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(54) Open end wrench capable of fast driving a workpiece

(57) An open end wrench (10) includes first and second jaws (23, 24). The first jaw (23) includes an arcuate sliding groove (27) having two support wall faces (272, 273) and an arcuate sliding wall face (271) between the support wall faces (272, 273). A slide (30) is slideably received in the sliding groove (27) and includes an arcuate sliding face (31) slideable along the sliding wall face (271). Two wings (37) respectively extend from top and bottom faces (301, 302) of the slide (30). Top and bottom extension faces (36) extend from a wrenching face (32) of the slide (30) and are located on inner faces (371) of the wings (37). A spacing (L) is formed between an outer face (372) of each wing (37) and one of the support wall faces (272, 273) to avoid friction, allowing smooth movement of the slide (30) between an driving position and a non-driving position.

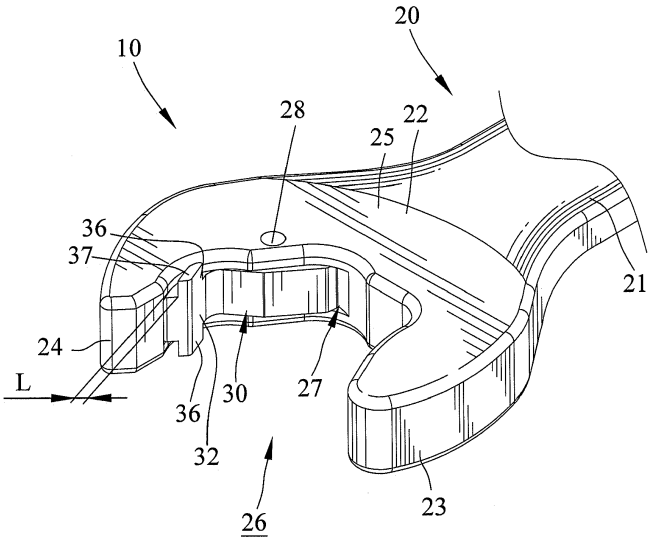


FIG.2

EP 2 457 691 A1

Description

[0001] The present invention relates to an open end wrench capable of fast driving a workpiece that has a hexagonal driving cross-section, and, more particularly, to an open end wrench capable of fast driving a workpiece without the risk of undesired shifting from the workpiece.

[0002] U.S. 1,320,668 discloses a wrench including a stationary jaw and a movable jaw slideable along a guide surface. The movable jaw is forced against an abutment at an outer end of the guide surface by a spring bearing against the stationary jaw. An end of the spring is received in a bore in the stationary jaw. The other end of the spring is received in another bore in the movable jaw. An intermediate portion of the spring is exposed between the stationary jaw and the movable jaw. When the user is intended to tighten or loosen a nut, the wrench is turned in a driving rotation direction during which operation the movable jaw remains in contact with the abutment. For reengagement of the wrench with the nut it is necessary only to turn the wrench in the opposite direction, during which operation the movable jaw slides backward by the pressure from the edges of the nut against the force of the spring. The movable jaw is forced forward again as soon as the bearing surfaces of the stationary and movable jaws are again parallel with two opposite sides of the nut. The nut can be tightened or loosened through repeated operations. However, the structural strength of the wrench is insufficient for high-torque operation, as the movable jaw merely encloses the guide surface and is not enclosed by other members. Furthermore, the guide surface is irregularly formed in a wrenching space of the wrench, leading to difficulties in processing. Further, the exposed portion of the spring, when compressed by the movable jaw, is liable to bend and, thus, be in frictional contact with the end edges of the bores of the stationary and movable jaws, leading to non-smooth compression of the spring or even permanent deformation of the spring. Further, the exposed portion of the spring is apt to be contaminated by oil to which debris easily adheres.

[0003] U.S. Patent No. 3,695,125 discloses an open end ratchet wrench including a head having a fixed jaw and an opposed pawl support portion. A pawl and a spring are mounted to an inner side of the pawl support portion. The pawl is biased by the spring and slideable between an extended torquing position and a retracted ratcheting position. Two side caps are fixed to two sides of the head to define a space receiving the pawl and the spring and to prevent disengagement of the pawl and the spring. The pawl includes a stop shoulder to prevent the pawl from moving out of the pawl support portion under the action of the spring. The pawl support portion includes an arcuate section and then extends perpendicularly to the fixed jaw. Such a structure is difficult to process. Furthermore, assembly of the open end ratchet wrench is troublesome. Further, the pawl is merely enclosed at both sides and has insufficient structural strength in the lateral direction. Further, a contact area of the workpiece (such as a nut) engaged with the movable pawl is smaller than a contact area of the workpiece engaged with the fixed jaw. When the nut is tightened to a position adjacent to an object to be fixed, wear or damage to the nut may occur if the nut has insufficient contact area or has a small volume.

[0004] U.S. Patent No. 4,706,528 discloses an adjustable wrench including a fixed jaw and an adjustable jaw. In an embodiment, a sliding jaw portion is provided on the fixed jaw. The sliding jaw includes a rectilinearly extending slot through which a pin is extended, preventing disengagement of the sliding jaw. A plate spring is mounted to an inner face of the fixed jaw to bias the sliding jaw outward. A hole is formed in an end wall of the slot and receives a coil spring to bias the sliding jaw inward. Thus, the sliding jaw is movable inward or outward and can be retained in place under action of the plate spring and the coil spring. Such a wrench is particularly suitable for rotation pipes, but not suitable for tightening or loosening fasteners such as bolts, nuts, or the like. This is because the sliding jaw can only slide rectilinearly, and the shape of the slot will cause the sliding jaw to slide along the slot to a position pressing against the periphery of the pipe.

[0005] U.S. Patent No. 7,024,971 discloses an open end ratchet wrench including first and second stationary jaws. The first stationary jaw supports a movable plate. A space is sandwiched between two face plates of the first stationary jaw to accommodate the movable plate. The movable plate includes two angled slots each receiving a pin extending through the space, avoiding disengagement of the movable plate. The wrench further includes a hole receiving a spring that has an end located outside of the hole for biasing the movable plate. Each angled slot of the movable plate includes a short section and a long section at an angle to the short section such that the movable plate can move in two stages each having a rectilinear travel. However, the stationary jaw is enclosed by the movable plate such that the contact area between the stationary jaw and the workpiece is significantly decreased. Instead, the supporting effect depends on the larger contact area between the workpiece and the movable plate with structural strength weaker than that of the fixed jaw. The holding force applied by the open end ratchet wrench is reduced.

[0006] U.S. Patent Publication No. US 2009/0301271 Al discloses an open-ended wrench including a first jaw and a second jaw. The second jaw includes an auxiliary jaw retracting opening that receives an auxiliary jaw. A spring is mounted between an end of the auxiliary jaw and an end wall of the auxiliary jaw retracting opening. The auxiliary jaw includes a limiting slot. An auxiliary jaw limiting member extends from a surface of the second jaw through an opening to the auxiliary jaw retracting opening and is coupled with the limiting slot for confining the auxiliary jaw to move between a first position in which the auxiliary jaw is non-longitudinally biased and a second position in which the auxiliary jaw is longitudinally

biased. The auxiliary jaw has an arcuate pushing surface and a driving surface. In use, the wrench can drive a nut in a driving rotation direction to a position and then directly move in a reverse direction about the center of the nut. The auxiliary jaw is compressed by a side of the nut and retracts into the auxiliary retracting opening. Thus, the wrench can be directly rotated in the reverse direction through an angle to a next driving position for driving the nut in the driving rotation direction without the need of disengaging from the nut and reengaging with the nut. However, it is difficult to form the auxiliary jaw retracting opening in the second jaw, which is particularly true for axial drilling. Furthermore, the pushing face and the driving surface of the auxiliary jaw must retract into the auxiliary retracting opening so that the wrench can move in the reverse direction to the next driving position. Thus, the widths of the pushing face and the driving surface must be smaller than the size of the auxiliary jaw retracting opening. However, if the nut is of a smaller thickness or if the nut is moved to a position adjacent to a surface of an object to be tightened such that the width of the side of the nut is smaller than the extent of the pushing face and the driving surface, the pushing face and the driving surface may be worn or damaged due to insufficient contact area with the side of the nut.

[0007] FIG. 1 shows a reciprocable open end wrench 50 including a jaw portion 51 having first and second jaws and defining a wrenching space 52. The second jaw includes a groove having a concave arcuate surface. A swing member 53 is received in the groove. A surface of the swing member 53 faces the second jaw and the swing member 53 has an arcuate slot for receiving a spring 54. The concave arcuate surface has a curvature corresponding to that of an arcuate face 532 of the swing member 53. The swing member 53 has a clamping face 531 for contacting with a side of a workpiece 90. The clamping face 531 is planar so as to be in surface contact with the side of the workpiece 90 for driving the workpiece 90. An example of such a wrench is disclosed in U.S. Patent Publication No. US 2010/0071516 A1. The diameter D53 of the curvature of the arcuate face 532 does not correspond to the wrenching width S between two parallel sides of the workpiece 90. After the wrench 50 has driven the workpiece 90 to rotate in a driving rotation direction, the rotation arc of the diameter D53 can not allow the wrench 50 to rotate in a reverse direction to the next driving position. Specifically, the wrench 50 has to be moved backwards relative to the nut through a certain travel so that the swing member 53 can slide along the side of the workpiece 90 and be rotated to the next driving position. If the wrench 50 is directly rotated about the center of the workpiece 90 without the backward travel, the clamping face 531 will be interfered by a side of the workpiece 90. The driving operation provided by the wrench is not smooth.

[0008] Thus, a need exists for an open end wrench capable of fast driving of a workpiece without the disadvantages of the above conventional open end wrenches.

[0009] The present invention solves this need and other problems in the field of reliable structural strength of fast drivable open end wrenches by providing, in a first aspect, an open end wrench capable of fast driving a workpiece in a driving rotation direction of the wrench. The workpiece includes a hexagonal driving cross-section to which the design of the jaw portion of the wrench is adapted and which, accordingly, is used herein for the design of the jaw portion and the arrangement of the engaging faces of the jaw portion as a projected reference cross-section. The hexagonal driving cross-section includes in its turn first, second, third, fourth, fifth, and sixth sides and, respectively, first, second, third, fourth, fifth, and sixth face portions that are force-receiving face portions of the sides when the workpiece is driven by the wrench in a first rotation direction, and respectively having first, second, third, fourth, fifth, and sixth face portions that are force-receiving face portion when the workpiece is driven by the wrench in a second rotation direction. The open end wrench includes a body having a handle and a jaw portion formed on an end of the handle. The spaced first and second jaws are formed on an end of the jaw portion opposite to the handle to define a wrenching space therebetween. The jaw portion further includes — preferably at least to the greater part along a length of the second jaw portion -an arcuate sliding groove facing the wrenching space. The sliding groove is defined by spaced first and second support wall faces and by an arcuate sliding wall face extending between the first and second support wall faces in a width direction of the groove and extending between two opposite circumferential ends of the arcuate sliding wall face in a circumferential length direction of the groove, wherein it is preferred if the sliding groove is open to the wrenching space along the whole circumferential length of the sliding wall face thereof. Preferably, the concave arcuate sliding wall face extends in said length direction along an arc of a circle. A guide element is fixed in the space of the sliding groove to cross the same. A slide is slideably received in the sliding groove. The slide includes a first side having a convex arcuate sliding face slideable along said length direction of the arcuate sliding wall face of the sliding groove at least between a driving position and a non-driving position. Preferably, the arcuate sliding face extends along an arc of a circle and the radius of the circle is preferably the same as that of a circular curvature of the arcuate sliding wall face of the sliding groove. The slide further includes a second side facing the wrenching space opposite to the first side of the slide. The second side of the slide includes a first wrenching face located outside of the sliding groove in the wrenching space. The first wrenching face is preferably designed to extend along and correspond to said fourth force-receiving face portion of the hexagonal cross-section of the workpiece in said first rotation direction of the workpiece when the slide is in a driving position and a force-applying face of the first jaw corresponds to said first force-receiving face portion in said first rotation direction. The slide further

includes a top face and a bottom face. The slide further includes an arcuate guiding slot extending along a length portion of the slide through the cross-section thereof from the top face through the bottom face. Preferably, the arcuate guiding slot extends concentrically to the arcuate sliding face of the slide. The guide element is received in the guiding slot to prevent the slide from disengaging from the sliding groove. The guiding slot includes two ends, one of which ends is preferably a pressing end. An elastic device has two ends respectively abutting the guide element and the slide, preferably the guide element and the pressing end of the guiding slot, for biasing the slide to the driving position. The first wrenching face of the slide includes faces of first and second wings facing the wrenching space and extending transverse to and beyond the top and bottom faces of the slide. The first and second jaws and the first wrenching face inclusive of the faces of the first and second wings of the slide preferably define together — in the driving position of the slide - a center corresponding to a center of a circle circumscribing the hexagonal reference cross-section of the workpiece and located on an axis of the reference cross-section of the workpiece, allowing the first and second jaws and the first wrenching face and the first and second wings of the slide to rotate about the workpiece in the driving rotation direction of the wrench, and allowing the first wrenching face and the faces of the first and second wings during sliding movement of the slide to slide along a circumference of a circumscribed circle of the hexagonal cross-section of the workpiece without interference in the non-driving rotation direction of the wrench. The first and second wings respectively each extend transverse to the first and second support wall faces to overlap with respective faces of the second jaw portion facing the wrenching space and increase a contact area between the first wrenching face of the workpiece in the driving rotation direction of the workpiece.

