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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 92/17115
A61B 17/00	A1	(43) International Publication Date:	15 October 1992 (15.10.92)

(21) International Application Number: PCT/US92/02694

(22) International Filing Date: 3 April 1992 (03.04.92)

(30) Priority data:
680,391 4 April 1991 (04.04.91) US

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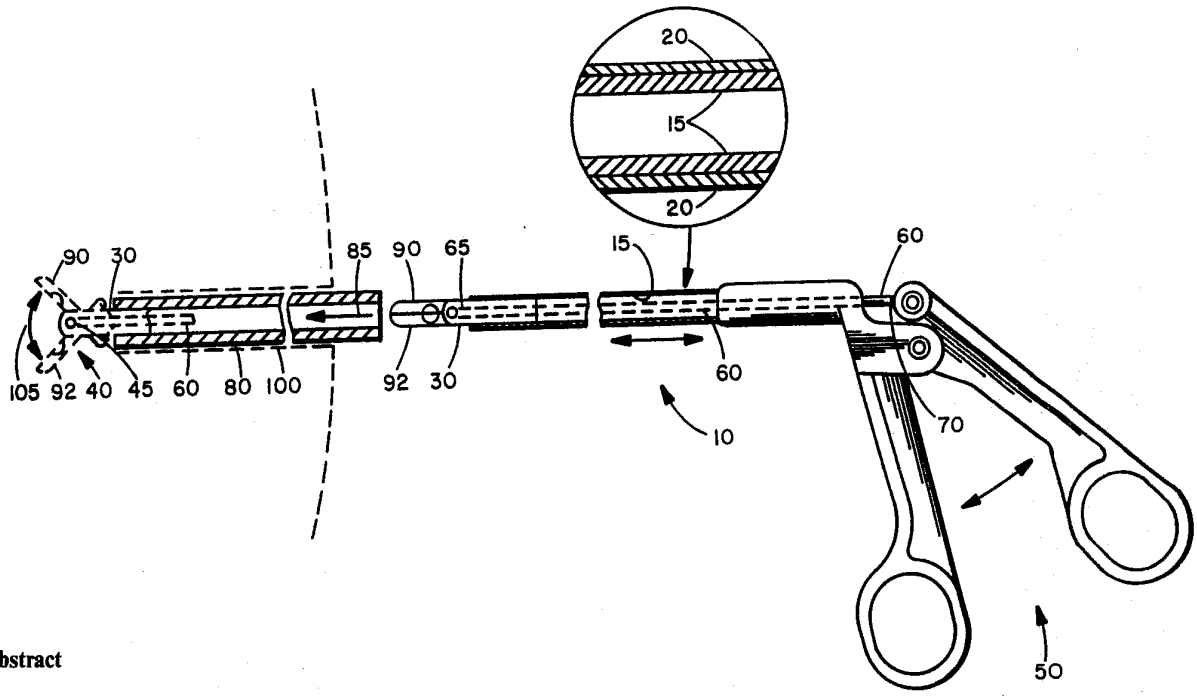
(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: CLEVIS FOR ENDOSCOPIC SURGICAL INSTRUMENT



(57) Abstract

A separately formed clevis (30) of an endoscopic surgical instrument is provided. The clevis (30) fixedly engages a hollow aluminum tube (15) of the disposable laparoscopic surgical instrument and pivotally engages an end effector (40) of the disposable laparoscopic surgical instrument. The clevis (30) includes: a hollow first portion (34) having a knurled outer surface (34) having a diameter slightly smaller than the inner diameter of the aluminum tube (15), for fitting closely within the aluminum tube and for fixedly engaging the aluminum tube (15) when the aluminum tube (15) is crimped thereover; a second portion having a base section with a bore corresponding to the inner diameter of the hollow first portion, and a pair of parallel, spaced apart, opposed arm members (36) and extending away from the hollow first portion; and a pivot rod (45) which engages the opposed arms (36) in a substantially transverse manner.

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CLEVIS FOR ENDOSCOPIC SURGICAL INSTRUMENT

BACKGROUND OF THE INVENTION

The present invention broadly relates to endoscopic surgical instruments. More particularly, the invention relates to surgical instruments which include end effectors such as cutters, graspers, and dissectors which are useful in endoscopy and laparoscopy procedures and which may be disposed of after a single use.

The endoscopy and laparoscopy procedures have recently become widely practiced surgical procedures. The endoscopy and laparoscopy procedures involve incising through body walls (e.g., such as the abdominal wall) for examining, viewing and/or operating on the ovaries, uterus, gall bladder, bowels, appendix, etc. or for general abdominal surgery. Typically, trocars are utilized for creating the incisions. Trocar tubes are left in place in the abdominal wall so that the endoscopic or laparoscopic surgical tools may be inserted through the tube. A camera or magnifying lens is often inserted through the largest diameter trocar tube (e.g. 10mm diameter) which for the laparoscopy procedure is generally located at the navel incision, while a cutter, dissector, or other surgical instrument is inserted through a smaller diameter trocar tube (e.g. 5 mm diameter) for purposes of manipulating and/or cutting the internal organ. Sometimes it is desirable to have several trocar tubes in place at once in order to receive several surgical instruments. In this manner, organ or tissue may be grasped with one surgical instrument, and simultaneously may be cut or stitched with another surgical instrument; all under view of the surgeon via the camera in place in the navel trocar tube.

The endoscopic and laparoscopic tools of the prior art are primarily reusable stainless steel tools. Between each use of a stainless steel tool, the tool must be soaked, scrubbed, and disinfected. The usual procedure is then to dry the tool, wrap it, and put it in a steam autoclave. The tool is kept sterile until just prior to use when it is removed from the autoclave and unwrapped in the locale of the sterile field of use.

