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SPEED SELECTION MODULE

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(71) Applicant(s)
SNAP-ON INCORPORATED

(72) Inventor(s)
ZHOU, Jianjun;MA, Hangyu;HE, Haolun

(74) Agent / Attorney
Griffith Hack, Level 15 376-390 Collins St, MELBOURNE, VIC, 3000, AU

ABSTRACT

A speed selection module that allows for independent control and display of speed settings of forward and reverse rotational directions of a power tool. The speed selection module includes two selection buttons (forward and reverse) and illumination elements (such as light emitting diodes (LEDs)) corresponding to each direction disposed on a speed selection printed circuit board (PCB) for independent control of speed settings of the forward and reverse rotational directions.

SPEED SELECTION MODULE

Technical Field of the Invention

[0001] The present invention relates generally to power tools, and more particularly to selection of speed of power tools.

Background of the Invention

[0002] Power tools, such as impact wrenches, drills, power ratchets, and other types of tools, are commonly used to complete industrial or home improvement tasks. Many power tools are portable and electrically powered, such as with a rechargeable battery, allowing a user to apply torque or force to a workpiece without exerting a substantial amount of energy. Power tools generally include a housing that houses a motor and electronic components for controlling the motor.

[0003] Power tools also typically include direction selection mechanisms that allow for switching between forward and reverse operational directions. Some power tools allow for speed adjustment. However, these tools do not provide for independent adjustment of the speed for the forward and reverse operational directions.

Summary of the Invention

[0004] The present invention relates broadly to a speed selection module that allows for independent control and display of speed settings of forward and reverse rotational directions of a power tool. The speed selection module includes two selection buttons (forward and reverse) and illumination elements (such as light emitting diodes (LEDs)) corresponding to each direction disposed on a speed selection printed circuit board (PCB) for independent control of speed settings of the forward and reverse rotational directions. This also allows for a distinct and separate speed setting of each of the forward and reverse rotational directions.

[0005] Distinct and separate speed settings of each of the forward and reverse rotational directions allow for a speed of the power tool to be selected for a particular application. For example, when operating a power tool, such as an impact driver or wrench, in the forward rotational direction, a high speed may be desired to run down a fastener and/or apply a high torque to the fastener, and a low speed may be desired to apply a low torque to a fastener. Similarly, when operating an impact driver or wrench in the reverse rotational direction, a high speed may be desired to quickly remove a fastener and/or apply a high torque to the fastener, and a low speed may be desired to apply a low torque to a fastener.

[0006] In another example, when operating a power tool, such as a drill, in the forward rotational direction, a high speed may be desired to run down a fastener and a low speed may be desired to apply a high torque to a fastener. Similarly, when operating a drill in the reverse rotational direction, a high speed may be desired to quickly remove a fastener and a low speed may be desired to apply a high torque to a fastener, such as to break a stuck fastener free.

[0007] In an embodiment, the present invention relates broadly to a speed selection module for a motorized tool that can selectively operate in first and second rotational directions. The speed selection module includes a first selection button corresponding to a first rotational direction of a motor shaft of the motorized tool, a second selection button corresponding to a second rotational direction of the motor shaft, a first set of illumination elements corresponding to the first selection button and adapted to indicate a speed setting corresponding to the first rotational direction, and a second set of illumination elements corresponding to the second selection button and adapted to indicate a speed setting corresponding to the second rotational direction.

[0008] In another embodiment, the present invention relates broadly to a tool including a motor with a motor shaft, and an output mechanism adapted to be driven by the motor shaft. The

tool includes a speed selection module operably coupled to the motor. The speed selection module includes a first selection button corresponding to a first rotational direction of the motor shaft, a second selection button corresponding to a second rotational direction of the motor shaft, a first set of illumination elements corresponding to the first selection button and adapted to indicate a speed setting corresponding to the first rotational direction, and a second set of illumination elements corresponding to the second selection button and adapted to indicate a speed setting corresponding to the second rotational direction.

Brief Description of the Drawings

[0009] 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.

[0010] FIG. 1 is a perspective view of an exemplar tool, including an embodiment of the present invention.

[0011] FIG. 2 is a rear perspective view of the exemplar tool of FIG. 1.

[0012] FIG. 3 is an exploded side view of the exemplar tool of FIG. 1 illustrating exemplar internal components of the tool.

[0013] FIG. 4 is a partial side view of the exemplar tool of FIG. 1 with a first housing portion removed showing exemplar internal components of the tool.

[0014] FIGS. 5 and 6 are perspective views of a controller assembly, according to an embodiment of the present invention.

[0015] FIGS. 7-9 are perspective views of a speed selector module, according to an embodiment of the present invention.

[0016] FIG. 10 is an exploded view of exemplar internal components of the exemplar tool of FIG. 1.

[0017] FIG. 11 is an exploded perspective view of illumination components of the exemplar tool of FIG. 1.

Detailed Description

[0018] 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, a preferred embodiment of the invention 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.

[0019] The present invention relates broadly to a speed selection module that allows for independent control and display of speed settings of forward and reverse rotational directions of a power tool. The speed selection module includes two selection buttons (forward and reverse) and illumination elements (such as light emitting diodes (LEDs)) corresponding to each direction disposed on a speed selection printed circuit board (PCB) for independent control of speed settings of the forward and reverse rotational directions. This also allows for a distinct and separate speed setting of each of the forward and reverse rotational directions.

[0020] Distinct and separate speed settings of each of the forward and reverse rotational directions allow for a speed of the power tool to be selected for a particular application. For

example, when operating a power tool, such as an impact driver or wrench, in the forward rotational direction, a high speed may be desired to run down a fastener and/or apply a high torque to the fastener, and a low speed may be desired to apply a low torque to a fastener. Similarly, when operating an impact driver or wrench in the reverse rotational direction, a high speed may be desired to quickly remove a fastener and/or apply a high torque to the fastener, and a low speed may be desired to apply a low torque to a fastener.

[0021] In another example, when operating a power tool, such as a drill, in the forward rotational direction, a high speed may be desired to run down a fastener and a low speed may be desired to apply a high torque to a fastener. Similarly, when operating a drill in the reverse rotational direction, a high speed may be desired to quickly remove a fastener and a low speed may be desired to apply a high torque to a fastener, such as to break a stuck fastener free.

[0022] Referring to FIGS. 1-4, an exemplar tool 100 (such as a cordless impact wrench) incorporating an embodiment of the present invention is illustrated. The exemplar tool 100 includes a housing 102 (also referred to as a tool housing) having first and second housing portions 104, 106 (respectively forming first and second sides of the housing 102), a motor 108 disposed in the housing 102, an output nose mechanism 110 coupled to the housing 102 at a front or working end of the tool 100 and operably coupled to the motor 108, a controller assembly 112 disposed in the housing 102, a speed selection module 114 operably coupled to the controller assembly 112, and an actuatable trigger 116 adapted to operate the motor 108 and thereby the output nose mechanism 110.

