

[54] MULTIBEAM CATHODE RAY TUBE
UTILIZING D.A.M. GRID

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[58] Field of Search 313/69 R, 70 R, 76,
313/77, 78, 83; 315/13 R, 13 ST

[56] References Cited
UNITED STATES PATENTS

2,449,339 9/1948 Sziklai 315/13

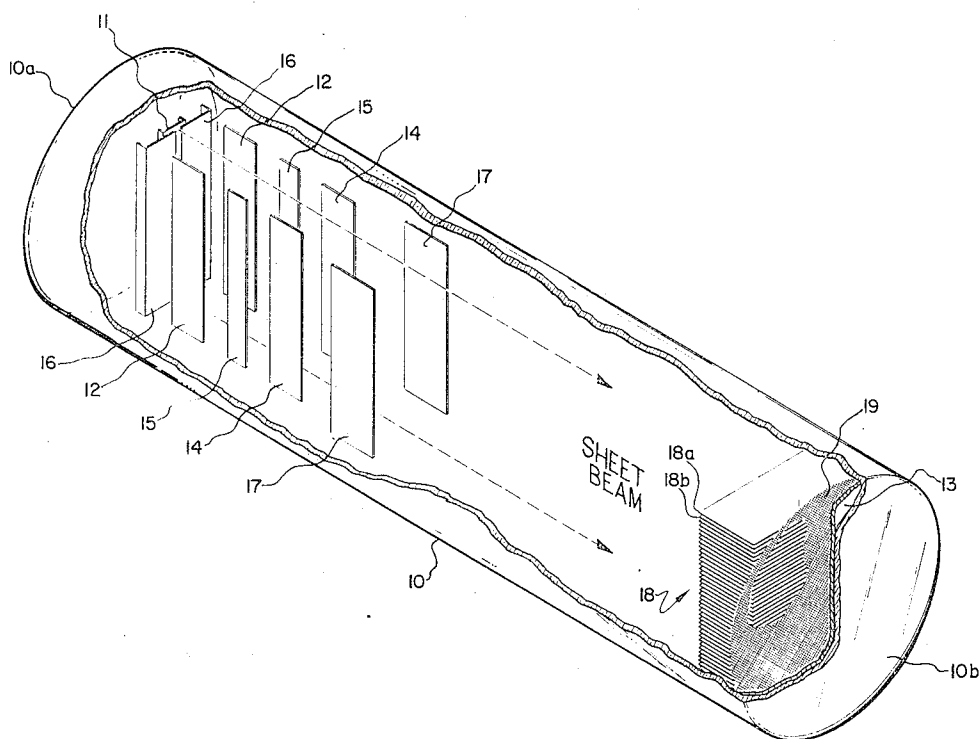
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[57] ABSTRACT

An electron gun within a glass envelope generates a

sheet electron beam which is focussed into a line on a phosphor screen positioned at the output end of the glass envelope. A plurality of parallel metal plates oriented in planes defined by the scan direction and normal to the phosphor screen are positioned within the glass envelope in close proximity to the phosphor screen. The plates are in the direct path of the sheet beam and result in the beam being divided into a plurality of parallel beams of number one less than the plurality of plates. Input signals simultaneously applied to the plates produce intensity modulation of the electron beams by generating electrostatic fields between adjacent plates in accordance with the input signal voltages and thereby control or modulate the fraction of each beam that passes between adjacent plates and reaches the screen. The plates thus function as a divide and modulate (D.A.M.) grid. Deflection coils or plates positioned between the electron gun and D.A.M. grid simultaneously deflect the sheet beam and resultant modulated beams in the scan (beam sweep) direction whereby the input signals can be simultaneously displayed on the screen.

