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(54) **DEVICE FOR PROCESSING A WORKPIECE**

(57) The present invention relates to a device(1) for processing a workpiece, comprising a housing (2), a drive arranged in the housing for driving a drive shaft (4) relative to the housing, a first coupling part (6) connected directly or indirectly to the drive shaft and provided with a toothing (8), and a first workpiece processing part (109 which is provided with a second coupling part (12) connectable in engaging manner to the first coupling part (6), and wherein the second coupling part (12) is provided for this purpose with a toothing (14) co-acting with the toothing (8) of the first coupling part (6), wherein the toothing (89 of the first coupling part (6) and the toothing (14) of the second coupling part (12) are mutually engageable crown gears, and wherein the device further comprises first clamping means (16) which are configured to clamp the crown gears (8, 14) of the first and the second coupling part (6, 12) in engaging contact against each other and to thus form a self-centering clearance-free coupling.

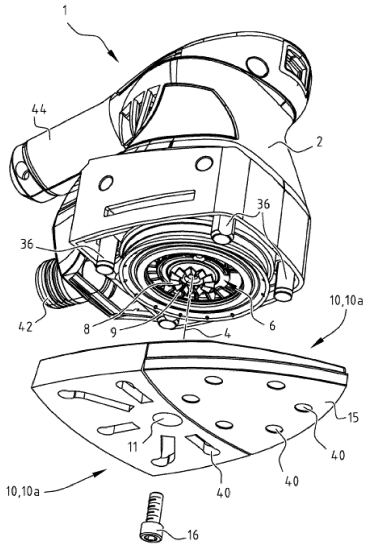

FIG.1

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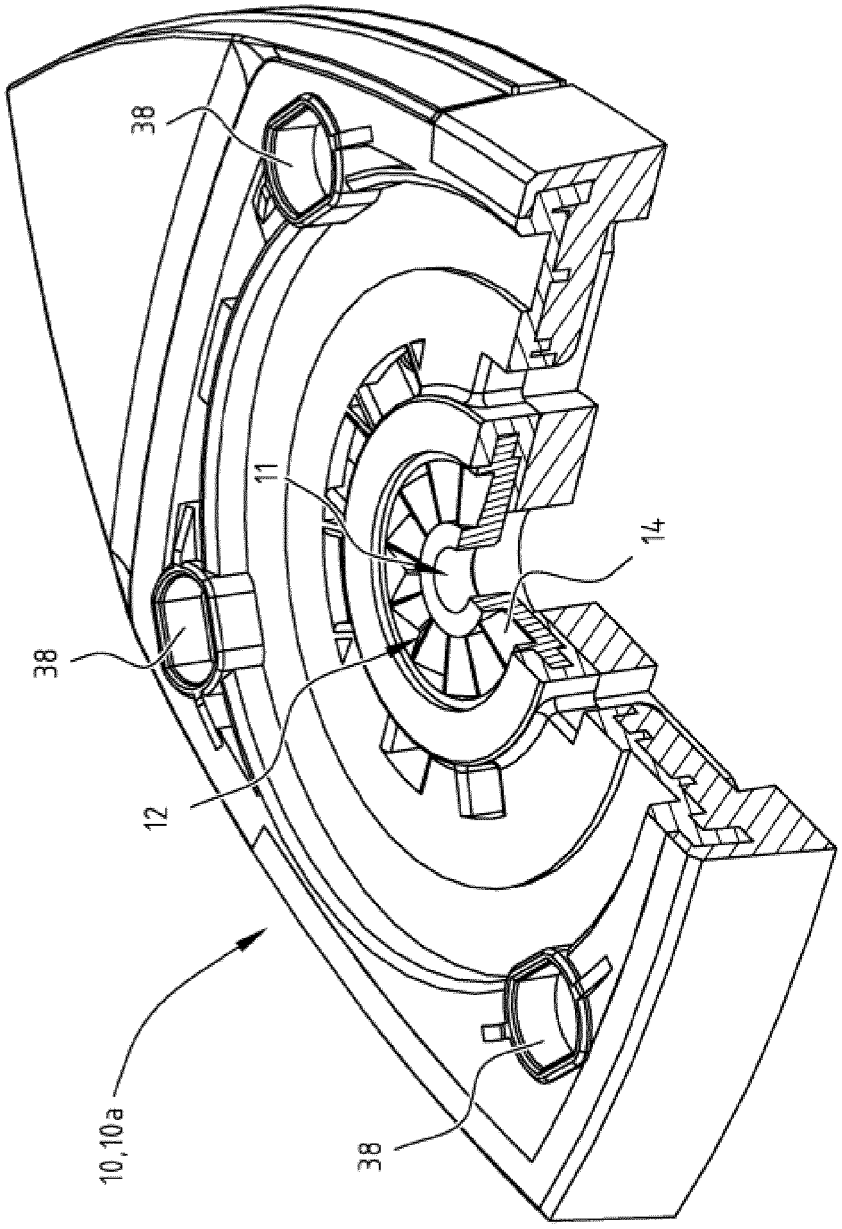

FIG.2

Description

[0001] The invention relates to a device for processing a workpiece.

[0002] Known devices for processing a workpiece to which the invention relates are for instance sanding machines and so-called multi-tools.

[0003] In processing devices the coupling between a drive shaft driven by a drive and a workpiece processing part can be embodied as a pin-hole connection.

[0004] A technically obvious solution is to then arrange the pins on the machine side, which can however result in hazardous situations if the machine is driven without a workpiece processing part being coupled thereto. The rotating pins can then cause serious injury.

[0005] In addition, some clearance between the pins and the holes of the pin-hole connection will be required for the purpose of making the coupling wherein the holes are inserted into the pins. Certainly in the case of oscillating movements such as made by a multi-tool, use will be made of this clearance in each movement cycle. Use of the processing device will therefore result in an increase in the clearance.

[0006] Even with sufficient clearance between the pins and the holes it requires some effort on the part of a user to connect all pins and holes. Positioning with an exact alignment is usually awkward and an undesirable use of time. This positioning process is made even more difficult when a sanding machine has flexible connecting legs which pre-align, and thereby bias to some extent, the connection between the processing machine and the workpiece processing part. Such flexible connecting legs ensure that the workpiece processing part makes small circular movements within a limited range.

[0007] An object of the present invention is to provide a device for processing a workpiece wherein the stated drawbacks do not occur, or at least do so to lesser extent.

[0008] Said object is achieved with the device for processing a workpiece according to the invention, the device comprising:

a housing;

a drive arranged in the housing for driving a drive shaft relative to the housing;

a first coupling part connected directly or indirectly to the drive shaft and provided with a toothing;

a first workpiece processing part which is provided with a second coupling part connectable in engaging manner to the first coupling part, and wherein the second coupling part is provided for this purpose with a toothing co-acting with the toothing of the first coupling part;

wherein the toothing of the first coupling part and the toothing of the second coupling part are mutually engageable crown gears; and

wherein the device further comprises first clamping means which are configured to clamp the crown gears of the first and the second coupling part in engaging contact against each other and to thus form a self-centering clearance-free coupling.

[0009] In contrast with a pin-hole connection, the first coupling part and the second coupling part are both provided with a toothing. These toothings of the two coupling parts co-act with each other in order to realize a coupling between the two coupling parts.

[0010] It is noted that a direct connection to the drive also comprises embodiments with an intermediate connection mounted between the drive motor and drive shaft, for instance via an eccentric.

[0011] The first coupling part can be connected directly as well as indirectly to the drive shaft. In the case of a direct connection the coupling part is connected directly to the drive shaft. A connection is indirect when a conventional connection is for instance applied between the drive shaft and a base plate, wherein a first coupling part provided with a toothing is arranged on the base plate. In the indirect embodiment with a toothing according to the invention the workpiece processing part is coupled to a part driven by the drive, and not directly to the drive itself.

[0012] A crown gear, also referred to as crown gearwheel, or simply crown wheel, has a disc-like surface provided with a toothing. The tooth shape is preferably helical, whereby the toothing is narrower on the inner side than on the outer side. Although crown gears are generally used to generate a pulsating movement, for instance in a hammer drill, according to the invention crown gears are clamped against each other and applied to transmit a rotating movement between parallel shafts. A self-centering and clearance-free coupling is in this way provided.

[0013] Such a self-centering, clearance-free coupling can also be obtained with a crown gear consisting of a surface provided with a toothing, wherein the toothing is not helical but wherein teeth lie at an angle. Self-centering is provided by the angle between the teeth.

