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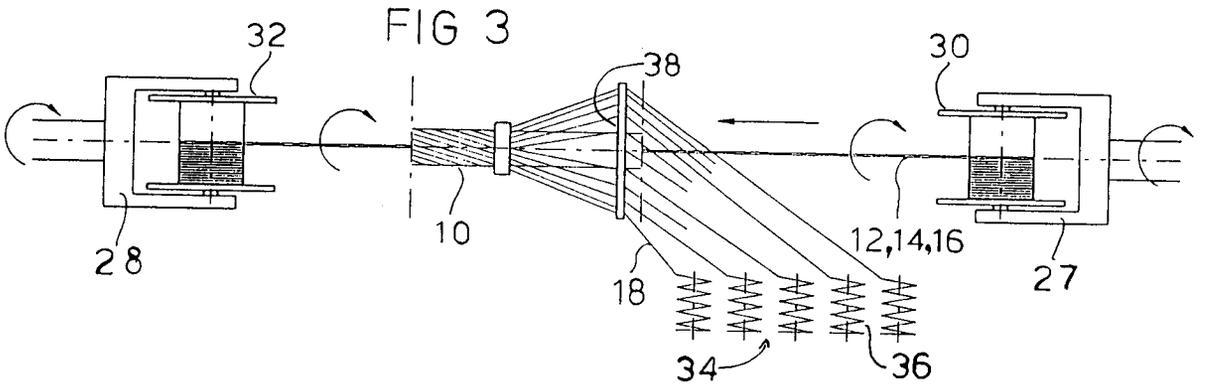
(54) A method and arrangement for the manufacture of an electric multi-conductor cable.

(57) A method and an arrangement for manufacturing electric cables (10). The cable (10) includes a cable body (12, 14, 16) which is comprised of at least two separate insulated conductors which are encased in a surrounding sheath and each of which is twisted spirally about its longitudinal axis. The cable is also comprised of wires or bands (18) which are also twisted spirally about their respective longitudinal axes and applied externally on the sheath. According to the invention, the conductors and the wires/bands (18) are spirally twisted at one and the same tine in one single working step, after sheathing the insulated conductors, wherein the cable body (12, 14, 16) is reeled-off from a first cable drum (30) and reeled onto a second cable drum (32).

FIG 3



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The present invention relates to a method of manufacturing an electric cable comprising a cable body which consists of at least two mutually separate, insulated conductors which are embraced by a surrounding sheath and each of which is twisted spirally about its long axis in parallel with the other, and further comprises wires, filaments or bands which are each twisted spirally parallel with one another on the outer surface of the sheath in the longitudinal direction.

The invention also relates to an arrangement for carrying out the method.

The purpose of spirally twisting the insulated conductors of an electric cable is primarily to make the cable flexible, so that it can be readily bent without being damaged, for instance when reeling the cable onto a cable drum or during installation work. If the conductors, etc., were not twisted spirally, there would be some risk that the individual cable conductors would become kinked or stretched due to the circumferential difference between the outer side and the inner side of the bent cable.

The electrical conductors are normally twisted spirally about their individual long axis continuously in a known manner in a separate operation in which each conductor is advanced individually by a respective drum to a twisting drum which rotates about its own axis. Naturally, the arrangement used may be one in which the individual drums intended for respective electric conductors are placed on a rotatable device which, in this case, advances the conductors to a stationary drum.

Alternatively, the conductors may be spirally wound in a special, separate operation by a so-called S-Z-spinning or laying process in which the conductors are advanced in parallel to a device which first twists the conductors in one direction, e.g., to the left, over a predetermined length of time, whereafter the conductor is locked and thereafter twisted in the opposite direction, i.e. to the right, and so on. This device thus twists the conductors alternately to the left and to the right. The letters S and Z used to define this operation refer to a left-hand pitch and a right-hand pitch respectively.

Twisting of the individual electric cables in a separate operation in accordance with the aforegoing involves an extra expense in comparison with conductors that are twisted spirally in accordance with the so-called integrated S-Z-method, in which further working steps are carried out at the same time, for instance sheathing the cable.

The S-Z-method, however, sometimes has certain limitations which renders the method unusable, e.g., in conjunction with flexible conductors.

The object of the present invention is primarily to provide a method and an arrangement which when spirally winding insulated conductors and the aforesaid sheathing wires or wires/bands of electric cables reduces the number of working operations with intermediate reeling of the conductors onto cable drums. This object is achieved with the method defined in the introduction by spirally winding the conductors and the wires/bands simultaneously in one single working step subsequent to sheathing the insulated conductors, wherein the cable body is unwound from a first cable drum and reeled onto a second cable drum with wires/bands applied.

