Device for Holding Wires and Method for Welding Wires

The invention relates to a device for holding wires, in particular for holding wires when welding, for example when welding longitudinal wires of a wire mesh with transverse wires thereof, wherein the device comprises a gripper for holding the wires.

Furthermore, the invention relates to a method for welding wires, for example longitudinal wires and transverse wires of a wire mesh, such as a reinforcing mesh, in particular with a device of the aforementioned type, wherein at least one wire is held with a gripper during welding.

In the production of wire meshes having longitudinal wires and transverse wires, each formed from a steel, the longitudinal wires are supplied in the production direction according to the prior art and are welded to transverse wires supplied transversely to the production direction. For the welding process, corresponding devices are provided with welding heads that are configured to be movable, such that a bundle of longitudinal wires at the same height may be welded to a single transverse wire at different positions. For this purpose, a single welding head that is movable linearly along a transverse wire may already be sufficient. A group of welding heads that is movable only in the vertical direction may also be provided.

In the production of wire meshes, the longitudinal wires are provided on an inlet side with a predetermined pitch, that is to say, with a predetermined spacing from one another. However, it may occur that this inlet-side pitch does not correspond to the pitch in the wire mesh because, for example, a different pitch is desired on an outlet side or in the wire mesh in order to optimize static properties.

In order to hold the supplied longitudinal wires in a suitable position when welding to a transverse wire, it is known from the prior art to use V-shaped components, such as angle plates, which are usually arranged on the welding head. By means of the V-shape, the longitudinal wires may be guided into a specific position regardless of the respective diameter before the welding process begins. The V-shaped components are usually actuated by means of pneumatic cylinders. Although, for example, angle plates allow flexibility with respect to the diameter, it is disadvantageous that a relative movement of the longitudinal wires relative to the V-shaped component occurs, which may lead to friction and damage to the transverse wire. It is furthermore disadvantageous that, without an additional displacement measuring system, a translation may be initiated, which is disadvantageous for

the product geometry. Finally, the pneumatic cylinders used exhibit a high failure rate because the forces resulting from impact on the product are introduced directly into the pneumatic cylinders.

Devices of the type mentioned at the outset are also known from the prior art, in which, for example, longitudinal wires are gripped and manipulated with grippers, although damage may likewise occur.

This is where the invention begins. The object of the invention is to further develop a device of the type mentioned at the outset such that a wire may be held safely and with positional accuracy, in particular for welding, wherein the risk of damage to individual wires is reduced.

A further object of the invention is to further develop a method of the type mentioned at the outset such that safe and accurate welding of wires is possible, wherein the risk of damage to individual wires is reduced.

The object of the invention is achieved in that, in a device of the type mentioned at the outset, the gripper comprises pivotable gripper elements and at least one drive member for the gripper elements, wherein the gripper elements, together with the at least one drive member, are movable substantially linearly from a starting position into a holding position and, in the holding position, are pivotable toward one another, in particular under positive guidance, in order to hold a wire.

According to the invention, the gripper comprises pivotable gripper elements and a drive member that is configured to pivot the gripper elements relative to one another. The device is configured such that the gripper elements together with the drive member are initially movable from a starting position into a holding position, wherein the movement is provided substantially along a straight line.

Advantageously, the linear movement of the gripper elements is first completed, after which the gripper elements are moved toward one another in order thereby to grip and hold a wire, in particular a supplied longitudinal wire. By the sequence of linear movement of the gripper elements followed by pivoting thereof, the gripped wire may be gripped safely and accurately and likewise welded. The pivoting of the gripper elements is achieved by the at least one drive member, which is initially moved passively together with the gripper elements into the holding position and is then actuated. The risk of damage to wires is thereby at least reduced.

In principle, it is also possible for the gripper elements to pivot, or for pivoting thereof to be initiated, while the gripper elements are being moved linearly. However, for design reasons, execution of these steps of movement and pivoting of the gripper elements discretely one after another is preferred. The device is therefore advantageously configured such that the gripper elements are pivotable only in the holding position. This ensures that the wire is reliably gripped and may also be released again. An applied force may be used first to bring about the translational movement into the holding position and then, when the gripper elements may no longer be moved further translationally, to initiate and complete the pivoting process. The actuating elements are thereby protected because the introduction of force into them is low.

