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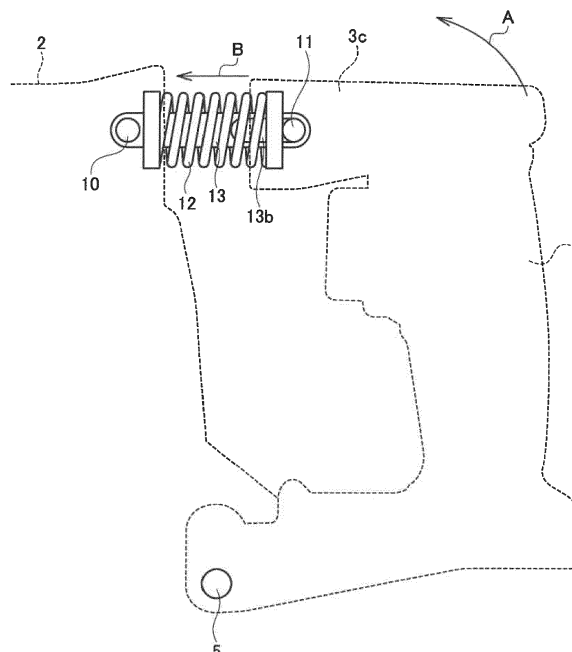
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(54) **ELECTRIC POWER TOOL**

(57) A grip 3 is joined to a rear side of a main body 2 by a first connector 5 and a second connector. The first connector 5 rotatably joins the main body 2 and the grip 3. The second connector has a coil spring 12 provided between the main body 2 and the grip 3, and a guide rod 13 that maintains a direction of load on the coil spring 12 in alignment with a direction of a line of axis of the coil

spring 12. The guide rod 13 has a first opening that a first rotation shaft 10 of the main body 2 is inserted in and a second opening 13b that a second rotation shaft 11 of the grip 3 is inserted in, and the second opening 13b is shaped such that the second rotation shaft 11 is slidable in a longitudinal direction of the guide rod 13.

FIG. 5



Description

[0001] The present invention relates to an electric power tool provided with a grip gripped by an operator on the rear side of the main body.

[0002] One known example of an electric power tool provided with a grip on the rear side of the main body is a hammer drill provided with an impact mechanism and a rotary mechanism that transmit the rotational output of the motor to the front-end tool. A hammer drill is used to, for example, bore, cut, etc. a concrete member or the like. Heavy vibration and impact are generated in the main body so that proposals are made to provide a vibration control structure between the main body and the grip so as to mitigate the load on the operator.

[0003] JP2010-567 discloses a hand-held work tool comprising: a work tool main body; a grip main body extending in a direction intersecting the longitudinal direction of the work tool main body; a lower connector rotatably supported by a rotation shaft provided at the lower rear end of the work tool main body; and an upper connector joined to the upper rear end of the work tool main body via a coil spring. The ends of the coil spring are fixed to the work tool main body and the upper connector, respectively.

[0004] According to the vibration control structure disclosed in JP2010-567, the upper connector makes a rotational motion around the rotation shaft relative to the work tool main body. Therefore, the load in the rotational direction is applied to the coil spring fixed at its ends to the work tool main body and to the upper connector. Oblique application of a load to the coil spring with respect to the direction the line of axis results in a change in the spring constant commensurate with the amount of compression or stretching, which makes it more difficult to obtain the benefit of linear vibration absorption and could reduce the life of the coil spring.

[0005] In this background, a purpose of the present invention is to provide an electric power tool provided with a suitable vibration control structure.

[0006] In this background, an electric power tool according to an embodiment comprises: a main body that houses a motor and a motion transmission mechanism for transmitting a rotational output of the motor to a front-end tool; and a grip joined to a rear side of the main body by a first connector and a second connector. The first connector rotatably joins the main body and the grip, and the second connector has an elastic body provided between the main body and the grip, and a guide rod that maintains a direction of load on the elastic body in alignment with a direction of a line of axis of the elastic body.

[0007] The figures depict one or more implementations in accordance with the present teaching, by way of example only, not by way of limitations. In the figures, like reference numerals refer to the same or similar elements.

tion;

Fig. 2 shows an example of the structure of the second connector;

Fig. 3 shows an example of the structure of the guide rod;

Fig. 4 shows an example of the structure of the spring support;

Fig. 5 shows the function of the vibration control structure according to the embodiment;

Fig. 6 shows the function of the vibration control structure according to the embodiment; and

Fig. 7 shows an example of the structure of the first connector.

[0008] One aspect of the invention will now be described by reference to the preferred embodiments. This does not intend to limit the scope of the present invention, but to exemplify the invention.

