

EXHIBIT 1009



- (51) International Patent Classification:
A61B 17/92 (2006.01)
- (21) International Application Number:
PCT/IB2013/060900
- (22) International Filing Date:
13 December 2013 (13.12.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
3866/DEL/2012 14 December 2012 (14.12.2012) IN
- (71) Applicant: **STRYKER GLOBAL TECHNOLOGY CENTER** [IN/IN]; Vatika Business Park, 10th Floor, Block -2, Sector-49, Sohna Road, Gurgaon, Haryana 122001 (IN).
- (72) Inventors: **SHARMA, Dinesh**; H.No. 2235, Sector 9, Faridabad, Haryana 121006 (IN). **REHAN, Md.**; H.No. C1010, Room No:10, Sanjay Gram, Sector 14, Gurgaon, Haryana 122002 (IN).
- (74) Agent: **SREEDHARAN, Sunita K.**; C1/611, Mayfair Tower, Charmwood Village, Surajkund, Faridabad, Haryana 121009 (IN).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

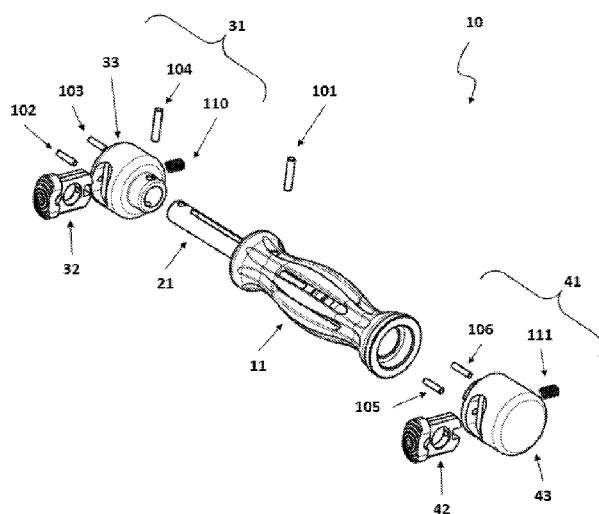
Declarations under Rule 4.17:

— as to the identity of the inventor (Rule 4.17(i))

[Continued on next page]

(54) Title: UNIVERSAL IMPACTOR WITH SLAP HAMMER

FIGURE 2



(57) Abstract: The present invention relates to universal impactor with slap hammer device for applying force for use to assist in the impaction and/or extraction of surgical instrument attached thereto from an orthopedics structure. The device acts as an impacting tool that is useful for mating to a medical instrument used during surgery. It can also be converted to an extracting tool by manipulating the quick release mechanism. The impacting/extracting device is effective in applying an axial force to the medical instrument to efficiently and effectively prepare a bone structure, insert or remove implant trial, insert or remove implant, or to remove a medical instrument from the bone structure.



-
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- Published:**
- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

TITLE:

Universal impactor with slap hammer.

FIELD OF INVENTION

- 5 The present invention relates to universal impactor with slap hammer that assists in orthopedic, surgeries. More particularly, the invention relates to a convertible medical impacting/extracting device adapted to apply force distally or proximally along the axis of an attached device used during orthopedics surgery.

10 **BACKGROUND OF THE INVENTION**

- Advancing age, injuries, diseases can damage or change the bones, joints and ligaments of the human body. Such injuries, damages usually appear in the form of physical degeneration. In order to correct these damages, additional support or prosthesis may be inserted by way of surgery. For instance in case of knee replacement or hip
15 replacements, incisions are made on the body of the patient for surgical access, whereupon damaged or diseased materials, such as bones and muscles are surgically removed. In instances where bone has to be removed, artificial prostheses are inserted in its place.

- 20 In such surgeries, the surgeons have to use a device called the 'impactor' for fixing instruments which include cutting guides, nails, pins, chisel in the surgical site. The said instruments are put into the desired place for surgery by placing the impactor on said fixing instruments and hammering the impactor with a mallet. Mallets are often used to apply impaction force on medical instruments. While mallets are effective, the
25 impacting force must be axially applied to avoid misalignment of the instruments, or the inadvertent removal of a bone. Moreover, the force applied must be sufficiently accurate to avoid damage to the receiving site in the patient body.

- In surgeries, an additional device called 'slaphammer' is used for extraction of various
30 tools/trial/implants from the bone. The slaphammer attaches to the instrument lodged into bone and extracts the instrument by applying multiple blows or 'slaps' axially. However, most slaphammer designs still have several drawbacks. Current slaphammers tend to be very large and heavy, and are thus difficult to handle. The size and weight of

the slaphammer can make it very difficult for the surgeon to maintain a steady hand. The size and weight can also result in problems with storage and cleaning.

US patent USPN 5,913,860 granted on June 22, 1999 discloses the device for impaction and extraction of nail from the bone. This device has slap hammer which can be
5 removed or attached to slide rod used for inserting the nail. Another patent, USPN 6,814,738 published on Aug 8, 2002 discloses medical impacting device which generates a distally directed force for inserting the 'tool' such as a chisel and/or an attached device into an orthopedic structure, or it can generate a proximally directed force to remove the tool (and/or attached device) from an orthopedic structure. The US patent USPN
10 6,709,439 published on May 1, 2003 provides medical instrument impacting tool. The impacting tool is effective for applying a force to the medical instrument to efficiently and effectively prepare a bone structure, insert or remove a trial implant, insert or remove an implant, or to remove a medical instrument positioned between adjacent bone structures.

15

The disadvantage of the devices in the current state of art technology is that they require two separate instruments for the purpose of impaction and extraction during a surgical procedure. For impacting an instrument/implant/trial onto the bone structure, an 'impactor' is used while for extracting instrument/implant/trial another tool called the
20 'slaphammer' is used. The presence of multiple separate instruments, require longer preparation and sterilization time as well as more hands during the surgery which results in additional time thereby increasing costs.

Accordingly, there remains a need for a single, more compact, lightweight device which
25 can be safely and effectively used to apply impaction and extraction force to a medical instrument or can work as a standalone device.

OBJECT AND SUMMARY OF THE INVENTION

In order to obviate the aforementioned drawbacks in the existing state of art technology,
30 the instant invention provides a device which is a universal impactor with slap hammer that can be used as an impactor and can be easily converted into an extractor to perform the function of extraction with user friendly ergonomic gripping handle for stability.

An object of the invention is to provide universal impactor with slap hammer having a unique locking mechanism which when locked acts as impact hammer and when unlocked becomes a slap hammer.

- 5 Another object of the invention is to provide fool proof locking/unlocking for both the usable option i.e. as an impactor or an extractor/slaphammer.

Yet another object of the invention is to provide the universal impact with slap hammer with modular end device which may or may not be configured to receive different types of modular instruments during surgical procedure. .

10

Accordingly, the instant invention relates to a universal impactor with slap hammer that comprises a slidable hollow handle, a central shaft within the hollow handle, a modular distal end to receive different types of surgical instruments, a proximal mechanism to switch between impactor and extractor mode, and an option to restrict the relative rotational motion between the hollow handle and the central shaft.

15

The advantage of this invention is that it reduces the number of instruments to be prepared which include reduction in the number instrument to be sterilized for use in a surgery and is helpful in reducing the number of non-productive surgical steps. Further it minimizes the chances of committing a surgical error.

20

Thus the invention provides for universal impactor with slap hammer device for impacting and extracting during surgical procedure, said device comprising of hollow handle, central shaft, proximal impaction end and quick connect mechanism. The hollow handle has inner and outer surface as well as proximal and distal end. The proximal impaction end has locking mechanism to switch the device from extractor mode to impactor mode or vice versa.

25

The central shaft also has corresponding proximal and distal ends and can be slidably engaged into the integrated hollow handle such that the proximal end of the central shaft which bears a tip is capable of being locked at proximal or distal end of the hollow handle while said device is in impactor mode.

30

For instance, the proximal end of the central shaft when slid into the hollow handle is capable of being locked with the proximal impaction end enabling the working of said device in the impactor mode. when the locking mechanism on the proximal impaction end is pressed, the central shaft is released up the hollow handle to the predetermined
5 movable length (l_{sl}) of the central shaft thereby enabling it to act as slap hammer i.e. in the extractor mode.

The fitting in of the proximal impaction end to the proximal end of the hollow handle helps form an integrated hollow handle, and can also be made permanent by welding
10 the proximal impact end to the hollow handle as is case of an embodiment which uses magnetic means as a mode converting system. The distal quick connect mechanism member has modular mechanism member at the distal end to attach additional surgical instruments if so required.

15 The locking mechanism may be a mechanical locking mechanism or magnetic quick connect locking mechanism. In case of magnetic quick connect locking mechanism the locking may be at proximal end or distal end. The locking at proximal end is achieved by providing magnets at the flat tip of central shaft and at the location of impaction head central hole of said integrated hollow handle. The locking at the distal end is achieved
20 by arranging magnets on distal rim of said integrated hollow handle and at the proximal end of said quick connect mechanism so that the device locks into place when the sets of magnets meet on impaction.

The mechanical locking mechanism on the other hand is achieved by the locking of
25 proximal tip of central shaft by pressing the proximal button located on proximal impaction end. The mechanical locking mechanism located on said proximal impaction end is selected from a variety of locking mechanisms including spring loaded button, rotating and unlocking screw or a taper lock. The mechanical locking mechanism located on said proximal impaction end passively receives proximal tip end of central
30 shaft when the tip is bulletted, or by positively pressing said mechanical locking mechanism as a toggle key to allow locking in and releasing, when tip of said central shaft is flat. The mechanical locking mechanism located on said proximal impaction end receives proximal tip end of central shaft locking in to facilitate use of said device as

impactor device, releasing said proximal tip end of said central shaft on pressing said mechanical locking mechanism to facilitate use of said device as extractor device.

5 In one embodiment, the surgical instrument can also be configured to be detachable or non-detachable from the central shaft, so that in the non-detachable mode the central shaft bearing the instrument on the other end acts as a standalone device. The hollow handle is capable of being rotated or prevented from being rotated by use of at least one anti-rotation mechanism which is can be either an anti-rotation pin to provide rotational constraint to handle during proximal-distal articulation or by way of anti-rotation
10 feature inherent to the structure of central shaft (21), hollow handle (11) or both. In a representative example the shape of the hollow in the hollow handle can be square instead of being cylindrical and if the central shaft too is square, then the inherent shape itself acts as a rotational restraint.

15 The central shaft also may have a plurality of mechanisms to allow variable slap length to provide required extraction force with corresponding calibration on said hollow handle easily visible to surgeon. The mechanism is selected from threading of central shaft with slap length nut or by way of having a plurality of variable length holes (560) located at calibrated distance along the length of the holed central shaft and slap length
20 pin that can be inserted by the surgeon at desired hole to provide a desired length for use as a slap hammer

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be fully understood from the following detailed description taken in
25 conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of a universal impactor with slap hammer mated to a medical instrument;

FIG. 2 is a perspective view of one embodiment of the tool shown in FIG. 1 in a disassembled form and having a hollow handle (11), a central shaft (21), a quick connect
30 mechanism member (31) bearing locking mechanism having distal button (32), and proximal impaction end (41) bearing locking mechanism having the proximal button (42), the proximal impaction end has impaction head (43). The figure also depicts antirotation pin (101), springs (110 and 111), locking pins (102, 103) to lock the distal

button to the distal quick connect mechanism, locking pins (104) to lock central shaft to distal quick connect mechanism, locking pins (105, 106) to lock the proximal button (42) to the proximal impaction end (41);

FIG. 3A is a perspective view of FIG. 2 depicting the hollow handle (11) adapted to receive the central shaft member (21) from the proximal end, the handle bearing an anti-rotation hole (13);

FIG. 3B is a perspective view of the central shaft (21) and anti-rotation pin (101) shown in FIG. 2. The central shaft is an elongated rod ending in a proximal bullet shaped tip (22) which is adapted to mate to the integrated hollow cavity formed by the integration of the hollow handle (11) to the proximal impaction end (41). The central shaft (11) also has an attachment hole (26) at the distal end to receive the pin that will affix it to the distal quick connect mechanism (31);

FIG. 3C is a perspective view of the distal quick connect end shown in disassembled form containing a quick connect cap, a distal button, locking pins and spring, and is adapted to be disposed with the hollow handle member of FIG. 3A and adapted to mate to the central shaft shown in FIG. 3B;

