

DESCRIPTION

TWISTING APPLIANCE AND TWISTING HEAD DEVICE AND METHOD
FOR TWISTING OR STRANDING CABLES

The invention relates to a twisting head device for twisting or stranding electrical and/or optical cables, a method for twisting or stranding electrical and/or optical cables with the twisting head device, a twisting appliance for twisting or stranding electrical and/or optical, a method for stranding or twisting electrical and/or optical cables with the twisting appliance, and a computer-implemented method for automatic determination and generation of datasets and/or movement commands for a twisting appliance according to the preambles of the independent claims.

In the manufacture of cable bundles, a distinction must be made between two manufacturing processes, twisting or stranding. However, these two terms are often confused in the literature. In this document a twisting operation is understood to mean the twisting of two or more cables around each other, resulting in twist lay length which indicates the length of a single 360° rotation or winding. In order to achieve a specific twist characteristic, in the simplest case in this manufacturing process the cable bundle must be overtwisted so that after a relaxation process it reaches the intended final twisting position. This method is very well suited for the most applications. Typically, twisting of insulated copper wires is carried out most frequently to produce twisted cable bundles in car manufacturing.

In comparison with this, only a small fraction of cable bundles are manufactured according to the principle of the stranding process. For the present purposes, a

stranding process is understood to involve laying two more cables around each other. The lay length, i.e., the distance between one winding and the next is preset by a stranding shuttle, which is moved from one cable end to the other cable end along the cables that are to be stranded as the cables to be stranded are laid around each other. The stranding process is significantly less stressful for the cables that are to be stranded because the torsion of the individual cables in the stranding process is absorbed or compensated inherently. This is the preferred method when very sensitive, e.g., very thin wires are to be twisted to form a cable bundle. Stranded cable bundles are typically used in sheathed cables.

Twisted or stranded cables are often used where two or more cables are integrated in a cable bundle at the same time or the cable bundles are subject to special technical requirements. Twisted cables are typically used in the automotive field or apparatus engineering. Twisted or stranded cables (e.g., "twisted pair", when two cables are twisted together to create a cable bundle) are used where the cables must be resistant to electromagnetic interference given their environment (electromagnetic compatibility (EMC)).

As part of their production, the cables that are to be twisted or stranded together are clamped into rotatably supported stranding and/or twisting heads. Then, the clamped cables are twisted and/or rotated around each other to create a cable bundle (a "twisted pair") as the end product.

DE 196 31 770 A1 shows a method and an apparatus for twisting at least two single lines. In this context, the cable ends of the individual wires are each clamped in a rotatable untwisting gripping jaw of a first

twisting head and at the other end clamped in a twisting gripping jaw of a second twisting head which is rotatable together about a twisting axis. During the twisting process, a twisting shuttle located between the two individual cables is moved along the single cables from the twisting gripping jaw to the untwisting gripping jaw. In this process, the travel speed of the twisting shuttle is adjusted with the aid of a controller.

The drawback with the abovementioned solution is that the twisting shuttle can only be moved by from the twisting gripping jaw to the untwisting gripping jaw during the twisting process. Therefore, the twisting shuttle must be returned to the twisting gripping jaw from the untwisting gripping jaw before each new twisting process. As a result, production takes up more time.

DE 20 2016 103 444 U1 discloses an apparatus for producing a cable bundle from lines which are clamped between two clamping apparatuses. One of the clamping apparatuses a rotatably mounted support and a housing, wherein the rotatably mounted support has a rotatably mounted clamping holder for each of the cables that are to be twisted. The support and the clamping holders are caused to rotate in the twisting process by a drive. The clamping holders are in operative connection with the housing via a gearbox assembly so that the clamping devices rotate in the opposite direction to the support with a predetermined transmission ratio.

The disadvantage of this solution is that during twisting there is always a fixed transmission ratio and a predetermined direction of rotation between the rotating clamping holders and the rotating supports,

which means that only a limited selection of cable types can be twisted with this apparatus.

It is an object of the present invention to remedy one or more drawbacks of the related art. In particular, it is intended to create a universally usable twisting head device and/or a method for stranding or twisting optical and/or electrical cables. Additionally, it is intended in particular to produce a universally usable twisting appliance for stranding or twisting and/or a method for stranding or twisting optical and/or electrical cables, and a computer-implemented method for a twisting appliance for twisting or stranding optical and/or electrical cables which eliminates one or more disadvantages of the related art.

This object is solved by the apparatuses, devices and methods defined in the independent claims. Advantageous further developments are presented in the figures, the description and in particular in the dependent claims.

A twisting head device according to the invention for twisting or stranding electrical or optical cables comprises a twisting rotor, a twisting rotor drive device for driving the twisting rotor, a first gripper device, which is arranged rotatably on the twisting rotor and at least one further gripper device which is arranged rotatably on the twisting rotor. The twisting rotor is arranged rotatably on the twisting head device and has an axis of rotation. At least the first gripper device is drivable by means of a gripper drive device and a drive shaft. The drive shaft extends at least partly through the twisting rotor.

In a twisting head device of such kind, at least the first gripper device may be driven independently of the twisting rotor. This makes it possible for example for

the twisting rotor and the first and the second gripper device each to be driven independently, in particular at different speeds or in different with directions of rotation. In this context, the twisting rotor drive device is mechanically disconnected from the gripper drive device. This then enables a reproducible process by which it is possible to strand or twist electrical and/or optical cables of very many different types and/or which may be highly sensitive.

The arrangement whereby the drive shaft extends at least partially into the twisting rotor allows a compact construction of the twisting head device, wherein the capabilities and/or flexibility in the drive variants of the twisting rotor drive device and the gripper drive device are increased at the same time.

The drive shaft is advantageously arranged coaxially with the axis of rotation of the twisting rotor. Then, the drive shaft and the twisting rotor are arranged about the same axis of rotation, thereby enabling a compact construction of the twisting head device.

At least the first gripper device is preferably arranged on a first gripper shaft and has a first gripper rotational axis. The arrangement on a first gripper shaft enables rotation of the first gripper device. Thus, a simple, robust construction of the first gripper device is assured on the twisting head device, with the result that only low centrifugal forces are exerted on the gripper device.

The first gripper shaft advantageously extends at least partly into the twisting rotor. This has the effect of improving the stable construction of the twisting head

device. At the same time, it allows an overall compact construction of the twisting head device.

The first gripper rotational axis is also advantageously spatially separate from the axis of rotation of the twisting rotor. The spatial separation of the axis of rotation of the twisting rotor from the axis of the rotational axis of the first gripper device creates a defined geometric structure in the twisting head device.

The first gripper rotational axis is advantageously radially separate from the axis of rotation of the twisting rotor. This allows the first gripper shaft to move in a circular path about the twisting rotor, thus enabling the cables to be twisted or stranded simply.

The twisting rotor preferably has a hollow rotor shaft, wherein the drive shaft is arranged at least partly inside the hollow rotor shaft. The arrangement of the drive shaft inside the hollow rotor shaft enables a compact construction of the twisting head device, wherein the inertia of the overall system is reduced, which in turn increases running stability in operation.

The drive shaft advantageously extends through the twisting rotor, wherein at least one drive bearing device is arranged at least partly inside the twisting rotor and supports the drive shaft rotatably. Thus, the drive shaft is at least partly supported inside the twisting rotor. This results in improved bearing stability of the drive shaft in the twisting head device. The location of the drive bearing device for the drive shaft inside the twisting rotor also enables improved suppression of drive shaft vibration. This in turn enables an improvement of quality in the

manufacturing process of the cables that are to be twisted or stranded.

The drive shaft is advantageously arranged so as to be rotatable relative to the rotatable twisting rotor, so that it is possible to operate the drive shaft and the twisting rotor in different directions of rotation and/or at different rotating speeds.

At least the further gripper device is preferably drivable via the gripper drive device and the drive shaft. This enables the further gripper device to be driven independently of the twisting rotor as well, which improves the quality in the manufacturing process of the cables that are to be twisted or stranded.

The further gripper device is advantageously arranged on a further gripper shaft. The arrangement on a further gripper shaft enables the further gripper device to rotate relative to the twisting rotor.

Also advantageously, the further gripper shaft extends at least partly into the twisting rotor and has a further gripper rotational axis as a result of which the compact construction of the twisting head device may be realised even with multiple gripper devices.

Also advantageously, the further gripper rotational axis is located at a distance from the axis of rotation of the twisting rotor, thus enabling a defined geometrical construction of the twisting head device.

Preferably, at least one gripper bearing device is arranged inside the twisting rotor and at least the first gripper device is supported rotatably thereon. This enables a simple support of the first gripper

device in the twisting head device and a compact construction of the twisting head device.

Advantageously, a further gripper bearing device also supports the further gripper device rotatably inside the twisting rotors, so that although the rotary system itself is complex it can be supported simply inside the twisting rotor.

The twisting rotor preferably has a dumb-bell shaft, by which an operative connection is established between the drive shaft and at least the first gripper shaft. The operative connection may be established with the aid of at least a first transmission device. The first transmission device is arranged between the drive shaft and the dumb-bell shaft. In this way, the dumb-bell shaft is spatially decoupled from the drive shaft in the twisting rotor yet still remains drivable via said gripper drive device.

The operative connection may advantageously be established with the aid of a further transmission device, which is arranged between the dumb-bell shaft and at least the first gripper shaft. In this way, the first gripper shaft is simply drivable by the gripper drive device.

The operative connection may also advantageously be established with the aid of the further transmission device, which is arranged between the dumb-bell shaft and at least the first gripper shaft and between the dumb-bell shaft and the further gripper shaft. In this way, the further gripper shaft as well as the first gripper shaft may also be driven simply with just one gripper drive device.

A connecting bearing device is preferably arranged inside the twisting rotors and supports the dumb-bell shaft rotatably. This serves to increase bearing stability and thus also to greater running stability of the dumb-bell shaft inside the twisting rotor.

The gripper drive device and the twisting rotor drive device are preferably at least partly arranged on a common fastening device. In this context, the individual drives may be mounted on a common fastening device independently of one another.

The gripper drive device and the twisting rotor drive device are advantageously connected to a control device. In this way, the gripper drive device and the twisting rotor drive device may each be connected to the control device independently of each other and may each receive control commands and/or movement commands independently.

Also advantageously, the gripper drive device and the twisting rotor drive device are at least partly arranged on a common fastening device. This arrangement allows the gripper drive device and the twisting rotor drive device to be fastened to the twisting head device simply and in space-saving manner. The gripper drive device and the twisting rotor drive device are also connected to the control device. Consequently, control commands and/or movement commands may each be sent from the control device to the gripper drive device and the twisting rotor drive device independently but simultaneously.

At least the first gripper device preferably has at least one gripper for gripping a cable end of the cable, thereby providing a simple means for clamping the cable end of the cable.

