Feb. 25, 1964 E. SIEGWART 3,122,115

METHOD OF AND APPARATUS FOR MAKING TUBES OR PIPES

Filed Feb. 8, 1961 2 Sheets-Sheet 1

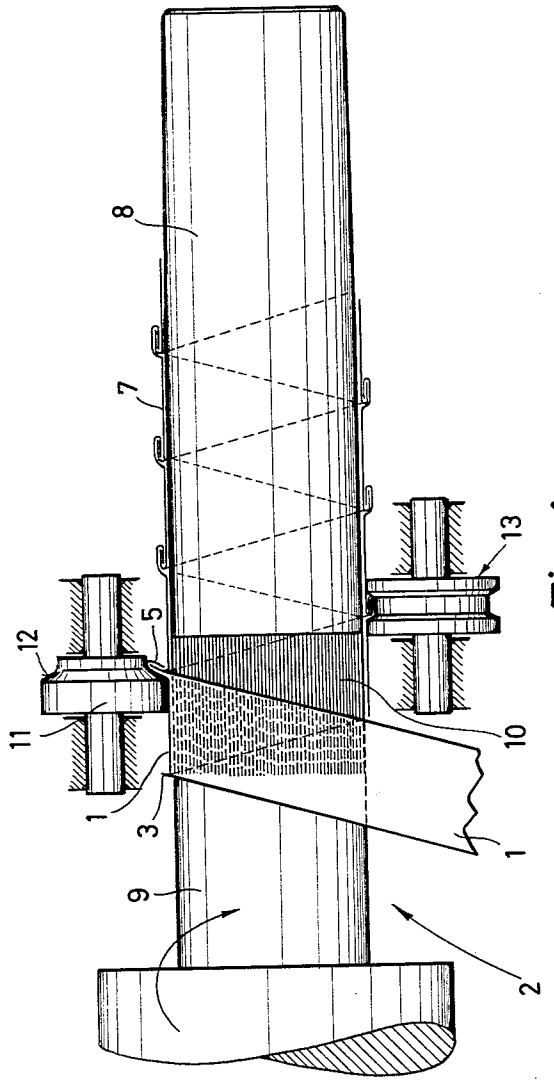

Fig. 1

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Filed Feb. 8, 1961 2 Sheets-Sheet 2

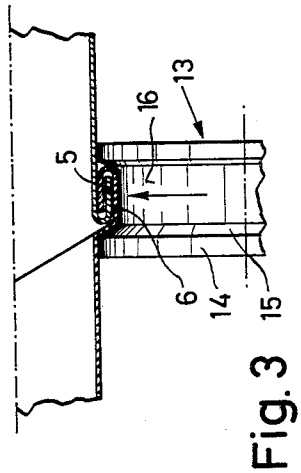

Fig. 3

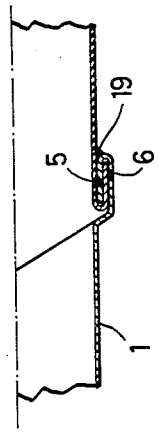

Fig. 5

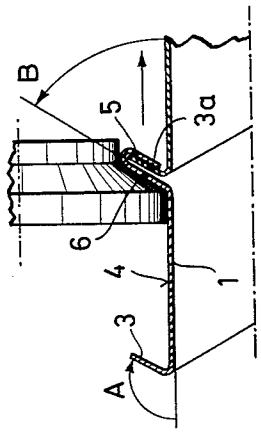

Fig. 2

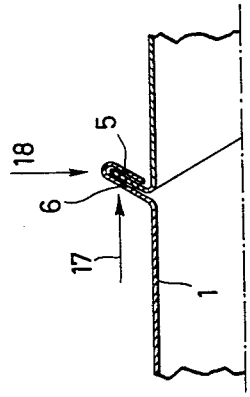

Fig. 4

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3,122,115

METHOD OF AND APPARATUS FOR MAKING TUBES OR PIPES

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14 Claims. (Cl. 113—35)

