(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 502 704 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.09.2012 Bulletin 2012/39

(51) Int Cl.:
B24B 23/02 *(2006.01)* ***B24B 45/00*** *(2006.01)*

(21) Application number: **12156650.9**

(22) Date of filing: **23.02.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **23.03.2011 JP 2011064688**

(71) Applicant: **Makita Corporation**
Anjo, Aichi 446-8502 (JP)

(72) Inventor: **Numata, Fumitoshi**
Anjo,
Aichi 446-8502 (JP)

(74) Representative: **Kramer - Barske - Schmidtchen**
Landsberger Strasse 300
80687 München (DE)

(54) **Power tool**

(57) In a grinder 1, a spindle (16) protruding from a main body (10) including a brake device (50) is provided with an inner member. The inner member contacts a pressing portion (16A and 16B) provided integrally with the spindle (16) and is pressed toward a tip end of the spindle (16) when the spindle (16) is braked by the brake device (50). A nut member (40) can be screwed on the tip end of the spindle (16) so that a disc-like tool (45) though which the spindle (16) extends perpendicularly can be held between the inner member and the nut member (40). The inner member comprises a locking member (20) that contacts the pressing portion and is pressed toward the disc-like tool (45) when the brake device (50) is operated, and an inner flange (30) which is detachably attached to the locking member (20) so as to be rotatable together with the locking member (20).

EP 2 502 704 A1

Description

BACKGROUND OF THE INVENTION

TECHNICAL FIELD

[0001] The present invention relates to power tools in which a disc-shaped tool is attached to a tip end of a spindle by a nut member.

BACKGROUND ART

[0002] A grinder as an example of power tools typically includes a disc-like tool attached via a nut member to a tip end of a spindle protruding from a main body, and a brake device configured to brake the spindle. However, in the grinder including the brake device, the nut member may become loose during operation of the brake device. In order to prevent the nut member from loosening, European Patent No. 1,663,574 discloses a grinder which has a brake device and is configured to prevent a nut member from loosening. In this grinder, a disc-like tool penetrated through a tip of a spindle is held between a nut member tightened on the tip of the spindle, and an inner member provided in a main body of the grinder and configured to prevent the nut member from rotating in a direction to loosen during operation of the brake device.

[0003] This grinder includes the inner member having one wedge member, and the spindle having the other wedge member. When the wedge member in the inner member slidingly contacts the other wedge member on the spindle, the inner member is pressed toward the disc-like tool, and then the nut member is pressed via the disc-like tool. Consequently, the nut member can be prevented from rotating in a direction to loosen.

[0004] In common methods for attaching a disc-like tool to a spindle, the disc-like tool is integrated with a spindle by being held between an inner member such as an inner flange and a nut member. However, even when a user attaches the inner member configured to prevent the nut member from loosening to the spindle as disclosed in European Patent No. 1,663,574, he may misunderstand the inner member as a member configured only to prevent the nut member from loosening, and additionally attach a member configured to hold the disc-like tool.

[0005] If the member to hold the disc-like tool is attached by mistake between the disc-like tool and the inner member to prevent the nut member from loosening, the inner member to prevent the nut member from loosening may be prevented from moving toward the disc-like tool during operation of the brake device. In this case, the nut member cannot be prevented from loosening.

SUMMARY OF THE INVENTION

[0006] The present invention is proposed in view of the above problems, and it is an object of the present invention to provide a power tool which is configured to prevent a nut member screwed on the spindle from loosening during operation of a brake device, wherein the power tool includes an inner member comprising a member to prevent the nut member from loosening and a member to hold a tool

[0007] According to a first aspect of the present invention, a power tool includes a main body, a brake device provided in the main body, a spindle protruding from the main body, an inner member provided on the spindle, a pressing portion provided integrally with the spindle, a nut member that can be screwed on a tip end of the spindle and a disc-like tool though which the spindle extends perpendicularly so that the disc-like tool can be held between the inner member and the nut member. In the power tool, the inner member comprises a first inner member and a second inner member. The first inner member contacts the pressing portion and is pressed toward the disc-like tool when the brake device is operated. The second inner member through which the spindle extends is detachably attached to the first inner member and rotatable together with the first inner member. Further, the disc-like tool can be held between the second inner member and the nut member when the second inner member is attached to the first inner member.

[0008] According to a second aspect of the present invention, in the first aspect, a width-across-flat portion parallel to a direction perpendicular to an axis of the spindle is provided on an outer periphery of the first inner member.