FIG. 3D is a perspective view of the proximal impaction end (41) shown in disassembled form having a impaction head member, a proximal button, locking pins and spring and is adapted to mate to the proximal end of the hollow handle of FIG. 3A and to accept the proximal end of the central shaft shown in FIG. 3B;

FIG. 4 is a cross-sectional illustration of the all of the components of the universal impactor with slap hammer shown in FIG. 2 in the assembled form;

FIG. 5A is a perspective view of another embodiment of the medical instrument shown in a distal position and having the hollow handle positioned proximal to the quick connect end of the tool;

FIG. 5B is a perspective view of the medical instrument of FIG. 5A shown in a proximal position;

FIG. 6A is a perspective view of the central shaft disclosed in FIG. 3B showing an alternative proximal end and shaft body;

FIG. 6B is a perspective view of universal impactor with slap hammer disclosed on FIG. 1-2 showing the alternate central shaft of FIG. 6A and an alternate adaptation of the hollow handle of FIG. 3A;

FIG. 7A is a perspective view of the universal impactor with slaphammer disclosed on FIG. 1 showing an alternative magnetic locking mechanism at the distal end of the tool;

FIG. 7B is a perspective view of one embodiment of the of the tool shown in FIG. 7A in a disassembled form and having a magnetic hollow handle, an integrated shaft and magnet quick connect cap, a button and a retaining pin;

FIG. 7C is a cross-sectional illustration of all of the components of the medical instrument impacting/extracting tool shown in FIG. 7A-7B in the assembled form;

FIG. 8A is a perspective view of the universal impactor with slaphammer disclosed on FIG. 1 showing an alternative version, having an adjustable slap length, in closed position;

FIG. 8B is a cross-sectional illustration of all of the components of the variable length impactor with slap hammer shown in FIG. 8A, in closed position;

FIG. 8C is a cross-sectional illustration of all of the components of the variable length impactor with slap hammer shown in FIG. 8A-8B, in open position;

FIG. 9A is a perspective view of the universal impactor with slaphammer disclosed on FIG. 8A, 8B and 8C showing an alternative version, having an adjustable slap length, using pin and hole mechanism;

FIG. 9B is a cross-sectional illustration of all of the components of the variable length impactor with slap hammer shown in FIG. 9A, in open position;

DETAILED DESCRIPTION OF THE INVENTION WITH REFERENCE TO DRAWINGS AND ILLUSTRATIVE EXAMPLES:

The present invention provides a device which is a universal impactor with slap hammer that is useful for mating to a medical instrument used during orthopedic surgery. The instrument acts as an impactor and can be converted to act as an extractor by triggering a mechanism, thereby providing dual functionality without the need to have two different instruments. The universal impactor with slap hammer is effective to apply a force to another medical instrument to efficiently and effectively prepare a bone structure, insert or remove an implant, or to remove a medical instrument positioned on the bone structures.

The hollow handle, which is slidably disposed over the central shaft is mated to the distal modular end and proximal impaction end. The central shaft also includes an

option on the proximal side to aid in locking/unlocking with the proximal mechanism. The device which includes a connector element formed on the distal end may be adapted to mate with a medical instrument. The connector element may be, for example, a reamer, a broach, instrument holding devices or other similar type of mechanical connector.

The hollow handle comprises of outer and inner surfaces, a proximal end, and a distal end. In one embodiment, the outer profile of the handle is designed ergonomically for grip while the inner surface allows for the central shaft to pass through it. The handle maybe slidably disposed around the central shaft to move from the proximal end of the instrument to the distal end. The presence of a locking mechanism at the proximal end allows the handle to be locked in the impactor mode. The same locking mechanism in other embodiment can release the handle to allow sliding over the central shaft thereby converting into an extractor. The presence of the anti-rotation pin, that passes through a slot in the central shaft and is fixed to the hollow handle, ensures that the reciprocation of the instrument is linearly guided. The rotational constraint may also be achieved by changing the cross section of the anti-rotation pin from circular to square/oval/rectangular.

In one embodiment, the hollow handle has multiple slots cut all around its periphery to achieved optimized/desired mass of the universal impactor with impact slap hammer. The slots extend between the proximal and the distal end of the hollow handle. During use, the instrument is kept locked into impactor position by sliding the distal end of the hollow handle near-to the distal modular end. In this configuration, the instrument may be used to impact another medical instrument by attaching it to the modular end and impacting at the proximal end using a mallet. To convert the instrument into an extractor, the mechanism at the proximal end is triggered to release the central shaft from locked position. This trigger allows the hollow handle to slide over the central shaft. In this configuration, the instrument can be used to extract another medical instrument by attaching it to the modular end. The presence of a stopping flange at the proximal end of the central shaft restricts the hollow handle from coming out of the instrument system.

FIG. 1 and FIG. 2 depict universal impactor with slap hammer in assembled and dissembled forms respectively. The Fig 1 illustrates the position and deployment of the universal impactor-with-slap hammer (10), the hollow handle (11), central shaft (21), distal quick connect mechanism (31), proximal impaction end (41) and medical instrument (100) mounted on the modular end.

The Fig 2 additionally depicts the components of distal quick connect mechanism (31), proximal impaction end (41). The components of the distal quick connect mechanism (31) are distal button (32), quick connect cap (33), anti-locking pin (102), a pair of locking pins (103, 104), a spring (110). Similarly the proximal impaction end (41) comprises of proximal button (42), impaction head (43), locking pins (105, 106) and spring (111). Figure 2 also depicts anti-rotation pin (101).

Fig. 3A illustrates the hollow handle (11) which comprises of proximal end (12) and distal end (17), outer wall (15) having an ergonomic profile, a profile that can be comfortably grasped by the user in hand, an inner wall (16), a through hole (13) for the anti-rotation pin, plurality of air-hole cut-outs (14), inner surface of the hollow handle (18), the proximal counter bore (19). The corresponding distal counter bore (20) is shown in Fig 4.

Fig 3B depicts the central shaft (21) having distal end (28), proximal end (29) having bullet tip (22) and neck region (23), distal wall (24), slot (25) on central shaft, attachment hole (26), central bore (27) on the central shaft. The movable length of the central shaft is defined as l_{S1} which is the distance between the central shaft distal end (28) and the distal wall (24) having diameter d_{S1} .

FIG. 3C illustrates the distal quick connect end (31), of the universal impactor with slap hammer (10) disclosed in FIG. 1 and FIG 2, in much detailed manner. As depicted in Fig 3C, the distal quick connect end comprises of the quick connect cap (33). The quick connect cap has slot (36) on its cylindrical surface and hole (39) at its distal face while the proximal surface (140) of the quick connect cap (33) having the cylindrical protrusion (141) which has a length l_{Q1} (that is the overhanging length of cylindrical protrusion

feature (141) from the proximal surface (140)). The distal button has distal button hole (35) and surface (34).

5 The quick connect cap is mated to the central shaft (21) by using the locking pin (104) passing through attachment hole (37) in the quick connect cap (33) and the attachment hole (26) in central shaft (21) depicted in FIG. 3B. The locking pin (104) is welded to make a permanent attachment of the quick connect cap and the central shaft (21). The distal button (32) is locked into the quick connect cap (33) by inserting it into the slot (36) and passing the locking pin (102) through the hole (39) on the distal face of the quick
10 connect cap (33). The spring (110) is retained in place by using locking pin (102) as shown in FIG. 4. The surface (34) of the distal button (32) is where the force is applied to compress the spring and make room for the medical instrument (100) to be locked in place after passing through the distal button hole (35).

15 Fig 3D illustrate the proximal impaction end (41) in details. The proximal impaction end (41) comprises of impaction head (43) which has proximal impaction surface (49) and distal surface (48) as well as a proximal button (42) which fits into the proximal slot (46) on the impaction head (43). The proximal button (42) is locked into the proximal impaction end (41) by inserting it into the slot (46) and passing the locking pin (105) through the hole (47) on the distal face of the impaction head (43). The spring (111) is
20 retained in place by using locking pin (106) (shown in FIG. 4). The surface (44) of the proximal button (42) is where the force is applied to compress the spring and make room for the central shaft proximal end (29) in general and bullet tip (22) in particular to be locked in place after passing through the proximal button hole (45). The impaction head (43) also comprises a proximal impaction surface (49) that acts as the surface where
25 impacting force is applied using a mallet. When the universal impactor with slap hammer (10) is used as an impactor (FIG. 5A), then the impaction force applied on the proximal impaction surface (49) using a mallet (not shown) is transferred to the medical instrument (100) attached at the modular attachment site (38).

30

The proximal button (42) and spring (111) are locked inside the impaction head (43) using locking pins (105, 106). Due to the springing action provided by the spring (111), the proximal button (42) is kept pushed, such that the proximal button hole (45) is offset

from the impaction head central hole (50) shown in FIG. 4. When the proximal button (42) is pressed by applying force on the surface (44), both the proximal button hole (45) and the impaction head central hole (50) become coaxially aligned and then the bullet tip (22) can pass through them. The locking mechanism inside the proximal impaction end explained here, is just one of the many ways by which the same locking intent could be achieved.

FIG. 4 shows a cross-sectional illustration of the components of the universal impactor with slap hammer (10) shown in FIG. 2 in the assembled form. The cut out (14) can be seen on the hollow handle (11). Also the central bore (27) on the central shaft (21) is visible in the sectional view.

FIG. 5A illustrates the hollow handle (11) in the distal position. FIG. 5B illustrates the hollow handle (11) in the proximal position from the user, wherein the bullet tip (22) of the inserted central shaft lies midway along the length l_{sl} . The preferred embodiment depicting the assembly of the Universal impactor with slap hammer is explained with reference to FIGS 3A, 3B, 3C, 3D, FIG 4, FIG 5A, 5B.

The hollow handle is an elongated rigid tube having a proximal end (12), a distal end surface (17), and an inner surface (18) extending between them (FIG 3A). While the outer surface (15) of hollow handle (11) shown having an ergonomic profile the inner surface of the hollow handle (11) may have any shape and size in conformation with outer surface of the central shaft. The hollow handle (11) is selectively movable between a first, distal position (shown in Fig 5A) and a second, proximal position (shown in FIGS. 1 and 5B), and is effective to apply a force to the instrument in both the proximal and distal direction.

As depicted in Fig 4, the proximal counterbore (19) of the hollow handle (11) mates with the surface (48) of the impaction head (43) (FIG. 3D) using a variety of attachment mechanism. These attachments for example may be welded, adhesively secured or mechanically connected by threads to make a rigid assembly of hollow handle (11) and proximal impaction end (41). The hollow handle (11) has an outer surface and inner surface (18) with inner diameter d_{HI} which runs from distal end of the proximal

counterbore (19) to the proximal end of the distal counterbore (20) (FIG. 4). The distal counterbore (20) of the hollow handle has diameter d_{H2} and depth l_{H1} .

When hollow handle (11) moves in extreme distal position (FIG. 5A) from the user, the cylindrical protrusion (141) of the distal quick connect member fits into the distal counterbore (20) having the diameter d_{H2} (FIG. 4) of the hollow handle (11). The diameter d_{Q1} is less than the diameter d_{H2} (FIG. 4) to allow free movement of the hollow handle (11) while the distal end surface (17) approaches the proximal quick connect cap surface (140). The cylindrical protrusion (141) has a length l_{Q1} (shown in FIG. 3C) that is the overhanging length of the cylindrical protrusion (141) from the surface (140). The length l_{Q1} is less than the length l_{H1} which ensures that the distal end surface (17) (FIG. 3A) flushes with the proximal quick connect cap surface (140) when the hollow handle (11) is moved toward extreme distal location (shown in FIG. 5A).

As shown in FIG 4 there is central shaft of diameter d_{S1} slidably disposed inside the inner surface (18) of the hollow handle having inner diameter d_{H1} . The inner diameter d_{H1} of the hollow handle (11) allows the central shaft (21) of diameter d_{S1} to slide freely in the proximal-distal direction. The difference between the diameter d_{S1} and the diameter d_{H1} is generally in the range 0.1 mm to 0.2 mm, and preferably about 0.125 mm. This difference in diameter guides the hollow handle (11) to be perfectly axial to the central shaft (21) during its proximal-distal articulation. The length l_{S1} of the central shaft (Fig 3B) is the distance between the central shaft distal end (28) and the distal wall (24) of the diameter d_{S1} . The length l_{S1} defines the movable length allowed to the hollow handle (11) while it acts as an extractor.

25

The distal wall (24) of the central shaft lies flush with the inner wall (16) of the hollow handle (11) (FIG. 3A and FIG. 4) in the extreme proximal position. The distal wall acts as the stopping feature which prevents the hollow handle (11) from ejecting out.