This invention concerns a method of and apparatus for making tubes or pipes from sheet metal strip which is pre-folded at the edges and which is fed helically onto a mandrel, the folded edges (which engage one into the other as the strip runs onto the mandrel) being bent over against the outside surface of the tube in order to close them and thereby unite the adjacent convolutions of the strip. In known methods of this kind, considerable force has to be applied during the bending over of the folded edges. According to the invention, this disadvantage is obviated by pre-folding the sheet metal strip to be wound, one longitudinal edge being folded through more than 90° at that side of the strip which is situated on the outside in the finished tube while, in order to form a U-shaped receiving channel for the aforesaid folded edge, the other somewhat wider edge of the strip is bent up at the same side of the strip and in parallel relationship to the first-mentioned folded edge and its outermost marginal portion is bent back to form a U. When the strip is wound over the mandrel this pre-folding results in a stretching of the outermost parts of the strip in such manner that the already inclined pre-folded edge parts bend over towards the outer surface of the tube practically automatically.

In one advantageous embodiment, during the pre-folding operation the one longitudinal edge is folded through about 120° and the other edge of the strip, which is about twice as wide as the first, is bent up through about 60° and its outer half is bent back to be parallel to the inner half. The winding mandrel is mounted so as to be axially non-displaceable, but axial feed of the finished tube, as it is being formed, can be obtained by using a fixed guide, for example, a rotatably mounted pressure roller, to exert an axial pressure on the interengaged folded edges or seam of the sheet metal strip, at least at one region, during the winding of the tube or pipe. Such a method is much more advantageous than a known process wherein the mandrel is formed with a peripheral helical depression into which the bent-over seam is pressed. In the latter instance, in practice, after a length of tube or pipe has been wound the mandrel must be unscrewed in the rearward direction. The automatically uninterrupted advance of the tube or pipe obtainable in accordance with the invention is facilitated if the winding mandrel, which is preferably motor-driven, is made slightly conical in its front part which extends into the finished tube or pipe.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a part-sectional elevation showing the essential parts of a tube or pipe winding apparatus according to the invention;

FIG. 2 is an enlarged detached section showing the form of the sheet metal strip when situated on the mandrel and showing also the form of the pre-folding thereof the figure corresponding to a point where one edge of the strip has just been fitted into the U-shaped channel of the other edge;

FIG. 3 is a view similar to FIG. 2 but showing the seam after bending-over and the roller used for such bending-over operation;

FIG. 4 is a view similar to FIG. 2 but with the roller

omitted and showing the forces exerted by the pressure and bend-over rollers on the folded edges, and

FIG. 5 shows the provision of a weld seam.

As will be apparent from FIGURES 1 and 2, a sheet metal strip **1** runs onto the winding face of a motor-driven winding mandrel **2** in a pre-folded condition. In effecting such pre-folding, the left-hand edge **3** of the sheet metal strip is bent through an angle A to the side **4** situated on the outside of the finished tube, the said angle being greater than 90°. In the example illustrated, angle A is 120°. The other pre-folded edge of the sheet metal strip is substantially twice as wide and is bent up through an angle B in parallel relationship to the edge **3**; hence it is bent through 60°. This edge forms a U-shaped receiving channel for the adjacent edge **3***a* of the next adjacent convolution of the strip which has already run onto the mandrel **2**. To form the said channel, the outer half **5** of the bent right-hand edge of the strip is bent back so as to be parallel to the inner half **6**. The pre-folding of the edges of the strip **1** is, of course, effected in known manner, for example by rolling. It is not necessary to explain the steps thereof in detail, since they will be readily understood and carried into practice by those skilled in the art.

The free end part **8** of the winding mandrel **2**, which extends into the finished tube **7** is of slightly conical form, while at least the region of the rear cylindrical part **9** to which the strip is fed is provided with grooves **10**, parallel to the axis of the mandrel, which grooves facilitate engagement with the tube which is being wound.

A pressure roller **11**, which is mounted to be freely rotatable with its axis parallel to the mandrel **2**, has a cylindrical face portion which defines with the mandrel face an axially elongated gap having parallel walls and receiving the flat central portion of the strip **1**. Another face portion **12** of the roller axially adjacent the cylindrical portion defines with the winding face of the mandrel a gap which flares toward the free end part **8**.

The pressure roller **11** serves to exert an axial thrust to the right (as shown by arrow **17** of FIGURE 4) on the wound tube and in order to correspond to the inclination of the fold seam **3**, **5**, **6** the face portion **12** is of conical construction with a cone angle of 120° on the side facing the finished tube **7** so as to exert a pressure to the right on the seam **3**, **5**, **6** and hence on the tube **7** without producing any deformation of the seam.

