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(54) Display apparatus

(57) A display apparatus comprises a support member and a plurality of light-emitting elements attached to the support member. The apparatus performs a predetermined display by light-emission controlling the light-emitting elements. The display apparatus further comprises one or a plurality of light-emitting element panels (5), each having a support frame (50F) and a plurality of light-emitting element bars (80) arranged in parallel at regular intervals (G) and connected to the support frame (50F), each light-emitting bar (80) being covered by a cylindrical translucent pipe (81); and further comprises light-emission control means (10 to 40, 51 to 53) including computers (11 to 13), which control the plurality of light-emitting element bars (80) in the one or the plurality of light-emitting element panels (50).

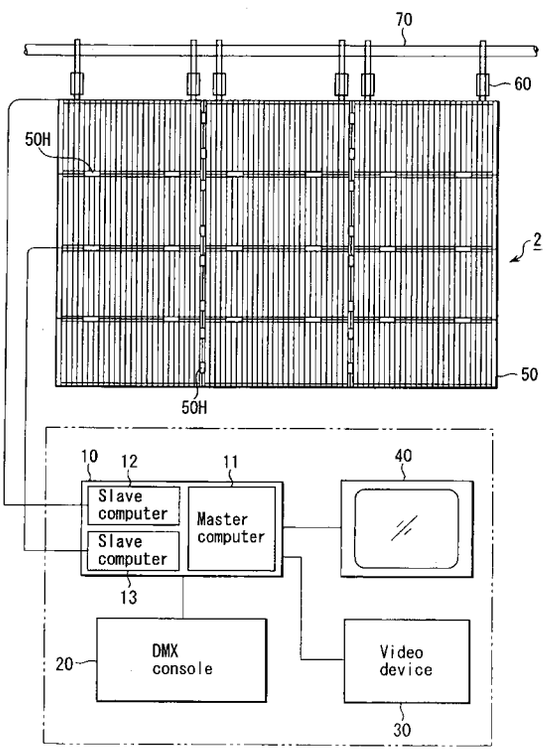

FIG. 1

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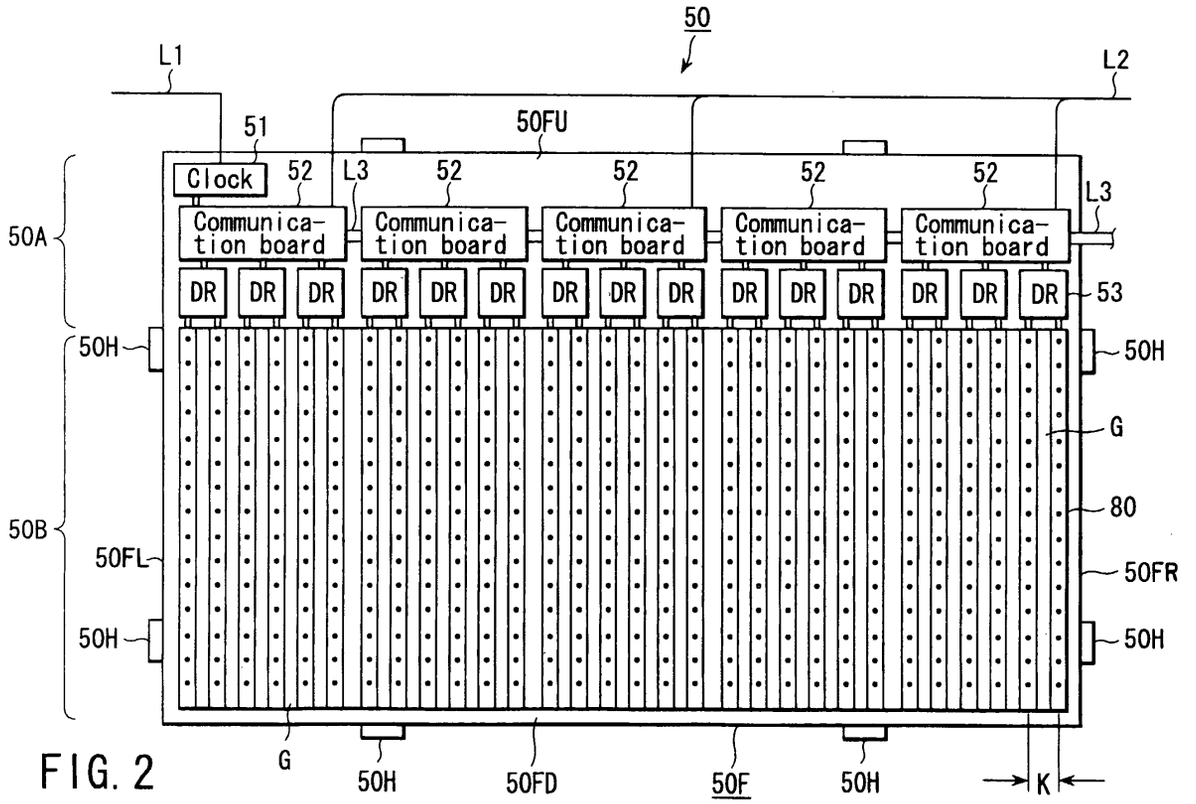

