



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.10.2020 Bulletin 2020/42

(51) Int Cl.:
B21L 7/00 (2006.01) A44C 27/00 (2006.01)
B21L 11/00 (2006.01)

(21) Application number: **20169976.6**

(22) Date of filing: **16.04.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventor: **Pettenuzzo, Gianni**
38122 Trento (TN) (IT)

(74) Representative: **Caldon, Giuliano et al**
Gallo & Partners S.r.l.
Via Rezzonico, 6
35131 Padova (IT)

(30) Priority: **09.04.2019 IT 201900005420**

(71) Applicant: **Pettenuzzo, Gianni**
38122 Trento (TN) (IT)

Remarks:

Pursuant to Rule 134 EPC the priority IT 102019000005420 has been validly claimed.

(54) **AUTOMATED MACHINE FOR PRODUCING ORNAMENTAL CHAINS AND PROCESS FOR PRODUCING ORNAMENTAL CHAINS**

(57) The present invention regards an automated machine employed in the field of production of jewelry articles for making ornamental chains of different varieties. The machine comprises a first rotatable support base (10) provided with first operating heads (100) adapted to produce different meshes for ornamental chains, and a second rotatable support base (20) provided with second operating heads (200) provided with grippers adapted to cooperate with the first operating heads (100) for moving the meshes of the chains. In addition, the machine comprises a control unit which, by means of movement means (11, 21), drives the support bases (10, 20) to rotate in order to bring a selected first operating head (100) and a selected second operating head (200) to a work station (50) in order to be able to change the type of meshes of the chain, allowing the production, in a simple and inexpensive manner, of multiple different models of ornamental chains.

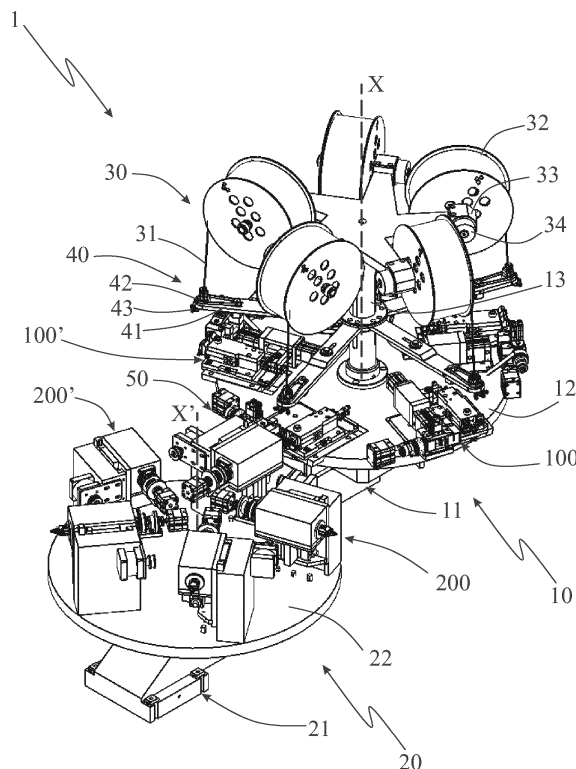


Fig. 1

Description

Field of application

[0001] The present invention regards an automated machine for producing ornamental chains and a process for producing ornamental chains, in particular for producing progressive chains, according to the preamble of the relative independent claims.

[0002] The present machine and the process are inserted in the industrial field of mechanical processing attained by means of cold cutting and plastic deformation of metal wires for jewelry.

[0003] In particular, the machine and the process, object of the invention, are advantageously intended to be employed for making ornamental chains of different varieties, such as grumetta, rolo, spiga, progressive chains, with rings of different dimensions, etc.

State of the art

[0004] Currently in the field of production of jewelry articles, there are machines for producing, in an automated manner, ornamental chains starting from a metal wire, generally made of precious material, such as gold alloys, silver alloys, platinum alloys etc.

[0005] In particular, these machines of known type comprise a support structure on which the following are mounted: a rotatable spool, around which a reel of metal wire is wound, and two operating heads adapted to receive the wire from the rotatable spool in order to make the ornamental chain.

[0006] In particular, the operating heads are arranged for deforming the metal wire in spiral form, cutting it in order to obtain, in succession, open meshes, closing each mesh and then inserting it in the subsequent open mesh.

[0007] The operating heads are adapted to repeat the previously described operations in cyclic mode, until an ornamental chain is obtained with the desired length.

[0008] More in detail, the two operating heads comprise a first operating head adapted to deform and to cut the metal wire for forming the meshes, and a second operating head provided with a gripping gripper adapted to move and maintain the meshes in the correct positions during the operation of the first operating head.

[0009] In particular, the first operating head is provided with a spiraling unit, which is fed with the metal wire and is generally provided with a spiral guide and a spiraling member adapted to advance the metal wire along the spiral guide in order to curve it according to the shape of the latter, up to having such wire exit, spiral-shaped, from an outlet end of the guide itself.

[0010] The first operating head is also provided with a cutting unit, which comprises two knives actuated by a mechanical actuator in order to cut a curved portion of the metal wire in spiral form exiting from the guide of the spiraling unit, in a manner such to obtain a corresponding

open mesh with substantially "C" shape with two separate ends.

[0011] The first operating head also comprises a closing unit provided with a clamp with two internal grooves counter-shaped with respect to the ends of the open mesh and adapted to be shut around such ends by means of a mechanical actuator, so as to bring the two ends close together, obtaining a closed mesh.

[0012] The second operating head is provided with a movement unit connected to the gripping gripper for driving the latter to grasp the shaped portion of the metal wire exiting from the guide of the spiraling unit in order to retain such shaped portion during the cutting executed by the cutting unit and, subsequently, bring the open mesh thus obtained to the closing unit. In addition, after the closing unit has obtained the closed ring, the gripping gripper is driven by the movement unit in order to bring such closed mesh to the outlet of the guide of the spiraling unit in order to insert it at one end of a new shaped portion of the metal wire exiting from the spiraling unit itself.

[0013] In particular, the abovementioned machines of known type are also capable of producing twisted meshes, by driving a twisting of the gripping gripper while the closed mesh is still retained within the clamp of the closing unit.

[0014] Several examples of automated machines of the abovementioned type are described in documents DE 3803498 and EP 0408520.

[0015] The machines for producing ornamental chains of the above-described known type have in practice shown that they do not lack drawbacks.

[0016] The main drawback of these machines of known type lies in the fact that do not allow, at least not in an easy manner, making changes of the characteristics of the chains produced, with meshes of different dimensions.

[0017] Indeed, the dimensions of the mesh are associated with a precise diameter of the metal wire and with precise dimensions of the components of the units of the first operating head which are involved with the processing of the wire itself.

[0018] In addition, in order to obtain a sufficiently high processing precision, also the gripping gripper of the second operating head must have size and an opening tied to the diameter of the metal wire and to the diameter of the mesh.

[0019] Therefore, in the abovementioned machines of known type, in order to change the dimensions of the meshes, it is necessary to substitute most of the components of the operating heads, if not both operating heads completely, with consequent slowing of the production.

[0020] In addition, the abovementioned machines of known type are unable to produce, in an automated manner, a same chain having meshes of different dimensions (of so-called "progressive" type) since the operating heads are capable, in their operating cycle, of producing only one type of mesh.

[0021] Therefore, in order to produce chains with

meshes of different dimensions, it is necessary to produce the different open meshes of the chain with different machines and then assemble the meshes manually, with consequent long production times and high worker costs.

[0022] A further drawback of these machines of known type lies in the fact that they are unable to ensure an optimal shape of the meshes of the chain, since the shaped portion of the metal wire, after it has been cut by the cutting unit, is subjected to a springback (i.e. to a partial recovery of the original form before deformation) which brings the ends of the open mesh to not mate with each other after the closure of the mesh, compromising the precision and the quality of the product.

[0023] A further drawback of these machines of known type lies in the fact that the movements of the units of the operating heads are driven by mechanical actuation members, in particular with cam driving, and therefore it is necessary to re-equip the machine in order to change the settings as a function of the material and shape of the mesh of the chain to be produced.

Presentation of the invention

[0024] In this situation, the problem underlying the present invention is therefore that of overcoming the drawbacks manifested by the abovementioned solutions of known type by providing an automated machine and a process for producing ornamental chains, which allow simply and inexpensively producing multiple different models of ornamental chains, in particular with different types of metal wires and with different dimensions and shapes of meshes.

[0025] More in detail, the claimed configuration, with operating heads mounted on corresponding rotary support bases driven by a control unit (such as a PLC), allows setting, by means of programming the control unit, the sequence for operating the different operating heads associated with the different mesh sizes, allowing the production, in a completely automated manner, of chains of any type (and in particular chains with progressive meshes of any size), according to production requirements.

[0026] A further object of the present invention is to provide an automated machine and a process for producing ornamental chains which are extremely versatile in use, in particular as a function of the different characteristics of the chains to be produced.

[0027] A further object of the present invention is to provide an automated machine and a process for producing ornamental chains which are able to obtain a high quality of the meshes of the chain.

[0028] A further object of the present invention is to provide an automated machine for producing ornamental chains which is simple and inexpensive to make.

