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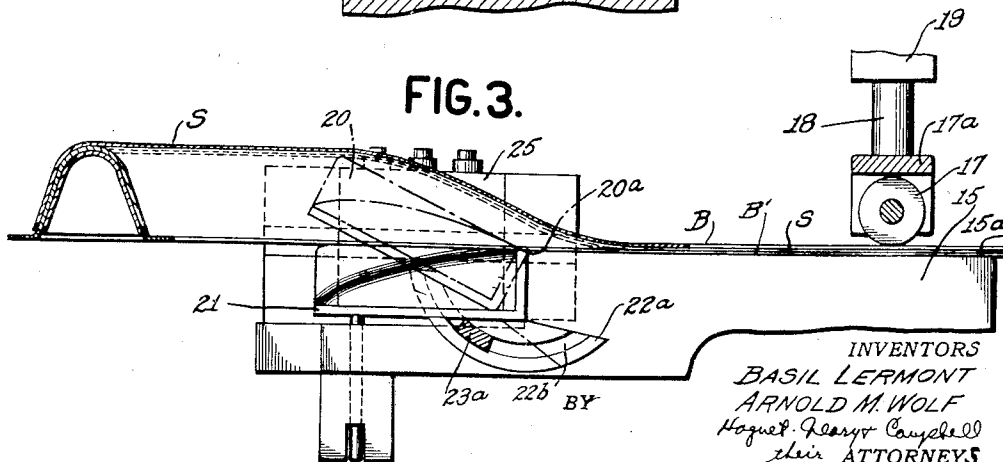
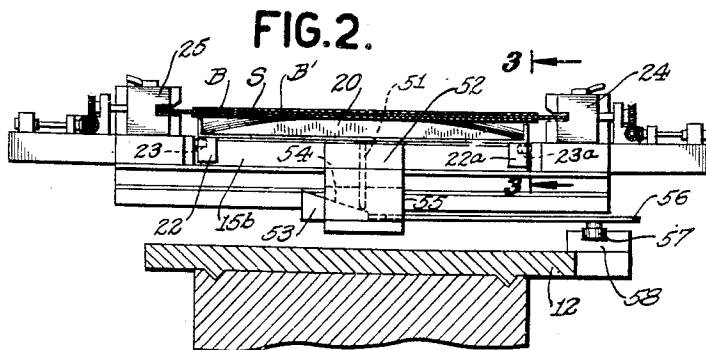
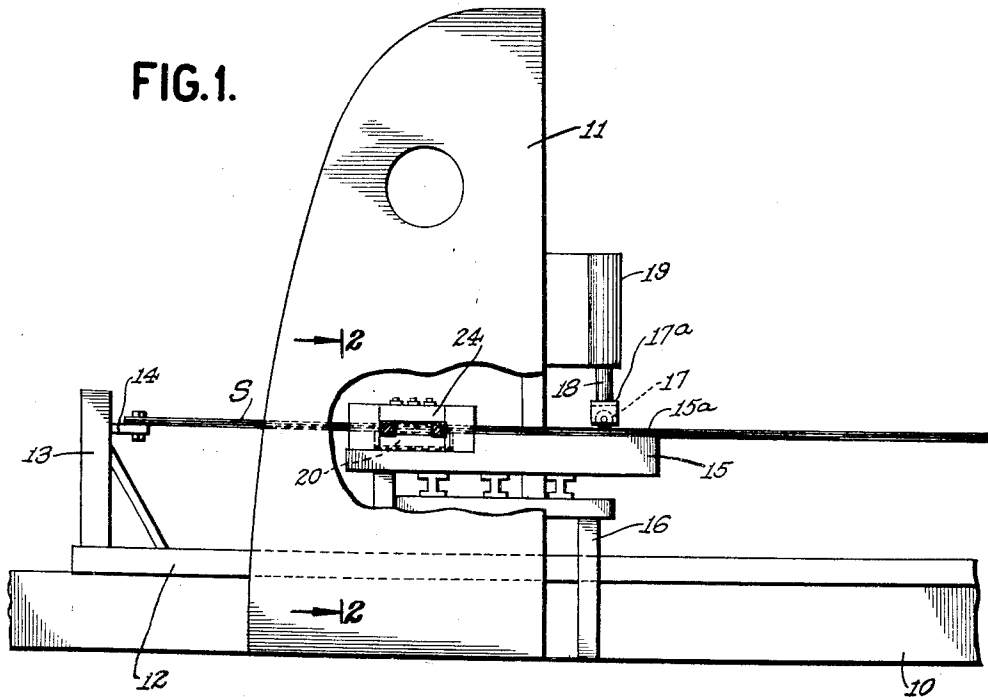
B. LERMONT ET AL

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METAL FORMING DEVICE

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2 Sheets-Sheet 1



INVENTORS
BASIL LERMONT
ARNOLD M. WOLF
Hoguel, Peery & Campbell
their ATTORNEYS

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METAL FORMING DEVICE

Basil Lermont, New York, and Arnold M. Wolf,
Brooklyn, N. Y., assignors to Cairns Corpora-
tion, New York, N. Y., a corporation of Dela-
ware

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This invention relates to a device for imparting curvatures to sheets of metal and relates more particularly to devices for pulling metallic sheets through suitable forming elements to stretch said sheets differentially and thereby cause them to assume transverse and longitudinal curvatures.