While reusable laparoscopic tools have functioned well for their intended purpose, the process of sterilizing the tool is problematic. Small pieces of tissue or organ often become lodged in the end effectors, and much labor is required to ensure that complete sterility is obtained and maintained. In addition, over time, sharp laparoscopic instruments such as a scissors get dull and must be discarded. However, prior to use of a particular instrument, the surgeon is not able to discern the state of the instrument and whether the instrument will satisfy the surgeon's requirements.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide disposable endoscopic surgical instruments.

It is another object of the invention to provide disposable endoscopic surgical instruments having which are easily assembled.

A further object of the invention is to provide disposable endoscopic surgical instruments of improved design with smooth transitions from an insulating shrink wrap to the end effectors and to the handle.

In accord with the objects of the invention, a surgical instrument for insertion through a trocar tube generally includes, a tube, a push rod which extends through the tube, an actuating means engaging the tube and the push rod for imparting reciprocal axial motion to the push rod, end effector means coupled to the push rod by linkage means which are also coupled to the push rod, and a clevis coupled to the tube at its proximal end and to the end effector means at its distal end, wherein axial movement of the push rod effects movement of the end effector means in a plane parallel to the longitudinal axis of the push rod. Plastic shrink wrap is preferably utilized to electrically insulate the disposable instrument and extends over the aluminum tube and over at least an adjacent portion of the clevis. The tube and push rod are preferably made of aluminum, the clevis is preferably made of a high-strength aluminum alloy, the actuating means is preferably made of plastic and aluminum, and the end effector means is preferably made of investment cast bronze.

The clevis of the invention is preferably a separately formed clevis having a knurled rod-like proximal end for mating with the end of the aluminum tube, and a post-supporting U-shaped distal portion for holding the end effector means. The post in the distal portion is perpendicular to the legs of the U-shaped distal portion and is arranged to extend through hole(s) in the end effector means. In this manner, the blades or prongs of the end effector means are held by, but can rotate around the post. Each leg of the U-shaped distal portion of the clevis also preferably includes a notch which serves as a terminating

location for the shrink-wrap. Another aspect of the clevis relates to the forming of the post integral with one of the legs of the distal portion of the clevis.

The end effector means of the invention can take any of many forms, such as, e.g., a scissors, a dissector, or a grasper. Additionally, the end effector means can be double acting or single acting. Regardless of the type of end effector utilized, the end effector is arranged with a hole to accept the post of the clevis so that the end effector can rotate around the post.

According to one aspect of the invention the push rod is flattened on its distal end, and the linkage means which couples the push rod and the end effector is a staple which extends through a hole in the flattened end of the push rod as well as another hole in the proximal end of the end effector. Because the outer tube is positioned at a fixed distance from the rotation hole in the end effector (due to the clevis), when the push rod is moved axially relative to the tube, the end effector cannot move axially. However, because the push rod is also a fixed distance away from another hole in the proximal end of the end effector (due to the staple), movement of the push rod relative to the tube causes rotation of the end effector in a plane. In other words, movement of the push rod relative to the tube causes the hole through the end effector through which the staple extends to rotate along an arc centered at the rotation hole in the end effector through which the post of the clevis extends. Movement in this manner typically effects a cutting, dissecting or grasping action.

A better understanding of the disposable laparoscopic surgical instruments of the invention, and additional advantages and objects of the invention will become apparent to those skilled in the art upon reference to the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side elevation view, partly in section, of a disposable endoscopic instrument prior to insertion into a trocar tube, and, in partial phantom format, after insertion into a trocar tube;

Figure 2a is a side elevation view, partly in section, of the clevis of the invention in conjunction with the distal end of the tube and shrink wrap of the invention;

Figure 2b is a cross-section view of the device of Figure 2a;

Figure 3 is a side elevation view of an alternate clevis embodiment of the invention prior to assembly with end effectors;

Figure 4a is a partially broken-away side elevation view of the actuating handle of the instrument of the invention;

Figure 4b is a rear elevation view of the device of Figure 4a;

Figure 5a is a side elevation view, partly in section, of a double acting dissector in conjunction with the clevis and the distal ends of the rod and tube of the disposable laparoscopic instrument of the invention, with the staple linkage means shown in perspective and broken out views; and

Figure 5b is a plan view of the device of Figure 5a.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to Figure 1, a disposable laparoscopic surgical instrument is indicated at 10. The instrument 10 broadly comprises an aluminum tube 15 surrounded by a peripheral insulating shrink wrap layer of plastic 20, a clevis means 30, end effectors 40, actuating means 50, and a push rod 60. The clevis means 30 is advantageously a separately formed aluminum piece which fixedly engages aluminum tube 15 as described in more detail hereinafter. The clevis 30 also engages the end effectors 40 which are pivotally engaged to clevis 30 at pivot pin 45. The end effectors 40 are preferably formed of investment cast bronze. The push rod 60, which is also formed of aluminum, is engaged at its distal end 65 to the end effectors 40, as hereinafter more fully described, and is connected at 70, at its proximal end to a manually operable actuating means 50. For purposes herein, the "distal end" of the instrument 10 or any part thereof, is the end closest to the surgical site and distant from the surgeon, while the "proximal end" of the instrument 10 or any part thereof, is the end most proximate the surgeon and distant the surgical site.

