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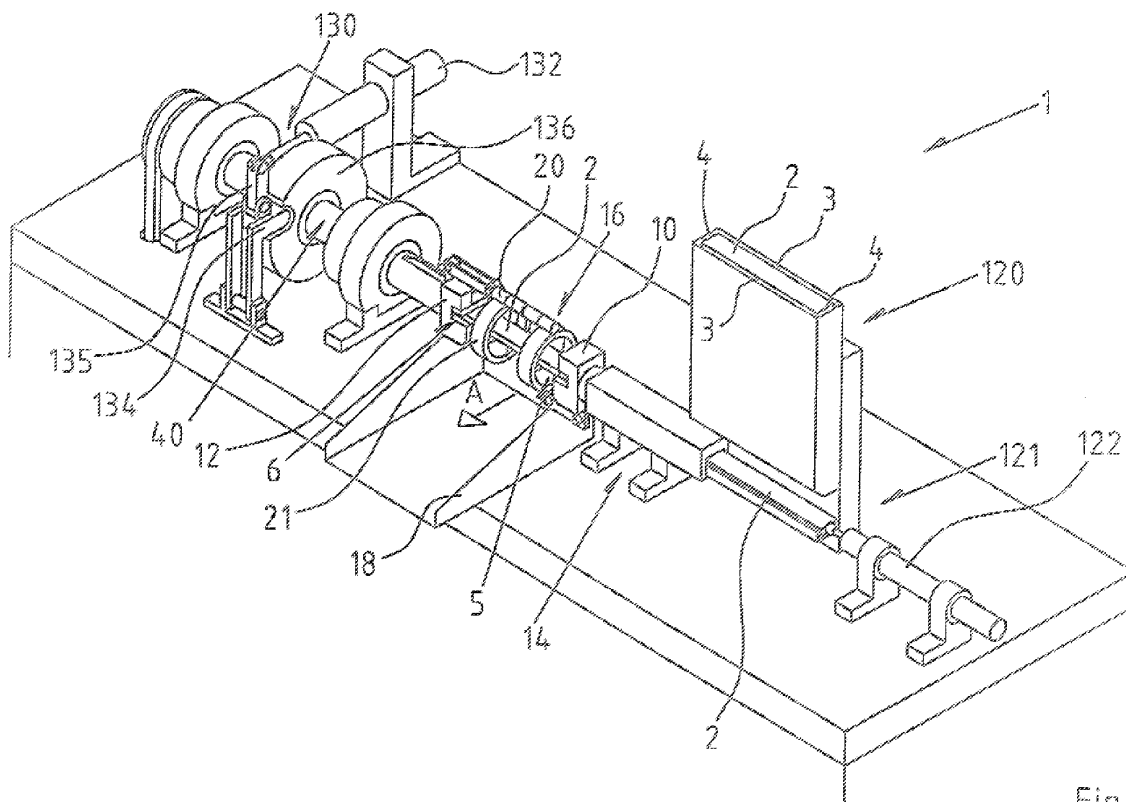
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(54) **Apparatus for twisting a metal strip**

(57) A coil winding apparatus (1) for forming an elongate strip (2) into an elongate helically wound coil (7) is disclosed. The present invention provides a machine which can efficiently manufacture such coils (7) to thereby increase through-put whilst at the same time eliminat-

ing the need for operator interference in the manufacturing process. The present invention also reduces the tendency for coils (7) to slightly unwind due to the elasticity of the strip (2) of material when being removed from the apparatus (1).



**Fig. 1**

## Description

### Introduction

**[0001]** The present invention relates to a coil winding apparatus for forming an elongate strip into an elongate helically wound coil, each strip having two parallel long edges interconnected by two parallel short edges.

**[0002]** Spiral shaped coils are used in a vast number of industrial applications, such as in heat exchange condensers in condenser boiler systems. To form such coils a strip of malleable metal is normally held fast at one end as the other end is manual wound. The manual processing of these coils is particularly time consuming and labour intensive and the industrial manufacture of such coils using the same principle poses other problems. These include that as the strip is being twisted it has a tendency to collapse in on itself as a result of the uneven tension that is being applied at the ends of the strip as it is being tested. Furthermore, when the ends of a strip are clamped a further problem encountered includes the difficulties associated with removing the coil from the clamps when they are opened to release the coil as the coil has a tendency to slightly unwind due to the elasticity of the material, and this causes the ends of the coil to jam in the clamps. In such circumstances operators are required to manually remove the jammed coil from the clamps, which is again particularly time consuming and slows down the manufacturing process.

**[0003]** It is a therefore one object of the present invention to provide a coil winding apparatus which goes some-way toward overcoming at least the above problems, and/or which will provide the public and/or industry with a useful choice.

**[0004]** It is acknowledged that the term 'comprise' may, under varying jurisdictions be provided with either an exclusive or inclusive meaning. For the purpose of this specification, and unless otherwise noted explicitly, the term comprise shall have an inclusive meaning - i.e. that it may be taken to mean an inclusion of not only the listed components it directly references, but also other non-specified components. Accordingly, the term 'comprise' is to be attributed with as broader interpretation as possible within any given jurisdiction and this rational should also be used when the terms 'comprised' and/or 'comprising' are used.

**[0005]** Further aspects of the present invention will become apparent from the ensuing description which is given by way of example only,

### Statements of Invention

**[0006]** According to the invention there is provided a coil winding apparatus for forming an elongate strip into an elongate helically wound coil, each strip having two parallel long edges interconnected by two parallel short edges characterised in that the apparatus comprises a sliding chuck for gripping a proximal end of the strip

spaced apart from a rotating chuck for gripping a distal end of the strip and means for simultaneously moving the sliding chuck a predetermined distance towards the rotating chuck as the rotating chuck is rotated to form the coil,

**[0007]** The present invention will provide a more time and labour efficient means for manufacturing such spiral shaped coils which overcomes the problems with prior art machines.

