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(54) **Apparatus and method for the manufacture of electrical cables**

(57) In the cables, particularly telecommunications cables, all the stranding elements are stranded with a reversing direction of lay. In first stranding sets (13), elements (15) are guided on the smooth external surface of stationary or rotary tubes (4) by stationary perforate discs (2) and by rotationally oscillating discs (5). Resulting elements (12) are wound with identifying bands (19) and combined into a higher-order cable (3). These elements (12) are guided, with an alternating direction of lay, on a tube (4) of a further, similar stranding unit (1). Revolving supply systems are not required.

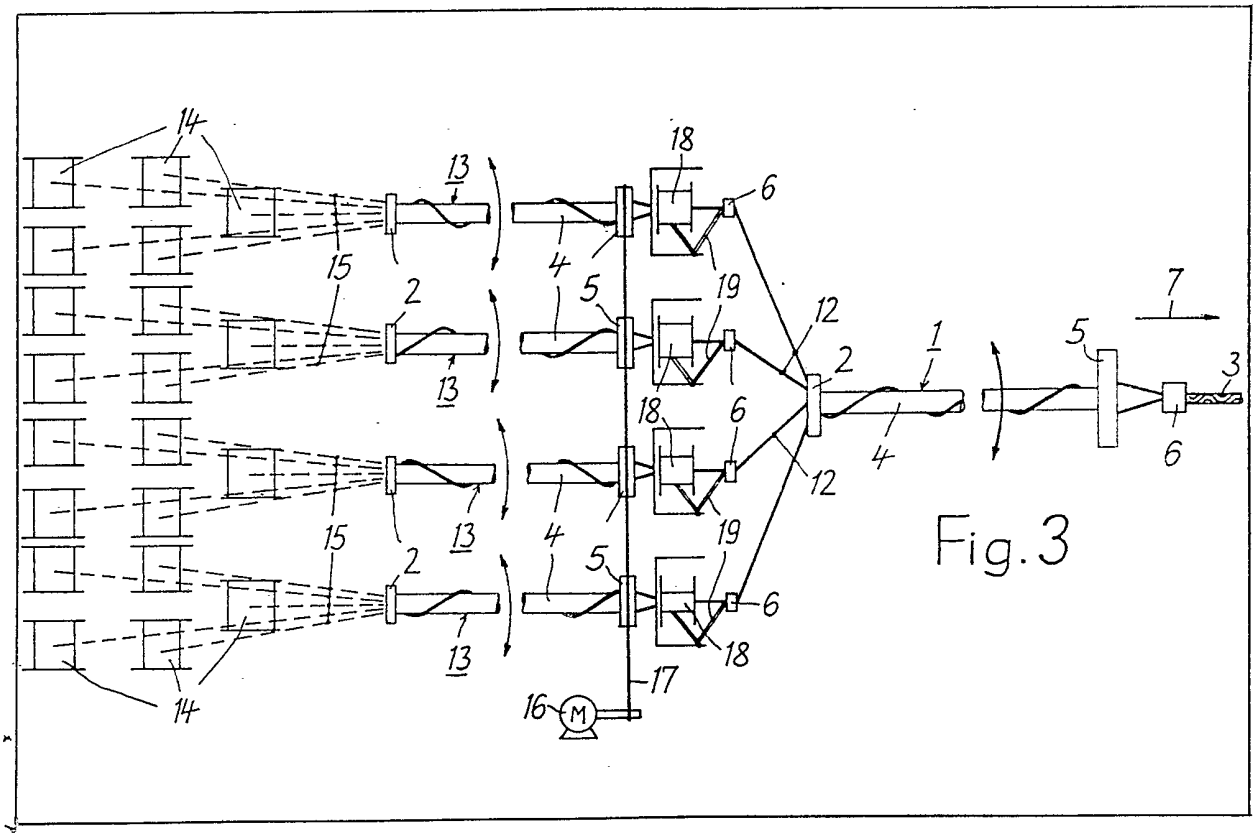

Fig.3

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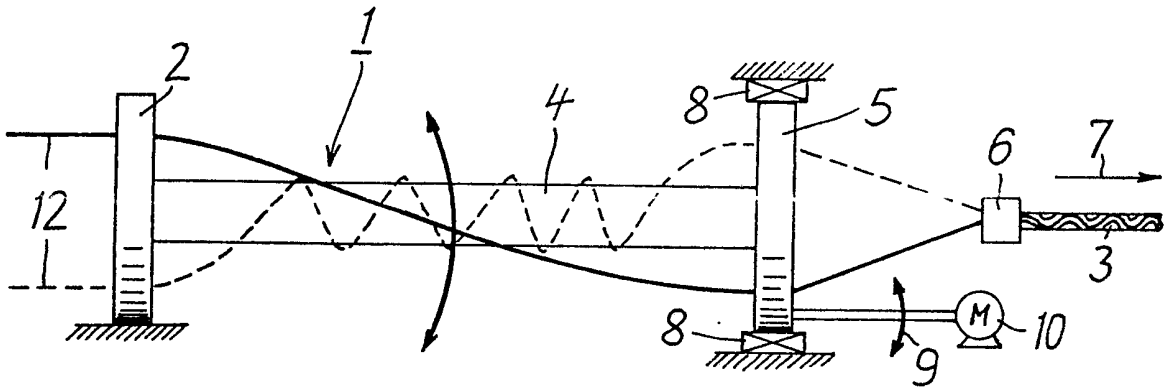

