Sept. 21, 1948. C. W. BECHLE ET AL 2,449,834

WIRE COVERING MACHINE, METHOD, AND PRODUCT

Filed May 9, 1946 3 Sheets-Sheet 1

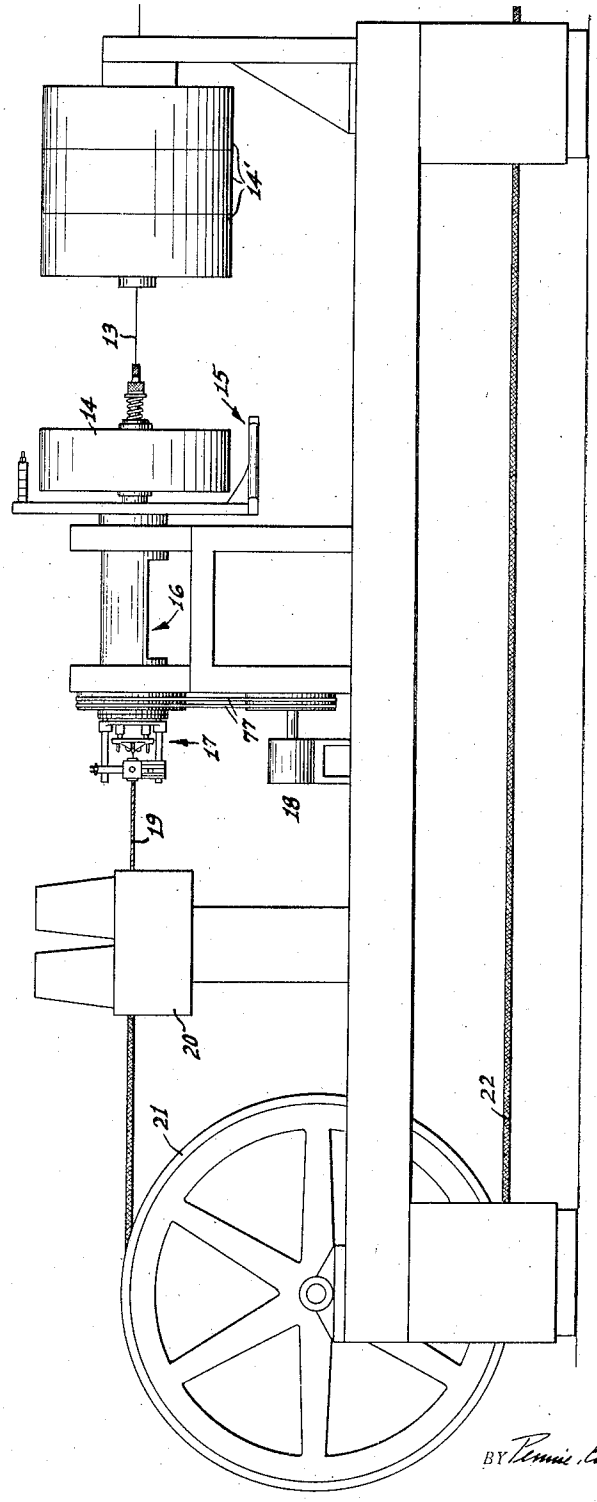


Fig. 1

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Fig. 2

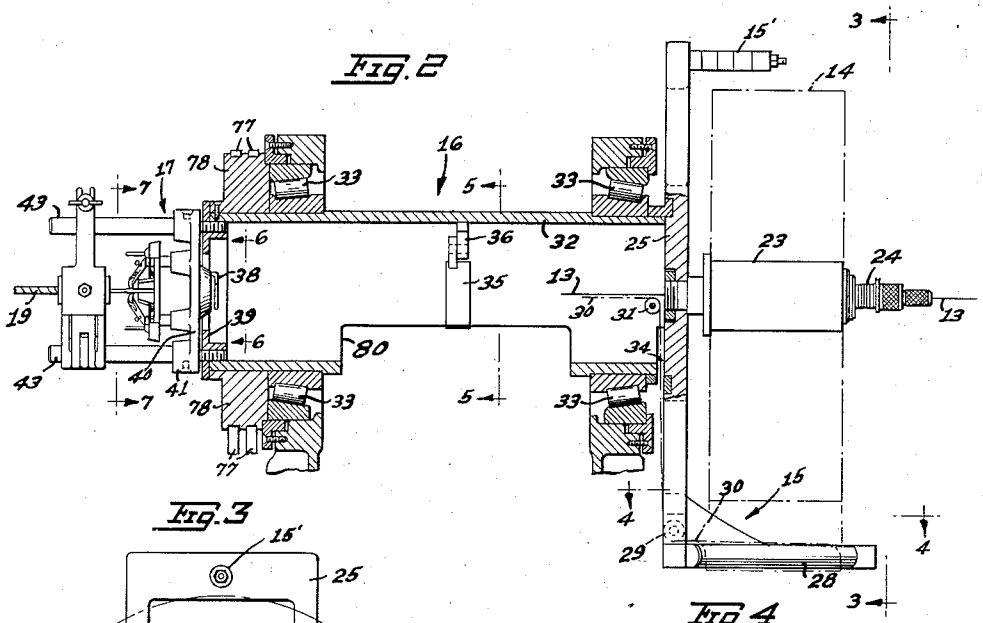


Fig. 3

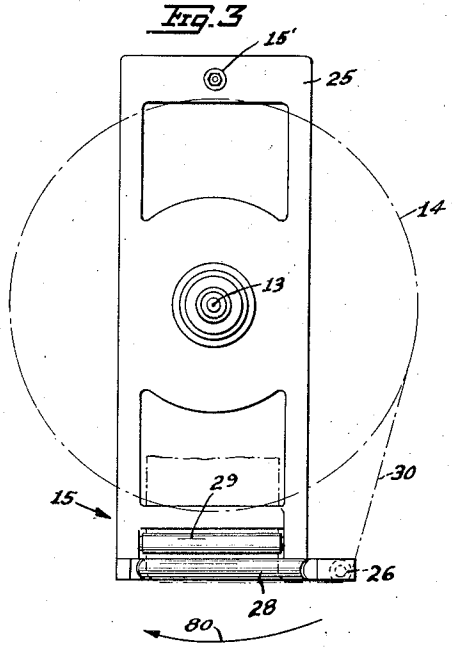


Fig. 4

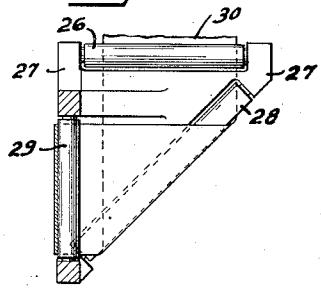


Fig. 5

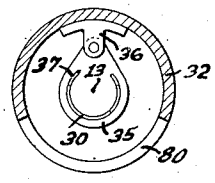
