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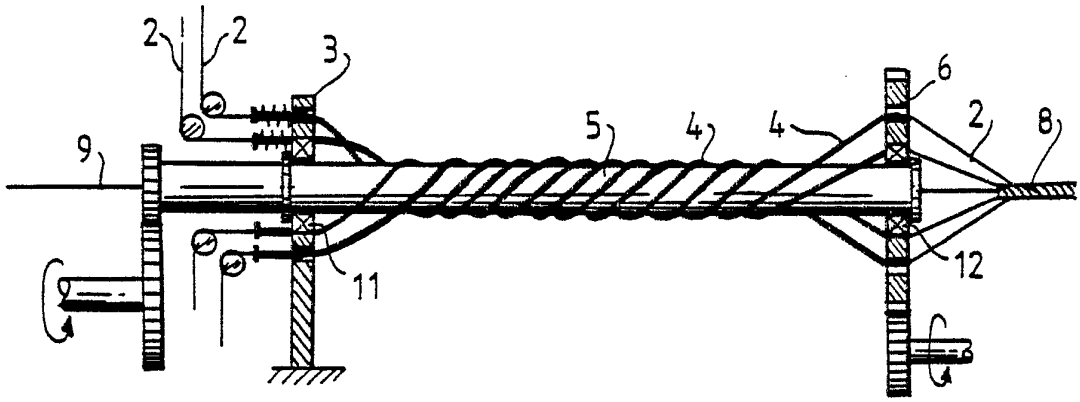

(57) Abstract

Alternate reverse or so-called SZ-twisting method and apparatus both to product as cable or similar produced by means of said alternate reverse twisting method and/or apparatus. The elements (2) to be alternate reversely twisted may be wires, leads, optical fibers, their groups and similar or which can also be quads of wires, leads, optical fibers etc. Said elements (2) to be twisted and a possible core element (9) are drawn from a fixed dividing means (3), preferably a perforated holeplate, through twisting means (6), preferably a perforated holeplate, rotating periodically to opposite directions, to pressing means (7), preferably a nipple, in which said elements to be twisted and said possible core element are pressed together, to form an alternate reversely twisted product (8). According to the invention between said dividing means (3) and said twisting means (6) is adapted a pipe group (4, 5) for defining the feedpaths of said elements (2) to be twisted and said possible core element (9). Said pipe group includes both a centrally located central pipe (5) for defining the feedpath of the possible core element and several peripherical pipes (4) for defining the feedpaths of said elements to be twisted, which peripherical pipes surround circumferentially said central pipe and are periodically twistable to opposite directions around and against said central pipe.

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Alternate reverse twisting method and apparatus both alternate reversely twisted product.

This invention relates in general to alternate reverse or so-called SZ-twisting, more accurately the object of the present invention is alternate reverse twisting method to form a product, as cable or similar, composed of an inner core element and/or of alternate reversely twisted elongated elements which can be wires, leads, optical fibers or their groups, or similar or which can be twisted as quads of wires, leads etc., by an alternate reverse twisting apparatus comprising:

- a fixed dividing means at the input end of the elements to be treated,
- to opposite directions periodically rotating twisting means at the output end of the treated elements,
- thereafter arranged pressing means, preferably a niple, for pressing the treated elements tightly against each other, and
- means for defining feedpaths of the elements to be treated, which means are arranged between said dividing and twisting means.

The object of the present invention is also an alternate reverse twisting apparatus to form a product, as cable or similar, composed of an inner core element and/or alternate reversely twisted elongated elements which can be wires, leads, optical fibers or their groups or similar or which can be twisted as quads of wires, leads etc., said apparatus comprising:

- a fixed dividing means at the input end of the elements to be treated,
- to opposite directions periodically rotating twisting means at the output end of the treated elements,
- thereafter arranged pressing means, preferably a niple, for pressing said treated elements tightly against each other, and
- means for defining feedpaths of said elements to be treated, which means are arranged between said dividing and twisting means.

Further the object of the present invention is an alternate reversely twisted product, as an electric and/or optical cable, lead or similar.

Elongated elements as leads, wires or similar are conventionally in a SZ-twisting apparatus for example by means of a tracked pulling device from input sides through a first circumferentially perforated holeplate serving as a fixed dividing means and through a periodically to opposite directions rotating second circumferentially perforated oscillating holeplate serving as a twisting means and thereafter into a pressing means, preferably a niple, in which the elements are pressed tightly against each other. Further can be used a spinning device to bind the pressed elements as an alternate reversely twisted product. After the pulling device spooling takes place or the twisted product can be fed to next work phase. In this kind of a conventional SZ-twisting device it has usually been placed between the dividing and twisting means a tubular intermediate element rotating with the twisting means being centrally fixed to it as well as mounted at its opoosite end in bearings to rotate in relation to the dividing means.

This kind of a conventional arrangement includes, however, the disadvantage, that the rotation speed of the intermediate element is always constant, so that twisting turns of elongated elements tends to accumulate to the end towards the twisting means, whereby the pitch of the elongated elements becomes denser and their angular deviation into the twisting means increases. Then between the direction reverse points of the twisting direction the number of helics of the twisted elements is very limited being 10 at the highest also the force reguired for pulling the elements increases whereby the helics of the twisted product tends to open.

This main problem, i.e. accumulation of the elements to be twisted, great pulling force and low number of helics has previously been tried to solve by principally three different methods, however, without finding a satisfactory solution.

Firstly, according to patent publications US-3910022 and US-4414802 between a fixed dividing holeplate and to opposite directions periodically oscillating twisting holeplate has been adapted one torsion-elastic torsion pipe, the inner space of which has been divided by spacers for keeping the elements to be twisted apart from each other, whereby said spacers thus define feedpats of individual elements to be twisted.

Secondly, according to public FI-patent application 803958 and publication US-4426838 between a fixed dividing holeplate and to opposite directions periodically oscillating twisting holeplate has been adapted a torsion-elastic torsion cable, rod or wire, to which have been fixed several disk-shaped and circumferentially perforated disks spaced apart in axial direction, whereby the opening of the perforated disks serve as guide means for individual elements to be twisted.

