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(54) Circuit board and circuit board assembly

Schaltungsplatte und Schaltungsplattenanordnung

Plaque de circuit et assemblage de plaques de circuit

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- **PATENT ABSTRACTS OF JAPAN vol. 15, no. 108 (E-1045), 14 March 1991 & JP 03 001598 A (KYUSHU HITACHI MAXELL), 8 January 1991,**

EP 0 722 264 B9

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to a circuit board and a circuit board assembly, and more particularly to a circuit board with a composition in which a wiring structure forming an electric circuit is covered by a resin layer and a circuit board assembly with a composition in which electrical parts and so on are mounted on the circuit board.

Description of the Related Art

[0002] A printed wiring board has a composition in which circuit patterns of thickness 35μ or 75μ made of electrolytic copper foil are formed on one side or both sides of a laminated insulating board (thickness 1mm - 3mm). Therefore, there are the problems that there are limits to the capacity of the current which can be passed in the circuit patterns, and that jumper wires are required at the solid crossing parts of the wiring. A circuit board proposed for solving the above problems has been disclosed in Japanese Patent JP 8064916-A.

[0003] As shown in Figure 23, this circuit board has a composition in which a wiring structure 1 which forms the circuit patterns is covered by a resin layer 2. As shown in Figure 24, wiring structure 1 has a configuration in which multiple wiring members 1a are assembled three-dimensionally. In the case of this composition, hole-shaped connecting parts 1b or lead units 1c are formed in wiring members 1a. When connecting small electrical parts to wiring structure 1, the terminals of the electrical parts are soldered to connecting parts 1b. Also, when connecting large electrical parts to wiring structure 1, the terminals of the electrical parts are inserted in lead units 1c for soldering.

[0004] However, with the above prior art composition, the height positions of connecting parts 1b are not uniform. Thus, the soldering work of small electrical parts cannot be carried out by using a printed wiring board solder bath facility. Therefore, it was necessary to solder the small electrical parts to connecting parts 1b one by one, either manually or by robots. Consequently, the workability of connecting the small electrical parts was poor. Moreover, after inserting the large electrical parts on lead units 1c, the soldering work was performed by turning the circuit board and the electrical parts upside down. As a result, the workability of connecting these electrical parts was even poorer.

[0005] FR-A-2638594 and US 3978375 disclose circuit boards which include a resin layer and a wiring structure buried in said resin layer, the wiring structure having connecting parts for soldered components and connecting holes for connecting components by inserting a fastening member.

SUMMARY OF THE INVENTION

[0006] Accordingly, one object of this invention is to provide a circuit board in which the workability of connecting electrical parts can be improved.

[0007] Another object of this invention is to provide a circuit board assembly in which the workability of connecting electrical parts can be improved.

[0008] Accordingly the present invention provides a circuit board assembly according to claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Figure 1 is a cross-section of a prior art circuit board assembly along the line A-A in Figure 2;
Figure 2 is an oblique view showing a prior art circuit board assembly;
Figure 3 is an oblique view showing a wiring structure shown in Figure 2;
Figure 4 is a cross-section of a circuit board assembly embodying the invention claimed;
Figure 23 is an oblique view showing a conventional circuit board; and
Figure 24 is an oblique view showing a conventional wiring structure in a circuit board shown in Figure 23.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, the embodiments of this invention will be described below.

[0011] The following is a description of a circuit board useful for understanding the principles of the invention, based on Figures 1 to 3. In Figure 2, first, four tapped holes 11a are formed in a molded body 11, which is equivalent to a "resin layer", and screws (not illustrated) are inserted in respective tapped holes 11a. Then, as shown in Figure 1, molded body 11 is secured to a device main body 12, such as a main body of an inverter device, by tightening screws into device main body 12.

Also, four supporting legs 11b (only two are shown) are incorporated with the underside of molded body 11. A space part 13 is formed between four supporting legs 11b and device main body 12.

[0012] A wiring structure 14 which forms the electric circuit is buried inside molded body 11. This wiring structure 14 is manufactured by cutting and bending a conductive metal plate and, as shown in Figure 3, has a configuration in which multiple wiring members 14a are

assembled three-dimensionally. Then, connecting parts 14b, which protrude downward, are formed in specified wiring members 14a respectively. As shown in Figure 1, these connecting parts 14b are arranged along the underside of molded body 11. By this means, they are exposed on the underside of molded body 11.

