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A. E. CHERNACK

2,366,087

MACHINE FOR MAKING TUBULAR STRUCTURES

Filed June 3, 1942

4 Sheets-Sheet 1

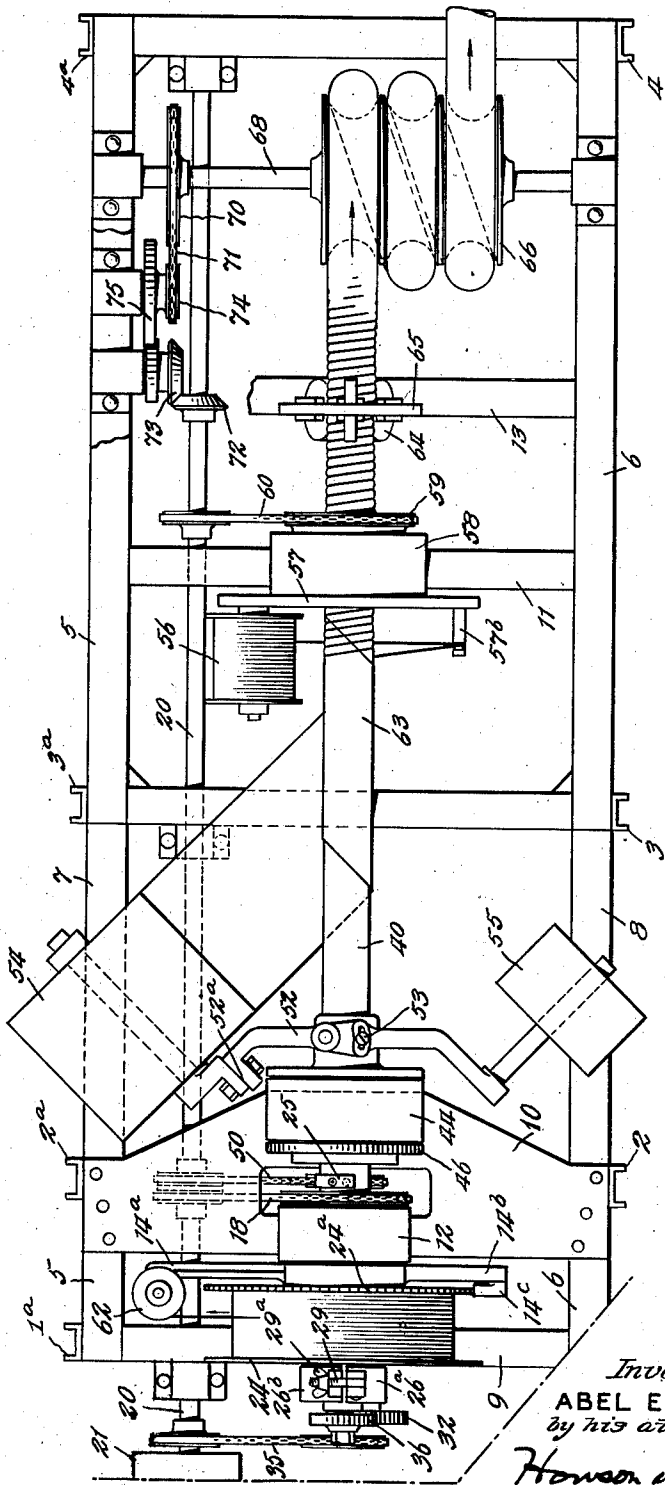


Fig. 1.

Inventor
ABEL E. CHERNACK
by his attorneys
Hanson and Hanson

Dec. 26, 1944.

