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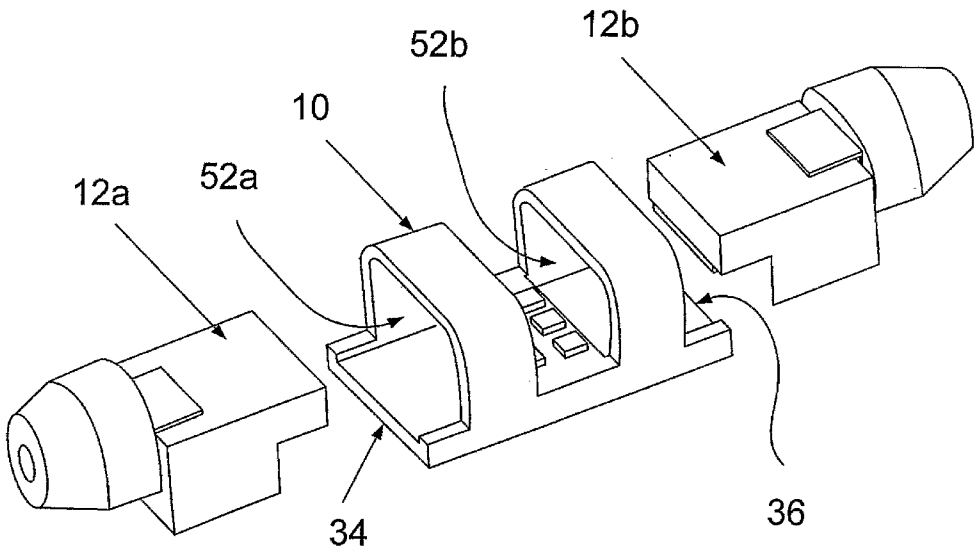
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(54) Title: MICROPHONE CARRIER FOR HEARING AID MICROPHONES



(57) Abstract: A microphone carrier for selectively coupling a microphone to an electric circuit of a hearing aid device, including locking means for selectively coupling the microphone to the carrier in a terminal position; and one or more electrically conductive contacts, wherein said one or more contacts are arranged for electrical communication with corresponding, electrically conductive contacts of the microphone ' when the microphone is arranged in said terminal position. The microphone carrier advantageously obviates the need to solder a microphone to an electric circuit.

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MICROPHONE CARRIER

Technical Field of the Invention

The present invention relates to a microphone carrier. For example, the present invention relates a microphone carrier for selectively coupling a microphone to an electric circuit of a hearing aid device without soldering the microphone. The present invention also relates to a microphone. For example, the present invention relates to a microphone for hearing aid device, the microphone being selectively couplable to a microphone carrier of the hearing aid device.

Background of the Invention

Behind-the-ear (BTE) and in-the-ear (ITE) hearing aid devices include, amongst other things, one or more microphones for receiving sound waves and converting them into electric signals. The microphones typically include a plurality of electrically conductive contacts for electrical communication with corresponding contacts of the electric circuit of the hearing aid device. The contacts of the microphones have previously been soldered directly to corresponding contacts of the electric circuit of the hearing aid device. The solder establishes a physical electrical connection between the microphone and the electric circuit of the hearing aid device. Conversely, the solder coupling a microphone to an electric circuit of a hearing aid device needs to be broken to replace a defective microphone, for example. Heat has previously been applied to melt the connections. It may not always be convenient to attach and remove microphones in the described manner.

US 2004151333 teaches use of a microphone module to couple a microphone to an electric circuit. However, the contacts of the microphone are soldered to corresponding contacts of the microphone module and the microphone is thereby physically connected to the microphone module. As such, similar difficulties with removing and connecting the microphones would likely be encountered.

Hearing aid devices that utilise paired microphones typically need both microphones to have the same operating parameters, such as the same sensitivity and the same phase. Prior to assembly, the microphones are paired in accordance with predetermined operating parameters. However, the heat generated by melting solder to form electrically conductive connections between the contacts of the microphone and corresponding contacts of the electric circuit may be sufficient to change the operating parameters of each microphone. Consequently, the operating parameters of the paired microphones may not match after they have been connected to the electric circuit of the hearing aid device.

It is generally desirable to overcome or ameliorate one or more of the above mentioned difficulties, or at least provide a useful alternative.

Summary of the Invention

In accordance with one aspect of the present invention, there is provided a microphone carrier for selectively coupling a microphone to an electric circuit of a hearing aid device, including:

(a) locking means for selectively coupling the microphone to the carrier in a terminal position; and

(b) one or more electrically conductive contacts,

wherein said one or more contacts are arranged for electrical communication with corresponding electrically conductive contacts of the microphone when the microphone is arranged in said terminal position.

Preferably, the locking means is shaped to at least partially receive a terminal end of a microphone.

Preferably, the locking means resiliently bears against the terminal end of the microphone and thereby secure the microphone in the terminal position.

In accordance with another aspect of the present invention, there is provided a microphone for hearing aid device, the microphone being selectively couplable to a microphone carrier of the hearing aid device, including:

(a) a terminal end for selectively coupling the microphone to the microphone carrier in a terminal position; and

(b) one or more electrically conductive contacts,

wherein electrically conductive contacts of the microphone are arranged for electrical communication with corresponding electrically conductive contacts of the microphone carrier when the microphone is arranged in the terminal position.

Preferably, the one or more electrically conductive contacts are arranged on a terminal end of the microphone that is shaped for insertion into a socket of the microphone carrier.

Preferably, the terminal end of the microphone is stepped and is shaped to at least partially overlie a corresponding stepped platform of the socket of the microphone carrier when located in the terminal position so that said one or more electrically conductive contacts engage respective ones of said corresponding electrically conductive contacts of the microphone carrier.

Advantageously, the microphone carrier allows microphones to be plugged into the microphone module without the need for soldering. The microphone carrier preferably, facilitates easy assembly and removal of microphones from electrical communication with the electric circuit of the hearing aid device.

Brief Description of the Drawings

Preferred embodiments of the present invention are hereafter described, by way of non-limiting example only, with reference to the accompanying drawing in which:

Figure 1 is a perspective view of a microphone carrier;

Figure 2 is a side view of the microphone carrier shown in Figure 1;

Figure 3 is a bottom view of the microphone carrier shown in Figure 1;

Figure 4 is a side view of a section of a hearing aid device with part of the housing removed so as to show the internal parts of the device;

Figure 5 is a perspective view of a microphone for electrical communication with the microphone carrier shown in Figure 1;

Figure 6 is a side view of the microphone carrier shown in Figure 1 coupled to two examples of the microphone shown in Figure 5;

Figure 7 is a perspective view of the microphone carrier and the microphones shown in Figure 6 arranged in another condition of use;

Figure 8 is a side view of the microphone carrier shown in Figure 1 coupled to another type of microphone;

Figure 9 is a top view of the microphone carrier and microphones shown in Figure 8;

Figure 10 is a perspective view of another microphone carrier;

Figure 11 is another perspective view of the microphone carrier shown in Figure 10;

Figure 12 is a side view of the microphone carrier shown in Figure 10;

Figure 13 is a top view of the microphone carrier shown in Figure 10;

Figure 14 is a side view of a section of a hearing aid device with part of the housing removed so as to show the internal parts of the device;

Figure 15 is a perspective view of a microphone for electrical communication with the microphone carrier shown in Figure 10;

Figure 16 is a perspective view of the microphone carrier shown in Figure 10 coupled to two of the microphones shown in Figure 15; and

Figure 17 is a perspective view of the microphone carrier and the microphones shown in Figure 16 arranged in another condition of use.

Detailed Description of Preferred Embodiments of the Invention

The microphone carrier 10 shown in Figures 1 to 3 is used to selectively couple first and second microphones 12a,12b to an electric circuit 14 of the hearing aid device 16 shown in Figure 4. The microphone carrier 10 includes first and second sets of electrically conductive contacts 18a,18b for electrical communication with corresponding electrically

conductive contacts 20 of the microphones 12, as shown in Figure 5. The microphone carrier 10 also includes locking means 22 for selectively coupling each microphone 12a,12b to the carrier 10. The locking means 22 is shaped to receive terminal ends of the microphones 12 and to locate these ends in terminal positions with respect to the carrier. Electrically conductive contacts 20 of the microphones 12 engage corresponding electrically conductive contacts 18 of the microphone carrier 10 when the microphones are located in said terminal positions. Examples of the locking means 22 locating the microphones 12 in said terminal positions are described in detail below.

The locking means 22 secures the terminal ends of the microphones 12 in said terminal positions and thereby holds the contacts 20 microphones 12 in electrical communication with the contacts 18 of the microphone carrier 10. The microphones 12a,12b are thereby held in electrical communication with the electric circuit 14 of the hearing aid device 16 without the need for soldering. The microphones 12a,12b can be selectively removed from hearing aid device 16 by removing the microphones 12a,12b from the locking means 22 without having to break a physical connection therebetween.

The microphone carrier 10 includes a rectangular base section 24 including generally planar top and bottom sides 26,28. The top side 26 includes a centrally disposed raised platform 30. The above-described contacts 18a,18b of the microphone carrier 10 are arranged in two adjacent rows that extend across the raised platform 30 between left and right sides 31,32 of the of the rectangular body portion 24. The rows of contacts 18a,18b are arranged so that the first and second microphones 12a,12b can each engage respective rows of contacts 18a,18b when coupled to the microphone carrier 10 from front and back ends 34,36 of the rectangular base section 24 in the manner shown in Figures 6 and 7. Each row of contacts 18a,18b includes, for example:

1. A contact for a ground signal;
2. A contact for a voltage source; and
3. A contact for signals generated by the microphone 12.

The six contacts from rows 18a, 18b located on the raised platform 30 are electrically connected to a group of four metal contacts 38 located on the bottom side 28 of the rectangular base section 24 by conductor traces (not shown). The metal contacts from rows 18a, 18b and group 38 are interconnected in a way, for example, in which the first metal contact of row 18a is connected to the first metal contact of group 38 to carry signal from the first microphone12a; the first metal contact of row 18b is connected to the second metal contact of group 38 to carry signal from the second microphone 12b. The remainder metal contacts of 18a and 18b comprising voltage and ground sources for the two microphones are joined to share common metal contact for ground at third metal contact of group 38 and common metal contact for voltage line at fourth metal contact of group 38.

The above-described interconnections are given by way of non-limiting example. Different, alternative, combinations of connections of the contacts may also be used.

The metal contacts 38 are also electrically coupled to an amplifier unit (not shown) of the hearing aid device 16 shown in Figure 4. The hearing aid device 16 includes a separate signal line for each microphone 12.

The contacts 18 are preferably inter-moulded metal contacts 18.

