

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to the field of plugs for insertion into sockets and more specifically to a plug to be used in a connector, which is to be connected to the system connector of a portable electronic device.

DESCRIPTION OF RELATED ART

[0002] Portable electronic devices like cellular phones are today getting smaller and smaller. In view of this it is often necessary to provide the system connectors used for among other things charging of the battery of the device to have a smaller height, which makes it necessary to use new designs for plugs to fit in these system connectors for ensuring safe contact. This requirement is especially important in so-called clamshell phones, which have two bodies that can be folded over each other and where only one such body includes the system connector. There is however still a problem of ensuring that the plug is not damaged when being bent while inserted in a socket.

[0003] The Ericsson plug for system connectors based on 3V and 4V platforms has used a plug with two flexible bars joined together by a snap hook at the tip, which bars are both break-off and overload safe. The bars are also flexible at the point of exit from the connector body. The problem with this construction is however that it is hard to dimension for use in phones that are thin. When inserting this plug into a socket it is inserted straight into the socket, while the plug needs to be bent in order to be removed from the socket.

[0004] Another type of plug is the type Molex-SD91180/91181 or the plug used in the Nokia phone model 5110. This plug has one rigid bar provided with a protrusion at the tip for engaging a recess of a mating socket. The plug is furthermore provided with a spring and a button, where the spring acts to force the bar against the wall including the recess and thereby acts to force the protrusion into the recess. The button forces the bar and spring downward for releasing the plug from the socket. When the button is depressed the protrusion is made to disengage with the recess of the socket. This type of plug is however not break-off or overload safe and can therefore break, i.e. does not safely release contact in case the plug is subjected to great forces in a direction essentially parallel to the opening area of the socket.

[0005] Yet another type of plug is the Nokia connector PoPPort®, which also includes a single rigid bar with a spring. The bar has a protrusion, which is pressed by the spring into a cut-out of a metal wall within the socket. The protrusion is shaped for being self-releasing when the pull-out force applied reaches a certain level. The bar is here short and the socket has a large chamber for

allowing the connector to be broken off without damage. Because of the low spring force of this plug and the short length of the plug, the fit within the socket can be less satisfactory, which can lead to unwanted disconnection of the plug.

[0006] There is thus a need for a new type of plug for use in system connectors that have small height dimensions for enabling insertion in thin devices, while at the same time avoiding breaking of the plug in case of a wrong disconnection of the plug from the socket into which it is plugged because of accidentally applied force in the wrong direction.

SUMMARY OF THE INVENTION

[0007] The present invention is thus directed towards solving the problem of providing a plug that can be inserted and taken out of a socket in an easy manner while providing damage-free break-off of the connection if the plug is subjected to a damaging force when being inserted.

[0008] According to a first aspect of the present invention, this problem is solved by a plug for insertion into a socket, comprising: a first and a second spaced apart bar each having a first essentially rigid section and a second essentially flexible section shaped for releasable engaging of the socket.

[0009] A second aspect of the present invention is directed towards a plug including the features of the first aspect, wherein the first section furthermore has a larger height than the second section.

[0010] A third aspect of the present invention is directed towards a plug including the features of the second aspect, wherein the first section of each bar is furthermore provided with a portion adjacent the second section, having a varying height.

[0011] A fourth aspect of the present invention is directed towards a plug including the features of the first aspect, wherein the height variation is linear.

[0012] A fifth aspect of the present invention is directed towards a plug including the features of the first aspect, wherein the second section includes a recess engaging a corresponding protrusion of the socket.

[0013] A sixth aspect of the present invention is directed towards a plug including the features of the first aspect, wherein the second section includes a protrusion for engaging a recess of the socket.

[0014] A seventh aspect of the present invention is directed towards a plug including the features of the first aspect, wherein the second sections of the two bars are joined in an end furthest from the first sections by a third section having a spring like action.

[0015] An eighth aspect of the present invention is directed towards a plug including the features of the first aspect, wherein the relationship between the height and the length of the plug is at least 1/3.

[0016] A ninth aspect of the present invention is directed towards a plug including the features of the first

aspect, further including a plug frame having a front end wall, wherein the two bars are fixedly attached at and project out from the front end wall of the plug frame.

[0017] A tenth aspect of the present invention is directed towards a plug including the features of the ninth aspect, wherein the bars are attached to the front end wall with the first sections.

[0018] The present invention is also directed towards solving the problem of providing a connector that can be plugged into and unplugged from a mating connector in an easy manner while providing damage-free break-off of the connection if the connector is subjected to a damaging force when being inserted.

[0019] According to an eleventh aspect of the present invention, this problem is solved by a connector including at least one plug for insertion into a socket of a corresponding connector, wherein the plug comprises:

a first and a second spaced apart bar each having a first essentially rigid section and a second essentially flexible section shaped for releasable engaging of the socket.

