



- (51) **International Patent Classification:**
H01R 13/11 (2006.01) *H01R 13/187* (2006.01)
- (21) **International Application Number:**
PCT/US2015/064291
- (22) **International Filing Date:**
7 December 2015 (07.12.2015)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
2014-266948 29 December 2014 (29.12.2014) JP
- (71) **Applicant:** MOLEX, LLC [US/US]; 2222 Wellington Court, Lisle, Illinois 60532 (US).
- (72) **Inventor:** HANYU, Takuji; c/o Molex, LLC, 2222 Wellington Court, Lisle, Illinois 60532 (US).
- (74) **Agent:** O'MALLEY, James A.; Molex, LLC, 2222 Wellington Court, Lisle, Illinois 60532 (US).
- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** FEMALE ELECTRICAL TERMINAL

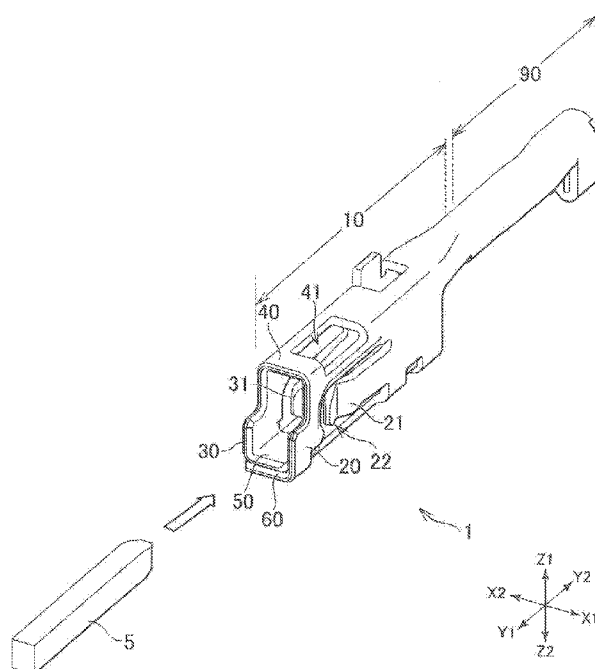


FIG. 1

(57) **Abstract:** The female electrical terminal has a cylindrical portion able to receive a male electrical terminal inserted from front to rear, and a left wall portion arranged so that a portion of the cylindrical portion runs along the outer surface of the male electrical terminal. The left wall portion has a left plate spring portion having a contact point pressing against the outer wall of the male electrical terminal and extending forward from the rear, and a slit surrounding the outer edge of the left plate spring portion to separate the other section of the left wall portion from the outer edge of the left plate spring portion. The other section of the left wall portion has a left protruding portion positioned forward relative to the tip of the left plate spring portion and bulging inwardly into the cylindrical portion. The left protruding portion is positioned at least on the edge of the slit.

FEMALE ELECTRICAL TERMINAL

RELATED APPLICATIONS

[0001] This application claims priority to Japanese Application No. 2014-266948, filed December 29, 2014, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to a female electrical terminal.

BACKGROUND ART

[0003] A cylinder-like female electrical terminal and a pin-like male electrical terminal are sometimes used to connect two cables. In Patent Document 1, a section of the wall portion of the male electrical terminal is a plate spring. When the male electrical terminal is inserted into the female electrical terminal, the plate spring makes contact with the outer surface of the male electrical terminal and an electrical connection is established between the two terminals.

[Patent Document 1] Laid-Open Patent Publication No. 2013-025988

SUMMARY OF THE INVENTION

[0004] As the male electrical terminal is being inserted into the female electrical terminal, the male electrical terminal is inclined relative to the female electrical terminal. As a result, the tip of the male electrical terminal strikes the tip of the plate spring in the female electrical terminal. In Patent Document 1, a protruding portion is formed in the female electrical terminal to protrude inward (the correcting portion 18 in Patent Document 1) in order to correct the position and orientation of the male electrical terminal relative to the female electrical terminal. However, in Patent Document 1, the protruding portion is formed on the front end of the female electrical terminal. When the position of the protruding portion is far from the tip of the plate spring, the tip of the male electrical terminal sometimes misses the protruding portion and strikes the tip of the plate spring.

[0005] The present disclosure provides a female electrical terminal which is able to effectively prevent the tip of a male electrical terminal from striking the tip of the plate spring in the female electrical terminal.

[0006] The present disclosure is a female electrical terminal comprising: a cylindrical portion able to receive a male electrical terminal inserted in a first direction, and a first wall portion forming a portion of the cylindrical portion and arranged so as to run along the outer surface of the male electrical terminal; the first wall portion including: a plate spring portion having a contact point pressed into the outer surface of the male electrical terminal and extending in a second direction being the direction opposite the first direction, and a slit surrounding the outer edge of the plate spring portion to divide the other section of the first wall portion from the outer edge of the plate spring portion; the other section of the first wall portion having a first protruding portion positioned in the second direction relative to the tip of the plate spring portion and bulging inwardly into the cylindrical portion, and the first protruding portion being positioned at least on the edge of the slit. In this way, the present disclosure is more effective than the prior art in preventing collisions between the tip of a male electrical terminal and the tip of the plate spring in a female electrical terminal.

[0007] The first protruding portion may bulge inwardly into the cylindrical portion relative to the section of the first wall portion positioned farther in the second direction from the edge of the slit. This creates a wider entrance in the cylindrical portion for insertion of the male electrical terminal compared to situations in which the entire portion of the slit positioned in the second direction bulges inwardly.