The locking means 22 includes first and second bridging members 50a,50b that extend between the left and right sides 31,32 of the top side 26 of the rectangular base section 24. The top side 26 of the rectangular base section 24 and the bridging members 50a,50b extending thereover define first and second sockets 52a,52b that are shaped to receive respective terminal ends 54a,54b of the first and second microphones 12a,12b in the manner shown in Figures 6 and 7. The sockets 52a,52b open in opposite directions, towards the front and back ends 34,36 of the rectangular base section 24 respectively.

The terminal end 54 of the microphone 12 shown in Figure 5, for example, is generally rectangular, corresponding to the shape of the socket 52a,52b defined by the top side 26 of the rectangular base section 24 and the locking means 22. The terminal end 54 of the

microphone includes a stepped portion 56 that is shaped to extend over the raised platform 30 of the rectangular base section 24 when arranged in a terminal position within the socket 52a. The microphone 12 is coupled to the carrier by inserting the terminal end 54 into the socket 52a and pushing the terminal end 54 of microphone 12 into the socket 52a until the stepped portion 56 abuts the raised platform 30. The stepped portion 56 of the terminal end 54 of the microphone 12 includes a row of three electrically conductive contacts 20 arranged for engagement with corresponding contacts 18 located on the raised platform 30 of the microphone carrier 10. The electrically conductive contacts 20 of the microphone overlie the electrically conductive contacts 18 of the microphone 12 when the microphone 12 is located in the socket 52a, in the terminal position, in the described manner.

The terminal end 54 of the microphone 12 is held in position by frictional engagement with the socket 52a. The bridging member 50a preferably resiliently bears against the terminal end 54 of the microphone 12 and thereby secures it in position for electrical communication with the contacts 18 of the carrier 10.

The cross-sectional area of each socket 52a,52b of the carrier 10 is preferably slightly smaller than the corresponding cross-sectional area of the terminal end 54 of the microphone 12 so that the bridging members 50a,50b resiliently bear against the terminal ends 54 of the microphones 12a,12b and thereby secures the microphones in the terminal position.

The terminal end 54 of the microphone 12 can otherwise be any shape suitable for insertion into a corresponding socket 52a,52b defined by the locking means 22.

The microphones 12 include inlet sockets 60 that are shaped to receive corresponding anchoring posts 62 of the hearing aid device 16. The anchoring posts 62 are arranged within the hearing aid device 16 so as to extend towards each other from spaced apart locations. The microphone carrier 10 can be coupled to the hearing aid device 16 by arranging the carrier 10 between the anchoring posts 62 and inserting the posts 62 into

corresponding inlet sockets 60. The microphones include suspension hoods 64 arranged around each inlet socket 60. The suspension hoods 64 are preferably made of elastic, oscillation damping material such as rubber or silicon. The suspension hoods 64 are resiliently compressible so as to fit the microphones 12 and the microphone carrier 10 between the anchoring posts 62. The suspension hoods 64 bear against the anchoring posts 62 when the microphones 12 and the carrier 10 are fitted there between. Consequently, the suspension hoods 64 resiliently bear against respective microphones 12 in opposite directions and push the microphones 12a,12b into their respective sockets 52a,52b of the carrier 10. The suspension hoods 64 assist in securing the microphones 12 in respective terminal positions.

The microphones 12a,12b shown in Figures 8 and 9 each include two inlet sockets 60 that open in opposite directions.

The microphone carrier 10, including the rectangular base section 24 and the locking means 22, is preferably made of polyamide or ACP.

The microphone carrier 110 shown in Figures 10 to 13 is used to selectively couple first and second microphones 112a,112b to an electric circuit 114 of the hearing aid device 116 shown in Figure 14. The microphone carrier 110 includes first and second sets of electrically conductive contacts 118a,118b for electrical communication with corresponding electrically conductive contacts 120 of the microphones 112 shown in Figure 15. The microphone carrier 110 also includes locking means 122 for selectively coupling each microphone 112a,112b to the carrier 110. The electrically conductive contacts 120 of each microphone 112 are held in engagement with corresponding electrically conductive contacts 118a,118b of the carrier 10 when the microphones 112 are held in position by the locking means 122. The microphones 12a,12b are thereby electrically connected to the electric circuit 114 of the hearing aid device 116 without soldering the microphones to the electric circuit 114. The microphones 112a,112b can be removed from electrical communication with the electric circuit 114 without having to break a physical connection therebetween.

The microphone carrier 110 includes first and second tubular members 126,128, each being concave in cross section, arranged end on end and separated by a partition 130. The terminal ends 132 of the microphones 112 are circular in cross-section and correspond to the inner peripheral surface of the tubular members 126,128. The terminal ends 132 of the microphones can therefore be inserted into respective open ends 134,136 of the tubular members 126,128 for electrical communication with the carrier 110. The terminal ends 132 of the microphones 112 is held in position by frictional engagement with the tubular members 126,128.

The tubular members 126,128 are incomplete circular walls that engage the 200° to 240° of the outer peripheral surface of the terminal ends 132 of the microphones 112. The radius of the inner peripheral surfaces of the tubular members 126,128 is preferably slightly less than the radius of the outer peripheral surface of the terminal ends 132 of the microphones. As such, the tubular members 126,128 resiliently expand when terminal ends 132 of the microphones 112 are located therein. The tubular members 126,128 resiliently bear against the terminal ends 132 of the microphones and thereby hold the microphones 112 in electrical communication with the carrier 110.

The above-described contacts 118a,118b of the microphone carrier 110 are arranged in groups on opposite side faces of the partition 130. The first and second microphones 112a,112b can each engage respective groups of contacts 118a,118b when coupled to the microphone carrier 10 through the open ends 134,136 of the tubular members 126,128 in the manner shown in Figures 16 and 17. Each group of contacts 118a,118b includes, for example:

1. A contact for a ground signal;
2. A contact for a voltage source; and
3. A contact for signals generated by the microphone 112.

The electrically conductive contacts from groups 118a,118b are electrically connected to four electrically conductive metal contacts of group 138 located on an outer peripheral surface of the tubular members 126,128 by conductive traces (not shown). The metal contacts from groups 118a, 118b and 138 are interconnected in a way, for example, in which the first metal contact of group118a is connected to the first metal contact of group 138 to carry signal from the first microphone 112a; the first metal contact of group 118b is connected to the second metal contact of group 138 to carry signal from the second microphone 112b. The remainder metal contacts of groups 118a and 118b comprising voltage and ground lines for the two microphones are joined to share common metal contact for ground at third metal contact of group 138 and common metal contact for voltage line at fourth metal contact of group 138.

The above-described interconnections are given by way of non-limiting example. Different, alternative; combinations of connections of the contacts may also be used.

The metal contacts 138 are also electrically coupled to an amplifier unit (not shown) of the hearing aid device 116 shown in Figure 14. The hearing aid device 116 includes a separate signal line for each microphone 112.

The microphones 112 include inlet sockets 140 and suspension hoods 142 arranged therearound. The suspension hoods 142 are preferably made of elastic, oscillation damping material such as rubber or silicon. Advantageously, the suspension hoods 142 inhibit vibration of the microphone 112 during use. When arranged in position in the hearing aid device 116 in the described manner, the suspension hoods 142 resiliently bear against the internal walls of the hearing aid device 116 and thereby inhibit movement of the microphone 112 with respect to the microphone carrier 110. The suspension hoods 142 assist in holding the microphone 112 in electrical communication with the microphone carried 110.

The microphone carrier 110 is preferably made of polyamide or ACP.

While we have shown and described specific embodiments of the present invention, further modifications and improvements will occur to those skilled in the art. We desire it to be understood, therefore, that this invention is not limited to the particular forms shown and we intend in the append claims to cover all modifications that do not depart from the spirit and scope of this invention.

List of Parts

Microphone carrier 10
Microphone 12
Electric circuit 14
Hearing Aid Device 16
Electrically Conductive Contacts 18,18a, 18b
Electrically Conductive Contacts 20
Locking Means 22
Rectangular Base Section 24
Top Side 26
Bottom Side 28
Raised Platform 30
Left Side 31
Right Side 32
Front End 34
Back End 36
Metal Contracts 38
Bridging member 50a,50b
Socket 52a,52b
Terminal End of Microphone 54
Stepped Portion 56
Inlet Socket 60
Anchoring Posts 62
Suspension Hood 64
Microphone carrier 110
Microphone 112
Electric circuit 114
Hearing Aid Device 116
Electrically Conductive Contacts 118,118a, 118b,
Electrically Conductive Contacts 120

Locking Means 122

Tubular Members 126,128

Partition 130

Terminal End of the Microphone 132

Open End of the Tubular Member 134,136

Metal Contracts 138

Inlet Sockets 140

Suspension Hoods 142

Claims Defining the Invention are as Follows:-

1. A microphone carrier for selectively coupling a microphone to an electric circuit of a hearing aid device, including:

(a) locking means for selectively coupling the microphone to the carrier in a terminal position; and

(b) one or more electrically conductive contacts,

wherein said one or more contacts are arranged for electrical communication with corresponding electrically conductive contacts of the microphone when the microphone is arranged in said terminal position.

2. The microphone carrier claimed in claim 1, wherein the locking means is shaped to at least partially receive a terminal end of a microphone.

3. The microphone carrier claimed in claim 2, wherein the locking means resiliently bears against the terminal end of the microphone and thereby secure the microphone in the terminal position.

4. The microphone carrier claimed in claim 2 or claim 3, wherein the locking means defines a socket shaped to receive the terminal end of the microphone and said one or more electrically conductive contacts are located within the socket for engagement with said corresponding electrically conductive contacts of the microphone when the microphone is located in the terminal position.

5. The microphone carrier claimed in any one of the claims 2 to 4, including a generally planar base section having a stepped platform arranged thereon, wherein said one or more electrically conductive contacts are arranged on the stepped platform for engagement with said corresponding contacts of the microphone.

6. The microphone carrier claimed in claim 5, wherein the socket is shaped to receive

the terminal end of the microphone so that it overlies the stepped platform when arranged in the terminal position so that said corresponding electrically conductive contacts of the microphone engage respective ones of said one or more electrically conductive contacts of the microphone carrier.

7. The microphone carrier claimed in claim 6, wherein the locking means is coupled to the generally planar base section and extends over the stepped platform.

8. The microphone carrier claimed in claim 7, wherein the locking means resiliently bears against the terminal end of the microphone when located in the terminal position and thereby clamps the electrically conductive contacts of the carrier in electrical communication with respective ones of the electrically conductive contacts of the microphone.

9. The microphone carrier claimed in any one of claims 5 to 8, wherein the microphone is located in the terminal position when at least part of the terminal end of the microphone abuts the stepped platform.

