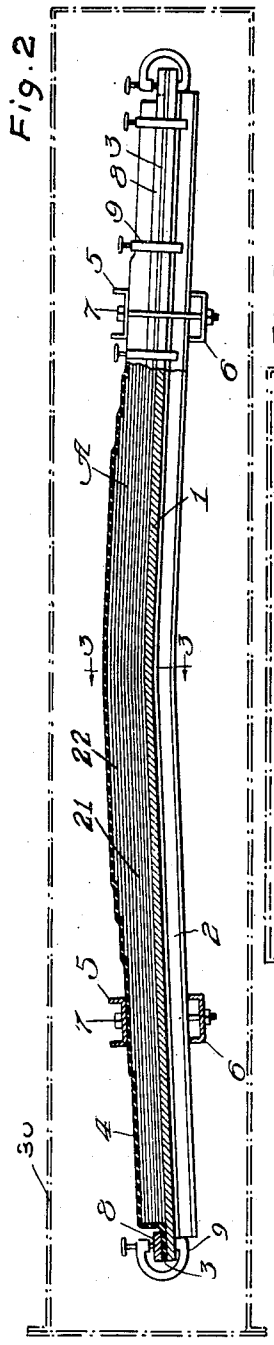
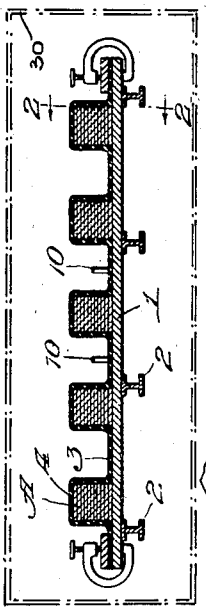
May 31, 1949. J. A. POTCHEN 2,472,023

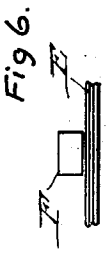
METHOD OF FORMING WOOD ASSEMBLIES

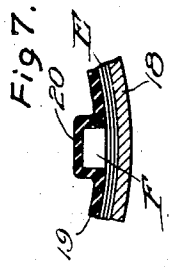
Filed Jan. 19, 1944

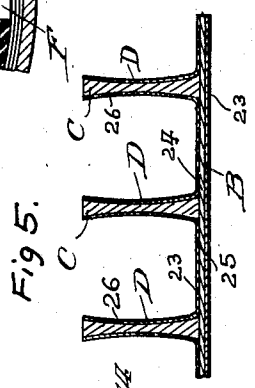


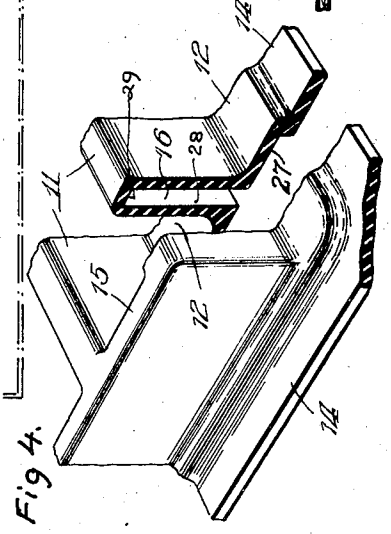












Inventor

Joseph A. Potchen

By Albert M. Austin

his Attorney

Patented May 31, 1949

2,472,023

UNITED STATES PATENT OFFICE

2,472,023

METHOD OF FORMING WOOD ASSEMBLIES

Joseph A. Potchen, Grand Rapids, Mich., assignor, by mesne assignments, to William B. Scarborough, Englewood, N. J., as trustee

Application January 19, 1944, Serial No. 518,890

2 Claims. (Cl. 154—133)

1

This invention pertains to the art of molding wood or the like material, and comprises novel apparatus, and a novel method, for performing the molding operation.

This application is a continuation in part of my copending application, Serial No. 321,175, filed February 28, 1940, now abandoned, to Apparatus for bonding laminated material.