50
L1
L2
51
50FU
Clock
52
L3
Communica-
tion board
DR
53
50A
50H
50B
50FL
50FR
G
80
50FD
50F
K

FIG. 2

Description

[0001] The present invention relates to a display apparatus suitable for a stage or a large outdoor screen.

[0002] Of the conventional display apparatuses of this type, a so-called light-emitting display board is known. In the light-emitting display board, a plurality of light-emitting elements, such as LEDs (light-emitting diodes), are arranged in a matrix on a comparatively large plate-like support member made of a rigid body, and the light-emitting elements are light emission-controlled by a controller.

[0003] There is no particular problem in the light-emitting display board in terms of mechanical strength, since the plate-like support member is made of a rigid body. Therefore, it can be used in an outdoor display apparatus. However, since the apparatus is inevitably set fixedly, it was difficult to suitably change the conditions of setting in accordance with the on-site situation. Therefore, the apparatus was difficult to be used as, for example, a display apparatus for a stage, in which various setting conditions are required.

[0004] To allow the conditions of setting to be changed relatively freely, a display apparatus is proposed, in which a flexible net is used in place of the plate-like support member and a plurality of light-emitting elements are arranged on the flexible net. With this proposed display apparatus, the degree of freedom of the setting conditions is considerably increased. However, this type of apparatus is disadvantageous in that the display screen may sway due to the wind pressure since it is easily affected by wind. Therefore, it is unsuitable for an outdoor display apparatus, particularly a large screen display apparatus.

[0005] An object of the present invention is to provide a display apparatus advantageous in that:

(a) the display screen is not susceptible to wind, so that it does not sway due to the wind pressure;
(b) the display screen can be installed in arbitrary setting conditions (the setting position, the setting attitude, etc.) in accordance with the on-site situation; and
(c) the background behind the display screen can be seen and the display screen can be illuminated from behind, so that notable stage effects can be obtained if the apparatus is used as a display apparatus for a stage.

[0006] The present invention is set out in the independent claim. Some optional features are set out in the claims dependent thereto.

[0007] According to an aspect of the present invention, there is provided a display apparatus comprising a support member and a plurality of light-emitting elements attached to the support member and performs a predetermined display by light-emission controlling the light-emitting elements, characterized by comprising: one or a plurality of light-emitting element panels, each having a support frame and a plurality of light-emitting element bars arranged in parallel at regular intervals and connected to the support frame, each light-emitting element bar being covered by a cylindrical translucent pipe; and light-emission control means including computers, which light-emission controls the plurality of light-emitting element bars in the one or the plurality of light-emitting element panels.

[0008] Preferably the light-emitting element panels are arranged in a predetermined pattern in vertical and horizontal directions and flexibly connected to one another by flexion means.

[0009] The invention can be more fully under stood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic diagram showing the overall structure of a display apparatus according to an embodiment of the present invention;
FIG. 2 is a diagram showing a concrete internal structure of a light-emitting element panel of the display apparatus according to the embodiment;
FIG. 3A is a perspective view of a main part of the display apparatus according to the embodiment, showing a concrete structure of a light-emitting element bar;
FIG. 3B is a front view of a display module showing a concrete structure of the light-emitting element bar of the display apparatus according to the embodiment;
FIG. 3C is a rear view of a display module showing a concrete structure of the light-emitting element bar of the display apparatus according to the embodiment; and
FIGS. 4A to 4D are diagrams showing examples of attitude changes of the overall display screen of the display apparatus according to the embodiment.

(Embodiment)

[0010] In FIG. 1, reference numerals 1 and 2 respectively denote a control system and a display system of a display apparatus.

[0011] The control system 1 comprises a controller 10, a DMX (illumination signal standard) console 20, a video device 30, a monitor display 40, etc. The controller 10 comprises a master computer 11, slave computers 12 and 13, etc., and incorporates a hard disk. The DMX console 20 controls, in real time, switching and mixture of various images, a change of colors, a reproduction rate of animation, a change rate of illuminations and the like, utilizing a DMX signal used as a worldwide standard for control signals of lighting equipment.

