March 9, 1965 R. E. BENN 3,173,049

PRINTING HEAD IN CATHODE RAY TUBE FACE

Filed Aug. 14, 1961

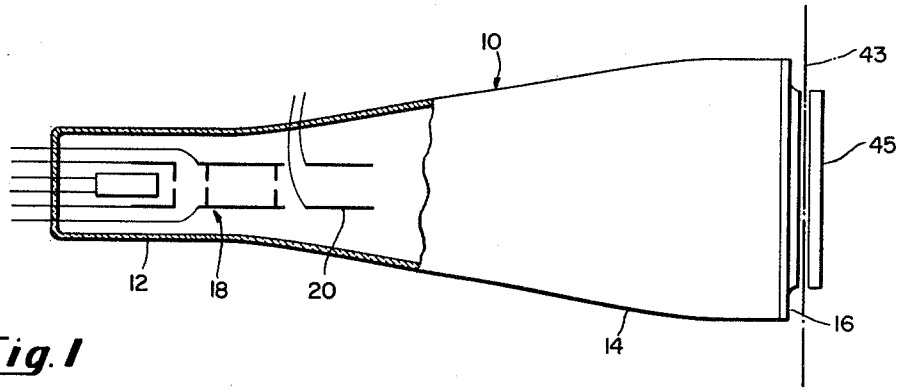


Fig. 1

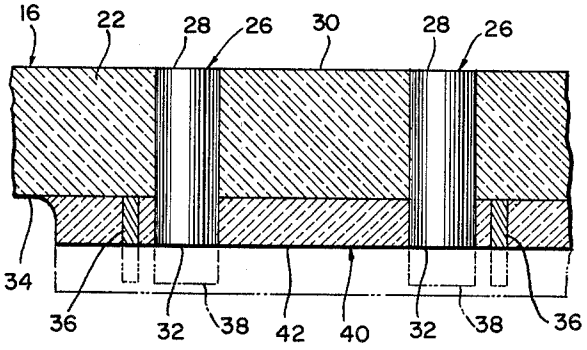


Fig. 3

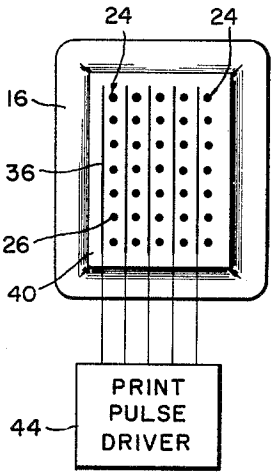


Fig. 2

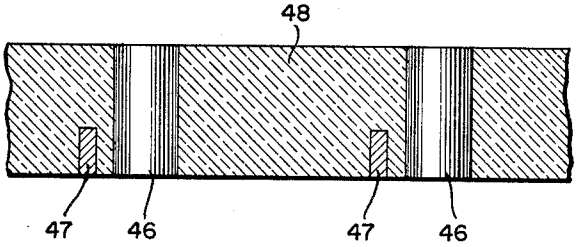


Fig. 4

INVENTOR.
ROBERT E. BENN
BY
AGENT

United States Patent Office 3,173,049 Patented Mar. 9, 1965

3,173,049
PRINTING HEAD IN CATHODE RAY TUBE FACE

Robert E. Benn, Broomall, Pa., assignor to Burroughs Corporation, Detroit, Mich., a corporation of Michigan

Filed Aug. 14, 1961, Ser. No. 131,337
7 Claims. (Cl. 313—89)

The invention hereinafter described and claimed has to do with electrostatic recording or printing. More particularly, however, it relates to cathode ray tubes incorporating electrostatic printing means in its envelope structure, but more specifically in the tube face.

The electrographic recording process consists broadly of three steps. The first step comprises establishing, or printing, electrically charged areas on selected portions of the recording medium, which areas are representative of information. The second step consists of developing such charged areas on the recording medium, by making them visible, for example. The third step, which is optional, consists in fixing or rendering such developed areas substantially permanent. In the electrographic recording process these three steps take place sequentially and at physically separate locations.

In co-pending patent application Serial No. 729,847, filed April 21, 1958, entitled "Electrographic Recording Process and Apparatus" by Robert E. Benn and Richard S. Sakurai, which application is assigned to the assignee of this application, the advantages of positively initiating the establishment of a charged area on a recording medium by creating an electrical discharge between an initiating electrode and a print electrode are set forth. In this co-pending application a separate pulse generating source for each print electrode and each initiating electrode in a matrix print head is required. The simultaneous occurrence or application of print and initiating pulses to corresponding print and initiating electrodes initiates the establishment of a charged area on the recording medium located in the gap between the pulsed print and initiating electrodes of the print head and a back electrode.