Brief description of the drawings

[0029] The technical characteristics of the present invention, according to the aforesaid objects, can be found

in the contents of the below-reported claims and the advantages thereof are more evident in the following detailed description, made with reference to the enclosed figures, which represent a merely exemplifying and non-limiting embodiment of the invention in which:

- figure 1 shows an embodiment of the automated machine for producing chains, object of the present invention;
- figure 2 shows a detail of the machine in figure 1, relative to a work station with a first and a second operating head of the machine itself;
- figure 3 shows a spiraling unit of one of the first operating heads of the machine, object of the present invention;
- figure 4 shows a cutting unit and a closing unit of one of the first heads of the machine, object of the present invention;
- figure 5 shows one of the second operating heads of the machine, object of the present invention;
- figure 6 shows a detail in exploded view of the spiraling unit illustrated in figure 3;
- figures 7a-f show several operating steps of the process for making ornamental chains, object of the present invention.

Detailed description of several preferred embodiments

[0030] With reference to the set of drawings, reference number 1 overall indicates an automated machine for producing ornamental chains in accordance with the present invention.

[0031] This is generally intended to be employed in order to make ornamental chains, such as necklaces or bracelets, starting from a metal wire, and is advantageously capable of producing different types of chains, such as grumetta, rolo, spiga, progressive chains, etc.

[0032] Hereinbelow with the expression "ornamental chain" it will be intended any one type of chain provided with metal meshes (in the form of closed rings) linked in series one after the other, also with different shapes and sizes.

[0033] In addition, with the expression "metal wire" it will be intended any one type of wire made of metal material, in particular precious metal (such as gold, silver, etc.), which can be made of substantially pure metal or of a metal alloy, or of a composite of two or more metals placed in contact. Such metal wire can, moreover, be internally hollow or be provided with a coating of another material, for example a polymer material.

[0034] In addition, with the expression "shaped wire portion" it will be intended a metal wire portion that has sustained a plastic deformation process, such that it has reached a substantially spiral-like shape, with spirals that can for example have substantially circular, oval or square form.

[0035] In addition, with the expression "open mesh" it will be intended a metal wire portion with substantially

curvilinear shape provided with two ends separate from each other, which in particular approximately corresponds to one or a multiple number of spirals of the aforesaid shaped portion.

[0036] In addition, with the expression "closed mesh" it will be intended the same metal wire portion of the mesh, in which the ends are brought close together so as to form a ring, in particular of a chain, with substantially closed form and in particular corresponding to that of the spiral of the metal wire portion.

[0037] In accordance with the embodiment of the enclosed figures, the machine 1 for producing ornamental chains according to the invention comprises at least one feed unit 30, which is adapted to supply a corresponding metal wire 31.

[0038] In addition, the machine 1 comprises at least one first operating head 100, susceptible of being fed with the metal wire 31 and provided with a spiraling unit 110, with a cutting unit 120 and with a closing unit 130.

[0039] The spiraling unit 110 is adapted to curve at least one portion of the metal wire 31, so as to obtain a shaped wire portion 31a in spiral form; the cutting unit 120 is adapted to cut the shaped wire portion 31a, so as to obtain an open mesh 31b provided with two separate ends 31c; the closing unit 130 is adapted to close the separate ends 31c of the open mesh 31b, so as to obtain a closed mesh 31d of a chain.

[0040] The machine 1 according to the invention is provided with at least one second operating head 200 adapted to cooperate with the at least one first operating head 100 and provided with a gripping gripper 210, which is susceptible of acting on the metal wire 31 at the aforesaid spiraling, cutting and closing units 110, 120, 130 of the first operating head 100.

[0041] In accordance with the idea underlying the present invention, the machine 1 comprises a first support base 10, rotatable, which is provided with a first rotation axis X and carries mounted thereon a plurality of the aforesaid first operating heads 100 positioned around the first rotation axis X, and a plurality of the aforesaid feed units 30, each of which operatively associated with the corresponding first operating head 100 in order to supply the corresponding metal wire 31 to the spiraling unit 110 of such first operating head 100.

[0042] In particular, the units 110, 120, 130 of each first operating head 100 (and the corresponding feed unit 30) are configured for operating on corresponding metal wires 31 characterized for example by their diameter and by the physical characteristics of the material forming them. In this manner, the first operating heads 100 can operate on different metal wires 31 in order to make different meshes and chains, as described hereinbelow.

[0043] According to the invention, the machine 1 also comprises a second rotatable support base 20, which is provided with a second rotation axis X' (preferably parallel to the first rotation axis X of the first support base 10) and carries mounted thereon a plurality of the aforesaid second operating heads 200 positioned around the

second rotation axis X'.

[0044] Advantageously, the gripping gripper 210 of each second operating head 200 is configured for operating with a corresponding operating head of the first operating heads 100 and in particular for correctly retaining and moving the metal wire 31 on which such first operating head 100 acts.

[0045] The present machine 1 is provided with a work station 50, which is intercepted by the first and by the second support bases 10, 20, and in which one of the first operating heads 100 and one of the second operating heads 200 are intended to be selectively positioned so as to cooperate with each other for the production of the chains.

[0046] On such matter, the machine 1 comprises first movement means 11 mechanically connected to the first support base 10 and actuatable in order to rotate the latter around its first rotation axis X so as to bring the first operating heads 100 to the work station 50.

[0047] In addition, the machine 1 comprises second movement means 21 mechanically connected to the second support base 20 and actuatable to rotate the latter around its second rotation axis X' so as to bring the second operating heads 200 to the work station 50.

[0048] In addition, the machine 1 is provided with at least one control unit (not shown in the enclosed figures), preferably of electronic type, which is operatively connected to the first movement means 11 and is adapted to drive the latter to rotate the first support base 10 in order to bring a selected first operating head of the first operating heads 100 to the work station 50.

[0049] The control unit is also operatively connected to the second movement means 21 and is adapted to drive the latter to rotate the second support base 20 in order to bring a selected second operating head of the second operating heads 200 to the work station 50.

[0050] In this manner, the machine 1 according to the invention allows producing different types of ornamental chains by simply arranging the corresponding first and second operating heads 100, 200 at the work station 50 adapted to work the corresponding metal wires 31.

[0051] In particular, in order to change the type of chain to be produced, it is sufficient to change the operating heads 100, 200 which operate in the work station 50 by rotating the corresponding support bases 10, 20 by means of the actuation of the respective movement means 11, 21 by the control unit. This allows, with the single machine 1, changing the production in a simple and quick manner, in particular without having to execute complex operations of re-equipping of the machine 1 and without long production downtime.

[0052] Therefore, the present machine 1 allows, by means of electronic management, automatically making any one type of chain and in particular chains with progressive meshes of any size. Indeed, it is possible to make the machine 1 produce meshes of different size, of any number and in any sequence, by simply setting the control unit for driving the actuation of the correspond-

ing operating heads 100, 200 according to the production requirements.

[0053] In particular, the machine 1 allows the automatic production of progressive chains, by means of setting by the operator of the control unit. More in detail, by setting the order of the sizes and of the thicknesses of the meshes and the number of meshes with such sizes and thicknesses, the control unit manages, in an automated manner, the operation of the different first and second operating heads 100, 200 in order to manage passing from the production of a mesh with specific dimensions to a mesh with greater or smaller dimensions and the linking (or binding) of such meshes.

[0054] Advantageously, the control unit of the machine 1 comprises at least one electronic unit (such as a PLC) programable for driving, in an automated manner, the operation of the operating heads 100, 200 for producing the ornamental chains.

[0055] In particular, the control unit comprises a drive panel by means of which a user can drive different operating settings (e.g. the operating heads 100, 200 which work in the work station 50).

[0056] The control unit can comprise multiple hardware units arranged for different components of the machine 1 (for example a central coordination unit or multiple peripheral units associated with the operating heads 100, 200), or it can be integrated in a same unit.

[0057] Advantageously, the movement means 11, 21 (adapted to drive the rotation of the corresponding support bases) comprise corresponding actuator motors (e.g. of electric or hydraulic type) mechanically connected, preferably by means of suitable transmission members, to the corresponding support bases 10, 20. Of course, without departing from the protective scope of the present patent, the movement means can comprise only one motor or power actuation connected to the two support bases 10, 20 by means of corresponding transmission members intended to be enabled in a controlled manner in order to actuate the movement of the corresponding support base 10, 20.

[0058] Therefore, the invention allows exchanging the first operating heads 100 and the second operating heads 200 with each other, if necessary, and sequentially associating corresponding first and second operating heads 100, 200 during the operation of the machine 1 without re-equipping it.

[0059] In particular, such exchange occurs in the modes provided by the present process, which will be illustrated in detail subsequently.

[0060] Advantageously, the first support base 10 comprises a first rotation shaft 13, positioned coaxially with first rotation axis X and mechanically connected to the first movement means 11, and a first platform 12, which is fixed to the first rotation shaft 13 and carries the first operating heads 100 peripherally mounted thereon.

[0061] Advantageously, the first platform 12 is fixed coaxially with respect to the first rotation shaft 13 and for example has substantially circular shape.

[0062] Preferably, the feed units 30 are mounted on the first rotation shaft 13 above the corresponding first operating heads 100.

[0063] Advantageously, the second support base 20 comprises (analogous to the first support base 10) a second rotation shaft positioned coaxially with the second rotation axis X' and mechanically connected to the second movement means 21, and a second platform 22, fixed to the second rotation shaft and carrying, peripherally mounted thereon, the second operating heads 200.

