June 2, 1942. D. S. HARDER 2,285,275

BENT TUBE SECTIONS AND A METHOD OF PRODUCING THE SAME

Filed Nov. 8, 1938 2 Sheets-Sheet 1

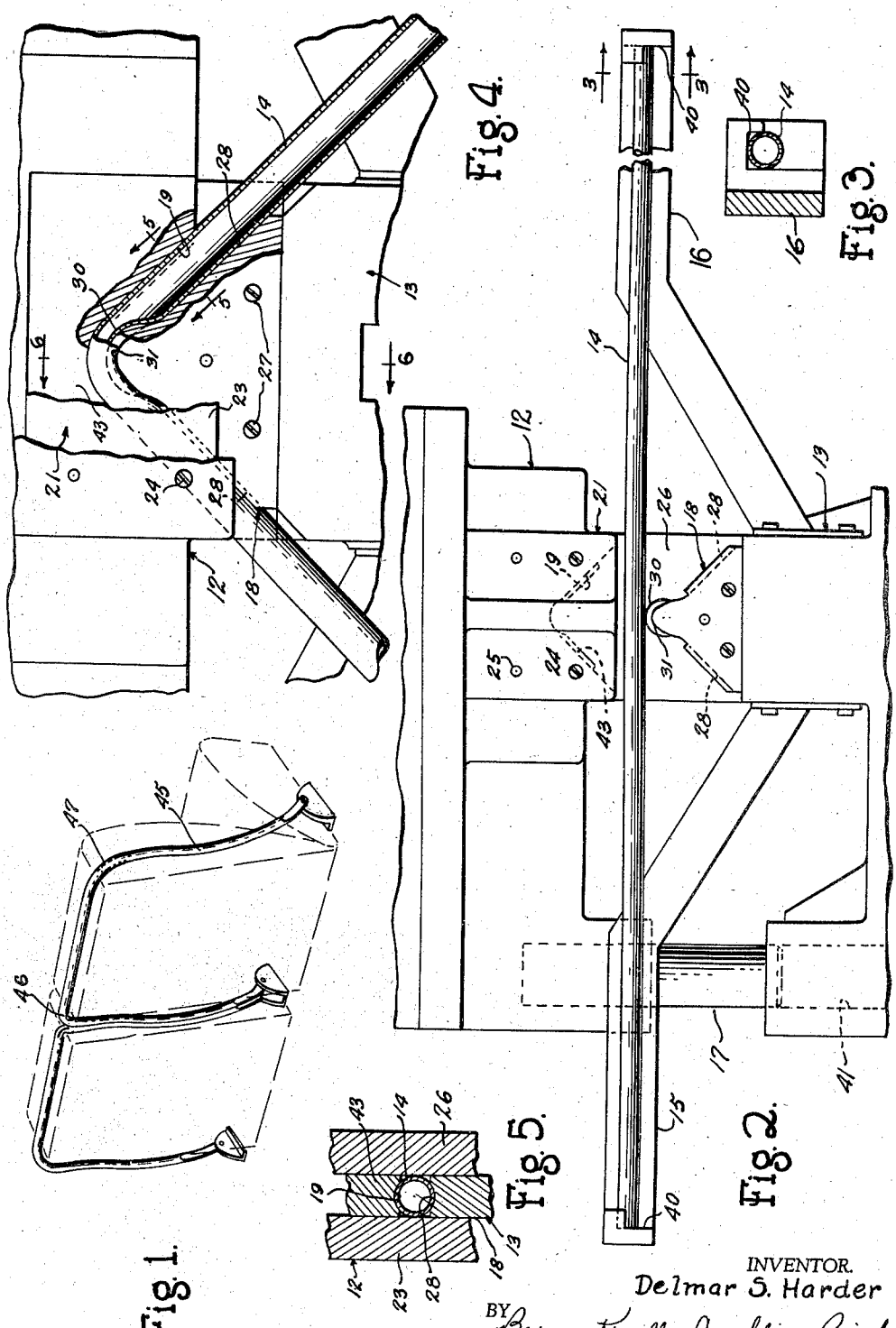


Fig. 4.

Fig. 3.

Fig. 1.

Fig. 5.

Fig. 2.