14 Claims, 3 Drawing Figures



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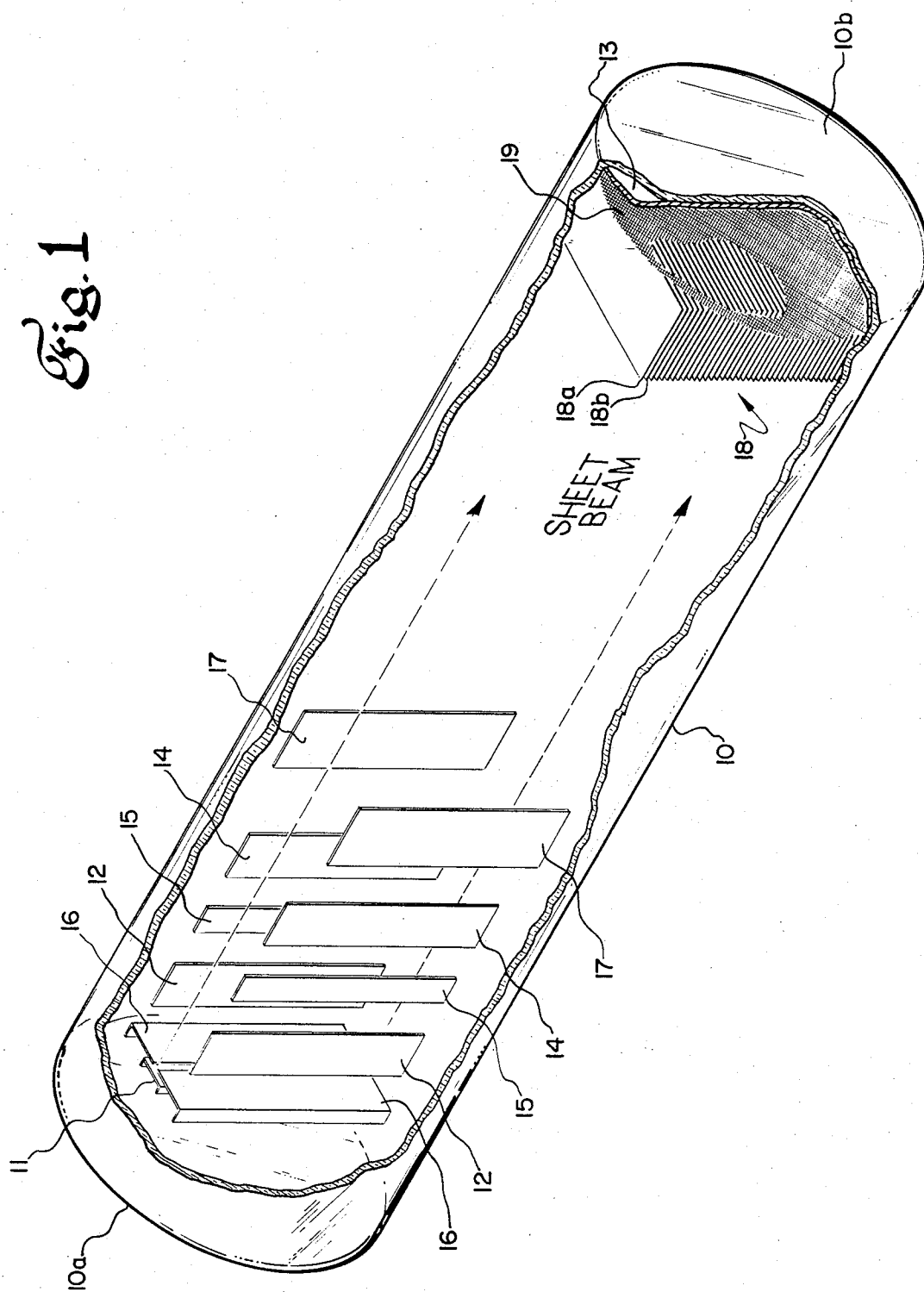


