June 28, 1960 J. T. McNANEY 2,943,220

CATHODE-RAY APPARATUS

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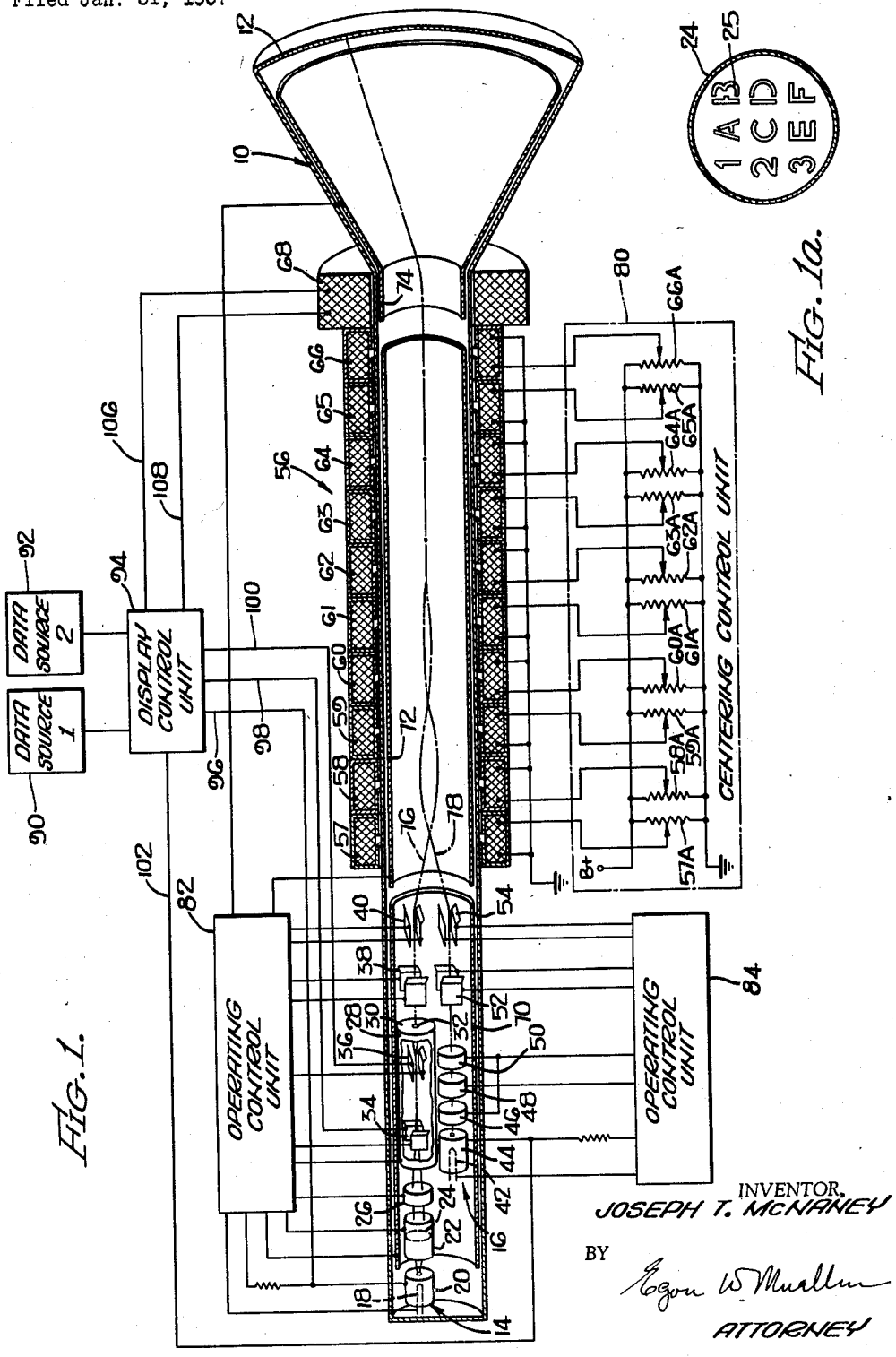

FIG. 1.

