Field of Search** ..... 313/73; 344/74 SB, 344/74 CR; 346/76

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[57] **ABSTRACT**

A plurality of belt conductors are arranged on the inner side of the face plate of a cathode ray tube, and a plurality of belt conductors are arranged on the outer side thereof. At the edge portion of the face plate which contacts a heat-sensitive paper, heat-radiative resistors are provided to connect both belt conductors. An earth terminal is connected with all of the belt conductors on the outer side of the face plate. The heat-radiative resistor radiates heat by electric current supplied from an electron beam through the inside belt conductor so as to enable the recording on the heat-sensitive paper in contact therewith. Belt conductors may be manufactured by forming a resistive coating of e.g., SiO_2 on a glass face plate and then by cutting to form a plurality of belts with a diamond cutter.

3 Claims, 6 Drawing Figures

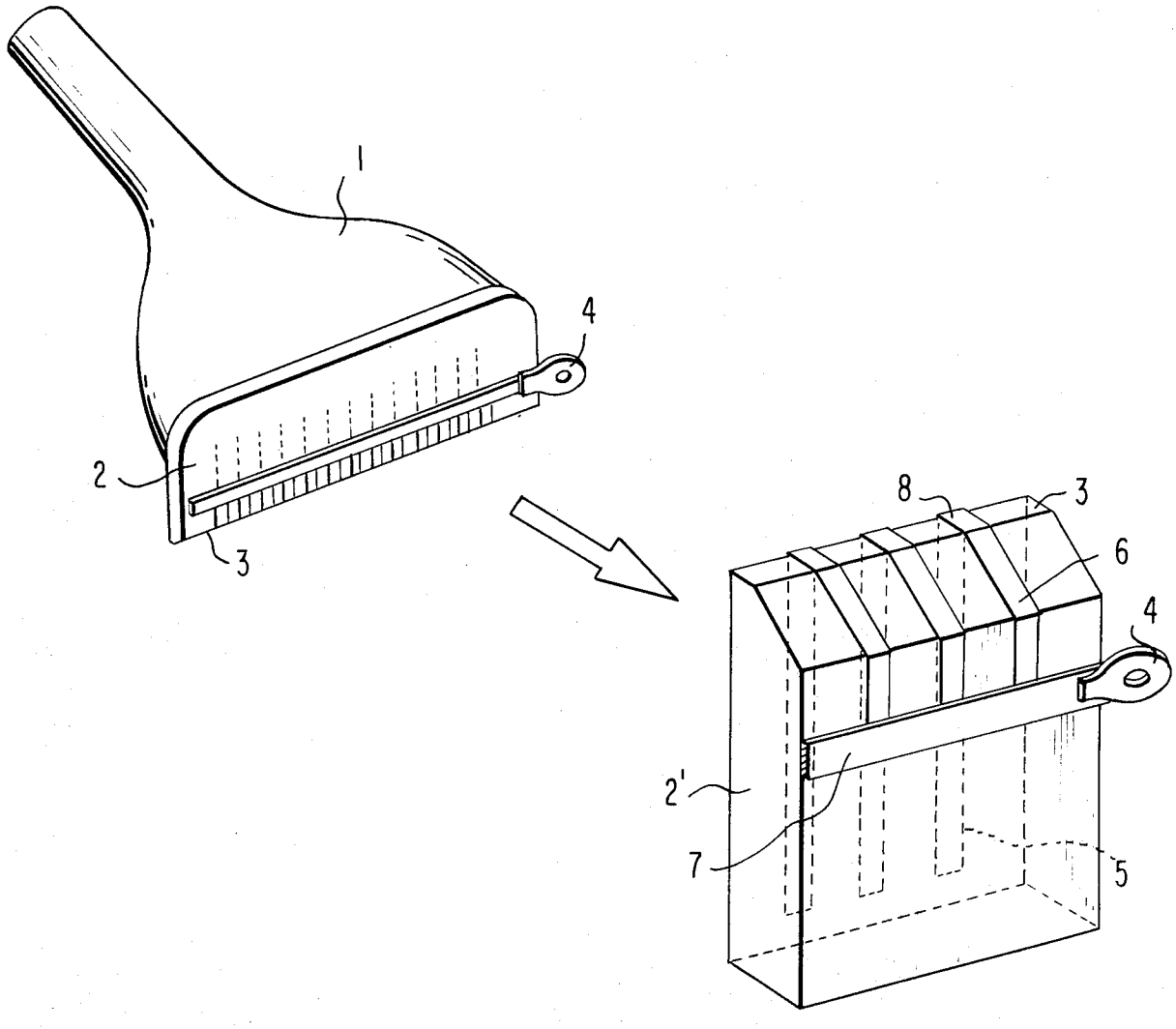


FIG. 1

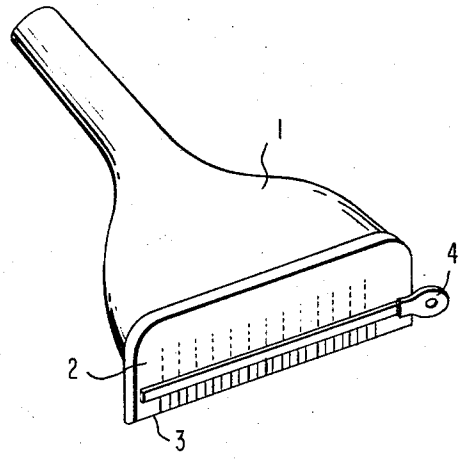


FIG. 2

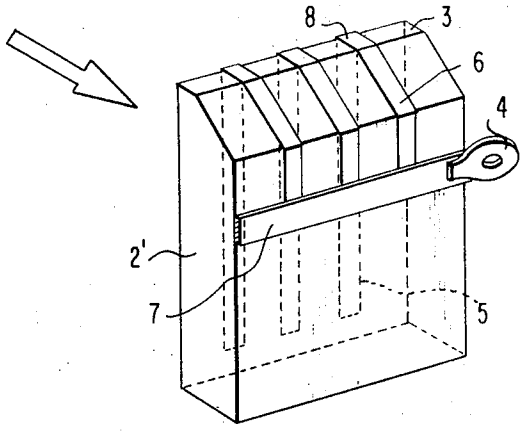


FIG. 3

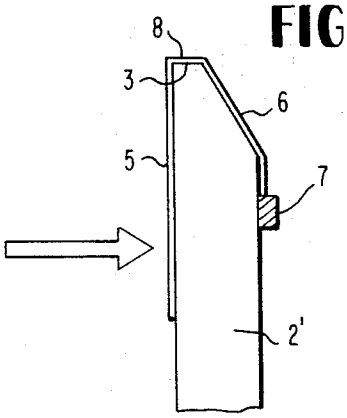


FIG. 4

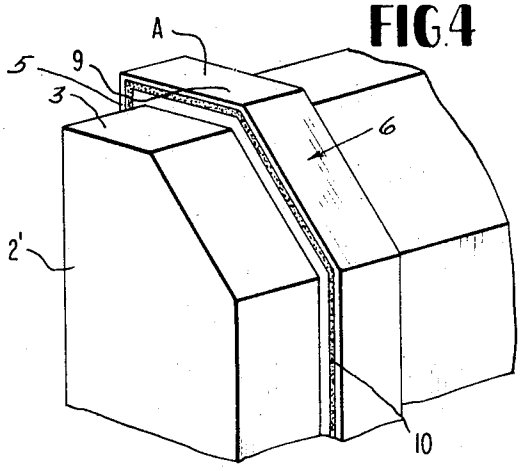


FIG. 5

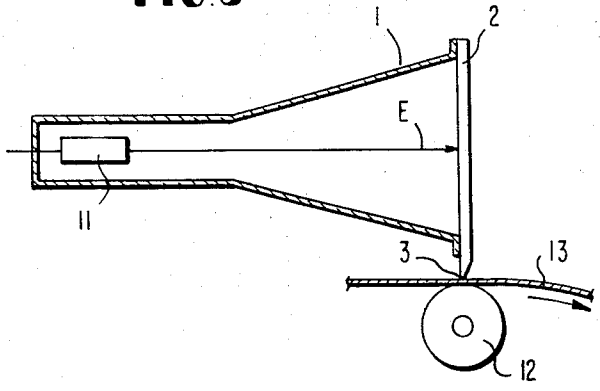
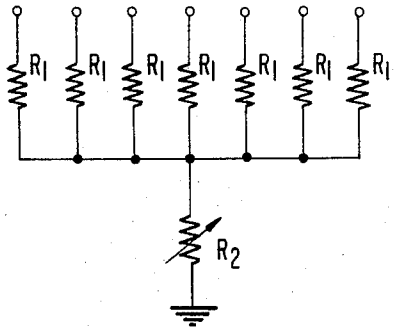


FIG. 6



THERMAL RECORDING TUBE

BACKGROUND OF THE INVENTION

The present invention relates to a cathode ray tube for heat-sensitive recording, particularly to a thermal recording tube, in which an electron beam current is drawn out of a cathode ray tube through conductors and supplied to a heat-radiative resistor so as to enable recording on a heat-sensitive paper by the heat radiated therefrom.

