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(54) **UNIVERSAL ACCESSORIES FOR OSCILLATING POWER TOOLS**

(57) An accessory for coupling to an attachment mechanism of an oscillating power tool includes a working end, an opposite rear end, and a fitment portion adjacent the rear end portion. The fitment portion includes a generally U-shaped opening open at the rear end and in communication with a central opening to receive a post of a tool clamping mechanism. The fitment portion further includes a first plurality of openings in communication

with and extending radially outward from the central opening, a second plurality of openings not in communication with and positioned radially outward from the central opening. The central opening, the first plurality of openings, and the second plurality of openings are configured to couple the fitment portion to a plurality of different configurations of attachment mechanisms for oscillating power tools.

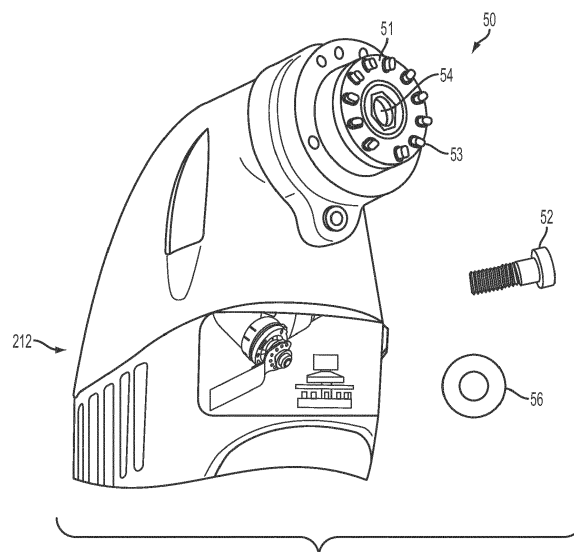


FIG. 1C

Description

[0001] This application relates to accessories (such as cutting tools, saw blades, and sanding tools) for oscillating power tools.

[0002] Oscillating power tools generally have a motor, an output shaft, and a transmission that connects the motor to the output shaft and converts rotary motion of the motor to oscillating motion of the output shaft. The output shaft is coupled to an accessory attachment mechanism that is used to removably attach various types of accessories, such as cutting tools, saw blades, and sanding tools, to the output shaft. Different brands of oscillating power tools tend to have different, often proprietary, accessory attachment mechanisms. It is desirable to have oscillating accessories with a universal attachment portion that can be attached to a multitude of different brands of oscillating power tools.

[0003] In an aspect, an accessory for coupling to an attachment mechanism of an oscillating power tool includes a working end, an opposite rear end, and a fitment portion adjacent the rear end. The fitment portion comprises a plurality of openings configured to receive projections on the attachment mechanisms on a plurality of different brands of oscillating power tools, e.g., oscillating power tools sold under the brand names Porter-Cable®, Mastercraft®, Dremel®, Bosch®, Milwaukee®, Skil®, Fein®, Craftsman®, and Ridgid®.

[0004] Implementations of this aspect may include one or more of the following features.

[0005] The plurality of openings include a generally U-shaped opening that is open at the rear end, a first set of openings in communication with and extending radially outward from the U-shaped opening, a second set of openings not in communication with and positioned radially outward from the U-shaped opening, and a third set of openings adjacent the rear end. The U-shaped opening is configured to receive a post of a Porter-Cable® branded oscillating power tool, and a central projection a Fein®, a Ridgid®, and a Mastercraft® branded oscillating power tool. The first set of openings is configured to receive round projections of Porter-Cable® branded oscillating power tools, round projections of Mastercraft® branded oscillating power tools, oblong projections of Dremel®, Bosch®, Milwaukee®, and Skil® branded oscillating power tools, radial projections Fein® branded oscillating power tools, radial projections of Craftsman® branded oscillating power tools, and radial projections of Ridgid® branded oscillating power tools. The second set of openings is configured to receive round projections of Porter-Cable® branded power tools, and oblong projections of Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. The third set of recesses is configured to receive round projections of Porter-Cable® branded oscillating power tools, and oblong projections of Dremel®, Bosch®, Milwaukee®, and Skil® branded oscillating power tools.

[0006] The first set of openings may include radial arm

slots at 90, 180, and 270 degrees. The second set of openings may include arc-shaped slots between pairs of openings the first set of openings. Alternatively, the second set of openings may include radial slots not connected with the U-shaped opening. The third set of openings may include notches in the rear end. Alternatively, the third set of openings may include notches formed in the U-shaped slot. In another alternative, the third set of openings may include chamfers tapering outward from the U-shaped opening to the rear end.

[0007] In another aspect, an accessory for coupling to an attachment mechanism of an oscillating power tool includes a working end, an opposite rear end, and a fitment portion adjacent the rear end portion. The fitment portion includes a generally U-shaped opening open at the rear end and in communication with a central opening to receive a post of a tool clamping mechanism. The fitment portion further includes a first plurality of openings in communication with and extending radially outward from the central opening, a second plurality of openings not in communication with and positioned radially outward from the central opening. The central opening, the first plurality of openings, and the second plurality of openings are configured to couple the fitment portion to a plurality of different configurations of attachment mechanisms for oscillating power tools.

[0008] Implementations of this aspect may include one or more of the following features.

[0009] The working end includes at least one of a cutting edge, a saw blade, a sanding surface, and an abrading surface. The central opening is semi-circular. The first plurality of openings includes a first radial arm slot extending from the central opening at 90 degrees to the U-shaped opening, a second radial arm slot extending from the central opening at 180 degrees to the U-shaped opening, and a third radial arm slot extending from the central opening at 270 degrees from the U-shaped opening. The second plurality of openings includes a first arc-shaped slot spaced radially outward from the central opening between the first and second radial arm openings, and a second arc-shaped slot spaced radially outward from the central opening between the second and third radial arm openings.

[0010] The first arc shaped slot subtends an angle of approximately 120 degrees to approximately 150 degrees relative to the U-shaped slot, and the second arc shaped slot subtends an angle of approximately 210 degrees to approximately 240 degrees relative to the U-shaped slot. The second plurality of openings includes a first pair of radial openings spaced radially from the central opening and between the first and second radial arm slots, and a second pair of radial openings spaced radially from the central opening and between the second and third radial arm slots. The first pair of radial openings are at angles of approximately 120 degrees and approximately 150 degrees relative to the U-shaped slot, and the second pair of radial openings are at angles of approximately 210 degrees and approximately 240 degrees

relative to the U-shaped slot.

[0011] The second plurality of openings further includes a third radial opening spaced radially from the central opening between the first radial arm slot and the U-shaped slot, and a fourth radial opening spaced radially from the central opening between the third radial arm slot and the U-shaped slot. The third radial opening is at an angle of approximately 60 degrees relative to the U-shaped slot, and the fourth radial opening is at an angle of approximately 300 degrees relative to the U-shaped slot. The fitment portion further includes a third plurality of openings extending circumferentially from the U-shaped slot, and spaced from the central opening. The third plurality of openings comprises a plurality of arc-shaped openings extending from the U-shaped slot and radially spaced from the central opening. The third plurality of openings comprises a pair of notches extending circumferentially from the U-shaped opening and radially spaced from the central opening.

[0012] The third plurality of openings comprises radial chamfers tapering outward from the U-shaped opening to the rear end. An adapter includes a generally a disc-like body with a central opening and a radial opening extending from the central opening to a periphery of the body, wherein the central opening of the body has a smaller diameter than the central opening of the fitment portion. The adapter further comprises a plurality of radial slots extending from the periphery and spaced radially outward from the central opening. The central opening, the first plurality of openings, and the second plurality of openings are configured to couple the fitment portion to at least three different configurations of accessory attachment mechanism on different brands of oscillating power tools.

[0013] In another aspect, an oscillating power tool and accessory includes a housing, a motor contained in the housing, a spindle extending from the housing, a transmission coupled to the motor and the spindle and configured to convert rotational motion of the motor to oscillating motion of the output shaft, an accessory attachment mechanism connected to the spindle for oscillating motion with the spindle, and an oscillating accessory. The accessory attachment mechanism has a clamping face with a plurality of projections, and a moveable flange portion coupled to the clamping face. The oscillating accessory is configured to be clamped between the clamping face and the flange portion. The oscillating accessory has a working end, an opposite rear end, and a fitment portion adjacent the rear end portion. The fitment portion includes a generally U-shaped opening open at the rear end in communication with a central opening, a first plurality of openings in communication with and extending radially outward from the central opening, and a second plurality of openings not in communication with and positioned radially outward from the central opening. The first and second plurality of openings are configured to receive the plurality of projections on the clamping face. The central opening, the first plurality of openings, and

the second plurality of openings are configured to be coupled to at least one other oscillating power tool having a different configuration of projections.

[0014] Implementations of this aspect may include one or more of the following features. An adapter includes a generally a disc-like body with a central opening and a radial opening extending from the central opening to a periphery of the body. The central opening of the body has a smaller diameter than the central opening of the fitment portion. A plurality of radial slots extend from the periphery and spaced radially outward from the central opening.

[0015] In another aspect, an adapter is disclosed for enhancing retention of an oscillating accessory in a clamping mechanism of an oscillating power tool. The oscillating accessory has a central opening having a first diameter, and the clamping mechanism having a plurality of projections. The adapter includes a generally a disc-like body having a peripheral edge, a central opening in the disc-like body, and a radial opening extending from the central opening to the peripheral edge of the disc-like body. The central opening has a smaller diameter than the central opening of the accessory. A plurality of radial slots extend from the peripheral edge and spaced radially outward from the central opening.

[0016] Advantages may include being able to couple the accessories to numerous different brands and configurations of oscillating power tools, including, but not limited to Cable®, Mastercraft®, Dremel®, Bosch®, Milwaukee®, Skil®, Fein®, Craftsman®, and Ridgid® branded oscillating power tools. Other advantages and features will be apparent from the description and the drawings.

FIG. 1A is a perspective view of a first embodiment of an oscillating power tool.

FIG. 1B is a perspective view of a portion of an accessory attachment mechanism of the oscillating power tool of FIG. 1A.

FIG. 1C is a perspective view of a second embodiment of an oscillating power tool.

FIG. 1D is a bottom view of the oscillating power tool of FIG. 1C.

FIGS. 2A-2F are schematic views of accessory attachment mechanisms for various brands of oscillating power tools.

FIGS. 3A-3H illustrate a first embodiment of a universal accessory attachment mechanism, including showing how the accessory fits to the accessory attachment mechanisms of FIGS. 2A-2F.

FIGS. 4A-4H illustrate a second embodiment of a universal accessory attachment mechanism, including showing how the accessory fits to the accessory attachment mechanisms of FIGS. 2A-2F.

FIGS. 5A-5H illustrate a third embodiment of a universal accessory attachment mechanism, including showing how the accessory fits to the accessory attachment mechanisms of FIGS. 2A-2F.

FIGS. 6A-6H illustrate a fourth embodiment of a universal accessory attachment mechanism, including showing how the accessory fits to the accessory attachment mechanisms of FIGS. 2A-2F.

FIGS. 7A-7B are perspective views of a third embodiment of an oscillating power tool.

FIGS. 8A-8B are perspective views of a fourth embodiment of an oscillating power tool.

FIG. 9A is a perspective view of an adapter for use with the oscillating accessories of FIGS. 2A-6H.

FIG. 9B is a perspective view illustrating the adapter of FIG. 9A and the accessory of FIG. 5A coupled to the oscillating power tool of FIG. 7A.

FIG. 9C is a perspective view illustrating the adapter of FIG. 9A and the accessory of FIG. 5A coupled to the oscillating power tool of FIG. 8A.

[0017] Referring to FIG. 1A, a first embodiment of an oscillating power tool 12 includes a tool body 18 including a housing 20 that contains a motor 22 to drive an output member 24. The output spindle 26 is coupled to the motor 22 via a transmission 25 that converts rotary motion of the motor 22 to oscillating motion of the spindle 26. The output of the spindle 26 is coupled to a first type of accessory attachment mechanism 10.

[0018] Referring also FIG. 1B, the first type of accessory attachment mechanism 10 does not require the use of a separate tool to couple a blade to the oscillating power tool (also known as a "tool-free" attachment mechanism). An exemplary tool-free attachment mechanism 10 includes a clamp assembly 30 having a first clamp member 36 fixedly coupled to the output spindle, a second clamp member 38 facing the first clamp member 36, and a lever 32 coupled to the second clamp member 38. The lever 32 includes a lever arm 40 with a user engagement portion 42 and a block 44. The lever 32 further includes a pivot portion 46 having a pivot axle 48. The second clamp member 38 includes a second clamp body 70 generally in the form of a ring having a central opening 72. The second clamp body 70 has a second clamping surface 74 having a plurality of mounting features 76 formed thereon. In the example shown, the plurality of mounting features 76 are in the form of male projections 78. In the particular example shown, eight protrusions each having a circular cross section and a tapered shape or form are provided. An oscillating accessory 14a (in this case a saw blade) is removably clamped between the first and second clamp members 36, 38, and includes a plurality of openings that receive the male projections 78 so as to inhibit rotation of the oscillating accessory 14a relative to the clamp members 36, 38.