In the art of molding wood or the like material, it is common practice to provide a die presenting a rigid surface, the contour of which is predetermined to conform with the desired surface contour of one side of the assembly of material to be fabricated. The practice is to place a layup of the material on the die, the layup comprising, for example, strips of wood veneer. The layup in position on the die is thereafter covered, for example with a blanket, to form a package, the cover being flexible and elastic, and impervious to moisture. Usually the cover is made of rubber, or a like elastic fabric. The package is subjected to pressure, usually accompanied with the application of heat, the simplest practice being to place the package in a steam chamber. The cover is sealed to prevent steam from entering between the cover and the die where it can contact and attack the material being molded. The fluid pressure impinging against the surface of the cover presses the layup into firm contacting engagement with the rigid surface of the die. The temperature of the steam operates to cure and set the adhesive, or to accelerate the setting time. The pressure operates to mold the material to conform with the contour of the die, and when the adhesive sets, the material becomes permanently set to the contour to which it was molded.

This process is more fully explained in the patent granted to me and Olin H. Basquin, No. 2,308,453, January 12, 1943.

The usual prior art practice is to use a cover of flat sheet rubber. The rubber being elastic, the fluid pressure applied to the package will press the rubber into engagement with the surface of the material being formed, and will press the material against the rigid surface of the die. In some places the cover may be wrinkled, but such wrinkles are usually so located that they are away from the layup and do not affect its final contour. In other places the cover will be stretched around exterior corners of the layup, or stretched to project into interior corners. In general, when covers made of flat sheets are used, they are distorted under the pressure of the molding operations.

2

There are a number of disadvantages in the prior art practice.

Where the cover is stretched over an outside corner, the net pressure is the sum of the fluid pressure plus the pressure incident to the cover being stretched. Where a cover is stretched to project it into an inside corner, the tension of the rubber being stretched will oppose the fluid pressure, and the effective pressure in the layup is the fluid pressure minus the pressure required for stretching of the cover. Accordingly, under prior art practice the effective pressure is not uniform throughout the surface of the layup.

Wherever the cover is wrinkled and subjected to the severe treatment of the steam, it deteriorates rapidly. Also, wherever the rubber is stretched, and in the stretched condition is subjected to the treatment of the steam, it deteriorates rapidly. Accordingly, the life of prior art molding bags and blankets is decidedly limited.

To obviate the above recited disadvantages, in the practice of the present invention I provide a cover molded to a contour to conform accurately with the contour of the assembly to be fabricated on the rigid die. Under certain circumstances, I actually mold the cover to the layup, using the layup as a pattern. Under some circumstances, and for reasons which will be explained more fully hereinafter, I mold the cover in a specially constructed mold. By whatever method fabricated, the surface of the cover is formed to conform with the composite surface of the assembly in position on the die.

I have found, that by the use of a premolded molding blanket, I am able to prolong the life of the blanket for many more molding operations. I further find that I am able to fabricate layups of much more complex contours, which I found impossible to produce using covers of flat sheets, such as are used under prior art practice.

A fuller appreciation of the nature of the invention will be derived from the accompanying drawings to which reference is now made. In the drawings—

Figure 1 is a side elevation of a typical layup, which can be fabricated into an assembly under the practice of the present invention,

Figure 2 is a side elevation of a package containing the layup of Figure 1, parts being broken away, and shown in section on line 2—2 of Figure 3, for clearness of illustration,

Figure 3 is a cross-sectional elevation, taken on line 3—3 of Figure 2,

Figure 4 is a fragmentary perspective view,

with portions in sections, illustrating a molding cover for molding a different type of assembly,

Figure 5 is an end view of an assembly such as is capable of being molded, using the cover of Figure 4,

Figure 6 is a fragmentary end elevation of a typical integral molding layup, and

Figure 7 is a fragmentary cross-sectional elevation illustrating the molding package for the layup of Figure 6.

The apparatus of Figures 2 and 3 is suitable for fabricating spar flanges, and Figure 1 presents a typical layup A of the spar flange. In the example shown, the layup A comprises a plurality of strips 21 of wood, or any other suitable material, the strips 21 being stacked on top of each other to attain the desired thickness to meet the strength requirements of the flange. As illustrated, the strips may be stepped for stress distribution in accordance with strength requirements, in which case the topmost strips 22, of the stack, are shorter to make the spar flange thicker and stronger midway between its ends. Any suitable adhesive is placed between surfaces of contact between strips 21 and 22.

To fabricate the spar flanges A, they are placed on the die 1 which comprises a rigid surface. The surface of the die 1 presents a predetermined contour which conforms with the desired contour of the spar flanges.

