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(54) Power tool

(57) A power tool (10) includes a motor (21), an output shaft (25), and a power transmission unit (22) that transmits rotational power of the motor to the output shaft. The power transmission unit decreases a rotation speed in accordance with a speed reduction ratio that can be changed. A gear shift actuator (27) changes the speed reduction ratio. A torque detector (41) detects the load torque applied to the output shaft. A control unit (23) controls the gear shift actuator to change the speed reduction ratio of the power transmission unit in accordance with the detected load torque. The control unit stops driving the motor if the detected torque reaches a threshold during a predetermined period from when the power transmission unit increases the speed reduction ratio. The control unit continues driving the motor when the detected load torque does not reach the threshold during the predetermined period.

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Description

[0001] The present invention relates to a power tool.

[0002] Japanese Laid-Open Patent Publication No. 2012-30347 describes an example of a power tool including a power transmission unit, which transmits rotational power generated by a motor, and a control unit, which controls the power transmission unit and automatically changes a speed reduction ratio by shifting gears when transmitting the rotational power. The motor includes an output shaft to which a tool (bit) is coupled. The load torque applied to the output shaft may be detected from a load current (drive current) that is supplied to the motor.

[0003] The power transmission unit is enlarged as the number of gears increases. In a power tool, especially, a portable power tool, it is desirable that the entire tool be reduced in size. This limits the number of gears that may be included in the power transmission unit of the power tool. Thus, the difference in the speed reduction ratio between gears is large.

[0004] In the power tool, when using a drill driver to fasten a screw, the load torque applied to the output shaft increases as the screw becomes fastened. Thus, the control unit controls the power transmission unit and shifts gears to one having a high speed reduction ratio. However, improper fastening of the screw to a fastened portion may lock the tool (output shaft), or lock the motor. This increases the load torque. In such a case, the user receives a large impact when the power tool shifts to a gear having a high speed reduction ratio. In particular, when using a power tool including a power transmission unit with gears having large speed reduction differences, the impact received by the user is further increased immediately after the power tool shifts to a gear that increases the speed reduction ratio.

[0005] To solve this problem, in addition to a threshold set to shift gears and increase the speed reduction ratio, a threshold may be set to determine locking of the motor. It is determined that the motor is locked when the load torque exceeds the gear shifting threshold and reaches the locking threshold. When determined that the motor is locked, the speed reduction ratio of the power transmission unit is not increased. This suppresses large impacts received by the user.

[0006] However, when fastening a screw with the power tool, the load torque increases at the moment the screw is seated. This may produce a condition similar to when the motor locks and thus interrupt the fastening of the screw before completion.

[0007] Accordingly, it is an object of the present invention to provide a power tool that detects motor locking with further accuracy.

[0008] One aspect of the present invention is a power tool including a motor, an output shaft, and a power transmission unit that transmits rotational power of the motor to the output shaft. The power transmission unit decreases a rotation speed, which is related with the rotational power, in accordance with a speed reduction ratio that can be changed. The power tool further includes a gear shift actuator, a torque detector, and a control unit. The gear shift actuator is configured to change the speed reduction ratio of the power transmission unit. The torque detector detects a load torque applied to the output shaft. The control unit controls the gear shift actuator to change the speed reduction ratio of the power transmission unit in accordance with the detected load torque. The control unit stops driving the motor if the detected torque reaches a threshold, which is set to detect locking of the motor, during a predetermined period from when a control is performed on the power transmission unit to increase the speed reduction ratio to when a certain amount of time elapses. The control unit continues driving the motor when the detected load torque does not reach the threshold during the predetermined period.

[0009] In the above configuration, the threshold set to detect locking is set to increase as time elapses after the control unit performs a control to increase the speed reduction ratio. The control unit stops driving the motor when the detected load torque reaches the threshold that is increased as time elapses. The control unit continues driving the motor when the load torque does not reach the threshold that is increased as time elapses.

[0010] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

[0011] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a schematic diagram of a power tool according to one embodiment of the present invention;
Fig. 2 is a diagram illustrating one example of the operation of the power tool shown in Fig. 1;
Fig. 3 is a diagram illustrating an example of the operation of another power tool;
Fig. 4 is a diagram illustrating an example of the operation of a further power tool;
Fig. 5 is a schematic diagram showing a further power tool; and
Fig. 6 is a schematic diagram showing a further power tool.

[0012] One embodiment of a power tool will now be described with reference to the drawings.

[0013] Referring to Fig. 1, a power tool 10 of the present embodiment is used as, for example, a drill driver. The power tool 10 includes a main body 11 and a battery pack 12, which is coupled to the main body 11 in a removable manner. The main body 11 of the power tool 10 includes a motor 21, a power transmission unit 22, and a control unit 23. The motor 21 is driven when supplied with power from the battery pack 12. The power transmission unit 22 transmits rotational power generated by the motor 21 to an output shaft 25. The control unit 23 controls the power tool 10 including the motor 21. The battery pack 12 includes a rechargeable battery formed by battery cells (e.g., lithium-ion cells).