[0013] As shown in Figure 3, first connecting holes 14c are formed in each connecting part 14b of wiring structure 14. These first connecting holes 14c are formed by carrying out a punching process on wiring structure 14, and are arranged in connecting parts 14b along the underside of molded body 11. Also, as shown in Figure 2, two openings 11c are formed in molded body 11. As shown in Figure 1, connecting parts 14b of wiring structure 14 are exposed on the upper surface of molded body 11 by passing through openings 11c. Also, comparatively small electrical parts, such as a resistor 15 and small capacity capacitors 16 are provided, and terminals 15a of resistor 15 and terminals 16a of small capacity capacitors 16 are soldered to first connecting holes 14c of connecting parts 14b through openings 11c.

[0014] Here, molded body 11 is manufactured by insert molding processing, in which resin is injected in wiring structure 14 in a state in which wiring structure 14 is housed in a mold (not illustrated). The material used for molded body 11 is a thermoplastic resin which can sufficiently withstand the heat when resistor 15 and capacitors 16 are soldered. As the functions of molded body 11, the ensuring of the insulation distances of electrical parts which are connected to wiring structure 14, and the protection from vibration, etc. of the connecting parts between the electrical parts and wiring structure 14 can be cited.

[0015] Second connecting holes 14d which are equivalent to "connecting holes" are formed in wiring structure 14. These second connecting holes 14d are formed in wiring structure 14 by carrying out a punching process, and are arranged in the same horizontal plane which is above the plane of formation of connecting parts 14b. Also, multiple openings 11d are formed in the underside of molded body 11. Second connecting holes 14d are exposed on the underside of molded body 11 through openings 11d. Then, comparatively large electrical parts, such as a rectifier 17 and large capacity capacitors 18, are inserted into openings 11d of molded body 11.

[0016] As shown in Figure 2, multiple circular openings 11e are formed in the upper surface of molded body 11. As shown in Figure 1, second connecting holes 14d of wiring structure 14 are exposed on the upper side of molded body 11 through openings 11e. Then, screws 19 which is equivalent to "fastening members" are tightened into rectifier 17 and capacitors 18 through second connecting holes 14d of wiring structure 14 from openings 11e of molded body 11. By this means, rectifier 11 and capacitors 18 are connected to wiring structure 14.

[0017] The following is a description of the manufacturing order of the above circuit board. First, after wiring structure 14 is housed in a cavity of a mold, molded body 11 is formed by injecting molten resin into the cavity. Next, terminal 15a of resistor 15 and terminals 16a of capacitors 16 are inserted in first connecting holes 14c of wiring structure 14 through openings 11c of molded body 11. Then a simultaneous soldering process is automatically performed using a solder bath facility for printed wiring boards.

[0018] When resistor 15 and capacitors 1.6 have been connected, rectifier 17 and capacitors 18 are inserted in openings 11d of molded body 11. Then, screws 19 are automatically tightened in rectifier 17 and capacitors 18 through second connecting holes 14d of wiring structure 14 from openings 11e of molded body 11. After connecting rectifier 17 and capacitors 18 to wiring structure 14, screws (not shown) are inserted in tapped holes 11a of molded body 11. These screws are tightened into device main body 12.

[0019] When using the above circuit board a composition was used of arranging multiple connecting parts 14b on the underside (the surface) of molded body 11 and soldering resistor 15 and capacitors 16 to these connecting parts 14b. For this reason, it is possible to perform automatic simultaneous soldering work using the facility of a solder bath for printed wiring boards. Therefore, the inefficient work of soldering small electrical parts one by one using manual work or robots is eliminated. As a result, the workability of connecting small electrical parts is improved.

[0020] Also in this circuit board a composition was used of forming second connecting holes 14d in wiring structure 14 and automatically tightening screws 19 in rectifier 17 and capacitors 18 through second connecting holes 14d. For this reason, as opposed to prior art in which soldering was performed by inserting the large electrical parts into lead units, automatic connection work is possible for large electrical parts, such as rectifier 17 and capacitors 18. Therefore, coupled with the automatic soldering work for small electrical parts, such as resistor 15 and capacitors 16, the connecting work for large electrical parts can be fully automated. Thus, the workability of connecting electrical parts is further improved. Also, as multiple connecting holes 14d are arranged in the same horizontal plane, there is also the advantage that the automatic tightening work for screws 19 becomes simpler to perform.

[0021] The following is a description of an embodiment of this invention based on Figure 4. The same symbols have been assigned to members which are the same as in the above description, and their descriptions have been omitted. The following is a description only of those members which are different. The positions of second connecting holes 14d of wiring structure 14 are vertically shifted according to the height dimension difference of rectifier 17 and capacitors 18, so that the lower surfaces of rectifier 17 and capacitors 18 are in the same plane. Furthermore, supporting legs 11b of molded body 11 are eliminated.

