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GB 1502653
GB 1489918
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GB 1350107
GB 1257554
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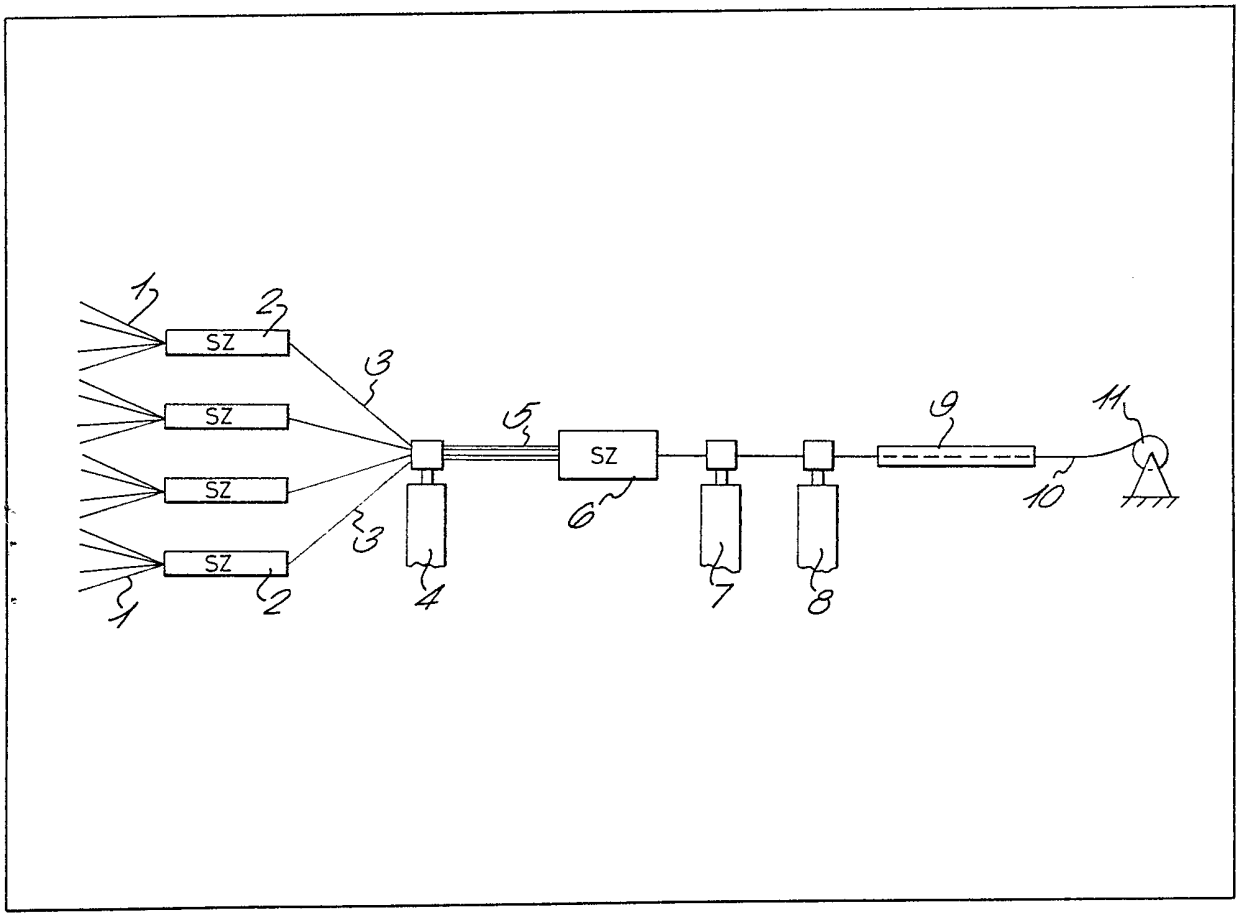
(54) Multi-core electrical power cable or line, and process for its manufacture

(57) The cable or line has insulated conductors (5) comprising multiple-wire conductors (3) whose individual wires (1) are stranded in an "SZ" mode. Conductors 1 or S—Z stranded at 2 to form conductors 3 which are each provided with insulation in extruder 4, which are S—Z stranded together at 6, and which are sheathed by extruders 7 and 8.