[0020] The invention has the following advantages. It is small and compact and allows small heights of the plug used for a system connector. It allows stable attachment of accessories to a system connector. It also allows damage-free break off of the plug from the socket of the system connector in case the plug is bent. The normal insertion and removal of the plug is furthermore direct and easily understandable because no bending is needed when removing the plug from the socket.

[0021] It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components, but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The present invention will now be described in more detail in relation to the enclosed drawings, in which:

fig. 1 shows a perspective view of an accessory connector including two plugs according to the invention,

fig. 2 shows a perspective view of a system connector including two sockets for receiving the plugs in the accessory connector,

fig. 3 shows a side view of a plug according to the invention,

fig. 4 shows a sectional view of a plug according to a first embodiment of the invention inserted into a socket, where the section has been taken along lines A-A of fig. 1 and 2,

fig. 5 shows a sectional view of a plug according to

a second embodiment of the invention inserted into a socket, where the section has been taken along lines A-A of fig. 1 and 2,

fig. 6 shows a sectional view of a plug according to another embodiment of the invention inserted into a socket, where the section has been taken along lines A-A of fig. 1 and 2, and

fig. 7 a -d shows a sectional view of a plug inserted into a corresponding socket and its disengagement from the socket when a break-off force is applied onto it.

DETAILED DESCRIPTION OF EMBODIMENTS

[0023] Fig. 1 shows a perspective view of an accessory connector 10 for insertion into a system connector of a portable electronic device. Such a device is preferably a cellular phone, but several other types of devices are also feasible. Such a device can for instance also be a PDA (personal digital assistant), a palm top computer, a lap top computer, a portable gaming machine and a smartphone. The accessory connector is normally provided for connection of an accessory such as a hands-free device to the phone. There are of course many other types of accessories that can be connected to a phone, like an additional keyboard, a charger, MP3-player or a camera. In order to do this the accessory connector 10 includes a number of electrical interfaces 11 provided between two plugs 12 according to the invention. The plugs 12 ensure safe mechanical connection of the connector to a system connector such that an electrical contact between the electrical interfaces 11 of the connector with corresponding electrical interfaces in the system connector is ensured. In the drawing a coordinate system indicating the different directions that the plug is extending into is included. The plug thus has a certain extension in the width dimension x, a certain extension in the length dimension y and a certain extension in the height dimension z. From the figure it is clear that the height is much smaller than the width. Also the bars of the plug are fairly wide and long in relation to the height.

[0024] Fig. 2 shows a perspective view of a corresponding system connector 11 provided with two sockets 17 in which the plugs of the connector can be inserted. The system connector also comprises mating electrical interfaces 9 for the electrical interfaces of the connector in fig. 1. In fig. 1 and 2 there is also shown a section taken straight through a socket and a plug in the longitudinal direction, which sections are denoted A-A. Also here the corresponding x-y-z coordinate system is included. The sections are thus taken in a plane extending in directions y and z.

[0025] Fig. 3 shows a side view of a plug 12 according to a first embodiment of the present invention. Here the z and y axis of the coordinate system are shown for indicating the dimensions of the plug 12. The plug 12, which is preferably made all in a plastic material, in-

cludes a first and a second long essentially parallel bar 13 and 15 extending in the y direction and having three sections. A first section 14 has a first portion 19 with an essentially even height in the z direction and a rectangular cross-section and a second portion 18 having a rectangular cross-section and an essentially linearly diminishing height in the z direction. The first section 14 is joined to a second section 16 having an even height in the z direction, which height is smaller than the height of the first portion 19 of the first section 14 and an essentially rectangular cross section. The second portion 18 of the first section 14 interconnects the first portion 19 of the first section 14 with the second section 16 such that the second portion 18 of the first section 14 has the same height at a point where it joins the first portion 19 of the first section 14 and has the same height as the second section 16 at the point of connection to this second section 16. The first section 14 of each bar 13 and 15 furthermore has a protrusion on the first portion 19 at the end furthest from the second section 16, and facing upwards and downwards, respectively, away from the neighbouring bar, which protrusion is used for securing the plug in the accessory connector. The interfaces between the different sections and portions of a bar are indicated with dashed lines. The side of the second portion 18 of the first section 14 of a bar facing the other bar is furthermore the side experiencing the height variation in the z direction in this embodiment, while the side facing away from the neighbouring bar is relatively straight. It should however be realised that the other side might just as well experience the height variation. The second sections 16 of both the bars are furthermore joined by a curved third section 20, such that the plug is provided as a unitary piece, which is more easily inserted into a socket. The second section 16 is provided with a curvature for provision of a recess 22, the use of which will be described later.

