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(54) Electric connector

(57) A connector for branching a two- or three-wire VVF cable (3') from an existing one (3) has two or three contacts (1) of a conductive metal and a connector body (2) of a plastics. The inverted-U shaped contacts are each composed of two parallel unit pieces (1a) each having two spaced-apart slits (11) for piercing an external insulating mantle (31) and an internal insulating jacket (32) of the cable. Each contact (1) has side cutters (13) to be forced in between the two jackets. The connector body (2) is composed of halves (2a,2b) engaging with one another and each having two parallel grooves (21,22) spaced from each other the same distance as the slits are. Two slots (23) for receiving the contacts are formed in one of the halves, so that the conductors (33) of the same polarity and extending through the branch or existing cable (3,3') are bitten respectively and connected together by the slits (11).

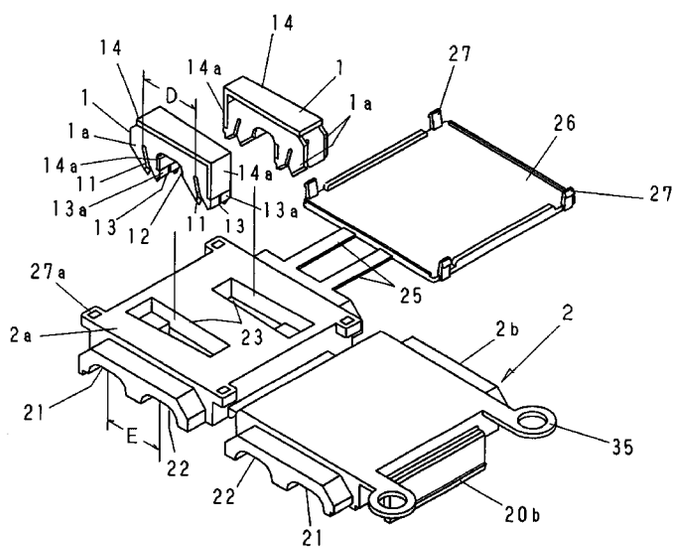

FIG. 1

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an electric connector for use to electrically connect two or more, particularly two 'VVF' cables together to diverge a branch from a bus cable, whether the latter is existing or being newly wired. Each 'VVF' cable consists of two or three conductors (in the so-called 'two-wire' cable or 'three-wire' cable, respectively) that are covered each tightly with an internal insulating jacket. An external insulating mantle in turn tightly covers the internal jackets. Both the jackets and the mantle are formed of the same or different polyvinyl chloride resins (symbolized as 'PVC-PVC' and abbreviated to 'VV') or the like. The two or three conductors are arranged side by side to render the cable flat (abbreviated to 'F'), so that the cables of this kind are usually called 'VVF' cables as above and will be referred to as so hereinafter.

Prior Art

[0002] Such branching works for two-wire or three-wire VVF cables are and have been being required and done very often in many cases. Although the conductors in each cable are usually covered with respective internal insulating jackets, it is necessary for them to be distinct one from another by colors of their jackets. This is for the purpose of ensuring that any electric apparatuses or equipments receive through the branches electric power with correct positive and negative polarities. Therefore, two colors such as 'white' and 'black' readily distinguishable from each other are applied to the internal insulators of two-wire VVF cables. Three colors such as 'white', 'black' and 'red' are also applied to three-wire VVF cables. When diverging a branch from a bus cable, every two conductors being of the same color and included in the branch and the bus cables are connected one to another.

[0003] If in such a branching operation the bus cable is a live wire, then this cable has to be switched off at first to avoid an electric shock. Fig. 19 shows a subsequent branching operation, in which the bus cable 3 will be severed to provide two cable ends at any desired location. The external mantle 31 are then removed from the two cable ends so that a positive conductor and a negative conductor have their end portions freed from the mantle. Thereafter, each conductor end 33 will be exposed by removing a proper length of its internal jacket 32. Likewise, an end of the branch VVF cable 3' will also be treated with to remove proper lengths of its insulating mantle 31 and jackets 32 from the positive and negative conductors so that end portions thereof are exposed. Next, the positive conductor ends 33a of the bus cable and branch cable are placed together into a metal sleeve 6, which is embedded in an insulating cap 61 having a closed end. By crimping the metal sleeve 6 with a pair of pressing tool's parts forcibly gripping the insulating cap, those juxtaposed ends of positive conductors are conductively united, with negative ones being treated with in the same manner.

[0004] In the prior art method summarized above, the live bus cable from which a branch has to be diverged must be switched off before beginning the branching operation, thereby causing power cut for safety of the branching operator in spite of a considerably elongated period of power cut due to very cumbersome and inefficient works.

[0005] Therefore, an object of the present invention is to provide an electric connector with which the branching operation can be finished safely and rapidly without necessity of previously removing the insulating mantle and jackets from VVF cables involved in the operation.

[0006] Another object of the present invention is to provide an electric connector having a body and contacts designed such that each contact being forced into the body can automatically separate positive conductors from negative conductors, all the conductors being tightly covered with respective jackets, whereby good conduction is achieved between mating conductors of the same polarity without impairing insulation between the neighboring conductors of different polarities.

SUMMARY OF THE INVENTION

[0007] In order to achieve these objects, an electric connector provided herein for use to diverge at least one VVF cable from another VVF cable does comprise at least two but less than four contacts and a connector body, wherein each contact is made of a conductive metal sheet and the body is made of an insulating plastics.

[0008] Each contact generally being of an inverted-U shape and composed of two parallel thin unit pieces has formed therein two slits spaced apart an appropriate distance from each other and shaped such that each slit can pierce an external mantle of one cable as well as an internal jacket covering one of conductors extending through the cable. Due to this feature, the two slits are allowed to bite the respective conductors and produce conduction between the conductors of the same polarity. Further, the contact comprises side cutters located adjacent to the respective slits so as to pierce the external mantle and be forced in between the neighboring two internal jackets. Each side cutter may be formed integral with lower ends of bent ears continuing from the parallel unit pieces and extending towards each other.

[0009] The connector body may preferably be composed of two complementary halves engageable with one another and each having two split grooves spaced substantially the same distance mentioned above from each other. The split grooves in one of the complementary halves cooperate with the other respective split

grooves in the other complementary half so that two complete bores may penetrate the connector in its completed state. Width of each groove is substantially equal to width of each cable. Two or more slots formed in a direction perpendicular to the grooves and through one of the complementary halves are intended to receive the contacts. The neighboring two slots are offset from each other by a distance equal to the pitch at which the conductors are arranged transversely of each cable.

[0010] Preferably, the contacts are made of a hard conductive material such as copper alloys harder than the conductors made of copper. Width of each slit is smaller than diameter of each conductor so that the latter will be bitten at its opposite lateral and preipheral portions by the slit, whereby these portions subjected to local plastic deformation are surely brought into conductive connection with said conductor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a perspective view of a connector provided in an embodiment of the present invention, with outsides of an upper and lower halves of the opened connector body facing up, and with contacts having not been placed yet through the upper half;

Fig. 2 also is a perspective view of the connector, with insides of those halves facing up;

Fig. 3 corresponds to Fig. 1, but two contacts having their lower portions inserted in the upper half to be held thereon temporarily;

Fig. 4 corresponds to Fig. 2, wherein one cable's body as a bus as well as another cable's end as a branch having been placed in the lower half of the connector, each cable being a two-wire VVF cable;

Fig. 5 is a perspective view showing the connector whose upper half have been folded onto the lower half to grip therebetween the cables, with the contacts having been set in slots formed in the upper half;

Fig. 6 corresponds to Fig. 5, but the contacts being currently forced by a press into the connector;

Fig. 7 in turn corresponds to Fig. 6, but the contacts having already been forced into the connector;

Fig. 8 is a perspective view of the connector and the cables crimped therein, with the contacts having been hidden with a closed lid of said connector;

Fig. 9 is a transverse cross section corresponding to Fig. 8;

Fig. 10 is an enlarged cross section taken along the line B - B in Fig. 9 so as to illustrate the function of side cutters;

Fig. 11 is an opened-up perspective view corresponding to Fig. 8, with some portions being cut off for the purpose of clear visual presentation;

Fig. 12 is an enlarged perspective view of an example of the contact shown in its disassembled state;

Fig. 13 corresponds to Fig. 12 and shows the contact in its assembled state;

Fig. 14 is an enlarged perspective view of another example of the contact shown in its disassembled state;

Figs. 15 corresponds to Fig. 14 and shows the contact in its assembled state;

Figs. 16(a) and 16(b) are plan views of some examples of slots for receiving the contacts;

Figs. 17(a), 17(b), 17(c) and 17(d) are plan views of the connector used in various modes;

Fig. 18 is a perspective view of the connector in another embodiment of the invention; and

Fig. 19 is a perspective view of VVF cables that are being crimped together by the prior art method.

THE PREFERRED EMBODIMENTS

[0012] Figs. 1 to 13 show an electric connector provided in an embodiment and adapted for use with two-wire VVF cables. Contacts 1 are made by pressing a conductive brass sheet harder than the cabies 3 and 3', and each of an inverted-U shape. Each contact 1 is composed of two parallel and thin unit pieces 1a, and two slits 11 formed in each piece are separated by a valley 12 to be spaced a distance 'D' from each other. Those slits 11 are shaped such that they will pierce an external insulating mantle 31 and an internal insulating jacket 32 so as to bite a conductor 33 covered therewith.

[0013] Side cutters 13 are disposed beside the respective slits 11, and each side cutter extends between and perpendicular to the parallel and thin unit pieces 1a and has its basal ends integral therewith. Those side cutters will pierce the mantle 31 at a portion thereof intermediate the jackets 32, so that the latter may be separated from each other.

