F. H. SLEEPER.

TUBE COILING MACHINE.

APPLICATION FILED JUNE 12, 1919.

1,353,186.

Patented Sept. 21, 1920.

2 SHEETS—SHEET 1.

Fig. 1.

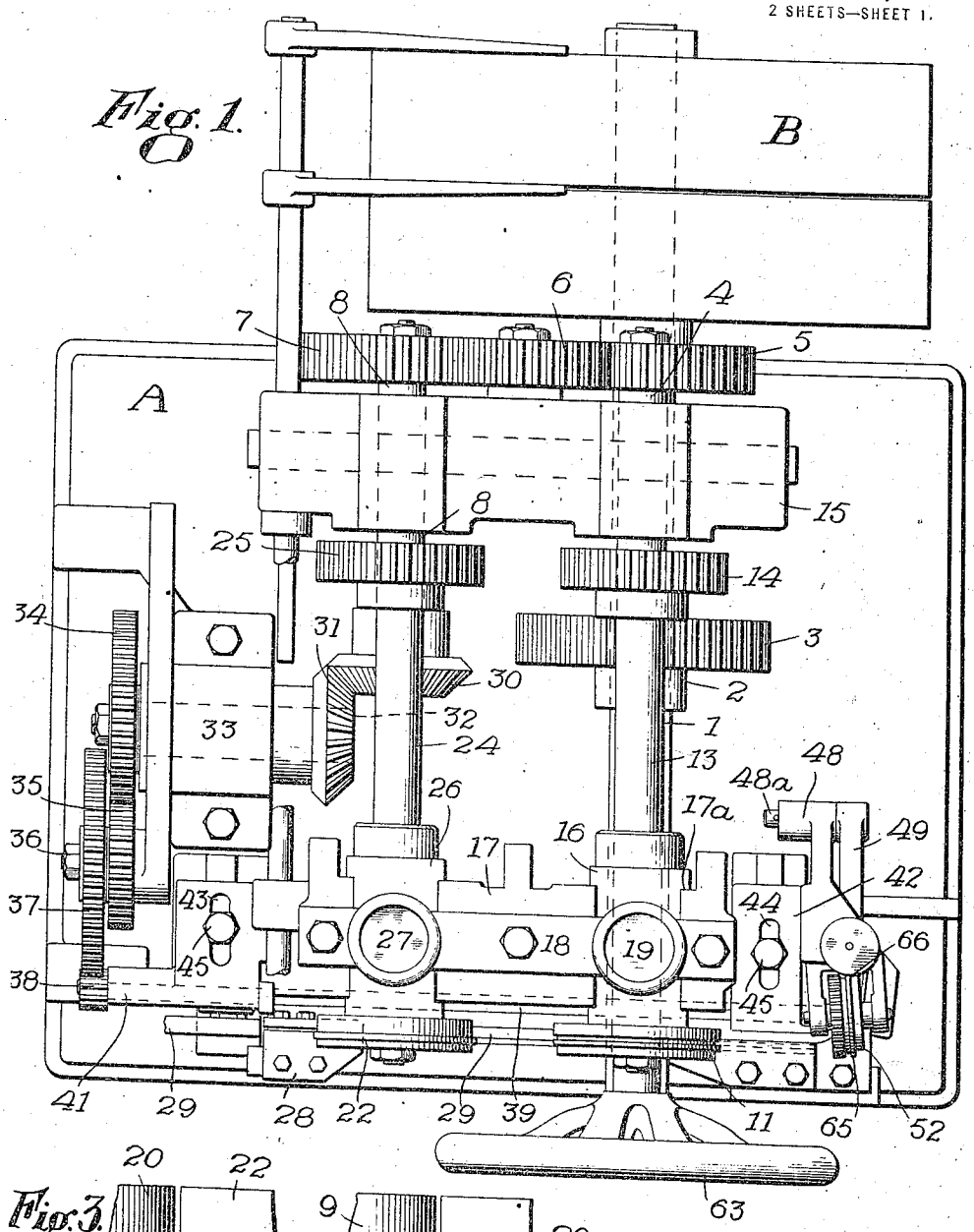


Fig. 3.

