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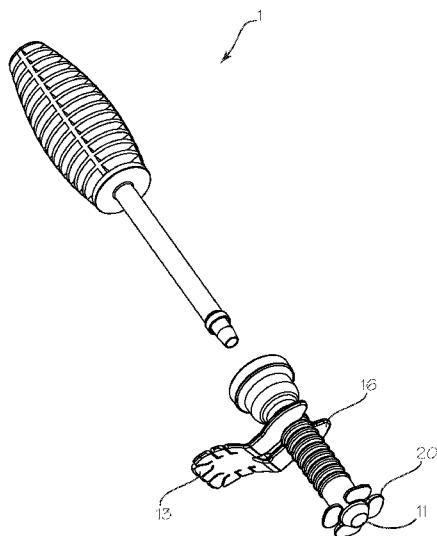
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(54) Title: ARTHROSCOPIC CANNULA AND SUTURE MANAGEMENT SYSTEM

Fig. 10



(57) Abstract: A flexible portal cannula for use in arthroscopic surgery. Distally positioned flaps extend radially outwardly from the outer surface of the cannula and are resiliently foldable to lie against the outer surface of the cannula during insertion into a surgical portal, and resiliently biased to return to the radially outwardly extending position when unconstrained. A clip disposed on the cannula outer surface outside of an arthroscopic workspace acts to clamp tissue disposed between the clip and the flaps. The clip has an extension to receive pairs of slots to sort and engage the sutures.



ARTHROSCOPIC CANNULA AND SUTURE MANAGEMENT SYSTEMField of the Inventions

[0001] The inventions described below relate to the field of arthroscopic surgery and more specifically, to portal access and suture management during arthroscopic surgery.

Background of the Inventions

[0002] Arthroscopy is a minimally invasive procedure for treating joint pathology and is a superior alternative to open joint arthrotomy. Arthroscopy has the advantage of less disruption to the joint tissues, and potentially faster healing. The scope of joints and pathologies that can be treated with arthroscopy has grown dramatically, and now includes hip, spine, and small joint procedures in addition to the traditional knee and shoulder procedures. However, arthroscopy remains a technically demanding procedure, and new instrumentation and procedures are constantly being developed.

[0003] Access to difficult to reach parts of the joint remains a significant challenge. While curved and flexible instruments are available to access these hard to reach areas of the joint, access portal devices have not kept up with the instrument advances. Some attempts have been made to develop flexible portals, however these have significant drawbacks either in being only slightly flexible, being very difficult to use, or being incompatible with standard portal placement techniques and instrumentation. For example, the Arthrex® PassPort Button Cannula™ is a rubbery cannula that provides instrument mobility in shoulder operations. However, delivery of the device is non-standard, requiring the surgeon to fold the device in half with a hemostat before insertion. What is needed is an instrument system that allows a high level of flexibility, high instrument mobility, and high ease of use

while retaining compatibility with standard cannula placement techniques involving switching sticks and guide wires.

[0004] Suture management is also a challenge in these procedures. In procedures where pairs of sutures are used in common double loaded suture anchors, it is possible that the surgeon may tie the wrong pairs of sutures together, which can require significant extra surgical time and cost, as well as additional risk and trauma to the patient to correct.

Summary

[0005] The systems described below provide for insertion of a flexible portal cannula into a surgical portal, providing better retention of the cannula within the surgical portal. Distally positioned flanges, tabs or flaps extend radially outwardly from the outer surface of the cannula and are resiliently foldable to lie against the outer surface of the cannula during insertion into an incision, and resiliently biased to return to the radially outwardly extending position when unconstrained. Once the cannula is inserted into the workspace, a clip disposed on the cannula outer surface outside of the arthroscopic workspace acts to clamp tissue disposed between the clip and the flaps. Ridges on the shaft of the cannula allow for incremental adjustment of the level at which the clip may be secured to effect compression of tissue between the flaps and the clip. The clip can easily be frictionally engaged to the cannula after insertion to the desired compression.

[0006] The cannula clip also features a suture sorter for easier suture management. The clip has pairs of slots to sort and engage pairs of sutures used in common "double loaded" suture anchors until the sutures are used. These slots may be identified with markings, letters or numbers that associate

the location and orientation of the slots to anatomical locations in the joint.

Brief Description of the Drawings

[0007] Figure 1 illustrates an elastomeric portal cannula and driver system with paired engagement features.

[0008] Figure 2 illustrates the system of Figure 1 with the driver disposed within the elastomeric portal cannula.

[0009] Figure 3 illustrates the system of Figures 1 and 2 with a switching stick disposed within a lumen of a cannulated driver.

[0010] Figure 4 illustrates the cannulated driver.

[0011] Figure 5 illustrates the switching stick.

[0012] Figure 6 illustrates an exploded view of a portal cannula and driver system having a plurality of gripping features.

[0013] Figure 7 illustrates the system utilizing a plurality of cylindrical gripping features.

[0014] Figure 8 illustrates the mating engagement between the plurality of cylindrical gripping features and the cannula of Figure 7.

[0015] Figure 9 illustrates a cannula with a distal flange and a clip with suture sorting.

[0016] Figures 10 through 15 illustrate a cannula with a plurality of flaps disposed on the distal end of the cannula.

[0017] Figures 16 and 17 illustrate detailed views of the flaps shown in Figures 10 through 15.

[0018] Figures 18 and 19 illustrate flaps disposed on a ring configured to engage the tube of the cannula.

[0019] Figure 20 illustrates a cannula with webs connecting the flaps to the cannula.

Detailed Description of the Inventions

[0020] Figure 1 illustrates an exploded view of the system for driving a cannula into a surgical site. The system includes a rigid driver 1, a cannula 2, and a switching stick 3. The driver, as shown in Figures 3 and 4, comprises a handle 9 attached to the rigid tube 4. The driver may have a hemispherical seal 23. The driver may be cannulated (as shown) through its core to allow for insertion of the switching stick (Figure 5). The cannula is delivered into place with the rigid tube 4 that has an interlocking feature at the distal tip that engages with a mating locking feature in the distal tip of the cannula. In this way, the proximal portion of the cannula is "pulled" into a surgical portal or incision from its distal tip as the distal tip is pushed. The system allows for the use of a switching 3, a rod typically about 4mm in diameter that is used as a guide wire to place a cannula into a surgical portal. It should be appreciated that the switching stick is an optional feature, as is the driver cannulation which accommodates the switching stick.