Advantageously, the gripper elements are movable substantially linearly, in particular vertically, up to a stop. The stop ensures that the gripper elements may not be moved beyond the holding position. For this purpose, the gripper elements may be connected to a flange, which comes to rest against the stop in the holding position. As a result, further linear movement beyond the holding position is blocked.

Although the invention is not limited thereto, the gripper elements generally grip a supplied longitudinal wire, which is, for example, placed on a transverse wire and welded to this transverse wire, in particular in order to produce a wire mesh of longitudinal wires and transverse wires in a horizontal plane. For the linear movement, the gripper elements are suitably mounted in the device, for example on a block that is movably mounted on one or more associated guide rods and carries the aforementioned flange. The gripper elements may be mounted pivotably at the side on this block.

In order to carry out the movements of the gripper elements, the device may comprise an actuator, by means of which the gripper elements and/or the drive member are movable and/or by means of which the gripper elements are pivotable. The actuator may, for example, be an electric or hydraulic actuator, but a pneumatic actuator is preferably provided. A single actuator is sufficient for all movements. When the gripper elements may be moved as far as a stop, they are located in the holding position. The at least one drive member moves along therewith and is mounted between the gripper elements such that it is movable further. Once the stop has been reached, the pivoting movement may then follow the vertical movement by further moving the at least one drive member linearly, thereby initiating the pivoting movement of the gripper elements. In principle, however, a plurality of separately operating

actuators may also be provided for different movements, although this is more complex.

In particular, it may be provided that the gripper elements comprise guides extending obliquely with respect to a vertical axis, into which a drive member engages, wherein the guides are configured to move the gripper elements toward one another when the drive member is moved in the holding position. The guides are preferably configured such that pivoting of the gripper elements is achieved by a further linear movement of the drive member in the holding position. A single drive member is then sufficient for one pair of gripper elements. When two or optionally more pairs of gripper elements are arranged, a single drive member may actuate a plurality of pairs of gripper elements or, in other words, activate gripping in the case of a plurality of grippers.

It may also be provided that the guides have a length and/or an angle relative to the vertical axis such that, in the holding position, when the gripper elements are pivoted toward one another, contact surfaces of the gripper elements hold the wire only by friction. In this particularly preferred variant, a wire to be welded may initially be gripped by the gripper elements with a clamping force but, during welding, be held exclusively by friction. For this purpose, the gripper elements may be configured relative to the vertical axis with an opening angle toward the bottom, that is to say, forming a downwardly open V. The gripper elements then remain in position on the wire by friction. Due to the open angle of the gripper elements and the existing self-locking effect, the gripper formed by the gripper elements acts as a guide during welding when the actuator is depressurized, and a change in the longitudinal wire in the direction of gravity (weld-in depth) during the welding process may be compensated for. As a result, welded joints of particularly high quality are obtained. In this regard, it is particularly preferred that the device comprises a pneumatic actuator and a control device, wherein the control device selectively depressurizes the actuator in the holding position when the gripper elements are pivoted toward one another. As a result, it is possible initially to grip a wire with a predetermined clamping force. For example, the actuator may be pressurized with a pressure of several bar. As soon as the wire has been gripped in the holding position and is ready for welding, the actuator may be depressurized. Due to the friction, the gripper elements cannot move and, in this situation, act, as mentioned, as a guide for the wire to be welded without the application of additional force.

It is also particularly preferably provided that a single drive member is provided for gripper elements cooperating in pairs. In particular, a plurality of pairs of cooperating gripper

elements may also be provided. If, for example, two pairs of cooperating gripper elements are provided, a single drive member may pivot four gripper elements, such that a total of four gripper elements are pivotable by means of one drive member and thus two grippers are actuable. A configuration of two or optionally more grippers provides the advantage that a torque may be introduced into the wire. As a result, in particular, nodes intersecting at an angle of 90° may be produced precisely.