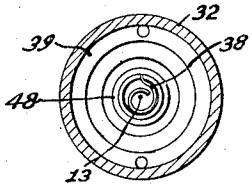


Fig. 6



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WIRE COVERING MACHINE, METHOD, AND PRODUCT

Filed May 9, 1946 3 Sheets-Sheet 3

Fig. 7

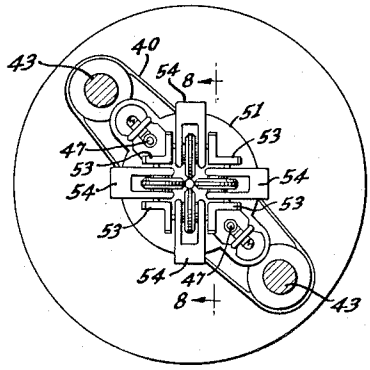


Fig. 8

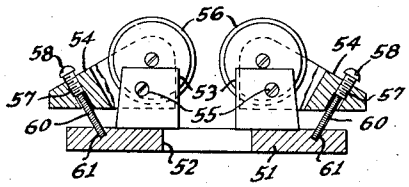


Fig. 10

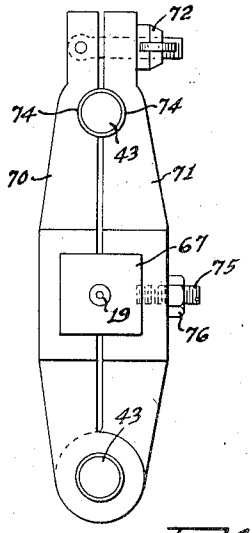


Fig. 9

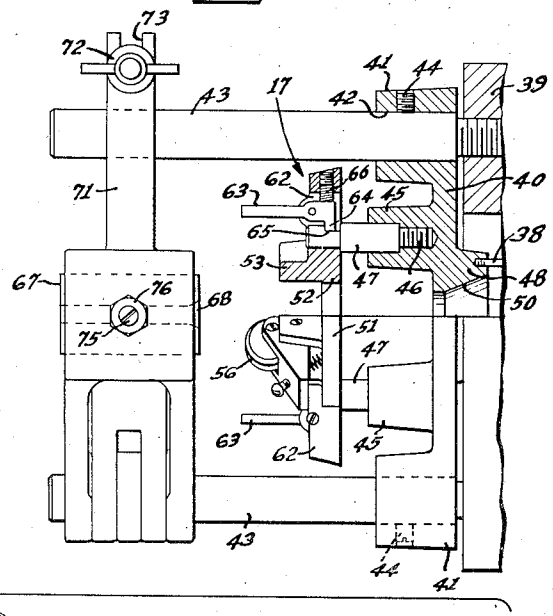
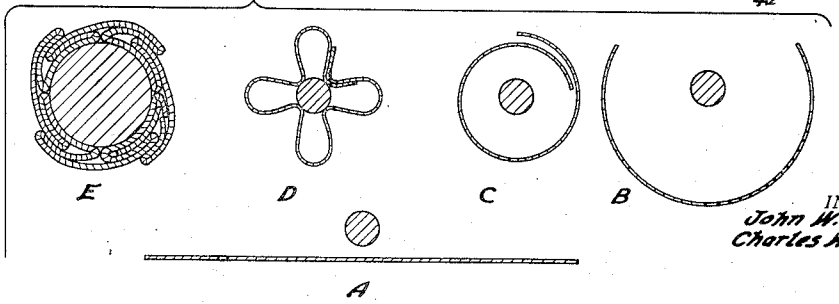


