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T. L. KIDD, JR., ET AL
NONFLAMMABLE, THIN, INTEGRALLY ILLUMINATED
CONTROL PANEL OVERLAY
Filed Feb. 16, 1968

3,580,755

Fig. 1.

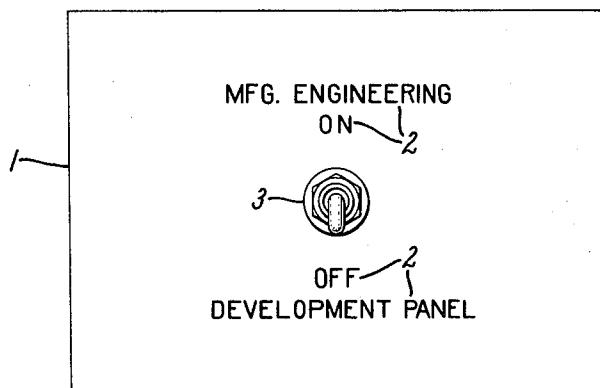


Fig. 2.

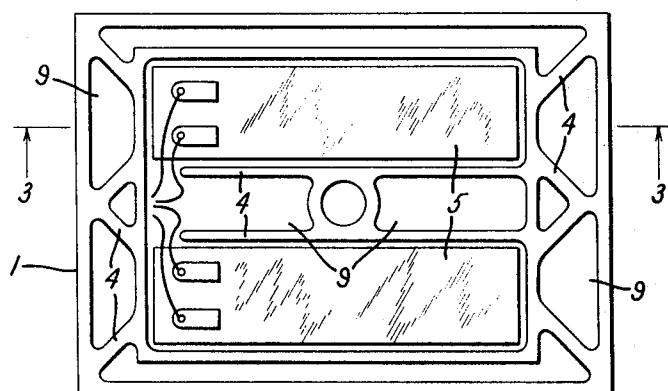


Fig. 3.

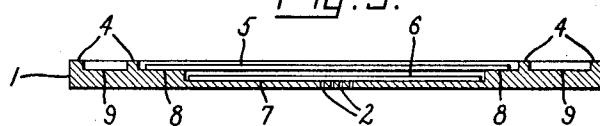
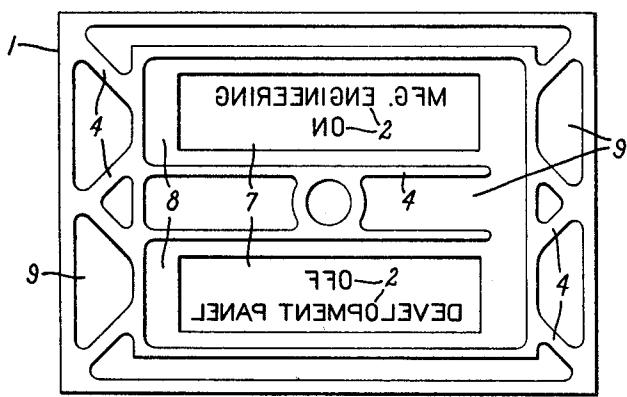


Fig. 4.



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NONFLAMMABLE, THIN, INTEGRALLY ILLUMINATED CONTROL PANEL OVERLAY
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2 Claims

ABSTRACT OF THE DISCLOSURE

A nonflammable control panel overlay with legible indicia openings, integral illumination and integral supporting means comprises a metallic member with indicia openings on the front thereof backed by a nonflammable, transparent backing member mounted in a recessed area on the back of the member behind the indicia openings, an electroluminescent lamp mounted in a second recessed area behind the transparent backing member and ribs on the back side of the member comprising the unetched areas left when the various mounting recesses are formed. Such a metallic overlay is made by mechanically engraving the indicia, on the front of a metal blank and then chemically etching the rear of the blank, in a stepwise fashion to form the various recesses and remove unnecessary material, until breakthrough to the indicia occurs.

INTRODUCTION

The invention herein described was made in the course of or under a contract with the Department of the Air Force.

This invention relates to a nonflammable control panel overlay suitable for use in aircraft and spacecraft. More specifically it pertains to such overlays which are thin, self-supporting and integrally illuminated.

BACKGROUND OF THE INVENTION

In the interest of weight reduction and space saving in and around the cockpit areas of aerospace vehicles, numerous efforts have been made to reduce the weight and volume of control panel display assemblies. Among the results of these efforts are displays which include a panel overlay comprised of transparent plastic material with electroluminescent or small incandescent lamps embedded therein. Replacement of individual embedded lamps in these overlays without replacement of the whole overlay is difficult if not impossible. Further, because such plastic overlays have little inherent stiffness, they usually require a backing member for support. Undesirable extra weight results because of the use of such support.

The biggest disadvantage of these plastic overlays, however, is their flammability. The organic matter contained in these overlays adds to the fire hazard present in any cockpit. Minimization of this hazard is one of the objectives of the present invention.

