United States Patent [19]

Forester

[11] **3,847,190**

[45] **Nov. 12, 1974**

[54] **METHOD AND APPARATUS FOR TWISTING WIRES**

[75] Inventor: **Glen Robert Forester,** Burnaby, British Columbia, Canada

[73] Assignee: **Phillips Cable Limited,** West Brockville, Ontario, Canada

[22] Filed: **Dec. 19, 1972**

[21] Appl. No.: **316,542**

[52] **U.S. Cl.** **140/149,** 57/77.3

[51] **Int. Cl.** **B21f 7/00**

[58] **Field of Search** 140/115, 149; 57/77.3; 174/32, 33, 34

[56] **References Cited**

UNITED STATES PATENTS

2,546,977	4/1951	Clary, Jr. et al.	57/58.55
3,053,039	9/1962	Demmel	57/35
3,169,360	2/1965	Corrall et al.	57/77.3
3,448,569	6/1969	Brown et al.	57/15

FOREIGN PATENTS OR APPLICATIONS

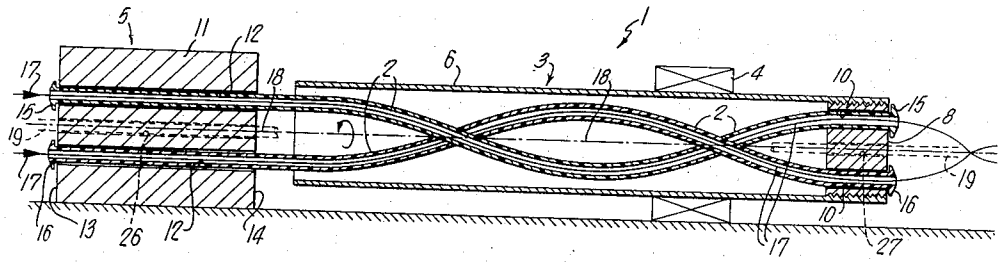
726,565	12/1966	Italy	140/149

Primary Examiner—Lowell A. Larson
Attorney, Agent, or Firm—Diller, Brown, Ramik & Wight

[57] **ABSTRACT**

An apparatus and method is disclosed for producing a set of wires in which each wire defines a helical path about the longitudinal axis of the set, the apparatus comprises flexible elongated guide means, for example, nylon tubes; the apparatus enables a set to be produced in which the number of reversals in the path of a wire in a set is reduced; there is also disclosed a cable and an apparatus and method of making it comprising a bundle of sets as defined above.

