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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) **Spring making machine**

(57) A spring making machine (2), comprising at least one main body (20), on which a forming device (22) is mounted; the forming device (22) being equipped with a guiding tool (220) to coil wire material (7) to arc shapes; a displacement device (25), which is connected to the main body (20) for moving it linearly as well as for moving linearly the forming device (22) and the guiding tool (220).

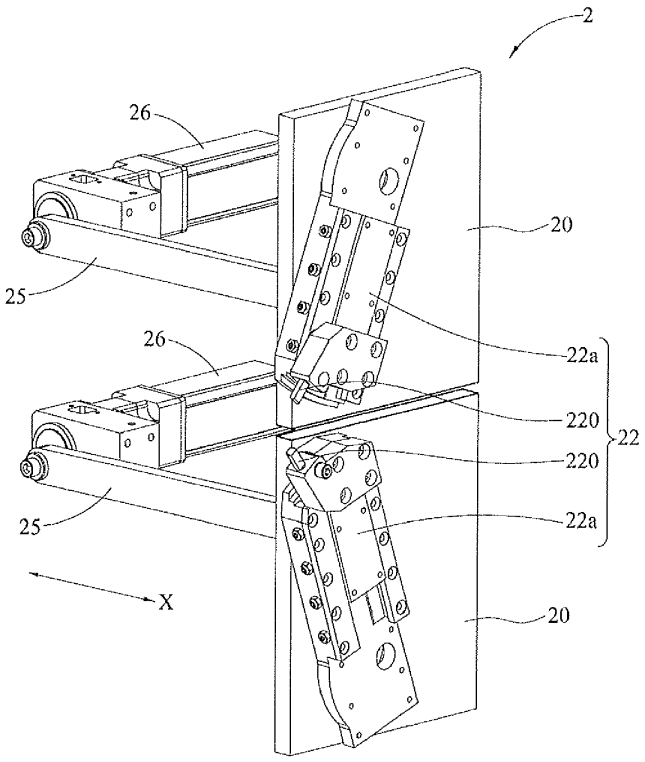


Fig. 2A

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Description

[0001] The present invention relates to a spring making machine.

[0002] As is known, spring making machines are widely used. Such machines comprise, as illustrated in Figures 1 and 1A, a main structure 10, a feeding device 11, forming devices 12, a pitch device 13 and a cutting device 14. The forming devices 12 are equipped with guiding tools 120 which are half-round grooved on the tip.

[0003] In the process of making springs the feeding device 11 feeds wire material 9 in horizontal direction to reach the forming device 12; the wire material 9 goes through the grooves of the guiding tools 120 which are defined on the forming device 12, then the wire material 9 is coiled to arc coil 9'; meanwhile, the pitch device 13 pushes each arc coil 9' to form helical shape as a spring, then the spring is cut off by the cutting device (14).

[0004] Moreover, as shown in Figures 1A to 1E, the forming devices 12 each contain an adjustment part 122. The adjustment parts 122 are able to change the initial tension of springs by manual adjustment of a fastener 123, such as a screw on the adjustment part 122. This manual adjustment changes the relative position of upper and lower guiding tools 120 and result in an additional force applied on the wire material 9 through the guiding tools 120. More specifically, as shown in Figures 1D and 1E, through the manual adjustment of the fastener 123, a relative movement between the upper and lower guiding devices 120 is generated. As a result, the twist angle of the arc coil 9' is adjustable by manual adjustment to get different initial tension on the arc coil.

[0005] However, for the conventional spring making machine (Figure 1), the initial tension is constant during the spring making process, since the manual adjustment of the fastener 123 cannot be carried out during the spring making process. In other words, the initial tension cannot be changed during the spring making process, thus the end of helical springs cambers (as shown in Figures 1F and 1G), or a gap appears in the first coil of closed pitch springs (as shown in Figure 1H). Even if a grinding treatment is executed, the thickness of the end of the spring is not uniform which might become a breaking point after long term working (as shown in Figures 1I, 1J, and 1K).

[0006] The aim of the present invention is to devise a spring making machine that overcomes the above indicated drawbacks.

[0007] The above aim and other objects that will become better apparent hereinafter are achieved by a spring making machine as defined in the appended claims.

[0008] More particularly, the spring making machine of the present invention comprises a main body on which a forming device is mounted. The forming device is equipped with a guiding tool to coil the wire material to an arc coil. A displacement device is connected to the main body for moving it linearly as well as the forming device and the guiding tool.

[0009] The present spring making machine has two sets of main body (upper and lower) with forming device, guiding tool and displacement device mounted on it. The two sets of main body are installed at the upper and lower side of wire material.

[0010] The displacement device of the present spring making machine is a linear moving device, which causes the main body to perform a linear movement. The two sets of main body are moved close to (or away from) each other by the displacement devices.

[0011] The present spring making machine also comprises a feeding device which feeds the wire to the forming devices.

[0012] The present spring making machine also comprises a pitch device, which pushes and squeezes the arc coils to form the helical shape of the spring.

[0013] Furthermore, the present spring making machine also comprises a cutting device to cut off springs.

[0014] According to the present invention, the spring making machine drives its main body as well as the forming device and the guiding tool to perform a linear movement which changes the relative position of the guiding tools. In other words, a relative movement between the upper and lower guiding tools is generated to change the initial tension of the helical springs. In comparison with conventional technology, the spring making machine of the present invention is able to change the initial tension during spring making process. Therefore the spring making machine of the present invention can improve the camber at the end of helical springs or eliminate the gap in the first coil of closed pitch springs.