[0010] A spacing is formed between the rear side of each of the first and second wings and the wrenching space defining faces of the second jaw portion including the sliding groove and, therefore, the free ends of the first and second support walls preferably in all sliding positions of the slide. The spacings avoid operational interference to sliding movement of the slide in the sliding groove while the first and second jaws and the first wrenching face and the first and second wings of the slide rotate about the workpiece in the non-driving rotation direction.

[0011] Preferably, the jaw portion and the slide are adapted to the projected driving cross-section of the workpiece in such a manner that the jaw portion and the slide are designed to be engaged — in the driving position of the slide — with that portions of the sides of the hexagonal driving cross-section, i.e. with that force-receiving faces of the hexagonal cross-section of the workpiece that are leading portions with respect to the transverse center line of the respective side of the hexagon in the driving rotation direction of the wrench, and are further preferably not engaged in the driving position of the slide with the respective trailing portions of the sides of the hexagon.

[0012] In a preferred embodiment of the present invention, the slide includes the wrenching face, that is increased by the faces of the wrenching space and follows the first wrenching face in the non-driving rotation direction of the wrench and encloses an angle of 120 degrees with the first wrenching face.

[0013] The present invention will be further described in light of the following detailed description of illustrative embodiments of this invention described in connection with the drawings.

[0014] The illustrative embodiments may best be described by reference to the accompanying drawings where:

FIG. 1 shows a partial, top view of a conventional open end wrench.

FIG. 2 shows a partial, perspective view of an open end wrench according to the preferred teachings of the present invention.

FIG. 3 shows a partial, exploded, perspective view of the open end wrench of FIG. 2.

FIG. 4 shows a perspective view illustrating use of the open end wrench of FIG. 2 on a workpiece.

FIG. 5 shows a cross sectional view of the open end wrench and the workpiece of FIG. 4.

FIG. 6 shows a cross sectional view of the open end wrench and the workpiece of FIG. 4 according to section line 6-6 of FIG. 4.

FIG. 7 shows a partial, top view of the open end wrench of FIG. 2, with a slide in a rest position.

FIG. 8 shows a view similar to FIG. 7, illustrating use of the open end wrench of FIG. 7 on a workpiece.

FIG. 9 shows a view similar to FIG. 8, illustrating rotation of the open end wrench of FIG. 8 in a non-driving rotation direction of the wrench reverse to a driving rotation direction, this is, during a rotation without driving the workpiece.

FIG. 10 shows a view similar to FIG. 9, illustrating further rotation of the open end wrench of FIG. 9 in the non-driving rotation direction.

FIG. 11 shows a view similar to FIG. 10, illustrating further rotation of the open end wrench of FIG. 10 in the non-driving rotation direction.

FIG. 12 shows a view similar to FIG. 11, illustrating further rotation of the open end wrench of FIG. 11 in the non-driving rotation direction.

[0015] All figures are drawn for ease of explanation of the basic teachings of the present invention only; the extensions of the figures with respect to number, position, relationship, and dimensions of the parts to form the preferred embodiments will be explained or will be within the skill of the art after the following teachings of the present invention have been read and understood. Further, the exact dimensions and dimensional proportions to con-

form to specific force, weight, strength, and similar requirements will likewise be within the skill of the art after the following teachings of the present invention have been read and understood.

[0016] Where used in the various figures of the drawings, the same numerals designate the same or similar parts. Furthermore, when the terms "first", "second", "third", "fourth", "fifth", "sixth", "lower", "upper", "inner", "outer", "side", "end", "portion", "section", "spacing", "clockwise", "counterclockwise", "width", "height", and similar terms are used herein, it should be understood that these terms have reference only to the structure shown in the drawings as it would appear to a person viewing the drawings and are utilized only to facilitate describing the invention.

[0017] FIGS. 2-12 show an open end wrench 10 according to the present invention. In the form shown, open end wrench 10 includes a body 20, a slide 30, and an elastic device 40. Body 20 includes a handle 21 and a jaw portion 22 formed on an end of handle 21. Jaw portion 22 can hold a hexagonal cross-section of a workpiece 90, such as a hexagonal head of a bolt, a nut, or the like. Workpiece 90 includes an outer periphery having first, second, third, fourth, fifth, and sixth sides 91, 92, 93, 94, 95 and 96, respectively having first, second, third, fourth, fifth, and sixth force-receiving faces 91 A, 92A, 93A, 94A, 95A and 96A in a first rotation direction of the workpiece that are leading portions of the sides in the first rotation direction. First, second, third, fourth, fifth, and sixth sides 91, 92, 93, 94, 95 and 96 of workpiece 90 respectively have first, second, third, fourth, fifth, and sixth force-receiving faces 91B, 92B, 93B, 94B, 95B and 96B in a second rotation direction of the workpiece that are leading portions of the sides in the second rotation direction. A user can grip the handle 21 and rotate body 20 together with jaw portion 22 about axis C of workpiece 90 to tighten or loosen workpiece 90.

[0018] Spaced first and second jaws 23 and 24 are formed on an end of jaw portion 22 opposite to handle 21. First and second jaws 23 and 24 can withstand reactive force from workpiece 90. First and second jaws 23 and 24 face each other. Furthermore, first and second jaws 23 and 24 and jaw portion 22 are integrally formed as a single and inseparable component of the same material to provide jaw portion 22 with excellent structural strength and to increase the torque bearing capacity of jaw portion 22.

[0019] Jaw portion 22 further includes a throat 25 intermediate first and second jaws 23 and 24. Throat 25 and first and second jaws 23 and 24 together define a wrenching space 26 therebetween. Workpiece 90 can enter wrenching space 26 by moving jaw portion 22 in a direction perpendicular to axis C of workpiece 90 or by moving jaw portion 22 along axis C of workpiece 90.

[0020] First jaw 23 includes a force-applying face 231 on a free end portion thereof, force-applying face 231 facing wrenching space 26 and facing a free end portion of second jaw 24 (cf. FIG. 7). Force-applying face 231 corresponds to first force-receiving face 91 A in the first rotation direction of workpiece 90 if the force-receiving faces 91 A, 92A, 93A, 94A, 95A and 96A are increasingly numbered in a counter-clockwise direction as shown in FIG. 8. Force-receiving face 91A is a leading portion of the respective side of the hexagonal cross-section of workpiece 90 if workpiece 90 (and wrench) are rotated in the clockwise direction in FIG.8, that is the driving rotation direction in the example of FIG. 8. Force-applying face 231 is substantially plane and preferably inclined with respect to the longitudinal direction of handle 21 by an acute angle, preferably by 30 degrees as shown in FIG. 7, the angle opening in a direction away from handle 21.

[0021] Second jaw 24 includes first and second faces 241 and 242 that are substantially plane. First face 241 is located on the free end portion of second jaw 24 and faces wrenching space 26 at the opening thereof and the force-applying face 231 of first jaw 23. Force-applying face 231 of first jaw 23 is inclined with respect to first face 241 by an acute angle that opens in a direction away from handle 21 and that is 30 degrees in the embodiment shown in the drawings, first face 241 extends in parallel with the longitudinal direction of handle 21. Second face 242 faces wrenching space 26 and the free end portion of first jaw 23. First face 241 is at an opening angle of 150 degrees to second face 242.

[0022] Further, as shown in the drawings, e.g., in FIG. 9, the free end portion of second jaw 24 forms a free end face between first face 241 and a rounded outer contour of second jaw 24, wherein the free end face and first face 241 enclose an over-obtuse angle of about 230 degrees in the embodiment shown in the drawings. On the other hand, the free end portion of first jaw 23 is rounded between force-applying face 231 and the outer contour of first jaw 23 as shown again, e.g., in FIG. 9.

[0023] Throat 25 includes a substantially plane push face 251 facing wrenching space 26. Push face 251 is at an angle of 120 degrees to force-applying face 231 of first jaw 23 such that push face 251 is parallel to and spaced by a gap from second force-receiving face 92A in the first rotation direction when workpiece 90 is drivingly engaged in jaw portion 22 (FIGS. 8 and 12). Second face 242 is intermediate first face 241 and push face 251 and intermediate second face 242 and first force-applying face 231.

[0024] Jaw portion 22 further includes a first free-space portion 221 between force-applying face 231 of first jaw 23 and push face 251 of throat 25. First free-space portion 221 is defined along a part that is adjacent to force-applying face 231 by a convex curvature and along a part that is adjacent to push face 251 by a concave curvature and can receive first force-receiving face 91 B in the second rotation direction of workpiece 90 and the corner between force-receiving faces 91B and 92A, when the wrench is rotated in the non-driving direction as shown in FIG, 9. Jaw portion 22 further includes a second free-space portion 222 between push face 251 of throat 25

and second face 242 of second jaw 24. Second free-space portion 222 is concavely curved and can receive second force-receiving face 92B in the second rotation direction of workpiece 90, when the wrench is rotated in the non-driving direction as shown in FIG. 9. Furthermore, jaw portion 22 includes a third free-space portion 223 between first faces 241 and throat 25, specifically between first and second faces 241 and 242 of the second jaw 24. Third free-space portion 223 is defined by a concave curvature at least along a part thereof that is adjacent to first face 241, and is preferably defined by a concave curvature throughout the free- space portion 223 between first and second faces 241 and 242 as shown in a dotted line in FIG. 9, and can receive third force-receiving face 93B in the second rotation direction of workpiece 90. Each of the free-space portions 221, 222, and 223 are defined by recesses of that faces of jaw portion 22 that define the wrenching space 26.

[0025] A substantially sickle--shaped arcuate sliding groove 27 having substantially rectangular cross-sections that are closed along tree sides is formed in second jaw 24 to extend from first face 241 to about the longitudinal middle of free-space portion 222, and opens toward wrenching space 26. The outer end of sliding groove 27 is spaced from the free end of second jaw 24, and is spaced in the embodiment from the free end of second jaw 24 by first face 241 and the free end face of second jaw 24. Sliding groove 27 is defined on both sides thereof by spaced first and second support wall faces 272 and 273 and a concave, arcuate sliding wall face 271 on a bottom thereof, sliding wall face 271 extending transversely between first and second support wall faces 272 and 273. Sliding wall face 271 is free of holes, grooves, recesses, etc, providing a complete concave arcuate surface and enhancing the structural strength of second jaw 24. Furthermore, sliding wall face 271 has a curvature of a circle along the circumferential length direction thereof. Thus, jaw portion 22 can withstand high-torque operation. Furthermore, a center of the arcuate sliding wall face 271 is located in wrenching space 26 such that sliding wall face 271 can be easily and rapidly processed with a single circular cutter at low costs while assuring structural strength of jaw portion 22. First and second support wall faces 272 and 273 are parallel to each other and have a spacing T27 therebetween.

[0026] A circular through-hole 274 is extended through first and second support wall faces 272 and 273 and crosses sliding groove 27. Through-hole 274 is located adjacent to throat 25 and receives a cylindrical guide element 28 in the form of a pin. Two ends of guide element 28 are received in two ends of through-hole 274 in first and second support wall faces 272 and 273 to retain slide 30 in sliding groove 27. Guide element 28 has a diameter D28.

