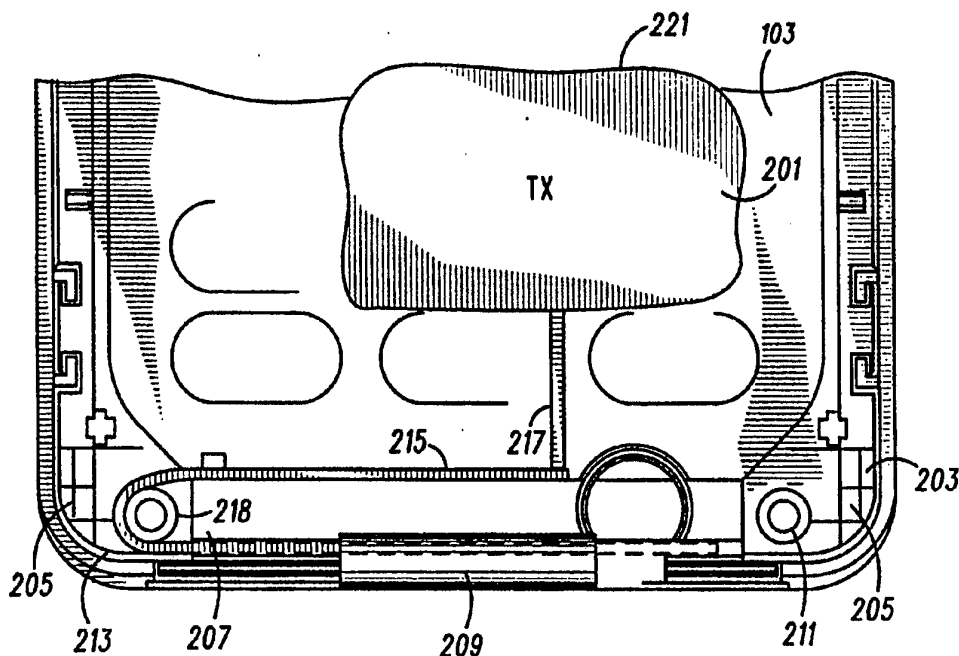




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(54) Title: ELECTRONIC DEVICE COUPLING APPARATUS



(57) Abstract

An electronic device coupling apparatus is used to couple two electronic devices through a hinge. A first electronic device (221) is disposed within the main housing of a radiotelephone (101). The second electronic device (301) is disposed within a movable element (103) of the radiotelephone (101). The coupling apparatus uses a piece of flex (215) which is torsionally twisted upon the opening of the movable element (103) of the radiotelephone (101). Additionally, the flex (215) is coupled to the electronic devices (221, 301) using an elastomeric connector (217).

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Electronic Device Coupling Apparatus

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Field of the Invention

This invention generally relates to coupling two electronic components using a flex circuit, and more specifically, electrically coupling a first electronic component in a main housing to a second electronic component disposed within a movable element of the electronic device using flex circuits.

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Background of the Invention

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Generally, portable radiotelephones send and receive radio frequency (RF) signals to and from a remote transceiver, commonly known as a radio communication link. This radio communication link allows a portable radiotelephone user to communicate with other people using other portable radiotelephones or land-line telephone equipment. Often, in order to improve the quality of the communication link, a portable radiotelephone employs diversity antennas. Diversity antennas allow a portable radiotelephone to receive the RF signals transmitted from the remote transceiver along two individual paths. Then, the portable radiotelephone may choose either the first path or the second path or a combination thereof in order to improve the communication link between the remote transceiver and the portable radiotelephone.

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Today, as portable radiotelephones decrease in size and weight, it becomes increasingly difficult to employ two independent receiving antennas in a portable communication device which would offer an improvement in a communication link. In portable radiotelephones, which include a movable element, or a flip, it would be advantageous to put the second antenna in the flip. Since the flip is hinged to the main housing, it is technically challenging to electrically couple the antenna in the flip to the other electrical components contained within the main housing of the radiotelephone. In the past, the antenna in the flip has been capacitively or inductively coupled to the electronics contained within the main housing. One such example can be found in U.S. Patent No. 5,014,346. Although this method was successful, it would be advantageous to make a direct electrical connection between the antenna in the flip and the electronics enclosed within the main housing. A direct connection would provide a reduction in the complexity of the connection as well as improved performance of the antenna.