10. The microphone carrier claimed in any one of the claims 2 to 4, wherein the locking means includes a tubular body portion shaped to at least partially receive the terminal end of the microphone, wherein said one or more electrically conductive contacts are arranged on said closed end of the tubular body portion for engagement with respective ones of said corresponding electrically conductive contacts of the microphone when arranged in the terminal position.

11. The microphone carrier claimed in claim 10, wherein the tubular body portion is an incomplete circular wall.

12. The microphone carrier claimed in claim 10 or claim 11, wherein the tubular body portion resiliently bears against the terminal end of the microphone when located in the terminal position and thereby holds the electrically conductive contacts of the

carrier in electrical communication with respective ones of the electrically conductive contacts of the microphone.

13. The microphone carrier claimed in any one of claims 9 to 12, wherein the microphone is located in the terminal position when the terminal end of the microphone abuts the closed end of the tubular body portion and the electrically conductive contacts of the carrier are held in electrical communication with respective ones of the electrically conductive contacts of the microphone.

14. The microphone carrier claimed in any one of the preceding claims, wherein the locking means is adapted to release the microphone from the terminal position.

15. A microphone for hearing aid device, the microphone being selectively couplable to a microphone carrier of the hearing aid device, including:

(a) a terminal end for selectively coupling the microphone to the microphone carrier in a terminal position; and

(b) one or more electrically conductive contacts,

wherein electrically conductive contacts of the microphone are arranged for electrical communication with corresponding electrically conductive contacts of the microphone carrier when the microphone is arranged in the terminal position.

16. The microphone claimed in claim 15, wherein the one or more electrically conductive contacts are arranged on a terminal end of the microphone that is shaped for insertion into a socket of the microphone carrier.

17. The microphone claimed in claim 16, wherein the terminal end of the microphone is stepped and is shaped to at least partially overlie a corresponding stepped platform of the socket of the microphone carrier when located in the terminal position so that said one or more electrically conductive contacts engage respective ones of said corresponding electrically conductive contacts of the microphone carrier.

18. The microphone claimed in any one of claims 15 to 17, wherein the microphone is located in the terminal position when at least part of the terminal end of the microphone abuts the stepped platform of the microphone carrier.

19. The microphone claimed in claim 16, wherein the terminal end of the microphone is shaped for insertion into an open end of a tubular body portion of the socket of the microphone carrier.

20. The microphone claimed in claim 19, wherein said one or more electrically conductive contacts arranged on the terminal end of the microphone engage respective ones of said corresponding electrically conductive contacts arrange on a closed end of the tubular body portion of the microphone carrier when the microphone is arranged in the terminal position.

21. The microphone claimed in claim 19 or claim 20, wherein the terminal end of the microphone is shaped to bear against the tubular body portion of the carrier and is thereby held in the terminal position.

22. The microphone claimed in any one of claims 19 to 21, wherein the microphone is located in the terminal position when the terminal end of the microphone abuts the closed end of the tubular body portion and the electrically conductive contacts of the microphone are held in electrical communication with respective ones of the electrically conductive contacts of the microphone carrier.

23. The microphone claimed in any one of claims 15 to 22, including a suspension hood for coupling the microphone to a hearing aid device.

24. The microphone claimed in claim 23, wherein the suspension hood assists in locating the microphone in the terminal position with respect to the microphone carrier.