FIG. 1a.

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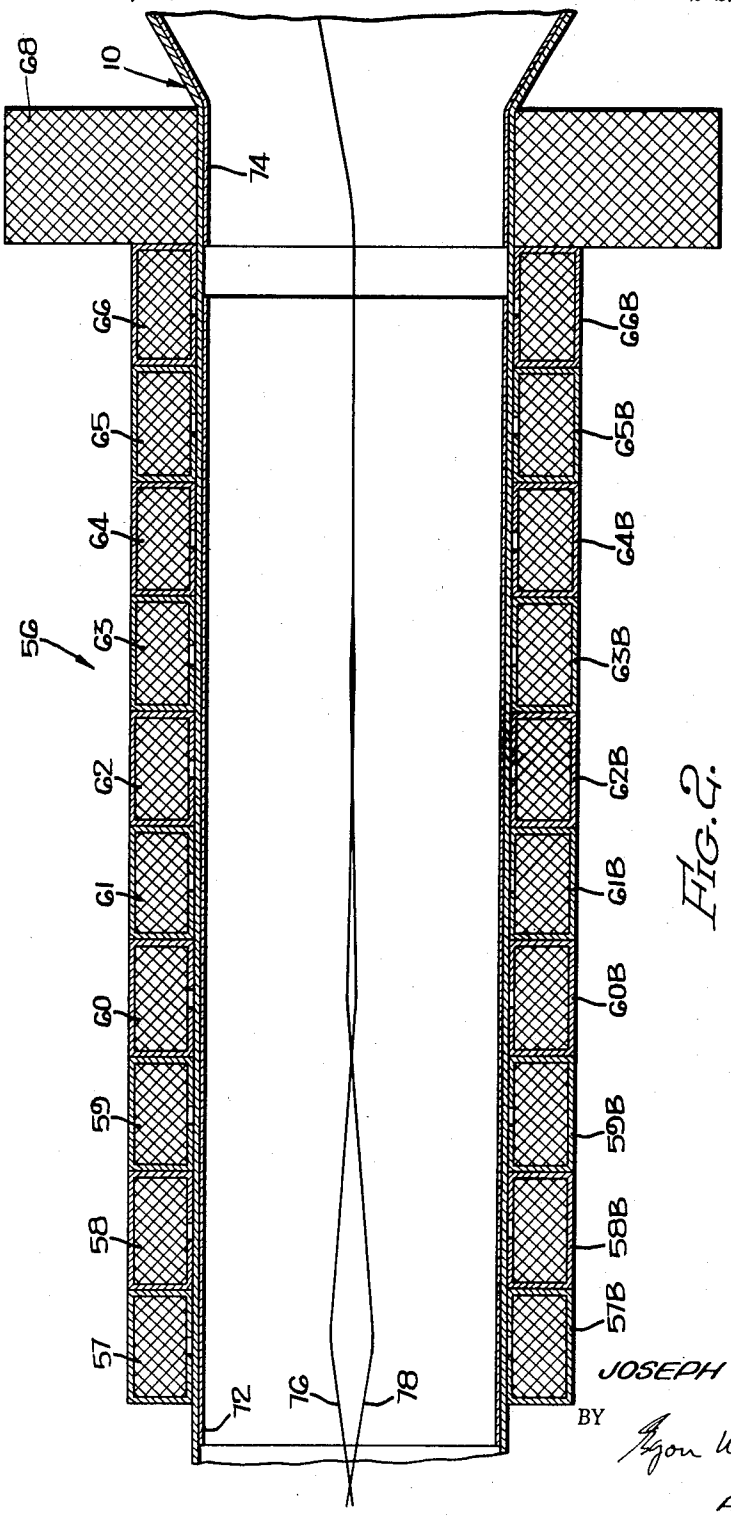

FIG. 2.