[0064] Advantageously, the second platform 22 is fixed coaxially with respect to the second rotation shaft and preferably has a substantially circular shape.

[0065] Advantageously, the work station 50 of the machine 1 is identified at the zone where the edge of the first platform 12 is across from the edge of the second platform 22 (in substance corresponding to the zone of least distance between the edges of the two platforms 12, 22), such zone in particular being traversed by a line that joins the two rotation axes X, X' of the support bases 10, 20.

[0066] Preferably, each feed unit 30 comprises a rotatable spool 32, which is provided with a shaft 33 rotatably constrained to the first support base 10 and on which the corresponding metal wire 31 is susceptible of being wound.

[0067] Advantageously, each feed unit 30 comprises a tensioning friction 34 acting on the shaft 33 of the rotatable spool 32 in order to maintain the metal wire 31 under tension.

[0068] In particular, the tensioning friction 34 is adapted to maintain the metal wire 31 at a constant tension and allows maintaining such tension constant even with the decrease of the diameter of the metal wire 31 winding around the spool 32.

[0069] For example, the aforesaid tensioning friction 34 is a magnetic tensioning friction.

[0070] Advantageously, the first support base 10 comprises a plurality of guide units 40 which are mounted on the first rotation shaft 13 and are positioned, each between the corresponding feed unit 30 and the corresponding first operating head 100, in order to intercept the metal wire 31 and maintain it in the desired position.

[0071] In particular, with reference to the embodiment of figure 2, each guide unit 40 comprises a support body 41, which is extended, preferably with elongated shape, in radial direction with respect to the first rotation axis X of the first support base 100, between an internal end, fixed to the first rotation shaft 13 and an opposite external end. The support body 41 is provided, at its external end, with at least one guide hole 42 positioned aligned above the spiraling unit 110 of the corresponding first operating head 100 and is susceptible of being traversed by the corresponding metal wire 31 in order to guide it towards such spiraling unit 110.

[0072] In addition, the guide unit 40 is advantageously provided with at least one photocell 43 and with a system for controlling the position of the wire 44 operatively con-

nected to the photocell 43 and adapted to rotate, around its own axis, the metal wire 31 that traverses the guide hole 42 of the guide unit 40. Such system for controlling the positioning of the wire 44 advantageously allows, if the metal wire has a visible longitudinal line, positioning such line always in the same position with respect to the guide hole 42 in a manner such that it is always positioned in the same side as the meshes to be produced.

[0073] As stated above, each feed unit 30 is adapted to feed the corresponding first operating head 100 with a corresponding metal wire 31.

[0074] Advantageously, with reference to figures 2, 3 and 6, the spiraling unit 110 of each first operating head 100 is situated in an approached position with respect to the cutting unit 120 and comprises a containment body 111, advantageously elongated, which is extended longitudinally along an extension axis Y and within which a spiral-shaped guide 112 is fixed which is extended along the same extension axis Y between a first end 112a and a second end 112b placed at the cutting unit 120.

[0075] In particular, the containment body 111 has substantially tubular shape and is provided with a longitudinal opening 111' intended to be traversed by the metal wire 31 coming from the feed unit 30 in order to allow the metal wire 31 to enter into the spiral-shaped guide 112.

[0076] The spiral-shaped guide 112 is provided with a central cavity 113, which is extended along the extension axis Y between the first and the second end 112a, 112b of the guide 112, and with a track 114, which is extended with spiral extension around the central cavity 113 between the first end 112a and the second end 112b and is susceptible of receiving the metal wire 31 at its interior.

[0077] Advantageously, the spiraling unit 110 also comprises a winding core 116, which is extended within the central cavity 113 of the spiral-shaped guide 112 along the same extension axis Y and is moved by the rotary and translational actuation means 117, 118.

[0078] More in detail, the translational actuation means 117 are mechanically connected to the winding core 116 and are adapted to translate it along the extension axis Y in a first operating travel, in which the winding core 116 is moved towards the second end 112b of the spiral-shaped guide 112, and in a second operating travel, in which the winding core 116 is moved away from the second end 112b of the spiral-shaped guide 112.

[0079] In particular, during the first and the second operating travel, the winding core 116 is moved between a first end stop position, in which it is situated in proximity to the first end 112a of the spiral-shaped guide 112, at a feed point 115 for feeding the metal wire 31 into the spiral-shaped guide 112, and a second end stop position, in which it is situated in proximity to the second end 112b of the spiral-shaped guide 112.

[0080] Preferably, the winding core 116 is always contained within the central cavity 113 of the spiral-shaped guide 112.

[0081] In addition, the rotary actuation means 118 are mechanically connected to the winding core 116 and are

adapted to rotate it around the extension axis Y in the first operating travel, in order to advance the metal wire 31 in the track 114 of the spiral-shaped guide 112 towards the cutting unit 120, in a manner such that, following the advancement of the metal wire 31 in the track 114 of the spiral-shaped guide 112, a spiral-shaped wire portion 31a exits from the second end 112b of such guide 112.

[0082] In operation, the winding core 116 engages, with its external surface via friction, the metal wire 31 and, following its rotational-translational movement during the first operating travel, drives the metal wire 31 along the track 114 in a manner such that the metal wire 31 is plastically deformed as a spiral, according to the extension of the track 114 itself. At the end of the first operating travel, the winding core 116 is brought back, by means of the second operating travel, into the first end stop position.

[0083] Preferably, the winding core 116 is provided with substantially oval section, in order to facilitate the engagement of the metal wire 31 during its rotational-translational motion.

[0084] In particular, the winding core 116 has frusto-conical shape, with smaller diameter in proximity to the second end 112b of the spiral-shaped 112, in order to facilitate the disengagement at least of the shaped wire portion 31a during the second operating travel.

[0085] In accordance with the preferred embodiment of the present invention illustrated in the enclosed figures, the rotary actuation means 118 comprise at least one rotation electric motor 119, which is provided with a rotor mechanically connected to the winding core 116 and is actuatable in order to rotate it during the first operating travel.

[0086] Advantageously, the rotation of the winding core 116 is actuated to rotate with the same rotation direction as that defined by the extension of the track 114.

[0087] In order to enable the rotation of the winding core 116, the control unit comprises a first electronic actuation module operatively connected to the rotation electric motor 119.

[0088] Advantageously, the first actuation module is also connected to the translational actuation means 117 in order to control the translation of the winding core 116.

[0089] In particular, the first electronic actuation module is programmed for driving in rotation electric motor 119 to rotate the winding core 116, during the first operating travel, by a rotation angle which is settable with a specific deviation value.

[0090] In particular, the aforesaid deviation value is defined as an additional angular value with respect to an angle of 360°.

[0091] Such deviation value allows compensating for possible springbacks of the metal wire 31 during the formation of the mesh, so as to ensure a precise correspondence of the ends of each closed mesh 31d.

[0092] Indeed, as is known, the metal wire 31 is subject to the phenomenon of hardening, i.e. to the increase of its own elastic modulus and hardness, and to the dimi-

nution of its own ductility when it is subjected to plastic deformations. For example, the wire wound in the rotatable spool 32 of the feed unit 30 undergoes plastic deformations that are different in relation to the proximity to the shaft 33 of the spool 32. In particular, the deformation, and therefore the elastic modulus, increases close to the shaft of the spool 32.

[0093] In addition, the metal wire 31 is provided with different elastic modulus also in relation to the material forming it, to the heat treatments to which it was subjected and other other processing variables. It is also known that the metal wire 31, by undergoing a subsequent deformation when it is worked by the spiraling unit 110, is subjected to a springback proportional to its elastic modulus and, hence, a rotation angle of the winding core of 360° is not sufficient for producing a closed mesh 31d with the ends in contact.

[0094] The first electronic actuation module and the rotary actuation means 118 of the invention allow setting the deviation value of the rotation angle as a function of the springback of the metal wire 31, ensuring a high precision in attaining the mesh.

[0095] With reference to the embodiment illustrated in figure 4, the cutting unit 120 of each first operating head 100 comprises a pair of knives 121, which are fixed to respective cutting supports 122 mechanically connected to at least one cutting actuator 123.

[0096] The cutting actuator 123 is adapted to move the pair of knives 121 between a first open position, in which the knives 121 are spaced from each other, in order to allow the shaped wire portion 31a to be inserted therebetween, and a first closed position, in which the knives 121 are closed against each other, in order to cut the shaped wire portion 31a.

[0097] In order to arrange the movement of the cutting unit 120 between the first open and closed positions, the first electronic actuation module is operatively connected to the cutting actuator 123.

[0098] According to the preferably embodiment, the closing unit 130 comprises a clamp 131, which is provided with a first and a second jaw 134, fixed on respective closure supports 132 mechanically connected to at least one closure actuator 133.

[0099] Advantageously, the first and the second jaw 134 are respectively provided with a first and a second internal face 135, which are facing and counter-shaped in order to be placed against each other.

[0100] In particular, on each internal face 135, a groove 136 is present that is counter-shaped with respect to a portion of closed mesh 31d corresponding to the separate ends 31c of the open mesh 31b.

