Oct. 13, 1959 A. L. LOUCKS 2,908,314

TUBE-FORMING APPARATUS

Filed May 6, 1954 4 Sheets-Sheet 1

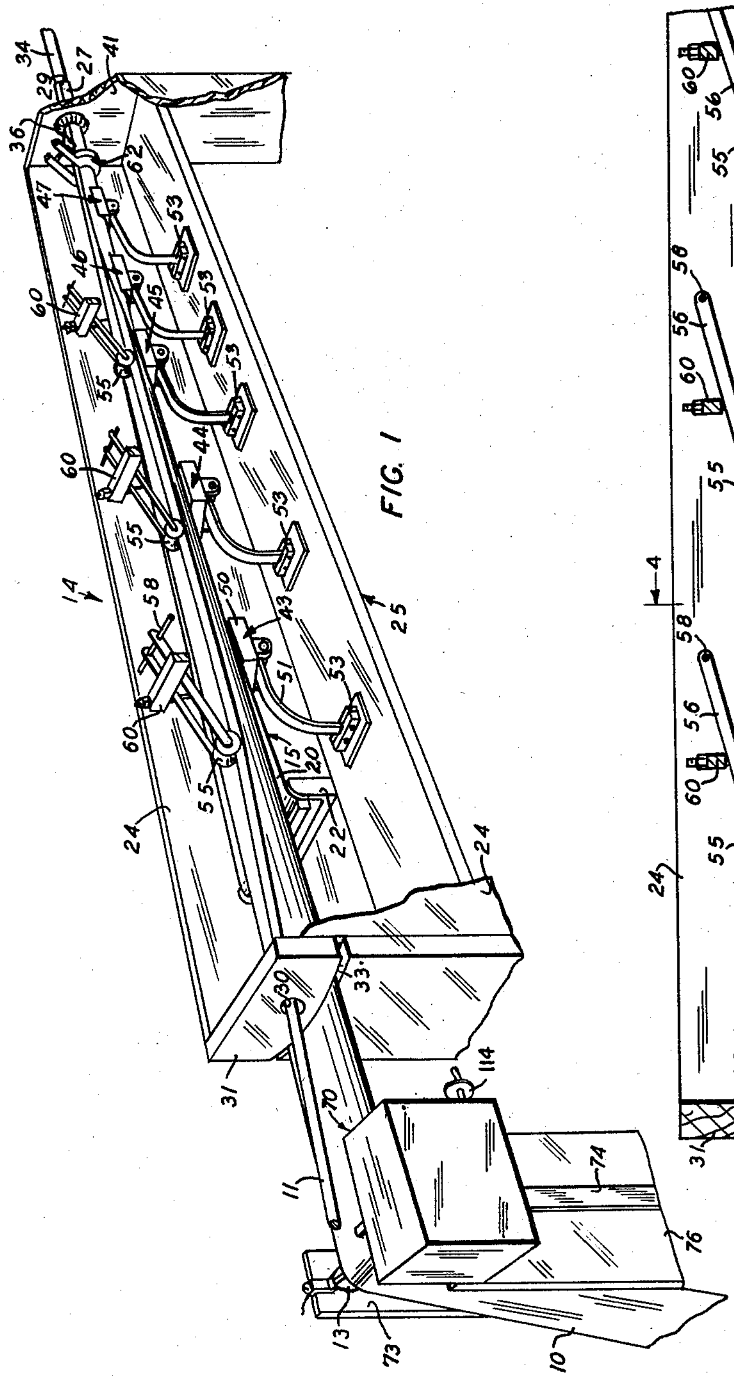

FIG. 1

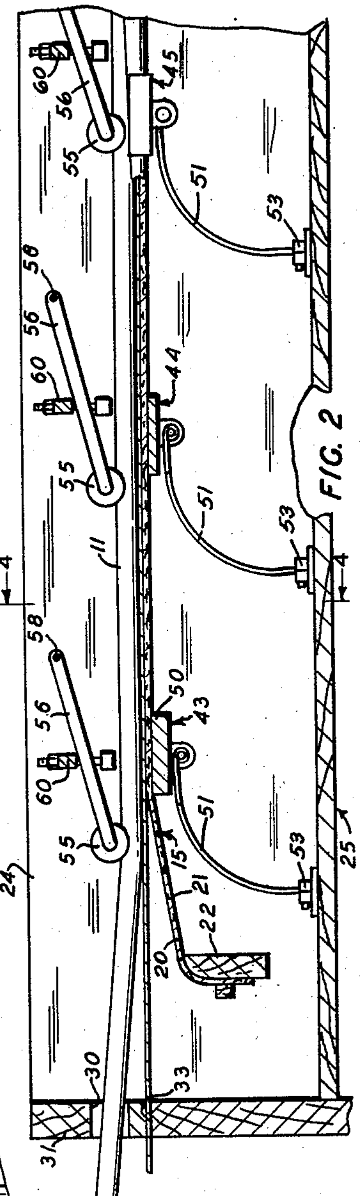

FIG. 2

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TUBE-FORMING APPARATUS

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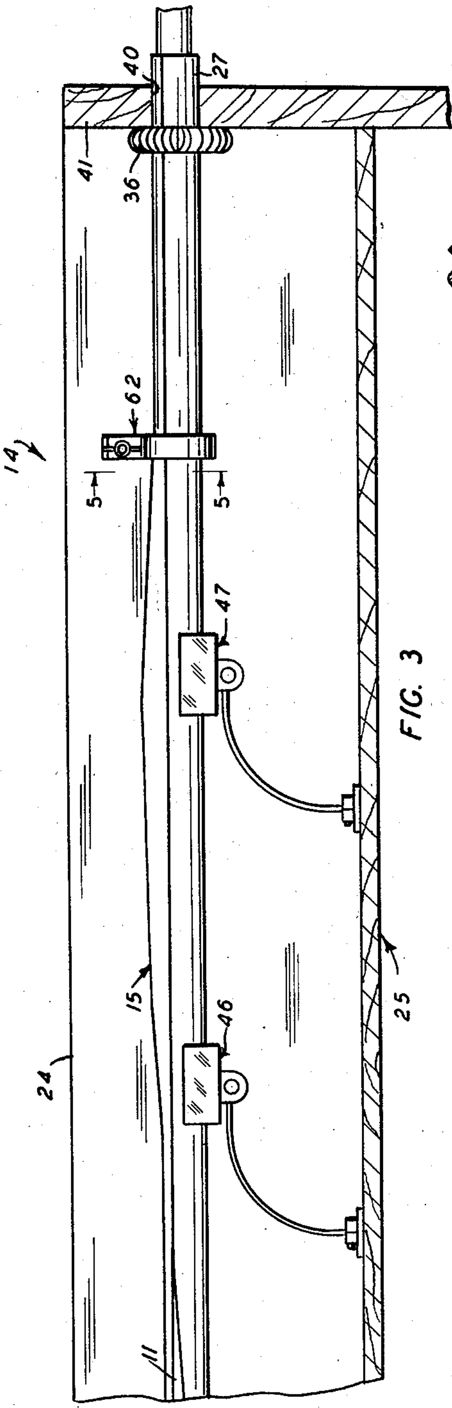

