Oct. 23, 1923. 1,471,906

A. K. LONGREN

METHOD OF FORMING CURVED BODIES FROM FIBER SHEETS

Filed April 10, 1922 2 Sheets-Sheet 1

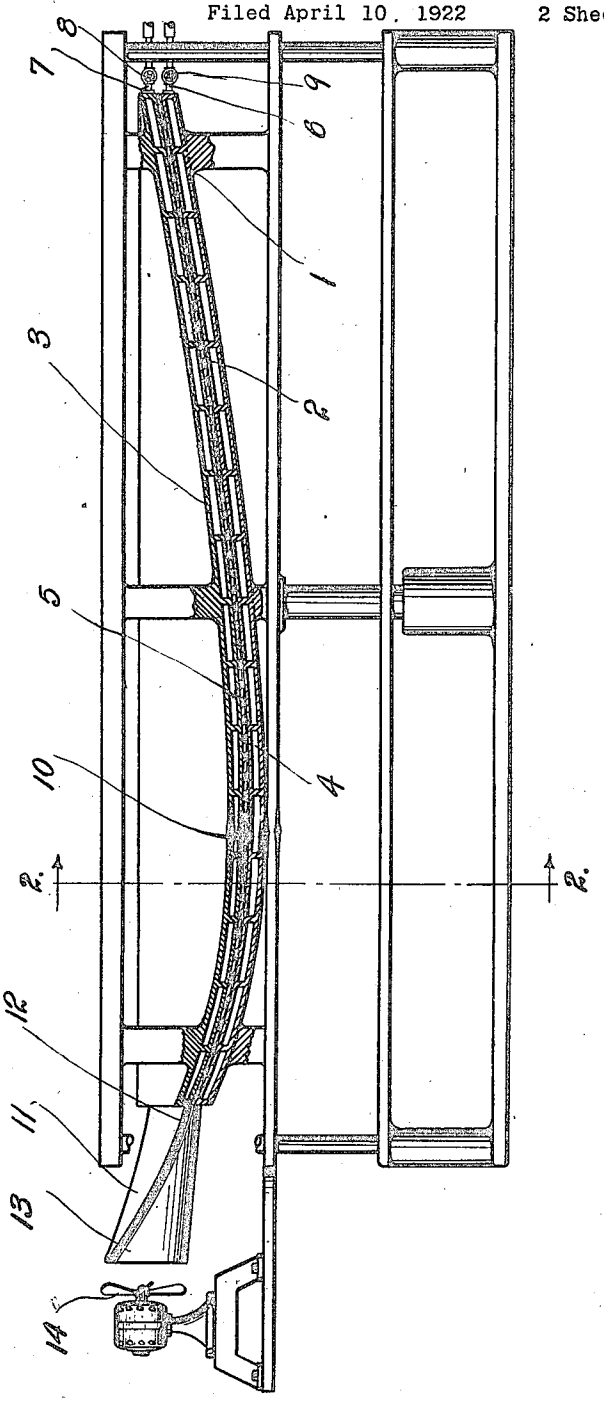

Fig. 1.

INVENTOR
A.K. Longren.
BY Arthur O'Brien
ATTORNEY

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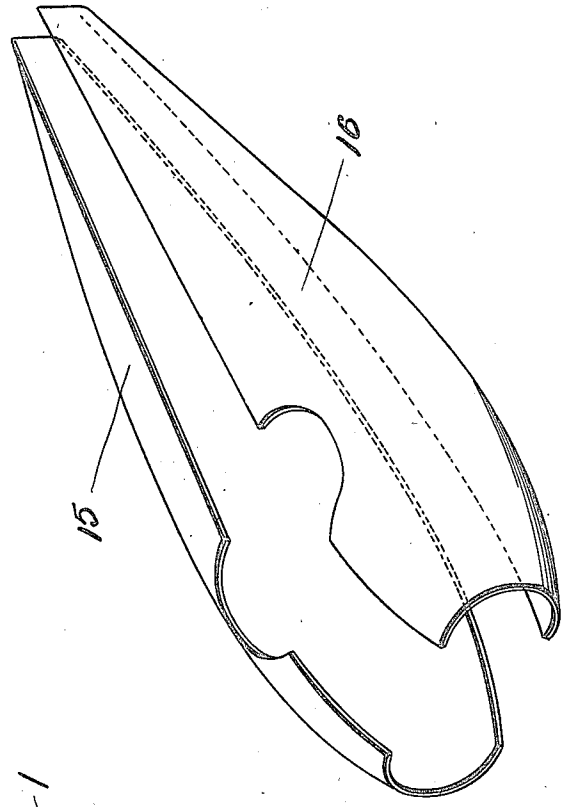

Fig. 3.