17 Claims, 9 Drawing Figures



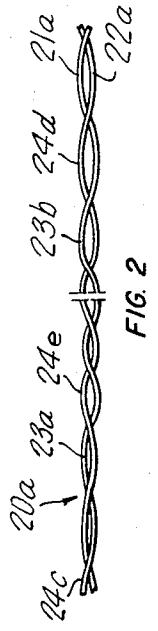


FIG. 2

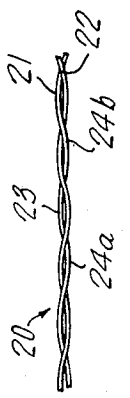


FIG. 1

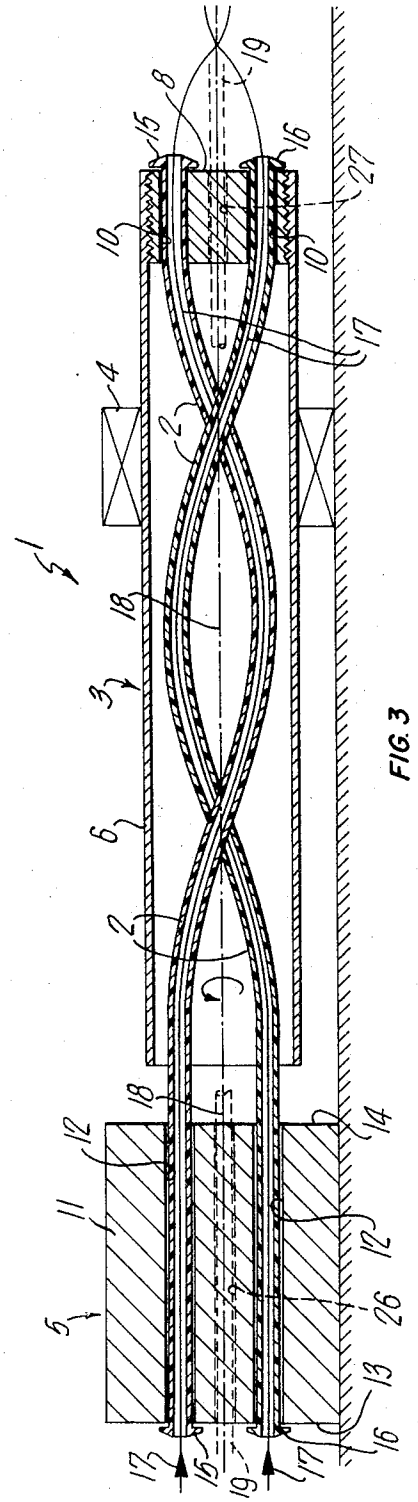


FIG. 3

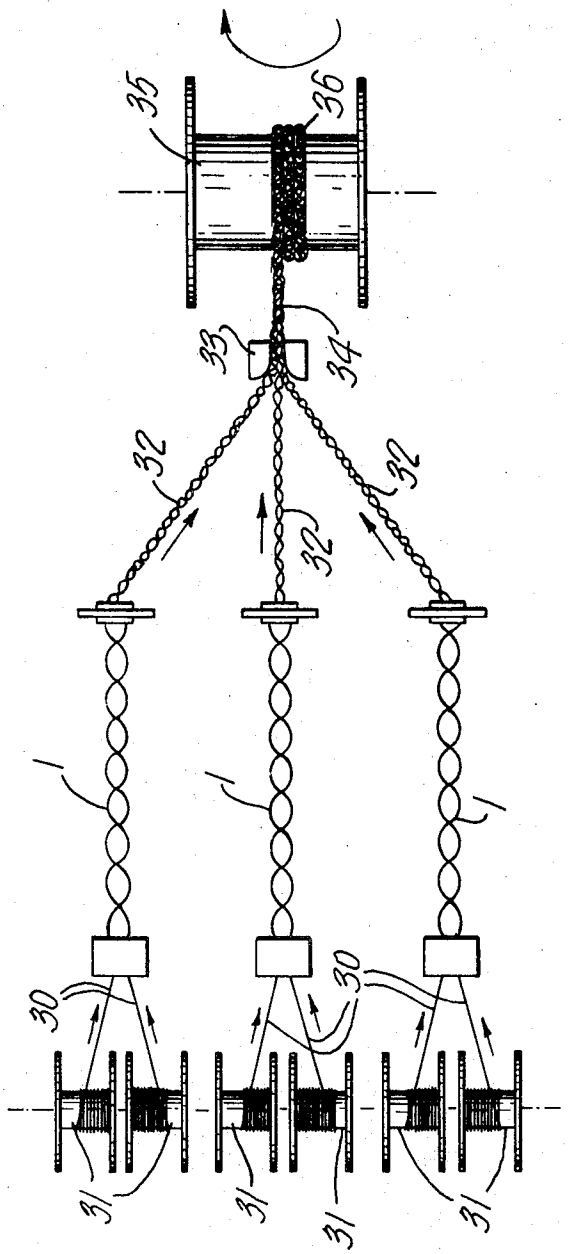


FIG. 4

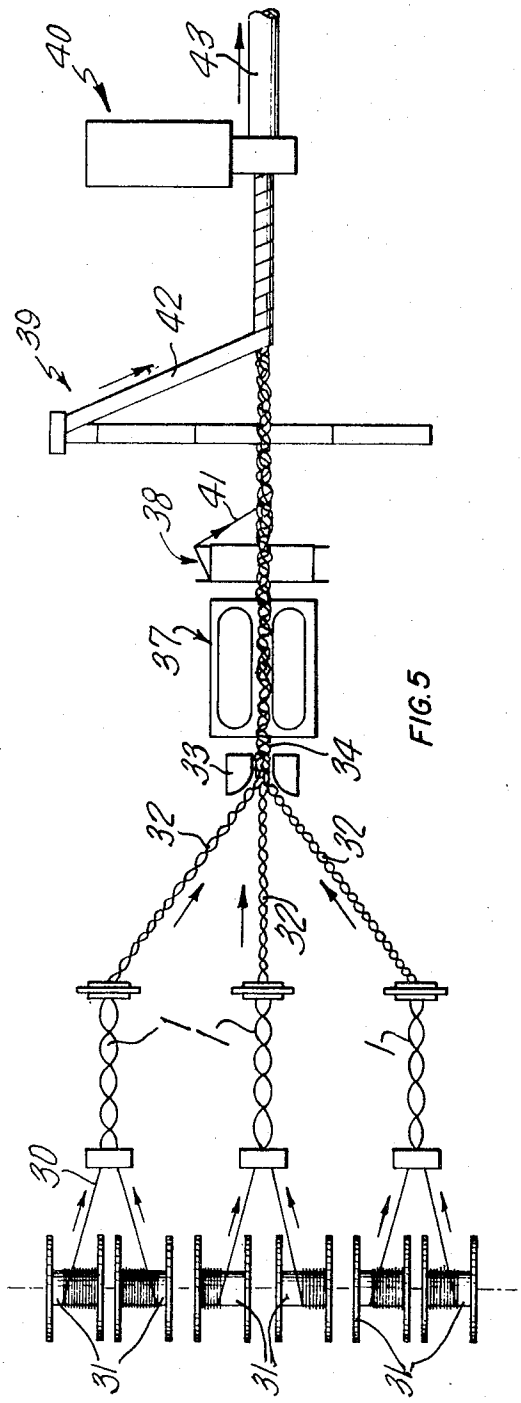


FIG. 5

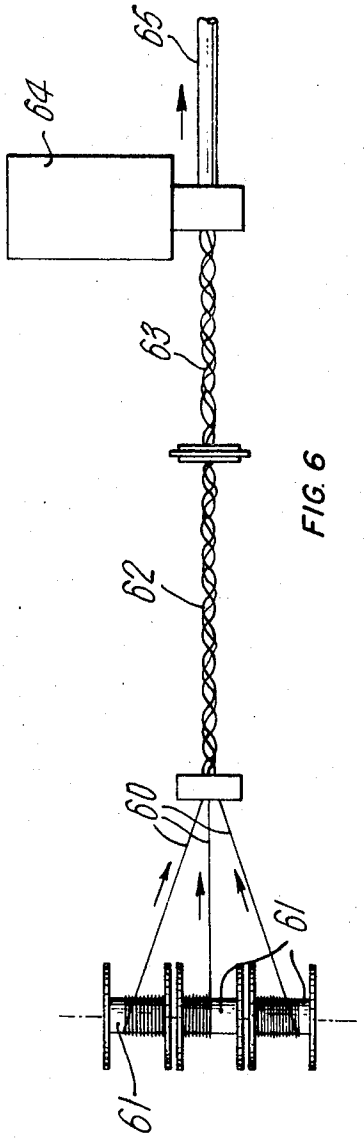


FIG. 6

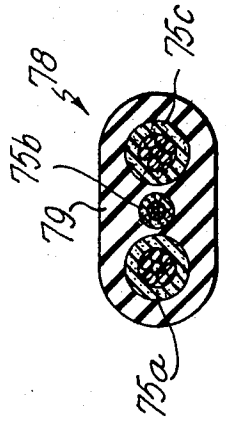

78
75c
75b
79
75a

FIG. 8

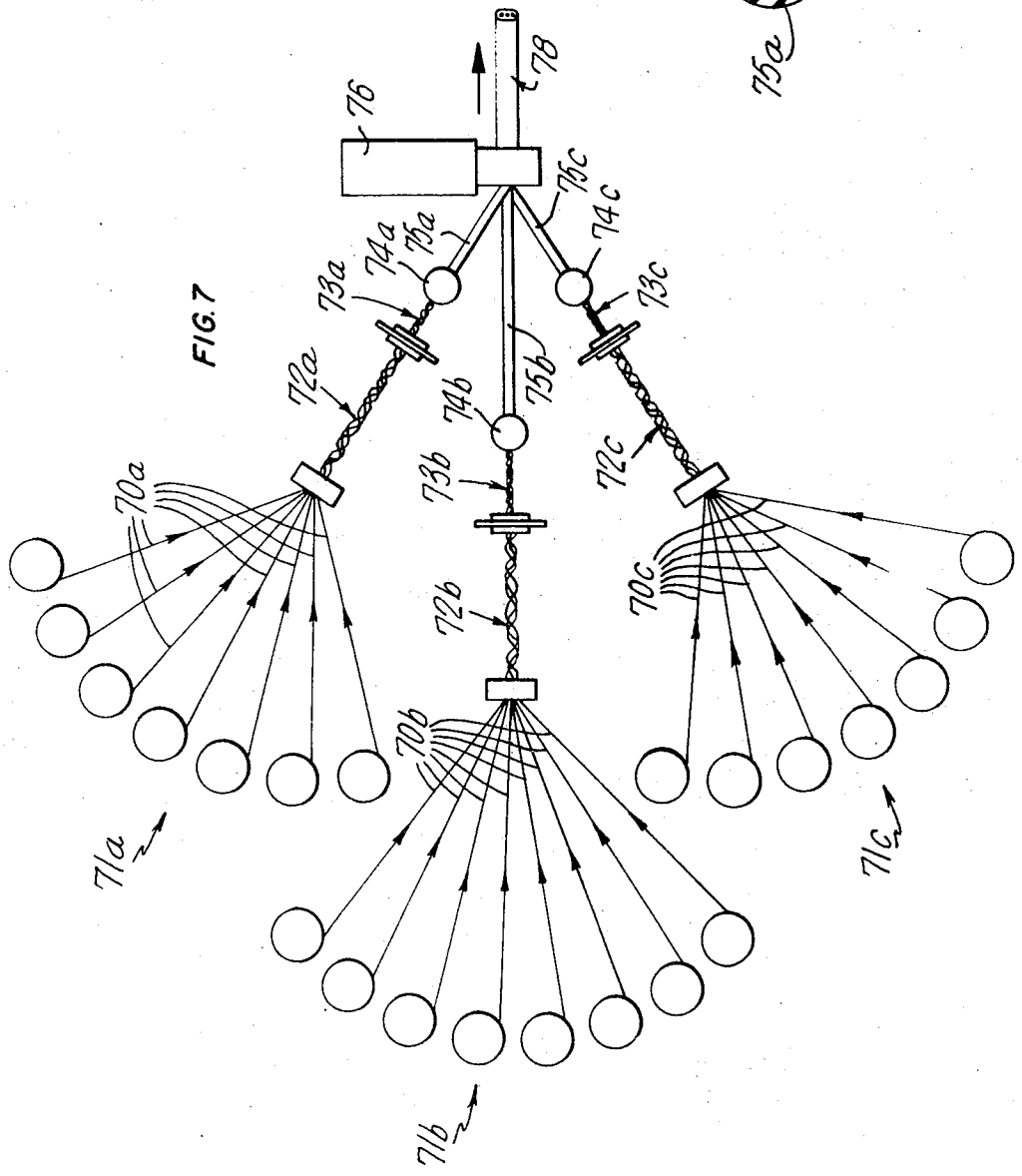

76
78
75c
74c
74a
75a
73a
73c
72a
75b
74b
73b
72c
70a
72b
70c
70b
71a
71c
71b

FIG. 7

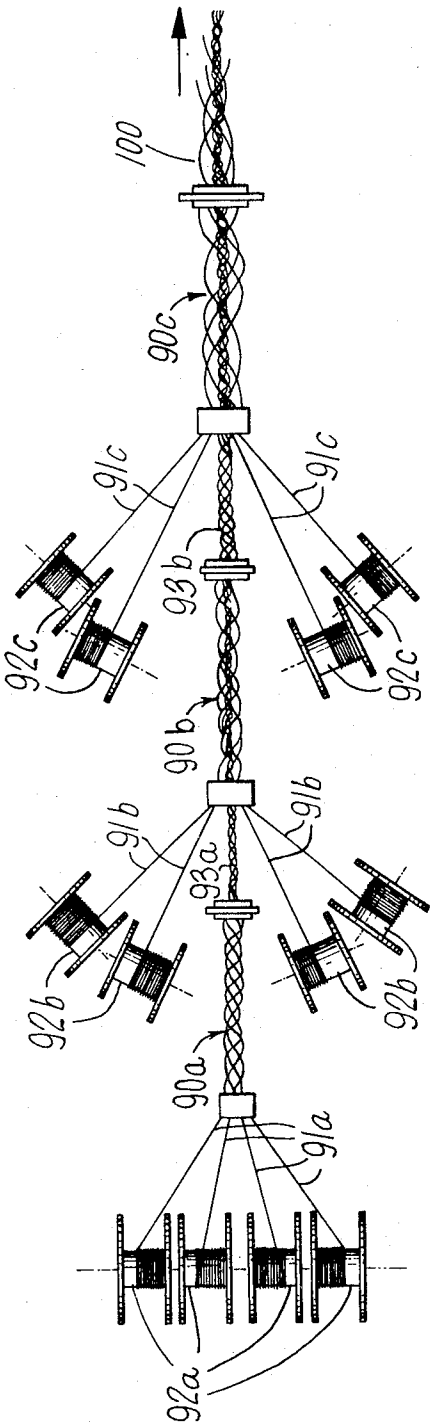


FIG. 9

METHOD AND APPARATUS FOR TWISTING WIRES

BACKGROUND OF THE INVENTION

a. Field of the Invention

This invention relates to a method and apparatus for twisting wires and to a method and apparatus for forming a bundle of wires comprising a plurality of sets of twisted wires and to such a bundle of wires.

More especially it is concerned with a method and apparatus for making electric cables which consist of or comprise a layer of wires which extend about a central axis, which may comprise a core, in a helical path which periodically reverses in direction. Thus the cable may comprise or consist of a plurality of wires twisted together to form a set such that each wire describes a helical path about the longitudinal axis of the set and in which the helical path periodically reverses in direction; the invention relates further to a method and apparatus for making an electric cable comprising a bundle of such sets of twisted conductors.

In this specification a wire includes a single electric conductor whether bare or insulated, and a group of two or more electric conductors whether bare or separately or collectively insulated, for example, a twisted telephone pair or a quad.

The term "core" when used in this specification means a single wire either bare or insulated, or a group of wires associated in any manner, which may or may not be enclosed within a common envelope.

b. Description of Prior Art