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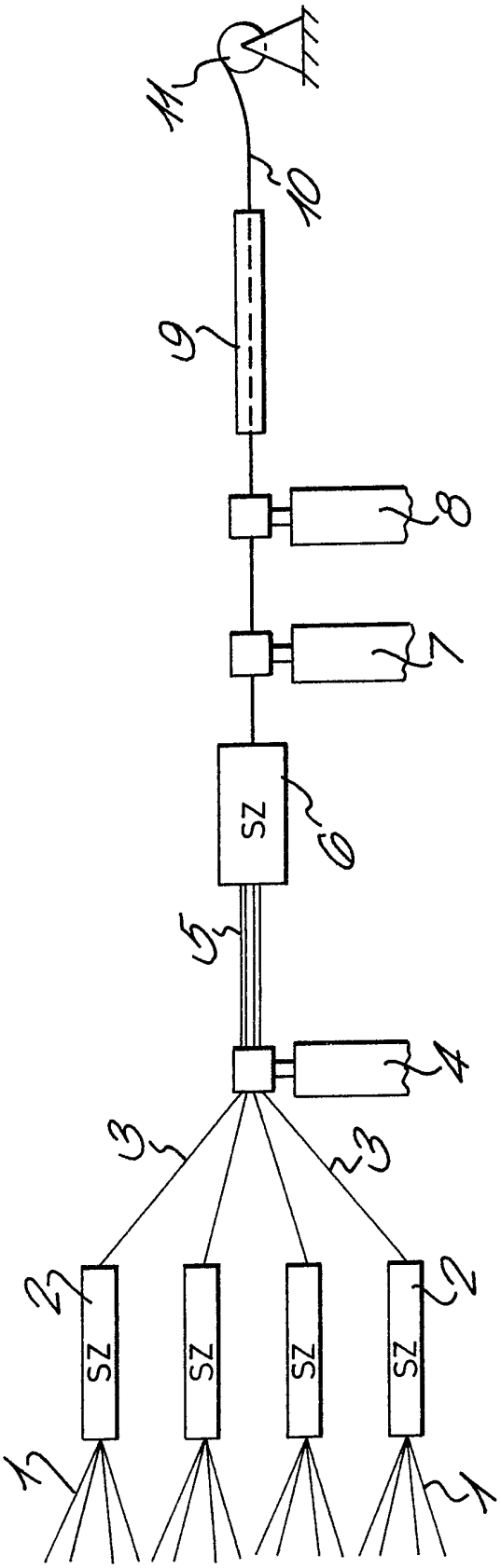
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SPECIFICATION

Multi-core electrical power cable or line, and process for its manufacture

The present invention relates to a multi-core electrical power cable or line, especially for low voltage service, incorporating insulated conductors which are stranded in an "SZ" mode, i.e. with a direction of twist which changes at intervals. The invention also includes a process for the manufacture of the cable or line.

Telecommunication cables have for some time been manufactured, to some extent, by "SZ" stranding, individual stranding elements here being stranded in a direction of twist which changes from section to section. This mode of stranding permits the use of stationary unwinding and winding-on devices, and it makes it possible to carry out a stranding operation without any interruption whatever. However, the "SZ" mode of stranding has been applied also in the manufacture of power cables and lines. For example, it is already known (German Offenlegungsschrift 2,202,643) to strand power lines with a direction of twist or length of twist which changes at certain intervals, and this has been applicable even with a relatively large number of individual conductors. The stranding technique employing the reversing stranding of the conductors, moreover, has been applied to cables for the transmission of relatively high power and correspondingly large conductor cross-sections. In this case, the conductors of the cable are first brought together into a bundle, and subsequently, while passing through a certain stretch of the production line which extends to a second stranding point, they are held together as a bunch in an extended state, being stranded together during this time when they are held together as a bunch and when they are passing through the said stretch (German Offenlegungsschrift 2,742,662).

In all these processes, the stranding operation starts from stranding elements which are already present as conductors, i.e. electrical conductors provided with an insulation. The manufacture of these conductors takes place before the stranding, in operations separate from the latter, and, consequently, said manufacture additionally involves, among other things, winding-on and unwinding or rewinding operations, storage, and so forth. More precisely, this applies to all cases in which the conductors do not take the form of a solid strand, but are formed from individual wires.

