

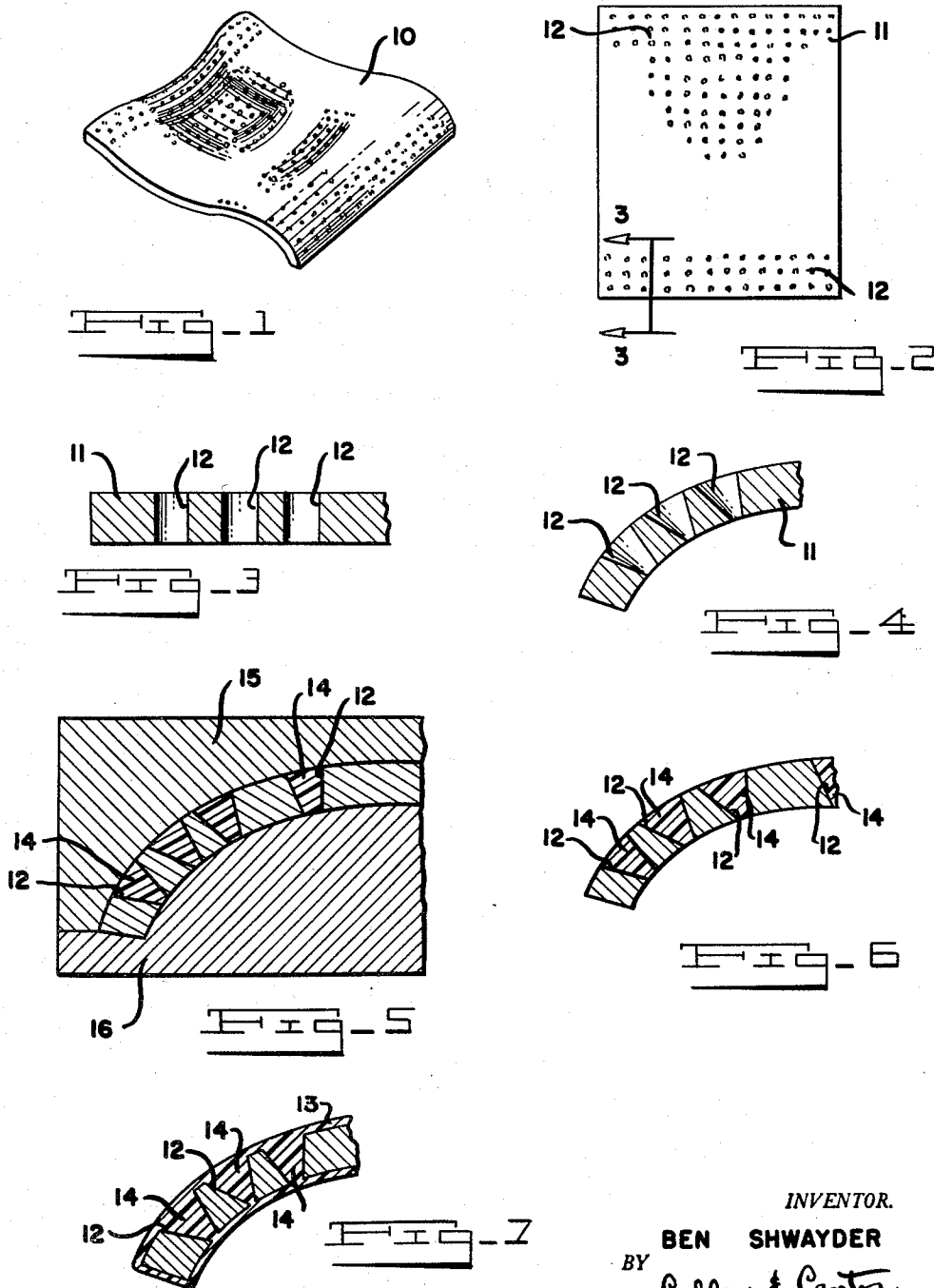
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B. SHWAYDER

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METHOD OF FORMING MULTIPLE CURVED PANELS

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INVENTOR.

