Jan. 25, 1966 J. E. WURTZ 3,230,601

METHOD FOR MAKING A DIRECT WRITING CATHODE RAY TUBE

Original Filed June 19, 1961 3 Sheets-Sheet 1

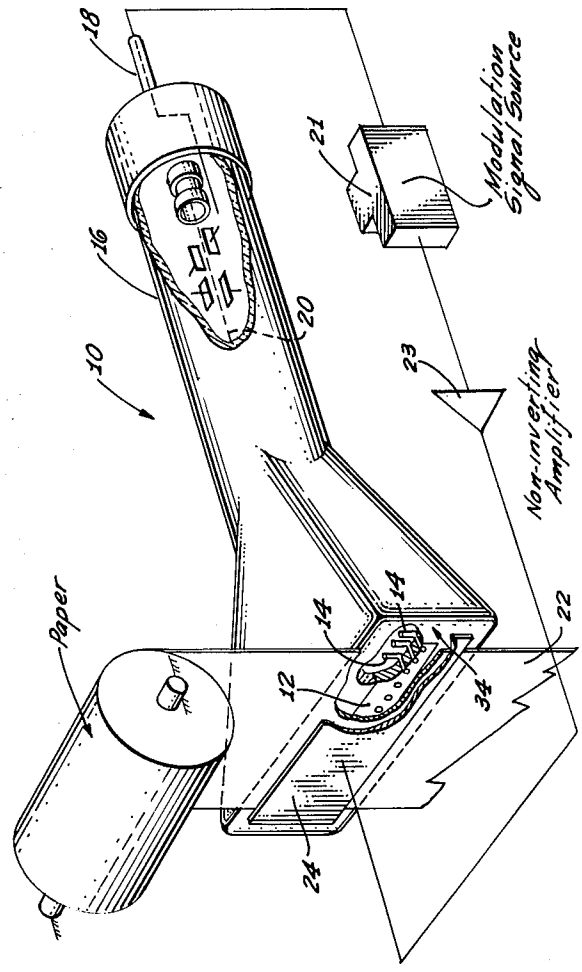


Fig. 1

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Fig. 2

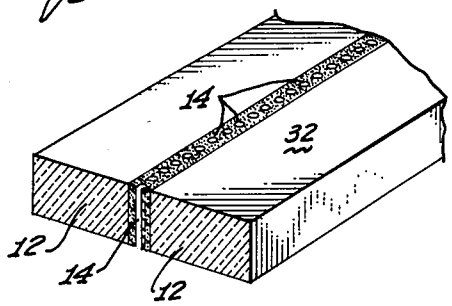


Fig. 3

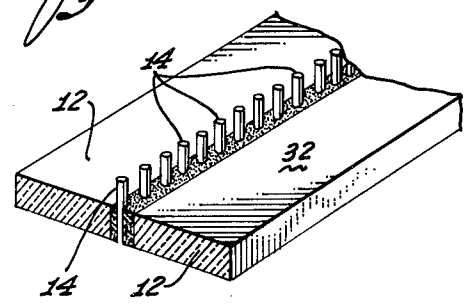


Fig. 4

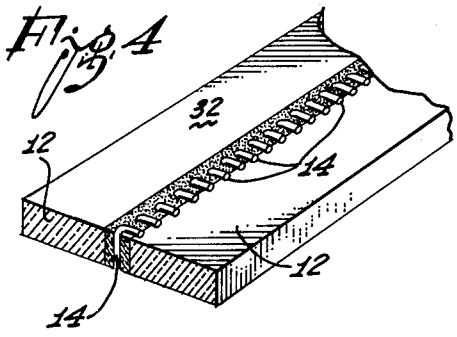
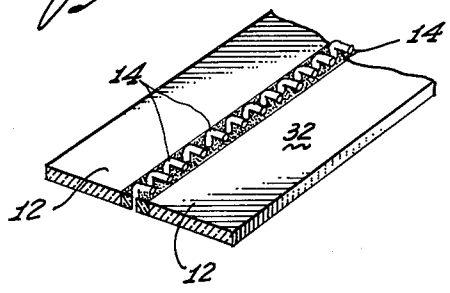