[0019] Referring to FIGS. 1C and 1D, a second embodiment of an oscillating power tool 212 includes a second type of accessory attachment mechanism 50 that requires the use of a separate tool such as a screwdriver or wrench to couple a blade to the oscillating power tool. Such an exemplary accessory attachment mechanism 50 includes a clamping face 51 that is fixedly attached

to the spindle to oscillate with the spindle, and a threaded bolt 52 that can be removably received (using a separate tool) in a threaded bore 54 in the spindle and/or in the clamping face 51. The accessory attachment mechanism 50 may optionally include a washer 56 received between the head of the bolt 52 and the clamping face 51. The clamping face 51 includes a plurality of mounting features in the form of projections 53 configured to engage with a plurality of recesses or openings 57 in an oscillating blade or accessory 58. To couple an oscillating blade 58 to the oscillating power tool, the bolt 52 and washer 56 are removed from the threaded bore 54, the oscillating blade 58 has its recesses or openings 57 aligned with the projections 53 on the clamping face 51, and the bolt 52 and washer 56 are reattached to the threaded bore 54 to hold the oscillating blade 58 between the bolt 52 and the clamping face 51. The oscillating blade 58 can be removed by removing the bolt 52 and/or washer 56 from the threaded bore 54.

[0020] Referring to FIGS. 2A-2F, a common feature of the disclosed accessory attachment mechanisms for oscillating tools (both the tool and tool-free types) is that they have mounting features in the form of a plurality of projections. However, different manufacturers and brands of oscillating power tools have mounting features with different patterns of projections for engaging different patterns openings in an accessory or cutting blade. In one aspect, this application discloses several embodiments of oscillating accessories that are universally adaptable to be coupled to the accessory attachment mechanisms on these different types of mounting features.

[0021] For example, FIG. 2A illustrates a projection pattern 100 on Porter-Cable® branded oscillating power tools (e.g., the Porter-Cable® PC250MTK oscillating power tool), which includes eight round projections 100a-100h arranged clockwise about a support post 102 for the clamping mechanism at angles of 0, 60, 90, 120, 180, 240, 270, and 300 degrees, respectively, relative to an imaginary vertical line 104 extending from the central hole 102 through the projection 100a. FIG. 2B illustrates a projection pattern 200 on Mastercraft® branded oscillating power tools (e.g., the Mastercraft® 054-1266-4 oscillating tool), which includes four round projections 200a-200d arranged clockwise about a central circular projection 202 at angles of 0, 90, 180, and 270 degrees, respectively, relative to an imaginary vertical line 204 extending from the central projection 202 through the projection 200a. FIG. 2C illustrates a projection pattern 300 on Dremel®, Bosch®, Milwaukee®, and Skil® branded oscillating power tools (e.g., the Dremel® Multi-Max MM-20 oscillating tool, the Bosch® MX25EC-21 Multi-X oscillating tool, the Milwaukee® 2426-22 oscillating tool, and the Skil® 1400-02 oscillating tool) which includes twelve oblong projections 300a-300l arranged clockwise about a central point 302 at angles of 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, and 330 degrees, respectively, relative to an imaginary vertical line extending from

the central point 302 through the projection 300a.

[0022] FIG. 2D illustrates a projection pattern 400 on Fein® branded oscillating power tools (e.g., the Fein® FMM-250 oscillating tool), which includes a central, circular projection 402, and four radial projections 400a-400d extending radially outward from the central projection 402 clockwise at angles of 0, 90, 180, and 270 degrees, respectively, relative to an imaginary vertical line 404 extending from the central projection 402 through the radial projection 400a. FIG. 2E illustrates a projection pattern 500 on Craftsman® branded oscillating power tools (e.g., the Craftsman® 2702 oscillating tool), which includes a four radial projections 500a-500d extending radially outward, and arranged clockwise about a central point 502 at angles of 0, 90, 180, and 270 degrees, respectively, relative to an imaginary vertical line 504 extending from the central point 502 through the radial projection 500a. FIG. 2F illustrates a projection pattern 600 on Ridgid® branded oscillating power tools (e.g., the Ridgid® R26800 oscillating tool), which includes a central, circular projection 602, and four radial projections 600a-600d extending radially outward from the central projection 602 clockwise at angles of 0, 90, 180, and 270 degrees, respectively, relative to an imaginary vertical line 604 extending from the central projection 602 through the radial projection 600a.

[0023] Referring to FIGS. 3A-3H, a first embodiment of an oscillating accessory 700 includes a working end 702 and a rear end 704. The rear end 704 has a fitment portion having a plurality of openings 706 configured to couple the accessory 700 to each of the projection patterns illustrated in FIGS. 2A-2F. The openings 706 include a generally U-shaped opening 708 extending from a rear end portion 710 of the accessory 700 and terminating in a generally circular central opening 709. Three radial arm openings 712a-712c are in communication with and extend radially outward from the central opening 709. The radial arm openings 712a-712c are positioned at 90, 180, and 270 degree angles relative to the U-shaped opening. A pair of arc-shaped openings 714a, 714b are not in communication with the central opening 709, and are disposed between the first and second radial openings 712a, 712b, and the second and third radial openings 712b, 712c, respectively. The arc-shaped opening 714a subtends an arc of approximately 120 degrees to approximately 150 degrees relative to the U-shaped opening. The arc-shaped opening 714b subtends an arc of approximately 210 degrees to approximately 240 degrees relative to the U-shaped opening. The rear end portion 710 includes a third plurality of openings in the form of a pair of notches 716a, 716b that extend circumferentially from the U-shaped opening 708, and that are spaced radially outward from the central opening 709.

[0024] The U-shaped opening 708 is opened at the rear end portion 710 in order to be able to receive the support post 102 of the Porter-Cable® branded power tool. The central opening 709 is configured to receive the

central projections 202, 402, and 602 of the Fein®, Ridgid®, and Mastercraft® branded power tools, respectively. The radial openings 712a-712c are configured to receive the round projections 100c, 100e, 100g of the Porter-Cable® branded power tools, the round projections 200b, 200c, 200d of the Mastercraft® branded power tools, the oblong projections 300d, 300g, 300j of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools, the radial projections 400b-400d of the Fein® branded power tools, the radial projections 500b-500d of the Craftsman® branded power tools, and the radial projections 600b-600d of the Ridgid® branded power tools. The arc-shaped openings 714a, 714b are configured to receive the round projections 100d, 100f of the Porter-Cable® branded power tools, and the oblong projections 300e, 300f, 300h, 300i of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. The notches 716a, 716b are configured to receive the round projections 100b, 100h of the Porter-Cable® branded power tools, and the oblong projections 300c, 300k of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. In this manner, the openings 700 can universally engage the attachment mechanism of any of the aforementioned oscillating power tools.

[0025] Referring to FIGS. 4A-4H, a second embodiment of an oscillating accessory 800 includes a working end 802 and a rear end 804. The rear end 804 has a fitment with a plurality of openings 806 configured to couple the accessory 800 to each of the projection patterns illustrated in FIGS. 2A-2F. The openings 806 include a generally U-shaped opening 808 extending from a rear end portion 810 of the accessory 800 and terminating in a generally circular central opening 809. Three radial arm openings 812a-812c are in communication with and extend radially outward from the central opening 809. The radial arm openings 812a-812c are positioned at angles of approximately 90 degrees, 180 degrees, and 270 degree relative to the U-shaped opening. A first pair of arc-shaped openings 814a, 814b are not in communication with and spaced radially outward from the central opening 809. The arc-shaped openings 814a, 814b are disposed between the first and second radial openings 812a, 812b, and the second and third radial openings 812b, 812c, respectively. The arc-shaped opening 814a subtends an arc of approximately 120 degrees to approximately 150 degrees relative to the U-shaped opening. The arc-shaped opening 814b subtends an arc of approximately 210 degrees to approximately 240 degrees relative to the U-shaped opening. A second pair of semi-arc-shaped openings 816a, 816b extend circumferentially from the U-shaped opening 808 and are spaced from the first and third radial openings 812c, 812a, and are spaced radially outward from the central opening 809. The radial openings 816a, 816b subtend an angle of approximately 30 degrees to approximately 60 degrees and an angle of approximately 300 degrees to approximately 330 degrees, relative to the, respectively, relative to the U-shaped opening 808.

[0026] The U-shaped opening 808 is opened at the rear end portion 810 in order to be able to receive the support post 102 of the Porter-Cable® branded power tool. The central opening 809 is configured to receive the central projections 202, 402, and 602 of the Fein®, Ridgid®, and Mastercraft® branded power tools, respectively. The radial openings 812a-812c are configured to receive the round projections 100c, 100e, 100g of the Porter-Cable® branded power tools, the round projections 200b, 200c, 200d of the Mastercraft® branded power tools, the oblong projections 300d, 300g, 300j of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools, the radial projections 400b-400d of the Fein® branded power tools, the radial projections 500b-500d of the Craftsman® branded power tools, and the radial projections 600b-600d of the Ridgid® branded power tools. The first set of arc-shaped openings 814a, 814b are configured to receive the round projections 100d, 100f of the Porter-Cable® branded power tools, and the oblong projections 300e, 300f, 300h, 300i of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. The second set of arc-shaped openings 816a, 816b are configured to receive the round projections 100b, 100h of the Porter-Cable® branded power tools, and the oblong projections 300c, 300k of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. In this manner, the openings 800 can universally engage the attachment mechanism of any of the aforementioned oscillating power tools.

[0027] Referring to FIGS. 5A-5H, a third embodiment of an oscillating accessory 900 includes a working end 902 and a rear end 904. The rear end 904 has a fitment with a plurality of openings 906 configured to couple the accessory 900 to each of the projection patterns illustrated in FIGS. 2A-2F. The openings 906 include a generally U-shaped opening 908 extending from a rear end portion 910 of the accessory 900 and terminating in a generally circular central opening 909. A first set of three radial arm openings 912a-912c are in communication with and extend radially outward from the central opening 908 at approximately 90 degrees, 180 degrees, and 270 degrees, respectively, relative to the U-shaped opening 909. A second set of six radial openings 914a-914f are spaced radially outward from and not in communication with the central opening 909, and are positioned at approximately 60 degrees, 120 degrees, 150 degrees, 210 degrees, 240 degrees, and 300 degrees relative to the U-shaped openings. In addition, a pair of chamfers 916a, 916b taper outward from the U-shaped opening 908 to the rear end portion 910 of the accessory 900.

[0028] The U-shaped opening 908 is opened at the rear end portion 910 in order to be able to receive the support post 102 of the Porter-Cable® branded power tool. The central opening 909 is also configured to receive the central projections 202, 402, and 602 of the Fein®, Ridgid®, and Mastercraft® branded power tools, respectively. The first set of radial openings 912a-912c are configured to receive the round projections 100c, 100e, 100g

of the Porter-Cable® branded power tools, the round projections 200b, 200c, 200d of the Mastercraft® branded power tools, the oblong projections 300d, 300g, 300j of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools, the radial projections 400b-400d of the Fein® branded power tools, the radial projections 500b-500d of the Craftsman® branded power tools, and the radial projections 600b-600d of the Ridgid® branded power tools. The second set of radial openings 914a-914f are configured to receive the round projections 100b, 100d, 100f, 100h of the Porter-Cable® branded power tools, and the oblong projections 300c, 300e, 300f, 300h, 300i, 300k of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. The chamfers 916a, 916b are configured to receive and provide clearance for the oblong projections 300b, 300l of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. In this manner, the openings 900 can universally engage the attachment mechanism of any of the aforementioned oscillating power tools.

[0029] Referring to FIG. 6A-6H, a fourth embodiment of an oscillating accessory 1000 includes a working end 1002 and a rear end 1004. The rear end 1004 has a fitment with a plurality of openings 1006 configured to couple the accessory 1000 to each of the projection patterns illustrated in FIGS. 2A-2F. The openings 1006 include a generally U-shaped opening 1008 extending from a rear end portion 1010 of the accessory 1000 and terminating in a generally circular central opening 1009. A first set of three radial arm openings 1012a-1012c are in communication with and extend radially outward from the central opening 1009 at angles of approximately 90 degrees, 180 degrees, and 270 degrees relative to the U-shaped opening. A second set of six radial openings 1014a-1014f are spaced radially outward from and not in communication with the central opening 1009 at angles of approximately 60 degrees, 120 degrees, 150 degrees, 210 degrees, 240 degrees, and 300 degrees relative to the U-shaped opening. In addition, a pair of circumferentially extending notches 1016a, 1016b are in communication with the U-shaped opening 1008, and spaced from the central opening 1009. The notches 1016a, 1016b are positioned at angles of approximately 30 degrees and approximately 330 degrees relative to the U-shaped opening 1008.