[0009] According to a third aspect of the present invention, in the first aspect, the pressing portion is a pair of flange portions that are provided to protrude in a radial direction of the spindle at positions symmetrical with respect to an axis of the spindle. Further, the pair of flange portions has a pressing surface facing the first inner member, while the first inner member has a fitting recess as a pressed surface in which the pair of flange portions is fitted with play so that the pressing surface of the pair of flange portions contacts a bottom of the fitting recess.

[0010] According to the power tool of the first aspect of the present invention, the first inner member to prevent the nut member from loosening and the second inner member to attach the disc-like tool to the spindle by holding the tool with the nut member are provided as separate members. Accordingly, it becomes easier for users to recognize the member to prevent the nut member form loosening and the member to hold the disc-like tool. Therefore, another member to hold the disc-like tool is prevented from being additionally attached by mistake, which allows the first inner member to reliably prevent the nut member from loosening when the spindle is braked by the brake device. Therefore, the nut member can be prevented from loosening.

[0011] According to the second aspect of the present invention, rotation of the spindle can be stopped by engaging a tool such as a spanner on the width-across-flat portion of the first inner member that contacts the spindle.

Therefore, the nut member is easily attached to or detached from the spindle whose rotation has been stopped. Accordingly, easy assembly can improve both the efficiency of the operation of holding the disc-like tool between the second inner member and the nut member to attach the disc-like tool to the spindle, and the efficiency of the operation of removing the disc-like tool together with the nut member from the spindle 16.

[0012] According to the third aspect of the present invention, rotation of the spindle can be transmitted to the first inner member with the pair of flange portions being fitted in the fitting recess of the first inner member, and an inertial force of the disc-like tool can be received by the entire flange portions fitted in the fitting recess. Therefore, concentration of the inertial force on a part of the flange portions can be suppressed, and damage to the flange portions can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG 1 is a longitudinal cross-sectional view of a main part of a grinder according to an embodiment of the present invention.
FIG 2 is an exploded perspective view of a spindle, a locking member, and an inner flange.
FIG 3 is a general view of the spindle.
FIG 4 is an enlarged view of a portion A in FIG 3.
FIG 5 is a plan view of the locking member.
FIG 6 is a cross-sectional view taken along line B-B in FIG 5.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0014] An embodiment of the present invention will be described with reference to FIGS. 1 to 6. As shown in FIG 1, a grinder 1 includes a housing 10, a locking member 20, an inner flange 30, a lock nut 40, and a brake device 50. It should be noted that the grinder 1 is an example of the power tool of the present invention.

[0015] The housing 10 comprises a cylindrical motor housing 11 and a gear housing 15. A motor M is accommodated in the motor housing 11, and a rotation shaft 12 of the motor M is rotatably supported in the motor housing 11 via a bearing 13. A first bevel gear 14 is provided on a tip end of the rotation shaft 12.

[0016] The gear housing 15 is attached in front of the motor housing 11, and the rotation shaft 12 protrudes from the motor housing 11 into the gear housing 15. In addition, a spindle 16 is rotatably supported in the gear housing 15 via a bearing 17 so as to extend perpendicularly to the rotation shaft 12. A second bevel gear 18 is fitted on an upper part of the spindle 16. The first bevel gear 14 meshes with the second bevel gear 18, whereby rotation of the rotation shaft 12 is transmitted to the spindle 16. A lower end of the spindle 16 protrudes below the gear housing 15. A pair of flange portions 16A and 16B and an externally threaded portion 16C are formed on a part of the spindle 16 which protrudes from the gear housing 15. It should be noted that the housing 10 is an example of the main body of the present invention.

[0017] As shown in FIGS. 2 and 3, the pair of flange portions 16A and 16B are shaped to protrude in a radial direction of the spindle 16 at positions symmetrical with respect to the axis of the spindle 16, and are provided integrally with the spindle 16. As shown in FIGS. 3 and 4, the lower surfaces of the pair of flange portions 16A and 16B are tilted surfaces 19A and 19B that form a predetermined angle with respect to a plane perpendicular to the axis of the spindle 16.

[0018] The locking member 20 is a disc-like member, and as shown in FIGS. 2, 5, and 6, includes width-across-flat portions 21 and a fitting recess 22. The width-across-flat portions 21 are formed on the outer periphery of the locking member 20, and extend parallel with each other on both sides of the spindle 16 in a direction perpendicular to the axis of the spindle 16. The fitting recess 22 opens in an upper surface of the locking member 20, and the flange portions 16A and 16B are fitted in the fitting recess 22 with play in a rotation direction. An insertion hole 23 through which the lower end of the spindle 16 is inserted is formed in the center of a bottom surface of the fitting recess 22.

