US 20070064169A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0064169 A1

Miyazono (43) Pub. Date: Mar. 22, 2007

(54) ELECTRICAL CONNECTOR AND LIQUID CRYSTAL DISPLAY DEVICE

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(21) Appl. No.: **11/511,336**

(22) Filed: **Aug. 29, 2006**

(30) **Foreign Application Priority Data**

Aug. 29, 2005 (JP) JP2005-248118

Publication Classification

(51) **Int. Cl.**
G02F 1/1333 (2006.01)

(52) **U.S. Cl.** **349/58**

(57) **ABSTRACT**

An electrical connector has a contact held by a housing and an operating member for operating the contact. The housing includes an insertion recess into which a shaft-like terminal is inserted in a first direction. A pair of elastic pieces of the contact respectively includes clamp portions for clamping the terminal in predetermined clamping directions orthogonal to the first direction. The first direction is in a radial direction of the terminal. The operating member includes widening operating portions for widening the distance between the clamp portions of the pair of elastic pieces.

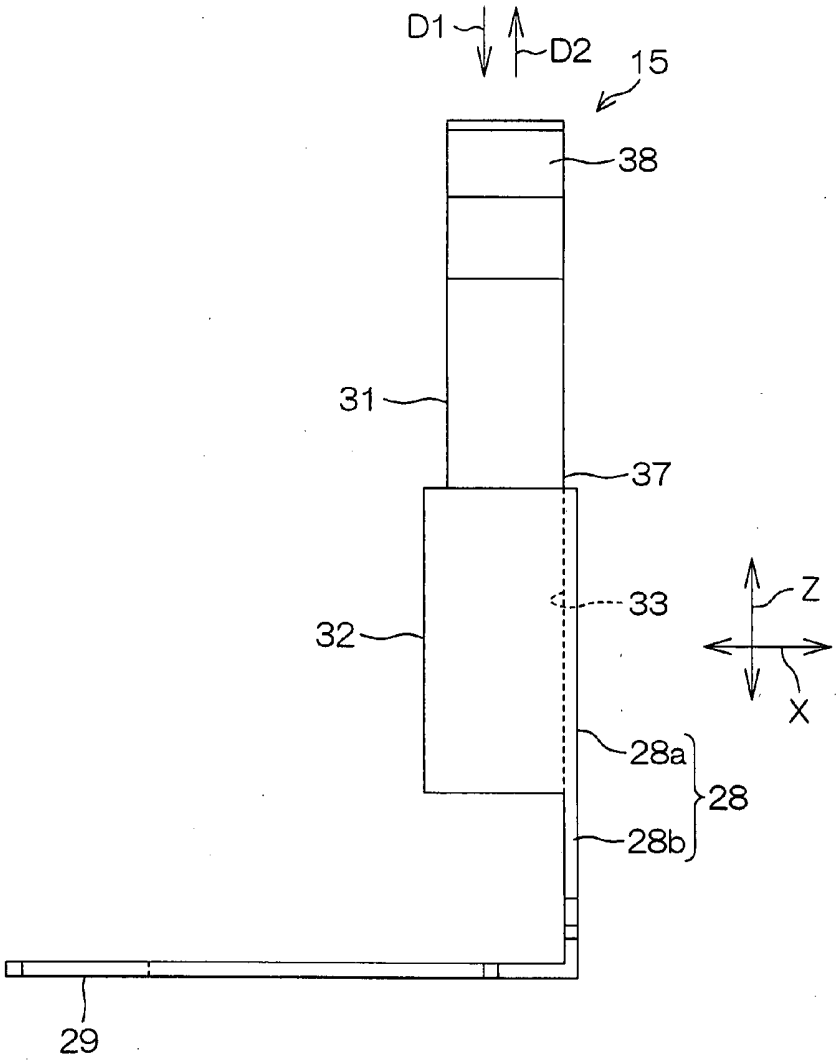
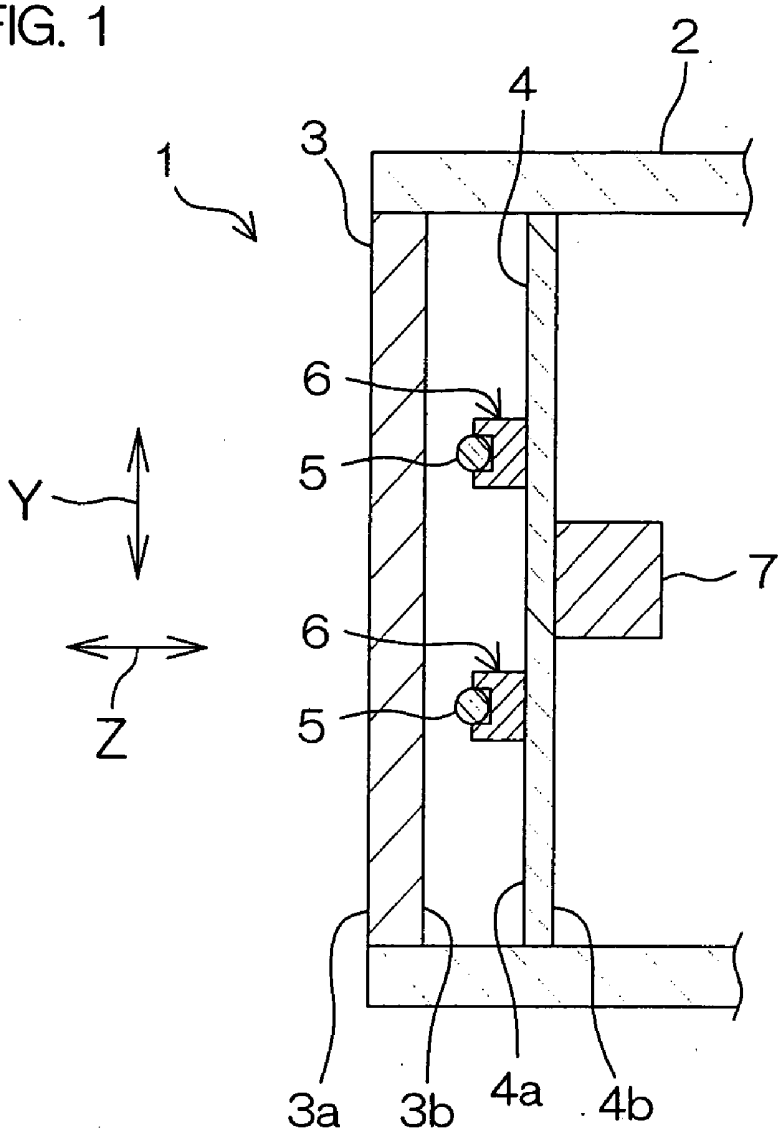