The at least one gripper advantageously has an axially guided locking sleeve for least partly enclosing the at least one gripper. The locking sleeve encloses the at least one gripper. This makes it possible to hold the cable end of the cable in place simply and securely.

The further gripper device advantageously has at least one further gripper for gripping a cable end of a further cable, whereby the cable end of the further cable can be clamped simply.

The at least one further gripper advantageously has an axially guided locking sleeve for at least partly enclosing the at least one further gripper. This makes it possible to hold the cable end of the cable in place simply and securely.

A further aspect of the invention relates to a method for twisting or stranding electrical and/or optical cables and includes at least the following steps:

- clamping a first cable end of a first cable in a first gripper device;
- clamping at least a first cable end of a further cable in a further gripper device;
- driving a twisting rotor with a first number of rotations about an axis of rotation of the twisting rotor with the aid of a twisting rotor drive device;
- driving at least the first gripper device about a first gripper rotational axis with a further number of rotations with the aid of a gripper drive device;

- driving at least the first gripper device about a further gripper rotational axis with the further number of rotations with the aid of the gripper drive device, wherein the first number of rotations and the further number of rotations are specified by a control device.

This makes it possible to twist the cables that are to be stranded or twisted about their respective longitudinal axes and also to twist them reciprocally about the axis of rotation of the twisting rotors, so that a twisting or stranding of the clamped cables is possible. In such a case, optical and/or electrical cables which react sensitively to the number of rotations and the consequent mechanical stress in the stranding process or twisting process may undergo stranding or twisting in a reproducible process with little waste during production.

The method is advantageously carried out with the twisting head device described earlier, resulting in the production of cable bundles of particularly high quality.

The further number of rotations is preferably equal to 50 % to 98 % of the first number of rotations. The difference in the number of rotations allows simultaneous reverse twisting of the individual cables during the twisting process for example.

The further number of rotations is advantageous equal to 60 % to 70 % of the first number of rotations, thereby enabling improved reverse twisting in the twisting process. The twisting rotor thus rotates with a greater number of rotations about the axis of rotation than the first gripper device and/or the

further gripper device rotate about their gripper rotational axes. This results in a saving of time in the stranding process and/or the twisting process.

The twisting rotor and at least the first gripper device are preferably driven in the same direction of rotation, or the twisting rotor and at least the first gripper device are driven in opposite directions of rotation, thereby enabling an integrated reverse twisting in the twisting process and/or making it possible to set certain properties in the cable bundle.

A further aspect of the invention relates to a twisting appliance for twisting or stranding electrical or optical cables, comprising a first twisting head device with a first twisting rotor and with a clamping device. The first twisting rotor is arranged rotatably the first twisting head device, and the first twisting head device and the clamping device are positioned at a distance from each other. The twisting appliance is equipped with a stranding shuttle, which is movable at least from a first position to another position in a direction between the first twisting head device and the clamping device. The twisting appliance has a control device for controlling at least the first twisting head device, wherein the twisting appliance includes at least one first sensor device for detecting the position of the stranding shuttle.

The detection of the position of the stranding shuttle makes it possible to communicate this position to an operator. An operator of the twisting appliance, who may be stationed in a control room at some distance from the twisting appliance, for example, is then able to find out what position the stranding shuttle is in. Based on this position, the operator can decide whether either a twisting process or a stranding process can be

started on the twisting appliance. Then the cable bundle may be produced using either a stranding process or a twisting process.

Since the position of the stranding shuttle is detected, both manufacturing processes can be carried out on the same apparatus without the operator of the twisting appliance having to be stationed directly at the machine, to check the position of the stranding shuttle, for example.

The stranding shuttle is typically embodied as a bolt, so the stranding shuttle is easy to produce.

The first sensor device is advantageously connected to the control device of the twisting appliance to enable sensor data to be exchanged. The sensor data, for example sensor data regarding the position of the stranding shuttle, may thus be communicated to the control device and may be collected in the control device and optionally processed further there. In this context, this sensor data may include, but is not limited to data sets for location information, position information or status information relating to the stranding shuttle.

As described herein, the twisting appliance advantageously has at least one twisting head device as a first twisting head device. The twisting head device includes a twisting rotor drive device and a gripper drive device. These are controllable by the control device of the twisting appliance independently of each other. It is thus possible to carry out either a twisting process or a stranding process on the twisting appliance. The construction of the first twisting head device is particularly compact. This in turn contributes to the compact construction of the twisting

appliance. Thus, the manufacturer of cable bundles from an immense variety of electrical and/or optical henceforth only needs one apparatus for stranding or twisting cables, thereby reducing the production costs in a manufacturing hall enormously.

The twisting appliance preferably has a first positioning device, on which the stranding shuttle is arranged. The stranding shuttle may be brought into a stranding position with the aid of said first positioning device. In this way, the twisting appliance allows a stranding process to be carried out when the stranding shuttle is in a stranding position.

Alternatively or additionally, the stranding shuttle may be moved into an idle position with this positioning device. In this way the twisting appliance allows a twisting process to be carried out when the stranding shuttle is in an idle position. The stranding shuttle may also simply be brought from the stranding position to the idle position and conversely from the idle position to the stranding position so that it becomes possible to carry out a stranding process or a twisting process on the twisting appliance.

A stranding position describes any position in which the stranding shuttle is located between the cables that are to be stranded. An idle position of the stranding shuttle describes any position in which the stranding shuttle makes no contribution to the stranding process.

The stranding shuttle may advantageously be brought into the stranding position or the idle position linearly, which enables an easily controllable movement of the stranding shuttle. The stranding shuttle is then

typically inserted between the cables that are to be stranded from one side of the twisting appliance.

The positioning device is advantageously designed so that the stranding shuttle may be brought linearly towards the cables that are to be stranded starting from a position above the twisting head device until it is between the cables that are to be stranded. This makes it easier for the operator to access the twisting appliance, for maintenance work, for example. This also ensures that at the end of the stranding process the finished stranded cable bundle will not be able to collide with the stranding shuttle when it falls into a collection container of the twisting appliance after it is released.

Alternatively or additionally, a support device is arranged on the first positioning device, and the support device may be brought into a bracing position and/or an idle position. The support device braces the cables during the stranding process or the twisting process, so that the cables to be stranded or twisted sag less and are therefore under less mechanical stress. This further improves the quality of the cable bundles.

A bracing position is described as any position in which the support device bears on the cables that are to be stranded or twisted. In such a case, for example, the cables that are to be stranded or twisted bear on the support device when clamped in the twisting appliance. An idle position of the support device is described as any position in which the support device makes no contribution to the manufacturing process.

Advantageously, the support device may be swivelled into a bracing position and into an idle position. In

this way, the support device may be moved particularly easily and positioned precisely on the first positioning device of the twisting appliance.

The twisting appliance preferably has a further support device for bracing at least one cable, wherein the further support device is movable. This enables the cable to be braced in a further position.

The further support device is advantageously arranged on a further positioning device and may be brought into a bracing position and an idle position. This means that the further support device with the further positioning device is movable independently of the stranding shuttle.

Advantageously, the further support device may be swivelled. In this way, the further support device may be moved particularly easily and positioned precisely on the further positioning device of the twisting appliance.

The twisting appliance preferably has a stranding shuttle drive for shifting the stranding shuttle from a stranding position to an idle position, whereby the stranding shuttle may easily be brought out of the stranding position.

The stranding shuttle drive is advantageously designed to shift the stranding shuttle from an idle position into a stranding position, thereby enabling an automatic positioning of the stranding shuttle.

Alternatively or additionally, the twisting appliance has a support device drive for shifting the support device from a bracing position into an idle position,

whereby the support device may easily be brought out of the bracing position.

Advantageously, the support device drive is designed to shift the support device from an idle position into a bracing position, so that the support device may be brought precisely and reproducibly up to the cables that are to be stranded or twisted.

Advantageously, the support device drive is designed to swivel the support device from an idle position into a bracing position, so that the support device may be brought particularly easily and reproducibly up to the cables that are to be stranded or twisted.

Advantageously, at least one of the two drives is connected to the control device. This allows the exchange of control data between the control device and the stranding shuttle drive and/or the support device drive, with which they are able to move the stranding shuttle and/or the support device and/or the further support device reproducibly between or up to the cables.

Advantageously, the twisting appliance has a further support device drive for positioning the further support device, which drive is connected to the control device. This allows the cables to be braced in at least one further position in the twisting appliance.

The further support device drive is advantageously designed to swivel the further support device from an idle position into a bracing position, whereby the further support device may be brought particularly easily and reproducibly up to the cables that are to be stranded or twisted.

The twisting appliance preferably includes at least one second sensor device, which is designed to detect the position of the support device, so that the bracing position on the cables to be twisted or stranded is detectable and the idle position of the support device is detectable. This enables a reproducible positioning of the support device.

The second sensor device is advantageously connected to the control device to enable the exchange of sensor data. Said sensor data further includes, but is not limited to data sets for location information, position information or status information relating to the support device. The sensor data may be processed in the control device and subsequently taken into account for the further control of the support device. This allows the cables that are to be stranded or twisted to be braced precisely, whereby sagging of the cables in the twisting appliance is prevented particularly in the case of very long cables, thus reducing the mechanical load on the cables in the stranding or twisting process.

The twisting appliance advantageously includes at least a third sensor device, which is designed to detect the position of the further support device, whereby the bracing position is detectable on the cables that are to be twisted or stranded, and the idle position of the further support device is detectable.

The third sensor device is advantageously connected to the control device to enable the exchange of sensor data. Said sensor data further includes, but is not limited to data sets for location information, position information or status information relating to the support device. The sensor data may be processed in the control device and subsequently taken into account for

the further control of the support device. This allows the cables that are to be stranded or twisted to be braced precisely at a further position, whereby sagging of the cables in the twisting appliance is prevented particularly in the case of very long cables.

The first positioning device of the stranding shuttle is preferably arranged movably on a first guide device, wherein the stranding shuttle is movable in a direction between the clamping device and the first twisting head device. In this way, the stranding shuttle may be moved from the clamping device towards the first twisting head device and from the first twisting head device towards the clamping device.

The first positioning device advantageously includes a drive device for moving the first positioning device on the first guide device, by which the stranding shuttle is movable automatically between the first twisting head device and the clamping device.

The stranding shuttle is advantageously arranged on the support device. This allows a simplified construction of the stranding shuttle and the support device on the first positioning device. For example, the support device and the stranding shuttle are constructed as a single part, allowing the cables to be simultaneously stranded and braced.

The stranding shuttle is advantageous in that with it the cables that are to be stranded can be stranded particularly precisely.

Alternatively or additionally, the support device is designed in the shape of a "T", with the result that the cables that are to be stranded may be held in place

particularly precisely and/or stranded and held in place.

Alternatively or additionally, the positioning device of the support device is arranged movably on the first guide device, wherein the support device is movable in a direction between the clamping device and the first twisting head device.