**[0008]** In another embodiment of the invention, the apparatus further comprises a strip dispenser for housing a plurality of strips, which strip dispenser comprises means for transferring each strip individually from the dispenser so that an end of the strip is positioned in each chuck.

**[0009]** The provision of a strip dispenser to automatically feed strips to be wound into the chucks will significantly increase the throughput of the system whilst at the same time reducing the need for operators to manually position the strips,

**[0010]** In one embodiment of the invention, the sliding chuck and the rotating chuck each have a U-shaped seating slot forming an open mouth having a top wall and a bottom wall spaced apart by a back and means for aligning the open mouths in the chucks so that each strip to can be gripped there between.

**[0011]** The means for aligning the open mouths in the chucks will ensure that the ends of the strips will be properly aligned prior to being twisted.

**[0012]** In another embodiment of the invention, the apparatus further comprises clamping means for releasably engaging each end of the strip within the slot formed in each chuck.

**[0013]** Suitable formed clamps will ensure that the ends of the strips are securely gripping during twisting.

**[0014]** Preferably, the clamping means comprises a locking arm which extends into each slot and means to pivot the locking arm in the slot so that it clamps the end of the strip against the bottom wall of the slot,

**[0015]** In another embodiment of the invention, the rotating chuck is fixed to a rotating arm which rotates to wind the distal end of the strip, the rotating arm further comprising means for tensioning the strip when it is clamped between the chucks.

**[0016]** In another embodiment of the invention, the sliding chuck is fixed to a proximal end of a sliding arm, the sliding arm being actuated to slide horizontally to move the sliding chuck towards the rotating chuck,

**[0017]** Moving the sliding chuck toward the rotating chuck will ensure that the appropriate tension is maintained on the strip as it is being twisted.

**[0018]** In another embodiment of the invention, the apparatus further comprises control means for setting the horizontal sliding distance of the sliding arm.

**[0019]** This will ensure that the correct changes in distance between the sliding arm and rotating arm is maintained as the rotating arm is turned to twist the strip.

**[0020]** In another embodiment of the invention, the

sliding arm comprises a longitudinally extending through bore, each strip being transferred to the chucks from the strip dispenser along the bore and through a strip receiving slit which extends through the back wall of the sliding chuck.

**[0021]** In another embodiment of the invention, the apparatus further comprises discharge means for moving the coil formed out of the chucks.

**[0022]** Such a provision will significantly increase the throughput by reducing the prior requirement for operators to manually extract the formed coil from the chucks.

**[0023]** Preferably, the discharge means comprises a split tube device which is formed from at least one pair of hingedly connected substantially U-shaped tube halves.

### **Detailed Description of the Invention**

**[0024]** The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view showing a coil winding apparatus according to the invention;

Fig. 2 is a perspective view showing the removal of a coil from the coil winding apparatus shown in Fig. 1;

Fig. 3 is a diagrammatic showing a chuck according to the invention;

Fig. 4 is a plan view showing the coil winding apparatus shown in Fig. 1;

Fig. 5 is a detailed plan view showing one side of the coil winding apparatus shown in Fig. 4, and

Fig. 6 is a detailed plan view showing the other side of the coil winding apparatus shown in Fig. 4, and

Fig. 7 is a schematic showing the formation of a coil from a rectangular strip.

**[0025]** Referring to the drawings, and initially to Figs. 1 to 3 thereof, there is provided a coil winding apparatus indicated generally by the reference numeral 1, for forming an elongate strip 2 into an elongate helically wound coil 7 (see Fig. 2). Each strip 2 has two parallel long edges 3 interconnected by two parallel short edges 4. The apparatus 1 comprises a sliding chuck 10 for gripping a proximal end, indicated generally by the reference numeral 5, of the strip 2 and a rotating chuck 12 for gripping a distal end, indicated generally by the reference numeral 6, of the strip 2. Also shown is means, indicated generally by the reference numeral 14, for simultaneously moving the sliding chuck 10 a predetermined distance towards the rotating chuck 12 as the rotating chuck 12 is rotated to

form the coil 7.

**[0026]** Also shown is a strip dispenser, indicated generally by the reference numeral 120 for housing a plurality of strips 2. The strip dispenser 120 comprises means, indicated generally by the reference numeral 121, for transferring each strip 2 individually from the dispenser 120 so that each end 5,6 of the strip 2 is positioned in each chuck 10,12. In the instance shown, the dispenser 120 comprises a vertical strip enclosure 123 in which are mounted a plurality of strips 2, one on top of the other. In use, the bottom most strip 2 in the enclosure 123 is displaced along its length by a dispenser ram 122 which pushes the strip into the chucks 10,12.

**[0027]** Fig. 3 is a diagrammatic showing a chuck 10,12, which chuck 10,12 comprises a U-shaped seating slot, indicated generally by the reference numeral 22, forming an open mouth having a top wall 24 and a bottom wall 26 spaced apart by a back wall 28. Fixed to the bottom wall 26 is a serrated block 30 upon which the end of the strip 2 is seated. With reference again to Fig. 1 there is also shown means, indicated generally by the reference numeral 130, for aligning the open mouths in the chucks 10, 12 so that each strip 2 can be gripped there between. In the instance shown, the means 130 comprises a ram 132 which actuates a lever 135 mounting a stop 134. In operation, the ram 132 pivots the lever 135 to in turn pull the stop 134 into a receiving notch in a sprocket wheel 136 to stop the rotating chuck 12 from rotating. It should be appreciated that the sprocket wheel 136 is rotated by a drive motor (not shown) to rotate a rotating arm 40 to which is fixed the rotating chuck 12. In this way, the stopping position of the slot 22 in the rotating chuck 12 can be controlled as required.