Fig. 1

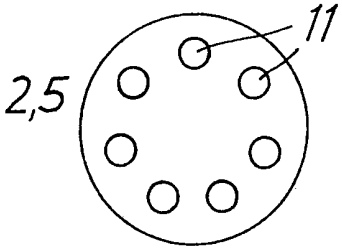

Fig. 2

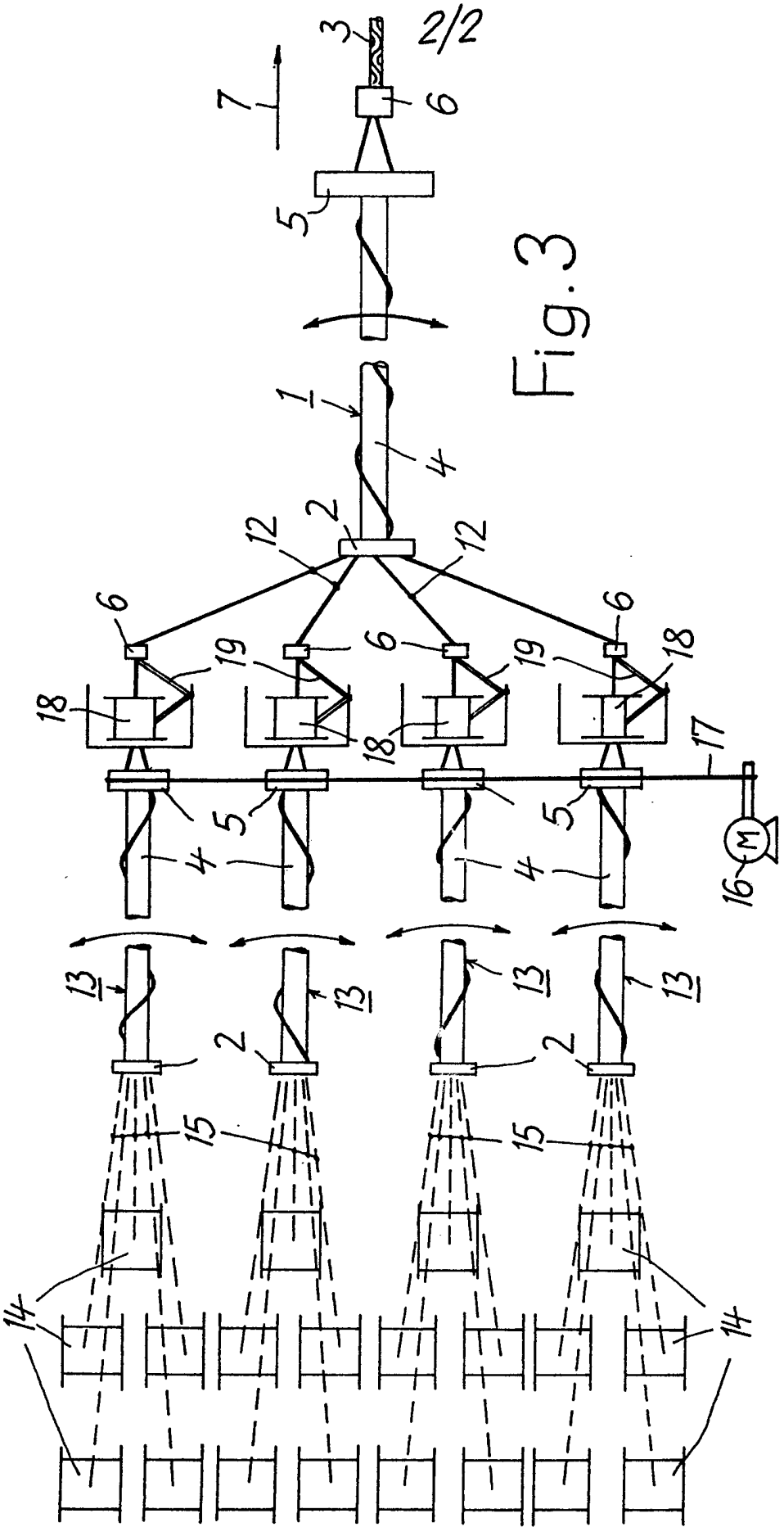
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Fig. 3

SPECIFICATION

Apparatus and method for the manufacture of electrical cables

The invention relates to apparatus for the manufacture of electrical cables which comprise stranding elements stranded together with a direction of lay which alternates at intervals, said apparatus comprising: a stranding unit with a stationary guide disc which has a plurality of bores, the number of these bores corresponding to the number of the stranding elements, and these bores serving (in use) for leading these stranding elements through; a rotatably mounted perforated disc rotatively drivable by a reversible electric motor, the perforations of which disc serve (in use) for leading through the stranding elements running through the bores of the guide disc; a smooth surfaced tube disposed between the guide disc and perforated disc, around which tube the stranding elements can be (in use) guided externally; and a stranding nipple which (in use) brings together the stranding elements issuing from the perforated disc.

The invention also includes a method of manufacturing electrical cables wherein an apparatus as just described is employed.