The positioning device advantageously has a drive device for moving the positioning device on the first guide, whereby the support device is automatically movable between the first twisting head device and clamping device.

The further positioning device of the further support device is advantageously arranged movably on the first guide device, wherein the further support device is movable in a direction between the clamping device and the first twisting head device.

The further positioning device advantageously has a drive device for moving the further positioning device on the first guide device, whereby the further support device is automatically movable between the first twisting head device and the clamping device.

The clamping device is preferably designed as a further twisting head device and is connected to the control device for controlling at least the further twisting head device. This increases the flexibility of the twisting appliance.

The clamping device is advantageously designed as the present further twisting head device, whereby a compact construction of the twisting appliance is possible.

The twisting appliance preferably includes a computing device and a memory device which are connected to the control device. This makes it possible to both calculate new data sets and/or movement commands in the computing unit and communicate data sets and/or movement commands stored in the memory unit to the control device.

Advantageously, at least sensor data from the first sensor device of the stranding shuttle may be processed with the aid of the computing device. Thus for example the sensor data from at least the first sensor device may be converted into control commands and/or movement commands for controlling the position or location of the stranding shuttle.

Alternatively or additionally, at least sensor data from the second sensor device of the support device may be processed with the aid of the computing device. Thus for example the sensor data from at least the second sensor device may be converted into data sets and/or movement commands for controlling the position or location of the support device.

The sensor data from the first sensor device may advantageously be stored in the memory device, so that the stored sensor data may be accessed as needed.

Alternatively or additionally, the sensor data from the second sensor device may be stored in the memory device, so that the stored sensor data may be accessed as needed.

Advantageously, at least sensor data from the third sensor device of the stranding shuttle may be processed with the aid of the computing device. Thus for example the sensor data from at least the third sensor device

may be converted into control commands and/or movement commands for controlling the position or location of the support device.

The sensor data from the third sensor device may advantageously be stored in the memory device so that the stored sensor data may be accessed as needed.

The twisting appliance preferably has a further guide device for moving at least the clamping device linearly in a direction between the first twisting head device and the clamping device. This enables a positioning at least of the clamping device in order to keep the cable tension constant during the stranding process or the twisting process.

Alternatively, the twisting appliance may have a further guide device for moving at least the first twisting head device linearly in a direction between the first twisting head device and the clamping device. This enables a positioning at least of the first twisting head device in order to keep the cable tension constant during the stranding process or the twisting process.

The first twisting head device and the clamping device are advantageously arranged on the further guide device so as to be movable linearly in a direction between the first twisting head device and the clamping device. This allows a simultaneous movement and/or a symmetrical movement of the first twisting head device and the clamping device during the twisting or stranding process.

The twisting appliance advantageously has at least one further sensor device, which detects a position of the first twisting head device on the further guide device

and transmits sensor data to the control device. This makes it possible subsequently to process the sensor data in the computing device and store it in the memory device. This raises the quality of the cable bundles produced.

Alternatively or additionally, the twisting appliance has at least one further sensor device, which detects a position of the clamping device on the further guide device and transmits sensor data to the control device. This makes it possible subsequently to process the sensor data in the computing device and store it in the memory device. Consequently, a completely reproducible movement of the first twisting head device and the clamping device may be carried out, so that the stranded or twisted cable bundle may be manufactured in reproducible manner.

A further aspect of the invention relates to a method for stranding or twisting at least two electrical and/or optical cables with a twisting appliance which is equipped with at least one first twisting head device with a twisting rotor. The method includes at least the following steps:

- clamping a first cable in the twisting appliance;
- clamping at least one further cable in the twisting appliance;
- detecting at least a location and determining a stranding position or an idle position of a stranding shuttle with a first sensor device;
- performing a stranding process or a twisting process on the at least two cables, wherein a stranding process is performed when the stranding

shuttle is in the stranding position and a twisting process is performed when the stranding shuttle is in the idle position.

The detection of the position of the stranding shuttle makes it possible communicate this position to an operator of the twisting appliance. This in turn enables an operator, who may be stationed in a control room at some distance from the twisting appliance, for example, to find out what position the stranding shuttle is in. Based on this position, the operator may decide whether either a twisting process or a stranding process may be started on the twisting appliance.

The twisting appliance is advantageously a twisting appliance such as is described here and includes a first twisting head device with a twisting rotor such as is described here, with which the stranding process or the twisting process may be carried out fully automatically.

The two cables are advantageously clamped in the twisting appliance parallel to each other, thereby enabling the cables that are to be stranded or twisted to be manufactured simply.

Preferably, at least the stranding shuttle is moved into a stranding position before the stranding process is carried out, or the stranding shuttle is moved into an idle position before the twisting process is carried out. In this way, it is possible for the process specified in advance by the operator of the twisting appliance to be executed automatically for manufacturing the cable bundles.

Preferably, a position of a support device is detected with a second sensor device. In this way, it is easy to

decide whether the support device is to be used in a stranding process or a twisting process.

Advantageously, the support device is moved from an idle position into a bracing position, which then causes the support device to bear on the cables that are to be stranded or twisted so that it can support them.

The support device is advantageously swivelled from an idle position into a bracing position, thus executing a simple movement.

The support device is advantageously moved from a first bracing position into a further bracing position during the stranding process or twisting process, so that the cables which are to be stranded or twisted always bear on the support device and consequently the quality of the stranded or twisted cable bundles produced is improved.

The stranding shuttle is preferably moved in a direction away from the clamping device and towards the first twisting head device during the stranding process, making it possible to adjust the lay length in the cable bundle to be stranded.

Advantageously, at least one position of the stranding shuttle along this direction is determined by at least one further sensor device, and the sensor data is communicated to the control device and processed further by the control device. This allows a precise setting and/or calculation of the lay length in the cable bundle that is to be stranded, thereby improving quality in the stranded cable bundle. For example, this ensures that the shortening of cable pair during stranding and/or twisting and therewith also the length

compensation by the travel of the clamping apparatus towards the first twisting head device is included in the calculation.

The support device is preferably moved in a direction away from the clamping device and towards the first twisting head device during the stranding process or during the twisting process. This allows a constant bracing of the cables to be stranded or twisted, particularly in the area close to the stranding shuttle.

Advantageously, at least one position of the support device along this direction is determined by at least one further sensor device, and the sensor data is communicated to the control device and processed further by the control device. With the aid of sensor data which has been evaluated and/or processed further it is possible to control the support device precisely so that stable support can be provided for the cables which are to be stranded or twisted, thereby improving the quality of the cable bundles produced.

After the stranding process, the stranding shuttle is preferably moved into an idle position so that the stranded cable bundle can be ejected easily from the twisting appliance.

Alternatively or additionally, the support device is moved into an idle position after the stranding process or the twisting process, so that the stranded cable bundle can be ejected easily from the twisting appliance.

The movement into the idle position is advantageously triggered the termination of the stranding process or

twisting process, thus increasing the speed of the manufacturing process for stranding or twisting.

The twisting appliance preferably includes a second twisting head device with a second twisting rotor which has at least one first gripper device and one further gripper device. During the stranding process, the twisting rotor of the first twisting head device is caused to rotate, and the first gripper device and the further gripper device of the second twisting head device are caused to rotate. The stranding shuttle is moved in a direction between the first twisting head device and the second twisting head device. In this way, it is possible to carry out a precise stranding process in a first direction between the first twisting head device and the second twisting head device.

The first twisting head device preferably has a first gripper device and a further gripper device. After the stranding process, two further cables are clamped into the twisting appliance and the first gripper device and the further gripper device of the first twisting head device are then caused to rotate. The twisting rotor of the second twisting head device is caused to rotate, wherein the stranding shuttle is moved in a direction between the first twisting head device and the second twisting head device. This makes it possible to carry out a stranding process in a direction opposite to the direction described previously. Thus, stranding processes may be carried out in both directions between the first twisting head device and the second twisting head device.

A further aspect of the invention relates to a computer-implemented method for automatically resolving and generating datasets and/or movement commands for controlling at least one twisting head device -

particularly as described herein - or one twisting appliance - particularly as described herein - which performs a method for twisting or stranding at least two cables, particularly a method such as is described herein. In this context, a position of a stranding shuttle is detected with a first sensor device, and at least one data set and/or one movement command indicating the position of the stranding shuttle is generated and stored. Thus, the position of the stranding shuttle may be determined fully automatically, and the position of the stranding shuttle may be monitored and processed further.

Alternatively or additionally, the at least one data set and/or movement command which is generated and stored specifies the movement of the stranding shuttle from an idle position to a stranding position. A reproducible moving of the stranding shuttle into the stranding position is thus enabled with the aid of the at least one generated and stored data set and/or movement command.

Advantageously, the at least one generated and stored data set and/or movement command specifies the movement of the stranding shuttle from a stranding position into an idle position. A reproducible moving of the stranding shuttle into the idle position is thus enabled with the aid of the at least one generated and stored data set and/or movement command.

Advantageously, a position of a support device is detected with a second sensor device, and at least one data set and/or movement command which specifies the position of the support device is generated and stored. Thus, the position of the support device may be determined fully automatically, and the position of the

stranding shuttle and the support device may be monitored and processed further.

Alternatively or additionally, the at least one data set and/or movement command which is generated and stored specifies the movement of the support device from an idle position into a bracing position. This enables the support device to be moved precisely up to the cables.

Advantageously the at least one data set and/or movement command which is generated and stored specifies the movement of the support device from a bracing position into an idle position, whereby the support device may be removed from the cables in controlled manner.

Advantageously, a position of a further support device is detected with a third sensor device, and at least one data set and/or movement command specifying the position of the further support device is generated and stored. In this way, the position of the further support device may be determined fully automatically, and the position of the stranding shuttle, the support device and the further support device can be monitored and processed further.

Alternatively or additionally, the at least one data set and/or movement command which is generated and stored specifies the movement of the further support device from an idle position into a bracing position. This enables the further support device to be moved precisely up to the cables.

Advantageously, the at least one generated and stored data set and/or movement command specifies the movement of the further support device from a bracing position

into an idle, so that the further support device may be removed from the cables in controlled manner.

Advantageously, multiple data sets and/or movement commands are generated and stored for each movement of the stranding shuttle and/or of the support device and/or of the further support device.

This enables programs and/or sequences of data sets and/or movement commands to be generated, with the result that the stranding process can be carried out fully automatically. Data sets and/or movement commands may also be defined and stored for a multiplicity of combination possibilities of different optical and/or electrical cables, so that the operator of the twisting appliance is able to start with a fully automatic and predefined stranding process or twisting process depending on the nature and selection of the cables or the cable bundles that are to be produced.

The twisting appliance is advantageously a twisting appliance as described herein, with a twisting head device as described herein, which carries out the method for twisting or stranding as described herein. Thus, a fully automatic twisting or stranding of optical and/or electrical cables with may be carried out with a compact twisting appliance.