Fig. 11



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Patented Sept. 21, 1948 2,449,834

UNITED STATES PATENT OFFICE

2,449,834

WIRE COVERING MACHINE, METHOD, AND PRODUCT

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Application May 9, 1946, Serial No. 668,594

16 Claims. (Cl. 57—18)

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This invention relates to the production of covered wire and, more particularly, to the production of paper-covered wire. The invention contemplates novel apparatus for the application of a paper covering about a wire, a novel method of covering wire with paper and a novel product comprising a paper-covered wire.

In the production of covered wire such as that known as weatherproof wire, the covering comprises fibrous material impregnated with a waterproofing material such as asphalt and the like. The covering about the wire serves as mechanical separation of sufficient thickness to prevent electrical contact between such covered wires in physical contact with one another. In conventional weatherproof wire the covering comprises one or more jackets of cotton braid or the like impregnated with a bitumen. In another form of covered wire of superior qualities the covering comprises an inner paper covering immediately adjacent the conductor and an outer cotton jacket, or the like, adapted to hold the paper covering in place and to protect it from normal wear by abrasion. The cotton or other fibrous jacket is naturally porous, and even when the jacketed paper-covered wire is impregnated with asphalt, or the like, there is a possibility of water reaching the inner paper covering. For this reason, it is not only desirable that the paper covering comprise several layers of paper about the conductor, but that these layers be so interconnected as to provide a barrier against penetration of water into the conductor. Thus, a spiral winding of paper tape does not satisfactorily meet this requirement and, as a result, various methods and apparatus have been devised and used to provide interlocked layers of paper about a wire. Such methods and apparatus, and the products thereof, are described and claimed in Patents Nos. 2,048,886, 2,067,333 and 2,095,076 to John W. Olson.

The present invention contemplates novel apparatus for the production of a plurality of interlocked and overlapping folds of paper about a wire, the term "paper" being used herein and in the claims to include other materials in similar strip form including cloth, felt and resins in fibrous or sheet form. The apparatus comprises means arranged to deliver a strip of paper longitudinally along the wire closely adjacent thereto, tube-forming means arranged to form the strip of paper into a tube disposed substantially concentrically about the wire and advantageously with the sides of the strip overlapping one another, loop-forming means arranged to form the tube

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into a plurality of loops of paper disposed radially about the axis of the wire, and twisting means arranged to twist the loops of paper into folds about the wire. By forming the paper strip into a tube about the wire, by forming this tube into loops of the paper disposed radially about the wire, and by then twisting these loops spirally about the wire, a plurality of interlocked and overlapping folds of paper are provided. As many as eight or nine layers of paper can be provided about the entire surface of the wire from a single strip of paper of normal width for use in such paper-covering operations.

An important element of the apparatus of the invention comprises a forming head adapted to form the tube of paper provided concentrically about the wire into loops disposed radially about the axis of the wire when viewed in cross-section. The forming head comprises a base member having a central opening adapted to permit passage of the tube and wire therethrough, and a plurality of pressure elements mounted on the base member at spaced intervals circumferentially about the tube and so arranged as to press against the tube. The portions of the tube between those portions against which the pressure elements bear are formed into a plurality of loops disposed radially about the wire. The pressure elements comprise with particular advantage rotatable wheels so arranged as to make rolling contact with the tube of paper as the tube is moved in a direction along the axis of the wire. The rotatable wheels are mounted adjacent one end of each of a plurality of rocker arms mounted on the base member at spaced intervals circumferentially about the tube passing through the central opening in the base member. Resilient means are provided to maintain the wheels in resilient contact with the tube at spaced intervals circumferentially thereabout with sufficient force to press these portions of the tube radially inwardly against the wire. Means are provided in accordance with the invention for twisting the resulting loops of paper spirally into folds about the wire. The twisting means is advantageously such that the loops of paper are flattened radially toward the wire as they are twisted so as to form the flattened loops into interlocking and overlapping folds about the wire.

