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(54) Title: RIVET SETTING TOOL

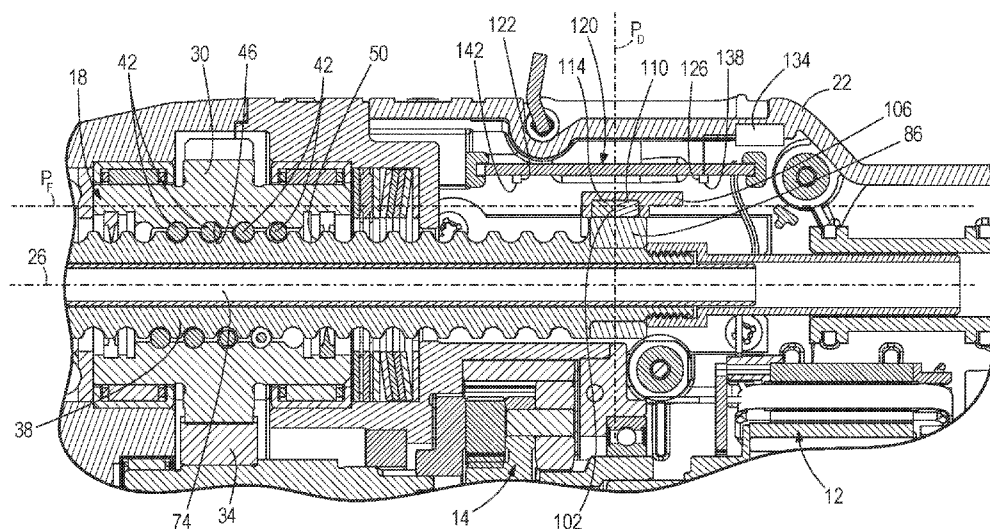


FIG. 5

(57) Abstract: A rivet tool for setting a rivet, the rivet tool including a motor and a pulling mechanism. The pulling mechanism is configured to receive torque from the motor and includes a moveable member moveable between first and second positions. A plurality of jaws are configured to clamp onto a mandrel of the rivet and pull the mandrel in response to the moveable member moving from the first position to the second position. A magnet is coupled for movement with the moveable member and includes a north pole face, an adjacent south pole face, and a pole junction therebetween. The north and south pole faces face away from the moveable member. A first sensor is configured to detect the pole junction when the moveable member is in the first position. A second sensor is configured to detect the pole junction when the moveable member is in the second position.

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RIVET SETTING TOOL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to co-pending U.S. Provisional Patent Application No. 63/033,900, filed on June 3, 2020, the entire content of which is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to rivet setting tools, and more particularly to pulling mechanisms for rivet setting tools.

BACKGROUND

[0003] Rivet setting tools use pulling mechanisms to pull a mandrel of a rivet to set a rivet. Pulling mechanisms sometimes have pulling members that move between a first position, in which the mandrel is ready to be received in the pulling mechanism, and a second position, in which the mandrel has been separated from the rivet, such that the pulling member can return to the first position.

SUMMARY

[0004] The present disclosure provides, in one aspect, a rivet tool for setting a rivet. The rivet tool includes a motor and a pulling mechanism configured to receive torque from the motor. The pulling mechanism includes a moveable member that is moveable between a first position and a second position in response to the pulling mechanism receiving torque from the motor, a plurality of jaws configured to clamp onto a mandrel of the rivet and pull the mandrel in response to the moveable member moving from the first position to the second position, and a magnet coupled for movement with the moveable member. The magnet includes a north pole face, an adjacent south pole face, and a pole junction therebetween. The north and south pole faces face away from the moveable member. The rivet tool further comprises a first sensor configured to detect the pole junction when the moveable member is in the first position and a second sensor configured to detect the pole junction when the moveable member is in the second position.

[0005] In some implementations, the north pole face and the south pole face are coplanar.

[0006] In some implementations, the magnet is moveable along a face plane defined by the north pole face and the south pole face.

[0007] In some implementations, the face plane is parallel to a pulling axis along which the moveable member moves between the first and second positions.

[0008] In some implementations, the second sensor is a north pole-detecting Hall-effect sensor. When the moveable member moves to the second position, the second sensor is configured to output a signal to a controller indicating that a north pole flux detected by the second sensor is zero.

[0009] In some implementations, in response to the controller receiving the signal from the second sensor indicating that north pole flux detected by the second sensor is zero, the controller is configured to deactivate the motor.

[0010] In some implementations, the first sensor is a south pole-detecting Hall-effect sensor. When the moveable member moves to the first position, the first sensor is configured to output a signal to the controller indicating that a south pole flux detected by the first sensor is zero.

[0011] In some implementations, in response to the controller receiving the signal from the first sensor indicating that south pole flux detected by the first sensor is zero, the controller is configured to deactivate the motor.

[0012] In another aspect, the disclosure provides a rivet tool for setting a rivet. The rivet tool includes a motor, and a pulling mechanism configured to receive torque from the motor and pull the rivet. The pulling mechanism includes a moveable member that is moveable between a first position and a second position in response to the pulling mechanism receiving torque from the motor. The pulling mechanism also includes a magnet coupled for movement with the moveable member, the magnet including a north pole face, an adjacent south pole face, and a pole junction therebetween. The rivet tool also includes a sensor configured to detect the pole junction when the moveable member is in the first position.

[0013] In yet another aspect, the disclosure provides a power tool including a motor, a moveable member that is moveable between a first position and a second position in response to receiving torque from the motor, and a magnet coupled for movement with the moveable member. The magnet includes a north pole face, an adjacent south pole face, and a pole junction therebetween. The power tool also includes a sensor configured to detect the pole junction when the moveable member is in the first position, and a controller configured to deactivate the motor based on a position of the pole junction detected by the sensor.

[0014] Other features and aspects of the disclosure will become apparent by consideration of the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a perspective view of a rivet setting tool.

[0016] FIG. 2 is a cross-sectional view of the rivet setting tool of FIG. 1.

[0017] FIG. 3 is a partial cross-sectional view of a jaw sleeve of the rivet setting tool of FIG. 1.