Recently, a heat-sensitive paper with high sensitivity has been colored sufficiently at temperatures below 100° C. In the case of coloring practice, owing to Joule's heat produced by direct electric conduction through a heat-sensitive paper, the inventor has found that the energy of 10mW, 0.001 sec, i.e., 10^{-5}J is sufficient therefor, and such a degree of energy is drawn easily out through an electron beam emitted from an electron gun in a cathode ray tube. Furthermore, the inventor has also found that, in a recording tube comprising a cathode ray tube with a needle electrode built in its face plate, i.e., a so-called electrostatic recording tube or pin tube, the desired thermal energy is easily obtained by drawing out electric current from the outer edge of the needle conductor and directly supplying it to a heat-radiative resistor.

SUMMARY OF THE INVENTION

As described above, the present invention intends to transform the energy of an electron beam in a cathode ray tube into thermal energy through heat-radiative resistors provided at the contacting portion of the face plate with a heat-sensitive paper.

In a thermal recording tube according to the present invention, belt conductors are provided in the face plate of a cathode ray tube, and heat-radiative resistors are provided in the portion of the face plate in contact with a heat-sensitive paper, connecting the needle conductors and the external earth terminal.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of the thermal recording tube according to the present invention;

FIG. 2 is an enlarged perspective view of the face plate portion of the thermal recording tube shown in FIG. 1;

FIG. 3 is a side view of the face plate portion shown in FIG. 2;

FIG. 4 is an enlarged perspective view of a portion of the tube of the present invention, illustrating an exemplary method of manufacture thereof;

FIG. 5 is a cross sectional side view of the thermal recording tube according to the present invention in its operative state, showing only the necessary parts thereof; and

FIG. 6 is an electric circuit diagram showing the heat-radiative resistors.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a thermal recording tube according to the present invention, wherein the lower edge 3 of the front face plate 2 of the tube 1 is adapted or formed to contact a heat-sensitive paper, and 4 is the earth terminal.

As shown in FIGS. 2 and 3, wherein the face plate portion is illustrated in detail, belt conductors 5 are

provided on the electron beam striking side, i.e., the inner side, of the glass plate 2', which constitutes the face plate, and on the outer side of the glass plate 2' belt conductors 6 are connected in common to the electrode 7, one edge of which is connected with the earth terminal 4. Additionally, the heat-radiative resistors 8, connecting the belt conductors 5 and belt conductors 6, are provided on the edge 3 of the glass plate 2'.