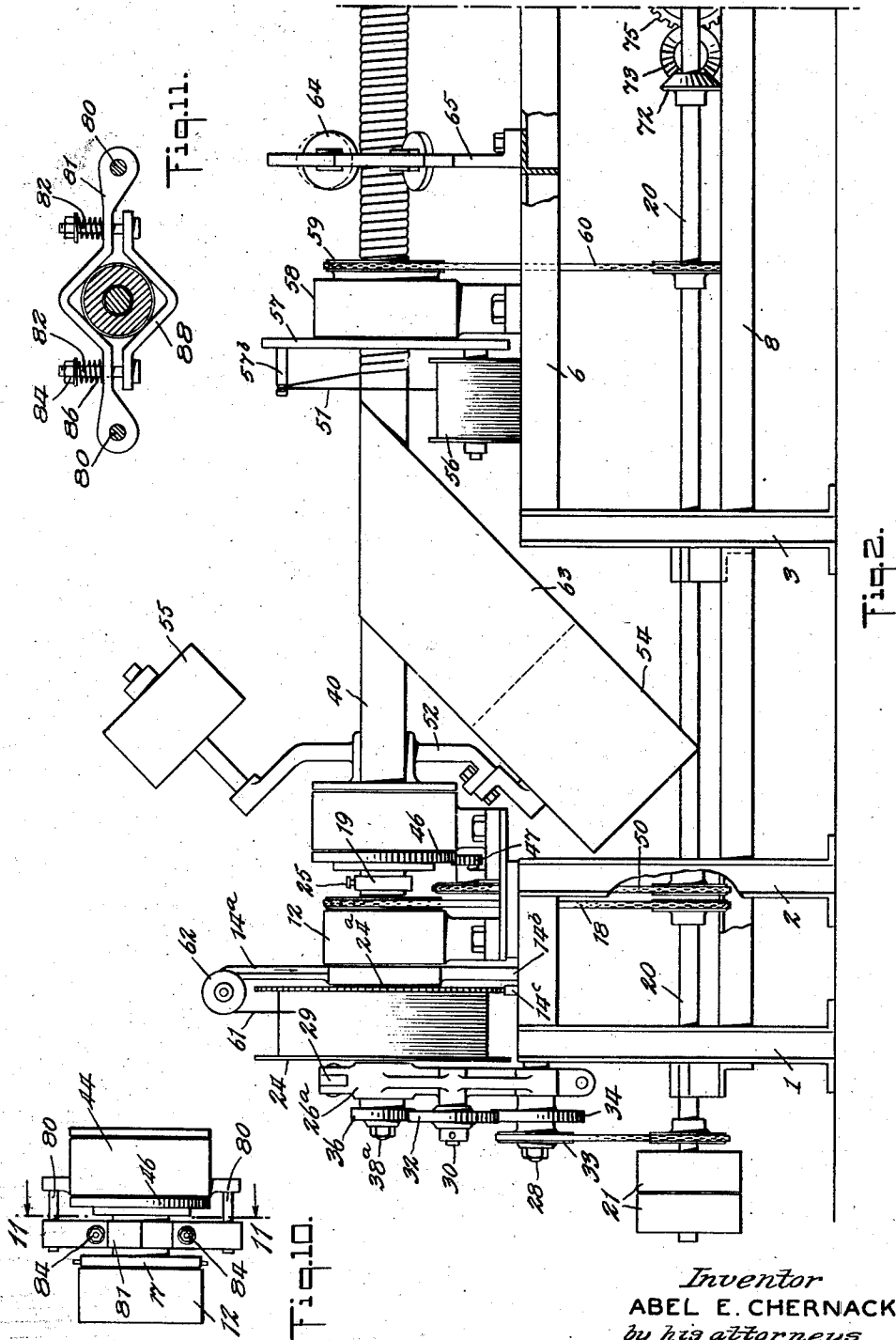
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Inventor
ABEL E. CHERNACK
by his attorneys
Howson and Howson