[0101] The closure actuator 133 is adapted to move the jaws 134 between a first open position, in which the jaws 134 are spaced from each other, in order to allow inserting the separate ends 31c of the open mesh 31b between the jaws 134 themselves, and a second closed position, in which the first and the second internal faces 135 are pressed in contact with each other, in order to

close the open mesh 31b and form the corresponding closed mesh 31d.

[0102] In order to arrange the movement of the closing unit 130 between the first open and closed positions, the first electronic actuation module is operatively connected to the closure actuator 133.

[0103] Advantageously, the closure supports 132 coincide with the cutting supports 122 and the closure actuator 133 coincides with the cutting actuator 123.

[0104] With reference to the embodiment of figure 5, each second operating head 200 comprises driving means 212, with electrical actuation, mechanically connected to the gripping gripper 210 and actuable for driving the gripping gripper 210 to be moved during the operation thereof.

[0105] In particular, the aforesaid driving means 212 are arranged for moving the gripping gripper 210 in an automated manner during opening and closing, and preferably for moving the gripping gripper 210 along a first displacement axis S1 parallel to the second rotation axis X' of the second support base (e.g. vertical) and advantageously along a second displacement axis S2 orthogonal to the first displacement axis S1 and substantially radial with respect to the second rotation axis X'.

[0106] Preferably, moreover, the driving means 212 are arranged for rotating the gripping gripper 210 around the aforesaid second displacement axis S2.

[0107] For example, each second operating head 200 comprises a support frame 201 fixed to the second support base 20 (and in particular to the second platform 22 of the latter) and carries the driving means 212 mounted thereon. The latter comprise a linear guide 202 extended according to the first displacement axis S1 and on which a slide 203 is slidably mounted; the gripping gripper 210 is mounted on such slide 203. The driving means 212 also comprise a first actuator 204 (e.g. electro-pneumatic) connected to the slide 203 in order to move it along the linear guide 202.

[0108] Advantageously, the driving means 212 comprise a gripper holder shaft 213 slidably mounted on the slide 203, longitudinally extended along the second displacement axis S2 and provided with an external end 213' (directed away from the second rotation axis X' of the second support base 20) on which the gripping gripper 210 is mounted. The driving means 212 are also provided with a second actuator 205 (e.g. electro-pneumatic) connected to the gripper holder shaft 213 in order to actuate the latter to slide along the second displacement axis S2.

[0109] Preferably, the gripper holder shaft 213 is rotatably mounted on the slide 203 and is connected to a third actuator 206 of the driving means 212 (e.g. an electric motor) adapted to rotate the gripper holder shaft 213 around the second displacement axis S2.

[0110] In particular, the gripping gripper 210 is susceptible of being moved by the driving means 212 between a first operating position, in which the gripping gripper 210 is positioned at the cutting unit 120 in order to retain

the open mesh 31b cut by the cutting unit 120 itself, and a second operating position, in which the gripping gripper 210 is positioned at the closing unit 130 in order to retain the open mesh 31b at the latter.

[0111] Advantageously, the gripping gripper 210 is provided with two tips 211, which are susceptible of being moved by the driving means 212 (and in particular by a fourth actuator of the latter) between a release position, in which the tips 211 are separated from each other and a retention position, in which the tips 211 are brought close together, up to grasping and retaining the metal wire portion 31, the open mesh 31b or the closed mesh 31d.

[0112] In order to arrange the movement of the gripping gripper 210, the control unit comprises a second electronic actuation module operatively connected to the driving means 212 (in particular to its actuators) for driving these, in an automated manner, to move the gripping gripper 210 between the first operating position and the second operating position.

[0113] Advantageously, the second actuation module 62 is also programmed for driving driving means 212 to move the gripping gripper 210 between the release position and the retention position.

[0114] Preferably, the second actuation module 62 is also programmed for driving means 212 to rotate the gripping gripper 210 by a settable twisting angle, in particular around the second displacement axis S2, advantageously by means of the rotation of the gripper holder shaft 213.

[0115] For example, the gripping gripper 210 is driven to rotate when the closed mesh 31d is situated between the first and the second jaw 134 in the second closed position thereof so as to obtain a twisted mesh 31e. In such case, the twisting angle of the gripping gripper 210 corresponds with the twisting angle of the twisted mesh 31e.

[0116] According to another possible example, the gripping gripper 210 rotates when it is situated in the first operating position following the closure of the open mesh 31b, so as to rotate the mesh in order to insert a further shaped wire portion 31f at its interior.

[0117] Advantageously, the gripping gripper 210 rotates both to obtain the twisted mesh 31e and to insert the further shaped wire portion 31f at its interior.

[0118] Preferably, as stated above, the control unit can be physically obtained with a unique and centralized unit or with multiple hardware units which in particular implement the first and second electronic actuation modules and are positioned for example in the first and second support bases 10, 20.

[0119] Analogously, the first and the second electronic actuation module can each comprise only one corresponding hardware unit adapted to drive the corresponding operating heads 100, 200, or they can comprise multiple separate units, each adapted to drive the corresponding operating head 100, 200.

[0120] Also forming the object of the present finding is a process for producing ornamental chains, in particular

for producing progressive chains, actuated by means of the automated machine 1 of the above-described type, regarding which the same reference numbers will be maintained hereinbelow for the sake of description simplicity.

[0121] In accordance with the idea underlying the present invention, the present process comprises at least one first step of setting a selected first operating head of the first operating heads 100, in which the first movement means 11 actuate the first support base 10 to rotate in order to bring the selected first operating head 100 to the work station 50.

[0122] In addition, the process comprises at least one second step of setting a selected second operating head of the second operating heads 200, in which the second movement means 21 actuate the second support base 20 to rotate in order to bring the selected second operating head 200 to the work station 50 in order to associate the selected second operating head 200 with the selected first operating head 100.

[0123] Advantageously, the aforesaid setting steps are actuated, for example by the operator through the drive panel of the control unit, at the start of a production process in order to select the type of chain to be produced (and hence the corresponding first and second operating heads 100, 200).

[0124] The process also comprises a bending step, in which the metal wire 31 is bent by the spiraling unit 110 of the selected first operating head 100, obtaining the shaped wire portion 31a in spiral form.

[0125] In particular, in the bending step, the winding core 116 of the spiraling unit 110 is actuated to execute the first operating travel towards the cutting unit 120, and is simultaneously actuated to rotate around the extension of the extension axis Y by a rotation angle, which is set with a specific deviation value defined as a function of a springback of the metal wire 31.

[0126] More particularly, the metal wire 31 is fed into the track 114 of the spiral-shaped guide 112 at the first end 112a of the guide itself and is driven to be deformed within the track 114 by the winding core 116 in the first operating travel, obtaining the shaped wire portion 31a.

[0127] The process also comprises a gripping step, subsequent to the bending step, in which the gripping gripper 210 of the selected second operating head 200 grasps the shaped wire portion 31a at the spiraling unit 110.

[0128] Subsequent to the gripping step, the process comprises a cutting step, in which the gripping gripper 210 retains the shaped wire portion 31a in spiral form advantageously at the cutting unit 120 and the cutting unit 120 cuts the shaped wire portion 31a retained by the gripping gripper 210, obtaining an open mesh 31b provided with two separate ends 31c.

[0129] In particular, the cutting step occurs through the movement of the knives 121 of the cutting unit 120 from the first open position to the first closed position.

[0130] Advantageously, the cutting step is followed by

a first movement step, in which the gripping gripper 210 moves the open mesh 31b at the closing unit 130 and in particular between the first and the second jaw 134.

[0131] Then, the process comprises a closing step, following the cutting step, in which the closing unit 130 brings close together the two separate ends 31c of said open mesh 31b retained by said gripping gripper 210, obtaining a closed mesh 31d.

[0132] In particular, the closing step occurs after the first movement step.

[0133] In operation, during the closing step, the first and the second jaw 134 are closed with a shutting force, while the separate ends 31c of the open mesh 31b are engaged in the grooves 136 on the internal faces 135 of the jaws 134 and are thrust to approach each other up to obtaining the closed mesh 31d.

[0134] According to an embodiment variant of the process, for the purpose of obtaining a twisted mesh 31e, the process also comprises a twisting step, after the closing step, in which the closed mesh 31d is simultaneously retained by the gripping gripper 210 and by the closing unit 130 and the gripping gripper 210 rotates around the second displacement axis S2.

[0135] Advantageously, the process following the closing step comprises the reopening of the jaws 134 and a second movement step, in which the gripping gripper 210 brings the closed mesh 31d back to the spiraling unit 110.

[0136] If there is a twisting step, the reopening of the jaws 134 and the second movement step occur after the twisting step.

[0137] The process also comprises a binding step, following the closing step, in which a further shaped wire portion 31f is inserted in the closed mesh 31d retained by the gripping gripper 210.

[0138] In particular, the binding step occurs after the second movement step.

[0139] In operation, during the binding step the gripping gripper 210 positions and retains the closed mesh 31d in proximity to the spiraling unit 110 in a manner such that the further shaped portion 31f, exiting outward from the spiraling unit 110, is inserted in the open mesh 31b, before being cut.

[0140] The process finally comprises a release step, in which the gripping gripper 210 releases the closed mesh 31d.

[0141] The aforesaid steps of the process, from that of bending to that of release, are cyclically repeated in order to produce a chain of the desired length.