The device may comprise at least one spring that biases the gripper elements into the holding position. The gripper elements may be mounted pivotably on a movable block having a flange. The flange may in turn be movable from a rest position to the stop along one or more guide rods. A spring may be mounted on one of these guide rods such that, upon the linear movement of the gripper elements from the rest position toward the stop, an additional spring force is produced. It is ensured through this additional spring force that, in particular in the case of pneumatic actuation, the drive member does not initiate the pivoting movement before the stop, or the holding position, has been reached. Conversely, upon opening, the drive member is first activated before the gripper elements may be moved into the starting position by overcoming the opposing spring force as well.

The device may furthermore comprise a linearly movable hold-down member, in particular a vertically movable hold-down member. As a result, it is possible to carry out double-wire welding in a simple manner with individual movable welding heads, although double-wire welding is also possible without a hold-down member. It should be ensured that a wire to be welded on is not pushed over a wire that has already been welded on. For this purpose, suitable means may be used where necessary, for example suitably designed guides for the wire to be welded on.

The device may be arranged on a freely movable welding carriage or on a dedicated running gear of a welding apparatus and preferably receives a longitudinal wire transversely to the production direction before welding. In principle, the gripper elements are configured to grip wires having a wire diameter of 2 mm to 26 mm, preferably 4 mm to 20 mm.

However, the use of a device according to the invention is not limited merely to the welding of wires. Rather, the device according to the invention may also be used, for example, for feeding wires to wire mesh welding installations or other installations, for example for the inlet-side feeding of longitudinal wires for producing wire meshes with a welding apparatus.

Furthermore, a device according to the invention may, for example, comprise a displacement measuring system for supplied longitudinal wires such that conclusions may be drawn regarding the quality of a weld. This may optionally also be achieved with other measuring systems, for example a measuring system for stray currents when welding, which likewise permits conclusions to be drawn regarding weld quality.

In a further aspect, the invention comprises a welding apparatus having a plurality of devices according to the invention, wherein the devices may be actuated independently of one another.

The further object of the invention is achieved in that, in a method of the type mentioned at the outset, pivotable gripper elements of the gripper are moved substantially linearly from a starting position into a holding position and are pivoted in the holding position in order to hold the at least one wire.

A particular advantage of a method according to the invention is that a wire may be gripped in a defined manner and held during welding. A discrete sequence of linear movement, in particular vertical movement, of the gripper elements followed by pivoting of the gripper elements thereby provides a high level of process reliability and permits safe and accurate welding of wires, wherein the risk of damage to a wire is significantly reduced compared with V-shaped angle plates.

Movement of the gripper elements and/or the drive member or drive members, which are configured to pivot the gripper elements, may, for example, be carried out electrically or hydraulically. Particularly preferably, the gripper elements and/or the drive member or drive members are initially moved linearly together pneumatically. Once a holding position of the gripper elements has been reached, the drive member or drive members may be moved further linearly in order to initiate a pivoting movement of the gripper elements toward one another. For this purpose, the elongate gripper elements may comprise lateral guides into which the drive member or drive members engage. These lateral guides have an angle relative to the plane along which the drive member or drive members are moved, in particular pneumatically. As a result, positive guidance is provided, causing the gripper elements to pivot toward one another and thereby grip a wire when the drive member or drive members are moved further linearly. The lateral guides of the gripper elements are coordinated with the wire diameter and a desired clamping force.

In particular, when both the gripper elements and the drive member or drive members are actuated pneumatically, it is advantageous for the gripper elements to be subjected to a spring force during the linear movement from the starting position into the holding position. The additionally applied spring force ensures that the gripper elements are first moved into the holding position before the drive member or drive members are actuated. It is thus possible to initiate the pivoting movement only once the holding position of the gripper elements has been reached. This may be the case in particular when the holding elements have been moved as far as a stop, against which, for example, a flange connected to the gripper elements comes to rest. The at least one drive member is mounted between the gripper elements and is moved relative thereto only when the gripper elements may no longer be moved further linearly in order to grip a wire.

It is also particularly preferable, and possible within the scope of the method using a device according to the invention, for the wire to be gripped in the holding position with a clamping force, after which the clamping force is reduced, in particular to substantially zero, and the wire is held by friction during welding. Thus, the wire to be welded may first be gripped and positioned in the holding position, or in a desired welding plane. A specific clamping force is provided for this purpose. Once the wire is in this position, the clamping force may be eliminated. When the gripper elements, relative to the wire diameter, form a predetermined angle of less than approximately 5° in the pivoted-toward-one-another state, which results from the pivotability of the gripper elements about a common pivot axis, the gripper elements likewise remain immovable when the pneumatic system is depressurized due to self-locking, or wedge action. As a result, the function of the gripper elements changes during welding with a welding head to merely guiding the wire. This results in particularly high-quality welded joints because the wire is welded virtually without the application of additional force.

