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(54) FASTENING TOOL FOR SCREW-COUPLING MEMBER

(57) [Technical Problem] Provided is a threaded member tightening tool having a function of temporarily tightening screws.

[Solution to Problem] A motor-driven screwdriver (1) includes a bit holder (18) securely holding a screwdriver bit (16), a drive motor (32) rotationally driving the bit holder, and a control unit (30) controlling the drive of the drive motor. In the motor-driven screwdriver (1), the control unit (30) controls the drive motor (32) such that the bit holder (18) is first rotated forward by a first rotation quantity and then automatically rotated reversely by a second rotation quantity less than the first rotation quantity. The control unit (30) controls the quantity of rotation of the bit holder (32) by controlling the drive time of the drive motor (32). If the forward drive time (first period of time) is set so that the first rotation quantity of the forward drive is a rotation quantity at which the screw will not be seated on a to-be-fastened member, the screw can be temporarily tightened even when using a toothed lock washer or the like, which prevents a once tightened screw from being easily loosened.

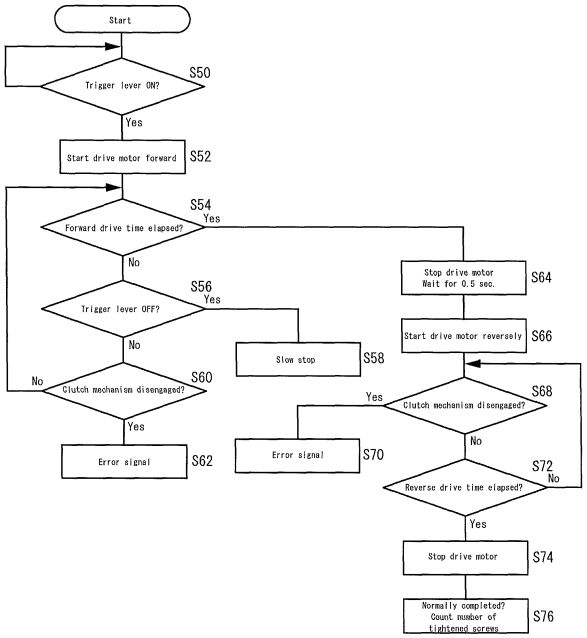

FIG. 4

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Description

Technical Field:

[0001] The present invention relates to a threaded member tightening tool and, more particularly, to a threaded member tightening tool having a function of temporarily tightening threaded members such as screws.

Background Art:

[0002] In an assembling operation in a production line, for example, threaded members such as screws or nuts may be tightened in a temporarily tightened condition, i.e. not completely tightened, with respect to members to be fastened with the threaded members. For example, when a to-be-fastened member is to be fastened with a plurality of screws, these screws are first temporarily tightened, and after final positional adjustment of the to-be-fastened member has been made, the screws are finally tightened, thereby enabling the to-be-fastened member to be fastened and secured in the correct position. Screws for securing terminals in a terminal block are usually in a temporarily tightened condition at the time of product shipment because these screws are intended to be finally tightened by each individual user after connecting terminals.

[0003] In a screw tightening operation in a production line, a motor-driven screwdriver such as that disclosed in Patent Literature 1 noted below is usually used. When performing a temporary screw tightening operation with such a motor-driven screwdriver, it is often the case that the operator stops the motor-driven screwdriver by actuating a lever before the screw is completely tightened.

Citation List:

Patent Literature:

[0004] Patent Literature 1: Japanese Patent No. 3992676

Summary of Invention:

Technical Problem:

[0005] However, if a threaded member is temporarily tightened by depending on the operator's intuitive operation as stated above, there is a possibility that the threaded member may be mistakenly tightened completely. If a threaded member is undesirably tightened completely, the threaded member needs to be loosened after a forward-reverse rotation switch has been changed over so as to reversely drive the threaded member tightening tool such as a motor-driven screwdriver, which is troublesome. When a toothed lock washer is used as a washer, for example, once a threaded member has been tightened completely, the threaded member cannot be easily loosened, and it becomes impossible to temporarily tighten the threaded members practically.

[0006] The present invention has been made in view of the above-described circumstances, and an object of the present invention is to provide a threaded member tightening tool having a function of temporarily tightening threaded members, which enables a threaded member to be temporarily tightened without depending on the operator's intuitive operation.

Solution to Problem:

[0007] The present invention provides a threaded member tightening tool having a function of temporarily tightening a threaded member. The threaded member tightening tool includes the following: a threaded member engaging unit engageable with the threaded member; a drive unit rotationally driving the threaded member engaging unit; and a control unit controlling the drive of the drive unit. The control unit controls the drive unit such that the threaded member engaging unit is first rotated forward by a first rotation quantity and then automatically rotated reversely by a second rotation quantity less than the first rotation quantity.

[0008] In the threaded member tightening tool, the threaded member engaging unit is automatically rotated reversely by the second rotation quantity after being rotated forward by the first rotation quantity. Therefore, if the first and second rotation quantities have been set appropriately in accordance with each threaded member to be used, threaded members can be temporarily tightened without depending on the operator's intuitive operation.

[0009] The control unit may be configured as follows. The control unit controls the quantity of rotation of the threaded member engaging unit by controlling the drive time of the drive unit such that the control unit first drives the drive unit forward for a first period of time, thereby rotating the threaded member engaging unit forward by the first rotation quantity, and then drives the drive unit reversely for a second period of time, thereby rotating the threaded member engaging unit reversely by the second rotation quantity. The first period of time may be set so that the first rotation quantity is a rotation quantity at which the threaded member will not be seated on a to-be-fastened member.

[0010] Because the first period of time is set so that the first rotation quantity is a rotation quantity at which the threaded member will not be seated on a to-be-fastened member, even when a toothed lock washer is used, for example, there is no possibility that the threaded member may be undesirably seated on and secured by the toothed lock washer. Further, when the threaded member is a screw or bolt, if the first period of time is set so that the first rotation quantity is a rotation quantity at which the screw or the like is tightened to a position immediately in front of where the head of the screw or the

like contacts the toothed lock washer, it is also possible to tighten the screw or the like in a temporarily tightened condition in which the head of the screw or the like is unseated from the to-be-fastened member by a predetermined quantity while confirming whether or not the internal thread has been formed as far as the innermost part.