The present invention is an improvement of the invention disclosed in our U. S. Patent No. 2,301,960, dated November 17, 1942. The devices disclosed in our copending application generally are characterized by one of more forming elements which stretch a sheet of metal unequally from its center to its edges as it is pulled through or over the forming elements. These devices are provided with mechanisms for retaining or stretching the sheet transversely during the drawing operation in order to control the amount that the sheet is stretched and thereby to control or regulate the radii of curvatures imparted to the sheets.

The present invention relates to devices similar to those disclosed in our copending application but includes an improved type of forming element for imparting varying curvatures to the sheets and a novel means and method for preventing scratching or otherwise marring the metallic sheets.

More particularly, the invention may include a mechanism for pulling a sheet of metal through elements which grip the lateral edges of the sheet and either prevent it from shrinking appreciably or for stretching the sheet transversely. In order to impart the desired longitudinal and transverse curvature to the sheet, a forming element having a variably curved surface from front to rear and edge to edge is disposed adjacent the sheet in a position to engage one surface thereof. By moving the forming element, the sheet is deflected from its normal path and is curved arcuately to greater or lesser extents. Inasmuch as the lateral edges of the sheet are retained against inward movement the arcuate curvature of the sheet can be accomplished only by stretching the sheet to increase its width. The resistance to movement of the sheet over the forming element and its deflection from its normal straight path will likewise increase the length of the sheet by stretching it in varying increments. These increased increments of length or width will impart a bulge or bend to the sheet which may be varied by the displacement of the forming element, thus permitting the sheet to be formed on varying longitudinal and transverse curvatures, if desired.

In order to protect the sheet from scratching

during its forming operation due to the presence of dirt, grit or other particles on the surface of the sheet or slight irregularities in the surface of the forming element, protective elements or blankets may be disposed on opposite sides of the sheet. The type of blanketing sheets used in the device may vary considerably. For example, these sheets may be formed of tough sheet metal. Entirely satisfactory results have been obtained, however, by the use of heavy kraft paper affixed to the opposite sides of the sheet by means of suitable adhesives which permit the sheets of paper to be stripped from the metallic sheet after formation of the latter.

For a better understanding of the present invention reference may be had to the accompanying drawings, in which:

Fig. 1 is a view in side elevation and partly broken away of a typical form of device embodying the present invention;

Fig. 2 is a view in vertical section taken on line 2—2 through a portion of the device;

Fig. 3 is an enlarged view of the forming mechanism of the present invention;

Fig. 4 is a view in plan of the device shown partly broken away to disclose details of its construction;

Fig. 5 is a plan view, partly broken away, disclosing a detail of the lateral stretching or sheet retaining mechanism; and

Fig. 6 is a view in section taken on line 6—6 of Fig. 5.

As shown in Fig. 1 of the drawings, a typical form of the device may consist of a mechanism, such as for example, a planer bench 10 and standards 11, 11 upon which the various elements of the device are supported. The table 10 supports for sliding movement a draw bench 12 which may be actuated in any suitable way to pull a sheet S from right to left as viewed in Figs. 1 and 4. The draw bench 12 may be provided with a standard 13 having clamping jaws 14 thereon for gripping one end of the sheet S.

The forming mechanism may include a platform 15 supported upon suitable standards 16 in a position in substantial alignment horizontally with the clamping jaws 14 on the draw bench. The platform 15 has a flat upper surface 15a at its rear end over which the sheet S is drawn. The sheet S is retained in engagement with the surface of the table 15 by means of a roller 17 which is suitably journaled in a U-shaped member 17 which is supported on a pair of plungers or pistons 18, 18 mounted slidably in the cylinders 19, 19 projecting from the rear of the stand-

ards 11, 11. The rollers 17 may be urged downwardly against the sheet in any suitable way, such as for example, by a hydraulic pressure exerted through the cylinders 19 and pistons 18.

At the end of the table 15 and disposed in a recess 15b therein is a forming element 20 best shown in Figs. 3 and 4. As shown particularly in Fig. 4 the forming element 20 is of generally rectangular shape in plan view and as shown in Fig. 3 is of variable transverse and longitudinal curvature from its forward to its rear edge so as to provide an infinite variation in curvature from one edge to the other. The element is of shortest radius of curvature at its left hand end as viewed in Fig. 3. The forming element 20 may be formed of metal or of hard wood and is mounted on a supporting frame 21 of generally L-shaped vertical cross-section as shown in Figs. 3 and 4.