FIG. 1



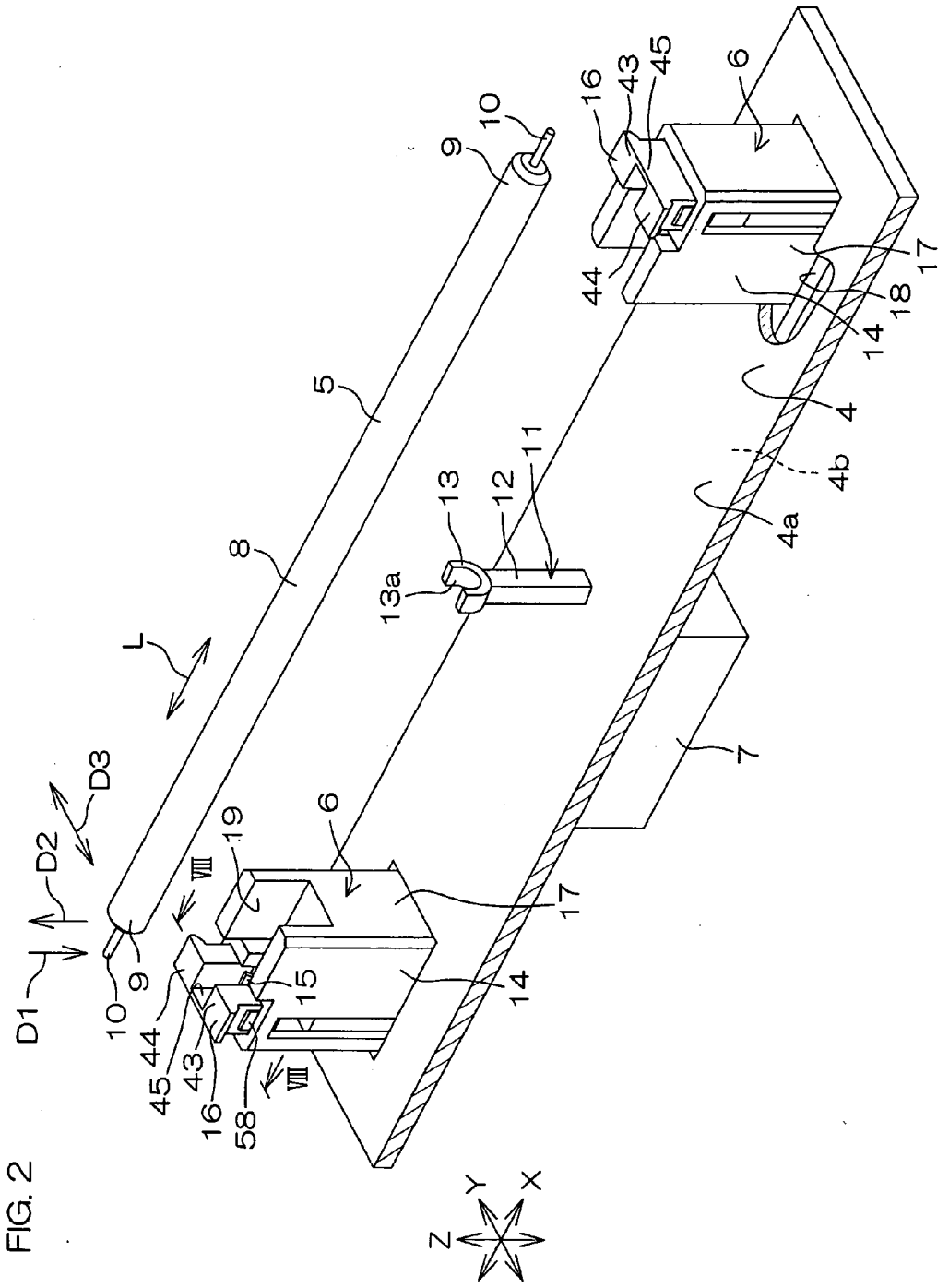

6
16
43
45
10
9
44
17
18
14
4
5
11
12
13
4b
4a
13a
8
L
7
D3
D2
D1
VIII
19
6
17
9
10
15
14
44
43
45
16
58
VIII
Y
X
Z

FIG. 2

FIG. 3

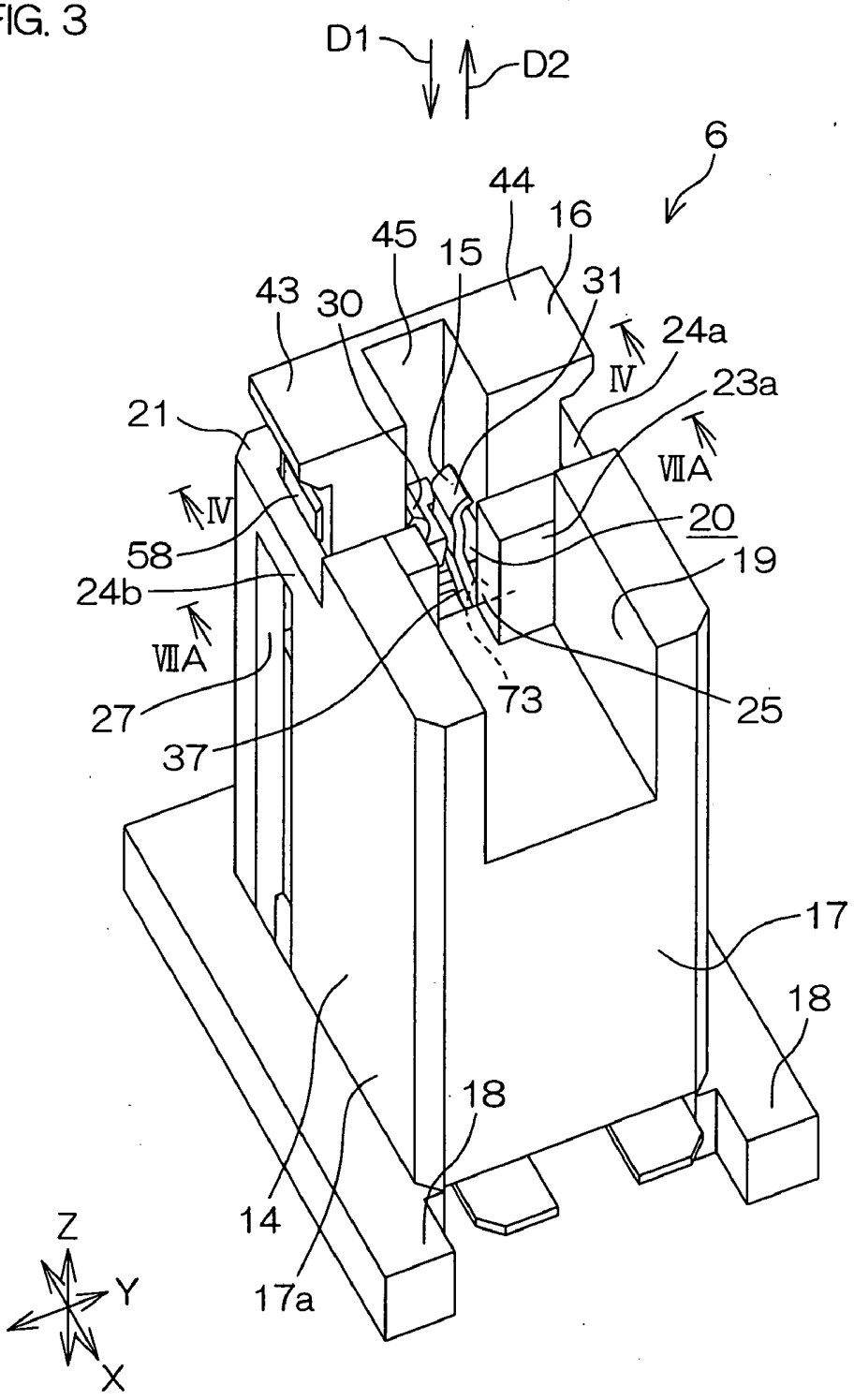

D1
D2
6
44
16
45
15
43
30
31
24a
IV
23a
21
VIIA
IV
20
58
19
24b
VIIA
73
25
27
37
17
18
18
14
17a
Z
Y
X

FIG. 4

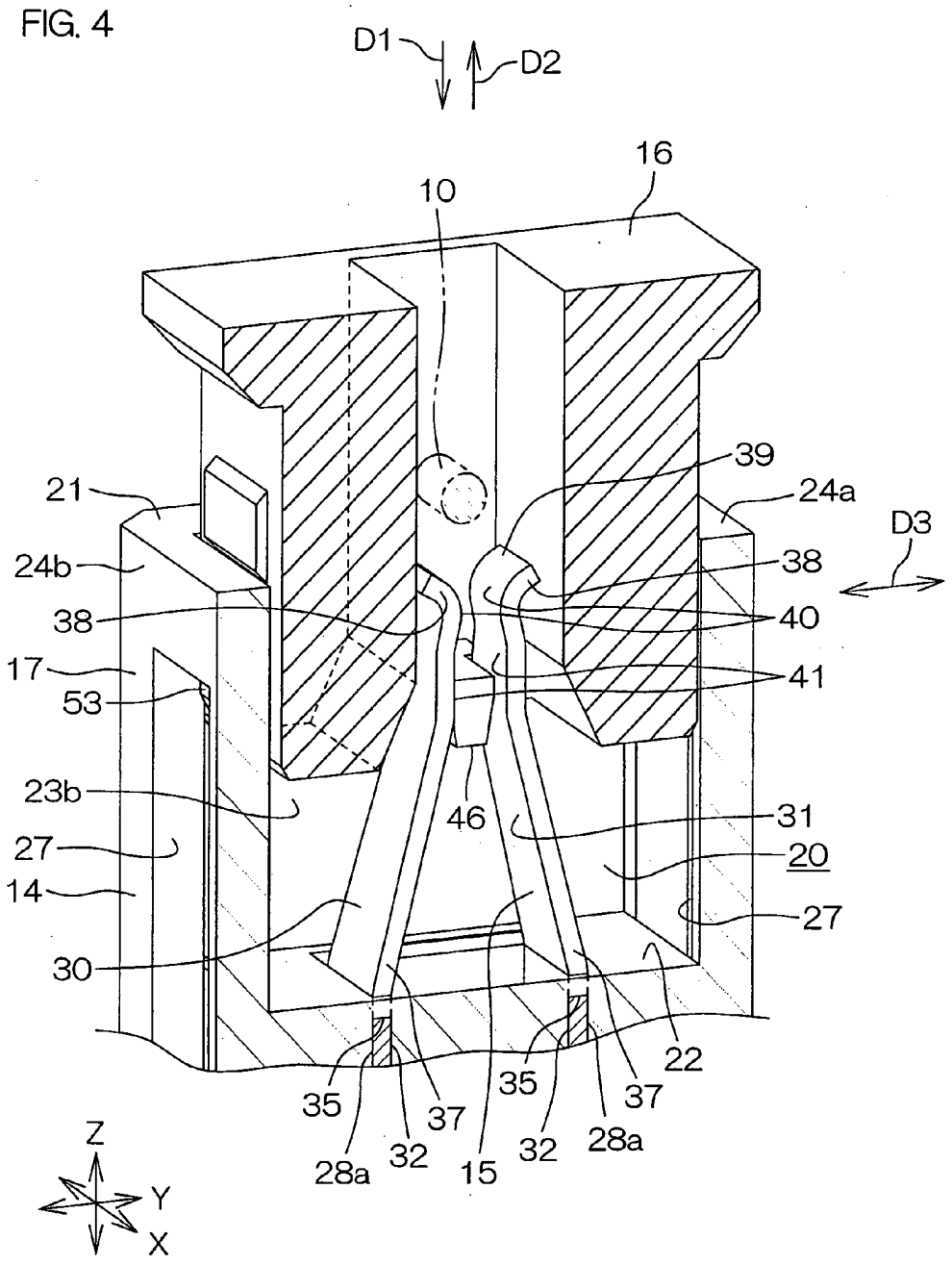
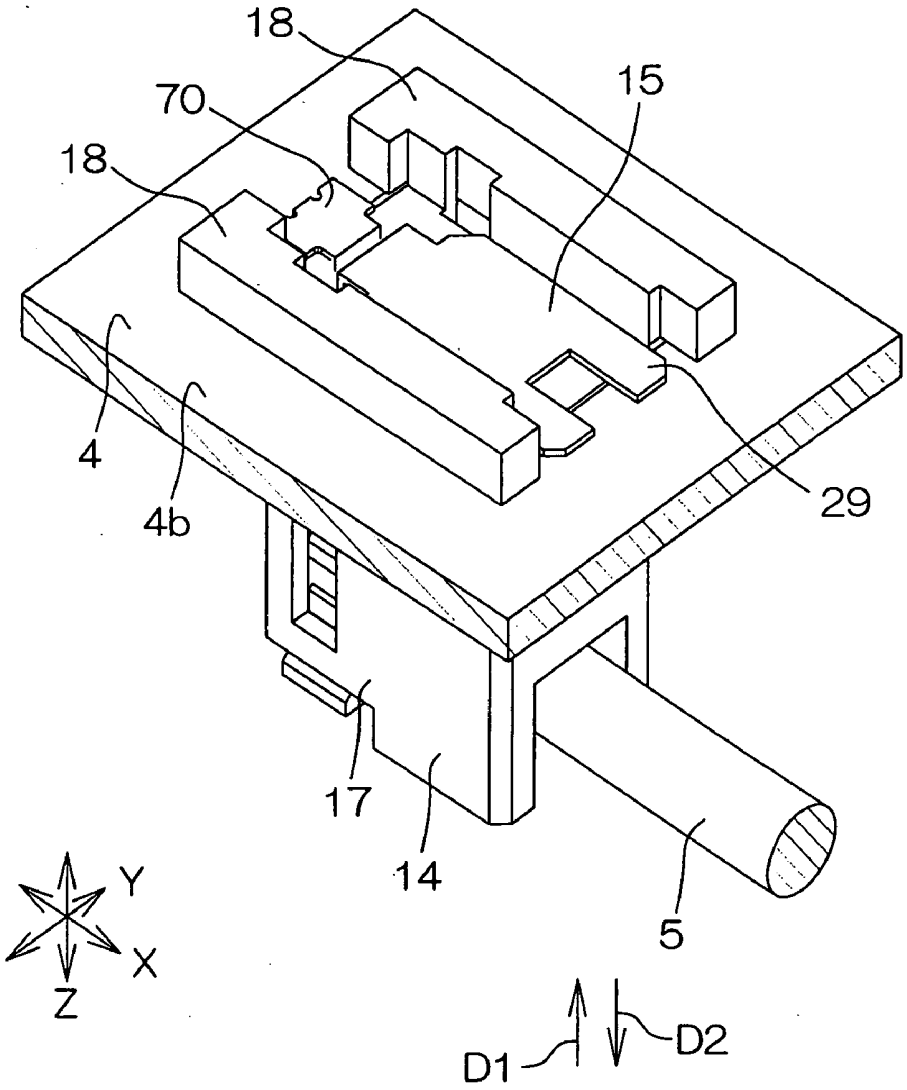

D1
D2
16
10
39
21
24a
D3
24b
38
38
40
17
41
53
23b
46
31
27
20
14
27
30
22
35
37
35
37
28a
32
15
32
28a
Z
Y
X