[0014] If desired, the angles between the teeth can vary in order to impose a specific coupling position. If on the other hand the teeth are distributed at equal angles, multiple coupling positions are then possible.

[0015] The clamping means ensure that the crown gears of both coupling parts are clamped against each other, whereby an engaging contact is brought about between the co-acting crown gears.

[0016] In clamped state two crown gears connectable in clamping manner in such a way have a large contact surface over which forces can be transmitted.

[0017] When two co-acting crown gears are placed in contact with each other, there moreover occurs a self-positioning alignment. The positioning process is hereby

considerably simplified, particularly when the connection between processing machine (sanding machine) and workpiece processing part (for instance a sanding plate or sanding foot) is provided with flexible connecting legs which bias the coupling between the two parts to some extent.

[0018] A crown gear - in contrast with the pin side of a pin-hole connection - further has a gradually upward and downward sloping form. The risk of a user being injured by an unguarded rotating crown gear is hereby many times smaller than the risk of a pin connection resulting in injury.

[0019] According to a further preferred embodiment, the first workpiece processing part is provided with a third coupling part with a toothing, and an attachment workpiece processing part is connectable in engaging manner to the first workpiece processing part, wherein the workpiece processing part is provided for this purpose with a fourth coupling part with a toothing which co-acts with the toothing of the third coupling part.

[0020] The first workpiece processing part, which is itself provided with a second coupling part with which it is connectable in engaging manner to a first coupling part connected directly and/or indirectly to the drive shaft, is provided according to this further embodiment with a third coupling part to which an attachment workpiece processing part is connectable. Because different types of attachment workpiece processing parts are connectable to the workpiece processing part, such as a finger-like accessory or a contour-following accessory, the applicability of a workpiece processing device is considerably increased. Using a (crown) gear according to the invention such an attachment workpiece processing part can moreover be positioned in different positions, this further increasing flexibility.

[0021] According to yet another preferred embodiment, the toothing of the third coupling part and the toothing of the fourth coupling part are mutually engageable crown gears, and the device further comprises second clamping means configured to clamp the crown gears of the third and the fourth coupling part in engaging contact against each other.

[0022] The coupling according to the invention, wherein co-acting toothings are applied between two coupling parts, can thus be applied on the one hand for connection between a first coupling part, which is connected directly or indirectly to a drive shaft, and a workpiece processing part. Such a coupling can on the other hand be applied between a workpiece processing part and a further attachment workpiece processing part.

[0023] Although it is recommended to apply a connection according to the invention for the coupling between the drive shaft and the first workpiece processing part, it is also possible to envisage a conventional connection being applied for this purpose. It is noted for the sake of completeness that the third and fourth coupling part described in the application in that case function as first and second coupling part. The second clamping means then function as first clamping means.

[0024] According to yet another preferred embodiment, the clamping means configured to clamp the crown gears in engaging manner against each other are a bayonet connection, screw connection, snap connection or swivel connection.

[0025] According to yet another preferred embodiment, the number of teeth of the toothing of the first coupling part connected directly and/or indirectly to the drive shaft and the number of teeth of the toothing of the third coupling part of the first workpiece processing part differ such that they have one or more common whole numbers as divisor and one or more common differingwhole numbers as divisor.

[0026] A partial incompatibility is intentionally created in that there are one or more common whole numbers (or integers) as divisor and one or more common differing whole numbers (or integers) as divisor.

[0027] When according to a first example the first coupling part has 16 teeth and the third coupling part arranged on the workpiece processing part is provided with 12 teeth, the following situation results:

(attachment) workpiece processing parts with a coupling part having 16 or 8 teeth can only be coupled to the first coupling part;

(attachment) workpiece processing parts with a coupling part having 12, 6 or 3 teeth can only be coupled to the third coupling part; and

(attachment) workpiece processing parts with 4 or 2 teeth can be coupled to both the first coupling part and the third coupling part.

[0028] When according to a second example the first coupling part has 20 teeth and the third coupling part arranged on the workpiece processing part is provided with 15 teeth, the following situation results:

(attachment) workpiece processing parts with a coupling part having 20, 10, 4 or 2 teeth can only be coupled to the first coupling part;

(attachment) workpiece processing parts with a coupling part having 15 or 3 teeth can only be coupled to the third coupling part; and

(attachment) workpiece processing parts with 5 teeth can be coupled to both the first coupling part and the third coupling part.

[0029] According to yet another preferred embodiment, the device further comprises an adapter part which is arrangeable between two coupling parts and provided on both sides with a crown gear. Such an adapter part can for instance function as spacer.

[0030] According to yet another preferred embodi-

ment, the teeth of the crown gear on both sides of the adapter part are offset relative to each other. In addition to the function as spacer, the adapter part in this embodiment also provides the option of coupling (attachment) workpiece processing parts in a greater number of orientations.

[0031] According to yet another preferred embodiment, the crown gears on both sides of the adapter part comprise a differing number of teeth. A whole or partial incompatibility can hereby be brought about or eliminated.

[0032] According to yet another preferred embodiment, the device comprises at least two exchangeable attachment workpiece processing parts, wherein at least one is embodied in a first embodiment and at least one is embodied in a second embodiment, wherein the orientation in which the crown gear of the fourth coupling part is arranged on the attachment workpiece processing part in the first embodiment differs from the orientation in which the crown gear of the fourth coupling part is arranged on the attachment workpiece processing part in the second embodiment. Because the orientation of the crown gears differs, the different embodiments of the attachment workpiece processing parts are each suitable for their own selection of orientations.

[0033] According to yet another preferred embodiment, the toothing of the first coupling part and the toothing of the second coupling part together form a toothed shaft connection. A toothed shaft connection is suitable for applications in which an at least partial axial displacement of the coupling is desired. Because clearance is required in order to bring about the connection of a toothed shaft connection, such connections are less suitable for use on a processing device with oscillating movements.

[0034] According to yet another preferred embodiment, the toothed shaft connection comprises a tapering form such that there is an end position wherein the toothings fit substantially close together. The toothed shaft connection in this way has a form-fitting end position which makes this connection suitable for oscillating applications.

[0035] According to yet another preferred embodiment, the processing device is a sanding machine, and the drive shaft is rotatable relative to the housing by the drive.

[0036] According to yet another preferred embodiment, the processing device is a multi-tool, and the drive shaft is rotatable reciprocally through an angular displacement relative to the housing by the drive.

[0037] The invention further relates to an adapter part configured to be arranged between two coupling parts of a device as described in the foregoing.

[0038] The invention further relates to a workpiece processing part or attachment workpiece processing part with a coupling part provided with a toothing and configured for coupling to a device for processing a workpiece as described in the foregoing.

[0039] Preferred embodiments of the present invention are further elucidated in the following description with reference to the drawing, in which:

Figure 1 is a perspective bottom view of a workpiece processing device according to the invention with a workpiece processing part of a first type;

Figure 2 is a perspective top view of the workpiece processing part of the first type shown in figure 1;

Figure 3 is a perspective bottom view of a workpiece processing device with a workpiece processing part of a second type;

Figure 4 is a perspective top view of the workpiece processing part of the second type shown in figure 3;

Figure 5 is a perspective bottom view of a workpiece processing device with an attachment workpiece processing part of a first type;

Figure 6 is a perspective top view of the workpiece processing part shown in figure 5 with two variants of an attachment workpiece processing part of the first type;

Figure 7 is a perspective top view of an operative mode of the workpiece processing device shown in figure 5;

Figure 8 is a perspective bottom view of a workpiece processing device with a workpiece processing part of a fourth type and an attachment workpiece processing part of a second type;

Figure 9 is a perspective top view of the workpiece processing part and the attachment workpiece processing part of the second type as shown in figure 8;

Figure 10 is a perspective view of an adapter part of a first type;

Figure 11 is a perspective view of an adapter part of a second type;

Figure 12 is a perspective view of a compatible coupling between a crown gear with 16 teeth (above) and a crown gear with 8 teeth (below);

Figure 13 is a perspective view of an incompatible coupling between a crown gear with 12 teeth (above) and a crown gear with 8 teeth (below);

Figure 14 is a perspective view of a compatible coupling between a crown gear with 16 teeth (above) and a crown gear with 4 teeth (below); and

Figure 15 is a perspective view of a compatible coupling between a crown gear with 12 teeth (above) and a crown gear with 4 teeth (below).