[0014] A lower end of each slit 11 intervenes between a pair of V-shaped blades designed such that they will pierce and sever both the mantle 31 and the jackets 32, thereby allowing the slit to bite and grip the conductor 33 in the so-called 'insulation displacement' manner.

[0015] As is shown in the drawings, the slits 11 are slanted with respect to two parallel, imaginarily vertical lines along which the contact will advance into the connector. Due to this feature, one of the conductors forced to fit in each slit will be repelled from the other conductor included in the same cable, as the contact is struck into the connector.

[0016] As will be best seen Fig. 12 and 13, each side cutter 13 consists of lower edges of ears 13a and 13a that protruding from and integral with the unit pieces 1a confronting one another. Each ear 13a is bent at right angle at its basal portion continuing to the piece 1a, so that ends of those ears protruding towards each other do abut against one another. Width in the vertical direction (in the same sense as above) of the ears 13a is rendered as small as possible, but not impermissibly lowering their strength. An idle space appearing above

each ear 13a is filled with one of vertical tablets 14a made of a plastics. Thus, the side cutters 13 will be provided with a sufficient ability of piercing the insulating mantle and jackets on one hand, and satisfactory protection from electric shock will be ensured even if they would fail to make their correct way in between the neighboring conductors 30 in one cable.

[0017] In the example shown in Figs. 12 and 13, the outer vertical tablet 14a is formed integral with a horizontal plastics tablet 14 to assume an L-shape. Alternatively, three discrete tablets 14, 14a and 14a may be employed, or two vertical ones 14a of them may be dispensed with.

[0018] The basal end of each ear 13a is included in the same plane as the unit piece 1a, but protruding sideways therefrom such that a shoulder 15 facing downwards is defined between said ear's end and a lateral lower edge of the piece's portion located beside each slit. Thus, a pair of those shoulders 15 disposed at opposite ends of each side cutter 13. Since no blade is formed in the shoulder 15, it will push down a small mass of the mantle 31 (usually made of a polyvinyl chloride resin) into a fine crevice present between the jackets 32 when the side cutter 13 intrudes the cable as illustrated in Figs. 9 and 10.

[0019] Thickness of the parallel unit pieces of the contact 1 and width of each slit 11 formed therein may desirably be designed such that an area of each conductor's portions brought into 'insulation displacement' contact with the slit is equal to or larger than its cross-sectional area. In a case wherein the conductor's diameter is 1.6 mm, with the unit pieces of each contact 1 being 0.5 mm thick, then the slits 11 may be about 1.2 mm wide. In another case wherein the conductors have a diameter of 2.0 mm and the contact is 0.6 mm thick, then the slits 11 may be about 1.5 mm wide. In any case, the shoulders 15 may protrude a distance of 0.8 - 1.0 mm from the unit piece.

[0020] The connector body 2 is an integral piece that may be formed of a Nylon (registered trademark), a polyethylene, a polypropylene or the like plastics. A pair of halves 2a and 2b constitute together with a lid 26 the connector body 2, wherein two parallel split grooves 21 and 22 formed in each half are spaced a distance 'E' one from another. One of those complementary halves 2a has two slots 23 formed therein and continues at one lateral side transversely to a foldable ear 24 which in turn continues to the other half 2b. Thus, those halves can be superimposed one on another to complete the body, wherein they have at their other ends a perforated principal ear 20a and a lug 20b fitting therein, respectively. The lid 26 connected by flexible band 25 to one of the halves 2a and extending outwardly thereof in a direction of the grooves can be folded back onto said half 2a to cover its face through which the contacts are inserted. Hooks 27 protruding from the lid 26 are engageable with additional perforated ears 27a of one of the halves 2a. Eye-tabs 35 of the other half 2b are for use to suspend or fix this connector to a neighboring article.

[0021] Width of each split groove 21 and 22 is substantially equal to width 'W(capital)' of each VVF cable 3 and 3' in a plane in which the conductors are arranged side by side in the VVF cable. The sum of depth of mating split grooves 21 or 22 is substantially the same as thickness 'w(minuscule)' of each cable. Therefore, those cables tightly fit in the respective completed grooves. Distance 'E' between the longitudinal axes of the two complete grooves 21 and 22 corresponds to that 'D' of the two slits 11. As seen in Fig. 1, each slot 23 is of a shape similar to that of the contact 1 in plan view, so that the lower parts of the contacts remain in said slots unless and until any external force is applied to them. The slots 23 are disposed offset transversely and relative to one another, corresponding to distance by which two conductors 33 are spaced in each VVF cable.

[0022] In the present embodiment, the contacts 1 and the slots 23 are of the same unsymmetrical shape, for example of the same elongate trapezoidal shape in plan view, for ensuring directivity in insertion of the former into the latter. By virtue of this feature, the side cutters 13 can always cut into the VVF cables just in between the neighboring conductors 33, thus assuring correct branching works as shown in Figs. 9 and 11.

[0023] As an alternative means for affording directivity to the contacts, they may have along their peripheries some indentations 23a or protrusions as shown in Figs. 16(a) and 16(b), corresponding to protrusions or indentations of the contacts not shown.

[0024] The foldable ear 24 is thin and W-shaped in side elevation so that the complementary halves 2a and 2b are easily folded onto each other, after the lower parts of the contacts 1 having fitted in the slots 23 so as to be temporarily held in place therein.

[0025] Annular grooves 29 are formed in both ends of each groove 21 and 22 for selectively and removably receiving therein a blind plate or stopper 28. This blind plate intended to bear against a cut end of the branch VVF cable may be transparent for visual confirmation of said end. Although the blind plate 28 in the present embodiment is an integral piece, it may be split into halves fittable in respective halves of any such annular groove 29.

[0026] Now an exemplified mode in use of the connector will be described, wherein one branch is taken from the live and existing VVF bus cable 3 in one direction. The blind plate 28 will at first be set in the annular groove 29 that is formed in the straight groove 21 for accommodation of a branch cable 3'. Then the bus cable 3 will be placed in one of the complementary halves 2a or 2b ('2b' in this example) as shown in Fig. 4. Thereafter, the branch cable 3' will be set in the other groove 22, to take a correct position with respect to polarity of its conductors relying on previous and visual check of its cut end that subsequently has to abut against the blind plate 28. Next, the other half ('2a' here

) of the connector body will be swung onto and fixed on the one of said halves, by bending the common ear 24 and engaging the hook 20b with the perforated ear 20a, to take a position shown in Fig. 5. The branch cable 3' may alternatively be inserted into such a closed body.

[0027] Subsequently, a proper pressing tool will be used to strike and press the upper faces of contacts 1 one by one as shown in Fig. 6, so that each of them is fully embedded in the connector as shown in Fig. 7. Finally, the lid 26 is placed on the upper face of the connector by bending the bands 25 and engaging the corner hooks 27 with the perforated ears 27a as shown in Fig. 8, to thereby hide the contacts' exposed outer ends.

[0028] As a result of the described operation, each contact 1 takes a position within the connector body 2 as shown in Figs. 9 and 11. Each contact penetrating the mantles 31 of the cables 3 and 3' will also pierce the jackets 32 covering the respective conductors 32 of the same polarity. The side cutters 13 of the contact thus having come into electric contact with said conductors 33 of one polarity ('+' or '-') will already have displaced them away from the other conductors 33 of the other polarity ('-' or '+'), a small distance within the connector. This effect is enhanced by the oblique slits 11 to thereby improve safety in respect of the branching an existing or bus cable. The eye-tabs 35 are useful to suspend the connector together with the cables 3 and 3' from any proper article or architectural part within a building.

[0029] One or more blind plates 28 may be set in any selected annular grooves 29 or may be dispensed with. In a case exemplified above, one blind plate is used in a manner shown in Fig. 17(a) to allow the branch 3' to protrude in only one way from the connector. Figs. 17(b) to 17(d) show other possibilities in location of the blind plates.

[0030] In a mode of Fig. 17(b), the blind plate 28 is removed to cause the branch 3' to extend in opposite directions out of the connector. Fig. 17(c) shows another manner of using the connector as a "relay connector", in which ends of two VVF cables 3 and 3 are put therein towards each other. Those cable ends in such a case are respectively stopped with the blind plates 28 fitted in the grooves 29 that are located at different sides of the connector. In still another mode shown in Fig. 17(d), both the cable ends 3 are disposed on the same side of the connector, which likewise serves as a relay connector.

[0031] As the slots 23 are offset from each other a distance between the neighboring conductors in each cable and transversely of the straight grooves, the contacts 1 can naturally connect the connectors 33 of the same polarity.

[0032] Although connectors for use with two-wire VVF cables have been described, they may be modified to comprise three contacts and three slots therefor in order to be connected to three-wire cables, without affecting all the other remaining features.

[0033] The foregoing embodiments may be modified in any manner without departing the spirit of the present invention. For example, the complementary halves 2a and 2b of the connector body may be quite separate parts engaging one another, with the common ear 24 being dispensed with.

[0034] The contacts of an inverted-U shape can alternatively be made by processing a metal sheet previously coated with an insulating material. Further, this sheet may not necessarily be a copper alloy sheet, but may be a sheet of any other metal or the like whose hardness is higher than the conductors of the VVF cables 3 and 3' and whose conductivity is high enough for use in the connector.

[0035] In summary, the connector provided herein is constructed such that whose contacts can simply be pressed to electrically engage even with a live existing VVF cable, without necessity of the previous switching off of it. The peculiar configuration of each contact is effective to displace one of the conductors away from the other simultaneously with the driving of the contact into the connector, thereby enhancing safety of the wiring and the branching operation. Besides, as its body is a simple integral piece of a plastics, the connector can be produced inexpensively.

