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(54) Method for operating a hand-held power tool

(57) Method for operating a hand-held power tool (1), in particular a combi hammer (2), with a rotating shaft (3), which hand-held power tool (1) is switchable to a first and second mechanical mode for driving the rotating shaft (3). The method comprises detecting a rotation movement characteristic of the rotating shaft (3) and determining an operational setting of the hand-held power tool (1) based on the detected rotation movement characteristic.

Hand-held power tool (1) for carrying out the method, the hand-held power tool (1) comprising a rotating shaft (3) and switchable to a first and second mechanical mode for driving the rotating shaft (3).

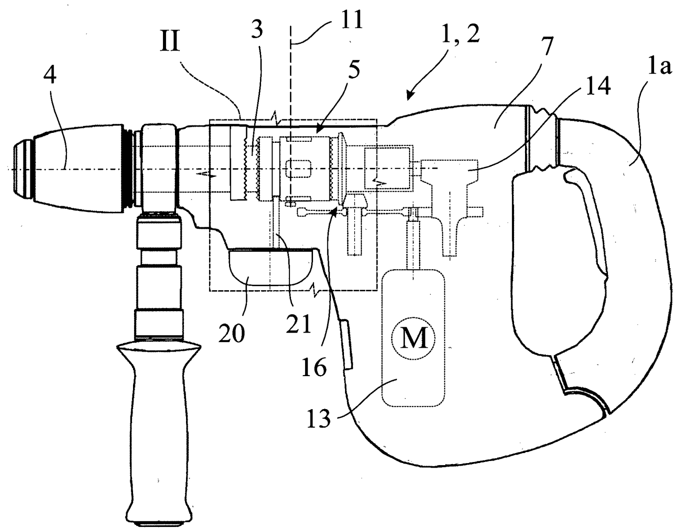

Fig. 1

EP 2 871 029 A1

Description

[0001] The present invention concerns a method for operating a hand-held power tool according to the preamble of claim 1 and a hand-held power tool according to claim 15.

[0002] Hand-held power tools regularly comprise a rotating shaft, such as a tool shaft for holding a tool or a tool holding cylinder, which tool shaft or tool holding cylinder is driven in a number of possible ways when operating the hand-held power tool. For such a rotating shaft, the mode of driving the rotating shaft depends on, inter alia, the kind of tool mounted and the desired working effect of the hand-held power tool. Combi hammers provide an example for a hand-held power tool with multiple functionality. Such a combi hammer may be operated in a drill mode and in particular in a hammer drill mode, in which the combi hammer's tool shaft is both rotated and driven back and forth axially. A combi hammer may also be operated in a chiseling mode, in which the tool shaft is only driven back and forth axially and not rotated.

[0003] For operation of the combi hammer in the hammer drill mode, it is regularly desirable to provide an anti-twist protection function. This anti-twist protection function disengages the tool shaft from the driving motor or near-instantly brakes the driving motor when a sufficiently rapid twisting, i.e. rotation, of the hand-held power tool is detected. This may for example occur when the tool affixed to the tool shaft is blocked in its rotation while the combi hammer is operated in a hammer drill mode. In that case, the torque on the now immobile tool shaft is exerted on the hand-held power tool itself, causing an undesirable rotation of the hand-held power tool along with its handle. The anti-twist protection function prevents such an incidence or stops it.

[0004] At the same time, such an anti-twist protection function is not desired and is in fact even disadvantageous when the hand-held power tool is operated in a chiseling mode. Even though no rotation of the tool shaft is expected in the chiseling mode, if the anti-twist protection function remains active in the chiseling mode, there is a statistical occurrence of erroneous activations of the anti-twist protection function. These incidences are annoying to the user of the hand-held power tool any may necessitate an interruption of the current work and a restart of the motor.

[0005] The prior art, from which the present invention proceeds, discloses a combi hammer with a user-operated switchover device by means of which the combi hammer can be mechanically switched between a hammer drill mode and a chiseling mode. This switchover device simultaneously also enables or disables an anti-twist protection function depending on whether the hammer drill mode or the chiseling mode is currently switched to.

[0006] This combi hammer from the prior art comprises only the two abovementioned operating modes. Therefore, for this combi hammer the activation of the anti-twist protection may be decided upon binarily dependent on the switchover device. However, it is conceivable that a hand-held power tool provides a number of different operating modes, with the currently active operating mode not determined by a single switchover device but rather based on a number of different user-settable switches or other input devices. Thus, determining whether or not to enable the anti-twist protection function may become a more complicated question.

[0007] It is therefore the problem of the invention to provide an improved approach for determining whether or not an operational setting, such as one determining the enablement of an anti-twist protection function, should be set for a hand-held power tool which can assume a number of different mechanical configurations with regard to driving a rotating shaft of the hand-held power tool.

[0008] The above noted problem is solved with regard to a method for operating a hand-held power tool according to a preamble of claim 1 with the features of the characterizing part of claim 1. With regard to a hand-held power tool, the above noted problem is solved with the features of claim 15.

[0009] The invention is based on the recognition that a rotation movement characteristic of a rotating shaft may be directly detected and analyzed in order to determine an operational setting of the hand-held power tool, especially when that rotation movement characteristic is based on a switchable mechanical mode of the hand-held power tool. In other words, an electrical mode of the hand-held power tool is brought into alignment with its corresponding, respective mechanical mode based on this detection of the rotation movement of the rotating shaft. Consequently, the resulting electrical mode of the hand-held power tool is not statically set as a direct consequence of a switch or a similar user-actuated element, but rather dynamically based on the detection during actual operation. This is advantageous in particular when the detected rotation movement characteristic of the rotating shaft more directly reflects the information based on which the operational setting of the hand-held power tool should be determined. Thus, in the example of a combi hammer, its anti-twist protection function can be enabled depending on whether or not the occurrence of a substantial rotation of e. g. its tool shaft or its tool holding cylinder is detected during operation.