The term "cables", in the context of the present invention, embraces telecommunications cables and multi-core conductors or conductor lines or cords. Stranding elements can accordingly be used which are in the nature of cores, pairs, quadruples or bundles (bunches). Stranding with an alternating direction of lay ("SZ" stranding) has, in comparison with ordinary stranding processes with a uniform direction of lay, the advantage that no rotating supply devices (e.g. reels or baskets) are required, which devices permit only a limited length of run of the stranding material, these devices also having to be dimensioned appropriately to take into account centrifugal forces, which are often considerable. "SZ" stranding, in contrast, offers the possibility of continuous production at high draw-off speeds.

German Laid-open Specification (Offenlegungsschrift) 2,262,705 describes apparatus for the manufacture of a cable with "SZ" stranding, in which stranding elements are guided, between a fixed guide disc and a rotatable perforated disc, through tubes made of a material with a low coefficient of friction. Twisting or tangling of the individual stranding elements is intended to be prevented by means of these tubes. Guiding the stranding elements through the tubes is disadvantageous, however, because the individual stranding elements have to be threaded in over long distances. Moreover, undesirably high wear occurs as a result of the unavoidable friction, so that the tubes have to be replaced frequently. Furthermore, even despite the use of the tubes, twisting or tangling cannot be entirely prevented from taking place, especially when the distance between the guide disc and perforated disc is large.