[0023] In an embodiment, the housing 102 is a clamshell-type housing having first and second housing portions 104, 106 that are mirror images of each other and coupled together via fasteners to cooperatively form the housing 102. In another embodiment, the housing 102 (including the

first and second housing portions 104, 106) may be a single integrated or monolithic piece. The housing 102 includes a motor housing portion 118 and a handle housing portion 120 formed by the first and second housing portions 104, 106. The handle housing portion 120 may extend from the motor housing portion 118 to a power source receiving end 122 that is adapted to receive and couple to a power source, such as a removable battery pack, for providing power to the tool 100. In an embodiment, the motor housing portion 118 and handle housing portion 120 may be disposed at an angle relative to each other, thus forming a pistol-grip type tool. For example, in an embodiment, a longitudinal axis of the motor housing portion 118 and a longitudinal axis of the handle housing portion 120 may be disposed at an angle of about 100 to about 120 degrees, and preferably about 110 degrees relative to each other. It will be appreciated that while the present invention is shown and described as an exemplar pistol-grip type tool, the present invention is not so limited and can be used with any type of tool that has selective first and second rotational directions.

[0024] Referring to FIGS. 3, 4, and 10, the motor 108 is disposed in and supported in the motor housing portion 118, proximal to a rear end of the housing 102, and operably coupled to the trigger 116 via the controller assembly 112. The motor 108 may be a frameless brushless DC (BLDC) or a brushed-type motor, or any other suitable motor (e.g., pneumatically or hydraulically operated or AC operated motor). The motor 108 may include a motor fan 124, and a motor shaft 126 (as shown in FIG. 10) that is operably coupled to the output nose mechanism 110. Thus, actuation of the trigger 116 by a user (such as depression of the trigger 116) causes the motor 108 to operate and operate the output nose mechanism 110.

[0025] The tool 100 may also include motor control electronics 128 (illustrated in FIGS. 3, 4, and 10) operably coupled to and adapted to control the motor 108. For example, the motor

control electronics 128 may include a motor printed circuit board (PCB) that is operably coupled to the controller assembly 112, such as via wiring 129. For example, the wiring 129 may include a connector, such as a pin connector or other type of connector. Alternatively, the wiring 129 may be operably coupled to the controller assembly 112 without a connector, such as via soldering.

[0026] The motor PCB may include one or more switching elements disposed thereon. The switching elements may be field effect transistors (FETs), such as, for example, metal-oxide semiconductor field-effect transistors (MOSFETs). In an embodiment, the switching elements may include three high-side switching elements, H1, H2, and H3, and three low-side switching elements, L1, L2, and L3, each being operable in either one of a first or conducting state and a second or non-conducting state. The switching elements are controlled by the controller assembly 112 and/or motor PCB to selectively apply power from a power source (e.g., a battery pack) to the motor 108 to achieve desired commutation. By selectively activating particular high-side and low-side switching elements, the motor 108 is operated by having the controller assembly 112 and/or motor PCB send a current signal through coils located on a stationary part of the motor 108 called a stator. The coils cause a magnetic force to be applied to a rotating part of the motor 108, called a rotor, when current runs through the coils. The rotor contains permanent magnets that interact with magnetic forces created by the windings of the stator. By selectively activating successive combinations of high and low-side switching elements in a particular order, thereby sending a particular order of current signals through the windings of the stator, the stator creates a rotating magnetic field which interacts with the rotor causing it to rotate, which causes rotation of the motor shaft 126, in a well-known manner.

[0027] Referring to FIGS. 3-6, the controller assembly 112 may be disposed in the handle housing portion 120. The controller assembly 112 includes a control printed circuit board (PCB) 130 that is operably coupled to the motor control electronics 128, power receiving terminals 132, and the trigger 116, for example, via wires. The power receiving terminals 132 are adapted to be operably coupled to a power source, such as a battery pack, to provide power to the tool 100. In an embodiment, the trigger 116 is disposed proximal to an intersection of the handle and motor housing portions 120 and 118, and is operably coupled to the controller assembly 112. Actuation of the trigger 116 (such as depression of the trigger 116) causes the motor 108 to operate and selectively rotate the motor shaft 126 in either one of first and second (e.g., forward and reverse or clockwise and counter-clockwise) rotational directions, in a well-known manner.

[0028] In an embodiment, the trigger 116 is a rocker type of trigger switch, where depression of a top portion (portion proximal to the motor housing portion 118) of the trigger 116 causes the tool 100 to operate in a first rotational direction (such as a clockwise rotational direction), and depression of a bottom portion (portion distal to the motor housing portion 118) of the trigger 116 causes the tool 100 to operate in a second rotational direction (such as a counter-clockwise rotational direction). In another embodiment, the trigger 116 may be a linearly depressible trigger that is depressible inwardly, relative to the tool 100, to cause the tool 100 to operate, and a release of the trigger 116 causes the trigger 116 to bias outwardly, relative to the tool 100, to cease operation of the tool 100. The trigger 116 and control printed circuit board (PCB) 130 may also operate via a variable speed type mechanism. In this regard, actuation or depression of the trigger 116 can cause the motor 108 to rotate the motor shaft 126 at a faster speed the further the trigger 116 is depressed, subject to a speed selection of the speed selection module 114 described below.

[0029] Referring to FIGS. 2-9, the speed selection module 114 is disposed in the motor housing portion 118 at a rear end of the tool 100, behind the motor 108, and is operably coupled to the controller assembly 112, for example, via wires 134, and thereby operably coupled to the motor 108 via the controller assembly 112. The wires 134 may or may not include a connector that operably couples to the speed selection module 114 to the controller assembly 112. For example, the wires 134 may include solder wires and be operably coupled to the controller assembly 112 without a connector, such as via soldering. Alternatively, the wires 134 may include a connector, such as a 6 pin connector or other type of connector including any number of pins.

[0030] The speed selection module 114 allows independent control and display of speed settings respectively of first and second rotational directions (i.e., clockwise and counter-clockwise rotational directions) of the tool 100. Thus, the speed selection module 114 allows a first speed setting for the first rotational direction, and a second speed setting for the second rotation direction of the motor 108, wherein the first and second speed settings may be the same or different.

[0031] The speed selection module 114 includes a speed selection printed circuit board (PCB) 136 with a control chip 137. The wires 134 may be operably coupled to the speed selection PCB 136, thereby operably coupling the speed selection PCB 136 to the motor 108 via the controller assembly 112. The wires 134 may be operably coupled to the speed selection PCB 136 with our without a connector. As illustrated, the wires 134 are soldered to the speed selection PCB 136. However, a connector, such as a 6 pin connector, a 10 pin connector, or other type of connector with any number of pins may be used instead. A first selection button 138 corresponding to the first rotational direction may be disposed on and operably coupled to the speed selection PCB

136, a second selection button 140 corresponding to the second rotational direction may be disposed on and operably coupled to the speed selection PCB 136, a first set of illumination elements 142a-c (such as light emitting diodes (LEDs)) corresponding to the first selection button 138 may be disposed on and operably coupled to the speed selection PCB 136, and a second set of illumination elements 144a-c (such as light emitting diodes (LEDs)) corresponding to the second selection button 140 may also be disposed on and operably coupled to the speed selection PCB 136. A first lens or cover 146 may also be disposed over the first set of illumination elements 142a-c, and a second lens or cover 148 may be disposed over the second set of illumination elements 144a-c. A speed selection cover 150 may also be disposed over the first and second selection buttons 138, 140 and the first and second sets of illumination elements 142a-c, 144a-c. The speed selection cover 150 may include first and second depressible button areas 152, 154 respectively corresponding to the first and second selection buttons 138, 140, and first and second transparent windows 156a-c, 158a-c corresponding to the first and second sets of illumination elements 142a-c, 144a-c. The speed selection cover 150 may also include one or more protrusions 160 that respectively engage one or more apertures 162 in the speed selection PCB 136 to couple the speed selection cover 150 to the speed selection PCB 136.