Fig. 2

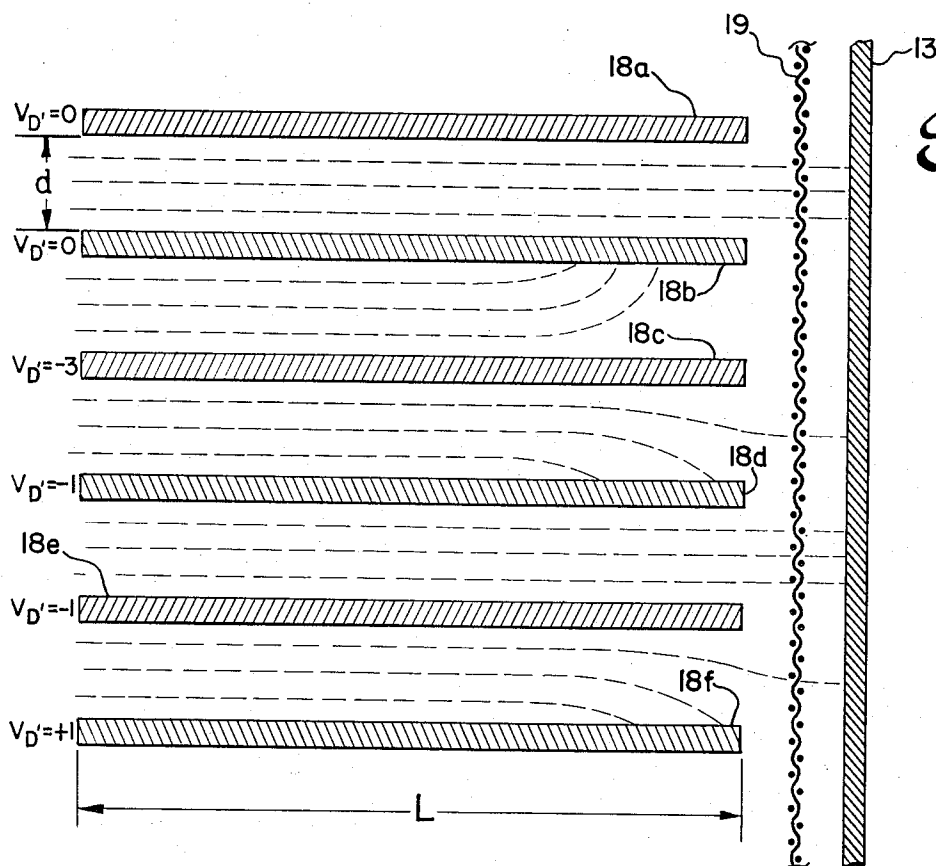
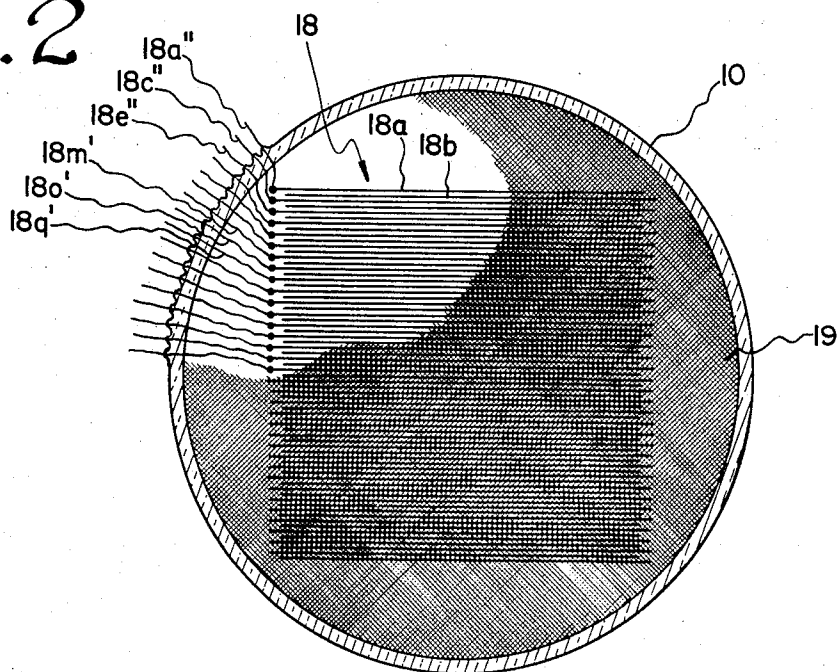


Fig. 3

MULTIBEAM CATHODE RAY TUBE UTILIZING D.A.M. GRID

My invention relates to a visual display device wherein a plurality of parallel electron beams are simultaneously swept across the output phosphor screen of the device to generate one display frame per sweep, and in particular, to a device wherein the plurality of beams are formed external of an electron gun and the visual image on the output screen is erect (i.e., noninverted) relative to the electrical input signals which produce the image.

There are many applications for high-speed, high brightness visual displays of information in two dimensions similar to those of television, but being presented at much higher speed. The use of a single-beam display tube, such as is utilized in television and conventional cathode ray tubes for the higher speed applications results in a severe limitation of the display brightness that can be produced due to the necessarily higher required sweep (scan) speeds, as well as placing stringent frequency response requirements on the display tube input video circuits.

In certain applications, the recent development of miniature sensor devices permits the fabrication of an apparatus comprising a linear array of such sensors which may be ultrasonic piezoelectric detectors or infra-red detectors as two examples. A single scan of such linear array obtains the two-dimensional information required for the display, the output (versus time) of each sensor being associated with a corresponding sweep line on the display tube. The single row of sensors, which may number 100 as one typical example, are simultaneously responsive, but the advantage of such simultaneous operation is obviously limited if the detected signals must be stored and then displayed sequentially, as when utilizing a conventional line-by-line scan single-beam cathode ray tube.

A specific example of an apparatus embodying the above-described single row of multi-sensors is described in a concurrently filed patent application Ser. No. 285,910, entitled "Method and Apparatus for Visual Imaging of Ultrasonic Echo Signals Utilizing a Single Transmitter", inventors John M. Houston and Jack D. Kingsley, and assigned to the assignee of the present invention. Such apparatus may be utilized in medical diagnostics in the examination of human organs undergoing motion, such as a beating heart, and the row of sensors (of the ultrasonic transducer type) are positioned parallel to the front of the patient when obtaining a visual display of a planar slice through the heart from front to back. Each transducer may receive several ultrasonic echo signals at various times corresponding to acoustic heterogeneities internal of the heart at various depths therein. Due to the motion (beating) of the heart, the ultrasonic echo signals must be generated at a sufficiently rapid rate to obtain reasonable resolution of the displayed image and an image that appears flicker-free to the eye of the observer. Although a visual display of the output (versus time) of a row of many simultaneously responsive transducers in which the information signals arrive at a rapid rate, and resulting from a sequential read-out of the transducers which is then presented as a serial input (line-by-line) on a single-beam cathode ray tube, may be satisfactory, it may be desired or necessary to eliminate the signal

storage step and thereby obtain a more rapid presentation of the display, or increased image brightness.