[0026] Fig. 4 shows a cross-sectional view of the plug 12 inserted into a socket 17 for providing safe contact between the accessory connector 10 and the system connector 13, where the section has been taken along lines A-A of fig. 1 and 2. In the drawing both the z- and y-axes are also shown. The first portions of the first sections of the first and second bars are here essentially wholly inserted in a cavity of the accessory connector in a direction, which is opposite to the direction y. Both these portions are thus surrounded by a plug frame 30 of the accessory connector, which plug frame has a front end wall 32 provided in a plane extending in the z direction, in which the opening of the cavity is provided. The protrusions on the first sections are here used to grip an interior wall of the cavity and the bars are pressed against interior walls of the cavity. A distance element 26 provided between the bars 13 and 15, approximately at the point of exit from the cavity, ensures that the bars are rigid in at least the first portion of the first section. Because of this element 26 the bars are fixedly attached at the front end wall 32 of the plug frame 30. The two

bars are thus projecting in parallel out from the end wall 32 of plug frame 30 in the horizontal direction y. This ensures that they are rigid close to this end wall. The flexibility of the two bars then increases with the distance from the wall in the longitudinal direction y. The second portion of the first section then ensures a progressive decrease of the rigidity until the plug is fairly flexible in the second section, which is used when allowing insertion of the plug in a socket. The plug is therefore to be inserted straight into a socket 17 having a cavity for receiving the plug along the horizontal direction y. The top end of the bars 13 and 15 are to be inserted in a corresponding cavity of the socket 17 of the system connector. This means that the third and second sections as well as the second portion of the first section of the two bars are inserted into the cavity of the socket 17, the shape of which corresponds to the outer shape of the plug. Here the walls of the socket cavity have two protrusions 28 corresponding to the recesses 22 of the second section of the two bars 13 and 15. The first section is here relatively stiff when being inserted into the cavity, while the second section is flexible allowing safe securing of the plug in the socket 17. When releasing the plug from the socket, it should be pulled straight out from the cavity backwards along the horizontal direction opposite to the direction y, without bending. This has the advantage that the user moves the plug in the opposite direction of the one he used for inserting the plug, which is more logical and therefore more user friendly than for some of the previous known plugs.

[0027] Sometimes the plug is subject to bending and then it is important that the connection is broken before the plug is destroyed. The third interconnecting section 20 here functions like a spring allowing separate bending of the two bars 13 and 15 while ensuring that the two bars are easily inserted into the socket 17.

[0028] The rigidities of the bars are naturally decreasing with the distance from the end of the plug frame 30. The height of the third sections can therefore be varied in that the first portion of the first section protrudes from the cavity of the end wall and is fairly long, such that the second portion of the first section is very short. In a second embodiment of the invention, which is shown in fig. 5, essentially showing the same view as fig. 4, the second portion 18 of the first section has been provided as a step size variation of the height between the first portion of the first section and the second portion. As can be seen here the first portion of the first section extends far beyond the end wall of the plug frame. This means that a more rigid second section than in the embodiment shown in fig. 3 and 4 will be obtained

[0029] Fig. 6 shows yet a variation of the plug in the same view as in fig. 5, where the second part of the first section is very short and has a quick steep transition into the second section and joins the second section essentially at the place where the recesses 22 are provided.

[0030] Now the break-off of the plug from the socket when it is subjected to an overly high force in the vertical

direction will be described in relation to fig. 7 a - d, which show a cross-sectional view taken along the same sections as in fig. 3 - 6 of yet another variation of the plug. Here the diminishing heights of the bars in the second portions of the first sections are provided on the upper and lower sides facing away from the neighbouring bar. The third section is here for illustrative purposes shown as a spring. In fig. 7A, the plug is fully inserted into the socket and no external force is applied on the plug in the vertical direction z. In fig. 7b a force is applied on socket 17 in an opposite direction to the direction z, i.e. in a direction perpendicular to the bars 13 and 15. Note that the force could equally as well have been provided on the connector body in the direction z in order to provide the same effect. Because of this the plug starts rotating around the insertion point into the socket and the two bars are bent downwards, where the first bar 13 experiences most of the pressure. The recess of the first bar 13 therefore now starts to disengage from the corresponding protrusion of the socket wall. As the pressure is increased the two bars are bent down further, leading to the recess of the top bar snapping out of the engagement with the corresponding socket wall as is shown in fig. 7 c. With more pressure applied the top bar has its connection with the socket cavity essentially broken and the energy in the two bars pushes the plug and socket apart, as is shown in fig 7d. In the process described above the spring like third section 20 allows the two bars to experience the pressure separately from each other, where the top bar is pressed closer to the second bar. This leads to a disengagement of the plug from the socket without the bars breaking. It should furthermore be realised that the plug and socket can also experience a similar type of pressure in the opposite direction than what was described here.

