Jan. 4, 1966 A. C. HOWELL, JR 3,226,767

APPARATUS FOR WIRE COILING

Filed May 16, 1961

3 Sheets-Sheet 1

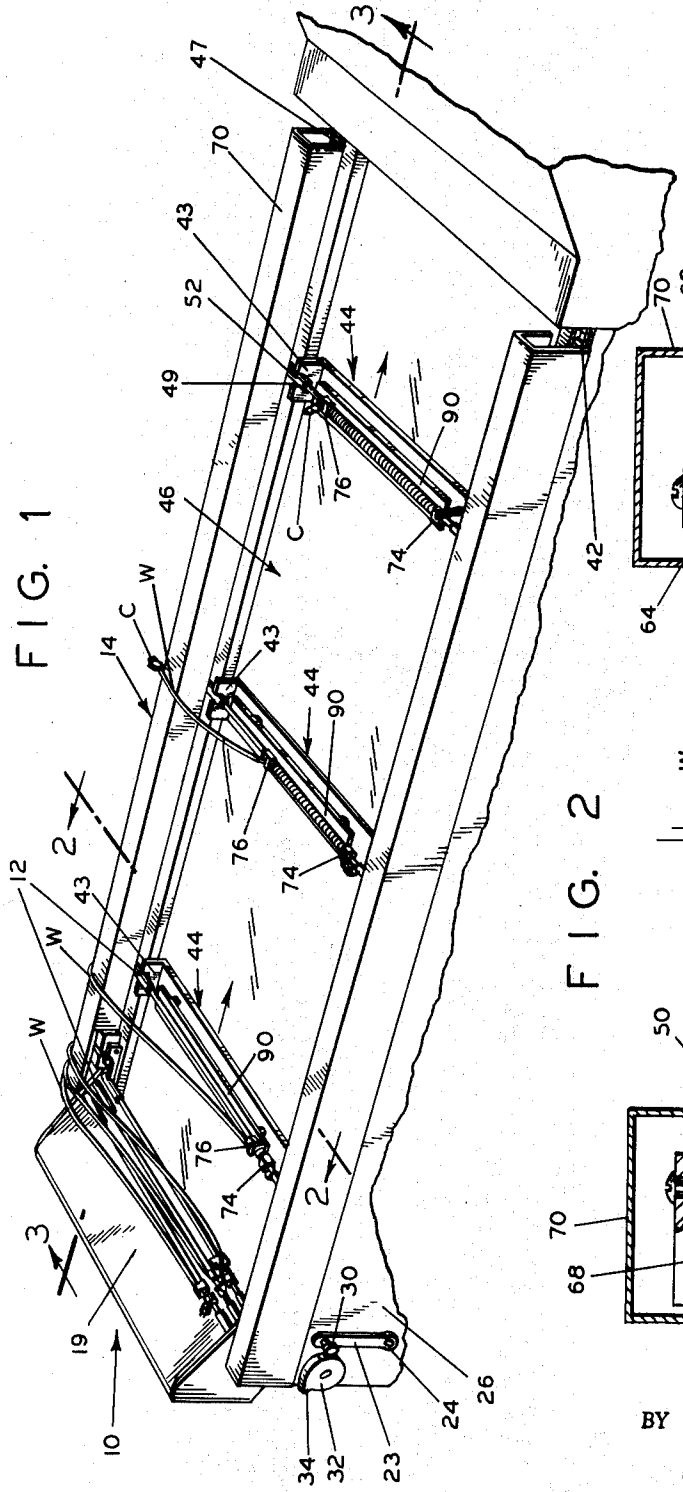


FIG. 1

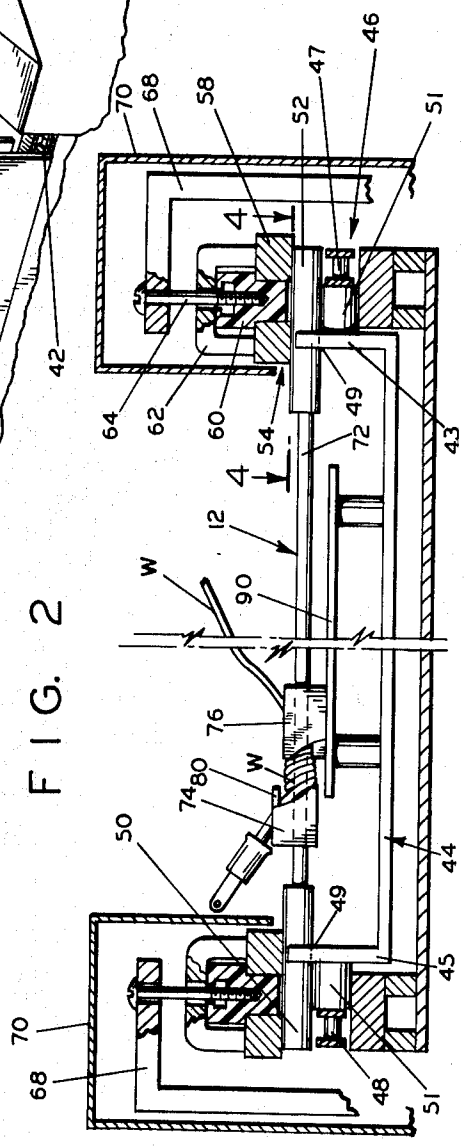


FIG. 2

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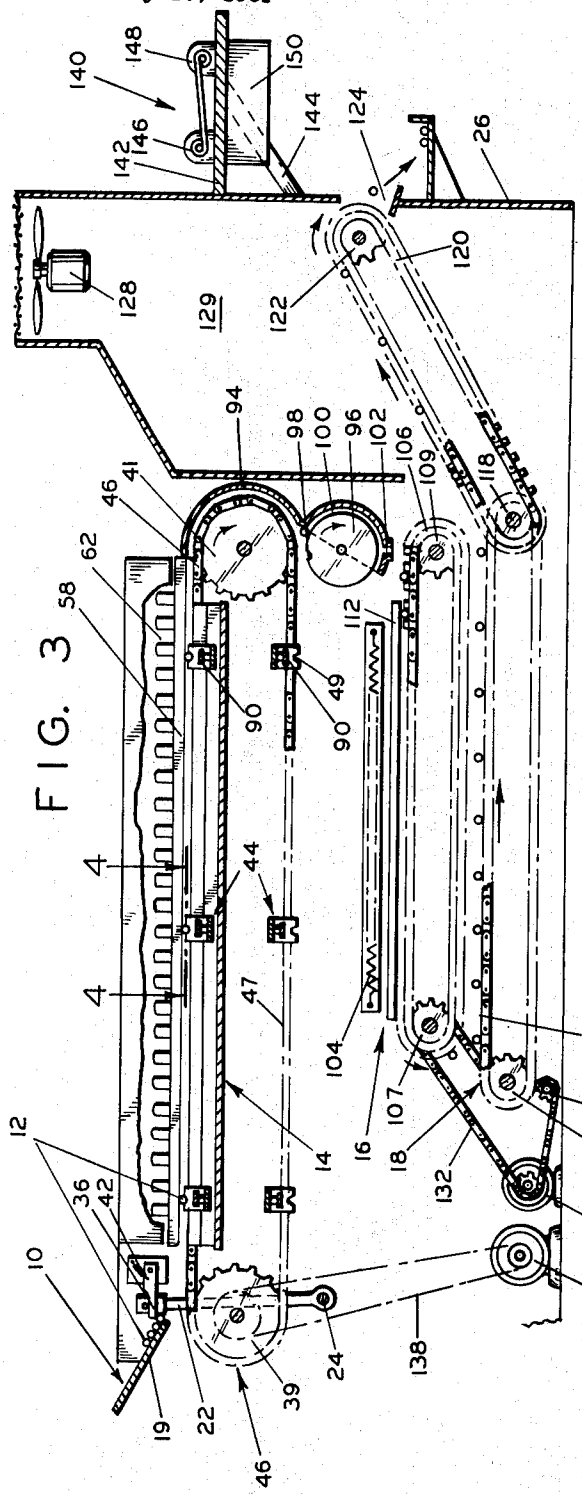