A cylindrical disc **13**, which is situated opposite the pressure roller **11** and which is also freely rotatable with its axis parallel to the mandrel **2**, serves for the bending of the seam **3**, **5**, **6** over against the outer surface of the finished tube **7**, and has a cylindrical surface **14** which touches the surface of the tube and a conical transition **15** to a continuous circumferential depression **16**, into which fits the seam bent-over by the pressure **18** (shown diagrammatically in FIGURE 4) exerted by the surface **16**.

The apparatus operates in the following manner. The strip **1** runs onto the winding mandrel **2** at an angle such that the U-shaped channel **5**, **6** automatically slips over the edge **3***a* of the strip of the preceding convolution. At the region where the edge **3***a* has already completely entered the channel, the roller **11** exerts an axial thrust, by its conical surface **12**, to the right, with the result that the finished tube **7** moves uniformly to the right during the winding process. No deformation of the inclined seam **5**, **6**, **3***a* results from the roller **11**. The grooves **10** on the cylindrical rear part of the mandrel ensure dependable engagement of the strip **1** by the mandrel **2** during the winding. Furthermore, the feed of the finished tube **7** by the conical front part **8** is facili-

tated by the considerably reduced friction resulting from the grooves **10**.

Since the edges have been pre-folded in the manner shown in FIGURE 2 during the pre-folding operation, that is to say before the strip **1** runs onto the winding mandrel **2**, only a little force must be applied by the bend-over roller **13** for bending the seam over against the outer surface of the tube **7**. During this bending over the cylindrical part **14** of the bend-over roller **13** bearing against the surface of the tube **7** forms a means preventing undesired opening of the tube **7** just after the bend-over station. The conical transition **15** also ensures that the bent-over seam will not deviate from the requisite helical line.

If it is required to produce a gas-tight or water-tight tube, an appropriate adhesive or sealing compound may be incorporated in the U-shaped channel just before the strip runs onto the winding mandrel, so that a sealed seam is obtained after setting of the adhesive or compound. Alternatively, as shown in FIGURE 5, welding or brazing **19** may be provided at the region where the U-shaped channel touches the surface of the tube.

The method described and the machine illustrated for performing the said method are also suitable for the production of tubes from relatively thick sheet metal strip. In this case, it is advantageous to heat the folds of the strip, and this may be carried out before pre-folding if required. The inclined upright fold can then be bent-over with less expenditure of force. One advantage of this process is that a very fluid-tight seam is obtained as a result of the shrinkage occurring during the cooling of the seam. In this way it is possible to make tubes or pipes which are adapted to withstand high pressures, for example a considerable crushing load when laid in the ground. In the case of galvanised, tinned and other pre-treated sheet metals, intimate fusion of the surface layers can be produced by the bend-over roller **13** during the winding process as a result of the heating of the coating layer.

A severing device (not shown) is used to cut off the tube. This may, for example, be in the form of a severing grindwheel which is mounted to be loosely slidable axially in parallel relationship to the mandrel. In such an arrangement, the severing device is driven automatically by the moving tube once the wheel has penetrated into the surface of the tube. This results in a cut perpendicular to the tube axis without it being necessary to provide special drives for the axial movement of the severing devices. To facilitate driving of the severing device, its guideway may be slightly inclined so that the coefficient of friction coincides with the inclination of the guideway.

By means of the method and apparatus of the invention tubes or pipes of different diameters may be made by changing the winding mandrel and adjusting the pressure roller **11** and bend-over roller **13**.

What I claim is:

1. A method of making a tube from an elongated, two-faced sheet having two longitudinal edge portions and a central portion intermediate said edge portions, comprising the steps of

(*a*) angularly folding one of said edge portions relative to said central portion until said one edge portion and one face of said central portion define an acute angle, and said one edge portion projects from said one face in an outward direction;

(*b*) folding one part of the other edge portion on the remaining part of said other edge portion in such a manner that the two parts jointly form an open longitudinal channel;

(*c*) angularly folding said other edge portion relative to said central portion until said other edge portion defines with said one face of said central portion an obtuse angle and projects from said one face in said outward direction;

(*d*) thereafter helically winding said strip having said folded edge portions about an axis into a plurality of successive turns so that the central portions of said turns jointly form a tube and said edge portions project radially outward from the central portion of said strip;

(*e*) engaging said one folded edge portion of one turn in the channel formed by the other folded edge portion of an adjacent turn to form a seam; and

(*f*) folding said seam on said tube.

