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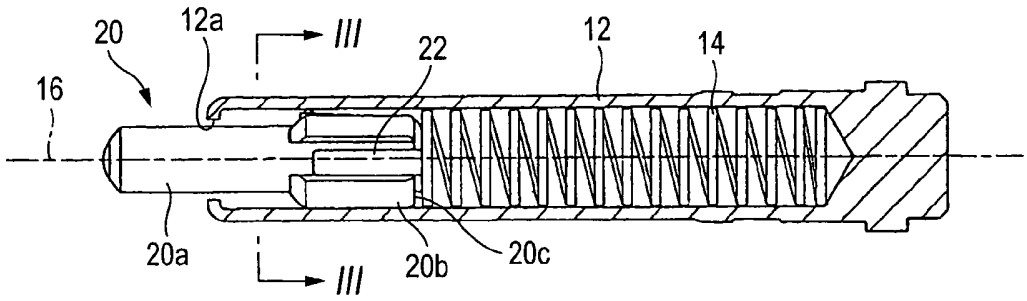
(54) Title: SPRING CONNECTOR



(57) Abstract: A cylindrical member has a hollowed space one end of which is formed with an opening having a first diameter. A terminal is provided with a first portion having a second diameter which is no greater than the first diameter, and a second portion having a third diameter which is greater than the first diameter. The terminal is disposed in the hollowed space such that at least a part of the first portion is projected outward from the opening. A coiled spring is disposed in the hollowed space so as to urge the second portion of the terminal toward the opening, so that the terminal is movable in an axial direction of the cylindrical member. An elastic member is attached to the terminal so as to provide an elastic force that brings the second portion of the terminal is directly brought into contact with a first part of an inner face of the hollowed space.

WO 2006/025510 A1

DESCRIPTION

SPRING CONNECTOR

TECHNICAL FIELD

This invention relates to a spring connector comprising a conductive cylindrical member accommodating a coiled spring and a conductive movable terminal such that one end of the movable terminal is projected from an open end of the cylindrical member and the other end of the movable terminal is disposed inside the cylindrical member while compressing the coiled spring, thereby the movable terminal is slidable in the axial direction of the cylindrical member while being urged by the compressed coiled spring.

BACKGROUND ART

Fig. 15 shows a related-art spring connector. In this example, a movable terminal 10 is formed of a conductive, rod-shaped member with its front end side being arranged as a small-diameter protruding part 10a, its rear end side being arranged as a large-diameter inner end part 10b, and an inner end face 10c being slant with respect to the direction of an axis 16. A cylindrical member 12, in which this movable terminal 10 is disposed, is formed of a conductive material, has a constricted part 12a, which allows the insertion of the protruding part 10a but does not allow the insertion of the inner end part 10b, provided at an open end part at one end, and is closed at the other end.

Also inside cylindrical member 12, a coiled spring 14 is disposed between the inner end face 10c of the movable terminal 10 and the closed part at the other end of the cylindrical member 12 while being compressed.

With this arrangement, the front end of the protruding part 10a of the movable terminal 10 is protruded to the exterior by the elastic force of the coiled spring 14 in the natural state. When the front end of the protruding part 10a is pressed towards the rear end along the direction of the axis 16, the movable terminal 10 is moved in the direction of being housed against the elastic force of the coiled spring 14. Here, since inner end face 10c of the movable terminal 10 is slant with respect to the direction of the axis 16, a component force that is orthogonal to the direction of the axis 16 acts on the inner end face 10c due to the elastic force of the coiled spring 14, and by this component force, the inner end part 10b of the movable terminal 10 becomes biased and brought into elastic contact with an inner peripheral face of the cylindrical member 12. Electric conduction between the movable terminal 10 and the cylindrical member 12 is thus achieved.

However, since the force that biases and puts the inner end part 10b in elastic contact with the inner peripheral face of the cylindrical member 12 depends on the degree of the elastic force of the coiled spring 14 and the slant angle of the inner end face 10c, it is not always to be obtained an adequate degree. In addition, the electrical conduction between the movable terminal 10 and the cylindrical member 12 might be interrupted momentarily by vibration or the like.

United States Patent No. 4,904,213 and Japanese Utility Model Publication No. 6-50260U disclose a configuration in which an inner end part of

the movable terminal is spread to act as an elastic contact member that elastically contacts an inner peripheral face of a cylindrical member, or an individual contact member having an outwardly spreading spring portion is fixed to the movable terminal so that the spring portion is brought into elastic contact with the inner peripheral face of the cylindrical member to realize electrical conduction between the movable terminal and the cylindrical member. The elastic force for realizing electrical conduction can thus be set regardless of the elastic force of the coiled spring and the electrical conduction can be reliably maintained against vibration or the like.

However, in the configuration that the inner end part of the movable terminal is made to act as the elastic contact member, the movable terminal must be made tubular by the boring of a bottomed hole along its axial direction from the inner end face, and this tubular part must be provided with a plurality of slits, extending along the axial direction from the inner end face, and must be bent outward so as to oppose to the inner peripheral face of the cylindrical member. Such a structure requiring complex processing would involve increase in manufacturing costs.