FIG. 3

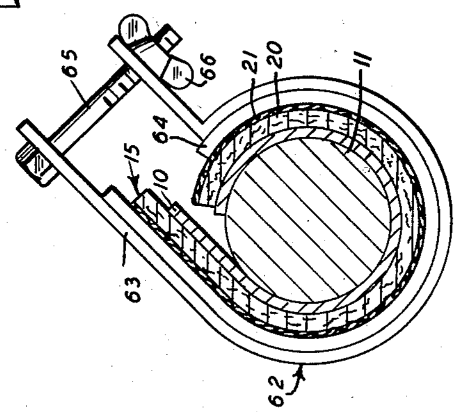

FIG. 5

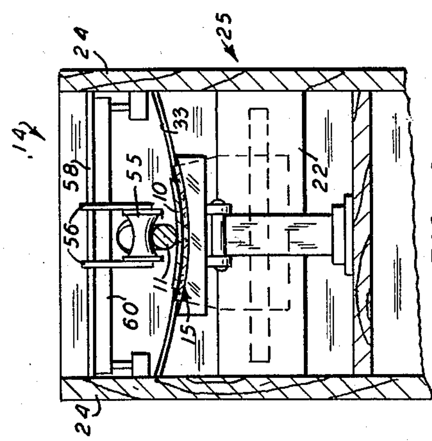

FIG. 4

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TUBE-FORMING APPARATUS