The tube-forming means in the apparatus of the invention comprises with advantage a plurality of guide members which guide a strip of the paper delivered longitudinally along the wire first into a U-shaped form partially enclosing the wire and finally into the form of a tube ad-

vantageously with the edges of the strip of paper overlapping one another, and with the wire disposed substantially concentrically within the tube. The strip of paper is delivered longitudinally along the wire advantageously from a roll of paper mounted concentrically about the wire. Means for delivering the paper in this manner comprises, in accordance with the invention, a support for the roll of paper and a plurality of guide surfaces mounted on the support and adapted to turn the paper from a direction of motion perpendicular to the axis of the wire to a direction of motion parallel to the axis of the wire. These guide surfaces include a first guide surface substantially parallel to the axis of the wire, a second guide surface disposed at an angle of about 45° to the axis of the wire, and a third guide surface disposed at right angles to the axis of the wire. All three guide surfaces advantageously lie in planes substantially parallel to one another and to the axis of the wire. In a specific embodiment of the invention these guide surfaces comprise guide rolls, the first guide roll having its axis disposed perpendicular to the axis of the wire, the second guide roll having its axis disposed at an angle of about 45° to the axis of the wire, and the third guide roll having its axis disposed substantially parallel to the axis of the wire, the axes of the rolls lying in planes substantially parallel to one another and to the axis of the wire. Means are provided for rotating about the axis of the wire the entire apparatus including the paper supporting means, the paper direction-changing means, the tube-forming means and the loop-forming head, whereby the loops of paper disposed radially about the wire are twisted spirally into overlapping folds.

The method of the present invention includes the steps of forming a tube of paper concentrically about a wire and of pressing against portions of the tube at spaced intervals about the circumference thereof in such manner as to form a plurality of loops of the paper disposed radially about the axis of the wire. A further step in the method of the invention comprises twisting these loops of paper into folds about the wire, advantageously in such manner as to flatten each loop of paper radially toward the wire while the loops are being twisted whereby a plurality of overlapping folds of paper are provided about the wire. The novel product in accordance with the invention comprises a covered wire having a conductor covered with overlapping folds of paper obtained by the novel method of applying the paper in accordance with the invention.

These and other novel features of the invention will be further understood from the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 shows wire-covering apparatus embodying the novel features of the invention;

Fig. 2 shows in more detail and partly in section the loop-forming, tube-forming and paper-delivering means in accordance with the invention;

Fig. 3 is an end view of the apparatus shown in Fig. 2 taken along section line 3—3;

Fig. 4 is a sectional view taken along line 4—4 in Fig. 2 showing the arrangement of guide rolls in the paper-delivering portion of the apparatus;

Fig. 5 is a sectional view taken along line 5—5 in Fig. 2 showing one of the elements of the tube-forming means;

Fig. 6 is a sectional view taken along line 6—6 in Fig. 2 showing another guide element in the tube-forming means;

Fig. 7 is an end view taken along line 7—7 in Fig. 2 showing the loop-forming head;

Fig. 8 is a section taken along line 8—8 in Fig. 7 showing mounting of the rocker arm and rotatable wheel assemblies of the loop-forming head;

Fig. 9 is a detailed side elevation of the loop-forming head and compacting die assembly shown at the left end of the apparatus in Fig. 2;

Fig. 10 is an end elevation of the compacting die assembly shown in Fig. 9; and

Fig. 11 is a series of cross-sectional graphical illustrations of the stages of forming a strip of paper into twisted overlapping folds about a wire in accordance with the invention.

The apparatus shown in Fig. 1 for covering a wire 13 in accordance with the invention includes supporting means for a roll of paper 14 mounted concentrically about the wire, paper direction-changing means 15, tube-forming means 16 adapted to form a strip of the paper into a tube disposed concentrically about the wire, a loop-forming head 17 and means such as a motor 18 adapted to rotate about the axis of the wire the entire assembly of elements of the apparatus referred to hereinbefore. The wire-covering apparatus further includes means for enclosing the paper-covered wire 19 with a fibrous jacket, this enclosing means comprising with advantage a cotton-jacketing device 20. The wire is drawn through the paper-covering and cotton-jacketing apparatus by means of a capstan 21, from which the paper-covered and cotton-jacketed wire 22 may be delivered to further processing such as asphalt impregnation, or the like.

As shown at the right end of Fig. 2, the roll of paper tape 14 is mounted on a suitable roll carrier 23. The roll carrier is advantageously provided with a constant tensioning device 24 such as that described in our copending application Serial No. 668,593, filed May 9, 1946. The roll carrier is mounted on a roll carrier support 25 adapted to carry the paper direction-changing means 15 on one end and a suitable counterweight 15' on the other end. As shown more clearly in Figs. 3 and 4, the direction-changing means 15 comprises a first guide roll 26 mounted with its axis parallel to the axis of the wire 13 and mounted in a frame 27 secured to the end of the roll carrier support 25. A second guide roll 28 is mounted in substantially the same plane as the first guide roll 26 parallel to the axis of the wire but with the axis of this guide roll 28 disposed at an angle of about 45° with respect to the axis of the wire. A third guide roll 29 is mounted in the end portion of the roll carrier support 25 with its axis substantially perpendicular to the axis of the wire 13. The axis of the third guide roll 29 lies in a plane which is substantially parallel to the plane of the first two guide rolls 26 and 28 but which is somewhat nearer the wire than the plane of the first two guide rolls.