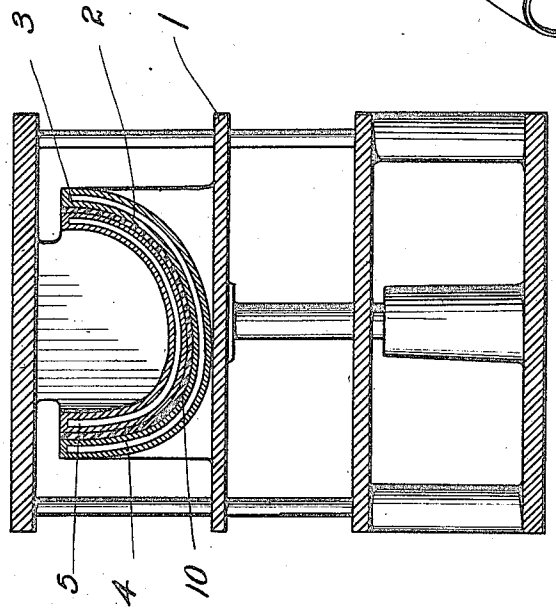

Fig. 2.

INVENTOR
A. K. Longren.
BY Munn & Brown
ATTORNEY

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UNITED STATES PATENT OFFICE.

ALBIN K. LONGREN, OF TOPEKA, KANSAS.

METHOD OF FORMING CURVED BODIES FROM FIBER SHEETS.

Application filed April 10, 1922. Serial No. 551,055.

To all whom it may concern:

Be it known that I, ALBIN K. LONGREN, a citizen of the United States, residing at Topeka, in the county of Shawnee and State of Kansas, have invented certain new and useful Improvements in Methods of Forming Curved Bodies from Fiber Sheets; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

This invention relates to a method of forming curved bodies such as aeroplane bodies from flat sheet of hard vulcanized fiber in such a manner that after the curved body is formed from the fiber sheet, it will not only retain its shape but will also retain the original dimensions of the mold matrix in which it was treated.

Fiber sheet has considerable tensile strength and it is admirably adapted for use in the manufacture of certain kinds of curved bodies, particularly the bodies or fuselages of aeroplanes, because the fuselages should possess the minimum of weight with the maximum of tensile and torsional strength as well as resistance to compression.

The difficulties encountered in former attempts to utilize fiber sheet for such purposes was due to the fact that the fiber sheet must first be soaked, immersed, or thoroughly saturated with wet steam in order to render it flexible enough to be bent into shape or pressed into compound curves. When moisture was applied and the shaping process finished, it was found that in drying, the sheet contracted irregularly, so that the body became warped or distorted and proportional dimensions were entirely destroyed so as to render the finished article entirely unfit for the purpose intended.

The shell of the fuselage of an aeroplane should be formed on stream line curvatures in order to offer the minimum resistance to the air when the machine is in flight; so it is apparent that if the fiber sheet is initially molded with a proper contour and subsequently becomes warped or distorted, the stream line surface is destroyed and by destroying the proportional dimensions, difficulty will be encountered in assembling the parts. The sections of a fuselage of general circular or oval character stream lined will partake of both the longitudinal and transverse curvature of the fuselage and this double curvature or flexure of the molded section affords increased strength and operates to resist the tendency of any force to alter the shape of the section.

I have provided a method of treating the fiber sheet so that the finished product will maintain the dimensions and contour given to it by the matrix of the mold in which it is formed, and the invention contemplates soaking, immersing or thoroughly saturating the sheet so as to render it flexible and then placing it between two members of a forming bench or mold in the presence of heat, preferably supplied by steam at relatively high pressure and temperature and maintaining the molded sheet in the matrix under pressure until it is thoroughly dry or at least dry enough to eliminate liability of further contraction or distortion. After the molded sheet has become thoroughly dry, it will maintain its shape as well as its tensile strength and the proportional dimensions given it by the mold.

I have provided an apparatus shown in the drawings as more or less diagrammatical for accomplishing the desired result, in which—

Fig. 1 is a longitudinal, sectional view through a mold or forming bench constructed in accordance with my invention.

Fig. 2 is a sectional view on the line 2—2 of Fig. 1, and

Fig. 3 is a perspective view of two halves of the fuselage of an aeroplane which may be connected by longerons or splines to provide a rigid, light structure.

The mold is shown as consisting of a frame 1, having a matrix 2, shown as a concave member, and a presser member 3, shown as a convex member. The member 2 is provided with a hollow wall 4 and the member 3 is provided with a hollow wall 5 to form a chamber for the admission of a heat fluid, such as steam, which may be admitted from the pipes 6 and 7 respectively and controlled through the medium of the valves 8 and 9.