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Brief Description of the Drawings

FIG. 1 is an illustration of a portable radiotelephone in accordance with the present invention.

25 FIG. 2 is an illustration of a portion of the radiotelephone of FIG. 1 in accordance with the present invention.

FIG. 3 is an illustration of an antenna and some mechanical components of a hinge in accordance with the present invention.

FIG. 4 is an illustration of the antenna of FIG. 3 inserted into the flip of the radiotelephone illustrated in FIG. 1.

FIG. 5 is an illustration of a side view of a knuckle of the portable radiotelephone illustrated in FIG. 2.

5 FIG. 6 is a six part illustration of the operation of the flip of the portable radiotelephone in accordance with the present invention.

Description of a Preferred Embodiment

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FIG. 1 is an illustration of a portable radiotelephone 101. The portable radiotelephone 101 includes diversity antennas, one of which is contained in the movable element or flip 103 of the portable radiotelephone 101. Part 1 of FIG. 1 illustrates the radiotelephone 101 with its flip 103 in an opened position. Part 15 2 of FIG. 1 illustrates the radiotelephone 101 with its flip 103 in a closed position.

FIG. 2 is an illustration of a portion of the radiotelephone 101 illustrated in FIG. 1. Specifically, FIG. 2 is an illustration of the rear of the radiotelephone 101 of FIG. 1 with its rear housing removed. This view illustrates the interaction of the coupling apparatus with other components within the radiotelephone 101. A front housing 203 of the portable radiotelephone contains a knuckle area 205. The knuckle area 205 is a hollowed out area for receiving the hinge 207 of the flip 103. The knuckle of the flip 209 is hollow and contains other hinge elements of the flip. Upon insertion of the flip 103 onto the radiotelephone 101, the knuckle of the flip 209 is aligned with the two knuckles of the front housing of the radiotelephone. The front housing of the radiotelephone 203

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also contains two pins 211, 213. Pins 211, 213 are used for a cam follower as shafts. FIG. 2 also illustrates a flex running from inside the flip knuckle 209 into the front housing knuckle 205, past to one side of pin 213, around boss 218 and into the main housing of the radiotelephone 101. When the flex 215 is inside the main housing of the radiotelephone, it is connected to the other electronic components using an elastomeric connector 217, such as a fuzz pin or a zebra connector. Additionally, the connection can be made using any other equally sufficient means including soldering.

FIG. 3 is an illustration of an antenna 301, that is used as the diversity antenna for the portable radiotelephone 101 of FIG. 1. One end of the antenna 301 is coupled to the flex 215. In the preferred embodiment, the antenna 301 is made from flex, thus, the flex 215 is a continuation of the antenna 301. It is anticipated that other antennas and electrical components could be attached to the flex 215. The coupling of the flex 215 to these other components would be done in a manner similar to that done for flex connection inside the radiotelephone 101. The free end of the flex 215 is inserted through a slot 303 in the first shaft 305. The flex 215 is then fed through a spring 307 and a second shaft 309. In the preferred embodiment, the second shaft 309 and the spring 307 are already inserted into the flex knuckle 209 for ease of assembly.

FIG. 4 is an illustration of the flip 103 of FIG. 1 with the antenna 301 of FIG. 3 assembled within the flip 103. In the preferred embodiment, the antenna 301 is placed in a depression 403 of the flip 103. This depression 403 allows the antenna 301 to be sub-flush with the top surface 405 of the flip 103. In the preferred embodiment, a label sets over the

antenna 301, the label being flush with the top surface 405 for aesthetic purposes. Additionally, FIG. 4 illustrates the hinge assembly including a first shaft 305, a spring 307 and a second shaft 309. The hinge assembly is inserted into the flip knuckle 209 with the flex 215 sticking out of the first end of the flex knuckle 209.

