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

(11) Publication number: **0 299 487 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **88111344.3**

(51) Int. Cl.4: **H01R 23/66**

(22) Date of filing: **14.07.88**

(30) Priority: **15.07.87 JP 176929/87**

(43) Date of publication of application:
18.01.89 Bulletin 89/03

(84) Designated Contracting States:
DE FR GB IT NL

(71) Applicant: **MINNESOTA MINING AND MANUFACTURING COMPANY**
3M Center, P.O. Box 33427
St. Paul, Minnesota 55133-3427(US)

(72) Inventor: **Sagawara, Naoto c/o Minn. Min. and Manuf. Co.**
2501 Hudson Road P.O. Box 33427
St. Paul Minnesota 55133-3427(US)

(74) Representative: **Baillie, Iain Cameron et al**
c/o Langner Parry Isartorplatz 5
D-8000 München 2(DE)

(54) Electrical connector.

(57) An electrical connector having contacts disposed in a body, which contacts have terminations in one face disposed in two rows and in columns and the contacts have tail portions which protrude from the other face with the terminal ends thereof disposed in a single row and the contacts are disposed to form mirror images about a plane perpendicular to the rows and through a midpoint between contacts to reduce possible crosstalk.

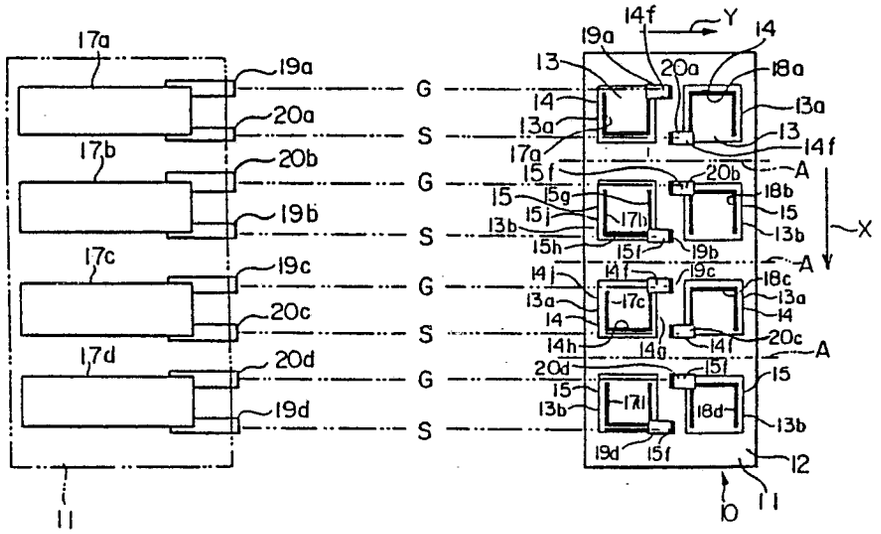


FIG.1

EP 0 299 487 A2

ELECTRICAL CONNECTOR

Background of the Invention

1. Field of the Invention

The present invention relates to an electrical connector, and, more particularly, to an electrical connector having two rows of connecting terminals or contactors, one end of each contactor having a bent and protruding tail portion which is disposed in such a manner that the tail portions as a whole are aligned in a row and at which the electrical connector is connected to a flat cable, in particular, to a flat cable for transmitting high speed pulse signals or those each having a short pulse width between computer mainframes or between a computer mainframe and any of its peripherals.

2. Description of the Prior Art

Figure 5 of the drawing shows a female connector 1 of the type described above which is used for high speed signal transmitting flat cable.

The connector 1 has two rows of connecting terminals or contractors 2a, 2b, 2c, 2d, 3a, 3b, 3c, and 3d. Contactors for signal lines 3a, 2b, 3c, and 2d and the contactors for ground lines 2a, 3b, 2c, and 3d among the two rows of contactors 2a, 2b, 2c, 2d, 3a, 3b, 3c, and 3d are located alternately or in a zigzag or checkerboard pattern when viewed from a side of the connector 1 to which pins are to be inserted. One end of each of the contactors of connector 1 is connected to a flat cable 4. In Figure 5, a reference symbol S indicates a signal line contactor, while G designates a ground line contactor. This alternate or checkerboard pattern arrangement of the signal line contactors or the signal lines S and the ground line contactors or the ground lines G is effective to reduce the crosstalk between the signal contactors or the signal lines. In the electrical connector described above, each contactor row is explained to have four contactors only for ease and clarification of the explanation. However, it may include five or more, or three or less, contactors.