[0014] The motor 21 includes a rotation shaft 24 coupled to the power transmission unit 22, which includes a speed reduction mechanism and a clutch mechanism. The power transmission unit 22, when transmitting the rotational power of the motor 21 to the output shaft 25, decreases a rotation speed, which is related to the rotational power, in accordance with a speed reduction ratio that can be changed. The power transmission unit 22 includes, for example, two gears, namely a high (H) gear and a low (L) gear. Thus, the speed reduction ratio of the power transmission unit 22 may be shifted in two steps. The output shaft 25 includes a distal end to which a tool 26 (bit) is coupled. Accordingly, when the power transmission unit 22 transmits rotational power from the motor 21 to the output shaft 25, the tool 26 is rotated together with the output shaft 25. The L gear of the power transmission unit 22 is set to have a higher speed reduction ratio (lower rotation speed and higher torque) than the H gear.

[0015] The power transmission unit 22 includes a gear shift actuator 27 to change the speed reduction ratio. The gear shift actuator 27 is, for example, a motor actuator and powered when supplied with drive power from a gear shift driver 28 under the control of the control unit 23. The gear shift actuator 27 functions to shift gears of the power transmission unit 22 under the control of the control unit 23 via the gear shift driver 28. The control unit 23 is powered when supplied with voltage-regulated power from the battery pack 12. The gear shift driver 28 is formed by, for example, an H-bridge circuit including a switching element (e.g., FET). The control unit 23 sends a control signal to the gear shift driver 28 to control the rotational direction of the motor 21 with the gear shift actuator 27 and to control the drive power supplied through pulse width modulation (PWM) control.

[0016] The motor 21 is driven to generate rotation when supplied with drive power from a switching drive circuit 29 including, for example, an H-bridge circuit formed by a switching element (e.g., FET). The switching drive circuit 29 receives power from the battery pack 12. The control unit 23 performs PWM control on the switching drive circuit 29 to control the drive power supplied to the motor 21 with the switching drive circuit 29. In other words, the control unit 23 controls the power supplied to the motor 21 with the switching drive circuit 29, and controls the speed of the rotation generated by the motor 21.

[0017] The main body 11 of the power tool 10 includes a trigger switch 31 that may be operated by a user. The trigger switch 31 includes a switch that starts and stops the motor 21 and sends an output signal to the control unit 23 in accordance with the operation amount of the trigger switch 31 (pulled trigger amount). The control unit 23 controls the power supplied to the motor 21 from the switching drive circuit 29 based on the output signal from the trigger switch 31 to start and stop the motor and regulate the rotation speed when operated.

[0018] A current detector 41 is arranged between the switching drive circuit 29 and the motor 21 to detect the load current (drive current) supplied to the motor 21. The current detector 41 includes a detection resistor 42, which is connected between the switching drive circuit 29 and the motor 21, and an amplification circuit 43 (operational amplifier), which amplifies a terminal voltage of the detection resistor 42 as a detection signal and provides the control unit 23 with the detection signal. The control unit 23 detects a load current based on the detection signal from the current detector 41 for each predetermined sampling period. Further, the control unit 23 detects the load torque applied to the output shaft 25 (tool 26) based on the detected load current and the gear of the power transmission unit 22 when the load current is detected. The control unit 23 detects locking of the motor 21 based on the detected load torque and controls the motor 21 accordingly.

[0019] The control unit 23 is configured to control the power transmission unit 22 and perform automatic gear shifting with the gear shift actuator 27 based on the detected load torque. The speed reduction mechanism of the power transmission unit 22 is, for example, a planetary gear speed reduction mechanism that includes a sun gear, which is rotated about the axis of the rotation shaft 24 of the motor 21, planet gears, which is engaged with and arranged around the sun gear, and a ring gear, which is engaged with the planet gear. The gear shift actuator 27 moves the ring gear to change the planet gear that is engaged with the ring gear and thereby control gear shifting. The power tool 10 may include a drive state detector that detects whether the ring gear has been moved to the correct position by the gear shift actuator 27. In such a case, the control unit 23 controls the gear shift actuator 27 based on detection signals from the drive state detector.

