June 4, 1946. E. C. BOOTH 2,401,542

PROCESS FOR MAKING TUBING

Filed April 3, 1944

Fig. 1.

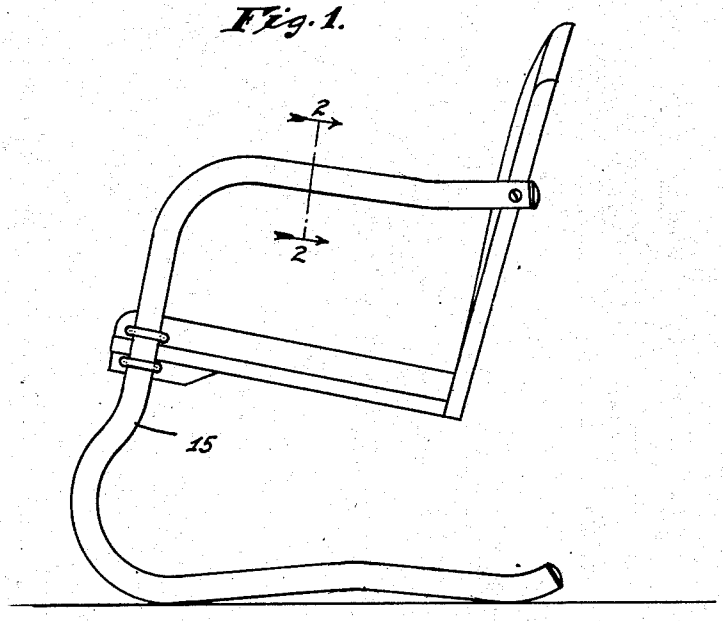


Fig. 2.

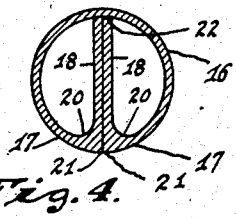


Fig. 3.

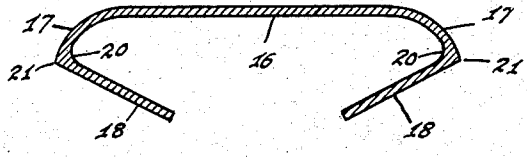


Fig. 4.

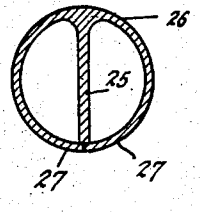


Fig. 5.

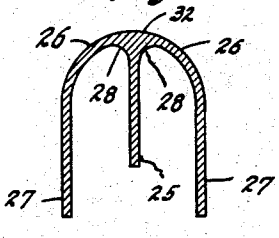


Fig. 6.

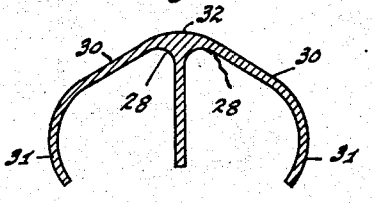


Fig. 7.

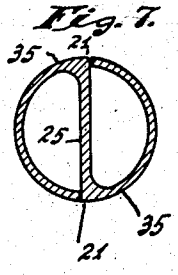


Fig. 8.

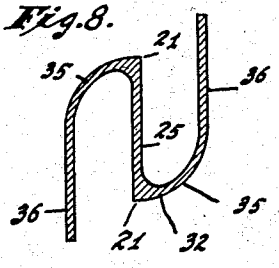


Fig. 9.

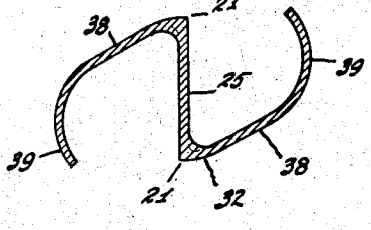
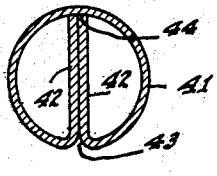


Fig. 10.



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ATTORNEYS.

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PROCESS FOR MAKING TUBING

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Application April 3, 1944, Serial No. 529,348

4 Claims. (Cl. 29—156)

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This invention relates to tubular metallic articles and more particularly to a process for producing them. My object is to reduce the cost of manufacture of such articles and to increase their strength.