In passing around the guide rolls of the direction-changing means, a strip of paper 30 leaving the paper roll 14 passes under the first guide roll 26, then under, around and over the second guide roll 28, and finally under the third guide roll 29. As the paper 30 passes under the guide roll 29, as shown in Fig. 2, it is moving in a direction substantially parallel to the axis of the wire 13, although displaced a considerable dis-

tance from the wire. In order to bring the paper close to the wire, the paper 30 leaving the third guide roll 29 is directed toward the wire 13 and over a fourth guide roll 31 mounted close to the wire with its axis parallel to that of the third guide roll 29. The fourth guide roll 31 is supported within a cylindrical shell 32 wherein the tube-forming elements are positioned for forming the strip of paper 30 into a tube positioned concentrically about the wire.

The cylindrical shell 32 of the tube-forming means is mounted on roller bearings 33 and thus rotatably carries the roll carrier support 25 which is secured to one end of the shell 32. An opening 34 is provided between the end of the shell 32 and the roll carrier support 25 for passage of the strip of paper 30 from the third guide roll 29 at the end of the roll carrier support 25 into the interior of the shell 32 and over the fourth guide roll 31 mounted therein. As the paper 30 passes over and partly around the fourth guide roll 31, it is directed longitudinally along the axis of the wire closely adjacent the wire.

The strip of paper passes from the fourth guide roll 31 through a preliminary forming guide 35 mounted within the shell 32. The preliminary forming guide 35, as shown in Fig. 5, comprises a disc pivotally supported from a hanger bracket 36. The disc-like guide 35 is provided with an arcuate slot 37 of sufficient width to permit free passage of the paper strip 30 therethrough and so positioned in the guide 35 as to shape the paper strip into a substantially U-shaped form surrounding the wire 13. The U-shaped paper then passes to a final tube-forming guide 38 mounted within a closure plate 39 located at the other end of the cylindrical shell 32. The closure plate 39 is provided with a central opening of sufficient size to permit passage of the tube of paper therethrough. The final tube-forming guide 38 is advantageously a piece of wire having one end brazed or otherwise secured to the end closure plate 39 and bent into a spiral disposed substantially coaxially about the wire 13. The size of the spiral coil of wire 38 is such as to form the U-shaped paper strip into a tube advantageously with the edges of the strip overlapping a substantial amount. As the paper leaves the final guide 38, it is in the form of a tube disposed concentrically about the wire 13, and in this form it passes to the loop-forming head 17.

The loop-forming head 17 is mounted on a supporting structure 40 which is shown in detail in Figs. 7 and 9. This supporting structure is provided at each end with a boss 41. Each boss 41 is provided with an opening 42 adapted to fit over a supporting pin 43 screwed into the end closure plate 38 of the cylindrical shell 32. The supporting structure is secured in a stationary position by a set screw 44 extending through each boss and bearing against the surface of the supporting pin 43. Approximately intermediate the two outer bosses 41 and the center of the supporting structure there is provided a pair of bosses 45 each provided with a threaded well 46. A supporting pin 47 for the loop-forming head is screwed into each of the wells 46. The central portion of the supporting structure 40 is provided with a struck-up collar 48 having a bell-shaped central opening 50 and adapted to fit within the central opening in the end closure plate 38 of the cylindrical shell 32. Thus, the supporting structure 40 is secured to the end of the tube-forming shell 32 and supports the loop-forming head 17.

The loop-forming head 17 is removably mounted on the supporting pins 47 carried by the supporting structure 40. The head comprises a circular base member 51 provided with a central opening 52 adapted to permit passage of the paper tube and wire through the base member. Mounted on the face of the circular base member 51 are four right-angled rocker arm supports 53 spaced circumferentially about the central opening 52. A rocker arm 54 is mounted on a pin 55 extending between the parallel legs of each adjoining pair of rocker supports 53. The end of each rocker arm 54 adjacent the central opening 52 is provided with a slot in which a rotatable wheel 56 is mounted. The relationship between the diameter of the wheels 56 and the positioning of the pivot pins 55 is such that as each rocker arm is pivoted the wheel moves toward or away from the wire and tube rather than merely parallel to the axis of the wire. The other end of each rocker arm is provided with a threaded opening 57 extending therethrough. A screw 58 mounted in each opening 57 serves as an adjustable seat for a compression spring 60 having one end inserted within the opening 57 and having its other end seated in a hole 61 drilled into the face of the base member 51.

It will be seen, accordingly, that the loop-forming head comprises a base member 51 provided with four rocker arms mounted on the base member at spaced intervals circumferentially about the tube of paper and wire. The rocker arms 54 are arranged for adjustably resilient pivotal movement radially toward and away from the wire and have a rotatable wheel mounted at one end of each rocker arm so as to make resilient rolling contact with the tube of paper as the tube moves through the head substantially along the axis thereof. The wheels 56 are advantageously provided with about a 45° chamfer so as to enhance the formation of loops of paper between adjacent wheels as the wheels press against the tube of paper passing therebetween.