[0009] Fig. 1 shows an appearance of an electric power tool 1 according to an embodiment of the present invention. The electric power tool 1 is provided with a main body 2 and a grip 3 gripped by an operator. The electric power tool 1 is provided with power from a secondary battery built in a detachable battery pack 4. In the embodiment, a hammer drill in which the grip 3 is joined to the rear end of the main body 2 is illustrated by way of example of the electric power tool 1, but the electric power tool 1 may be other work tools such as a chipping machine. Referring to Fig. 1, the longitudinal direction of the tool is defined such that the left side fitted with a front-end tool 9 is the tool front side, and the right side provided with the grip 3 is the tool rear side.

[0010] The main body 2 is provided with a housing that at least houses a motor and a motion transmission mechanism for transmitting the rotational output of the motor to the front-end tool 9. The motion transmission mechanism is provided with an impact mechanism that transforms the rotational output of the motor decelerated by a deceleration mechanism into a reciprocal motion and transmits the reciprocal motion to the front-end tool 9, and a rotary mechanism that transmits the rotational output of the motor decelerated by the deceleration mechanism to the front-end tool 9. The grip 3 is provided with a trigger switch 8. When the operator pulls the trigger switch 8, the motor is supplied with power from the secondary battery and is driven into rotation, and the motion transmission mechanism transmits the rotational output of the motor to the front-end tool 9.

[0011] The grip 3 has a handle 3a extending substantially perpendicular to the direction of the line of axis of the front-end tool 9, a lower extension 3b extending from the lower end of the handle 3a in a direction substantially parallel to the direction of the line of axis, and an upper extension 3c extending from the upper end of the handle 3a in a direction substantially parallel to the direction of the line of axis. In the electric power tool 1, the main body 2 and the grip 3 are configured as separate components. The grip 3 is joined to the rear side of the main body 2

Fig. 1 shows an appearance of an electric power tool 1 according to an embodiment of the present inven-

by a first connector 5 and a second connector 7. Outside of the second connector 7 is provided a stretchable protection cover 6 to protect the second connector 7 from being exposed outside. The first connector 5 and the second connector 7 constitute a vibration control structure in the electric power tool 1.

[0012] The first connector 5 rotatably joins the main body 2 and the grip 3. The first connector 5 may have a threaded member that rotatably joins the front end of the lower extension 3b and the lower part of the housing rear side of the main body 2. One first connector 5 is provided on left side of the electric power tool 1, and another first connector 5 is provided on right side of the electric power tool 1.

[0013] Fig. 2 shows an example of the structure of the second connector 7. The second connector 7 is provided with a coil spring 12 as an elastic body provided between the main body 2 and the grip 3, and a guide rod 13 that maintains the direction of load on the coil spring 12 in alignment with the direction of the line of axis of the coil spring 12. In the second connector 7, the coil spring 12 is provided between the main body 2 and the grip 3 so as to be movable in coordination with the motion of the guide rod 13. The guide rod 13 has a role of aligning the direction of the line of axis of the coil spring 12 with the longitudinal direction of the guide rod 13.

[0014] Fig. 3 shows an example of the guide rod 13. The guide rod 13 is a rod-shaped member made of a resin material and has a first opening 13a at one end and a second opening 13b at the other end. The second opening 13b is an elongated through hole extending in the longitudinal direction of the guide rod 13. The cross section of the elongated through hole is formed with a rectangular zone and two semicircular zones which are located at the longitudinal ends of the rectangular zone. The first opening 13a is formed as a through hole having a circular cross section.

[0015] Referring back to Fig. 2, the upper part of the rear side of the main body 2 is provided with a cylindrical first rotation shaft 10 that extends in a transversal direction, and the front end of upper extension 3c is provided with a cylindrical second rotation shaft 11 that extends in a transversal direction. The main body 2 and the grip 3 are joined by the guide rod 13 so as to be rotatable relative to each other by inserting the first rotation shaft 10 into the first opening 13a of the guide rod 13 and inserting the second rotation shaft 11 into the second opening 13b of the guide rod 13. The second opening 13b is shaped such that the second rotation shaft 11 is slidable in the longitudinal direction of the guide rod 13. As shown in Fig. 3, the second opening 13b is formed as an elongated through hole.

[0016] In the embodiment, the guide rod 13 is guided inside the coil spring 12 and is placed in alignment with the line of axis of the coil spring 12. This can make the second connector 7 compact. The guide rod 13 is provided with a first spring support 14a and a second spring support 14b. The coil spring 12 is supported by the first

spring support 14a and the second spring support 14b. The first spring support 14a and the second spring support 14b have the same shape and will be referred to as "spring support 14" except when distinction is made.

[0017] Fig. 4 shows an example of the spring support 14. The spring support 14 has a spring support surface 15a that the end of the coil spring 12 comes into contact with, a through hole 15b that the guide rod 13 is inserted through, and an annular rising portion 15c that rises from the outer circumference of the spring support surface 15a and prevents the lateral slip of the spring end.