There is an anti-rotation pin (101), which can pass through the option through hole of handle into the slot (25) of the central shaft which is along the length l_{S1} . The function of the anti-rotation pin is to restrict the hollow handle (11) from rotating during proximal-distal articulation. The anti-rotation pin (101) can be fixed in the through hole (13) using welding or adhesive. The anti-rotation pin (101) can have a variety of shapes, but is

30

preferably cylindrical. An alternate anti-rotation pin of oval shape is shown in FIG. 7B and FIG. 7C. The anti-rotation pin (101) can have any shape unless it conforms to the shape of the slot (25) and provides adequate strength to restrict the rotation of the hollow handle (11) while in proximal-distal actuation.

5

The proximal end (29) of the central shaft (21) includes an optional bullet shaped tip (22) and a neck region (23). The bullet tip (22) acts as a guiding feature for the central shaft to facilitate entry into the proximal button (42) through the proximal button hole (45) of the proximal button (42). The neck region (23) is the feature that locks the proximal
10 button (42) under the spring force from the proximal spring (111) (FIG. 3D).

The tip can have different shape. An alternate flat tip (222) (FIG. 6A) can also be used. The shape of the tip (22, 222) defines the mechanism by which the proximal end of the central shaft locks into the proximal button (42). For example, when tip is bullet shaped,
15 the hollow handle (11) can easily lock into place without pressing the proximal button (42).). However for the flat tipped (222) central shaft force need to be applied on the surface (44) of the proximal button (41) to lock the hollow handle (11).

At the distal end (28) of the central shaft the quick connect cap (33) is mated to the
20 central shaft (21) by using the locking pin (104) passing through attachment hole (37) in the quick connect cap (33) and the attachment hole (26) in central shaft (21) depicted in FIG. 3B. The locking pin (104) is welded to make a permanent attachment of the quick connect cap (33) and the central shaft (21). The central shaft (21) also comprises central bore (27) (FIG.3B and FIG.4) that acts as a drilled hole made to reduce the overall mass of
25 the central shaft (21).

The hollow handle (11) can optionally include a plurality of air flow cut outs (14) extending from the outer surface (15) to the inner surface (18) (FIG 3A). These cut outs are not only effective in preventing the buildup of pressure within the hollow handle
30 (11) and proximal impaction end (41) assembly but also effectively allow the hollow handle (11) and proximal impaction end (41) assembly to slide freely between the central shaft proximal end (29) and central shaft distal end (28) shown in FIG. 3B. Further the cut outs (14) are also helpful in achieving desired/optimum mass and size of the hollow

handle (11). In addition, the cut outs (14) facilitate easy cleaning of the instrument. The cut outs (14) can have any shape and size, and can be formed anywhere along the length.

FIG 4 along with FIG 5A depicts the embodiment for the conversion of universal impactor with slap hammer from extractor to impactor. In FIG 4 the hollow handle (11) is shown at a location nearing the extreme proximal length of its allowable movement whereby the distal wall (24) of the central shaft (21) is approaching the inner wall (16) of the hollow handle (11). The hollow handle (11) is disposed around the central shaft (21) and is guided axially by the diameter d_{SI} sliding inside diameter d_{HI} when the universal impactor with slap hammer tool (10) is used as an extractor. The presence of anti-rotation pin (101) (FIG. 4) prevents the rotation of the hollow handle (11) thereby providing a better extraction grip tactile feeling. The proximal button (42) is pushed outside the impaction head (43) due to the presence of the spring (111) constrained by the locking pin (106). When the distal end surface (17) (FIG. 4) of the hollow handle (11) moves distally towards the proximal quick connect cap surface (140); simultaneously at the proximal end; the bulleted tip (22) of the central shaft comes in contact with the proximal button hole (45) at the proximal end of hollow handle.

On further movement, the neck region (23) snaps in the proximal button hole (45) due to the springing action of spring (111) and the entire universal impactor with slap hammer (10) takes the configuration as shown in FIG. 5A. For the proximal quick connect cap surface (140) to flush with the distal end surface (17), the diameter d_{QI} should be less than the diameter d_{H2} and the length l_{QI} (FIG. 3C) should be less than length l_{HI} . Universal impactor with slap hammer acts as impactor in the configuration depicted in Fig 5A. The impaction force applied on the proximal impaction surface (49) of the said impactor using a mallet (not shown) is transferred to the medical instrument (100) attached at the modular attachment site (38).

The same locking mechanism can be used to convert the universal impactor with slap hammer (10) from impactor configuration into extractor configuration of the by just pushing the surface (44) of the proximal button (42) thereby moving the spring (111) downward. This downward movement of the spring creates the room to move the tip of the central shaft out from the proximal button hole (45) thereby enabling the central shaft

to slide along proximal-distal direction such that the instruments said device can be converted into the extractor configuration (5B). The universal impactor with slap hammer (10) can have a variety of configurations. For example, the hollow handle (11) can also be disposed around a portion of the central shaft (21), positioned along distal side of the central shaft (21) from the user, or positioned proximal side of central shaft (21) from the user.

FIG. 6A is a perspective view of the central shaft (11) disclosed in FIG. 3B showing an alternative proximal end and shaft body. Fig 6B is a perspective view of the universal impactor with slap hammer (210) containing the flat end central shaft (221) instead of the central shaft (21) shown in FIG. 2. The flat end central shaft (221) contains two variations with respect to the central shaft (21). The bullet shaped tip (22) of the central shaft (21) has been removed to accommodate a flat tip (222). This variation changes the way the universal impactor with slap hammer (10) is locked and converted into an impactor. The proximal button (42) needs to be pressed by applying force on the surface (44) (FIG. 3D) to facilitate the flat tip (222) to pass through the proximal button hole (45) and in turn get locked. In case of the bullet shaped tip (22) (FIG. 3B) of the central shaft (21), the bulleted tip (22) can pass through the proximal button hole (45) without applying force on the surface (44) due to the profile of the bulleted tip (22).

20

The bullet shaped tip (22) is advantageous for specific surgery needs where only a single slap-out action is required every time, as the bullet shaped tip (22) helps in auto-locking for every slap-out whereas flat tip (222) allows flexibility for multiple slap-out actions till the desired extraction action is complete.

25

FIG 6B shows another variation in the flat ended central shaft (221) in which the slot (25) is absent from the similar central shaft (21). For the central shaft (221) the hole (226) is equivalent to the attachment hole (26) (FIG. 3B). Similarly, neck (223) is equivalent to neck (23) shown in FIG. 3B. The distal wall (224) is equivalent to the distal wall (24) shown in FIG. 3B except that in this variation of the central shaft (221), the distal wall (224) is split into two surfaces separated by the ridge (225). The hollow handle (211) of the universal impactor with slap hammer (210) is free to rotate in addition to the permissible proximal-distal articulation. The locking of the instrument (210) in the

30

impactor mode, needs proximal button to be pressed unlike the locking mechanism of the universal impactor with slap hammer (10).

FIGS. 7A, 7B and 7C show an alternate variant of the universal impactor with slap hammer (10) of FIG. 1 and FIG. 2. This alternate variant is called magnetic impactor with slap hammer (310). FIG. 7A shows the assembled view of the magnetic impactor with slap hammer (310), while the FIG. 7B shows the dissembled view and FIG. 7C depicts the cross section view of the magnetic impactor with slap hammer (310) when assembled.

The magnetic impactor with slap hammer (310) comprises an integrated shaft and magnetic quick connect cap (321), a magnetic hollow handle (311), an anti-rotation pin (401), a distal button (32), locking pins (102 and 103) and spring (110) (not shown). The entire proximal impaction end (41) which housed the locking mechanism is removed.

The hollow handle comprises of single or multiple magnets (312) on its distal wall (313) as depicted in FIG 7A, while multiple magnets are on the proximal wall of the integrated shaft and magnetic quick connect (321). The locking of the magnetic hollow handle (311) to the integrated shaft and magnetic quick connect (321) is achieved by using magnet (312) (FIG. 7A) and (322) (FIG. 7B) on the distal wall (313) of the hollow handle (311) and the proximal wall (323) of the integrated shaft and magnetic quick connect (321). The anti-rotation pin (401) assembles in the magnetic hollow handle (311) and performs dual function; one of being an anti-rotation member and second of keeping the integrated shaft and magnetic quick connect (321) and magnetic hollow handle from disassembling.

This alternate embodiment of the medical instrument impacting/extracting tool (10) reduces the overall weight and expanse of the instrument making it more convenient to use. The presence of magnetic locking allows the surgeon to effectively use the instrument for applications where he needs locking after every extraction slap to review the surgical site. The magnets (312) should be positioned in a manner that the poles are aligned to attract and not repel.

FIGS. 8A, 8B and 8C show another alternate variant of the universal impactor with slap hammer (10) of FIG. 1 and FIG. 2. This alternate variant is called variable length impactor with slap hammer (410) and uses a threaded central shaft (421) and slap length nut (450) to achieve variable slap length. FIG. 8A shows the perspective view of the variable length impactor with slap hammer (410) while FIGS. 8B and 8C shows the cross sectional view of the variable length impactor with slap hammer (410) in open and closed positions, respectively. The variable length impactor with slap hammer (410) comprises of a threaded central shaft (421), distal quick connect end (31), proximal impaction end (41), slotted handle (411), distal button (32), proximal button (42), slap length nut (450), locking pins (102 and 103) and springs (110 and 111).

The extraction force that can be applied using the impactor with slap hammer (10) or any of its variants (210, 310 and 410) directly depends on the slap length l_{S1} (FIG. 3B). For applications where only a fraction of the total extraction force available via the impactor with slap hammer (10) is required; altering the slap length l_{S1} provides the flexibility. Variable length impactor with slap hammer (410) serves the purpose of providing a system where the slap length l_{S1} can be varied.

The presence of slap length nut (450) over the threaded central shaft (421) allows the fixed slap length l_{S1} (shown in FIG. 3B) to be converted to variable slap length l_{SH1} (shown in FIG. 8B). The slap length nut (450) consists of internal threads (452) that mate with the external threads (460) on the threaded central shaft. The slap length nut (450) can be moved from distal end of threaded central shaft (421) to the proximal end of the threaded central shaft (421) by rotating it through the cut out (414). When the slap length nut (450) is at the distal end of the threaded central shaft (421), the variable slap length l_{SH1} becomes zero and when the slap length nut (450) is at the proximal end of the threaded central shaft (421), the variable slap length l_{SH1} becomes maximum and is equal to the fixed slap length l_{S1} (shown in FIG. 3B).

The distance between the distal surface (451) of the slap length nut (450) and the inner wall (16) defines the variable slap length l_{SH1} . The slotted handle (411) has the freedom to move axially over the threaded central shaft (421) until the inner wall (16) flushes with the distal surface (451) of the slap length nut (450). For the system to be functional, the

outer diameter d_{LNI} of slap length nut (450) is less than the inner diameter d_{HI} of slotted handle (411). The inner diameter d_{HI} of the slotted handle (411) allows the outer diameter d_{LNI} of slap length nut (450) to slide freely in the proximal-distal direction. The difference between the diameter d_{LNI} and the diameter d_{HI} is generally in the range 0.1 mm to 0.2 mm, and preferably about 0.125 mm. This difference in diameter guides the slotted handle (411) to be perfectly axial to the threaded central shaft (421) during its proximal-distal articulation.

FIGS. 9A and 9B show another alternate variant of the variable length universal impactor with slap hammer (410) of FIG. 8A through 8C. This alternate variant uses a holed central shaft (521) and slap length pin (550) to achieve variable slap length. FIG. 9A shows the perspective view of the variable length impactor with slap hammer (510) while FIGS. 9B shows the cross sectional view of the variable length impactor with slap hammer (510) in open position.

The variable length impactor with slap hammer (510) comprises of a holed central shaft (521), distal quick connect end (31), proximal impaction end (41), slotted handle (411), distal button (32), proximal button (42), slap length pin (550), locking pins (102 and 103) and springs (110 and 111).

The extraction force that can be applied using the impactor with slap hammer (10) or any of its variants (210, 310, 410 and 510) directly depends on the slap length l_{SI} (FIG. 3B). For applications where only a fraction of the total extraction force available via the impactor with slap hammer (10) is required; altering the slap length l_{SI} provides the flexibility. Variable length impactor with slap hammer (510) serves the purpose of providing a system where the slap length l_{SI} can be varied.

