United States Patent

[11] **3,609,235**

[72] Inventor **Samuel P. Sawyer**
Evanston, Ill.

[21] Appl. No. **866,978**
[22] Filed **Oct. 16, 1969**
[45] Patented **Sept. 28, 1971**
[73] Assignee **Zenith Radio Corporation**
Chicago, Ill.

[54] **MASK COMPENSATION FOR MATRIXED-ELEMENT FLAT-PANEL TELEVISION DISPLAY**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **178/7.85,** 250/237, 313/117
[51] **Int. Cl.** **H04n 5/72,** H01j 5/16, H01j 61/40, H01k 1/26
[50] **Field of Search** ..... 313/65, 70 C, 92 B, 117; 250/217 CR, 237; 178/5.2 A, 5.2 D, 7.85, 7.87

[56] **References Cited**
UNITED STATES PATENTS

2,721,900	10/1955	Oliver	315/9 X
2,726,351	12/1955	Theile	315/9

Primary Examiner—Roy Lake
Assistant Examiner—V. Lafranchi
Attorney—John J. Pederson

ABSTRACT: A flat-panel television display of matrixed emitting, controlling or reflecting image elements which differ in light output per unit excitation is compensated by a mask having transmitting areas of a size and configuration corresponding to those of the image elements which vary inversely in transmissivity from area to area with the brightness of each corresponding display element.