[0012] Thus, the control system 1 is constructed to allow the display system 2 to reproduce bitmap image data animation stored in the controller 10, perform full-color illuminations by means of an abstraction image

based on data calculated by control software of the master computer 11, and display a TV image by means of the video device 30.

[0013] The display system 2 comprises, for example, twelve units of light-emitting element panels 50, arranged in a matrix with four rows and three columns. The light-emitting element panels 50 are flexibly connected to one another by flexion means 50H, i.e., the combination of, for example, a hinge mechanism and a lock mechanism. In this embodiment, LEDs (light-emitting diodes) are used as light-emitting elements. The display system 2 as a whole can be suspended from a support rail 70 by means of suspending members 60, so that it can be set as a stage display apparatus or a large-screen outdoor display apparatus.

[0014] The display system 2 is controlled by the control system 1 and an internal control section (to be described later), and constructed to perform arbitrary display such that the overall system serves as a large single screen or only a part of the system serves as a limited screen.

[0015] The number and arrangement pattern of light-emitting element panels connected to form the screen are not particularly limited. In other words, an arbitrary number of panels can be arranged in an arbitrary pattern in accordance with the situation.

[0016] FIG. 2 is a diagram showing a concrete internal structure of one of the light-emitting element panels 50. A control section 50A is housed inside an upper frame 50FU of a support frame 50F of the light-emitting element panel 50. A display section 50B lies in the overall display region of the light-emitting element panel 50. Actually, the width of the upper frame 50FU is substantially the same as those of a lower frame 50FD, and left and right frames 50FL and 50FR.

[0017] The control section 50A comprises a clock pulse generator 51, a plurality of (five in this embodiment) communication boards 52 and drivers 53. The clock pulse generator 51 operates in response to a control signal supplied from the controller 10 through a signal cable L1. Each of the communication boards 52 includes a communication circuit, which receives a clock pulse generated by the clock pulse generator and exchanges information with the controller 10 through a signal cable L2. The drivers 53 operate in response to a command signal from the communication boards 52 and control the light emission of the display section 50B.

[0018] The clock pulse from the clock pulse generator 51 is supplied in series to the communication boards 52 through a signal cable L3. Each communication board 52 is connected to three drivers 53. Each driver 53 drives two light-emitting element bars 80 of the display section 50B.

[0019] In the display section 50B, a plurality of (30 in this embodiment) light-emitting element bars 80 are arranged in parallel at regular intervals G and connected to the support frame 50F made of a rigid material, for example, metal. In this embodiment, the light-emitting element bars 80 are arranged in parallel at pitch K of, for example, about 60 mm. Each light-emitting element bar 80 is covered by a cylindrical translucent pipe.

[0020] FIGS. 3A to 3C show a concrete structure of the light-emitting element bar 80. As shown in FIG. 3A, the light-emitting element bar 80 has a pipe 81 of an outer diameter of about 20 mm and a thin display module 82 inserted in the pipe 81. The pipe 81 is made of a translucent material, for example, transparent polycarbonate. The display module 82 comprises, as shown in FIG. 3B, pixels P1, P2 and P3 mounted on the front surface of a long wiring board 83. Each pixel has LEDs (light-emitting diodes) respectively emitting lights of three primary colors: R (red), G (green) and B (blue), and arranged in proximity along the vertical direction. The rear surface of the wiring board 83 includes print wiring PR as shown in FIG. 3C. A reference symbol T denotes a terminal for connecting the print wiring PR and the driver 53.

[0021] The wiring board 83 has a width W, which is substantially the same as an inner diameter d of the cylindrical translucent pipe 81. Therefore, when the wiring board 83 is inserted in the translucent pipe 81, it is automatically positioned at the center of the pipe 81.

[0022] FIGS. 4A to 4D are diagrams showing examples in which the attitude of the overall display screen of the display apparatus is changed by flexing operations of the flexion means 50H interposed between the light-emitting element panels 50. FIGS. 4A and 4A are top views and FIGS. 4C and 4D are side views of the display screen.

[0023] In the attitude shown in FIG. 4A, left and right light-emitting element panels 50L and 50R are bent inward when viewed from the direction E indicated by the arrow in the drawing. When the panels are set in this attitude, a so-called panoramic effect can be emphasized.

[0024] In the attitude shown in FIG. 4B, one of the left and right light-emitting element panels 50L and 50R (e.g., the left panel 50L) is bent outward when viewed from the direction E indicated by the arrow in the drawing. When the panels are set in this attitude, a wild impression can be emphasized.