[0040] The workpiece processing device 1 shown in figure 1 comprises a housing 2 and a drive (not shown) therein for driving a drive shaft 4 relative to this housing 2. In the embodiment shown in figure 1 a first coupling part 6 provided with a toothing 8 is connected directly to drive shaft 4.

[0041] Housing 2 of device 1 further comprises a handgrip 44 and a suction conduit 42.

[0042] Further shown is a first workpiece processing part 10 of a first type 10a which is a so-called multi-foot provided with suction openings 40 through which abraded material can be suctioned away and extracted from device 1 via suction conduit 42.

[0043] The first workpiece processing part 10 of the first type 10a further comprises an opening 11 through which this workpiece processing part 10a is can be engaged with a bolt 16 in a recess 9 provided with screw thread in the first coupling part 6.

[0044] Arranged on housing 2 of device 1 are connecting legs 36 which can be received in receiving spaces 38 of the first workpiece processing part 10, 10a of the first type shown in figure 1. These receiving spaces 38 for connecting legs 36 are shown in the partly cut-away perspective top view of figure 2.

[0045] A second coupling part 12 with a toothing 14 is arranged in first workpiece processing part 10. This second coupling part 12 is provided with the opening 11 through which bolt 16 can connect to the recess 9 provided with screw thread in the first coupling part 6 mounted on drive shaft 4 of device 1.

[0046] Figures 3 and 4 show device 1 according to the invention with a first workpiece processing part 10 of a second type 10b, which is a rotating sanding plate. Such a rotating sanding plate is also referred to as a random orbit sander (ROS). So that the first workpiece processing part 10 of the second type 10b can rotate freely, it is provided with a channel-like recess 13 arranged in peripheral direction in which the connecting legs 36 can hang freely without being engaged by a rotating ROS workpiece processing part.

[0047] A second coupling part 12 with a toothing 14 is also arranged in this first workpiece processing part 10 of the second type 10b.

[0048] By inserting a bolt 16 through the opening 11 arranged in second coupling part 12 the second coupling part 12 can be clamped against the first coupling part 6 connected to drive shaft 4 of device 1.

[0049] Device 1 shown in figures 5-7 comprises a first workpiece processing part 10 of a third type 10c which resembles the multi-foot shown in figure 1. At the position of the sanding foot tip part 15 shown in figure 1 the first workpiece processing part 10 of the third type 10c comprises a third coupling part 18 with a crown gear 20. Using second clamping means 28 in the form of a shaft provided with screw thread and with a rotary knob, an attachment workpiece processing part 22 can be coupled to the first workpiece processing part 10 of the third type 10c.

[0050] In the top view shown in figure 6 the attachment workpiece processing part 22 of the first type 22a is shown in two variants 22a-1 and 22a-2. Both these variants 22a-1 and 22a-2 differ from each other in that the crown gear 26 of the fourth coupling part 24 arranged thereon has a slightly different orientation. Both variants 22a-1 and 22a-2 of the attachment workpiece processing part 22 of the first type 22a can hereby both be coupled in different orientations to the third coupling part 18. A possible orientation is shown in figure 7, wherein it is also noted that the first workpiece processing part 10 of the third type 10c is arranged at an angle of 90° on housing 1. In the shown embodiment the connecting legs 36 are arranged rotation-symmetrically such that they once again fall into a receiving space 38 for the connecting legs.

[0051] A further embodiment of device 1 is shown in figures 8 and 9, wherein a first workpiece processing part 10 of a fourth type 10d is applied. This first workpiece processing part 10 of the fourth type 10d is likewise provided with a third coupling part 18 with a crown gear 20.

[0052] Applied in the shown embodiment is the attachment workpiece processing part 22 of a second type 22b which is once again provided with a fourth coupling part 24 with a crown gear 26.

[0053] An adapter part 30 can be provided in order to create some distance between two coupling parts, for instance third coupling part 18 and fourth coupling part 24. By embodying this adapter part 30 as a first type 30a with offset crown gears the adapter part provides the option of coupling the attachment workpiece processing part in a greater number of orientations than the initial number of teeth already makes possible (figure 10).

[0054] According to an alternative embodiment thereof, adapter part 30 is embodied as a second type 30b with a different number of teeth (figure 11).

[0055] It is noted that, in order to obtain compatibility between different numbers of teeth, the tooth shape is preferably adapted in order to retain the greatest possible contact surface between the tooth flanks.

[0056] When the largest number of teeth present in the applied coupling parts 6, 12, 18, 24 is for instance sixteen, the tooth shape of a tooth of any of these sixteen teeth can then be taken as basis.

[0057] In order to obtain a crown gear with a small number of teeth, for instance twelve teeth, which still guarantees the greatest possible contact surface, the same angle of inclination for the tooth flanks is chosen as for the tooth shape of the crown gear with the sixteen teeth which serves as basis.

[0058] The twelve teeth are distributed proportionally over the 360° periphery, wherein the tooth top is formed proportionally as a flattened tooth shape. As shown in figures 11, 13 and 15, the crown gear with twelve teeth hereby has a tooth shape which is flattened to some ex-

tent.

[0059] Referring to figures 12-15, further elucidation will be made as to how partial compatibility and partial incompatibility between different coupling parts are obtained according to the invention.

[0060] The basis for the partial compatibility and partial incompatibility between different coupling parts is that the number of teeth of these different coupling parts differs such that they have one or more common whole numbers as divisor and one or more common differing whole numbers as divisor.

[0061] When the first coupling part 6 connected to the drive shaft has for instance sixteen teeth and the third coupling part 18 arranged on workpiece processing part 10 is provided with twelve teeth, the following situation results:

(attachment) workpiece processing parts 10, 22 with a coupling part having sixteen or eight teeth can only be coupled to first coupling part 6. See figure 12 for a compatible coupling between first coupling part 6 having a crown gear with sixteen teeth (above) and a second coupling part 12 with a crown gear with eight teeth (below);

(attachment) workpiece processing parts 10, 22 with a coupling part having twelve, six or three teeth can only be coupled to third coupling part 18. See figure 13 for an incompatible coupling between a third coupling part 18 having a crown gear with twelve teeth (above) and a second coupling part 12 having a crown gear with eight teeth (below); and

(attachment) workpiece processing parts 10, 22 with four or two teeth can be coupled to both first coupling part 6 and third coupling part 18. See figures 14 and 15 where a coupling between a crown gear of respectively sixteen teeth (first coupling part 6 in figure 14, above) and twelve teeth (third coupling part 18 in figure 15, above) can be coupled in compatible manner to a second coupling part 12 or fourth coupling part 24 with a crown gear having four teeth (figures 14 and 15, below).

[0062] The incompatible coupling shown in figure 13 prevents the possibility of an undesired coupling being made. It is thus impossible for instance to couple a finger-like attachment workpiece processing part of the first type 22a to first coupling part 6 of workpiece processing device 1. This coupling would cause the attachment workpiece processing part 22a to rotate in hazardous manner relative to housing 2 of workpiece processing device 1.

[0063] As elucidated above, a desired compatibility and incompatibility can be intentionally realized according to the invention between on the one hand the first coupling part 6 connected to the drive shaft and the third coupling part 18 arranged on a first workpiece processing part 10 and on the other hand, optionally connectable to coupling parts 6, 18, a second coupling part 12 of a first workpiece processing part 10 and fourth coupling part 24 of an attachment workpiece processing part 22.

[0064] Although they show preferred embodiments of the invention, the above described embodiments are intended solely to illustrate the present invention and not to limit the scope of the invention in any way. It is particularly noted that the skilled person can combine technical measures of the different embodiments.

[0065] Although the workpiece processing device shown in the figures is a sanding device, the invention is not limited thereto. The invention can also be applied to other workpiece processing devices such as so-called multi-tools or right-angle grinders.

[0066] The described rights are defined by the following claims, within the scope of which many modifications can be envisaged.

Claims

1. A sanding device (1), comprising:

a housing (2);
a drive shaft (4) configured to rotate relative to the housing (2),
characterized in that
the sanding device (1) further comprises:

a first coupling part (6) connected directly or indirectly to the drive shaft (4) and provided with a first crown gear (8);
a sanding plate (10) provided with a second coupling part (12) for matching with the first coupling part (6), wherein the second coupling part (12) is provided with a second crown gear (14) for facing and engaging with the first crown gear (8); and
first clamping means (16) configured to clamp the sanding plate (10) and the first coupling part (6);

wherein when the first clamping means (16) clamps the sanding plate (10) and the first coupling part (6), the second crown gear (14) and the first crown gear (8) engages against each other.