The presence of slap length pin (550) inserted into the holed central shaft (521) allows the fixed slap length l_{SI} (shown in FIG. 3B) to be converted to variable slap length. The slap length pin (550) can be inserted into any of the variable length holes (560) present in the holed central shaft (521). The variable length holes (560) are located at calibrated distance along the length of the central shaft (521) and provide site to insert slap length pin (550) to control the slap length by accessing it through the cut out (414). The slap length pin

(550) can be inserted in any of the variable length holes (560) by withdrawing it from one of the variable length hole (560) and inserting it into another variable length hole (560). When the slap length pin (550) is at the distal most hole of the holed central shaft (521), the variable slap length becomes zero and when the slap length pin (550) is at the proximal most hole of the holed central shaft (521), the variable slap length becomes maximum and is equal to the fixed slap length l_{s1} (shown in FIG. 3B).

Referring back to FIG. 1, the instrument (10) has a modular attachment site (38) adapted to mate to a medical device (100). The instrument (10) can be used with a variety of medical devices, and thus can include virtually any type of modular attachment site (38) effective to mate to the desired medical device. Although the invention is described with reference to use with a bone removing instrument, any type of broaching device can be used. In addition, it is understood that the impacting tool of the invention can be used with virtually any medical instrument having any configuration, especially those used during joint surgery. For example, the impacting tool can be used with prosthesis placement tools, bone preparation instruments, implant removal tools, spreader devices, and the like. Exemplary medical instruments include chisels, rasps, broaches, saws, spreaders, and trial implants.

In another variant, the instrument universal impactor with slap hammer (10) itself is a standalone device having the medical device (100) integral to its construct and not as a modular attachment. In this condition, all the medical devices (100) that have an impaction and extraction application can have the mechanism of impactor with slap hammer (10) inbuilt into them, thereby saving surgical time in attachment and detachment.

The invention is not to be limited by what has been particularly shown and described by way of examples:

Example 1:

The distal quick connect mechanism (31) is connected to the central shaft (21) by means of locking pin (104). The hollow handle (11) is then rigidly connected to the proximal impaction end (41) to form an integrated hollow handle. The mode of fixing may be a

temporary fixture including by way of threading to screw the proximal impaction end in place or holding in place through the use of holding pins etc. A surgical instrument of choice is fitted into the distal end (33) of the distal quick connect mechanism by means of the locking mechanism located on the distal quick connect mechanism.

5

When the device is to be used in impactor mode, the central shaft is pushed into the integrated hollow handle till the tip at the proximal end of the central shaft clicks into the proximal impaction end locking it into place and thereby turning the device into an impactor. In this mode a mallet can be used on the impaction head (43) of the proximal
10 impaction end to hammer the said surgical instrument into the bone during surgery.

If the device is to be used in extractor mode to extract a surgical device or pins during surgery, the proximal button (42) on the proximal impaction end (41) is pressed to release the tip of the central shaft enabling the shaft to move within the integrated
15 hollow handle upto the predetermined length multiple times thereby giving the device a leverage to work in the extractor mode or to work as a slap hammer.

The surgical instrument fixed on the quick connect mechanism (31) can be removed and / or replaced by another surgical instrument by pressing the distal button (32) to release
20 the used surgical instrument. Both the distal button (32) on the distal quick connect mechanism (31) and the proximal button (42) on the proximal impact end (41) may be used as toggle buttons with one press fixing the implement and another press releasing the same.

25 **Example 2:**

In another embodiment, the proximal impactor end (41) can be permanently fixed on the hollow handle (11) such as by welding them together or by using adhesive to form a permanently integrated hollow handle.

30 **Example 3:**

Instead of using a mechanical locking system of converting the device into impactor mode by pushing the central shaft into the integrated hollow handle, the locking may also be achieved by using light magnets. The light magnets (322) may be positioned on

the respective rim or proximal wall (323) of the distal quick connect mechanism carrying the central shaft with the corresponding set of light magnets (312) on the rim or distal wall (313) of the integrated hollow handle, so that when the device is desired to be used in impactor mode, the central shaft is pushed into the integrated hollow handle till the
5 respective rims bearing the magnets meet affixing the central shaft to the integrated hollow handle. When the device is to be used in extractor mode, force is applied to push apart rims of the quick connect device and the integrated hollow handle to enable free movement of the central shaft inside the integrated hollow handle. In this embodiment, the proximal impactor end does not have the mechanical locking device including the
10 proximal button.

Example 4:

In some embodiments, the free movement of the length of the central shaft may be controlled by the surgeon. In these embodiments, the central shaft has a series of holes
15 at predetermined lengths along the central shaft. Depending on the length of the central shaft required to have proper leverage in slap hammer or extractor mode, a slap length pin (550) can be inserted through the hollow handle into the variable length hole (560) positioned on the central shaft (21).

20 In yet another embodiment, the central shaft (421) bears threads (460) on to which slap length nut (450) is manipulated through the hole cut outs (14, 414) on the hollow handle (11) to obtain the variable length of the central shaft to provide desirable leverage when using the device in slap hammer or extractor mode. (FIGS. 8A, 8B, 8C).

Example 5:

25 In yet another embodiment, the device can also be used as a standalone device. In this example, the surgical instrument is permanently fixed on to the central shaft so that the particular device can only be used in impactor or extractor mode for that one surgical device. In this kind of standalone use, the quick connect member is dispensable since it
30 is not required.

We claim:

1. Universal impactor with slap hammer device (10) for impacting and extracting during surgical procedure, said device comprising of hollow handle (11), central shaft (21), proximal impaction end (41) and quick connect mechanism (31)

said hollow handle (11) having inner surface (18) and outer surface (15) and proximal end (12) and distal end (17) wherein said proximal end (12) of the said hollow handle is engaged with said proximal impaction end (41) to form integrated hollow handle;

said central shaft (21) having proximal end (28) and distal end (29), said central shaft (21) being slidably engaged in a manner that the outer surface of said central shaft (21) is being slidably engaged with inner surface (18) of said hollow handle in a manner that said proximal end (28) of the central shaft is capable of being locked at proximal or distal end of the hollow handle (11) while said device is in impactor mode;

said distal quick connect mechanism member (31) having modular mechanism member (38) at the distal end to attach additional surgical instruments if so required;

said proximal impaction end (41) having locking mechanism to switch said device from extractor mode to impactor mode or vice versa;

wherein, proximal end (12) of said hollow handle is fixed to said proximal impaction end (41) creating a hollow cavity into which the outer surface of said central shaft (21) is being slidably engaged with inner surface (18) of said hollow handle in a manner that said proximal end (28) of the central shaft is capable of being locked with the proximal impaction end (41) while said device is in the impactor mode, while in extractor mode said locking mechanism allows the central shaft to release the hollow handle up to the predetermined movable length (l_{s1}) of the central shaft thereby enabling it to act as slap hammer.

2. Universal impactor with slap hammer device as claimed in claim 1, wherein said device is switched from the impactor mode to extractor mode or vice-versa by locking mechanism.

3. Universal impactor with slap hammer device as claimed in claim 2, wherein said locking mechanism is selected from mechanical locking mechanism (42) or magnetic quick connect (321) locking mechanism.
- 5 4. Universal impactor with slap hammer device as claimed in claim 3, wherein magnetic quick connect (321) locking mechanism allows for locking at proximal end or distal end,
wherein said locking at proximal end occurs due to presence of magnet at the flat tip (222) of said central shaft and at the location of impaction head central
10 hole (50) of said integrated hollow handle (11), or
wherein said locking at distal end occurs due to arrangement of magnets on distal rim of said integrated hollow handle (11) and proximal end of said quick connect mechanism (31)
- 15 5. Universal impactor with slap hammer device as claimed in claim 3 wherein mechanical locking mechanism comprises locking of said proximal tip of central shaft by pressing said proximal button (42) located on proximal impaction end (41).
- 20 6. Universal impactor with slap hammer device as claimed in claim 5, wherein said mechanical locking mechanism located on said proximal impaction end is selected from a variety of locking mechanisms including spring loaded button, rotating and unlocking screw or a taper lock.
- 25 7. Universal impactor with slap hammer device as claimed in claim 5 wherein said mechanical locking mechanism located on said proximal impaction end passively receives proximal tip end (22) of said central shaft when said tip is bulleted, or by positively pressing said mechanical locking mechanism as a toggle key to allow locking in and releasing, when said tip of said central shaft is flat.
- 30 8. Universal impactor with slap hammer device as claimed in claim 5 wherein said mechanical locking mechanism located on said proximal impaction end receives proximal tip end (22) of said central shaft locking in to facilitate use of said device

as impactor device, releasing said proximal tip end of said central shaft on pressing said mechanical locking mechanism to facilitate use of said device as extractor device.

- 5 9. Universal impactor with slap hammer device as claimed in claim 1 wherein said distal quick connect mechanism (31) has modular mechanism member (38) at the distal end to attach at least one surgical instrument (100, ..., n) which is adapted to lock into said modular mechanism member (38).
- 10 10. Universal impactor with slap hammer device as claimed in claim 9 wherein said surgical instrument is so configured as to be detachable or non-detachable from said central shaft (21).
- 15 11. Universal impactor with slap hammer device as claimed in claim 9 wherein said distal quick connect mechanism (31) at distal end of said central shaft (21) is replaced by surgical instrument.
- 20 12. Universal impactor with slap hammer device as claimed in claim 1, wherein said hollow handle is capable of being rotated or prevented from being rotated by use of at least one anti-rotation mechanism.
- 25 13. Universal impactor with slap hammer device as claimed in claim 12, wherein said anti-rotation mechanism is selected from use of anti-rotation pin to provide rotational constraint to said handle during proximal-distal articulation or anti-rotation features inherent to the structure of central shaft (21), hollow handle (11) or both.
- 30 14. Universal impactor with slap hammer device as claimed in claim 1 wherein said central shaft has a plurality of mechanisms to allow variable slap length to provide required extraction force with corresponding calibration on said hollow handle (11) easily visible to surgeon.

15. Universal impactor with slap hammer device as claimed in claim 14, wherein said mechanism is selected from central shaft with threading (460) and central shaft with holes.
- 5 16. Universal impactor with slap hammer device as claimed in claim 15, wherein said central shaft is provided with threading (460) along with adjustable slap length nut (450) to adjust the available length of said central shaft (21).
- 10 17. Universal impactor with slap hammer device as claimed in claim 15, wherein said central shaft is provided with a plurality of variable length holes (560) located at calibrated distance along the length of the holed central shaft (521) into which slap length pin (550) is inserted to adjust the available length of said central shaft.
- 15 18. Universal impactor with slap hammer device as claimed in claim 1 wherein said proximal impactation end (41) is engaged with said hollow handle (11) by way of temporary engagement means or by welding to form said integrated hollow handle.