Claims

1. An electric connector for use to diverge at least one VVF cable from another VVF cable, each VVF cable being selected from a group consisting of a two-wire cable and a three-wire cable, the connector comprising at least two but less than four contacts and a connector body, wherein each contact is made of a conductive metal sheet and the body is made of an insulating plastics,

   characterized in that each contact is generally of an inverted-U shape and composed of two parallel unit pieces, two slits formed in each unit piece are spaced apart a first distance from each other and shaped such that each slit is capable of piercing an external insulating mantle of one cable as well as an internal insulating jacket covering one of conductors included in the cable, whereby the two slits are allowed to bite the respective conductors and produce conduction between the conductors of the same polarity,

   that each contact comprises side cutters located adjacent to the respective slits so as to pierce the mantle and be forced in between the neighboring two jackets, wherein each side cutter is formed integral with lower ends of bent ears continuing from the parallel unit pieces and extending towards each other,

   and that the connector body is composed of two complementary halves engageable with one another and has two straight grooves lying

in parallel with each other and spaced a second distance from each other, the second distance being substantially equal to the first distance, and at least two slots for receiving the contacts are formed in a direction perpendicular to the straight grooves and through one of the complementary halves.

2. An electric connector as defined in claim 1, wherein shoulders facing down and devoid of blades are formed in each contact at locations each between the side cutter and the slit and adjacent to the side cutter.

3. An electric connector as defined in claim 1 or 2, wherein the contacts and the slots are of the same unsymmetrical shape for ensuring directivity in insertion of the former into the latter.

4. An electric connector as defined in claim 1 or 2, wherein the slits are oblique with respect to vertical lines imaginarily lying perpendicular to the contact so that the conductors included in one connector are displaced from each other when the contact is forced into the connector.

5. An electric connector as defined in claim 1 or 2, wherein at least one blind plates are set in annular grooves located at opposite end regions of each straight groove.

6. An electric connector as defined in claim 5, wherein the blind plates are made of an insulating transparent material.

7. An electric connector as defined in claim 1 or 2, wherein each contact has an upper face covered with a an insulating horizontal tablet made of a plastics.

8. An electric connector as defined in claim 7, wherein each of insulating vertical tablets is disposed above the bent ears whose lower ends are formed as each side cutter, with the vertical tablet not protruding up beyond the horizontal tablet.

9. An electric connector as defined in claim 8, wherein one of the vertical tablets is formed integral with the horizontal tablet so as to assume an L-shape as a whole.

FIG. 1

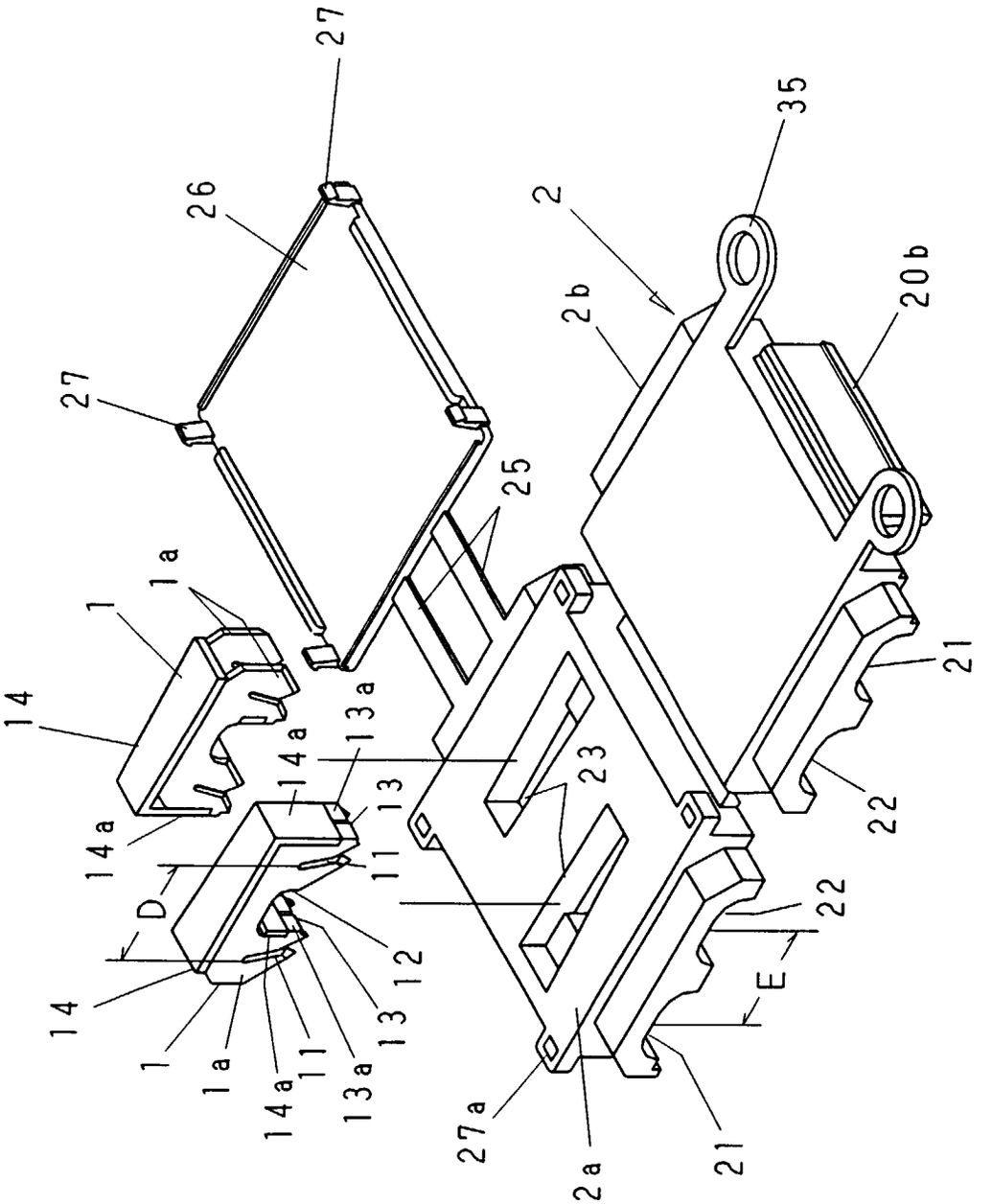
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FIG. 2

