United States Patent	12390908
Kind Code	B2
Date of Patent	August 19, 2025
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Internal dual pawl mechanism for indexable motorized ratchet tools

Abstract

A pawl mechanism for an indexable tool and adapted to selectively transmit rotational motion of a yoke of the tool to a drive lug of the tool in one of first and second rotational directions. The pawl mechanism including a pawl carrier, first and second pawls pivotably coupled to the pawl carrier, and a selector switch rotatably coupled to the pawl carrier and adapted to selectively position the first and second pawls to transmit rotational motion of the yoke to the drive lug in one of the first and second rotational directions.

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Appl. No.: **17/329423**

Filed: **May 25, 2021**

Prior Publication Data

Document Identifier	Publication Date
US 20220379444 A1	Dec. 01, 2022

Publication Classification

Int. Cl.: **B25B21/00** (20060101); **B25B23/00** (20060101); **B25F5/02** (20060101)

U.S. Cl.:

CPC **B25B21/004** (20130101); **B25B23/0028** (20130101); **B25F5/02** (20130101);

Field of Classification Search

USPC: None

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Background/Summary

TECHNICAL FIELD OF THE INVENTION

(1) The present invention relates generally to indexable hand tools, and more particularly, the present invention relates to an internal dual pawl mechanism for indexable ratchet tools.

BACKGROUND OF THE INVENTION

(2) Power hand tools, such as, for example, motorized ratchet wrenches and drivers, are commonly used in automotive, industrial, and household applications to install and remove threaded fasteners and apply torque and/or angular displacement to a work piece, such as a threaded fastener, for example. Power hand tools, such as cordless power ratchets and drivers, generally include an electric motor contained in a housing, along with other components, such as switches, light emitting diodes (LEDs), and batteries, for example. The housing may be a clamshell-type housing that generally includes two or more housing portions coupled together by fasteners, such as screws or rivets, to cooperatively form the housing.

(3) Power hand tools, such as, for example, motorized ratchet wrenches and drivers, include a ratcheting-type head that is driven by a motor. However, the head is generally fixed relative to the tool body. The fixed nature of the head can make it difficult to reach fasteners and other work pieces located in tight or otherwise hart to access places.

(4) In order to better access work pieces located in tight or otherwise hard to access places, conventional power tools utilize an indexable ratchet head that can pivot relative to the housing of the tool. These conventional tools have single internal pawl or single external pawl ratchet mechanisms. However, these pawl ratchet mechanisms have relatively low torque application capabilities and fatigue strength. This low ultimate torque output makes it difficult for power tools having these types of ratchet mechanisms to tighten and untighten work pieces with a high prevailing torque.

(5) Other conventional power tools have external double pawl mechanisms. However, these pawl ratchet mechanisms also have relatively low torque output due to limited impact energy caused by the pawl teeth impacting the ratchet gear teeth, which makes it difficult for power tools having these types of ratchet mechanisms to tighten and untighten work pieces with a high prevailing torque. Moreover, the ratchet heads are enlarged to accommodate all the components required for the external double pawl mechanism.

SUMMARY OF THE INVENTION

(6) The present invention relates broadly to an internal dual pawl mechanism for indexable ratchet tools, such as, for example, a motorized ratcheting-type tool. The ultimate torque and fatigue strength of the internal dual pawl mechanism of the present invention is improved compared to pawl mechanisms in conventional indexable tools. Specifically, the ultimate torque output of the pawl mechanism of the present invention is approximately double the ultimate torque output of a conventional single internal pawl mechanism. Moreover, the size of the ratchet head utilizing the pawl mechanism of the present invention is increased marginally compared to a ratchet utilizing a conventional single internal pawl mechanism, and thus significantly smaller than a ratchet head housing a dual pawl external pawl mechanism.

