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DE-A- 3 736 922
US-A- 4 623 821

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Description

The present invention relates to a fluorescent lamp, and particularly to a fluorescent lamp for use in a large sized color image display apparatus.

FIG.6 is a front view of a conventional special type fluorescent lamp for use in a light emitting device for a large sized color image display apparatus. The special type fluorescent lamp has a hexagonal-shaped glass enclosure 20 comprising six triangular compartments 16a, 16b, 16c, 17a, 17b, 17c divided by six partitions, a filament cathode 19 common for all of the six triangular compartments disposed at the center part of the hexagonal enclosure, and six anode electrodes 18, 18, ... disposed near respective bottoms of the six triangular compartments. Respective triangular compartments have fluorescent films of three colors, for instance red, green, blue, red, green, blue. Such hexagonal type color fluorescent lamp is disclosed in the Japanese published unexamined patent application (Tokkai) Sho 61-55851. In the above-mentioned fluorescent lamp of the prior art, there are several shortcomings that: arrangement of the fluorescent lamp on a large sized color display panel is complicated and the assembling and wiring thereof is also complicated since the enclosure has a hexagonal shape; that each triangular compartment constitutes a discharge path only in a narrow straight-bar-shaped region between the filament cathode and each anode in a large triangular compartment, and therefore the effective light emitting area is limited to a very narrow area in the triangular compartment, hence limiting ratio of brightness per area of the display apparatus; and that since the filament cathode is disposed with its coil axis in a direction of one partition wall of the hexagonal enclosure, the conditions of discharge for six compartments are not uniform, thereby producing non-uniformity of thermal electron supplies for compartments of different colors, hence inducing non-uniformities of discharge retention voltage and brightness of colors.

JP-A-62 188 160 describes an one pixel fluorescent lamp in which a common electrode is installed in an electrode chamber of an electrode chamber unit attached to the outer bottom part of a light source tube member. Discharge paths are formed by partition walls inside the light source tube member, and the whole planes of respective discharge paths are coated with phosphors. Positive electrodes arranged on an opening plane of the electrode chamber are inserted into the respective discharge paths.

The purpose of the present invention is to provide a fluorescent lamp which is easy in arrangement on a color display panel, and has a high brightness and uniformity of brightness.

This object is achieved in a fluorescent lamp according to the features of claim 1.

The fluorescent lamp in accordance with the present invention comprises a rectangular gas-tight enclosure having a transparent or translucent face panel on the front face and a filament electrode container provided at the central parts on the rear wall, and the filament electrode container contains a common filament electrode therein. The rectangular enclosure and the filament electrode container together constitute an integral gas-tight enclosure. In the rectangular enclosure, plural partitions are provided so as to divide the inside space of the rectangular enclosure into plural, such as six rectangle compartments, each of which is connected through respective connection holes to the space of the filament electrode container. The plural rectangle compartments form discharge spaces for lights of different colors. The filament electrode provided in the filament electrode container is disposed with its coil axis in a direction perpendicular to the lengthwise (hence vertical in the embodiment) partition walls disposed in the enclosure. Each compartment has an other electrode on the far end part from the connection hole. The inside walls of respective compartments have phosphor layers of different colors. A discharge gas comprising a rare gas, e.g. Ar, and Hg is confined in the enclosure. Therefore, gas discharge paths are constituted between the common filament electrode and the respective other electrodes at the far side of the compartments via respective connection holes. Thus, the rectangle enclosure coupled with the filament electrode container constitutes plural fluorescent lamps of different colors of light. Lighting or extinguishing of respective fluorescent lamps is controlled by potentials to be applied to the other electrodes, and the brightness of light is controlled by controlling currents or time periods (duty times) of the currents. The upper half portion of the rectangle enclosure having three compartments for three primary colors of light constitutes one pixel, and the lower half portion similarly constitutes the other one pixel. Therefore, the rectangle enclosure having six compartments constitutes two pixels.

The invention, both as to organization and content, will be better understood and appreciated, along with other objects and features thereof, from the following detailed description taken in conjunction with the drawings.

FIG.1 is an exploded view of the fluorescent lamp embodying the present invention.

FIG.2 is a front view of the fluorescent lamp of FIG.1.

FIG.3 is a chromaticity diagram of light emitted by the fluorescent lamp of the embodiment (hatched region) and NTSC color reproduction

range (in the chain line triangle region).

