May 10, 1949. A. LOGAN 2,469,565

APPARATUS FOR FORMING METAL TAPE INTO TUBULAR CONDUCTORS

Filed Nov. 23, 1943

3 Sheets-Sheet 1

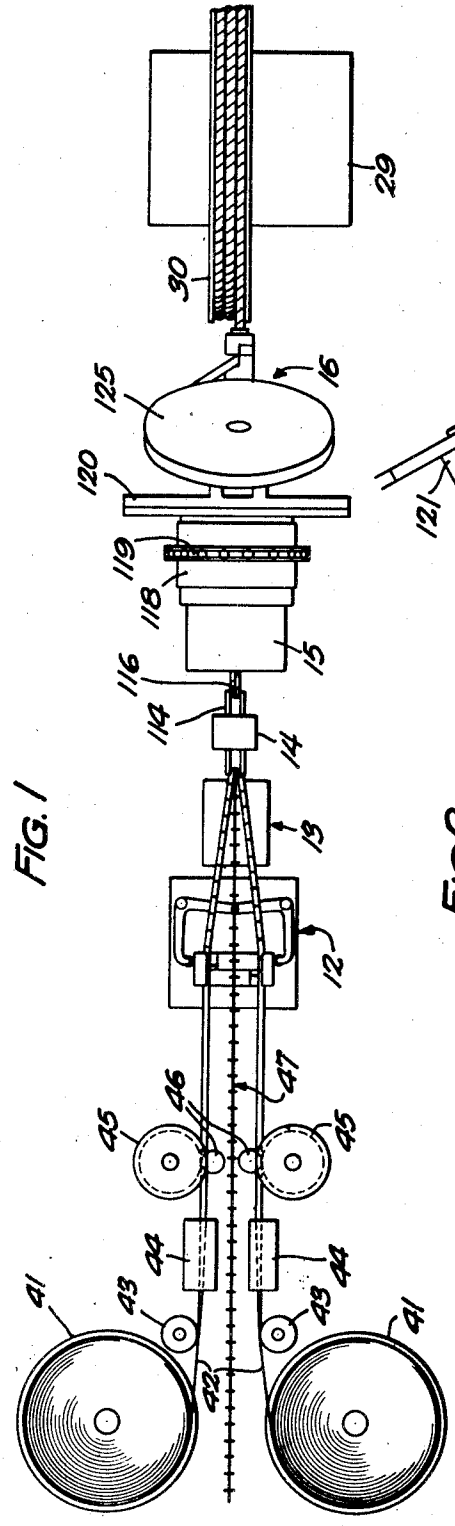