As previously noted, the loop-forming head 17 is removably mounted on the supporting structure 40. To this end, the base member 51 is provided with two lugs 62 extending radially outwardly in the plane of the base member. A toggle 63 is pivotally mounted in a slot 64 in each lug, the innermost end of each toggle being provided with a tooth 64 adapted to engage a notch 65 formed in each of the head supporting pins 47. The tooth 64 is held in engagement with the notch 65 by means of a compression spring 66 seated in the outermost end of the lug. Thus, by pressing together on the exterior end of each toggle 63, the tooth 64 of each toggle is disengaged from the notch in each supporting pin 47 so that the entire loop-forming head may be lifted off the ends of the pins. Thus, the loop-forming head 17 is removably mounted on supporting pins carried by the supporting structure 40.

Also carried by the supporting structure 40 is a compacting die 67 provided with a bell-shaped opening 68. The die is mounted in a die holder supported on the ends of the long supporting pins 43. The die holder comprises two clamping arms 70 and 71 hinged together at one end by being mounted rotatably on the end of one supporting pin 43. The other end of one clamping arm 70 is provided with a pivoted wing nut 72 adapted to engage the slotted end 73 of the other clamping arm 71. By tightening the wing nut 72, a grooved

surface 74 adjacent this end of each clamping arm is tightened against the end portion of the other supporting pin 43. Thus, the clamping arms 70 and 71 of the die holder can be opened to release the compacting die 67 and they can be closed in locked position adjacent the ends of the supporting pins 43. The die 67 is held in position within the die holder by means of a set screw 75 which may advantageously be provided with a locknut 76.

Thus, the tube of paper passing through the opening in the end closure plate 38 of the tube-forming means passes through the loop-forming head 17. As the tube passes through this head, the chamfered wheels 56 press radially inwardly against the tube of paper with the result that the portion of the paper tube between each pair of adjacent wheels is formed into a loop. The plurality of wheels 56 form a plurality of such loops at spaced positions disposed radially about the wire. The entire assembly comprising the paper roll carrier support with its direction-changing means, the tube-forming means and the loop-forming head is rotated on bearings 33 by suitable means such as the belt drive 77 engaging a pulley 78 mounted on the end of the tube-forming shell 32 and driven by the motor 18. Rotation of the paper carrying and forming elements of the apparatus while the end of the paper is held firmly against the longitudinally moving wire by the compacting die imparts a twisting movement to the loops of paper disposed radially about the wire adjacent the loop-forming head 17. As a result, each loop is flattened radially toward the wire and is simultaneously twisted so as to form a plurality of overlapping mushroom-like folds about the wire. The twisted folds of paper being drawn through the compacting die 67 are forcibly pressed against the wire to form a firm covering providing as many as eight or nine layers of paper over the entire surface of the wire.

The conductor, thus provided with interlocked and overlapping folds of paper, advantageously is passed through the cotton-jacketing machine 20 where it may receive one or more jackets of cotton adapted to provide additional abrasion resistance and thickness of covering. When the jacketed wire is impregnated with asphalt, or the like, it provides a moistureproof wire of high durability characterized by exceptionally high electrical spacing factor and resistance to penetration by moisture in service.

The steps or stages in the formation of paper strip into twisted folds about a wire in accordance with the invention are shown in Fig. 11 by cross-sectional representations of the form of the paper at key positions from the fourth guide roll 31 to the point where the loops of paper are twisted about the wire. Thus, the paper as it leaves the fourth guide roll (stage "A") is still in the form of a flat strip moving longitudinally along and in position close to the wire. In the preliminary tube-forming guide (stage "B") the paper is given a U-shape with the sides of the U partially enclosing the wire, and in the final tube-forming guide (stage "C") this U-shaped paper is formed into a tube with the edges of the paper substantially overlapped. Following this, the tube passes under the wheels of the loop-forming head (stage "D") where the wheels form valleys in the tube at spaced positions about its circumference, thus leaving the tube in the form of a plurality of loops disposed at spaced intervals radially about the wire. Rotation of the loop-forming head and other parts of the apparatus handling the paper in previous stages of its formation causes the loops to be twisted about the wire (stage "E"). As this takes place, the loops are flattened radially toward the wire and are twisted to form overlapping folds of paper which are pressed firmly together about the wire in the compacting die. The paper covering thus formed about the wire provides a large number of layers of paper about the entire surface of the wire with the folds overlapping and interlocking in such manner as to enhance the moisture resistance of the finished covered and impregnated wire. Moreover, the paper covering is adapted to be applied at high speeds, a linear rate of 1,500 feet per hour and higher being readily attained.

A magazine 14' of several rolls of paper is mounted on a suitable supporting stand with the wire 13 to be covered passing through the stand and roll magazine. When the roll of paper 14 is completely used, a new roll from the magazine 14' is moved along the wire into place on the roll carrier 23. The strip of paper from the new roll is then threaded through the apparatus by carrying it under the first guide roller 26, then under, around and over the second guide roll 28, and from there under and in back of the third guide roller 29 up to the fourth guide roll 31 mounted inside the tube-forming shell 32. The end of the strip of paper is then passed through the arcuate slot 37 in the preliminary forming guide 35 and through the coiled guide 38, both of which can be reached through an opening 80 formed in the side of the shell 32. The paper is then passed through the central opening 50 in the supporting structure 40 and through the central opening 52 in the base member 51. The wheels 56 are held outward while the tube of paper is first pulled through the loop-forming head and then released to press against the tube of paper. The end of the tube is clamped in place within the die 67 with the end of the paper overlapping the end of the previous roll of paper twisted onto the wire.