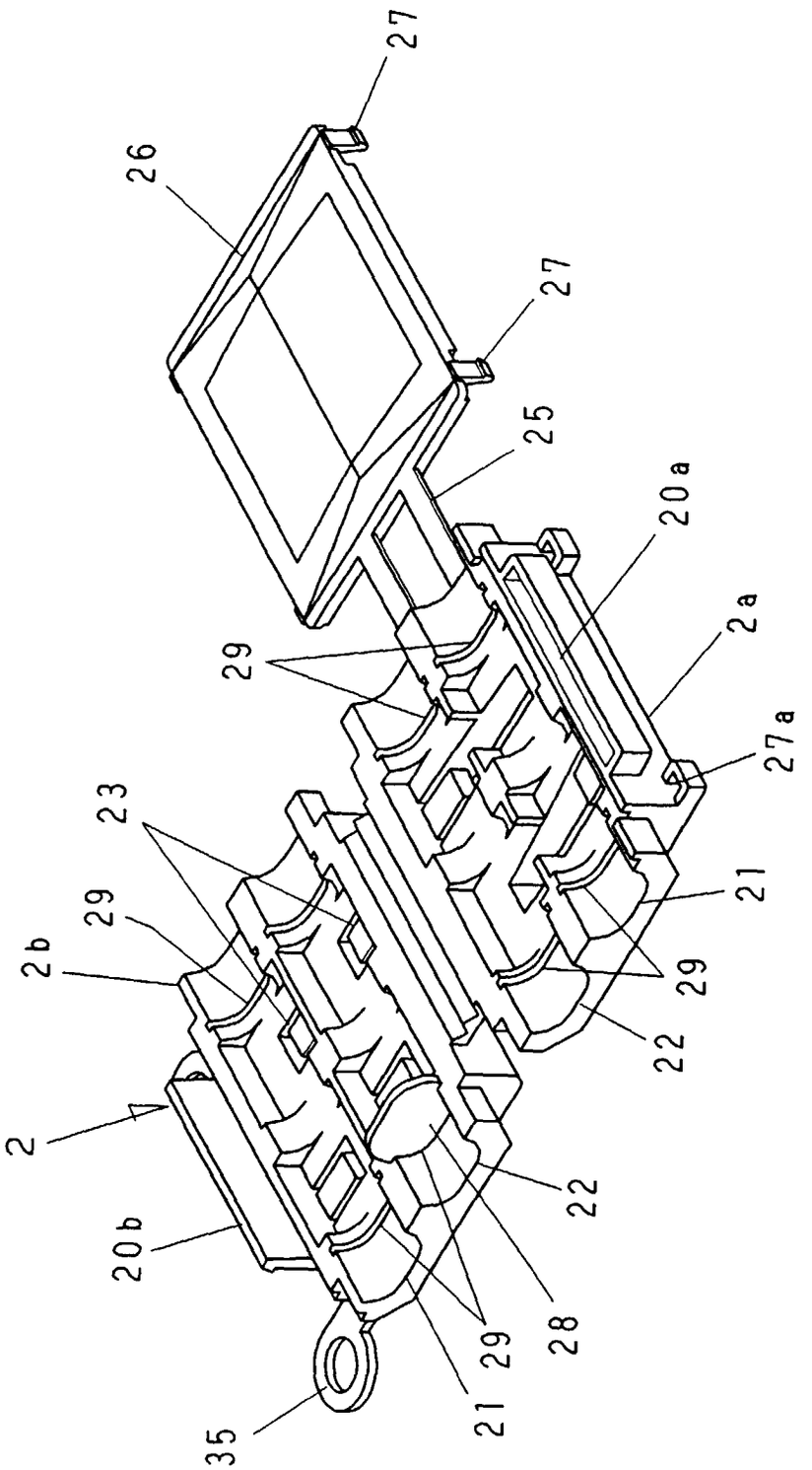

FIG. 3

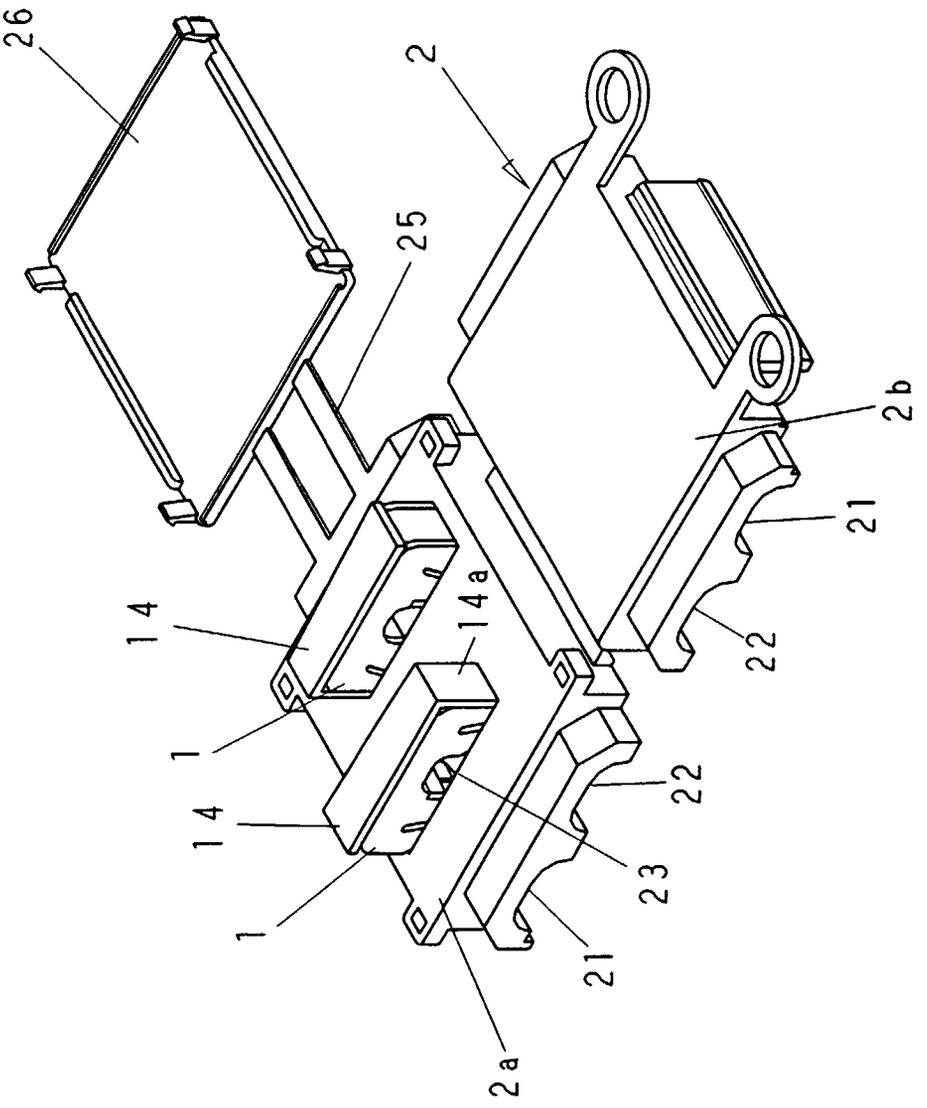

FIG. 4

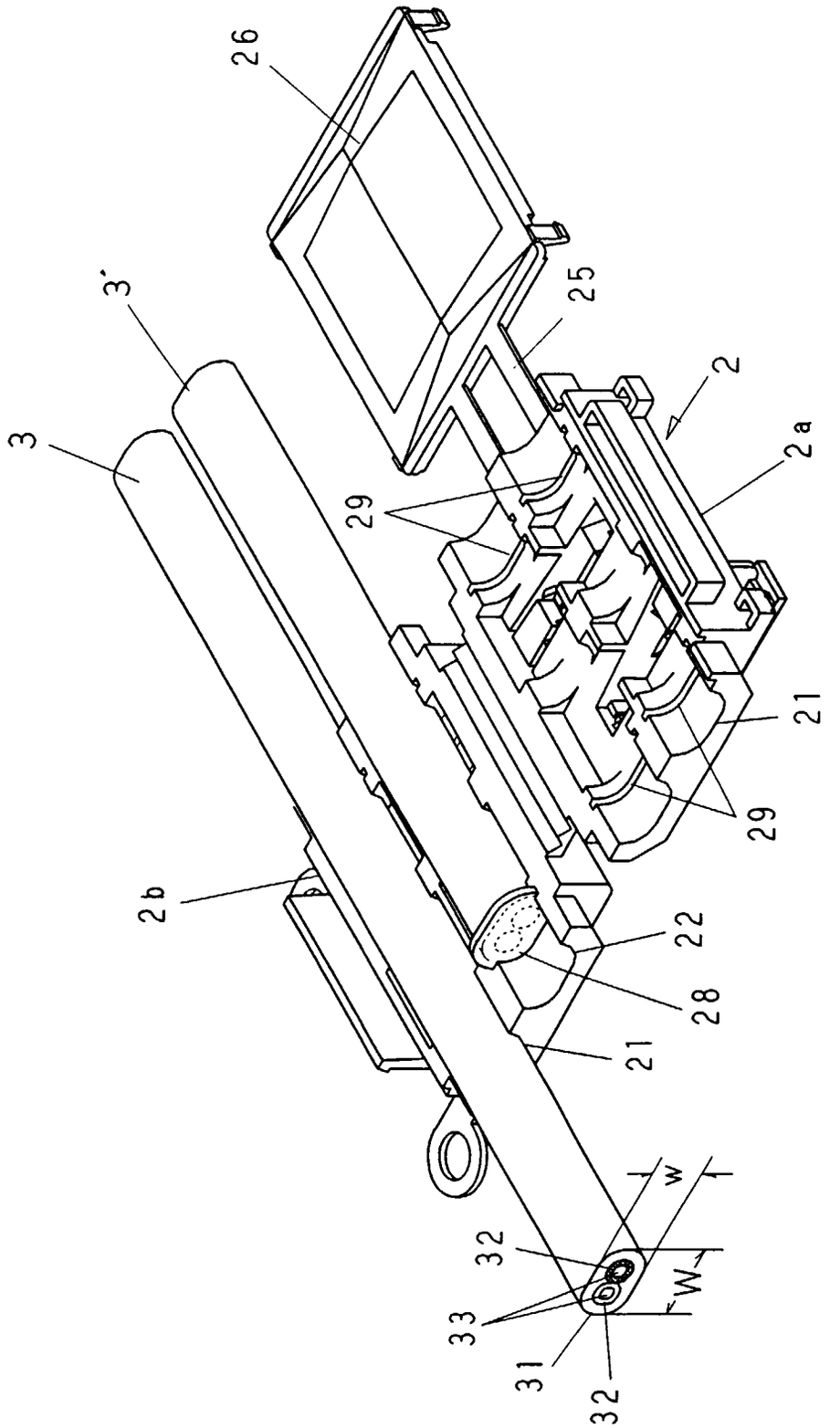

FIG. 5

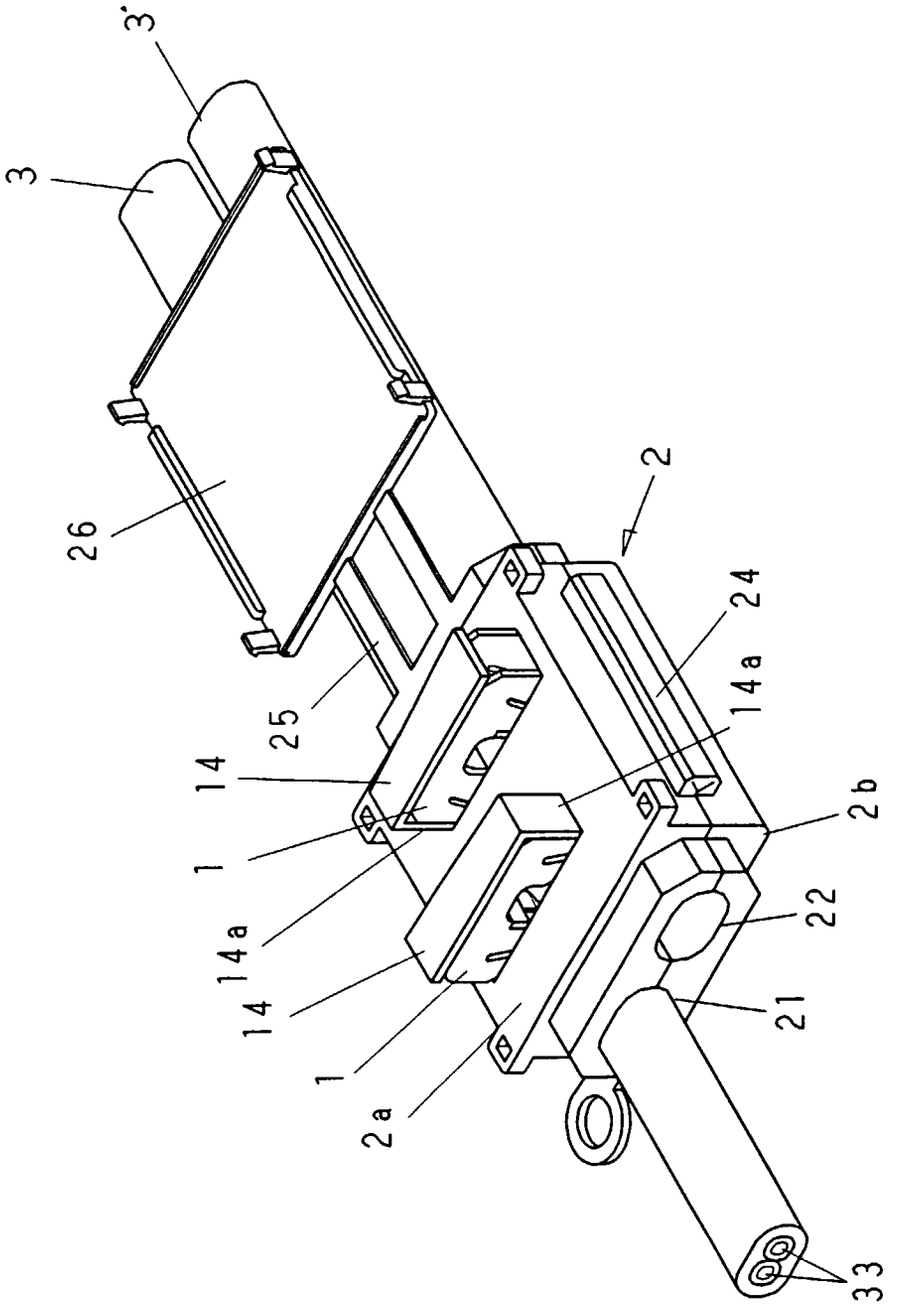

FIG. 6