[0010] The preferred embodiments of claims 8 to 10 describe an advantageous sensor arrangement, in particular with regard to the position relative to the rotating shaft, within the hand-held power tool for detecting and analyzing a rotating movement characteristic of the rotating shaft during operation.

[0011] The preferred embodiments of claims 11 to 13 describe a further development of the sensor arrangement and its placement with regard to the rotating shaft, which further development ensures both a high effectiveness of detecting the rotation movement characteristic of interest and an identical detection quality irrespective of the mechanical mode of the hand-held power tool.

[0012] Finally, the preferred embodiment according to claim 14 describes an advantageous approach for combining the above preferred arrangement with a preferred mechanical way of switching between the mechanical modes of the hand-held power tool.

[0013] In the following, the invention shall be further explained in detail with reference to the illustration depicting a single embodiment of the invention. In the illustration

Fig. 1 presents a simplified view of a hand-held power tool according to the proposal, which is here a combi hammer,

Fig. 2a-b) present a detailed view of the rotating shaft and the sensor arrangement of the hand-held power tool of Fig. 1 in two mechanical modes, and

Fig. 3a-c) illustrate the functioning of the sensor arrangement for detecting a rotation movement characteristic of the rotating shaft of the hand-held power tool of Fig. 1.

[0014] The hand-held power tool 1 of Fig. 1, which by way of example is a combi hammer 2, comprises a rotating shaft 3, which in the present embodiment and preferably is a tool holding cylinder linked or linkable to a tool shaft. To such a tool holding cylinder e.g. a drill bit or a chisel - depending on the desired work to be performed and presently not shown - may be directly or indirectly attached. This rotating shaft 3 is configured for actual rotation in a quasi-stationary manner, which is to say that it is configured to cyclically perform full rotations with quasi-stationary rotation characteristics, examples for such rotation characteristics being rotational speed, angular velocity or angular acceleration. Thus any component or shaft which is only configured for pivoting, in particular pivoting back and forth, e.g. a rotary switch, cannot be understood as rotating shaft 3 in the present sense. The rotating shaft 3 may be arranged within the drive train for a tooling of the hand-held power tool 1, as is the case in the present embodiment for the tool holding cylinder, but it may equally be arranged outside such a drive train.

[0015] The hand-held power tool 1 is switchable to a first and second mechanical mode for driving the rotating shaft 3. Each such mechanical mode corresponds to a different mechanical configuration of the hand-held power tool 1 affecting the driving of the rotating shaft 3. In other words, there is some change in the mechanical state of the hand-held power tool 1 between the first and second mechanical mode which results in the rotating shaft 3 being driven differently by the hand-held power tool 1 in each mechanical mode.

[0016] The hand-held power tool 1 may be switchable to more than two mechanical modes. In particular, the hand-held power tool 1 may be switchable to a mechanical mode defined by an analog value in a continuum, i. e. by a continuous value, preferably between two limits. One such example would be a continuously variable transmission of the hand-held power tool 1 for driving the rotating shaft 3, where each set gear ratio would correspond to a mechanical mode of the hand-held power tool 1. Thus, this feature only requires that there be a minimum of two mechanical modes, i.e. at least a first and second mechanical mode, which are mutually distinguishable by their associated mechanical configuration of the hand-held power tool 1.

[0017] The proposed method for operating such a hand-held power tool 1 is characterized in that it comprises detecting a rotation movement characteristic of the rotating shaft 3 and determining an operational setting of the hand-held power tool 1 based on the detected rotation movement characteristic. An operational setting of the hand-held power tool 1 in the present sense may be any property or parameter value which is settable to one of a plurality of values and which determines the operation of the hand-held power tool 1 in anyway. This may correspond to that property or parameter value being settable to one of a discrete number of values or to an analog value in a continuum as described above with reference to the mechanical mode.

[0018] In the present example and as preferred, the first mechanical mode, which is preferably a drill mode, is for driving the rotating shaft 3 with a rotating movement. This rotating movement may be understood as a rotating movement with a first set of rotation movement characteristics, such as a rotational speed value, angular velocity value or angular acceleration value. The first mechanical mode may preferably also be a hammer drill mode for in addition driving the rotating shaft 3 with an axial movement, which is here a back and forth movement in the axial direction 4 of the rotating shaft 3.

[0019] Further, in this preferred embodiment the second mechanical mode, which is preferably a chiseling mode, is for driving the rotating shaft 3 with a further rotating movement or substantially stationary with respect to rotation. Analogously to the above rotating movement, also this further rotating movement may be understood as a rotating movement with a second set of rotation movement characteristics, e. g. a further rotational speed value, a further angular velocity value or further angular acceleration value. Driving the rotating shaft 3 substantially stationary with respect to rotation may also be formulated as there being substantially no driving of the rotating shaft 3 with respect to rotation around the axial direction 4 of the rotating shaft 3. The second mechanical mode, in particular when the second mechanical mode is the chiseling mode, may also be for driving the rotating shaft 3 with an axial movement, i.e. a back and forth movement in the axial direction 4 of the rotating shaft 3.

