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Power tool and clutch assembly thereof

Abstract

Discloses are a power tool and a clutch assembly. The power tool includes a housing; a motor; and a transmission assembly, driven by the motor and including a clutch assembly. The clutch assembly includes an intermediate shaft, and an elastic member and a clutch block that are sleeved on the intermediate shaft. A front end of the elastic member is supported on the intermediate shaft, and a rear end of the elastic member is supported on the clutch block. The clutch block includes: a gear; a friction plate; and a nut. The gear rotates relative to the friction plate and the nut, in response to a driving force of the motor for driving the gear being greater than a sum of a friction force between the gear and the friction plate and a friction force between the gear and the nut.

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Background/Summary

CROSS REFERENCE (1) The present application is a continuation-application of International (PCT) Patent Application No. PCT/CN2021/141991, filed on Dec. 28, 2021, which claims priority of Chinese Patent Application No. 202011601479.6, filed on Dec. 29, 2020, the entire contents of which are hereby incorporated by reference in its entirety.

TECHNICAL FIELD
(1) The present disclosure relates to the technical field of power tools, in particular to a power tool and a clutch assembly.
BACKGROUND
(2) In order to prevent a motor from burning out when an output part of a conventional power tool is stuck by an external force, the power tool is usually equipped with a clutch assembly. In this way, when the output part is stuck and cannot rotate, the clutch assembly separates the output part from the motor.
(3) Referring to Chinese Patent No. CN2842064Y, which discloses a clutch assembly. The clutch assembly includes a small bevel gear and a large plate gear, two friction plates, two stop gaskets, and an elastic washer sleeved on the small bevel gear. The two friction plates are respectively arranged on both sides of the large plate gear, each of the two friction plates is arranged with one stop gasket arranged on the outside thereof, and the elastic washer is arranged on the outside of the stop gasket below the large plate gear and is arranged with a nut at the outside of the elastic washer. The components of the whole clutch assembly are assembled from top to bottom, which leads to the length of the clutch assembly being great, increasing the volume of the power tool. In addition, after the clutch assembly has been used for a long time, the wear occurs between the friction plates and the large plate gear, and the pressure exerted by the elastic washer on the friction plate decreases. In this case, it is necessary to disassemble the housing of the power tool and take out the clutch assembly, and tighten the nut to the small bevel gear again so as to reach the pressure value exerted by the elastic washer on the friction plate before the wear of the large plate gear and the friction plate. However, the tightening operation of the nut is cumbersome and time-consuming.
(4) Therefore, it is desired to provide a new power tool that solves the problems of the clutch assembly with excessive length and the requirement for continuously tightening the nut.
SUMMARY OF THE DISCLOSURE
(5) The present disclosure provides a power tool and a clutch assembly.
(6) In a first aspect, the present disclosure provides a power tool, including: a housing, extending along a front-to-rear direction; a motor, retained in the housing; and a transmission assembly,

configured to be driven by the motor and including a clutch assembly disposed in the housing; wherein the clutch assembly includes an intermediate shaft extending along the front-to-rear direction, and an elastic member and a clutch block that are sleeved on the intermediate shaft; wherein a front end of the elastic member is supported on the intermediate shaft, and a rear end of the elastic member is supported on the clutch block; wherein the clutch block includes: a gear, configured to be driven by the motor; a friction plate, disposed between the elastic member and the gear; and a nut, threadedly connected to the intermediate shaft; wherein a rear end of the nut is supported on a rear side of the gear, and a front end of the nut passes through the gear and is clamped by the friction plate; the nut is configured to drive the friction plate to be compressed on the elastic member; the motor is configured to drive the gear to rotate together with the intermediate shaft; wherein the gear rotates relative to the friction plate and the nut, in response to a driving force of the motor for driving the gear being greater than a sum of a friction force between the gear and the friction plate and a friction force between the gear and the nut.

(7) In a second aspect, the present disclosure provides a power tool, including: a housing, extending along a front-to-rear direction; a motor, retained in the housing and arranged with a motor shaft extending along the front-to-rear direction; and a transmission assembly, configured to be driven by the motor and including a clutch assembly disposed in the housing; wherein the clutch assembly includes an intermediate shaft extending along the front to rear direction, and an elastic member and a clutch block that are sleeved on the intermediate shaft; wherein both ends of the elastic member are supported on the intermediate shaft and the clutch block in the front-to-rear direction, respectively; wherein the clutch block includes: a gear, configured to be driven by the motor shaft; and a nut, threadedly connected to the intermediate shaft; wherein the nut compresses the gear against the elastic member so that the elastic member is clamped between the gear and intermediate shaft, and the motor is configured to drive the gear and the intermediate shaft to rotate together via the elastic member.