[0018] Referring back to Fig. 2, the first spring support 14a is thrust by the coil spring 12 to come into contact with the first rotation shaft 10, and the second spring support 14b is thrust by the coil spring 12 to come into contact with the second rotation shaft 11. By supporting the ends of the coil spring 12 by the first spring support 14a and the second spring support 14b provided in the guide rod 13, the coil spring 12 moves along with the guide rod 13 in response to the vibration or impact in the main body 2.

[0019] Figs. 5 and 6 show the function of the vibration control structure according to the embodiment. As shown in Fig. 5, when vibration or shock impact is generated in the main body 2 while the operator is using the tool, the vibration control structure causes the grip 3 to be rotated in the direction indicated by the arrow A around the first connector 5. The guide rod 13 transforms the rotational motion of the grip 3 into linear motion in the direction indicated by the arrow B, i.e., the longitudinal direction of the guide rod 13, by sliding the second rotation shaft 11 in the second opening 13b.

[0020] Fig. 6 shows a state in which the grip 3 is rotated relative to the main body 2 so as to be relatively closer. In the process in which the grip 3 approaches the main body 2, the vibration is absorbed by the coil spring 12. Fig. 6 shows a state in which the second rotation shaft 11 moves in the second opening 13b so as to compress the coil spring 12. The guide rod 13 always transforms the rotational motion of the grip 3 into linear motion in the direction indicated by the arrow B. Therefore, the direction of load applied to the coil spring 12 moving in coordination with the guide rod 13 is maintained in the direction of the arrow B, i.e., the direction of the line of axis of the coil spring 12.

[0021] According to the embodiment, the coil spring 12 is compressed or stretched in the presence of a load in the direction of the line of axis so that the spring constant is maintained constant during compression or extraction. As a result, the vibration control structure capable of providing linear vibration absorption function is realized. Since the coil spring 12 does not receive a load obliquely relative to the direction of the line of axis, the life of the spring can be extended without deteriorating the spring property of the coil spring 12. In particular, the above-described advantage of the vibration control structure according to the embodiment will be appreciated more significantly when the electric power tool 1 is configured to be compact so that the interval between the first connec-

tor 5 and the second connector 7 is reduced.

[0022] Fig. 7 shows an example of the structure of the first connector 5. In the first connector 5, the lower part of the housing rear side of the main body 2 is provided with a threaded groove. A screw member 18 is inserted through a spacer 17 provided in a through hole of the lower extension 3b and tightened to the main body 2 accordingly. This supports the lower extension 3b so as to be rotatable relative to the main body 2. The spacer 17 may be made of an elastic material. By configuring the spacer 17 to be elastic, the first connector 5 is provided with the function of absorbing vibration.

[0023] Described above is an explanation based on an exemplary embodiment. The embodiment is intended to be illustrative only and it will be understood by those skilled in the art that various modifications to constituting elements and processes could be developed and that such modifications are also within the scope of the present invention.

[0024] In the embodiment, the second connector 7 in which the guide rod 13 is inserted inside the coil spring 12 and the guide rod 13 and the coil spring 12 are integrated with each other is shown. In one variation, the guide rod 13 and the coil spring 12 may be separate on the condition that the guide rod 13 maintains the direction of load on the coil spring 12 to in alignment with the direction of the line of axis of the coil spring 12. In this case, a plurality of guide rods 13 may be provided or a plurality of coil springs 12 may be provided. Where a plurality of coil springs 12 are provided, it is preferable that the coil springs 12 be arranged in the transversal direction.

[0025] In the embodiment, the first rotation shaft 10 is inserted in the first opening 13a of the guide rod 13, and the second rotation shaft 11 is inserted in the second opening 13b of the guide rod 13. Alternatively, the second rotation shaft 11 may be inserted in the first opening 13a and the first rotation shaft 10 may be inserted in the second opening 13b. In the embodiment, the second opening 13b is formed as an elongated through hole. Alternatively, both the first opening 13a and the second opening 13b may be formed as elongated through holes. The coil spring 12 is shown as exemplifying an elastic body. A spring different from the coil spring 12 may be used as an elastic body. Still alternatively, a rubber body made of a resin material may be used.

[0026] A summary of one embodiment of the present invention is as follows.

[0027] An electric power tool (1) according to an embodiment of the present invention comprises: a main body (2) that houses a motor and a motion transmission mechanism for transmitting a rotational output of the motor to a front-end tool (9); and a grip (3) joined to a rear side of the main body by a first connector (5) and a second connector (7). The first connector (5) rotatably joins the main body (2) and the grip (3), and the second connector (7) has an elastic body (12) provided between the main body (2) and the grip (3) and a guide rod (13) that maintains a direction of load on the elastic body in alignment

with a direction of a line of axis of the elastic body.