[0021] Figure 2 illustrates the system of Figure 1 when assembled, with the cannula disposed over the rigid tube 4. The cannula shown has a side port 5 to allow fluid inflow and outflow from the joint, providing fluid management in order to maintain clarity in the joint during the arthroscopic surgical procedure. The cannula has a flexible distal flange 6 or flap to retain the cannula in the joint, preventing it from backing out of the surgical site. An expandable distal wiper seal 7 may be provided to hold fluid in the joint and prevent fluid

leakage. External retention ridges 8 are disposed over the exterior of the cannula.

[0022] In use, the driver is inserted into the proximal end 2P of the cannula 2 until the distally extending protrusion 12 at the distal tip 11 of the rigid driver engages the mating locking feature in the cannula. When the driver is engaged, the cannula is supported by the rigid tube. The switching stick 3 is inserted through the proximal end 11 of the driver 1, through the driver, and out the distal end of the driver and through the cannula. The entire assembly comprising the switching stick, rigid driver and cannula are inserted into the surgical portal or incision. When the cannula is in the desired position in the surgical site, the switching stick 3 is withdrawn, and then the rigid driver 1 is withdrawn.

[0023] The driver and cannula can have a plurality of engaging features, as shown in Figure 6, 7 and 8. Each of the driver gripping features 12 correspondingly mate with detents 13 disposed on the inside wall of the cannula. Rather than one engagement point at the distal tip, the engagement features may be distributed along the length of the cannula. The plurality of engagement features allow the driver to push longer and lower durometer flexible cannulas into a surgical portal. The driver may have a uniform diameter. The gripping feature 12 of the driver engages with a proximally facing shoulder 13 of the cannula as shown in Figures 7 and 8.

[0024] Generally, the cannula is a flexible portal cannula for use in conjunction with the cannula driver. The cannula driver comprises a shaft having a distal end and a proximal end and at least one distally extending projection extending from its distal end, or extending distally from the outer surface of the driver proximate its distal end. The flexible portal cannula comprises a flexible tube, characterized by a proximal end and a distal end and a lumen extending from the

proximal end to the distal end of the flexible tube, and a distal tip on the distal end. The distal tip of the flexible tube is adapted for insertion through a surgical portal into an arthroscopic workspace proximate a joint in a patient. The flexible tube has a proximally facing groove disposed on an inner surface thereof, proximate its distal end, which is sized and dimensioned to receive a distally extending projection of the cannula driver. The proximally facing groove can be an annular groove entirely circumscribing the inner diameter of the portal cannula, or it may extend merely partially around the inner diameter. As illustrated, the groove is most conveniently formed by a ring extending proximally within the distal tip of the portal cannula. The ring can be suspended or fixed to an inwardly protruding flange which protrudes inwardly from the inner wall of the portal cannula, but can also be fixed directly to, or depend directly from, the inner wall of the portal cannula. The driver may be a solid shaft, but is preferably hollow, with a lumen suitable for passage of a switching stick. Also, the driver may be split longitudinally, into two or more elongate sections, to be used in conjunction with a portal cannula having two or more lumens separated by longitudinally extending webs, where the webs are sized to fit in the space separating the elongate sections, to provide a system for inserting a multi-lumen portal cannula.

[0025] Figure 9 illustrates a cannula 14 with a distal flange 15 and a clip 16. The flange 15 is resiliently foldable in a proximal direction while the cannula is passed through the surgical incision, and resiliently biased to return to the radially outwardly extending position after passing through the incision and into the arthroscopic workspace. The combination of the distal flange 15 and the clip 16 is operable to clamp the tissue disposed between the clip and the flange. The distal flange 15 is disposed at the

distal end of the cannula and may have one or more slits 17 that allow the flange to fold back and thus reduce the force needed to push the cannula into the workspace. Perforations at the base of the flange where the flange connects to the outer surface of the cannula may be provided for ease of folding. Alternatively, the flange with split arrangement can be characterized as separate flaps attached to the outer surface of the cannula as shown. Ridges 18 on the shaft of the cannula allow for incremental adjustment of compression applied by the clip. The clip 16 is configured to frictionally engage the cannula and can easily be slipped onto the cannula after insertion to the desired compression. The clip 16 can be positioned, relative to the flange 15, to compress intervening tissue.

[0026] The cannula clip 16 features an extension 13 for sorting sutures. The extension 13 sorts and engages sutures coming out of a shoulder during a rotator cuff repair or any repair procedure involving sutures. The clip 16 has an extension 13 for sorting and arranging sutures for the convenience of the surgeon, consisting of a plurality of slots 19 around the perimeter of the extension 13 of the clip 16. The extension 13 has pairs of slots 19 to sort pairs of sutures used in common double loaded suture anchors, to keep the sutures neatly out of the way of other tools, and conveniently held for retrieval. In this way the surgeon can avoid tying the wrong pairs of sutures together, which can require significant extra surgical time and cost, as well as additional risk and trauma to the patient to correct. These slots 19 may be identified with markings, letters or numbers that associate the location and orientation of the slots to anatomical locations in the joint. An example of such identifying marks is the "clock" nomenclature for identifying anatomic locations on the shoulder glenoid, for example 12:00, 3:00, 6:00, and 9:00. The slots can be tapered to grip

different diameters of sutures. The slots can be "L shaped" (as shown in Figure 10) to cleat the suture and keep the sutures from slipping out of the slot 19.

[0027] Figures 10 through 17 show an embodiment with a plurality of flaps or tabs 20 which fold back when the cannula is inserted into the incision. In the embodiment shown there are four separate tabs, but any plurality of tabs may be provided. The tabs 20 are disposed at the distal end of the cannula, proximate the distal tip 11, and extend radially outwardly from the outer surface of the cannula. Each tab has a root 21 and a tip 22, with the root 21 at a first end nearest to the cannula outer surface and the tip 22 at the second end of the tab furthest from the cannula outer surface. The root is the part of the flap immediately adjacent to the cannula. As shown in Figure 16, the root has a width dimension B, that is smaller than the tab face width, dimension A, so that the force of insertion into a portal will cause each tab to fold back.