[0008] The first protruding portion may extend in a direction orthogonal to the first direction. In this way, the present disclosure is more effective at preventing collisions between the tip of a male electrical terminal and the tip of the plate spring in a female electrical terminal.

[0009] The other section of the first wall portion may have a second protruding portion, and the second protruding portion may be positioned relative to the plate spring portion in a direction orthogonal to the first direction and extending in the first direction. This can strengthen the portion in which the second protruding portion is arranged.

[0010] The second protruding portion may be positioned on the edge of the slit. In this way, the present disclosure is more effective at preventing collisions between the tip of a male electrical terminal and the tip of the plate spring in a female electrical terminal.

[0011] The first protruding portion and the second protruding portion may be formed along the edge of the slit and connected to each other. In this way, the present disclosure is more effective at preventing collisions between the tip of a male electrical terminal and the tip of the plate spring in a female electrical terminal.

[0012] The cylindrical portion may include a second wall portion positioned on the opposite side of the first wall portion so as to interpose the male electrical terminal, and the second wall portion may have the plate spring portion, the slit, and the first protruding portion. In this way, the present disclosure is more effective at preventing collisions between the tip of a male electrical terminal and the tip of the plate spring in a female electrical terminal.

[0013] The plate spring portion may have an end surface extending in the second direction from the tip of the plate spring portion, and the end surface of the plate spring portion may be concealed by the first protruding portion when the cylindrical portion is viewed in the first direction. In this way, the present disclosure is more effective at preventing collisions between the tip of a male electrical terminal and the tip of the plate spring in a female electrical terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a perspective view of a female electrical terminal in an embodiment of the present disclosure.

[0015] FIG. 2 is a left side view of a female electrical terminal in an embodiment of the present disclosure.

[0016] FIG. 3 is a right side view of a female electrical terminal in an embodiment of the present disclosure.

[0017] FIG. 4 is a front view of the cylindrical portion in an embodiment of the present disclosure.

[0018] FIG. 5 is a cross-sectional view of the profile of the cylindrical portion of an embodiment of the present disclosure when viewed from the front.

[0019] FIG. 6 is a cross-sectional view of the profile of the cylindrical portion of a variation of an embodiment of the present disclosure when viewed from the front.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] The following is an explanation of an embodiment of the present disclosure (referred to below simply as the embodiment) with reference to FIG. 1 through FIG. 6. FIG. 1 is a perspective view of the female electrical terminal 1 in the embodiment, FIG. 2 is a left side view of the female electrical terminal 1 in the embodiment, FIG. 3 is a right side view of the female electrical terminal 1 in the embodiment, FIG. 4 is a front view of the cylindrical portion 10 of the female electrical terminal 1 in the embodiment, FIG. 5 is a cross-sectional view of the cylindrical portion 10 of the female electrical terminal 1 in the embodiment when viewed from V-V in FIG. 2, and FIG. 6 is a cross-sectional view of the profile of the cylindrical portion 10 of the female electrical terminal 1 in a variation of the embodiment when viewed from the front.

[0021] In the following explanation, direction X1 and direction X2 in the drawings refer, respectively, to the left direction and the right direction. Direction Y1 and direction Y2 in the drawings refer, respectively, to the forward direction and the rearward direction. Direction Z1 and direction Z2 in the drawings refer, respectively, to the up direction and the down direction.

[0022] The embodiments disclosed in the present specification are just examples of the present disclosure, and any modifications of the present disclosure easily devised by a person of skill in the art fall within the scope of the claims. Also, the widths, thicknesses, and shapes of the component shown in the drawings are represented schematically and should not be understood to limit the interpretation of the present disclosure.

[0023] As shown in FIG. 1, the female electrical terminal 1 is formed out of an electrically conductive material such as metal, and can be mounted in the housing (not shown) of a first connector (not shown) connected to an electrical component in an automobile or measuring device. The housing of the first connector is engaged with the housing (not shown) of a second connector (not shown) to establish an electrical connection between the first connector and the second connector. More specifically, pin-like male electrical terminals 5 in the housing of the second connector are inserted into female electrical terminals 1 to establish an electrical connection between the first connector and the second connector.

[0024] As shown in FIG. 1, the female electrical terminal 1 has a cylindrical portion 10 able to receive a male electrical terminal 5 inserted from front to rear, and has a crimped portion 90 connected electrically to an electric wire (not shown) such as a copper wire using

crimping. The crimped portion 90 is formed with an upside-down U-shaped profile so that the left and right ends are free ends. The left and right ends are bent inwardly to interpose an electrical wire placed inside the crimped portion 90, secure the electrical wire to the female electrical terminal 1, and establish an electrical connection between the electrical wire and the female electrical terminal 1.

[0025] As shown in FIG. 1, the cylindrical portion 10 of the female electrical terminal 1 has an angular profile which is substantially rectangular in cross section, a left wall portion 20 arranged on the left side, a right wall portion 30 arranged on the right side, and an upper wall portion 40 arranged on the top side. The cylindrical portion 10 is formed by bending a flat electrically conductive material so that it overlaps on the bottom of the cylindrical portion 10. More specifically, it is formed so that an inner lower wall portion 50 overlaps on the inside of the cylindrical portion 10, and an outer lower wall portion 60 overlaps on the outside. The left wall portion 20, the right wall portion 30, the upper wall portion 40, the inner lower wall portion 50, and the outer lower wall portion 60 are arranged so as to run along the outer surface of the male electrical terminal 5 when it has been inserted into the female electrical terminal 1.

