Aug. 4, 1959 H. D. ISENBERG 2,897,542

APPARATUS FOR FORMING COAXIAL CABLES

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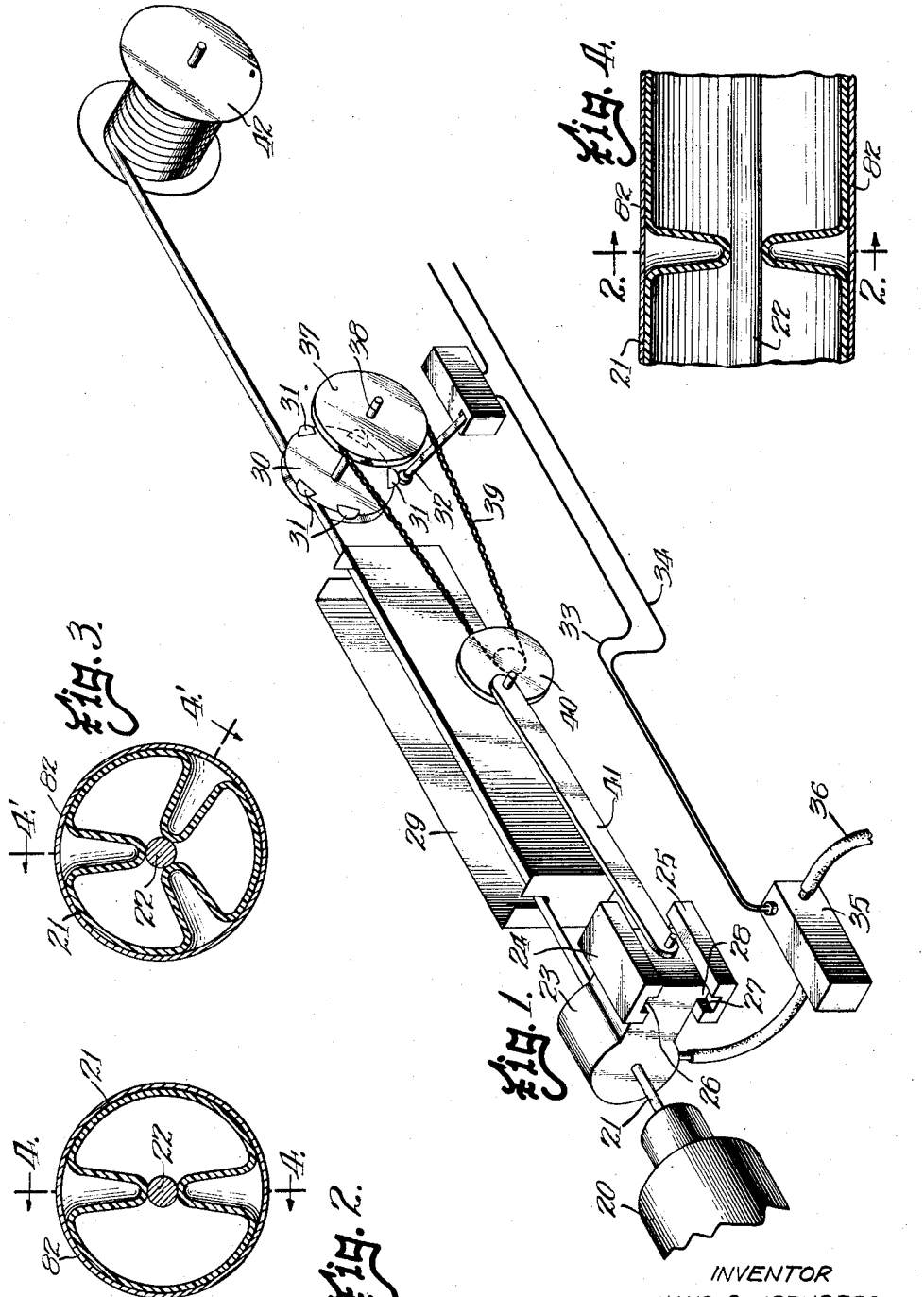