Preferably, at least one stored data set and/or at least one stored movement command is transmitted to the control device, with which the control device is able to forward control commands to the respective drives.

Further advantages, features and particulars of the invention will be apparent from the following description, in which embodiments of the invention are described with reference to the drawing. Ordinal

qualifiers such as first, second, third or further serve solely to identify the components.

The list of reference signs is an integral part of the disclosure in the same way as the technical content of the claims and figures. The figures are described thematically and associatively. Identical reference signs denote identical components, reference signs with different indices indicates functionally equivalent or similar components.

In the drawing:

Fig. 1 is a side view of a first embodiment of a twisting appliance according to the invention,

Fig. 2 is a plan view of the twisting appliance of Fig. 1,

Fig.3 shows the twisting appliance of Fig. 2 with partly hidden elements,

Fig. 4 is a side view along line A-A in Fig. 1,

Fig. 5 is a detail view from Fig. 4,

Fig. 6 is a further view according to Fig. 4,

Fig. 7 is a detail view of the twisting rotor in Fig. 6,

Fig. 8 shows the twisting head device in cross sectional view along line C-C in Fig.2,

Fig. 9 shows the view along section line B-B if Fig. 8, and

Fig. 10 shows an alternative embodiment of the twisting appliance according to Fig. 1.

Figures 1 to 3 show a twisting appliance 15 for twisting or stranding electrical or optical cables 16. The twisting appliance 15 comprises a base 17, on which a first twisting head device 20 with a twisting rotor 22 and a clamping device 28 are arranged. The twisting rotor 22 includes a twisting rotor drive device 21 and is mounted on the first twisting head device 20 so as to be rotatable about an axis of rotation 23. The first twisting head device 20 located at a distance from the clamping device 28.

The twisting appliance 15 has a first guide device 18, on which a positioning device 70 is arranged. The guide device 18 includes a guide rail 19, on which the positioning device 70 is arranged so as to be movable in a direction between the clamping device 28 and the first twisting head device 20. The guide rail 19 extends from the first twisting head device 20 as far as the clamping device 28 and continues above the clamping device 28, so that the positioning device 70 may be moved past the clamping device 28 and into a position outside of the region between the twisting head device 20 and the clamping device 28. The positioning device 70 has a drive device 75 for moving the positioning device 70 along the guide rail 19, wherein the drive device has a servomotor 76.

Servomotors are conventionally equipped with resolvers, which capture the exact number of rotations and the angular position on the motor shaft with reference to a starting position at very high resolution and make this information available to the control device 60. If each servomotor is equipped with a position feedback device, even complex automations with many servomotors can be

controlled with extreme precision and exact timing. Advantageously, brushless resolvers are used which are ideal rotor position encoders for position feedback from brushless motors (servomotors), robots or direct drives.

A rotary encoder, an angle sensor or an encoder may be used as alternatives to a resolver.

A stranding shuttle 65 and a support device 85 are arranged on the positioning device 70 and are movable from a first position to a further position in a direction between the first twisting head device 20 and the clamping device 28. The movement of the stranding shuttle 65 and the support device 85 along this direction is determined by a further sensor device 68, and the sensor data is transmitted to the control device 60 and processed further by the control device 60. At the same time, the stranding shuttle 65 and the support device 85 are also movable along the guide rail 19 in the area between the twisting head device 20 and the clamping device 28. In an alternative configuration, only the support device 85 is located on the positioning device 70.

The twisting appliance 15 has a first feeding device 29 and a second feeding device 34 which in use according to the invention are arranged above the cables 16 and above the axis of rotation 23. The feeding devices 29, 34 guide the cables 16 out of the cable intake region, which in use according to the invention is located in the rear area of the twisting appliance 15, to the two gripper devices 30, 45 and to the clamping device 28 (not shown). The feeding device 34 is arranged on the twisting appliance 15 fixedly relative to the first twisting head device 20. The feeding device 29 is arranged above the clamping device 28, fixedly relative

thereto, and together with the clamping device 28 it is displaceable in the longitudinal direction of the twisting appliance 15 by servomotor and configurable to the cable length that is to be processed.

The cables 16 are clamped between the first twisting head device 20 and the clamping device 28 and are twisted or stranded as described in the following text. This causes a shortening of the distance between the first twisting head device 20 and the clamping device 28.

The twisting appliance 15 is equipped with a further guide device 100 with a further guide rail 101 and with a drive 102, wherein with the aid of the guide device 100 it is possible to compensate for the distance between the first twisting head device 20 and the clamping device 28 in the stranding process or twisting process. In this context, the clamping device 28 is arranged movably on the further guide rail 101. The clamping device 28 is thus movable along the guide rail 101 in a direction between the clamping device 28 and the first twisting head device 20 with the aid of the drive 102, so that length compensation may take place while cables 16 are twisted or stranded.

The twisting appliance 15 includes a control device 60, a computing device 61 and a memory device 62. The control device 60 of the twisting appliance 15 is connected electrically to the drive devices and drives which will be described in the following text. The control device 60 also receives sensor data from sensor devices in the drive devices and drives, and processes said data in the computing device 61 to create data sets and/or movement commands and/or control commands, which are transmitted back to the drive devices and drives.

The twisting appliance 15 includes a sensor device 110, which detects a position of the clamping device 28 on the further guide device 100 and communicates sensor data to the control device 60. The further sensor device 110 is arranged on the drive 102, which is embodied as a servomotor 111 with a resolver 115.

The clamping device 28 includes a first clamping gripper and a second clamping gripper for clamping the cables 16, each of which is supported rotatably and driven by means of a clamping drive device (not shown). The clamping grippers have a common rotational axis and are arranged so as to be rotatable together about this axis. The clamping device 28 has a clamping rotor, which may be caused to rotate with the aid of the clamping drive device. The clamping drive device has a servomotor with a resolver. The number of rotations and the angular position on the servomotor shaft relative to a start position may be captured with the aid of the resolver, and the resolver data may be transmitted to the control device 60 of the twisting appliance 15 as sensor data.

The components with reference signs 26, 40, 41, 56, 80, 10, 95 - 97 illustrated here in Figures 1 to 3 will be described in the following text with reference to Figure 8.

Figures 4 to 7 show the positioning device 70 and the twisting head device 20 of the twisting appliance 15 in sectional view along line A-A in Figure 1.

The positioning device 70 includes a stranding shuttle drive 72 for shifting the stranding shuttle 65 from a stranding position into an idle position. The stranding shuttle 65 is either in a stranding position (see

Figures 4 and 5 - also described as the extended, working position) or in an idle position (see Figures 6 and 7 - also described as the retracted, starting position). The stranding shuttle drive 72 is equipped with a linear guide device, which in this case is embodied as a lifting cylinder 73. The stranding shuttle 65 is arranged on one of the two ends of the lifting cylinder 73. Thus, the stranding shuttle 65 is movable from the stranding position between the cables 16 into the idle position outside of the cables 16 by means of a linear motion, and is movable from the idle position outside of the cables 16 into the stranding position between the cables 16 movably by means of a linear motion. In the embodiment shown, the stranding shuttle 65 designed in the form of a bolt. Alternatively, the stranding shuttle 65 may also be T-shaped, so that the stranding shuttle 65 may also be used as a support device (not shown). Lifting cylinders are typically equipped with end position sensors, which are also connected to the control device 60 (see Figure 1). In this way, it is possible to determine exactly whether a piston stroke was completed in accordance with the program and whether all end positions are present as programmed and were damped (reached).

The positioning device 70 also has a support device drive 87 for shifting the support device 85 from a bracing position into an idle position. The support device drive 87 includes a linkage assembly 89 on which the support device 85 is arranged. The support device 85 is connected movably to the linkage assembly 89 via links 90, wherein a servomotor 91 is present to move the linkage assembly 89. Thus, the support device 85 is movable from the idle position into the bracing position with a swivelling motion (see Figures 4 and 5), or is movable from the bracing position into the idle position with the swivelling motion (see Figures 6

and 7). The support device 85 is designed as a bolt which bears on one side of the cables 16 and supports the cables 16 from this side.

The stranding shuttle drive 72 and the support device drive 87 are driven with the aid of the servomotor 91. Alternatively, electrical, pneumatic or hydraulic drives may also be used. In addition, the stranding shuttle drive 72 and the support device drive 87 may each be driven by their own servomotors (not shown).

The twisting appliance 15 includes a first sensor device 66 for detecting the position of the stranding shuttle 65 and a second sensor device 82 for detecting the position of the support device 85. In this context, the first and second sensor devices 66 and 82 are connected to the control device 60 of the twisting appliance 15 in order to exchange sensor data (see Figure 1).

The first sensor device 66 is arranged on the stranding shuttle drive 72. The stranding shuttle drive 72 is equipped with a lifting cylinder 73 with end position sensors. The end position of each cylinder is detected with the aid of the end position sensors. The lifting cylinder 73 is in the stranding position or in the idle position depending on the end position. The position, that is to say the respective sensor data, may be transmitted to the control device 60 of the twisting appliance 15 (see Figure 1).

The second sensor device 82 is arranged on the support device drive 87. The support device drive 87 is equipped with the servomotor 91, which includes a resolver 92. The number of rotations and the angular position on the servomotor shaft relative to a starting position can be detected with the aid of the resolver

92. The data from the resolvers 92 may be transmitted to the control device 60 of the twisting appliance 15. The sensor data may further contain position data or location data for the support device 85 and/or the stranding shuttle 65. In this context, for example coordinate data from the support device 85 and/or from the stranding shuttle 65 in a coordinate system of the twisting appliance 15 is captured by the sensor devices 66 and/or 82 and/or 110 and transmitted to control device 60 of the twisting appliance 15 (see Figure 1).

Alternatively, light barriers, distance sensors or lifting cylinders with end position sensors which are also connected to the control device 60 for exchanging sensor data may also be used as sensor devices 66 and/or 82 and/or 110.

Figure 8 shows a view of the twisting head device 20 of the twisting appliance 15 in cross section along line C-C in Figure 2, but in this case viewed from the rear. The following description of Figure 8 will also refer to Figures 1 to 3, in particular with reference to the components denoted with reference signs 26, 40, 41, 56, 80, 10, 95 - 97.

The twisting head device 20 comprises a twisting rotor 22 and a twisting rotor drive device 21. The twisting rotor drive device 21 drives the twisting rotor 22. The twisting head device 20 has first gripper device 30 and a second gripper device 45. The gripper devices 30 and/or 45 are each arranged rotatably on the twisting rotor 22 and are driven by a gripper drive device 55. The first gripper device 30 has a first gripper shaft 31, and the second gripper device 45 has a second gripper shaft 46.

The gripper drive device 55 and the twisting rotor drive device 21 are arranged on a common fastening device 54, and the gripper drive device 55 and the twisting rotor drive device 21 are connected electrically to a control device 60 of the twisting appliance 15 (not shown).

