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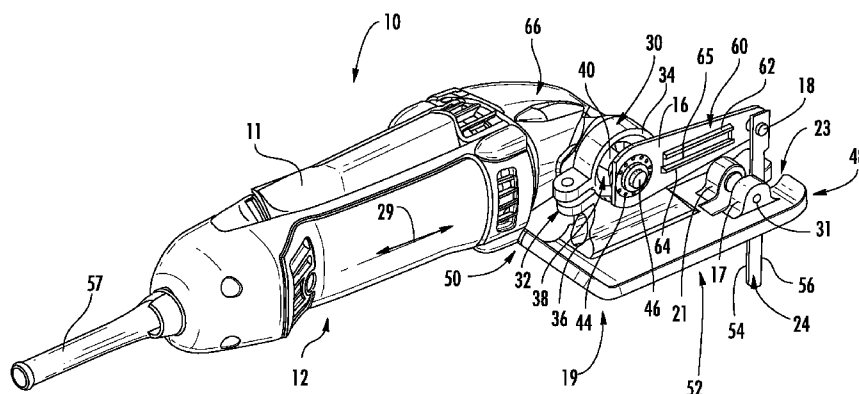


FIG. 2

(57) Abstract: A multi-tool including a reciprocating tool attachment and a reciprocating tool attachment for use with a multi-tool. The reciprocating tool attachment includes an oscillating link having a pivot at an end of the link and a blade coupled to the pivot. The attachment also includes a support, a foot and a blade guide, wherein the blade moves along a substantial linear direction through an aperture in the support in a reciprocating fashion. The tool attachment includes a generally linear cutting edge or a curved cutting edge.

OSCILLATING TOOL

This application claims priority to U.S. Provisional Patent Application Serial No. 61/779,624 entitled "Oscillating Tool Attachment" by Rubens et al., filed March 13, 2013, the disclosure of which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

[0001] This disclosure relates to a powered multi-tool and more particularly to an attachment for a multi-tool.

BACKGROUND

[0002] Powered multi-tools are used by a wide variety of individuals, including professionals and hobbyists, to shape many different materials including metal, wood and plastic. Multi-tools include a motor and are powered by batteries or by being plugged into an electrical outlet. The drive unit of many such multi-tools is relatively small and lightweight and is capable of being easily used by a user. Multi-tools include rotary hand tools that can have a diameter of less than about two inches and a length of about six inches. The tool can include a small but powerful electric motor that drives an output shaft at a high rotating speed to which a rotary implement can be attached and which is axially aligned with a longitudinal axis of the generally cylindrical hand tool. Tool attachments for the multi-tools vary in size, shape, and function, and include drill bits, sanders, grinders, polishers, router bits, and cutting wheels.

[0003] Oscillating multi-tools are another type of multi-tool and are extremely popular due to an ability to shape various materials better than other tools. In part, the ability to shape the material results from the fact that the multi-tool relies on a high-speed oscillation in which the

drive shaft rotates in a reversing direction, such that the tool oscillates in a side-to side motion about an axis of rotation. A tool attachment is coupled to the oscillating drive shaft and corresponding moves side to side. A tool attachment, such as a sanding tool, can be particularly effective in sanding materials since the oscillating motion imparted to the sanding material can be particularly effective in a sanding operation. When an oscillating-type saw blade is attached to an oscillating multi-tool, however, certain drawbacks are found. In particular, the direction of the cut and the orientation of the teeth reduces the effectiveness of the oscillating saw blade for the following reasons: 1) it is difficult to make extended or long cuts; 2) it is difficult to make curved cuts; and 3) the depth of a cut is limited, since the cutting depth of the tool is dependent on the diameter of the blade. In order to address these drawbacks, a user often uses other tools incorporating a linear reciprocating blade, such as a jigsaw or a reciprocating saw, when extended cuts are desired.

[0004] Consequently, there is a need for a multi-tool and an attachment for a multi-tool which can make extended cuts along a path, including linear and curved paths.

SUMMARY

[0005] The present disclosure relates to a multi-tool including a reciprocating attachment for a multi-tool and also to a reciprocating tool attachment for use with a multi-tool. The reciprocating attachment for a multi-tool converts the oscillating motion of multi-tool into an oscillating or reciprocating motion of an accessory. By using the oscillating motion, a saw blade attachment is used to provide the cutting function of a jigsaw. Such an attachment enables the user to use a single multi-tool to complete the standard reciprocating functions that were either

performed poorly in the past or were not capable of being performed. Consequently, the versatility of the multi-tool is increased by being able to perform these new types of cuts.

[0006] In one embodiment, there is provided a tool attachment for a multi-tool having a housing, a mounting portion, and a reciprocating drive shaft. The tool attachment includes a link having a first end and a second end, the first end operatively connected to the reciprocating drive shaft and the second end including a pivot. A blade is operatively connected to the pivot. A support includes a blade guide through which the blade extends and a coupler of the support is configured to operatively couple the support to the mounting portion of the multi-tool.

[0007] In another embodiment, there is provided a tool attachment for a multi-tool configured to shape a workpiece wherein the multi-tool includes a housing defining a longitudinal axis, a mounting portion, and a reciprocating drive shaft disposed substantially perpendicular to the longitudinal axis. The tool attachment includes a blade and a link including a first end and a second end. The first end is operatively connected to the reciprocating drive shaft, and the second end includes a pivot to which the blade is pivotably coupled. A support includes a collar configured to be fixedly coupled to the mounting portion and a blade aperture through which the blade extends. A blade stop is disposed adjacent to the aperture and is configured to limit movement of the blade about the pivot.

[0008] In still another embodiment, a hand-held tool configured to shape a workpiece includes a body defining a longitudinal axis and a reciprocating drive shaft disposed substantially perpendicular to the longitudinal axis. The hand-held tool includes a blade, a link including a first end and a second end wherein the first end is operatively connected to the reciprocating drive shaft and the second end includes a pivot to which the blade is pivotably coupled. Movement of the reciprocating drive shaft moves the blade along a blade longitudinal axis

inclined with respect to the tool longitudinal axis. A support is fixedly coupled to the body. The support includes a blade aperture through which the blade extends and a blade stop disposed adjacent to the aperture. The blade stop is configured to restrict movement of the blade about the pivot in at least one direction.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. 1 is a side elevational view of a multi-tool placed on a side and a reciprocating tool attachment coupled to the multi-tool.

[0010] FIG. 2 is a perspective view of the multi-tool and reciprocating tool attachment of FIG. 1.