[0032] As shown in FIG. 4, the speed selection module 114 may be disposed in the motor housing portion 118, with the speed selection PCB 136 disposed in a channel 164 in the housing 102, and the speed selection cover 150 accessible from an exterior of the tool 100 through a cutout 166 in the housing 102.

[0033] Referring to FIG. 7, the first selection button 138 allows selection of a speed setting corresponding to the first rotational direction, and the second selection button 138 allows selection of a speed setting corresponding to the second rotational direction. For example, a user

may cycle through first, second, and third settings of the first rotational direction speed settings by sequentially or repeatedly pressing the first button area 152, thereby actuating the first selection button 138. When the first setting of the first rotational direction speed settings is selected, a first one of the first set of illumination elements 142a is illuminated to indicate that the first setting of the first rotational direction speed settings is selected. When the second setting of the first rotational direction speed settings is selected, a second one of the first set of illumination elements 142b is illuminated (alternatively, each of the first and second illumination elements 142a and b may be illuminated) to indicate that the second setting of the first rotational direction speed settings is selected. When the third setting of the first rotational direction speed settings is selected, a third one of the first set of illumination elements 142c is illuminated (alternatively, each of the first-third illumination elements 142a-c may be illuminated) to indicate that the third setting of the first rotational direction speed settings is selected.

[0034] Similarly, a user may cycle through first, second, and third settings of the second rotational direction speed settings by sequentially or repeatedly pressing the second button area 154, thereby actuating the second selection button 140. When the first setting of the second rotational direction speed settings is selected, a first one of the second set of illumination elements 144a is illuminated to indicate that the first setting of the second rotational direction speed settings is selected. When the second setting of the second rotational direction speed settings is selected, a second one of the second set of illumination elements 144b is illuminated (alternatively, each of the first and second illumination elements 144a and b may be illuminated) to indicate that the second setting of the second rotational direction speed settings is selected. When the third setting of the second rotational direction speed settings is selected, a third one of the second set of illumination elements 144c is illuminated (alternatively, each of the first-third

illumination elements 144a-c may be illuminated) to indicate that the third setting of the second rotational direction speed settings is selected.

[0035] In an embodiment, the first settings of the respective first and second rotational direction speed settings may be a lowest speed setting, the second settings of the respective first and second rotational direction speed settings may be a middle speed setting, and the third settings of the respective first and second rotational direction speed settings may be a highest speed setting. However, it will be appreciated that other arrangements or settings can be used, and the foregoing is just exemplar. For example, and without limitation, the first settings may be a highest speed setting and the third settings may be a lowest speed setting.

[0036] Further, while three settings and three illumination elements are shown and described for each of the first and second rotational direction speed settings, more or less than three settings and three illumination elements can be used.

[0037] Referring to FIG. 10, the output nose mechanism 110 of the exemplar tool 100 includes a nose housing 168 and an impact mechanism including a gear carrier 170, a ring gear 172, a hammer 174, and an anvil 176. The nose housing 168 is adapted to be supported in the housing 102 and coupled to the housing 102 via fasteners or other means. The nose housing 168 is adapted to house the impact mechanism and support and couple to a ring gear exterior surface or outer diameter of the ring gear 172. In general, the nose housing 168 includes opposing first and second nose housing ends 178, 180. The gear carrier 170 is operably coupled to the ring gear 172, hammer 174, and anvil 176, and the ring gear 172 is coupled to the nose housing 168 at the first nose housing end 178, with the gear carrier 170, hammer 174, and anvil 176 disposed in the nose housing 168, and an output drive lug 182 of the anvil 176 extending out of the second nose housing end 180. The second nose housing end 180 is also adapted to receive a nose bushing 184

that receives and supports the output drive lug 182 of the anvil 176 extending outwardly from the second nose housing end 180.

[0038] The gear carrier 170 is operably coupled to the motor shaft 126 and ring gear 172 via bearings 186, 188, and is adapted to receive rotational force from the motor 108 and transfer the rotational force to the hammer 174 and anvil 176. The gear carrier 170 also includes planet gears 190 operably coupled to the gear carrier 170, and gear carrier ball grooves 192 that respectively receive balls 194. When the gear carrier 170 is installed, the motor shaft 126 is disposed between the planet gears 190. Planet gear teeth of the planet gears 190 meshingly engage gear teeth of the motor shaft 126. This allows the motor shaft 126 to rotate the gear carrier 170, as described below. The gear carrier ball grooves 192 and balls 194 are adapted to move the hammer 174 axially against a bias force of bias member 196 and away from the anvil 176 when a minimum amount of torque is reached, as discussed below.

[0039] Referring to FIG. 11, the tool 100 may also include a work area illumination module 200. The work area illumination module 200 may be disposed in the forward end or second nose housing end 180 of the nose housing 168 to illuminate a work area. The work area illumination module 200 may include an illumination PCB 202 with one or more illumination elements 204 (such as light emitting diodes (LEDs)), and that operably couples to the controller assembly 112 via a connector 206. The illumination PCB 202 may be disposed in a recess 208 formed in the nose housing 168 with wiring to the connector 206 running along a groove 210 formed in the nose housing 168. An illumination cover 212 may also be disposed over the illumination PCB 202 to protect the illumination PCB 202. The illumination cover 212 may be coupled to the nose housing 168 covering the recess 208, and include one or more windows 214 that respectively align with the one or more illumination elements 204.

[0040] During use of the tool 100, the speed selection module 114 displays the currently selected speed settings of the respective first and second rotational directions (i.e., clockwise and counter-clockwise rotational directions) via illumination of the corresponding illumination elements of the first and second sets of illumination elements 142a-c, 144a-c. For example, when a power source, such as a battery pack is inserted into the power source receiving end 122 and operably coupled to the power receiving terminals 132, the corresponding illumination elements of the first and second sets of illumination elements 142a-c, 144a-c may illuminate for a predetermined amount of time (such as about 1-10 seconds) to indicate the currently selected speed settings of the respective first and second rotational directions.

[0041] In an embodiment, the user may alter or change the currently selected speed setting of the first rotational direction by pressing the first button area 152, thereby actuating the first selection button 138. The user may also alter or change the currently selected speed setting of the second rotational direction by pressing the second button area 154, thereby actuating the second selection button 140. When either one of the first and second selection buttons 138, 140 is actuated, the speed selection module 114 may display and continue to display the currently selected speed settings of the respective first and second rotational directions for a predetermined amount of time (such as about 1-10 seconds).

[0042] The speed selection module 114 also displays the currently selected speed settings of the respective first and second rotational directions (i.e., clockwise and counter-clockwise rotational directions) via illumination of the corresponding illumination elements of the first and second sets of illumination elements 142a-c, 144a-c when the trigger 116 is actuated. When the trigger 116 is released, the speed selection module 114 may continue to display the currently

selected speed settings of the respective first and second rotational directions for a predetermined amount of time (such as about 1-10 seconds).