[0030] The U-shaped opening 1008 is opened at the rear end portion 1010 in order to be able to receive the support post 102 of the Porter-Cable® branded power tool. The U-shaped opening 1008 is also configured to receive the central projections 202, 402, and 602 of the Fein®, Ridgid®, and Mastercraft® branded power tools, respectively. The first set of radial openings 1012a-1012c are configured to receive the round projections 100c, 100e, 100g of the Porter-Cable® branded power tools, the round projections 200b, 200c, 200d of the Mastercraft® branded power tools, the oblong projections 300d, 300g, 300j of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools, the radial projections 400b-

400d of the Fein® branded power tools, the radial projections 500b-500d of the Craftsman® branded power tools, and the radial projections 600b-600d of the Ridgid® branded power tools. The second set of radial openings 1014a-1014f are configured to receive the round projections 100b, 100d, 100f, 100h of the Porter-Cable® branded power tools, and the oblong projections 300c, 300e, 300f, 300h, 300i, 300k of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. The notches 1016a, 1016b are configured to receive the oblong projections 300b, 300l of the Dremel®, Bosch®, Milwaukee®, and Skil® branded power tools. In this manner, the openings 1000 can universally engage the attachment mechanism of any of the aforementioned oscillating power tools.

[0031] Referring to FIGS. 7A-9C, an adapter may enhance the attachment of aforementioned oscillating accessories 700, 800, 900, or 1000 to some embodiments of oscillating power tools. Referring to FIGS. 7A and 7B, an example a third embodiment of an oscillating power tool is a Dremel® MM40 Multi-Max oscillating power tool 1100. The power tool 1100 has an accessory attachment mechanism 1150 with a clamping face 1151 that is fixedly attached to the spindle to oscillate with the spindle. The clamping face 1151 includes a plurality of mounting features in the form of projections 1153 configured to engage with a plurality of recesses or openings in an oscillating blade or accessory. The projections 1153 having the same configuration as the projections 300 on the Dremel® oscillating power tool shown in FIG. 2C. However, instead of a removable threaded bolt, the power tool 1100 includes an axially moveable clamping flange 1152 that is connected to a lever 1154 via a central rod 1156 received through the center of the clamping face 1151. Actuating the lever 1154 moves the clamping flange 1152 axially between an open or unclamped position (FIG. 7A) and a closed or clamped position (FIG. 7B) for clamping a saw blade between the flange 1152 and the clamping face 1153.

[0032] Referring to FIGS. 8A and 8B, an example of a fourth embodiment of an oscillating power tool is a Bosch® MX30E Multi-X oscillating power tool 1200. The power tool 1200 has an accessory attachment mechanism 1250 with a clamping face 1251 that is fixedly attached to the spindle to oscillate with the spindle. The clamping face 1251 includes a plurality of mounting features in the form of projections 1253 configured to engage with a plurality of recesses or openings in an oscillating blade or accessory. The projections 1253 having the same configuration as the projections 300 on the Bosch® oscillating power tool shown in FIG. 2C. However, instead of a removable threaded bolt, the power tool 1200 includes a radially expandable clamping post 1252 that is connected to a lever 1254 via a central rod received through the center of the clamping face 1251. The clamping post 1252 has an enlarged end portion 1256 with a pair of semi-circular flanges 1258a, 1258b separated by a space. Actuating the lever 1254 moves the clamping

flanges 1258a, 1258b between an open or unclamped position where the flanges 1258a, 1258b are relatively close to one another (FIG. 8A) to enable insertion of a saw blade, and a closed or clamped position where the flanges 1258a, 1258b are radially further apart (FIG. 8B) for clamping a saw blade between the flange 1258a, 1258b and the clamping face 1253.

[0033] Referring to FIG. 9A, an adapter 1300 may enhance the ability of the oscillating accessories 700, 800, 900, and 1000 to be coupled to the attachment mechanisms 1150, 1250, or the attachment mechanisms of other oscillating power tools. The adapter includes a generally flat disc-like body 1302 having a generally circular or partially circular shape. The body 1302 includes a central opening 1304 with a radial opening 1306 extending from the central opening 1304 to the periphery of the body 1302. The central opening has an inner diameter D that is less than an inner diameter of the central openings 709, 809, 909, 1009 in the accessories 700, 800, 900, 1000. The adapter 1300 may further include a plurality of peripheral radial slots 1308 configured to receive the plurality of projections on the clamping faces of the oscillating power tools.

[0034] Referring to FIG. 9B, in one example, the adapter 1300 may help couple oscillating accessory 900 to the Dremel® MM40 Multi-Max oscillating power tool 1100. The adapter 1300 is received between the oscillating accessory 900 and the flange 1152 of the clamping mechanism 1150. The smaller inner diameter of the central opening 1304 of the adapter helps retain the oscillating accessory 900 on the tool 1100 by providing greater surface area for engagement by the flange 1152. Meanwhile, the projections 1153 are received in the radial openings 1308 in the adapter 1300 to prevent rotation of the adapter 1300 and accessory 900 relative to the clamping mechanism 1150. Thus, the adapter 1300 helps retain the accessory 900 on the power tool 1100.

[0035] Referring to FIG. 9C, in another example, the adapter 1300 may help couple the oscillating accessory 900 to the Bosch® MX30E Multi-X oscillating power tool 1200. The adapter 1300 is received between the oscillating accessory 900 and the flanges 1258a, 1258b of the clamping mechanism 1250. The smaller inner diameter of the central opening 1304 of the adapter helps retain the oscillating accessory 900 on the tool 1200 by providing greater surface area for engagement by the flanges 1258a, 1258b. Meanwhile, the projections 1253 are received in the radial openings 1308 in the adapter 1300 to prevent rotation of the adapter 1300 and accessory 900 relative to the clamping mechanism 1250. Thus, the adapter 1300 helps retain the accessory 900 on the power tool 1200. It should be understood that this or a similar adapter may be used to help retain any of the accessories 700, 800, 900, 1000 on any of the oscillating power tool attachment mechanisms discussed in this application, whether tool-free or not.

[0036] Numerous modifications may be made to the exemplary implementations described above. For exam-

ple, the shapes and configurations of the openings in the oscillating accessories and/or the adapter could be modified, or the openings could be made as recesses. The oscillating accessory may be any type of accessory used with oscillating tool such as a cutting tool, a saw blade, or a sanding or abrading tool. These and other implementations are within the scope of this application.

Claims

1. An accessory (900) for coupling to an attachment mechanism of an oscillating power tool, the accessory comprising:

a working end portion (902); and
an opposite rear end portion (910) configured to be coupled to a plurality of different configurations of attachment mechanisms for oscillating power tools, the rear end portion including:

a generally U-shaped opening (908) open to the rear end portion (910), the U-shaped opening having a central portion configured to receive a central post of a tool clamping mechanism, and a rearward portion in communication with the central portion and open to the rear end portion of the accessory;

a first plurality of openings (912) in communication with and extending radially outward from the central opening, the first plurality of openings including a first radial arm slot (912a) extending from the central portion at approximately 90 degrees to the U-shaped opening, a second radial arm slot (912b) extending from the central portion at approximately 180 degrees to the U-shaped opening, and a third radial arm slot (912c) extending from the central portion at approximately 270 degrees from the U-shaped opening;

a second plurality of openings (914) not in communication with and positioned radially outward from the central opening and between adjacent radial arm slots in the first plurality of openings (912); and

a pair of chamfers (916a, 916b) tapering outward from the U-shaped opening (908) to the rear end portion (910).

2. The accessory of claim 1 wherein the chamfers (916a, 916b) comprise rear edges of the rear end portion (910) and taper outwardly as they extend rearwardly.

3. The accessory of any preceding claim, wherein the working end portion (902) comprises at least one of

a cutting edge, a saw blade, a sanding surface, and an abrading surface.

4. The accessory of any preceding claim, wherein the central portion has a substantially arc-shaped edge (909).

5. The accessory of any preceding claim, wherein the second plurality of openings (914) includes a first arc-shaped slot spaced radially outward from the central portion between the first and second radial arm slots, and a second arc-shaped slot spaced radially outward from the central portion between the second and third radial arm slots.

6. The accessory of any preceding claim, wherein the second plurality of openings (914) includes a first pair of radial openings (914b, 914c) spaced radially from the central portion and between the first and second radial arm slots, and a second pair of radial openings (914d, 914e) spaced radially from the central portion and between the second and third radial arm slots.

7. The accessory of claim 6, wherein the first pair of radial openings (914b, 914c) are at angles of approximately 120 degrees and approximately 150 degrees relative to the U-shaped opening, and the second pair of radial openings (914d, 914e) are at angles of approximately 210 degrees and approximately 240 degrees relative to the U-shaped opening.

8. The accessory of any preceding claim, wherein the second plurality of openings (914) further includes a third radial opening (914a) spaced radially from the central portion between the first radial arm slot and the U-shaped opening, and a fourth radial opening (914f) spaced radially from the central portion between the third radial arm slot and the U-shaped opening.

9. The accessory of claim 8, wherein the third radial opening (914a) is at an angle of approximately 60 degrees relative to the U-shaped opening, and the fourth radial opening (914f) is at an angle of approximately 300 degrees relative to the U-shaped opening.