FIG.4 is a drawing to show the arrangement of the fluorescent lamp of FIG.1 through FIG.3 in a color image display apparatus.

FIG.5 is a drawing to show an arrangement of the fluorescent lamp of another example in a color image display apparatus.

FIG.6 is a front view of the fluorescent lamp of the prior art.

It will be recognized that some or all of the Figures are schematic representations for purposes of illustration and do not necessarily depict the actual relative sizes or locations of the elements shown.

As shown in FIG.1, the fluorescent lamp of a preferred embodiment has a gas-tight rectangle enclosure 1 made of rectangle ceramic box of 34 mm height x 17 mm width x 10 mm depth size made of ceramics wherein the front face is a glass sheet 2 bonded gas-tightly on the front part of the ceramic enclosure 1 with low melting point glass. Rectangle enclosure 1 has several partition walls 5, 5, 5′ therein to divide the inside space of the enclosure 1 into six rectangle compartments. That is, two lengthwisely i. e. vertically disposed partitions 5, 5 and one crosswisely i. e. horizontally disposed partition 5' are provided like a lattice thereby producing six rectangle compartments 6a, 6b, 6c, 7a, 7b, 7c. In the embodiment, the size of each compartment is 14 mm length x 3.5 mm width x 3.5 mm depth. The ceramic rectangle enclosure 1 has six widthwise rectangle connection holes 86a, 86b, 86c, 87a, 87b, 87c on the rear wall in the compartment 6a, 6b, 6c, 7a, 7b, 7c, respectively, and a filament electrode container 4 having a filament electrode 9 therein is mounted in a circular recess 3 formed on the rear face of the rear wall and bonded gas-tightly to the rear wall with low temperature glass. The widthwisely rectangular connection holes 86a, 86b, 86c, 87a, 87b, 87c connect the inside space of the filament electrode container 4 and respective rectangle compartments 6a, 6b, 6c, 7a, 7b, 7c, respectively. The filament 9 is about 10 mm long, has a known emission oxide coating thereon, and is supported by a pair of inside lead wires 10, 10 which are provided on a glass stem 11. A pair of outer lead wires is connected to the inside lead wires 10, 10, respectively, and an evacuation tube 12 is provided on the stem 11. The filament 9 serves as a common cathode for all the six rectangle compartments 6a, 6b, 6c, 7a, 7b, 7c, and is disposed with its coil axis to be perpendicular to the planes of the lengthwise partitions 5, 5, and off-set rearward from the back face of rear wall 19 of the ceramic rectangle enclosure by 3—7mm. Respective compartments 6a, 6b, 6c, 7a, 7b, 7c comprise anode electrodes 14a, 14b 14c, 15a, 15b, 15c, all made of Ni-plated iron wire or the like high melting point metal, at their far end parts from the connection holes 86a, 86b, 86c, 87a, 87b, 87c, respectively. Of course, lead-wires to these anode electrodes are provided with gas-tight seal parts on the rear wall 19.

By the above-mentioned construction, six fluorescent lamps are constituted in the six compartments 6a, 6b, 6c, 7a, 7b, 7c, wherein gas discharge paths are formed between their anodes 14a, 14b, 14c, 15a, 15b, 15c and a common filament cathode 9 through the individual through-holes 86a, 86b, 86c, 87a, 87b, 87c, respectively.

On the inside faces of the rear wall 19 of the respective compartments, rare-earth phosphor layers for respective light colors are provided, for instance, a green emitting phosphor layer in the compartments 6a, 7a, a red light emitting phosphor layer in the compartments 6b and 7b, and a blue light emitting phosphor layers in the compartments 6c and 7c.

As discharge gas, a rare gas, e. g. Ar of 1300—2000 Pa (10—15 Torr)., especially of about 1730 Pa (13 Torr). is confined together with a necessary amount of Hg in the rectangle enclosure 1.

In this way, the compartments 6a, 6b, 6c constitute one square pixel and the compartments 7a, 7b, 7c constitute another square or rectangle pixel, and therefore, the fluorescent lamp comprises two (namely, upper and lower) pixels. FIG.4 is a front view showing an arrangement of an assembly of the fluorescent lamps shown in FIG.1 and FIG.2, wherein straight lines show outside faces of the outside walls 1′, 1′, of the rectangle enclosure 1, and double parallel vertical lines show vertical partition walls 5, 5 in the rectangle enclosure 1.