[0142] Advantageously, so as to make chains of progressive type (constituted by meshes of different type) the present process can provide for changing - with each mesh production cycle - the first and the second operating head 100, 200 positioned at the work station 50 so as to make and link together meshes obtained with metal wires that are different and/or that have different shapes.

[0143] For such purpose, the first setting step of the selected first operating head 100 and the second setting step of the selected second operating head 200 are ex-

ecuted in each cycle for producing a mesh in order to change the operating heads 100, 200 (and hence the type of mesh produced) with each cycle.

[0144] More in detail, with each cycle, the first setting step is executed between the closing step and the binding step in order to bring another of the first operating heads 100' to the work station 50.

[0145] In particular, the first setting step follows the second movement step.

[0146] Advantageously, in the subsequent binding step, the further shaped wire portion 31f produced by the other first operating head 100' is inserted in the closed mesh 31d retained by the gripping gripper 210.

[0147] In addition, with each cycle, after the release step, the second setting step is executed in order to bring another of the second operating heads 200' to the work station 50.

[0148] Of course, without departing from the protective scope of the present patent, the setting steps can also be executed once every two or more cycles, or with variable frequency, as a function of the type and order of arrangement of the meshes of the chain to be produced.

[0149] Preferably, the above-described cyclic cycle of the setting steps is obtained by means of a suitable programming of the control unit of the machine 1.

[0150] The invention thus conceived therefore attains the pre-established objects.

30 Claims

1. Automated machine (1) for producing ornamental chains, which comprises:

- at least one feed unit (30), which is adapted to supply a corresponding metal wire (31);
- at least one first operating head (100), susceptible of being fed with said metal wire (31) and provided with:

- a spiraling unit (110), adapted to curve at least one portion of said metal wire (31), so as to obtain a shaped wire portion (31a) in spiral form;

- a cutting unit (120), adapted to cut said shaped wire portion (31a), so as to obtain an open mesh (31b);

- a closing unit (130), adapted to close said open mesh (31b), so as to obtain a closed mesh (31d) of a chain;

- at least one second operating head (200) adapted to cooperate with said at least one first operating head (100) and provided with a gripper (210) for gripping the metal wire (31), which is susceptible of acting on said metal wire (31) at said spiraling, cutting and closing units (110, 120, 130);

said automated machine (1) being **characterized in that** it also comprises:

- a first support base (10), rotatable, which is provided with a first rotation axis (X) and carries mounted thereon:
 - a plurality of said first operating heads (100) positioned around said first rotation axis (X), and
 - a plurality of said feed units (30), each of which is operatively associated with a corresponding said first operating head (100) in order to supply the corresponding said metal wire (31) to the spiraling unit (110) of said first operating head (100);
- a second rotatable support base (20), which is provided with a second rotation axis (X') and carries mounted thereon a plurality of said second operating heads (200) positioned around said second rotation axis (X');
- a work station (50) intercepted by said first support base (10) and by said second support base (20);
- first movement means (11) mechanically connected to said first support base (10) and actuable in order to rotate said first support base (10) around said first rotation axis (X);
- second movement means (21) mechanically connected to said second support base (20) and actuable in order to rotate said second support base (20) around said second rotation axis (X');
- at least one control unit, which:
 - is operatively connected to said first movement means (11) and is adapted to drive said first movement means (11) to rotate said first support base (10) in order to bring a selected first operating head of said first operating heads (100) to said work station (50),
 - is operatively connected to said second movement means (21) and is adapted to drive said second movement means (21) to rotate said second support base (20) in order to bring a selected second operating head of said second operating heads (200) to said work station (50).

2. Automated machine (1) according to claim 1, characterized in that said spiraling unit (110) comprises:

- a containment body (111), which is extended along an extension axis (Y);
- a spiral-shaped guide (112), which is fixed within said containment body (111), is extended along said extension axis (Y) between a first end

(112a) and a second end (112b) placed at said cutting unit (120), and is provided with:

- a central cavity (113) extended along said extension axis (Y) between said first end (112a) and said second end (112b);
- a track (114) which is extended with spiral extension around said central cavity (113) between the first end (112a) and the second end (112b) of said spiral-shaped guide (112), and is susceptible of receiving said metal wire (31) at its interior;
- a winding core (116) extended within the central cavity (113) of said spiral-shaped guide (112) along said extension axis (Y);
- translational actuation means (117) mechanically connected to said winding core (116) and adapted to translate said winding core (116) along said extension axis (Y) in a first operating travel, in which said winding core (116) is moved towards the second end (112b) of said spiral-shaped guide (112), and in a second operating travel, in which said winding core (116) is moved away from the second end (112b) of said spiral-shaped guide (112);
- rotary actuation means (118), mechanically connected to said winding core (116) and adapted to rotate said winding core (116) around said extension axis (Y) in said first operating travel, in order to advance said metal wire (31) in the track (114) of said spiral-shaped guide (112) towards said cutting unit (120).

3. Automated machine (1) according to claim 2, characterized in that said rotary actuation means (118) comprise at least one rotation electric motor (119) provided with a rotor mechanically connected to said winding core (116) and actuable in order to rotate said winding core (116) in said first operating travel.

4. Automated machine (1) according to claim 3, characterized in that said control unit comprises at least one first electronic actuation module operatively connected to said rotation electric motor (119) and programmed for driving said rotation electric motor (119) to rotate said winding core (116), in said first operating travel, by a rotation angle which is settable with a specific deviation value intended to be defined as a function of a springback of said metal wire (31).

5. Automated machine (1) according to one of the preceding claims, characterized in that each said second operating head (200) comprises drive means (212), with electrical actuation, mechanically connected to said gripping gripper (210) and actuable for driving said gripping gripper (210) to be moved between:

- a first operating position, in which said gripping gripper (210) is positioned at said cutting unit (120) at least for retaining said open mesh (31b) cut by said cutting unit (120), and
- a second operating position, in which said gripping gripper (210) is positioned at said closing unit (130) for retaining said open mesh (31b) at said closing unit (130);

wherein said control unit comprises a second electronic actuation module operatively connected to said drive means (212) in order to drive, in an automated manner, said drive means (212) to move said gripping gripper (210) between said first operating position and said second operating position.

6. Automated machine (1) according to one of the preceding claims, **characterized in that** said first support base (10) comprises:

- a first rotation shaft (13), positioned coaxially with said first rotation axis (X) and mechanically connected to said first movement means (11);
- a first platform (12) fixed to said first rotation shaft (13) and carrying, peripherally mounted thereon, said first operating heads (100);

wherein said feed units (30) are mounted on said first rotation shaft (13) above the corresponding said first operating heads (100).

7. Automated machine (1) according to claim 6, **characterized in that** each said feed unit (30) comprises

- a rotatable spool (32), which is provided with a shaft (33) rotatably constrained to said first support base (10) and on which the corresponding said metal wire (31) is susceptible of being wound;
- a tensioning friction (34) acting on the shaft (33) of the rotatable spool (32) in order to maintain said metal wire (31) under tension.

8. Process for producing ornamental chains actuated by means of an automated machine (1) according to any one of the preceding claims, and such process comprises the following steps in succession:

- a bending step, wherein said metal wire (31) is bent by said spiraling unit (110), obtaining said shaped wire portion (31a) in spiral form,
- a gripping step, wherein said gripping gripper (210) grasps said shaped wire portion (31a) at said spiraling unit (110),
- a cutting step, wherein said cutting unit (120) cuts said shaped wire portion (31a) retained by said gripping gripper (210), obtaining an open mesh (31b) provided with two separate ends

(31c),

- a closing step, wherein said closing unit (130) brings close together the two separate ends (31c) of said open mesh (31b) retained by said gripping gripper (210), obtaining a closed mesh (31d),
- a binding step, wherein a further shaped wire portion (31f) is inserted in said closed mesh (31d) retained by said gripping gripper (210),
- a release step, wherein said gripping gripper (210) releases said closed mesh (31d),

said steps being cyclically repeated;

said process being **characterized in that** it also comprises:

- at least one first step of setting a selected first operating head of said first operating heads (100), wherein said first movement means (11) actuate said first support base (10) to rotate in order to bring said selected first operating head (100) to said work station (50);
- at least one second step of setting a selected second operating head of said second operating heads (200), wherein said second movement means (21) actuate said second support base (20) to rotate in order to bring said selected second operating head (200) to said work station (50) in order to associate said selected second operating head (200) with said selected first operating head (100).

9. Process according to claim 8, **characterized in that** it comprises, between said closing step and said binding step, said first setting step in order to bring another of said first operating heads (100') to said work station (50); wherein, in said subsequent binding step, said further shaped wire portion (31f) produced by said other first operating head (100') is inserted in said closed mesh (31d) retained by said gripping gripper (210); wherein said process comprises, after said release step, said second setting step in order to bring another of said second operating heads (200') to said work station (50).

10. Process according to claim 8 or 9, obtained by means of an automated machine (1) according to claim 4, **characterized in that**, in said bending step, said winding core (116) is actuated to execute said first operating travel towards said cutting unit (120), and is simultaneously actuated to rotate around said extension axis (Y) by a rotation angle, which is set with a specific deviation value as a function of a spring-back of said metal wire (31).