[0018] FIG. 4 is a perspective view of the rivet setting tool of FIG. 1, with portions removed.

[0019] FIG. 5 is an enlarged cross-sectional view of the rivet setting tool of FIG. 1.

[0020] FIG. 6 is a plan view of a magnet of the rivet setting tool of FIG. 1.

[0021] FIG. 7 is a plan view of a magnet of the rivet setting tool of FIG. 1.

[0022] Before any implementations of the disclosure are explained in detail, it is to be understood that the disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The disclosure is capable of other implementations and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION

[0023] With reference to FIGS. 1 and 2, a rivet setting tool 10, such as a blind rivet setting tool, a rivet nut setting tool, or other deformable fastener setting tools, includes an electric motor 12 and a transmission 14 (e.g., a multi-stage planetary transmission) that receives torque from the motor 12. The tool 10 also includes a pulling mechanism 18 that is actuated in response to activation of the motor 12 to initiate a rivet setting process. In the illustrated implementation, the rivet setting tool 10 includes a battery pack 20 for providing power to the motor 12. In other implementations, the rivet setting tool 10 may include an electrical cord for connection to a remote power source (e.g., an alternating current source).

[0024] With reference to FIG. 2, the tool 10 includes a housing 22 in which the pulling mechanism 18 is positioned and arranged along a pulling axis 26 along which a rivet is pulled. For example, the rivet may include a mandrel that is pulled, or may include a rivet nut or other deformable fastener in other implementations. The pulling mechanism 18 includes a ball nut 30 that receives torque from a gear 34 of the transmission 14, and a pulling member, such as a ball screw 38, arranged within the pulling head 30. A plurality of rollers 42 (FIG. 5) are arranged between threads 46 of the ball nut 30 and threads 50 of the ball screw 38 such that in response to rotation of the ball nut 30 about the pulling axis 26, the rollers 42 facilitate smooth axial movement of the ball screw 38 between a first position and a second position, as explained in further detail below.

[0025] With reference to FIG. 2, the pulling mechanism 18 also includes a jaw sleeve 54 that is coupled to the ball screw 38 for movement therewith. With reference to FIG. 3, the jaw sleeve 54 includes a plurality of interior recesses 58 that are obliquely oriented with respect to the pulling axis 26, converging in a direction away from the ball screw 38. The pulling mechanism 18 also includes a plurality of jaws 62 (FIG. 2), with each jaw 62 respectively arranged within each of the recesses 58. The jaws 62 are biased away from the ball screw 38 by a jaw pusher 66, which is in turn biased away from the ball screw 38 by a compression spring 70 that is arranged within the jaw sleeve 54 and seated against the ball screw 38. A spent-mandrel tube 74 extends along the pulling axis 26 through the jaw pusher 66, the compression spring 70, and the ball screw 38, terminating in a mandrel container 78 to collect severed mandrels after a rivet-setting operation has been completed. A nosepiece 82 is coupled to the housing 22 at an end opposite the mandrel container 78.

[0026] With reference to FIGS. 2, 4, and 5, a carrier 86 is coupled to the ball screw 38 and includes a pair of oppositely extending posts 90 on which a pair of rollers 94 are respectively arranged (FIG. 4). Each roller 94 is respectively arranged and configured to roll between a pair of rails 98. The carrier 86 is rotationally affixed to the ball screw 38 and prevents the ball screw 38 from rotating about the pulling axis 26 in response to rotation of the ball nut 30. Specifically, because the rollers 94 supported by the carrier 86 are confined between the rails 98, in response to rotation of the ball nut 30, the ball screw 38 is inhibited from rotating, and is instead limited to a single degree of freedom (i.e., translation along the pulling axis 26) between a first, home position, in which a mandrel of the rivet may be set in the jaws 62, and a second, complete position, in which the mandrel has been severed from the rivet and the setting operation is complete.

[0027] With continued reference to FIGS. 2, 4, and 5, a magnet 102 is supported upon the carrier 86 and is covered by a magnet cover 106. With reference to FIG. 6, the magnet 102 includes a North pole face 110 and an adjacent South pole face 114. The North pole face 110 is separated from the South pole face 114 by a pole junction (indicated by plane P_D) that is perpendicular to the pulling axis 26. As shown in FIG. 5, in the illustrated implementation, the north and South pole faces 110, 114 are coplanar, with the north and South pole faces 110, 114 collectively defining a face plane P_F (FIG. 5) that is parallel to the pulling axis 26. As also shown in FIG. 5, both of the north and South pole faces 110, 114 face away from the ball screw 38 and both of the north and South pole faces 110, 114 are in facing relationship with a printed circuit board (PCB) 120 that is parallel to the pulling axis 26. As shown in FIG. 7, the magnet 102 includes a second South pole face 118 on a side of the magnet 102 opposite the North pole face 110 and a second North pole face 120 on the side of the magnet 102 opposite the South pole face 114.

[0028] When the ball screw 38 is in the first position, the magnet 102 is proximate a first sensor 122 on the PCB 120. As described in further detail below, the first sensor 122 is configured to detect presence of the magnet 102 when the ball screw 38 is in the first position. When the ball screw 38 is in the second position, the magnet 102 is proximate a second sensor 126 on the PCB 120. As described in further detail below, the second sensor 126 is configured to detect presence of the magnet 102 when the ball screw 38 is in the second position. In the illustrated implementation, the first and second sensors 122, 126 are Hall-effect sensors.