In use, the instrument 10 is inserted with the blades or graspers 90, 92 of the end effector 40 in the closed position, into trocar tube 80, as indicated at the arrow 85 of Figure 1. The distal portion of the instrument 10 passes through the trocar tube 80 into body incision 100. Upon the distal portion of the instrument 10 exiting the trocar tube 80, the blades 90, 92 can be opened and closed as indicated at 105 by reciprocal motion of push rod 60 which results from operation

of the manual actuating means 50. As is discussed more fully hereinafter, the clevis effectively translates the reciprocal motion of the push rod 60 into the end effector means action indicated at 105.

Turning to Figures 2a and 2b, a preferred configuration of the clevis 30 of the present invention is seen. The clevis has a knurled rod-like proximal portion 34 for press fit mating with the end of the aluminum tube 15, and a post-supporting U-shaped distal portion 32 for holding the end effector means. The outer diameter of the distal portion 32 of the clevis is larger than the outer diameter of the proximal portion 34; shoulder 39 being formed therebetween. The proximal portion 34 of the clevis is preferably hollow, as indicated at 33, to permit the push rod 60 to extend therethrough. The distal portion 32 of the clevis 30 is provided with legs 36 and a post or pivot pin 45. The post 45 is generally perpendicular, i.e. transverse, to the legs 36 of the clevis and is arranged to extend through hole(s) 39 in the end effector means 40. In this manner, the blades or prongs of the end effector means 40 are held by, but can rotate around, i.e. are rotatably engaged with the post 45.

As seen in Figure 2a, a recess or notch 380 is provided which extends across each leg 36 of the clevis 30. Consequently, a peripherally applied electrically insulating plastic wrap 20 can be end-cut at recess 380 and a smooth transition from the end effector means 40 via the clevis 30 to tube 15 can be achieved. Even if slight outward flaring of wrap 20 occurs at the end-cut, as is common, this flaring can be tolerated as it will be within the envelope of the normal outer surface indicated at 43.

Clevis 30 is preferably made from a high strength aluminum base alloy (e.g. 2024 alloy of Alcoa) which is preferably harder than the aluminum base alloy (e.,g. 6061 or 6063 alloys of Alcoa) from which tube 15 is fabricated. The post portion of the clevis may be made out of the identical alloy or, for added strength, out of a stainless steel nail. In assembly of the surgical instrument 10, serrated or knurled portion 34 of clevis 10 is fit snugly into tube 15 (e.g., by press fitting) such that the walls of tube 15 abut the peripheral shoulder 39 of clevis 30, with the outer surface of tube 15 and the adjacent outer surface of clevis 30 having essentially the same diameter. Mechanical pressure is then applied, if desired, to tube 15 peripherally at the location of knurled portion 34, thereby crimping the end portion of tube 15 onto the knurled portion 34. Mechanical pressure causes the projections of the knurls to bite into and firmly engage tube 15 as indicated at 37 due to the higher hardness of the clevis material. Once the clevis 30 and tube 15 have been properly joined, the plastic shrink wrap 20 can be applied over the tube 15 and an adjacent portion of the clevis 30 and end-cut at recess 380.

Figure 3 shows an alternate embodiment for the clevis means of the present invention wherein the clevis 30 is formed and machined from aluminum base alloy as one integral element. As seen in Figure 2b, the arms 36' of clevis 30 are bent outwardly away from each other. Pivot pin 45' is integral with one arm 36' as indicated at 48 and has a terminal portion 47 of reduced diameter which will engage slightly larger hole 49 when the arms 36 are bent inwardly and parallel with each other (i.e. after end effectors 40 of Figure 2a are attached). Upon bending of the arms 36', the tip of terminal portion 47 engages and is suitably flattened in recess 59 as indicated at 53.

With reference to Figures 4a and 4b, manually operable actuating means are indicated at 50 which includes an electrically insulating housing 914 having a fixed handle portion 410 integral therewith and a lever portion 420 pivotally engaged to housing 914 at pivot pin 430. Push rod 60 passes through aluminum tube 15 (covered by shrink wrap 20) and engages cross pin 440 at 454; set screw 441 being used to extend into cross pin 440 and set push rod 60 in the cross pin 440. The cross pin 440 is fixedly positioned in lever member 420. Upon pivotal motion of lever arm 420, as indicated at 450, using a conventional hand grip as indicated at 455 to apply pressure to extended handle element 456 of lever member 420, push rod 60 will move linearly as indicated at 460 to actuate an end-effector (not shown in Figure 4a) coupled thereto as hereinabove described. There may be occasions, in the course of certain laparoscopic procedures, that certain surgeons will prefer to hold the actuating means 50 in the manner indicated at 465 with fingers grasping housing 914 and the thumb 467 adjacent a portion 470 of lever member 420 which is positioned on the opposite side of cross-pin 440 from extended handle element 456. Thus, in accord with one aspect of the invention, a roughened knurled or serrated surface 480 is provided integral with portion 470 of lever member 420 to enable a frictional engagement with thumb 467. Utilizing serrated surface 480, when thumb motion as indicated at 490 is initiated, pivotal motion of lever arm 420 is accomplished, as indicated at 450, as is the linear motion of push rod 60 as indicated at 460.

Also seen in Fig. 4a is an insulating ferrule 910 which is designed to extend over and bridge the shrink wrap tubing 20 and the housing 914 so as to guarantee that all portions of the tube 15 is insulated. The ferrule 910 permits a cautery procedure to be accomplished (see cautery terminal 999) without concern of shock to the surgeon. Also, preferably, the ferrule 910 is formed of plastic and is color coded so

that a different color is used for each instrument or class of instruments. Thus, for example, scissors may be provided with a red ferrule, while graspers might be provided with a yellow ferrule; clamps with a green ferrule; etc.