FIG. 3

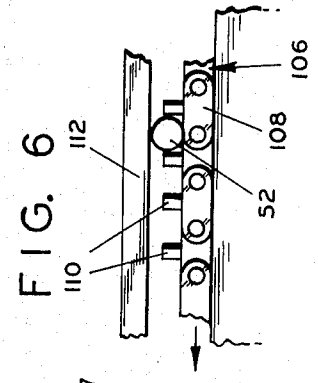


FIG. 6

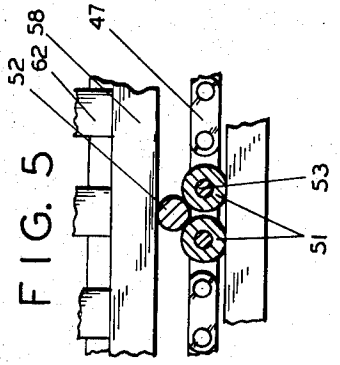


FIG. 5

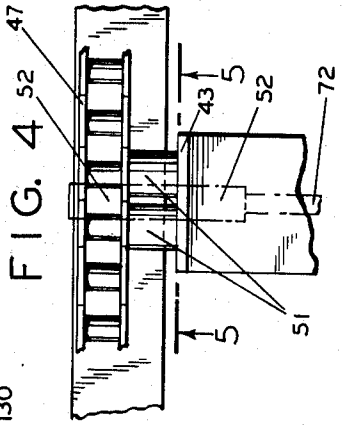


FIG. 4

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FIG. 7A

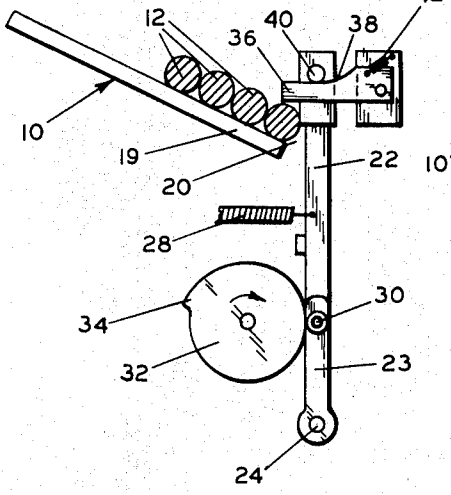


FIG. 7B

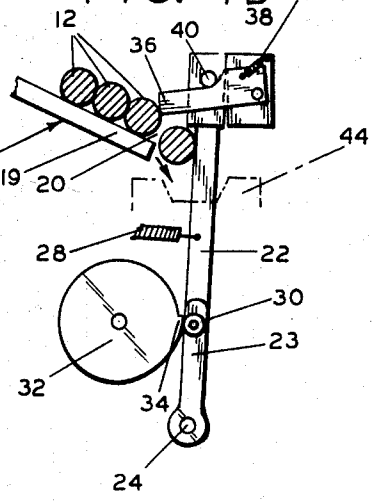


FIG. 8

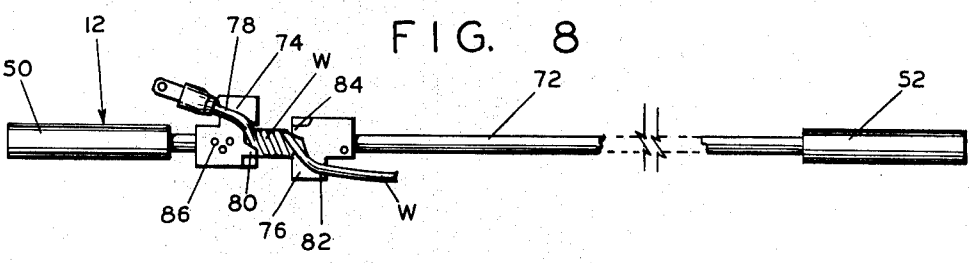


FIG. 9

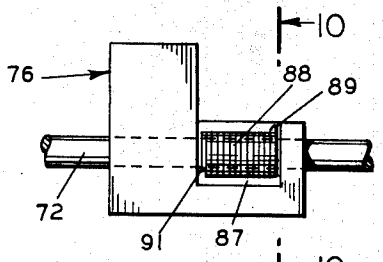


FIG. 10

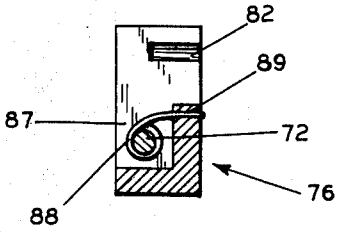
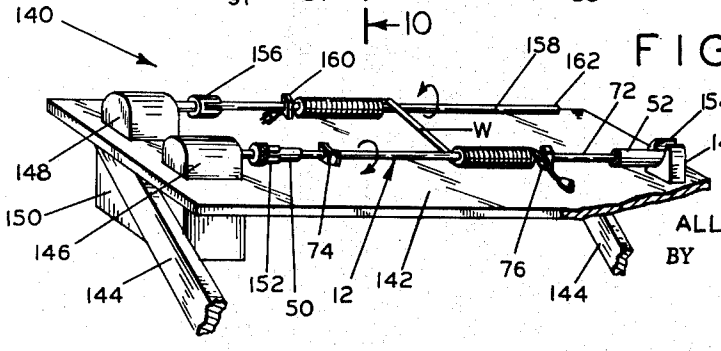


FIG. 11



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United States Patent Office

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APPARATUS FOR WIRE COILING

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Filed May 16, 1961, Ser. No. 110,508
5 Claims. (Cl. 18—19)

This invention relates to an apparatus for permanently coiling coated wire, and more particularly to an apparatus which automatically coils coated wire on a mandrel and heats said mandrel-wound wire to permanently set a coiled configuration therein.

The permanent setting of insulation coated wire with a coiled configuration has become extremely popular. One most popular usage is a telephone hand sets. Other adaptations, such as electric shaver cords, appliance cords, and tractor-trailer wire connectors are increasingly being made. Such increased popularity is due to several factors. The coiled configuration imparts a neat appearance to the wire. In addition, the wire does not tangle, and to an extent, is self-recoiling. Furthermore, less overall wear and tear results by reason of the coiled configuration.

In the past, production techniques for such coiled wire generally involved both manual and machine-operated steps. This was especially true where short lengths with connectors at their ends, such as electric shaver cords, were subjected to the technique. An operator would first thread and then manually wind the insulated wire upon a machine driven mandrel. The latter would then be physically moved to an oven where it was heated for a specified length of time. Upon cooling, the wire upon the mandrel would have a permanently coiled set. The wire was then removed from the mandrel and carried to succeeding operational steps, such as reverse coiling, inspection, packing and the like.