[0020] When the user pulls the trigger switch 31 of the power tool 10, the trigger switch 31 provides the control unit 23 with an output signal, which is in correspondence with the pulled amount. The control unit 23 controls the switching drive circuit 29 based on the output signal from the trigger switch 31 to stop and start the motor 21 and control the rotation speed of the motor 21. The power transmission unit 22 transmits the rotational power of the motor 21 to the output shaft 25 to rotate the tool 26. Further, the control unit 23 shifts the power transmission unit 22 to the H gear or the L gear in accordance with the load torque. The power transmission unit 22 selects the H gear when the load torque is small so that the tool 26 is driven at a high rotation speed with a low torque. When activated, the power transmission unit 22 selects the H gear. When the load torque increases and exceeds a predetermined torque, the power transmission unit 22 selects the L gear so that the tool 26 is driven at a low rotation speed with a high torque. Further, based on detection signals from the current detector 41, the control unit 23 detects the locking of the motor 21 and controls the stopping of the motor 21. When the L gear is selected, to determine whether or not the motor 21 is locked, in addition to the load torque (current) detected by the current detector 41, temporal changes in the load torque are also detected.

[0021] The operation of the motor 21 will now be described.

[0022] Based on the load torque detected by the current detector 41, the control unit 23 detects locking of the motor 21.

[0023] Fig. 2 is a graph illustrating the load torque T when the power tool 10 is driven by the H gear, when gears are shifted, and when the power tool 10 is driven by the L gear. For example, when fastening a screw with the power tool 10, the operation starts at time t0. This varies the load torque (load current). More specifically, inrush current flows to the motor 21 when the motor 21 is activated. Then, the load produced by the task that is performed varies the load current. For example, when fastening a screw, the load current increases as the screw becomes seated (head of screw comes into contact with fastened subject). The increase in the load current becomes significant when the screw (fastening length) is longer and when the fastened subject is harder.

[0024] At time t1, the power tool 10 is driven by an H gear, and the load torque T reaches the threshold S1. In this case, the control unit 23 determines that the load torque T satisfies a speed shifting condition and controls the power transmission unit 22 to shift from the H gear to the L gear. Here, the control unit 23 interrupts the supply of power to the motor 21.

[0025] At time t2, an activation current is generated when the control unit 23 restarts the supply of power to the motor 21 after shifting to the L gear. At time t3, after shifting to the L gear and subsequent to the generation of an activation current (inrush current), a timer C starts measuring time.

[0026] A threshold S3 (lock condition) for the load torque T after gear shifting (after shifting to the L gear) is set to allow for the control unit 23 to detect locking of the motor 21. When the load torque T reaches the threshold S3 and the elapsed time measured by the timer C is within a predetermined period (period from time t3 to time t4), the control unit 23 determines that locking has occurred and stops driving the motor 21. After shifting to the L gear and subsequent to the generation of an activation current, or inrush current (time t3), as long as the load torque T does not reach the threshold S3 during the predetermined period (period from time t3 to time t4), the control unit 23 continues driving the motor 21. Here, the timer C measures the time after the activation current is generated. Thus, the activation current is not compared with the threshold S3, and locking of the motor 21 is not determined based on the activation current.

[0027] The advantages of the present embodiment will now be described.

(1) The control unit 23 stops driving the motor 21 when the load torque (load current) reaches the locking threshold S3 set to detect locking of the motor 21. The load torque is detected within a predetermined period (from time t3 to time t4) from when the speed reduction ratio is increased by controlling the power transmission unit 22. The control unit 23 continues driving the motor 21 when the detected load torque does not reach the threshold S3 within the predetermined period (from time t3 to time t4). Lock detection is performed within a predetermined period after shifting to the high torque gear. This reduces the possibility of the user receiving an impact from the power tool 10 caused by locking of the motor 21. Further, after gear shifting, locking detection is not performed after the predetermined period elapses. This ensures that the fastening of a screw is completed (screw is seated). Thus, the locking of the motor 21 may be accurately detected.

(2) The control unit 23 starts measuring time with the timer C from time t3 when inrush current decreases and the load current stabilizes after the shifting of gears. Since the inrush current is not compared with the threshold S3, erroneous locking determination of the motor 21 is not caused by inrush current.

[0028] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms. Particularly, it should be understood that the present invention may be embodied in the following forms.

[0029] In the above embodiment, a single locking threshold S3 is set for the predetermined period from when the timer C starts measuring time (time t3) to time t4. However, predetermined thresholds may be set in accordance with the elapsed time from when the timer C starts measuring time. For example, as shown in Fig. 3, a predetermined period from when the timer C starts measurement (time t5) to time t9 includes four sessions. Four locking thresholds S4a, S4b, S4c, and S4d are respectively set for the four sessions. The threshold S4a used from when the timer C starts measurement (time t5) to when time t6 is reached is set to be lower than the other thresholds S4b, S4c, and S4d. The threshold S4b used from time t6 to time t7 is set to be lower than thresholds S4c and S4d. The threshold S4c used between time t7 and time t8 is lower than the threshold S4d used between time t8 and time t9.