[0027] Slide 30 is slideably received in sliding groove 27 and can drive workpiece 90 to rotate in a driving rotation direction when the slide 30 is in a driving position, or can slide along a perimeter of workpiece 90 in an opposite non-driving rotation direction of the wrench opposite to the driving rotation direction without driving workpiece 90, when the slide 30 slides in sliding groove 27 or is in a non-driving position. Slide 30 is substantially arcuate in longitudinal cross section and includes a rear side having a convex, arcuate sliding face 31 slideably contacting sliding wall face 271 of sliding groove 27, allowing relative arcuate sliding movement between slide 30 and jaw portion 22. Sliding face 31 is free of holes, grooves, recesses, etc, providing a complete convex, arcuate surface and enhancing the structural strength of slide 30. Thus, slide 30 can withstand high-torque operation.

[0028] Sliding face 31 of slide 30 has a curvature the same as that of sliding wall face 271 of sliding groove 27 to allow smooth sliding of sliding face 31 on sliding wall face 271. Furthermore, when slide 30 is subjected to reactive force from workpiece 90, the reactive force from the workpiece 90 can be transmitted to sliding wall face 271 through a large area of sliding face 31 due to the same and concentric curvatures. Thus, the force imparted to slide 30 can be distributed, avoiding stress concentration and increasing the torque bearing capacity of slide 30 when workpiece 90 is driven by body 20.

[0029] The other side of slide 30 opposite to sliding face 31 is angled in a recessed manner by 120 degrees and located to project outside of sliding groove 27 in all sliding positions of slide 30 and to project transversely beyond each of the bottom faces of third free-space portion 223 and second face 242 of second jaw 24 and includes first and second wrenching faces 32 and 33. First and second wrenching faces 32 and 33 are adapted to drive workpiece 90 to rotate in the driving rotation direction. First wrenching face 32 is at an angle of 120 degrees to second wrench face 33 such that first and second wrenching faces 32 and 33 correspond respectively to fourth and third force-receiving faces 94A and 93A of workpiece 90 in the first rotation direction, when slide 30 is in a driving position as shown in FIG. 8. And First wrenching face 32 of slide 30 is parallel to force-applying face 231 of first jaw 23 when slide 30 is in the driving position shown in FIG. 8. A concavely curved free-space portion 34 is formed between first and second wrenching faces 32 and 33 and can receive third force-receiving face 93B in the non-driving rotation direction of the wrench corresponding to the second rotation direction of workpiece 90 as shown in FIGS. 9 and 10, after a small sliding movement of slide 30.

[0030] As shown in FIG. 7, sliding 30 further includes a blunt free end face on an outer free end portion of the slide 30 that projects beyond the outer end of sliding groove 27, the free end face facing away from handle 21 to enclose an outside angle of preferably 240 to 250 degrees with wrenching face 32. Further, said free end face preferably encloses an outside angle of about 150 degrees with first face 241 of second jaw 22 in the driving position of slide 30 as shown in FIG. 8. Thereby, a further free-space portion is formed by and between said free

end face of slide 30 and first face 241 to be adapted to receive fourth force-receiving face 94B in the non-driving rotation direction of the wrench as shown in FIGS. 9 and 10.

[0031] Slide 30 further includes a top face 301 and a bottom face 302 respectively at upper and lower sides thereof. First and second wrenching faces 32 and 33 extend transversely between top and bottom faces 301 and 302. Top and bottom faces 301 and 302 are parallel to each other and respectively in contact with first and second support wall faces 272 and 273 of sliding groove 27. Slide 30 has a height H30 between top and bottom faces 301 and 302 in a height direction. Ignoring the tolerance, height H30 of slide 30 is the same as spacing T27 of sliding groove 27. This allows top and bottom faces 301 and 302 of slide 30 to be symmetrically supported by first and second support wall faces 272 and 273 of sliding groove 27, avoiding wobbling of slide 30 while sliding in sliding groove 27 along an arcuate path and increasing operational stability of open end wrench 10.

[0032] Slide 30 further includes a guiding slot 35 extending from top face 301 through bottom face 302. Guiding slot 35 is arcuate in cross section and has a curvature concentric to the curvature of sliding wall face 271 of sliding groove 27. Since guiding slot 35 extends from top face 301 through bottom face 302, a height H35 of guiding slot 35 in the height direction of slide 30 is the same as height H30 of slide 30. Furthermore, guiding slot 35 has a width W35 (between inner and outer arcuate surfaces thereof) in a width direction perpendicular to the height direction of slide 30. Namely, width W35 is equal to a difference between a radius of the outer arcuate surface and a radius of the inner arcuate surface of guiding slot 35. Ignoring the tolerance, width W35 of guiding slot 35 is the same as diameter D28 of guide element 28. Height H35 of guiding slot 35 is larger than 1.5 times width W35 of guiding slot 35 (i.e., width W35 of guiding slot 35 is smaller than 0.66 times height H35 of guiding slot 35). In this embodiment, height H35 of guiding slot 35 is larger than two times width W35 of guiding slot 35 (i.e., width W35 of guiding slot 35 is smaller than 0.5 times height H35 of guiding slot 35).

[0033] Guiding slot 35 receives guide element 28 to prevent slide 30 from disengaging from sliding groove 27. Since the curvature of sliding face 31 of slide 30 is concentric to those of guiding slot 35 and sliding wall face 271 of sliding groove 27, smooth sliding movement between guiding slot 35 of slide 30 and guide element 28 in sliding groove 27 can be obtained while sliding face 31 of slide 30 is moving along sliding wall face 271 of sliding groove 27 along the arcuate path. Undesired interference between slide 30, guide element 28, and sliding wall face 271 is avoided. Since sliding wall face 271 of sliding groove 27 and sliding face 31 of slide 30 are circular arcs, sliding movement of slide 30 can also described to be a rotational movement.

[0034] Guiding slot 35 further includes an abutting end 351 and a pressing end 352. When slide 30 is in an initial rest position not in contact with workpiece 90 as shown in FIG. 7, abutting end 351 is in contact with guide element 28, and pressing end 352 is in contact with elastic device 40. Since all of the surfaces of guiding slot 35 are free of holes, grooves, recesses, etc, stress concentration is avoided, and the structural strength of slide 30 is assured. Thus, slide 30 can withstand high-torque operation. Furthermore, since sliding face 31 and all of the surfaces of guiding slot 35 of slide 30 are free of holes, grooves, recesses, etc, the manufacturing costs of slide 30 can be reduced while providing open end wrench 10 with high-torque capacity and allowing open end wrench 10 to be produced at low costs for wider industrial application.

[0035] Elastic device 40 has two ends respectively abutting guide element 28 and pressing end 352 of guiding slot 35 for returning slide 30 to its initial rest position. Elastic device 40 includes an elastic element. After mounting, the elastic element is completely received in guiding slot 35. The elastic element has a height H40 in the height direction of slide 30. Height H40 of the elastic element is not larger than height H35 of guiding slot 35 and larger than width W35 of guiding slot 35. Furthermore, height H40 of the elastic element is larger than 0.5 times height H35 of guiding slot 35. By providing such an elastic element, the elastic element will not move away from its initial rest position in guiding slot 35, reliably returning slide 30 to the driving position under the bias of the elastic element.

[0036] With reference to FIG. 3, the elastic element can be of different types and shapes. For example, the elastic element can be one of a resilient plate 41, a compression spring 42, a torsion spring 43, or a dual compression spring 44 having spaced upper and lower coil portions and a connecting portion between the upper and lower coil portions. The upper and lower coil portions are spaced in the height direction of slide 30. In another example, elastic device 40 can include a base 46 having two protrusions 461 spaced in the height direction of slide 30 and two compression springs 45 each having an end mounted to one of protrusions 461. The overall height of springs 45 are not larger than height H35 of guiding slot 35. Thus, springs 45 are spaced from each other in the height direction of slide 30 to prevent mutual interference during operation. In a further example, elastic device 40 includes a base 48 having two receptacles 481 spaced in the height direction of slide 30 and two compression springs 47 each having an end received in one of receptacles 481. The overall height of springs 47 are not larger than height H35 of guiding slot 35. Thus, springs 47 are spaced from each other in the height direction of slide 30 to prevent mutual interference during operation Height of the elastic member of elastic device 40 is preferably larger than 0.5 times height H35 of guiding slot 35 such that the elastic member will not rotate in guiding slot 35m assuring returning of slide 30 to the natural position. Detailed structure of these examples of elastic device 40 is disclosed in U.S. Patent Application No. 12/881.243 filed

September 14, 2010, the entire contents of which are incorporated herein by reference.

[0037] With reference to FIGS 5 to 8, an important feature of the present invention is that first wrenching face 32 includes top and bottom extension faces 36 respectively extending away from top and bottom faces 301 and 302. Top and bottom extension faces 36 are coplanar to first wrenching face 32. The front end of slide 30 includes two wings 37 respectively extending away from top and bottom faces 301 and 302 of slide 30 to project beyond said faces 301 and 302, respectively. Each wing 37 includes an inner face 371 and an outer face 372. Top extension face 36 is located on inner face 371 of one of wings 37, and bottom extension face 36 is located on inner face 371 of the other wing 37. When slide 30 is in the driving position, first wrenching face 32 corresponds to fourth force-receiving face 94A of workpiece 90 in the first rotation direction. Force-applying face 231 of first jaw 23 and first wrenching face 32 including the faces of top and bottom extension faces 36 and wrenching face 33 of slide 30 together define - when the slide 30 is in the driving position as shown in FIG. 8 - three sides 91, 93, and 94 of a reference hexagon that corresponds to the projected or reference hexagonal cross-section of workpiece 90, the reference hexagon - and thus a curvature of a circle circumscribing the reference hexagon- having a center located on axis C of workpiece 90. Thus, first and second jaws 23 and 24 and first wrenching face 32 including wings 37 and top and bottom faces 36 of slide 30 can slide along a circumference of a circumscribed circle of workpiece 90 having a diameter D without interference. After slide 30 is received in sliding groove 27, wings 37 and top and bottom faces 36 respectively extend beyond first and second support wall faces 272 and 273 to increase the contact area between slide 30 and fourth force-receiving face in the first rotation direction 94A of workpiece 90.

[0038] In the form shown, wing 37 on top face 301 of slide 30 is spaced from the tree faces of the wall of second jaw 24 , that has first support wall face 272, by a spacing L. Wing 37 on bottom face 302 of slide 30 is spaced from second support wall face 273 by a spacing L. Spacings L avoid operational interference to sliding movement of slide 30 in sliding groove 27 while first and second jaws 23 and 24 and first wrenching face 32 and wings 37 of slide 30 rotate about workpiece 90. Specifically, outer face 372 of each wing 37 does not contact with body 20, avoiding friction between wings 37 and body 20. Thus, sliding movement of slide 30 is smooth without the risk of getting stuck. More specifically, when open end wrench 10 drives workpiece 90 in a direction towards first jaw 23 (the clockwise direction in FIG. 8), outer faces 372 of wings 37 are spaced from first and second support wall faces 272 and 273, allowing smooth movement of slide 30 between the driving position and the non-driving position without the risk of getting stuck.

[0039] Furthermore, after workpiece 90 (such as the hexagonal head of a bolt) is screwed to a flat surface (FIG. 4), open end wrench 10 can be in contact with an overall height h2 of workpiece 90 by first wrenching face 32 and top and bottom extension faces 36, providing high-torque operation by increasing the contact area between workpiece 90 and slide 32 at first wrenching face 32 and top and bottom extension faces 36 through provision of wings 37 while avoiding slide 32 from getting stuck, as shown in FIG. 6. First wrenching face 32 of slide 30 contacts a portion h1 of height h2 of workpiece 90.

[0040] With reference to FIG. 8, when a user intends to rotate workpiece 90 in the driving rotation direction towards first jaw 23 (the clockwise direction in FIG. 8), workpiece 90 is firstly entered wrenching space 26 to a driving position with force-applying face 231 of first jaw 23 of jaw portion 22 abutting first force-receiving face 91 A of workpiece 90 in the first rotation direction, wherein workpiece 90 is engaged by jaw portion 22 and slide 30. Jaw portion 22 and slide 30 are preferably designed to engage only on three force-receiving sides 91, 93, and 94 of the hexagonal driving cross-section of workpiece 90, when the slide 30 is in the driving position, and only on those portions of the actual force-receiving sides 91, 93, and 94 that are leading portions 91A, 93A, and 94A of said force-receiving sides in the driving rotation direction of the wrench, without engaging on trailing portions 91B, 93B, and 94B of said force-receiving sides 91, 93, and 94 in the driving rotation direction of the wrench, and with first wrenching face 32 and top and bottom extension faces 36 of slide 30 abutting fourth force-receiving face 94A of workpiece 90 in the first rotation direction. Operation of driving workpiece 90 in the driving rotation is disclosed in U.S. Patent Application No. 12/881,243 filed September 14, 2010, the entire contents of which are incorporated herein by reference.