Thirdly, according to publications US-4426839 and SU-549943 between the fixed dividing holeplate and to opposite directions periodically oscillating twisting holeplate have been circumferentially adapted several separate pipe or spiral means, so that the space inside each individual pipe or spiral means serves as a guide means for individual elements to be twisted. According to said US-publication the pipe means have been bound together by plates provided with circumferential openings for the pipe means, while according to the SU-publication the spiral means extend freely between dividing and twisting means.

The above-mentioned disadvantage, i.e. accumulation of elements, great pulling force, low number of helics and especially at high rotating speeds occuring so-called "skip-rope" phenomenon has also been tried to solve by a solution according to US-patent 3847190, in which the pipes defining feed-paths of individual elongated elements to be twisted have been arranged inside a larger cylindrical mantle tube and fixed at their one ends to a fixed dividing holeplate both at their other ends to the end flange of said rotating mantle tube. Disadvantages have also been tried to solve by the apparatus according to DE-publication 3404264 being an improved conventional SZ-starnding apparatus which include one rigid central pipe rotating with the twisting means whereby elements to be twisted are wound around the periphery of said central pipe. The jamming effect, caused of accumulation, has been tried to solve by providing the dividing holeplate with an own rotation drive and by mounting an intermediate circumferentially perforated holeplate in bearings onto the periphery of the central pipe and providing it with own rotation drive. Thus the axial distance by which the elongated elements are wound around the central pipe can due to the rotable intermediate plate somewhat be increased, but the main problem, i.e. growing friction and low number of helics cannot yet be eliminated.

Though it has been possible by the afore-mentioned solutions to slightly reduce the accumulation tendency of the elements to be twisted as well as the adverse effects og this disadvantage the goal has not yet been achieved in a satisfactory manner. The most substantial disadvantages include.

- When a torsion-elastic pipe, inside which the elongated elements to be twisted pass, is used between dividing and twisting means the limited twisting ability of the torsion pipe restricts twisting turns of the pipe and thus also twisting turns of the elements to be twisted, whereby the reverse points in the twisting direction must be placed remarkable close to each other, which is disadvantageous.

- When a torsion cable or similar is used between dividing and twisting means and when said torsion cable is provided with several axially apart spaced perforated disks to guide individual elongated elements, said elongated elements are wound against said torsion cable. Thus it is impossible to eliminate the very remarkable disadvantages, i.e. jamming factor and growing friction when the number of twisting turns to one direction increase over 10. Further can be mentioned that it is impossible to produce by this kind of method or apparatus products demanding the use of central or "core" element.

When parallel and annularly adapted means, i.e. spirals or pipes, for defining the feedpats for individual elongated elements are used between dividing and twisting means it is not possible to apply high rotational speeds for twisting, but because of sag and centrifugal force said means for defining the feedpats of elements strive to detach and also easily twist unevenly in relation to each other, which significantly impedes easy twisting and increases the probability for producing a cable unfit for its purpose.

The main object of the present invention is to provide an improved alternate reverse twisting method and apparatus, by which the above mentioned disadvantages related to previously known alternate reverse twisting methods and apparatus could essentially be eliminated.

This object has been achieved by the afore-mentioned alternate reverse twisting method according to the present invention so, that the elongated

elements to be twisted are drawn from said dividing means to said pressing means through torsion-elastic peripherical pipes arranged peripherically around a central pipe whereby each individual elongate element to be twisted is adapted to pass inside one of said peripherical pipes, and so that said peripherical pipes are twisted periodically in one direction several turns around and against said central pipe.

The object has also been achieved by the afore-mentioned alternate reverse twisting apparatus according to the present invention so that said means for defining the feedpaths are support and guide means for said elements to be treated and include essentially a centrally disposed central pipe and periodically to opposite directions twistable peripherical pipes (4) adapted between said dividing and twisting means so that said peripherical pipes are during each twisting stage into one direction against the periphery of said central pipe, and so, that said elements to be twisted are arranged to pass through said peripherical pipes.

The second significant object of the present invention is to produce an essentially new-looking alternate reversely twisted product in which the distance between each reverse point of twisting direction would be essentially longer than previously has been able even to imagine.

According to the present invention the new-looking alternate reversely twisted product differs from the previously known alternate reversely twisted products, in that the number of twisting turns of the individual peripherical twisted elements of said product between the reverse points of the twisting direction are between 10 to 100, preferably between 30 to 80.

The present invention is based on that genious idea that the means adapted between dividing ant twisting means are intended both to support every individual element to be twisted and to define frigtion-free feedpath for every single element to be passed through the apparatus according the present invention. Due to the present invention it is now possible essentially to increase both the number of twisting turns to both directions and the distance between the reverse points of twisting direction as well as the effective lateral distance by which the peripherical torsion-elastic pipes of the apparatus are wound around the periphery of the central pipe. Thus

can essentially be decreased both the accumulation tendency of the elongated elements towards the twisting means and high friction effect both high pulling force applied to the elongated elements to be twisted.

Preferred embodiments of the present invention will now be descriped by manner of example with reference to accompanying drawing in which;

FIG. 1 is a side elevational view partly in cross-section of alternate reverse twisting apparatus according to the first advantageous embodiment of the present invention,

FIG. 2 is a cross-sectional view of means according to one advantageous embodiment for defining the feedpats of elongated elements to be passed through the SZ-twisting apparatus, whereby said means are adapted between the dividing and twisting means,

FIG. 3 is a longitudinal cross-section of means according to another advantageous embodiment for defining the feedpats of elongated elements to be passed through the SZ-twisting apparatus, whereby said means are adapted between the diving and twisting means,

FIG. 4 is a simplified and partly cross-sectional side view of the alternate reverse twisting apparatus according to the second advantageous embodiment of the present invention, and

FIG. 5 is a cross-section of an advantageous fastening arrangement of a peripherical pipe adapted into one opening of the dividing and/or twisting means.