[0030] When determining that the threshold S4a has been reached between time t5 to time t6, the control unit 23 determines that the locking condition has been satisfied and stops driving the motor 21. When the threshold S4a is not reached between time t5 to time t6, the control unit 23 continues to drive the motor 21. When determining that the threshold S4b has been reached between time t6 to time t7, the control unit 23 determines that the locking condition has been satisfied and stops driving the motor 21. When the threshold S4b is not reached between time t6 to time t7, the control unit 23 continues to drive the motor 21. When determining that the threshold S4c has been reached between time t7 to time t8, the control unit 23 determines that the locking condition has been satisfied and stops driving the motor 21. When the threshold S4c is not reached between time t7 to time t8, the control unit 23 continues to drive the motor 21. When determining that the threshold S4d has been reached between time t8 to time t9, the control unit 23 determines that the locking condition has been satisfied and stops driving the motor 21. When the threshold S4d is not reached between time t8 to time t9, the control unit 23 continues to drive the motor 21. Fig. 3 shows an example in which the motor 21 is continuously driven until the fastening of a screw is completed.

[0031] As described above, the thresholds S4a, S4b, S4c, and S4d used to detect locking of the motor 21 are set to increase as time elapses after the control unit 23 executes control to significantly increase the speed reduction ratio. When the load torque reaches the threshold S4a, S4b, S4c, or S4d, the control unit 23 stops driving the motor 21. When the load torque does not reach the thresholds S4a, S4b, S4c, and S4d, the control unit 23 continues driving the motor 21. If the user recognizes that the speed reduction ratio has been changed as time elapses, protection becomes unnecessary. Thus, by gradually moderating (increasing) the locking threshold, the operability may be improved.

[0032] In the above embodiment, when re-driving the motor 21 after shifting to the L gear, the timer C does not start measuring time when inrush current is generated. However, as long as a threshold is set taking into consideration the inrush current as shown in Fig. 4 (i.e., as long as the threshold is set to be greater than the inrush current), time measurement may be started as soon as gears are shifted. In the example shown in Fig. 4, the control unit 23 starts measuring time with the timer C when the motor 21 restarts the driving of the motor 21 (time t2). Then, after the driving of the motor 21 is restarted, the control unit 23 compares the load current (load torque) with threshold S5a until time t10 during which inrush current is generated. The control unit 23 determines that the locking condition is satisfied when the load current (load torque) reaches threshold S5a and stops driving the motor 21. When the load current (load torque) does not reach threshold S5a, the control unit 23 continues driving the motor 21. Then, the control unit 23 compares the load current (load torque) with threshold S5b from time t10 0 to time t5, which is when the inrush current decreases and the load current stabilizes. The control unit 23 determines that the locking condition is satisfied when the load current (load torque) reaches threshold S5b and stops driving the motor 21. When the load current (load torque) does not reach threshold S5b, the control unit 23 continues driving the motor 21.

[0033] This modification obtains advantage (2) of the above embodiment.

[0034] Although not particularly mentioned in the above embodiment, locking detection may be performed when the H gear is selected. For example, as shown by the broken lines in Fig. 2, when the tool 26 (motor 21) becomes locked at time tx1, the load torque T suddenly increases. For the detected load torque T, threshold S1 (gear shifting condition) for shifting from the H gear to the L gear and threshold S2 (locking condition) for detecting locking of the motor 21 are set in the control unit 23. Threshold S2 is set as a larger torque value than threshold S1.

[0035] When the load torque T exceeds threshold S1 within a short period and suddenly increases to threshold S2, the control unit 23 determines that the motor 21 is locked and stops the motor 21 (time tx2). That is, the control unit 23 determines that locking of the motor 21 has occurred when the load torque T exceeds gear shifting threshold S1 within a short period and suddenly increases to threshold S2. When such lock determination is given, the control unit 23 does not shift to the L gear even when the load torque T exceeds the threshold S1.

[0036] Although not particularly mentioned in the above embodiment, as shown in Fig. 1, a rotation detector 51 that detects the rotation speed of the motor 21 may be used to detect locking of the motor 21. The rotation detector 51 is arranged on, for example, the rotation shaft 24 of the motor 21. The rotation detector 51 is fixed to the rotation shaft 24 so as to rotate integrally with the rotation shaft 24. Further, the rotation detector 51 includes a sensor magnet 52, which has a plurality of magnetic poles, and a Hall element 53, which is arranged opposing the sensor magnet 52. The Hall element 53 provides the control unit 23 with a detection signal indicating changes in the magnetic flux caused by rotation of the sensor magnet 52. The control unit 23 detects the rotation speed of the motor 21 based on the detection signal from the rotation detector 51. The control unit 23 also detects locking of the motor 21 from changes in the rotation speed. More specifically, the control unit 23 detects locking based on the rotation speed of the motor 21 that is detected by the rotation detector 51. When the motor 21 locks, the rotation speed of the motor 21 suddenly decreases. Accordingly, the control unit 23 is configured to detect locking based on both of the load torque T and the rotation speed. For example, even when the load torque T exceeds the threshold S2, as long as the rotation speed does not decrease or the decreasing rate of the rotation speed is low, the control unit 23 determines that the motor 21 is not locked. This increases the locking detection accuracy.

