

Description

TECHNICAL FIELD

[0001] This invention relates to a bus bar connecting terminal and, more particularly, to a bus bar connecting terminal for connecting a plurality of bus bars to the terminals of circuit breakers and other electrical devices through which a large electric current flows.

BACKGROUND ART

[0002] Fig. 7 is a schematic front view showing a drawer-type circuit breaker having conventional bus bar connecting terminals, Fig. 8 is a schematic side view of the bus bar connecting terminals of Fig. 7 in a bus bar omitted state, Fig. 9 is a front view showing the conventional bus bar connecting terminal shown in Fig. 7, Fig. 10 is a plan view of Fig. 9, Fig. 11 is a dissected front view of the bus bar connecting terminal of Fig. 9, Fig. 12 is a front view of Fig. 11, Fig. 13 is a front view of the conventional bus bar connecting terminal shown in Fig. 7 in a bus bar connected state, and Fig. 14 is a plan view of Fig. 13.

[0003] In Figs. 7 and 8, a drawer-type circuit breaker 10, or an electrical device through which a large electric current flows, comprises a drawer frame 10a and a circuit breaker 10b mounted within the drawer frame 10a, in which the drawer frame 10a is provided with a mounting base 10c made of a synthetic resin for holding bus bar connecting terminals 30. Although not illustrated, the terminals of the circuit breaker 10b are connected to the inner end of each of the bus bar connecting terminals 30 held by the mounting base 10c. The mounting base 10c is provided with a backup plate 40 for preventing the mounting base 10c from being broken by an action of an electromagnetic force induced in the directions shown by the arrows in Fig. 8 by an excessive electric current during short-circuiting and other faults between the bus bar connecting terminals 30 connected to each pole of the drawer frame 10a. The backup plate 40 also prevents the mounting base 10c from being broken upon the action thereon of an excessive load due to the weights of the bus bars 50 being connected to each bus bar connecting terminal 30 following the connection of the bus bars 50 to the bus bar connecting terminals 30.

[0004] In general, bus bar connecting terminals used in circuit breakers with large capacities, say 4,000 - 6,300 ampere frames, have a structure as shown in Figs. 9 to 14, which is a vertically converting structure including vertical and horizontal portions for eliminating temperature rises due to thermal convection occurring between the load side terminals (not shown) of the circuit breaker 10b and the bus bars 50, the structure being formed by connecting vertical terminals 33 to horizontal terminals 31 by the braze welding or the like.

[0005] As best seen from Figs. 11 and 12, the horizontal terminal 31 has first positioning grooves 31a for

fitting the vertical terminals 33 at U-shaped notches 33b thereof, a plurality of fitting holes 31b for screw-fastening to the backup plate 40 and notches 31c for fitting into the mounting base 10c.

[0006] The vertical terminals 33 have a plurality of fitting holes 33a for screw-fastening the bus bars 50 by bus bar connecting screws (not illustrated) to be described later and the U-shaped notches 33b for fitting to the horizontal terminal 31.

[0007] In the conventional bus bar connecting terminals of this configuration, for the purpose of connecting with standard bus bars, interval L1 (Fig. 10) among the plurality of vertical terminals 33 is set at a dimension larger than the thickness of the standard bus bars that is determined by the rated current. For instance, for connecting with the standard bus bars having a thickness of 10mm (L0), interval L1 among the vertical terminals 33 is set in a range of from 10.5mm to 11.5mm with a slight clearance given. While, the thickness of the vertical terminals 33 should never be smaller than thickness L0 because it is necessary to give among the bus bars 50 an interval that must be identical with thickness L0 of the bus bars 50 at the smallest (see Fig. 14).

[0008] Thus, when the bus bars 50 are inserted in the spaces among the vertical terminals 33 of the bus bar terminal 30 and then fastened with bolts 60 and nuts 65 for connecting bus bars to bring the vertical terminals 33 into contact with the bus bars 50 tightly as shown in Figs. 13 and 14, the vertical terminals 33 are bent and deformed as shown in Fig. 14. In this state, the section in the vertical terminals 33 that is in contact with the bus bars 50 is limited to section S2 covering the distance from one end of the vertical terminal 33 to the bending position thereof, rather than section S1 covering fully the distance in which the vertical terminals 33 lie alongside the bus bars 50, thus reducing the area of electrical contact from that provided duly upon contacting of these conductors. This could therefore cause an increase in the electrical contact resistance between the bus bars 50 and the vertical terminals 33. Furthermore, the heat generated within the circuit breaker 10b does not readily dissipate to the bus bars 50 via the bus bar connecting terminals 30, leading to a difficulty in attaining a satisfactory cooling of the circuit breaker 10.

[0009] In addition, in order to allow the plurality of bus bars 50 to be connected, as shown in Figs. 11 and 12, the plurality of positioning grooves 31a must be formed in the horizontal terminals 31, and the plurality of vertical terminals 33 each having the holes 33a and the notches 33b must be manufactured, and moreover all these components must be braze-jointed to each other, so that the manufacturing cost for the bus bar connecting terminal 30 is disadvantageously high.

[0010] The present invention therefore has as its object the provision of a bus bar connecting terminal that is free from the problems discussed above, and the provision of a bus bar connecting terminal ensuring a stable and good electric and thermal connective relationship

between bus bars and bus bar connecting terminals.

[0011] The present invention also has as its object the provision of a low-priced bus bar connecting terminal which is easily producible and highly reliable.

DISCLOSURE OF INVENTION

[0012]

(1) The bus bar connecting terminal of the present invention comprising, in order to achieve the above objects, a conductor section to be electrically connected to an electrical apparatus, a plurality of connecting plate sections to be connected to a plurality of bus bars by alternating with each other, and a support section for connecting and supporting each other the conductor section and the connecting plate sections, the plurality of connecting plate sections being separated from each other at an interval larger than the thickness of the bus bars; characterized in that a flexible section is provided between the connecting plate sections and the support section.

(2) The flexible section may be the one having a thickness less than that of the connecting plate sections, and (3) the support section may be the one being connected with the conductor section at one end and with a plurality of connecting plate sections at the other having the flexible section being disposed inbetween to form a conductor block.