[0041] Since fourth force-receiving face 94A of workpiece 90 in the first rotation direction is parallel to first force-receiving face 91A in the first rotation direction, to make first wrenching face 32 and top and bottom extension faces 36 of slide 30 be in surface contact with fourth force-receiving face 94A in the first rotattion direction, elastic device 40 in slide 30 is compressed and deformed to move slide 30 along the arcuate path such that first wrenching face 32 and top and bottom extension faces 36 of slide 30 can automatically abut fourth force-receiving face 94A in the first rotation direction while first wrenching face 32 and top and bottom extension faces 36 of slide 30 are substantially parallel to force-applying face 231 of first jaw 23.

[0042] In this case, the user can drive handle 21 in the clockwise direction to rotate jaw portion 22 about axis C of workpiece 90. The force applied by the user is transmitted through force-applying face 231 of first jaw 23 to first force-receiving face 91A of workpiece 90 in the first rotation direction. At the same time, the force applied by the user is transmitted through first wrenching face 32 and top and bottom extension faces 36 of slide 30 to fourth force-receiving face 94A of workpiece 90 in the first rotation direction. Thus, workpiece 90 rotates togeth-

er with jaw portion 22.

[0043] Since first jaw 23 and jaw portion 22 are integrally formed as a single and inseparable component of the same material, force-applying face 231 of first jaw 23 can effectively withstand the reactive force from first force-receiving face 91A of workpiece 90 in the first rotation direction. Furthermore, since second jaw 24 and jaw portion 22 are integrally formed as a single and inseparable component of the same material and since sliding face 31 of slide 30 and sliding wall face 271 of sliding groove 27 are free of holes, grooves, recesses, etc and have the same curvature and are in surface contact with each other, sliding face 31 of slide 30 can contact with sliding wall face 271 by a large area, avoiding wobbling of slide 30 in sliding groove 27 while driving workpiece 90. Thus, open end wrench 10 according to the present invention can withstand high-torque operation.

[0044] In this embodiment, second wrenching face 33 of slide 30 abuts third force-receiving face in the first rotation direction 93A of workpiece 90. Since second jaw 24 and jaw portion 22 are integrally formed as a single and inseparable component of the same material and since sliding face 31 of slide 30 and sliding wall 271 of sliding groove 27 are free of holes, grooves, recesses, etc and have the same curvature and are in surface contact with each other, sliding face 31 of slide 30 can contact with sliding wall face 271 by a large area, avoiding wobbling of slide 30 in sliding groove 27 while driving workpiece 90. Thus, open end wrench 10 according to the present invention can withstand high-torque operation.

[0045] FIGS. 9-11 show rotation of open end wrench 10 according to the present invention in the reverse, non-driving rotation direction towards second jaw 24 without driving workpiece 90. Namely, open end wrench 10 is moved in the reverse direction back to a position ready for driving workpiece 90 without the need of disengaging workpiece 90 from wrenching space 26 of jaw portion 22 and subsequent reengaging workpiece 90 in wrenching space 26, allowing fast driving of workpiece 90.

[0046] When the user moves handle 21 in the counterclockwise direction, jaw portion 22 and handle 21 rotate freely relative to workpiece 90 such that first and second free-space portions 221 and 222 of jaw portion 22 and free-space portion 34 of slide 30 respectively approach first, second, and third force-receiving faces 91B, 92B, and 93B of workpiece 90 in the second rotation direction. Namely, first, second, and third force-receiving faces 91B, 92B, and 93B of workpiece 90 in the second rotation direction enter first and second free-space portions 221 and 222 and free-space portion 34.

[0047] Further rotation of jaw portion 22 in the counterclockwise direction causes free-space portion 34 of slide 30 to come into contact with third force-receiving face 93B of workpiece 90 in the second rotation direction. In this case, elastic device 40 is compressed and moves slide 30 in sliding groove 27 along the arcuate path. Since outer faces 372 of wings 37 are spaced from body 20, friction does not exist between wings 37 and body 20 while open end wrench 10 drives workpiece 90 to rotate. Thus, movement of slide 30 between the driving position and the non-driving position is smooth without the risk of getting stuck.

[0048] When slide 30 is pressed and moved along the arcuate path relative to jaw portion 22, jaw portion 22 can continue its rotation in the counterclockwise direction. Next, force-applying face 231 of first jaw 23 moves across first force-receiving face 91B of workpiece 90 in the second rotation direction and approaches second force-receiving face 92A of workpiece 90 in the first rotation direction. At the same time, first wrenching face 32 of slide 30 moves across fourth force-receiving face 94B of workpiece 90 in the second rotation direction and approaches fifth force-receiving face 95A of workpiece 90 in the first rotation direction. In this embodiment, second wrenching face 33 of slide 30 also moves across third force-receiving face 93B of workpiece 90 in the second rotation direction and approaches fourth force-receiving face 94A of workpiece 90 in the first rotation direction.

[0049] With reference to FIG. 12, when rotation of open end wrench 10 in the reverse direction is finished, slide 30 can be smoothly and rapidly moved to the driving position, because the two ends of elastic device 40 respectively presses against guide element 28 and pressing end 352 of guiding slot 35. When force-applying face 231 of first jaw 23 abuts second force-receiving face 92A of workpiece 90 in the first rotation direction, elastic device 40 returns slide 30 to the driving position and makes first wrenching face 32 of slide 30 abut fifth force-receiving face 95A of workpiece 90 in the first rotation direction. Furthermore, first wrenching face 32 of slide 30 automatically comes in surface contact with fifth force-receiving face 95A of workpiece 90 in the first rotation direction such that first wrenching face 32 of slide 30 is substantially parallel to force-applying face 231 of first jaw 23, reliably positioning jaw portion 22 in the new driving position ready for driving workpiece 90 in the clockwise direction without the need of disengaging workpiece 90 from wrenching space 26 of jaw portion 22 and subsequent reengaging workpiece 90 in wrenching space 26, allowing fast driving of workpiece 90.

[0050] Thus, open end wrench 10 is moved to the next driving position and is in a state similar to that shown in FIG. 8. The user can again rotate handle 21 in the clockwise direction to make jaw portion 22 rotate about axis C of workpiece 90 and, thus, drive workpiece 90 in the clockwise direction.

[0051] Spacings L between wings 37 and the faces of the support walls that are forming first and second support wall faces 272 and 273 vary during rotation of open end wrench 10 in the non-driving rotation direction (see spacings L1, L2, and L3 in FIGS. 8-12). Spacings L avoid operational interference to sliding movement of slide 30 in sliding groove 27 while first and second jaws 23 and 24 and first wrenching face 32 and wings 37 of slide 30 rotate about axis C of workpiece 90 in non-driving rotation direction of the wrench 10. The arrangement and design

of the several free-space portions 221, 222, and 223 as explained above allow for a proper operation of the wrench 10 in the non-driving rotation direction without adversely affecting a high structural strength of the jaw portion 22.

[0052] Thus since the invention disclosed herein may be embodied in other specific forms without departing from the spirit or general characteristics thereof, some of which forms have been indicated, the embodiments described herein are to be considered in all respects illustrative and not restrictive. The scope of the invention is to be indicated by the appended claims, rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

Claims

1. An open end wrench (10) for fast driving a workpiece (90), that has a hexagonal driving cross-section, in a driving rotation direction of the wrench (10), and for rotating relative to the workpiece (90) in a non-driving rotation direction of the wrench (90), the open end wrench (10) comprising:

a wrench body (20) including a handle (21) and a jaw portion (22) formed on an end of the handle (21), with spaced first and second jaws (23, 24) and a throat (25) intermediate the first and second jaws (23,24) formed by the jaw portion (22) opposite to the handle (21) to define a one-side open wrenching space (26), the first jaw (23) including a force-applying face (231) facing the wrenching space (26) and the jaw portion (22) further including an arcuate sliding groove (27) facing the wrenching space (26) and formed at least to a greatest extent along the longitudinal length of the sliding groove (27) between two opposite longitudinal ends thereof, the sliding groove (27) arranged in a distance from the free end of the second jaw (24) and defined by spaced, first and second support wall faces (272, 273) and an arcuate sliding wall face (271) extending in a transverse direction between the first and second support wall faces (272, 273) to form the bottom of the sliding groove (27) along the length thereof, with a guide element (28) fixed to the support wall faces (272, 273),

a slide (30) slideably received in the sliding groove (27) to be slidable in the sliding groove (27) between at least a driving position and a non-driving position, the slide (30) including an arcuate sliding face (31) facing the sliding wall face (271) of the sliding groove (27) to be slidable along the sliding wall face (271), the slide (30) further including a second side opposite to the arcuate sliding face (31), a top face (301), a bottom face (302) and an arcuate guiding slot (35) that extends from the top face (301) and through the bottom face (302) and receives the guide element (28), the second side of the slide (30) including a first wrenching face (32) located outside of the sliding groove (27) in the wrenching space (26) and parallel with the force-applying (231) of the jaw (23) in the driving position of the slide (30), the top face (301) slideably abutting the first support wall (272), with the bottom face (302) slideably abutting the second support wall (273), with the top and bottom faces (301, 302) symmetrically supported by the first and second support walls (272, 273), the guiding slot (35) including an abutting end (351) and a pressing end (352), and

an elastic device (40) mounted in the guiding slot (35) and having two ends respectively abutting the guide element (28) and the pressing end (352) of the guiding slot (35), with the elastic device (40) urging the abutting end (351) of the guiding slot (35) to contact with the guide element (28) for biasing the slide (30) to the driving position,

the slide (30) including two wings (37) that extend from the top face (301) and bottom face (302) of the slide (30) transversely beyond the first and second support wall faces (272, 273) of the sliding groove (27), with each of the first and second wings (37) including inner and outer faces (371, 372), with the inner faces (371) of wings (37) adapted to drive the workpiece (90), the inner faces (371) of the wings (37) adapted to contact with the outer periphery of the workpiece (90) received in the wrenching space (26) to increase the first wrenching face (32) of the slide (30), with the outer faces (372) of the wings (37) spaced from the body (20) to avoid friction between the body (20) and the first and second wings (37), allowing smooth sliding movement of the slide (30) between the driving position and the non-driving position.

2. The open end wrench as claimed in claim 1, with the first wrenching face (32) including a top extension face (36) extending away from the top face (301) and a bottom extension face (36) extending away from the bottom face (302), with the top and bottom extension faces (36) coplanar to the first wrenching face (32) and located on the inner faces (371) of the two wings (37).

3. The open end wrench as claimed in claim 2, with the first and second jaws (23, 24) and the first wrenching face (32) and the top and bottom extension faces (36) of the slide (30) together defining a curvature of a circle circumscribing the hexagonal workpiece (90) having a center located on axis (C) of the workpiece

(90), with the first and second jaws (23, 24) and the first wrenching face (32) and the top and bottom extension faces (36) of the slide (30) rotatable along about the center (C) of the workpiece (90), with the first wrenching face (32) and the top and bottom extension faces (36) slideable along a circumference of a circumscribed circle of the workpiece (90), having a diameter (D), without interference.

4. The open end wrench as claimed in claim 1, with the sliding wall (271) of the sliding groove (27) free of holes, grooves and recesses and having a concave, arcuate face, with the sliding face (31) of the slide (30) free of holes, grooves and recesses and having a convex, arcuate face, and with the guiding slot (35) free of holes, grooves, and recesses.

5. The open end wrench as claimed in claim 1, with the force-applying face (231) facing the front end of the second jaw (24), with the sliding groove (27) formed in the second jaw (24), with the force-applying face (231) adapted to correspond to the first force-receiving face (91A) of the workpiece (90) in the first rotation direction, with the first wrenching face (32) and the wings (37) of the slide (30) adapted to correspond to the fourth force-receiving face (94A) of the workpiece (90) in the first rotation direction when the slide (30) is in the driving position.