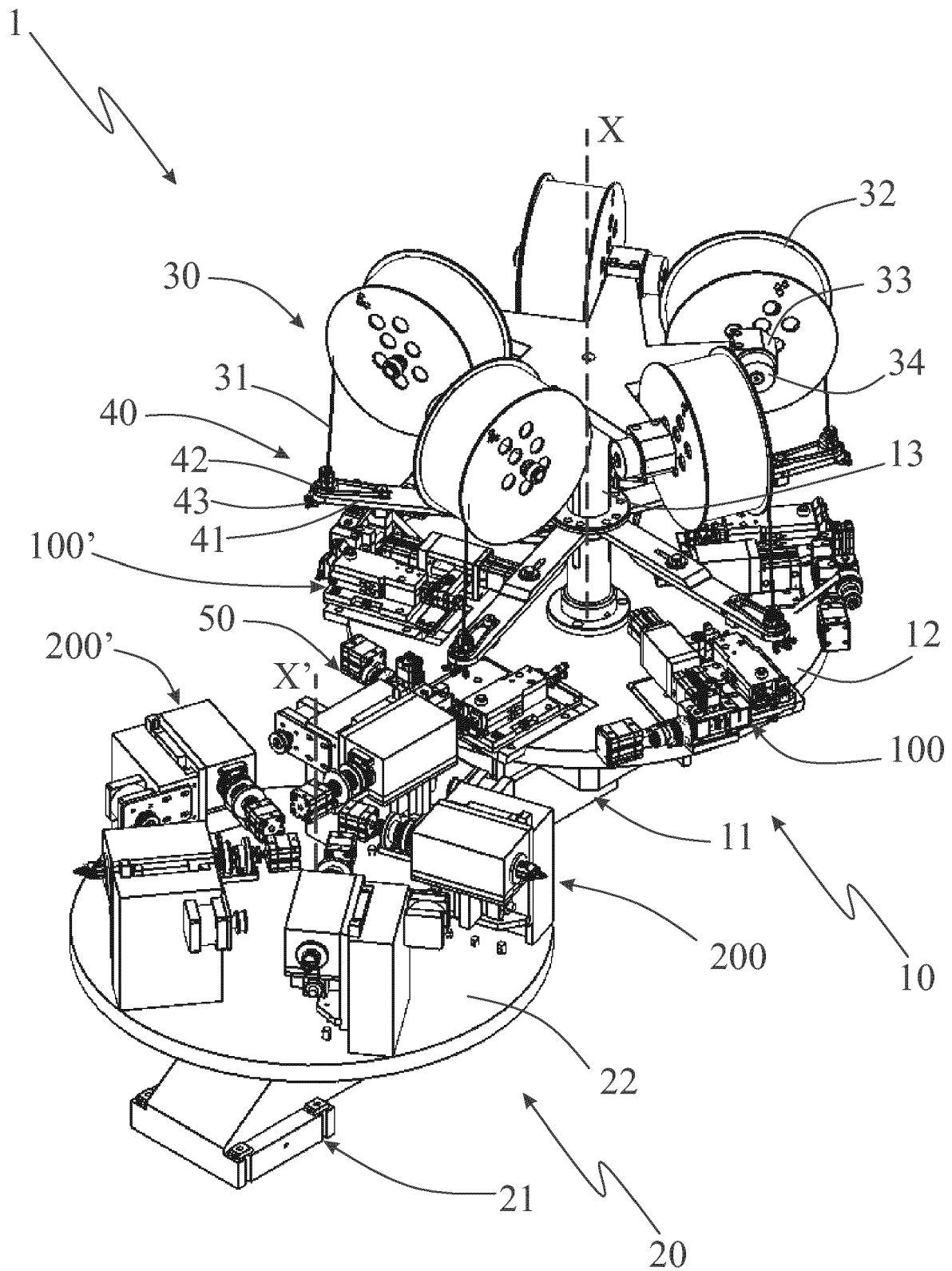


Fig. 1

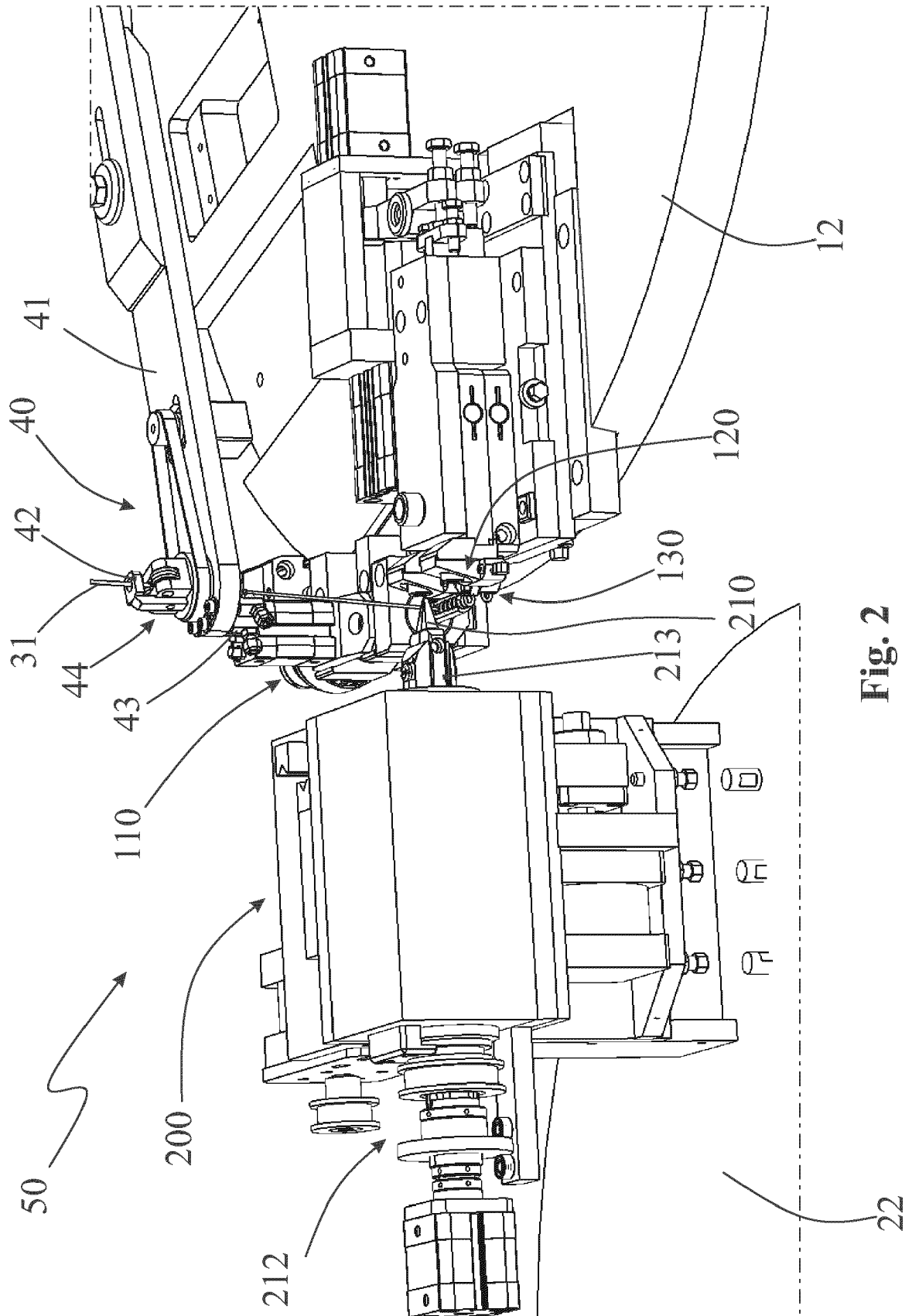


Fig. 2

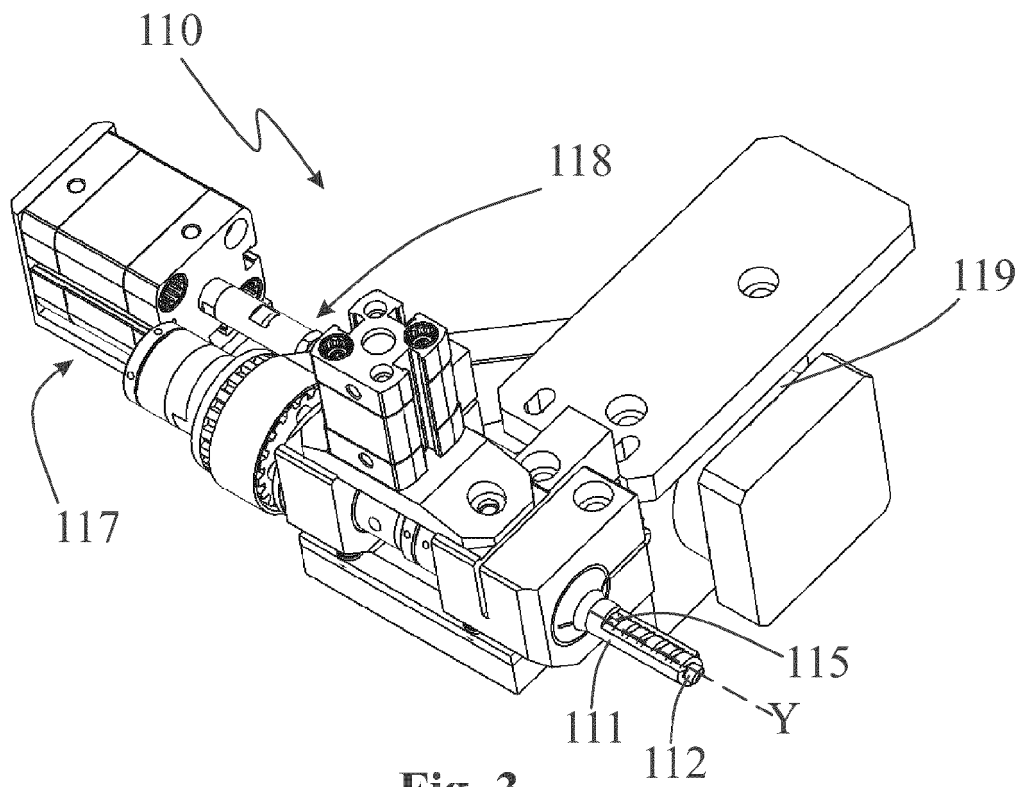


Fig. 3

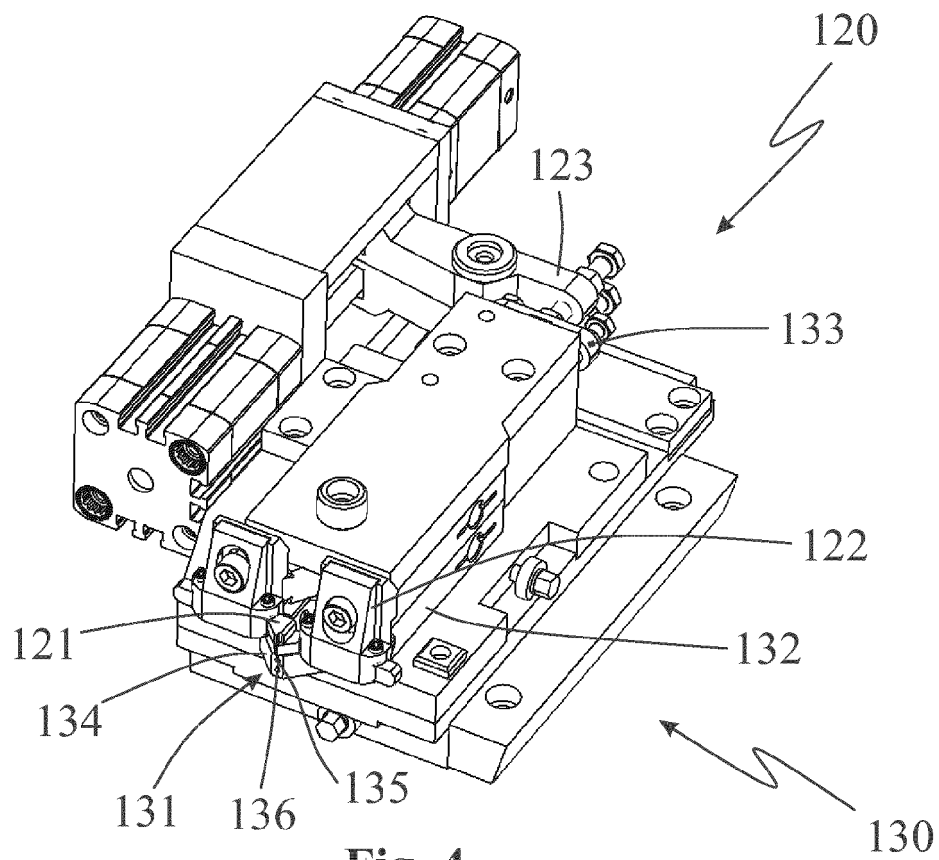


Fig. 4

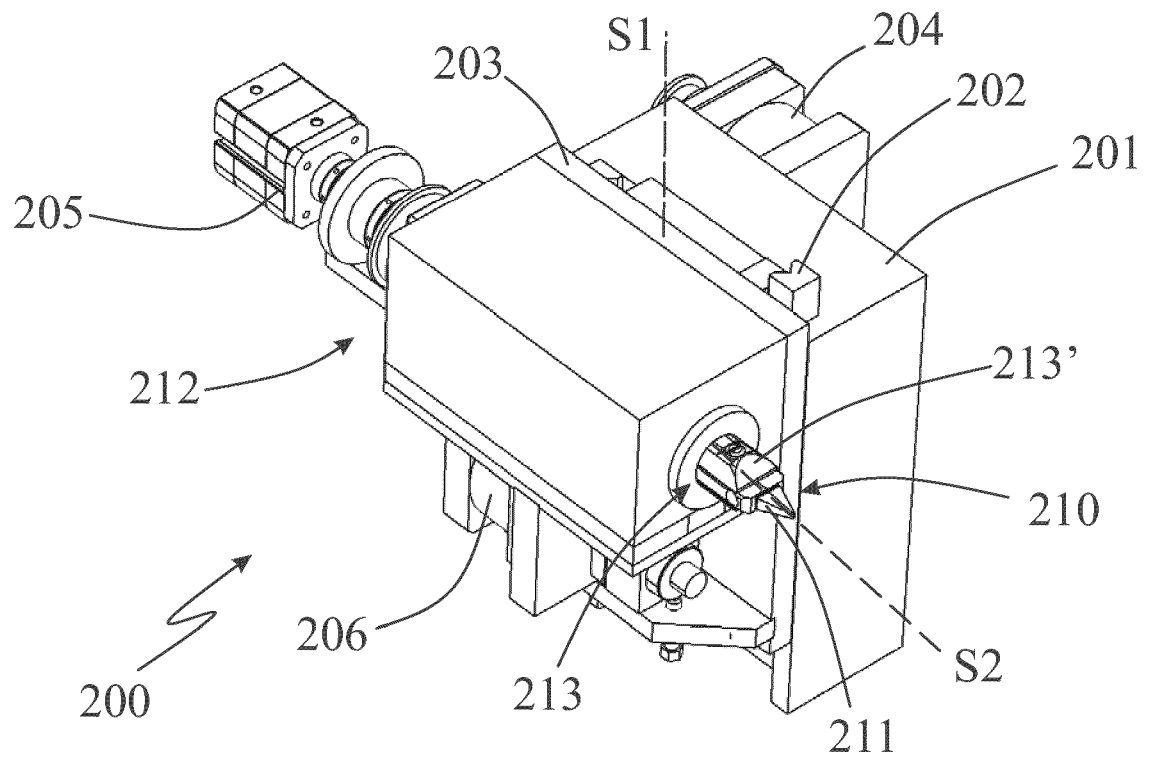


Fig. 5

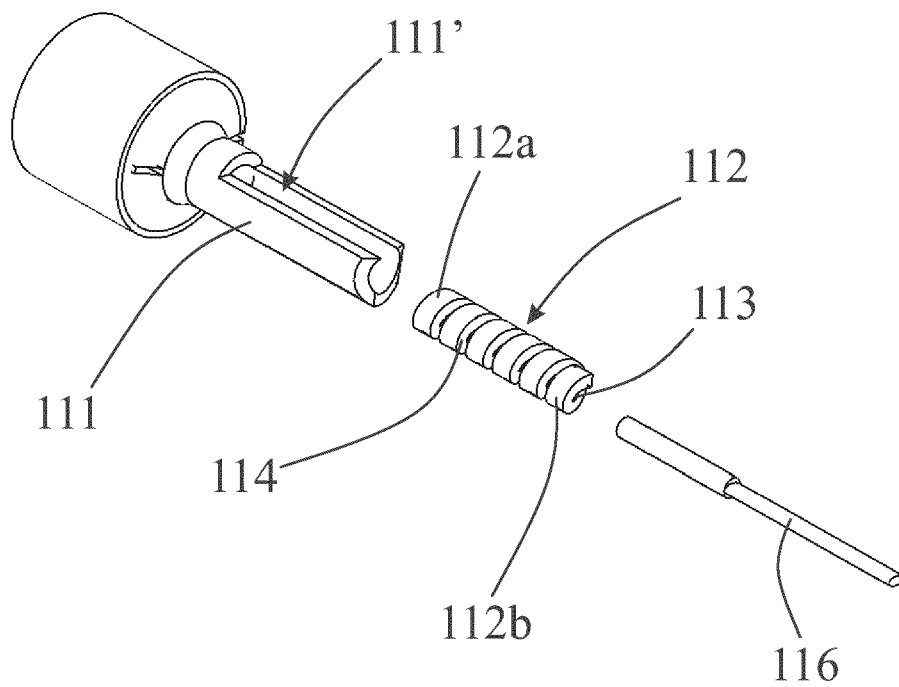


Fig. 6

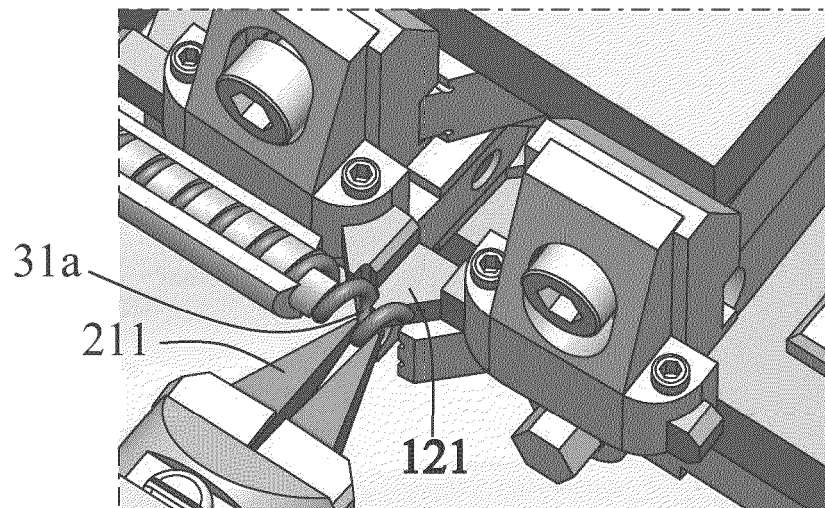


Fig. 7a

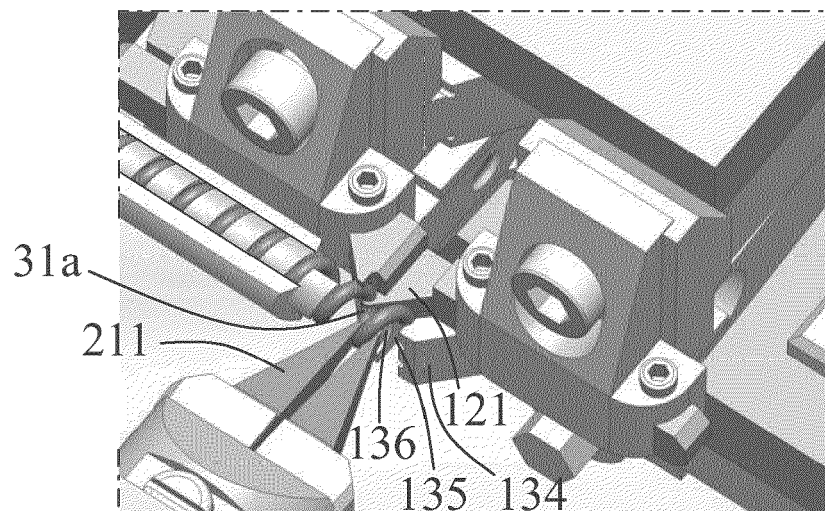


Fig. 7b

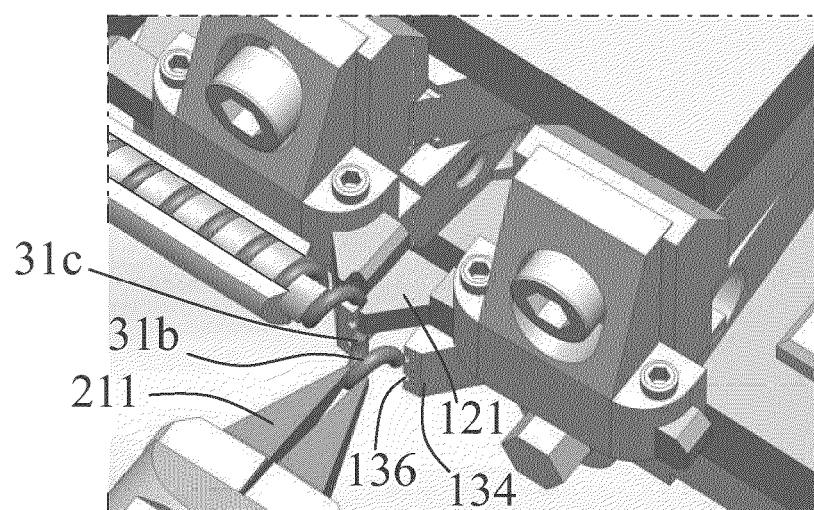


Fig. 7c

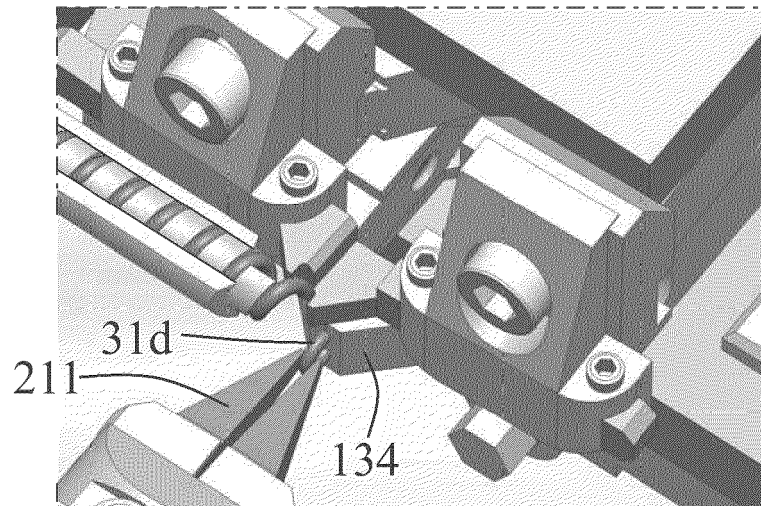


Fig. 7d

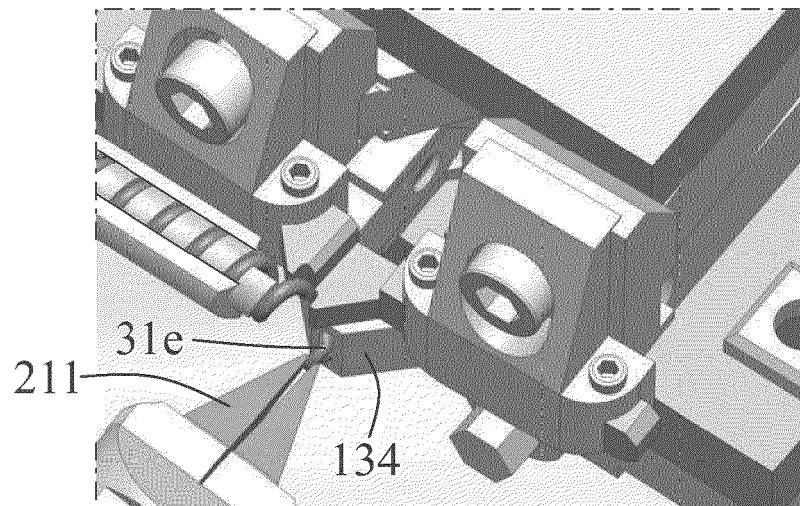


Fig. 7e