2. The sanding device of claim 1, wherein when the first clamping means (16) clamps the sanding plate (10) and the first coupling part (6), the second crown gear (14) and the first crown gear (8) form a self-centering clearance-free coupling.

3. The sanding device of claim 1, wherein the sanding device (1) further comprises connecting legs (36) arranged on the housing (2), and the sanding plate (10) is provided with receiving spaces (38, 13) for

receiving the connecting legs (36).

4. The sanding device of claim 1, wherein the sanding plate (10) is provided with an opening (11) through the second coupling part (12), and the first clamping means (16) comprise a bolt (16) passing through the opening (11) to mount the sanding plate (10) to the first coupling part (6).

5. The sanding device of claim 4, wherein the first coupling part (6) is provided with a recess (9) for receiving the bolt (16).

6. The sanding device of claim 2, wherein the tooth shape of the first crown gear (8) and the second crown gear (14) is helical.

7. The sanding device of claim 2, wherein teeth of the first crown gear (8) and the second crown gear (14) lie at an angle.

8. The sanding device of claim 1, wherein the sanding device (1) further comprises an adapter part (30) which is arranged between first crown gear (8) and second crown gear (14) and provided on both sides with a crown gear.

9. The sanding device of claim 8, wherein teeth of the crown gear on both sides of the adapter part (30) are offset relative to each other.

10. The sanding device of claim 8, wherein the crown gears on both sides of the adapter part (30) comprise a differing number of teeth.

11. The sanding device of claim 1, wherein the number of teeth of the first crown gear (8) and the number of teeth of the second crown gear (14) differ such that they have one or more common whole numbers as divisor.

12. The sanding device of claim 1, wherein the number of teeth of the first crown gear (8) is the same as the number of teeth of the second crown gear (14).

13. The sanding device of claim 1, wherein the sanding plate (10) is capable of being removed.

14. The sanding device of claim 1, wherein the sanding plate (10) is provided with a third coupling part (18) with a third crown gear (20), the sanding device (1) comprises an attachment workpiece (22) provided with a forth coupling part (24) with a forth crown gear (26) for engaging with the third crown gear (20), and the sanding device (1) further comprises second clamping means (28) for clamping the third crown gear (20) and the forth crown gear (26).

