June 26, 1962 J. H. KOCH 3,040,444

DISPLAY PANEL ASSEMBLY

Filed Oct. 31, 1960 2 Sheets-Sheet 1

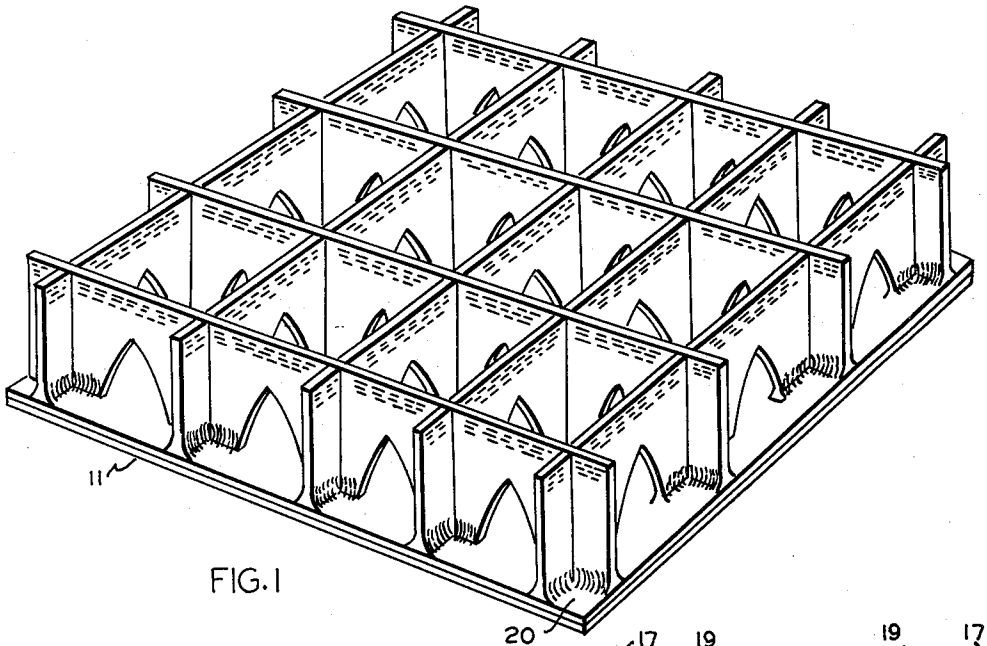


FIG. 1

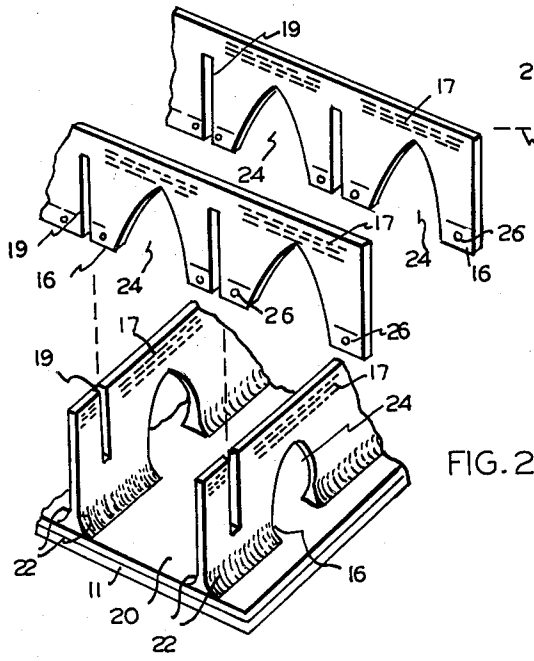


FIG. 2

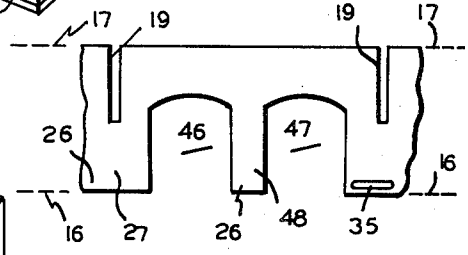


FIG. 5

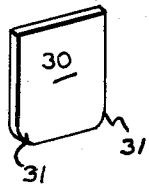


FIG. 6

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DISPLAY PANEL ASSEMBLY

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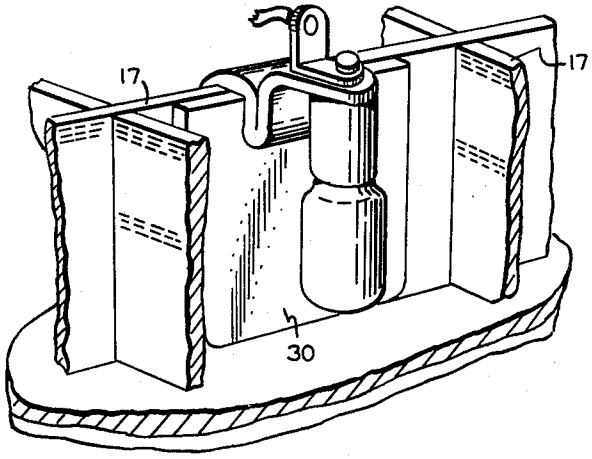


FIG.3

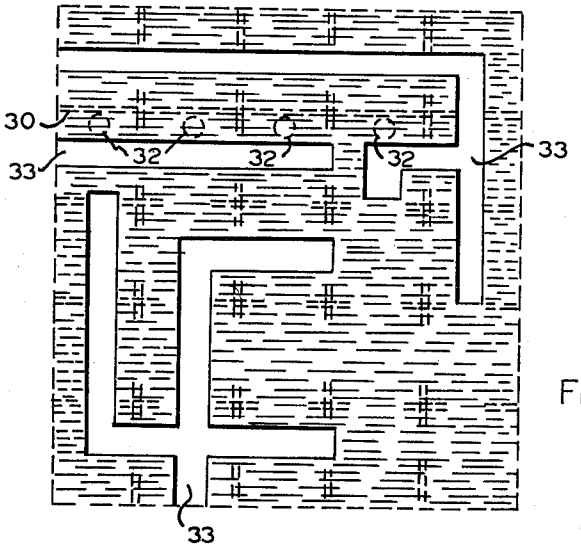


FIG.4

United States Patent Office 3,040,444 Patented June 26, 1962

3,040,444
DISPLAY PANEL ASSEMBLY

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10 Claims. (Cl. 35—1)

This invention relates to display panels, such as animated panels for training persons in the operation of, or enabling visual monitoring of, conditions associated with various systems and processes, such as fluid flow systems in chemical plants, gas and oil transmission systems, electrical transmission and distribution systems, missile control and monitoring systems, aviation, railway and other transportation or traffic systems, and the like. Shown in my prior Patent No. 2,952,079 issued September 13, 1960, is a display panel assembly comprising a light-transmissive front panel having a network of crossed opaque strips mounted on its back to form a plurality of compartments, with light bulbs mounted to illuminate individual compartments. By selectively switching lights in accordance with conditions being displayed, indicated or simulated, the display becomes "animated," so that understanding and analysis of the system operation illustrated or displayed is facilitated. Since one or more light bulbs may be mounted on the edges of each compartment merely by clipping them on, and because such bulbs may be relocated or replaced or removed by simply pulling them off, the replacement of any one of the usually large number of light bulbs for purposes of maintenance, and any desired alteration of the panel display, in the event of a missile system modification, for example, may be accomplished much more easily than with other prior display panels. By use of a network of interfitting, thin flexible metal strips mounted on a thin, flexible light-transmissive plastic sheet, as shown in my prior patent, an economical rigid assembly which has great strength for its light weight, may be produced.