2. A method as set forth in claim 1, wherein said acute angle and said obtuse angle are substantially supplementary.

3. A method as set forth in claim 1, wherein said longitudinal channel has two substantially parallel spaced longitudinal walls.

4. A method as set forth in claim 1, wherein said other edge portion has an unfolded transverse width about twice the width of said one edge portion.

5. A method as set forth in claim 1, wherein said longitudinal channel has two spaced longitudinal walls, each of said walls defining an obtuse angle with said one center portion face.

6. A method as set forth in claim 1, wherein said one folded edge portion of said one turn is engaged in said channel formed by the other folded edge portion of an adjacent turn while one of the two last-mentioned turns is being helically wound to form a portion of said tube.

7. A method as set forth in claim 1, wherein said one folded edge portion of said one turn is engaged in said channel formed by the other folded edge portion of an adjacent turn while said adjacent turn is being helically wound to form a portion of said tube.

8. A method of making a tube from an elongated, two faced sheet having two longitudinal edge portions and a central portion intermediate said edge portions, comprising the steps of

(*a*) folding one of said edge portions relative to said central portion so that said one edge portion and one face of said central portion define an acute angle and said one edge portion projects from said one face in an outward direction;

(*b*) folding one part of the other edge portion on the remaining part of the other edge portion and on said central portion in such a manner that the two parts jointly form an open longitudinal channel projecting from said one face in said outward direction, and each wall of said channel defines with said one face an obtuse angle substantially supplementary to said acute angle;

(*c*) helically winding said strip having folded edge portions into a plurality of turns, the central portions of said turns jointly forming a tube;

(*d*) engaging said one folded edge portion of one turn in the channel formed by the other folded edge portion of an adjacent turn to form a seam while said adjacent turn is being helically wound; and

(*e*) folding said seam on said tube.

9. Apparatus for making a helical tube comprising, in combination:

(*a*) an elongated mandrel having an axis of rotation, a winding face about said axis, and a free axial end portion;

(*b*) drive means for rotating said mandrel about said axis of rotation;

(*c*) means for feeding a strip to a predetermined axial portion of said winding face and for winding said strip on said face in a helix having a plurality of axially successive turns, said feeding and winding means including

(1) a roller member rotatable about an axis

spaced from said axis of rotation, said roller member having

(2) a first face portion about said axis thereof, said first face portion defining with said winding face a gap elongated in the direction of said axis of rotation and having substantially parallel axial walls, and

(3) a second face portion axially adjacent said first face portion, said second face portion defining with said winding face a gap flaring at an acute angle from said elongated gap toward said free end portion of said mandrel and said first and second face portions jointly defining an obtuse angle in said gaps,

(4) whereby a strip having an elongated central portion and two elongated edge portions respectively folded relative to said central portion at an acute angle and an obtuse angle, one of the edge portions being partially bent on itself to form a longitudinal channel, may be engaged in said gaps in such a manner that the channel of one turn axially abuts against said second face portion of said roller member while the other edge portion of an adjacent turn is received in said channel to form a seam therewith, and the central portion of one of said turns is received in said elongated gap; and

(*d*) folding means axially spaced from said roller member toward said free end portion for folding said seam toward said winding face until the folded seam lies against the outer surface of the tube formed.

10. An apparatus as set forth in claim 9, wherein a portion of said mandrel adjacent said free end is conical.

11. An apparatus as set forth in claim 10, wherein a portion of said winding face opposite said roller member is formed with recesses.

12. An apparatus as set forth in claim 11, wherein said recesses are axially elongated.

13. An apparatus as set forth in claim 9, wherein said folding means include a folding roller rotatable about an axis spaced from the axis of rotation of said mandrel and extending in the direction of elongation of said mandrel, said folding roller being formed with an annular groove about the axis thereof.

14. An apparatus as set forth in claim 13, wherein said folding roller has a conical wall axially bounding said groove.

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