(4) In addition, the support section and the connecting plate sections may be formed as a continuous integral conductor block.

(5) Furthermore, the conductor block may be the one being formed by cutting an extrusion-molded material having a cross section in a shape comprising the support section, the connecting plate section and the flexible section into a predetermined dimension.

BRIEF DESCRIPTION OF THE INVENTION

[0013]

Fig. 1. is a front view showing an embodiment of the bus bar connecting terminal of the present invention;

Fig. 2. is a plan view of the bus bar connecting terminal of Fig. 1;

Fig. 3. is an exploded front view showing the disassembled bus bar connecting terminal of Fig. 1;

Fig. 4. is a sectional view of the vertical terminal of Fig. 1;

Fig. 5. is a front view showing the bus bar connecting terminal of Fig. 1 in a bus bar connected state;

Fig. 6. is a plan view of the bus bar connecting terminal of Fig. 5;

Fig. 7. is a schematic front view showing a drawer-

type circuit breaker having conventional bus bar connecting terminals;

Fig. 8. is a schematic side view showing the bus bar connecting terminal of Fig. 7 in a bus bar omitted state;

Fig. 9. is a front view showing the conventional bus bar connecting terminal shown in Fig. 9;

Fig. 10 is a plan view of Fig. 9;

Fig. 11 is an exploded front view of the bus bar connecting terminal of Fig. 9;

Fig. 12 is a front view of Fig. 11;

Fig. 13 is a front view showing the conventional bus bar connecting terminal shown in Fig. 7 in a bus bar connected state; and

Fig. 14 is a plan view of Fig. 13.

BEST MODES FOR CARRYING OUT THE INVENTION

[0014] One embodiment of the bus bar connecting terminal of the present invention is shown in Figs. 1 and 6, in which the bus bar connecting terminal is shown as a bus bar connecting terminal for connecting a plurality of bus bars to the terminal of a circuit breaker or an electrical apparatus through which a large electric current flows. In these figures, Fig. 1 is a front view showing one embodiment of the bus bar connecting terminal of the present invention, Fig. 2 is a plan view of the bus bar connecting terminal of Fig. 1, Fig. 3 is an exploded front view showing the disassembled bus bar connecting terminal of Fig. 1, Fig. 4 is a sectional view of the vertical terminal of Fig. 1, Fig. 5 is a front view showing a state in which the bus bar connecting terminal of Fig. 1 is connected with a bus bar and Fig. 6 is a plan view of the bus bar connecting terminal of Fig. 5.

[0015] In these figures, the bus bar connecting terminal 70 of this invention comprises a conductor section 71 to be electrically connected to an electrical apparatus such as a circuit breaker (see Fig. 7), a plurality of connecting plate sections 73 which are separated in parallel from each other and connected to a plurality of bus bars 50 in an alternately juxtaposed relationship with each other, as shown in Figs. 5 and 6, and a support section 72 having one end rigidly connected and supported to the conductor section 71 by way of brazing or the like and the other end supporting the plurality of connecting plate sections 73 in parallel, thereby connecting and supporting the conductor section 71 and the connecting plate sections 73 each other.

[0016] While the conductor section 71 has similar structures to those shown in Figs. 7 - 14, such as the notches 71c and holes 71b for the connection to the unillustrated electrical devices, the end portion 71a connected to the support section 72 has no grooves or the like and is accommodated by the grooves 72e formed in the support section 72 and firmly secured thereto by brazing or the like.

[0017] In the illustrated example, the support section 72 is formed as a single conductor block member and

is different from the corresponding section of the conventional connecting terminals shown in Figs. 7 - 14 that composed of a plurality of plate members. In addition, the groove 72e is formed for accepting the conductor section 71 therein.

[0018] Each of the plurality of connecting plate sections 73 has, as best seen from Fig. 4, a thickness L1 which is at least equal to a thickness L0 of the bus bar 50 to be connected thereto, and thickness L1 is set in a suitable dimension range so that the bus bars 50 after being connected are separated at a not-too-small interval. Further, interval L2 among the connecting plate sections 73 is set at an interval that is slightly larger than thickness L0 of the bus bar 50 for an ease of the insertion of the bus bar 50. In addition, a bolt hole 73d is formed for fastening the bus bars 50 inserted between the connecting plate sections 73 by the unillustrated bolts and nuts.

[0019] According to the present invention, each of the connecting plate sections 73 has a contact area section 73b of size S3 (Figs. 4 and 6) large enough to provide an electrically and thermally sufficient contact area, and is supported by the support section 72 through a flexible section 74. The flexible section 74 is a thin section having thickness L3 which is less than thickness L1 of the connecting plate sections 73. The flexible section 74 serves, as understood by comparing Figs. 4 and 6, as a section to cause a tight contacting with the bus bar 50 of the entire area of the contact section 73b being expressed by reference character S3 of the connecting plate sections 73 because the flexible section 74 readily deflects and deforms when the bus bars 50 having thickness L0 are interposed with the connecting plate sections 73 and fastened by fastening members such as bolts 60 and nuts 65. There would therefore be neither an increase in the electric contact resistance between the bus bars 50 and the connecting plate sections 73 nor any hindrance to the movement of the heat generated in the interval, thus ensuring a full dispersion of the heat from the circuit breaker 10b or other electrical machinery and apparatus. Although the flexible section 74 in the illustrated example is formed to give a groove 73c having roughly circular cross section, it causes no specific trouble if the groove has a cross section of polygons such as rectangle or of oval.

[0020] The support section 72, the connecting plate sections 73 and the flexible section 74 are formed as a continuous integral conductor block 75, and in the illustrated example, the conductor block 75 is the one formed by cutting and processing a long extrusion molding material having a cross section in the shape as shown in Fig. 4 composed of the support section 72, the connecting plate sections 73 and the flexible section 74 to have predetermined dimensions suitable for a bus bar connecting terminal. Thus, the manufacturing processes so far needed, or the manufacture of a plurality of horizontal terminals 31 as shown in Figs. 11 and 12, the forming of a plurality of positioning grooves 31a therefor,

the manufacture of a plurality of vertical terminals 33 each having the holes 33a and the notches 33b, and the assembling by brazing-joining of all these many parts, can be eliminated, and additionally the manufacturing cost of the bus bar connecting terminal is lowered and the conductor blocks in such connecting terminals are highly reliable because they are not assembled ones.