Due to the many manual steps involved in the technique, the process was slow and tedious and operator faults, such as loose, uneven or incomplete winding, frequently occurred. The slowness of the process increased the cost and loose, uneven or incomplete winding resulted in non-uniform coils. Such non-uniform coils were unattractive and would tangle in use.

An object of this invention is to provide an apparatus for automatically imparting a permanently coiled configuration to coated wire in high quantity production line operations.

Another object of this invention is to provide an apparatus of the above character which imparts a relatively tight coil to the wire.

A further object of this invention is to provide an apparatus of the above character which imparts a relatively uniform coil to the wire over substantially its entire length.

A still further object of this invention is to provide an apparatus of the above character which is relatively safe to operate.

Another object of this invention is to provide an apparatus of the above character which is self-contained within one unit.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly relates to an apparatus embodying features of construction, combinations of elements and arrangement of parts for coiling coated wires, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawings in which:

FIGURE 1 is a perspective view of the wire winding mechanism of the apparatus of this invention;

FIGURE 2 is a transverse cross-sectional view of the mechanism of FIGURE 1 taken along line 2—2;

FIGURE 3 is a sectional side elevation view of the entire apparatus of this invention, taken along line 3—3 of FIGURE 1;

FIGURE 4 is an enlarged fragmentary top plan view of the conveyor chain and associated elements of the URE 3;

FIGURE 5 is a fragmentary cross sectional side view of the mechanism shown in FIGURE 4, taken along line 5—5, in FIGURE 4;

FIGURE 6 is an enlarged fragmentary side view of a portion of the heating zone conveyor, shown in FIGURE 3;

FIGURES 7A and 7B are progressive schematic side views of the trigger release gate mechanism of the hopper;

FIGURE 8 is an enlarged top view of a wire-coiling mandrel used in the apparatus of the invention;

FIGURE 9 is a detailed bottom view of the sliding latch guide of the mandrel of FIGURE 8;

FIGURE 10 is a cross sectional view of the sliding latch guide shown in FIGURE 9, taken along line 10—10 in FIGURE 9; and

FIGURE 11 is a perspective view of the mandrel unwinder mechanism of the apparatus.