The twisting rotor 22 is arranged on the twisting head device 20 so as to be rotatable about an axis of rotation 23. In order to drive the twisting rotor 22, the twisting rotor drive device 21 has a servomotor 26 and a belt drive, which is in the form of a synchronous belt drive 27.

The gripper drive device 55 is equipped with its own servomotor 56 and its own belt drive for driving the two gripper shafts 31, 46. The belt drive is embodied as a synchronous belt drive 57. In addition, other positively engaged traction drives, such as chain drives or a gear drive may be used.

The servomotors 26, 56 each comprise a resolver 40 and 41, which determined the respective number of rotations and the respective angular position of the twisting rotor 22 and/or the first gripper device 30 and the further gripper device 45. The resolver data relating to the number of rotations and the angular positions of the twisting rotor 22 and/or the first gripper device 30 and the further gripper device 45 are transferred to the control device 60 as sensor data.

The twisting rotor 22 has a hollow rotor shaft 35. The twisting rotor 22 and the hollow rotor shaft 35 are constructed as a single part. The twisting rotor 22 is caused to rotate about the axis of rotation 23 by means of toothed belt of a synchronous belt drive 27. In this context, the synchronous belt drive 27 transmits the

rotary movement from the servomotor 26 to the rotatably supported hollow rotor shaft 35. A drive shaft 24 for driving the two gripper devices 30 and 45 is arranged inside the hollow rotor shaft 35. The drive shaft 24 is arranged coaxially with the hollow rotor shaft 35. Two bearings 25a and 25b, for example ball bearings, are arranged inside the hollow rotor shaft 35 as a drive bearing device 25. The drive shaft 24 is thus supported with the bearings 25a and 25b so as to be rotatable relative to the hollow rotor shaft 35.

A dumb-bell shaft 36 is arranged inside the twisting rotor 22 and establishes an operative connection between the drive shaft 24 and the gripper shaft 31 and between the drive shaft 24 and the gripper shaft 46. The dumb-bell shaft 36 is arranged and supported rotatably inside the twisting rotor 22 by means of a connecting bearing device 37. The connecting bearing device 37 comprises a first bearing and a further bearing (not shown).

The operative connection referred to earlier is established by means of a first transmission device 48 and a second transmission device 49. The first transmission device 48 is arranged between the drive shaft 24 and the dumb-bell shaft 36. The second transmission device 49 is arranged between the dumb-bell shaft 36 and the first gripper shaft 31 and the second gripper shaft 46.

The two transmission devices 48 and 49 each embodied as synchronous belt drives 42 and 38, further alternative frictional engagement belt and chain drives or positively engaged belt and chain drives and gear drives are also usable.

The two gripper shafts 31 and 46 are each arranged rotatably on the twisting rotor 22 and each extends into the twisting rotor 22. The two gripper shafts 31 and 46 each have a first gripper rotational axis 32 and a second gripper rotational axis 47, each of which is radially separated from the axis of rotation 23 of the twisting rotor 22. The two gripper shafts 31 and 46 are arranged on a pitch circle inside the twisting rotor 22. The cables 16 clamped in the gripper 33 and 43 of the two gripper shafts 31, 46 then rotate not only about their own gripper rotational axes 32 and 47, but also on a circular path about the axis of rotation 23 of the twisting rotor 22. The first gripper shaft 31 and the further gripper shaft 46 are supported and/or arranged rotatably inside the twisting rotors 22 by means of a gripper bearing device 50. The gripper bearing device 50 has at least a first and a second bearing for the first gripper shaft 31 and first and a second bearing for the further gripper shaft 46 (not shown).

The first gripper device 30 has a gripper 33 for gripping a cable end of the cable 16, wherein the gripper 33 has a axially guided locking sleeve 44 for at least partly surrounding the gripper 33.

The further gripper device 45 has a gripper 43 for gripping a cable end of the cable 16, wherein the gripper 43 has a further axially guided locking sleeve for at least partly surrounding the gripper 43.

Figure 9 shows a cross sectional view along line B-B in Figure 8.

The twisting rotor 22 is connected to the twisting rotor drive device 21 via the synchronous belt drive 27 and is driven thereby. The dumb-bell shaft 36 is

connected to the drive shaft 24 via the synchronous belt drive 42, and the drive shaft in turn is connected to the synchronous belt drive 57 of the gripper drive device 55 (see Figure 8). The dumb-bell shaft 36 is driven with the gripper drive device 55 and the servomotor 56 thereof as well as the synchronous belt drive 57. The first gripper shaft 31 and the further gripper shaft 46 are connected to the dumb-bell shaft 36 via the further transmission device 49, which has the form of a synchronous belt drive 38, via which these are drivable with the gripper drive device 55.

In the following section, a typical twisting process is described.

For twisting electrical or optical cables, a first cable end of a first cable 16 is clamped in the gripper 33 of the first gripper device 30. The second cable end of the first cable 16 is clamped in a clamping gripper of the clamping device 28 (see Figures 1 to 9).

Then, at least a first cable end of a further cable 16 is clamped in the gripper 43 of the further gripper device 45 and a second cable end of the further cable 16 is clamped in a clamping gripper of the clamping device 28.

Then the twisting rotor 22 is driven for a first number of rotations about the axis of rotation 23 of the twisting rotor 22. The twisting rotor 22 is driven via the servomotor 26 of the twisting rotor drive device 21.

At the same time, the first gripper device 30 and the second gripper device 45 are driven about their respective gripper rotational axes 32 and 47 for a second number of rotations, this being carried out by

means of the servomotor 56 of the gripper drive device 55. The first number of rotations and the second number of rotations are predetermined by the control device 60 of the twisting appliance 15, wherein for example the second number of rotations has a value equal to 60 % to 70 % of the first number of rotations. The twisting rotor 22 and the two gripper devices 30 and 45 driven in the same direction of rotation. The clamping device 28 moves along the guide rail 101 of the guide device 100 during the twisting process to compensate for the length of the cable 16 which becomes shorter during the twisting process. This movement is predetermined by the control device 60. At the end of the twisting, the grippers 33 and 43 of both gripper devices 30 and 45 and both clamping grippers are released to allow the twisted cables 16 to be removed from the twisting head device 20 and the clamping device 28, and/or to fall into a collecting channel arranged below the twisting head device 20 and/or below the clamping device 28 under its own weight.

For stranding or twisting at least two electrical and/or optical cables 16, the cables 16 are first picked up in pairs by the two feeding devices 29 and 34 and guided between the first twisting head device 20 and the clamping device 28. Then, the two cables 16 are clamped in the twisting appliance 15, wherein a first cable end of the first cable 16 is clamped in the gripper 33 of the first gripper device 30, and a first cable end of the further cable 16 is clamped in the gripper 43 of the gripper device 45. The second cable ends of the two cables 16 are clamped in the clamping device 28. The cables 16 are clamped in der twisting appliance 15 parallel to each other.

Then a location and a stranding position or an idle position of the stranding shuttle 65 is determined with the first sensor device 66.

Then a stranding process or a twisting process is carried out with at least two cables 16, wherein a stranding process is performed when the stranding shuttle 65 is located in the stranding position and a twisting process is performed when the stranding shuttle 65 is located in the idle position.

Initially, the stranding shuttle 65 is located in an idle position, wherein the stranding shuttle 65 is located outside of the two cables 16 and is consequently unused in the ensuring twisting process. For example, the stranding shuttle 65 is located in a rest position. In the rest position the stranding shuttle 65 is disposed at an outermost position of the guide rail 19.

In the twisting process, the two gripper shafts 31 and 46 and the cables 16 clamped in the grippers 33 and 43 are each caused to rotate by the servomotor 56 of the gripper drive device 55.

At the same time, the twisting rotor 22 is caused to rotate about the axis of rotation 23 by the servomotor 26 of the twisting rotor drive device 21 via the hollow rotor shaft 35.

The gripper shafts 31 and 46 are arranged on a pitch circle in the twisting rotor 22. The cables 16 clamped in the grippers 33 and 43 of the two gripper shafts 31 and 46 then rotate not only about their own gripper rotational axes 32, 47, but also about the axis of rotation 23 of the twisting rotor 22 and accordingly on the circular path thereof. As a result, the cables 16

are wound around each other, and also caused to rotate about their own gripper rotational axes 32 and 47. (For example, the clamped ends of the cables 16 may thus retain their angular position on the pitch circle of the twisting rotor 22 and consequently also relative to each other comparably with the clamped cable ends in the clamping device 28).

During the twisting process, the support device 85 is usable for bracing the cables 16 that are to be twisted. In such case, the position of the support device 85 is detected with a second sensor device 82 and the support device 85 is swivelled from an idle position into a bracing position before the twisting process is carried out. Then, the support device 85 bears on one side of the cables 16 that are to be twisted and braces them so that the cables 16 cannot sag and are not placed under tension. During the twisting process, the support device 85 is shifted or moved with the aid of the positioning device 70 as necessary along the guide rail 19 and the cables 16 to be twisted from the first bracing position into a further bracing position. The bracing positions are predetermined by the control device 60 of the twisting appliance 15. In the process, the support device 85 is moved along the guide device 18 away from the clamping device 28 and towards the first twisting head device 20. The positions of the support device 85 along the guide device 18 are also determined by at least sensor device 82, and the sensor data is transmitted to the control device 60. In the control device 60, the sensor data is processed further to create data sets and/or movement commands and stored in the memory device 61.

After the twisting process, the support device 85 is swivelled into then idle position by the support device drive 87, this being initiated by the termination of

the twisting process. Then, the twisted cables 16 are released from the twisting appliance 15 and fall into a collecting tray (not shown).

In the following section, a typical stranding process is described.

It should be noted that in the configuration of the twisting appliance 15 described here the stranding process is started on the side of the clamping device 28 due to the setup of the system.

When stranding from the side of the clamping device 28 (side I) towards the first stranding head device 20 (side II) the first stranding head device 20 is operated in standing mode. The servomotor 56 of the gripper drive device 55 causes the first gripper shaft 31 and the further gripper shaft 46 to rotate, each about its own gripper rotational axis 32 and 47, via the drive shaft 24 and via the dumb-bell shaft 36 with the synchronous belt drives 38 and 42 and 57. The servomotor 26 of the twisting rotor drive device 21 is connected to the hollow rotor shaft 35 via the synchronous belt drive 27.

The cables 16 that are to be stranded are clamped into the clamping grippers in the clamping device 28. The opposite ends of the cables 16 are clamped in the grippers 33 and 43 of the twisting rotor 22 of the twisting head device 20. An appropriate tensile force is applied axially to the cables 16 that are to be stranded. This tensile force is produced as a result of positioning of the displaceable clamping device 28 at the distance from the stranding head device 20 stored by the control device 60.

The stranding shuttle 65 which is able to travel on the positioning device 70 in the longitudinal direction is lowered from above between the clamped cables 16 before the clamping device 28 by a linear movement, and the support device 85 is swivelled in pneumatically under the cables 16 to brace the cables 16.