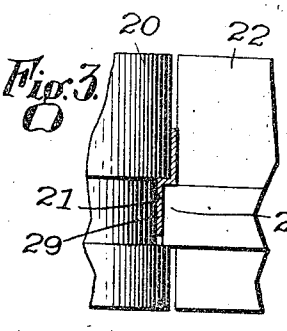
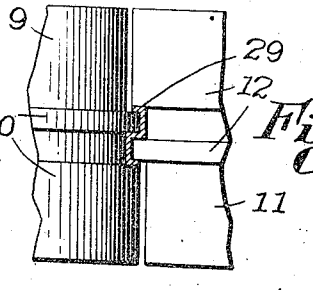


Fig. 4.



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2 SHEETS—SHEET 2.

Fig. 2.

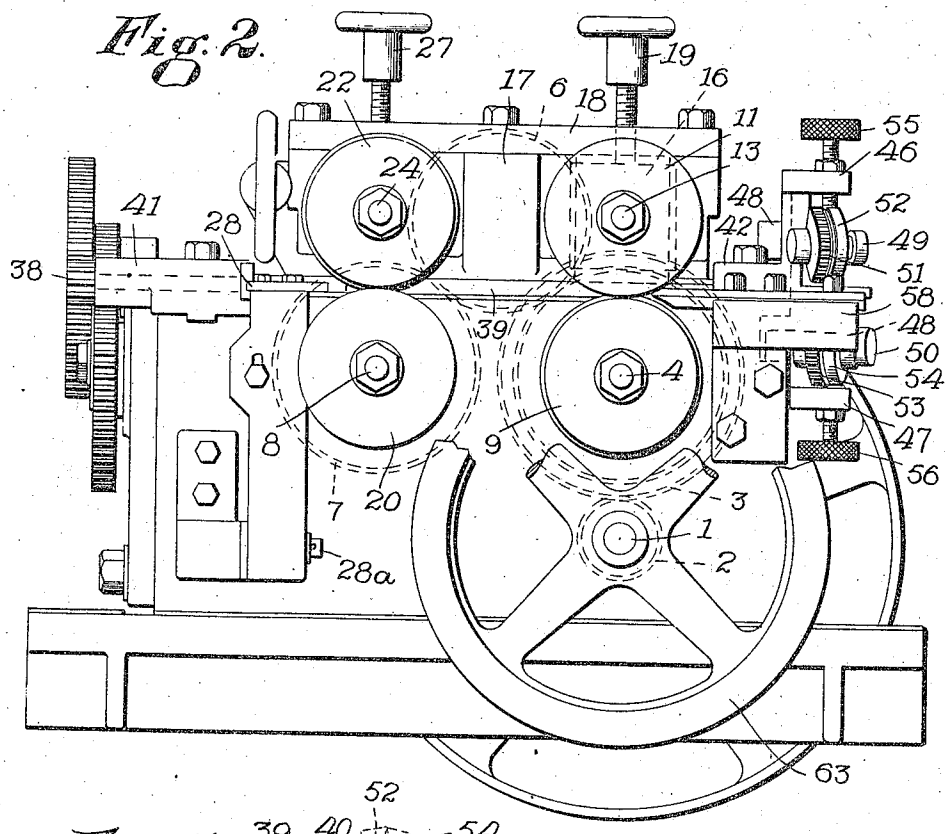
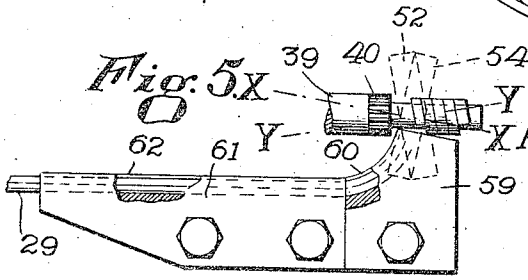


Fig. 5.