[0043] Additionally, when the trigger 116 is actuated, the controller assembly 112 and/or motor PCB selectively supplies power from the power source (e.g., battery pack) to the motor 108 to cause rotation of the motor shaft 126 at the selected speed setting and in of the selected clockwise or counter-clockwise rotational directions, depending on how the trigger 116 is actuated, which causes rotation of the gear carrier 172 and the hammer 174. Rotation of the hammer 174 causes rotation of the anvil 176 and the output drive lug 182. Once an amount of torque required to rotate or drive the output drive lug 182 exceeds a minimum torque amount, the gear carrier 170 rotates at a faster rotational velocity than the hammer 174 and the anvil 176, thereby causing the balls 194 to traverse along the gear carrier ball grooves 192. As the balls 194 traverse the gear carrier ball grooves 192, the hammer 174 overcomes the bias force applied by the biasing member 196 and moves in an axial direction towards the motor 108 and away from the anvil 176 until hammer lugs of the hammer 174 no longer contact impact sections 198 (also known as anvil wings). Once the hammer lugs no longer contact the impact sections 198, the bias member 196 causes the hammer 174 to move axially towards the anvil 176 and deliver a sudden rotational impact force to the anvil 176 and, consequently, the output drive lug 182.

[0044] While the tool 100 is described above as having an output drive lug 182, the tool 100 may have different types of output mechanisms. For example, the tool 100 may include a drill chuck, a hammer type output with a drill chuck or a drive lug, an impact type mechanism with a drill chuck or a drive lug, etc. The drive lug or drill chuck or can be coupled to other devices, such as a socket or other adapter, to apply torque to a work piece, such as, for example, a screw or bolt, in a well-known manner.

[0045] While the tool 100 is described as powered by a battery, the tool 100 may be power by other electrical power sources, such as an external wall outlet, etc.

[0046] As discussed herein, the tool 100 is a pistol grip type power tool, such as an impact wrench. However, the tool 100 can be any electrically powered or hand-held impact tool, including, without limitation, a hammer drill, impact drill, impact ratchet wrench, or other powered impact tool, that is powered by electricity via a power source (such as a wall outlet and/or generator outlet) or a battery. The tool 100 can also be any electrically powered or hand-held tool with a motor, including, without limitation, a drill, ratchet wrench, grinder, sander, polisher, or other powered tool, that is powered by electricity via a power source (such as a wall outlet and/or generator outlet) or a battery.

[0047] 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.

[0048] 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

WHAT IS CLAIMED IS:

1. A tool including a motor having a motor shaft, and an output mechanism adapted to be driven by the motor shaft, the tool comprising:

a speed selection module operably coupled to the motor and including:

a first speed selection button corresponding to a first rotational direction of the motor shaft;

a second speed selection button corresponding to a second rotational direction of the motor shaft;

a first set of illumination elements corresponding to the first speed selection button and adapted to indicate a first selected speed setting corresponding to the first rotational direction; and

a second set of illumination elements corresponding to the second speed selection button and adapted to indicate a second selected speed setting corresponding to the second rotational direction.

2. The tool of claim 1, wherein the speed selection module further includes a speed selection printed circuit board (PCB), and each of the first and second speed selection buttons and the first and second sets of illumination elements are disposed on and operably coupled to the speed selection PCB.

3. The tool of claim 2, wherein the speed selection module further includes a speed selection cover coupled to the speed selection PCB.

4. The tool of claim 3, wherein the speed selection cover includes first and second depressible button areas that are respectively disposed over the first and second speed selection buttons.

5. The tool of claim 3, wherein the speed selection cover includes first and second sets of transparent windows respectively disposed over the first and second sets of illumination elements.

6. The tool of claim 3, wherein the speed selection PCB includes an aperture and the speed selection cover includes a protrusion that engages the aperture to couple the speed selection cover to the speed selection PCB.

7. The tool of claim 1, wherein the speed selection module is disposed in the tool behind the motor.

8. The tool of claim 1, wherein actuation of the first selection button causes the first and second sets of illumination elements to respectively indicate the speed settings corresponding to the first and second rotational directions.

9. The tool of claim 1, wherein actuation of the second selection button causes the first and second sets of illumination elements to respectively indicate the speed settings corresponding to the first and second rotational directions.

10. The tool of claim 1, wherein repeated actuation of the first speed selection button causes cycling through the speed settings corresponding to the first rotational direction.

11. The tool of claim 1, wherein repeated actuation of the second speed selection button causes cycling through the speed settings corresponding to the second rotational direction.

12. A speed selection module for a motorized tool, the speed selection module comprising:

a first selection button adapted to select a first speed of a first rotational direction of a motor shaft of the motorized tool;

a second selection button adapted to select a second speed of a second rotational direction of the motor shaft;

a first set of illumination elements corresponding to the first selection button and adapted to indicate a first speed setting corresponding to the selected first speed; and

a second set of illumination elements corresponding to the second selection button and adapted to indicate a second speed setting corresponding to the selected second speed.

13. The speed selection module of claim 12, further comprising a speed selection printed circuit board (PCB), and wherein each of the first and second selection buttons and the first and second sets of illumination elements are disposed on and operably coupled to the speed selection PCB.

14. The speed selection module of claim 13, further comprising a speed selection cover coupled to the speed selection PCB.

15. The speed selection module of claim 14, wherein the speed selection cover includes first and second depressible button areas that are respectively disposed over the first and second selection buttons.

16. The speed selection module of claim 14, wherein the speed selection cover includes first and second sets of transparent windows respectively disposed over the first and second sets of illumination elements.

17. The speed selection module of claim 14, wherein the speed selection PCB includes an aperture and the speed selection cover includes a protrusion that engages the aperture to couple the speed selection cover to the speed selection PCB.

18. The speed selection module of claim 12, wherein actuation of the first selection button causes the first and second sets of illumination elements to respectively indicate the speed settings corresponding to the first and second rotational directions.

19. The speed selection module of claim 12, wherein actuation of the second selection button causes the first and second sets of illumination elements to respectively indicate the speed settings corresponding to the first and second rotational directions.

20. The speed selection module of claim 12, wherein repeated actuation of the first selection button causes cycling through the speed settings corresponding to the first rotational direction; and repeated actuation of the second selection button causes cycling through the speed settings corresponding to the second rotational direction.

21. A speed selection module for a motorized tool having a motorized drive shaft, the speed selection module comprising:

a first selection button adapted to select any one of first, second, and third speeds of a first rotational direction of the motor drive shaft;

a second selection button adapted to select any one of first, second and third speeds of a second rotational direction of the motor drive shaft;

a first set of illumination elements corresponding to the selected first, second or third speed of the first rotational direction; and

a second set of illumination elements corresponding to the selected first, second or third speed of the second rotational direction.