[0031] By providing the two parallel bars 13 and 15 it is possible to provide a small enough sized plug, the height of which can be held to a very small size, which is about 2,4 mm in the preferred embodiment. Safe mechanical contact is ensured while the breaking of the connection is ensured in case a too strong mechanical force is applied in the wrong direction on the connector, i.e. in essentially a vertical direction, so that the bars are not destroyed. This is ensured by providing two essentially parallel bars instead of one. The length of the part of the bars projecting out of the plug frame are 6,5 mm and the plug height is 2,4 mm in the preferred embodiment. The ratio between them is at least 1/3. The bars are furthermore preferably between 0,7 and 1 mm high at the point of exit from the plug frame 30, i.e. in the first portion of the first section, and the second section preferably has a height of 0,4 - 0,5 mm.

[0032] Another possible variation is to provide the second section closer to the end wall than in fig. 4 or 5 as well as to provide the second section longer from the end wall. It is also possible to have varying lengths of the second portion of the first section for providing varying degrees of decrease in height of the second portion

of the first section. There are thus a number of ways that these parts of the bars can be varied in order to provide suitable rigidity while at the same time being flexible at the top for providing engagement of the plug. Normally though it is the dimensioning of the first section, which decides how much bending the bars are to be allowed to be subjected to, while the dimensioning of the second section is more decisive regarding how easy or hard it is to insert the plug in the socket. It should furthermore be realised that the two bars do not have to be separate in the end where they are inserted into the cavity of the plug frame, but can be joined there. The front end wall of the connector body does also not have to have a cavity into which the two bars extend. It can just as well be a solid wall out from which the bars extend. The bars can therefore also be beams that are solidly fixed to the front end wall of the plug frame. What is important though is that they are separate when they leave the plug frame in order to provide bars that are rigid at least at the point of exit from the plug frame. The plug according to the invention can furthermore be provided without the third section.

[0033] The present invention has many advantages. It is small and compact and allows small heights of the plug used for a system connector. It allows stable attachment of accessories to a system connector. It also allows damage-free break off of the plug from the socket of the system connector in case the plug is bent. The normal insertion and removal of the plug is furthermore direct and easily understandable because no bending is needed when removing the plug from the socket.

Claims

1. Plug (12) for insertion into a socket (17), comprising:
 - a first (13) and a second (15) spaced apart bar each having a first essentially rigid section (14) and a second essentially flexible section (16) shaped for releasable engaging of the socket.
2. Plug according to claim 1, wherein the first section has a larger height than the second section.
3. Plug according to claim 2, wherein the first section of each bar is furthermore provided with a portion (18) adjacent the second section, having a varying height.
4. Plug according to claim 3, wherein the height variation is linear.
5. Plug according to any previous claim, wherein the second section (16) includes a recess (22) engaging a corresponding protrusion (28) of the socket (24).

6. Plug according to any of claims 1 - 4, wherein the second section includes a protrusion for engaging a recess of the socket.
7. Plug according to any previous claim, wherein the second sections (16) of the two bars (13, 15) are joined in an end furthest from the first sections by a third section (20) having a spring like action. 5
8. Plug according to any previous claim, wherein the relationship between the height and the length of the plug is at least 1/3. 10
9. Plug according to any previous claim, further including a plug frame (30) having a front end wall (32), wherein the two bars are fixedly attached at and project out from the front end wall (32) of the plug frame (30). 15
10. Plug according to claim 9, wherein the bars are attached to the front end wall with the first sections. 20
11. Connector (10) including at least one plug (12) for insertion into a socket (17) of a corresponding connector (11), wherein the plug comprises: 25
 - a first (13) and a second (15) spaced apart bar each having a first essentially rigid section (14) and a second essentially flexible section (16) shaped for releasable engaging of the socket. 30