INVENTOR.
Delmar S. Harder
BY Barnes, Kisselle, Laughlin & Raisch
ATTORNEYS

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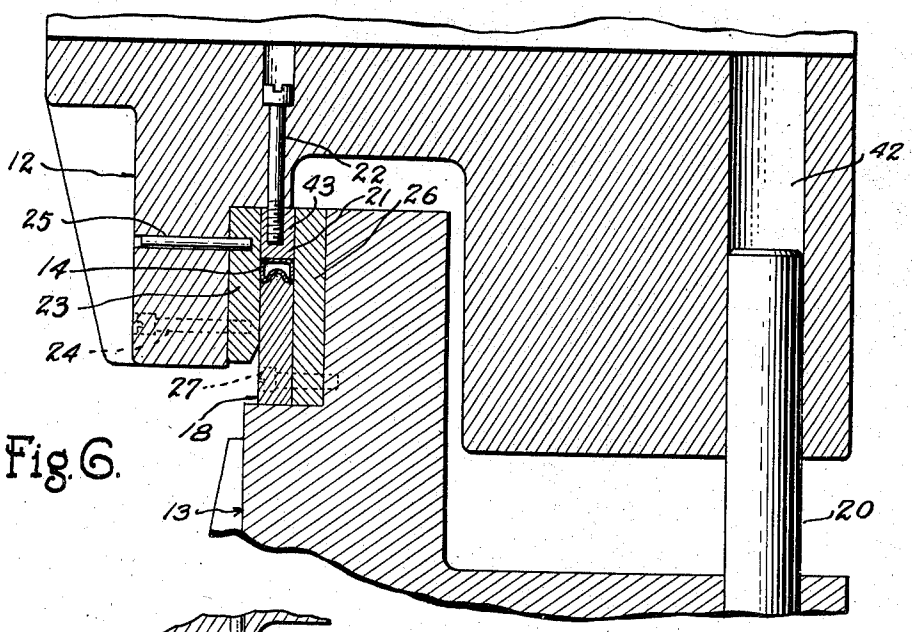


Fig. 6.

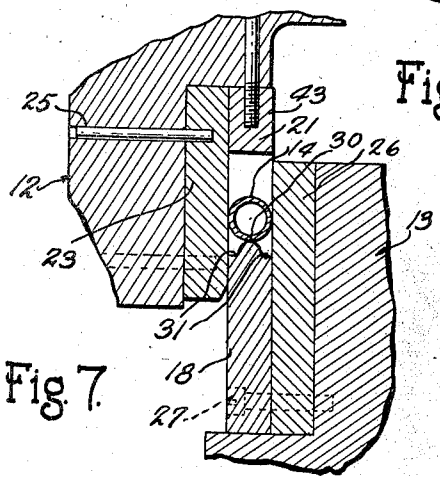


Fig. 7.

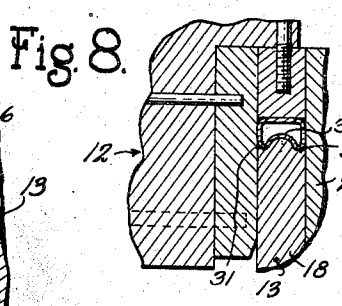


Fig. 8.

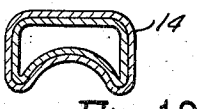


Fig. 12.

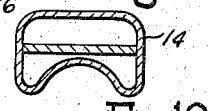


Fig. 13.

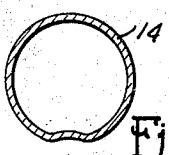


Fig. 11b.

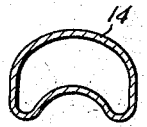


Fig. 11a.

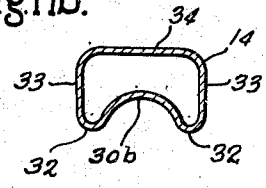


Fig. 11.

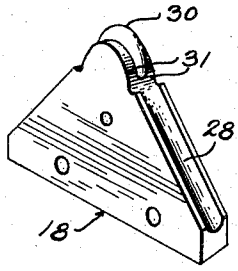


Fig. 9.

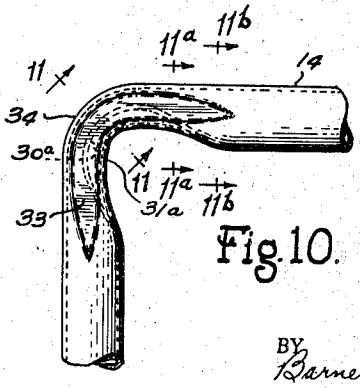


Fig. 10.