The die 1 is supported by and reinforced by one or more beams 2, and is preferably constructed wide enough for the molding of a plurality of flanges A, as will be clear from Figure 3. The flanges having been placed in position on the die 1 to form a layup, a cover 3, preferably in the form of a blanket, is laid over the layup. The blanket 3 covers the exposed surfaces of the several flange layups A, as well as areas outside the borders of layups including the die surface between layups, and extending to the bordering edges of the die 1. The blanket 3 thus comprises a diaphragm, which covers the layup overall. The layup, positioned between the blanket 3 and the die, is completely enveloped thereby.

The layup is sealed within the blanket, and pursuant to this purpose the bordering frame 8 is provided, which overlies the blanket 3 at the edges of the die 1. C-clamps 9, spaced apart around the edge of the die 1, operate to press the frame 8 against the blanket 3, to press the blanket into sealing engagement with the die 1.

In the case of the spar flange layup A shown, the clamping bars 5 and 6 are preferably provided, and these are drawn up by means of the lag bolts 7. The clamps 5, 6 operate to flex the material of the layup A into preliminary surface contact with the die 1. This construction is found especially useful when the material of the layup is of such heavy stock that flexing the material from the flat condition shown in Figure 1 to the contoured condition of Figure 2 subjects the blanket 3 to unduly heavy strain.

The nipples 10, which may be in the form of valves, are provided to exhaust air, as well as other gases which may be generated between the cover 3 and the die 1 in the fabricating operation. The gases may be exhausted by a vacuum being applied preparatory to the layup being treated with heat and pressure, and during the adhesive curing operation.

The package, as it appears in Figures 2 and 3, is ready to be placed in an atmosphere of steam in the manner disclosed in Patent No. 2,308,453 previously referred to.

In accordance with the practice of the present invention, the blanket 3 is molded to the contour of the layup in its fabricated form in position on the die. Accordingly, in the present case the blanket 3 is provided with the elongated pockets 4, each of which is formed to the exact contour of the spar flange A in assembled condition. The contour of the pockets 4 can be attained in a number of ways.

One practice is to place the layup A on the die 1 and to cover it with raw rubber, or rubber in some other uncured form, or other suitable material capable of being vulcanized. The uncured rubber is pressed to a shape which approximately conforms with the contour of the layup positioned on the die. In this case, the layup A is mechanically held to its contour in engagement with the die 1 by means of the clamps 5, 6. The frame 8 and the C-clamps 9 are applied to the edge of the blanket of uncured rubber in the same manner as is employed for molding a layup with a premolded vulcanized blanket. The blanket of uncured rubber is treated with a curing agent in any suitable manner, as is well understood in the rubber fabricating art.

The resultant package, as it appears in Figures 2 and 3, is treated with heat and pressure in a chamber 30, in the manner hereinbefore described, and as disclosed in the patent, No. 2,308,453, referred to. The pressure of the steam molds the blanket 3 exactly to the contour of the layup A positioned on the mold 1, and the heat of the steam operates to cure the rubber. The heat of the steam also operates to cure or set the adhesive applied to surfaces of contact between strips 21 and 22 of the material comprising the layup A. When the package is removed from the heat and pressure chamber, the assembled spar flanges are removed from the pockets 4 of the blanket 3. The blanket 3 is now available as a molding blanket for future layups of spar flanges A, it having been vulcanized under the treatment of steam.

Figure 5 comprises a structural assembly of, so called, integral molding, i. e. a structure which in general terms comprising a shell, skin, or the like, of molded wood or the like material, reinforced by backing members in the form of bulkheads, ribs, beams, or the like.

In the present case, the structure of Figure 5 comprises an assembly suitable for airplane floors and the like. It comprises the skin-like flooring deck section B, which in the illustrated case is made up of a plurality of laminae or plies of wood or the like material. The flooring deck section B, since in the present case it is contemplated to be used for an airplane flooring, is illustrated as flat. Obviously, depending upon its particular use, it may comprise a curved contour, which may be either of simple or compound curvature.

The flooring deck section B may comprise as many plies as are necessary to afford the desired strength and thickness. In the embodiment shown, the deck B comprises the face ply 23 and core ply 24, an additional face ply opposite ply 23 being provided by the reinforcing backing members hereinafter described.