Further developments of this method are defined in the dependent Claims 2-5.

An arrangement for carrying out the aforedescribed method is primarily characterized in that the arrangement includes a globally rotatable reeling-off device in which a first cable drum for reeling-off the cable body can be mounted with its drum axis in a rotational plane of the reeling-off device, a rotatable reeling-on device in which a second cable drum for reeling-on the cable can be mounted with its axis in a rotational plane of the reeling-on device, and a wire or band magazine with associated distribution plate which is located between the reeling-off device and the reeling-on device for advancing wire/band to be wound spirally around the sheathing.

It will be understood that the same effect is achieved when either the reeling-off device or the reeling-on device has the form of a so-called single twister or double twister. For the sake of simplicity, the drawing illustrates the principle of a drum which is rotated in the plane of its axis by its respective reeling-off and reeling-on device.

The invention will now be described in more detail with reference to a preferred exemplifying embodiment thereof and also with reference to the accompanying drawing, in which

Figure 1 is a cross-sectional view of a multi-conductor cable;

Figure 2 illustrates an arrangement in which sheathing is applied to the individual, insulated conductors; and

Figure 3 illustrates an arrangement in which the insulated conductors and the wires/bands are twisted spirally in accordance with the principles of the invention.

The electric multi-conductor cable 10 illustrated in cross-section in Figure 1 includes three identical conductors 12, each of which is embraced by an insulating layer 14. By way of information, it can be mentioned that each conductor 12 has an area of about 0.5-16.0 mm^2. Including its insulation, each conductor will thus have a diameter which is normally smaller than 7 mm. The insulated conductors 12, 14 are each twisted about their individual longitudinal axis and surrounded by sheathing 16

which may comprise, for instance, a filling in the form of an extruded plastic or rubber layer. The sheathing 16 may, in some cases, also be obtained by banding, e.g. by means of a plastic band. Located externally on the sheathing 16 are a plurality of wires or filaments 18 which, similar to the insulated conductors 12, 14, are twisted individually in the direction of their longitudinal axes. These wires or filaments 18 preferably form a reinforcement of galvanized steel wires although they may also form a copper screen. Copper bands or plastic bands may be used in some instances, instead of wires. Further structural elements, for instance further bands, wires or an outer sheath, can be applied to the outer surfaces of the wires 18, although this has not been shown in the drawing.

Figure 2 illustrates an arrangement for applying the aforesaid filler sheathing 16 to the insulated conductors 12, 14. Each conductor is wound onto a corresponding conductor spool 20. Since the multi-conductor cable shown in Figure 1 includes three insulated conductors 12, 14, the embodiment illustrated in Figure 2 comprises three similar conductor spools 20. The three insulated conductors 12, 14 are brought together in an extruder head 22 by means of the conductor spools 20. The filler sheathing 16 is applied in the extruder head 22 with the aid of an extruder 24. The sheathed cable body 12, 14, 16 is reeled-up onto a separate cable body drum 26 which has a relatively large core diameter. The insulated conductors 12, 14 encased in the sheathing 16 have still not yet been twisted and the cable body 12, 14, 16 will not be able to withstand any powerful bending force. Consequently, it is necessary to dimension the core diameter of the drum 26 so that the inner side and outer side of the cable body will not be kinked and stretched when wound onto the drum.

Figure 3 illustrates an inventive arrangement which is intended to enable the insulated conductors 12, 14 and the aforesaid wires/bands 18 to be twisted spirally in one single working step subsequent to providing the insulated conductors 12, 14 with a filler sheathing 16, as described with reference to Figure 2. To this end, there is used in the Figure 3 embodiment a reeling-off device 27 and a reeling-on device 28 which can be rotated about their respective axes. A cable body drum 30 is detachably mounted in the reeling-off device 27 such that the drum axis will lie in the rotational plane of the reeling-off device 27. The cable body 12, 14, 16 is reeled onto a corresponding cable drum 32 detachably mounted in the reeling-on device 28, the drum axis of the cable drum 32 lying in the rotational plane of the reeling-on device 28. The cable drum 32 is provided with a drive means which rotates around the drum in the direction in which the cable 10 is advanced. This drive means is of a known kind and is therefore not shown in the drawing.