Therefore, one of the principal objects of my invention is to provide a new visual display device which has a high speed of operation.

Another object of my invention is to provide a device which obtains a high brightness of the visual display thereon.

A further object of my invention is to provide the device with a plurality signal input for simultaneously displaying the outputs of a plurality of sensors which develop the input signals without the need for signal storage.

Briefly stated, and in accordance with my invention, I provide a visual display device of the multi-beam type wherein a single sheet electron beam is divided into a plurality of parallel beams which are individually modulated in accordance with input signals. An electron gun generates the sheet beam which is emitted in a plane normal to an output phosphor screen of the device and normal to the beam scan direction. A grid of a plurality of metal plates oriented in planes parallel to the beam scan direction and normal to the phosphor screen, and also normal to the plane of the undeflected sheet beam provides the electron beam divide and modulate (D.A.M.) functions. The grid is aligned with the electron gun and screen and is positioned therebetween in close proximity to the screen and divides the sheet beam into a plurality of parallel beams of number one less than the plurality of plates in the grid. The grid provides intensity modulation of the electron beams by generating electrostatic fields between adjacent plates in accordance with various input signals simultaneously applied to corresponding plates of the grid. These electrostatic fields control or modulate the passage of each beam between adjacent plates and thereby control the fraction of each beam that may reach the screen. An electrostatic or electromagnetic means positioned between the electron gun and D.A.M. grid provides deflection of the sheet beam and the electron beams reaching the screen to obtain simultaneous scans across the phosphor screen whereby the input signals can be simultaneously displayed.

The features of my invention which I desire to protect herein are pointed out with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawings wherein like parts in each of the several figures are identified by the same reference character, and wherein:

FIG. 1 is a perspective view of a preferred embodiment of my multibeam cathode ray tube;

FIG. 2 is an enlarged front view, partly broken away, of the D.A.M. grid and a fine mesh grid located between the D.A.M. grid and phosphor screen, and

FIG. 3 illustrates the operation of the D.A.M. grid in providing the electron sheet beam divide and modulation functions.

Referring now in particular to FIG. 1, there is shown a preferred embodiment of my multibeam cathode ray tube invention which is comprised of a sealed tubular member 10 typically of cylindrical or square cross section. Member 10 may be a glass envelope having an input end 10a near which are located electron sheet

beam forming elements (electron gun), and an output end 10b along which inner surface thereof is deposited or otherwise formed an output phosphor screen 13. Member 10 may also be formed of other materials such as a ceramic or other electrically insulating, nonmagnetic material which is compatible with a low pressure the order of 10^{-5} torr pressure or lower. Although tube 10 is illustrated as being of constant diameter, it can be of smaller width dimension along the input end enclosing the electron gun.

The sheet electron beam forming elements (electron gun) of my visual display device are conventional and provide a means for generating a sheet electron beam which may be described as being a planar beam which is focussed into a straight line on the phosphor screen 13 in its nondeflected state. For purposes of simplicity, the sheet beam will be described herein as being vertical, it being understood that the beam orientation may be horizontal or at angles between horizontal and vertical as determined by the orientation of the electron gun elements. As one typical example, the electron gun elements consist of a vertically elongated cathode 11, a beam width defining electrode 16, two pair of accelerating electrodes 12, 14 and a pair of focus electrodes 15, the elements preferably being fabricated as a single electrically insulated assembly suitably supported in member 10 near the input end 10a thereof and having its center-line axis coincident with the tube 10 axis. Cathode 11 is positioned closest to tube input end 10a, and consists of a uniform electron emitting source. The electron source 11 may be in the form of a directly or indirectly heated electron emitting strip 11 extending vertically across the tube 10 center-line axis a height equal to the height of the desired vertical sheet beam. Since the electron beam emitted from strip 11 may be of nonuniform width greater than the desired width of the sheet beam, a slit electrode 16 is positioned in close proximity to emitter 11 in the direction of phosphor screen 13. The slit in electrode 16 is vertically oriented, and its height and width dimensions substantially define the corresponding dimensions of the sheet beam passing therethrough. The width of the slit may typically be in the range of 0.020 to 0.060 inch, and a height of 3.0 inches for a 3 inch raster on screen 13. Slit electrode 16 is typically operated at a voltage in the range of 0 to -20 volts relative to cathode 11 and also functions to control the magnitude of the sheet beam current.

