

March 20, 1934.

P. H. CHASE ET AL

1,951,394

TUBING

Filed Dec. 3, 1930

FIG. 1.

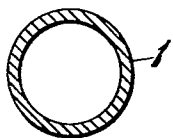


FIG. 2.

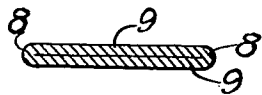


FIG. 3.



FIG. 4.

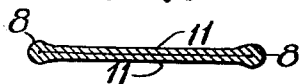


FIG. 5.



FIG. 6.

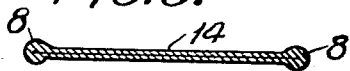


FIG. 10.

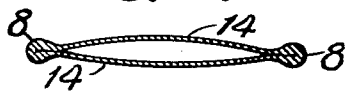


FIG. 7.

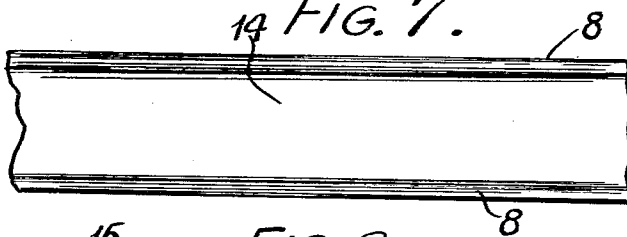


FIG. 8.

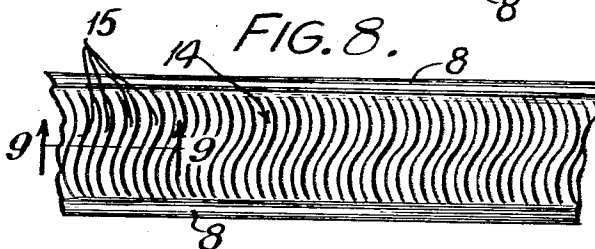
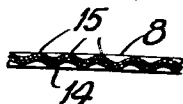


FIG. 9.



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UNITED STATES PATENT OFFICE

1,951,394

TUBING

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4 Claims. (Cl. 137—75)

This invention relates to a method of, and apparatus for shaping tubing for use in cables and the like, and with regard to certain more specific features, to a method of, and apparatus for shaping tubing to have edge portions thicker than the remainder of said tubing.

Among the several objects of the invention may be noted the provision of a thin-walled, flat tubing which has reinforcing portions at the edges of the tube thicker than the central portions thereof; the provision of a tubing of the class described which is flexible or bendable when deflated or in a flat position and which has an increased rigidity when inflated or filled; the provision of a tubing of the class described which is readily expandable and contractible; the provision of means for forming tubing of the class described from metal tubing of normally circular cross section; and the provision of means of the class described which permits the tubing to assume its final shape without setting up deleterious stresses and/or strains which would otherwise tend to effect an inferior product. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structure hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a cross section illustrating a tube of circular shape comprising raw material for the present invention;

Fig. 2 is a cross section showing the tubing of Fig. 1 after a first operation thereon;

Fig. 3 is a cross section showing the tubing of Fig. 1 after a second operation thereon;

Fig. 4 is a cross section illustrating the tubing of Fig. 1 after a third operation thereon;

Fig. 5 is a cross section illustrating the tubing of Fig. 1 after a fourth operation thereon;

Fig. 6 is a cross section illustrating the tubing of Fig. 1 after a fifth operation thereon and illustrating the cross section of one embodiment of the product of the present invention;

Fig. 7 is a plan view of the tubing product shown in Fig. 6;

Fig. 8 is a plan view similar to Fig. 7 showing a second embodiment of the tubing product;

Fig. 9 is a longitudinal section taken on line 9—9 of Fig. 8; and

Fig. 10 is a cross section similar to Fig. 6, showing the tubing of Figs. 6 and 7 in an expanded position.

Similar reference characters indicate corresponding parts throughout the several views of the drawing.

In certain industries, including the electric cable industry, it is desirable to have a hollow, flat, flexible, expandable metal tubing which has sufficient strength to withstand ordinary handling and which in addition is sufficiently flexible and expandable to permit of ready expansion and contraction under heating and chilling conditions, and in addition having sufficient flexibility to permit of its incorporation in a cable, for example, with a minimum of working difficulties. A cable employing metal tubing of this classification is shown in the co-pending application of Philip H. Chase, Serial Number 295,222 and other applications. We have observed that ordinary thin-walled, flat metal tubing, exhibits in some instances a weakness along the edges of the flat tube. This may be accounted for by the fact that in the flattening operation the metal at the edges of the flat tube is to a slight extent thinned by the bending, or is at best only the same thickness as the flat portions of the flat tube. In utilization, this flat tubing is subjected to bending and twisting strains, and these strains take place at the edge of the flattened tube to a greater extent than in the center thereof.

The present invention eliminates the above difficulty by providing a flat tube wherein the edge portions are relatively thicker than the remainder of the tubes and are accordingly stronger.

It is to be understood that the tubing of the present invention is useful in industries other than the electric cable industry indicated above. For example, tubing of the type described in this application is useful in the formation of radiator cores and the like, wherein similar stresses and strains may be set up.

Referring now more particularly to Fig. 1, there is illustrated at numeral 1 a metal tube of circular cross section. The metal forming the tube 1 may be any suitable metal, such as copper, which has sufficient ductility and flexibility for the requirements of the final product. Seamless tubing of the type shown in Fig. 1 can be readily obtained in indefinite lengths.