[0026] Here, as shown in FIG. 1 and FIG. 2, a left plate spring portion 21 is formed in the left wall portion 20 positioned on the left side of the female electrical terminal 1, and a slit 22 is formed to surround the outer edge of the left plate spring portion 21. This slit 22 separates the left plate spring portion 21 from the rest of the left wall portion 20 excluding the left plate spring portion 21.

[0027] The left plate spring portion 21 is formed longitudinally in the forward direction from the rear. Also, the left plate spring portion 21 inclines into the cylindrical portion 10 as it moves forward, and has a contact portion near the tip which presses against the outer surface of the male electrical terminal 5. The tip of the left plate spring portion 21 is elastically deformable to the left, and the contact point of the left plate spring portion 21 and the contact point on the right plate spring portion 31 described below make contact with the interposed male electrical terminal 5 inserted into the cylindrical portion 10. The left plate spring portion 21 is bent forward from the contact point and is inclined outward from the cylindrical portion 10.

[0028] As shown in FIG. 2, the left wall portion 20 also has a left forward protruding portion 23 positioned in front of the tip of the left plate spring portion 21 and bulges into the

cylindrical portion 10. The left forward protruding portion 23 is arranged so as to extend vertically at least on the edge of the slit 22 (that is, longitudinally).

[0029] More specifically, the left forward protruding portion 23 is formed on the edge of the slit 22 and bulges into the cylindrical portion 10 relative the portion of the left wall portion 20 positioned in front of the edge of the slit 22. This creates a wider entrance in the cylindrical portion 10 for insertion of the male electrical terminal 5 compared to situations in which the entire portion of the slit 22 positioned in the forward direction bulges inwardly.

[0030] The left forward protruding portion 23 is press-formed so that the left forward protruding portion 23 is not formed a certain distance from the lower end of the edge in front of the slit 22. By providing a region in which the left forward protruding portion 23 is not formed, the complexity of the process can be reduced. The left forward protruding portion 23 does not have to be press-formed. Any other method can be used.

[0031] As shown in FIG. 2, the left wall portion 20 also has a left upward protruding portion 24. The left upward protruding portion 24 is arranged so as to extend longitudinally (that is, horizontally) and upward relative to the left plate spring portion 21.

[0032] More specifically, the left upward protruding portion 24 is formed on the edge of the slit 22, and constitutes a continuation of the protruding portion by connecting the left forward protruding portion 23 to the left upward protruding portion 24. In other words, the left forward protruding portion 23 and the left upward protruding portion 24 surround the left plate spring portion 21 in front and above.

[0033] As shown in FIG. 1 and FIG. 3, the right wall portion 30 located on the right side of the female electrical terminal 1 has a right plate spring portion 31 having a function and shape identical to those of the left plate spring portion 21 and a slit 32 surrounding the outer edge of the right plate spring portion 31. As shown in FIG. 3, the right wall portion 30 has a right forward protruding portion 33 positioned in front of the tip of the right plate spring portion 31 and bulges into the cylindrical portion 10. The right forward protruding portion 33 is arranged so as to extend vertically at least on the edge of the slit 32 (that is, longitudinally).

[0034] As shown in FIG. 3, the right wall portion 30 also has a right upward protruding portion 34 positioned above the right plate spring portion 31 and bulging into the cylindrical portion 10. The right upward protruding portion 34 is arranged so as to extend longitudinally and upward (that is, horizontally) on the edge of the slit 32. The right forward protruding portion 33 and the right upward protruding portion 34 are connected to each other to form a

continuous protruding portion.

[0035] Here, as shown in FIG. 4, the left forward protruding portion 23 and the right forward protruding portion 33 bulge into the cylindrical portion 10. When the cylindrical portion 10 is viewed from the front as shown in FIG. 4, the end surface 21S constituting the tip of the left plate spring portion 21 is concealed by the left forward protruding portion 23. More specifically, the left forward protruding portion 23 protrudes into the cylindrical portion 10 from the end surface 21S. In other words, the width of the left forward protruding portion 23 is greater than the width of the end surface 21S in the transverse direction. The end surface 31S constituting the tip of the right plate spring portion 31 is concealed by the right forward protruding portion 33 in a similar manner.

[0036] When the left forward protruding portion 23 and the right forward protruding portion 33 are formed in this manner, the left forward protruding portion 23 (or right forward protruding portion 33) press against the tip of a male electrical terminal 5 inserted into the cylindrical portion 10 on an incline, causing it to evade the end surface 21S of the left plate spring portion (or the end surface 31S of the right plate spring portion) as it travels towards the rear of the cylindrical portion 10. As a result, a collision with the end surface 21S can be prevented. Also, because the left forward protruding portion 23 and the right forward protruding portion 33 are each positioned longitudinally in the section nearest the plate spring portions, avoidance of a collision is more reliable.

[0037] Because the left forward protruding portion 23 and the left upward protruding portion 24 are connected and surround the region directly adjacent to the left plate spring portion 21 both on top and in front, a collision between the male electrical terminal 5 and the end surface 21S of the left plate spring portion can be avoided even more reliably. Similarly, because the right forward protruding portion 33 and the right upward protruding portion 34 are connected and surround the region directly adjacent to the right plate spring portion 31 both on top and in front, a collision between the male electrical terminal 5 and the end surface 31S of the right plate spring portion can be avoided even more reliably.

[0038] As shown in FIG. 1, an opening 41 is formed in the upper wall portion 40 of the female electrical terminal 1. This opening 41 is designed to engage a securing portion (not shown) such as a hook or spring formed in the female housing in order to secure the female electrical terminal 1 inside the female housing. Here, the opening 41 is preferably provided widthwise in order to more reliably engage the securing portion of the female housing. In the

present embodiment, as shown in FIG. 1 and FIG. 5, the opening 41 is shifted to the left from the center of the upper wall portion 40 so as to jut into the left wall portion 20.

[0039] When the opening 41 is shifted to the left from the center of the upper wall portion 40, there is concern that the terminal has less resistance to external impacts because the vertical width is narrower from the left edge of the opening 41 to the upper edge of the slit 22 (see FIG. 2). However, because a left upward protruding portion 24 is formed on the upper edge of the slit 22 which bulges into the cylindrical portion 10, the strength of the left upper portion remains above a sufficient level. Also, because the right upward protruding portion 34 formed on the upper edge of the slit 32 in the right wall portion 30 bulges into the cylindrical portion 10, the strength of the right upper portion of the cylindrical portion 10 is even greater than the prior art.

[0040] The present disclosure is not limited to the embodiment described above. Many variations are possible within the scope of the present disclosure. The following is an explanation of another embodiment of the present disclosure (variation).

[0041] In the embodiment described above, the left forward protruding portion 23 was formed on the edge of the slit 22 in the left wall portion 20. However, the left forward protruding portion 23 can also be formed from the edge of the slit 22 to the forward tip of the cylindrical portion 10. In other words, the left wall portion 20 can bulge inwardly from the edge of the slit 22 forward on the cylindrical portion 10.

[0042] In this situation, the right forward protruding portion 33 is also formed from the edge of the slit 32 to the forward tip of the cylindrical portion 10 in the right wall portion 30. In other words, the right wall portion 30 can bulge inwardly from the edge of the slit 22 forward on the cylindrical portion 10.

[0043] In the embodiment explained above, the left upward protruding portion 24 was formed above the left plate spring portion 21 in the left wall portion 20. However, the left wall portion 20 may be formed so as to be wider below the left plate spring portion 21 and the slit 22. Here, a left downward protruding portion (not shown) having a shape extending longitudinally (horizontally) and bulging into the cylindrical portion 10 is formed below the left plate spring portion 21. As a result, resistance of the cylindrical portion 10 to external impacts from the lower left is greater than that of the prior art.

[0044] Here, the left lower protruding portion may be formed so as to connect to the lower end of the left forward protruding portion 23 and surround the left plate spring portion 21

from below. Because the region directly adjacent to the left plate spring portion 21 is surrounded in front and below, collisions between the end surface 21S of the left plate spring portion and the male electrical terminal 5 can be more reliably prevented.

[0045] In the right wall portion 30, as in the left wall portion 20, a right downward protruding portion (not shown) similar to the left downward protruding portion is formed below the right plate spring portion 31 and the slit 32. Also, the right lower protruding portion may be formed so as to connect to the lower end of the right forward protruding portion 33 and surround the right plate spring portion 31 from below. This improves the strength of the cylindrical portion 10 on the lower right, and prevents collisions between the end surface 31S of the right plate spring portion and the male electrical terminal 5.

[0046] In the embodiment described above, the opening 41 is shifted to the left from the center of the upper wall portion 40. However, the opening 41 may be shifted to the right so as to jut into the right wall portion 30. As shown in FIG. 6, the terminal may also be widened on both sides so that the opening may jut into both the left wall portion 20 and the right wall portion 30. In this situation, there may be some concern that the vertical section from the right edge of the opening 41 to the upper edge of the slit 32 is weaker than the embodiment described above. However, because a right forward protruding portion 34 is formed on the upper edge of the slit 32, the upper strength of the right wall portion 30 remains above a sufficient level.

CLAIMS

1. A female electrical terminal comprising:
a cylindrical portion able to receive a male electrical terminal inserted in a first direction; and
a first wall portion forming a portion of the cylindrical portion and arranged so as to run along an outer surface of the male electrical terminal, the first wall portion including,
a plate spring portion having a contact point to be pressed into the outer surface of the male electrical terminal, the plate spring portion extending in a second direction, the second direction being the direction opposite the first direction, and
a slit surrounding an outer edge of the plate spring portion, the slit being configured to separate a remaining section of the first wall portion from the outer edge of the plate spring portion, the remaining section of the first wall portion having a first protruding portion positioned in the second direction relative to a tip of the plate spring portion and bulging inwardly into the cylindrical portion, the first protruding portion being positioned at least on an edge of the slit.
2. A female electrical terminal according to claim 1, wherein the first protruding portion bulges inwardly into the cylindrical portion relative to a section of the first wall portion positioned farther in the second direction from the edge of the slit.
3. A female electrical terminal according to claim 1, wherein the first protruding portion extends in a direction orthogonal to the first direction.
4. A female electrical terminal according to claim 1, wherein the remaining section of the first wall portion has a second protruding portion, the second protruding portion being positioned relative to the plate spring portion in a direction orthogonal to the first direction, the second protruding portion extending in the first direction.

5. A female electrical terminal according to claim 4, wherein the second protruding portion is positioned on the edge of the slit.
6. A female electrical terminal according to claim 5, wherein the first protruding portion and the second protruding portion are formed along the edge of the slit and are connected to each other.
7. A female electrical terminal according to claim 1, wherein the cylindrical portion includes a second wall portion positioned on an opposite side of the first wall portion so as to interpose the male electrical terminal, the second wall portion having the plate spring portion, the slit, and the first protruding portion.
8. A female electrical terminal according to claim 1, wherein the plate spring portion has an end surface extending in the second direction from the tip of the plate spring portion, an end surface of the plate spring portion being concealed by the first protruding portion when the cylindrical portion is viewed in the first direction.