Similar reference characters refer to similar parts throughout the several views of the drawings.

The objects enumerated above, are accomplished by the use of a novel apparatus which permits mass production of coiled lengths of wire. The apparatus as schematically illustrated in FIGURES 1 and 3, utilizes a hopper 10, coiling mandrels 12, a mandrel revolving or winding mechanism 14, mandrel heating zone 16, mandrel cooling zone 18, and a reverse-coiling mandrel unwinder, all combined with a housing as a unitary device.

Broadly the technique of using the apparatus comprises the loading of lengths of wire or like material onto suitable clamping mandrels 12. The loaded mandrels are then placed in the hopper 10 (FIGURES 1 and 3) where they are released individually onto one of the saddles 44 on the coiling conveyor 46. The saddles 44 are carried in spaced relationship through the coiling zone 14 by the endless belt or chain conveyor 46 (FIGURES 1 and 2).

The mandrels 12 are rotatably carried by saddles 44 as they move along the length of the conveyor. Their rotation coupled with the action of certain clamps on the mandrel automatically coils the wire lengths about each mandrel. After full coiling of the wire lengths, the mandrel and wire is passed through a heating zone 16 to set the coiled configuration in the wire. If desired, it may then be passed through a cooling zone 18 and then delivered to a delivery opening. Here, the mandrel is inserted into a mandrel unwinder 140 where the coiled wire is removed and simultaneously reverse coiled to further tighten the coil.

More specifically the technique involves loading a length of wire W, such as a webbed insulated plastic or neoprene coated paired conductor with connector plugs at each end, onto one of the coiling mandrels **12**. Such loading is accomplished by threading the wire at one end into a fixed clamp **74** secured to the mandrel **12** (FIGURES 2, 8). The next adjacent portion of the wire is then slidably secured to a sliding latch guide **76** which is rotatably mounted upon the mandrel. The latch guide **76** is so constructed that it will helically feed the wire tightly about the mandrel rod **72** as the mandrel rotates. A novel locking means contained within the latch guide **76** prevents any accidental reversal of the helical winding action during the winding movement.

After the mandrel has been threaded, it is placed, with other loaded mandrels, into the hopper **10** of the apparatus. One end of the wire W dangles over an edge of the apparatus (see FIGURE 1).

A novel trigger release hopper gate (FIGURES 1, 7A, 7B) automatically dispenses the mandrels, one at a time, from the hopper onto a saddle **44** of the winding mechanism. The saddles **44** are carried in spaced relationship by an endless belt or chain conveyor **46** through the coiling zone **14** (FIGURES 1 and 2).

The winding mechanism **14** may be broadly described as the conveyor **46** with means thereon to move each mandrel laterally while the mandrel is being rotated about its own axis. Such rotation is accomplished by rolling the mandrel against a longitudinally disposed track.

During spinning of the mandrel, the sliding latch guide is cammed against reverse rotary movement. Such camming results in a helical coiling of the wire about the rotating mandrel.

To overcome drag caused by the dangling end of the wire, the track along which the mandrel rolls is provided with magnetic elements. The magnetic attraction thus created between the track and the mandrel prevents slippage of the mandrel. Thus, the mandrel is forced to roll along the track as it laterally traverses the conveyor path. A forceful rotary motion is thereby imparted to the mandrel.

The winding conveyor **46** is of such length that the wire will be completely wound about the mandrel when the latter reaches the end of the conveyor path. To overcome any possibility of incomplete winding, the conveyor is somewhat longer than actually necessary for complete winding. Use of a magnetic track permits slippage of the mandrel after the sliding latch guide **76** has caught the connector at the dangling end of the wire and is therefore generating a torque greater than the frictional torque exerted by the magnetic track on the mandrel.

When coiling is completed, the coiled wire is automatically retained around its mandrel **12** while the mandrel passes through the subsequent stages of the process.

The loaded mandrels are next lowered to a heating conveyor **106** by way of a timing delivery mechanism **96** (FIGURE 3). Conveyor **106** carries the mandrel through the heating zone **16** (FIGURE 3). Thence they travel to a cooling zone **18**, where the mandrels and the wire lengths coiled around them return to room temperature, and a delivery conveyor **120** then carries the mandrels to a delivery chute **124**. Here the wire is unwound from the mandrel **12** by a novel mandrel unwinder **140** which simultaneously unwinds and reverse coils the short coiled length of wire. This results in a tighter coil. It should be evident that the method and apparatus of the present invention effect automatic and continuous coiling, heating, and cooling of lengths of wire, such as insulation-coated conductor pairs. With an initial single quick "loading" operation performed upon each wire length, all of the processing treatments then follow automatically. And with a simple manual or automatic manipulation, the wire is subsequently removed from the mandrel and simultaneously reverse coiled. Operator faults are substantially eliminated during these consecutive steps and high-volume production of uniform, tightly coiled wire lengths is made possible.