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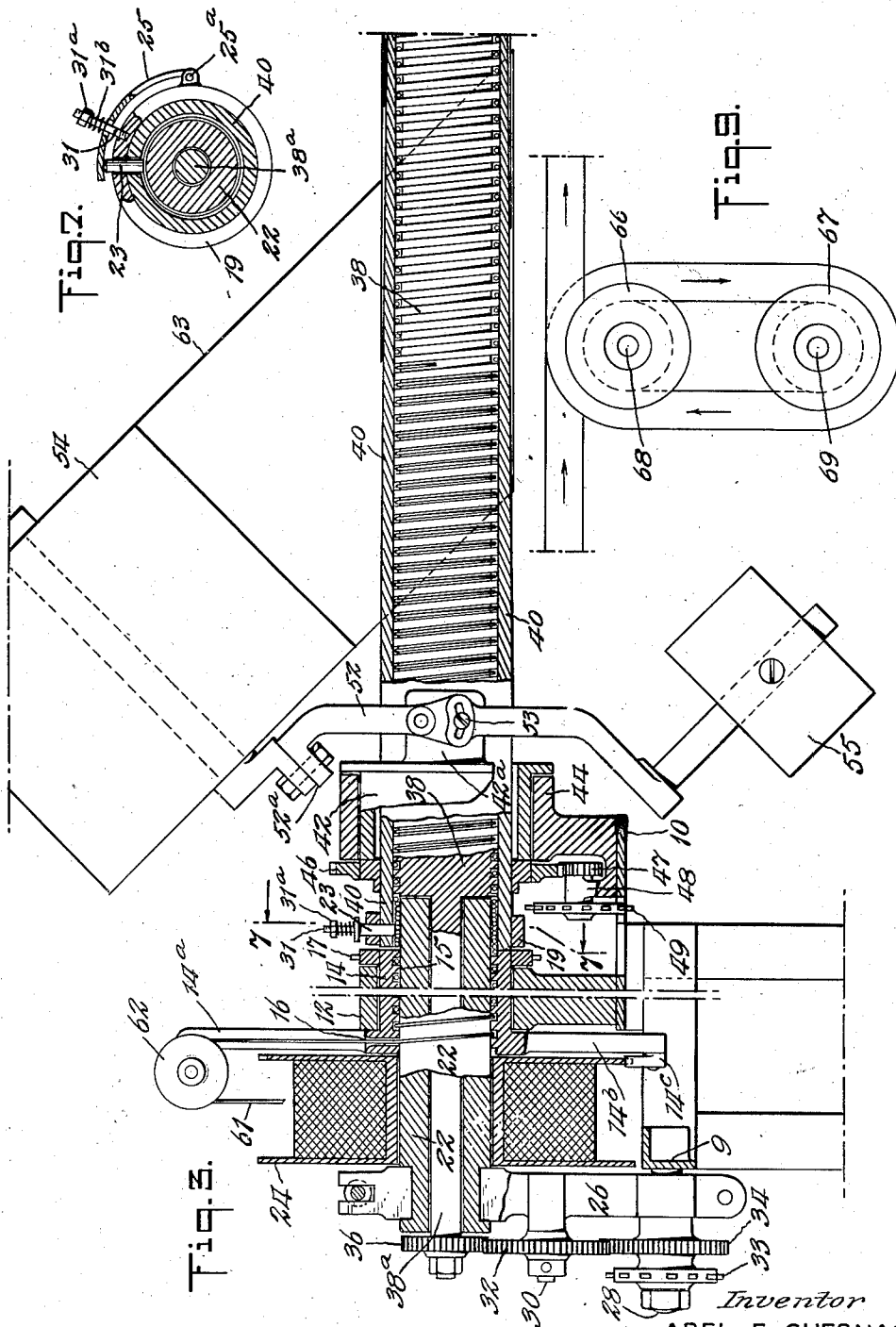
A. E. CHERNACK

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Inventor
ABEL E. CHERNACK
by his attorneys
Howson and Howson