[0021] While the bus bar connecting terminals for connecting bus bars to a circuit breaker has been explained as an example, it is needless to say that the bus bar connecting terminal of this invention can be also applied to other electric devices such as electromagnetic contactors, switches which are generally connected to bus bars.

INDUSTRIAL APPLICABILITY

[0022] As described, the bus bar connecting terminal according to the present invention is particularly useful as a bus bar connecting terminal for connecting the plurality of bus bars to the terminals of an electric device such as a circuit breaker through which a large electric current flows.

Claims

1. A bus bar connecting terminal comprising a conductor section to be electrically connected to an electrical apparatus, a plurality of connecting plate sections to be connected to a plurality of bus bars by alternating with each other, and a support section for connecting and supporting each other said conductor section and said connecting plate sections, said plurality of connecting plate sections being separated from each other at an interval larger than the thickness of said bus bars; **characterized in that**
a flexible section is provided between said connecting plate sections and said support section.
2. A bus bar connecting terminal as claimed in claim 1 **characterized in that** said flexible section is a section having a thickness less than the thickness of said connecting plate sections.
3. A bus bar connecting terminal as claimed in claim 1 or 2 **characterized in that** said support section is a conductor block member.
4. A bus bar connecting terminal as claimed in any one of claims 1 to 3 **characterized in that** said support section, said connecting plate sections and said flexible section are formed as a continuous integral conductor block.
5. A bus bar connecting terminal as claimed in claim 4 **characterized in that** said conductor block is the

one formed by cutting an extrusion-molded material having a cross section in a shape comprising said support section, said connecting plate section and said flexible section into a predetermined dimension.