FIG. 1

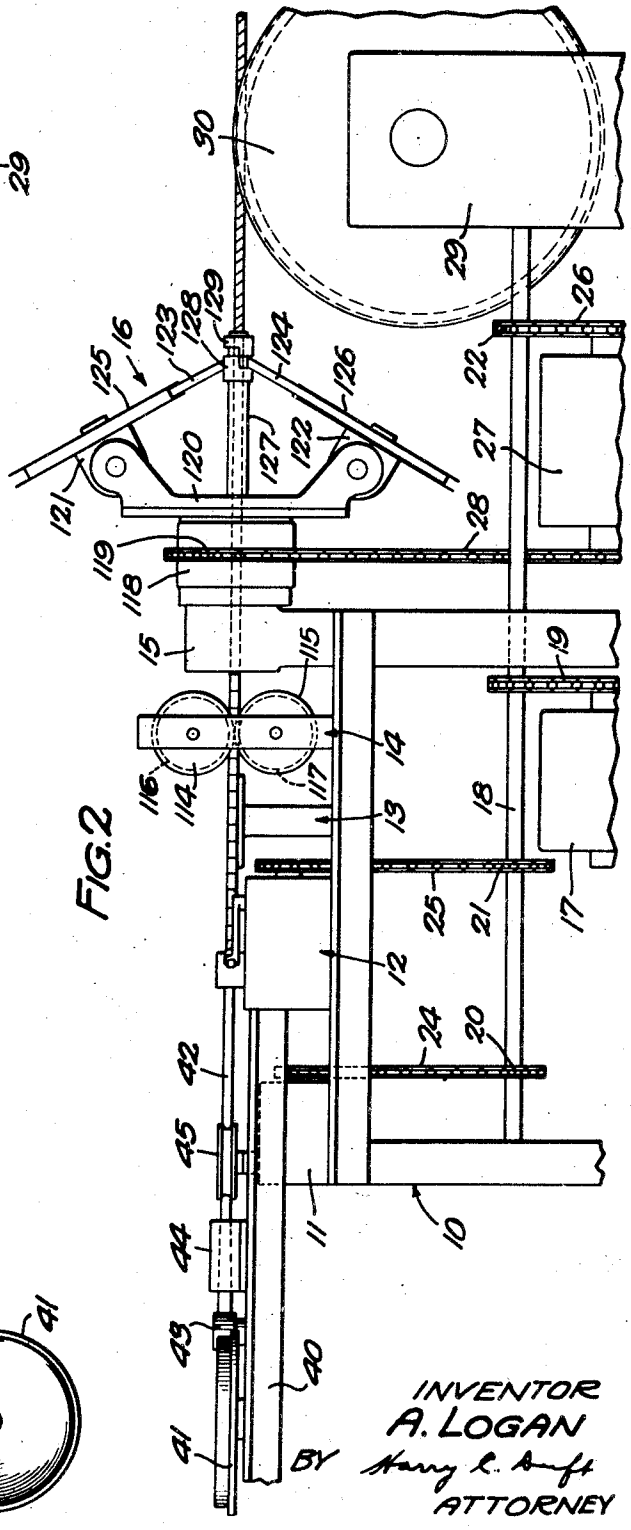


FIG. 2

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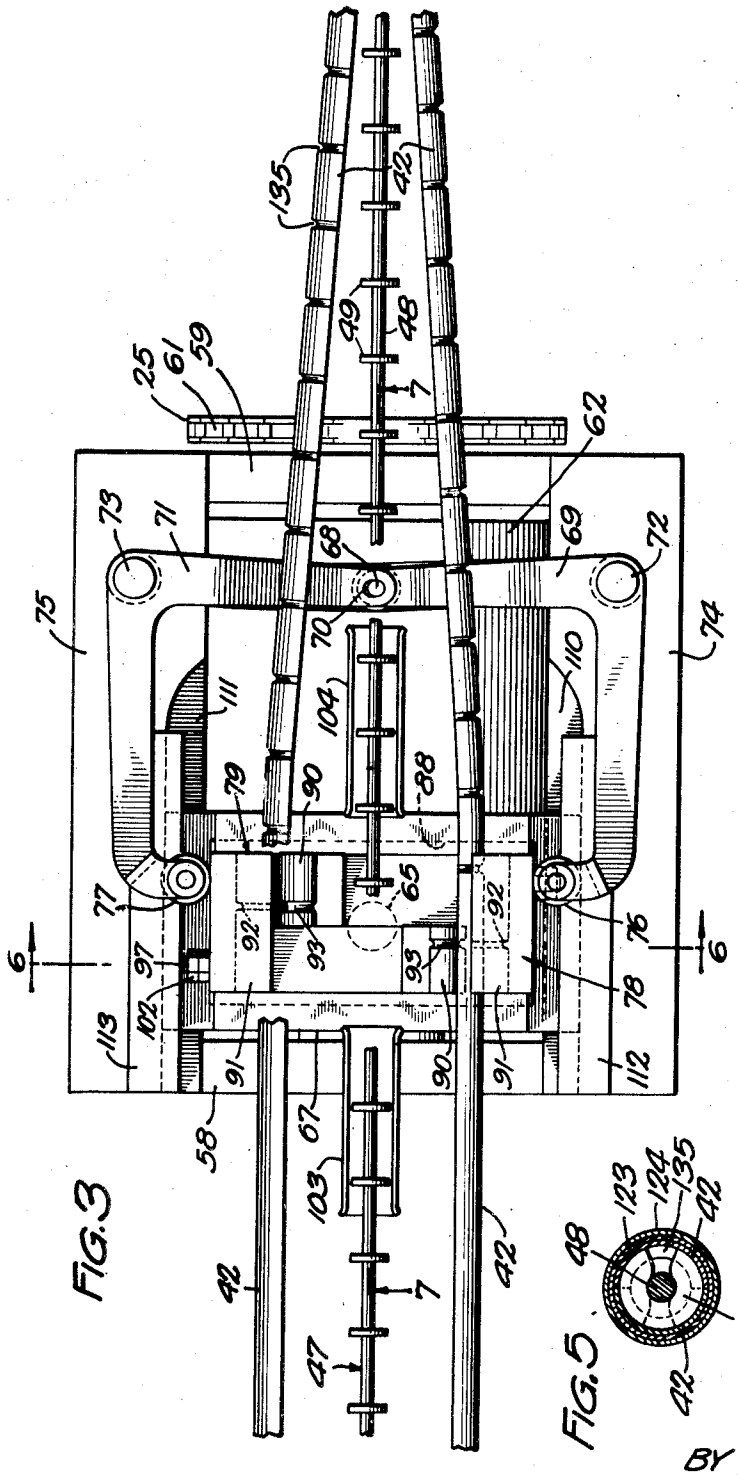