The fluorescent lamp in accordance with the present invention has a rectangle outside shape, wherein each compartment as discharge space is also rectangle. Therefore, the space factor of the discharge space per area of the compartment is high. Furthermore, since the outside shape of the rectangle enclosure 1 is rectangle, its arrangement on the large-sized display panel is very simple as shown in FIG.4. That is, the enclosures can only be disposed in vertical and horizontal rows. Since the common filament electrode 9 is disposed with its coil axis perpendicular to the plane of the vertical partition walls, in other words, perpendicular to the discharge paths in respective compartments 6a, 6b, 6c, 7a, 7b, 7c, with an off-set distance from the back face of the rear wall 19, the supply of thermal electrons to respective discharge spaces is uniform. Therefore, discharge maintain voltages for all discharge paths are uniform, and hence there is substantially no irregularity of brightness on the screen. Since the rectangle enclosure 1 is made of a ceramic box, it is easily produced with a highly

accurate size and shape.

In order to display a picture with the fluorescent lamp of the embodiment, first a voltage above a discharge start voltage is applied from an auxiliary discharge current source to respective anodes 14a, 14b, 14c, 15a, 15b, 15c and the common cathode, thereby to start discharging with auxiliary discharge currents which are limited to small currents of, e.g. about 10 μA. Then, from a dynamic current source which issues pulse-width modulated currents of about thousand times as large as the auxiliary discharge currents, large discharge currents e.g. about 10 mA are fed to the respective anodes, controlling the duty times thereof based on picture signals. By the duty time control, it is possible to produce any light of colors within the triangle range shown by hatching in the chromaticity diagram of FIG.3, which is substantially similar to the chromaticity triangle of NTSC color reproduction range shown by chain lines. By the PWM modulation of the current of the anode circuit, any desired color picture within the range of the chromaticity triangle shown in FIG.3 is freely obtainable. Therefore, by combining the fluorescent lamp in vertical and horizontal rows as shown in FIG.4, any desired large scale color television display is produced.

When the brightness of the fluorescent lamp in accordance with the present invention is compared with the fluorescent lamp of the prior art shown in FIG.6, the ratio of brightness to input electric power was improved to 1.3 times the ratio of the conventional fluorescent lamp shown in FIG.6. Furthermore, by arranging the fluorescent lamps in accordance with the present invention as shown in FIG.4, the number of fluorescent lamps per area can be increased to 1.3 times the number using the conventional fluorescent lamp shown in FIG.6. Use of the ceramic box in place of conventional glass box as the rear part of the rectangle fluorescent lamp enclosure of this example improves reflectivity of emitted light, and improves the brightness in comparison with the use of an all glass fluorescent lamp enclosure. Furthermore, because of achievement of a uniform discharge maintain voltage of the respective element discharge paths in each fluorescent lamp, substantially no brightness fluctuation or irregularity was observed.

In a still other embodiment of FIG.5, 3n (n is 1, 2, 3 ...) (in this example 6) rectangular compartments are formed in widthwise direction thereby to provide 2n (in this example 4) pixels (i.e. n upper pixels and n lower pixels) in one rectangle fluorescent lamp having a widthwisely long filament electrode, as shown in FIG.5.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form can been changed in the details of construction and the combination and arrangement of parts may be resorted to without departing from the scope of the claims.

Claims

1. A fluorescent lamp comprising:

a rectangular gas-tight enclosure (1) having a transparent or translucent face panel (2) on the front face,

3n-1 (n is 1, 2, 3 ...) lengthwise partitions (5, 5) and a widthwise partition (5') which are provided in said rectangular enclosure (1) to divide its inside space into 3n (n is 1, 2, 3, ...) rectangular compartments in an upper row and in a lower row,

a filament electrode container (4) provided at the central part on the rear wall (19) of said rectangular gas-tight enclosure (1) in a manner to be connected to the inside space of said rectangular enclosure (1) through 3n (n is 1, 2, 3 ...) connection holes formed in said plural rectangular compartments at the central part of said rear wall (19), respectively,

a common filament electrode (9) provided in said filament electrode cointainer (4) with its axis substantially perpendicular to the plane of said lengthwise partitions in a manner to substantially extend to face all the connection holes,

plural other electrodes provided in respective ones of said compartments at their far end regions from said connection holes,

phosphor layers for emission of light of three different colors (R, G, b) provided on each of the first-side pixel regions which are formed by the 3n compartments (6a, 6b, 6c) on one side of said widthwise partition (5') and of the second-side pixel regions which are formed by the 3n compartments (7a, 7b, 7c) on the other side of said widthwise partition (5'), and

a discharge gas comprising at least a rare gas and Hg, whereby

discharge paths are formed in respective rectangular compartments between said common filament electrode and respective ones of other electrodes, to provide 2n pixels.