FIG. 1

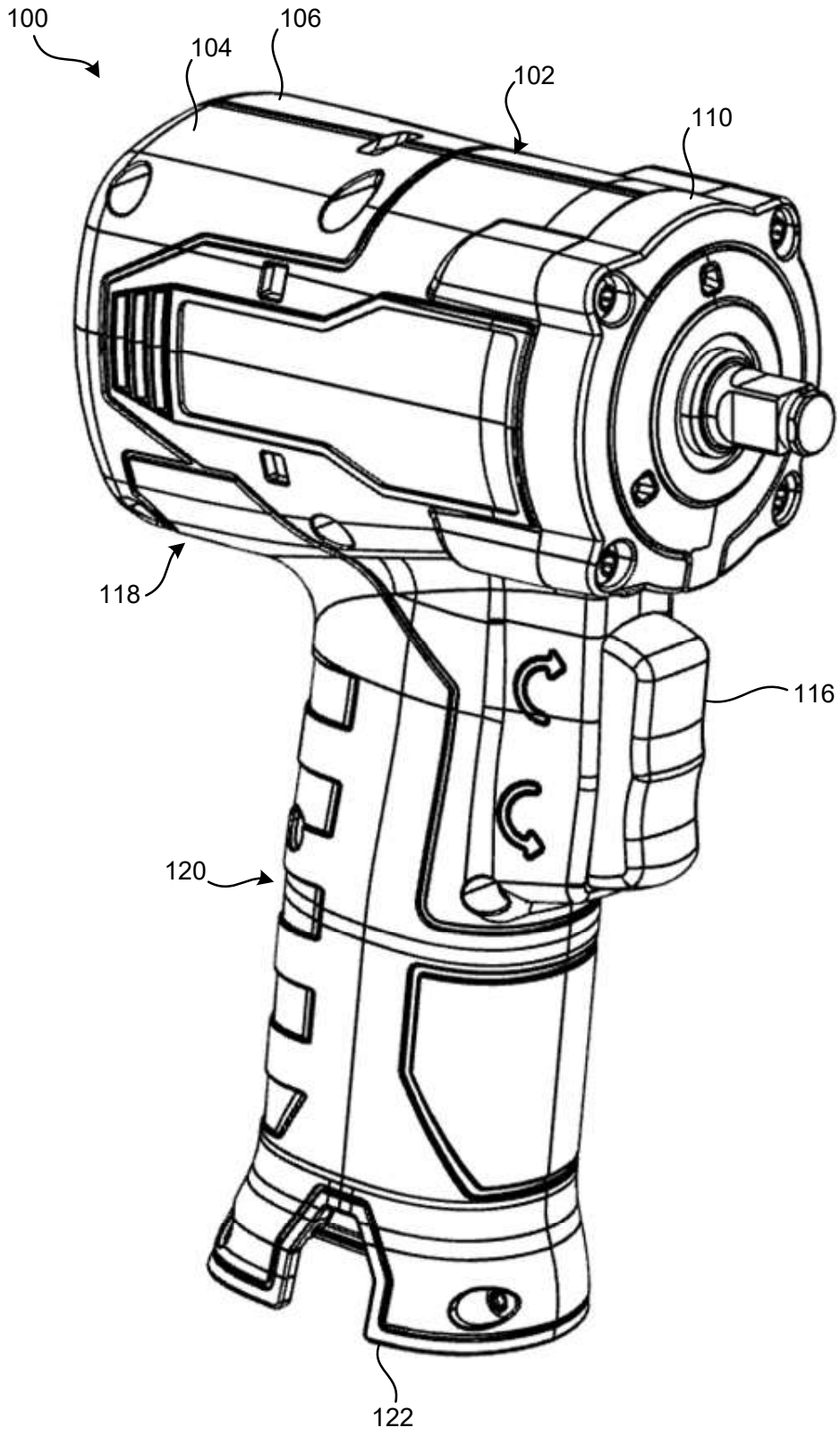

FIG. 2

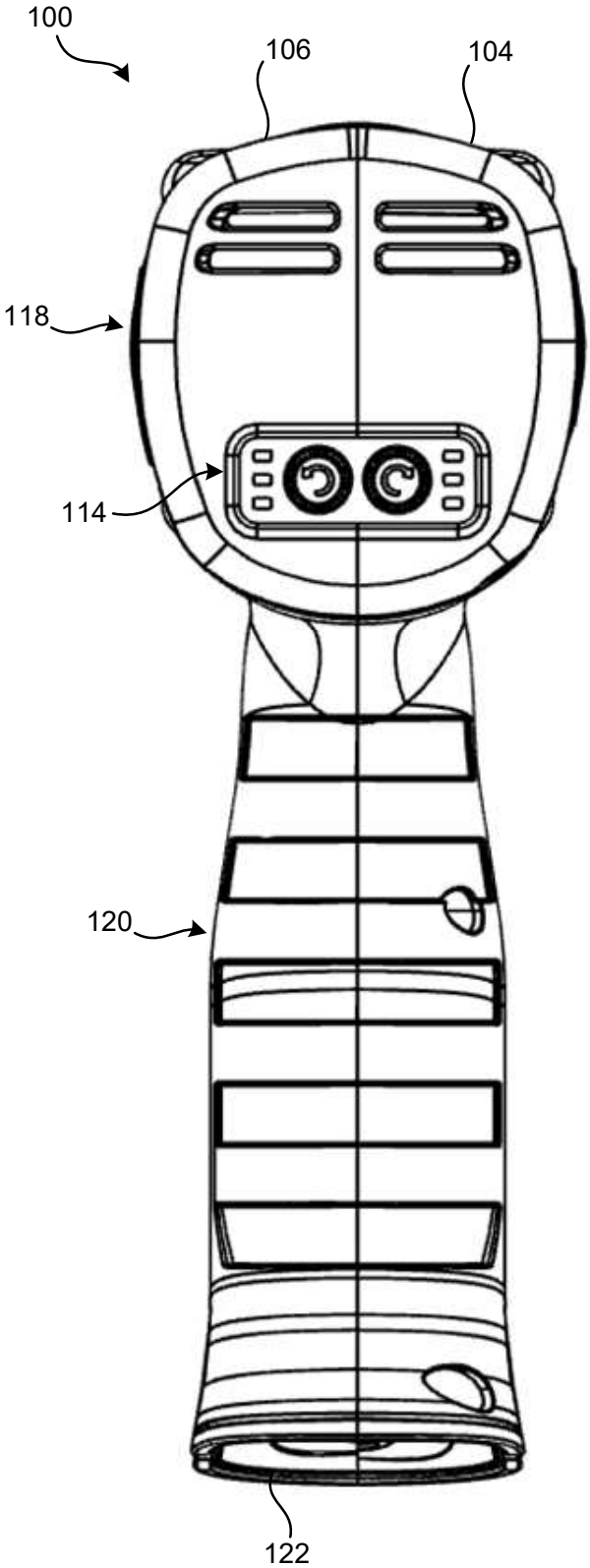

FIG. 3

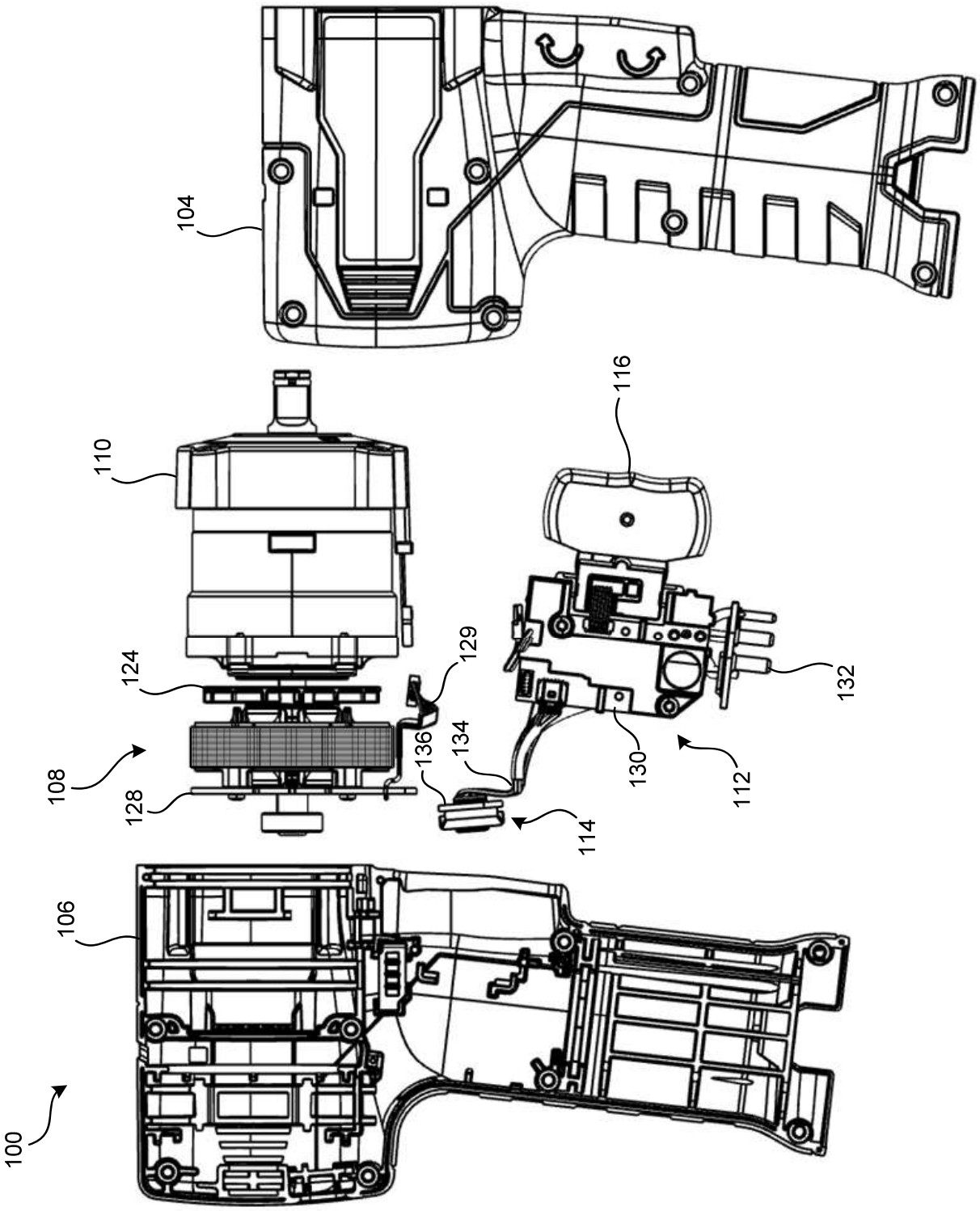