With reference to Figures 5a-5b, details are seen of an end effector 40 and the linkage means for linking the end effector 40 to the push rod 60. In particular, in Figs. 5a-5b, a double acting dissector is shown with blades 90', 92' which are respectively rotatably mounted on pivot pin 45 of clevis 30'. Each blade 90', 92' of the dissector has a forwardly extending manipulating portion 94, and a rearwardly extending planar base portion 96 with a through-hole 98. Each of the through-holes 98 of planar base portions 96 is separately engaged by a separate connecting or linkage means 110, 112.

As shown in Fig. 5a, according to one preferred embodiment, each linkage means 110, 112 is in the form of a thin metal member generally in the shape of an outwardly flared staple. Each linkage means may be generally described as having a U-shaped section 114 with a base 111 perpendicular to and bridging the arms 118 of the U, and two generally parallel spaced apart outwardly extending side or tab elements 113 which are generally parallel to base 111. Each of the linkage means 110, 112 has one of its tab elements 113 engaged in a through-hole 98 of a planar base 96, with the U-shaped section of the linkage means extending respectively in opposite directions as illustrated. The other tab element 113 of the linkage means 110, 112 engage through-holes 120 formed in a flattened plate-like terminal portion 122 of push rod 60. As can be seen from Fig. 5a, movement of push rod 60 in the direction indicated at 124 will cause blades 90', 92' to move in the direction indicated at 127 to the position 129 without

interference between the oppositely positioned staple-like linkage means 110, 112.

That manipulators (blades) 90' and 92' open and close in response to the axial movement of push rod 60 may be understood by understanding the relationship of the clevis 30' and linkage means 110, 112 to the blades 90', 92', the push rod 60, and the tube 15. In particular, due to the fact that the clevis 30' is rigidly attached to the tube 15 (as described above with reference to Fig. 2a), the tube 15 is a fixed distance from the rotation pin 45 of the clevis, and hence to the holes in the blades 90' and 92' through which rotation pin 45 extends. Thus, when the push rod 60 is moved axially relative to the tube 15 (the tube being fixed in place), the blades of the end effector cannot move axially with the push rod. However, because the push rod 60 is also a fixed distance away from holes 98 in the base portion of the end effector blades (due to staple linkage means 110, 112), movement of the push rod relative to the tube must cause movement of the holes 98 in the end effector blades. Because one part each blade is fixed, but another part must move when the push rod 60 is moved relative to the tube 15, end effector blades 110 and 112 rotate along an arc centered at the fixed rotation hole in the end effector through which the post 45 of the clevis 30' extends. Movement in this manner typically effects a cutting or grasping action.

The preferred instruments of the invention are preferably assembled in the following fashion. The knurled portion 34 of the clevis 30 of the invention is press fit inserted into the aluminum tube 15 which had been previously insert molded in the fixed handle portion 914, 410 of the actuating means 50. The aluminum tube 15 is crimped over the knurls 37 to effect mating. Shrink wrap 20 is then applied over the aluminum tube 15 and end-cut at grooves 380 in the arms 36 of the clevis 30.

Ferrule 910 is slid over the distal end of the aluminum tube 15, up over the end of the housing 914, and snapped into place, thereby providing complete insulation. The rod 60, staples 110, 112, and end effectors (e.g. 90, 92) are assembled, with the staples coupling the rod to the end effectors. The rod is slid through the clevis and down the aluminum tube, until the end effectors are located between the arms of the clevis. When the holes in the proximal end of the end effectors (e.g. 96, 98) are lined up with the through-holes 39 in the arms of the clevis, the rotation post 45, which may either be integral with the clevis, or a separate post or nail, is inserted through the holes in the end effectors, and secured in the holes of the clevis arms such as by tapping. At this point, all that remains to be assembled is the actuating means 50. To assemble the actuating means, a cross pin 440 is inserted in handle 420. Handle 420 is then arranged such that the push rod 60 which extends out of the fixed handle portion will extend through the cross pin 440. With rod 60 in the cross pin 440, handle 420 is lined up with handle 410 such that the handle rotation pivot pin 430 can be inserted. With pivot pin 430 in place, and with the end effectors in the closed position, set screw 441 is tightened into the cross pin until it bites into rod 60, thereby holding rod 60 in place relative to cross pin 440.

There has been described and illustrated herein a disposable endoscopic instrument. While particular embodiments of the invention have been described, it is not intended that the invention be limited exactly thereto, as it is intended that the invention be as broad in scope as the art will permit. Thus, while particular end effectors were disclosed, it will be appreciated that other end effectors such as, e.g., duck-bill graspers, duck-bill dissectors, atraumatic graspers, and traumatic (rat-tooth) graspers, could be utilized. Also, while various materials were described as being preferred for various parts, it will be appreciated that

other materials could be utilized. By way of example only, and not by way of limitation, while the tube and clevis are preferably made from aluminum alloys, with the clevis being harder than the tube, if desired, the tube could be harder than the clevis. Therefore, it will be apparent to those skilled in the art that other changes and modifications may be made to the invention as described in the specification without departing from the spirit and scope of the invention as so claimed.

What is claimed is:

1. In a surgical instrument for insertion through a trocar tube and having a longitudinal axis and including a hollow aluminum tube having an inner diameter, one of grasping, cutting, clamping, dissecting, and extracting end effector means, an actuating means coupled to said hollow aluminum tube, push rod means extending through said aluminum tube and coupled to said actuating means and said end effector means, and a clevis means, with said clevis means fixedly engaging said hollow aluminum tube and having a pair of parallel, spaced apart, opposed arm members and a pivot rod means engaging the opposed arm members in a manner substantially transverse said longitudinal axis with said end effector means pivotally engaging said pivot rod means, and said clevis means being in the form of an integral aluminum component, an improvement in said clevis means comprising:

a) a hollow first portion having an outer diameter slightly smaller than the inner diameter of the aluminum tube, said hollow first portion press fit within the aluminum tube and fixedly engaging the aluminum tube;

b) a second portion having a base section with a bore corresponding to the inner diameter of the hollow first portion, and said pair of parallel, spaced apart, opposed arm members integrally joined to said base portion at respective first ends of said opposed arm members, said pair of arm members extending away from said hollow first portion.