[0037] In the above embodiment, the load torque T is indirectly detected from the load current that is supplied to the motor 21. However, there is no limitation to such a structure. For example, the torque applied to the output shaft 25 may be directly measured.

[0038] In the above embodiment, the power tool 10 may include an acceleration sensor that detects movement of the power tool 10 (main body 11) in the rotation direction of the output shaft 25.

[0039] For example, as shown in Fig. 5, in the main body 11 of the power tool 10, the control unit 23 is incorporated in a battery pack support 61 that supports the battery pack 12. An acceleration sensor 62 is arranged on a substrate of the control unit 23. Under a situation in which the tool 26 (output shaft 25) becomes locked thereby causing the power tool 10 to rotate, the acceleration sensor 62 detects movement of the power tool 10 as acceleration and provides the control unit 23 with a detection signal indicating the acceleration. The arrow 63 shown in Fig. 5 indicates the rotation direction of the power tool 10 when locked, and the arrow 64 indicates the direction of the detected acceleration component. This configuration allows for the control unit 23 to determine whether or not locking has caused movement of the power tool, that is, whether or not the motor 21 is locked.

[0040] The acceleration of the power tool 10 increases as the distance from the rotation axis of the tool 26 (output shaft 25) increases. Accordingly, the locking detection accuracy may be increased by arranging the acceleration sensor 62 at a location separated as much as possible from the rotation axis. The acceleration sensor 62 may be arranged between the main body 11 of the power tool 10 and the battery pack 12. Alternatively, the acceleration sensor 62 may be incorporated in the battery pack 12. In each of these cases, the acceleration sensor 62 is configured to send a detection signal to the control unit 23.

[0041] The direction, component, and the like of the acceleration detected by the acceleration sensor 62 may be changed in accordance with the configuration of the power tool 10. For example, Fig. 6 shows a power tool 10 for a saw or the like. In this case, the rotation direction of the tool 26 (circular saw) and the holding style of the power tool 10 differs from the drill driver shown in Fig. 5. Thus, the acceleration component detected by the acceleration sensor 62 is set based on the direction the power tool 10 moves when the motor 21 locks.

[0042] In the above embodiment, the power transmission unit 22 shifts to one of two speed reduction ratios. Instead, the power transmission unit 22 may shift to one of three or more speed reduction ratios.

[0043] In the above embodiment, the gear shift actuator 27 is a motor actuator. However, the drive source does not have to be a motor and may be a solenoid or the like.

[0044] In the above embodiment, the power tool 10 is a drill driver. Instead, the power tool 10 may be of a different type such as an impact driver, an impact wrench, a hammer drill, a vibration drill, a jigsaw, a sealing gun, or the like.

[0045] In the above embodiment, after increasing the speed reduction ratio, the control unit 23 may start measuring timing with the timer C as the load current detected when restarting driving of the motor 21 becomes lower than the threshold set to detect locking of the motor 21.

[0046] This avoids erroneous determination of motor locking based on the inrush current generated when restarting driving of the motor. Thus, locking may be detected with further accuracy.

[0047] The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

Claims

1. A power tool (10) including:

a motor (21);
an output shaft (25);
a power transmission unit (22) that transmits rotational power of the motor (21) to the output shaft (25), wherein the power transmission unit (22) decreases a rotation speed, which is related with the rotational power, in accordance with a speed reduction ratio that can be changed;
a gear shift actuator (27) configured to change the speed reduction ratio of the power transmission unit (22);
a torque detector (41) that detects a load torque applied to the output shaft (25); and
a control unit (23) that controls the gear shift actuator (27) to change the speed reduction ratio of the power transmission unit (22) in accordance with the detected load torque,
the power tool (10) being **characterized in that**:

the control unit (23) stops driving the motor (21) if the detected torque reaches a threshold, which is set to detect locking of the motor (21), during a predetermined period from when a control is performed on the power transmission unit to increase the speed reduction ratio to when a certain amount of time elapses; and
the control unit (23) continues driving the motor (21) when the detected load torque does not reach the threshold during the predetermined period.

2. The power tool (10) according to claim 1, being **characterized in that**:

the threshold set to detect locking is set to vary as time elapses after the control unit (23) performs a control to increase the speed reduction ratio;
the control unit (23) stops driving the motor (21) when the detected load torque reaches the threshold that is varied as time elapses; and
the control unit (23) continues driving the motor (21) when the load torque does not reach the threshold that is varied as time elapses.