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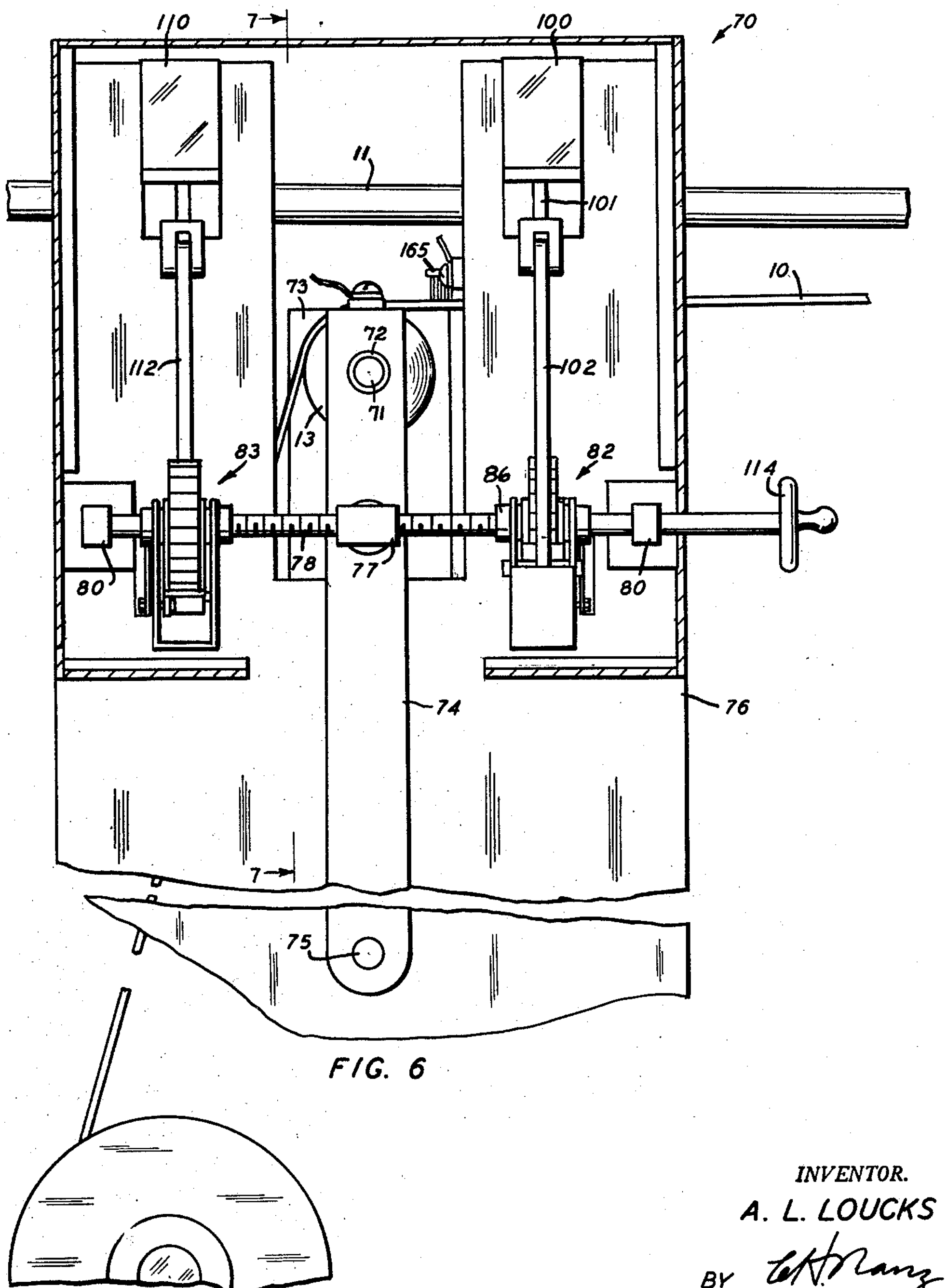

FIG. 6

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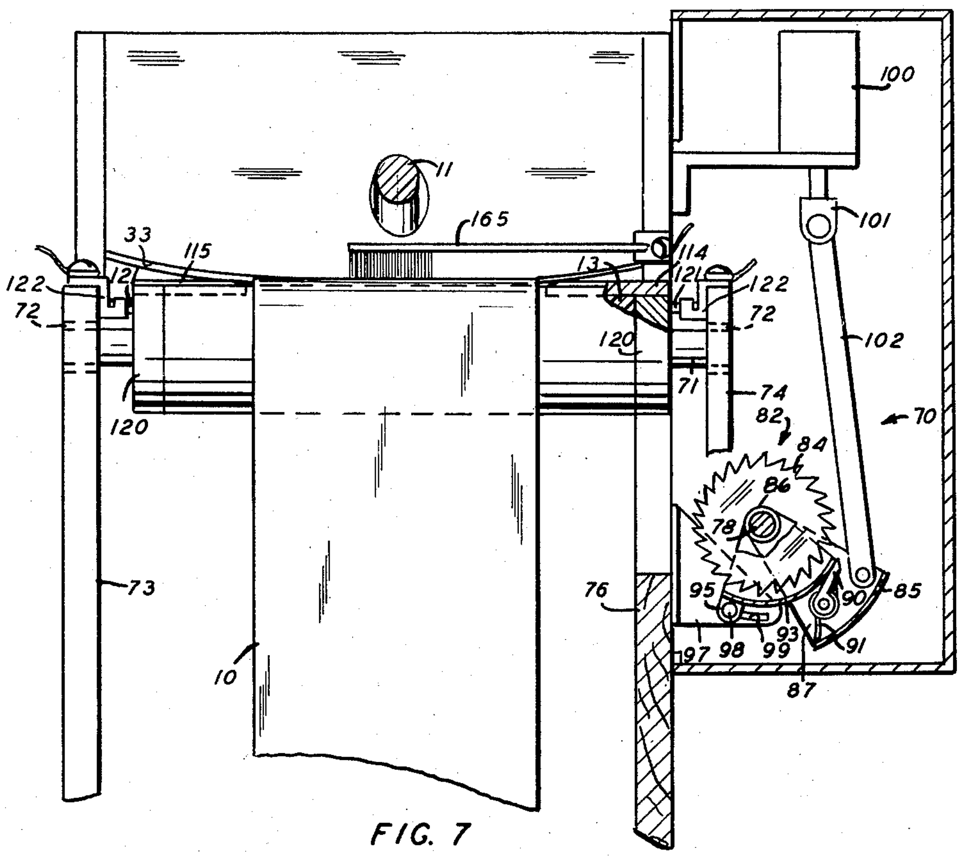