15. The sanding device of claim 14, wherein the attachment workpiece (22) is capable of being removed.

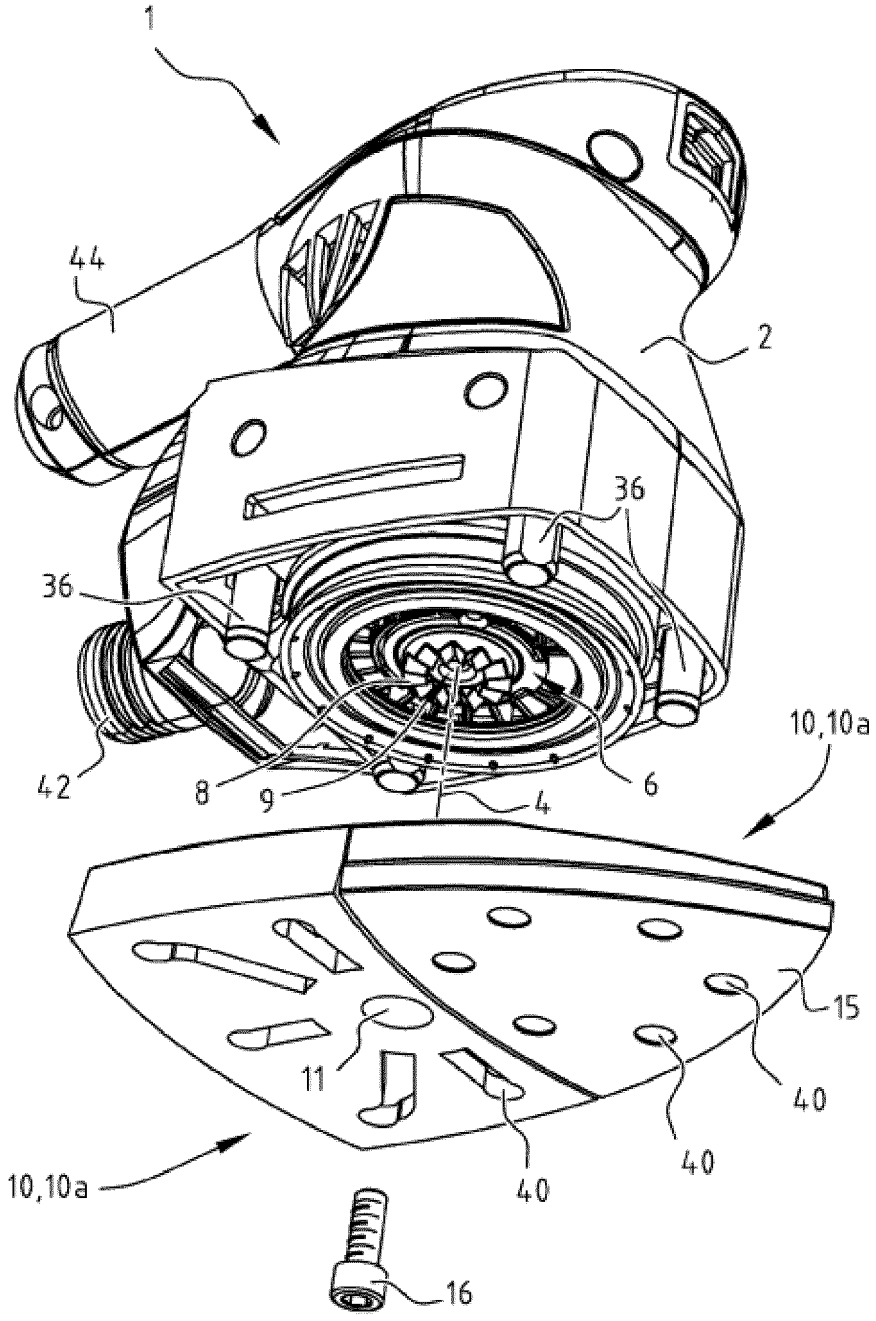

FIG.1

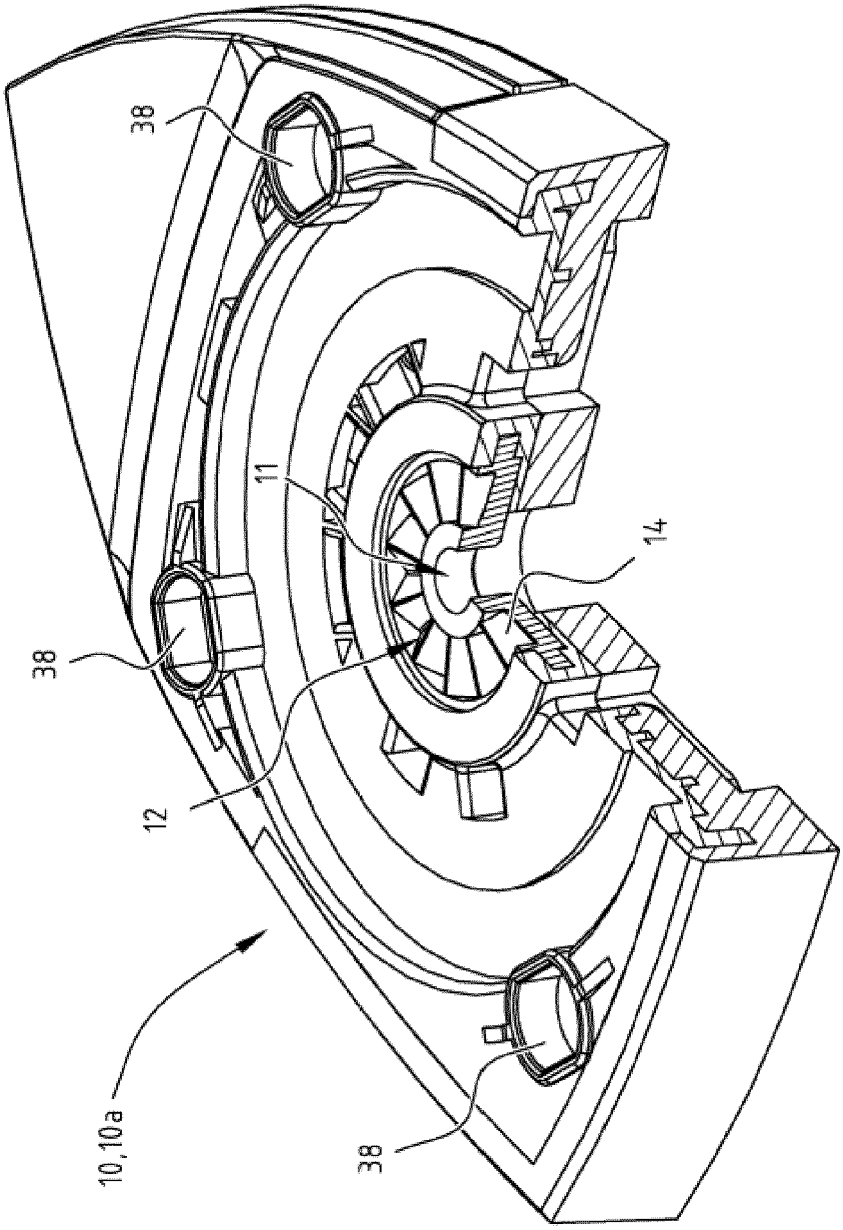

FIG.2

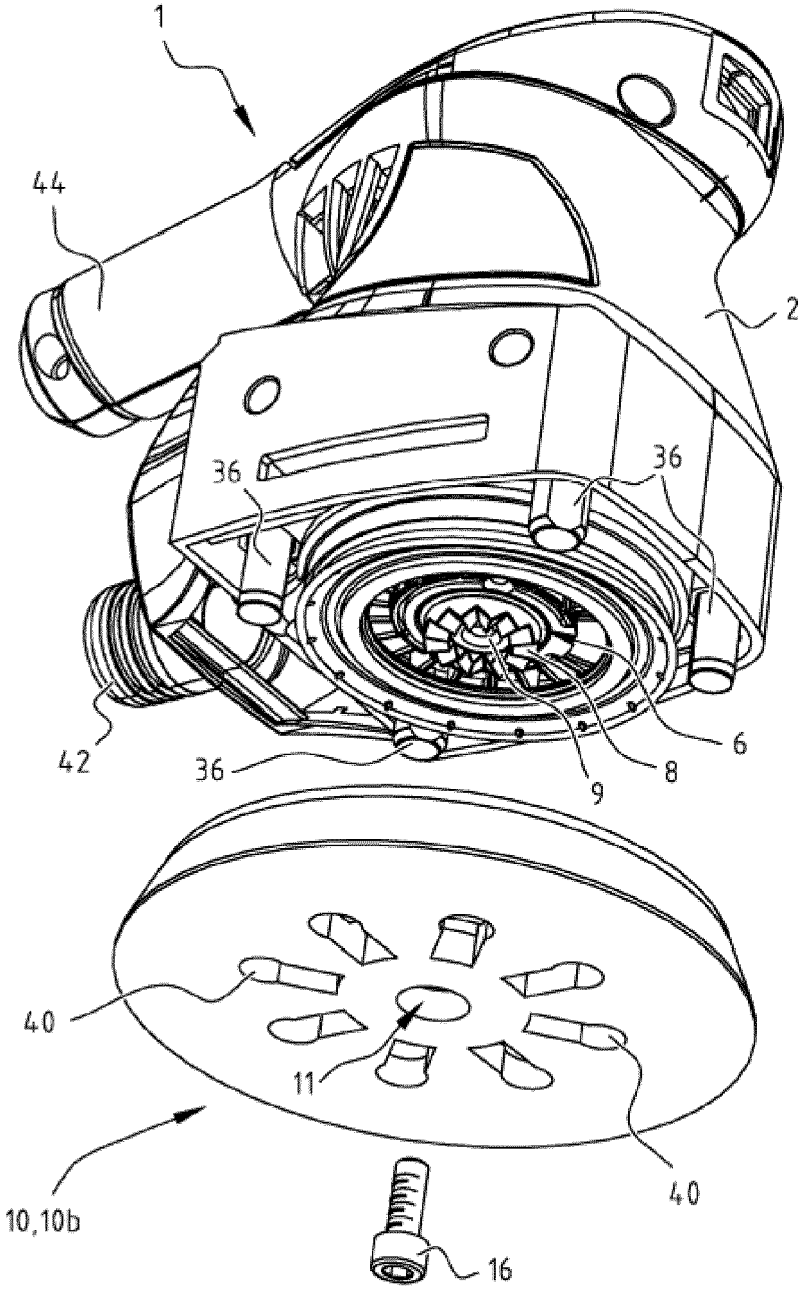

FIG.3

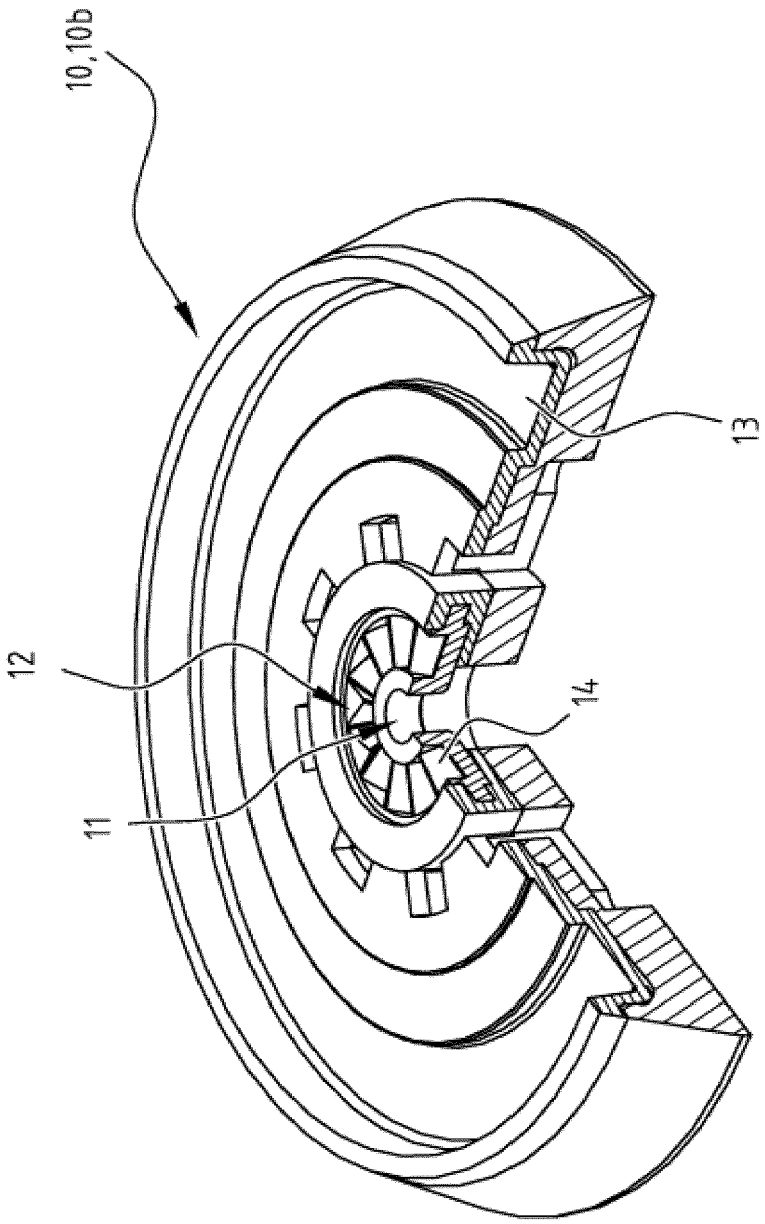