[0019] Tilted surfaces 24A and 24B are provided on the bottom surface of the fitting recess 22. The tilted surfaces 24A and 24B can contact the tilted surfaces 19A and 19B, respectively, when the flange portions 16A and 16B are fitted in the fitting recess 22. The tilted surfaces 19A and 19B are formed as the lower surfaces of the flange portions 16A and 16B at such positions that they face the tilted surfaces 24A and 24B when the flange portions 16A and 16B are fitted in the fitting recess 22. A protrusion 25 that protrudes downward is formed on the lower surface of the locking member 20. The insertion hole 23 extends through the protrusion 25.

[0020] As shown in FIG 2, the inner flange 30 is a disc-like member having a larger diameter than the locking member 20, and includes a recess groove 31 and a through hole 32. The recess groove 31 extends in a direction perpendicular to the axis of the spindle 16. The inner flange 30 can be attached to or detached from the locking member 20 by engaging or disengaging the protrusion 25 of the locking member 20 with or from the recess groove 31. With the inner flange 30 being attached to the locking member 20, the spindle 16 inserted through the insertion hole 23 is inserted through the through hole 32 as well, and thus extends through the inner flange 30.

[0021] As shown in FIG 1, the lock nut 40 can be attached to a tip end of the spindle 16 by screwing the externally threaded portion 16C into a screw hole (not shown). The spindle 16 extends through a disc-like grinding stone 45 provided perpendicularly to the spindle 16. The grinding stone 45 is held between the inner flange 30 attached to the locking member 20 and the lock nut 40 attached to the tip end of the spindle 16, and thus is

fixed to the spindle 16. A rear part of the grinding stone 45 is covered by a safety cover 46 mounted below the gear housing 15. In the present embodiment, the inner flange 30 need not necessarily be attached to the locking member 20, and the grinding stone 45 may be fixed to the spindle 16 by holding the grinding stone 45 between the locking member 20 and the lock nut 40. The grinding stone 45 is an example of the disc-like tool of the present invention, and the lock nut 40 is an example of the nut member of the present invention. The locking member 20 is an example of the first inner member of the present invention, and the inner flange 30 is an example of the second inner member of the present invention.

[0022] The brake device 50 is provided to stop rotation of the spindle 16 by braking the rotation shaft 12 of the motor M, and is accommodated in a front part of the motor housing 11. As shown in FIG 1, the brake device 50 includes a brake plate 51, a brake member 52, and a coiled spring B.

[0023] The brake plate 51 is a cylindrical member having a disc-like flange portion provided on the periphery thereof, and is mounted on the rotation shaft 12. The brake member 52 is placed in front of the brake plate 51 in an axial direction of the rotation shaft 12. A brake shoe 53 is fixed to a rear surface of the brake member 52 that faces the brake plate 51. The coiled spring B is fitted in the motor housing 11, and biases the brake member 52 in a direction to bring the brake member 52 into contact with the brake plate 51. The brake member 52 is separated from the brake plate 51 in response to the operation of turning on a drive switch (not shown) of the motor M, and the brake shoe 53 is pressed hard against the brake plate 51 by a biasing force of the coiled spring B in response to the operation of turning off the drive switch so that rotation of the rotation shaft 12 and the spindle 16 can be stopped in this manner.

[0024] Operation of the grinder 1 will be described below. When the grinding stone 45 is fixed to the spindle 16, the spindle 16 is first inserted through the insertion hole 23 of the locking member 20. The flange portions 16A and 16B are then fitted in the fitting recess 22 of the locking member 20 so that the tilted surfaces 19A, 19B contact the tilted surfaces 24A and 24B. The locking member 20 is attached to the spindle 16 via a C ring so as to be retained on the spindle 16. Then, after the spindle 16 is inserted through the through hole 32 of the inner flange 30, the protrusion 25 of the locking member 20 is engaged with the recess groove 31 of the inner flange 30 to attach the inner flange 30 to the locking member 20. Moreover, the lock nut 40 is screwed onto the spindle 16 extending through the grinding stone 45, so that the grinding stone 45 is held between the inner flange 30 and the lock nut 40.

[0025] If the motor M is driven and rotation of the rotation shaft 12 is transmitted to the spindle 16 in the above state, the spindle 16 rotates in a direction to tighten the lock nut 40. At this time, since the flange portions 16A and 16B have been fitted in the fitting recess 22, the side surfaces of the flange portions 16A and 16B contact an inner surface 22A (see FIG 5) of the fitting recess 22. Therefore, rotation of the spindle 16 is transmitted to the locking member 20. As a result, the inner flange 30 having the locking member 20 attached thereto rotates together with the locking member 20.