In the stranding process (also referred to as stranding function mode), the clamping rotor of the clamping device 28 rotates with the cable ends clamped in the clamping grippers.

The two gripper shafts 31 and 46 are caused to rotate by the servomotor 56, so that the clamped cable ends rotate parallel to each other about their respective gripper rotational axes 32 and 47. The rotating speed of the two gripper shafts 31 and 46 is controlled by software depending on the rotation of the clamping rotor of the clamping device. With this function, the cables that are to be stranded in the process are relaxed immediately and completely or to a certain degree in terms of rotation stresses, because at that point the rotation of the grippers 31 and 46 is able to compensate for the self-twisting of the individual cables 16. In the function described here, the hollow rotor shaft 35 of the first twisting head device 20 is not caused to rotate by the servomotor 26.

The stranding process begins in front of the clamping device 28, wherein the positioning device 70 with the stranding pin 65 and the support device 85 moves towards the twisting head device 20, wherein the positioning device 70 with the stranding pin 65 and the support device 85 is moved away from the clamping motor by a distance in the magnitude of the programmed strand lay length with each revolution of the clamping rotor. The displaceable stranding shuttle 65 dictates the lay

length that is to be created. This process is repeated in all subsequent stranding rotations. By varying the distance by which the stranding shuttle is displaced for each rotation of the clamping rotor and/or by varying the distance from the first position of the stranding shuttle 65 to a further position of the stranding shuttle, the lay length produced may be varied and produced according to the program over the length to the cable bundle, and/or altered over the length of the cable bundle.

The stranding process has the effect of reducing the total length of the cables 16 which were originally aligned parallel to each other with each stranding lay until the cable bundle (also called twisted pair) is fully stranded. The tensile force acting axially on the cables 16 during stranding is regulated, wherein the servomotor 111 shifts the clamping device 28 under control of the software and thus assures the length compensation. The stranding process is ended when the cables have been stranded with the programmed rotations and lay lengths or have been fully wound around each other. The displaceable positioning device 70 with the stranding shuttle 65 and the support device 85 is then located on the side of the twisting head device 20 of the twisting appliance 15 and subsequently travels back to its starting position in front of the clamping device 28. The grippers 33 and 43 on the gripper shafts 31 and 46 and the clamping grippers of the clamping device 28 are opened, and the stranded cable bundle falls out of the grippers and into a collection tray or catch tray.

In the twisting process (also called "twisting function" mode), the gripper shafts 31 and 46 with the cables 16 clamped therein are each caused to rotate separately by the servomotor 56. The hollow rotor shaft

35 of the first twisting head device and the clamping rotor of the clamping device 28 also rotate. The gripper shafts 31 and 46 are arranged on a pitch circle on the twisting rotor 22. The cables 16 clamped in the gripper 33 and 43 of the gripper shafts 31 and 46 then rotate not only about their own axes, but also about the axis of rotation 23 of the twisting rotors 22 on the circular path thereof, wherein they usually retain their angular position on the circular path and therewith also relative to each other. The twisting rotor 22 and the clamping rotor of the clamping device 28 rotate in opposite directions for twisting. Consequently, the cables 16 are twisted or wound around each other.

With twisting, the stranding shuttle 65 which is able to travel in the lengthwise direction to produce the stranding lay length is not brought into engagement between the cables 16 that are to be twisted.

In the twisting process, the cables 16 to be twisted are clamped side by side by both cable ends in the grippers 33 and 43 with locking sleeves 44 and then twisted around each other according to the program, e.g., helically. The nature of the system means that the cables 6 to be twisted are also rotated about their own axis, with the result that internal stresses build up inside the cables 16, and they must first be overtwisted and subsequently returned to a state in which the cable bundle appears externally to be under no tension with the required lay length by calculated reverse twisting. Thus for example a reverse twisting of about 30 % to 40 % of the preceding twisting rotation is required to achieve the desired lay length. Besides the process time for overtwisting, the time for reverse twisting must therefore also be added to the total time. The finished twisted cable bundle falls

into a collection tray or catch tray after all of the grippers are opened.

In addition, the twisting appliance 15 presented here has a further support device 95 for bracing at least one cable 16. The additional support device 95 is arranged movably on a further positioning device 80 and may be swivelled into a bracing position towards the cables 16 and into an idle position away from the cables 16. The further positioning device 80 is arranged movably on the guide device 18 of the twisting appliance 15. The further positioning device 80 and the further support device 95 arranged thereon are movable in a direction between the clamping device 28 and the first twisting head device 20.

The further positioning device 80 includes a drive device, for example a servomotor 81, for moving the further positioning device 80 along the first guide device 18 and is connected to the control device 60 of the twisting appliance 15. In this way, the further support device 95 is automatically movable between the first twisting head device 20 and clamping device 28. The further positioning device 80 has a separate support device drive 97, for example a servomotor with a resolver or a lifting cylinder, with which the further support device 95 may be swivelled into a bracing position against the cables 16 and into an idle position away from the cables 16. The support device drive 97 is connected to the control device 60 of the twisting appliance 15.

The twisting appliance 15 has a third sensor device 96, which is designed to detect the position of the further support device 95. The third sensor device 96 is connected to the control device 60 for the purpose of exchanging sensor data. In this case, said sensor

includes but it not limited to data sets for positional information, location information or status information relating to the further support device 96.

If a stranding process is to be carried out, the stranding shuttle 65 is moved into a stranding position between the two clamped cables 16 before the stranding process begins. For this, the lifting cylinder 73 of the stranding shuttle drive 72 is activated by the control device 60 and the stranding shuttle 65, which is embodied as a bolt, moves between the two cables 16 that are to be stranded.

Then, the position of the support device 85 is detected with a second sensor device 82, and the support device 85 is swivelled from an idle position into a bracing position.

The stranding shuttle 65 and the support device 85 are positioned in front of the clamping device 28 with the aid of the positioning device 70.

Then, both clamping grippers of the clamping device 28 are caused to rotate by the clamping drive device or by its servomotor.

At the same time, the twisting rotor 22 of the twisting head device 20 is caused to rotate.

During the stranding process, the stranding shuttle 65 and the support device 85 are moved in the direction away from the clamping device 28 and towards the first twisting head device 20 by the positioning device 70. At the same time, a position of the stranding shuttle 65 is determined by the sensor device 66 and the sensor data is transmitted to the control device 60 of the twisting appliance 15. The sensor data is then

processed further by the control device 60 and stored in the memory device 62. The movement of the stranding shuttle 65 from a first position to a further position thus determines the lay length and/or the number of lays for the cables 16 that are to be stranded.

The stranding shuttle 65 and the support device 85 are moved as far as the first twisting head device 20, and after the stranding process they are moved into an idle position, this movement being triggered by the completion of the stranding process.

As is shown in Figure 10, an alternative configuration of the twisting appliance 215 also has a second twisting head device 240 in addition to a first twisting head device 220, both of which are arranged on the base 217. The second twisting head device 240 thus replaces the clamping device 28 of the twisting appliance 15 (see Figure 1). The two twisting head devices 220 and 240 are identical and constructed as described here (see for example Figure 8). The first twisting head device 220 has a twisting rotor drive device 222 for driving the hollow rotor shaft 235 and a gripper drive device 255 for driving the first gripper shaft 231 and the second gripper shaft 246. The second twisting head device 240 has a twisting rotor drive device 241 for driving the hollow rotor shaft 269 and a gripper drive device 273 for driving the first gripper shaft 263 and the second gripper shaft 264. In this embodiment, therefore, it is possible to strand cables 216 in a method as described above (and here), in which the stranding shuttle 265 and the support device 285 are moved or displaced by the first twisting head device 220 towards the second twisting head device 240. In this embodiment a stranding of cables 216 is also possible in which the stranding shuttle 265 and the support device 285 is moved away from the second

twisting head device 240 towards the first twisting head device 220. The first twisting head device 220 is operated in twisting mode and the second twisting head device 240 is operated in stranding mode to relieve the tension in the cables 216 that are to be stranded during the stranding process. The positioning device 270 is arranged movably on the guide device 218. The stranding shuttle 265 travelling on the positioning device 270 determines the lay length.

The cables 216 that are to be stranded are clamped in the gripper of the gripper shafts 263 and 264 in the second twisting head device 240, wherein the grippers are first opened and then closed axially by locking sleeves actuated by compression springs, for example.

The servomotors 226, 256 of the first twisting head device 220, the servomotors 274, 275 of the second twisting head device 240, the drives of the stranding shuttles 265 and the drives of the support device 285 and the drives of the positioning device 270 are connected to the control device 260 of the twisting appliance 215 for exchanging control commands. The drives - as described here - have sensor devices which communicate the sensor data to the control device 260, which data is processed in the computing device 261 and the memory device 262.

The two ends of the cables 216 are clamped in the grippers of the first and second twisting head devices 240. The gripper shafts 231 and 246 of the first twisting head device 220 are driven by the servomotor 256. They are supported on a pitch circle in the hollow rotor shaft 235. The hollow rotor shaft 235 rotated, driven by the servomotor 226. The servomotor 256 of the gripper shafts 231 and 246 combined with the servomotor 226 of the hollow rotor shaft 235 is regulated in such

manner that the angular position of the gripper shafts 231 and 246 in the pitch circle of the hollow rotor shaft 235 relative to the hollow rotor shaft 235 is maintained throughout the entire rotation.

On the side of the second twisting head device 240, the gripper shafts 263 and 264 are also caused to rotate by the servomotor 274, so that the clamped cable ends 216 on the side of the second twisting head device 240 rotate about their own axes, although the hollow rotor shaft 269 on this side, unlike the hollow rotor shaft 235 of the first twisting head device 220, is not caused to rotate by the servomotor. The direction rotation is the same for all rotations, that is to say of the gripper shafts 231 and 246 and the gripper shafts 263 and 264 and the hollow rotor shaft 235 of the first twisting head device 220, so that for example in a first case all rotations described take place clockwise when viewed from the side of the first twisting head device 220 along the cables 216 that are to be stranded.

An appropriate axial tensile force is applied to the cables 216 that are to be stranded, wherein this force is created as a result of the programmed positioning of the mobile twisting head device 240 depending on the length of the cables 216 that are to be stranded.

The second twisting head device 240 is operated in stranding mode. The drive shaft 224 or central shaft is driven by the servomotor via synchronous belt drive. It is also coupled to the dumb-bell shaft via synchronous belt drive. The dumb-bell shaft is itself connected to the two gripper shafts 263 and 264 via a synchronous belt drive. In this way, the two gripper shafts 263 and 264 are driven separately or caused to rotate by the servomotor 274. The servomotor 275 of the twisting

rotor drive device 241 of the second twisting head device 240 is connected to the hollow rotor shaft of the second twisting head device 240 via the synchronous belt drive, although in the function described here this hollow rotor shaft is not caused to rotate.