In the known female connector 100 of the above-described type which is shown in Figures 6 and 7, connecting terminals or contactors 101a, 101b, 101c, 101d, 102a, 102b, 102c, and 102d, which respectively correspond to the connecting terminals or contactors 2a, 2b, 2c, 2d; 3a, 3b, 3c, and 3d of the connector 1 shown in Figure 5, are each formed of a bent metal sheet 103 having the same shape. The two rows of contactors are disposed in such a manner that those in one row correspond to those in the other row when they are turned by 180 degrees. In the conventional connector 100, tail portions 106a, 107a, 106b, 107b, 106c, 107c, 106d, and 107d bendingly protrude from the sides of the respective contactors 102a, ..., 102d, 103a, ..., 103d at which the contactors are connected to an external cable, in such a manner that they are aligned in a row. These tail portions are therefore aligned in the order of G, S, S, G, G, S, S, and G, as shown in Figure 6.

When the tail portions of the contactors are aligned in the manner shown in Figure 6, the tail portions for the signal lines are brought adjacent to each other, as in the case of the tail portions 107a and 106b or the tail portions 107c and 106d, increasing the possibility of occurrence of the crosstalk of signals to be transmitted through the adjacent respective tail portions.

The present invention is designed to obviate the above-described problem of crosstalk, and an object thereof is to provide an electrical connector which is so improved as to reduce the possibility of occurrence of crosstalk between the tail portions at which the contactors are connected to an external cable.

Summary of the Invention

The above-described object is achieved according to the present invention by providing an electrical connector having tail portions disposed at positions mirror symmetrical with each other around a mirror plane which is perpendicular to an extending direction of said row of tail portions and which passes through a midpoint between the connecting terminals adjacent to each other in the extending direction of said row.

In the electrical connector of this invention, since the tail portions are disposed at positions mirror symmetrical with each other around a mirror plane which is perpendicular to an extending direction of said row of said tail portions and which passes through a midpoint between the connecting terminals adjacent to each other in the extending direction of said row, the signal line tail portions in the bent and protruding tail portions aligned in a row are always positioned between the ground line tail portions, even if the two rows of connecting terminals are disposed in such a manner that the signal line terminals and the ground line terminals form a checkerboard pattern when viewed from the

side of contact of each connecting terminals (the side opposite to that at which the tail portions are provided), and therefore the possibility of occurrence of crosstalk between the signal line tail portions can be reduced.

Brief Description of the Drawing

Figure 1 is a side and front view of a connector, showing a preferred embodiment of the present invention;

Figure 2 is a perspective view of the connector of Figure 1, showing the structure and the arrangement thereof;

Figures 3 and 4 are exploded views of two types of contactor forming metal sheets which are employed in the connectors shown in Figures 1 and 2 and which are schematically shown in Figures 1 and 2, respectively;

Figure 5 is a perspective view of a female connector connected to a flat cable, as viewed from the side thereof to which pins are to be inserted;

Figure 6 is a view similar to Figure 1, showing a known prior art connector; and

Figure 7 is a view similar to Figure 2, showing the prior art connector of Figure 6.

Description of the Preferred Embodiment

A female electrical connector 10 according to the preferred embodiment of the present invention will be described with reference to Figures 1 to 4 (this connector looking just like the one shown in Figure 5, when viewed from the side for receiving pins).

A housing 11 of the electrical connector 10 is made of an electrically insulating plastic, and has substantially square column shaped through-holes 13 extending from one end surface 12 thereof to the other end surface (not shown). The through-holes 13 are the same in size and aligned in two rows at the equal spacings. More specifically, the two through-holes 13 in each pair of through-holes adjoin to each other in the direction perpendicular to the extending direction X of the through-hole rows. Each of a pair of through-holes 13a which are disposed alternately in the direction X of extension of each row, houses a first bent metal sheet 14, while the remaining through-holes 13b each accommodate a second bent metal sheet 15.

The first bent metal sheet 14 which is schematically shown in Figures 1 and 2 is a metal sheet pinched into a shape shown in Figure 3 and bent at broken lines 14a and 14b at right angles so that three side surfaces 14g, 14h and 14j out of four side surfaces which form a square tube constitute a female contact pressingly inserted into the corresponding through-hole 13a. A projection 14c which extends from the outer side of the end of the side surface 14g is bent at broken lines 14d and 14e at right angles. The projection 14c has a distal end or a tail portion 14f at which the connecting terminal or contactor is electrically connected to a wire such as a flat cable by soldering.