As may be seen from FIG. 1 or 4 the alternate reverse twisting apparatus, which hereafter is called as "SZ-twisting apparatus", according to the invention include;

- fixed dividing means 3 adapted to the input end of the elements 2 to be twisted, as electric and/or optical wires, leads and fibers, both partial wires or leads and quads as well groups thereof, which hereafter is called as "wires". drawn from starting spools and twisted by SZ-twisting apparatus,
- periodically to opposite directions rotable twisting means 6 adapted to the output end of the wires to be twisted, as well as
- support and guide means 4 and 5 arranged between the dividing and twisting means 3 and 6, which define the feedpaths for the wires 2 to be twisted.

When a SZ-twisted product is being manufactured by the SZ-twisting apparatus according to the invention the wires 2 to be twisted and a possible core element 9, which can be for instance a cable, electric or optical lead, polypropene, polystyrene or paper core wire or similar, is drawn, as already mentioned before, throuhg the dividing means 3 into the support and guide means 4 and 5 and therefrom through the twisting means 6 into pressing means 7, preferably a niple having in the feeding direction of wires 2 a conically tapering opening in which the SZ-twisted wires 2 and the possible core element 9 are pressed tightly against each other to form a alternate reversely twisted product 8 which can further be bound by a suitable spinning device (not shown in the accompanying drawing) to eliminate the danger og untwisting.

Both the dividing means 3 and the twisting means 6 are composed preferably of a perforated holeplate, or the like both including;
- a central opening for the central pipe 7 and the possible core element 9 to be drawn through it, and
- several circumferentially with equal distance from each other arranged, and radially from said central opening separated openings for the peripherical pipes 4 and wires 2 to be drawn therethrough.

In the SZ-twisting apparatus according to the first and second advantageous embodiment of the present invention shown in FIGS. 1 and 4 the fixed holeplate 3 for dividing wires 2 and the possible core element 9 is stationary fastened to a first support structure of the SZ-twisting apparatus. The perforated twisting holeplate at the output end of the wires 2 and the possible core element 9 is mounted in bearings to a second support structure of the SZ-twisting apparatus and is provided with its own rotation drive, preferably composed of an electric motor with chain, gear or belt transmission, whereby the oscillating rotation speed regulation and reversing automatics can be realized in a simple manner.

To achieve the goal of the invention the support and guide means 4 and 5, which define the feedpaths for wires 2 and for the possible core element 9, are composed of a pipe group shown in FIG. 2, whereby the pipe group include a central pipe 5, through which is drawn the possible core element 9 of the product to be manufactured, and several peripherically the central pipe 5 surrounding both aroun it twistable peripherical pipes 4, through

which are drawn the wires 2 to be twisted.

In the SZ-twisting apparatus according to the invention said peripherical pipes 4 are thin, diameter between 5 to 20 mm preferably about 10 mm, and resilient being made of torsion-elastic material, preferably of polyamide or polytetrafluorethylene and fixed into the circumferentially arranged openings of both the dividing holeplate or holedisk and the twisting holeplate or holedisk, whereby the peripherical pipes 4 form a pipe mantle around the central pipe 5. According to one preferred embodiment of the invention shown in FIG. 2 the peripherical pipes 4 are arranged side by side close to each other, so that the pipe mantle formed by individual peripherical pipes 4 extends essentially uniform around the central pipe 5. When the peripherical pipes 4 are made of e.g. polytetrafluorethylene is obtained also the advantage that sliding friction between the peripherical pipe 4 and wire 2 is extremely low which tends to facilitate the easy passing of wires 2 inside the peripherical pipe 4.

During the twisting phase of the wires 2 the peripherical pipes 4 are wound around the periphery of the central pipe 5 as a result of the rotational movement of the twisting holeplate 6. Compensate the growing tensile tress caused of this twisting the ends of the peripherical pipes 4 have been in the advantageous embodiment of the present invention fixed in their axial direction resiliently into the circumferentially existing openings in the dividing holeplate 3. Corresponding resilient connection can also be used in the end of twisting holeplate 6 adapted in circumferential openings of the same. If the SZ-twisting apparatus is used for rapid twisting of thin wires, like e.g. electric leads or optical fibers, it is preferable to bind the peripherical pipes 4 elastically to each other, whereby the harmful effect caused of centrifucal forces can be totally eliminated. This can most simply be made e.g. by adapting an elastic conneting ring (not shown) around the peripherical pipes or by connecting the peripherical pipes already in their manufacturing phase together e.g. by elastic strip portions.

Because the wires 2 to be twisted pass inside the peripherical pipes 4 they are not in contact with the central pipe 5, whereby the rotating central pipe does not either cause friction impeding the drawing of wires or generate any jamming danger.

To obtain atleast 10 or even 100, preferably between 30 to 80 as used with good results in test carried out, twisting turns of the peripherical pipes 4 into one direction around the central pipe 5 each torsion-elastic peripherical pipe 4 is fastened according to the preferred embodiment of the present invention shown in FIG. 5 into the circumferentially existing openings or borings of the perforated dividing holeplate 3 and/or into the circumferentially existing openings or borings of the perforated twisting holeplate 6 (which, however is not shown in FIGS. 1 or 3), resiliently in the axial direction of its longitudinal axis both rotably around its longitudinal axis. Due to the rotable attachment twisting of each peripherical pipe 4 around the central pipe 5 does not cause a torsional load to the peripherical pipe 4 and due to the resilient attachment also the generating tensile load can be kept as small as possible. This kind of attachment can be obtained e.g. in such a way, that each peripherical pipe 4 is compressedly locked between conical countersurfaces of two compression locking pieces 13 and 14, whereby the outer locking piece 14 is mounted with bearings into the opening of the perforated dividing holeplate 3 (or twisting holeplate 6) to rotate around and to move axially in relation to the longitudinal axis of the peripherical pipe 4. The locking can be made e.g. by a wedge means 17 locking the outer piece 14 and the bearing 18. To achieve resiliency one of the locking pieces 13 or 14 (in FIG. 5 that is the inner locking piece 13) is provided with flange 16, whereby between said flange 16 and the perforated disk 3 (or 6) has been arranged resilient means 15, for example a coil spring as shown in FIG. 5, rotating with the peripherical pipes and collapsing when the peripherical pipes 4 are wounding around the central pipe 5, whereby too high tension of the peropherical pipes 4 can be prevented.