[0022] The height positions of these second connect-

ing holes 14d are adjusted based on alteration of the bending positions of wiring members 14a. The underside of rectifier 17 is secured to device main body 12 by tightening screws 20, which are equivalent to "securing members", into device main body 12. Also, the undersides of capacitors 18 are secured to device main body 12 via mounts 21, which are equivalent to "securing members", by tightening screws 20 into device main body 12.

[0023] When using the above embodiment, the positions of second connecting holes 14d are adjusted according to the difference of height dimensions of rectifier 17 and capacitors 18. The undersides of rectifier 17 and capacitors 18 are secured to the stable surface (the flat portion) of device main body 12. For this reason, both the top and bottom sides of rectifier 17 and capacitors 18 are stably supported, respectively.

[0024] Therefore, despite the fact that rectifier 17 and capacitors 18 are large and heavy, even if external forces, such as vibration or shocks, act on device main body 12, no stresses such as vibration will act on the connecting parts between rectifier 17 and second connecting holes 14d or on the connecting parts between capacitors 18 and second connecting holes 14d. As a result, the connecting parts of rectifier 17 and the connecting parts of large capacity capacitors 18 are protected. Therefore, the reliability of the whole device is improved. Moreover, as molded body 11 is supported by rectifier 17 and capacitors 18, there is also the advantage that supporting legs 11b of molded body 11 can be eliminated.

[0025] In the embodiment above, rectifier 17 and capacitors 18 are secured to device main body 12 with screws 20. However, this invention is not restricted to these embodiments. For instance, riveting may be used instead of using screws 20.

[0026] Furthermore, in the embodiment above, rectifier 17 is directly secured to device main body 12. However, this invention is not limited to these embodiments. Rectifier 17 may be secured via a mount in the same way as for capacitors 18.

[0027] Also, in the above embodiment, screws 19 are given as examples of "fastening members". However, this invention is not limited to these embodiments. For instance, rivets may also be used instead of screws 19.

[0028] Moreover, in the above embodiment, multiple connecting parts 14b are positioned along the underside of molded body 11. However, this invention is not limited to this embodiment. They may be on the upper surface or on the side surface, of molded body, instead of the underside of molded body 11.

[0029] Furthermore, in the above embodiment, second connecting holes 14d are formed as hole shapes. However, this invention is not limited to these embodiments. For instance they may also be formed as tapped hole shapes, instead.

[0030] As is clear from the above description, the circuit board and the circuit board assembly of this invention exhibit the following effects. Electrical parts can be soldered simultaneously to multiple connecting parts by using a solder bath for printed wiring boards. Moreover, electrical parts can be connected by the automatic insertion of their fastening members into the connecting holes. For this reason, the work of connecting electrical parts can be fully automated, thus improving the workability of connection work.

Claims

1. A circuit board assembly comprising:

a wiring layer embedded in a resin body having opposed outer surfaces, the wiring layer comprising at least one conductive strip member (14), said strip member being formed with a stepped structure so as to provide at least two regions which are at different distances from the outer surfaces of the resin body,
said wiring layer including at least one connecting part (14b) in a surface of said resin body for soldering a first electrical component (15, 16) and at least one connecting hole (14c) for connecting a first electrical component by inserting an electrical component terminal (15a, 16a);
said resin body having openings (11d,11e) formed in at least one of its surfaces leaving exposed said at least two regions of the conducting strip at correspondingly different depths in the resin body,
two second electrical components (17,18)

characterised in that
said second electrical components are connected one each to each one of said at least two regions of the stepped structure,
and **in that** the two second electrical components (17,18) are of different heights, the height dimension being defined as the distances between a first surface of the electrical component body adjacent the connected region and an opposite second surface of the electrical component body,
whereby the second surfaces of the bodies of said two second electrical components (17, 18) lie in the same plane and protrude by equal amounts from one surface of the resin body.

2. A circuit board assembly according to claim 1 wherein first electrical component openings (11c) are formed in at least one surface of the resin body in correspondence of the at least one connecting part (14b) and the at least one connecting hole (14c), and of a suitable depth to enable the first electrical components to be partly or completely recessed into the resin body.

3. A circuit assembly according to claim 1 comprising a further mounting board to which the second surface

of each of the bodies of the at least two said second electrical components (17,18) are attached.