A second bent metal sheet 15 which is schematically shown in Figures 1 and 2 is a metal sheet punched into a shape shown in Figure 4 and bent at broken lines 15a and 15b at right angles so that three side surfaces 15g, 15h and 15j out of four side surfaces which form a square tube constitute a female contact pressingly inserted into the corresponding through-hole 13b. A projection 15c which extends from the inner side of one end of the side surface 15g is bent at broken lines 15d and 15e at right angles. The projection 15c has a distal end or a tail portion 15f at which the connecting terminal or contactor is electrically connected to a wire such as a flat cable by soldering.

While the projection 14c of each bent metal sheet 14 projects from the outer side of the one end of the side surface 14g, the projection 15c of each bent metal sheet 15 extends from the inner side of the one end of the side surface 15g, ie., from the vicinity of the broken line 15a. Therefore, the tail portions of the bent metal sheets are positioned mirror symmetrical with each other around or about a virtual mirror plane A which is perpendicular to the X direction and passes through a midpoint between the contactors adjacent to each other in the direction X. The tail portion 15f of each bent metal sheet 15 inserted into the through-hole 13b adjoins the tail portion 14f of the adjacent bent metal sheet 14 inserted into the through-hole 13a in the same row.

Connecting tail portions 19a, 19b, 19c, 19d; 20a, 20b, 20c, 20d of two rows of connecting terminals or contactors 17a, 17b, 17c, 17d; 18a, 18b, 18c, 18d of the connector 10 are aligned in a row. However, the tail portions 20a, 19b, 20c, and 19d for connecting signal lines do not adjoin to each other but are disposed between the corresponding tail portions 19a, 20b, 19c, and 20d for connecting ground lines. In other words, the tail portions are disposed as a whole in the order of G, S, G, S, ... with G and S disposed alternately and at the same spacing. In consequence, the possibility of crosstalks of signals which occur at the tail portions is reduced.

In addition, the tail portions which are connected to a flat cable or the like may be buried in a resin.

The connector of this invention may be connected to a coaxial ribbon cable instead of the flat

cable.

The bent body which forms a contactor may have any shape instead of that shown in Figures 1 to 4, so long as its tail portion is placed at a location shown in the figure and that it has three or four side surfaces which constitute a contact. The bent body may have the same expanded form.

If the spacings between the through-holes 13 are large compared with the size of the through-hole 13, the tail portions may be disposed at locations which are away from the ends of the through-holes in the X direction toward the intermediate portion thereof. If the size of the through-holes for the signal lines is different or it is different from that of the through-holes for the ground lines, the tail portions may be disposed in any way so long as the alternate arrangement of the S and G is ensured.

The contactor of this connector may be male in place of female.

Claims

1. In the electrical connector having two rows of connecting terminals, each of said connecting terminals having a tail portion which bendingly protrudes from one end thereof in such a manner that the tail portions as a whole are aligned in a row, and at which said connector is adapted to be electrically connected,
wherein said tail portions are disposed at positions mirror symmetrical with each other around a mirror plane which is perpendicular to an extending direction of said row of tail portions and which passes through a midpoint between the connecting terminals adjacent to each other in the extending direction of said row.

2. A connector according to claim 1, wherein the other end of each of said connecting terminals form a female contact.

3. A connector according to claim 1 or 2, wherein each of said connecting terminals is formed of a bent metal sheet.

4. In an electrical connector having two rows of connecting terminals, pairs of identical electrical contactors are disposed oppositely in adjacent rows and alternately with a contactor of a dissimilar pair of contactors in the rows, wherein said contactors have first terminal ends disposed in said rows and projecting tail portions opposite said first terminal portions for connection to wires of a cable.

5. In an electrical connector according to claim 4, wherein said pairs of contactors are formed of conductive metal sheets of two dissimilar patterns, each having a plurality of fold lines to form a female terminal on said first terminal ends and projecting tail portions which are disposed in a single row and plane at their other ends.

