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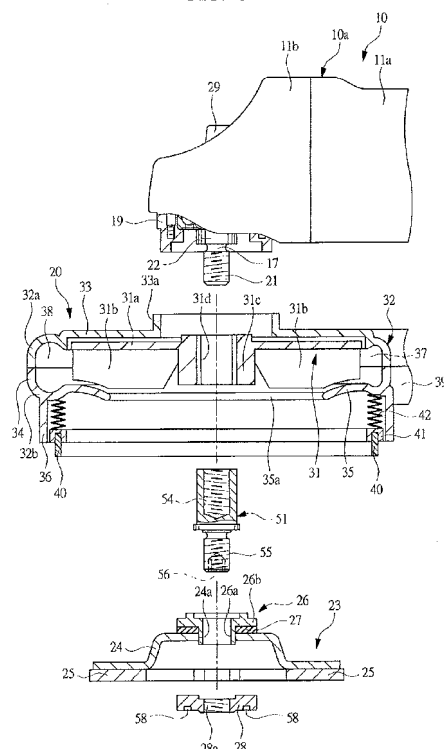
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(54) **Dust collection adapter and power tool including dust collection adapter**

(57) To a power tool main body (10a) to which a main body spindle (17) rotationally driving a tip tool (23) is provided, a dust collection adapter (20) for collecting dusts generated when a material to be ground is processed by the tip tool (23) is held thereto. The dust collection adapter includes: a dust collection fan (31) rotationally driven by the main body spindle (17); and a dust collection cover (32) for containing the dust collection fan (31) and covering a diametrical outside of the tip tool (23). The dust collection fan includes: a fan main body to which a plurality of blade portions (31b) are provided; and a threaded shaft portion (51) provided to a center portion of the fan main body. To the threaded shaft portion, a female thread portion (54) thread-coupled to the main body spindle (17) and a male thread portion (55) thread-coupled to a fastening thread member (28a) for fixing the tip tool (23) are provided.

FIG. 6



Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a power tool such as a disc grinder which performs a grinding process to a material to be ground by a tip tool, and relates to a dust collection adapter which is held to the power tool to collect dusts generated in the process.

BACKGROUND OF THE INVENTION

[0002] There are a disk grinder and others as a power tool which rotationally drives a tip tool such as a rotational grindstone by a power source to perform a working process to a surface of a material to be processed. The disk grinder is used so as to rotationally drive the tip tool by an electric motor or an air motor to perform a grinding work to the surface of the material to be processed. As the tip tool, there are a disk-shaped grindstone, a diamond cutter, a cup-shaped grindstone, a wire brush, and others, from which any tip tool is selected depending on a type of the material to be ground. For example, in order to perform the grinding work to the surface of the material to be processed such as concrete or stone material, the diamond cutter is selected as the tip tool, and the grinding process to the surface is performed by the power tool. The power tool which performs the grinding process to the surface of the material to be processed by the tip tool is also called "disk sander" or "polisher".

[0003] The power tool such as the disk grinder or the disk sander which performs the grinding process by the tip tool has a dust collection type including a dust collection adapter by which dusts generated in the working are not scattered outside. For example, Patent Literature 1 (Japanese Patent Application Laid-Open Publication No. 2009-138203) and Patent Literature 2 (Japanese Utility Model Application Publication No. S55-103143) describe a disk sander configured such that a dustproof brush is held to an opening portion of a dust collection cover. Inside a dust collection cover described in Patent Literature 3 (Japanese Patent Application Laid-Open Publication No. 2009-23005), a guide member for guiding dusts toward an exhaust duct is provided. Inside the dust collection cover of the power tool described in Patent Literature 1, a dust collection fan for taking dusts in and supplying them to the exhaust duct is provided. The dust collection adapter is formed of the dust collection fan held to a spindle for driving the tip tool and the dust collection cover for covering the dust collection fan.

SUMMARY OF THE INVENTION

[0004] The power tool such as the disk grinder or the disk sander has a dust collection type including the dust collection cover held thereto and a general-purpose simple type not including the dust collection cover. Optionally, the power tool of the simple type has a type that a

dust collection adapter obtained by unitizing the dust collection fan and the dustproof cover in which the dust collection fan is embedded can be attached to a main body of the power tool. In the simple type, the spindle for driving the tip tool such as the grinding stone has a length by which the tip tool is directly attached thereto. Therefore, when the dust collection fan and the dust collection cover are attached to the power tool of the simple type, the length of the spindle is insufficient, which results in difficulty in the attachment of the tip tool.

[0005] In order to allow specification change from the power tool of the simple type to the power tool of the dustproof type without detaching the spindle previously provided to the power tool of the simple type, that is, without detaching a main body spindle, it is required to couple a threaded shaft member, that is, an extension spindle to a tip of the main body spindle. In order to couple the extension spindle to the main body spindle, a female thread portion thread-coupled to a male thread portion of the main body spindle is provided on a base end portion of the extension spindle. And, in order to attach the tip tool to a tip portion of the extension spindle, a male thread portion thread-coupled with a lock nut for fastening the tip tool is provided to the tip of the extension spindle.

[0006] On the other hand, when the tip tool is connected and disconnected to/from the main body spindle for replacement of the tip tool, that is, is attached and detached thereto/therefrom, a lock button provided on the power tool main body is operated to lock the main body spindle so as not to rotate it. Therefore, when the tip tool is replaced, while a worker operates the lock button with worker's one hand to fix the main body spindle, the worker rotationally operates the lock nut with worker's other hand to fasten the tip tool to the main body spindle.

[0007] However, in order to replace the tip tool which has been attached to the extension spindle, if the lock nut which has fastened the tip tool is tried to be loosened while the rotation of the main body spindle is stopped by the lock button, the lock nut does not rotate against the extension spindle, and the lock nut and the extension spindle rotate together, and therefore, the thread-coupled portion between the extension spindle and the main body spindle may be loosened, which may result in their disconnection from each other.

[0008] If the extension spindle is loosened and disconnected from the main body spindle, a state that the extension spindle and the tip tool are fixed to each other occurs, and therefore, another work for detaching the tip tool from the extension spindle is required, which results in a problem of poor workability for the tool replacement.

[0009] A preferred aim of the present invention is to provide a dust collection adapter to which a tip tool such as a grindstone wheel can be attached even with a configuration that a dust collection function is provided to a general-purpose power tool main body, and provide a power tool including the dust collection adapter.

[0010] Another preferred aim of the present invention is to provide a dust collection adapter which can improve

the replacement workability for the tip tool such as the grindstone wheel with respect to the power tool main body, and provide a power tool including the dust collection adapter.

[0011] One viewpoint of the present invention is a dust collection adapter which is attached to a power tool main body and which collects dusts generated when a material to be ground is processed by a tip tool rotationally driven by a main body spindle of the power tool main body. The dust collection adapter is provided such that the dust collection adapter comprises: a dust collection fan which is rotationally driven by the main body spindle; and a dust collection cover which is held to the power tool main body to contain the dust collection fan therein and which covers a diametrical outside of the tip tool, the dust collection fan includes: a fan main body having a plurality of blades; and a threaded shaft portion which is provided to a diametrical center portion of the fan main body and where a female thread portion thread-coupled to a male thread portion of the main body spindle is formed, and a male thread portion thread-coupled to a fastening member for fixing the tip tool is provided at a tip of the threaded shaft portion.

[0012] Another viewpoint of the present invention is a power tool which performs a grinding process to a material to be ground by a tip tool. The power tool is provided such that the power tool comprises: a power tool main body to which a main body spindle for rotationally driving the tip tool is provided; a dust collection fan which is rotationally driven by the main body spindle; and a dust collection cover which is held to the power tool main body to contain the dust collection fan and which covers a diametrical outside of the tip tool, the dust collection fan includes: a fan main body having a plurality of blades; and a threaded shaft portion which is provided at a diametrical center portion of the fan main body and where a female thread portion thread-coupled to a male thread portion of the main body spindle is formed and where a male thread portion thread-coupled to a fastening member for fixing the tip tool is provided, and dusts generated when a material to be ground is processed are sucked into the dust collection cover.

[0013] The threaded shaft portion which is attached to the main body spindle provided on the power tool main body is provided to the fan main body of the dust collection fan, and the male thread portion to which the fastening member for fixing the tip tool is thread-coupled is provided to this threaded shaft portion. Therefore, when a dust collection function is provided to a general-purpose power tool main body to which a dust collection cover is not provided, the dust collection fan and the dust collection cover can be held to the main body spindle without replacing the main body spindle.

[0014] When the fastening member which is thread-coupled to the male thread portion of the threaded shaft portion to fasten the tip tool is rotated, an attachment/detachment jig is engaged with a rotation-restricting portion of the threaded shaft portion, and the fastening mem-

ber is engaged with another attachment/detachment jig, so that the fastening member can be easily rotated against the threaded shaft portion. In this manner, in the attachment/detachment work for the fastening member with respect to the threaded shaft portion, more particularly, in the replacement of the tip tool, an operation for detaching the fastening member from the threaded shaft portion can be easily performed, and therefore, workability in the replacement of the tip tool can be improved.

BRIEF DESCRIPTIONS OF THE DRAWINGS

[0015]

FIG. 1 is a partially-cutaway front view showing a disk grinder serving as a power tool in a state that a dust collection adapter is held;

FIG. 2 is an enlarged cross-sectional view of a principal portion of FIG. 1;

FIG. 3 is an enlarged cross-sectional view showing a disk grinder in a state that the dust collection adapter is detached;

FIG. 4 is a cross-sectional view showing a procedure of detaching the dust collection adapter from the disk grinder;

FIG. 5 is a base view of FIG. 4;

FIG. 6 is an exploded view showing the dust collection adapter detached from the disk grinder;

FIG. 7A is an enlarged front view showing a tip portion of a main body spindle;

FIG. 7B is an enlarged cross-sectional view showing an extension spindle portion;

FIG. 8A is a front view showing a modified example of the extension spindle portion;

FIG. 8B is a right side view of FIG. 8A;

FIG. 9A is a front view showing another modified example of the extension spindle portion;

FIG. 9B is a right side view of FIG. 9A;

FIG. 10A is a front view showing still another modified example of the extension spindle portion;

FIG. 10B is a right side view of FIG. 10A;

FIG. 11A is a front view showing still another modified example of the extension spindle portion;

FIG. 11B is a right side view of FIG. 11A;

FIG. 12A is a front view showing still another modified example of the extension spindle portion;

FIG. 12B is a right side view of FIG. 12A;

FIG. 13A is a front view showing still another modified example of the extension spindle portion;

FIG. 13B is a right side view of FIG. 13A;

FIG. 14 is a cross-sectional view showing a disk grinder in a state that a dust collection adapter is held, as a modified example;

FIG. 15 is an exploded view showing the dust collection adapter detached from the disk grinder shown in FIG. 14;

FIG. 16 is a cross-sectional view showing a dust collection adapter having a net-shaped member;

FIG. 17 is a base view showing a disk grinder to which the dust collection adapter shown in FIG. 16 is held;

FIG. 18 is a perspective view of the disc grinder shown in FIG. 17;

FIG. 19 is a cross-sectional view showing inclination angles of a plate spring and a guide piece shown in FIG. 16 along a circumferential direction;

FIG. 20 is an enlarged cross-sectional view taken along line 20-20 in FIG. 17;

FIG. 21 is a base view showing a disk grinder to which the dust collection adapter as another modified example is held;

FIG. 22 is a base view showing a disk grinder to which the dust collection adapter as still another modified example is held;

FIG. 23 is a partially-cutaway view showing a disk grinder to which the dust collection adapter as still another modified example is held;

FIG. 24 is a base view of FIG. 23;

FIG. 25 is an enlarged side view showing an engagement groove formed in a holder;

FIG. 26 is an exploded perspective view showing the holder and a skirt member attached thereto;

FIG. 27 is an enlarged cross-sectional view showing the holder and the skirt member attached thereto;

FIG. 28A is an enlarged front view showing a part of the skirt member and the dust collection cover in a state that the skirt member collides against a foreign substance;

FIG. 28B is a lateral cross-sectional view showing the skirt member in the state that the skirt member collides against the foreign substance;

FIG. 29A is a base view showing a part of a skirt member as a modified example;

FIG. 29B is a cross-sectional view taken along line 29B-29B in FIG. 29A;

FIG. 30A is a base view showing a part of a skirt member as another modified example;

FIG. 30B is a cross-sectional view taken along line 30B-30B in FIG. 30A;

FIG. 31 is an enlarged front view showing a part of a skirt member and a dust collection cover as a modified example;

FIG. 32 is a partially-cutaway front view showing a disk grinder to which a dust collection adapter as still another modified example is held;

FIG. 33 is a base view of FIG. 32;

FIG. 34 is an enlarged cross-sectional view showing a part of the skirt member and a holder to which the skirt member is attached, shown in FIG. 33;

FIG. 35 is a base view showing a disk grinder to which a dust collection adapter as still another modified example is held;

FIG. 36 is a cross-sectional view showing a part of a skirt member as still another modified example; and

FIG. 37 is a base view showing a disk grinder to

which a dust collection adapter as still another modified example is held.

DESCRIPTIONS OF THE PREFERRED EMBODIMENTS

[0016] A power tool shown in the figures is a portable, that is, a handheld type disk grinder 10. The disk grinder 10 is used for performing the grinding process to a surface of, for example, concrete, a stone material, or others as a material to be ground, and is also called "disk sander". In each figure, common members are denoted by the same reference symbol.

[0017] As shown in FIGs. 1 and 2, the disk grinder 10 includes: a cylindrical motor case 11a; and a gear case 11b attached to a tip portion thereof, and an electric motor 12 is contained inside the motor case 11a as the power source, as shown in FIG. 2. The electric motor 12 is connected to a commercial power source, which is not shown, via a power source cord 13 drawn out from a rear end portion of the motor case 11a, and is driven by power supplied from the commercial power source. A bevel gear 15 is attached to a rotation shaft 14 of the electric motor 12, and a bevel gear 16 engages with the bevel gear 15. The bevel gear 16 is attached to a main body spindle 17 arranged at a right angle to the rotation shaft 14. In this manner, torque of the electric motor 12 is transmitted to the main body spindle 17 via the bevel gears 15 and 16, so that the main body spindle 17 is rotated around a rotational center shaft. This main body spindle 17 is rotatably supported by a bearing 18 attached to the gear case 11b. The bearing 18 is attached to the gear case 11b by a cylindrical member 19 fixed to the gear case 11b. The cylindrical member 19 is arranged coaxially with the main body spindle 17, and is provided diametrically outside the main body spindle 17.

[0018] In the disk grinder 10, a power tool main body 10a is composed of: the motor case 11a; the gear case 11b; and the above-described members embedded inside the motor case 11a and the gear case 11b. A dust collection adapter 20 is detachably provided on this power tool main body 10a. When the dust collection adapter 20 is held to the power tool main body 10a, a type of the disk grinder 10 is the dust collection type as shown in FIG. 2. On the other hand, when the dust collection adapter 20 is detached from the power tool main body 10a and a grindstone wheel 23 which is the tip tool is attached to the main body spindle 17, the disk grinder 10 of the simple type is configured as shown in FIG. 3. As shown in FIGs. 2 and 3, a male thread portion 21 is provided at a tip portion of the main body spindle 17. A large-diametrical flange portion 22 is provided closer to a base end portion side thereof than the male thread portion 21, and this flange portion 22 strikes onto the bearing 18.

[0019] As shown in FIG. 3, when the disk grinder 10 is the simple type, a cup-shaped grindstone wheel 23 serving as the tip tool is directly attached to the male thread portion 21 positioned at the tip portion of the main

body spindle 17. This grindstone wheel 23 includes a base 24 formed in a cup shape, and a plurality of diamond grindstones 25 are fixed to an front-surface outer peripheral portion of this base 24 by means such as adhesion. A boss 26 is attached to a diametrical center portion of the base 24. As shown in FIG. 2, the boss 26 includes: a cylindrical portion 26a inserted into a through-hole 24a of the base 24; and an annular end plate portion 26b provided at an end portion of the cylindrical portion 26a, and a vibration-proof rubber sheet 27 is sandwiched between the end plate portion 26b and the base 24.

[0020] The grindstone wheel 23 is attached to the main body spindle 17 by a lock nut 28 serving as the fastening member thread-coupled to the male thread portion 21 of the main body spindle 17. A female thread portion 28a thread-coupled to the male thread portion 21 is provided on the lock nut 28. When the grindstone wheel 23 is attached to the main body spindle 17, the cylindrical portion 26a is inserted into the male thread portion 21 so that the end plate portion 26b of the boss 26 strikes onto the flange portion 22. Next, the male thread portion 21 and the cylindrical portion 26a are inserted into the through-hole 24a to provide such a state that the base 24 is contacted to the end plate portion 26b via the vibration-proof rubber sheet 27, and the lock nut 28 is attached to the male thread portion 21 for fastening and fixing. In order not to rotate the main body spindle 17 in the fastening of the lock nut 28, a lock button 29 is provided on the gear case 11b.

[0021] A lock pin (not shown) which is reciprocable in a direction parallel to the main body spindle 17 is provided on the lock button 29. In FIG. 3, by pushing the lock button 29 to a position shown by a two-dot chain line 29a, the lock pin is engaged with a recess portion, which is not shown, formed in the bevel gear 16, so that the bevel gear 16 is fixed to restrict the rotation of the main body spindle 17. In this manner, by rotating the lock nut 28 in the state that the rotation of the main body spindle 17 is restricted, the lock nut 28 can be easily thread-coupled to the male thread portion 21. Also when the lock nut 28 is loosened to be detached from the male thread portion 21, the main body spindle 17 is locked by pushing the lock button 29, so that the rotation is restricted.

[0022] As shown in FIG. 2, the dust collection adapter 20 includes: a dust collection fan 31 rotationally driven together with the grindstone wheel 23 by the electric motor 12; and a dust collection cover 32 for containing the dust collection fan 31 therein and covering a diametrical outside of the grindstone wheel 23. The dust collection fan 31 includes: a disk portion 31a; and a plurality of blade portions 31b provided on a front-surface side of the disk portion 31a, so that a fan main body is formed of the disk portion 31a and the plurality of blade portions 31b. The dust collection fan 31 and the grindstone wheel 23 are rotated around a rotational center shaft of the main body spindle 17.