In one convenient form, electron emitter 11 is an elongated oxide-coated, nickel, U-shaped member as illustrated, with a correspondingly elongated heater adjacent the tube input end 10a of the U-shaped emitter, both oriented vertically for generating a vertical sheet beam. Alternatively, emitter 11 is a directly heated oxide-coated ribbon, also vertically oriented. The oxides utilized in the emitter may be the conventional mixtures of the oxides of barium, strontium and calcium. In the case of an indirectly heated thermionic emitter, the electron emitting element is assumed to be at the device reference potential which may be zero, but can also be some voltage such as -3,000 volts whereby the phosphor screen voltage can then be zero, and inner heater element is connected to a power supply operating at a low voltage typically being 12 volts.

Another means for generating a sheet beam is described in U.S. Pat. No. 3,609,401, inventors L.A. Harris and N.D. Punskey, and assigned to the assignee of the present invention.

A first pair of accelerating electrodes 12 are spaced from slit electrode 16 and comprise vertically oriented parallel plates slightly spaced from each other. A pair of focussing electrodes 15 are spaced slightly from accelerating electrodes 12 in the direction of screen 13, and also comprise vertically oriented parallel plates which typically are spaced apart the same amount as electrodes 12. A second pair of accelerating electrodes 14 are spaced slightly from focussing electrodes 15 in the direction of screen 13, and also comprise vertically oriented parallel plates typically spaced apart the same amount as electrodes 12. The sheet beam passing between electrodes 12, 15 and 14 is thus accelerated (by electrostatic fields developed between electrodes 12 and 16) and focussed (by electrostatic fields developed between electrodes 15) and adjacent electrodes 12 and 14 into a fine vertical line through the center of phosphor screen 13 in this undeflected state of the sheet beam.

A means for deflecting the sheet beam in the beam scan direction (on screen 13), which is horizontal for the present example of a vertical sheet beam, is spaced from accelerating electrodes 14 in the direction of screen 13. The beam deflecting means can be of conventional electro-static or electromagnetic type, and will be described herein with reference to the electro-static type. Thus, the beam deflecting means comprises a pair of vertically oriented parallel plates 17 which are longitudinally spaced a slight distance from plates 14 toward screen 13. Alternatively, the beam deflecting means may be of the electromagnetic type comprising a pair of pancake type coils each circumscribing slightly less than half of the circumference of tube 10, and supported along the outer surface of tube 10 to provide electromagnetic deflection of the beam in the desired (horizontal) direction. Each pair of plates 12, 15, 14, and 17 are symmetrically oriented about the device center-line axis and parallel thereto. Each plate is flat and fabricated of an electrically conductive material, preferably a metal such as nickel or stainless steel, and is of rectangular form. A D.C. voltage typically in the order of 3,000 volts positive, relative to cathode 11, is applied to each pair of accelerating electrodes 12 and 14. Focus electrodes 15 are operated at a D.C. voltage typically in the range of +500 to +2000 volts relative to the cathode. A median D.C. voltage typically of +3000 volts relative to the cathode is applied to both deflecting plates 17 and a sawtooth deflecting voltage in the order of ± 100 volts as one example is applied from the output of a conventional sweep generator across plates 17 for sweeping the sheet beam horizontally back and forth across phosphor screen 13 in the absence of any additional structure. The various voltages are applied to the hereabove-described elements by means of suitably electrically insulated conductors having first ends connected to the respective elements, and second ends connected to terminals passing through the sidewall, or input end 10a wall of tube 10.

In general, phosphor screen 13 is operated at the same potential as accelerating electrodes 14 in order to obtain a relatively electric field-free region therebetween and thereby assure the electrons of the sheet beam continue in a straightline path toward the screen in the absence of any beam deflection. Phosphor screen 13 may be a layer of any suitable phosphor material typically utilized in cathode ray tubes such as zinc cadmium sulfide, willemite or zinc oxide.

The (vertical) sheet beam is divided into a plurality of parallel electron beams by means of a plurality of closely spaced, superposed, parallel rectangular metal plates 18 oriented in planes defined by the beam scan direction, that is, parallel to both the beam scan direction and device center-line axis defined by the aligned center-line axes of the sheet beam generating means and phosphor screen and normal to both the screen 13 and the plane of the sheet beam. The grid of metal plates 18 is supported in tube 10 in alignment with the electron gun and screen 13 and is positioned between deflecting plates 17 and screen 13, and in close proximity to the screen. The plates 18 are each of the same size and are also of flat form, and may be fabricated of the same metal as electrodes 12, 14, 15, 17 and have applied thereto a median D.C. voltage equal to the voltage of screen 13 and accelerating electrodes 14, that is, +3000 volts (relative to the cathode) for the above-recited voltages. Since the grid 18 is in the path of the sheet beam passing from the beam deflecting means 17 to screen 13, and at the same voltage, grid 18 results in dividing the sheet beam into a plurality of parallel beams of number one less than the number of plates in the grid. Thus, in the case of 101 plates, the sheet beam is divided into 100 electron beams of equal beam intensity, assuming plates 18 are equally spaced apart.