FIG. 7

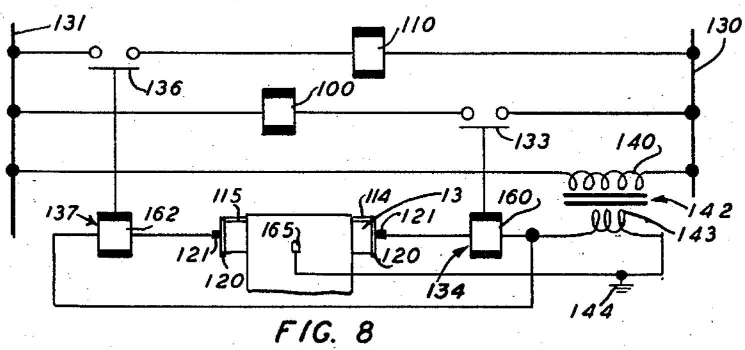

FIG. 8

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Patented Oct. 13, 1959

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2,908,314

TUBE-FORMING APPARATUS

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Application May 6, 1954, Serial No. 427,958

8 Claims. (Cl. 153—1)

This invention relates to tube-forming apparatus, and more particularly to apparatus for forming a flat strip of metal foil into a continuous tubular sheath about a continuously advancing core.

In the manufacture of certain types of composite communication cables it is necessary to form a thin, flat strip of metal, such as aluminum foil or the like, into a continuous, tubular sheath having overlapping seam edges about a continuously advancing cable core. It is essential that the finished sheath be free from wrinkles, tears, kinked edges and like defects which would make the cable unsuitable for high frequency transmission purposes. It has been found that, due to the relatively fragile nature of thin metal foils, conventional apparatus for forming strip material into tubes was unsatisfactory. The forming members employed in conventional apparatus were not sufficiently flexible to accommodate slight irregularities in the cable core without damaging the thin metal foil which frequently would "freeze" between the core and the forming member.

An object of this invention is to provide new and improved tube-forming apparatus.

Another object of this invention is to provide new and improved apparatus for forming a flat strip of metal foil into a continuous tubular sheath about a continuously advancing core.

An apparatus embodying certain features of the invention may include an elongated forming member made of a flexible sheet configurated to provide a generally frustoconical interior forming surface, and means for guiding a strip of a deformable material and a core simultaneously along the forming member, whereby the strip is formed into a continuous tubular sheath about the core by the interior forming surface of the forming member.

A complete understanding of the invention may be obtained from the following detailed description of an apparatus forming a specific embodiment thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary, perspective view of the apparatus, with parts thereof broken away for clarity;

Fig. 2 is an enlarged, fragmentary side elevation of the left hand portion of a forming unit constituting a part of the apparatus, with parts thereof broken away for clarity;

Fig. 3 is an enlarged, fragmentary, side elevation of the right hand portion of the forming unit, with parts thereof broken away for clarity;

Fig. 4 is a fragmentary, vertical section taken along line 4—4 of Fig. 2;

Fig. 5 is a fragmentary, vertical section taken along line 5—5 of Fig. 3;

Fig. 6 is an enlarged, fragmentary, side elevation of a strip aligning unit forming part of the apparatus, with parts thereof broken away for clarity;

Fig. 7 is an enlarged, fragmentary, vertical section taken along line 7—7 of Fig. 6, with parts thereof broken away for clarity, and

Fig. 8 is a schematic diagram of a control circuit forming part of the apparatus.

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Referring now to Fig. 1 of the drawings, there is shown an apparatus for forming a strip **10** of metal foil, such as aluminum foil or the like, into a continuous, tubular sheath about a plastic-jacketed cable core **11**. The cable core **11** is advanced continuously from left to right, as viewed in Fig. 1, by means of a suitable takeup capstan (not shown).

The strip **10** passes from a suitable supply reel (not shown) over a freely rotatable idler roller **13** to a tube-forming unit, indicated generally at **14**. The tube-forming unit **14** includes an elongated, flexible, supple forming member **15** (Figs. 2 and 3) made of a layer **20** (Fig. 5) of soft felt backed by a layer **21** of canvas or other supple material. The left hand end of the flexible, supple forming member **15**, as viewed in Fig. 1, is secured fixedly to a transversely extending support **22** mounted between vertical sides **24**—**24** of an elongated, channel-like frame **25** within which the forming unit **14** is mounted.

Beginning at the support **22**, the contour of the upper surface of the felt layer **20** constituting a part of the forming member **15** changes progressively and smoothly from a flat plane at the left hand end thereof to a generally frustoconical surface near the right hand end thereof. The lateral edges of the forming member **15** curve arcuately inwardly toward each other to form a closed tube portion **27** of circular cross section at the extreme right hand end thereof. The inner lateral edge of the forming member **15**, as viewed in Fig. 1, is cut away progressively at **29** (Fig. 1) to provide clearance for the inner edge of the metal foil strip between the lateral edges of the forming member until the latter edges overlap to form the tube portion **27**.

The continuously advancing cable core **11** enters the forming unit **14** through an opening **30** in an end member **31** mounted transversely between the sides **24**—**24** of the frame **25**. The opening **30** is located a short distance above a transversely extending, slightly curved slot **33** (Fig. 4), which is provided in the end member **31** to permit the passage of the strip **10** therethrough. After advancing through the opening **30**, the cable core **11** moves along the forming member **15** simultaneously with the metal foil strip **10** and exits through the closed tube portion **27** at the right hand end of the forming member with the metal foil strip formed into a tubular sheath thereabout.