[0015] Further characteristics and advantages of the present invention will become better apparent from the description of a preferred, but not exclusive, embodiment of the spring making machine according to the present invention, which is illustrated by way of non -limiting example in the accompanying drawings, wherein:

Figure 1 illustrates a conventional spring making machine;
Figure 1A is a pictorial drawing of part of Figure 1;
Figure 1B is an enlarged view of Figure 1;
Figure 1C is a profile drawing of line A-A in Figure 1B;
Figures 1D and 1E demonstrate the action of Figure 1;
Figures 1F, 1G, and 1H illustrate the defect of the springs formed by conventional spring making machine;
Figures 1I, 1J, and 1K illustrate the disadvantage of the springs which are formed by conventional spring making machine after a grinding treatment;
Figure 2A is a front view of a pictorial drawing of the spring making machine of the present invention;
Figure 2B is a rear view of pictorial drawing of the spring making machine of the present invention;
Figures 3A and 3B are side views of the spring making machine of Figure 2A;
Figure 3C is an enlarged drawing of part of Figure 2A;

Figures 3D, 3E, and 3F illustrate the improvement of the springs formed by this invention

Figures 3G, 3H, and 3I illustrate the advantage of the springs which are formed by the spring making machine of the present invention after the grinding treatment.

[0016] With reference to the figures, the present invention will be explained. It should be taken into account that the structure, scale and size are only exemplary and that any modification of the structure, change of scale, or adjustment of size, which has no influence on the function and effect of the present invention, should be still under the scope of the present invention. Moreover, the words like "upper", "lower", "one" or "two used in the present application are only used in order to understand the invention, and are not used to limit in any way the present invention, Any change of relation between components, which does not change the technical principal of the present invention, should be still under the scope of the present invention.

[0017] Figures 2A and 2B illustrate the spring making machine of the present invention. As shown in Figures 2A and 2B, the spring making machine 2 includes at least one main body and preferably two sets of main bodies 20, forming devices 22, displacement devices 25 and driving devices 26. The spring making machine 2 processes wire material 7 to manufacture springs.

[0018] The forming device 22 is mounted on the respective main body 20 and carries a guiding tool 220 which coils the wire material 7 to arc coil 7'. The forming device 22 includes holding implement 22a. Each holding implement 22a contains one set of guiding tool 220. More specifically, the two guiding tools 220 are at both upper and lower sides of the wire material 7.

[0019] The displacement device 25 is connected to the main Body 20 and moves it linearly as well as it moves linearly the forming Device 22, the holding implement 22a and the guiding tool 220. In the present embodiment, two displacement devices 25 control the main bodies 20 independently.

[0020] The above mentioned driving device 26 is for example a motor, which drives the displacement device 25. In this embodiment, the two driving devices 26 control the displacement devices 25 independently.

[0021] Operation is as shown in Figures 3A and 3B. The displacement devices 25 move the main bodies 20 linearly by rotating an eccentric turning mechanism 250 (or cam mechanism) which is driven by driving devices 26 (for instance, a motor). Accordingly, the holding implement 22a moves with the guiding tool 220 simultaneously in the direction of X arrows shown in Figure 3B. As a result, the two sets of forming devices 22 (as well as the holding implements 22a and the guiding tools 220) reciprocate along with the main bodies 20 to move close to (or away from) each other. More specifically, the two sets of holding implements 22a, guiding tools 220, and main bodies 20 which are located at upper and lower sides of wire material perform a relative displacement thus adjusting the twist angle of Arc Coil 7' to change the initial tension during spring making process.

[0022] As shown in Figure 3B, the upper displacement device 25 moves the upper holding implement 22a and the guiding tool 220 along with the main body 20 linearly, while the lower displacement device 25 does not move the lower holding implement 22a, the guiding tool 220, and the main body 20, As a result the twist angle of arc coil 7' is changed because of the relative movement of the upper and lower guiding tools 220. Therefore the initial tension of the arc coil 7' is changed to improve the camber at the end of helical springs (as shown in Figures 3D and 3E) or eliminate the gap in the first coil of closed pitch springs (as shown in Figure 3F). In case a grinding process is executed, the thickness of the end of the spring is uniform which extends the duration of working life of springs (as shown in Figures 3G, 3H, and 3I).

[0023] Moreover, the mentioned arc coil 7' is coiled by feeding the wire material 7 in order to reach the guiding tool 220, as shown in Figure 3C.

[0024] Besides, the eccentric turning mechanism (cam mechanism) 250 can be substituted by other types. It is not to be limited to a cam mechanism.

[0025] The structure of the displacement device 25 and the method to perform the linear movement of the main body 20 can be carried out in various manners, for instance, by means of a cam, eccentric mechanism, ball screw, pneumatic control or hydraulic control, et cetera.

[0026] The driving devices 26 can be a cam, or eccentric mechanism, or pneumatic control, or hydraulic control, or electric motor, and the like.

[0027] In practice it has been found that the spring making machine according to the present invention fully achieves the intended aim and objects, in that it allows to change the initial tension during spring making process. Therefore the spring making machine of the present invention can improve the camber at the end of helical springs or eliminate the gap in the first coil of closed pitch springs

[0028] The spring making machine thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0029] In practice the materials employed, and the contingent dimensions and shapes, may be any according to requirements and to the state of the art.

[0030] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Symbols:

1	spring making machine
10	main structure

(continued)

11	feeding device
12,22	forming device
120,220	guiding tool
122	adjustment part
123	fastener
13	pitch device
14	cutting device
2	spring making machine
22a	holding implement
25	displacement device
250	eccentric turning mechanism
26	driving device
7	wire material
7'	arc coil
9	wire material
9'	arc coil
X	moving direction of main body

Claims

1. A spring making machine (2), **characterized in that** it comprises:

at least one main body (20), on which a forming device (22) is mounted;
the forming device (22) being equipped with a guiding tool (220) to coil wire material (7) to arc shapes;
a displacement device (25), which is connected to the main body (20) for moving it linearly as well as for moving linearly the forming device (22) and the guiding tool (220).