2. In a surgical instrument according to claim 1, wherein:

said hollow first portion of said clevis means has a knurled outer surface.

3. In a surgical instrument according to claim 2, wherein:

said clevis means is comprised of a first aluminum alloy and said aluminum tube is comprised of a second aluminum alloy, said first aluminum alloy being harder than said second aluminum alloy.

4. In a surgical instrument according to claim 1, wherein:

each said opposed arm member has an undercut groove therein along an outer surface of said arm member and substantially transverse said longitudinal axis for receiving an end of a shrink wrap tubing, wherein the distance between the outer surfaces of said opposed arm members is substantially equal to the outer diameter of said aluminum tube.

5. In a surgical instrument according to claim 3, wherein:

each said opposed arm member has an undercut groove therein along an outer surface of said arm member and substantially transverse said longitudinal axis for receiving an end of a shrink wrap tubing, wherein the distance between the outer surfaces of said opposed arm members is substantially equal to the outer diameter of said aluminum tube.

6. In a surgical instrument for insertion through a trocar tube, having a longitudinal axis with a hollow aluminum tube having an inner diameter, one of grasping, cutting, clamping, dissecting, and extracting end effector means, an actuating means coupled to said hollow aluminum tube, push rod means extending through said aluminum tube and coupled to said actuating means and said end effector means, electrically insulating shrink wrap covering at least a portion of said hollow aluminimum tube, and a clevis means, with said clevis means fixedly engaging said hollow aluminum tube and having a

pair of parallel, spaced apart, opposed arm members with at least one of said opposed arm members having a hole, and a pivot rod means engaging the opposed arm members at said hole in a manner substantially transverse said longitudinal axis with said end effector means pivotally engaging said pivot rod means, and with at least a portion of the clevis means being covered by said electrically insulating shrink wrap, an improvement in said clevis means comprising:

a) a hollow first portion having an outer diameter slightly smaller than the inner diameter of the aluminum tube, said hollow first portion press fit within the aluminum tube and fixedly engaging the aluminum tube;

b) a second portion having a base section having with a bore corresponding to the inner diameter of the hollow first portion, and said pair of parallel, spaced apart, opposed arm members integrally joined to said base portion at respective first ends of said opposed arm members, said pair of arm members extending away from said hollow first portion, and each said opposed arm member having an undercut groove therein along an outer surface of said arm member substantially transverse said longitudinal axis, wherein the electrically insulating shrink wrap terminates in the undercut grooves of the arm members.

7. In a surgical instrument according to claim 6, wherein:

said hollow first portion of said clevis means has a knurled outer surface.

8. In a surgical instrument according to claim 7, wherein:

said clevis means is comprised of a first aluminum alloy and said aluminum tube is comprised of a second aluminum alloy, said first aluminum alloy being harder than said second aluminum alloy.

9. In a surgical instrument according to claim 6, wherein:
each said opposed arm member has a through-hole for receiving said pivot rod.

10. In a surgical instrument according to claim 9, wherein:
said pivot rod comprises a stainless-steel nail.

11. A surgical instrument for insertion through a trocar tube, said surgical instrument comprising:

a) a hollow aluminum tube having an inner diameter and a longitudinal axis;

b) one of grasping, cutting, clamping, dissecting, and extracting end effector means;

c) a rod extending through said hollow aluminum tube, said rod coupled to said end effector means;

d) actuation means engaging said rod for moving said rod relative to said hollow aluminum tube; and

e) an integral aluminum clevis means having a hollow first portion having an outer diameter slightly smaller than the inner diameter of said aluminum tube and press fit within and fixedly engaging said aluminum tube, and a second portion having a base section with a bore corresponding to the inner diameter of the hollow first portion, and a pair of parallel, spaced apart, opposed arm members extending parallel to said longitudinal axis and away from said hollow first portion and integrally joined to said base portion at respective first ends of said opposed arm members,

f) a pivot rod means engaging said opposed arm members of said clevis means in a manner substantially transverse said longitudinal axis, wherein said end effector means pivotally engage said pivot rod means.

12. A surgical instrument according to claim 11, wherein:

said hollow first portion of said clevis means has a knurled outer surface, and said clevis means is comprised of a first aluminum alloy and said aluminum tube is comprised of a second aluminum alloy, said first aluminum alloy being harder than said second aluminum alloy.

13. A surgical instrument according to claim 11, wherein:

each said opposed arm member has an undercut groove therein along an outer surface of said arm member and extending in a manner substantially transverse said longitudinal axis for receiving an end of a shrink wrap tubing.

14. A surgical instrument according to claim 13, further comprising:

electrically insulating shrink wrap covering at least a portion of said hollow aluminum tube and covering at least a portion of said clevis means, and terminating in said undercut grooves of said opposed arm members of said clevis means.

15. A surgical instrument according to claim 14, wherein:

said hollow first portion of said clevis means has a knurled outer surface, and said clevis means is comprised of a first aluminum alloy and said aluminum tube is comprised of a second aluminum alloy, said first aluminum alloy being harder than said second aluminum alloy.

16. A surgical instrument according to claim 13, wherein:

at least one of said opposed arm members has a through-hole which receives said pivot rod means.