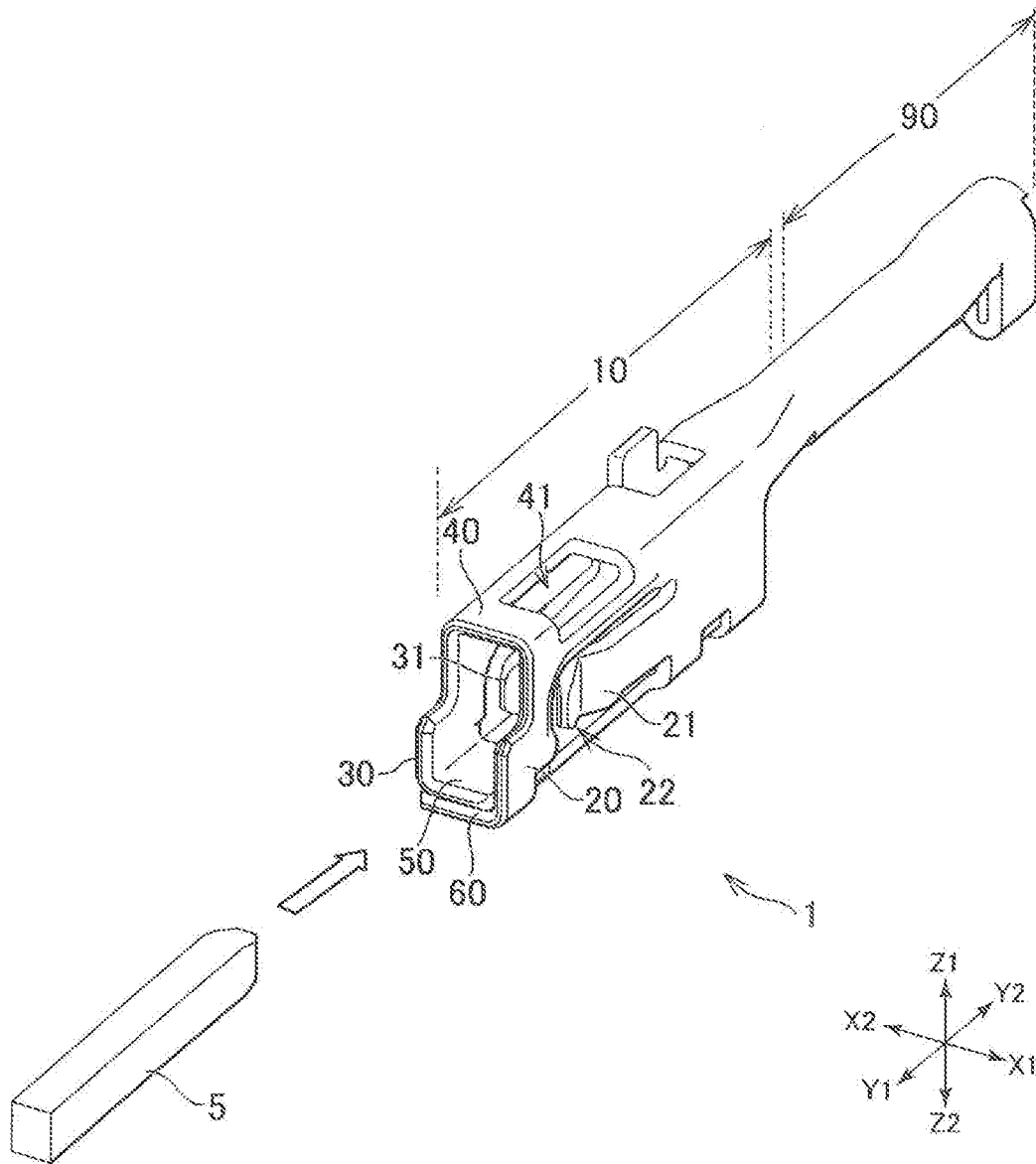


FIG. 1

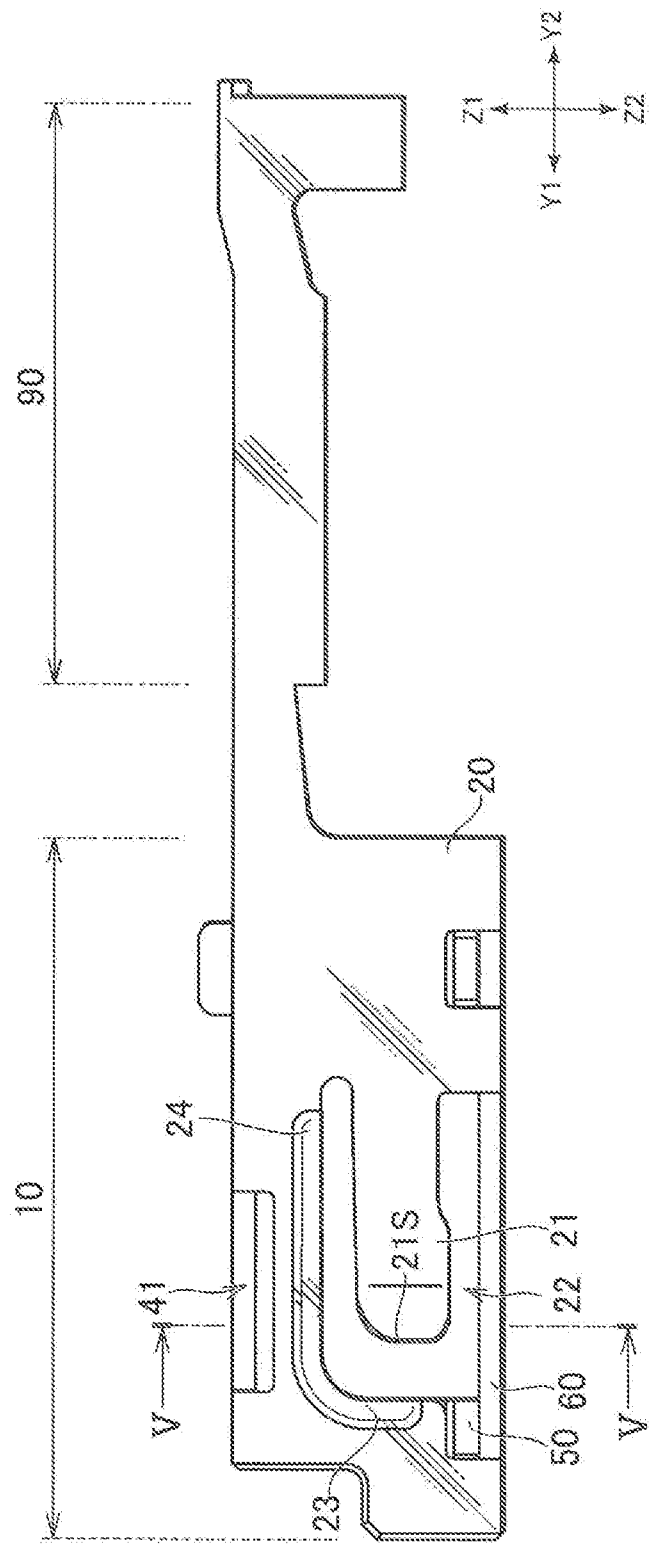


FIG. 2

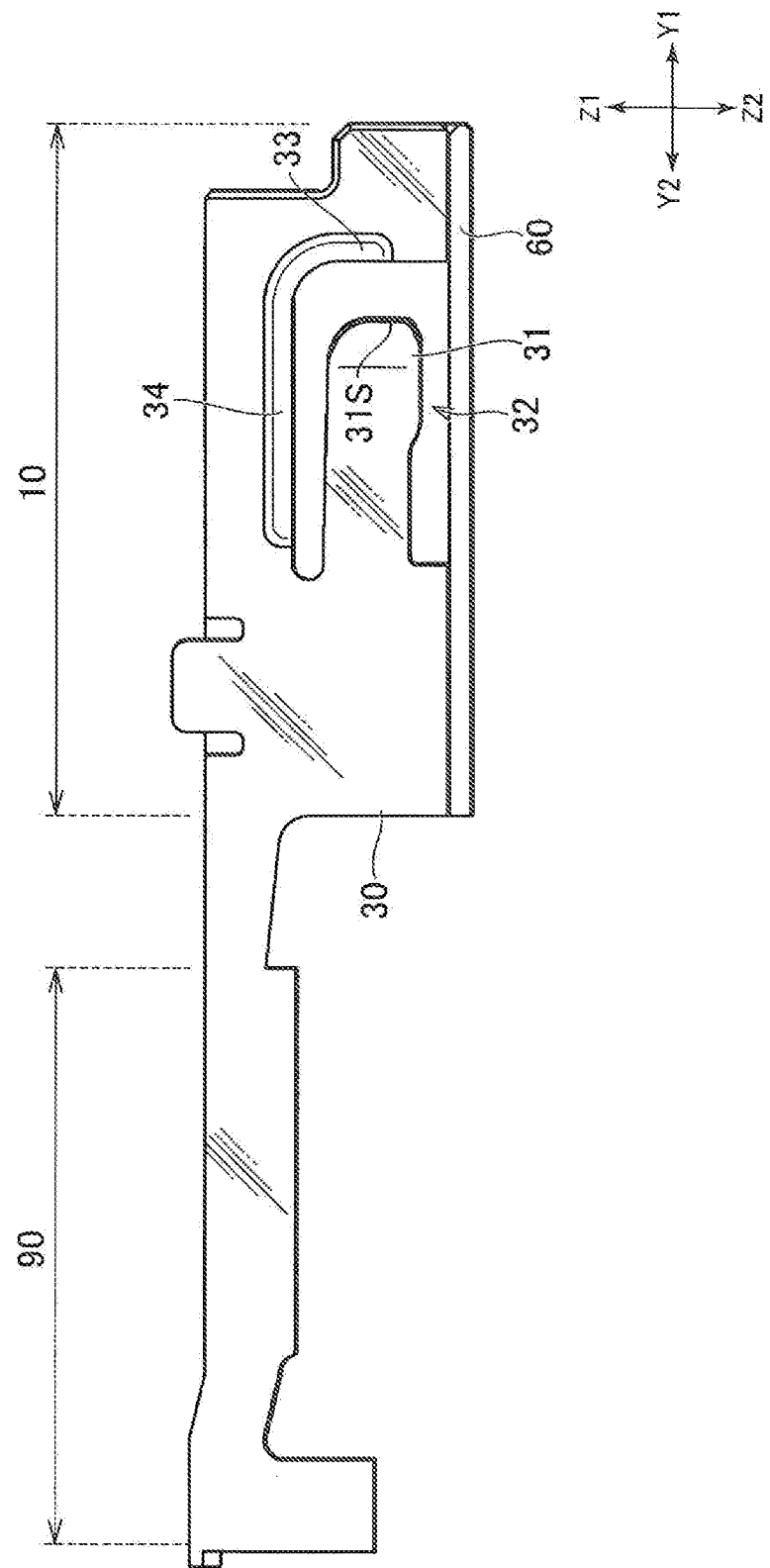


FIG. 3

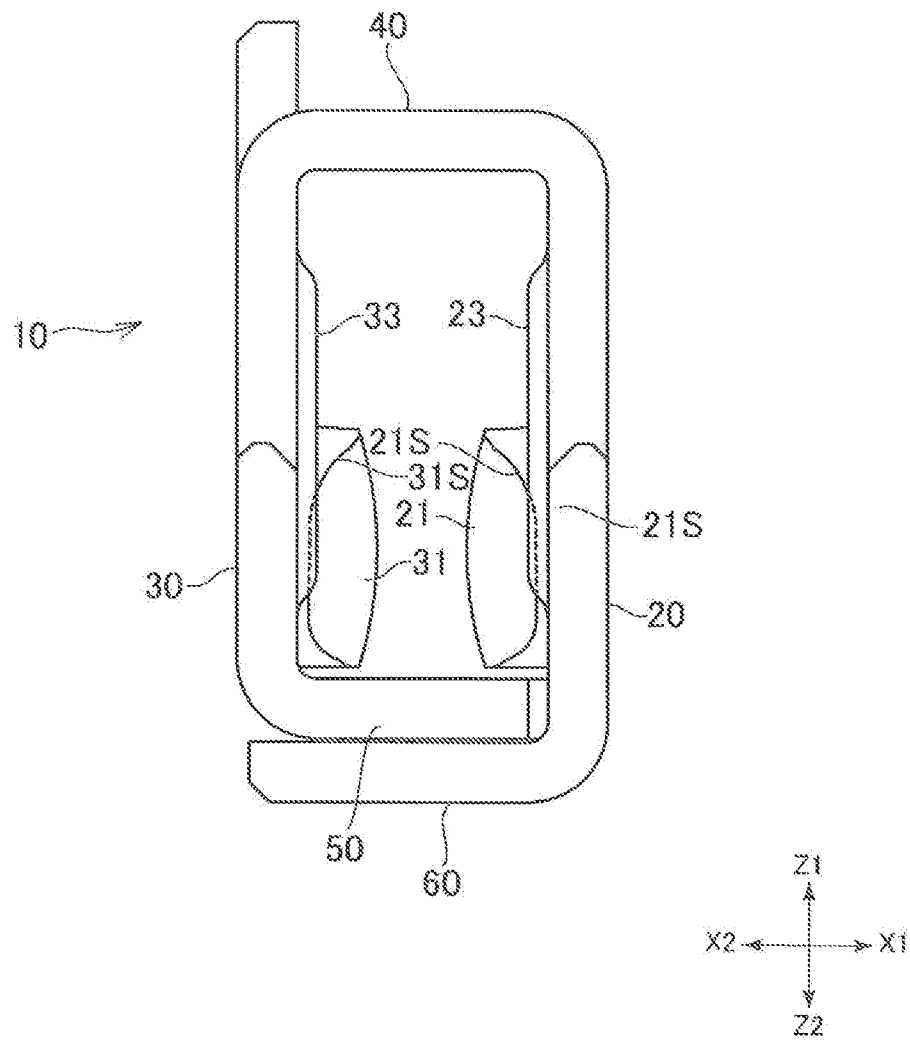


FIG. 4

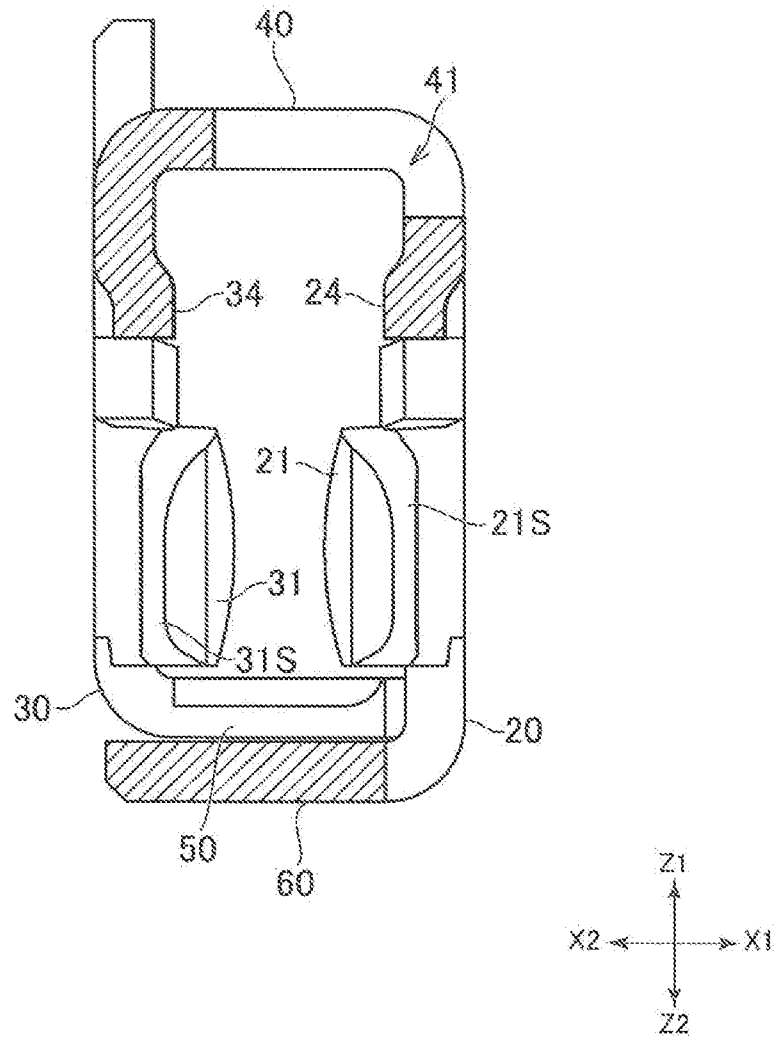


FIG. 5

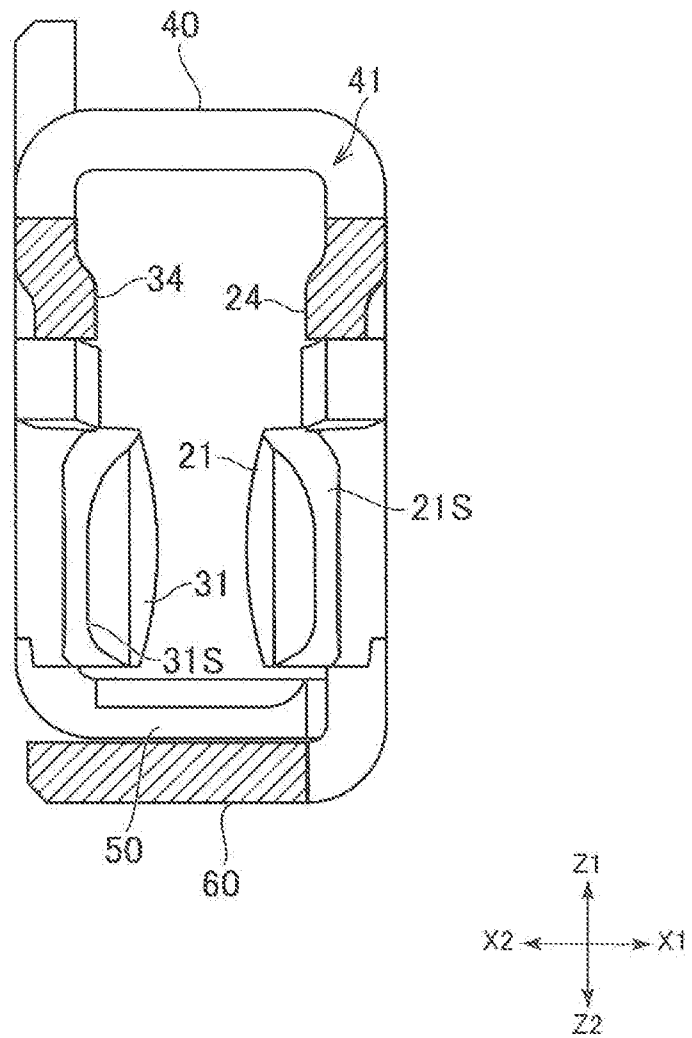


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/064291**A. CLASSIFICATION OF SUBJECT MATTER****H01R 13/11(2006.01)i, H01R 13/187(2006.01)i**

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)

H01R 13/11; H01R 13/115; H01R 13/12; H01R 4/48; H01R 13/187

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords:terminal, slit, spring, protruding portion

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2013-025988 A (SUMITOMO WIRING SYST., LTD.) 04 February 2013 See paragraphs [0018]-[0023], claim 1 and figures 1-6.	1-8
Y	WO 98-16972 A1 (UNITED TECHNOLOGIES AUTOMOTIVE, INC.) 23 April 1998 See abstract, page 4, lines 3-5 and figures 1-4.	1-8
A	US 5868590 A (JORIS DOBBELAERE) 09 February 1999 See abstract, column 4, line 54 - column 6, line 14 and figures 1-3.	1-8
A	US 4076369 A (HAROLD JOSEPH OSTAPOVITCH) 28 February 1978 See abstract, column 2, lines 39-63, column 3, line 54 - column 4, line 51 and figures 4, 12-16.	1-8
A	US 5755599 A (GHEORGHE HOTEA) 26 May 1998 See abstract, column 1, line 65 - column 4, line 35 and figures 1-4.	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 March 2016 (15.03.2016)

Date of mailing of the international search report

15 March 2016 (15.03.2016)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

KIM, Sung Gon

Telephone No. +82-42-481-8746



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/064291

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2013-025988 A	04/02/2013	None	
WO 98-16972 A1	23/04/1998	CN 1206509 A EP 0873580 A1 JP 2000-516030 A US 5890936 A	27/01/1999 28/10/1998 28/11/2000 06/04/1999
US 5868590 A	09/02/1999	EP 0786830 A1	30/07/1997
US 4076369 A	28/02/1978	US 4152042 A	01/05/1979
US 5755599 A	26/05/1998	EP 0750799 A1 EP 0750799 B1 EP 0848454 A2 EP 0848454 A3 EP 0848454 B1 WO 95-25362 A1	15/04/1998 02/09/1998 17/06/1998 08/07/1998 11/10/2006 21/09/1995