The backing members operate as stringers or beams which support the deck B, and comprise the core pieces C which are reinforced by means of the channel members D to constitute a ply structure. The core pieces C may comprise one or more plies, a single ply being present in the embodiment shown.

The channel members D present a U-shaped cross-section, comprising the base section 25, and

the side legs 26 continuous therewith and projecting therefrom, as shown. The base section 25 operates as a face ply for the deck B opposite the face ply 23. Proximate side legs 26 of adjacent channel members D operate as opposite face plies for core piece C positioned between them, whereby each core piece C is laid up to form a ply structure stringer or beam.

The stringers, comprising the core pieces C and face plies of proximate side legs 26 of adjacent channel members D, may be constructed of any suitable cross-section in accordance with principles of stress distribution as applied to beam structures. In the embodiment shown, the core pieces C are shaped undercut between their edges, to take advantage of the principles of I-beam cross-section.

In the preferred practice of laying up the structure of Figure 5, the channel members D are preformed to a U-shaped cross-sectional contour. The plies or laminae of the deck section B are laid up on a rigid die, which in the instant embodiment comprises a flat surfaced plate. The face ply 23 is first laid up, and the core ply 24 is laid up upon the face ply 23. The channel members D are now laid up side by side with core pieces C between each two adjacent channel members D. Preferably, and in accordance with the practice of the present invention the blanket of Figure 4 is employed to facilitate assembly of the layups of the stringers comprising the core pieces C and channel members D.

The blanket of Figure 4 comprises the upstanding channel sections 11 which break the continuity of the flat surfaces 27 of sections 12 of the blanket intermediate the channel sections 11. The flat surfaces 27 overlie the areas of deck B between stringers C, D, and more specifically, the surfaces 27 overlie the base sections 25 of the channel members D. The upstanding channel sections 11 of the blanket are located spaced apart the same distance as the core pieces C of the floor assembly. The channel sections 11 provide the channels 16 which have a contour to fit the stringer members C, D.

The entire blanket is provided with a border 14 for sealing it against the surface of the die at its edges outside the border of the layup. End walls 15 are usually provided normal to the channels 11, to join the channels 11 and close them at their ends.

The side walls 28 of the channels 16 may be formed to the contours that the side legs 26 of the channel members D assume in the floor assembly, which contour is shown in Figure 5. According to preferred practice, however, the side walls 28 are molded flat, as shown in Figure 4, it being found that this deviation from exact conformity with the contour of the assembled structure is not detrimental. It is important, however, that the depths of the channels 16 be great enough to extend to the full depth of the channel members D, so that, when pressure is applied to sections 12 of the blanket to press surfaces 27 against the base sections 25 of the channel members D into bonding engagement with the deck layup B, there is no stretching of the side wall surfaces 28. In actual practice the stringers comprising the core pieces C and the channels D are trimmed to accurate depth, after the molding operation. Accordingly, the channels 16 are molded to a depth measured between surfaces 27 and 29 which is at least as great as the maximum depth that the stringers C, D attain under

normal production practices of the molding operation.

The premolded blanket of Figure 4 is employed to locate the stringers C, D in the layup. Thus, the premolded blanket operates as a jig. Proximate legs 26 of adjacent channel members D are positioned in each channel 16 of the blanket, with a core piece C positioned between the two legs 26 in each channel 16. With a complete layup of stringers C, D made in the blanket, in the described manner, and a layup of deck section B comprising face and core plies 23 and 24, respectively, made on the rigid die as hereinbefore described, the blanket is positioned on the die, and clamped at its edges 14 to seal it. This completes a package ready to be treated to mold and set the layup, in the manner hereinbefore described, and disclosed more fully in Patent No. 2,308,453.

The molding cover of Figure 4 can be fabricated by molding it to a previously fabricated assembly of Figure 5, in a manner similar to the fabrication of the blanket 3 of Figure 2. However, in the preferred practice of the invention, the cover of Figure 4 is premolded in a special die which gives the desired contour, this practice being found advisable to attain the desired depth of the channels 16.

Figures 6 and 7 disclose an additional embodiment of the invention as applied to the fabrication of a shell or skin member E backed by reinforcing ribs F, the whole being adhered together to form an assembly. The shell member E may comprise a plurality of layers of veneer which are laid up in the concave die 18. The ribs F are also laid up in the die in engagement with the shell layup E in backing relationship therewith. The blanket or cover 19 is now placed over the layup.

