Oct. 18, 1938. H. D. ISENBERG 2,133,620

MEANS FOR MAKING TUBULAR INSULATION

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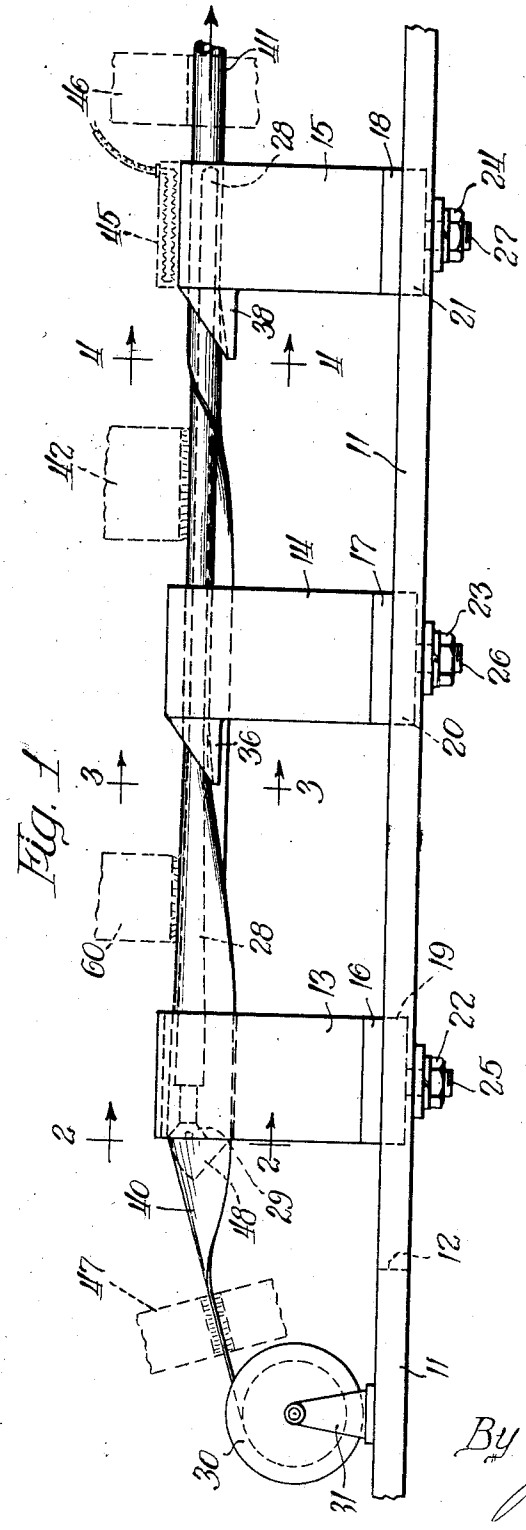


Fig. 1

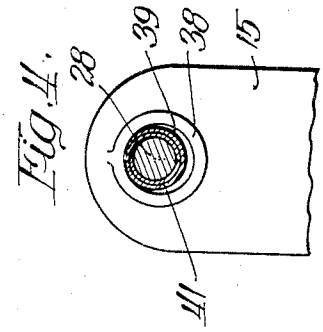


Fig. 4.

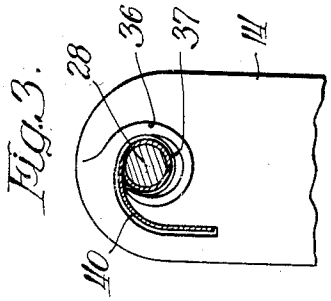


Fig. 3.

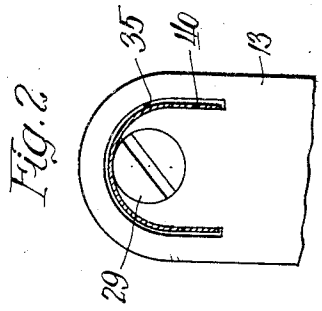


Fig. 2

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Fig. 5.

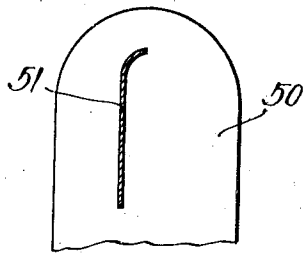


Fig. 6.

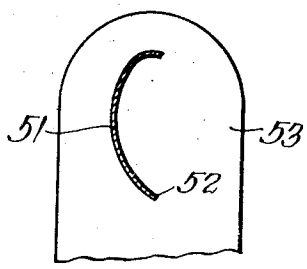


Fig. 7.