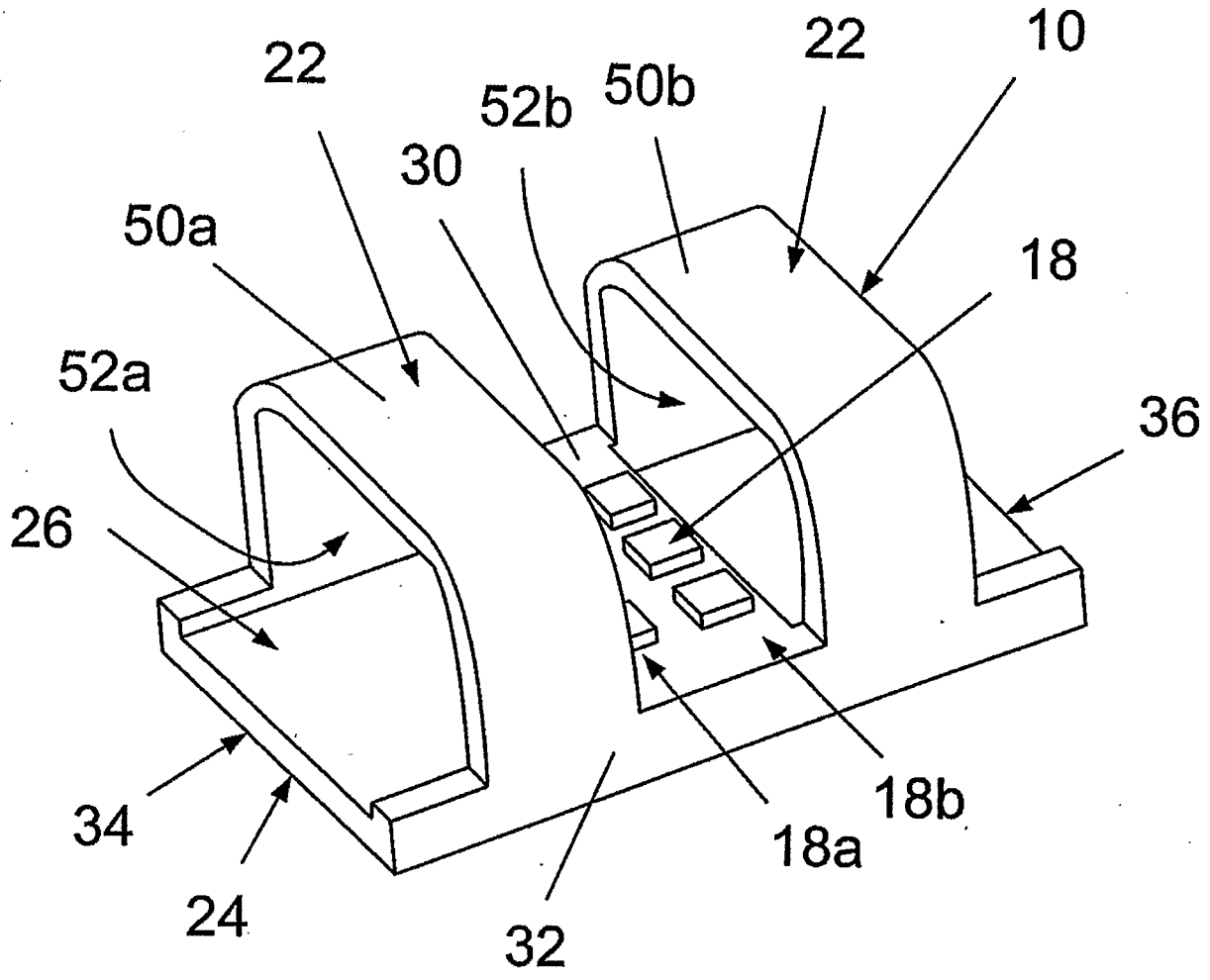


Figure 1

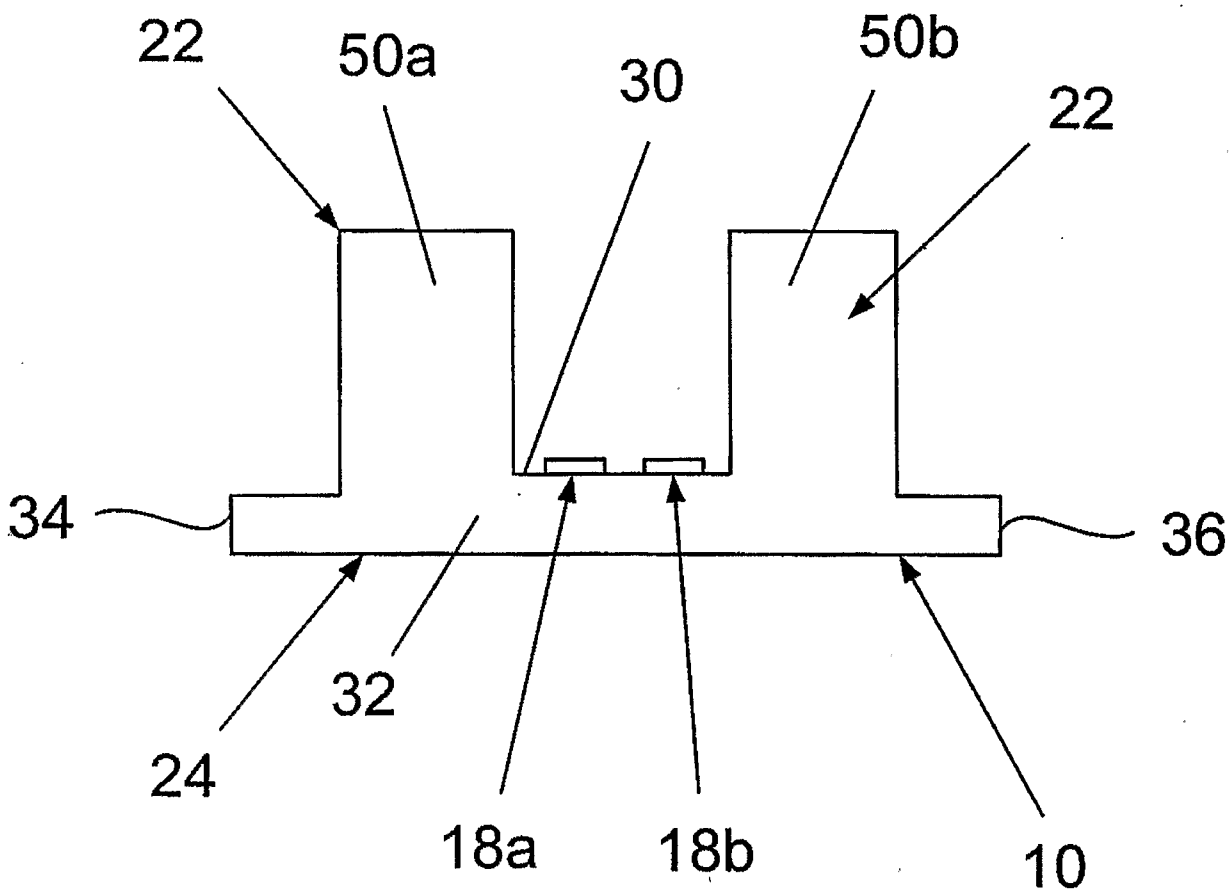


Figure 2

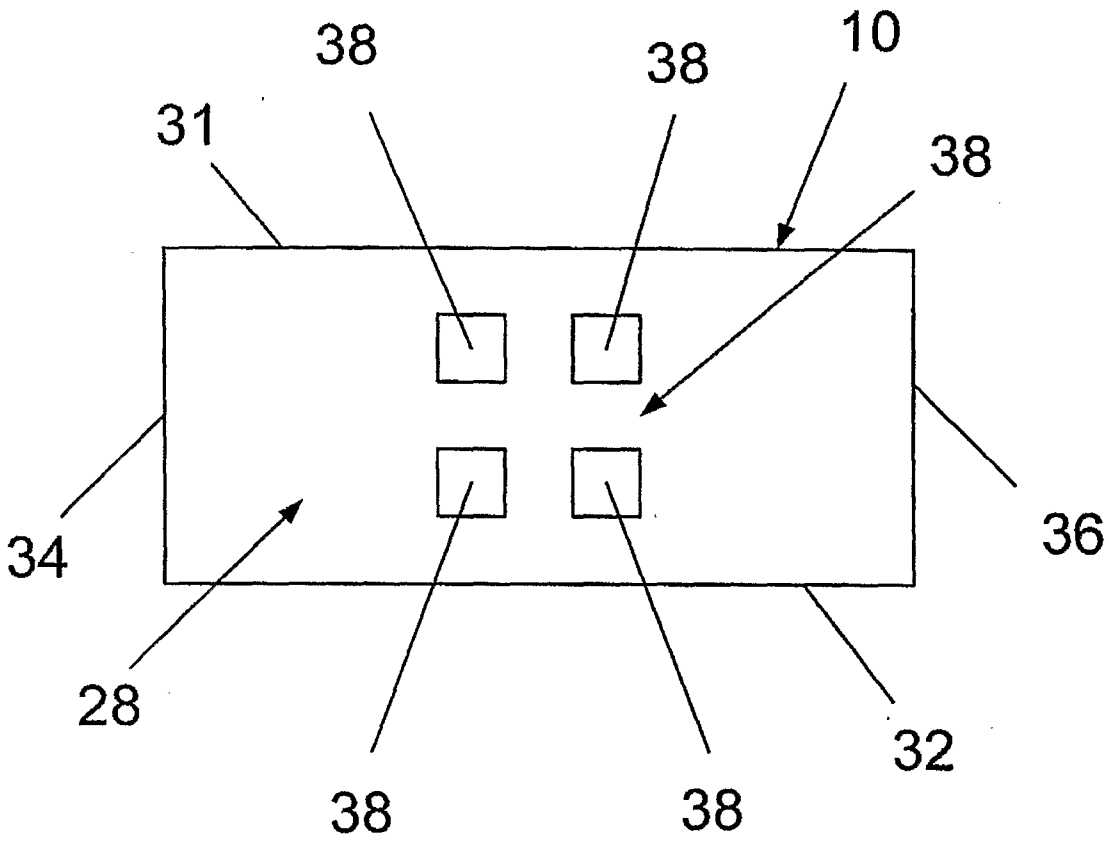


Figure 3

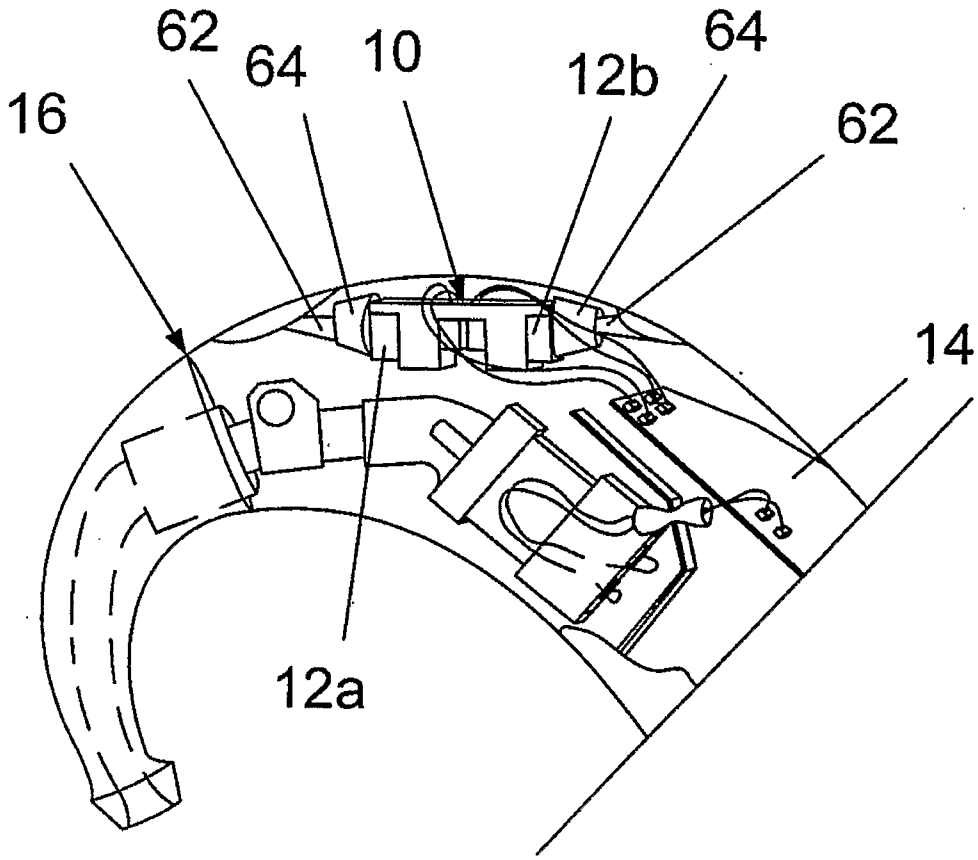


Figure 4

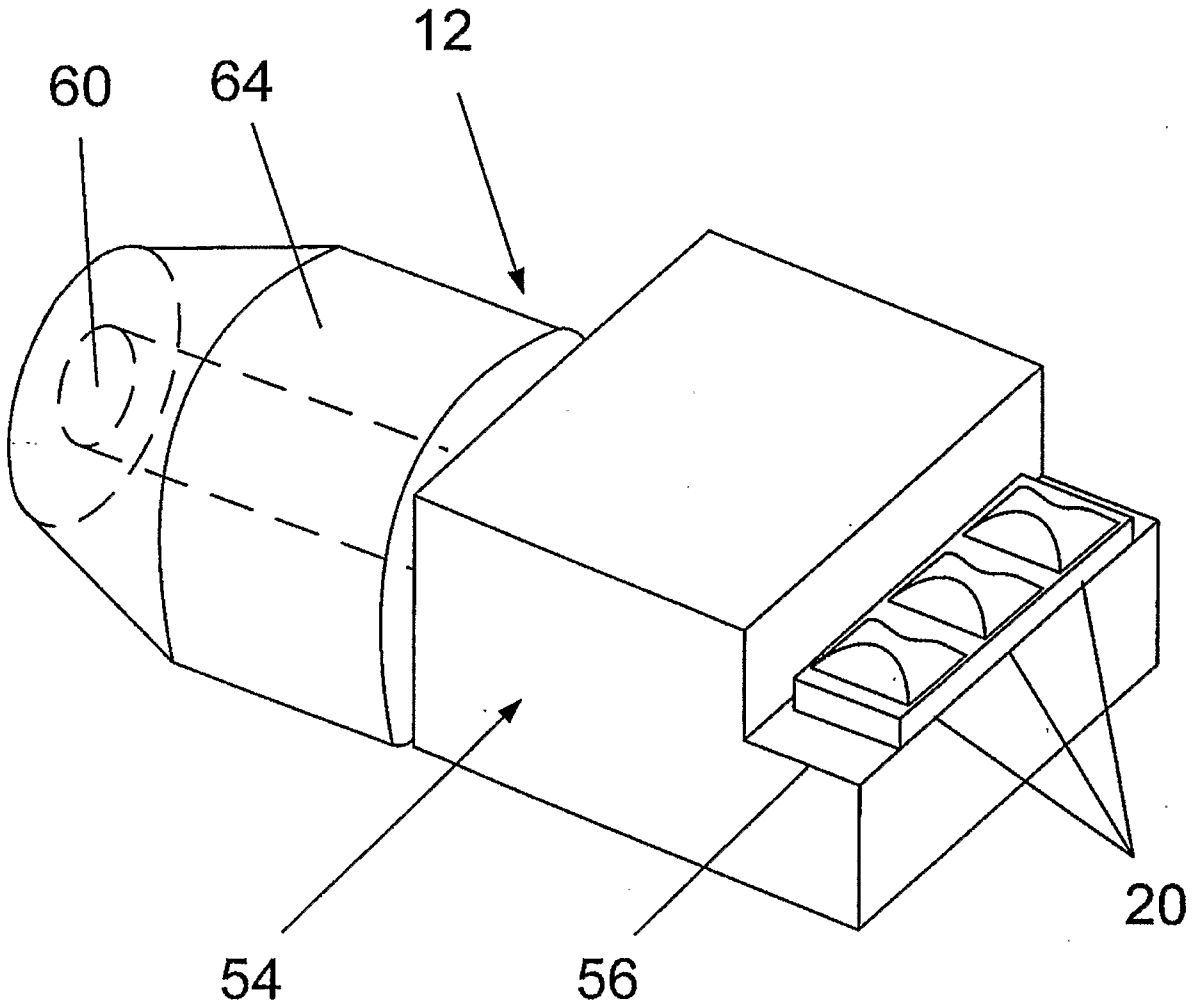


Figure 5

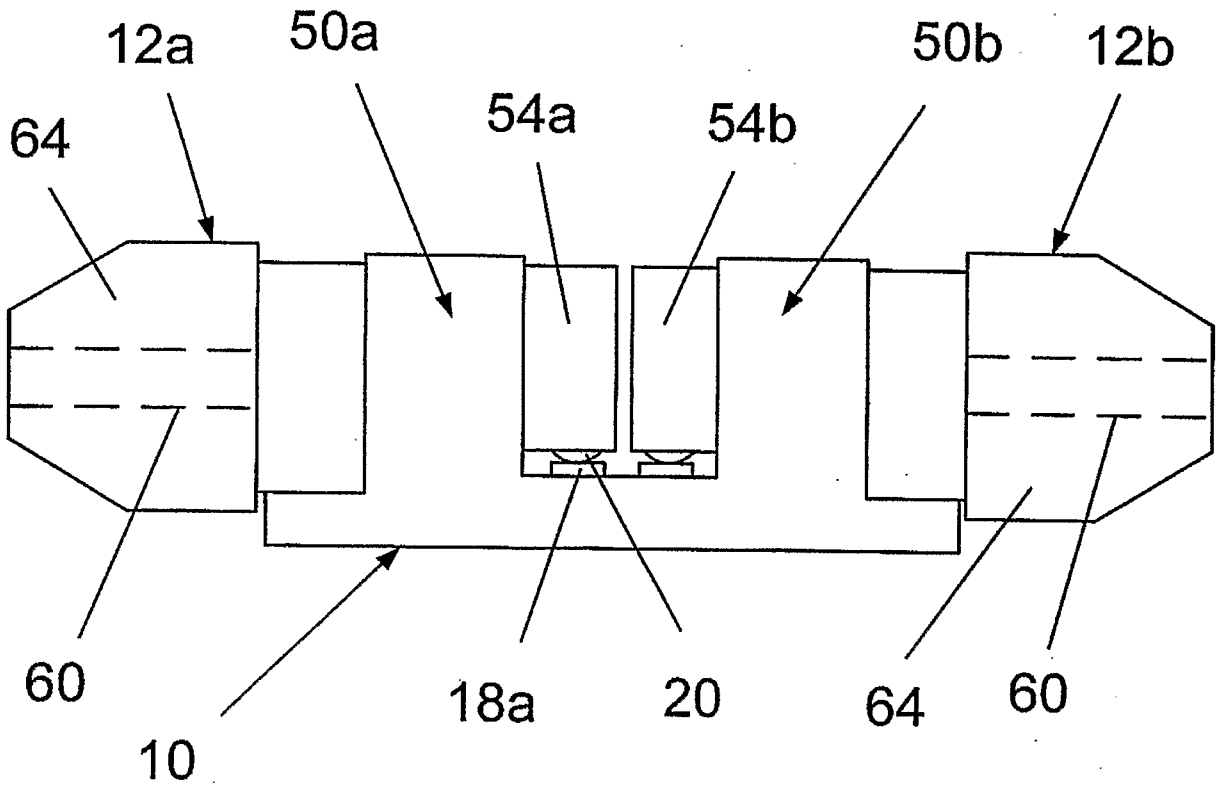


Figure 6

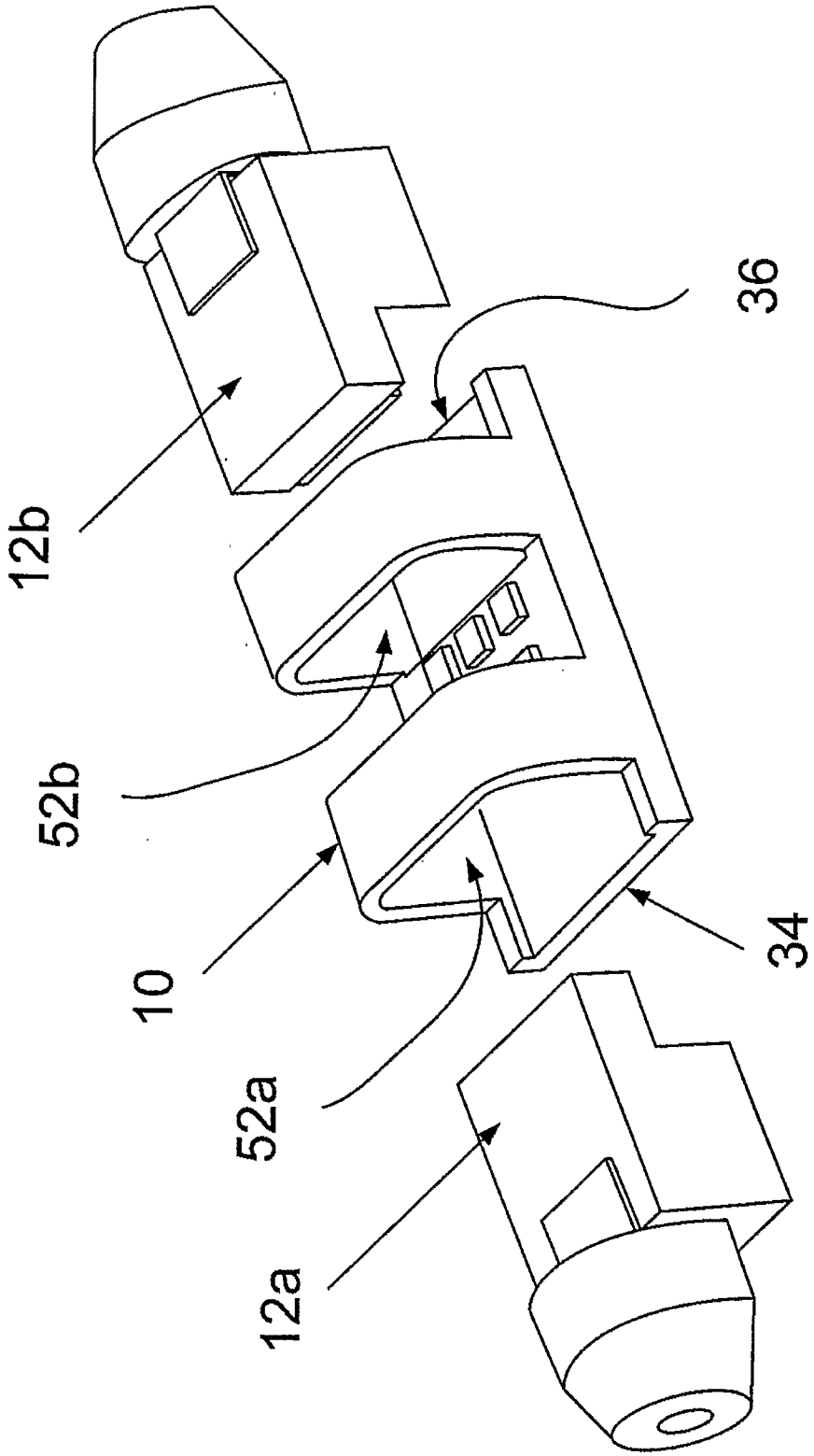


Figure 7

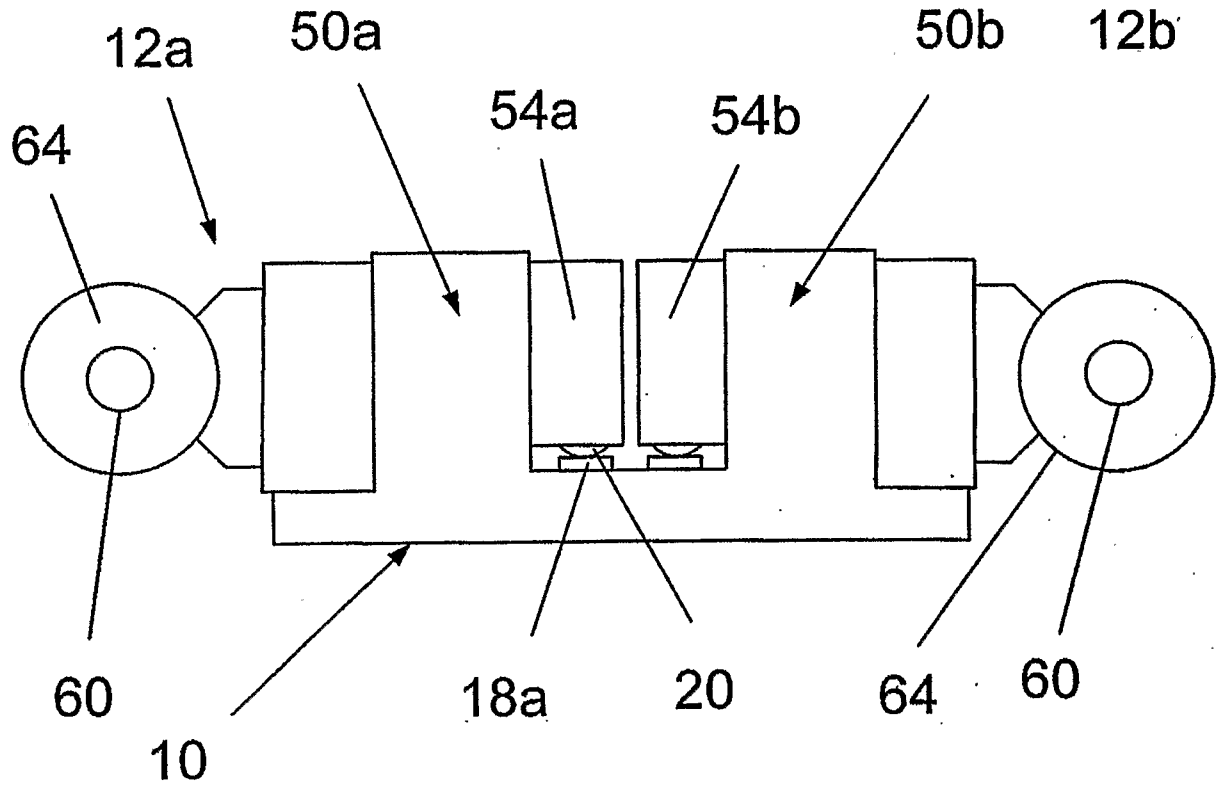


Figure 8

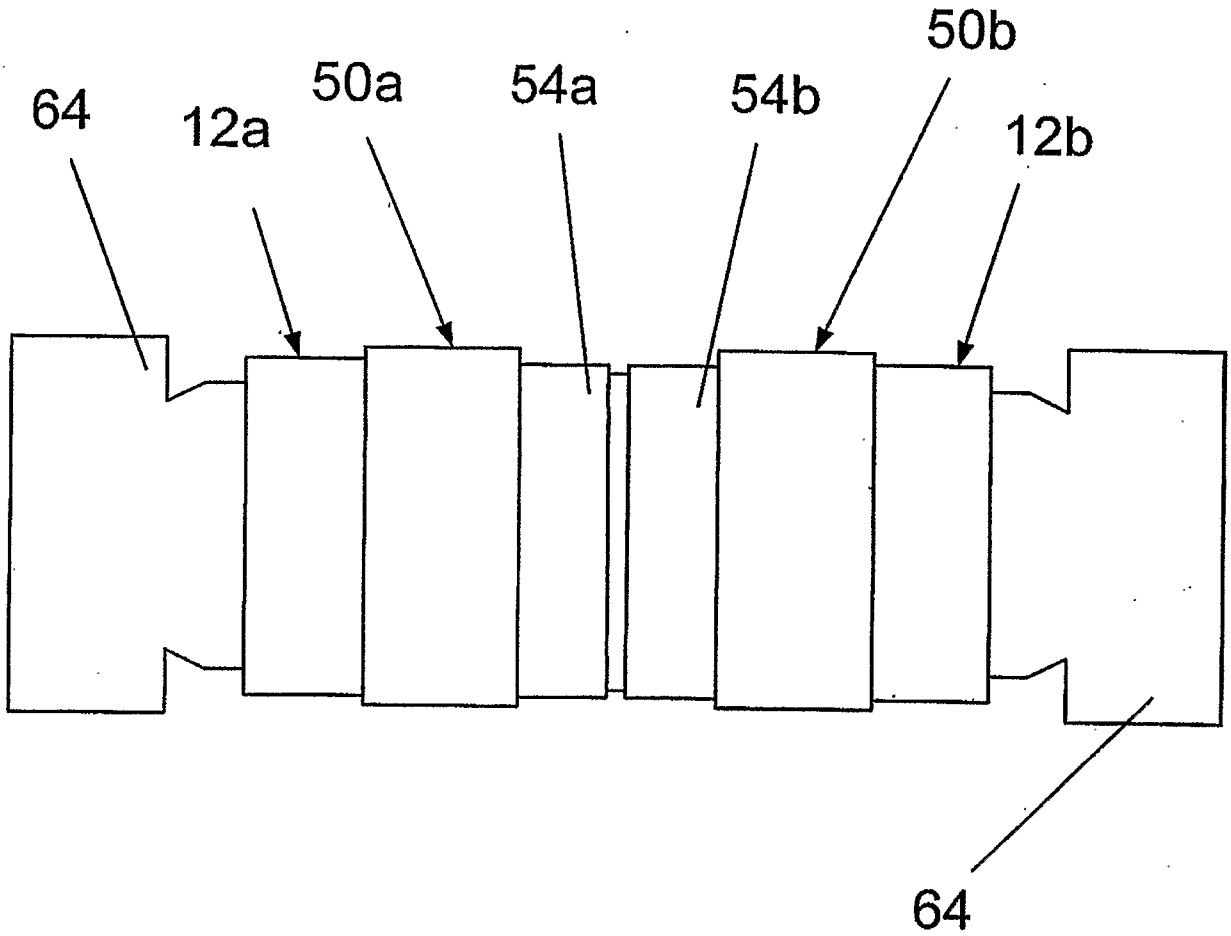


Figure 9