[0023] The dust collection cover 32 includes: an end wall portion 33; a cylindrical peripheral wall portion 34;

and a partition wall 35 opposed to the end wall portion 33 via an outer peripheral portion of the dust collection fan 31. The end wall portion 33 and the peripheral wall portion 34 are fixed to each other by a fixing element (not shown) such as a thread. An annular partition wall 35 protruding diametrically inward is integrally provided with the peripheral wall portion 34, and a suction opening 35a is formed in the partition wall 35. On a front-surface side of the peripheral wall portion 34, a cylindrical tool cover 36 is integrally provided with the peripheral wall portion 34. The tool cover 36 has an inner diameter larger than an outer diameter of the grindstone wheel 23 to cover a diametrical outside of the grindstone wheel 23.

[0024] At a diametrical center portion of the end wall portion 33, a cylindrical holding portion 33a fitted to the cylindrical member 19 of the power tool main body 10a is provided. The dust collection cover 32 is detachably held to the cylindrical member 19 at the holding portion 33a. When the holding portion 33a is fitted to an outer periphery of the cylindrical member 19, the dust collection cover 32 and the tool cover 36 are fixed to the cylindrical member 19. A fan containing chamber 37 is formed between the end wall portion 33 and the partition wall 35, so that the dust collection fan 31 is embedded inside the fan containing chamber 37. When the dust collection fan 31 is rotated, air flows from outside into the fan containing chamber 37 via the suction opening 35a. A volute flow path 38 formed between the peripheral wall portion 34 and an outer periphery of the dust collection fan 31 has a cross-sectional area which gradually becomes larger toward a downstream side in a circumferential direction. As shown in FIG. 1, an exhaust duct 39 is provided on the dust collection cover 32 so as to communicate with a most downstream portion of the volute flow path 38.

[0025] The dust collection cover 32 is configured by combining a first case half body 32a and a second case half body 32b each made of a resin material such as nylon. In the first case half body 32a, a part of the end wall portion 33 and the peripheral wall portion 34 and a part of the exhaust duct 39 are integrated with each other. In the second case half body 32b, a rest part of the peripheral wall portion 34, a rest part of the exhaust duct 39, the partition wall 35, and the tool cover 36 are integrated with each other.

[0026] A hose 39a is attached to the exhaust duct 39 as shown in FIG. 1, and the exhaust duct 39 is connected to a dust collection bag (not shown) by the hose 39a. Therefore, the dusts generated in the polishing work by the grindstone wheel 23 are sucked into the fan containing chamber 37 inside the dust collection cover 32 by the rotation of the dust collection fan 31, and then, are guided to the dust collection bag through the hose 39a. In this manner, the dusts generated in the polishing work are removed by the dust collection bag without scattering around the disk grinder 10.

[0027] Inside the tool cover 36, a skirt member 40 serving as a sealing member is arranged movably in an axial direction of the main body spindle 17. The skirt member

40 is attached to an annular holder 41, and a plurality of compression coil springs 42 serving as spring members are held between the holder 41 and the partition wall 35, so that spring force is applied to the skirt member 40 by the compression coil springs 42 in a protrusion direction from a tip surface of the tool cover 36. When the surface of the concrete or others is polished by the grindstone wheel 23, the skirt member 40 serving as the sealing member covers a diametrical outside of the grindstone wheel 23, so that it can be exactly prevented that the dusts are blown outside.

[0028] An extension spindle portion 51 serving as the threaded shaft portion is detachably attached to a boss portion 31c of the dust collection fan 31. A base end portion 52 of the extension spindle portion 51 is inserted into an attaching hole 31d formed in the boss portion 31c of the dust collection fan 31. Two flat surfaces are formed on an inner peripheral surface of the attaching hole 31d so as to be shifted from each other by a phase of 180° in a circumferential direction. On the other hand, as shown in FIG. 8, two flat surfaces 53 are formed on an outer peripheral surface of the base end portion 52 of the extension spindle portion 51 so as to correspond to a cross-sectional shape of the attaching hole 31d and so as to be shifted from each other by a phase of 180° in the circumferential direction, which results in a width-across-flat structure for the base end portion 52. As shown in FIGs. 2 and 7B, a female thread portion 54 which is a thread hole thread-coupled to the male thread portion 21 of the main body spindle 17 is formed in the base end portion 52. By the flat surfaces 53 and the attaching hole 31d, the extension spindle portion 51 and the dust collection fan 31 are positioned in the circumferential direction, and besides, they are configured so as to be movable in the shaft direction. In this manner, when the dust collection adapter 20 is attached to the disk grinder 10, the positioning in the circumferential direction is achieved by only matching the positions of the extension spindle portion 51 and the attaching hole 31d of the dust collection fan 31 with each other and inserting them, so that driving force of the disk grinder 10 can be transmitted to the dust collection fan.

[0029] A male thread portion 55 thread-coupled to the female thread portion 28a of the lock nut 28 is formed on a tip portion of the extension spindle portion 51. The male thread portion 21 of the main body spindle 17 and the male thread portion 55 of the extension spindle portion 51 have the same outer diameter and thread pitch with each other, so that the grindstone wheel 23 can be attached to the male thread portion 21 of the main body spindle 17 as shown in FIG. 3, and besides, the grindstone wheel 23 can be attached to the male thread portion 55 of the extension spindle portion 51 as shown in FIG. 2. The grindstone wheel 23 is fastened by the lock nut 28 thread-coupled to the male thread portions 21 and 55. As shown in FIG. 2, when the grindstone wheel 23 is attached to the main body spindle 17 via the extension spindle portion 51, and besides, when the dust collection

adapter 20 is attached to the power tool main body 10a, the type of the disk grinder 10 is the dust collection type. On the other hand, as shown in FIG. 3, when the grindstone wheel 23 is attached to the main body spindle 17, the type of the disk grinder 10 is the simple type.

[0030] Each of the male thread portions 21 and 55 is a right-hand thread, and has the same helical direction with the other. Therefore, when the grindstone wheel 23 is attached to the main body spindle 17 as shown in FIG. 3, the lock nut 28 is thread-coupled to the male thread portion 21. At this time, the lock button 29 is operated, so that the lock nut 28 is rotated rightward as viewed from a front surface side of the lock nut 28, that is, from below in FIG. 3, in the state that the rotation of the main body spindle 17 is restricted.

[0031] In order to attach the extension spindle portion 51 to the main body spindle 17, the lock button 29 is operated, so that the extension spindle portion 51 is similarly rotated rightward to be thread-coupled to the main body spindle 17 in the state that the rotation of the main body spindle 17 is restricted. Further, in order to attach the grindstone wheel 23 to the main body spindle 17, the boss portion of the grindstone wheel 23 is fitted on the tip portion of the extension spindle portion 51, so that the lock nut 28 is thread-coupled to the male thread portion 55. Also at this time, the state that the rotation of the main body spindle 17 is restricted is provided by the lock button 29, and the lock nut 28 is rotated rightward. In this manner, when the dust collection fan 31 is coupled to the main body spindle 17 via the extension spindle portion 51, and besides, when the dust collection cover 32 is held to the power tool main body 10a, the type of the disk grinder 10 is the dust collection type. Since the grindstone wheel 23 is attached to the main body spindle 17 via the extension spindle portion 51, the length of the thread portion in the axial direction required for the attachment can be sufficiently secured, and the attachment can be exactly performed. Still further, even if the blade portions 31b of the dust collection fan 31 are formed to be thick, the thread-coupling can be sufficiently performed, and therefore, an air volume for the dust collection can be increased as achieving the exact attachment.

[0032] When the grindstone wheel 23 is detached from the disk grinder 10 to which the dust collection adapter 20 has been held, the lock nut 28 is rotated in the loosening direction. At this time, in some cases, the thread coupling of the female thread portion 54 of the extension spindle portion 51 to the male thread portion 21 of the main body spindle 17 may be loosened although the lock nut 28 is not loosened. Besides, since the worker rotates the lock nut 28 with the worker's other hand as the worker is pushing the lock button 29 with the worker's one hand, this operation is not easy because the positions of the lock button 29 and the lock nut 28 are farther away from each other than the positions in the case that the lock nut 28 is detached from the male thread portion 21 of the main body spindle 17.

[0033] Therefore, in the tip portion of the extension

spindle portion 51, a recess portion 56 opened in a tip surface of the extension spindle portion 51 is formed as a rotation-restricting portion. As shown in FIG. 8B, the recess portion 56 is formed as a hexagonal hole, and an attachment/detachment jig 57 whose outer peripheral surface is hexagon can be engaged with this hexagonal hole. FIG. 4 shows a state that the attachment/detachment jig 57 is engaged with the recess portion 56 serving as the rotation-restricting portion. A plurality of recess portions 58 are formed in an end surface of the lock nut 28 at the same radial positions with each other from the rotation center, and an attachment/detachment jig 59 can be engaged with the recess portions 58, as shown in FIGs. 4 and 5. In the attachment/detachment jig 59, protrusions 59a engaged with the recess portions 58 are provided.

[0034] In a state of engagement of the attachment/detachment jig 57 with the recess portion 56 and engagement of the protrusions 59a of the attachment/detachment jig 59 with the recess portions 58 as shown in FIG. 4, the lock nut 28 is rotated leftward in FIG. 5 corresponding to the loosening direction by the attachment/detachment jig 59 as the rotation of the extension spindle portion 51 is restricted by the attachment/detachment jig 57 as shown in FIG. 5. In this manner, the lock nut 28 can be easily detached from the male thread portion 55 of the extension spindle portion 51 without rotating the extension spindle portion 51 against the main body spindle 17. At this time, since the lock nut 28 can be loosened by relatively rotating the lock nut 28 against the extension spindle portion 51 leftward in FIG. 5, the attachment/detachment jig 57 may be rotated rightward as the attachment/detachment jig 59 is fixed, or both of them may be rotated simultaneously.

[0035] FIG. 6 shows the disk grinder 10 in states that the grindstone wheel 23 is detached from the extension spindle portion 51 and that the extension spindle portion 51 is detached from the main body spindle 17. When the extension spindle portion 51 is detached from the main body spindle 17 in the state that the grindstone wheel 23 is detached from the extension spindle portion 51, the lock button 29 is pushed, so that the rotation of the main body spindle 17 is restricted, and the extension spindle portion 51 is rotated leftward. At this time, the extension spindle portion 51 may be rotationally operated leftward by the attachment/detachment jig 57, or the extension spindle portion 51 may be rotated leftward as the worker holds the boss portion 31c of the dust collection fan 31 with the worker's hand. When the extension spindle portion 51 is thread-coupled to the main body spindle 17, the extension spindle portion 51 may be rotationally operated rightward by the attachment/detachment jig 57, or the extension spindle portion 51 may be rotated rightward as the worker holds the boss portion 31c of the dust collection fan 31 with the worker's hand.

[0036] Each of FIGs. 9A to 13B shows a modified example of the extension spindle portion 51. In the tip portion of the extension spindle portion 51 shown in FIGs.

9A and 9B, a one-line recess-shaped groove, that is, a minus-symbol groove 56a extending in a diametrical direction is provided as the rotation-restricting portion. In the tip portion of the extension spindle portion 51 shown in FIGs. 10A and 10B, a crossing two-line recess-shaped groove, that is, a plus-symbol groove 56b is provided as the rotation-restricting portion. Therefore, in order to attach/detach the lock nut 28 to/from the extension spindle portion 51 as shown in FIGs. 9A and 9B, a member engaged with the minus-symbol groove 56a is used as the attachment/detachment jig. In order to attach/detach the lock nut 28 to/from the extension spindle portion 51 as shown in FIGs. 10A and 10B, a member engaged with the plus-symbol groove 56b is used as the attachment/detachment jig.

[0037] In the tip portion of the extension spindle portion 51 shown in FIGs. 11A and 11B, a hexagonal-shaped protrusion 56c is provided as the rotation-restricting portion so as to protrude from the tip surface thereof. In the tip portion of the extension spindle portion 51 shown in FIGs. 12A and 12B, a square-shaped protrusion 56d is provided as the rotation-restricting portion so as to protrude from the tip surface thereof. In the tip portion of the extension spindle portion 51 shown in FIGs. 13A and 13B, a protrusion 56e is provided so as to protrude from the tip surface thereof, and a through-hole 56f which faces in the diametrical direction with respect to the rotational center shaft of the extension spindle portion 51 is provided in the protrusion 56e serving as the rotation-restricting portion. Therefore, in order to attach/detach the lock nuts 28 to/from the extension spindle portions 51 shown in FIGs. 11A to 12B, a spanner or others is used as the attachment/detachment jig. In order to attach/detach the lock nut 28 to/from the extension spindle portion 51 shown in FIGs. 13A and 13B, a rod member which penetrates through the through-hole 56f is used as the attachment/detachment jig.

[0038] In this manner, as the rotation-restricting portion for restricting the rotation of the extension spindle portion 51, any shape such as the recess portion, the protrusion, and the shape obtained by forming the through-hole in the protrusion may be used as long as the attachment/detachment jig can be engaged with the extension spindle portion 51. Further, the shape of the lock nut 28 is not limited to the shape obtained by forming the plurality of recess portions 58 in the end surface thereof, and a lock nut 28 whose outer peripheral surface has a square shape or a hexagonal shape may be used.

[0039] FIG. 14 is a cross-sectional view showing a modified example of the disk grinder, and FIG. 15 is a cross-sectional view showing the disk grinder in the state that the dust collection adapter 20 and the dust collection fan 31 are detached from the power tool main body 10a as shown in FIG. 14.

[0040] As shown in FIG. 14, in an outer periphery of the holder 41, a plurality of engagement stops 41a are provided in a circumferential direction at a predetermined interval. Inside the tool cover 36, a plurality of engage-

ment grooves 36a engaged with the engagement stops 41a are provided. Protruding movement of the skirt member 40 pressed by the compression coil springs 42 is restricted by contact of the engagement stops 41a with a stopper 36b. Also in the holder 41 shown in FIG. 2, engagement stops engaged with engagement grooves formed in the tool cover 36 are formed.

[0041] A threaded shaft portion 51a is fixed to the boss portion 31c of the dust collection fan 31. As shown in FIG. 14, in the threaded shaft portion 51a, a female thread portion 54 thread-coupled to the male thread portion 21 of the main body spindle 17 is formed. In the threaded shaft portion 51a, a male thread portion 55 protruding from the boss portion 31c is provided. Therefore, while the above-described extension spindle portion 51 is formed of a member different from the dust collection fan 31 so that the extension spindle portion 51 can be separated from the dust collection fan 31, the threaded shaft portion 51a having a structure corresponding to that of the extension spindle portion 51 is fixed to the dust collection fan 31 shown in FIGs. 14 and 15. This threaded shaft portion 51a configures the extension spindle portion.

[0042] In this manner, the type of the disk grinder 10 shown in FIG. 14 is the dust collection type as shown in FIG. 14 by attaching the dust collection fan 31 integrated with the threaded shaft portion 51a to the male thread portion 21 of the main body spindle 17, and then, attaching the grindstone wheel 23 to the male thread portion 55 of the threaded shaft portion 51a so as to fasten the lock nut 28 to the male thread portion 55. On the other hand, the type of the disk grinder 10 is the simple type by not attaching the dust collection fan 31 to the main body spindle 17 but directly attaching the grindstone wheel 23 to the male thread portion 21 as shown in FIG. 3.

[0043] The threaded shaft portion 51a serving as the extension spindle shown in FIG. 14 is fixed to the dust collection fan 31, and therefore, when the dust collection fan 31 is detached from the main body spindle 17, the threaded shaft portion 51a is detached from the main body spindle 17 as shown in FIG. 15.

[0044] The threaded shaft portion 51a shown in FIG. 14 is made of a metal material, and the dust collection fan 31 is made of a resin material. When the dust collection fan 31 is molded by a mold, the threaded shaft portion 51a is arranged inside the mold, and the threaded shaft portion 51a is molded together with the dust collection fan 31. However, by integrally molding the threaded shaft portion 51a and the dust collection fan 31 from a light metal material or a resin material by the mold, the dust collection fan 31 having the integrated structure including the threaded shaft portion 51a is obtained.

[0045] In the tip of the threaded shaft portion 51a, a recess portion 56 serving as the rotation-restricting portion and engaged with the attachment/detachment jig 57 is formed. As the rotation-restricting portion, as shown in FIGs. 9A to 13B, any shape such as the recess portion, the protrusion, and the shape obtained by forming the

through-hole in the protrusion may be used as long as the attachment/detachment jig 57 can be engaged therewith.

[0046] FIG. 16 is a cross-sectional view showing a modified example of a dust collection adapter, FIG. 17 is a base view showing a disk grinder to which the dust collection adapter shown in FIG. 16 is held, and FIG. 18 is a perspective view of the disk grinder. FIGs. 17 and 18 show the dust collection adapter 20 in a state that the grindstone wheel 23 is detached from the extension spindle portion 51. FIG. 16 shows a state that the extension spindle portion 51 serving as the threaded shaft portion is attached to the dust collection fan 31.

[0047] As shown in FIG. 16, between the holder 41 and the partition wall 35, a plurality of plate springs 43 serving as spring members are held in the circumferential direction at an equal interval in order to apply the spring force to the skirt member 40 in the direction of protrusion from a tip surface of the tool cover 36. One end portion of each of the plate springs 43 is fixed to the partition wall 35, and the other end portion thereof abuts on the holder 41. Each of the plate springs 43 extends from the one end portion toward the other end portion along an inner peripheral surface of the dust collection cover 32 in a rotational direction of the grindstone wheel 23, and besides, inclines toward a front of the dust collection cover 32. In the dust collection adapter 20 shown in FIG. 16, five plate springs 43 are provided.