[0011] Preferably, the threaded member tightening tool may further include a torque detecting device detecting that a load torque greater than a predetermined value has been applied to the threaded member engaging unit. The control unit may stop the drive unit when the torque detecting device detects a load torque greater than the predetermined value while the drive unit is being controlled so as to rotate the threaded member engaging unit forward by the first rotation quantity.

[0012] Further, the arrangement may be as follows. The first rotation quantity is a rotation quantity at which the threaded member engaging unit is rotated until the threaded member is tightened by a predetermined tightening torque after being seated on a to-be-fastened member. The control unit is configured such that the threaded member engaging unit is first rotated by the first rotation quantity, thereby seating the threaded member on the to-be-fastened member and further applying a predetermined tightening torque to the seated threaded member, and then the threaded member engaging unit is automatically rotated reversely by the second rotation quantity.

[0013] Because each threaded member is temporarily seated on the to-be-fastened member, threaded members can be temporarily tightened at a uniform position, independently of variations in the length of threaded members and variations in the initial placement condition of threaded members. Further, application of a predetermined tightening torque to the seated threaded member enables the bearing surface condition to be stabilized and makes it possible to tighten the threaded member even more stably at the time of final tightening performed after temporary tightening. That is, when the bearing surface has burrs, for example, the burrs on the bearing surface can be flattened by application of a predetermined tightening torque during temporary tightening. Therefore, a load due to burrs can be reduced at the time of final tightening. When the bearing surface is soft, for example, the bearing surface is crushed once by application of a predetermined tightening torque during temporary tightening. Therefore, at the time of final tightening, the bearing surface need not be crushed, and final tightening can be surely performed without the possibility of the screw being undesirably unseated.

[0014] Preferably, the threaded member tightening tool may further include a clutch mechanism and a clutch sensor. The clutch mechanism drivably connects the drive unit and the threaded member engaging unit. The clutch mechanism is configured such that the drivable connection between the drive unit and the threaded member engaging unit is cancelled when a torque greater than the predetermined tightening torque is applied to the threaded member engaging unit. The clutch sensor detects that the drivable connection through the clutch mechanism has been canceled. The control unit may be configured to judge that the threaded member engaging unit has been rotated forward by the first rotation quantity when the clutch sensor detects cancellation of the drivable connection.

[0015] The clutch mechanism makes it possible to prevent application of an excessive load to the threaded member and the to-be-fastened member.

[0016] The control unit may be configured to allow selection between a time control mode and a torque control mode. In the time control mode, the control unit controls the quantity of rotation of the threaded member engaging unit by controlling the drive time of the drive unit such that the control unit first drives the drive unit forward for a first period of time, thereby rotating the threaded member engaging unit forward by the first rotation quantity, and then drives the drive unit reversely for a second period of time, thereby rotating the threaded member engaging unit reversely by the second rotation quantity. The first period of time is set so that the first rotation quantity is a rotation quantity at which the threaded member will not be seated on a to-be-fastened member. In the torque control mode, the first rotation quantity is a rotation quantity by which the threaded member is rotated so that the threaded member has been tightened by a predetermined tightening torque after being seated on a to-be-fastened member. In the torque control mode, the threaded member engaging unit is first rotated by the first rotation quantity, thereby seating the threaded member on the to-be-fastened member and further applying a predetermined tightening torque to the seated threaded member, and then the threaded member engaging unit is automatically rotated reversely by the second rotation quantity.

[0017] The threaded member tightening tool may further include a counter unit counting the number of threaded members normally temporarily tightened by judging that a temporary tightening has been normally completed when the threaded member engaging unit has been first rotated forward by the first rotation quantity and then automatically rotated reversely by the second rotation quantity. The provision of the counter unit makes it possible to know the number of threaded members normally temporarily tightened.

[0018] Preferably, the threaded member tightening tool may further include a remote setting device configured to change set values of the first and second rotation quantities through wireless communication with the control unit.

[0019] One embodiment of a threaded member tightening tool according to the present invention will be explained below on the basis of the accompanying drawings. Brief Description of Drawings:

[0020]

Fig. 1 is an external view of a motor-driven screwdriver according to the embodiment of the present invention.

Fig. 2 is a circuit block diagram of the motor-driven screwdriver shown in Fig. 1.

Fig. 3 is a control flow chart showing a torque control mode of a temporary tightening mode.

Fig. 4 is a control flow chart showing a time control mode of the temporary tightening mode.

Description of Embodiments:

[0021] As shown in Fig. 1, the motor-driven screwdriver 1 according to the embodiment of the present invention includes a motor-driven screwdriver body 10 and a remote setting unit 12.

[0022] The motor-driven screwdriver body 10 includes a housing 14, a screwdriver bit 16 engageable with a screw, a bit holder 18 detachably and securely holding the screwdriver bit 16, a trigger lever 20 actuated to start and stop the drive of the bit holder 18, a forward-reverse rotation changeover switch 22 used to change over the rotational direction of the bit holder 18, and an operation display unit 24 secured to the housing 14. The housing 14 has therein, as shown in Fig. 2, a control unit 30 comprising a main control section 26 and a motor control section 28, and a drive motor 32 that is drive-controlled by the motor control section 28. The bit holder18 is rotationally driven by the drive motor 32 drive-controlled by the motor control section 28. The rotational direction of the bit holder18 can be changed by changing over the forward-reverse rotation changeover switch 22 among "forward" (R), "neutral" and "reverse" (L) to thereby change the rotational direction of the drive motor 32. Between the drive motor 32 and the bit holder18 is provided a clutch mechanism (not shown) to drivably connect the drive motor 32 and the bit holder18. When a torque exceeding a predetermined tightening torque used to finally tighten a screw is applied to the bit holder 18, the clutch mechanism is activated to cancel the drivable connection between the drive motor 32 and the bit holder 18. The housing 14 further has therein a clutch sensor 34 detecting that the drivable connection through the clutch mechanism has been cancelled, a counter unit 36 counting the number of screws finally tightened and temporarily tightened, and an infrared receiving unit 38 receiving infrared signals from the remote setting unit 12.

[0023] As shown in Fig. 1, on the operation display unit 24 are disposed an LED display part 40, a 7-segment display part 42, and various operation buttons 44. The LED display part 40 displays operating statuses of the motor-driven screwdriver 1 with LED colors. The 7-segment display part 42 displays set parameters at the time of parameter setting and also displays, when any error occurs, a number or the like corresponding to the error. With the various operation buttons 44, the settings of the motor-driven screwdriver body 10 can be changed, and the motor-driven screwdriver body 10 can be switched over among a normal drive mode, a temporary tightening mode, an infrared communicating mode, a screwdriver body setting mode, and a screw tightening time measuring mode, which will be described later.

