

Feb. 6, 1962

O. F. HAMANN

3,020,441

CHARACTER BEAM-SHAPED TUBE

Filed Oct. 9, 1957

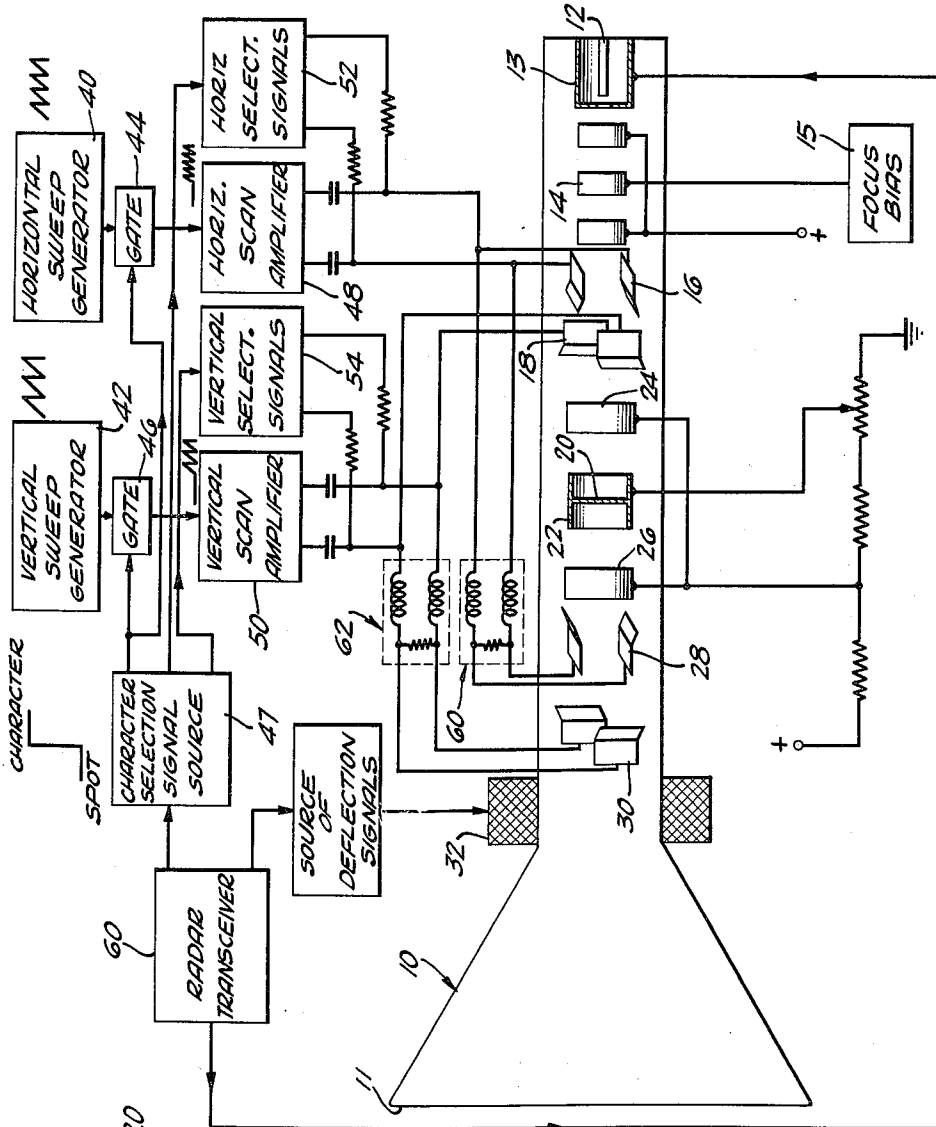


FIG. 1

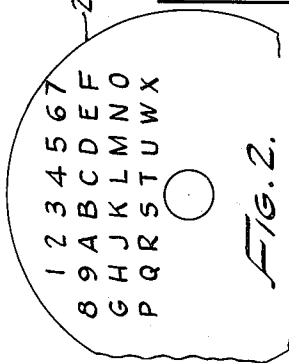


FIG. 2.