Manufacture of a cable comprising or consisting of a plurality of electric conductors twisted together to form sets such that each conductor describes a helical path about the longitudinal axis of the set which reverses in direction periodically, can be effected by passing the conductors from their supply bobbins through a fixed lay plate and to and through an oscillating lay plate spaced apart from the fixed lay plate. In this case the oscillating lay plate oscillates angularly up to 360° about the longitudinal axis of the set. The twisted conductors leaving the oscillating lay plate pass to a closing die where the twist is held.

If the oscillating lay plate is rotated more than 360° in either direction then the section of the wires passing between the fixed lay plate and the oscillating lay plate rub together and may be damaged, also if the oscillating lay plate is rotated several revolutions in one direction, then this section of the wires become snarled and tangled with consequest damage to the wires and delay in the process as the wires have to be disentangled before the process can be continued.

The speed of through-put of the above described process is thus low owing to the limitations on the periodicity of oscillation of the oscillating lay plate.

SUMMARY OF THE INVENTION

The present invention has an object to provide a method and apparatus for manufacture of cables of the kind described, in which an angle of oscillation greater than 360° may be used without damage to the electric conductors due to their rubbing against each other during the travel of the electric conductors from a fixed plate to the point at which the twisted cable is formed.

The invention further provides an apparatus and method for producing a set of twisted together wires in which the direction of twist reverses periodically in direction, and in which a relatively large number of twists can be produced in one direction without a change in direction. This means that for a given length of a set of twisted together wires, there can be fewer reversal points.

According to the invention apparatus for twisting a plurality of wires to form a set in which each wire defines a helical path about the longitudinal axis of the set comprises flexible elongated guide means for the wires, said guide means being twistingly rotatable about said longitudinal axis through an angle greater than 360° relative to the untwisted wires.