[0028] Each flap includes a root portion proximate the outer surface of the cannula, a radially outward portion radially outward of the root, and a proximal face and a distal face, wherein the root portion spans a first circumferential arc (dimension B) and the radially outward portion spans a second circumferential arc (dimension A) larger than the first circumferential arc. The root portion of each flap has a first thickness D, and in the radially outward portion each flap has a second thickness C greater than the first thickness D, as shown in Figure 17. The tabs are arranged circumferentially around the distal end of the cannula proximate the distal tip. The tabs are made of a flexible material.

[0029] Distally positioned flaps or tabs 20 extend radially outwardly from the outer surface of the cannula and

are resiliently foldable in a proximal direction while passing through the surgical portal, to lie against the outer surface of the cannula, and resiliently biased to return to a radially outwardly extending position when unconstrained when the distal tip of the cannula is within the arthroscopic workspace.

[0030] Figures 18 and 19 show an embodiment in which the tabs are disposed on a ring 24 that mounts onto the body of a cannula. The cannula 25 has a retaining groove 26 for matable attachment to a ring 24. The tabs 27 are disposed circumferentially around the ring. The matable attachment of the ring 24 and cannula 25 may be via retaining groove 26, screw, snap-fit or other means.

[0031] Figure 20 shows an embodiment with two tabs or flaps 28 disposed on the distal end of the cannula 29 in opposition to each other. Each flap has a proximal face, which is the face closest to the cannula proximal end, and a distal face. Each flap has a flexible web 30 provided on the proximal face of the flap connecting the proximal face of the tab to the outer surface of the cannula. The flaps fold inward toward the outer surface of the cannula when the cannula is being inserted into the incision and resiliently return to the original unconstructed or extended position when the flaps are placed within the arthroscopic workspace. The webs maintain the flaps in the extended position.

[0032] While the preferred embodiments of the devices and methods have been described in reference to the environment in which they were developed, they are merely illustrative of the principles of the inventions. The elements of the various embodiments may be incorporated into each of the other species to obtain the benefits of those elements in combination with such other species, and the various beneficial features may be employed in embodiments alone or in combination with each

other. Other embodiments and configurations may be devised without departing from the spirit of the inventions and the scope of the appended claims.

I claim:

1. A cannula for use in arthroscopic surgery, said cannula comprising;

a cannula tube, said cannula tube having a proximal end, a distal end, and a lumen extending therethrough, and a distal tip on the distal end, said distal tip configured for insertion through an incision into an arthroscopic workspace, proximate a joint in a patient;

a plurality of flaps disposed on the distal end of the tube, proximate the distal tip, said flaps extending radially outwardly from an outer surface of tube, said flap resiliently foldable in a proximal direction when constrained while passing through the incision, to lie against the outer surface of the tube, and resiliently biased to return to a radially outwardly extending position when unconstrained.

2. The cannula of claim 1, wherein:

each flap is characterized by a root portion proximate the outer surface of the cannula, a radially outward portion radially outward of the root, and a proximal face and a distal face, wherein said root portion spans a first circumferential arc and the radially outward portion spans a second circumferential arc larger than the first circumferential arc.

3. The cannula of claim 1, wherein:

each flap is characterized by a root portion proximate the outer surface of the cannula, a radially outward portion radially outward of the root, and a proximal face and a distal face, wherein, in the root portion, each flap has a first thickness, and in the radially

outward portion each flap has a second thickness greater than the first thickness.

4. The cannula of claim 2, wherein:

in the root portion, each flap has a first thickness, and in the radially outward portion each flap has a second thickness greater than the first thickness.

5. The cannula of claim 3, wherein:

said root portion spans a first circumferential arc and the radially outward portion spans a second circumferential arc larger than the first circumferential arc.

6. The cannula of claim 1, further comprising;

a clip configured for a friction fit on the cannula tube, whereby, in conjunction with the flaps in the radially outwardly extending position when unconstrained and disposed within arthroscopic workspace, and with the clip disposed on the cannula tube outside the arthroscopic workspace, to clamp tissue disposed between the clip and the flaps.