Wire processed by the above technique is found to be permanently coiled in a tight, uniform manner over substantially its entire length. It is exceptionally neat in appearance. When used, it is resilient and self-recoiling due to the resistance of its coiled configuration to stretching. It does not tangle, and by reason of its self-coiling feature, it tends to be less subject to wear.

A detailed discussion and description of the various parts of the apparatus and of the technique of operation follows hereinafter.

The hopper

The hopper **10** consists of an inclined mandrel chute **19** with a dispenser opening **20** at its lower end (see FIGURES 1, 3, and 7). Loaded mandrels **12** are placed in chute **19** by the operator, and are singly released for coiling and heating treatment by the trigger and gate mechanism now to be described.

The dispenser opening **20** is normally closed by a gate, which comprises an upwardly extending gate rod **22** pivoted at **24** to the frame **26** of the apparatus. Gate rod **22** is biased counterclockwise by spring **28** to normally block the dispenser opening **20**. A cam follower **30** affixed to a gate rod crank **23** coacts with a clockwise rotating cam disk **32** to pivot rod **22**. When cam peak **34** engages follower **30**, rod **22** pivots away from the dispenser opening. Such pivotal movement unblocks the opening and permits a wire-loaded mandrel **12** to pass through the opening.

To effect singular release of the mandrels in the hopper, the upper end of gate rod **22** contains a trigger pin **40** which rides on the forward upwardly concave surface **38** of trigger finger **36**.

Trigger finger **36** is biased clockwise by trigger spring **42** so that pin **40** will continuously bear against surface **38**.

With the unblocking of the dispenser opening **20** by the clockwise pivoting of rod **22**, pin **40** moves along the concave surface **38** of the trigger finger **36** (compare FIGURE 7A to FIGURE 7B). Such movement pivots the free end of the trigger finger **36** downwardly to block passage of subsequent mandrels **12** into the dispenser opening (see FIGURE 7B). Thus, singular release of mandrels contained in the hopper is accomplished.

The mandrels

Referring particularly to FIGURES 8 through 10, each mandrel **12** consists of a rod **72** with enlarged ends **50** and **52**. The enlarged ends may be integral with rod **72** or else separately machined tubular members which have been mounted upon and secured to the rod ends. The rod ends contact the winding mechanism as explained in detail hereinafter.

The rod **72** of each mandrel contains an encircling fixed clamp **74** and a sliding latch guide **76**. Both the clamp and the guide have an angular block configuration with the rod **72** extending through one arm portion of said block configuration.

Fixed clamp **74** (FIGURE 8) contains a channel **78** which receives and retains wire W. An ear **80** aids to lock the wire W within the channel. The clamp is fixedly swaged to rod **72** by punched dimples **86** in its rod-containing leg. Obviously other methods of fixation, such as keying, brazing or spot welding may be used.

Sliding latch guide **76** has a channel **82** which also receives and contains wire W. The channel **82** has a depth sufficient to properly guide the wire therethrough onto the rod **72**. Ear **84** aids in locking wire W within the channel.

The main distinction between the fixed clamp and the sliding latch guide **76** is that the latter is free to revolve about rod **72** but only in a unidirectional manner (counter-clockwise in FIGURE 10). Such unidirectional rotary motion is accomplished by a unique spring lock mecha-

nism. The spring lock mechanism consists of a helical rod-encircling spring **88** contained within a recess **87**. One end **89** of the spring is fixedly secured to the latch guide while the other end **91** of the spring is permitted to ride freely on the rod **72**. The internal diameter of spring **88** is dimensioned for frictional engagement with the surface of rod **72**. Thus when torque is applied to the latch guide tending to rotate it in a direction which loosens the spring about the rod (e.g., counterclockwise in FIGURE 10), the latch guide will rotate about and move longitudinally over the length of rod **72**. This occurs because such counterclockwise torque is opposed only by the frictional grip of the remote free end of spring **88** upon rod **27**, and spring **88** therefore uncoils until too few coils remain in frictional engagement with rod **72** to resist rotation of latch guide **76** about rod **72**. However, when an attempt is made to pivot latch guide **76** about rod **72** in a direction which tightens the spring around the rod (e.g., clockwise in FIGURE 10), such tightening increases the frictional engagement of spring **88** with rod **27**, and the spring therefore seizes and clamps the rod so that no rotary nor longitudinal movement is possible. Thus, unidirectional rotary motion is latch guide **76** is permitted while at the same time, a lock against an opposite rotary motion is effected.

The winding mechanism

As each mandrel is dispensed from the hopper, it falls into a saddle **44** of a coiling zone conveyor **46** (FIGURES 1, 2, 3). Each saddle is formed in a flat U-shape, as shown in FIGURE 1. Its arms **43** and **45** are affixed through rotatable spacers **51** to two outer chains **47** and **48** of the conveyor **46** (FIGURES 2, 4, 5). The spacers **51** rotate upon extensions of the chain link pins **53**.

The chains **47** and **48** each ride over a powdered sprocket wheel **39** and an idler sprocket wheel **41**. Since the span of each saddle is less than the length of each mandrel, mandrel ends **50** and **52** extend through slots **49** in the upstanding arms **43** and **45** of each saddle (see FIGURES 1, 2) and are supported by the rotatable spacers **51** (see FIGURES 2, 4 and 5). The mandrel is thus able to rotate while resting on said spacers.

Disposed over each winding mechanism chain, is a magnetic track **54** (see FIGURE 2). Since both tracks are similar, only one track **54** will be described in detail.