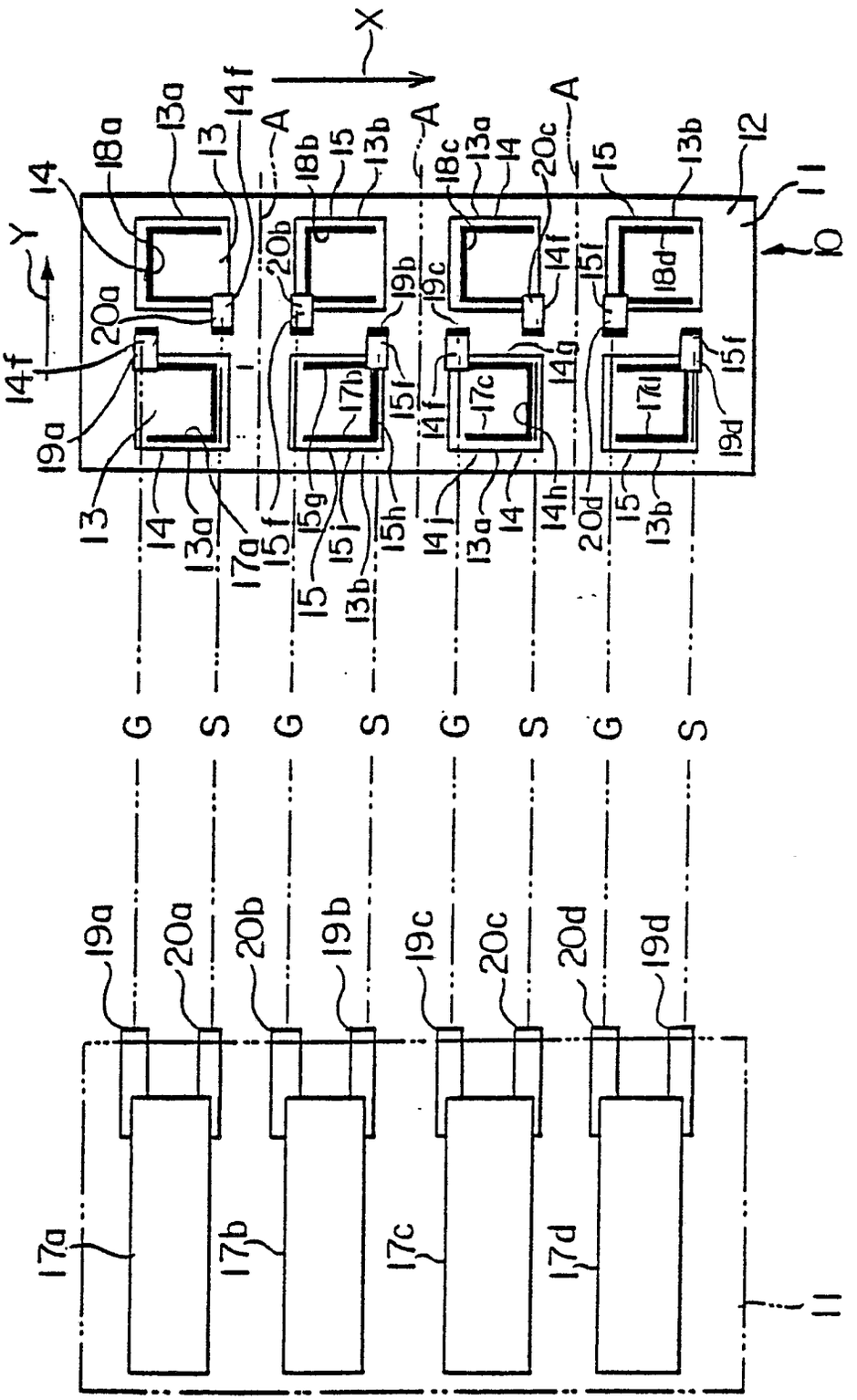

X
Y
A
A
G
S
G
S
G
S
G
S
10
11
11
12
13
13a
13b
14
14f
15
15f
17a
17b
17c
17d
18a
18b
18c
18d
19a
19b
19c
19d
20a
20b
20c
20d