[0025] In the attitude shown in FIG. 4C, the upper two light-emitting element panels 50M and 50N are leaned forward when viewed from the direction E indicated by the arrow in the drawing, while the lower two light-emitting element panels 50V and 50W are kept vertical. When the panels are set in this attitude, a so-called planetarium effect can be expected.

[0026] Further, in the attitude shown in FIG. 4D, the light-emitting element panels 50M, 50N, 50V and 50W are bent zigzag so that the panels 50M and 50V are leaned forward when viewed from the direction E indicated by the arrow in the drawing. When the panels are set in this attitude, a wild impression can be emphasized as in the case shown in FIG. 4B.

[0027] The display apparatus of the embodiment

comprises a support member and a plurality of light-emitting elements attached to the support member and performs a predetermined display by light-emission controlling the light-emitting elements, the display apparatus being characterized by comprising: one or a plurality of light-emitting element panels 50, each having a support frame 50F and a plurality of light-emitting element bars 80 arranged in parallel at regular intervals G (for example, about 40 mm) and connected to the support frame 50F, each light-emitting bar 80 being covered by a cylindrical translucent pipe 81; and light-emission control means (10 to 40, 51 to 53) including computers (11 to 13), which light-emission controls the plurality of light-emitting element bars 80 in the one or the plurality of light-emitting element panels 50.

[0028] In the above display apparatus, the light-emitting element bars 80 are fixed to the support frame 50F. Moreover, gaps of about 40 mm are formed between the light-emitting element bars 80, each covered by the cylindrical translucent pipe 81. Therefore, when the display apparatus is set outdoors, even if it is used in a strong wind, the wind can smoothly pass through the gap. Accordingly, the display apparatus is not easily affected by wind: the display screen does not sway due to the wind pressure, and the light-emitting element panels 50 are not destroyed by the wind.

[0029] The light-emitting element panels 50 are arranged in a predetermined pattern in vertical and horizontal directions and flexibly connected to one another by the flexion means 50H.

[0030] In this display apparatus, since the light-emitting element panels 50 are flexibly connected to one another, the setting conditions of the overall display screen (the set position, the set attitude, etc.) can be freely changed to a certain extent. In addition, since the light-emitting element panels 50 are regular-sized and unitized, they can be easily manufactured in a simple process. Moreover, the transfer and assembly works can be very easy.

[0031] The light-emitting element bar 80 comprises a cylindrical translucent pipe 81 and a display module 82 inserted in the translucent pipe 81, and the display module 82 having a long board 83 and a plurality of pixels P1, P2, P3... arranged in a line along the longitudinal direction of the board 83, each pixel having LEDs of the three primary colors of red (R), blue (B) and green (G), and wiring PR for light-emission control being connected to the pixels P1, P2, P3... .

[0032] In the above display apparatus, the display module 82 having LEDs of the three primary colors as pixels arranged on the long wiring board 83 is compactly housed in the translucent pipe 81. Therefore, the display apparatus can be manufactured and handled easily, and highly weather-resistant.

[0033] The long wiring board 83 of the display module 82 is a print wiring board having a width W substantially equal to the inner diameter d of the cylindrical translucent pipe 81.

[0034] In the above display apparatus, when the print wiring board 83 is inserted in the translucent pipe 81, it is automatically positioned at the center of the pipe. Therefore, the display module can be assembled easily without using a special positioning member.

[0035] The pixels P1, P2, P3... in the display modules 82 are arranged in a matrix in at least each light-emitting element panel 50 and two-dimensionally selected and light-emission controlled through the wiring PR, with the result that a color image can be displayed.

[0036] In the above display apparatus, full-color illuminations by means of an abstraction image, a TV image and the like can be flexibly displayed on the overall region or a limited region of the display screen of a single light-emitting panel 50 or a plurality of light-emitting panels 50 connected to one another. In addition, the background behind the display screen can be seen and the display screen can be illuminated from behind, so that more notable stage effects can be obtained if the apparatus is used as stage setting. The display apparatus can also be utilized as a large-screen display apparatus for an outdoor event.

[0037] The translucent pipe 81 is made of transparent polycarbonate.

[0038] In this display apparatus, the translucent pipe 81, which serves as a cover, is drip-proof and readily available.

[0039] The display apparatus according to the embodiment may be modified as follows:

the translucent pipe may be formed of plastic material of a predetermined color,
the flexion means may be an elastic member instead of the hinge mechanism,
light-emitting elements other than LEDs may be used.