2. The spring making machine according to claim 1, **characterized in that** it comprises two sets of main bodies (20), each having a forming device (22) and a guiding tool (220).

3. The spring making machine according to claim 2, **characterized in that** the two sets of guiding tools (220) are at both upper and lower sides of the wire material (7).

4. The spring making machine according to claim 1, **characterized in that** the guiding tools (220) are coiling points.

5. The spring making machine according to claim 1, **characterized in that** the displacement device (25) is a linear moving device adapted to move the main body linearly as well as the forming device (22) and the guiding tool (220).

6. The spring making machine according to claim 5, **characterized in that** the displacement device (25) is moved by an eccentric turning mechanism or cam to perform linear reciprocating motion.

7. The spring making machine according to one or more of the preceding claims, **characterized in that** it comprises a main structure (10) on which the main bodies (20), the forming devices (22) and the displacement devices (22) are mounted.

8. The spring making machine according to one or more of the preceding claims, **characterized in that** the two main bodies (20) are moved close to or away from each other by the respective displacement devices (22).

9. The spring making machine according to claim 1, **characterized in that** it comprises a feeding device (11) which feeds the wire material (7) to the forming device (22).

10. The spring making machine according to one or more of the preceding claims, **characterized in that** it comprises a pitch device (13) adapted to push the arc coil to form helical shape as a spring.

11. The spring making machine according to claim 1, **characterized in that** it comprises a cutting device (14), which cuts off the springs from the arc coil.

Amended claims in accordance with Rule 137(2) EPC.

1. A spring making machine (2), **characterized in that** it comprises:

two sets of main bodies (20)
on each of which a respective forming device (22) is mounted;
each forming device (22) being equipped with a guiding tool (220) to coil wire material (7) to arc shapes;
two displacement devices (25), each of which is connected to a respective
main body (20) for moving it linearly as well as for moving linearly the forming device (22) and the guiding tool (220);
wherein said two displacement devices (25) control the main bodies (20) independently; and wherein
the two sets of forming devices (22) reciprocate along with the main bodies (20) to move close to or away from each other in a moving direction (X) which is orthogonal to the plane of said main bodies (20) so that after such relative displacement the two sets of forming devices (22) are

spaced apart along said direction (X),
thus adjusting the twist angle of arc coil (7') to change the initial tension during spring making process.

2. The spring making machine according to claim 1, wherein the two sets of guiding tools (220) are at both upper and lower sides of the wire material (7).

3. The spring making machine according to claim 1 or 2, wherein the guiding tools (220) are coiling points.

4. The spring making machine according to one of the previous claims,
wherein the displacement device (25) is a linear moving device adapted to move the main body (20) as well as the forming device (22) and the guiding tool (220) linearly.

5. The spring making machine according to claim 4, wherein the displacement device (25) is moved by an eccentric turning mechanism or cam to perform linear reciprocating motion.

6. The spring making machine according to one or more of the preceding claims,
comprising a main structure (10) on which the main bodies (20), the forming devices (22) and the displacement devices (22) are mounted.

7. The spring making machine according to any of the previous claims,
comprising a feeding device (11) which feeds the wire material (7) to the forming device (22).

8. The spring making machine according to comprising a pitch devices (13) adapted to push the arc coil (7') to form helical shape as a spring.

9. The spring making machine according to any of the previous claims,
comprising a cutting device (14), which cuts off the springs from the arc coil (7').