[0026] On the other hand, when driving of the motor M is stopped, the brake shoe 53 of the brake device 50 is pressed against the brake plate 51, and rotation of the rotation shaft 12 is stopped by the torque in a direction opposite to the rotation direction of the rotation shaft 12. At this time, the lock nut 40 is subjected to a force in a direction to loosen the lock nut 40, by the friction with the grinding stone 45 that tends to keep rotating due to inertia.

[0027] However, as described below, the locking member 20 is configured to prevent the lock nut 40 from loosening in the direction to loosen the lock nut 40 (a locking mechanism). That is, if rotation of the rotation shaft 12 is stopped, the tilted surfaces 19A and 19B of the flange portions 16A and 16B slidingly contact the tilted surfaces 24A and 24B of the locking member 20. Therefore, the tilted surfaces 19A and 19B press the tilted surfaces 24A and 24B toward the grinding stone 45, and then the inner flange 30 attached to the locking member 20 is pressed toward the grinding stone 45. Therefore, the lock nut 40 is pressed via the grinding stone 45 so as to prevent the lock nut 40 from rotating in the direction to loosen the lock nut 40. The flange portions 16A and 16B are an example of the pressing portion of the present invention. The tilted surfaces 19A and 19B are an example of the pressing surface of the first inner member of the present invention, and the tilted surfaces 24A and 24B are an example of the pressed surface of the present invention.

[0028] Rotation of the spindle 16 can be prevented by engaging, e.g., a spanner on the width-across-flat portions 21 of the locking member 20 attached to the spindle 16. Thus, for example, when replacing the worn grinding stone 45, the lock nut 40 can be easily attached to or detached from the spindle 16 whose rotation has been stopped. Accordingly, the grinding stone 45 can be easily replaced with a new one.

[Effects of the Present Embodiment]

[0029] In the grinder 1 of the present embodiment, the locking member 20 to prevent the lock nut 40 from loosening and the inner flange 30 to fix the grinding stone 45 to the spindle 16 are provided as separate members. Accordingly, it becomes easier for users to recognize the member to prevent the lock nut 40 from loosening and the member to fix the grinding stone 45. Therefore, in order to fix the grinding stone 45, a member except the inner flange 30 can be prevented from being additionally attached to the spindle 16, which allows the locking member 20 to reliably prevent the lock nut 40 from loosening when rotation of the spindle 16 is stopped by the brake

device 50. Therefore, the lock nut 40 can be prevented from loosening.

[0030] Rotation of the spindle 16 can be stopped by engaging a spanner on the width-across-flat portions 21 of the locking member 20 having the flange portions 16A and 16B of the spindle 16 fitted therein. Therefore, it becomes easier for users to attach or detach the lock nut 40 to or from the spindle 16 whose rotation has been stopped. Consequently, easy assembly can improve both the efficiency of the operation of holding the grinding stone 45 between the inner flange 30 and the lock nut 40 to fix the grinding stone 45 to the spindle 16, and the efficiency of the operation of removing the grinding stone 45 together with the lock nut 40 from the spindle 16.

[0031] Since rotation of the spindle 16 is transmitted to the locking member 20 with the flange portions 16A and 16B being fitted in the fitting recess 22 of the locking member 20, an inertial force of the grinding stone 45 can be received by the entire flange portions 16A and 16B fitted in the fitting recess 22. Therefore, concentration of the inertial force on a part of the flange portions 16A and 16B can be suppressed, so that damage to the flange portions 16A and 16B can be prevented.

[0032] The present invention is not limited to the above embodiment, and a part of the configuration can be modified as appropriate without departing from the scope and spirit of the invention. For example, a recess may be provided in the inner flange 30 instead of the recess groove 31, and the inner flange 30 can be attached to or detached from the locking member 20 by fitting the protrusion 25 of the locking member 20 in the recess. Unlike the above embodiment, the inner flange 30 may have a protrusion protruding upward, and the locking member 20 may have a recess groove with and from which the protrusion is engaged or disengaged, so that the inner flange 30 can be attached to or detached from the locking member 20.

[0033] The locking member 20 may not have the width-across-flat portions 21, and the brake device 50 may be an electric brake that brakes the motor M. Although the above embodiment is described with respect to an example in which the present invention is applied to a grinder, the present invention is not limited to this, and may be applied to power tools such as a sander.