The invention sets out from the known practice in respect of "SZ" stranding, in the field of *inter alia* power transmission cable and line manufacture. An object of the invention is, on the basis of the "SZ" stranding technique, to make it possible to simplify further the manufacture of cables and lines, and therefore to save production costs.

According to the invention, there is provided a multi-core electrical power cable or line, incorporating insulated conductors which are stranded in an "SZ" mode, i.e. with a direction of twist which changes at intervals, characterised in that the insulated conductors are multiple-wire conductors wherein the individual wires are also stranded in an "SZ" mode, i.e. with a direction of twist which changes at intervals. A cable or line as just defined can readily meet the relevant requirements in respect of electrical properties, and good flexibility is also readily obtained.

If, according to an optional feature of the invention the conductor insulation is applied directly over the stranded conductors, a secure retention of the individual wires in the structure can be ensured in a simple way.

To manufacture a cable or line according to the invention, there is provided a process wherein the stranding of the conductors and the application of further layers, up to a final sheathing, are carried out as a continous operation, characterised in that: this operation is preceded by the stranding of the individual wires of the conductors, these individual wires being drawn off from supplies accommodated in fixed positions and being stranded in an "SZ" mode and being fed immediately thereafter to an extruder for the concurrent application of the insulations of all the conductors; the "SZ" stranding of the insulated conductors is effected, after the application of their insulations, in a subsequent step, but in the same operation; and an outer sheath is thereafter applied. The concurrent insulation of all the conductors may be effected in a single extruder with a multiple extruder head. The application of the outher sheath may be preceded by the application of a rounding inner sheath or wrapping. The production sequence contemplated here, which, starting with the assembly of the conductors, provides for all the subsequent production steps to be carried out in a single continuous operation, permits high production speeds. A further saving is possible in respect of winding-on and unwinding devices, including the shortening of the setting-up times necessary for these; and storage capacity for prefabricated lengths of conductor need not be provided.

Depending on the nature of the conductor material used it may be advantageous if, according to an optional feature of the invention, the conductor wires, stranded in the "SZ" mode, are taped before their insulation, i.e. wrapped, in the stranded state, with a conductive or insulating tape. This measure may also prove desirable if the distance, dictated by machine design considerations, between the stranding means and insulating extruder has to be so long as to entail a danger of untwisting of the stranded individual wires. On the other hand, if the stranding means and extruder can be brought so close together that the insulation can take place immediately after the stranding, then the wires can be held together securely by means of the insulating material extruded around them and based on e.g. a polymeric material.

An essential feature of the process according to the invention is, as stated above, that the

insulation of the conductors takes place concurrently. For this purpose, a plurality of individual extruders disposed in parallel, according to the number of conductors, can be used, if it is not more advantageous, especially with regard to the control of the system as a whole, to use a single extruder with a multiple extruder head for the concurrent insulation of all the conductors.

An improvement in the quality of the conductors, particularly in the case of conductors of large cross-sections, can be achieved if the individual conductor wires, stranded in the "SZ" mode, are compressed before their concurrent insulation. For this purpose, a drawing nipple or an appropriately acting pair of rollers can be assigned to each conductor, for example, upstream of the insulating extruder or extruders.

The individual wires of the conductors can all be stranded together simultaneously, for which purpose stranding means known per se can be used. However, the individual conductor wires can instead be stranded in layers, for example around a core wire, as in processes known in telecommunication cable technology for the stranding of insulated conductors.

A procedure which can reduce the risk of unstranding before insulation, and which can therefore increase the stability of the uninsulated conductor, is that which, according to a further optional feature of the invention, comprises bringing the individual conductor wires together in bundles, stranding the conductor wires of these bundles in the "SZ" mode; these bundles are subsequently stranded together to form a conductor, the stranding to form the conductor also being effected in the "SZ" mode.

The invention will now be explained in more detail with reference to the accompanying diagrammatic drawing, the single Figure of which is a side view of equipment in use in a process according to the invention for the manufacture of multi-core power lines.