Also shown in Fig. 3 is clamping means, indicated generally by the reference numeral 99, for releasably engaging each end 5,6 of the strip 2 within the slot 22 formed in each chuck 10,12. The clamping means 99 comprises a locking arm 100 which extends into each slot 22 and means (not shown) to pivot the locking arm 100 in the slot 22 so that it clamps the end 5,6 of the strip 2 against the bottom wall 26 of the slot 22. or in the instance shown, the serrated block 30.

**[0028]** Figs. 4 to 6 show the coil winding apparatus of Fig. 1, again identified by the same reference numeral 1, with parts similar to those described already identified by the same reference numeral

**[0029]** With specific reference to Fig. 5, the rotating chuck 12 is fixed to one end of the rotating arm, indicated generally by the reference numeral 40, which rotates to wind the distal end 6 of the strip 2. The rotating arm 40 comprises an inner shaft 42 which is slidable relative to a concentric outer shaft 44. Also shown is means, indicated generally by the reference numeral 46, for tensioning the strip 2 when it is clamped between the chucks 10,12. In the instance shown, means 46 comprises a linkage 48 to the locking arm 100, which linkage 48 is mounted on one end of the inner shaft 42 through a slot 50 cut in the corresponding end of the outer shaft 44.

The other end of the inner shaft 42 terminates in an end bearing 52 mounted on a rigid block 54 which is pivotally connected intermediate the ends of a lever arm 56. The lever arm 56 is in turn pivotally connected at one end to a lever arm ram 58 and to a pivotal connection 60 at the other end. In operation, actuation of the ram 58 will cause the lever arm 56 to pivot and pull the end bearing 52 and therefore the inner shaft 42 in the direction indicated generally by the arrow B. Such movement will cause the locking arm 100 to pivot in the direction of the arrow B so as to clamp the end of the strip within the chuck 12. Further slight adjustment of the inner shaft 42 in the direction of the arrow B may also then be made to further tension the clamped strip 2.

[0030] Referring now to Fig. 6, the sliding chuck 10 is fixed to a proximal end, indicated generally by the reference numeral 64, or a sliding arm 62, which sliding arm 62 is actuated to slide horizontally to move the sliding chuck 10 towards, the rotating chuck 12. The sliding arm 62 further comprises control means, indicated generally by the reference numeral 66, for setting the horizontal sliding distance of the sliding arm 62. The control means 66 comprises a block 70, and on which block 70 is pivotally mounted a cam 72 which is operable by a cam pivot ram 74. The block 70 bears against a fixed collar 76 within which the sliding arm 62 is slidable, and which is mounted between the block 70 and the distal end 67 of the sliding arm 62. Also shown is a ram 78 pivotally connected to a link arm 80, the ram 78 actuating the link arm 80 to exert a constant pushing force on the end of the sliding arm 62 in the direction indicated generally by the arrow C. It should be appreciated that the control means 66 operates to permit movement of the sliding arm 62 under the force being applied by the ram 78. Accordingly, when the ram 74 is actuated it causes the cam 72 and the block 70 to move, which in turn allows the sliding arm 62 to move horizontally towards the rotating chuck 12. Once the sliding arm 62 has moved a predetermined distance towards the rotating chuck 12, and the coil has been formed, the pressure exerted by the rams 74,78 is reversed to return the sliding arm 62 to its initial position so that the block 70 is adjacent the fixed collar 76 so that the next coil can be formed. Also shown is ram 68 which is pivotally connected to the locking arm 100, actuation of the ram 68 causing the locking arm 100 to pivot and clamp the end of the strip 2 within the chuck 10.

[0031] In the instance shown, the strip dispenser 120 is mounted adjacent the distal end 67 of the sliding arm 62. The sliding arm 62 also comprises a longitudinally extending through bore 82 and each strip 2 is transferred from the dispenser 120 to the chucks 10,12 along the bore 82 and through a strip receiving slit 84 (see Fig. 7) which extends through the back wall 28 of the sliding chuck 10.

[0032] With reference to Fig. 1, the apparatus 1 further comprises discharge means, indicated generally by the reference numeral 16, for moving the coil, when formed, out of the chucks 10, 12. Also shown is a receiving re-

ceptacle 16 which is positioned beneath the chucks 10, 12 and into which the formed coil are deposited by the discharge means 16 once removed out of the chucks 10, 12. In the instance shown, the discharge means 16 comprises a split tube device 20 which is formed from two pairs of hingedly connected substantial U-shaped tube halves 21. Initially, whilst the coil 7 is being formed the tube halves 21 are in a closed position, as shown in Fig. 1. Once the coil 7 has been formed the split tube device 20 is then moved by a ram (not shown) in the direction indicated generally by the arrow A to effectively grip the coil 7 intermediate its ends 5,6 and to slide the coil 7 formed out of the chucks 10,12. The tube halves 21 are then opened and the coil 7 is released. A receptacle 18 may be appropriately positioned to receive the coil 7 when it is released. The tube halves 21 are then closed and the split tube device 20 returns to its initial starting position between the chucks 10,12.