FIG. 1

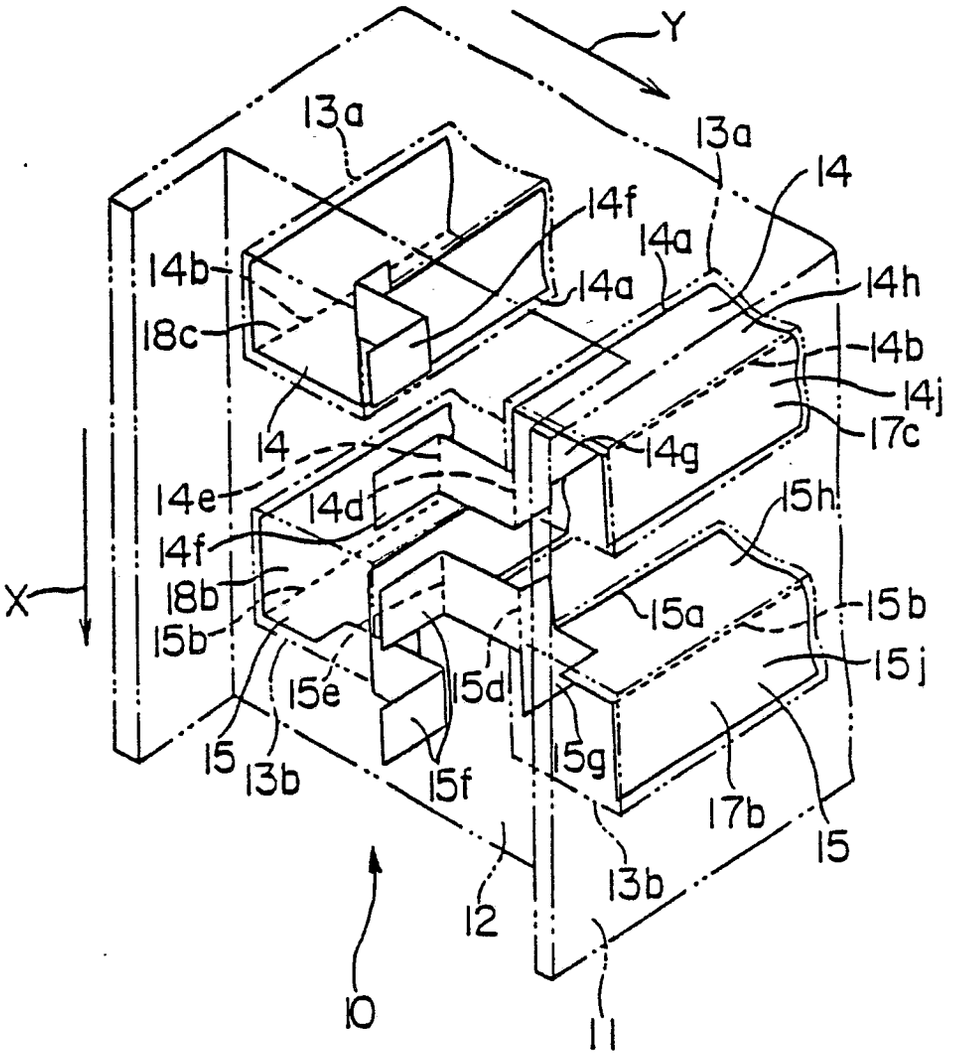

Y
13a
13a
14
14f
14a
14b
14a
14h
18c
14b
14j
17c
14
14g
14e
14d
15h
14f
18b
15a
15b
X
15b
15j
15e
15d
15
13b
15f
15g
17b
15
13b
12
10
11