Claims

1. A display apparatus comprising a support member and a plurality of light-emitting elements attached to the support member, the apparatus arranged to perform a predetermined display by light-emission by controlling the light-emitting elements, **characterized in that** the apparatus further comprises:

   a light-emitting element panel (50) having a support frame (50F) and a plurality of light-emitting element bars (80) arranged in parallel at regular intervals (G) and connected to the support frame (50F), each light-emitting element bar (80) being covered by a cylindrical translucent pipe (81); and
   light-emission control means (10 to 40, 51 to 53) including computers (11 to 13), arranged to control the light-emission of the plurality of the light-emitting element bars (80) in the light-

emitting element panel (50).

2. A display apparatus according to claim 1, including a plurality of light-emitting element panels (50).

3. A display apparatus according to claim 2, in which the light-emitting element panels (50) are arranged in a predetermined pattern in vertical and horizontal directions and are flexibly connected to one another by flexible means (50H).

4. A display apparatus according to any one of claims 1 to 3, **characterized in that** the light-emitting element bar (80) comprises the cylindrical translucent pipe (81) and a display module (82) inserted in the translucent pipe (81), the display module (82) having a long board (83) and a plurality of pixels (P1, P2, P3...) arranged in a line along a longitudinal direction of a long wiring board (83), each pixel having LEDs of the three primary colors of red (R), blue (B) and green (G), and wiring (PR), for control of light-emission, being connected to the pixels (P1, P2, P3...).

5. A display apparatus according to claim 4, **characterized in that** the long wiring board (83) of the display module (82) is a print wiring board having a width (W) substantially equal to an inner diameter (d) of the cylindrical translucent pipe (81).

6. A display apparatus according to claim 4, **characterized in that** the pixels (P1, P2, P3...) in the display modules (82) are arranged in a matrix in the light-emitting element panel (50) and are two-dimensionally selected and light-emission controlled through the wiring (PR), thereby displaying a color image.

7. A display apparatus according to claim 4, **characterized in that** the translucent pipe (81) is made of translucent polycarbonate.