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CATHODE-RAY APPARATUS

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8 Claims. (Cl. 313—86)

This invention relates to cathode-ray apparatus and, more particularly, to an improved apparatus and technique for producing joint displays of cathode-ray images and other data.

One of the problems in air traffic control is to have a presentation not only of the location of airplanes, but also their identity. Such a display would both facilitate the handling of the control problem, enable an accurate allocation of air traffic priority, and could reduce the chances of accidents. Thus, a cathode-ray tube apparatus which can simultaneously present both radar data and identification symbols can fill such a need. Such apparatus may also be employed in certain computer applications wherein output data must be jointly presented in the form of images such as symbols, numerals, or characters which are generated in response to data from one source and beam writing in response to data from a second source, which produces equations or other code group displays.

An object of this invention is to provide an improved cathode-ray tube which produces joint displays consisting of both shaped beams and a single beam which is describing a desired path.

Another object of the present invention is to provide a novel multiple gun cathode-ray tube which can produce a joint display of both digital and analog data.

Still another object of the present invention is to provide a useful cathode-ray tube capable of producing both location data and identification data.

Yet another object of the present invention is to provide a novel improved multiple-gun cathode-ray tube capable of receiving and displaying data from a plurality of data sources.

These and other objects of this invention are achieved by providing a multiple-gun cathode-ray tube wherein the electron beam from one of the guns can be shaped to represent a character in response to data from one source. This shaped beam is then deflected toward the center of the cathode-ray tube envelope. A second gun produces a beam which is given a regular shape. By "regular shape" is meant either a circle, rectangle, or ellipse, or any one of the usual shapes given to the cathode-ray beam for causing it to impinge as a spot upon the cathode-ray tube screen. The term "regular" is employed to distinguish the shape of the beam from the character-shaped beams. This regular shape beam is also deflected toward the center of the cathode-ray tube envelope.

Intensity-control means for each of the beams is provided, whereby in response to instructions from the first data source, the character-shaped beam intensity may be controlled, and in response to the instructions from the second data source the regular-shaped beam intensity may be controlled. Means are provided for directing both beams, which have been deflected toward the center of the cathode-ray tube, along a path which extends substantially coaxially with the axis of the cathode-ray beam tube. The coaxial path guidance means is followed by

deflection means for directing both beams to a desired portion of the cathode-ray tube screen to be displayed responsive to deflection data received from either one of the two data sources.

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 is a cross section in perspective of one embodiment of the invention;

Figure 1*a* is an enlarged view of a matrix or beam-shaping means employed in the embodiment of the invention; and

Figure 2 is an enlarged sectionalized side view of a portion of the structure shown in Figure 1.

Examples of cathode-ray tube apparatus wherein selective character-shaped beams are generated and displayed are described and claimed in my Patents Nos. 2,735,956 and 2,761,988 for Cathode Ray Apparatus.

Reference is now made to Figure 1 of the drawing, which shows a sectionalized perspective view of an embodiment of the invention. This comprises an evacuated envelope **10** for the tube having the usual cathode-ray tube screen **12** at one end of the envelope and multiple electron gun structure in the other end of the envelope. By way of illustration of the principles of this invention, two electron guns are shown. This is not to be construed as a limitation since it will be appreciated by those well skilled in the art that more than two guns can be employed within a single envelope, if required. One of these electron guns **14** is a character-shaped beam-producing means; the other of these electron guns **16** is a regular-shaped beam-producing means.

The character-shaped beam-producing means includes a cathode **18**, a control grid **20**, followed by an accelerating electrode **22**, within which is located a matrix, or beam-shaping means **24** containing a plurality of shaped openings. This beam-shaping means, shown enlarged in Figure 1*a*, is positioned to intercept the electron beam emanated from the cathode. Accordingly, there is produced as a result a plurality of electron beams, each having the shape of one of the plurality of apertures in the matrix **24**. Figure 1*a* is an enlarged view illustrating one form which the matrix **24** with the beam-shaping apertures **25** may take. It will be understood that the number and types of character-shaping apertures may be varied as required.