FIG. 5



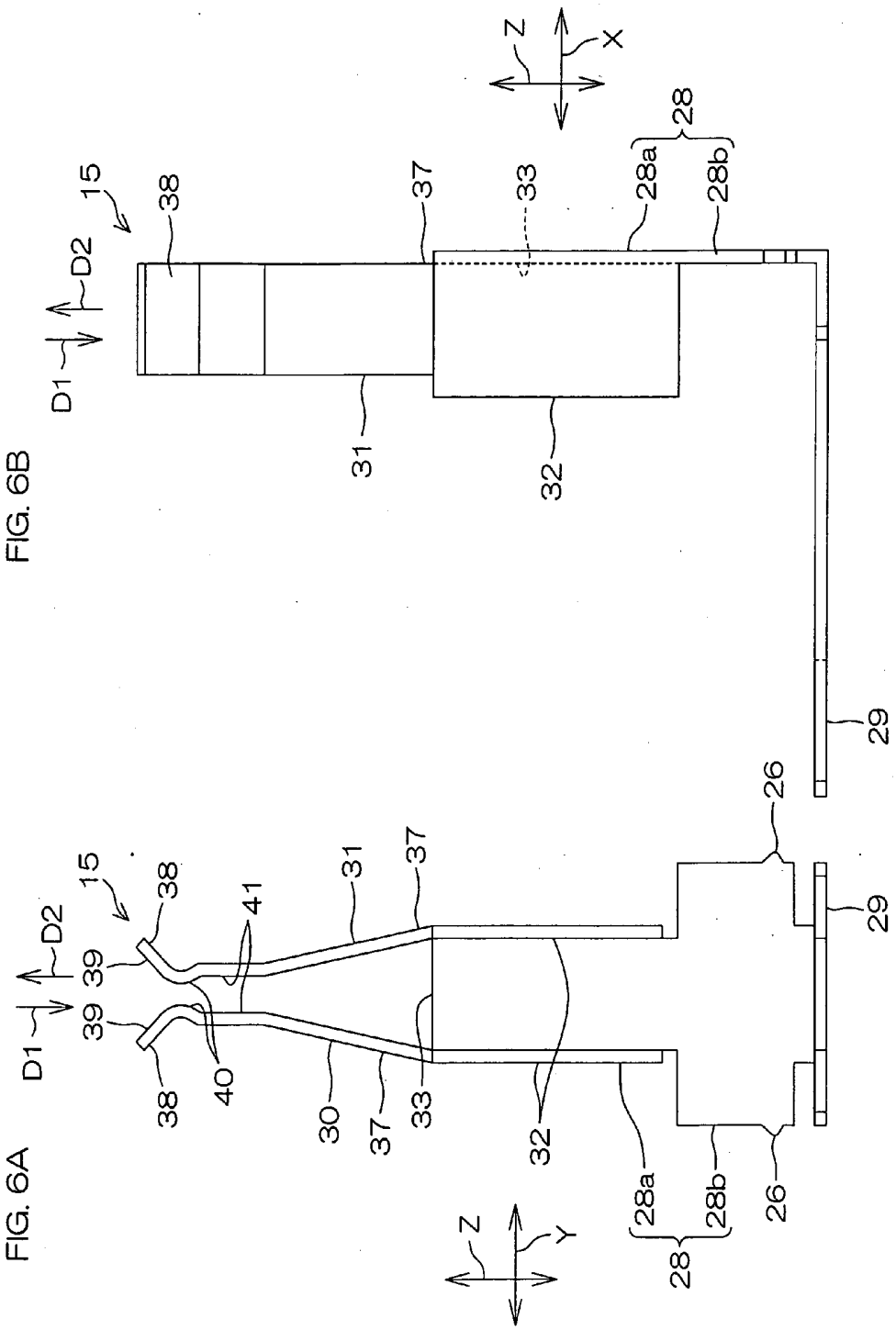


FIG. 6B

FIG. 6A

FIG. 7A

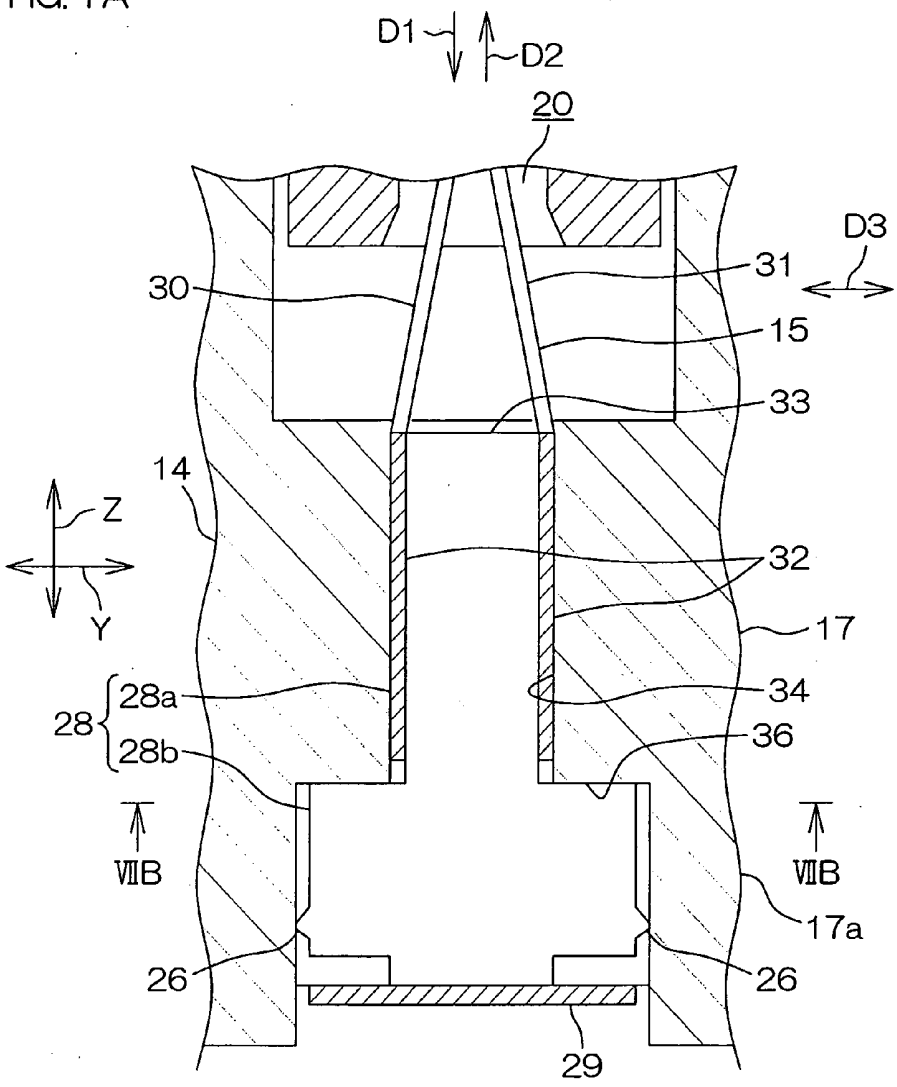

D1
D2
20
D3
31
30
15
33
14
Z
32
Y
17
28a
34
28
28b
36
VIIB
VIIB
17a
26
26
29

FIG. 7B

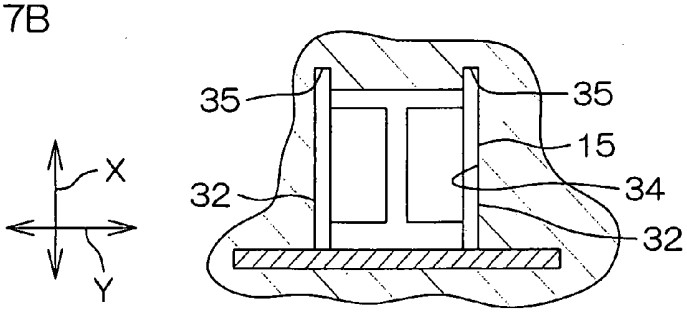
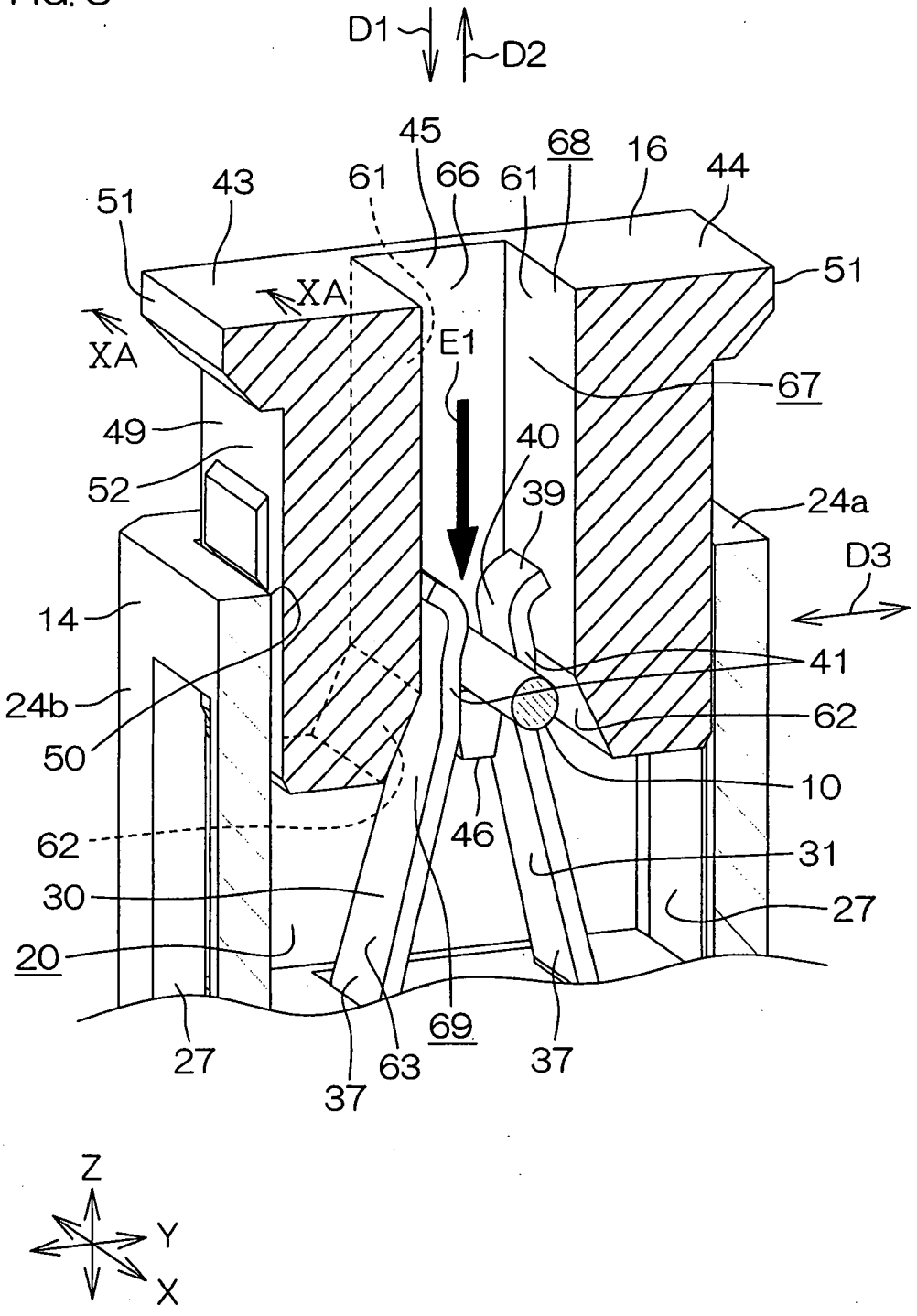

35
35
15
X
32
34
32
Y

FIG. 8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D2
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16
44
43
61
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61
51
51
XA
XA
E1
67
49
40
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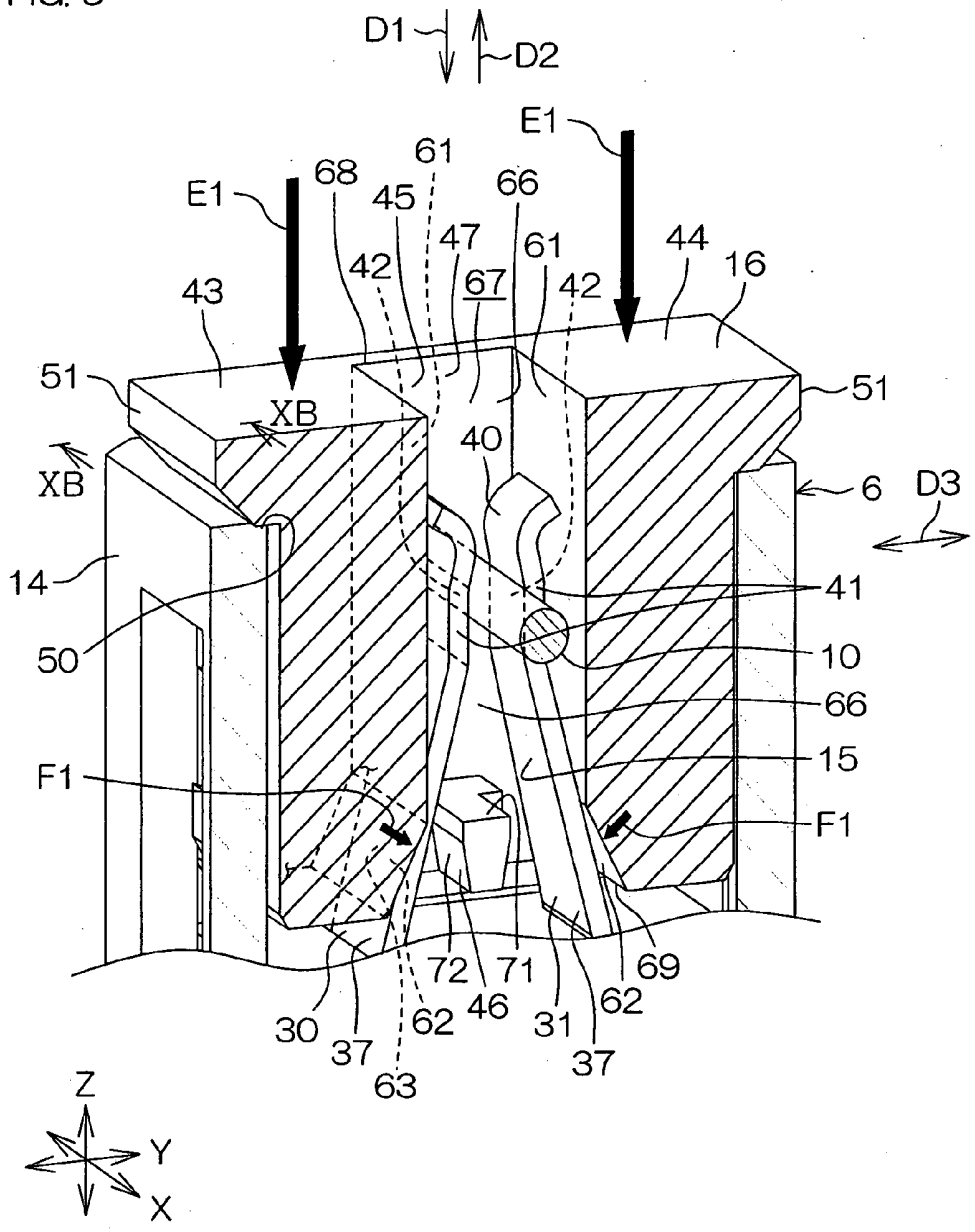
39
24a
D3
14
41
24b
62
50
10
46
62
31
30
27
20
69
27
63
37
37
Z
Y
X

FIG. 9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D2
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E1
E1
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61
44
16
43
42
67
42
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51
XB
XB
40
6
D3
14
41
50
10
66
F1
15
F1
72
71
69
30
37
62
46
31
62
37
63
Z
Y
X