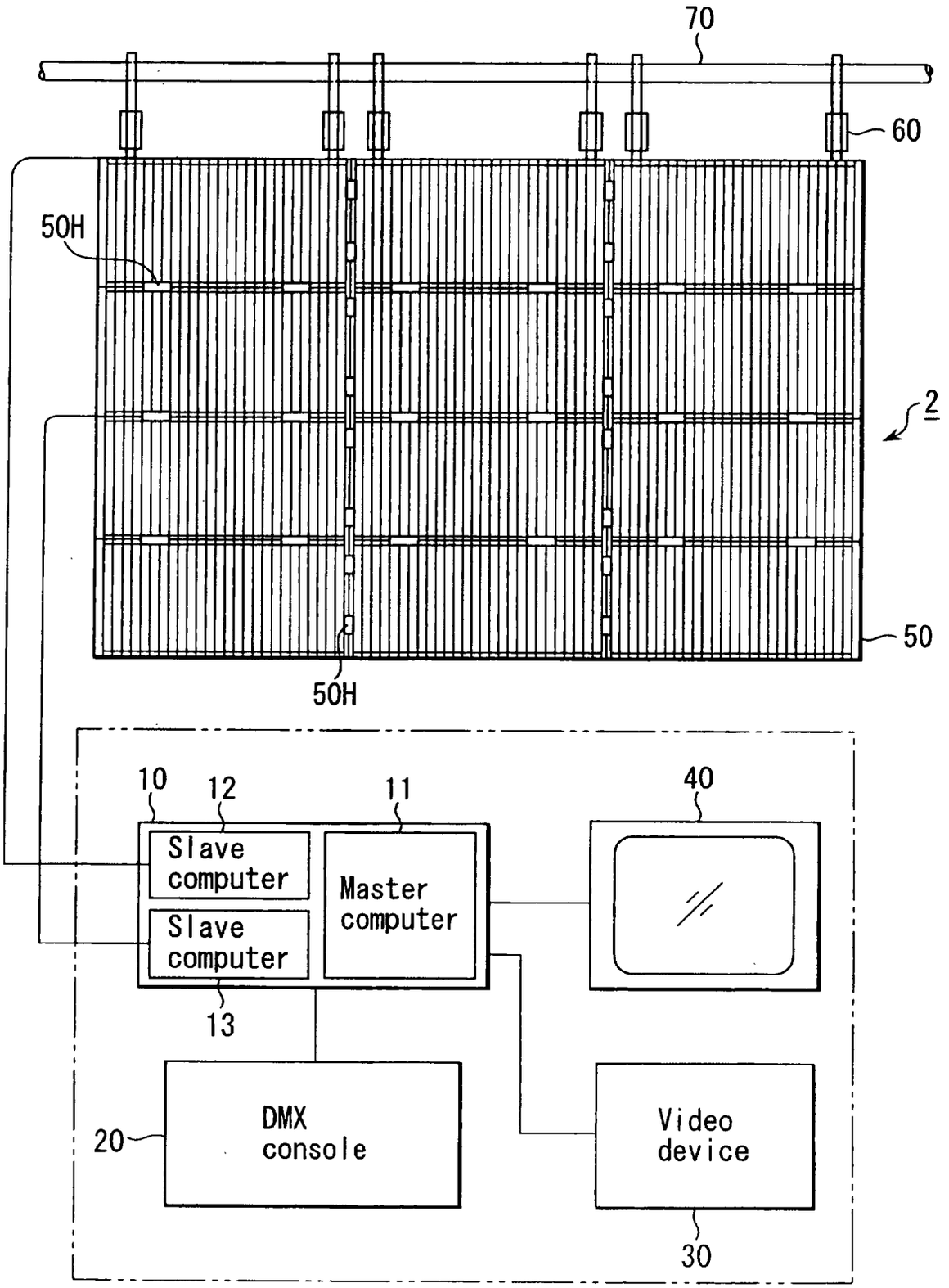

70
60
50H
2
50
50H
10
12
11
40
Slave computer
Slave computer
Master computer
13
20
DMX console
Video device
30