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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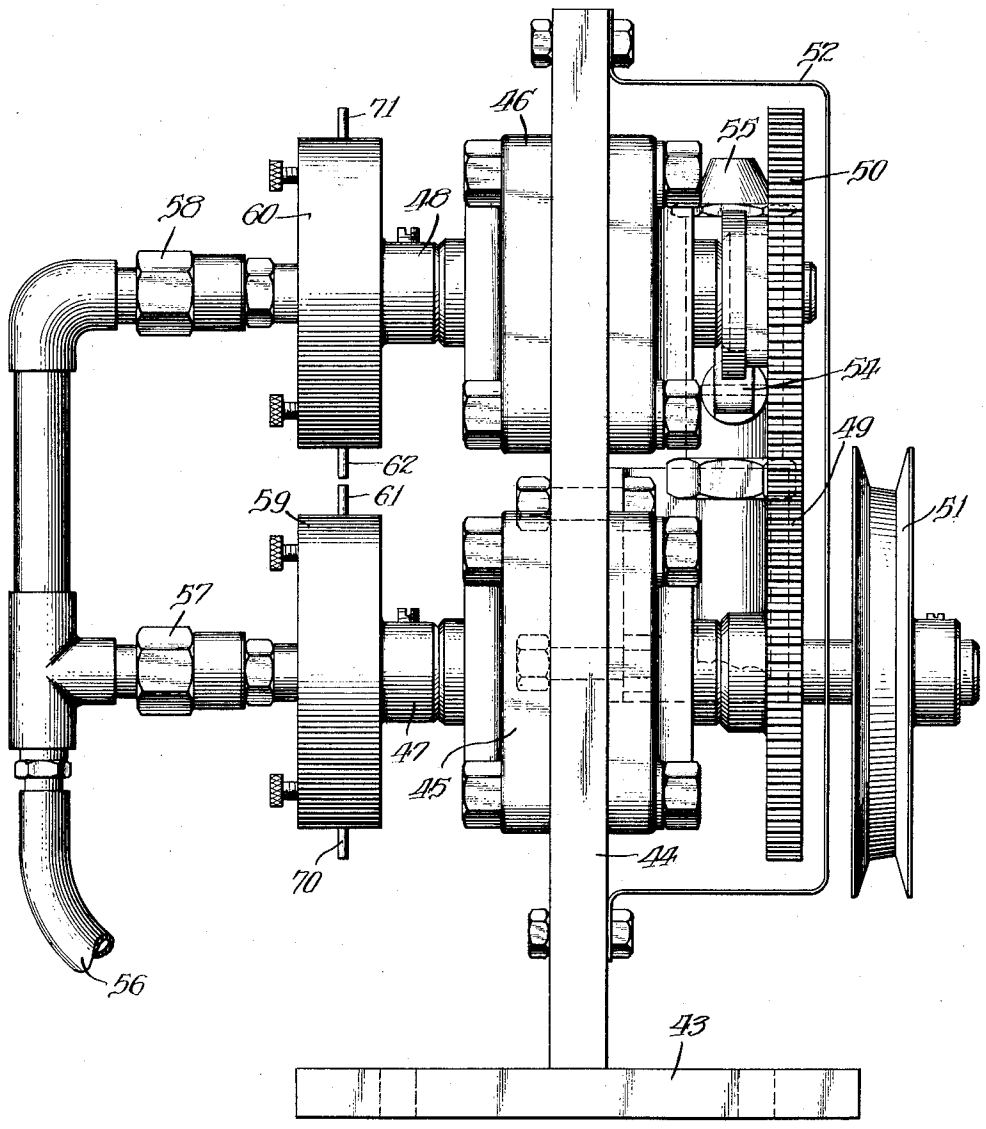


Fig. 5.

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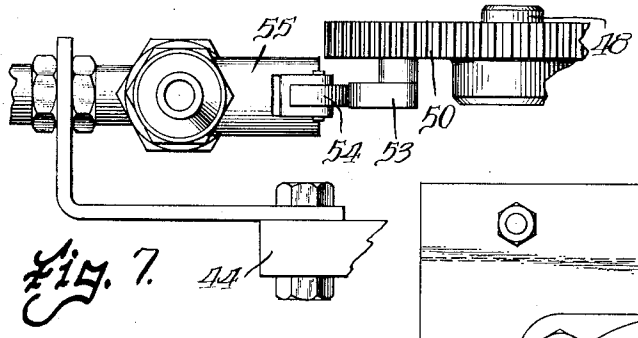


Fig. 7.