[0011] FIG. 3 is an exploded perspective view of the multi-tool and the reciprocating tool attachment of FIG. 1.

[0012] FIG. 4 is an exploded perspective view of a nose-portion of a multi-tool and a reciprocating tool attachment.

[0013] FIG. 5 is a perspective view of the multi-tool and of a reciprocating tool attachment.

[0014] FIG. 6 is an perspective view of a nose-portion of a multi-tool and a reciprocating tool attachment.

[0015] FIG. 7 is a schematic side view of a saw blade of a reciprocating tool attachment of in a first position.

[0016] FIG. 8 is a schematic side view of a reciprocating tool attachment of FIG. 7 in a second position.

DESCRIPTION

[0017] For the purposes of promoting an understanding of the principles of the disclosure, reference will now be made to the embodiments illustrated in the drawings and described in the following written specification. It is understood that no limitation to the scope of the disclosure is thereby intended. It is further understood that the present disclosure includes any alterations and modifications to the illustrated embodiments and includes further applications of the principles of the disclosure as would normally occur to one of ordinary skill in the art to which this disclosure pertains.

[0018] FIG. 1 is a side elevational view of a multi-tool 10 including a tool body 11 placed on a side 12 thereof and a reciprocating tool attachment 14 coupled to the tool body 11. The tool attachment 14 includes a link 16, having a pivot 18 at an end of the link 16. In addition, a support 19 includes a foot 20 and a blade guide 22. The blade guide 22, in the illustrated embodiment, includes a first portion 17 and a second portion 21 extending from the foot 20 and defining therebetween an aperture 23. (See FIG. 2) A blade 24 is coupled to the pivot 18 and extends through the aperture 23 adjacent to the blade guide 22.

[0019] The link 16 mounts to a standard multi-tool oscillating interface and oscillates under fixed or adjustable speed control provided by the multi-tool 10. This oscillation creates an arc at a tip 15 of the link 16. Since the angle of oscillation is relatively small relative to the length of the link, the arc is fairly linear and approximates to a reciprocating motion of the blade 24 along a direction 25 which extends at an inclined angle with an axis 27 of the oscillating link 16. The axis 27 extends generally along a longitudinal axis 29 of the body 11. In one embodiment, the inclined angle of the blade 24 is approximately 90 degrees with respect to the axis 27. The pivot 18 transfers the arc motion to the blade 24, but provides a release of rotation which is located at

the tip 15 of the link 16 at the end in which the pivot 18 is located. The release in rotation prevents the blade 24 from bouncing on a work piece. In different embodiments, the pivot 18 is a post (metal, plastic, or another material sufficiently rigid to provide support), a rivet, a bushing, or a fastener. The pivot 18 provides an axis of pivot about which the blade 24 freely moves. In different embodiments, the reciprocating blade 24 includes any blade that is able to cut as it moves up and down in a cutting displacement corresponding to a generally linear path along the direction 25.

[0020] The blade guide 22 supports the blade along a cutting path and substantially prevents the reciprocating blade 24 from rotating away from a workpiece being cut. In different embodiments, the blade guide 22 includes a post 31. In other embodiments, the post 31 includes a post (metal, plastic, or other material sufficiently rigid for support), a bearing, or a jigsaw roller guide. The support 19 supports the blade guide 22 and provides the foot 20 which includes a substantially planar surface 26 to contact the work piece. The support 19 mounts to an accessory mounting portion or ring 28 on the tool 10 (see FIG. 3) so that the support 19 is fixed with respect to the body 11 and is fixed to not move with movement of the oscillating link 16. The support 19 includes a coupler 30 which includes an adjustment mechanism 32, both of which define a closable member, the force of which is adjusted, in one embodiment, with a threaded screw and nut 33 to insure a tight fit of the support 19 to the mounting ring 28. The mounting ring includes a mounting surface 35 including detent portions 37, which in different embodiments are raised or lowered from the mounting surface 35.

[0021] FIG. 2 illustrates a perspective view of the tool 10 including the attachment 14. As seen in FIG. 2, the coupler 30 includes a collar 34 which is supported from a base 36 of the coupler 30 and which defines an aperture 38 through which a drive shaft 40 of the tool 10

extends substantially perpendicularly to the longitudinal axis 29 of the body 11 of the tool 10. The collar interfaces with the mounting surface 35 of the mounting ring 28. The drive shaft 40 in one embodiment includes one or more mounting lugs 42 (see FIG. 3) which provides for fixedly mounting of the oscillating link 16 to the shaft 40. A mounting portion 44 of the link 16 is disposed at an end of the link 16 opposite the end at which the pivot 18 is located. The mounting portion 44 includes features which locate the link 16 at the mounting lugs 42 and which are held in place by a coupler 46, which in one embodiment includes a nut which is tightened to hold the link 16 to the drive shaft 40. The support 19 includes a front portion 48 and a rear portion 50 which extend away from a plane 52 defined by a bottom surface 26 of the foot 20 toward the collar 30, wherein the plane 52 extends along the substantially planar surface 26 of the foot 20.

[0022] As illustrated in both FIGS. 1 and 2, the blade 24 includes a substantially flat edge 54 which moves up and down (as illustrated) and which is located at the blade guide 22. As can also be seen, the blade 24 extends through aperture 23 of the foot 20. In one embodiment, the aperture 23 is a slot which extend generally along the length of the link 16 through which the blade extends. On a side of the blade 24 opposite the smooth edge, a plurality of teeth at a cutting edge 56 is configured to shape a workpiece. While the blade 24 is shown in a position with the teeth 56 facing away from the body 11, in another embodiment, the blade 24 is configured with the teeth 56 facing toward a rear portion of the body 11 wherein a power cable 57 extend in some embodiments. Other embodiments are battery powered. With the toothed edge of the blade 24 being alternately locatable, the tool 10 provides the capability of cutting while the tool 10 is pushed forward or away from a user or while the tool 10 is pulled rearward or toward a user.

[0023] The link 16 includes a reinforcing structure 60 which extends generally along the axis 27. In one embodiment, the structure 60 includes first and second longitudinally oriented reinforcing structures 62 and 64 extending away from a surface of the link 16. In one embodiment, the link is stamped from a metal to provide an aperture 65 and the extending portions 62 and 64 are formed from the stamped metal by bending the metal away from the surface of the link 16. In other embodiments, the extending portions comprise a reinforcing structure which is attached to the link 16, through known methods such as an adhesive or a weld.