[0020] With respect to the operational setting described above, it is preferred that determining the operational setting comprises switching to a first or second electrical mode of the hand-held power tool 1. Just as the first and second mechanical modes are distinguished by a difference in the mechanical configuration of the hand-held power tool 1, the first and second electrical modes of the hand-held power tool 1 are distinguished by a respective difference in the electrical configuration of the hand-held power tool 1. Analogously to the mechanical modes of the hand-held power tool 1, there may also be more than two electrical modes of the hand-held power tool 1. In particular, the different electrical modes may correspond to analog values in a continuum as already described above with reference to the mechanical mode.

[0021] Here it is also further preferred that the first and second electrical mode of the hand-held power tool 1 correspond to the first and second mechanical mode for driving the rotating shaft 3, respectively. In other words, switching to the first or the second mechanical mode for driving the rotating shaft 3 sets the hand-held power tool 1 to a different functionality. Based on the detected rotation movement characteristic of the rotating shaft 3, according to this embodiment the hand-held power tool 1 is also set to the proper electrical mode corresponding to the mechanical mode the hand-held power tool 1 is set to. Thus, the detection of the rotation movement characteristic brings the electrical mode of the hand-held power tool 1 into alignment with the mechanical mode of the hand-held power tool 1. It follows that setting the mechanical mode of the hand-held power tool 1 precedes setting the electrical mode of the hand-held power tool 1.

[0022] With regard to the electrical mode, it is preferred that switching to the first electrical mode comprises setting a functional parameter for an electric function of the hand-held power tool 1 to a first parameter value. This functional parameter could be a number or other value supplied or written into an electronic unit or could also be for example an analog voltage supplied to a motor or some other electric component in the hand-held power tool 1. Further, it is preferred that the functional parameter is an activation threshold of the electric function, i.e. a parameter for comparison, which comparison in turn is the basis for activating or deactivating the electric function. It is preferred that this electric function is a safety function, i.e. a function the activation of which is to ensure or improve the operational safety of the hand-held power tool 1. Preferably, switching to the second electrical mode comprises setting the functional parameter for the electric function of the hand-held power tool 1 to the second parameter value. This second parameter value is preferably different from the first parameter value. Thus, the electric function would have a different activation sensitivity between the first electrical mode and the second electrical mode.

[0023] In particular the activation threshold may be set to one of the parameter values such that the electric function cannot be activated. This corresponds to the preferred embodiment according to which switching to the first electrical mode comprises enabling the electric function and that switching to the second electrical mode comprises disabling the electric function. Thus, in the second electrical mode, the electric function cannot be activated according to this embodiment.

[0024] As already mentioned in the introduction, such an electric safety function could be an anti-twist protection function. It is further preferred that the functional parameter in the above sense defines a threshold value for activating the anti-twist protection function. Such a threshold value could also be a rotation movement characteristic in the above sense which in this case, however, would be a rotation movement characteristic of the hand-held power tool itself or of a fixed part of the hand-held power tool 1 such as a handle 1a of the hand-held power tool 1.

On the other hand, it is also preferred that the detected rotation movement characteristic is a rotational speed and/or an angular velocity and/or an angular acceleration of the rotating shaft 3In line with this consideration it is preferred that determining an operational setting of the hand-held power tool 1 based on the detected rotation movement characteristic comprises determining the operational setting based on a comparison of the detected rotation movement characteristic with a - preferably predefined - rotation movement characteristic threshold. This rotation movement characteristic threshold may in particular be the a rotational speed threshold and/or an angular velocity threshold and/or an angular acceleration threshold. Consequently, it is preferred that the anti-twist protection function is enabled if the detected rotation movement characteristic exceeds the above rotation movement characteristic threshold. In the current example, a comparison of a detected rotational speed with a rotational speed threshold may indicate whether the current mechanical mode is a (hammer) drill mode or a chiseling mode. Thus, when substantial rotational speed of the rotating shaft 3 is detected - which corresponds to the (hammer) drill mode - the activation threshold as a functional parameter of the anti-twist protection function is set to enable the anti-twist protection function and when no substantial rotational speed of the rotating shaft 3 is detected - which corresponds to the chiseling mode - the activation threshold as a functional parameter of the anti-twist protection function is set to disable the anti-twist protection function.

[0025] Elaborating now on advantageous arrangements for detecting the above rotation movement characteristic of the rotating shaft 3, it is preferred that the hand-held power tool 1 comprises a sensor arrangement 5 for detecting the rotation movement characteristic of the rotating shaft 3. The sensor arrangement 5 is preferably a Hall effect sensor arrangement, depicted in more detail in Fig. 2. In accordance with Fig. 2 it is preferred that a first component 6a of the sensor arrangement 5 is arranged laterally with respect to the rotating shaft 3. In the present case this first component 6a is a probe, i.e. a component generating a detection signal. The lateral arrangement of the first component 6a with respect to the rotating shaft 3 simply means that the first component 6a is arranged with a distance to the rotating shaft 3 in the lateral direction, i.e. a direction normal to the axial direction 4. It is further preferred that this first component 6a is non-rotatably arranged with respect to a casing 7 of the hand-held power tool 1. In other words, when the rotating shaft 3 rotates with respect to the casing 7 of the hand-held power tool 1, this first component 6a does not rotate together with the rotating shaft 3 but rather stays fixed to the casing 7 and there is a resultant relative movement between the rotating shaft 3 and the first component 6a.