4. A circuit assembly according to any preceding claim comprising a plurality of stepped conductive strip members for interconnecting corresponding groups of components, the conductive strip members extending through the resin body in different directions to interconnect each corresponding group of components.

5. A circuit assembly according to any one of the preceding claims wherein said first electrical components (15, 16) are comparatively small electrical parts and second electrical components (17,18) are comparatively large electrical parts.

6. A circuit assembly according to any one of the preceding claims wherein each of the second electrical components is connected to the respective region by a fastening member.

7. A circuit assembly according to claim 5 wherein the fastening member is one of a screw or a rivet.

Patentansprüche

1. Leiterplattenanordnung, aufweisend:

eine Verdrahtungslage, eingebettet in einen Harzkörper mit entgegengesetzten äußeren Oberflächen, wobei die Verdrahtungslage aufweist wenigstens ein leitendes Streifenglied (14), wobei das Streifenglied gebildet ist mit einer stufigen Struktur, um so wenigstens zwei Regionen bereitzustellen, die in unterschiedlichen Abständen von den äußeren Oberflächen des Harzkörpers angeordnet sind,

wobei die Verdrahtungslage beinhaltet wenigstens ein Verbindungsteil (14b) in einer Oberfläche des Harzkörpers zum Löten einer ersten elektrischen Komponente (15,16) und wenigstens ein Verbindungsloch (14c) zum Verbinden einer ersten elektrischen Komponente durch Einsetzen eines elektrischen Komponententerminals (15a, 16a) ;
wobei der Harzkörper Öffnungen (11d,11e) aufweist, die gebildet sind in wenigstens einer der Oberflächen, an wenigstens zwei Regionen des Leitstreifens ausgesetzt gelassen an korrespondierend unterschiedlichen Tiefen im Harzkörper,
zwei zweite elektrische Komponenten (17,18), **dadurch** gekennzeichent, daß
jede der zweiten elektrischen Komponenten mit jeder der wenigstens zwei Regionen der gestuften Struktur verbunden sind,
und daß die zwei zweiten elektrischen Komponenten (17,18) von unterschiedlicher Höhe sind, wobei die Höhendimensionierung definiert ist als die Distanzen zwischen einer ersten Oberfläche des elektrischen Komponentenkörpers, angrenzend an die verbundene Region, und einer gegenüberliegenden zweiten Oberfläche des elektrischen Komponentenkörpers,
wobei die zweiten Oberflächen der Körper der zwei zweiten elektrischen Komponenten (17,18) in der gleichen Ebene liegen und sich über gleiche Beträge von einer Oberfläche des Harzkörpers erstrecken.

2. Leiterplattenanordnung nach Anspruch 1, wobei die ersten elektrischen Komponentenöffnungen (11c) gebildet sind in wenigstens einer Oberfläche des Harzkörpers in Korrespondenz zu dem wenigstens einen Verbindungsteil (14b) und dem wenigstens einen Verbindungsloch (14c) und von einer passenden Tiefe, um es den ersten elektrischen Komponenten zu ermöglichen teilweise oder vollständig im Harzkörper eingebaut zu sein.

3. Leiterplattenanordnung nach Anspruch 1, aufweisend eine weitere Montageplatte, zu der die zweite Oberfläche von jedem der Körper von den wenigstens zwei zweiten elektrischen Komponenten (17,18) angebracht ist.

4. Leiterplattenanordnung nach einem der vorhergehenden Ansprüche, aufweisend eine Mehrzahl an gestuften leitenden Streifengliedern zum Verbinden entsprechender Komponentengruppen, wobei die leitenden Streifenglieder sich in unterschiedliche Richtungen durch den Harzkörper erstrecken, um jede entsprechende Komponentengruppe zu verbinden.

5. Leiterplattenanordnung nach einem der vorhergehenden Ansprüche, wobei die ersten elektrischen Komponenten (15,16) vergleichsweise kleine elektrische Teile und zweite elektrische Komponenten (17,18) vergleichsweise große elektrische Teile sind.

6. Leiterplattenanordnung nach einem der vorhergehenden Ansprüche, wobei jede der zweiten elektrischen Komponenten verbunden ist mit der entsprechenden Region mittels eines Befestigungsgliedes.