(7) In an embodiment, the present invention broadly relates to tool having a first housing portion. The tool broadly comprises a ratchet housing portion pivotably coupled to the first housing portion, a yoke rotatably disposed in the ratchet housing, a pawl mechanism disposed in the ratchet housing portion and adapted to selectively transmit rotational motion of the yoke to a drive lug in one of first and second rotational directions. The pawl mechanism includes a pawl carrier rotatably

disposed in the ratchet housing portion, first and second pawls pivotably coupled to the pawl carrier, and a selector switch rotatably coupled to the pawl carrier and adapted to selectively position the first and second pawls to transmit rotational motion of the yoke to the drive lug in one of the first and second rotational directions.

(8) In another embodiment, the present invention broadly relates to a pawl mechanism for an indexable tool and adapted to selectively transmit rotational motion of a yoke of the tool to a drive lug of the tool in one of first and second rotational directions. The pawl mechanism includes a pawl carrier, first and second pawls pivotably coupled to the pawl carrier, and a selector switch rotatably coupled to the pawl carrier and adapted to selectively position the first and second pawls to transmit rotational motion of the yoke to the drive lug in one of the first and second rotational directions.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) For the purpose of facilitating an understanding of the subject matter sought to be protected, there is illustrated in the accompanying drawing embodiments thereof, from an inspection of which, when considered in connection with the following description, the subject matter sought to be protected, its construction and operation, and many of its advantages, should be readily understood and appreciated.

(2) FIG. **1** is a perspective side view of an exemplar ratcheting tool incorporating an embodiment of the present invention.

(3) FIG. **2** is a side perspective view of a ratchet housing and first and second housing portions of the ratcheting tool of FIG. **1**, according to an embodiment of the present invention.

(4) FIG. **3** is a side perspective view of the ratchet housing pivoted relative to the first and second housing portions of the ratcheting tool of FIG. **1**, according to an embodiment of the present invention.

(5) FIG. **4** is a side perspective exploded, disassembled view of the ratchet and first and second housing portions of the ratcheting tool of FIG. **2**, according to an embodiment of the present invention.

(6) FIG. **5** is a side perspective exploded, disassembled view of the pawl mechanism of the ratcheting tool of FIG. **1**, according to an embodiment of the present invention.

(7) FIG. **6** is another side perspective exploded, disassembled view of the pawl mechanism of the ratcheting tool of FIG. **1**, according to an embodiment of the present invention.

(8) FIG. **7** is a top detailed view of the pawl mechanism of the ratcheting tool of FIG. **1**, selecting a first rotational drive direction, according to an embodiment of the present invention.

(9) FIG. **8** is a top detailed view of the pawl mechanism of the ratcheting tool of FIG. **1**, selecting a second rotational drive direction, according to an embodiment of the present invention.

DETAILED DESCRIPTION

(10) While the present invention is susceptible of embodiments in many different forms, there is shown in the drawings, and will herein be described in detail, embodiments of the invention, including a preferred embodiment, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to embodiments illustrated. As used herein, the term “present invention” is not intended to limit the scope of the claimed invention and is instead a term used to discuss exemplary embodiments of the invention for explanatory purposes only.

(11) The present invention relates broadly to an internal dual pawl mechanism for indexable ratchet tools, such as, for example, a motorized ratcheting-type tool. The ultimate torque output and fatigue strength of the internal dual pawl mechanism of the present invention is improved and greater

compared to conventional pawl mechanisms with indexable tools. Specifically, the ultimate torque output of the pawl mechanism of the present invention is approximately double the ultimate torque output of a conventional single internal pawl mechanism. Moreover, the size of the ratchet head utilizing the pawl mechanism of the present invention is increased marginally, compared to a ratchet utilizing a conventional single internal pawl mechanism, and yet smaller than a ratchet head housing a dual pawl external pawl mechanism.

(12) Referring to FIGS. **1**-**8**, an indexable tool **100**, such as, for example, a cordless ratchet-type tool, includes a tool housing **102** having a ratchet housing portion **104**, a first housing portion **106**, a second housing portion **108**, and a motor housing portion **110**. As discussed herein, the indexable tool **100** is a ratchet-type wrench. However, the present invention is not limited as such, and the tool **100** can be any type of hand-held tool, including, without limitation, electrically or pneumatically powered tools, such as, a drill, router, impact wrench, ratchet wrench, screwdriver, or other powered tool.