[0034] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. A power tool (1), in which a spindle (16) protrudes from a main body (10) including a brake device (50), an inner member is provided in the spindle (16), a pressing portion is provided integrally with the spindle (16), and a nut member (40) can be screwed on a tip end of the spindle (16) so that a disc-like tool (45) through which the spindle (16) extends perpendicularly can be held between the inner member and the nut member (40), **characterized in that**
the inner member comprises a first inner member (20) that contacts the pressing portion and is pressed toward the disc-like tool (45) when the brake device (50) is operated, and a second inner member (30) through which the spindle (16) extends is adapted to be detachably attached to the first inner member (20) and rotate together with the first inner member (20), wherein the disc-like tool (45) can be held between the second inner member (30) and the nut member (40) when the second inner member (30) is attached to the first inner member (20).

2. The power tool (1) according to claim 1, wherein a width-across-flat portion (21) parallel to a direction perpendicular to an axis of the spindle (16) is provided on an outer periphery of the first inner member (20).

3. The power tool (1) according to claim 1 or 2, wherein the pressing portion is a pair of flange portions (16A, 16B) that are provided to protrude in a radial direction of the spindle (16) at positions symmetrical with respect to an axis of the spindle (16), and the pair of flange portions (16A, 16B) has a pressing surface (19A, 19B) facing the first inner member (20),
while the first inner member (20) has a fitting recess (22) having a pressed surface (24A, 24B), in which fitting recess (22) the pair of flange portions (16A, 16B) is fitted with play so that the pressing surface (19A, 19B) of the pair of flange portions (16A, 16B) contacts a bottom of the fitting recess (22).

4. The power tool (1) according to claim 3, wherein the pressing surface is a pair of first tilted surfaces (19A, 19B) that form a predetermined angle with respect to a plane perpendicular to the axis, and
the pressed surface is a pair of second tilted surfaces (24A, 24B) that can contact the pair of first tilted surfaces (19A, 19B) with the pair of flange portions (16A, 16B) being fitted in the fitting recess (22).

5. The power tool (1) according to any one of claims 1 to 4, wherein
one of the first inner member (20) and the second inner member (30) has a protrusion (25) that protrudes toward the other inner member, and the other inner member has a recess groove (31) with and

from which the protrusion (25) can be engaged and disengaged, and
the first inner member (20) can be attached to the second inner member (30) by engaging the protrusion (25) with the recess groove (31).