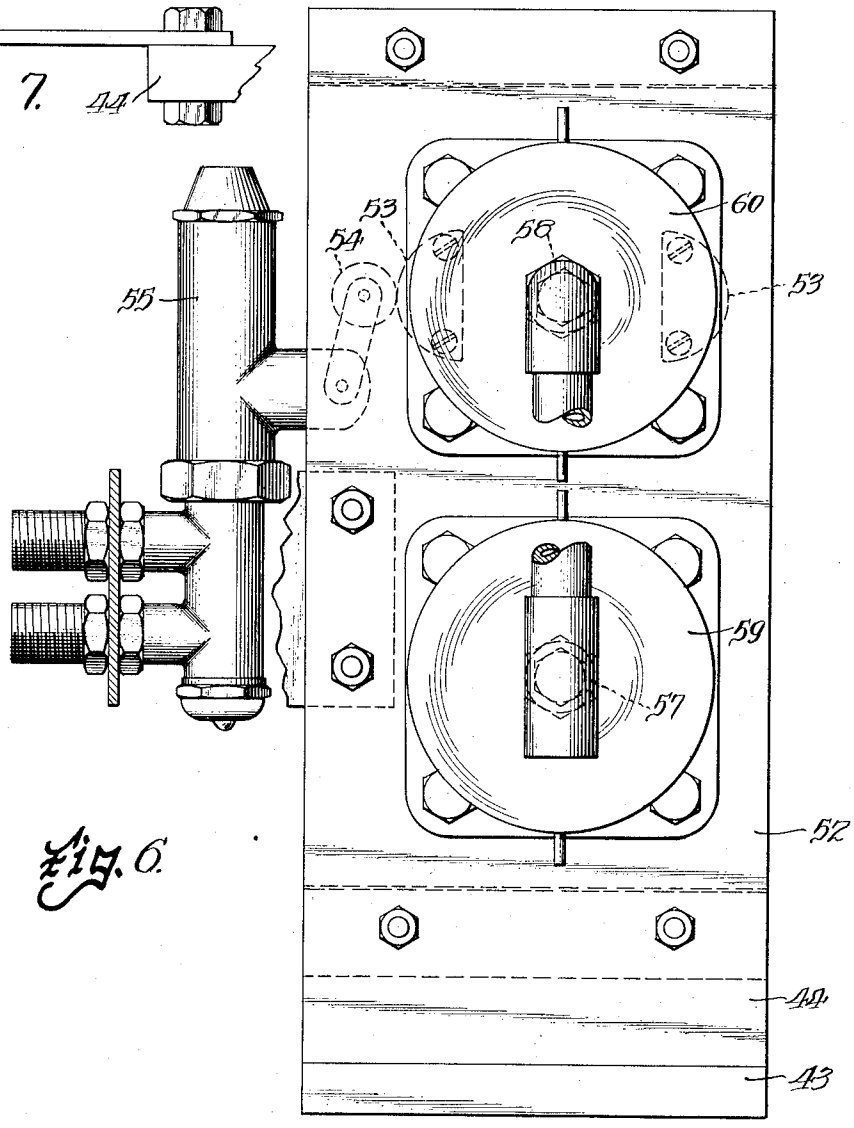


Fig. 6.

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Fig. 8.

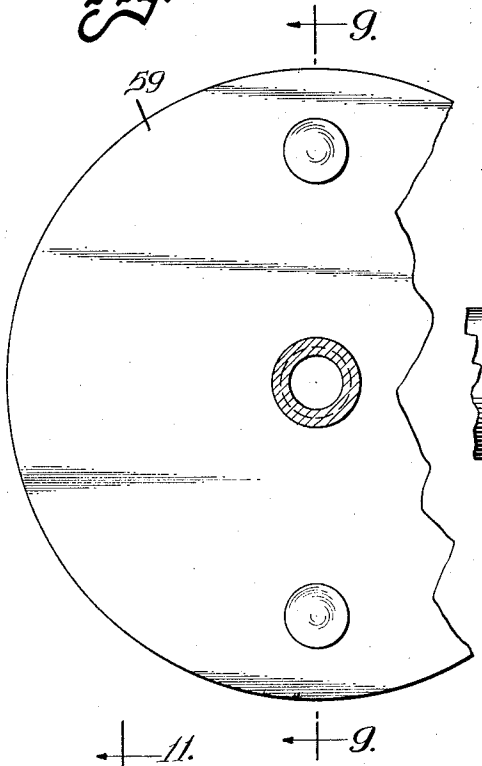
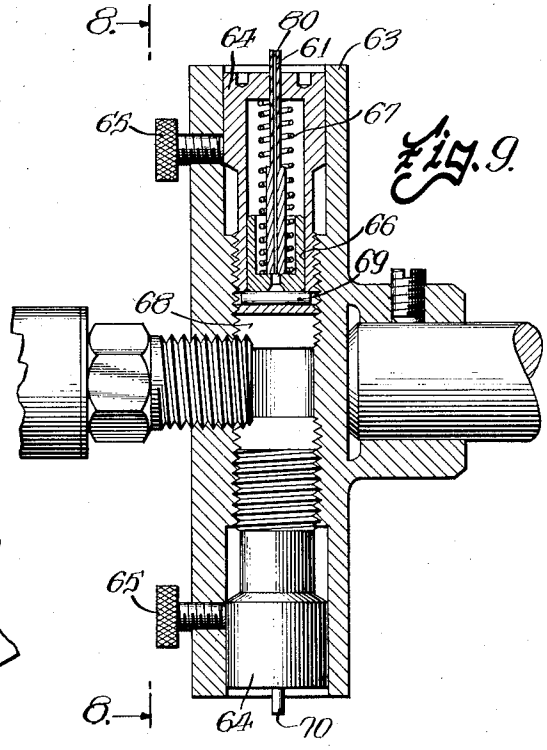


Fig. 9.



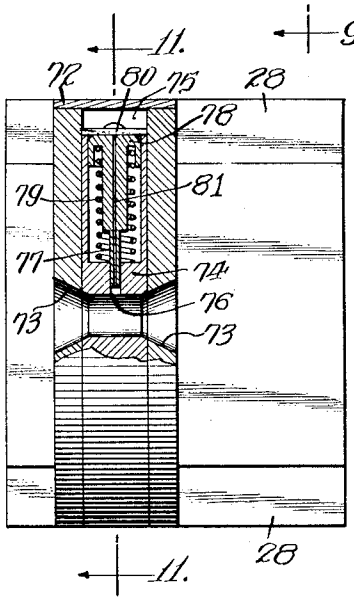


Fig. 10.

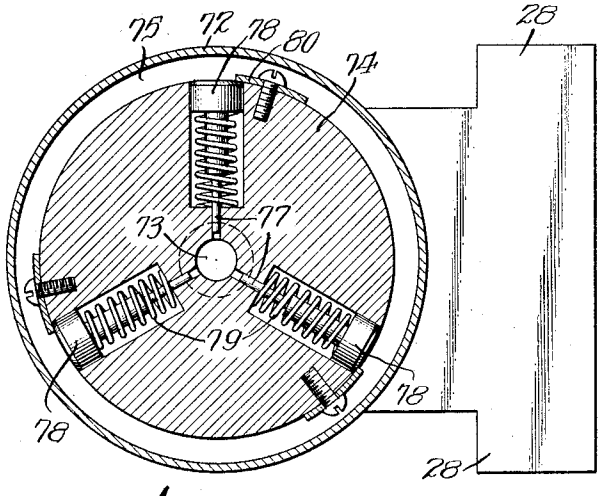


Fig. 11.