BEN SHWAYDER

BY

Cullen & Cantor

ATTORNEYS

1

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METHOD OF FORMING MULTIPLE CURVED PANELS

Ben Shwayder, Bloomfield Hills, Mich., assignor to Shwayder Bros. Inc., Detroit, Mich.

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1 Claim. (Cl. 18—56)

This invention relates to a method of forming multiple curved panels and more particularly to a method of bending and forming flat panels or sheets, of the type which normally resist bending and normally tend to elastically return into their previous flat shape after bending, into multiple curves and bends which are permanently set in their bent condition.

The present application is a continuation-in-part of my copending application Ser. No. 577,396, filed April 10, 1956, now abandoned.

In the construction of bent or shaped panels, as for example for chair seats, flat panels, such as plywood, hardboard, or certain types of plastics, are pressed in dies under heat and pressure to impart a desired bent shape or indentation to such panels. However, it has been found that after the die pressing operation has been completed, the panels tend to spring back into their original flat form. Likewise, many of these flat panels resist bending altogether, and thus cannot be bent into deep curves or multiple curves, i.e., curves in two or more directions.

Thus, it is an object of this invention to provide a method for bending and forming and permanently setting a panel into deep curves and compound curves, where the panel is of the type which normally resists bending under heat and pressure and which normally tends to return to its undeformed condition after deformation.

Another object of this invention is to provide a method for bending and forming and permanently setting panels as mentioned above, and at the same time providing an outer, protective plastic type covering for the panel wherein panels which are of some inexpensive, relatively unattractive, and difficult to bend, material can be utilized.

These and other objects of this invention will become apparent after reading the following description, of which the attached drawings form a part.

Referring to the drawings, in which:

Fig. 1 illustrates a perspective view of a finished, shaped panel bent into compound, deep curves and which in this case, is suitable for use as a chair seat.

Fig. 2 is a front view of the perforated flat sheet forming the panel.

Fig. 3 is an enlarged cross-sectional view taken on line 3—3 of Fig. 2 and illustrates the perforations or holes formed in the sheet.

Fig. 4 is a cross-sectional view similar to Fig. 3 but shows the outer sheet bent and the holes distorted.

Fig. 5 shows a vertical cross-sectional view of a portion of the sheet in a forming die, and,

Fig. 6 illustrates a vertical cross-sectional fragment of the panel after release from the forming die.

Fig. 7 shows a vertical cross-sectional fragment of a modification, wherein the sheet is covered with outer protective plastic layers.

The method

In Fig. 1, a deeply bent, compound curved panel 10, suitable for use as a chair seat, is shown. This panel is

2

formed of a flat sheet 11 of a relatively inexpensive material such as ordinary plywood, or hardwood, such as that known and marketed under the trade name "Masonite," or particle board formed of wood particles and a resin binder, or the like.

These materials are all readily available, but all have the common characteristic of strongly resisting deformation, even under heat and pressure, and of tending to elastically return to their original flat shape after deformation. Thus, in the absence of the method of this invention, these materials could not be used for panels where deep bends and multiple curves are desired.

The method herein consists first of perforating the sheet with numerous closely spaced holes in the areas of the sheet to be bent. The holes or perforations 12 extend through the sheet 11, as seen in Fig. 3, and preferably are quite small in diameter, normally being longer in their direction transverse of the sheet than in the hole width direction taken along the plane of the sheet. The holes may be punched or drilled into the sheet and enough holes are provided to weaken the sheet, that is, to reduce the resistance of the sheet to deformation in the areas to be deformed. Thereafter, the holes are filled with a liquid resin substance 14 of a type which will harden and set under heat and pressure. Next, the sheet is deformed, in a suitable set of dies 15 and 16 under heat and pressure, into the desired deep bends and compound curves.

In the dies, the hole walls are deformed, as shown in Fig. 4, and thus, the resin which fills the holes is thermally hardened into the deformed contours of these walls. After, the resin has set, the dies are released and the hardened plastic acts as plugs in the holes to maintain the holes in their deformed shape and to thereby maintain the sheet in its bent and curved shape. In this finished condition the sheet is permanently retained in the desired shape against any resilient tendency of the sheet to return to its original shape.