[0048] In the holder 41, twelve guide pieces 44 protruding from an inner peripheral surface thereof toward a diametrical inside thereof are integrally provided in a rib shape. A length of the protrusion of each of the guide pieces 44 in a diametrically-inward direction is shorter than a length of the protrusion of each of the plate springs 43 in the diametrically-inward direction. As shown in FIG. 17, each of the guide pieces 44 extends along the inner peripheral surface of the holder 41 in the circumferential direction, and besides, inclines along a rotational direction of the dust collection fan 31 shown by an arrow in a direction of approaching from an opening side of the dust collection cover 32 to the partition wall 35 side, that is, inclines so that each of the guide pieces 44 approaches toward the suction opening 35a. A height of the protrusion of each of these guide pieces 44 from the inner peripheral surface of the holder 41 to the diametrical inside is uniformed from one end to the other end. Further, all of the twelve guide pieces 44 have the same shape, they are arranged in the circumferential direction at equal intervals, and adjacent guide pieces 44 are arranged to be shifted from each other in the circumferential direction so that they do not overlap with each other as viewed from the shaft direction of the main body spindle 17. In this manner, the holder 41 integrally provided with the guide pieces 44 can be molded easily by using a pair of molds for mold injection which are divided in the axial direction, and therefore, a mold having a complicated configuration is unnecessary, so that a manufacturing cost of the dust collection cover 32 including this holder

41 can be reduced.

[0049] FIG. 19 is a cross-sectional view showing angles of the inclination of each plate spring 43 and guide piece 44 along the circumferential direction. As shown in FIG. 19, it is set that the inclination angle "A" of the plate spring 43 is larger than the inclination angle "B" of the guide piece 44. It is set that, even if the holder 41 moves toward the partition wall 35 to a stroke edge as elastically deforming the plate spring 43, the inclination angle A of the plate spring 43 is not smaller than the inclination angle B of each guide piece 44.

[0050] As shown in FIGs. 17 and 18, a net-shaped member 61 is provided on a front surface of the partition wall 35 as a protector. This net-shaped member 61 includes: a ring portion 62 whose diameter is smaller than an inner diameter of the suction opening 35a; and a plurality of rib portions 63 extending from an outer peripheral portion of the partition wall 35 toward the ring portion 62 as curving in the rotational direction of the dust collection fan 31. Each of the rib portions 63 is formed in an arc shape integrally with the ring portion 62, and a diametrical inside portion of each of the rib portions 63 protrudes to a front of the suction opening 35a. In the partition wall 35, twelve rib portions 63 less than fifteen which is the number of blades of the dust collection fan 31, that is, the number of blade portions 31b, are arranged in the circumferential direction of the dust collection cover 32 at equal intervals. A front surface of the net-shaped member 61 protrudes forward more than the front surface of the partition wall 35.

[0051] In this manner, since the net-shaped member 61 is composed of: the ring portion 62; and the plurality of rib portions 63 protruding from a front-surface flange portion of the partition wall 35 toward the diametrical inside, the net-shaped member 61 has a rectifying function which guides flow of the dusts. By providing the net-shaped member 61 integrally with the dust collection cover 32, the dust collection cover 32 having the rectifying function can be manufactured at low cost. Since tip portions of the plurality of rib portions 63 on the inner peripheral side are coupled to each other by the ring portion 62, strength of the net-shaped member 61 can be increased, and therefore, durability and operation reliability of the dust collection cover 32 can be enhanced.

[0052] The net-shaped member 61 overlaps an outer peripheral portion of the suction opening 35a. Therefore, even if relatively-large foreign substances such as concrete pieces generated by grinding a member to be ground in the grinding work are sucked toward the suction opening 35a, the foreign substances are captured by the net-shaped member 61. In this manner, it is prevented that the foreign substances enter from the suction opening 35a toward the dust collection fan 31.

[0053] While a cross-sectional shape of the diametrical outside portion of each rib portion 63 relative to the partition wall 35 has a rectangular shape, a cross-sectional shape of a portion of each rib portion 63 relative to the suction opening 35a has an arc-shaped portion 63a as

shown in FIG. 20 at a corner of end portions thereof opposed to the dust collection fan 31, the corner being positioned on a rear side of the rotational direction of the dust collection fan 31. Therefore, swirling flow which flows from the grindstone wheel 23 side toward the dust collection fan 31 is smoothly guided to the dust collection fan 31 so as to flow toward the axial direction relative to the dust collection fan 31 by the arc-shaped portion 63a of each rib portion 63. In this manner, a suction efficiency is enhanced by this dust collection fan 31. An arrow "C" in FIG. 20 indicates the flow of the sucked air.

[0054] When the dust collection cover 32 is held to the disk grinder 10, the entire grindstone wheel 23 is covered by the dust collection cover 32, and besides, a back surface of the grindstone wheel 23 opposed to a grinding surface of the grindstone wheel 23 is covered by the partition wall 35 and the net-shaped member 61. When the electric motor 12 is activated in a state that the dust collection cover 32 is held to the disk grinder 10, the dust collection fan 31 is rotated together with the grindstone wheel 23 so that suction power is generated at the suction opening 35a. When the grindstone wheel 23 is pressed onto the material to be ground such as concrete or tile so that the grinding work is performed, the dusts such as grinding powders are scattered diametrically outside from the outer peripheral portion of the grindstone wheel 23. The scattered dusts are blocked by the skirt member 40 from their external leakage, and are captured inside the tool cover 36. The dusts captured inside the tool cover 36 are sucked from the suction opening 35a to the fan containing chamber 37 by the suction power of the dust collection fan 31, pass through the volute flow path 38, and are exhausted from the exhaust duct 39. The exhausted dusts are collected in the dust collection bag (not shown) provided at the end portion of the exhaust duct 39.

[0055] The dusts generated by the grinding by the grindstone wheel 23 are scattered from the outer peripheral portion of the grindstone wheel 23 toward a tangential direction thereof, pass through between the outer peripheral portion of the grindstone wheel 23 and the holder 41 as swirling inside the tool cover 36, and are sucked toward the suction opening 35a. At this time, in the inner peripheral surface of the holder 41, the guide pieces 44 are provided so as to extend along the flow of the dusts and so as to be inclined relative to the circumferential direction. Therefore, the dusts flow along these guide pieces 44, so that the dusts are guided by the guide pieces 44 to also flow in the axial direction toward the suction opening 35a as swirling in the same direction with the grindstone wheel 23. That is, the dusts flow spirally inside the tool cover 36.

[0056] The flow of the dusts after passing through between the outer peripheral portion of the grindstone wheel 23 and the holder 41 passes through between the plate springs 43. Since these plate springs 43 are also provided so as to extend along the flow of the dusts and so as to be inclined relative to the circumferential direc-

tion, the dusts flow along the plate springs 43, so that the dusts are guided by the plate springs 43 to also flow in the axial direction toward the suction opening 35a as enhancing the swirling flow toward the rotational direction of the dust collection fan 31. Even if the skirt member 40 moves vertically as following asperity of the material 50 to be ground, the swirling flow of the dusts is not weakened by the guidance by the plate springs 43 because the inclination angle A of each plate spring 43 is not smaller than the inclination angle B of each guide piece 44.

[0057] Then, the swirling flow of the dusts enhanced by the guide pieces 44 and the plate springs 43 flows along the rib portions 63, and is guided to the suction opening 35a. These rib portions 63 extend along the rotational direction of the dust collection fan 31, and besides, are curved toward the shaft center of the dust collection fan 31, and therefore, the flow of the dusts are guided toward the center of the dust collection fan 31 as further enhancing the swirling flow by the rib portions 63. Further, the flow of the dusts flowing from the suction opening 35a into the volute flow path 38 is guided by the ring portion 62 which couples the tips of the rib portions 63, and is directed toward the axial direction (an inflow direction) of the dust collection fan 31. Since each of the guide pieces 44, plate springs 43, and rib portions 63 is arranged in the circumferential direction at equal intervals, the dusts flow from the suction opening 35a into the volute flow path 38 as maintaining substantially uniform flow relative to the circumferential direction.

[0058] The dusts after the inflow from the suction opening 35a into the volute flow path 38 are exhausted diametrically outward by rotational force of the dust collection fan 31 as passing through between the respective blade portions 31b, pass through the volute flow path 38, are exhausted from the exhaust duct 39, and are collected in the dust collection bag (not shown). In this manner, inside the dust collection cover 32, the flow of the dusts exhausted from the grindstone wheel 23 flow into the volute flow path 38 as swirling in the same direction with the rotational direction of the dust collection fan 31 by the guide pieces 44, the plate springs 43, and the rib portions 63 which are provided in the holder 41, and therefore, efficiency of the dust collection by the dust collection fan 31 can be increased. Therefore, the efficiency of the dust collection by the dust collection fan 31 can be increased without largely manufacturing the dust collection fan 31, and the dusts exhausted from the grindstone wheel 23 can be collected further efficiently.

[0059] Since the number of the rib portions 63 is different from the number of the blade portions 31b of the dust collection fan 31, each phase of pressure fluctuation generated between each blade portion 31b of the dust collection fan 31 and each rib portion 63 is shifted from the other for every blade portion 31b. In this manner, resonance of noises due to the pressure fluctuation is prevented, so that the noises of this dust collection cover 32 can be reduced.

[0060] The net-shaped member 61 including the rib

portions 63 and the ring portion 62 is provided to the suction opening 35a of the dust collection cover 32, and therefore, even if the relatively-large foreign substances such as concrete pieces which are ground in the grinding work enter the inside of the dust collection cover 32 carelessly, the foreign substances are captured by the net-shaped member 61. In this manner, the entering of the foreign substances from the suction opening 35a into the volute flow path 38 can be prevented. Therefore, it is prevented to block the rotation of the dust collection fan 31 or break the dust collection fan 31 due to the foreign substances generated by grinding the material 50 to be ground during the grinding work, so that operation reliability of this dust collection cover 32 can be enhanced.

[0061] FIG. 21 shows a modified example of the net-shaped member 61 provided to the dust collection cover 32. The net-shaped member 61 includes: an outer ring portion 62a; and an inner ring portion 62b whose diameter is smaller than that of the outer ring portion 62a. The diameter of the inner ring portion 62a is smaller than that of the ring portion 62 shown in FIG. 17. A crossing-belt-shaped portion 64 having a lattice pattern is provided between both the ring portions 62a and 62b. A plurality of rib portions 63 are provided to the outer ring portion 62a similarly to the ribs shown in FIG. 17. By providing the lattice-pattern crossing-belt-shaped portion 64 to the net-shaped member 61, the strength of the net-shaped member 61 can be enhanced.

[0062] FIG. 22 shows still another modified example of the net-shaped member 61 provided to the dust collection cover 32. This net-shaped member 61 has an annular protective plate 66 in which twelve circular through-holes 65 are formed at equal intervals. To the protective plate 66, rib portions 63 similarly to the rib portions shown in FIG. 17 are provided. By forming the net-shaped member 61 with using such a protective plate 66, the net-shaped member 61 can be provided so as to have a simple and strong configuration. The net-shaped members 61 shown in FIGs. 21 and 22 may be made of a resin material so as to be integrally formed with a case half body 32b of the dust collection cover 32, or the net-shaped members 61 may be made of resin or metal so as to be separately formed as a different member from the case half body 32b and be attached to the partition wall 35.

[0063] FIG. 23 is a cross-sectional view showing the disk grinder 10 to which a dust collection adapter of a modified example is provided, and FIG. 24 is a base view of FIG. 23. FIG. 25 is a side view showing a recess portion provided to the holder, and FIG. 26 is a perspective view showing the holder and a skirt portion attached thereto.

[0064] Four engagement grooves 36a are formed in the dust collection cover 32, and engagement stops 41a engaged with the respective engagement grooves 36a are provided to the holder 41 which is made of resin. As shown in FIG. 25, the engagement groove 36a includes: a first recess portion 71a which opens at a front end surface of the dust collection cover 32; and a second recess

portion 71b which is away from the first recess portion 71a in the circumferential direction, and the first recess portion 71a and the second recess portion 71b are communicated with each other by a guide recess portion 71c. In the second recess portion 71b, a stopper surface 71d for supporting the engagement stop 41a is provided. In this manner, in order to attach the holder 41 to the dust collection cover 32, the holder 41 is pushed and inserted into the dust collection cover 32 against the spring force of the compression coil spring 42 in a state that the engagement stop 41a is engaged with the first recess portion 71a. And, the holder 41 is rotated until the engagement stop 41a reaches a position of the second recess portion 71b through the guide recess portion 71c in a state that the engagement stop 41a abuts on a guide surface 71e of the guide recess portion 71c. When the pushing force to the holder 41 is released in this state, the engagement stop 41a abuts on the stopper surface 71d of the second recess portion 71b. In this manner, the holder 41 is held to the dust collection cover 32, so that the detachment thereof from the dust collection cover 32 is prevented. In this manner, by engaging the engagement stop 41a with the engagement groove 36a, the holder 41 can be attached to the dust collection cover 32 exactly and easily. The holder 41 can move vertically relative to the dust collection cover 32 in the state that the engagement stop 41a in the second recess portion 71b is biased by the spring force.

[0065] In the holder 41, an attachment groove 41b to which the skirt member 40 is held is formed on its one end surface as shown in FIG. 26, and a protrusion 41c to which the compression coil spring 42 is held is provided on the other end surface as shown in FIG. 27. The skirt member 40 is formed in an annular shape so that both ends of a fabric material made of felt and formed in a band shape are abutted to each other. It is set that a thickness of the skirt member 40 is larger than a width of the attachment groove 41b, and, when the skirt member 40 is pushed into the attachment groove 41b, the skirt member 40 is fixed to the holder 41. A front end surface of the skirt member 40 fixed to the holder 41 protrudes forward over a front surface of the grindstone wheel 23.

[0066] When the grinding work is performed by the disk grinder 10, the skirt member 40 protrudes over the front surface of the grindstone wheel 23, and therefore, the skirt member 40 is pressed onto the material 50 to be ground by the spring force of the compression coil springs 42, so that it is suppressed to generate a space between the skirt member 40 and the material 50 to be ground. In this state, the grindstone wheel 23 is rotationally driven in a direction shown by an arrow in FIG. 24, so that the disk grinder 10 is moved along a surface of the material 50 to be ground. At this time, as shown in FIGs. 28A and 28B, even if a protruding portion 50a exists on the surface of the material 50 to be ground, it is suppressed to generate the space in a portion of the skirt member 40 which contacts the protruding portion 50a because the skirt

member 40 is continuously formed in a series of shape except for the abutting portion 40a. In this manner, the flowing of the dusts or others into the fan containing chamber 37 is prevented.

[0067] Since the skirt member 40 is pressed into the attachment groove 41b to be held to the holder 41, the attaching work of the skirt member 40 to the holder 41 can be simplified. Since the skirt member 40 which is made of fabric can be manufactured at a lower cost than that of a brush or others, increase in a maintenance cost thereof can be prevented even if the skirt member 40 is frequently replaced with new one. Since air sucked by the dust collection fan 31 flows into the fan containing chamber 37 from the suction opening 35a and is exhausted to the exhaust duct 39, pressure is most lowered in a region where the exhaust duct 39 communicates with the fan containing chamber 37. The skirt member 40 is held to the attachment groove 41b so that the abutting portion of the both ends thereof is positioned to match a portion where the suction power is most excellent, that is, the region where the exhaust duct 39 communicates with the fan containing chamber 37. The abutting portion 40a is not particularly stitched or adhered, and therefore, a slight space may be generated in some cases. However, as shown in FIG. 24, by arranging the abutting portion 40a at the position where the suction power is excellent, it can be suppressed that the dusts or others are exhausted from the abutting portion 40a to an outside.

[0068] Since the holder 41 is held to the dust collection cover 32 in the state that the skirt member 40 has been previously attached thereto, the skirt member 40 can be easily held to the dust collection cover 32. Since rigidity of the skirt member 40 can be maintained by the holder 41, the ring shape thereof can be exactly maintained even if the skirt member 40 contacts the material 50 to be ground such as the concrete surface so that load is applied thereto. Since the skirt member 40 is inserted and fixed to the attachment groove 41b of the holder 41, the attachment of the skirt member 40 to the holder 41 can be performed easily. Even if the skirt member 40 is worn by the grinding, the replacement work thereof with a new skirt member 40 can be easily performed, and therefore, the maintenance performance for the disk grinder 10 can be improved.

[0069] FIG. 29A is a base view showing a skirt member 40 of a modified example, and FIG. 29B is a cross-sectional view taken along line 29B-29B in FIG. 29A.

[0070] As shown in FIGs. 29A and 29B, in the holder 41, an engagement stop 72 protruding into the attachment groove 41b is provided. When the skirt member 40 is pressed into the attachment groove 41b, the engagement stop 72 bites into the skirt member 40, so that it is suppressed that the skirt member 40 falls off from the attachment groove 41b. In this manner, the skirt member 40 can be exactly fixed to the holder 41. A recess portion where the engagement stop 72 slips in the skirt member 40 may be previously formed.

[0071] FIG. 30A is a base view showing a skirt member

40 of still another modified example, and FIG. 30B is a cross-sectional view taken along line 30B-30B in FIG. 30A.

[0072] The skirt member 40 shown in FIGs. 30A and 30B is formed by laminating three fabrics. In this manner, by laminating a plurality of fabrics, the skirt member 40 can be formed.

[0073] FIG. 31 is a front view showing a part of a skirt member 40 of still another modified example. In the skirt member 40, a string 73 is woven as two lines into a portion thereof which protrudes from the holder 41. By weaving the string 73 into the skirt member 40, the strength and the flexibility of the skirt member 40 can be adjusted to a desired characteristic.

[0074] FIG. 32 is a partially-cutaway front view showing a disk grinder to which a dust collection adapter of still another modified example is held. FIG. 33 is a base view of FIG. 32, and FIG. 34 is an enlarged cross-sectional view showing a part of a skirt member and a holder to which the skirt member is attached, shown in FIG. 33.

[0075] While the above-described skirt member 40 is formed of one band-shaped fabric, this skirt member 40 is formed of a plurality of fabric sheet members 74 as shown in FIG. 33. In the holder 41, a plurality of attachment grooves 41b to which the respective sheet members 74 are attached are formed. A length of the sheet member 74 is almost equal to that of the attachment groove 41b, and is formed in a strip shape so that a thickness thereof is larger than a width of the attachment groove 41b. As shown in FIG. 34, the sheet member 74 is held to the attachment groove 41b so that a portion thereof on one side in the width direction protrudes from a front surface of the holder 41.