According to another feature of the invention the apparatus further includes first and second spaced apart housing means for the guide means, said first housing means being adapted to support one end of the guide means and said second housing means being adapted to twistingly rotate the guide means through an angle greater than 360° relative to the first housing.

According to another aspect of the invention a method of twisting wires comprises passing a plurality of wires from a fixed pathway to and through flexible elongated guide means, rotating said guide means through an angle greater than 360° relative to the untwisted wires about the longitudinal axis of the set of twisted wires to be formed, thereby forming a set of twisted wires in which each wire defines a helical path about the longitudinal axis of the set.

By means of the apparatus and method according to the invention, a cable of the type which consists of or comprises a layer of wires, which extend about a central axis in a helical path, which periodically reverses in direction can be produced having a greater number of twists following each other in the same direction for a given speed of the wire through the apparatus and for a given speed of rotation of the twisting apparatus.

According to another aspect of the invention a method of forming a bundle of wires comprising a plurality of sets of twisted together wires, comprises: twisting wires together to form a plurality of sets in such a way that each wire in a set defines a helical path about the longitudinal axis of the set, said helical path reversing periodically in direction, and feeding said plurality of sets together to produce the bundle.

According to another feature of this aspect of the invention the wires of at least some sets are given a different twist from the wires of other sets so that the wires of at least some sets of wires in the bundle have a non-parallel relationship with the wires of other sets of wires in the bundle.

According to another feature of this aspect of the invention twist holding means is applied to each set substantially at the point where the direction of the helical path of each wire in a set is reversed in direction.