7. Leiterplattenanordnung nach Anspruch 5, wobei das Befestigungsglied eine Schraube oder eine Niete ist.

Revendications

1. Plaque de circuit comprenant :

une couche de câblage incorporée dans un

corps en résine ayant des surfaces extérieures opposées, la couche de câblage comprenant au moins un élément (14) conducteur en forme de bande, l'élément en forme de bande étant conformé en ayant une structure en escalier de manière à ménager au moins deux régions qui sont à des distances différentes des surfaces extérieures du corps en résine ;
la couche de câblage comprenant au moins une partie (14b) de connexion dans une surface du corps en résine pour souder un premier composant (15, 16) électrique et au moins un trou (14c) de connexion pour connecter un premier composant électrique en insérant une borne (15a, 16a) de composant électrique ;
le corps en résine ayant des ouvertures (11d, 11e) formées dans au moins l'une de ses surfaces laissant exposer les au moins deux régions de la bande conductrice à des profondeurs différentes de manière correspondante dans le corps de résine ;
deux deuxièmes composants (17, 18) électriques,

caractérisée en ce que les deuxièmes composants électriques sont reliés chacun à chacune des au moins deux régions de la structure en escalier et **en ce que** les deux deuxièmes composants (17, 18) électriques sont de hauteur différente, la dimension en hauteur étant définie comme la distance entre une première surface du corps du composant électrique voisine de la région connectée et une deuxième surface opposée du corps de composant électrique ;
les deuxièmes surfaces des corps des deuxièmes composants (17, 18) électriques étant dans le même plan et faisant saillie de quantités équivalentes d'une surface du corps de résine.

2. Plaque de circuit suivant la revendication 1, dans laquelle des premières ouvertures (11c) de composants électriques sont formées dans au moins une surface du corps en résine en correspondance avec la au moins une partie (14b) de connexion et le au moins un trou (14c) de connexion et d'une profondeur appropriée pour permettre aux premiers composants électriques d'être en retrait en tout ou partie dans le corps de résine.

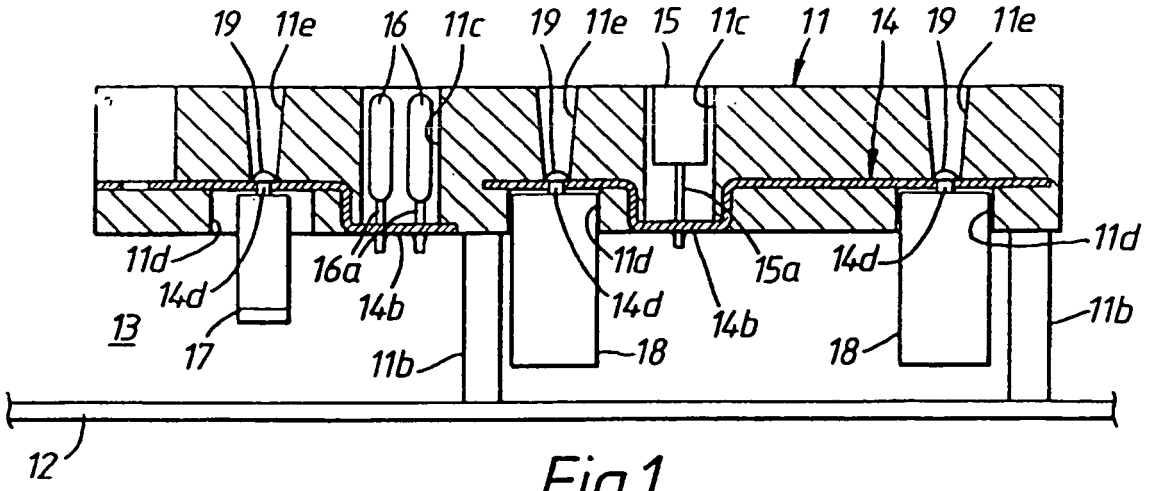
3. Plaque de circuit suivant la revendication 1 comprenant, en outre, une plaque de montage à laquelle sont reliées la deuxième surface de chacun des corps des au moins deux deuxièmes composants (17, 18) électriques.

4. Plaque de circuit suivant l'une quelconque des revendications précédentes comprenant une pluralité d'éléments conducteurs en forme de bande en escalier pour interconnecter des groupes correspondants de composants, les éléments conducteurs en forme de bande s'étendant dans le corps de résine dans des directions différentes pour interconnecter chaque groupe correspondant de composants.

5. Plaque de circuit suivant l'une quelconque des revendications précédentes, dans laquelle les premiers composants (15, 16) électriques sont des pièces électriques relativement petites et les deuxièmes composants (17, 18) électriques sont des pièces électriques relativement grandes.

6. Plaque de circuit suivant l'une quelconque des revendications précédentes, dans laquelle chacun des deuxièmes composants électriques est relié à la région respective par un élément de fixation.

