

March 16, 1965

J. R. STONE ETAL

3,173,745

IMAGE PRODUCING DEVICE AND CONTROL THEREFOR

Filed June 15, 1960

2 Sheets-Sheet 1

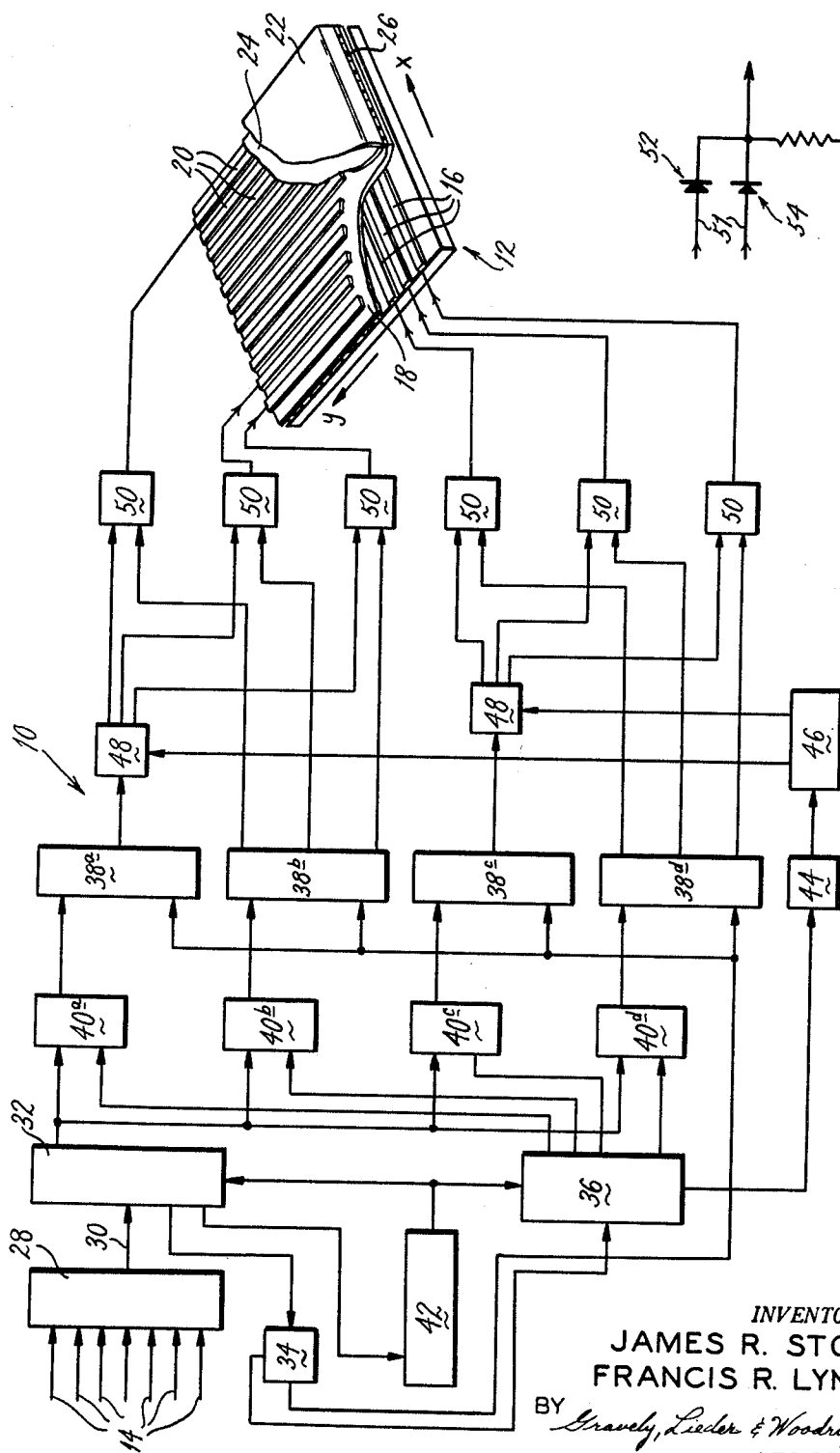


Fig. 1.