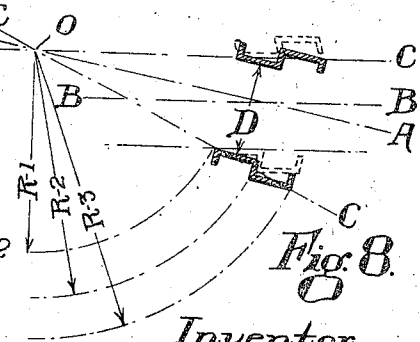


Fig. 8.

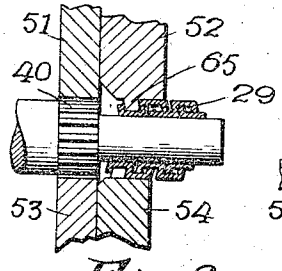


Fig. 6.

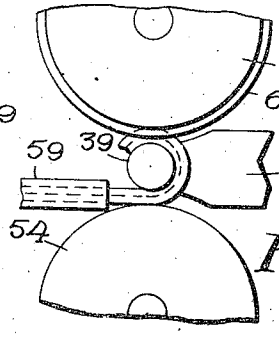


Fig. 7.

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TUBE-COILING MACHINE.

1,353,186. Specification of Letters Patent. Patented Sept. 21, 1920.

Application filed June 12, 1919. Serial No. 303,700.

To all whom it may concern:

Be it known that I, FRANK H. SLEEPER, a citizen of the Dominion of Canada, residing at Worcester, in the county of Worcester and Commonwealth of Massachusetts, United States of America, have invented a new and useful Improvement in Tube-Coiling Machines, of which the following, together with the accompanying drawings, is a specification.

My invention relates to tube coiling machines and the present application is a continuation, in part, of my copending application Serial No. 34,067, filed June 14, 1915.

The object of my invention is to provide a novel form of tube coiling machine for the production of flexible metallic tubing or casing from flat or rectangular stock.

In the production of flexible metallic tubing from flat or rectangular stock, it is necessary to give a certain amount of initial curvature to the stock before being coiled upon the mandrel so that it will wrap naturally and easily into a cylindrical spiral without exhibiting any tendency to buckle or to coil into a cone shape with resulting loss of flexibility. Tube coiling machines for producing this type of tubing, as heretofore constructed, have usually comprised several sets of rolls for forming and coiling the stock, the pivotal axes of the forming and coiling rolls being arranged at an angle to each other in order to produce lateral deflection of the stock as it is delivered to the coiling mandrel. With this arrangement, difficulties have been encountered in properly positioning and adjusting the rolls in order to produce the desired amount of lateral deflection in the stock without buckling or unduly distorting it.

By my invention I propose to eliminate the above described difficulties by running the strip straight through the forming and feeding rolls and providing a suitably curved guide adjacent to the coiling mandrel that will bend the strip edgewise into a curve approximating very closely to the pitch angle of the helix being coiled. A straight guide is further provided between the forming rolls and the curved guide in order to support the strip and to prevent its buckling. In addition, provision is made for readily changing the guides and the coiling mandrel in order to form tubes of different diameters.

In the accompanying drawings,

Figure 1 is a plan view of a tube coiling machine embodying my invention.

Fig. 2 is a view in side elevation of the parts shown in Fig. 1.

Figs. 3 and 4 are detail views of the forming rolls employed in the machine.

Fig. 5 is an enlarged plan view showing the arrangement of the guides with relation to the coiling mandrel.

Figs. 6 and 7 are enlarged fragmentary views showing the arrangement of the coiling rolls and coiling point.

Fig. 8 is a diagrammatic view showing the manner of determining the curvature of the guide.

Similar reference characters refer to similar parts in the different figures.