(13) The ratchet housing portion **104** encloses/houses a pawl mechanism **112** that transfers torque from a motor of the tool **100** to a drive lug **114** in a manner described below. The drive lug **114** is adapted to apply torque to a work piece, such as a fastener, via an adapter, bit, or socket coupled to the drive lug **114**, such as a bi-directional ratcheting square or hexagonal drive. As illustrated, the drive lug **114** is a “male” connector designed to fit into or matingly engage a female counterpart. However, the drive lug **114** may alternately include a “female” connector designed to matingly engage a male counterpart. The drive lug **114** may also be structured to directly engage a work piece without requiring coupling to an adapter, bit, or socket. The rotational direction of the drive lug **114** can be selected by rotation of a selector switch **116** to be either a first or second rotational direction (such as, clockwise or counterclockwise) in a manner described below.

(14) The ratchet housing portion **104** and the first housing portion **106** are pivotably coupled to each other, for example, via a housing pivot pin **118**. The housing pivot pin **118** may be a pin, rivet, threaded fastener, or other suitable fastener, that provides a pivotable coupling between the ratchet housing portion **104** and the first housing portion **106**. As illustrated in FIG. **3**, the pivotable coupling allows the ratchet housing portion **104** to pivot relative to a longitudinal axis of the pivot pin **118**, which is substantially perpendicular to a longitudinal axis of the tool **100**, thereby allowing the ratchet housing portion **104** to pivot relative to the first housing portion **106**, the second housing portion **108**, and the motor housing portion **110**.

(15) The first housing portion **106** includes first **118** and second **120** arms adapted to receive the housing pivot pin **118**, thereby pivotably coupling the ratchet housing portion **104** and the first housing portion **106**. In an embodiment, the first housing portion **106** is threadably coupled to the second housing portion **108**. In another embodiment, the first **106** and second housing portions are a single integral housing.

(16) The second housing portion **108** encloses/houses a crankshaft **150** adapted to operably couple the pawl mechanism **112** to the motor in a well-known manner. The second housing portion **108** is adapted to couple to the motor housing **110** using attachment features including, for example, cutouts **124** and/or channels **126**. In an embodiment, the attachment features are machined into the second housing portion **108** after the second housing portion **108** is threadably coupled to the first housing portion **106** to ensure the ratchet housing portion **104** is properly oriented relative to the motor housing portion **110**. In an embodiment, the second housing portion **108** is one of a number of interchangeable second housing portions having different lengths and/or configurations to accommodate crankshafts having different lengths. In an embodiment, the second housing portion **108** is a machined part, thereby allowing different lengths and configurations to be made at lower costs and complexity, compared to a cast part since multiple molds do not have to be made or used.

(17) Housing cover plates **128** are coupled to the first **106** and second **108** housing portions via, for example, fasteners **130**, such as, for example, rivets, screws, etc. The housing cover plates **128** restrict containments from infiltrating the interiors of the first **106** and second **108** housing portions