The first operation comprises passing the circular cross section tube 1 through a pair of flat

rollers, whereby the tubing 1 is pressed to a flat tube shown in Fig. 2. This Fig. 2 tube, it will be seen, has edge portions 8 wherein the metal is substantially equal to the original thickness of the tube 1, as well as center flat portion 9, wherein the metal is also substantially as thick as the walls of the original circular tube 1. The tubing shown in Fig. 2, comprising the result of the first operation of the present invention, is the final product of previous types of apparatus for forming flat tubes.

In the second operation the flat tube of the Fig. 2 conformation is passed between a pair of longitudinal convoluting rollers. The edge portions 8 of the tube project at the sides of the rollers and are not subjected to rolling. Under these conditions, the flattened tube is increased in width by the flowing or stretching of the metal portion between the edges 8, with a consequent thinning of the tube walls. It will be seen, however, that the edges 8 are left in substantially their original thickness.

The tubing, after the second operation is shown in Fig. 3. It will be seen that the edged portions 8 are still of their original thickness, and that the longitudinally convoluted portions, comprising troughs 22 and crests 23, have been thinned by the rolling operation.

The third operation comprises passing the convoluted tubing of Fig. 3 between a pair of flat rollers. The rollers smooth out the troughs 22 and crests 23 of the convolutions in the central portion 11 of the tubing and in so doing increase the width of said tube. The length of the tubing is also somewhat increased. The effective portions of the rollers are narrower than the overall width of the tube, so that said rollers do not engage or press the edge portions 8.

The product of the third operation is illustrated in Fig. 4. It will be seen that the tubing is now considerably wider than in the Fig. 2 development, but that the center portions 11 have been uniformly thinned. The edge portions 8 retain substantially their original, or Fig. 2, thickness.

In the fourth operation the Fig. 4 tube is again subjected to longitudinal convolution by rolling between a pair of convoluting rollers. Again the effective portions of the rollers are narrower than the width of the tube, so that the edge portions 8 are not rolled and the effect of the convolution is to thin the metal comprising the central portions of the tubes.

The tubing after the fourth operation has been performed thereon is shown in Fig. 5. It will be seen that the edge portions still retain substantially their original Fig. 2 thickness while the central portions are now, at the troughs 22, even thinner than in the Fig. 4 form.

The fifth operation is similar in function to the third operation. In the fifth operation the convolutions produced in the fourth operation are smoothed out, with the result that the tubing is again made wider and somewhat longer, and the central portion 14 is again made thinner.

The product of the fifth operation is shown in Fig. 6. It will be seen that there is now a greater difference between the thickness of the end portions 8 and the thickness of the central portion 14.

The corrugating and smoothing operations described may be repeated any suitable number of times. The present description has concerned a method in which two convolutions and two smoothings are employed. It will be seen, however, that under different circumstances one or

any larger number of convoluting and smoothing operations can be employed with satisfactory results.

It is also to be understood that Figs. 1 to 6 are purely diagrammatic, and that in operation additional features are employed which are customarily used in the tube rolling art. For example, it may be desirable to provide a sequence of two or more pairs of rollers for any one operation, whereby the smoothing is gradually effected, rather than by a single pair of rollers as indicated. It is desirable also that the rollers be adjustable relative to the compression between them.

Thus the product of the invention, as shown in Figs. 6 and 7 comprises a flat tube having thicker edge portions 8 and thinner flat body portions 14.

For certain uses, the Fig. 6 tube can be opened or expanded to the Fig. 10 conformation, for example, by an internal mandrel, and/or by forcing gases or fluids therein.

In order to obtain increased combined expansibility and flexibility in the finished product, we have found it advantageous to pass the tubing in its Figs. 6 and 7 form through an additional pair of smooth cylindrical rollers, which, by reason of additional applied pressure, lengthen the thin body portions of the tubing without lengthening the thicker edges. As a result of this operation, on account of the longitudinal restraining effect of the edges 8, the now lengthened body portion 14 buckles into transverse or lateral ripples or corrugations, as illustrated in Figs. 8 and 9. The rippling action does not occur in the events occurring between the Figs. 3-4 and Figs. 5-6 events, because most of the expanding action of the compressed high portions takes place laterally. When there are no high and low portions and rolling is effected, expansion is longitudinal primarily and the tensile resistance causes the buckling into the ripples. These lateral ripples or corrugations increase the available surface of the tube for heat-radiating purposes; they also permit a more ready expansion and contraction of the tube, particularly when the tube is used in a bent or curved form.

With some metals it is desirable to anneal the tubing during or after the forming operations, in order to relieve strains and stresses set up by the rolling, etc. For example, copper tubing is desirably passed through a suitable bath such as molten lead maintained at a proper temperature after each, or as many as found desirable, of the rolling operations.

We claim:

1. A seamless tube having portions of its walls thinner than the remainder of said walls, said thinner portions being provided with lateral corrugations.

2. Seamless, flat metallic tubing, the longitudinal edges of which are integral with the remainder of the tube, but which edges are formed of relatively thicker metal than the remainder of the tube.

3. Seamless, relatively flat metallic tubing comprising walls of relatively thin metal formed at their edges with integral beads of relatively thick metal, said walls being provided with lateral corrugations for increasing their expansibility.

4. A relatively flat, seamless tube, relatively thin wall portions therein and relatively thick portions joining said wall portions, said relatively thin wall portions being provided with corrugations.

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