(8) In a third aspect, the present disclosure provides a clutch assembly, including: an intermediate shaft; and an elastic member and a clutch block, sleeved on the intermediate shaft; wherein a front end of the elastic member is supported on the intermediate shaft, and a rear end of the elastic member is supported on the clutch block; wherein the clutch block includes: a gear, configured to be driven by a motor; a friction plate, disposed between the elastic member and the gear; and a nut, threadedly connected to the intermediate shaft; wherein a rear end of the nut is supported on a rear side of the gear, and a front end of the nut passes through the gear and is clamped by the friction plate; the nut is configured to drive the friction plate to be compressed on the elastic member; the gear is configured to, driven by the motor, rotate together with the intermediate shaft; wherein the gear rotates relative to the friction plate and the nut, in response to a driving force of the motor for driving the gear being greater than a sum of a friction force between the gear and the friction plate and a friction force between the gear and the nut.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a perspective view of a power tool of the present disclosure.

(2) FIG. **2** is a partial cross-sectional view of the power tool of FIG. **1**.

(3) FIG. **3** is a perspective view of a clutch assembly of the power tool of FIG. **2**.

(4) FIG. **4** is a cross-sectional view of the clutch assembly of FIG. **3**.

DETAILED DESCRIPTION

(5) Reference will now be made in detail to the embodiments of the present disclosure.

(6) Referring to FIGS. **1**-**4**, a power tool **100** is described in detail by taking an electric drill as an example. The power tool **100** includes a housing **10** extending along a front to rear direction, a

motor **2** retained in the housing **10**, and a transmission assembly **3** driven by the motor **2**; the transmission assembly **3** includes a clutch assembly **31** with an overload clutch mode and an output assembly **32** connected to the clutch assembly **31**. When the power tool **100** works normally, the motor **2** drives the clutch assembly **31** and the output assembly **32** for rotary output; when the transmission assembly **3** is in the overload clutch mode, the output assembly **32** is clamped by an external force and cannot be rotated for output, and the clutch assembly **31** separates the transmission of the motor **2** from the output assembly **32**.

(7) The clutch assembly **31** includes an intermediate shaft **311** located in the housing **10**, and an elastic member **313** and a clutch block that are sleeved on a periphery of the intermediate shaft **311**. The clutch block includes a gear **312**, a nut **314**, and a friction plate **315**. The elastic member **313** is composed of several elastic pieces formed by stamping and sleeved on the intermediate shaft **311**. In some embodiments, the intermediate shaft **311** includes a first step portion **311**A and a second step portion **311**B. The elastic member **313** is sleeved on the first step portion **311**A of the intermediate shaft **311** and the clutch block is sleeved on the second step portion **311**B of the intermediate shaft **311**. An outer diameter of the first step portion **311**A is greater than an outer diameter of the second step portion **311**B. The output direction of the power tool **100** is defined as the front direction, a front end of the elastic member **313** abuts against the intermediate shaft **311**, and a rear end of the elastic member **313** abuts against the friction plate **315**. The friction plate **315** is located between the elastic member **313** and the gear **312**, a rear end of the nut **314** is supported on a rear side of the gear **312**, and a front end of the nut **314** passes through the gear **312** and is clamped on the friction plate **315**. The nut **314** defines a flat position or a keyway located in the front end thereof, and the friction plate **315** is clamped on the flat position or keyway and protrudes from the front end of the nut **314**, so that the friction plate **315** and the nut **314** are relatively stationary in a circumferential direction. The intermediate shaft **311** defines an external thread on the periphery thereof, and the nut **314** is threadedly connected to the intermediate shaft **311** and pushes against the friction plate **315** to compress the elastic member **313**. As shown in FIG. **4**, the second step portion **311**B of the intermediate shaft **311** corresponds to the external thread to which the nut **314** is threadedly connected. The nut **314** defines a step part **314**A that protrudes radially outwardly from the rear end thereof, and the step part **314**A pushes the gear **312** toward the elastic member **313**. The gear **312** defines a receiving groove which is recessed inward from a rear surface thereof. The step part **314**A is received in the receiving groove and abuts against an inner wall surface of the receiving groove so as to push the gear **312** toward the elastic member **313**. The step part **314**A of the nut **314** is received in the receiving groove and does not protrude from the rear surface of the gear **312**, which is conducive to shortening the overall length of the clutch assembly **31** and miniaturizing the power tool **100**.