Track **54** consists of two horizontally disposed rails **58** which are integral with or securely connected to the pole ends of a series of inverted horseshoe magnets **62** (see FIGURE 3 which illustrates the series). The pole of the magnets are aligned so that each rail has either a north or a south polarity.

Disposed in the bight portion of the inverted series of horseshoe magnets is a non-magnetic support strip **60**. A plastic or aluminum strip is suitable for this purpose. Bolts **64** along the length of the strip secure the magnetic track to an elongated angular support bracket **68**. A downwardly faced channeled cover plate **70** encloses the magnetic track assembly.

The suspended magnetic track or tram is positioned so that it engages the end of each mandrel **12**. Thus as the mandrel is moved laterally or broadside down the conveyor path an upside down or "reverse" rolling of the mandrel occurs.

"Reverse" rolling can best be visualized by rolling a rod shape to the right across the top and bottom surfaces of a horizontal plane. On the top surface the rod rolls with the direction of movement, clockwise. On the bottom surface it "reverse rolls" counterclockwise. As shown in FIGURES 2 and 5, the cylindrical end **52** of mandrel **12** is rotatably supported on the rollers **51** in frictional rolling engagement with the underside of track rails **58**. The mandrel end **52** thus provides a closed path for the magnetic flux of magnet **62**, and is held by magnetic attraction against rails **58**. As saddle **44** carries the mandrel along winding conveyor **46**, reverse rolling of mandrel end **52** beneath rails **58** occurs, coiling wire W about rod **72** of mandrel **12**.

Such reverse rolling in coaction with the camming of latch guide **76** as described hereinafter winds wire W into a tightly coiled helical configuration around each mandrel **12**. The magnetism of the track creates a sufficient attractive force between the mandrel and the track that any dragging force of the dangling end of wire W is overcome.

The camming of the movable wire guide **76** is effected by a cam table **90** within each saddle. The lower unnotched surface of the movable latch guide **76** bears against table **90**, and is thus prevented from rotating. Simultaneous with such camming, the mandrel and the fixed clamp are reverse rolling along rails **58**. This reverse rolling of the mandrel with camming of the movable latch guide **76** draws wire W through slot **82** in latch guide **76**, and coils the wire about rod **72**. The coiled wire urges latch guide **76** sideways along rod **72**, from left to right in FIGURE 2. Wire W is fed to the rod by a proper depth of channel **82**, to cause a tight helical winding of wire about the rod.

It should be noted that the diameter of wire W will govern the number of turns per unit length of the coil. This can be seen by noting that channel **82** is so formed (see FIGURES 2 and 8) that it feeds the wire to the rod so that the juxta-positioned edges of the coiled wire act to "guide" and cam the next turn of wire being fed to the rod. Hence, a tight winding of wire W about rod **72** is accomplished.

When the end of wire W reaches the movable latch guide **76**, connection C jams in the entrance to groove **82**, being too large to pass into the groove. The connection C may be a plug, a terminal, or for that matter, even a knot in the wire or any enlarged body not capable of sliding through channel **82**.

Catching of the connection by the guide blocks the further feeding of wire W through groove **82** around rod **72**, and thus blocks further revolution of rod **72** and therefore of mandrel **12**. Since no further mandrel rotation can occur, the magnetic track friction is overcome. The mandrel merely slides over the track to the terminal end of the winding mechanism. It then disengages from the track and is carried in saddle **44** around idler sprocket wheel **41**.

At the end of conveyor **46**, the saddle **44** is inverted by a 180° turn around the sprocket wheel **41**, and the mandrel drops off the saddle to rest between guide **94** and a vertical power driven rotating feed mechanism comprising two spaced rotating notched wheels **96** (FIGURE 3). Each wheel contains a notch or slot **98** in its periphery. Notches **98** are of sufficient depth to engage and carry the enlarged ends **50** and **52** of the mandrel **12** around the semi-circular path **100** defined by the wheel periphery and its enclosing guide **94**. After being carried about the half circular path **100**, the mandrel is delivered through an opening **102** in guide **94**, and thence to the heating zone conveyor **106**.

The heating zone

The heating zone **16** of the apparatus of this invention consists of heating means, such as a radiant heating element **104** spaced longitudinally over the heating zone conveyor **106**. Obviously other heating means, such as banks of infra-red bulbs or induction heating of the mandrel could also be utilized.

The heating zone conveyor **106** consists of two spaced chains at the outer side edges of the apparatus which engage the ends of each mandrel. As shown in FIGURE 3, each chain rides over a driven sprocket wheel **107** and an idler sprocket wheel **109**. Both chains are driven at an equal rate of speed to prevent any skewing of the mandrel as it travels down the conveyor path.

As illustrated in detail in FIGURE 6, each link **103** of the chain conveyor **106** is formed with outwardly ex-

tending dogs **110**. These dogs **110** with the link form a pinion-type surface for receiving and retaining the enlarged ends of each mandrel.

To effect even distribution of heat to the coiled wire, mandrel is rolled as it travels along the conveyor path. Such rolling movement is effected by overlying friction shoes **112** which engage the ends of the mandrel. In this instance, the shoes are not magnetic because not only would the heat of the heating zone destroy the magnetism but also normal rolling friction is sufficient to rotate the mandrel since no coiling of the wire W is required in this stage of the process. At this stage, there is no drag of the wire. To insure rolling of the mandrel, it is generally, desirable to apply stripping; such as, felt or neoprene to the surface of the shoe. Obviously, other friction generating rolling surfaces may be employed.