In the configuration that the elastic contact member that is provided as the individual member is fixed to the inner end part of the movable terminal, since electrical conduction between the movable member and the cylindrical member is achieved via the elastic contact member (i.e., there are two contact points), the resistance becomes large.

DISCLOSURE OF THE INVENTION

It is therefore an object of the invention, there is provided a spring connector capable of securely maintaining the electric conduction between a movable terminal and a cylindrical member with lower resistance and without being interrupted by vibration or the like.

In order to achieve the above object, according to the invention, there is provided a spring connector, comprising:

a cylindrical member, having a hollowed space one end of which is formed with an opening having a first diameter;

a terminal, comprising a first portion having a second diameter which is no greater than the first diameter, and a second portion having a third diameter which is greater than the first diameter, the terminal being disposed in the hollowed space such that at least a part of the first portion is projected outward from the opening;

a coiled spring, disposed in the hollowed space so as to urge the second portion of the terminal toward the opening, so that the terminal is movable in an axial direction of the cylindrical member; and

an elastic member, attached to the terminal so as to provide an elastic force that brings the second portion of the terminal is directly brought into contact with a first part of an inner face of the hollowed space.

With this configuration, the degree of the elastic force generated by the elastic member can be arbitrarily determined. In addition, since the terminal can be directly brought into contact with the cylindrical member to secure electrical conduction, it will not be interrupted even by vibration or the

like, and a fixed electrical path having low resistance is secured.

There may be configured such that the elastic member comprises an elastic arm inserted between an outer circumferential face of the second portion of the terminal and a second part of the inner face of the hollowed space.

With this configuration, the second portion of the terminal can be reliably brought into contact with the inner face of the hollowed space by the elastic force generated by the elastic arm.

There may be configured such that: the elastic member is fitted with an outer circumferential face of the second portion of the terminal; and an elastic protrusion is formed at least one of a first face of the elastic member facing a second part of the inner face of the hollowed space and a second face of the elastic member facing the outer circumferential face of the second portion of the terminal.

With this configuration, the second portion of the terminal can be reliably brought into contact with the inner face of the hollowed space by the elastic force generated by the elastic protrusion.

There may be configured such that: the second portion of the terminal is formed with a groove extending in the axial direction of the cylindrical member; the elastic member is formed by bending an end portion of the coiled spring; and the end portion of the coiled spring is inserted into the groove such that a first part thereof comes in elastic contact with a bottom of the groove and a second part thereof comes in elastic contact with a second part of the inner face of the hollowed space.

With this configuration, the second portion of the terminal can be

reliably brought into contact with the inner face of the hollowed space by the elastic force generated by the end portion of the coiled spring. In addition, since the elastic member is formed by bending a part of the coiled spring, the number of parts can be reduced.

There may be configured such that: the second portion of the terminal is formed with a hole; and the elastic member is a coiled spring inserted into the hole such that one end thereof comes in elastic contact with a bottom of the hole and the other end thereof comes in elastic contact with a second part of the inner face of the hollowed space.

With this configuration, the second portion of the terminal can be reliably brought into contact with the inner face of the hollowed space by the elastic force generated by the coiled spring inserted into the hole.

There may be configured such that: the second portion of the terminal is formed with a groove extending in the axial direction of the cylindrical member; and the elastic member is a rubber block inserted into the groove such that a first part of the rubber block comes in elastic contact with a bottom of the groove and the other end thereof comes in elastic contact with a second part of the inner face of the hollowed space.

With this configuration, the second portion of the terminal can be reliably brought into contact with the inner face of the hollowed space by the elastic force generated by the rubber block.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and advantages of the present invention will become more apparent by describing in detail preferred exemplary embodiments thereof with reference to the accompanying drawings, wherein:

Fig. 1 is a section view of a spring connector according to a first embodiment of the invention;

Fig. 2 is a perspective view of a movable terminal and an elastic contact member in the spring connector of Fig. 1;

Fig. 3 is a section view taken along a line III-III in Fig. 1;

Fig. 4 is a perspective view of a movable terminal and an elastic contact member in a modified example of the spring connector of Fig. 1;

Fig. 5 is a section view of a spring connector according to a second embodiment of the invention;

Fig. 6A is a top view of an elastic contact member in the spring connector of Fig. 5;

Fig. 6B is a front view of the elastic contact member of Fig. 6A;

Fig. 6C is a side view of the elastic contact member of Fig. 6A;

Fig. 7A is a perspective view showing a disassembled state of a movable terminal and the elastic contact member in the spring connector in Fig. 5;

Fig. 7B is a perspective view showing an assembled state of the movable terminal and the elastic contact member in the spring connector in Fig. 5;

Fig. 8 is a section view of a spring connector according to a third

embodiment of the invention;

Fig. 9 is a perspective view of a movable terminal and an elastic contact member in the spring connector of Fig. 8;

Fig. 10 is a section view of a spring connector according to a fourth embodiment of the invention;

Fig. 11 is a perspective view of a movable terminal and an elastic contact member in the spring connector of Fig. 10;

Fig. 12 is a perspective view of a movable terminal and an elastic contact member in a modified example of the spring connector of Fig. 10;

Fig. 13 is a section view of a spring connector according to a fifth embodiment of the invention;

Fig. 14 is a perspective view of a movable terminal and an elastic contact member in the spring connector of Fig. 13; and

Fig. 15 is a section view of a related-art spring connector.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiments of the invention will be described below in detail with reference to the accompanying drawings. Components similar to those in the related-art shown in Fig. 15 will be designated by the same reference numerals and repetitive explanations for those will be omitted.