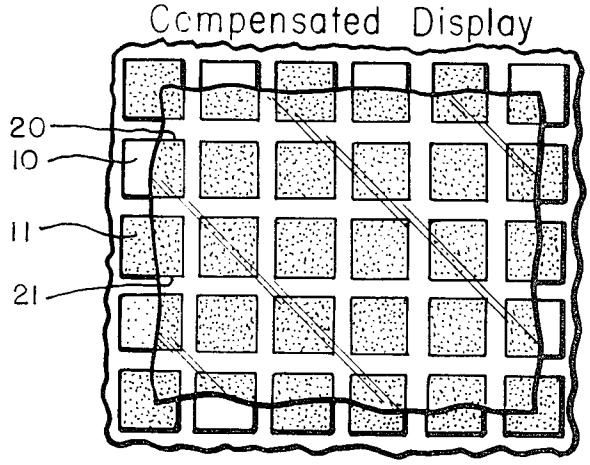


FIG. 1

Imaging Panel

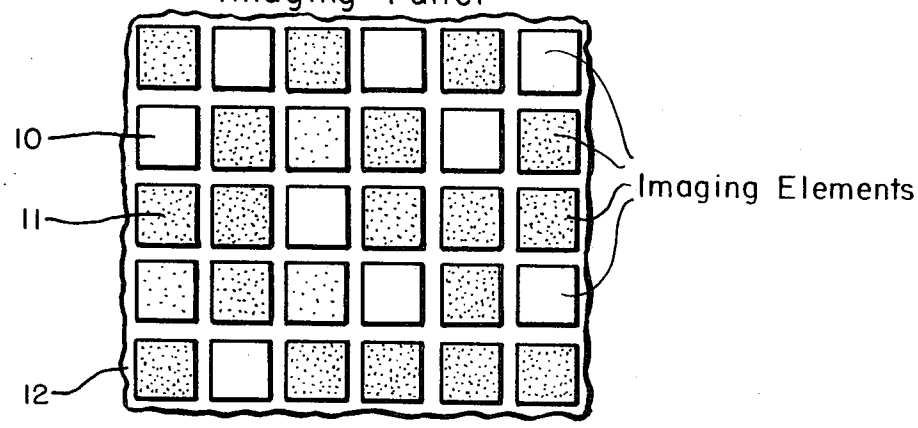


FIG. 2

Film Transparency Mask

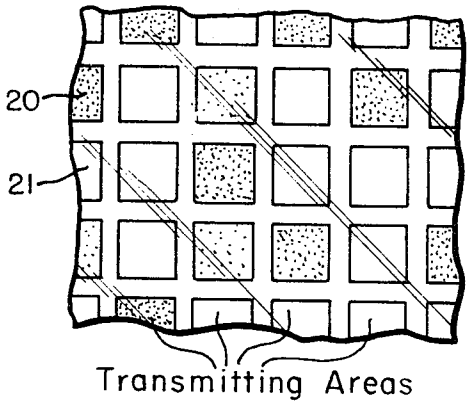
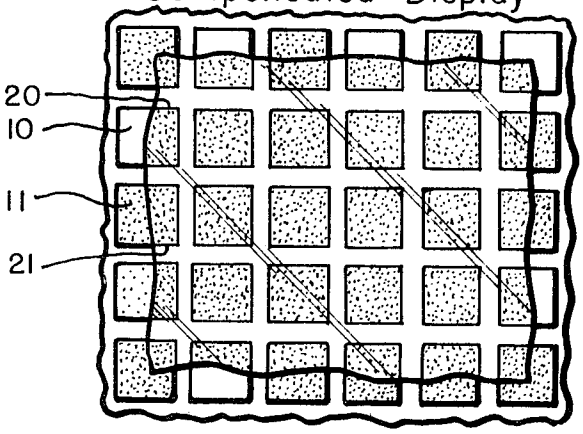


FIG. 3

Compensated Display



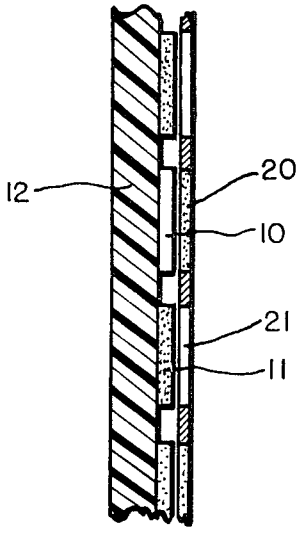


FIG. 4

Inventor
Samuel P. Sawyer
By John J. Pederson
Attorney

MASK COMPENSATION FOR MATRIXED-ELEMENT FLAT-PANEL TELEVISION DISPLAY

BACKGROUND OF THE INVENTION

This invention generally relates to a flat-panel television display of the type having discrete matrix image elements. More particularly, it relates to a flat-panel television display in which such elements vary in brightness for a given excitation and are compensated so that each element will appear to be at the same brightness level as any other, for the same excitation.

Flat-panel displays, of the type embodying matrixed arrays of discrete image elements, such as electroluminescent cells, gas plasma cells, or injection diodes, have in common certain deficiencies inhibiting their wider application and use, not the least of which is a tendency of a given constituent image element to emit or reflect more light than another element for the same actuating signal.

Such nonuniform brightness characteristics are further aggravated by the demands of mass production, since uniform standards for the image elements in the vast numbers required are difficult to maintain, and imperfections in the assembly of such numbers of elements will unavoidably occur. These must be compensated if the display is not to present a degraded image.

Therefore, it is an object of the present invention to provide an improved television flat display wherein nonuniform brightness characteristics are compensated.

It is a further object of this invention to provide a television flat-panel display of matrixed elements wherein the light output characteristics of the image elements are individually adjusted in a simple and economical manner so that light output of each element is the same for the same excitation.

It is yet another object of this invention to provide a television flat-panel display of matrixed elements in which the light output elements are simply and economically compensated on an individual basis without internal modification of the elements or panel.

A television system wherein a flat imaging panel displays television image information visible from viewing locations in front of the imaging panel is improved in accordance with the invention to include a plurality of discrete matrixed image display elements which together comprise the image display panel, the elements having nonuniform brightness characteristics from element to element for a given excitation. Also included are means for compensating such nonuniform brightness characteristics comprising a plurality of matrixed image transmitting areas of a size and configuration corresponding to those of the image display elements, placed between the matrixed elements and the viewing locations and in registration with the image elements, and having nonuniform light transmissivity from area to area. The light transmissivity of such transmitting areas varies inversely from element to element with the brightness characteristics of the image elements, so that the display has a net uniform brightness over its entire area.