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2,897,542

APPARATUS FOR FORMING COAXIAL CABLES

Hans D. Isenberg, Wilmette, Ill.

Application December 5, 1952, Serial No. 324,314

12 Claims. (Cl. 18—13)

This invention relates to a new and improved apparatus for forming coaxial cable and more particularly to apparatus for forming coaxial cable in which the walls of an insulating layer positioned between the outer and inner conductors of the cable are distorted to thereby position the conductors in spaced coaxial relationship and to apparatus for forming the distortions in the insulating layer.

Prior arrangements for spacing the inner and outer conductors of a coaxial cable have been of two general types. The first type has involved the insertion of a series of separate insulating members, such as discs or the like, on the inner conductor and applying an outer conductor about the outer periphery of the insulating spacers. Apparatus employing this method has been mechanically complex, usually involving the utilization of a large number of coordinated moving parts, and for this reason the apparatus has been expensive to construct and maintain. Attempts have been made to provide an insulating member which is spirally wound around the inner conductor to thereby separate the inner and outer conductors, but this type of cable is also expensive to produce due to the large amount of material required in the insulating layer.

The second general type system of the prior art has involved the use of tubular insulating layers which are provided with webs formed integrally with the tubular layer and extending inward from the exterior wall into contact with the inner conductor. While this second system is a considerable improvement over the first type in the reduction of the number of moving parts, the cost of the insulating layer has nevertheless remained high due to the amount of material necessary to form the webs. The second type system has also involved the use of special type extruding dies and complex systems for opening and closing the dies to form the web, which, of course, add considerably to the cost of the apparatus for producing the cable.

The present invention overcomes the difficulties of the prior art systems by providing a new and improved coaxial cable which is less costly to manufacture and which is produced by apparatus which is mechanically simple in that the structure utilized involves a minimum number of moving parts. The cable is formed by continuously extruding a plastic tube in spaced coaxial relationship with an inner conductor, periodically distorting the walls of the plastic tube while the tube is in a soft, pliable state by means of air jets which are directed radially of the inner conductor. In this manner, the soft portions of the distorted sections of the tube wall are forced into contact with the inner conductor so that when the tube is cooled, the distorted portion of the tube wall adheres to the conductor and holds it firmly in position. Timing means are employed to control the duration and the sequence of the air blasts so that the tube wall distortions occur at desired positions in the tube wall. It is apparent that this system will produce a coaxial cable in which the insulating layer between the outer and inner conductors is of uniform thickness throughout its extent and in which the inner conductor is maintained in spaced coaxial relationship by the series of indentations in the tubular wall produced by the air blasts. Provision is made for adjusting the air nozzles with respect to the plastic tube so that the apparatus may be made to conform to the size cable being manufactured. The apparatus of the present invention permits the manufacture of coaxial cables at a high speed which is limited only by the rate at which the plastic tube can be extruded.

Accordingly, it is an object of the present invention to provide a non-complex apparatus for forming a coaxial cable which utilizes a minimum number of moving parts.

A still further object is to provide an apparatus for producing a coaxial cable at high speed by applying a force to the walls of an extruded plastic tube to thereby produce a series of inwardly directed radial wells which serve to hold the inner conductor in spaced coaxial relationship with respect to the outer conductor.

Another object of the invention is to provide an apparatus for applying a distorting force to the walls of an extruded plastic tube and for controlling the time of duration of the application of said force and the time intervals between applications in order that the tube walls may be distorted at a series of intervals along the extent of the tube whereby the distortions serve to position the inner conductor of the coaxial cable in spaced relationship with respect to the outer conductor.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 illustrates in diagrammatic form one type of apparatus of the present invention;

Fig. 2 is a cross sectional view taken along a line substantially corresponding to line 2—2 of Fig. 4 and shows a type of coaxial cable formed by means of the present invention by utilizing two jets directed radially with respect to the longitudinal axis of the cable;

Fig. 3 shows a cross sectional view of a coaxial cable formed by employing three of the aforementioned radial jets;

Fig. 4 is a longitudinal sectional view of the cable taken along a line substantially corresponding to line 4—4 of Fig. 2, and line 4'—4' of Fig. 3;

Fig. 5 is a front elevation view of one type of apparatus which may be used for controlling the actuation of the plungers from the compressed air supply to control a two jet system for producing a cable of the type shown in Fig. 2;

Fig. 6 is a side elevation view of the apparatus shown in Fig. 5;

Fig. 7 is a broken away view of a portion of the apparatus of Fig. 5 showing the details of the cam and switch arrangement for controlling the flow of air through an air valve;

Fig. 8 is a partial front view taken along a line substantially corresponding to line 8—8 of Fig. 9 and showing one type of wire locating unit which may be used in conjunction with the apparatus of Fig. 5;

Fig. 9 is a cross sectional view of the unit of Fig. 8 taken along a line substantially corresponding to line 9—9 of that figure;

Fig. 10 is a partial sectional view illustrating a wire locating unit which may be employed to form a cable of the type shown in Fig. 3; and

Fig. 11 is a sectional view taken along a line substantially corresponding to line 11—11 of Fig. 10.