FIG. 3

FIG. 5

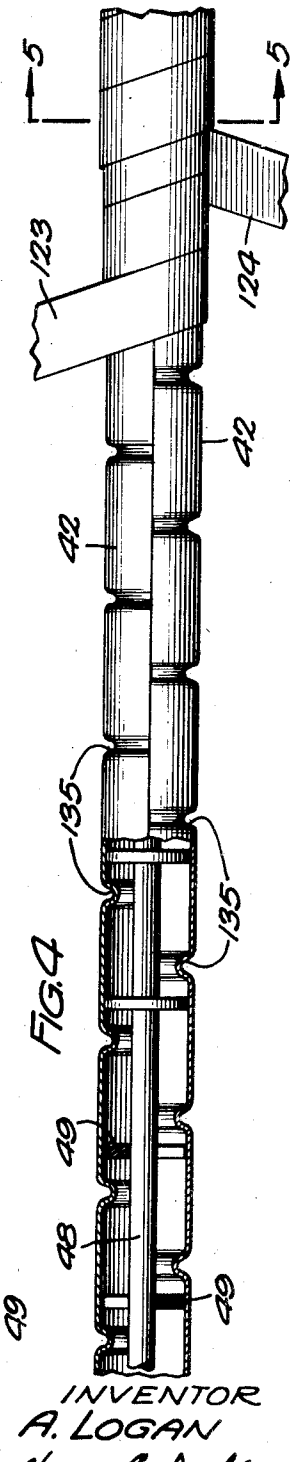


FIG. 4

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APPARATUS FOR FORMING METAL TAPE INTO TUBULAR CONDUCTORS

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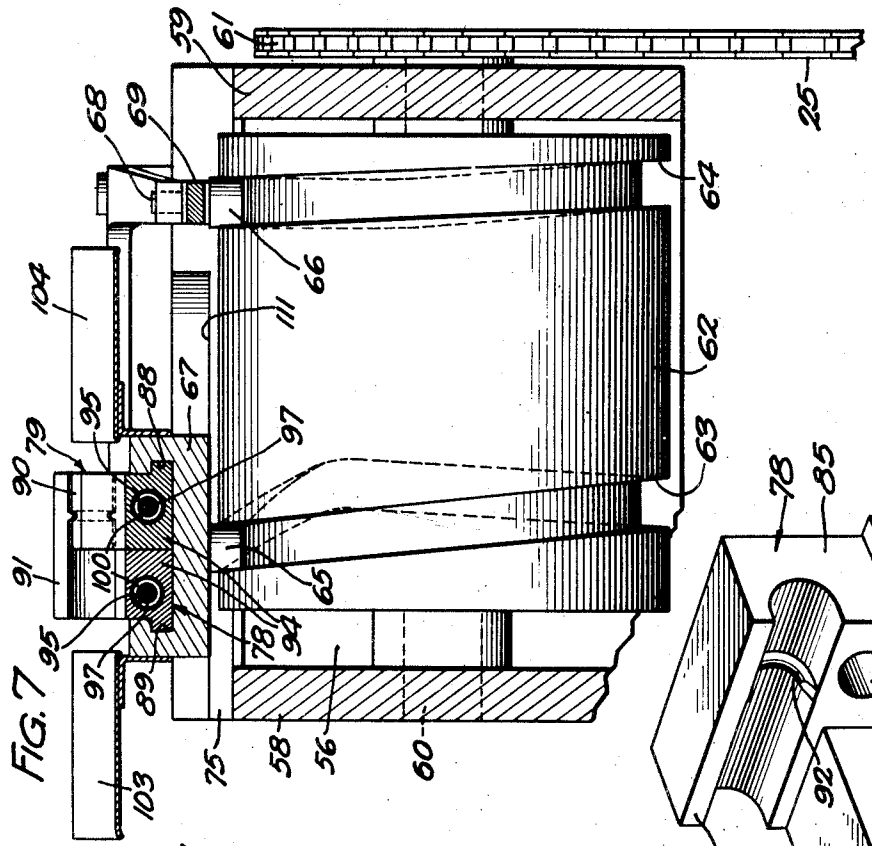