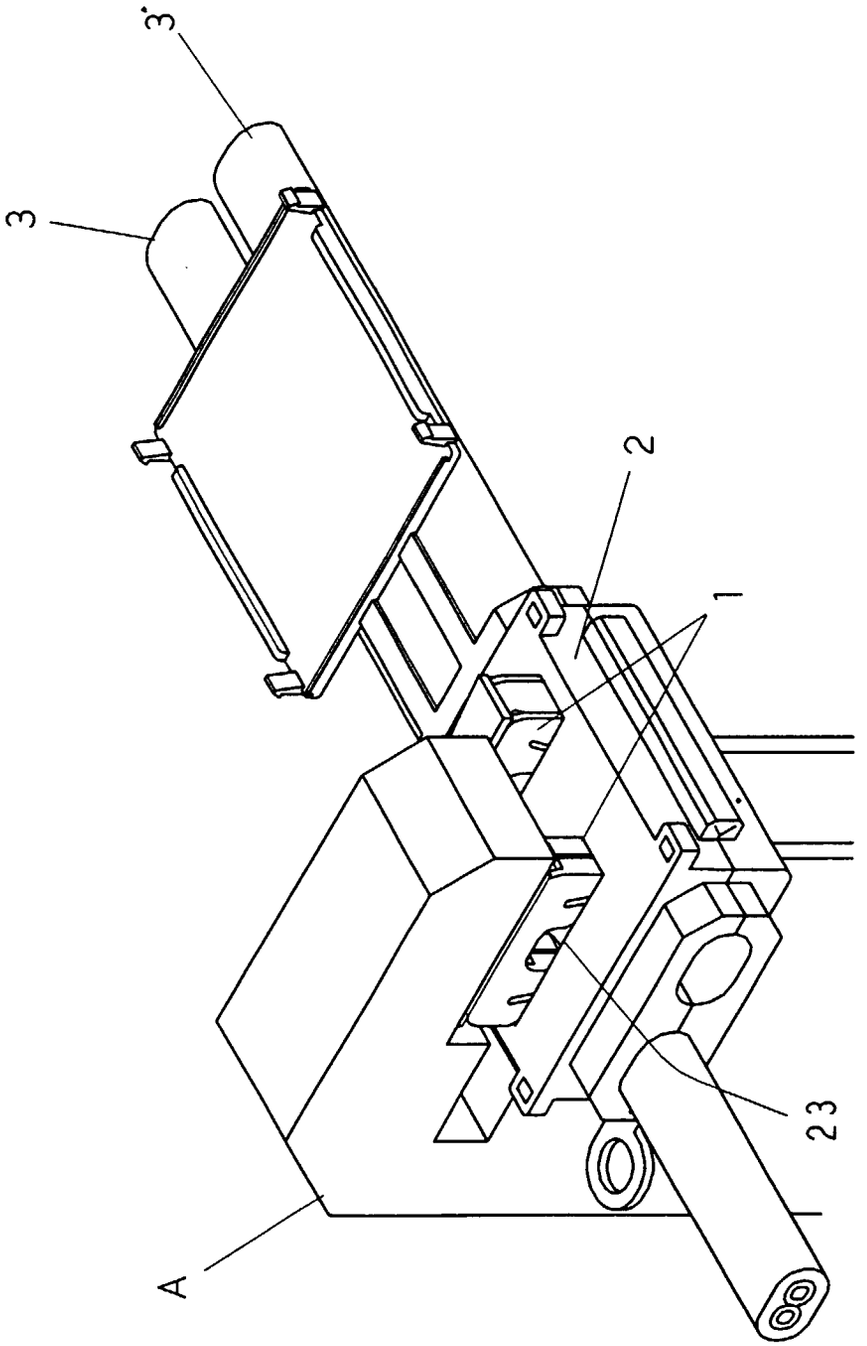

FIG. 7

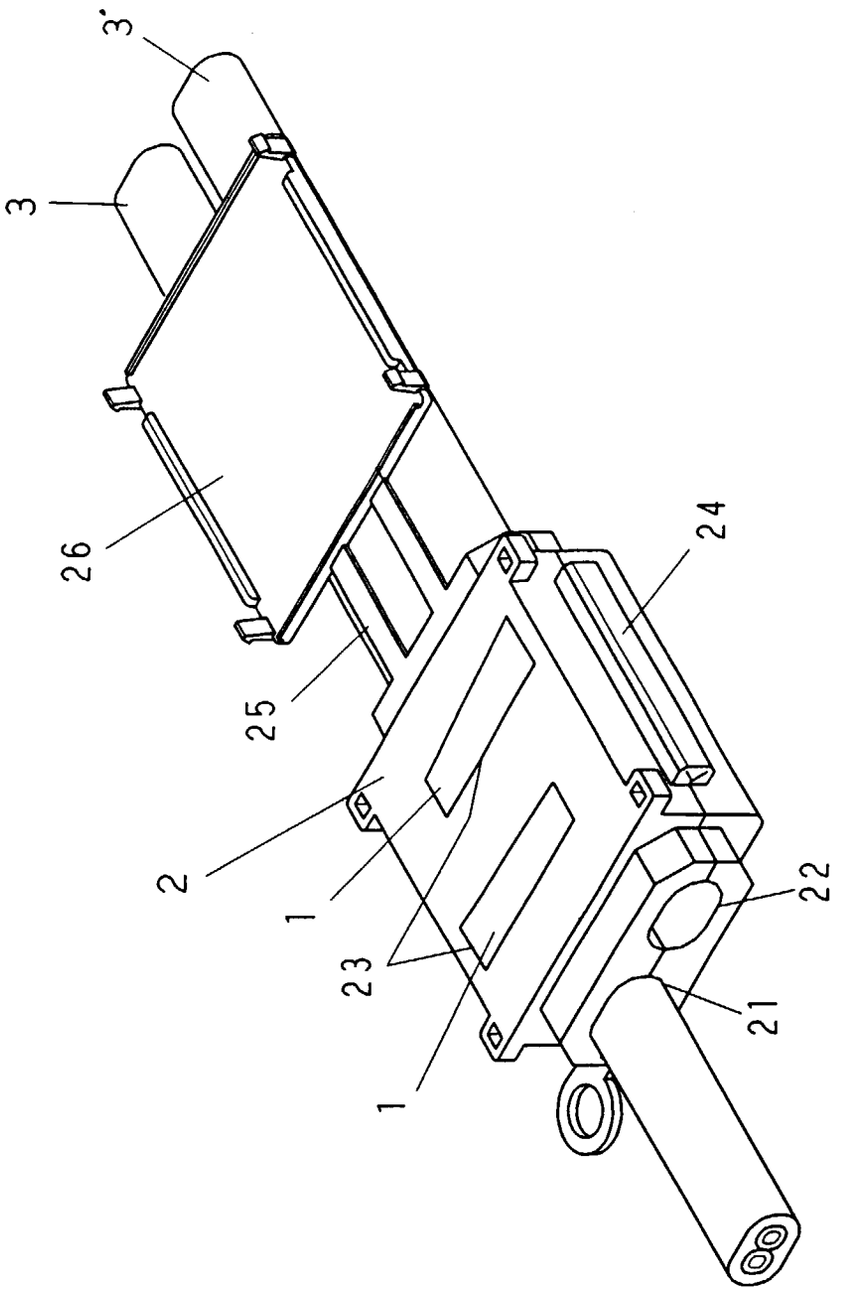

FIG. 8

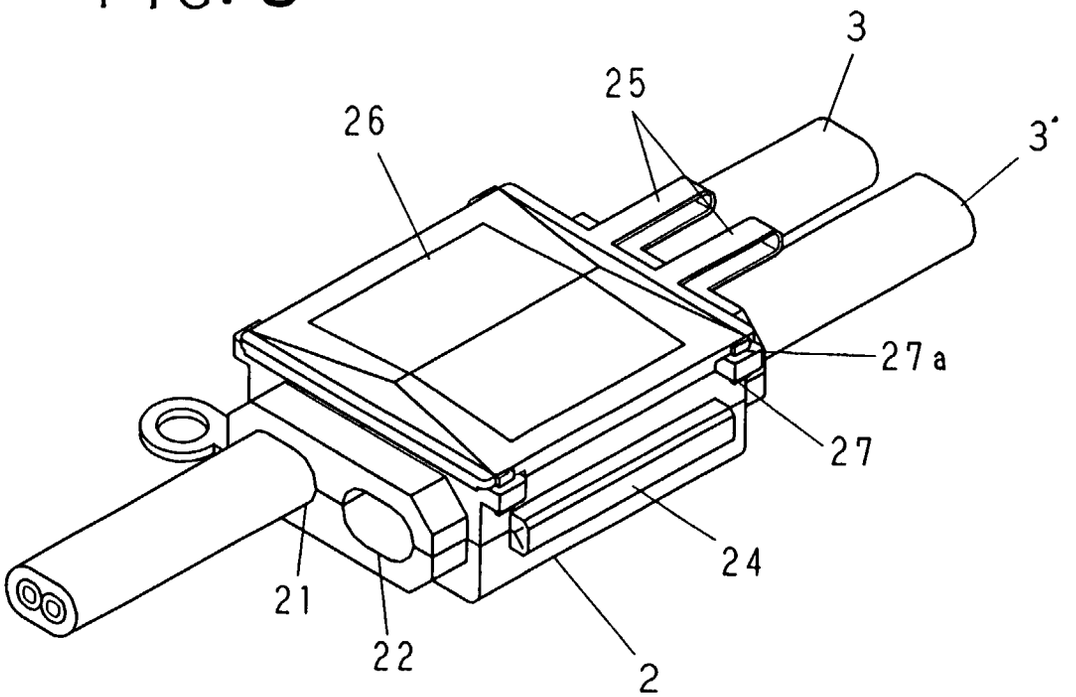

FIG. 11

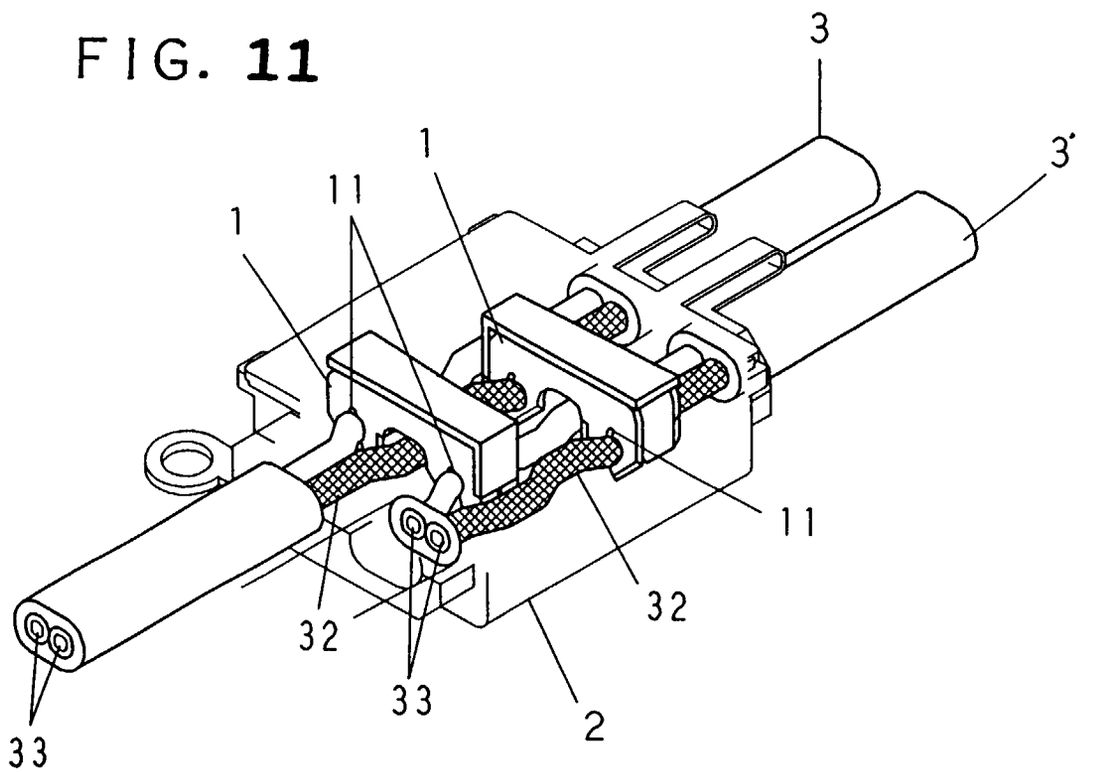

FIG. 9