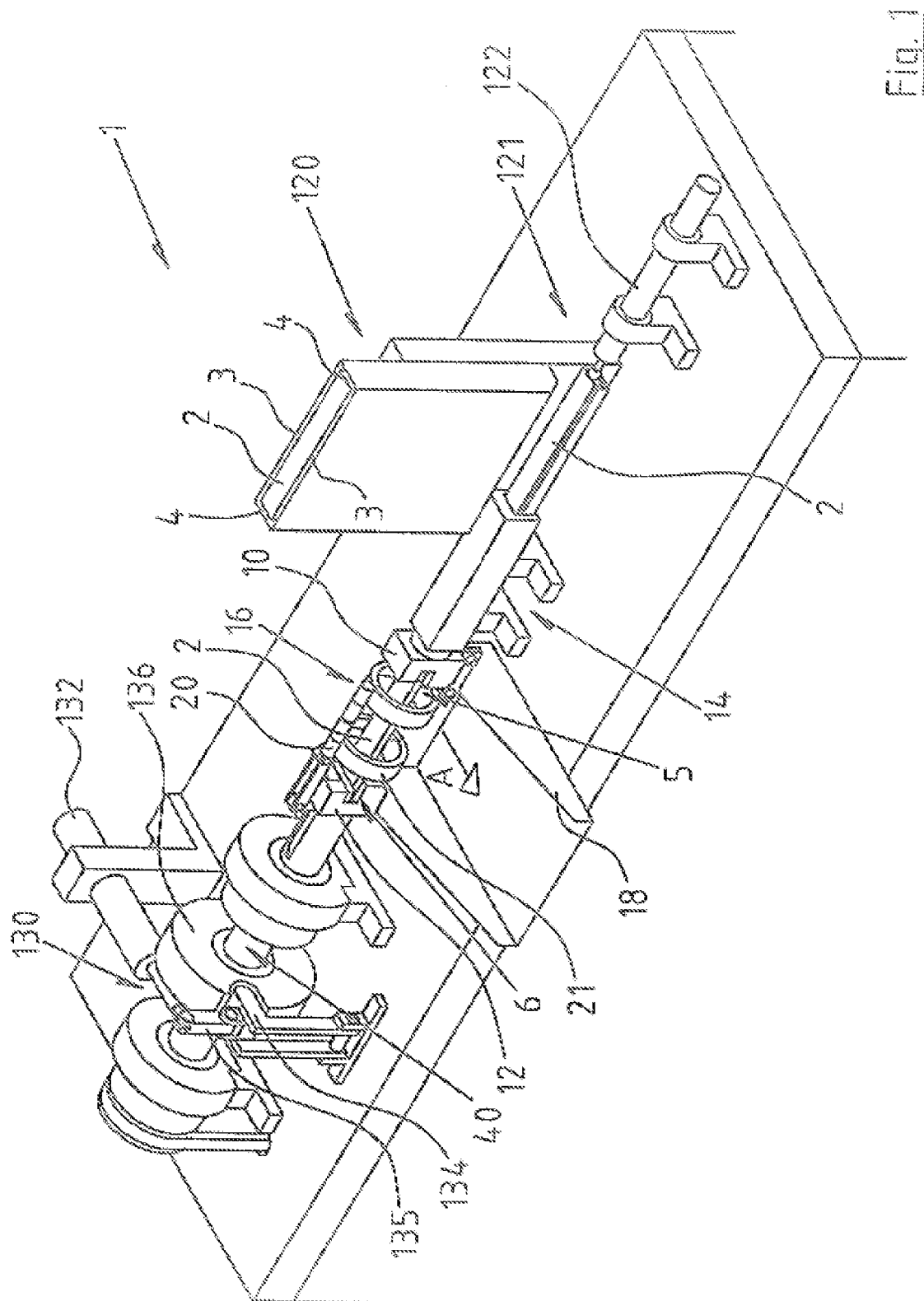
[0033] With reference now to Fig. 7, again with like parts using the same numeral identification system of Figs. 1 to 6, a coil 7 is formed as follows. Initially, at step (a) the slots 22 in the sliding chuck 10 and the rotating chuck 12 are aligned. At step (b) a strip 2 is inserted via a through slit 84 in the base wall of the sliding chuck 10 so that it is positioned between chucks 10,12. At step (c) the sliding clamp 10 and the rotating clamp 12 are actuated to grip the end of the strip 2, and the rotating clamp 12 places a tension on the strip 2. At step (d) the sliding clamp 10 simultaneously moves in towards the rotating clamp 12 as the rotating clamp 12 is rotated to form the coil 7. Finally, at step (e) the split tube 20 is operated to remove the formed coil from the chucks 10,12 which is then deposited into a receptacle 18 positioned beneath the chucks 10,12.

[0034] Aspects of the present invention have been described by way of example only and it should be appreciated that additions and/or modifications may be made thereto without departing from the scope thereof as defined within the scope of the appended claims.

## Claims

1. A coil winding apparatus (1) for forming an elongate strip (2) into an elongate helically wound coil (7), each strip (2) having two parallel long edges (3) interconnected by two parallel short edges (4) **characterised in that** the apparatus (1) comprises a sliding chuck (10) for gripping a proximal end (5) of the strip (2) spaced apart from a rotating chuck (12) for gripping a distal end (6) of the strip (2) and means (14) for simultaneously moving the sliding chuck (10) a predetermined distance towards the rotating chuck (12) as the rotating chuck (12) is rotated to form the coil (7).
2. A coil winding apparatus (1) as claimed in claim 1, further comprising a strip dispenser (120) for housing

- a plurality of strips (2), which strip dispenser comprises means (121) for transferring each strip (2) individually from the dispenser (120) so that an end (5,6) of the strip (2) is positioned in each chuck (10,12). 5
3. A coil winding apparatus (1) as claimed in claim 1 or 2, in which the sliding chuck (10) and the rotating chuck (12) each have a U-shaped seating slot (22) forming an open mouth having a top wall (24) and a bottom wall (26) spaced apart by a back wall (28), and means (130) for aligning the open mouths in the chucks (10,12) so that each strip (2) can be gripped there between. 10 15
4. A coil winding apparatus (1) as claimed in any preceding claim, further comprising clamping means (99) for releasably engaging each end (5,6) of the strip (2) within the slot (22) formed in each chuck (10,12), 20
5. A coil winding apparatus (1) as claimed in claim 4, in which the clamping means (99) comprises a locking arm (100) which extends into each slot (22) and means to pivot the locking arm (100) in the slot (22) so that it clamps the end (5,6) of the strip (2) against the bottom wall (26) of the slot (22). 25
6. A coil winding apparatus (1) as claimed in any preceding claim, in which the rotating chuck (12) is fixed to a rotating arm (40) which rotates to wind the distal end (6) of the strip (2), the rotating arm (40) further comprising means (46) for tensioning the strip (2) when it is clamped between the chucks. (10,12). 30 35
7. A coil winding apparatus (1) as claimed in any preceding claim, in which the sliding chuck (10) is fixed to a proximal end (64) of a sliding arm (62), the sliding arm (62) being actuated to slide horizontally to move the sliding chuck (10) towards the rotating chuck (12). 40
8. A coil winding apparatus (1) as claimed in claim 7, further comprising control means (66) for setting the horizontal sliding distance of the sliding arm (62). 45
9. A coil winding apparatus (1) as claimed in claim 7 or 8, in which the sliding arm (62) comprises a longitudinally extending through bore (82), each strip (2) being transferred to the chucks (10,12) from the strip dispenser (120) along the bore (82) and through a strip receiving slit (84) which extends through the back wall (28) of the sliding chuck (10). 50
10. A coil winding apparatus (1) as claimed in any preceding claim, further comprising discharge means (16) for moving the coil (7) formed out of the chucks (10,12). 55
11. A coil winding apparatus (1) as claimed in claim 10, in which the discharge means comprises a split tube device (20) which is formed from at least one pair of hingedly connected substantial U-shaped tube halves (21).