[0024] FIG. 3 illustrates an exploded view of the tool 10 and the attachment 14. As previously described, the tool 10 includes the mounting ring 28 to which the coupler 30 is attached. The mounting ring 28 is fixed with respect to a nose 66. The shaft 40 extends from the nose 66, through the mounting ring 28 and terminates at the lugs 42 which are located on a mounting plate 68 fixedly coupled to the shaft 40. In one embodiment, the mounting plate 68 is a metal disk having a predetermined thickness and diameter where the lugs 42 are formed on a surface of the plate 68. The mounting plate 68 alternately moves in a direction 70 and a direction 72 as is understood by one skilled in the art. The reciprocating alternating directions of the mounting plate 68, when coupled to the mounting portion 44 of the link, drive the blade 24 as previously described.

[0025] As further seen in FIG. 3, the attachment 14 includes a blade guide roller 80 which is also illustrated in FIG. 4. The blade guide roller 80 is supported for rotational movement about an axis 82 defined by a pin 84 which is inserted into corresponding apertures 86 and 88 of the first portion 17 and the second portion 21 of the blade guide 22 (see FIG. 4). The roller 80 includes a centrally located recess such as a notch or groove 90 configured to align the blade 24 at a generally middle location of the aperture 23. The groove 90 is located between two halves

of the roller 90 and in different embodiments the roller includes one or more pieces. When the blade 24 cuts a material and moves along the direction 25, the roller 80 moves about the axis 82. The roller 80 also acts as a blade stop such that the blade 24 does not pivot significantly about the pivot 18 to thereby maintain the up and down movement of the blade 24 along the direction 25 during a cutting operation. The blade 24 is coupled at the pivot 18 by a connector 92 inserted through an aperture 94 of the link 16 and an aperture 96 of the blade 24. The coupler 30 includes a one or more projections 98 configured to increase the friction between an inside surface of the coupler 30 and the mounting ring 28. A friction fit fixes the location of the attachment 14 with the nose 66.

[0026] FIG. 5 illustrates another embodiment of the attachment 14 coupled to the tool 10. In this embodiment, a second roller 100 is located on an opposite side of the blade 24 when compared to the first roller 80 of FIG. 3. The second roller 100 is located at a front portion 102 of the blade guide 22 and is supported for pivotal movement about an axis 104 extending through the first portion 17 and a second portion 21. In this embodiment the teeth 56 of the blade are closer to the second roller 100 than the first roller 80. The location of the blade 24 is generally fixed between the two rollers 80 and 100 and consequently the blade 24 cannot move excessively about the pivot 18 in either direction. Since the blade cannot rotate forward as illustrated (away from the body 11), a binding of the blade 24 with the material being cut does not swing the blade 24 out of the generally vertical cutting position as illustrated.

[0027] FIG. 6 illustrates another embodiment of the attachment 14 which includes the roller 80 as previously described and a blade stop 106. In this embodiment, the blade stop 106 is a fixed stop, which in different embodiments includes a plug inserted into an end of the aperture 23 or which is formed as part of the support 19.

[0028] In another embodiment as illustrated in FIGS. 7 and 8, a saw blade 110 includes a shape distinct from the shape of the saw blade 24 of FIGS. 1 and 2. The saw blade 110 is attached at the pivot 18 such that a cutting operation is made by the user pulling the tool 10 rather than pushing the tool 10 through the workpiece. The saw blade 110 includes a unique geometry configured to provide a cutting stroke which provides a linear cut of a workpiece 112. As illustrated, the blade 110 includes a cutting edge 114 which includes a curved profile. Under some circumstances, which can depend on the thickness and type of the workpiece, if the arc motion of the blade about the pivot 18 reduces the cutting performance, a blade 110 having the curved cutting edge 114 is used instead of the previously described blades. In this embodiment, the curved profile on the cutting edge 114 converts the arc motion of the blade 110 interacting with the pivot 18 and the blade guide 22 to a substantially linear motion on the cutting edge 114. As can be seen in FIGS. 7 and 8, the width of the blade from a first end to a second end varies with the length. The blade 110 includes a width which is larger toward the pivot 18 and is narrower toward a bottom portion 116. Consequently, if the blade is oriented under the force of gravity to hang from the pivot unobstructed, the cutting edge 114 at a top portion 118 of the blade 110 is closer to a vertical line 120 than the cutting edge at the bottom portion 116. In another embodiment, the side of the blade opposite the curved cutting edge is also curved.

[0029] The tool attachment and the multi-tool having the tool attachment of the present invention can be embodied in a number of different types and configurations. The following embodiments are provided as examples and are not intended to be limiting.

[0030] Embodiment 1. A multi-tool including a reciprocating tool attachment.

[0031] Embodiment 2. A reciprocating tool attachment for a multi-tool.

[0032] Embodiment 3. A reciprocating tool attachment for a multi-tool including an oscillating link having a pivot at an end of the link and a blade coupled to the pivot.

[0033] Embodiment 4. The reciprocating tool attachment of embodiment 3 including a support having a foot and a blade guide wherein the blade moves along a substantially linear direction through an aperture in the support in a reciprocating fashion.

[0034] Embodiment 5: The reciprocating tool attachment of embodiment 4 wherein the blade includes a substantially linear cutting edge.

[0035] Embodiment 6. The reciprocating tool attachment of embodiment 4 wherein the blade includes a curved cutting edge.

[0036] Embodiment 7. A multi-tool including the reciprocating tool attachment of embodiments 3, 4, 5, and/or 6.

[0037] While the disclosure has been illustrated and described in detail in the drawings and foregoing description, the same should be considered as illustrative and not restrictive in character. It is understood that only the preferred embodiments have been presented and that all changes, modifications and further applications that come within the spirit of the disclosure are desired to be protected.

CLAIMS:

What is claimed is:

1. A tool attachment for a multi-tool having a housing, a mounting portion, and an oscillating drive shaft, the tool attachment comprising:

 a link including a first end and a second end, the first end operatively connectable to the reciprocating drive shaft to reciprocate with the drive shaft and the second end including a pivot;

 a blade operatively connected to the pivot to pivot relative to the link;

 a support including a blade guide offset from the link through which the blade extends and a coupler configured to operatively couple the support to the mounting portion.

2. The tool attachment of claim 1 wherein the multi-tool defines a longitudinal axis and the link extends from the first end to the second end substantially parallel the longitudinal axis.

3. The tool attachment of claim 2 wherein the blade extends from the second end of the link at an angle inclined with respect to the longitudinal axis.

4. The tool attachment of claim 3 wherein the support includes a guide foot defining a substantially planar surface, the guide foot being configured to support the multi-tool on a workpiece along a path selected by a user.

