ELECTRON BEAM THERMOPLASTIC RECORDER WITH CONDUCTOR COATED THERMOPLASTIC RECORDING MEDIUM

Original Filed March 23, 1962

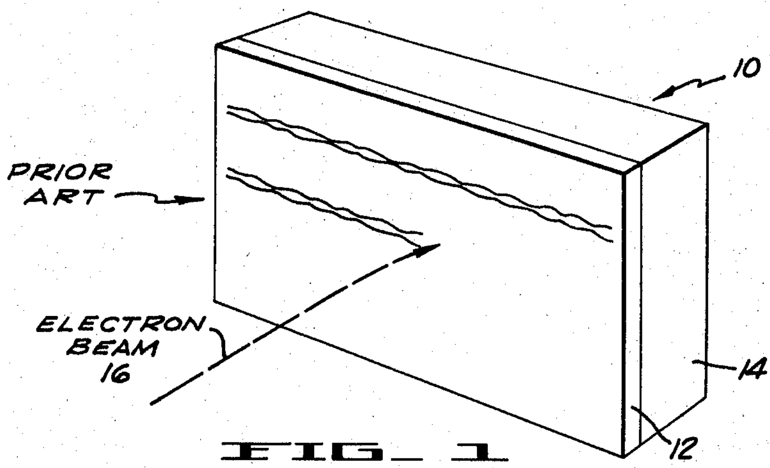

FIG_1

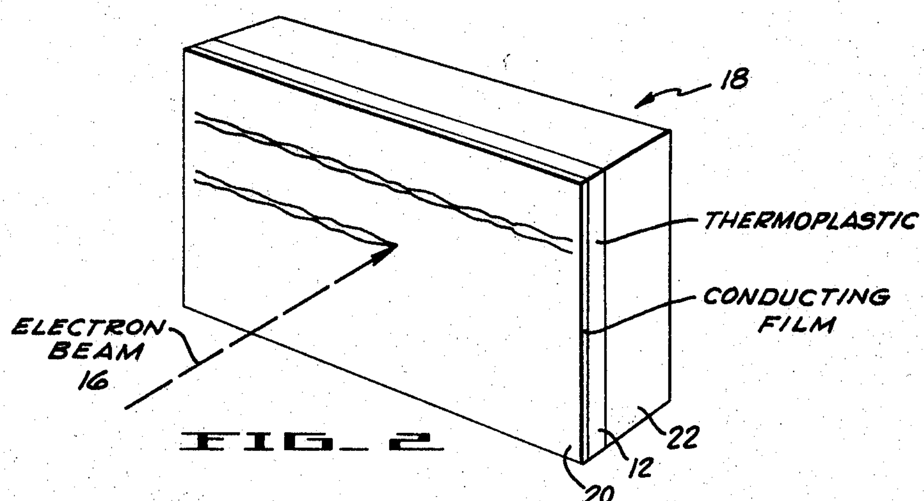

FIG_2

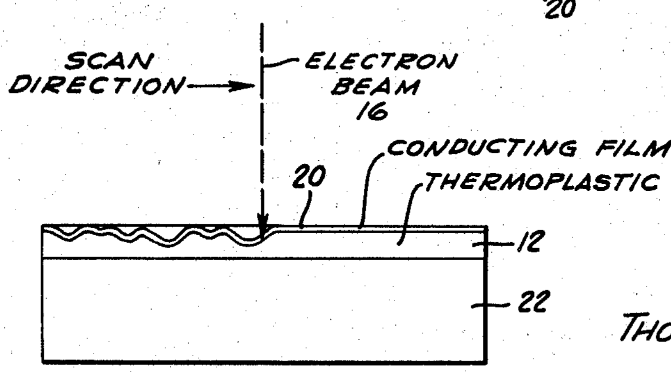

FIG_3

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3,430,255
Patented Feb. 25, 1969

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3,430,255

ELECTRON BEAM THERMOPLASTIC RECORDER WITH CONDUCTOR COATED THERMOPLASTIC RECORDING MEDIUM

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Continuation of application Ser. No. 181,983, Mar. 23, 1962. This application Nov. 2, 1964, Ser. No. 408,422
U.S. Cl. 346—74 **1 Claim**
Int. Cl. G01d *15/06, 15/34*

ABSTRACT OF THE DISCLOSURE

An electrically conductive film is provided in a thermoplastic recording medium, for dissipating electron charges which build up in the thermoplastic material, and thus for confining within the thermoplastic material the electric fields generated by the stored electron charges.