3.

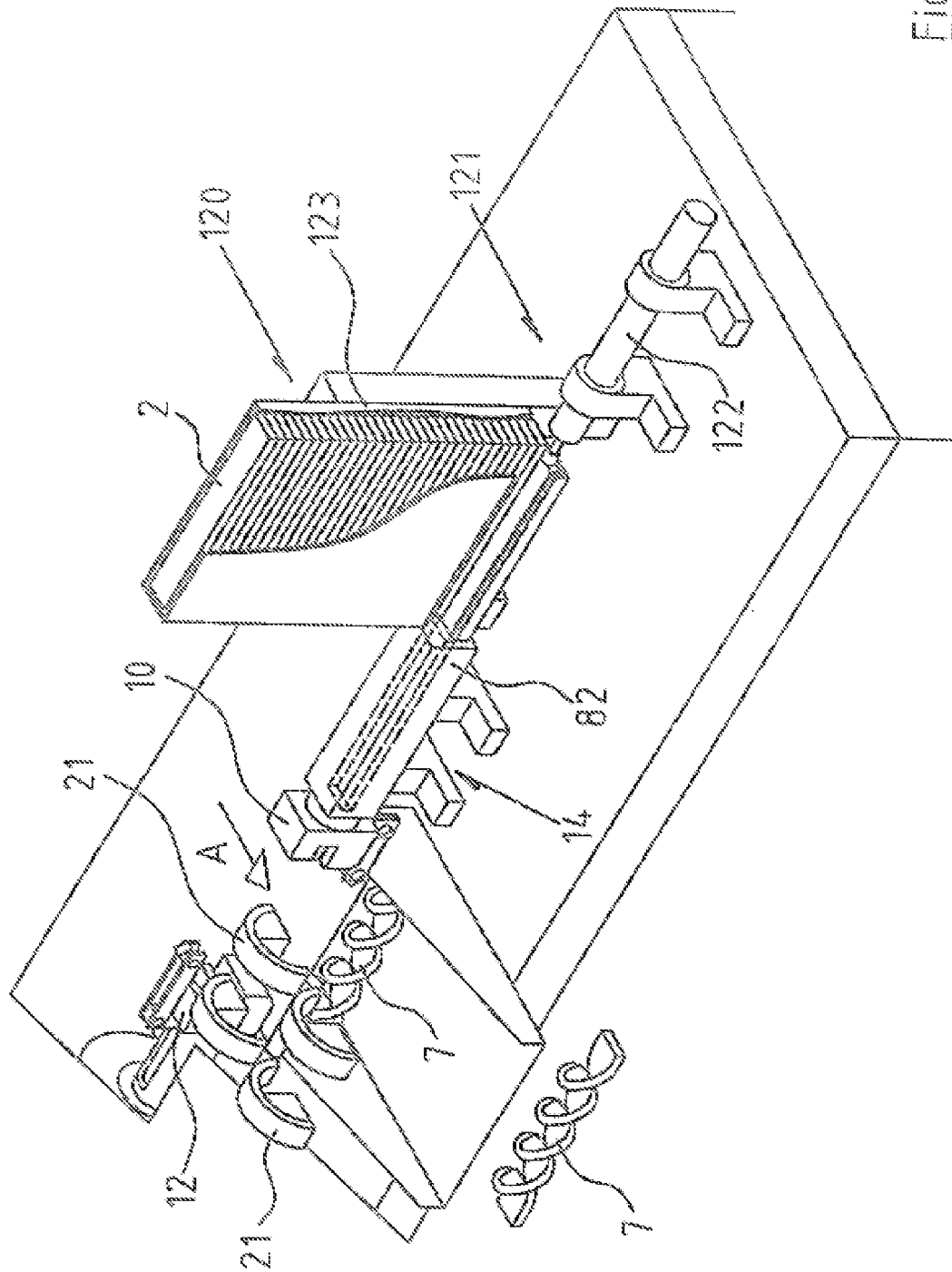


Fig. 2