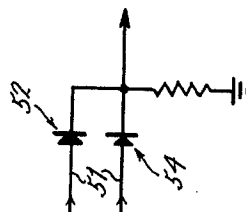


FIG. 4.

INVENTORS
JAMES R. STONE
FRANCIS R. LYNCH
BY *Gravely, Lieder & Woodruff*
ATTORNEYS

March 16, 1965

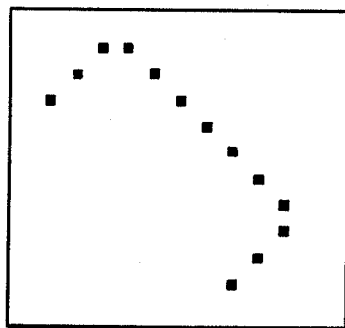
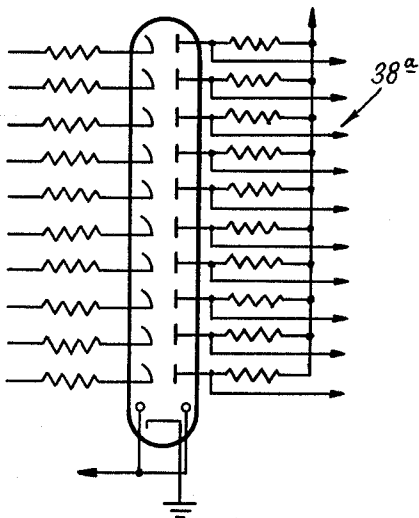
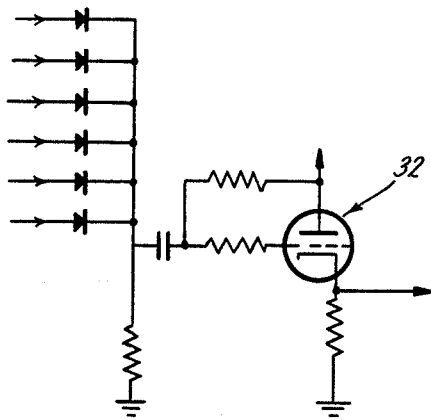
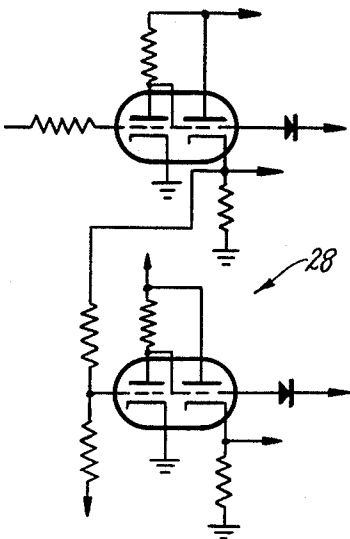
J. R. STONE ETAL

3,173,745

IMAGE PRODUCING DEVICE AND CONTROL THEREFOR

Filed June 15, 1960

2 Sheets-Sheet 2



INVENTORS
JAMES R. STONE
FRANCIS R. LYNCH
BY *Gravelly, Lieder & Woodruff*
ATTORNEYS

1

2

3,173,745

IMAGE PRODUCING DEVICE AND CONTROL THEREFOR

James R. Stone, Florissant, and Francis R. Lynch, Richmond Heights, Mo., assignors to McDonnell Aircraft Corporation, St. Louis, Mo., a corporation of Maryland
Filed June 15, 1960, Ser. No. 35,260
17 Claims. (Cl. 346—107)

The present invention relates to image producing devices in general and more particularly to an electrical image producing device such as a plotter or display device and to the control means therefor.

Many image producing devices such as plotters and display devices and many methods of producing images in graphical and other forms have been devised in the past. Some of the known devices have been electrical and some have also employed luminescent means for reproducing and recording the results. For the most part, however, the known devices are slow and tedious to operate, are relatively inaccurate being subject to human errors, are manual, and have not been able to automatically interpret and handle digital information and use such information directly in the producing of a graph or display. Furthermore the known devices must receive information in an orderly or preplanned arrangement to be efficient which is not true of applicants' device. For these and other reasons the known devices have been unsatisfactory.