FIG. 2

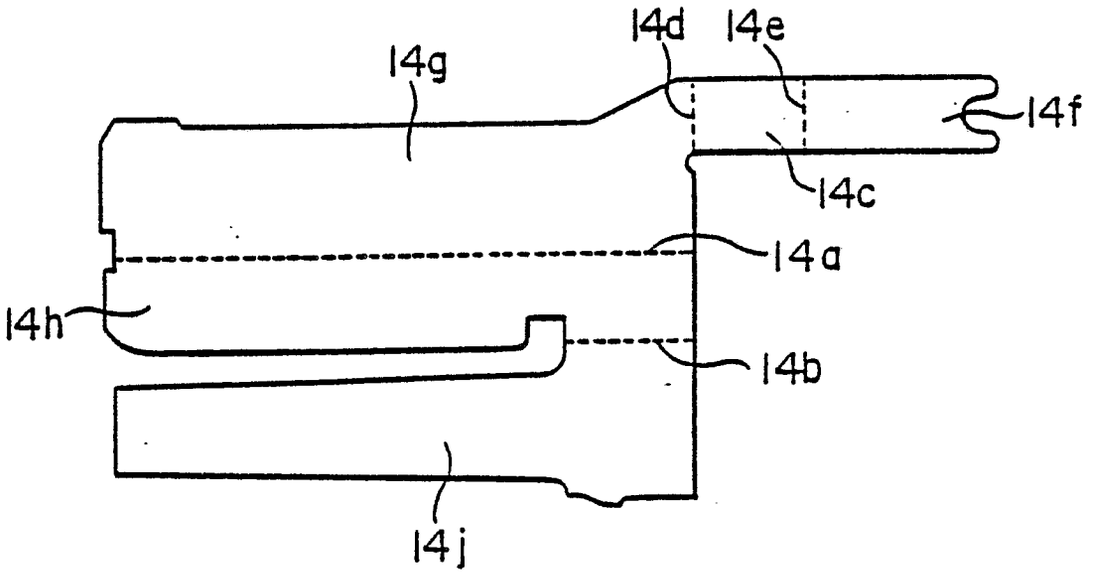

14d
14e
14g
14f
14c
14a
14h
14b
14j

FIG. 3

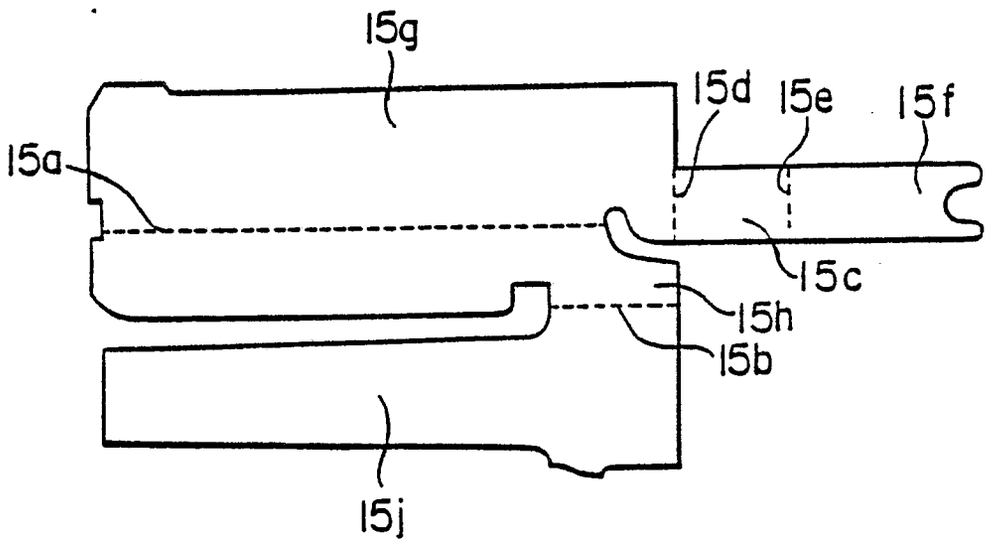

15g
15d
15e
15f
15a
15c
15h
15b