3. The power tool (10) according to claim 1, being **characterized in that**:

   the threshold set to detect locking is set to increase as time elapses after the control unit (23) performs a control to increase the speed reduction ratio;
   the control unit (23) stops driving the motor (21) when the detected load torque reaches the threshold that is increased as time elapses; and
   the control unit (23) continues driving the motor (21) when the load torque does not reach the threshold that is increased as time elapses.

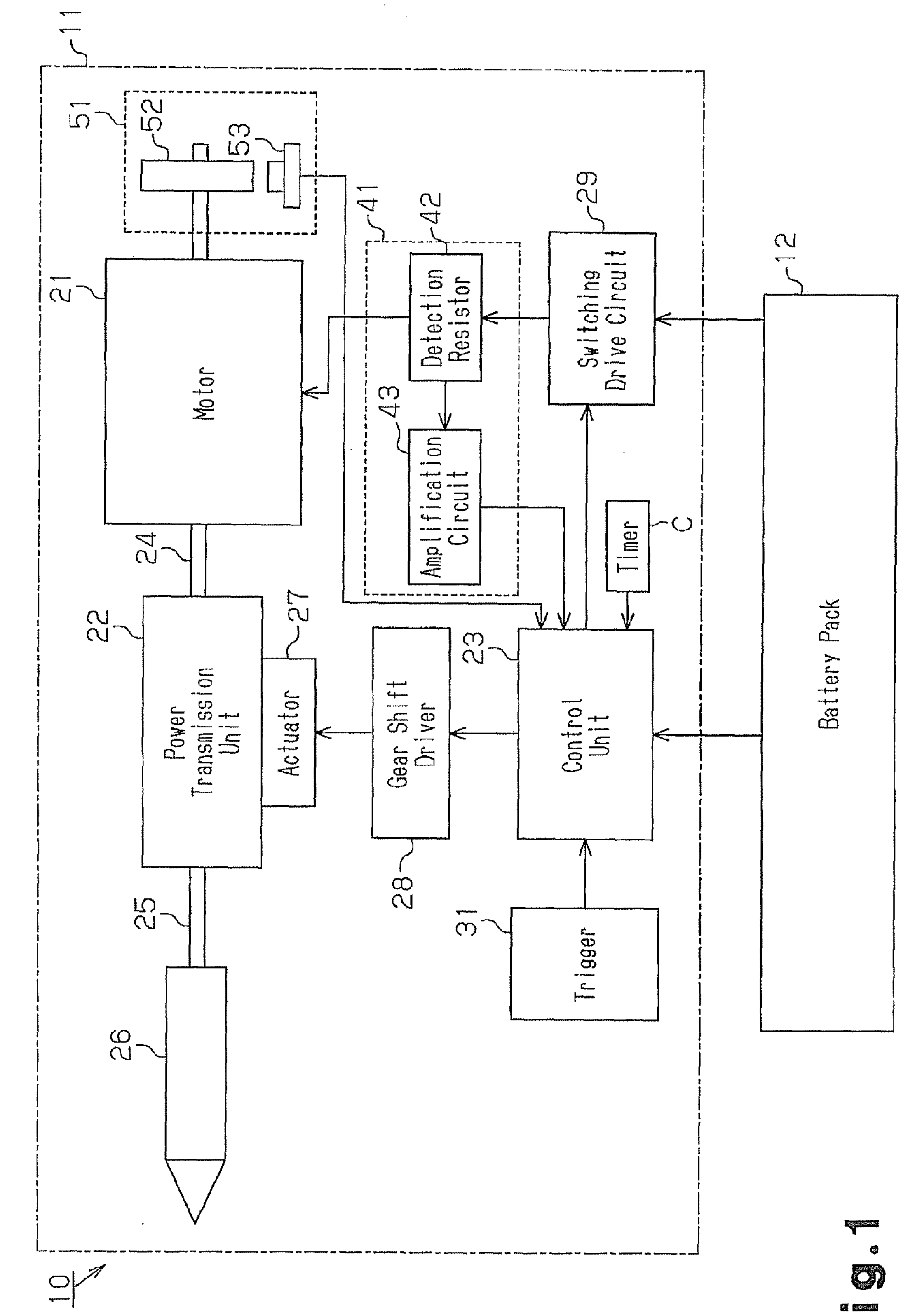
4. The power tool (10) according to claim 3, being **characterized in that**:

   the predetermined period includes a first session (t5-t6), a second session (t6-t7), a third session (t7-t8), and a fourth session (t8-t9);
   the threshold set to detect locking takes a first value (S4a) in the first session (t5-t6), a second value (S4b) in the second session (t6-t7), a third value (S4c) in the third session (t7-t8), and a fourth value (S4d) in the fourth session (t8-t9);
   the first value (S4a) is smaller than the second value (S4b);
   the second value (S4b) is smaller than the third value (S4c); and
   the third value (S4c) is smaller than the fourth value (S4d).