The present invention overcomes these and other disadvantages and inaccuracies of the known devices by teaching the construction and operation of an extremely high speed device, such as a plotter, capable of handling digital, as distinguished from analog information, capable of producing visual images and permanent photographic records therefrom in the form of graphs or other displays, and capable of handling and using information in random order.

It is therefore a principal object of the present invention to provide high speed automatic means for making graphs or other images from digital information.

Another object is to increase the accuracy of graph plotting.

Another object is to provide electrical or electronic means for energizing selected members in a grid structure to produce a luminescent image from digital information.

Another object is to make a permanent record of an image formed by electrical impulses used to momentarily energize angularly arranged elements in an electroluminescent grid structure.

Another object is to provide relatively simple and inexpensive means for selecting and energizing elements of an electroluminescent structure with impulses representing digital information to produce an image thereon.

Another object is to provide graph making means capable of receiving information from known and available computers, storage, devices, tape devices and other sources of digital information.

Another object is to provide means for making a visible image from digital information which operates at the same speed and accuracy regardless of the order in which the input digital information is received.

Another object is to provide means for plotting digital information which are compatible with known computing machines, digital storage and read out devices, tape read out means and other sources of digital information.

Another object is to provide improved means for handling and using digital information in the forming of images such as graphs and charts representative thereof.

These and other objects and advantages of the present

invention will become apparent after considering the following detailed specification which covers a particular embodiment of the present invention in conjunction with the accompanying drawings, wherein:

FIG. 1 is a schematic block diagram of an image producing device including a control network therefor constructed according to the present invention;

FIG. 2 is a schematic wiring diagram of a typical buffer circuit employed with the network of FIG. 1;

FIG. 3 is a schematic wiring diagram of a typical translator circuit of the same control network;

FIG. 4 is a schematic wiring diagram of a typical gate circuit employed in the control network of FIG. 1;

FIG. 5 is a schematic wiring diagram of a typical register circuit for the same control network; and

FIG. 6 is an enlarged plan view of a photograph showing a graph plotted thereon by the subject device.

Referring to the drawings by reference numerals, the number 10 indicates a control network for energizing a graph plotting device such as grid structure 12. The network 10 is energized at the input leads 14 by digital information such as impulses which are available at the output of a computing machine, storage unit, tape device or other digital emitting device. The impulses can be in binary coded decimal form or any other suitable form. The digital information enters the network 10 and is interpreted and handled by various interconnected circuits in the network 10 and the output therefrom is used to energize the grid structure 12 to produce an image as will be shown.

The grid structure 12 is formed by a plurality of spaced parallel conductors 16 which extend thereacross in a layer in one direction. A layer of electroluminescent material 18 such as a layer of phosphor or the like is positioned adjacent to the layer of conductors 16 and another layer of spaced parallel conductors 20 are positioned adjacent the opposite surface of the layer 18 and are spaced by said layer 18 from the layer of conductors 16. The conductors 20 extend at an angle to the conductors 16, and for illustrative purposes the angle is shown as being a right angle. The conductors 20 are formed of relatively thin light conductive material for reasons which will become apparent hereinafter. For illustrative purposes the conductors 16 will be considered herein as being parallel to the x-axis of an x-y coordinate system and the conductors 20 as being parallel to the y-axis. The number and size of the conductors 16 and 20 can be varied depending on the size and number of digits to be plotted on each axis, the detail required to be shown, and the size and shape of the image to be produced. In FIG. 1 the size of the grid 12 and the size, number and spacing of the conductors has been intentionally enlarged for illustrative purposes.

A film housing 22 (FIG. 1) is hingedly mounted on the grid 12, and a film 24 is positioned in the housing in intimate contact with the grid 12 adjacent the transparent conductors 20. A hinge device such as the hinge 26 may be provided for raising and lowering the film housing 22 when installing and removing film 24. During operation of the device, the film 24 is positioned in the housing as described.

