

Feb. 26, 1929.

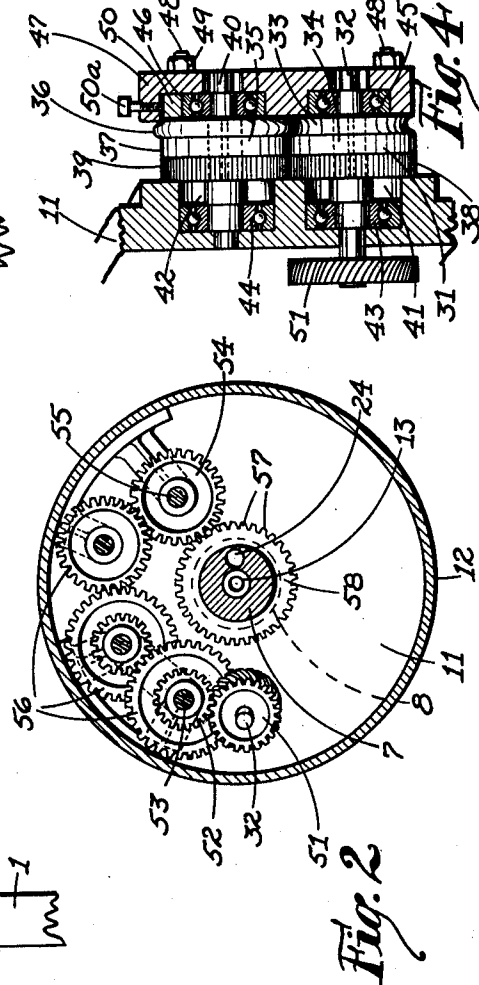
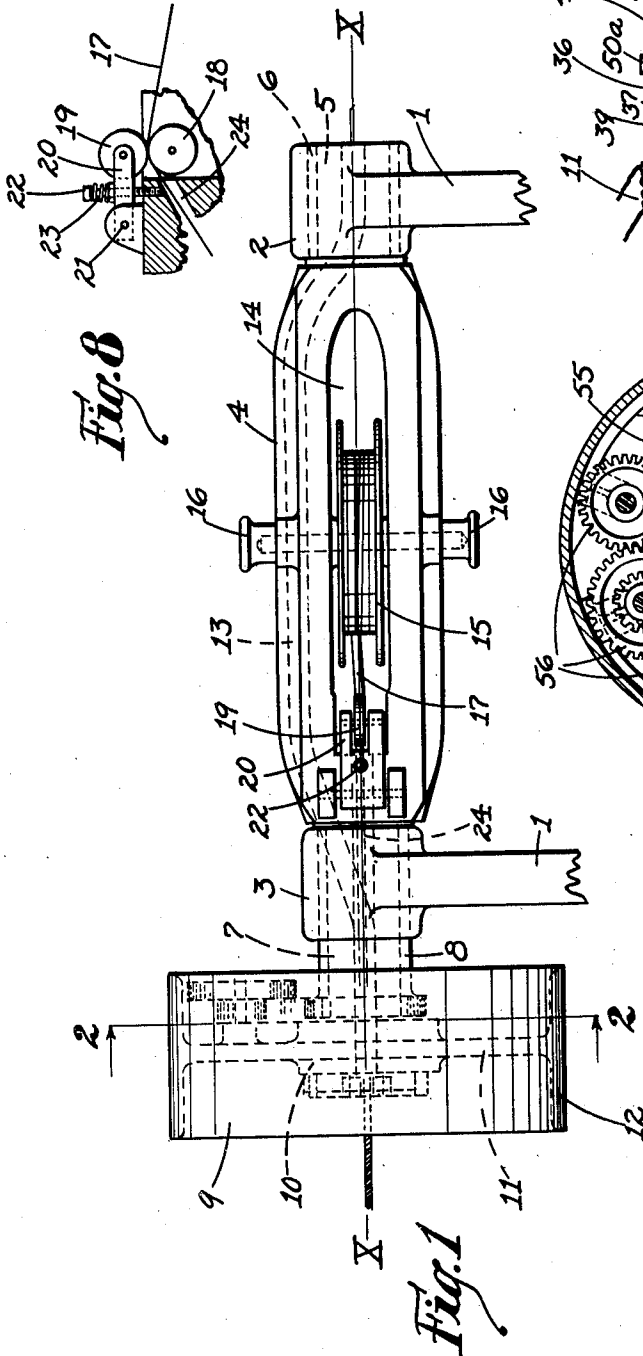
F. H. SLEEPER