The visual image formed on phosphor screen 13 results from electrical signals obtained from a plurality of signal sources such as simultaneously responsive sensors which, as mentioned hereinabove, may be a single row of ultrasonic transducers utilized in an apparatus for medical diagnostic applications such as the examination of the beating human heart with the ability of viewing its motion as well as internal portions thereof such as the valves, arteries, etc. The visual image is obtained in erect (i.e., noninverted) form on the phosphor screen 13 by intensity modulation of the plurality of parallel electron beams formed (divided) by grid 18 in accordance with the electrical input signals obtained from the transducers which are time-discriminated, that is, each transducer may develop several signals at slightly different times corresponding to the ultrasonic echo signals received from different depths of the heart. It is assumed that the plurality of transducers is equal in number to the plurality of electron beams formed by grid 18 and the outputs of the transducers are serially connected to corresponding grid 18 plates with each plate, except the two outer ones, being common to the outputs of two adjacent transducers. The input electrical signals (from the transducer outputs) are supplied to the grid 18 plates such that each transducer voltage signal applied to adjacent plates of the grid 18 causes intensity modulation of the electron beam passing therebetween in accordance with that transducer voltage signal magnitude.

As illustrated in FIG. 2, the input signals from the transducers are supplied to the grid plates 18a, b, - by means of a plurality of insulated electrical conductors equal in number to the plurality of grid plates and having first ends correspondingly connected (such as by spot-welding) to the grid plates and having second ends correspondingly connected to separate terminals passing through the sidewall of tube 10 and preferably symmetrically arranged around the circumference thereof. For purposes of ease of connection, and to readily attain the circumferential terminal arrangement, the input signal conductors are connected to alternate

sides of the grid plates 18a, b, ... Thus, alternate grid plates 18a, c, e, . . . are connected by means of conductors 18a', c', e', . . . to terminals 18a'', c'', e'', ... However, for purposes of minimizing line cross-over in the drawing, three of the alternate conductors are identified in FIG. 2 as 18m', o', q' and three terminals associated with three other alternate conductors are identified as 18a'', c'', e''. The separate grid terminals have the advantage of providing a lower electrical capacitance. Alternatively, the grid conductors may be bundled together in insulated relationship and passed through the side wall of tubular member 10 as one thick multi-conductor member but this approach may present difficulties in accomplishing as well as increasing the capacitance. Assuming a 100 beam cathode ray tube with a circumference of 4.5 inch, the 101 grid terminals are symmetrically arranged to be approximately 140 mils apart which presents no problem in fabrication. The multibeam cathode ray tube preferably mates with a socket also having 101 connections for supplying the 100 electrical input signals to the 101 grid plates from 100 transducers. This specific example of my multibeam cathode ray tube would thus be utilized to display the output (versus time) of a single row of 100 sensors wherein each (ultrasonic) sensor or transducer receives information (ultrasonic echo signals) at rates as high as several separate signal levels per microsecond. A conventional single-beam cathode ray tube requires an intermediate, time-consuming, signal storage step to display these high speed signals sequentially. Thus, signals which may be arriving simultaneously at the grid 18 inputs of my multibeam cathode ray tube from the different transducers can be simultaneously displayed, a capability not possible for a single-beam tube.

For most applications, there would be a minimum of 20 sweep or scan lines simultaneously developed on the output phosphor screen 13 in order to obtain a reasonable image resolution, thereby requiring at least a corresponding 21 plate grid 18. However, I visualize the use of considerably more than 20 sweep lines in most applications, a general application having in the range of 50 to 100 sweep lines and an upper limit of approximately 1000, the number of sweep lines being governed primarily by the desired resolution and size of the visual display to be presented as well as by the ability to retain the grid plates 18 in equally and closely spaced relationship.

The operation of grid 18 for achieving intensity modulation of the electron beams passing therethrough will now be explained with reference to FIG. 3. A fine mesh suppressor grid 19 of an electrically conductive material is positioned between the end of the divide-and-modulate (D.A.M.) grid 18 and screen 13, and is operated at a D.C. potential in the range of -40 to -50 volts relative to the screen 13 and grid 18 and functions to prevent slow secondary electrons which may be generated in the D.A.M. grid 18 from reaching screen 13. Suppressor grid 19 is flat and oriented parallel to the back (output end) edges of the grid plates 18a, b, . . . and is of size to at least superpose the entire surface presented by the back edges of grid plates 18a, b, ... Thus, only electrons traversing the narrow spaces between the grid 18 plates can reach the screen 13 to produce a spot of light thereon. Modulation of the light intensity produced by any one electron beam impinging on screen 13 is obtained by the application of a beam deflecting voltage V_D across the corresponding two

bounding plates of grid 18 wherein the deflecting voltage results from the output of the corresponding transducer in the hereinabove described single row array of transducers. The deflecting voltage generates an electrostatic field of intensity and direction determined by the magnitude and polarity of the corresponding signal voltage applied between the two bounding plates, and such field causes a fraction or all of the beam to deflect onto one of the bounding plates (assuming the deflecting voltage is other than zero) and therefore not reach screen 13.