In order to expose the film 24 and form a graphical image thereon, selected pairs of the crossed conductors 16 and 20 are simultaneously energized by electrical impulses. When two crossed conductors are energized by suitable electric impulses the photo emissive phosphor layer 18 between the cross over point of the particular energized conductors is excited to brightness and forms a spot of light which is recorded on the film 24. By energizing a plurality of said cross over points at different locations according to the digital information fed into the

leads at 14, a graph can be produced on the film 24. The speed at which the graph is made depends substantially entirely on the speed that the input information is fed into the network 10 at leads 14 and to a lesser extent of the speed of the network 10 itself. It will now be explained more in detail how the network 10 operates.

The network 10 is made up of a number of interconnected circuits including a plurality of buffer circuits 28, a typical one of which is shown in FIG. 2. Each buffer circuit 28 has a plurality of the input leads 14 which are connected at their opposite ends to the output of a computer, a storage unit, or some other suitable source of digital information (not shown). The information fed to the buffers 28 is in the form of control and digital impulses which correspond to particular grid conductors 16 and 20 to be energized. If, for example, the grid 12 has 100 conductors 16 extending parallel to the x-axis and 100 conductors 20 parallel to the y-axis, then it will be necessary to feed into the buffers 28 four digits; two of which correspond to the units and tens digit positions representing a particular x conductor and two of which correspond to the unit and tens digits representing a particular y conductor. For example, the conductors can be represented by pairs of digits such as 00, 01, 02, 03 . . . 10, 11 . . . 22, 23 . . . to 99 in both directions. The number of conductors in both directions, as indicated, can be increased or decreased depending upon the requirements of the graphs and the number of points to be plotted, and the basic circuits forming the network 10 can be expanded or reduced as required. In FIG. 2 is shown a typical one of the buffer circuits 28 in an actual model which includes six similar buffer circuits. The buffer circuit 28 amplifies and complements the incoming digital impulses and passes this information along to other circuits. The operation of the buffer involves well known electronic principles and need not be described in detail.

The outputs of the buffer circuits 28 are fed by a plurality of leads 30 to a translator circuit 32. The translator circuit 32 has means therein which recognize certain input impulses and use of them to establish control conditions for passing along the digital information. A control digit usually accompanies and precedes the digital information corresponding to a particular point to be plotted and is used to energize a reset generator 34. When energized the reset generator 34 emits an impulse that causes a digit counter 36 and a plurality of registers, such as registers 38a, 38b, 38c and 38d, to reset and clear out information previously stored therein. After the registers are cleared, the translator 32 proceeds to feed the digital information that follows the control impulse to the several registers 38a, 38b, 38c and 38d. The registers are controlled to receive the digital information by the counter 36 and also by a plurality of associated gate circuits 40a, 40b, 40c and 40d.

After a digit is read into and stored in each of the registers 38a, 38b, 38c and 38d, other circuits are energized to transfer this information to the proper conductors 16 and 20 of the grid 12. Bear in mind that two digits are required to represent each conductor 16 and 20 in a 100 conductor square grid. This is accomplished using a plurality of gate circuits, signal generators or oscillators, and associated controls therefor.

To more fully understand the operation of the present device and the functions of the circuits involved, consider by way of example the operations involved in plotting a point corresponding to the particular input information "P-2-7-1-9." In the example, "P" represents a control impulse, the digits "2" and "7" represent a particular one of the conductors 20, and the digits "1" and "9" represent a particular one of the conductors 16. The subject input information "P-2-7-1-9" is represented by impulses appearing on input leads 14 of the buffer circuits 28.

The input impulses P-2-7-1-9 arrive at the buffer circuits 28 and are amplified and complemented by known electronic means and are fed to the translator circuits 32.

The translator circuits include means therein that recognize the control impulse "P" as being the reset command and respond thereto by providing an output to energize the reset generator 34. Thereupon the reset generator 34 emits an output signal which energizes and resets the digit counter 36 to an initial or starting position. The reset generator 34 also emits an output signal to clear any information that may still be in the registers 38a, 38b, 38c and 38d.