[0028] The guide rod (13) may have a first opening (13a) that a first rotation shaft (10) of the main body is inserted in and a second opening (13b) that a second rotation shaft (11) of the grip is inserted in, and the first opening or the second opening may be shaped such that the first rotation shaft or the second rotation shaft is slidable in a longitudinal direction of the guide rod. The first opening (13a) or the second opening (13b) may have a shape of an elongated hole extending in the longitudinal direction of the guide rod.

[0029] The elastic body may be a coil spring (12) and the guide rod (13) may be inserted inside the coil spring (12). A pair of spring supports (14a, 14b) that support ends of the coil spring (12) may be provided in the guide rod (13), and the pair of spring supports may come into contact with the first rotation shaft (10) and the second rotation shaft (11), respectively.

[0030] While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications may be made therein and that the subject matter disclosed herein may be implemented in various forms and examples, and that they may be applied in numerous applications, only some of which have been described herein. It is intended by the following claims to claim any and all modifications and variations that fall within the true scope of the present teachings.

Claims

1. An electric power tool (1) comprising:

a main body (2) that houses a motor and a motion transmission mechanism for transmitting a rotational output of the motor to a front-end tool (9); and
a grip (3) joined to a rear side of the main body by a first connector (5) and a second connector (7), wherein
the first connector (5) rotatably joins the main body (2) and the grip (3), and
the second connector (7) has an elastic body (12) provided between the main body (2) and the grip (3), and a guide rod (13) that maintains a direction of load on the elastic body in alignment with a direction of a line of axis of the elastic body.

2. The electric power tool according to claim 1, wherein the guide rod (13) has a first opening (13a) that a first rotation shaft (10) of the main body is inserted in and a second opening (13b) that a second rotation shaft (11) of the grip is inserted in, and the first opening or the second opening is shaped such that the first rotation shaft or the second rotation shaft is slidable in a longitudinal direction of the guide rod.

3. The electric power tool according to claim 2, wherein the first opening (13a) or the second opening (13b) has a shape of an elongated hole extending in the longitudinal direction of the guide rod.

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4. The electric power tool according to any one of claims 1 to 3, wherein the elastic body is a coil spring (12) and the guide rod (13) is inserted inside the coil spring.

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5. The electric power tool according to claim 4, wherein a pair of spring supports (14a, 14b) that support ends of the coil spring (12) are provided in the guide rod (13).

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6. The electric power tool according to claim 5, wherein the pair of spring supports (14a, 14b) come into contact with the first rotation shaft (10) and the second rotation shaft (11), respectively.