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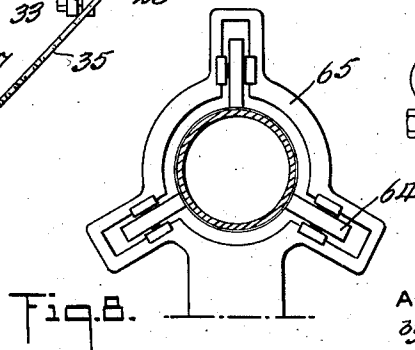
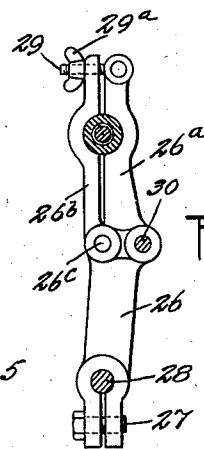
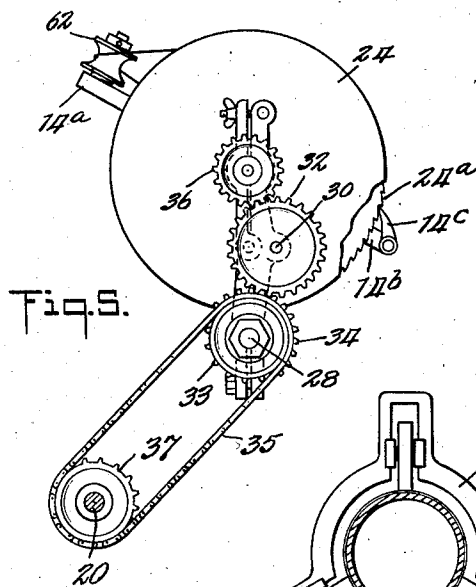
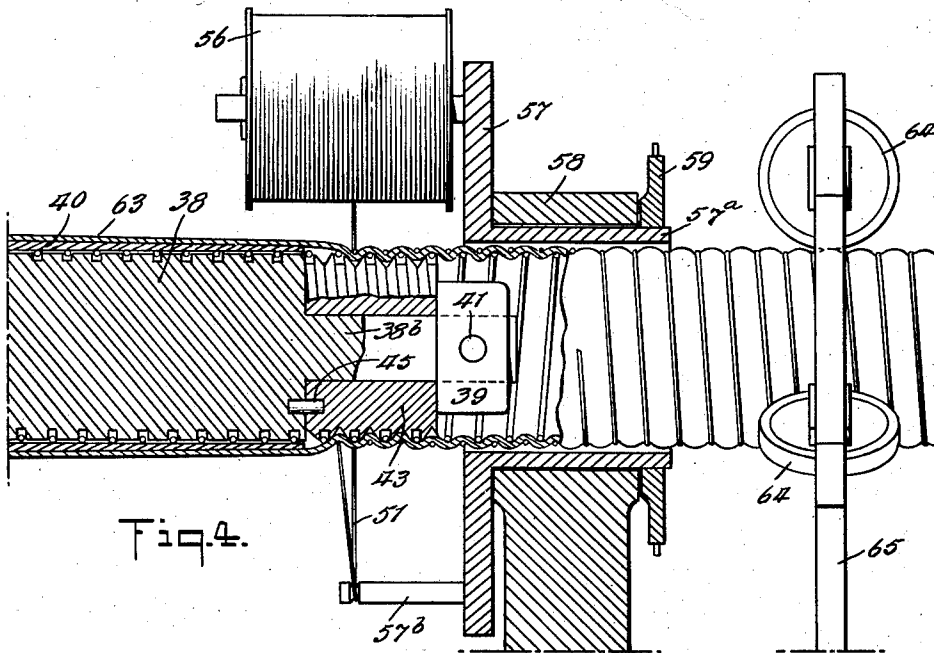
A. E. CHERNACK

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Inventor
ABEL E. CHERNACK
by his attorneys

Hawson and Hawson

UNITED STATES PATENT OFFICE

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MACHINE FOR MAKING TUBULAR STRUCTURES

Abel E. Chernack, Elmwood, Conn.

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17 Claims. (Cl. 154-6)

This invention relates to machines for making tubular structures and more particularly to a machine for forming tubing comprising an inner spiral supporting member and a covering member preferably wrapped about the supporting member and it is an object of this invention to provide a machine of the class described of improved construction and by which all steps of making such a tubular structure may be performed so as to produce a continuous tubular structure. It is also an object of this invention to provide a machine of the class described of simple and efficient construction and which may be easily operated and maintained.

In the drawings in which a machine of a preferred construction is shown for the purpose of illustration,

Figure 1 is a top plan view of a tube forming machine constructed in accordance with this invention;

Figure 2 is a partial view in side elevation of the machine shown in Figure 1, some parts being broken away to show other parts more clearly;

Figure 3 is a partial view, partly in vertical section of a machine such as is shown in Figures 1 and 2, the view being taken on the longitudinal axis of the machine and showing a section of a machine for making a tube of relatively larger diameter than the machines of Figures 1 and 2;

Figure 4 is a partial vertical sectional view drawn to a larger scale showing parts of the machine adjacent to the parts shown in Figure 3 and forming a continuation of the showing of Figure 3;

Figure 5 is a fragmentary view in elevation showing the driving mechanism at the left end of the machine as shown in Figures 1 and 2;

Figure 6 is a view in elevation of the means supporting the gearing shown in Figure 5, shown detached from the machine and stripped of the gearing;

Figure 7 is a fragmentary vertical sectional view taken as on line 7-7 of Figure 3 and showing, in side elevation the means for applying an adjustable frictional resistance to the movement of the coils longitudinally of the mandrel;

Figure 8 is an end view showing the arrangement of the tube supporting and guiding rolls shown in Figures 1, 2 and 4;

Figure 9 is a substantially diagrammatic view in side elevation of the take-up rolls for drawing the finished tubing from the machine;

Figure 10 is a fragmentary plan view showing the application to the machine of Figs. 1 and 2

of means of modified construction for applying pressure to the coils of the spiral; and

Figure 11 is a sectional view taken as on line 11-11 of Fig. 10 and showing on elevation the means for applying pressure to the coils of the spiral.