FIG. 5 is an illustration of a side view of the front housing knuckle 205. The front housing knuckle 205 contains the pin 213. Upon assembly of the flip 103 to the front housing 203, the first end of the flex 215 is inserted into the front housing knuckle 205. The flex will insert to one side of pin 213 and must be maneuvered back around the boss 218 and come back out into the front housing of the radiotelephone 203. This is more clearly illustrated in FIG. 2. Once the flex 215 is fed through the front housing knuckle 205, the two shafts 305, 309 may be pinched together such that the flip knuckle 209 may be mated with the front housing knuckles 205.

FIG. 6 illustrates the operation of the flip 103 with the radiotelephone 101 in its interaction in the flex 215. Part 1 of FIG. 6 indicates points 1 and 2 and the relative positions when the flip is in a closed position. Part 2 of FIG. 6 indicates length L which is equal to 36 millimeters in the preferred embodiment. Additionally, part 2 indicates the torsional twist on the flex 215 as the flip 103 is opened. Part 3 of FIG. 6 is a side view of a portion of radiotelephone 101 with the flip 103 in a closed position. The relative position of point 1 and point 2 can be seen in the knuckle of the radiotelephone. With the flip closed, points 1 and 2 are aligned vertically with each other. Part 4 of FIG. 6 is a side view illustration of a portion of radiotelephone 101 with the flip 103 in an opened position.

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Additionally, part 4 illustrates the relative positions of points 1 and 2 with the flip 103 in the opened position. As can be seen from the illustration, point 2 is in the same position as it was in the illustration of part 3. However, point 1 is twisted proportionately with the flip 103 across length L as illustrated in part 2. Part 5 of FIG. 6 is an illustration of the flip 103 and its interaction on the flex 215 with the flip 103 in the closed position. Notice that the flex 215 runs straight through the flex flip knuckle 209 without any twists or bends or flexes. Part 6 of FIG. 6 illustrates the flip 103 in an opened position and its interaction on the flex 215 when the flip is in the open position. Notice that the flex 215 here is twisted torsionally within the flex flip knuckle 209.

In the preferred embodiment, the flex 215 is used to couple an antenna 103 to the transceiver 221 in a portable radiotelephone 101. However, it is anticipated that the flex 215 could be used to couple any type of electric components to each other. Such anticipation includes coupling the electronic devices of a display contained within a hinged movable element to a microprocessor contained within a main housing of an electronic device. Additionally, the anticipation includes coupling a speaker contained within a movable element to a micro-logic device contained within the main housing of an electronic device.

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We claim:

1. A radiotelephone comprising:
 - a housing;
 - a movable element coupled to the housing by a hinge;
 - a transceiver for processing radio frequency signals
- 5 disposed within the housing;
- an antenna disposed within the movable element;
 - an electronic coupler for electrically coupling the antenna
- to the transceiver, the electronic coupler comprising a flex
- 10 having a first end and a second end and a body, the first end of the flex coupled to the antenna, the body of the flex is disposed within the hinge and the second end of the flex coupled to the transceiver, such that the flex is torsionally twisted and untwisted during movement of the movable element.

2. A radiotelephone in accordance with claim 1 wherein the electrical coupler further comprises adhesive for adhering at least a portion of the flex to the housing.

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3. A radiotelephone in accordance with claim 1 wherein the electrical coupler further comprises an electrically conductive elastomeric connector coupling the the second end of the flex to the transceiver.

4. An electronic device having a housing and a movable element, the electronic device comprising:

5 a hinge for coupling the movable element to the housing, the hinge including a knuckle, at least a first cam, and a spring;

a first electric component disposed in the first housing

a second electric component disposed within the movable element;

10 an electric coupler electrically coupling the first electric component to the second electric component, the electric coupler comprising a flex having a first end and a second end and a body, the first end of the flex coupled to the first electric component, the body of the flex is disposed within the at least
15 first cam and the spring of the hinge and the second end of the flex coupled to the second electric component, such that the flex is torsionally twisted and untwisted during movement of the movable element.

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5. An electronic device in accordance with claim 4
wherein the electrical coupler further comprises adhesive for
adhering at least a portion of the flex to the housing.

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6. An electronic device in accordance with claim 4
wherein the electrical coupler further comprises an
electrically conductive elastomeric connector coupling the the
second end of the flex to the first electric component.