1,703,250

ARMOR OR TUBE FORMING MACHINE

Filed Jan. 8, 1923

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

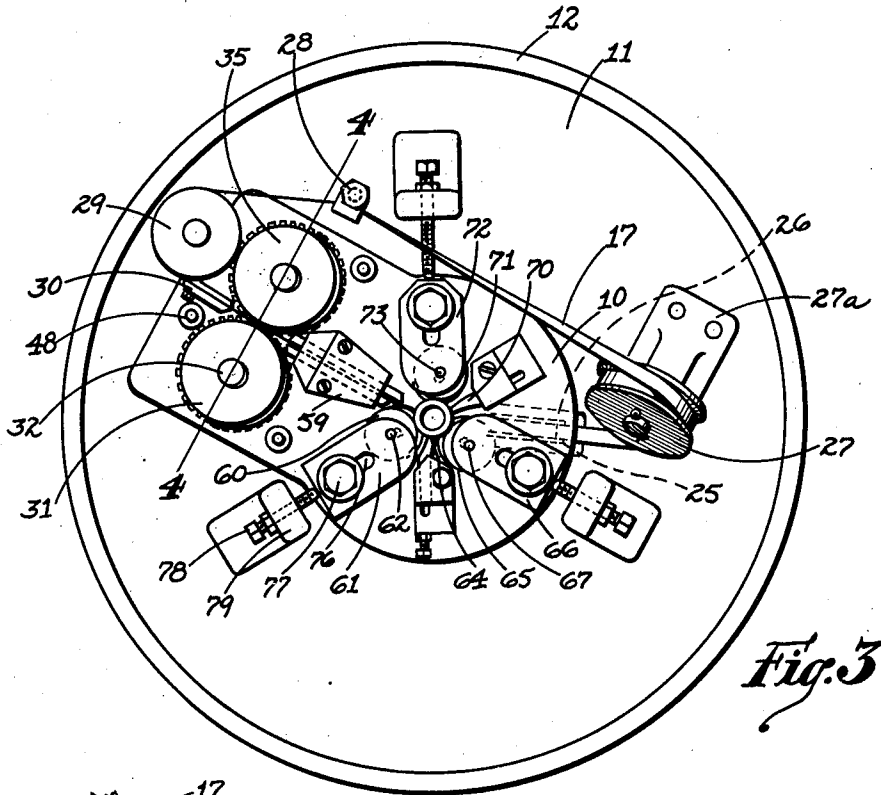


Fig. 3

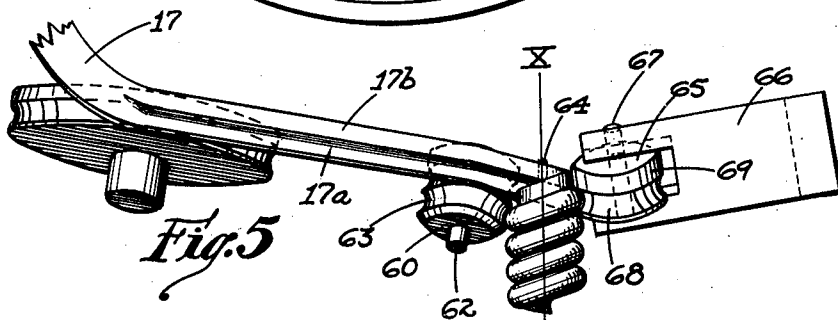


Fig. 5

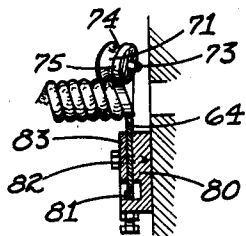


Fig. 6

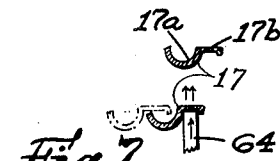


Fig. 7

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UNITED STATES PATENT OFFICE.

FRANK H. SLEEPER, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO SLEEPER & HARTLEY, INC., OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

ARMOR OR TUBE FORMING MACHINE.

Application filed January 8, 1923. Serial No. 611,331.

My invention relates to tube forming machines, and has for its object to provide an improved machine of the class described, which is particularly adapted for the production of flexible metallic armor or casing from flat or rectangular stock.

In Patent No. 1,458,997, issued to me on June 19, 1923, there is shown and described a winding and cabling machine characterized by a balanced rotatable flier having an elongated body portion carrying the supply of metal strip to be wound symmetrically disposed with respect to the axis of rotation of the flier. The machine of the present invention comprises a balanced flier embodying the same general principles of construction as the flier shown in my aforesaid patent, and in addition, the machine of the present invention is adapted to form tubing in a particularly simple and effective manner not heretofore contemplated in machines of this type.

In the improved machine contemplated by the present invention, the several strip feeding and forming devices, together with the tube forming devices, are carried by the head of the flier, and as the latter rotates, are adapted to form continuous, flexible tubing or casing about the axis of rotation of the flier. My improved machine is believed