Fig. 5



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Fig. 6

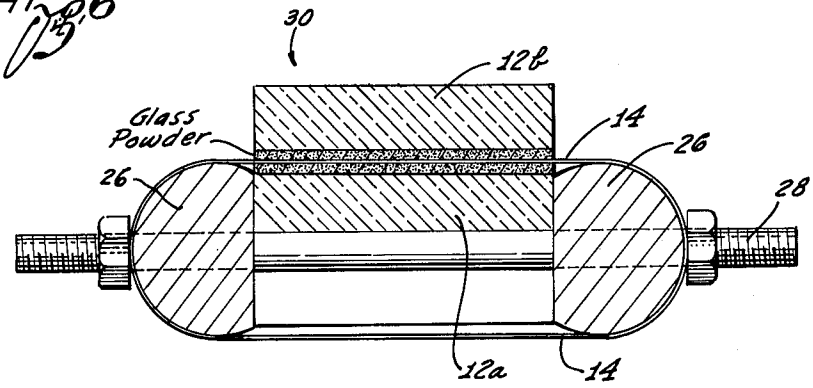
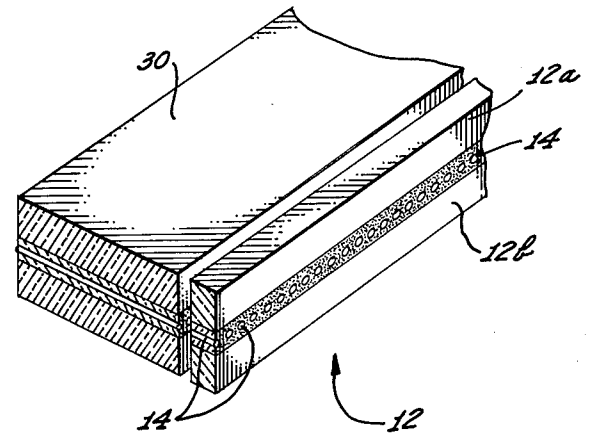


Fig. 7



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3,230,601
METHOD FOR MAKNG A DIRECT WRITING CATHODE RAY TUBE

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Original application June 19, 1961, Ser. No. 118,188. Divided and this application Nov. 2, 1964, Ser. No. 410,820

5 Claims. (Cl. 29—25.14)

This is a divisional application of application Serial No. 118,188, filed June 19, 1961, now abandoned.

This invention relates to cathode ray tubes of the type which wire elements extend through the target faceplate of the tube, and, more particularly, to a method for making the faceplate for such tubes.

In patent application No. 16,734, entitled "High Speed Direct Writing Cathode Ray Tube," by Norman F. Fyler, filed March 22, 1960, and assigned to a common assignee, there are disclosed cathode ray tubes and methods for making faceplates for such tubes. The faceplates disclosed in the foregoing application have the ends of the wire conductors traversing the faceplate and projecting from the internal surface of the insulating material of the faceplate. The wire conductors transmit electrical signals from an impinging electron beam to a record sheet, or the like, outside the cathode ray tube. With the target configuration described in the above identified application, the use of a single row of wire presents certain disadvantages. These disadvantages arise from the small diameter of the ends of the wire conductors, which may, for example, be less than 0.001 inch. However, there are applications wherein a single row of wire conductors is desirable. Whenever the single row of wires is desired, it becomes necessary to provide an electron beam having extremely accurate linear sweep, that is, a beam sweep which does not deviate more than one mil from a straight line when a one-mil electron beam is used. There are no known electron beam deflection systems which are capable of such tolerances. Such extreme tolerances in beam control also increase the time required for initial alignment of the electron beam. In addition, the wire-to-wire capacitance is high, which may result in loss of definition or resolution.

In accordance with one concept of the abovementioned patent application, it was proposed that the cross-section of the ends of the wire conductors be increased by building up the interior ends by electroplating. This method, while satisfactory for the intended purpose, is somewhat less effective than might be desired in providing a wire configuration to reduce the extreme linearity requirements of the electron beam sweep for a single row of wires.

The foregoing enumerated and other limitations of the prior art devices may be overcome by providing an improved single row wire element faceplate for use in a high speed writing tube capable of providing excellent resolution. The present invention provides a method of constructing the target faceplate for the high speed writing tube. In addition, the conductive wires may have a configuration which minimizes the necessity of an extremely linear sweep for the electron beam while also providing a large area on the wires for beam interception without sacrificing resolution.

A principal object of the present invention is to minimize the linearity requirements of the sweep for the electron beam without the sacrifice of resolution. This object is achieved through the use of an electrostatic writing tube having a faceplate in which the internal ends of the wire conductors are bent down substantially perpendicular to the path of the electron beam.

Another object of the invention is to provide a method for fabricating a faceplate which has the advantages of simplicity and ease of construction, while providing a highly reliable vacuum seal between the wires and insulating material.