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FIG. 1

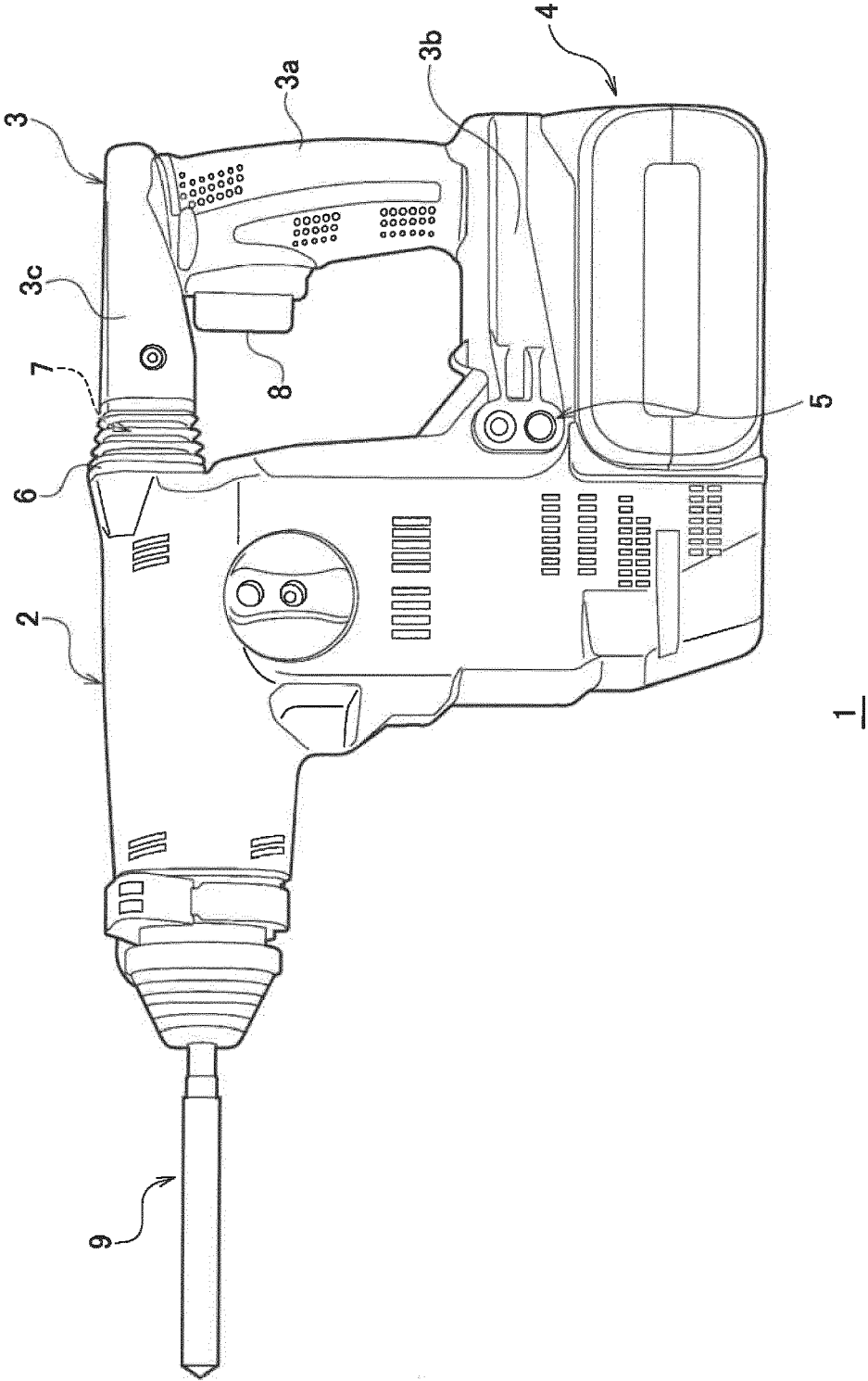


FIG. 2