FIG. 7

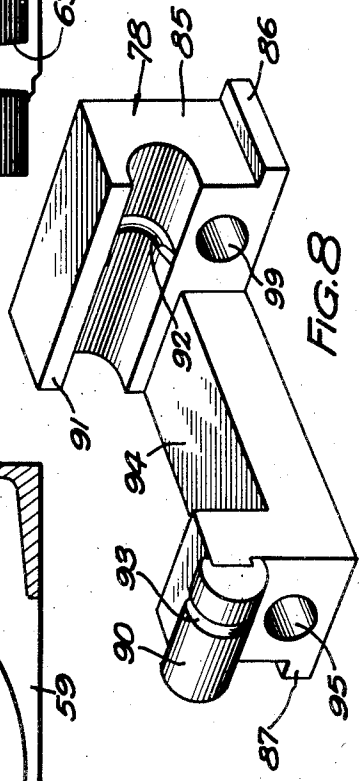


FIG. 8

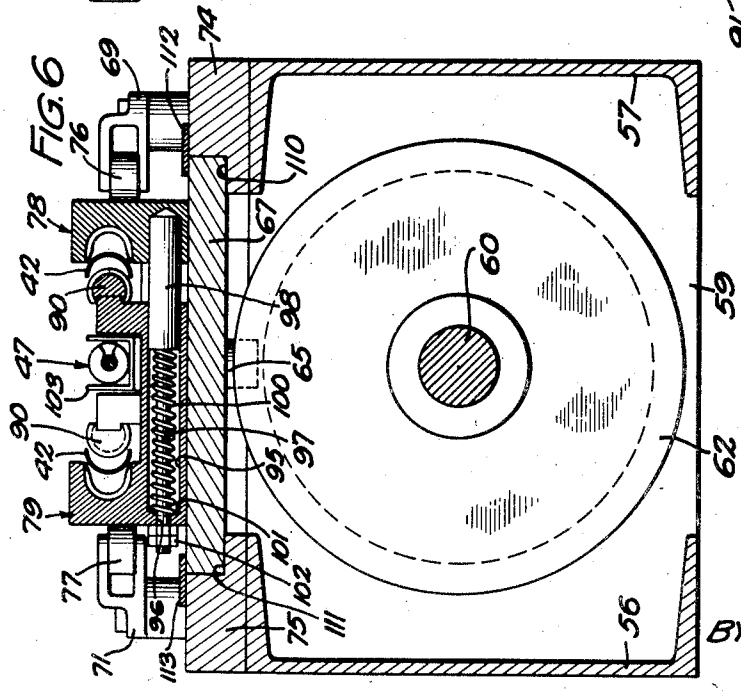


FIG. 6

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UNITED STATES PATENT OFFICE

2,469,565

APPARATUS FOR FORMING METAL TAPE INTO TUBULAR CONDUCTORS

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Application November 23, 1943, Serial No. 511,496

3 Claims. (Cl. 113—33)

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This invention relates to article forming apparatus and more particularly to an apparatus for forming a flexible co-axial cable.

It is an object of the present invention to provide a simple apparatus for rapidly and accurately forming an article.

In accordance with one embodiment of the invention, a central core member, on which insulating discs have been placed at spaced intervals, is fed between two supply pads of copper tape from which tape is withdrawn at a predetermined rate proportional to the rate of movement of the core and attached insulators. As the copper tape is withdrawn from the pad, it is passed through forming dies to form it to a concavo-convex cross section and is then directed to a crimping unit, which has crimping dies movable relative to the tapes to crimp the tapes at spaced intervals and to travel with the tapes during the crimping action. As the crimped tapes move out of the crimping apparatus, they are directed to taping rolls, which guide them into association with the washers on the central core, after which binding layers of metallic tape are wrapped around the two crimped tapes, which, in the finished cable, will constitute the shell conductor and the completed cable is then passed over a driving capstan to any suitable takeup or receiving devices.

A complete understanding of the invention may be had from the following detailed description when considered in conjunction with the accompanying drawings, wherein

Fig. 1 is a plan view of the apparatus embodying the present invention;

Fig. 2 is a side elevational view of the apparatus shown in Fig. 1, parts being broken away to conserve space;