FIG. 10A

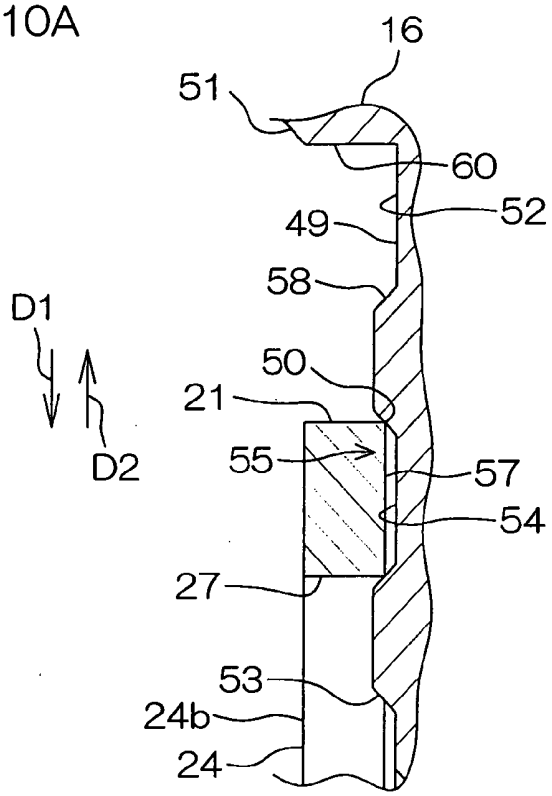


FIG. 10B

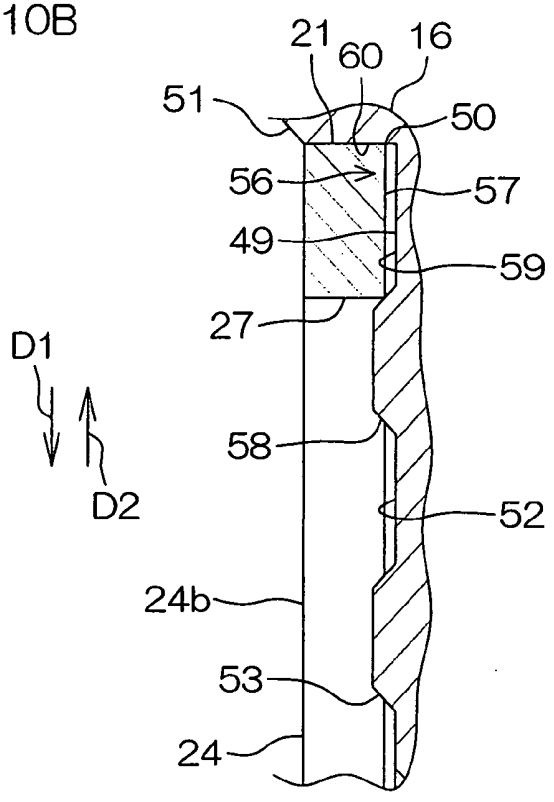


FIG. 11

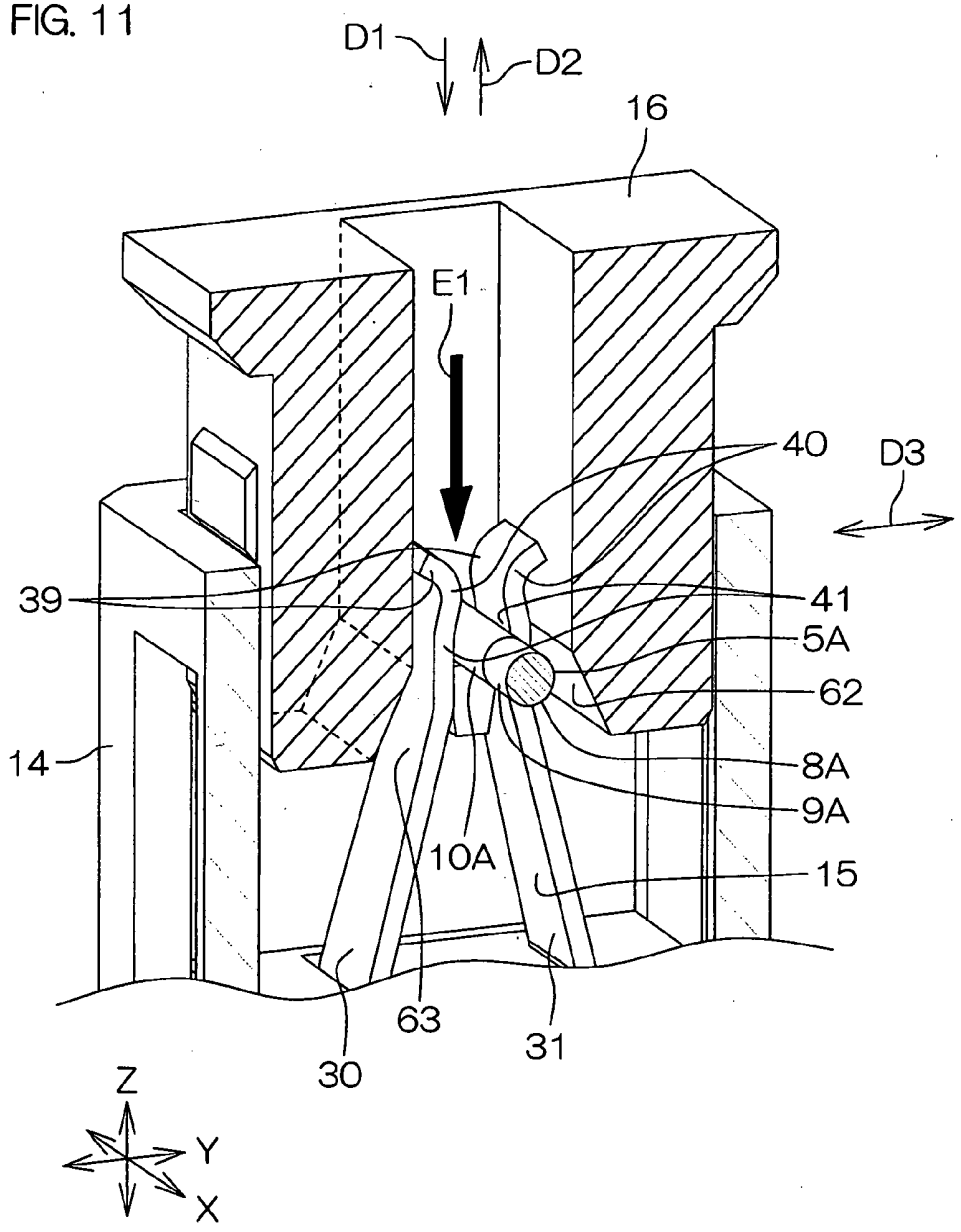


FIG. 12

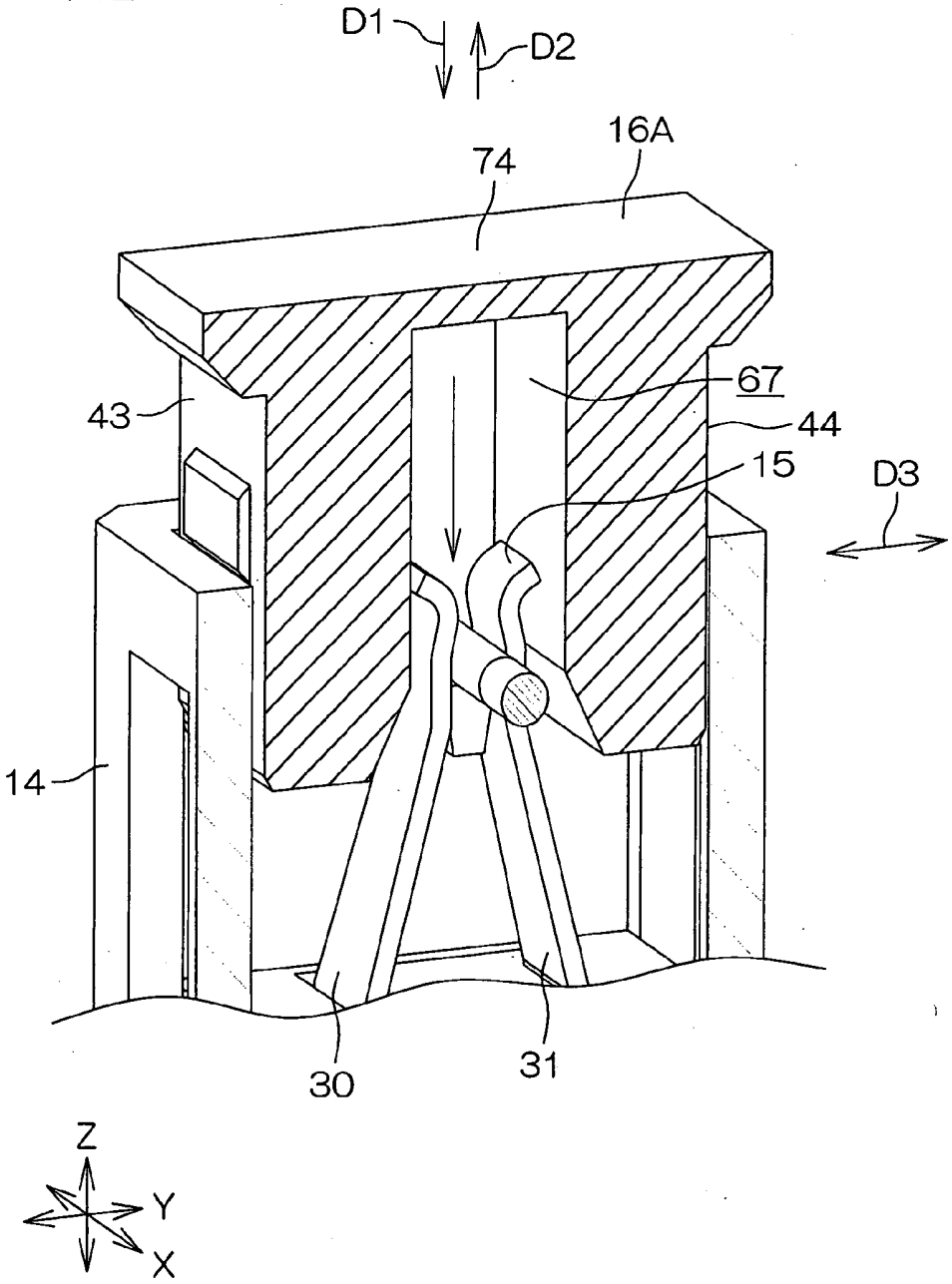


FIG. 13

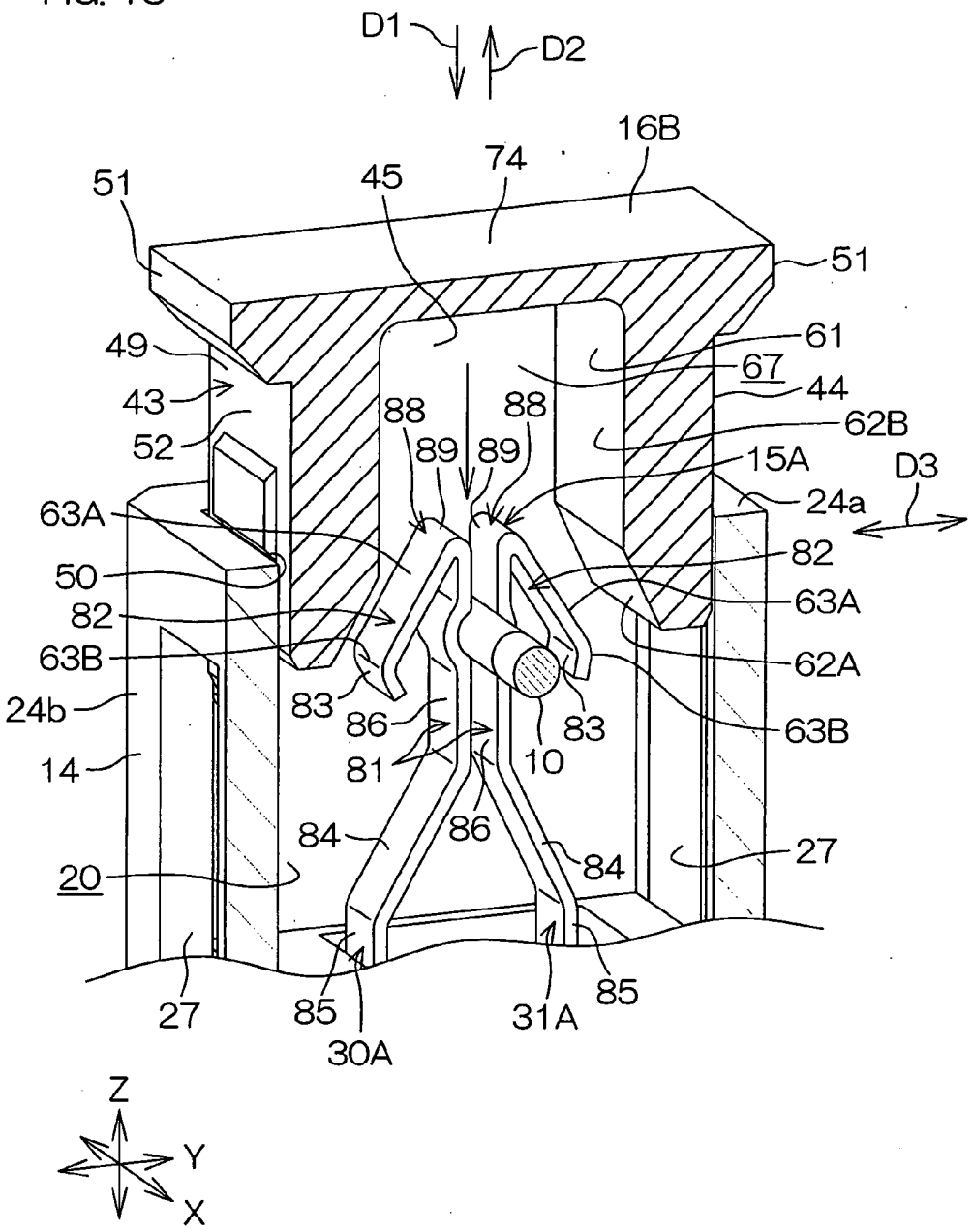

D1
D2
16B
74
45
51
51
49
61
67
44
43
88
88
62B
52
89
89
15A
D3
24a
63A
82
50
63A
82
62A
63B
24b
83
86
83
63B
14
81
10
84
86
84
27
20
27
85
85
31A
30A
Z
Y
X