INVENTOR.
OMER F. HAMANN

BY

Egon W. Mueller

ATTORNEY

1

3,020,441

CHARACTER BEAM-SHAPED TUBE

Omer F. Hamann, San Diego, Calif., assignor to General Dynamics Corporation, Rochester, N.Y., a corporation of Delaware

Filed Oct. 9, 1957, Ser. No. 689,121

7 Claims. (Cl. 315-8.5)

This invention relates to improved cathode-ray tube apparatus for selectively displaying apparatus having predetermined shapes such as characters, symbols, and numerals.

In Patents Nos. 2,735,956, and 2,761,988, for cathode-ray apparatus, which patents are issued to Joseph T. McNaney, there are described character beam-shaped tubes of the type wherein characters and other intelligible marks may be displayed on the screen of cathode-ray tube apparatus in a manner to establish intelligible data. The arrangement for obtaining the individual characters comprises, within the tube, an aperture mask having a plurality of character-shaped apertures. The aperture mask is positioned to intercept the electron beam on its way from the electron gun to the cathode-ray tube screen. Sets of deflection voltages are applied to deflecting means which direct the electron beam at a selected character-shaped aperture. The beam passing through the aperture has its cross section shaped to that of the aperture. The character-shaped beam thereafter is deflected onto the cathode-ray tube screen at a location whereby, in connection with other previous and succeeding activations of the screen phosphor, intelligence is conveyed.

In an application by Joseph T. McNaney, for Radar Identification System, filed September 9, 1957, Serial No. 682,776, now U.S. Patent No. 2,976,529, assigned to a common assignee, there is described an arrangement whereby the character beam-shaped tube also has a "non-character" shaped aperture which may be a round hole through which the cathode-ray beam may pass. In this tube, radar data is presented on the screen of the cathode-ray tube in addition to characters which identify the target blips on the screen comprising the radar data.

In the system described and claimed in this McNaney application, a pulse is transmitted from a radar transmitter which is reflected from a target. These targets may be equipped with responding apparatus which, when triggered by the transmitter pulse, send back to the receiver a pulse code. The pulse code is converted into a set of deflection potentials, designated as character-selection potentials. The usual sweep potentials are obtained from the radar system, and the beam is intensified at the proper time, whereby the cathode-ray tube screen is illuminated at the proper time to establish the location of a target. Further, target display information is withheld until the character-selection potentials have deflected the beam to be shaped into the characters which identify the target. These characters are displayed on the screen in association with the target blip.

In the operation of the character beam-shaped tube, characters are illuminated by directing an electron beam through a particular matrix character and for the optimum character resolution the matrix plane is focused on the viewing screen. The uniformity of character illumination is dependent upon the uniformity of emission from the cathode surface and the intensity of a displayed character is directly related to the current density of the electron beam as it intercepts the plane of the aperture plate. When the aperture plate has an opening to enable the presentation of radar information, it was found necessary to dynamically change the focus of the electron beam from a large cross section, which is used to adequately overlap a selected aper-

2

ture, to a small cross section, which is used to present the radar information. In making the change from large to small cross section, and vice versa, it is desirable that the focus be in the plane of the aperture plate. In doing this, the centroid of the beam shifts position, necessitating the use of a corrective signal applied to the selection plates.

An object of the present invention is to eliminate the necessity for changing beam focus when changing the presentation on the cathode-ray tube screen from character to radar information.

Another object of the present invention is to provide a simple arrangement for eliminating a position shift of the centroid of the electron beam cross section when changing the beam focus in the plane of the aperture mask in a character beam-shaped tube.

Yet another object of the present invention is to present uniformly illuminated characters in a character beam-shaped tube regardless of the lack of uniformity of emission from the cathode surface.

Another object of the invention is to permit the utilization of a matrix having smaller intermediate character apertures than possible when a circular beam is used for electron illumination of an aperture.