[0029] In operation, an operator inserts a mandrel of a rivet through the nosepiece 82. The mandrel initially pushes the jaws 62 away from the nosepiece 82, along their respective recesses 68, until the jaws 62 move far enough away from the pulling axis 26 that the mandrel moves between the jaws 62. The jaws 62, biased by the jaw pusher 66 toward the nosepiece 82, thereafter exert a radial clamping force on the mandrel. The operator then pulls a trigger 130 on the tool 10 to rotate the motor 12 in a first rotational direction, which causes the transmission 14 to rotate the gear 34, thus causing the ball nut 30 to rotate. Rotation of the ball nut 30 causes the ball screw 38 to translate from the first position toward the second position (toward the right in the frame of reference of FIG. 5). As the ball screw 38 translates from the first position toward the second position, the jaw sleeve 54 is also drawn away from the nosepiece 82 in unison with the ball screw 38, causing the mandrel to be drawn, via the clamped jaws 54, away from the nosepiece 82. As the ball screw 38 continues to move toward the second position, the rivet is eventually set on the workpiece and the mandrel is severed prior to or upon the ball screw 38 reaching the second position. As noted above, when the ball screw 38 reaches the second position, the second sensor 126 detects that the magnet 102 is proximate the second sensor 126.

[0030] The second sensor 126 detects when the ball screw 38 has reached the second position because the magnet 102 includes adjacent North pole and South pole faces 110, 114. Specifically, in the illustrated implementation, the second sensor 126 is a North pole-detecting Hall-effect sensor and is configured to output a signal indicative of detected North pole magnetic flux to a controller 134 (shown schematically in FIG. 5). As the magnet 102 translates with the ball screw 38 toward the second sensor 126, the second sensor 126 first detects the North pole magnetic flux from the North pole face 110, prior to the ball screw 38 reaching the second position.

[0031] When the ball screw 38 reaches the second position, the second sensor 126 detects that the pole junction P_D has reached a second signaling position with respect to the second sensor 126. Specifically, the second sensor 126 detects that the pole junction P_D has reached the second signaling position because the detected North pole flux drops to 0, due to the South pole magnetic flux from the South pole face 114 canceling out the North pole magnetic flux from the North pole face 110. In some implementations, the second signaling position is defined by the position of the magnet 102 when the pole junction P_D intersects a center 138 of the second sensor 126. In other implementations, the second signaling position

is defined by the position of the magnet 102 when the pole junction P_D is offset from the center 138 of the second sensor 126, taking into account the following factors: (1) timing of the signal sent from the second sensor 126 to the controller 134; (2) electronic logic delay of the controller 134 to interpret the signal received from the second sensor 126 to determine that the ball screw 38 has reached the second position; and (3) the speed of movement of the ball screw 38 as it travels toward the second position.

[0032] In response to the second sensor 126 outputting a signal to the controller 134 that indicates that the detected North pole flux has dropped to zero, the controller 134 stops rotation of the motor 12, thus stopping movement of the ball screw 38 in the second position. The broken mandrel is now free to slide through the spent-mandrel tube 74 for collection in the mandrel container 78. In contrast to including a magnet with a single-pole face (e.g., a North pole) in facing relationship with the PCB 120 and Hall-effect sensors 122, 126, because the magnet 102 has a North pole face 110 and South pole face 114 in facing relationship with the PCB 118, the second sensor 126 is able to more precisely detect when the ball screw 38 has reached the second position by detecting when the North pole flux has dropped to zero. Hall-effect sensors detecting a single-pole face of a magnet are more susceptible to variation of detected magnetic flux based on the distance separating the single-pole face magnet from the Hall-effect sensor. By more precisely determining when the ball screw 38 has reached the second position, potential damage to the pulling mechanism due to overtravel, i.e., traveling past the second position after the mandrel has been severed from the rivet, is reduced.

[0033] In other implementations, the second sensor 126 is a South pole detecting Hall-effect sensor and the controller 134 is able to determine that the ball screw 38 has reached the second position when the controller 134 receives a signal from the second sensor 126 indicating that detected South pole flux increases from zero to a non-zero value. Specifically, as the North pole face 110 approaches the South pole detecting Hall-effect second sensor 126, the second sensor 126 does not detect any South pole flux and thus, the detected value is zero. However, as the pole junction P_D has reached the second signaling position, the second sensor 126 for the first time detects the South pole flux from the South pole face 114. Upon the controller 134 receiving a signal from the second sensor 126 indicating that detected South pole has increased from zero to a non-zero value, the controller 134 instructs the motor 18 to deactivate.

[0034] After stopping the motor 12, the controller 134 subsequently causes the motor 12 to rotate in a second rotational direction that is opposite the first rotational direction, causing the ball screw 38 to move from the second position back toward the first position. As noted above, when the ball screw 38 reaches the first position, the first sensor 122 detects that the magnet 102 is proximate the first sensor 122. The first sensor 126 detects when the ball screw 38 has reached the first position (indicating that the tool 10 is ready to set another rivet) because the magnet 102 includes adjacent North pole and South pole faces 110, 114. Specifically, in the illustrated implementation, the first sensor 122 is a South pole detecting Hall-effect sensor and is configured to output a signal indicative of detected South pole magnetic flux to the controller 134. As the magnet 102 translates along the magnet axis 118 toward the first sensor 122, the first sensor 122 first detects the South pole magnetic flux from the South pole face 114, prior to the ball screw 38 reaching the first position.

[0035] When the ball screw 38 reaches the first position, the first sensor 122 detects that the pole junction P_D has reached a first signaling position with respect to the first sensor 122. Specifically, the first sensor 122 detects that the pole junction P_D has reached the first signaling position because the detected South pole flux drops to zero, due to the North pole magnetic flux from the North pole face 110 canceling out the South pole magnetic flux from the South pole face 114. In some implementations, the first signaling position is defined by the position of the magnet 102 when the pole junction P_D intersects a center 142 of the first sensor 122. In other implementations, the first signaling position is defined by the position of the magnet 102 when the pole junction P_D is offset from the center 142 of the first sensor 122, taking into account the following factors: (1) timing of the signal sent from the first sensor 122 to the controller 134; (2) electronic logic delay of the controller 134 to interpret the signal received from the first sensor 122 to determine that the ball screw 38 has reached the first position; and (3) the speed of movement of the ball screw 38 as it travels toward the first position.