In the equipment shown in the Figure, individual conductor wires 1 are fed from supplies (not shown) accommodated in fixed positions to a stranding device 2, comprising e.g. a rotating perforated disc, and are stranded together there, to form conductors 3, in an "SZ" mode, i.e. with a direction of twist which changes at intervals. These conductors 3, of which four are shown here, are fed to a quadruple extruder 4, and are provided by it with the requisite insulation, so that insulated conductors 5 are obtained. After passing, if required, through a cooling trough (not shown), these conductors 5 are stranded, again in the "SZ" mode, by means of a device 6, and the core thus produced is fed to an inner-sheath extruder 7 and thereafter to an outer-sheath extruder 8. After passing through a cooling trough 9, the finished cable or line 10 is wound on to take a take-up drum 11 mounted in a fixed position.

From the initial stage of feeding the conductor wires 1 to the stranding device 2 to the final stage of winding-on the final product 10, only small masses have to be moved, thus permitting high production speeds. Various winding-on and unwinding operations previously considered necessary are avoided.

Although any applicable processes and devices can be employed for the "SZ" stranding itself, a certain device known from telecommunication cable technology has proved especially advantageous for the "SZ" stranding of bare (i.e. uninsulated) conductor wires (German Offenlegungsschrift 2,411,151 or German Patent Specification 2,615,275). This device comprises a fixed guide disc, a driven perforated disc mounted rotatably, and a tube with a smooth surface disposed between these two discs. This tube may be surrounded by a concentric larger tube, whose inside diameter is sufficiently large to enable the holes in the rotatable perforated disc and the bores in the fixed guide disc to be situated within this larger tube, and, furthermore, the rotatable perforated disc may be provided with a ring of holes which surrounds the larger tube all round, through which holes can be guided portions, running outside the larger tube, of stranding elements guided through corresponding bores in the fixed guide disc; the individual conductor wires can then be stranded in two layers one above another, in the "SZ" mode, i.e. with an alternating direction of twist, in both layers.

The invention is, of course, not restricted to this particular technique of "SZ" stranding. Other known processes and devices can also be used, according to the type and cross-section of the conductor elements.

CLAIMS

1. Multi-core electrical power cable or line, incorporating insulated conductors which are stranded in an "SZ" mode, i.e. with a direction of twist which changes at intervals, characterised in that the insulated conductors are multiple-wire conductors wherein the individual wires are also stranded in an "SZ" mode, i.e. with a direction of twist which changes at intervals.

2. Cable or line according to claim 1, characterised in that the conductor insulation is applied directly over the stranded conductors.

3. Process for the manufacture of a cable or line according to claim 1 or 2, in which process the stranding of the conductors and the application of further layers, up to a final sheathing, are carried out as a continuous operation, characterised in that: this operation is preceded by the stranding of the individual wires of the conductors, these individual wires being drawn off from supplies accommodated in fixed positions and being stranded in an "SZ" mode and being fed immediately thereafter to an extruder for the concurrent application of the insulations of all the conductors; the "SZ" stranding of the insulated conductors is effected, after the application of their insulations, in a subsequent step, but in the same operation; and an outer sheath is thereafter applied.

4. Process according to claim 3, characterised in that the application of the outer sheath is

preceded by the application of a rounding inner sheath or wrapping.

5. Process according to claim 3 or 4, characterised in that the conductor wires, stranded in the "SZ" mode, are taped before their insulation.

6. Process according to claim 3, 4 or 5, characterised in that the concurrent insulation of all the conductors is effected in a single extruder with a multiple extruder head.

7. Process according to claim 3, 4, 5 or 6, characterised in that the individual conductor wires, stranded in the "SZ" mode, are compressed before their concurrent insulation.

8. Process according to any of claims 3 to 7, characterised in that the individual conductor wires are stranded in layers.

9. Process according to claim 8, characterised in that the individual conductor wires are stranded in layers around a core wire.

10. Process according to any of claims 3 to 9, characterised in that the individual conductor wires are brought together in bundles, the conductor wires of these bundles being stranded in the "SZ" mode, these bundles subsequently being stranded together to form a conductor, and the stranding to form the conductor also being effected in the "SZ" mode.

11. Process according to claim 3, substantially as described with reference to the accompanying drawing.

12. A cable or line manufactured by a process according to any of claims 3 to 11.

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