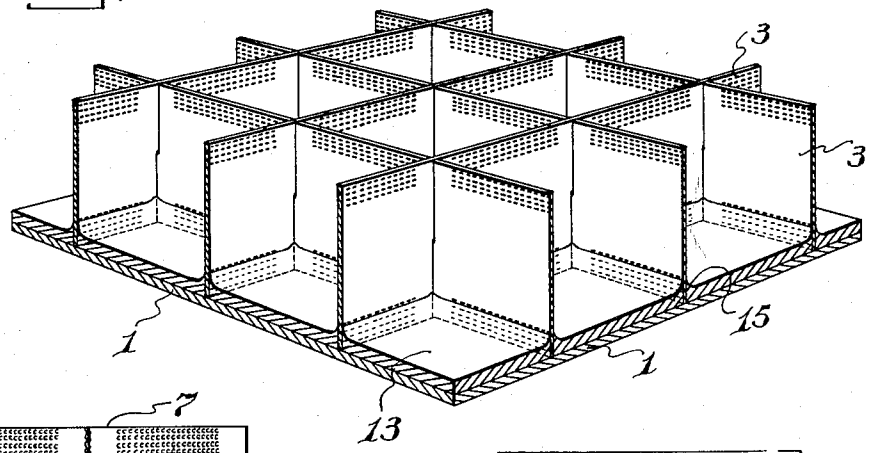
April 27, 1965 J. H. KOCH 3,180,774

METHOD FOR MAKING DISPLAY DEVICE

Original Filed June 15, 1959

Fig. 1



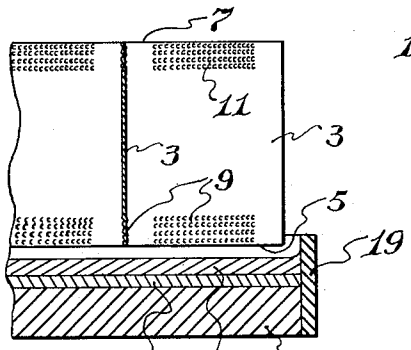


Fig. 2

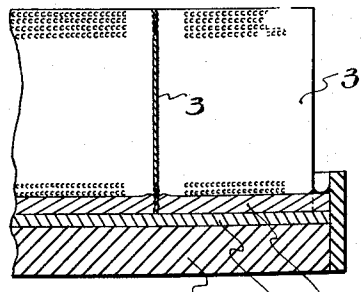


Fig. 3

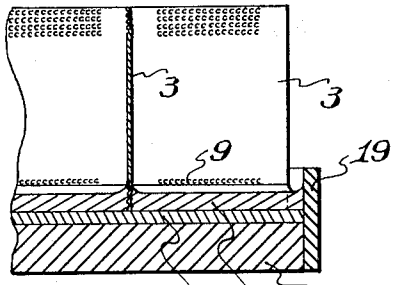


Fig. 4

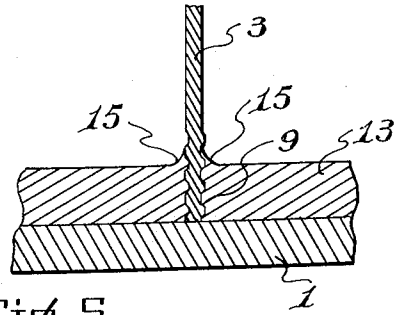


Fig 5

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METHOD FOR MAKING DISPLAY DEVICE

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Original application June 15, 1959, Ser. No. 820,479, now Patent No. 2,985,968, dated May 30, 1961. Divided and this application Apr. 17, 1961, Ser. No. 103,513

8 Claims. (Cl. 156—73)

The present invention relates to methods for making display devices, and more particularly to methods for making training panel assemblies for instruction or visual monitoring purposes in which a plurality of light sources such as electric lights indicate fluid flow systems, gas, electric circuitry, or traffic control or the like, as disclosed for example in my prior Patent No. 2,952,079, issued September 13, 1960. This is a division of my copending application Serial No. 820,479, filed June 15, 1959, now Patent Number 2,985,968.

It is an object of this invention to provide improvements on the structure disclosed in the above identified co-pending application.

Another object of the present invention is the provision of display devices and methods for making the same, characterized in that improved mounting means for the light sources are provided.

Still another object of the present invention is the provision of such display devices and methods for making the same, including strips secured to a light penetrable panel, in which an improved attachment is effected between the strips and the panel.

Finally, it is an object of the present invention to provide display devices which will be relatively inexpensive to manufacture, easy to operate, adjust, maintain and repair, and rugged and durable in use; and it is an object of the invention to provide methods for making the same which will be quick, easy and dependable to practice with uniformly good results.

Other objects and advantages of the present invention will become apparent from a consideration of the following disclosure, taken in connection with the accompanying drawing, in which:

FIGURE 1 is a fragmentary perspective view of a portion of the rear of a display device according to the present invention;

FIGURES 2, 3 and 4 are fragmentary cross-sectional views showing stages in the production of a display device according to the present invention; and

FIGURE 5 is an enlarged fragmentary cross-sectional view showing the attachment of the strips to the panel of the present invention.