Projecting downwardly from the ends of the supporting frame 21 are a pair of arcuate brackets 22 and 22a which have arcuate grooves 22b therein. The grooves 22b receive the arcuate lugs 23 and 23a projecting inwardly from the edges of an aperture 15b in the forward edge of the table 15. The lugs 23 and 23a slide in the grooves 22b and thus permit the member 20 to rock around its upper rear edge 20a. It will be observed that the grooves 22b are concentric with the edge 20a of the forming element 20, thus permitting the rocking movement described above.

In order to retain the edges of the sheet against inward movement or to stretch the sheet transversely we have provided in this device a pair of edge-gripping elements 24 and 25 similar to those disclosed in our issued Patent No. 2,301,960.

Each of these edge-gripping elements, as best shown in Figs. 5 and 6, may include a pair of angularly related chains 26 and 27, which are mounted between a pair of clamping blocks 28 and 29 so that the innermost passes or flights of the chains 26 and 27 are urged together to grip the edges of the sheet and travel therewith as the work is advanced. As shown particularly in Fig. 6, the rear flight of the upper chain 26 may be supported by suitable rollers 30 fixed to the block 29 while the inner flight of the chain 26 is urged downwardly by a bearing block 31 mounted in a cavity or groove 32 in the clamping member 29.

The outer flight of the chain 27 is supported by rollers 33 fixed to the pressure block 28 while the inner flight of this chain is supported in a bearing element 34 mounted in a groove 35 in the block 28.

The blocks 28 and 29 are capable of relative sliding movement upon the pins 36 and may be drawn together by means of the threaded bolts 37 having the handles 38 thereon.

The blocks 28 and 29 are normally urged apart by means of the springs 39 encircling the bolts 37 and engaging the pressure members 28 and 29.

As disclosed in Fig. 5, edge-retaining members 24 and 25 are capable of swinging movement in a horizontal plane in order to grip the sheets and stretch them, if desired. Adjacent the forward edge of the gripping members 24 and 25 are lugs 40 which are pivotally connected to brackets 41 fixed to the table 15. At the rear and outer edge of the clamping members 24 and 25 are pivotally connected the threaded shafts 42 which pass through an internally threaded worm gear 43 which bears against a thrust bearing 44 interposed between the gear 43 and an upstanding flange 45 on a bracket 46

which is fixed to the table 15. The worm gear 43 is rotated by means of a worm 47 which is fixed to a shaft 48 journaled in a bracket 49 also fixed to the table 15. A motor 50 is provided by means of which beveled gearing 5 drives the worm 47 to cause the gripping members 24 and 25 to move in a horizontal plane, as described above.

If desired, automatic control means similar to that disclosed in our copending application, referred to above, may be provided for controlling the movement of the gripping members 24 and 25.

As shown particularly in Fig. 4, the gripping members 24 and 25 extend substantially coextensively with the forming member 20 so that the edges of the sheet S are gripped and retained as the sheet is drawn over the forming element 20. This arrangement permits the sheet to be stretched transversely as well as longitudinally and causes the desired curvatures to be imparted to the sheet.

Referring now to Fig. 2, one form of mechanism for swinging the forming element 20 is disclosed therein. This control mechanism may include a plunger 51 slidably mounted in a block 52 attached to the table 15 and disposed directly beneath the forming member 20. The lower end of the plunger 51 is engaged by a cam 53 having an inclined upper surface 54. The cam 53 is slidable transversely of the draw bench 12 in a passage 55 in the lower end of the block 52. A rod 56 is connected to the right hand end of the cam and is provided with a downwardly projecting roller 57 which engages an elongated cam member 58 fixed to one edge of the draw bench 12. Depending upon the contour of the cam 58, the forming member 20 may be moved up and down by the movement of the cam 53 to impart greater or lesser stretch to the sheet S.

Due to the presence of grit or dirt or irregularities in the surface of the forming member 20, the metallic sheets are sometimes scratched or marred thus causing them to fail to meet specifications. In order to overcome such marring of the sheets we have provided a means for protecting the sheet during the forming operation. As best shown in Fig. 3, this means may consist of a pair of protecting sheets or blankets B and B' which are disposed above and below the sheet S. The forward edges of the sheets B and B' are gripped in the clamping jaws 14 and drawn through the device together with the sheet S. The sheets B and B' are not engaged by the members 24 and 25 and thus are not stretched longitudinally and transversely like the sheet S. Therefore the sheets B and B' can be used repeatedly to protect successive sheets of material during processing.