5. The tool attachment of claim 4 wherein the coupler is configured to operatively connect to the mounting portion such that the reciprocating drive shaft extends through the coupler and operatively connects to the first end of the link.
6. The tool attachment of claim 5 wherein the coupler comprises a collar configured to couple to the mounting portion of the multi-tool.
7. The tool attachment of claim 5 wherein the support includes a front portion defining an aperture as the blade guide and a blade stop disposed at the aperture, wherein the blade stop is configured to limit a rotational movement of blade about the pivot at the link.
8. The tool attachment of claim 7 wherein the blade stop is located between the blade and the coupler of the support.
9. The tool attachment of claim 7 wherein the blade is located between the coupler and the blade stop.
10. The tool attachment of claim 7 wherein the blade stop comprises a roller configured to rotate about an axis, wherein the axis is substantially perpendicular to the axis of cutting displacement of the saw blade.
11. The tool attachment of claim 5 wherein the link includes a reinforcing structure extending from a surface of the link and the reinforcing structure is disposed between the first end and the

second end of the link.

12. The tool attachment of claim 1 wherein the blade includes a curved cutting edge.

13. A tool attachment for a multi-tool configured to shape a workpiece, the multi-tool having a housing defining a longitudinal axis, a mounting surface, and a reciprocating drive shaft disposed substantially perpendicular to the longitudinal axis, the tool attachment comprising:

a blade;

a link including a first end and a second end, the first end operatively connected to the reciprocating drive shaft, and the second end including a pivot to which the blade is pivotably coupled; and

a support including a collar configured to be releasably coupled to and to interface with the mounting surface, a blade aperture through which the blade extends, and a blade stop disposed adjacent to the aperture and configured to limit movement of the blade about the pivot.

14. The tool attachment of claim 13 wherein the support includes a guide foot defining a substantially planar surface extending along the longitudinal axis, the guide foot being configured to support the multi-tool on the workpiece, wherein the blade stop is disposed between the substantially planar support surface and the link.

15. The tool attachment of claim 14 wherein the blade stop includes a first portion and a second portion and the blade is located between the first portion and second portion.

16. The tool attachment of claim 15 wherein one of the first portion and the second portion comprises a roller.

17. The tool attachment of claim 13 wherein the blade stop includes a spacer located in the aperture.

18. The tool attachment of claim 13 wherein the blade includes one of a straight cutting edge and a curved cutting edge.

19. A hand-held tool configured to shape a workpiece, the tool having a body defining a longitudinal axis and a reciprocating drive shaft disposed substantially perpendicular to the longitudinal axis, the hand-held tool comprising:

a blade;

a link including a first end and a second end, the first end operatively connected to the reciprocating drive shaft, and the second end including a pivot to which the blade is pivotably coupled, wherein movement of the reciprocating drive shaft moves the blade along a blade longitudinal axis inclined with respect to the tool longitudinal axis, and

a support fixedly coupled to the body, the support including a blade aperture through which the blade extends and a blade stop disposed adjacent to the aperture, the blade stop configured to restrict movement of the blade about the pivot in at least one direction.

20. The hand-held tool of claim 19 wherein the support includes a guide foot defining a substantially planar surface extending along the tool longitudinal axis, the guide foot being

configured to support the tool on the workpiece, wherein the blade stop is disposed between the substantially planar support surface and the link.

21. The hand-held tool of claim 20 wherein the blade stop comprises a roller configured to rotate during contact with the blade.

22. The hand-held tool of claim 21 wherein the roller includes a recess configured to locate the blade.

23. The hand-held tool of claim 21 wherein the aperture defines a longitudinal slot substantially aligned with the longitudinal axis of the body, wherein the roller is located along the slot on one side of the blade and a second roller is located along the slot on another side of the blade.