[0024] The remote setting unit 12 includes an infrared transmitting unit 46 transmitting infrared signals to the infrared receiving unit 38 of the motor-driven screwdriver body 10, a button operating unit 48, a liquid crystal display unit 50, and a control unit 52 controlling these units. The remote setting unit 12 is used when the motor-driven screwdriver body 10 has been switched to an infrared communication mode, to change various settings of the motor-driven screwdriver body 10 through infrared communication with the main control section 26 of the motor-driven screwdriver body 10. The remote setting unit 12 enables more detailed settings to be made as compared to setting items that can be set through the operation display unit 24 of the motor-driven screwdriver body 10.

[0025] The motor-driven screwdriver body 10 enters into a password input state in response to turning on the power supply and shifts to the normal drive mode, which is a drivable state, when a preset password is entered. It should be noted that setting of a password is optional and that the motor-driven screwdriver body 10 may be shifted to the normal drive mode immediately when the power supply is turned on, without entering a password.

[0026] In the normal drive mode, when the trigger lever 20 is turned on in a state where the forward-reverse rotation changeover switch 22 is placed in the forward (R) or reverse (L) position, and where the screwdriver bit 16 is pressed against the head of a screw in an initial placement condition (i.e. a state where the distal end of the screw is engaged with an internal thread of a to-be-fastened member), the drive motor 32 is controlled so that the bit holder 18 is rotated in a direction that has been selected through the forward-reverse rotation changeover switch 22. When the trigger lever 20 is turned off, the drive motor 32 is stopped, and the rotation of the bit holder 18 is stopped. It should, however, be noted that even when the trigger lever 20 is maintained in an on state, if an overcurrent is detected flowing through the drive motor 32, or if the forward-reverse rotation changeover switch 22 is activated, or if the drive has been continued in excess of a predetermined maximum drive time, it is judged that an error has occurred, and the drive motor 32 is forcedly stopped to stop the rotation of the bit holder18. Also when the trigger lever 20 is turned off before a predetermined minimum drive time has elapsed, an error signal is delivered, and the drive motor 32 is forcedly stopped. When an error occurs, an indication corresponding to the error is displayed on the 7-segment display part. When the drive motor 32 is normally stopped without an error, it is judged that final tightening of the screw has been normally completed, and the counter unit 36 updates the number of screws finally tightened.

[0027] In the temporary tightening mode, when the trigger lever 20 is turned on, the control unit 30 controls the drive motor 32 such that the bit holder 18 is first rotated

forward by a predetermined first rotation quantity and then automatically rotated reversely by a predetermined second rotation quantity less than the first rotation quantity. The temporary tightening mode, more particularly, comprises two control modes. One of the two control modes is a torque control mode in which the bit holder18 is judged to have been rotated forward by a first rotation quantity when the clutch sensor 34 detects that the clutch mechanism has been disengaged as a result of application of a predetermined tightening torque to a screw seated on a to-be-fastened member (i.e. the head of the screw is engaged with the to-be-fastened member) (Fig. 3). The other is a time control mode in which the bit holder18 is judged to have been rotated forward by a first rotation quantity when the drive motor 32 has been driven for a predetermined period of time (Fig. 4). The control unit 30 may be configured to enable the torque control mode and the time control mode to be selectively changed through a switching mechanism (not shown). Alternatively, the control unit 30 may be configured to perform control in only either of the torque control mode or the time control mode.

[0028] In the torque control mode of the temporary tightening mode, as shown in Fig. 3, when the trigger lever 20 is turned on (S10), the control unit 30 starts to drive the drive motor 32 in the forward direction, and the bit holder18 is started to be rotated forward (S12). If the trigger lever 20 is turned off during the forward rotation of the bit holder18 (S14), the drive motor 32 is gradually stopped (S16). When the screw is seated, the bit holder18 is subjected to a load torque, and when the load torque exceeds a predetermined tightening torque, the clutch mechanism is disengaged. The control unit judges that the bit holder18 has been rotated by a first rotation quantity when the clutch mechanism is disengaged as stated above and the disengagement of the clutch mechanism is detected by the clutch sensor 34 (S18). When the clutch mechanism is disengaged, the control unit 30 stops the drive of the drive motor 32 for a predetermined time, e.g. 0.5 sec. (S20). After the stop for a predetermined time, the drive motor 32 is started to be driven in the reverse direction, and the bit holder18 is automatically started to be rotated reversely (S22). The control unit 30 judges that the bit holder18 has been rotated by a second rotation quantity when a predetermined time has elapsed from starting the reverse rotation of the bit holder 18 (S28). If the bit holder18 fails to be rotated reversely due to biting of the screw, for example, a load torque greater than a predetermined value is applied to the bit holder18, causing the clutch mechanism to be disengaged. When the clutch sensor 34 detects the disengagement of the clutch mechanism before a predetermined reverse drive time has elapsed (S24), an error signal is delivered, and the drive motor 32 is stopped (S26). When the predetermined reverse drive time has elapsed from starting the reverse rotation (S28), the drive motor 32 is stopped, and consequently, the rotational drive of the bit holder18 is also stopped (S30). In this way, the screw is temporarily tightened in a state where the head thereof is unseated from the to-be-fastened member by a predetermined quantity. Thus, each screw is untightened by a predetermined quantity (second rotation quantity) after having been once tightened. Therefore, a plurality of screws can be temporarily tightened in a state where the heads of the screws are unseated from the to-be-fastened member by a substantially uniform quantity, independently of variations in the length of screws and variations in the initial placement condition of screws (initial placement condition is a state where each screw is engaged at its distal end with an internal thread of a to-be-fastened member before being tightened). When the temporary tightening of the screw has been normally completed, the counter unit 36 updates the number of temporarily tightened screws (S32). In this embodiment, it is judged that the bit holder 18 has been rotated reversely by the second rotation quantity when a predetermined time has elapsed from starting the reverse rotation. However, the arrangement may also be such that a predetermined number of revolutions has previously been set as the second rotation quantity, and the predetermined number of revolutions is counted to judge that the bit holderl 8 has been rotated reversely by the second rotation quantity.