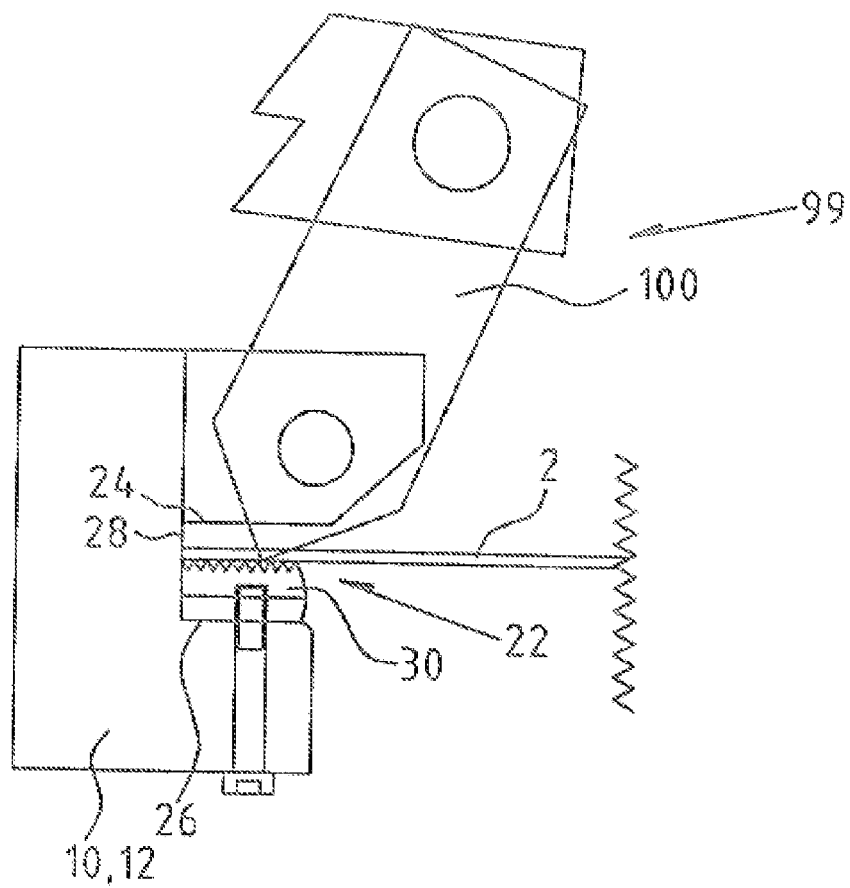
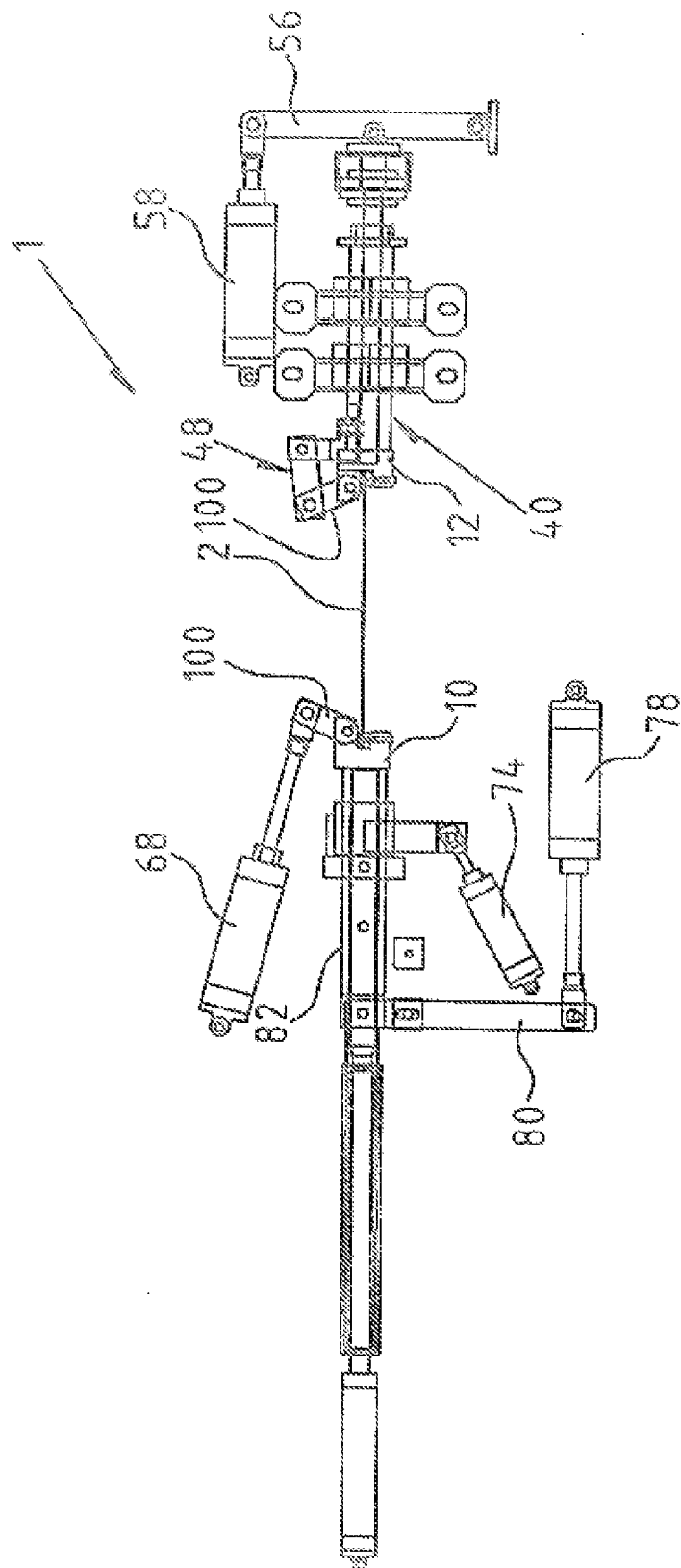


