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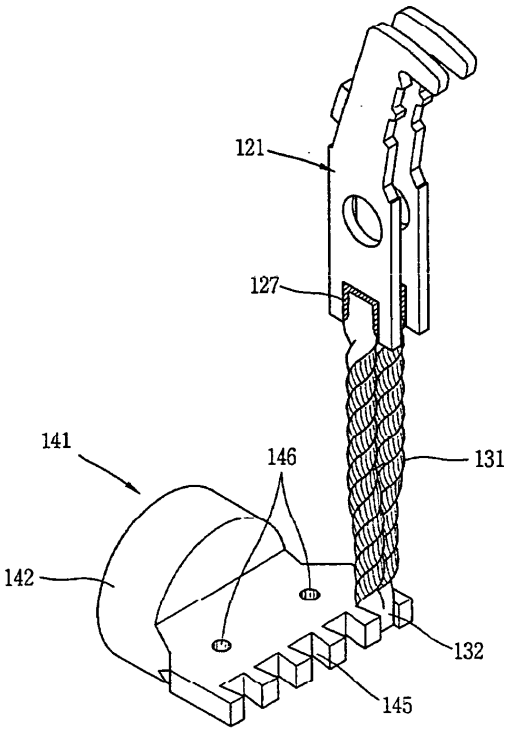
(54) Movable contact assembly for air circuit breaker and connection method for flexible wire thereof

(57) A movable contactor of an air circuit breaker and connection method for flexible wire thereof is disclosed. The movable contactor of the air circuit breaker, comprising: a plurality of fingers (121), flexible wires (131) each having one end connected to each of the fingers, and a connector (141) having inserting grooves (152) for inserting another end of the flexible wires to one side thereof, wherein the inserting groove has an extended section having a width gradually increased from an opening in an insertion direction of the flexible wires. Accordingly, a short circuit and thermal deformation can be prevented, and manufacturing time and cost can be reduced.

FIG. 6



EP 1 914 768 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a movable contactor of an air circuit breaker and a connection method for a flexible wire thereof, and more particularly, to a movable contactor of an air circuit breaker and a connection method for a flexible wire thereof, which can prevent thermal deformation and reduce manufacturing time and cost by reducing the number of welding processes or a welding section(point).

2. Description of the Background Art

[0002] In general, a circuit breaker is a device disposed on an electric path for opening/closing the electric path when occurring abnormal state such as a short circuit, and the like.

[0003] Such circuit breakers may be divided into an alternating current circuit breaker, a direct current circuit breaker, and the like according to a line applied. Also, the circuit breakers may be divided into an air circuit breaker, a gas circuit breaker, a vacuum circuit breaker, and the like according to medium for extinguishing the arc. Among those circuit breakers, the air circuit breaker is the circuit breaker to perform a switching operation in air. Such air circuit breaker includes a frame having a receiving space therein, fixed and movable contactors disposed inside the frame so as to contact and be separated from the frame, a driving unit for driving the movable contactor, and a detecting unit for detecting an overcurrent and a fault current.

[0004] Figure 1 is a side view showing a movable contactor of a related art air circuit breaker. Figure 2 is a front view of a connector in Fig. 1. As shown in drawings, a movable contactor 30 of an air circuit breaker is disposed at one side of a fixed contactor 10 connected to one of a power side and a load side inside a frame (not shown) so as to contact and be separated from the fixed contactor 10 by rotation. A driving unit 20 is provided at one side of the movable contactor 30 to open/close the movable contactor 30 according to a control signal, and includes a plurality of links 21, springs 23, and the like.

[0005] The movable contactor 30 includes a plurality of fingers 41 having a movable contact 42 contacting the fixed contactor 10, a cage 31 for receiving and supporting the fingers 41, and a connector 51 disposed at one side of the cage 31 and connected to another of the power side and the load side.

[0006] The fingers 41 and the connector 51 are connected by flexible wires 45. A plurality of inserting grooves 53 are formed at the connector 51 such that an end of the flexible wires 45 connected to each of the fingers 41 can be inserted therein. The flexible wires 45 inserted into the inserting grooves 53 are weld-coupled with a peripheral portion of the inserting grooves 53. A welding portion 54 is formed at an end of each of the flexible wires 45 and an opening of each inserting groove 53.

[0007] However, in the movable contactor of the related art air circuit breaker, a welding operation is performed after the flexible wires 45 are inserted into the inserting grooves 53 of the connector 51. Accordingly, the connector 51 may be deformed by high heat generating when welding.

[0008] In addition, the flexible wires 45 may be short-circuited when welding, thereby reducing its conducting performance.

[0009] Further, due to characteristics of the welding operation, additional welding equipment is needed. Also, the end of the flexible wires 45 and the peripheral portion of the inserting grooves 53 should be individually welded, thereby requiring a lot of time for the welding operation.

SUMMARY OF THE INVENTION

[0010] Therefore, it is an object of the present invention to provide a movable contactor of an air circuit breaker and a connection method for flexible wire thereof, which can prevent a short circuit and thermal deformation.

[0011] It is another object of the present invention to provide a movable contactor of an air circuit breaker and a connection method for flexible wire thereof, which can reduce manufacturing time and cost.

[0012] To achieve this and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a movable contactor of an air circuit breaker, comprising: fingers contacting a fixed contact; flexible wires each having one end connected to each of the fingers; and a connector disposed at one side of the fingers to be connected to either a power side or a load side, and having inserting grooves for inserting another end of the flexible wires therein, wherein the inserting groove has an extended section having a width gradually increased from an opening in an insertion direction of the flexible wires.

[0013] Here, the inserting groove may have a cross-section of a polygonal shape or of a circular arc shape.

[0014] Preferably, the flexible wires undergo plastic deformation after being inserted into the inserting groove.

[0015] The finger has a receiving portion for receiving an end of the flexible wires, and the receiving portion can have a side wall portion having a width gradually decreased toward an opening in a tensile direction of the flexible wires.

[0016] The receiving portion may have a cross-section of a polygonal shape or of a circular arc shape.

[0017] The flexible wires may undergo plastic deformation or may be weld-coupled after being received in the receiving portion.

[0018] The receiving portion may be formed in plurality.

[0019] Further, the receiving portion may be caulked after being coupled to an end of the flexible wires.

[0020] According to another aspect of the present in-

vention, in a movable contactor of an air circuit breaker having fingers contacting a fixed contact, a connector having one end connected to either a power side or a load side and flexible wires for connecting the fingers and the connector, a connection method for a flexible wire of the movable contactor of the air circuit breaker, comprising: forming inserting grooves at the connector so that a width thereof can be gradually increased from an opening in an insertion direction of the flexible wires; and inserting one end of the flexible wires into the inserting grooves.

[0021] Here, the method may further comprise a step of plastic-deforming the end of the flexible wires, after performing the step of inserting one end of the flexible wires into the inserting grooves.