After a fixed exposure time in the heating zone, the plastic or neoprene coating on the wire has been sufficiently oriented to retain its coiled set. The mandrel is then deposited onto a third conveyor which passes through a cooling zone in the apparatus.

The cooling zone

At the end of the heating zone conveyor, each mandrel drops onto a cooling zone conveyor **114**. Here again, the construction of the conveyor preferably consists of two spaced chains located at the outer edge portion of the apparatus. Each chain rides over a driven sprocket wheel **116** and an idler sprocket wheel **118**.

The cooling zone **18** in the preferred embodiment is located at the lower portion of the apparatus. This permits a gravity feed of each mandrel from the upper winding conveyor **46** to the lower cooling zone. It also permits a three-tiered arrangement with the winding mechanism at the upper level where visual inspection of the most crucial step in the technique is possible at all times. A draft of air for cooling is effected by a fan **128** located in flume **129** of the apparatus.

While the three-tiered arrangement is indicated as the preferred embodiment it should be understood that, with some modification the functioning elements can be positioned in different arrangements. It is also possible to eliminate the cooling zone from the apparatus provided that some provision is made to permit self-cooling of each mandrel after it has been dispensed from the apparatus.

Delivery

At the end of the cooling zone, each mandrel is taken up by a delivery conveyor **120**, which is primarily located in flume **129** where additional cooling is possible. The construction of conveyor **120** is basically similar to the other construction of the conveyors. It consists of two spaced chains located at the outer side portions of the apparatus. Each chain rides over a driven sprocket wheel **118** and an idler wheel **122**. Wheel **118** is driven by chain **114** of the cooling zone.

At the delivery end of delivery conveyor **120**, the mandrel is dispensed through delivery chute **124** in the apparatus housing **26**. An operator or an auxiliary conveying mechanism may be stationed at this opening to receive each mandrel. Here the wire is removed from the mandrel using a novel reverse coiling mandrel unwinder. The empty mandrel is reused to wind and set additional wire.

Mandrel unwinder and reverse coiling means

The mandrel unwinder, generally indicated at **140**, is shown in detail in FIGURE 11. As shown in FIGURE 3, it has a shelf element **142**, which is affixed to housing **26** with the aid of angular support brackets **144**. Again referring to FIGURE 11, the shelf element supports a mandrel chuck and drive means **146**, a mandrel support **147** and an unwind spindle chuck and drive means **148**. Both means are driven, as indicated below, by a motor and gearing housed in motor housing **150** extending below the shelf element **142**.

The mandrel chucking and driving means includes a quick-connect chuck **152** into which the enlarged end **50** of mandrel **12** is inserted. The other enlarged end **52** of the mandrel is rotatably supported in a V-shaped slot **154** in mandrel support **147**.

The unwind spindle chuck and drive means also includes a chuck **156** which supports an unwind spindle **158** which is similar to rod **72** of mandrel **12**. The unwind spindle has a fixed clamp **160** into which the released end of the coiled wire W is inserted prior to the unwinding and reverse coiling operation.

In operation, both chuck means are driven in opposite directions and at a rate of speed which causes unwinding of wire W from mandrel **12** and reverse coiling onto spindle **158** without stressing the wire.

Mandrel **12** is driven by mandrel drive means **148** to unroll the wire from the mandrel (counterclockwise in FIGURE 3). Spindle **158** is driven to wind the coiled wire against its coiled set; i.e., over the spindle and in a clockwise direction in FIGURE 3, so that reverse coiling occurs.

After fully unwound and reverse coiled, the wire is released from clamp **160** and the reverse coiled length removed from the spindle **158** by axial sliding movement of the length toward and past the free end **162** of the spindle.

Power means

As illustrated in FIGURE 3 the heating zone conveyor, the cooling zone conveyor, and the delivery conveyor are powered by motor **130** acting through a chain drive **132** and a tensioned guide wheel **134**. A separate motor **136** with chain **138** drives sprocket wheel **39** of the winding mechanism conveyor.

Motors **130** and **136** may be combined provided appropriate gearing is used to provide a unitary drive for all of the chain conveyors. In the embodiment shown, the two-motored arrangement was preferred because it simplified control of the operating parts.

As to the unwinder power means, it consists of a motor and appropriate gearing to power each of the chuck and drive means **146** and **148**. The power means may be controlled by an on-off switch (not shown) preferably having a pedal actuator.

While it is believed that the foregoing detailed description has sufficiently indicated the sequence involved in permanently coiling wire, the operating procedure is nevertheless discussed in detail below to insure a thorough understanding of the invention.

Initially, electrical current is supplied to motors **130** and **136**, fan **128**, and heating element **104**. One or more "loading" operators are stationed at hopper **10** and a second operator or an auxiliary conveyor is stationed at delivery chute **124**.

The first operator threads individual mandrels with the heat-coilable insulation covered wire. He does this by inserting one end of a wire W into the channel **78** of the fixed clamp **74** in each mandrel. He then inserts the next adjacent portion of wire W into channel **82** of the sliding latch guide **76**. After threading the mandrel with wire, it is placed into hopper **10**. The free end of the wire is dangled over the far edge of the apparatus (see FIGURE 1). At this point, automatic operation begins.

Singular mandrels are dispensed one at a time, by the machine into saddles **44** affixed to the conveyor chain of the winding mechanism. The saddle conveys the mandrel over the conveyor path of the winding mechanism. During such conveyance of the mandrel, overlying magnetic friction tracks **58** engage the mandrel ends and rotate the mandrel. This movement of the mandrel winds the wire about the mandrel in a tight helical coil. When fully wound, the latch guide catches the connector at the dangling end of the wire to overcome the magnetic

friction of the overlying tracks. At this point, rotation of the mandrel ceases. It merely slides to the end of the track.