Apparatus for the manufacture of cables which are provided with stranding elements stranded by the "SZ" process is described in German Patent Specification 2,615,275, said apparatus comprising a fixed guide disc and a rotatable perforated disc which is surrounded by a perforated rim. Two tubes which extend in the draw-off direction are disposed coaxially to one another between the two discs, with a relatively large gap between these tubes. To manufacture a cable whose stranding elements lie in two layers, one above another, these stranding elements are guided partly through the gap between the two tubes, and partly externally (i.e. around the outer tube) and through bores or perforations provided for them in the two discs. The known apparatus is actually restricted, however, to the manufacture of cables whose stranding elements are arranged in layers one above another. Bunched cables, such as are commonly required in telecommunications work, and such as are described in (e.g. German Patent Specification 1,515,812, cannot be manufactured with this apparatus. Moreover, it is possible only with difficulty to identify the individual layers of the stranding elements, for example by spinning a coloured spiral around them.

German Laid-open Specification (Offenlegungsschrift) 2,411,151 shows apparatus as described in the first paragraph of the present description. By means of this apparatus, an outer layer of stranding elements is formed, by the "SZ" process, around a core which consists of stranding elements stranded with a uniform lay and which is guided through the tube disposed between the stationary guide disc and the rotatable perforated disc. With this known apparatus, however, only one outer layer of stranding elements can be stranded, with a reversing lay, around the core guided through the tube.

It is an object of the present invention to provide apparatus by means of which all the stranding elements of a cable comprising a plurality of bundles or bunches can be stranded in a simple way by the "SZ" process, and all the bundles or bunches can be provided as desired with a means of identification extending along the entire length of the cable.

According to the present invention, apparatus as described in the first paragraph of the present description is characterised in that: there are disposed upstream of the stranding unit at least two stranding sets, these sets each comprising a guide disc, tube, perforated disc and stranding nipple, and being disposed parallel to one another and being of analogous construction to the stranding unit, to which sets stranding elements with at least one core are (in use) supplied, whereby from the stranding nipples of these sets there issue (in use) the stranding elements for the stranding unit; a banding device is provided between the perforated disc and stranding nipple of each stranding set; and the perforated discs of all the stranding sets can be driven by a common reversible electric motor.

By means of this apparatus, bunched cables

whose stranding elements are all stranded by the "SZ" process can be manufactured in a simple way in a single operation. The stranding elements obtained in the stranding sets just mentioned are "SZ"-stranded in themselves, and they are "SZ"-stranding together in the stranding unit. Since all the stranding sets are driven by only one electric motor (which may drive them in the same direction or in opposite directions), the apparatus is of an especially simple construction. Each stranding element issuing from a stranding set can be provided with a suitable identification in the respective banding device. For this purpose, for example, variously coloured bands can be spun around the individual stranding elements.

The invention also includes a method of manufacturing electrical cables which comprise stranding elements stranded together with a direction of lay which alternates at intervals, wherein the requisite stranding elements are led through the relevant discs, tubes and nipples of an apparatus according to the invention, the motors of the apparatus thereafter being energised with concurrent drawing off of the stranded product from the stranding nipple of the stranding unit.

One embodiment of the invention is illustrated in the accompanying diagrammatic drawings, in which:—

Figure 1 is a side view of a stranding unit used in the apparatus concerned,

Figure 2 is a face view (or axial view) of a guide or perforated disc, and

Figure 3 is a side view of the complete apparatus.