To achieve the goal of the invention the central pipe 5 may comprise of a rigid, preferably prestressed and rotating metal pipe arranged onto support structures or of a torsion-elastic torsion pipe made e.g. of plastic-based material, preferably of polyamide, and arranged onto support structures.

In the embodiment shown in FIG. 1 the central pipe 5 is made of polyamide. It must be emphasized that the central pipe 5 can in this embodiment also be made of metal, e.g. steel. In this embodiment the central pipe 5 is prestressed between a first and a second support structure, whereby the disadvantages due to the sag and centrifugal forces can be eliminated.

As shown in FIG. 1 the end of the central pipe 5 towards the input side of wires to be twisted is adapted into the central opening or boring of the perforated dividing holeplate 3 and is provided with a bearing arrangement 11 resisting axial load, e.g. thrust or ball bearing. To ensure the axial immobility of the central pipe 5 the outer surface of the central pipe 5 is provided with a radially extending support flange supported against the above mentioned bearing 11. As further shown in FIG. 1 the end of the central pipe 5 towards the output side of wires 2 to twisted has been rigidly fastened into the central opening or boring of the perforated twisting holeplate 6. This opening is preferably conical, in which case the central pipe 5 is compressedly locked at its outer surface by a locking piece corresponding the inner surface of said conical opening or boring. In this embodiment the rotating movements of the central pipe 5 as well as the oscillating twisting movements of the peripherical pipes 4 to opposite directions thus are achieved by means of the alternate reversely rotating twisting holeplate 6.

When the central pipe 4 is made torsion-elastic it is preferable to provide that end of the cental pipe towards the dividing holeplate 3 with own rotation drive to adjust the twisting rate of the central pipe 4, whereby it is possible to increase the effective lenght on which the wires 2 will wound inside the peripherical pipes 5 around the central pipe further it is possible by this kind of an arrangement to decrease both the accumulation tendency and the angular deviation at the end of the central pipe towards the twisting holeplate 6.

In the embodiment shown in FIG. 4 the central pipe 4 is made of metal, e.g. steel, and prestressed between a first and a second support structures (not shown). Whereby the disadvantages caused by sag and centrifugal forces can be minimized. Naturally the central pipe 4 can in this second embodiment be also made of plastic based material, e.g. polyamide.

According to this second embodiment shown in FIG. 4 the central pipe 5 is adapted centrally both to stationary dividing holeplate 3 and to alternate reversely rotating twisting holeplate 6 and mounted to rotate essentially freely and untwistingly in relation to both dividing and twisting holeplates. In this embodiment the central pipe 5 is supported at its both ends with bearings 11 and 12, preferably thrust- or ball-type bearings resisting

axial load. The axial immobility of the central pipe 5 can in this embodiment be ensured for example by providing the outer surface of the central pipe 5 with radially extending flanges, one of which is support to the bearing 11 at the side of the dividing holeplate 3, and the other of which is supported to the bearing 12 at the side of the twisting holeplate 6. As further can be sen in FIG. 4 that end of the central pipe 5 towards the dividing holeplate 3 is provided with a rotating drive, which can be e.g. an electric motor with chain. belt, gear or similar force transmission. Due to the freely, in relation to the rotational movements of the twisting holeplate 6, adjustable oscillating rotational speed as well as direction of the central pipe 5 is achieved the advantage, that the central pipe 5 can be oscillatingly rotated with different speed or even direction compared with the oscillating rotation movements of the twisting holeplate 6 and peripherical pipes 4, whereby it is possible to reduce friction between central pipe 5 and peripherical pipes 4 and spread the wounding of peripherical pipes 4 onto a longer portion of the surface of the central pipe 5. Arrangement according to this second preferred embodiment evens out the pitch of the peripherical pipes 5 wound around the central pipe 5 particularly at that end of the central pipe towards the twisting holeplate 6 or reduces the so-called pitch error.

On one hand to prevent flattening of the peripherical pipes 4 wound around the central pipe 5, which may impede movements of the wires 2 through the peripherical pipes 4, and on the other to eliminate sliding of the peripherical pipes 4 axially on the surface of the central pipe 5, which may increase jamming probability, pitch eror and the accumulation of the peripherical pipes 4 especially at the side of twisting holeplate 6, the outer perimeter of the central pipe 5 is provided as shown in FIG. 3 with a resilient material layer 10, which according to one preferred embodiment of the invention is made of polyurethane and to which the peripherical pipes 4 are pressed during wounding around the central pipe 5.

When SZ-twisted product is manufactured by the SZ-twisting apparatus according to the present invention, which product should include a central core element 9 and SZ-twisted peripherical wires 2 surrounding peripherically the core element 9. The core element 9 which will extend to the whole lenght of the product to be manufactured is drawn through the central pipe 5 into the niple 7 simultaneously when the wires 2 to be twisted are drawn

through the peripherical pipes 4 to be wound around the central pipe 5 into the niple 7.

When the inner diameter of the central pipe 5 is selected essentially greater than the diameter of the core element 9 to be drawn therethrough, the core element 9 can be coated before the twisting holeplate 6, preferably before the dividing holeplate 3, with an intermediate, e.g. insulation or binding agent, layer. When said binding agent layer is used, the above mentioned binding after the niple 7 by means of thread or band for ensuring the twisting maintenance can be eliminated and the twisted wires 2 are fastened keeping their pitch in the niple to said binding agent layer 10.

