Nov. 11, 1969 R. A. MARTEL ET AL 3,478,217

STORED IMPEDANCE IMAGE-TRANSLUCENT SCREEN

Filed Jan. 4, 1968

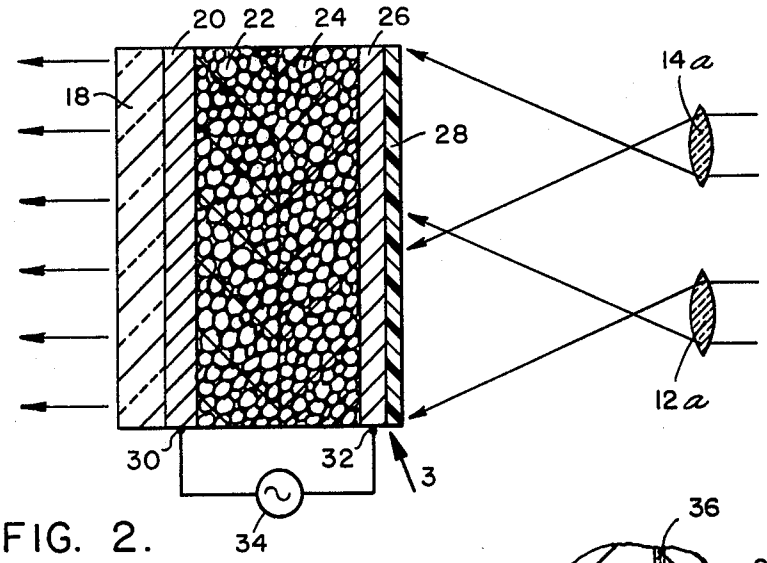

FIG. 2.

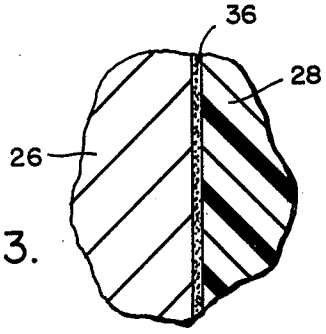

FIG. 3.

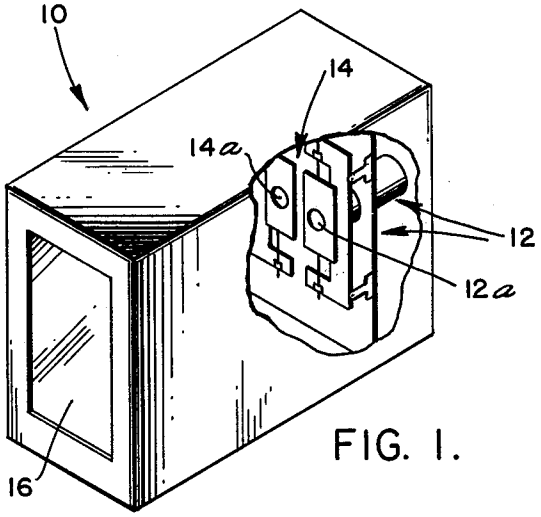

FIG. 1.

INVENTORS.
RICHARD A. MARTEL
WILLIAM R. DAVIS
CARL E. SUTTON
BY
MICHAEL F. OGLO
ROY MILLER
ATTORNEYS.

United States Patent Office 3,478,217 Patented Nov. 11, 1969

3,478,217

STORED IMPEDANCE IMAGE-TRANSLUCENT SCREEN

Richard A. Martel, Sylmar, William R. Davis, Glendale, and Carl E. Sutton, Los Angeles, Calif., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Filed Jan. 4, 1968, Ser. No. 695,614
Int. Cl. H01j 31/50, 39/12
U.S. Cl. 250—213 3 Claims

ABSTRACT OF THE DISCLOSURE

A display screen of the type coated with luminescent laminae has a dual mode of operation. One of the modes of operation is derived from a lay-up of laminae of predetermined photoluminescent and electroluminescent qualities sandwiched between electrode films. This mode of operation is to present a luminescent image corresponding to a latent phosphor impedance image stored upon a phosphor lamina in the lay-up. The other mode of operation is derived from the adaptation of the lay-up to be translucent. This latter mode of operation is the common translucent screen mode of operation in which illumination impinging on the rear side of a translucent screen produces an image on its front side. The capability of the dual mode screen to do the latter is enhanced by a special construction on the backside of the lay-up as follows. The electrode film which is normally the backside element of the lay-up is made of gold film and a sheet of clear and transparent plastic is intimately bonded to the face of the gold film.