FIG. 1

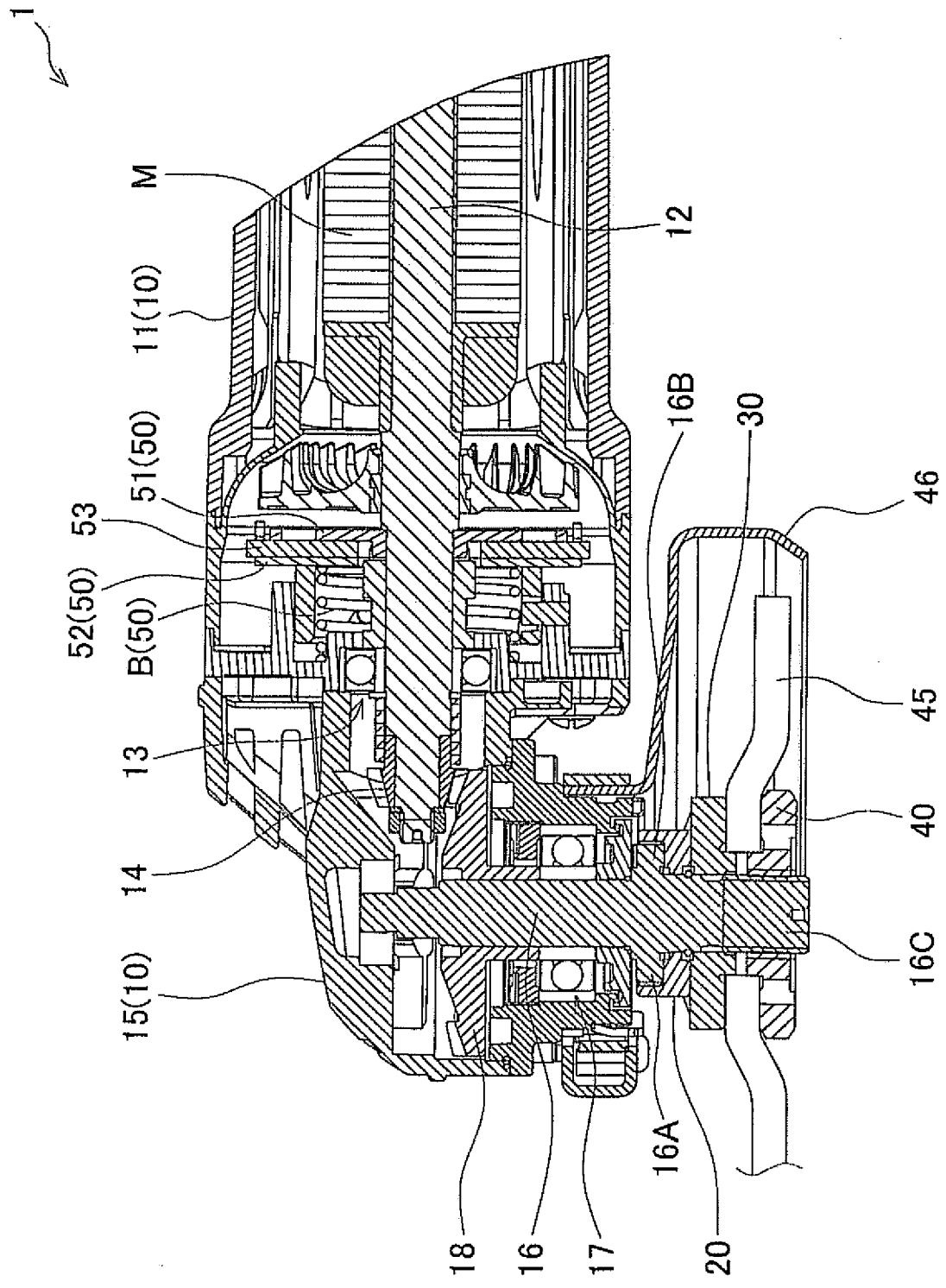

1
M
12
11(10)
51(50)
53
52(50)
B(50)
13
14
15(10)
16B
30
46
45
40
16C
16A
18
16
17
20

FIG. 2

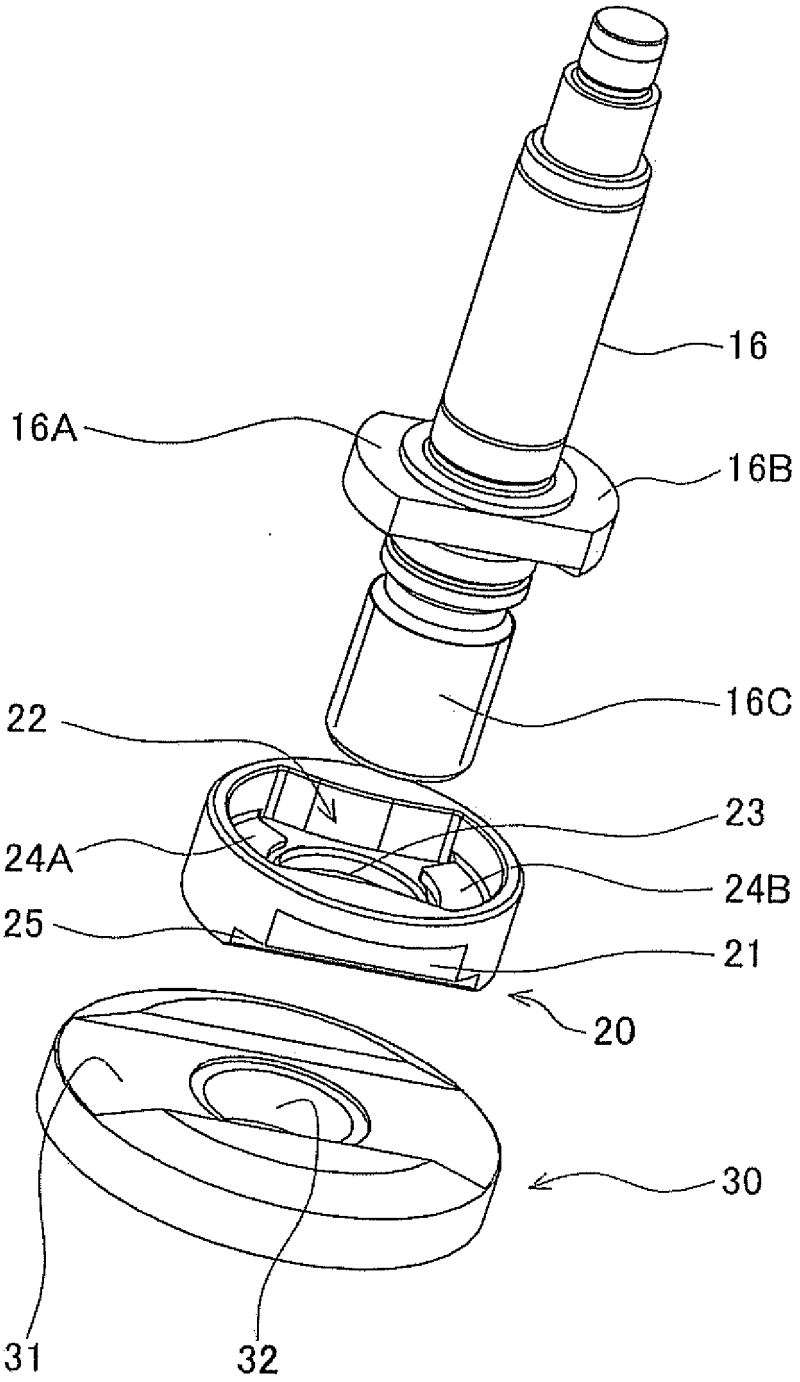


FIG. 3

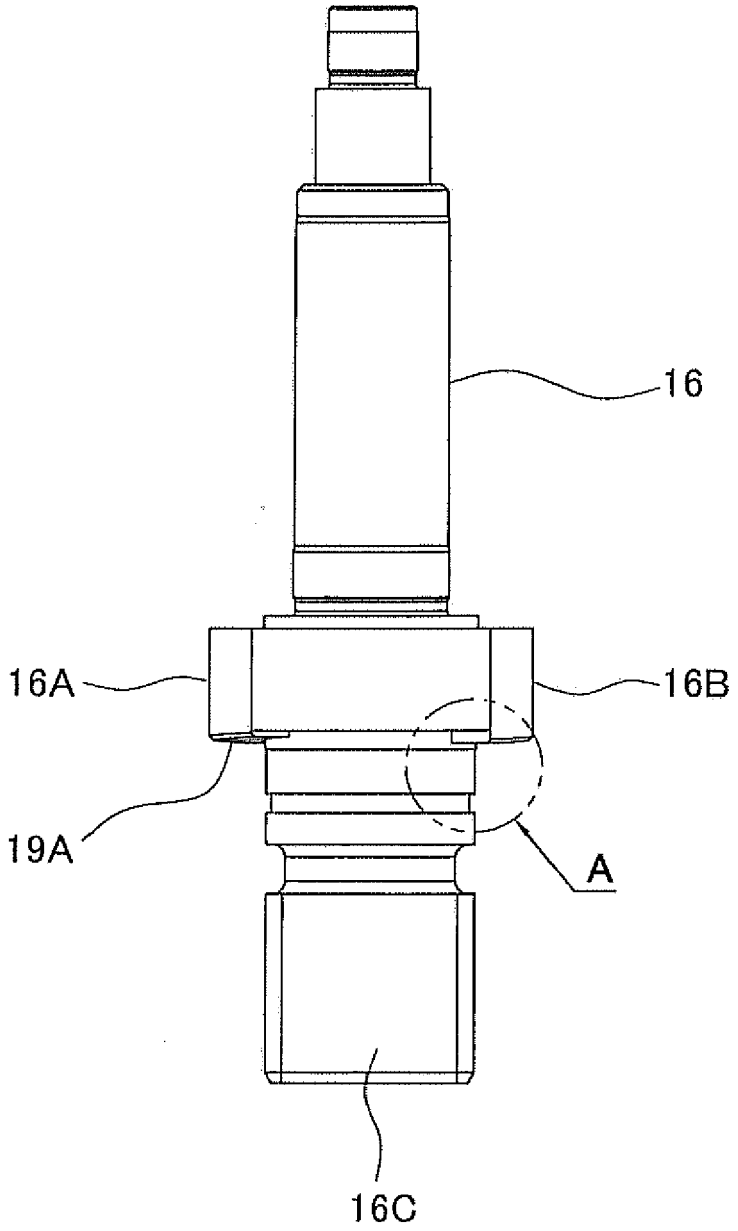


FIG. 4

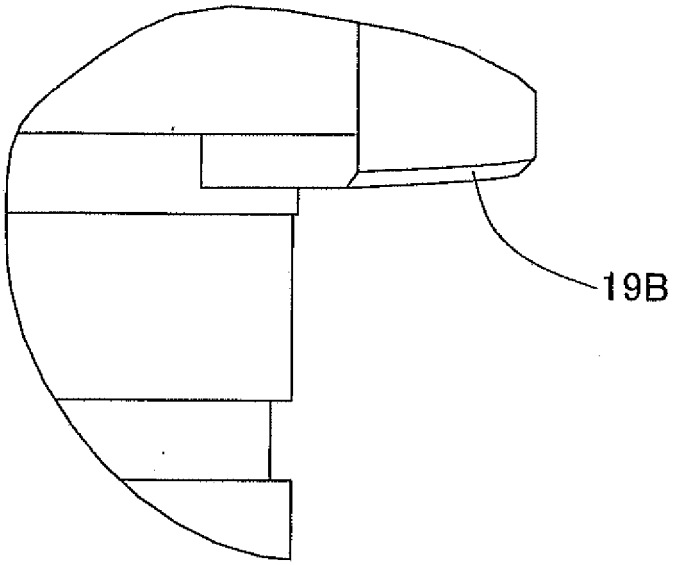


FIG. 5

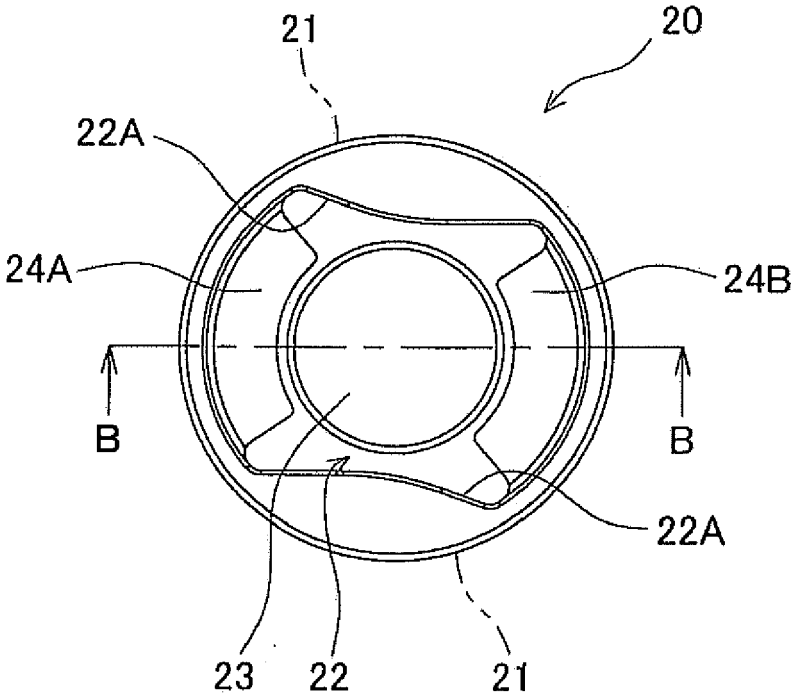
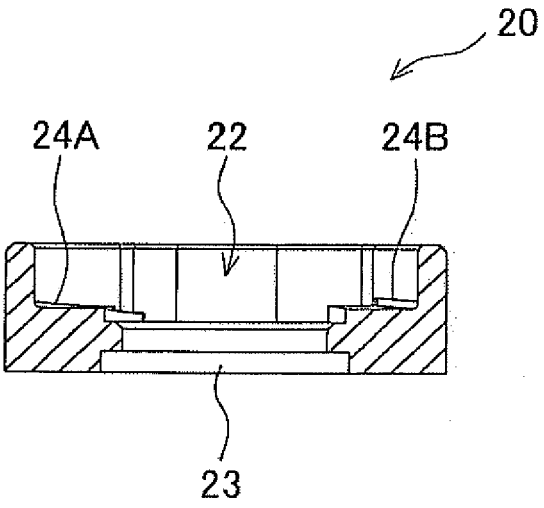


FIG. 6



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 15 6650

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	EP 1 663 574 A1 (BOSCH GMBH ROBERT [DE]) 7 June 2006 (2006-06-07) * figure 1 *	1-5	INV. B24B23/02 B24B45/00