My copending application Serial Number 820,479 filed June 15, 1959, now Patent No. 2,985,968, for "Display Device and Method for Making the Same" discloses further improvements for panels of the type described above, including the idea of knurling the thin metal strips and fastening the strip network to the front sheet panel by embedding knurled portions of the strips in a hardenable translucent plastic, thereby providing an extremely rigid yet economical and lightweight assembly of a type ideal for animated display panels. Both of my prior inventions have been used widely and successfully, and panels constructed according to these inventions are marketed under the trademark "Modular Cell" by the assignee of this application.

Application Serial Number 830,284 filed July 29, 1959, now Patent No. 3,025,613, by Charles R. Mitchell for "Display Device," which application is assigned to the same assignee as the present invention, discloses a novel arrangement for mounting relatively heavy and bulky assemblies on the rear side of panels constructed according to my above-mentioned inventions. With the ever-increasing complexity of technological systems, it becomes increasingly desirable to be able to mount more complex and heavier equipment on the back of animated display panels, unavoidably increasing the weight of the complete assembly. It is highly desirable not to decrease the strength or rigidity of such panels in view of the ever-increasing rigidity requirements. Furthermore, the principal advantages of the "Modular Cell" display panel assemblies have included the fact that such panels may be mounted on simple and light supports, and the fact that large panels, self-supported or supported by light frames, may be constructed economically.

In panels constructed according to my prior inventions the complete length of each thin, straight, compartment-defining strip butted against the translucent front panel, substantially completely sealing off each compartment and preventing the passage of light from one compartment to the inside of any adjacent compartment. It is desirable in many animated display applications to provide pluralities of adjacent lighted compartments all lighted at the same time and with exactly the same color and all at the same intensity. For example, a row of six successive compartments might be required to be all lighted the same color to indicate that fluid of the color shown was being pumped along a certain line. Since the light bulbs in the six compartments may differ slightly or greatly in age, or coloring, or intensity, or other characteristics, the six-compartment line may not appear as a continuous single area, but rather as a plurality of six discrete and slightly differing areas, with slightly dark lines between them. Such lines, discontinuities, and changes in shade and intensity, are sometimes regarded as very distracting. By careful selection of light bulbs it is usually possible to obtain acceptable uniformity of color and intensity, but the presence of the metal strips, no matter how thin, against the translucent panel, makes it very difficult to prevent the appearance of dark lines or shadows between compartments.

Therefore, it is a primary object of the present invention to provide an improved display panel construction divided into a plurality of separate individually illuminable compartments, which can be illuminated so that separate, plural adjacent compartments can be caused to appear blended together into single areas, without distracting discontinuities. It is an auxiliary object of the invention to provide an improved construction of the type described which nevertheless allows provision, when desired, of sharp, discrete light boundaries, and changes of light intensity and color at desired boundary lines. It is a further object of the invention to provide such a construction while still maintaining the essential economy, rigidity, structural soundness and light weight of the "Modular Cell" panel displays.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is an isometric view of the rear of an improved panel constructed in accordance with the present invention, prior to the mounting of lights or other equipment thereon;

FIG. 2 is a fragmentary view similar to FIG. 1 in which the network of interfitting opaque strips is shown separated to reveal the details of individual strips;

FIG. 3 shows a portion of a panel constructed according to the present invention in which a detachable light dam is inserted;

FIG. 4 is a front view of a portion of a panel constructed in accordance with the present invention;

FIG. 5 shows an alternative form of strip constructed in accordance with the invention; and

FIG. 6 illustrates a light dam of the nature which may be used with the invention.