This is a continuation of application Ser. No. 181,983, filed on Mar. 23, 1962 and now abandoned.

This invention relates to an improved thermoplastic structure for electron beam recording and reproducing.

Thermoplastic recording may be achieved, in one manner, by means of a modulated electron beam that scans the surface of a thermoplastic medium and deposits electrons thereon. By heating the thermoplastic, the surface becomes deformed in an undulated pattern related to the number of electrons deposited at each discrete surface area that has been scanned.

Recording and reproducing by means of an electron beam is preferred because high scanning speeds and high density recording are possible. However, one of the difficulties encountered with the use of an electron beam for scanning a thermoplastic is that the electron beam is subject to deflection by the deposited electron charges in the thermoplastic, as the electrons of the beam approaches the surface of the thermoplastic. Such spurious deflection of the beam results in poor resolution, erratic tracking, and provides a distorted signal upon reproduction of the thermoplastic record.

An object of this invention is to provide an improved thermoplastic structure that prevents undesirable electron beam deflection during the recording or reproducing modes in a thermoplastic storage system.

This invention includes an electron beam means and a thermoplastic structure comprising a thin thermoplastic layer usually disposed on a substrate, and a very thin conducting film fixed on the recording surface of the thermoplastic layer. During the recording of signal information by electron beam scanning of the thermoplastic structure, electrons are stored in the thermoplastic layer. The very thin conducting film confines the electric fields that are associated with the stored electron charges within the thermoplastic structure, and prevents these fields from extending beyond the thermoplastic structure into the beam scanning area. In effect, the film forms a barrier to the electric field such that an electron beam that is directed to scan the thermoplastic surface for recording or playback is not erratically deflected by such fields.

The invention will be described in greater detail with reference to the drawing in which:

FIGURE 1 is a perspective view of a thermoplastic structure, as found in the prior art;

FIGURE 2 is a perspective view of a thermoplastic structure, in accordance with this invention; and

FIGURE 3 is a sectional view of the inventive structure.

Similar reference numerals refer to similar parts throughout the drawing.

In FIGURE 1, a prior art thermoplastic structure **10** comprises a thin thermoplastic layer **12** disposed on a support or substrate **14**, which may be a metal backing or a conducting glass layer for example. The thermoplastic structure **10** is located within a demountable electron beam producing device, with electron beam deflection similar to a cathode ray tube. Electron beam means are well known in the art and described in such publications as U.S. Patent 3,118,969, issued to W. E. Glenn, Jr. on Jan. 21, 1964, and U.S. Patent 3,120,991, issued to S. P. Newberry et al. on Feb. 11, 1964. For this reason the electron beam means is shown diagrammatically. Similarly associated transport means is well known. An electron beam **16** is directed at the thermoplastic layer **12**. The electron beam **16**, which has a minimum diameter ranging between 100 Angstroms and 100 microns, is modulated with signal information, in a well known manner, and scans the thermoplastic layer **12** in accordance with deflection signals provided by a deflection system (not shown) associated with the electron beam device.