The stranding unit 1 shown in Figure 1 comprises a stationary guide disc 2, a tube 4 which extends in the draw-off direction (see arrow 7) of a cable 3 manufactured in the apparatus concerned, a rotatably mounted perforated disc 5, and a stranding nipple 6. The disc 5 is mounted rotatably in bearings 8, and can be rotated in either direction (see arrow 9) by means of a reversible electric motor 10.

The disc 2, like the disc 5, as shown in Figure 2, has bores or holes 11, distributed at uniform angular intervals, through which are led stranding elements 12. For the sake of clarity, only two elements 12 are shown in Figure 1.

The tube 4 can be fastened, as a stationary component, to the disc 2. However, it can instead by connected to the disc 5, so that it rotates together with the latter. The tube 4 is preferably of steel, with as smooth a surface as possible. To enable the elements 12 to slide along it easily, the tube can be coated with a friction-reducing material.

The stranding unit of Figure 1 operates, for example, as follows:

Through the disc 2 are led elements 12 which are subsequently drawn through the holes of the disc 5 and the nipple 6 and which are drawn off in the direction of the arrow 7. During the drawing-off, the disc 5 is rotated with a continually alternating direction of rotation, making approximately eight revolutions in each direction, so that, as indicated by broken lines in Figure 1, the elements 12 form approximately four turns round the tube 4. When the disc 5 thereafter rotates in the opposite direction, the wound turns of the elements 12 are unwound, and approximately four turns are formed in the opposite direction. Since the elements 12 are brought together in the nipple 6 immediately beyond the disc 5, their "SZ" condition which arises during this stranding operation can no longer become undone.

The complete apparatus shown in Figure 3 comprises a stranding unit 1 as shown in Figure 1 and (e.g.) four stranding sets 13 which are preferably constructed in the same way as the stranding unit 1. The draw-off direction of the cable is again shown by an arrow 7. The stranding sets 13 are disposed upstream of the stranding unit 1, and the elements 12 issuing from these stranding sets 13 are supplied to the stranding unit 1. The finished cable 3 issues from the nipple 6 of the stranding unit 1, and this finished cable can, if required, be combined with further similar cables into a higher-order cable core. Since the stranding sets 13 preferably have exactly the same construction as the stranding unit 1, the individual parts of the stranding sets 13 bears the same reference numerals 2, 4, 5 and 6 as the stranding unit 1.

This complete apparatus operates as follows:

From a large number of supply units, e.g. run-off reels 14 (which can rotate about fixed axes), reels lying on a flange, or drums, there are drawn stranding elements 15 with a smaller number of cores than the stranding elements 12, although at least one core must be present. The elements 15 are led through the bores 11 of the discs 2 of the four stranding sets 13. After passing through the tubes 4, the elements 15 reach the discs 5 and are drawn through their holes 11, and subsequently pass through the nipples 6. During the operation of the present apparatus, the discs 5 of the stranding sets 13, and, if appropriate, also their tubes 4, are driven by a common electric motor 16, e.g. by means of a belt 17. Here again the direction of rotation is reversed after a certain number of revolutions, so that the elements 15 are stranded together in the reversed direction. Stranding elements 12 whose elements 15 are stranded together in the "SZ" mode then issue from the nipples 6 of the stranding sets 13. Since, in the case illustrated, four elements 12 are to be combined into a cable 3, these elements 12 are indentified by means of banding devices 18, which spin differently coloured bands 19 round the respective elements 12 being assembled in the nipples 6.

In preferred cases, the elements 15 are cores, pairs, triads, quadruples or basic bundles (bunches) which are to be stranded with one another.

Figure 3 shows an apparatus with four stranding sets 13, but the number of stranding sets can be 2, 3, 4, 5, 6 or more as desired.

By means of the present apparatus, it is

possible to manufacture basic bunches or bundles, for example, by supplying four single cores (as stranding elements 15) to each stranding set 13, e.g. from reels 14. In this case, quadruples (as stranding elements 12) issue from each stranding set 13, and are stranded into a basic bundle or bunch (cable 3) in the stranding unit 1. For this application, we should use five stranding sets 13, preferably mounted in a common frame, and we should drive the discs 5 of the stranding sets 13 in this case at different speeds.