After the control impulse "P" has performed the above described operations, the digital information in the form of impulses representing the four digits which identify the conductors to be excited are received into the translator circuit 32 and are fed therefrom to the registers. In the example, the digit impulse "2" is the first to be received and is also the first to be fed out of the translator 32. While the digit "2" impulse is being fed out of the translator circuit 32 and into the register there is produced a pulse which energizes a so-called "one-shot" generator circuit 42. Thereupon the one-shot generator emits a control impulse which is used to control the output of the translator circuit 32 and assures that all digit impulses representing the particular digit, in this case digit "2," are received by the translator 32 before being decoded and read out. Thereafter, the translator emits an output signal on a lead assigned to the digit 2. In the drawing only one of the many leads into and out of the translator 32 and other circuit components is shown for illustrative purposes and it is to be understood that there are actually many such leads in order to accommodate all of the possible digits.

The translator output on lead 2 is fed to all four of the gate circuits 40a, 40b, 40c and 40d. However, the gate circuits 40 are controlled by the setting in the digit counter 36, and at this time with the counter 36 still in its initial setting position, only the gate circuit 40a is able to receive and pass the digit "2" information to the associated register 38a where it is retained for later purposes.

The "one-shot" generator 42 also generates a delayed impulse which energizes the digit counter 36 after the digit "2" information has been read out of the translator 32. The delayed impulse is used to advance the counter 36 to its second setting position. This energizes the second gate 40b which is associated with the register 38b in preparation for the read out from the translator 32 of the digit "7" information. Therefore, with the digit "2" already stored in the register 38a, circuits are established to read into the register 38b information representative of the second digit, namely the digit "7."

The second digit being a "7" is represented in the binary coded decimal system by pulses appearing in the input to the translator on the leads "1," "2," and "4." After amplification and decoding the second digit information, the information is fed to the inputs of all four gates 40a, 40b, 40c and 40d. However, only the gate 40b is able to pass the information to the register 38b because the digit counter 36 is in its second setting position. Again the "one-shot" impulse has a delayed portion which advances the digit counter 36, this time to its third setting position. Digits are now stored in registers 38a and 38b corresponding to the two digits needed to identify and energize one of the conductors 20, and circuits are established to read the third digit into the register 38c. The third and the fourth digits, namely "1" and "9" respectively, are read into their respective registers 38c and 38d in a similar way to the first two digits, and together they represent one of the conductors 16.

When the fourth digit is being stored in the register 38d, the digit counter 36 is again advanced by a delayed one-shot impulse from the generator 42. This time the counter 36 moves to its fifth setting position and energizes another impulse generator 44. The generator 44 thereupon emits an impulse that energizes a gated oscillator circuit 46. The circuit 46 generates impulses that are

fed through circuits established by the registers 38 to appropriate conductors 16 and 20. In an actual device the oscillator circuit 46 generates two square wave output signals for an interval of approximately 400 microseconds duration and at a frequency of about 25 kilocycles. The oscillator 46 also generates the two output square wave signals mutually 180° out of phase, and each of the oscillator output signals is fed to a different set of gate circuits 48. One set of the gate circuits 48 is associated with circuits for feeding the conductors 20 and the other with circuits for feeding the conductors 16. Therefore, the signals reaching the particular conductors 16 and 20 representing the spot to be illuminated are out of phase.

The gate circuits 48 and the other gate circuits employed in the network 10 may be two legged gate circuits of the type shown in FIG. 4 wherein each has two inputs, one being connected to the output from one of the registers 38a and 38c, and the other being connected to the associated oscillator output.

The outputs from each of the gate circuits 48 are applied to as many as 10 different output gate circuits 50. The output gates 50 are similar in construction to the gates 48 in that they have two input connections and one output connection (FIG. 4).

One of the input connections to each of the gates 50 is connected to the output of one of the gates 48, and the other input to each of the gates 50 is connected to the outputs of the associated registers 36b and 38d which represent the units digit for each of the conductor positions. The selected gates 50 pass electric impulses to the conductors associated therewith corresponding to the particular digits stored in the associated registers.