2. A fluorescent lamp in accordance with claim 1, wherein n is 1.

3. A fluorescent lamp in accordance with claim 1 or 2, wherein

said connection holes are made on a recessed area (3) on the rear face of said rear wall (19), and

said filament electrode container (4) is mounted in and fixed to said recess.

Patentansprüche

1. Eine fluoreszente Leuchtvorichtung, die aufweist:

ein rechteckiges gasdichtes Gehäuse (1) mit einer transparenten oder lichtdurchlässigen Seitenplatte (2) an der Vorderseite,

3n-1 (wobei n 1, 2, 3 ... ist) längsverlaufende Trennwände (5, 5) und eine in der Breite verlaufende Trennwand (5'), die in dem rechteckigen Gehäuse (1) vorgesehen sind, um seinen Innenraum in 3n (wobei n 1, 2, 3 ... ist) rechteckige Unterteilungen in einer oberen Reihe und in einer unteren Reihe zu unterteilen,

einen Filamentelektrodenbehälter (4), der an dem Mittelteil an der Rückwand (19) des rechteckigen gasdichten Gehäuses (1) auf eine Weise vorgesehen ist, daß er mit dem Innenraum des rechteckigen Gehäuses (1) durch 3n (wobei n 1, 2, 3 ... ist) Verbindungslöcher verbunden ist, die in den mehreren rechteckigen Unterteilungen in dem Mittelteil der Rückwand (19) ausgebildet sind,

eine gemeinsame Filamentelektrode (9), die in dem Filamentelektrodenbehälter (4) vorgesehen ist, wobei ihre Achse im wesentlichen senkrecht zu der Ebene der längsverlaufenden Trennwände derartig liegt, daß sie im wesentlichen derart verläuft, daß sie all den Verbindungslöchern gegenüberliegt,

mehrere andere Elektroden, die in jeweiligen Unterteilungen an deren von den Verbindungslöchern weiter entfernt liegenden Endbereichen vorgesehen sind,

Phosphorschichten zur Emission von Licht von drei verschiedenen Farben (R, G, b), die an jedem der Pixelbereiche einer ersten Seite vorgesehen sind, die durch die 3n Unterteilungen (6a, 6b, 6c) an einer Seite der in der Breite verlaufenden Trennwand (5') ausgebildet sind, und an jedem der Pixelbereiche einer zweiten Seite, die durch die 3n Unterteilungen (7a, 7b, 7c) an der anderen Seite der in der Breite verlaufenden Trennwand (5') ausgebildet sind, und

ein Entladungsgas, das wenigstens ein Edelgas und Hg aufweist, wobei

Entladungspfade in jeweiligen rechteckigen Unterteilungen zwischen der gemeinsamen Filamentelektrode und jeweiligen anderen Elektroden ausgebildet sind, um 2n Pixel zu schaffen.

2. Eine fluoreszente Leuchtvorrichtung nach Anspruch 1, wobei n gleich 1 ist.

3. Eine fluoreszente Leuchtvorrichtung nach Anspruch 1 oder 2, wobei

die Verbindungslöcher in einem ausgesparten beziehungsweise vertieften Abschnitt (3) auf der Rückseite der Rückwand (19) ausgebildet sind, und

der Filamentelektrodenbehälter (4) in der Aussparung beziehungsweise Vertiefung angebracht und mit ihr befestigt ist.