Fig. 3 is an enlarged fragmentary plan view of the tape crimping portion of the apparatus;

Fig. 4 is a detail view of the completed cable, partially in section, and showing the relative positions of the tapes which form the shell or outer conductor of the cable, as well as the binding tapes wrapped about the shell;

Fig. 5 is a sectional view taken substantially along the line 5—5 of Fig. 4 in the direction of the arrows showing the cable in cross section;

Fig. 6 is a vertical sectional view taken substantially along the line 6—6 of Fig. 3 in the direction of the arrows;

Fig. 7 is a longitudinal vertical sectional view taken substantially along the line 7—7 of Fig. 3 in the direction of the arrows; and

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Fig. 8 is a detailed view in perspective of one of the crimping die elements.

In the drawings, particular reference being had to Figs. 1 and 2, there is shown a suitable framework 10, which supports the various parts of the apparatus, the details of construction of which are not essential to an understanding of the invention, it being sufficient to note that the frame supports a gear box 11, a crimping die assembly 12, a tape guiding assembly 13, a guide roller support 14, a bearing support 15 for a taping head assembly 16, and other suitably positioned mechanisms to be described hereinafter. Suitably mounted beneath the framework 10 is a driving motor 17, which drives a main shaft 18 through a sprocket and chain arrangement 19. The main shaft 18 has a plurality of sprockets 20, 21 and 22 thereon for driving chains 24, 25 and 26, respectively. The chain 24 is adapted to drive the gears in the gear box 11, the chain 25 is adapted to transmit motion to the crimping die assembly 12 and the chain 26 is adapted to drive a gear reducer 27, which, through a chain 28, drives the taping head assembly 16. In addition to driving the various sprockets just described, the main drive shaft 18 drives suitable gearing in a gear box 29, which, in turn, drives a takeup capstan 30.