FIG. 4

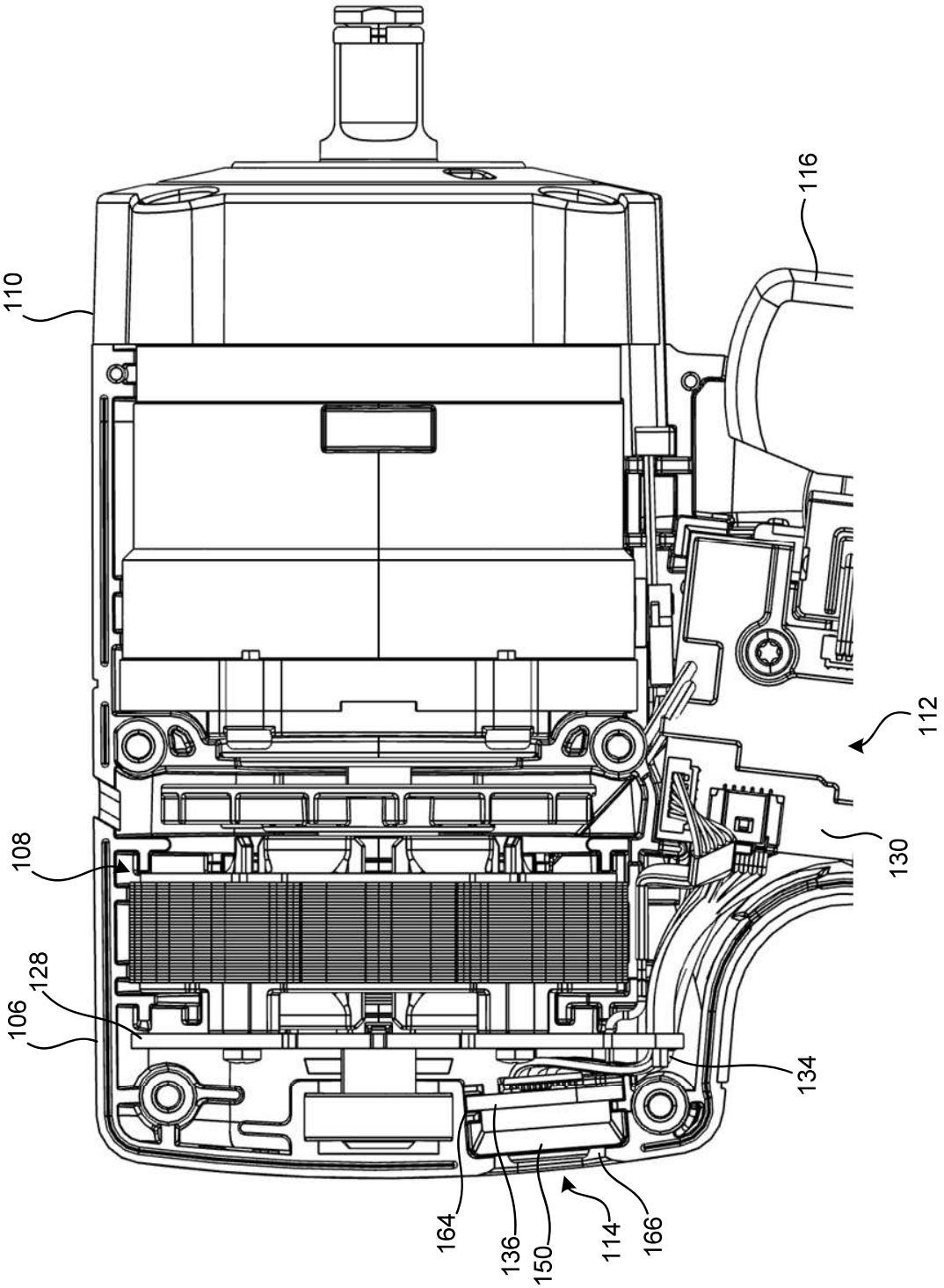

FIG. 5

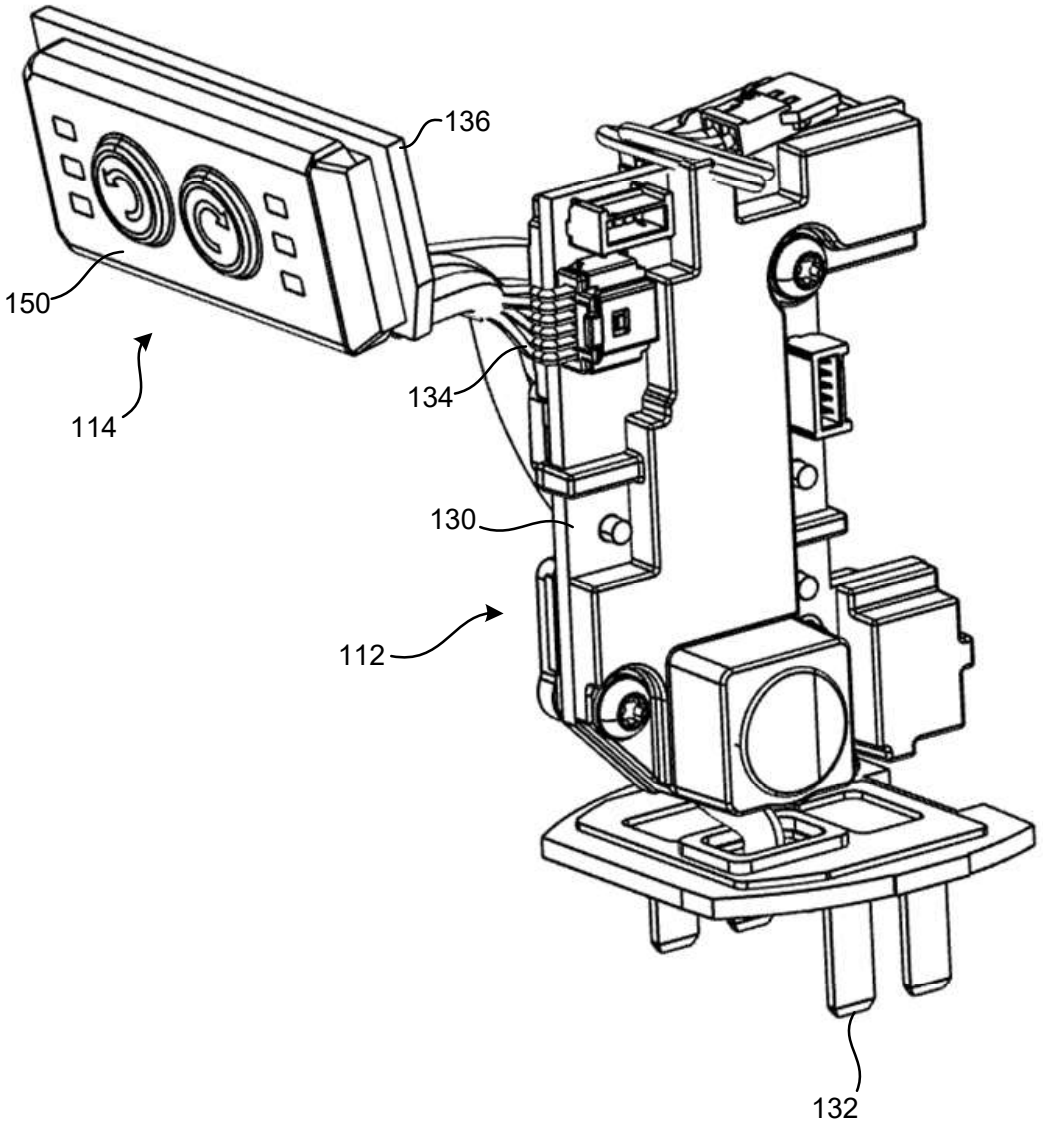

FIG. 6

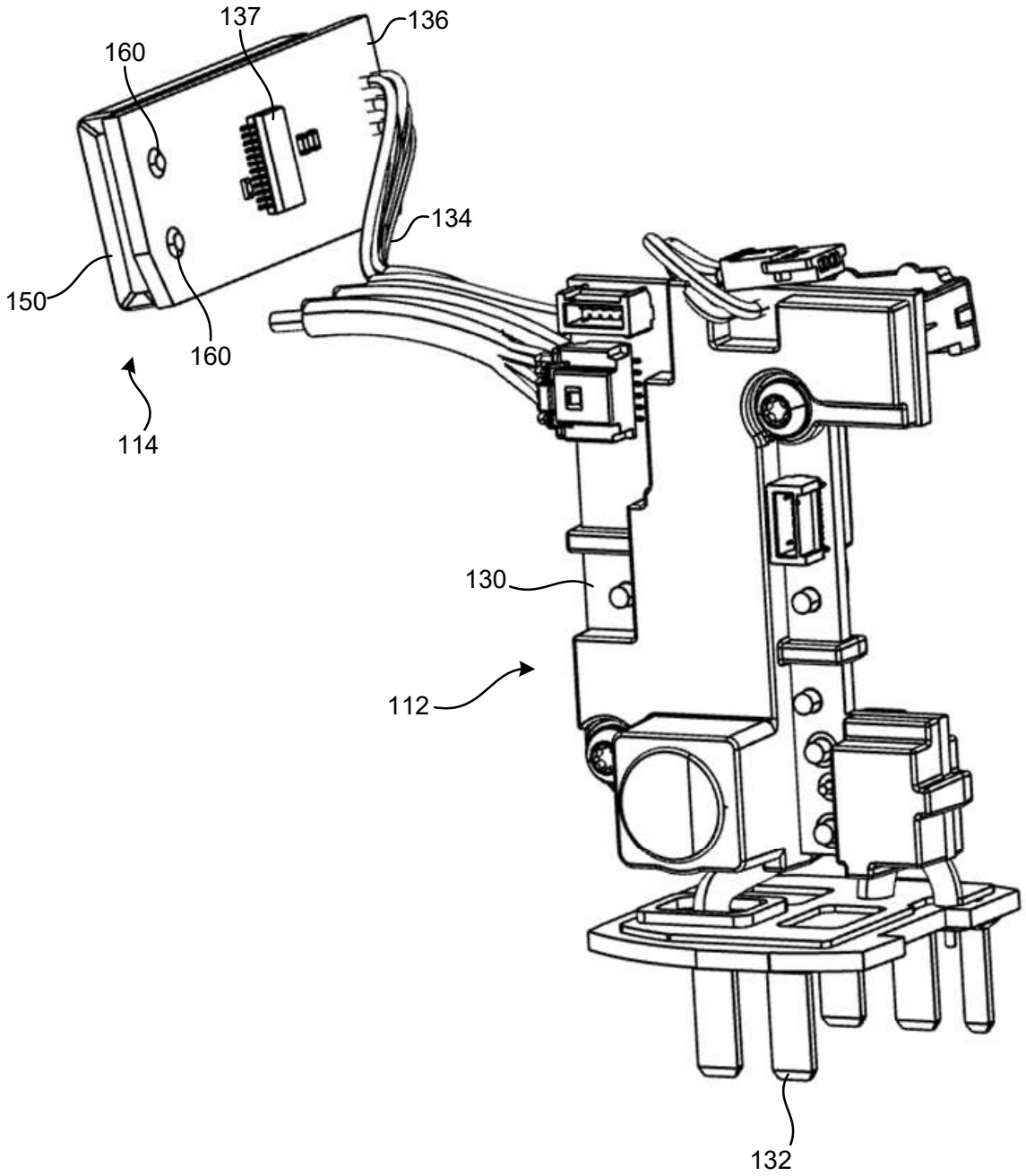