Figs 1 to 3 show a spring connector according to a first embodiment of the invention. In this embodiment, a movable terminal 20, which is formed of brass or other conductive material, comprises a small-diameter protruding part 20a at the front end side and a large-diameter inner end part 20b at the

rear end side, and three grooves 20d and 20e, extending along the direction of an axis 16 from an inner end face 20c, are provided in an outer peripheral face of an inner end part 20b. As shown in Figs. 2 and 3, these grooves are formed, for example, at the respective lateral sides and the upper side of the outer peripheral face of the inner end part 20b. An elastic member 22 is formed of a plate metal of phosphor bronze, etc., which is conductive and has an elastic property, and is arranged with three arms 22a and 22b, which are respectively inserted in the three grooves 20d and 20e provided in the outer peripheral face of the inner end part 20, being joined at a bottom part 22c. The arms 22a, which are disposed so as to oppose each other, are inserted in the grooves 20d so as to be brought into elastic contact with the bottoms of the grooves 20d. Thereby the inner end part 20b is clamped by the arms 22a. The arm 22b is inserted in the groove 20e so as to be elastically deformable inside the groove 20e without being brought into elastic contact with the bottom of the groove 20e. In this condition, a contact 22d provided at the front end of the arm 22b protrudes upwards from the outer peripheral face of the inner end part 20b.

When the elastic member 22 is assembled onto the movable terminal 20 and is disposed inside a cylindrical member 12, into which a coiled spring 14 has been inserted in advance, the contact 22d of the arm 22b at the upper side of the elastic member 22 elastically contacts an upper inner peripheral face of the cylindrical member 12. Here, by the elastic force of the arm 22b, the inner end part 20b of the movable terminal 20 is biased towards the lower side in the figure and the inner end part 20b of the movable terminal 20 is brought into direct, elastic contact with the inner peripheral face of the

cylindrical member 12. Since the movable terminal 20 can thus be brought into direct contact with the cylindrical member 12 and the elastic force that realizes this elastic contact can be set as suited by the elastic member 22, a fixed electrical path of low resistance can be secured and the electrical path will not be interrupted by vibration or the like.

In this embodiment, the inner end face 20c of the movable terminal 20 and the bottom part 22c of the elastic member 22 are arranged to be perpendicular to the direction of the axis 16. However, the bottom part 22c of the elastic member 22, to which the front end of the coiled spring 14 is brought into elastic contact, may be slant with respect to the direction of the axis 16 as in the related-art configuration shown in Fig. 15, so that a component force is generated at the lower side in Fig. 1.

In this embodiment, the three grooves 20d and 20e are provided in the outer peripheral face of the inner end part 20b of the movable terminal 20. However, as shown in Fig. 4, only the groove 20e may be left and two bottomed holes 20f may be bored along the direction of the axis 16 from the inner end face 20c in place of providing the two grooves 20d at the respective lateral sides, so that the two arms 22a of the elastic member 22 can be inserted into the holes 20f.

Figs. 5 to 7 show a spring connector according to a second embodiment of the invention. In this embodiment, a movable terminal 30, which is formed of a conductive material, comprises a small-diameter protruding part 30a at the front end side and a large-diameter inner end part 30b at the rear end side, and a single circumferential groove 30c is provided in an outer peripheral face of the inner end part 30b. An elastic member 32 is

formed of a plate metal has a C-shaped cross section enabling insertion into and engagement with the circumferential groove 30c. Protruded contacting pieces 32a, which are protruded outward, and recessed contacting pieces 32b, which are protruded inward, are formed in the elastic member 32 by cutting and bending, etc.

When elastic member 32 is inserted and engaged in the circumferential groove 30c of the movable terminal 30 as shown in Fig. 7B, the protruded contacting pieces 32a project outward beyond the outer peripheral face of the inner end part 30b of the movable terminal 30 and the recessed contacting pieces 32b are brought into contact with the bottom of circumferential groove 30c. When these parts are inserted into the cylindrical member 12, the protruded contacting pieces 32a elastically contact an upper inner peripheral face of the cylindrical member 12, and the recessed contacting pieces 32b elastically contact bottom parts of circumferential groove 30c, so that the movable terminal 30 is brought into elastic contact with a lower inner peripheral face of the cylindrical member 12 by the elastic forces generated by the protruded contacting pieces 32a and the recessed contacting pieces 32b. The movable terminal 30 can be brought into elastic contact with the cylindrical member 12 by the provision of either the protruded contacts 32a or the recessed contacts 32b.