The resin

One resin found to be suitable for this method is given, in parts by weight, as follows: 58 parts of polyester resin "Plyothene," which is identified as Reichold No. 8006 polyester resin, a glycol phthalic-maleic anhydride reaction product; 40 parts calcium carbonate, as a filler; 0.5 part benzoyl peroxide; 1.5 parts styrene monomer.

The holes 12 may be filled with resin before the sheet 11 is placed in the mold or they may be filled by pouring the liquid resin in while the sheet is in the mold. The resin may be cured and the sheet bent at a curing pressure of 70–300 p.s.i. and a temperature range of 200°–300° F. for a sufficient length of time to harden the resin, depending upon the amount of filler and other variable operating conditions.

Many other types of synthetic resin materials may be substituted for that resin specifically named above. Thus, for example those synthetic resins identified by the generic names of epoxy, phenolic, melamine, silicone, and similar thermo-setting resins may be employed instead of the polyesters specifically identified above. While the thermo-setting resins are preferred, it is also possible to use thermo-plastic resins in connection with this invention, such as polystyrene, or polyvinyl chloride. Where a phenolic resin is employed, satisfactory results may be employed with many of the polymerizable phenol formaldehyde resins produced by the Carbide and Carbon Chemicals Corporation. For example, the carbide and carbon resin designated as Bakelite XRS 17582 is a very satisfactory phenol formaldehyde resin. Good results may be obtained where this particular resin is formulated with one part of styrene for every ten parts by weight of the Bakelite resin, with 2% to 3% benzoyl peroxide being employed based on the weight of the Bakelite resin.

Such a formulation will have a viscosity on the order of 35,000 centipoises at 60° F. As much filler may be employed as is necessary to obtain the visual effects desired, consistent with good strength characteristics. Many other suitable molding resins will readily occur to those skilled in the art.

Curing of the resin may take place at the curing pressure and temperature peculiar to the resin employed.

Outer coatings

Where desired, in some cases, to protect and strengthen the sheet 11, an outer plastic layer 13 may be bonded to the sheet at the same time that the resin in the holes 12 are hardened. The outer layer gives the added advantage of providing a good looking, water impervious, surface to the sheet so that the sheet itself may be of inexpensive, rough appearing material, but the finished panel will be attractive and extremely strong.

While many types of plastic materials may be selected for use in the outer layer, one example of a suitable material is a mat of loose fibrous glass of $\frac{3}{4}$ to $1\frac{1}{2}$ ounces per square foot of O.C.S. type 503, impregnated with a liquid resin composition, such as the polyester example, given above, or any of the other suitable resins mentioned.

It is desirable to have a resin which, when combined with the fibers, will be of high impact resistance, high tensile strength and water impervious. Also, the percentage of resin to fibrous glass may be varied considerably, but it is essential to use a sufficient amount to thoroughly penetrate the fibrous mat, coat the individual fibers, and fill in the perforations 12 in the sheet 11.

In molding the laminate, the perforated sheet 11 is desirably placed directly in the mold, and the resin is then poured over the sheet in a sufficient quantity to coat each surface of the inner layer 11 and fill each of the perforations 12. Preferably, the resin-forming mat is placed in position on the inner layer 11 before the inner layer 11 is placed in the mold. If convenient, the mat may be impregnated with the resin formulation before placing in the mold.

With the specific polyester formulation identified above, laminated with a glass mat on each surface thereof having a weight of $\frac{3}{4}$ oz. per square foot O.C.S. type 503, and an inner layer of $\frac{1}{8}$ " thick Masonite, a cure for 30 minutes at 230° F. under a pressure of 100 p.s.i. produced an exceptionally fine product, having good strength characteristics, a desirable appearance, light weight, and resistance to abrasion and chemical attack.

Regardless of the molding material employed, it is desirable that the outer layer of resin 13 be of sufficient thickness to provide a clearly-defined film over the entire surface. Best results are obtained when this clearly-defined film has a thickness of at least 0.0035".