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FIG. 1

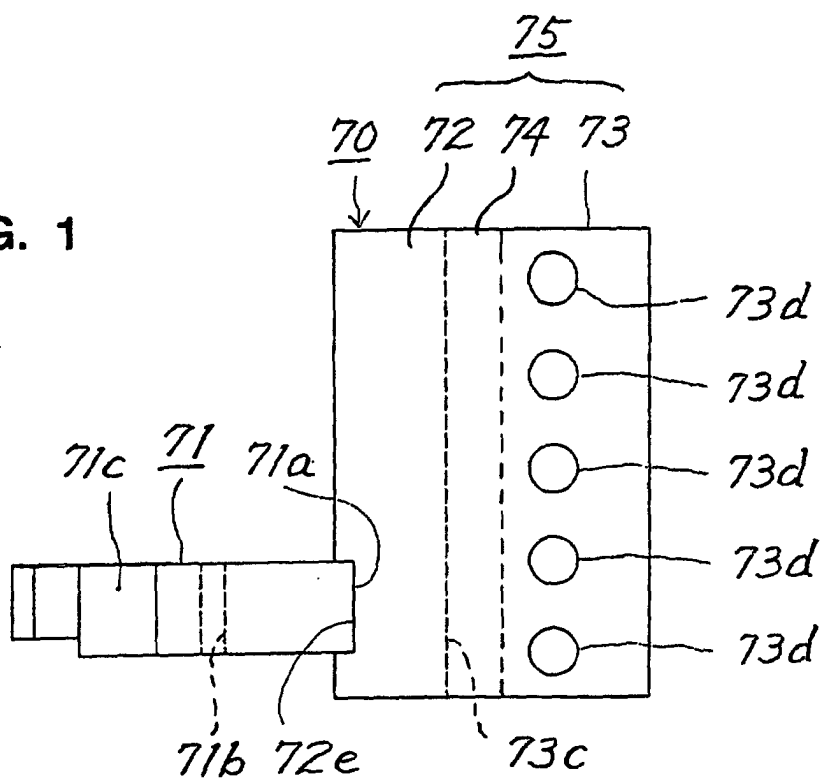


FIG. 2

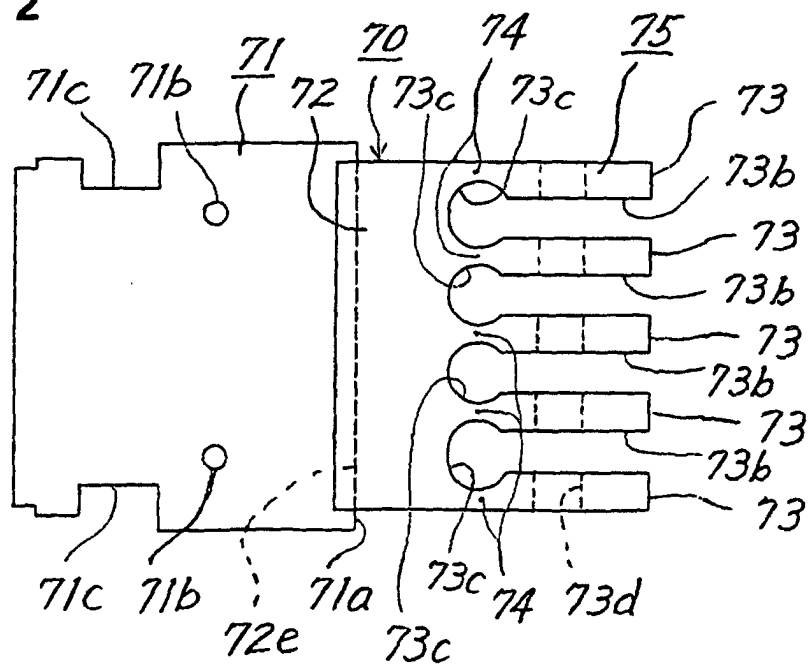


FIG. 3