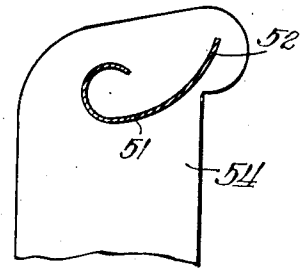


Fig. 8.

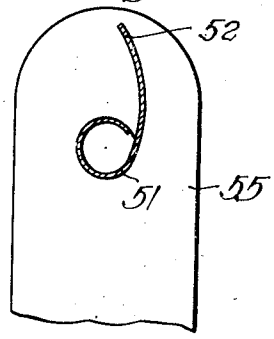


Fig. 9.

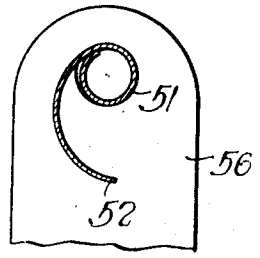


Fig. 10.

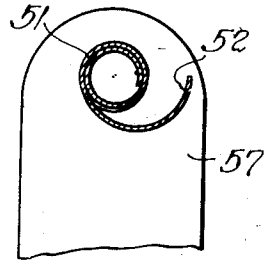


Fig. 11.

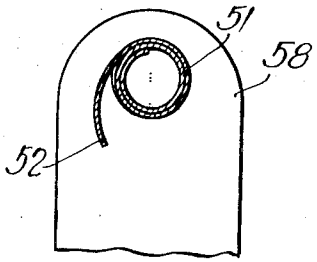
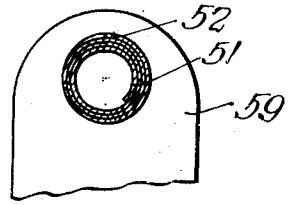


Fig. 12



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UNITED STATES PATENT OFFICE

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MEANS FOR MAKING TUBULAR INSULATION

Hans D. Isenberg, Chicago, Ill.

Application April 8, 1935, Serial No. 15,265

3 Claims. (Cl. 154—2.5)

This invention relates generally stated to a method and to means for making tubular insulation and is particularly concerned with the production of sleeving or tubing for electrical insulating purposes.

The principles which I employ in realizing my invention may be applied for making tubing of various materials and for numerous different purposes and, as will be shown presently, the invention may also be successfully used for providing insulation of the so-called "push-back" type directly to electrical conductors in a simpler and more efficient manner than was heretofore possible. I will presently describe and explain my invention with reference to specific embodiments but it will be understood from the foregoing remarks and from explanations which are to follow that this is being done merely for the purpose of facilitating the description and not in order to demonstrate any particular inherent limitations.

The following remarks concerning the prior art are made in order to furnish a basis for a better understanding of my invention.

The tubing in which I am primarily interested is used mostly in the electrical industry and is known under various names such as—"sleeving"—"varnished tubing"—and is also sometimes referred to as—"spaghetti tubing". It consists usually of fibrous material which is braided or woven into tubular shape and varnished, impregnated or otherwise treated with suitable insulating lacquer or the like according to the purpose for which the tubing is intended. It may be furnished cut to size in any suitable and normal length, or stored on drums and cut to size at the place where it is ultimately put to use. Tubing of this type is used for insulating electrical conductors in a great many apparatus assemblies, e. g., in the case of transformers or radio sets and the like. It is simply cut to the desired size and slipped and pushed into place over the corresponding conductor or conductors.

The manufacturing drawbacks arising in the case of the customary braided and/or woven tubing or sleeving of this type reside in the relatively expensive machinery required for its production and in the relatively small output that can be accomplished with existing methods. Among other things, a core is required around which the material is woven or braided and this core must be manually removed from the finished tubing. It may be mentioned at this point that certain machinery used at the present time for producing tubing of about 0.059 inch inside diameter is adapted to furnish per hour only approximately 36 feet of tubing. These conditions are of course reflected in the relatively high cost of the product.