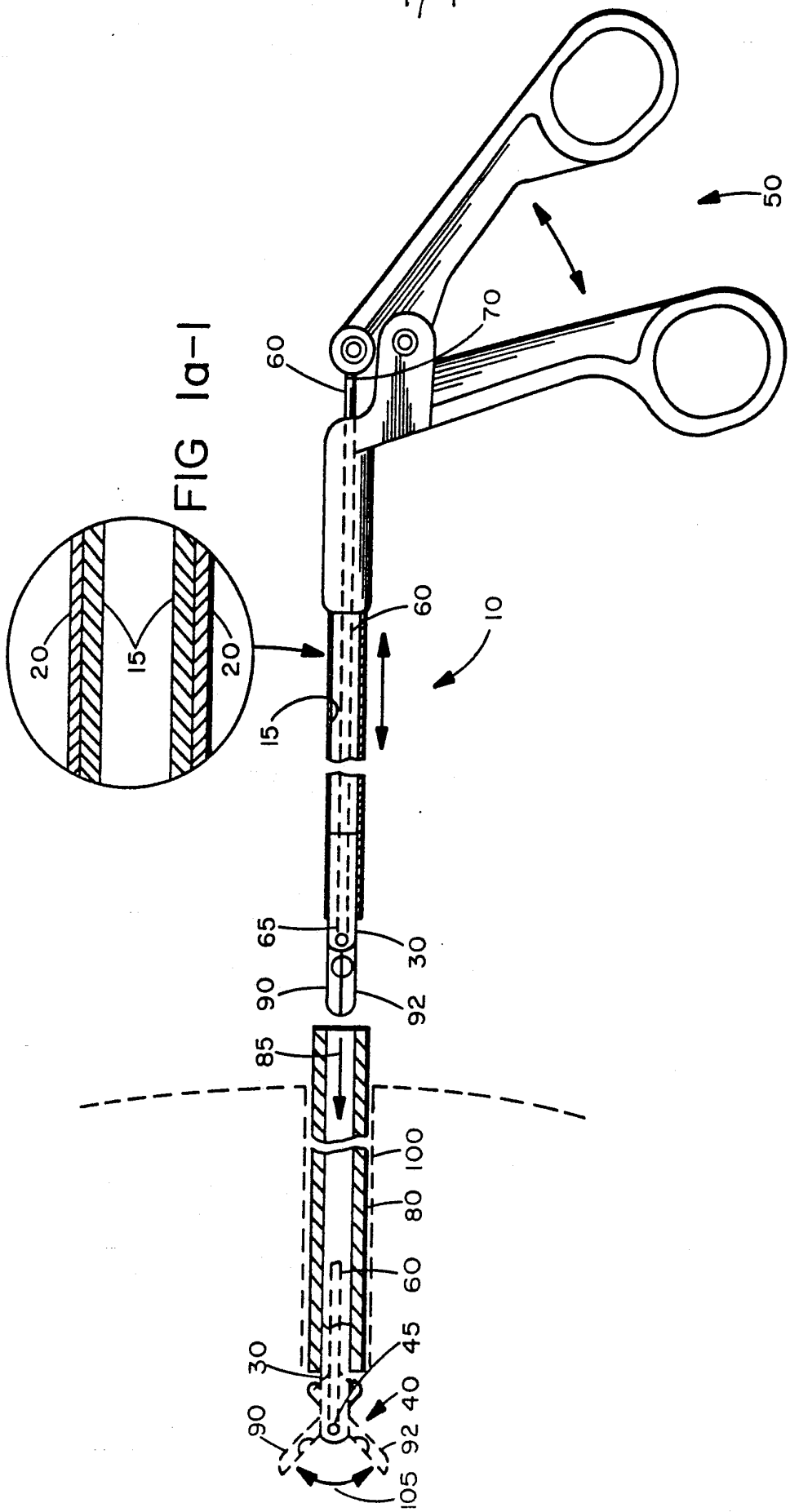


FIG 1a-1

FIG. 1

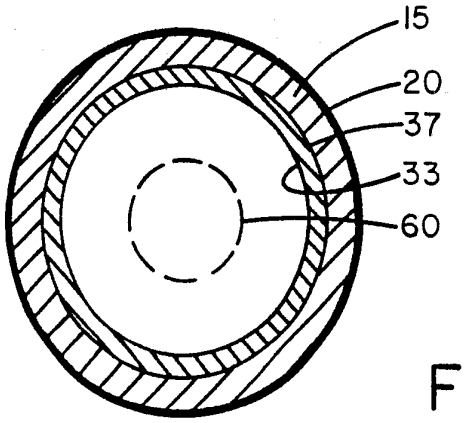


FIG. 2b

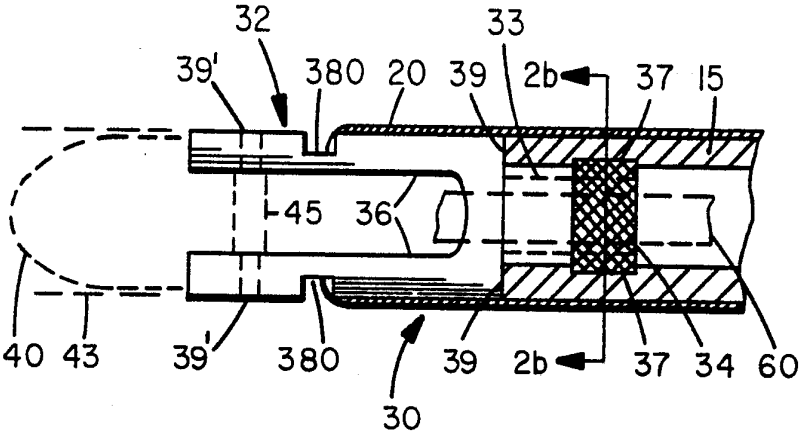


FIG. 2a