It is possible to utilize known techniques for manufacturing a thin film circuit in order to make such a face plate portion. However, in order to make it more easily and more precisely, a resistive coating is formed onto the whole surface of the glass plate 2' and then the conductive coating is superimposed thereon, as illustrated in FIG. 4. Although SiO_2, In_2O_3, CdO, TiO_2 and the like may be used as the resistive material, a coating of SiO_2 has proven to be excellent because of its stable resistance and its great mechanical strength. To give further a detailed description in this case, the glass plate 2' is heated to a temperature between 200° C and 400° C and then dried air, passing through $SiCl_4$ anhydride, is blown thereon, with the result of forming non-conductive SiO_2 coating. The non-conductive SiO_2 coating gains conductivity when heated by a reducing gas flame having a temperature between 200° C and 400° C, and it is, therefore, heated until it gains the desired resistivity. Thus, the desired resistive SiO_2 coating is easily obtained. The conductive coating may be formed by means of vacuum evaporation, and may be formed of gold, silver, copper, aluminum or the like.

After that, using a diamond cutting machine, the coatings are cut out so as to draw lines with the desired width and pitch. FIG. 4 shows the result of the line-drawing cutting, wherein there is provided the remaining portion of the conductive coating 9 and the resistive coating 10 and the removed portion thereof. Then, the conductive coating 9 on the edge portion A of the glass plate 2' is removed by chemically dissolving it or physically removing it by polishing or the like. Thus, in the line-drawing cutting, it is possible to cut lines by five lines/mm over the extent of 100 mm, so that the irregularity of the resistance value of the heat-radiative resistor portions is small.

FIG. 5 illustrates the thermal recording tube of the present invention in its operative state, wherein electron beam E emitted from the electron gun 11 in the tube 1 strikes a belt conductor on the inside of the face plate 2, through which electric current is drawn out of the tube 1. The electric current flows into the heat-radiative resistor provided on the lower edge 3 on the face plate 2 so as to be transformed into thermal energy. The thermal energy enables recording on the heat-sensitive paper 13 pressed against the lower edge 3 by the roller 12.

In addition, by inserting a variable resistor between the earth terminal of the face plate and the earth, it will be possible to easily control the thermal energy supplied to the heat-sensitive paper. As illustrated in FIG. 6, each heat-radiative resistor has resistance R_1 and the variable resistor has resistance R_2 to be determined. Now, assuming that electron beam current drawn out through each belt conductor is 10 KV, 100 μA, R_1 is 10^6 ohms and R_2 is 9.9×10^7 ohms, the powers consumed in R_1 and R_2 are respectively 10 mW and 990 mW, i.e., the thermal energy is adjusted to about 1/100

and it will be seen, therefore, the resistor R_2 also gives protection to the thermal recording tube.

What is claimed is:

1. A thermal recording tube, comprising:

a cathode ray tube having a face plate in contact with a heat sensitive paper at its edge portion,

belt conductors provided on external and internal surfaces of said face plate, at aligned laterally spaced positions,

means for scanning said internal surface belt conductors with an electron beam, and

heat-radiative resistors provided on said edge portion of said face plate adapted to contact a heat-sensitive paper, said resistors electrically connecting said conductors and an external earth terminal commonly connecting said belt connectors on said external surfaces of said face plate.

2. A thermal recording tube, comprising:

a cathode ray tube having a face plate in edge portion contact with a heat sensitive paper,

inner belt conductors provided on the inner surface of said face plate,

outer belt conductors provided on the outer surface of said face plate and connected in common to an earth terminal,

means for scanning said inner belt conductors with an electron beam, and

heat-radiative resistors provided on the paper contacting edge portion of said face plate and electrically connected respectively to corresponding inner and outer belt conductors.

3. A thermal recording tube as set forth in claim 2, wherein said heat-radiative resistors are composed of an SiO_2 coating deposited onto said face plate.

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