Revendications

1. Lampe fluorescente comprenant :
   - une enceinte rectangulaire étanche aux gaz (1) ayant un panneau facial transparent ou translucide (2) sur la face avant,
   - 3n-1 (n est 1, 2, 3, ...) cloisons longitudinales (5, 5) et une cloison transversale (5') qui sont prévues dans ladite enceinte rectangulaire (1) afin de diviser son espace intérieur en 3n (n est 1, 2, 3, ...) compartiments rectangulaire dans une rangée supérieure et dans une rangée inférieure,
   - un conteneur (4) d'électrode à filament prévu à la partie centrale de la paroi arrière (19) de l'enceinte rectangulaire étanche aux gaz (1) de manière à être connecté à l'espace intérieur de ladite enceinte rectangulaire (1) par l'intermédiaire de 3n (n est 1, 2, 3 ...) trous de liaison ménagés dans ladite multitude de compartiments rectangulaires à la partie centrale de ladite paroi arrière (19), respectivement,
   - une électrode commune à filament (9) prévue dans ledit conteneur d'électrode à filament (4) avec son axe sensiblement perpendiculaire au plan desdites cloisons longitudinales de manière à s'étendre pratiquement pour être en regard des trous de liaison,
   - plusieurs autres électrodes prévues dans des compartiments respectifs parmi lesdits compartiments à leurs zones du côté éloigné par rapport auxdits trous de liaison,
   - des couches de substance fluorescente pour l'émission d'une lumière de trois couleurs différentes (R, V, B) prévues sur chacune des zones de pixels du premier côté qui sont formées par les 3n compartiments (6a, 6b, 6c) sur un côté de ladite cloison transversale (5') et des zones de pixels du second côté qui sont formées par les 3n compartiments (7a, 7b, 7c) à l'autre côté de ladite cloison transversale (5'), et

- un gaz de décharge comprenant au moins un gaz rare et Hg, d'où il résulte que :
- des trajets de décharge sont formés dans les compartiments rectangulaires respectifs entre ladite électrode commune à filament et des électrodes respectives parmi les autres électrodes, de manière à fournir 2n pixels.

2. Lampe fluorescente selon la revendication 1, dans laquelle n est égal à 1.

3. Lampe fluorescente selon la revendication 1 ou 2, dans laquelle:
- lesdits trous de liaison sont ménagés sur une zone évidée (3) à la face arrière de ladite paroi arrière (19), et
- ledit conteneur (4) d'électrodes à filament est monté dans ledit évidement et lui est fixé.

FIG.1

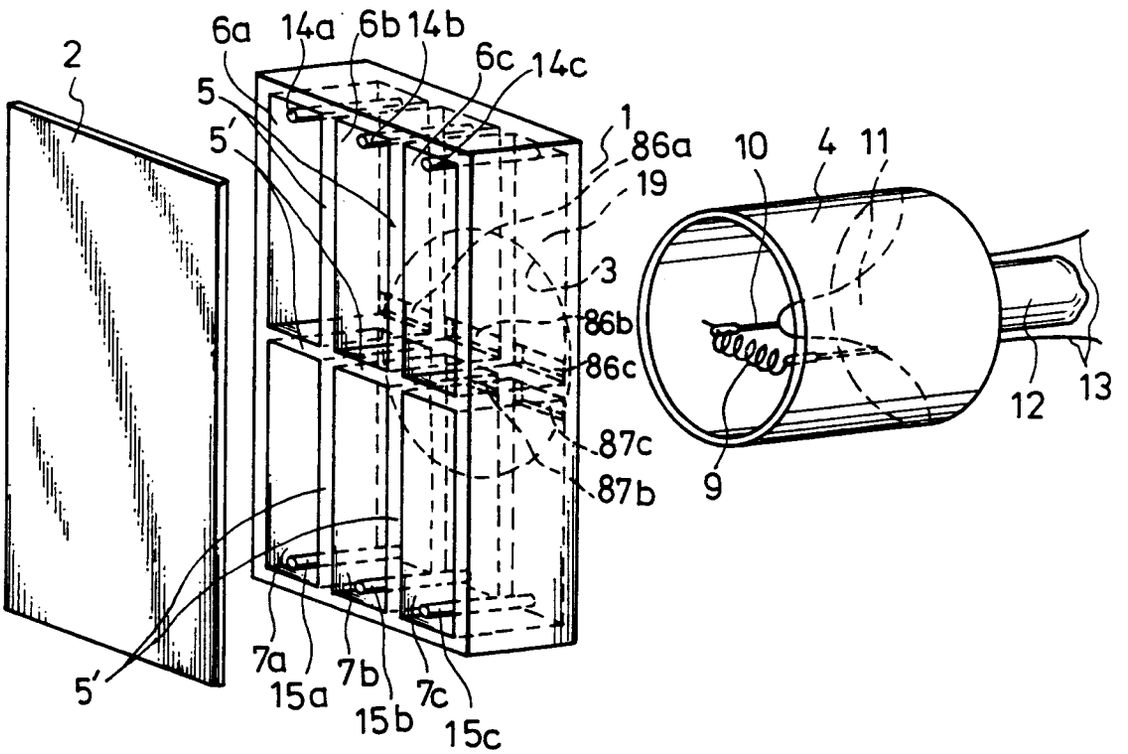
2
6a
14a
6b
14b
6c
14c
5
5'
1
86a
10
4
11
19
3
86b
86c
87c
87b
9
12
13
5'
7a
15a
7b
15b
7c
15c