The accelerating electrode **22** is followed by a first anode **26**, a second anode **28**, which contains at one end a beam-intercepting member **30**, having a selection aperture **32**. The beam-intercepting member is a disc having the opening **32** at the center thereof. Within the second anode is contained horizontal deflecting electrodes **34** and vertical deflecting electrodes **36**. The plurality of shaped beams which pass through the matrix **24** may thus be deflected by the horizontal and vertical deflecting means **34** and **36**, so that a desired shaped beam passes through the aperture **32** and the others are intercepted and prevented from continuing by the beam-intercepting means **30**. The shaped beam which passes through the aperture **32** is then properly guided or deflected by a second set of horizontal deflecting plates **38** and vertical deflecting plates **40** toward the center of the cathode-ray tube apparatus.

The means for generating the electron beam having the regular shape includes the cathode **42**, a control grid **44**, an accelerating electrode **46**, a first anode **48**, a second anode **50**, followed by means for directing the reg-

ular-shape beam toward the center of the cathode-ray tube, or envelope. This latter structure includes the horizontal deflecting plates 52, followed by the vertical deflecting plates 54.

Mounted about the tube envelope portion which follows the portion at said one end in which the multiple electron guns are found are the elements of a multi-beam-centering means 56. This comprises a plurality of short electromagnetic induction units 57 through 66. These are followed by the usual display deflection means 68, which comprises the well-known electromagnetic deflection coils. A plurality of other acceleration anodes are provided, consisting of aquadag coating 70, 72, and 74. The beams represented by the lines 76 and 78, which are deflected toward the center of the tube envelope, are projected into the field of influence of the joint beam-centering means 56, which, as will be further shown herein, causes the beam to seek a common path that is essentially coaxial with the axis of the tube envelope 10. The deflection means 68 can then deflect both beams to a desired portion of the screen 12, wherein the joint display of images and other cathode-ray data is effectuated.

The potentials required by the plurality of induction coils forming the joint beam-centering means are provided from a centering control unit 80 to the respective coils 57 through 66 by way of separate leads. All the induction coils are connected to a common ground. The centering control unit 80 includes a separate potentiometer 57A–66A for each centering coil. These are connected across a potential source and enable individual adjustment of the current through each coil and thereby the field strength of each coil.

The operating potentials required by the electron gun 14 are provided by an operating control unit 82. The operating potentials required by the electron gun 16 are provided by an operating control unit 84. The potentials applied to the deflecting plates 38, 40 and 52, 54 from the respective operating control units 82, 84 are such as to deflect the beams 76, 78 into the field of influence of the joint beam-centering means 56 at proper angles incident to the axis of the tube envelope 10.

A first and second data source 90, 92 respectively apply their data to a display control unit 94. Display control unit 94 serves to convert the data from data source 90 and data source 92 into the necessary control potentials required to be applied to the two guns 14 and 16 to select a character-shaped electron beam, to withhold it until the proper time by controlling its intensity, and to suitably modulate the intensity of the regular-shaped electron beam. Display control unit 90 also takes the signals from one of the other or both of the data sources, as required, to properly control the deflection of the electron beams by means of deflection control means 68. For example, different signals appearing from data source 1 may be converted by the display control unit 94 into grid control potentials, which are applied over lead 96 to the control electrode 20 and into horizontal and vertical selection potentials which are applied over leads 98 and 100, respectively to the horizontal deflection electrodes 34 and vertical deflection electrodes 36. Input signals received from data source 2 are applied over lead 102 to the control electrode 44 of the second electron gun and also into potentials which are applied over leads 106 and 108 to control the vertical and horizontal deflection operation of the display deflection coils 68. Display control unit 94 may be well-known digital-to-analog conversion apparatus since the output required of it, for operating the invention in the manner described above, consists of analog currents and voltages.