BACKGROUND OF THE INVENTION

This invention relates to luminescent coating display screens and more particularly to those of the type adapted for a dual mode of operation consisting of: a first mode which is to store a phosphor impedance image and convert it into an electroluminescent display; and a second mode which is the common translucent screen mode. It is in some respects an improvement to the invention disclosed in U.S. Patent 3,344,280 of R. A. Martel, entitled "Electroluminescent-Photoconductive Display With Long Persistence."

The dual mode screen of the type described has been proposed for use in anti-submarine warfare tracking plotters. In this application, the target positions are stored in the impedance image mode so that a track of previous target positions can be selectively displayed for analysis of maneuvers or the like. Own ship's position is presented as continuous non-persistent display using the simple transluscent screen mode.

The brightness of the display in the simple transluscent screen mode has been found to be critical in this application. Losses in passing through the laminae of luminescent coatings, make it difficult to produce an image of sufficient brightness for use in rooms having desired lighting conditions. Increasing the illumination light source for the non-persistent image is not possible because this causes cross interference effects with the luminescent coating mode of operation.

Accordingly, an object of the invention is to provide an improved construction of a dual mode display screen of the type described, which enhances the brightness of the image in the translucent screen mode of operation without increasing the illumination source.

Another objective is to provide a display screen construction in accordance with the previous objective which is simple and inexpensive to manufacture.

Other objects and many of the attendant advantages of this invention will be readily appreciated as it becomes better understood by reference to the description and accompanying drawing which follows:

BRIEF DESCRIPTION OF DRAWING

FIG. 1 is an isometric of a plotter employing the screen construction of the present invention;

FIG. 2 is a diagrammatic of a cross section of a screen construction in FIG. 1, the thickness of layers not being in proportion to those of a real screen; and

FIG. 3 is an enlarged detail of a portion of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, and in particular to FIG. 1, a combined persistent and non-persistent image display mechanism **10** comprises image projectors **12** and **14** and a screen **16**. Projector **12** employs ultraviolet rich light, and projector **14** employs yellow light having no appreciable ultraviolet energy. Screen **16** serves both as an image storage screen for the image from projector **12** and as a translucent screen for the image from projector **14**. Image projectors **12** and **14** have corresponding focusing lens **12***a* and **14***a* which are mechanically positionable to place the image anywhere on screen **16**. For further details of the general mechanical structure, reference is made to U.S. Patent 3,207,898 of C. R. Linsley entitled "Optical Projector for Use With a Phosphorescent Screen."

Referring now to FIG. 2, screen **16** is composed of a lay-up of films and laminae on the backside of the glass substrate. The lay-up comprises a conductive film **20**, an electroluminescent lamina **22**, a photoluminescent lamina **24**, another conductive film **26**, and a lamina **28** of clear plastic. Conductive films **20** and **26** form electrode laminae. Each electrically communicates with bus wires disposed along the film edges. The bus wires are not shown in the drawing but are schematically represented as terminals **30** and **32**. An alternating current source **34**, typically 100 volts at 400 c.p.s., is connected across terminals **30**, **32**. The choice of conductive films and luminescent layers are such that screen **16** is translucent.

Film **20**, laminae **22**, **24**, film **26**, and A.C. source **34** constitute the sandwich construction and excitation source for storing the image from the ultraviolet rich projector **12**. Briefly, an image projected from source **12** will cause an electrical impedance change in lamina **24** which persists after removal of the photo energy. (It also causes lamina **24** to initially luminesce, but this decays before decay of the impedance image.) Energizing sandwiched laminae **22** and **24** by the A.C. source will cause portions of electroluminescent lamina **22** to luminesce in accordance with the stored impedance image on lamina **24**. The image from the yellow light projector **14** does not affect this mode of operation because image storage lamina **24** is chosen to respond only to ultraviolet rich photo energy. For further discussion of this principles, reference is made to previously cited U.S. Patent 3,344,280.