to differ fundamentally from the tube coiling machines heretofore constructed, by reason of the fact that the tubing is formed entirely by the rotation of the stock feeding forming and deflecting devices about the axis of the flier, without the use of a mandrel. My improved machine is adapted to form flexible armor tubing, either with or without a central core, as may be desired. The above and other advantageous features of my machine will hereinafter more fully appear, reference being had to the accompanying drawings, in which

Fig. 1 is a view in side elevation of a machine embodying my invention.

Fig. 2 is a transverse sectional view along the line 2—2 of Fig. 1, looking in the direction of the arrows.

Fig. 3 is an enlarged end view of the flier head of the machine shown in Fig. 1.

Fig. 4 is a detailed sectional view along the line 4—4, Fig. 3.

Figs. 5, 6 and 7 are fragmentary views illustrating the operation of the strip deflecting devices shown in Fig. 3.

Fig. 8 is a fragmentary view of the strip guiding device shown in Fig. 1.

Like reference characters refer to like parts in the different figures.

Referring first to Fig. 1, the machine generally comprises a frame 1 providing upwardly extending bearing pedestals 2 and 3, between which is rotatably supported a flier body 4. The flier body 4 is provided at one end with a reduced journal portion 5 received in a sleeve bearing 6, carried by the pedestal 2. The other end of the flier body 4 is provided with a reduced shaft portion 7 which extends through and beyond a sleeve bearing 8, carried by the pedestal 3. A flier head 9 is provided with a central hub 10 keyed to the end of the shaft portion 7, and further comprises a radial web 11 surrounded by a cylindrical flange 12, the flange 12 being adapted to receive a belt, not shown, whereby the flier may be driven from any suitable source of power.