15j

FIG. 4

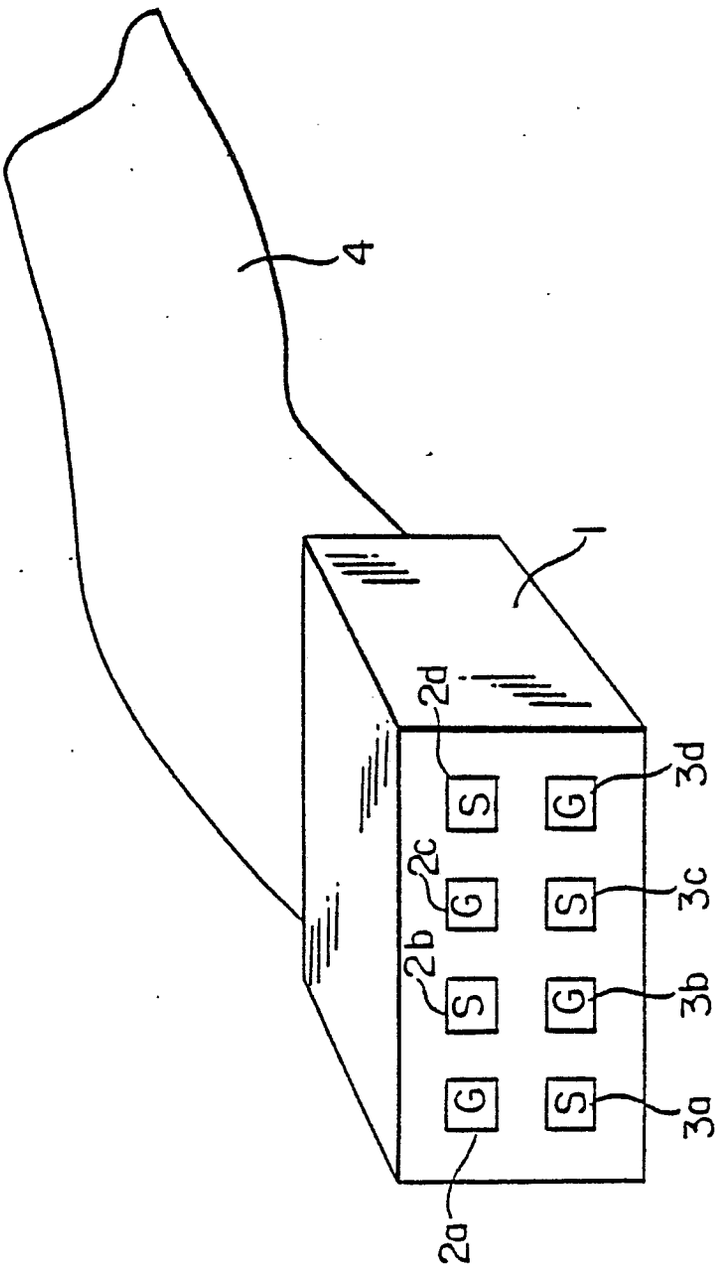


FIG.5

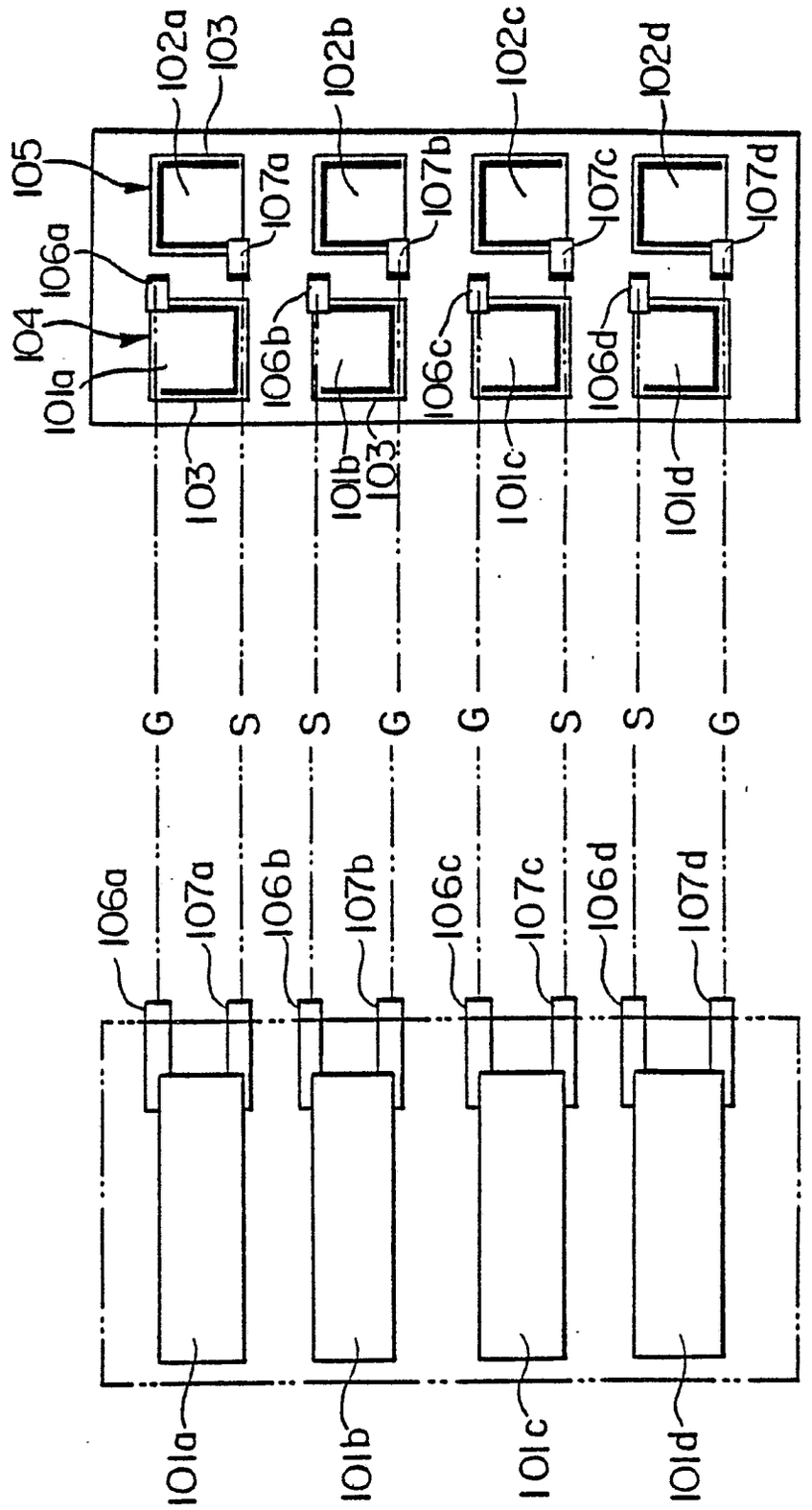

102a
103
102b
102c
102d
105
107a
107b
107c
107d
106a
104
101a
106b