7. Plaque de circuit suivant la revendication 5, dans laquelle l'élément de fixation est l'un d'une vis ou d'un rivet.


19
11e
16
11c
19
11e
15
11c
11
14
19
11e
11d
14d
13
17
16a
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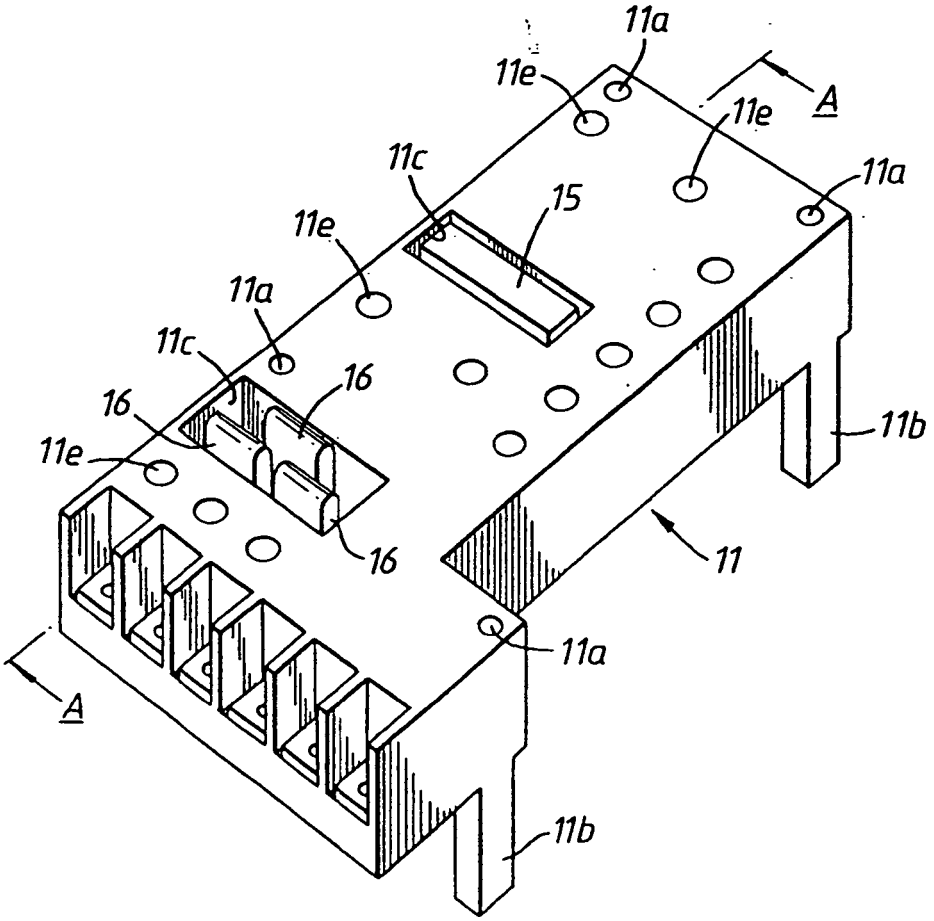
18
11d
14d
14b
15a
14d
18
11d
11b
12

Fig.1


11a
11e
A
11e
11c
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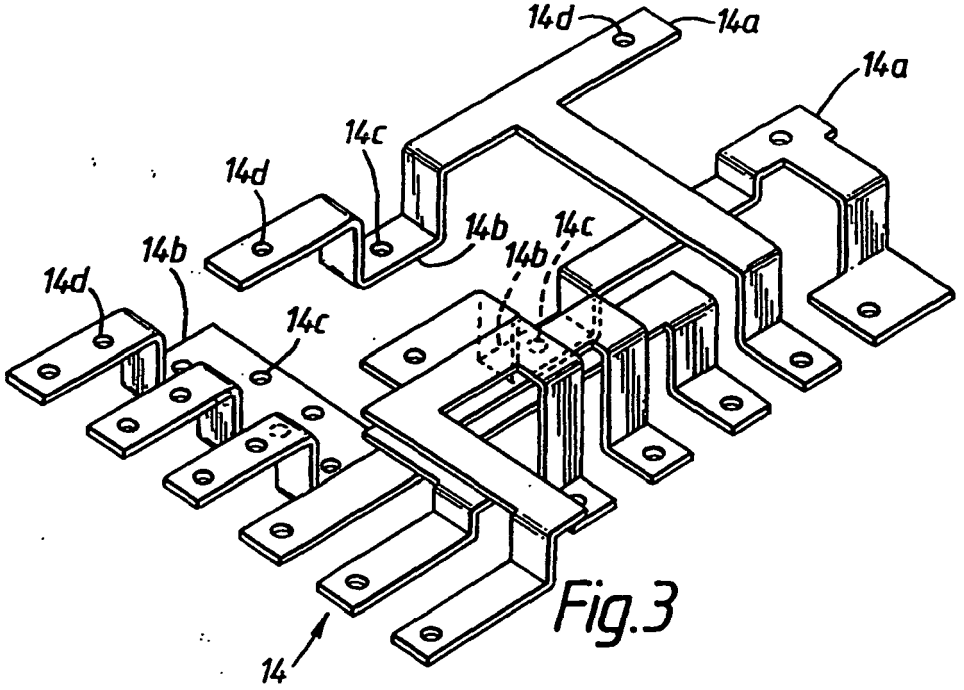
15
11e
11a
11c
16
16
11e
16
11b
11
11a
A
11b