As the electron beam **16** scans the thermoplastic layer **12**, electron charges are deposited on the surface of the thermoplastic layer and stored therein. The thermoplastic may be preheated, or heated during the scanning process, or post-heated causing the thermoplastic material to become fusible. The intensity of the modulated electron beam **16** that scans each discrete surface area of the thermoplastic layer **12** results in a series of hills and valleys or indentations that correspond to the signal information contained within the electron beam **16**. The pattern thus formed may be fixed permanently in the surface by cooling the thermoplastic. The stored information may be read out by optical or electron beam scanning means that convert the varying pattern to electrical signals, such as described in copending patent application Ser. No. 81,010, filed in behalf of E. V. Boblett on Jan. 6, 1961, now issued as Patent No. 3,168,726 and assigned to the same assignee.

However, the stored electric charges create localized electric fields or lines of force that tend to deflect the electrons of the electron beam **16** from the intended path of travel. In the recording process represented by FIGURE 1, the beam **16** is shown in a deflected path such that the electrons from the beam are deposited at a surface area of the thermoplastic displaced from the correct intended area. Therefore the stored information is not an accurate representation of the signal information recorded, and a distorted reproduction will be obtained upon readout.

In accordance with this invention, a thermoplastic structure **18** as shown in FIGURES 2 and 3 incorporates a very thin metallic conducting film **20** that shapes the lines of force of the electric fields such that the fields do not extend past the scanned surface of the thermoplastic structure **18**. The thin film **20** confines the electric fields within the structure thereby preventing undesirable field forces from affecting the electron beam **16** but is such a thickness as to be transparent to the recording electron beam. Therefore, the electron beam **16** approaches the thermoplastic structure **18** along its predetermined course, and a true and accurate tracking is achieved during the scanning process.

To practice the invention successfully, an electron beam **16** having a diameter in the range of 100 Angstroms to 100 microns with a potential of 2–20 kilovolts may be directed at a thermoplastic layer **12** that is 250 Angstroms to 100 microns thick. The thin metallic coating or film **20** is preferably 50–500 Angstroms in thickness. The metallic coating or film **20** may be formed by evaporating an aluminum film onto the thermoplastic layer **12** in a well known manner. It is understood that many other conducting metals, including silver, nickel, tantalum and gold may be employed for coating the layer **12** with a thin film for the same purpose.

The very thin film **20** should be a metal having a low vapor pressure in a vacuum atmosphere, and be of such thickness and permeability that the scanning electron beam is able to penetrate to the thermoplastic layer **12**. Furthermore, the very thin film **20** should be subject to deformation with the corresponding changes in the thermoplastic layer, as shown in FIGURE 3.

The thermoplastic material may be formed from a mixture of 70% polystyrene, 28% m-terphenyl and 2% of a copolymer consisting substantially of butadiene and styrene.

By means of this invention the resolution achieved with thermoplastic recording and reproduction is substantially improved by minimizing the deleterious effects of electron beam deflection and dispersion.

I claim:

1. Thermoplastic recording apparatus comprising the combination of:

electron beam means;

a thermoplastic recording structure that is scanned by said electron beam means for recording or reproducing signal information;

said thermoplastic recording structure further including:

a substrate;

a thermoplastic layer of the order of 500 Angstroms to 100 microns thick disposed on the substrate, the thickness being commensurate with the intensity of the electron beam, said thermoplastic layer adapted to adhere to the substrate, said thermoplastic layer being responsive to the electron beam to accumulate electron charges within the layer giving rise to undesirable electric fields;

a metallic electrically conducting film permanently disposed directly on and coextensive with the thermoplastic layer, such film having a low vapor pressure in vacuum and capable of shaping and thus confining the undesirable electric fields associated with the electrons accumulated within the thermoplastic layer while remaining transparent to said electron beam, said conducting film further being of a thickness less than 500 A. and thus sufficiently pliable to conform to surface deformations of the thermoplastic layer in response to the impingement thereof by the electron beam, and adapted to operate at a vacuum pressure;

said electron beam means further including,

an electron source having a potential of the order of from 2 to 20 kilovolts, said source being disposed to impinge directly the conducting film of the thermoplastic recording structure.

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U.S. Cl. X.R.

346—77; 340—173; 117—201, 218