A toroidal coil spring **36** presses the closed tube portion **27** of the forming member **15** about the formed metal foil sheath to compact the latter tightly about the enclosed cable core **11**. The right end of the forming member **15** is received in and supported by a circular opening **40** provided in an end member **41**.

Between the support **22** and the end member **41** the forming member **15** is resiliently supported by a series of spring-loaded backing blocks **43**, **44**, **45**, **46** and **47** (Figs. 1, 2 and 3). Since the backing blocks **43** to **47**, inclusive, are similar in construction, the following description of one of them, for example the backing block **43**, will be understood to apply equally as well to the others. The backing block **43** includes a solid presser member **50** (Fig. 2) provided with an upper bearing surface shaped to conform to the shape of the under surface of forming member **15** which it supports. The presser member **50** is mounted hingedly to one end of a leaf spring **51**, the other end of which is attached to the bottom of the frame **25** by means of an adjustable mount **53**. The mount **53** is made adjustable to permit regulation of the resilient force exerted by the leaf spring **51** on the member **50**.

Mounted above the forming member **15** are a plurality of adjustable pressure rollers **55**—**55**, each of which is mounted between a pair of arms **56**—**56**. The arms **56**—**56** are pivotally mounted between the sides **24**—**24** of the frame 25 on transversely disposed pins 58—58. The rollers 55—55 have concave surfaces designed to rollingly engage the advancing cable core 11 as it advances along and through the forming element 15. Associated with the rollers 55—55 are individually adjustable stop members 60—60, which adjustably limit the upward movement of the rollers. The rollers 55—55 are designed to cooperate with the series of spring-loaded blocks 43 to 47, inclusive, to maintain the metal foil strip 10 in contact with the bottom side of the cable core at all times as the strip moves along the forming member 15.

Positioned between the backing block 47 and the toroidal coil spring 36 is an adjustable binding unit 62 (Figs. 1, 3 and 5). The binding unit 62 includes a metal strap 63 (Fig. 5) provided with a rubber insert 64 which fits around the forming member 15 and serves to hold all of the metal foil strip 10, except the left edge thereof, as viewed in Fig. 5, tightly against the cable core 11. The left edge of the foil strip 10 passes at an angle between the ends of the strap 63. A threaded bolt 65 provided with a wing nut 66 permits the adjustment of the strap 63 to vary the radial pressure exerted thereby on the forming member 15 and the enclosed cable core 11 and foil strip 10.

To insure proper alignment of the tape as it enters the forming unit, an automatic strip aligning unit, indicated generally at 70 in Fig. 1, is associated with the idler roller 13 over which the foil strip 10 passes from the supply reel. The idler roller 13 is mounted rotatably on a shaft 71, the opposite ends of which are provided with self-aligning ball bearings 72—72. The ball bearing 72 on the left end of the shaft 71, as viewed in Fig. 7, is mounted on a rigid, upright column 73, whereas the ball bearing 72 at the opposite end of the shaft is mounted on an adjustable mounting bracket arm 74.

The bracket arm 74 is pivotally connected by a pin 75 (Fig. 6) to a rigid upright column 76 and is arranged for angular movement in a vertical plane parallel to the longitudinal axis of the forming unit 14. Pivotally attached to the bracket arm 74 at a point immediately below the bearing 72 is an internally threaded, floating nut 77 (Fig. 6), which is threadedly received on a longitudinal extending right hand threaded screw 78. The screw 78 is supported rotatably at its opposite ends by bracket members 80—80 secured fixedly to the upright column. Rotation of the screw 78 in either direction is effected by two ratchet and pawl devices 82 and 83 (Fig. 6) positioned on opposite ends of the screw. The devices 82 and 83 are substantially identical, but are arranged so as to effect rotation of the screw 78 in opposite directions.

Referring now to Fig. 7, there is shown in detail the ratchet and pawl device 82, which is positioned adjacent to the right hand end of the screw 78 for effecting counterclockwise rotation of the screw, as viewed in Fig. 7. The assembly 82 includes a ratchet wheel 84 having a hub 86 which is mounted on the screw 78 and is keyed thereto for rotation therewith. Mounted loosely on the hub 86 is a U-shaped crank element 85 having two spaced, generally triangular shaped arms 87—87 which straddle the ratchet wheel 84. A pawl 90 is pivotally mounted between the arms 87—87, and is biased resiliently in a counterclockwise direction, as viewed in Fig. 7, by a torsion spring 91.

The pawl 90 is held normally out of engagement with the toothed periphery of the ratchet wheel 84 by an adjustable guard 93 in the form of an arcuate strip of sheet metal. When the crank element 85 is in its normal, inoperative position, as illustrated in Fig. 7, the upper end of the guard 93 prevents the engagement of the pawl 90 with the teeth of the ratchet wheel 84. The lower end of the adjustable guard 93 is secured fixedly to one end of an adjustable support arm 95, the other end of which is mounted loosely on the hub 86. The end of the support arm 95 to which the guard 93 is secured is attached adjustably to a stationary support bracket 97 by means of a threaded fastener 98. The bracket 97 is secured fixedly to the upright column 76, and is provided with an arcuate slot 99 in which the fastener 98 is received. When the threaded fastener 98 is loosened, the support arm 95 may be moved angularly to adjust the position of the guard 93. The position of the guard 93 establishes the degree of active engagement of the pawl 90 with the ratchet wheel 84.