In carrying out my invention, I form the tube by transversely curving a suitably shaped metal strip having portions which, in the finished tube, respectively form a cylindrical tube-wall and a diametrically extending web. In the finished tube, the web is united at both its longitudinal edges with the cylindrical wall. When the tube is to be of aluminum or aluminum alloy, the strip is conveniently formed by extrusion in any convenient cross-sectional shape adapted to be curved into the desired reinforced tubular form. In use, the tubular article will be so disposed about its axis that the load will be applied in the plane of the web; and if the tubing is bent in forming the finished article, the bending is preferably done in the plane of the web.

The accompanying drawing illustrates my invention. Fig. 1 is a side elevation of a chair embodying tubular supporting elements formed in accordance with my invention; Fig. 2 is a transverse section on the line 2—2 of Fig. 1; Fig. 3 is a transverse section of an extruded strip suitable for use in forming the tube shown in Fig. 2; Fig. 4 is a transverse section through a modified form of tube; Figs. 5 and 6 are transverse sections of alternative strips suitable for use in forming the tube of Fig. 4; Fig. 7 is a section similar to Fig. 2 illustrating a further modification; Figs. 8 and 9 are transverse sections illustrating alternative strips suitable for use in forming the tube of Fig. 7; and Fig. 10 is a transverse section similar to Fig. 2 showing a tube formed of flat strip stock.

The chair illustrated in Fig. 1 is shown merely to illustrate one use for my invention and embodies supporting members 15 formed of metal tubing and located at opposite sides of the chair. The tubing of which the member 15 is formed is circular in section and embodies interiorly a diametrically extending web.

The tube shown in Fig. 2 is conveniently formed from a metal strip having the cross-sectional shape illustrated in Fig. 3. Such strip has a central portion 16, which may be approximately plane, side or intermediate portions 17; and edge portions 18. The portions 17 are desirably curved on a radius equal to the radius of curvature of the cylindrical wall in the finished tube. The edge portions 18 are plane. Desirably, the interior of the junction between each curved portion 17 and the adjacent plane portion 18 is

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formed with a rather generous fillet 20, while exteriorly such junction is characterized by a well-defined edge 21 representing the intersection of the mutually perpendicular outer surfaces of the portions 17 and 18. The strip of Fig. 3 is desirably formed of aluminum, aluminum alloy, or similar metal by extrusion.

In forming a tube from a strip of the cross-section illustrated in Fig. 3, the center portion of the strip is curved transversely to bring the edges 21—21 together with the opposed faces of the edge portions 18 in contact with each other to form a diametrically extending web, as shown in Fig. 2. To complete the tubing, the edges 21—21 are welded together, and the free edge of the web formed by the portions 18—18 is welded to the center portion 16 at the point indicated at 22 in Fig. 2. Such welding need not be continuous, and is desirably carried out by the "condenser-type" process.

In the tubing illustrated in Fig. 4, the center web 25 is of single thickness. This tubing may be formed of an extruded strip having a generally T-shaped cross-section similar to those illustrated in Figs. 5 and 6. In Fig. 5, the center web 25 is united along one edge with two oppositely projecting flanges. Adjacent the web 25, the flanges are curved in cross-section as indicated at 26, desirably to the curvature of the cylindrical wall of the tubing in Fig. 4; while beyond such curved portions the flanges are approximately plane, as indicated at 27. The junction of the web 25 with each curved flange-portion 26 is characterized by an interior fillet 28.

In forming a tube of the strip shown in Fig. 5, the relatively plane flange-portions 27 are curved to abut each other over the free edge of the web 25, as will be clear from Fig. 4; and the abutting flange-edges are then welded together and to the adjacent edge of the web 25.

The strip illustrated in Fig. 6 is similar to that shown in Fig. 5 except that the flanges have their relatively plane portions 30 located near their junctions with the flange 25 and their outer edges curved as indicated at 31. In forming a tube of the strip of Fig. 6, the flange-portions 30 are curved to bring the free edges of the portions 31 together above the free edge of the web 25, and all such edges are then welded together.