Great simplification in the printing station, in the structure of the print heads, and the necessary control and pulse generating circuitry required to print alphanumeric information for example, results when one of the types of the electrodes in the matrix print heads, the print electrode, for example, are connected in parallel. Still greater simplification is possible if each row of parallel connected print electrodes is replaced by a bar electrode, as described and claimed in the co-pending application Serial No. 734,253, filed May 9, 1958, now Patent No. 3,068,479, entitled "Electrographic Recording Apparatus," by Robert E. Benn, Richard S. Howell and Richard S. Sakurai, which application is assigned to the assignee of the present application.

The present invention has for its primary purpose to incorporate the teaching in the above mentioned Benn, Howell and Sakurai co-pending application in a cathode ray tube, by incorporating a dual-electrode (initiating and print) printing means in the envelope structure of such a tube. A particular advantage of the system taught in the above identified co-pending applications is that it is only the initiating or selection electrodes which need to be driven by such a tube, and since the occurrence of the discharge from an initiating electrode to the adjacent printing or bar electrode, which is connected to a suitable positive printing voltage, automatically brings the two electrodes within a few hundred volts of each other in potential, the voltage excursion of the initiating electrodes as a result of secondary-emission phenomena is restricted, making the operation of the system less sensitive to different secondary-emission characteristics of various targets.

Briefly the invention provides a cathode ray tube for use in the art of electrostatic recording or printing and comprising a hermetically sealed tube envelope having the usual cathode ray beam generating and deflecting means in one portion and a beam actuated printing head in another portion. The head is positioned so that the cathode ray beam can impinge upon and energize an initiating electrode to affect printing in the manner set forth in the above identified Benn, Howell and Sakurai application. In its preferred form, the print head comprises at least one row of initiating electrodes formed by pins extending through the envelope and hermetically sealed therein with their inner ends positioned to be struck by the cathode ray beam, and their exterior ends terminating on an outer surface of the envelope. A bar printing electrode is positioned closely adjacent and across the ends of the pin electrodes.

The invention will be more fully appreciated from the following description of the preferred embodiment thereof taken in conjunction with the appended drawings, in which:

FIG. 1 is a schematic view of a cathode ray tube incorporating a pin-bar electrostatic printing matrix in accordance with the invention;

FIG. 2 is an end view of the cathode ray tube of FIG. 1 showing the pin-bar matrix;

FIG. 3 is a greatly enlarged fragmentary sectional view taken through the face plate of the cathode ray tube and showing the construction of the pin-bar printing elements; and

FIG. 4 is a view similar to FIG. 3 but showing a modified form of the invention.

Now with reference to the details of the various figures of drawings, and first to FIG. 1, it is seen that a combined cathode ray pin-bar electrostatic recording and printing tube exemplary of the preferred form of the invention, comprises a glass envelope **10** having a narrow neck portion **12** and a flared opposite end portion **14**, having a faceplate **16** sealed thereto. The beam producing apparatus such as an electron gun **18** of conventional construction is positioned in the narrow neck portion **12** of the tube. While only one gun is shown in this embodiment it will be understood that the invention contemplates more if desired. When necessary, deflection plates **20** are provided adjacent the gun for cooperation with suitable well known circuitry, not shown, to deflect the beam in the manner and for the purpose described hereinafter.

The faceplate **16** is formed by a sheet of glass **22** (FIG. 3) and has provided therein a pin-bar electrostatic printing head comprising at least one but preferably a plurality of rows **24** of pin electrodes **26** extending completely through the plate **22** with their inner ends **28** preferably flush with the inner surface **30** of the faceplate **22** and their outer ends **32** extending slightly beyond the outer face **34** of the plate **22**, for the purpose to be described below. As seen in FIG. 2 in this preferred form of invention there are provided five vertical rows of 7 pins each thus to form a well known 5 x 7 printing matrix.

Each row **24** of pins is provided with a common bar electrode **36** positioned across and closely adjacent the projecting ends **32** of the pins. The pins and bars may be secured to the faceplate **22** in any of various methods, two of which have been shown here in FIGS. 3 and 4. In FIG. 3, for example, the pins are secured through the faceplate by softening the plate sufficiently for the pins to be pushed through the plate. Preferably the inner end **28** of the pins is ground off flush with the inner surface **30** while the outer ends **32** are permitted to extend beyond the plate to an extent slightly beyond that desired for the finished product, as indicated by the broken lines **38**. The bar electrodes **36** are then positioned across the ends, as indicated by the full and broken lines, and secured

thereat by epoxy resin or molten glass frit **40** which may be sprayed or otherwise applied over the ends **32** of the pins and the bar electrodes **36**. The frit is melted by subjecting it to necessary heat after which it is allowed to cool and harden, thus to adhere to outer surface **34** of faceplate **22** and bond the bar electrodes **36** closely adjacent to the ends **32** of the pin electrodes **26**. After the frit **40** has hardened the excess end portions of the pin and bar electrodes are ground off to a planar surface **42** across which the recording medium **43** may be fed by suitable means not shown but which is fully described in the above identified co-pending application.