7. The cannula of claim 1, wherein:

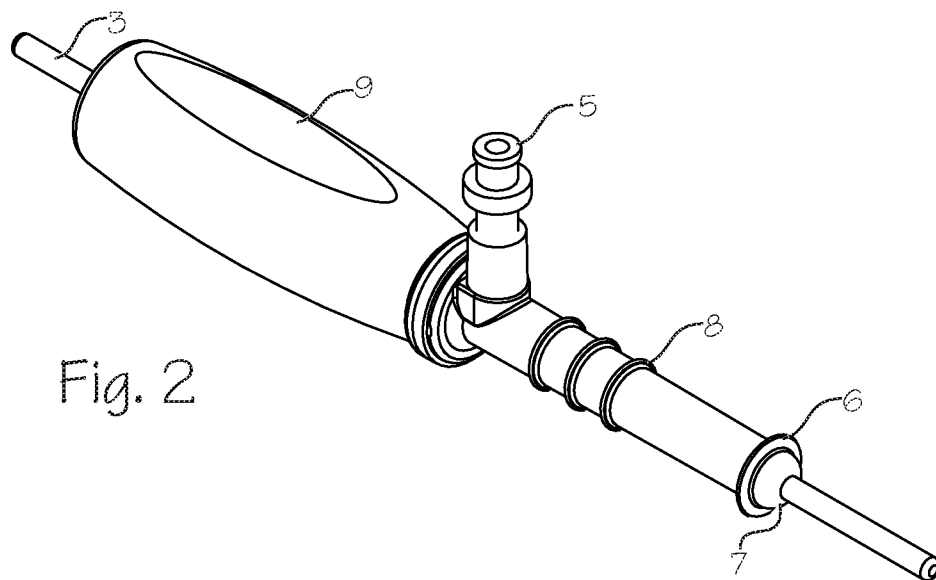
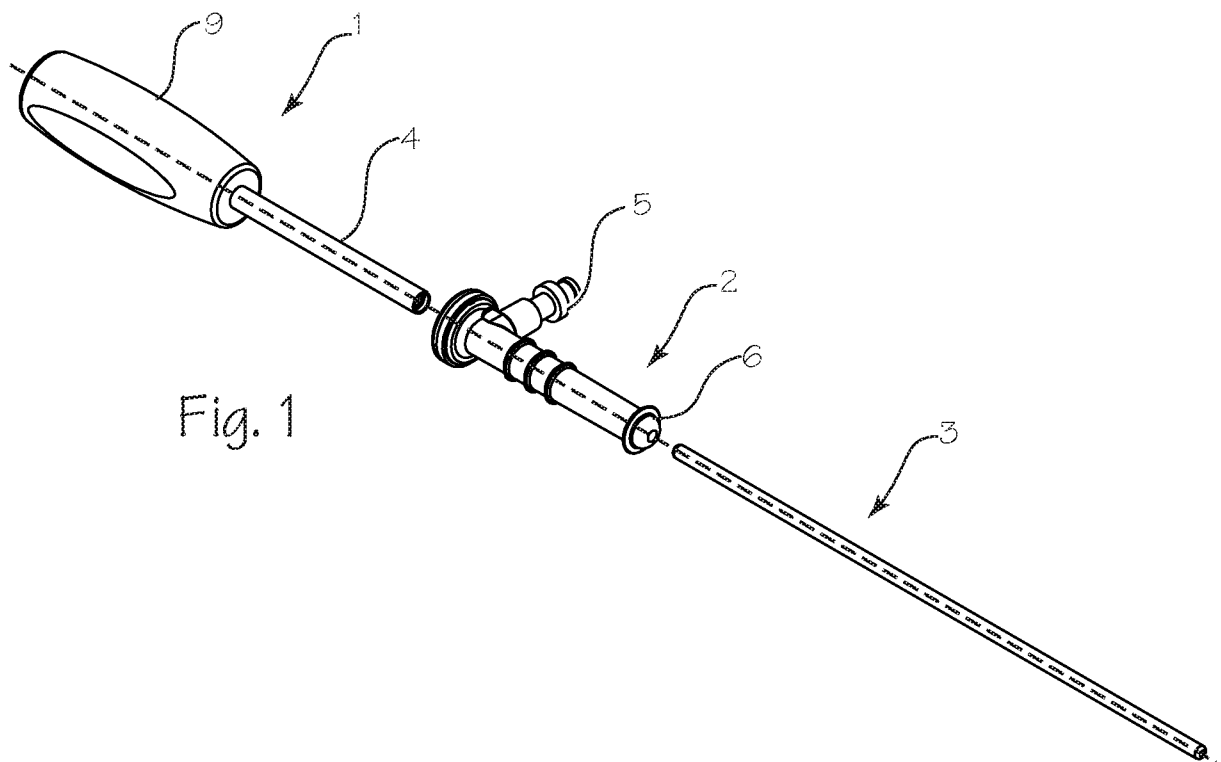
each flap is characterized by a proximal face and a distal face, said cannula further comprising a flexible web disposed on the proximal face of the flap and operably connecting the proximal face of the tab to the outer surface of the cannula tube.

8. A device for use with a cannula during an arthroscopic procedure using sutures, said device comprising;

a clip, said clip operable to be releasably positioned on an outer surface of a cannula, said clip operably connected to an extension, said extension having a perimeter, said extension further comprising at least one slot disposed around the perimeter of the extension.

9. The clip of claim 8 wherein the extension further comprises markings associated with the extension slots.

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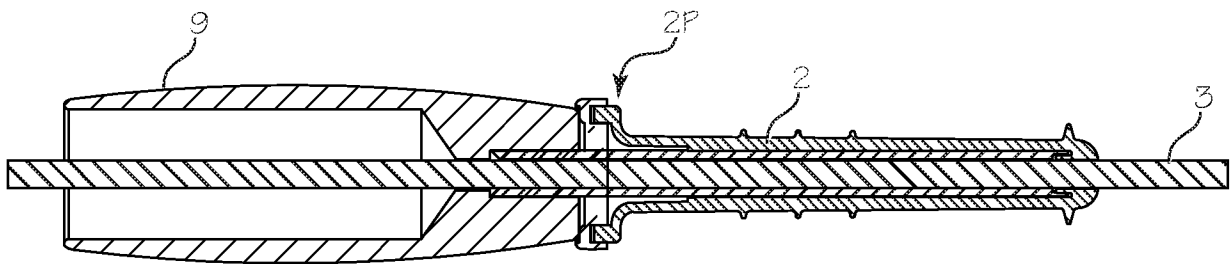