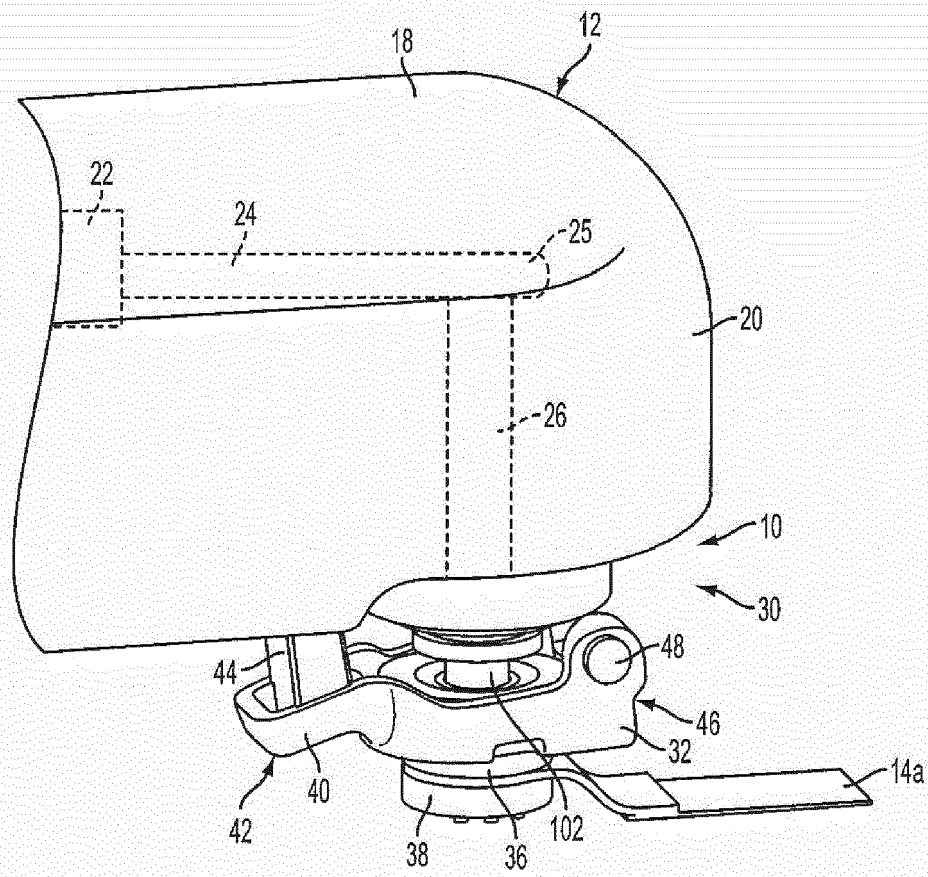


FIG. 1A

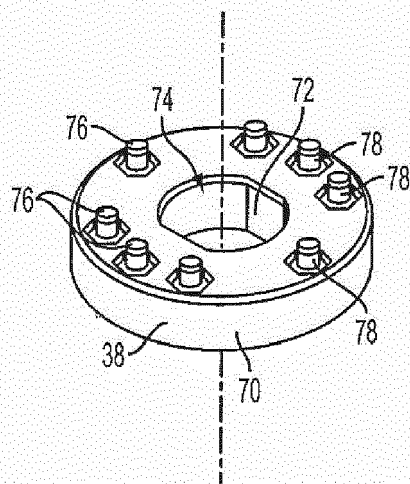


FIG. 1B

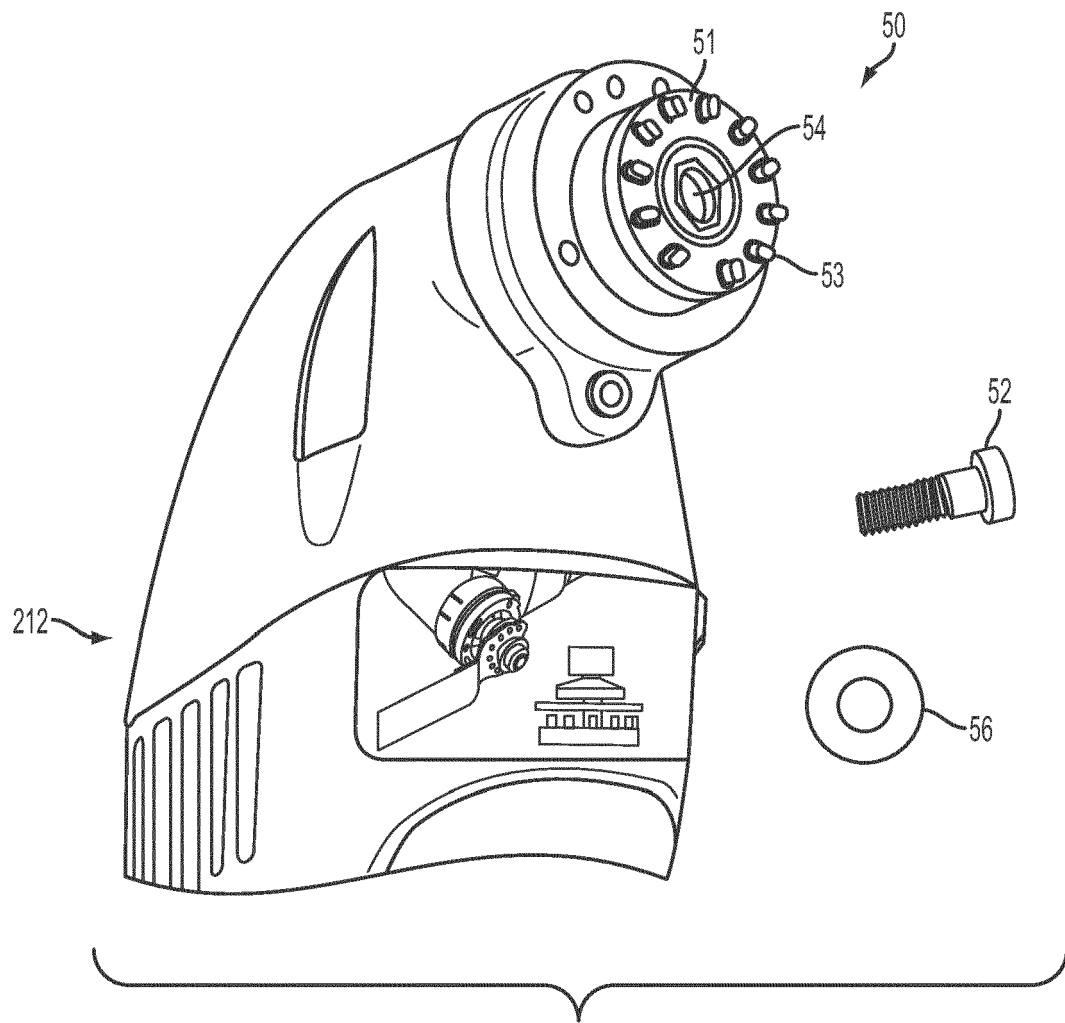


FIG. 1C

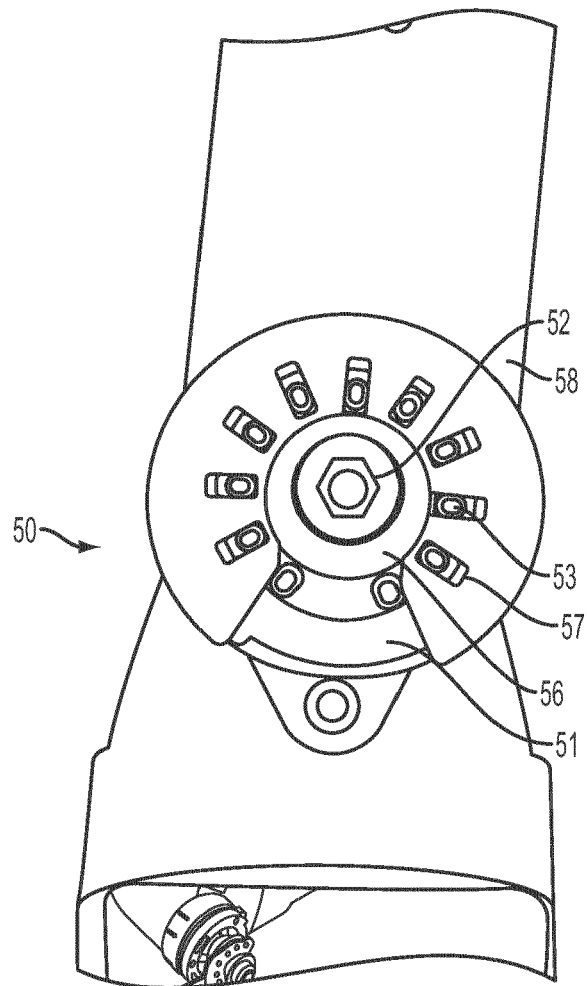
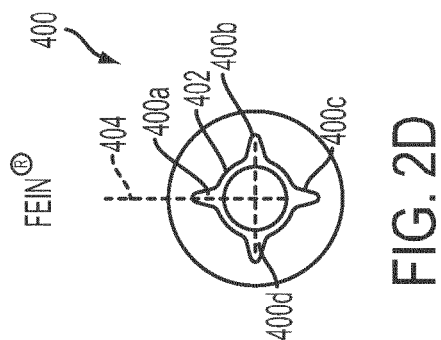
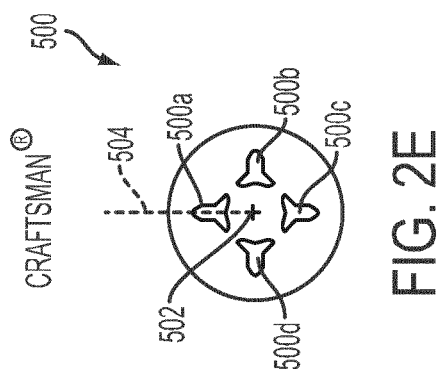
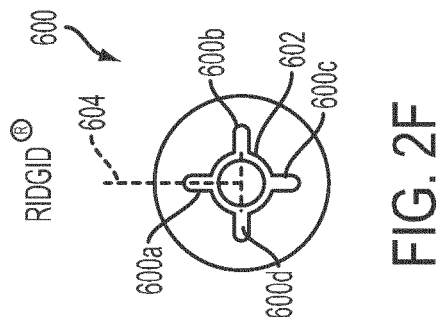
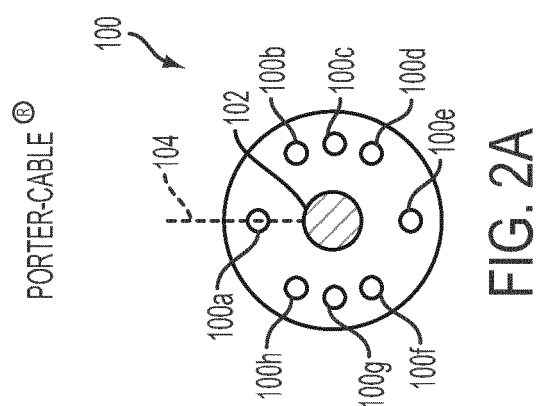
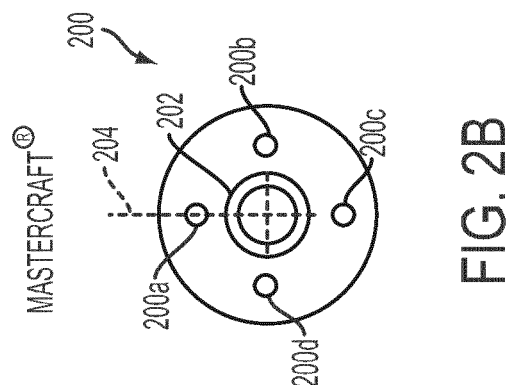
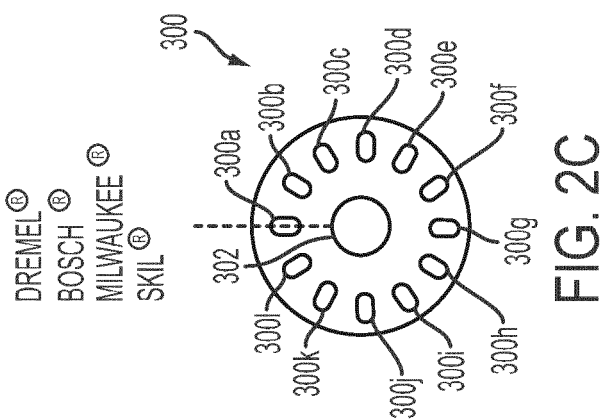