As previously noted one signal from the oscillator 46 is applied to the gates associated with the registers 38a and 38b and another signal from the oscillator 46, which is out of phase with the aforementioned oscillator signal, is applied to the gates associated with the registers 38c and 38d. Also the output of the gates 50 associated with the registers 38a and 38b are connected to the grid conductors 20 and the output of the gates 50 associated with the registers 38c and 38d are connected to the grid conductors 16. Therefore, the oscillator signals applied to the conductors 20 are out of phase with the signals applied to the conductors 16, and this condition is necessary in order to energize the phosphor layer 18 and produce a spot of light. This means that a light spot will only be produced at the cross-over location of a conductor 16 and 20 when the particular conductor 16 and the particular conductor 20 are simultaneously energized by out of phase signals. This is so because it requires the voltage difference produced by the out of phase voltages on the two crossed conductors to excite the phosphor layer 18 to produce light. The total time required to produce a light spot is less than one millisecond.

The particular type of gate circuit shown and described herein has been used successfully in an actual plotter constructed according to the present invention. It will be readily apparent, however, that other equally suitable gates could also be used. Furthermore, in an actual test model semiconductor diodes were used in the various gates in order to conserve space. Those skilled in the art will readily recognize these gates as being negative "and" gates. The principle of operation of a typical "and" gate will be described hereinafter in connection with the circuit of FIG. 4.

The gate of FIG. 4 has a pair of input leads 51, each with a semiconductor diode 52 and 54 connected therein. The polarity of the diodes is such as to result in easy conduction therethrough when a positive voltage is applied, and a positive input will result in substantially the same voltage being at the output. If, however, the input voltage applied to diode 54 is lower than the input voltage applied to diode 52 no current will flow in diode 54 because it will then be biased into a non-conducting condition by the higher voltage on the other diode 52. Therefore, the output voltage under this condition of the

gate must necessarily be substantially the same as the higher or more positive input voltage. Therefore, if we define an input signal as being a reduction in positive input voltage from some quiescent level, there can only be an output signal, that is to say a reduction in positive output voltage, when the same reduction in the input signal is present on both inputs or when the higher of two input signals is reduced.

The same principle can be expanded to a gate circuit having a greater number of inputs, as for example the circuit shown in FIG. 3, which illustrates one section of the translator 32. The gates 40a, 40b, 40c, 40d, 48, and 50 can all be similar in construction to the two legged gate circuit shown in FIG. 4.

Applying the principle of the gate to the gates 48, it will be apparent that if the particular digit stored in the register 38a is 2, then the digit "2" gate in the gate circuit 48 will have a low voltage on its input and all of the other 9 gates representing the other possible digits in gate 48 will have relatively higher voltages applied thereto. Now, if the output signal from the oscillator 46 varies between voltages that are greater than the voltage supplied to the digit "2" gate from the register 38a and less than the voltage applied to the input to the other digit gates from the register 38a, then the digit "2" gate will be the only gate with a signal on the output and this in turn will be the only gate with a signal applied to an output gate 50. The same applies to the other gates 48. Likewise only the gate 50 which has received the digit "2" signal and that also receives a digit 7 impulse from the register 38b will pass a signal on to a conductor 20, and only the gate 50 which receives a signal "1" from the register 38c and also a signal "9" from the register 38d will energize a conductor 16.

Only a portion of the overall circuitry necessary to produce an image on a one hundred conductor grid are shown in the drawings to illustrate the invention.

FIG. 2 shows a schematic diagram of one of a plurality of buffer circuits 28 employed in the present device; and FIG. 5 shows schematically the circuit of one of the registers such as register 38a. These circuits operate on known principles, and it is not deemed necessary to describe their structures and operations in detail.

FIG. 6 is an enlarged view of a photograph showing a graph formed by a plurality of points plotted photoelectrically by the present device.

It should be noted that one of the advantages of the present device is that it can plot points in any random order or arrangement with equal speed and equal facility, which is not true of known plotting devices and it can do so using known and available digital equipment.

For reasons of simplicity and clarity, a relatively small portion of the grid 12 and the associated circuitry therefor has been shown and described herein. It is obvious however, that the size and number of conductors and associated circuits can be greatly expanded without changing the principles of this invention. Furthermore, the particular circuitry chosen to illustrate the invention has been selected for convenience, and it is to be understood that many different electrical and electronic devices such as vacuum tubes, relays, rectifiers and similar devices could be used and are clearly anticipated. Still further, it is contemplated to expand the capacity of the present device to accommodate greater numbers of grid conductors, and therefore greater numbers of possible plotting points, and it is also contemplated to energize certain grid conductors at more than one cross-over point with the conductors in the other layer in order to make grid lines at preselected locations as required.