Stranding should take place with a defined lay length. With the stranding direction described here, stranding begins immediately in front of the first twisting head device 220. The two cables 216 which are to be stranded are arranged parallel and beside each other. A stranding shuttle 265 which is displaceable longitudinally on a positioning device 270 is arranged between the cables 216 and in front of the first twisting head device 220, and is shifted under software control away from the hollow rotor shaft 235 of the first twisting head device 220 and towards the second twisting head device 240 by a distance in the magnitude of the desired strand lay length for each rotation of the hollow rotor shaft 235. The displaceable stranding shuttle 265 is located between the two cables 216 that are to be and accordingly determines the lay length produced. This process is repeated in all subsequent stranding rotations. By varying the travel distance of the stranding shuttle, the lay length produced may also be varied and produced under software control over the length of the cables 216 that are to be stranded. The swivelling support device 285 which supports the cables 216 from below in the process is also arranged on the positioning device 270.

The stranding process has the effect of reducing the total length of the cables 216 which were originally aligned parallel to each other with each stranding lay until the cable bundle is fully stranded. The tensile force acting axially on the cables 216 during stranding is regulated, wherein the drive 222 shifts the second

twisting head device 240 under software control, thereby assuring length compensation. The stranding process is ended when the cables 216 have been wound around each other with the programmed rotations and lay lengths. The displaceable stranding shuttle 265 is then located on the side of the second twisting head device 240 of the twisting appliance 215. The support device 285 and the stranding shuttle 265 are retracted to their neutral position. The grippers on the gripper shafts 231, 246 and 263, 264 are opened, and the stranded cable bundle falls out of the grippers and into a collection tray or catch tray.

After this, all elements may be returned to their first starting positions and the stranding process can be started again. However it is also possible that in a further extension the stranding process described above is carried out in the reverse direction, wherein the second twisting head device 240 is operated in twisting mode and the first twisting head device 220 is operated in stranding mode. In this case, two further cables 216 are clamped into the twisting appliance 215 before the stranding process is performed. The positioning device 270 is arranged in front of the second twisting head device 240 and is moved along the guide device 218 towards the first twisting head device 220 during the stranding process. The stranding shuttle 265 travelling on the positioning device 270 again dictates the lay length, and the support device 285 is moved up against the cables 216 and is displaced with the positioning device 270.

In the twisting or stranding processes presented here with the twisting appliance 15, 215, the control device 60, 260 of the twisting appliance 15, 215 determines and generates the data sets and/or movement commands for controlling the twisting head devices 20,

220, 240 which carry out a method for twisting or stranding at least two cables 16, 216. A position of the stranding shuttle 65, 265 is detected with a first sensor device 66, and a position of a support device 85, 285 is detected with a second sensor device 82, and at least one data set and/or at least one movement command is generated and stored in each case. The respective at least one data set and/or at least one movement command specifies at least the position of the Stranding shuttle 65, 265 and/or the movement of the stranding shuttle 65, 265 from an idle position into a stranding position and/or the position of the support device 85, 285 and/or the movement of the support device 85, 285 from an idle position into a bracing position. As was noted previously, the servomotors and/or lifting cylinders of the stranding shuttle drives 65, 265, the support device 85, 285 and optionally the further support device 95 are connected to the control device 60, 260. Moreover, the servomotors of the gripper drive device 55, 255 and the twisting rotor drive device 21, 221 of the first twisting head device 20, 220 and the servomotors of the gripper drive device 273 and the twisting rotor drive device 241 of the second twisting head device 240 and/or the clamping device 28, are connected to the control device 60, 260. Accordingly, all sensor data from the sensor devices and from the servomotors or their resolvers is transmitted to the control device 60, 260 and corresponding data sets and/or movement commands are generated. The data sets and/or movement commands are stored in the memory device 62, 262 and may be communicated to the control device 60, 260. The data sets and/or movement commands are converted into control commands in the control device 60, 260 and then stored in the memory device 62, 262 and/or forwarded to the drives of the twisting appliance 15, 215 present here for controlling said drives.

Accordingly, the present twisting appliance 15, 215 enables the implementation of a method for twisting or stranding which is executed with a program (typically with an automation software program), which is executed in the computing device 61, 261 and controls the twisting appliance 15, 215 fully automatically.

The control device 60, 260 may also be integrated advantageously in a network, so that the status of the twisting appliance 15, 215 may also be displayed on said network.

REFERENCE LIST

- 15 Twisting appliance or machine
- 16 Cables or cable pair
- 17 Base of 15
- 18 Guide device or linear axis
- 19 Guide rail of 18
- 20 Twisting head device and reversible
 stranding/twisting rotor
- 21 Twisting rotor drive device
- 22 Twisting rotor
- 23 Axis of rotation
- 24 Drive shaft or central shaft
- 25 Drive bearing device
- 25a Bearing
- 25b Bearing
- 26 Servomotor of 21 or drive motor for
 stranding/twisting rotor
- 27 Synchronous belt drive of 21
- 28 Clamping device
- 29 1st feeding device
- 30 1st gripper device
- 31 1st gripper shaft
- 32 1st gripper rotational axis
- 33 Gripper
- 34 Further feeding device
- 35 Hollow rotor shaft
- 36 Dumb-bell shaft
- 37 Linkage bearing device
- 38 Synchronous belt drive of 49

- 40 Resolver of 26
- 41 Resolver of 56
- 42 Synchronous belt drive of 48
- 43 Gripper
- 44 Locking sleeve
- 45 Further gripper device

46	Further gripper shaft
47	Gripper rotational axis
48	1st transmission device
49	Further transmission device
50	Gripper bearing device
54	Fastening device
55	Gripper drive device
56	Servomotor of 55
57	Synchronous belt drive
60	Control device
61	Computing device
62	Memory device
65	Stranding shuttle or bolt or stranding pin
66	1st sensor device
68	Further sensor device
70	Positioning device or linear guide
72	Stranding shuttle drive
73	Lifting cylinder
75	Drive device of 70
76	Servomotor of 75
80	Further positioning device
81	Servomotor of 80
82	Second sensor device
85	Support device or bearing support pin
87	Support device drive
89	Linkage assembly
90	Links
91	Servomotor
92	Resolver of 91
95	Further support device or bearing support pin
96	3rd sensor device
97	Support device drive
100	Guide device or linear motion slide or slide
101	Guide rail
102	Drive or length compensation drive
110	Sensor device
111	Servomotor

115	Resolver of 111
215	Twisting appliance or machine
216	Cables
218	Guide device or linear axis
220	1st twisting head device or reversible stranding/twisting rotor
221	Twisting rotor drive device of 220
222	Drive or length compensation drive
224	Drive shaft or central shaft of 220
226	Servomotor of 221
231	1st gripper shaft of 220
235	Hollow rotor shaft of 220
240	2nd twisting head device or reversible stranding/twisting rotor
241	Twisting rotor drive device of 240
246	2nd gripper shaft of 220
255	Gripper drive device of 220
256	Servomotor of 255
260	Control device
261	Computing device
262	Memory device
263	1st gripper shaft of 240
264	2nd gripper shaft of 240
265	Stranding shuttle or bolt or stranding pin
269	Hollow rotor shaft of 240
270	Positioning device or linear guide
273	Gripper drive device of 240
274	Servomotor of 273
275	Servomotor of 241
285	Support device

CLAIMS

1. A twisting head device (20; 220, 240) for twisting or stranding electrical or optical cables (16; 216), comprising a twisting rotor (22), a twisting rotor drive device (21; 221, 241) for driving the twisting rotor (22), a first gripper device (30) which is arranged rotatably on the twisting rotor (22), at least one further gripper device (45) which is arranged rotatably on the twisting rotor (22), wherein the twisting rotor (22) is arranged rotatably on the twisting head device (20; 220, 240) and has an axis of rotation (23), wherein at least the first gripper device (30) can be driven by means of a gripper drive device (55; 255, 273) and a drive shaft (24; 224), and the drive shaft (24; 224) extends at least partly through the twisting rotor (22), characterized in that the twisting rotor (22) has a dumb-bell shaft (36) which establishes an operative connection between the drive shaft (24; 224) and at least a first gripper shaft (31; 231, 263), wherein the operative connection can be established with the aid of at least a first transmission device (48) which is arranged between the drive shaft (24; 224) and the dumb-bell shaft (36).
2. The twisting head device (20; 220, 240) according to Claim 1, characterized in that at least the first gripper device (30) is arranged on the first gripper shaft (31; 231, 263) and has a first gripper rotational axis (32), wherein the first gripper shaft (31; 231, 263) preferably extends at least partly into the twisting rotor (22) and the first gripper rotational axis (32) is preferably at a distance from the axis of rotation (23) of the twisting rotor (22).

3. The twisting head device (20; 220, 240) according to Claim 1 or 2, characterized in that the twisting rotor (22) has a hollow rotor shaft (35; 235, 269), wherein the drive shaft (24; 224) is at least partly arranged inside the hollow rotor shaft (35; 235, 269) and the drive shaft (24; 224) in particular extends rotatably through the twisting rotor (22), wherein at least one drive bearing device (25) which supports the drive shaft (24; 224) rotatably is at least partly arranged inside the twisting rotor (22).
4. The twisting head device (20; 220, 240) according to any one of Claims 1 to 3, characterized in that at least the further gripper device (45) can be driven by means of the gripper drive device (55; 255, 273) and the drive shaft (24; 224), wherein the further gripper device (45) in particular is arranged on a further gripper shaft (46; 246, 264) which preferably extends at least partly into the twisting rotor (22), and has a further gripper rotational axis (47), wherein the further gripper rotational axis (47) is preferably at a distance from the axis of rotation (23) of the twisting rotor (22).
5. The twisting head device (20; 220, 240) according to any one of Claims 1 to 4, characterized in that at least one gripper bearing device (50) is arranged inside the twisting rotor (22), and supports at least the first gripper device (30) rotatably, and preferably supports the further gripper device (45) rotatably.
6. The twisting head device (20; 220, 240) according to claim 4, characterized in that the dumb-bell

shaft (36) establishes an operative connection between the drive shaft (24; 224) and the further gripper shaft (46; 246, 264), and the dumb-bell shaft (36) and at least the first gripper shaft (31; 231, 263) can be established preferably with the aid of a further transmission device (49) which is arranged between the dumb-bell shaft (36) and at least the first gripper shaft (31; 231, 263), and in particular between the dumb-bell shaft (36) and the further gripper shaft (46; 246, 264).

7. The twisting head device (20; 220, 240) according to Claim 6, characterized in that a connecting bearing device (37) is arranged inside the twisting rotor (22) and supports the dumb-bell shaft (36) rotatably.
8. The twisting head device (20; 220, 240) according to any one of Claims 1 to 7, characterized in that the gripper drive device (55; 255, 273) and the twisting rotor drive device (21; 221, 241) are arranged at least partly on a common fastening device (54), and/or the gripper drive device (55; 255, 273) and the twisting rotor drive device (21; 221, 241) are connected to a control device (60; 260).
9. The twisting head device (20; 220, 240) according to any one of Claims 1 to 8, characterized in that at least the first gripper device (30) has at least one gripper (43) for gripping a cable end of the cable (16; 216), and the at least one gripper (43) preferably has an axially guided locking sleeve (44) for at least partly enclosing the at least one gripper (43).