FIG. 1D



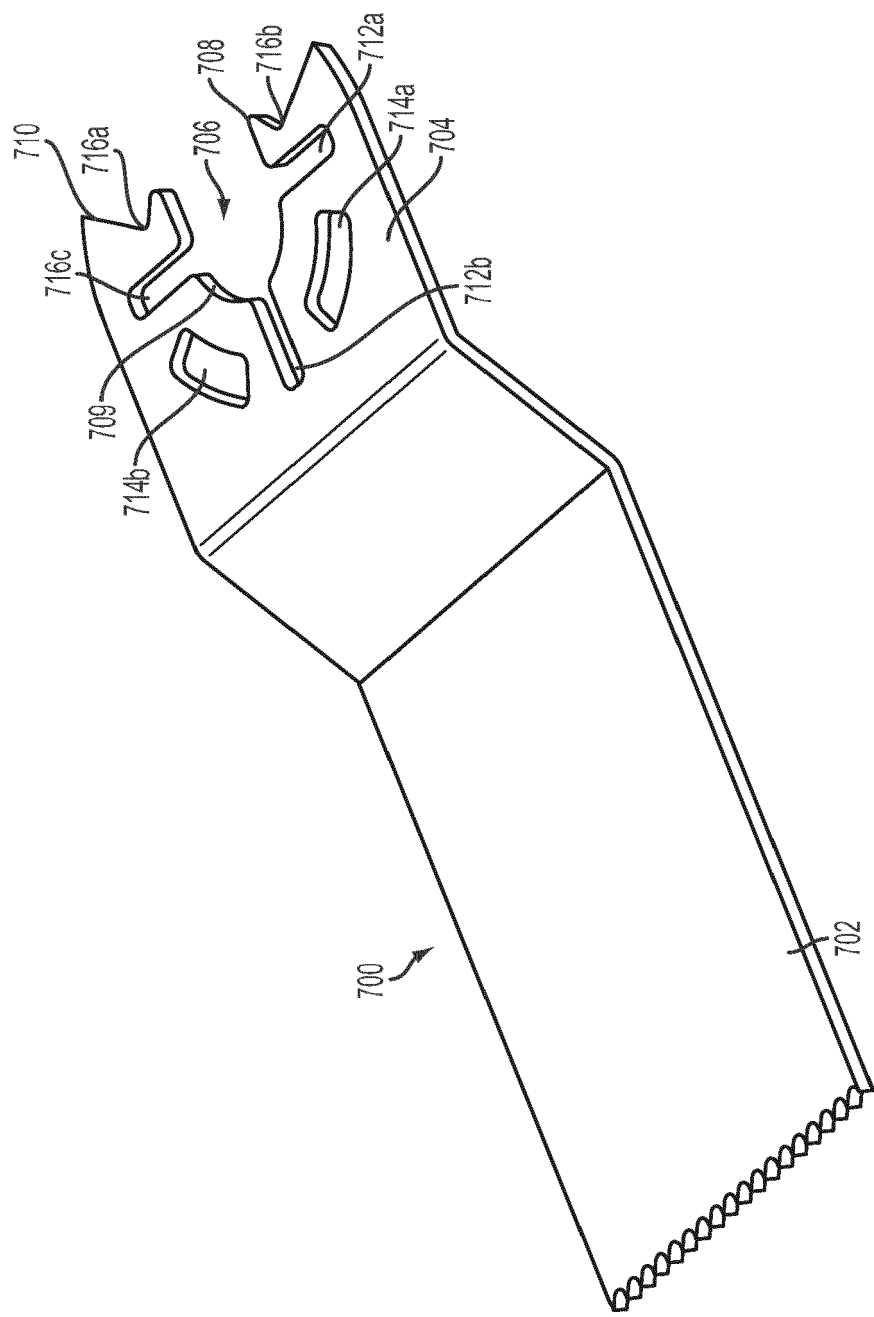


FIG. 3A

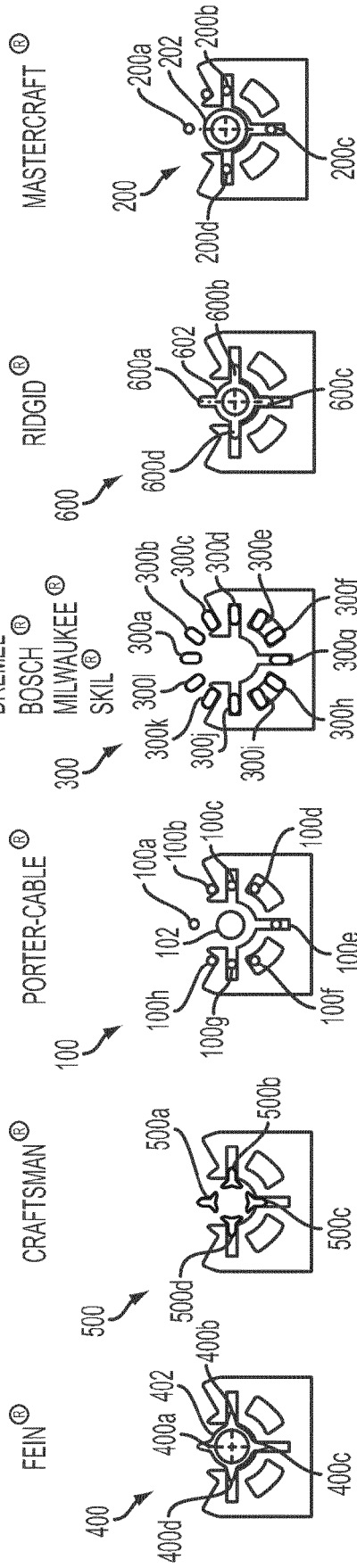


FIG. 3C

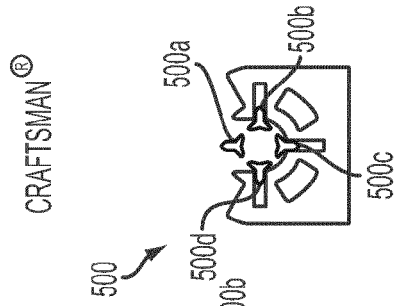


FIG. 3D

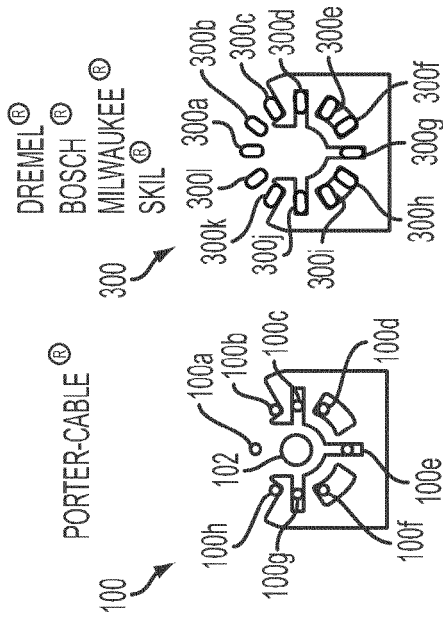


FIG. 3E

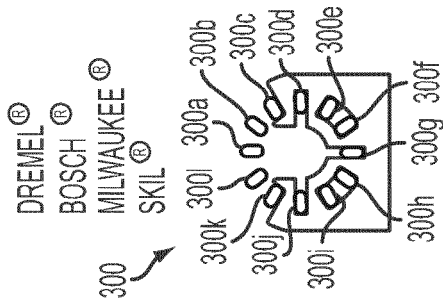


FIG. 3F

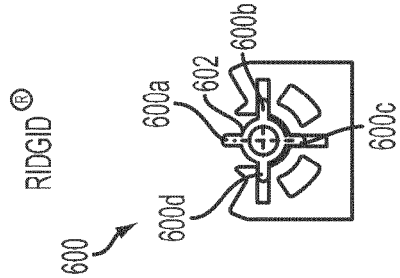


FIG. 3G

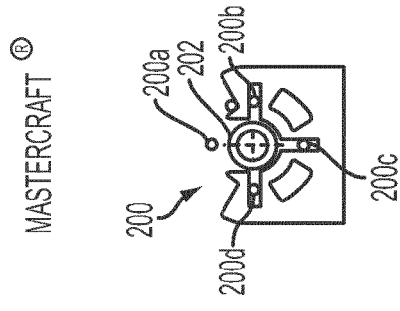


FIG. 3H

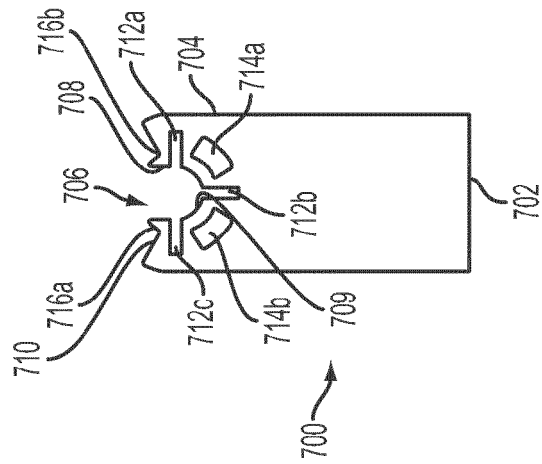
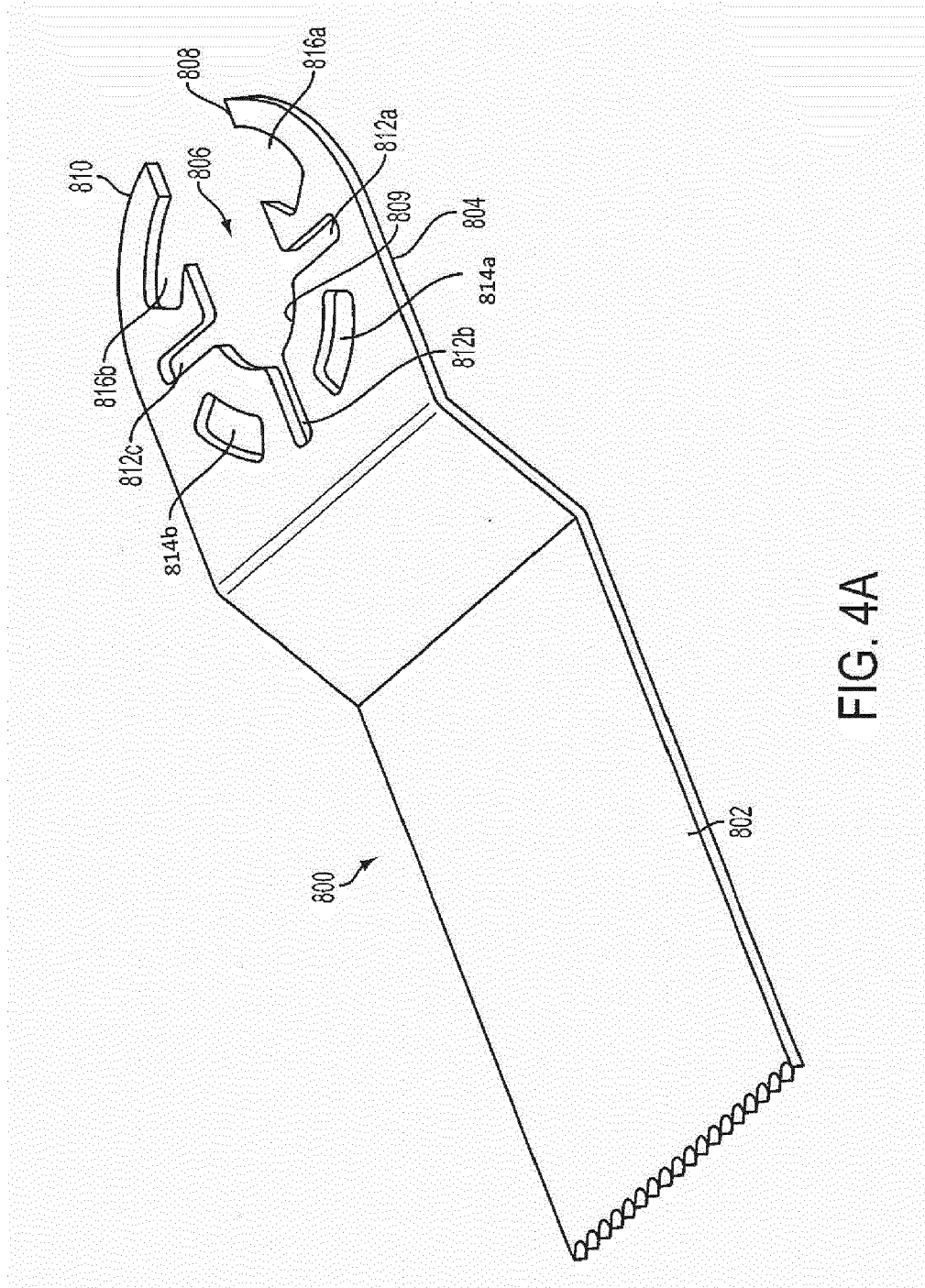