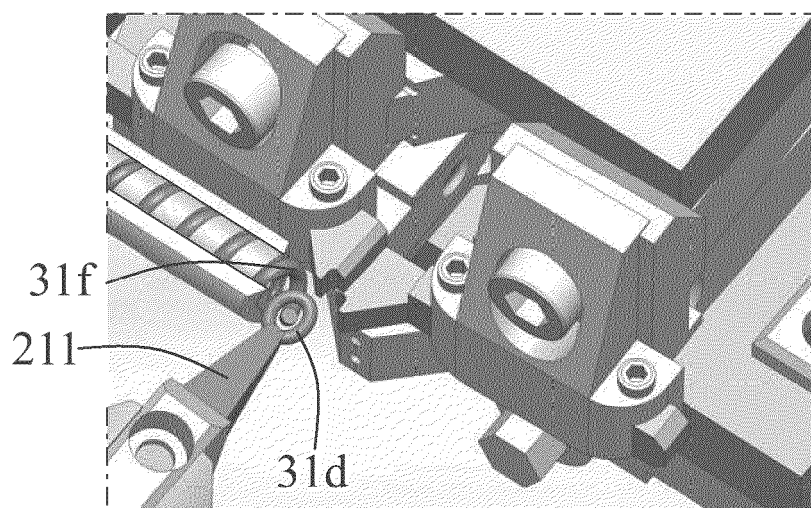


Fig. 7f



EUROPEAN SEARCH REPORT

Application Number
EP 20 16 9976

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	DE 38 03 498 A1 (CMS CONST MECC SPEC [IT]) 18 August 1988 (1988-08-18) * column 4, line 62 - column 5, line 11; figures 1-3 *	1,8	INV. B21L7/00 A44C27/00 B21L11/00
A	WO 2015/047390 A1 (BODHI TECHNOLOGY VENTURES LLC [US]) 2 April 2015 (2015-04-02) * paragraphs [0031] - [0036]; figures 6-7 *	1,8	
A,D	EP 0 408 520 A2 (ICM ITALIANA COST METALMECC [IT]) 16 January 1991 (1991-01-16) * column 5, lines 8-45; figure 9 *	1,8	
			TECHNICAL FIELDS SEARCHED (IPC)
			B21L A44C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 July 2020	Examiner Augé, Marc
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 16 9976

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3803498 A1	18-08-1988	DE 3803498 A1	18-08-1988
		ES 2006302 A6	16-04-1989
		IT 1207830 B	01-06-1989
		US 4903475 A	27-02-1990
WO 2015047390 A1	02-04-2015	NONE	
EP 0408520 A2	16-01-1991	EP 0408520 A2	16-01-1991
		IT 1233709 B	14-04-1992
		US 5152133 A	06-10-1992

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 3803498 [0014]
- EP 0408520 A [0014]