In accordance with the present invention, the last mentioned object may be achieved by taking a single row wire element faceplate fabricated in accordance with any one of several suitable methods, and etching away part of the internal surface of the insulating material. The exposed ends of the wires, which result from the etching process, are then bent over at their base forming substantially a right angle with the ends embedded in the insulating material. The surface of the insulating material facing the bent ends of the wires is again etched away to provide a preselected separation between the wires and the body of the faceplate.

The novel features which are believed to be characteristic of the invention both as to its organization and method of construction and operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawing in which illustrative embodiments of the invention are disclosed by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only, and not as a limitation of the invention.

In the drawing:

FIGURE 1 shows an improved direct writing cathode ray tube in accordance with the present invention;

FIGURES 2, 3, 4 and 5 illustrate several steps in the process of fabricating the faceplate of the tube shown in FIGURE 1; and

FIGURES 6 and 7 show several steps in the method of constructing a faceplate for an electrostatic writing tube.

With reference to the drawing, FIGURE 1 shows a cathode ray direct writing tube **10** having a faceplate **12** with a plurality of wire conductors **14** extending therethrough. The cathode ray tube includes a conventional electron gun and beam deflection structure in the neck portion **16** of the tube. Suitable connections to the gun electrodes and to the deflection structure are accomplished through the pin connection assembly **18**. External magnetic deflection coils may, of course, be employed.

The faceplate **12** includes a low dielectric constant insulating material, for example, a lead-potash glass, having a plurality of fine wire conductors **14** embedded therein and traversing the target faceplate. The ends of the wire conductor inside the vacuum envelope, hereinafter referred to as the folded ends, are bent substantially perpendicular to the path of the electron beam. When the folded ends of the conductors **14** are bombarded by an electron beam **20**, an electrostatic charge is developed in the conventional manner and transported to the exterior ends of the wires.

As shown in FIGURE 1, a dielectric paper **22** is moved at a preselected rate past the exterior ends of the conductors **14**, and is backed by a conductive plate **24** which is positioned contiguous with the remote side of paper **22** and adjacent faceplate **12**. The process of depositing the charge pattern on the paper is well known in the cathode ray tube art, and, therefore, it will not be discussed here.

Referring now more particularly to target faceplate **12**, attention is directed to FIGURES 2, 3, 4 and 5 wherein there is shown several isometric views of fragmentary pieces of the target faceplate illustrating different steps in the process of fabricating the faceplate **12** in accord-

ance with the present invention. The faceplate **12** may be constructed by any suitable process, such as that shown in FIGURES 6 and 7 for example. In FIGURE 6, the wire **14** is wound around a frame including a pair of chorded rods **26** which support a sheet of dielectric material **12***a*, and an assembly screw **28**. A second dielectric sheet **12***b* is placed over the wires along with a preselected amount of a suitable powdered dielectric material, such as a frit material for example, which may be glass of substantially the same coefficient of expansion as sheets **12***a* and **12***b* to fuse the wires and the two abutting layers together in a vacuum tight seal. The fusing process may be accomplished by raising the entire assembly to an elevated temperature, whereby the two pieces of dielectric material **12***a* and **12***b* are fused with the powdered material to form a composite assembly **30**. The conductive wires form a highly reliable vacuum seal in the composite assembly. As shown in FIGURE 7, the composite assembly may be cut into thin strips generally designated **12** to form the initial faceplate member shown in FIGURE 2. As shown in FIGURE 2, the fragmentary section of the faceplate **12** has a single row of conductors **14** which extend across the faceplate.

The faceplate assembly of FIGURE 3 is somewhat thinner than that shown in FIGURE 2. A reduction in thickness is accomplished by etching away a preselected amount of interior surface **32**. Before the etching process is employed, the exterior side and edges of the faceplate **12** are masked by brushing or spraying on a coat of stop material, such as a nitrocellulose or polymerized methyl methacrylate base lacquer, leaving only interior faceplate surface **32** exposed to the etching solution. The entire faceplate **12** is then immersed in an etching solution, such as ammonium bifluoride, for example, and the unmasked surface **32** is uniformly etched away a predetermined amount, the resulting thickness of insulating material is about 0.045 inch for this illustrative embodiment. The resulting faceplate has a single row of wires extending along the length of the faceplate, as shown in FIGURE 3.