[0036] In response to the first sensor 122 outputting a signal to the controller 134 that indicates that the detected South pole flux has dropped to zero, the controller 134 stops rotation of the motor 12, thus stopping movement of the ball screw 38 in the first position. The operator is now able to start a new rivet setting operation. In contrast to using a magnet with a single-pole face (e.g. a North pole) as mentioned above, because the magnet 102 has a North pole face 110 and South pole face 114 in facing relationship with the PCB 118 with a

pole junction P_D therebetween that is detected by the first sensor 122, the first sensor 122 is able to more precisely detect when the ball screw 38 has reached the first position by detecting when the South pole flux has dropped to zero.

[0037] In other implementations, the first sensor 122 is a North pole detecting Hall-effect sensor and the controller 134 is able to determine that the ball screw 38 has reached the first position when the controller 134 receives a signal from the first sensor 122 indicating that North pole flux increases from zero to a non-zero value. Specifically, as the South pole face 114 approaches the North pole detecting Hall-effect first sensor 122, the first sensor 122 does not detect any North pole flux and thus, the detected value is zero. However, as the pole junction P_D reaches the first signaling position, the first sensor 122 for the first time detects the North pole flux from the North pole face 110. Upon the controller 134 receiving a signal from the first sensor 122 indicating that detected North pole has increased from zero to a non-zero value, the controller 134 instructs the motor 18 to deactivate, stopping the ball screw 38 in the first position.

[0038] It should be understood that other configurations of North and South pole faces and North and South pole detecting Hall-effect sensors may be employed in other arrangements in order to detect the pole junction P_D reaching a signaling position based on either increasing flux strength from zero or decreasing flux strength towards zero. In some implementations, the magnet may include two or more pole junctions. For example, the magnet 102 may include three, four, or any number of coplanar pole faces 110, 114 (e.g., alternating North and South in series along a length of the magnet 102) defining a pole junction P_D between each adjacent pair of coplanar poles 110, 114. In such implementations with multiple pole junctions P_D , Hall effect sensors 122, 126 having the same pole-detection capabilities (e.g., both North pole detecting or both South pole detecting, rather than one North pole detecting and one South pole detecting) could be disposed at the first and second positions. In any implementation, the signal for deactivating the motor 18 may be generated based on the flux strength reaching (e.g., decreasing to or increasing to) a threshold value, which may be zero or a non-zero value, and may rely on whether the flux strength has reached zero and then subsequently risen.

[0039] As shown in FIG. 6, the magnet 102 includes a notch 146 to visually assist a manufacturer that is placing the magnet 102 on the carrier 86 during the assembly or manufacturing process, such that the North pole and South pole faces 110, 114 can be

correctly oriented with respect to the first and second sensors 122, 126. By including a magnet 102 with North pole and South pole faces 110, 114 with a pole junction P_D therebetween, the first and second sensors 122, 126 both have more precise sensing windows in determining when the ball screw 38 has reached the first and second positions, respectively. Thus, the controller 134 is able to more precisely stop the ball screw 38 in the first and second positions, achieving a benefit that is normally only available with traditional limit switches, while increasing the longevity of the pulling mechanism 18, as a magnet 102 in combination with Hall-effect sensors 122, 126 has greater longevity than traditional limit switches. In other implementations, the magnet 102 with North pole and South pole faces 110, 114 can be used in other applications and tools where precise sensing windows are necessary.

[0040] Although the disclosure has been described in detail with reference to certain preferred implementations, variations and modifications exist within the scope and spirit of one or more independent aspects of the disclosure as described. Various features of the invention are set forth in the following claims.

CLAIMS

What is claimed is:

1. A rivet tool for setting a rivet, the rivet tool comprising:
a motor;
a pulling mechanism configured to receive torque from the motor, the pulling mechanism including
a moveable member that is moveable between a first position and a second position in response to the pulling mechanism receiving torque from the motor,
a plurality of jaws configured to clamp onto a mandrel of the rivet and pull the mandrel in response to the moveable member moving from the first position to the second position, and
a magnet coupled for movement with the moveable member, the magnet including a north pole face, an adjacent south pole face, and a pole junction therebetween, wherein the north and south pole faces face away from the moveable member;
a first sensor configured to detect the pole junction when the moveable member is in the first position; and
a second sensor configured to detect the pole junction when the moveable member is in the second position.
2. The rivet tool of claim 1, wherein the north pole face and the south pole face are coplanar.
3. The rivet tool of claim 2, wherein the magnet is moveable along a face plane defined by the north pole face and the south pole face.
4. The rivet tool of claim 3, wherein the face plane is parallel to a pulling axis along which the moveable member moves between the first and second positions.
5. The rivet tool of claim 1, wherein the second sensor is a north pole-detecting Hall-effect sensor, and wherein when the moveable member moves to the second position, the

second sensor is configured to output a signal to a controller indicating that a north pole flux detected by the second sensor is zero.

6. The rivet tool of claim 5, wherein in response to the controller receiving the signal from the second sensor indicating that north pole flux detected by the second sensor is zero, the controller is configured to deactivate the motor.