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7. A method of assembling an electronic device, the electronic device including a housing, a movable element, a first electric component and second electric component, the first electric component disposed in the housing and the
5 second electric component disposed in the movable element, the method comprising the steps of:

inserting at least a first cam and a spring into a knuckle, the knuckle coupled to the movable element;

1 0 feeding a first end of a flex into the knuckle, through the at least first cam and the spring, and into the housing;

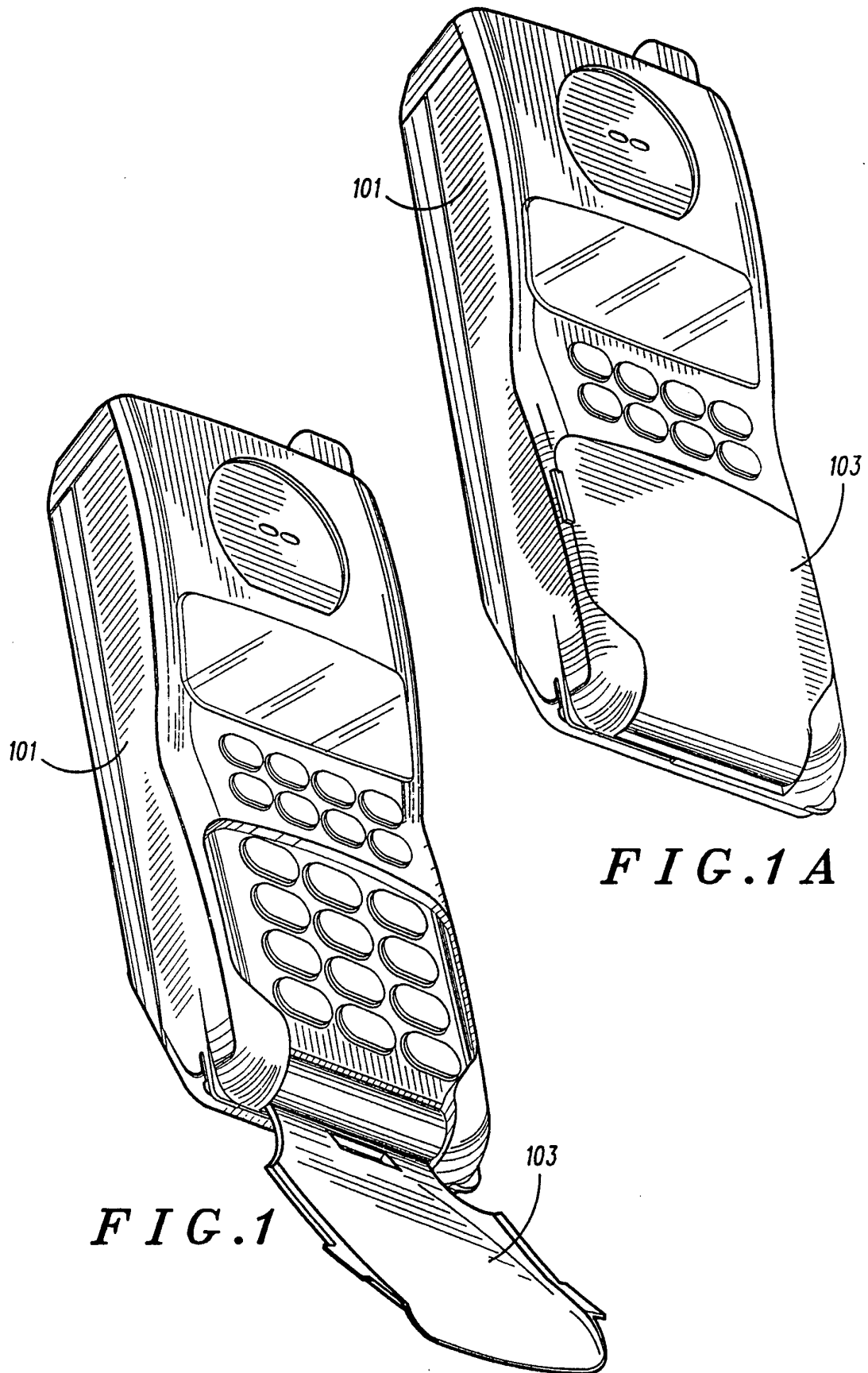
coupling the first end of the flex to the first electronic device; and

1 5 mating the knuckle to a knuckle receptacle shaped from the housing, such that the movable element is rotatable with respect to the housing and that the flex is torsionally twisted during the rotation.

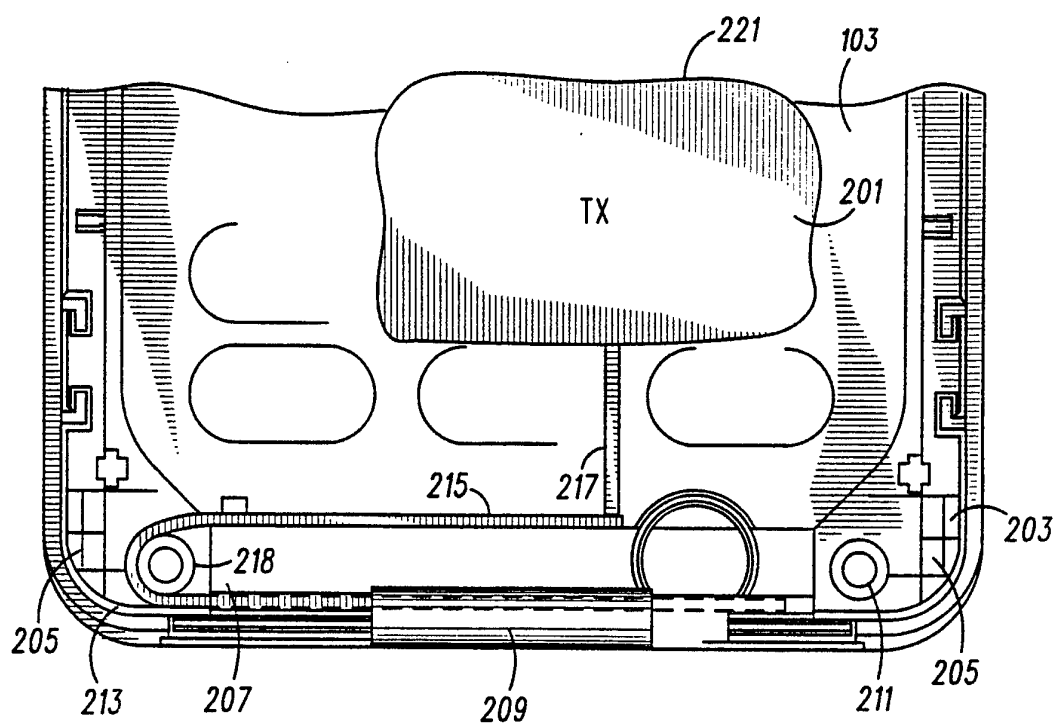
8. A method of assembling in accordance with claim 7 wherein the step of coupling further comprises:

2 0 adhering at least a portion of the flex to the housing; and providing an electrically conductive elastomeric connector between the first end of the flex and the first electronic device.

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FIG. 2

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FIG. 5

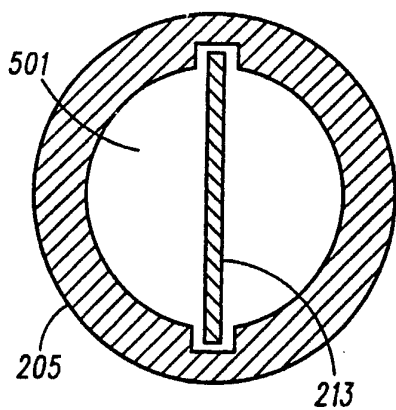


FIG. 3

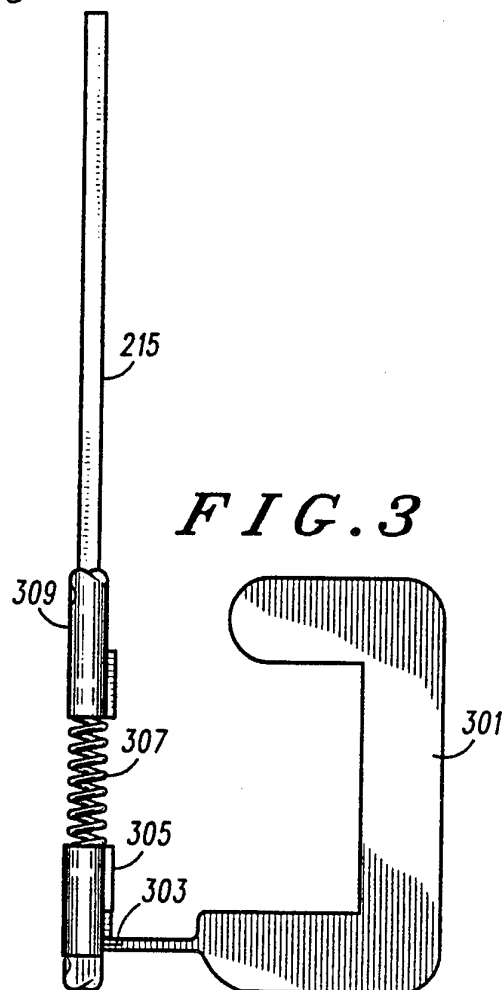
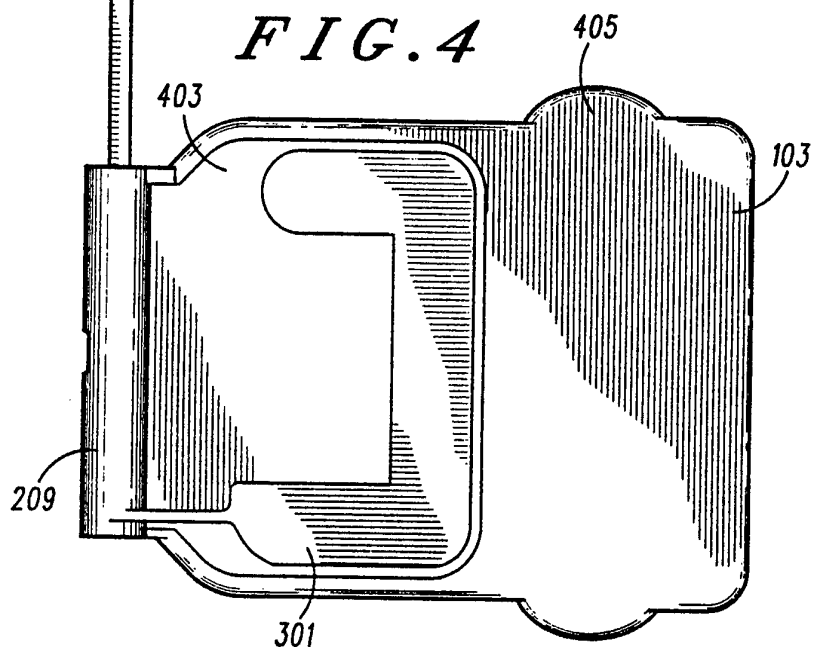