[0022] Further, the method may further comprise a step of forming a receiving portion at the fingers so as to receive the end of the flexible wires, and a step of inserting the end of the flexible wires to the receiving portion.

[0023] The method may also comprise a step of welding the receiving portion and the flexible wires, after performing the step of inserting the end of the flexible wires to the receiving portion.

[0024] The method may also comprise a step of plastic deforming the end of the flexible wires, after performing the step of inserting the end of the flexible wires to the receiving portion.

[0025] The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0027] In the drawings:

Figure 1 is a side view showing a movable contactor of a related art air circuit breaker;

Figure 2 is a front view of a connector in Fig. 1;

Figure 3 is a perspective view showing a movable contactor of an air circuit breaker according to one embodiment of the present invention;

Figure 4 is a separated perspective view showing a coupling process of the finger and the connector in Fig. 2;

Figure 5 is a front view of the connector in Fig. 4;

Figure 6 is a view showing a coupled state between the flexible wires and the connector in Fig. 4;

Figures 7 and 8 respectively show a modified example of the inserting groove in Fig. 3;

Figure 9 shows a modified example of the receiving portion of the finger in Fig. 4;

Figure 10 is a view for describing a coupled state between the finger and the flexible wires according to another embodiment of the present invention;

Figure 11 is a perspective view showing a finger of the movable contactor of the air circuit breaker according to still another embodiment of the present invention; and

Figure 12 is a view showing the coupled state in Fig. 11.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Description will now be given in detail of the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0029] Referring to Figs. 3 and 4, a movable contactor of an air circuit breaker of the present invention includes fingers 121 contacting a fixed contact of a fixed contactor (not shown); flexible wires 131 each having one end connected to each of the fingers 121; and a connector 141 disposed at one side of the fingers 121 to be connected to either a power side or a load side, and having inserting grooves 152 at one end thereof for inserting another end of the flexible wires 131, wherein the inserting groove 152 has an extended section 154 having a width gradually increased from an opening in an insertion direction of the flexible wire 131.

[0030] The fingers 121 are received to be coupled to an inside of a cage 111 having a receiving space divided for the fingers 121 therein, and a rotation supporting portion 113 is disposed at one side of the cage 111 such that the connector 141 can be rotatably coupled thereto. The rotation supporting portion 113 rotates with respect to the cage 111 centering around a rotation shaft 115.

[0031] The finger 121 is formed in a long plate shape made of copper (Cu) material. A movable contact 122 is formed at one side of each of the fingers 121 to contact the fixed contact, and a bending portion 124 horizontally bent with respect to a longitudinal direction is formed at one end of each of the fingers 121. A receiving portion 125 is formed at another end of each of the fingers 121 so as to receive one end of the flexible wires 131 therein. The receiving portion 125 is formed in a rectangular concave groove in a thickness direction.

[0032] The flexible wires 131 are formed of a plurality of wires having a thin diameter so as to have flexibility. Compressed portions 132 are individually formed at both ends of each of the flexible wires 131 so as to be easily inserted into the receiving portion 125 and the inserting groove 152.

[0033] Meanwhile, the connector 141 includes a connecting portion 142 connected to either the power side or the load side, and a wire connecting portion 145 to which the flexible wires 131 are connected. The connecting portion 142 has a circular rod shape, and the wire connecting portion 145 having a relatively thin plate shape is integrally formed with the connecting portion

142 at one side of the connecting portion 142. A plurality of coupling holes 144 are penetratingly formed at an end surface of the connecting portion 142 so as to be connected to the power side or the load side by a fixing bolt, and the like.

[0034] Bolt holes 146 are formed at the wire connecting portion 145 so as to pass the fixing bolts 147 coupled to the rotation supporting portion 113. A plurality of inserting grooves 152 are formed at one end of the wire connecting portion 145 so as to insert the end of the flexible wires 131 therein. One end of each inserting groove 152 is formed to have a size enough to insert two compressed portions 132, that is, the end of the flexible wires 131 connected to the receiving portion 125 of the fingers 121. In this embodiment, the wire connecting portion 145 has five inserting grooves 152 such that the flexible wires 131 connected to ten fingers 121 can be inserted therein.

[0035] As shown in Fig. 5, each of the inserting grooves 152 is formed to have an extended section 154 having a width gradually increased from the opening in an insertion direction of the flexible wires 131. As shown in Fig. 6, this is to prevent the separation of the inserted compressed portions 132 of each of the flexible wires 131 in an opposite direction of the insertion direction, when each of the flexible wires 131 is disposed perpendicularly to the plate surface of the wire connecting portion 145, and if each of the compressed portions 132 is forcibly inserted into the opening. Here, the inserting grooves 162, as shown in Fig. 7, may be configured to have a cross-section of a circular arc shape having an extended section 164 with a predetermined length from an opening. As shown in Fig. 8, the inserting grooves 172 may be configured to have a cross-section of a polygonal shape having an extended section 174 with a predetermined length from an opening.

[0036] The two compressed portions 132 of the flexible wires 131 are forcibly inserted simultaneously into one inserting groove 152, pressed, and then are plastic-deformed into a shape corresponding to an inner shape of the inserting groove 152. That is, the flexible wires 131 are formed as follows: a plurality of thin wires are twisted, and a first compression is performed to both ends of the flexible wires 131 to make a shape to be inserted to the inserting groove 152 and the receiving portion 132, thereby forming each of the compressed portions 132. The compressed portion 132 to be inserted into the inserting groove 152 among the compressed portions 132 is compressed again, and then is plastic-deformed into a shape corresponding to that of the inserting groove 152. Accordingly, the end of each flexible wire 131, that is, the compressed portion 132 can be prevented from being separated from the opening in an opposite direction of the insertion direction.

[0037] With such structure, the connection method between the connector 141 and the flexible wires 131 will be described in detail. First, the two compressed portions 132 of the flexible wire 131 are forcibly inserted simultaneously into each inserting groove 152 of the connector 141. Then, the compressed portions 132 forcibly inserted into the corresponding inserting groove 152 are pressed again, as shown in Fig. 5, thereby forming compressed portions 133 plastic-deformed into the shape corresponding to that of the inserting groove 152.

[0038] Meanwhile, the connection method between the flexible wires 131 and the fingers 121 is as follows: first, another compressed portion 132 of the flexible wires 131 is forcibly inserted into each receiving portion 125 of the finger 121. Next, the receiving portion 125 and the compressed portion 132 of the flexible wires 131 are welded together, thereby forming a welding portion 127.