Five separate examples of the electron beam intensity modulation obtained in grid 18 are illustrated in FIG. 3. Thus, a zero deflecting voltage $V_D = 0$ applied across adjacent plates 18a and 18b (and 18d and 18e) resulting from the equal voltages $V_D = 0$ applied to plates 18a, 18b and $V_D' = 1$ applied to plates 18d, 18e results in none of the beam(s) passing therebetween from being deflected, and the entire beam(s) pass to screen 13. A slight deflecting voltage $V_D = +2$ applied across adjacent plates 18c and 18d (resulting from plate voltage $V_D' = -3$ volts and -1 volt, respectively) and applied across adjacent plates 18e and 18f ($V_D' = -1$ volt and $+1$ volt, respectively) results in a proportional fraction of the beams being deflected (to the more positive polarity plate) and not reaching screen 13. Finally, a substantial deflecting voltage $V_D = -3$ applied across adjacent plates 18b and 18c ($V_D' = 0$ and -3 volts, respectively) results in the entire beam being deflected (to more positive plate 18b) and not reaching the screen. Thus, the noninverted image formed by the intensity modulation of the electron beams within grid 18, and their deflection in the scan direction by the deflecting plates 17, is similar to that of a photographic negative in that the input signals are represented on the screen raster as dots of total, or partial, absence of light depending on the differential signal magnitudes. The image formed on screen 13 can be positive, that is, the input signals can be represented on the screen as dots of light of varying intensity including maximum intensity for a maximum input signal by applying small fixed deflecting voltages between the plates so that the beams are normally deflected to the plates and do not reach the screen in the absence of input signals from the transducers.

Since each plate (except the two outer ones) of grid 18 is common to two adjacent electron beams, the transducers (or more correctly, the amplifiers connected to outputs of corresponding transducers) which supply the input signals to the grid plates must have their outputs connected in series. To avoid having the grid 18 voltages departing very far from the median voltage ($+3000$ in the example), the transducer amplifiers have their outputs being of alternate voltage polarity whereby the electron beams between each adjacent pair of grid 18 plates are deflected in alternating directions in order to cut off their beams as depicted in FIG. 3.

The length dimension L, of the D.A.M. grid plates is determined from the equation:

$$V_D/V_0 = 4d^2/L^2$$

where d is the minimum deflection required to cut off a beam completely (which must take place in the distance L); V_D/V_0 is of the order of 10^{-3} ($V_0 = 3000$ volts, the grid median voltage, and $V_D = 3$ volts, the maximum deflecting voltage between adjacent grid plates ob-

tained from a solid-state circuit). Thus, for $d = 0.030$ inch (assuming a 3 inch raster with 100 lines), then $L/d = 63$ resulting in $L = 1.89$ inch (and the spacing between adjacent plates is d).

The use of such relatively large plates in grid 18 produces a relatively high capacitance which must be charged by the modulating circuits. The capacitance between adjacent plates is:

$$C = \epsilon_0 R \quad 4V_0/V_D$$

where R is the raster size and ϵ_0 is a constant representing the permittivity of free space. For the raster size $R = 3$ inches, and $V_0/V_D = 3000$, $C = 42.5$ picofarad. Assuming that the video (input signal) voltage must change by 3 volts in 10^{-7} seconds, the charging current is 1.28 milliampere and the maximum instantaneous modulating power per beam is 4 milliwatts, which are readily attainable with present solid-state circuits.

From the foregoing description, it is apparent that my invention attains the objectives set forth and makes available a new visual display device which has the capability of simultaneously displaying the outputs of a plurality of sensors without the need for memory circuits or other special signal processing. My device has a high speed of operation due to the simultaneous generation of all of the sweep lines on the output phosphor screen, that is, one complete display frame is formed per sweep. Since the electrical signals to be displayed as a visual image on the phosphor screen are supplied to the multi-inputs (grid 18) of my tube simultaneously, instead of sequentially as required by the line-by-line scan on conventional single beam cathode ray tubes, in some applications the sweep speed in my tube may be reduced compared to the sweep speed required for a corresponding display on the conventional single-beam tube, thereby increasing the brightness intensity of the visual display and also relaxing the bandwidth requirements of the circuits providing the input signals to the plates of the D.A.M. grid. My device is therefore adapted to display the input signals in substantially real time and the high speed of operation permits the viewing of objects in motion such as that of the beating human heart.

