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APPARATUS FOR PRODUCING SHEET-LIKE MATERIAL

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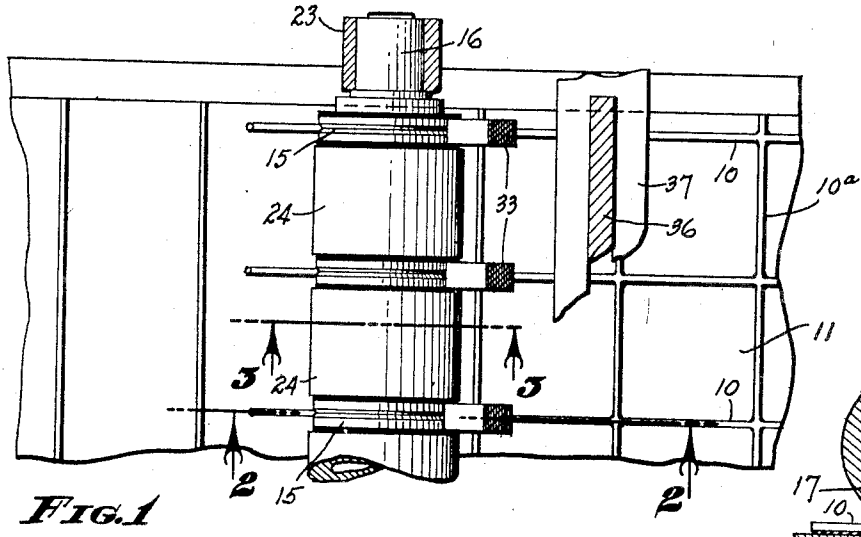