Figs. 8 and 9 shows a spring connector according to a third embodiment of the invention. In this embodiment, a movable terminal 40, which is formed of a conductive material, comprises a small-diameter protruding part 40a at the front end side and a large-diameter inner end part 40b at the rear end side, and a single groove 40c is provided in an outer

peripheral face of the inner end part 40b so as to extend in the direction of an axis 16 from an inner end face of the inner end part 40b. A front end part of a coiled spring 42 opposing the movable terminal 40 is bent to be within a plane containing the direction of the axis 16, to form an elastic contact part 42b. This elastic contact part 42a is inserted into the groove 40c in the movable terminal 40 so that a lower side of the elastic contact part 42a contacts the bottom of the groove 40c and an upper side of the elastic contact part 42a projects above the outer peripheral face of the inner end part 40b.

In the state of being assembled inside cylindrical member 12 as shown in Fig. 8, the upper side of the elastic contact part 42a is elastically deformed by being brought into elastic contact with an upper inner peripheral face of the cylindrical member 12, so that the inner end part 40b of the movable terminal 40 is brought into elastic contact with a lower inner peripheral face of the cylindrical member 12 by the elastic force generated by the elastic contact part 42a. With this configuration, the number of parts can be reduced.

Figs. 10 and 11 show a spring connector according to a fourth embodiment of the invention. In this embodiment, a movable terminal 50, which is formed of a conductive material, comprises a small-diameter protruding part 50a at the front end side and a large-diameter inner end part 50b at the rear end side. In addition, the upper side of the inner end part 50b is formed as a flat face 50c in which a bottomed hole 50d is bored in a direction perpendicular to the direction of an axis 16. A coiled spring 52 is inserted in the hole 50d. When no external force is applied to, one end of the coiled spring 52 is brought into contact with the bottom of the hole 50d and the other end of the coiled spring 52 is projected from the opening of the hole 50d.

Here, upon being assembled into the cylindrical member 12, the projected end of the coiled spring 52 elastically contacts an upper inner peripheral face of the cylindrical member 12 so that the inner end part 50b of the movable terminal 50 is brought into elastic contact with a lower inner peripheral face of the cylindrical member 12 by the elastic force generated by the coiled spring 52.

As shown in Fig. 12, a groove 50e extending in the direction of the axis 16 may be provided in the outer peripheral face of the inner end part 50b in place of bottomed hole 50d of the movable terminal 50, and a V-shaped plate spring 54 may be assembled into this groove 50e in place of the coiled spring 52.

Figs. 13 and 14 show a spring connector according to a fifth embodiment of the invention. In this embodiment, a movable terminal 60, which is formed of a conductive material, comprises a small-diameter protruding part 60a at the front end side and a large-diameter inner end part 60b at the rear end side, and a single groove 60c is provided in an outer peripheral face of the inner end part 60b so as to extend in the direction of an axis 16 from an inner end face of the inner end part 60b. An elastic member 62 formed by a rubber block is inserted into the groove 60c so that a lower side thereof contacts the bottom of the groove 60c and the upper side thereof projects above the outer peripheral face of the inner end part 60b. Upon being assembled into cylindrical member 12, the upper side of the elastic member 62 is elastically deformed by being brought into elastic contact with an upper inner peripheral face of the cylindrical member 12 so that the inner end part 60b of the movable terminal 60 is brought into elastic contact with a lower inner peripheral face of the cylindrical member 12 by the elastic force

generated by the elastic member 62.

In all the above embodiments, since the inner end part of the movable terminal is brought into direct, elastic contact with an inner peripheral face of the cylindrical member, there is just one point of electric contact between the movable terminal and the cylindrical member. In addition, the elastic force that brings the movable terminal into elastic contact with the cylindrical member can be set to a suitable degree regardless of the elastic force of the coiled spring that elastically urges the movable terminal in the axial direction of the cylindrical member. Electrical conduction will therefore not be interrupted by vibration or the like, and a fixed electrical path that is small in resistance can be reliably secured and maintained.

In the above embodiments, the expressions of "upper side" and "lower side" in the figures are used for the sake of description, the spring connector of the invention may be positioned in any way about the axis 16 and the structure is in no way restricted by the expressions of "upper side" and "lower side" in the above description.

Although the present invention has been shown and described with reference to specific preferred embodiments, various changes and modifications will be apparent to those skilled in the art from the teachings herein. Such changes and modifications as are obvious are deemed to come within the spirit, scope and contemplation of the invention as defined in the appended claims.

CLAIMS

1. A spring connector, comprising:

a cylindrical member, having a hollowed space one end of which is formed with an opening having a first diameter;

a terminal, comprising a first portion having a second diameter which is no greater than the first diameter, and a second portion having a third diameter which is greater than the first diameter, the terminal being disposed in the hollowed space such that at least a part of the first portion is projected outward from the opening;

a coiled spring, disposed in the hollowed space so as to urge the second portion of the terminal toward the opening, so that the terminal is movable in an axial direction of the cylindrical member; and

an elastic member, attached to the terminal so as to provide an elastic force that brings the second portion of the terminal is directly brought into contact with a first part of an inner face of the hollowed space.

2. The spring connector as set forth in claim 1, wherein the elastic member comprises an elastic arm inserted between an outer circumferential face of the second portion of the terminal and a second part of the inner face of the hollowed space.

3. The spring connector as set forth in claim 1, wherein:

the elastic member is fitted with an outer circumferential face of the second portion of the terminal; and

an elastic protrusion is formed at least one of a first face of the elastic member facing a second part of the inner face of the hollowed space and a second face of the elastic member facing the outer circumferential face of the second portion of the terminal.