Fig. 3



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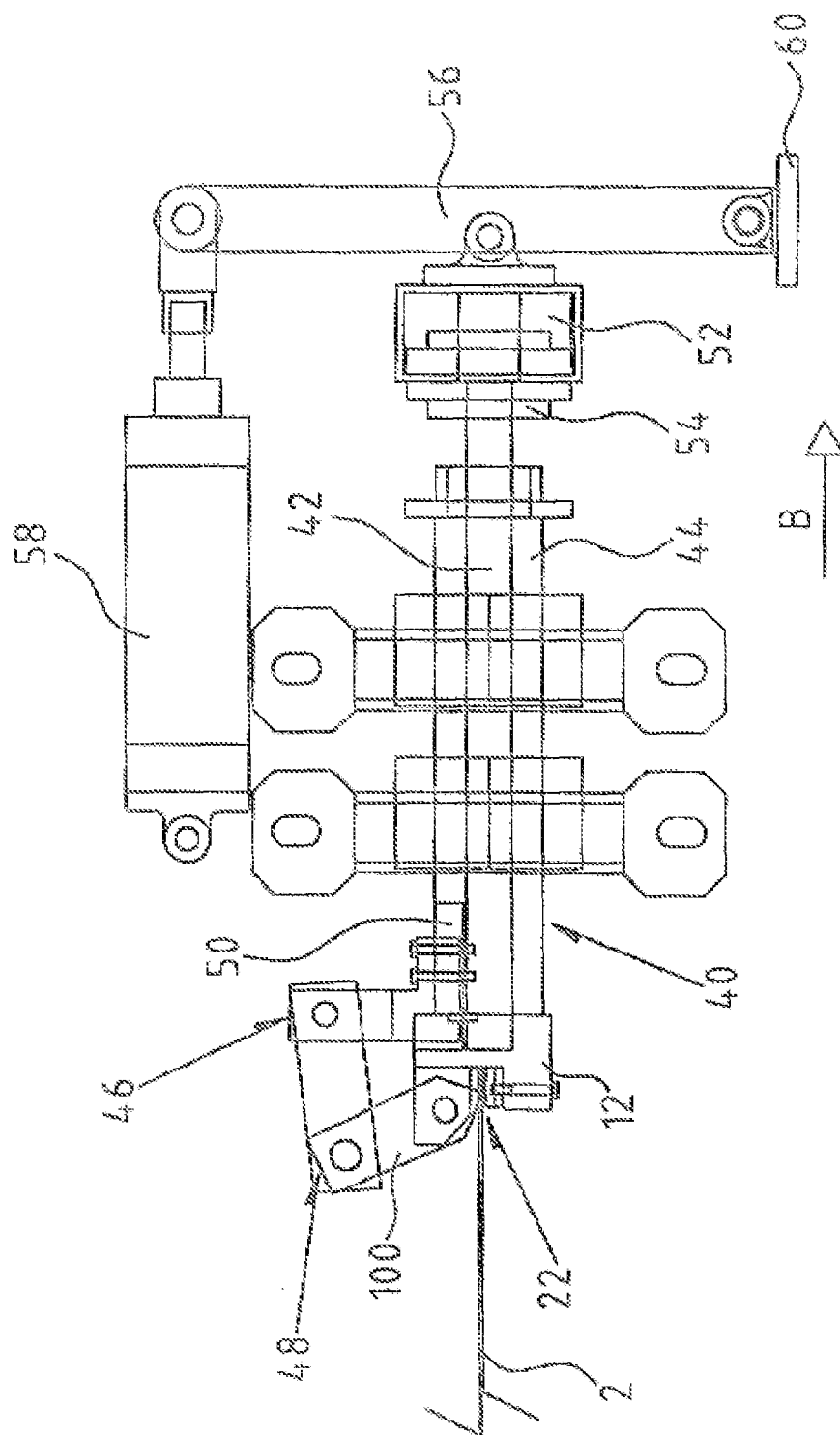
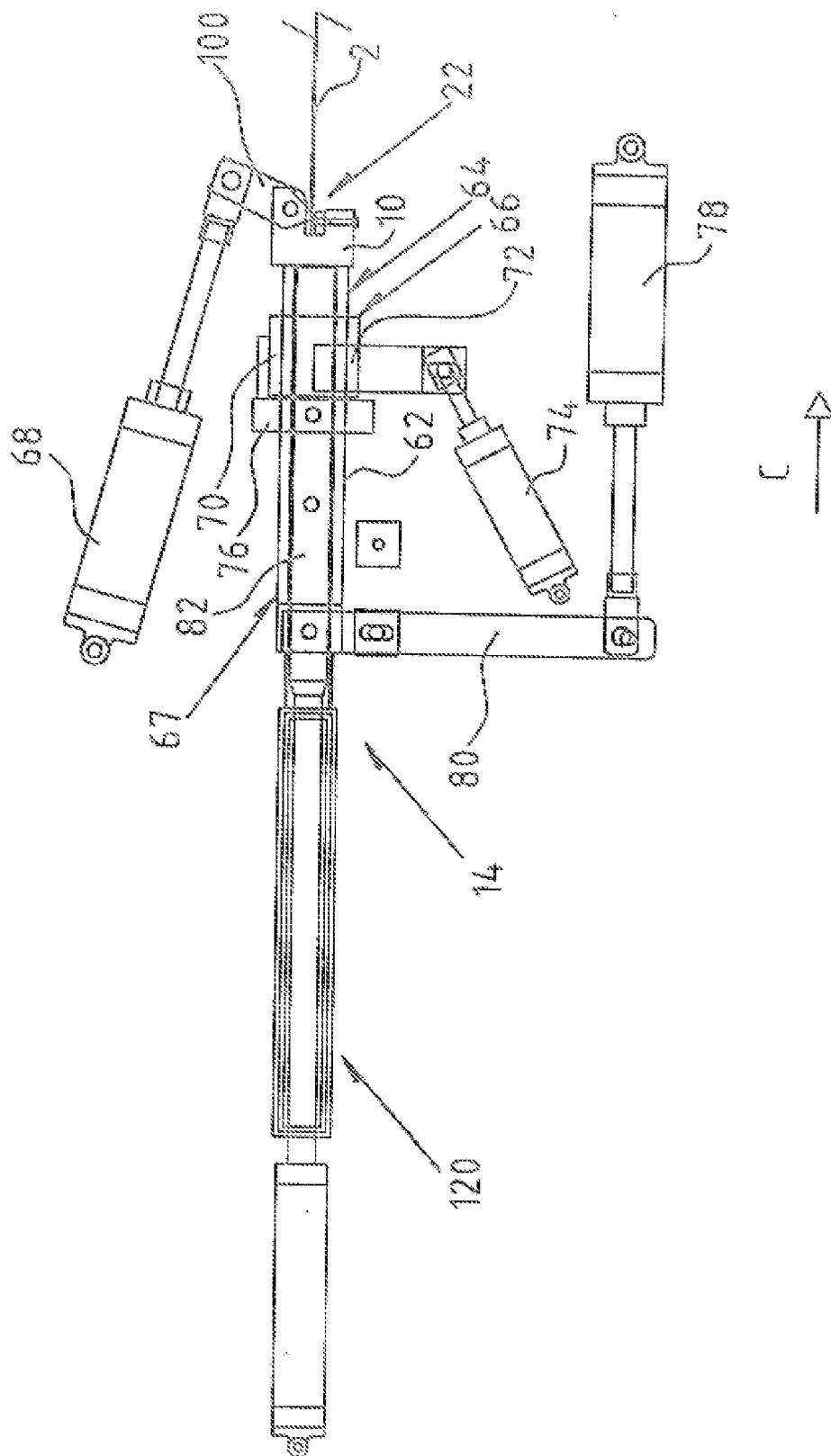