Y	DE 36 13 987 A1 (METABOWERKE KG [DE]) 29 October 1987 (1987-10-29) * figure 3 *	1-5	
A	DE 195 10 291 A1 (BOSCH GMBH ROBERT [DE]) 26 September 1996 (1996-09-26) * figure 1 *	1-5	
A	DE 100 17 457 A1 (BOSCH GMBH ROBERT [DE]; SWAROVSKI TYROLIT SCHLEIF [AT]) 11 October 2001 (2001-10-11) * figure 11 *	1-5	

TECHNICAL FIELDS SEARCHED (IPC)

B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 June 2012	Müller, Andreas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
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 12 15 6650

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-06-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1663574 A1	07-06-2006	DE 10337853 A1	17-03-2005
		EP 1663574 A1	07-06-2006
		WO 2005016594 A1	24-02-2005
DE 3613987 A1	29-10-1987	NONE	
DE 19510291 A1	26-09-1996	NONE	
DE 10017457 A1	11-10-2001	CN 1366483 A	28-08-2002
		DE 10017457 A1	11-10-2001
		EP 1274544 A1	15-01-2003
		JP 2003530229 A	14-10-2003
		US 2003129933 A1	10-07-2003
		WO 0176823 A1	18-10-2001

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1663574 A **[0002] [0004]**