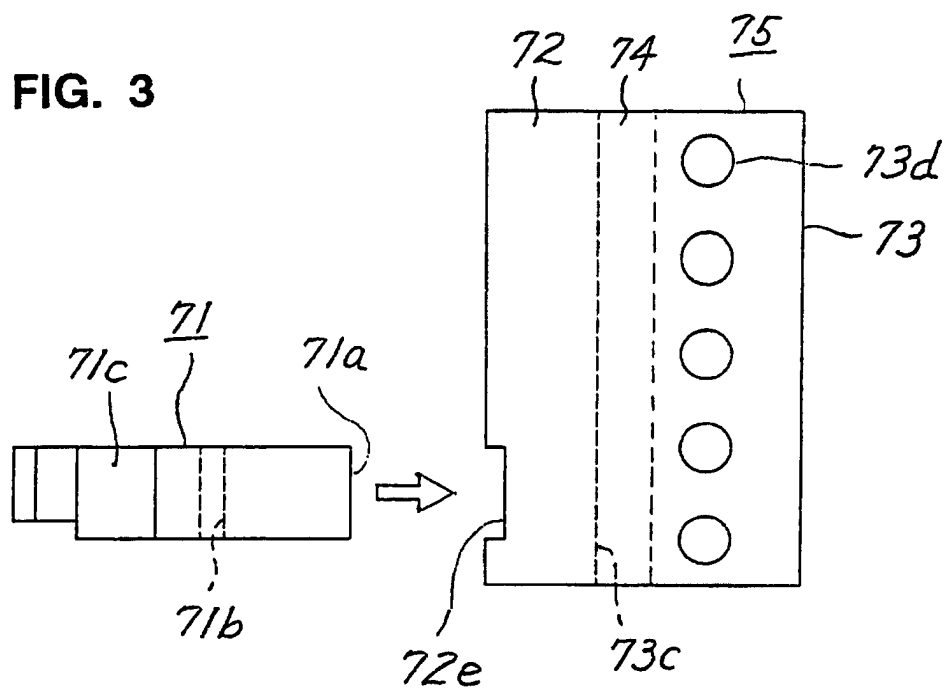


FIG. 4

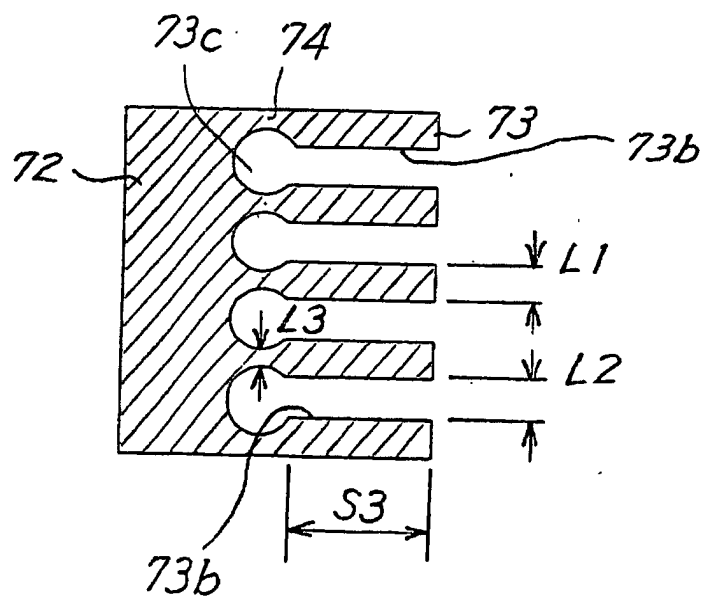


FIG. 5

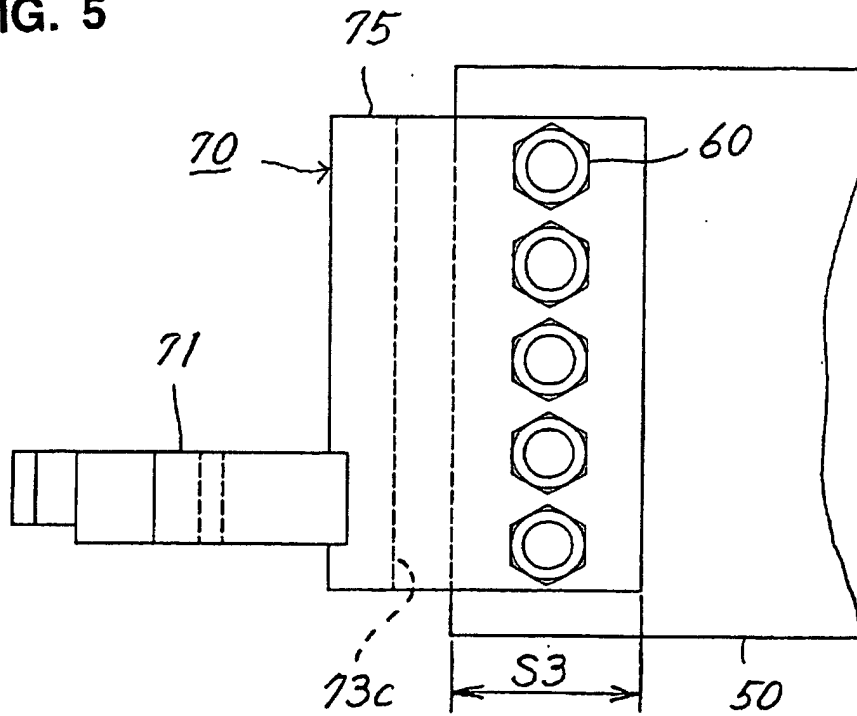


FIG. 6