In the drawings a machine in accordance with this invention is shown as comprising a suitable frame having spaced vertical supporting members 1, 1a, 2, 2a, 3, 3a, 4 and 4a joined by upper longitudinal members 5, 6, lower longitudinal members 7, 8 and upper and lower transverse members. The upper longitudinal members 5, 6 are cut away between the vertical supporting members 2a, 3a, and 2, 3, respectively. The upper longitudinal members 5, 6 are joined at the vertical supporting members 2, 2a, by an irregularly shaped plate 10 which serves to support a journal box or bearing 12. Rotatably mounted in the bearing 12 is a tubular nut or box 14 having an internal spiral groove 15 extending from a tangentially arranged leading-in passage 16 at one end of the nut 14 to the opposite end of the nut. A sprocket 17 fixed on an end of the nut 14 and connected by a chain 18 to a corresponding sprocket fixed on a drive shaft 20 serves to drive the nut 14. The drive shaft 20 is journaled in bearings mounted on the lower transverse members of the frame and has, at one end, the usual fast and loose drive pulleys 21 for driving the shaft 20 from a suitable source of power.

Closely fitting the cylindrical opening of the nut 14 is a mandrel 22 which projects at both ends of the nut 14. As shown in Figure 3, the mandrel projects but a short distance to the right of the nut 14 while it projects to the left sufficiently to serve as a support for the spool 24 of wire or other metallic strip material of which the interior supporting spiral or spring of the tubing is formed and to provide a groove for engagement by a clamping means or bracket 26 which holds the mandrel 22 against rotation and longitudinal movement. The bracket 26 is split at its lower end and the separated portions may be drawn together by means of a bolt 27 so as to permit of the bracket being secured on a stud 28 mounted in the upper transverse member 9. The upper end of the bracket 26 is formed of two portions, one portion 26a being integral with the remainder of the bracket and having a bolt 29 pivotally mounted at its upper end while the other portion 26b is pivotally connected at one end to the main portion of the bracket 26, as at 26c, and is forked at its other

end to receive the bolt 29. The bracket portions 26a and 26b fit into the groove in the end of the mandrel 22 and, when drawn together by the winged nut 29a on the bolt 29, hold the mandrel in fixed position.

Mounted in the bracket 26 is a stud 30 on which is journaled a gear 32 driven by a gear 34 and driving a gear 36. The gear 34 is journaled on the stud 28 and is attached to a sprocket 33 driven by a chain 35 from a corresponding sprocket 37 fixed on the drive shaft 20. The gear 36 is fixed on the reduced end 38a of a threaded shaft 38. The threaded shaft abuts an end of the mandrel 22 and has its reduced end portion 38a extending through the mandrel 22 to receive the gear 36. The gear 36 is of less diameter than the adjacent end of the mandrel 22 so that when the bracket 36 is released from the mandrel 22 and rotated slightly on the stud 28, carrying the gear 32 from the gear 36, the spool 24 can be removed from the mandrel without necessitating removal of the gear 36 from the shaft 38, thus providing for the replacement of empty spools with a minimum of dismantling of the machine. The main body portion of the threaded shaft 38 is rotatably mounted in a sleeve 40. The sleeve 40 which abuts the end of the nut 14, overlapping the adjacent end of the mandrel 22, extends to the end of the main body portion of the shaft 38 and tapers gradually in thickness from a point intermediate its length. The sleeve 40 is mounted to rotate with a bracket support 42 journaled in a bearing 44 mounted on the plate 10. The bracket support 42 is rotated by means of a gear 46 fixed to the bracket support 42 and driven by a pinion 47. The pinion 47 is fixed on a shaft journaled in a bearing 48 mounted on the plate 10 and this shaft has fixed thereon a sprocket 49 driven by a chain 50 from a suitable sprocket fixed on the drive shaft 20. Adjustably mounted on an extension 42a of the bracket support 42, are the bracket arms 52 having, at one end, an axle supporting a roll 54 of suitable wrapping material and, at the other end, a second roll or a counterweight 55 of suitable proportions. A screw 53 passing through a slot in the arms 52 and engaging in a threaded opening in the extension 42a serves to retain the arms 52 in adjusted position. The arms 52 may be jointed, as at 52a, to provide for adjustment of the roll 54 in each of two directions.