[0039] Figure 9 is a perspective view showing a finger of the movable contactor of the air circuit breaker according to another embodiment of the present invention. Figure 10 is a view for describing a coupled state between the finger and the flexible wires in Fig. 9. The same and/or equivalent parts to the above-mentioned and described structure will not be shown for the sake of convenience in explanation, and the same reference numerals will be used to describe. As shown in drawings, the movable contactor of the air circuit breaker includes a plurality of fingers 121 contacting a fixed contact and having a receiving portion 185 at one end thereof, flexible wires 131 having one end connected to each of the fingers 121, and a connector 141 disposed at one side of the fingers 121 to be connected to a power side or a load side, and having inserting grooves 152 for inserting another end of the flexible wires 131 to one side thereof, wherein the inserting groove 152 has an extended section 154 having a width gradually increased from the opening in an insertion direction of the flexible wires 131.

[0040] A receiving portion 185 is formed at one end of the finger 121 to receive the compressed portion 132 of the flexible wires 131. The compressed portion 132 of the flexible wires 131 is inserted into the inside of the receiving portion 185, and then is plastic-deformed into a shape corresponding to the inner shape of the receiving portion 185.

[0041] As shown in Fig. 10, a welding portion 187 is formed at an opening of the receiving portion 185 in a thickness direction so as to prevent the separation of the flexible wires 131 in a thickness direction of the finger 121.

[0042] If the flexible wires 131 are extended in a longitudinal direction, the receiving portion 185 is formed to have an inner width W1 gradually reduced toward the opening in a longitudinal direction of the finger 121. This is to prevent the separation of the end of the flexible wires 131 received inside the receiving portion 185 from the receiving portion 185 when the flexible wires 131 are pulled. Further, it is to reduce a welding section and welding time by lowering bond strength required after the welding process. Here, the receiving portion 185 may have a cross-section of a circular arc shape as shown in Fig. 7, or have a cross-section of a polygonal shape as shown in Fig. 8.

[0043] With such structure, when connecting the finger

121 and the flexible wires 131, the compressed portion 132 of the flexible wires 131 is inserted into the receiving portion 185 of the finger 121. Next, the receiving portion 185 and the compressed portion 132 of the flexible wires 131 are welded together, thereby forming the welding portion 187.

[0044] Figure 11 is a perspective view showing a finger of the movable contactor of the air circuit breaker according to still another embodiment of the present invention, and Figure 12 is a view showing the coupled state in Fig. 11. As shown in drawings, the movable contactor of the air circuit breaker includes fingers 121 contacting a fixed contact and having a plurality of receiving portions 195 at one end thereof, flexible wires 131 having one end connected to each of the fingers 121, and a connector 141 disposed at one side of the fingers 121 to be connected to a power side or a load side, and having inserting grooves 152 for inserting another end of the flexible wires 131 to one side thereof, wherein the inserting groove 152 has an extended section 154 having a width gradually increased from the opening in an insertion direction of the flexible wires 131.

[0045] The plurality of receiving portions 195 are formed at one end of the fingers 121 to receive the compressed portion 135 of the flexible wires 131 therein, and the plurality of compressed portions 135 are formed at one end of the flexible wires 131 and compressed by being divided according to the number of the receiving portions 195.

[0046] Each of the compressed portions 135 of the flexible wires 131 is received in each of the receiving portions 195, and is plastic-deformed into a shape corresponding to the receiving portion 195. Here, to more effectively prevent the separation of the flexible wires 131 in the thickness direction of the fingers, a caulking portion 197 may be plastic-deformed by a caulking operation such that the opening of the receiving portion 195 in a thickness direction can be narrower.

[0047] If the flexible wires 131 are extended, the receiving portion 195 is formed to have an inner width W2 gradually reduced toward the opening. This is to prevent the separation of the compressed portion 135, that is, the end of the flexible wires 131 received inside the receiving portion 195, from the receiving portion 195 when the flexible wires 131 are pulled. Here, the receiving portion 195 may have a cross-section of a circular arc shape as shown in Fig. 7, or have a cross-section of a polygonal shape as shown in Fig. 8.

[0048] With such structure, when connecting the fingers 121 and the flexible wires 131, the compressed portions 135 formed at the end of the flexible wires 131 are forcibly inserted into each of the receiving portions 195 of the finger 121. Next, the compressed portions 135 received inside of each receiving portion 195 are pressed to be plastic-deformed into a shape corresponding to the inner shape of the receiving portions 195. And, to more effectively prevent the separation of the flexible wires 131 in a thickness direction of the finger 121, a caulking portion 197 may further be plastic-deformed by a caulking operation such that the opening of the receiving portion 195 in a thickness direction can be narrower.

[0049] As described so far, according to the present invention, a welding process is eliminated by forming the inserting groove to the connector so as to have the extended section having a width gradually increased from the opening in an insertion direction of the flexible wires, thereby controlling deformation by a high heat of the connector and preventing a short circuit of the flexible wires. Further, a bond strength, which is the almost same as that when coupling by a welding process, can be obtained and conducting performance can be enhance.

[0050] Further, according to the present invention, welding processes may be eliminated or welding areas may be reduced, by forming the inserting groove having the extended section at the connector and by forming the receiving portion having a width gradually reduced toward the opening in a tensile direction of the flexible wires at the finger. Accordingly, deformation of components due to the welding operation may be controlled and a short circuit of the flexible wires can be prevented.

[0051] In addition, according to the present invention, both ends of the flexible wires are respectively connected to the connector and the finger, and then are plastic-deformed into a shape corresponding to the inserting groove and the receiving portion. Accordingly, the welding processes can be eliminated, thereby not requiring the use of the welding equipment. The manufacturing process is simplified, thereby shortening its manufacturing time and reducing manufacturing cost.

[0052] As the present features may be embodied in several forms without departing from the characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalents of such metes and bounds are therefore intended to be embraced by the appended claims.

Claims

1. A movable contactor of an air circuit breaker, comprising:

fingers contacting a fixed contact;
flexible wires each having one end connected to each of the fingers; and
a connector disposed at one side of the fingers to be connected to either a power side and a load side, and having inserting grooves for inserting another end of the flexible wires,

wherein the inserting groove has an extended sec-

tion having a width gradually increased from an opening in an insertion direction of the flexible wires.

2. The movable contactor of claim 1, wherein the inserting groove has a cross-section of a polygonal shape.

3. The movable contactor of claim 1, wherein the inserting groove has a cross-section of a circular arc shape.

4. The movable contactor of claim 1, wherein the flexible wires undergo plastic deformation after being inserted into the inserting groove.

5. The movable contactor of claim 1, wherein the finger has a receiving portion for receiving an end of the flexible wires.

6. The movable contactor of claim 5, wherein the receiving portion has a side wall portion having a width gradually decreased toward an opening in a tensile direction of the flexible wires.

7. The movable contactor of claim 6, wherein the receiving portion has a cross-section of a polygonal shape.

8. The movable contactor of claim 6, wherein the receiving portion has a cross-section of a circular arc shape.

9. The movable contactor of claim 6, wherein the flexible wires undergo plastic deformation after being received in the receiving portion.