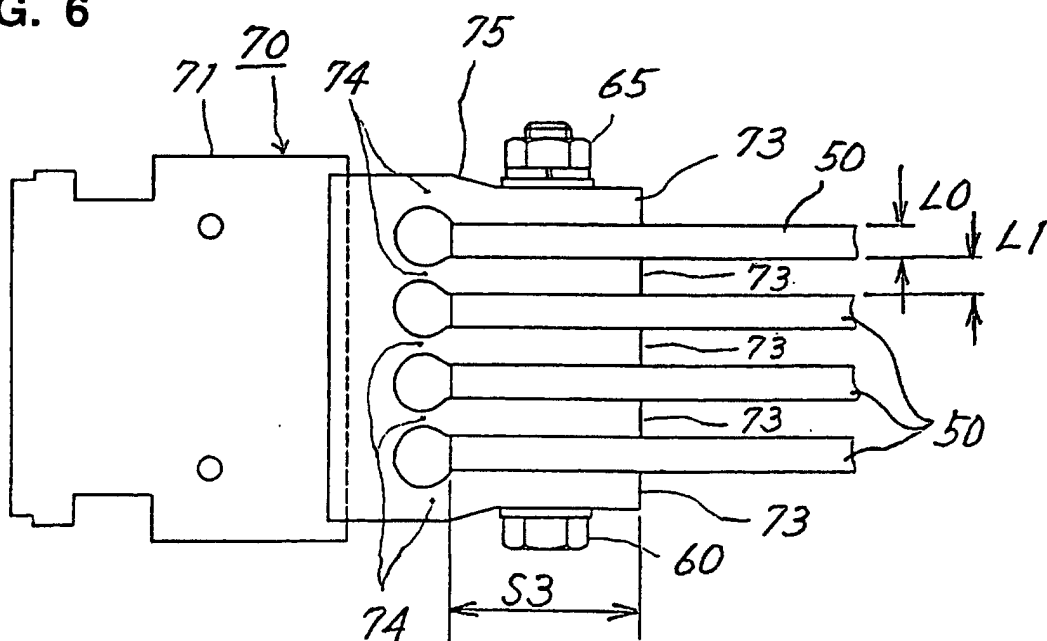


FIG. 7

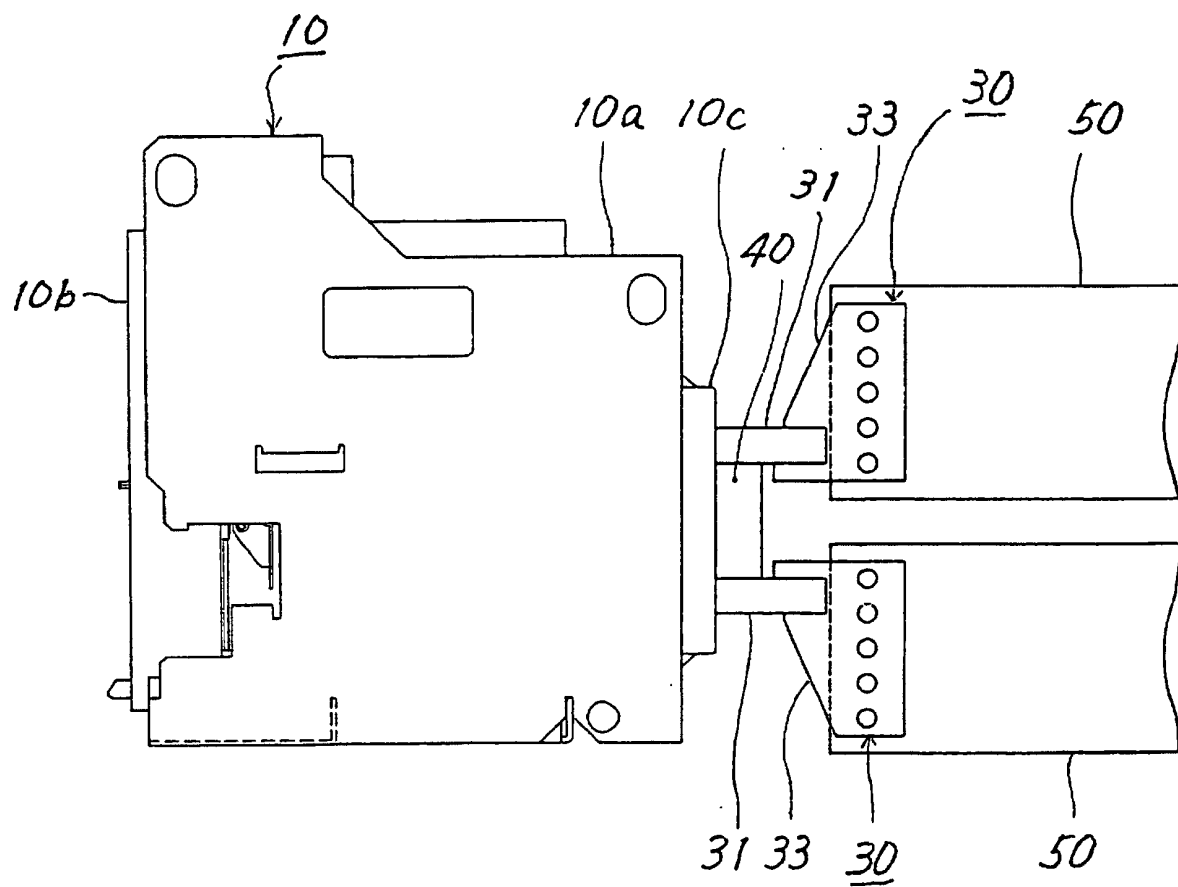


FIG. 8

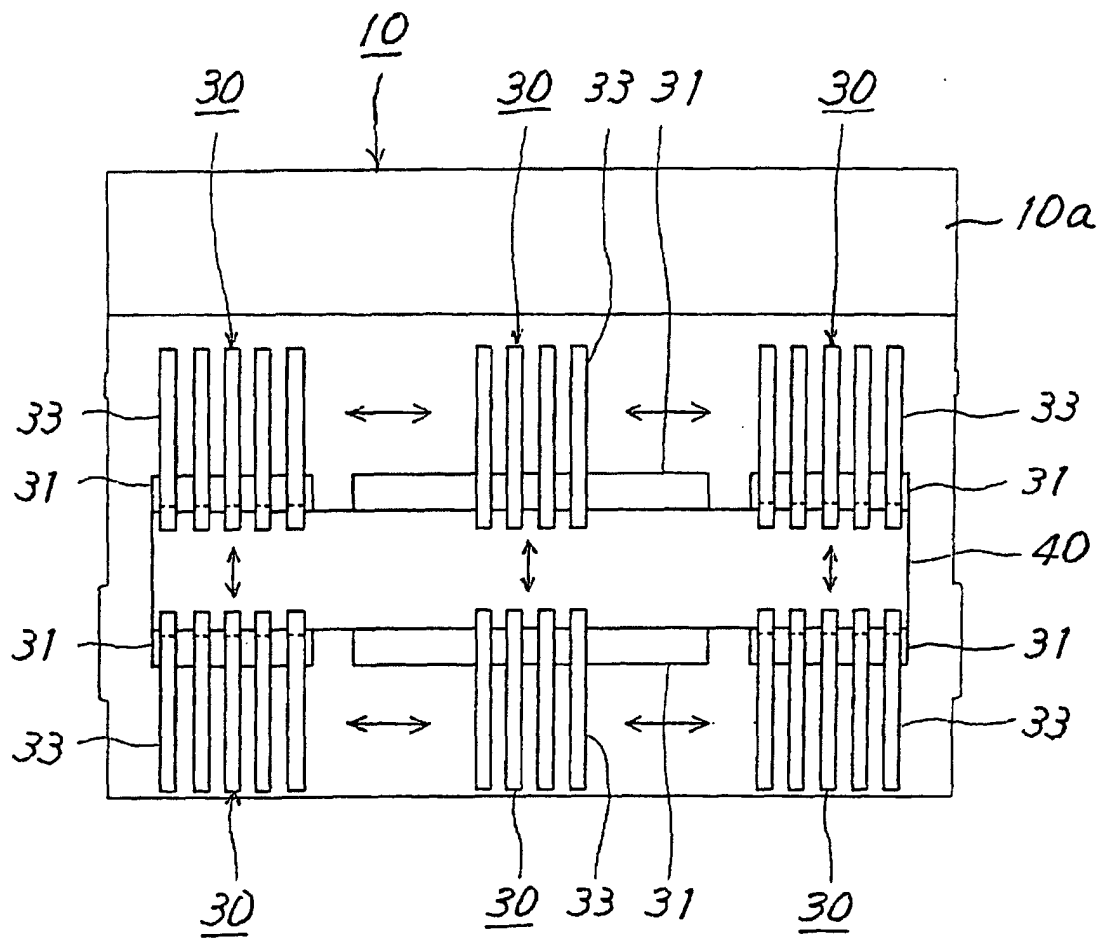


FIG. 9

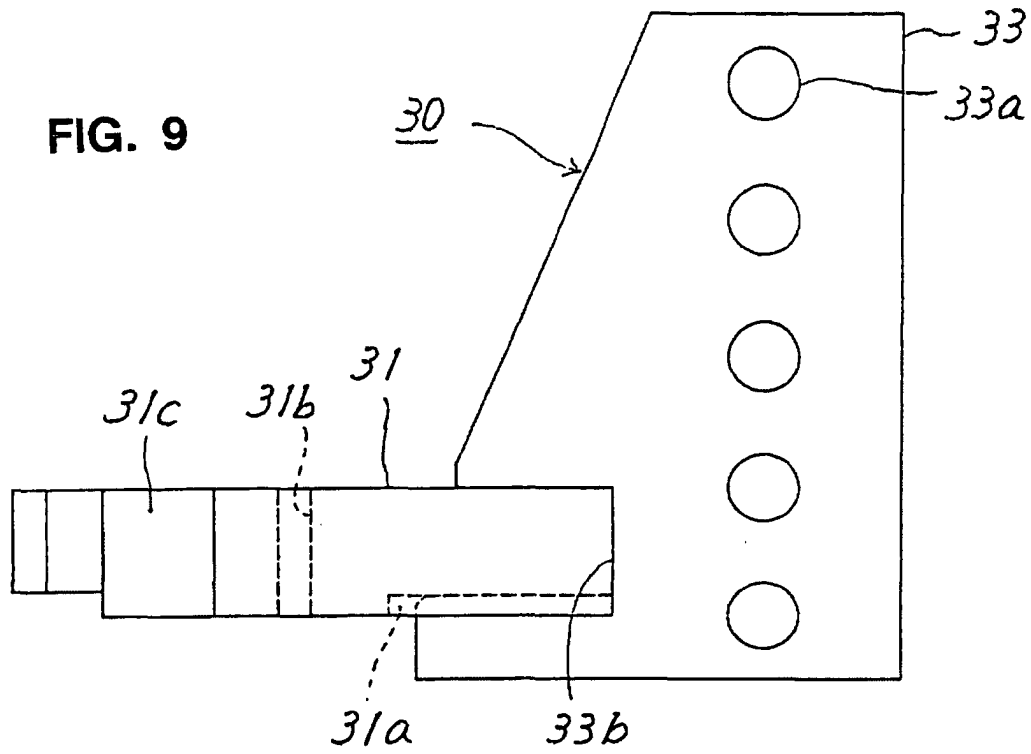