[0029] In the time control mode of the temporary tightening mode, as shown in Fig. 4, when the trigger lever 20 is turned on (S50), the control unit 30 starts to drive the drive motor 32 in the forward direction, and the bit holder18 is started to be rotated forward (S52). If the trigger lever 20 is turned off before a predetermined forward drive time (first period of time) has elapsed from turning on the trigger lever 20 (S56), the drive motor 32 is gradually stopped (S58). If a load torque greater than a predetermined value is applied to the bit holder 18 during forward driving due, for example, to incomplete formation of the internal thread, the clutch mechanism is disengaged. When the clutch sensor 34 detects the disengagement of the clutch mechanism (S60), an error signal is delivered, and the drive motor 32 is stopped (S62). When the predetermined forward drive time (first period of time) has elapsed (S54), the drive motor 32 is temporarily stopped to wait for 0.5 sec. (S64). After the waiting, the drive motor 32 is started to be driven in the reverse direction by the control unit, and the bit holder18 is automatically started to be rotated reversely (S66). If the clutch sensor 34 detects disengagement of the clutch mechanism due to the application of a load torque greater than a predetermined value to the bit holder18 during the reverse drive (S68), an error signal is delivered, and the drive motor 32 is stopped (S70). When a predetermined reverse drive time (second period of time) shorter than the forward drive time (first period of time) has elapsed from starting the reverse rotation (S72), the drive motor 32 is stopped (S74). Thus, the bit holder18 is first rotated forward by a predetermined first rotation quantity and then rotated reversely by a second rotation quantity less than the first rotation quantity; therefore, the screw is tem-

porarily tightened in a state where the head thereof is unseated from the to-be-fastened member by a predetermined quantity. When the time control mode is selected, the forward drive time (first period of time) is set so that the first rotation quantity is a rotation quantity at which the screw will not be seated on the to-be-fastened member. By so doing, the screw can be temporarily tightened without being seated on the to-be-fastened member. Therefore, the screw can be temporarily tightened even when using such a member as a toothed lock washer, which prevents a once tightened screw from being easily loosened. Further, by setting the first rotation quantity to a rotation quantity at which the screw is tightened to a position immediately in front of where the screw will be seated, whether or not the internal thread has been correctly formed can be checked through as far as a deeper position. When the temporary tightening of the screw has been normally completed, the counter unit 36 updates the number of temporarily tightened screws (S76).

[0030] When the motor-driven screwdriver body 10 is switched to the infrared receiving mode, it becomes possible to perform infrared communication with the remote setting unit 12. That is, it is possible with the remote setting unit 12 to change the settings of the driving speed, forward drive time (first period of time) and reverse drive time (second period of time) of the drive motor 32. When the motor-driven screwdriver body 10 is switched to the screwdriver body setting mode, it becomes possible to change the above-described various settings through the operation display unit 24 of the motor-driven screwdriver body 10.

[0031] In the screw tightening time measuring mode, times required to tighten screws actually used in a production line are measured, thereby making it possible to set the above-described maximum drive time and minimum drive time. Specifically, time required to actually tighten a screw from turning on the trigger lever 20 is automatically measured, and if the measured time is greater than the already-measured maximum drive time, the maximum drive time is updated by the measured time. If the measured time is less than the already-set minimum drive time, the minimum drive time is updated by the measured time. By performing such an operation for a plurality of screws, it is possible to appropriately set a range of drive time for judging that final tightening has been normally completed in the normal drive mode.

[0032] In the foregoing embodiment, a combination of the clutch mechanism and the clutch sensor 34 is used as a torque detecting device for detecting a torque applied to the bit holder18. However, it is also possible to measure the torque with a torque sensor or to determine the torque by measuring an electric current flowing through the drive motor 32. Further, the control unit 30 and the counter unit 36 may be disposed outside the motor-driven screwdriver body 10 and wired-connected to the motor-driven screwdriver body 10. Further, although the remote setting unit 12 communicates with the control unit 30 of the motor-driven screwdriver body 10 through optical wireless communication using infrared rays, it is also possible to perform wireless communication using electromagnetic waves in other frequency bands.

[0033] Although the foregoing embodiment shows a motor-driven screwdriver using the electric drive motor 32 as the drive unit rotationally driving the bit holder 18, it is also possible to use a pneumatic screwdriver having an air motor using compressed air as a drive source. In such a case, the pneumatic screwdriver may be provided with an electromagnetic valve controlling compressed air to be supplied to the air motor, and the electromagnetic valve may be controlled by the control unit. Further, threaded members to be temporarily tightened and finally tightened are not limited to cross recessed screws but may be other threaded members such as hexagon socket head bolts and nuts. In such a case, the screwdriver bit 16 as the threaded member engaging unit is replaced with other types of threaded member engaging units, e.g. screwdriver sockets, in accordance with threaded members to be tightened. The threaded member engaging unit may be securely held to the tool body so as not to be detachable therefrom.

List of Reference Signs:

[0034] Motor-driven screwdriver 1; motor-driven screwdriver body 10; remote setting unit 12; housing 14; screwdriver bit 16; bit holder18; trigger lever 20; forward-reverse rotation changeover switch 22; operation display unit 24; main control section 26; motor control section 28; control unit 30; drive motor 32; clutch sensor 34; counter unit 36; infrared receiving unit 38; LED display part 40; 7-segment display part 42; various operation buttons 44; infrared transmitting unit 46; button operating unit 48; liquid crystal display unit 50; control unit 52.

Claims

1. A threaded member tightening tool having a function of temporarily tightening a threaded member, the threaded member tightening tool comprising:

   a threaded member engaging unit engageable with the threaded member;
   a drive unit rotationally driving the threaded member engaging unit; and
   a control unit controlling drive of the drive unit;
   wherein the control unit controls the drive unit such that the threaded member engaging unit is first rotated forward by a first rotation quantity and then automatically rotated reversely by a second rotation quantity less than the first rotation quantity.

2. The threaded member tightening tool of claim 1, wherein the control unit controls a quantity of rotation

of the threaded member engaging unit by controlling a drive time of the drive unit such that the control unit first drives the drive unit forward for a first period of time, thereby rotating the threaded member engaging unit forward by the first rotation quantity, and then drives the drive unit reversely for a second period of time, thereby rotating the threaded member engaging unit reversely by the second rotation quantity, the first period of time being set so that the first rotation quantity is a rotation quantity at which the threaded member will not be seated on a to-be-fastened member.