By means of the present apparatus it is also possible to produce main bundles or bunches if pairs, triads or quadruples are supplied, as stranding elements 15, to the stranding sets 13, e.g. from reels 14. In this case, basic bunches or bundles (as stranding elements 12) issue from the stranding sets 13 and are stranded into main bunches or bundles (cable 3) in the stranding unit 1.

By means of the present apparatus, it is further possible to manufacture main bunches or bundles and cables (cores), by supplying basic bunches or bundles, as stranding elements 15, to the stranding sets 13, e.g. from reels 14. In this case, main bunches or bundles (as stranding elements 12) issue from the stranding sets 13, and are stranded into cables 3 (cores) in the stranding unit 1.

The discs 5 of the stranding sets 13 are driven by the common electric motor 16, as stated earlier, and their direction of rotation can be the same in all the stranding sets 13. However, by appropriate guidance of the belt 17, the discs 5 of two of the stranding sets 13 can instead be rotated in the opposite direction to the direction of rotation of the discs 5 of the other stranding sets 13. It is also possible to drive the discs 5 of the individual stranding sets 13 at different speeds.

CLAIMS

1. Apparatus for the manufacture of electrical cables which comprise stranding elements stranded together with a direction of lay which alternates at intervals, said apparatus comprising: a stranding unit with a stationary guide disc which as a plurality of bores, the number of these bores corresponding to the number of the stranding elements, and these bores serving (in use) for leading these stranding elements through; a rotatably mounted perforated disc rotatively drivable by a reversible electric motor, the perforations of which disc serve (in use) for leading through the stranding elements running through the bores of the guide disc; a smooth surfaced tube disposed between the guide disc and perforated disc, around which tube the stranding elements can (in use) be guided externally; and a stranding nipple which (in use) brings together the stranding elements issuing from the perforated disc; characterised in that: there are disposed upstream of the stranding unit (1) at least two stranding sets (13), these sets each comprising a guide disc (2), tube (4), perforated disc (5) and stranding nipple (6), and being disposed parallel to one another and being of analogous construction to the stranding elements (15) with at least one core are (in use) supplied, whereby from the stranding nipples of these sets (13) there issue (in use) the stranding elements (12) for the stranding unit (1); a banding device (18) is provided between the perforated disc (5) and stranding nipple (6) of each stranding set; and the perforated discs of all the stranding sets can be driven by a common reversible electric motor (16).

2. Apparatus according to claim 1, characterised in that there are mounted in a common frame four stranding sets (13) to which stranding elements (15) with at least one core are (in use) supplied.

3. Apparatus according to claim 2, characterised in that the stranding elements (15) are (in use) supplied to the stranding sets (13) from supply reels (14) rotating about fixed axes.

4. Apparatus according to claim 1, 2 or 3, characterised in that the perforated discs (5) of the stranding sets (13) are (in use) drivable simultaneously in different directions.

5. Apparatus according to any of claims 1 to 4, characterised in that the stranding sets (13) are (in use) drivable at different speeds.

6. Apparatus according to claim 1, substantially as described with reference to the accompanying drawings.

7. A method of manufacturing electrical cables which comprise stranding elements stranded together with a direction of lay which alternates at intervals, wherein the requisite stranding elements are led through the relevant discs (2 and 5), tubes (4) and nipples (6) of an apparatus according to any of claims 1 to 6, the motors of the apparatus thereafter being energised with concurrent drawing off of the stranded product from the stranding nipple (6) of the stranding unit (1).

8. A method according to claim 7, substantially as described with reference to the accompanying drawings.

9. An electrical cable manufactured by means of an apparatus according to any of claims 1 to 6 or by a method according to claim 7 or 8.

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