The invention has been above described only by means of some preferred embodiments. This is not, however, ment to limit the present invention, but several modificatons as well as variations are possible within the spirit and scope of the accompanying claims.

Thus the afore-described bearing and rotating solutions for the central pipe 5 are not naturally the only ones to achieve the goal of the present invention.

When the central pipe 5 is composed of a torsion-elastic torsion pipe it must be observed, that the bearing arrangement of the central pipe 5 at the end of the dividing holeplate 3 described in connection with the FIG. 1 is not necessary. The central pipe 5 can be adapted between the first and second support structures so that it is stationary and centrally fastened at its one end to the dividing holeplate 3 and at its other end also stationary and centrally to the twisting holeplate 6, whereby the central pipe 5 is twisted periodically to opposite directions corresponding to the oscillating rotational movement of the twisting holeplate 6.

When the central pipe has been made as torsion pipe its end towards the dividing holeplate 3 has been adapted in bearing arrangement, preferably resisting axial load, and provided with rotation drive, as an electric motor with suitable power transmission. The other end of the central pipe can then be fastened centrally and stationary to the twisting holeplate, whereby by changing the rotation speed or direction of that end of the

central pipe towards dividing holeplate 3 the twisting of the central pipe around its longitudinal axis can be accelerated, retarded or hold up.

In connection with the supporting of the central pipe 5 it must still be stated that in accordance with the present invention instead of the bearing arrangement resisting axial load it is possible to use a bearing arrangment enabling an axial movement of the central pipe in relation to dividing means or twisting means. Such a bearing arrangement, by which the central pipe 5 can be adapted floatingly between dividing and twisting means, can be realized by e.g. a sliding or closed bearing mounted at that end of the central pipe which has not been stationary fastened to the twisting means rotating the central pipe or at that end of the central pipe which is not connected with the rotating drive. Such a floating central pipe is not, of course, prestressed and it can therefore be used most advantageously in solutions where large span between support structures are not required.

Furter must be stated thet the guide and support means, which define the feedpats for the wires to twisted, are not necessarily composed of separate torsion-elastic pipes as described before, but they can also be constructed of a torsion-elastic and hollow multichannel profile element, which is manufactured e.g. be extrusion, and which includes one central channel for the possible core element and several hollow peripherical channels for the wires to be twisted surrounding the central channel.

The central pipe or central channel can also be equipped with spacers defining into the inner space of the central pipe or central channel desired number of parallel feedpaths for core elements. In this case also an elongated core unit can be assembled by mutually twisted wire elements by twisting the central pipe simultaneously with the twisting of the peripherical pipes.

CLAIMS

1. Alternate reverse twisting method to form a product, as cable or similar, composed of an inner core element (9) and/or of alternate reversely twisted elongated elements (2) which can be wires, leads, optical fibers or their groups, or similar or which can be twisted as quads of wires, leads etc., by a alternate reverse twisting apparatus comprising:
- a fixed dividing means (3) at the input end of the elements (2,9) to be treated,
- to opposite directions periodically rotating twisting means (6) at the output end of the treated elements (2,9),
- thereafter arranged pressing means (7), preferably a niple, for pressing the treated elements (2,9) tightly against each other, and
- means (4,5) for defining feedpaths of the elements (2,9) to be treated, which means are arranged between said dividing and twisting means,

characterized in that the elongated elements (2) to be twisted are drawn from said dividing means (3) to said pressing means (3) through torsion-elastic peripherical pipes (4) arranged peripherically around a central pipe (5) whereby each individual elongate element (2) to be twisted is adapted to pass inside one of said peripherical pipes (4) and that said peripherical pipes (4) are twisted periodically into one direction several turns around and against said central pipe (5).

2. Alternate reverse twisting method according to claim 1, characterized in that said core element (9) is drawn from said dividing means (3) to said pressing means (7) through said central pipe (5) the inner diameter of which is essentially greater than the diameter of said core element.

3. Alternate reverse twisting method according to claim 2, characterized in that said core element (9) is coated before entering into said pressing means (7).

4. Alternate reverse twisting method according to anyone of the preceeding claims 1 to 3, characterized in that as said central (5) pipe is used an essentially rigid pipe which is fixed centrally to the twisting means (6) and mounted in bearings, which are adapted centrally in the dividing means (3) whereby said central pipe is rotated with said twisting means.

5. Alternate reverse twisting method according to anyone of the preceeding claims 1 to 3, characterized in that as said central pipe (5) is used a pipe both ends of which are in bearings and that atleast one end of said central pipe is provided with a rotation drive whereby the rotation speed and rotation direction is adjusted in relation to said twisting means by means of said rotation drive.

6. Alternate reverse twisting method according to anyone of the preceeding claims 1 to 3, characterized in that as said central pipe (5) is used a torsion-elastic and preferably prestressed pipe, one end of which is fixed solidly and centrally to said twisting means (6), and the second of which is in bearings centrally at said dividing means (3), and that said second end of said central pipe is provided with a rotation drive whereby oscillating rotation and twisting speed and/or oscillating rotation and twisting direction are adjusted in relation to said twisting means by means of said rotation drive.

7. Alternate reverse twisting method according to anyone of the preceeding claims 1 to 6 characterized in that as said peripherical pipes (4) are used torsion-elastic pipes, preferably made of polyamide or polytetrafluorethylene, one ends of which are connected circumferentially to said dividing means (3) and the other ends of which are connected circumferentially to said twisting means (6) and that the oscillating twisting rate and direction periodically to opposite directions around said central pipe (5) are defined by the rotation movement of said twisting means (6).

8. Alternate reverse twisting method according to anyone of the preceeding claims 5 to 7, characterized in that during the twisting of said periferical pipes (4) by means of said twisting means (6) said central pipe (5) is rotated by means of said rotation drive with different speed and/or direction in relation to the speed and/or direction of said twisting means to decrease friction between said central pipe and said peripherical pipes and the tendence of said peripherical pipes to accumulate with denser pitch at the end of said central pipe towards said twisting means as well as to increase twisting turns around said central pipe in one direction.