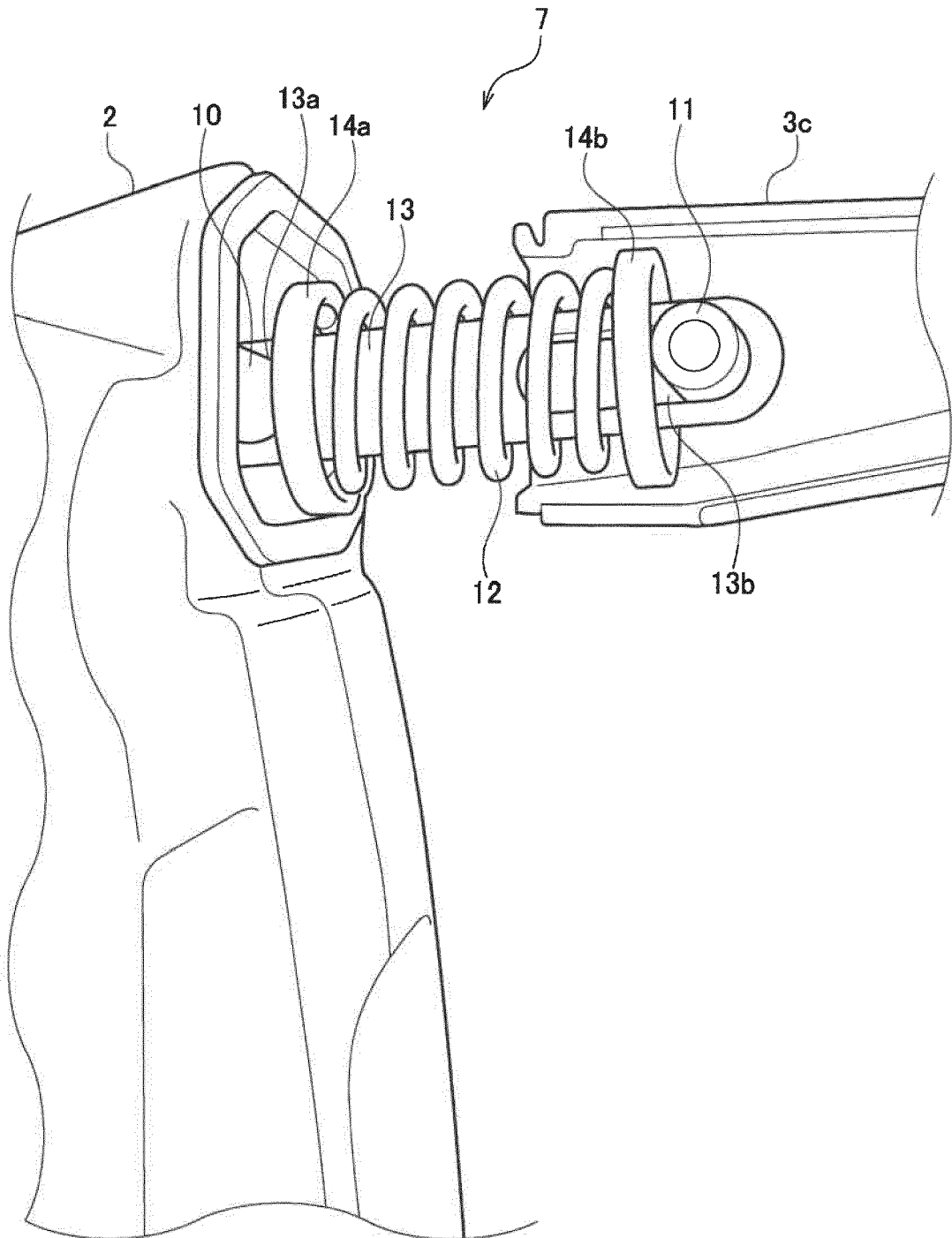


FIG. 3

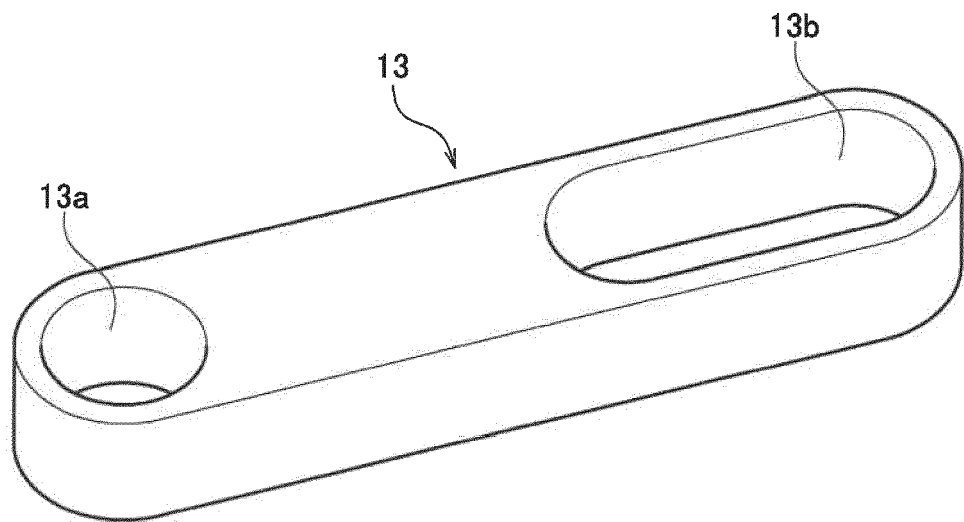
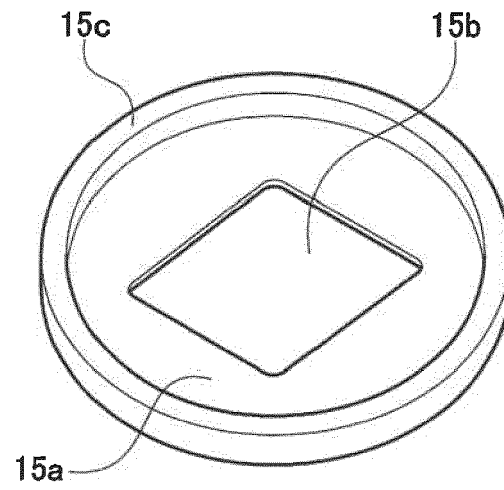