BRIEF DESCRIPTION OF THE DRAWING

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood, however, by reference to the following description taken in connection with the accompanying drawing, in the several figures of which like reference numerals indicate like elements, and in which:

FIG. 1 is a fragmentary front schematic view in enlarged detail of the imaging panel of a typical uncompensated flat display;

FIG. 2 is a fragmentary view in enlarged detail of a mask for use with the panel of FIG. 1;

FIG. 3 is a fragmentary front schematic view in enlarged detail of an embodiment of the compensated television flat display constructed according to the invention; and

FIG. 4 is a side view of the embodiment shown in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The usual flat television display panel having discrete image elements is illustrated in FIG. 1. It is the typical image display means for many well-known television systems adapted to address discrete display elements in, for example, the row and column fashion now common in the art. Such elements, two of which are elements **10** and **11**, are positioned in a matrixed arrangement and fixed in an inert substrate **12**, may either emit, reflect or otherwise control light, and may individually vary in light output in response to an actuating or excitation signal so that when the panel is viewed as a whole from viewing locations in front of the panel a television image can be formed and seen upon it. Typically, electroluminescent cells, gas plasma cells, liquid crystal assemblies, injection diodes, or other types of electrooptical devices may be used as image elements, and upon being assembled into the display, will usually be found to differ in light output even when actuated by the same excitation signal, i.e., to be of different light-producing or light-controlling efficiency.

FIG. 2 illustrates a mask in the form of an array of light transmitting areas, typical ones of which are **20** and **21**. These are positioned in a matrixed arrangement duplicating as closely as possible the arrangement of the image elements in the panel of FIG. 1, to permit these areas to be placed in registration with corresponding image elements in the panel. The areas of the mask are of nonuniform transmissivity, as is illustrated by elements **21** and **20**, the former being comparatively clear, the latter darker. The mask transmissivity varies from area to area inversely with the degree of brightness of the image element to which it corresponds.

Although construction of a mask meeting the foregoing requirements may be accomplished in many ways, it is preferred to expose a photographic film large enough to cover the display panel to the panel while all the image elements are uniformly actuated. The developed negative constitutes a film transparency which can then be used as a mask since it exhibits a matrix of transmitting areas of a size and configuration corresponding to those of the image elements of the display, with transmissivity varying so that the brighter the corresponding image element the darker the associated mask transmitting area. The strength of the display excitation signal and the length of the exposure time can be adjusted to control the degree of darkening of the film so that light from the weakest image element is transmitted substantially undiminished. Further, if an achromatic film is used, the display to be compensated can be a color display.

This mask and the display panel is combined into the finished compensated television display as illustrated in FIGS. **3** and **4**. The mask is positioned so that each of its transmitting areas is in registration with its corresponding image element and so that it is between the image elements and the locations from which the display is to be viewed; each such area then supplies only the amount of light intensity attenuation needed to bring the element into line with the intensity of the other elements, for a given signal, thus in effect individually adjusting each image element. For example, originally image element **10** is relatively brighter than element **11**, as is shown in the FIG. **4** side view and in FIG. **1**. But where the mask covers these elements in FIG. **3**, it is seen that area **20** somewhat attentuates element **10** and is darker than area **21**, which transmits substantially the full light output of the weaker image element **11**. The mask may be placed either in contact with the display panel, as shown in FIG. **4** or as close as possible, in order to minimize parallax distortion.

Thus the invention constitutes a compensated flat display which is adaptable to simple and rapid mass fabrication through use of economical photographic techniques, and enables many annoying adjustments ordinarily necessary to obtain an acceptable flat display to be dispensed with at very little additional cost.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without de-

parting from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. In a television system wherein a flat imaging panel displays television image information visible from viewing locations in front of said imaging panel, the improvement which comprises:

a plurality of discrete matrixed image display elements which together comprise said image display panel, said elements having nonuniform brightness characteristics from element to element for given excitation;

and means for compensating said nonuniform brightness characteristics, comprising a mask which includes a plurality of matrixed image transmitting areas corresponding in size and configuration to said image display elements and is disposed between said matrixed elements and said viewing locations and in registration with said image elements, said mask having nonuniform light transmissivity from area to area, with the light transmissivity of said transmitting areas varying inversely from element to element with the relative brightness characteristics of said image elements, so that the mask compensates the display to provide a uniform net brightness over its entire area.

2. The improvement as in claim 1, in which said mask is in surface contact with said matrixed plurality of display elements.

3. The improvement as in claim 1, in which said mask is a photographic film transparency.