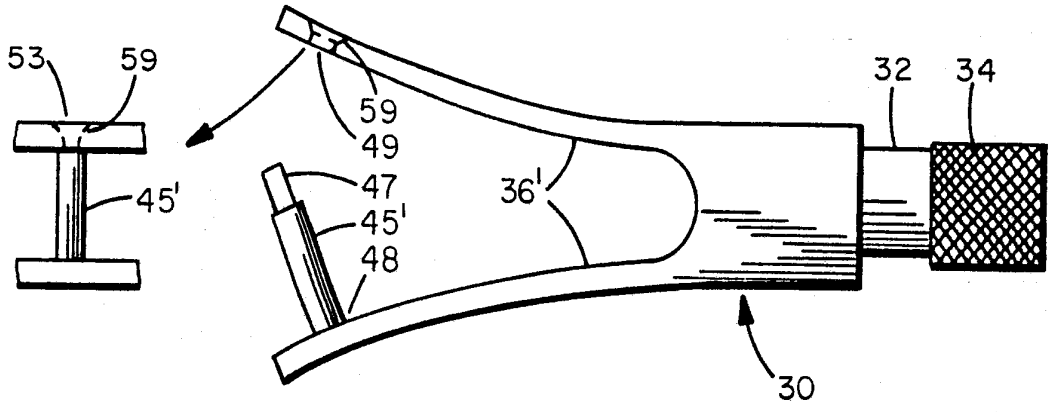
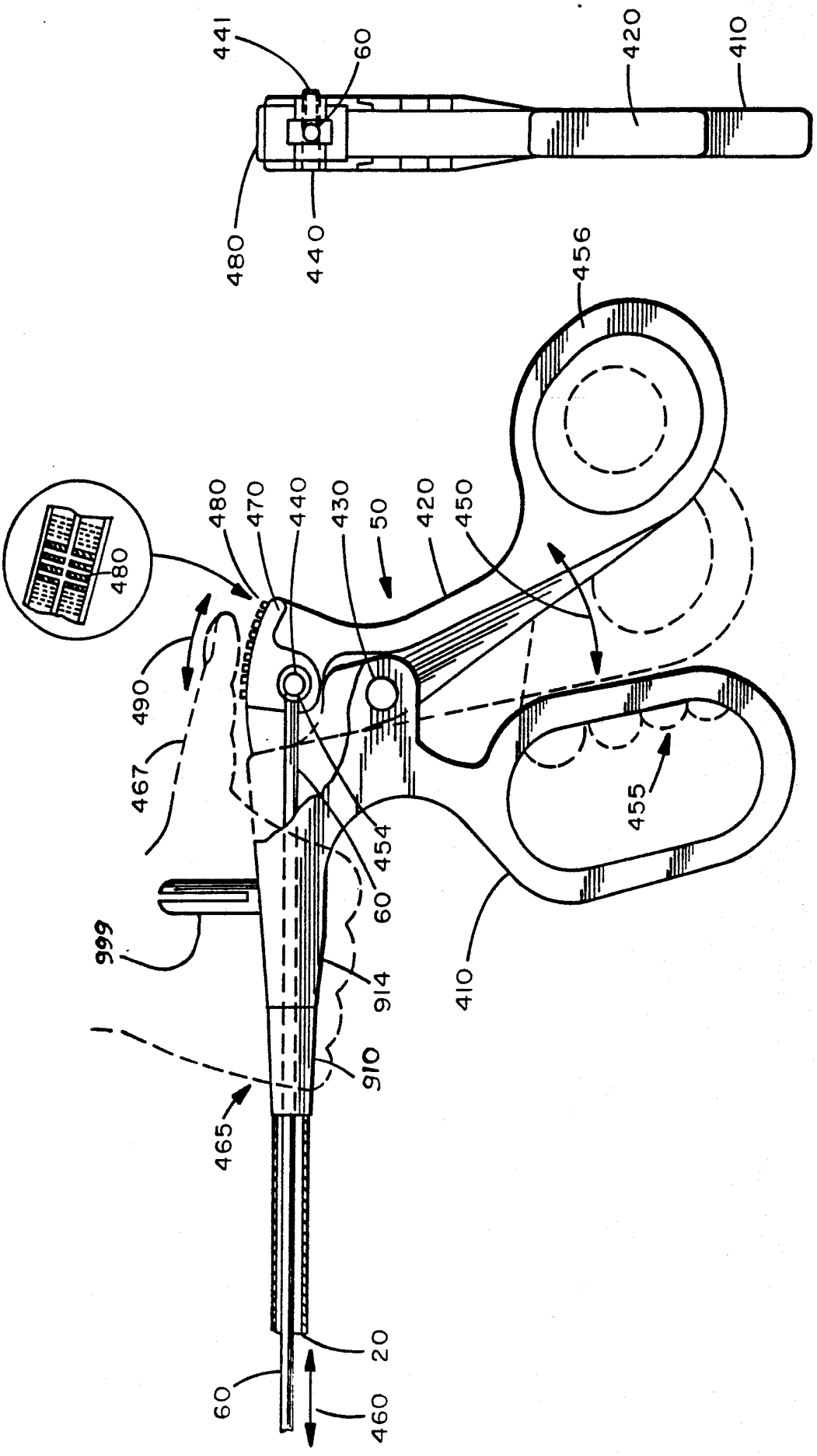


FIG. 3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999
914
410
910
465
20
60
460