[0076] Each of the sheet members 74 is inclined relative to a tangential direction of a radius of the dust collection fan 31 so that a downstream portion in the rotational direction of the dust collection fan 31 is formed diametrically inward from an upstream portion thereof toward the downstream portion. In the downstream portion of the sheet member 74, a taper portion 74a whose tip portion is sharpened is formed, and the taper portion 74a overlaps with a base end portion of the other sheet member 74 so as to sandwich a space therebetween. In this manner, since the space is formed between the overlapping portion of two sheet members 74 adjacent to each other, a plurality of communication flow paths 75 through which air flows by the respective spaces as shown by an arrow in FIG. 33 are formed in the skirt member 40.

[0077] Each of the communication flow paths 75 is inclined so as to be involved in the swirling flow generated by the grindstone wheel 23 by the rotation of the dust collection fan 31, and therefore, air is involved from the outside and flows into the skirt member 40. In this manner, a large volume of air is guided into the fan containing chamber 37. Since each of the sheet members 74 overlaps with the other sheet member 74 so as to sandwich the space therebetween at their both end portions in the longitudinal direction, it is prevented that the dusts which

are scattered diametrically outward by the grindstone wheel 23 fall out from the skirt member 40. The length and a flow path cross-sectional area of each of the communication flow paths 75 and the inclination angle of each of the communication flow paths 75 are set in accordance with the grinding performance of the grindstone wheel 23 and the suction performance of the dust collection fan 31.

[0078] FIG. 35 is a base view showing a disk grinder 10 to which a skirt member 40 of a modified example is provided. This skirt member 40 is formed of a plurality of sheet members 74 whose thicknesses are uniform in their longitudinal direction as a whole.

[0079] FIG. 36 is a cross-sectional view showing a skirt member 40 of a modified example, and this skirt member 40 is formed so that a plurality of fabric materials are laminated for each of the sheet members 74. Each of the sheet members 74 may be formed by laminating a fabric material, a resin sheet, and a metal brush.

[0080] FIG. 37 is a base view showing a disk grinder to which a dust collection adapter of a still another modified example is held. This skirt member 40 is formed of a plurality of sheet members 74 continuously attached to the attachment grooves 41b via a space so as to sandwich the space therebetween in a circumferential direction. An end surface of each of the sheet members 74 is inclined as shown in FIG. 37, and a communication flow path 75 is formed by a space between the end surfaces of the sheet members 74. However, the skirt member 40 may be formed of one band-shaped fabric, and a plurality of through-holes forming the communication flow paths may be formed in the skirt member 40. Further, even if the communication flow paths 75 are formed in the skirt member 40 so as to protrude in the diametrical direction, the dusts which are scattered by the grindstone wheel 23 are guided by the air flowing inside from the communication flow paths 75, and therefore, it is prevented that the dusts are exhausted outside the skirt member 40.

[0081] In the foregoing, the invention made by the inventors has been concretely described based on the embodiments. However, it is needless to say that the present invention is not limited to the foregoing embodiments and various modifications and alterations can be made within the scope of the present invention. For example, the disk grinder 10 which is shown is an electric tool using an electric motor as a driving source, that is, a power tool. However, the present invention can be also applied to a power tool of a type using an air motor as the driving source. The disk grinder 10 which is shown is used to perform a grinding process to a surface of a material to be ground, so that the surface of the material to be ground can be roughly processed by the grinding process. On the other hand, a finishing process is called "polishing process", and a power tool performing the polishing process is called "disk sander" or "polisher". The power tool of the present invention can be also applied to an apparatus performing the polishing process.

Claims

1. A dust collection adapter which is attached to a power tool main body and which collects dust generated when a material to be ground is processed by a tip tool rotationally driven by a main body spindle of the power tool main body, **characterized in that** the dust collection adapter includes:

a dust collection fan which is rotationally driven by the main body spindle; and
a dust collection cover which is held to the power tool main body to contain the dust collection fan therein and which covers a diametrical outside of the tip tool,

the dust collection fan includes:

a fan main body having a plurality of blades; and
a threaded shaft portion which is provided to a diametrical center portion of the fan main body and where a female thread portion thread-coupled to a male thread portion of the main body spindle is formed, and
a male thread portion thread-coupled to a fastening member for fixing the tip tool is provided to a tip of the threaded shaft portion.

2. The dust collection adapter according to claim 1, **characterized in that** a rotation-restricting portion for restricting rotation of the dust collection fan in a rotational direction of the fastening member when the fastening member is rotated with respect to the male thread portion is provided to the threaded shaft portion,

3. The dust collection adapter according to either of claim 1 or claim 2, **characterized in that** the rotation-restricting portion is a recess portion such as a hexagonal hole which opens at a tip surface of the male thread portion of the threaded shaft portion and which is engaged with an attachment/detachment jig, and
the attachment/detachment jig is engaged with the recess portion to restrict the rotation of the dust collection fan in the rotational direction of the fastening member.

4. The dust collection adapter according to any one of the previous claims, in particular claim 2, **characterized in that** the rotation-restricting portion is a protrusion such as a hexagonal protrusion which protrudes from a tip surface of the male thread portion of the threaded shaft portion and which is engaged with an attachment/detachment jig, and
the attachment/detachment jig is engaged with the protrusion to restrict the rotation of the dust collection

fan in the rotational direction of the fastening member.

5. The dust collection adapter according to any one of the previous claims **characterized in that** the threaded shaft portion is fixed to the fan main body.

6. The dust collection adapter according to any one of the previous claims **characterized in that** the threaded shaft portion is formed integrally with the fan main body.

7. The dust collection adapter according to any one of the previous claims **characterized in that** the threaded shaft portion is an extension spindle portion which is detachably held to the fan main body and which extends the main body spindle.

8. The dust collection adapter according to any one of the previous claims **characterized in that** a net-shaped member which suppresses entering of a foreign substance from the tip tool to the dust collection fan is provided to the dust collection cover.

9. The dust collection adapter according to any one of the previous claims, in particular claim 8, **characterized in that** the net-shaped member includes: a ring portion; and a plurality of rib portions which are curved from an inner peripheral surface of the dust collection cover in the rotational direction of the dust collection fan and which extend toward the ring portion so as to be integrated with the ring portion.

10. The dust collection adapter according to any one of the previous claims **characterized in that** the dust collection adapter further includes: an annular holder which is arranged at a tip portion of the dust collection cover so as to be movable in an axial direction; a skirt member made of fabric which is held to the holder and which prevents scattering of dust generated when the material to be ground is processed; and a spring member which is arranged between the holder and the dust collection cover and which applies spring force to the holder in a direction that the skirt member protrudes from a front surface of the dust collection cover.

11. The dust collection adapter according to any one of the previous claims, in particular claim 10, **characterized in that** the skirt member is held to the holder so that both ends of a band-shaped member are abutted to each other, and the abutting portion is arranged in a region corresponding to an exhaust opening of the dust collection cover.

12. The dust collection adapter according to any one of the previous claims, in particular claim 10, **characterized in that**
 a plurality of engagement stops which protrude diametrically outward are provided to the holder, attachment grooves which are engaged with the respective engagement stops are formed in the dust collection cover, and each of the attachment grooves includes: a first recess portion which opens at a front surface of the dust collection cover; a second recess portion which includes a stopper surface for supporting the engagement stop so as to be away from the first recess portion in a circumferential direction; and a guide recess portion which couples the first recess portion and the second recess portion to each other.
13. The dust collection adapter according to any one of the previous claims, in particular claim 10, **characterized in that**
 a plurality of communication flow paths for communicating an inside of the skirt member and an outside thereof with each other are formed in the skirt member.
14. A power tool which performs a grinding process to a material to be ground by a tip tool, **characterized in that**
 the power tool includes:
 a power tool main body to which a main body spindle for rotationally driving the tip tool is provided; and the dust collection adapter according to any one of the previous claims, wherein dust generated when a material to be ground is processed by the tip tool is sucked into the dust collection cover,
15. The power tool according to claim 14, **characterized in that**
 the threaded shaft portion is an extension spindle portion which is detachably held to the fan main body and which extends the main body spindle.