10. The movable contactor of claim 5, wherein the flexible wires are weld-coupled after being received in the receiving portion.

11. The movable contactor of claim 5, wherein the receiving portion is formed in plurality.

12. The movable contactor of claim 11, wherein the receiving portion is caulked after being coupled to an end of the flexible wires.

13. In a movable contactor of an air circuit breaker having fingers contacting a fixed contact, a connector having one end connected to either a power side or a load side and flexible wires for connecting the fingers and the connector,
a connection method for a flexible wire of the movable contactor of the air circuit breaker, comprising:

forming inserting grooves at the connector so that a width thereof can be gradually increased from an opening in an insertion direction of the flexible wires; and
inserting one end of the flexible wires into the inserting grooves.

14. The method of claim 13, further comprising:

plastic-deforming the end of the flexible wires, after performing the step of inserting one end of the flexible wires into the inserting grooves.

15. The method of claim 13, further comprising:

forming a receiving portion at the fingers so as to receive the end of the flexible wires: and
inserting the end of the flexible wires to the receiving portion.

16. The method of claim 15, further comprising:

welding the receiving portion and the flexible wires, after performing the step of inserting the end of the flexible wires to the receiving portion.

17. The method of claim 15, further comprising:

plastic deforming the end of the flexible wires, after performing the step of inserting the end of the flexible wires to the receiving portion.