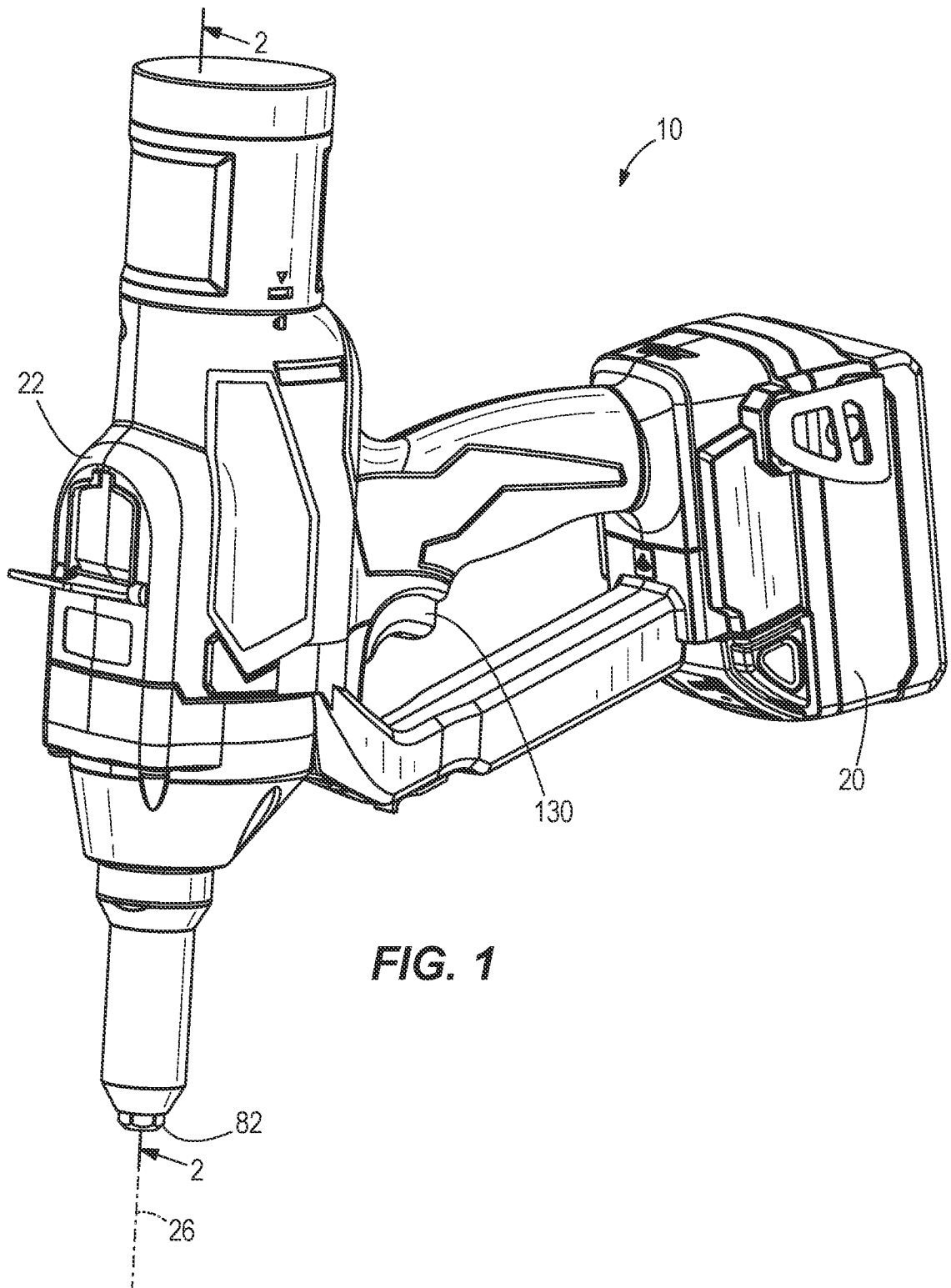
7. The rivet tool of claim 6, wherein the first sensor is a south pole-detecting Hall-effect sensor, and wherein when the moveable member moves to the first position, the first sensor is configured to output a signal to the controller indicating that a south pole flux detected by the first sensor is zero.

8. The rivet tool of claim 7, wherein in response to the controller receiving the signal from the first sensor indicating that south pole flux detected by the first sensor is zero, the controller is configured to deactivate the motor.

9. A rivet tool for setting a rivet, the rivet tool comprising:
a motor;
a pulling mechanism configured to receive torque from the motor and pull the rivet,
the pulling mechanism including
a moveable member that is moveable between a first position and a second
position in response to the pulling mechanism receiving torque from the motor, and
a magnet coupled for movement with the moveable member, the magnet
including a north pole face, an adjacent south pole face, and a pole junction
therebetween; and
a sensor configured to detect the pole junction when the moveable member is in the
first position.
10. The rivet tool of claim 9, wherein the north and south pole faces face away from the
moveable member.
11. The rivet tool of claim 9, wherein the north pole face and the south pole face are
coplanar.
12. The rivet tool of claim 9, wherein the magnet is moveable along a face plane coplanar
with the north pole face and the south pole face.
13. The rivet tool of claim 12, wherein the face plane is parallel to a pulling axis along
which the moveable member moves between the first and second positions.
14. The rivet tool of claim 9, wherein the sensor is a Hall-effect sensor, and wherein when
the moveable member moves to the first position, the sensor is configured to detect the pole
junction by detecting a flux strength dropping towards zero.
15. The rivet tool of claim 14, further comprising a controller configured to deactivate the
motor based on the flux strength reaching a threshold.

16. The rivet tool of claim 9, wherein the sensor is a Hall-effect sensor, and wherein when the moveable member moves to the first position, the sensor is configured to detect the pole junction by detecting a flux strength increasing from zero.
17. The rivet tool of claim 16, further comprising a controller configured to deactivate the motor based on the flux strength reaching a threshold.
18. The rivet nut tool of claim 9, further comprising a controller configured to deactivate the motor based on a position of the pole junction detected by the sensor.
19. The rivet tool of claim 9, further comprising a plurality of jaws configured to clamp onto a mandrel of the rivet and pull the mandrel in response to the moveable member moving from the first position to the second position.

20. A power tool, comprising:
- a motor;
 - a moveable member that is moveable between a first position and a second position in response to receiving torque from the motor, and
 - a magnet coupled for movement with the moveable member, the magnet including a north pole face, an adjacent south pole face, and a pole junction therebetween;
 - a sensor configured to detect the pole junction when the moveable member is in the first position; and
 - a controller configured to deactivate the motor based on a position of the pole junction detected by the sensor.