Fig. 5



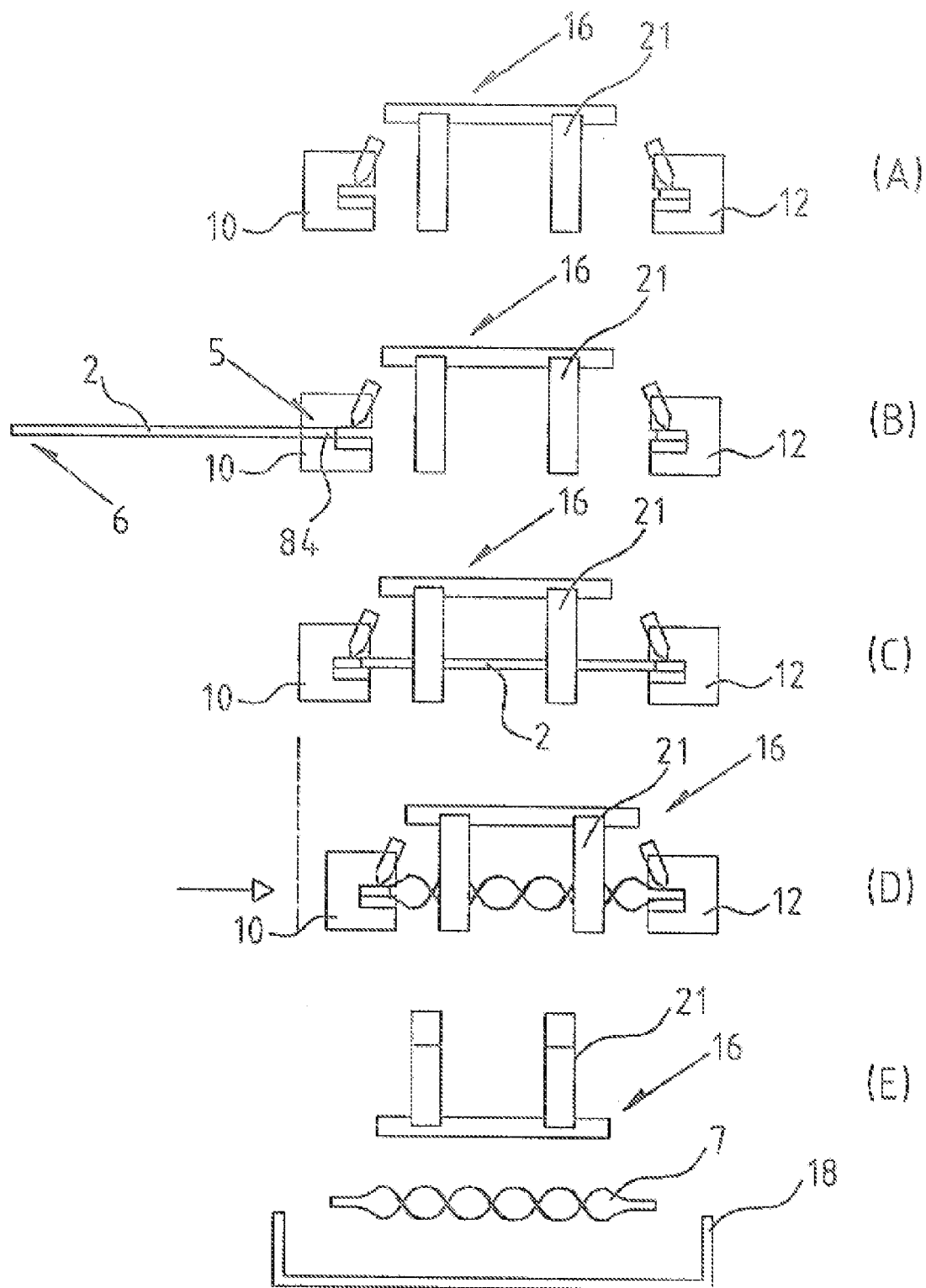


Fig. 7



European Patent  
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Application Number  
EP 06 12 1696

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                            |                                                            |                                                    |
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| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Citation of document with indication, where appropriate, of relevant passages                                              | Relevant to claim                                          | CLASSIFICATION OF THE APPLICATION (IPC)            |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | * column 3, line 27 - line 39 *<br>* column 5, line 33 - line 42 *<br>* column 7, line 18 - line 60; claim 1;<br>figures * |                                                            |                                                    |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                            |                                                            |                                                    |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                            | Date of completion of the search<br><b>7 February 2007</b> | Examiner<br><b>Barrow, Jeffrey</b>                 |
| <p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>.....<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                            |                                                            |                                                    |

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

EP 06 12 1696

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  
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