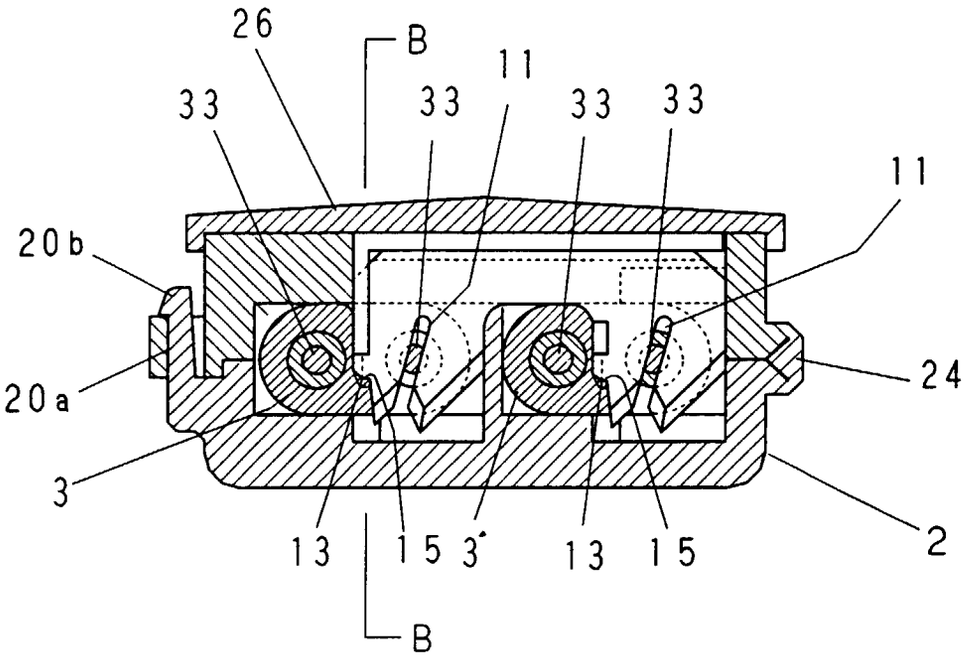
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FIG. 10

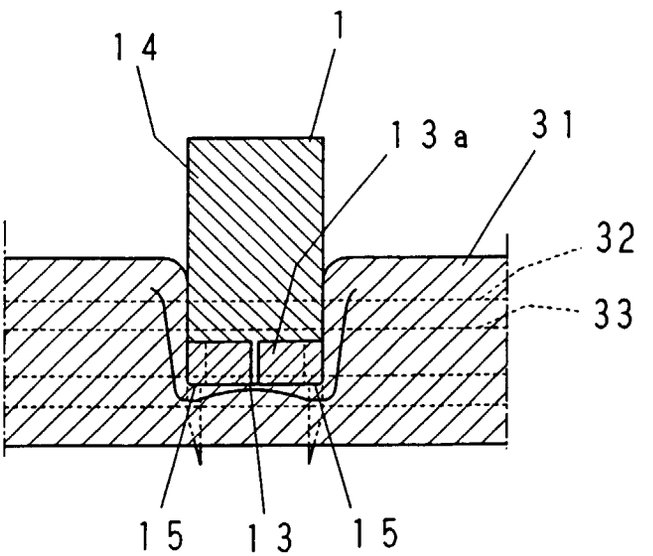
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FIG. 12

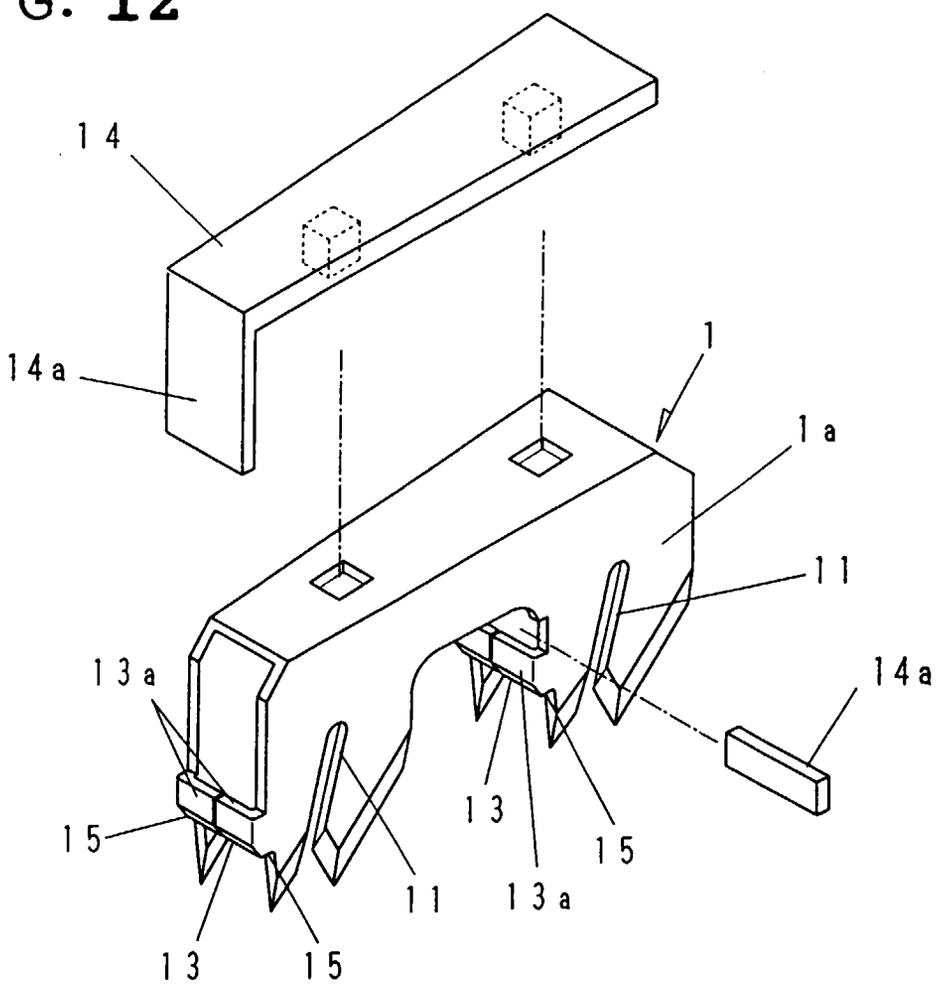
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FIG. 13

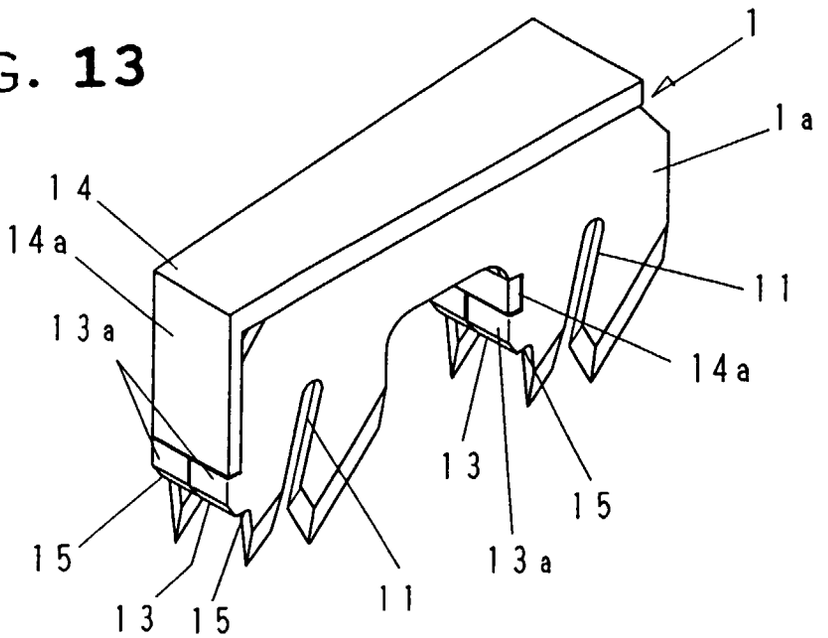
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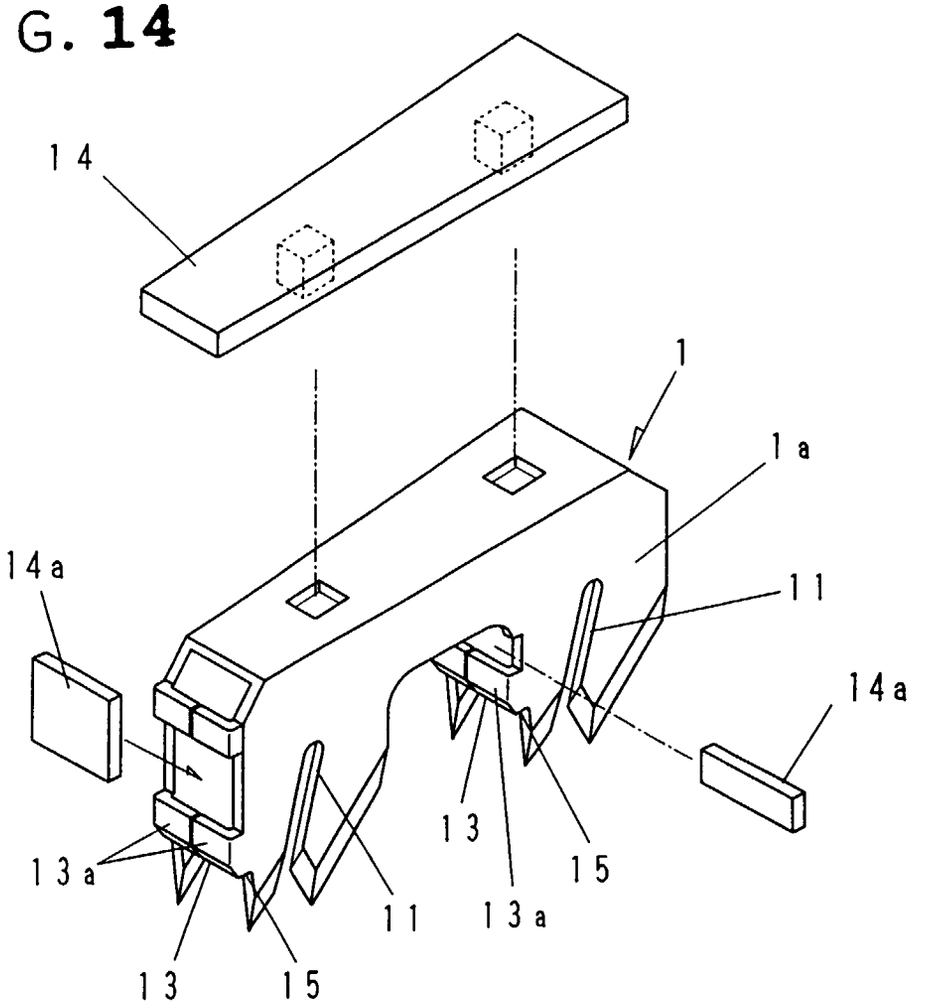
FIG. 14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11
14a
13
13a
15
11
13a
13
15

FIG. 15

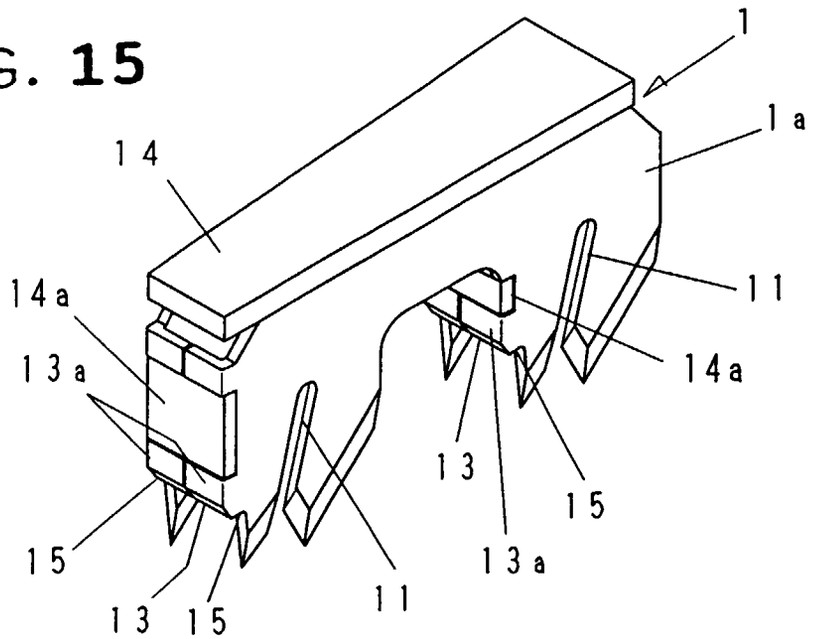

1
1a
14
11
14a
14a
13a
13
15
15
13a
11
13
15

FIG. 16(a)

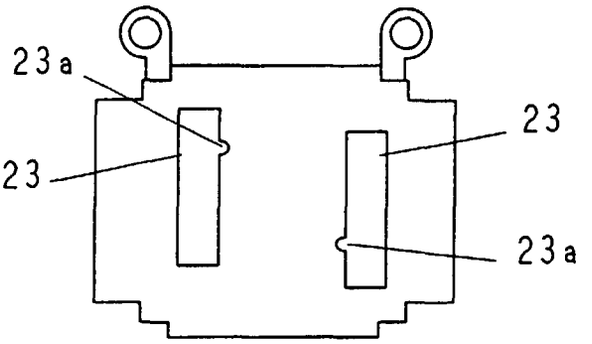


FIG. 16(b)