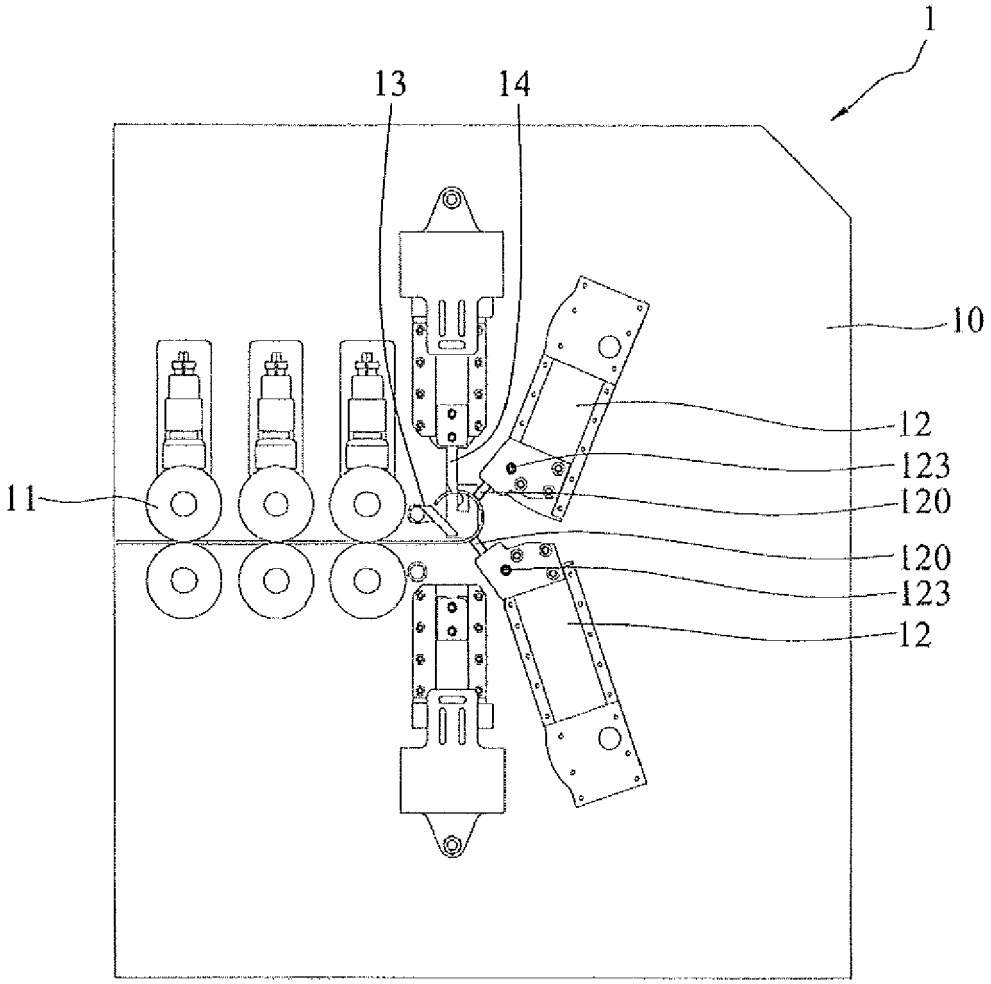


Fig. 1

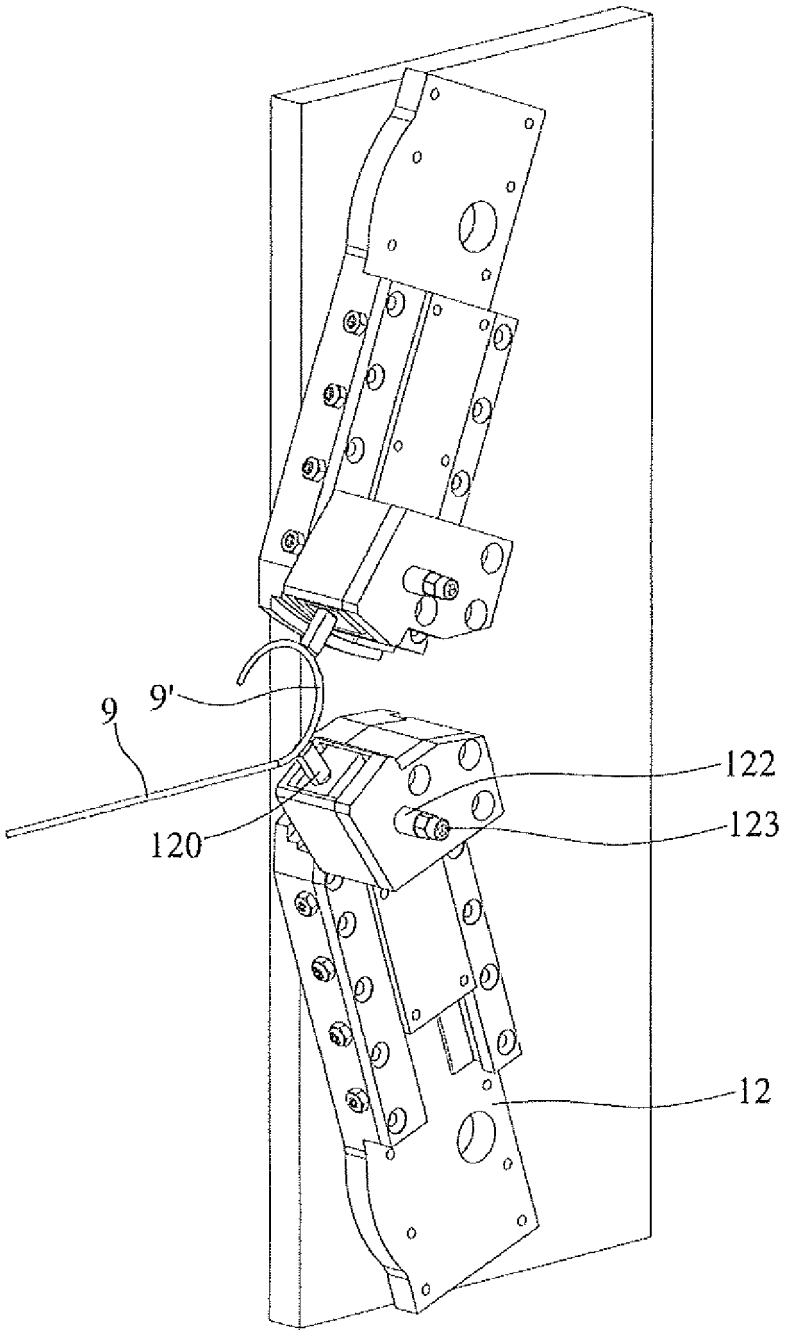


Fig. 1A

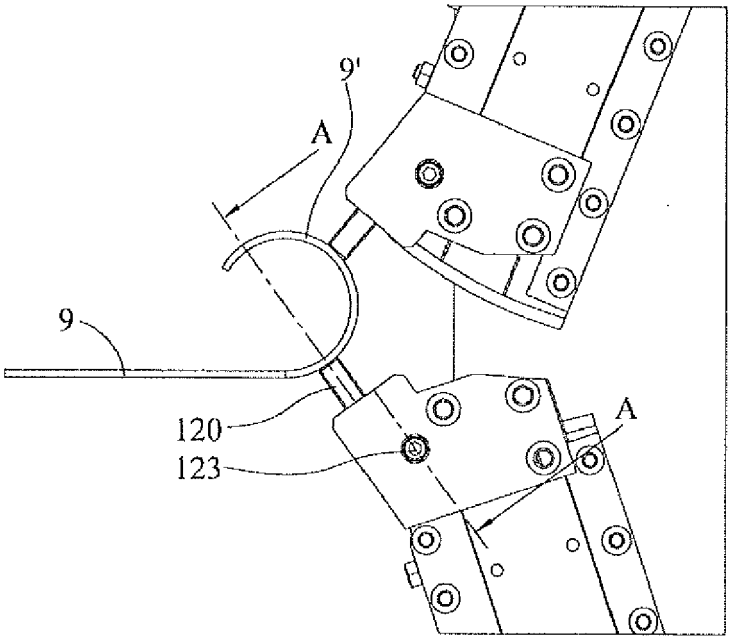


Fig. 1B

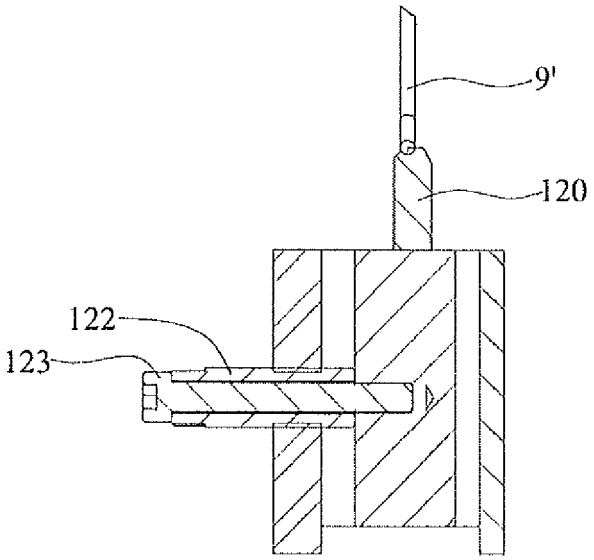


Fig. 1C

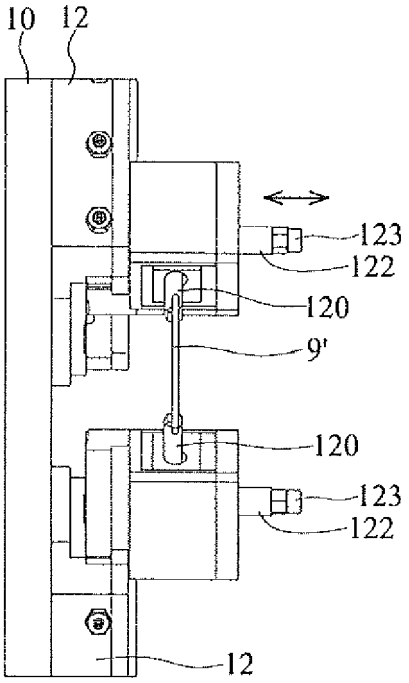

10
12
123
122
120
9'
120
123
122
12

Fig. 1D

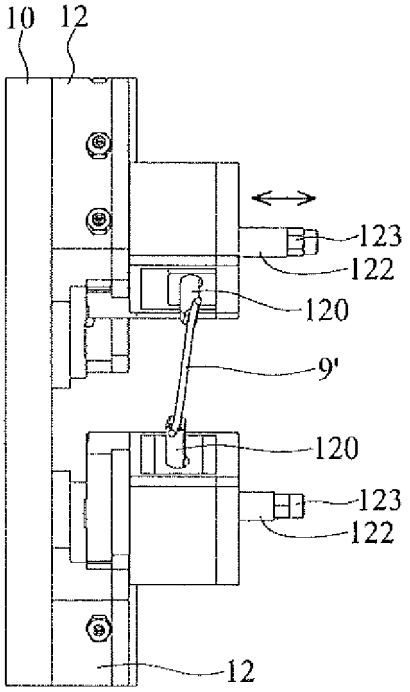

10
12
123
122
120
9'
120
123
122
12

Fig. 1E

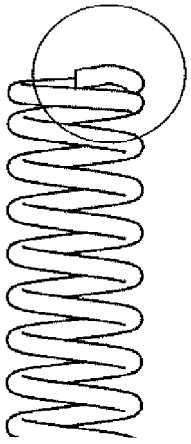


Fig. 1F

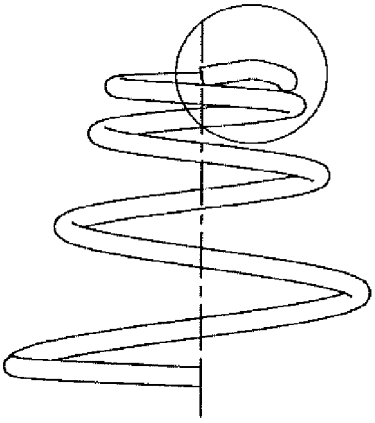