FIG.4

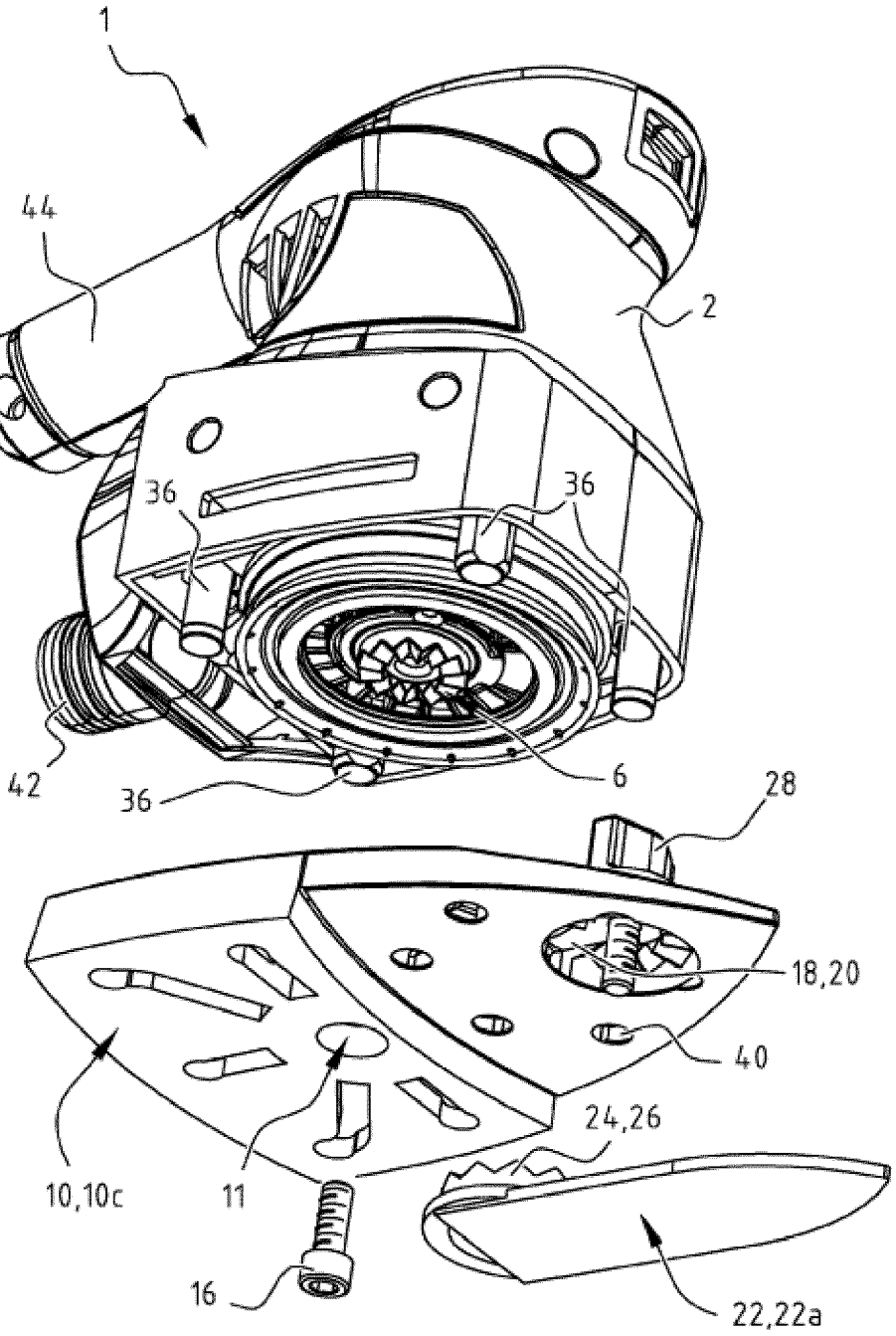

FIG.5

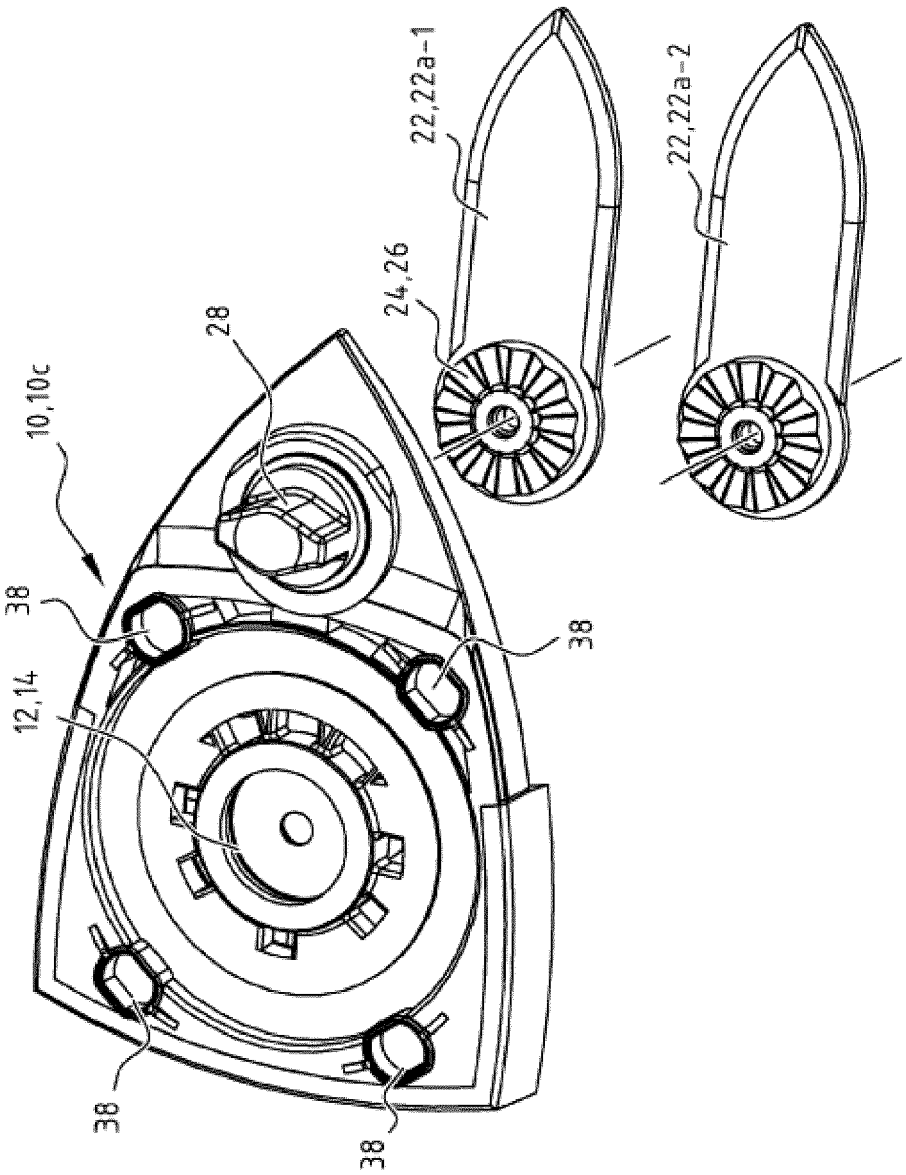

FIG.6

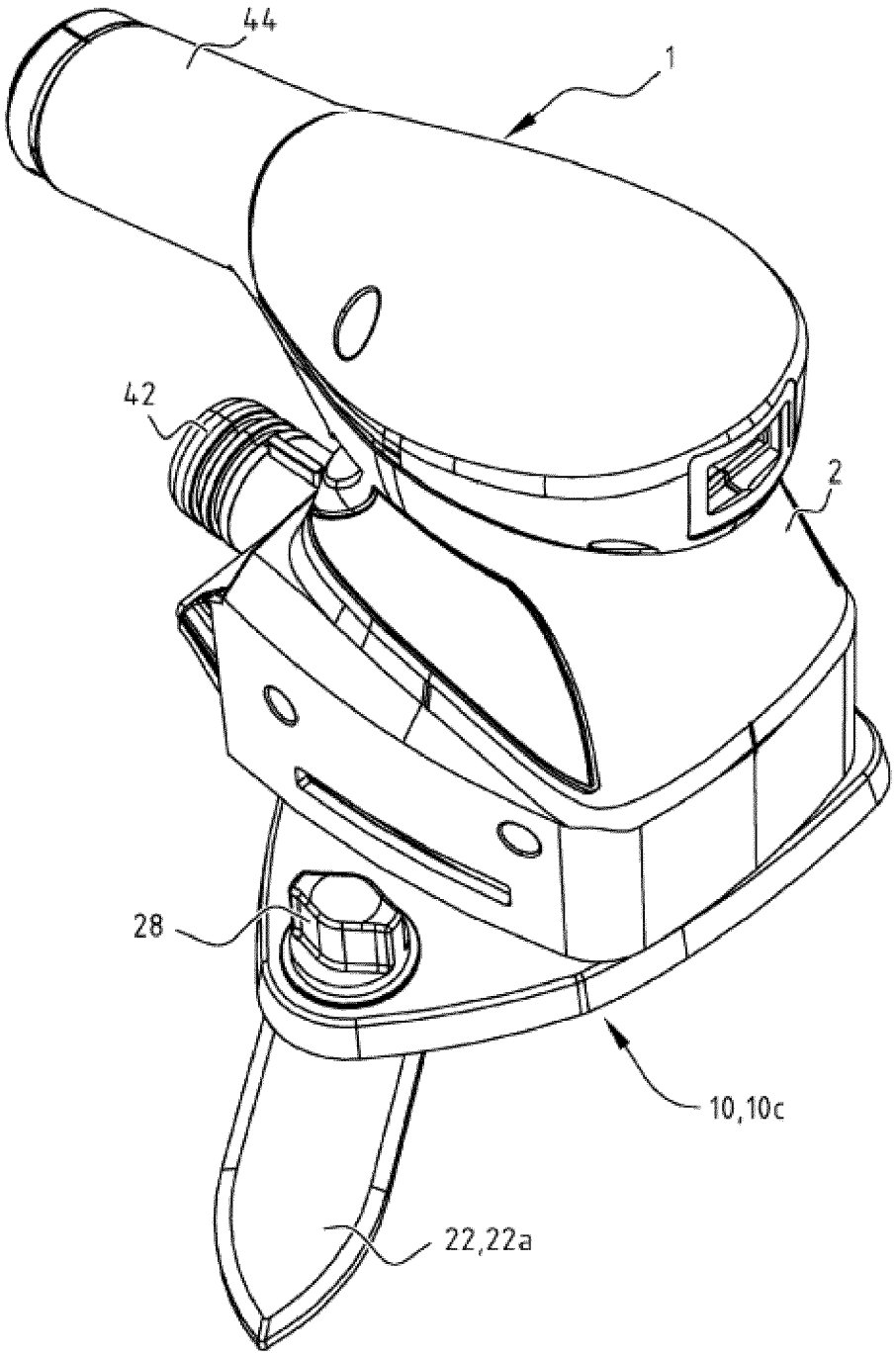

FIG.7

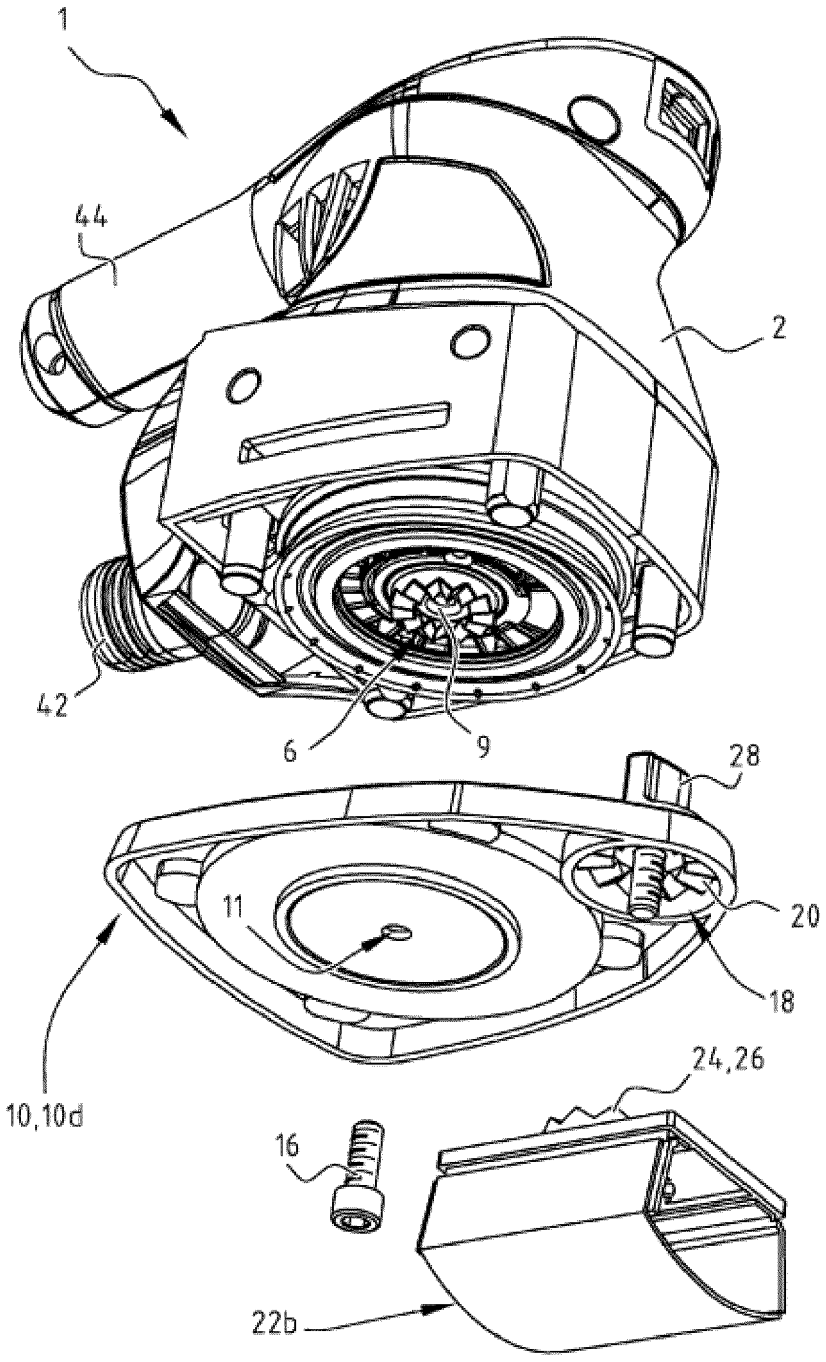

FIG.8

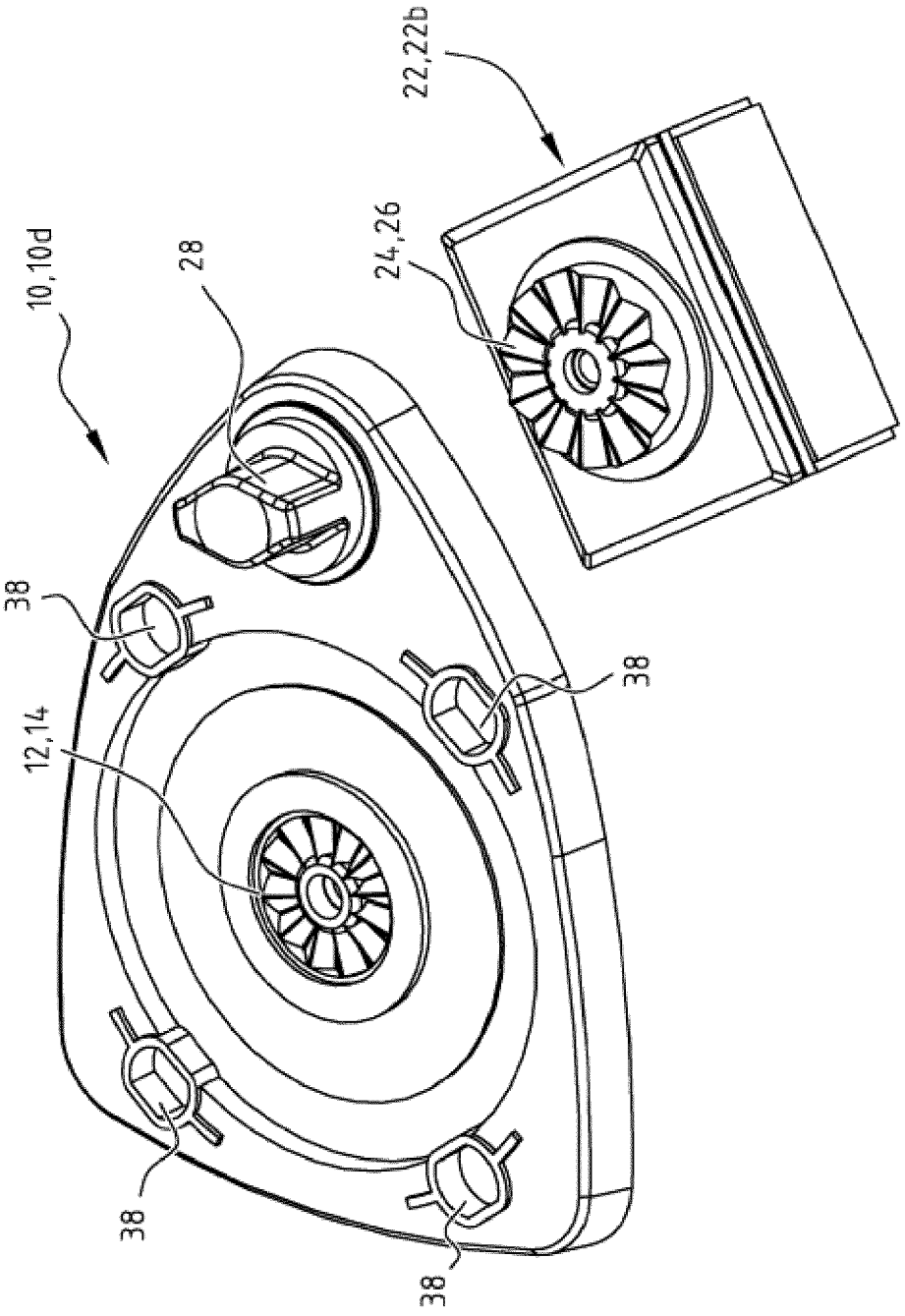

FIG.9

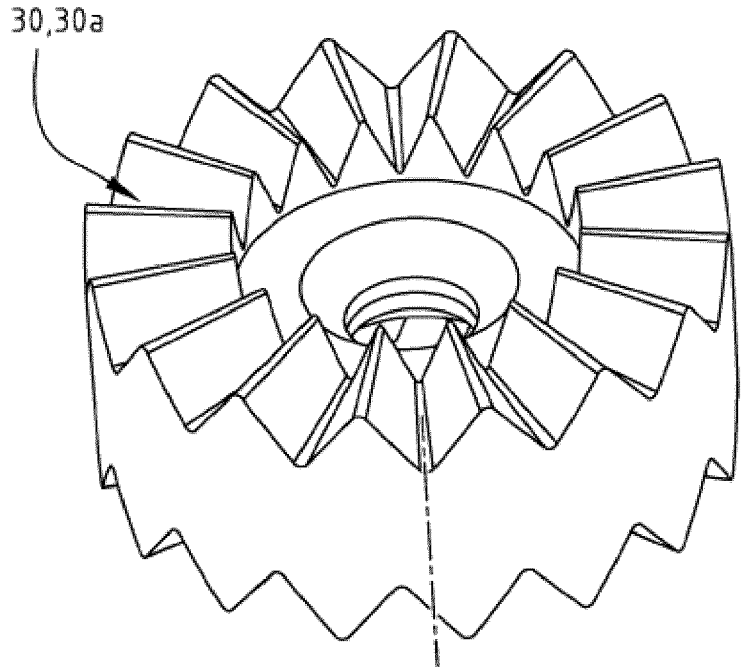