The main body portion of the threaded shaft 38 is of uniform diameter for the full length of the sleeve 40 and has a cylindrical portion 38b of reduced diameter projecting beyond the sleeve 40. A collar 39 fastened to the projecting portion 38b by a pin 41 secures an externally threaded sleeve 43 on the projecting portion 38b. A dowel 45 engaging the adjacent ends of the main body portion of the shaft 38 and the sleeve 43 secures the sleeve 43 in a predetermined position with respect to the shaft 38 and prevents relative rotation of the shaft and sleeve. The sleeve 43 is formed with a plurality of external spiral grooves, one of which forms a continuation of the groove of the shaft 38 and receives the wire or metallic strip forming the interior spiral of the tube. The other of the grooves is deeper than the first groove and provides space to permit of corrugating the tube by means of a suitable wire or cord 51 which is wrapped about the tube between the coils of the inner metallic spiral and serves to corrugate the tube and secure the wrappings in position.

The wire or cord 51 is supplied from a spool 56

rotatably mounted on a support 57 which has a tubular journal 57a permitting the passage of the tube and supported in a bearing 58 carried by the upper transverse member 11 of the frame.

5 The support 57 is rotated by means of a sprocket 59 fixed on the journal 57a and connected by a chain 60 to a corresponding sprocket fixed on the drive shaft 20.

When the machine is in operation wire 61 or other suitable strip metallic material passes from the spool 24 around a guide roller 62 carried by an arm 14a mounted on the nut 14. From the guide roller the wire 61 passes through the leading-in passage 16 to the spiral groove in the nut 14, the spiral groove forming a passage between the nut 14 and the mandrel 22, and the rotation of the nut 14 while the mandrel 22 is held stationary causing the coils of the wire to be advanced along the mandrel 22. To prevent the full load of starting rotation of the spool 24 being carried by the wire 61 and the tension on the wire thereby increased, the nut 14 is provided with an arm 14b carrying a pawl 14c adapted to engage ratchet teeth 24a in a side of the spool 24 so that the spool 24 can not rotate at a less rate than the nut 14, but can be rotated faster.

The wire coils will be advanced uniformly along the mandrel 22 by the nut 14 until the end of the nut 14 is reached whereupon the advance of the coils is slowed as their further movement along the mandrel is dependent upon the delivery of additional coils of the wire from the nut 14. This delivery of additional coils from the nut 14 gradually forces the coils forward on the mandrel 22 to be engaged in the groove of the threaded shaft 38. In order to increase the friction on the coils or spring on the fixed mandrel 22 to assure the formation of the spring or spiral the sleeve 40, where it overlaps the adjacent projecting end of the mandrel 22 where the coils of the spiral are closely grouped, is provided with a collar or ring 19 shrunk or otherwise secured on the sleeve 40 at its end. The ring 19 and the sleeve 40 are provided with aligned openings so positioned that a plunger 23 mounted in the openings, bears against the closely grouped coils on the mandrel. A lever 25 pivotally connected at one end, as at 25a, to the ring 19 bears at its other end on the outer end of the plunger 23. Intermediate its ends the lever 25 is provided with an opening to receive freely a bolt 31 having one end engaged in a threaded opening in the ring 19. The other end of bolt 31 is threaded to adjustably receive a nut 31a which serves to adjustably stress a spring 31b confined between the nut and the lever 25 and thus adjustably control the pressure exerted by the plunger 23 on the coils closely grouped on the mandrel 22. The threaded shaft 38 is operated at the same speed of rotation as the nut 14 so that the coils are removed from the end of the mandrel 22 by the shaft 38 as fast as they are supplied by the nut 14. The coils in the groove of the shaft 38 tend to unwind and expand, particularly during an initial starting operation of the machine, causing the coils to drag heavily on the sleeve 40. By rotating the sleeve 40 slowly in the direction opposite to the rotation of the shaft 38 a twisting or tightening effect is had upon the coils, the friction of the coils upon the sleeve greatly reduced and the movement of the coils along the sleeve 40 by the threaded shaft 38 greatly facilitated.

Rotating with the sleeve 40 is the spool 54 of any suitable wrapping material 63 which is wrapped about the sleeve 40, the number of layers

provided being varied as required by varying the width of the wrapping material, speed of rotation about the sleeve and the angle at which the material is supplied to the sleeve. In starting the wrapping of the material 63, it is necessary that it be held against rotation about the axis of the sleeve but this is aided by the slow rotation of the sleeve and the tapering of the thickness of the sleeve, the tapering starting in the winding zone of the material 63. As the tube formed of the wrapped material 63 passes from the end of the sleeve 40, it is engaged with the coils of the wire 61, which are also initially held against rotation, and then pressed between the coils of the wire spiral by the wrapping or binding wire 61.