According to another feature of this aspect of the invention the twist holding means comprises an adhesive means for example, glue, adhesive tape or polybutene.

According to another feature of this aspect of the invention the plurality of sets of wires is twisted together to form a twisted bundle.

According to another feature the method of forming a bundle comprises passing a plurality of groups of wires from fixed pathways to and through a plurality of

flexible elongated guide means, rotating said guide means through an angle greater than 360° relative to the untwisted wires about the respective longitudinal axis of the corresponding set of twisted wires to be formed, to form said plurality of sets.

According to another aspect of the invention apparatus for forming a bundle of wires comprising a plurality of sets of twisted together wires comprises: means for twisting wires together to form a plurality of sets in such a way that each wire in a set defines a helical path about the longitudinal axis of the set, said helical path periodically reversing in direction, and means for feeding said plurality of sets together to produce the bundle.

According to another feature of this aspect of the invention the means for twisting comprises flexible elongated guide means for the wires for each set to be formed, said guide means being twistingly rotatable about the respective longitudinal axis of the corresponding set to be formed through an angle greater than 360° relative to the untwisted wires.

According to another feature of this aspect of the invention the means for twisting the wires of at least one set further includes first and second spaced apart housing means for the guide means, said first housing means being adapted to support one end of the guide means and said second housing means being adapted to twistingly rotate the guide means through an angle of greater than 360° relative to the first housing.

According to another feature of this aspect of the invention the apparatus further includes means for applying twist holding means to each set substantially at the points where the direction of the helical path of each wire in a set is reversed in direction.

BRIEF DESCRIPTION OF DRAWINGS

A preferred embodiment of the invention is illustrated with reference to the accompanying drawings in which:

FIG. 1 illustrates a pair of wires or twin having a reverse twist,

FIG. 2 illustrates a pair of wires or twin having a different reverse twist,

FIG. 3 illustrates apparatus for twisting a pair of wires together to produce a twin,

FIG. 4 illustrates schematically apparatus for producing a bundle of three sets of twins,

FIG. 5 illustrates schematically apparatus for producing a cable,

FIG. 6 illustrates schematically another apparatus for producing a cable,

FIG. 7 illustrates schematically another apparatus for producing a cable,

FIG. 8 is a cross-section of a cable produced using the apparatus of FIG. 7,

FIG. 9 illustrates schematically an apparatus for producing a cable comprising sets of twisted together wires in which some sets have a non-parallel relationship with other sets.

DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to FIG. 1 a wire pair **20** having a reverse twist comprises wires **21** and **22**, the point **23** being the point of reversal of twist; the portion **24***a* is provided with a right-hand twist and the portion **24***b* is provided with a left-hand twist.

With reference to FIG. 2 a wire pair **20***a* having a reverse twist comprises wires **21***a*, **22***a*, the points **23***a* and **23***b* being points of reversal of twist, the portions **24***c* and **24***d* being provided with a right-hand twist and the portion **24***e* being provided with a left-hand twist. In this wire pair **20***a*, there are thus two points of reversal **23***a* and **23***b*; the amount of twist or the pitch of the portions **24***c* and **24***d* being substantially identical and different from the amount of twist or pitch in portion **24***e*.

With reference to FIG. **3** apparatus **1** for producing cables comprises tubular guides **2** of a low friction material, for example, nylon, housed at one end in a housing **3** mounted for oscillatory movement in a bearing **4** and at the other end in a housing **5.**

The housing **3** comprises a cylindrical wall **6** and a side wall **8,** one end of the housing **3** being open.

The side wall **8** has holes or bores **10** therein, one for each of the tubular guides **2** which pass therethrough.

The housing **5** comprises a block **11** having bores **12** passing between end walls **13** and **14** respectively to accommodate each of the tubular guides **2.**

The tubular guides **2** are arranged to pass through the bores **12** in the housing **5** and the holes or bores **10** in the housing **3.** Each of the tubular guides **2** has lips **15** and **16** at its extreme ends. The lips **15** and **16** abut against the end wall **13** of the housing **5** and the side wall **8** of the housing **3** respectively and retain the ends of the tubular guides **2** outside of the housings **3** and **5.**

In operation electric conductors **17** pass through the tubular guides **2.** On emerging from the housing **3** the conductors **17** may pass to a holding means, where necessary having regard to the nature of the wires, which may be, for example, a closing die (not shown) which holds the conductors **17** in the configuration in which they emerge from the housing **3,** alternatively if the cable is to be sheathed the conductors may pass to a sheathing station, and in this case the sheathing of the conductors serves to hold them in the configuration in which they emerge from the housing **3.**

During the passage of the electric conductors **17** through the tubular guides **2** the housing **3** is rotated in its bearing **4** about the axis **18** through an angle greater than 360°. This rotation of the housing **3** results in the tubular guides **2** being twisted together within the housing **3** and the electric conductors **17** being twisted on their emergence from the housing **3.**

When the housing **3** has been rotated several times in one direction thereby resulting in a twist in the tubular guides **2** and in the electric conductors **17** emerging from the housing **3,** in a first direction the rotation is reversed; this has the effect of untwisting the tubular guides **2** and then twisting them in a second direction opposite to the first twisting direction.

The degree of twist in the tubular guides **2** will depend upon the angle through which the housing **3** is rotated, and it has been found that the housing **3** can be rotated several times in one direction without difficulty. Clearly the length of the housing **3** is of significance. If the distance between housing **5** and the side wall **8** is comparatively short in length, then the length of the tubular guides **2** which can be twisted will be correspondingly less and so a fewer number of successive rotations of the housing **3** in one direction can be made.