and potentially damaging components contained therein.
(18) In an embodiment, the ratchet housing **104** is selectively positioned relative to the first **106** and second **108** housing portions by a detent mechanism. In this embodiment, the ratchet housing **104** includes indents **132** adapted to selectively engage one or more detents **134**, such as, for example, a detent pin or ball, disposed in the first housing portion **106**. The detent(s) **134** is biased towards the indents **132** via a biasing member **136**, such as, for example, a spring.
(19) The motor housing portion **110** encloses or houses one or more of an electric or pneumatic motor, a switch assembly, display with buttons for configuring and setting the tool, one or more status indicators such as light emitting diodes, and other components for operation of the tool, for example. The motor housing portion **110** may also include a textured or knurled grip to improve a user's grasp of the tool **100** during use. In an embodiment, the motor housing portion **110** includes first and second motor housing portions coupled together in a clamshell-type manner. In an embodiment, the motor housing portion **110** is comprises plastic or metal.
(20) The motor (not shown) is adapted to operably engage the pawl mechanism **112** via the crankshaft **150** to provide torque to the drive lug **114**. In an embodiment, the motor may be a brushless or brushed electric motor, a pneumatic motor, or any other suitable motor. A power source (not shown) can be associated with the tool **100** to provide power to the tool **100** for operation, such as, for example, electric, hydraulic, or pneumatic, to operate the motor. In an embodiment, the power source can be housed in an end of the motor housing portion **110**, opposite the ratchet housing portion **104**, a midsection of the motor housing portion **110**, or any other portion of the tool **100**/motor housing portion **110**. The power source may also be an external component not housed by the tool **100**, but that is operatively coupled to the tool **100** through, for example, wired or wireless means. In an embodiment, the power source is a removable and/or rechargeable battery that is adapted to be disposed in the end of the motor housing portion **110** and electrically coupled to corresponding terminals of the tool **100** in a well-known manner.
(21) In an embodiment, the tool **100** includes a trigger **138** that can be actuated by a user to cause the tool **100** to operate. For example, the user can depress the trigger **138** inwardly to selectively cause power to be drawn from the power source and cause the motor to operate and provide torque to the drive lug **114** in a desired rotational direction. Any suitable trigger **138** or switch can be implemented without departing from the spirit and scope of the present invention. For example, the trigger **138** may also be biased such that the trigger **138** is inwardly depressible, relative to the tool **100**, to cause the tool **100** to operate, and a release of the trigger **138** causes the trigger **138** to move outwardly, relative to the tool **100**, to cease operation of the tool **100** via the biased nature of the trigger **138**. The trigger **138** and switch mechanism may also be a variable speed type mechanism. In this regard, actuation or depression of the trigger **138** causes the motor to operate at a faster speed the further the trigger **138** is depressed.
(22) A yoke **140** is rotatably disposed in the ratchet housing portion **104**. The yoke **140** includes gear teeth **142** disposed on an internal circumference of the yoke **140**. The yoke further includes a recess **144** adapted to be operably coupled to the crankshaft **150** via first **146** and second **148** drive members, as described below.
(23) The first drive member **146** is rotatably coupled to the recess **144** of the yoke **140**, such as, for example, by a first bushing **152**, and slidably coupled to the housing pivot pin **118**. The second drive member **148** is also slidably coupled to the housing pivot pin **118** and includes two arms disposed on either side of the first drive member such that the first **146** and second **148** drive members move along the housing pivot pin **118** simultaneously. The second drive member **148** is also rotatably coupled to the crankshaft **150** via a second bushing **154**. Accordingly, rotational motion of the crankshaft **150** caused by operation of the motor drives the first **146** and second **148** drive members in a reciprocating linear motion along the housing pivot pin **118**. The reciprocating linear motion of the first drive member **146** is transmitted to the yoke **140**, so that the yoke **140** rotates back and forth repeatedly in the ratchet housing portion **104**. The rotational motion of the

yoke **140** is transmitted to the drive lug **114** via the pawl mechanism **112** in one of the first and second rotational directions, as described below.

(24) The pawl mechanism **112** is rotatably disposed in the ratchet housing portion **104**. The pawl mechanism **112** includes the selector switch **116**, a pawl carrier **156**, and first **158** and second **160** pawls. The pawl mechanism **112** transmits the rotational motion of the yoke **140** to the drive lug **114** in one of the selected first and second rotational directions.

(25) The selector switch **116** is rotatably coupled to the pawl carrier **156** and is adapted to selectively position the first **158** and second **160** pawls to transmit rotational motion of the yoke **140** to the drive lug **114** in either one of the first and second rotational directions. The selector switch **116** can be a lever or knob. The selector switch **116** includes first **162** and second **164** selector switch apertures and first **166** and second **168** outwardly biased members respectively received in the first **162** and second **164** selector switch apertures. The first **166** and second **168** outwardly biased members are respectively biased towards the first **158** and second **160** pawls using, for example, springs. In an embodiment, the selector switch **116** has a grease fitting **186** adapted to allow grease to be applied to the pawl mechanism components for continued maintenance and use.