Referring to the drawings, the machine comprises a base or bed plate A, upon which is mounted a shaft 1 extending across the bed plate and provided at one end with a driving pulley B. A pinion 2 is carried on the shaft 1 and drives a gear 3 on a shaft 4 extending parallel to the shaft 1. The shaft 4 is provided at its end adjacent to the pulley B with a gear 5, and an intermediate gear 6 meshes with the gear 5 and a gear 7 mounted on a shaft 8 that extends parallel to the shaft 4. The shaft 8 is thus driven at substantially the same speed and in the same direction of rotation as the shaft 4. The shaft 4 is further provided at its end opposite from the pulley B with a forming roll 9 that is provided with peripheral projections 10, best shown in Fig. 4. A second forming roll 11 is similarly provided with peripheral projections 12 that are adapted to fit in between the projections 10 and is carried on a shaft 13 extending parallel to the shaft 4 and driven therefrom by means of a gear 14. The shaft 13 is rotatably supported at one end in a pivoted bearing 15 and at the other end in a journal box 16 that is slidably mounted in a support 17 carried by the bed plate A. The journal box 16 is held in its seat 17ª by

means of a top member 18, and a stud 19 in threaded engagement with the member 18 is provided to position the journal box 16 in the support 17, for a purpose to be hereinafter described.

The shaft 8 is provided at its end opposite from the gear 7 with a forming roll 20 that is provided with a peripheral groove 21. A second forming roll 22 is provided with a peripheral projection 23 that is adapted to be received in the groove 21 and is carried on a shaft 24 driven from the shaft 8 by the gear 25. The shaft 24 is rotatably mounted in the bearing 15 and in a slidable journal box 26 that is positioned in the support 17 by a set screw 27, in the same manner as the journal box 16. A guide member 28 is mounted on the bed plate B at a point adjacent to the forming rolls 20 and 22, and is provided with a slot for the passage of a strip 29 that is received between the forming rolls. The guide 28 is pivoted at 28^a, so that it may be laterally adjusted with respect to the forming rolls.

The shaft 8 is provided with a bevel gear 30 which is in mesh with a second bevel gear 31 carried on a shaft 32 extending at right angles to the shaft 8 and held in position by a bearing cap 33. A gear 34 is carried at the other end of the shaft 32 and meshes with a pinion 35 carried on an intermediate shaft 36. The shaft 36 is further provided with a gear 37 that meshes with a pinion 38 carried at one end of a coiling mandrel 39. The mandrel 39 extends along the front of the bed plate A substantially parallel to the crimping rolls and is provided at its other end with integrally cut teeth 40, as shown in Fig. 5. The mandrel 39 is rotatably mounted in bearing brackets 41 and 42 that are respectively provided with slots 43 and 44 and studs 45 coacting therewith, by means of which the brackets may be adjusted with respect to the bed plate A, for a purpose to be hereinafter described.

The bearing bracket 42 is provided with arms 46 and 47 extending above and below the coiling mandrel 39 that are respectively provided with a laterally extending projection 48, as shown in Fig. 1. Coiling roll brackets 49 and 50 are pivotally mounted on studs 48^a carried by the projections 48. A gear 51 and a coiling roll 52 are pivotally mounted between the arms of the upper bracket 49, and a gear 53 and coiling roll 54 are mounted between the arms of the lower bracket 50, the pivotal axis X—X of the gear 53 and roll 54 being inclined with respect to the pivotal axis Y—Y of the gear 51 and the roller 52, as shown in Fig. 5. The teeth of the gears 51 and 53 are respectively in mesh with the top and bottom portions of the teeth 40 on the mandrel 39. The brackets 49 and 50 are adapted to be positioned with respect to the mandrel 39 by means of set screws 55 and 56, respectively in threaded engagement with the arms 46 and 47 of the bracket 42.

As best shown in Figs. 1 and 5, a curved guide 59 is mounted on a table 58 at a point adjacent to the teeth 40 of the mandrel 39 and is provided with a groove 60 for the passage of the strip 29. It will be noted that a line tangent to the curve at the end of the groove 60 is substantially at right angles to the pivotal axis X—X of the guide roller 55, shown in dotted lines. The radius of the curved guide is substantially the same as the radius of curvature of the strip 29, if it were to be uncoiled from the mandrel 39 as will hereinafter appear. A straight guide 61 is mounted adjacent to the guide 59 and is provided with a groove 62 that conforms to the formed contour of the strip and is adapted to receive the strip 29 from the forming rolls 9 and 11.