The degree of twist in the electric conductors **17** will depend on both the speed of travel of the conductors through the tubular guides **2** and the speed of rotation of the housing **3.**

The lips **15** and **16** at the ends of the tubular guides **2** may be fixed to the end wall **13** and the side wall **8** respectively, and in this case, there should be sufficient slack in the tubular guides **2** to allow them to be twisted a number of times, or the tubular guides **2** should be of an elastic material, which will stretch and thereby facilitate the twisting. Alternatively the lips **15** and **16** may simply abut against the end wall **13** and the side wall **8** and be free to move away therefrom.

The apparatus **1** has been illustrated with two tubular guides **2,** however the invention is not limited to two and there may suitably be a greater number as desired, a useful number of tubular guides **2** is from two to twenty-five.

The tubular guides **2** are preferably of a material having a low coefficient of friction, to allow the guides **2** to slide easily against one another.

It is also within the scope of the invention to twist the electric conductors **17** about a wire core **19.** In this case the wire core **19** would suitably be fed along the axis **18** through passages **26** and **27** in housings **5** and **3** respectively.

With reference to FIG. **4** a plurality of wires **30** may be continuously withdrawn from supply reels **31** by suitable means for example, a capstan (not shown) and is advanced to apparatus **1,** which may be of the kind illustrated with reference to FIG. **3** where the wires **30** are twisted into pairs **32** with a reverse twist. The twisted pairs **32** advance through a die former **33,** which brings the pairs **32** together to form a unit **34,** which passes to a rotating take-up reel **35.** The take-up reel **35** may optionally oscillate or rotate unidirectionally about a radial axis of the reel to twist the unit **34** to produce a stranded unit **36** in which the pairs **32** are twisted together with a reversing twist or a twist in one direction respectively.

The pairs **32** may be given different amounts of twist per unit length by suitably adjusting the rate of oscillation of apparatus **1,** so that the wires of different pairs **32** will have a non-parallel relationship. Also the twist in a pair **32** may be varied as illustrated in FIG. **2** by varying the rate of oscillation of the apparatus **1** through which the wires **30** of a pair pass.

In addition the two described effects can be combined so that the amount of twist varies within a pair **32** and also between different pairs **32.**

With reference to FIG. **5,** the apparatus is essentially similar to that described with reference to FIG. **4,** except that the take-up reel **35** is replaced by an oscillating capstan **37,** which oscillates to produce a twist in the stranded unit **34,** and a binding head **38,** taping head **39** and extruder **40** are included.

In the binding head **38** the stranded unit **34** is bound with a binder **41,** for example, string to hold the stranded unit compactly.

The taping head **39** winds a tape **42** around the stranded unit **34;** the tape **42** may be of a material, which will act as an electrical shield, for example, aluminium tape, or it may be any other conventional tape for cables, for example, paper tape or polyethylene tape.

The extruder **40** extrudes a jacket of insulating material, for example, polyethylene, around the taped unit to produce a cable **43.**

It will be apparent that the amount of twist per unit length in the pairs **32** can be varied, and that the amount of twist may be different in different pairs **32** as described with reference to FIG. **4.**

With reference to FIG. **6,** wires **60** may be continuously withdrawn from supply reels **61** by suitable means, for example, a capstan (not shown), and are advanced to apparatus **62** similar to apparatus **1** illustrated in FIG. **3,** but having three tubular guides **2.** The wires **60** are twisted together with a reverse twist in the manner described with reference to FIG. **3** to form a set **63,** which is advanced to an extruder **64** in which a jacket of insulating material is extruded around it to produce a cable **65.**

With reference to FIG. **7,** there is illustrated an apparatus for making a power cord of the kind shown as Type S, which is used, for example, in electrically operated tools. A plurality of wires **70***a*, **70***b* and **70***c* may be withdrawn continuously from supply reels **71***a*, **71***b* and **71***c* by suitable means, for example, capstans (not shown) and are advanced to apparatus **72***a*, **72***b* and **72***c*, where they are twisted to form sets **73***a*, **73***b* and **73***c* having a reverse twist.

The sets **73***a*, **73***b* and **73***c* are passed through extruders **74***a*, **74***b* and **74***c* respectively, where they are each provided with a cover of an insulating material, for example, polyethylene. The insulated sets **75***a*, **75***b* and **75***c* are then advanced together to an extruder **76,** where they are jacketed with an insulating material, for example, polyethylene, to produce a cable **78.**

In the embodiment illustrated in FIG. **7** various modifications are possible. The apparatus **72***a*, **72***b* and **72***c* may be of the type illustrated in FIG. **3,** but having a greater number of guide tubes **2.** This apparatus is much preferred, since it allows for a greater number of twists in one direction before reversal is necessary, and it is relatively simple. However, more conventional apparatus may be used particularly if the number of reversals per unit length is not too important.

Also, in the apparatus illustrated in FIG. **7,** it is possible to produce a cable **78** in which one or all of the sets **73***a*, **73***b* and **73***c* has a different amount of twist or pitch from the others. To achieve this, the wires **70***a*, **70***b* and **70***c* would be advanced at the same rate, but the rate of oscillation of, for example, **72***b* would be different from the rate of oscillation of **72***a* and **72***c*.

With reference to FIG. **8,** a cable **78** produced using the apparatus illustrated in FIG. **7** comprises jacketed sets **75***a*, **75***b* and **75***c* surrounded by a jacket **79.** As set **75***b* is conventionally a ground wire, it may in some cases be permissible to omit the insulation and the associated extruder **74***b*.