4. The spring connector as set forth in claim 1, wherein:

the second portion of the terminal is formed with a groove extending in the axial direction of the cylindrical member;

the elastic member is formed by bending an end portion of the coiled spring; and

the end portion of the coiled spring is inserted into the groove such that a first part thereof comes in elastic contact with a bottom of the groove and a second part thereof comes in elastic contact with a second part of the inner face of the hollowed space.

5. The spring connector as set forth in claim 1, wherein:

the second portion of the terminal is formed with a hole; and

the elastic member is a coiled spring inserted into the hole such that one end thereof comes in elastic contact with a bottom of the hole and the other end thereof comes in elastic contact with a second part of the inner face of the hollowed space.

6. The spring connector as set forth in claim 1, wherein:

the second portion of the terminal is formed with a groove extending in the axial direction of the cylindrical member; and

the elastic member is a rubber block inserted into the groove such that a first part of the rubber block comes in elastic contact with a bottom of the groove and the other end thereof comes in elastic contact with a second part of the inner face of the hollowed space.

FIG. 1

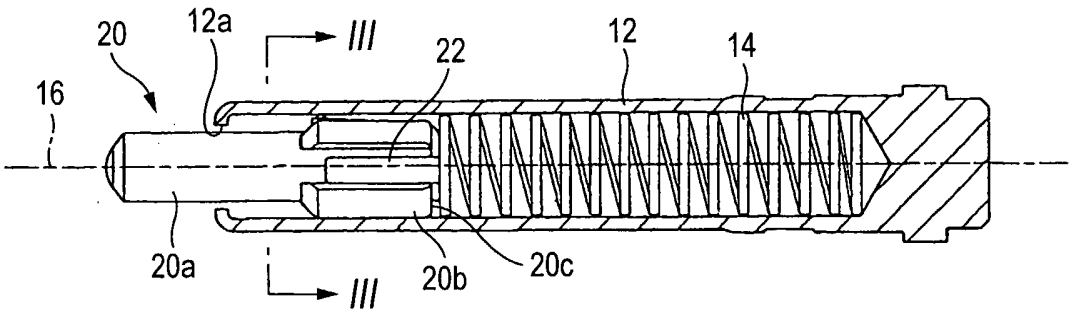

20
12a
III
22
12
14
16
20a
III
20b
20c

FIG. 2

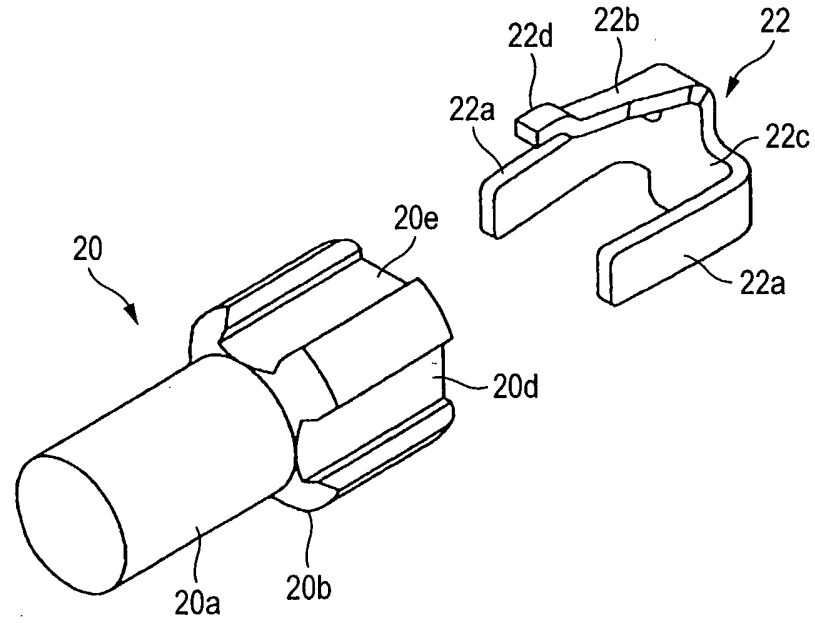

22d
22b
22
22a
22c
20e
20
22a
20d
20a
20b

FIG. 3

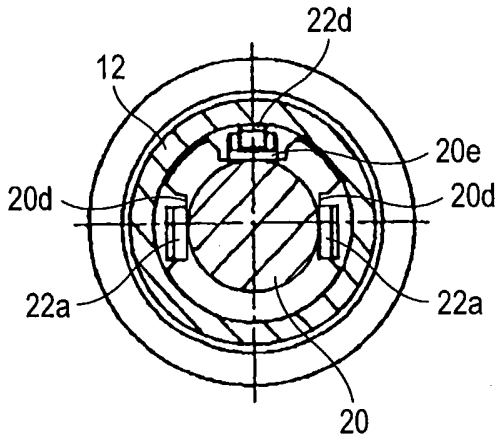

22d
12
20e
20d
20d
22a
22a
20

FIG. 4

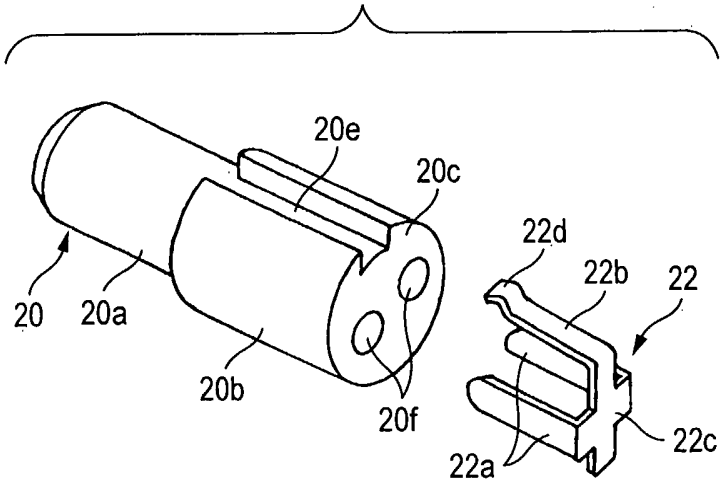