FIG. 2

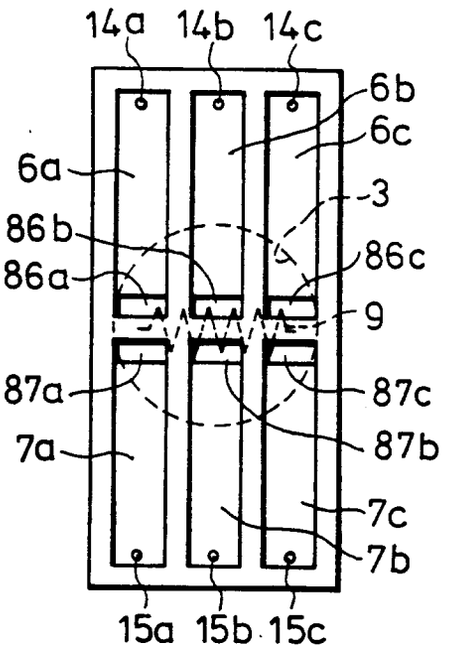
14a
14b
14c
6b
6c
6a
3
86b
86c
86a
9
87a
87c
87b
7a
7c
7b
15a
15b
15c

FIG.3

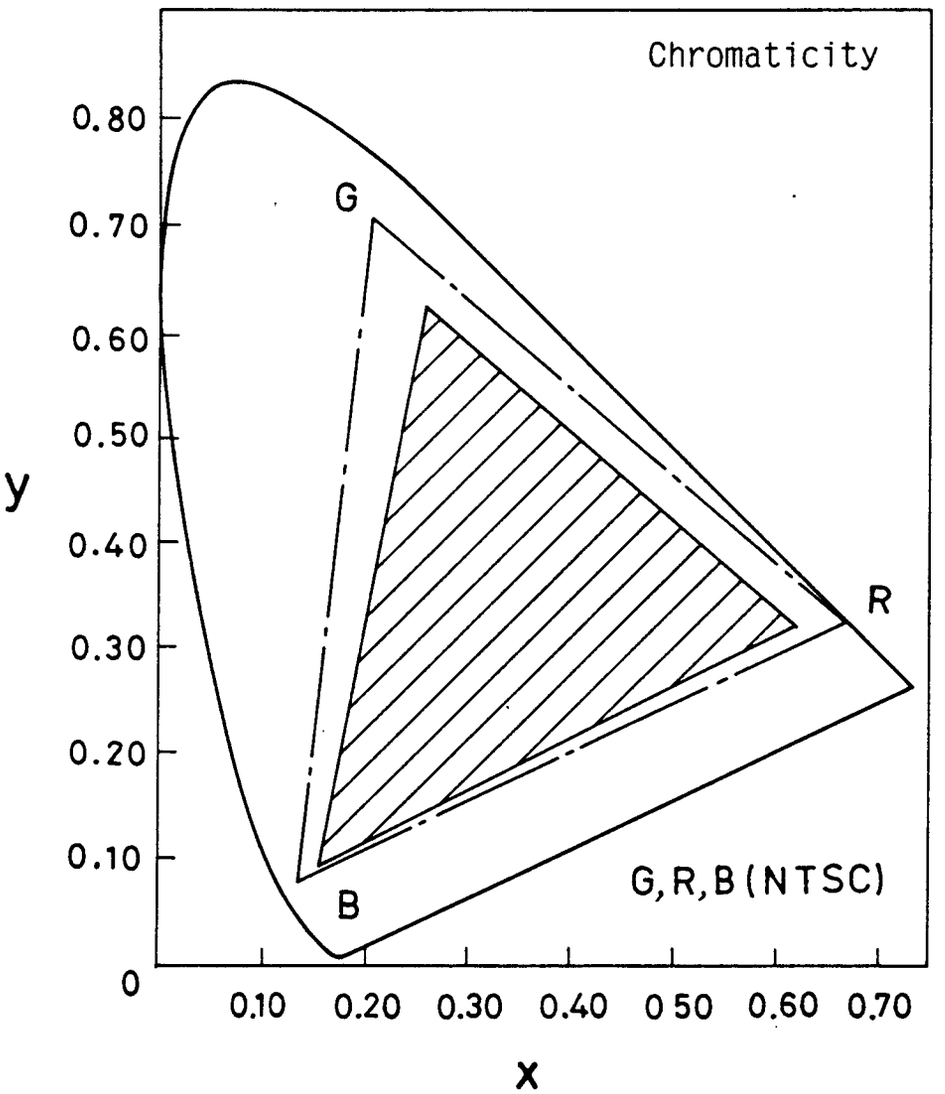
Chromaticity
G
R
B
G,R,B(NTSC)
y
x
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0
0.10
0.20
0.30
0.40
0 50
0.60
0.70