5. The power tool (10) according to any one of claims 1 to 4, being **characterized in that** the control unit (23) further includes a timer (C) that starts measuring time after an inrush current flows to the motor (21) subsequent to when a control for increasing the speed reduction ratio is performed on the power transmission unit (22).

6. The power tool (10) according to any one of claims 1 to 5, being **characterized by**:

   an acceleration sensor (62) that detects acceleration of the power tool (10) and provides the control unit (23) with a detection signal indicating the acceleration;
   wherein the control unit (23) determines whether or not the motor (21) is locked based on the detection signal.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Battery Pack
28
25
31
Trigger
26
10

Fig. 1

Fig.2

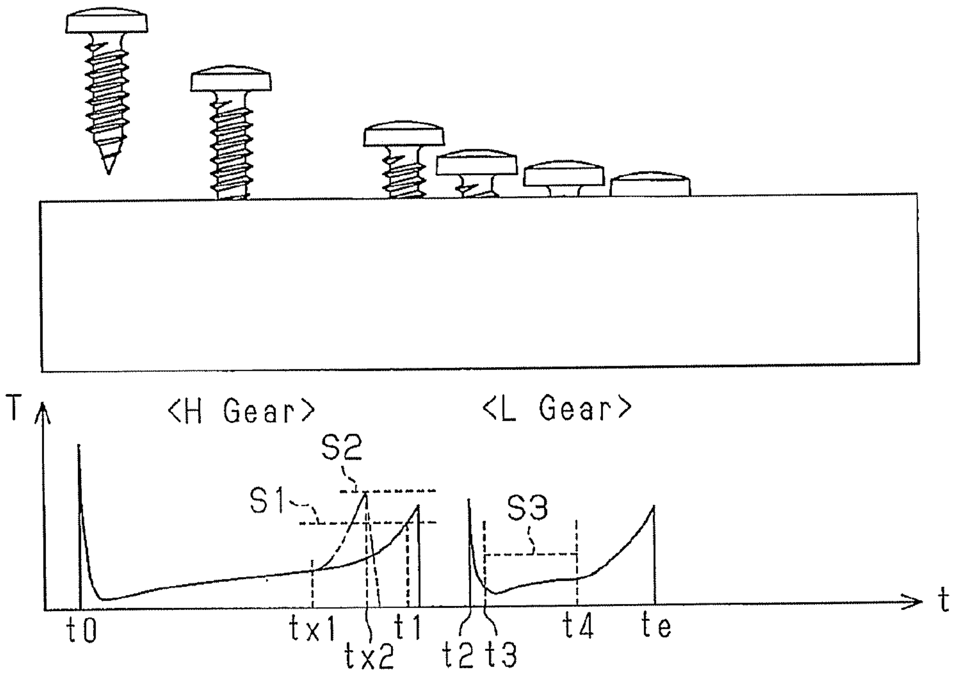
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Fig.3