The cover 19 of Figure 7 is preformed to the contour of the assembly E, F in position on the die 18, the cover including the preformed channels 20. The preformed cover 19 can be produced in a number of ways. It can be molded to the first layup, and fabricated simultaneously therewith, in the manner of forming of blanket 3, in the embodiment of Figures 1, 2, and 3. The blanket 19 may also be fabricated separate from the layup, by being molded in a special die to give it the predetermined contour, in the manner of fabricating the blanket of Figure 4, as hereinbefore described. However, in a structure such as is disclosed in Figure 6, it is usually preferred to fabricate the blanket 19 in the manner hereinafter described.

To form the blanket 19, the shell E is laid up in the die 18 and molded, using, for example, a flat blanket. The shell E is thereafter removed from the die 18, and the reinforcing ribs F are adhered thereto by a secondary assembly operation, in a manner well understood in the art. This assembly, comprising the shell E backed by the reinforcing members F, is now repositioned in the die 18, and is covered with a molding cover of uncured rubber comprising the blanket 19. This cover is formed to approximate the contour of the assembly, comprising the shell E and reinforcing ribs F, positioned in the die 18. This comprises a package which is now subjected to heat and pressure, for example, in the manner disclosed in the patent, No. 2,308,453. The uncured rubber of the cover 19 has previously been treated with a curing agent in a manner well understood in the art.

The package, when removed from the heat and

pressure chamber, presents a vulcanized rubber blanket 19 molded exactly to the contour of the layup E, F, positioned in the die 18. The vulcanized blanket 19 is available for fabricating successive assemblies of like contour, using layups E, F. The channels 20, in the blanket 19, operate to engage and hold the ribs F, until the blanket is positioned on the layup comprising the shell E in position on the die 18. Thus the blanket 19 of Figure 7 operates as a jig, in the manner of the blanket 4 in the embodiment of Figures 4, 5.

As is well understood in the art, each layup of the several embodiments of Figures 1, 2, and 3, of Figures 4 and 5, and of Figures 6 and 7, comprises plies or laminae of material, which may be wood or any other suitable material. Between plies, and between the components which comprise the assemblies of the various embodiments of Figures 1, 5 and 6, suitable adhesive is applied to surfaces of contact between pieces. Any suitable adhesive may be used. According to the preferred modern practice, a suitable thermosetting adhesive, such as a phenolic resin, is employed, but the particular adhesive employed forms no part of the present invention.

The hereinbefore disclosure presents a number of embodiments of the device of the invention, as well as various modifications of methods for carrying out the practice of the invention. The invention is not limited to the embodiments shown and described, but its scope is determined by the accompanying claims.

I claim:

1. The method of fabricating a plurality of like assemblies of molded wood, which comprises placing a layup of an assembly in position on the rigid forming surface of a die, covering the material in position on the die with an uncured flexible blanket capable of being molded and set to a predetermined contour, and subjecting the blanket to pressure and heat to mold and set the blanket to the contour of the assembly.

2. The method of fabricating a plurality of like assemblies of molded wood, which comprises placing the elements of a layup of an assembly in position on the rigid forming surface of a die, covering the material in position on the die with uncured rubber blanket capable of being molded and set to a predetermined contour, subjecting the blanket to pressure and heat to bond the elements of the assembly and to mold and set the blanket to the contour of the assembly, whereby a premolded blanket is produced for subsequent production of like wood assemblies, the blanket having an increased life due to its relative freedom from stretching in subsequent assembling and molding operations.

JOSEPH A. POTCHEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,158,389	Piper	Oct. 26, 1915
1,701,625	Luce	Feb. 12, 1929
2,147,218	Reimel	Feb. 14, 1939
2,168,285	Durham	Aug. 1, 1939
2,276,004	Vidal et al.	Mar. 10, 1942
2,298,132	Johnson	Oct. 6, 1942
2,307,985	Beasecker	Jan. 12, 1943
2,311,561	Miller	Feb. 16, 1943
2,329,425	Steel	Sept. 14, 1943
2,338,879	Teague	Jan. 11, 1944

FOREIGN PATENTS

Number	Country	Date
662,551	Germany	Feb. 17, 1935
443,696	Great Britain	Mar. 4, 1936
456,503	Great Britain	Nov. 10, 1936
545,489	Great Britain	May 28, 1942