The pitch of the groove of the sleeve 43 which engages the wire coils determines the final spacing of these coils and this pitch may differ materially from the pitch of the grooves of the nut 14 and shaft 38. The spool 56 is rotated in synchronism with and in the same direction as the shaft 38. The wire or cord 51 from the spool 56 is passed over a guide 57b carried by the support 57 so as to retain the wire 51 in position with respect to the corrugating groove in the sleeve 43 so that, once having been placed in proper wrapping position in the groove it remains in the groove thereafter.

The tubing, after having the binding wire or cord applied thereto passes between guide and supporting rolls comprising a plurality of rolls 64 radially disposed with respect to the completed tubing and radially adjustable in a suitable frame 65 carried by an upper transverse frame member 13. From the rolls 64 the tubing passes to take-up rolls comprising spaced rolls 66 and 67, each having a plurality of grooves for receiving the tubing and over which the tubing is successively passed. The rolls 66 and 67 are supported on shafts 68 and 69, respectively, journaled in bearings carried by the upper and lower longitudinal frame members, respectively. The upper shaft 68 has keyed thereon a sprocket 70 which is driven from the drive shaft 20 by means of the bevel gears 72, 73, reduction gearing 75, sprocket 74 and chain 71. From the take-up rolls the tubing passes to suitable reels or other types of holders upon which it is rolled in desired lengths for shipment.

While the spring pressed plunger 23 shown in Figs. 3 and 7 arranged to bear on the coils of the spiral and increase the resistance to slippage of the spiral about the mandrel has been shown as mounted on the sleeve 40 and rotated about the mandrel, stationary means may be provided as shown in Figs. 10 and 11 to apply the necessary pressure to the coils of the spiral. Such means comprises a bar or member 81 mounted on studs 80 carried by the bearing 44. The member 81 is angularly shaped at its central portion to fit about the spiral on the mandrel 22 between the adjacent ends of the sleeve 40 and the nut 14. Spaced openings are provided in the member 81 to receive bolts 82 which also engage in spaced openings in an angularly shaped member 83 forming with the member 81 a substantially rectangular opening receiving the mandrel and the coils of the spiral. Springs 86 confined between the member 81 and nuts 84 on the bolts 82 serve to yieldingly hold the member 83 in engagement with the closely grouped coils of the spiral. Adjustment of the nuts 84 permits of applying the desired pressure to the coils of the spiral.

What is claimed is:

1. In a tube forming machine, a fixed mandrel,

means for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, a rotatable threaded shaft for advancing the spiral from said mandrel, a tubular sleeve for holding the coils of the spiral in the groove of said shaft and means for rotating said sleeve.

2. In a tube forming machine, a fixed mandrel, means for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, a rotatable threaded shaft for advancing the spiral, a tubular sleeve for holding the coils of the spiral in the groove of said shaft and means for rotating said sleeve slowly oppositely to said shaft.

3. In a tube forming machine, a fixed mandrel, means for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, said nut ending short of an end of said mandrel and permitting engagement of the coils of the spiral at said end of said mandrel, and a rotatable threaded shaft for advancing the coils of the spiral from said mandrel.

4. In a tube forming machine, a fixed mandrel, means for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, said nut ending short of an end of said mandrel and permitting engagement of the coils of the spiral at said end of said mandrel, a rotatable threaded shaft for advancing the coils of the spiral from said mandrel and a sleeve rotatable oppositely to said threaded shaft and engaging the spiral on said mandrel and threaded shaft.

5. In a tube forming machine, a rotatable threaded shaft for advancing the coils of a continuous metallic spiral, a rotatable sleeve enclosing said shaft and holding the spiral coils in the thread of said shaft, said sleeve having its exterior diameter decrease gradually toward the end away from said mandrel, and means for winding covering material for the spiral about said sleeve, said covering material being shifted along said sleeve and engaged with said spiral.

6. In a tube forming machine, a rotatable threaded shaft for advancing the coils of a continuous metallic spiral, a sleeve enclosing said shaft and holding the coils of the spiral in the shaft thread, said sleeve being arranged to rotate oppositely to said shaft, and means for winding strip material about said sleeve to form a covering for said spiral, said covering being shifted longitudinally of said sleeve synchronously with the coils of said spiral and engaged with said spiral.