FIG. 3B



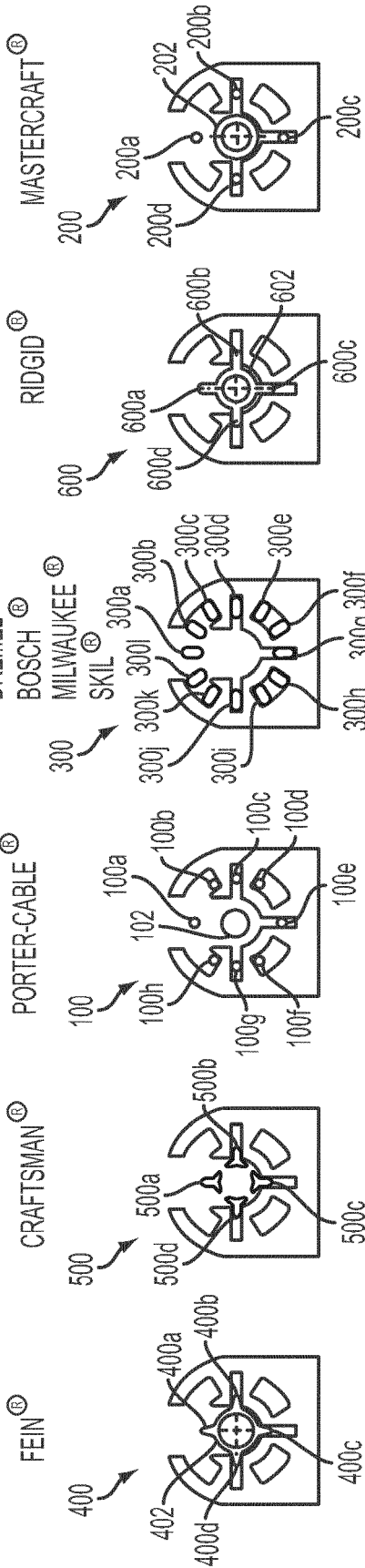


FIG. 4C

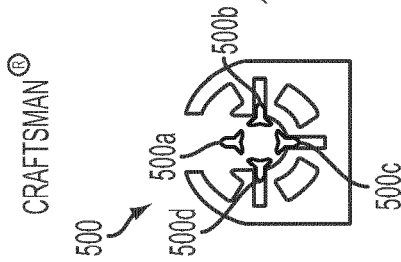


FIG. 4D

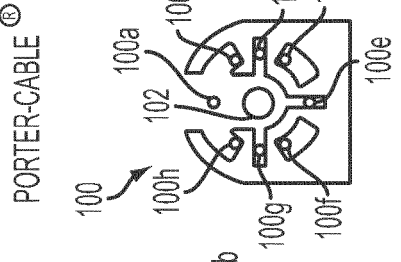


FIG. 4E

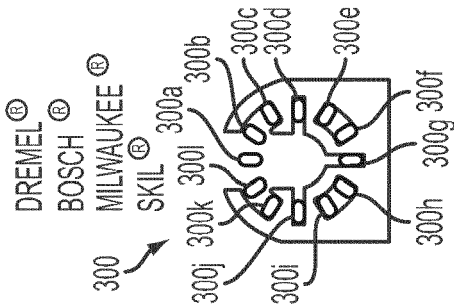


FIG. 4F

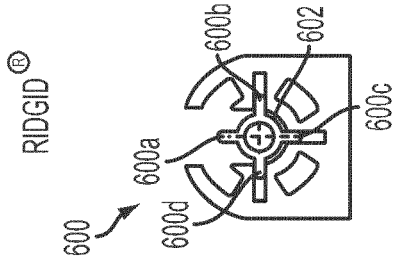


FIG. 4G

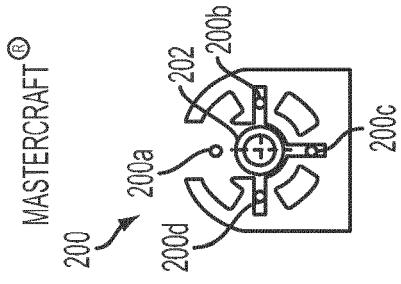


FIG. 4H

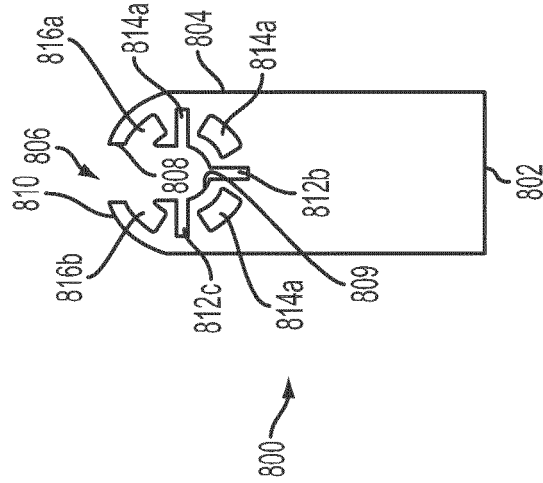


FIG. 4B

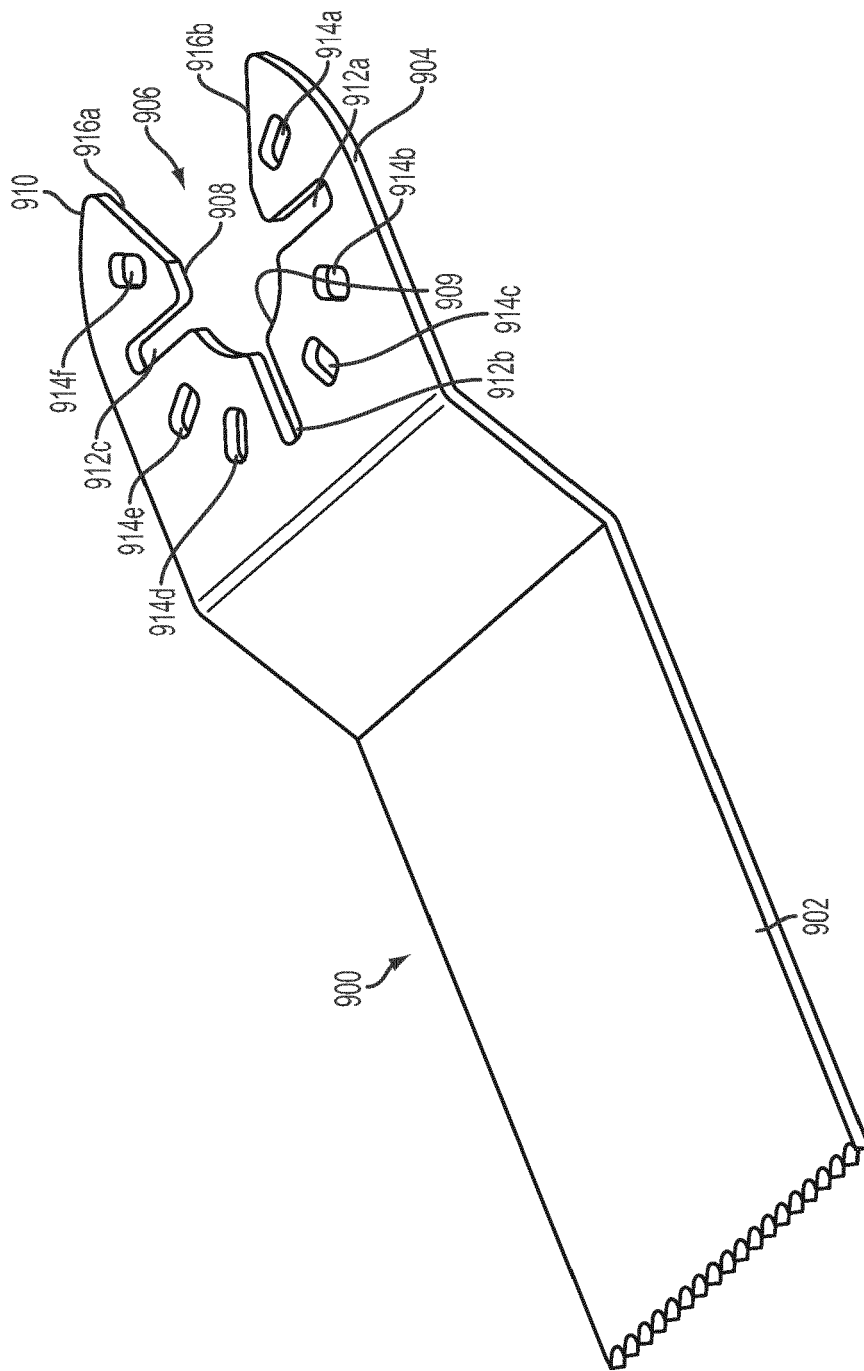
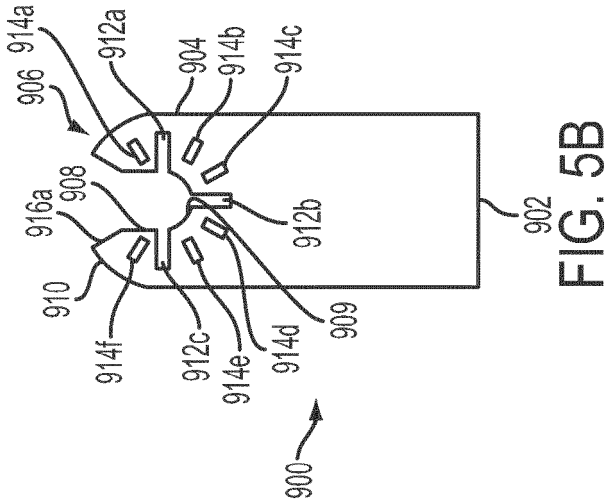
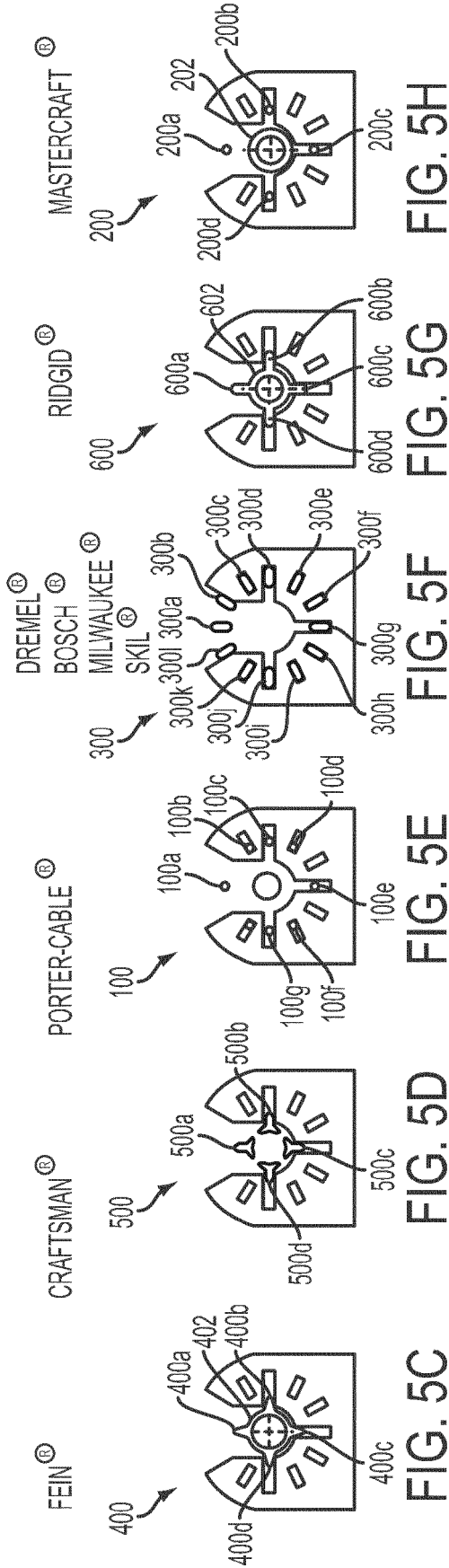