Mounted upon the frame 10 is a bracket 40 having suitably positioned thereon a pair of reels or pads 41—41, on each of which there is wound a supply of metal tape 42, preferably made of copper, which is to be formed, in the present apparatus, into concavo-convex tube halves, which, in the ultimate product, will form the outer conductor of a co-axial cable. The tapes or ribbons 42 withdrawn from the pads 41 are directed past the guide rollers 43—43 to forming dies 44—44 mounted upon the bracket 40. Both of the forming dies 44 are of exactly the same construction and gradually bend the flat tape to a semi-circular cross-sectional shape. These dies may be of any suitable construction and, therefore, are not shown in detail. The tapes or ribbons 42 are drawn through the forming dies 44 by driven rollers 45—45 and cooperating idler rollers 46—46, which are suitably pressed against the driven rollers 45. The power for driving the rollers 45 is transmitted to them through the gear box 11 and the speed of operation of the driven rollers 45 is synchronized with the feeding between the forming dies 44 and sets of rollers 45—46 of a core unit 47 comprising a relatively heavy copper wire 48 having spacers or discs 49—49 of insulating material attached thereto. These insulators or discs 49 are each provided

with a slot 58, as shown in Fig. 5, into which the wire 48 has been forced, whereby the insulators 49 will be attached to the wire 48 at regularly spaced intervals and will be carried along with the wire. The rate of feed of the core unit 47 depends on the speed of the takeup capstan 30 and the spacing of the insulators 49 thereon is controlled with a high degree of accuracy by mechanism not shown and the operation of the apparatus comprising the present invention is synchronized with the rate of operation of the mechanism which applies the discs or insulators 49 to the central conductor or wire 48. Any suitable mechanism may be provided for attaching the insulators to the wire and, therefore, no specific disclosure of such mechanism is deemed necessary herein. It should be noted that the speed of the feeding of the tapes or ribbons 42 is synchronized with the movement of the core unit 47, but the speed of forward advance of the tapes 42 in the area of the dies 44 is slightly faster than the speed of advance of the core unit since the tapes will be crimped in the crimping die assembly 12, as will be described hereinafter, to, in effect, shorten the tapes.

In the crimping die assembly 12, there is provided, as shown most clearly in Figs. 3, 6, 7 and 8, a pair of channel members 56 and 57 having set into the ends of them a pair of bearing plates 58 and 59, in which a cam shaft 60 is suitably journalled. The shaft 60 has a sprocket 61 on its right end (Figs. 3 and 7) for engagement by the chain 25, whereby rotation is imparted to the shaft 60 and, consequently, to a cam drum 62 fixed on the shaft and having a pair of cam grooves 63 and 64 formed in it for receiving cam rollers or pins 65 and 66, which are, in turn, mounted upon a slidable support plate 67 and a stud shaft 68, respectively. The stud shaft 68 is fixed to a bell crank lever 69 (Figs. 3 and 7) extending downwardly therefrom to support the cam roller 66 and extending upwardly therefrom to enter a slot 70 in a corresponding bell crank lever 71. The bell crank levers 69 and 71 are pivotally mounted at 72 and 73, respectively, on bearing plates 74 and 75, respectively, which are, in turn, mounted upon the upper flanges of the channel members 57 and 56, respectively.