At the end of the winding conveyor path, the mandrel is fed onto the conveyor of the heating zone. Sufficient heat is applied for a predetermined length of time by the radiant heating element **104** to set a coiled configuration into the mandrel-wound wire, producing the desired thermosetting or heat-curing treatment of the insulation coating on each wire W. To insure even heating, friction shoe **112** rotates the mandrel during travel over the heating zone conveyor.

At the end of the heating zone, the mandrel drops onto the cooling zone conveyor. Cool air is sucked through the apparatus by fan **128** to cool the mandrel. After cooling, the mandrel is tanken up by an upwardly inclined dispensing conveyor **120** and fed to opening or chute **124**. The second operator or the auxiliary conveyor stationed at this opening catches the mandrel as it is dispensed.

The wire is then unwound from the mandrel by the novel unwinder **140** which simultaneously reverse coils the wire to further enhance the resilience and retractability of the coiled length. Empty mandrels are returned to the first operator for reuse.

After such reverse coiling, the coiled lengths are ready for packaging and shipment to the user.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

I claim:

1. Apparatus for imparting a coiled configuration to a cord comprising, in combination,

(A) a mandrel upon which said cord may be wound,

(B) holding means to hold one end of said cord secured to said mandrel,

(C) driving means to rotate said mandrel in a first direction,

(D) and a self-locking cord guide

(1) slidably mounted on said mandrel and permitting free rotation of said mandrel therein in said first direction to coil said cord helically in successive turns about said mandrel during rotation thereof,

(2) restraining said mandrel against rotation therein in a direction opposite to said first direction,

(3) and blocked against rotating with said mandrel during rotation of the latter in said first direction, whereby said cord is helically coiled and retained on said mandrel for subsequent coil-setting operations.

2. The combination defined in claim **1** in which a helical coil spring

(A) has one end anchored in said cord guide

(B) with a plurality of its turns closely surrounding said mandrel in sliding contact therewith,

whereby said relative rotation in said first direction tends to uncoil said spring while relative counter-rotation tends to coil said spring, bringing its turns into gripping engagement with said mandrel to provide said restraining action.

3. Apparatus for imparting a permanently coiled configuration to a length of cord comprising in combination,

(A) a mandrel upon which said cord may be wound,

(B) holding means to secure one end of said cord to said mandrel,

(C) a staged mandrel-conveyor having a winding stage incorporating driving means to rotate said mandrel,

(D) a self-locking cord guide unidirectionally rotatably mounted on said mandrel and slidable therealong

(1) from an initial position adjacent to said holding means

(2) to a remote position spaced away from said holding means

(3) to coil said cord in successive helical turns arrayed along said mandrel between said two positions as said driving means rotates said mandrel and to hold said cord coiled on said mandrel

(E) and setting means juxtaposed with a second stage of said mandrel-conveyor to set said cord permanently in its coiled configuration while it is held coiled on said mandrel.

4. Automatic apparatus for imparting a permanently coiled configuration to a series of heat-settable cords comprising, in combination,

(A) a plurality of mandrels upon which said cords may be wound,

(B) a holder on each mandrel positioned to secure one end of one of said cords to said mandrel,

(C) a movable cord guide journaled upon each said mandrel,

(D) an automatically dispensing storage rack for said mandrels with cords end-secured thereon,

(E) a conveyor supporting at least one saddle for serially receiving said mandrels from said dispensing rack at predetermined intervals and rotatably holding and moving said mandrels serially along said conveyor,

(F) mandrel rotating means comprising a magnetic track extending along said conveyor and presented in magnetic engagement with each said saddle-held mandrel to cause rolling of said mandrel along its track during movement of said conveyor-supported saddle from an initial point toward a delivery point,

(G) cam means on each said saddle blocking rotary movement of the cord guide journalled on the associated mandrel during rotation of the latter,

(H) and heating means automatically receiving said mandrels serially from said conveyor at said delivery point to set said cords while coiled on said mandrels into a permanently coiled configuration.

5. Automatic apparatus for imparting a permanently coiled configuration to a cord, comprising, in combination,

(A) a mandrel upon which said cord may be wound,

(B) a holder securing one end of said cord to said mandrel,

(C) a movable cord guide journaled upon said mandrel,

(D) and means to rotate said mandrel while said movable cord guide is cammed against rotary movement including

(1) a conveyor supporting a saddle for rotatably holding and moving said mandrel along said conveyor,

(2) a magnetic track extending along said conveyor and presented in magnetic engagement with said saddle-held mandrel to cause rolling of said mandrel along said track during movement of said conveyor-supported saddle from an initial point toward a delivery point,

(3) and cam means on said saddle blocking rotary movement of said cord guide while said mandrel is rotated.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,226,767 January 4, 1966

Alleyne C. Howell, Jr.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 15, for "a" read -- in --; column 2, line 16, after "the", second occurrence, insert -- winding mechanism, taken along line 4-4 of FIG- --; column 5, lines 14 and 21, for "27", each occurrence, read -- 72 --; line 23, for "is" read -- of --; same column 5, line 35, for "powdered" read -- powered --; column 8, between lines 51 and 52, insert as a centered italicized heading "The operating procedure"; column 9, line 16, for "tanken" read -- taken --.

Signed and sealed this 13th day of December 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents