(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 672 749 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.06.2006 Bulletin 2006/25

(51) Int Cl.:
H01R 24/02 *(2006.01)*

(21) Application number: **05027310.1**

(22) Date of filing: **14.12.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **17.12.2004 JP 2004366606**
07.12.2005 JP 2005353632

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(54) Coaxial connector

(57) In a coaxial connector, a cylindrical insulator 19 is integrally formed to protrude from one surface of a substantially rectangular insulation base 18, and a tip portion 190 of the cylindrical insulator 19 has an enlarged diameter. An outer conductor shell 13 is provided that covers a circumferential surface of the cylindrical insulator on the side closer to the insulation base 18 than the tip portion 190. A notch 131 is formed in a front edge of the outer conductor shell 13 and a protrusion 192 formed to protrude from a rear end of the tip portion 190 of the cylindrical insulator 19 toward the insulator base 18 enters the notch 131 so that the notch 131 and the protrusion 192 engage each other in a circumferential direction of the cylindrical insulator 19.

FIG. 1A

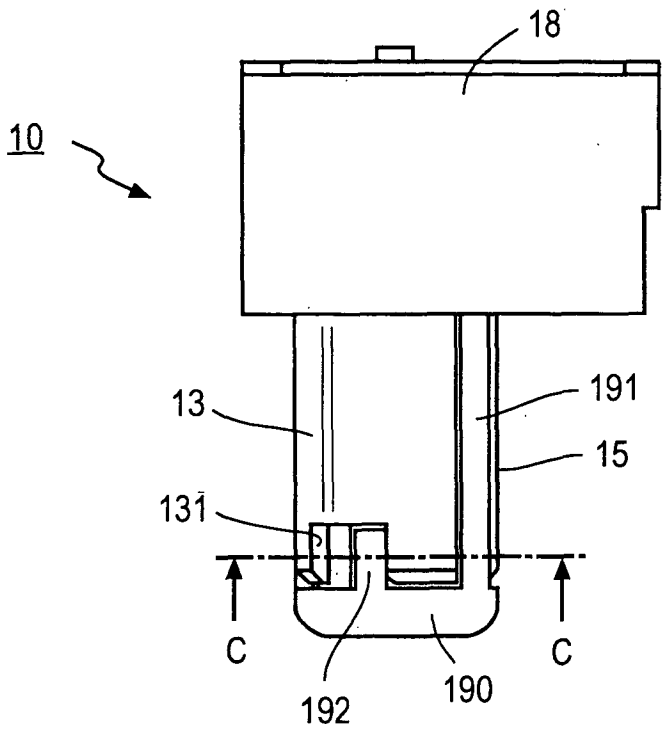

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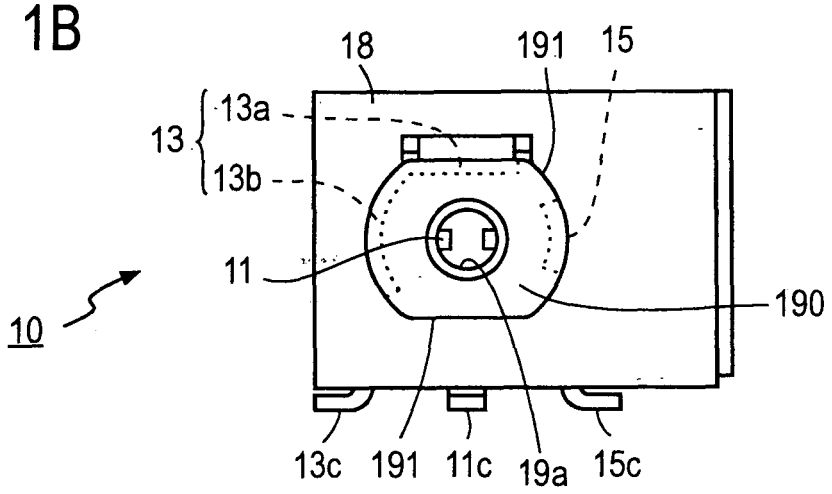
FIG. 1B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13a
13b
11
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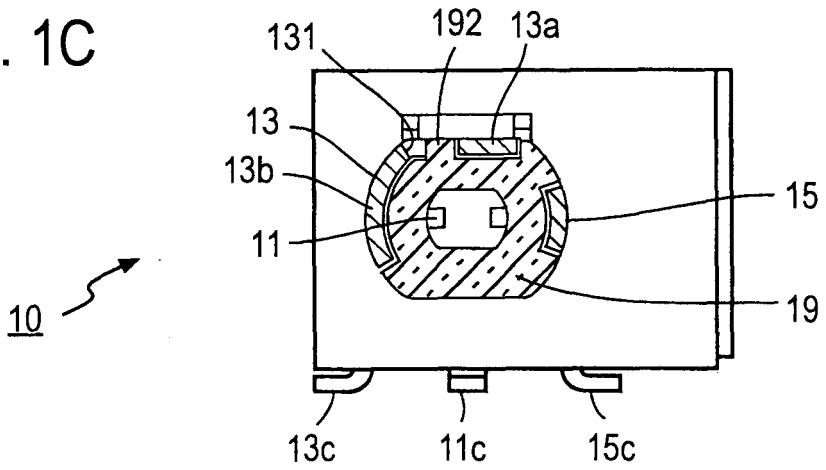
190
13c
191
11c
19a
15c

FIG. 1C


131
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13a
13
13b
11
15
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19
13c
11c
15c

Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to a coaxial connector, and more particularly to a coaxial connector in which an outer conductor shell partly covers a cylindrical insulator having an inner conductor contact with one or more of right and left side surfaces or upper and lower side surfaces of the cylindrical insulator being exposed.

DESCRIPTION OF THE RELATED ART

[0002] A conventional example of a coaxial connector will be described with reference to Figs. 5A and 5B. This example constitutes, for example, an I/O connector 100 of a mobile phone as disclosed in Japanese Patent Application Laid-Open No. 2003-323949, and a coaxial connector 10 and a multi-connector receptacle 17 are provided on the same base 18. Fig. 5A shows the coaxial connector 10 and the multi-connector receptacle 17 seen from above with a metal housing 12 of the I/O connector 100 being cut half, and Fig. 5B shows the I/O connector 100 seen from the front in a mounting direction. In Fig. 5A, a tip portion of a mating connector plug 200 is also shown by broken lines.

[0003] In Figs. 5A and 5B, reference numeral 10 denotes the coaxial connector; 13c, an outer conductor terminal; 19a, a contact holding hole; 11, an inner conductor contact; 11c, an inner conductor terminal; 12, a metal housing; 13, an outer conductor shell; 14, a multi-connector contact; 14c, a contact terminal; 15, a detection conductor contact; 15c, a detection conductor terminal; 16, a multi-connector plate-like contact holder made of synthetic resin; 17, the multi-connector receptacle; 18, a substantially rectangular insulation base made of synthetic resin material; 19, a cylindrical insulator made of synthetic resin material; 20, a coaxial connector of the mating connector plug; 21, a metal housing of the mating connector plug; 22, an annular outer conductor of the coaxial connector of the mating connector plug; 23, an inner conductor pin of the coaxial connector of the mating connector plug; and 24, a multi-connector plug of the mating connector.

[0004] The cylindrical insulator 19 and the multi-connector plate-like contact holder 16 integrally protrude from a front surface of the insulation base 18. An outer diameter of a tip portion 190 of the cylindrical insulator 19 is larger than an outer diameter of the other portion of the cylindrical insulator 19 substantially by the thickness of the outer conductor shell 13. Reference numeral 191 shows an exposed portion of the cylindrical insulator 19. The contact holding hole 19a is formed in the cylindrical insulator 19 to extend from its front end to the rear surface of the insulation base 18 along the axis of the cylindrical insulator 19. The outer conductor shell 13 is also mounted at its rear end to the front surface of the base 18 at a rear end thereof. In the conventional example, the outer conductor shell 13 is provided only on a left side surface only of the cylindrical insulator 19 to cover the side surface thereof, and the detection conductor contact 15 is provided on a right side surface to cover the side surface thereof. Thus, upper and lower side surfaces are exposed to form the exposed portion 191 of the cylindrical insulator 19.

[0005] The inner conductor contact 11 connects to the inner conductor terminal 11c. The outer conductor shell 13 connects to the outer conductor terminal 13c. The detection conductor contact 15 connects to the detection conductor terminal 15c. A plurality of contact grooves 16g extending in parallel with a connector mounting direction are formed in one surface of the plate-like contact holder 16, each of the multi-connector contact 14s is mounted in corresponding one of the contact grooves 16g, and a rear end of each multi-connector contact 14 protrudes from the insulation base 18 to constitute the connector terminal 14c.

[0006] The coaxial connector 10 described with reference to Figs. 5A and 5B shows a receptacle side of a coaxial connector that can mate with and be removed from the mating coaxial connector 20 shown by broken lines in Fig. 5A. The coaxial connector 10 includes the detection conductor contact 15 for detection of mating and removal states between the coaxial connectors 10 and 20. When the cylindrical insulator 19 is pressed into the annular outer conductor 22 of the mating coaxial connector 20 from the tip portion 190 thereof, the outer conductor shell 13 that surrounds a surface of the cylindrical insulator 19 electrically and mechanically connects to the annular outer conductor 22 of the mating coaxial connector 20, and the inner conductor pin 23 of the mating coaxial connector 20 enters the contact holding hole 19a of the cylindrical insulator 19 to engage the inner conductor contact 11.

[0007] When mounting the mating connector plug 200 to the I/O connector 100, the tip portion 190 of the cylindrical insulator 19 is not always pressed into the annular outer conductor 22 with the centerline of the cylindrical insulator 19 and the centerline of the annular outer conductor 22 of the mating coaxial connector 20 being aligned. If the metal housing 21 of the mating connector plug 200 is inserted into the metal housing 12 of the I/O connector 100 with the centerline of the annular outer conductor 22 of the mating coaxial connector 20 and the centerline of the cylindrical insulator 19 of the coaxial connector 10 crossing each other, a front left corner of the metal housing 21 of the mating connector plug 200 may hit the tip portion 190 of the cylindrical insulator 19 of the coaxial connector 10. In the case of an I/O connector of such a construction in which the positions of the coaxial connector 10 and the multi-connector receptacle 17 are interchanged each other, a front right corner of the metal housing 21 may hit the tip portion 190 of the cylindrical insulator 19.

[0008] For example, a width of the I/O connector for the mobile phone is a dozen or so mm, and the diameter of the cylindrical insulator 19 is 2 mm at most, and thus a lateral external force applied to the tip portion 190 may cause the cylindrical insulator 19 to be bent together with the detection conductor contact 15 and deformed. On the other hand, no external force is applied to the outer conductor shell 13 and the outer conductor shell 13 keeps the shape thereof, thereby creating a space between the outer conductor shell 13 and the cylindrical insulator 19. In this state, even if the connector plug 200 is returned to a correct position, the annular outer conductor 22 may hit the tip portion 190 of the cylindrical insulator 19 to prevent connection of the connector, and may damage the cylindrical insulator 19 in some cases. This is because the width of the I/O connector for the mobile phone is considerably large relative to the clearance between the front end of the cylindrical insulator 19 and the front face of the metal housing 12, and when a direction of the mating connector plug 200 is inclined relative to the I/O connector 100 in a plane of the sheet of Fig. 5A, the left or right corner of the metal housing 21 can enter deep into the metal housing 12 of the I/O connector 100 to strike against the tip of the cylindrical insulator 19.

[0009] On the other hand, since the mating connector plug 200 has relatively small height relative to the above mentioned clearance, if the mating connector plug 200 is inclined in a plane perpendicular to the sheet of Fig. 5A with the mating connector plug 200 being held in a correct direction relative to the I/O connector in the plane of the sheet of Fig. 5A, an upper or lower front edge of the metal housing 21 cannot enter deep into the metal housing 12 and therefore is less likely to strike against the tip portion 190 of the cylindrical insulator 19. Thus, depending on a circumferential state of around the coaxial connector 10, an unpreferable external force may be applied to the tip portion 190 of the cylindrical insulator 19 from a particular direction, thereby disabling connection or damaging the connector.

SUMMARY OF THE INVENTION

[0010] An object of the present invention is to provide a coaxial connector that is less likely to be deformed and thus damaged even if a cylindrical insulator of a coaxial connector is subjected to an external force from a particular direction.

[0011] A coaxial connector according to the present invention includes:

a substantially rectangular insulation base;

a cylindrical insulator integrally formed to protrude from one surface of said insulation base, said cylindrical insulator including a tip portion having an outer periphery of an enlarged diameter and a contact holding hole formed therein to extend rearward from a front end thereof for receiving therein an inner conductor pin of a mating coaxial connector;

an inner conductor contact disposed in said cylindrical insulator, for making contact with said inner conductor pin inserted into said contact holding hole; and

an outer conductor shell covering at least part of a circumferential surface of said cylindrical insulator on the side closer to said insulation base than said tip portion, and held by said insulation base,

wherein a protrusion and a notch that engage each other in a circumferential direction of said cylindrical insulator are formed in one and the other of a front edge of said outer conductor shell and a rear edge of said tip portion of said cylindrical insulator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1A is a plan view for illustrating an embodiment of the present invention;

Fig. 1B is a front view for illustrating the embodiment of the present invention;

Fig. 1C is a partial sectional view for illustrating the embodiment of the present invention;

Fig. 2 is a perspective view of the embodiment of the present invention;

Fig. 3 is a partial sectional view of a modified embodiment of the present invention;

Fig. 4 is an exploded perspective view of an I/O connector using a coaxial connector according to the present invention;

Fig. 5A is a partial exploded view of an I/O connector for illustrating a conventional example; and

Fig. 5B is a front view of the conventional I/O connector.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] An embodiment of a coaxial connector according to the present invention will be described with reference to Figs. 1A, 1B, 1C and 2. Fig. 1A shows the coaxial connector seen from above, Fig. 1B shows the coaxial connector seen from the front, and Fig. 1C shows a section taken along the line C-C in Fig. 1 A. Fig. 2 is a perspective view of the coaxial connector. In the embodiment, the same reference numerals as in a conventional example in Figs. 5A and 5B denote the same components.

[0014] The coaxial connector 10 described with reference to Figs. 1A, 1B, 1C and 2 shows a coaxial connector that can mate with and be removed from an unshown mating coaxial connector.

[0015] In the embodiment, a cylindrical insulator 19 is integrally formed to vertically protrude from one surface of a substantially rectangular insulation base 18. A tip portion 190 of the cylindrical insulator 19 has a large diameter, and upper and lower side surfaces that face each

other diametrically of the cylindrical insulator 19 are planar. An outer conductor shell 13 covers part of a circumferential surface of the cylindrical insulator over a range wider than 90° and narrower than 300° on the side closer to the insulation base 18 than the tip portion 190. In the embodiment, the outer conductor shell 13 has a curved portion 13b that covers a curved surface of the cylindrical insulator 19 and a planar portion 13a that covers the planar face.

[0016] A detection conductor contact 15 extending from a rear end of the tip portion 190 of the cylindrical insulator 19 into the insulation base 18 is provided on one side surface that constitutes the circumferential surface of the cylindrical insulator 19. Mating and removal states between the coaxial connector 10 and the mating coaxial connector can be detected with the detection conductor contact 15. The circumferential surface of the cylindrical insulator 19 other than areas covered with the outer conductor shell 13 and the detection conductor contact 15 forms an exposed portion 191. The outer conductor shell 13 and the detection conductor contact 15 are fixedly held in the insulation base 18, and rear ends of the outer conductor shell 13 and the detection conductor contact 15 extend downward in Fig. 1B to constitute an outer conductor terminal 13c and a detection conductor terminal 15c protruding from the insulation base 18.

[0017] Reference numeral 192 denotes a protrusion formed in the cylindrical insulator. An outer diameter of the tip portion 190 of the cylindrical insulator 19 is larger than an outer diameter of a body of the cylindrical insulator 19 substantially by the thickness of the outer conductor shell 13 as described above. The protrusion 192 having substantially the same thickness as the outer conductor shell 13 is integrally molded to extend rearward in a rear end peripheral edge of the tip portion 190. A notch 131 into which the protrusion 192 enters is formed in part of a tip of the outer conductor shell 13 surrounding the cylindrical insulator 19. When the coaxial connector 10 is assembled, the protrusion 192 enters the notch 131, and the protrusion 192 and the notch 131 engage each other.

[0018] Thus, the protrusion 192 of the cylindrical insulator 19 enters the notch 131 of the outer conductor shell 13, and when an external force to the right is applied to a left corner of the tip portion 190 of the cylindrical insulator 19 in Fig. 1A, a side edge of the notch 13 engages a side edge of the protrusion 192 to receive the external force, and thus the cylindrical insulator 19 is reinforced by the outer conductor shell 13 against an external force from the left. Further, in the embodiment in Figs. 1A, 1B, 1C and 2, the outer conductor shell 13 is such a member that is composed of the curved portion 13b covering a left side surface of the cylindrical insulator 19 and the planar portion 13a covering an upper planar face of the cylindrical insulator 19 and that has a substantially L shaped section and, therefore, is less likely to be bent by the external force, thus providing a large reinforcing effect of the cylindrical insulator 19. It is, of course, apparent that the cylindrical insulator 19 is supported by the outer conductor shell 13 and is prevented from being deformed also when an external force from the right is applied to the tip portion 190 of the cylindrical insulator 19.

[0019] In the embodiment in Figs. 1A, 1B, 1C and 2, the case has been described where the protrusion 192 extending from the tip portion 190 is formed in the cylindrical insulator 19 and the notch 131 is formed in the outer conductor shell 13, but a protrusion may be formed to protrude forwardly from the front end of the outer conductor shell 13 and a notch may be formed in a rear edge of the tip portion 190 of the cylindrical insulator. Eventually, a protrusion may be formed in one of the outer conductor shell 13 and the tip portion 190 of the cylindrical insulator 19 and a notch may be formed in the other so that the protrusion and the notch engage each other in a circumferential direction of the cylindrical insulator 19.

[0020] Fig. 3 shows a modified embodiment of the present invention. In this modified embodiment, the outer conductor shell 13 is extended to also cover a lower planar face of the cylindrical insulator 19 and form another planer portion 13d, and a protrusion is formed in one of the outer conductor shell 13 and the tip portion 190 of the cylindrical insulator 19 and a notch is formed in the other so that the protrusion and the notch engage each other also in the lower plane. Thus, in the modified embodiment, the outer conductor shell 13 has a U-shaped section, and is more rigid against an external force than the outer conductor shell 13 having the substantially L-shaped section in Figs. 1A, 1B and 1C, thereby allowing a stronger reinforcement of the cylindrical insulator 19. Further, the modified embodiment provides a reinforcing effect of the tip portion 190 of the cylindrical insulator 19 against an external force in any direction: left, right, up, and down. Other configurations are the same as in the embodiment in Figs. 1A, 1B and 1C.

[0021] Fig. 4 is an exploded perspective view of the I/O connector 100 when the coaxial connector according to the present invention in Figs. 1A, 1B and 1C is applied to a coaxial connector 10 of an I/O connector 100 in Figs. 5A and 5B. An insulation base 18 is substantially rectangular, and a cylindrical insulator 19 and a plate-like contact holder 16 vertically protrude from a front surface of the insulation base 18 at an interval along the length of the insulation base 18. Configurations of a cylindrical insulator 19, an inner conductor contact 11 mounted to the cylindrical insulator 19, an outer conductor shell 13, and a detection conductor contact 15 are the same as those in Figs. 1A, 1B and 1C.

[0022] The inner conductor contact 11, the outer conductor shell 13, and the detection conductor contact 15 are inserted through unshown slits from a rear surface of the insulation base 18, and mounted to the inside and a circumferential surface of the cylindrical insulator 19. A multi-connector contacts 14 are inserted through unshown slits from the rear surface of the insulation base 18, and mounted to grooves 16g arranged in one surface of the plate-like contact holder 16.

[0023] A metal housing 12 is formed in a box-shape having openings in a front surface and a rear surface by stamping and bending a metal sheet. The insulation base 18 to which the contacts 11, 15 and 14 and the outer conductor shell 13 are mounted is fixedly inserted through the opening in the rear surface of the metal housing 12. Front ends of the cylindrical insulator 19 and the plate-like contact holder 16 are placed behind the opening in the front surface of the metal housing 12. The whole I/O connector in Fig. 4 may be regarded as a coaxial connector including a metal housing 12.

[0024] As is apparent from the above description, a corner of the metal housing of a mating plug may hit a tip portion 190 of the cylindrical insulator 19 in the metal housing 12, and an external force to the right or the left may be applied to the tip portion 190. With the coaxial connector according to the present invention, however, the cylindrical insulator 19 is reinforced by the outer conductor shell 13 and is thus less likely to be deformed by the external force.

[0025] In each of the aforementioned embodiments of the coaxial connectors according to the present invention, it is also possible to modify such that the metal pieces of the outer conductor shell 13 and the detection conductor contact 15 are used to function as a detection conductor contact and an outer conductor shell, respectively.

EFFECT OF THE INVENTION

[0026] According to the present invention, the notch formed in the tip of the outer conductor shell that covers the cylindrical insulator and the protrusion formed in the cylindrical insulator engage each other in a circumferential direction, thereby making the outer conductor shell less likely to be deformed or torn off from the cylindrical insulator when the external force is applied to the cylindrical insulator.

Claims

1. A coaxial connector comprising:

a substantially rectangular insulation base;
a cylindrical insulator integrally formed to protrude from one surface of said insulation base, said cylindrical insulator including a tip portion having an outer periphery of an enlarged diameter and a contact holding hole formed therein to extend rearward from a front end thereof for receiving therein an inner conductor pin of a mating coaxial connector;
an inner conductor contact disposed in said cylindrical insulator, for making contact with said inner conductor pin inserted into said contact holding hole; and
an outer conductor shell covering at least part of a circumferential surface of said cylindrical insulator on the side closer to said insulation base than said tip portion, and held by said insulation base,

wherein a protrusion and a notch that engage each other in a circumferential direction of said cylindrical insulator are formed in one and the other of a front edge of said outer conductor shell and a rear edge of said tip portion of said cylindrical insulator.

2. The coaxial connector according to Claim 1, wherein said notch is formed to cut into the front edge of said outer conductor shell toward said insulation base, said protrusion is formed to extend from the rear edge of said tip portion of said cylindrical insulator toward said insulation base and enters said notch.

3. The coaxial connector according to Claim 1 or 2, wherein said circumferential surface of said cylindrical insulator includes a first planar face formed in at least one side surface of said cylindrical insulator, and said outer conductor shell includes a curved portion that covering part of the circumferential surface of said cylindrical insulator and a first planar portion covering said first planar face.

4. The coaxial connector according to Claim 3, wherein said circumferential surface of said cylindrical insulator includes a second planar face opposite said first planar face, and said outer conductor shell is extended to form a second planar portion covering said second planar face on the side closer to said insulation base than said tip portion.

5. The coaxial connector according to Claim 1, there is provided on the circumferential surface of said cylindrical insulator a detection conductor contact that diametrically faces part of said outer conductor shell and extends from the rear edge of the tip portion toward said insulation base.

6. The coaxial connector according to Claim 1, wherein said outer conductor shell covers the circumferential surface of said cylindrical insulator over a range wider than 90° and narrower than 300°.

7. The coaxial connector according to any of Claims 1 to 6, further comprising a metal housing substantially of a box shape that surrounds said insulation base and said cylindrical insulator, and has a front opening located forwardly of a front end of said cylindrical insulator; for receiving therein a mating connector plug.

FIG. 1A

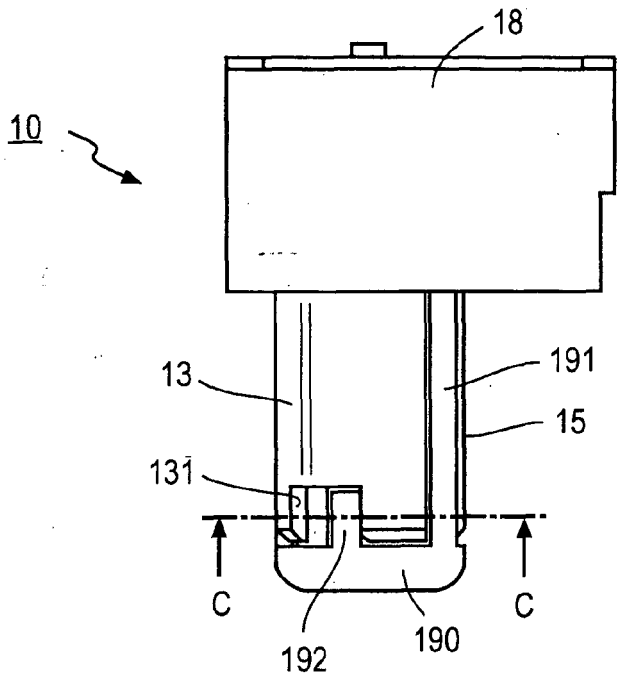

FIG. 1B

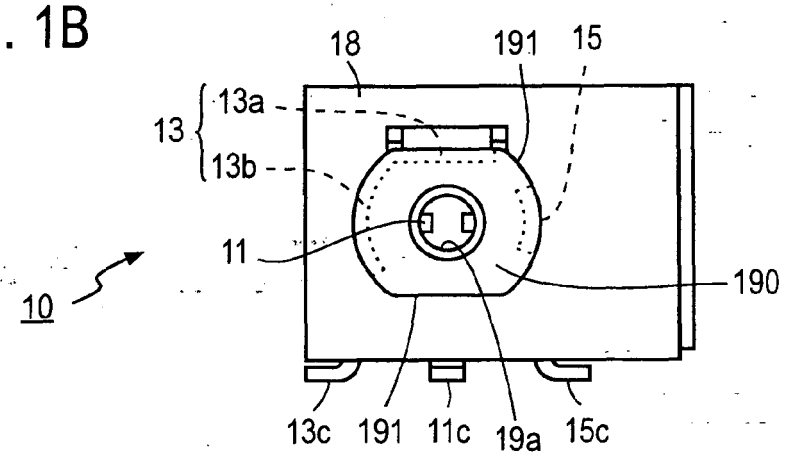

FIG. 1C

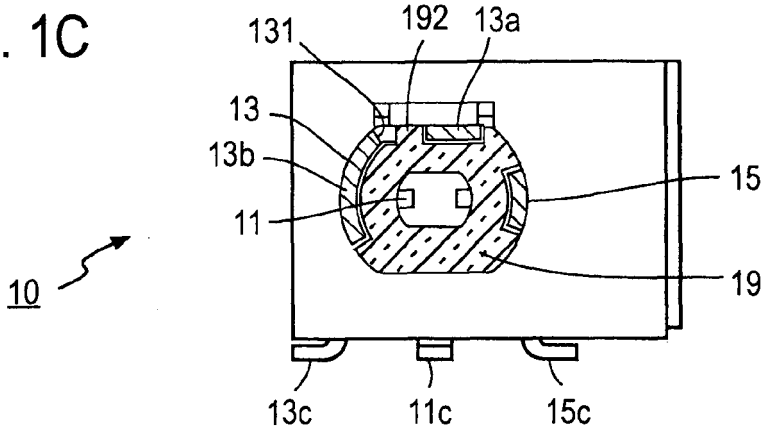

FIG. 2

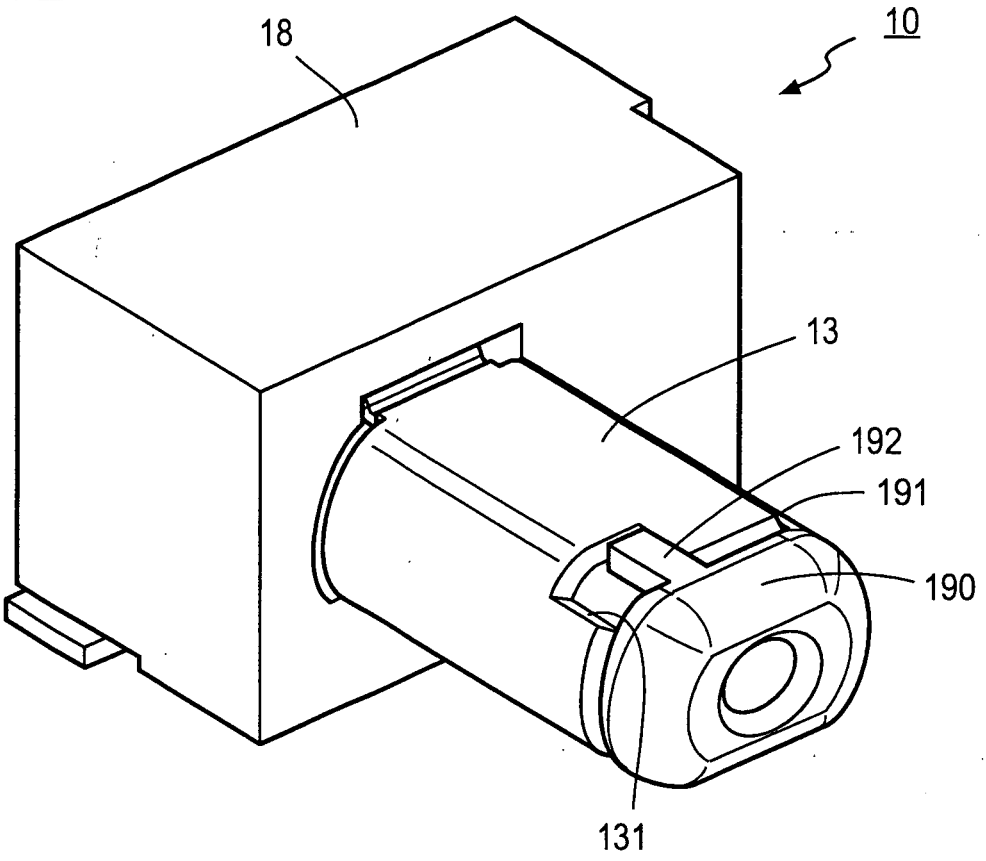
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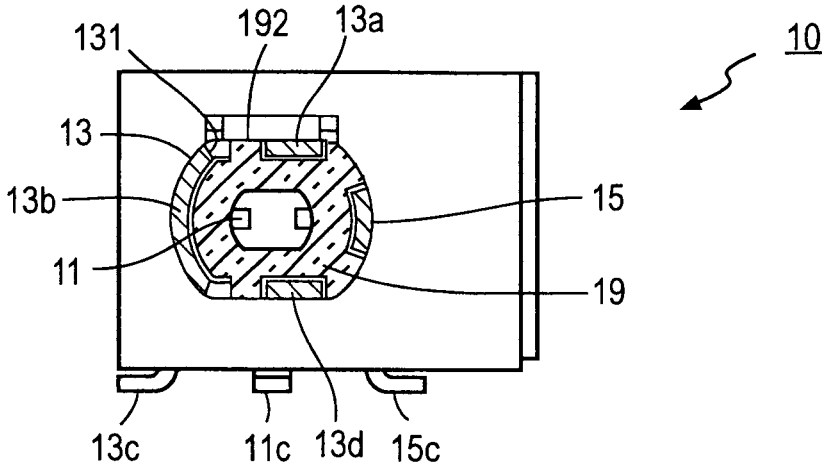
FIG. 3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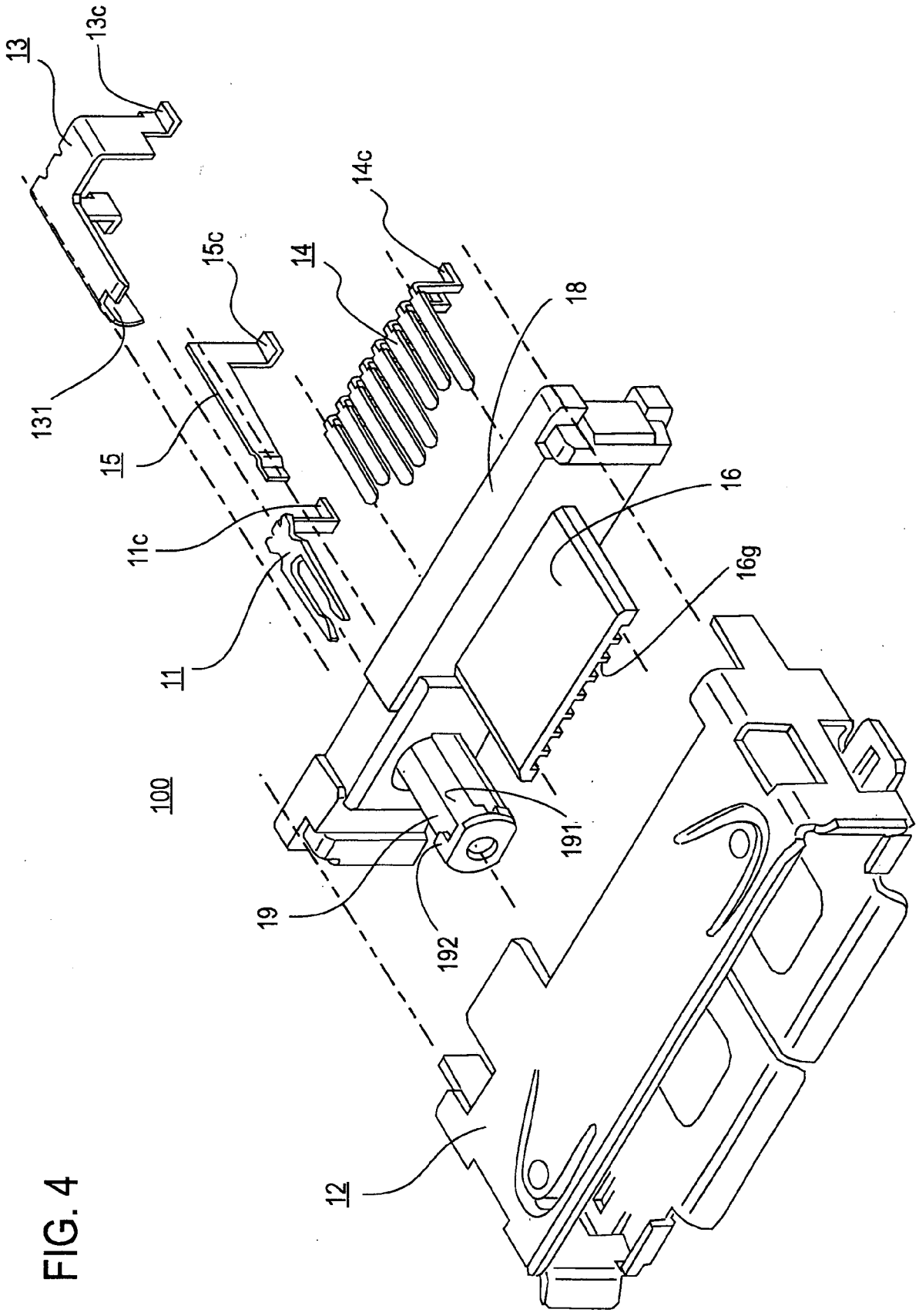

FIG. 4

FIG.5A

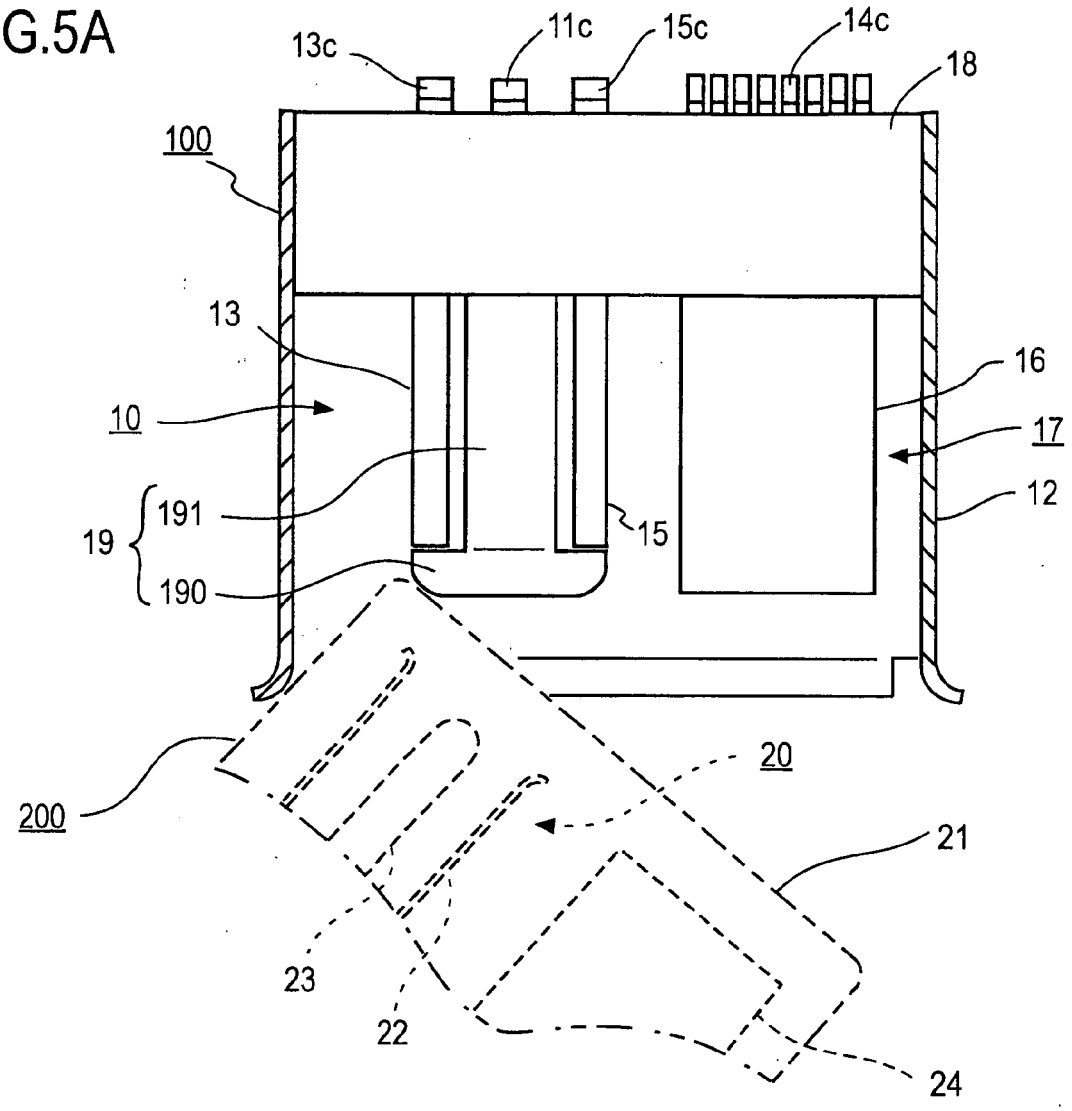
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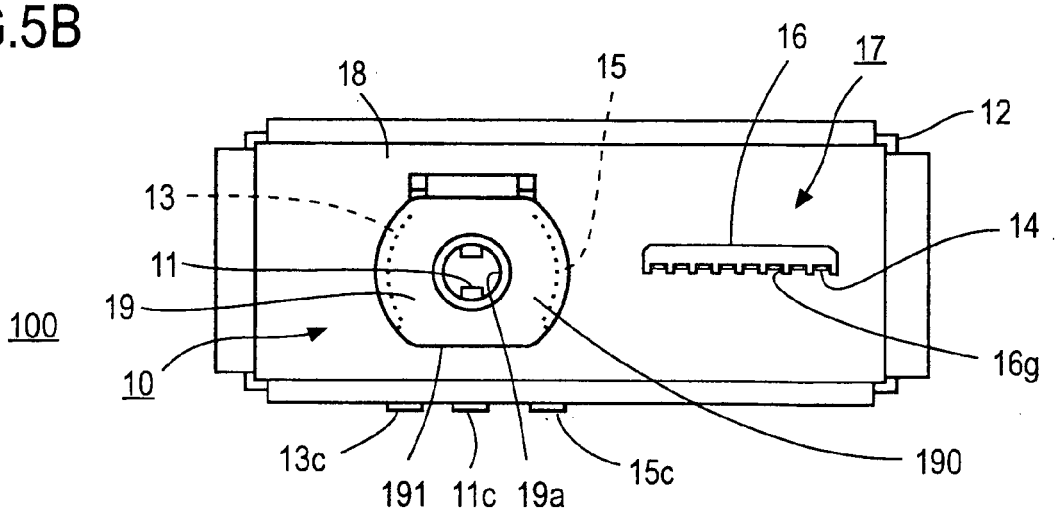
FIG.5B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EUROPEAN SEARCH REPORT

Application Number
EP 05 02 7310

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 11, 3 January 2001 (2001-01-03) & JP 2000 223224 A (JAPAN AVIATION ELECTRONICS INDUSTRY LTD), 11 August 2000 (2000-08-11) * abstract; figures 1-3 * -----	1	H01R24/02
D,A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) & JP 2003 323949 A (MOLEX INC), 14 November 2003 (2003-11-14) * abstract; figures 2,8,10 * -----	1	
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 03, 31 March 1999 (1999-03-31) & JP 10 335010 A (SMK CORP), 18 December 1998 (1998-12-18) * abstract; figures 1,2 * -----		TECHNICAL FIELDS SEARCHED (IPC)
A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 04, 2 April 2003 (2003-04-02) & JP 2002 367739 A (SMK CORP), 20 December 2002 (2002-12-20) * abstract; figures 1-5 * -----	1	H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 March 2006	Garcia Congosto, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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28-03-2006

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