FIG. 5A



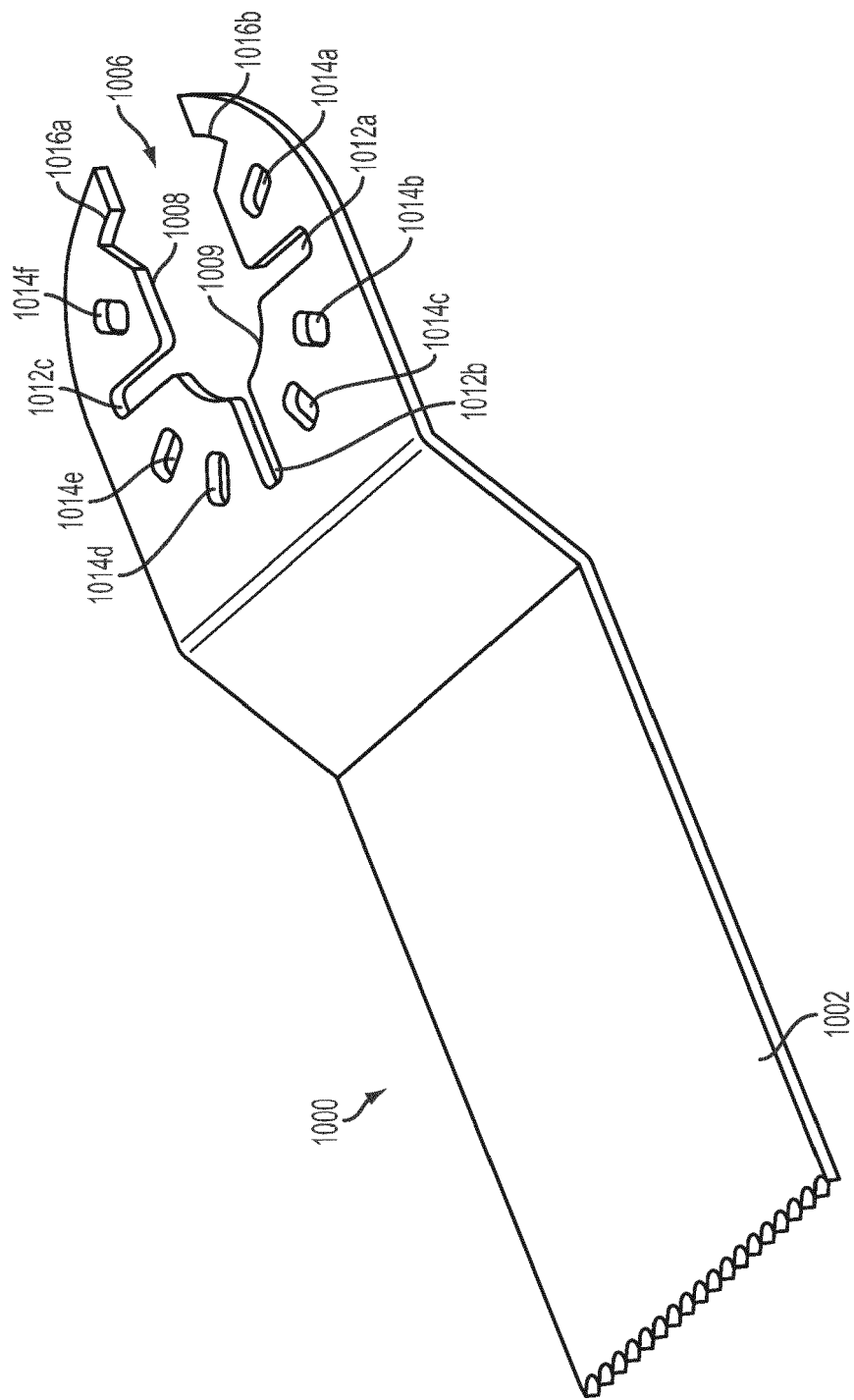


FIG. 6A

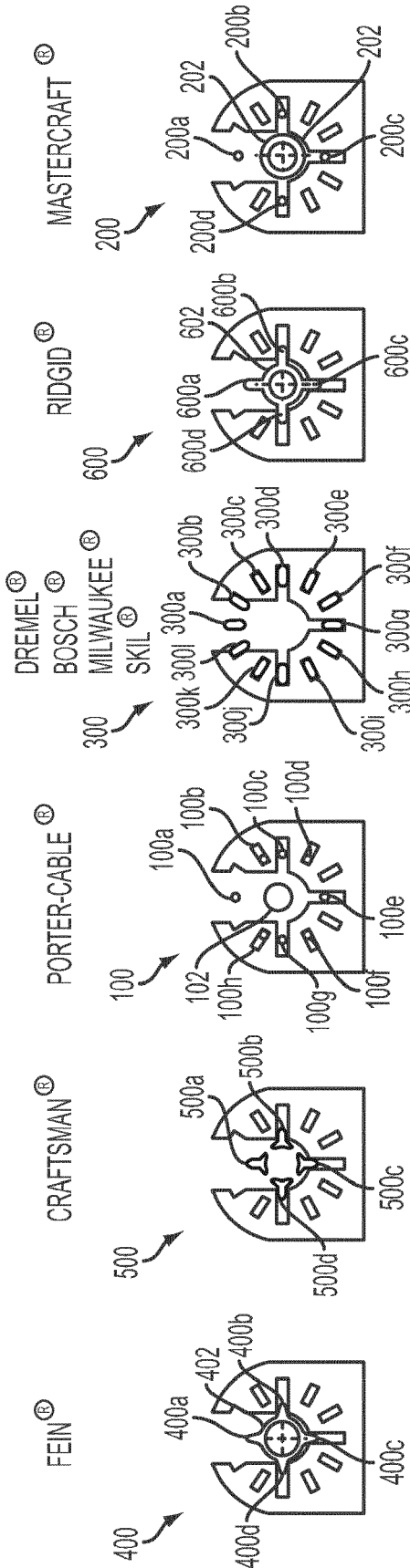


FIG. 6C

FIG. 6D

FIG. 6E

FIG. 6F

FIG. 6G

FIG. 6H

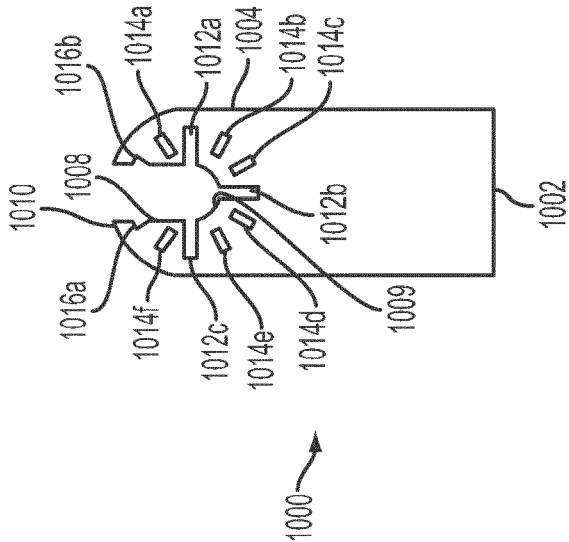


FIG. 6B

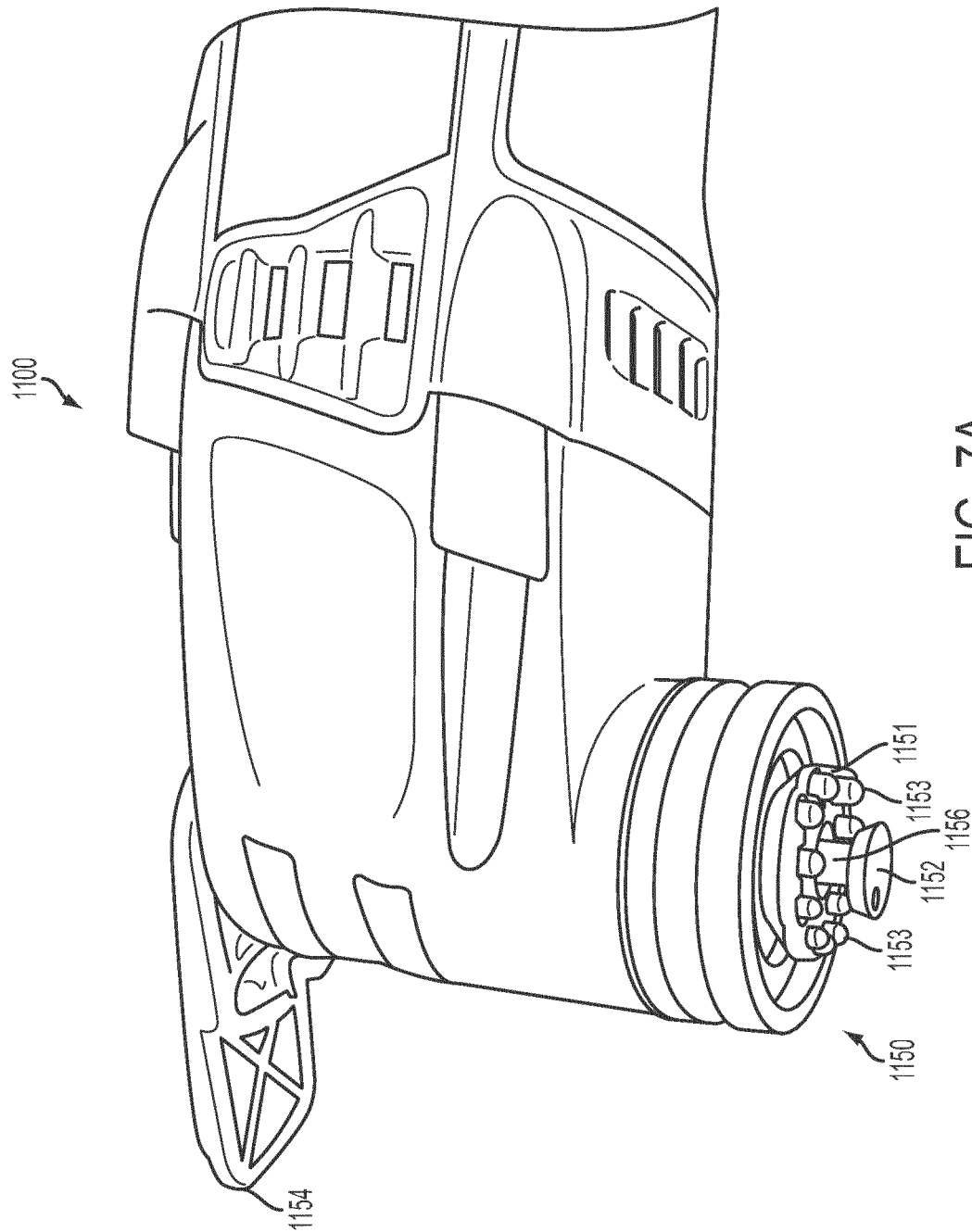


FIG. 7A

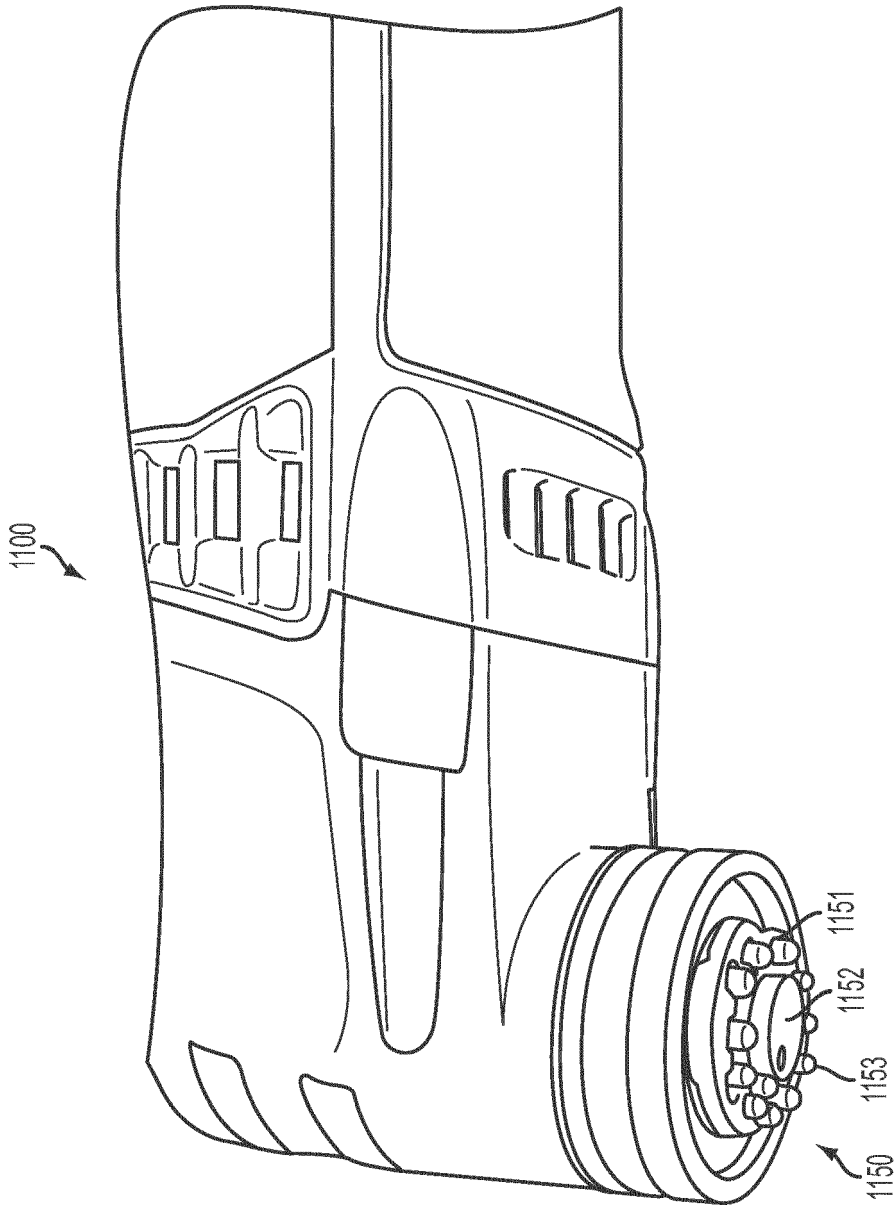


FIG. 7B

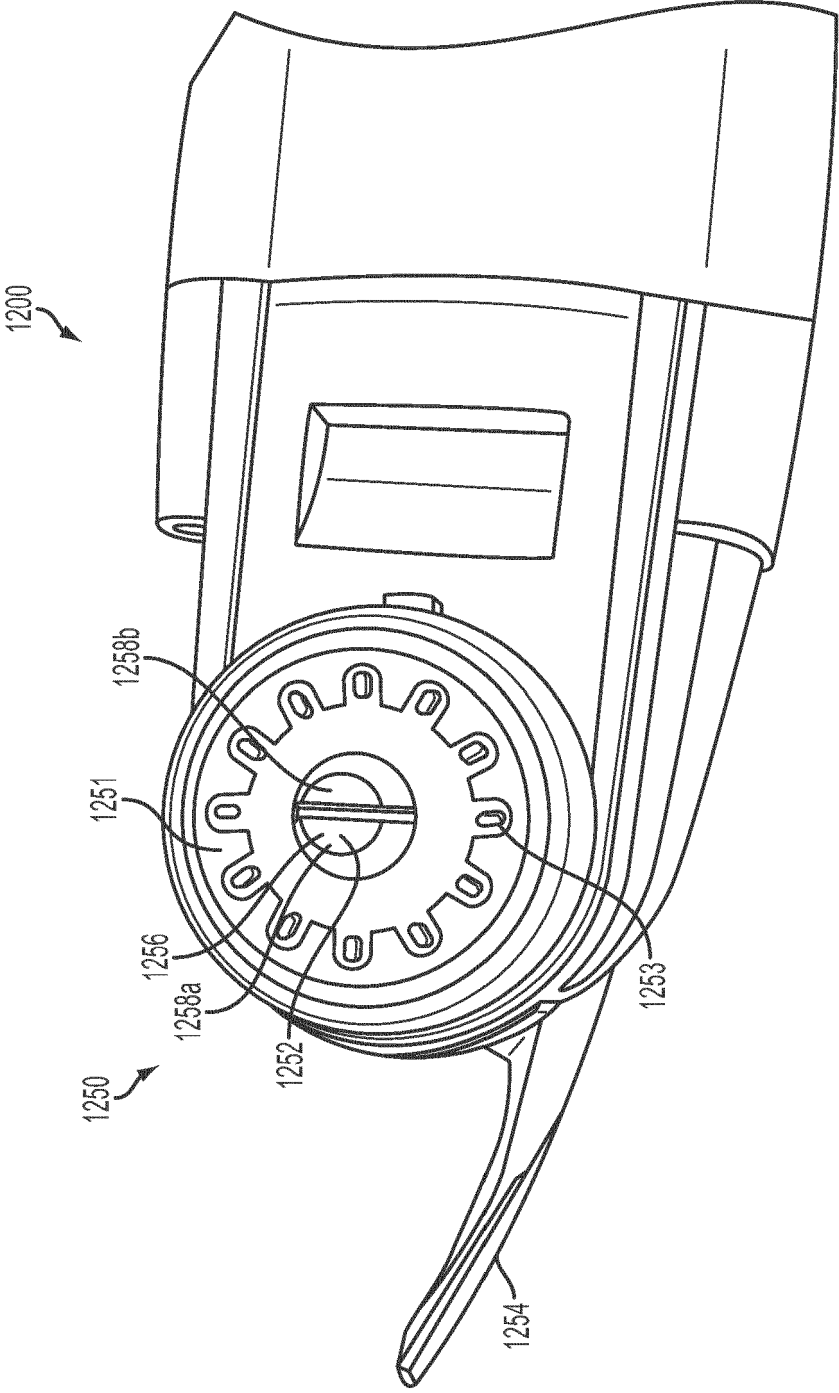


FIG. 8A

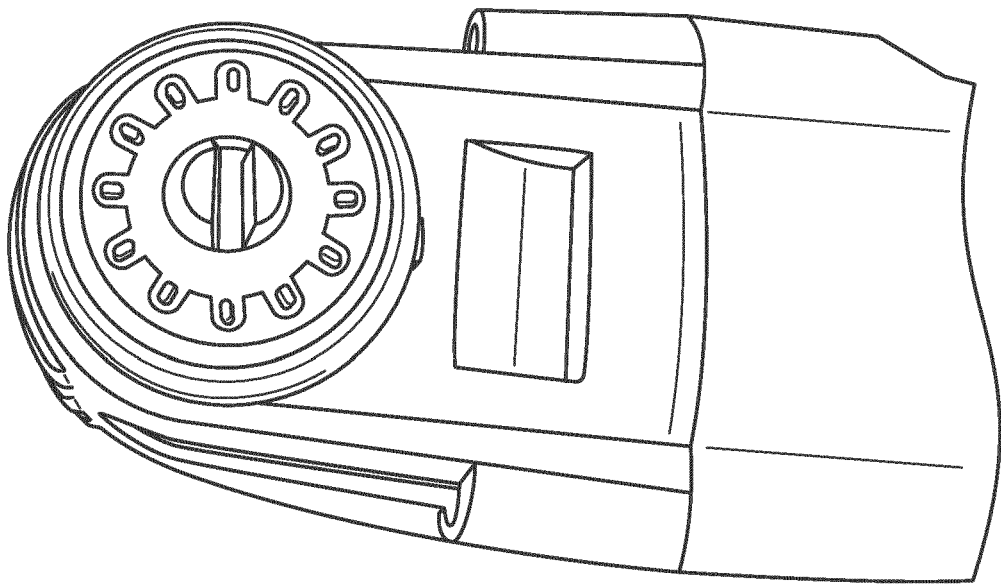


FIG. 8B

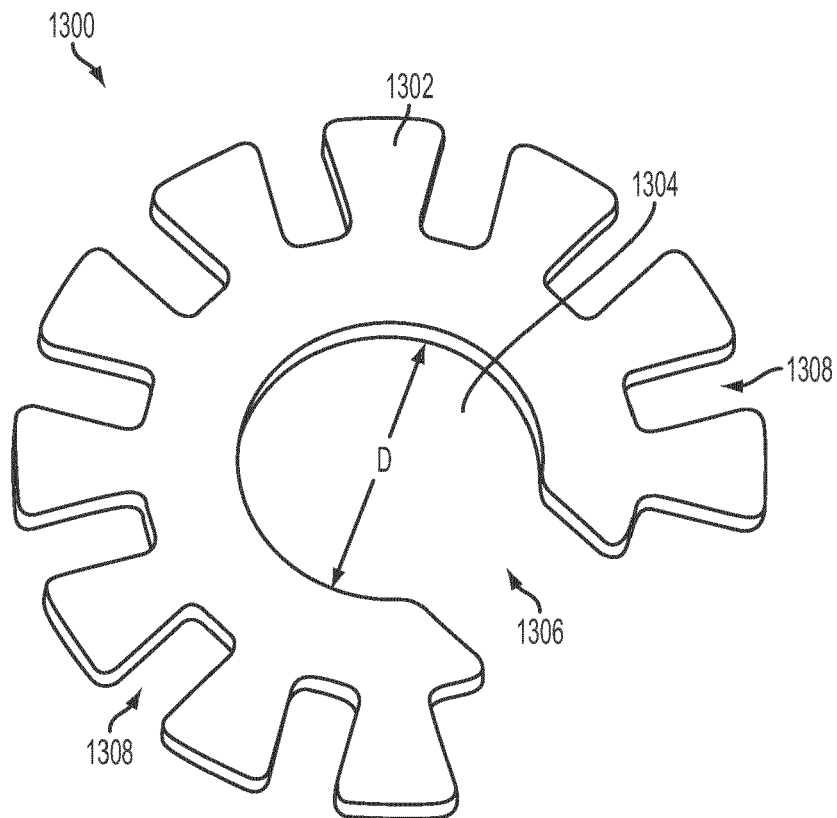


FIG. 9A

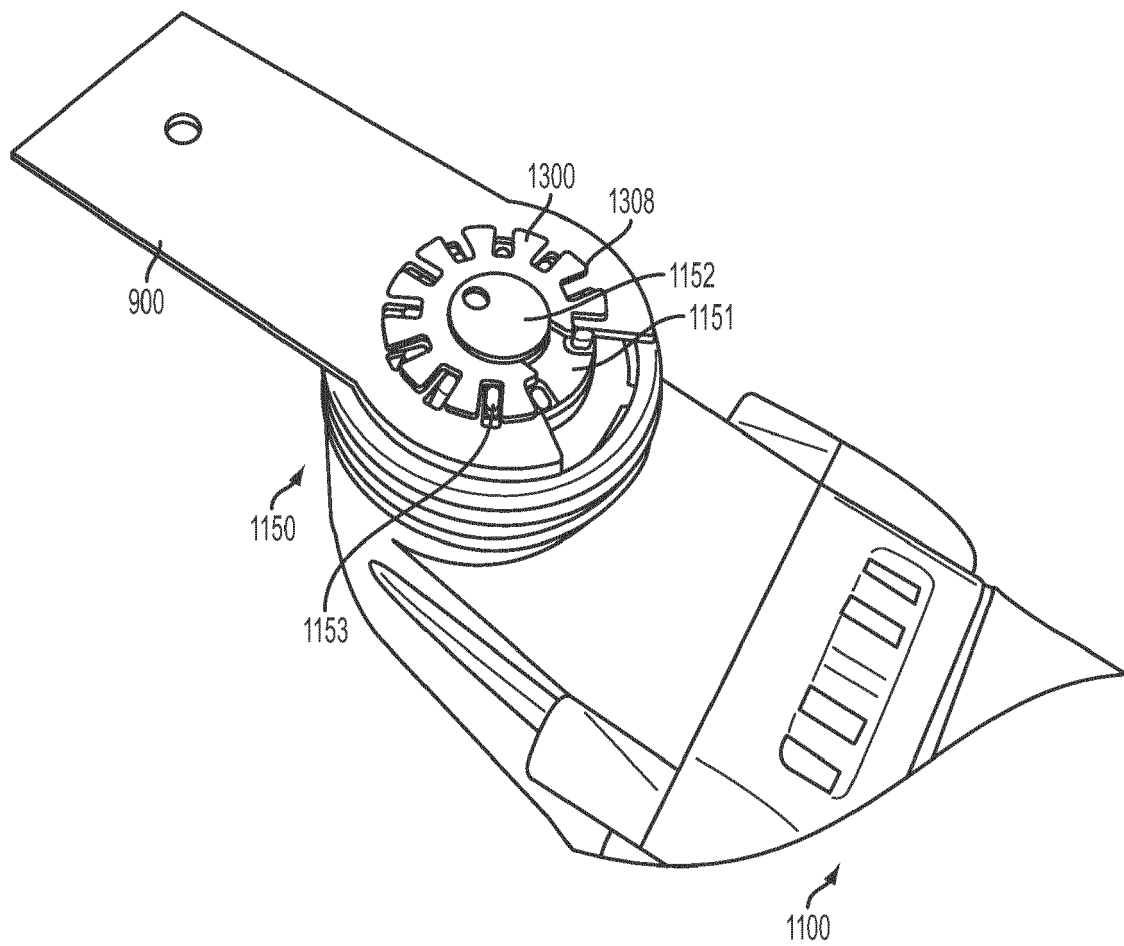


FIG. 9B

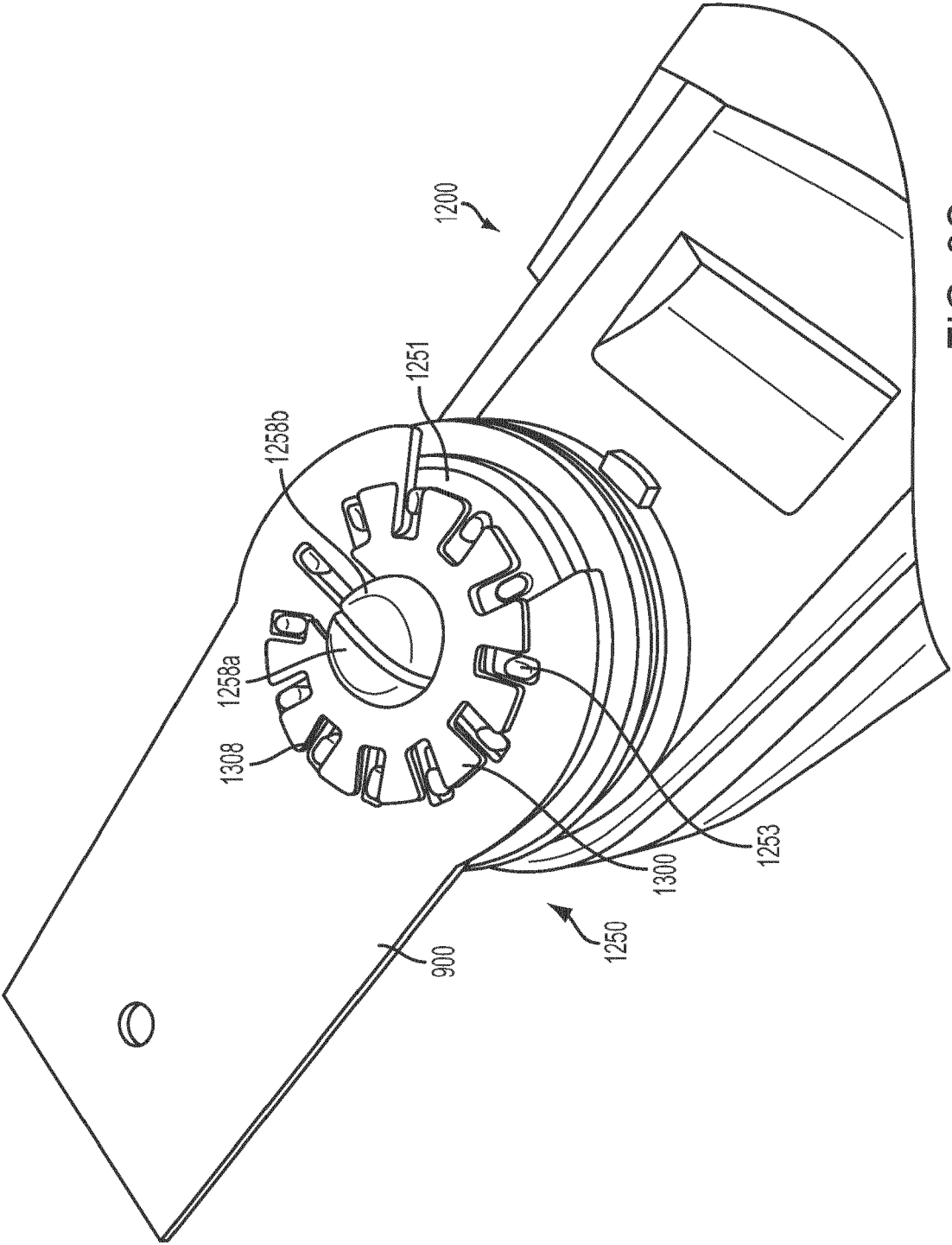


FIG. 9C



EUROPEAN SEARCH REPORT

Application Number
EP 18 18 1208

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 102 31 393 A1 (AESCULAP AG & CO KG [DE]) 29 January 2004 (2004-01-29)	1-8	INV.
A	* paragraph [0043] - paragraph [0071]; figures 1-5 *	9	B25F3/00 B25F5/00
Y	US 2012/169018 A1 (LU TAO [CN] ET AL) 5 July 2012 (2012-07-05)	1-8	
A	* paragraph [0027] - paragraph [0035]; figures 1-10 *	9	
A	US 2011/309589 A1 (MARAS VERICA [US]) 22 December 2011 (2011-12-22)	1	
A	* the whole document *		
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B25F
Place of search		Date of completion of the search	Examiner
The Hague		9 October 2018	Dewaele, Karl
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 18 18 1208

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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