The flier body 4 is provided with a passage 13 extending longitudinally therethrough, the passage 13 beginning at the center of the journal portion 5, and terminating at the center of the shaft portion 7. The flier body 4 is further provided with an opening 14 extending diametrically therethrough, within which is rotatably mounted a reel 15 on suitable trunnions 16 extending substantially at right angles to the axis X—X of the flier 4. The reel 15 carries a quantity of strip 17 rectangular in cross section, the strip 17 passing from the reel 15 between a pair of rolls 18 and 19. As best shown in Fig. 8, the roll 18 is rotatably supported within the opening 14 on a fixed axis, while the roll 19 is rotatably supported at the end of an arm 20, pivotally supported at its other end on a pin 21. A stud 22 extends upwardly from the flier body through the arm 20 and is surrounded by a spring 23 which presses on the arm 20, thereby causing the roller 19 to press the strip 17 into engagement with the roller 18.

The strip 17 passes from between the rolls 18 and 19 into a passage 24 extending through the shaft portion 7 parallel to the passage 13 to a point within the head 9, from whence it bends outwardly to the hub 10. As best shown in Fig. 3, a pulley 25 is rotatably mounted in an opening 26 extending through the hub 10 from one side of the web 11 to the other, the pulley 25 serving to lead the strip 17 to a second pulley 27 rotatably mounted on a bracket 27^a carried by the web 11, with its axis of rotation inclined with respect to the axis of rotation of the pulley 25. From the pulley 27 the strip 17 is adapted to pass through a twist guide 28 to a third pulley 29 rotatably mounted on the web 11, with its axis of rotation substantially parallel to the axis of rotation X—X of the flier head 9. In passing from the pulley 25 to the pulley 29, the strip 17 is twisted from a plane substantially parallel to the web 11 into a plane substantially at right angles thereto, as will be apparent from an inspection of Fig. 3. From the pulley 29, the strip 17 passes through a guide 30 to the strip forming and winding devices, which will now be described.

A forming roll 31 is mounted on a shaft 32 which is rotatably supported by the web 11 at an angle with respect to the axis of rotation X—X of the flier, the inclination of the shaft 32 being determined by the angular pitch desired for the tube to be coiled. The guide 30 is adapted to deliver the strip 17 to the roll 31 in a plane substantially tangential thereto. As best shown in Fig. 4, the roll 31 is provided on its periphery with a concave groove 33 and a cylindrical portion 34 adjacent thereto, while a second forming roll 35 is provided with a convex bead 36 and a cylindrical portion 37, corresponding portions of the rolls 31 and 35 being spaced apart to receive the strip. The shaft 32 of roll 31 is provided with a spur gear 38 in mesh with a spur gear 39 mounted on the shaft 40 of the roll 35, whereby the rolls 31 and 35 are adapted to be driven in unison.

The shafts 32 and 40 are received in recesses 41 and 42 provided in the web 11, and are rotatably supported therein by ball bearings 43 and 44. The opposite ends of the shafts 32 and 40 are rotatably supported in ball bearings 45 and 46 carried by a housing 47 which is supported on studs 48 projecting from the web 11, and having nuts 49 coacting therewith to hold the housing 47 and its bearings in position. The studs 48 are shown clearly in Fig. 3, the housing 47 having been removed therefrom in order to illustrate the arrangement of the rolls 31 and 35. The housing 47 is provided with a block 50 having a stud 50^a cooperating therewith, whereby the bearing 46 and the shaft 40 may be adjusted with respect to the shaft 32.

The shaft 32 of the roll 31 projects through the web 11 and has mounted thereon a helical

gear 51, which, as best shown in Fig. 2, is in mesh with a gear 52 mounted on a shaft 53 extending parallel to the axis of rotation of the flier. The shaft 53 is adapted to be driven from a gear 54 on a shaft 55 through intermediate gearing 56, and the gear 54 is in mesh with a plurality of gear teeth 57 provided on the periphery of a flange 58 formed on the sleeve bearing 8. Consequently, when the head 9 is rotated, the gear 54 will be driven as it revolves about the sleeve bearing 8, with its teeth in mesh with the fixed teeth 57. Obviously, the speed of the forming roll shaft 32 will be considerably less than the speed of the shaft 55, by reason of the interposition of the reduction gearing 56, and my invention contemplates the driving of the forming rolls at any desired speed which may be obtained by properly proportioning the gearing 56. In this way the speed of the feeding and forming rolls 31 and 35 can be so adjusted as to positively feed just enough stock for each revolution of the flier to form one finished convolution of the tubing.