FIG. 14A

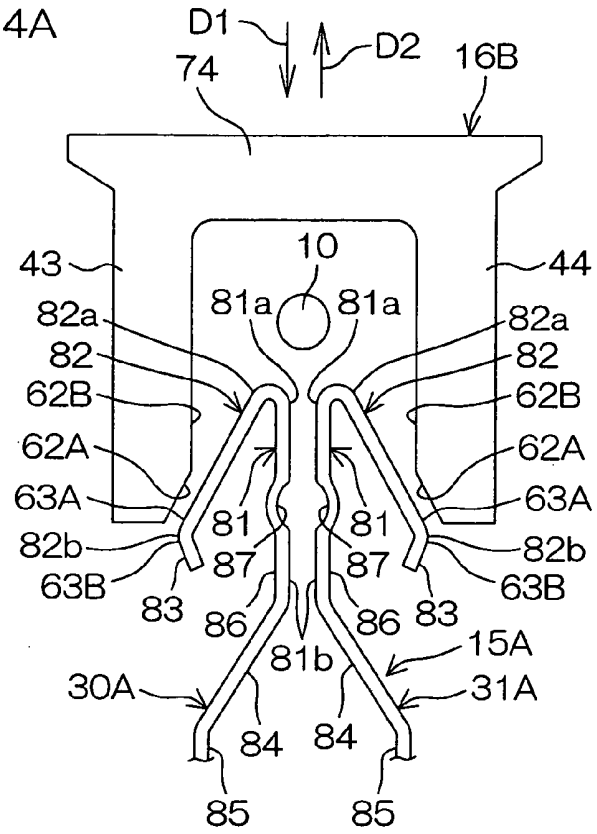


FIG. 14B

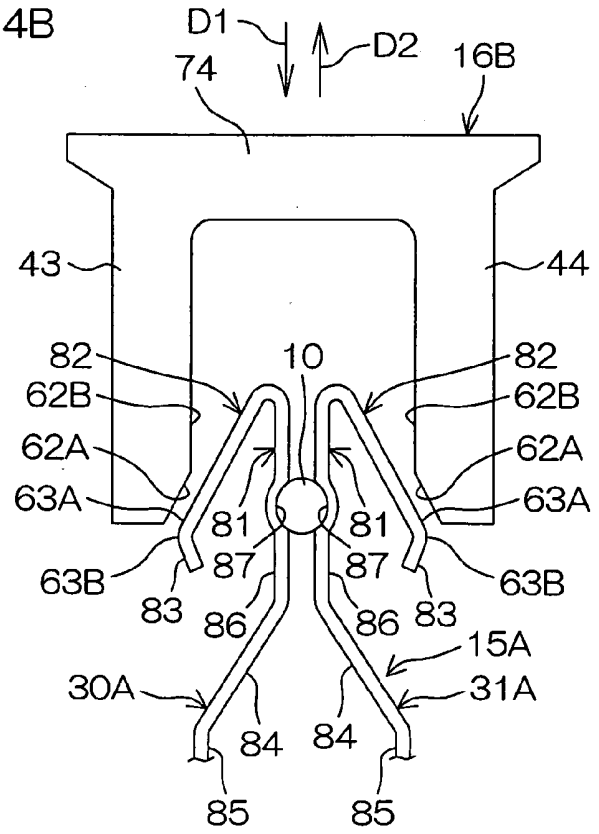


FIG. 15A

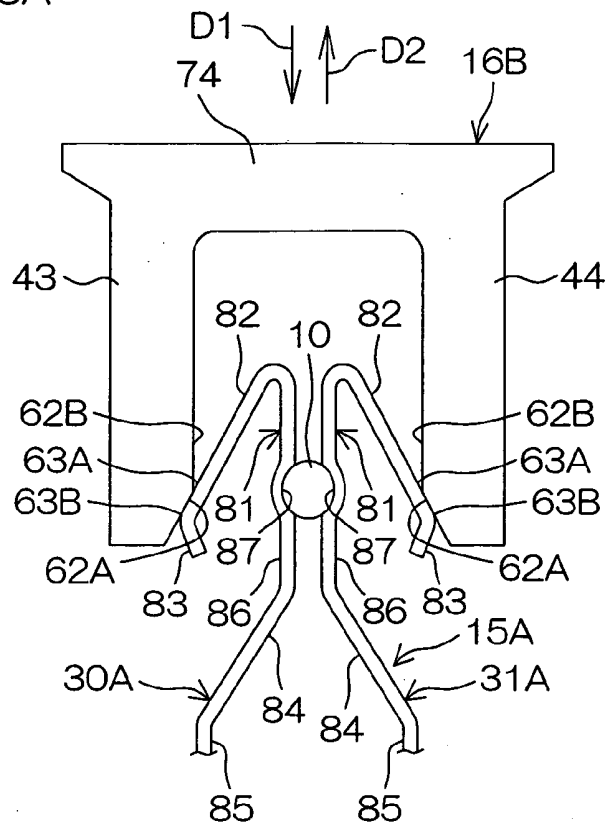
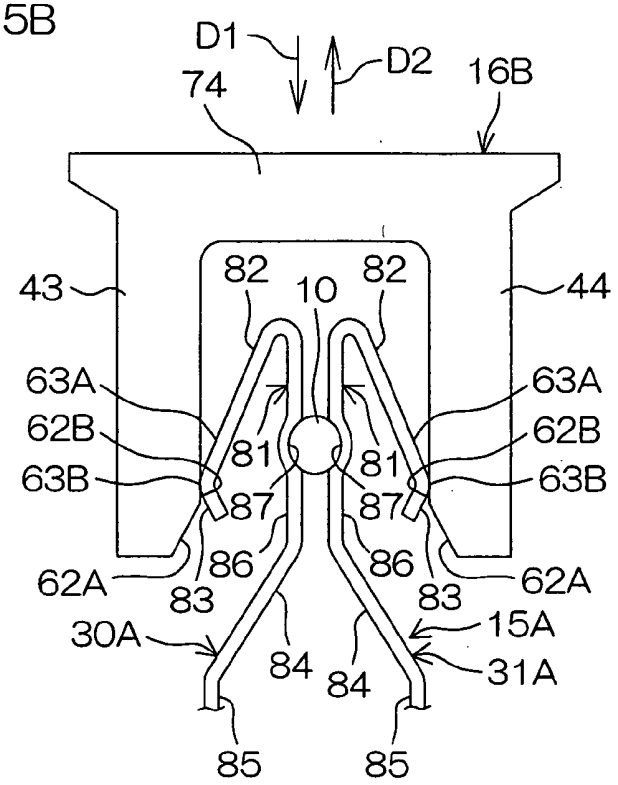


FIG. 15B



ELECTRICAL CONNECTOR AND LIQUID CRYSTAL DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an electrical connector which is connected to a fluorescent tube, etc., and a liquid crystal display device including the same.

[0003] 2. Description of Related Arts

[0004] For example, as a connecting structure of a terminal of a fluorescent tube such as a cold cathode fluorescent tube to be used as a backlight of a liquid crystal display type television or a monitor, the following documents 1 and 2 have been proposed:

Document 1: Japanese Unexamined Patent Publication No. 2001-250605 (date of publication: Sep. 14, 2001)

Document 2: Japanese Unexamined Patent Publication No. 2004-259645 (date of publication: Sep. 16, 2004)

[0005] In the documents 1 and 2, a connection fitting fixed to one end of an electric wire is soldered to a terminal (electrode) of a cold cathode fluorescent tube. The other end of the electric wire is connected to an inverter circuit via a connector. Electric power from the inverter circuit is supplied to the cold cathode fluorescent tube via the connector and the electric wire.

[0006] However, in the documents 1 and 2, a continuity failure may occur between the terminal and the connection fitting due to defective soldering. In addition, the soldering is troublesome. In particular, the cold cathode fluorescent tube has a thin shape with a diameter of several millimeters, and the terminal is thinner than this, so that handling of these requires great care. Therefore, enormous labor is required for soldering.

[0007] Not only the case of using a cold cathode fluorescent tube but also cases of using other fluorescent tubes such as an external electrode fluorescent tube or using a shaft-like terminal other than the fluorescent tubes also have a similar problem.

[0008] An object of the present invention is to provide an electrical connector that realizes reliable and easy connection of a shaft-like terminal and a liquid crystal display device including the same.

SUMMARY OF THE INVENTION

[0009] According to a preferred mode of the present, invention, an electrical connector includes an insulating housing, a contact held by the housing, and an operating member for operating the contact. The housing includes an insertion recess into which a shaft-like terminal is inserted in a first direction. The contact includes a pair of elastic pieces facing each other. At least a portion of the pair of elastic pieces is exposed to the insertion recess. Each elastic piece is in a cantilevered shape having a base end portion and a tip end portion. The pair of elastic pieces is inclined with respect to the first direction so as to make a distance between the tip end portions narrower than a distance between the base end portions. The pair of elastic pieces has clamp portions, respectively, for clamping the terminal in predetermined clamping directions orthogonal to the first direction. The first direction is in a radial direction of the terminal. The operating member includes a widening operating portion for widening a distance between the clamp portions of the pair of elastic pieces.

[0010] According to the mode, while the distance between the clamp portions of the pair of elastic pieces of the contact are widened by the widening operating portion of the operating member, the terminal can be readily inserted between the clamp portions in their diameter directions. Next, by releasing the widening operation by the widening operating portion, the terminal is elastically clamped between the clamp portions. Thereby, a predetermined contact pressure is generated between the contact and the terminal, and as a result, electrical connection between the contact and the terminal can be reliably performed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a schematic sectional view showing a general construction of a liquid crystal display device including an electrical connector according to an embodiment of the present invention;

[0012] FIG. **2** is an exploded perspective view of a main part of the liquid crystal display device;

[0013] FIG. **3** is a perspective view of an electrical connector;

[0014] FIG. **4** is a sectional view of a main part in the IV-IV line of FIG. **3**;

[0015] FIG. **5** is a partially broken perspective view of a main part of the liquid crystal display device, showing a state observed from a second surface side of a circuit board;

[0016] FIG. **6**A is a front view of a contact, and FIG. **6**B is a right side view of the contact of FIG. **6**A;

[0017] FIG. **7**A is a sectional view in the VIIA-VIIA line of FIG. **3**, and FIG. **7**B is a sectional view of a main part in the VIIB-VIIB line of FIG. **7**A;

[0018] FIG. **8** is a sectional view in the VIII-VIII line of FIG. **2**, showing a state that the contact is widened;

[0019] FIG. **9** is a sectional view in the VIII-VIII line of FIG. **2**, showing a state that widening of the contact is released;

[0020] FIG. **10**A is a sectional view in the XA-XA line of FIG. **8**, and FIG. **10**B is a sectional view in the XB-XB line of FIG. **9**;

[0021] FIG. **11** is a partially broken perspective view of a main part of an electrical connector according to another embodiment of the present invention; and

[0022] FIG. **12** is a partially broken perspective view of a main part of an electrical connector according to still another embodiment of the present invention.

[0023] FIG. **13** is a partially sectional perspective view of an electrical connector according to another embodiment of the present invention;

[0024] FIG. **14**A and FIG. **14**B are schematic diagrams which show sequential using processes of the electrical connector in FIG. **13**.

[0025] FIG. 15A and FIG. 15B are schematic diagrams which show sequential using processes of the electrical connector directly after the process in FIG. 14B;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0026] A preferred embodiment of the present invention will be described with reference to the accompanying drawings.

[0027] FIG. 1 is a schematic sectional view showing a general construction of a liquid crystal display device including an electrical connector according to an embodiment of the present invention. Referring to FIG. 1, the liquid crystal display device 1 is used as, for example, a monitor of a television or a personal computer.

[0028] The liquid crystal display device 1 includes a casing 2, a liquid crystal panel 3, a circuit board 4, a plurality of cold cathode fluorescent tubes 5 as fluorescent tubes, electrical connectors 6 (hereinafter, can be simply referred to as connectors), and an inverter circuit 7.

[0029] The liquid crystal panel 3 is a non light-emitting display panel, and is attached to an opening on the front of the casing 2. The front face 3*a* of the liquid crystal panel 3 faces forward of the casing 2, and the back face 3*b* thereof faces rearward of the casing 2.

[0030] The circuit board 4 is a plate-shaped member disposed parallel to the liquid crystal panel 3 and fixed to the casing 2, and includes a first surface 4*a* facing the back face 3*b* of the liquid crystal panel 3 and a second surface 4*b* on the opposite side of the first surface 4*a*.

[0031] A plurality (two cold cathode fluorescent tubes 5 are shown in FIG. 1) of cold cathode fluorescent tubes 5 serve as a backlight of the liquid crystal panel 3, and are disposed between the back face 3*b* of the liquid crystal panel 3 and the first surface 4*a* of the circuit board 4. The number of cold cathode fluorescent tubes 5 is, for example, 2 per 1 inch of the liquid crystal panel 3.

[0032] As shown in FIG. 2, the longitudinal direction L of each cold cathode fluorescent tube 5 is in the direction X (corresponding to the left and right direction of the casing 2: the direction perpendicular to the sheet surface in FIG. 1). Referring to FIG. 1, each cold cathode fluorescent tube 5 is disposed at predetermined intervals in the direction Y (corresponding to the vertical direction of the casing 2). Each cold cathode fluorescent tube 5 is parallel to the back face 3*b* of the liquid crystal panel 3. Each respective cold cathode fluorescent tube 5 and the liquid crystal panel 3 are spaced at a predetermined distance in the direction Z (corresponding to the lateral direction of the casing 2). Each cold cathode fluorescent tube 5 irradiates the liquid crystal panel 3 with light from the rear side.

[0033] The electrical connector 6 is for realizing electrical connection between the cold cathode fluorescent tubes 5 and the circuit board 4 (and eventually the inverter circuit 7). This connector 6 is attached to each pair of ends of the respective cold cathode fluorescent tube 5 between the back face 3*b* of the liquid crystal panel 3 and the first surface 4*a* of the circuit board 4. The respective connectors 6 are attached to the circuit board 4.

[0034] The inverter circuit 7 is for supplying driving power to the cold cathode fluorescent tubes 5, and is attached to the second surface 4*b* of the circuit board 4. The inverter circuit 7 and the respective cold cathode fluorescent tubes 5 are electrically connected to each other via the circuit board 4 and corresponding connectors 6.

[0035] The attaching structures of the respective cold cathode fluorescent tubes 5 are the same, so that the attaching structure of one cold cathode fluorescent tube 5 will be mainly described below.

[0036] Referring to FIG. 2, the cold cathode fluorescent tube 5 includes a cylindrical main body 8 extending straight in the direction X, and outer leads 10 and 10 (electrodes) as a pair of terminals provided on a pair of end portions 9 and 9 of the main body 8, respectively. The respective outer leads 10 as terminals project in the longitudinal direction L from the corresponding end portions 9 of the main body 8.

[0037] The main body 8 is a member made of, for example, glass with a diameter of several millimeters through several tens of millimeters. The pair of outer leads 10 and 10 are metal-made shaft-like conductive members made of soft iron, etc., and are exposed in the direction X from the respective corresponding end portions 9. These outer leads 10 have a diameter of, for example, approximately 1 millimeter and a length of several millimeters.

[0038] A clamping member 11 is provided for holding the cold cathode fluorescent tube 5 and supporting the weight of the cold cathode fluorescent tube 5. One or a plurality (one in this embodiment) of clamping members 11 are provided for each cold cathode fluorescent tube 5. The number of clamping members 11 is properly determined according to the length of the cold cathode fluorescent tube 5. The clamping member 11 is arranged at a middle portion of the main body 8 of the cold cathode fluorescent tube 5 with respect to the direction X.

[0039] This clamping member 11 is, for example, a synthetic resin molded item, and includes a support column 12 and an arced holder 13. The support column 12 is fixed to the first surface 4*a* of the circuit board 4 and extends in the direction Z. The holder 13 holds the middle portion of the main body 8 of the cold cathode fluorescent tube 5 while restraining radial (in the directions Y and Z in FIG. 2) movements of the cold cathode fluorescent tube 5.

[0040] This holder 13 is in an arced shape that can surround a portion slightly longer than a peripheral half of the main body 8 of the cold cathode fluorescent tube 5. In a portion in the peripheral direction of the holder 13, an opening 13*a* in which the main body 8 of the cold cathode fluorescent tube 5 is inserted is formed.

[0041] In the opening 13*a*, the middle portion in the longitudinal direction L of the main body 8 of the cold cathode fluorescent tube 5 is inserted and held in a first direction D1 as an attaching direction corresponding to the radial direction of the cold cathode fluorescent tube 5 to the connectors 6. The opening 13*a* is open to a second direction D2 (corresponding to a removing direction of the cold cathode fluorescent tube 5 from the connectors 6) opposite to the first direction D1.

[0042] The connector 6 is provided on the pair of end portions 9 and 9, respectively, of the main body 8 of the cold

cathode fluorescent tube **5** as described above. The constructions of the respective connectors **6** are the same, so that one connector **6** will be mainly described below.

[**0043**] Referring to FIG. **2** and FIG. **3**, the connector **6** has lengths of 10 through 15 millimeters in the directions X, Y and Z, respectively, and includes a housing **14**, a contact **15** held by this housing **14**, and an operating member **16**; for operating this contact **15**.

[**0044**] The housing **14** is an integrally molded item made of a synthetic resin, and has a main body **17** and seating portions **18** extended from the main body **17**.

[**0045**] The main body **17** is generally shaped into a box. In the circuit board **4**, a through hole is formed at the place where the connector **6** is disposed, and through this through hole, the main body **17** projects from the first surface **4***a* to the back face **3***b* (see FIG. **1**) of the liquid crystal panel **3**.