9. Alternate reverse twisting method as hereinbefore described with reference to anyone of the embodiments descriped and/or shown in the accom-

panying specification and/or drawings

10. Alternate reverse twisting apparatus to form a product, as cable or similar, composed of an inner core element (9) and/or alternate reversely twisted elongated elements (2) which can be wires, leads, optical fibers or their groups or similar or which can be twisted as quads of wires, leads etc., said apparatus comprising:

- a fixed dividing means (3) at the input end of the elements (2,9) to be treated,
- to opposite directions periodically rotating twisting means (6) at the output end of the treated elements (2,9),
- thereafter arranged pressing means (7), preferably a niple, for pressing said treated elements (2,9) tightly against each other, and
- means (4,5) for defining feedpaths of said elements (2,9) to be treated, which means are arranged between said dividing and twisting means (3,6),

characterized in that said means (4,5) for defining the feedpaths are support and guide means for said elements (2,9) to be treated and include essentially a centrally disposed central pipe and periodically to opposite directions twistable peripherical pipes (4) adapted between said dividing and twisting means (3,6) so that said peripherical pipes are during each twisting stage into one direction against the periphery of said central pipe (5), and that said elements (9) to be twisted are arranged to pass through said peripherical pipes (5).

11. Alternate reverse twisting apparatus according to claim 10, **characterized** in that one end of said central pipe (5) is fixed centrally and solidly to said twisting means (6) to rotate with it, and that the other end of said central pipe is mounted by means of bearings centrally to said dividing means (3) to rotate in relation to said dividing means.

12. Alternate reverse twisting apparatus according to claim 10, **characterized** in that said central pipe (5) is a torsion-elastic and preferably prestressed torsion pipe, that one end of said torsion pipe is fixed centrally and solidly to said twisting means (6) to rotate with it, and that the other end of said torsion pipe is mounted centrally by means of bearings to said dividing means and is provided with its own rotion drive to adjust oscillating rotation and twisting speed as well as direction in relation to said twisting means (6).

13. Alternate reverse twisting apparatus according to claim 10, characterized in that said central pipe (5) is an essentially rigid and preferably prestressed pipe, that both ends of said central pipe are mounted centrally by means of bearings one end to said dividing means (3) and the other end to said twisting means (6), and that atleast that end of said central pipe towards said dividing means is provided with a rotation drive to rotate said central pipe independently in relation to said twisting means.

14. Alternate reverse twisting apparatus according to claim 10 and to one of the preceeding claims 11 to 13, characterized in that means for defining said feedpaths of the elongated elements (2) to be twisted are composed of several torsion-elastic peripherical pipes (4) surrounding said central pipe (5) and being twistable around and against said central pipe.

15. Alternate reverse twisting apparatus according to claim 10, characterized in that means (4,5) for defining the feedpaths of both the core element (9) and the elongated elements (2) to be twisted is composed of a multichannel hollow-core profile element, whereby said multichannel hollow-core profile element is attached at its one end solidly and centrally to said dividing means (3) and at its other end also solidly and centrally to said twisting means (6).

16. Alternate reverse twisting apparatus according to any of the preceeding claims 10 to 15, characterized in that the inner diameter of said central pipe (5) or the central channel of said hollow-core profile element is essentially greater than the inner diameter of said peripherical pipes (4) or said peripherical channels of said hollow-core profile element.

17. Alternate reverse twisting apparatus according to anyone of the preceeding claims 10 to 16, characterized in that said peripherical pipes (4) are arranged essentially parallel in close vicinity to each other, so that they form an essentially uniform pipe mantle around said central pipe (5).

18. Alternate reverse twisting apparatus according to anyone of the preceeding claims 10 to 17, characterized in that said central pipe (5) is

coated by a resilient material layer, preferably made of polyurethane, to which said peripherical pipes (4) are pressed during the twisting phase.

19. Alternate reverse twisting apparatus according to anyone of the preceeding claims 10 to 18, **characterized** in that to compensate the tensile load caused by the twisting of said peripherical pipes (4) each of said peripherical pipes include resilient means (15) to connect the peripherical pipe in the direction of its own longitudinal axis flexibly to said dividing means (3) and/or to said twisting means (6), and that to minimize the torsional load caused by the twisting of said peripherical pipes each of said peripherical pipes is connected to said dividing means and/or to said twisting means rotably around its own longitudinal axis, so that said resilient means (15) for each of said peripherical pipes is adapted to rotate with said peripherical pipes in relation to the openings of said dividing means and/or twisting means.

20. Alternate reverse twisting apparatus according to anyone of the preceeding claims 10 to 19, **characterized** in that lenghth of both said central pipe (5) and said peripherical pipes (4) is between 5 to 30 meters, preferably between 10 to 20 meters.

21. Alternate reverse twisting apparatus. arranged, constructed and adapted to operate substantially as hereinbefore described with reference to anyone of the embodiments shown and/or descriped in the accompanying drawings and/or specification.

22. Alternate reversely twisted product, as electric and/or optical cable, lead or similar, **characterized** in that the number of twisting turns of the individual peripherical twisted elements (2) of said product between two twisting direction reverse points are between 10 to 100, preferably between 30 to 80

23. Product, produced, arranged and constructed substantially as hereinbefore described with reference to anyone of the embodiments shown and/or descriped in the accompanying drawings and/or specification.