3. The threaded member tightening tool of claim 2, further comprising:

a torque detecting device detecting that a load torque greater than a predetermined value has been applied to the threaded member engaging unit;
wherein the control unit stops the drive unit when the torque detecting device detects a load torque greater than the predetermined value while the drive unit is being controlled so as to rotate the threaded member engaging unit forward by the first rotation quantity.

4. The threaded member tightening tool of claim 1, wherein the first rotation quantity is a rotation quantity by which the threaded member is rotated so that the threaded member is tightened by a predetermined tightening torque after being seated on a to-be-fastened member;
the control unit being configured such that the threaded member engaging unit is first rotated by the first rotation quantity, thereby seating the threaded member on the to-be-fastened member and further applying a predetermined tightening torque to the seated threaded member, and then the threaded member engaging unit is automatically rotated reversely by the second rotation quantity.

5. The threaded member tightening tool of claim 4, further comprising:

a clutch mechanism drivably connecting the drive unit and the threaded member engaging unit, the clutch mechanism being configured such that a drivable connection between the drive unit and the threaded member engaging unit is cancelled when a torque greater than the predetermined tightening torque is applied to the threaded member engaging unit; and
a clutch sensor detecting that the drivable connection through the clutch mechanism has been canceled;
wherein the control unit judges that the threaded member engaging unit has been rotated forward by the first rotation quantity when the clutch sensor detects cancellation of the drivable connection.

6. The threaded member tightening tool of claim 5, wherein the threaded member engaging unit is judged to have been rotated by the second rotation quantity when a predetermined time has elapsed from starting reverse rotation of the threaded member engaging unit.

7. The threaded member tightening tool of claim 1, wherein the control unit allows selection between:

a time control mode in which the control unit controls a quantity of rotation of the threaded member engaging unit by controlling a drive time of the drive unit such that the control unit first drives the drive unit forward for a first period of time, thereby rotating the threaded member engaging unit forward by the first rotation quantity, and then drives the drive unit reversely for a second period of time, thereby rotating the threaded member engaging unit reversely by the second rotation quantity, the first period of time being set so that the first rotation quantity is a rotation quantity at which the threaded member will not be seated on a to-be-fastened member; and
a torque control mode in which the first rotation quantity is a rotation quantity by which the threaded member is rotated so that the threaded member is tightened by a predetermined tightening torque after being seated on a to-be-fastened member, and in which the threaded member engaging unit is first rotated by the first rotation quantity, thereby seating the threaded member on the to-be-fastened member and further applying a predetermined tightening torque to the seated threaded member, and then the threaded member engaging unit is automatically rotated reversely by the second rotation quantity.

8. The threaded member tightening tool of any one of claims 1 to 7, further comprising:

a counter unit counting a number of threaded members normally temporarily tightened by judging that a temporary tightening has been normally completed when the threaded member engaging unit has been first rotated forward by the first rotation quantity and then automatically rotated reversely by the second rotation quantity.

9. The threaded member tightening tool of any one of claims 1 to 8, further comprising:

a remote setting device configured to change set values of the first and second rotation quantities through wireless communication with the control unit.

Amended claims under Art. 19.1 PCT

1. (Amended) A threaded member tightening tool having a function of temporarily tightening a threaded member, the threaded member tightening tool comprising:

a drive unit rotationally driving a threaded member engaging unit engageable with the threaded member; and
a control unit controlling drive of the drive unit;
wherein the control unit controls the drive unit such that the threaded member engaging unit is first rotated forward by a first rotation quantity and then automatically rotated reversely by a second rotation quantity less than the first rotation quantity.

2. The threaded member tightening tool of claim 1, wherein the control unit controls a quantity of rotation of the threaded member engaging unit by controlling a drive time of the drive unit such that the control unit first drives the drive unit forward for a first period of time, thereby rotating the threaded member engaging unit forward by the first rotation quantity, and then drives the drive unit reversely for a second period of time, thereby rotating the threaded member engaging unit reversely by the second rotation quantity, the first period of time being set so that the first rotation quantity is a rotation quantity at which the threaded member will not be seated on a to-be-fastened member.

3. The threaded member tightening tool of claim 2, further comprising:

a torque detecting device detecting that a load torque greater than a predetermined value has been applied to the threaded member engaging unit;
wherein the control unit stops the drive unit when the torque detecting device detects a load torque greater than the predetermined value while the drive unit is being controlled so as to rotate the threaded member engaging unit forward by the first rotation quantity.

4. The threaded member tightening tool of claim 1, wherein the first rotation quantity is a rotation quantity by which the threaded member is rotated so that the threaded member is tightened by a predetermined tightening torque after being seated on a to-be-fastened member;
the control unit being configured such that the threaded member engaging unit is first rotated by the first rotation quantity, thereby seating the threaded member on the to-be-fastened member and further applying a predetermined tightening torque to the seated threaded member, and then the threaded member engaging unit is automatically rotated reversely by the second rotation quantity.

5. The threaded member tightening tool of claim 4, further comprising:

a clutch mechanism drivably connecting the drive unit and the threaded member engaging unit, the clutch mechanism being configured such that a drivable connection between the drive unit and the threaded member engaging unit is cancelled when a torque greater than the predetermined tightening torque is applied to the threaded member engaging unit; and
a clutch sensor detecting that the drivable connection through the clutch mechanism has been canceled;
wherein the control unit judges that the threaded member engaging unit has been rotated forward by the first rotation quantity when the clutch sensor detects cancellation of the drivable connection.

6. (Amended) The threaded member tightening tool of claim 5, wherein the control unit judges that the threaded member engaging unit has been rotated by the second rotation quantity when a predetermined time has elapsed from starting reverse rotation of the threaded member engaging unit.

7. The threaded member tightening tool of claim 1, wherein the control unit allows selection between:

a time control mode in which the control unit controls a quantity of rotation of the threaded member engaging unit by controlling a drive time of the drive unit such that the control unit first drives the drive unit forward for a first period of time, thereby rotating the threaded member engaging unit forward by the first rotation quantity, and then drives the drive unit reversely for a second period of time, thereby rotating the threaded member engaging unit reversely by the second rotation quantity, the first period of time being set so that the first rotation quantity is a rotation quantity at which the threaded member will not be seated on a to-be-fastened member; and
a torque control mode in which the first rotation quantity is a rotation quantity by which the threaded member is rotated so that the threaded member is tightened by a predetermined tight-

ening torque after being seated on a to-be-fastened member, and in which the threaded member engaging unit is first rotated by the first rotation quantity, thereby seating the threaded member on the to-be-fastened member and further applying a predetermined tightening torque to the seated threaded member, and then the threaded member engaging unit is automatically rotated reversely by the second rotation quantity.