As the strip 17 passes from the guide 30 between the forming rolls 31 and 35, the form of its cross section is changed from that of a rectangle into a form closely approximating that of the space between the corresponding projecting recessed portions of the rolls 31 and 35, as clearly indicated in Fig. 4. The formed strip 17 passes from the rolls 31 and 35 into a delivery guide 59, from which the strip emerges to be acted upon by the winding devices, which will now be described.

After passing through the delivery guide 59, the strip 17 passes over a roll 60, the axis of rotation of which is parallel to the axis of the forming roll 31, as best shown in Fig. 5. The roll 60 is journaled in the slotted end of a bar 61 on a stud 62, and the periphery of the roll 60 is provided with grooves 63 of substantially the same curvature as the concave portion 17^a of the formed strip 17. The straight portion 17^b of the strip 17 is not engaged by the roll 60, but this portion is engaged by a tool 64, located adjacent to the roll 60 and projecting radially inwardly toward the axis of the tube, as best shown in Fig. 6. As the straight portion 17^b of the strip 17 passes over the tool 64, it is crowded toward the axis of the tube being coiled.

The crowding action of the tool 64 is illustrated diagrammatically in Fig. 7, in which a cross section of the formed strip 17 as it comes from the rolls 31 and 35, is illustrated above the tube axis X—X, from which it is apparent that the edge of the concave portion 17^a of the strip 17 is flush with the top surface of the straight portion 17^b, and that the strip passes over the first coiling roll 60 in this form. As the straight portion 17^b passes over the tool 64 however, it is crowded toward the axis of the tube, as indicated by the small arrows, so that the cross section of the

strip 17 then appears as shown below the axis of the tube, in which case the edge of the concave portion 17^a is at a greater distance from the axis X—X than the nearest surface of the straight portion 17^b. The advantage of thus compressing the straight portion 17^b will hereinafter more fully appear.

After passing over the tool 64, the strip 17 is deflected upwardly to the next roll 65, which, as best shown in Fig. 5, is rotatably mounted with its axis of rotation oppositely inclined with respect to the axis of the roll 60. The roll 65 is journaled in the slotted end of a bar 66 on a stud 67, and is provided with a concave peripheral groove 68 and a cylindrical portion 69 of substantially the same width as the straight portion 17^b of the strip 17. The roll 65 serves to deflect the strip to a second tool 70 which further crowds the portion 17^b, and from which the strip passes to a third coiling roll 71, which, as best shown in Fig. 6, is mounted with its axis of rotation inclined with respect to the axis of the tube. The roll 71 is journaled at the end of a slotted bar 72 on a stud 73, and is provided with a peripheral groove 74 and a cylindrical portion 75 of substantially the same proportions as the groove 68 and portion 69 of the roll 65.

From the foregoing, it is believed to be apparent that as the formed strip 17 is successively engaged by the roll 60, the tool 64, the roll 65, the tool 70 and the roll 71, it will be formed into a tube in which the convolutions will have a pitch determined by the angle which the axis of rotation of the roll 60 makes with the axis X—X of the tube. The formation of the tube will be carried on rapidly and easily without any crushing effect between adjacent convolutions of the tube. This latter effect is due to the fact that the edge of the concave portion 17^a of the strip is adapted to be laid evenly on the straight portion 17^b, by reason of the fact that the straight portion 17^b has been previously crowded or compressed by the tools 64 and 70 to such an extent that the outer diameter of the straight portion 17^b, after it has been wound into cylindrical form, is a trifle less than the diameter at the edge of the portion 17^a, as clearly illustrated in Fig. 7. Consequently, the completed tube is extremely flexible, owing to the fact that the curved portion 17^a of the strip has been wound upon the straight portion 17^b thereof without crushing the fibres of the curved portion.