The fiber sheet 10 may first be immersed in hot water for a short time or it can be subjected to contact with very wet steam

under pressure in a standard retort such as is used for steaming wood. If subjected to steam, the steam is introduced under pressure. After the sheet has been treated so as to render it flexible, it is placed in the matrix, the member 2 being preferably stationary and the member 3 being the presser member, which may be actuated by hydraulic pressure in a known manner if desired. When the proper amount of pressure has been applied to cause the sheet to partake of the curvature of the matrix, the temperature of the members 4 and 5 will be raised sufficiently to cause the moisture in the fiber sheet to dry out, the amount of temperature being determined by the pressure of the steam admitted through pipes 6 and 7 and the temperature of the members 2 and 3 will be maintained for a long enough period to evaporate all moisture, say from one to several hours.

It is important in carrying out the process that the moisture be dissipated from the treated sheet and in order to do this, I slightly separate the presser member from the matrix at intervals so that there will be an unimpeded space between them. This is done while the sheet is still in the matrix and during this time the moisture in the form of vapor is forced from between the members 2 and 3.

In order to efficiently accomplish this step, I may employ an air conduit consisting of the member 11 having one end 12 discharging adjacent to the matrix and another enlarged end 13 adjacent to an air impeller or fan 14. When the presser member and matrix are separate, the fan will direct currents of air toward the mold, which will be guided by the member 11 so that the air will pass between the two members 2 and 3 and force out the vapor, thereby materially assisting in drying the sheets as well as preventing blistering or disintegration of the fibers.

On account of the relatively large areas treated, considerable difficulty has been experienced during my experiments in forming the board into proper shape and maintaining it in such shape after it comes out of the presser and I have heretofore found considerable difficulty in preventing blistering of the surfaces as well as warping of the finished product, if the temperature was raised above a certain point, or below a certain point, it would not dry out thoroughly, but by intermittently applying heat and pressure and subjecting the board to the action of moisture dissipating air, the enumerated difficulties have been overcome.

The sheets need not actually consist of halves of the fuselage because I have found for ease of assembly, it is more practical sometimes to make the two halves up of several sheets and fastening them to the ribs and longerons of the fuselage. Thus the number of sections of an aeroplane body may be varied and each section will have the transverse and longitudinal curvature of the body.

In actual practice the sheet may be placed in the mold with a protruding edge all around the perimeter of the mold and after the drying out step has been completed, the surplus material may be trimmed off even with the mold, leaving the finished article, for example, like 15 or 16 in Fig. 3, these constituting the two halves of the fuselage shell, which, as above explained, may be connected by longerons or splines, preferably of wood, which may be grooved to receive the edges of the members 15 and 16 and then connected by fastening devices so that a complete shell is formed, partaking of stream line curvatures and providing a symmetrical body having the maximum tensile strength with the minimum weight.

So far as I am aware, no one, prior to my invention, has attempted to form hollow bodies, particularly members of the fuselage of an aeroplane, from compressed fiber sheets by subjecting the saturated sheet to a mold adapted to evaporate the moisture therefrom and maintaining the sheet in the mold until substantially all of the moisture has been dissipated.

What I claim and desire to secure by Letters-Patent is:

1. The herein described method of forming curved bodies such as aeroplane bodies from hard vulcanized fiber sheets which consists in soaking, immersing or otherwise saturating the sheet to render it flexible, subjecting the sheet to the action of a heated forming matrix, and opening the matrix and blowing air therethrough to produce a positive circulation of air to carry off the moisture from the sheet to dry the same uniformly and thereby preserve the set or shape of the sheet.

2. The method of forming curved aeroplane bodies from hard vulcanized fiber sheets which consists in soaking, immersing or otherwise saturating the sheet to render it flexible, pressing the sheet between two heated members having the form which the sheet is to take, and moving one member with respect to the other and causing air to pass between one of the members and the sheet to carry off moisture from the sheet and dry the same uniformly and thereby preserve the set or shape of the molded sheet.

3. The method of forming aeroplane bodies from hard vulcanized fiber sheets which consists in soaking, immersing or otherwise saturating the sheet to render it flexible, subjecting the sheet to the action of a heated forming matrix to form an aeroplane body section, and positively passing air over th section to carry away moisture

therefrom and uniformly dry the said section and thereby preserve the set or shape of the same.

4. The method of forming aeroplane bodies from hard vulcanized fiber sheets. which consists in soaking, immersing or otherwise saturating the sheet to render it flexible, subjecting the sheet to the action of a heated forming matrix to form an aeroplane body section having a transverse and longitudinal curvature and opening the matrix and positively producing a circulation of air over the section to carry away moisture and uniformly dry the said section and thereby preserve the set or shape of the same.

In testimony whereof I affix my signature.

ALBIN K. LONGREN.