Referring now to the drawing in greater detail, there is shown a flat, light-penetrable panel 1, which may for example be a sheet of glass fiber impregnated with a cured thermosetting resin. Secured to panel 1 is a plurality of intersecting strips 3 each of which is a straight, flat, thin metallic member, which may for example be aluminum or aluminum base alloy. Each strip 3 has a longitudinal side edge 5 contiguous to panel 1 and a longitudinal side edge 7 parallel to edge 5 and remote from panel 1. The edges 5 of all strips 3 are disposed in the same plane, which is the plane of the rear face of panel 1. All of the edges 7 of strips 3 are disposed in another common plane which is parallel to the first-mentioned common plane and to the panel. The strips intersect each other at substantial angles, which are right angles in the illustrated embodiment, by means of interengaging slots about half way through each strip, the lines of intersection thus formed being perpendicular to both of the common planes described above and to panel 1.

All of the structure recited thus far is described in greater detail in the above-identified copending application, to which reference is had to avoid the unnecessary repetition of detailed disclosure.

Extending along edge 5 of each strip is knurling 9, which in the illustrated embodiment is embossed on one side of the strip and embossed on the other side of the strip, this knurling having been formed by a knurling roller which provides in effect a multiplicity of small punches that deform the thin material of strips 3. Obviously, this knurling may be formed in a variety of ways, as by the described method, or by cutting but not deforming the surface so as to roughen the same, and so on; but regardless of the method of producing it, the knurling is characterized by portions of varying distance from the plane of the surface of strip 3. Knurling 11 is also provided along edge 7 of each strip, this latter knurling serving not only to provide anti-slip surfaces for the retentions of clip on light sources, but also to prevent bowing of the strip as would result from knurling along one edge only. The knurling is preferably provided on both sides of strip 3 as well as along opposite longitudinal side edges thereof.

Disposed on the rear or strip side of panel 1 is a layer of hardened plastic material 13, which may for example be hardened thermosetting or thermoplastic resin. A particular example of a suitable substance is a cured epoxide resin comprising the condensation product of bisphenol A and epichlorohydrin. But regardless of the composition of the hardened plastic material, it is essential that it be light-penetrable and rigid.

The surface of the hardened plastic material 13 remote from panel 1, that is, the exposed rear surface, is glossy and is generally flat except that adjacent the strips 3 and the intersections of those strips, it curves away from panel 1 toward the planes of the strips in rounded fillets 15, which extend along the intersections between the surface and the strips and into the corner formed by the intersections between the strips, to provide in effect rounded corners at the bottoms of the cells which are defined between the panel and the strips and which are open to the rear. It is particularly to be noted, however, that the surface of hardened plastic material 13, regardless of its irregularities, is disposed between the parallel planes in which edges 5 and 7 lie. The fillets 15 thus assure that a width of strip 3 will be contacted by the hardened plastic material and that this contacted width of the strip will be substantially greater than the depth of the hardened plastic material at other places, thereby to provide in effect bracing webs along the strips at their intersections, so as to improve the strength of the assembly.

To produce a display device according to the present invention, it is necessary only to lay a thin sheet of light penetrable hardened plastic material, preferably impregnated glass fiber, on the upper surface of a vibratory table 17. Side strips 19 are then provided projecting a substantial distance above the panel, and a plastic material in liquid phase such as an epoxide resin is poured on the upper surface of panel 1 and is retained thereon by strips 19. Specifically, to a portion of epoxide resin in a liquid state, 25% by weight of a curing agent consisting of metaphenylene diamine is added and mixed. The epoxide resin is sold commercially by Shell Corporation as "Epon 828," an epoxide resin having a melting point of 9° C., a viscosity of 12,400 centipoises at 25° C., a specific gravity at room temperature of 1.1676, an epoxy value of 0.52 as measured by the pyridinium chloride method, a hydroxyl value of 0.08 as measured by the lithium aluminum hydride method, and an esterification value of 1.26. The coating is applied to a depth of about 1/16" and extends over the entire upper or exposed surface of panel 1 on table 17. In order to assure that the liquid resin rapidly takes on a uniformly smooth surface, the

table bearing the panel may be vibrated on a vibratory bed as disclosed in Patent No. 2,555,688, at a frequency of, for example, 1000 cycles per second.

Meanwhile, an assembly of strips has been formed by simultaneously knurling opposed longitudinal side edges of a continuous strip and then cutting the continuous strip to lengths equal to one of the two dimensions of panel 1. It is particularly to be noted that the simultaneous knurling of both longitudinal side edges of the strip prevents bowing of either edge of the strip, as would result if only one side edge were knurled. The strips are then sorted and assembled, and the assembly is lowered into the liquid coating of epoxide resin until it contacts and rests on panel 1. The step of lowering the assembly of strips into the liquid resin coating is shown in FIGURES 2 and 3.