FIG. 1

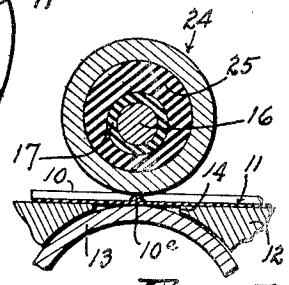


FIG. 3

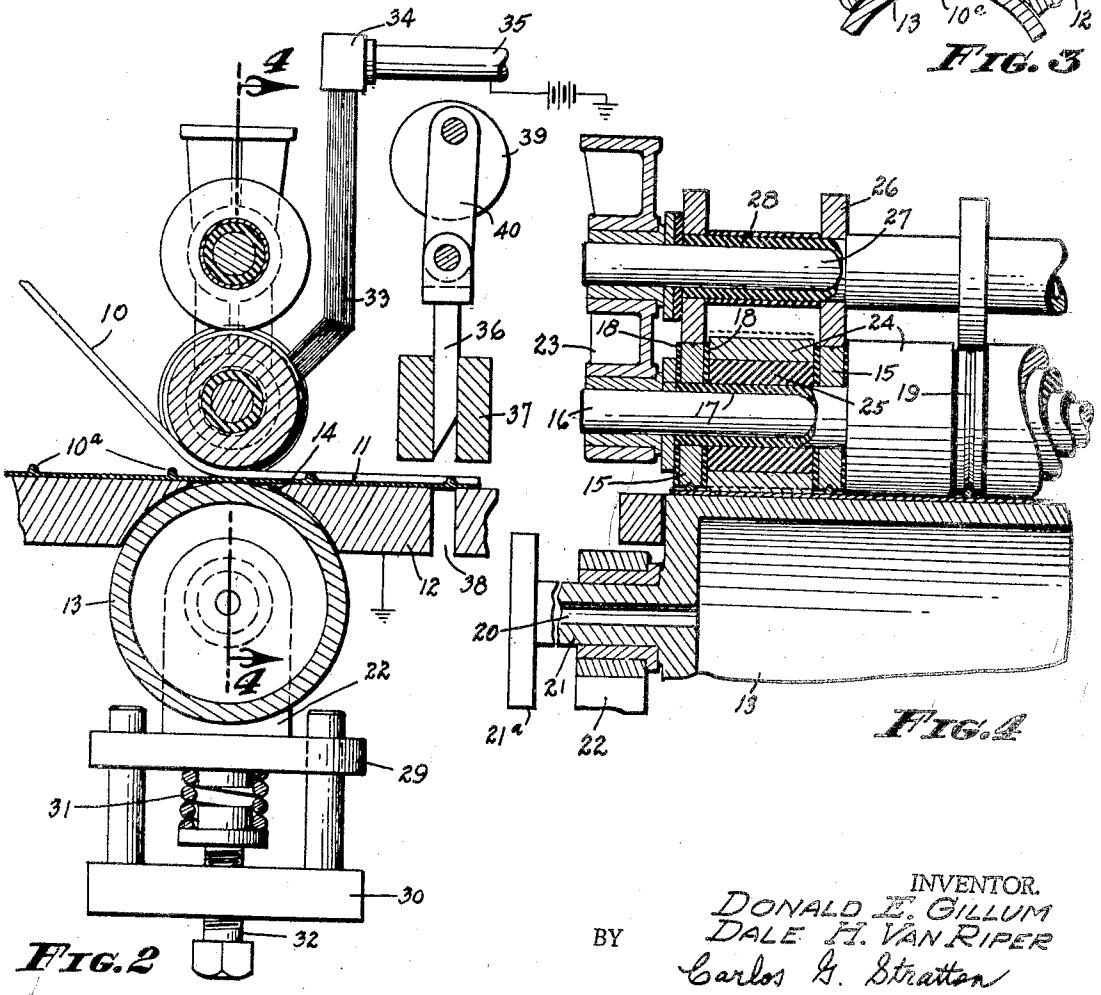


FIG. 2

FIG. 4

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APPARATUS FOR PRODUCING SHEETLIKE MATERIAL

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13 Claims. (Cl. 219—4)

The present invention relates generally to apparatus for producing sheet-like material from sheet metal, such as sheet steel, sheet aluminum, and the like, used where weight-stiffness ratio is of importance, as for example the skin coverings or panel construction of airplanes, airships, automobiles, railway cars and in fact many other uses where such sheet metal is subjected to vibrating influences, and has for its primary object to provide means for the application of reenforcing and stiffening elements to the sheet metal in such manner as to become substantially an integral part thereof for greatly stiffening the sheet material against such vibrating influences while adding comparatively little to its weight.

With the above in mind, the present invention particularly proposes apparatus to decrease the weight-stiffness ratio of sheet metals by the welding of wires, rods and like elements upon a face of the sheet metal while the latter is held against warping under the heat of the welding operation, and particularly proposes as the basic conception thereof an apparatus by which the foregoing may be accomplished in a practical, efficient manner.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. However, the drawing merely shows and the following description merely describes one embodiment of the present invention, which is given by way of illustration or example only.

In the drawing, like reference characters designate similar parts in the several views.

Fig. 1 is a partial top plan view.

Fig. 2 is a vertical longitudinal sectional view taken therethrough on line 2—2 of Fig. 1.

Fig. 3 is a partial vertical longitudinal sectional view taken substantially on line 3—3 of Fig. 1, and

Fig. 4 is a vertical transverse sectional view taken substantially on line 4—4 of Fig. 2.

Reference is made (1) to our co-pending application Serial No. 454,974, filed August 15, 1942, which is a continuation-in-part of the present case, and which covers features of the method of producing sheet-like material described herein, and (2) to our co-pending application Serial No. 440,040, filed April 22, 1942, which covers products of the present apparatus.

Our apparatus is designed to weld wires 10 in spaced parallel relation upon a surface of sheet metal 11 so that these suitably spaced wires of themselves or in cooperation with other similar angularly related wires, similarly welded to the sheet metal surface, will materially stiffen the sheet metal with a minimum addition to its weight.

In Figs. 2 and 3, the metal sheet 11 is shown disposed flatwise upon a table 12 and arranged horizontally for passage between a lower supporting roll 13 operating through a transversely slotted throat 14 of the table, and a gang seam welder which includes a series of suitably spaced, coaxially alined and related welding rollers 15.