FIGURE 1

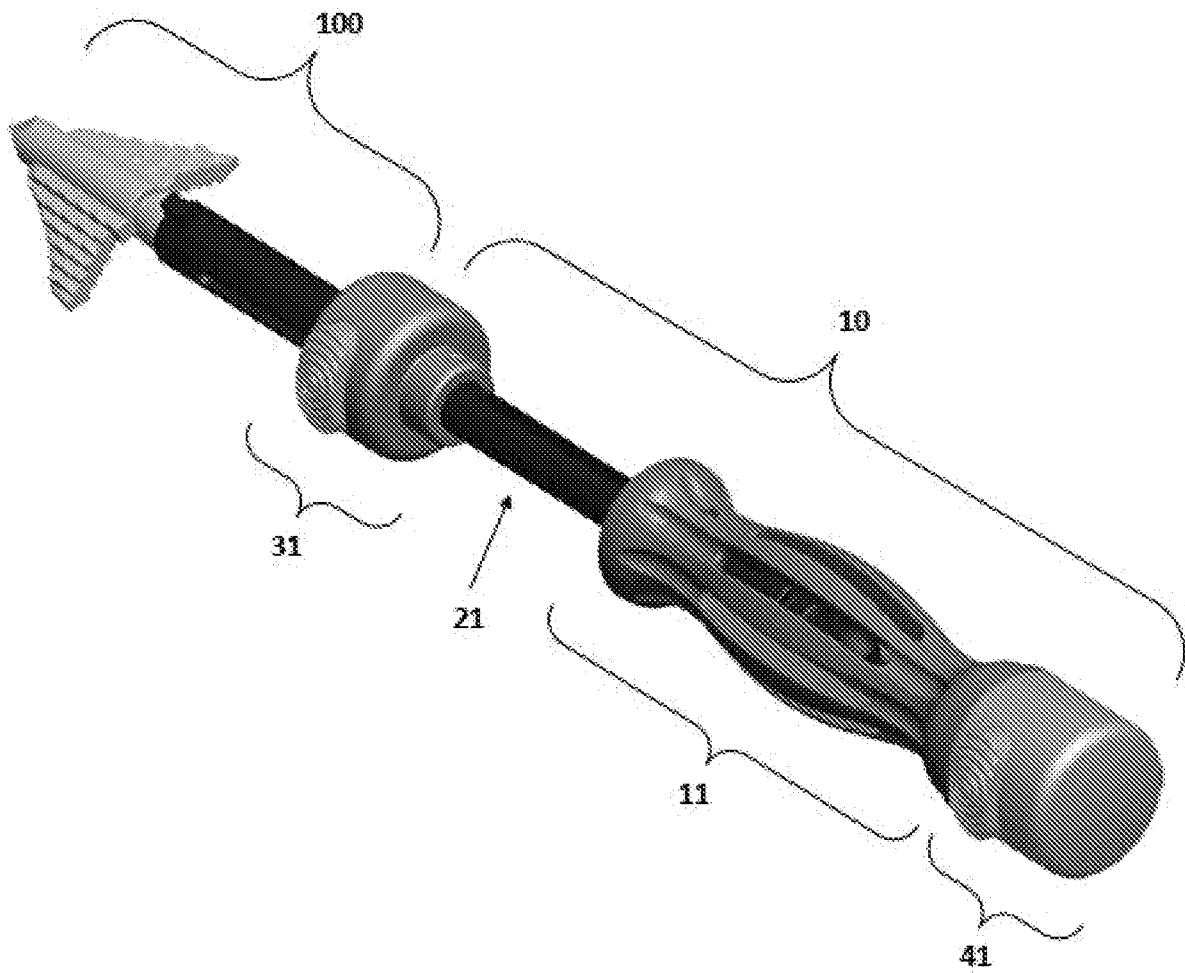


FIGURE 2

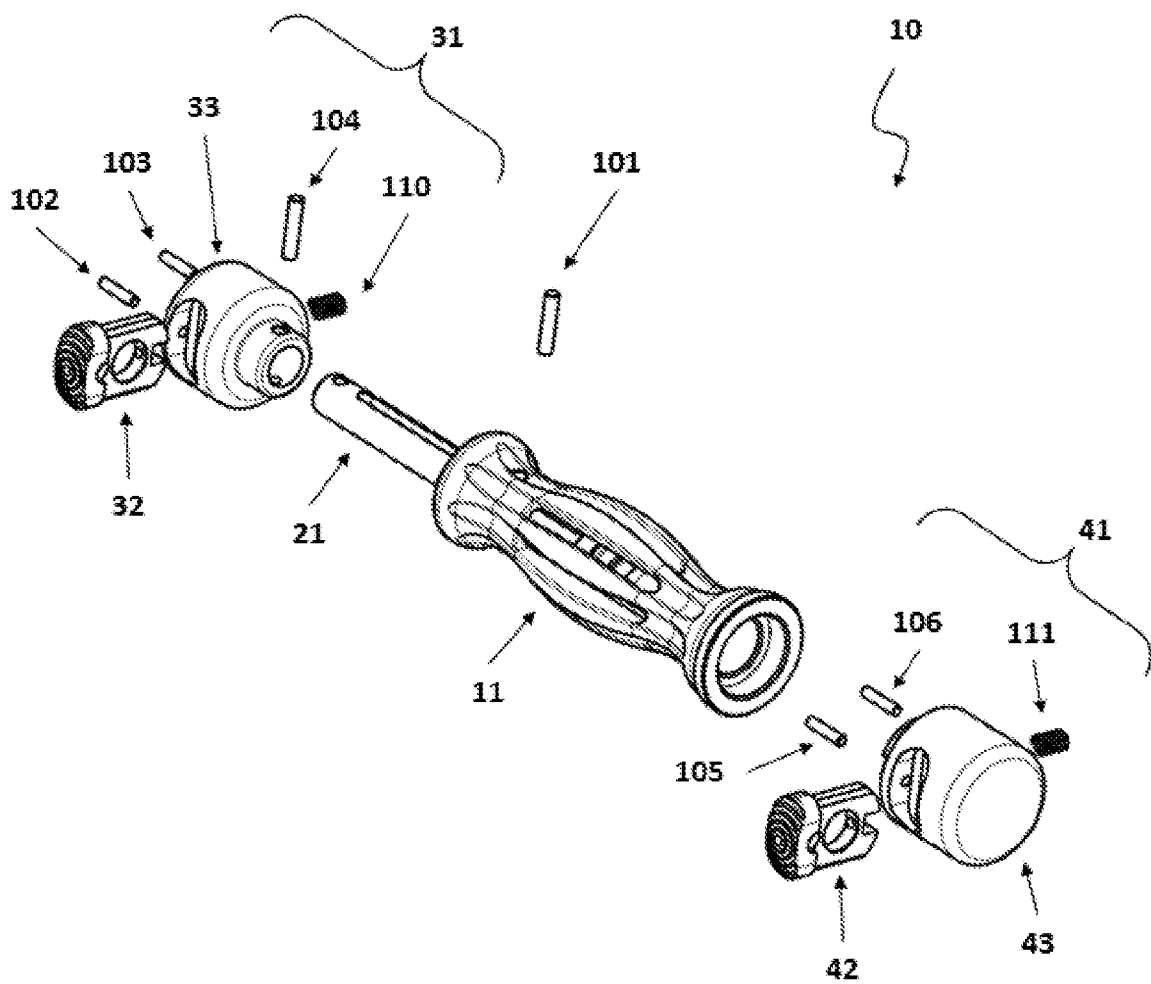


FIGURE 3A

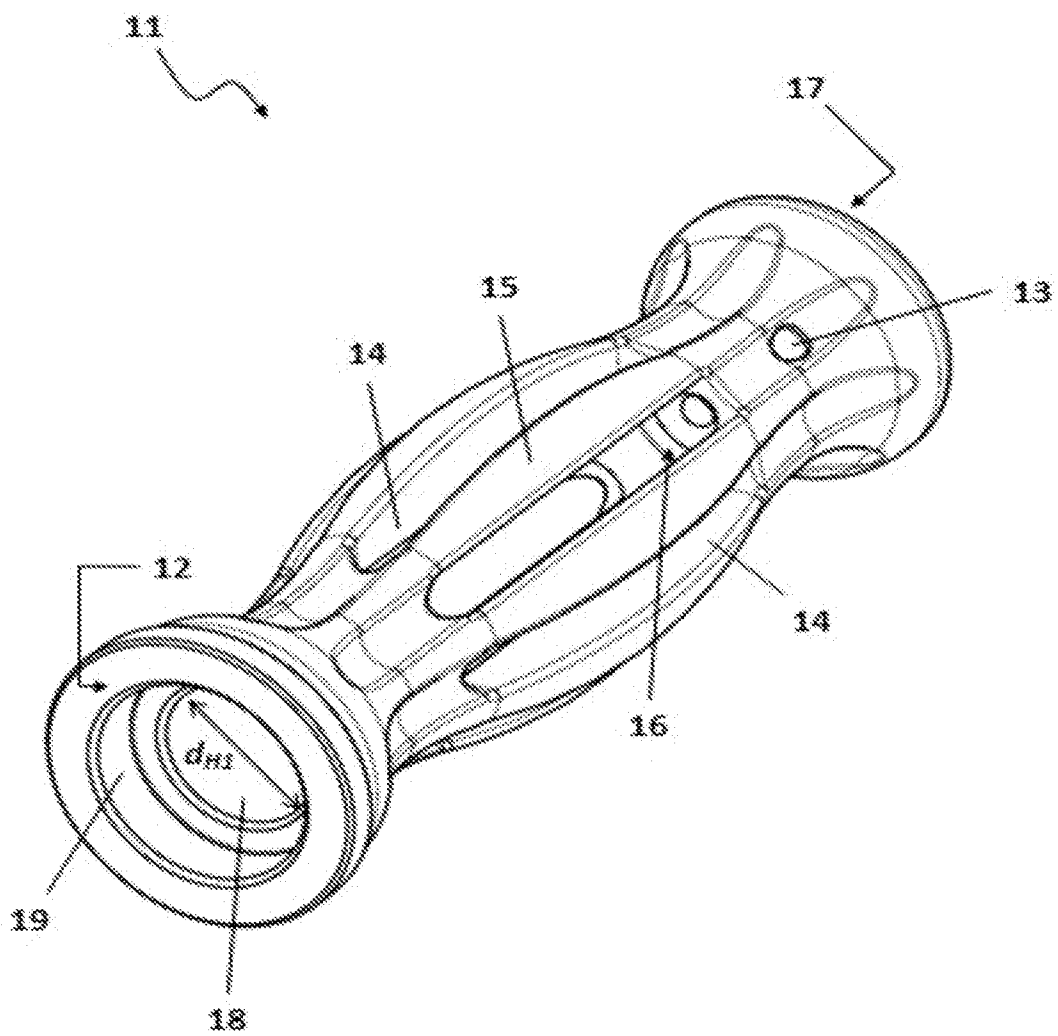


FIGURE 3B