INVENTOR.
Delmar S. Harder

BY
Barnes, Kisselle, Laughlin & Raich
ATTORNEYS

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BENT TUBE SECTION AND A METHOD OF PRODUCING THE SAME

Delmar S. Harder, Detroit, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application November 8, 1938, Serial No. 239,524

4 Claims. (Cl. 153—2)

This invention relates to bending of tubing and more particularly to a method of bending a tube and the bent tube as an article.

When a tube is bent about a sharp corner, for example, a 90° bend, the tube buckles and has its cross-section substantially changed and materially weakened at the bend. It is an object of this invention to bend tubing about sharp corners and retain substantially the original strength of the tubing at the bend. This object is achieved by predetermining and controlling the cross-sectional shape of the tube at the bend.

In the drawings:

Fig. 1 discloses a typical application for sharp cornered structural tubing—a supporting frame for automobile seats.

Fig. 2 shows the machine for bending, with a tube in position to be bent.

Fig. 3 illustrates the details of the jig arm at the section 3—3 of Fig. 2.

Fig. 4 is a cut-away view of the dies of the bending machine at the end of the bending stroke, revealing the relation of the work and the dies.

Fig. 5 is the section 5—5 of Fig. 4 showing the relative positions of the dies and materials at that point upon the completion of the bending stroke.

Fig. 6 is a section at 6—6 on Fig. 4.

Fig. 7 is a section through the dies and the work during the bending stroke.

Fig. 8 illustrates the work and dies at the completion of the stroke.

Fig. 9 is a perspective of the lower die.

Fig. 10 is a side view of the finished product.

Fig. 11 is the section 11—11 of Fig. 10 showing the structure at the bend.

Figs. 11*a* and 11*b* are sections along the lines 11*a*—11*a* and 11*b*—11*b* of Fig. 10.

Figs. 12 and 13 are sections through the corner of the bent tube which has previously been reinforced by a tube and strip of metal respectively.

In Fig. 2, 12 generally denotes an upper die holder and 13 a lower die holder. A guide post 17 keeps them in alignment. The tube to be bent, referenced 14, when placed on male die member 18, is held thereon by the jig arms 15 and 16 (Fig. 3) which are rigidly attached to the lower die 13. The ends of the jig arms 15 and 16 take the form of sockets 40 which abut the ends of the tube to hold it against longitudinal movement and which fit over the top and side portions of the end of the tube to hold it on the die 18 against lateral movement. Female die member 21 is in the form of an inverted V socket and complements die member 18 in bending the tubing 14.

Die member 21 is a composite die comprising upper die member 43 and front die member 23. Die member 21 is held to the upper die holder 12 by a bolt 22. Die member 23 is secured to the upper die holder 12 by bolts 24 and pin 25. The lower inner edge of die member 23 is beveled to facilitate the sliding of the work 14 and die member 18 past this point. The die member 18 is backed by the die member 26 and both are secured to the lower die holder 13 by bolts 27.

The contour of die members 18 and 21 will depend upon the bend desired. As herein shown the tube 14 is bent about a 90° angle. Therefore the lower die member 18 is an inverted V in form. The sides of die 18 are grooved at 28 to fit the tube. The complementary die member 21 is similarly grooved at 19, Fig. 5. The side die members 23 and 26 form vertical plane walls which restrain lateral distortion of the tube.

The die member 18 has a rounded head portion in the form of a bead 30 of such shape as to form the indentation 30*a* in work 14, Fig. 10, and of cross-section such as to form the rounded portion 30*b* of Fig. 11. Die member 18 is provided with shoulders 31 on each side of the bead 30. These shoulders 31 project above and without the projected plane of grooved die faces 28. Thus, as viewed in Fig. 10, the radial diameter of the tube taken along the radius of the bend or height of the tube at the bend, as viewed in Fig. 11, is decreased but the width of the tube at the bend, as viewed in Fig. 11, is the same as the original diameter of the tube. This shortening of the radial diameter or height of the tube at the bend provides sufficient metal so that the side walls 33 (Fig. 11) of the tube can be straightened or pressed into plane form without decreasing the thickness of the wall of the tube at the bend.

If for any reason it is desired to increase the strength of the tube at this corner bend, this can be done in several ways. A second tube, either split or seamless, that fits snugly inside the principal tube 14 can be inserted at the place to be bent. The result will be a double wall bend instead of a single one, see Fig. 12. Another way to reinforce the corner is to place strip metal within the tube at the area to be bent. Preferably the metal strip is as wide as the inside diameter of the tube and is firmly gripped by the sides and thus acts as a strengthening member, see Fig. 13.