Having described the various parts entering into my invention, the operation thereof is as follows:—The strip 29, which is, originally, substantially rectangular in cross section, is pushed through the slot in the guide 28 and is introduced between the forming rolls 20 and 22 by starting the machine in operation, or by turning a hand wheel 63 carried at the end of the shaft 1. As the strip 29 passes between the rolls 20 and 22, it is given the form shown in Fig. 3 by the co-acting projecting and recessed portions of the rolls. The strip 29 is then introduced between the rolls 9 and 11 where it is given the form shown in Fig. 4 by the coacting projecting portions of the rolls. The strip 29 then passes from the rolls 9 and 11 into the groove 62 of the straight guide 61 which delivers it to the curved groove 60 of the guide 59. The strip is bent laterally in passing through the groove 60 and is delivered between the mandrel 39 and the lower coiling roll 54 in a plane that is substantially tangential to the mandrel, as shown in Fig. 7. The strip 29 is then bent by hand around the curved end of a coiling point 64 and is directed between the mandrel and the upper coiling roll 52, a peripheral projection 65 being provided on the roll to engage the groove formed in the strip 29. The line of peripheral motion of the coiling roll 52 being at an angle to the line of peripheral motion of the coiling roll 54, the strip is naturally coiled into a helix, with the projecting edge of one coil located in the groove of the next adjacent coil, as shown clearly in Fig. 6. The strip coils readily owing to its lateral deflection which approximates very closely the pitch angle of the helix being coiled.

Adjustment of the forming rolls can be obtained by means of the set screws 19 and 27. Turning the screws down, prevents up-

ward movement of the journal boxes in their slides and causes the upper rolls 11 and 22 to engage the strip more closely. Adjustment of the studs 19 and 26 also permits the reception of strips of varying thickness between the forming rolls. Adjustment of the coiling rolls is obtained by the screws 55 and 56, by means of which the rolls 52 and 54 can be made to engage the strip with an equal pressure.

If it is desired to produce tubing of a different diameter but with the same formed section, it is only necessary to remove the mandrel 39, and the curved guide 59, and substitute therefor a mandrel of different diameter and a curved guide having a radius bearing a definite relation to the diameter of the tubing to be produced. The adjustment between the brackets 41 and 42 permits the use of different sizes of pinions 38 with the mandrels in order to vary the speed of the mandrel. The mounting of the brackets 49 and 50 on the bearing bracket 42 insures that the guide roll axes X—X and Y—Y will intersect on the axis of the mandrel 39 after the mandrel is changed.

The radius of curvature of the guide 59 is determined in the following manner. Referring to Fig. 8, it has been found that a straight formed strip 29, when coiled freely, without the use of coiling rolls, tends to assume the form shown in full lines, the axis of the coil being represented by the line A—A and its diameter by D. When, however, the straight strip is forced between the mandrel and the coiling rolls, it is bent or crushed into the form shown in dotted lines, the axis of the coil then being represented by the line B—B. In thus coiling the strip, it is obvious that one side thereof is distorted and I have found that the center about which the fibers of the strip move during this distortion is determined by the intersection of the geometrical axes C—C of a cross section of the strip with the axis A—A, as indicated at O. If then a guide is constructed having radii of curvature equal to R^1, R^2, R^3 for different sections of the strip, the guide will give to the strip the lateral deflection necessary to permit it to be coiled as shown in Fig. 6, without any further bending or distortion. In this way guides may be laid out for producing tubing of different diameters.

From the foregoing it is apparent that a tube coiling machine constructed in accordance with my invention is adapted to produce flexible tubing from flat or rectangular stock without any of the difficulties heretofore encountered, for it is obvious that my machine differs in important particulars from machines previously employed for coiling tubes. The forming rolls form the strip to be coiled and deliver it in a straight line to the straight guide. The strip is then laterally deflected to the desired curvature by the curved guide, the straight guide resisting any strains imposed upon the strip by the lateral bending. By bending the strip to approximate the pitch of the helix being coiled, the strip coils easily and compactly without losing any flexibility, a result extremely difficult, if not impossible, to obtain if only the angular relation between the forming and coiling rolls were depended upon to impart this lateral curvature to the strip.