FIG. 1

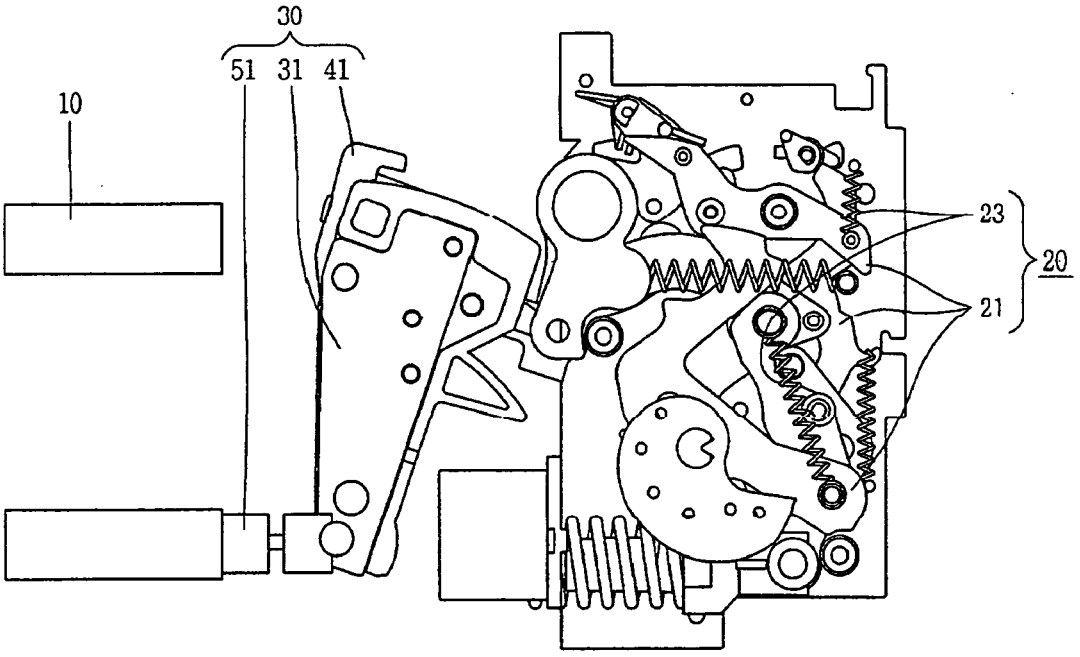


FIG. 2

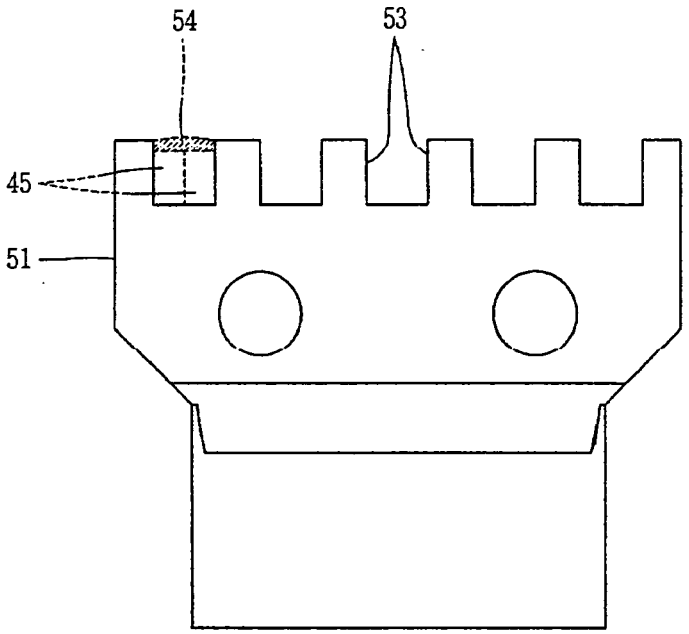


FIG. 3

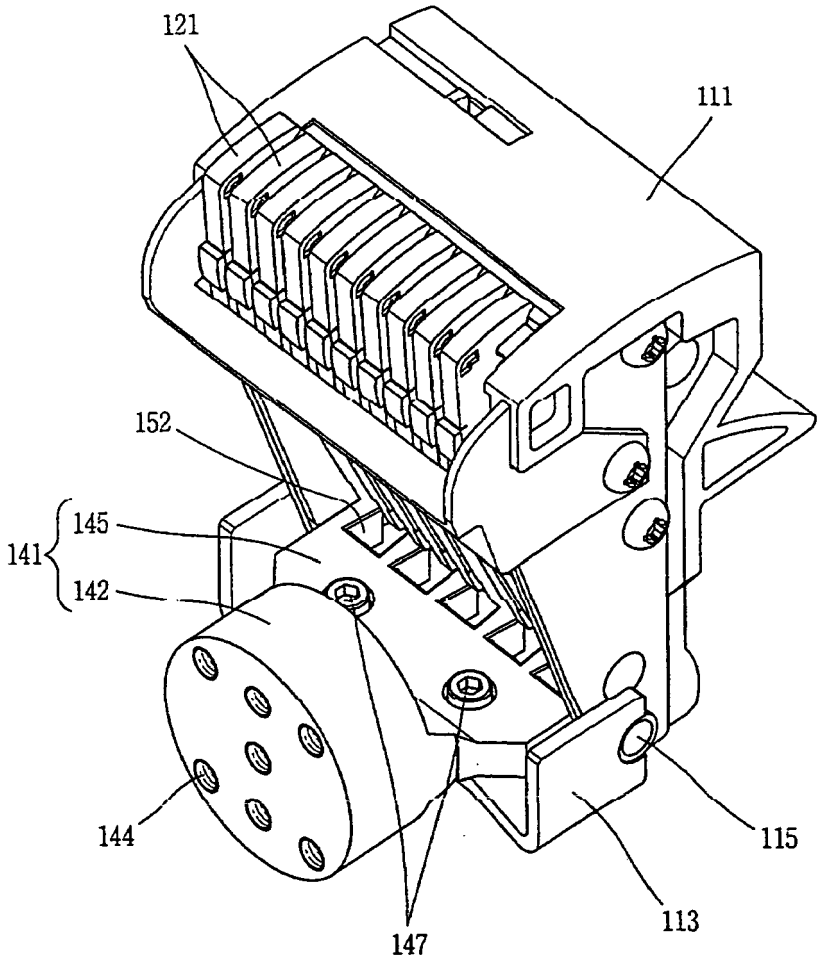


FIG. 4

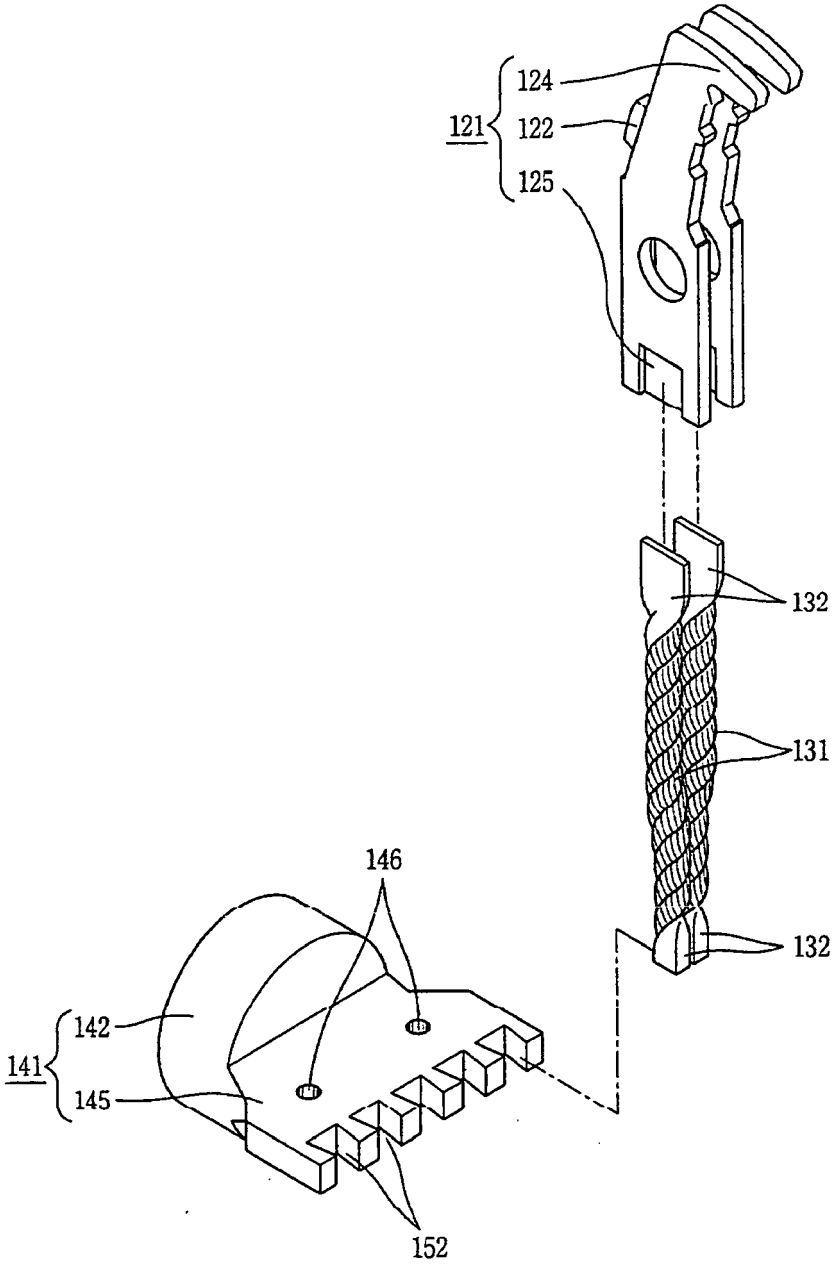


FIG. 5

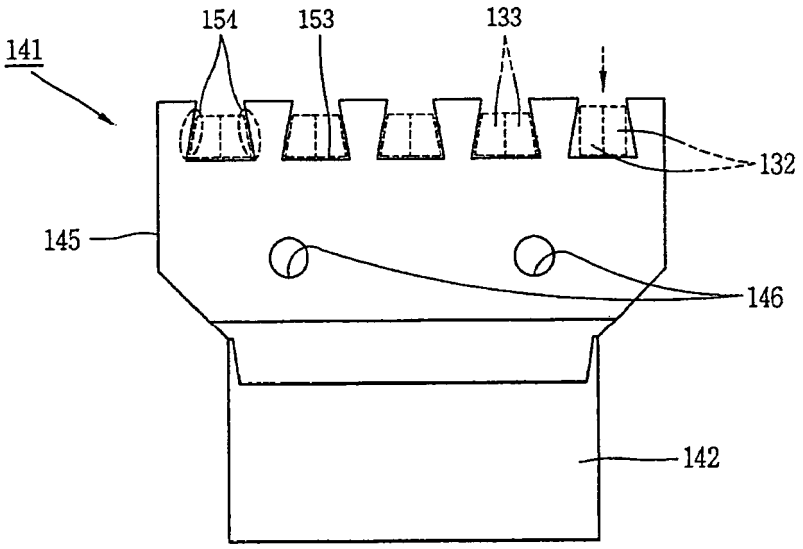


FIG. 6

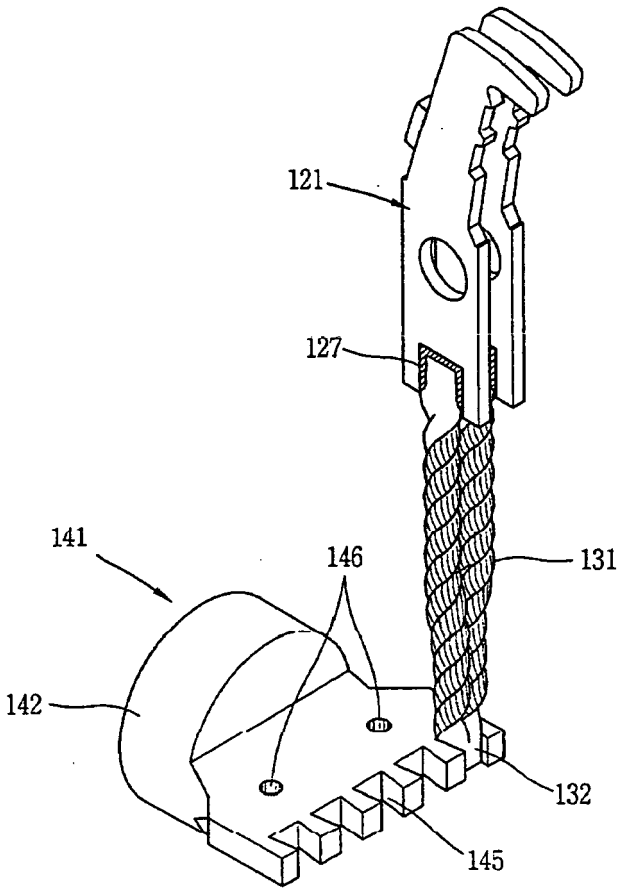


FIG. 7

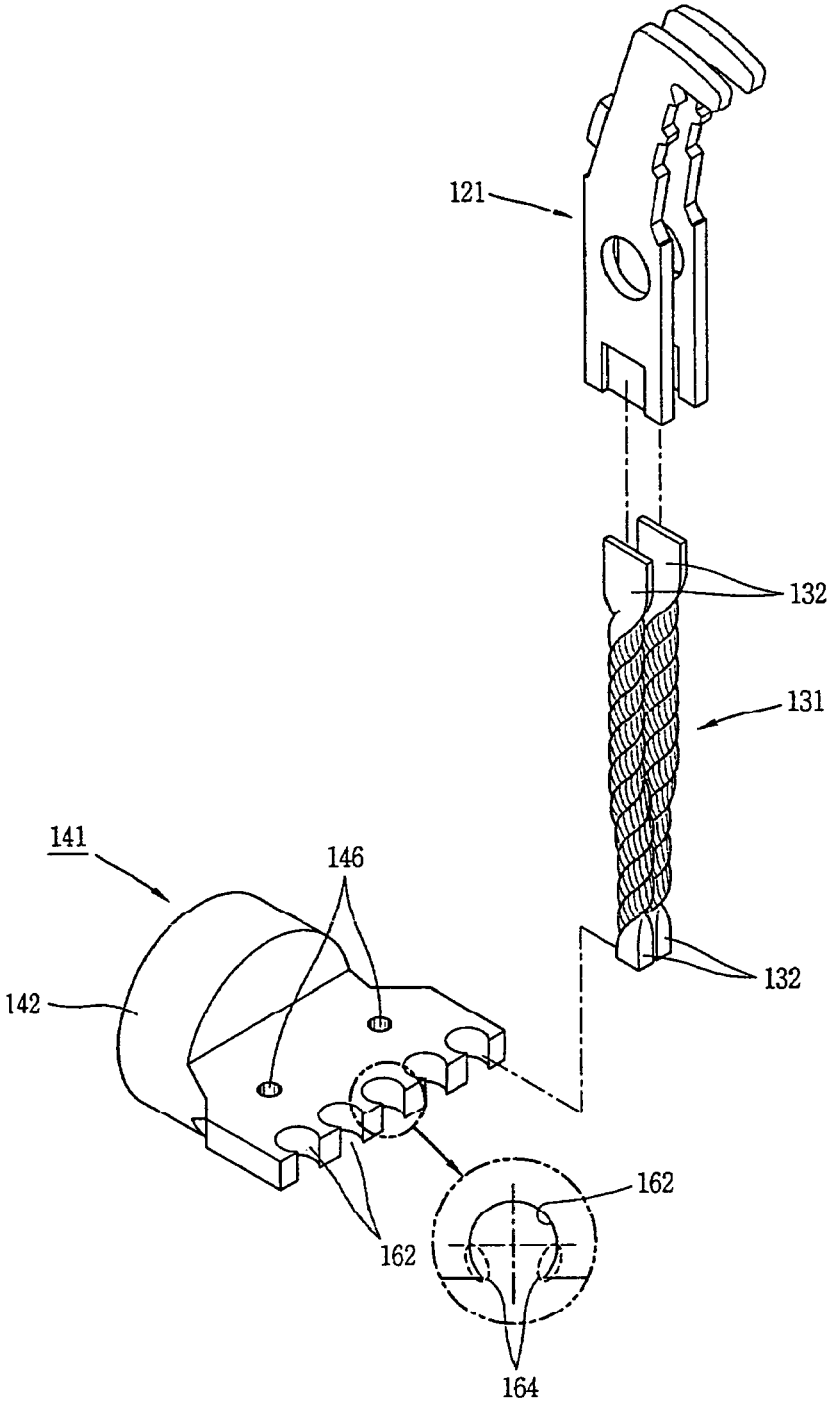


FIG. 8

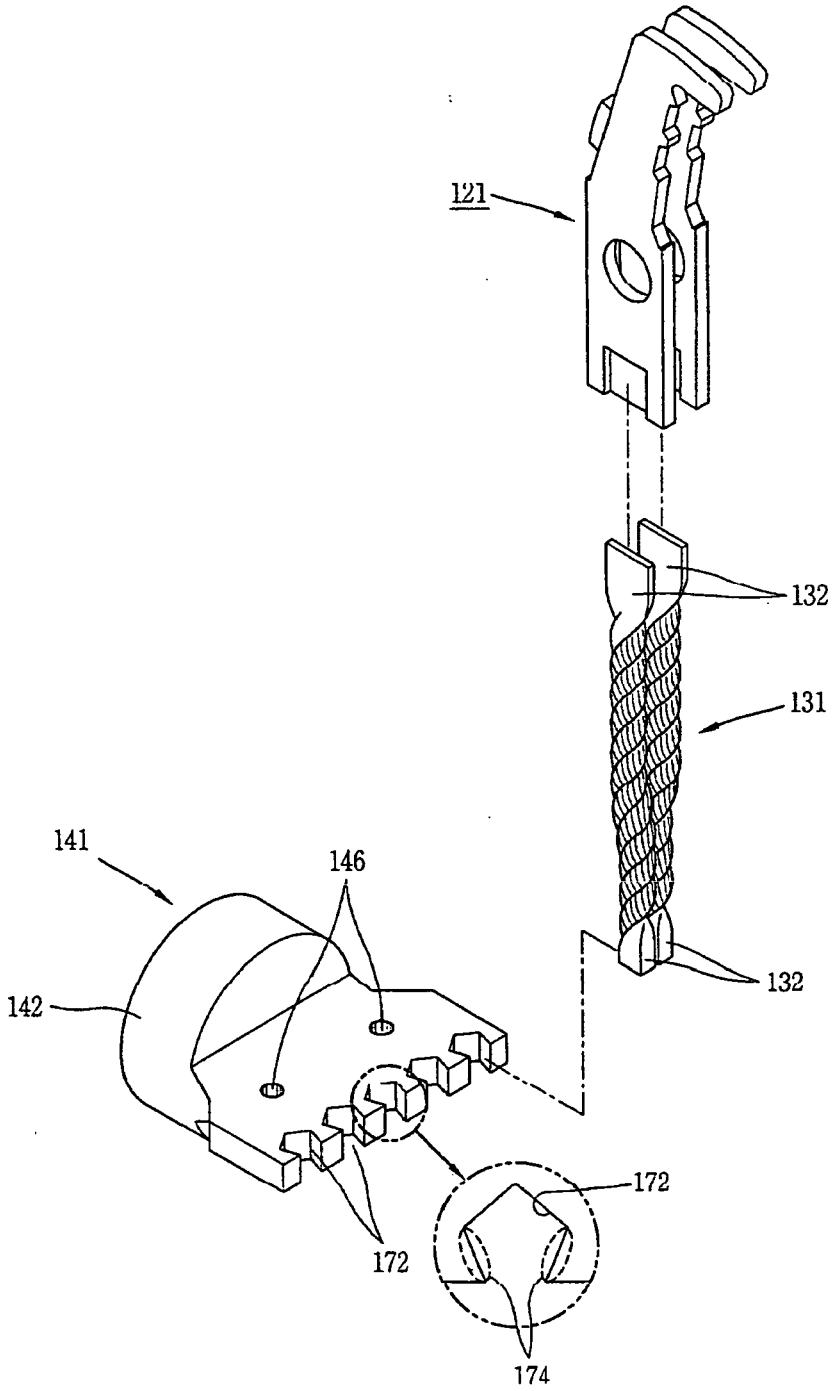


FIG. 9