6. The open end wrench as claimed in claim 1, with the sliding face (31) of the slide (30) having a curvature, with the sliding wall face (271) of the sliding groove (27) having a curvature equal to the curvature of the sliding face (31), with the sliding face (31) of the slide (30) smoothly slideable along the sliding wall face (271) of the sliding groove (27), with the sliding face (31) adapted to transmit reactive force from the workpiece (90) to the sliding wall face (271) to avoid concentration of stress on the slide (30), increasing torque bearing capacity of the slide (30) when the workpiece (90) is driven by the body (20) to rotate, with the guiding slot (35) having a curvature equal to the curvature of the sliding wall face (271), allowing relative smooth, arcuate sliding between the guiding groove (35) of the slide (30) and the guide element (28) in the sliding groove (27) without operational interference therebetween.

7. The open end wrench as claimed in claim 1, with the slide (30) further including a second wrenching face (33) at an angle of 120 degrees to and located behind the first wrenching face (32), with the second wrenching face (33) adapted to correspond to the third force-receiving face (93A) of the workpiece (90) in the first rotation direction, with the slide (30) further including an evasive portion (34) between the first and second wrenching faces (32, 33), with the free-space portion (34) of the slide (30) adapted to allow entrance of the third force-receiving face (93B) of the workpiece (90) in the second rotation direction.

8. The open end wrench as claimed in claim 7, with the throat (25) including a push face (251) facing the wrenching space (26), with the push face (251) at an angle of 120 degrees to the force-applying face (231) of the first jaw (23), with the push face (251) of the throat (25) adapted to correspond to the second force-receiving face (92A) of the workpiece (90) in the first rotation direction.

9. The open end wrench as claimed in claim 8, with the second jaw (24) including first and second faces (241, 242), with the first face (241) of the second jaw (24) facing the wrenching space (26) and the force-applying face (231) of the first jaw (23), with the second face (242) of the second jaw (24) facing the wrenching space (26) and the free end portion of the first jaw (23), with the first face (241) of the second jaw (24) at an angle of 120 degrees to the second face (242) of the second jaw (24), with the first and second faces (241, 242) of the second jaw (24) adapted to correspond respectively to the fourth and third force-receiving faces (94A, 93A) of the workpiece (90) in the first rotation direction, with the first face (241) of the second jaw (24) parallel to the force-applying face (231) of the first jaw (23), with a first free-space portion (221) formed between the force-applying face (231) of the first jaw (23) and the push face (251) of the throat (25), with the first free-space portion (221) adapted to allow entrance of the first force-receiving face (91B) of the workpiece (90) in the second rotation direction, with a second free-space portion (222) formed between the push face (251) of the throat (25) and the second face (242) of the second jaw (24), with the second free-space portion (222) adapted to allow entrance of the second force-receiving face (92B) of the workpiece (90) in the second rotation direction, with the jaw portion (22) further including a third evasive portion (223) between first and second faces (241, 242) of the second jaw (24), with third free-space portion (223) adapted to allow entrance of the third force-receiving face (93B) of workpiece (90) in the second rotation direction.

10. The open end wrench as claimed in claim 1, with the elastic device (40) including an elastic element (41; 42; 43; 44) received in the guiding slot (35), with the first and second support wall faces (272, 273) of the sliding groove (27) parallel to each other and having a spacing (T27) therebetween, with the top and bottom faces (301, 302) of the slide (30) parallel to each other and having a height (H30) in a height direction of the slide (30) equal to the spacing (T27) between the first and second support wall faces (272, 273), with the guiding slot (35) of the slide (30) having a

height (35) in the height direction of the slide (30) equal to the height (H30) of the slide (30), with the guiding slot (H35) having a width (W35) in a width direction perpendicular to the height direction of the guiding slot (35), with the width (W35) of the guiding slot (35) equal to a diameter (D28) of the guide element (28), with the height (H35) of the guiding slot (35) larger than 1.5 times the width (W35) of the guiding slot (35), with the elastic element (41; 42; 43; 44) having a height (H40) in the height direction of the slide (30) not larger than the height (H35) of the guiding slot (35), with the height (H40) of the elastic element (41; 42; 43; 44) larger than the width (W35) of the guiding slot (35) and larger than 0.5 times the height (H35) of the guiding slot (35).

11. The open end wrench as claimed in claim 10, with the elastic element being one of a resilient plate (41), a compression spring (42), a torsion spring (43), and a dual compression spring (44), with the dual compression spring (44) having spaced upper and lower coil portions and a connecting portion between the upper and lower coil portions, with the upper and lower coil portions spaced in the height direction of slide (30).

12. The open end wrench as claimed in claim 1, with the elastic device (40) including a base (46; 48) and two compression springs (45; 47), with the base (46; 48) including two protrusions (461) spaced in a height direction of the slide (30) or two receptacles (481) spaced in the height direction of the slide (30), with each of the two compression springs (45; 47) having an end mounted to one of the two protrusions (461) or one of the two receptacles (481), with the two compression springs (45; 47) spaced in the height direction of the slide (30).

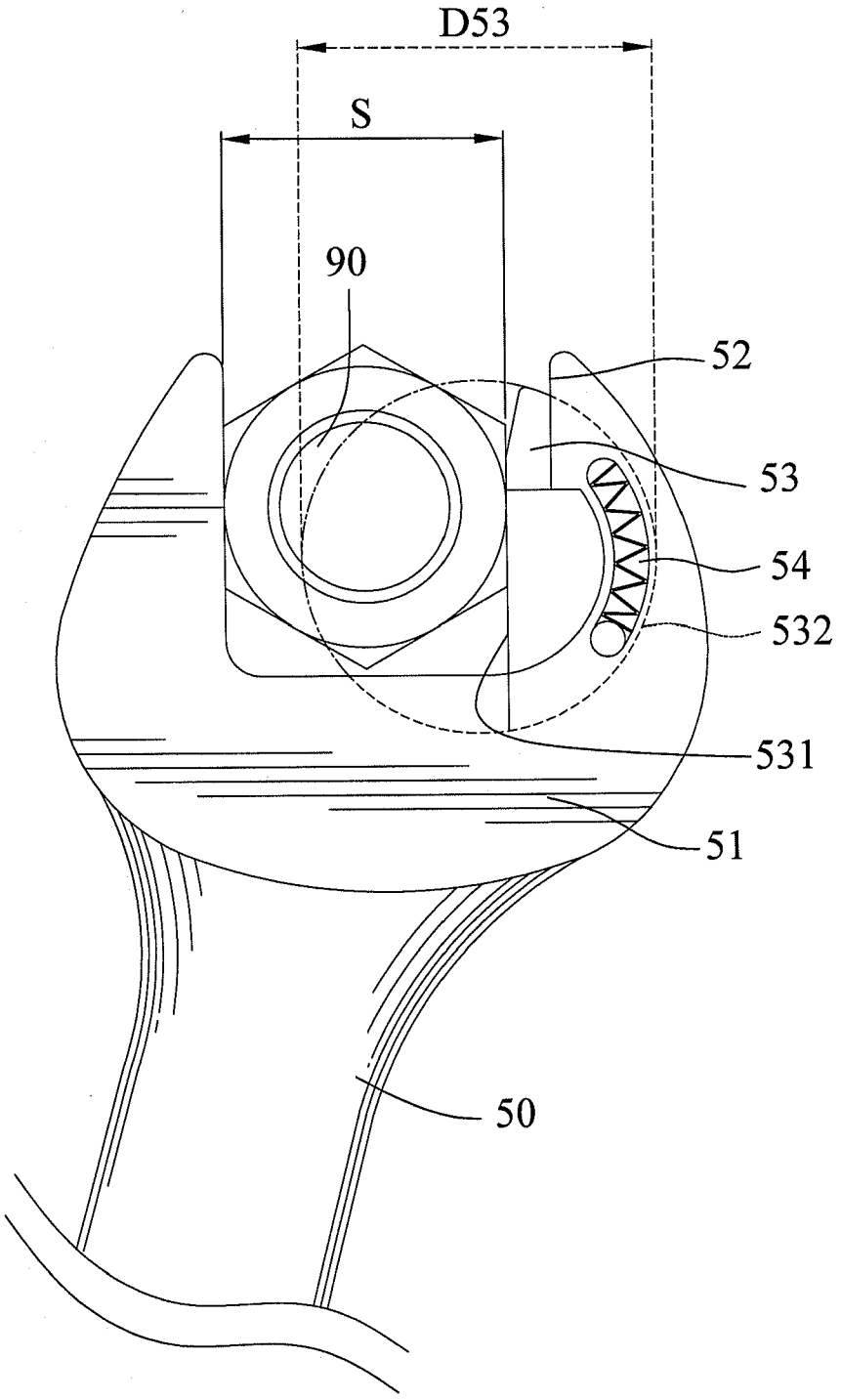


FIG.1
PRIOR ART

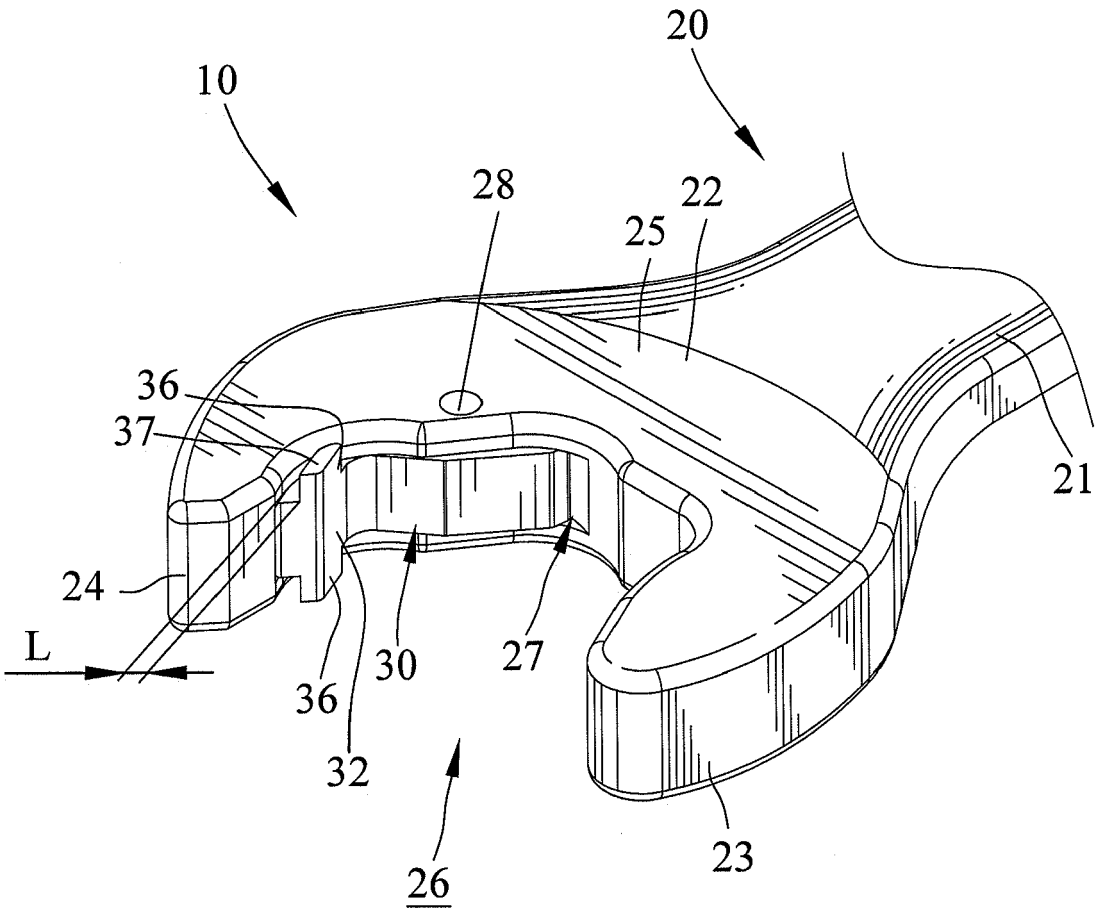
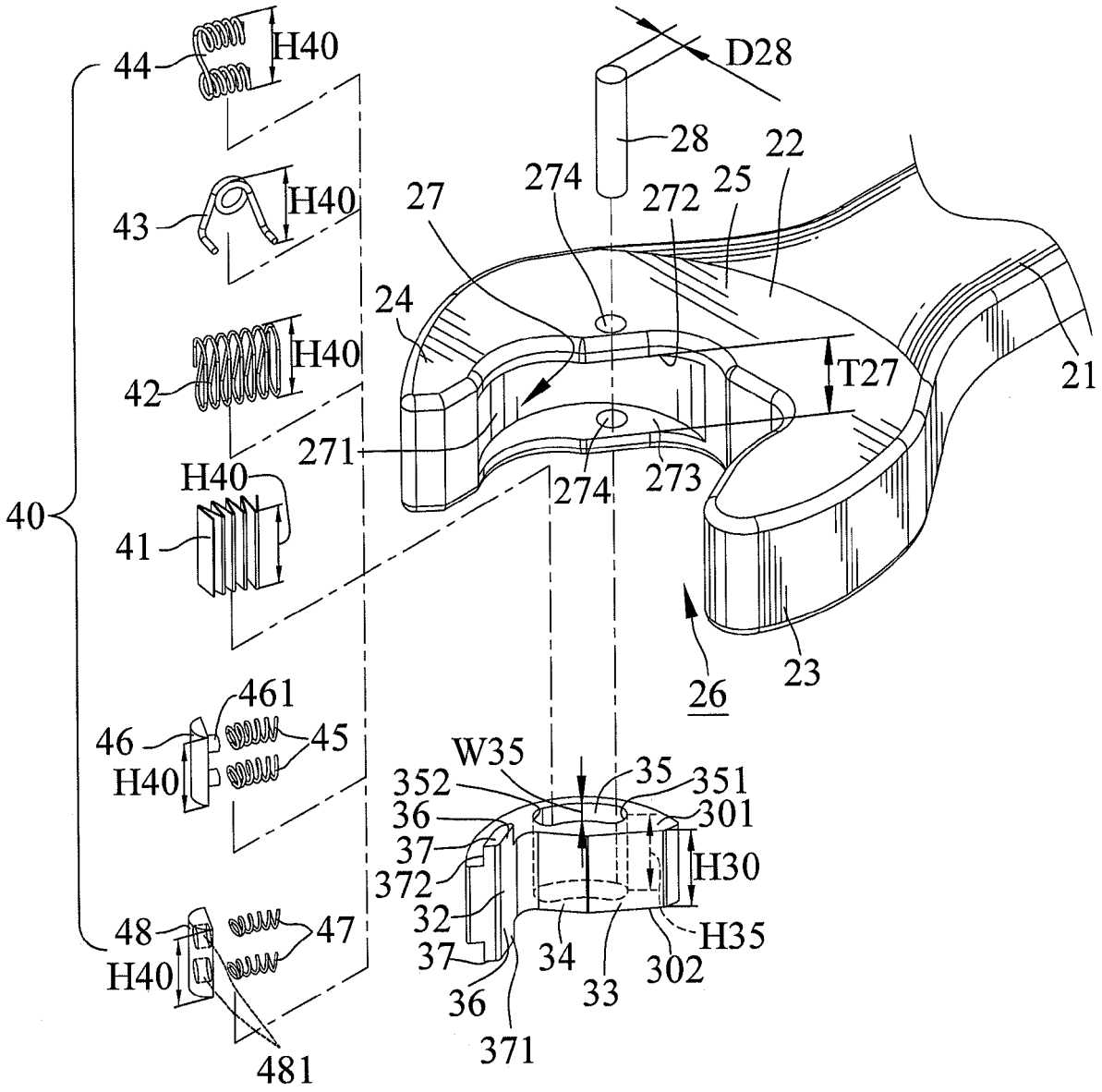