The sequence of the linear movement of the gripper elements and the closing movement requires approximately 200 ms. Due to the positive mechanical guidance, position switches and the associated position evaluation between the two movements may be omitted when the gripper elements and the drive member or drive members are positively mechanically guided. For this purpose, in particular, a device according to the invention may be used to carry out the method.

The method according to the invention may also be used for producing double-wire welds when, for example, a first longitudinal wire is welded to a transverse wire in the manner

explained above, after which a further longitudinal wire is gripped with the gripper and placed on the transverse wire, after which the gripper elements are closed such that both longitudinal wires are held, after which a hold-down member is lowered onto the longitudinal wires, after which the second longitudinal wire is welded to the transverse wire.

Further features, advantages, and effects of the invention will become apparent from the exemplary embodiments described below. In the drawings, to which reference is made:

Fig. 1 shows a schematic illustration of a device according to the invention and of a welding process;

Fig. 2 shows a schematic illustration of a method for producing double-wire welds;

Fig. 3 shows a perspective illustration of a device according to the invention;

Fig. 4 shows a sectional view through a device according to the invention;

Figs. 5 to 7 show various states upon actuation of a device according to the invention.

Fig. 1 shows, in a highly schematic manner, a device 1 according to the invention and a method using the same. The device 1 comprises a gripper 2 having two gripper elements 3. Furthermore, a drive member 4 is provided for the two gripper elements 3. The gripper elements 3 are mounted pivotably toward one another about a pivot axis S. The gripper elements 3, like the drive member 4, are mounted such that they are movable linearly along a vertical axis V. As a rule, the linear movement is provided along a vertical direction, in particular when a wire mesh is produced in a horizontal plane. The gripper elements 3 are connected to the drive member 4, wherein the drive member 4 engages the gripper elements 3 such that they are pivotable upon linear movement of the drive member 4. Furthermore, an actuator 14, not shown, is provided, which is configured for pneumatically actuating the gripper elements 3 and the drive member 4. In addition, a spring 7 is provided, which biases the gripper elements 3 toward a stop 5 along the arrow shown in Fig. 1.

In the starting position A shown at the upper left in Fig. 1, the actuator 14 initially holds the gripper elements 3 in the starting position A against the spring force by the application of a corresponding force. In order to grip a longitudinal wire L to be welded, a force is applied by the actuator 14 in the opposite direction, such that, according to the second position in the upper row of Fig. 1, an actuating force is produced that acts in the same direction as the

spring force. As a result, the gripper elements 3 are moved linearly until the gripper elements 3 reach a holding position H because a part connected to the gripper elements 3 comes to rest against a stop 5. The gripper elements 3 may then no longer be moved further. However, due to the pneumatic actuating force still being present, the drive member 4 may now be moved linearly and, due to the positively guided connection with the gripper elements 3, closes the latter, or moves the gripper elements 3 toward one another, such that they grip the longitudinal wire L. Thus, the translational extension of the gripper elements 3 is followed by rotational closing thereof by the drive member 4.

In this context, the spring force exerted by the spring 7 is required to prevent actuation of the actuator 14 from simultaneously initiating a closing movement by the drive member 4. Due to the spring force, closing is possible only once the stop 5, or the holding position H, has been reached.