Fig. 1G

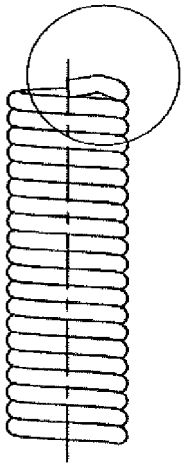


Fig. 1H

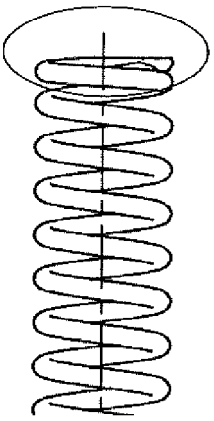


Fig. 1I

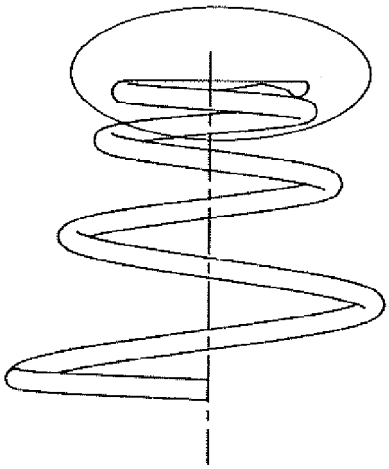


Fig. 1J

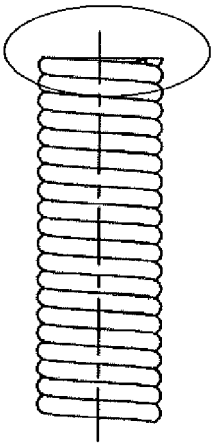


Fig. 1K

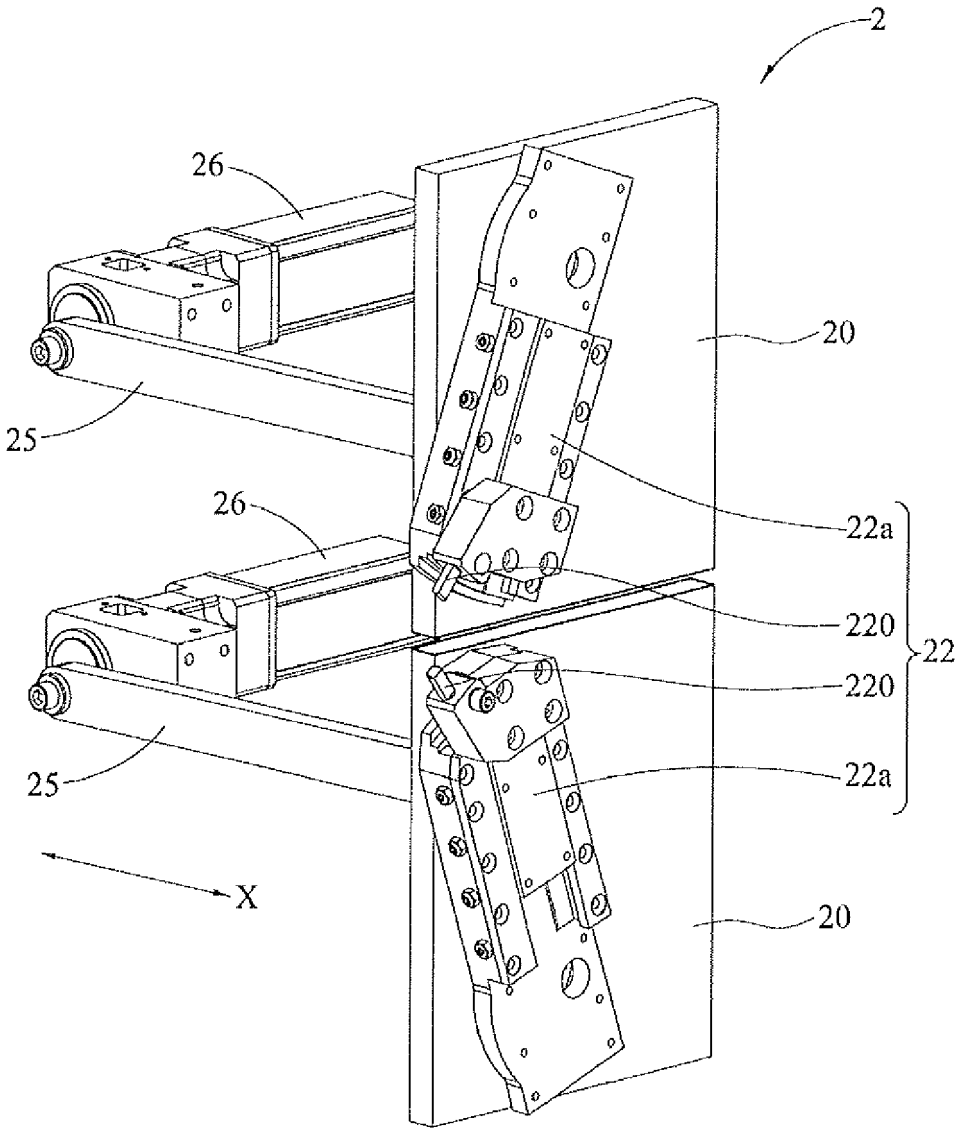


Fig. 2A

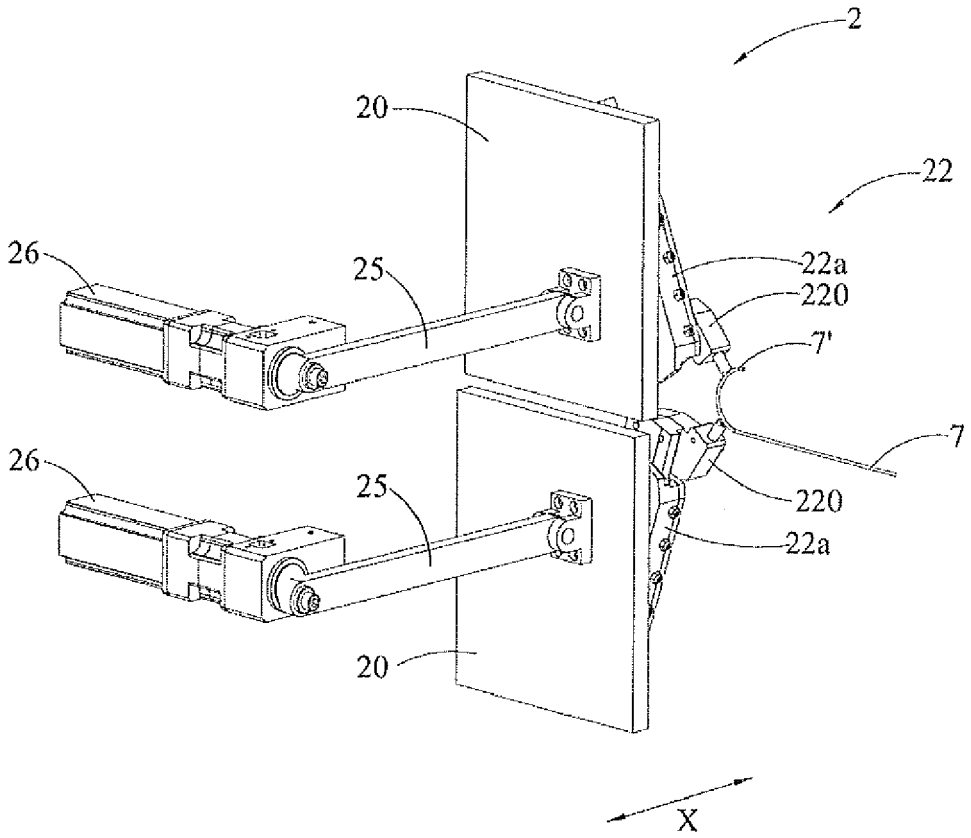


Fig. 2B

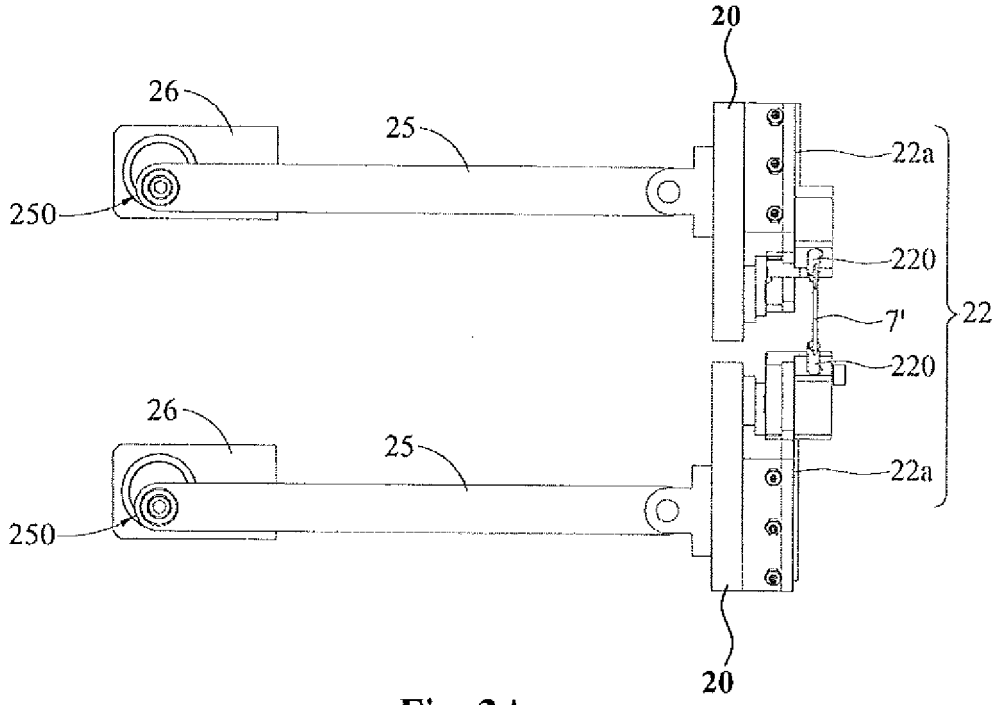

20
26
25
22a
250
220
7'
22
220
26
25
250
22a
20

Fig. 3A

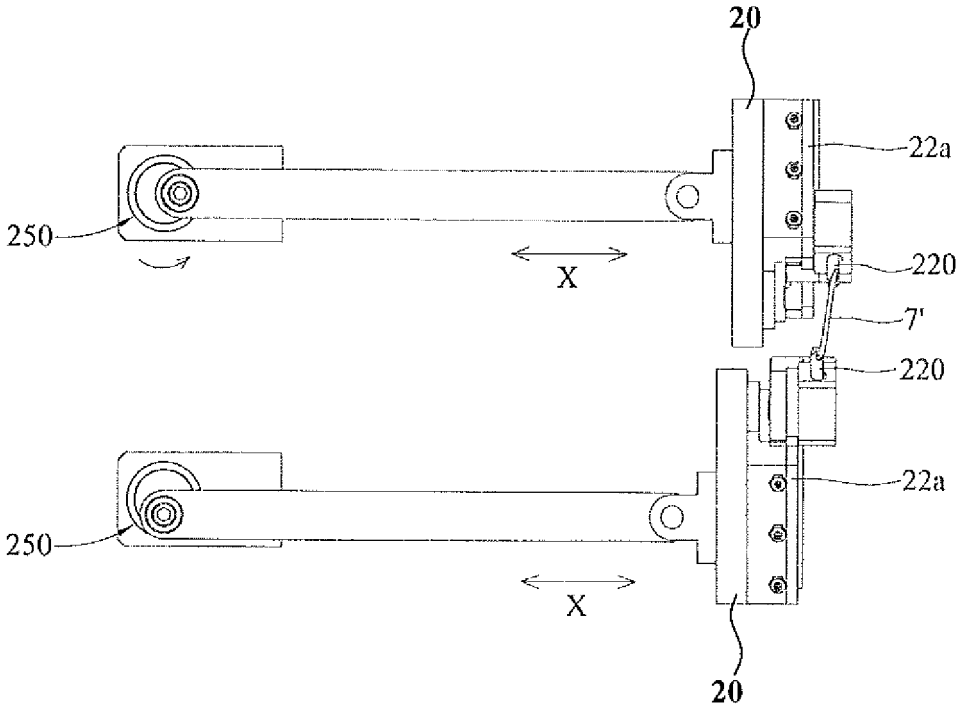

20
22a
250
X
220