Other disadvantages of a character that becomes chiefly manifest in the use of the tubing reside in the difficulties in the way of controlling the flexibility and determining the dielectric strength of the product. The flexibility is very largely dependent upon the material used for making the tubing and the type of substance employed for its impregnation. Inasmuch as both factors in turn determine the dielectric strength, it will be understood that particularly where electrical conditions require high dielectric strength, this can be obtained only at the expense of the flexibility of the tubing. A further drawback that may be noted in this connection resides in the fact that tubing of standard or customary size can be impregnated only on the outside; the application of impregnating material such as lacquer or varnish to the walls of the passage or inside of the tubing is not feasible for obvious reasons. Neither is it possible to furnish a braided or woven tubing with even and smooth inside walls which would permit its application on a wire without any trouble. The very character of the manufacturing methods used for braiding or weaving material into tubular shape results in a product having rough and uneven inside walls which handicap the work of slipping the tubing over the wire. This drawback is particularly serious in the case of mass production requiring mass assembly of electrical apparatus such as radio sets and the like where a great many conductors must be provided with insulating tubing or sleeving. The case of providing the previously intimated "push-back" type of insulation on electrical conductors may also be briefly considered. The term—"push-back"—denotes a type of insulation which is applied on a conductor in such a manner that it can be pushed back from the end of a piece of wire without any difficulties, thus exposing the wire for connection to its proper terminal or point of attachment and eliminating the skinning operations which would otherwise be necessary. The insulation on such a wire is usually applied by means of special braiding machines and the inherent nature of the manufacturing process usually involved renders a rather expensive product. As I have stated previously, my invention is also adapted to be used for producing this "push-back" type of insulation in a simpler and less expensive manner than was possible in the past.

Briefly stated, instead of braiding or weaving the material to form the tubing or the insulation,

respectively, I pull suitable insulating material such as cambric in tape form through one or through a series of folding and forming dies or gauges, whereby the tape material is progressively folded and rotated from one or from both sides of the tape to form the desired tubing or the insulation on a wire. In the case of tubing, a mandrel is used for determining the diameter of the tube opening; in the case of insulating a conductor, the conductor wire itself functions in the manner of a mandrel. Binding material may be applied and the material of the tubing may be impregnated during the production process. There are no rotating parts as such, but the folding and forming dies or gauges through which the tape material is progressively pulled or advanced, cause rotation of the material intermediate of the first and the last die or gauge. The seam in the resulting tubing extends substantially parallel to the axis of the tubing. Single or multiple layer tubing and/or insulation can be produced if desired. The production speed will depend upon the tensile strength of the material and can be controlled in the case of multiple layer tubing or insulation by the number of layers into which the tape material is rolled, folded or rotated. I am enabled by this process to increase the speed of production many times as compared with the customary methods. In certain instances I am enabled to increase the speed one hundred times. Whereas only about thirty-six feet of tubing of a certain type and size could be produced in one hour with old methods, I can produce about thirty-six hundred feet of tubing of substantially the same type.

Some of the important objects and features of my invention may be separately listed as follows:

One object is concerned with furnishing a new method and novel means for producing tubing generally, and specifically insulating tubing of the character mentioned above and to do this in a simpler and more efficient manner than was possible in the past.

Another object resides in eliminating during the production process the core formerly used for making tubing.

A further object is realized by the provision of a process and means for producing tubing wherein the flexibility and the dielectric strength of the product can be definitely controlled and determined.

Another object has to do with the production of tubing having smooth and even inside walls.

Still another object is realized by a tube forming process and means whereby the speed of production depends primarily and in most instances fully on the tensile strength of the material.

Other objects which will be brought out as the description progresses refer to the elimination of rotating parts at present required in tube producing machinery and also to various other features, for example to means for applying varnish or suitable impregnating material in such a manner that it will appear on the inside as well as on the outside walls of the finished article, and means for simplifying the application of adhesive substance during the production process. These and other objects and features not specifically mentioned above will presently appear.

It will be clear from the foregoing that it is also an object of my invention to furnish a novel process for manufacturing tubing and the like as well as new and improved machinery for carrying out the process. The product obtained by my new process and machinery is also new inasmuch as I furnish a tubing having smooth and substantially even inside walls and inasmuch as I am enabled to produce tubing which is varnished inside as well as outside. The fact that I am also able to determine and to control the dielectric strength as well as the flexibility of the product may be listed as an additional advantage.

The invention is illustrated diagrammatically in the accompanying drawings, in which:

Fig. 1 represents a schematic view of one embodiment of the machine and its salient parts illustrating the new method and its application in practice;

Fig. 2 is a diagrammatic view along the line 2—2 of Fig. 1, showing on a larger scale the first forming or folding die or gauge and its function;

Figs. 3 and 4 are diagrammatic views along lines 3—3 and 4—4, respectively of Fig. 1, illustrating the successive forming or folding dies and their functions;

Figs. 5 to 12, inclusive, are diagrammatic views of successive forming or folding dies or gauges and their functions according to another embodiment of my invention.