FIG. 4



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FIG. 5

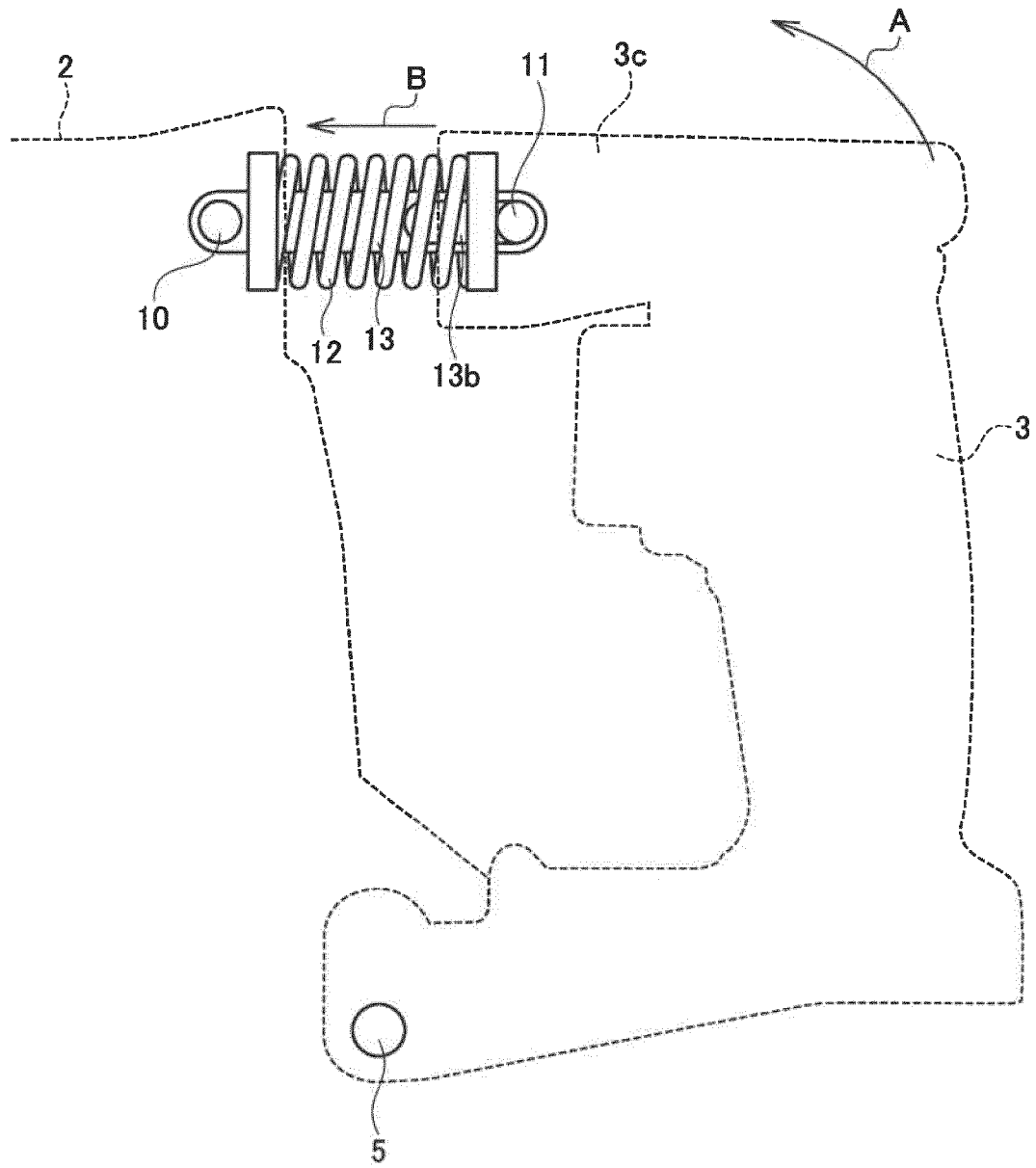


FIG. 6

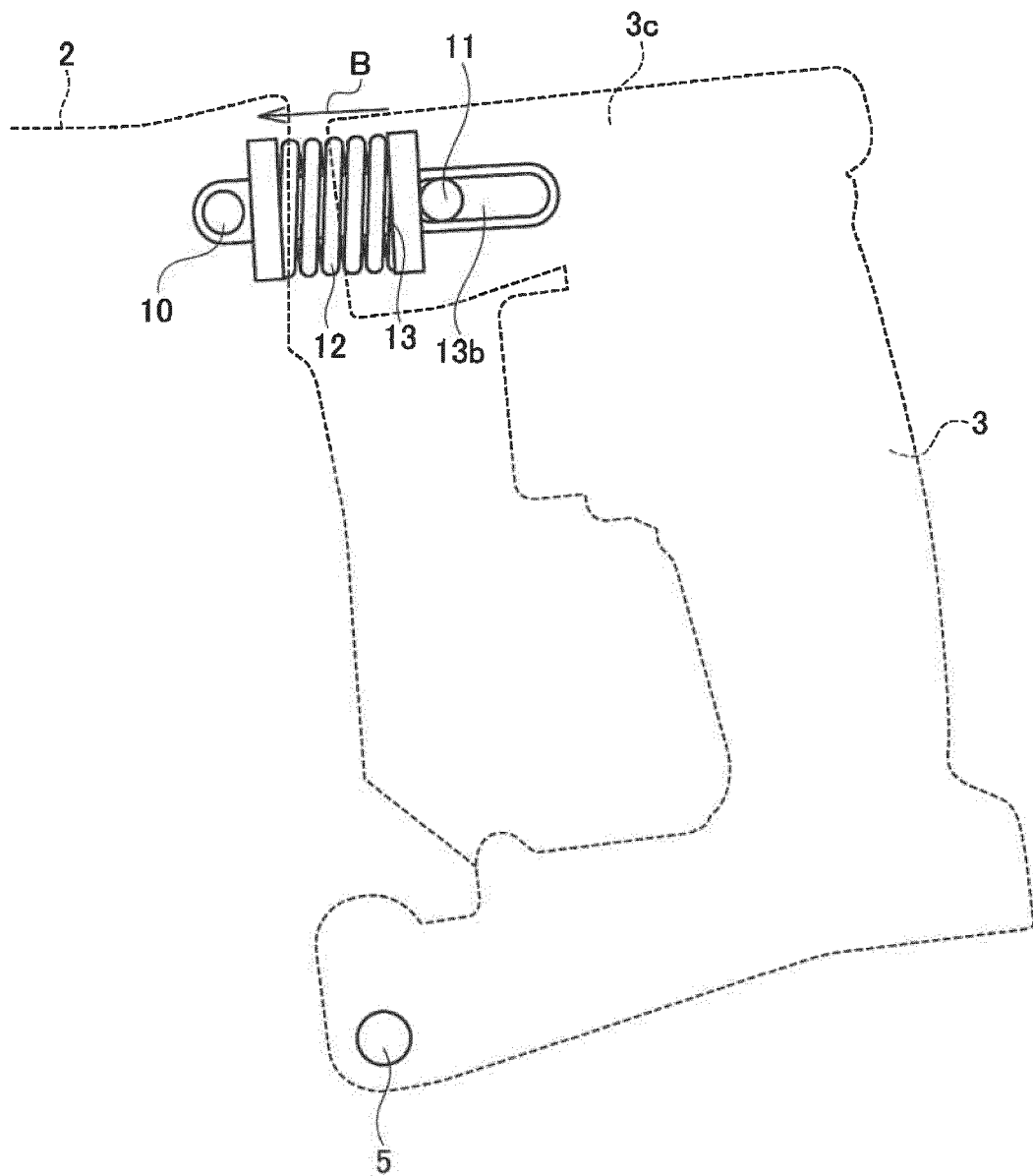
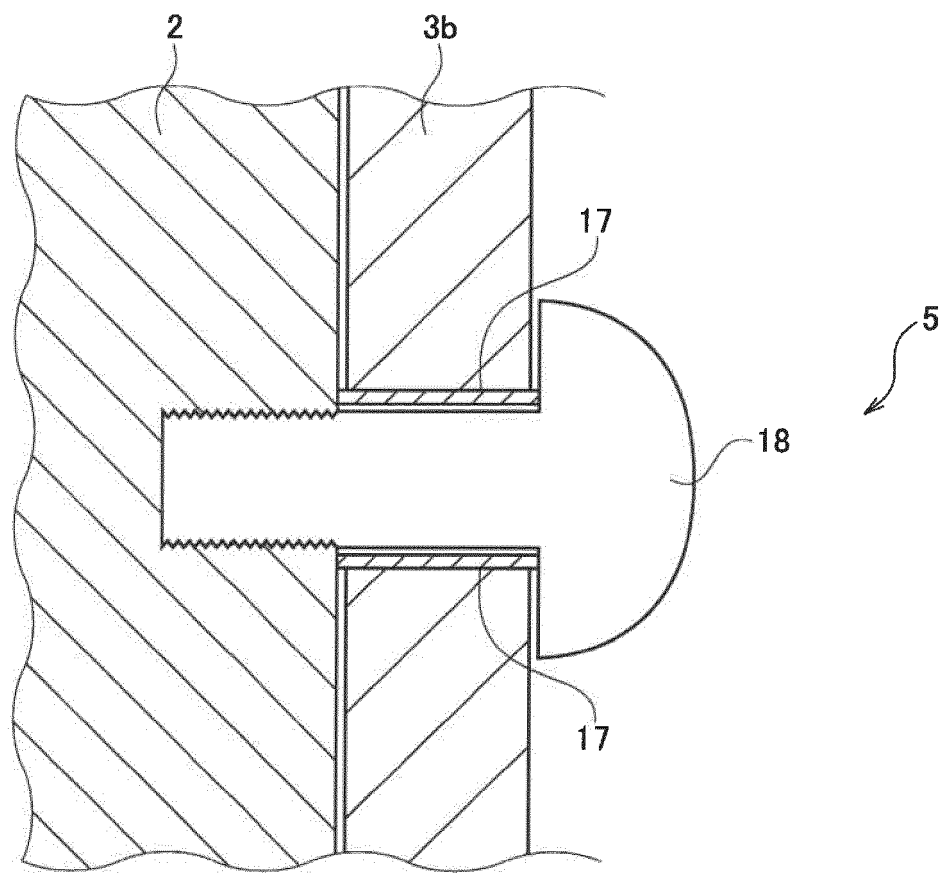


FIG. 7





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Application Number
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Place of search The Hague		Date of completion of the search 31 July 2018	Examiner Bonnin, David
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