35

40

45

50

55

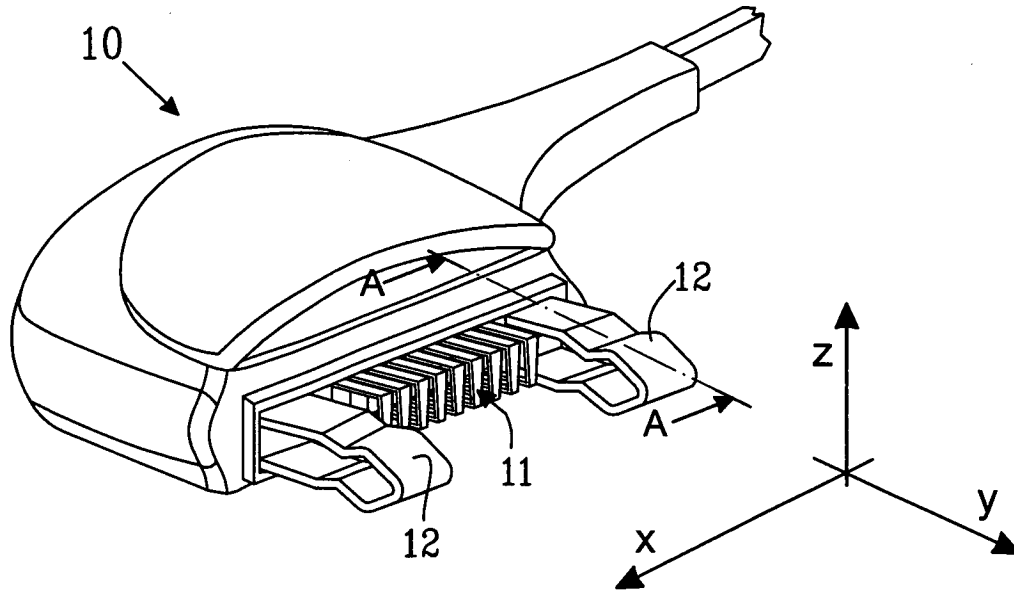


FIG. 1

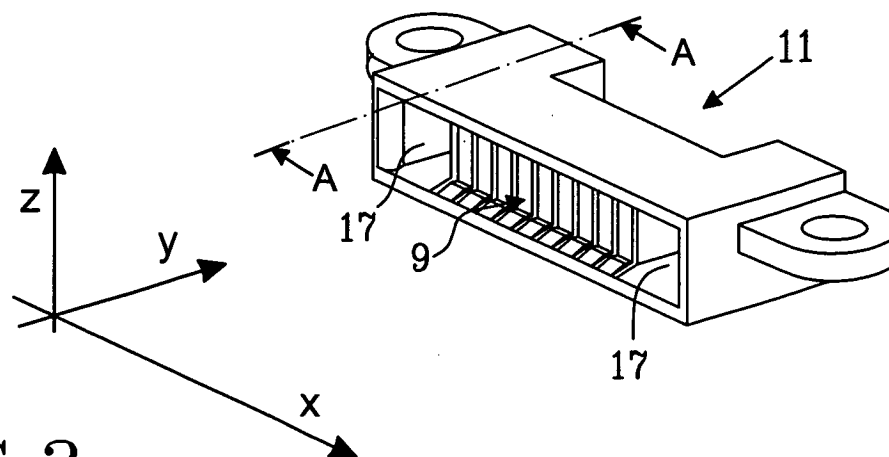