As illustrated in Fig. 5, this invention is specifically directed to the molding of a sheet formed of a resilient, elastic material which, in its final molded shape, is deformed from its normal state. The resin filling the perforations 12, after the molding operation has been completed, is integral with the resin in the surface film, and results are integral with any resin which may have penetrated into the sheet 11. Depending upon the viscosity of the sheet 11, and its time of contact with the impregnating resin, the sheet 11 may or may not be somewhat impregnated. The forming dies 15 and 16 press the laminate into the desired shape and maintain it at the desired molding pressure and temperature during the curing operation. After the curing or molding has been completed, the product is completely encased by a film of plastic material which in many areas of the molded object penetrates completely through the object at the perforations thereof.

The use of a fiber glass mat as the reinforcing agent for the plastic is preferred because of the excellent bonding characteristics and high strength imparted to the molded product by this material. However, similar fib-

rous reinforcing agents may be substituted for the fiber glass mat with good results. Such materials as sisal and horse hair may be employed, for example.

During the molding operation, it has been found desirable to use a parting agent on the forming dies 15 and 16, to avoid any adhesion of the resin to the die surfaces. If desired, cover sheets of cellophane may be employed over the mold faces for this purpose.

Conclusion

In the drawings, the perforations 12 are generally shown in greatly enlarged form. When the panel is distorted by the forming molds, the perforations 12 become distorted usually with the part of the perforations at the outside of the bend being stretched and the part at the inside of the bend being compressed. This effect of the distortion is shown in Fig. 4. The fluid material filling these perforations assumes their shape, so that the perforations, though distorted, still remain filled (see Fig. 5). During the curing and molding operation, the material filling the perforations quickly sets or hardens. Thus, the perforations are restrained from returning to their original shapes and the panel likewise becomes permanently set in its bent shape.

The perforations also function to provide areas in the panel where the panel is initially weakened, e.g. before the material filling the perforations is set, thus permitting the panel to be easily bent and shaped.

This invention may be developed within the scope of the following claims without departing from the essential features of said invention. Accordingly, it is desired that the specification and drawings be read as being merely illustrative of a practical embodiment of the same and not in a strictly limiting sense.

I claim:

A method for forming permanent multiple curves in selected areas of a panel which is formed of a thick, flat sheet of wood-like, fibrous material, such as plywood, hardboard and the like, which material is of the type which has a substantial resistance to bending and which elastically springs back a substantial degree to its flat, unbeat shape after being bent, said method comprising essentially the steps of perforating the sheet with numerous holes, extending through the sheet from one face of the sheet to the opposite face thereof and substantially perpendicular to the plane of the sheet, the holes being located in the area of the sheet which is to be bent into curves and being in sufficient number of weaken that area and reduce the resistance of that area to bending, and with the holes each being of a size to undergo substantial deformation of the walls defining each hole when the sheet area is bent and each being of a length at least as great as its diameter and each being of a size to receive and retain a fluid resin substance; filling the holes with a fluid resin substance characterized by being normally in a liquid state and being thermosetting into a rigid, solid state and being non-deformable from its solid state physical dimensional condition; applying sufficient pressure to the selected areas of the sheet to bend those areas into the desired curves and simultaneously to deform the walls of the holes, and thermally setting said resin substance into its solid state while maintaining said pressure so that the deformed walls of each hole act as a mold for the resin contained in that hole and the resin solidifies into plugs which externally conform to the shape and size of the deformed walls, and then releasing said pressure whereby the plugs fix the walls of the holes in their deformed shape and thus retain the bent curves in the sheet and prevent the curved areas from springing back towards their flat, unbent shape.

References Cited in the file of this patent

UNITED STATES PATENTS

287,146 Martin Oct. 23, 1883

(Other references on following page)

2,934,790

5

UNITED STATES PATENTS

779,851	Holtzman	Jan. 10, 1905
1,876,849	Bronson	Sept. 13, 1932
2,042,976	Aalto	June 2, 1936
2,153,596	Schmerhorn	Apr. 11, 1939
2,253,825	Tully	Aug. 26, 1941
2,632,722	Libberton	Mar. 24, 1953

2,674,543
2,731,078
2,800,423

6

Khndzorian-Iablokoff et al.	Apr. 6, 1954
Cadman et al.	Jan. 17, 1956
De Swart	July 23, 1957

FOREIGN PATENTS

Great Britain	Nov. 25, 1937
Great Britain	June 16, 1947

475,756
589,260