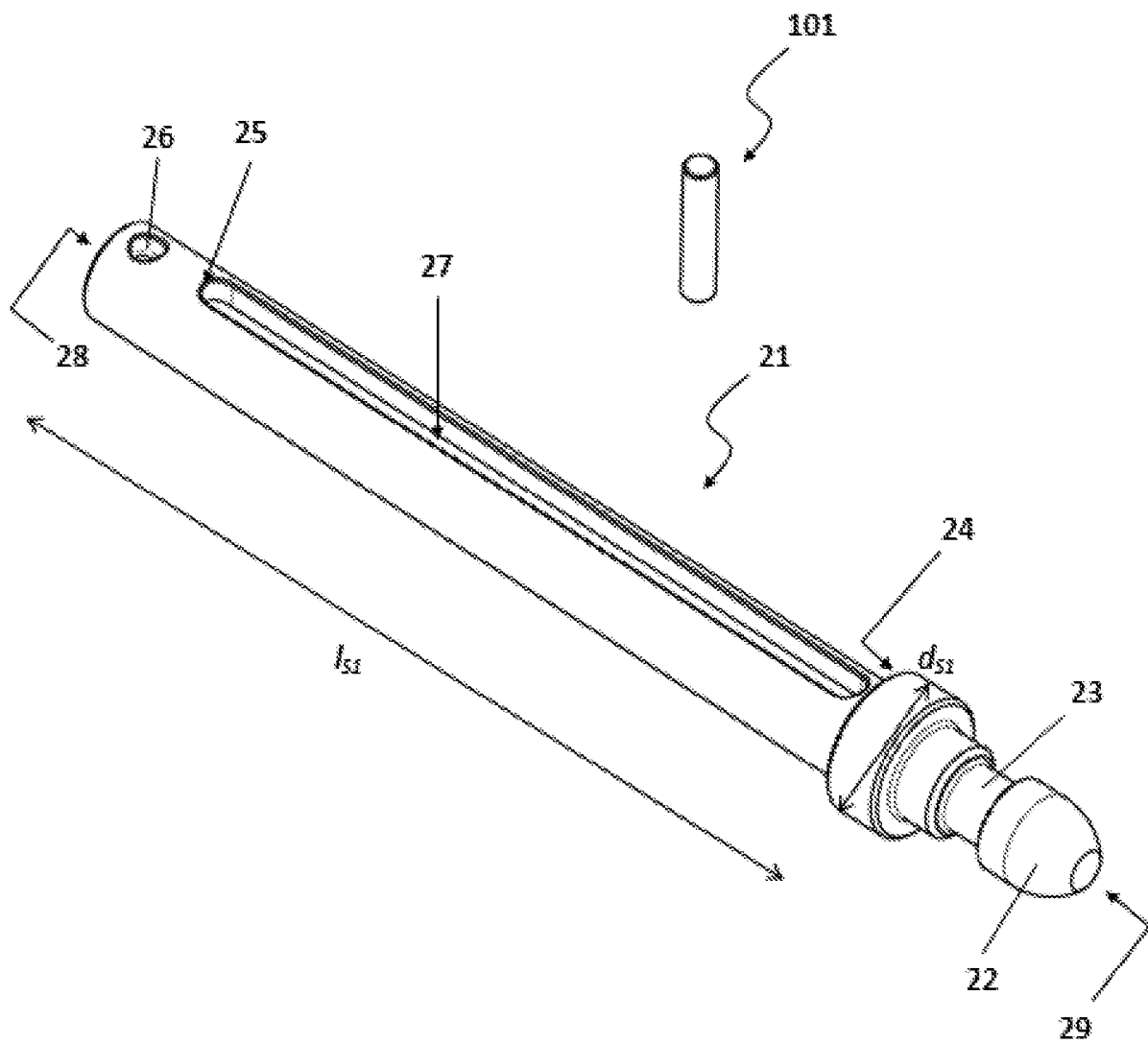


FIGURE 3C

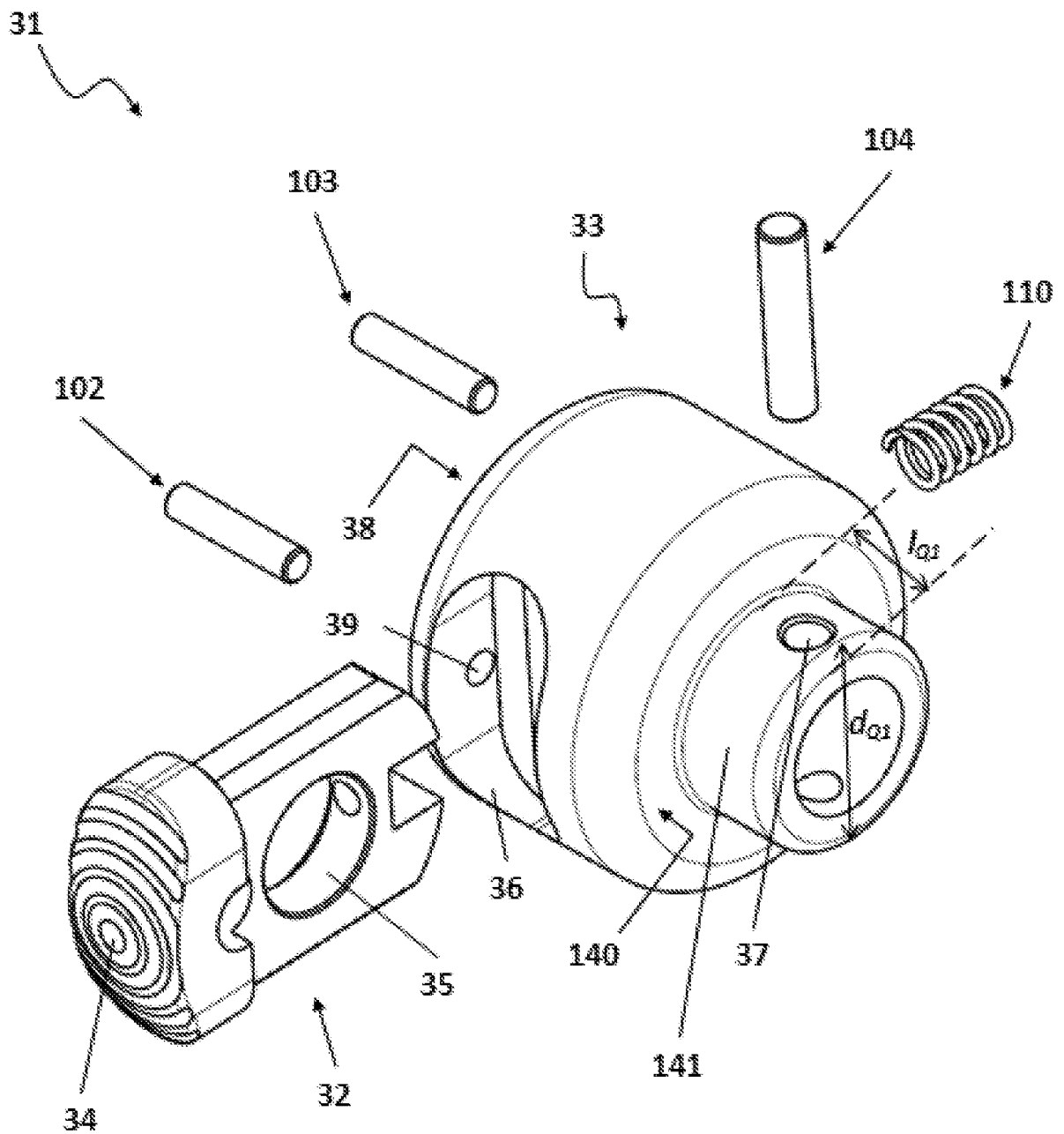


FIGURE 3D

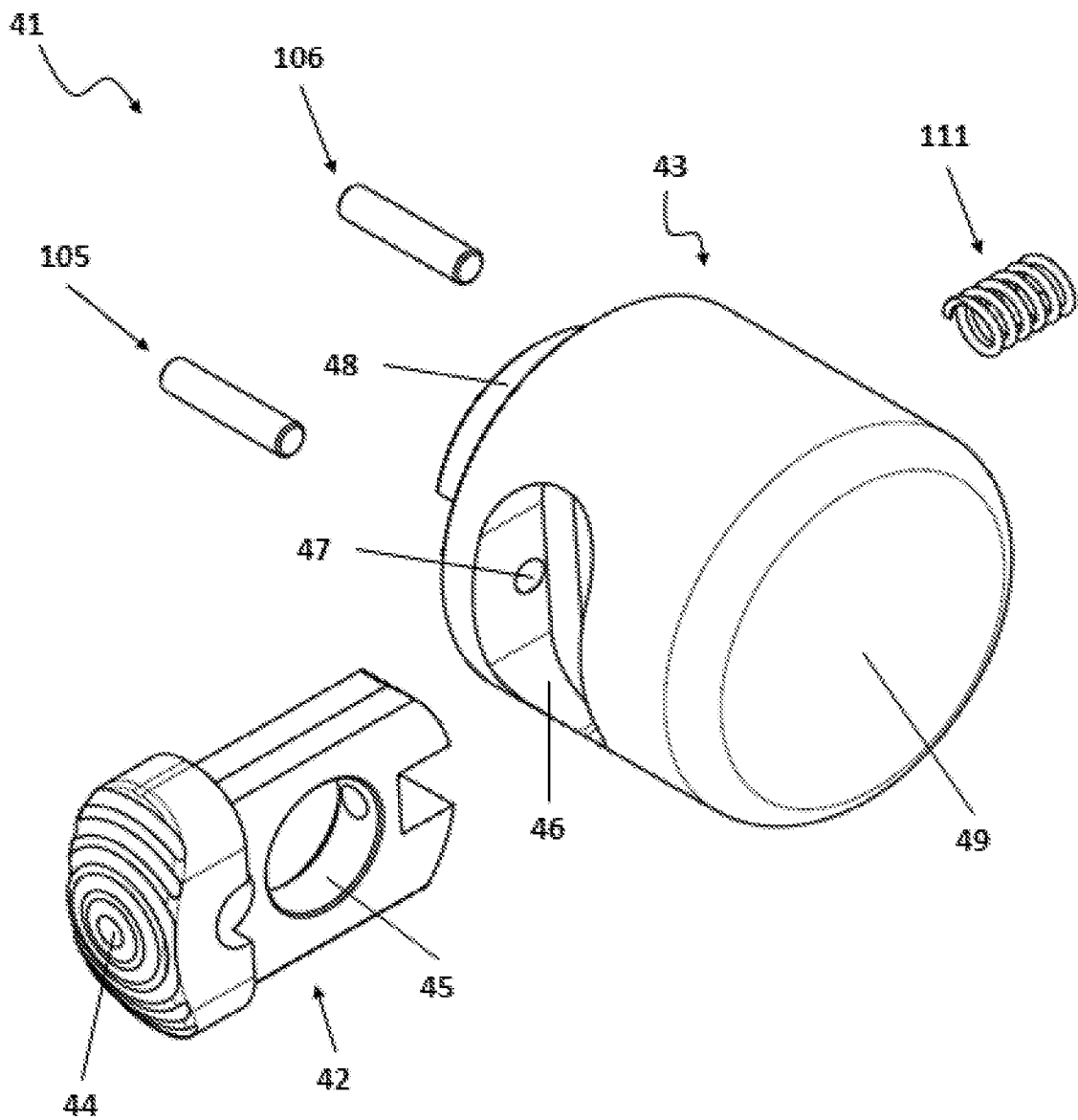


FIGURE 5A