(8) The motor **2** is arranged with a motor shaft extending in the front to rear direction, and a front end of the motor shaft is engaged with the gear **312**. The output assembly **32** includes an output shaft **321** extending forward from the housing **10** and a large gear **322** fixed at the rear end of the output shaft **321**, and the intermediate shaft **311** includes an intermediate shaft gear **311′** integrally formed at the front end thereof. The intermediate shaft gear **311′** is engaged with the large gear **322**, and rotation axes of the output shaft **321**, the intermediate shaft **311**, and the motor shaft are parallel to each other.

(9) When the transmission assembly **3** is in a non-overloaded clutch mode, that is, when the power tool **100** works normally, the motor **2** is in transmitted connection with the gear **312**. As the gear **312** is pressed by the elastic member **313**, the gear **312** generates static friction with the friction plate **315** and the step part **314**A of the nut **314** respectively, so as to drive the nut **314** to rotate together, so that the nut **314** drives the intermediate shaft **311** to rotate together, and the intermediate shaft gear **311′** of the intermediate shaft **311** drives the output shaft **321** to rotate together.

(10) When the transmission assembly **3** is in the overload clutch mode, the output shaft **321** is

clamped by an external force and cannot rotate, and the large gear **322** fixedly connected with the output shaft **321** and the intermediate shaft gear **311′** engaged with the large gear **322** also cannot rotate. In this case, the nut **314** screwed on the intermediate shaft **311** cannot rotate, and the driving force of the motor **2** driving the gear **312** is greater than the static friction force generated by the gear **312** with the friction plate **315** and the step part **314**A of the nut **314**. Then, the gear **312** rotates relative to the friction plate **315** and the step part **314**A of the nut **314** and generates sliding friction, and only the motor **2** drives the gear **312** to rotate together to prevent the motor **2** from burning out due to overload.

(11) The rear end of the nut **314** defines multiple fixing holes which are recessed forward from the rear end thereof. The nut **314** defines two fixing holes in this embodiment. During the installation of the clutch assembly **31**, the operator inserts a tool into the two fixing holes respectively and tightens the nut **314** on the intermediate shaft **311**. Thus, changing the tightening degree can change the maximum static friction force generated by the gear **312** with the friction plate **315** and the step part **314**A of the nut **314**, thereby adjusting the critical torque value of the overload clutch of the transmission assembly **3**.

(12) The intermediate shaft **311** is arranged with a stop portion **316** located in the front end of the external thread. When the power tool **100** is completely installed, the nut **314** runs through the gear **312** along the front to rear direction and is spaced with the stop portion **316**, that is, a certain distance between the two is maintained. The output rotation direction of the intermediate shaft **311** is consistent with the tightening rotation direction of the nut **314**. When the gear **312**, the friction plate **315**, and the step part **314**A of the nut **314** are not worn, although the gear **312** continuously tightens the nut **314** by static friction force or sliding friction force, the nut **314** can no longer be tightened in the tightening direction because of the enough thrust the of elastic member **313** on the gear **312**. After the power tool **100** works under load for a long time, the gear **312**, the friction plate **315**, and the step part **314**A of the nut **314** are worn, the thrust of the elastic member **313** against the gear **312** is reduced, the gear **312** tightens the nut **314** by static friction force or sliding friction force, and nut **314** cannot be rotated and tightened when the thrust of the elastic member **313** against the gear **312** is large enough.

(13) The rear end of the nut **314** of the power tool **100** is supported on the rear side of the gear **312**, and the front end of the nut **314** passes through the gear **312** and is clamped on the friction plate **315**, which not only ensures that the nut **314** has a stable thread engagement length with the intermediate shaft **311**, but also shortens the overall length of the clutch assembly **31**, which is conducive to the miniaturization of the power tool **100**. In addition, the gear **312** is clamped between the friction plate **315** and the nut **314**, which is conducive to improving the convenience of assembly. The nut **314** is threadedly connected to the intermediate shaft **311** and pushes against the gear **312** to compress the elastic member **313**. The output rotation direction of the intermediate shaft **311** is consistent with the fastening rotation direction of the nut **314**. When the gear **312** is worn with the friction plate **315** and the step part **314**A of the nut **314**, the gear **312** can tighten the nut **314** by friction force, thereby automatically compensating the wear of the clutch assembly **31**, which solves the problem that the pressure of the elastic member **313** is weakened after the components are worn. In addition, the friction plate **315** is arranged between the elastic member **313** and the gear **312** and sleeved at the end of the nut **314** in a circumferential stationary manner. The step part **314**A of the nut **314** and the friction plate **315** can simultaneously transfer the friction force transmitted by the gear **312** to the nut **314**, increasing the fastening force transmitted by the gear **312** to the nut **314**.

