Sept. 1, 1931. E. B. CARNS 1,820,936

METHOD AND APPARATUS FOR SHAPING CURVED SHEETS

Filed March 11, 1927 2 Sheets-Sheet 1

Fig. 1.

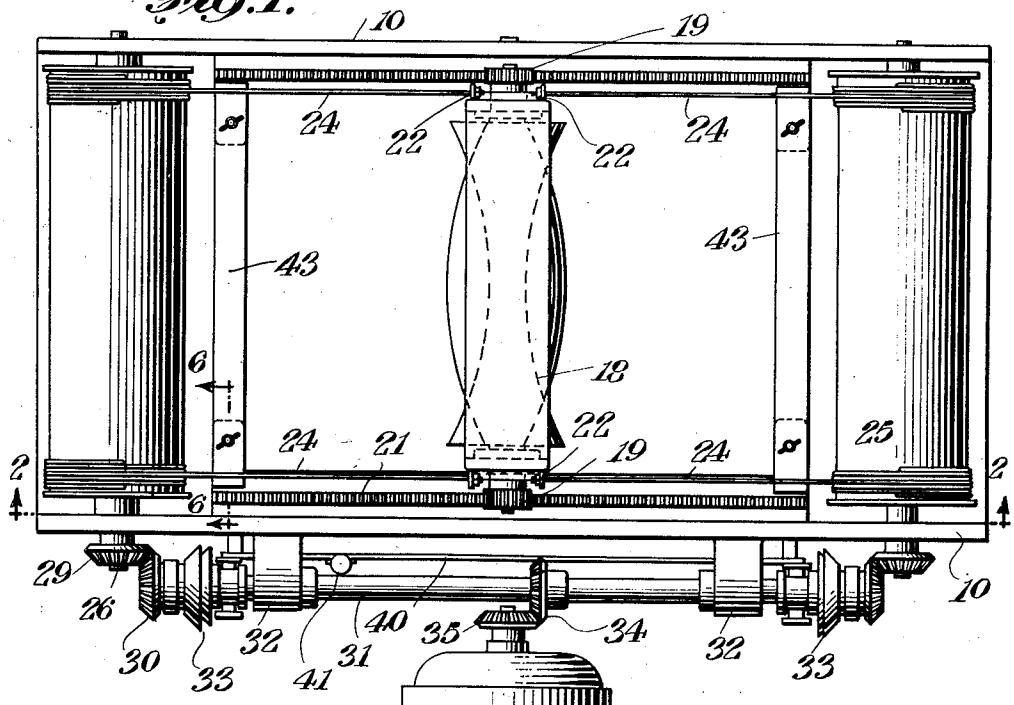
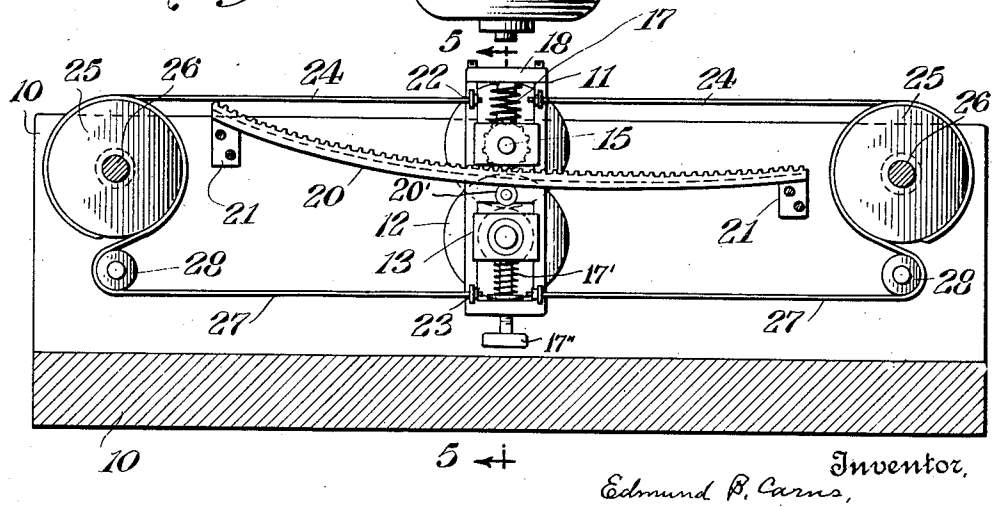


Fig. 2.



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Filed March 11, 1927 2 Sheets-Sheet 2

Fig. 3.

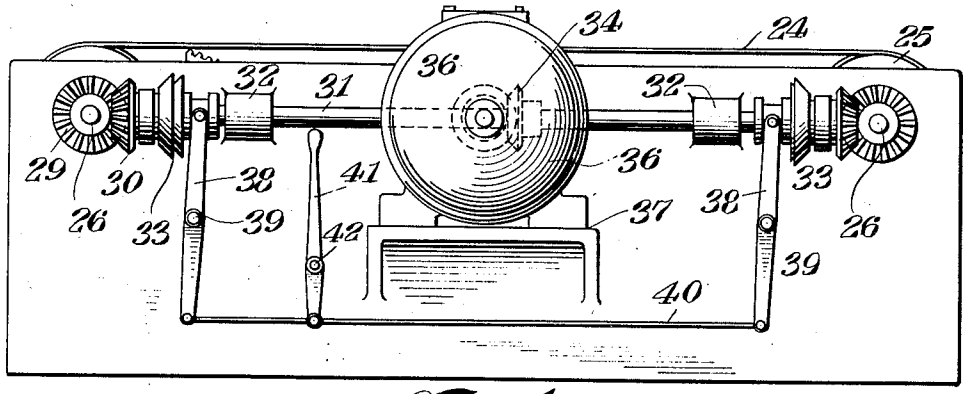


Fig. 4.

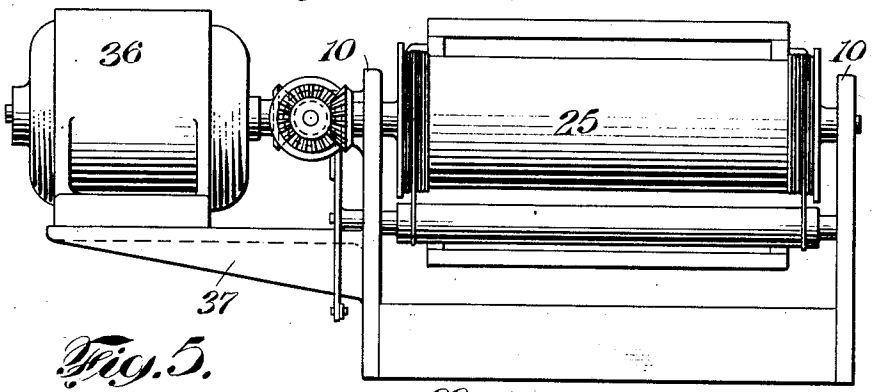


Fig. 5.

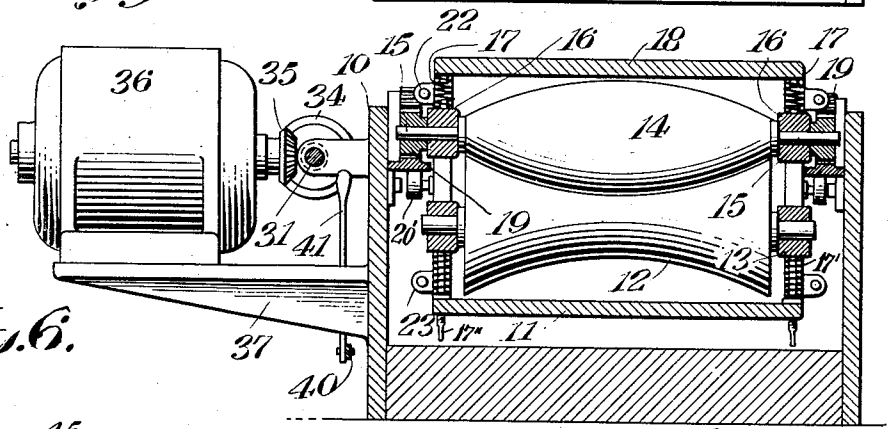
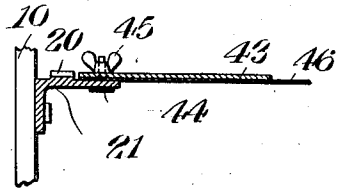


Fig. 6.



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1,820,936

UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR SHAPING CURVED SHEETS

Application filed March 11, 1927. Serial No. 174,454.

My invention relates to improvements in the art of shaping sheets with compound curves, that is, sheets curved in two directions with the arcs of the two curves intersecting at all points. My invention includes the method of shaping sheets of this character and also the means for thus shaping the sheets.

The object of my invention is to produce a rapid economical means of rolling crowning sheets of the form described, so that the fibers of the sheet will not be disrupted or distorted but will be disposed so that all the fiber stresses of the metal or sheet material will work in a manner to produce a rigid shock resisting curved sheet.

The general practice of shaping sheets of this character is by pressing or dieing and if the sheets are rather large this necessitates expensive ponderous machinery and dies, and the metal or material of the sheet is likely to be disturbed in such a way as to injuriously affect the formed sheet.

My invention is intended to roll the sheets and in accomplishing this result, I subject the sheet to be formed to the action of shaping rollers representing one curve of the sheet to be shaped and move these rollers along a curved path, representing the other curve of the sheet to be formed, so that the sheet is rolled to shape but a compound curve is formed, the arcs of which intersect at all points. While the preferred practice is to have the sheets made crowning they can, by disposing the shaping rollers, be made dishing or concave and with compound curves with equal facility.

My invention is further intended to produce a satisfactory and economical way of making sheets of this character and, as above indicated, by a roller process which will not injure the sheet. Primarily, the invention is intended to form a good and economical means of forming sheets adapted for use in the manufacture of aircraft, but obviously there is a wide use for sheets of this character, and the invention can be applied to making sheets for any purpose where a compound curved sheet is desirable.

My invention is further intended to produce an economical way of rolling the sheets, of applying power to the shaping rollers and of moving the rollers bodily along a path representing one curve of the sheet to be formed.

From the description which follows, it will be apparent that I have shown a simple and practical means of carrying my invention into effect, but it will also appear that in many of its details the structure shown can be changed without affecting the principle of the invention.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar reference characters indicate corresponding parts in all the views.

Fig. 1 is a plan view of a machine suitable for carrying out my improved method.

Fig. 2 is a vertical longitudinal section on the line 2—2 of Fig. 1.

Fig. 3 is a side elevation of the machine.

Fig. 4 is an end view thereof.

Fig. 5 is a cross section on the line 5—5 of Fig. 2, and

Fig. 6 is a detail showing a means of fastening one end of the sheet while it is being operated on.

The machine is provided with a substantial open-ended frame 10 which can be of any approved design, and mounted in the frame, so as to move longitudinally, is preferably arranged a carriage 11, in which is mounted a pair of shaping rollers, the lower roller 12 being concave, as shown in Fig. 5, so as to represent the lateral curve of the sheet to be formed, and this roller can be an idler turning in suitable bearings 13 in the carriage 11. Mating with this roller 12 is a convex roller 14 which is likewise carried in the carriage 11 and this roller has trunnions 15 mounted in the bearings 16, vertically movable as shown, and are pressed by tension springs 17 between the bearings 16 and the removable top 18 of the carriage. The bearings of the lower roller 12 are likewise shown as supported by tension springs 17′ which can be adjusted by the screws 17″ threaded in the lower parts of the carriage 11. Obviously, the roller 14 can be mounted in any conventional or approved way which

will permit of its vertical movement or separation from the roller 12. These trunnions are turned by pinions 19 which run along curved tracks 20, which are shown as racks engaging the pinions and are attached to the inner side walls of the frame or any convenient support, and they represent a bed curved to the desired longitudinal curvature of the sheet to be formed. These racks can be supported in any convenient way and are attached to their supports by means of lugs 21 or equivalent means, so that the racks can be removed, if desired, and others of different curvatures substituted. It will be seen that as the rollers are revolved they give shape to a sheet between them and the moving of the rollers bodily along the curved bed, or, in other words, the racks 20, will cause the sheet under treatment to be shaped in conformity with the curve represented by the bed and thus the sheet will be rolled to a desired compound curvature. To insure a smooth steady movement of the carriage 11, it may have rollers 20′ disposed to bear against the under side of the racks 20. In the drawing, I have shown the convex roller 14 above the concave roller 12 which will produce a sheet curved or crowning in a longitudinal direction, but if it is desired to bend the sheet in the opposite direction the position of the shaping rollers will be reversed and the concave roller will be above the convex one.

It will be understood that the carriage in which the rollers 12 and 14 are mounted can be moved back and forth in many ways which will be apparent to any mechanic. I have shown, however, a satisfactory means and to this end the carriage is provided near the top and opposite ends with spaced lugs 22 and near the bottom with similar lugs 23; the upper lugs connect with cables 24, extending in opposite directions and adapted to be rolled on and attached to operating drums 25 which are carried by shafts 26 suitably mounted at opposite end portions of the frame. The lower lugs 23 are connected also with the drums 25 by cables 27, but in order that they will be given the desired direction so that both cables 24 and 27 will move conjointly, the cables 27 are passed over guide rollers 28, as shown in Fig. 2. Thus, it will be seen when the drums turn in one direction the carriage 11 and its rollers will move in the same direction, and when the drums are oppositely turned the carriage and its rollers will be returned. In this way the carriage and its rollers may be moved back and forth, as desired. As a means of turning the drums, moving the carriage and revolving the roller 14, and consequently the idler roller 12, I have shown the shafts 26 of the drums connected by beveled gears 29 with beveled gears 30 on a shaft 31 which runs lengthwise of the machine mounted in suitable supports 32, and is provided with conventional clutches 33, by which the shaft may be thrown in and out of driving connection with the machine, as desired. The shaft 31 connects, by beveled gears 34 and 35, with a motor 36 which can be an electric motor or, obviously, any suitable driving mechanism can be substituted for that shown.

In Fig. 3, I have shown means for simultaneously operating both clutches 33 which comprises a pair of levers 38, each connecting with one of the clutches, and each lever is pivoted as shown at 39 and the lower ends are connected by a rod 40 secured to the lower end of lever 41, which is pivoted as shown at 42, and thus, by a single lever and the connections described, both clutches may be simultaneously moved.

To provide for fastening the sheet ends, I have shown cross-bars 43 (see Figs. 1 and 6) which can be attached to the brackets 21 secured to the machine frame. The cross-bars are arranged adjacent the ends of the racks 20. Each cross-bar has bolts 44 extending through it and through a part of the bracket 21 while wing nuts 45 are applied to the bolts and by these the cross-bar may be clamped down upon the sheet 46 which lies beneath the cross-bar and between it and the bracket 21, but obviously other means can be used for securing the sheet to prevent its endwise movement. When the sheet is to be formed the rollers are separated slightly by any suitable means and the sheet is threaded endwise between the rollers 14 and 12 and secured at one end, as above described. The machine is then started, the roller 14 presses down upon the sheet which passes between it and the idler roller 12, and the rollers will obviously give the desired transverse shape to the sheet. Meanwhile, the rollers will be moved bodily along the rack beds 20 by means of the cables 24 and 27, and thus the sheet will be curved lengthwise to correspond with the path through which the rollers travel, and it will be seen that the sheet will therefore be rolled to assume a crowning shape and with compound curves, having intersecting arcs and corresponding to the curve of the shaping rollers and to the curved path through which these rollers travel. It will be understood that the drums 25 can be reversed in their rotation and, as illustrated, this can be done by reversing the direction of the motor 26, or any suitable means can be used for reversing the driving direction of the drums.

From the foregoing description, it will be apparent that the essential thing is to have the sheet subjected to the action of the shaping rollers and have these rollers movable in a curved path, as described, and that the means for mounting and moving the rollers can be very materially changed without in the least affecting the invention.

It will be seen that by my system of rolling a sheet is produced which is an improved product having the desired compound curve with the fibres rolled without disruption so as to give the sheet great strength in proportion to its weight.

I claim:

1. The method of forming crowning sheets with compound curves having intersecting arcs which comprises fixing a sheet at a margin thereof, subjecting the sheet to the action of complementary opposed rollers shaped to represent one curve and at the same time moving the rollers bodily along the sheet in a path representing another curve.

2. The method of forming a sheet with compound curved surfaces having intersecting arcs which comprises fixing a sheet at a margin thereof, rolling the sheet between complementary opposed shaping rollers and moving the rollers along the sheet in a curved path, the arc of which intersects the arc of the curve of the shaping rollers.

3. The method of forming a sheet with compound curved surfaces having intersecting arcs which comprises fixing a sheet at a margin thereof, moving a pair of complementary opposed shaping rollers along the stationary sheet in a path representing a different curve from the curve of the shaping rollers.

4. A machine for shaping sheets with compound curves which comprises means for fixing a margin of a sheet in position, a set of complementary opposed shaping rollers to engage the sheet, and means for moving the rollers bodily along a curved path.

5. A machine for shaping sheets with compound curves comprising opposite shaping rollers, and means for moving the shaping rollers along a longitudinally curved path and also driving the rollers.

6. A machine of the kind described comprising a pair of shaping rollers, means for moving the rollers in a curved path, and means disposed along said curved path for turning the rollers.

7. A machine of the kind described comprising a pair of shaping rollers, means for moving the radius rollers in a curved path, a toothed rack coincident with the curved path, and a pinion on a shaft of one of the shaping rollers engaging said rack.

8. A machine of the kind described comprising a reciprocating carriage, a pair of shaping rollers arranged in the carriage, a curved rack forming the path of the shaping rollers, and a pinion connection between the rack and one of the shaping rollers.

9. A machine of the kind described comprising a reciprocating carriage, shaping rollers on the carriage, rotatable drums on opposite sides of the carriage, cables operatively connecting the carriage with the drums whereby the rotation of the drums moves the carriage, a curved bed, and driving means disposed along the curved bed for engaging and driving one of the shaping rollers.

In testimony whereof, I have signed my name to this specification this 9th day of March, 1927.

EDMUND B. CARNS.