FIG. 1

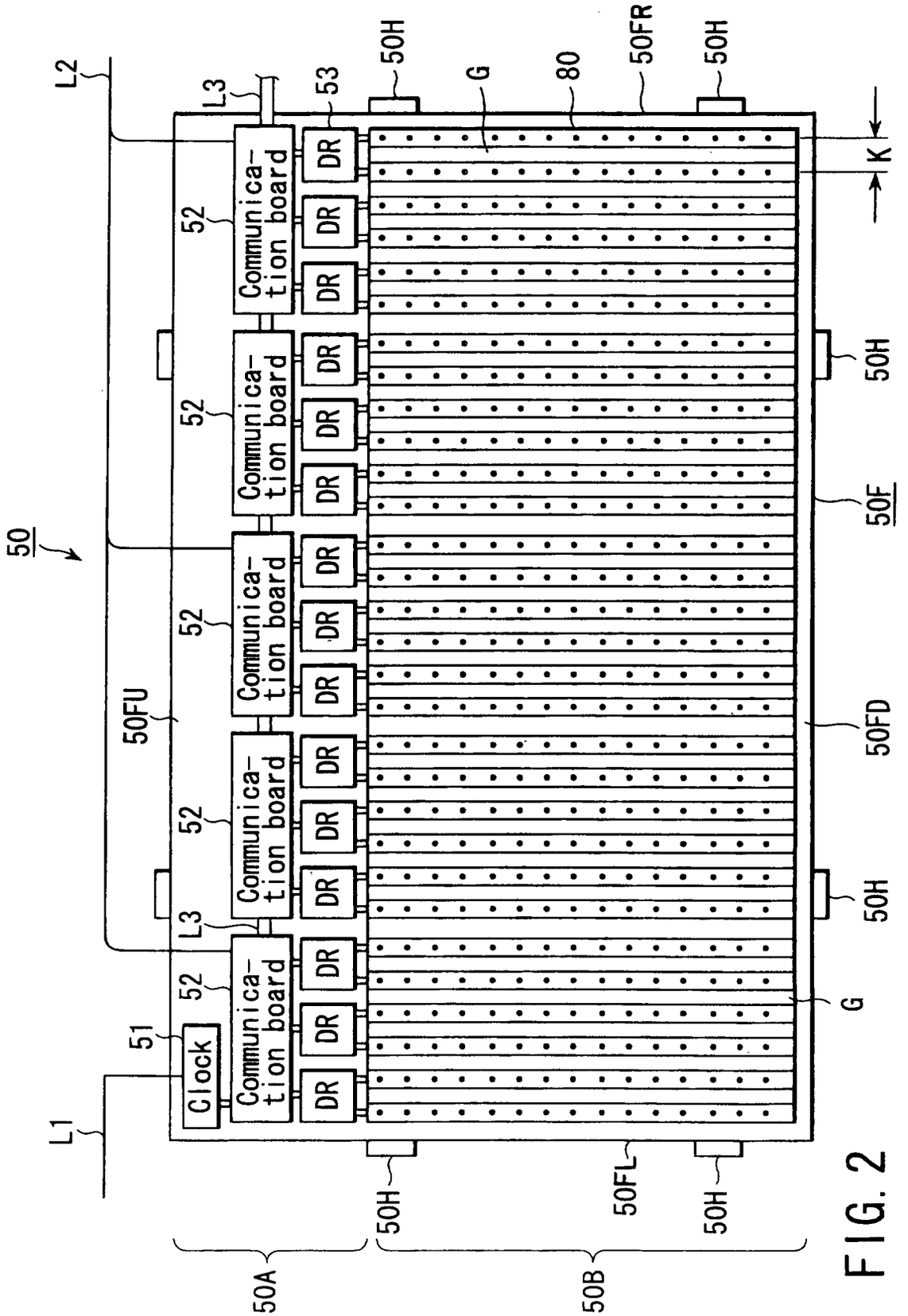

50
L1
L2
L3
51
Clock
52
Communica-tion board
DR
53
50H
G
80
50FR
K
50F
50FU
50FD
50FL
50A
50B

FIG. 2

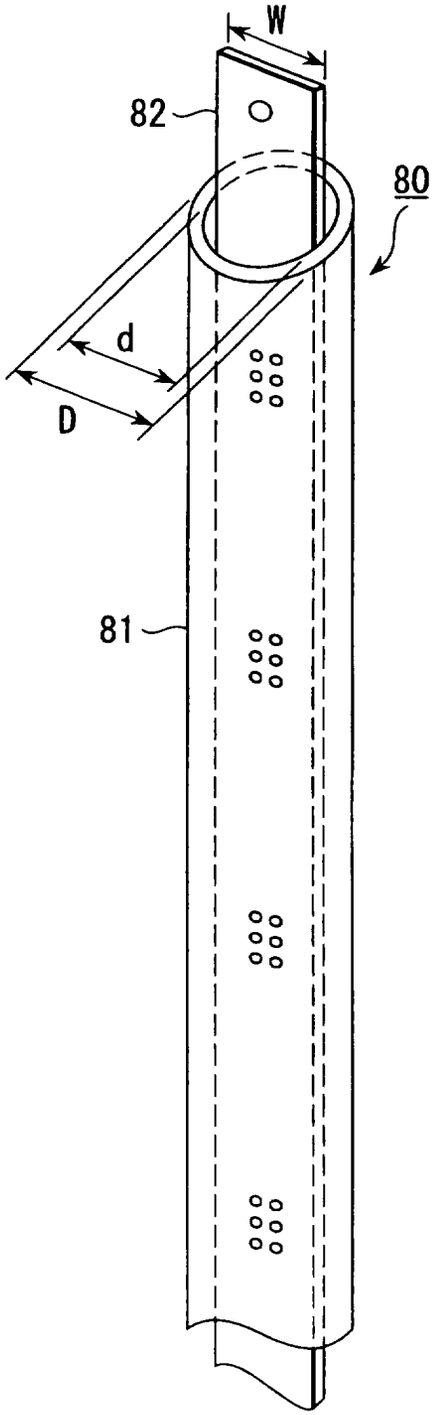


FIG. 3A

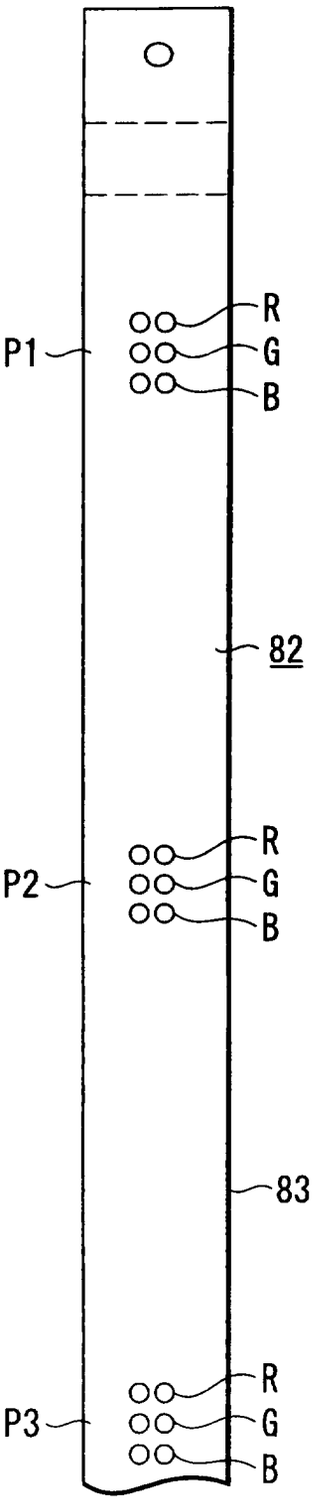


FIG. 3B