AMENDED CLAIMS
[received by the International Bureau on 20 August 1987 (20.08.87);
original claims 14 and 15 cancelled; claims 1,2,10 and 16 amended;
other claims unchanged (3 pages only)]

1. Alternate reverse twisting method to form a product, as cable or similar, composed of an inner core element (9) and/or of alternate reversely twisted elongated elements (2) which can be wires, leads, optical fibers or their groups, or similar or which can be twisted as quads of wires, leads etc., by a alternate reverse twisting apparatus comprising:
- a fixed dividing means (3) at the input end of the elements (2,9) to be treated,
- to opposite directions periodically rotating twisting means (6) at the output end of the treated elements (2,9),
- thereafter arranged pressing means (7), preferably a niple, for pressing the treated elements (2,9) tightly against each other, and
- concentrically between said dividing and twisting means (3,6) arranged first and second means (4,5) for defining feedpaths of the elements (2,9) to be treated,

characterized in that elongate elements (2) to be twisted are drawn from said dividing means (3) to said pressing means (7) inside said first means composed of torsion-elastic peripherical pipes (4), which are arranged peripherically around said second means composed of an oscillating rotable and/or twistable central pipe (5), which is supported by both said dividing means (3) and twisting means (6), and that said elongate elements (2) are twisted by means of said peripherical pipes (4) which are twisted periodically into one direction several turns around and against said central pipe (5).

2. Alternate reverse twisting method according to claim 1, characterized in that a core element (9) is drawn from said dividing means (3) to said pressing means (7) through said central pipe (5) the inner diameter of which is essentially greater than the diameter of said core element.

3. Alternate reverse twisting method according to claim 2, characterized in that said core element (9) is coated before entering into said pressing means (7).

4. Alternate reverse twisting method according to anyone of the preceeding claims 1 to 3, characterized in that as said central (5) pipe is used an essentially rigid pipe which is fixed centrally to the twisting means (6)

increase twisting turns around said central pipe in one direction.

9. Alternate reverse twisting method as hereinbefore described with reference to anyone of the embodiments descriped and/or shown in the accompanying specification and/or drawings

10. Alternate reverse twisting apparatus to form a product, as cable or similar, composed of an inner core element (9) and/or alternate reversely twisted elongated elements (2) which can be wires, leads, optical fibers or their groups or similar or which can be twisted as quads of wires, leads etc., said apparatus comprising:

- a fixed dividing means (3) at the input end of the elements (2,9) to be treated,
- to opposite directions periodically rotating twisting means (6) at the output end of the treated elements (2,9),
- thereafter arranged pressing means (7), preferably a niple, for pressing said treated elements (2,9) tightly against each other, and
- first and second means (4,5) for defining feedpaths of said elements (2,9) to be treated, which first and second means are arranged concentrically between said dividing and twisting means (3,6),

characterized in that said first and second means for defining the feedpaths are support and guide pipes (4,5) for said elements (2,9) to be treated and include:

- an oscillating rotated and/or twisted central pipe (5), which is supported by both said dividing means (3) and said dividing means (6) and
- periodically to opposite directions twistable, torsion-elastic peripherical pipes (4), one ends of which are supported by said dividing means (3) and the other ends of which are supported by said twisting means (6), and which are arranged peripherically around said central pipe (5) and are during each twisting stage into one direction against the periphery of said central pipe (5),

and that each individual element (9) to be twisted is adapted to pass between said dividing and twisting means (3,6) individually through one of said peripherical pipes (5).

11. Alternate reverse twisting apparatus according to claim 10, **characterized** in that one end of said central pipe (5) is fixed centrally and

solidly to said twisting means (6) to rotate with it, and that the other end of said central pipe is mounted by means of bearings centrally to said dividing means (3) to rotate in relation to said dividing means.

12. Alternate reverse twisting apparatus according to claim 10, characterized in that said central pipe (5) is a torsion-elastic and preferably prestressed torsion pipe, that one end of said torsion pipe is fixed centrally and solidly to said twisting means (6) to rotate with it, and that the other end of said torsion pipe is mounted centrally by means of bearings to said dividing means and is provided with its own rotation drive to adjust oscillating rotation and twisting speed as well as direction in relation to said twisting means (6).

13. Alternate reverse twisting apparatus according to claim 10, characterized in that said central pipe (5) is an essentially rigid and preferably prestressed pipe, that both ends of said central pipe are mounted centrally by means of bearings one end to said dividing means (3) and the other end to said twisting means (6), and that atleast that end of said central pipe towards said dividing means is provided with a rotation drive to rotate said central pipe independently in relation to said twisting means.

16. Alternate reverse twisting apparatus according to any of the preceeding claims 10 to 13, characterized in that the inner diameter of said central pipe (5) is essentially greater than the inner diameter of said peripherical pipes (4).

17. Alternate reverse twisting apparatus according to anyone of the preceeding claims 10 to 16, characterized in that said peripherical pipes (4) are arranged essentially parallel in close vicinity to each other, so that they form an essentially uniform pipe mantle around said central pipe (5).

18. Alternate reverse twisting apparatus according to anyone of the preceeding claims 10 to 17, characterized in that said central pipe (5) is coated by a resilient material layer, preferably made of polyurethane, to which said peripherical pipes (4) are pressed during the twisting phase.

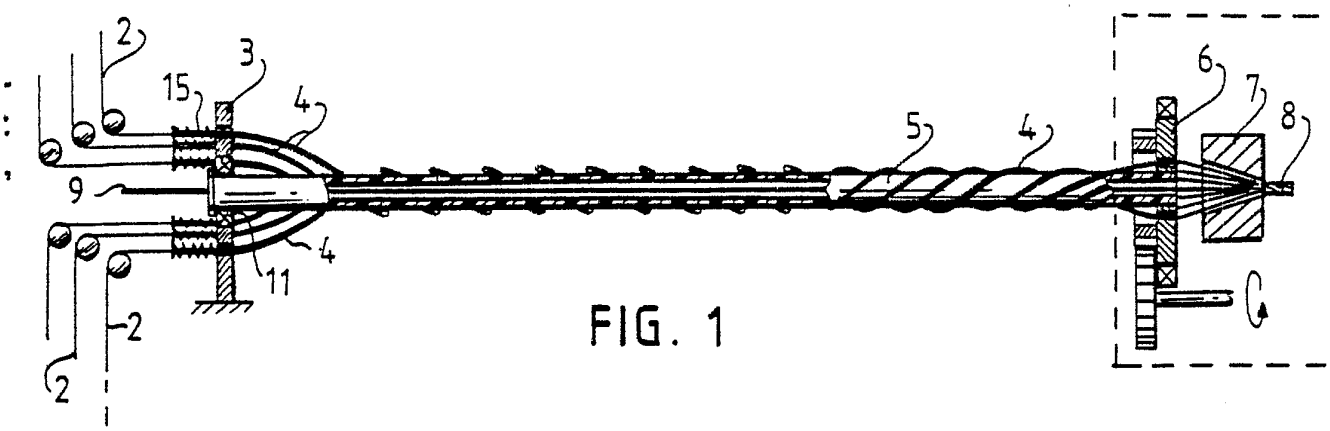
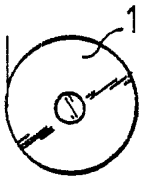


