(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 204 087 B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
27.09.2006 Bulletin 2006/39

(21) Application number: **00911358.0**

(22) Date of filing: **24.03.2000**

(51) Int Cl.:
G09G 3/32 *(2006.01)*

(86) International application number:
PCT/JP2000/001832

(87) International publication number:
WO 2000/057397 (28.09.2000 Gazette 2000/39)

(54) **FULLCOLOR LED DISPLAY SYSTEM**

VOLLFARBIGES LED-DIODE ANZEIGESYSTEM

SYSTEME D'AFFICHAGE COULEUR A DIODES ELECTROLUMINESCENTES

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **24.03.1999 JP 7966399**
30.03.1999 JP 8823499

(43) Date of publication of application:
08.05.2002 Bulletin 2002/19

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- **PATENT ABSTRACTS OF JAPAN vol. 018, no. 050 (P-1683), 26 January 1994 (1994-01-26) & JP 05 273939 A (SHARP CORP), 22 October 1993 (1993-10-22)**

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EP 1 204 087 B1

Printed by Jouve, 75001 PARIS (FR)

Description

<Technical Field>

[0001] The present invention relates to a fullcolor LED display system displaying gradation-rich, multicolor images by combining, for example, LED lamps of three primary colors of RGB (red, green and blue). Particularly, the invention relates to a system of pulse-width modulation method for lighting and activating an LED lamp by an activating pulse having been pulse-width modulated based on gradation data for each color.

<Background Art>

==Basic Structure of Fullcolor LED Display System==

[0002] Following the development of high-luminance blue LEDs (light-emitting diodes), fullcolor LED display systems, combining the three primary colors RGB, are beginning to become popular. An example of a specification of a typical device is as below. A display screen is in a large size of 2.4 meters in height and 3.4 meters in width. A total of 61,440 pixel lamps of 480 lines with 128 dots per line are arrayed in this screen. Each of the pixel lamps is an LED-multicolor-assembled lamp in which respective LEDs in the three primary colors RGB are densely gathered. Pixel data for driving one pixel consists of a total of 24 bits, that is 8 bits respectively for each RGB. The displaying gradation for each of the colors RGB is 256 tones respectively, and thus, a fullcolor expression of 16,777,216 colors is made possible.

[0003] In this type of fullcolor LED display system, it is possible to use, as its video source, an NTSC video signal used in a regular television broadcasting system or a VTR. An NTSC video signal having been input to a display-control device is A/D converted, and is converted and processed into digital signals of a total of 24 bits of 8 bits respectively for RGB. Image data for one screen, containing (61,440 x 24) bits corresponding to the 61,440 pixel lamps, is buffered in a frame memory. From this frame memory, image data of 24 bits for a single pixel is respectively distributed to a activating circuit of each pixel lamp, and is latched to a register in the activating circuit.

[0004] In the pixel-lamp activating circuit, the red LEDs are activated and lit at a tone corresponding to the 8 bits of red data latched in the register. Similarly, the green LEDs are activated and lit at a tone corresponding to the 8 bits of green data, and the blue LEDs are activated and lit at a tone corresponding to the 8 bits of blue data.

==Gradation Control with Pulse-Width Modulation Method==

[0005] Such a gradation control is generally conducted by a known pulse-width modulation method. A clock pulse of a sufficiently-high constant frequency is continuously generated; a (2^8)= 8-bit counter is incremented by the clock pulse; and an 8-bit count value of the counter is repetitively changed at a constant period Ts from all "0" to all "1". By comparing, with a digital comparator, the magnitude between this 8-bit calculated value and the 8-bit gradation data latched in the register of the activating circuit, an activating pulse with a pulse width Tw corresponding to the 8-bit gradation data and with the above-mentioned period Ts is output from the comparator. The pixel-lamp activating circuit feeds a constant current through the LED and lights it for a time period of the pulse width Tw of the activating pulse. This pulse lighting is repeated at period Ts.

[0006] That is, the pulse width Tw of the activating pulse with a period Ts is determined proportional to the binary value of the 8-bit gradation data, and a displaying luminance corresponding to the 8-bit gradation data is obtained by pulse-lighting the LED with a constant current for time Tw during period Ts.

==Gamma Correction of TV Signals==

[0007] Even nowadays, the mainstream television-image display devices are CRT television sets. Since the RGB three-colored fluorescent materials of the CRT television sets do not illuminate in proportion to the voltage of the input video signal, the relation between the input signal and the optical output is nonlinear. As well known, such a characteristic is referred to as GAMMA. If the nonlinearity (gamma) of the CRT is corrected at each television set, the television set becomes complicated and expensive. Thus, in the current television method, signals having been gamma-corrected at the sending side are broadcasted. The actual gamma value becomes a quite different value according to measuring conditions and measuring methods. In the NTSC method, gamma correction is conducted assuming that the gamma value of the image-display device is 2.2.

[0008] However, in an LED display system, the relation between the input signal and the optical output is approximately linear, and is not nonlinear as of a gamma of a CRT television set. The relation is not completely nonlinear, but the characteristic is significantly different from the gamma of a CRT.

[0009] If a gamma-corrected NTSC video signal is taken as a video source of an LED display system, it would be necessary to carry out an inverse-gamma correction with means of some kind and carry out gradation control according to the approximately-linear characteristic of the LED, if a high-quality image displaying were to be realized.

==Gradation control by Nonlinear Pulse-Width Modulation==

[0010] In a Japanese Patent Application Laid-open Publication (No. 7-306659) issued in 1995, a technique as follows was disclosed concerning a multicolor LED display unit:

(1) An LED display unit (screen) is formed by orderly

arraying a multitude of LEDs in the three primary colors RGB. An LED lighting circuit for lighting each of the LEDs and adjusting the lighting color and brightness thereof is installed to the unit.

(2) The LED lighting circuit comprises: a pulse-width modulation circuit which outputs an activating pulse corresponding to an inputted gradation data; and an LED activating circuit which lights the LED with the activating pulse from the pulse-width modulation circuit.

(3) The pulse-width modulation circuit comprises: a nonlinear counter in which the relation between time and a count value takes a nonlinear action; and a digital comparator which compares the magnitude between the count value of the nonlinear counter and the gradation data stored to a buffer memory to generate the aforementioned activating pulse.

(4) The nonlinear counter comprises: a pulse generator which generates a count pulse of 16 types, each having a different period; a selection circuit which selects one type of count pulse out of the 16 types; a binary counter which counts the count pulse having been selected by the aforementioned circuit; and a decoder circuit which generates a selection signal for selecting the 16 types of count pulses from the higher-order 4 bits of the binary counter.

(5) When the count value of the binary counter is small, the selection circuit has selected a count pulse having a short period according to the selection signal from the decoder circuit, and thus, the count value of the binary counter increases rapidly. When the count value of the binary counter becomes large, the selection signal from the decoder circuit changes, and the selection circuit selects a count pulse having a long period, and thus, the count value of the binary counter increases slowly.

(6) Gradation data is successively sent from an external device, such as a display controller, to the LED display system, and is temporarily stored in a memory. The gradation data stored in the memory is input to the digital comparator via the buffer memory. The pulse width Tw of the activating pulse which is output from the digital comparator is nonlinearly modulated in view of the gradation data; in a range where the gradation data is small, the rate of change of the pulse width Tw is small, and as the gradation data becomes large, the rate of change of the pulse width Tw becomes large.

[0011] In the conventional multicolor LED display unit as described above, by adopting gradation control according to nonlinear-pulse-width modulation, in the case where a gamma-corrected NTSC video signal is taken as a video source, it is possible to carry out an inverse-gamma correction of a line-graph like approximation which matches the approximately linear characteristic of the LED, to carry out image displaying of a higher quality.

[0012] However, in this known technique, since an inverse-gamma correction of a line-graph like approximation is conducted, it is difficult to carry out an inverse-gamma correction of high quality with a simple circuit structure, and it is also difficult to realize a superior image quality of sufficient satisfaction. Further, since a circuit structure, which carries out gradation control by nonlinear pulse-width modification, is installed to the LED display unit, there were structural problems as described below when considering adaptation to an embodiment of particularly a large-screen LED display device.

[0013] In a downtown area of a city, there are seen many large-screen full-color LED displays installed on walls of buildings. In such a system, a configuration, wherein screen modules installed on such as a building wall is connected with data-sending modules arranged within a building room through data-transmission cables, is adopted. A screen module is equivalent to a required number of the LED display units of the aforementioned known document being connected together. A data-sending module is equivalent to what is represented as the external device such as the display controller in the aforementioned known document.

[0014] In the full-color LED display system as described above, it is desired to enhance image quality by optimizing a display-gradation-control characteristic through various factors, such as variably controlling, in a suitable manner, control characteristics of display tones according to gradation-expression characteristics (gamma-correction characteristic of a TV signal is one such characteristic) of an image data to be displayed, or, variably controlling, in a suitable manner, the control characteristics of display tones according to if it is daytime when sunlight is shining or nighttime when it is not.

[0015] In order to realize the aforementioned function, an optimization information for the display-gradation-control characteristic would be sent from the data-sending module (a computer for controlling display) which feeds image data to the screen module. In the known technique, the characteristic of the nonlinear counter, which is installed to the LED display unit (the structural component of the screen module), would be successively changed by a signal fed from the display controller (the data-sending module).

[0016] It is possible to realize such a circuit system. However, matters, such as what kind of signal is to be fed from the data-sending module to which part of the nonlinear counter in the multitude of LED display units structuring the screen module and how its characteristic is to be variably controlled, were not the theme of the invention disclosed in the aforementioned known document.

[0017] In the aforementioned known document, it is described that the pulse generator (generating the 16 types of count pulses), which is a structural component of the nonlinear counter, may be a program counter, and that its set value (a value for determining the respective periods of the 16 types of count pulses) can be optimized from an external point. From this description, it is possible to think of a control system which changes the set value of the pulse generator within the nonlinear counter in the multitude of LED display units structuring the screen module by signals from the data-sending module connected to the screen module through the data-transmission cable. However, in such a case, the control system would have a complicated and expensive circuit structure requiring a multitude of signal-sending lines. Even when adopting such a complicated and expensive circuit structure, it is only possible to carry out gradation control of the aforementioned line-graph-like characteristics, and to carry out an extremely limited characteristic change of modifying the slope of each of the line segments of the line graph.

[0018] A control system apart from the aforementioned type is to be considered. For example, in the aforementioned known technique, it is possible to think of a system configuration wherein: the pulse generator, which is a structural component of the nonlinear counter, is installed to the side of the data-sending module; and the count pulses of 16 kinds which are output from the pulse generator are transferred to the screen module through the data-transmission cable and are input to the selection circuit in the nonlinear counter. Then, in order to change the characteristic of the nonlinear counter, the characteristic of the pulse generator is variably set by the computer of the data-sending module, and the period of the 16 types of the count pulses is appropriately modified. However, alike the aforementioned system, this control system becomes a complicated and expensive circuit structure. Even when such a complicated and expensive circuit structure is adopted, it is only possible to carry out gradation control of the aforementioned line-graph-like characteristics, and to carry out an extremely limited characteristic change of modifying the slope of each of the line segments of the line graph.

<Disclosure of the Invention>

[0019] The object of the present invention is to provide a system configuration which, in accordance to a gradation-expression characteristic of such as an NTSC video signal to be taken as a video source, can easily carry out suitable correction of such characteristic to adapt to the characteristic of an LED by means of a simple circuit system, and can carry out full-color image display of high quality, in a full-color LED display system which is system-configured from a screen module and a data-sending module.