Fig. 3

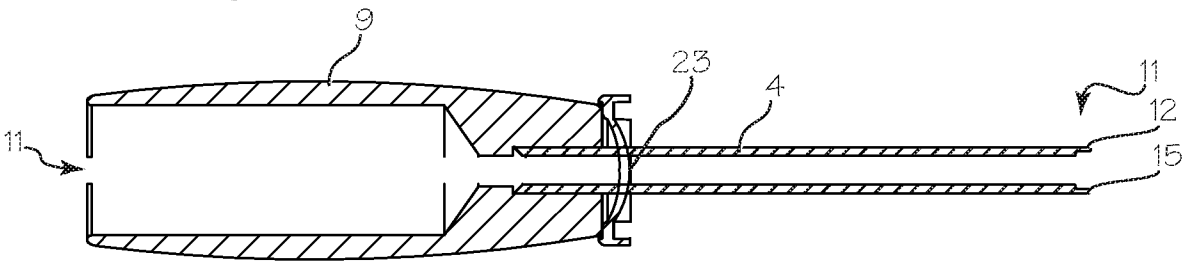


Fig. 4

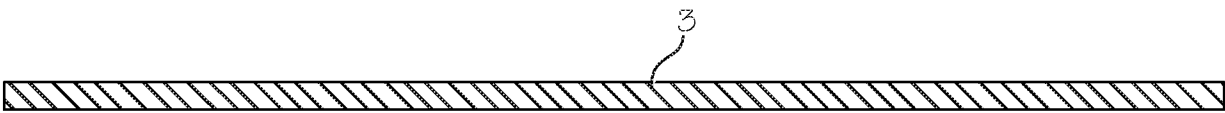
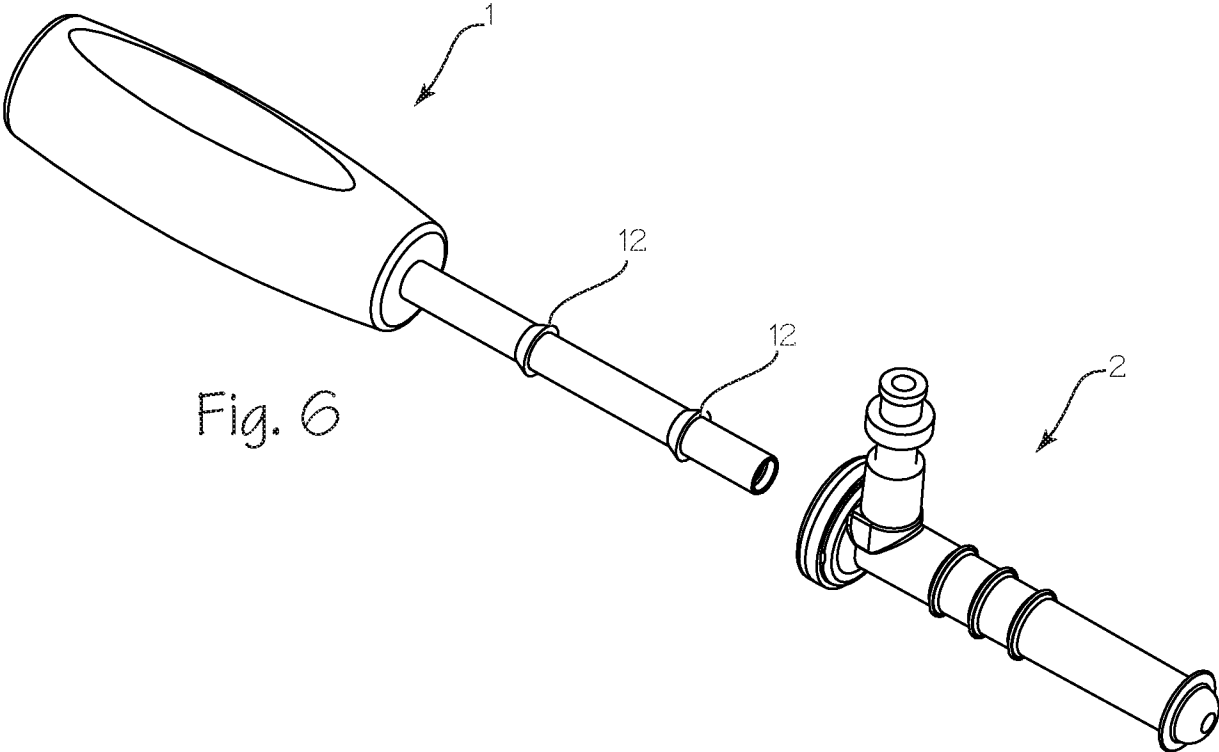