Having described a preferred embodiment of my invention, it should be apparent to those skilled in the art that various changes may be made without departing from the scope of my invention. Thus, the electron gun may be of any conventional type suitable for generating a sheet beam, and the D.A.M. grid plates need not be of rectangular form as long as they provide equal length paths L across the plates, i.e., each plate can be defined along the input and output edges thereof by parallel curves. Thus, it is to be understood that changes may be made in the particular embodiment of my invention as described which are within the full intended scope of the invention as defined by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A multibeam visual display device comprising means for generating a sheet electron beam, a phosphor screen positioned in alignment with said sheet electron beam generating means and spaced a substantial distance therefrom in the direction of electron beam emission therefrom, means positioned between said phosphor screen and said sheet electron beam generating means for ac-

celerating the electrons in the sheet beam and focussing the beam on said phosphor screen, a grid consisting of a plurality of superposed parallel electrically conductive plates positioned between said accelerating and focussing means and said phosphor screen and aligned therewith, said parallel plates oriented normal to the plane of the sheet beam and parallel to the device center-line axis defined by the aligned center-line axes of said sheet beam generating means and said phosphor screen whereby the sheet beam in its passage through said grid is divided into a plurality of parallel electron beams of number one less than the plurality of plates, said grid positioned in close proximity to said phosphor screen and adapted to have electrical input signals applied thereto from a plurality of signal sources such as simultaneously responsive transducers of number equal to the plurality of electron beams, said signal sources providing the electrical input signals which are in time-spaced form and which intensity modulate the electron beams in their passage within the grid, and means positioned between said accelerating and focussing means and said grid for deflecting the sheet beam in a direction perpendicular to the plane of the sheet beam in its nondeflected state to thereby simultaneously deflect the plurality of intensity modulated electron beams in a like direction and thereby form on said phosphor screen a raster of a like plurality of simultaneously generated sweep lines intensity modulated by the electrical input signals to form a resultant visual image corresponding to the input signals wherein the spacings between intensity modulated points along each sweep line are in accordance with the time-spacings of the signals provided by a corresponding one of the signal sources.

2. The multibeam visual display device set forth in claim 1 and further comprising
 a sealed tubular member having input and output ends and fabricated of an electrically nonconductive and nonmagnetic material,
 said sheet electron beam generating means supported within said tubular member adjacent the input end thereof,
 said phosphor screen supported within said tubular member at the output end thereof, and
 said grid supported within said tubular member.

3. The multibeam visual display device set forth in claim 1 wherein
 said accelerating and focussing means is of the electrostatic type and is adapted to be operated at relatively high positive potentials relative to said sheet beam generating means.

4. The multibeam visual display device set forth in claim 2 wherein
 said electron beam deflecting means is of the electromagnetic type and is supported around the outside of said tubular member.

5. The multibeam visual display device set forth in claim 2 wherein
 said electron beam deflecting means is of the electrostatic type and is supported within said tubular member.

6. The multibeam visual display device set forth in claim 2 and further comprising

a plurality of electrically conductive terminals equal in number to the plurality of grid plates and passing through a side wall of said tubular member, and
 a like plurality of insulated electrical conductors having first ends connected to corresponding said grid plates and having second ends connected to corresponding said terminals whereby the plurality of input signals are applied to said grid plates by means of said terminals and electrical conductors.

7. The multibeam visual display device set forth in claim 6 wherein
 said plurality of terminals are symmetrically arranged around the circumference of said tubular member.

8. The multibeam visual display device set forth in claim 2 wherein
 said sealed tubular member is fabricated of glass and is evacuated to a relatively low pressure in the order of 10^{-5} torr or lower.

9. The multibeam visual display device set forth in claim 1 wherein
 said grid consists of at least 21 equally spaced apart said plates, and
 the resultant visual image formed on said phosphor screen in the case of the simultaneously responsive transducers corresponds to sensed time-spaced signals received thereby and converted into the time-spaced electrical input signals wherein the spacings between intensity modulated points along each sweep line are in accordance with the times of arrival of the sensed time-spaced signals at a corresponding one of the transducers.

10. The multibeam visual display device set forth in claim 1 and further comprising
 a fine mesh grid positioned between said parallel plate grid and said phosphor screen for preventing slow secondary electrons which may be generated in said parallel plate grid from reaching said phosphor screen.

11. The multibeam visual display device set forth in claim 1 wherein
 the grid plates are closely spaced in equally spaced apart relationship.

12. The multibeam visual display device set forth in claim 1 wherein
 the grid plates are each of the same size.

13. The multibeam visual display device set forth in claim 1 wherein
 the grid plates are each of rectangular shape.

14. The multibeam visual display device set forth in claim 1 wherein
 the grid plates are operated at a median D.C. potential substantially equal to the D.C. potential of said phosphor screen relative to said sheet beam generating means,
 said grid plates are each of the same size and in equally spaced apart relationship, and
 the length dimension L of each grid plate is determined from the equation

$$V_d/V_0 = 4d^2/L^2$$

where d is the spacing between adjacent plates, V_d is the deflection voltage between adjacent grid plates, and V_0 is the median D.C. potential of the grid plates relative to the cathode.

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