FIG.2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H40
43
H40
42
H40
H40
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40
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H40
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22
274
272
25
27
24
T27
21
271
274
273
26
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33
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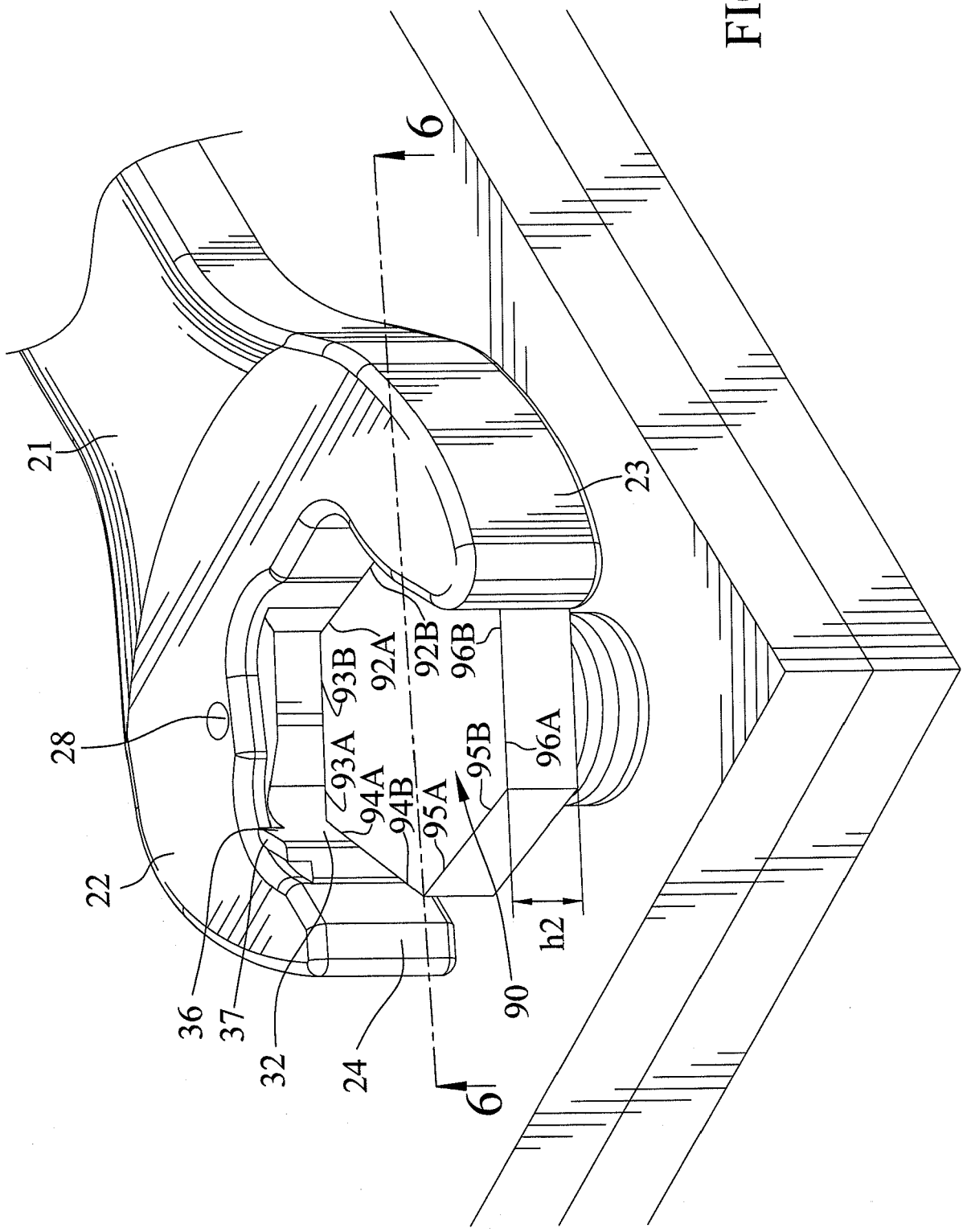
FIG.3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23
28
22
36
37
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h2
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92B
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93A
94A
94B
95A
95B
96A