It is understood, as described in the above mentioned Benn, Howell and Sakurai application, that in use the bar electrodes are connected to a suitable positive printing voltage as indicated at **44**, and that a grounded back electrode **45** is provided.

In the modification shown in FIG. 4 the pin and bar electrodes **46** and **47** respectively, are secured within the faceplate **48** by first positioning the electrodes and then pouring molten glass around them in a mold to form the plate.

Thus it is seen that the invention provides a combined pin-bar electrostatic recording or printing means in a cathode ray tube whereby the cathode ray is effective to energize the initiating pin electrode **26** by impingement on the inner face thereof to effect printing on a recording medium.

What is claimed is:

1. A cathode ray tube usable as an electrostatic printing head comprising, an hermetically sealed envelope of electrically insulating material, means in one portion of said envelope for generating a cathode beam and directing it to a second portion, a first electrode extending through a wall of said envelope at said second portion with a portion thereof on the inner side in a position to be impinged by said beam, and another portion on the outer side, and a second electrode electrically insulated from the cathode beam and fixed to the exterior of said envelope closely adjacent to the outer portion of said first electrode and forming therewith a pair of electrodes capable of printing or recording electrostatically on a record medium.

2. A cathode ray tube usable as an electrostatic printing head comprising, an hermetically sealed envelope of electrically insulating material, means in one portion of said envelope for generating a cathode beam and directing it to a second portion, a plurality of first electrodes extending through a wall of said envelope at said second portion with a portion of each on the inner side arranged to be impinged by said beam selectively, and another portion on the outer side arranged in a predetermined array, and a second electrode electrically insulated from the cathode beam and fixed to the exterior of said envelope adjacent to the outer portion of each said first electrodes and forming therewith an array of electrodes capable of printing or recording electrostatically on a record medium.

3. A cathode ray tube usable as an electrostatic printing head comprising, an hermetically sealed envelope of electrically insulating material, means in one portion of said envelope for generating a cathode beam and directing it to a second portion, a plurality of print initiating electrodes extending through a wall of said envelope at said second portion with a portion of each on the inner side arranged to be impinged by said beam selectively, and another portion on the outer side arranged in a row, and a printing electrode electrically insulated from the cathode beam and fixed to the exterior of said envelope

closely adjacent to and extending across the outer portions of said initiating electrodes and forming therewith a row of pin-bar electrodes capable of printing or recording electrostatically on a record medium.

4. A cathode ray tube usable as an electrostatic printing head comprising, an hermetically sealed envelope of electrically insulating material, means in one portion of said envelope for generating a cathode beam and directing it to a second portion, a plurality of print initating electrodes extending through a wall of said envelope at said second portion with a portion of each on the inner side arranged to be impinged by said beam selectively, and another portion of each on the outer side all arranged in a plurality of aligned rows, and a printing electrode electrically insulated from the cathode beam and fixed to the exterior of said envelope adjacent to and across the outer portion of each row of said initiating electrodes and forming therewith a matrix of pin-bar electrodes capable of printing or recording electrostatically on a record medium.

5. A cathode ray tube usable as an electrostatic printing head comprising, an elongated hermetically sealed envelope of electrically insulating material, means in one end of said envelope for generating a cathode beam and directing it to a second portion, means for deflecting said beam, a plurality initiating electrodes extending through the faceplate of said envelope at the opposite end of the envelope with a portion of each on the inner surface of said faceplate and arranged to be impinged by said beam selectively, and another portion on the outer side of said faceplate arranged in a plurality of aligned rows, and printing electrodes electrically insulated from the cathode beam and fixed to the exterior surface of said faceplate adjacent to and across the outer portion of said initiating electrodes and forming therewith a matrix of pin-bar electrodes capable of printing or recording electrostatically on a record medium.

6. A cathode ray tube usable as an electrostatic printing head comprising, an hermetically sealed envelope of electrically insulating material, means in one portion of said envelope for generating a cathode beam and directing it to a second portion, a plurality of initiating pin electrodes extending through and sealed in a wall of said envelope at said second portion with a first portion of each flush with the inner face of said second portion of said envelope and arranged to be impinged by said beam selectively, and a second portion flush with the outer face of said second portion of said envelope and arranged in a row, and a bar electrode electrically insulated from the cathode beam and fixed to and flush with said outer face closely adjacent to and extending across the outer portion of said initiating electrodes and forming therewith a row of combined pin-bar electrodes capable of printing or recording electrostatically on a record medium.

7. A construction according to claim 6 wherein there is provided a plurality of rows of such pin-bar electrodes thus to form a matrix of such electrodes.

References Cited in the file of this patent

UNITED STATES PATENTS

2,918,580	Howell	Dec. 22, 1959
2,978,607	Borden	Apr. 4, 1961
3,041,611	Moss	June 26, 1962

FOREIGN PATENTS

1,224,349	France	Feb. 8, 1960