The tube illustrated in Fig. 7 resembles that shown in Fig. 4 except that the flanges forming the cylindrical tube-wall are united respectively with opposite edges of the center web 25. Such a tubing may be formed of a strip having the general Z-shaped cross-section illustrated in Fig. 8.

In that strip, the two flanges are joined respectively with the opposite edges of the plane web **25**, each flange having a curved portion **35** adjacent the web **25** and a relatively plane edge portion **36**. In forming a tube of the strip shown in Fig. 8, the plane portions **36** of the two flanges are curved to bring the ends into engagement with the web **25**, as shown in Fig. 7, and the flange-edges are then welded to the web **25**.

The strip illustrated in Fig. 9, which also may be used to produce the strip of Fig. 7, is similar to the strip shown in Fig. 8 except that the plane portions **38** of the flanges are located adjacent the web while the edge portions are curved as indicated at **39**.

The extrusion process, which I prefer to use in producing the strip of which my tubing is formed, has the advantage that it produces a strip admirably suited to the production of tubing of attractive appearance. Desirably, a large part of the transverse extent of the strip-portions which are to constitute the cylindrical tube-wall are formed in the extrusion process to have a curvature corresponding to the curvature of that wall. This reduces the amount of transverse bending which must be performed in converting the strip into a tube. Further, strip-portions whose form cannot be readily changed in the operation of converting the strip into a tube may be formed by the extrusion process to have a curvature corresponding to that of the outer surface of the finished tube. Examples of such strip-portions are those adjacent the edges **21** in Fig. 2 and those adjacent the bases of the webs and indicated at **32** in Figs. 5, 6, 8, and 9. Again, the extrusion process permits the formation of relatively sharp edges **21** on portions which are to be joined to others in the finished tube and thus aids in making the joint relatively inconspicuous.

The tube shown in Fig. 10 is made of flat strip-stock having a center portion **41** transversely curved to form the cylindrical tube wall and edge portions **42** bent inwardly and lying in juxtaposed relation to form the reinforcing web. The edges of the central portion are secured together by welding at the point **43**, and the free edge of the web is welded to the cylindrical wall at the point **44**.

In forming the chair-supporting element **15** from any of the tubes described, the tube is converted into the desired shape by bending it in the plane of the interior web. In such bending, the web is prevented from buckling by reason of the fact that both its longitudinal edges are secured to the tube-wall, and the web adds greatly to the strength of the element. Where the tubing embodies but one joint or seam visible from the exterior, as is the case in the tubes of Figs. 3 and 10, the joint is desirably disposed on the inside of the bend where it will be least conspicuous.

I claim as my invention:

1. A process of forming metal tubing having a transversely extending, interior web, which comprises extruding metal to produce an integral elongated strip having wall-forming and web-forming portions, parts of each wall-forming portion and the junction of the web-forming and wall-forming portions being shaped in the extrusion to the cross-sectional form they are to possess in the finished tubing, curving the other part or parts of each wall-forming portion to form a closed tube across the interior of which the web-forming portion extends diametrically with its edge in contact with a wall-forming portion, and then welding such web-edge and wall-forming portion together.

2. A process of forming metal tubing having a transversely extending, interior web, which comprises extruding metal to produce an integral elongated strip having a central, plane, web-forming portion and symmetrical wall-forming portions extending in opposite directions from one edge of said web-forming portions, a part of each wall-forming portion and the junction of the web-forming and wall-forming portions being shaped in the extrusion to the cross-sectional shape they are to have in the finished tubing, curving the other part of each wall-forming portion to form a closed tube with the free edges of the wall-forming portions meeting at the free edge of the web-forming portion, and then welding such free edges together.

3. A process of forming metal tubing having a transversely extending, interior web, which comprises extruding metal to produce an integral elongated strip having a central, plane, web-forming portion and symmetrical wall-forming portions extending in opposite directions from one edge of said web-forming portions, the junction of the web-forming and wall-forming portions being shaped in the extrusion to the cross-sectional shape they are to have in the finished tubing, curving each wall-forming portion to form a closed tube with the free edges of the wall-forming portions meeting at the free edge of the web-forming portion, and then welding such free edges together.

4. The process set forth in claim 1 with the further step of bending the tubing in the plane of the web.

EARL C. BOOTH.