20e
20c
22d
22b
22
20
20a
20b
20f
22c
22a

FIG. 5

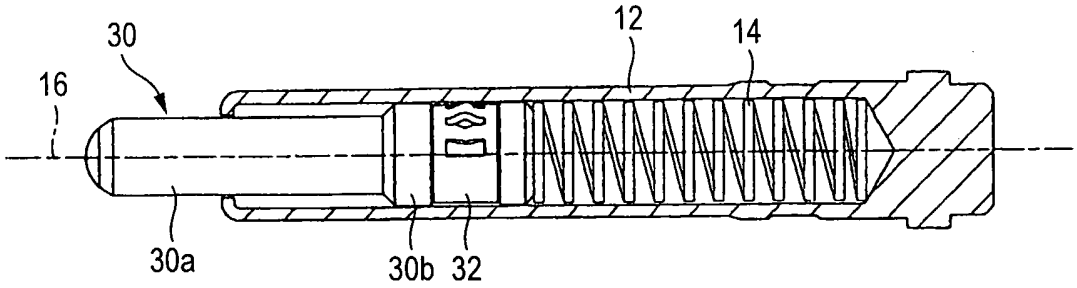


FIG. 6A

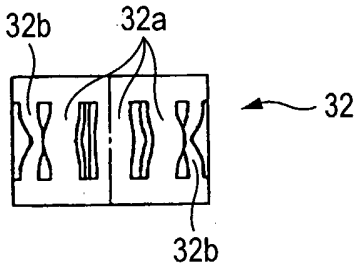


FIG. 6B

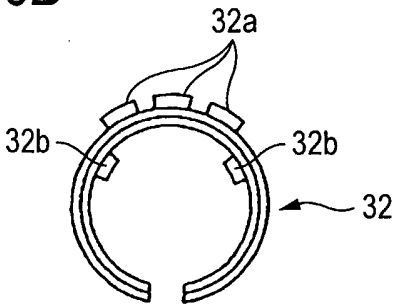


FIG. 6C

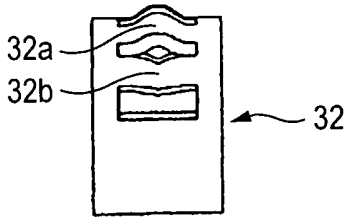


FIG. 7A

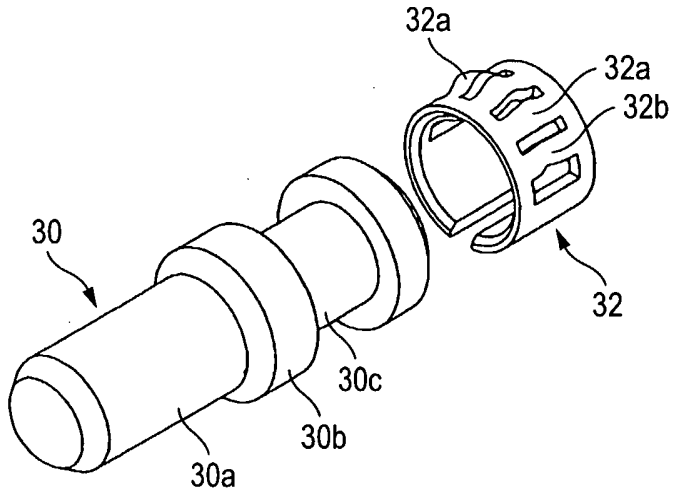


FIG. 7B

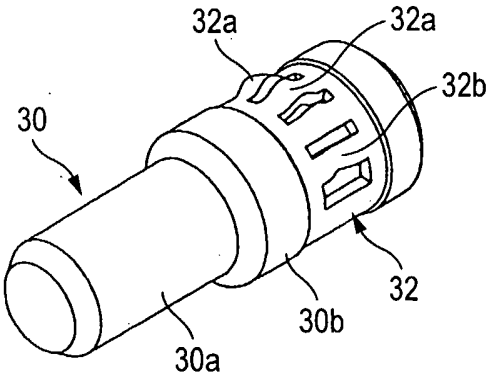


FIG. 8

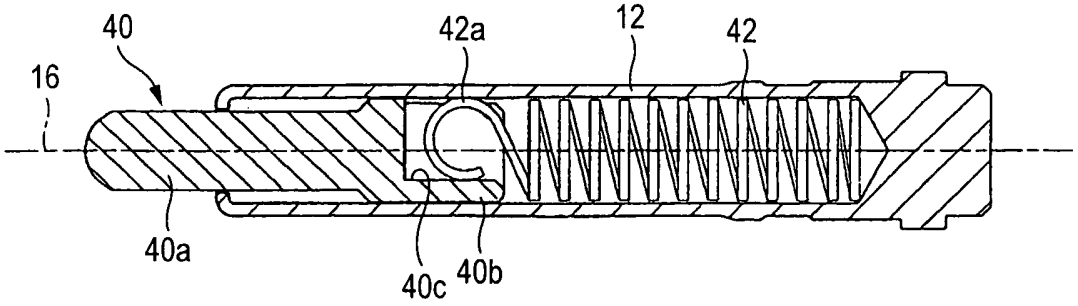


FIG. 9

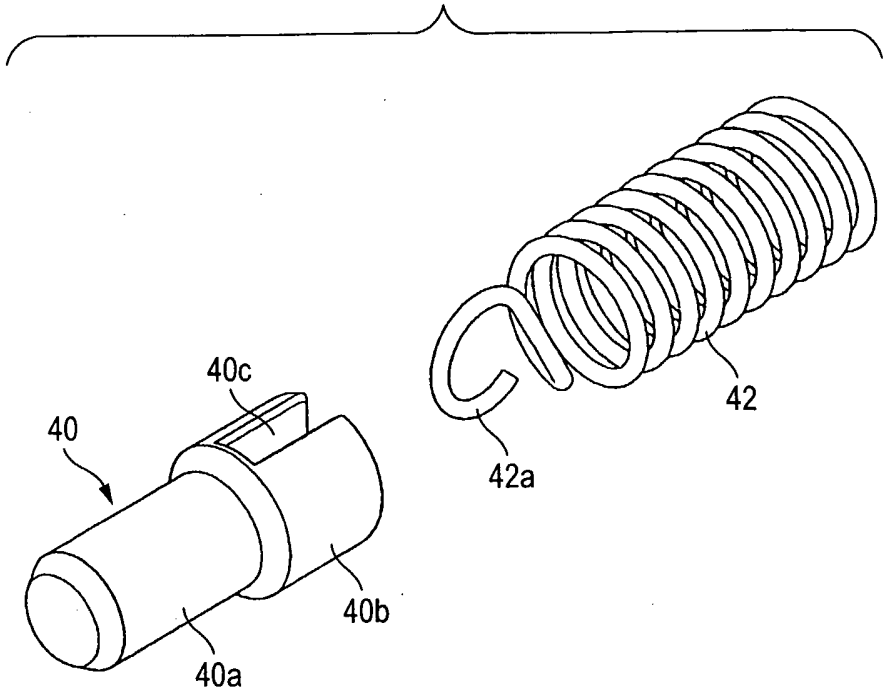


FIG. 10

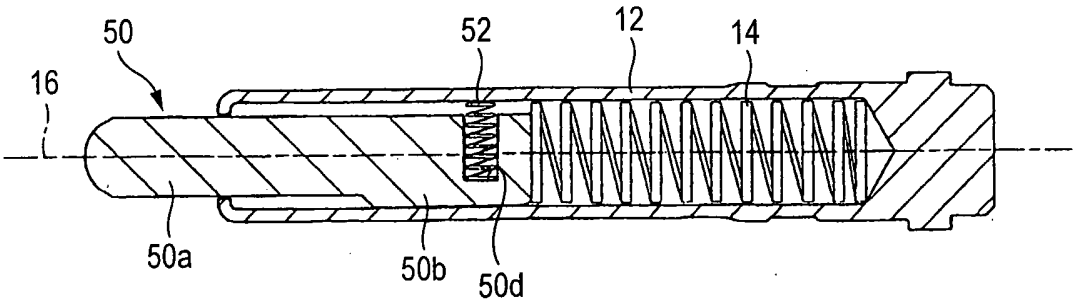


FIG. 13

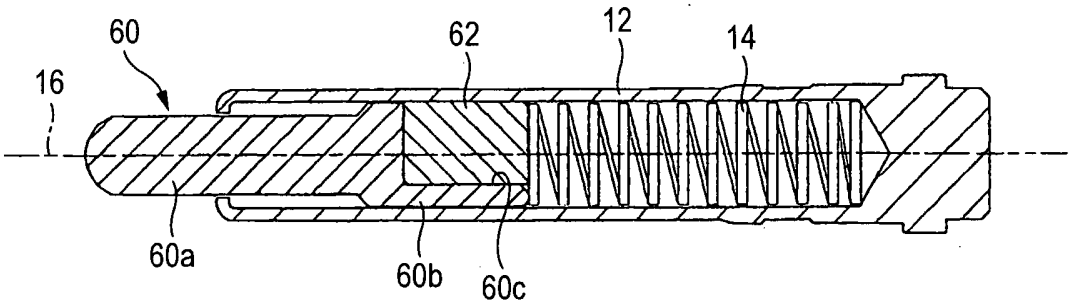


FIG. 14

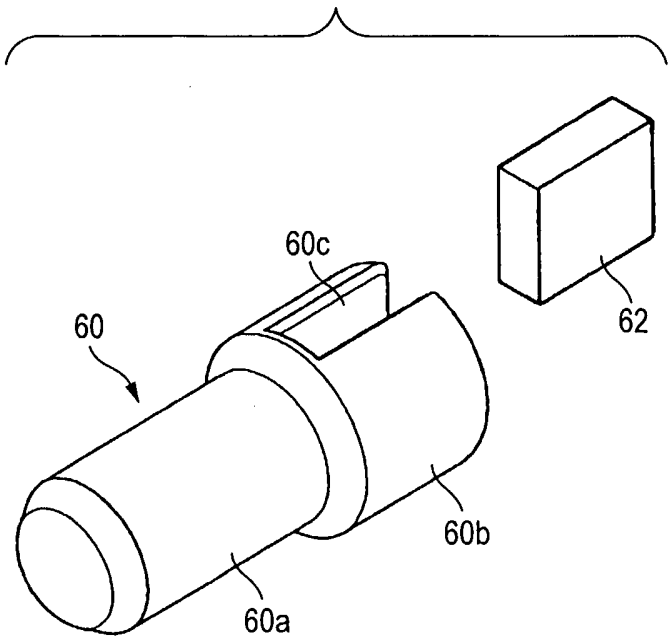


FIG. 11

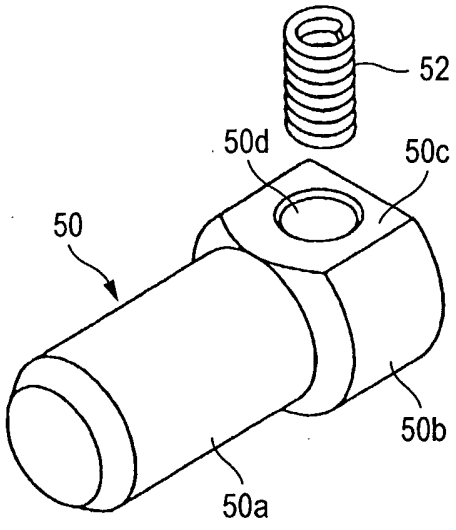


FIG. 12

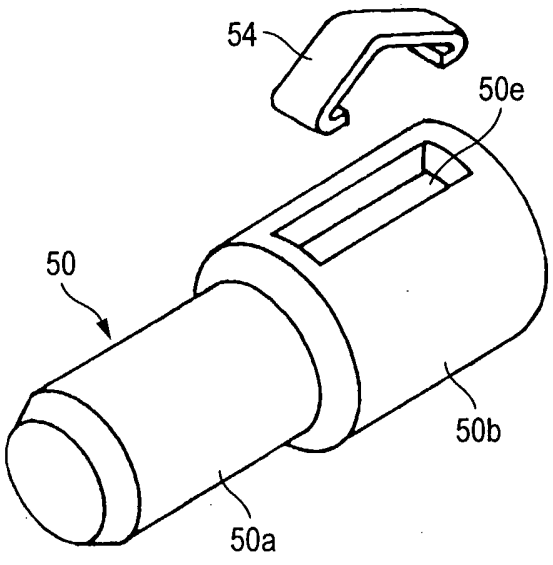
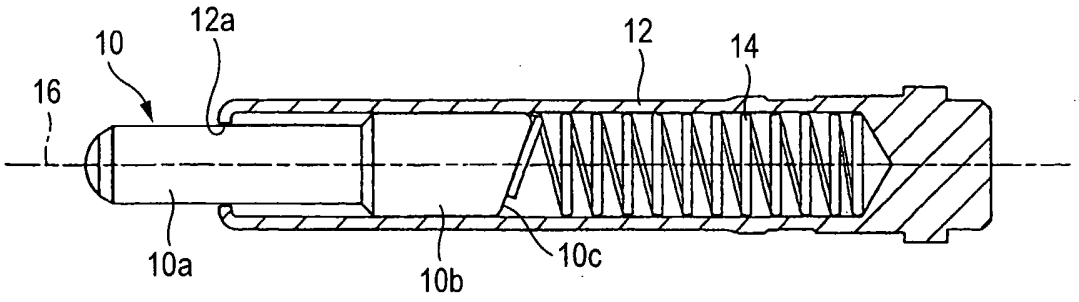


FIG. 15



INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP2005/016057

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R13/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 30 12 491 A1 (FEINMETALL GMBH; FEINMETALL GMBH, 7033 HERRENBERG, DE) 8 October 1981 (1981-10-08) abstract; claim 4; figures 1-4	1-6
X	GB 2 398 436 A (* ITO MANUFACTURING CO LTD; * SMK CORPORATION) 18 August 2004 (2004-08-18) abstract; figure 1	1
X	EP 0 573 690 A (SPRECHER ENERGIE AG) 15 December 1993 (1993-12-15) abstract; figure 3	1-6
X	DE 203 15 894 U1 (FEINMETALL GMBH) 18 December 2003 (2003-12-18) abstract; figures 1-3	1-6

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
7 November 2005	17/11/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Jiménez, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/JP2005/016057

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