Thus it is apparent that there has been shown and described novel means for making a graphical representation from digital information. Said means comprises an electroluminescent panel having two spaced layers of parallel conductors extending in different directions, and a layer of electroluminescent material positioned there-

between, one of said layers of conductors being transparent, and means for simultaneously energizing one or more conductors in each of said layers to produce illumination at their crossings, and photosensitive means responsive to said illumination for making a photographic record thereof.

Many changes, modifications and variations of the present invention will become apparent to those skilled in the art after considering this specification in conjunction with the accompanying drawings. All such changes, modifications and alterations which do not depart from the spirit and scope of the invention are deemed covered by the invention which is limited only by the claims which follow.

We claim:

1. Means for producing light comprising an electroluminescent panel having first and second layers of parallel conductor members arranged so that the conductors in one layer are at an angle relative to the conductors in the other layer, and a layer of electroluminescent material positioned between said conductor layers, said electroluminescent layer composed of material capable of producing light therein between selected conductors in said layers whenever said selected conductors have a preselected voltage difference therebetween, a source of electric impulses coded to correspond to different ones of the conductors on said layers, means for establishing a preselected voltage different between selected conductors in said first and second layer including a circuit network adapted to receive coded electric impulses corresponding to the selected conductors, means responsive to the coding of said electric impulses for establishing circuits through the circuit network to the corresponding selected conductors, and a voltage source connected to said circuit network for applying voltages to the selected conductors through the established circuits thereto.

2. The means for producing light defined in claim 1 wherein said voltage source produces two different voltages, one of which is applied to the selected conductors of the first layer and another which is applied to the selected conductors of the second layer.

3. Means for making a display from digital information comprising means for generating electrical impulses coded to represent corresponding digital information, electroluminescent means including a grid structure having spaced layers of parallel conductors, the conductors in each of said layers extending in different direction, and a layer of electroluminescent material positioned between said layers, and means for simultaneously energizing a conductor in each of said layers to produce a luminous spot in the grid structure where the conductors cross, said conductor energizing means including means for receiving electrical impulses from the impulse generator, means responsive to the coding of said impulses for establishing electrical circuits to the conductors corresponding to the coding of the impulses received, means for generating a first signal to be applied through the established circuits to the corresponding conductor in one of said spaced layers, means for generating a second signal to be applied through the established circuits to the corresponding conductor in the other of said spaced layers, and means including the established circuits for simultaneously applying said first and second signals to the corresponding conductors in the layers.

4. The means for making a display defined in claim 3 wherein said first and second generated signals have out-of-phase components.

5. Means for making an image from digital information comprising means generating a signal having impulses coded to represent digital information, an electroluminescent panel for reproducing an image representing the digital information, said panel having spaced layers of conductors and a layer of electroluminescent material positioned therebetween, the conductors in one of said layers of conductors being light conductive and being

angularly related to the conductors of the other of said layers, and means for simultaneously applying electrical signals to a selected conductor in each of said layers to produce luminescence in the electroluminescent layer therebetween, said electric signal applying means including means for receiving the generated coded impulses representing the digital information, means responsive to the coding of said impulses for establishing electrical circuits to conductors corresponding to digital representation of the generated impulses, means for generating a first signal to be applied through said established circuits to the selected conductor in one of said layers, and means for generating a second signal of different phase from the first signal to be applied through said established circuits to the selected conductor in the other of said layers.

6. The means for making an image defined in claim 5 wherein a photosensitive member is positioned in intimate contact with the panel adjacent to said layer of light conductive conductors.

7. The means for making an image defined in claim 5 wherein said means for establishing electrical circuits to the panel conductors include digital storage means and gate means.

