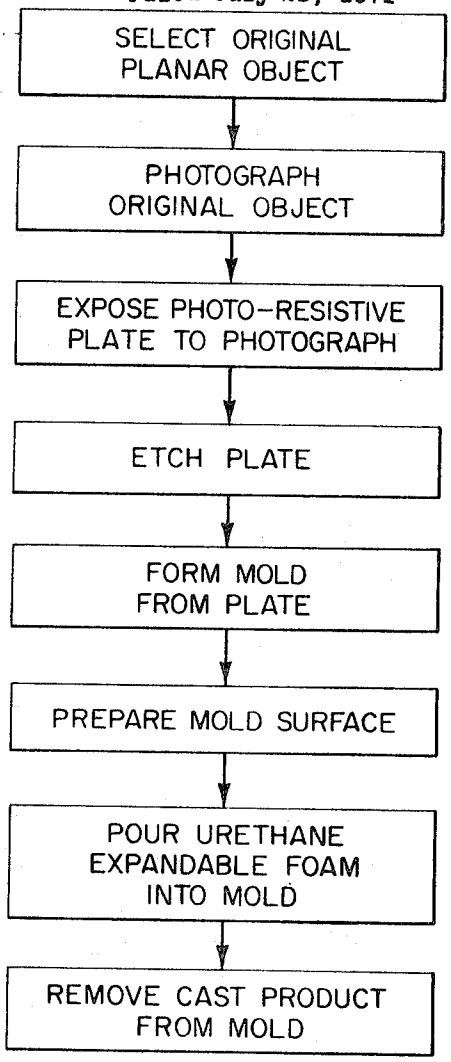
June 12, 1973 G. W. SMITH 3,739,051
METHOD OF MAKING A MOLDED FOAM DECORATIVE PRODUCT
Filed July 21, 1971



United States Patent Office 3,739,051 Patented June 12, 1973

3,739,051

METHOD OF MAKING A MOLDED FOAM DECORATIVE PRODUCT

George Warren Smith, P.O. Box 506, Pigeon Cove, Mass. 01966

Filed July 21, 1971, Ser. No. 164,512
Int. Cl. B29c *1/02;* B29d *27/04*
U.S. Cl. 264—48 13 Claims

ABSTRACT OF THE DISCLOSURE

A method and product of producing a three dimensional colored decorative product. The method preferably comprises photographing a line drawing, employing the resulting photographic transparency to expose a photosensitive plate, etching the plate, forming a flexible elastomer mold from the etched plate and casting a foamable liquid reaction mix in the mold to form a cured non-resilient urethane foam three dimensional product. The mold interior can be painted with a pigmented coating before the urethane foam is cast. The mold can include a frame portion.

BACKGROUND OF THE INVENTION

Conventionally, engravings are hand-tooled in metal or wood plates to create three dimensional representations of ships, flowers, seascapes and the like. Engraving is an art practiced by relatively few highly skilled artisans. Commercial enterprises manufacturing decorative objects such as framed engravings generally incur high manufacturing costs because of their dependence upon engravers who command high wages and work work quite slowly.

It is an object of this invention to provide a manufacturing process which creates a decorative object having the appearance of a framed engraving which is made entirely of plastic. The inventive process can be operated by workers who have no artistic skills whatsoever.

It is another object of this invention to provide a process which can produce a master mold from a planar line drawing in a relatively short time and which can produce cast products from the mold on an assembly line basis.

It is still another object of this invention to provide a process which produces a cast decorative object entirely from plastic which is virtually indistinguishable from a metal engraving having a wooden frame.

SUMMARY OF THE INVENTION

To achieve the foregoing objects, this invention comprises a process which includes the following steps in its preferred embodiment. A planar original object is selected. A photograph is made of the object and the photographic transparency is imaged onto a photo-resistive plate. The plate is etched and then used to make a silicone elastomeric master mold. Urethane foam is poured into the mold and after the urethane has expanded and cured, the rigid unit is pulled from the mold.