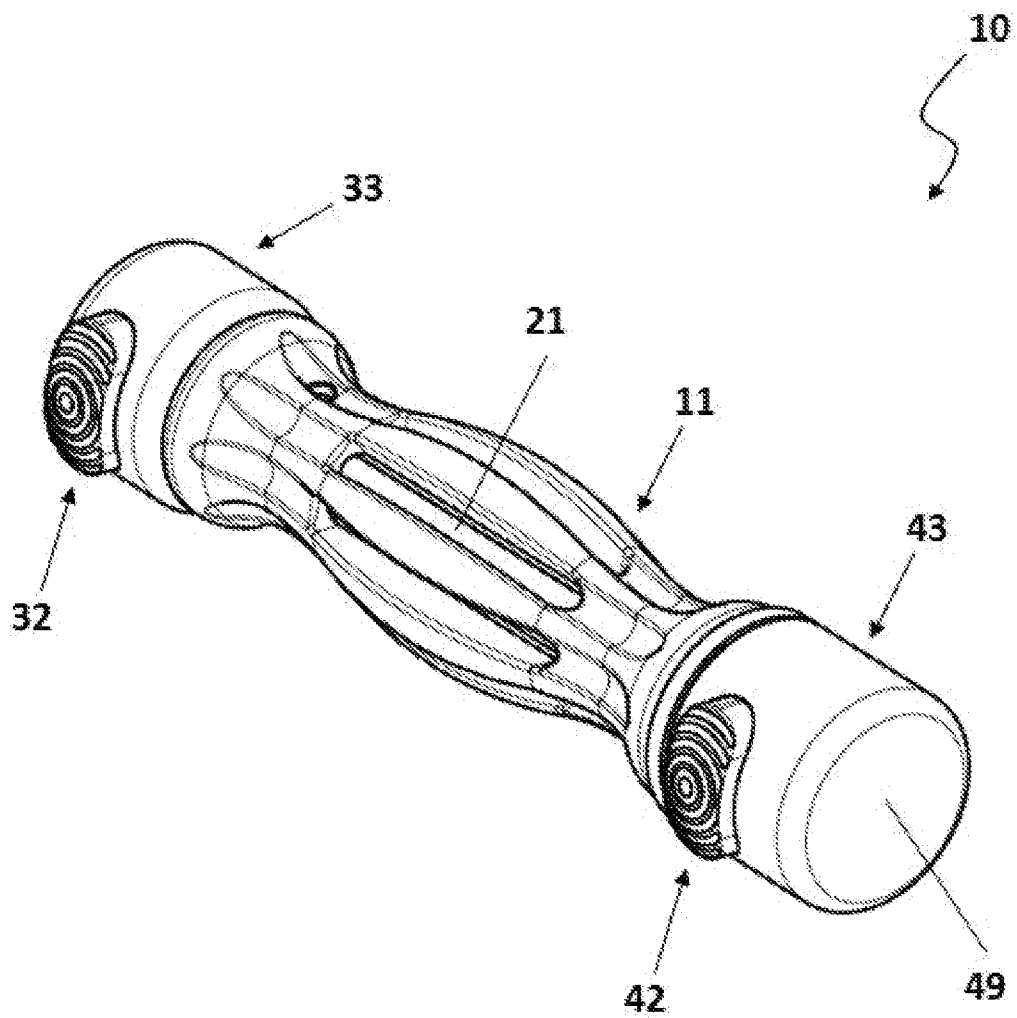


FIGURE 5B

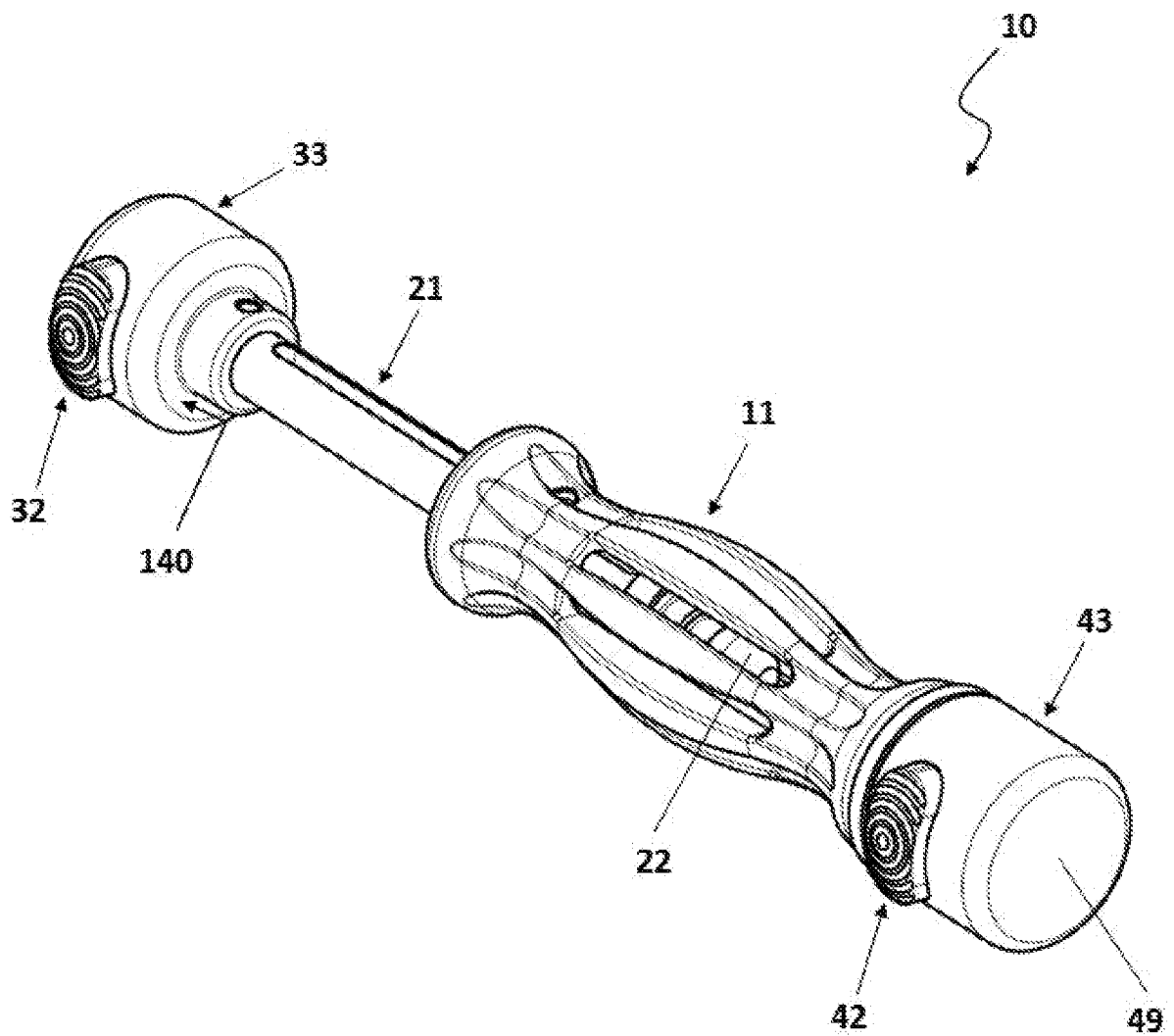


FIGURE 6A

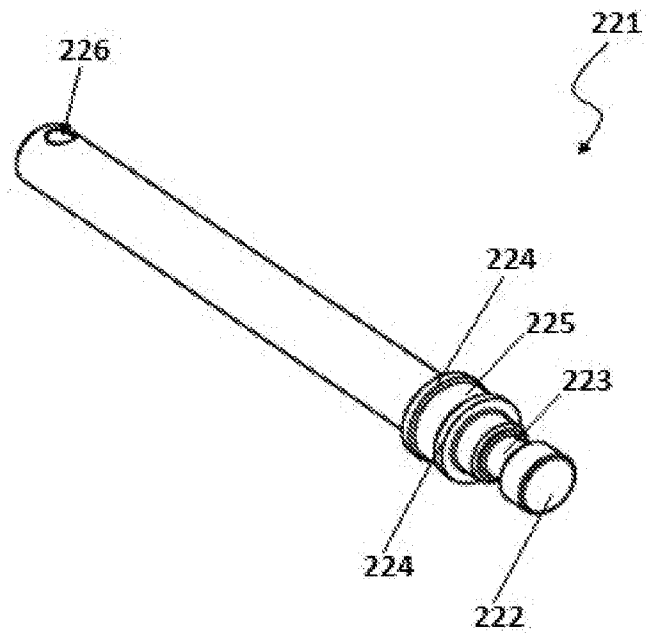
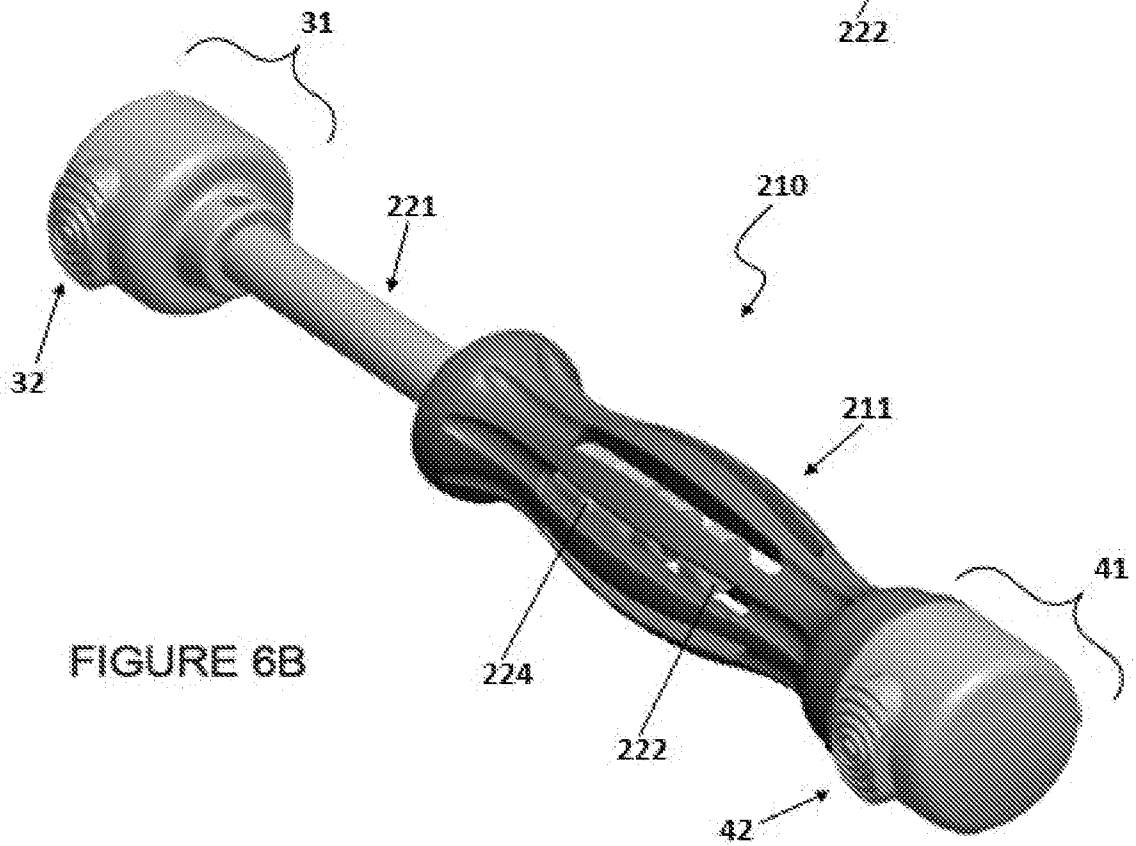