10. A method for twisting or stranding electrical or optical cables (16; 216) with a twisting head device (20; 220, 240) according to any of Claims 1 to 9, comprising the following steps:
- clamping a first cable end of a first cable (16) into a first gripper device (30);
 - clamping at least a first cable end of a further cable (16; 216) into a further gripper device (45);
 - driving a twisting rotor (22) with a first number of rotations about an axis of rotation (23) of the twisting rotor (22) with the aid of a twisting rotor drive device (21; 221, 241);
 - driving at least the first gripper device (30) about a first gripper rotational axis (32) with a further number of rotations with the aid of a gripper drive device (55; 255, 273);
 - driving at least the further gripper device (45) about a further gripper rotational axis (47) with the further number of rotations with the aid of the gripper drive device (55; 255, 273), wherein the first number of rotations and the further number of rotations is specified by a control device (60; 260).
11. The method according to Claim 10, characterized in that the further number of rotations has a value that is 50 % to 98 %, advantageously 60 % to 70 % of the first number of rotations.

12. The method according to Claim 10 or 11, characterized in that the twisting rotor (22) and at least the first gripper device (30) are driven in the same direction of rotation, or the twisting rotor (22) and at least the first gripper device (30) are driven in opposite directions of rotation.

13. A twisting appliance (15; 215) for twisting or stranding electrical or optical cables (16; 216), comprising

a first twisting head device (20; 220, 240) according to any of Claims 1 to 9, with a first twisting rotor (22), wherein the first twisting rotor (22) is arranged rotatably on the first twisting head device (20; 220, 240),

a clamping device (28), wherein the first twisting head device (20; 220, 240) and the clamping device (28) are arranged at a distance from each other,

a stranding shuttle (65; 265) which is movable in a direction between the first twisting head device (20; 220, 240) and the clamping device (28) at least from a first position into a further position,

a control device (60; 260) for controlling at least the first twisting head device (20; 220, 240), characterized in that

the twisting appliance (15; 215) has at least one first sensor device (66) for detecting the position of the stranding shuttle (65; 265) and determining a stranding position or an idle position of a stranding shuttle (65; 265), wherein in particular the first sensor device (66) is connected to the

control device (60; 260) in order to exchange sensor data.

14. The twisting appliance (15; 215) according to Claim 13, characterized in that the twisting appliance (15; 215) has a first positioning device (70; 270), on which the stranding shuttle (65; 265) and/or a support device (85; 285) are arranged and with which the stranding shuttle (65; 265) can be brought into a stranding position and/or into an idle position, in particular linearly, and in particular the support device (85; 285) can be brought into a bracing position and/or into an idle position, and in particular is swivellable.
15. The twisting appliance (15; 215) according to Claim 13 or 14, characterized in that the twisting appliance (15; 215) has a further support device (95) for bracing at least one cable (16; 216), wherein the further support device (95) is movable, and is preferably arranged on a further positioning device (80) and can be brought into a bracing position and into an idle position, and in particular is swivellable.
16. The twisting appliance (15; 215) according to any of Claims 13 to 15, characterized in that the twisting appliance (15; 215) has a stranding shuttle drive (72) for shifting the stranding shuttle (65; 265) from a stranding position into an idle position and/or the twisting appliance (15; 215) has a support device drive (87) for shifting, particularly swivelling the support device (85; 285) from a bracing position into an idle position, wherein in particular at least one of the two drives (72, 87) is connected to the control device (60; 260), and in particular has a further support device

drive (97) for shifting, particularly swivelling the further support device (95), which is connected to the control device (60; 260).

17. The twisting appliance (15; 215) according to any of Claims 13 to 16, characterized in that the twisting appliance (15; 215) has at least one second sensor device (82), which is designed to detect the position of the support device (85; 285), wherein the second sensor device (82) in particular is connected to the control device (60; 260) for exchanging sensor data, and in particular has at least one third sensor device (96), which is designed to detect the position of the further support device (95), wherein the third Sensor device (96) in particular is connected to the control device (60; 260) for exchanging sensor data.
18. The twisting appliance (15; 215) according to any of Claims 13 to 17, characterized in that the positioning device (70; 270) of the stranding shuttle (65; 265) and/or the positioning device (70; 270) of the support device (85; 285) are arranged movably on a first guide device (18), wherein the stranding shuttle (65; 265) and/or the support device (85; 285) are movable in a direction between the clamping device (28) and the first twisting head device (20; 220, 240), and the stranding shuttle (65; 265) is preferably arranged on the support device (85; 285), and in particular the further positioning device (80) of the further support device (95) is arranged movably on the first guide device (18), wherein the further support device (95) is movable in a direction between the clamping device (28) and the first twisting head device (20; 220, 240).

19. The twisting appliance (15; 215) according to any of Claims 13 to 18, characterized in that the clamping device (28) is embodied as a further twisting head device, in particular as a twisting head device (20; 220, 240) according to one of Claims 1 to 9 and is connected to the control device (60; 260) for controlling at least the further twisting head device.
20. The twisting appliance (15; 215) according to any of Claims 13 to 19, characterized in that the twisting appliance (15; 215) has a computing device (61; 261) and a memory device (62; 262) which are connected to the control device (60; 260), wherein in particular at least sensor data of the first sensor device (66) of the stranding shuttle (65; 265) can be processed, and/or at least sensor data of the second sensor device (82) of the support device (85; 285) can be processed and can preferably be stored in the memory device (62; 262), and in particular at least sensor data of the third sensor device (96) of the further support device (95) can be processed and preferably stored in the memory device (62; 262) with the aid of the computing device (61; 261).
21. The twisting appliance (15; 215) according to any of Claims 13 to 20, characterized in that the twisting appliance (15; 215) has a further guide device (100) for linear movement of the clamping device (28) or for linear movement of at least the first twisting head device (20; 220, 240) in a direction between the first twisting head device (20; 220, 240) and the clamping device (28), wherein in particular the first twisting head device (20; 220, 240) and the clamping device (28) are arranged

to be linearly movable in this direction on the further guide device (100), and the twisting appliance (15; 215) preferably has at least one further sensor device (110), which detects a position of the first twisting head device (20; 220, 240) and/or of the clamping device (28) on the further guide device (100) and transmits sensor data to the control device (60; 260).

22. A method for stranding or twisting at least two electrical and/or optical cables (16; 216) with a twisting appliance (20; 220, 240) according to one of Claims 13 to 21, which has at least one first twisting head device (20; 220, 240) with a twisting rotor (22) according to one of Claims 1 to 9, wherein the method comprises the following steps:

- clamping a first cable (16; 216) in the twisting appliance (15; 215);
- clamping at least one further cable (16; 216) in the twisting appliance (15; 215), wherein in particular the two cables (16; 216) are clamped parallel to each other;
- detecting at least one location and determining a stranding position or an idle position of a stranding shuttle (65; 265) with a first sensor device (66);
- performing a stranding process or a twisting process on the at least two cables, wherein a stranding process is performed when the stranding shuttle (65; 265) is in the stranding position and a twisting process is performed when the stranding shuttle (65; 265) is in the idle position.

23. The method according to Claim 22, characterized in that at least the stranding shuttle (65; 265) is moved into a stranding position before the performance of the stranding process, or the stranding shuttle (65; 265) into an idle position before the performance of the twisting process.
24. The method according to Claim 22 or 23, characterized in that a location of a support device (85; 285) is detected with a second sensor device (82), and in particular the support device (85; 285) is moved, particularly swivelled, from an idle position into a bracing position, or preferably is moved from a first bracing position into a further bracing position during the stranding process or the twisting process.
25. The method according to one of Claims 22 to 24, characterized in that the stranding shuttle (65; 265) is moved in a direction away from the clamping device (28) towards the first twisting head device (20; 220) during the stranding process, and at least one position of the stranding shuttle (65; 265) along this direction is determined by at least one further sensor device (68), and the sensor data is communicated to the control device (60; 260) and processed further by the control device (60; 260).
26. The method according to Claim 24 or 25, characterized in that the support device (85; 285) is moved in a direction away from the clamping device (28) towards the first twisting head device (20; 220) during the stranding process or during the twisting process, and at least one position of the support device (85; 285) along this direction is determined by at least one further sensor device

(68), and the sensor data is communicated to the control device (60; 260) and processed further by the control device (60; 260).

27. The method according to one of Claims 22 to 26, characterized in that the stranding shuttle (65; 265) is moved into an idle position after the stranding process, and/or the support device (85; 285) is moved into an idle position after the stranding process or the twisting process, wherein this is preferably triggered by the termination of the standing process or of the twisting process.
28. The method according to one of Claims 22 to 27, wherein the twisting appliance (15; 215) has a second twisting head device, which has a second twisting rotor which has at least one first gripper device and one further gripper device, characterized in that the twisting rotor (22) of the first twisting head device (20; 220) is caused to rotate and the first gripper device and the further gripper device of the second twisting head device (240) are caused to rotate during the stranding process, wherein the stranding shuttle (65; 265) is moved in a direction between the first twisting head device (20; 220) and the second twisting head device (240).
29. The method according to Claim 28, wherein the first twisting head device (20; 220) has a first gripper device (30) and a further gripper device (45) characterized in that after the stranding process two further cables (16; 216) are clamped in the twisting appliance (15; 215) and then the first gripper device (30) and the further gripper device (45) of the first twisting head device (20; 220) are caused to rotate and the twisting rotor of the

second twisting head device (240) is caused to rotate, wherein the stranding shuttle (65; 265) is moved in a direction between the first twisting head device (20; 220) and the second twisting head device.

30. A computer-implemented method for automatic determination and generation of data sets and/or movement commands for controlling at least one twisting head device (20; 220, 240) according to one of Claims 1 to 9, or a twisting appliance (15; 215) according to one of Claims 13 to 21 which performs a method to twisting or stranding at least two cables (16; 216), in particular the method for twisting or stranding according to one of Claims 22 to 29, wherein a position of a stranding shuttle (65; 265) is detected with a first sensor device (66) and preferably a position of a support device (85; 285) is detected with a second sensor device (82), and at least one data set and/or one movement command is generated and stored, in particular multiple data sets and/or movement commands are generated and stored, which indicates at least the position of the stranding shuttle (65; 265) and/or the movement from an idle position into a stranding position and preferably indicates the position of the support device (85; 285) and/or the movement from an idle position into a bracing position.
31. The computer-implemented method according to Claim 30, characterized in that at least one stored data set and/or at least one stored movement command is communicated to the control device (60; 260).