[0026] Preferably the sensor arrangement 5 comprises a second component 6b non-rotatably arrangeable with respect to the rotating shaft 3. This means that the second component 6b can, at least, be brought into a state or position in which it is non-rotatable with respect to the rotating shaft 3. Advantageously, the second component 6b is already and fixedly in such a state or position. Therefore it is preferred that the second component 6b is non-rotatably arranged with respect to the rotating shaft 3. Thus, the second component 6b rotates together with the rotating shaft 3 if and when the rotating shaft 3 rotates. This second component 6b is preferably a magnetic field generator and - as illustrated in the present embodiment - a permanent magnet. It is pointed out that the second component 6b and therefore also the permanent magnet need not consist of a single object but may be an arrangement of several subcomponents of the second component 6b. In the present example and as illustrated in Fig. 3, the second component 6b may comprise four magnet strips 8, as described in more detail below.

[0027] For the non-rotatable arrangement with respect to the rotating shaft 3, the second component 6b need not be directly attached to the rotating shaft 3. Instead and as shown in Fig. 2, the second component 6b can be arranged on a shaft cover 9 arranged axially slidable and non-rotatably arrangeable, preferably non-rotatably arranged, with respect to the rotating shaft 3. The shaft cover 9 may be any structure arranged or fixed on the rotating shaft 3 and is preferably, as in the present embodiment, a shaft sleeve 10, i.e. a structure surrounding the rotating shaft 3 around its circumference with respect to the axial direction 4 of the rotating shaft 3.

[0028] As illustrated in Fig. 3, it is preferred that the second component 6b is axially symmetric with regard to the rotating shaft 3. As already described, Fig. 3 shows that the second component 6b comprises a permanent magnet with four individual magnet strips 8. By way of example, the magnet strips 8 are spaced at a relative angle of 90 degrees with respect to the axial direction 4 of the rotating shaft 3. Other relative angles between such magnet strips 8 are equally possible. In other words, in the present embodiment the second component 6b is symmetric to a rotation by - in this example - 90 degrees of the rotating shaft 3 around its axial direction 4. However, Fig. 3 also illustrates that the second component 6b is rotationally asymmetric with regard to the rotating shaft 3. In other words, there exist rotations for which symmetry is not preserved. Thus, rotating the situation of Fig. 3a by e.g. 45 degrees would result in the arrangement of Fig. 3b, which is not identical to the arrangement of Fig. 3a. Coming back to Fig. 2, it is preferred that the first component 6a and the second component 6b are arranged on a sensing plane 11 which is defined axially with respect to the rotating shaft 3. This means that the axial direction 4 of the rotating shaft 3 is normal to the sensing plane 11, which is a plane in the geometrical sense. It is in particular a geometrical plane on which both the first component 6a and the second component 6b are arranged, i.e. a plane that intersects both the first component 6a and the second component 6b, as can be seen from Fig. 2. From the functioning of e.g. Hall effect sensors, it is evident that the interaction of the first component 6a and the second component 6b occurs strongest in the sensing plane 11.

[0029] It is particular advantageous if the arrangement of the first component 6a and the second component 6b on the sensing plane 11 is invariant with respect to sliding the shaft cover 9. As can be seen in particular with respect to Fig. 2a and 2b, if the shaft cover 9 is slid in the axial direction 4 between the position of Fig. 2a and 2b, then the sensor arrangement 5 seen by the sensing plane 11, in particular the relative position of the first component 6a and the second component 6b, is invariant. The first component 6a does not slide axially, therefore being invariant, and also for the second component 6b the magnet strips 8 have an extension in the axial direction 4 which is sufficient, such that even after sliding the shaft cover 9, the portion of the magnet strips 8 seen by the sensing plane 11 is indistinguishable from the situation before sliding. Thus, from the point of view of the sensing arrangement 5 there is no discernible difference between the sliding positions of the shaft cover 9 and in fact such a sliding as such is not detectable by the sensing arrangement 5.

[0030] Based on this, it is preferred that the first and second mechanical mode correspond to a first axial position 12a and a second axial position 12b of the shaft cover 9 with respect to the rotating shaft 3. As illustrated in Fig. 2a and 2b, the first axial position 12a in the first mechanical mode moves to the second axial position 12b in the second mechanical mode. The difference between the first and second mechanical mode may comprise not only this different position of the shaft cover 9 in the axial direction 4, but may involve other differences in the mechanical configuration as well. By way of example - not corresponding to the illustrated embodiment - it may be that the shaft cover 9 is arranged rotatable with respect to the rotating shaft 3 in either the first or second axial position 12a,b and non-rotatable in the respective other axial position 12a,b. Another example which does correspond to the embodiment illustrated will be explained in the following.

[0031] In accordance with the embodiment of Fig. 1 and 2, it is preferred that the hand-held power tool 1 comprises a motor 13 for driving the rotating shaft 3 and that sliding the shaft cover 9 between the first axial position 12a and the second axial position 12b selectively engages and disengages the motor 13 with the rotating shaft 3 with regard to driving the rotating shaft 3 in a rotating movement. Referring to the combi hammer 2 of Fig. 1, both in the hammer drill mode and in the chiseling mode there is an axial movement of the rotating shaft 3. An axial driving gear 14 transmits a rotating movement of the motor 13 to an axial movement of the rotating shaft 3.

[0032] However, there is only a rotating movement of the rotating shaft 3 in the hammer drill mode, not in the chiseling mode. Therefore, sliding the shaft cover 9 axially, in particular between the first axial position 12a and the second axial position 12b, may provide the mechanism - as illustrated in Fig. 2a and 2b - of selectively engaging the motor 14 with the rotating shaft 3 for rotation. In particular, rear teeth 15a of the shaft sleeve 10 engage a bevel gear 16 driven by the motor 13 when the shaft cover 9, which is presently the shaft sleeve 10, is in the first axial position 12a as illustrated in Fig. 2a. Since the shaft sleeve 10 is arranged non-rotatably with regard to the rotating shaft 3, the rotating movement imparted on the shaft sleeve 10 by the bevel gear 16 is transmitted to the rotating shaft 3. In contrast, the rear teeth 15a disengage the bevel gear 16 when the shaft cover 9 is in the second axial position 12b, which corresponds to the situation in Fig. 2b.