Angular movement of the crank element 85 in a counterclockwise direction, as viewed in Fig. 7, is accomplished by means of a pull type solenoid 100 having a plunger 101 connected eccentrically to the crank element 85 through a pivoted connecting rod 102. Normally, the solenoid 100 is de-energized and the combined weights of the plunger 101, the connecting rod 102 and the crank element 85 hold the crank element in the position shown in Fig. 7, wherein the spring-biased pawl 90 is held out of engagement with the ratchet wheel 84 by the guard 93. However, when the solenoid 100 is energized, the crank element 85 is rotated counterclockwise through a predetermined angle. As the crank element 85 moves in the counterclockwise direction, the spring-biased pawl 90 slips over the end of the guard 93 and engages a tooth on the ratchet wheel 84 to rotate the screw 78 until the crank element reaches the limit of its counterclockwise movement. Subsequently, when the solenoid 100 is again de-energized, the crank element 85 returns due to gravity to its normal position with the spring-biased pawl 90 disengaged from the ratchet wheel 84.

The ratchet and pawl device 83 (Fig. 6), which is substantially identical to its counterpart described above in detail, is operated by means of a solenoid 110 through a connecting rod 112. The solenoid 110 is identical to the solenoid 100. Energization of the solenoid 110 causes a predetermined clockwise angular rotation of the screw 78, as viewed in Fig. 7, in a manner similar to that described in relation to the solenoid 100. The solenoids 100 and 110 are suitably mounted on the upright column 76, and are positioned above their associated ratchet and pawl devices 82 and 83, respectively. A handwheel 114 is provided on the right hand end of the screw 78 to facilitate manual adjustment of the position of the roller 13.

Referring again to Fig. 6, it may be seen that the rotation of the screw 78 effected by the energization of the solenoid 100 results in a predetermined clockwise angular movement of the pivoted bracket arm 74, which supports the self-aligning ball bearing 72 of the idler roller 13. Conversely energization of the solenoid 110 results in a predetermined counterclockwise movement of the bracket arm 74. The rotational axis of the idler roller 13 always remains substantially in a horizontal plane, but it changes its angular position relative to the longitudinal axis of the forming unit 14 with changes in the angular position of the bracket arm 74. When the bracket arm 74 is positioned vertically, the rotational axis of the idler roller 13 is perpendicular to the longitudinal axis of the forming unit 14.

The idler roller 13, as illustrated in Fig. 7, is made of an insulating material. Partially embedded in the surface of the roller 13 are a pair of metallic contacts 114 and 115. The contacts 114 and 115 are spaced apart a predetermined distance, which is slightly greater than the width of the metal foil strip 10. The contacts 114 and 115 are arranged so that as long as the metal foil strip 10 remains properly aligned with respect to the longitudinal axis of the forming unit 14 it does not engage either of the contacts. However, if the metal foil strip 10 should move out of alignment, in one direction or the other, one of the contacts 114 and 115 will be engaged by the corresponding edge of the metal foil strip.

The width of each of the contacts 114 and 115 with respect to the circumference of the idler roller 13 is relatively small. Hence, the engagement of the strip 10 with the particular contact 114 or 115, depending upon the direction of the misalignment, is not continuous, but is quickly made and broken once per revolution of the roller. As shown in Fig. 7, the top surfaces of the contacts **114** and **115** are raised slightly above the periphery of the idler roller **13**, but not enough to interfere with the smooth running of the metal foil strip **10** over the roller. The contacts **114** and **115** are connected electrically to metallic contact rings **120—120** mounted coaxially on either end of the idler roller **13**. As the idler roller **13** rotates the contact rings **120—120** are contacted by spring-pressed carbon brushes **121—121** mounted in conventional brush holders **122—122** supported on the upright columns **73** and **76**, respectively.

Illustrated in Fig. 8 is a schematic diagram of an electrical circuit associated with the contacts **114** and **115** and the solenoids **100** and **110**. The circuit includes a pair of power supply lines **130** and **131** connected to a suitable source of A.C. voltage. The solenoid **100** is connected across the lines **130** and **131** through a normally open contact **133** of a solenoid operated relay **134**. Similarly, the solenoid **110** is connected across the lines **130** and **131** through a normally open contact **136** of a solenoid operated relay **137**. Also connected across the supply lines **130** and **131** is a primary winding **140** of a step-down transformer **142**. The secondary winding **143** of the transformer **142** is connected on one side to ground at **144**. The ungrounded side of the secondary winding **143** is connected to the contact **114** on the idler roller **13** through a solenoid **160** of the relay **134**, the spring-pressed carbon brush **121** and the ring **120**. The contact **115** on the idler roller is connected through the spring-pressed carbon brush **121** and a solenoid **162** of the relay **137** to the ungrounded side of the secondary winding **143**. The advancing metal foil strip **10** is grounded by means of a metal brush **165** (Fig. 7), which is mounted on the column **76** in continuous pressing electrical contact with the surface of the strip.