Referring now to the drawings, wherein like reference

characters designate like or corresponding parts throughout the several views, there is shown in Fig. 1 an extruder 20 for continuously extruding a plastic tube 21 around an inner conductor 22 which is likewise continually moving in spaced coaxial relationship within the tube. The extruded plastic material may be polyethylene, tetrafluoroethylene, trichlorofluroethylene, silicone rubber, or other similar dielectric materials. However, these materials are cited purely for purposes of illustration since it is manifest that virtually any suitable dielectric insulating material may be utilized.

The extruded plastic tube 21 and the inner conductor 22 spaced therein are passed through a center wire locating unit 23 while the plastic material of the tube is still in a soft, pliable condition. The wire locating unit is reciprocally mounted upon a pair of slide rails 24 and 25 which are positioned on opposite sides of the unit 23 so that longitudinal slots 26 and 27 in the rails serve to receive the keys 28 formed integral with the locating unit. The unit 23 is used to supply a radially directed force to the walls of the tube 21 in order to distort the walls of the tube a sufficient distance to enable the soft, pliable plastic to be brought into contact with the inner conductor 22 in a manner to be subsequently described in more detail. After the walls of the tube have been distorted by the desired amount, the tube is passed through a cooling trough 29 which may be filled with a cooling liquid in order to cause the plastic tube to harden and to cause the distorted portions of the walls in contact with the inner conductor to adhere thereto.

When the hardened tube emerges from the cooling trough it may be passed over a capstan 30 which applies a moving force to the hardened plastic tube and the inner conductor held thereby in order to draw the tube and the conductor through the trough 29. The capstan 30 is provided with a plurality of cams 31 which are spaced equi-distantly around the outer periphery of the capstan so as to contact the movable arm of a cam-controlled electrical switch 32 positioned in the path of rotation of the cams 31. The switch 32 is electrically connected through the conductors 33 and 34 to a solenoid or the like which actuates an air valve 35 to control the flow of air from a source of compressed air through the air line hose 36 to the wire locating unit 23.

A cam pulley 37 mounted on a shaft 38, which also serves to drive the capstan 30, is connected by a driving chain 39 to a cam wheel 40 so that movement of the capstan 30 causes the wheel 40 to be rotated. Interconnecting the wheel 40 and the wire locating unit 23 is a connecting bar 41 which enables the wire locating unit 23 to be reciprocated upon the slide rails 24 and 25 when the wheel 40 is rotated by movement of the capstan 30. In this manner, movement of the hardened plastic tube over the capstan 30 causes the wire locating unit 23 to be moved at a rate equal to the movement of the tube so that upon actuation of the force applying means of the wire locating unit there is no relative movement between the unit and tube. Manifestly, if the tube were moved relative to the unit 23 as the force applying means is actuated, a tearing of the soft plastic walls of the tube would result. After the plastic tube has been hardened and passed over the capstan 30 a take up reel 42 may be provided for storing the finished cable.

There is shown in Fig. 5 a machine which may be employed to perform the present invention for forming a cable of the type shown in Fig. 2 having only two radial wells in the insulating tube at any one position along the longitudinal axis of the cable. As is apparent from the drawing, the machine includes a horizontal base 43, and an upright support member 44 formed integral therewith. Secured to the support member in any suitable manner are a pair of bearing assemblies 45 and 46 which journal shafts 47 and 48 respectively. Mounted on these shafts are a pair of intermeshing spur gears 49 and 50 which serve to impart simultaneous rotation to both of the shafts. A capstan 51 mounted on the shaft 47 serves as a driving source for the well producing means. The inner conductor is wound several times around the capstan before entering the extruder so that the well forming means is synchronized with the extrusion speed at all times. A bracket 52 secured to the upright member 44 provides additional support for the shaft 47 and the capstan 51. Secured to the spur gear 50 and mounted for rotation with the shaft 47 is a switch operating cam 53 which actuates a movable arm 54 positioned in the path of rotation of the cam in a manner similar to the cam and switch arrangement 31 and 32 of Fig. 1. The movable arm 54 actuates a mechanism for opening and closing an air valve 55 either mechanically or electrically in a manner conventional in the art. The air valve 55 is connected through a hose 56 and swivel hose connections 57 and 58 to a pair of wire locating units 59 and 60 so that movement of the movable arm 54 by the cam 53 causes the valve to open to thereby admit compressed air from a compressed air source, which is not shown, to the locating units 59 and 60.

The units 59 and 60 are identical in construction and are positioned on opposite sides of the extruded plastic tube and the inner conductor which is continuously moving with the tube. Plungers 61 and 62 are reciprocally mounted within the units 59 and 60, respectively, and are positioned closely adjacent the extruded tube which is passing therebetween. The unit 59 includes a housing 63 rotatably mounted on the shaft 48 and having a plurality of radial bores spaced equi-distantly therein. Threadedly inserted into each of the bores is a hollow cylindrical insert 64 held in position within the bore by a knurled adjusting screw 65 which extends through the wall of the housing 63 so as to contact the outer surface of the insert 64. The plunger 61 is slidably mounted within the hollow of the cylindrical insert 64 so as to extend through a central opening in the head of the insert into the hollow portion of the insert so that a plunger head 66 secured to the inner end of the plunger 61 fits closely within the hollow of the insert 64. A compression spring 67 is inserted between the plunger head 66 and the outer face of the insert 64 so as to encompass the plunger 61 within the hollow of the cylindrical insert.