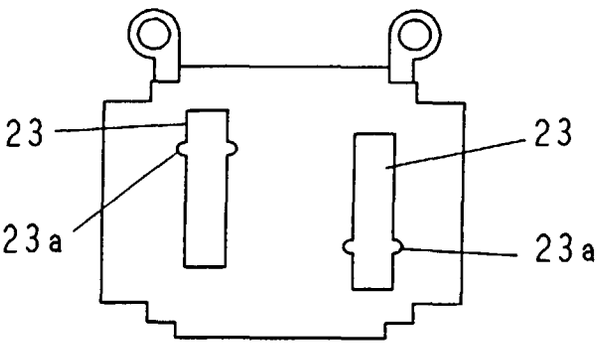


FIG. 19

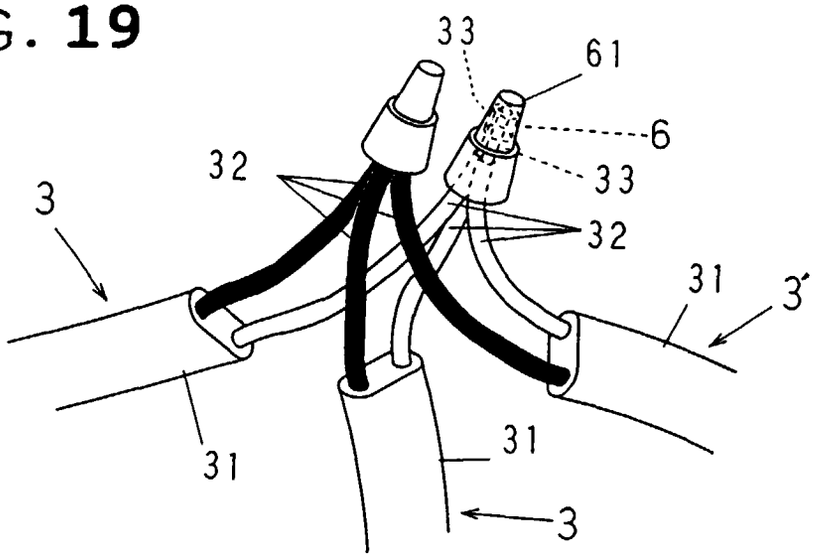


FIG. 17(a)

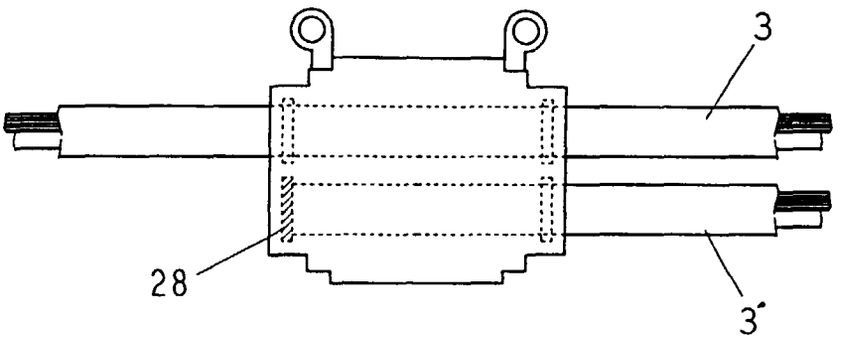


FIG. 17(b)

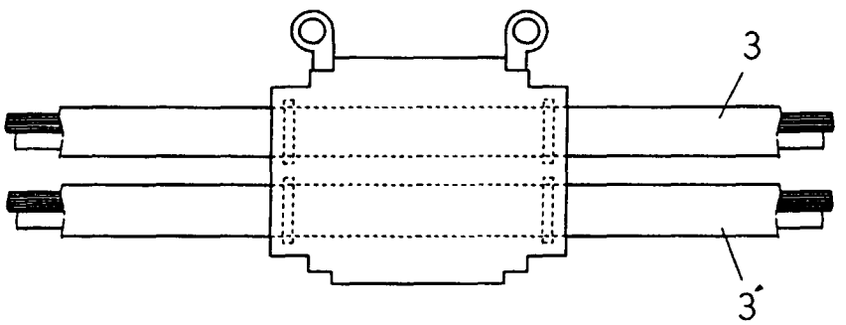


FIG. 17(c)

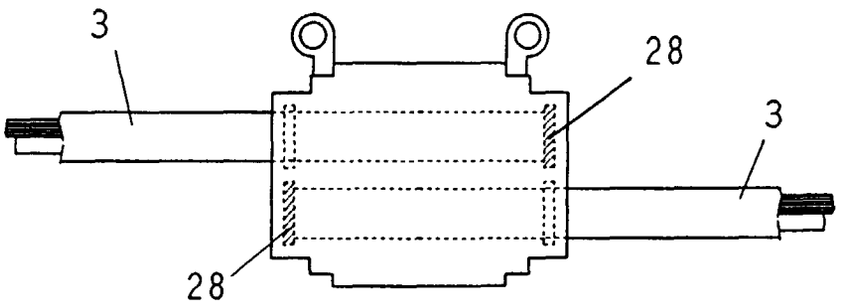


FIG. 17(d)

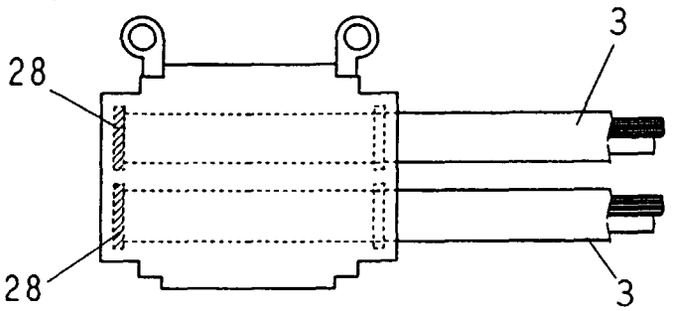
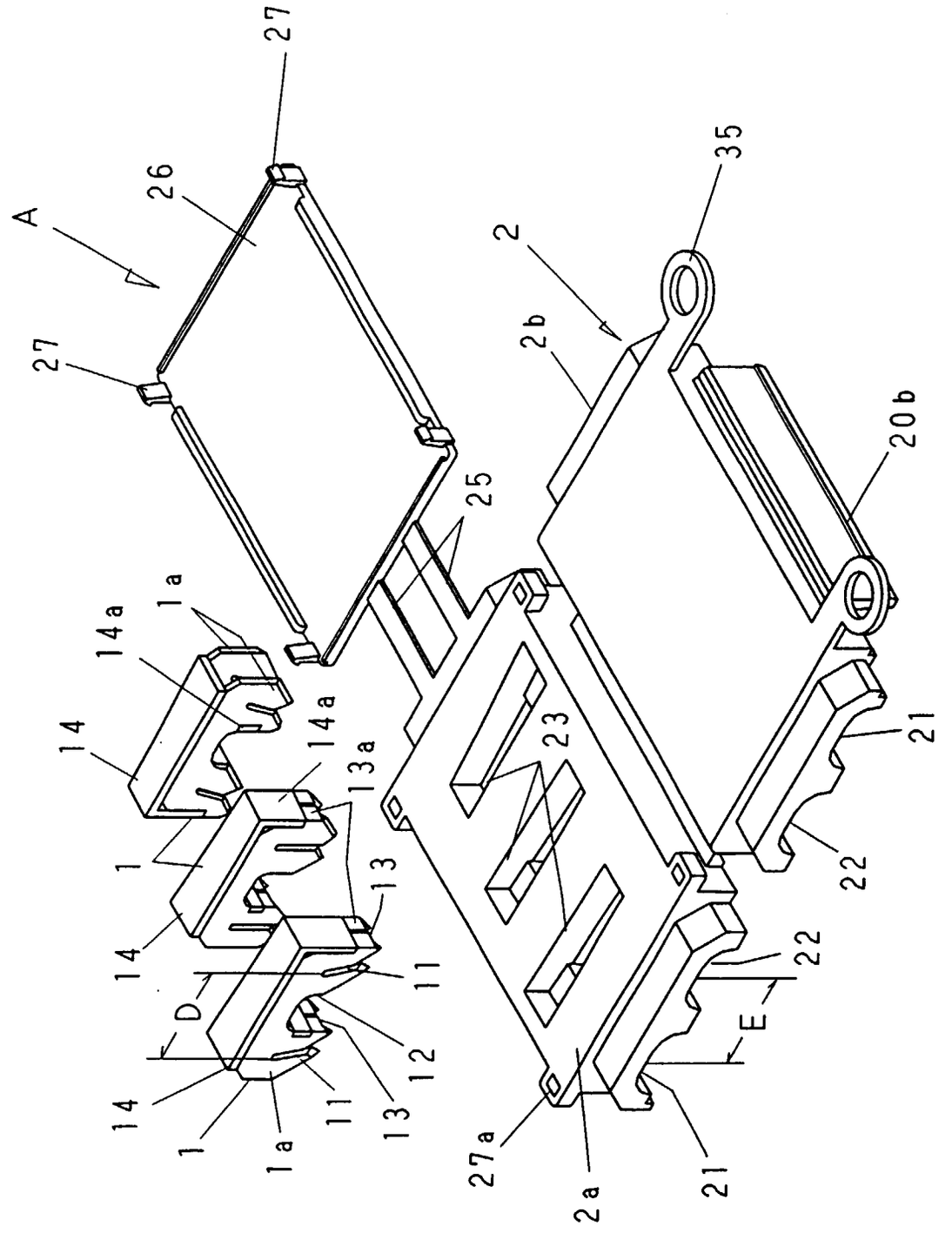


FIG. 18


27
26
A
27
35
2
2b
20b
25
1a
14a
14
14a
13a
23
1
13
21
14
11
22
D
22
12
E
14
11
13
1
1a
27a
2a
21