FIG. 10

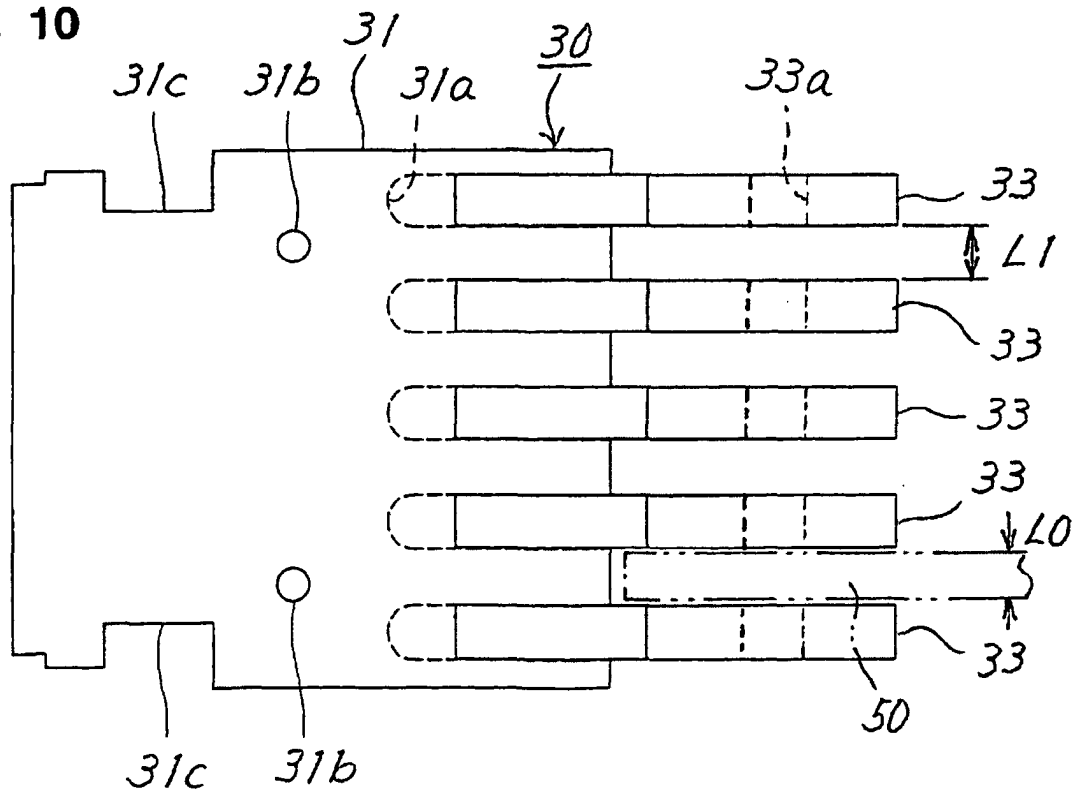


FIG. 11

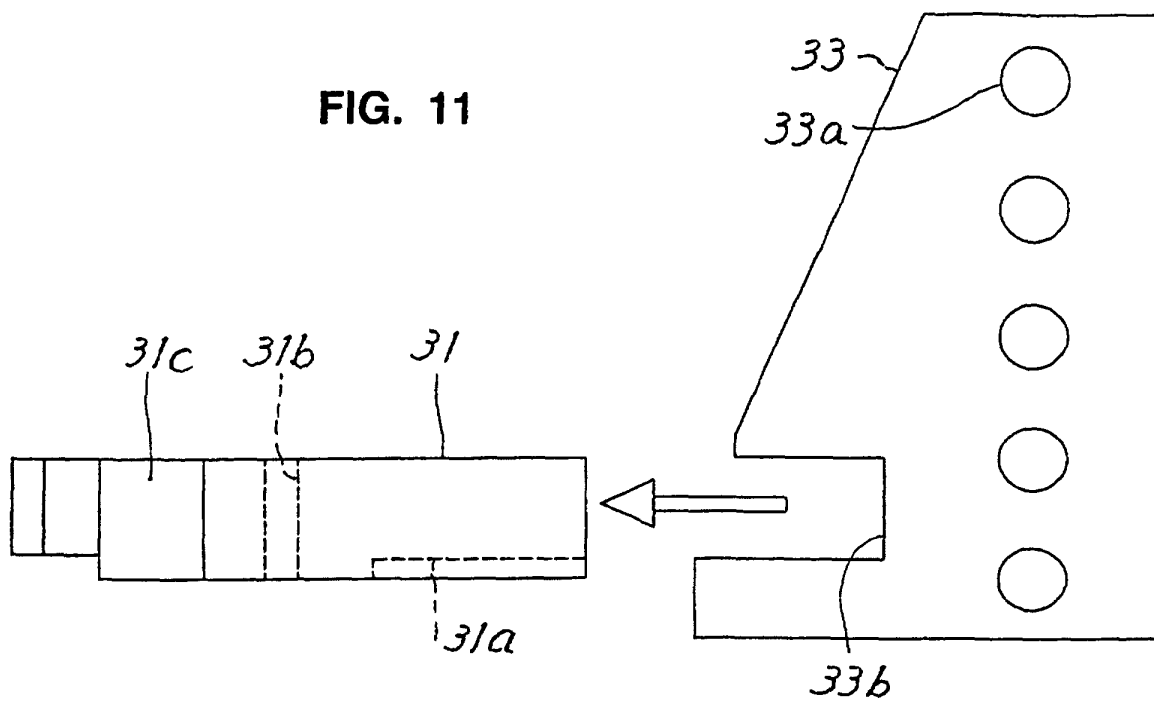
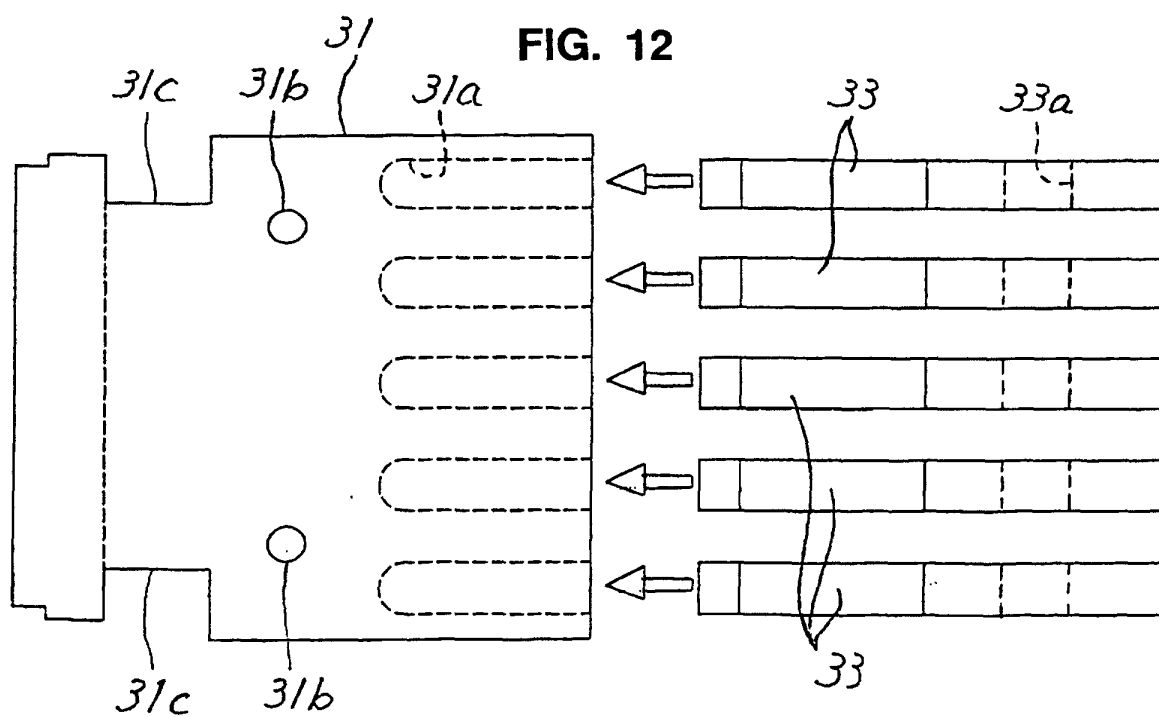