In order to provide for adjusting the strip deflecting devices to produce tubing of the desired diameter, I have provided means whereby each roll and tool may be adjusted radially with respect to the axis of winding. Each of the bars 61, 66 and 72 is provided with a slot 76 for receiving a bolt 77, whereby the bar may be adjusted on the hub 10. In order to more accurately adjust the position of

each bar 61, 66 and 72, there is provided an adjusting stud 78 in threaded engagement with a lug 79 projecting from the web 11 of the head and bearing against the end of the corresponding bar. When adjusting one of the rolls, the bolt 77 is loosened slightly to permit movement of the bar by the stud 78, after which the bar may be clamped in position by tightening the bolt 77. As best shown in Fig. 6, the tool 64 is mounted in a block 80 and is adapted to be moved with respect to the axis of the tube by means of an adjusting screw 81. A bolt 82, coacting with a plate 83, is provided for clamping the tool 64 in position after it has been adjusted by means of the screw 81. The tool 70 is similarly provided with adjusting means.

From the foregoing it is apparent that by my invention I have provided an improved tube forming machine which is adapted to produce tubing or casing from flat or rectangular stock. My improved machine is characterized by the fact that the formation of the tube is accomplished entirely by the revolution of the flier about the axis of the tube being formed, so that the production of tubing can be carried out without the use of a central mandrel or core, it being understood of course, that the tube can be formed on a core if desired, as when producing armored electric cable. When the machine is operating, the power for driving the feeding and forming rolls is derived entirely from the rotation of the flier carrying the strip deflecting devices, by an extremely simple mechanism, the speed of the rolls being readily adjustable so as to feed the stock at the proper rate, as hereinafter pointed out. My machine is further characterized by the fact that during the formation of the tubing, a portion of the formed strip is crowded or compressed to such an extent that the curved portion of the strip may be readily deflected thereon with an entire absence of crushing or jamming of the fibres of adjacent convolutions, which would tend to reduce the flexibility of the tubing.

From a consideration of the general structure of my improved machine, it is obvious that the flier may be operated at high speeds without being subject to injurious vibrations set up by a centrifugal force, for the reason that the flier is always completely in balance. The fact that the axis of rotation of the reel 15 passes through the axis X—X of the flier substantially at right angles, insures that the material on the reel is symmetrical about the axis X—X, so that the weight of the material will not result in upsetting the balance of the flier as it rotates between the bearings 2 and 3. This construction also allows the strip to be conducted to the flier head carrying the strip forming and deflecting devices in a line substantially parallel to the axis of the flier, so that there are no forces acting

on the strip tending to displace it. The use of a balanced flier carrying the strip material symmetrical about the axis of rotation of the flier, and in addition, a number of forming feeding and deflecting rolls, is believed to be both novel and of considerable advantage in armor or tube forming machines.

While I have shown my invention as being embodied in a machine of a preferred form, it is not so limited, but is susceptible of various modifications without departing from the spirit and scope of my invention. I desire therefore, that only such limitations be imposed thereon as may come within the scope of the appended claims.

I claim:

1. In a machine for the continuous production of flexible tubing from metal strip, a rotatably driven flier carrying a supply of strip, a group of freely rotatable deflecting rolls on said flier arranged about the axis of rotation of said flier, with the axes of the said rolls inclined with respect to each other, and means carried by the flier for positively feeding said strip to said rolls simultaneously with the rotation of said flier to cause the strip to coil itself into a self-supporting flexible tubing.

2. In a machine for the continuous production of flexible tubing from metal strip, a rotatably driven flier, strip feeding rolls carried by the flier, a group of freely rotatable deflecting rolls carried by the flier and arranged about its axis of rotation, and means for driving said feeding rolls simultaneously with the rotation of said flier, whereby said rolls are adapted to feed said strip to said deflecting rolls which form it into self-supporting tubing without the use of a mandrel.