FIG. 7

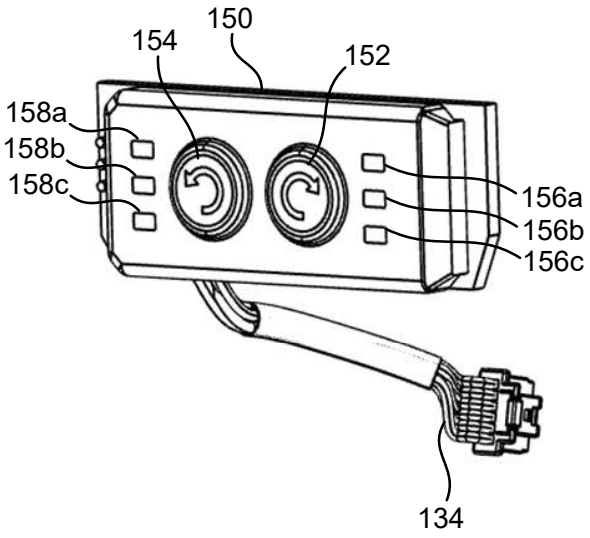

FIG. 8

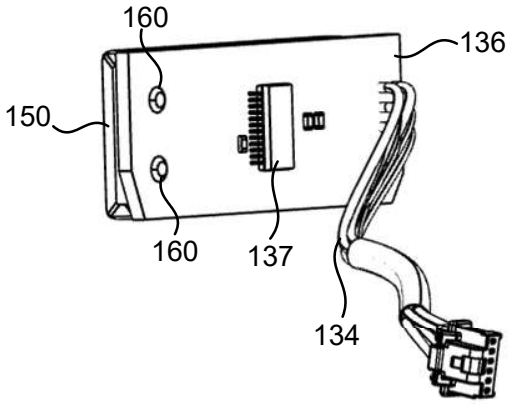

FIG. 9