Superfluous structural matter which follows logically as a result of my teaching and which can be understood by those skilled in the art without any specific description is not being shown in the drawings in order to simplify the explanations and to facilitate understanding.

Referring now particularly to Figs. 1–4, inclusive, numeral 11 indicates a suitable bench or base having an elongated slot or channel 12 in which may be mounted the forming or folding dies such as 13, 14 and 15. Each die may be provided with a laterally extending flange such as indicated at 16, 17 and 18, respectively, and with an extension such as 19, 20 and 21 projecting into the channel 12 on the bench, and each die may be secured in its proper place by suitable means such as the nuts 22, 23 and 24, respectively, engaging the corresponding threaded studs 25, 26 and 27, each of which is a part of the corresponding dies 13, 14 or 15. It is thus possible to place each die or gauge on the bench and to determine the distance between the dies. Any given gang or set of dies will shape and fold tape material advanced or pulled therethrough in a predetermined manner yet to be described. The type and dimensions of the tape material which is to be formed into tubing or into insulation, respectively, will determine the proper distance between the dies which is most suitable for a speedy operation. Figs. 1–4 illustrate the manner of forming tubing, and the description furnished below is therefore principally concerned with this problem.

The gauge or die designated by numeral 13 is provided with a mandrel 28 (shown in Fig. 1 in dotted lines). This mandrel may be secured in die 13 at one end, as shown, e. g., by means of a screw such as 29 and extends through the successive dies into or beyond the last die 15. It determines the inside diameter of the tubing to be formed. The mandrel is removably mounted so as to provide an adjustable unit wherein each part may be easily removed and placed according to the function intended for it so as to meet any given requirement. A larger or a smaller mandrel may be used in place of mandrel 28 if called for, by the structure and nature of the tubing which is to be produced.

The tape material may be taken from a drum 30 suitably mounted at 31. It may consist of any desired material such as treated or untreated

cambric or paper or the like. In the case of insulating tubing, cambric will be ordinarily the preferred material.

Let us now briefly examine the structure of the various dies before explaining their individual function, keeping in mind that it is the purpose of the apparatus to furnish means whereby a suitable tape material can be advanced or pulled successively and quickly through a series of dies, in a straight line, and emerge in the form of a tubing the same of which extends substantially parallel with the axis of the tubing, and also remembering that there should not be any rotating parts for accomplishing this purpose. However, if the tubing is to be produced from flat tape material it will be apparent that either one or both edges, or rather to say, sides of the tape material must be rolled or rotated so as to fold correctly toward the center and to form the tubing. This rotation of the tape takes place between the first and the final shaping die and is determined and controlled by all of the dies. Each die has its specific purpose, namely, the purpose of progressively rolling the tape material toward and around the mandrel (or, in the case of producing insulation on a wire, toward and around the wire).

As shown particularly in Fig. 2, the first die or gauge **13** is provided with a folding channel **35** which forms substantially an inverted U. The mandrel **28** extends from the die **13** in the direction of and through the successive dies as indicated in Fig. 1. The second die or gauge **14**, as shown in Fig. 3, is provided with a guide skirt **36** adapted to guide the tape material circumferentially. The forming channel **37** has a different form, that is, one leg of the U-shaped channel, as shown in Fig. 3, has been eliminated in the case of the second die **14** and coiled toward the periphery of mandrel **28**. The third die **15**, as illustrated in Fig. 4, also carries a guide skirt **38** which is adapted to guide and to fold the tape from both sides toward the forming channel **39** which is closed around the mandrel **28**. Expressed in other words, the other left hand leg of the U-shaped channel shown in Fig. 2 has been coiled toward the center, that is, toward the periphery of mandrel **28**.