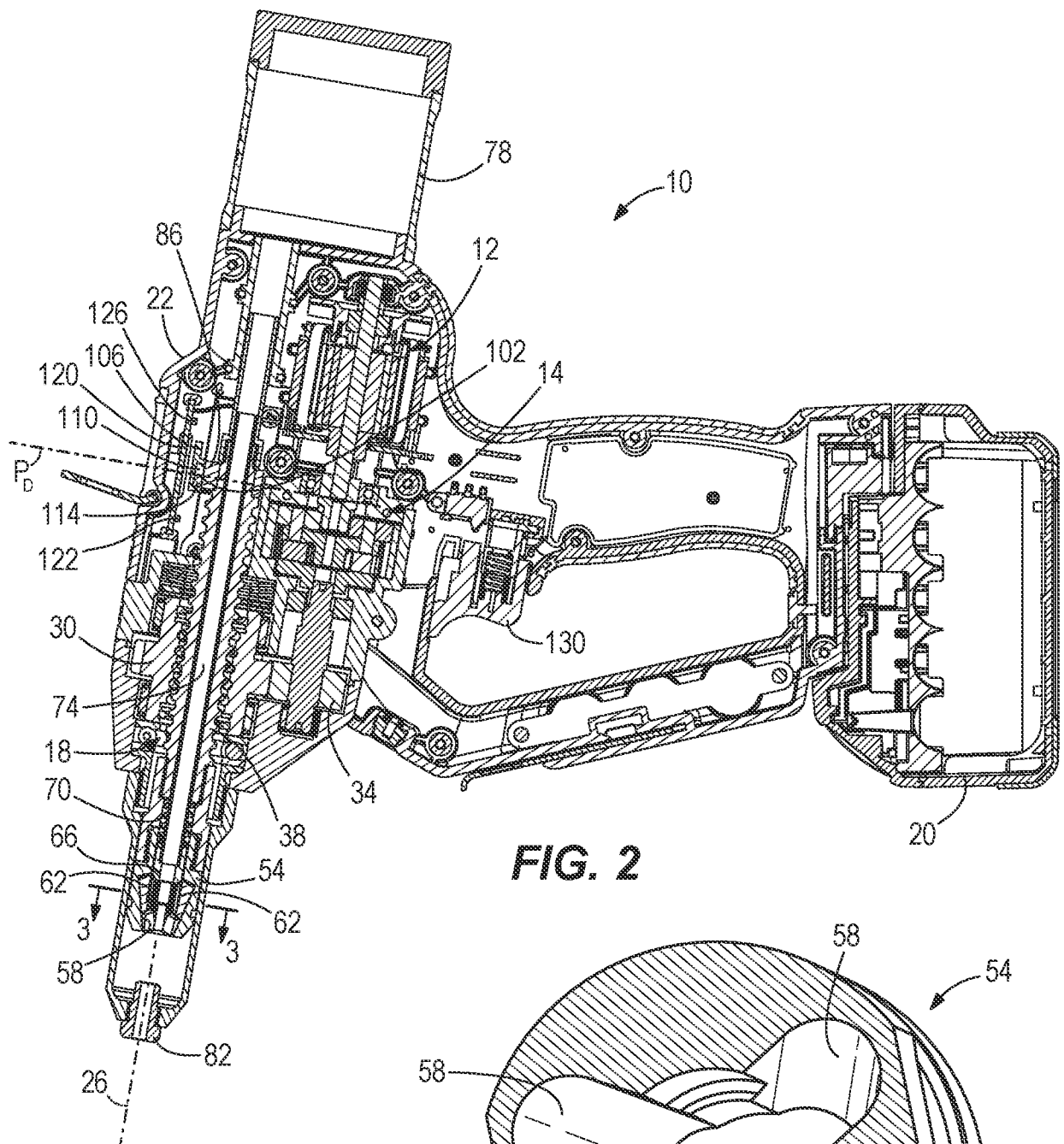


FIG. 2

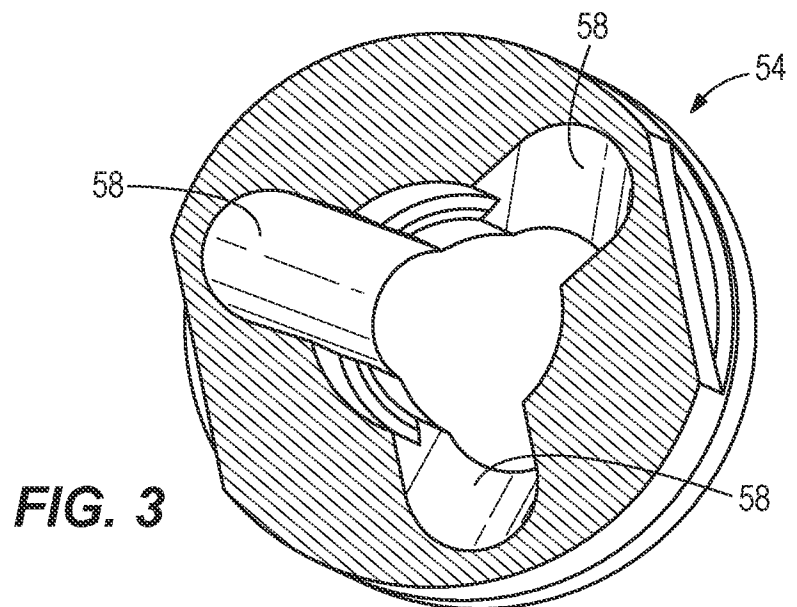
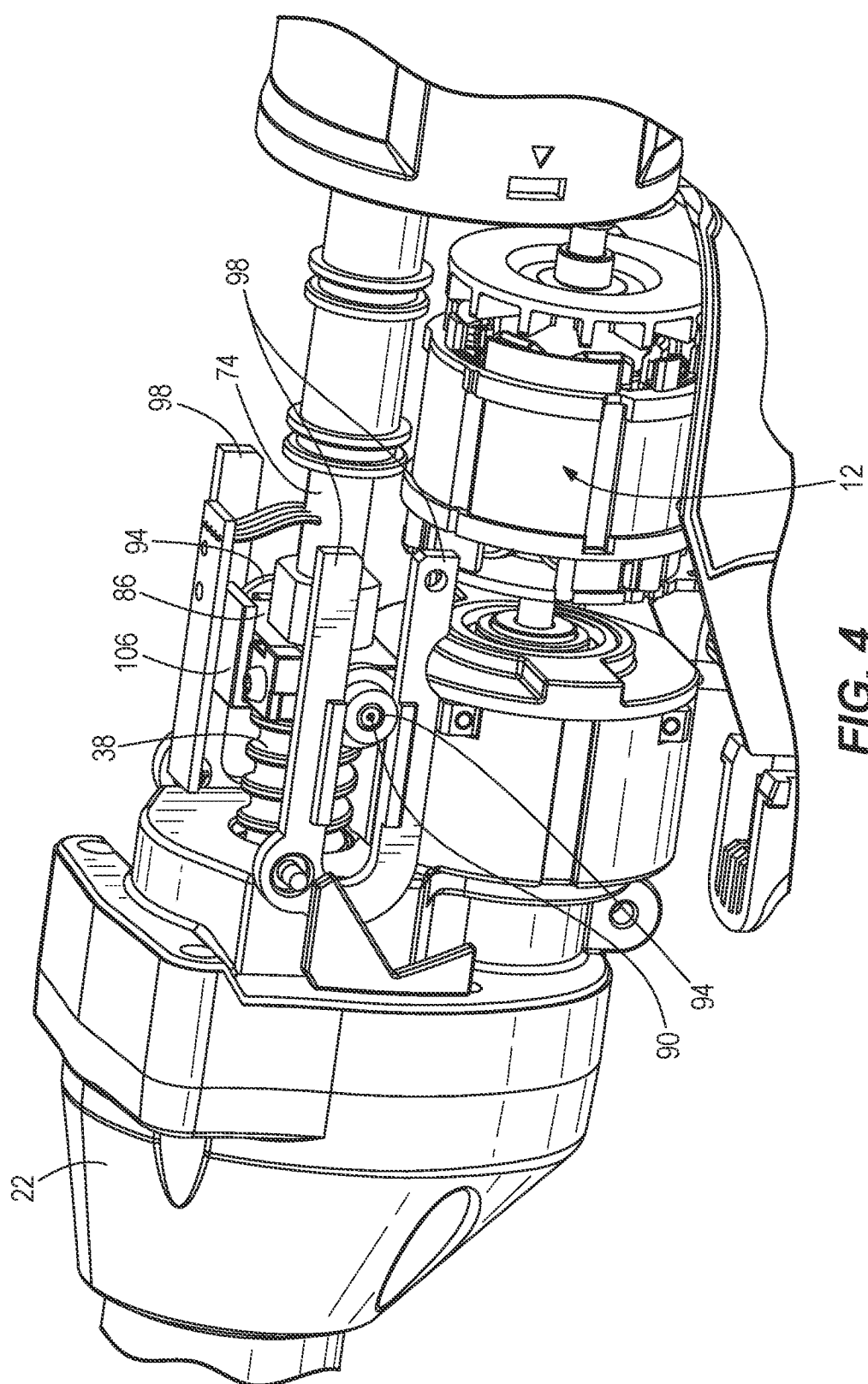