==First Embodiment==

[0020] According to a first aspect of the invention, there is provided a fullcolor LED display system, wherein the system comprises:

- a screen module for displaying a multicolor image on a screen in which a multitude of pixel lamps (10) are arrayed, each pixel lamp being made of a plurality of first- color LEDs (11), second-color LEDs (12), and third-color LEDs (13);
- and a data- sending module (1) which is connected with the screen module via data-sending means, and which gives a control signal as well as image data, the image data being an assembly of gradation data for each color of each pixel lamp (10) on the screen;

said screen module further comprises:

- first-color gradation-control circuits, second-color gradation-control circuits and third-color gradation-control circuits respectively for each pixel lamp (10) on the screen for pulse-lighting the LEDs;
- data-transferring shift registers (30) for giving the gradation data to the respective first- color gradation-control circuits, second-color gradation-control circuits and third-color gradation-control circuits; and one or a plurality of data-distributing circuits (3) for distributing the gradation data given from the data-sending module (1) to the data-transferring shift registers (30);

said first-color gradation-control circuit, second-color gradation-control circuit and third-color gradation-control circuit further comprise:

- an n-bit counter (41) for counting high-speed pulse trains given from the data-sending module (1);
- a latch register (31-33) for latching the gradation data given from the data-transferring shift register (30);
- a digital comparator (51-53) for comparing magnitude between an n-bit count value from the n-bit counter and the gradation data latched to the register;
- and a constant-current driver (21-23) for turning ON and OFF a current-passing to the LED according to a binary output of the digital comparator (51-53);

said data-sending module (1) further comprises:

- a frame memory (2) for temporarily storing image data to be displayed by the screen module;
- means for reading out the image data from the frame memory, and successively sending, to the screen module, the image data in a predetermined pixel lamp order;
- first-color high-speed pulse-train generating means, second-color high-speed pulse-train generating means, and third-color high-speed pulse-train generating means for generating high-speed pulse trains to be given to the respective first-color gradation-control circuit, second-color gradation-control circuit and third-color gradation-control circuit;

- and means for sending, towards the screen module, the respective high-speed pulse trains for the respective first color, second color and third color;

such that, said screen module is adapted to perform the following method steps:

- the gradation data for each color of each pixel lamp (10) successively given from the data-sending module (1) is respectively fed to the latch register (31-33) in the gradation-control circuit for the corresponding color in the corresponding pixel lamp (10) via the data-transferring shift register (30) and the data-distributing circuit (3);

- and the first-color high-speed pulse trains, the second-color high-speed pulse trains and the third-color high-speed pulse trains, given from the data-sending module, are respectively fed as a count input to the n-bit counter (41) in the gradation-control circuit of the corresponding color;

and wherein, said high-speed pulse-train generating means for the first color, the second color and the third color in the data-sending module (1) further comprise:

- a waveform memory (40) storing digital data in which the pulse trains are expressed as a static binary waveform pattern;

- and memory-data-reading means for repetitively generating, with a constant period, the high-speed pulse trains by read-accessing the waveform memory at a predetermined speed and in a predetermined order, and outputting, in series, the digital data of the binary waveform pattern;

said high-speed pulse-train generating means are arranged to repetitively generate high-speed pulse trains according to predetermined cycles, wherein one cycle of each high-speed pulse train is made up of 2^n different pulse widths and wherein the intervals between the pulses in one cycle of each high-speed pulse train vary according to a predetermined pulse-interval-varying characteristic.

==Second Embodiment==

[0021] A fullcolor LED display system according to the second embodiment is characterized in that:

the first-color high-speed pulse-train generating means, the second-color high-speed pulse-train generating means, and the third-color high-speed pulse-train generating means are replaced by a single-system high-speed pulse-train generating means which is shared among process systems for the first color, second color and third color; and the data-sending module sends the single-system high-speed pulse trains towards the screen module.

==Third Embodiment==

[0022] According to a second aspect of the invention, there is provided a fullcolor LED display system, wherein the system comprises:

- a screen module for displaying a multicolor image on a screen in which a multitude of pixel lamps (10) are arrayed, each pixel lamp being made of a plurality of first- color LEDs (11), second-color LEDs (12), and third-color LEDs (13);
- and a data-sending module (1) which is connected with the screen module via data-sending means, and which gives a control signal as well as image data, the image data being an assembly of gradation data for each color of each pixel lamp (10) on the screen;

said screen module further comprises:

- one or a plurality of color-select circuits (70) for selecting LEDs of one color among a set of first-color LEDs, second-color LEDs and third-color LEDs forming a same pixel lamp on the screen;

- gradation-control circuits, which are allotted respectively to each pixel lamp (10) on the screen, for pulse-lighting the LEDs by means of the color selected by the color-select circuit (70);

- data-transferring shift registers (30) for giving the gradation data to the gradation-control circuits; and one or a plurality of data-distributing circuits (3) for distributing the gradation data given from the data-sending module (1) to the data-transferring shift registers (30);

said gradation-control circuit further comprises:

- an n-bit counter (41) for counting high-speed pulse trains given from the data-sending module (1);
- a latch register (31) for latching the gradation data given from the data-transferring shift register (30);
- a digital comparator (51) for comparing magnitude between an n-bit count value from the n-bit counter (41) and the gradation data latched to the register; - and a constant-current driver (21) for turning ON and OFF a current-passing to the LED according to a binary output of the digital comparator (51);

said first-color LEDs (11), the second-color LEDs (12) and the third-color LEDs (13) of the same pixel are connected in parallel to the constant-current driver via the select circuit (70);
said data-sending module (1) further comprises:

- a frame memory (2) for temporarily storing image data to be displayed by the screen module;

- means for orderly reading out first-color gradation data, second-color gradation data and third-color gradation data within the image data from the frame memory (2), and successively sending, to the screen module, the data in a predetermined pixel lamp order;

- high-speed pulse-train generating means for generating high-speed pulse trains to be given to the gradation-control circuit;

- and means for sending the high-speed pulse trains towards the screen module;

such that, said screen module is adapted to perform the following method steps:

- the gradation data, which is for each color for each pixel lamp given from the data-sending module (1), is fed to the latch register (31) in the gradation-control circuit for the corresponding pixel lamp (10) via the data-transferring shift register (30) and the data-distributing circuit (3);

- and the high-speed pulse trains, given from the data-sending module, are fed as a count input to the n-bit counter (41) in the gradation-control circuit;

said screen module further comprises means arranged for:

- controlling the color-select circuit (70) in synchronism with the image data given from the data-sending module (1), such that activating the first-color LEDs according to the first-color gradation data in a first-color activating period, then activating the second-color LEDs according to the second-color gradation data in a second- color activating period, and activating the third-color LEDs according to the third-color gradation data in a third-color activating period,
- applying divided-time intervals of the first-color activating period, the second-color activating period and the third-color activating period;

and wherein, said high-speed pulse-train generating means further comprise:

- a waveform memory (40) storing digital data in which the pulse trains are expressed as a static binary waveform pattern;

- and memory-data-reading means for repetitively generating, with a constant period, the high-speed pulse trains by read-accessing the waveform memory at a predetermined speed and in a predetermined order, and outputting, in series, the digital data of the binary waveform pattern;

said high-speed pulse-train generating means are arranged to repetitively generate high-speed pulse trains according to predetermined cycles and in order during each of the first-color activating period, the second-color activating period and the third-color activating period, wherein one cycle of each high-speed pulse train is made up of 2^n different pulse widths and wherein the intervals between the pulses in one cycle of each high-speed pulse train vary according to a predetermined pulse-interval-varying characteristic that is provided respectively for each of the first color, the second color, and the third color.

==Fourth Embodiment==

[0023] A fullcolor LED display system according to the fourth embodiment is characterized in that the high-speed pulse-train generating means in the data-sending module is replaced by a function-arithmetic-operation means for repetitively generating, with a constant period, the high-speed pulse trains by conducting, at high speed, a function-arithmetic operation according to a program in which a time, until a succeeding pulse Pi+1 is output after a pulse Pi has been output, is expressed as a function of i.

==Fifth Embodiment==

[0024] A fullcolor LED display system according to the fifth embodiment is characterized in that the data-sending module comprises a characteristic-varying means for changing the varying characteristic of the high-speed pulse trains by changing the function having been programmed to the function-arithmetic-operation means.

==Sixth Embodiment==

[0025] A fullcolor LED display system according to the sixth embodiment is characterized in that, as for a group of the LEDs with the same color in a plurality of pixels adjacently arranged on the screen, a group of the gradation-control circuits for the respective LEDs is integrated into one integrated circuit; and in the group of gradation-control circuits, one n-bit counter is shared among the respective gradation-control circuits.

<Brief Description of the Drawings>

[0026]

Fig. 1 is a structural diagram of one pixel lamp and its peripheral circuits according to one example of the present invention;
Fig. 2 is a diagram showing an arrangement example of each of the RGB LEDs in the above-mentioned

one pixel lamp;

Fig. 3 is a schematic structural diagram of distributing-and-transferring system of image data according to one example of the present invention;

Fig. 4 is a graph showing a pulse-interval characteristic of high-speed pulse trains according to one example of the present invention

Fig. 5 is a graph showing a time-varying characteristic of count values of the above-mentioned high-speed pulse trains;

Fig. 6 is a graph showing a functional characteristic of gradation data and an activating-pulse width based on the above-mentioned high-speed pulse train;

Fig. 7 is a structural diagram of one pixel lamp and its peripheral circuits according to another example of the present invention; and

Fig. 8 is a timing chart showing a pixel-lamp activating method according to the example of Fig. 7.

<Best Mode for Carrying Out the Main Embodiment>

[0027] As an example of a full-color LED display system according to the present invention, explanation will be made on a screen module with a pixel configuration of 480 lines with 128 dots per line, as was exemplified in the Background Art. Each of the pixel lamps of a total of 61,440 pieces is an LED-multicolor-assembled lamp having densely gathered LEDs in the three primary colors RGB. Pixel data for activating one pixel lamp is made of data of a total of 24 bits, 8 bits respectively for each RGB. Thus, a full-color expression in 16,777,216 colors is made possible. Image data for one screen is made of data of (61,440 x 24) bits. The image-data source is an NTSC video signal. A/D conversion of the analog video signal into digital image data is carried out for the respective RGB colors in 8 bits. The data is stored to a frame memory 2 of a data-sending module 1.

==Pixel Lamps and Data Distribution==

[0028] Fig. 1, Fig. 2 and Fig. 3 show a configuration regarding one pixel lamp. One pixel lamp 10 is made by gathering and mixing six pieces of red LEDs 11, three pieces of green LEDs 12, and three pieces of blue LEDs 13. Fig. 2 shows an arrangement example of the twelve LEDs included in one pixel lamp 10.

[0029] As shown in Fig. 1, the red LEDs 11 are connected in series between a power source Vcc and a constant-current driver 21. The green LEDs 12 are connected in series between the power source Vcc and a constant-current driver 22. The blue LEDs 13 are connected in series between the power source Vcc and a constant-current driver 23. The data-sending module distributes and transfers to the 61,440 pieces of pixel-lamp-activating circuits (corresponding to the gradation-control circuits described above), at high speed, the image data for one screen provided in the frame memory. A shift register 30 in Fig. 1 is used for the data transferring.

[0030] The data-sending module 1 outputs, in series and at a high speed, the image data for one screen provided in the frame memory 2 in a predetermined order on an 8-bits basis, and sends the data to a data-distribution circuit 3. The data-distribution circuit 3 distributes image data, among the image data of one whole screen, corresponding to a pixel-lamp assembly of the respective 480 lines configuring the display screen. The lamp assembly of one line consists of 128 pieces of pixel lamps 10.

Data-transferring shift registers 30 in the activating circuits of the 128 pieces of pixel lamps are connected in series, and a data-transfer line of shift registers with 8 bits x 3 segments x 128 pieces is configured.

[0031] When image data (gradation data of 8 bits for each red, green and blue color) corresponding to each of the 128 pieces of pixel lamps 10 is packed into the data-transfer line, a latch signal is applied to registers 31, 32, 33 in each of the pixel-lamp-activating circuit from the data-sending module 1, and the red data, green data and blue data, comprised respectively of 8 bits and provided in the data-transferring shift registers 30, are respectively latched to the registers 31, 32, 33.

==Activating Control of Pixel Lamp==

[0032] The red data, green data and blue data, comprised respectively of 8 bits and latched to the respective registers 31, 32, 33 are taken as data for determining a pulse width of an activating pulse for lighting and activating respective red LEDs 11, green LEDs 12, and blue LEDs 13 in a pixel lamp 10. Since the control system for the respective three colors RGB operate according to exactly the same mechanism, an explanation of the control system for red will be representatively made below.

[0033] The magnitude of the 8-bit gradation data A latched to the register 31 and an 8-bit count value B from a counter 41 is compared in a digital comparator 51. When $A \geq B$, the output of the comparator 51 turns ON. This output from the comparator 51 becomes the activating pulse for a constant-current driver 21. During the ON period, an output transistor of the constant-current driver 21 turns ON and a constant current is passed through a series circuit of the red LEDs 11, and the LEDs are lighted.

[0034] The counter 41 is a 8-bit counter, and its 8-bit count value B changes from all "0" to all "1" repetitively with a constant period Ts. Thus, the activating pulse output from the comparator 51 has a period of Ts. The pulse width Tw of the activating pulse is determined, as explained below, corresponding to the binary value of the red data latched to the register 31. Note that a desirable frequency (1/Ts) of the activating pulse is about a few kHz.

==High-speed Pulse Train==

[0035] The count input, which activates the 8-bit counter 41, is a high-speed pulse train output from a waveform memory 40. In the waveform memory 40, there is stored digital data in which the 256 pulse trains, the pulse intervals thereof changing with time according to a varying characteristic having been set, are expressed as a static binary waveform pattern. An address space of the waveform memory 41 is repetitively scanned by an address counter 43 being stepped by a clock from a clock generator 42; whereby the 256 pulse trains, of which the pulse intervals are varied with time according to a predetermined varying characteristic, are repetitively output from the waveform memory 40 with the aforementioned period Ts.

[0036] The pulse intervals of the high-speed pulse trains are set as follows. The pattern of the 256 pulse trains, which are orderly output from the waveform memory 40 with period Ts, is set so that the pulse intervals become gradually longer from the head towards the end of trains. This characteristic is shown as a graph in Fig. 4. In other words, in the beginning portion of the period Ts of the high-speed pulse trains, the pulse-generating frequency is high, whereas in the end portion, the pulse-generating frequency gradually becomes low.