FIG.4

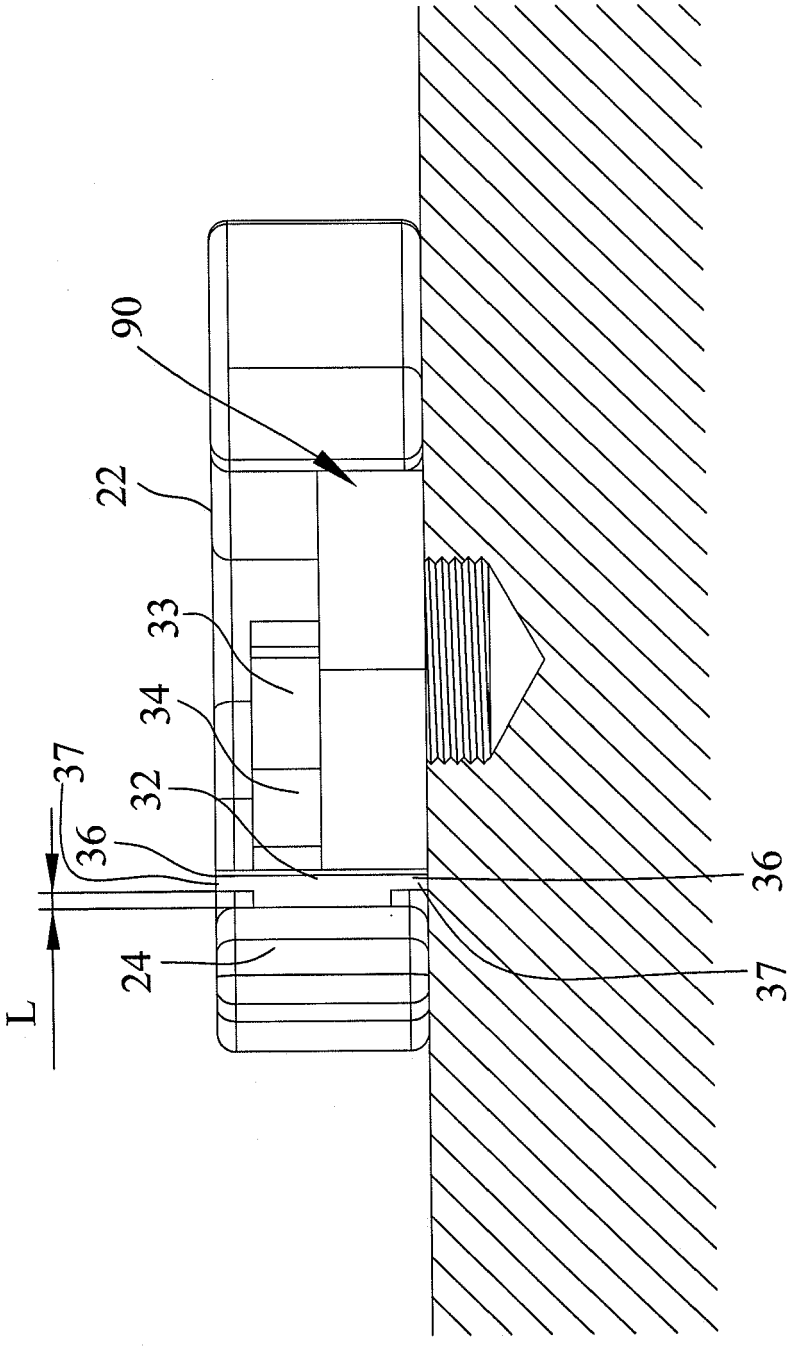


FIG.5

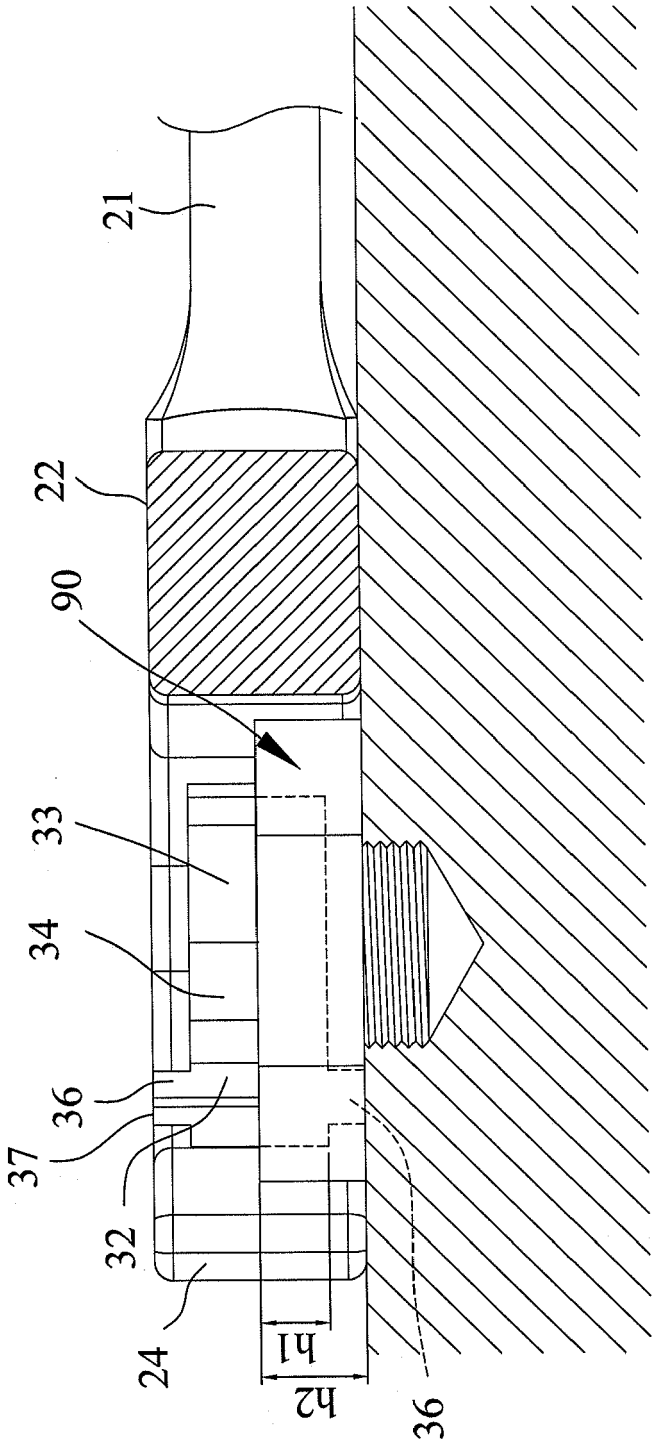
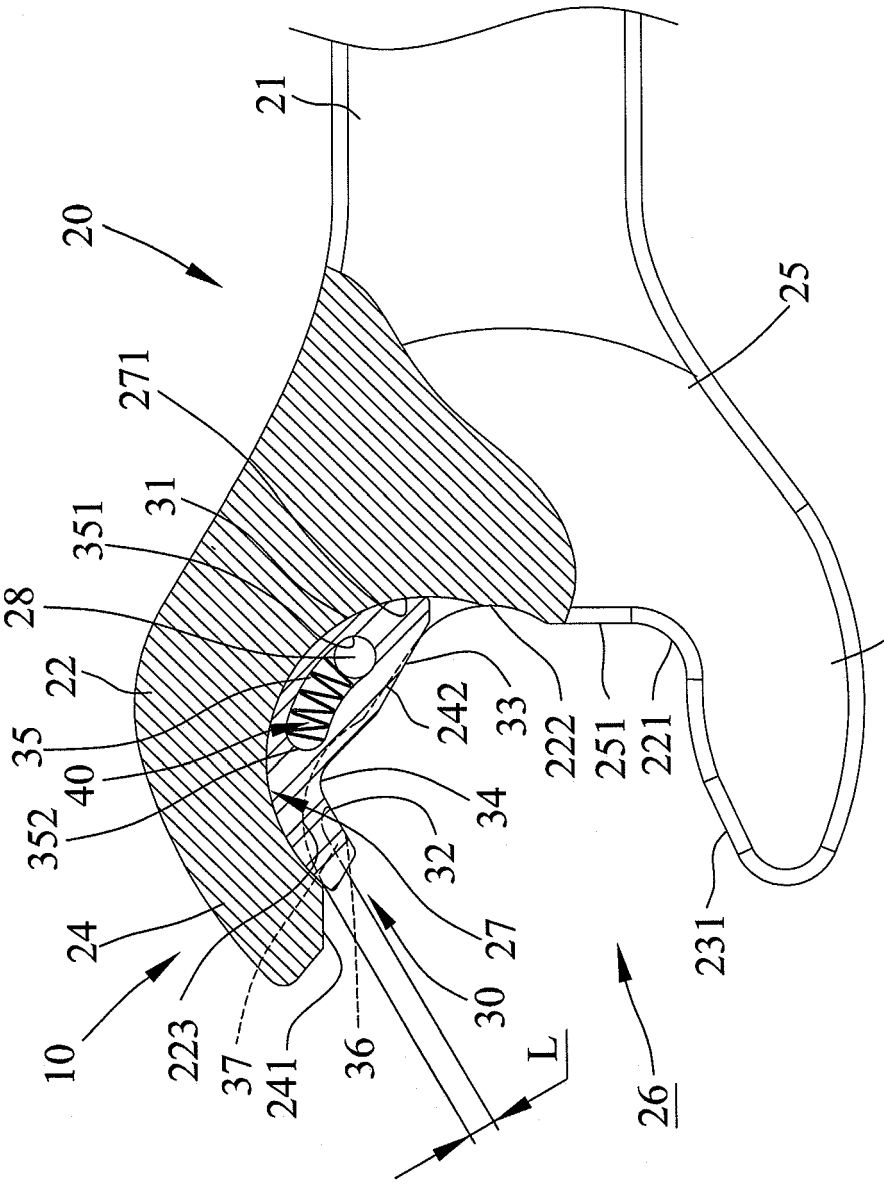


FIG.6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23

FIG.7

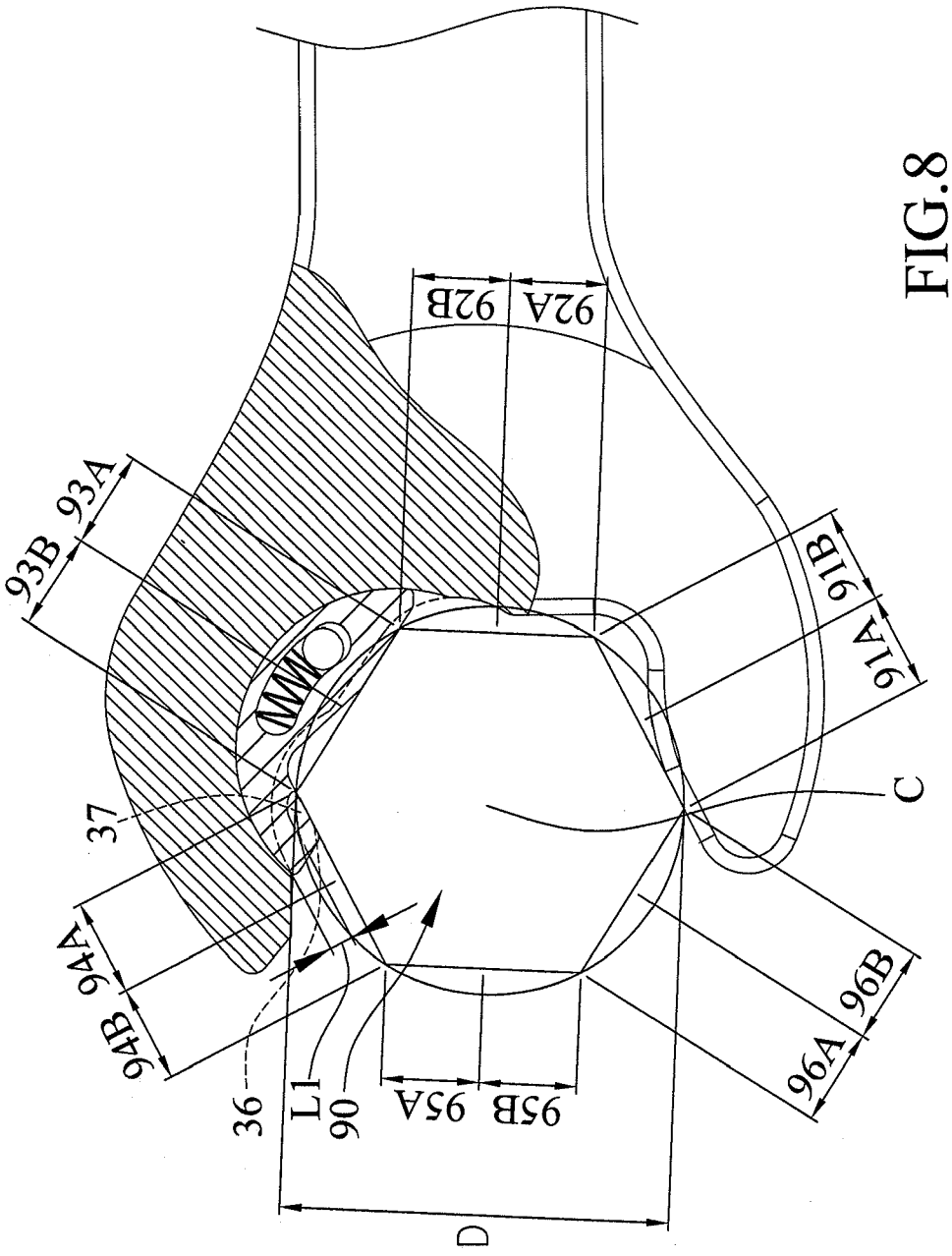

FIG.8

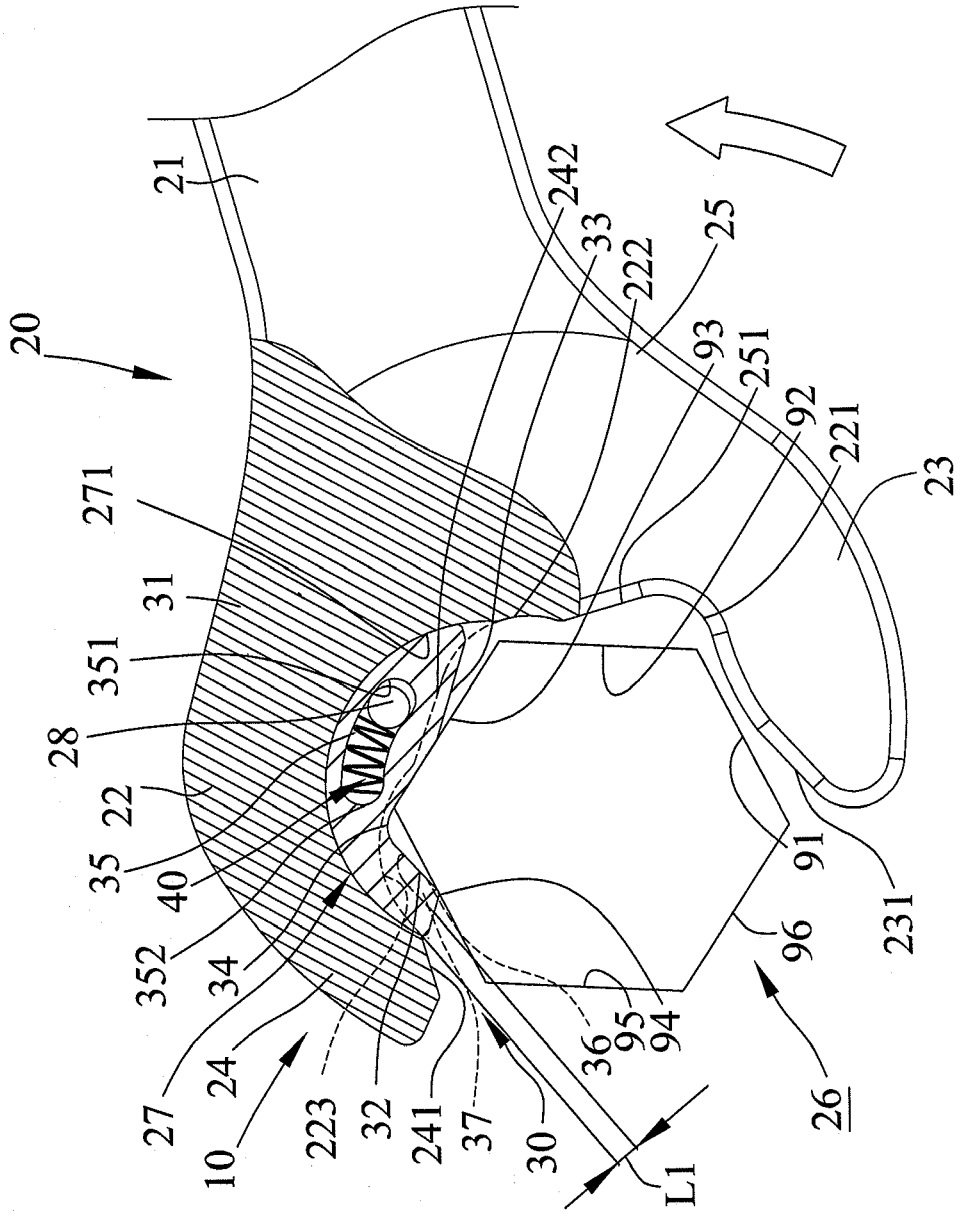
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FIG.9