FIG. 3

4
FIG.

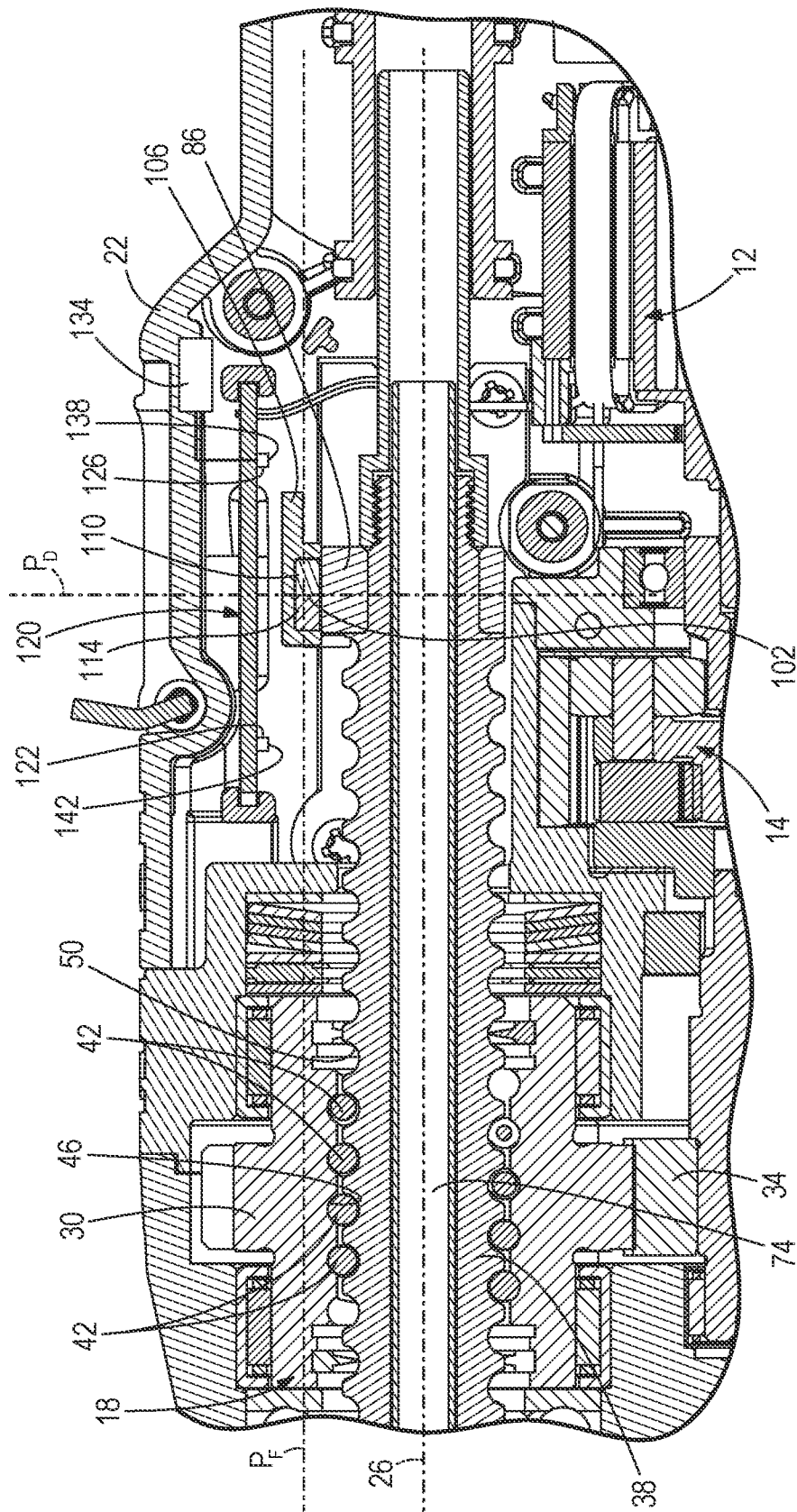


FIG. 5

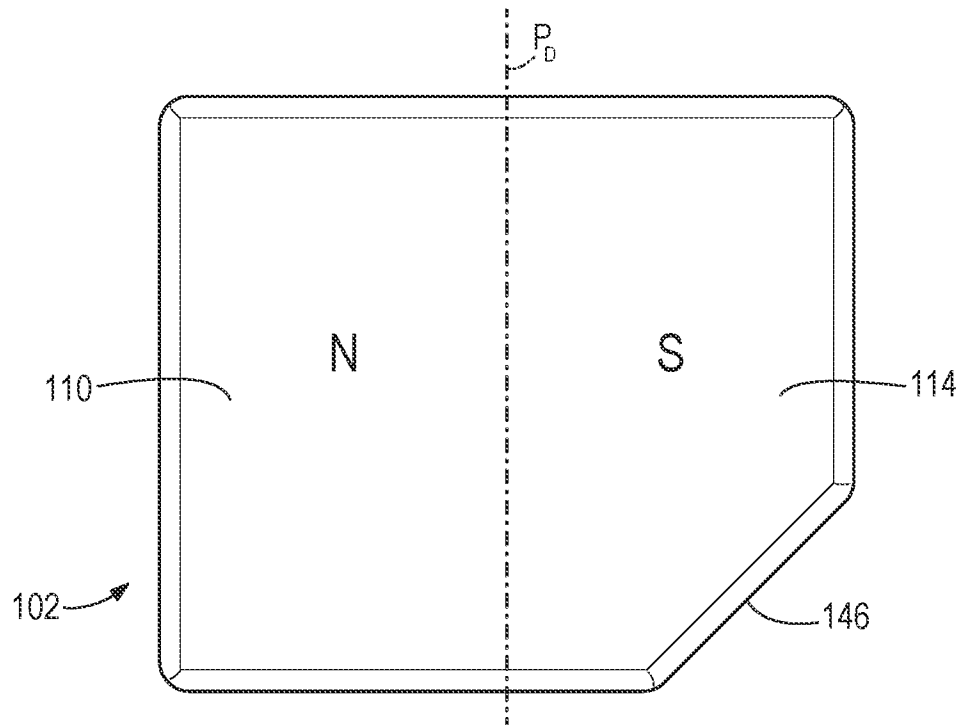


FIG. 6

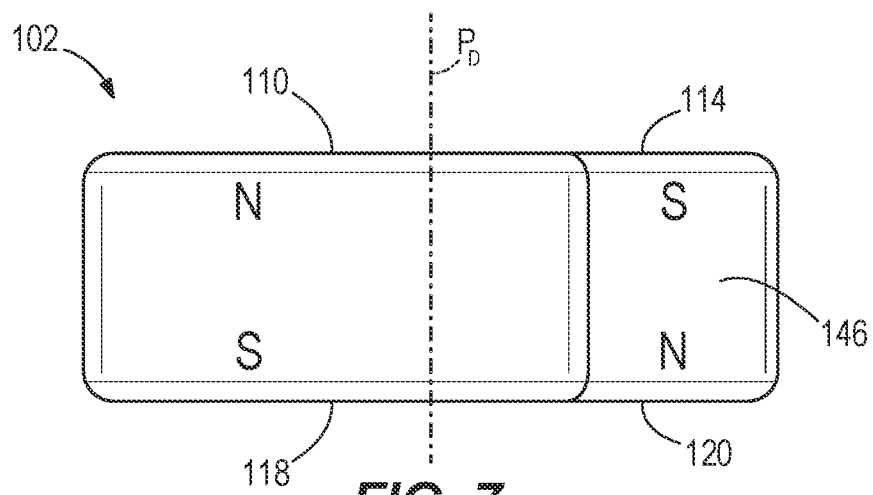


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2021/035720

A. CLASSIFICATION OF SUBJECT MATTER B21J 15/36(2006.01)i; B21J 15/04(2006.01)i; B21J 15/10(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B21J 15/36(2006.01); B21J 15/26(2006.01); B21J 15/32(2006.01); B23P 11/00(2006.01); G05B 19/18(2006.01) Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models Japanese utility models and applications for utility models Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS(KIPO internal) & Keywords: rivet tool, motor, pulling mechanism, moveable member, jaws, magnet, north pole face, south pole face, sensor		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2020-0130047 A1 (MAKITA CORPORATION) 30 April 2020 (2020-04-30) paragraphs [0013]-[0120]; and figures 2-8	1-20
Y	US 2014-0100687 A1 (BLACK & DECKER INC.) 10 April 2014 (2014-04-10) paragraphs [0148]-[0197]; and figures 8, 8A-8D	1-20
Y	US 2010-0139067 A1 (CHEN, HSIN-CHI) 10 June 2010 (2010-06-10) paragraphs [0017]-[0022]; and figures 2-6	1
A	US 2015-0033525 A1 (LOBTEX CO., LTD.) 05 February 2015 (2015-02-05) paragraphs [0033]-[0049]; and figure 4	1-20
A	KR 10-1796793 B1 (NEWFREY L.L.C.) 10 November 2017 (2017-11-10) paragraphs [0012]-[0029]; and figures 1-6	1-20
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "D" document cited by the applicant in the international application "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 23 September 2021		Date of mailing of the international search report 23 September 2021
Name and mailing address of the ISA/KR Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon 35208, Republic of Korea Facsimile No. +82-42-481-8578		Authorized officer HWANG, Chan Yoon Telephone No. +82-42-481-3347

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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