Fig.2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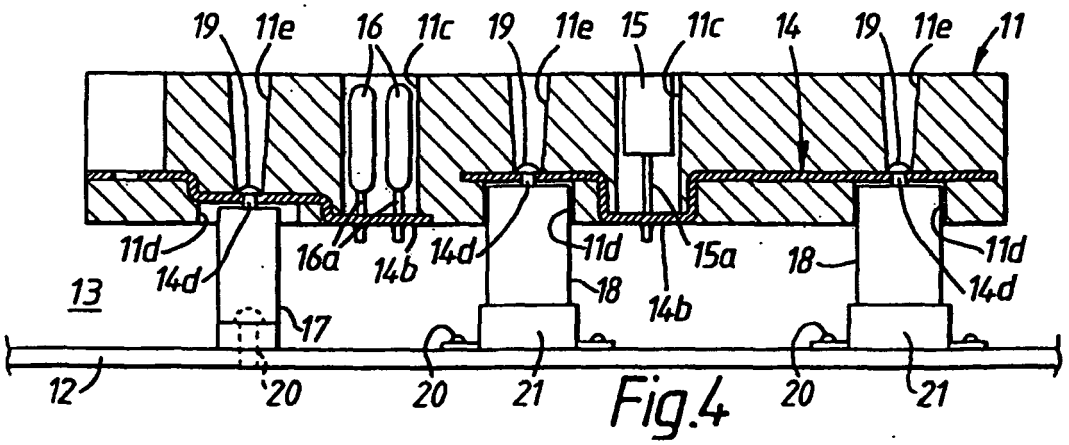
14a
14c
14d
14b
14b
14c
14d
14b
14c
14
Fig.3


19
11e
16
11c
19
11e
15
11c
14
19
11e
11
11d
14d
16a
14b
14d
11d
15a
18
11d
14d
13
18
14b
17
12
20
20
21
20
21
Fig.4