106c
106d
103
101b
103
101c
101d
G
S
S
G
G
S
S
G
106a
107a
106b
107b
106c
107c
106d
107d
101a
101b
101c
101d

FIG. 6

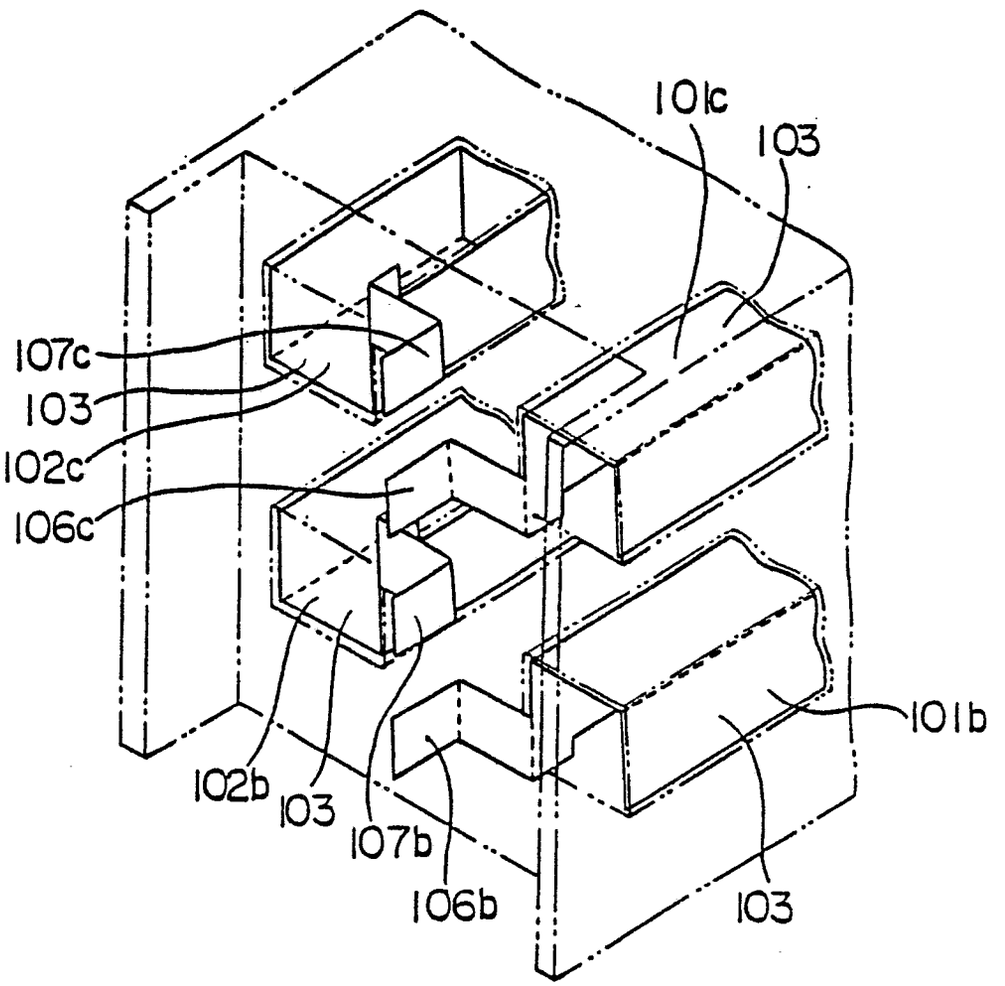


FIG. 7