FIG. 4

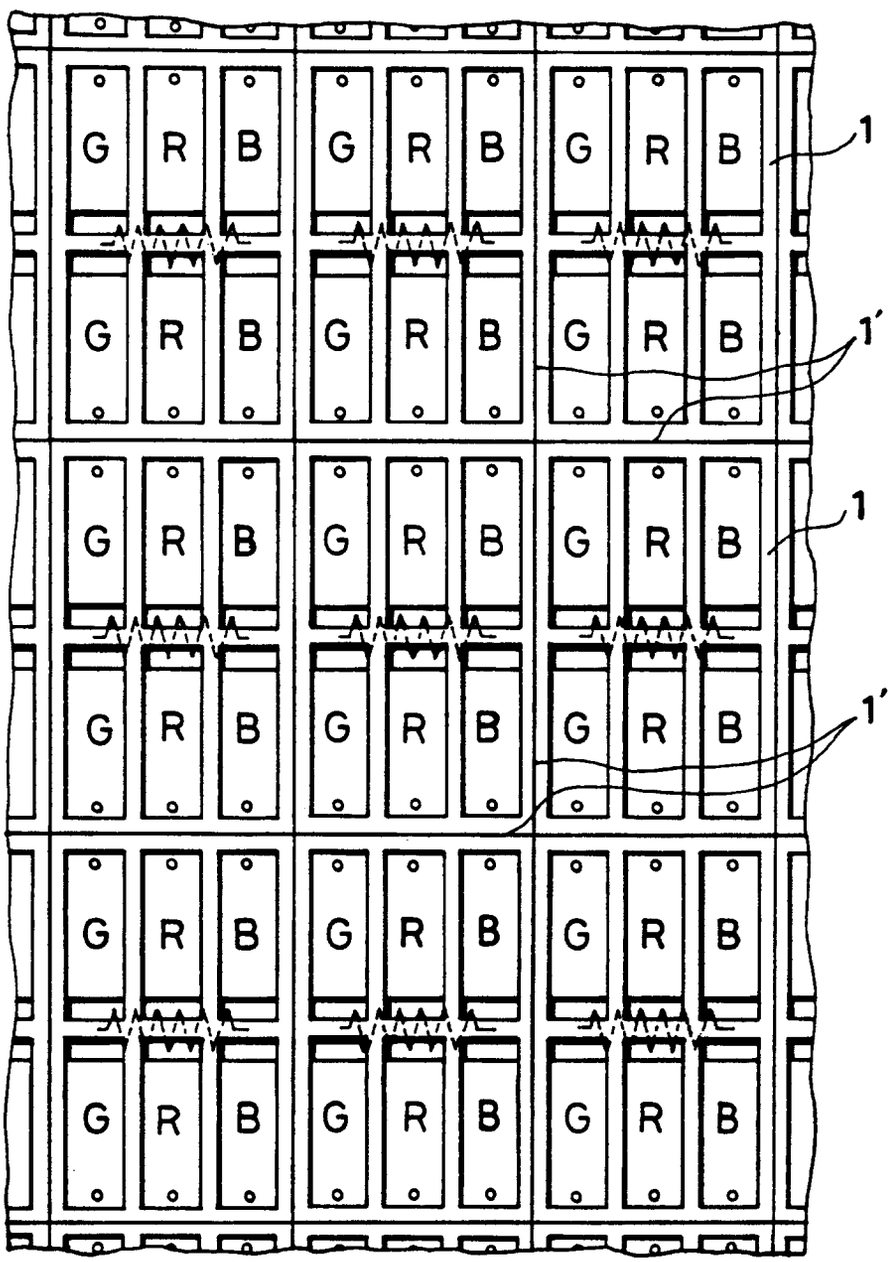

FIG. 5