Operation

Let it be assumed that the apparatus is operating and is continuously forming a tubular sheath of metal foil about the advancing cable core **11**. The metal foil strip **10**, the initial end of which is attached fixedly to the cable core **11** by suitable means, advances simultaneously with the cable core through the forming unit **14**. The pressure rollers **55—55** cooperate with the spring-loaded backing blocks **43** to **47**, inclusive, to urge the cable core **11** against the metal foil strip **10** advancing therewith through the flexible forming member **15**.

As the metal foil strip **10** advances along the flexible forming member **15** it follows the inner, generally frustoconical shaping surface of the soft felt layer **20**, whereby the lateral edges of the metal foil strip are forced curvingly inwardly toward each other to form a tight tubular sheath about the cable core **11**. A suitable lubricant, such as a light oil or graphite may be applied to the surface of the felt layer to facilitate the operation.

As shown in Fig. 5, the inner or right lateral edge of the strip **10** is pressed tightly against the core **11** before the adjacent outer edge is pressed down to overlap the inner edge so as to eliminate the possibility of engagement of the edges until after they have been bent into overlapping relationship. The seam thus formed by the overlapping parallel edges of metal foil strip lies longitudinally along the top of the completed metal foil sheath. The closed tube portion **27** of the forming member **15** serves to compact the metal foil sheath tightly about the cable core **11**.

The stop members **60—60**, which limit the upward movement of the pressure rollers **55—55**, are adjusted to obtain an optimum condition which insures the application of a smooth tight tubular sheath **34**, free from wrinkles, crimps or like defects, about the cable core. One of the important features of the forming unit **14** is its inherent flexibility. In addition to the fact that the

forming member **15** is itself flexible, it is supported resiliently intermediate of its ends by the adjustable, spring-loaded backing blocks **43** to **47**, inclusive, which complement the flexibility of the forming member. Thus, it is apparent that any irregularities in the cable core, which in practice are inadvertently present despite the fact that the cable core **11** is prestraightened prior to entering the forming unit **14**, are absorbed without injury to the fragile metal foil strip **10**, as a result of the resilient mounting and the flexibility of the forming member **15**. Difficulties, such as "freezing" of the ductile metal foil between the cable core and the forming member are completely eliminated, since the backing blocks yield before such damage can occur.

During the operation, the metal foil strip **10** advances continuously from its supply reel to the forming unit **14**. In moving toward the forming unit **14** the strip **10** passes over the freely rotatable idler roller **13**, which guides it toward the forming member **15**. The automatic strip aligning unit **70** (Figs. 6 and 7) associated with the idler roller **13** functions throughout the operation to insure the alignment of the longitudinal axis of the advancing strip **10** with the longitudinal axis of the forming member **15**.

To illustrate the operation of the strip aligning unit **70**, let it be assumed, for example, that for some reason or another the tape moves momentarily to the right out of proper alignment, and its right edge, as viewed in Fig. 7, extends into the path of the contact **114** mounted on the periphery of the idler roller **13** near the right end thereof. As long as the strip **10** remains misaligned the contact **114** will engage the metal strip, which is grounded electrically by the metal brush **165**, once per revolution of the idler roller **13**. Each time the contact **114** engages the metal foil strip **10** momentarily, a low voltage circuit is completed through the secondary winding **143** of the transformer **142** to energize the solenoid **160** of the relay **134**, whereby its associated contact **133** is closed momentarily.

When the normally open contact **133** closes momentarily, the solenoid **100** is energized to operate the connecting rod **102** connected to the crank element **85** of the ratchet and pawl device **82**. Upon energization of the solenoid **100**, the crank element **85** is rotated angularly in a counterclockwise direction, as viewed in Fig. 7, to effect a predetermined angular rotation of the screw **78**. This counterclockwise rotation of the screw **78** results in a clockwise angular movement (as viewed in Fig. 6) of the bracket arm **74** which supports the self-aligning ball bearing **72** of the idler roller **13**.

This predetermined angular movement of the bracket arm **74** displaces the rotational axis of the idler roller **13** from its normal perpendicular orientation with respect to the longitudinal axis of the forming unit **14** in a direction such that the right end of the roller moves forward a predetermined distance in the direction of travel of the strip **10**. The rotational axis of the idler roller **13** remains substantially horizontal, but it assumes an angle of less than 90° with respect to the longitudinal axis of the forming unit **14**. This change in the angular orientation of the idler roller **13** tends to cause the strip to shift laterally from right to left, as viewed in Fig. 7, as it advances, thereby tending to move the strip back into longitudinal alignment with the forming unit **14**.

If the correction is not sufficient to move the strip **10** back into alignment before the contact **114** makes another revolution, the electrically grounded strip **10** will again engage the contact **114** to operate the ratchet and pawl device **82** again and cause an additional predetermined angular movement of the idler roller **13** in the manner previously described.