Referring now to the drawings in greater detail, the improved panel construction is shown as including a light-transmissive front sheet **11**, which may consist of a frost-coated glass or plastic, or, preferably, a sheet made of glass fibers impregnated with a cured thermosetting resin, "Fiberglas" sheet having been found to be eminently suitable. A network of thin, flexible, opaque, interfitting strips is shown fastened to the rear side of panel **11** by means of the technique shown in more detail and claimed in my abovementioned copending application. Each thin flat strip is a straight metallic member having parallel inner and outer edges. As shown in my prior copending application, each strip may comprise an aluminum or aluminum base alloy, or stainless steel or the like and may be knurled along at least part of its inner and outer edges. As best seen in FIG. 2 strip **15** is knurled along its inner edge **16**, its outer edge **17** and along a middle band **18**. Knurling along inner edge **16**, which is contiguous to panel **11** when the panel is assembled, allows a transparent thermosetting resin which is poured onto sheet **11** to grip each strip more securely. The front or inner edges **16, 16** of all strips lie against the back of transparent sheet **11**, and the rear or outer edges **17, 17** of all strips **15, 15** lie in another common plane and present a network of exposed edges **17, 17** upon which various devices may be mounted, as will be described in more detail below. The thin strips intersect each other at substantial angles, and, in fact, in most embodiments of the invention the strips comprise two groups of mutually perpendicular strips, providing intersections of the nature shown. Transverse slots **19** are provided in each strip to engage mating transverse slots in other strips, so that all strips may interfit and be positioned against the back surface of translucent sheet **11**. It will be seen that each compartment defined by the thin strips is closed on one end, its front end, by the front panel **11**, and open on its rear end.

As mentioned above, the inner edges **16, 16** of the strips are knurled, or else the surface is roughened or made irregular in equivalent fashion. Disposed on the rear side of panel **11** is a layer **20** of hardenable translucent plastic, such as a hardened thermosetting or thermoplastic resin, one cured epoxide resin which has been found particularly suitable being the condensation product of bisphenol A and epichlorohydrin. While the composition of the material may vary in different embodiments, it is important that the material be at least translucent, and rigid at the temperatures contemplated for operation of the panel.

As described in more detail in my abovementioned copending application, the liquid epoxide resin (such as "Epon 828" sold by Shell Corporation), together with a curing agent, metaphenylene diamine, may be poured on a front sheet to a depth of approximately 1/16 to 1/8 inch, and then a network of previously interfitted strips is lowered onto the sheet, so that some of the knurling along inner edges **16** is immersed in liquid resin **20**. Vibration, at a fairly high frequency then will aid the resin **20** to surround inner edges **16, 16** of the thin strips, thereby to form fillets, **22, 22** as shown, which considerably strengthen the bond between the strips and the front sheet. Vibration, which tends to form the fillets, usually is not applied until the entire network of strips is lowered onto the light-transmissive front panel, and the fillets are shown in FIG. 2, wherein the entire network has not been shown in place, merely for convenience of explanation. The particular epoxide resin referred to, after vibration to form fillets, then requires baking at an elevated temperature in order to set.

As mentioned in my previous application, knurling is provided along the outer edges **17, 17** of strips **15, 15** as well as along the inner edges, not only to prevent the tendency of the strips to curl or bow if knurled along only one edge, but also to provide improved gripping surfaces for devices to be mounted on the rear edges **17, 17**.

The assembly, as thus far described, is completely disclosed in my abovementioned prior Patent No. 2,952,079 and in copending application Serial Number 820,479, and the improvements which form the subject matter of the present invention now will be specified in detail. Centered longitudinally between each pair of adjacent partial transverse slits **19, 19** in each thin strip an archway area **24** has been cut out, each archway, or cutaway portion, extending from the inner edge **16** of the strip **15** transversely approximately halfway across the strip. Each archway or cutaway portion **24** widens from its apex at **25** near the center of its associated strip to a maximum width near the outer surface of resin layer **20**, and then narrows sharply, providing widened foot-like strip edge portions **26, 26** to seat against front panel **11**. The longer the "foot," i.e. the longer the edge **26** of the strip not cut away, the better the strip network is anchored to the front panel, but on the other hand, the narrower the passageway between compartments will be, and hence the narrower the visible portions of the display will be. To further insure a secure bonding of the strip network to the front panel a series of small holes **21, 21** may be provided along the inner edge **16** of each strip. Each hole **21** is located near enough to the inner edge **16** of each strip to allow flow of resin **20** through each hole **21** when the strip network is lowered onto panel **11**.