BRIEF DESCRIPTION OF THE DRAWINGS

The figure is a diagrammatic showing of the sequence of steps taken in the practice of the preferred embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

This invention is practiced by first selecting a planar original object. This object will become the subject matter of the final molded product which, in the preferred embodiment, has the appearance of an engraving mounted in a frame.

The preferred original objects for use in this invention are black and white line drawings with distinct and clearly defined black and white areas. Other planar representations which include sharp contrasts are also suitable, but representations such as charcoal or pastel drawings, water color paintings and the like do not produce good results.

If the original planar object is sharp enough, as for example an India ink drawing on a Mylar sheet, it may be suitable for imaging directly. However, usually there is the need for an intermediate step. For example, if the original object is a line drawing on opaque paper, the next step is to photograph it and to develop the negative. The negative is then used for the next step which is imaging.

In order to transfer the original planar objects's pattern onto an etchable surface, a photo-resistive plate is employed. The term photo-resistive plate, as used in this application, means a surface which is sensitized to the action of radiant energy so that when a pattern of light strikes the surface a chemical reaction occurs on the exposed surface areas. Depending on the sensitizing chemicals used in the plate coating composition, either the exposed or the unexposed surface areas are thereafter resistant to the corrosive action of an etching agent, such as acid or alkali.

In imaging the photo-resistive plate, the negative (or the usable original) is placed in contact with the photo-resistive plate and then the plate is exposed to a suitable light, such as actinic or ultraviolet. Of course, if it is desired to change the scale of the image pattern, the negative can be spaced from the plate.

In practice, applicant has successfully employed a Revere Triplemaster Plus photo-resistive plate which is believed to be made of magnesium. It is believed that a Du Pont Dycril plastic plate will also operate successfully. After imaging the light pattern of the original object onto the photo-resistive plate, the plate is then etched with a corrosive chemical agent. The etching step is conventional and employs in the case of a metal plate a dilute acid or in the case of a plastic plate a dilute alkali. Etching causes the non-resistive portions of the plate to pit or be eaten away. The most aesthetic results have been achieved when the etching action forms pitted lines and areas corresponding to the black lines and areas on the original object. It has been found that the etching process produces shallow angled grooves where the non-resistant plate lines are narrow, and deeper flatter grooves where the non-resistant plate areas are wider.

After etching, a flexible skin mold is made which must conform to the intricate design of the etched plate. The etched plate is first cleaned to rid all oils or contaminants. Preferably an elastomeric silicone rubber, such as General Electric RTV Silicone No. 662 or Dow Corning Silastic E–RTV, is used as the mold material. Other mold making materials, such as elastomeric urethane or latex, could also be used but have drawbacks not associated with silicone rubber such as the need for a release or parting agent.

Silicone rubber mold making techniques are described in Dow Corning Bulletin 08–347 dated January 1969 entitled "Information About Silicone Mold Making Materials." Urethane mold making techniques are described in U.S. Pat. No. 3,428,725.

To make the mold, the etched plate is fixed into position on a flat base and a wooden frame dam is placed around the etched plate. An interesting feature of this invention is that a wooden (or other) decorative frame can also be placed around the etched plate within the framework dam and the elastomer silicone rubber material flows over this frame as well as over the etched plate. Thus, the mold will include an impression of both the etched plate and the wooden frame as an integrated object.

The silicone rubber mold material comprises a polymer and a catalyst which are first carefully weighed and mixed. Then, the mixture is usually placed into a vacuum chamber for degassing so that the air bubbles are removed. The elastomeric mixture is then carefully poured into the dammed cavity and a lid (which has previously been sprayed with a release agent) is placed over the dam frame and tightly clamped in position. The lid has air vent holes drilled therein to release pressure and to permit the escape of excess elastomer material.