Any suitable and necessary number of such forming and folding dies may be arranged on the bench **11** properly spaced from one another and performing the tube shaping operations. These are in detail as follows:

The tape material **40** is taken from the storage drum **30** and the end is inserted into the U-shaped channel **35** of die **13** and then progressively into the channels **37** and **39** of dies **14** and **15** respectively. The tape will then emerge from the die **15** in tubular form, as indicated at **41**. Both sides of the tape are coiled around the mandrel **28** forming a tubing which is in this case composed of two layers. Devices such as indicated in dotted lines at **42** and **60**, respectively, may be provided between the dies **13** and **14** and **14** and **15** in order to feed adhesive to the tape so as to glue the folded layers in place. Either one or both devices may be used. If desired, the last shaping gauge or die **15** may be provided with a heating device generally indicated at **45** in order to accelerate the drying process. It is understood that I have shown an electrical heating means combined with the die **15** merely for convenience of description. It may be secured separately and independent of any die and any suitable heating device may be employed.

The automatic operation can now begin by suitably fastening the tubing end **41** to a device which exerts a substantially straight line pull in the direction of the arrow shown at the right end of Fig. 1. This device may be a drum such as the drum **30**, Fig. 1, supplied with means for rotating it at the proper speed, and functioning as a takeup drum for the finished tubing.

The finished tubing which emerges progressively and continuously from the die **15** may be wound on a suitable storage drum. It will be apparent that the dies fold the tape to assume the shape indicated progressively in Figs. 2, 3 and 4 merely in response to a straight line pull. The rotation of the edges of the tape toward the mandrel **28**, and, where multiple layers are desired, around the mandrel, **28**, takes place intermediate of the dies. The speed of production, that is, the speed with which the tape can be pulled through the forming dies depends upon the tensile strength of the tape material at the point of emergence from the final forming die, in the present case, die **15**. The tensile strength of the tubing having two layers is naturally approximately twice the tensile strength of the raw material in tape form. Therefore, in this particular instance the speed of production can actually be increased beyond the speed determined by the normal tensile strength of the material. The tubing thus produced may be wound flat on storage drums and can be used for sleeving to insulate wires.

If it is desired to produce impregnated varnished tubing, this can be done by providing one or more impregnating devices generally indicated at **46** through which the finished tubing is drawn in the process of continuous production. Again, as in the former case, the varnished or impregnated insulating tubing may be stored on suitable drums or cut to size and suitably packaged. A suitable cutting device may be placed at the right of the apparatus shown in Fig. 1 so as to combine the cutting with the general production process.

Certain cases may call for a tubing which is varnished inside as well as outside. Such tubing can be produced by placing a suitable impregnation feeding device **47** between the storage drum **30** and the first forming die **13** and drawing the tape material through it. An outwardly flaring curved guide skirt **48** may extend from the die **13** as shown in Fig. 1 so as to facilitate the initial insertion of the tape and its feeding into the channel **35** of die **13**.

The devices for supplying adhesive and impregnating media, varnish, etc. form as such no part of the invention. Any suitable device may be employed in each instance. The same is generally true of the heating device **45**. If occasion demands, these means may also be placed differently than I have shown. It is understood, of course, that the use of these devices in combination with the different features and objects of my invention includes novel forms, products and novel results and wherever this is the case, such use constitutes part of my invention and teaching.

The invention thus far described may be briefly summed up by stating that it consists in a process and means for producing tubing comprising the requisite devices adapted to perform the steps of first folding or pre-shaping both edges of a tape material into a generally U-shaped form, then folding or rolling one leg of the resulting structure peripherally on a station-

ary mandrel and then folding or rolling the other leg of the pre-shaped structure against or around the mandrel to form the tubing, the preshaping and subsequent rolling and folding of the tape being accomplished by separate stationary dies or gauges which are adjustably arranged on a suitable foundation or base and through which the mandrel extends, and the feeding of the tape material though the dies being accomplished by automatically pulling or advancing the resulting tubing in a straight line, thus continuously feeding tape material from the other end of the device into the dies, together with means for applying adhesive or suitable impregnating or protecting media to the tape or to the resulting tubing, and means for applying heat at any desired point of the production process for accelerating the drying and solidifying of fluid media applied.

Some of the advantages resulting from my invention are listed as follows: The choice of material in web form, e. g., suitable cambric and the like permits determining the flexibility of the tubing and its dielectric strength due to the uniformity of the material that can be achieved and due to the continuity of treatment that is applied. The production is speedier than in any process now known. There is no need for using a core in producing the tubing and the labor for removing the core from the finished product is therefore eliminated. The machine and its parts are extremely simple. Any suitable material may be employed for making the tubing. The process is not strictly limited to the production of insulating tubing. The ease with which adhesive or liquid or semi-liquid impregnating or insulating media can be applied at any point of the production process tends to enhance the utility of the invention considerably.