It may now be apparent from the foregoing that provision of the cut-out archways **24, 24** allows the illumination within one compartment to blend into the illumination of all of its adjacent compartments, thereby allowing provision of a continuous "flow" of light through plural compartments, without the distracting "cross lines" heretofore obtained at compartment walls, and it has been found that providing such archways does not detract materially from the strength and rigidity of an assembled panel. Light flowing from one compartment through an open archway area or passageway to a second compartment will not uniformly light the second compartment. It should be apparent that light passing through any archway will tend not to illuminate those corners of the second compartment nearest the archway, and hence the corner portions of the compartments will tend to be poorly lighted. The "feet" **26, 26** or inner edges **16, 16** of strips **15, 15** contact the front panel **11** near the strip intersections, or corners of the compartments formed. By masking front panel **11** to cover where the strip edges contact the front panel the compartment corners also are masked out, leaving only light pathways in line with the passageways defined by the archways, and since these pathways are unfettered by any strip edges, the light flow along unmasked portions of the panel is continuous and without distractions or shadows.

It is necessary, however, to provide simulated flow lines which bend or turn, and also frequently necessary to provide discrete boundaries which separate different colors and/or different light intensities, so that it becomes necessary frequently to provide compartment walls with continuous inner edges, in the manner of my previous applications, and it is not economical to provide or to stock a large variety of special strips having partly archways and having continuous edges in particular special locations. The invention, however, allows efficient and economic provision of an effective light dam in the manner shown in FIG. 3, so that all strips may be provided with archways when fabricated, and the archways dammed later where necessary. Wherever such a dam is desired, an essentially rectangular opaque metal or plastic piece of proper size readily may be fastened into place. Light dam **30** is shown in detail in FIG. 6. In

FIG. 3 metal plate **30**, when in place, extends from the surface of the hardened epoxide **20** to be flush with the outer edges **17** of the assembled metal strips, and corners **31, 31** of the plate are tailored approximately to fit the fillets **22, 22** located at the strip intersections. It will be seen that such dam plates are extremely simple and cheap to provide, and that they are quick and easy to mount or detach. The clip-type of light bulb mounting shown in my prior Patent No. 2,952,079 may be used to hold metal plate light dams in many locations where such dams would be desired, and similar clips, without light bulbs may be used in other places where dams are desired on compartments not provided with light bulbs. Thus since it is so easy and economical to utilize detachable light dams like plate **30**, the metal strip network may be formed completely of stock sizes of pre-cut strips having portions of their edges cut away as shown, and detachable light dam plates may be used to cover any light passageways it becomes desirable to block. In FIG. 2 it will be seen that two different types of strips need be made and kept in stock, one being the type having its transverse slots facing the inner edge **16**, the same as its archways, and the other being the type which has its transverse slots disposed along the opposite, or outer edge **17**. The light dams may be attached and then detached without making any permanent change in the basic structure. The opaque covering used on the front of the panel to define the continuous passageways may comprise a suitable adhesive tape or a paint, and in either event it may be applied and later taken off, with no permanent change made in the basic panel structure, so that the display panel structure retains its original flexibility and economy.

In FIG. 4, the front view of a panel utilizing the invention, a plurality of unshaded paths **33** represent unmasked, or visible portions of the panel, while all other portions are masked, by means of opaque tape or paint, preferably usually, of a removable variety. The "feet" portions **26, 26** of strip edges **16** are shown in phantom in FIG. 4 because they touch the rear face of panel **11**, while the cutaway edges along the archway portions of the strips are not shown in FIG. 4 because they do not touch front panel **11**. Having the cutaway portions described, the strips bear against panel **11** only near their intersections with each other, and thus the strips are shown in FIG. 4 in phantom, as merely a plurality of intersections or crossings. The intersections will be seen to be masked over, so all that is seen are the unshaded paths passing through various compartments and from compartment to compartment through the archways. To form changes in the direction of the illuminable pathways and to terminate same where desired, light dams of the type shown in FIGS. 3 and 6 may be used, and several such dams **30, 30** are shown in FIG. 4 held in place by the mounting clips of lamp bulbs **32**.