At their left ends, as viewed in Fig. 3, the bell crank levers 69 and 71 carry camming rollers 76 and 77, respectively, which are freely rotatable within forked portions of the ends of the bell crank levers and which engage the outer surfaces of a pair of similarly formed crimping dies 78 and 79, respectively. The crimping dies 78 and 79, as mentioned, are of the same construction and the crimping die 78, which is shown in perspective in Fig. 8, comprises a block 85 having flanges 86 and 87 formed thereon which extend into ways 88 and 89 extending from the upper surface of the slidable support plate 67. While the block 85 may be formed from a plurality of interconnected parts, it has, for the sake of simplicity, been shown as a single block of metal having a concave forming die portion cut therein and a convex forming die 90 attached thereto. The concave forming die, designated 91, has a ridge 92 formed thereon for cooperation with a groove 93 formed on the convex forming die 90 of the crimping die 79. Similarly, the forming groove 93 on the convex forming die 90 of the crimping die 78 cooperates with a corresponding ridge 92 on the convex portion 91 of the crimping die 79. In each of the crimping dies 78 and 79, the concave and convex forming dies

91 and 90 are joined by a web 94 so that the two forming dies which constitute a part of the crimping die will move together.

In each of the crimping dies 78 and 79, there is provided an aperture 95, which extends through the web portion 94 and the portions of the crimping die beneath the concave and convex forming portions thereof. The aperture 95, as shown most clearly in Fig. 6, is reduced in size, as shown at 96, to receive the shank 97 of a plunger 98. A socket 99 is formed in each of the crimping dies 78 and 77 to receive the enlarged portion of the plunger 98 and a compression spring 100 is interposed between the enlarged portion of the plunger 98 and a shoulder 101, which is formed at the place where the aperture 95 is reduced in size. This compression spring 100 encircles the shank 97 of the plunger and normally urges the plunger into its socket 99. It will be understood that there are two of these plungers urging the crimping dies 78 and 79 into engagement with the rollers 76 and 77. In order to simplify the assembling of the crimping dies 78 and 79, the shank 97 of the plunger 98 is threaded to receive a lock nut assembly 102, which will limit the movement of the plunger 98 under the action of the spring 100. In addition to supporting the crimping dies 78 and 79, the slidable supporting plate 67 also supports a pair of channel-shaped guides 103 and 104, which serve to guide the core unit 47 into position between the tapes or ribbons 42, which, before their entrance into position between the crimping dies 78 and 79, have been formed to concavo-convex shape, as shown in Fig. 6.

The slidable support plate 67 is slidable in ways formed by cooperating surfaces 110 and 111 formed on the bearing plates 74 and 75, and by retainer plates 112 and 113, suitably fixed to the upper surfaces of the bearing plates 74 and 75, whereby the slidable support plate will travel with the core unit 47 during the crimping of the tapes 42 under the action of the cam drum 62 on cam roller 65. In this manner, the crimped tapes will be fed over the tape-guiding assembly 13, which serves to support the tapes in position to enclose the core unit 47. After the tapes and core unit pass over the tape-guiding assembly 13, the crimped tapes will be engaged by guide rollers 114 and 115, which have grooves 116 and 117 formed in them to guide the tapes into association with the core unit.

After passing the rollers 114 and 115, which are freely rotatable in the guide roller support 14, the tapes 42 will pass through the bearing support 15 on which there is rotatably mounted a hub 118 having an annular sprocket 119 encircling it for engagement with the chain 28. The hub 118 carries a pad supporting bracket 120, on which there is mounted a pair of pad supports 121 and 122, the angularity of which, with respect to the core unit and its enclosing tapes, may be adjusted to determine the angle at which armor tapes 123 and 124 may be fed from reels or tape pads 125 and 126. Extending outwardly from the bracket 120 is a guide sleeve 127 carrying guide dies 128 and 129, which direct the armor tapes 123 and 124 into engagement with the crimped tapes 42. After the armor tapes 123 and 124 are thus applied to the assembled crimped tapes 42 and the core unit 47, the tape-covered coaxial cable thus formed may be wrapped several times around the capstan 30 and then fed to any suitable reel or other support.