FIG. 12



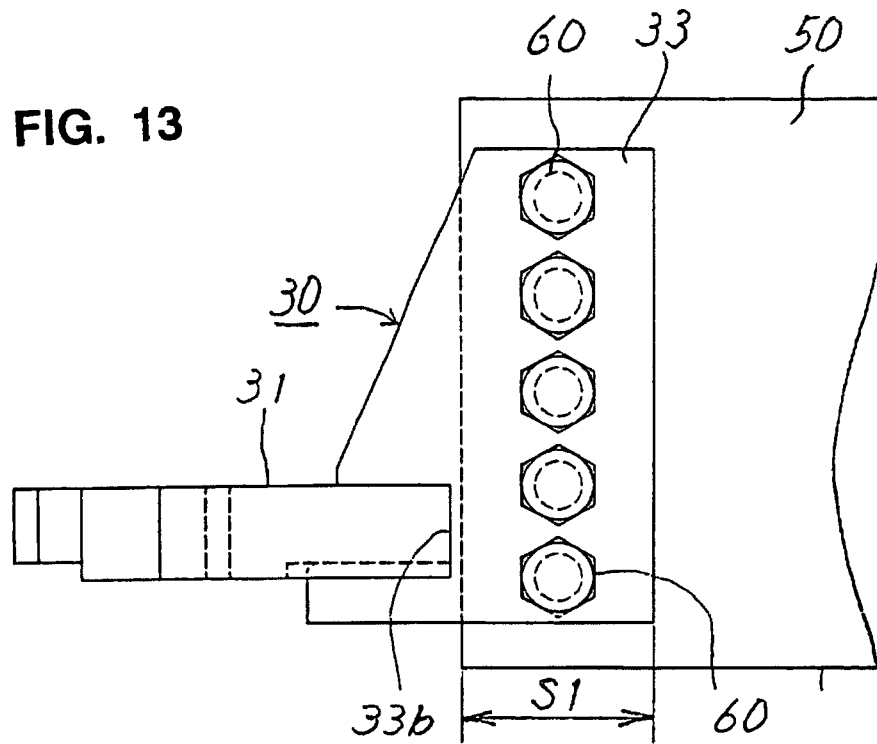
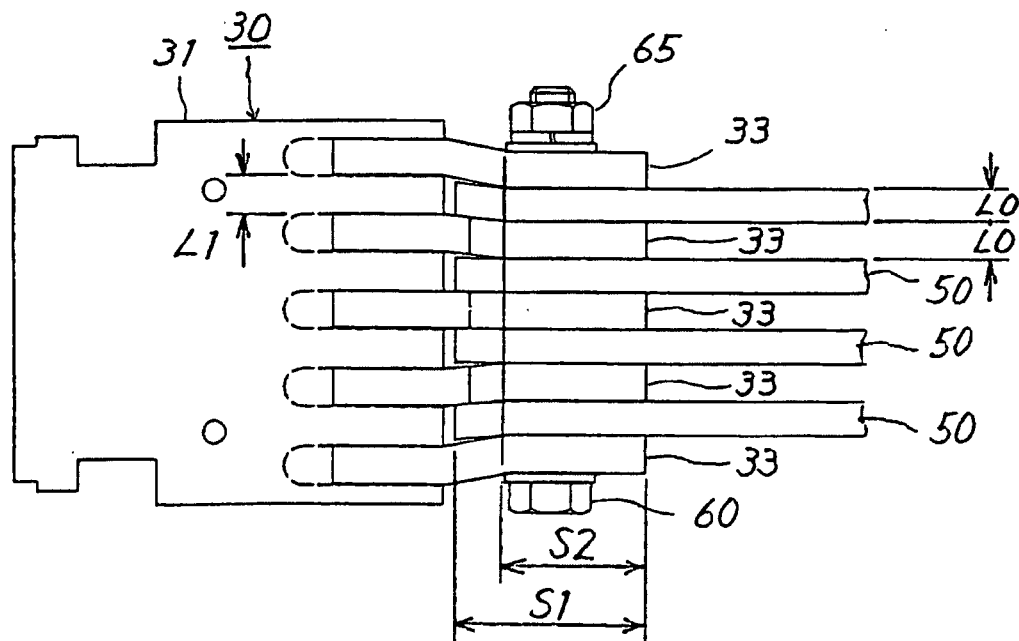


FIG. 14



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/05071

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ H02G5/06, H02B11/04, H01H1/38, H01R4/38 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) Int.Cl ⁷ H02G5/06, H02B11/04, H01H1/38, H01R4/38 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1940-1996 Toroku Jitsuyo Shinan Koho 1994-2001 Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 155271/1977 (Laid-open No. 79988/1979), (Fujitsu Limited), 06 June, 1979 (06.06.79), Full text; Figs. 1 to 4 (Family: none)	1
A		2-5
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 47214/1981 (Laid-open No. 159312/1982), (Mitsubishi Electric Corporation), 06 October, 1982 (06.10.82), Full text; Figs. 1 to 5 (Family: none)	1-5
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 48794/1993 (Laid-open No. 20012/1995), (Toshiba Corporation), 07 April, 1995 (07.04.95), Full text; Figs. 1 to 7 (Family: none)	1-5
☒ 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 document 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 16 August, 2001 (16.08.01)		Date of mailing of the international search report 04 September, 2001 (04.09.01)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/05071

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 39480/1985 (Laid-open No. 156414/1986), (Nissin Electric Co., Ltd.), 27 September, 1986 (27.09.86), Full text; Figs. 1 to 6 (Family: none)	1-5
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 83727/1984 (Laid-open No. 412/1986), (Fuji Electric Co., Ltd.), 06 January, 1986 (06.01.86), Full text; Figs. 1 to 4 (Family: none)	1-5
A	JP 59-207517 A (Fuji Electric Co., Ltd.), 24 November, 1984 (24.11.84), Full text; Figs. 1 to 6 (Family: none)	1-5

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