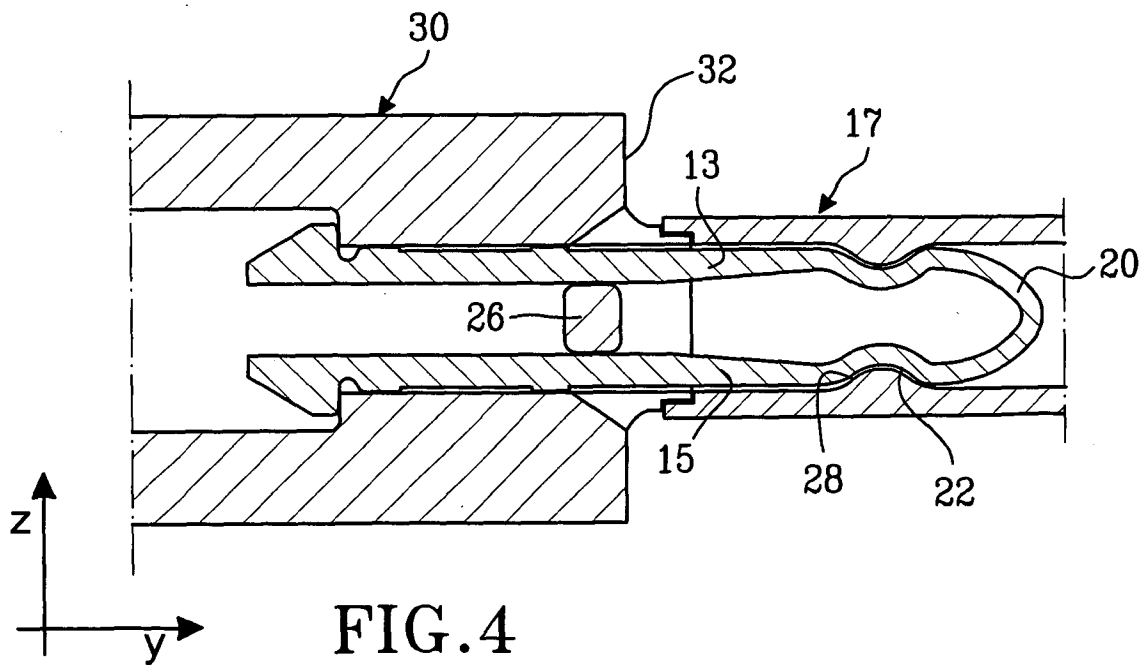
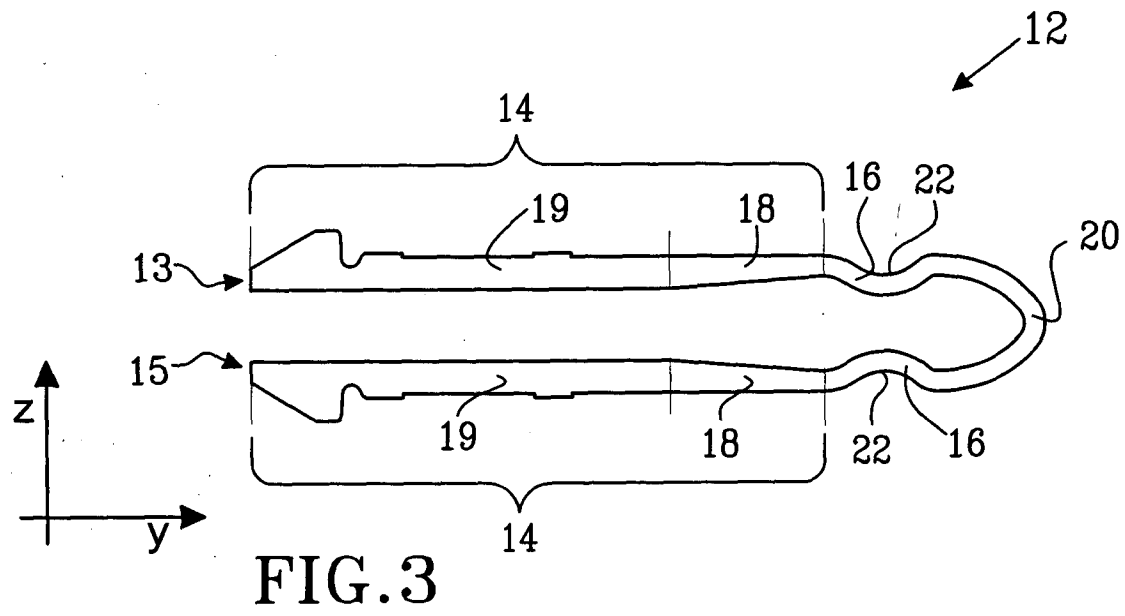