FIG.10

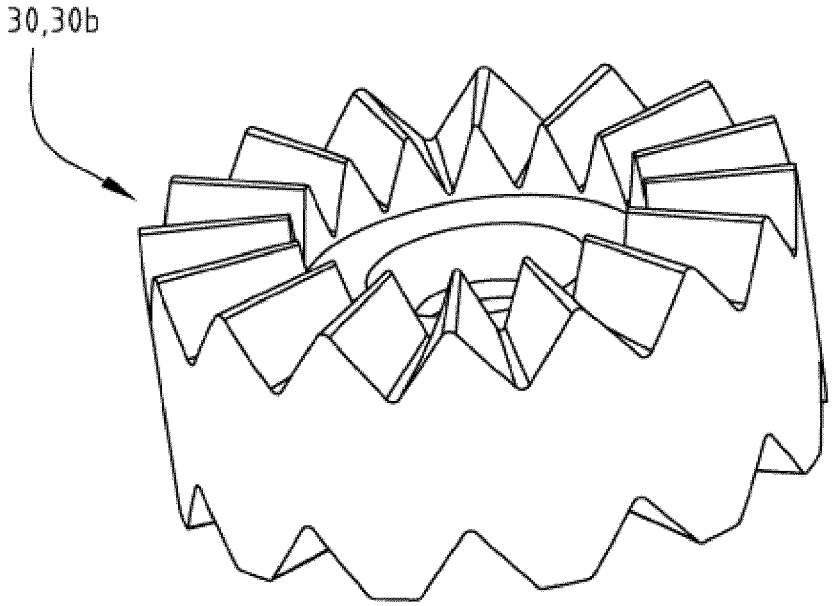

FIG.11

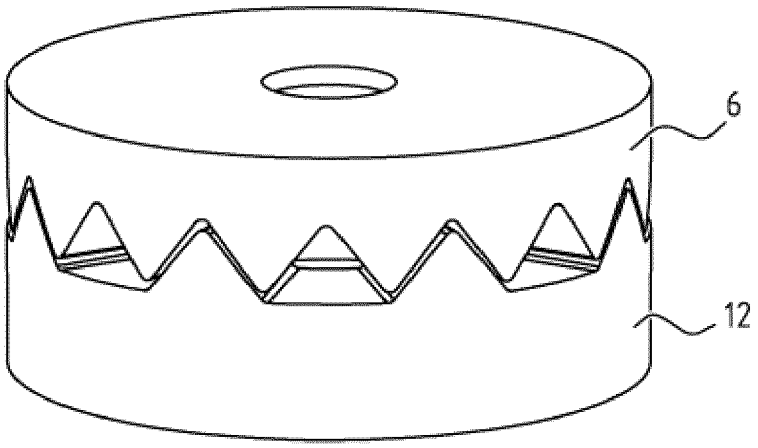

FIG.12

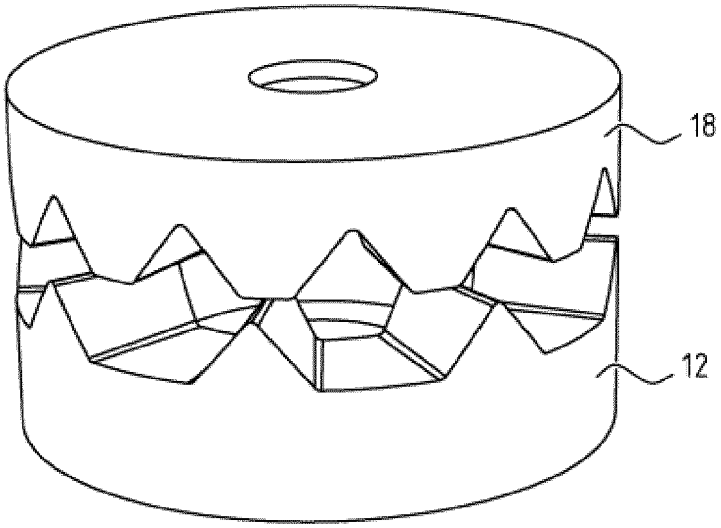

FIG.13

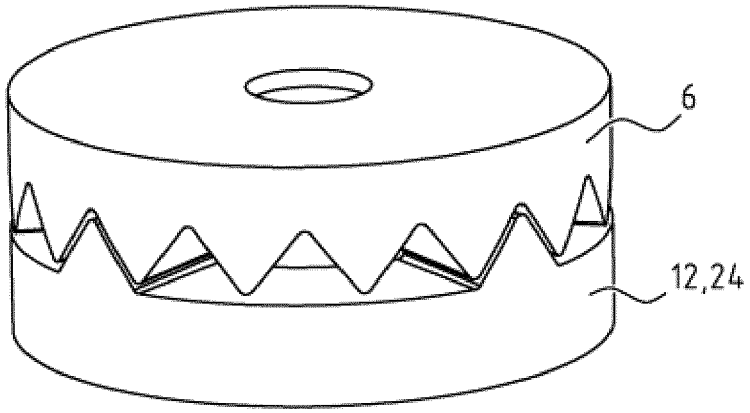

FIG.14

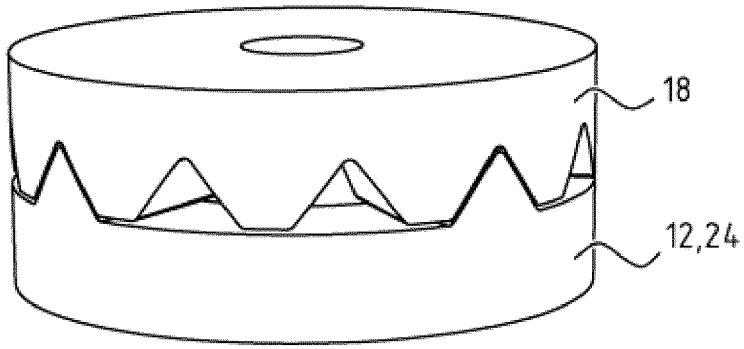

FIG.15

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EUROPEAN SEARCH REPORT

Application Number
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B24B
F16H
F16D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 February 2021	De Backer, Tom

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