The welding rollers 15 are mounted in a series on a rotating shaft or arbor 16, around an insulating sleeve 17 on said arbor and between insulating discs 18, and each roller preferably has a central peripheral groove 19 which not only serves to effectively guide its individual wire 10, but provides for a desired contour of the wire as applied to, and welded on, the metal sheet 11.

The lower pressure and feed roll 13 may extend for the full length of the throat 14, and may be hollow as seen in Figs. 2 and 4, with circulating channels 20 through its end trunnions 21, the latter being journaled in stationary side brackets 22. One of the trunnions 21 is shown in Fig. 4 as provided with a pulley 21*a* by means of which the feed roll 13 may be driven. Thus cooling fluid may be circulated through the roll 13 to control its temperature, since this roll contacts the metal sheet directly in vertical line with the application of welding heat as will be hereinafter seen.

The shaft or arbor 16 supporting the welding rollers 15 is journaled at its ends in side bearing brackets 23, and the spaces between the several rollers 15 are occupied by a series of pressure cylinders 24 having live rubber or other resilient cores 25 around the insulating sleeve 17 to thus adapt the cylinders 24 to yieldingly engage the metal sheet and hold the same against warping or heat distortion along the line of applied welding heat. This arrangement permits independent movement of the several cylinders 24 relative to the metal sheet in over-riding cross wires which may have been previously welded thereon and which are indicated at 10*a*.

The welding rollers 15 are set to be peripherally spaced from the metal sheet 11 and are preferably held against yielding relative thereto by pressure rollers 26 bearing thereon, and arranged in a series on an upper parallel arbor or shaft 27 so that the welding rollers remain at all times in their set relation to the sheet metal as distinguished from the yielding capabilities of the pressure cylinders as seen by a comparison of Figs. 3 and 4. The upper shaft or arbor 27 may

be journaled at its ends in the bearing brackets 23 and, since its pressure rollers 26 are in constant pressure contact with the welding rollers 15, they are preferably fixed in properly spaced relation around an insulating sleeve 28 on shaft 27 so as to be insulated from said shaft as well as from one another.

Adjustable pressure by the lower pressure roll 13 is preferably provided for by connecting its bearing brackets 22 to a cross head 29 adjustable vertically with respect to a cross frame 30. A spring 31 is shown in Fig. 2 beneath the cross head and resting on a spring supporting bolt 32 which is adjustably threaded through the cross frame 30 to thus provide for adjustment of the effective tension of the spring.

As seen in Figs. 1 and 2, brushes 33 are in contact at their lower ends with the several welding rollers 15. For the supply of welding current to the brushes 33, they may be arranged to depend from a bus bar 34 to which leads a current supplying electrode 35. Thus, assuming the other electrode to be the table 12, it is obvious that, as the metal sheet 11 is fed along the table 12 from left to right in Figs. 1 and 2, the wires 10 will be rolled and pressed tightly against the upper surface of the sheet and continuously welded thereto, as well as to the cross wires 10a if such have been previously welded or even laid on the sheet.

It will be understood that the crossing wires 10a may be laid without welding, but that in any event when wires 10 are applied as herein contemplated, they provide crossing joins since the wires 10 and 10a will be welded to one another at such joins, as well as to the metal sheet 11. In this operation the peripheral spacing of the bonding rollers, hereinbefore referred to, relative to the sheet 11, enables them to lightly ride over the wires 10a, pressure and heat causing the wires 10 to be substantially deformed at the wire intersections.

The wires 10 may extend from any suitable sources of supply, as for instance reels, and will be deformed as they are welded to the metal sheet, in accord with the contour of the welding roller grooves 19 and the set spacing of these rollers relative to the metal sheet.

There is shown in Figs. 1 and 2 portions of a sheet cutting mechanism including a vertically movable cutting blade 36 in a guide 37 above a slot 38 in the table 12. Thus the blade 36 actuated by a crank disc 39 and connecting arm 40, will be effective to cut the sheet metal 11 in sections after passing the welding station.