After the elastomer has cured, the clamps are removed and lid, frame, flat base and etched plate are separated from the flexible mold. The mold is then ready for use. Optionally, however, the mold may need to be prepared before use begins.

If the mold is made of silicone rubber elastomer, a release or parting agent is not necessary. If the mold is made of urethane elastomer, a release agent, such as Dow Corning DC–7 silicone oil must be applied to the mold interior. Furthermore, if it is desired that the finished product be colored, it is a feature of this invention that the mold interior can be sprayed or otherwise covered with a pigmented coating prior to the introduction of the plastic foam. The spray painting can be carried out using several different colors with various mold portions being masked and with some portions receiving multiple coats in view of the fact that only the first coat which is sprayed is visible on the finished product. The coating used has a greater affinity for the urethane foam which is subsequently poured into the mold than for the mold interior. This attribute produces an excellent painted surface on the decorative object which also can be subsequently hand finished, if desired.

It has been found that a pleasing result is obtained by spraying the etched plate portion of the mold with an opaque lacquer containing copper pigment while masking the frame portion of the mold. Then, the mask is removed and the entire mold is sprayed with rich brown woody lacquer. The finished product will have a copper-like etched plate portion and a wood-like frame portion. Furthermore, after the product has been stripped from the mold, it can be brushed with pigmented varnish and then wiped with a rag so that the brushed color is left only in the recesses. This provides an antiquing effect. Obviously, colors can be applied to the product in many ways not detailed here. The point of the foregoing discussion was to show that one feature of the process of this invention is its capability of applying coating to the mold before the foam is introduced.

The next step is to introduce urethane expandable foam into the mold. This is a conventional processing step and is completely described in trade literature published by Diamond Shamrock Chemical Company entitled "Shedding New Light on the Use of Urethane Foam in the Manufacture of Furniture." This brochure bears the description RP–US–1 on the back page and has a 1970 copyright.

Applicant has successfully used Diamond Shamrock machinery to weigh, blend and pour the foam into the mold. These processing steps can also be done by hand. Urethane foam is the reactive product of a polyol (resin) and a polyisocyanate (prepolymer). In this invention, it is preferred to select a polyol which has a chain length and branch points which will yield a rigid urethane foam. Density and physical properties depend upon the choice of base polyols, surfactants, catalysts and other chemical components. When the resin and prepolymer are mixed in a fixed ratio by a specific mixing method and under controlled conditions of temperature in a properly constructed mold, the foam will expand and cure to faithfully reproduce the form and surface texture of the mold.

Preferably, a water blown system is employed because it is more stable in its thermal character. Water blown systems have a more resilient cell structure and handling temperatures are less critical. Water blown systems result in a more uniform cross-sectional density, less skin effect, better dimensional stability and fewer blisters.

Alternatively, a fluorocarbon blown system can be used at a somewhat lower material cost especially if it is desired to achieve a thicker skin, lower thermal conductivity or better flowability.

Mixing the resin and prepolymer is done by carefully weighing the two constituents to obtain the desired proportions, combining them and then mixing them without entrapping air. At the same time, the mold and mold lid are pre-heated to the proper temperature. Before the reaction begins (cream-time), the mixture is poured into the pre-heated mold and distributed evenly across the entire mold surface. The mold lid is then placed on the mold and clamped securely. The foam then expands until the complete dissipation of exotherm heat and pressure. At that time, the urethane foam has cured and the part can be removed from the flexible mold.

The specific chemicals used, times, temperatures, etc. have not been given because it is not desired to be limited to any specifics in this regard. Depending upon the physical properties required, a foam system can be selected which has the desired density, cream-time, flow-out, and mold cycle. The inventive process will operate with many plastic expandable foams. However, best results have been obtained with urethane foam of the type just described which produces a rigid cured product having a density of approximately 8 to 12 pounds per cubic foot. However, a density range of approximately 4 to 25 pounds per cubic foot is usable.