As mentioned earlier, screen **16** serves as a translucent screen providing a non-persistent image in response to illumination on its backside. Projector source **14** employing yellow light will produce an image by this mode, only. The improvement of the present invention is the discovery of a construction on the backside of screen **16** which greatly enhances the brightness of this non-persistent image. This construction comprises the application of clear plastic lamina **28** to the backside of the screen **16**. In one embodiment found to produce highly successful results, electrode film **26** was formed as a thin deposit of gold, and the transparent lamina **28** formed as a 9 mil sheet of clear fluorohalocarbon plastic bonded to the gold deposit by an adhesive joint **36**, FIG. 3, of a clear epoxy-polyamide cement. Care should be taken to avoid any air pockets.

It has been found that lamina **28** acts to enhance transmission of light through screen **16**. This results in appreciably brighter images in response to yellow light projector **14**. The improvement in transmissive properties of screen **16** will now be further described in connection with examples from a test program.

Example I

A screen **16** essentially as described and with photoluminescent laminae and electroluminescent laminae as described in the referenced U.S. Patent 3,344,280 was subjected to illumination by a nine foot lambert light source contiguous to its front face. Without the presence of clear lamina **28**, the light emitted from its back side was measured at 0.45 foot lamberts. After application of laminae **28**, the emission at the back side was measured at 0.79 foot lamberts.

Example II

A screen construction like that of Example I but made in different batch, was subject to the same test.. Before application of the lamina **28**, it was found that 0.59 foot lamberts of light were emitted from the screen back side. After application of that laminae, 0.79 foot lamberts were emitted at the back side.

The phenomena of this improvement in light transmissivity is not fully understood. In fact, it is somewhat of an anomaly because the improvement is achieved despite inherent losses due to the added layer. A present tentative conclusion as to the causes of the phenomena is that the gold film surface **26** deposited on the photoluminescent lamina **26** is not smooth and that the super position of the clear lamina **30** having a smooth rear surface reduces the amount of scattered light, thereby increasing the amount of transmitted light. Whatever the cause of the improvement it can be seen that the effects are appreciable, of the order of a 50% improvement in light transmission. Moreover, this degree of improvement is of particular importance in the application of the invention to plot display mechanisms such as mechanism **10**, where there is a given limit to the amount of light from projector **14** in order to avoid cross interference with the impedance image mode.

Obviouly many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a latent phosphor impedance image screen of the type having a transparent substrate forming the front of the screen and having on the backside of the substrate a translucent lay-up composed of a first electrode film, an electroluminescent lamina, a phosphor impedance-storage lamina, and a second, substantially flat, electrode film, in that order, said screen further being of the type adapted to serve as a translucent screen which provides a non-persistent image in response to photo energy which impinges the rear side of the screen and is transmitted through the translucent lay-up to the front side of the screen, the improvements in combination comprising;

a clear and transparent lamina adjoining the backside of the second electrode film, said clear and transparent lamina being a sheet of plastic which serves to enhance the proportion of the impingent photo energy which is transmitted from the backside of the screen to the frontside through said translucent lay-up,

said second electrode film being a deposit of metal on the backside of the phosphor impedance-storage lamina, and

a clear plastic adhesive bonding the clear and transparent lamina continuously to the back face of the deposit of metal at all points of their confronting surfaces.

2. The combination in accordance with claim **1**, wherein: the plastic of the sheet is fluorohalocarbon.

3. The combination in accordance with claim **2**, wherein: the clear plastic adhesive is epoxy-polyamide cement.

References Cited

UNITED STATES PATENTS

3,114,045	12/1963	Mash	250—213
3,152,222	10/1964	Loebner	250—213
3,244,891	4/1966	Orthuber	250—213
3,247,389	4/1966	Kazan	250—213
3,264,479	8/1966	Peek	250—213
3,268,755	8/1966	Reschauer	250—213
3,339,075	8/1967	Szepesi	250—213
3,344,280	9/1967	Martel	250—213

RALPH G. NILSON, Primary Examiner

C. M. LEEDOM, Assistant Examiner

U.S. Cl. X.R.

313—94