[**0046**] Referring to FIG. **2** and FIG. **3** again, at an end portion in the second direction D2 of the main body **17**, an introducing groove **19** having a U-shaped or a groove-shaped section is formed. Into the introducing groove **19**, a corresponding end portion **9** of the cold cathode fluorescent tube **5** can be introduced. The end portion **9** of the cold cathode fluorescent tube **5** introduced into the introducing groove **19** is protected by being surrounded by the inner surface of the introducing groove **19**.

[**0047**] Referring to FIG. **3** ad FIG. **4**, at the end portion in the second direction D2 of the main body **17**, an insertion recess **20** is provided. Into the insertion recess **20**, an outer lead **10** as a terminal of the cold cathode fluorescent tube **5** is inserted in the first direction D1 as the attaching direction.

[**0048**] The insertion recess **20** is demarcated by a peripheral wall **21** and a bottom wall **22** and has a rectangular section, and functions as a receiving cavity for receiving the outer lead **10**. The peripheral wall **21** includes a pair of first side portions **23***a* and **23***b* facing each other in the direction X and a pair of second side portions **24***a* and **24***b* facing each other in the direction Y.

[**0049**] One first side portion **23***a* is adjacent to the introducing groove **19**, and divides between the introducing groove **19** and the insertion recess **20**. In the first side portion **23***a*, at the center in the direction Y, a notched groove **25** is provided. Into the notched groove **25**, a corresponding outer lead **10** can be inserted.

[**0050**] In the second side portions **24***a* and **24***b*, through holes **27** are formed, respectively. The respective through holes **27** extend in the direction Z, and in the through holes, first and second convex portions **53** and **58** described later of the operating member **16** are inserted.

[**0051**] The seating portions **18** are a pair of flange portions provided on the end portion **17***a* of the main body **17** in the first direction D1. The seating portions **18** are disposed on the pair of end portions in the direction Y of the main portion **17**, respectively, and extend longitudinally in the direction X. Referring to FIG. **5**, the respective seating portions **18** are in contact with and received by the second surface **4***b* of the circuit board **4**. Thereby, the position of the housing **14** in the direction Z with respect to the circuit board **14** is determined. A metal-made reinforcement member **70** attached to the main body **17** of the housing **14** is fixed to the second surface **4***b* of the circuit board **4**.

[**0052**] Referring to FIG. **2**, FIG. **6**A, and FIG. **6**B, the contact **15** is, for example, a conductive member made of a metal, etc. In detail, the contact **15** is a sheet metal member. The contact **15** is electrically connected to the outer lead **10** of the cold cathode fluorescent tube **5** attached in the first direction D1. By the contact **15**, electrical connection between the outer lead **10** and the circuit board **4** is realized.

[**0053**] Referring to FIG. **6**A, FIG. **6**B, FIG. **7**A, and FIG. **7**B, the contact **15** is symmetrical to the direction Y, and has a main body **28**, a lead **29**, and a pair of elastic pieces **30** and **31** facing each other. The main body **28** extends longitudinally in the direction Z, and has a first portion **28***a* and a second portion **28***b*.

[**0054**] The first portion **28***a* has a U-shaped section orthogonal to the direction Z, and a pair of portions facing each other of the U shape is formed into flange portions **32**. In the first portion **28***a*, the section sandwiched by the flange portions **32** is defined as an intermediate portion **33**.

[**0055**] The second portion **28***b* extends to the second direction D2 side from the intermediate portion **33** of the first portion **28***a*, and is in a roughly rectangular shape relatively long in the direction Y and relatively short in the direction Z. The second portion **28***b* projects toward both sides of the direction Y with respect to the first portion **28***a*. Each of the pair of edges of the second portion **28***b* is provided with a projection **26** for press-fitting and engaging with the housing **14**.

[**0056**] The main body **28** is press-fitted in and fixed to an insertion hole **34** formed in the main body **17** of the housing **14**. The insertion hole **34** extends in the direction Z to the insertion recess **20** from the end portion **17***a* in the second direction D2 of the main body **17** of the housing **14**. The peripheral surface of the insertion hole **34** surrounds the main body **28** of the contact **15**.

[**0057**] On the peripheral surface of the insertion hole **34**, a pair of engaging grooves **35** and **35** that engage with the pair of flange portions **32**, respectively, are formed. The engaging grooves **35** extend in the direction Z, and in the engaging grooves **35**, the first portion **28***a* of the main body **28** of the contact **15** can be inserted. The pair of engaging grooves **35** end before the insertion recess **20** so as to prevent the first portion **28***a* of the main body **28** from projecting to the insertion recess **20** as shown in FIG. **4**.

[**0058**] Referring to FIG. **6**A, FIG. **6**B, FIG. **7**A, and FIG. **7**B again, the second portion **28***b* is inserted into the insertion hole **34**, and the main body **28** is press-fitted and fixed to the housing **14** by pressure contact between the peripheral surface of the insertion hole **34** and the respective projections **26** of the second portion **28***b*. The second portion **28***b* is received by a stepped portion **36** of the insertion hole **34**, and thereby, the contact **15** is positioned in the direction Z with respect to the housing **14**.

[**0059**] Referring to FIG. **5**, FIG. **6**A, and FIG. **6**B, the lead **29** comes into contact with the second surface **4***b* of the circuit board **4** and realizes electrical connection between the circuit board **4** and the contact **15**. This lead **29** is provided on the tip end portion of the second portion **28***b* of the main body **28**, extends to one side of the direction X, and is parallel to the second surface **4***b*. The lead **29** and the second surface **4***b* of the circuit board **4** are in contact with

each other. The lead **29** is soldered to the circuit board **4** and connected to the inverter circuit via the circuit board **4**.

[**0060**] Referring to FIG. **4** and FIG. **6**A, a pair of elastic pieces **30** and **31** is electrically connected to a corresponding outer lead **10**, respectively. The pair of elastic pieces **30** and **31** faces each other in the direction Y. The pair of elastic pieces **30** and **31** are disposed on the second direction D**2** side with respect to the corresponding flange portions **32** and extend so as to project to the insertion recess **20**, and almost the entirety thereof are exposed to the insertion recess **20**.

[**0061**] It is also possible that only a part of the pair of elastic pieces **30** and **31** is exposed to the insertion recess **20**. The pair of elastic pieces **30** and **31** bends and deform around their base end portions **37**, and as a result, the tip end portions **38** and **38** of the pair of elastic pieces **30** and **31** can elastically come close to or apart from each other.

[**0062**] Each of the pair of elastic pieces **30** and **31** is in a cantilevered shape having the base end portion **37** and the tip end portion **38**. In a free state (a state without an external force applied), when the respective pair of elastic pieces **30** and **31** are observed in the direction X, the elastic pieces **30** and **31** are inclined with respect to the first direction D**1**. As a result, the distance between the tip end portions **38** of the pair of elastic pieces **30** and **31** becomes narrower than the distance between the base end portions **37**.

[**0063**] Each of the elastic pieces **30** and **31** includes a guide portion **39**, a narrowing portion **40**, and a straight clamp portion **41** for clamping the outer lead **10** in a predetermined clamping direction D**3** (corresponding to the radial direction of the outer lead **10**). The clamp portion **41** extends straight in the first direction D**1**.

[**0064**] The pair of guide portions **39** is provided on each side surface (inner side surfaces) of the corresponding tip end portions **38**. The pair of guide portions **39** is for guiding the attaching of the outer lead **10**, and is provided on the sides opposite the pair of clamp portions **41** with respect to the pair of narrowing portions **40**. The pair of guide portions **39** is formed into smoothly curved shapes, and narrows their distance toward the first direction D**1**.

[**0065**] The pair of narrowing portions **40** is for preventing the corresponding outer lead **10** from improperly coming off in the second direction D**2** from the pair of clamp portions **41**. The pair of narrowing portions **40** are provided on the first direction D**1** side with respect to the pair of guide portions **39**, and provided on the sides (second direction D**2** sides) opposite the first direction D**1** with respect to the pair of clamp portions **41**.

[**0066**] The distance between the pair of narrowing portions **40** is made narrower than the distance between the pair of guide portions **39**, and made narrower than the distance between the pair of clamp portions **41**. When the pair of elastic pieces **30** and **31** is elastically made close to each other, the distance between the pair of narrowing portions **40** becomes narrower than the diameter of the outer lead **10**.

[**0067**] The pair of clamp portions **41** are for allowing relative movements of the corresponding outer lead **10** in the first and second directions D**1** and D**2** (direction Z) while realizing electrical connection between the corresponding outer lead **10** and the contact **15**. The respective clamp portions **41** are provided on the tip end portions **38** of corresponding elastic pieces **30** and **31**, and positioned on the first direction D**1** sides of the corresponding narrowing portions **40**. The respective clamp portions **41** extend in the direction Z (first direction D**1** side) in a free state, and face parallel to each other.

[**0068**] Referring to FIG. **9**, in each clamp portion **41**, a portion in contact with the outer lead **10** forms a contact portion **42**. The pair of contact portions **42** faces each other in the direction Y, and elastically clamps the outer lead **10** there between in the radial direction. The contact portions **42** are disposed between the back face **3***b* of the liquid crystal panel **3** and the first surface **4***a* (see FIG. **1**) of the circuit board **4**.

[**0069**] Referring to FIG. **8**, the operating member **16** is for performing operations of clamping and releasing the clamping of the outer lead **10** by the pair of clamp portions **41**. The operating member **16** is fitted in the insertion recess **20** of the housing **14** relatively movably in the first and second directions D**1** and D**2**. In FIG. **8**, the operating member **16** at a widening position is illustrated, and in FIG. **9**, the operating member **16** at a widening released position is illustrated. The attaching of the operating member **16** to the housing **14** may be before or after the housing **14** is mounted on the circuit board.

[**0070**] Referring to FIG. **2** and FIG. **8**, the operating member **16**; is a resin molded item symmetrically formed to the direction Y, and its section orthogonal to the Direction Z is in a groove shape. The operating member **16** has a pair of portions **43** and **44** facing each other at a distance in the direction Y, a joint **45** that joins the pair of portions **43** and **44**, and a widening operating portion **46** provided on the joint **45**.

[**0071**] The pair of portions **43** and **44** is disposed on both sides across the pair of elastic pieces **30** and **31** in the insertion recess **20**. One portion **43** is disposed between one elastic piece **30** and the other second side portion **24***b* of the peripheral wall **21**. The other portion **44** is disposed between the other elastic piece **31** and the second side portion **24***a* of the peripheral wall **21**. The pair of portions **43** and **44** extends longitudinally in the direction Z, respectively.

[**0072**] The tip ends on the second direction D**2** sides of outer side surfaces **49** of the pair of portions **43** and **44** (only one outer side surface **49** is shown in FIG. **8**) project outward of the direction Y with respect to a peripheral edge **50** of the opening of the insertion recess **20**, and these projecting portions serve as knobs **51**. An operator can operate the operating member **16** in the first and second directions D**1** and D**2** by pinching the knobs **51**.

[**0073**] Referring to FIG. **8** and FIG. **10**A, in the pair of outer side surfaces **49** (only one outer side surface **49** is shown in FIG. **10**A), portions where the knobs **51** are not provided are formed into straight portions **52** extending in the direction Z. On the respective straight portions **52**, first convex portions **53** are provided. The pair of first convex portions **53** are for preventing the operating member **16** from improperly coming off from the insertion recess **20**, and are disposed on the tip ends in the first direction D**1** of the respective straight portions **52**.

[**0074**] The respective first convex portions **53** are fitted in corresponding through holes **27** of the peripheral wall **21**, and they are received by the peripheral edges of the corre-

sponding through holes **27** to prevent the operating member **16** from coming off from the insertion recess **20**.

[**0075**] The tip ends on the first direction D**1** side of the first convex portions **53** are formed into inclined shapes. Thereby, when the operating member **16** is fitted in the insertion recess **20**, these inclined portions smoothly engage with the peripheral edge **50** of the opening of the peripheral wall **21**.

[**0076**] Referring to FIG. **10**A and FIG. **10**B, the connector **6** is provided with first and second holding mechanisms **55** and **56**.

[**0077**] Referring to FIG. **10**A, the first holding mechanism **55** holds the operating member **16** at the widening position. The first holding mechanism **55** includes first concave portions **54** provided on the respective straight portions **52** of the operating member **16**, and engaging portions **57** that are provided on the pair of second side portions **24** of the peripheral wall **21**, respectively, and engage with corresponding first concave portions **54**.

[**0078**] The first concave portion **54** is demarcated between the first convex portion **53** and the second convex portion **58**. The second convex portions **58** are provided on the respective straight portions **52** and arranged side by side with corresponding first convex portions **53** in the second direction D**2**. The engaging portions **57** include the portions disposed on the second direction D**2** side of the through holes **27** on the pair of second side portions **24** of the peripheral wall **21**, respectively, and are fitted in the first concave portions **54** when the operating member **16** is at the widening position.

[**0079**] Referring to FIG. **10**B, the second holding mechanism **56** holds the operating member **16** at the widening released position. The second holding mechanism **56** includes second concave portions **59** provided on the respective straight portions **52** of the operating member **16** and the engaging portions **57** that are provided on the pair of second side portions **24** of the peripheral wall **21**, respectively, and engage with corresponding second concave portions **59**. That is, the engaging portions **57** form a part of the first holding mechanism **55** and a part of the second holding mechanism **56**.

[**0080**] The second concave portions **59** are demarcated between the second convex portions **58** and stepped portions **60** of the respective knobs **51** facing the peripheral wall **21** side. The engaging portions **57** are fitted in the second concave portions **59** when the operating member **16** is at the widening released position.

[**0081**] Referring to FIG. **8**, the inner side surfaces **61** of the pair of portions **43** and **44** face each other at a predetermined distance in the direction Y and sandwich the pair of elastic pieces **30** and **31** of the contact **15**. The tip ends in the first direction D**1** of these inner side surfaces **61** of the pair of portions **43** and **44** are formed into inclined cam surfaces, and the distance therebetween widens toward the first direction D**1**.