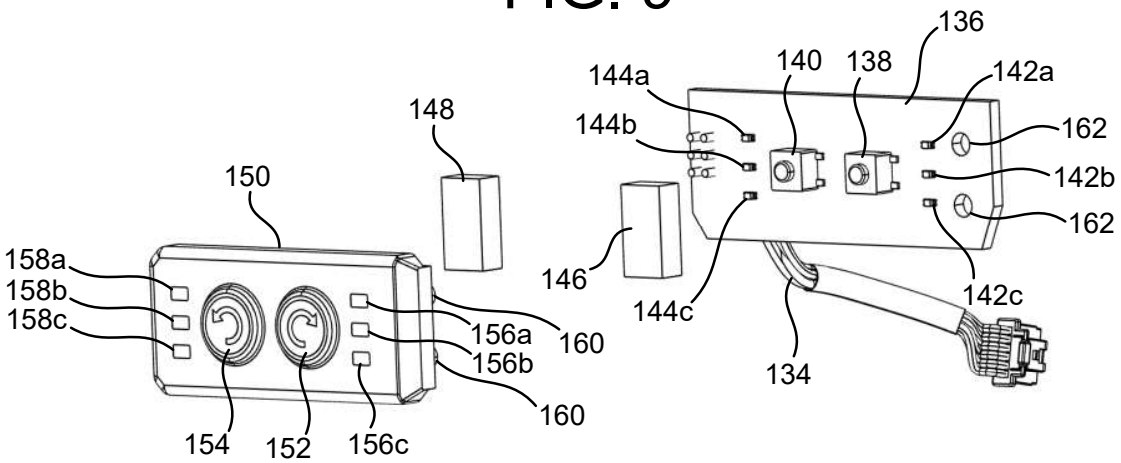

FIG. 10

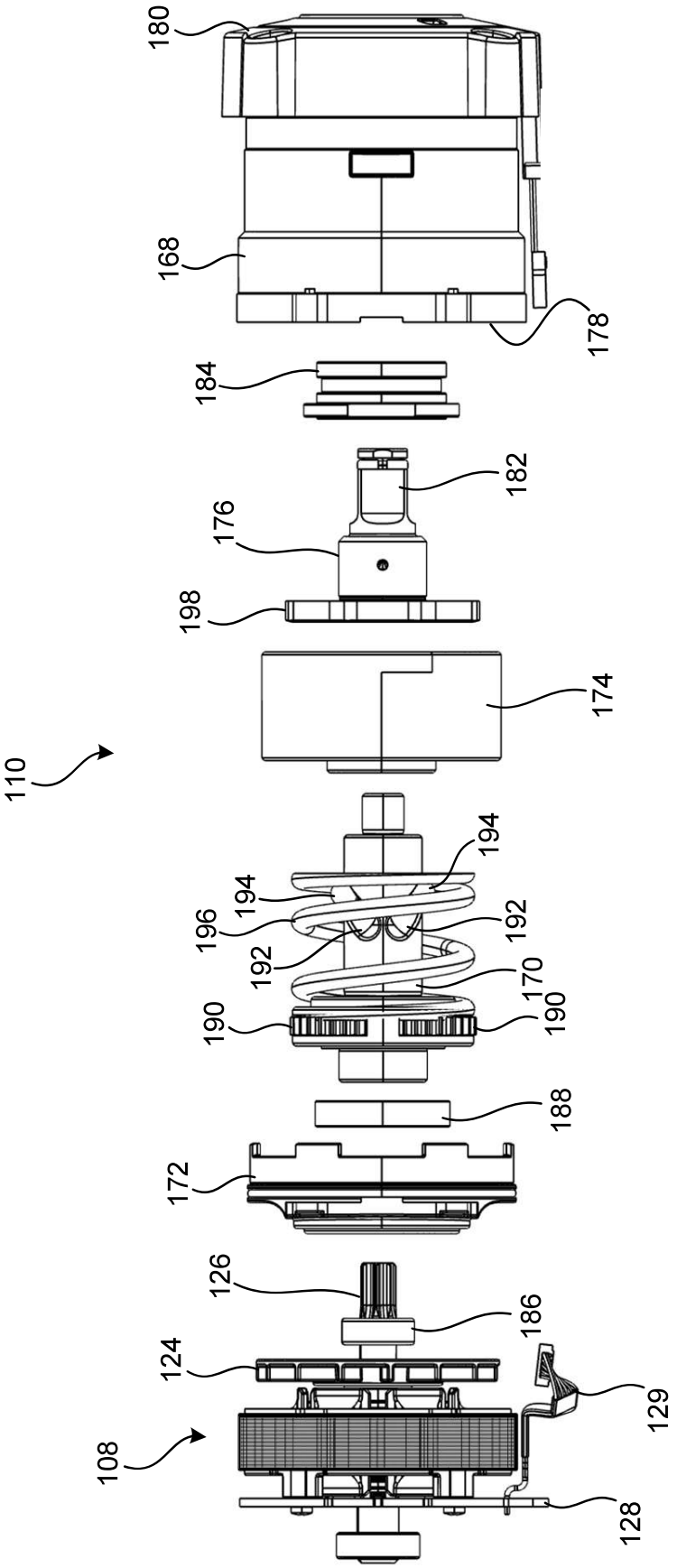
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FIG. 11