Reference is now made to Figure 2, which shows an enlarged section of the portion of the cathode-ray tube apparatus about which the centering means 56 are disposed. The induction units 57 through 66 are individually enclosed within material 57B through 66B of high magnetic permeability, whereby the electromagnetic fields produced are concentrated such that deflections of the electron beams 76, 78 are primarily influenced by the radial components of said fields. The reaction produced by the field of the induction coil 57 is such that the trajectories of electron beams 76 and 78 are caused to bend sharply, and the beam path to become convergent. The fields of induction coils 58 and 59 are adjusted such that the path of electron beams 76, 78 converge very gradually and cross over just prior to entering the field of induction coil 60. The field of induction coil 60 is adjusted such that immediately after crossing over the trajectories of electron beams 76 and 78 are again caused to bend sharply and the beam paths again converge. The fields of induction coils 61 and 62 are adjusted such that beam-path convergence is again very gradual and beam crossover occurs just prior to entry into the field of induction coil 63. The field of induction coil 63 is adjusted such that the electron beam trajectories again bend sharply, causing their paths to again converge. The fields of induction coils 64 and 65 are adjusted such that the convergence is very gradual and beam crossover once again occurs just prior to entry into the field of induction coil 66.

It will be seen from Figure 2 that the angles of convergence become progressively smaller. Convergence angles are thus progressively reduced such that upon entering the field of induction coil 68 the electron beams 76 and 78 are deflected onto parallel paths which are essentially coaxial. The fields of the even-numbered induction coils 58, 60, 62, 64, and 66 are reversed from those of the odd numbered induction coils 57, 59, 61, 63, and 65 such that spiraling of the electron beams in transit is compensated.

The number of induction coils which have been selected to obtain the parallel coaxial result has been selected by way of example and not to serve as a limitation. It will be readily apparent to those skilled in the art that the numbers of inductors in electron-beam excursions necessary to produce essentially coaxial beam paths are flexible and are dependent upon such variable factors as the initial angle of incidence with which electron beams enter the field of influence of joint beam-centering means 25.

In view of the fact that the shaped electron beams 76 and the regular cross-sectional electron beams 78 enter the field of influence of the display deflection means 68 along the common path which is essentially coaxial with the axis of the envelope, the images and other data displayed are accurately aligned at all positions upon the display screen 12. In other words, good registration is provided. Since the electron beams employed are thus effectively projected from a common source, the apparatus is capable of presenting data from two or more sources simultaneously. Although the means whereby the electron beams are deflected to seek a common path is exemplified by a plurality of coils, it is within the skill of those versed in the art to employ electrostatic means for this purpose and such means is included within the scope of this invention.

Accordingly, there has been described and shown herein a novel, useful, and improved cathode-ray tube apparatus which is capable of displaying data simultaneously which is received from a plurality of different data sources. While certain embodiments of the invention have been specifically disclosed, it is to be understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

I claim:

1. Apparatus for the simultaneous display of radar and character presentations, comprising: an evacuated con-

tainer having side by side at one end two different electron beam-producing means, one of said electron beam-producing means including means to generate a first electron beam, a beam-shaping member positioned to intercept said first beam and presenting thereto a plurality of character-shaped apertures whereby a plurality of character-shaped beams are obtained having the shapes of the apertures of said shaping member, means for selecting a desired one of said character-shaped beams, and means for deflecting said selected character-shaped beam toward the center of said container; said other beam-producing means including means to generate a second beam, means to control the intensity of said second beam, and means to deflect said second beam toward the center of said container; means following said two different electron beam-producing means for centering the output beams therefrom in said container, a screen at the other end of said container, and means for deflecting the centered output beams to impinge at a desired location on said screen.

2. In the combination recited in claim 1 wherein said means for selecting a desired one of said shaped beams includes a beam-intercepting member having an aperture large enough to pass one of said character-shaped beams, said beam-intercepting member being positioned to intercept said character-shaped beams, and means for deflecting said plurality of shaped beams until a desired one of said shaped beams passes through said aperture.