While metallic control panel displays would avoid the flammability problem of plastic overlays, no practical means for providing integrally illuminated indicia therein has been known. In addition to the bulk and weight of bulbs, sockets and mountings therefor, another factor inhibiting the use of metallic displays has been difficulty in producing clear lettered indicia openings in thin metal-

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lic face members. The present invention is also directed to that problem.

A general object of the present invention is to provide a thin, nonflammable, integrally illuminated panel assembly.

Another object is to provide a nonflammable, lightweight, integrally illuminated, self-supporting panel overlay.

A further object of this invention is to provide an inexpensive, easily manufactured, integrally illuminated, nonflammable panel overlay including highly legible illuminated character openings therein.

It is also an object to provide improved methods for making metallic control panel overlays with precisely formed character openings therein.

BRIEF DESCRIPTION OF THE INVENTION

These and other objects are met, in accordance with the present invention, by a metallic overlay with indicia openings therein, a nonflammable, flat, transparent backing member mounted in a recessed area behind the indicia openings, and an electroluminescent lamp mounted in a second recessed area behind the transparent backing member. The overlay may also include integral supporting ribs on the back side thereof.

The necessary character openings and recesses and integral reinforcement ribs on the back side of the overlay are made preferably by mechanically engraving the front of the overlay in the shape of the character openings desired and applying a temporary support material, such as a maskant, to the whole overlay including the first engraved areas. Recesses are then chemically etched, in stages, on the back of the overlay, exposing from the reverse side the previously engraved characters and providing mounting seats for a permanent transparent support member behind the etched character openings and for an electroluminescent lamp behind the transparent support member. Unetched areas on the back of the overlay provide integral supporting ribs therefor.

DETAILED DESCRIPTION OF THE INVENTION

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter of the present invention, this invention may be better understood from the following description, taken in conjunction with the following drawings, in which:

FIG. 1 is a front view of a control panel overlay comprising the preferred embodiment of the present invention;

FIG. 2 is a rear view of the overlay shown in FIG. 1;

FIG. 3 is a cross section of the overlay shown in FIGS. 1 and 2; and

FIG. 4 is a rear view of a metal blank engraved and etched in accordance with the present invention to produce the overlay shown in FIGS. 1-3.

Referring more specifically to FIG. 1 there is shown an anodized aluminum overlay 1 with indicia openings 2 and a control switch 3.

In FIG. 2 the rear of overlay 1 is seen with switch 3 removed. Also seen in FIG. 2 are integrally formed supporting ribs 4 for the overlay 1 and electroluminescent lamps 5 including necessary connectors and wiring.

A cross section of the same control panel overlay is shown in FIG. 3, in which is also shown, a flat transparent backing member 6, specifically a piece of zinc

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borosilicate glass, mounted behind indicia openings 2 in a recessed area 7. Mounted behind backing member 6 in a second recessed area 8 is an electroluminescent lamp 5. The connectors and connecting wire for electroluminescent lamp 5 as well as control switch 3 is omitted from FIG. 3 for purposes of clarity.

Other materials may, of course, be substituted for those described above. However, the overlay 1 will generally be comprised of a metallic material for purposes of non-flammability. Zinc borosilicate glass is selected in the preferred form of the present invention for the transparent backing member because of its flexibility and high temperature resistance relative to other glasses and for its nonflammability relative to plastics. Transparent backing member 6, bonded generally with a chemically adhesive such as an epoxy cement in recessed area 7, supports the free centers of indicia openings 2. Backing member 6 may be tinted to control color or brightness in the illuminated indicia openings.

In use, the metallic overlay of the present invention is either assembled with a dust cover on the back thereof or mounted on some form of control panel backing member.

To produce the highly legible indicia openings in the overlays of the present invention, the indicia are first mechanically engraved on one side of a metal blank to a uniform depth somewhat less than the blank thickness. The remaining unengraved thickness holds the free centers of the indicia characters and makes possible very precise character formation. Support material is then applied to the engraved side of the blank and the reverse side is chemically etched. When this process is complete the thickness of the blank in the area surrounding the indicia is sufficiently reduced to expose the indicia on the reverse side of the blank. Openings in the shape of complex indicia characters are thus formed with good precision. In the process of chemical etching the back side of the indicia, mounting recesses for backing member 6 and lamps 5 may also be formed and excess material around integral supporting ribs may be removed.

For example, the metallic overlay shown in FIGS. 1-3 was made from a five inch by seven inch blank of 0.091 inch thick 7075-T6 aluminum. (In other examples, 6061-T6 aluminum has also been used with equal success. These materials are commercially recognized as structural grade aluminum alloy.)

A rear view of this metal blank following engraving and etching is seen in FIG. 4. The indicia were formed on one side of the blank, by mechanical engraving, to a flat depth of 0.01 inch, with a cutter having a side taper on the order of 3°. Generally the width of the indicia character lines was about 0.026 inch and the ratio of line length to line width was about 6 to 1.