After the tube has been positioned on die member 18 and its ends interengaged with the sockets 40, the die members 18 and 21 are brought together. As the die members are brought together they are guided by posts 17 and 20 and their cooperating guide openings 41 and 42 respectively. Post 17 is fixed to die holder 12 and slidably guided in opening 41 in die holder 13. Post member 20 is fixed in die member 13 and slidably guided in opening 42 in die holder 12. Preferably the upper die 21 descends on the stationary bottom die 18, see Figs. 7 and 8. As the dies close, the bead 30 of die member 18 preferably first indents the tube 14 as at 30*a* and 30*b* and thereafter further closing of the dies causes die 21 to bend tube 14 about die 18. However, the step of indenting and bending can be simultaneous. Fig. 4 shows the die members 18 and 21 at the end of their working stroke with the tube 14 between them. In the closing movement of the dies, die 21 bends the tube 14 about die 18 causing the ends of the tube to disengage sockets 40 in the jig arms 15 and 16.

As the dies complete their stroke the side walls 33 of the tube at the corner are flattened into plane surfaces against die members 23 and 26 and the outer face 34 of the bend is also flattened along the outer circumference of the bend by die 43. Rounded corners are also produced between the side faces 33 and the outer face 34 at the bend. The inner face of the tube at the bend is indented as at 30*b* with an indentation having a semi-circular cross-section which adds considerable strength to the tube at the bend.

As shown in Fig. 11 the cross-section of the tube at the bend may be described as a channel section having an outer wall 34 and side walls 33 which are bridged by the wall 30*b* which curves inwardly of the channel. The indentation 30 is deepest along the line 11—11 of Fig. 10 and then becomes shallower and gradually fades out and merges with the tube on each side of the line 11—11. The flattened outer circumference 34 reaches its greatest width at line 11—11, Fig. 10, and it too gradually decreases in width and tapers down and finally fades into the outer face of the tube. This is illustrated by Figs. 11*a* and 11*b*.

In Fig. 1 there is shown a tubular frame 45 for an automotive vehicle seat which has been formed from a straight length of tubing. It will be noted that the frame 45 has a sharp bend or corner 46 which has been bent according to the method hereabove outlined. The frame 45 also has a bend 47 therein, which bend was made about a radius of sufficient length so that the cross sectional form of the tube is substantially maintained. However, bend 46 is about a radius of insufficient length to maintain the original cross sectional shape of the tube. It is evident that the herein described method of bending a tube is particularly applicable to sharp bends, that is, a bend of such short radius that the original cross sectional shape of the tube cannot be maintained during and at the completion of the bend. The method herein disclosed is essentially characterized in that the change in cross sectional shape of the tube at the bend is controlled so that the tube at the bend is changed from a tubular section into a section having substantially equal strength.

I claim:

1. A method for bending a tube comprising indenting the tube in the area to be bent and bending the tube about a sharp corner so that the indentation is on the inside of the bend and during such bending confining the tube and pressing the same to flatten the side walls and the outer wall of the tube at the bend.

2. A method of bending a straight length of tubing about a sharp corner which comprises longitudinally indenting a face of the tube that is to be the inside of the bend and simultaneously bending the tube so that said indentation is on the inside of the bend and during such bending confining the tube and pressing the same to flatten the side walls and the outer wall of the tube at the bend.

3. A method of bending tubing about a corner which comprises longitudinally indenting the face of the tube that is to be the inside of the bend, bending the tube at the indentation by applying force substantially perpendicular to the tube at each side of the said corner so that said indentation is on the inside of the bend and flattening the tube on the outer face of the bend and on the sides of the bend perpendicular to said flattened outer face while said tubing still engages said corner.

4. An article of manufacture comprising a tube having a substantially right angle bend, an outer face at the area of the bend which has its greatest width at the mid portion of the bend and decreases in width and gradually merges into the round wall of the tube on each side of the mid portion of the bend, the side walls of the bend being substantially flat and merging at each end into the round side walls of the tube, the inner face of the bend being curved inwardly of the tube to a depth which is greatest at the mid portion of the bend and which gradually decreases on either side of the mid portion of the bend.

DELMAR S. HARDER.