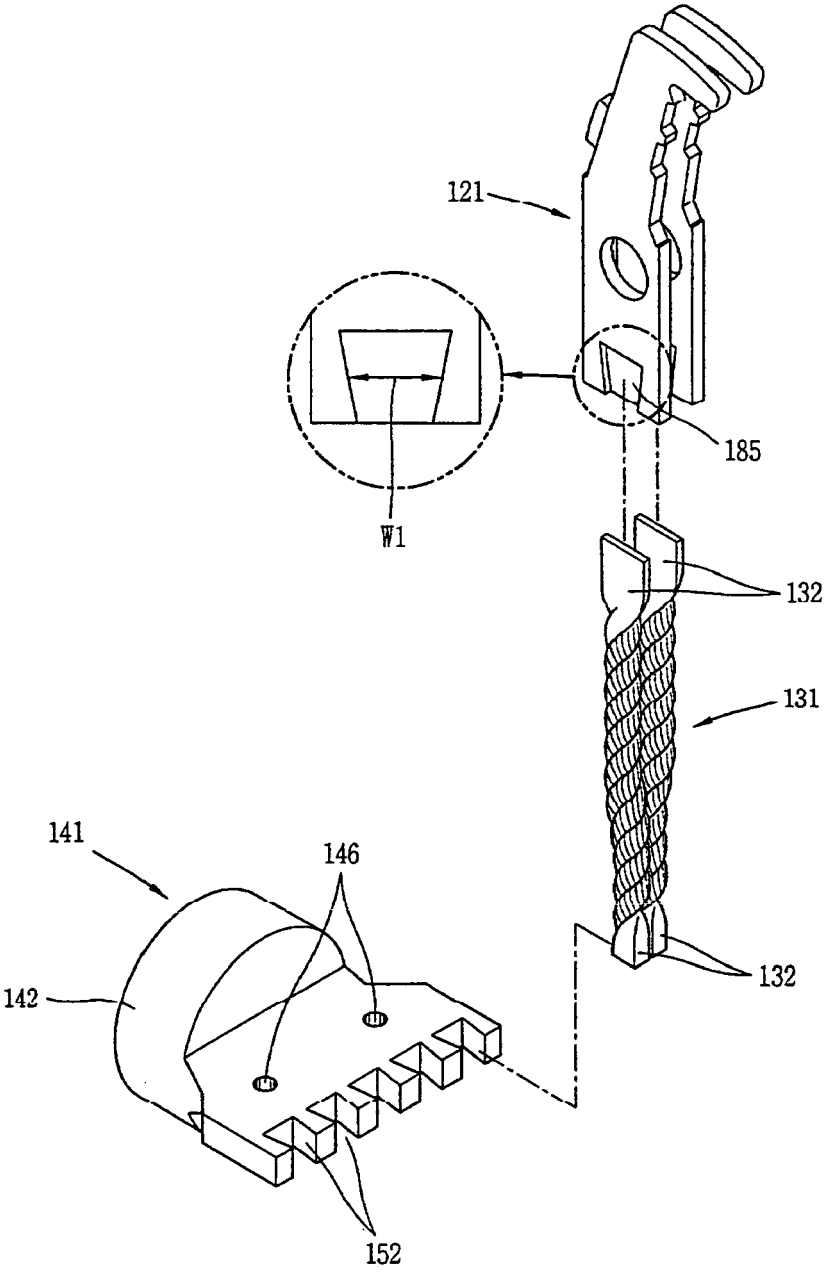


FIG. 10

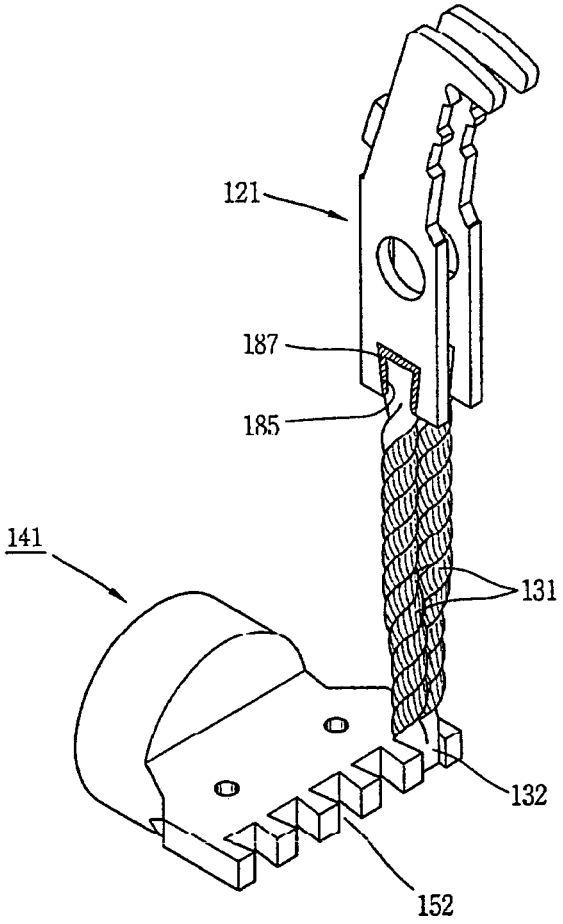


FIG. 11

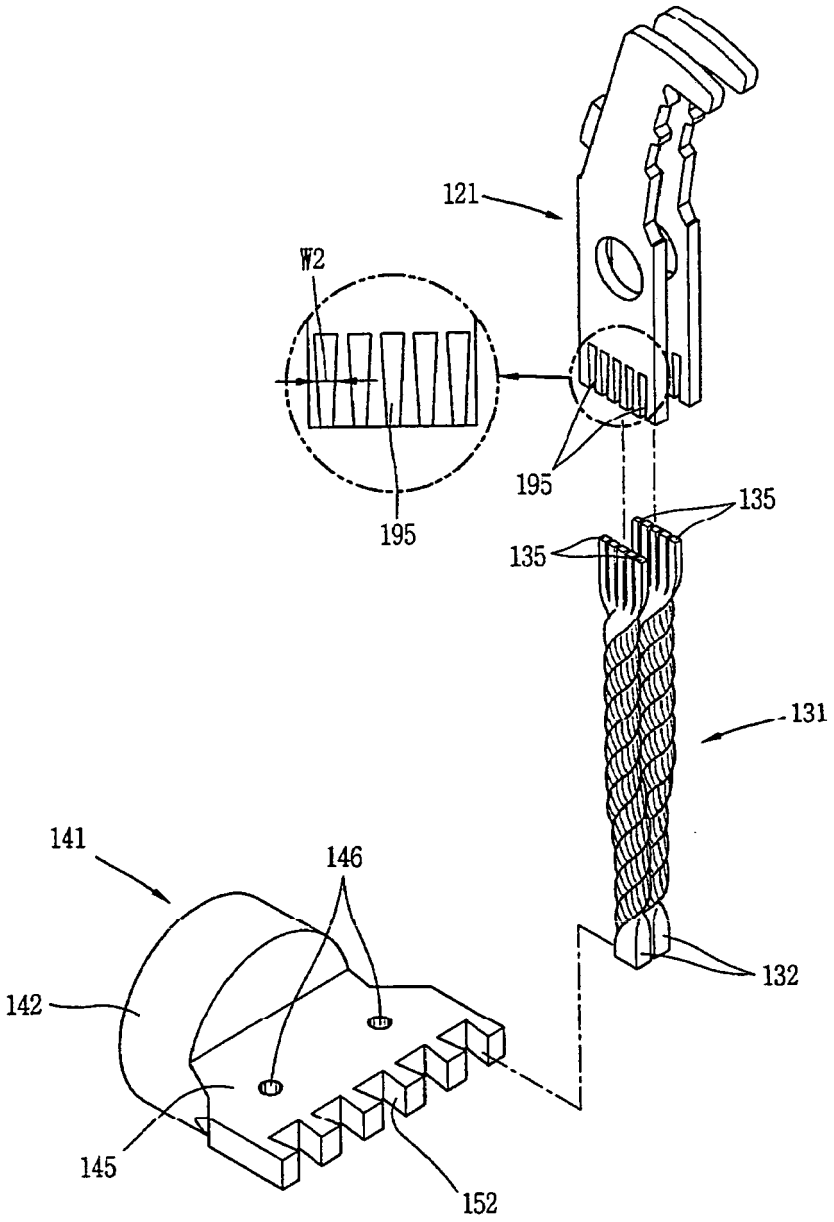
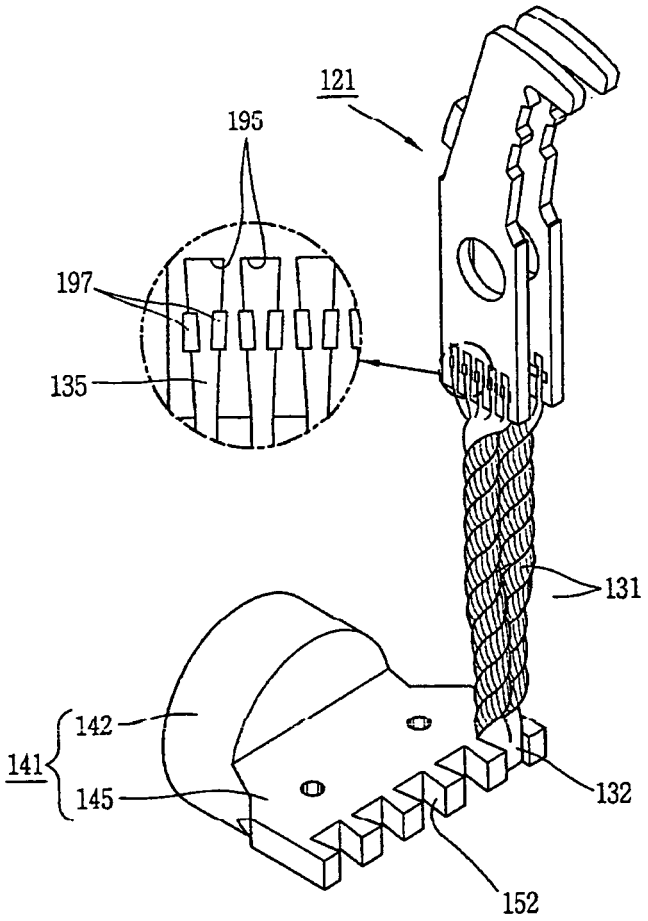


FIG. 12



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 01 9936

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 Y	DE 10 2004 058764 A1 (SIEMENS AG [DE]) 1 June 2006 (2006-06-01) * paragraphs [0016] - [0021]; figures 1,2 * -----	1,2,4-7, 9,10, 13-17 11,12	INV. H01H1/58 ADD. H01H1/22
X	US 5 032 813 A (GULA LANCE [US] ET AL) 16 July 1991 (1991-07-16) * column 3, line 40 - column 5, line 56; figures 1-8 * -----	1,3-6,8, 9,13-15, 17	
Y	DE 296 14 720 U1 (SIEMENS AG [DE]) 18 December 1997 (1997-12-18) * page 3, line 27 - page 5, line 14; figures 1-3 * -----	11,12	
Y	JP 11 213762 A (FUJI ELECTRIC CO LTD) 6 August 1999 (1999-08-06) * abstract * -----	12	
A	FR 1 279 798 A (AMP INC) 22 December 1961 (1961-12-22) * the whole document * -----	4,9	TECHNICAL FIELDS SEARCHED (IPC) H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 January 2008	MAEKI-MANTILA, M

CATEGORY OF CITED DOCUMENTS

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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

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 01 9936

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