In the center of the housing 63 is a central air chamber 68 which simultaneously applies a blast of compressed air from the air valve 55 to each of the plunger heads 66 to thereby actuate the plungers and force them outward away from the air chamber. As the plungers 61 and 62 are forced outwardly the wall of the plastic tube which is passing between the plungers is molded inwardly until the walls are forced into contact with the inner conductor. The plungers are maintained in their outward position for an instant of time which is determined by the duration of the blast of compressed air from the supply to the air chamber 68. The time during which compressed air is in the chamber is in turn controlled by the shape of the cams 53 and the speed of rotation of the gear 50 on which the cams are mounted which, of course, determines the period during which the air valve 55 is open. As soon as the supply of compressed air is cut off by the valve 55 when the cam 53 has passed over the movable arm 54 the plunger 61 is returned to its inward position by the compression spring 67, which had been compressed between an inner face of the cylindrical insert 64 and the plunger head 66 during the outward movement of the plunger. The compression spring 67 forces the plunger inwardly toward the air chamber 68 until the plunger head 66 contacts a stop 69 fixedly mounted within the bore of the housing 63 in order to prevent movement of the plunger head into the air chamber 68. The plunger will remain in its inward position until a subsequent

blast of compressed air is admitted to the chamber through the air valve **55** by the actuation of the arm **54** by the next succeeding cam on the gear **50**. Thus, it can be seen that the time between air blasts and the time between actuations of the plungers is controlled by the speed of rotation of the gear **50** and the spacing between the cams **53**.

The position of the plungers may be varied to correspond to the size of plastic tube being extruded and consequently to the size of coaxial cable being formed by loosening the adjustable screw **65** and threading the insert **64** to the desired depth so that the plunger **61** is thereby moved in the desired direction. Of course, it is desirable that each of the plungers be adjusted to exactly the same depth so that the actuation of the plungers from the air supply will cause equal movement of the tube walls in all directions.

It can be seen that the apparatus of Figs. 5, 6, 7, 8 and 9 are designed for the simultaneous actuation of two control units to simultaneously produce two indentations in the tube walls when the plungers **61** and **62** are actuated. The coaxial cable produced by such apparatus has a cross-sectional appearance somewhat similar to that shown in Fig. 2 in which it can be seen that the plastic tube **21** has been forced inwardly in two diametrically opposed positions to contact the inner conductor **22**. In the production of small diameter coaxial cables it may be desirable to employ only two such indentations since the use of an excessive number of distortions of the tube walls may force the plastic to run together.

In the overall operation of the apparatus of Fig. 5, movement of the inner conductor **22** over the capstan **51** causes rotation of the shaft **47**, the wire locating unit **59** mounted thereon and the spur gear **49** secured thereto. The intermeshing gear **50** is thereby rotated to rotate the shaft **48**, the cam **53** and the wire locating unit **60** concurrently with the rotation of the shaft **47** and the rotation of the wire locating unit **59**. At the instant when the plungers **61** and **62** are aligned, the cam **53** pivots the control arm **54** to open the air valve **55** and admit pressure to the air chambers of the units **59** and **60** to thereby actuate the plungers toward each other. The soft plastic tube which is located between the plungers is thus distorted until a firm contact is formed with the inner conductor **22**. The valve **55** is closed as soon as the cam **53** has passed and the plungers are then retracted, whereupon the units **59** and **60** continue to rotate until the plungers **70** and **71** located on diametrically opposite sides of the wire locating units from the plungers **61** and **62** are aligned, at which time the plungers **70** and **71** will be actuated to cause another distortion in the walls of the plastic tube.

In the event that a larger diameter cable is being manufactured it may be desirable to employ a wire locating unit such as the one shown in Figs. 10 and 11. The type unit shown in these figures corresponds to the unit **23** of Fig. 1 in which the keys **28** are designed to be reciprocated within a pair of cooperating slotted rails. The unit also includes a hollow cylindrical housing **72** which is provided with a pair of tapered central openings **73** passing through the faces of the cylindrical housing to permit the passage of the soft, plastic extruded tube and the inner conductor therethrough. Fitting within the hollow portion of the cylinder **72** and having a plurality of radial bores equidistantly spaced therein is a solid disc **74** which fits within the cylindrical housing **72** so as to leave an air chamber **75** between the inner surface of the cylindrical wall of the housing and the outer surface of the disc **74**. The disc **74** is also provided with a central opening **76** which is aligned with the tapered openings **73** so that the extruded tube and the inner conductor may pass through the aligned openings. Within each of the radial bores of the disc **74** is inserted a plunger **77**, the inner end of which is positioned near the opening **76** and the outer end of which is secured to a plunger head **78**. A compression spring **79** is inserted between the plunger head **78** and the lower extremity of the radial bores in the disc **74**. When a blast of compressed air is admitted to the chamber **75** from the air valve **35**, the plunger head **78** and the plunger **77** are moved inwardly until the plunger contacts the extruded tube passing through the aligned openings **73** and **76**. The simultaneous movement of each of the plungers **77** causes a series of indentations or radial wells to be formed in the plastic tube in such manner that the inner extremities of these indentations contact and adhere to the inner conductor **22** positioned in the center of the tube. As soon as the air blast is removed, the compression spring **79**, which is compressed between the plunger head **78** and the lower extremity of the bore in the disc **74** by the inward movement of the plunger, expands to force the plungers outwardly, whereupon the extruded cable which is passing through the aligned openings is passed without distorting the walls thereof. The outward movement of the plunger **77** and the plunger head **78** is limited by a stop **80** which is secured to the disc **74** in any suitable manner in the path of movement of the plunger head.