While I have shown the invention in its simple and preferred form, it is not limited as it is susceptible of various modifications within the scope of the appended claims.

I claim,

1. In a tube coiling machine, the combination with means for forming and feeding a strip and means for coiling the strip in the form of a tube, the longitudinal axis of which is substantially parallel to the line of motion of the strip, of guiding means independent of said forming and coiling means for causing lateral deflection of the formed strip before being coiled.

2. In a tube coiling machine, the combination with means for forming and feeding a strip and means for coiling the strip in the form of a tube, the longitudinal axis of which is substantially parallel to the longitudinal axis of the strip being formed, of separate guiding means interposed between said forming and coiling means for imparting lateral deflection to the formed strip before being coiled.

3. In a tube coiling machine, the combination with means for forming and feeding a strip and means for coiling the strip in the form of a tube, the longitudinal axis of which is substantially parallel to the longitudinal axis of the strip being formed, of separate guiding means interposed between said forming and coiling means for imparting lateral deflection to the formed strip and delivering it to the coiling means in a line corresponding to the pitch line of the coiled tube.

4. In a tube coiling machine, the combination with means for forming and feeding a strip and means for coiling the strip in the form of a tube, the longitudinal axis of which is substantially parallel to the longitudinal axis of the strip being formed, of guiding means interposed between said forming and coiling means, the said guiding means comprising a curved portion for imparting lateral deflection to the formed strip.

5. In a machine of the class described, a coiling arbor, a pair of feed rolls for feeding a formed strip without lateral deflection of the strip from its line of feed, a straight guide having a groove fitting the formed contour of the strip, said guide being in

alinement with the feed rolls, and a second guide in alinement with said straight guide and curved in the arc of a circle to receive the strip from said straight guide and deliver it to the coiling arbor in a plane tangential to the periphery of the arbor.

6. In a machine of the class described, a coiling arbor, a pair of feed rolls for feeding the strip to be coiled, a straight guide in alinement with the feed rolls, and a second guide to receive the strip from said straight guide, said second guide being curved to impart an edgewise bend to the fed strip and deliver it in a line corresponding with the pitch line of the coiled tube on said arbor.

7. In a tube coiling machine, a plurality of rolls for feeding and forming a strip, a mandrel and rolls coöperating therewith for coiling the formed strip in the form of a tube, the longitudinal axis of which is parallel to the longitudinal axis of the strip being formed, and a guide interposed between said forming rolls and said mandrel for imparting lateral deflection to the formed strip.

8. In a tube coiling machine, a plurality of rolls for feeding and forming a strip, a mandrel and rolls coöperating therewith for coiling the formed strip in the form of a tube, and a curved guide interposed between said forming rolls and said mandrel for delivering the formed strip to the coiling rolls in a line corresponding to the pitch angle of the coiled tube.

9. In a tube coiling machine, a plurality of rolls for feeding and forming a strip, a mandrel and rolls coöperating therewith for coiling the formed strip in the form of a tube, and a curved guide interposed between said forming rolls and said mandrel for delivering the formed strip to the coiling rolls in a line corresponding to the pitch angle of the coiled tube, the said guide and the said mandrel being interchangeable with other guides and mandrels to produce tubes of different diameters in coöperation with said coiling rolls.

10. In a tube coiling machine, a plurality of rolls for feeding and forming a strip, a mandrel and rolls coöperating therewith for coiling the formed strip in the form of a tube, and a curved guide interposed between said forming rolls and said mandrel for delivering the formed strip to the coiling rolls in a line corresponding to the pitch angle of the coiled tube, the radius of curvature of said guide being determined by the diameter of the tube.

11. In a tube coiling machine, a curved guide for causing lateral deflection of a formed strip to be coiled, the center of curvature of the said guide being determined by the intersection of the geometrical axis of a cross section of the formed strip with the longitudinal axis of the tube to be coiled.

Dated this 29th day of May, 1919.

FRANK H. SLEEPER.

Witnesses:

NELLIE WHALEN,

PENELOPE COMBERBACH.