The next step in the process is that of bending the free ends of the wire down until they lie against the insulating material along surface **32**. Bending of the wires may be accomplished by using a common steel straight edge or any straight instrument suitable for bending all the wires in a row simultaneously. Pressure is applied uniformly to the wires at their base as close to the surface **32** as possible. The faceplate with the bent wires is shown in FIGURE 4. In the next step, the unmasked surface **32** is again etched away about 0.005 inch to provide a slight separation between the folded ends of the wires **14** and the surface **32**; the resulting structure is shown in FIGURE 5, wherein the final thickness of the faceplate is about 0.040 inch. The completed faceplate section **12** shown in FIGURE 5 is then hermetically sealed to a larger faceplate member **34** which encloses the target end of the direct writing tube **10** of the invention.

The cathode ray direct writing tube shown in FIGURE 1 operates in substantially the same manner as the device described in patent application 16,734 referenced hereinabove. The essential differences arise from the fact that the folded ends of wires **14** provide large areas upon which the electron beam may impinge. In this illustrative embodiment, the folded end of each wire **14** may be at least 0.005 inch long as opposed to the 0.001 diameter of the wires disclosed in the aforesaid patent application and preferably longer, on the order of 0.040 inch. Thus, it will be appreciated by those versed in the cathode ray tube art that the electron beam is not required to have a highly linear sweep in traversing the single row of wires. More particularly, the sweep of the beam is required to have only one-fortieth the linear accuracy, when the folded wire ends are 0.040 inch, as that required when the ends of the wires are one mil in diameter

and unbent. As it is impractical, if not impossible, for existing deflection systems to maintain the sweep of the beam within a two to three mils limitation as it moves across the faceplate, the present invention provides a faceplate which may be utilized in a direct writing tube having a deflection system no better than those presently available.

Another advantage of this present invention is derived from the fact that the wires extend a slight distance from the interior surface of the faceplate. In the present embodiment, the distance between the bent ends of the wires and the surface of the faceplate is about 0.005 inch. More particularly, the wire-to-wire capacitance is appreciably reduced by etching the interior surface away from the wires so that the dielectric between the wires is a vacuum which has a smaller dielectric constant than the insulating material from which the body of the faceplate is made. The reduction in wire-to-wire capacitance, which results from removing a portion of the insulating material adjacent the folded ends of the wires, provides a tube having enhanced resolution in writing and also provides a faceplate which is capable of increased writing speeds.

It is to be understood that the above described embodiments are illustrative of the principles applicable to the invention. Numerous other arrangements and modifications may be devised by those skilled in the art without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention is to be limited only by the spirit and scope of the appended claims.

What is claimed as new is:

1. In a method of treating a faceplate target structure for a cathode ray tube having a plurality of fine wires embedded therein running from a first side of the structure to a second opposite side, the combination of steps comprising: preparing the first side of said structure to have a planar surface; etching back the first side of said structure so that the wires project out from the first surface; bending said projected wires parallel to said first surface; and further etching back the first side of said structure so that the folded wires project out from the first surface.

2. The combination of steps defined in claim **1** which further include the step of affixing said faceplate structure to the face of a direct writing cathode ray tube.

3. The method of making a target faceplate structure for a cathode ray tube, the combination of steps comprising: disposing a powdered insulating material and a plurality of wires in spaced single file between a first and a second sheet of insulating material; heating said wires, powdered insulating material and sheets of insulating material to a temperature sufficient to form a composite body; cutting a thin layer from said composite body along a first plane surface perpendicular to said wires; etching back along said first plane surface so that the wires project out from said first plane surface; bending said projected wire parallel to said first plane surface; and further etching back said first plane surface so that the bent wires project out from said first plane surface.

4. In a method of forming a faceplate target structure for a direct writing cathode ray tube having a plurality of fine wires embedded therein running from a first side of the structure to a second opposite side, the combination of steps comprising: preparing a composite body having two sheets of insulating material with a plurality of fine wires in single file embedded in a frit material sandwiched between said sheets of insulating material; cutting a thin layer from said composite body, said layer having a first plane surface perpendicular to the axis of said wires; etching back along said first plane surface so that the wires project out from said first plane surface; bending said projected wire parallel to said plane surface; further etching back said plane surface; and affixing said faceplate structure to the face of said direct writing cathode ray tube.

5. In a method of forming a faceplate target structure for a direct writing cathode ray tube having a plurality of fine wires embedded therein running from a first side of the structure to a second opposite side, the combination of steps comprising: preparing a composite body having two sheets of insulating material with a plurality of fine wires in single file sandwiched between said sheets of insulating material; cutting a thin layer from said composite body, said layer having a first plane surface perpendicular to the axis of said wires; etching back along said first plane surface so that the wires project out from said first plane surface; bending said projected wire parallel to said plane surface; further etching back said plane surface; and affixing said faceplate structure to the face of said direct writing cathode ray tube.

No references cited.

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