FIG. 4b

FIG. 4a

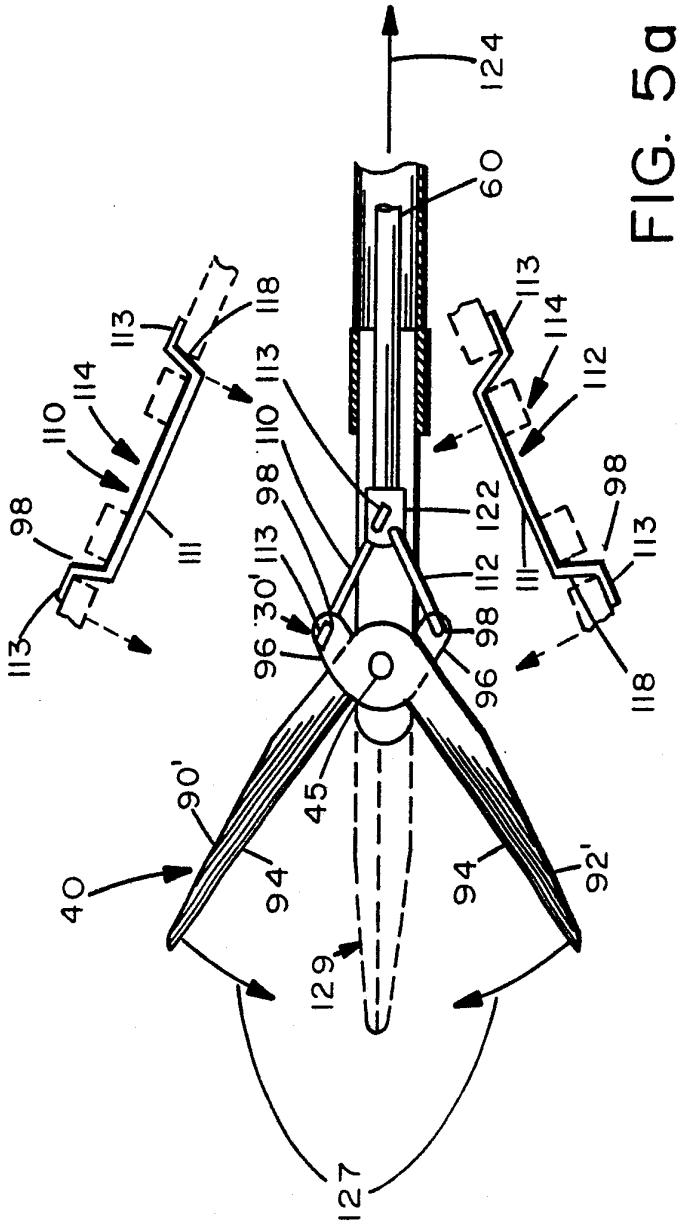
124
60
113
118
114
110
98
111
122
112
30'
96
45
90'
40
94
92'
129
127

FIG. 5a

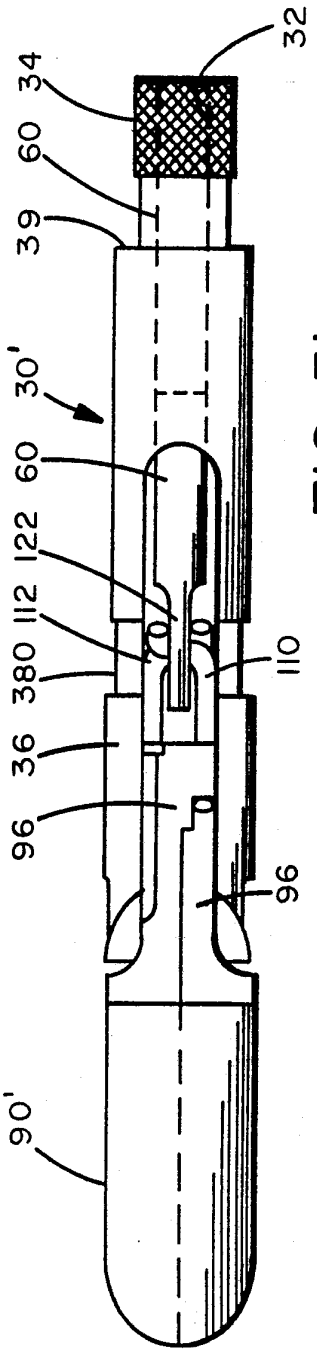
32
34
60
39
30'
122
112
380
36
96
110
90'

FIG. 5b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/02694

A. CLASSIFICATION OF SUBJECT MATTER
IPC(5) :A61B 17/00
US CL :606/174, 170 128/751 AND 403/79
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)

U.S. : 606/174, 170 128/751 AND 403/79

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

N/A

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

30/250, 251, 242, 155, 266, 267, 335; 74/105 128/749; 606/205-208, 167; 403/279, 282, 284

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 3,895,636 (Schmidt), 22 July 1975 entire reference.	1-16
A	US,A, 4,896,678 (Ogawa), 30 January 1990 entire reference.	1-16
A	US,A, 3,920,338, (Dah L), 18 November 1975 entire reference.	1-16
A	US,A, 3,001,000 (Wantz) 19 September 1961 entire reference.	1-16
A,P	US,A, 5,026,371, (Rydell et al.) 25 June 1991 entire document.	6-10

☐ 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 part of particular relevance

"E" earlier document published on or after the international filing date

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"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	Date of mailing of the international search report
11 JULY 1992	28 AUG 1992
Name and mailing address of the ISA/ Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer for SAMUEL GILBERT NGUYEN NGOC-HO INTERNATIONAL DIVISION Telephone No. (703) 308-0858

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