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FIG. 1

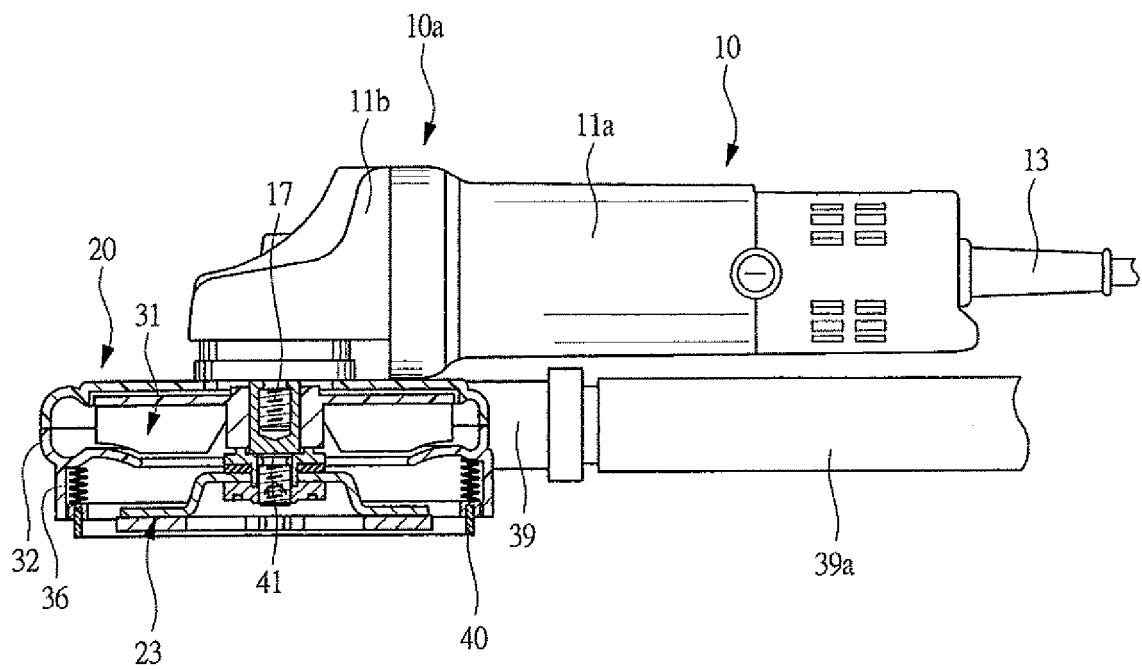


FIG. 2

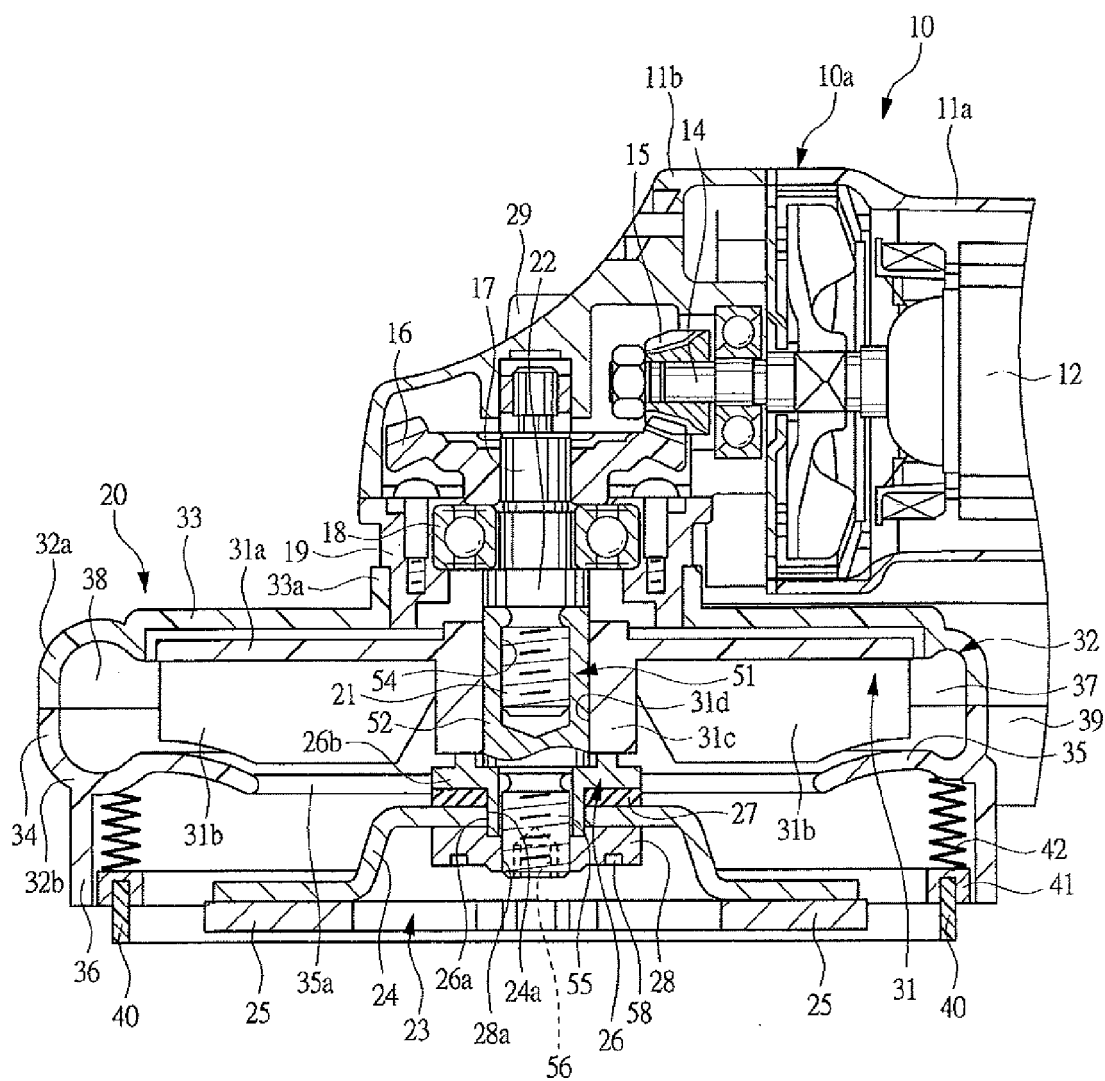


FIG. 3

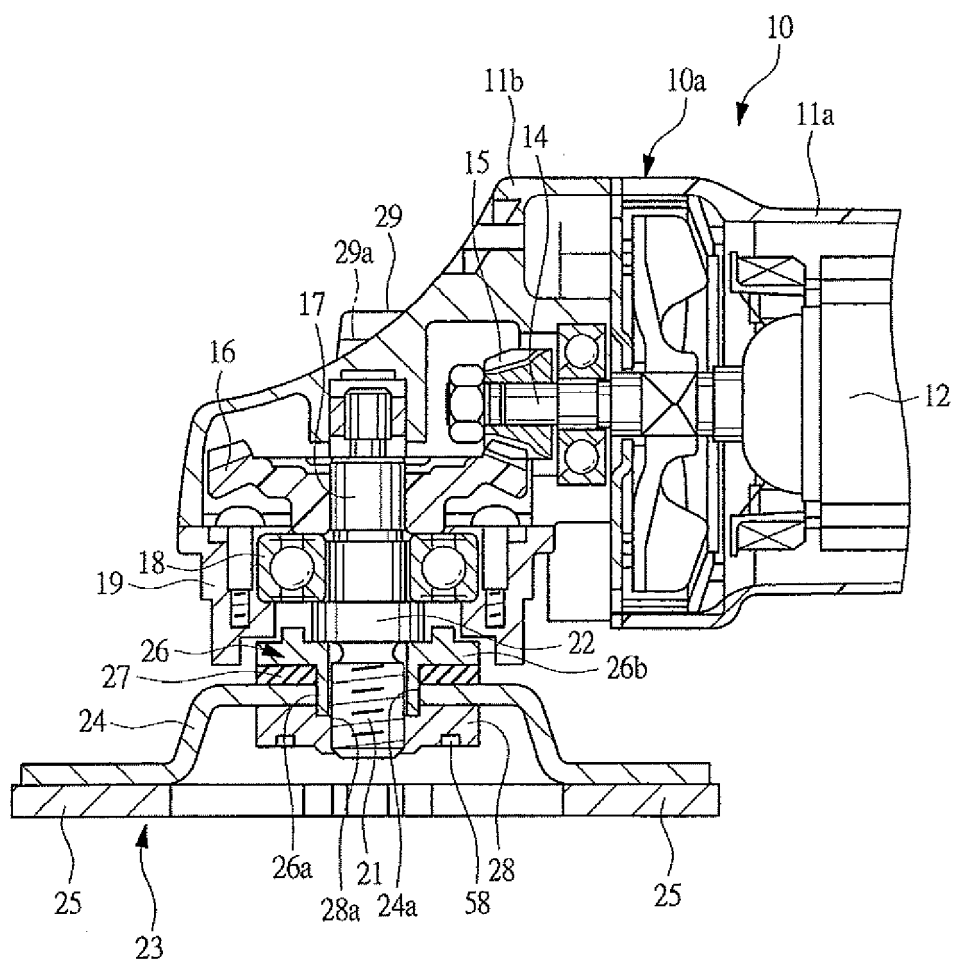


FIG. 4

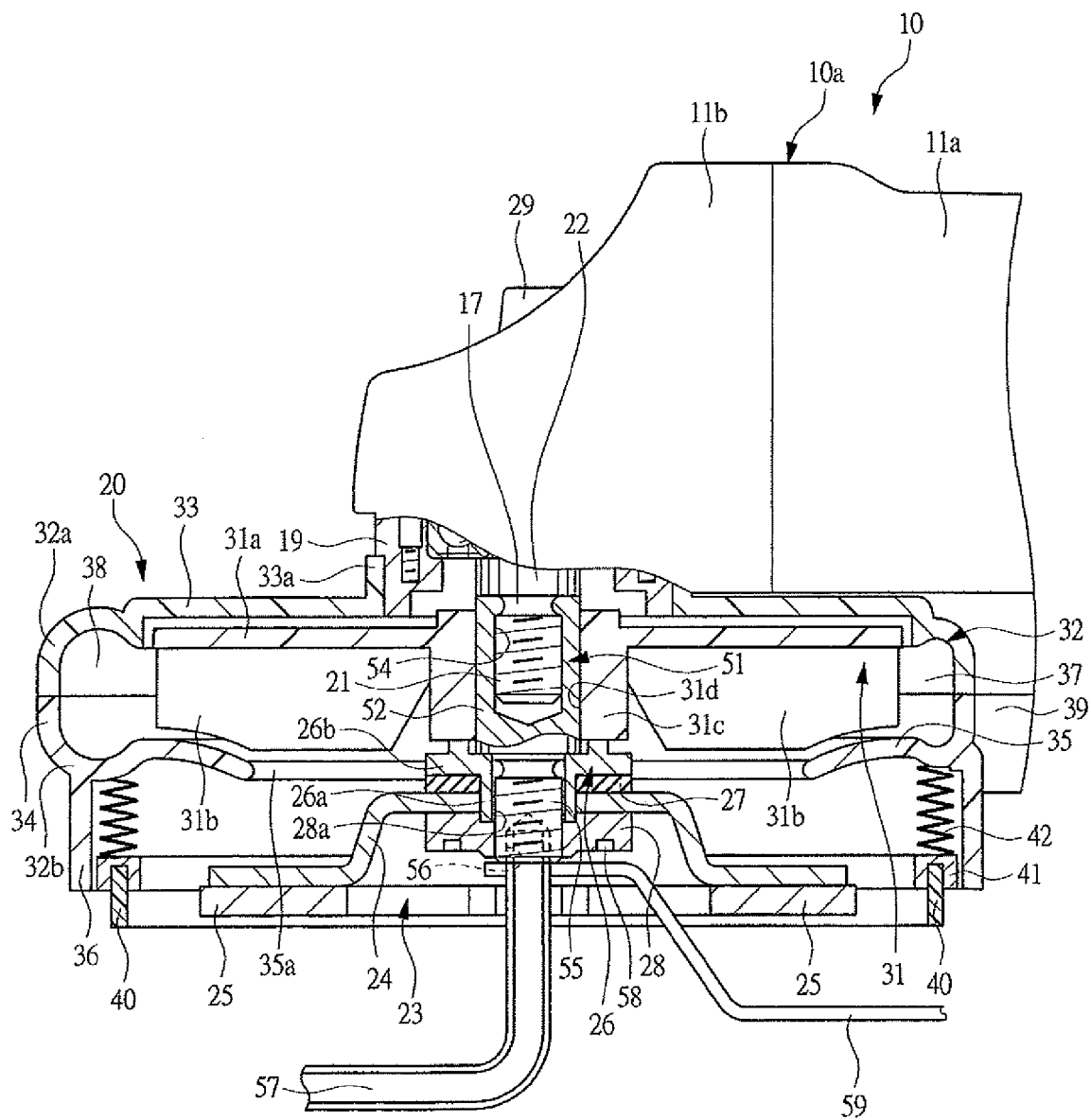


FIG. 5

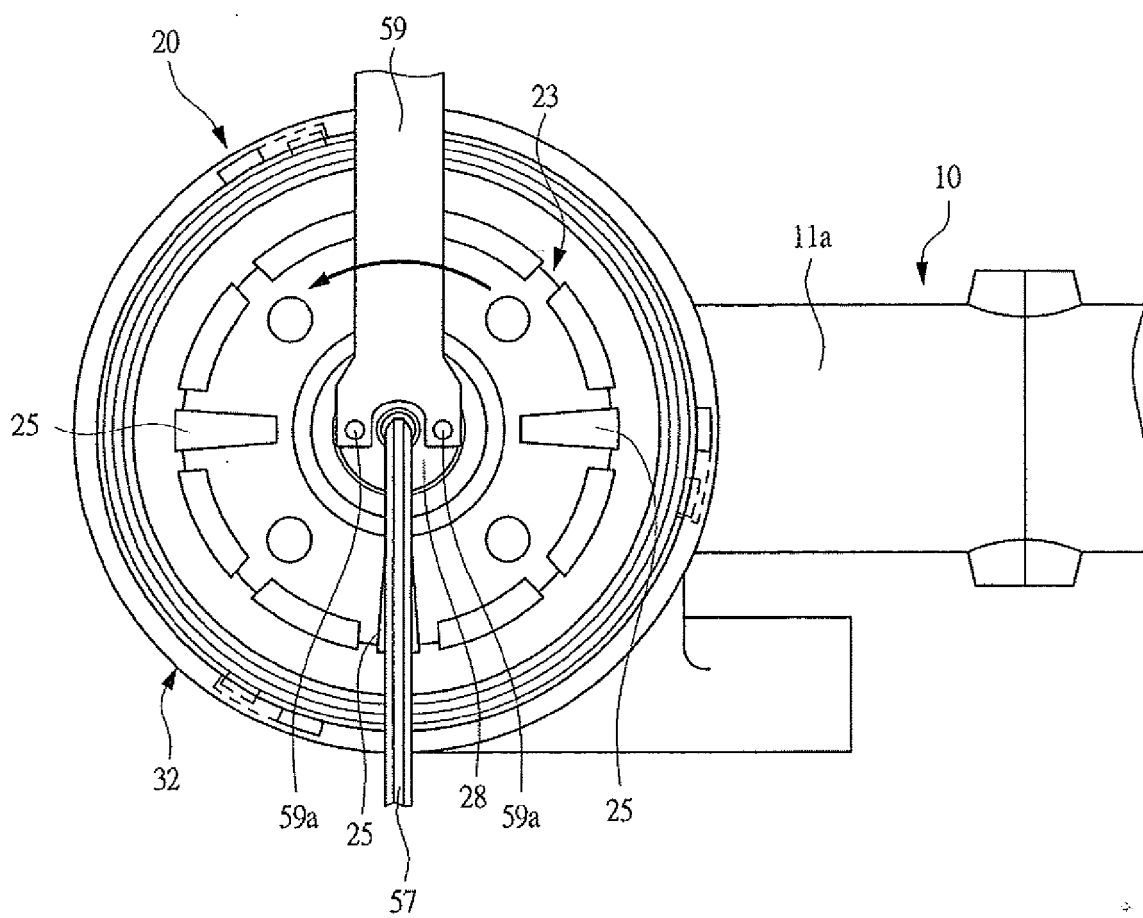


FIG. 6

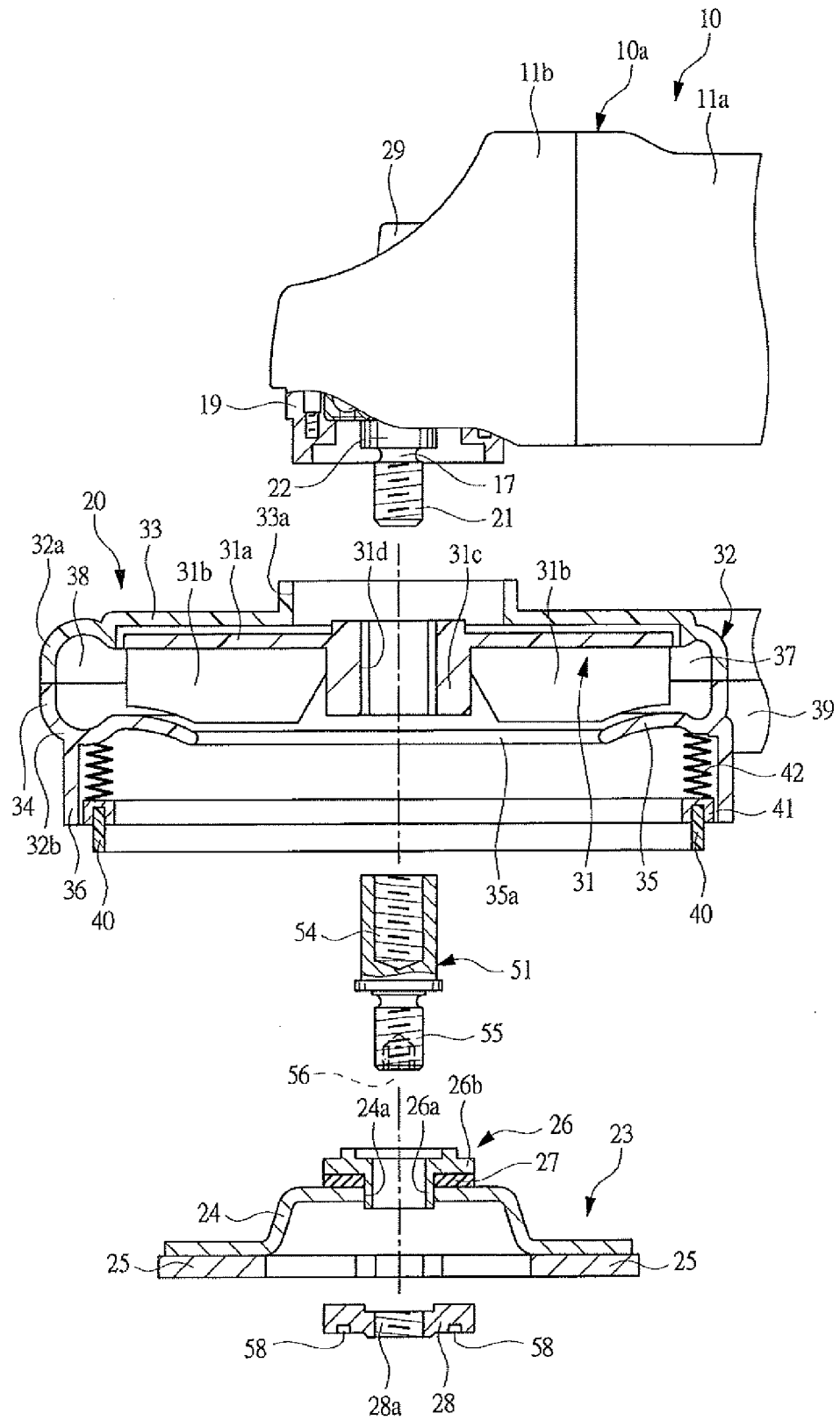


FIG. 7A

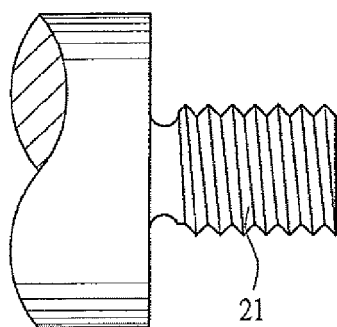


FIG. 7B

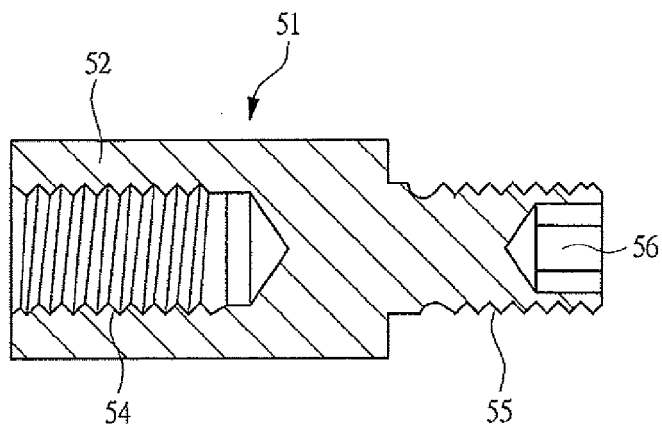


FIG. 8A

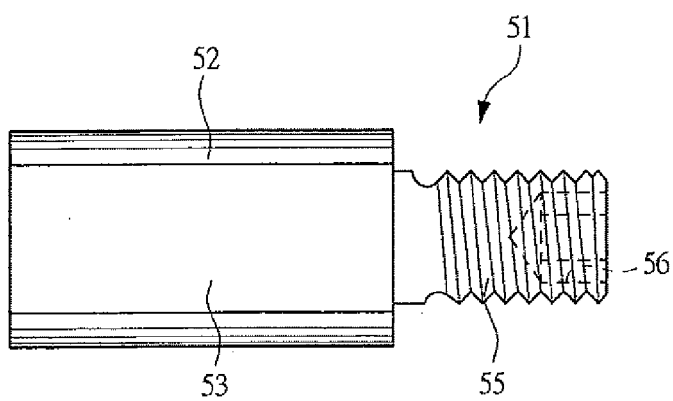


FIG. 8B

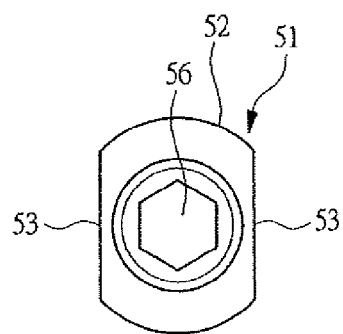


FIG. 9A

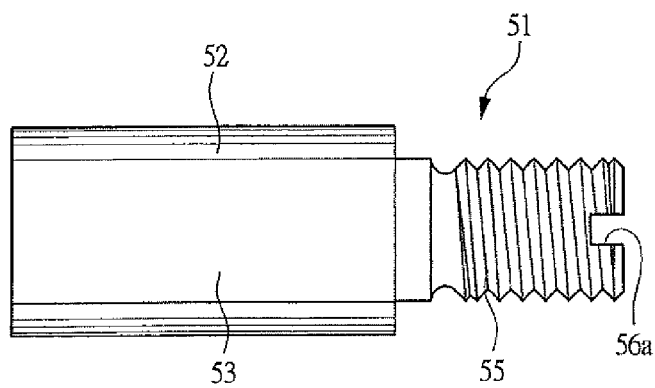


FIG. 9B

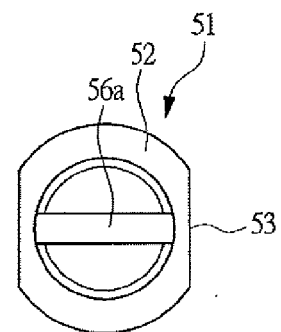


FIG. 10A

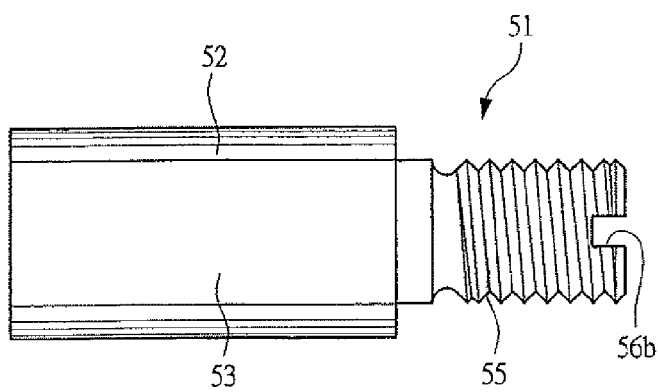


FIG. 10B

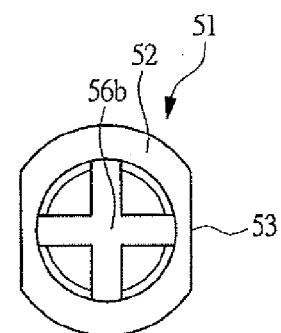


FIG. 11A

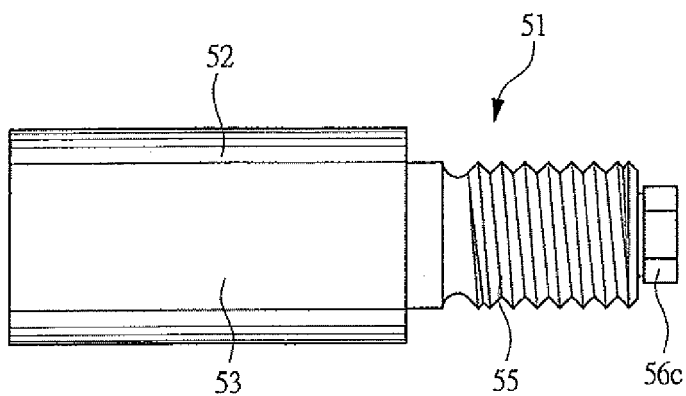


FIG. 11B

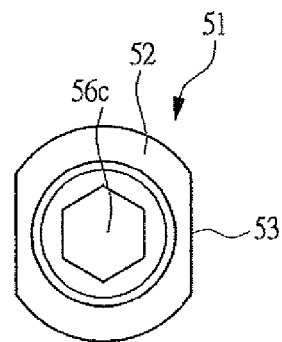


FIG. 12A