The roll of paper 14 is so mounted on the carrier 23 and so threaded over the first guide roll 26 that the wind created by rotation of the apparatus in the direction indicated by the arrow 80 in Fig. 3 will cause the paper to balloon as it is unwound from the roll. It has been found that such ballooning facilitates unwinding of the roll and tends to smooth out operation of the apparatus.

As previously pointed out, a plurality of layers of paper are provided about a wire in accordance with the invention when starting with a single strip of paper. It has been found that an unsized, conventional weight, crepe-like, single paper strip two inches wide will provide as many as 8 or 9 thicknesses of the paper when formed in accordance with the invention about a #8 copper conductor. The invention is not limited, however, to the use of a single strip of paper inasmuch as two or more strips may be applied simultaneously in any overlapping arrangement provided that they are delivered to the loop-forming head in a shape which makes possible the forming of the tube into radially disposed loops which may be twisted spirally about the wire.

It will be seen that the covered wire of the invention comprises a conductor covered with mushroomed loops of paper disposed radially about the wire and flattened into a plurality of overlapping folds disposed spirally about the wire. Thus, the conductor is covered with a

plurality of mushroomed loops of paper flattened against the conductor with adjacent mushroomed loops overlapping to form a paper sheath composed of a considerable number of thicknesses of paper completely surrounding the conductor. The paper-covered conductor may advantageously be enclosed in a fabric jacket such, for example, as a served braided or knitted jacket of cotton or other textile material. The paper covering about the conductor produced in accordance with the invention provides a paper sheath about the conductor of such protective thickness that for many purposes a jacket comprising a single layer of fabric is adequate. In this way, the invention makes possible the production of a covered wire in which the major bulk of the covering comprises relatively inexpensive paper, or the like, thus presenting a considerable saving in the use of the more expensive jacketing fabric. The jacketed wire may advantageously be impregnated with a compound or composition having moisture-resistant properties so as to produce a moisture-proof covered wire. Such compositions include asphalt and other bitumens, stearin pitch and other naturally-occurring and synthetic materials which may impart not only moisture-resistance to the covered wire but other desirable properties such as flame-proofing and the like.

We claim:

1. A forming head adapted to form a tube of paper provided concentrically about and spaced radially from a wire into a plurality of loops disposed radially about the axis of the wire comprising a base member having a central opening adapted to permit passage of the tube and wire therethrough, and a plurality of pressure elements mounted on the base member at spaced intervals circumferentially about the tube so arranged as to press against peripherally spaced portions of the tube and transform the periphery of the tube into the shape of a plurality of loops.

2. A forming head adapted to form a tube of paper provided concentrically about and spaced radially from a wire into a plurality of loops disposed radially about the axis of the wire comprising a base member having a central opening adapted to permit passage of the tube and wire therethrough, and a plurality of pressure elements resiliently mounted on the base member at spaced intervals circumferentially about the tube and so arranged as to press resiliently against peripherally spaced portions of the tube and transform the periphery of the tube into the shape of a plurality of loops, each of said pressure elements comprising a rotatable wheel so arranged as to make rolling contact with said tube as the tube moves through said central opening.

3. A forming head adapted to form a tube of paper provided concentrically about and spaced radially from the axis of a wire into a plurality of loops disposed radially about the axis of the wire comprising a base member having a central opening adapted to permit passage of the tube and wire therethrough, a plurality of rocker arms mounted on said base member at spaced intervals circumferentially about the tube and arranged for pivotal movement radially toward and away from the wire, resilient means arranged to cause the inner end of each rocker arm to press against peripherally spaced portions of the tube and transform the periphery of the tube into the shape of a plurality of loops, and a wheel rotatably mounted adjacent said end of each rocker arm adapted to make rolling contact with said tube as the tube moves through said central opening.

4. Apparatus adapted to form twisted folds of paper about a wire comprising a forming head having a base member provided with a central opening adapted to permit passage of the wire therethrough and having a plurality of pressure elements mounted on the base member at spaced intervals circumferentially about the wire and so arranged as to press against peripherally spaced portions of a tube of paper disposed concentrically about and spaced radially from the wire and thus form the tube into a plurality of loops of paper disposed radially about the wire, and means for twisting the loops of paper into folds about the wire.

5. Apparatus adapted to form twisted folds of paper about a wire comprising means arranged to deliver a strip of paper longitudinally along the wire closely adjacent thereto, tube-forming means arranged to form the strip of paper into a tube disposed concentrically about and spaced radially from the wire, loop-forming means arranged to form said tube into a plurality of loops of paper disposed radially about the axis of the wire, and twisting means arranged to twist the loops of paper into folds about the wire.