Another object of the invention is to permit the use of variable sized characters in the matrix.

Still another object of the present invention is the provision of a novel method and means for operating a character beam-shaped tube.

These and other objects of this invention are achieved in a character beam-shaped tube of the type having an aperture plate or matrix in which there are apertures having character shapes for shaping the electron beam, by reducing the beam cross section in the plane of the aperture mask to be less than that of the aperture and employing raster scan techniques for scanning a selected character-shaped aperture.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 shows a sectional view of a character beam-shaped tube of the type which may be employed for presenting both radar information and characters, together with a block diagram of a system embodying the principles of the invention; and

FIGURE 2 shows a portion of an aperture mask employed in the tube.

Referring now to FIGURE 1, there may be seen a cathode-ray tube in section and the associated block schematic diagram embodying this invention. The cathode-ray tube employed in this invention includes an evacuated envelope 10 within which, at one end, is a cathode 12 within a control grid 13, which controls the intensity of the electron beam emanated from the cathode 12. A focusing electrode 14 biased from a bias source 15 serves the function of focusing the electron beam to have a desired circular cross sectional area at the matrix plane. Vertical and horizontal pairs of electrostatic deflectors, respectively 16 and 18, serve the function of directing the electron beam either along the axis of the tube towards the screen 11 or through a desired character-shaped aperture in an aperture plate 20. The aperture plate 20, as shown in FIGURE 2, besides character-shaped apertures, also has a round hole in its center. As indicated in section, the aperture plate 20 is mounted within an electrostatic lens element 22. The surface of the plate is normal to the tube axis and the shaped openings may have the

form of symbols, numbers, characters, etc. The purpose of the round hole in the aperture plate is to provide for noninterrupted passage of the electron beam along the tube axis, if desired, so that the tube may be operated conventionally to present radar information when it is not being operated to present character information. It should be understood that the round hole is merely exemplified as being along the tube axis, the invention not being so limited, however.

There are also provided lens elements 24, 26, between which the lens element 22 is supported. These lens elements are biased to provide an electrostatic field to form a "lens" configuration, whereby the electron beam will have a curved trajectory. It will enter the field, pass through the selected aperture, and thereafter it approaches the common axis of the tube and lens as it begins to leave the field. Horizontal and vertical pairs of deflection plates, respectively 28, 30, are employed to redeflect the electron beam into its path along the axis of the tube after leaving the field of influence of the lens elements. A deflection yoke 32 is employed for deflecting the electron beam to the correct position on the screen 11.

Heretofore, when the electron beam was deflected by means of the deflection plates 16, 18 toward a character-shaped aperture, in order to insure adequate electron illumination of the aperture, a defocusing voltage was applied to the focusing grid 13. Then, when it was desired to show radar data, the electron beam was again focused to a spot in the plane of the aperture mask, so that it could pass through the hole which, in the exemplification, is positioned in the center of the aperture mask. In accordance with this invention, there are provided a vertical-sweep voltage generator 42 and a horizontal-sweep voltage generator 40. The sawtooth frequency of the vertical-sweep generator is made very much smaller than the sawtooth frequency of the horizontal-sweep generator, for example, on the order of one-tenth of the time permitted for a character presentation. Thus, there may be at least ten raster scans of a character-shaped aperture by an electron beam. The output of the respective sweep generators 40, 42 are applied to two gates, respectively 44, 46. These gates are closed to the passage of the respective vertical and horizontal sweep voltages until such time as a second input is received from a character-selection signal source 47. This second signal is indicative of the fact that a character selection and presentation is being made. At this time, the respective gate outputs are applied to a horizontal-scan amplifier 48 and a vertical-scan amplifier 50. These amplify the sweep voltages until they will provide a sufficient deflection of the beam to adequate cover or scan the selected character-shaped aperture.