FIGURE 6B



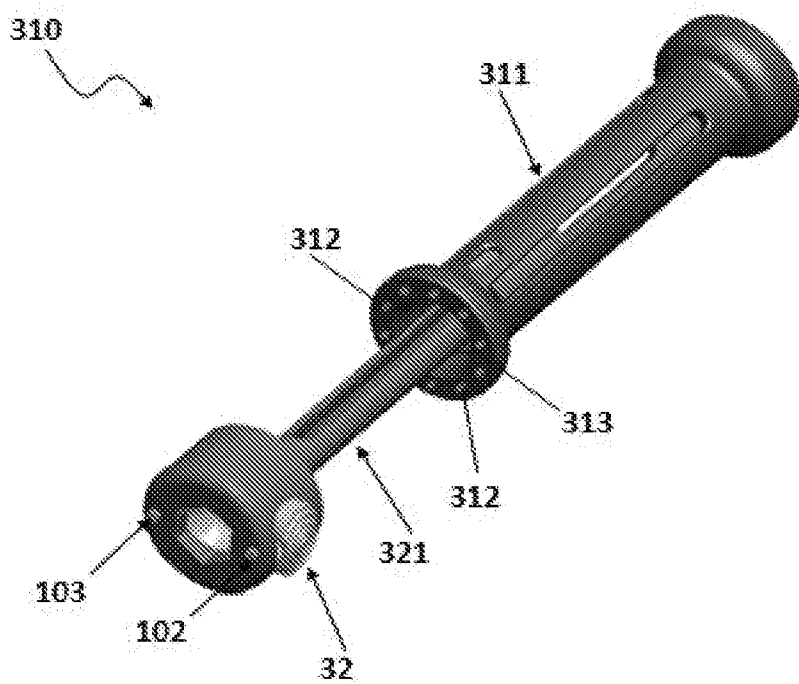


FIGURE 7A

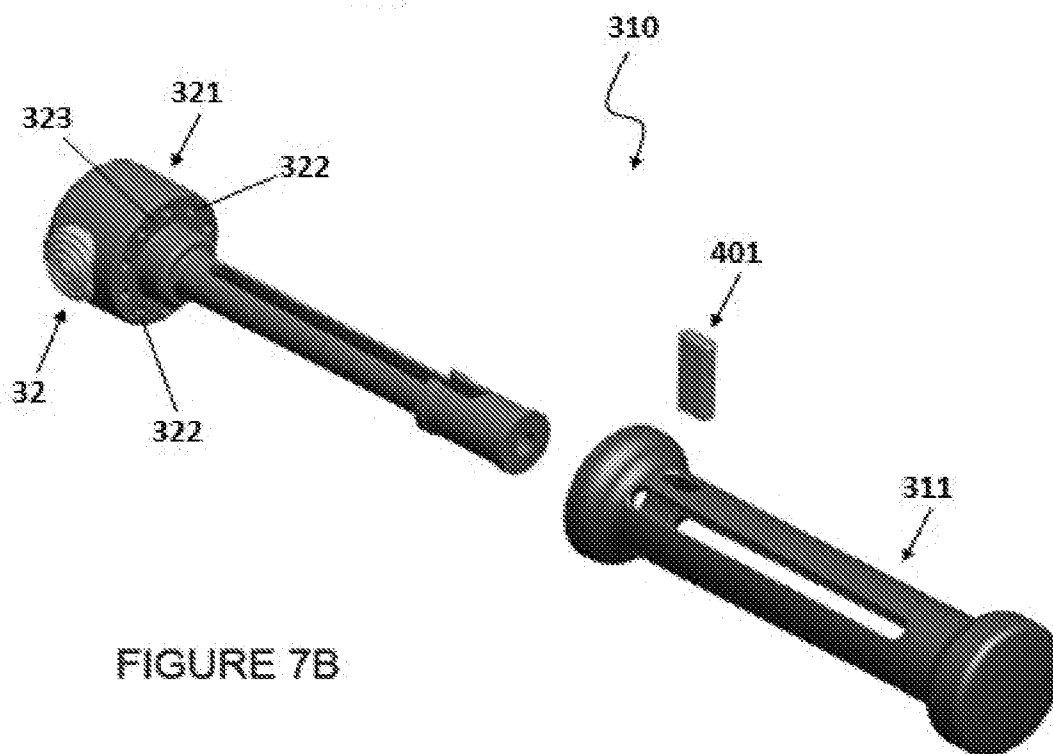
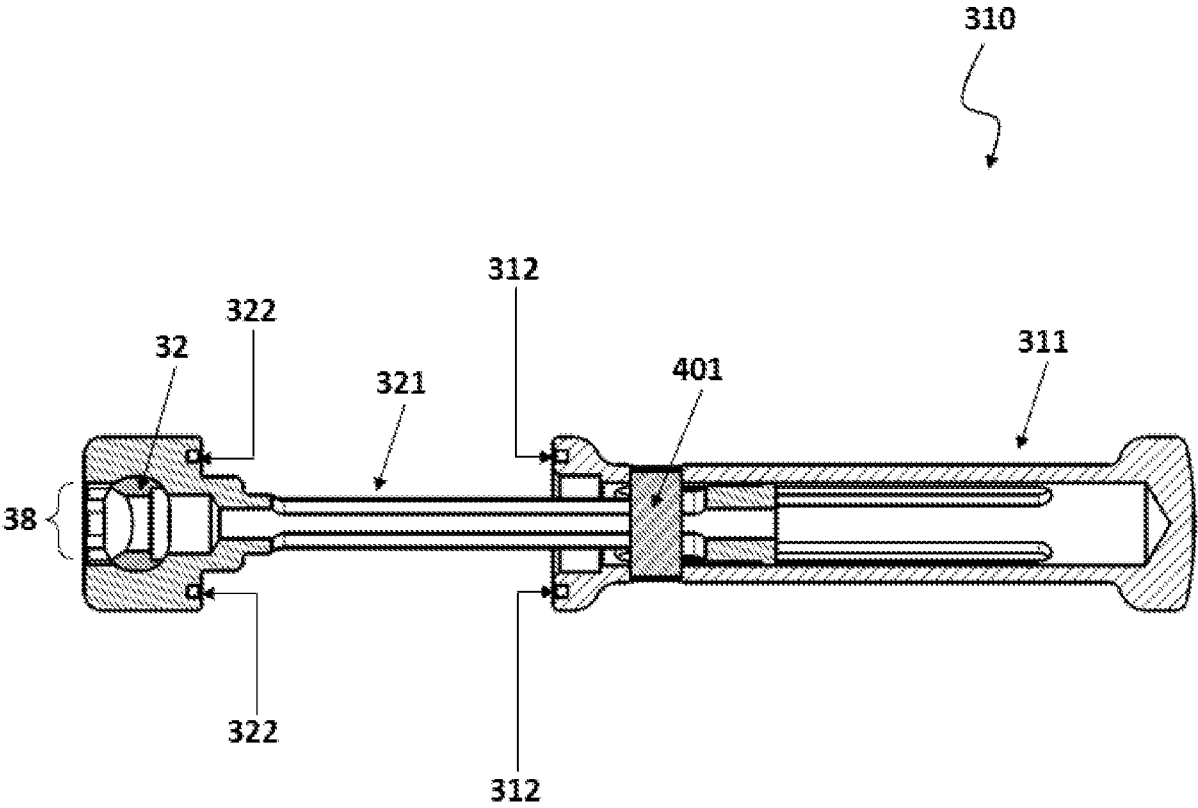
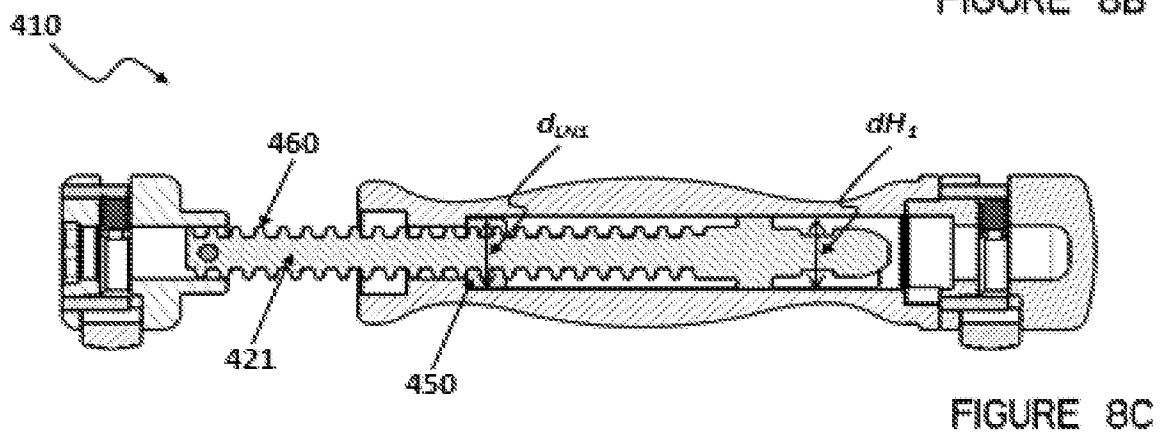
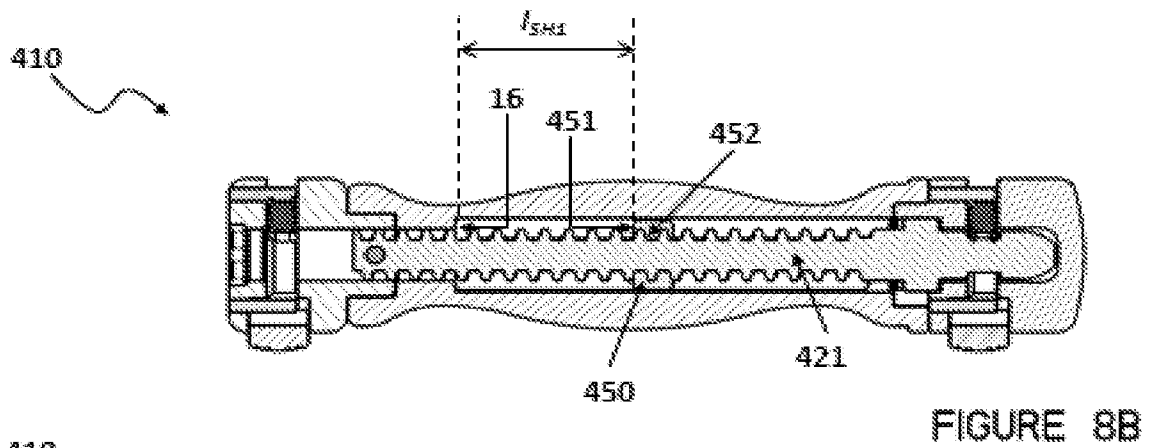
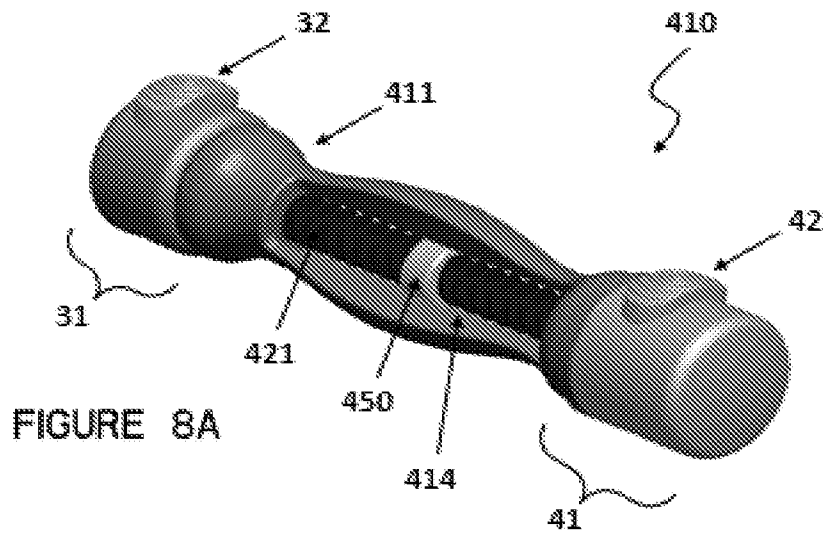


FIGURE 7B

FIGURE 7C





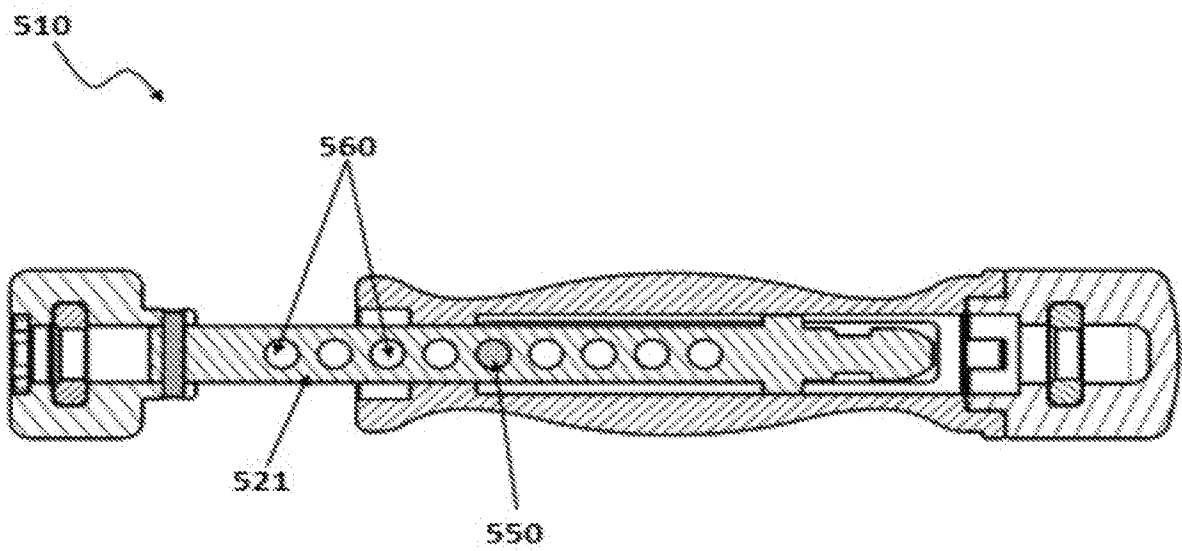
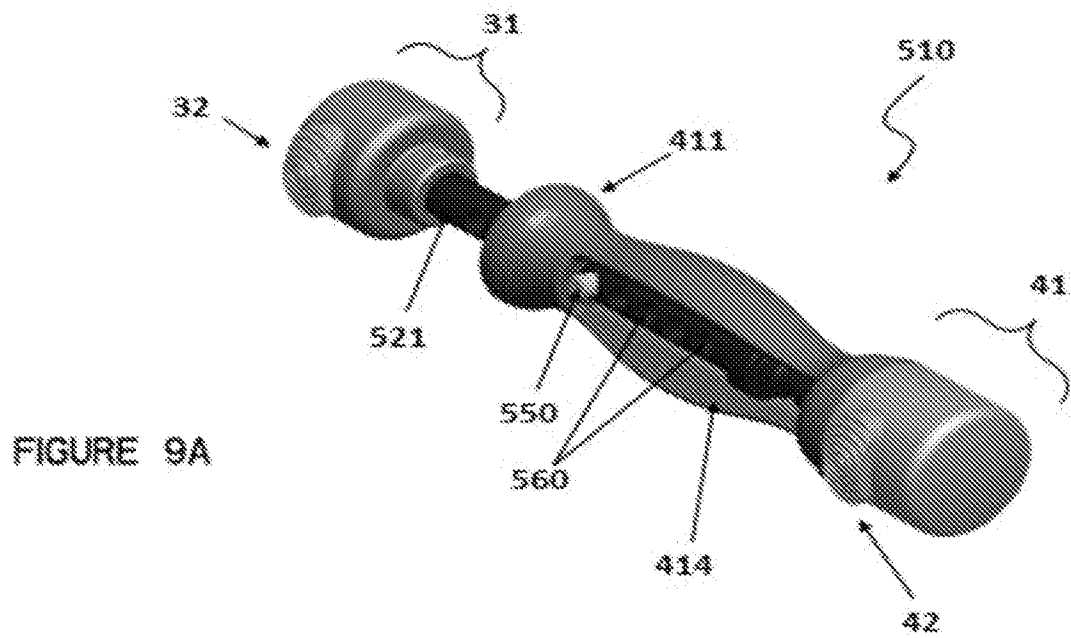


FIGURE 9B

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/060900

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/92
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006/178673 A1 (CURRAN PETER [GB]) 10 August 2006 (2006-08-10) figure 1	1
A	US 2010/331851 A1 (HUENE DONALD [US]) 30 December 2010 (2010-12-30) figures 2a,2b	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

9 May 2014

Date of mailing of the international search report

30/05/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Hamann, Joachim

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2013/060900

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006178673 A1	10-08-2006	GB 2440052 A	16-01-2008
		US 2006178673 A1	10-08-2006
		WO 2006107401 A2	12-10-2006

US 2010331851 A1	30-12-2010	US 2010331851 A1	30-12-2010
		US 2013304073 A1	14-11-2013