The position shown at the far right in the upper row of Fig. 1 corresponds to a situation in which the longitudinal wire L is gripped with a clamping force and brought into a welding position. For this purpose, the actuator 14 may be pneumatically pressurized with a pressure of, for example, several bar. The longitudinal wire L is then located in the welding position corresponding to the far left position in the lower row. In this situation, the actuator 14 may be depressurized. The spring force continues to act in order to hold the gripper elements 3 in the welding position. Furthermore, the gripper elements 3, in interaction with the drive member 4, may be configured, in particular by means of a downwardly open opening angle, such that the gripper elements 3 cannot move in this depressurized situation. The longitudinal wire L is then held only by friction. This is an optimum situation for the subsequent welding process, indicated by the arrow pointing toward the longitudinal wire and indicating the pressure exerted by a welding head, which permits the production of welded joints of very high quality. Subsequently, the process proceeds in reverse. The actuating force of the actuator 14 initially causes the drive member 4 to be moved linearly in the opposite direction, which, due to the positive guidance, leads to opening of the gripper elements 3. Only after this opening has taken place may the gripper elements 3 be moved back into the starting position A against the spring force of the spring 7.

In Fig. 2, an analogous method for producing double-wire welds with steps 1 to 7 is shown schematically. In this case, an additional hold-down member 9 is required. A longitudinal wire L is placed on a transverse wire in the manner explained above and welded thereto by

means of a movable welding head 10. After the first longitudinal wire L has been welded to the transverse wire, the gripper 2 is opened, the welding head 10 is raised, the gripper 2 is raised, and an auxiliary gripper takes over a second longitudinal wire L. This second longitudinal wire L is placed on the transverse wire next to the first longitudinal wire L. Thereafter, a hold-down member 9 is lowered onto the two longitudinal wires L such that the second longitudinal wire L cannot be pushed over the first longitudinal wire L. Thereafter, the gripper 2 is positioned such that both longitudinal wires L are gripped from a respective side, after which the second longitudinal wire L may be welded to the transverse wire.

In Fig. 3 and the sectional view according to Fig. 4, a practical embodiment of a device 1 according to the invention is shown. The device 1 comprises two grippers 2, each having two pairs of gripper elements 3. The gripper elements 3 are mounted pivotably about a pivot axis S and are movable linearly between a starting position A and a holding position H. The device 1 is typically installed in a welding installation such that the gripper elements 3 are movable vertically in order to grip a longitudinal wire L and hold it during welding in the manner explained with reference to Fig. 1 or Fig. 2. The gripper elements 3 are connected to a block having a flange 11. The block having the flange 11 is linearly movable on guide rods 12 as far as a stop 5. In the opposite direction, springs 7 are mounted on the guide rods 12, the springs being clamped between the flange 11 and a counterpart 13.

The gripper elements 3 are actuated by a pneumatic actuator 14. In the starting position A, the actuating force of the actuator 14 acts against the spring force of the springs 7 such that the starting position A is maintained.

As is apparent in particular from Fig. 4, the gripper elements 3 are connected to the drive member 4. In the paired configuration of two grippers 2, each having two gripper elements 3, a single drive member 4 is preferably provided for all of the gripper elements 3. The drive member 4 then actuates four gripper elements 3. For this purpose, the gripper elements 3 comprise lateral guides 6. The guides 6 may be configured as elongated holes as illustrated, although other types of guides 6 are also possible. Projections of the drive member 4 engage in the guides 6. As a result, upon a linear movement of the drive member 4, the gripper elements 3 are pivoted purely mechanically about the pivot axis S due to the positive guidance.

Various operating states are apparent from Figs. 5 to 7, as explained with reference to the

schematic illustration in Fig. 1. Fig. 5 corresponds to a situation in which the gripper elements 3 are located in a starting position A. A force applied by the actuator 14 acts against the spring force of the springs 7. If the actuator 14 is then actuated such that a force acts in the opposite direction, the force of the actuator 14 together with the spring force of the springs 7 causes the gripper elements 3 to be moved linearly until the flange 11 comes to rest against the stop 5. The drive member 4 is not actuated during this linear movement; instead, the state according to Fig. 6, and thus the holding position H, is first reached. Only after this holding position H has been reached may the drive member 4 be moved linearly and, due to the positive guidance in the guides 6 of the gripper elements 3, bring about the desired pivoting thereof and thus the gripping of a longitudinal wire L. The longitudinal wire L is then gripped and is located in a suitable welding position. In this welding position, the actuator 14 may then be depressurized such that the longitudinal wire L is held only by friction at contact surfaces 8 of the gripper elements 3, given a suitable configuration of the guides 6, and movement of the gripper elements 3 is prevented. A downwardly open angle of less than 5°, formed by the contact surfaces 8, is indicated by dashed lines in Fig. 7. The longitudinal wire L is then located in an optimum starting situation A for producing high-quality welded joints.