A cable produced by the wire locating unit of Figs. 10 and 11, using three radial jets, would have an appearance similar to that shown in Fig. 3 in which it can be seen that the inner extremities of the radial wells formed in the tube **21** are forced into contact with the inner conductor **22**. Each of the plungers used in the apparatus is provided with a longitudinal slot **81** passing through the entire length of the plunger to permit a portion of the compressed air to pass therethrough. The blasts of air through these slots aid in shaping the indentions in the plastic tube wall and at the same time help to cool the soft plastic to cause it to begin to harden. The air through this longitudinal slot also aids in freeing the plungers from the soft plastic material so that withdrawal of the plungers will not distort the shape of the radial wells formed in the tube.

In the embodiments herein disclosed the outer conductor **82** of the coaxial cable is applied by wrapping the plastic tube with a metallic sheath after the tube has hardened. It is apparent however, that the outer conductor might also be applied by inserting the plastic tube and the inner conductor held thereby within a tubular outer conductor, or by spraying the outer conductor over the outer portion of the hardened tube, or by any other means well known in the art. It is also possible to extrude the plastic tube between an inner conductor and an outer sheath so that the tube is positioned near the outer surface of the sheath. A force applied to the outer surface of the sheath can then be transmitted through the sheath to the soft plastic tube to cause indentations in the tube and hold the inner conductor in position. Hence, it can be seen that these and many other modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described and it is intended to cover all modifications within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In an apparatus for forming cables from an inner conductor disposed within an outer tube, the combination of means for continuously moving said conductor and said tube, means for distorting the walls of the tube into engagement with the inner conductor, means operated in time correlation with the conductor moving means for periodically rendering said distorting means effective to distort the walls of the tube in order to form the distortions at predetermined spaced apart regions of said tube, means to direct fluid adjacent the distorting means

and against the distortions in the tube during each operation of the distorting means, and means operated in synchronism with the periodic operating of the distorting means for moving the distorting means in the direction of movement of the conductor and at substantially the same rate as said movement during each period when said walls are being distorted.

2. In an apparatus for forming cables from an inner conductor disposed within an outer tube, the combination of a plurality of force applying means each including a jet forming means and mounted in a plane perpendicular to the conductor and tube, means for moving the conductor and tube through the force applying means, fluid pressure means for supplying fluid to the force applying means and to the jet forming means to distort portions of the tube walls into engagement with the inner conductor and to direct fluid blasts against the distorted portions of the tube walls, and means operated in synchronism with the moving means for sequentially rendering said fluid pressure means operable to supply fluid to said force applying means and said jet forming means for periods of predetermined duration and at predetermined intervals, whereby the distorted portions of the tube walls are formed at longitudinally spaced apart regions in order to hold the inner conductor in position within the tube.

3. In an apparatus for forming cables from an inner conductor disposed within an outer tube, the combination of means for distorting spaced apart regions of the walls of the tube into engagement with the inner conductor, means for moving said conductor and said tube past the distorting means, said distorting means comprising support structure disposed adjacent the path of movement of the tube and including a plurality of bores extending radially of the tube, a piston having an enlarged head fitting within each of said bores and also having a stem on said head, a common fluid supply connected to each of said bores to supply fluid pressure for moving said pistons within said bores and forcing the stem portions against the walls of the tube, means defining a fluid passage in each piston opening at one end to the fluid pressure from the supply and extending through the stem to deliver fluid pressure to the tube walls, and control means energized in synchronism with the movement of the conductor and the tube for periodically supplying fluid from the supply to all of the bores to move said pistons and, at the same time, to direct fluid through the passages against the distortions in the tube walls formed by the stems.

4. Apparatus for forming cables which comprises means for continuously moving a conductor, an extruder for continuously extruding plastic material in spaced relationship with respect to said conductor, means for distorting the walls of the extruded material into engagement with the outer surface of said conductor in order to hold the conductor in position, means operated in time correlation with the conductor moving means for periodically energizing said distorting means in order to form distortions in the walls at regular predetermined intervals in said material, means to direct fluid blasts radially of said material during each interval of operation of the distorting means, and means operated in synchronism with the periodic energization of said distorting means for moving the distorting means in the direction of movement of said conductor and at substantially the same rate as said movement during each period when said walls are being distorted.

5. Apparatus for forming cables which comprises means for continuously moving a conductor, an extruder for continuously extruding a plastic material around said conductor, means for applying force radially of the walls of said material in order to distort the material into engagement with said conductor, means operable by the conductor moving means for periodically energizing the force applying means in order to form the distortions in said plastic material at regular predetermined positions, means to direct fluid blasts radially of said walls during each interval of operation of the distorting means, and means operated in synchronism with the periodic energization of said force applying means for moving the latter in the direction of movement of said conductor and at substantially the same rate as said movement during the periods when said force applying means is effective to distort said material.