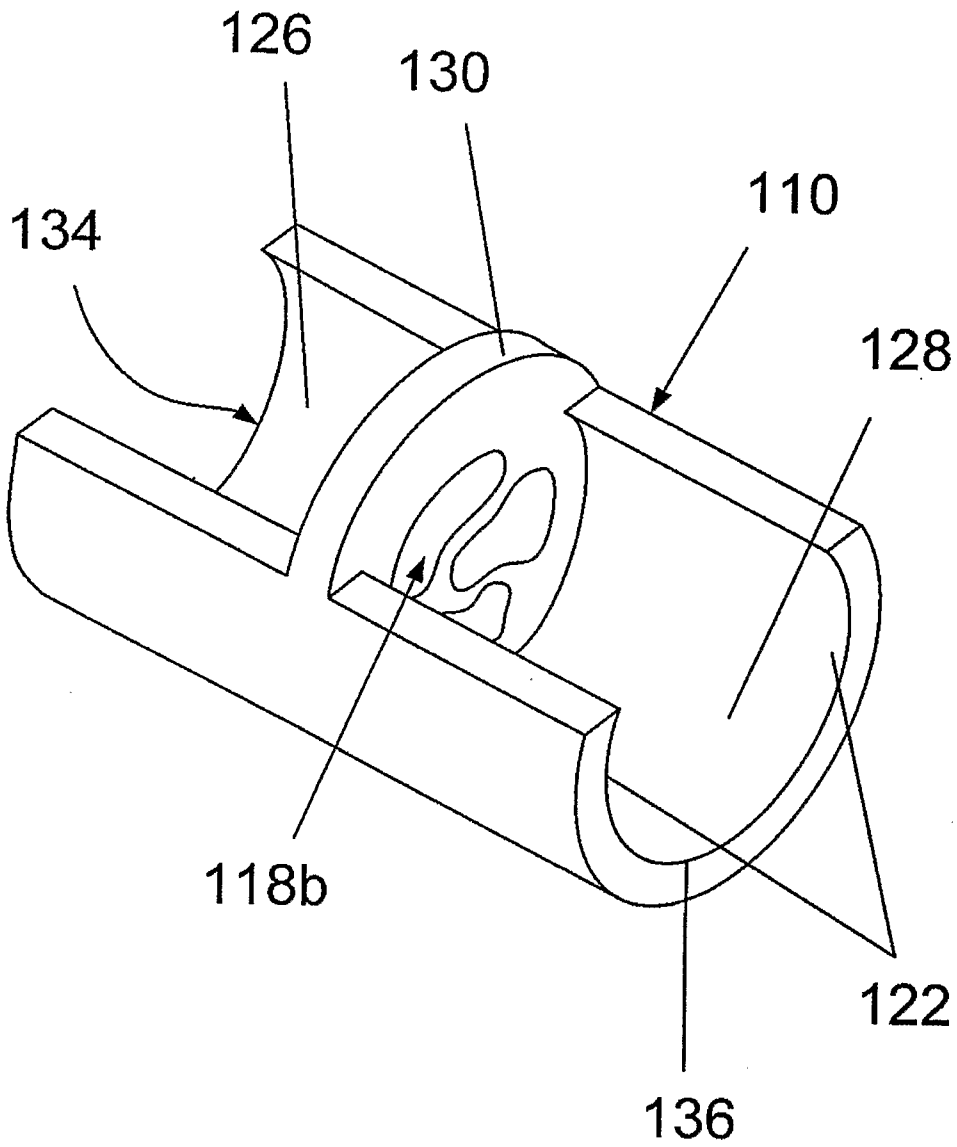


Figure 10

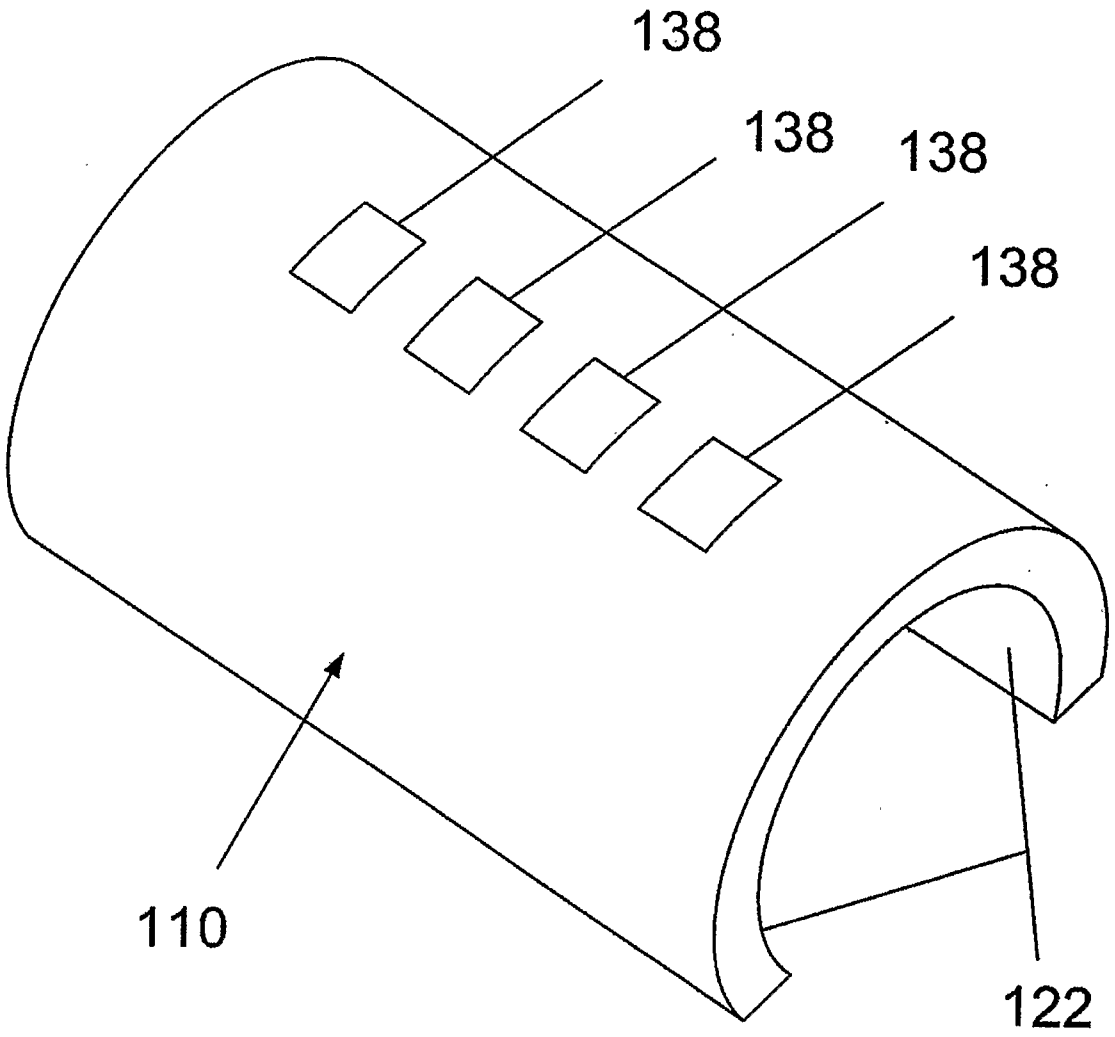


Figure 11

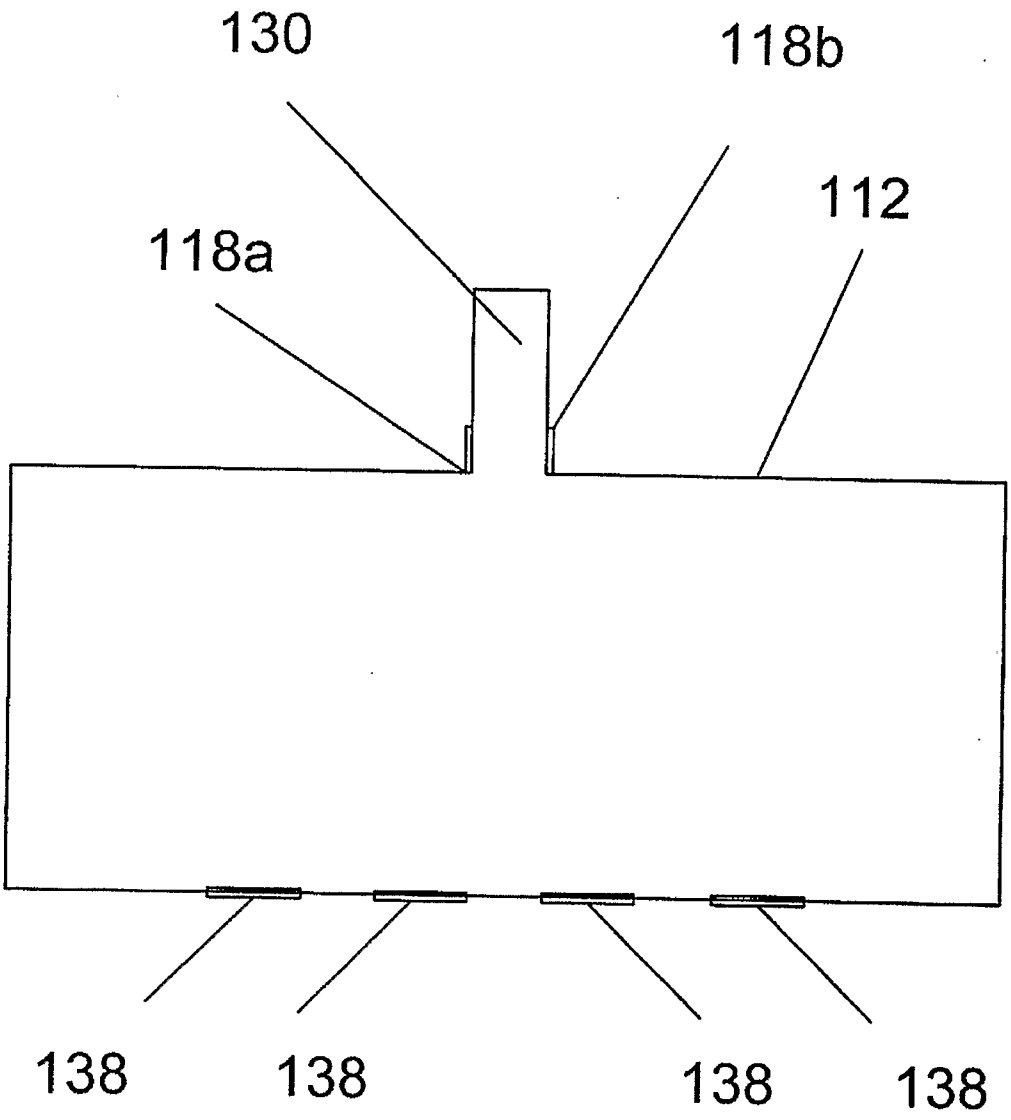


Figure 12

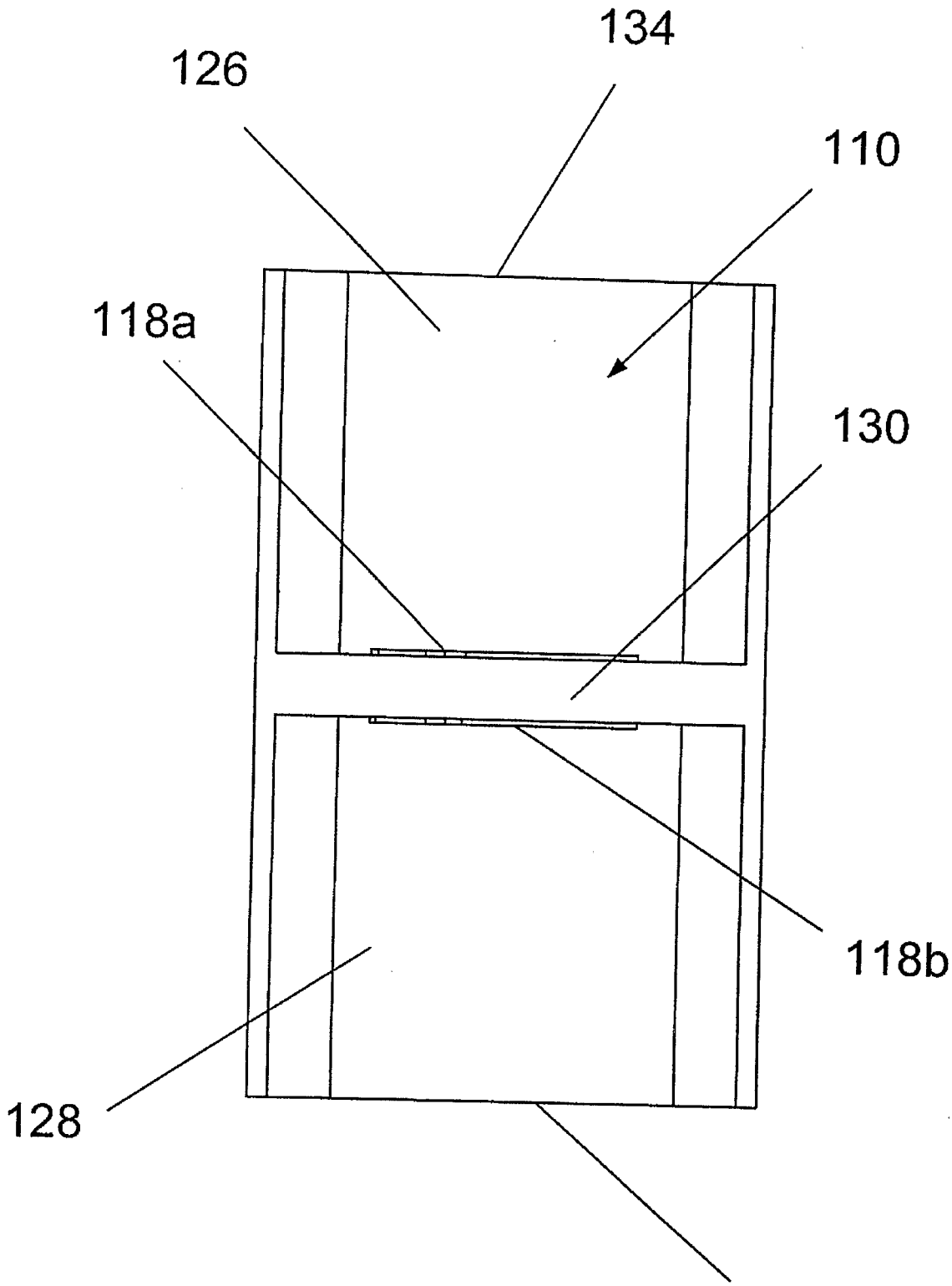


Figure 13

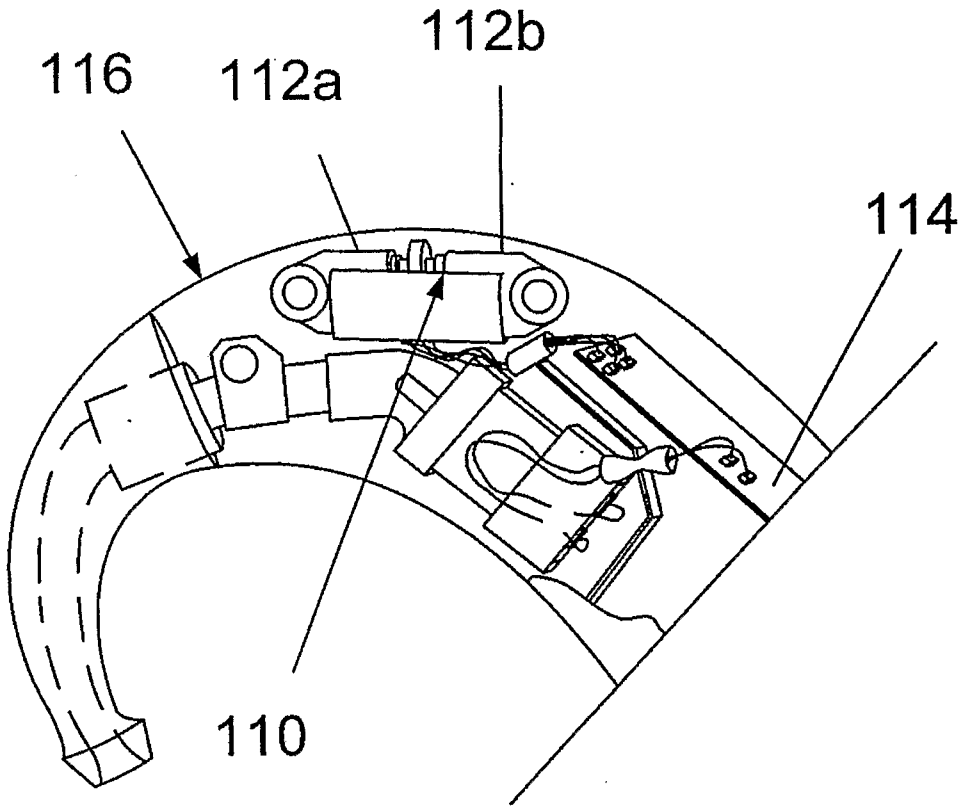


Figure 14

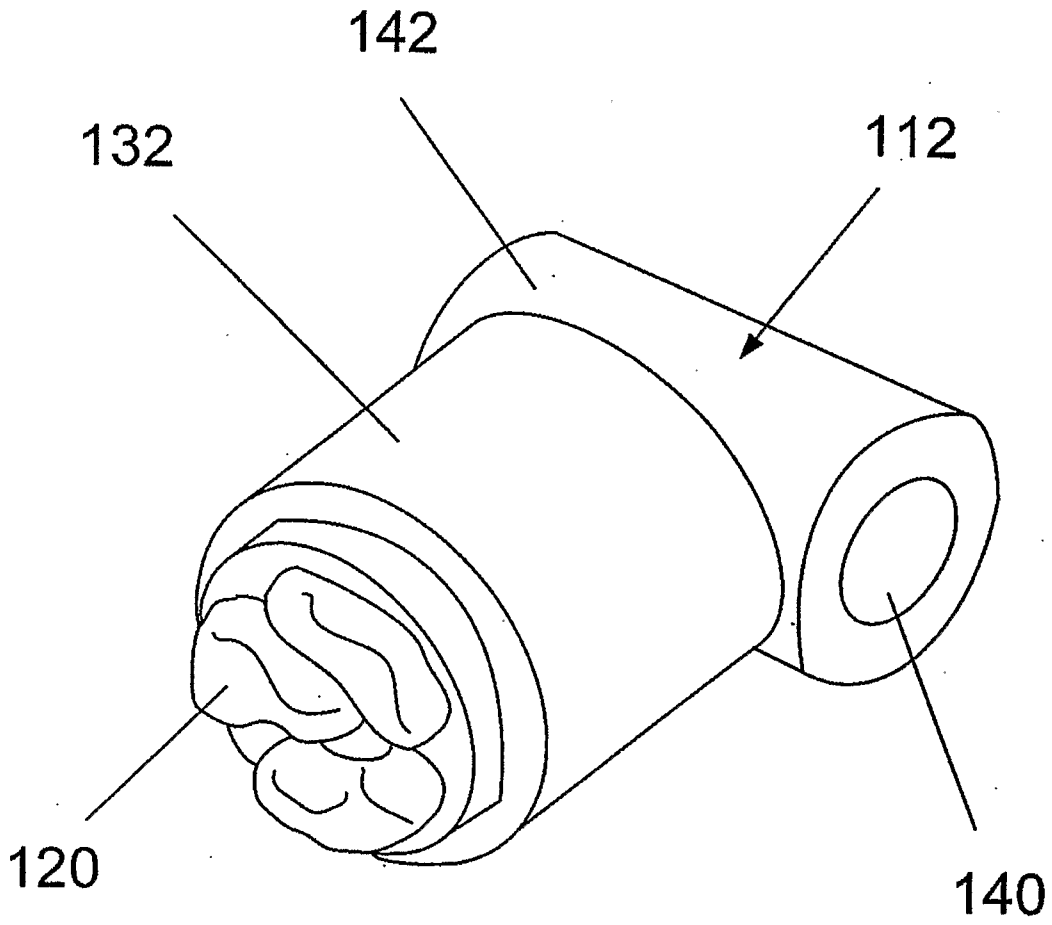


Figure 15

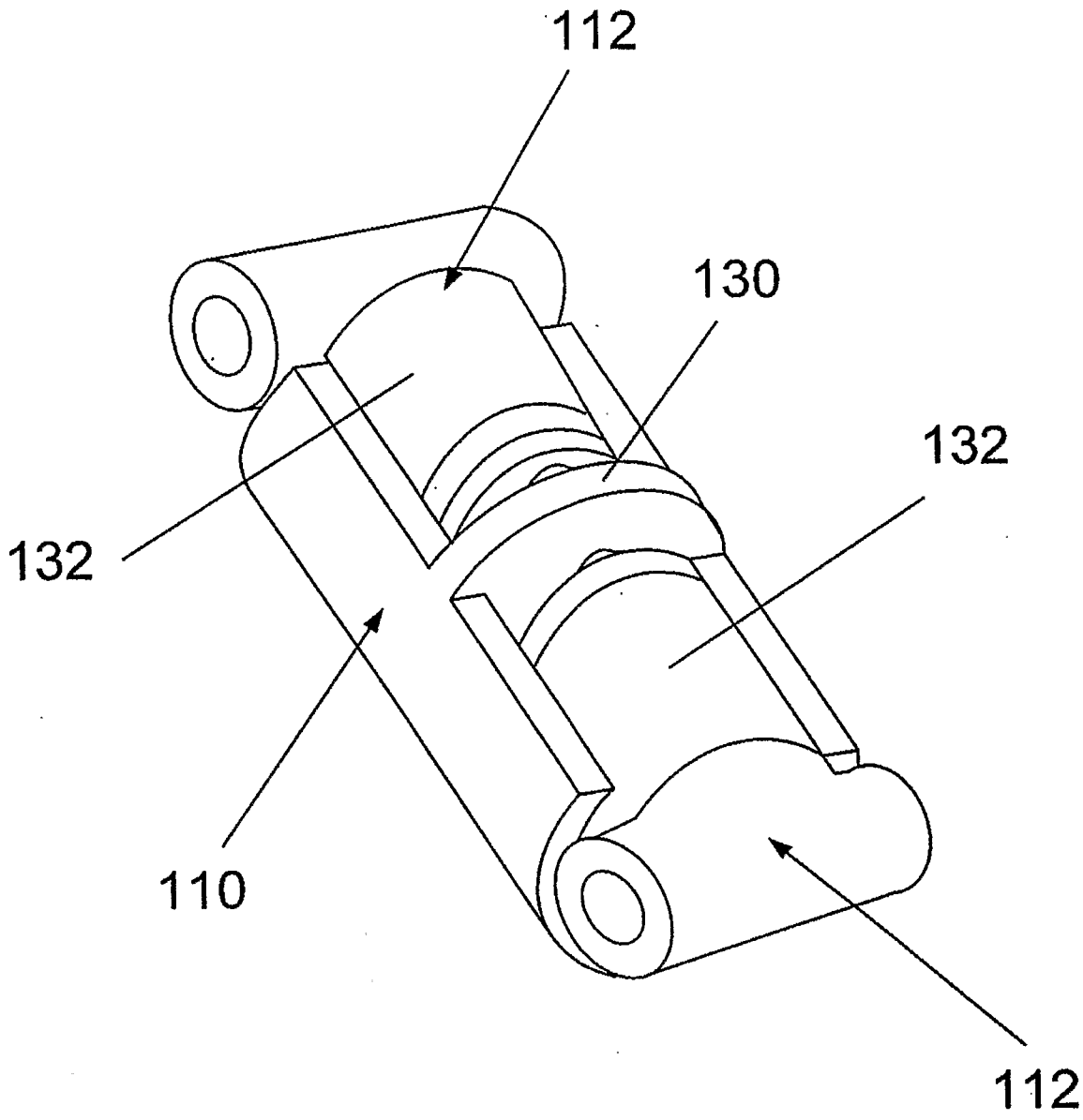


Figure 16

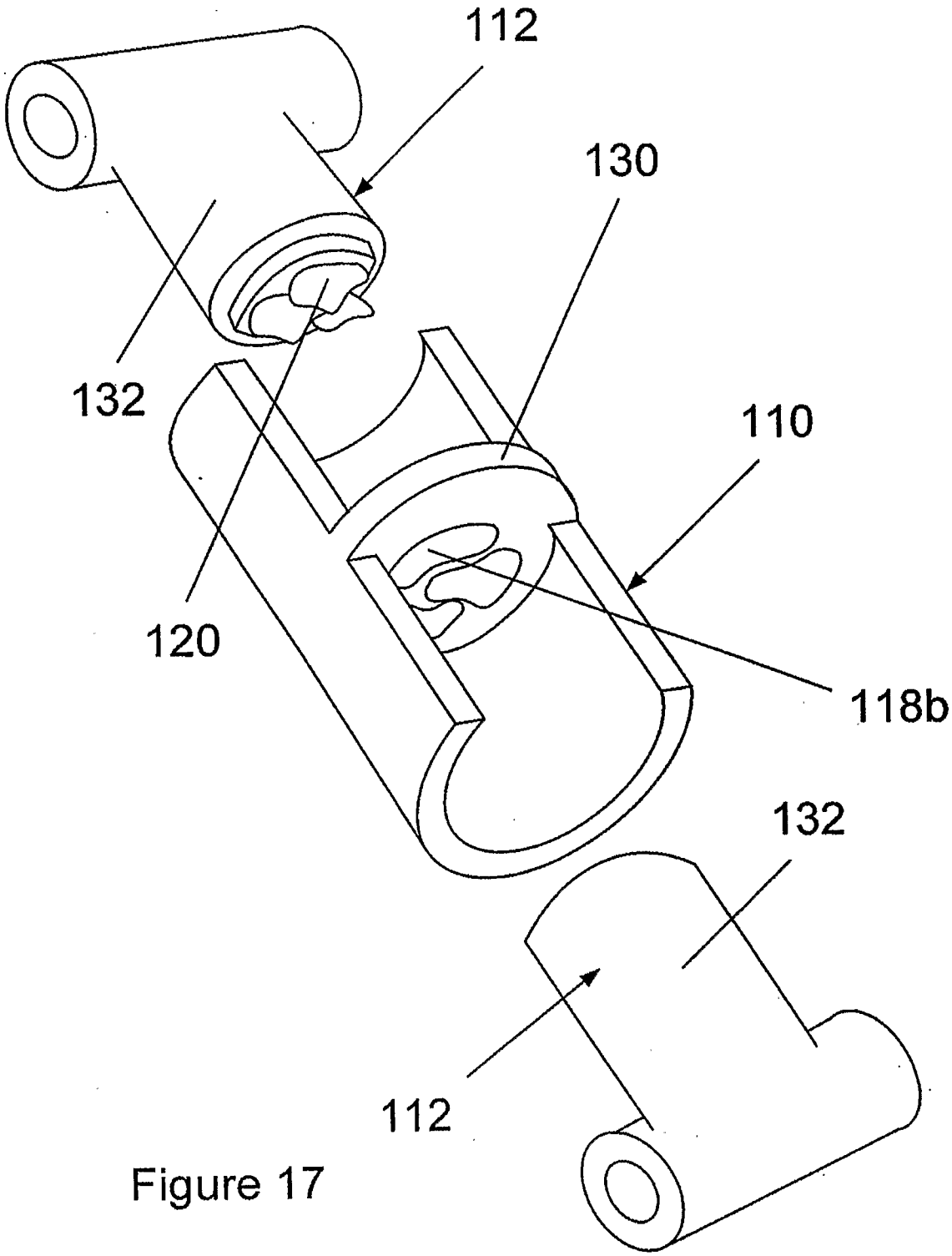


Figure 17

INTERNATIONAL SEARCH REPORT

International application No