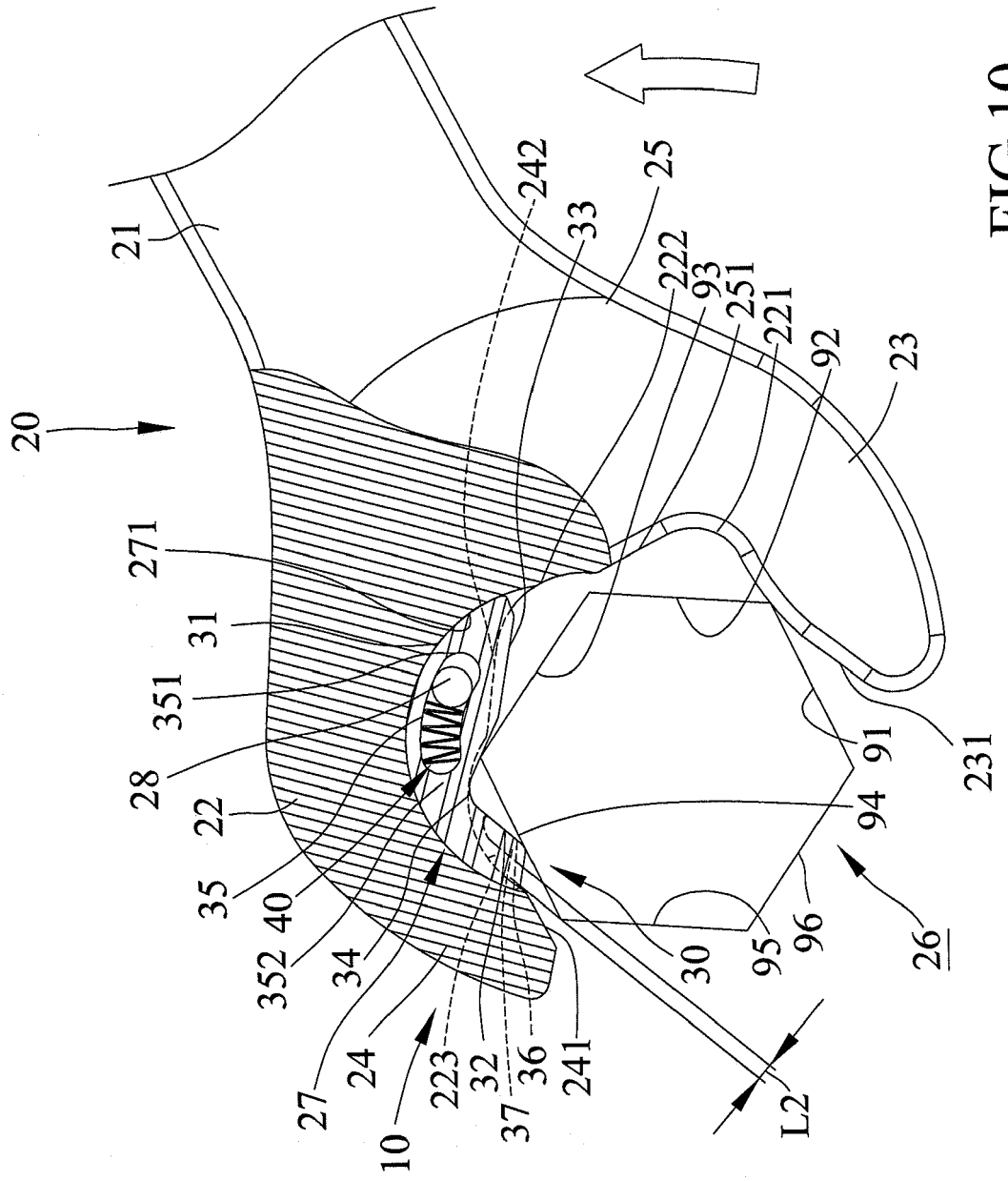
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FIG.10

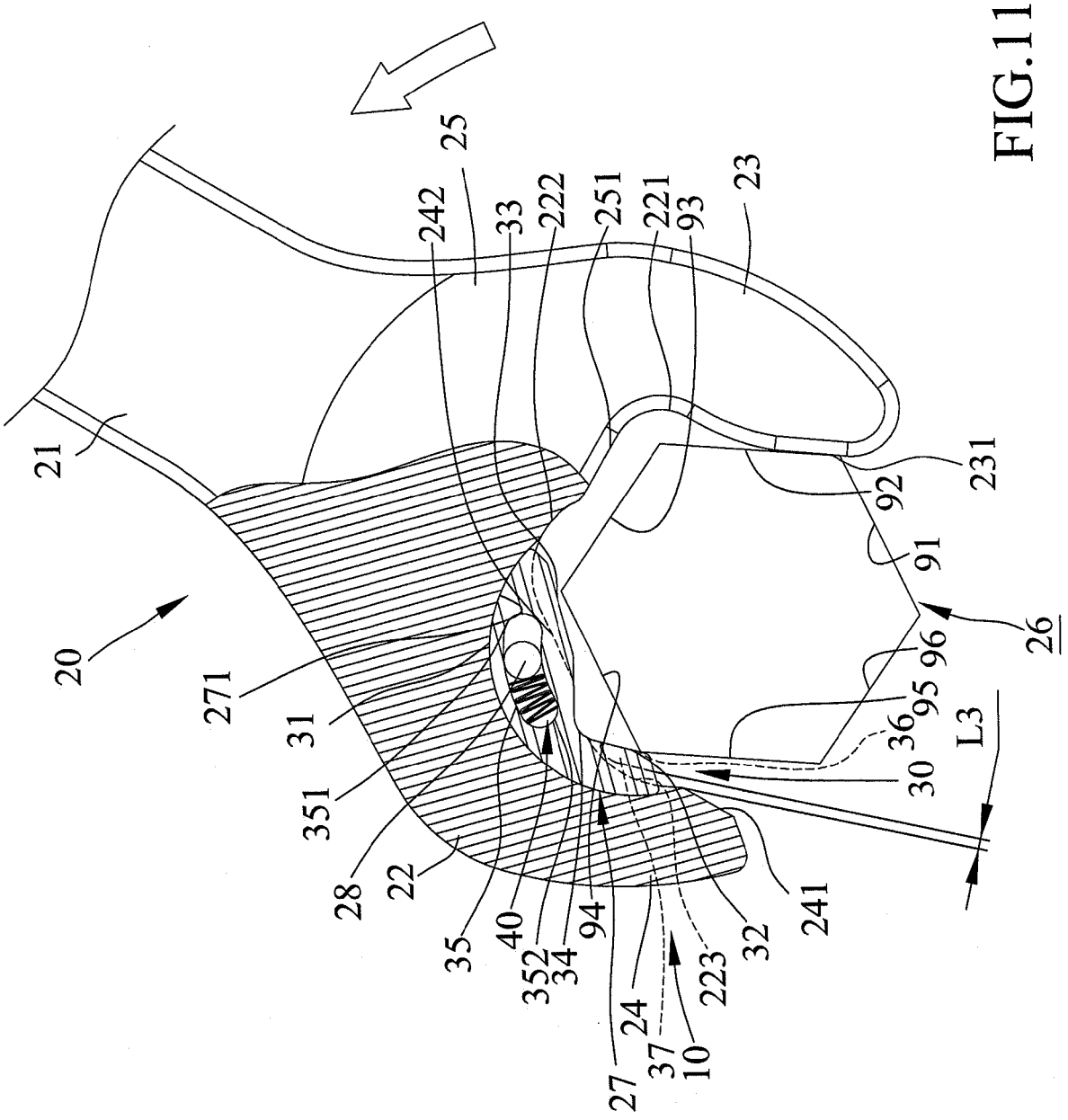
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FIG.11

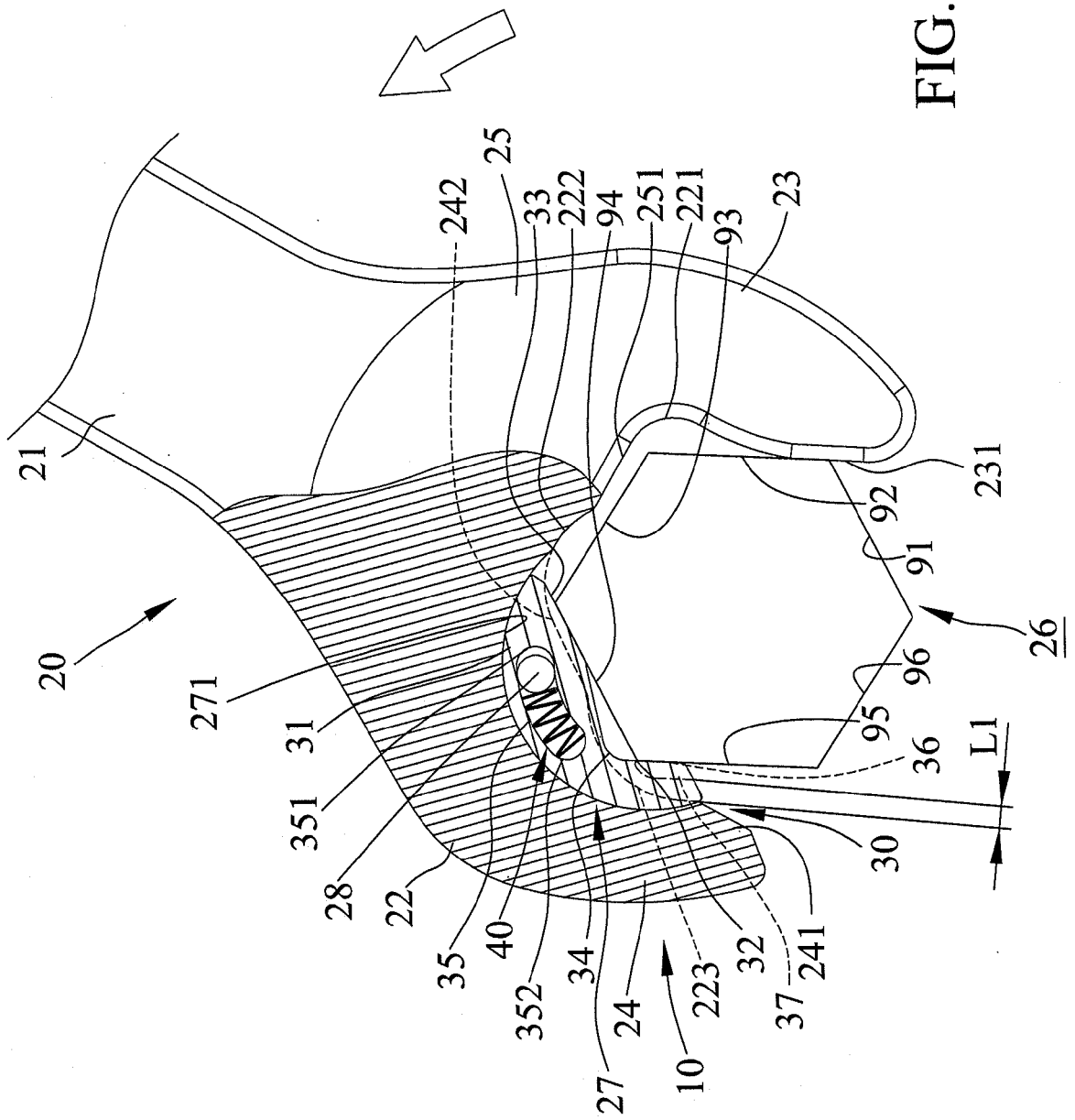
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FIG.12

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EUROPEAN SEARCH REPORT

Application Number
EP 11 18 7374

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	US 2010/083797 A1 (LEE LI-JU [TW]) 8 April 2010 (2010-04-08) * paragraph [0060] - paragraph [0063]; figures 1,3,7,8,11 *	1,2,5, 10,11	
A	US 2010/071516 A1 (WU ARTHUR [TW]) 25 March 2010 (2010-03-25) * paragraph [0035] - paragraph [0042]; figures 1-8 *	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 February 2012	Majerus, Hubert

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09-02-2012

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