6. Apparatus for forming cables which comprises means for continuously moving a conductor, an extruder for continuously extruding a plastic tube in spaced coaxial relationship with respect to said conductor, means for applying force directed radially of said tube to force the same into engagement with the conductor, means operated by said conductor moving means for periodically energizing the force applying means in order to distort the tube at positions spaced longitudinally of said conductor, timing means also driven by said conductor moving means for controlling the duration of the application of force to the walls of said tube, means operated in synchronism with the periodic energization of said force applying means for moving the latter in the direction of movement of said conductor and at substantially the same rate as said movement during each period when the force applying means is effective to distort the tube walls, and means driven by said conductor moving means for returning the force applying means to its initial position at the termination of each period of force application.

7. An apparatus for forming cables which comprises means for continuously moving a conductor, an extruder for continuously extruding a plastic tube in coaxial relationship with respect to said continuously moving conductor, a plurality of force applying means mounted in a single plane perpendicular to the moving conductor and the extruded tube at a position near the extruder so that the force of each of said means is directed radially of the conductor and the tube, means controlled by the movement of the tube and the conductor for periodically deenergizing the force applying means for predetermined intervals and for sequentially energizing the force applying means at the termination of each of said predetermined intervals, means also controlled by the movement of said tube and said conductor for maintaining said force applying means in an energized condition for a predetermined duration sufficient to distort the walls of the tube into engagement with the conductor whereby a cable is produced having a conductor held in position by the distortions of the tube walls.

8. An apparatus for forming cables which comprises means for continuously moving a conductor, an extruder for continuously extruding a plastic tube in coaxial relationship with respect to said conductor, a plurality of force applying means mounted in a single plane perpendicular to the moving conductor and the extruded tube at a position near the extruder so that the force applying means are directed radially of the conductor and the tube, means for adjusting the radial position of said force applying means with respect to the tube to conform to the size of the cable being formed, means operated by the conductor moving means for sequentially energizing said force applying means during spaced apart intervals of predetermined duration so that the force applying means forces longitudinally spaced portions of the tube into engagement with the conductor in order to form a cable.

9. In an apparatus for forming cables the combination of means for continuously moving a conductor, an extruder for continuously extruding a plastic tube in coaxial relationship with respect to said continuously moving conductor, a plurality of force applying means each including a jet forming means mounted in a single plane perpendicular to the moving conductor and the extruded tube at a position near the extruder, fluid pressure means for supplying fluid under pressure to the force applying means including the jet forming means to direct a plurality of fluid jets radially of said conductor and the tube,

and means controlled by the conductor moving means for sequentially rendering said fluid pressure means operable to supply fluid under pressure to said force applying means and said jet forming means for periods of predetermined duration and at regular predetermined intervals whereby longitudinally spaced portions of the tube are forced into engagement with the conductor to hold the latter in position.

10. In an apparatus for forming cables the combination of means for continuously moving a conductor, an extruder for continuously extruding a plastic tube in coaxial relationship with respect to said conductor, a plurality of force applying means each including a jet forming means mounted in a single plane perpendicular to said conductor at a position adjacent the extruder, means for supplying fluid under pressure to said force applying means including the jet forming means to direct a flow of fluid radially of the conductor and the tube, means for adjusting the radial position of the jet forming means with respect to the tube to conform to the size of the cable being formed, means controlled by the conductor moving means for actuating the fluid pressure supplying means at spaced intervals of predetermined duration in order to sequentially supply fluid to the force applying means and the jet forming means to force portions of the tube into engagement with the conductor.

11. In an apparatus for forming cables the combination of means for continuously moving a conductor, an extruder for continuously extruding a plastic tube in coaxial relationship with respect to said conductor, a plurality of force applying means each including a jet forming means mounted in a single plane perpendicular to the moving conductor and the extruded tube at a position adjacent the extruder, means for supplying fluid under pressure to said force applying means including said jet forming means to direct a plurality of jets radially of the conductor and the tube, a valve for simultaneously controlling the flow of fluid to said jet forming means, means for adjusting the radial position of said jet forming means with respect to the tube to conform to the size of the cable being formed, means controlled by the movement of the tube and the conductor for maintaining the valve in closed position for predetermined intervals and for sequentially opening the valve at the termination of said predetermined intervals, said last named means including at least one cam driven by the means for moving said conductor for maintaining the valve open to supply fluid for a predetermined duration to said force applying means and said jet forming means in order to force portions of the tube into engagement with the conductor, the sequential opening and closing of said valve being effective to produce longitudinally spaced distortions in the tube in order to hold the conductor in position.

12. In an apparatus for forming cables the combination of means for continuously moving a conductor, an extruder for continuously extruding the plastic tube in coaxial relationship with respect to said conductor, a plurality of force applying means mounted in a single plane perpendicular to the conductor and the extruded tube in a position adjacent the extruder, means for supplying fluid under pressure to said force applying means to direct forces radially of the conductor and the tube, a valve for simultaneously controlling the flow of fluid to all of said force applying means, means controlled by the movement of the tube and the conductor for maintaining the valve in closed position for predetermined intervals and for sequentially opening the valve at the termination of each of said predetermined intervals, said last named means including at least one cam driven by the means for moving said conductor for maintaining the valve open for a predetermined duration at the termination of each of said intervals in order to supply fluid to the force applying means for a period of time sufficient to force portions of the tube into engagement with the conductor, the sequential operation of said valve being effective to produce a plurality of longitudinally spaced distortions in the tube which function to hold the conductor in fixed coaxial relationship with respect to the tube.

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