(26) The pawl carrier **156** is rotatably disposed in the ratchet housing portion **104**. In an embodiment, the pawl carrier **156** is integral with the drive lug **114**. However, the invention is not limited as such and the pawl carrier **156** and drive lug **114** can be separate components coupled together. The pawl carrier **156** includes pawl positioning member apertures **170** adapted to respectively receive a pawl positioning member **172** slidably disposed therein. In an embodiment, the pawl positioning members **172** are pins. The pawl carrier **156** further includes pivot member apertures **174** adapted to respectively receive a pivot member **176**. In an embodiment, the pivot members **176** are pins.

(27) The first pawl **158** is pivotably coupled to the pawl carrier **156** via one of the pivot members **176**. The first pawl **158** includes first teeth **178** and second teeth **180** that are adapted to selectively engage the gear teeth **142** of the yoke based on a selected position of the selector switch **116**. For example, when the selector switch **116** is disposed in a positon to select the first rotational direction (e.g., clockwise), the first teeth **178** engage the gear teeth **142**. Similarly, when the selector switch **116** is disposed in a position to select the second rotational direction (e.g., counter-clockwise), the second teeth **180** engage the gear teeth **142**.

(28) The second pawl **160** is pivotably coupled to the pawl carrier **156** via the other of the pivot members **176**. The second pawl **160** includes first teeth **182** and second teeth **184** that are adapted to selectively engage the gear teeth **142** of the yoke based on a position of the selector switch **116**. For example, when the selector switch **116** is disposed in a position to select the first rotational direction (e.g., clockwise), the first teeth **182** engage the gear teeth **142**. Similarly, when the selector switch **116** is disposed in a position to select the second rotational direction (e.g., counter-clockwise), the second teeth **184** engage the gear teeth **142**. In an embodiment, the first **158** and second **160** pawls are substantially identical. The first **158** and second **160** pawls are adapted to pivot substantially simultaneously about the respective pivot members **176** via the pawl positioning members **172**.

(29) As illustrated in FIG. **7**, when the selector switch **116** is moved to a position to select the first rotational direction (e.g., clockwise), the first **166** and second **168** outwardly biased members respectively engage the first **158** and second **160** pawls to cause the first **158** and second **160** pawls to pivot about respective pivot members **176** such that the first teeth **178** of the first pawl **158** and the first teeth **182** of the second pawl **160** engage the gear teeth **142** of the yoke **140**.

(30) As illustrated in FIG. **8**, when the selector switch **116** is moved to a position to select the second rotational direction (e.g., counter-clockwise), the first **166** and second **168** outwardly biased members respectively engage the first **158** and second **160** pawls to cause the first **158** and second **160** pawls to pivot about respective pivot members **176** such that the second teeth **180** of the first

pawl **158** and the second teeth **184** of the second pawl **160** engage the gear teeth **142** of the yoke **140**.

(31) As used herein, the term “coupled” and its functional equivalents are not intended to necessarily be limited to direct, mechanical coupling of two or more components. Instead, the term “coupled” and its functional equivalents are intended to mean any direct or indirect mechanical, electrical, or chemical connection between two or more objects, features, work pieces, and/or environmental matter. “Coupled” is also intended to mean, in some examples, one object being integral with another object. As used herein, the term “a” or “one” may include one or more items unless specifically stated otherwise.

(32) The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only and not as a limitation. While particular embodiments have been shown and described, it will be apparent to those skilled in the art that changes and modifications may be made without departing from the broader aspects of the inventors' contribution. The actual scope of the protection sought is intended to be defined in the following claims when viewed in their proper perspective based on the prior art.