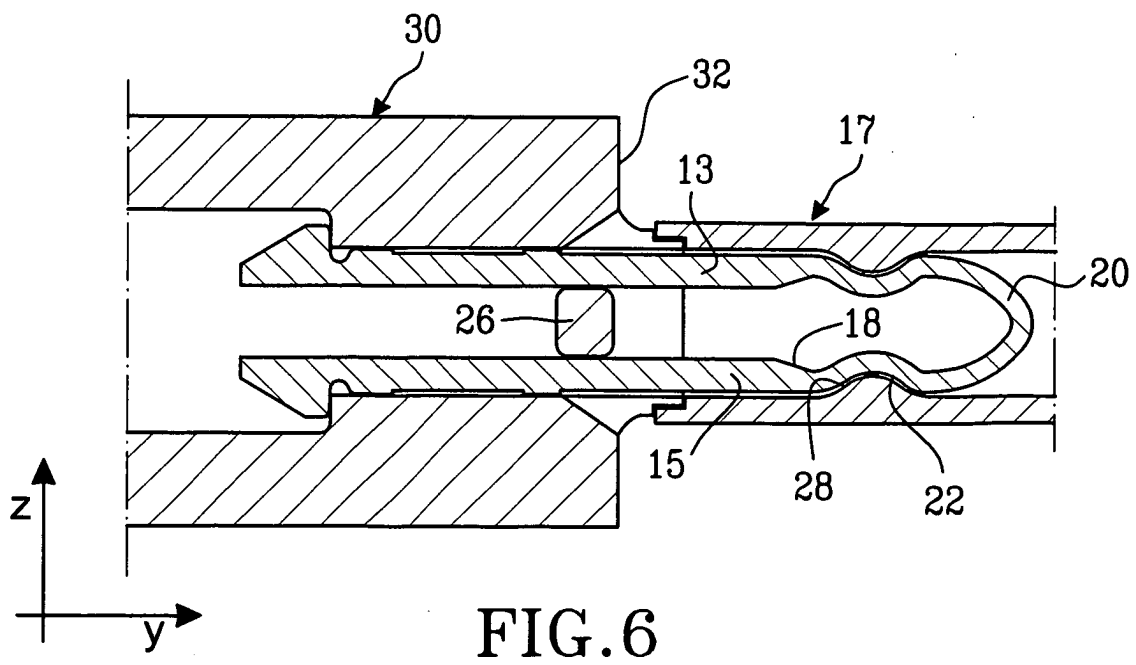
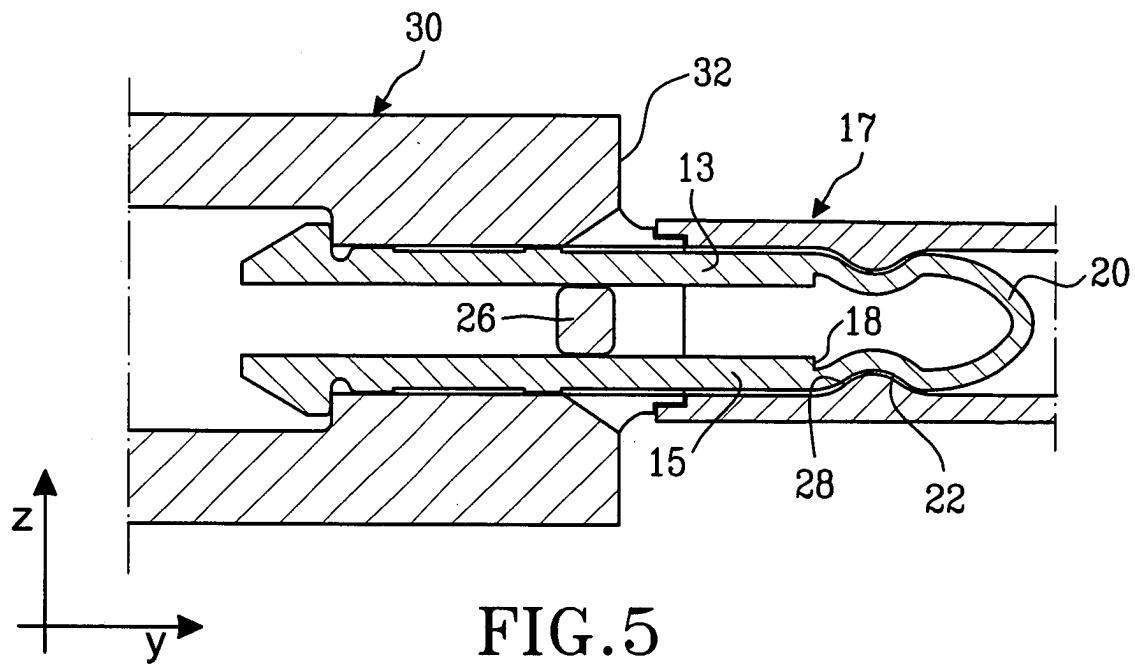