(14) Although the present disclosure has been described with reference to particular embodiments, it is not to be construed as being limited thereto. Various alterations and modifications can be made to the embodiments without in any way departing from the scope or spirit of the present disclosure as defined in the appended claims.

Claims

1. A power tool, comprising: a housing, extending along a front-to-rear direction; a motor, retained in the housing; and a transmission assembly, configured to be driven by the motor and comprising a clutch assembly disposed in the housing; wherein the clutch assembly comprises an intermediate shaft extending along the front-to- rear direction, and an elastic member and a clutch block that are sleeved on the intermediate shaft; wherein a front end of the elastic member abuts against the intermediate shaft, and a rear end of the elastic member abuts against the clutch block; wherein the clutch block comprises: a gear, configured to be driven by the motor; a friction plate, disposed between the elastic member and the gear; and a nut, threadedly connected to the intermediate shaft; wherein a rear end of the nut is supported on a rear side of the gear, and a front end of the nut passes through the gear and is clamped by the friction plate; the friction plate and the gear are sleeved on an outer periphery of the nut, and the nut is configured to cause the friction plate to squeeze the elastic member; the elastic member is caused to push the friction plate and the gear against a step part of the nut, and the motor is configured to drive the gear to rotate synchronously with the intermediate shaft through the nut; wherein a thread fastening direction of the nut is the same as an output rotation direction of the intermediate shaft; the intermediate shaft defines an external thread matched with the nut and a stop portion disposed at a front end of the external thread, and the front end of the nut is spaced from the stop portion; wherein the step part of the nut protrudes radially outwardly from the rear end of the nut, and the step part pushes the gear toward the elastic member.
2. The power tool as claimed in claim 1, wherein the gear defines a receiving groove recessed inwards from a rear surface of the gear, and a rear end of the nut is accommodated in the receiving groove and abuts against an inner wall surface of the receiving groove.
3. The power tool as claimed in claim 1, wherein the nut defines a flat position or a key groove disposed in the front end of the nut, and the friction plate is clamped on the flat position or the key groove so as to enable the friction plate and the nut to be relatively static in a circumferential direction.
4. The power tool as claimed in claim 1, wherein the nut defines a plurality of fixing holes recessed forwards from a rear end of the nut.
5. The power tool as claimed in claim 1, wherein the elastic member is composed of a plurality of elastic pieces formed by stamping and sleeved on the intermediate shaft.
6. The power tool as claimed in claim 1, wherein the motor is arranged with a motor shaft extending along the front-to-rear direction, and a front end of the motor shaft is meshed with the gear.
7. The power tool as claimed in claim 6, wherein the transmission assembly comprises an output assembly connected with the clutch assembly, and the output assembly is arranged with an output shaft extending out of the housing forwards and a large gear fixed to a rear end of the output shaft; rotation axes of the output shaft and the motor shaft are parallel to each other.
8. The power tool as claimed in claim 6, wherein the intermediate shaft comprises an intermediate shaft gear integrally formed at a front end of the intermediate shaft; the intermediate shaft gear is engaged with the large gear and is configured to rotate together with the output shaft.
9. The power tool as claimed in claim 1, wherein the gear defines a receiving groove recessed inwards from a rear surface of the gear; the step part is received in the receiving groove and abuts against an inner wall surface of the receiving groove so as to push the gear toward the elastic member.
10. A clutch assembly, comprising: an intermediate shaft; and an elastic member and a clutch block, sleeved on the intermediate shaft; wherein a front end of the elastic member abuts against the intermediate shaft, and a rear end of the elastic member abuts against the clutch block; wherein the

clutch block comprises: a gear, configured to be driven by a motor; a friction plate, disposed between the elastic member and the gear; and a nut, threadedly connected to the intermediate shaft; wherein a rear end of the nut is supported on a rear side of the gear, and a front end of the nut passes through the gear and is clamped by the friction plate; the friction plate and the gear are sleeved on an outer periphery of the nut, and the nut is configured to cause the friction plate to squeeze the elastic member; the elastic member is caused to push the friction plate and the gear against a step part of the nut, and the motor is configured to drive the gear to rotate synchronously with the intermediate shaft through the nut; wherein a thread fastening direction of the nut is the same as an output rotation direction of the intermediate shaft; the intermediate shaft defines an external thread matched with the nut and a stop portion disposed at a front end of the external thread, the front end of the nut is spaced from the stop portion; wherein the step part of the nut protrudes radially outwardly from the rear end of the nut, and the step part pushes the gear toward the elastic member.

11. The power tool as claimed in claim 1, wherein a spacing between the front end of the nut and the stop portion is changeable during use.