The wires/bands 18 are applied from a stationary wire/band magazine 34 between the reeling-off device 27 and the reeling-on device 28. Each wire/band 18 is taken from a corresponding wire/band spool 36 included in the magazine and is passed to the cable body 12, 14, 16 for application externally to the filler sheathing 16, through the intermediary of a distribution plate 38 which provides the desired spacing between said wires/bands 18.

The reeling-off device 27 and the reeling-on device 28 preferably rotate in the plane of the drum axis in mutually the same direction and at separately adjustable rotational speeds. By mutually changing the rotational speeds of the reeling-off device 27 and the reeling-on device 28, it is now possible to vary both the pitch direction and the lengths in which the spiral twisting is effected along the insulating conductors 12, 14 and the wires/bands 18.

The reeling-off device 27 and the reeling-on device 28 may, of course, be formed as so-called single twisters or double twisters, in a known manner.

It can be mentioned that the cost of producing an electric multi-conductor cable in accordance with the invention is much lower than the costs incurred by conventional methods.

The illustrated preferred embodiment of the inventive arrangement can be modified within the scope of the following Claims.

Claims

1. A method of manufacturing an electric cable (10) which includes a cable body (12, 14, 16) comprising at least two separate, insulated conductors (12, 14) which are encased in a sheath (16) and each of which is twisted spirally about its longitudinal axis parallel with one another, and further comprising wires or bands (18) which are disposed on the outer surface of the sheath (16) and each of which is also twisted spirally about its longitudinal axis, **characterized** by spirally twisting the conductors (12, 14) and the wires/bands (18) simultaneously in one single working step subsequent to sheathing the insulated conductors (12, 14), wherein the cable body (12, 14, 16) is reeled-off from a first cable drum (30) and with wires/bands (18) applied is reeled onto a second cable drum (32).

2. A method according to Claim 1, **characterized** in that the wires/bands (18) are applied to the cable body (12, 14, 16) from a stationary

wire and band magazine (34), wherein the cable body is twisted about its own longitudinal axis.

3. A method according to Claim 1 or 2, **characterized** in that twisting is effected with the first cable drum (30) rotating at a first rotational speed and with the second cable drum (32) rotating at a second rotational speed.

4. A method according to Claim 3, **characterized** in that the first cable drum (30) rotates in the same direction as the second cable drum (32).

5. A method according to Claim 4, **characterized** in that the first cable drum is rotated at a higher speed than the second cable drum.

6. An arrangement for carrying out the method in the manufacture of an electric cable (10) which comprises a cable body (12, 14, 16) consisting of at least two separate insulated conductors (12, 14) which are encased in a sheath (12), each of said conductors being twisted spirally about its longitudinal axis, parallel with one another, and further comprising wires or bands (18) which are applied externally to the sheath (16) and each of which is also twisted spirally about its longitudinal axis in accordance with any one of Claims 1-5, **characterized** in that the arrangement includes a rotatable reeling-off device (27), in which a first cable drum (30) for reeling-off the cable body (12, 14, 16) can be mounted, said device (27) being rotatable in the plane of the drum axis; a reeling-on device (28), in which a second cable drum (32) for reeling-on the cable (12) can be mounted, said device (28) being rotatable in the plane of the drum axis, and a wire or band magazine (34) with associated distributing plate (38) which is located between the reeling-off device (27) and the reeling-on device (28) for advancing the wire/band (18) to be twisted spirally on the outside of the sheath (16).

7. An arrangement according to Claim 6, **characterized** in that the reeling-off device (27) and the reeling-on device (28) are rotatable in mutually the same direction.

8. An arrangement according to Claim 6 or 7, **characterized** in that each of the reeling-off (27) and reeling-on (28) devices is rotated at a separate, adjustable speed.