The above described method may be modified by employing a series of folding and forming devices or dies constructed so as to roll the tape material from one side progressively around a mandrel in order to produce a multiple layer tubing. The different successive steps in such modified application of the invention are illustrated in Figs. 5 to 12, inclusive, showing transverse diagrammatic views of the requisite dies or successive folding steps.

In Fig. 5 numeral 50 designates a die in which is disposed a channel for taking the tape material 51. It will be observed that only the upper edge of the tape material is at this instant connected with a suitable mandrel (not shown) whereas the remainder of the tape extends straight downwardly. In Fig. 6 the downwardly extending end 52 of the tape 51 has been rotated slightly to the right. This operation may be performed by a separate die 53. In Fig. 7 a die 54 is provided with a channel forcing the edge 52 of the tape 51 in an upward direction as shown. In Fig. 8 the die 55 is provided with a channel forcing the edge 52 of the tape still further around the mandrel and almost completing the first layer of the tape around the same. In Fig. 9 the tape is shown advanced through an additional die 56 continuing the rotation of the side 52 of the tape 51 to coil the tape a second time around the mandrel. Fig. 10 shows the die 57 and a further step according to which the side 52 of the tape 51 is coiled around the mandrel. The second layer is almost completed in this figure. In Fig. 11 the forming die 58 is provided with a progressively curved channel as shown so as to force the side 52 of the tape material 51 to form the third layer of the tube structure; and Fig. 12 shows the final step which is accomplished in the last forming die 59. The edge 52 of the tape 51 is coiled completely around the mandrel and the multiple layer tubing is finished. At any point intermediate of these steps of the process, adhesive or impregnating or insulating material may be applied to the tape or to the tubing as previously described.

Either the first or the second described method of successively rolling or rotating first one side and then the other side of a tape material over a suitable mandrel (Figs. 1–4) or of progressively rolling and folding only one side of the tape material over a mandrel to form a multiple layer tubing (Figs. 5–12) may be employed for insulating electrical conductors to form the previously mentioned push-back type of insulation. It is merely necessary to eliminate the mandrel 28 shown in Fig. 1 and to feed or advance the conductor into and through the shaping and folding dies simultaneously with the tape material, a straight line pull being applied to both. The tape will then be rotated and rolled or folded around the wire and the insulated wire will emerge from the final die instead of tubing. Impregnation and the like may also be applied if desired or necessary. Adhesive may be employed at any step in the process as previously described.

Changes may be devised in order to meet any given condition, but it is expressly understood that all such changes are to be considered within the scope of my invention which meet the terms of the appended claims.

I claim:

1. A device for producing tubing and particularly insulating tubing comprising, a support, a plurality of stationary forming dies adjustably secured on said support in a straight row and in predetermined spaced relation to each other, a mandrel extending from said first die through the successive dies into the last die in said row, means for supporting a supply of tape material at one end of said row of dies, said tape material extending through said dies, means at the other end of said row of dies for continuously moving said material through said stationary dies whereby said material is circumferentially rolled around said mandrel to form said tubing, and means for applying adhesive to said material during the folding thereof, said stationary dies being arranged to roll only one side of said continuously moving tape material progressively around said mandrel to form said tubing.

2. A device for producing tubing and particularly insulating tubing comprising, a support, a plurality of stationary forming dies adjustably secured on said support in a straight row and in predetermined spaced relation to each other, a mandrel extending from said first die through the successive dies into the last die in said row, means for supporting a supply of tape material at one end of said row of dies, said tape material extending through said dies, means at the other end of said row of dies for continuously moving said material through said stationary dies whereby said material is circumferentially rolled around said mandrel to form said tubing, and means for applying adhesive to said material during the folding thereof, said stationary dies being arranged to roll both sides of said continuously moving tape material progressively around said mandrel to form said tubing.

3. A device for producing tubing and particu-

larly insulating tubing comprising, a support, a plurality of stationary forming dies adjustably secured on said support in a straight row and in predetermined spaced relation to each other, a mandrel extending from said first die through the successive dies into the last die in said row, means for supporting a supply of tape material at one end of said row of dies, said tape material extending through said dies, means at the other end of said row of dies for continuously moving said material through said stationary dies whereby said material is circumferentially rolled around said mandrel to form said tubing, means for applying adhesive to said material during the rolling thereof, and means disposed posteriorly of the last die in said row for continuously impregnating said tubing.

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