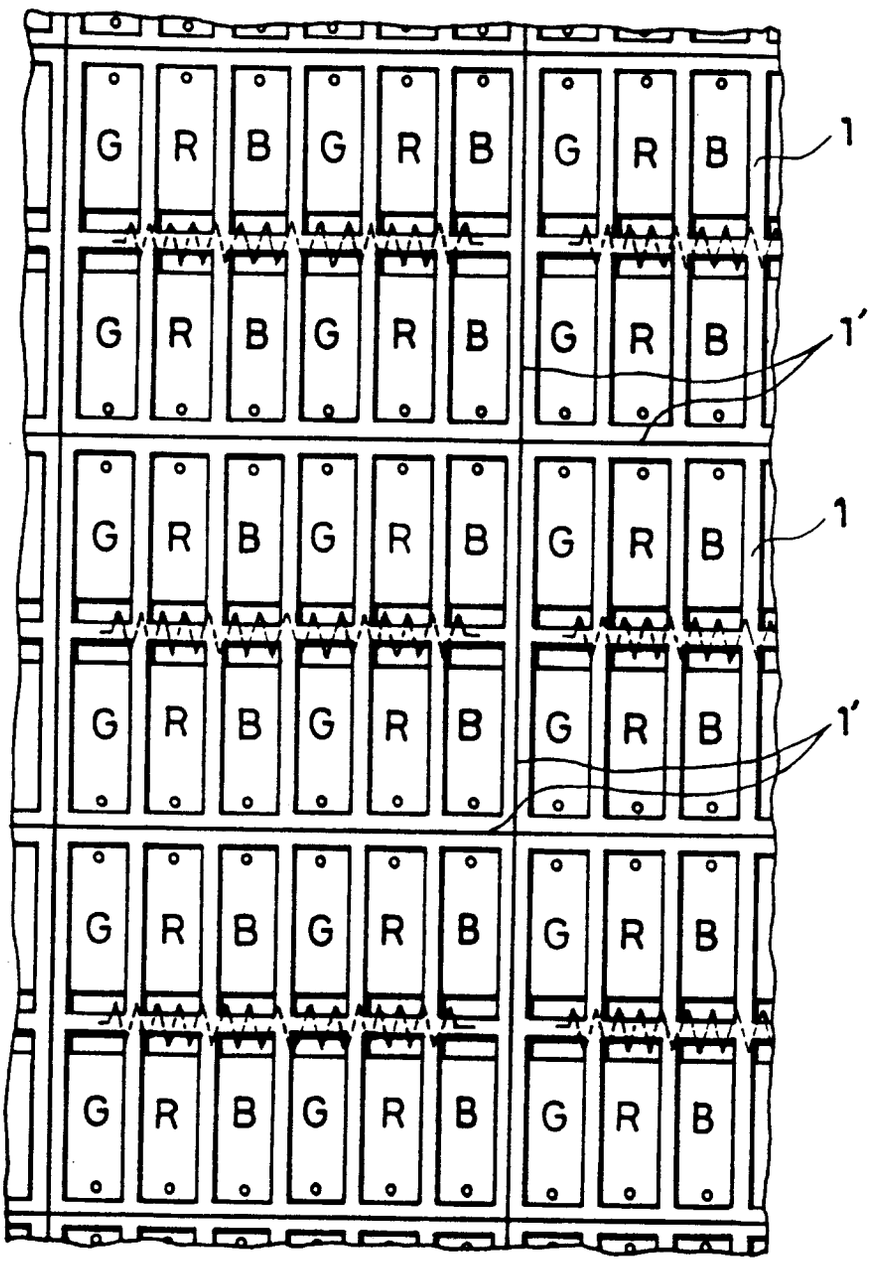

FIG. 6 (Prior Art)