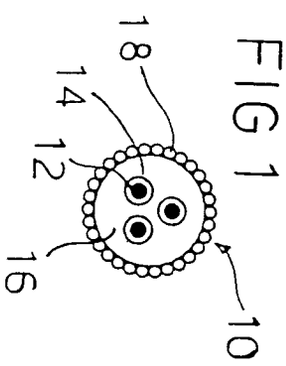

FIG 1

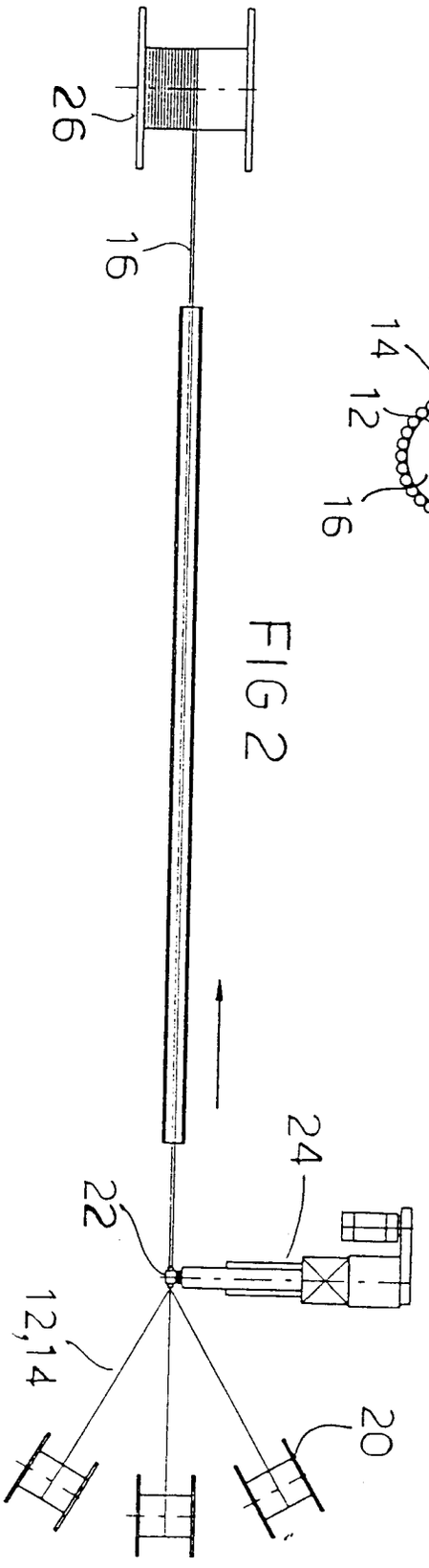

FIG 2

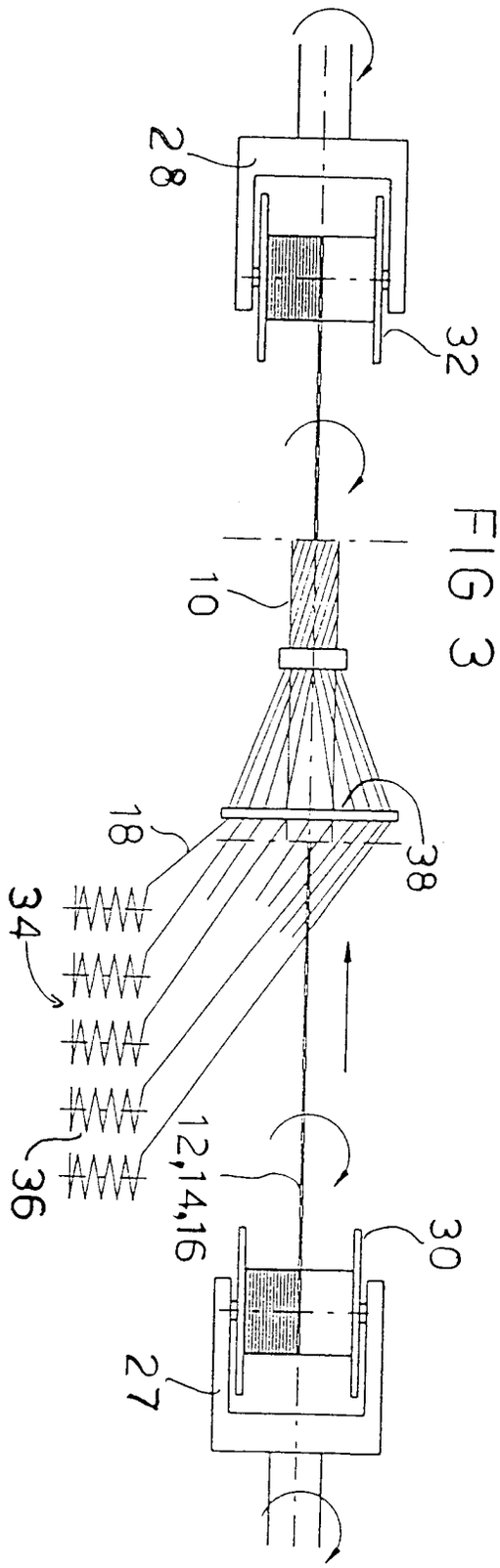

FIG 3