FIG. 5 shows an alternative form of outer opaque strip, and the characteristics of display panels constructed with such alternative strip should be obvious in view of its similarity and in view of the previous explanation. The alternative strip is provided with plural (two) cutaway portions **46, 47** between successive slits **19**, so it will be apparent that two unseparated light passage ways extend through any compartment wall formed by intersections of the alternative strip. If the middle foot portion **48** is masked over, as well as the end feed portions **26, 26** two parallel continuous passageways will appear to run through each compartment. Suitable "inner" strips for use with the strip illustrated in FIG. 5 may be identical, except that their transverse slots should extend in from edge **16** rather than from edge **17**. It should be apparent that even more than two passageways can be provided, if desired, and further, that strips of the type shown in FIGS. 1–4 sometimes can be used with strips like that of FIG. 5 and with further types for special displays. Anchoring holes **21, 21** are shown along the inner edge of the modified strip for improving the bond to panel **11**,

and although not shown, it will be recognized that knurling also may be provided as in the other embodiments of the invention. Slots of the type shown at **35** in FIG. 5 may be used in any embodiment of the invention to aid in anchoring in strips to the panel.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained, and since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A display device comprising a light-transmissive panel, a plurality of thin opaque strips mounted on their inner edges and defining a plurality of compartments on the rear side of said panel, each of said strips having a plurality of cut-away portions along their inner edges to allow passage of light between various of said compartments, each of said compartments being closed on one end by said panel and open on its opposite end; and a plurality of lights extending into respective of said compartments.

2. An animated display device for providing variable indications, comprising in combination, a light-transmissive sheet panel mounted for observation from its front side; an interdigitating network of thin strips mounted on their inner edges on the rear side of said panel to provide a plurality of compartments each closed on one end by said panel and open at the other end, said thin strips including a first group of mutually parallel strips extending in a first direction and a second group of mutually parallel strips extending in a second direction, each of said strips having a plurality of transverse slits partially across their widths, with transverse slits of said first group meshed with transverse slits of said second group to provide said interdigitating network, each of said thin strips having a plurality of cutaway portions along said inner edges to allow passage of light between various of said compartments; and a plurality of detachable light dam plates clipped to various of said strips to cover various of said cutaway portions.

3. A display device, comprising a light-transmissive front panel; and a plurality of thin opaque strips mounted on their inner edges against said panel and intersecting with each other to form a plurality of compartments on the rear side of said panel, said strips having a plurality of cutaway portions along their inner edges forming uninterrupted passageways to allow light to pass directly between various of said compartments.

4. Apparatus according to claim 3 in which said strips are provided with transverse slits partially across their widths, and in which said cutaway portions are spaced evenly between said slits.

5. Apparatus according to claim 3 in which said strips are fastened to said panel by means of a layer of translucent plastic in which the edges of said strips are embedded.

6. Apparatus according to claim 3 having opaque coverings on the front side of said panel for defining the edges of said passageways.

7. Apparatus according to claim 3 in which each of said cutaway portions provides a passageway between a single pair of adjacent compartments.

8. Apparatus according to claim 3 including at least one detachable plate means adapted to be clipped against one of said strips to cover one of said cutaway portions.

9. Apparatus according to claim 3 including a plurality of lights mounted on outer edges of said strips to extend into respective single ones of said compartments, at least one detachable plate means adapted to be clipped against one of said strips to cover one of said cutaway portions, and means for holding both one of said lights and said

detachable plate means against one of said strips and within one of said compartments.

10. Apparatus according to claim 5 in which said strips are provided with plural small holes located along the inner edges of said strips, near enough to the inner edges of said strips for said plastic to flow through said holes, thereby to strengthen the bond of said strips to said panel.

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