7'
220
22a
250
X
20

Fig. 3B

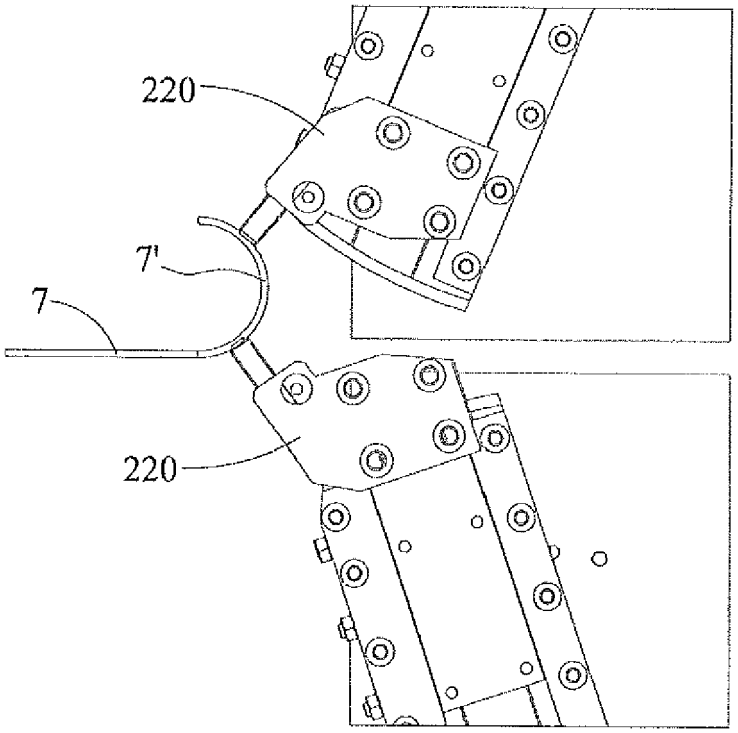


Fig. 3C

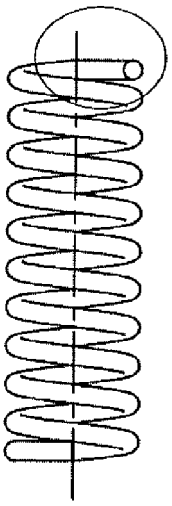


Fig. 3D

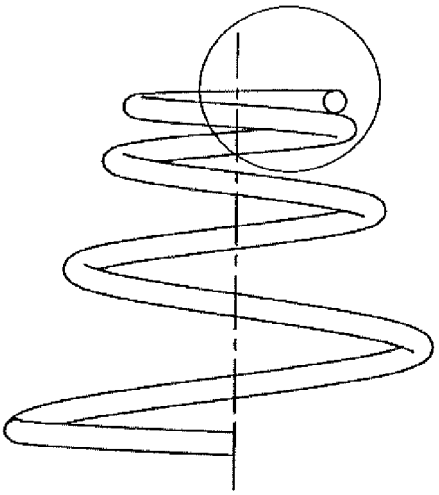


Fig. 3E

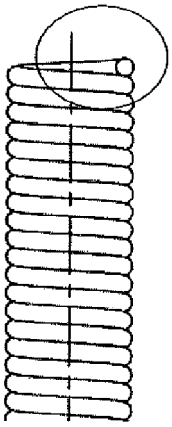


Fig. 3F

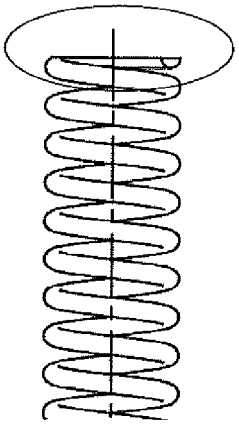


Fig. 3G

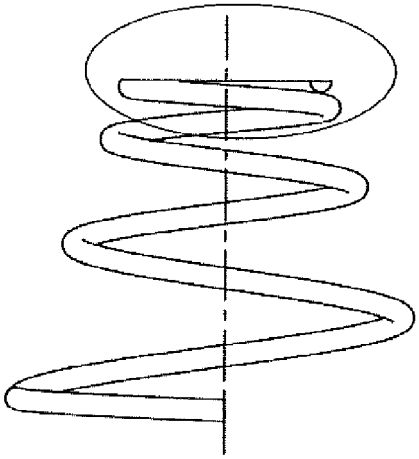


Fig. 3H

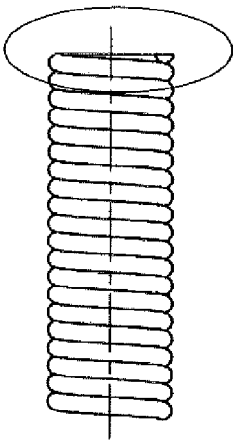


Fig. 3I

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 16 8873

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2004/154365 A1 (TSURITANI KATSUHIDE [JP]) 12 August 2004 (2004-08-12) * paragraph [0022] * * paragraph [0026] - paragraph [0034]; figures 1-5 *	1,4-7, 9-11	INV. B21F3/02 B21F35/00
X	US 5 657 657 A (WELSH COLIN [US] ET AL) 19 August 1997 (1997-08-19) * column 2, line 40 - line 63 * * column 4, line 57 - column 5, line 31 * * column 8, line 1 - line 19; figures 1,2,5-7 *	1,4-7, 9-11	
X	DE 198 25 970 A1 (ITAYA SEISAKUSHO [JP] ITAYA SEISAKU SHO TOKIO TOKYO [JP]) 17 December 1998 (1998-12-17) * column 7, line 40 - column 11, line 32; figures 1-4 *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

B21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 September 2013	Ritter, Florian

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 16 8873

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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09-09-2013

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