[**0082**] By the inclined cam surfaces, pressurizing portions **62** are formed. The pair of pressurizing portions **62** can pressurize pressurized portions **63** (only one pressurized portion **63** is shown in FIG. **8**) provided on the one-side ends (outer side surfaces) of corresponding base end portions **37** of the pair of elastic pieces **30** and **31**.

[**0083**] When the operating member **16** is at the widening released position shown in FIG. **9**, the pair of pressurizing portions **62** come into contact with and pressurize the corresponding pressurized portions **63**, thereby the distance between the pair of clamp portions **41** is narrowed, and as a result, the force for clamping the outer lead **10** by these clamp portions **41** can be increased. In addition, lowering in the clamping force due to settling of the pair of elastic pieces **30** and **31** can be prevented.

[**0084**] The pair of pressurizing portions **62** come into contact with and pressurizes corresponding pressurized portions **63** when the operating member **16** shifts from the widening position shown in FIG. **8** to the widening released position shown in FIG. **9** in the first direction D**1**. Thereby, the forces for pressurizing the corresponding pressurized portions **63** in the first direction D**1** are converted into forces in the direction Y orthogonal to the first direction D**1**. Thereby, the pair of elastic pieces **30** and **31** comes close to each other.

[**0085**] The joint **45** is formed into a plate shape, and joins one-side ends in the direction X of the pair of portions **43** and **44**.

[**0086**] Referring to FIG. **8**, in the operating member **16**, an external form of a section of a portion where the knob **51** is not provided cut in a direction orthogonal to the direction Z is substantially made coincident with the shape of the peripheral edge **50** of the opening of the insertion recess **20** observed from the first direction D**1**. Thereby, the insertion recess **20** is used as a guide groove for guiding the operating member **16** to the widening position and the widening released position in the first and second directions D**1** and D**2**.

[**0087**] By the inner side surface **66** of the joint **45** and the inner side surfaces **61** of the pair of portions **43** and **44**, a space **67** in which the pair of elastic pieces **30** and **31** can be accommodated (space between the pair of portions **43** and **44**) is demarcated.

[**0088**] The tip end in the first direction D**1** and the tip end in the second direction D**2** of this space **67** are respectively opened to the outside, and these open portions are made into a pair of open portions **68** and **69**. By the open portion **68**, the space **67** is opened to the second direction D**2**, and thereby, the space **67** can be observed from the outside. Through the open portion **68**, a corresponding outer lead **10** can be inserted into the space **67**.

[**0089**] Referring to FIG. **8** and FIG. **9**, the widening operating portion **46** is for widening the distance between the clamp portions **41** by engaging with the corresponding clamp portions **41** of the pair of elastic members **30** and **31**, and is made of small pieces projectedly provided on the inner side surface **66** of the joint **45**. The widening operating portion **46** is sandwiched between the pair of pressurizing portions **62** in the direction Y, and is inserted between the pair of elastic pieces **30** and **31** of the contact **15**.

[**0090**] When the operating member **16** is at the widening position, the widening operating portion **46** is in contact with the pair of clamp portions **41**, respectively, and thereby, the distance between the pair of clamp portions **41** and the pair

of narrowing portions **40** is made larger than the outer diameter of the outer lead **10**.

[**0091**] One-side surface of the widening operating portion **46** turned toward the second direction D**2** faces a corresponding outer lead **10** in the direction Z, and is used as a receiving portion **71** for receiving the outer lead **10**. When the operating member **16** is at a widening position, the receiving portion **71** can receive the corresponding outer lead **10** at positions corresponding to the pair of clamp portions **41**.

[**0092**] The widening operating portion **46** includes a pair of side surfaces (only one side surface is shown in FIG. **9**) facing each other in the direction Y, and the side surfaces include inclined cam surfaces **72** inclined with respect to the first direction D**1**, respectively.

[**0093**] The pair of inclined cam surfaces **72** performs a function to widen the distance between the pair of narrowing portions **40** when the operating member **16** is fitted in the insertion recess **20** in the first direction D**1**. The distance between the pair of inclined cam surfaces **72** narrows toward the first direction D**1**. When the operating member **16** is fitted inside the insertion recess **20** in the first direction D**1**, the pair of inclined cam surfaces **72** smoothly engages with the pair of narrowing portions **40**, thereby the distance between the pair of narrowing portions **40** can be smoothly widened.

[**0094**] Referring to FIG. **3**, one first side portion **23***a* of the peripheral wall **21** includes a restricting portion **73**. The restricting portion **73** is for restricting the pair of elastic pieces **30** and **31** from shifting in the direction X (longitudinal direction L of the cold cathode fluorescent tube **5**: direction in the axial direction of the outer lead **10**). The restricting portion **73** is provided on one side surface (inner side surface facing the insertion recess **20**) of the one first side portion **23***a* and faces the base end portions **37** of the respective elastic pieces **30** and **31**. The restricting portion **73** restricts the elastic pieces **30** and **31** from moving to one side of the direction X (side on which the cold cathode fluorescent tube disposed).

[**0095**] Referring to FIG. **8** and FIG. **9**, the widening position of the operating member **16** can be defined as a position for widening the distance between the pair of clamp portions **41** by the widening operating portion **46** so that the outer lead **10** can be inserted between the pair of clamp portions **41** with no insertion force. The widening released position can be defined as a position for releasing this widening.

[**0096**] Referring to FIG. **2** and FIG. **4**, in the liquid crystal display device having the above-described general construction, the cold cathode fluorescent tube **5** (outer lead **10**) is mounted as follows; first, the operating member **16** is held at the widening position. Thereby, the widening operating portion **46** of the operating member **16** engages with the respective clamp portions **41** of the pair of elastic members **30** and **31**, and the distance between the pair of elastic pieces **30** and **31** is widened. At this time, the distance between the pair of clamp portions **41** is made wider than the diameter of the outer lead **10**, and the distance between the pair of first narrowing portions **40** is made wider than the diameter of the outer lead **10**.

[**0097**] In this state, the corresponding cold cathode fluorescent tube **5** is grasped by hand (not shown), and the outer lead **10** of the cold cathode fluorescent tube **5** is made to face the operating member **16** in the direction Z. Then, the cold cathode fluorescent tube **5** is moved toward the first direction D**1** and the middle portion of the cold cathode fluorescent tube **5** is fitted in the holder **13** of the clamping member **11**. Thereby, the middle portion of the cold cathode fluorescent tube **5** is held by the clamping member **11**.

[**0098**] At this time, the corresponding outer lead **10** of the cold cathode fluorescent tube **5** is moved into the insertion recess **20** in the arrow E**1** as shown in FIG. **8**, passes between the pair of guide portions **39** and between the pair of narrowing portions **40** and disposed between the pair of clamp portions **41**. The outer lead **10** disposed between the pair of clamp portions **41** is received by the receiving portion of the widening operating portion **46**, and is positioned in the direction Z with respect to the pair of clamp portions **41**.

[**0099**] Next, the operating member **16** is moved toward the first direction D**1** and shifted from the widening position to the widening released position shown in FIG. **9**. Thereby, the widening of the distance between the pair of clamp portions **41** by the widening operating portion **46** is released and the support of the corresponding outer lead **10** by the receiving portion **71** is released. As a result, due to the elastic restitution of the pair of elastic pieces **30** and **31**, the corresponding outer lead **10** is clamped between contact portions **42** of the clamp portions **41** of the pair of elastic pieces **30** and **31**. Thereby, electrical connection between the contact **15** and the corresponding outer lead **10** is achieved. The distance between the pair of narrowing portions **40** becomes narrower than the diameter of the corresponding outer lead **10**.

[**0100**] In addition, by shifting the operating member **16** to the widening released position, the pair of pressurizing portions **62** pressurize the corresponding pressurized portions **63** as shown by the arrow F**1** to move these pressurized portions **63** in the direction Y so as to come close to each other. Thereby, the distance between the base end portions **37** of the pair of elastic pieces **30** and **31** is narrowed, and as a result, pressurizing forces act on the pair of elastic pieces **30** and **31** so as to narrow the distance between the pair of clamp portions **41**. Thereby, the force for clamping the corresponding outer lead **10** by the pair of clamp portions **41** is increased.

[**0101**] On the other hand, in order to remove the outer lead **10** from the contact **15**, first, the operating member **16** is shifted from the widening released position to the widening position in the second direction D**2** as shown in FIG. **8**. Thereby, the pressurizing of the pair of pressurized portions **63** by the pair of pressurizing portions **62** is released.

[**0102**] When the operating member **16** is shifted to the widening position, the widening operating portion **46** enters between the pair of clamp portions **41**, and thereby, the distance between the pair of clamp portions **41** is widened. As a result, electrical connection between the pair of clamp portions **41** and the corresponding outer lead **10** is released.

[**0103**] Next, as shown in FIG. **2** and FIG. **4**, the cold cathode fluorescent tube **5** is removed from the holder **13** of the clamping member **11** by grasping the cold cathode fluorescent tube **5** by hand, etc., and moved toward the second direction D**2**. Thereby, the corresponding outer lead **10** of the cold cathode fluorescent tube **5** passes between the

pair of narrowing portions **40** and between the pair of guide portions **39** from the point between the pair of clamp portions **41**, and is then extracted from the insertion recess **20**.

[**0104**] As described above, according to this embodiment, the pair of elastic pieces **30** and **31** comes into contact with a corresponding outer lead **10** with a predetermined contact pressure by elastically clamping the outer lead **10**. Thereby, electrical connection between the contact **15** and the outer lead **10** can be reliably performed.

[**0105**] Furthermore, by widening the distance between the pair of clamp portions **41** by the widening operating portion **46**, the outer lead **10** can be readily inserted between the clamp portions **41** with a little force, and as a result, electrical connection to the outer lead **10** can be readily performed. In addition, the pair of elastic pieces **30** and **31** can be formed into simple overturned-V shapes, so that the pair of elastic pieces **30** and **31** can be readily formed.

[**0106**] Furthermore, to connect the connectors **6** to the pair of respective outer leads **10** of the cold cathode fluorescent tube **5** and attach the connectors **6** to the circuit board **4**, first, the pair of connectors **6** is singly attached to the circuit board **4**. Thereafter, the pair of outer leads **10** of the cold cathode fluorescent tube **5** is inserted into the insertion recesses **20** of corresponding connectors **6** in the first direction D1 so that the pair of outer leads **10** is clamped between the corresponding pairs of clamp portions **41**. That is, the connectors **6** are singly attached to the circuit board **4**, and thereafter, the connectors **6** can be connected to the outer leads **10**.

[**0107**] Therefore, conventional troublesome operations, that is, operations of manufacturing an assembly including connectors attached to each of the pair of outer leads, positioning the connectors of the assembly on the circuit board and attaching the connectors while maintaining the positioned state become unnecessary. Therefore, the operation of attaching the connectors **6** to the circuit board **4** can be readily performed.

[**0108**] The contact **15** and the corresponding outer lead **10** can be electrically connected by a simple operation of moving the operating member **16** toward the first direction D1 and shifting the same from the widening position to the widening released position, so that the electrical connecting operation between the contact **15** and the corresponding outer lead **10** can be automated by using machinery.

[**0109**] In addition, by widening the distance between the pair of clamp portions **41** by positioning the operating member **16** at the widening position, the corresponding outer lead **10** can be readily inserted between these clamp portions **41** with no insertion force. In addition, by releasing the widening by the widening operating portion **46** by shifting the operating member **16** to the widening released position after the outer lead **10** is inserted, the outer lead **10** can be reliably clamped by the elastic forces of the pair of elastic pieces **30** and **31**, thereby the electrical connection to the outer lead **10** can be made more reliable.

[**0110**] In addition, the outer lead **10** that is very small in diameter and readily deformable can be readily inserted between the pair of clamp portions **41** with a little force, and as a result, an excessive force can be prevented from acting on the outer lead **10**. The outer lead **10** can thus be prevented from being damaged.

[**0111**] Furthermore, the operating member **16** is held by the housing **14** in a manner enabling the operating member **16** to shift between the widening position and the widening released position, so that while holding the operating member **16** by the housing **14**, the operating member **16** can be shifted to the widening position and the widening released position.

[**0112**] Furthermore, by providing the pair of pressurizing portions **62** on the operating member **16**, the forces of the pair of clamp portions **41** to clip the outer lead **10** can be increased, and as a result, the contact between the clamp portions **41** and the outer lead **10** can be performed more reliably.

[**0113**] By providing the pressurizing portions **62** on the pair of portions **43** and **44** of the operating member **16**, respectively, the pair of elastic pieces **30** and **31** can be clamped by the pair of pressurizing portions **62**, and as a result, the pressurizing forces can be reliably supplied to these elastic pieces **30** and **31**.

[**0114**] Furthermore, by forming an open portion **68** in the operating member **16**, the space **67** between the pair of portions **43** and **44** can be visually observed through the open portion **68**. Thereby, it can be readily confirmed whether the respective clamp portions **41** are in contact with the corresponding outer leads **10** and whether the pair of pressurizing portions **62** are pressurizing the pair of pressurized portions **63**.

[**0115**] By using the insertion recess **20** as a guide groove, by a simple operation of moving the operating member **16** in the insertion recess **20**, the operating member **16** can be reliably shifted between the widening position and the widening released position.

[**0116**] Furthermore, by placing the outer lead **10** on the receiving portion **71** of the widening operating portion **46** of the operating member **16** at the widening position, the outer lead **10** can be readily and reliably positioned with respect to the clamp portions **41**.

[**0117**] By the first holding mechanism **55**, the operating member **16** can be reliably held at the widening position.

[**0118**] Furthermore, by the second holding mechanism **56**, the operating member **16** can be reliably held at the widening released position.

[**0119**] In addition, by disposing the cold cathode fluorescent tubes **5** on the first surface **4***a* of the circuit board **4** and disposing the inverter circuit **7** on the second surface **4***b* of the circuit board **4**, these members can be stacked in the thickness direction of the circuit board **4**. Thereby, the area occupied by the circuit board **4** in the plane direction can be reduced and space-saving thereof can be realized. By disposing the circuit board **4** between the cold cathode fluorescent tube **5** and the inverter circuit **7**, the circuit board **4** can be used as an insulating layer between the cold cathode fluorescent tube **5** and the inverter circuit **7**.