Fig. 5



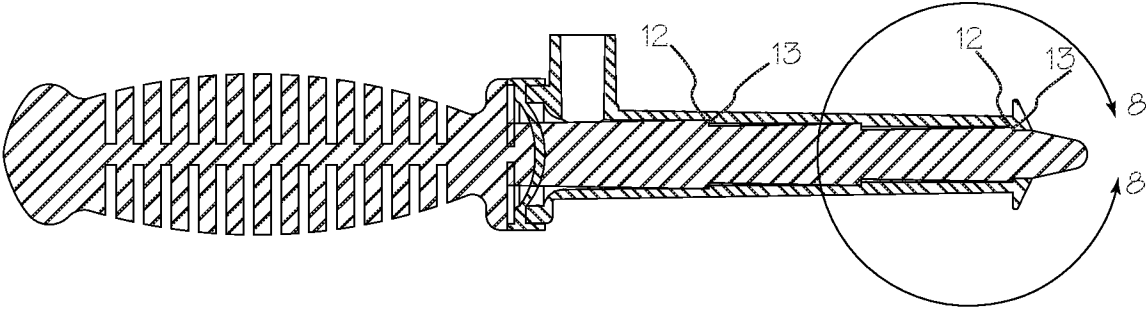


Fig. 7

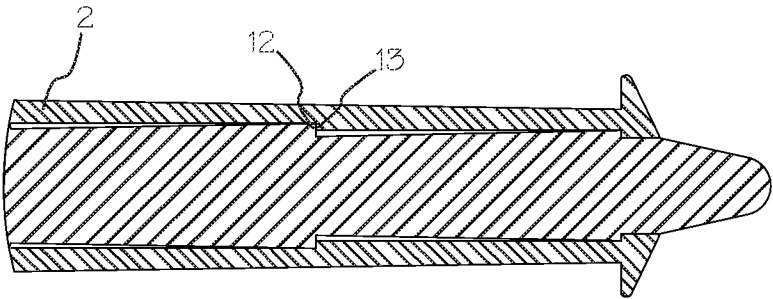
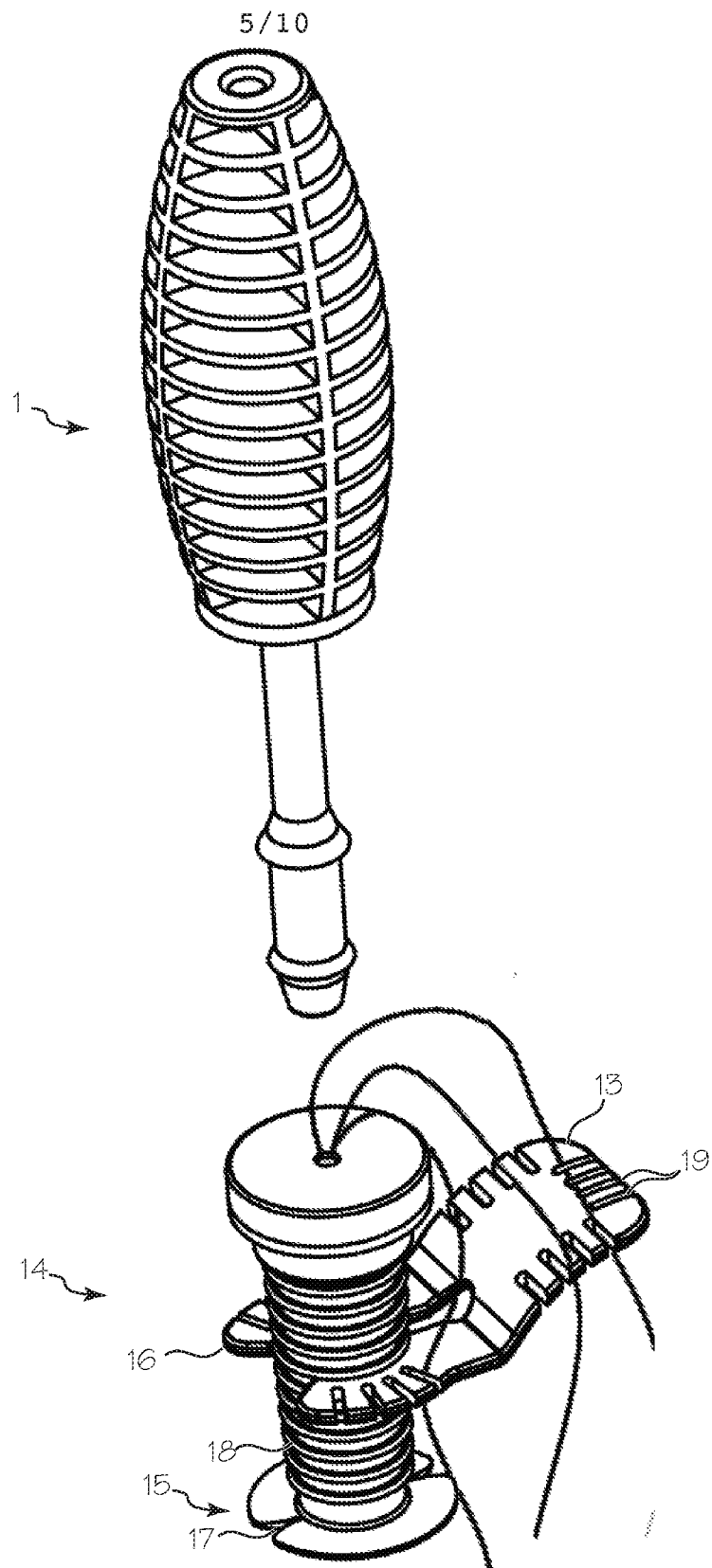