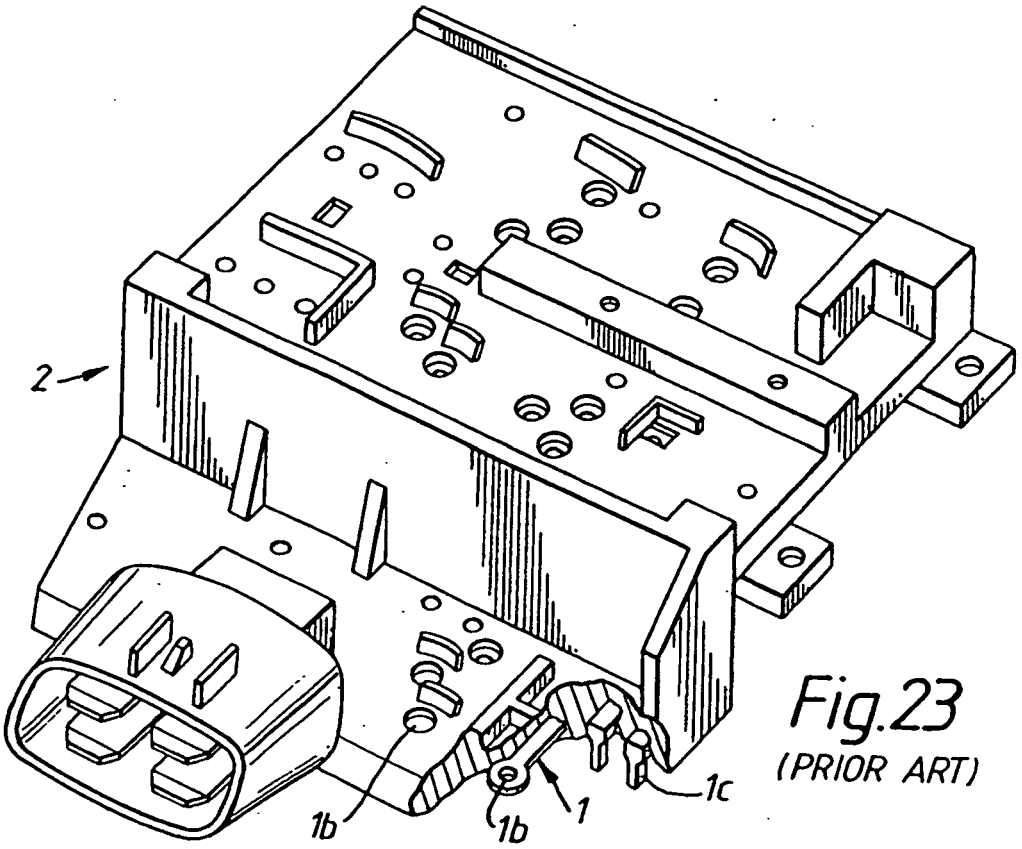


Fig.23
(PRIOR ART)

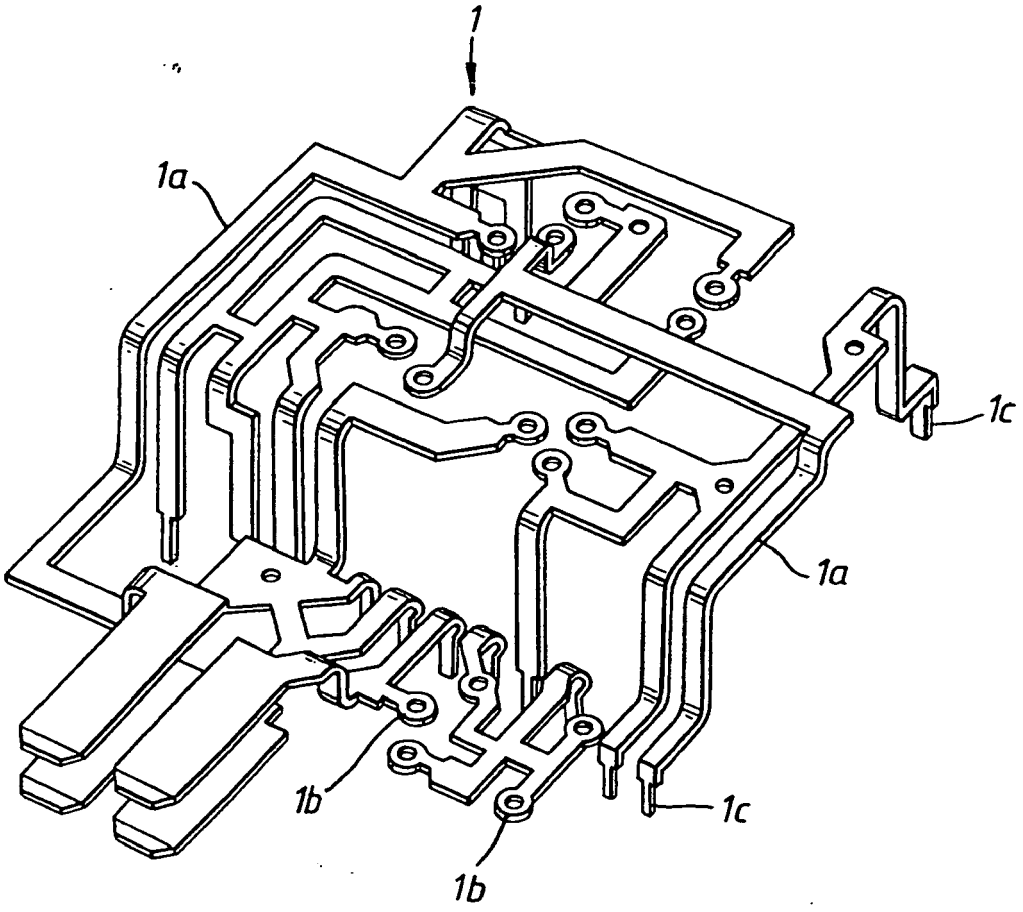


Fig. 24

(PRIOR ART)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 8064916 A **[0002]**
- FR 2638594 A **[0005]**
- US 3978375 A **[0005]**