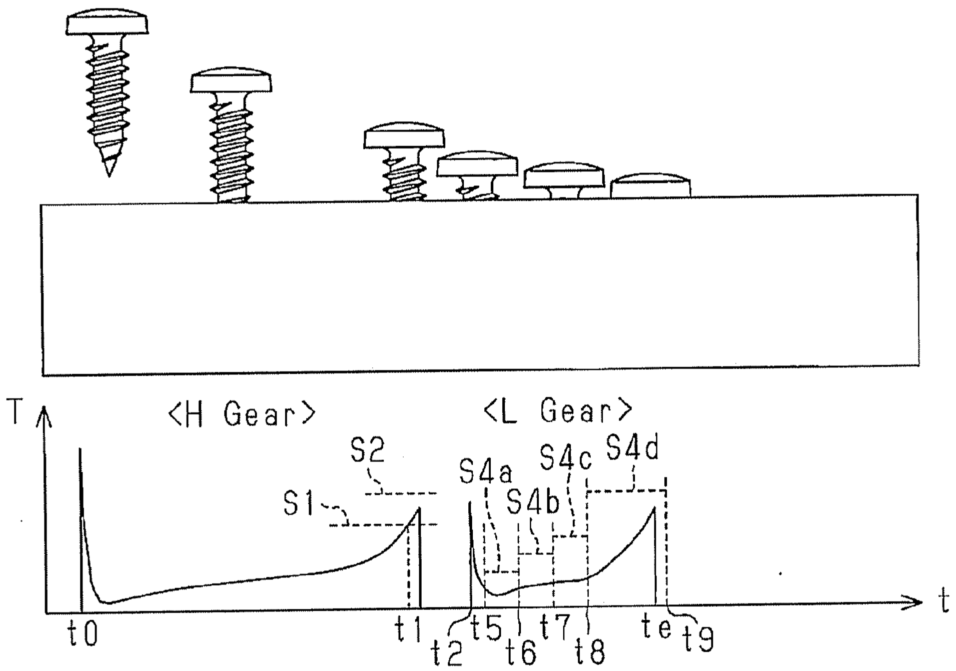
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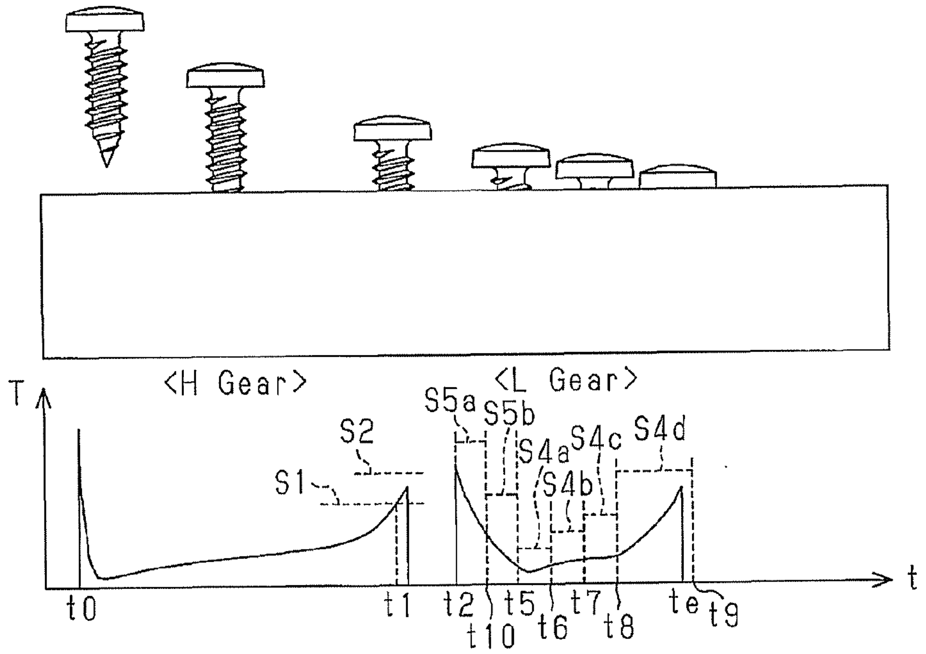
Fig.4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t8
te
t9

Fig.5

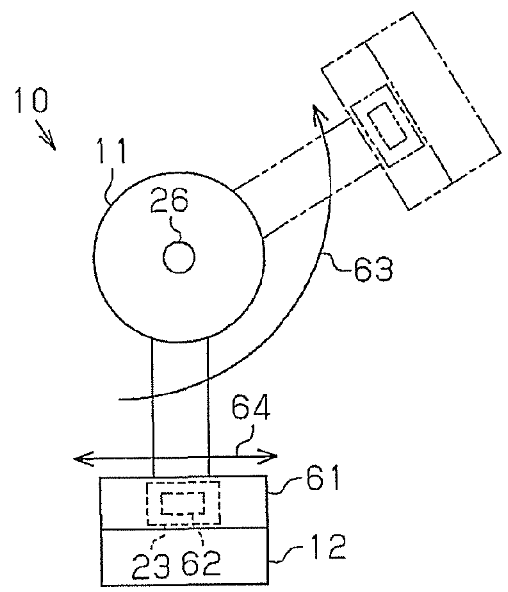
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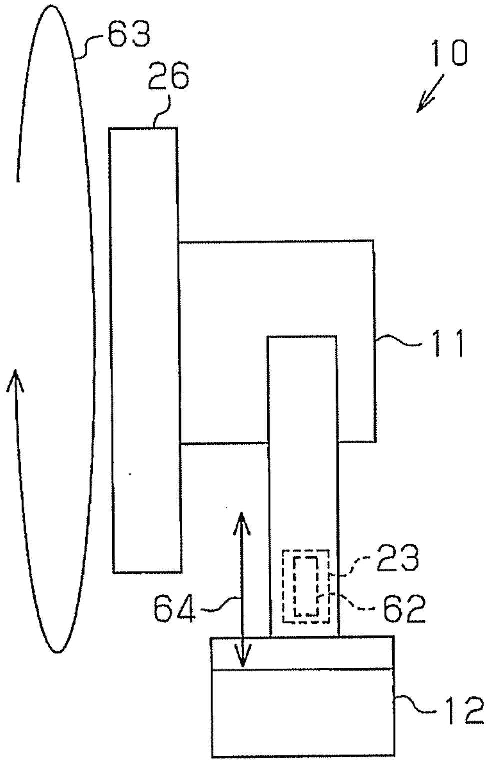
Fig.6



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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 0623

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B25H
B25F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	5 March 2014	Gavaza, Bogdan

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