PCT/SG2005/000254

A. CLASSIFICATION OF SUBJECT MATTER
H04R25/00

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)
H04R

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94/13116 A (KNOWLES ELECTRONICS, INC) 9 June 1994 (1994-06-09) page 4, line 24 - page 6, line 5 page 8, line 25 - page 9, line 25; figures 2,5,6	1-14
X	EP 0 802 700 A (MICROTRONIC NEDERLAND B.V; SONIONMICROTRONIC NEDERLAND B.V) 22 October 1997 (1997-10-22) column 5, line 32 - column 6, line 14; figure 1	15-18
Y		23,24

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
23 February 2006	03/03/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Nieuwenhuis, P

INTERNATIONAL SEARCH REPORT

International application No
PCT/SG2005/000254

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/154790 A1 (STEEMAN MICHAEL G. M ET AL) 24 October 2002 (2002-10-24) paragraph '0023! - paragraph '0024! paragraph '0034! - paragraph '0036! paragraph '0046!; figures 2,4,8	15,16, 19-22
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Y	EP 0 453 200 A (UNITRON INDUSTRIES LTD) 23 October 1991 (1991-10-23) column 4, line 10 - column 5, line 20; figures 8-11	23,24
A	EP 0 361 594 A (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) 4 April 1990 (1990-04-04) the whole document	1-14
A	US 5 526 430 A (ONO ET AL) 11 June 1996 (1996-06-11) column 2, line 61 - column 4, line 22 column 5, line 12 - line 35; figures 1a,1b,5	
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