Claims

1. A tool having a first housing portion, the tool comprising: a ratchet housing portion pivotably coupled to the first housing portion by a pivot pin, a drive member disposed on the pivot pin and adapted to be driven linearly along the pivot pin; a yoke rotatably disposed in the ratchet housing and operably coupled to the drive member, wherein linear movement of the drive member along the pivot pin causes rotational motion of the yoke; and a pawl mechanism disposed in the ratchet housing portion and adapted to selectively transmit rotational motion of the yoke to a drive lug in either one of first and second rotational directions, wherein the pawl mechanism includes: a pawl carrier rotatably disposed in the ratchet housing portion; first and second pawls pivotably coupled to the pawl carrier; and a selector switch rotatably coupled to the pawl carrier and adapted to selectively position the first and second pawls to transmit rotational motion of the yoke to the drive lug in one of the first and second rotational directions.

2. The tool of claim 1, wherein the ratchet housing portion includes indents adapted to selectively engage a detent disposed in the first housing portion to selectively position the ratchet housing portion relative to the first housing portion, wherein the detent is biased towards the ratchet housing portion by a biasing member.

3. The tool of claim 1, further comprising a second housing portion threadably coupled to the first housing portion.

4. The tool of claim 3, further comprising a motor housing portion, wherein the second housing portion has a first end coupled to the first housing portion and a second end coupled to the motor housing portion, wherein the second housing portion includes one or more of cutouts and channels disposed at the second end and coupled to the motor housing portion.

5. The tool of claim 4, wherein the motor housing portion includes first and second motor housing portions coupled together in a clamshell type manner.

6. The tool of claim 1, wherein the yoke includes gear teeth disposed on an internal circumference of the yoke, and wherein the first and second pawls respectively include pawl teeth adapted to selectively engage the gear teeth based on a selected position of the selector switch.

7. The tool of claim 1, wherein the first and second pawls are pivotably coupled to the pawl carrier by respective pivot members received by the pawl carrier.

8. The tool of claim 7, wherein pawl positioning members are slidably disposed in the pawl carrier and are adapted to cause the first and second pawl to substantially simultaneously pivot about the respective pivot members.

9. The tool of claim 1, wherein the selector switch includes first and second outwardly biased

members adapted to respectively engage the first and second pawls to selectively position the first and second pawls to transmit rotational motion of the yoke to the drive lug in one of the first and second rotational directions.
10. The tool of claim 1, wherein the pawl carrier is integral with the drive lug.
11. The tool of claim 1, wherein the pawl carrier is coupled to the drive lug.
12. A pawl mechanism for an indexable tool and that is adapted to selectively transmit rotational motion of a yoke of the tool to a drive lug of the tool in one of first and second rotational directions, the pawl mechanism comprising: a pawl carrier; first and second pawls pivotably coupled to the pawl carrier; and a selector switch rotatably coupled to the pawl carrier and adapted to selectively position the first and second pawls to transmit rotational motion of the yoke to the drive lug in one of the first and second rotational directions; and a grease fitting disposed in the selector switch and adapted to allow grease to be applied to the pawl mechanism.
13. The pawl mechanism of claim 12, wherein the pawl carrier is integral with the drive lug.
14. The pawl mechanism of claim 12, wherein the first and second pawls are pivotably coupled to the pawl carrier by respective pivot members received by the pawl carrier.
15. The pawl mechanism of claim 14, wherein pawl positioning members are slidably disposed in the pawl carrier and are adapted to cause the first and second pawl to substantially simultaneously pivot about the respective pivot members.
16. The pawl mechanism of claim 12, wherein the selector switch includes first and second outwardly biased members adapted to respectively engage the first and second pawls to selectively position the first and second pawls to transmit rotational motion of the yoke to the drive lug in one of the first and second rotational directions.
17. The pawl mechanism of claim 12, wherein the first and second pawls are substantially identical.
18. The pawl mechanism of claim 12, wherein the pawl carrier is coupled to the drive lug.
19. The pawl mechanism of claim 12, wherein the first and second pawls respectively include pawl teeth adapted to selectively engage gear teeth disposed on an internal circumference of the yoke based on a selected position of the selector switch.