The outputs of the respective horizontal- and vertical-scan amplifiers are applied to the respective vertical and horizontal-deflectors 16, 18, together with the outputs of horizontal- and vertical-deflection amplifiers 52, 54. These deflection amplifiers receive inputs from the character-selection signal source 47, which serve either to deflect the electron beam toward the central opening in the aperture for radar presentation or toward a desired character-shaped aperture for character presentation. In the absence of selection deflection or raster scan signals, voltages are applied from the character-selection signal source, which causes the deflectors to deflect the electron beam along the tube axis. The combined effect of the horizontal- and vertical-sweep voltages and the deflection voltages is to cause the electron beam to scan an aperture in the manner of a television scanning raster.

From the above, it will be appreciated that there is no need to change the focus of the beam when shifting from a radar to a character presentation, and vice versa. Since the beam is focussed to have a small cross-sectional area, the effects of nonuniform cathode emission are obviated. Since it is only desired to affect the electron beam by the

sweep voltages only before the beam passes through the apertures, the coupling between the first pair of deflectors 16, 18 and the second pair of deflectors 28, 30 is made through low-pass filters 60, 62, which permit the regular deflection voltages to pass and block the higher frequency sweep voltages.

The radar transceiver 60, in response to a transmitted pulse, will receive from a properly equipped target both an echo pulse and a pulse code representing character identification of the target. A deflection signal source 62, in well-known manner, provides the required deflection signals, timed by information received from the radar transceiver. The radar transceiver can also include a pulse code receiver which demodulates the pulse code from its carrier frequency and applies it to the character selection signal source 47 for conversion from the digital to analog form required for selecting an aperture in the aperture plate. For complete details of a suitable arrangement, reference is made to the aforementioned McNaney application.

From the foregoing description, it will be appreciated that there has been described a novel method and means for operating a cathode-ray tube of the type wherein an electron beam is shaped by passing it through an aperture on its way toward the tube screen. The invention is useful not only where both radar and character presentations are to be made, but also where a character presentation alone is to be made, since it effectively overcomes the deleterious effects of nonuniform cathode emission and permits a more efficient use of the effective matrix area.

I claim:

1. In a cathode-ray tube display system for displaying characters on the screen of a cathode-ray tube of the type having an aperture plate with character-shaped apertures for intercepting and shaping the electron beam cross section, the improvement comprising means for focusing said electron beam cross section to have a smaller cross-sectional area than a character-shaped aperture, means for generating vertical- and horizontal-sweep potentials for scanning a character-shaped aperture, means for generating aperture selection voltages, and means to apply both said vertical- and horizontal-sweep potentials and said aperture deflection potentials to said electron beam to select and raster scan a desired one of said character-shaped apertures and means for causing the electrons that traverse said character-shaped aperture to impinge on a viewing screen.

2. In a cathode-ray tube display system for displaying radar information and characters on the screen of a cathode-ray tube of the type having an aperture plate with character-shaped apertures for intercepting and shaping the electron beam cross section, the improvement comprising means for focusing said electron beam to have a cross-sectional area smaller than a character-shaped aperture, means for generating vertical- and horizontal-sweep potentials for scanning a character-shaped aperture, means for applying deflection voltages to said electron beam for presenting radar information and for selecting a desired character-shaped aperture, and means to apply said sweep potentials to said means for applying said deflection voltages to said electron beam only when a desired character-shaped aperture is selected.

3. In a cathode-ray tube display system for displaying radar information and characters on the screen of a cathode-ray tube of the type having an aperture plate with character-shaped apertures for intercepting and shaping the electron beam cross section, the improvement comprising means for focusing said electron beam to have a cross-sectional area smaller than a character-shaped aperture, vertical electron beam deflecting means, horizontal electron beam deflecting means, means for applying a first set of deflection potentials to said vertical and horizontal electron beam deflecting means for presenting radar information, means for applying a second set of

5

deflection potentials to said vertical and horizontal electron beam deflecting means for selecting desired character-shaped apertures, and means for respectively applying said vertical- and horizontal-sweep potentials to said vertical and horizontal electron beam deflecting means only during the application of said second set of deflection potentials to raster scan said selected characters.