Among other things, a device 1 according to the invention has the advantage that it is of very simple construction with only a single actuator 14 and, due to the provided positive guidance between the gripper elements 3 and the drive member 4, the spring forces exerted by the springs 7, and a sequence of linear movements and pivoting movements that is discrete in operation, enables the production of high-quality welded joints.

Claims

1. Device (1) for holding wires, in particular for holding wires when welding, for example when welding longitudinal wires (L) of a wire mesh with transverse wires thereof, wherein the device (1) comprises a gripper (2) for holding the wires, characterized in that the gripper (2) comprises pivotable gripper elements (3) and at least one drive member (4) for the gripper elements (3), wherein the gripper elements (3), together with the at least one drive member (4), are movable substantially linearly from a starting position (A) into a holding position (H) and, in the holding position, are pivotable toward one another by means of the at least one drive member (4), in particular under positive guidance, in order to hold a wire.

2. Device (1) according to claim 1, characterized in that the gripper elements (3) are pivotable only in the holding position (H).

3. Device (1) according to claim 1 or 2, characterized in that the gripper elements (3) are movable substantially linearly, in particular vertically, as far as a stop (5).

4. Device (1) according to one of claims 1 to 3, characterized in that the device (1) comprises an actuator by means of which the gripper elements (3) and/or the drive member (4) are movable and/or by means of which the gripper elements (3) are pivotable.

5. Device (1) according to one of claims 1 to 4, characterized in that the gripper elements (3) comprise guides (6) extending obliquely with respect to a vertical axis (V), into which a drive member (4) engages, wherein the guides (6) are configured to move the gripper elements (3) toward one another when the drive member (4) is moved in the holding position (H).

6. Device (1) according to claim 5, characterized in that the guides (6) have a length and/or an angle relative to the vertical axis V) such that, in the holding position (H), when the gripper elements (3) are pivoted toward one another, contact surfaces (8) of the gripper elements (3) hold the wire by friction.

7. Device (1) according to one of claims 1 to 6, characterized in that the device (1) comprises a preferably pneumatic actuator (14) and a control device, wherein the control device controls the actuator (14), and wherein the control device selectively depressurizes the actuator (14) in the holding position (H) when the gripper elements (3) are pivoted toward

one another.

8. Device (1) according to one of claims 1 to 7, characterized in that a single drive member (4) is provided for gripper elements (3) cooperating in pairs.

9. Device (1) according to one of claims 1 to 8, characterized in that a plurality of pairs of cooperating gripper elements (3) are provided.

10. Device (1) according to one of claims 1 to 9, characterized in that the device (1) comprises at least one spring (7) that biases the gripper elements (3) into the holding position (H).

11. Device (1) according to one of claims 1 to 10, characterized in that the device (1) comprises a linearly movable hold-down member (7), in particular a vertically movable hold-down member.

12. Device (1) according to one of claims 1 to 11, characterized in that the gripper elements (3) are configured to grip wires having a wire diameter of 2 mm to 26 mm, preferably 4 mm to 20 mm.

13. Welding apparatus comprising a plurality of devices (1) according to one of claims 1 to 12, wherein the devices (1) are actuable independently of one another.

14. Method for welding wires, for example longitudinal wires (L) and transverse wires of a wire mesh, such as a reinforcing mesh, in particular with a device (1) according to one of claims 1 to 12, wherein at least one wire is held by a gripper (2) during welding, characterized in that pivotable gripper elements (3) of the gripper (2) are moved substantially linearly from a starting position (A) into a holding position (H) and are pivoted in the holding position (H) in order to hold the at least one wire.

15. Method according to claim 14, characterized in that the gripper elements (3) and/or the drive member (4) are moved linearly pneumatically in order to pivot the gripper elements (3).

16. Method according to claim 14 or 15, characterized in that the gripper elements (3) are subjected to a spring force during the linear movement from the starting position (A) into the holding position (H).

17. Method according to one of claims 14 to 16, characterized in that the wire is gripped in

the holding position (H) with a clamping force, after which the clamping force is reduced and the wire is held by friction during welding.