FIG. 4



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FIG. 6

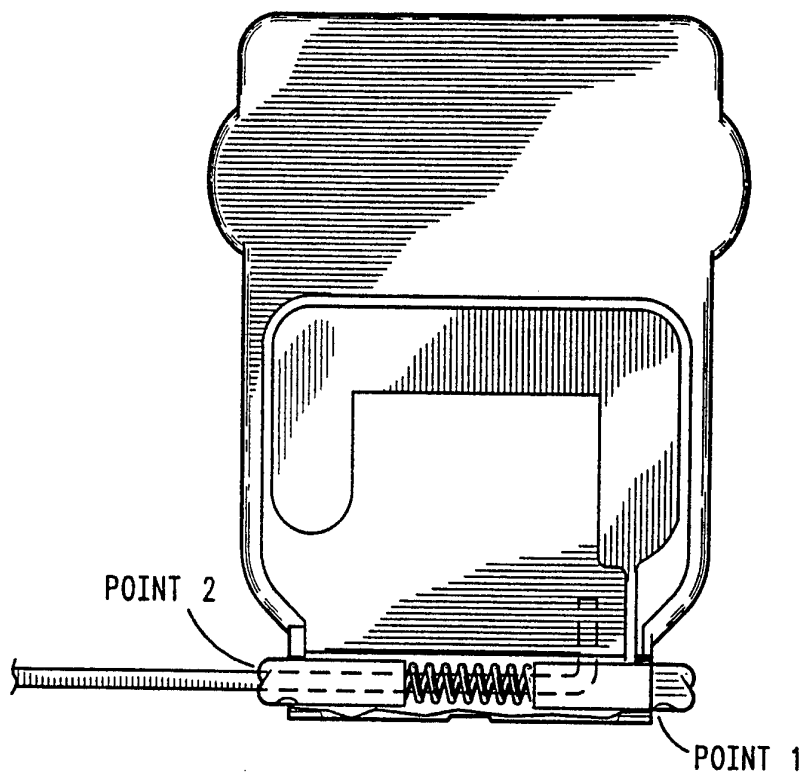
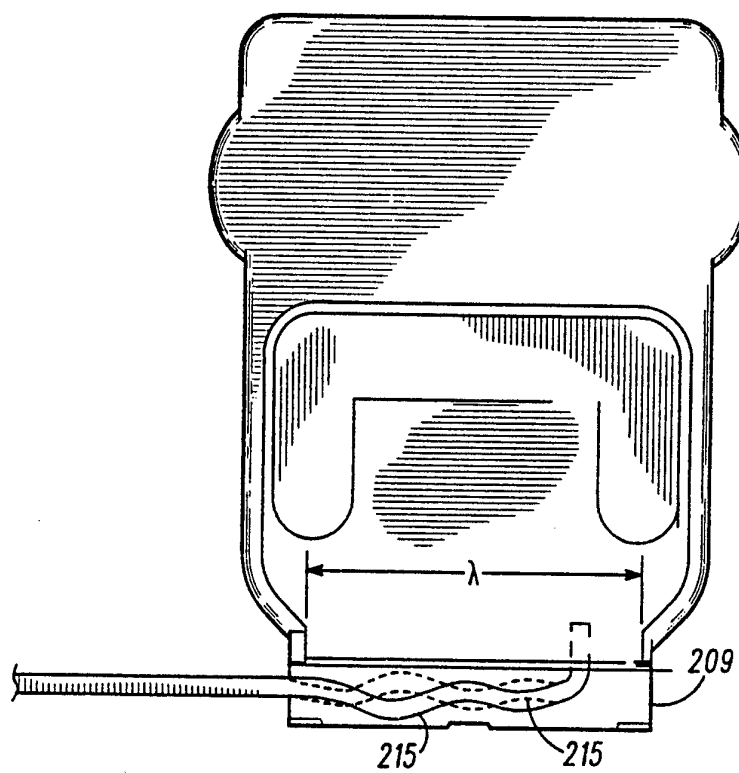