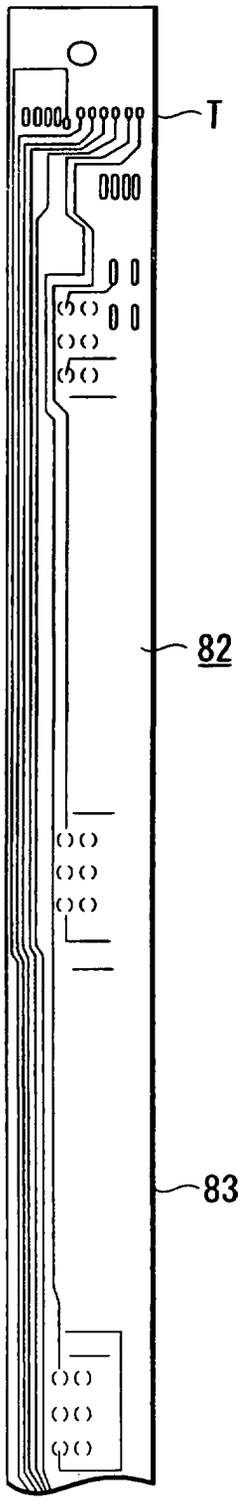


FIG. 3C

FIG. 4A

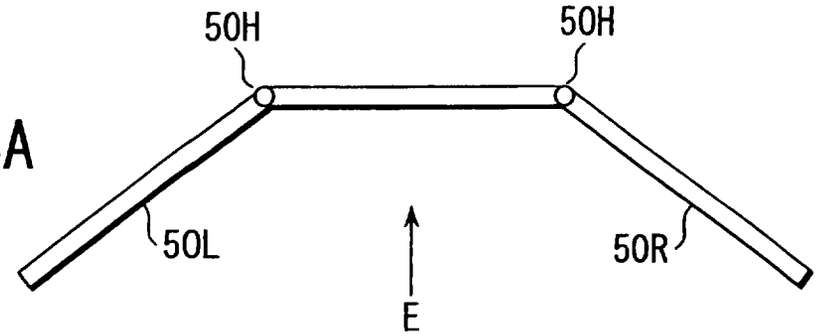
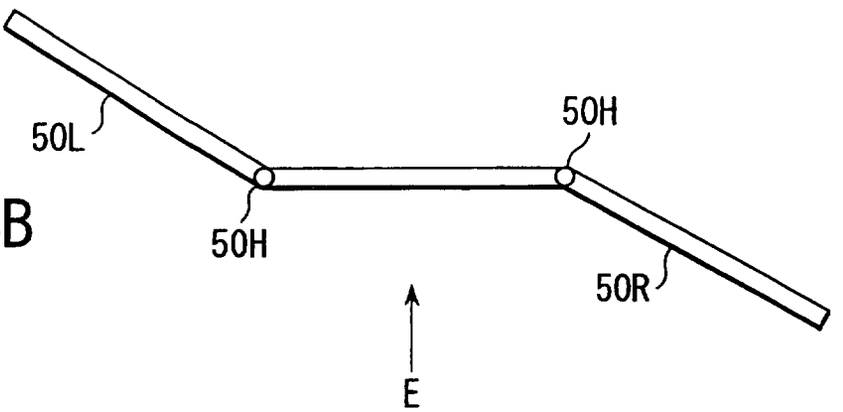


FIG. 4B



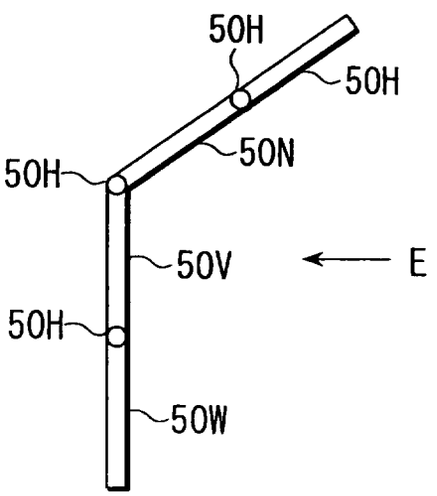


FIG. 4C

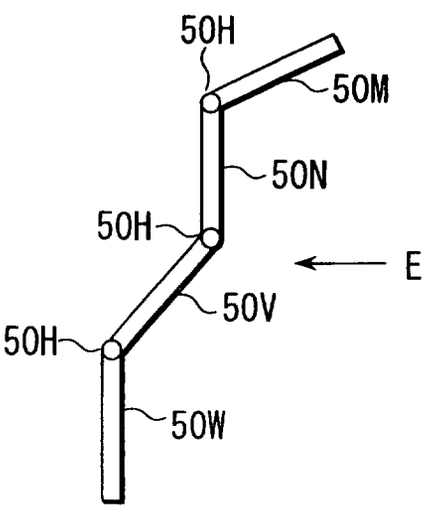


FIG. 4D