With reference to FIG. **9** apparatus for producing a cable core **100** comprises twisting units **90***a*, **90***b* and **90***c*, which may be of the kind illustrated with reference to FIG. **3** for the embodiment illustrated in FIG. **9,** there would be **4** tubular guides **2** in each unit **90***a*, **90***b* and **90***c;* however, the number of tubular guides **2** in each twisting unit will be dependent on the number of wires **91***a*, **91***b*, **91***c*. Also, there might be a greater number than four of wires **91***a*, **91***b* and **91***c* respectively and generally the number of wires **91***b* would be greater than the number of wires **91***a* and the number

of wires **91***c* would be greater than the number of wires **91***b*.

A plurality of wires **91***a* is withdrawn continuously from supply reels **92***a* by suitable means, for example, capstans (not shown), and is advanced to twisting unit **90***a* where they are twisted to form a set **93***a* having a reversing twist.

A second plurality of wires **91***b* is withdrawn continuously from supply reels **92***b* by suitable means, and is advanced to twisting unit **90***b*. Set **93***a* is advanced to twisting unit **90***b* at the same rate as wires **91***b*, but the rate of oscillation of twisting unit **90***b* may be different from that of **90***a* so that the lay is different in each layer. Set **93***a* retains its identity passing centrally through the twisting unit **90***b* while wires **91***b* pass through tubular guides similar to tubular guides **2** in FIG. **3**. On emerging from twisting unit **90***b*, wires **91***b* are twisted around set **93***a* with a reversing twist to produce a set **93***b* in which the set **93***a* is a core.

A third plurality of wires **91***c* is withdrawn continuously from supply reels **92***c* by suitable means, and is advanced to twisting unit **90***c*. Set **93***b* is advanced to twisting unit **90***c* at the same rate as wires **91***c*, but the rate of oscillation of twisting unit **90***c* may be different from that of **90***b* so that the lay is different in each layer.

Set **93***b* retains its identity passing centrally through the twisting unit **90***c* while wires **91***c* pass through tubular guides similar to tubular guides **2** in FIG. **3**. On emerging from twisting unit **90***c*, wires **91***c* are twisted around set **93***b* with a reversing twist to produce a cable core **100** in which the set **93***b* is a core.

The cable core may pass through further operations, for example, the operations described with reference to FIG. **5**.

Further, the amount of twist per unit length produced by each of twisting units **90***a*, **90***b* and **90***c* may be the same or different, and the amount of twist produced by each of twisting units **90***a*, **90***b* and **90***c* may vary as described with reference to FIGS. **2** and **4**.

In an example, with reference to FIG. **3**, four tubular guides **2** made of nylon were used, these being 4.5 feet in length and 0.25 inches in diameter. The tubular guides **2** were threaded through a tubular steel housing **3**, the housing **3** being 4 feet long and 1 inch in diameter. Insulated electric conductors **17** having a diameter of 0.060 inches were fed through the tubular guides **2** at a speed of 300 ft./min. and the housing **3** was rotated for 10 revolutions in a first direction at a speed of 360 revs./min. after which it was stopped and rotated at a speed of 360 revs./min. in the reverse direction for 20 revolutions and so on for 20 revolutions.

A cable was thus produced having 360/300 twists per foot, i.e. a 10 inch lay. The first part of the cable, i.e. the part comprising the conductors **17**, which first emerged from the housing **3**, will have half the number of twists in one direction as the following cable, i.e. if the first part of the cable has *n* twists in one direction, the second part of the cable will have 2*n* twists in the reverse direction, and there will then be successively 2*n* twists in each direction.

As described above, it is also within the scope of the invention to have two or more apparatus **1** each having two or more wires passing therethrough to form several twisted pairs or sets, the twisted pairs or sets then being brought together and optionally twisted to form a unit, and a number of units being optionally twisted together and sheathed to form a large cable. In this case the pairs or sets might each be given a different amount of twist in the two or more apparatus **1**, so that the wires of different pairs or sets in a unit would not be parallel. This is advantageous in telephone cables, since if the pairs or sets of wires are parallel, there will be induction between the pairs or sets which results in "cross-over" during a telephone conversation. If the pairs or sets are brought together and optionally twisted together in a non-parallel fashion then inductance between pairs and hence cross-over is diminished.

In this embodiment the twist produced in each pair of wires as it emerges from its housing **3** in the apparatus **1** of FIG. **3** may be held by the application of a small amount of glue to the twisted together wires immediately before the direction of rotation of housing **3** and hence direction of twist is changed. Polybutene has been found to be particularly useful for holding the end twist in a twisted pair prior to the formation of twist in the reverse direction.

It will be apparent that if the twist is not held, as by gluing, that when the direction of rotation of housing **3** is changed, the twisted wires may be untwisted. Generally some form of twist holding means is desirable unless the twisted wires are passed immediately to a further operation, for example, a sheathing operation, which would additionally serve as twist holding means. However, the necessity for twist holding means will also depend on the nature of the wires. For example, for polyethylene insulated copper wires normally encountered in the telephone industry, there is substantially no tendency for the opposing twists to cancel each other, and therefore, the wires do not revert to an untwisted state. However, where a reversing twist is to be applied to relatively resilient wires, the twisted wires may be taped, wrapped, or otherwise held as indicated above to prevent cancellation of the opposing twists.