[0037] The high-speed pulse trains with the above-mentioned characteristic are taken as the count input of the 8-bit counter 41. Thus, the variation-with-time characteristic of the 8-bit count value B of the counter 41 is as shown in Fig. 5. In the beginning portion of the period Ts, the increasing rate is high, and as the period Ts heads towards the end, the increasing rate decreases.

==Inverse-gamma Correction Characteristic==

[0038] As mentioned above, although the 8-bit count value B of the counter 41 repetitively changes from all "0" to all "1" with a constant period Ts, the increasing rate of the value B is not constant, and in the beginning portion of the period Ts, the value changes at a high increasing rate, and as the period Ts heads towards the end, the increasing rate drops. Through magnitude comparison between the 8-bit count value B and the 8-bit gradation data A latched to the register 31, the pulse width Tw of the activating pulse is determined. Thus, the relation between the binary value A of the gradation data and the pulse width Tw will not have a linear, proportional characteristic.

[0039] When A≥B, the activating pulse turns ON. Thus, as shown in Fig. 6, as for the varying characteristic of the activating-pulse width Tw in view of the binary value A of the gradation data, in a region where the binary value A of the gradation data is small, the varying rate of the pulse width Tw is small, and as the value A becomes larger, the varying rate of the pulse width Tw also becomes larger. This nonlinearity is a characteristic approximate to the gamma characteristic of a CRT television set, and is the inverse-gamma correction characteristic for canceling the gamma-correction characteristic that has been previously applied to an NTSC video signal.

==Location of the High-speed-pulse-train Source==

[0040] As apparent from the above explanation, the high-speed pulse trains, which are output from the waveform memory 40, become a common signal for all of the pixel-lamp activating circuit of the screen module. The waveform memory 40, the address counter 43, and the clock generator 42 are installed to the data-sending module 1 shown in Fig. 3, and a configuration is provided in which the high-speed pulse trains are fed to each of the pixel-lamp activating circuits through the data-sending line connecting the data-sending module 1 and the screen module.

[0041] In the example of Fig. 1, the high-speed pulse train is a single-system signal common for each of the colors; and a configuration is provided in which the 8-bit count values, which are output from the 8-bit counter 41 that counts the high-speed pulse trains, are given in a common manner to the three digital comparators 51, 52, 53 provided for gradation control of red, green and blue colors. Therefore, what is fed from the data-sending module 1 to the screen module is only the high-speed pulse trains of a single-system; and thus, only one data-sending line needs to be assigned therefor. Consequently, the configuration of the circuit for sending and receiving signals, and the configuration of the data-sending line are extremely simple, and they can be implemented inexpensively.

[0042] Note that there are embodiments in which high-speed pulse trains, having different characteristics for the respective red, green and blue colors, are generated, and in which the high-speed pulse trains in three systems are sent in a parallel manner from the data-sending module 1 to the screen module. Since this mode provides an optimum nonlinear-pulse-width modulation for each of the three primary colors, it is possible to realize a more superior image quality. In this case too, there is only the need to assign three data-sending lines for sending, in a parallel manner, the high-speed pulse trains for red-color control, the high-speed pulse trains for green-color control and the high-speed pulse trains for blue-color control; and thus, the configuration is simple, and implementation is inexpensive.

==Pixel-lamp-activating circuit Made Into IC==

[0043] As for the above-mentioned pixel-lamp-activating circuit (gradation-control circuit), a typical product made into an IC is used. With reference to Fig. 1, the typical IC-type activating circuit is, for example, a circuit having integrated: a data-transferring shift register 30 for 16 pixels; 16 pieces of registers 31, 32, 33... for the 16 pixels; 16 pieces of comparators 51, 52, 53... for the 16 pixels; 16 pieces of constant-current drivers 21, 22, 23...

for the 16 pixels; and one counter 41. This example is a preferred circuit structure for installing one activating circuit for activating one color of the 16 pixels adjacently arranged on the screen module. Three of the aforementioned ICs are made to correspond to the 16 pixels, and the three ICs are used separately for the respective red, green and blue colors. In this case, when the high-speed pulse trains are input to a predetermined input terminal of the aforementioned IC, the counter 41 within the IC counts the high-speed pulse trains, and the count value is input to the sixteen digital comparators within the IC.

==Data Rewriting of Waveform Memory 40==

[0044] A significant feature of the present invention is that it is possible to variably set, in a free manner, the functional characteristic of the gradation data A and the activating-pulse width Tw by virtue of the pulse-interval characteristic of the binary-wave pattern of the high-speed pulse trains stored in the waveform memory 40. Therefore, the present invention is not only beneficial for canceling a particular gamma-correction characteristic having been previously applied to an NTSC video signal, but is a technical idea having various applications.

[0045] For example, a configuration is made so that the waveform memory 40 is provided in the data-sending module 1, and that the contents of the memory 40 can be freely rewritten by a computer within the device. Then, by rewriting the data in the waveform memory 40 in view of a gradation-expression characteristic of an image data to be displayed, it is possible to realize high-quality display through appropriate gradation control for each image. Further, in the case where an LED display device is placed outside, by rewriting the data of the waveform memory 40 in view of change in peripheral light-ray conditions, such as between daytime and nighttime or according to seasons or climate, it is possible to realize high-quality display through appropriate gradation control according to circumstances. In these cases, many different data to be written to the waveform memory 40 will be provided, and these data will be selectively used.

[0046] Further, by specifically analyzing the characteristics of an activating current and optical output of the LEDs being used, it is possible to accurately realize a correction characteristic which exactly matches the analyzed characteristics by the data of the waveform memory 40. Here, it may be considered that the lighting characteristic may differ between the red LED, green LED and blue LED. In this case, separate waveform memories 40 and counters 41 for respective control systems for each of the colors will be provided, and count values B, respectively having different increasing characteristics, will be generated and fed to the digital comparators for each of the colors.

==Arithmetic Operation Output of High-speed Pulse Train==

[0047] In the above example, (2^n) pieces of high-speed pulse trains, of which the pulse intervals are varied with time according to a predetermined varying characteristic, are repetitively generated with a constant period Ts by outputting, in series and at a predetermined speed, digital data recorded in the waveform memory 40. Such structure can be replaced by a circuit means as follows.

[0048] In order to define a characteristic of pulse intervals of the high-speed pulse trains which are varied with time, an arithmetic equation is made in which a time, until a succeeding pulse Pi+1 is output after a pulse Pi has been output, is expressed as a function of i. According to this arithmetic equation, a process of repetitively generating (2^n) of high-speed pulse trains with a constant period of Ts is realized by a computer program. For example, after outputting a first pulse, a pulse-interval value between the first and second pulses, which is obtained through arithmetic operation, is set to and counted down by a timer; then, after this value comes down to zero, the second pulse is output; and then, a pulse-interval value between the second and third pulses, which is obtained through arithmetic operation, is set to and counted down by a timer; and after this value comes down to zero, the third pulse is output. Such an operation may be repetitively implemented by a program process. When adopting such a method, alike the aforementioned waveform-memory method, it is possible to easily change the setting to various characteristics by changing the aforementioned arithmetic equation. It is of course possible to conduct this arithmetic-operation-output process by a dedicated circuit.

==Embodiment of Third Invention==

[0049] Fig. 7 and Fig. 8 show the main points of an embodiment of the third invention. Alike the above-mentioned example, a total of 61,440 pieces of pixel lamps are orderly arrayed in a screen module. One pixel lamp 10 is an assembled lamp in which six red LEDs 11, three green LEDs 12 and three blue LEDs 13 are densely gathered. Pixel data for driving one pixel is data consisting of a total of 24 bits, 8 bits respectively for each RGB; and a fullcolor expression of 16,777,216 colors is made possible. The image data for one whole screen is data of (61,440 x 24) bits.

[0050] As shown in Fig. 7, the six red LEDs 11, the three green LEDs 12 and the three blue LEDs 13 in one pixel lamp 10 are connected in series on a color-by-color basis. The cathode sides of the LED-series connections for the respective colors are connected to an open-collector output of a constant-current driver 21 through a common connection. The anode sides of the LED-series connections for the respective colors are connected to a power source Vcc via a red switch 71, green switch 72 and blue switch 73 of an RGB-select circuit 70. The constant-current driver 20 and the RGB-select circuit 70 operate, as follows, according to a signal given from the data-sending module 1 (see Fig. 3), and lights and activates the pixel lamp 10.

[0051] Fig. 8 shows a timing relation of signals given to the pixel-lamp-activating circuit of the screen module and to the RGB-select circuit 70 from the data-sending module 1.

[0052] To the RGB-select circuit 70 are given a red-select signal for turning ON the red switch 71, a green-select signal for turning ON the green switch 72, and a blue-select signal for turning ON the blue switch 73. These select signals are made, in the screen module, by the aforementioned data-transfer clock or the latch signal. As is clearly shown in Fig. 8, the red switch 31, the green switch 32 and the blue switch 33 are selectively, orderly and repetitively turned ON respectively for a constant time.

[0053] To the 8-bit register is given a latch signal being in synchronism with the switching of the RGB-select signals, and is given image data via the data-transferring shift register 30. Right before the red-select signal turns ON, an 8-bit red data is transferred and latched to a latch circuit 31. The 8-bit red data being output from the latch circuit 31 is input to the digital comparator 51. To the other input of the comparator 51 is applied an 8-bit count value from a 8-bit counter 41. Here, the high-speed pulse trains being input to the counter 41 from the data-sending module 1 are pulse trains for red-gradation control having a nonlinear characteristic. The comparison output of the comparator 51 is an activating pulse which is input to the constant-current driver 21, and the red LEDs 11 are lighted in response to the activating pulse.

[0054] Next, right before the green-select signal turns ON, an 8-bit green data is transferred and latched to the latch circuit 31. Here, the high-speed pulse trains being input to the counter 41 from the data-sending module 1 are pulse trains for green-gradation control having a nonlinear characteristic. The comparison output of the comparator 51 is an activating pulse which is input to the constant-current driver 21, and the green LEDs 12 are lighted in response to the activating pulse.

[0055] Next, right before the blue-select signal turns ON, an 8-bit blue data is transferred and latched to the latch circuit 31. Here, the high-speed pulse trains being input to the counter 41 from the data-sending module 1 are pulse trains for blue-gradation control having a nonlinear characteristic. The comparison output of the comparator 51 is an activating pulse which is input to the constant-current driver 21, and the blue LEDs 13 are lighted in response to the activating pulse.

[0056] The above-mentioned operation is repeated at high speed. For example, a period, in which a turning-ON operation of the red switch 71, green switch 72 and blue switch 73 makes a turnaround, is set at 1/60 second. That is, the time in which one switch is turned on is 1/180 second.

[0057] In one pixel lamp comprised by gathering red LEDs, green LEDs and blue LEDs, even with the method of the present invention in which the red-activating time, the green-activating time and the blue-activating time are time-divided at high speed, the additive-color process is performed in a superior manner, and it is possible to realize an image display of sufficiently high-quality from the viewpoint of time-space characteristic in relation to chromaticity. Note that the present invention is similarly effective as the above description in pixel configuration wherein the red LEDs, green LEDs and blue LEDs are evenly dispersed and arranged throughout the whole display surface of the screen.

[0058] As for time-space characteristic in view of luminance, a comparison will be made between the 1/3-dynamic-activating method of the present example, and a conventional 1/3-dynamic-activating method according to simple line selection. In the method of the present invention, all of the pixel lamps constructing the display screen are simultaneously lighted, whereas in the conventional method, the pixel lamps that are simultaneously lighted are 1/3 of the whole number. Thus, the present invention is advantageous and superior in terms of flickering-sense and resolution. As for circuit structure, it can be said that basically there is no superiority or inferiority between the method of the present example and conventional method, if it is the same 1/3-dynamic-activating method. According to the present invention, an image display of a higher quality than before can be realized with almost the same burden in circuit structure.

[0059] In terms of circuit structure, a comparison will be made between the 1/3-dynamic-activating method of the present example, and a conventional 1/3-dynamic-activating method according to simple line selection. An assumption is made that a white color with high luminance is displayed on the whole screen of both the devices. According to the method of the present invention, there is no period in which, for example, the red LEDs, green LEDs and blue LEDs of the 128 pieces of pixel lamps forming one line are lighted in unison, and only the LEDs of one color among red, green and blue are lighted at a moment. On the contrary, in the conventional method, even though one line out of three lines are orderly lighted, the red LEDs, green LEDs and blue LEDs of the 128 pieces of pixel lamps forming the lighted line are all lighted in unison.

[0060] The total amount of electric power for activation in both methods is, of course, the same; however, when viewing the instantaneous value of activating current being fed to one line, the current for the method of the present invention is 1/3 compared to that of the conventional method. This signifies that the configuration of a power-source device and power-source-feeding system for each of the lines in the present invention is managed with a small capacity and simple structure. This requirement is not so important in compact LED-multicolor-display devices, but when configuring a high-luminance LED-multicolor-display device for outside use having a super-large-size screen, it becomes an extremely realistic and important technical requirement. The present invention is superior in this aspect.

[0061] Further, in the examples shown in Fig. 7 and Fig. 8, since time-divided transferring of high-speed pulse trains for red-gradation control, high-speed pulse trains for green-gradation control, and high-speed pulse trains for blue-gradation control is carried out using a data-sending line of a single-system, high-speed pulse train. Thus, gradation control of an extremely high-performance can be realized by an extremely simple configuration.

Claims

1. A fullcolor LED display system, wherein the system comprises:

- a screen module for displaying a multicolor image on a screen in which a multitude of pixel lamps (10) are arrayed, each pixel lamp being made of a plurality of first-color LEDs (11), second-color LEDs (12), and third-color LEDs (13);
- and a data-sending module (1) which is connected with the screen module via data-sending means, and which gives a control signal as well as image data, the image data being an assembly of gradation data for each color of each pixel lamp (10) on the screen;

said screen module further comprises:

- first-color gradation-control circuits, second-color gradation-control circuits and third-color gradation-control circuits respectively for each pixel lamp (10) on the screen for pulse-lighting the LEDs;
- data-transferring shift registers (30) for giving the gradation data to the respective first-color gradation-control circuits, second-color gradation-control circuits and third-color gradation-control circuits; and one or a plurality of data-distributing circuits (3) for distributing the gradation data given from the data-sending module (1) to the data-transferring shift registers (30);

said first-color gradation-control circuits, second-color gradation-control circuits and third-color gradation-control circuits further comprise:

- an n-bit counter (41) for counting high-speed pulse trains given from the data-sending module (1);
- a latch register (31-33) for latching the gradation data given from the data-transferring shift register (30);
- a digital comparator (51-53) for comparing magnitude between an n-bit count value from the n-bit counter and the gradation data latched to the register;
- and a constant-current driver (21-23) for turning ON and OFF a current-passing to the LED according to a binary output of the digital comparator (51-53);

said data-sending module (1) further comprises:

- a frame memory (2) for temporarily storing image data to be displayed by the screen module;
- means for reading out the image data from the frame memory, and successively sending, to the screen module, the image data in a predetermined pixel lamp order;
- first-color high-speed pulse-train generating means, second-color high-speed pulse-train generating means, and third-color high-speed pulse-train generating means for generating high-speed pulse trains to be given to the respective first-color gradation-control circuits, second-color gradation-control circuits and third-color gradation-control circuits;
- and means for sending, towards the screen module, the respective high-speed pulse trains for the respective first color, second color and third color;

such that, said screen module is adapted to perform the following method steps:

- the gradation data for each color of each pixel lamp (10) successively given from the data-sending module (1) is respectively fed to the latch register (31-33) in the gradation-control circuit for the corresponding color in the corresponding pixel lamp (10) via the data-transferring shift register (30) and the data-distributing circuit (3);
- and the first-color high-speed pulse trains, the second-color high-speed pulse trains and the third-color high-speed pulse trains, given from the data-sending module, are respectively fed as a count input to the n-bit counter (41) in the gradation-control circuit of the corresponding color;

and **characterised in that**, said high-speed pulse-train generating means for the first color, the second color and the third color in the data-sending module (1) further comprise:

- a waveform memory (40) storing digital data in which the pulse trains are expressed as a static binary waveform pattern;
- and memory-data-reading means for repetitively generating, with a constant period, the high-speed pulse trains by read-accessing the

waveform memory at a predetermined speed and in a predetermined order, and outputting, in series, the digital data of the binary waveform pattern;

said high-speed pulse-train generating means are arranged to repetitively generate high-speed pulse trains according to predetermined cycles, wherein one cycle of each high-speed pulse train is made up of 2^n different pulse widths and wherein the intervals between the pulses in one cycle of each high-speed pulse train vary according to a predetermined pulse-interval-varying characteristic.

2. A fullcolor LED display system according to claim 1, **characterized in that**:

the first-color high-speed pulse-train generating means, the second-color high-speed pulse-train generating, means, and the third-color high-speed pulse-train generating means are replaced by a single-system high-speed pulse-train generating means which is shared among process systems for the first color, second color and third color; and
the data-sending module (1) sends the single-system high-speed pulse trains towards the screen module.

3. A fullcolor LED display system, wherein the system comprises:

- a screen module for displaying a multicolor image on a screen in which a multitude of pixel lamps (10) are arrayed, each pixel lamp being made of a plurality of first- color LEDs (11), second-color LEDs (12), and third-color LEDs (13);
- and a data-sending module (1) which is connected with the screen module via data-sending means, and which gives a control signal as well as image data, the image data being an assembly of gradation data for each color of each pixel lamp (10) on the screen;

said screen module further comprises:

- gradation-control circuits, which are allotted respectively to each pixel lamp (10) on the screen, for pulse-lighting the LEDs by means of the color selected by a color-select circuit (70);
- data-transferring shift registers (30) for giving the gradation data to the gradation-control circuits; and one or a plurality of data-distributing circuits (3) for distributing the gradation data given from the data-sending module (1) to the data-transferring shift registers (30);

said each gradation-control circuit further comprises:

- an n-bit counter (41) for counting high-speed pulse trains given from the data-sending module (1);
- a latch register (31) for latching the gradation data given from the data-transferring shift register (30);
- a digital comparator (51) for comparing magnitude between an n-bit count value from the n-bit counter (41) and the gradation data latched to the register;
- and a constant-current driver (21) for turning ON and OFF a current-passing to the LED according to a binary output of the digital comparator (51);

said first-color LEDs (11), the second-color LEDs (12) and the third-color LEDs (13) of the same pixel are connected in parallel to the constant-current driver via the select circuit (70);
said data-sending module (1) further comprises:

- a frame memory (2) for temporarily storing image data to be displayed by the screen module;
- means for orderly reading out first-color gradation data, second-color gradation data and third-color gradation data within the image data from the frame memory (2), and successively sending, to the screen module, the data in a predetermined pixel lamp order;
- high-speed pulse-train generating means for generating high-speed pulse trains to be given to the gradation-control circuits;
- and means for sending the high-speed pulse trains towards the screen module;

such that, said screen module is adapted to perform the following method steps:

- the gradation data, which is for each color for each pixel lamp given from the data-sending module (1), is fed to the latch register (31) in the gradation-control circuit for the corresponding pixel lamp (10) via the data-transferring shift register (30) and the data-distributing circuit (3);
- and the high-speed pulse trains, given from the data-sending module, are fed as a count input to the n-bit counter (41) in the gradation-control circuit;

said screen module further comprises means arranged for:

- controlling the color-select circuit (70) in synchronism with the image data given from the data-sending module (1), such that activating the first-color LEDs according to the first-color gradation data in a first-color activating period, then activating the second-color LEDs according to

the second-color gradation data in a second-color activating period, and activating the third-color LEDs according to the third-color gradation data in a third-color activating period,
- applying divided-time intervals of the first-color activating period, the second-color activating period and the third-color activating period;

and **characterized in that**, said high-speed pulse-train generating means further comprise:

- a waveform memory (40) storing digital data in which the pulse trains are expressed as a static binary waveform pattern;
- and memory-data-reading means for repetitively generating, with a constant period, the high-speed pulse trains by read-accessing the waveform memory at a predetermined speed and in a predetermined order, and outputting, in series, the digital data of the binary waveform pattern;

said high-speed pulse-train generating means are arranged to repetitively generate high-speed pulse trains according to predetermined cycles and in order during each of the first-color activating period, the second-color activating period and the third-color activating period, wherein one cycle of each high-speed pulse train is made up of 2^n different pulse widths and wherein the intervals between the pulses in one cycle of each high-speed pulse train vary according to a predetermined pulse-interval-varying characteristic that is provided respectively for each of the first color, the second color, and the third color.

4. A fullcolor LED display system according to either one of claims 1, 2 or 3, **characterized in that** a structure of the high-speed pulse-train generating means in the data-sending module (1) is replaced by function-arithmetic-operation means for repetitively generating, with a constant period, the high-speed pulse trains by conducting, at high speed, a function-arithmetic operation according to a program in which the pulse time duration, until a succeeding pulse Pi+1 is output after a pulse Pi has been output, is expressed as a function of i.

5. A fullcolor LED display system according to claim 4, **characterized in that** the data-sending module (1) comprises characteristic-varying means for changing the pulse-interval-varying characteristic of the high-speed pulse trains by changing the function having been programmed to the function-arithmetic-operation means.

6. A fullcolor LED display system according to claims 1 or 2, **characterized in that**, LED groups are formed on said screen, each LED group being made up of LEDs that have the same color and that belong to a plurality of pixels adjacently arranged on the screen; the gradation-control circuits for the LEDs in one LED group are grouped and integrated into one integrated circuit; and in the group of gradation-control circuits, one n-bit counter is shared among the respective gradation-control circuits.

Patentansprüche

1. Vollfarbiges LED-Anzeigesystem, wobei das System umfasst:

- ein Schirmmodul zum Anzeigen eines Mehrfarbbilds auf einem Schirm, in welchem eine Vielzahl von Pixellampen (10) angeordnet sind, wobei jede Pixellampe aus einer Mehrzahl von Erstfarb-LEDs (11), Zweitfarb-LEDs (12) und Drittfarb-LEDs (13) hergestellt ist;
- und ein Datensendemodul (1), welches mit dem Schirmmodul über Datesendemittel verbunden ist, und welches ein Steuersignal sowie Bilddaten gibt,

wobei die Bilddaten eine Zusammenstellung von Abstufungsdaten für jede Farbe von jeder Pixellampe (10) auf dem Schirm ist;
wobei das Schirmmodul ferner umfasst:

- Erstfarb-Abstufungssteuerschaltkreise, Zweitfarb-Abstufungssteuerschaltkreise und Drittfarb-Abstufungssteuerschaltkreise jeweils für jede Pixellampe (10) auf dem Schirm für pulsierendes Blitzen der LEDs;
- Datenübertragungs-Schieberegister (30) zur Übergabe der Abstufungsdaten an jeweils die Erstfarb-Abstufungssteuerschaltkreise, Zweitfarb-Abstufungssteuerschaltkreise und Drittfarb-Abstufungssteuerschaltkreise; und einen oder eine Mehrzahl von Datenverteilungsschaltkreisen (3) zur Verteilung der Abstufungsdaten, die von dem Datensendemodul (1) zu dem Datenübertragungs-Schieberegister (30) gegeben werden;

wobei die Erstfarb-Abstufungssteuerschaltkreise, Zweitfarb-Abstufungssteuerschaltkreise und Drittfarb-Abstufungssteuerschaltkreise ferner umfassen:

- einen n-Bit-Zähler (41) zum Zählen von Hochgeschwindigkeits-Pulszügen, die aus dem Datensendemodul (1) ausgegeben werden;
- ein Verriegelungsregister (31-33) zum Verriegeln der Abstufungsdaten, die aus dem Datenübertragungs-Schieberegister (30) ausgegeben werden;

- einen Digitalvergleicher (51-53) zum Vergleichen des Betrags zwischen einem n-Bit-Zählwert aus dem n-Bit-Zähler und den bei dem Register verriegelten Abstufungsdaten;
- und einen Konstantstromtreiber (21-23) zum EIN- und AUS-Schalten eines zu dem LED fließenden Stroms in Übereinstimmung mit einer binären Ausgabe des digitalen Vergleichers (51-53);

wobei das Datensendemodul (1) ferner umfasst:

- einen Rahmenspeicher (2) zum zeitweiligen Speichern von Bilddaten, die durch das Schirmmodul anzuzeigen sind;
- Mittel zum Auslesen der Bilddaten aus dem Rahmenspeicher und zum aufeinander folgenden Senden zu dem Schirmmodul der Bilddaten in einer vorbestimmten Pixellampen-Reihenfolge;
- Erstfarb-Hochgeschwindigkeits-Pulszugerzeugungsmittel, Zweitfarb-Hochgeschwindigkeits-Pulszugerzeugungsmittel und Drittfarb-Hochgeschwindigkeits- Pulszugerzeugungsmittel zum Erzeugen von Hochgeschwindigkeits-Pulszügen, die zu den jeweiligen Erstfarb-Abstufungssteuerschaltkreisen, Zweitfarb-Abstufungssteuerschaltkreisen und Drittfarb-Abstufungssteuerschaltkreisen auszugeben sind;
- und Mittel zum Senden der jeweiligen Hochgeschwindigkeits-Puls züge für die jeweilige erste Farbe, zweite Farbe und dritte Farbe zu dem Schirmmodul hin;

so dass das Schirmmodul geeignet ist, die nachfolgenden Schritte auszuführen:

- die Abstufungsdaten für jede Farbe jeder Pixellampe (10), die nacheinander aus dem Datensendemodul (1) gegeben werden, werden jeweils zu dem Verriegelungsregister (31-33) in dem Abstufungssteuerschaltkreis für die entsprechende Farbe in der entsprechenden Pixellampe (10) über das Datenübertragungs-Schieberegister (30) und den Datenverteilungsschaltkreis (3) zugeführt;
- und die Erstfarb-Hochgeschwindigkeits-Pulszüge, die Zweitfarb-Hochgeschwindigkeits-Pulszüge und die Drittfarb-Hochgeschwindigkeits-Pulszüge, die aus dem Datensendemodul ausgegeben werden, werden jeweils als eine Zähleingabe in den n-Bit-Zähler (41) in dem Abstufungssteuerschaltkreis der entsprechenden Farbe zugeführt;

und **dadurch gekennzeichnet, dass** das Hochgeschwindigkeits-Pulszugerzeugungsmittel für die erste Farbe, die zweite Farbe und die dritte Farbe in dem Datensendemodul (1) ferner umfasst:

- einen Wellenformspeicher (40), der Digitaldaten speichert, in welchem die Pulszüge als ein statisches binäres Wellenformmuster ausgedrückt werden;
- und Speicherdatenlesemittel zum wiederholten Erzeugen mit einer konstanten Periode der Hochgeschwindigkeits-Pulszüge durch Lesezugriff auf den Wellenformspeicher mit einer vorbestimmten Geschwindigkeit in einer vorbestimmten Reihenfolge und serielles Ausgeben der Digitaldaten des binären Wellenformmusters;

wobei die Hochgeschwindigkeits-Pulszugerzeugungsmittel dahingehend angeordnet sind, wiederholt Hochgeschwindigkeits-Pulszüge gemäß vorbestimmten Zyklen zu erzeugen, wobei ein Zyklus von jedem Hochgeschwindigkeits-Pulszug durch 2^n unterschiedliche Pulsbreiten gebildet wird und wobei die Intervalle zwischen den Pulsen in einem Zyklus von jedem Hochgeschwindigkeits-Pulszug in Übereinstimmung mit einer vorbestimmten Puls-Intervall-Variationskennlinie variieren.

2. Vollfarbiges LED-Anzeigesystem gemäß Anspruch 1, **gekennzeichnet durch**:

das Erstfarb-Hochgeschwindigkeits-Pulszugerzeugungsmittel, das Zweitfarb-Hochgeschwindigkeits-Pulszugerzeugungsmittel und das Drittfarb-Hochgeschwindigkeits-Pulszugerzeugungsmittel sind **durch** ein Einzelsystem-Hochgeschwindigkeits-Pulszugerzeugungsmittel ersetzt, welches unter Verarbeitungssysteme für die erste Farbe, die zweite Farbe und die dritte Farbe geteilt ist, und
das Datensendemodul (1) sendet die Einzelsystem-Hochgeschwindigkeits-Pulszüge zu dem Schirmmodul.

3. Vollfarbiges LED-Anzeigesystem, wobei das System umfasst:

- ein Schirmmodul zum Anzeigen eines Mehrfarbbildes auf einem Schirm, in welchem eine Vielzahl von Pixellampen (10) angeordnet ist, wobei jede Pixellampe aus einer Mehrzahl von Erstfarb-LEDs (11), Zweitfarb-LEDs (12) und Drittfarb-LEDs (13) hergestellt ist;
- und ein Datensendemodul (1), welches mit einem Schirmmodul über Datensendemittel verbunden ist, und welches ein Steuersignal sowie Bilddaten ausgibt, wobei die Bilddaten eine Zusammenstellung von Abstufungsdaten für jede Farbe von jeder Pixellampe (10) auf dem Schirm ist;

wobei das Schirmmodul ferner umfasst:

- Abstufungssteuerschaltkreise, welche jeweils jeder Pixellampe (10) auf dem Schirm zugewiesen sind für pulsierendes Blitzen der LEDs mittels der durch einen Farbauswahlschaltkreis (70) ausgewählte Farbe;
- Datenübertragungs-Schieberegister (30) zum Ausgeben der Abstufungsdaten zu den Abstufungssteuerschaltkreisen; und einen oder eine Mehrzahl von Datenverteilungsschaltkreisen (3) zum Verteilen der Abstufungsdaten, die aus dem Datensendemodul (1) zu den Datenübertragungs-Schieberegistern (30) ausgegeben werden;

wobei jeder Abstufungssteuerschaltkreis ferner umfasst:

- einen n-Bit-Zähler (41) zum Zählen von Hochgeschwindigkeits-Pulszügen, die aus dem Datensendemodul (1) ausgegeben werden,
- ein Verriegelungsregister (31) zum Verriegeln der Abstufungsdaten, die aus dem Datenübertragungs-Schieberegister (30) gegeben werden;
- einen Digitalvergleicher (51) zum Vergleichen eines Betrags zwischen einem n-Bit-Zählwert aus dem n-Bit-Zähler (41) und den bei dem Register verriegelten Abstufungsdaten;
- und einen Konstantstromtreiber (21) zum EIN- und AUS-Schalten eines zu der LED fließenden Stroms in Übereinstimmung mit einer binären Ausgabe des Digitalvergleichers (51);

wobei die Erstfarb-LEDs (11), die Zweitfarb-LEDs (12) und die Drittfarb-LEDs (13) desselben Pixels parallel an dem Konstantstromtreiber über den Auswahlschaltkreis (70) angeschlossen sind;
wobei das Datensendemodul (1) ferner umfasst:

- einen Rahmenspeicher (2) zum zeitweiligen Speichern von Bilddaten, die durch das Schirmmodul anzuzeigen sind;
- Mittel zum geordneten Auslesen von Erstfarb-Abstufungsdaten, Zweitfarb-Abstufungsdaten und Drittfarb-Abstufungsdaten innerhalb der Bilddaten aus dem Rahmenspeicher (2) und zum aufeinander folgenden Senden zu dem Schirmmodul der Daten in einer vorbestimmten Pixellampen-Reihenfolge;
- Hochgeschwindigkeits-Pulszugerzeugungsmittel zum Erzeugen von Hochgeschwindigkeits-Pulszügen, die zu den Abstufungs-Steuerschaltkreisen auszugeben sind;
- und Mittel zum Senden der Hochgeschwindigkeits-Pulszüge zu dem Schirmmodul;

so dass das Schirmmodul geeignet ist, die nachfolgenden Verfahrensschritte auszuführen:

- die Abstufungsdaten, welche für jede Farbe für jede Pixellampe ist, die aus dem Datensendemodul (1) ausgegeben wird, wird zu dem Verriegelungsregister (31) in dem Abstufungssteuerschaltkreis für die entsprechende Pixellampe (10) über das Datenübertragungs-Schieberegister (30) und den Datenverteilungs-Schaltkreis (3) gegeben;
- und die Hochgeschwindigkeits-Pulszüge, die aus dem Datensendemodul ausgegeben werden, werden als eine Zähleingabe dem n-Bit-Zähler (41) in dem Abstufungssteuerschaltkreis zugeführt;

wobei das Schirmmodul ferner Mittel umfasst, die angeordnet sind zum:

- Steuern des Farbauswahl-Schaltkreises (70) synchron mit den Bilddaten, die aus dem Datensendemodul (1) ausgegeben werden, so dass Aktivieren der Erstfarb-LEDs in Übereinstimmung mit den Erstfarb-Abstufungsdaten in einer Erstfarb-Aktivierungsperiode, dann Aktivieren der Zweitfarb-LEDs in Übereinstimmung mit den Zweitfarb-Abstufungsdaten in einer Zweitfarb-Aktivierungsperiode und Aktivieren der Drittfarb-LEDs in Übereinstimmung mit den Drittfarb-Abstufungsdaten in einer Drittfarb-Aktivierungsperiode ausgeführt wird,
- Anwenden unterteilter Zeitintervalle der Erstfarb-Aktivierungsperiode, der Zweitfarb-Aktivierungsperiode und der Drittfarb-Aktivierungsperiode;

und **dadurch gekennzeichnet, dass** das Hochgeschwindigkeits-Pulszugerzeugungsmittel ferner umfasst:

- einen Wellenformspeicher (40) zum Speichern von Digitaldaten, in welchem die Pulsdaten als ein statisches binäres Wellenformmuster ausgedrückt werden;
- und Speicherdatenlesemittel zum wiederholten Erzeugen mit einer konstanten Periode der Hochgeschwindigkeits-Pulszüge durch Lesezugriff auf den Wellenformspeicher mit einer vorbestimmten Geschwindigkeit in einer vorbestimmten Reihenfolge und serielles Ausgeben der Digitaldaten des binären Wellenformmusters;

wobei die Hochgeschwindigkeits-Pulszugerzeugungsmittel dahingehend angeordnet sind, wiederholt Hochgeschwindigkeits-Pulszüge in Übereinstimmung mit vorbestimmten Zyklen und in Reihenfolge während jeder der Erstfarb-Aktivierungsperiode, der Zweitfarb-Aktivierungsperiode und der Drittfarb-Aktivierungsperiode zu erzeugen, wobei ein Zyklus von jedem Hochgeschwindigkeits-Pulszug aus 2^n unterschiedlichen Pulsbreiten gebildet wird und wobei die Intervalle zwischen den Pulsen in einem Zyklus von jedem Hochgeschwindigkeits-Pulszug in Übereinstimmung mit einer vorbestimmten Pulsintervall-Variationskennlinie variieren, die jeweils für jede der ersten Farbe, der zweiten Farbe und der dritten Farbe vorgesehen ist.

4. Vollfarbiges LED-Anzeigesystem gemäß irgendeinem der Ansprüche 1, 2 oder 3, **dadurch gekennzeichnet, dass** ein Aufbau des Hochgeschwindigkeits-Pulszugerzeugungsmittels in dem Datensendemodul (1) durch ein funktionsarithmetisches Operationsmittel für wiederholtes Erzeugen mit konstanter Periode der Hochgeschwindigkeits-Pulszüge durch Ausführen mit hoher Geschwindigkeit einer funktionsarithmetischen Operation in Übereinstimmung mit einem Programm ersetzt ist, in welchem die Pulszeitdauer, bis ein darauf folgender Puls Pi+1 ausgegeben wird, nachdem ein Puls Pi ausgegeben wurde, als eine Funktion von i ausgedrückt wird.

5. Vollfarbiges LED-Anzeigesystem gemäß Anspruch 4, **dadurch gekennzeichnet, dass** das Datensendemodul (1) Kennlinien-Variationsmittel zum Ändern der Pulsintervall-Variationskennlinie der Hochgeschwindigkeits-Pulszüge durch Ändern der Funktion, welche in dem funktionsarithmetischen Operationsmittel programmiert wurde, umfasst.

6. Vollfarbiges LED-Anzeigesystem gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** LED-Gruppen auf dem Schirm ausgebildet sind, wobei jede LED-Gruppe aus LEDs gebildet wird, die die gleiche Farbe aufweisen und die zu einer Mehrzahl von Pixeln gehören, die benachbart auf dem Schirm angeordnet sind; wobei die Abstufungssteuerschaltkreise für die LEDs in einer LED-Gruppe in einem integrierten Schaltkreis gruppiert und integriert sind; und wobei in der Gruppe der Abstufungssteuerschaltkreise ein n-Bit-Zähler unter den jeweiligen Abstufungssteuerschaltkreisen geteilt wird.

Revendications

1. Système d'affichage couleur à diodes électroluminescentes (LED), le système comportant :

- un module d'écran pour afficher une image multicolore sur un écran dans lequel une multitude de lampes à pixels (10) sont disposées, chaque lampe à pixels étant constituée d'une pluralité de LED de première couleur (11), de LED de deuxième couleur (12), et de LED de troisième couleur (13),
- et un module d'envoi de données (1) qui est connecté au module d'écran via des moyens d'envoi de données, et qui délivre un signal de commande ainsi que des données d'image, les données d'image étant un ensemble de données de gradation pour chaque couleur de chaque lampe à pixels (10) sur l'écran,

ledit module d'écran comporte en outre :

- des circuits de commande de gradation de première couleur, des circuits de commande de gradation de deuxième couleur et des circuits de commande de gradation de troisième couleur respectivement pour chaque lampe à pixels (10) sur l'écran pour éclairer par impulsion les LED,
- des registres à décalage de transfert de données (30) pour délivrer les données de gradation aux circuits de commande de gradation de première couleur, aux circuits de commande de gradation de deuxième couleur et aux circuits de commande de gradation de troisième couleur respectifs, et un circuit ou une pluralité de circuits de distribution de données (3) pour distribuer les données de gradation délivrées par le module d'envoi de données (1) aux registres à décalage de transfert de données (30),

lesdits circuits de commande de gradation de première couleur, lesdits circuits de commande de gradation de deuxième couleur et lesdits circuits de commande de gradation de troisième couleur comportent en outre :

- un compteur à n bits (41) pour compter des trains d'impulsions à haute vitesse délivrés par le module d'envoi de données (1),
- un registre à verrouillage (31-33) pour verrouiller les données de gradation délivrées par le registre à décalage de transfert de données (30),
- un comparateur numérique (51-53) pour comparer une grandeur entre une valeur de compte à n bits provenant du compteur à n bits et les données de gradation verrouillées dans le registre,
- et un circuit d'attaque en courant constant (21, 23) pour rendre PASSANT et BLOQUER un courant passant à travers la LED conformément à une sortie binaire du comparateur numérique (51-53),

ledit module d'envoi de données (1) comporte en outre :

- une mémoire de trames (2) pour mémoriser temporairement des données d'image à afficher par le module d'écran,

- des moyens pour extraire les données d'image de la mémoire de trames, et envoyer successivement, au module d'écran, les données d'image dans un ordre de lampes à pixels prédéterminé,
- des moyens de génération de trains d'impulsions à haute vitesse de première couleur, des moyens de génération de trains d'impulsions à haute vitesse de deuxième couleur, et des moyens de génération de trains d'impulsions à haute vitesse de troisième couleur, pour générer des trains d'impulsion à haute vitesse à délivrer aux circuits de commande de gradation de première couleur, aux circuits de commande de gradation de deuxième couleur, et aux circuits de commande de gradation de troisième couleur respectifs,
- et des moyens pour envoyer, en direction du module d'écran, les trains d'impulsions à haute vitesse respectifs pour la première couleur, la deuxième couleur et la troisième couleur respectives,

de sorte que, ledit module d'écran est adapté pour exécuter les étapes du procédé suivantes :

- les données de gradation pour chaque couleur de chaque lampe à pixels (10) délivrées successivement par le module d'envoi de données (1) sont respectivement envoyées au registre à verrouillage (31-33) du circuit de commande de gradation pour la couleur correspondante dans la lampe à pixels correspondante (10) via le registre à décalage de transfert de données (30) et le circuit de distribution de données (3),
- et les trains d'impulsions à haute vitesse de première couleur, les trains d'impulsions à haute vitesse de deuxième couleur et les trains d'impulsions à haute vitesse de troisième couleur, délivrés par le module d'envoi de données, sont respectivement envoyés en tant qu'entrée de compte au compteur à n bits (41) dans le circuit de commande de gradation de la couleur correspondante,

et **caractérisé en ce que**, lesdits moyens de génération de trains d'impulsions à haute vitesse pour la première couleur, la deuxième couleur et la troisième couleur dans le module d'envoi de données (1) comportent en outre :

- une mémoire de formes d'onde (40) mémorisant des données numériques dans lesquelles les trains d'impulsions sont exprimés en tant que diagramme de forme d'onde binaire statique,
- et des moyens de lecture de données de mémoire pour générer de manière répétitive, selon une période constante, les trains d'impulsions à haute vitesse en accédant par lecture à la mémoire de formes d'onde à une vitesse prédéterminée dans un ordre prédéterminé, et délivrer en sortie, en série, les données numériques du diagramme de forme d'onde binaire,

lesdits moyens de génération de trains d'impulsions à haute vitesse sont conçus pour générer de manière répétitive des trains d'impulsions à haute vitesse conformément à des cycles prédéterminés, chaque cycle de chaque train d'impulsions à haute vitesse étant constitué de deux largeurs d'impulsion différentes et les intervalles entre les impulsions d'un cycle de chaque train d'impulsions à haute vitesse variant conformément à une caractéristique de variation d'intervalle entre impulsions prédéterminée.

2. Système d'affichage couleur à diodes électroluminescentes selon la revendication 1, **caractérisé en ce que** :

les moyens de génération de trains d'impulsions à haute vitesse de première couleur, les moyens de génération de trains d'impulsions à haute vitesse de deuxième couleur, et les moyens de génération de trains d'impulsions à haute vitesse de troisième couleur sont remplacés par des moyens de génération de trains d'impulsions à haute vitesse de type à système unique qui sont partagés entre des systèmes de processus sur la première couleur, la deuxième couleur et la troisième couleur, et
le module d'envoi de données (1) envoie les trains d'impulsions à haute vitesse du système unique en direction du module d'écran.

3. Système d'affichage couleur à diodes électroluminescentes, dans lequel le système comporte :

- un module d'écran pour afficher une image multicolore sur un écran dans lequel une multitude de lampes à pixels (10) sont disposées, chaque lampe à pixels étant constituée d'une pluralité de LED de première couleur (11), de LED de deuxième couleur (12), et de LED de troisième couleur (13),
- et un module d'envoi de données (1) qui est connecté au module d'écran via des moyens d'envoi de données, et qui délivre un signal de commande ainsi que des données d'image, les données d'image étant un ensemble de données de gradation pour chaque couleur de chaque lampe à pixels (10) sur l'écran,

ledit module d'écran comporte en outre :

- des circuits de commande de gradation qui sont attribués respectivement à chaque lampe à pixels (10) sur l'écran, pour éclairer par impulsion les LED par l'intermédiaire de la couleur sélectionnée par un circuit de sélection de couleur (70),
- des registres à décalage de transfert de données (30) pour délivrer les données de gradation aux circuits de commande de gradation, et un circuit ou une pluralité de circuits de distribution de données (3) pour distribuer les données de gradation délivrées par le module d'envoi de données (1) aux registres à décalage de transfert de données (30),

chacun desdits circuits de commande de gradation comporte en outre :

- un compteur à n bits (41) pour compter des trains d'impulsions à haute vitesse délivrés par le module d'envoi de données (1),
- un registre à verrouillage (31) pour verrouiller les données de gradation délivrées par le registre à décalage de transfert de données (30),
- un comparateur numérique (51) pour comparer une grandeur entre une valeur de compte à n bits provenant du compteur à n bits (41) et les données de gradation verrouillées dans le registre,
- et un circuit d'attaque en courant constant (21) pour rendre PASSANT et BLOQUER un courant passant à travers la LED conformément à une sortie binaire du comparateur numérique (51),

lesdites LED de première couleur (11), lesdites LED de deuxième couleur (12) et lesdites LED de troisième couleur (13) du même pixel sont connectées en parallèle au circuit d'attaque en courant constant via le circuit de sélection (70),
ledit module d'envoi de données (1) comporte en outre :

- une mémoire de trames (2) pour mémoriser temporairement des données d'image à afficher par le module d'écran,
- des moyens pour extraire dans l'ordre des données de gradation de première couleur, des données de gradation de deuxième couleur et des données de gradation de troisième couleur dans les données d'image de la mémoire de trames (2), et envoyer successivement, au module d'écran, les données dans un ordre de lampes à pixels prédéterminé,
- des moyens de génération de trains d'impulsions à haute vitesse pour générer des trains d'impulsion à haute vitesse à délivrer aux circuits de commande de gradation,
- et des moyens pour envoyer les trains d'impulsions à haute vitesse en direction du module d'écran,

de sorte que ledit module d'écran est adapté pour exécuter les étapes du procédé suivantes :

- les données de gradation, lesquelles sont pour chaque couleur pour chaque lampe à pixels, délivrées successivement par le module d'envoi de données (1), sont envoyées au registre à verrouillage (31) du circuit de commande de gradation pour la lampe à pixels correspondante (10) via le registre à décalage de transfert de données (30) et le circuit de distribution de données (3),
- et les trains d'impulsions à haute vitesse, délivrés par le module d'envoi de données, sont envoyés en tant qu'entrée de compte au compteur à n bits (41) du circuit de commande de gradation,

ledit module d'écran comporte en outre des moyens conçus pour :

- commander le circuit de sélection de couleur (70) en synchronisme avec les données d'image délivrées par le module d'envoi de données (1), de manière à activer les LED de première couleur conformément aux données de gradation de première couleur au cours d'une période d'activation de première couleur, activer ensuite les LED de deuxième couleur conformément aux données de gradation de deuxième couleur au cours d'une période d'activation de deuxième couleur, et activer les LED de troisième couleur conformément aux données de gradation de troisième couleur au cours d'une période d'activation de troisième couleur,
- appliquer des intervalles de temps divisé de la période d'activation de première couleur, de la période d'activation de deuxième couleur et de la période d'activation de troisième couleur,

et **caractérisé en ce que**, lesdits moyens de génération de trains d'impulsions à haute vitesse comportent en outre :

- une mémoire de formes d'onde (40) mémorisant des données numériques dans lesquelles les trains d'impulsions sont exprimés sous forme de diagramme de forme d'onde binaire statique,
- et des moyens de lecture de données de mémoire pour générer de manière répétitive, selon une période constante, les trains d'impulsions à haute vitesse en accédant par lecture à la mémoire de formes d'onde à une vitesse prédéterminée et dans un ordre prédéterminé, et délivrer

en sortie, en série, les données numériques du diagramme de forme d'onde binaire,

lesdits moyens de génération de trains d'impulsions à haute vitesse sont conçus pour générer de manière répétitive des trains d'impulsions à haute vitesse conformément à des cycles prédéterminés et dans l'ordre pendant chacune de la période d'activation de première couleur, de la période d'activation de deuxième couleur et de la période d'activation de troisième couleur, un cycle de chaque train d'impulsions à haute vitesse étant constitué de deux largeurs d'impulsion différentes et les intervalles entre les impulsions d'un cycle de chaque train d'impulsions à haute vitesse variant conformément à une caractéristique de variation d'intervalle entre impulsions prédéterminée qui est délivrée respectivement pour chacune de la première couleur, de la deuxième couleur et de la troisième couleur.

4. Système d'affichage couleur à diodes électroluminescentes conformément à l'une quelconque des revendications 1, 2 ou 3, **caractérisé en ce qu'**une structure des moyens de génération de trains d'impulsions à haute vitesse dans le module d'envoi de données (1) est remplacée par des moyens d'opération arithmétique-fonction pour générer de manière répétitive, selon une période constante, les trains d'impulsions à haute vitesse en exécutant, à haute vitesse, une opération arithmétique-fonction conformément à un programme dans lequel la durée d'impulsion jusqu'à ce qu'une impulsion suivante Pi+1 soit délivrée en sortie après qu'une impulsion Pi ait été délivrée en sortie, est exprimée en fonction de i.

5. Système d'affichage couleur à diodes électroluminescentes conformément à la revendication 4, **caractérisé en ce que** le module d'envoi de données (1) comporte des moyens de variation de caractéristique pour changer la caractéristique de variation d'intervalle d'impulsion des trains d'impulsions à haute vitesse en changeant la fonction ayant été programmée dans les moyens d'opération arithmétique-fonction.

6. Système d'affichage couleur à diodes électroluminescentes selon les revendications 1 ou 2, **caractérisé en ce que**, les groupes de LED sont formés sur ledit écran, chaque groupe de LED étant constitué de LED qui ont la même couleur et qui appartiennent à une pluralité de pixels disposés de manière adjacente sur l'écran, les circuits de commande de gradation pour les LED d'un groupe de LED sont regroupés et intégrés dans un circuit intégré, et dans le groupe de circuits de commande de gradation, un compteur à n bits est partagé entre les circuits de commande de gradation respectifs.

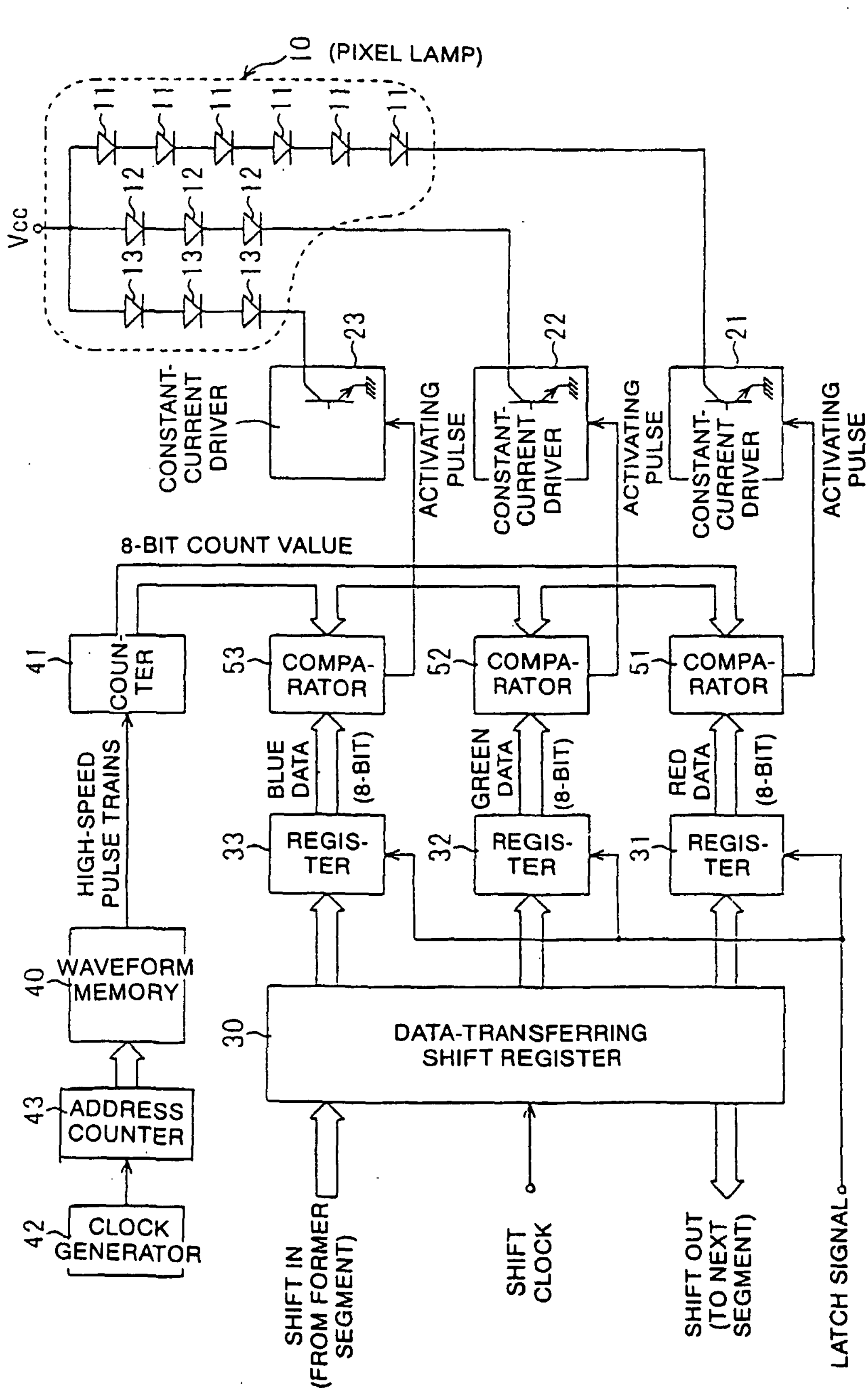

10 (PIXEL LAMP)
Vcc
11
12
13
CONSTANT-CURRENT DRIVER
23
22
21
ACTIVATING PULSE
8-BIT COUNT VALUE
41 COUNTER
53 COMPARATOR
52 COMPARATOR
51 COMPARATOR
HIGH-SPEED PULSE TRAINS
BLUE DATA (8-BIT)
GREEN DATA (8-BIT)
RED DATA (8-BIT)
33 REGISTER
32 REGISTER
31 REGISTER
40 WAVEFORM MEMORY
30 DATA-TRANSFERRING SHIFT REGISTER
43 ADDRESS COUNTER
42 CLOCK GENERATOR
SHIFT IN (FROM FORMER SEGMENT)
SHIFT CLOCK
SHIFT OUT (TO NEXT SEGMENT)
LATCH SIGNAL

FIG. 1

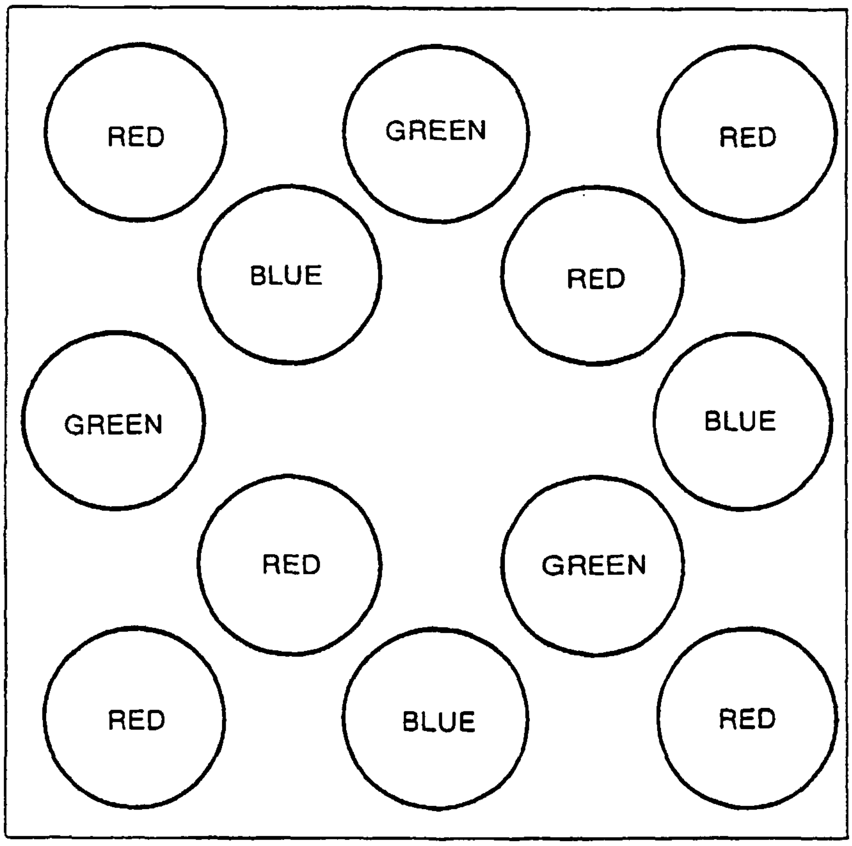


FIG. 2

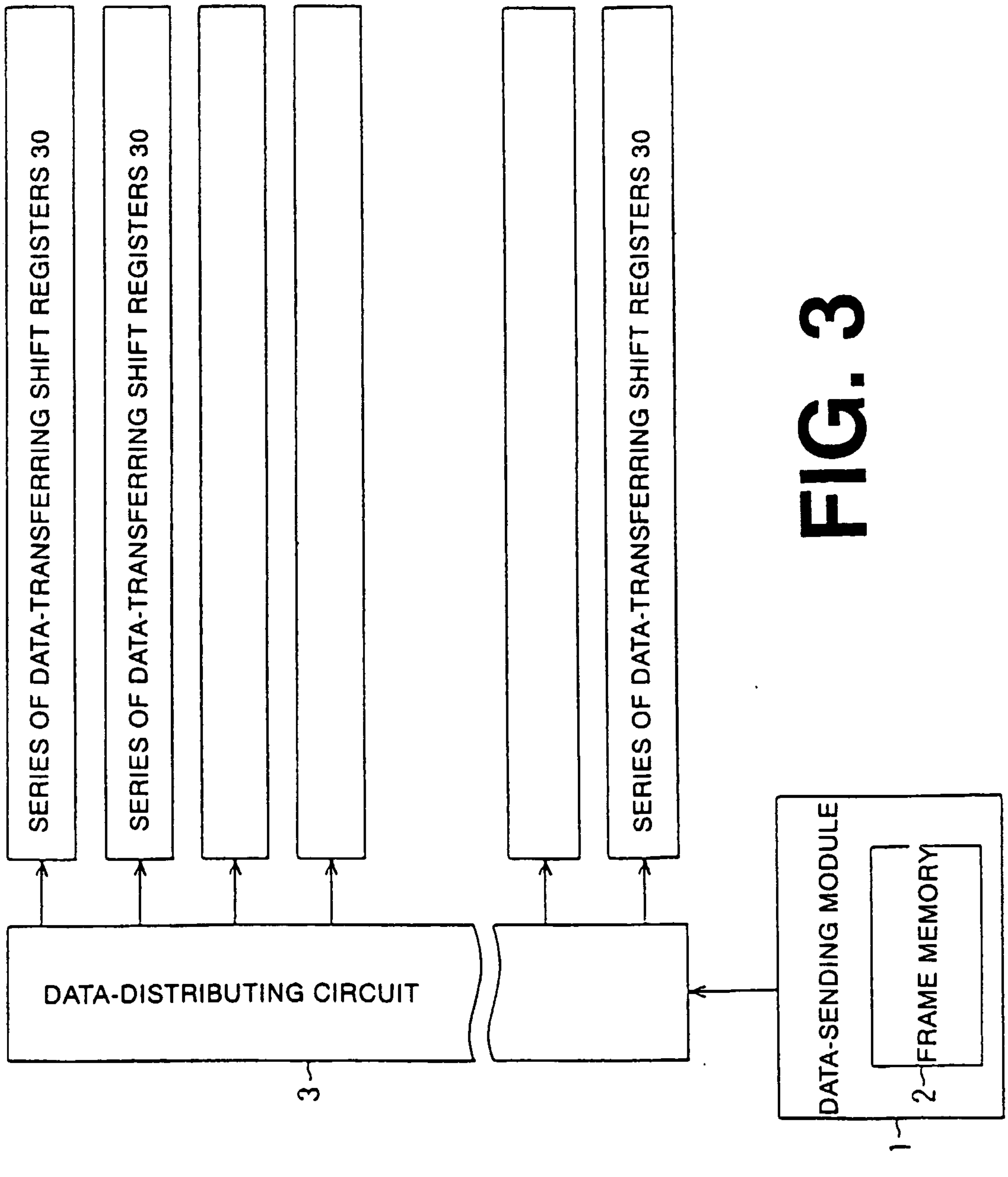

SERIES OF DATA-TRANSFERRING SHIFT REGISTERS 30
SERIES OF DATA-TRANSFERRING SHIFT REGISTERS 30
SERIES OF DATA-TRANSFERRING SHIFT REGISTERS 30
DATA-DISTRIBUTING CIRCUIT
3
DATA-SENDING MODULE
FRAME MEMORY
2
1

FIG. 3

FIG. 4

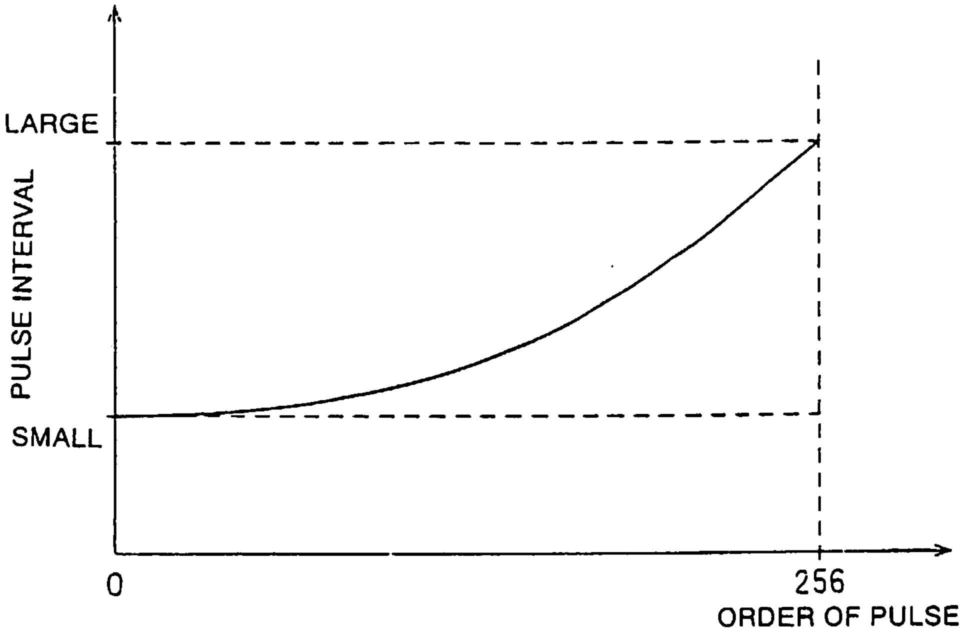
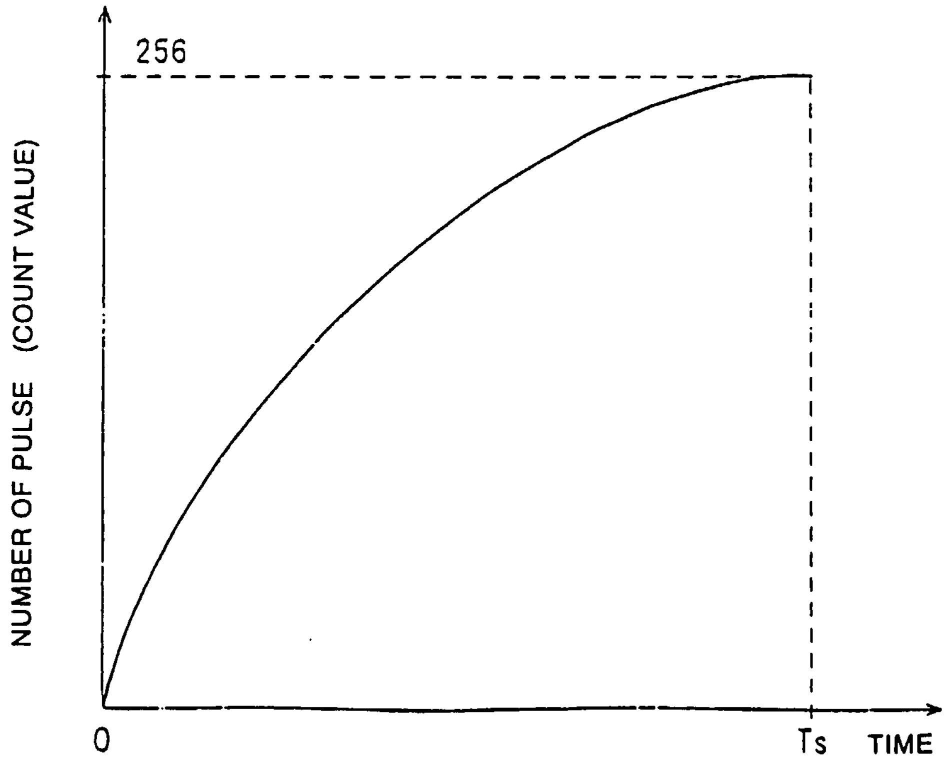

LARGE
PULSE INTERVAL
SMALL
0
256
ORDER OF PULSE

FIG. 5


256
NUMBER OF PULSE (COUNT VALUE)
0
Ts
TIME

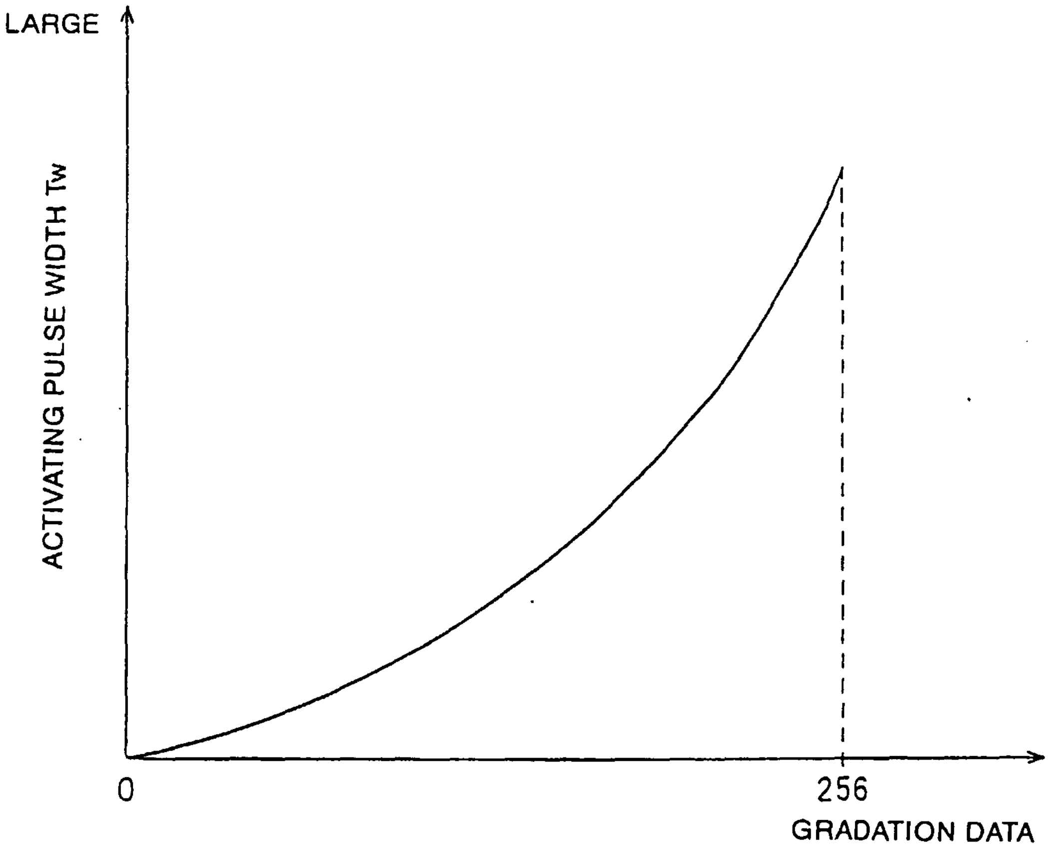


FIG. 6

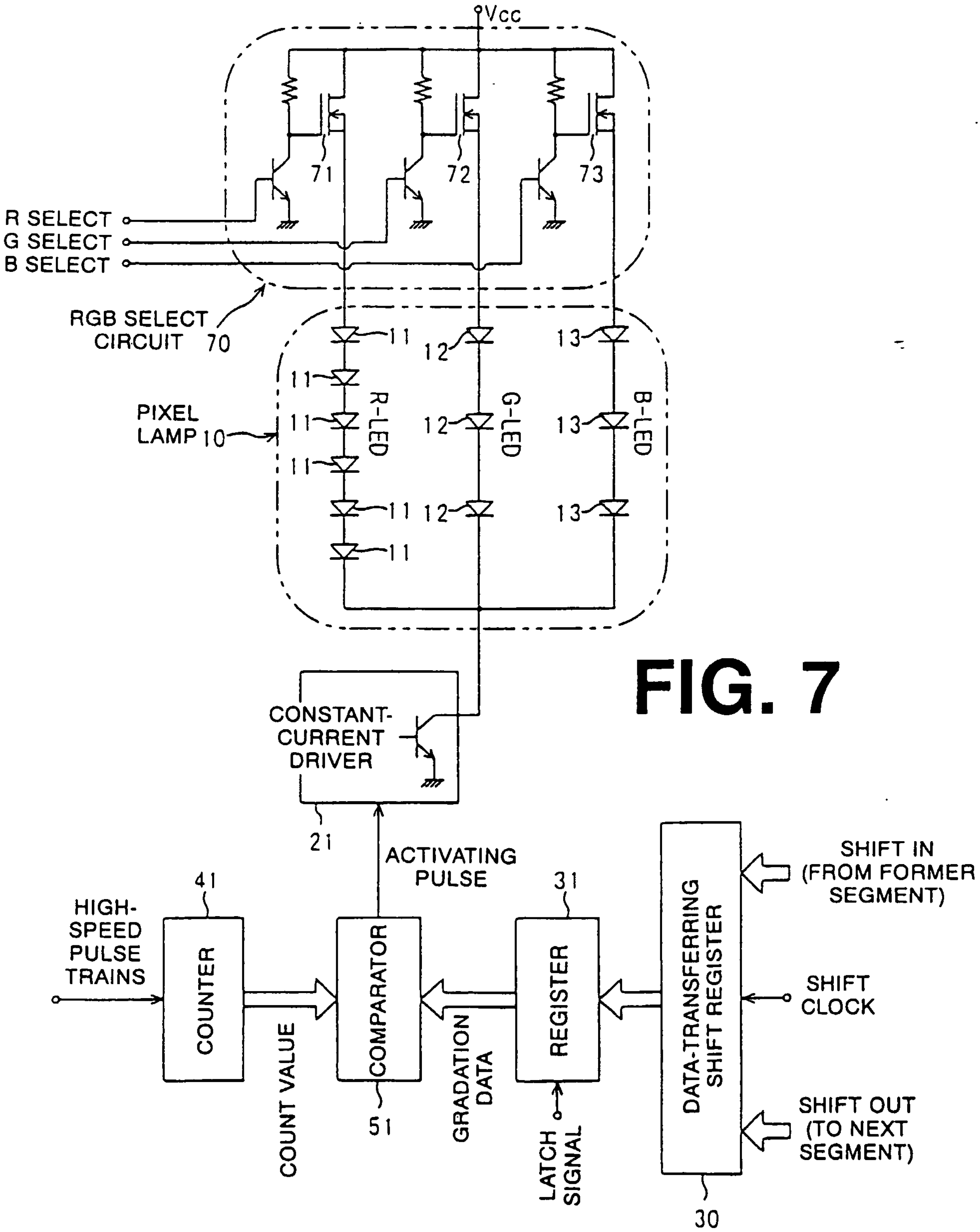

Vcc
71
72
73
R SELECT
G SELECT
B SELECT
RGB SELECT CIRCUIT 70
PIXEL LAMP 10
11
12
13
R-LED
G-LED
B-LED
CONSTANT-CURRENT DRIVER
21
ACTIVATING PULSE
HIGH-SPEED PULSE TRAINS
41
COUNTER
COUNT VALUE
COMPARATOR
51
GRADATION DATA
31
REGISTER
LATCH SIGNAL
DATA-TRANSFERRING SHIFT REGISTER
30
SHIFT IN (FROM FORMER SEGMENT)
SHIFT CLOCK
SHIFT OUT (TO NEXT SEGMENT)

FIG. 7

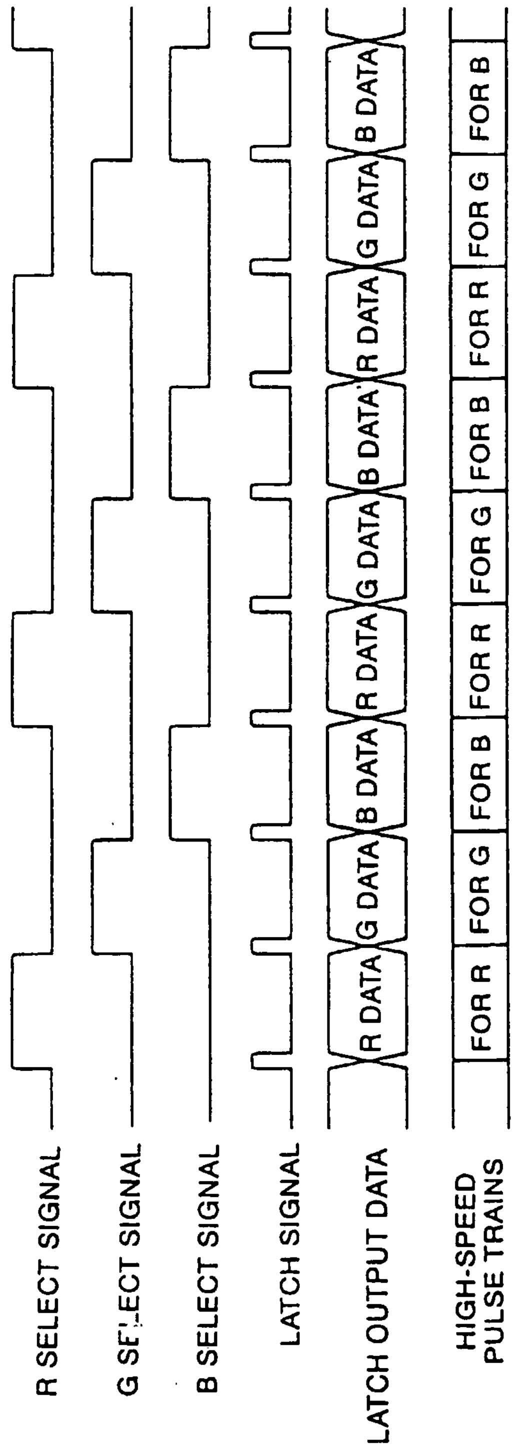

R SELECT SIGNAL
G SELECT SIGNAL
B SELECT SIGNAL
LATCH SIGNAL
LATCH OUTPUT DATA
HIGH-SPEED PULSE TRAINS
R DATA
G DATA
B DATA
R DATA
G DATA
B DATA
R DATA
G DATA
B DATA
FOR R
FOR G
FOR B
FOR R
FOR G
FOR B
FOR R
FOR G
FOR B

FIG. 8

专利名称(译)	全彩LED显示系统		
公开(公告)号	EP1204087B1	公开(公告)日	2006-09-27
申请号	EP2000911358	申请日	2000-03-24
[标]申请(专利权)人(译)	AVIX		
申请(专利权)人(译)	AVIX INC.		
当前申请(专利权)人(译)	AVIX INC.		
[标]发明人	TOKIMOTO TOYOTARO OHISHI MASATOSHI		
发明人	TOKIMOTO, TOYOTARO OHISHI, MASATOSHI		
IPC分类号	G09G3/32 G09G3/20 G09G5/02		
CPC分类号	G09G3/2014 G09G3/2018 G09G3/2085 G09G3/32 G09G5/02 G09G2300/0452 G09G2310/0272 G09G2320/0276 G09G2320/0666		
优先权	1999079663 1999-03-24 JP 1999088234 1999-03-30 JP		
其他公开文献	EP1204087A4 EP1204087A1		
外部链接	Espacenet		

摘要(译)

采用的是一种系统配置，其中屏幕模块在多个第一色LED，第二色LED和第三色LED有序排列的屏幕上显示多色图像，以及数据发送模块，要在屏幕模块上显示的控制信号和图像数据通过数据发送装置连接。在屏幕模块上，对于屏幕上的每个像素，安装有第一颜色灰度控制电路，第二颜色灰度控制电路和用于脉冲点亮LED的第三颜色灰度控制电路。数据发送模块包括：帧存储器，用于临时存储要在屏幕模块上显示的图像数据;图像数据传送控制装置，用于从帧存储器中读出图像数据，并以预定的像素顺序将图像数据与预定的数据传送时钟一起输出到数据发送装置;第一种颜色的高速脉冲序列发生装置，第二颜色高速脉冲串产生装置和第三色高速脉冲串产生装置，用于产生高速脉冲序列，给予相应的第一颜色灰度控制电路，第二颜色灰度控制电路和第三色渐变控制电路;高速脉冲串输出装置，用于向数据发送装置输出各自的第一颜色，第二颜色和第三颜色的高速脉冲序列。用于每种颜色的高速脉冲串产生装置以恒定周期重复产生（2n）个或接近其下方的数字的高速脉冲序列，其脉冲间隔根据变化的特性随时间变化。组。

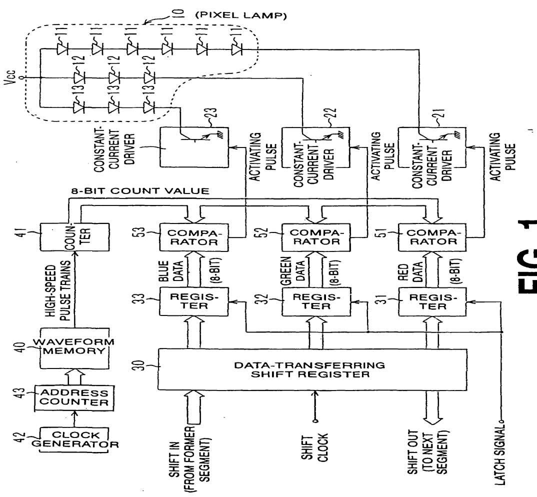


FIG. 1