While we have illustrated and described what we now regard as the preferred embodiment of our invention, the construction is, of course, subject to modifications without departing from the spirit and scope of our invention. We therefore, do not wish to restrict ourselves to the particular form of construction illustrated and described, but desire to avail ourselves of all modifications that may fall within the scope of the appended claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. In an apparatus for applying to sheet material stiffening ribs adapted to be fused into bonding relation therewith: a table for supporting the sheet material for movement thereon; an axially alined series of spaced bonding rollers adapted to ride adjacent the sheet material, each roller including guide means adapted to receive and apply rod-like reinforcing elements to said sheet material; means operating through said rollers to heat said material and reinforcing elements to fusing temperatures thereby to bond said reinforcing elements to said sheet material; and pressure rollers operating substantially in line with, and located in the spaces between, said bonding rollers and bearing against said sheet material independently of, and insulated from, the bonding rollers along the line of applied bonding heat to hold said material against warping, said bonding rollers and pressure rollers being mounted upon a common rotatable support.

2. In an apparatus for applying to sheet material, stiffening ribs adapted under predetermined temperature conditions to bond with said sheet material; a continuous roller structure; an axially alined series of spaced bonding rollers coacting with said roller structure to pass therebetween a sheet of material; each bonding roller adapted to receive and guide into contact with said sheet material a strip of material capable when heated of bonding therewith to form a rib; means operating through said rollers to heat and bond said sheet and strip materials; a common rotatable support for said bonding rollers; and other rollers substantially coaxially disposed on said support with respect to said bonding rollers operating in the spaces between and insulated from said bonding rollers to hold said sheet material along the line of bonding heat applied by the bonding rollers.

3. An apparatus for applying to sheet material stiffening ribs adapted under predetermined temperature conditions to bond with said sheet material wherein said apparatus comprises: opposed roller structures adapted to pass sheet material therebetween and forming substantially continuous supporting contact with said sheet material between its opposite edges; one of said roller structures including an axially alined series of spaced apart bonding rollers, pressure rollers in the spaces between said bonding rollers, and a common rotatable support for said bonding and pressure rollers, means yieldably mounting said pressure rollers on said common support; each bonding roller adapted to receive and guide into contact with said sheet material a strip of material capable of bonding therewith to form an integral rib; and means operating through said bonding rollers to heat and bond said sheet and strip materials.

4. An apparatus for applying and bonding stiffening ribs to sheet material in more than one direction thereon whereby a grid pattern of stiffening ribs is formed, comprising: opposed roller structures adapted to pass the sheet material therebetween and forming substantially continuous supporting contact with said sheet material between its opposite edges; one of said roller structures including an arbor, and bonding and pressure rollers mounted alternately thereon, and yieldable means interposed between the pressure rollers and said arbor to permit eccentric displacement of said pressure rollers with respect to said bonding rollers whereby the pressure rollers may ride over previously bonded crosswise extending stiffening ribs; each bonding roller adapted to receive and guide into contact with said sheet material a rod-like rib element capable of bonding therewith under heat and pressure to form an integral rib; and means operating through said bonding rollers to heat and bond said sheet material and rib elements.

5. An apparatus for welding stiffening ribs to sheet metal, comprising: a pair of opposed roller structures arranged on opposite sides of and extending across the sheet of metal to be stiffened; one of said roller structures including alternately disposed welding and pressure rollers mounted on

a common arbor; each welding roller including guide means for directing a wire into contact with said metal sheet; and means for supplying a welding current through said welding rollers and wires as said sheet is moved between the roller structures to weld said wires along said metal sheet thereby forming integral ribs.

6. An apparatus for welding stiffening ribs to sheet metal in more than one direction thereon whereby a grid pattern of stiffening ribs may be formed, comprising: opposed roller structures adapted to pass a metal sheet therebetween and forming substantially continuous supporting contact with said metal sheet between its opposite edges; one of said roller structures including an arbor and welding and pressure rollers mounted alternately thereon, there being yieldable means incorporated in said pressure rollers to permit eccentric displacement of said pressure rollers whereby said pressure rollers may ride over crosswise extending stiffening ribs previously bonded to said metal sheet; each welding roller adapted to receive and guide into contact with said metal sheet a metal wire adapted when welded thereto to form an integral rib; and electric welding means operating through said welding rollers to weld said wires thereon longitudinally with respect to the direction of travel of said metal sheet through said roller structures.