It is further within the scope of the invention for a case in which several tubular guides **2** are housed in a housing **3** to form the holes or bores **10** into groups of two or more concentric circles; in this case, a first group of conductors **17**, which pass through the inner concentric circle of holes or bores **10** are twisted together with a reverse twist. A second group of conductors **17** passes through the circle of holes or bores **10** adjacent the inner circle, and are twisted together with a reverse twist about the first group of twisted together conductors, which form a core for the second group.

Thus, a cable can be produced from a single apparatus **1** comprising a plurality of layers of conductors **17** twisted together with a reverse twist; the number of layers being limited only by the number of concentric circles of holes or bores **10** in the housing **3**.

I claim:

1. An apparatus for the continuous production of an electric cable comprising a set of twisted together electric conductor wires in which each wire defines a helical path about the longitudinal axis of the set which reverses periodically in direction in a predetermined manner, which comprises an entrance housing and spaced apart therefrom an exit housing; a plurality of flexible elongated tubular sleeves continuous from end to end of a low friction material; said apparatus having a longitudinal axis about which said wires are twisted through an angle greater than 360°; said sleeves being entrained from end to end between and supported at their ends by said housings; said entrance housing being

rigidly mounted and said exit housing being mounted for oscillatory movement about said longitudinal axis of said apparatus to twistingly rotate the sleeves through an angle greater than 360°; and means for continuously feeding electric conductor wires to and through said tubular sleeves as the sleeves are twistably rotated.

2. A method of continuously producing an electric cable comprising a set of electric conductor wires twisted together in which each wire defines a helical path about the longitudinal axis of the set which reverses periodically in direction in a predetermined manner which comprises:

a. continuously feeding a plurality of wires from a fixed pathway to and through a plurality of flexible elongated sleeves continuous from end to end of a low friction material such as nylon, said sleeves being entrained from end to end between and supported at their ends in a stationary housing and an oscillatable housing, said wires entering said sleeves adjacent said stationary housing and emerging from said sleeves adjacent said oscillatable housing,

b. rotating said oscillatable housing about said longitudinal axis of the set to be formed through an angle greater than 360° relative to the untwisted wires in a first direction to produce a first portion of said set having a twist in one direction, in said wires emerging from said sleeves,

c. applying a twist holding means to said first portion and

d. reversing the direction of rotation of said oscillatable housing and rotating the oscillatable housing in such reverse direction through an angle greater than 360° to produce a second portion of said set adjacent the first portion, having a twist in a second direction counter to the said first direction.

3. A method according to claim **2** wherein a core wire is fed between said sleeves along the longitudinal axis of the set to be formed, said set being formed around said core.

4. Apparatus according to claim **1** and further including holding means adapted to hold the set in its twisted configuration.

5. Apparatus according to claim **1** wherein said exit housing has a plurality of bores defined therein in two or more concentric circles, said sleeves being retained in said bores.

6. A method according to claim **2** in which the oscillatable housing is oscillated a plurality of times through an angle greater than 360°, thereby producing a set in which the helical path of each wire in the set reverses periodically in direction in a predetermined manner.

7. A method according to claim **6** in which the speed of rotation of the oscillatable housing is changed when the direction of rotation is reversed whereby the helical path of the wires in one direction is different from the helical path of the wires in the other direction.

8. A method according to claim **2** in which the ends of the sleeves are supported on the circumferences of a plurality of imaginary concentric circles having their centres on the longitudinal axis of the set of wires to be formed, whereby a set is formed comprising a core of wires twisted together in which each wire defines a helical path about the longitudinal axis of the core which reverses periodically in direction, and a plurality of layers of wires twisted together in which each wire defines a helical path about the core which reverses periodically in direction, the number of said layers being one less than the number of concentric circles.

9. A method according to claim **2** in which twist holding means is applied to the set to retain the twist in the set as the oscillatable housing is rotated in said second direction.

10. A method according to claim **2** including the further step of feeding a plurality of such sets together to form a bundle.

11. A method according to claim **10** wherein the wires of at least some sets are given a different twist from the wires of other sets, so that the wires of at least some sets of wires in the bundle have a non-parallel relationship with the wires of other sets of wires in the bundle.

12. A method according to claim **11** wherein the plurality of sets is twisted together to form a twisted bundle.

13. A method according to claim **10** wherein a sheath of insulating material is extruded around each set to form a plurality of sheathed sets,

the sheathed sets are fed together into an extrusion apparatus and a jacket of insulating material is extruded around the sheathed sets.

14. A method according to claim **10** wherein one of said plurality of sets provides a core and the other of said plurality of sets form layers around said core.

15. A unit for the continuous production of an electric cable comprising a bundle of sets of twisted together electric conductor wires in which each wire in a set defines a helical path about the longitudinal axis of the set which reverses periodically in direction in a predetermined manner, which comprises a plurality of devices each having an entrance housing and spaced apart therefrom an exit housing; a plurality of flexible elongated tubular sleeves continuous from end to end of a low friction material; each device having a longitudinal axis about which said wires are twisted through an angle greater than 360°; said sleeves being entrained from end to end between and supported at their ends by said housings; said entrance housing being rigidly mounted and said exit housing being mounted for oscillatory movement about said longitudinal axis of each said device to twistingly rotate the sleeves through an angle greater than 360°; means for continuously feeding electric conductor wires to and through said tubular sleeves as the sleeves are twistably rotated said devices being aligned so that the sets emerging from said devices can be fed together, and means for feeding said sets together to form a bundle.

16. Unit according to claim **15** including means for applying twist holding means to each set substantially at the points where the direction of the helical path of each wire in a set is reversed in direction.

17. Unit according to claim **15** including means for twisting the plurality of sets together to form a twisted bundle.

* * * * *