Similar protection may be obtained by securing the sheets of heavy tough kraft paper to opposite surfaces of the sheet S by means of an adhesive, such as, for example, the tacky rubber adhesives or the non-drying adhesives used on the so-called "Scotch tape." Such adhesives cause the paper to be retained tightly upon the sheet S during the forming operation but permit the paper to be stripped from the sheet S at the conclusion of the forming operation.

The operation of our apparatus is as follows: With the forming member 20 lowered into the plane of the table 15, a sheet of metal S is threaded beneath the roller 17 and through the gripping devices 24 and 25. The end of the sheet S is then secured to the standard 13 by means of the clamping jaws 14. The opposite surfaces of

the sheet S may be protected by means of the blankets B, B' which may be either tough paper secured by means of an adhesive to the sheet S or metal sheets which are gripped at one end by the jaws 14.

The edge gripping members 24 and 25 are then closed by means of the bolts 37 and handles 38 to grip the edges of the sheet S. The blankets B, B' are not engaged by the members 24 and 25.

The draw bench 12 is then moved in a direction to draw the sheet over the forming element 20 and this element is rocked into a position out of the plane of the table 15 by means of the cam 53 and the cam 58 to stretch the sheet S both longitudinally and transversely beyond its elastic limit. As the sheet advances the roller 17 guides it into the gripping members 24 and 25.

The amount that the sheet is stretched may be varied by varying the position of the forming member 20 and spacing of the gripping members 24 and 25. Thus by varying the positions of these members during the movement of the sheet, a variable controlled curvature can be imparted to the sheet.

Inasmuch as the sheet is stretched beyond its elastic limit and is stretched both longitudinally and transversely, a permanently curved sheet is produced.

From the foregoing description it will be apparent that we have provided a simplified but highly versatile type of mechanism for forming sheets of metal into various compound curved shapes without danger of scratching or marring such sheets. Because of the variation in curvature of the improved forming element, it is possible to impart widely varying curvatures to metallic sheets without the necessity of using interchangeable forming elements. Moreover, inasmuch as such forming elements can be made from readily worked materials, such as for example hard wood, plastics and the like, the replacement of the forming elements and the production of differently shaped forming elements are simple and inexpensive.

While the invention has been described with reference to a specific form of device, it should be understood that this device may be varied considerably without departing from the invention and that it should be considered as illustrative and not as limiting the scope of the following claims.

We claim:

1. An apparatus for imparting transverse and longitudinal curvatures to sheets of metal comprising means for gripping and retaining the edges of a sheet of metal, a movable forming member disposed between said means, said member having a surface of varying transverse and longitudinal curvature means for moving said forming member to bring portions of different curvature into engagement with said sheet, and means for pulling said sheet over said forming member while said sheet is gripped and retained to stretch said sheet longitudinally and transversely.

2. An apparatus for imparting transverse and

longitudinal curvatures to sheets of metal comprising means for gripping and retaining portions of the longitudinal edges of a sheet of metal, a forming member pivotally movable about an axis spaced from said sheet of metal and extending transversely of said sheet, said forming member being disposed between said gripping and retaining means and having a surface varying from flat to a curvature of relatively short radius, means for rocking said forming element about its axis to bring portions of its surface of different curvature selectively into engagement with a surface of said sheet, to bend said sheet into a transverse curvature substantially complementary to the curvature of the engaging portion of said forming element, and means for pulling said sheet over said forming element while its edges are gripped by said gripping means to stretch said sheet transversely and longitudinally.

3. An apparatus for imparting longitudinal and transverse curvatures to sheets of metal comprising a draw bench for gripping one end of an elongated sheet of metal, a pair of gripping members including chain members for gripping and releasing successive portions of the longitudinal edges of said sheet of metal, a forming member having a curved surface of varying radii interposed between said gripping members and movable between positions out of engagement with said sheet and positions bending a portion of said sheet between said gripping members on a curvature of relatively short radius, and means for moving said draw bench to pull said sheet over said forming element while the edge portions adjacent said gripping members are retained against inward movement.

4. An apparatus for imparting longitudinal and transverse curvatures to sheets of metal which comprises means for gripping and retaining successive portions of the longitudinal edges of a sheet of metal, means for advancing the sheet of metal between said gripping means, a member mounted for pivotal movement about an axis extending between said gripping means, said member having a surface of varying transverse and longitudinal curvature, and means for moving said member to engage said surface with said sheet and bend said sheet transversely between the portions thereof gripped by said gripping means.

5. A forming member for imparting transverse and longitudinal curvatures to sheets of metal comprising, a forming block having a surface adapted to engage a metal sheet, said surface being curved longitudinally and transversely on varying radii to vary the curvature of said surface at one end from substantially a plane to a curve of short radius at the other end and a pair of flanges projecting from said member having arcuate grooves therein forming pivots for movement of said block about an axis lying substantially at said one end of said member.

BASIL LERMONT.
ARNOLD M. WOLF.