3. In a machine of the class described, a rotatable member, positively driven rolls carried by said member for forming and feeding flat strip, freely rotatable deflecting rolls arranged about the axis of said member, one revolution of said member being adapted to cause said feeding rolls to deliver enough strip to said deflecting rolls to make one complete convolution of tubing.

4. In a machine of the class described, a rotatable member, positively driven forming and feeding rolls carried by said member, a group of deflecting rolls arranged about the axis of said member for free rotation on divergent axes, said forming and feeding rolls being adapted to form and feed flat strip at a predetermined rate to said deflecting rolls, whereby revolution of said member results in the continuous production of flexible tubing which moves away from said deflecting rolls as it is formed.

5. A machine of the class described, comprising a rotatable flier carrying a reel of strip material symmetrical about the axis of

said flier, a strip forming and feeding device, means for conducting said material from said supply in a direction substantially parallel to the axis of rotation of said flier, and further means for conducting said strip to the forming and feeding device in a line of movement substantially at right angles to the axis of rotation.

6. A machine of the class described, comprising a rotatable flier carrying the strip to be wound, a plurality of freely rotatable deflecting rolls arranged about the axis of rotation of the flier, and a non-rotatable forming tool carried by the flier for engaging a portion of the strip and compressing it toward the axis of rotation of the flier.

7. A machine of the class described, comprising a rotatable flier carrying the strip to be wound, a strip forming and feeding device for delivering the formed strip to a plurality of freely rotatable deflecting rolls arranged about the axis of rotation of the flier, and a non-rotatable forming tool carried by the flier for engaging a portion of the formed strip and compressing it toward the said axis of rotation as the strip is wound.

8. A winding machine of the character described comprising a frame, a tubular shaft rotatably mounted in said frame, a winding head secured on one end of said shaft and rotatable therewith, a strip-holding spool mounted rotatably on the frame adjacent to the opposite end of said shaft, and guiding means arranged to conduct the stock carried by said spool in a path leading into the interior of said shaft.

9. In a machine for the continuous production of flexible tubing from metal strip, a rotatably driven flier, strip feeding rolls carried by the flier, a group of freely rotatable deflecting rolls carried by the flier and arranged about its axis of rotation, and means for driving said feeding rolls simultaneously with the rotation of said flier, whereby said rolls are adapted to feed said strip to said deflecting rolls which form it into self-supporting tubing without the use of a mandrel.

10. In a machine of the class described, a rotatable member, positively driven rolls carried by said member for forming and feeding flat strip, freely rotatable deflecting rolls arranged about the axis of said member, one revolution of said member being adapted to cause said feeding rolls to deliver enough strip to said deflecting rolls to make one complete convolution of tubing.

11. In a machine of the class described, a rotatable member, positively driven forming and feeding rolls carried by said member, a group of deflecting rolls arranged about the axis of said member for free rotation on divergent axes, said forming and feeding rolls being adapted to form and feed flat strip at a predetermined rate to said deflecting rolls, whereby revolution of said member

results in the continuous production of flexible tubing which moves away from said deflecting rolls as it is formed.

5 12. A machine of the class described, comprising a rotatable flier carrying a reel of strip material symmetrical about the axis of said flier, a strip forming and feeding device, means for conducting said material from said

supply in a direction substantially parallel to the axis of rotation of said flier, and further means for conducting said strip to the forming and feeding device in a line of movement substantially at right angles to the axis of rotation. 10

Dated this 29th day of December, 1922.

FRANK H. SLEEPER.

CERTIFICATE OF CORRECTION.

Patent No. 1,703,250.

Granted February 26, 1929, to

FRANK H. SLEEPER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Pages 4 and 5, strike out lines 102 to 130, and 1 to 14, respectively, comprising claims 9, 10, 11 and 12; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of April, A. D. 1929.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.

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