To control glare from the front of the panel and to improve its appearance, the blank was anodized, by a conventional anodization process, after it had been mechanically engraved.

A chemical etch maskant coating was then flow coated on both sides of the blank. After allowing the maskant to dry it was cut and removed in the area defining backing member recess 7. This exposed area was then etched to a depth of 0.01 inch with a conventional sodium hydroxide etchant bath at 180-200° F. Typically, this bath was made up of 20 ounces of sodium hydroxide crystals, 0.3-0.4 ounce of sodium gluconate and 0.2-1.0 ounce of sodium sulfide per gallon of water. (Other maskants, other sodium hydroxide baths, and other types of etchants, such as hydrochloric acid baths, have been used.) In "The Surface Treatment and Finishing of Aluminum and Its Alloys," S. Wernick and R. Pinner, Robert Draper Ltd., Teddington, England, Third edition, 1964, at page 182, continuing to page 183, there are listed, as maskants which have been used for etching in alkaline baths, neoprene, acrylonitrile, styrene elastomers, chlorinated or butyl rubber, polyvinylchloride and polyvinylidene chloride, polystyrene and polyethylene.

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Maskant was then cut and removed from the area defining lamp mounting recess 8 and the area 9 surrounding supporting ribs 4. These areas were etched with the conventional sodium hydroxide etchant described above until breakthrough to the flat bottomed indicia engraving was achieved. The recessed areas produced by the two step etching process just described are seen most clearly in FIG. 4.

The complex indicia characters thus formed by the combined mechanical engraving-chemical etch procedure of the present invention are much superior in sharpness and legibility to any heretofore known to have been produced by either mechanical or chemical means alone. Typically, these indicia have the form of continuous penetrations (rather than a succession of dots in line) which may include completely closed loops, so that the portion of the metal blank inside a loop is completely separated from the remainder.

In order to complete the metallic overlay produced as described above, it is necessary to provide a permanent supporting means for the area surrounding, and the free centers of the indicia openings. It is also necessary to remove the remaining maskant from the overlay.

In the preferred form of the present invention a zinc borosilicate backing member 6 is bonded with a conventional epoxy cement in recess 7. A problem arises however in that the epoxy cement makes it difficult to remove the maskant from the front of the overlay. Therefore it has been found best to apply a polyvinyl alcohol (PVA) parting layer and a silicone rubber elastomer overcoat to the back of the indicia after the chemical etching process. The maskant is then easily removed from the front of the overlay and a PVA parting layer and silicone rubber overcoat is applied to the front of the overlay. After removing the previously applied PVA-silicone from the back thereof, the glass backing member may be permanently bonded in place. The PVA-silicone on the front of the metallic panel overlay is then easily removed without damage to the indicia openings.

While the foregoing invention has been described with reference to particular embodiments thereof for purposes of clarity and convenience, it should be understood that numerous modifications may be made by those skilled in the art without departing from the invention's true spirit and scope. Therefore the appended claims are intended to cover all such equivalent variations as come within the true spirit and scope of the present invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

- 50 1. A process for producing a metal panel provided with indicia in the form of continuous penetrations through the panel, the said indicia including at least one completely closed loop which completely separates the portion of the metal panel inside it from the remainder of the panel, such separated portion being held in position relative to the remainder of the panel by a light-transmissive support, comprising the steps of:
 - (a) engraving the indicia upon the front of a metal blank to a depth less than the thickness of the blank;
 - (b) then applying a coating of etch maskant to at least the front of the blank;
 - (c) then providing on the back of the blank an exposed metal surface opposite the general area bearing engraving;
 - (d) then chemically etching the exposed metal surface to a depth sufficient to remove the bottom of the engraving, whereby the engraved indicia are rendered penetrations through the blank;
 - (e) then applying to the thus etched surface a coating of parting compound;
 - (f) then applying to the coating of parting compound a layer of elastomeric material;
 - (g) then removing the maskant from the front of the blank;

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- (h) then applying a coating of parting compound to the front of the blank;
- (i) then applying to the coating of parting compound upon the front of the blank a layer of elastomeric material;
- (j) then removing from the back of the blank the parting compound and elastomeric material applied to it in steps e and f;
- (k) then cementing to the back of the blank including separated portions thereof a sheet of non-flammable transparent material;
- (l) then removing from the front of the blank the coating of parting compound and elastomer applied to it in steps h and i.

2. A process as recited in claim 5, wherein:

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- (a) the therein said metal is an aluminum alloy;
- (b) the therein said parting compound is polyvinyl alcohol;
- (c) the therein said elastomeric material is silicone rubber.

References Cited**UNITED STATES PATENTS**

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JACOB H. STEINBERG, Primary Examiner
U.S. CL. X.R.

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