A more complete understanding of the inven-

tion may be had by reference to the following brief description of the mode of operation thereof. After the core unit 47, comprising the discs or insulators 49 and wire 48, has been formed in any suitable manner, it may be directed between the pads 41, through the channel-shaped guides 103 and 104 and thence between the guide rollers 114 and 115 and the sleeve 127 simultaneously with the feeding of tapes 42 from the pads 41 through the crimping die assembly 12. After the apparatus has been loaded and the operation thereof is started, the capstan 30 will draw the cable through the apparatus, assisted by the driven rollers 45 and their cooperating idler rollers 46. In being drawn through the forming dies 44, the tapes will be formed to concavo-convex configuration and will then be directed to the crimping die assembly 12, which, in each cycle of rotation of the drum 62, will cause the slidable supporting plate 67 to be advanced to the right (Fig. 7) and then retracted to the position shown. As the slidable supporting plate 67 moves to the right (Fig. 7), the bell crank levers 69 and 71 will be rocked about their pivots, as shown as 72 and 73, and will move the crimping dies 78 and 79 toward each other to crimp the tapes 42 as shown at 135. In performing this crimping action, the ridge 92 on crimping die 78 will cooperate with groove 93 on crimping die 79 and the ridge 92 on crimping die 79 will cooperate with the groove 93 on crimping die 78. The movement of the crimping dies toward each other will compress the springs 100 to clamp the tapes 42 between the crimping dies and effect the forming thereof as the support 67 moves together with the tapes 42. As soon as the crimping operation is completed, the bell crank levers 69 and 71 will be returned to their normal position, as shown in Fig. 3, and the support plate 67 will be returned to the position shown due to the configuration of the cam grooves 63 and 64. After the tapes 42 have been crimped, they will be guided together by the guide rollers 114 and 115 and then will be fed through the sleeve 127 and will have the armor tapes 123 and 124 wrapped spirally around them to retain them in position.

What is claimed is:

1. In an article forming apparatus, means for advancing continuously a cable core along a predetermined path, means for advancing a pair of conductive tapes continuously along opposite sides of the predetermined path, means for forming into concavo-convex sections said pair of conductive tapes as the tapes are advanced by the tape advancing means, a support reciprocable along a line parallel to the predetermined path, a cam-follower secured to the support, a cam for actuating the cam follower to reciprocate the support, a pair of convex dies slidably secured to the support, a pair of concave dies secured to the support and slidable directly transversely to the line of reciprocation of the support for cooperating with the convex dies to crimp the tapes therebetween, means associated with the cam for moving the convex and the concave dies into operative engagement with each other

to crimp the tapes therebetween when the support is moved in the direction the tapes are advanced, means for separating the convex and the concave dies while the support is moved in the direction of movement of the tapes, means for guiding the crimped portions of the tape into association with the cable core, and means for serving tapes around the crimped portions of the first-mentioned tapes after the latter have been guided into association with the cable core.

2. An article forming apparatus, which comprises a male forming die, a female forming die, means for connecting the male forming die rigidly to the female forming die in positions in which they face the same direction, a second male forming die complementary to the female forming die, a second female forming die complementary to the first male forming die, a second connecting means for connecting the second male forming die rigidly to the second female forming die in positions in which they face the same direction, means for mounting the dies in positions in which the male forming dies face the female forming dies, means for slidably supporting the dies and the conecting means, and means for effecting closing movement of the dies, whereby two tapes positioned between the dies may be crimped simultaneously.

3. An article forming apparatus, which comprises a member having a male forming die formed on one end thereof and a female forming die formed on the other end thereof, said dies facing in the same direction and being offset laterally from each other, a second member having a female forming die complementary to the male forming die and formed on one end thereof and a male forming die complementary to the female forming die of the first member and formed on the other end thereof, said dies of the second member facing in the same direction and being offset laterally from each other, means for slidably mounting said members in opposed positions, and means for effecting relative movement between said members to move the male forming dies into forming engagement with the female forming dies.

ALEXANDER LOGAN.

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