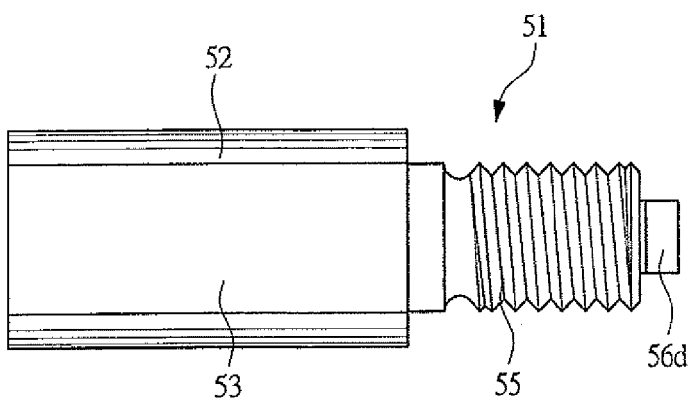


FIG. 12B

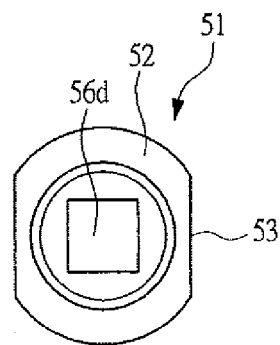


FIG. 13A

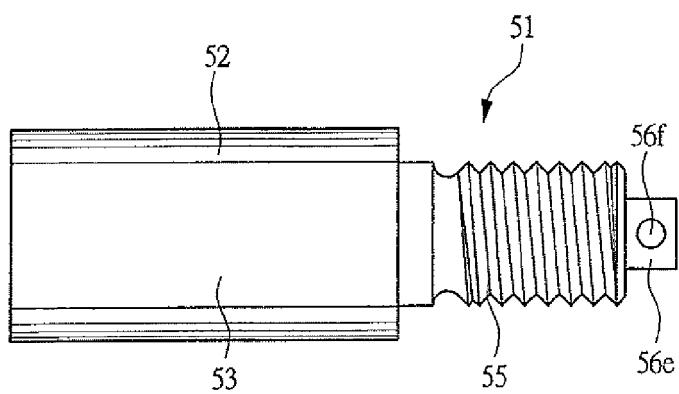


FIG. 13B

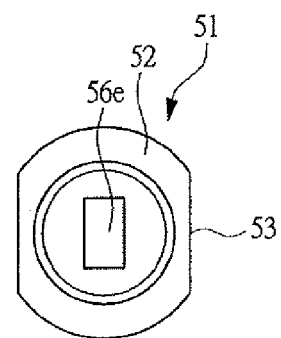


FIG. 14

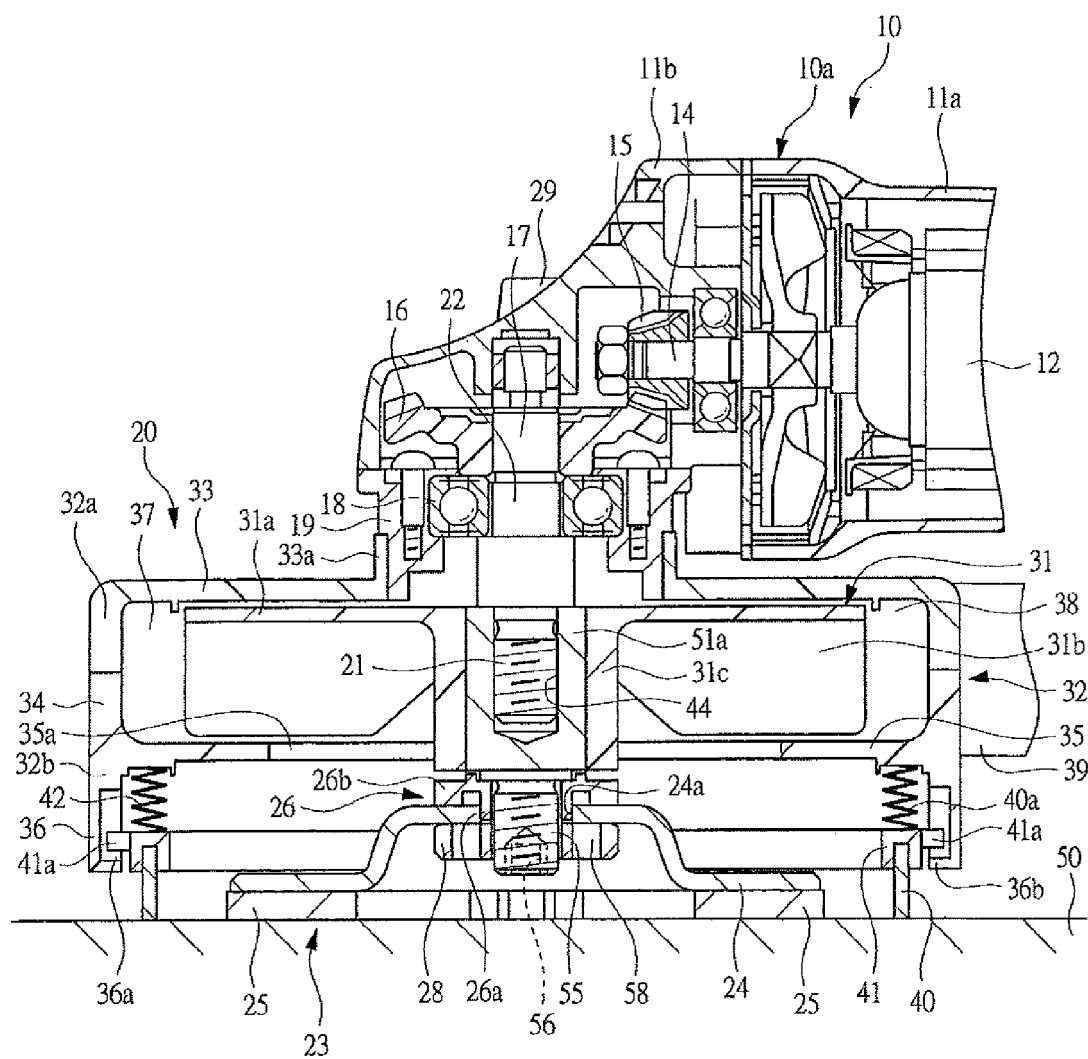


FIG. 15

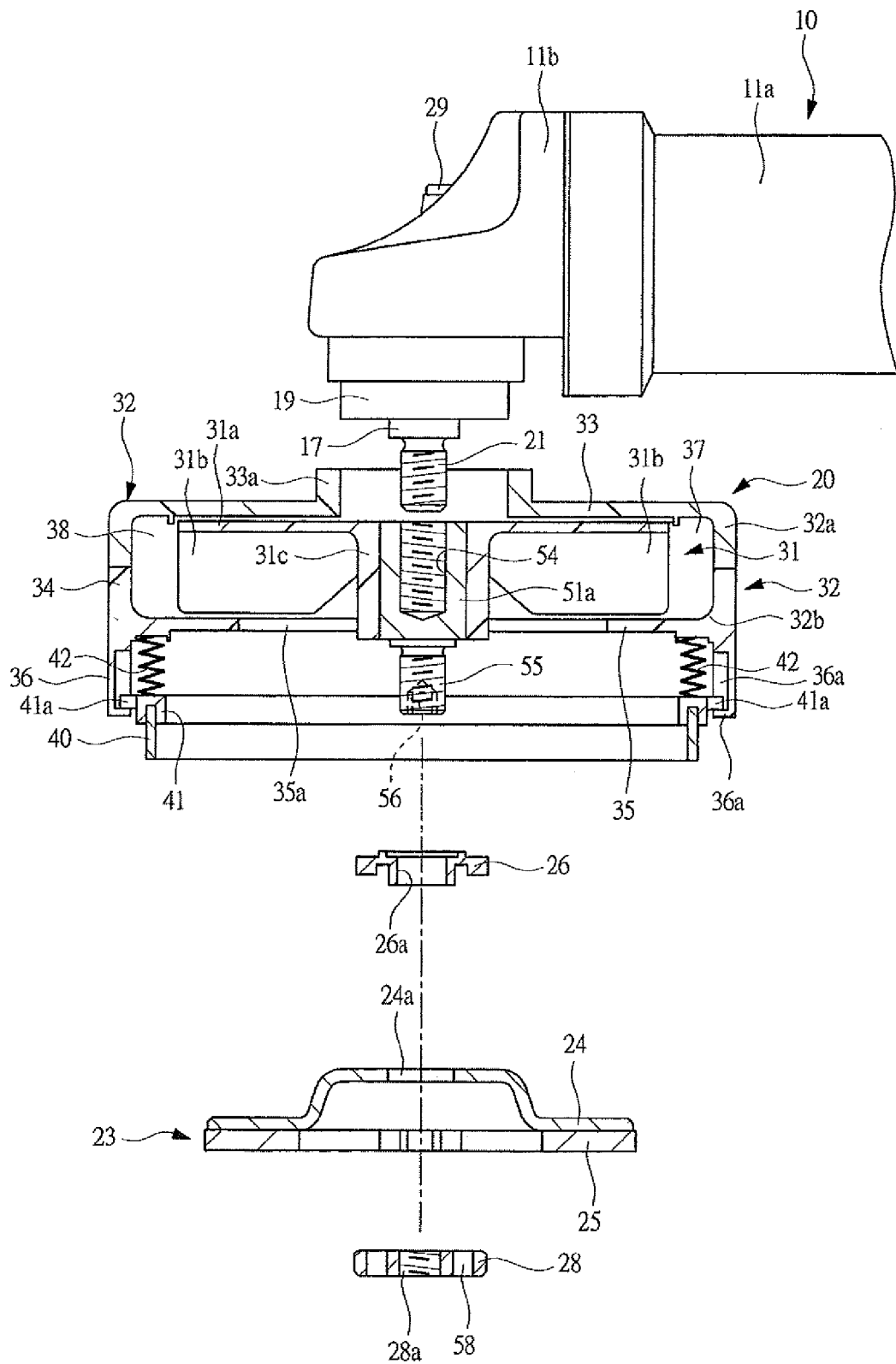


FIG. 16

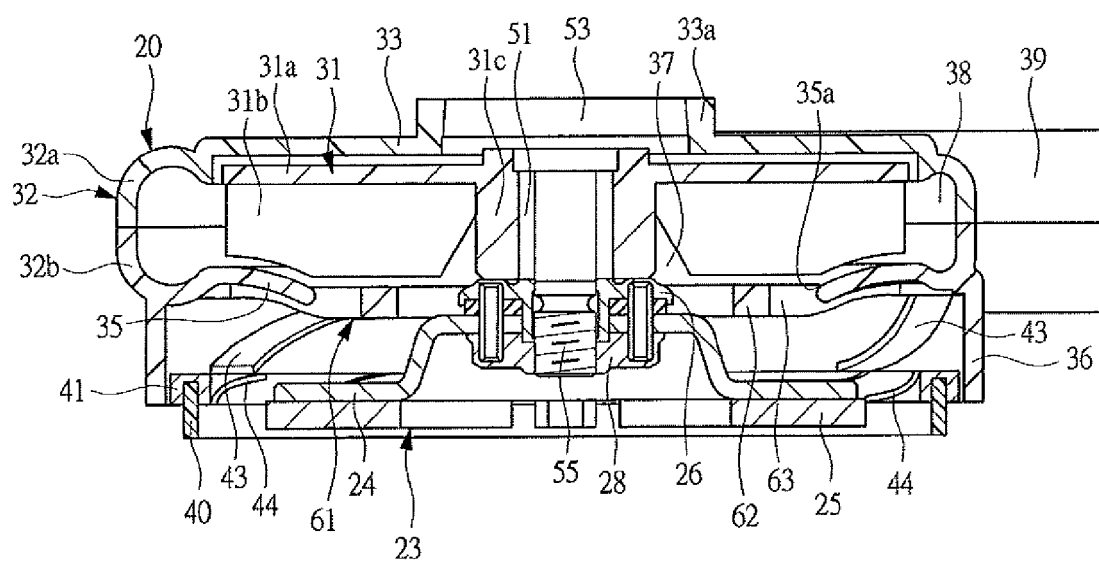


FIG. 17

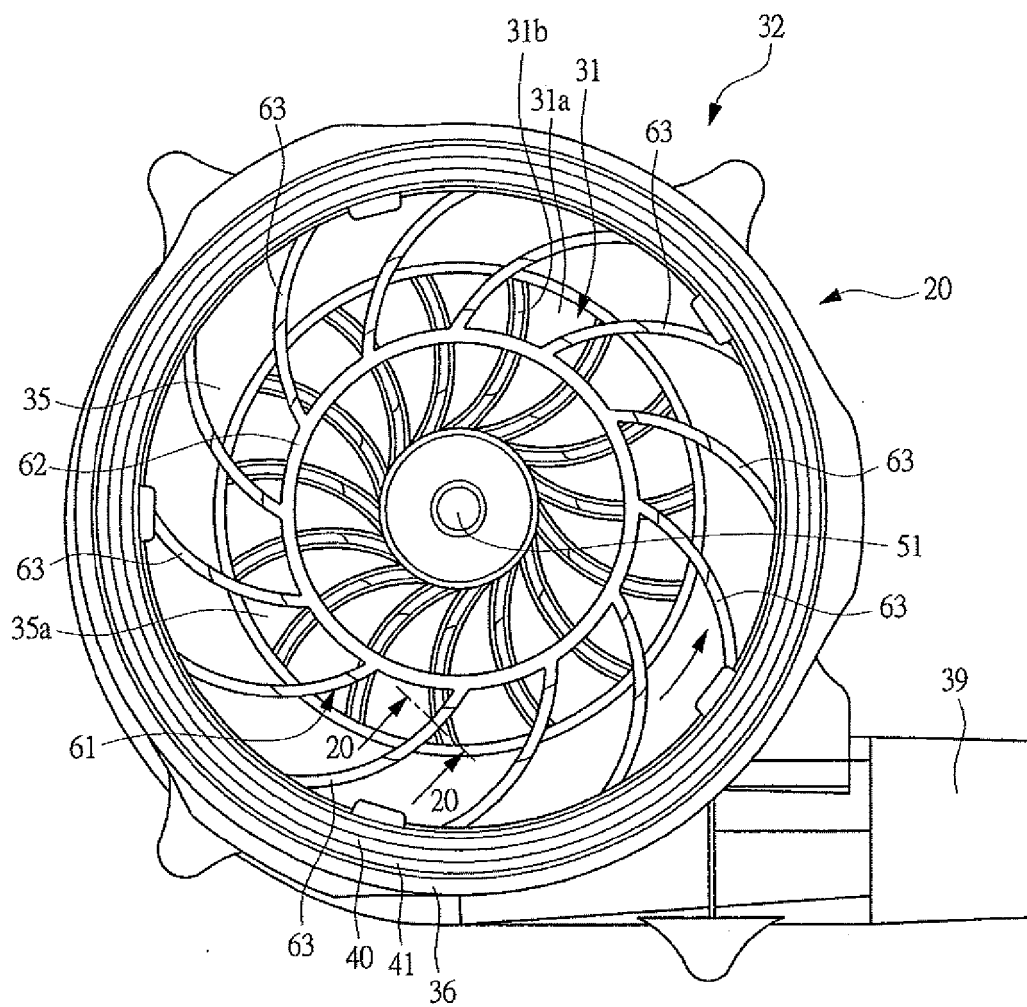


FIG. 18

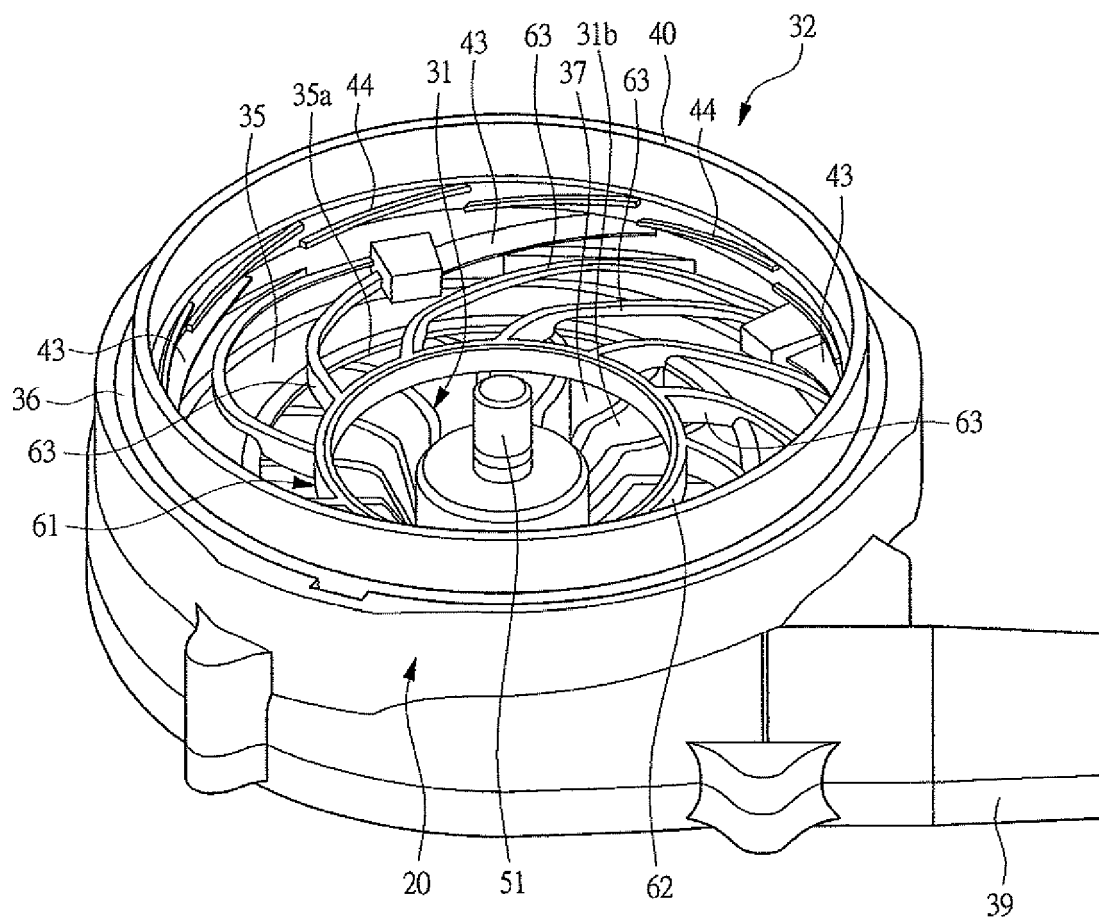


FIG. 19

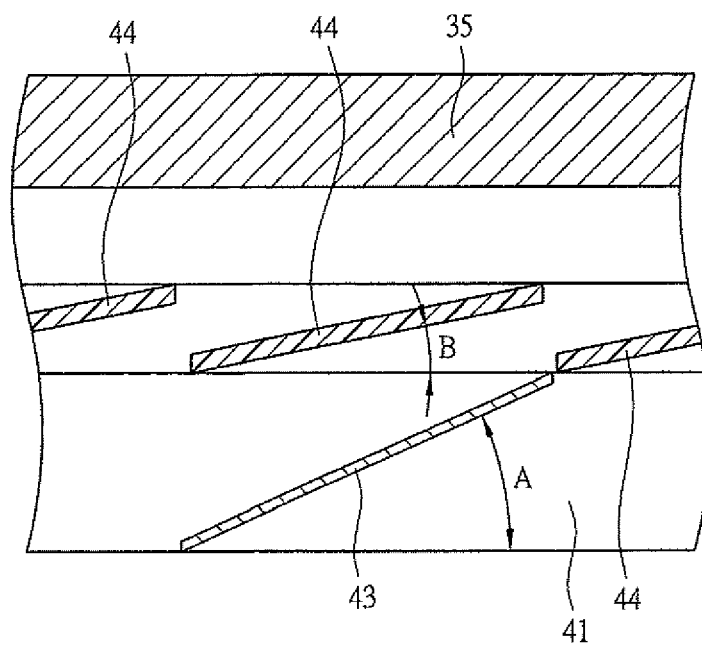


FIG. 20

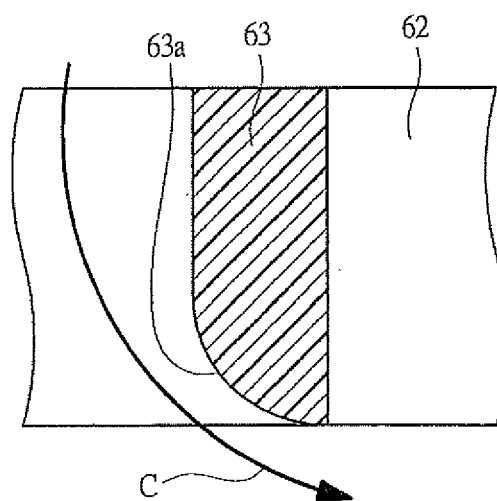


FIG. 21

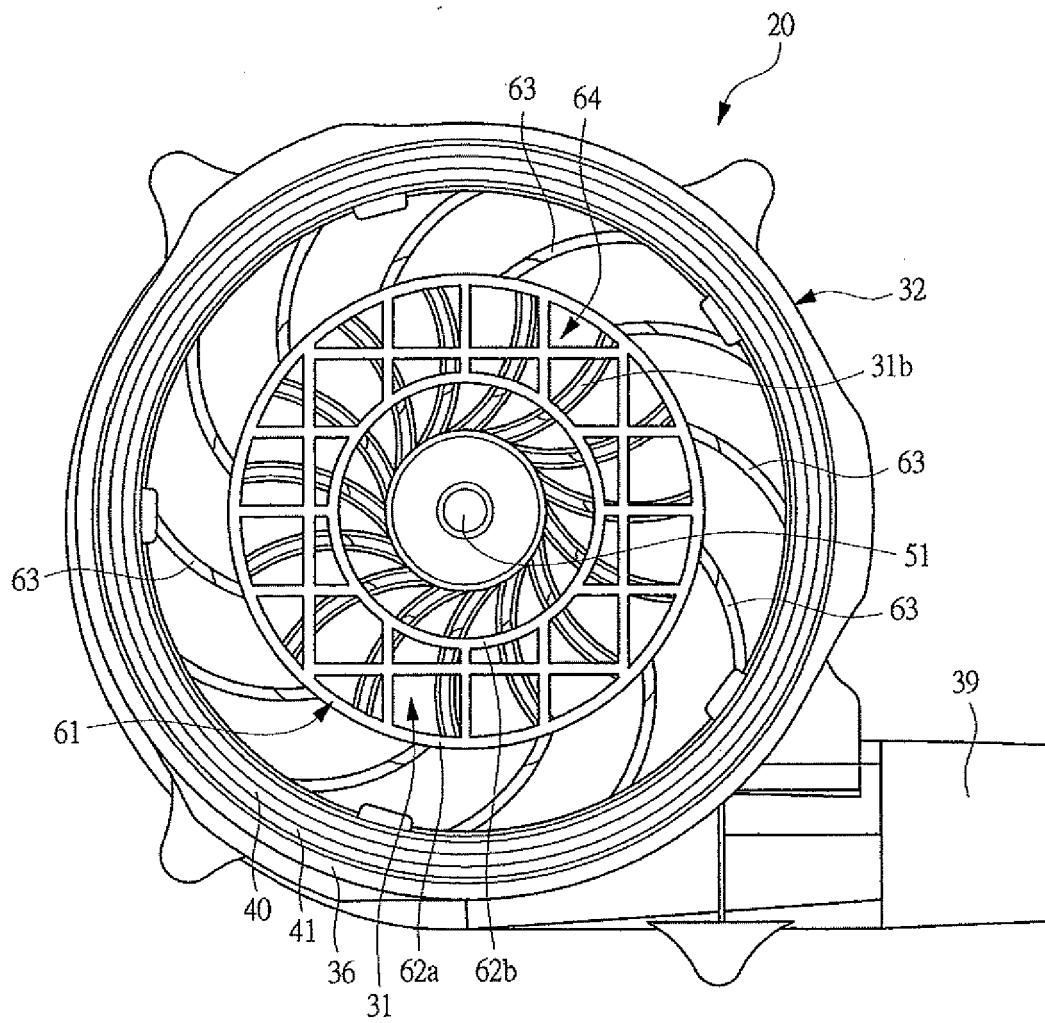


FIG. 22

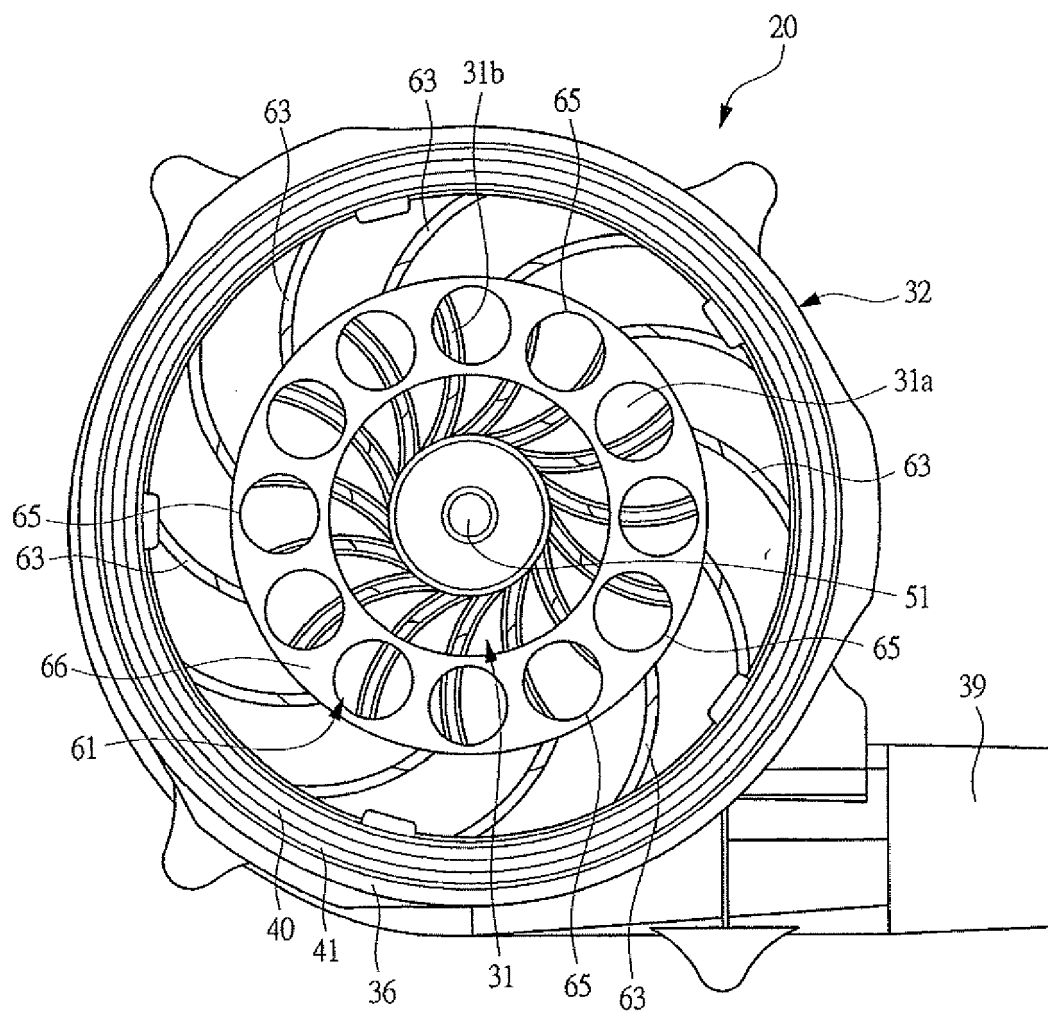


FIG. 23

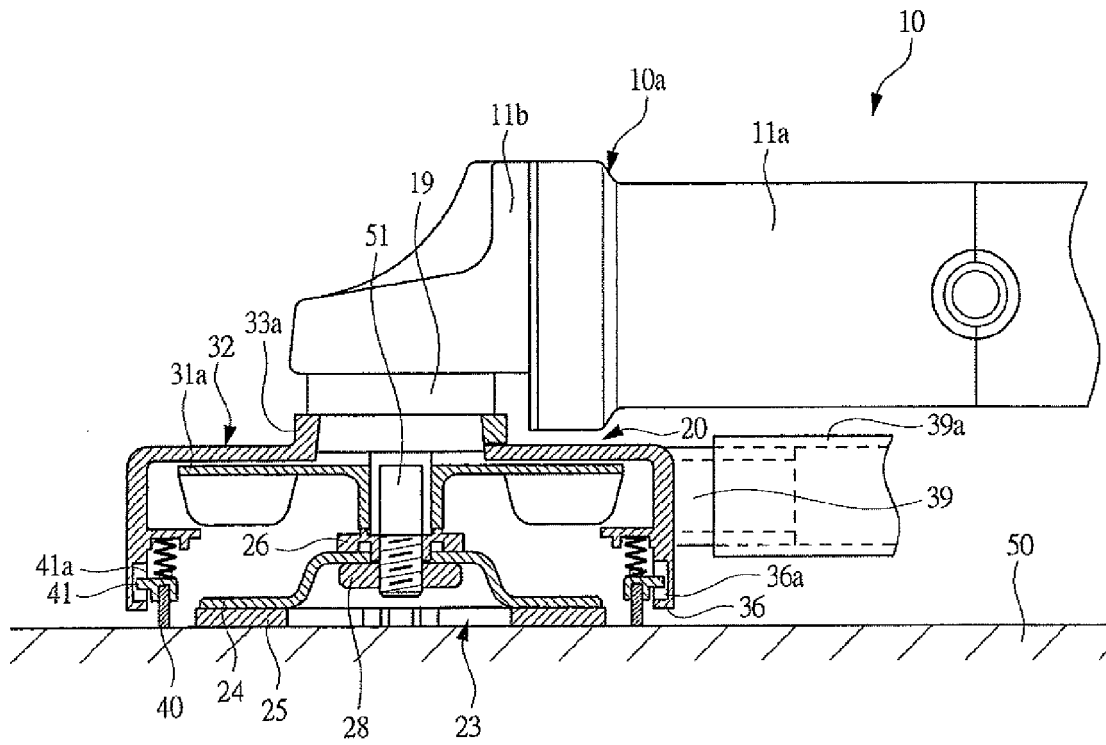


FIG. 24

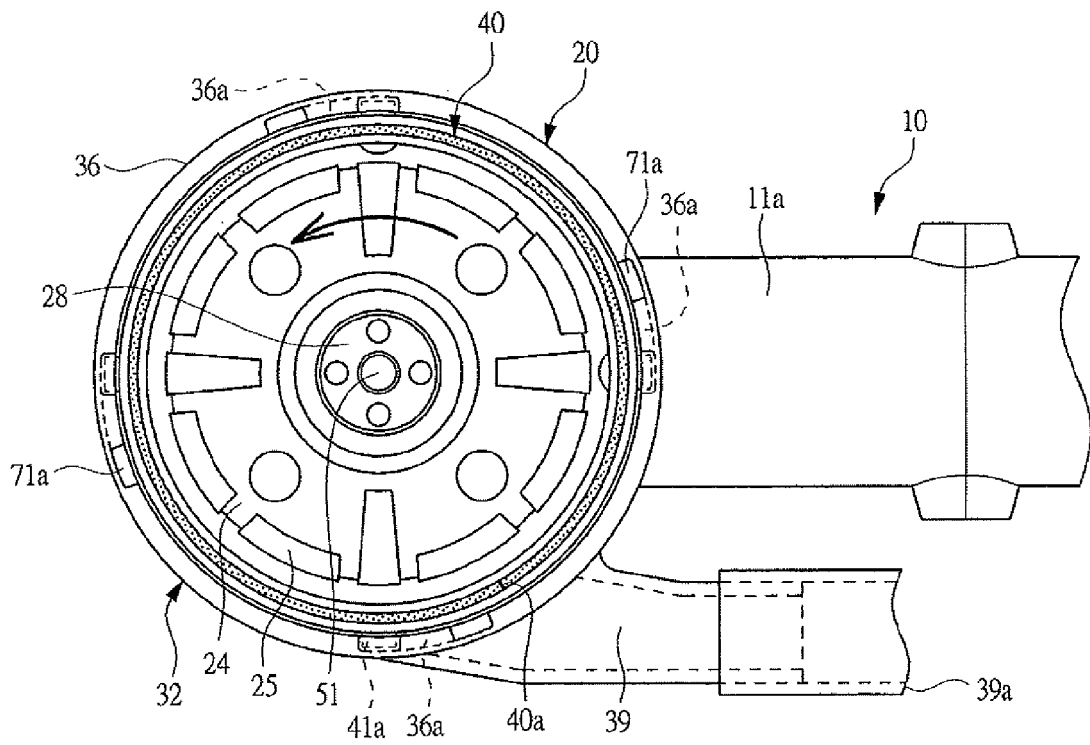


FIG. 25

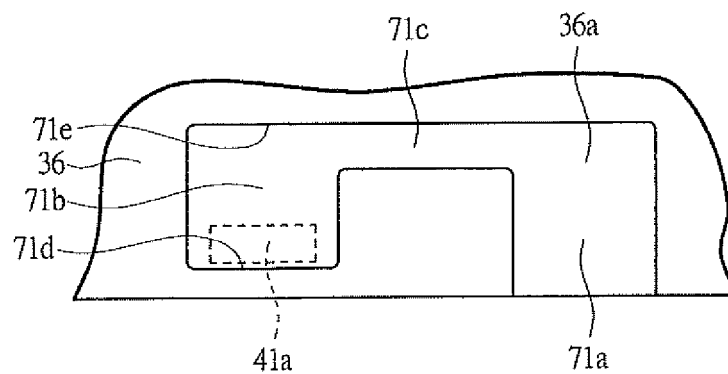


FIG. 26

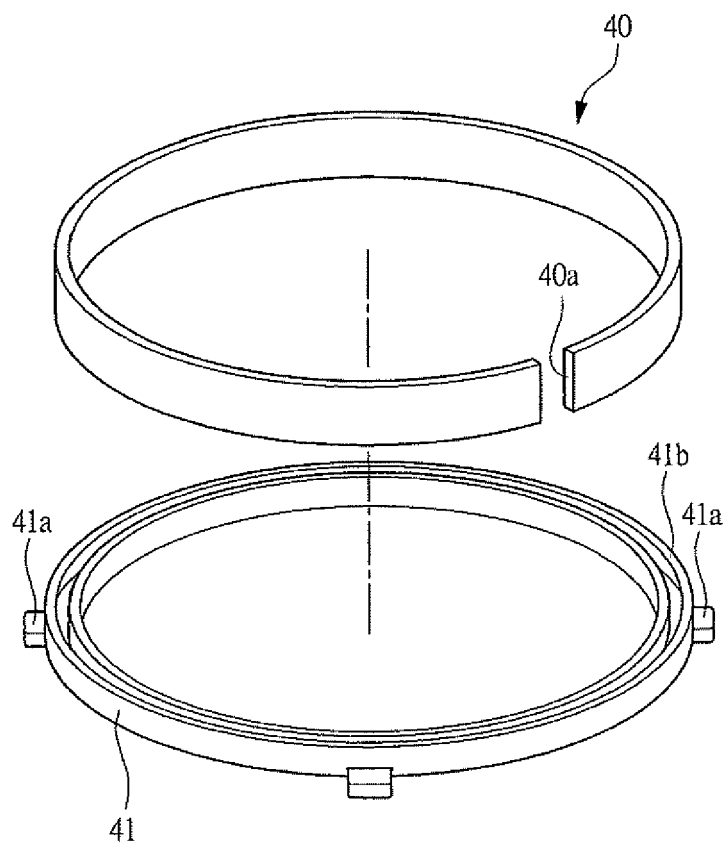


FIG. 27