The above description obviously suggests many possible variations and modifications of this invention which would not depart from its spirit and scope. It should be understood, therefore, that the invention is not limited in its application to the details of structure specifically described or illustrated and that within the scope of the appended claims, it may be practiced otherwise than as specifically described or illustrated.

I claim:

1. A process for molding a three dimensional decorative product from a line drawing, said process comprising the following steps:
   (a) photographing a line drawing;
   (b) positioning the resultant photographic transparency over a photo-resistive plate;
   (c) projecting light through the negative to expose the underlying photo-resistive plate to a light pattern corresponding to the line drawing;
   (d) etching the exposed photo-resistive plate to lower the non-imaged portions of the plate;
   (e) placing the etched plate within a hollow framework dam;
   (f) pouring a liquid elastomer mold material over the etched plate to completely fill the hollow framework dam;
   (g) closing the framework dam to distribute the elastomer mold material throughout the entire interior of the enclosed framework dam;
   (h) permitting the elastomer mold material to cure into a flexible mold, and removing the mold from the framework dam;
   (i) pouring a foamable liquid reaction mix into the mold and closing the mold; and
   (j) permitting the mix to expand and cure into a non-resilient foam decorative product, and removing the decorative product from the mold.

2. The process of claim 1 wherein the line drawing is two dimensional.

3. The process of claim 1 wherein the line drawing is three dimensional.

4. The process of claim 1 wherein the photo-resistive plate is metal and the plate is etched with acid.

5. The process of claim 1 wherein the photo-resistive plate is plastic and the plate is etched with alkali.

6. The process of claim 1 wherein the mold material is silicone elastomer which, when the polymer is combined with a catalyst, becomes a pourable liquid which cures to become a flexible mold.

7. The process of claim 1 wherein before the reaction mix is poured, the flexible mold is heated above room temperature.

8. The process of claim 1 wherein, before the reaction mix is poured, the mold interior is covered with a pigmented color coating which has a greater affinity for the reaction mix than for the mold material.

9. The process of claim 1 wherein the non-resilient foam decorative product is urethane.

10. The process of claim 9 wherein the cured urethane foam has a final density of between four and twenty-five pounds per cubic feet.

11. The process of claim 1 wherein the decorative product is painted with a pigmented coating after it has been removed from the mold.

12. The process of claim 1 wherein the decorative product includes an integral frame.

13. A process for molding a three dimensional decorative product from a line drawing, said process comprising the following steps:

(a) positioning a line drawing over a photo-resistive plate;

(b) projecting light through the line drawing to expose the underlying photo-resistive plate to a light pattern corresponding to the line drawing;

(c) etching the exposed photo-resistive plate to lower the non-imaged portions of the plate;

(d) placing the etched plate within a hollow framework dam;

(e) pouring a liquid elastomer mold material over the etched plate to completely fill the hollow framework dam;

(f) closing the framework dam to distribute the elastomer mold material throughout the entire interior of the enclosed framework dam;

(g) permitting the elastomer mold material to cure into a flexible mold, and removing the mold from the framework dam;

(h) pouring a foamable liquid reaction mix into the mold and closing the mold; and

(i) permitting the mix to expand and cure into a non-resilient foam decorative product, and removing the decorative product from the mold.

References Cited

UNITED STATES PATENTS

3,487,134	12/1969	Burr	264—45
3,504,079	3/1970	Hall	264—225
3,548,041	12/1970	Steding	264—225 X

FOREIGN PATENTS

9,017	6/1899	Great Britain	264—219

OTHER REFERENCES

Dow Corning Corp., "Greater Versatility in Design and Production with Silastic RTV" (Bulletin), Midland, Mich., © 1961, all pages.

PHILIP E. ANDERSON, Primary Examiner

U.S. Cl. X.R.

156—8; 161—164, 413; 264—102, 219, 225, 226, 338