[0033] Whereas the hammer drill mode entails substantial rotation of the rotating shaft 3, it is regularly desired that the rotating shaft 3, which here is the tool holding cylinder, is non-rotatable in the chiseling mode. Therefore and as shown in Fig. 2a and 2b, sliding the shaft cover 9 to the second axial position 12b engages front teeth 15b of the shaft cover 9 with a corresponding structure of the casing 7, thereby fixing also the rotating shaft 3 against rotation. In the first axial position 12a, the front teeth 15b are disengaged from the casing 7 to enable rotation of the rotating shaft 3. Thus, the shaft cover 9 here combines the functions of housing the first component 6a of the sensor arrangement 5, of engaging the motor 13 with the rotating shaft 3 in the hammer drill mode and of fixing the rotating shaft 3 against rotation in the chiseling mode.

[0034] If the first and second mechanical mode correspond to the hammer drill mode and the chiseling mode, respectively, the axial driving of the rotating shaft 3 by the motor 13 remains identical for both axial positions 12a, b of the shaft cover 9 because of the axial driving gear 14. As already observed, the relative, effective internal constellation of the sensing arrangement 5, i.e. the relative position of the first component 6a to the second component 6b as detectable by the sensing arrangement 5, remains invariant to this sliding. Only when the motor 13 actually drives the rotating shaft 3 and thus the rotating shaft 3 is either rotated or not does the sensing arrangement 5 detect the difference.

[0035] Fig. 3a-c illustrate by way of example how the sensor arrangement 5 may detect a rotating movement characteristic of the rotating shaft 3. Fig. 3a depicts a cross section view of the sensor arrangement 5 in the sensing plane 11 when the rotating shaft 3 - and with it the shaft cover 9 - does not rotate. Whether or not the rotating shaft 3 moves in the axial direction 4 is substantially irrelevant, due to the above-described invariance of the sensor arrangement 5 with respect to axial movement, for the detection of the sensor arrangement 5 described in the following. The first component 6a, being the probe and facing a magnet strip 8 in the sensing plane 11, detects the magnetic field of the second component 6b, being the permanent magnet, with a high, constant value because the rotating shaft 3 does not rotate. Thus the first detected signal 17a, which is shown also in Fig. 3a as magnetic field 18 plotted over time 19, is constant. In Fig. 3b, the rotating shaft 3 also does not rotate, but the first component 6a does not directly face any of the magnet strips 8 which are therefore set at an angle relative to the first component 6a. Again independent of axial movement of the rotating shaft 3, the magnetic field detected by the probe is also constant but, because the first component 6a does not directly face any of the magnet strips, that constant detected magnetic field is lower than in the case of Fig. 3a, shown in Fig. 3b as second detected signal 17b. Fig. 3c finally depicts the situation for a rotating shaft 3 actually driven to a rotating movement. In this case, the first component 6a alternatingly faces the magnet strips 8 rotating with the rotating shaft 3 as well as the intervals in between. Therefore, the magnetic field seen by the first component 6a and by the sensor arrangement 5 as a whole corresponds to a changing magnetic field, which may be approximated as a rectangular function-here shown as third detected signal 17c - or sinusoidal function in time. The periodicity of the sinusoidal function is indicative of the rotational speed and the angular velocity of the rotating shaft 3 and the change in periodicity is indicative of angular acceleration of the rotating shaft 3. Again, any axial movement of the rotating shaft 3 is substantially irrelevant for the third detected signal 17c. In this way, the sensor arrangement 5 may detect a rotating movement characteristic of the rotating shaft 3.

[0036] Referring back to Fig. 1, it is preferred that the hand-held power tool 1 comprises a user-actuatable mechanical switch 20 for switching between the first and second mechanical mode. This mechanical switch 20 may be any kind of component of the hand-held power tool 1 with which mechanical change can be effected by the user. As in the present case, that mechanical switch 20 may be a turning switch. Here it is preferred that the mechanical switch 20 is arranged to slide the shaft cover 9 between the first axial position 12a and the second axial position 12b, which in the present example and as already noted above also respectively engages and disengages the motor 13 with the rotating shaft 3 with regard to driving the rotating shaft 3 in a rotating movement. In the present example, this sliding of the shaft cover 9 is effected with an eccentric pin 21. Actuating the mechanical switch 20 may also comprise further changes in the mechanical configuration of the hand-held power tool 1 not shown in the present example.

[0037] A hand-held power tool 1, and in particular a combi hammer 2, according to the proposal is configured for carrying out the method as proposed. The hand-held power tool 1 according to the proposal comprises a rotating shaft 3 and is switchable to a first and second mechanical mode for driving the rotating shaft 3. Preferred embodiments of this proposed hand-held power tool 1 correspond to preferred embodiments of the method for operating a hand-held power tool 1 according to the proposal.

Claims

1. Method for operating a hand-held power tool (1), in particular a combi hammer (2), with a rotating shaft (3), which hand-held power tool (1) is switchable to a first and second mechanical mode for driving the rotating shaft (3),
characterized in that,
the method comprises detecting a rotation movement characteristic of the rotating shaft (3) and determining an operational setting of the hand-held power tool (1) based on the detected rotation movement characteristic.