FIG. 2





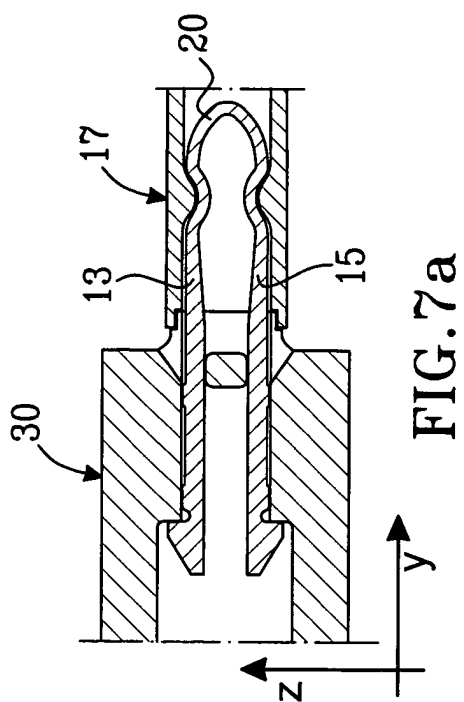


FIG. 7a

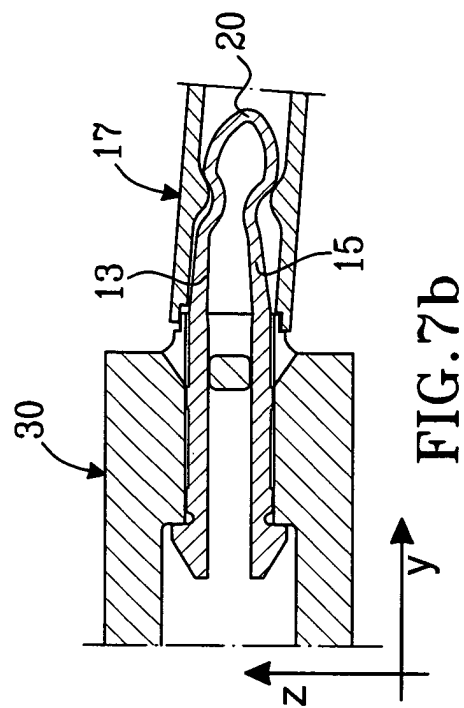


FIG. 7b

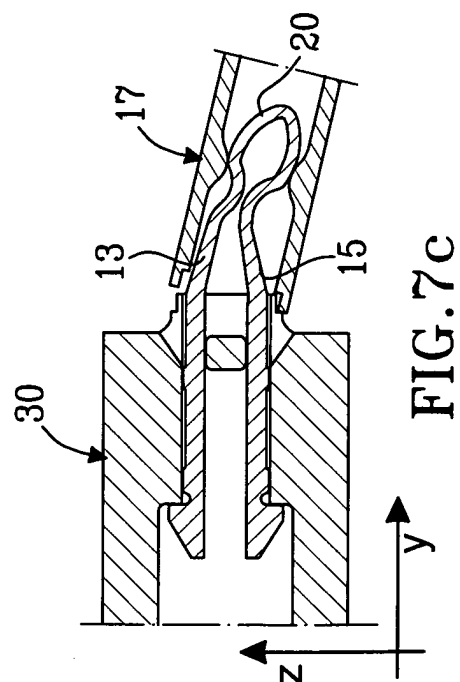


FIG. 7c

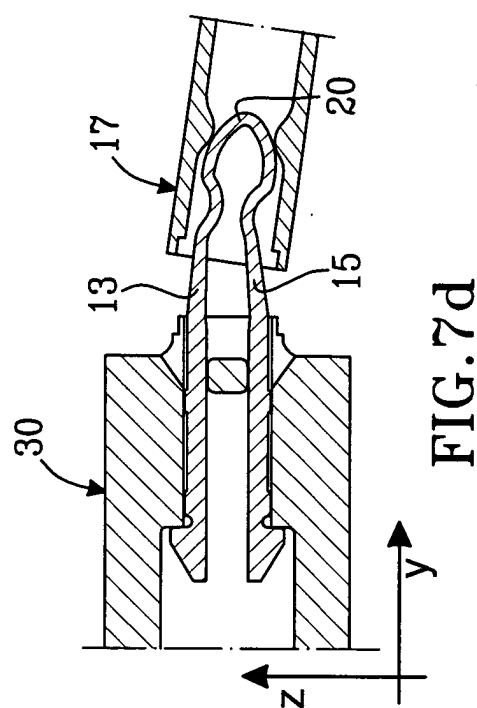


FIG. 7d



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 00 2387

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CI.7)
X	US 5 848 456 A (SJOEQVIST INGVAR) 15 December 1998 (1998-12-15) * abstract; figures * * column 2, line 63 - column 5, line 13 * ---	1-11	H01R13/627
A	EP 1 030 408 A (DELPHI TECH INC) 23 August 2000 (2000-08-23) * abstract; figures 1,2 * * column 3, line 11 - column 6, line 35 * ---	1	
X	EP 0 622 869 A (SUMITOMO WIRING SYSTEMS) 2 November 1994 (1994-11-02) * abstract; figures 3-6 * * column 4, line 39 - column 8, line 12 * ---	1-3,5-8, 11	
A	EP 1 220 370 A (FRANCE CHIRURGIE INSTR) 3 July 2002 (2002-07-03) * abstract; figures 1-4 * * column 2, line 24 - column 4, line 45 * -----	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.CI.7)
			H01R
Place of search		Date of completion of the search	Examiner
THE HAGUE		11 November 2003	Serrano Funcia, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P/MC01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 00 2387

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-11-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5848456 A	15-12-1998	SE 509658 C2	22-02-1999
		AU 714283 B2	23-12-1999
		AU 2417497 A	29-10-1997
		BR 9708514 A	03-08-1999
		CN 1215507 A , B	28-04-1999
		DE 69700960 D1	20-01-2000
		DE 69700960 T2	27-04-2000
		EE 9800312 A	15-02-1999
		EP 0891644 A1	20-01-1999
		ES 2141614 T3	16-03-2000
		JP 2000508464 T	04-07-2000
		KR 2000005074 A	25-01-2000
		SE 9601307 A	05-10-1997
		WO 9738470 A1	16-10-1997
EP 1030408 A	23-08-2000	DE 19906446 A1	17-08-2000
		BR 0000469 A	05-09-2000
		EP 1030408 A2	23-08-2000
EP 0622869 A	02-11-1994	JP 2910505 B2	23-06-1999
		JP 6310212 A	04-11-1994
		DE 69411224 D1	30-07-1998
		DE 69411224 T2	28-01-1999
		EP 0622869 A2	02-11-1994
		US 5439387 A	08-08-1995
EP 1220370 A	03-07-2002	NL 1017001 C2	01-07-2002
		EP 1220370 A1	03-07-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82