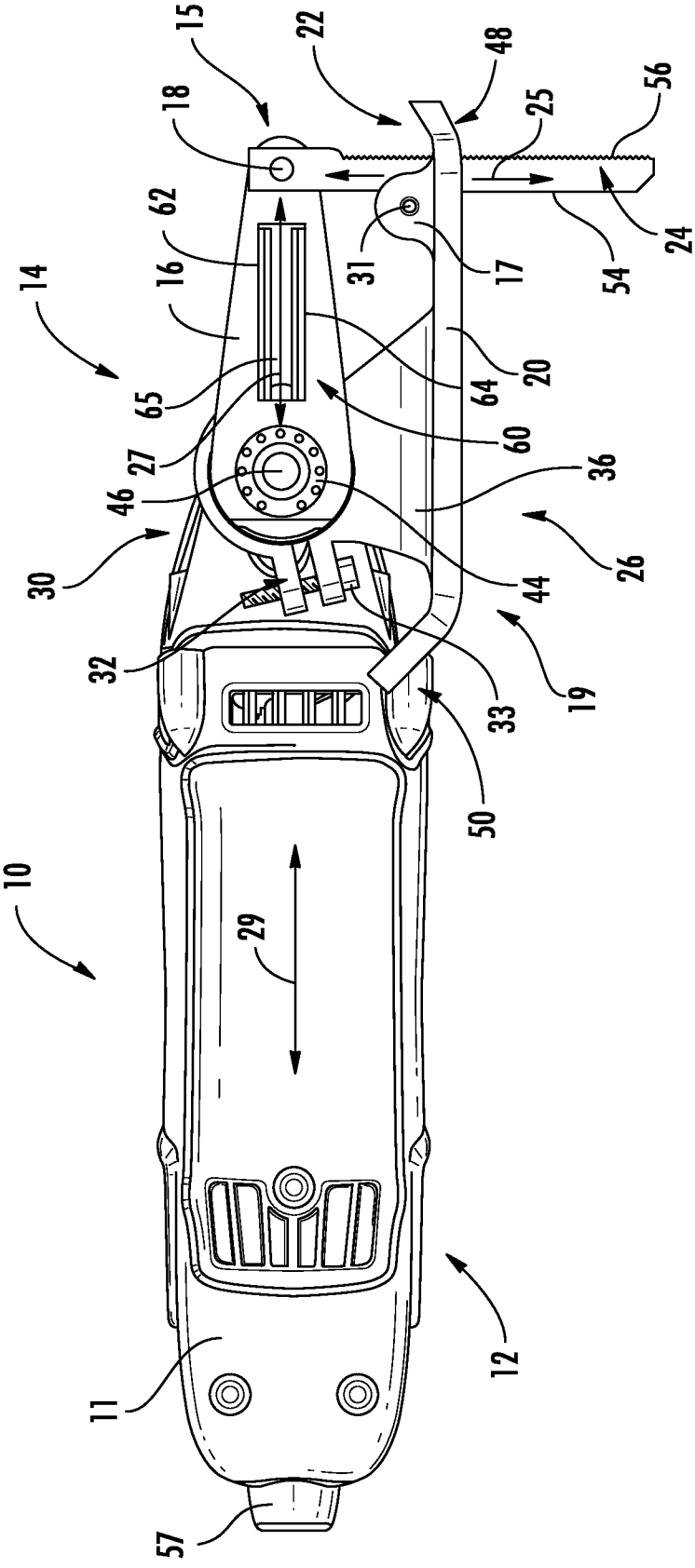


FIG. 1

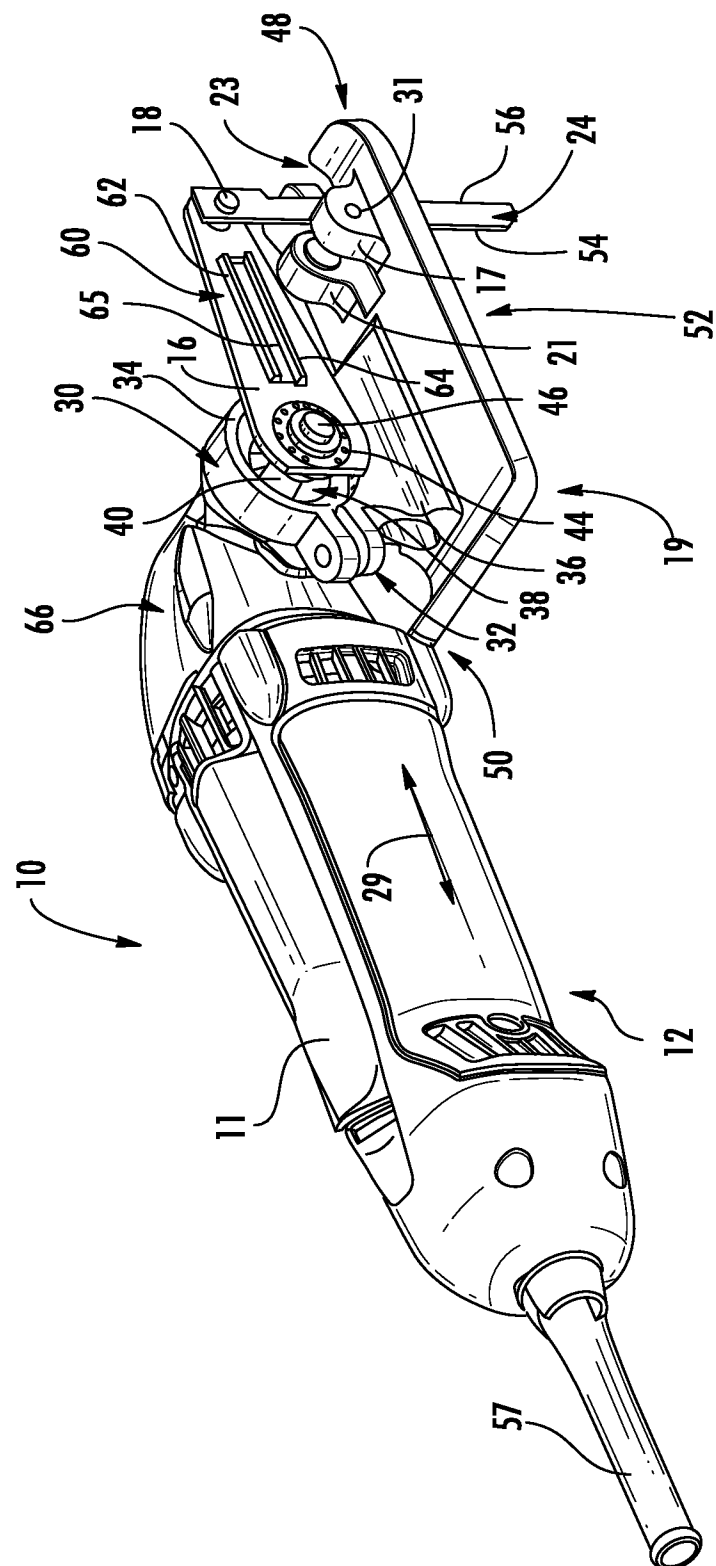


FIG. 2

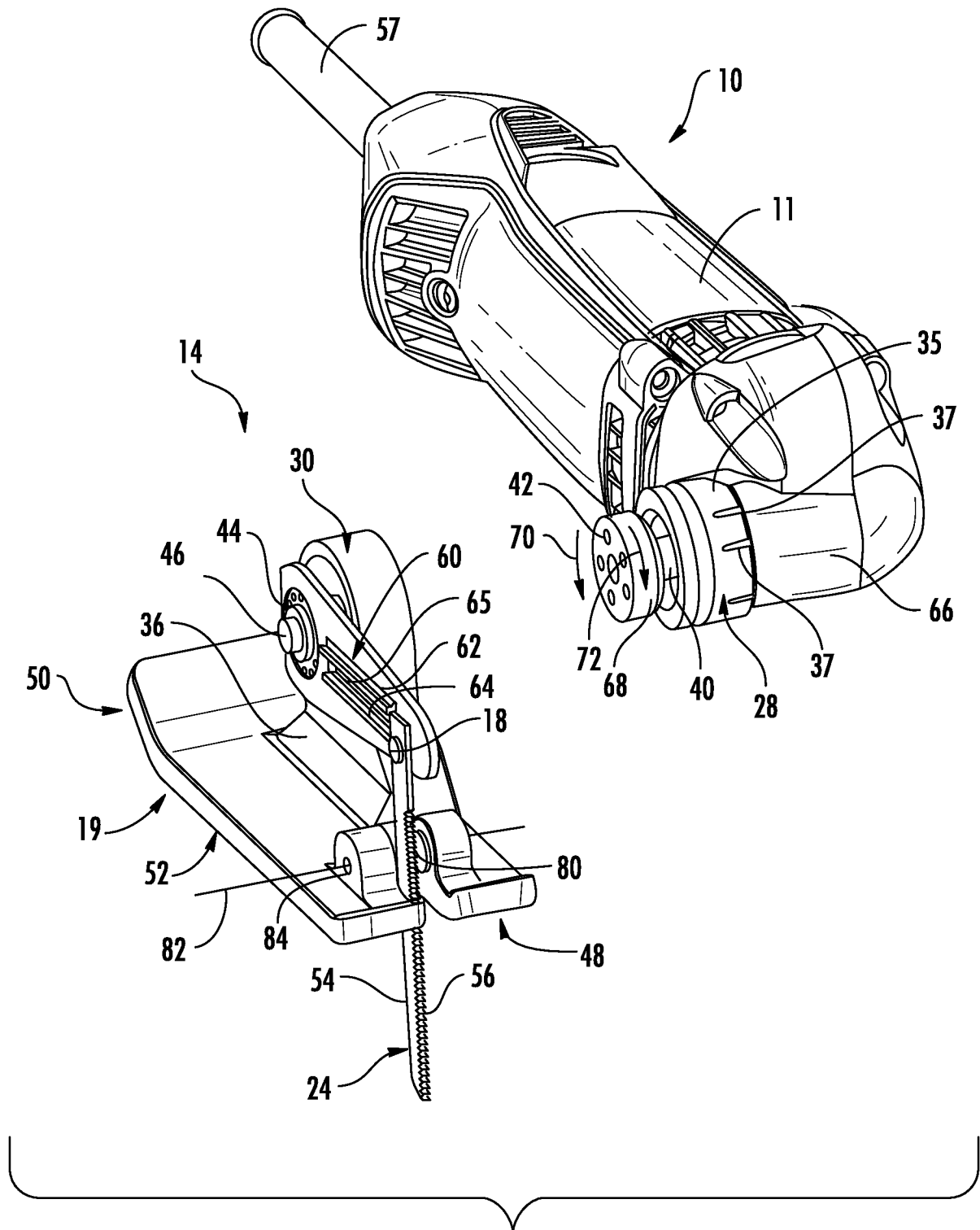


FIG. 3

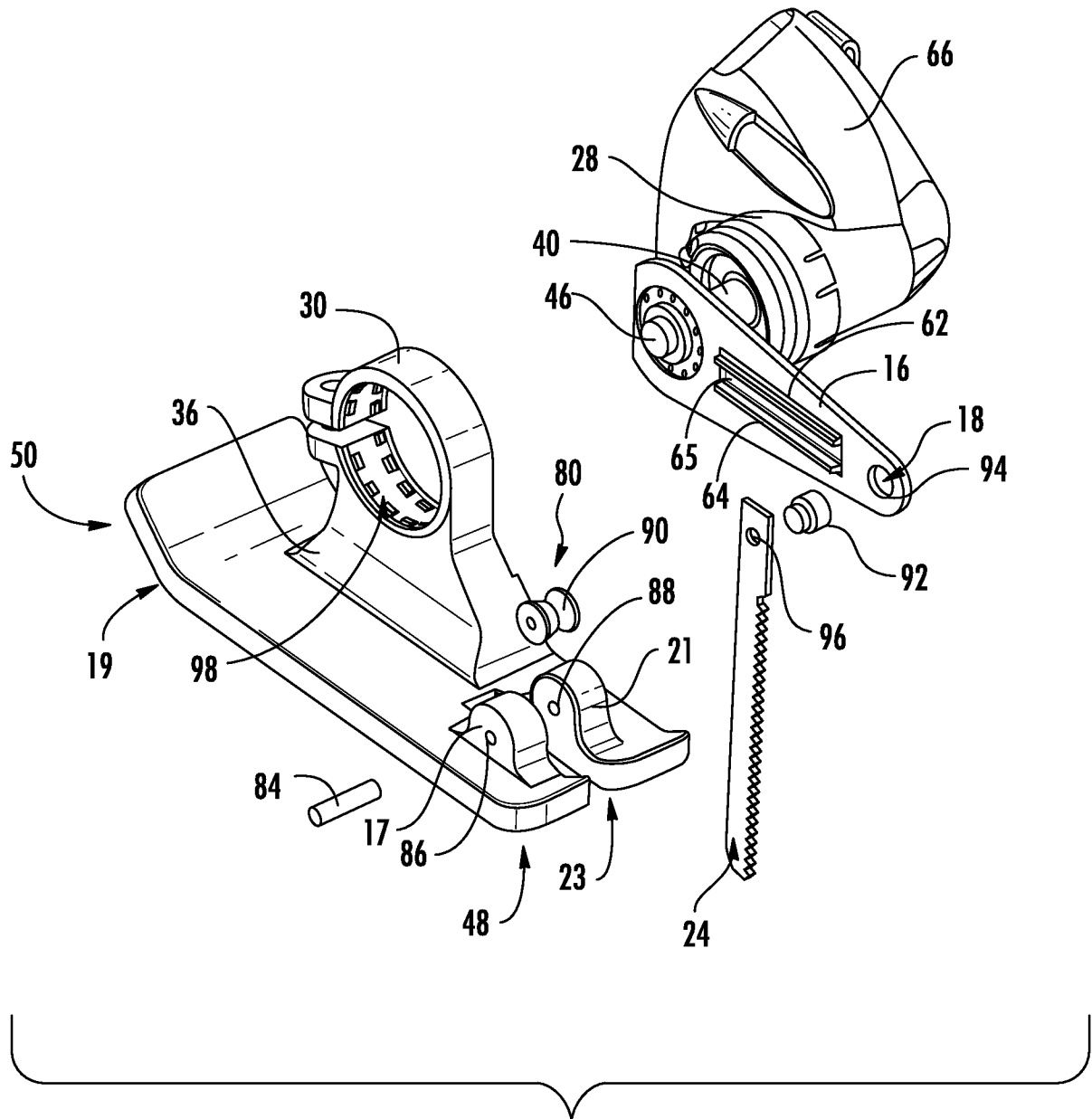


FIG. 4

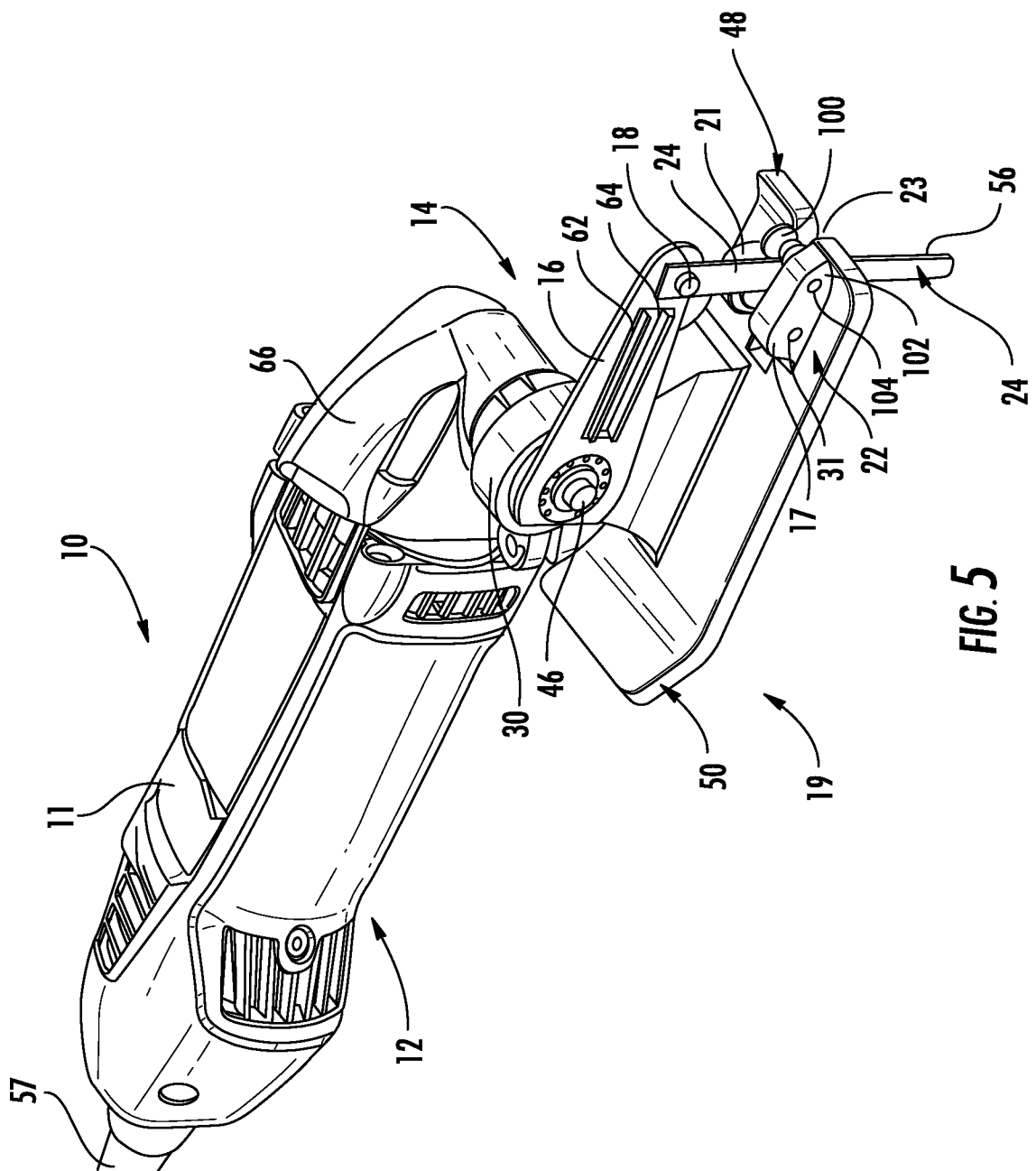


FIG. 5

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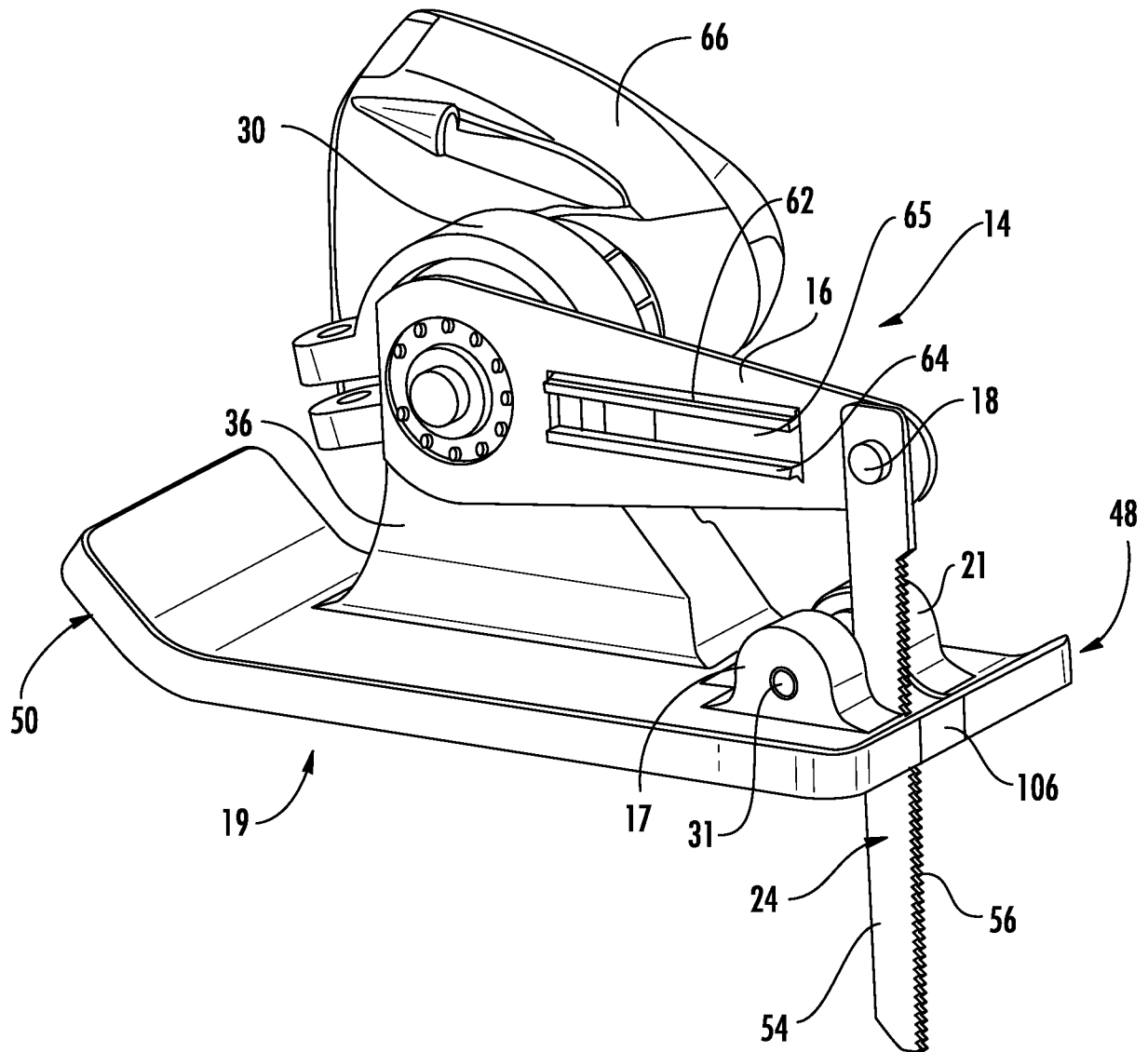
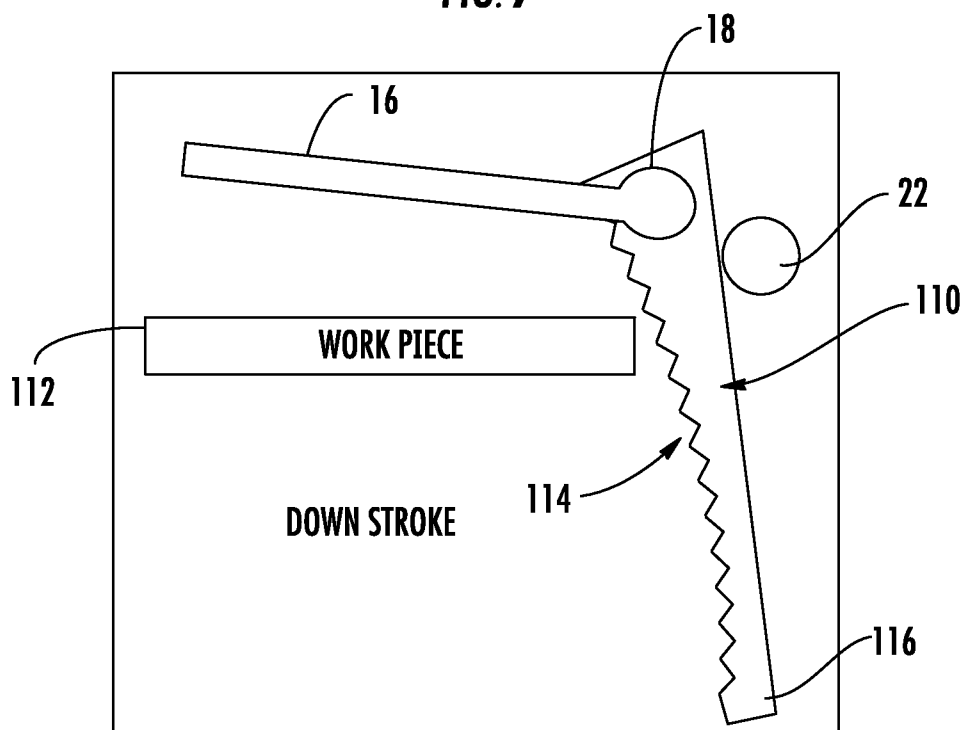
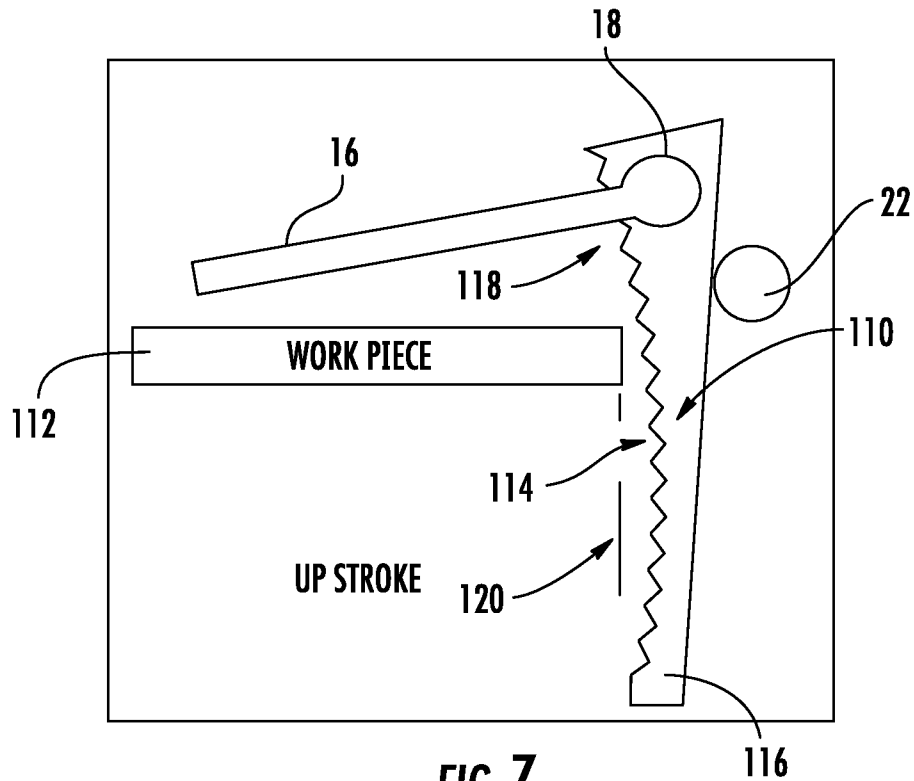


FIG. 6