It is apparent that if the metal foil strip **10** should move out of alignment in the opposite direction, the contact **115** would be engaged to operate its associated ratchet and pawl device **83** which moves the idler roller in the opposite direction to cause the strip to tend to shift toward the right and back into alignment. Thus, the automatic strip aligning unit **70** insures proper alignment of the advancing strip **10** with respect to the longitudinal axis of the forming uint **14**.

It will be understood that the embodiment of the invention herein disclosed is merely illustrative and may be modified in various ways without departing from the spirit and scope of the invention.

What is claimed is:

1. Tube-forming apparatus, which comprises an elongated forming member made of a supple sheet configurated to provide a generally frustoconical interior forming surface, means for preventing longitudinal movement of the supple sheet and for maintaining the interior surface of the forming member in a substantially frustoconical configuration and yet permitting local deformation of the forming member, and means for sliding a strip of a deformable material and a core simultaneously along the relatively stationary forming member, whereby the strip is formed into a continuous tubular sheath about the core by the interior forming surface of the forming member.

2. Tube-forming apparatus, which comprises an elongated forming member made of a flexible sheet of limber fabric configurated to provide a generally frustoconical interior forming surface, means for preventing longitudinal movement of the flexible sheet and for maintaining the interior surface of the forming member in a substantially frustoconical configuration and yet permitting local deformation of the forming member, and means for sliding a strip of metal foil and a core simultaneously along the relatively stationary forming member, whereby the strip is formed into a continuous tubular sheath about the core by the interior forming surface of the forming member.

3. Apparatus for forming a flat strip of a deformable material into a continuous tubular sheath about a continuously advancing core of indefinite length, which comprises an elongated forming member made of a composite sheet comprising an inner layer of felt and an outer layer of a supple backing material, said sheet being configurated to provide a generally frustoconical interior forming surface, means for preventing longitudinal movement of the composite sheet and for maintaining the interior surface of the forming member in a substantially frustoconical configuration and yet permitting local deformation of the forming member, and means for sliding a strip of deformable material and a core simultaneously along the relatively stationary forming member, whereby the strip is formed into a continuous tubular sheath about the core.

4. Apparatus for forming a flat strip of metal foil into a continuous tubular sheath about a continuously advancing core of indefinite length, which comprises an elongated forming member made of a composite sheet comprising an inner layer of felt and an outer layer of canvas, said sheet being configurated to provide a generally frustoconical interior forming surface, means for preventing longitudinal movement of the composite sheet and for maintaining the interior surface of the forming member in a substantially frustoconical configuration and yet permitting local deformation of the forming member, and means for sliding a strip of metal foil and a core simultaneously along the relatively stationary forming member, whereby the strip is formed into a continuous tubular sheath about the core.

5. Apparatus for forming a flat strip of metal foil into a tubular sheath about a core, which comprises a forming member made of a supple sheet configurated to provide a generally frustoconical interior shaping surface, means for preventing longitudinal movement of the supple sheet, means for sliding a strip of metal foil and a core simultaneously along the relatively stationary forming member, said strip being supported by the interior shaping surface of the forming member as it moves therealong, resilient means for supporting the forming member at spaced intervals therealong, and resilient means for applying radial forces circumferentially of the core for pressing the metal foil strip against the core, whereby it is formed progressively into a continuous tubular sheath about the core by the forming member.

6. Apparatus for forming a flat strip of metal foil into a tubular sheath about a core, which comprises a forming member made of a flexible sheet of fabric configurated to provide a generally frustoconical interior shaping surface, means for preventing longitudinal movement of the flexible sheet, means for sliding a strip of metal foil and a core simultaneously along the relatively stationary forming member, said strip being supported by the interior shaping surface of the forming member as it moves therealong, resilient means for supporting the flexible forming member at spaced intervals therealong, and spring-biased means for pressing the core against the metal foil strip, whereby it is formed progressively into a continuous tubular sheath about the core by the forming member.

7. Apparatus for forming a flat strip of metal foil into a continuous tubular sheath about a continuously advancing core of indefinite length, which comprises a forming member made of a flexible sheet material configurated to provide a generally frustoconical interior shaping surface, means for guiding a strip of metal foil along the forming member simultaneously with a continuously advancing core to form the metal foil progressively into a continuous tubular sheath about the core, and a series of presser members positioned adjacent to and spaced longitudinally along the forming member, said presser members having bearing surfaces complementary to adjacent portions of the exterior surface of the forming member, and resilient means for urging the presser members against the forming member, whereby said presser members resiliently support the forming member and press the metal foil strip against the core.

8. Apparatus for forming a flat strip of metal foil into a continuous tubular sheath about a continuously advancing core of indefinite length, which comprises a forming member made of a flexible sheet material configurated to provide a generally frustoconical interior shaping surface, means for guiding a strip of metal foil along the forming member simultaneously with a continuously advancing core to form the metal foil progressively into a continuous tubular sheath about the core, a series of spring-pressed blocks spaced longitudinally along the forming member and provided with bearing surfaces complementary to the forming member, said blocks being designed to resiliently support the forming member and press the metal foil strip against the core, and means for adjusting individually the resilient forces exerted by the spring-pressed blocks on the forming member.

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