FIG. 6A



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FIG. 6B

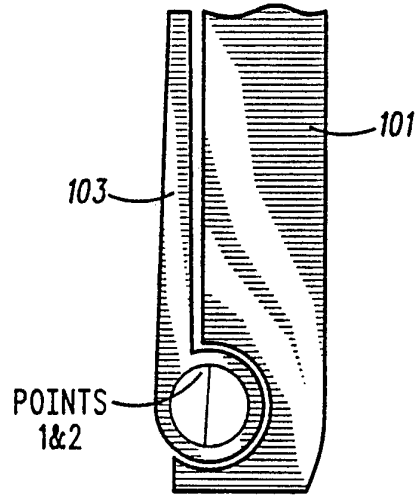


FIG. 6C

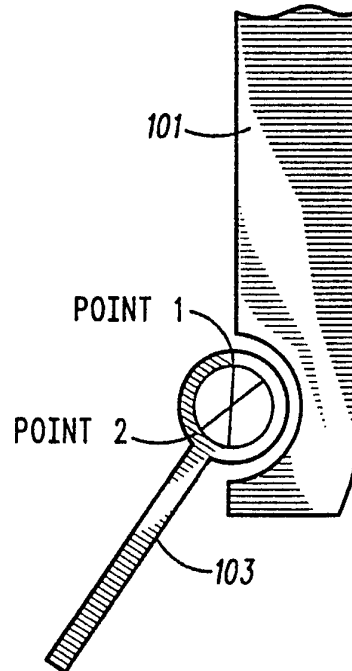


FIG. 6D

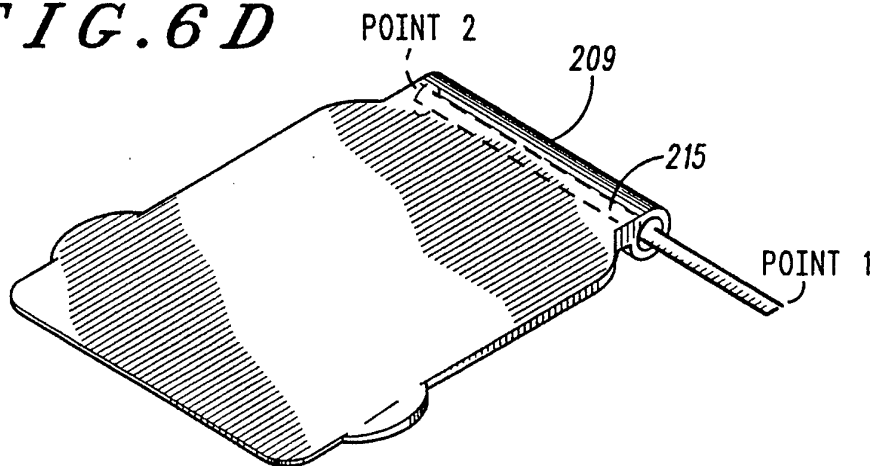
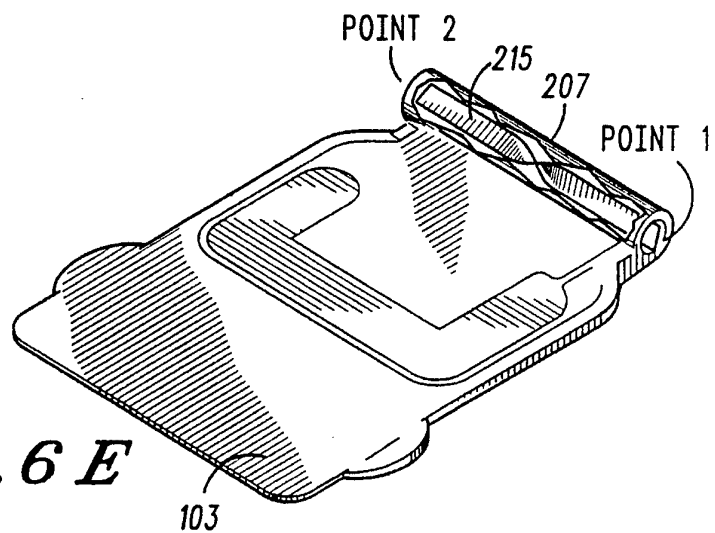


FIG. 6E



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/10956

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : H04B 1/38; H01R 39/00; G06F 1/00; H04M 1/00

US CL : 455/89, 90, 129, 280, 351; 379/433; 439/31; 343/702; 361/814

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U.S. : Please See Extra Sheet.

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NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,825,395 (KINSER et al) 25 April 1989 (see figures 6 and 7)	1-8
Y	PCT, A, WO 93/18592 (MOTOROLA, INC.) 16 SEPTEMBER 1993 (see figures 1 and 8)	1-8
A	US, A, 4,845,772 (METROKA et al) 4 July 1989 (see figures 1-3)	1-8
A	US, A, 5,170,173 (KRENZ et al) 08 December 1992 (see figures 1 and 5)	1-8
A	US, A, 5,014,346 (PHILLIPS et al) 07 May 1991 (see figures 1 and 2A and column 1)	1-8

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:	
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Date of the actual completion of the international search

12 NOVEMBER 1994

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

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B. FIELDS SEARCHED

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455/89, 90, 128-129, 280, 347-349, 351; 379/433-434; 439/11, 15, 31, 67; 343/702, 882; 361/681, 683, 785, 814;
364/708.1; 16/223