4. In a system for presenting on a cathode ray tube both radar information from an object and characters corresponding to coded information peculiar to said object for identifying portions of said radar information, said cathode ray tube having a viewing screen, electron-emitting means, beam deflection means, and an apertured mask having shaping apertures for producing character-shaped displays and a non-shaping aperture for producing a substantially round-shaped display, said cathode ray tube further having a first fixed-strength electron lens means for imaging the electrons from said electron emitting means onto said apertured mask in the form of an image substantially smaller than said character-shaped apertures, control means for applying deflection potentials to said beam deflection means in response to said coded information for positioning said imaged beam on an aperture selected in accordance with a particular code, said control means further supplying horizontal and vertical sweep potentials to said deflection means for causing said image to raster-scan the aforesaid selected aperture, means responsive to radar information for directing said electron beam through said non-shaping aperture without raster-scanning it, and a second fixed-strength electron lens means for imaging the plane of said aperture mask onto said viewing screen—whereby said first and second fixed-strength electron lenses cause clear characters and radar displays to be produced on said viewing screen.

5. In a system for presenting on a cathode ray tube radar information from an object and characters corresponding to coded information peculiar to said object for identifying portions of said radar information, said cathode ray tube having a viewing screen, electron emitting means, beam deflection means, and an apertured mask having shaping apertures for producing character-shaped displays and a non-shaping aperture for producing a substantially round-shaped display, said beam deflection means being disposed between said emitting means and said mask, said cathode ray tube further having a first fixed-strength electron lens means for imaging the electrons from said electron emitting means onto said apertured mask in the form of an image substantially smaller than said character-shaped apertures, control means for supplying deflection potentials to said beam deflection means in response to said coded information for positioning said imaged beam on an aperture selected in accordance with a particular code, said control means fur-

6

ther supplying sweep potentials to said beam deflection means for causing said image to raster-scan the aforesaid selected aperture, means responsive to said radar information for directing said electron beam through said non-shaping aperture without raster-scanning it, and a second fixed-strength electron lens means for imaging said aperture mask onto said viewing screen—whereby said first and second fixed-strength electron lenses cause clear characters and radar displays to be produced on said viewing screen.

6. A cathode ray tube for presenting both radar information and characters for identifying portions of said radar information, comprising: an evacuated envelope having a viewing screen and electron emitting means; an apertured mask having character-shaped apertures for producing character-shaped displays and a non-shaping aperture for producing a substantially round-shaped display; a first fixed-strength electron lens means for imaging the electrons from said electron emitting means onto said apertured mask in the form of an image substantially smaller than said character-shaped apertures; a second fixed-strength electron lens means for imaging said apertured mask onto said viewing screen—whereby said first and second fixed-strength electron lenses cause clear characters and radar displays to be produced on said viewing screen.

7. A cathode ray tube for presenting a radar display and characters for identifying portions of said radar display, comprising: an evacuated envelope having a viewing screen and electron emitting means; an apertured mask having shaping apertures for producing character-shaped displays and a non-shaping aperture for producing a substantially round-shaped display; means for causing an image of said electron emitting means to raster-scan a selected aperture, said scanning means comprising horizontal and vertical sweep potentials; means for causing said image to traverse said non-shaping aperture without raster-scanning it—whereby said first and second fixed-strength electron lenses cause a radar display and clear characters to be produced on said viewing screen.

References Cited in the file of this patent

UNITED STATES PATENTS

2,283,383	McNaney	May 19, 1942
2,728,872	Smith	Dec. 27, 1955
2,761,988	McNaney	Sept. 4, 1956
2,834,831	Giffard	May 13, 1958

OTHER REFERENCES

New Apparatus and Techniques of Air Traffic Control Data Handling and Display, D. J. Antony, IRE Convention Record, Instrumentation, etc. Part 10, vol. 3, No. 6-10, 1955.