7. In a tube forming machine, a fixed mandrel, a spool for supplying continuous metallic material rotatable on said mandrel, guiding means for said metallic material rotatable about said mandrel for wrapping said metallic material about said mandrel for forming a continuous spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, a rotatable threaded shaft for advancing the coils of the spiral from said mandrel and a tubular sleeve rotatable oppositely to the direction of rotation of said threaded shaft and retaining the coils of the spiral engaged with the shaft thread.

8. In a tube forming machine, a rotatable threaded shaft for advancing a continuous spiral spring, a rotatable tubular sleeve engaging the coils of said spring on said threaded shaft, means

for wrapping covering material about said sleeve to form a covering for said spring and means engaging said covering with said spring.

9. In a tube forming machine, a fixed mandrel, a spool for supplying continuous metallic material rotatable on said mandrel, means for forming a continuous spiral spring of said material on said mandrel, a nut rotatable about said mandrel for advancing said spring on said mandrel and means supporting an end of said mandrel adjacent said spool, said means being removable to permit removal and replacement of said spool.

10. In a tube making machine, a fixed mandrel, a spool for supplying continuous metallic material rotatable on said mandrel adjacent an end thereof, means for forming a continuous spiral spring of said material on said mandrel, a nut rotatable about said mandrel for advancing said spring on said mandrel, a threaded shaft for advancing said spring from said mandrel, said shaft being journaled in said mandrel, means supporting the mandrel end adjacent said spool and driving means for said threaded shaft comprising cooperating means on said shaft and said supporting means, said supporting means being removable to permit removal and replacement of said spool.

11. In a tube forming machine, a fixed mandrel, a spool for supplying continuous metallic material rotatable on said mandrel adjacent an end thereof, means for forming a continuous spiral spring of said material on said mandrel, a nut rotatable about said mandrel for advancing said spring on said mandrel, a threaded shaft for advancing said spring from said mandrel, said shaft being journaled in said mandrel, means engaging said mandrel adjacent said spool and holding said mandrel in fixed position and driving means for said threaded shaft comprising cooperating gearing mounted on said shaft and said mandrel engaging means, said mandrel engaging means being removable to permit replacement of said spool.

12. In a tube forming machine, a fixed mandrel, means rotatable about said mandrel for forming a continuous metallic spiral on said mandrel, a rotatable threaded shaft for advancing the spiral from said mandrel, a tubular sleeve for holding the coils of the spiral in the groove of said shaft and means for varying the frictional resistance of said spiral to movement on said mandrel.

13. In a tube forming machine, a fixed man-

drel, means rotatable about said mandrel for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, said nut ending short of an end of said mandrel and permitting engagement of the coils of the spiral at said end of said mandrel, a rotatable threaded shaft for advancing the coils of the spiral from said mandrel, a tubular sleeve engaging the coils of the spiral and said mandrel and shaft and means carried by said sleeve and engaging coils on said mandrel beyond said nut for varying the frictional resistance of said coils to movement on said mandrel.

14. In a tube forming machine, a fixed mandrel, means for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, a rotatable threaded shaft for advancing the spiral from said mandrel, means for holding the coils of the spiral in the groove of said shaft and means for setting the coils of said spiral to a desired pitch.

15. In a tube forming machine, a fixed mandrel, means for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, a rotatable threaded shaft for advancing the spiral from said mandrel, means for holding the coils of the spiral in the groove of said shaft and means detachably secured to said shaft for setting the coils of said spiral to a desired pitch.

16. In a tube forming machine, a fixed mandrel, means for forming a continuous metallic spiral on said mandrel, a nut rotatable about said mandrel for advancing said spiral on said mandrel, a rotatable threaded shaft for advancing the spiral from said mandrel, means for holding the coils of the spiral in the groove of said shaft and threaded means detachably secured to said shaft to rotate therewith for setting the coils of said spiral to a desired pitch.

17. In a tube forming machine, rotatable means for advancing tubular material comprising a metallic spiral and a covering thereon, means driven by said advancing means for setting the pitch of said metallic spiral and means rotatable synchronously with said pitch setting means for wrapping a binding means about said tubular material at said pitch setting means and in a constant relation with respect to said pitch setting means.

ABEL E. CHERNACK.