Fig. 8

Fig. 9



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Fig. 10

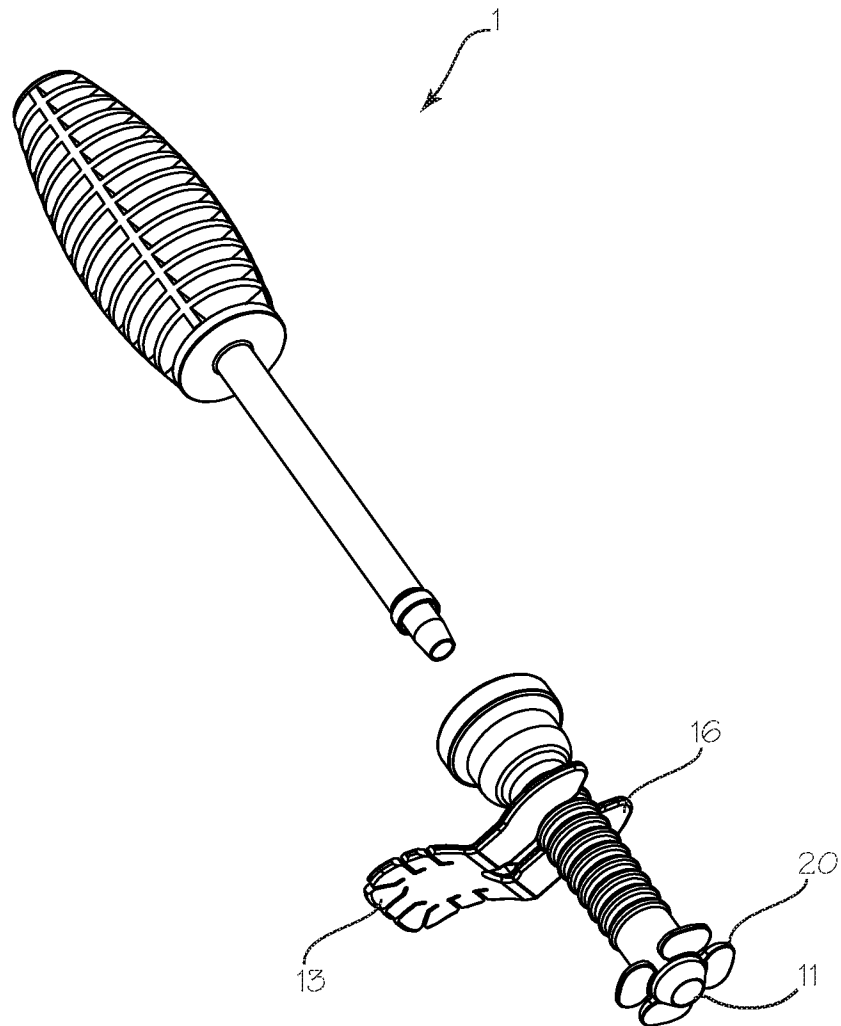


Fig. 11

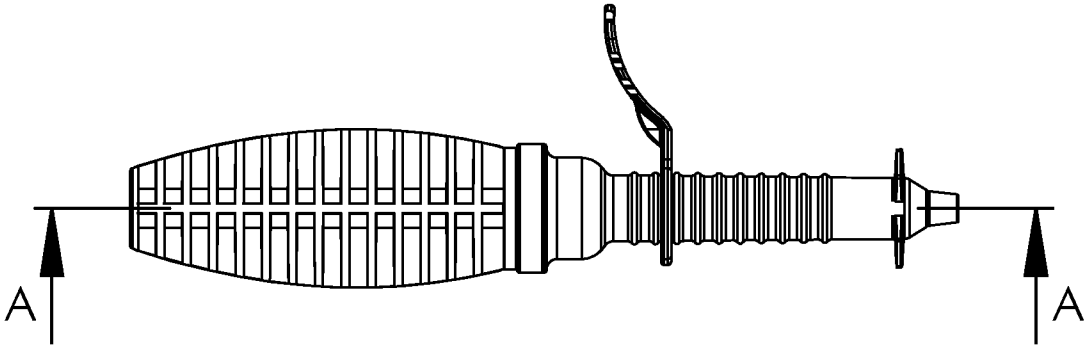


Fig. 12

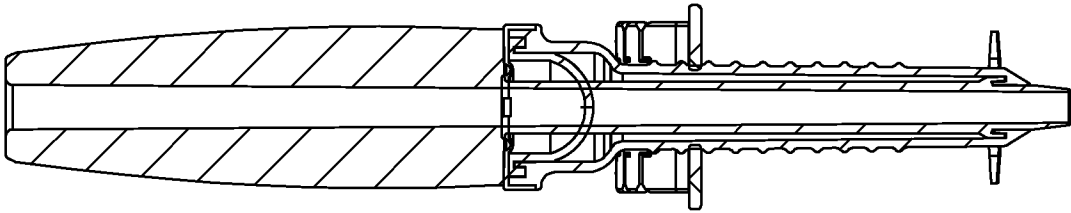


Fig. 13

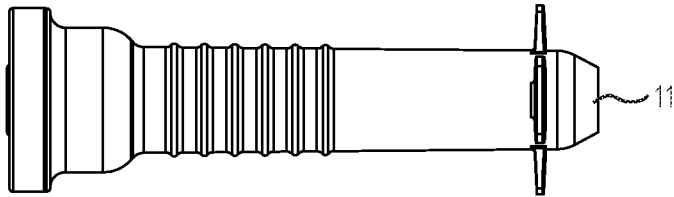


Fig. 14

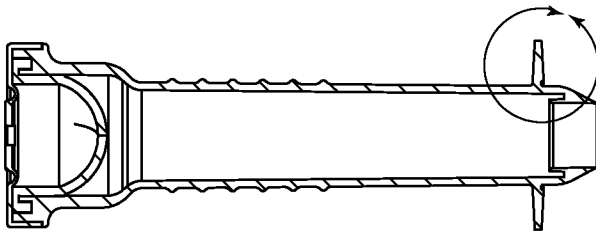


Fig. 15

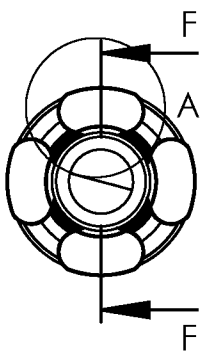


Fig. 16

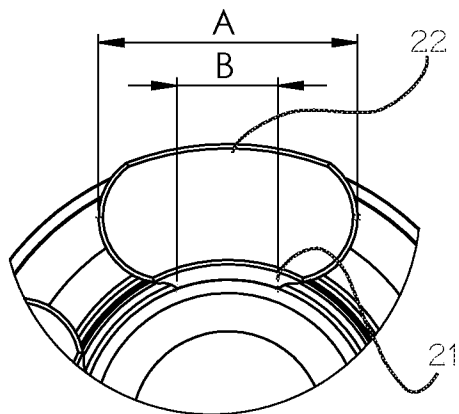
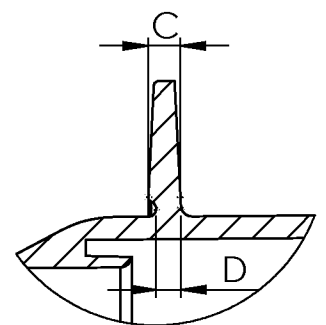