7. In an apparatus for decreasing the weight-stiffness ratio of sheet metal by welding reinforcing ribs thereon, comprising: a support for the sheet metal; a series of spaced wire guiding and seam welding rollers above said support and adapted to direct wires into electrical contact with said metal sheet as said sheet passes thereunder; an electric welding current supply circuit including said welding rollers for passing a welding current through said wires and metal sheet whereby said wires form ribs integral with said sheet; pressure rollers engageable with said metal sheet disposed substantially coaxially between and alternating with said welding rollers a common rotatable support extending through said bonding and pressure rollers, and means providing for yielding movements of the pressure rollers relative to said support.

8. In an apparatus for decreasing the weight-stiffness ratio of sheet metal by welding reinforcing ribs thereon, comprising: a support for the sheet metal; a series of spaced wire guiding and seam welding rollers above said support and adapted to direct wires into electrical contact with said metal sheet as said sheet passes thereunder; an electric welding current supply circuit including said welding rollers for passing a welding current through said wires and metal sheet whereby said wires form ribs integral with said sheet; pressure rollers engageable with said metal sheet disposed substantially coaxially between and alternating with said welding rollers; a common rotatable support extending through said bonding and pressure rollers, and means providing for individually yielding movements of said pressure rollers toward and away from the support and relative to the welding rollers.

9. In an apparatus for decreasing the weight-stiffness ratio of sheet metal by welding reinforcing ribs thereon, comprising: a support for the metal sheet; an arbor extending across the sheet; a series of spaced wire guiding and seam welding rollers mounted on but insulated from said arbor; a series of pressure rollers between said welding rollers and likewise mounted on but insulated from said arbor, said pressure rollers including yieldable cores whereby said pressure rollers may be displaced eccentrically with respect to said welding rollers; said welding rollers adapted to direct metal wires into electrical contact with said metal sheet; and an electric welding current supply circuit including said welding rollers for passing welding current through said wires and sheet, whereby said wires form ribs integral with said sheet.

10. In an apparatus for decreasing the weight-stiffness ratio of sheet metal by welding reinforcing ribs thereon, comprising: a support for the metal sheet to be reinforced; an arbor extending across the metal sheet; a plurality of welding rollers carried by said arbor, each having a peripheral groove for guiding metal wires onto said metal sheet; pressure rollers on said arbor between said welding rollers, said pressure rollers being larger in diameter than said welding rollers whereby said welding rollers are normally spaced from said metal sheet, the spacing being such that the wires bridge the spaces to afford electrical connection between the welding rollers and the metal sheet; and an electric welding current supply circuit including said welding rollers for passing welding current through said wires and sheet, whereby said wires form ribs integral with said sheets.

11. A construction as set forth in claim 10 wherein said pressure rollers are provided with yieldable cores permitting eccentric displacement of said pressure rollers whereby said pressure rollers may ride over ribs transecting the wires being welded without corresponding displacement of said welding rollers away from said metal sheet.

12. In an apparatus for decreasing the weight-stiffness ratio of sheet metal by welding reinforcing ribs thereon, comprising: a support for the metal sheet to be reinforced; a shaft extending across the metal sheet; a plurality of welding rollers carried by said shaft and spaced from said metal sheet a predetermined distance, each welding roller having a peripheral groove for guiding a wire into electrical bridging connection between said roller and sheet; a counter shaft also extending across said sheet parallel with said shaft; backing rollers carried by said counter shaft for engagement with said welding rollers to restrain said rollers from movement away from said sheet; pressure rollers on said shaft between but insulated from said welding rollers, said pressure rollers being larger in diameter and engageable with said sheet and coacting with said support to restrain said sheet against warping between said welding rollers; and an electric welding current supply circuit including said welding rollers for passing welding current through said wires and sheet, whereby said wires form ribs integral with said sheets.

13. A construction as set forth in claim 12 wherein said pressure rollers are provided with yieldable cores permitting eccentric displacement of said pressure rollers whereby said pressure rollers may ride over ribs transecting the wires being welded.

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