8. Means for making a graph from digital information in the form of electrical impulses comprising means for generating electrical impulses in coded form representing digits to be plotted on a graph, an electroluminescent panel for reproducing the digital information in the form of light spots, said panel having a layer of electroluminescent material, a first layer of parallel conductors positioned adjacent to one surface of said electroluminescent layer, and a second layer of parallel conductors positioned adjacent to the opposite surface of said electroluminescent layer, the conductors in said second layer being at an angle to the conductors in said first layer, and the conductors in one of said layers being light conductive, and means for simultaneously applying electric signals to selected conductors in said first and second layers corresponding to the digits represented by the electrical impulses to energize the electroluminescent layer at crossover locations of the energized conductors of said layers to produce illumination at said crossover locations, said last named means including means for generating an electrical signal to be applied to the selected conductors, and means responsive to the digital representations of the electrical impulses for establishing circuits between the signal generating means and the selected conductors.

9. The means for making a graph defined in claim 8 wherein said signal generating means include means for simultaneously generating out-of-phase signal components, and said circuit establishing means includes means for applying a signal of one phase to the conductors of said first layer of conductors, and a signal of a different phase to the conductors of said second layer of conductors.

10. Means for producing light images on a panel corresponding to impulses representing digital information comprising a panel having a first layer of parallel spaced conductors, a second layer of parallel spaced conductors substantially at right angles to the conductors of the first layer and spaced from said first layer, and a layer of electroluminescent material positioned between said first and said second layers of conductors and capable of producing illumination in response to preselected voltage differences between conductors in said first and second layers, means for producing electrical impulses coded to representing digits, and an electric network including circuit-means connected to the panel conductors, said network including means responsive to the coding of digital impulses for establishing circuits in the circuit means to selected panel conductors corresponding to the digital representations of the impulses, and means for generating electrical signals to be applied through said established circuits to the associated selected conductors in the first and second

layers of conductors to produce preselected voltage differences therebetween.

11. The means for producing light images on a panel defined in claim 10 wherein said means generating electrical signals to be applied to selected conductors includes means generating an electrical signal of one phase to be applied to the conductors of the first layer and means generating an electrical signal of a different phase to be applied to the conductors of the second layer.

12. The means for producing light images on the panel defined in claim 10 wherein said means for establishing circuits to the panel conductors include a plurality of gate circuits and digital register means.

13. Means for making a graphical record of digital information in the form of binary coded decimal impulses comprising in combination an electroluminescent panel and a circuit network therefor, said panel including a first layer of spaced parallel conductor members, a second layer of spaced parallel conductor members positioned at an angle to the conductors of the first layer, and a layer of electroluminescent material positioned between said first and said second layers, said electroluminescent layer being constructed of a material capable of producing light at the crossing locations of conductors in said layers when said conductors have a preselected voltage appearing therebetween, and said circuit network includes means connected to a source of binary coded decimal impulses to be graphically recorded, circuit means connected to the conductors in each of said layers, means responsive to the coding of said impulses for establishing circuits to selected conductors in said layers corresponding to the coding of said binary coded impulses, and means for generating voltages to be applied through the established circuits to the selected ones of the conductors in said layers to produce light at the crossing locations of said selected conductors.

14. The means for making a graphical record defined in claim 13 wherein the conductors in one of said layers are light conductive.

15. The means for making a graphical record defined in claim 14 including a photosensitive member positioned adjacent to the panel on the side thereof adjacent to the light conductive conductors.

16. An electric network for handling coded impulses representing digital information comprising an input circuit adapted to be connected to a source of coded impulses representing digital information, an output circuit including a plurality of leads each representing a different digit, signal generating means, and means responsive to the coding of the impulses for connecting the signal generating means to the ones of said plurality of output leads corresponding to the coded input impulses, said connecting means including means for decoding the input impulses, means for registering the decoded impulses, and means for establishing circuits from the signal generating means to the output leads corresponding to the registered impulses, said last named means including a plurality of gating circuits.

17. The electric network defined in claim 16 wherein the coded impulses include a control impulse, and wherein said network includes control means responsive to said control impulse for controlling the energizing of the decoding means, the registering means, and the signal generating means.

References Cited by the Examiner

UNITED STATES PATENTS

2,859,385	11/58	Bentley	315—169
2,885,558	5/59	Destriau	250—80 X
2,892,968	6/59	Kallmann et al.	315—169
2,932,770	4/60	Livingston	313—108.1

LEYLAND M. MARTIN, *Primary Examiner*.

RALPH G. NILSON, GEORGE N. WESTBY,
Examiners.