Fig. 17



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Fig. 18

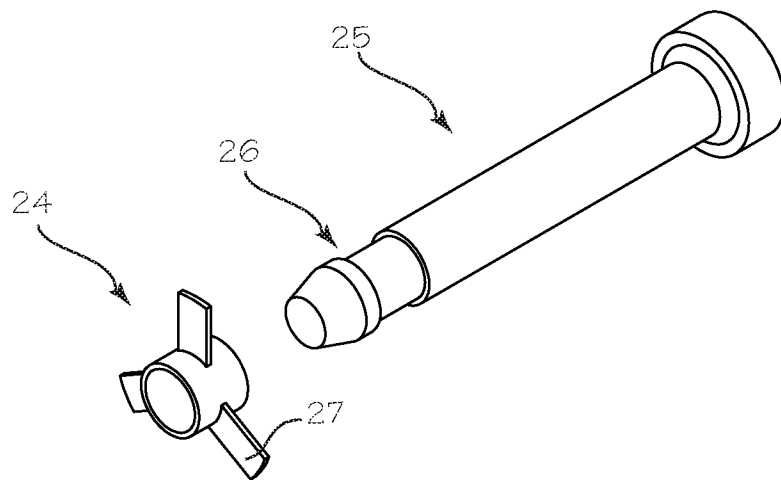
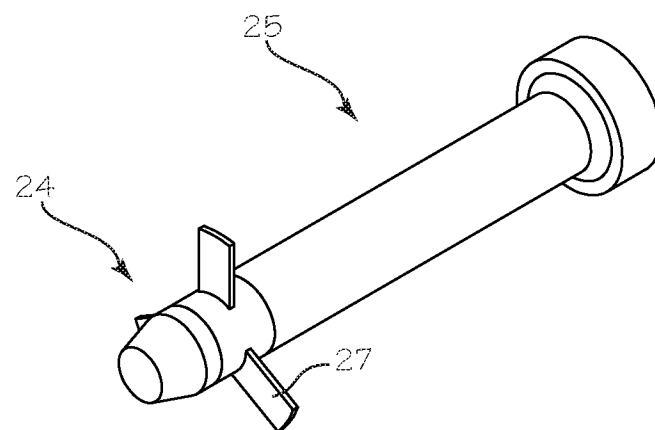
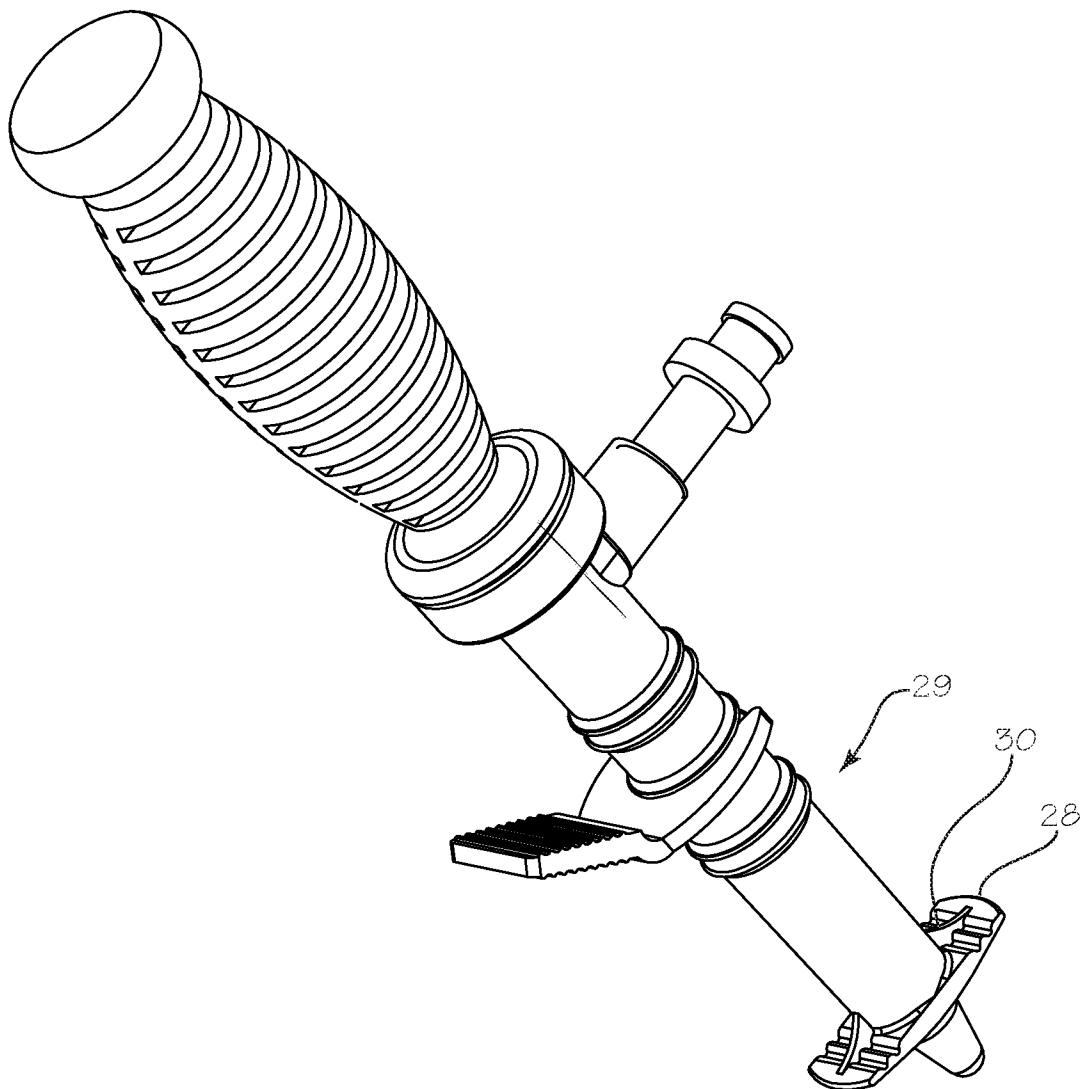


Fig. 19



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Fig. 20



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/041210**A. CLASSIFICATION OF SUBJECT MATTER****A61B 17/34(2006.01)i, A61B 17/04(2006.01)i, A61B 17/88(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B 17/34; A61B 1/32; A61B 17/02; A61M 25/00; A61M 39/02; A61M 5/14; A61B 17/04; A61B 17/88

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: cannula, anthroscopic surgery, flexibility, flap, clip, web, thickness, slot

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2017-0273717 A1 (CANNUFLOW, INC.) 28 September 2017 paragraphs [0046]–[0062]; figs. 1–7, 14, 38	1–9
Y	US 2008-0108875 A1 (KUNKEL, SANFORD S. et al.) 08 May 2008 paragraphs [0053]–[0059]; figs. 13A–15	1–7
Y	US 5830191 A (HILDWEIN, ROGER L. et al.) 03 November 1998 column 8, line 49 – column 9, line 17; figs. 23–27	3–5
Y	JP 09-500796 A (MEDICAL INNOVATIONS CORP.) 28 January 1997 page 8, line 13 – page 9, line 12; figs. 1, 2	7
Y	US 2010-0100045 A1 (PRAVONGVIENGKHAM, KENNII et al.) 22 April 2010 paragraphs [0023], [0035]	8,9



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

28 October 2020 (28.10.2020)

Date of mailing of the international search report

28 October 2020 (28.10.2020)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

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Authorized officer

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2020/041210

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017-0273717 A1	28/09/2017	CN 105338913 A EP 2964113 A2 JP 2016-513501 A JP 6298836 B2 US 10085768 B2 US 2014-296647 A1 US 2019-298409 A1 US 9675379 B2 WO 2014-138746 A2	17/02/2016 13/01/2016 16/05/2016 28/03/2018 02/10/2018 02/10/2014 03/10/2019 13/06/2017 12/09/2014
US 2008-0108875 A1	08/05/2008	US 2008-0140013 A1 US 7377897 B1 US 8100864 B2 US 8128601 B2	12/06/2008 27/05/2008 24/01/2012 06/03/2012
US 5830191 A	03/11/1998	CA 2099354 A1 EP 0577400 A1 JP 07-275252 A US 5391156 A US 5490843 A US 5562677 A	31/12/1993 05/01/1994 24/10/1995 21/02/1995 13/02/1996 08/10/1996
JP 09-500796 A	28/01/1997	CA 2171938 A1 EP 0740556 A1 JP 2935570 B2 WO 95-18640 A1	13/07/1995 06/11/1996 16/08/1999 13/07/1995
US 2010-0100045 A1	22/04/2010	EP 2086430 A2 EP 2476384 A1 US 10485578 B2 US 2015-0141938 A1 US 8945058 B2 WO 2008-064344 A2	12/08/2009 18/07/2012 26/11/2019 21/05/2015 03/02/2015 29/05/2008