8. The threaded member tightening tool of any one of claims 1 to 7, further comprising:

a counter unit counting a number of threaded members normally temporarily tightened by judging that a temporary tightening has been normally completed when the threaded member engaging unit has been first rotated forward by the first rotation quantity and then automatically rotated reversely by the second rotation quantity.

9. The threaded member tightening tool of any one of claims 1 to 8, further comprising:

a remote setting device configured to change set values of the first and second rotation quantities through wireless communication with the control unit.

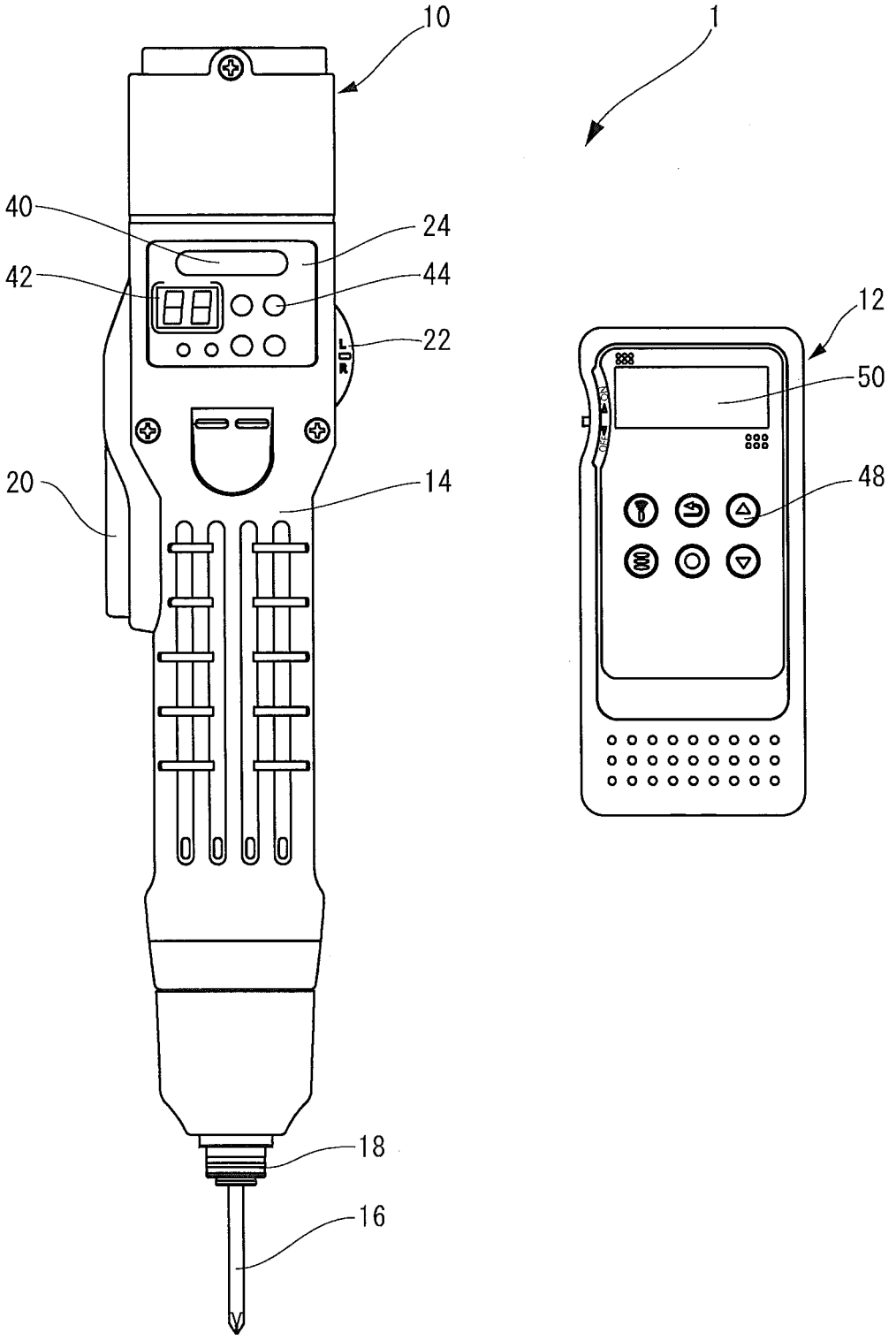

FIG. 1

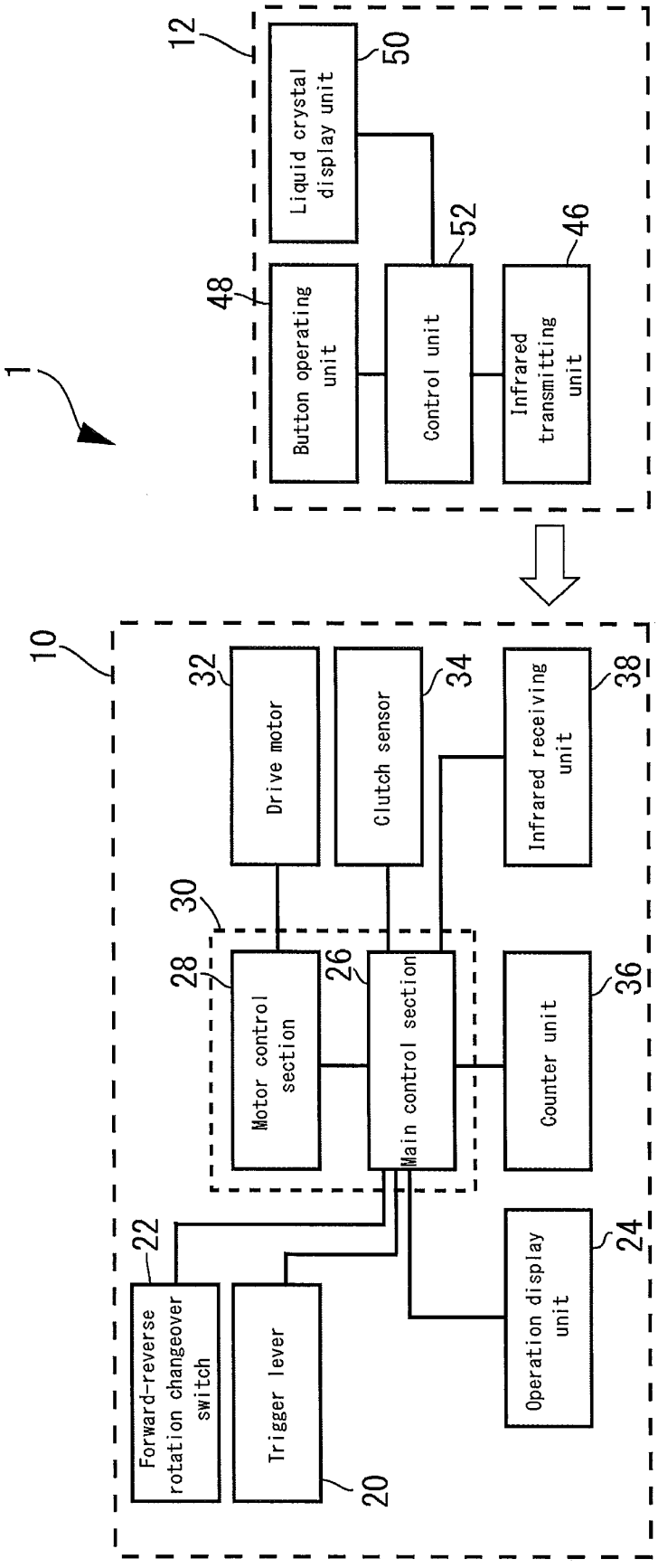
1
12