2. Method according to claim 1, **characterized in that** the first mechanical mode, preferably a drill mode and/or a hammer drill mode, is for driving the rotating shaft (3) with a rotating movement, preferably, also with an axial movement, and that the second mechanical mode, preferably a chiseling mode, is for driving the rotating shaft (3) with a further rotating movement or substantially stationary with respect to rotation, preferably also with an axial movement.

3. Method according to claim 1 or 2, **characterized in that** determining an operational setting comprises switching to a first or second electrical mode of the hand-held power tool (1), preferably, wherein the first and second electrical mode of the hand-held power tool (1) correspond to the first and second mechanical mode for driving the rotating shaft (3), respectively.

4. Method according to claim 3, **characterized in that** switching to the first electrical mode comprises setting a functional parameter, preferably an activation threshold, for an electric function, preferably electric safety function, of the hand-held power tool (1) to a first parameter value, further preferably, that switching to the second electrical mode comprises setting the functional parameter for the electric function of the hand-held power tool (1) to a second parameter value, in particular, that switching to the first electrical mode comprises enabling the electric function and that switching to the second electrical mode comprises disabling the electric function.

5. Method according to claim 4, **characterized in that** the electric function is an anti-twist protection function, preferably, that the functional parameter defines a threshold value for activating the anti-twist protection function.

6. Method according to one of claims 1 to 5, **characterized in that** the detected rotation movement characteristic is a rotational speed and/or an angular velocity and/or an angular acceleration of the rotating shaft (3).

7. Method according to one of claims 1 to 6, **characterized in that**, determining an operational setting of the hand-held power tool (1) based on the detected rotation movement characteristic comprises determining the operational setting based on a comparison of the detected rotation movement characteristic with a, preferably predefined, rotation movement characteristic threshold.

8. Method according to one of claims 1 to 7, **characterized in that**, the hand-held power tool (1) comprises a sensor arrangement (5), preferably a Hall effect sensor arrangement, for detecting the rotation movement characteristic of the rotating shaft (3), in particular, that a first component (6a), preferably a probe, of the sensor arrangement (5) is arranged laterally with respect to the rotating shaft (3), further preferably, that the first component (6a) is non-rotatably arranged with respect to a casing (7) of the hand-held power tool.

9. Method according to claim 8, **characterized in that** the sensor arrangement (5) comprises a second component (6b), preferably a magnetic field generator, in particular a permanent magnet, non-rotatably arrangeable, preferably non-rotatably arranged, with respect to the rotating shaft (3), in particular arranged on a shaft cover (9), further preferably on a shaft sleeve (10), arranged axially slidable and non-rotatably arrangeable, preferably non-rotatably arranged, with respect to the rotating shaft (3).

10. Method according to claim 9, **characterized in that** the second component (6b) is axially symmetric with regard to the rotating shaft (3), preferably, wherein the second component is rotationally asymmetric with regard to the rotating shaft (3).

11. Method according to claim 9 or 10, **characterized in that** the first component (6a) and the second component (6b) are arranged on a sensing plane (11)

defined axially with respect to the rotating shaft (3), preferably, that the arrangement of the first component (6a) and second component (6b) on the sensing plane (11) is invariant with respect to sliding the shaft cover (9).

12. Method according to one of claims 9 to 11, **characterized in that** the first and second mechanical mode correspond to a first axial position (12a) and a second axial position (12b) of the shaft cover (9) with respect to the rotating shaft (3).

13. Method according to claim 12, **characterized in that**, the hand-held power tool (1) comprises a motor (13) for driving the rotating shaft (3) and that sliding the shaft cover (9) between the first axial position (12a) and second axial position (12b) selectively engages and disengages the motor (13) with the rotating shaft (3) with regard to driving the rotating shaft (3) in a rotating movement

14. Method according to one of claims 1 to 13, **characterized in that**, the hand-held power tool comprises a user-actuatable mechanical switch (20) for switching between the first and second mechanical mode, preferably, wherein the mechanical switch (20) is arranged to slide the shaft cover (9) between the first axial position (12a) and the second axial position (12b) on actuation.

15. Hand-held power tool (1), in particular combi hammer (2), for carrying out the method according to one of claims 1 to 14, the hand-held power tool (1) comprising a rotating shaft (3) and switchable to a first and second mechanical mode for driving the rotating shaft (3).