FIG. 1



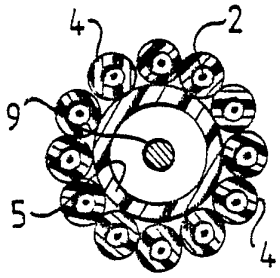


FIG. 2

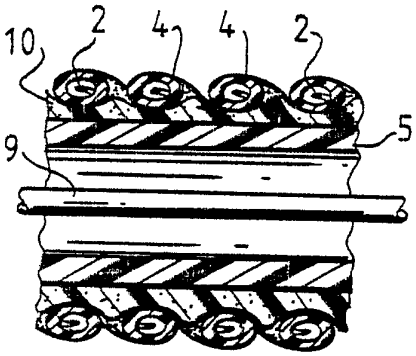


FIG. 3

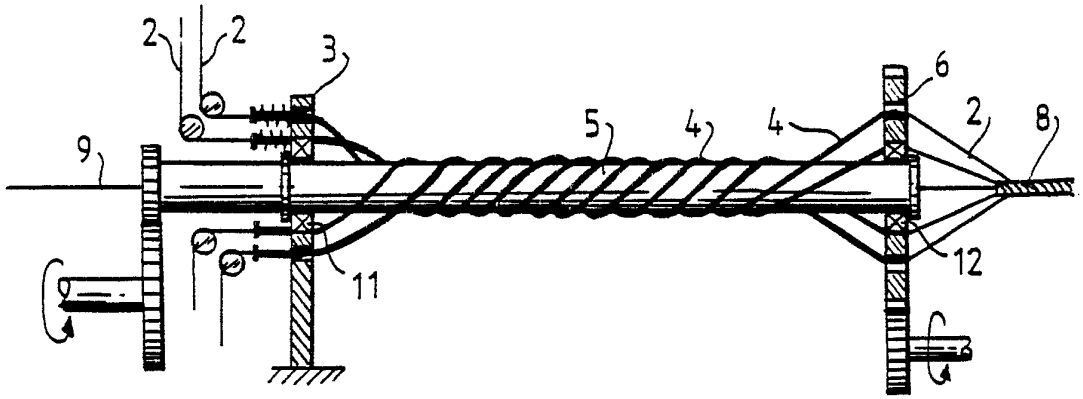


FIG. 4

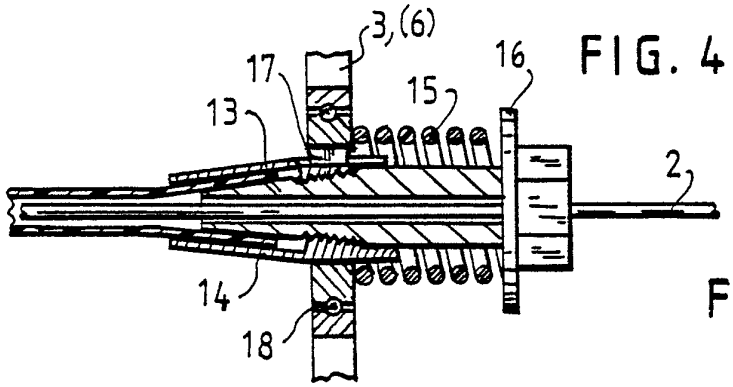


FIG. 5

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI87/00043

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

H 01 B 13/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B 65 H 57/00, /12, /16, /28; B 21 F 7/00; D 07 B 3/00, 7/00, /02; H 01 B 13/00-/04
Nat Cl	21c: 3/04, 4/02 .../...

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 3 847 190 (PHILLIPS CABLE LTD) 12 November 1974	1-8, 10-20, 22
X	EP, A, 0 103 963 (NORTHERN TELECOM LTD) 28 March 1984 & JP, 59054435 CA, 1174914	1-8, 10-20, 22
X	EP, A, 0 104 725 (NORTHERN TELECOM LTD) 4 April 1984 & JP, 59054116 CA, 1174911	1-8, 10-20, 22
Y	US, A, 3 910 022 (NORTHERN ELECTRIC COMPANY LTD) 7 October 1975	15
Y	DE, A, 3 227 481 (SIEMENS AG) 26 January 1984	1
Y	DE, A, 1 465 550 (FELTEN & GUILLEAUME CARLSWERK AG) 30 January 1969 .../...	1

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1987-06-16	1987 -06- 25
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Stefan Svahn

Form PCT/ISA/210 (second sheet) (January 1985)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Fields Searched (cont)

US Cl 57: 34, 51, 58.83, 59.63, 77.3, 91, 106, 166;
140: 149;
156: 47;
174: 32-36

V. [X] OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. [ ] Claim numbers....., because they relate to subject matter not required to be searched by this Authority, namely:

2. [X] Claim numbers 9,21 and 23, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out specifically:

Claims 9, 21 and 23 do not meet the requirements of rule 6.2a because they rely on references to the drawings and/or the description

3. [ ] Claim numbers....., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. [ ] OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. [ ] As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

[ ] The additional search fees were accompanied by applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
X	Derwent's abstract no J 8082 D/38, SU 781 982 23 November 1980	1-8,10-20,22