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/024687**A. CLASSIFICATION OF SUBJECT MATTER****B23B 31/10(2006.01)i, B23B 31/08(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)

B23B 31/10; B23B 31/08; B23B 45/00; B27B 19/04; B23D 51/10; B23D 49/16; F16H 21/18; B23B 31/103

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: oscillate, reciprocate, saw, attachment, adapter, accessory, link, extension and support

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3547166 A (EDMUND C. DUDEK ST. CHARLES, III) 15 December 1970 See abstract, column 2, lines 1-26, column 3, lines 19-69, column 4, lines 60-63, and figures 1, 4, 6.	1-23
A	US 7451546 B2 (DELFINI et al.) 18 November 2008 See abstract, column 2, line 56 - column 3, line 60, and figure 1-3.	1-23
A	US 2004-0060179 A1 (ALBRIGHTSON, TODD A.) 01 April 2004 See abstract, paragraphs [0027]-[0030], and figure 1.	1-23
A	US 6264211 B1 (GRANADO, RENE) 24 July 2001 See abstract, column 4, line 30 - column 5, line 21, and figures 4-7.	1-23
A	US 2011-0266759 A1 (GOLDMAN DAVID A.) 03 November 2011 See abstract, paragraphs [0061]-[0064], and figures 4-6.	1-23



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

27 June 2014 (27.06.2014)

Date of mailing of the international search report

27 June 2014 (27.06.2014)

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