Liquid crystal display unit
50
Button operating unit
48
Control unit
52
Infrared transmitting unit
46
10
32
Drive motor
Clutch sensor
34
Infrared receiving unit
38
30
28
Motor control section
26
Main control section
Counter unit
36
22
Forward-reverse rotation changeover switch
Trigger lever
20
Operation display unit
24

FIG. 2

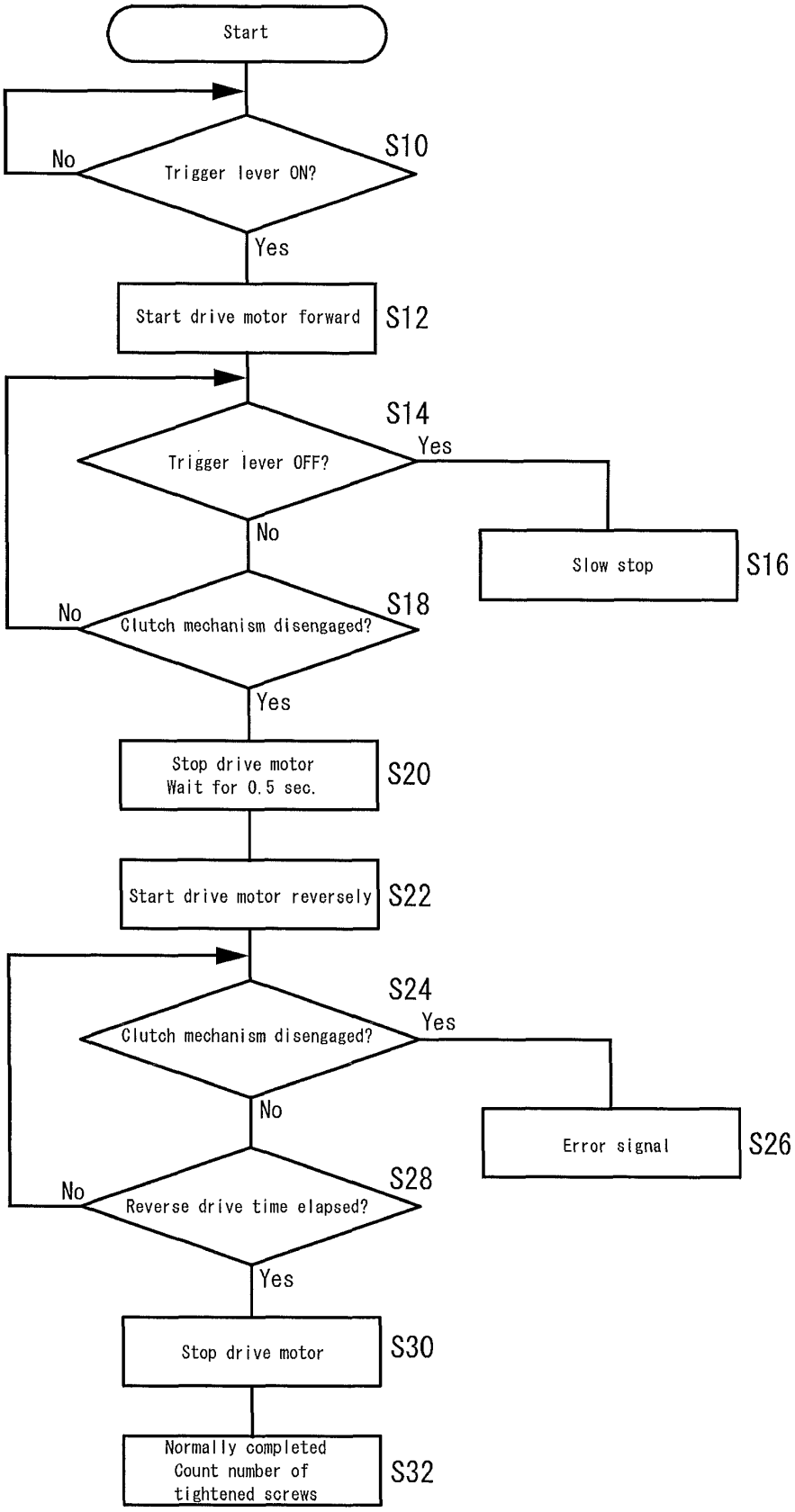
Start
Trigger lever ON?
No
S10
Yes
Start drive motor forward
S12
Trigger lever OFF?
S14
Yes
No
Slow stop
S16
Clutch mechanism disengaged?
No
S18
Yes
Stop drive motor
Wait for 0.5 sec.
S20
Start drive motor reversely
S22
Clutch mechanism disengaged?
S24
Yes
No
Error signal
S26
Reverse drive time elapsed?
No
S28
Yes
Stop drive motor
S30
Normally completed
Count number of
tightened screws
S32