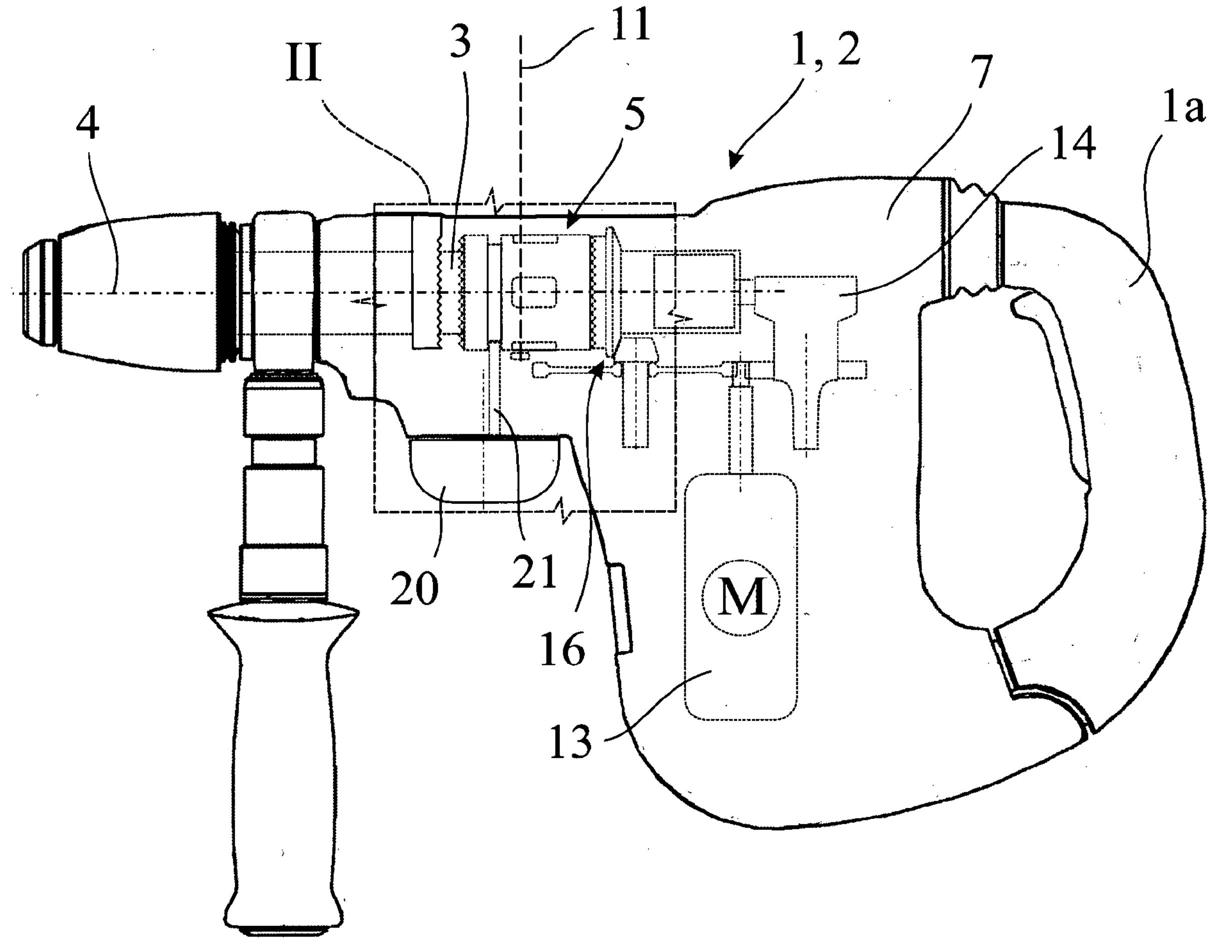

Fig. 1

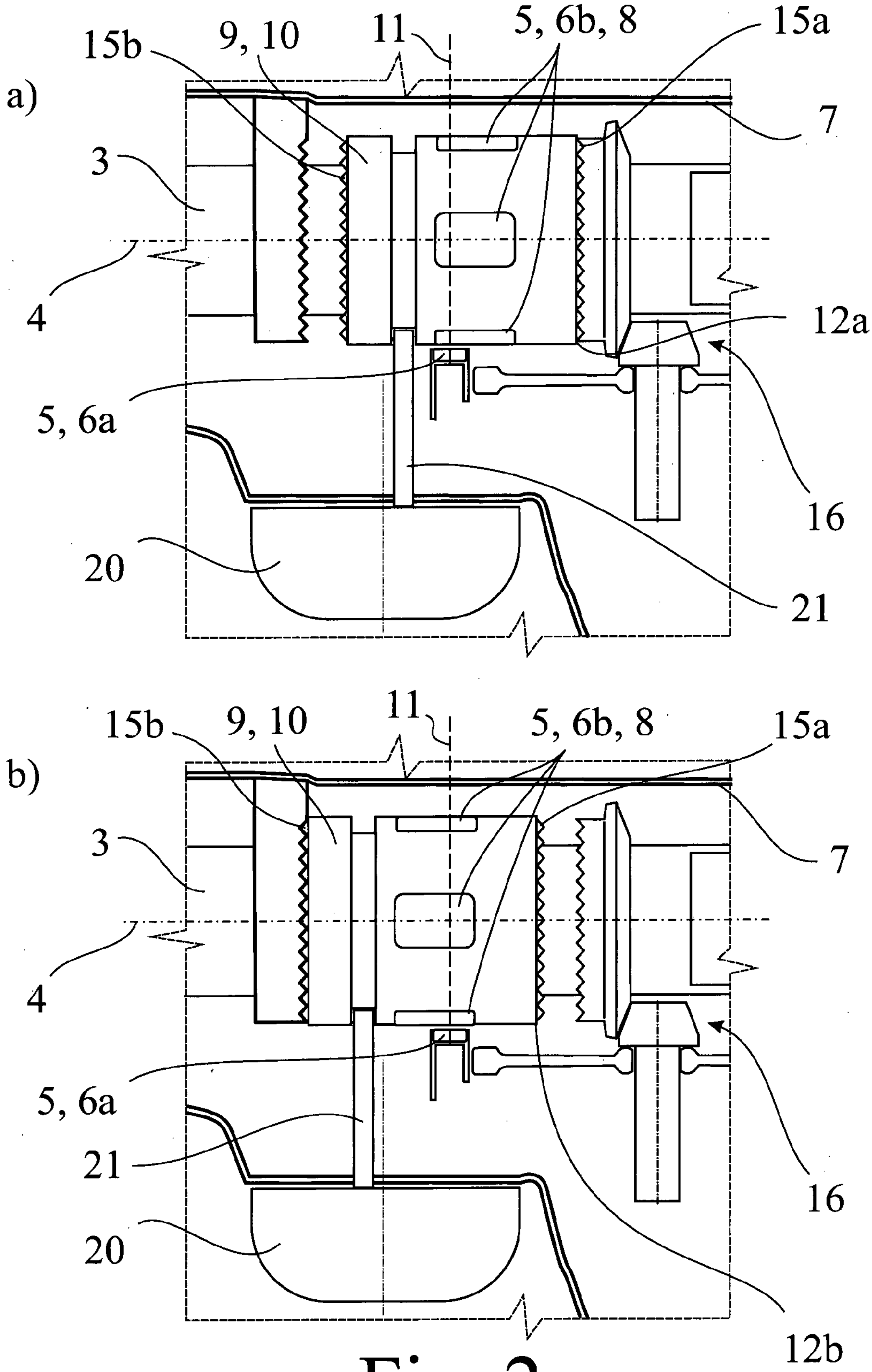
a)
15b
9, 10
11
5, 6b, 8
15a
7
3
4
12a
5, 6a
16
20
21
b)
15b
9, 10
11
5, 6b, 8
15a
7
3
4
5, 6a
16
21
20
12b