6. Apparatus adapted to form twisted folds of paper about a wire comprising means arranged to deliver a strip of paper longitudinally along a wire closely adjacent thereto, tube-forming means arranged to form the strip of paper into a tube disposed concentrically about and spaced radially from the wire, a loop-forming head having a base member provided with a central opening adapted to permit passage of the tube and wire therethrough and having a plurality of pressure elements mounted on the base member at spaced intervals circumferentially about the tube arranged to press against peripherally spaced portions of the tube and thus form a plurality of loops of paper disposed radially about the wire, and twisting means arranged to twist the loops of paper into folds about the wire.

7. Apparatus adapted to form a plurality of overlapping folds of paper about a wire from a tube of said paper disposed concentrically about and spaced radially from the wire comprising forming means arranged to press against spaced portions of the tube around the periphery thereof and thereby form the tube into a plurality of loops of paper disposed radially about the wire, and compressing means arranged to flatten each loop radially toward the wire and to twist the flattened loops into overlapping folds of paper about the wire.

8. Apparatus adapted to form a plurality of overlapping folds of paper about a wire from a tube of said paper disposed concentrically about and spaced radially from the wire comprising a loop-forming head having a base member provided with a central opening adapted to permit passage of the tube and wire therethrough and having a plurality of pressure elements mounted on the base member at spaced intervals circumferentially about the tube arranged to press against peripherally spaced portions of the tube and thus form a plurality of loops of paper disposed radially about the wire, and compressing means arranged to flatten each loop radially toward the wire and to twist the flattened loop into overlapping folds of paper about the wire.

9. Apparatus adapted to form a plurality of overlapping folds of paper about a wire compris-

ing means for supporting a roll of paper strip concentrically about the wire, paper direction-changing means arranged to change the direction of motion of the paper unwound from the roll from a direction perpendicular to the axis of the wire to a delivery direction parallel to the axis of the wire, tube-forming means arranged to form the strip of paper so delivered into a tube disposed concentrically about and spaced radially from the wire, a loop-forming head having a base member provided with a central opening adapted to permit passage of the tube and wire therethrough and having a plurality of pressure elements mounted on the base member at spaced intervals circumferentially about the wire arranged to press against peripherally spaced portions of the tube as it moves through said central opening and thus form a plurality of loops disposed radially about the wire, and twisting means arranged to twist the loops of paper into folds about the wire.

10. Apparatus adapted to form a plurality of overlapping folds of paper about a wire comprising means for supporting a roll of paper strip concentrically about the wire, paper direction-changing means arranged to change the direction of motion of the paper unwound from the roll from a direction perpendicular to the axis of the wire to a delivery direction parallel to the axis of the wire, tube-forming means arranged to form the strip of paper so delivered into a tube disposed concentrically about and spaced radially from the wire, a loop-forming head having a base member provided with a central opening adapted to permit passage of the tube and wire therethrough and having a plurality of pressure elements mounted on the base member at spaced intervals circumferentially about the wire arranged to press against peripherally spaced portions of the tube and thus form a plurality of loops disposed radially about the wire, and means for rotating the paper supporting means, the paper direction-changing means, the tube-forming means and the loop-forming head about the axis of the wire whereby the loops of paper are twisted into folds about the wire.

11. The method of forming about a wire a plurality of loops of paper adapted to be twisted into folds about the wire which comprises forming a tube of paper concentrically about and spaced radially from the wire, and pressing against portions of the tube at spaced intervals about the circumference thereof in such manner as to form a plurality of loops of the paper disposed radially about the axis of the wire.

12. The method of forming twisted folds of paper about a wire which comprises forming a tube of paper concentrically about and spaced radially from the wire, pressing against portions of the tube at spaced intervals about the circumference thereof in such manner as to form a plurality of loops of the paper disposed radially about the axis of the wire, and twisting the loops of paper into folds about the wire.

13. The method of forming a plurality of overlapping folds of paper about a wire which comprises forming a tube of paper concentrically about and spaced radially from the wire, pressing against portions of the tube at spaced intervals about the circumference thereof in such manner as to form a plurality of loops of the paper disposed radially about the axis of the wire, and twisting the loops of paper about the wire in such manner as to flatten each loop radially toward the wire and to twist the flattened loops into overlapping folds of paper about the wire.

14. An electrical conductor comprising a wire covered with a strip of paper extending longitudinally along the wire and having transverse loops disposed radially about the wire, said loops lying against the wire in overlapping relation to one another.

15. An electrical conductor comprising a wire covered with a strip of paper extending longitudinally along the wire and having transverse loops disposed radially about the wire, said loops being mushroomed against the wire in overlapping relation to one another.

16. An electrical conductor comprising a wire covered with a strip of paper extending longitudinally along the wire and having transverse loops disposed radially about the wire, said loops lying against the wire in overlapping relation to one another, and an abrasion-resistant fabric jacket enclosing the paper covering, the jacketed wire being impregnated with a moisture-resistant composition.

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