FIG. 3

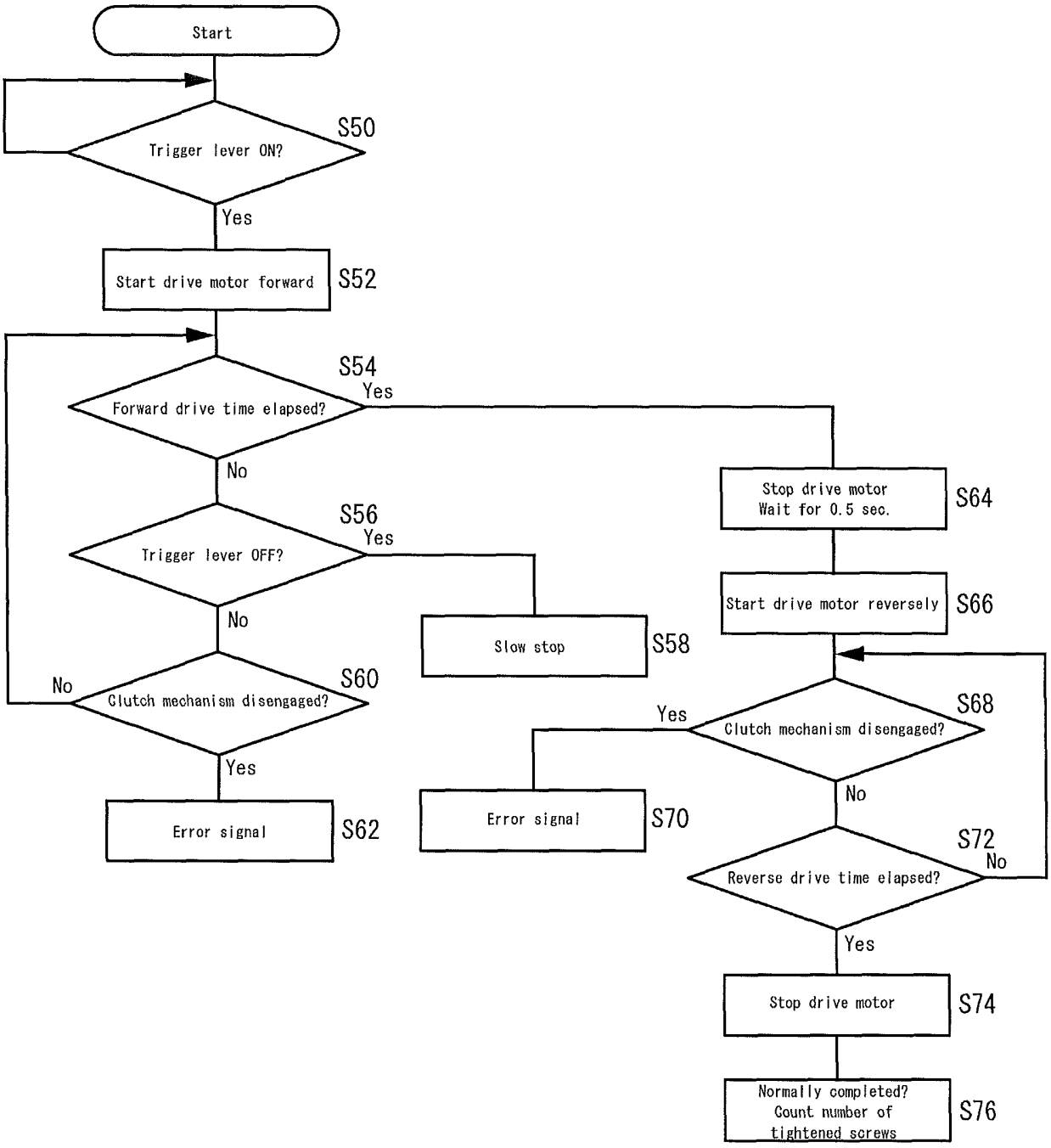
Start
Trigger lever ON?
S50
Yes
Start drive motor forward
S52
Forward drive time elapsed?
S54
Yes
No
Trigger lever OFF?
S56
Yes
No
Slow stop
S58
Clutch mechanism disengaged?
S60
No
Yes
Error signal
S62
Stop drive motor
Wait for 0.5 sec.
S64
Start drive motor reversely
S66
Clutch mechanism disengaged?
S68
Yes
No
Error signal
S70
Reverse drive time elapsed?
S72
No
Yes
Stop drive motor
S74
Normally completed?
Count number of
tightened screws
S76

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/059537

A. CLASSIFICATION OF SUBJECT MATTER
B25B23/14(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B25B23/14, B25B21/00, B25F5/00, B23P19/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 4-75879 A (Hayashi Watch-works Co., Ltd.), 10 March 1992 (10.03.1992), page 2, upper right column, line 1 to page 3, lower right column, line 1; fig. 1, 3 (Family: none)	1-6,9 7-8
X Y A	WO 2008/093418 A1 (Fujitsu Ltd.), 07 August 2008 (07.08.2008), paragraphs [0091] to [0094]; fig. 13 to 14 (Family: none)	1,9 8 2-7
X A	JP 2-269579 A (Daihatsu Motor Co., Ltd.), 02 November 1990 (02.11.1990), column 20, line 19 to column 23, line 11; fig. 1 (Family: none)	1,9 2-8

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 June 2016 (09.06.16)	21 June 2016 (21.06.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/059537

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 2003-191174 A (Fujitsu Ten Ltd.), 08 July 2003 (08.07.2003), paragraphs [0049] to [0054] (Family: none)	1,9 2-8
Y	JP 7-308865 A (Nissan Motor Co., Ltd.), 28 November 1995 (28.11.1995), paragraphs [0020] to [0022] (Family: none)	8
A	JP 52-46599 A (Sanyo Machine Works, Ltd.), 13 April 1977 (13.04.1977), entire text; all drawings & US 4095325 A entire text; all drawings & DE 2558251 A1	1-9
A	JP 3-294123 A (Toyota Motor Corp.), 25 December 1991 (25.12.1991), entire text; all drawings (Family: none)	1-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3992676 B **[0004]**