Fig. 2

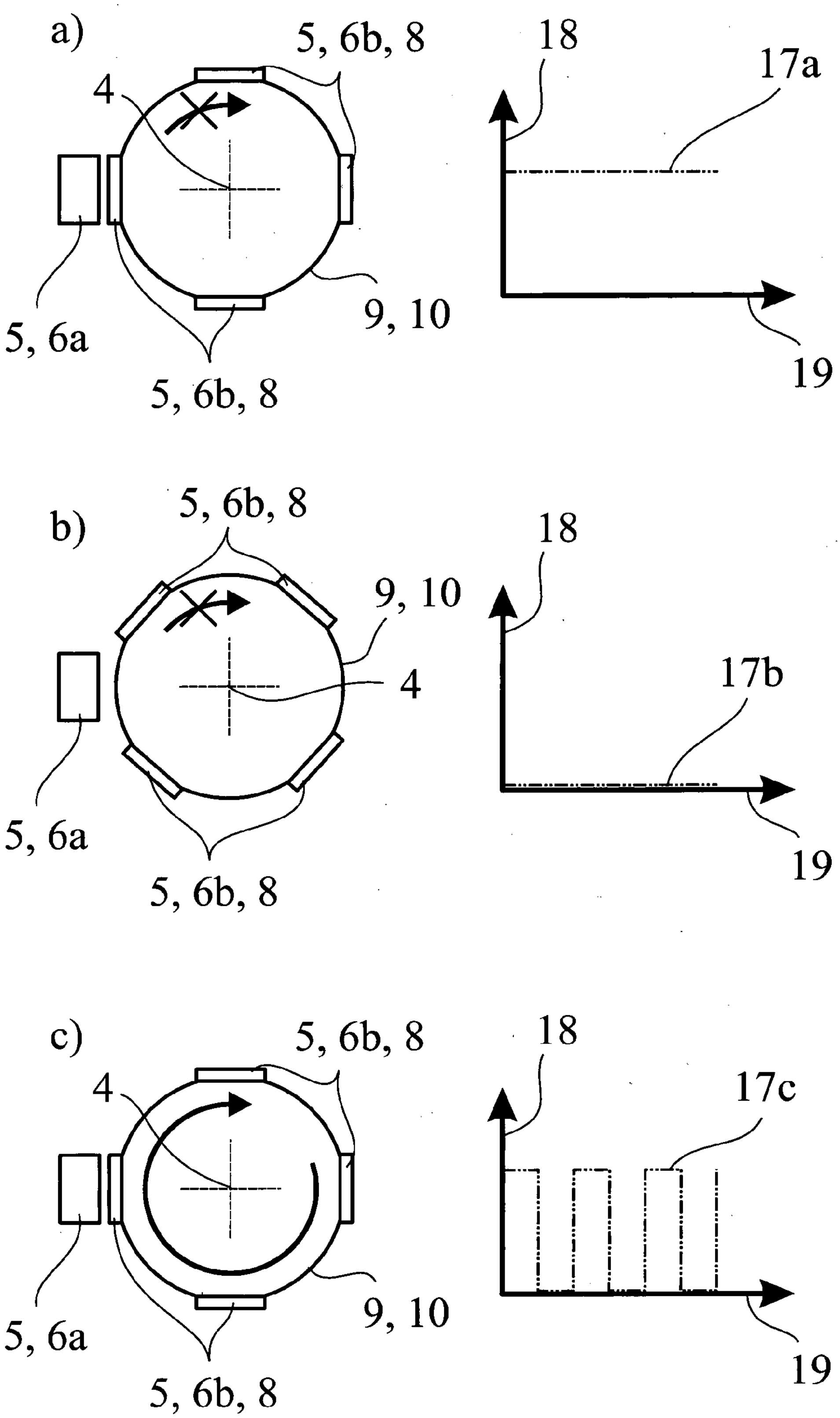
a)
5, 6b, 8
4
5, 6a
5, 6b, 8
9, 10
18
17a
19
b)
5, 6b, 8
9, 10
4
5, 6a
5, 6b, 8
18
17b
19
c)
5, 6b, 8
4
5, 6a
5, 6b, 8
9, 10
18
17c
19

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	12 May 2014	Rilliard, Arnaud

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Application Number
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Place of search	Date of completion of the search	Examiner
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