[**0120**] The present invention is not limited to the contents described in the embodiment given above.

[**0121**] For example, an external electrode fluorescent tube **5**A can be used instead of the cold cathode fluorescent tube **5** as shown in FIG. **11**. In this case, an electrode layer **10**A as a terminal is covered on the respective peripheral surfaces

of a pair of end portions **9**A (only one end portion **9**A is shown in FIG. **11**) of the main body **8**A of the external electrode fluorescent tube **5**A.

[**0122**] In this case, the electrode layer **10**A can be readily inserted between the pair of clamp portions **41** with a little force, and an excessive force can be prevented from acting on the electrode layer **10**A. The electrode layer **10**A can be prevented from rubbing against and being damaged by the pair of elastic pieces **30** and **31**.

[**0123**] The pair of pressurizing portions **62** and the corresponding pair of pressurized portions **63** can be omitted. Furthermore, the pair of guide portions **39** can be omitted, the pair of narrowing portions **40** can be omitted, and the receiving portion **71** of the widening operating portion **46** can be omitted.

[**0124**] In addition, instead of the operating member **16**, the operating member **16**A shown in FIG. **12** can be used. The operating member **16**A has an opening preventive portion **74** that prevents the space **67** between the pair of portions **43** and **44** from opening to the second direction D**2**.

[**0125**] The opening preventive portion **74** is integrally formed with the pair of portions **43** and **44** by using a single member. This opening preventive portion **74** connects the tip end portions in the second direction D**2** of the pair of portions **43** and **44** to each other, respectively. By providing the opening preventive portion **74**, intrusion of foreign matter in the space **67** between the pair of portions **43** and **44** can be prevented.

[**0126**] By forming the section of the opening preventive portion **74** from a transparent material, the space **67** between the pair of portions **43** and **44** can be observed from the outside. It is also possible that the opening preventive portion **74** is separately formed from the pair of portions **43** and **44** and is joined thereto via a hinge mechanism. In this case, the space **67** between the pair of portions **43** and **44** can be observed by opening the opening preventive portion **74**.

[**0127**] FIG. **13**, FIG. **14**A, FIG. **14**B, FIG. **15**A and FIG. **15**B show another embodiment of the present invention. Referring to FIG. **13** and FIG. **14**A, this embodiment is different from that of FIG. **8** and FIG. **9** mainly in that a contact **15**A is used instead of the contact **15** and an operating member **16**B is used instead of the operating member **16**.

[**0128**] The operating member **16**B is the same as the operating member **16**A in FIG. **12** in that the operating member **16**B has the opening preventive portion **74**. Further, the operating member **16**B is different form the operating member **16**A in FIG. **12** in that the widening operating portion **46** is omitted in the operating member **16**B. Further, the operating member **16**B is different form the operating member **16**A in FIG. **12** in that the operating member **16**B has a first pressurizing portion **62**A and a second pressurizing portion **62**B. The operating member **16**B is retained by the housing **14** so as to be deformable in the first direction D**1** or the second direction D**2**. The operating member **16**B is deformed between a non-pressurizing position (see FIG. **3**, FIG. **14**A and FIG. **14**B) in which a pair of elastic pieces **30**A and **31**A are released without being restrained, and a finally-pressurizing position (see FIG. **15**B) in which pressurizing on the pair of elastic pieces **30**A and **31**A are completed.

[**0129**] The contact **15**A comprises the pair of elastic pieces **30**A and **31**A. The pair of elastic pieces **30**A and **31**A respectively have a first piece **81**, a second piece **82**, a third piece **83**, a fourth piece **84** and a fifth piece **85**.

[**0130**] Each first piece **81** straightly extends generally in the second direction D**2** as being the removing direction of the terminal **10**. Each first piece **81** is supported by the respectively corresponding fourth piece **84** in an inclined shape, and each fourth piece **84** is supported by the fifth piece **85** extending in the second direction D**2**.

[**0131**] Each second piece **82** is extended from the respectively corresponding first piece **81** and supported by the respectively corresponding first piece **81** in a cantilever shape. Each third piece **83** is extended from the respectively corresponding second piece **82**.

[**0132**] The first piece **81** of each of the elastic pieces **30**A and **31**A has a tip end portion **81***a* and a base end portion **81***b*.

[**0133**] The first piece **81** of each of the elastic pieces **30**A and **31**A has a straight portion **86**, as a clamp portion, which extends with a predetermined length from the tip end portion **81***a* to the base end portion **81***b* thereof in the first direction D**1** as being the removing direction of the terminal **10**.

[**0134**] When the operating member **16**B is disposed at the non-pressurizing position shown in FIG. **14**A and the terminal **10** is not introduced between the elastic pieces **30**A and **31**A, a width between the straight portion **86** of the elastic piece **30**A and the straight portion **86** of the elastic piece **31**A is set slightly smaller than the diameter of the terminal **10**. As a result, the terminal **10** which is introduced between the straight portions **86** of the pair of elastic pieces **30**A and **31**A can be moved smoothly in the first direction D**1** while receiving a slight friction resistance.

[**0135**] Further, with respect to the first direction D**1**, on a middle portion of each straight portion **86**, a contact portion **87**, as a clamp portion, is provided for positioning and retaining the terminal **10** in the first direction D**1** as shown in FIG. **14**B and also ensuring an electric contact with the retained terminal **10**. The contact portion **87** of each straight portion **86** comprises an arced surface which substantially corresponds to a part of the outer circumferential surface of the retained terminal **10**.

[**0136**] Referring to FIG. **13**, the second piece **82** of each of the elastic pieces **30**A and **31**A is folded back outside in an inclined manner from the respectively corresponding first piece **81** via a curved portion **88**. A part of the curved portion **88** forms a guide portion **89** which guides the introduction of the terminal **10** between the both straight portions **86**.

[**0137**] Referring to FIG. **14**A, a distance between the base end portions **82***a* of the second pieces **82** of the pair of elastic pieces **30**A and **31**A is narrower than a distance between the base end portions **82***b* of the second pieces **82** of the pair of elastic pieces **30**A and **31**A. At least a part of the outside surface of each second piece **82** forms a first pressurized portion **63**A.

[**0138**] The third piece **83** of each of the elastic pieces **30**A and **31**A is folded so as to incline in a direction opposite to the respectively corresponding second piece **82**. A tip portion, which is formed between the second piece **82** and the

third piece **83** of each of the elastic pieces **30**A and **31**A, forms a second pressurized portion **63**B.

[**0139**] While the terminal **10** is kept clamped and retained between the contact portions **87** of the pair of elastic pieces **30**A and **31**A as shown in FIG. **14**B, the operating member **16**B is displaced to the finally-pressurizing position shown in FIG. **15**B. During the process in which the operating member **16**B is displaced to the finally-pressurizing position, each inclined first pressurizing portion **62**A of the operating member **16**B first pressurizes the first pressurized portion **88** of the respectively corresponding inclined second piece **82**, as shown in FIG. **15**A. As a result, each second piece **82** is elastically bent and deformed whereby to increase the clamping force on the terminal **10** between the both contact portions **87**.

[**0140**] When the operating member **16**B reaches the finally-pressurizing position shown in FIG. **15**B, each second pressurizing portion **62** of the operating-member **16**B pressurizes the second pressurized portion **63**B of the corresponding elastic piece **30**A or **31**A. As a result, each second piece **82** is elastically bent and deformed with a sufficient deforming amount whereby to increase the clamping force on the terminal **10** between the both contact portions **87**.

[**0141**] Furthermore, the restricting portion **73** can be omitted. The number of clamping members **11** to be provided for one cold cathode fluorescent tube **5** can be two or more. Furthermore, the connector **6** can be applied to an edge light type liquid crystal display device.

[**0142**] It is also possible that the connector of the present invention is used for connection to a shaft-like terminal of other than the fluorescent tube. For example, it can be used for connection to a terminal of a multipole cable including a number of twisted wires. In the case of the multipole cable, the diameter of the terminal becomes large, so that a sufficient contact pressure with the contact must be secured. Therefore, the effect of using the connector of the present invention which can secure a sufficient contact pressure and can be attached to the contact with no insertion force is significant.

[**0143**] The present invention is described in detail above based on a detailed embodiment, and those skilled in the art who understand the details of the description given above will readily conceive alterations, modifications, and equivalents thereof. Therefore, the scope of the present invention should be within the range of the claims and the equivalents thereof.

[**0144**] The present application corresponds to Japanese Patent Application No. 2005-248118 submitted to the Japanese Patent Office on Aug. 29, 2005, and the entire disclosure of this application is incorporated herein by reference.

1. An electrical connector comprising:

an insulating housing;

a contact held by the housing; and

an operating member for operating the contact, wherein

the housing includes an insertion recess into which a shaft-like terminal is inserted in a first direction,

the contact includes a pair of elastic pieces facing each other,

at least a part of the pair of elastic pieces is exposed to the insertion recess,

each of the elastic pieces is in a cantilevered shape having a base end portion and a tip end portion,

the pair of elastic pieces are inclined with respect to the first direction so that a distance between the tip end portions becomes narrower than a distance between the base end portions,

the pair of elastic pieces respectively include clamp portions for clamping the terminal in predetermined clamping directions orthogonal to the first direction,

the first direction is in a radial direction of the terminal, and

the operating member includes a widening operating portion for widening a distance between the clamp portions of the pair of elastic pieces.

2. The electrical connector according to claim 1, wherein

the operating member can shift toward the first direction and a second direction opposite to the first direction,

the operating member shifts to a widening position according to shifting toward the second direction, and shifts to a widening released position according to shifting toward the first direction, and

by the widening operating portion of the operating member that has shifted to the widening position, the distance between the pair of clamp portions is widened to a distance which enables the terminal to be inserted between the pair of clamp portions with no insertion force.

3. The electrical connector according to claim 2, wherein

the operating member is held by the housing in a manner enabling the operating member to shift between the widening position and the widening released position.

4. The electrical connector according to claim 2, wherein

the operating member includes a pair of pressurizing portions, and

the pair of pressurizing portions pressurize the pair of elastic pieces, respectively so as to narrow a distance between the pair of clamp portions when the operating member is at the widening released position.

5. The electrical connector according to claim 4, wherein

the operating member includes a pair of portions disposed on both sides across the pair of elastic pieces in the insertion recess, and

the pair of pressurizing portions are provided on the pair of portions, respectively.

6. The electrical connector according to claim 5, wherein

the operating member forms an open portion for opening a space between the pair of portions to the second direction.

7. The electrical connector according to claim 5, wherein

the operating member includes an opening preventive portion that prevents the space between the pair of portions from opening to the second direction.

8. The electrical connector according to claim 2, wherein

the insertion recess includes a guide groove for guiding the operating member to the widening position and the widening released position in the first and second directions.

9. The electrical connector according to claim 2, wherein

the widening operating portion of the operating member includes a receiving portion for receiving the terminal at a position corresponding to the clamp portions when the operating member is at the widening position.

10. The electrical connector according to claim 2, further comprising:

a holding mechanism for holding the operating member at the widening position.

11. The electrical connector according to claim 2, further comprising:

a holding mechanism for holding the operating member at the widening released position.

12. The electrical connector according to claim 1, wherein

the terminal includes a terminal of a fluorescent tube.

13. The electrical connector according to claim 12, wherein

the fluorescent tube includes a cold cathode fluorescent tube, and

the terminal includes an outer lead exposed from an end portion of the cold cathode fluorescent tube.

14. The electrical connector according to claim 13, wherein

the fluorescent tube includes an external electrode fluorescent tube, and

the terminal includes an electrode layer coated on a peripheral surface of an end portion of the external electrode fluorescent tube.

15. A liquid crystal display device comprising:

a liquid crystal panel having a front face and a back face;

a circuit board having a first surface facing the back face of the liquid crystal panel and a second surface opposite to the first surface;

an electrical connector attached to the circuit board;

a fluorescent tube for a backlight which is disposed between the back face of the liquid crystal panel and the first surface of the circuit board, and has a terminal on an end portion; and

an inverter circuit which is disposed on the second surface of the circuit board and supplies electrical power to the fluorescent tube, wherein

the electrical connector comprises:

an insulating housing;

a contact held by the housing; and

an operating member for operating the contact,

a longitudinal direction of the fluorescent tube is parallel to the back face of the liquid crystal panel,

the housing includes an insertion recess into which a shaft-like terminal is inserted in a first direction,

the contact includes a pair of elastic pieces facing each other,

at least a part of each of the elastic pieces is exposed to the insertion recess,

each of the elastic piece is in a cantilevered shape having a base end portion and a tip end portion,

the pair of elastic pieces are inclined with respect to the first direction so that a distance between the tip end portions becomes narrower than a distance between the base end portions,

the pair of elastic pieces include clamp portions for clamping the terminal in a predetermined clamping direction orthogonal to the first direction, respectively,

the first direction is in a radial direction of the terminal,

the operating member includes a widening operating portion for widening the distance between the clamp portions of the pair of elastic pieces,

the clamp portions of the pair of elastic pieces of the contact of the electrical connector clamp the terminal of the end portion of the fluorescent tube between the back face of the liquid crystal panel and the first surface of the circuit board,

the contact includes a lead connected to the inverter circuit, and

the lead extends in the second surface of the circuit board.

* * * * *

专利名称(译)	电连接器和液晶显示装置		
公开(公告)号	US20070064169A1	公开(公告)日	2007-03-22
申请号	US11/511336	申请日	2006-08-29
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IPC分类号	G02F1/1333		
CPC分类号	H01R4/5083 H01R33/02 H01R13/193		
优先权	2005248118 2005-08-29 JP		
其他公开文献	US7530828		
外部链接	Espacenet USPTO		

摘要(译)

电连接器具有由壳体和操作构件保持的触点，用于操作触点。壳体包括插入凹部，轴状端子沿第一方向插入到该插入凹部中。触头的一对弹性件分别包括夹紧部分，用于在与第一方向垂直的预定夹紧方向上夹紧端子。第一方向是在终端的径向方向上。操作构件包括加宽操作部分，用于加宽该对弹性件的夹紧部分之间的距离。