3. In the combination recited in claim 1 wherein said means for centering said two output beams in said container include a plurality of induction coils mounted adjacent each other with their axes extending along the center of said container.

4. The combination comprising: an evacuated envelope containing a viewing screen at one end and at the other end means comprising a first electron gun and a cathode for producing a regular-shaped electron beam, and means comprising a second electron gun and a cathode for producing a character-shaped electron beam; and means for causing said electron beams to simultaneously produce a regular-shaped pattern and a character-shaped pattern that are adjacent and maintain substantially the same spatial relationship regardless of where they appear on said viewing screen.

5. The combination comprising: an evacuated envelope having a neck portion at one end and a fluorescent screen at the other end; electron-beam-producing means, comprising a first electron gun and a cathode, positioned in said neck portion, for producing a regular-shaped electron beam, and electron-beam-producing means comprising a second electron gun and a cathode positioned in said neck portion for producing a character-shaped electron beam; means directing said first beam toward the center of said envelope; means directing said second beam toward the center of said envelope; means centering both said beams; and means synchronously deflecting said centered beams to adjacent areas of said screen—whereby said electron beams produce a presentation that simultaneously contains a character-shaped pattern and a regular shaped pattern.

6. The combination comprising: evacuated envelope containing at one end thereof means, comprising a first electron gun and a cathode, for producing a regular-shaped electron beam, and means, comprising a second electron gun and a cathode, for producing a character-shaped electron beam, and containing at the other end thereof a viewing screen; means causing the cross section of said character-shaped electron beam to correspond to a given character; means causing each said beam to be centered substantially coaxially with said envelope, said means comprising a plurality of electron lenses; and means for synchronously deflecting said centered beams onto said viewing screen—whereby said centered beams seem to originate at the same point and are therefore deflected to produce fixedly adjacent patterns that move synchronously across said screen.

7. Display apparatus for causing a specific identifying character to be associated in a fixed spatial relationship with a given movable pattern on the fluorescent screen of a cathode ray tube, comprising in combination: a cathode ray tube; means, comprising a first electron gun and a cathode, positioned at one end of said tube, for producing a regular-shaped electron beam; means, comprising a second electron gun and a cathode, positioned at the same end of said tube for producing a character-shaped electron beam; means causing the cross section of said character-shaped electron beam to correspond to a desired character; means causing the trajectory of each said beam to become substantially coaxial with said envelope, said means comprising a plurality of fixed-strength, magnetically-produced electron lenses; a fluorescent viewing screen positioned at the other end of said tube; and means for identical deflection of said axial beams onto the adjacent areas of said viewing screen—whereby the respective light patterns of said beams move simultaneously while maintaining a fixed spatial relationship.

8. Vehicle tracking apparatus for causing specific identifying characters to be associated in a fixed spatial relationship with respective movable patterns on the fluorescent screen of a cathode ray tube, comprising in combination: a cathode ray tube; means, comprising a first electron gun and a cathode, positioned at one end of said tube, for producing a regular-shaped electron beam; means, comprising a second electron gun and a cathode, positioned at the same end of said tube for producing a character-shaped electron beam; means causing the cross section of said character-shaped electron beam to correspond to a desired character; means causing the trajectory of said pair of beams to become substantially coaxial with said envelope, said means comprising a plurality of fixed-strength, magnetically-produced electron lenses; a fluorescent viewing screen positioned at the other end of said tube; deflection means for identical deflection of said axial beams across said viewing screen—whereby the respective adjacent light patterns of said beams move simultaneously with a fixed spatial relationship; means causing the cross section of said character-shaped electron beam to correspond to a second character; means causing the trajectory of said second pair of beams comprising said second-character-shaped beam and said regular-shaped beam to become substantially coaxial with said envelope, said means comprising said plurality of fixed-strength, magnetically-produced electron lenses; and means, comprising said deflection means, for identical deflection of said axial second pair of beams across said viewing screen—whereby the respective adjacent light patterns of said pairs of beams move simultaneously with a fixed spatial relationship.

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