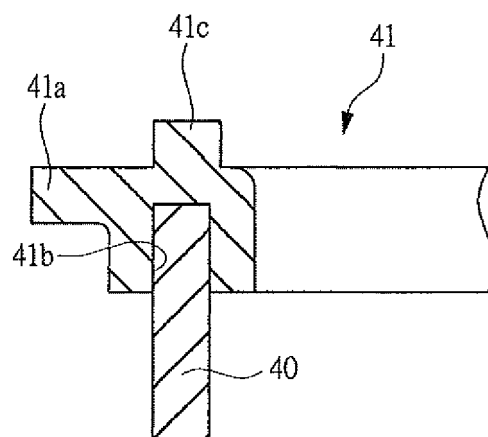


FIG. 28A

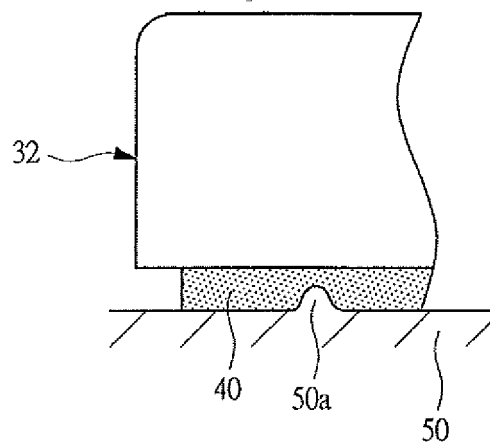


FIG. 28B

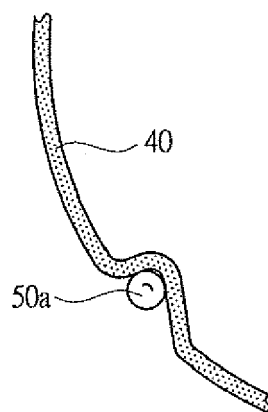


FIG. 29A

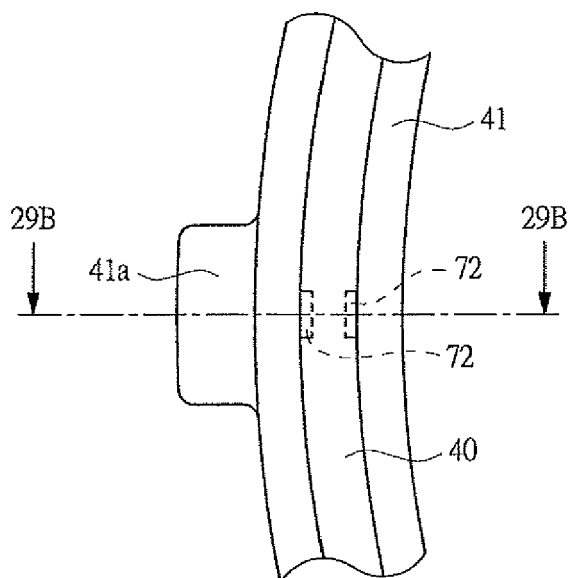


FIG. 29B

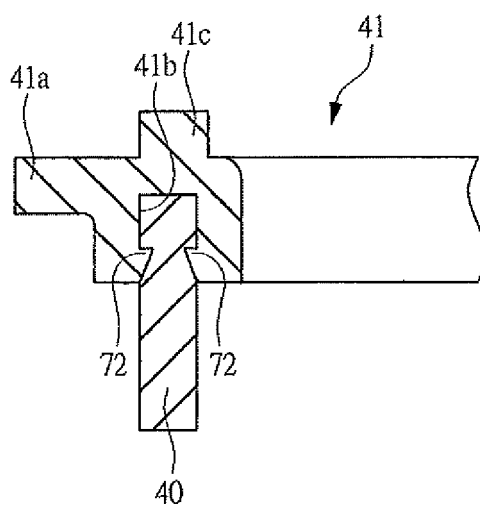


FIG. 30A

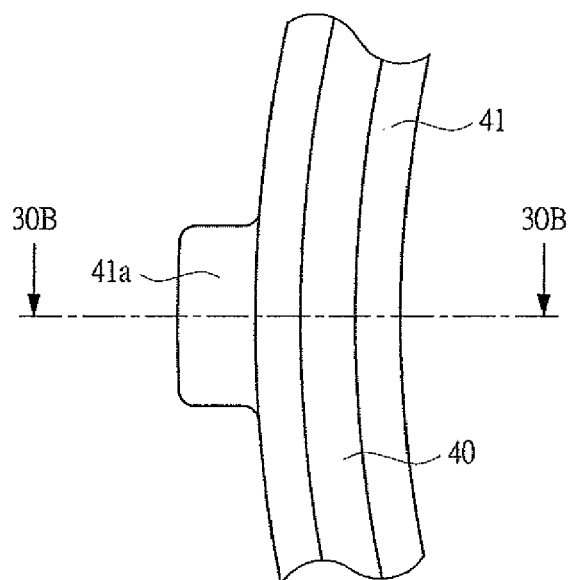


FIG. 30B

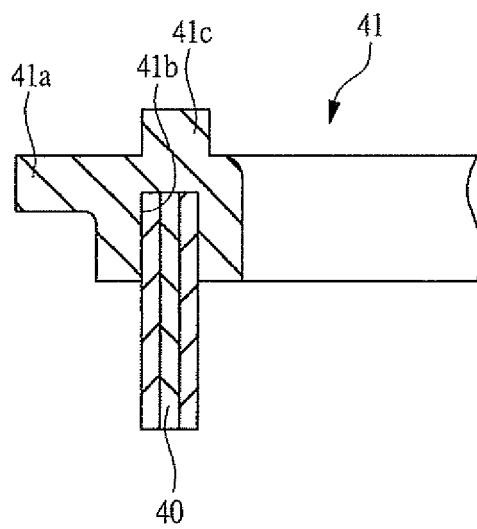


FIG. 31

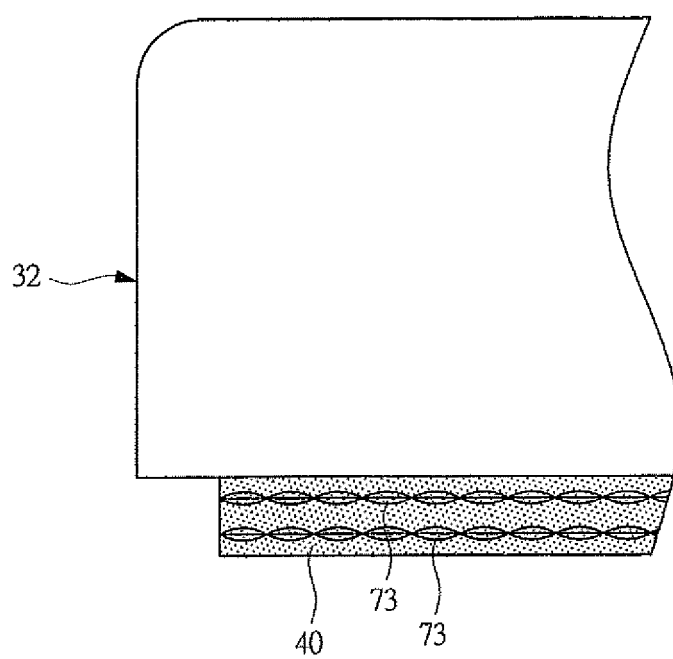


FIG. 32

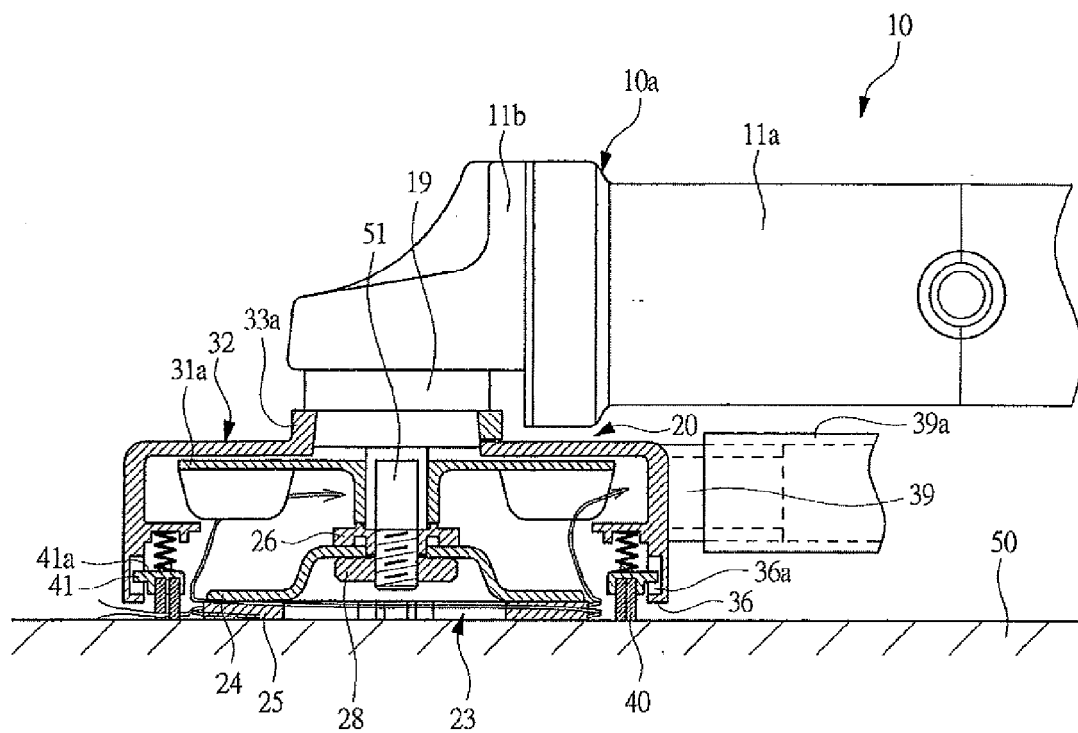


FIG. 33

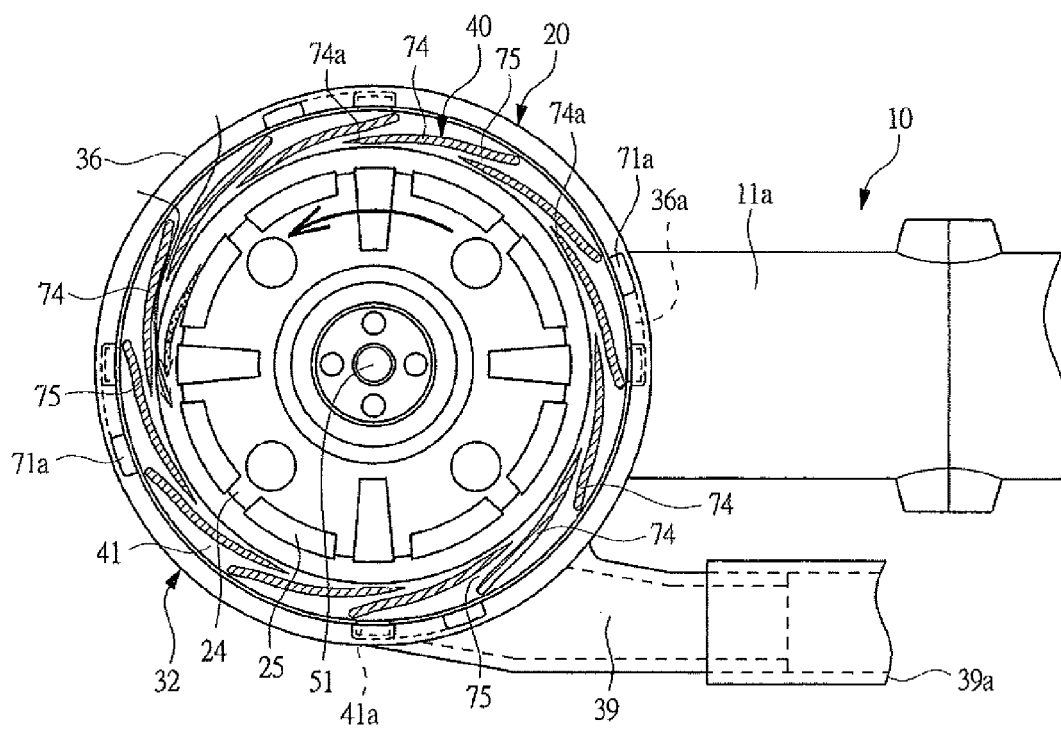


FIG. 34

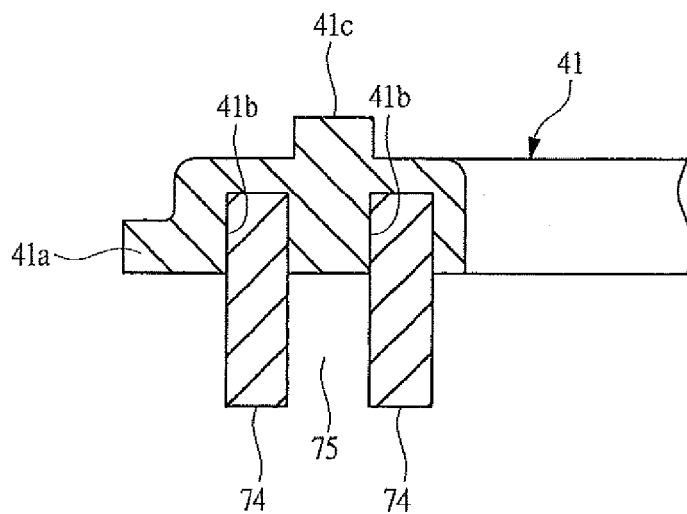


FIG. 35

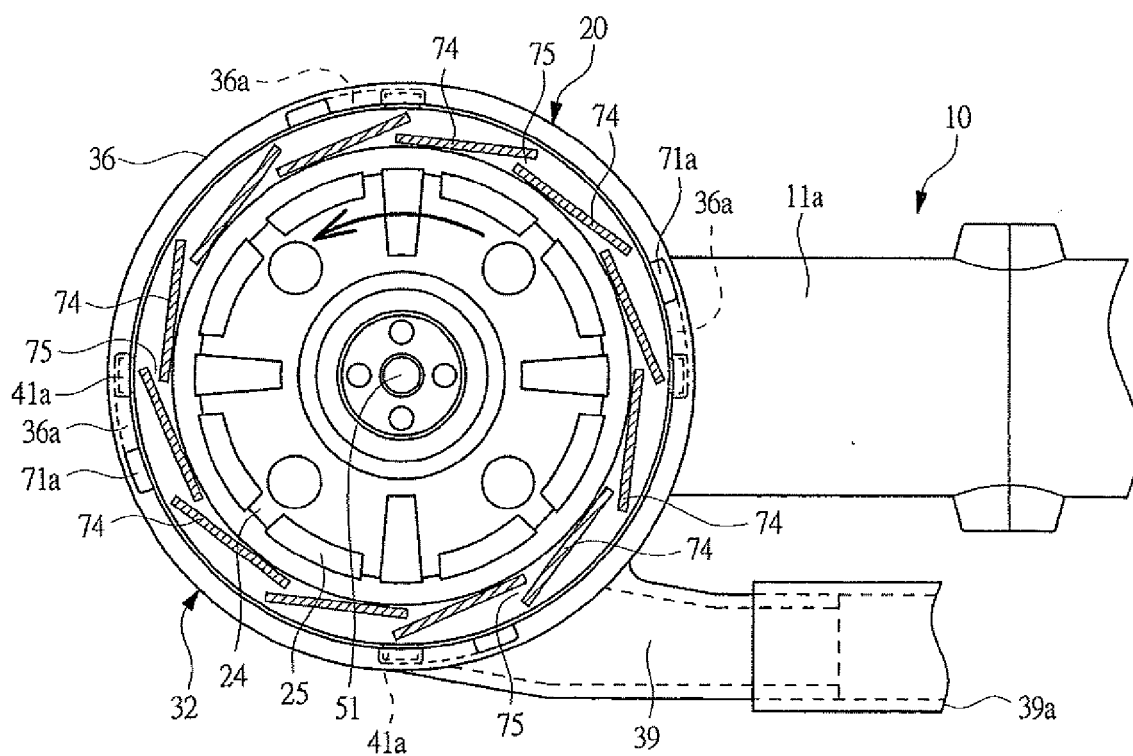


FIG. 36

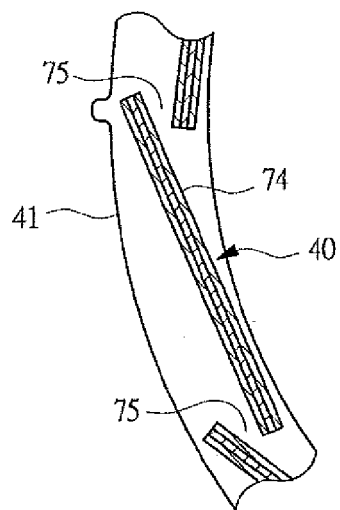
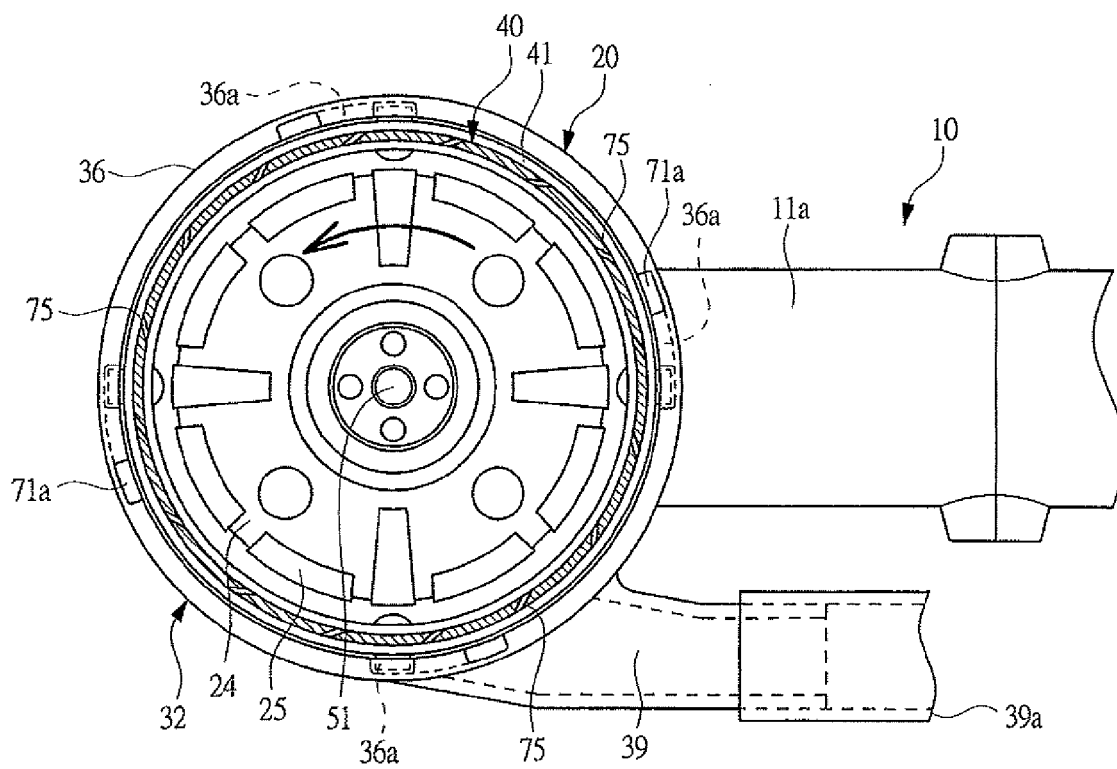


FIG. 37





EUROPEAN SEARCH REPORT

Application Number
EP 12 15 1597

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 A	US 5 419 737 A (BRAZELL KENNETH M [US] ET AL) 30 May 1995 (1995-05-30) * column 3, line 2 - column 4, line 13; figure 3 *	1-7,14, 15 8-13	INV. B24B55/10
A	----- US 4 930 264 A (HUANG KAN-CHI [TW]) 5 June 1990 (1990-06-05) * the whole document *	1-15	
A	----- US 2001/023168 A1 (WUENSCH STEFFEN [DE] ET AL) 20 September 2001 (2001-09-20) * paragraph [0016] - paragraph [0019]; figure 1 *	1-15	
A	----- FR 2 872 076 A1 (M B H DEV SARL [FR]) 30 December 2005 (2005-12-30) * figure 1 *	1-15	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B24B
Place of search		Date of completion of the search	Examiner
Munich		15 May 2012	Watson, Stephanie
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1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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15-05-2012

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

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- JP S55103143 B [0003]
- JP 2009023005 A [0003]