As seen in FIGURE 3, the edges 5 of the strips upon penetrating the liquid resin form a positive or bowed meniscus, as the resin is quite tacky and has about the same consistency as honey. In order to destroy this positive meniscus, table 17 carrying the panel and strip assembly is vibrated at a frequency of about 1000 cycles per second, as for example on the vibratory bed described above, whereupon the liquid hardenable plastic material not only loses its positive meniscus but also rises along the sides of the strips 3 into negative menisci, so that the strips are covered with plastic to a substantially greater depth than the average depth of the plastic on panel 1. The significance of this, as seen in FIGURE 5, is that an unusually great width of knurling 9 is contacted by the plastic, thereby to hold the strips even more firmly in place on the panel; and also the fillets 15 provided by these menisci serve as lateral reinforcement for the strips 3.

The assembly may then be subjected to radiant heating in an oven, in which the plastic material can be made to set up into a permanently hard, infusible material by heating at 300° F. for about 35 minutes. In this cured condition, the exposed surface of the plastic material is glossy and the cured plastic is almost transparent and just off-white.

It is particularly important to note that the knurling along those longitudinal side edges of the strips 3 performs a unique triple function, in that the simultaneous knurling along both edges prevents the knurling on either edge from causing the strip to bow in its own plane, as would be the case if the strip were knurled along only one edge, in that the knurling along edges 5 provides improved grip between the hardened plastic and the strips, particularly in view of the raised fillets of hardened plastic material along the strips, and in that the knurling along the edges 7 provides an anti-slip gripping surface for the clips by which the lights are attached to the exposed edges 7 of the display device.

From a consideration of the foregoing disclosure, it will be obvious that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. For example, although an example of curing the plastic material at elevated temperature has been given, it will be understood that plastic materials that harden at room temperature may also be used, as in the case of thermoplastic resins or epoxide resins of the type disclosed in Patent No. 2,651,589; and that a variety of plastic substances curing or hardening at elevated temperature may be used, for example those disclosed in Patents Nos. 2,506,486, 2,510,885 or 2,615,008. These and other modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A method of producing a display device, comprising the steps of knurling simultaneously both longitudinal side edges of an elongated flat metal strip having a pair of parallel longitudinal side edges, applying to one side of a flat light penetrable panel a layer of a hardenable light-penetrable plastic material in liquid phase, embedding one knurled longitudinal side edge of the strip in the plastic material while the plastic material is still in liquid phase, and maintaining the plane of the strip perpendicular to the plane of the panel until the plastic material hardens to a solid phase about said one edge of the strip.

2. The method according to claim 1 in which said hardenable light-penetrable plastic material comprises an epoxide resin.

3. The method according to claim 1 in which the recited step of maintaining includes heating said panel, said strip and said plastic material to set said plastic material.

4. The method according to claim 1 including the further step of vibrating at a high frequency said panel and said applied liquid plastic material before said plastic material hardens, until positive menisci in said plastic material caused by insertion of said strip into said liquid plastic material becomes negative menisci, so that said strip is covered with plastic to a greater depth than the average depth of said liquid plastic on said panel, thereby providing fillets of plastic when said plastic material hardens.

5. The method according to claim 1 wherein a plurality of flat metal strips are knurled and embedded in said plastic material in intersecting relationship.

6. A method of assembling an improved display device, comprising the steps of covering a translucent flat front panel with a thermo-setting liquid plastic material to a substantially uniform depth; embedding in said liquid plastic material the knurled longitudinal front edges of a cellular network of interfitted thin metal strips having knurled longitudinal front and rear edges so that the knurled front edges of said strips are embedded in said plastic material and the opposite longitudinally extending rear portions of said strips protrude from said plastic material, said strips being knurled along said front edges; vibrating said panel at a high frequency for a fixed period of time, and then heating said panel and strips while simultaneously maintaining said network fixed with respect to said panel while said liquid plastic material hardens.

7. A method of assembling an improved display device, comprising the steps of covering a translucent flat front panel with a settable liquid plastic material to a substantially uniform depth, embedding in said liquid plastic material the knurled longitudinal front edges of a cellular network of interfitting thin metal strips having knurled longitudinal front and rear edges so that the knurled front edges of said strips are embedded in said plastic material and the opposite longitudinally extending rear portions of said strips protrude from said plastic material, vibrating said panel for a period of time, and then maintaining said network fixed with respect to said panel while said liquid plastic material hardens.

8. A method of producing a display device, comprising the steps of knurling simultaneously both longitudinal side edges of a first elongated flat metal strip having a pair of parallel longitudinal side edges, knurling simultaneously both longitudinal side edges of a second elongated flat metal strip having a pair of parallel longitudinal side edges and a width the same as the width of said first strip, arranging said first and second strips in intersecting assembly at a substantial angle to each other with one longitudinal side edge of each of the first and second strips disposed in a common plane and the other longitudinal side edge of each of the first and second strips disposed in another common plane, applying to one side

of a flat light-penetrable panel a layer of a hardenable light-penetrable plastic material in liquid phase, embedding the assembled strips in the plastic material and vibrating the assembly while the plastic material is still in liquid phase with the surface of the plastic material disposed between said common planes, and maintaining the planes of both assembled strips perpendicular to the plane of the panel until the plastic material hardens to solid phase about a longitudinal side edge of each strip.

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